BluMetric™ Environmental

SITE CONCEPTUAL MODEL UPDATE AND CONTAMINANT ATTENUATION ZONE DELINEATION

Waste Management
Richmond Landfill Site

Submitted to:

WASTE MANAGEMENT

Waste Management of Canada Corporation
1271 Beechwood Road
R.R. #6 Napanee, ON K7R 3L1

Prepared by:

BluMetric Environmental Inc.
4 Cataraqui Street
The Woolen Mill, The Tower
Kingston, ON K7K 1Z7

Project Number: 170193-11

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

This report is an update to the Site Conceptual Model (SCM) Update and Contaminant Attenuation Zone (CAZ) Delineation report dated January 2016 and Addendum dated April 2016 (BluMetric™, 2016a and 2016b)[1,2]. The purpose of this document is to provide supplementary technical information to support Waste Management of Canada Corporation's (WM) upcoming application to amend Environmental Compliance Approval (ECA) No. A371203 for the WM Richmond Landfill (the Site), to incorporate the use of a land parcel as a CAZ to bring the Site into compliance with the Reasonable Use Limits (RULs) in Guideline B-7, and the continued use of the property for general rural purposes. The site location is presented on **Figure 1**.

The complementary hydrogeological work described in this report was conducted to address the concerns outlined in the technical review comments from MOECC technical staff Kyle Stephenson and Victor Castro, as outlined in their letters dated July 4 and 12, 2016, respectively, and provided in a letter from Kingston District Office Acting Manager James Mahoney dated July 27, 2016. The review comments were further discussed with Mr. Stephenson and Mr. Castro during a site visit conducted on September 23, 2016, and a work program was developed to address their comments. MOECC technical staff were consulted prior to undertaking each significant step in order to review and discuss preliminary results, and adjust the work program as required based on these discussions.

The scope of work, outlined in a memorandum dated October 5, 2016 (BluMetric, 2016c)[3], included the following main field tasks:

- Task 1 – Karst Assessment
- Task 2 – Complementary Shallow Groundwater Investigation
- Task 3 – Complementary Intermediate Bedrock Groundwater Investigation

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

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

[3] BluMetric 2016c *Proposed Work Program for Complementary CAZ Investigation, Waste Management Richmond Landfill, Town of Greater Napanee*, BluMetric Environmental Inc., Memorandum dated October 5, 2016

The methodology associated with these tasks, including additions and adjustments made based on interim results obtained throughout the investigation, are described in more detail in Section 2 while results from the complementary investigation are provided in Section 3. Section 4 provides a discussion and interpretation of the results including an update to the hydrogeological SCM based on historical and recent results. Finally, Section 5 provides updated recommendations regarding the proposed Contaminant Attenuation Zone associated with the Richmond Landfill.

2. FIELD PROGRAM

The reader is referred to the site plan on **Figure 2** where monitoring locations are shown, including new and existing locations discussed in the following sections.

2.1 TASK 1 – PRELIMINARY KARST ASSESSMENT

BluMetric, on behalf of WM, retained the services of independent karst expert Daryl Cowell, P.Geo., M.Sc., to complete a preliminary karst assessment, with the objective of assessing the role of karst in the hydrogeological setting of the CAZ. The assement focused on known karst features, identifed the presence of additional potential karst features, and provided recommendations on the monitoring network for the CAZ as it relates to the karst features. Mr. Cowell conducted a field investigation on October 18 and 19, 2016, and the preliminary karst assessment report was submitted on December 14, 2016. The karst assessment is described in detail in a report prepared by Cowell & Associates Inc., provided in **Appendix A.1** of this report.

Based on the results from the karst assessment, Cowell (2016) recommended that the following additional tasks should be completed:

- Task 1a: A new monitoring well should be installed between M187 and M64-2;
- Task 1b: Water level data loggers (including temperature and conductivity) should be installed in monitoring wells M179, M186, M187, M188-1, M190, M194 and the new well proposed in Task 1a; and
- Task 1c: The unnamed creek southeast of the CAZ should be investigated during the spring freshet period to observe flow dynamics; specifically, observations should be made of any recharge to the stream via soil seepage and bedrock springs.

All of the recommended tasks were incorporated in the complementary investigation and were completed, as described in more detail below.

2.1.1 Task 1a – New Monitoring Well Between M187 and M64-2

Installation and testing of this new monitoring well, labelled M195 and shown on **Figure 2**, is described in Section 2.3 below.

2.1.2 Task 1b – Water Level Data Loggers

Solinst Model 3001 LTC Levelogger Edge data loggers were installed on February 27, 2017 in several monitoring wells recommended by Cowell (2016), within the area of the proposed CAZ where the potential for karst has been identified (M179, M186, M187, M188-1, M190), and in two additional wells (M122, M166) located in the northern portion of the proposed CAZ, upgradient from the identified karst. In addition, LTC Levelloggers were installed on May 18, 2017 in the newly instrumented wells (M194-1, M194-2 and M195). The LTC Leveloggers were programmed to record conductivity, water level and temperature readings at fifteen minute intervals. The LTC Levelloggers will be maintained for a two year period as recommended by Mr. Cowell. Analyses will focus on event characteristics including spring melt and through significant rainfall events to examine water level responses (rising and falling heads and well-to-well relationships). Continued use of the loggers will be re-examined after the two-year period.

2.1.3 Task 1c – Supplementary Stream Survey

A supplementary stream survey was completed by Karst expert Daryl Cowell following his recommendations in the preliminary karst assessment report (Cowell, 2016), to evaluate potential karst connections between the unnamed creek and the karst interpreted within the CAZ. The stream survey was completed on March 22, 2017, timed to coincide with the spring freshet inasmuch as possible, in order to observe runoff, spring and seepage conditions when groundwater is at or near its highest elevations. The supplementary stream survey is described in detail in a report dated June 13, 2017 prepared by Cowell & Associates Inc., provided in **Appendix A.2** of this report.

2.2 TASK 2 – COMPLEMENTARY SHALLOW GROUNDWATER INVESTIGATION

The objective of this task was to perform additional delineation of the shallow groundwater impacts in the central portion of the proposed CAZ south of Beechwood Rd, and to investigate the presence of a shallow groundwater flow divide in this portion of the study area. Two shallow monitoring wells (M178R-5 and M188-2) and three drive point piezometers (DP01-16, DP02-16 and DP03-16) were installed along a transect extending from the north to the south side of the surface water course in this area, as shown on **Figure 3**.

2.2.1 Borehole Drilling

Shallow boreholes M178R-5 and M188-2 were drilled between November 14 and 16, 2016 near existing monitoring wells installed in the intermediate bedrock at these locations (see **Figure 2**). Drilling was completed by GET Drilling Ltd. of Napanee, ON, using air-rotary techniques. Supervising BluMetric staff made notes regarding stratigraphy and water encountered during drilling. Borehole logs are provided in **Appendix B**.

2.2.2 Drive-Point Piezometer Installation

Three drive-point piezometers, labelled DP01-16, DP02-16 and DP03-16, were installed in the overburden along a transect between M178R-5 and M188-2 on November 17, 2016. The drive-point piezometers were constructed of 1.25" (31.75 mm) diameter stainless steel with a 0.50 m screen length, driven down to refusal, believed to correspond to bedrock surface at these locations based on known depth to bedrock information from nearby wells. The locations of the new piezometers and existing monitoring wells are shown on **Figure 2**. A closeup in plan view and vertical cross-section of the transect running between M178R-5 and M188-2 is shown on **Figure 3** and drivepoint logs are provided in **Appendix B**.

2.2.3 Water Level Measurements

Water levels were recorded using an electronic water level meter from the new shallow monitoring wells (M178R-5 and M188-2) and drive point piezometers (DP01-16, DP02-16 and DP03-16) on April 21, April 28, May 18 and May 25, 2017.

2.2.4 Groundwater Sampling

Groundwater samples were collected from monitoring wells M178R-5 and M188-2 on May 25 and June 8, 2017 using dedicated Waterra inertial lift pumps connected to dedicated polyethylene tubing. A minimum of three casing volumes of water were removed from each monitoring well prior to the collection of groundwater samples. During purging, readings for pH, conductivity and temperature were recorded on a regular basis. The stabilization of the parameters was used to assess when well purging was complete. However, if the monitoring well purged dry it was allowed to recover sufficient volume at which time the sample was collected.

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. Samples were analysed by Maxxam Analytics Inc. of Mississauga, ON, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA).

The samples were analyzed for general/inorganic parameters and VOCs shown in **Table 1**, which correspond to those in Tables 2 and 3 from the Interim Environmental Monitoring Plan (EMP) (BluMetric, 2016d)[4].

Table 1: Groundwater Quality Analytical Parameters

Inorganic and General Parameters	Total Dissolved Solids (TDS), Conductivity, Alkalinity, Calcium, Magnesium, Sodium, Potassium, Boron, Iron, Manganese, Ammonia (total), Nitrate, Nitrite, Chloride, Sulphate, Dissolved Organic Carbon (DOC)
Volatile Organic Compounds (VOCs)	1,4-Dioxane, Benzene, Toluene, Ethylbenzene, m&p-Xylene, o-Xylene, Styrene, 1,3,5-Trimethylbenzene, Chlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, Chloromethane, 1,1,2,2-Tetrachloroethane, 1,1,1,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,1-Dichloroethane, 1,2-Dichloroethane, Chloroethane, 1,1-Dichloroethylene, Cis-1,2-Dichloroethylene, Trans-1,2-Dichloroethylene, Trichloroethylene, Tetrachloroethylene, Vinyl chloride

2.3 Task 3 – Complementary Intermediate Groundwater Investigation

Three monitoring wells targeting the intermediate bedrock groundwater flow zone were installed and tested; monitoring wells M194-1 and M194-2 were installed in the vicinity of the near surface karst feature approximately 75 m southwest of monitoring well M187. Monitoring well M195 was installed between M187 and M64-2, as recommmended by Cowell (2016) based on the results from the preliminary karst assessment. The locations of the new wells and existing monitoring wells are shown on **Figure 2**.

The field methods used to conduct the work associated with the new wells were consistent with previous iterations of the CAZ hydrogeological investigation, including the SCM Report (BKA and WESA, 2009)[5], Groundwater Action Plan Investigation Report (BKA and WESA, 2012)[6] and SCM Update and CAZ Delineation Report and related Addendum (BluMetric, 2016a and 2016b). The methodology associated with this task is summarized below.

2.3.1 Borehole Drilling

Borehole M194, later renamed M194-1, targeting the intermediate bedrock groundwater flow zone was drilled November 14 to 16, 2016 in the vicinity of the near karst feature located

[4] BluMetric 2016d: *Revised Interim Environmental Monitoring Plan v. 05, WM Richmond Landfill, Town of Greater Napanee, Ontario*, BluMetric Environmental Inc., Report dated April 2016.
[5] BKA and WESA 2009: *Site Conceptual Model Report, WM Richmond Landfill*, B. Kueper & Assoc. Ltd. and WESA Inc., Report dated October, 2009.
[6] BKA and WESA 2012: *Groundwater Action Plan Investigation Report, WM Richmond Landfill*, B. Kueper & Assoc. Ltd. and WESA Inc., Report dated October, 2012.

approximately 50 m to the southwest of monitoring well M187. A second borehole, M195, was drilled on December 19 – 20, 2016 at the location recommended in the karst assessment report, between existing monitoring wells M64-2 and M187. Following review of the draft downhole geophysical logs (Section 3.3.1) and pumping test results (Section 3.3.2) related to borehole M194, it was decided that an additional borehole near the original location was warranted, targeting a shallower fracture identified within the intermediate bedrock flow zone at approximately 24 mbgs. The new well (M194-2) was drilled on March 29 and April 4, 2017. The locations of the new boreholes are shown on **Figure 2**.

Drilling was completed by GET Drilling Ltd. of Napanee, ON, using air-rotary techniques. After drilling through the overburden, steel casing was installed from ground surface and cemented into the upper portion of the bedrock. Supervising BluMetric staff made notes regarding stratigraphy and water encountered during drilling. Borehole logs are provided in **Appendix B**.

DGI Geoscience Inc. of Toronto, ON conducted downhole geophysical surveys of boreholes M194-1 and M195; optical and acoustic televiewer logs, along with caliper logs and interpreted features encountered in the boreholes, are provided in **Appendix C**.

2.3.2 Long-Term Constant Discharge Pumping Test (Pumping Test)

Monitoring well M194-1 (previously labelled M194) was selected as the pumping well for a long-term constant discharge pumping test. MOECC hydrogeologists were consulted during the planning stage of the test regarding the pumping well location, the intervals to be monitored in the new boreholes, and the network of adjacent existing monitoring wells where the water levels were to be observed during pumping. The monitoring network selection was based on the previously established hydraulic responsiveness of monitoring wells in the vicinity of the pumping well. Prior to conducting the long-term constant discharge test, an appropriate pumping rate was selected by completing a step-discharge pumping test. **Appendix D** summarizes the monitoring well network used for the pumping test, while **Figure 4** illustrates the location of the observation wells relative to the pumping well.

Groundwater was pumped from the M194-1 borehole using a three inch Grundfos SQE pump and discharged through 1.5” (38.1 mm) black polyethylene tubing. The flow rate was monitored by a Lake inline displacement gauge and flow rate was controlled by adjustment of a gate valve at the well head.

Solinst Leveloggers (pressure transducers) were installed in all observation wells and set to acquire groundwater level readings at five minute intervals. The Solinst Leveloggers were hung below the water level in the well using optical connection cables that allowed data to be checked and downloaded from the surface without removing the logger from the well. Loggers were installed at least 24 hours prior to the start of the step test or long term constant discharge test to collect background data under static (pre-pumping) conditions. Atmospheric pressure was also recorded during the testing period to allow for barometric compensation of the Solinst Levelogger data. In addition to the Solinst Levelogger data, manual water levels were collected using an electronic water level tape prior to and several times during the pumping and recovery phases of the test. During the long term constant discharge test, BluMetric staff collected manual water level readings and were responsible for maintaining the generators to power the pump, maintaining a constant flow rate, and monitoring discharge line.

On completion of the pumping and recovery components of the constant discharge test, the water level measurements collected by the data loggers were downloaded and the Solinst Leveloggers removed from the wells.

Water level data from the Solinst Leveloggers was corrected for barometric pressure changes and plotted in Microsoft Excel. Water level measurements were normalized to a zero point coinciding with the start of the pumping phase of the constant discharge pumping test to facilitate recognition of the extent of drawdown and recovery.

The behaviour of the water level at each monitoring well was characterized as either responsive, possibly responsive or non-responsive to pumping. Constant discharge pumping test results are provided in **Appendix E** and are discussed in detail in Section 3.3.3 below.

2.3.3 Formation Hydraulic Testing

It was not possible to conduct packer testing on boreholes M194-1 and M195 because the static water level was too deep. Pumping test results (Section 3.3.2) confirmed that the new boreholes M194-1 and M195 are in hydraulic communication with each other, and also to other monitoring wells known from previous iterations of testing to be part of the hydraulically active intermediate bedrock flow zone.

Because pumping at M194-1 took place in the open borehole where multiple potentially water bearing fractured intervals were identified during drilling and from downhole geophysical logs, it was decided to conduct additional testing to isolate the individual fractures zones in this borehole from one another, and evaluate which were hydraulically connected to the active flow zone in the intermediate bedrock. Prior to the instrumentation of M194-1 three complementary pumping tests were conducted using inflatable packers to isolate the observed fracture zones. The test setup and results associated with the intrawell hydraulic testing are presented in **Appendix F** and described below.

1. The first test used two inflatable packers to isolate the zone between 26.78 and 29.44 mbgs in order to test the water bearing fracture observed at 29.30 mbgs. The pump for the first test was installed between the two packers with an intake depth of 28.36 mbgs. The fracture at 29.30 mbgs did not yield sufficient water for a prolonged pumping test, even at the minimal pumping rate of approximately 0.1 L/min.

2. The second test used a single inflatable packer set spanning 29.38 mbgs and 30.00 mbgs in order to islolate the fracture at 31.20 mbgs. The pump for the second test was set below the bottom packer with an intake depth below 30.00 mbgs and a pumping rate of 79.8 L/min for 120 minutes.

3. The third test used a single inflatable packer set spanning 28.80 mbgs and 29.42 mbgs in order to isolate the fracture observed at 26.50 mbgs as well as the feature observed at 22.20 mbgs that caused a loss of circulation during drilling. The pump for the third test was set above the top of the packer with an intake depth of 25.26 mbgs and a pumping rate of 1.9 L/min for approximately 152 minutes.

Solinst Leveloggers (pressure transducers) were installed above and below the isolated zones to acquire groundwater level readings at one minute intervals. In addition to the Solinst Levelogger data, manual water levels above the packer assembly were collected using an electronic water level tape prior to and several times during the pumping and recovery phases of the testing. Nearby monitoring well M187 was monitored during the second and third tests (while pumping above and below the packer in M194-1) to determine which fracture zones were hydraulically connected to the active intermediate bedrock.

Two groundwater samples were collected from M194-1 during the additional hydraulic testing; one from the second test, which represents conditions below 30.00 mbgs; and one from the third test, which represents conditions above 28.80 mbgs. Both 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. Samples were analysed for 1-4 dioxane and alkalinity by Maxxam Analytics Inc. of Mississauga, ON, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA).

2.3.4 Groundwater Level Measurements

Groundwater level measurements were collected on May 18, 2017 using an electronic water level meter in the monitoring wells newly installed in the intermediate bedrock flow zone (M194-1, M194-2 and M195), as well as from a number of intermediate bedrock monitors in the same area of the proposed CAZ. This allowed the groundwater elevations between the existing and new monitoring wells in this area to be compared on the same date. In addition groundwater levels for all monitoring wells used in the routine environmental monitoring program (EMP) for the landfill were measured on April 28, 2017, prior to the construction of the new intermediate bedrock monitoring wells. These were interpreted to prepare the intermediate bedrock flow zone groundwater contours and inferred flow directions across the landfill property and proposed CAZ areas south and southeast from the landfill.

2.3.5 Groundwater Sampling

Groundwater samples were collected from monitoring wells M194-1, M194-2 and M195 on May 25 and June 8, 2017 using dedicated Waterra inertial lift pumps connected to dedicated polyethylene tubing. Where possible, a minimum of three casing volumes of water were removed from each monitoring well prior to the collection of groundwater samples. During purging, readings for pH, conductivity and temperature were recorded on a regular basis. The stabilization of the parameters was used to assess when well purging was complete. However, if the monitoring well purged dry it was allowed to recover sufficient volume at which time a the sample was collected.

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. Samples were analysed by Maxxam Analytics Inc. of Mississauga, ON, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA).

The samples were analyzed for general/inorganic parameters and VOCs as prescribed by the Interim EMP (BluMetric, 2016d) and summarized in **Table 1**.

3. RESULTS

3.1 Task 1 – Preliminary Karst Assessment

The preliminary karst assessment is described in detail in the report prepared by Cowell & Associates Inc., provided in **Appendix A.1** of this report, and is summarized below. Results from this assessment indicate that the karst within the proposed CAZ displays three distinct karst conditions:

1. A deep, likely paleokarst-controlled, conduit system in the west;
2. A shallower conduit system developing under post-glacial conditions in the east (represented by a groundwater trough observed in intermediate bedrock piezometric surfaces); and
3. A very shallow epikarst, located in areas of shallow soil over bedrock.

The karst conduits drain portions of the southwestern and central portions of the CAZ but do not appear to be influencing water levels in the area of the leachate influenced plume. The plume lies upgradient of the karst in an area of artesian conditions (e.g. M121, M125, M167, M178R-2 and -3) that is not affected by the karst.

Groundwater conditions within the CAZ are well monitored and the extents of the leachate plume in the intermediate bedrock flow zone have been delineated using primary leachate indicators 1,4 dioxane and high alkalinity. Downgradient monitoring wells located within or adjacent to the kasrt (e.g. M187, M174, M176 and M179) have not been impacted (below detection for 1,4 dioxane and alklalinity below 400 mg/L). However, pumping tests have indicated hydraulic connections between M187 and M64-2 and between M187 and M178R-2/-3; and leachate has been detected at M64-2 and M178R-2/-3. New monitoring wells, M194-1, M194-2 and M195, have been installed south and southwest of these two wells to monitor potential plume encroachment on the karst. Results from these two new wells are presented in Section 3.3 below.

Studies to further define the hydrologic characteristics of wells located between the plume and the karst have also been undertaken; preliminary results from these studies are described in Sections 3.1.2 and 3.1.3 below.

3.1.1 Task 1a – New Monitoring Well Between M187 and M64-2

Results from this new monitoring well, M195, are described in Section 3.3 below.

3.1.2 Task 1b – Water Level Data Loggers

Plots of normalized groundwater elevations vs. daily precipitation, and temperature vs conductivity from the loggers installed in wells listed previously in section 2.1.2 are provided in **Appendix H** for the period from February 28 to June 7, 2017. Based on their response to rain events and the spring freshet wells have been subdivided into three groups according to the apparent response in groundwater elevations and/or electrical conductivity following significant rain events. The wells are categorized as follows: responsive, potentially responsive and non-responsive.

Responsive wells include M166, M179 an M187. All three wells exhibited changes in groundwater elevation that correcleted directly with precipitation events and the spring freshet. Additionally, all three wells exhibited temporary declines in conductivity that were correlated with precipitation events or the spring freshet. Five wells were classified as potentially responsive due to the apparent but more subtle and/or inconsistent changes following rainfall, including M122, M190, M194-1 and M195. The remaining wells clearly did not respond to precipitation events

(M176, M186, M188-1 and M194-2). Temperature was very similar in all wells and did not show apparent changes following rain events.

3.1.3 Task 1c – Supplementary Stream Survey

The preliminary karst assessment supplementary stream survey is described in detail in the report prepared by Cowell & Associates Inc., provided in **Appendix A.2** of this report, and is summarized below. The primary purpose of the survey was to evaluate the potential karst connections between the unnamed creek and the interpreted karst within the proposed CAZ. The key findings of the survey are as follows:

1. Field readings (temperature and conductivity) taken at the time of the survey do not reveal evidence of significant karst inflows in the creek;
2. No major sinkholes or sinkpoints were observed in association with the unnamed creek;
3. Streamflow along the investigation portion of the unnamed creek are not significantly influenced by karst features; and
4. There is no evidence of karst interconnections within the CAZ between the stream and the two karst conduit systems identified in the preliminary karst assessment.

It was recommended that the downstream location in the unnamed creek be sampled annually during the spring freshet and analyzed for leachate indicator parameters for a period of two years.

3.2 Task 2 – Complementary Shallow Groundwater Investigation

3.2.1 Geology

The conditions encountered in boreholes M178R-5 and M188-2 are consistent with previous interpretations of the local geology. The overburden thickness at these locations was 2.4 and 0.6 metres, respectively, and consisted of sandy clay over trace gravel (M178R-5) and silty clay with trace organics (M188-2). Limestone bedrock was encountered in the boreholes M178R-5 and M188-2 at elevations of 114.69 and 115.13 masl, respectively. Borehole logs are provided in **Appendix B**.

3.2.2 Monitoring Well Installation

The target monitoring well screen elevations were identified from all available results (borehole logs, downhole geophysics and pumping tests) and discussed with MOECC hydrogeologists prior to installation. A summary of monitoring well construction details is provided in **Table 2** while complete borehole logs and monitoring well installation details are provided in **Appendix B**.

Figure 3 shows the elevations in cross section of the ground and bedrock surfaces, as well as well screen intervals.

Table 2: Summary of Shallow Monitoring Well Construction Details

Monitoring Well	Easting	Northing	Ground Surface Elevation (masl)	Bedrock Elevation (masl)	Screened Interval (masl)
M178R-5	335997	4902232	116.49	114.69	114.05 – 115.27
M188-2	335978	4902068	115.71	115.13	112.36 – 114.19

3.2.3 Piezometer Installation

A summary of piezometer construction details is provided in **Table 3**. Complete installation details are provided in **Appendix B** and shown in cross section on **Figure 3**.

Table 3: Summary of Piezometer Construction Details

Monitoring Well	Easting	Northing	Ground Surface Elevation (masl)	Bedrock Elevation (masl)	Screened Interval (masl)
DP01-16	335995	4902174	115.54	114.20	114.35-114.85
DP02-16	335988	4902146	115.35	113.90	114.05-114.45
DP03-16	335982	4902121	115.43	114.20	114.35-114.85

3.2.4 Groundwater Levels

Groundwater levels were measured on April 28, 2017 as part of the routine spring monitoring event from shallow groundwater flow zone monitoring locations across the WM Richmond Landfill site and two locations south of Beechwood Road within the proposed CAZ area. A map showing the groundwater elevations and the potentiometric contours interpreted from the data is presented on **Figure 5(a)**, while groundwater elevations are provided in **Appendix G**.

The groundwater flow patterns in the shallow groundwater flow zone within the landfill property North of Beechwood Road have been observed from previous results over several years to be highly predictable. The most recent groundwater contour map (**Figure 5(a)**) is consistent with historical results and shows that shallow groundwater elevation is influenced by topography and surface water features. The Empey Hill drumlin, a local topographic high located southwest from the landfill, creates a local flow divide, with shallow groundwater being directed both to the north and the south towards areas of lower hydraulic heads. North of the landfill, shallow groundwater converges towards Marysville Creek in the area immediately east of County Road 10 (Deseronto Road), while shallow 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 stormwater management ponds.

Further south, within the central portion of the proposed CAZ, shallow groundwater elevations were measured on several dates between January and May, 2017 in the newly installed monitoring wells M178R-5 and M188-2, as well as the new piezometers DP01-16, DP02-16 and DP03-16. Results are shown in **Table 4** while **Figure 3** shows the groundwater elevations from April 21, 2017 relative to ground and bedrock surfaces in cross-sectional view of the shallow monitoring points.

Table 4: Groundwater Elevations in New Shallow Groundwater Monitoring Wells and Drivepoint Piezometers

Units	Date	[NORTH] M178R-5	DP01-16	DP02-16	DP03-16	[SOUTH] M188-2
masl	2016-12-09	116.493	115.572	115.301	115.439	115.442
masl	2017-01-04	115.813	115.582	115.381	115.564	115.602
masl	2017-04-21	116.508	115.587	115.336	115.509	115.752
masl	2017-04-28	116.503	115.587	115.311	115.494	115.547
masl	2017-05-18	116.498	115.582	115.271	115.474	115.527
masl	2017-05-25	116.473	115.577	115.286	115.449	115.512

While variable, in particular at the shallow wells at the northern and southern extremities of the transect, results consistently showed that the shallow potentiometic surface within the central area of the proposed CAZ is highest to the north (M178R-5) and south (M188-2) and lowest in the area closest to the surface water course (DP02-16). Shallow groundwater in this area correlates well with the elevation of the ground and bedrock surfaces. The groundwater elevations indicate that a shallow groundwater divide is present in the central portion of the proposed CAZ, with shallow groundwater converging from the higher areas to the north and south towards the low topographic area that coincides with the surface water course.

3.2.5 Groundwater Chemistry

The groundwater chemistry results from samples collected for M175R-5 and M188-2 on May 25, 2017 and June 8, 2017 are presented in **Table A**.

Background concentrations of leachate indicator parameters in the shallow flow zone at the WM Richmond Landfill site are presented in the EMP (BluMetric, 2016d) for the site along with the calculated Guideline B-7 Reasonable Use Limits (RULs) for those parameters that have Ontario Drinking Water Standards. Results for M178R-5 indicate several parameters exceed RULs

(DOC, iron, manganese, TDS); in addition, the presence of 1,4 dioxane (0.0074 mg/L and 0.0070 mg/L) and elevatated alkalinity (430 mg/L and 420 mg/L) were detected at this location during both sampling events. Results for M188-2 indicate that manganese exceeded the RUL; however, all other parameters were below the RULs including alkalinity (270 mg/L and 260 mg/L) and 1,4 dioxane (below detection limits for both samples).

These results further confirm the presence of a shallow groundwater flow divide corresponding with the topographic low area and surface water course in the central portion of the proposed CAZ, with shallow groundwater impacted by landfill leachate to the north at M178R-5, located in an area where discharge of leachate impacted groundwater has been observed as seeps at surface during wet periods, while groundwater characteristic of background chemisty and exempt of landfill leachate impacts was observed to the south at M188-2.

3.3 Task 3 – Complementary Intermediate Bedrock Groundwater Investigation

3.3.1 Geology

The overburden materials and bedrock encountered in boreholes M194-1, M194-2 and M195 were consistent with previous interpretations of the local geology. The overburden thickness at these locations was 1.7, 1.7 and 0.3 metres, respectively, and consisted of clayey silt till with fine gravel at all three wells. Limestone bedrock was encountered in the boreholes M194-1, M194-2 and M195 at elevations of 113.19, 113.11 and 117.30 masl, respectively. Borehole logs are provided in **Appendix B**.

Downhole geophysical log results indicate several major open joints/fractures between 29 and 34 mbgs in borehole M194-1 (originally labelled M194), and a single major open joint/fracture at approximately 30 mbgs in borehole M195 (**Appendix C**). The downhole geophysicals results for borehole M194-1, supplemented by field notes from drilling and testing, revealed the following depth intervals of interest where potentially hydraulically significant fractures were identified:

- Zone 1: four distinct fractures between 30.9 and 34.1 mbgs;
- Zone 2: fracture at 29.1 mbgs
- Zone 3: feature between 24.1 and 24.8 mbgs with possible secondary mineralization

3.3.2 M194-1 Long-Term Constant Discharge Pumping test (Pumping Test)

A pumping test was conducted starting on February 14, 2017 to evaluate connectivity of fractures observed in the new wells to the previously documented responsive wells. **Table 5** summarizes the flow rate and maximum observed drawdown in the pumping well for the pumping test.

Table 5: Long Term Pumping Test Summary at M194-1

Pumping Well	Test Start Date	Ave. Flow Rate		Duration (hrs)	Max. Drawdown in pumping well (m)
		L/min	USgpm		
M194-1*	Feb. 14, 2017	83	22	48	8.8

** M194-1 was originally labelled M194*

Response curves from the pumping test conducted at borehole M194 (later instrumented as M194-1) are presented in **Appendix E**, grouped according to the presence or absence of response observed when pumping started and/or stopped. Five of the 13 monitored wells and open boreholes instrumented with pressure transducers were determined to respond to pumping, as shown on **Figure 4**. Monitoring well locations M173, M174, M185-2 and M187 responded to the test at M194, as did the new borehole M195 that also showed a characteristic drawdown and recovery response to the pumping test. Three additional monitoring wells, M177, M188-1 and M189, may also have responded to pumping, but melt/rain events and a change in barometric pressure coinciding with pump shut off made interpretation of small responses challenging. These wells were categorized as “possibly responsive”. Lastly, water levels in monitoring wells M64-2, M178-2, M179, M185-1 and M190 did not respond to the pumping test; however, as mentioned previously, interpretation of subtle changes was difficult, therefore a lack of response does not necessarily mean a lack of hydraulic connection. The fact that most of the non-responsive wells are also located far from the pumping well may also explain the lack of apparent hydraulic response to pumping.

3.3.3 Formation Hydraulic Testing

Appendix F shows the packer depth intervals and pumping depths from the complementary hydraulic testing at M194 (later instrumented as M194-1), along with related results (hydrographs). An assessment of the results indicates that:

- only the bottom set of fractures in M194-1 (Zone 1) appears to be hydraulically connected to the intermediate bedrock flow zone (M187, M195, etc);
- no (or very limited) direct hydraulic connection appears to exist between the three fracture zones within borehole M194-1; and
- the fractures and features observed at 22.20 mbgs, 26.50 mbgs and 29.30 mbgs do not produce sufficient yield to be considered hydraulically connected to the active intermediate bedrock flow zone.

Despite the evidence suggesting that the feature identified from downholed geophysical logs at a depth of approximately 24.4 mbgs (Zone 3) is not in hydraulic connection with the deeper fractures at 29.1 mbgs (Zone 2) or between 30.9 and 34.1 mbgs (Zone 1), it was decided to drill a second borehole (M194-2) targeting the feature from Zone 3.

3.3.4 Monitoring Well Installation

Monitoring well screen intervals were determined based on observations during drilling, downhole geophysics results, formation hydraulic testing and constant discharge pumping test results. The proposed monitoring well screen elevations were discussed with MOECC hydrogeologists prior to installation. A summary of monitoring well construction details is provided in **Table 6**. Complete borehole logs and monitoring well installation details are provided in **Appendix B**. A longer screen was installed at M194-1 from approximately 28 mbgs to the bottom of the borehole, to intercept the fractures from Zones 1 and 2, while M194-2 was instrumented at a depth corresponding to Zone 3, taking into account the high dip angle and azimuth, and distance between M194-1 and M194-2. Lastly, M195 was screened to intercept the single fracture observed at approximately 30 mbgs.

Table 6: Summary of Intermediate Bedrock Monitoring Well Construction Details

Monitoring Well	Easting	Northing	Ground Surface Elevation (masl)	Bedrock Elevation (masl)	Screened Interval (masl)
M194-1	335564	4901886	114.86	113.19	81.25 - 86.40
M194-2	335568	4901889	114.78	113.12	94.50 – 97.50
M195	335592	4902084	118.96	117.30	86.90 – 89.80

3.3.5 Groundwater Levels

Groundwater levels were measured on April 28, 2017 at 71 Intermediate Bedrock Flow Zone monitoring locations as prescribed in the EMP (BluMetric, 2016d). A map showing the groundwater elevations and the potentiometric contours interpreted from the data is presented on **Figure 5(b)**, while water levels are provided as **Appendix G**.

The groundwater in the intermediate bedrock has been observed from previous results to generally flow to the north, west, and south relative to the landfill. South of the landfill footprint, the groundwater flow orientation is to the south and southeast, and continues onto the proposed CAZ properties south of Beechwood Road. The most recent groundwater contour map (**Figure 5(b)**) is consistent with historical results and shows that the water levels in the monitoring wells within the areas to the west, east and directly south of the landfill and Beechwood Road are very similar with a relatively large region with groundwater elevations between approximately 122 and 123 masl. This is indicative of an area of rock with a relatively higher bulk hydraulic conductivity, and with a well-connected fracture network resulting in lower hydraulic gradients. Conversely, the areas to the southwest and southeast exhibit steep hydraulic gradients (closely spaced piezometric contours and rapidly declining hydraulic heads over short distances) and artesian conditions in some locations (e.g., M167, M178R-2 and -3).

As shown in **Table 7**, the new monitoring wells M194-1, M194-2 and M195 exhibited very low groundwater elevations at approximately 96 and 98 masl, consistent with nearby monitors installed in the Intermediate Bedrock Flow Zone (e.g., M173, M174, M187) and the general flow orientation in this area.

Table 7: Groundwater Elevations in New and Selected Existing Intermediate Bedrock Monitoring Wells – May 18, 2017

Well	GW Elevation (masl)	Well	GW Elevation (masl)
M122	121.87	M187	96.02
M166	122.54	M188-1	115.58
M173	101.00	M189	104.94
M174	96.14	M190	116.00
M176	110.62	M194-1	97.61
M179	111.04	M194-2	97.87
M186	114.92	M195	96.03

3.3.6 Groundwater Chemistry

Groundwater chemistry results for samples collected on May 25 and June 8, 2017 from M194-1, M194-2 and M195, as well as recent results for monitoring well M193, are presented in **Table A**.

There is no evidence of impacts from landfill leachate at the new intermediate bedrock wells. Background concentrations of leachate indicator parameters in the intermediate bedrock at the WM Richmond Landfill site, along with the calculated Guideline B-7 Reasonable Use Limits (RULs) for those parameters that have Ontario Drinking Water Standards, are presented in the latest EMP for the site (BluMetric, 2016d). Results for M194-1, M194-2 and M195 indicate that some parameters exceed their respective RULs (DOC, manganese, and TDS at M194-2; sodium and TDS at M195); however, 1,4 dioxane was below the reporting limit at all three wells (<0.001 mg/L), and alkalinity was below the calculated RUL of 400 mg/L. Results for M193 indicate several paramenters exceed the RULs (chloride. DOC, manganese, sodium, TDS, benzene); however, alkalinity was below the calculated RUL and 1,4 dioxane was below the detection limits. These results are consistent with previous findings and are indicative of naturally degraded groundwater at this location.

4. INTERPRETATION AND UPDATE TO SITE CONCEPTUAL MODEL

The current SCM used for the WM Richmond Landfill was first presented in BKA and WESA (2009). Refinements to the SMC were developed as part of the Action Plan investigation documented in BKA and WESA (2012). Subsequent phases of investigation beginning in 2012, have focused on properties south of Beechwood Road, as well as the adjacent property to east of the WM property and north of Beechwood Road. The information obtained from these investigations has been used to further refine and extend the SCM, and to establish the extent of the proposed CAZ for the site. The most recent update to the SCM was provided in BluMetric (2016a and 2016b). The information has also been used to develop the EMP for the landfill (BluMetric, 2016d).

This section provides an up-to-date conceptualization of the SCM for the WM Richmond Landfill, building on the previous SCM updates presented in the documents listed above, among others, and taking into account the findings from the latest hydrogeological investigations documented in sections 2 and 3 of the present report. Section 5 provides recommendations related to the proposed CAZ boundary based on the updated SCM and delineation of landfill leachate impacted groundwater.

4.1.1 Geology

The Richmond Landfill Site is located within the Napanee Plain which, on a regional scale, is a flat to slightly undulating plain of limestone dipping slightly to the south and typically covered with a relatively thin veneer of overburden. In the immediate vicinity of the Site, the ground surface slopes approximately 1 m to 3 m per kilometre to the south. A drumlin (Empey Hill) is present on the Site southwest of the landfill. The dominant drainage feature on the Site is Marysville Creek located north of the landfill, while Beechwood Ditch provides Site drainage south of the landfill.

The overburden consists of less than 0.5 m to 10 m of clayey silt till and thickens to approximately 20 m in the area of Empey Hill to the southwest of the landfill. The overburden is underlain by the Verulam Formation which consists of horizontally bedded, medium to coarse crystalline limestone with interbedded shale layers. The Verulam is interpreted to be a few metres thick at the Site and is underlain by the Bobcaygeon Formation which generally consists of horizontally bedded, crystalline limestone with interbedded shale in the upper part and interbedded calcarenite in the lower part. The thickness of the Bobcaygeon Formation beneath the Site varies from approximately 11 m to 15 m. The Bobcaygeon Formation is underlain by the Gull River Formation which consists of horizontally bedded limestone and exhibits a thickness of approximately 75 m beneath the Site.

As summarized in Section 3.1 and discussed in more detail in **Appendix A.1**, three distinct karst conditions are also present within the proposed CAZ south of Beechwood Road: 1) a deep, likely paleokarst-controlled, conduit system in the west; 2) a shallower conduit system developing under post-glacial conditions in the east (represented by a groundwater trough); and, 3) a very shallow epikarst, located in areas of shallow soil over bedrock.

4.1.2 Physical Hydrogeology

The active groundwater flow zone at the Site extends to a depth of approximately 30 m below the top of bedrock. The dominant fracture orientation in the upper 30 m of bedrock is parallel to bedding (horizontal to sub-horizontal) distributed throughout the upper 30 m of bedrock, implying that there are no particular depth horizons exhibiting anomalous amounts of fracturing. Some borings do exhibit a shallow weathered zone, however, in which fracturing is more pronounced. A moderate amount of vertical to sub-vertical fractures exist providing hydraulic connections between the various horizontal fractures.

The area south of the landfill footprint and east of the landfill entrance road is characterized by interconnected fractures that appear to be well connected to recharge/discharge features, which are likely in direct connection to surface infiltration. The well-connected area has a significant role in the local variation of the potentiometric surface as the water levels vary throughout the year by as much as 4 to 6 m. The results of various CAZ investigations over the past several years, which demonstrated hydraulic connection between monitoring wells north and south of Beechwood Road, have confirmed that the hydraulically well-connected area extends onto the proposed CAZ properties, as far south and southeast as well locations M188, M190 and M167.

The results of hydraulic conductivity tests conducted in boreholes and monitoring wells within the well-connected area have been compiled, and compared to the results from tests conducted outside of the apparent boundaries of this area (BluMetric, 2016a). The geometric mean of the hydraulic conductivities measured inside the area of well-connected boreholes was slightly higher than the geometric mean of the hydraulic conductivities measured outside the area and the distribution of results showed a much higher proportion of hydraulic conductivities greater than $1x10^{-5}$ m/s within the area of well-connected boreholes, relative to the area outside. The increased distribution of higher hydraulic conductivities and the observed connections between monitoring wells within this area are consistent with the interpretation that this area consists of a well-connected fracture network through which groundwater can flow at a greater rate than outside of the area.

It is important to emphasize that the area of well-connected bedrock fractures described above interacts hydraulically with other areas of the Site. It is distinct due to its behavioral differences during recharge/discharge time periods, but does not represent a separate flow regime. Furthermore, the zones of lower hydraulic conductivity surrounding the area to the west, south and east do not represent a barrier to flow; rather the rate of groundwater flow is slower within these lower permeability zones within the fractured bedrock. The presence of the less permeable zones is clearly seen by comparison of temporal water level variations inside and outside of the area of well-connected fractures. Flow out of the area is controlled by the lower hydraulic conductivity in the surrounding rock. Infiltrating water recharging into the well-connected area is stored, resulting in the noticeable rise in water levels, which then dissipate as groundwater flow moves through and out of the area.

Another area that exhibits a distinct hydraulic behaviour was identified in the southern portion of the proposed CAZ. Static groundwater elevations in intermediate bedrock zone monitoring wells located within this area (eg, M173, M174, M181, M187, M189, M194-1, M194-2 and M195) were observed to be much deeper compared to wells in the area of higher hydraulic conductivity monitoring wells introduced previously. Static water levels at these locations were deep, between 15 and 30 mbgs (105 masl or lower) compared to 5 mbgs typically (116 masl or greater) within the higher conductivity area (see **Figure 5(c)**). Similarly, groundwater elevations at M176 and M179, while not as deep (2.0 and 6.1 mbgs, respectively), also exhibited static groundwater elevations of 111 masl or lower.

While most wells in this group exhibit low permeability across the vertical profile, relatively more permeable fracture zones were identified in some boreholes (eg, M189, M187. M194-1). At well location M187, a highly permeable fracture was encountered at a depth of approximately 26 mbgs (~90 masl). Despite the limited drawdown that could be achieved during the pumping test at this location with a relatively high pumping rate of more than 100 L/min, M187 was confirmed to be hydraulically connected to other wells defining the periphery of the area of responsive monitoring wells (eg, M64-2, M173, M179 and M185). Similarly, significant water bearing fractures were identified in M194-1 at comparable depths (29-33 mbgs or 82-86 masl), and also hydraulically connected to the network of hydraulically active wells (M187, M174, etc) and new well M195 (active fracture at 30 mbgs or 89 masl).

The karst conduits found within the southwestern and central portions of the CAZ do not appear to be directly influencing water levels in the aforementioned area of higher hydraulic conductivity in the northern portion of the proposed CAZ and south part of the landfill property. This higher hydraulic conductivity area lies upgradient of the karst and includes an area of artesian conditions near its southern/eastern boundary (e.g. M167, M178R-2 and -3). The presence of artesian conditions in juxtaposition to karst is of interest as karst conduits are characterized by relatively high hydraulic conductivities. If the entire site were affected by the karst, one would not expect the presence of areas with such high hydraulic heads (artesian conditions), rather the karst would serve to act as a drain, keeping heads low.

4.1.2.1 Shallow Groundwater Zone

The shallow groundwater flow zone comprises overburden, the overburden-bedrock contact, and the first one to two metres of depth into bedrock. Water level monitoring indicates that these three portions of the shallow flow system act in concert and can be treated as a single flow zone or hydrostratigraphic unit. The directions of groundwater flow in the shallow flow zone are strongly influenced by ground surface topography, which is typical where the water table is generally shallow.

Shallow zone flownets are constructed seasonally (spring, summer and fall) at the site using water level data from hydraulically responsive wells. **Figure 5(a)** presents the most recent piezometric surface for the shallow groundwater flow zone. The flownets, documented in semi-annual reports, show that there is a water level high beneath Empey Hill stemming from the elevated topography of this feature. Empey Hill creates a flow divide west of the landfill with shallow groundwater being directed both to the north and the south. The northerly flowing groundwater discharges to Marysville Creek. The southerly flowing groundwater flows towards Beechwood Ditch in the southwest portion of the Site. Shallow groundwater south of the landfill and south of Beechwood Road also flows towards the area of lower water levels in the southwest portion of the Site.

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 well location M96 flows to the north and ultimately into Marysville Creek while groundwater south of well location M96 flows to the south-southeast. The shallow groundwater flow directions described here do not vary significantly with season despite the fact that water levels at the Site can be up to approximately 2 m higher in the spring months compared to the fall months. The lack of variation of shallow groundwater flow direction with season stems from the fact that the shallow flow system is topographically controlled and indicates that an appropriately located monitoring well network will detect a potential contaminant plume in the shallow zone.

Farther south, shallow groundwater discharges into a low-lying area in the central portion of the proposed CAZ south of Beechwood Road where a surface water course is present. The land surface rises south of this low-lying area which acts as a local divide for the shallow groundwater flow in this part of the CAZ, as is apparent from the vertical cross section shown on **Figure 3**.

4.1.2.2 Intermediate Bedrock Groundwater Zone

The intermediate bedrock groundwater flow zone extends from one to two metres below the top of bedrock to a depth of approximately 30 m below the top of bedrock. The 30 m limitation was selected on the basis of the fact that groundwater salinity increases significantly below 30 m depth into bedrock and the fact that fresher groundwater, including leachate, does not have the ability to displace the denser, saline groundwater. In addition, because of the significant anisotropy exerted by the dominance of horizontal to sub-horizontal fractures, the primary groundwater flow direction in bedrock is horizontal. This does not, however, rule out localized occurrences of vertical flow within the intermediate flow zone. The deep groundwater below 30 m depth into bedrock is classified as non-potable according to the Ontario Drinking

Water Standards, Objectives and Guidelines. At some well locations, naturally saline waters exist in the intermediate bedrock at depths of less than 30 metres, particularly in areas of lower hydraulic conductivity and slower groundwater flow rates. These waters are distinguishable by elevated sodium, chloride and TDS concentrations, low alkalinity and often the presence of ammonia and BTEX compounds.

As with shallow groundwater, the intermediate zone groundwater will always flow from regions of high hydraulic head to regions of low hydraulic head. The hydraulic testing programs conducted since 2009 have revealed that there is continuity of hydraulically connected fractures in the intermediate flow zone surrounding the landfill to the west, south and southeast. Pumping of individual wells at various depths induced hydraulic responses up to 450 m away, supporting the interpretation that groundwater flow occurs primarily through horizontal and sub-horizontal fractures that are connected to each other by vertical to sub-vertical fractures.

Intermediate zone flownets (e.g., **Figure 5(b)**) illustrate that groundwater flowing under the landfill generally flows to the west from the western edge of the landfill, to the south-southeast from the southern edge of the landfill, and to the southwest from the southwest corner of the landfill. The hydraulic influence of Empey Hill is seen in the intermediate flow zone in that a relatively stagnant zone (weaker hydraulic gradients) is created southwest of the landfill. Unlike the shallow zone flow system, however, the intermediate zone flow system exhibits significant flow direction changes with season. This stems from the fact that the intermediate flow zone is not as constrained by topographic control as the shallow zone flow system. The regional groundwater flow direction is southward, following the dip of the limestone bedrock as well as the general slope of the topographic surface.

Area South of Landfill

The groundwater contours and orientations of groundwater flow for the intermediate bedrock in the area of well-connected fractures south of the landfill and east of the landfill access road can be distinguished by periods of higher groundwater levels and periods of lower groundwater levels. During periods of high groundwater levels, the groundwater generally flows south-southeast across this area toward Beechwood Road (see **Figure 5(b)**). Groundwater from the southern edge of the landfill east of the entrance road flows towards the southeast in the direction of well location M105 and continues southeastward toward Beechwood Road.

During periods of lower water levels, groundwater flow is oriented toward the central portion of the well-connected area from the north; west and south (see BluMetric (2016a), Figures 5(a) and 5(c)). Flow from the eastern half of the landfill footprint is directed toward the central portion of this area, as is flow from west of the landfill entrance road, as well as flow from properties south of Beechwood Road. Based on the water level contours, groundwater flows eastward south of the landfill, and continues toward the east-southeast. During periods of low water level, the data suggest that a groundwater divide is established south of Beechwood Road, along an approximate orientation from northwest to southeast. This is particularly apparent on the potentiometric surface for October 2013 (BluMetric (2016a), Figure 5(a)), where groundwater north of the divide flows onto the landfill property from the properties south of Beechwood Road, and groundwater south of the divide flows southward. The groundwater divide is present only during periods of low water levels; at other times, the flow is more consistently southeastward.

Flownets developed over the past several years indicate that the groundwater flow continues in a southeastward orientation across the properties that are proposed to be used for the CAZ. Monitoring wells outside of the well-connected area typically exhibit much lower water levels than the wells within the area. Monitoring wells within this area had similar water levels to each other, which is indicative of an environment of higher bulk rock hydraulic conductivity and lower hydraulic gradients. The identification of karst systems in the southwest and southeast portons of the proposed CAZ area is consistent with this interpretation.

The implication of the changing flow direction seen in the intermediate bedrock is that hydraulically downgradient locations within the intermediate flow zone will vary with season, and that an appropriate monitoring network to assess groundwater quality in the downgradient flow direction will need to comprise a network of monitoring wells at various locations. A corollary to this is that the changing groundwater flow directions in the intermediate flow zone will cause potential leachate plumes to shift in flow direction with season, thereby ensuring that a network of monitoring wells is capable of detecting their presence.

Groundwater from the intermediate bedrock groundwater flow zone is believed to be naturally discharging to ground surface in a large wet area located in the central portion of the proposed CAZ. Covering approximately 500 m by 100 m, this area extends between well locations M178/M178R and M173/M187. This diffuse discharge area is located on the north side of the local shallow groundwater flow divide that corresponds to the topographically low area, as described above in section 4.1.2.1 and shown on the vertical cross-section on **Figure 3**.

Multiple lines of evidence confirm that groundwater discharge is occurring in this area:

- Strong vertical hydraulic connections exist within the intermediate bedrock groundwater flow zone in this area, for example between M178R-4 (screened 4.5 m below bedrock surface) and the deeper wells (M178R-2 and M178R-3, screened 17 and 11 m below bedrock, respectively);
- Artesian conditions exist in several intermediate bedrock monitoring wells in this area (eg, M178, M178R where hydraulic heads have been observed to reach as much as 4.9 m

above ground surface, at M178R-2 on May 15, 2015), indicating the presence of strong upward vertical hydraulic gradients;

- Groundwater discharge points have been observed at ground surface in various locations within this diffuse area, and found to flow intermittently depending on the conditions, including during winter where some discharge points remain flowing and wet at times when temperatures are well below freezing;
- Areas where groundwater was observed to discharge to surface were sampled and found to be impacted with low 1,4 dioxane concentrations (between 1.5 and 4.0 μg/L in fall 2015, well below the PWQO compliance limit for surface water (20 μg/L)). The results from the new shallow monitoring well M178R-5, located near the discharge area, had 1,4 dioxane concentrations 7.0 to 7.4 μg/L.

Karst features have been observed south of Beechwood Road in the central portions of the proposed CAZ area. The karst assessment (**Appendix A.1**) revealed that three distinct karst conditions exist within the proposed CAZ:

1. A deep, likely paleokarst-controlled, conduit system in the west;
2. A shallower conduit system developing under post-glacial conditions in the east (represented by a groundwater trough); and,
3. A very shallow epikarst, located in areas of shallow soil over bedrock.

The karst conduits drain portions of the southwestern and central portions of the CAZ but do not appear to be influencing water levels in the area of the leachate impacted plume. Downgradient monitoring wells located within or adjacent to the karst (e.g. M187, M174, M176 and M179) have not been impacted (below detection for 1,4 dioxane and alklalinity below 400 mg/L). Additionally, the supplementary study conducted by the karst expert (**Appendix A.2**) of the unnamed creek running from northeast to southwest along the southeast limits of the proposed CAZ confirm that, while minor losses or gains from shallow bedrock in the vicinity of the creek cannot be ruled out, there is no evidence of karst interconnections within the proposed CAZ.

Area North and Northwest of Landfill

The area north and northwest of the landfill footprint, between the landfill and Marysville Creek, has been identified through hydraulic testing as an area where relatively lower hydraulic conductivity exists. This does not imply that there is zero groundwater flow through this area, but rather that the groundwater flow rate is lower than in other areas around the landfill site.

Marysville Creek is the primary potential receptor and should continue to be monitored north of the landfill. The extensive amount of monitoring to date, including testing for 1,4 dioxane and other primary leachate indicators, demonstrates that impacts have not been identified in the groundwater adjacent to the creek or in the surface water in the creek. Impacts are seen in the groundwater within approximately 50 metres north and west of the unlined Phase 1 portion of the landfill; however, because of the lower hydraulic conductivity and slow rate of groundwater flow, no impacts are observed in groundwater along the creek.

4.1.2.3 Deep Bedrock

The deep bedrock zone is defined as groundwater occurring greater than approximately 30 m below the top of bedrock. The deep groundwater is saline and not suitable for potable use. There is limited hydraulic interaction between the intermediate bedrock flow zone and the deep bedrock because of the differences in groundwater density related to salinity. Deep bedrock groundwater generally flows to the south in a horizontal direction, although vertical components of flow may also exist. Bulk rock hydraulic conductivity is generally lower at depths greater than 30 m below the top of bedrock, and fracture apertures are generally smaller below this depth. It follows that the movement of groundwater in the deep bedrock will be slower than in the shallow and intermediate bedrock flow zones.

4.1.3 Groundwater Quality and Extent of Impacts

Background groundwater quality in the shallow and intermediate bedrock flow zones is characterized by geochemistry in several monitoring wells on the landfill property, as described in the EMP (BluMetric, 2016d).

The primary indicators that are used to delineate impacts from landfill leachate at the site are 1,4 dioxane and alkalinity. 1,4 dioxane is a synthetic volatile organic compound (VOC) used as a chemical stabilizer for chlorinated solvents that does not exist in nature, is entirely miscible in water and does not readily biodegrade or adsorb onto soils or rock[7]. Consequently, the presence of 1,4 dioxane in groundwater at detectable concentrations (> 0.001 mg/L) is used to indicate the furthest extent of impacts. In addition, where 1,4 dioxane is detected, alkalinity has been found to be generally above 400 mg/L. Other parameters are also used to assist in determining impacts and are included in the routine monitoring program.

Groundwater sample data collected from on-site monitoring wells indicate that leachate impacted groundwater is flowing from the northwest corner of the unlined Phase 1 footprint of the landfill in the shallow and intermediate bedrock groundwater flow zones. **Figure 6(a)** and

[7] U.S. EPA 2014: *Technical Fact Sheet for 1,4 Dioxane*, January 2014: https://www.epa.gov/sites/production/files/2014-03/documents/ffrro_factsheet_contaminant_14-dioxane_january2014_final.pdf

Figure 6(b) illustrate on a site plan the approximate extents of the impacted area in the shallow and intermediate bedrock flow zones, respectively.

In the shallow groundwater zone north of Beechwood Road (**Figure 6(a)**), impacts are evident at monitoring wells M100, M101, M103 and M104 north and west of the Phase 1 landfill cell. These monitoring wells are all in close proximity to the landfill. Further downgradient, in particular along Marysville Creek, no impacts have been observed in the shallow groundwater. Similarly, monitoring well M41, located approximately 25 m south from the landfill footprint, has been impacted by leachate while no subsurface impacts from landfill leachate have been observed at shallow groundwater monitoring locations farther downgradient (e.g., M54-4 or M70-3, located south and southeast of the landfill, respectively).

An area of shallow groundwater discharge exists within the proposed CAZ, approximately 400 m south of Beechwood Road in an area just upgradient (north) from the unnamed surface water course that extends between two dug ponds (see **Figure 6(a)**). The shallow groundwater in this area shows detectable concentrations of 1,4 dioxane. The extent of shallow groundwater impacts within the proposed CAZ (shown on **Figure 6(a)**) has been delineated based on shallow groundwater, seep and surface water chemistry. In this area, upward hydraulic gradients, groundwater seeps and generally wet conditions are observed (e.g., BluMetric, 2016a). Sampling results from M178R-5 and nearby seeps (BluMetric, 2016a)) show evidence of landfill impacts at those locations (presence of 1,4 dioxane at detectable but low concentrations), while no impacts have been detected to the immediate south, including in the surface water course (which corresponds to a local divide for shallow groundwater as described in section 4.1.2.1) nor in shallow groundwater (M188-2).

In the intermediate bedrock groundwater zone (**Figure 6(b)**), impacts are evident within 50 m north of the landfill footprint at monitoring wells M6-3 and OW4 where the highest concentrations of 1,4 dioxane (up to 0.35 and 0.13 mg/L respectively) have been measured (**Table A**), while no evidence of impacts is seen further downgradient, closer to Marysville Creek. This is consistent with the hydraulic testing results which show an area of low hydraulic conductivity north and northwest of the landfill.

There is no evidence of impacts in any of the monitoring wells located south of the landfill footprint and west of the site entrance road.

Along the eastern boundary of the landfill property, 1,4 dioxane has been detected above the RUL of 0.001 mg/L at montoring wells M168 and M170. The leachate impacted groundwater plume extends onto the southwestern corner of the property located to the east of the southeast limit of the WM property, up to monitoring well M192 where 1,4 dioxane has been detected at the reporting limit of 0.001 mg/L.

South of the landfill, 1,4 dioxane has been detected in monitoring wells within the north and central portion of the proposed CAZ at concentrations above the RUL of 0.001 mg/L and show impact to groundwater quality originating from the landfill. These impacted monitoring wells have all been determined to be hydraulically responsive to pumping tests, including monitoring well M64-2 which did not respond to most pumping tests and responded subtly to pumping at M187 and appears to correspond to the western boundary of the area of higher hydraulic conductivity. However, contrary to what has been observed at most of the other impacted wells, other leachate indicator parameters, particularly alkalinity and tritium (BKA and WESA, 2009), are not elevated at M64-2. Ongoing monitoring since 2013 has confirmed the presence of 1,4 dioxane at this location at low but stable concentrations between 0.002 and 0.003 mg/L (see **Table B**). The presence of 1,4 dioxane in this monitoring well demonstrates that lower hydraulic conductivity monitoring wells, even if non-responsive during pumping tests, are also part of the intermediate bedrock flow system and can be utilized to monitor groundwater impacts from the landfill.

Based on the results of previous hydrogeological investigations and the latest iteration reported in this document, it is concluded that groundwater impacts have been delineated and extend downgradient from the landfill onto the proposed CAZ as far southwest, south and southeast as well locations M64-2, M178R and M167, respectively. The monitoring wells within the proposed CAZ and located outside of the extent of impacts are listed in **Table 8**.

Table 8: Intermediate Bedrock Monitoring Wells in Proposed CAZ Outside of the Extent of Impacts

M63-2	M179	M185-2	M190
M173	M181-1	M186	M191
M174	M181-2	M187	M194-1
M176	M182	M188-1	M194-2
M177	M185-1	M189	M195

5. RECOMMENDATIONS FOR CONTAMINANT ATTENUATION ZONE

Eastern CAZ Limits: Recent monitoring results have confirmed that the groundwater in a small portion of the southwest corner of the property located to the east of the southeast corner to of the landfill property limit has been impacted by landfill leachate. WM proposes 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. WM has re-entered into negotiations with the owner of this property to obtain control of groundwater rights on this parcel.

Western CAZ Limits: to address concern regarding the western limit of the CAZ, and considering the low permeability bedrock commonly encountered in the western portion of the proposed CAZ area south of Beechwood Road, and the well-defined direction of groundwater flow in the intermediate bedrock in the northern portion of the CAZ in this area, WM proposes to extend the proposed CAZ westerly to Deseronto Road to include additional buffer.

Figure 7 shows the properties south of Beechwood Road that are owned by WM, as well as the updated proposed CAZ including the extended area to the west. The impacted area has been delineated conservatively using the detection limit for 1,4 dioxane (0.001 mg/L). Based on 1,4 dioxane concentration results collected since 2013 from an extensive network of hydraulically active groundwater monitoring wells, the extent of the contaminant plume originating from the landfill has been adequately defined. The limits of the proposed CAZ extend a minimum buffer of 250 m outside of the outer extent of the plume, which includes a number of unimpacted downgradient monitoring wells used to detect potential impacts.

Respectfully submitted,
BluMetric Environmental Inc.

PROFESSIONAL GEOSCIENTIST
ANDREW D. DAY
PRACTISING MEMBER
2407
ONTARIO

Andrew Day, M.Sc., P.Geo.
Intermediate Hydrogeologist

PROFESSIONAL GEOSCIENTIST
FRANÇOIS A. RICHARD
PRACTISING MEMBER
1401
ONTARIO

Francois Richard, P.Geo., Ph.D.
Senior Hydrogeologist

PROFESSIONAL GEOSCIENTIST
PHILIP A. TIBBLE
PRACTISING MEMBER
1107
ONTARIO

Phil Tibble, M.Sc., P.Geo.
Senior Hydrogeologist

TABLES

Table A. Groundwater Chemistry from New Monitoring Wells

		GENERAL / INORGANIC PARAMETERS																VOLATILE ORGANIC COMPOUNDS (VOCs)					
Name	Sam Date	Alkalinity mg/L	Ammonia mg/L	Boron mg/L	Calcium mg/L	Chloride mg/L	Conductivity µS/cm	Dissolved Organic Carbon mg/L	Iron mg/L	Magnesium mg/L	Manganese mg/L	Nitrate mg/L	Nitrite mg/L	Potassium mg/L	Sodium mg/L	Sulphate mg/L	Total Dissolved Solids mg/L	1,1,1,2-Tetrachloroethane mg/L	1,1,1-Trichloroethane mg/L	1,1,2,2-Tetrachloroethane mg/L	1,1,2-Trichloroethane mg/L	1,1-Dichloroethane mg/L	1,1-Dichloroethylene mg/L
Shallow Flow Zone																							
	RUL*	390				130		3.6	0.18		0.03				109		452						0.0035
M178R-5	5/25/2017	430	< 0.15	0.21	130	78	1000	3.8	0.21	27	0.040	< 0.1	< 0.01	4.6	59	20	540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00043	< 0.0001
M178R-5	6/8/2017	420	0.22	0.2	120	70	980	3.3	0.21	26	0.034	< 0.1	< 0.01	4.6	57	17	558	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00046	< 0.0001
M188-2	5/25/2017	270	0.26	0.39	72	3.6	650	1.7	< 0.1	25	0.071	0.16	0.014	5.8	30	65	362	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M188-2	6/8/2017	260	< 0.15	0.34	78	2.5	620	0.98	< 0.1	25	0.071	0.37	0.023	5.3	23	60	358	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
Intermediate Bedrock Flow Zone																							
	RUL*	400				132		3.5	0.18		0.03				106		465						0.0035
M193	6/8/2017	310	1.42	0.63	49	350	1800	2.2	0.25	49	0.260	< 0.1	< 0.01	18	240	12	868	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M194-1	5/25/2017	230	< 0.15	0.033	91	6.2	500	2.2	< 0.1	4.5	0.004	< 0.1	< 0.01	1.1	7	19	262	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M194-1	6/8/2017	240	< 0.15	0.035	90	6.1	500	1.8	< 0.1	4.5	0.004	< 0.1	< 0.01	1	6.9	17	270	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M194-2	5/25/2017	250	0.19	0.2	80	24	770	9.3	< 0.1	12	0.043	< 0.1	< 0.01	5.9	74	100	462	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M194-2	6/8/2017	270	0.18	0.24	80	3.2	790	6.6	< 0.1	14	0.044	< 0.1	< 0.01	6.2	78	15	482	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M195	5/25/2017	380	0.68	0.81	46	75	1100	1.9	0.1	15	0.008	< 0.1	< 0.01	8.7	190	77	634	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001
M195	6/8/2017	390	0.74	0.84	37	67	1100	1.5	0.11	13	0.008	< 0.1	< 0.01	7.8	190	77	612	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001

** RUL: Reasonable Use Limit (mg/L)*

Highlighted cells indicate results above RUL

Table A. Groundwater Chemistry from New Monitoring Wells

Name	Sam Date	VOLATILE ORGANIC COMPOUNDS (VOCs)																					
		1,2-Dichlorobenzene (o) mg/L	1,2-Dichloroethane mg/L	1,3,5-Trimethylbenzene mg/L	1,3-Dichlorobenzene (m) mg/L	1,4-Dichlorobenzene (p) mg/L	1,4-Dioxane mg/L	Benzene mg/L	Chlorobenzene mg/L	Chloroethane mg/L	Chloromethane mg/L	Cis-1,2-Dichloroethylene mg/L	Dichloromethane mg/L	Ethylbenzene mg/L	m+p-Xylene mg/L	o-Xylene mg/L	Styrene mg/L	Tetrachloroethylene mg/L	Toluene mg/L	Total Xylenes mg/L	Trans-1,2-dichloroethylene mg/L	Trichloroethylene mg/L	Vinyl Chloride mg/L
	RUL*						0.001	0.0014						0.0013					0.0121	0.15			
M178R-5	5/25/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0074	< 0.0001	< 0.0001	0.0011	< 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-5	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.007	< 0.0001	< 0.0001	0.0011	< 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
M188-2	5/25/2017	< 0.0002	< 0.0002	< 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
M188-2	6/8/2017	< 0.0002	< 0.0002	< 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
	RUL*						0.001	0.0014						0.0013					0.0121	0.15			
M193	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.003	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00016	< 0.0001	< 0.0002	< 0.0001	0.00022	0.00016	< 0.0001	< 0.0001	< 0.0002
M194-1	5/25/2017	< 0.0002	< 0.0002	< 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	0.00053	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M194-1	6/8/2017	< 0.0002	< 0.0002	< 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	0.00042	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M194-2	5/25/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00022	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00028	0.00014	< 0.0002	< 0.0001	0.0016	0.00042	< 0.0001	< 0.0001	< 0.0002
M194-2	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0002	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00027	0.00013	< 0.0002	< 0.0001	0.0092	0.0004	< 0.0001	< 0.0001	< 0.0002
M195	5/25/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00028	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00013	< 0.0001	< 0.0002	< 0.0001	0.00055	0.00013	< 0.0001	< 0.0001	< 0.0002
M195	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00038	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00015	< 0.0001	< 0.0002	< 0.0001	0.00085	0.00015	< 0.0001	< 0.0001	< 0.0002

** RUL: Reasonable Use Limit (mg/L)*

Highlighted cells indicate results above RUL

Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		GENERAL / INORGANIC PARAMETERS																VOLATILE ORGANIC COMPOUNDS (VOCs)							
Name	Sam Date	Alkalinity mg/L	Ammonia mg/L	Boron mg/L	Calcium mg/L	Chloride mg/L	Conductivity µS/cm	Dissolved Organic Carbon mg/L	Iron mg/L	Magnesium mg/L	Manganese mg/L	Nitrate mg/L	Nitrite mg/L	Potassium mg/L	Sodium mg/L	Sulphate mg/L	Total Dissolved Solids mg/L	1,1,1,2-Tetrachloroethane mg/L	1,1,1-Trichloroethane mg/L	1,1,2,2-Tetrachloroethane mg/L	1,1,2-Trichloroethane mg/L	1,1-Dichloroethane mg/L	1,1-Dichloroethylene mg/L	1,2-Dichlorobenzene (o) mg/L	1,2-Dichloroethane mg/L
M10-1	4/24/2013	480	0.78	0.32	130	120	1290	7.4	18	32	0.72	< 0.1	< 0.01	5.3	94	14	690	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.003	0.00023	< 0.0002	< 0.0002
M10-1	4/30/2013																								
M10-1	10/21/2013	560	0.74	0.39	170	170	1580	7.8	21	44	0.88	< 0.1	< 0.01	6.8	94	11	874	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.002	0.00025	< 0.0002	< 0.0002
M10-1	5/8/2014	360	0.63	0.23	86	45	814	5.1	11	21	0.4	< 0.1	< 0.01	4.4	54	8	406	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.002	0.00018	< 0.0002	< 0.0002
M10-1	9/4/2014	510	0.8	0.2	150	140	1410	6.6	19	37	0.75	< 0.1	< 0.01	5	73	11	856	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0026	0.00025	< 0.0002	< 0.0002
M10-1	10/21/2014	540	0.8	0.31	180	160	1580	7.2	20	44	0.77	< 0.1	< 0.01	5.9	84	27	912								
M10-1	4/23/2015	470	0.72	0.22	140	140	1270	7.9	20	34	0.65	< 0.1	< 0.01	5.5	91	9	760	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0027	0.00028	< 0.0002	< 0.0002
M49-1	4/24/2013	380	1.02	0.93	13	400	2190	2.3	< 0.1	5.9	0.026	< 0.1	< 0.01	8.3	440	33	1160	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M49-1	10/21/2013	400	0.94	0.94	9	340	1920	3.1	< 0.1	3.8	0.013	< 0.5	< 0.05	7.3	400	31	1010	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M49-1	5/8/2014	400	0.9	0.95	12	340	1940	4.2	< 0.1	5.4	0.01	< 0.1	< 0.01	7.4	400	32	1030	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M49-1	10/21/2014	390	0.78	1.1	11	320	1880	4.2	< 0.1	5.5	0.011	< 0.1	< 0.01	7.2	370	27	1190								
M49-1	4/23/2015	360	0.87	1	13	290	1740	2.5	< 0.1	6.2	0.0099	< 0.1	< 0.01	8.2	340	27	940	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M53-2	5/1/2013																								
M53-2	10/18/2013						1952																		
M63-2	6/20/2013	400	1.86	1.9	18	300	1999	1.3	< 0.1	11	0.016	< 0.1	< 0.01	10	300	23	950	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M63-2	12/9/2014	390																							
M63-2	1/12/2015	350																							
M64-2	6/20/2013	300	1.09	1	47	90	1177	1.3	< 0.1	28	0.0089	< 0.1	< 0.01	9.5	100	14	484	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M64-2	9/5/2014	320	1.08	0.95	51	110	875	0.9	< 0.1	28	0.0071	< 0.1	< 0.01	9	91	4	512	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M64-2	11/4/2014	300																							
M64-2	11/26/2015	290	0.94	1	53	110	962	0.9	< 0.1	30	0.0085	< 0.1	< 0.01	10	95	1.2	520	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M64-2	5/6/2016	280	1.02	0.96	53	120	957	1.2	< 0.1	30	0.0081	< 0.1	< 0.01	10	92	3.4	392	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M64-2	10/20/2016	300	1.02	0.97	51	110	950	1.7	< 0.1	31	0.008	< 0.1	< 0.01	10	97	23	486	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M64-2	5/3/2017	310	1.01	0.95	54	120	970	1	< 0.1	31	0.008	< 0.1	< 0.01	10	95	2.9	558	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M70-2	5/1/2017	390	2.84	1.5	71	640	2800	2	4.5	58	0.031	< 0.1	0.011	18	510	< 1	1280	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M105	4/23/2013	570	0.94	0.34	170	160	1600	6.9	< 0.1	68	0.0096	< 0.1	< 0.01	9.4	89	12	944	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M105	4/30/2013																								
M105	10/21/2013	550	0.8	0.38	160	190	1630	6.6	< 0.1	62	0.0094	< 0.1	< 0.01	9.1	97	10	932	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M105	5/6/2014	630	0.7	0.41	180	200	1790	9.4	< 0.1	66	0.01	< 0.1	< 0.01	7.2	110	8	954	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M105	9/4/2014	460	0.75	0.43	130	250	1650	5.7	< 0.1	52	0.0083	< 0.1	< 0.01	7.5	120	20	1080	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M105	10/22/2014	470	0.82	0.43	170	310	1880	6.6	< 0.1	63	0.0083	< 0.1	< 0.01	8.2	130	13	1140								
M105	4/21/2015	600	0.67	0.38	160	170	1640	7.1	< 0.1	57	0.0095	< 0.1	< 0.01	7.7	110	9	908	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M107	4/30/2013																								
M107	6/20/2013	430	0.23	0.16	130	96	1100	6.3	5.2	32	0.35	< 0.1	< 0.01	3.6	66	15	630	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	0.00014	< 0.0002	< 0.0002
M107	10/21/2013	540	0.2	0.18	180	140	1460	6.5	7.3	43	0.47	< 0.1	< 0.01	4.2	78	13	794	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.001	0.00017	< 0.0002	< 0.0002
M107	5/6/2014	370	0.24	0.14	98	48	862	4.8	5	24	0.28	< 0.1	< 0.01	3.1	53	8	456	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00099	0.00013	< 0.0002	< 0.0002
M107	9/4/2014	440	0.18	0.14	120	100	1110	5.1	8	30	0.43	< 0.1	< 0.01	3.4	53	9	650	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00076	0.00011	< 0.0002	< 0.0002
M107	10/22/2014	480	0.24	0.15	160	130	1290	6	9.5	38	0.5	< 0.1	< 0.01	3.7	63	9	694								
M107	4/21/2015	480	0.28	0.2	130	98	1180	6.7	9	34	0.43	< 0.1	< 0.01	4.1	79	12	668	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	0.00016	< 0.0002	< 0.0002
M108	4/30/2013																								
M108	10/18/2013						974																		
M108	9/5/2014	510	0.98	0.29	140	140	1340	5.6	0.44	42	0.053	< 0.1	< 0.01	7.6	88	7	794	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00034	< 0.0001	< 0.0002	< 0.0002
M108	11/25/2015	560	1	0.32	160	140	1480	6.3	0.8	50	0.082	< 0.1	< 0.01	9	97	3.2	820	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00037	< 0.0001	< 0.0002	< 0.0002
M108	5/4/2016	470	0.84	0.26	100	66	1040	5.5	0.73	33	0.072	< 0.1	< 0.01	7.2	73	3.7	604	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00032	< 0.0001	< 0.0002	< 0.0002
M108	10/19/2016	510	0.86	0.3	110	110	1200	5.7	0.26	40	0.062	< 0.1	< 0.01	7.7	84	< 1	676	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00034	< 0.0001	< 0.0002	< 0.0002
M108	5/1/2017	490	0.92	0.31	110	80	1100	4.7	1.3	37	0.091	< 0.1	< 0.01	7.7	76	5	664	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00033	< 0.0001	< 0.0002	< 0.0002

Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		GENERAL / INORGANIC PARAMETERS																VOLATILE ORGANIC COMPOUNDS (VOCs)							
Name	Sam Date	Alkalinity mg/L	Ammonia mg/L	Boron mg/L	Calcium mg/L	Chloride mg/L	Conductivity µS/cm	Dissolved Organic Carbon mg/L	Iron mg/L	Magnesium mg/L	Manganese mg/L	Nitrate mg/L	Nitrite mg/L	Potassium mg/L	Sodium mg/L	Sulphate mg/L	Total Dissolved Solids mg/L	1,1,1,2-Tetrachloroethane mg/L	1,1,1-Trichloroethane mg/L	1,1,2,2-Tetrachloroethane mg/L	1,1,2-Trichloroethane mg/L	1,1-Dichloroethane mg/L	1,1-Dichloroethylene mg/L	1,2-Dichlorobenzene (o) mg/L	1,2-Dichloroethane mg/L
M114-1	41394																								
M114-1	10/18/2013						969																		
M114-1	9/4/2014	450	0.51	0.25	130	130	1230	5.7	9.1	29	0.48	< 0.1	< 0.01	5.1	81	8	666	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00025	0.00032	< 0.0002	< 0.0002
M114-1	11/24/2015	580	0.38	0.26	190	160	1590	7.3	14	47	0.69	< 0.1	< 0.01	6.9	100	5.1	942	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00067	0.00034	< 0.0002	< 0.0002
M114-1	5/5/2016	350	0.32	0.16	83	45	814	4.3	5.3	20	0.3	< 0.1	< 0.01	4.3	59	7.3	286	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00045	0.00025	< 0.0002	< 0.0002
M114-1	10/19/2016	400	0.36	0.21	100	120	1100	5.1	5.8	29	0.32	< 0.1	< 0.01	5.7	93	3	612	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	0.00024	< 0.0002	< 0.0002
M114-1	5/1/2017	380	0.28	0.18	94	47	870	4.1	6.1	22	0.32	< 0.1	< 0.01	4.7	59	8.7	450	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00043	0.00024	< 0.0002	< 0.0002
M115-1	4/30/2013																								
M115-1	10/22/2013						1658																		
M116	5/1/2013																								
M116	10/17/2013						1151																		
M116	9/4/2014	420	0.67	0.14	140	160	1330	3.9	9.9	34	0.66	< 0.1	< 0.01	4.3	81	30	900	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.01	0.00089	< 0.0002	< 0.0002
M117	5/1/2013																								
M117	10/17/2013						765																		
M117	9/4/2014	420	0.46	0.27	110	100	1100	4.5	< 0.1	31	0.022	< 0.1	< 0.01	5.5	58	30	642	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M121	2/21/2013	570	1.48	0.42	140	150	1520	6.4	< 0.1	63	0.013	< 0.1	< 0.01	14	120	20	818	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00011	< 0.0001	< 0.0002	< 0.0002
M121	5/1/2013																								
M121	10/17/2013	540	1.86	0.44	100	480	2590	6	0.1	53	0.037	< 0.1	< 0.01	13	120	29	2570	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M121	9/4/2014	540	1.35	0.33	91	91	1260	4.6	0.11	46	0.0091	< 0.1	< 0.01	12	96	18	708	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M121	11/24/2015	510	1.72	0.53	130	510	2580	4.8	< 0.1	76	0.0044	< 0.1	< 0.01	16	320	15	1560	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M121	5/5/2016	520	1.56	0.48	110	390	2090	5.2	< 0.1	58	0.0028	< 0.1	< 0.01	13	230	12	1130	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M121	10/20/2016	550	1.44	0.51	90	220	1700	5	< 0.1	52	0.003	< 0.1	< 0.01	13	200	14	890	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M121	5/3/2017	520	1.26	0.34	99	96	1300	4.2	< 0.1	47	0.003	< 0.1	< 0.01	12	98	10	770	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M122	2/21/2013	460	0.57	0.24	140	110	1160	5.1	1.2	43	0.05	< 0.1	< 0.01	6.3	76	18	652	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M122	5/1/2013																								
M122	10/17/2013	510	0.6	0.27	140	97	1240	5.3	2.3	47	0.077	< 0.1	< 0.01	5.7	46	18	714	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M122	9/5/2014	480	0.56	0.28	140	96	1060	4.1	2.8	46	0.039	< 0.1	< 0.01	5.5	37	16	818	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	2/21/2013	390	0.37	0.18	130	75	969	4.1	0.14	27	0.042	< 0.1	< 0.01	4.3	59	18	524	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	5/1/2013																								
M123	10/17/2013	420	0.4	0.21	130	81	1060	4.4	< 0.1	26	0.042	< 0.1	< 0.01	4.1	54	19	590	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	9/5/2014	360	0.33	0.16	100	42	789	3.1	< 0.1	20	0.026	< 0.1	< 0.01	3.5	43	16	462	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	11/25/2015	450	0.3	0.16	140	75	1050	4.1	< 0.1	28	0.016	< 0.1	< 0.01	4.3	51	7.9	582	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	5/5/2016	410	0.33	0.18	110	42	887	4.2	< 0.1	24	0.012	< 0.1	< 0.01	4	56	7.9	512	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	10/20/2016	400	0.25	0.16	100	41	870	3.8	< 0.1	22	0.016	< 0.1	< 0.01	3.8	48	8.2	470	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M123	5/4/2017	430	0.28	0.18	120	59	980	3.6	< 0.1	25	0.013	< 0.1	< 0.01	4.1	52	8.1	556	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00011	< 0.0001	< 0.0002	< 0.0002
M125	2/21/2013	520	0.32	0.23	170	130	1400	7.6	14	38	0.67	< 0.1	< 0.01	5.5	100	18	762	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0029	0.00078	< 0.0002	< 0.0002
M125	5/1/2013																								
M125	10/17/2013	510	0.32	0.22	150	140	1370	7.3	11	36	0.55	< 0.1	< 0.01	5	87	13	732	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	0.00056	< 0.0002	< 0.0002
M125	9/4/2014	380	0.31	0.17	110	100	1080	4.1	9.4	27	0.47	< 0.1	< 0.01	4.2	65	37	636	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0013	0.00046	< 0.0002	< 0.0002
M166	8/13/2013	580	0.66	0.33	190	150	1560	7.1	< 0.1	45	0.039	< 0.1	< 0.01	6.8	96	18	896	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M166	10/18/2013	580	0.68	0.33	180	150	1560	7.7	< 0.1	44	0.022	< 0.1	< 0.01	7.1	93	17	860	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M166	9/5/2014	480	0.55	0.29	120	91	1090	4.9	< 0.1	30	0.0095	< 0.1	< 0.01	5.4	80	12	648	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M167	8/13/2013	520	1.78	1	75	130	1360	4.1	< 0.1	45	0.0081	< 0.1	< 0.01	16	160	21	754	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M167	10/18/2013	510	1.78	1	77	170	1540	6.1	< 0.1	50	0.017	< 0.1	< 0.01	16	180	25	852	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M167	8/8/2014	500				500		6.7	0.3		0.025				310		1380								
M167	9/5/2014	520	1.84	0.84	98	310	1790	4.1	< 0.1	56	0.0063	< 0.1	< 0.01	15	210	21	1000	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002

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Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		GENERAL / INORGANIC PARAMETERS																VOLATILE ORGANIC COMPOUNDS (VOCs)							
Name	Sam Date	Alkalinity mg/L	Ammonia mg/L	Boron mg/L	Calcium mg/L	Chloride mg/L	Conductivity µS/cm	Dissolved Organic Carbon mg/L	Iron mg/L	Magnesium mg/L	Manganese mg/L	Nitrate mg/L	Nitrite mg/L	Potassium mg/L	Sodium mg/L	Sulphate mg/L	Total Dissolved Solids mg/L	1,1,1,2-Tetrachloroethane mg/L	1,1,1-Trichloroethane mg/L	1,1,2,2-Tetrachloroethane mg/L	1,1,2-Trichloroethane mg/L	1,1-Dichloroethane mg/L	1,1-Dichloroethylene mg/L	1,2-Dichlorobenzene (o) mg/L	1,2-Dichloroethane mg/L
M167	11/26/2015	420	1.74	0.91	82	230	1580	3.5	< 0.1	51	0.0027	< 0.1	< 0.01	17	180	11	802	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M167	5/5/2016	430	1.9	0.94	87	250	1640	4.2	< 0.1	56	0.0022	< 0.1	< 0.01	18	180	12	874	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M167	10/19/2016	410	1.89	0.97	89	450	2200	4	< 0.1	58	0.003	< 0.1	< 0.01	17	230	8.3	1150	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M167	5/3/2017	380	1.93	0.95	100	360	1900	3.2	< 0.1	62	0.002	< 0.1	< 0.01	19	190	12	1060	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M168	8/13/2013	530	1.65	0.46	120	140	1400	5.3	< 0.1	53	0.0091	< 0.1	< 0.01	15	98	29	776	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M168	10/21/2013	530	1.57	0.5	120	130	1410	5.4	< 0.1	56	0.01	< 0.1	< 0.01	16	100	28	764	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	9/5/2014	330	1.62	0.3	170	420	1930	3.6	< 0.1	63	0.0053	< 0.1	< 0.01	15	120	30	1780	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	11/26/2015	390	1.51	0.38	150	330	1850	3.6	< 0.1	60	0.0045	< 0.1	< 0.01	16	130	15	1020	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	3/8/2016	350	1.45	0.36	170	340	1870	4.3	< 0.1	61	0.0068	< 0.1	< 0.01	16	130	16	1150	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M168	3/21/2016	410	1.35	0.39	160	300	1770	4.7	< 0.1	57	0.0038	< 0.1	< 0.01	15	130	18	964	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	5/6/2016	410	1.29	0.39	150	290	1660	4.6	< 0.1	50	0.0034	< 0.1	< 0.01	14	120	15	950	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	10/19/2016	410	1.43	0.41	140	320	1800	5.1	< 0.1	55	0.004	< 0.1	< 0.01	15	140	14	1030	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M168	5/3/2017	350	1.19	0.36	120	260	1700	4.3	< 0.1	43	0.003	< 0.1	< 0.01	13	130	35	918	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M170	8/13/2013	430	1.91	1.9	52	850	3520	2.8	1.1	38	0.037	< 0.1	< 0.01	15	630	29	1880	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M170	10/21/2013	500	1.88	2	60	940	4030	3.4	< 0.1	46	0.025	< 0.1	< 0.01	16	720	23	2040	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	9/5/2014	460	2.66	2.3	110	1700	5840	2.6	< 0.1	87	0.0059	< 0.1	< 0.01	24	1000	22	3490	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	11/26/2015	620	1.52	2.3	38	620	3220	5	< 0.1	32	< 0.002	< 0.1	< 0.01	15	640	12	1750	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	3/8/2016	700	1.52	2.2	26	410	2630	4.9	< 0.1	21	0.0022	< 0.1	0.012	13	470	4.9	1470	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M170	3/21/2016	690	1.46	2.2	27	430	2670	6.9	< 0.1	20	0.0041	< 0.1	< 0.01	12	560	2.9	1450	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	5/4/2016	700	1.53	2.4	29	450	2670	5.3	< 0.1	22	0.0023	< 0.1	< 0.01	13	580	6.5	1480	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	10/19/2016	600	2.03	2.2	61	1000	4400	3.8	< 0.1	52	0.002	< 0.1	< 0.01	17	740	3.6	2300	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M170	5/1/2017	740	1.44	2.3	26	390	2700	4.4	< 0.1	20	0.004	< 0.1	< 0.01	12	520	1.1	1410	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M172	8/13/2013	520	0.68	0.33	160	130	1380	6.7	19	37	0.89	< 0.1	< 0.01	5.1	98	14	776	< 0.0005	< 0.00025	< 0.0005	< 0.0005	0.0041	< 0.00025	< 0.0005	< 0.0005
M172	11/24/2015	580	0.87	0.26	190	190	1730	8.9	27	46	0.91	< 0.1	< 0.01	6	110	4.1	1020	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0037	0.00028	< 0.0002	< 0.0002
M172	5/5/2016	310	0.62	0.11	83	28	667	4.4	11	20	0.44	< 0.1	< 0.01	3.7	35	8	366	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.002	0.00015	< 0.0002	< 0.0002
M172	10/20/2016	520	0.74	0.15	160	140	1400	6.9	23	38	0.82	< 0.1	< 0.01	4.9	61	3.2	754	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0027	0.00023	< 0.0002	< 0.0002
M172	5/4/2017	330	0.53	0.11	86	34	720	4.4	12	19	0.44	< 0.1	< 0.01	3.6	39	8.6	398	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0019	0.0002	< 0.0002	< 0.0002
M173	9/5/2014	250	0.18	0.055	100	16	512	2.1	< 0.1	7.2	0.01	< 0.1	0.016	1.6	8.3	23	434	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M176	9/4/2014	250	1	0.34	93	400	1870	2.4	< 0.1	29	0.019	< 0.1	< 0.01	6.3	210	38	1140	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M177	9/4/2014	250	0.6	0.32	58	4	528	1.3	< 0.1	13	0.027	< 0.1	< 0.01	4.7	27	28	320	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M177	11/25/2015	240	0.58	0.4	71	7.6	528	1.6	< 0.1	17	0.008	< 0.1	< 0.01	6.5	13	23	304	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M177	5/3/2016	240	0.48	0.27	76	6.7	522	2	< 0.1	16	0.0065	< 0.1	< 0.01	5.3	9.6	34	308	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M177	10/20/2016	250	0.56	0.37	76	9.7	560	4.4	< 0.1	17	0.008	< 0.1	< 0.01	6.4	8.5	36	514	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M177	5/4/2017	250	0.42	0.26	77	6.4	560	1.7	< 0.1	16	0.006	< 0.1	< 0.01	5.2	7.1	38	330	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M178R-1	11/18/2015	420	5.79	4	220	4700	14800	7.6	< 0.5	140	0.22	< 0.1	< 0.01	44	2800	350	8340	< 0.002	< 0.001	< 0.002	< 0.002	< 0.001	< 0.001	< 0.002	< 0.002
M178R-1	11/25/2015	340	5.47	4.2	240	4400	15100	4.5	< 0.5	140	0.18	< 0.1	< 0.01	43	2700	380	8670	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M178R-1	11/30/2015	460	5.58	4.2	230	4400	15400	2.2	< 0.1	130	0.1	< 0.5	< 0.05	42	2700	380	8460	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M178R-1	3/7/2016	420	5.82	3.8	220	4600	15600	25	< 0.1	140	0.16	< 0.5	< 0.05	41	2900	420	9020	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0025	< 0.0025	< 0.005	< 0.005
M178R-1	5/3/2016	430	5.29	4.2	230	4700	14700	7.8	< 0.5	140	0.071	< 0.5	< 0.05	41	2900	400	8950	< 0.01	< 0.005	< 0.01	< 0.01	< 0.005	< 0.005	< 0.01	< 0.01
M178R-1	10/18/2016	430	5.4	3.9	230	4900	15000	12	< 0.5	150	0.071	< 0.5	< 0.05	41	2800	430	8680	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0025	< 0.0025	< 0.005	< 0.005
M178R-2	11/17/2015	450	0.3	0.24	140	87	1110	5.1	1.1	32	0.061	< 0.1	< 0.01	5.8	63	21	618	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0013	0.00011	< 0.0002	< 0.0002
M178R-2	11/25/2015	440	0.27	0.23	140	79	1090	5.3	1.1	29	0.055	< 0.1	< 0.01	5.7	60	21	594	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0013	< 0.0001	< 0.0002	< 0.0002
M178R-2	11/30/2015	430	0.27	0.23	130	75	1070	4.6	1	28	0.053	< 0.1	< 0.01	5.6	55	21	614	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	< 0.0001	< 0.0002	< 0.0002
M178R-2	3/7/2016	420	0.27	0.19	130	63	1010	5.5	1.1	27	0.056	< 0.1	< 0.01	5.2	56	19	558	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	< 0.0001	< 0.0002	< 0.0002
M178R-2	5/3/2016	380	0.26	0.19	110	42	850	5	0.92	23	0.051	< 0.1	< 0.01	4.9	49	18	502	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	< 0.0001	< 0.0002	< 0.0002
M178R-2	10/18/2016	380	0.22	0.15	99	41	840	4.5	0.69	21	0.043	< 0.1	< 0.01	4.5	42	15	486	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	< 0.0001	< 0.0002	< 0.0002
M178R-2	5/4/2017	390	0.22	0.19	110	57	930	3.9	0.98	24	0.056	< 0.1	< 0.01	5	50	20	524	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0012	< 0.0001	< 0.0002	< 0.0002

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Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		GENERAL / INORGANIC PARAMETERS																VOLATILE ORGANIC COMPOUNDS (VOCs)							
Name	Sam Date	Alkalinity mg/L	Ammonia mg/L	Boron mg/L	Calcium mg/L	Chloride mg/L	Conductivity µS/cm	Dissolved Organic Carbon mg/L	Iron mg/L	Magnesium mg/L	Manganese mg/L	Nitrate mg/L	Nitrite mg/L	Potassium mg/L	Sodium mg/L	Sulphate mg/L	Total Dissolved Solids mg/L	1,1,1,2-Tetrachloroethane mg/L	1,1,1-Trichloroethane mg/L	1,1,2,2-Tetrachloroethane mg/L	1,1,2-Trichloroethane mg/L	1,1-Dichloroethane mg/L	1,1-Dichloroethylene mg/L	1,2-Dichlorobenzene (o) mg/L	1,2-Dichloroethane mg/L
M178R-3	11/17/2015	440	0.33	0.23	140	85	1100	4.8	0.96	31	0.063	< 0.1	< 0.01	5.9	62	22	606	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	< 0.0001	< 0.0002	< 0.0002
M178R-3	11/25/2015	450	0.31	0.23	140	86	1110	4.7	0.97	31	0.059	< 0.1	< 0.01	6.1	63	21	626	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	< 0.0001	< 0.0002	< 0.0002
M178R-3	11/30/2015	440	0.31	0.23	140	87	1120	4.8	0.81	29	0.054	< 0.1	< 0.01	6	56	21	622	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00097	< 0.0001	< 0.0002	< 0.0002
M178R-3	3/7/2016	460	0.35	0.2	140	83	1140	5.6	0.74	30	0.051	< 0.1	< 0.01	5.6	61	18	610	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.0011	< 0.0001	< 0.0002	< 0.0002
M178R-3	5/3/2016	410	0.32	0.21	120	56	937	5.6	0.56	26	0.042	< 0.1	< 0.01	5.2	54	19	552	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00097	< 0.0001	< 0.0002	< 0.0002
M178R-3	10/18/2016	410	0.29	0.17	100	44	900	4.6	3.7	24	0.075	< 0.1	< 0.01	5.3	49	13	530	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00097	< 0.0001	< 0.0002	< 0.0002
M178R-3	5/4/2017	430	0.29	0.22	120	71	1000	4	0.81	28	0.053	< 0.1	< 0.01	5.4	57	20	556	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00099	< 0.0001	< 0.0002	< 0.0002
M178R-4	11/13/2015	450	0.26	0.22	140	85	1090	4.4	0.12	29	0.013	< 0.1	< 0.01	4.6	56	20	620	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00011	< 0.0001	< 0.0002	< 0.0002
M178R-4	11/25/2015	440	0.36	0.24	140	87	1100	4.4	< 0.1	29	0.013	< 0.1	< 0.01	4.6	59	19	632	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00011	< 0.0001	< 0.0002	< 0.0002
M178R-4	11/30/2015	440	0.25	0.23	140	83	1100	4.5	< 0.1	27	0.012	< 0.1	< 0.01	4.5	53	20	626	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M178R-4	3/7/2016	470	0.28	0.22	150	100	1210	6.9	< 0.1	31	0.01	< 0.1	< 0.01	4.5	62	20	656	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00016	< 0.0001	< 0.0002	< 0.0002
M178R-4	5/3/2016	460	0.26	0.22	140	73	1020	5.1	< 0.1	29	0.0099	< 0.1	< 0.01	4.4	60	18	626	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00018	< 0.0001	< 0.0002	< 0.0002
M178R-4	10/18/2016	420	0.25	0.21	110	49	950	4.8	< 0.1	25	0.01	< 0.1	< 0.01	4.5	52	17	536	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00022	< 0.0001	< 0.0002	< 0.0002
M178R-4	5/4/2017	450	0.27	0.23	130	81	1100	4.3	< 0.1	29	0.02	< 0.1	< 0.01	5	60	19	608	< 0.0002	< 0.0001	< 0.0002	< 0.0002	0.00049	< 0.0001	< 0.0002	< 0.0002
M179	9/4/2014	340	0.24	0.11	120	36	796	3	0.62	11	0.041	< 0.1	< 0.01	2.5	26	27	474	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M179	11/25/2015	260	0.15	0.12	100	39	701	3.7	0.95	12	0.031	< 0.1	< 0.01	3.6	26	37	420	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M179	12/21/2015	270	0.16	0.15	110	48	762	3.4	0.91	13	0.027	< 0.1	< 0.01	3.6	29	38	396								
M179	5/4/2016	250	< 0.15	0.14	87	45	666	3.8	0.48	11	0.027	< 0.1	< 0.01	3.9	42	24	388	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M179	10/20/2016	320	0.27	0.28	98	64	830	3.8	0.83	16	0.044	< 0.1	0.015	4.5	49	30	434	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M179	5/4/2017	220	< 0.15	0.1	75	31	560	3.2	0.38	9.1	0.018	< 0.1	< 0.01	3.9	25	22	310	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M180	9/4/2014	260	< 0.15	0.028	92	120	852	2.7	0.66	9.7	0.27	< 0.1	< 0.01	1.1	74	24	494	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M181-1	9/4/2014	210	< 0.15	0.062	78	2	453	2.5	< 0.1	7.1	0.0068	0.1	< 0.01	1.6	2.1	26	266	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M181-2	9/4/2014	180	< 0.15	0.071	68	1	395	3.5	< 0.1	5.9	0.012	< 0.1	< 0.01	1.9	1.5	29	240	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M182	9/4/2014	250	< 0.15	0.023	88	17	532	2.9	< 0.1	6.4	< 0.002	< 0.1	< 0.01	1.3	9.5	14	318	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M183	9/4/2014	300	2.36	0.85	31	190	1410	1.8	< 0.1	11	0.01	< 0.5	< 0.05	9.3	230	91	836	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M185-1	11/26/2015	410	1.13	1.2	42	260	1970	29	0.35	11	0.034	< 0.1	0.015	10	410	130	1090	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M185-1	12/22/2015	430	6	0.93	50	350	2380	4.3	< 0.1	14	0.057	< 0.5	< 0.05	22	440	280	1400	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M185-1	5/3/2016	290	0.28	0.16	67	25	687	2.9	< 0.1	9.7	0.015	1.07	0.091	11	73	55	432	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-1	10/20/2016	330	2.1	0.26	39	180	1400	2.2	< 0.1	7.2	0.019	0.5	0.024	9	86	92	630	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M185-1	5/4/2017	210	1.15	0.29	48	66	700	4.8	< 0.1	8.2	0.016	0.59	< 0.01	7.4	69	37	450	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M185-2	9/4/2014	290	0.73	0.52	61	22	695	1.8	< 0.1	21	0.029	< 0.1	< 0.01	6.2	48	50	402	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-2	11/25/2015	310	< 0.15	0.12	120	2.6	603	2.1	< 0.1	8.5	0.012	< 0.1	< 0.01	2.4	4.5	20	340	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-2	5/3/2016	290	0.2	0.16	120	13	578	2.5	< 0.1	10	0.015	< 0.1	< 0.01	2.8	7.8	22	362	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-2	10/20/2016	290	0.15	0.27	100	17	650	2	0.11	9.9	0.014	< 0.1	< 0.01	2.7	14	37	374	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M185-2	5/4/2017	270	0.16	0.22	130	64	760	1.9	< 0.1	11	0.019	< 0.1	< 0.01	3	13	29	482	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	9/5/2014	300	2.18	1.3	160	1200	4260	3.7	< 0.1	67	0.21	< 0.1	< 0.01	13	690	29	2890	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	11/26/2015	300	2.47	1.5	120	1300	4690	3.7	1.4	64	0.43	< 0.1	< 0.01	22	770	51	2480	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	12/21/2015	320	2.63	1.5	150	1100	4330	3.5	13	81	0.34	< 0.1	< 0.01	18	870	13	2390								
M186	5/4/2016	320	2.48	2	78	1200	4390	2.7	0.7	54	0.21	< 0.1	< 0.01	21	700	19	2360	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	10/19/2016	360	2.18	1.9	75	1200	4600	7.7	0.19	53	0.11	< 0.1	< 0.01	21	750	42	2440	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M186	5/3/2017	340	2.56	2.1	72	1200	4500	2.9	0.47	52	0.073	< 0.1	< 0.01	22	780	12	2400	< 0.002	< 0.001	< 0.002	< 0.002	< 0.001	< 0.001	< 0.002	< 0.002
M187	11/11/2015	260	< 0.15	0.1	120	33	733	2.1	< 0.1	10	0.0028	0.66	< 0.01	2.5	23	74	440	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	11/25/2015	260	< 0.15	0.11	130	36	770	2	< 0.1	10	0.0024	0.45	< 0.01	2.6	25	81	484	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	11/30/2015	260	< 0.15	0.12	120	38	777	2.1	< 0.1	9.5	0.0022	0.49	< 0.01	2.6	25	82	476	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	3/8/2016	250	< 0.15	0.12	150	48	931	2.8	< 0.1	12	< 0.002	0.34	< 0.01	2.7	30	160	562	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	5/4/2016	250	< 0.15	0.13	150	49	921	2.7	< 0.1	13	0.0051	0.3	< 0.01	2.9	41	160	602	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M187	10/19/2016	260	0.32	0.33	140	200	1400	2.1	< 0.1	19	0.013	0.11	0.017	5	110	130	836	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002

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Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		GENERAL / INORGANIC PARAMETERS																VOLATILE ORGANIC COMPOUNDS (VOCs)							
Name	Sam Date	Alkalinity mg/L	Ammonia mg/L	Boron mg/L	Calcium mg/L	Chloride mg/L	Conductivity µS/cm	Dissolved Organic Carbon mg/L	Iron mg/L	Magnesium mg/L	Manganese mg/L	Nitrate mg/L	Nitrite mg/L	Potassium mg/L	Sodium mg/L	Sulphate mg/L	Total Dissolved Solids mg/L	1,1,1,2-Tetrachloroethane mg/L	1,1,1-Trichloroethane mg/L	1,1,2,2-Tetrachloroethane mg/L	1,1,2-Trichloroethane mg/L	1,1-Dichloroethane mg/L	1,1-Dichloroethylene mg/L	1,2-Dichlorobenzene (o) mg/L	1,2-Dichloroethane mg/L
M187	5/3/2017	240	< 0.15	0.072	98	19	580	2.3	< 0.1	7.2	0.002	0.57	< 0.01	2.3	16	34	404	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188-1	11/13/2015	330	0.68	0.69	52	75	874	2	< 0.1	21	0.011	< 0.1	< 0.01	6.6	100	15	468	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188-1	11/25/2015	330	0.68	0.74	57	81	895	2	< 0.1	24	0.011	< 0.1	< 0.01	7.2	110	15	504	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M188-1	11/30/2015	330	0.71	0.72	53	80	906	2.1	< 0.1	21	0.0094	< 0.1	< 0.01	6.9	100	18	504	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188-1	3/7/2016	340	0.73	0.61	64	82	931	2.6	< 0.1	24	0.0095	< 0.1	< 0.01	6.8	98	18	496	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188-1	5/3/2016	320	0.66	0.61	63	65	821	2.2	< 0.1	23	0.0095	< 0.1	< 0.01	6.7	86	18	464	< 0.0005	< 0.00025	< 0.0005	< 0.0005	< 0.00025	< 0.00025	< 0.0005	< 0.0005
M188-1	10/18/2016	320	0.68	0.55	59	65	830	2	< 0.1	23	0.009	< 0.1	< 0.01	6.6	86	19	472	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M188-1	5/4/2017	320	0.56	0.56	54	61	830	1.9	< 0.1	20	0.008	< 0.1	< 0.01	6.2	87	18	458	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M189	11/11/2015	340	0.29	0.45	130	140	1230	3.1	< 0.1	24	0.14	< 0.1	< 0.01	5.6	100	79	656	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M189	12/1/2015	330	0.6	0.51	110	72	974	3.2	< 0.1	20	0.12	0.11	0.018	5.8	62	65	550	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M189	3/8/2016	270	0.22	0.32	120	40	767	2.9	0.19	17	0.13	0.48	0.016	6.6	46	57	442	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M189	5/4/2016	340	0.23	0.64	120	71	1030	3.2	0.78	23	0.2	< 0.1	< 0.01	8.4	88	99	624	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M189	10/18/2016	370	0.24	0.71	120	120	1200	2.2	0.7	28	0.16	< 0.1	< 0.01	8.3	90	110	664	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	11/11/2015	300	< 0.15	0.088	130	73	849	3.4	< 0.1	14	0.011	< 0.1	< 0.01	3.5	19	39	462	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	11/25/2015	280	< 0.15	0.081	120	48	776	3.3	< 0.1	13	0.01	< 0.1	< 0.01	3.4	20	39	460	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	11/30/2015	290	< 0.15	0.087	120	48	777	3.6	< 0.1	12	0.009	< 0.1	< 0.01	3.5	19	38	448	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	3/8/2016	260	< 0.15	0.087	110	58	740	3.7	< 0.1	12	0.0067	< 0.1	< 0.01	3.4	26	37	390	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	5/4/2016	260	0.34	0.1	110	45	697	3.8	< 0.1	12	0.011	< 0.1	< 0.01	3.3	27	29	420	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	10/18/2016	310	< 0.15	0.094	120	48	820	2.9	< 0.1	13	0.009	< 0.1	< 0.01	3.6	24	45	458	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M190	5/4/2017	260	0.15	0.11	100	57	740	3	< 0.1	12	0.009	< 0.1	< 0.01	3.6	27	33	424	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M191	11/17/2015	180	9.11	1.9	3900	31000	73700	260	12	2600	2	< 1	< 0.1	120	15000	870	61500	< 0.02	< 0.01	< 0.02	< 0.02	< 0.01	< 0.01	< 0.02	< 0.02
M191	12/1/2015	150	10.6	2.3	4700	41000	89300	190	11	3100	2.1	< 0.1	< 0.01	130	15000	610	73900	< 0.02	< 0.01	< 0.02	< 0.02	< 0.01	< 0.01	< 0.02	< 0.02
M191	3/8/2016	150	20	2.9	5000	44000	95200	180	7.7	3600	1.5	< 0.5	< 0.05	170	17000	480	74700	< 0.01	< 0.005	< 0.01	< 0.01	< 0.005	< 0.005	< 0.01	< 0.01
M191	5/3/2016	140	22.3	3.7	5700	45000	87400	140	5.2	4200	1.3	< 1	< 0.1	220	18000	380	86000	< 0.004	< 0.002	< 0.004	< 0.004	< 0.002	< 0.002	< 0.004	< 0.004
M191	10/18/2016	140	25	3.6	5500	44000	> 100000	94	< 5	4600	1.2	< 0.5	0.077	240	20000	290	80700	< 0.01	< 0.005	< 0.01	< 0.01	< 0.005	< 0.005	< 0.01	< 0.01
M192	3/8/2016	350	2.32	1.3	83	580	2600	2.1	< 0.1	57	0.041	< 0.1	0.01	19	340	2.3	1410	< 0.001	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001
M192	3/21/2016	340	2.22	1.4	85	580	2600	2.2	< 0.1	60	0.037	< 0.1	< 0.01	20	360	8	1270	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M192	5/6/2016	330	2.37	1.3	81	580	2620	2.5	< 0.1	57	0.035	< 0.1	< 0.01	19	320	2	1390	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M192	9/13/2016	320	2.37	1.3	100	640	2700	2.6	< 0.1	64	0.069	< 0.1	< 0.01	21	340	5.2	1550	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M192	10/18/2016	320	2.27	1.3	95	650	2700	2.4	< 0.1	68	0.033	< 0.1	< 0.01	21	350	11	1540	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M192	5/4/2017	430	2.16	1.8	99	580	2900	3.7	< 0.1	70	0.042	< 0.1	< 0.01	22	360	2.6	1510	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M193	3/8/2016	260	1.46	0.46	26	370	1790	4.2	< 0.1	25	0.032	< 0.1	< 0.01	16	300	34	944	< 0.0004	< 0.0002	< 0.0004	< 0.0004	< 0.0002	< 0.0002	< 0.0004	< 0.0004
M193	3/21/2016	280	1.46	0.5	28	320	1680	5.5	< 0.1	21	0.13	< 0.1	< 0.01	15	360	24	746	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M193	5/6/2016	300	1.49	0.55	35	370	1900	2.6	< 0.1	33	0.08	< 0.1	< 0.01	16	250	23	844	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M193	9/13/2016	310	1.43	0.53	39	270	1500	1.7	< 0.1	38	0.12	< 0.1	< 0.01	17	220	13	762	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M193	10/18/2016	320	1.43	0.58	42	320	1700	2.4	0.16	42	0.4	< 0.1	< 0.01	17	240	13	882	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M193	6/8/2017	310	1.42	0.63	49	350	1800	2.2	0.25	49	0.26	< 0.1	< 0.01	18	240	12	868	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M194-1	5/25/2017	230	< 0.15	0.033	91	6.2	500	2.2	< 0.1	4.5	0.004	< 0.1	< 0.01	1.1	7	19	262	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M194-1	6/8/2017	240	< 0.15	0.035	90	6.1	500	1.8	< 0.1	4.5	0.004	< 0.1	< 0.01	1	6.9	17	270	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M194-2	5/25/2017	250	0.19	0.2	80	24	770	9.3	< 0.1	12	0.043	< 0.1	< 0.01	5.9	74	100	462	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M194-2	6/8/2017	270	0.18	0.24	80	3.2	790	6.6	< 0.1	14	0.044	< 0.1	< 0.01	6.2	78	15	482	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M195	5/25/2017	380	0.68	0.81	46	75	1100	1.9	0.1	15	0.008	< 0.1	< 0.01	8.7	190	77	634	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002
M195	6/8/2017	390	0.74	0.84	37	67	1100	1.5	0.11	13	0.008	< 0.1	< 0.01	7.8	190	77	612	< 0.0002	< 0.0001	< 0.0002	< 0.0002	< 0.0001	< 0.0001	< 0.0002	< 0.0002

Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Name	Sam Date	1,3,5-Trimethylbenzene mg/L	1,3-Dichlorobenzene (m) mg/L	1,4-Dichlorobenzene (p) mg/L	1,4-Dioxane mg/L	Benzene mg/L	Chlorobenzene mg/L	Chloroethane mg/L	Chloromethane mg/L	Cis-1,2-Dichloroethylene mg/L	Dichloromethane mg/L	Ethylbenzene mg/L	m+p-Xylene mg/L	o-Xylene mg/L	Styrene mg/L	Tetrachloroethylene mg/L	Toluene mg/L	Total Xylenes mg/L	Trans-1,2-dichloroethylene mg/L	Trichloroethylene mg/L	Vinyl Chloride mg/L
M10-1	4/24/2013	< 0.0002	< 0.0002	< 0.0002		0.0001	< 0.0001	0.0091	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00037
M10-1	4/30/2013				0.0157																
M10-1	10/21/2013		< 0.0002	< 0.0002	0.0219	< 0.0001	< 0.0001	0.011	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00035
M10-1	5/8/2014	< 0.0002	< 0.0002	< 0.0002		0.00011	< 0.0001	0.0075	< 0.0005	0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00023
M10-1	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.0102	< 0.0001	< 0.0001	0.009	< 0.0005	0.00011	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00033
M10-1	10/21/2014																				
M10-1	4/23/2015	< 0.0002	< 0.0002	< 0.0002		0.00011	< 0.0001	0.011	< 0.0005	0.00012	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00061
M49-1	4/24/2013	< 0.0002	< 0.0002	< 0.0002		< 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
M49-1	10/21/2013		< 0.0002	< 0.0002		< 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
M49-1	5/8/2014	< 0.0002	< 0.0002	< 0.0002		< 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
M49-1	10/21/2014																				
M49-1	4/23/2015	< 0.0002	< 0.0002	< 0.0002		< 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
M53-2	5/1/2013				0.00462																
M53-2	10/18/2013				0.0202																
M63-2	6/20/2013	< 0.0004	< 0.0004	< 0.0004		0.00051	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0004	< 0.0002	< 0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0004
M63-2	12/9/2014				< 0.001																
M63-2	1/12/2015				< 0.001																
M64-2	6/20/2013	< 0.0002	< 0.0002	< 0.0002		< 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	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.0022	< 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	11/4/2014				0.00215																
M64-2	11/26/2015	< 0.0002	< 0.0002	< 0.0002	0.0027	< 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	5/6/2016	< 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
M64-2	10/20/2016	< 0.0005	< 0.0005	< 0.0005	0.0025	< 0.00025	< 0.00025	< 0.005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M64-2	5/3/2017	< 0.0004	< 0.0004	< 0.0004	0.0029	< 0.0002	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0004	< 0.0002	< 0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0004
M70-2	5/1/2017	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0058	< 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
M105	4/23/2013	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.0012	< 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
M105	4/30/2013				0.0138																
M105	10/21/2013		< 0.0002	< 0.0002	0.022	< 0.0001	< 0.0001	0.00086	< 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
M105	5/6/2014	< 0.0005	< 0.0005	< 0.0005		< 0.00025	< 0.00025	0.0015	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M105	9/4/2014	< 0.0005	< 0.0005	< 0.0005	0.0184	< 0.00025	< 0.00025	0.0012	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M105	10/22/2014																				
M105	4/21/2015	< 0.0002	< 0.0002	< 0.0002		< 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
M107	4/30/2013				0.0166																
M107	6/20/2013	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.0063	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00022
M107	10/21/2013		< 0.0002	< 0.0002	0.014	< 0.0001	< 0.0001	0.0083	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00025
M107	5/6/2014	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.0044	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00028
M107	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.00819	< 0.0001	< 0.0001	0.0044	< 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
M107	10/22/2014																				
M107	4/21/2015	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.0072	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00041
M108	4/30/2013				0.0198																
M108	10/18/2013				0.0165																
M108	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.0128	< 0.0001	< 0.0001	0.0054	< 0.0005	< 0.0001	0.0034	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00062	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M108	11/25/2015	< 0.0002	< 0.0002	< 0.0002	0.014	< 0.0001	< 0.0001	0.0058	< 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	5/4/2016	< 0.0002	< 0.0002	< 0.0002	0.011	< 0.0001	< 0.0001	0.0047	< 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	10/19/2016	< 0.0002	< 0.0002	< 0.0002	0.011	< 0.0001	< 0.0001	0.0048	< 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	5/1/2017	< 0.0002	< 0.0002	< 0.0002	0.012	< 0.0001	< 0.0001	0.0052	< 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

Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Name	Sam Date	1,3,5-Trimethylbenzene mg/L	1,3-Dichlorobenzene (m) mg/L	1,4-Dichlorobenzene (p) mg/L	1,4-Dioxane mg/L	Benzene mg/L	Chlorobenzene mg/L	Chloroethane mg/L	Chloromethane mg/L	Cis-1,2-Dichloroethylene mg/L	Dichloromethane mg/L	Ethylbenzene mg/L	m+p-Xylene mg/L	o-Xylene mg/L	Styrene mg/L	Tetrachloroethylene mg/L	Toluene mg/L	Total Xylenes mg/L	Trans-1,2-dichloroethylene mg/L	Trichloroethylene mg/L	Vinyl Chloride mg/L
M114-1	41394				0.0147																
M114-1	10/18/2013				0.0119																
M114-1	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.00719	< 0.0001	< 0.0001	0.012	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00026
M114-1	11/24/2015	< 0.0002	< 0.0002	< 0.0002	0.013	< 0.0001	< 0.0001	0.016	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00031
M114-1	5/5/2016	< 0.0002	< 0.0002	< 0.0002	0.0052	< 0.0001	< 0.0001	0.011	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0004
M114-1	10/19/2016	< 0.0002	< 0.0002	< 0.0002	0.0056	< 0.0001	< 0.0001	0.011	< 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
M114-1	5/1/2017	< 0.0002	< 0.0002	< 0.0002	0.0066	< 0.0001	< 0.0001	0.0098	< 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
M115-1	4/30/2013				0.0133																
M115-1	10/22/2013				0.0197																
M116	5/1/2013				0.0121																
M116	10/17/2013				0.0112																
M116	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.00469	0.0012	< 0.0001	0.0051	< 0.0005	0.0001	< 0.0005	< 0.0001	0.00088	0.00012	< 0.0002	< 0.0001	< 0.0002	0.001	< 0.0001	< 0.0001	0.00022
M117	5/1/2013				0.00987																
M117	10/17/2013				0.0083																
M117	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.00634	< 0.0001	< 0.0001	0.0015	< 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	2/21/2013	< 0.0002	< 0.0002	< 0.0002		0.0035	< 0.0001	0.0083	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.0011	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.0011	< 0.0001	< 0.0001	< 0.0002
M121	5/1/2013				0.0136																
M121	10/17/2013	< 0.0002	< 0.0002	< 0.0002	0.0135	0.0066	< 0.0001	0.0018	< 0.0005	< 0.0001	< 0.0005	0.00022	0.0015	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.0015	< 0.0001	< 0.0001	< 0.0002
M121	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.0112	0.0015	< 0.0001	0.0035	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00013	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00013	< 0.0001	< 0.0001	< 0.0002
M121	11/24/2015	< 0.001	< 0.001	< 0.001	0.0098	0.045	< 0.0005	0.0039	< 0.0025	< 0.0005	< 0.0025	0.0011	0.013	0.00065	< 0.001	< 0.0005	< 0.001	0.014	< 0.0005	< 0.0005	< 0.001
M121	5/5/2016	< 0.001	< 0.001	< 0.001	0.01	0.034	< 0.0005	0.0046	< 0.0025	< 0.0005	< 0.0025	0.00098	0.0098	0.00056	< 0.001	< 0.0005	< 0.001	0.01	< 0.0005	< 0.0005	< 0.001
M121	10/20/2016	< 0.001	< 0.001	< 0.001	0.0087	0.039	< 0.0005	< 0.025	< 0.0025	< 0.0005	< 0.0025	0.0013	0.0096	0.00078	< 0.001	< 0.0005	< 0.001	0.01	< 0.0005	< 0.0005	< 0.001
M121	5/3/2017	< 0.0002	< 0.0002	< 0.0002	0.01	0.0025	< 0.0001	0.0049	< 0.0005	< 0.0001	< 0.0005	0.00015	0.00084	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00084	< 0.0001	< 0.0001	< 0.0002
M122	2/21/2013	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.0055	< 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
M122	5/1/2013				0.0131																
M122	10/17/2013	< 0.0002	< 0.0002	< 0.0002	0.0116	< 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
M122	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.00983	< 0.0001	< 0.0001	0.00042	< 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
M123	2/21/2013	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00011	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00011	< 0.0001	< 0.0001	< 0.0002
M123	5/1/2013				0.00653																
M123	10/17/2013	< 0.0002	< 0.0002	< 0.0002	0.00726	0.00019	< 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
M123	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.0049	< 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
M123	11/25/2015	< 0.0002	< 0.0002	< 0.0002	0.0074	< 0.0001	< 0.0001	0.0037	< 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
M123	5/5/2016	< 0.0002	< 0.0002	< 0.0002	0.0063	< 0.0001	< 0.0001	0.0036	< 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
M123	10/20/2016	< 0.0002	< 0.0002	< 0.0002	0.0046	< 0.0001	< 0.0001	0.0044	< 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
M123	5/4/2017	< 0.0002	< 0.0002	< 0.0002	0.0067	< 0.0001	< 0.0001	0.0053	< 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
M125	2/21/2013	< 0.0002	< 0.0002	< 0.0002		< 0.0001	< 0.0001	0.015	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00033
M125	5/1/2013				0.0159																
M125	10/17/2013	< 0.0002	< 0.0002	< 0.0002	0.0131	0.00016	< 0.0001	0.012	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00023
M125	9/4/2014	< 0.0002	< 0.0002	< 0.0002	0.00616	< 0.0001	< 0.0001	0.011	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.0003
M166	8/13/2013	< 0.0005	< 0.0005	< 0.0005	0.019	< 0.00025	< 0.00025	< 0.025	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M166	10/18/2013		< 0.0002	< 0.0002	0.019	0.00017	< 0.0001	0.003	< 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
M166	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.0106	0.00018	< 0.0001	0.0032	< 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	8/13/2013	< 0.0005	< 0.0005	< 0.0005	0.00722	0.00032	< 0.00025	< 0.025	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M167	10/18/2013		< 0.0002	< 0.0002	0.00768	0.0033	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00025	< 0.0001	< 0.0002	< 0.0001	0.00022	0.00025	< 0.0001	< 0.0001	< 0.0002
M167	8/8/2014				0.00886																
M167	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.00895	0.00098	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00013	0.00011	< 0.0002	< 0.0001	0.00097	0.00024	< 0.0001	< 0.0001	< 0.0002

Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Name	Sam Date	1,3,5-Trimethylbenzene mg/L	1,3-Dichlorobenzene (m) mg/L	1,4-Dichlorobenzene (p) mg/L	1,4-Dioxane mg/L	Benzene mg/L	Chlorobenzene mg/L	Chloroethane mg/L	Chloromethane mg/L	Cis-1,2-Dichloroethylene mg/L	Dichloromethane mg/L	Ethylbenzene mg/L	m+p-Xylene mg/L	o-Xylene mg/L	Styrene mg/L	Tetrachloroethylene mg/L	Toluene mg/L	Total Xylenes mg/L	Trans-1,2-dichloroethylene mg/L	Trichloroethylene mg/L	Vinyl Chloride mg/L
M167	11/26/2015	< 0.0002	< 0.0002	< 0.0002	0.0051	0.00038	< 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
M167	5/5/2016	< 0.0002	< 0.0002	< 0.0002	0.0035	< 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
M167	10/19/2016	< 0.0002	< 0.0002	< 0.0002	0.0033	0.0013	< 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
M167	5/3/2017	< 0.001	< 0.001	< 0.001	0.0026	< 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
M168	8/13/2013	< 0.0005	< 0.0005	< 0.0005	0.0126	< 0.00025	< 0.00025	< 0.025	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M168	10/21/2013	< 0.0002	< 0.0002	< 0.0002	0.0137	< 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
M168	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.00529	< 0.0001	< 0.0001	0.00052	< 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	11/26/2015	< 0.0002	< 0.0002	< 0.0002	0.0075	< 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
M168	3/8/2016	< 0.0004	< 0.0004	< 0.0004	0.0062	< 0.0002	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0004	< 0.0002	< 0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0004
M168	3/21/2016	< 0.0002	< 0.0002	< 0.0002	0.0065	< 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
M168	5/6/2016	< 0.0002	< 0.0002	< 0.0002	0.0064	< 0.0001	< 0.0001	0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M168	10/19/2016	< 0.0002	< 0.0002	< 0.0002	0.0063	< 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
M168	5/3/2017	< 0.001	< 0.001	< 0.001	0.0051	< 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
M170	8/13/2013	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.00025	< 0.00025	< 0.025	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	0.0018	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M170	10/21/2013	< 0.0002	< 0.0002	< 0.0002	0.00137	0.00025	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00041	0.00013	< 0.0002	< 0.0001	0.0012	0.00054	< 0.0001	< 0.0001	< 0.0002
M170	9/5/2014	< 0.0002	< 0.0002	< 0.0002	0.00197	0.00025	< 0.0001	< 0.0002	< 0.0005	< 0.0001	0.0027	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00059	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M170	11/26/2015	< 0.0002	< 0.0002	< 0.0002	0.0063	< 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
M170	3/8/2016	< 0.0004	< 0.0004	< 0.0004	0.0081	< 0.0002	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0004	< 0.0002	< 0.0004	< 0.0002	< 0.0002	< 0.0002	< 0.0004
M170	3/21/2016	< 0.0002	< 0.0002	< 0.0002	0.0087	< 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
M170	5/4/2016	< 0.0002	< 0.0002	< 0.0002	0.009	< 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
M170	10/19/2016	< 0.0002	< 0.0002	< 0.0002	0.0064	0.00012	< 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	5/1/2017	< 0.0002	< 0.0002	< 0.0002	0.011	< 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	8/13/2013	< 0.0005	< 0.0005	< 0.0005	0.0146	< 0.00025	< 0.00025	< 0.025	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M172	11/24/2015	< 0.0002	< 0.0002	< 0.0002	0.021	0.00013	< 0.0001	0.011	< 0.0005	0.00014	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00054
M172	5/5/2016	< 0.0002	< 0.0002	< 0.0002	0.0039	0.00011	< 0.0001	0.0045	< 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	10/20/2016	< 0.0002	< 0.0002	< 0.0002	0.0076	< 0.0001	< 0.0001	0.0075	< 0.0005	0.00012	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00026
M172	5/4/2017	< 0.0002	< 0.0002	< 0.0002	0.0049	< 0.0001	< 0.0001	0.0068	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	0.00027
M173	9/5/2014	< 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
M176	9/4/2014	< 0.0005	< 0.0005	< 0.0005	< 0.001	0.022	< 0.00025	< 0.0005	< 0.0013	< 0.00025	< 0.0013	0.00042	0.0038	0.00071	< 0.0005	< 0.00025	0.0051	0.0045	< 0.00025	< 0.00025	< 0.0005
M177	9/4/2014	< 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	0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M177	11/25/2015	< 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
M177	5/3/2016	< 0.001	< 0.001	< 0.001	< 0.001	< 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
M177	10/20/2016	< 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
M177	5/4/2017	< 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-1	11/18/2015	< 0.002	< 0.002	< 0.002	< 0.001	0.0012	< 0.001	< 0.002	< 0.005	< 0.001	< 0.005	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	0.0049		< 0.001	< 0.001	< 0.002
M178R-1	11/25/2015	< 0.001	< 0.001	< 0.001	< 0.001	0.00069	< 0.0005	< 0.001	< 0.0025	< 0.0005	< 0.0025	< 0.0005	0.00053	< 0.0005	< 0.001	< 0.0005	0.0024	0.00053	< 0.0005	< 0.0005	< 0.001
M178R-1	11/30/2015	< 0.0002	< 0.0002	< 0.0002	< 0.009	0.00036	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.0005	0.00017	< 0.0002	< 0.0001	0.0015		< 0.0001	< 0.0001	< 0.0002
M178R-1	3/7/2016	< 0.005	< 0.005	< 0.005	< 0.001	< 0.0025	< 0.0025	< 0.005	< 0.013	< 0.0025	< 0.013	< 0.0025	< 0.0025	< 0.0025	< 0.005	< 0.0025	0.0055	< 0.0025	< 0.0025	< 0.0025	< 0.005
M178R-1	5/3/2016	< 0.01	< 0.01	< 0.01	< 0.001	< 0.005	< 0.005	< 0.01	< 0.025	< 0.005	< 0.025	< 0.005	< 0.005	< 0.005	< 0.01	< 0.005	< 0.01	< 0.005	< 0.005	< 0.005	< 0.01
M178R-1	10/18/2016	< 0.005	< 0.005	< 0.005	< 0.001	0.0026	< 0.0025	< 0.005	< 0.013	< 0.0025	< 0.013	< 0.0025	< 0.0025	< 0.0025	< 0.005	< 0.0025	0.005	< 0.0025	< 0.0025	< 0.0025	< 0.005
M178R-2	11/17/2015	< 0.0002	< 0.0002	< 0.0002	0.007	< 0.0001	< 0.0001	0.0029	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00027		< 0.0001	< 0.0001	< 0.0002
M178R-2	11/25/2015	< 0.0002	< 0.0002	< 0.0002	0.0064	< 0.0001	< 0.0001	0.0016	< 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	11/30/2015	< 0.0002	< 0.0002	< 0.0002	0.0062	< 0.0001	< 0.0001	0.0017	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002		< 0.0001	< 0.0001	< 0.0002
M178R-2	3/7/2016	< 0.0002	< 0.0002	< 0.0002	0.0053	< 0.0001	< 0.0001	0.0016	< 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	5/3/2016	< 0.0002	< 0.0002	< 0.0002	0.0052	< 0.0001	< 0.0001	0.0017	< 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	10/18/2016	< 0.0002	< 0.0002	< 0.0002	0.004	< 0.0001	< 0.0001	0.0016	< 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	5/4/2017	< 0.0002	< 0.0002	< 0.0002	0.006	< 0.0001	< 0.0001	0.0023	< 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

Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Name	Sam Date	1,3,5-Trimethylbenzene mg/L	1,3-Dichlorobenzene (m) mg/L	1,4-Dichlorobenzene (p) mg/L	1,4-Dioxane mg/L	Benzene mg/L	Chlorobenzene mg/L	Chloroethane mg/L	Chloromethane mg/L	Cis-1,2-Dichloroethylene mg/L	Dichloromethane mg/L	Ethylbenzene mg/L	m+p-Xylene mg/L	o-Xylene mg/L	Styrene mg/L	Tetrachloroethylene mg/L	Toluene mg/L	Total Xylenes mg/L	Trans-1,2-dichloroethylene mg/L	Trichloroethylene mg/L	Vinyl Chloride mg/L
M178R-3	11/17/2015	< 0.0002	< 0.0002	< 0.0002	0.0067	< 0.0001	< 0.0001	0.0026	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00029		< 0.0001	< 0.0001	< 0.0002
M178R-3	11/25/2015	< 0.0002	< 0.0002	< 0.0002	0.0073	< 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
M178R-3	11/30/2015	< 0.0002	< 0.0002	< 0.0002	0.0062	< 0.0001	< 0.0001	0.0022	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002		< 0.0001	< 0.0001	< 0.0002
M178R-3	3/7/2016	< 0.0002	< 0.0002	< 0.0002	0.0071	< 0.0001	< 0.0001	0.0032	< 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	5/3/2016	< 0.0002	< 0.0002	< 0.0002	0.0061	< 0.0001	< 0.0001	0.0028	< 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	10/18/2016	< 0.0002	< 0.0002	< 0.0002	0.0053	< 0.0001	< 0.0001	0.0023	< 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	5/4/2017	< 0.0002	< 0.0002	< 0.0002	0.0069	< 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
M178R-4	11/13/2015	< 0.0002	< 0.0002	< 0.0002	0.007	< 0.0001	< 0.0001	0.0013	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	< 0.0002		< 0.0001	< 0.0001	< 0.0002
M178R-4	11/25/2015	< 0.0002	< 0.0002	< 0.0002	0.007	< 0.0001	< 0.0001	< 0.01	< 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	11/30/2015	< 0.0002	< 0.0002	< 0.0002	0.007	< 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	< 0.0002
M178R-4	3/7/2016	< 0.0002	< 0.0002	< 0.0002	0.0078	< 0.0001	< 0.0001	0.0016	< 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	5/3/2016	< 0.0002	< 0.0002	< 0.0002	0.0068	< 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
M178R-4	10/18/2016	< 0.0002	< 0.0002	< 0.0002	0.0066	< 0.0001	< 0.0001	0.0019	< 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	5/4/2017	< 0.0002	< 0.0002	< 0.0002	0.0075	< 0.0001	< 0.0001	0.0034	< 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	9/4/2014	< 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
M179	11/25/2015	< 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
M179	12/21/2015																				
M179	5/4/2016	< 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
M179	10/20/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 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	5/4/2017	< 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
M180	9/4/2014	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0029	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00022	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00022	< 0.0001	< 0.0001	< 0.0002
M181-1	9/4/2014	< 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
M181-2	9/4/2014	< 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
M182	9/4/2014	< 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
M183	9/4/2014	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.00025	< 0.00025	< 0.0005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M185-1	11/26/2015	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.0025	< 0.0005	< 0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.0005	0.048	< 0.0005	< 0.0005	< 0.0005	< 0.001
M185-1	12/22/2015	< 0.0004	< 0.0004	< 0.0004	< 0.009	0.00021	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	0.00035	< 0.0002	< 0.0004	< 0.0002	0.012	0.00035	< 0.0002	< 0.0002	< 0.0004
M185-1	5/3/2016	< 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	10/20/2016	< 0.0004	< 0.0004	< 0.0004	< 0.001	0.0004	< 0.0002	< 0.004	< 0.001	< 0.0002	< 0.001	< 0.0002	0.00024	< 0.0002	< 0.0004	< 0.0002	0.0013	0.00024	< 0.0002	< 0.0002	< 0.0004
M185-1	5/4/2017	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.0025	< 0.0005	< 0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.0005	0.042	< 0.0005	< 0.0005	< 0.0005	< 0.001
M185-2	9/4/2014	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00016	< 0.0001	< 0.0002	< 0.0001	0.00034	0.00016	< 0.0001	< 0.0001	< 0.0002
M185-2	11/25/2015	< 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	5/3/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00018	< 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	10/20/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 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
M185-2	5/4/2017	< 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
M186	9/5/2014	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00018	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00033	< 0.0001	< 0.0002	< 0.0001	0.01	0.00033	< 0.0001	< 0.0001	< 0.0002
M186	11/26/2015	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00065	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	0.00018	0.0018	0.00051	< 0.0002	< 0.0001	0.0017	0.0023	< 0.0001	< 0.0001	< 0.0002
M186	12/21/2015																				
M186	5/4/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00067	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	0.00018	0.001	0.00043	< 0.0002	< 0.0001	0.00067	0.0015	< 0.0001	< 0.0001	< 0.0002
M186	10/19/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00043	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00025	0.00018	< 0.0002	< 0.0001	< 0.0002	0.00043	< 0.0001	< 0.0001	< 0.0002
M186	5/3/2017	< 0.002	< 0.002	< 0.002	< 0.001	< 0.001	< 0.001	< 0.002	< 0.005	< 0.001	< 0.005	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.002
M187	11/11/2015	< 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	< 0.0002
M187	11/25/2015	< 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
M187	11/30/2015	< 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	< 0.0002
M187	3/8/2016	< 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	0.00058	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M187	5/4/2016	< 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	0.00025	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M187	10/19/2016	< 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

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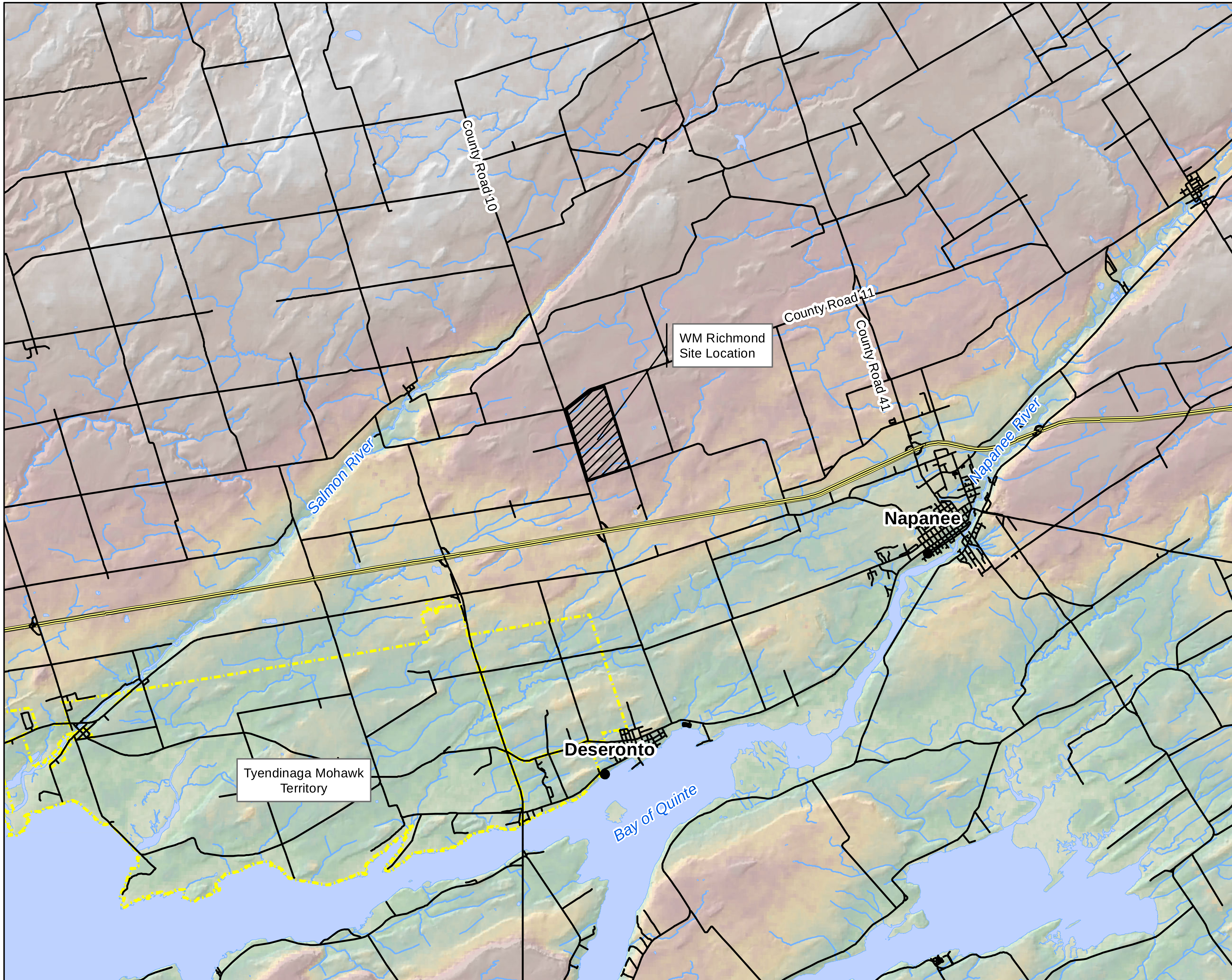
Table B. Groundwater Chemistry Results from Proposed CAZ Wells and Selected Wells North of Beechwood Road

		VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Name	Sam Date	1,3,5-Trimethylbenzene mg/L	1,3-Dichlorobenzene (m) mg/L	1,4-Dichlorobenzene (p) mg/L	1,4-Dioxane mg/L	Benzene mg/L	Chlorobenzene mg/L	Chloroethane mg/L	Chloromethane mg/L	Cis-1,2-Dichloroethylene mg/L	Dichloromethane mg/L	Ethylbenzene mg/L	m+p-Xylene mg/L	o-Xylene mg/L	Styrene mg/L	Tetrachloroethylene mg/L	Toluene mg/L	Total Xylenes mg/L	Trans-1,2-dichloroethylene mg/L	Trichloroethylene mg/L	Vinyl Chloride mg/L
M187	5/3/2017	< 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	11/13/2015	< 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	0.00059		< 0.0001	< 0.0001	< 0.0002
M188-1	11/25/2015	< 0.0004	< 0.0004	< 0.0004	< 0.001	< 0.0002	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	< 0.0002	< 0.0002	< 0.0004	< 0.0002	0.00056	< 0.0002	< 0.0002	< 0.0002	< 0.0004
M188-1	11/30/2015	< 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	0.00034		< 0.0001	< 0.0001	< 0.0002
M188-1	3/7/2016	< 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	5/3/2016	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.00025	< 0.00025	< 0.0005	< 0.0013	< 0.00025	< 0.0013	< 0.00025	< 0.00025	< 0.00025	< 0.0005	< 0.00025	< 0.0005	< 0.00025	< 0.00025	< 0.00025	< 0.0005
M188-1	10/18/2016	< 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	5/4/2017	< 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	0.0011	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M189	11/11/2015	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00031	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00032		< 0.0001	< 0.0001	< 0.0002
M189	12/1/2015	< 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	0.00021		< 0.0001	< 0.0001	< 0.0002
M189	3/8/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	< 0.0001	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00017	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00017	< 0.0001	< 0.0001	< 0.0002
M189	5/4/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00012	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00016	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00016	< 0.0001	< 0.0001	< 0.0002
M189	10/18/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00053	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00021	< 0.0001	< 0.0002	< 0.0001	< 0.0002	0.00021	< 0.0001	< 0.0001	< 0.0002
M190	11/11/2015	< 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	< 0.0002
M190	11/25/2015	< 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	11/30/2015	< 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	< 0.0002
M190	3/8/2016	< 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	0.00026	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M190	5/4/2016	< 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	10/18/2016	< 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	0.00035	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M190	5/4/2017	< 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	0.0014	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M191	11/17/2015	< 0.02	< 0.02	< 0.02	< 0.001	0.16	< 0.01	< 0.02	< 0.05	< 0.01	< 0.05	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	0.052		< 0.01	< 0.01	< 0.02
M191	12/1/2015	< 0.02	< 0.02	< 0.02	< 0.001	0.15	< 0.01	< 0.02	< 0.05	< 0.01	< 0.05	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	0.022		< 0.01	< 0.01	< 0.02
M191	3/8/2016	< 0.01	< 0.01	< 0.01	< 0.001	0.14	< 0.005	< 0.01	< 0.025	< 0.005	< 0.025	< 0.005	< 0.005	< 0.005	< 0.01	< 0.005	0.12	< 0.005	< 0.005	< 0.005	< 0.01
M191	5/3/2016	< 0.004	< 0.004	< 0.004	< 0.001	0.16	< 0.002	< 0.004	< 0.01	< 0.002	< 0.01	< 0.002	< 0.002	< 0.002	< 0.004	< 0.002	0.033	< 0.002	< 0.002	< 0.002	< 0.004
M191	10/18/2016	< 0.01	< 0.01	< 0.01	< 0.001	0.2	< 0.005	< 0.01	< 0.025	< 0.005	< 0.025	< 0.005	< 0.005	< 0.005	< 0.01	< 0.005	0.042	< 0.005	< 0.005	< 0.005	< 0.01
M192	3/8/2016	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.0025	< 0.0005	< 0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.001	< 0.0005	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.001
M192	3/21/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0003	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00014	< 0.0001	< 0.0002	< 0.0001	0.002	0.00014	< 0.0001	< 0.0001	< 0.0002
M192	5/6/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00028	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00011	< 0.0001	< 0.0002	< 0.0001	0.0013	0.00011	< 0.0001	< 0.0001	< 0.0002
M192	9/13/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00046	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00063	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M192	10/18/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00029	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.0015	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M192	5/4/2017	< 0.0002	< 0.0002	< 0.0002	0.001	0.00035	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00042	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M193	3/8/2016	< 0.0004	< 0.0004	< 0.0004	< 0.001	0.0037	< 0.0002	< 0.0004	< 0.001	< 0.0002	< 0.001	< 0.0002	0.00089	0.00043	< 0.0004	< 0.0002	0.0078	0.0013	< 0.0002	< 0.0002	< 0.0004
M193	3/21/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0033	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	0.00012	0.001	0.00038	< 0.0002	< 0.0001	0.007	0.0014	< 0.0001	< 0.0001	< 0.0002
M193	5/6/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.004	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	0.00024	0.0021	0.00074	< 0.0002	< 0.0001	0.0024	0.0028	< 0.0001	< 0.0001	< 0.0002
M193	9/13/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0022	< 0.0001	< 0.0002	< 0.001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00025	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M193	10/18/2016	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0015	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0002	< 0.0001	0.00072	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M193	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.003	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00016	< 0.0001	< 0.0002	< 0.0001	0.00022	0.00016	< 0.0001	< 0.0001	< 0.0002
M194-1	5/25/2017	< 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	0.00053	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M194-1	6/8/2017	< 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	0.00042	< 0.0001	< 0.0001	< 0.0001	< 0.0002
M194-2	5/25/2017	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00022	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00028	0.00014	< 0.0002	< 0.0001	0.0016	0.00042	< 0.0001	< 0.0001	< 0.0002
M194-2	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.0002	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00027	0.00013	< 0.0002	< 0.0001	0.0092	0.0004	< 0.0001	< 0.0001	< 0.0002
M195	5/25/2017	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00028	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00013	< 0.0001	< 0.0002	< 0.0001	0.00055	0.00013	< 0.0001	< 0.0001	< 0.0002
M195	6/8/2017	< 0.0002	< 0.0002	< 0.0002	< 0.001	0.00038	< 0.0001	< 0.0002	< 0.0005	< 0.0001	< 0.0005	< 0.0001	0.00015	< 0.0001	< 0.0002	< 0.0001	0.00085	0.00015	< 0.0001	< 0.0001	< 0.0002

BluMetric™ Environmental

FIGURES



LEGEND

- Streams
- Water bodies
- Site Location

Topography (m)

High : 180

Low : 50

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
DO NOT SCALE DRAWING.
THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 11"x17" FORMAT DRAWINGS.

0 1 2 4 Kilometres

N

CLIENT

PROJECT

WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

SITE LOCATION MAP

BluMetric™ Environmental

The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #		DATE	
170193-11		July, 2017	
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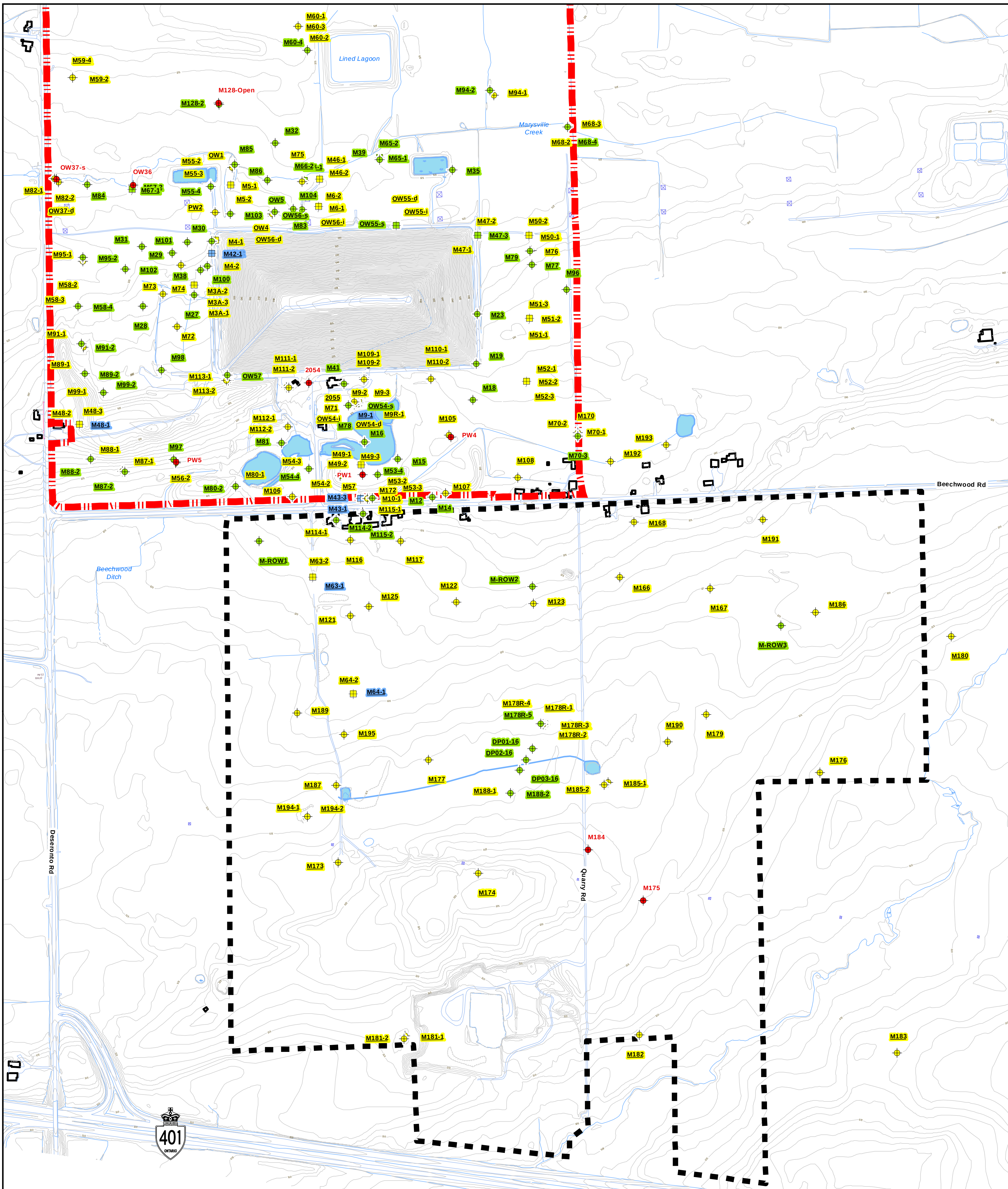
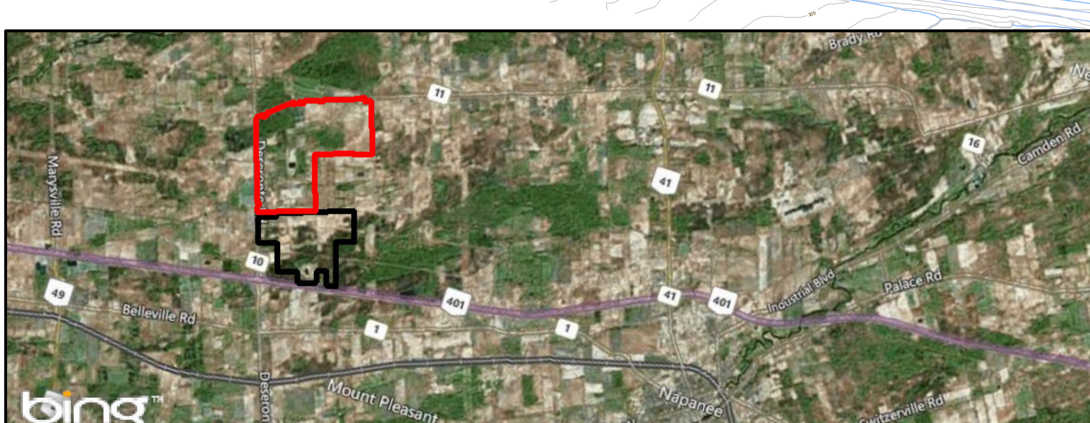




LEGEND

OW36 Open Borehole

Single Well

M39 Active Shallow Monitoring Well

M9R-1 Active Intermediate Monitoring Well

M69-1 Active Deep Monitoring Well

Multi-Level Wells

M65-2 Active Shallow Monitoring Wells

M63-2 Active Intermediate Monitoring Well

M42-1 Active Deep Monitoring Wells

Hydro Tower

Buildings

Roads

Topographic Contours (1 m)

Watercourses

Property Boundary

Water bodies

Previously Proposed Contaminant Attenuation Zone (CAZ), BluMetric (2016a)

REFERENCES

-UNITS: METERS
-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN

0 25 50 100 150 200

Metres

BluMetric™ Environmental

The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

CLIENT

WM WASTE MANAGEMENT

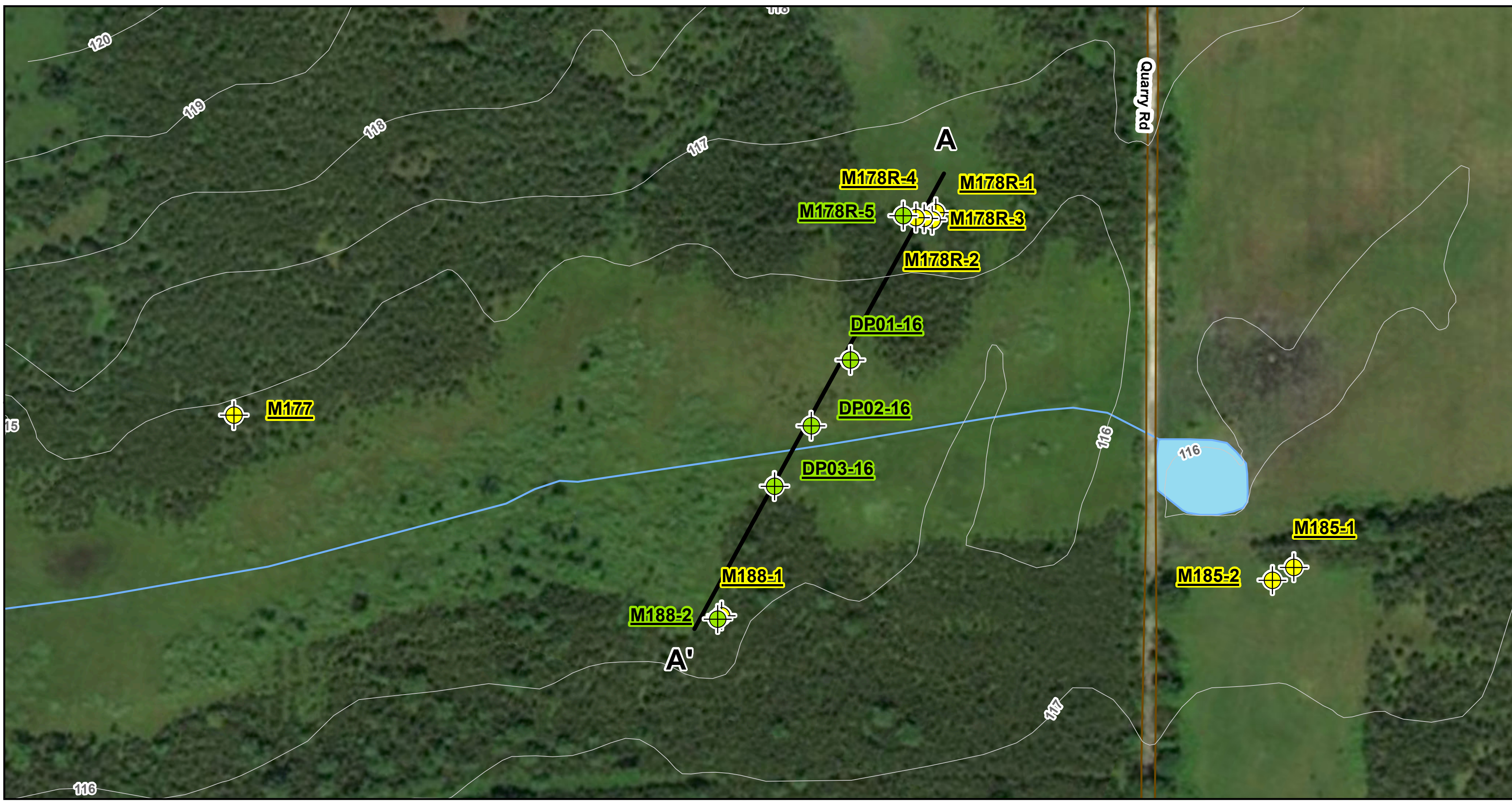
PROJECT

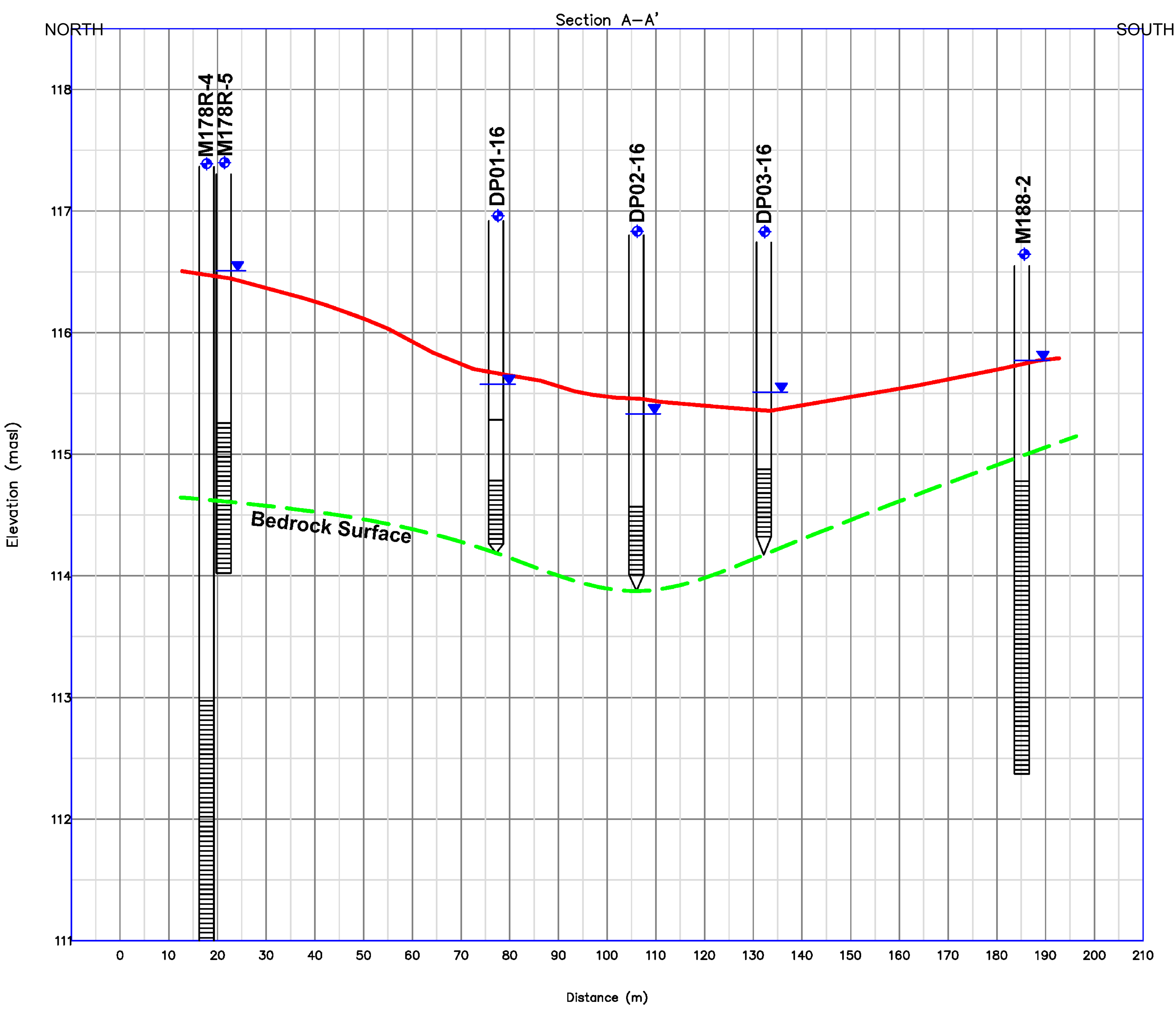
WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

SITE PLAN AND MONITORING LOCATIONS

PROJECT #	DATE		
170193-11	July, 2017		
DRAWN	CHECKED	FIG NO.	REV
IB	FR	2	0





LEGEND

Single Well

M39 Shallow Monitoring Well

M9R-1 Intermediate Monitoring Well

Groundwater Elevation (masl) - April 21, 2017

Ground Surface

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
DO NOT SCALE DRAWING.
THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED ARE BASED ON 16.5"x23" FORMAT DRAWINGS.
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-PROJECTION: UTM NAD83 ZONE 18
-DATA SOURCE: WM CANADA, BLUMETRIC, MNRO, NRCAN
-VERTICAL EXAGG.: 25X

0 5 10 20 30 40
Metres

BluMetric Environmental

The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

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PROJECT

WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

VERTICAL CROSS-SECTION SHOWING SHALLOW GROUNDWATER FLOW DIVIDE IN PROPOSED CAZ

PROJECT #		DATE	
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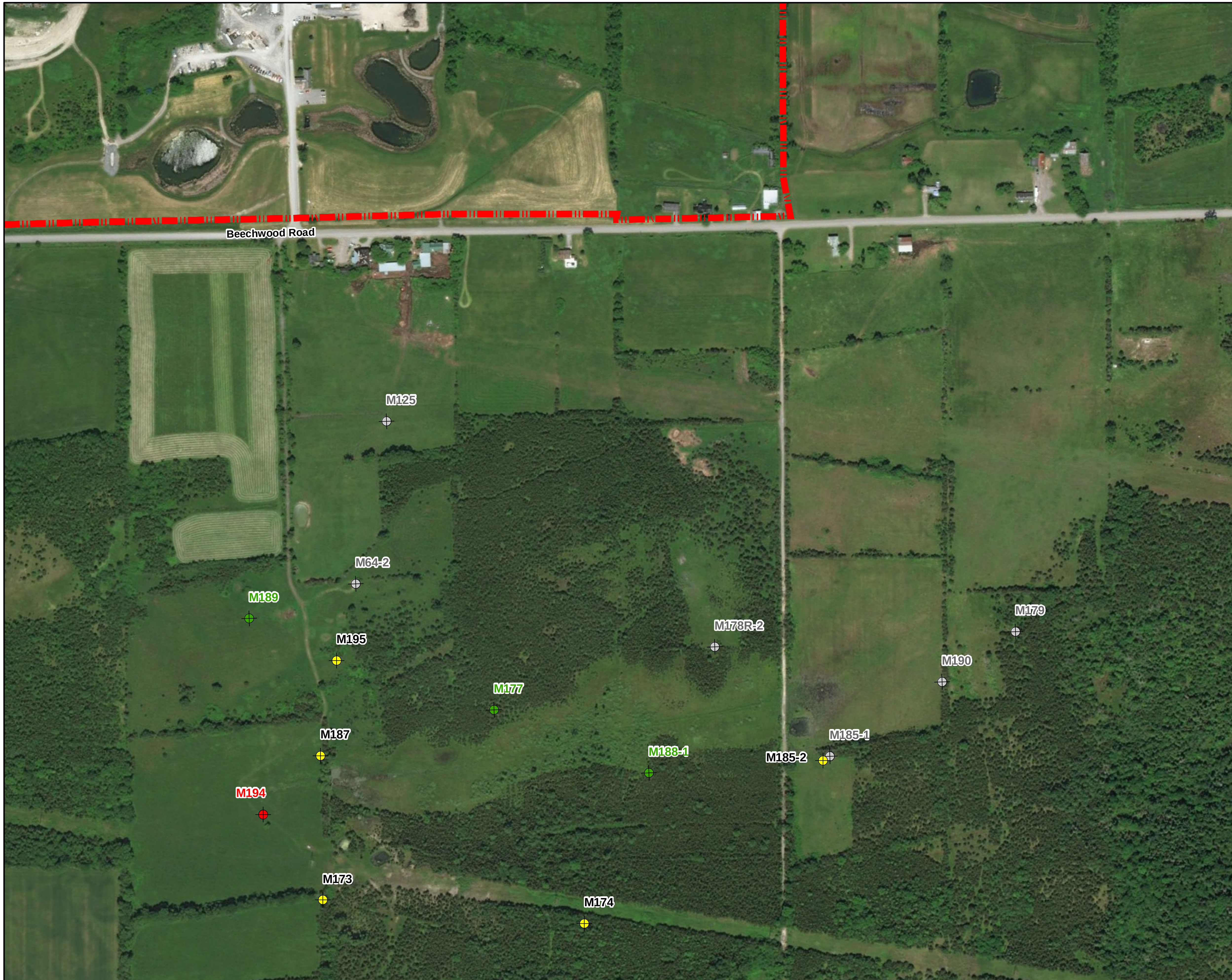

LEGEND

- Pumping Well
- Responsive
- Possibly Responsive
- Non-Responsive

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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0 50 100 200 Metres

CLIENT

PROJECT

WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

RESPONSE IN MONITORING WELL NETWORK FOR M194 PUMPING TEST

The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
170193-11	July, 2017

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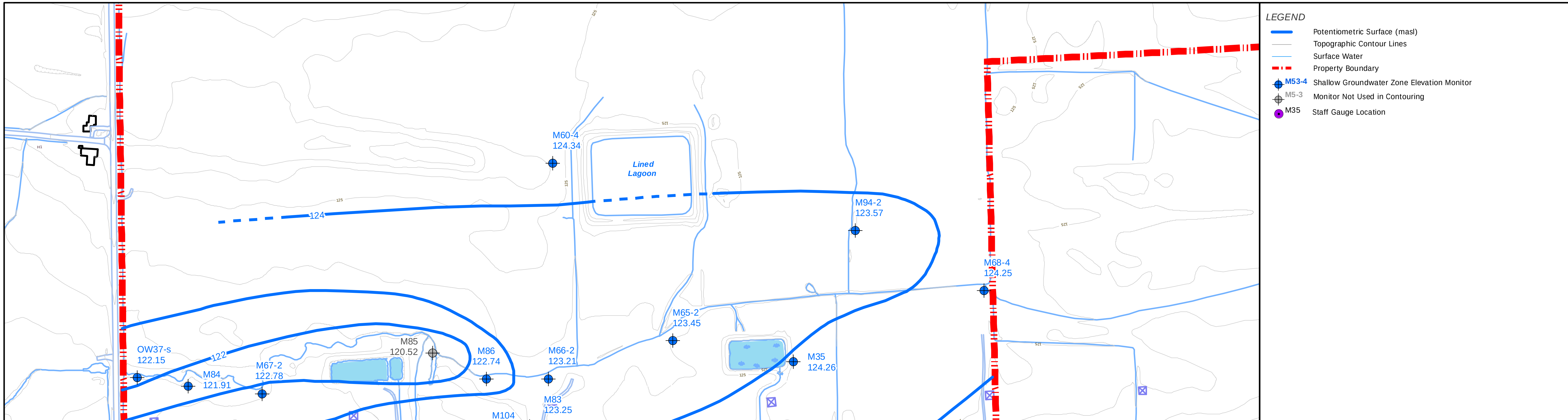

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REV.	DESCRIPTION	YY/MM/DD	BY	CHK

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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0 50 100 Metres

CLIENT

WASTE MANAGEMENT

PROJECT

WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

SHALLOW GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE – APRIL 28, 2017

BluMetric™ Environmental

The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
170193-11	July, 2017

DRAWN	CHECKED	FIG NO.	REV
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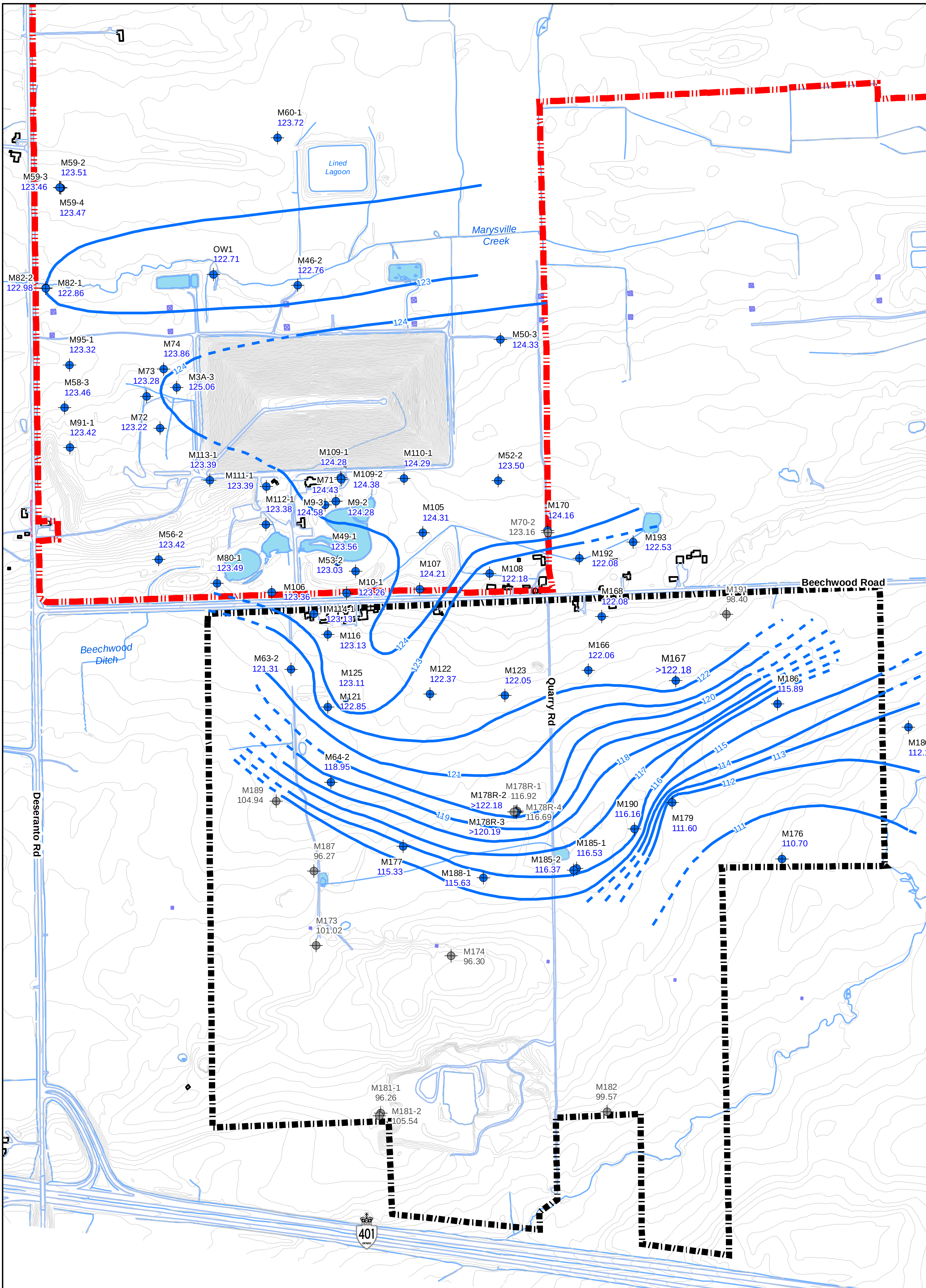


LEGEND

- Potentiometric Surface (masl)
- Topographic Contour Lines
- Surface Water
- Property Boundary
- Previously Proposed Contaminant Attenuation Zone (CAZ), BluMetric (2016a)
- M166 Intermediate Groundwater Zone Elevation Monitor
- M189 Monitor Not Used in Contouring

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 50 100 200 300 400
Metres
1:8,000

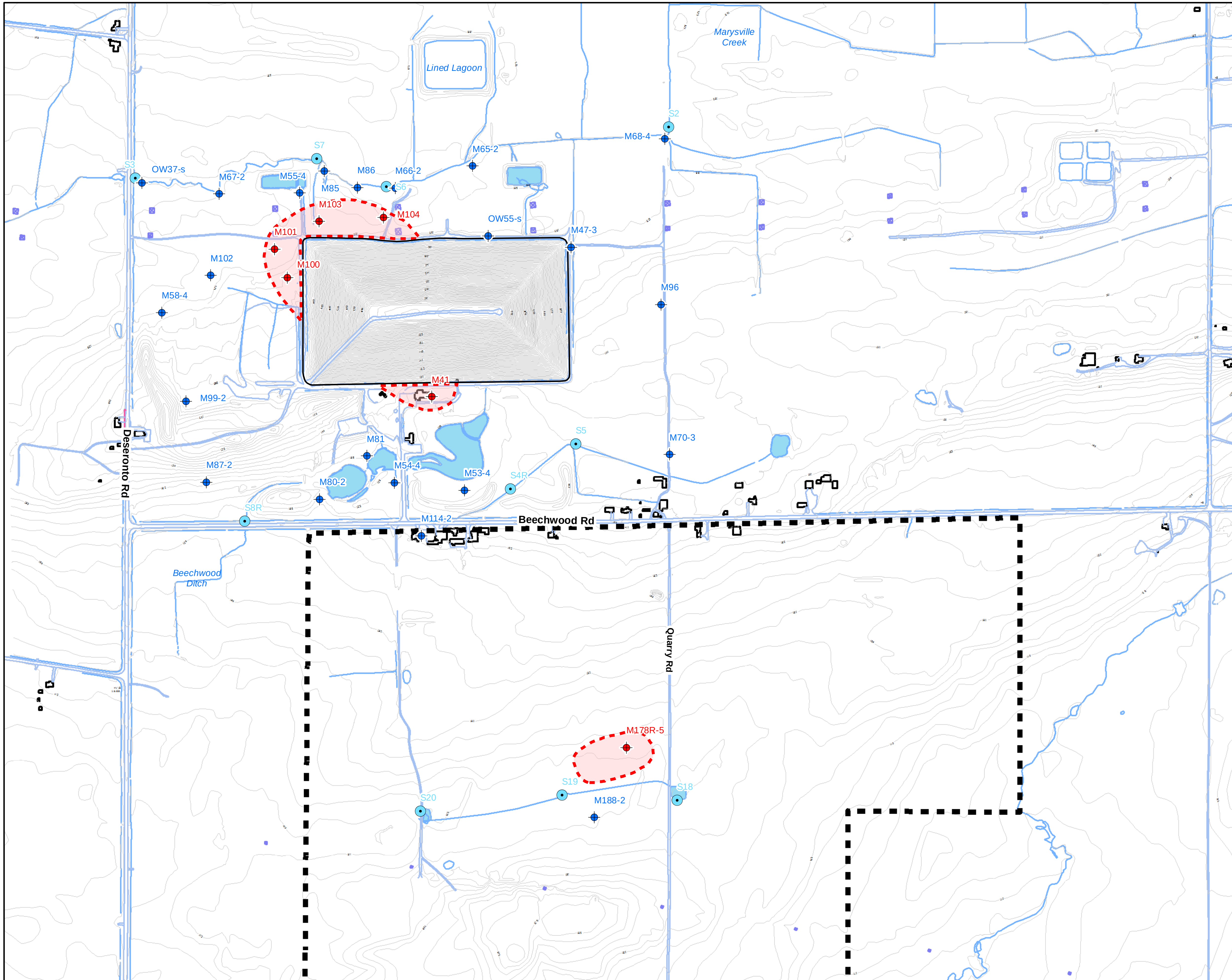
BluMetric Environmental
The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

CLIENT

PROJECT
WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE
INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE POTENTIOMETRIC SURFACE - APRIL 28, 2017

PROJECT #		DATE	
170193-11		July, 2017	
DRAWN	CHECKED	FIG NO.	REV
YL	FR	5b	0



LEGEND

- M64-2 Shallow Bedrock Monitoring Well (No 1,4 dioxane impacts)
- M121 Shallow Bedrock Monitoring Well (1,4 dioxane ≥ 0.001 mg/L)
- S2 Surface Water Monitoring Location
- Topographic Contour Lines
- Surface Water
- Previously Proposed Contaminant Attenuation Zone (CAZ), BluMetric (2016a)
- Approximate Extent of Known 1,4 Dioxane Impacted Area

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

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0 25 50 100 150 200
Metres

CLIENT

WASTE MANAGEMENT

PROJECT

WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

DELINEATION OF 1,4 DIOXANE IMPACTED AREA – SHALLOW GROUNDWATER FLOW ZONE

BluMetric™ Environmental
3108 Carp Road PO Box 430
Ottawa, Ontario K0A 1L0
TEL: (613) 839-3053
FAX: (613) 839-5376
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE
170193-11	July, 2017

DRAWN	CHECKED	FIG NO.	REV
IB	FR	6a	0

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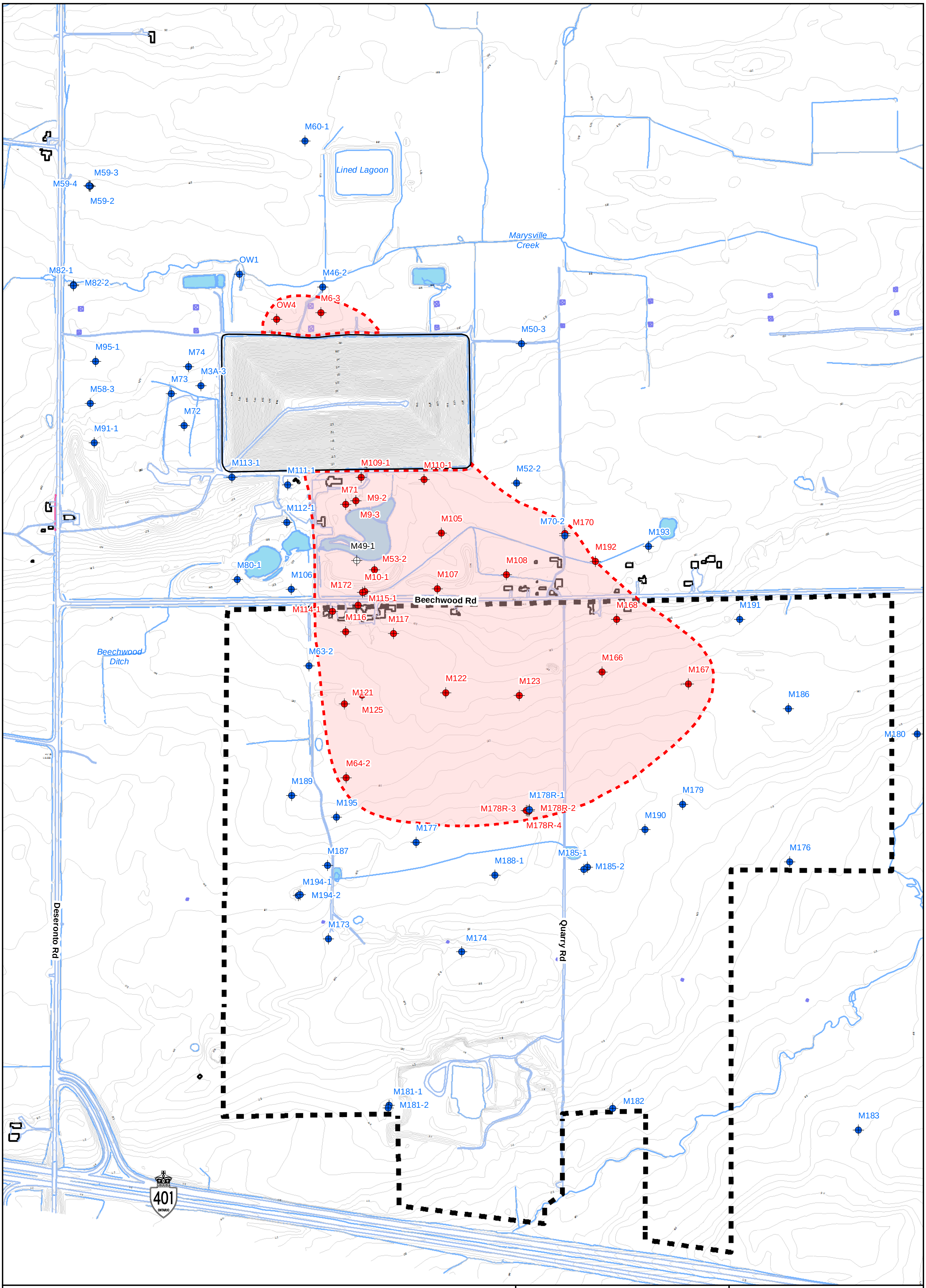

LEGEND

- M64-2 Intermediate Bedrock Monitoring Well (No 1,4 dioxane impacts)
- M121 Intermediate Bedrock Monitoring Well (1,4 dioxane ≥ 0.001 mg/L)
- M121 Intermediate Bedrock Monitoring Well (no results1,4 dioxane)
- Topographic Contour Lines
- Surface Water
- Previously Proposed Contaminant Attenuation Zone (CAZ), BluMetric (2016a)
- Approximate Extent of Known 1,4 Dioxane Impacted Area

REFERENCES

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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
1:8,000

BluMetric™ Environmental
The Tower - The Woolen Mill,
4 Cataraqui St.,
Kingston, Ontario K7K 1Z7
TEL: (613) 531-2725
FAX: (613) 531-1852
Email: info@blumetric.ca
Web: http://www.blumetric.ca

CLIENT

PROJECT
WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE
DELINEATION OF 1,4 DIOXANE IMPACTED AREA – INTERMEDIATE BEDROCK GROUNDWATER FLOW ZONE

PROJECT #	DATE		
170193-11	July, 2017		
DRAWN	CHECKED	FIG NO.	REV
IB	FR	6b	0

LEGEND

- WM Owned Property
- Lot Parcels
- Updated Proposed Contaminant Attenuation Zone (CAZ)

REV.	DESCRIPTION	YY/MM/DD	BY	CHK
1				

REFERENCES

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF BLUMETRIC ENVIRONMENTAL INC.
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0 100 200 Metres

N E S W

CLIENT

WASTE MANAGEMENT

PROJECT

WASTE MANAGEMENT RICHMOND - COMPLEMENTARY CAZ INVESTIGATION

TITLE

PROPERTIES INCLUDED IN THE PROPOSED CAZ

BluMetric Environmental
3108 Carp Road PO Box 430
Ottawa, Ontario K0A 1L0
TEL: (613) 839-3053
FAX: (613) 839-5376
Email: info@blumetric.ca
Web: http://www.blumetric.ca

PROJECT #	DATE		
170193-11	July, 2017		
DRAWN	CHECKED	FIG NO.	REV
IB	FR	7	0

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APPENDIX A

Preliminary Karst Assessment
(Daryl W. Cowell & Assoc. Inc.)

A1: Preliminary Karst Assessment Report, December 14, 2016

WASTE MANAGEMENT RICHMOND LANDFILL
(NAPANEE ONTARIO)
PRELIMINARY KARST ASSESSMENT

Submitted to:

BluMetric Environmental Inc.
4 Cataraqui Street
The Wollen Mill, The Tower
Kingston, ON K7K 1Z7

On Behalf of:

Waste Management of Canada Corporation
1271 Beechwood Road
R.R.#6 Napanee, ON K7R 3L1

Submitted by:

Daryl W. Cowell & Associates Inc.
27 Rita Crescent, RR1, Tobermory, ON N0H 2R0
Ph: 519.596.8187
Email: dcowell@amtelecom.net

December 14, 2016

TABLE OF CONTENTS

WASTE MANAGEMENT RICHMOND LANDFILL

(NAPANEE ONTARIO)

PRELIMINARY KARST ASSESSMENT

1.0 INTRODUCTION

Daryl W. Cowell & Associates was retained by BluMetric Environmental Inc. (BluMetric) to undertake a preliminary karst assessment of lands south of the Richmond Landfill on behalf of Waste Management (WM). The work is focused on an area between Beechwood Road and Highway 401, approximately 8 km west of Napanee, Ontario. This encompasses an area referred to as the Contaminant Attenuation Zone (CAZ) which is currently being monitored to characterize the nature and extent of leachates associated with the Richmond Landfill located north of Beechwood Road. BluMetric has implemented a dense network of bedrock groundwater wells ("intermediate bedrock groundwater zone"), surface water and surface groundwater seepage sampling.

Detailed information on the monitoring well locations, borehole logs, sampling program, geology, borehole properties (pumping tests), well interference testing, water levels, groundwater chemistry, and seepage and surface water chemistry is presented in a series of reports submitted by BluMetric on the CAZ. These include the hydrogeological investigation (January 2016); site conceptual model updates (January 2016 and April 2016), and a semi-annual monitoring report (July 2016).

The primary objective of this study is to identify and assess the role of karst in the hydrogeological setting of the CAZ. Further, depending on the nature of karst hydrogeology that may occur on the Site, identify potential additional monitoring requirements that could be implemented. This assessment should be considered preliminary as it did not include undertaking targeted drilling, carbonate chemistry sampling and analysis, dye tracing, or geophysical surveys.

2.0 KARST GEOLOGY

Karst is a geoscience that deals with the development of surface and subsurface landforms resulting from complex hydrological, hydrogeological and hydrochemical processes. Karst occurs only in certain types of rocks, particularly limestone and dolostone rocks (referred to as types of "carbonate rock").

The most important factor to understand is that these rock types are chemically dissolved by weak acids contained in rainwater, snowmelt, and soil seepage. The acid weathers the rock by separating calcium (Ca) from carbonate (CO3) creating dissolved constituents that freely move with the flowing water. Pre-existing weaknesses in the rocks, such as fractures, allow the water to penetrate the bedrock and continued recharge from precipitation and other sources result, given sufficient time, in the preferential expansion of selected fractures creating concentrated pathways for groundwater to follow.

These pathways are referred to as "conduits" effectively increasing the hydraulic conductivity of the aquifer over time. The result is the formation of a karst aquifer whereby surface water enters the rock (recharge) via distinct surface openings (sinkholes and exposed surface joints), passes through the rock in discrete conduits, then discharges to discrete springs at lower elevations. Karst conduits typically develop along primary fractures that include both bedding planes and joints. The critical point in the development of a karst conduit occurs when fracture flow evolves from laminar flow to turbulent flow (Ford and Williams 2007). Such conduits can be only a few mm in width.

Characteristics of a karst aquifer includes the absence of a continuous water table; dry wells located in close proximity to high-yielding wells; the presence of underground streams; a low density of surface streams; surface stream channels with significant changes in flow over the hydrological season (dry to flooded); rapid short-term changes in flow rates; and changing spring locations as flows in the connecting conduits increase or decrease.

3.0 BRIEF GEOLOGY of the SITE

The "Site Conceptual Model Update and Contaminant Attenuation Zone Delineation" (BluMetric, January 2016) provides the following summary (pages 7/8):

> "The Richmond Landfill Site is located within the Napanee Plain which, on a regional scale, is a flat to slightly undulating plain of limestone dipping slightly to the south and typically covered with a relatively thin veneer of overburden…In the immediate vicinity of the Site, the ground surface slopes approximately 1 m to 3 m per kilometer to the south. A drumlin (Empey Hill) is present on the Site southwest of the landfill. The dominant drainage feature on the Site is Marysville Creek located north of the landfill. Beechwood Ditch provides Site drainage south of the landfill.
>
> "The overburden…consists of less than 0.5 m to 10 m of clayey silt till…underlain by the Verulam Formation which consists of horizontally bedded, medium to coarse crystalline limestone with interbedded shale layers. The Verulam is interpreted to be a few metres thick at the Site and is underlain by the Bobcaygeon Formation which generally consists of horizontally bedded, crystalline limestone with interbedded shale in the upper part and interbedded calcarenite in the lower part. The thickness of the Bobcaygeon Formation beneath the Site varies from approximately 11 m to 15 m. The Bobcaygeon Formation is underlain by the Gull River Formation which consists of horizontally bedded limestone and exhibits a thickness of approximately 75 m beneath the Site.
>
> "The active groundwater flow zone at the Site extends to a depth of approximately 30 m below the top of bedrock. The dominant fracture orientation in the upper 30 m of bedrock is parallel to bedding (horizontal to sub-horizontal)...distributed throughout the upper 30 m of bedrock, implying that there are no particular depth horizons exhibiting anomalous amounts of fracturing. Some borings do exhibit a shallow weathered zone, however, in which fracturing is

> more pronounced…a moderate amount of vertical to sub-vertical fractures exist providing hydraulic connections between the various horizontal…fractures…
>
> “The area [south of the landfill] is characterized by interconnected fractures that appear to be well connected to recharge/discharge features, which are likely in direct connection to surface infiltration. The well-connected area has a significant role in the local variation of the potentiometric surface as the water levels vary throughout the year by as much as 4 to 6 m. the results of the recent proposed CAZ investigation, which demonstrated hydraulic connection between monitoring wells north and south of Beechwood Road, have demonstrated that the hydraulically well-connected area extends onto the proposed CAZ properties, as far south and southeast as well locations M188, M190, and M167.”

There is little available information on karst of the Napanee Plain. The Karst Map (Brunton and Dodge 2008) does not indicate the presence of “known karst” over much of the area. However, the map does refer to some karst features west of the study area in the Tyendinaga area. The map refers to this as a paleokarst (formed under paleodrainage conditions not currently operative) and note that it occurs at/near the contact of the lower Bodcaygeon with the upper Gull River. The presence of karst at or near this contact has been noted by Brunton (F. Brunton, Ontario Geological Survey, personal communication). In addition, this author (Cowell) has investigated karst features in the Verulam and Gull River formations nearby (P.E. County, Amherst Island, and Westport).

4.0 RESULTS OF SITE ASSESSMENT

The site visit was conducted on the 18th and 19th of October, 2016. A reconnaissance of surface water features and topography in the wider region along Beechwood and Deseronto Road (including Sucker Creek south of Highway 401) and the on-site abandoned quarry was undertaken on the 18th. The 19th was devoted to features and monitoring wells within the Contaminant Attenuation Zone (CAZ). The Site visit was accompanied by BluMetric staff (Brad McCallum and Francois Richard) and focused on surface geomorphological features and monitoring wells within the CAZ as well as the unnamed creek that crosses the southeast edge of the CAZ.

The boundaries of the CAZ in the area south of the landfill, location and identifiers of monitoring wells, and the location of the unnamed creek are shown in Figure 1. Four pre-field targets for the karst assessment were determined based on information in the background documents and discussions with staff. Field targets included the abandoned quarry; the known karst sinkhole feature located in the west central CAZ immediately west of monitoring well M187 (crescent-shaped contour west of M187 on Figure 1); the area of the apparent groundwater “trough” on the intermediate bedrock groundwater potentiometric surface between M179 and M166 (Figure 2); and the unnamed creek immediately adjacent to the SW corner of the CAZ.

4.1 Western Streamsink Complex

Photo 1 shows the area of the main sinkhole at the downstream end of an ephemeral channel that serves as an overflow drain to a dug cattle pond. There are several small sinkpoints ("streamsinks") within this channel including the one furthest downstream (behind position of Photo 1) and two circular "collapse" type sinkholes (Photo 2). The sinkholes appear conformal with the surface drainage system which collects shallow groundwater seepage and runoff from the central portion of the CAZ including the north slope of the hill located to the south of the sinkholes. During snowmelt and following heavy rains, water flows westward following a shallow "valley", eventually sinking into the sinkhole complex.

It is likely that the existing surface drainage opportunistically tapped into an older paleokarst feature underlying the Site at this location. This is suggested by the fact that karst drainage via the sinkholes is very efficient; *i.e.*, the karst drains all the surface water without significant ponding that might reflect a young post-glacial karst. Also, water levels in nearby wells M187 and M174 (to the southeast) consistently have the lowest heads encountered on-site (94.7 to 94.74 masl during the Spring 2016 monitoring), well below the overall potentiometric surface (Figure 2).

4.2 Groundwater Trough Area

Perturbations in the potentiometric surface such as elevations that 'point' up-gradient, similar to surface contours crossing streams, often indicate the presence of karst conduits. The potentiometric map for the study area dated July 13, 2016 (Figure 2) displays this character between M179 (110.07 masl) at the downstream end and M167 (120.87 masl) at the upstream end.

The area along the trough was walked in the field from southeast of monitoring well M179 northwest toward M123 then across to M167. Interestingly, surface karst features were observed at the downgradient end of the trough, supporting the postulation that the trough may represent a karst conduit of some sort. These included two small, circular closed depressions were observed in the field immediately north of M179[1], along the eastern "flank" of the trough (Photo 3). These features were very small but the field rose to the east toward M167 and a long ephemeral drainage feature could be seen leading toward the eastern flank of the trough. This "channel" terminated in the vicinity of the groundwater trough.

Within 10 to 20 m south of monitoring well M179, are several closed depressions with the bedrock surface exposed. Open joints were visible and these were clearly solutionally enhanced (Photos 4 and 5). One such feature displayed intersecting joints and was a total of about 4 m long[2].

Additional small closed depressions were observed in the vicinity of M176 that appeared as shallow frost-shattered pockets[3]. Bedrock was exposed at the surface in this area[4].

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[1] UTM's for these features are: 18T0336317E/4902413 and 0336266E/4902383N

[2] 18T 0336385E/4902283N; joints oriented 90-270°, 97-277° and 75-255°.

[3] 18T0336685E/4902442N

[4] Exposed joint oriented 150-330°.

4.3 Unnamed Creek

This creek flows from northeast toward the southwest, immediately southeast of the CAZ (Figure 1). It crosses Highway 401 south of the abandoned quarry forming a tributary to Sucker Creek in the area northwest of Deseronto. Shallow, post-glacial karsts in southern Ontario commonly drain to nearby surface water features, particularly streams and creeks. If the creek receives karst discharge water from the Site, this creek would be a potential sampling target.

The creek channel was walked from east of M176 downstream to where it was crossed by a power line. This stream reach included a wetland portion, a couple of small beaver dams, a broad open "meadow", and a small pond at the power line crossing. No evidence of springs was observed in this length and no evidence of marl was found in the open water pond. If bedrock groundwater discharged to the stream, some evidence of marl (precipitated calcium carbonate) in quiet water locations could be expected. No direct springs were observed and the upper portion through the wetland downstream to the open meadow was basically dry with the exception of small ponds upstream of each of the beaver dams.

The channel through the open area was dry (Photo 6) and bifurcated. One small distributary channel appeared to terminate in a small sinkpoint (Photo 7) but this could not be confirmed at the time of observation as there was no flow and the channel's grade was low.

Downstream of the open meadow, minor seepage could be observed into the channel but the volume was low and the temperature was not cold enough (not measured) to suggest a deep groundwater source. It is most likely this seepage was from shallow soil in the area resulting for heavy rains on the two prior days.

The available evidence suggests that this creek is at least partially a losing stream and does not receive groundwater from the area of the CAZ. However, this would need to be confirmed during the spring melt period. It is possible that both conditions are true – the creek receives groundwater baseflow, especially when the aquifer is high, and loses surface water to the during low water conditions.

5.0 KARST DISCUSSION

5.1 Overview

The karst within the CAZ displays three distinct karst conditions: 1) a deep, likely paleokarst-controlled, conduit system in the west; 2) a shallower conduit system developing under post-glacial conditions in the east (represented by the groundwater trough); and 3) a very shallow epikarst, located in areas of shallow soil over bedrock.

The karst conduits are found within the southwestern and central parts of the CAZ but do not appear to be influencing the leachate plume. The plume lies up-gradient of the karst in an area of artesian conditions (e.g., M167, M178R-2 and -3). The presence of artesian conditions in juxtaposition to karst is of interest as karst conduits are characterized by relatively high hydraulic conductivities. If the entire site was affected by the karst, one would not expect the presence of areas with such high heads, rather, the karst would serve to act as drains, keeping heads low. This condition may explain why, based on sampling results to date, the plume appears to be limited to the central and northern portion of the CAZ.

5.2 Western Deep Karst

The orientation and elevation of the conduit controlling groundwater flow beneath the western streamsink is not accurately known. However, in my opinion, it is not coincidental that the lowest head found on-site occurs at nearby well M187 which is repeated at well M174, to the southeast. It is speculative at this point to try to connect the dots with only two wells, however these are aligned in the direction of maximum hydraulic gradient, roughly in line with one of the measured joint planes.

Interestingly, the borehole logs for both M174 and M187 reveal “water bearing fractures” at ~88 masl (M174) and ~89 masl (M187). The DGI Geoscience Inc. acoustic and optical televiewer analysis log for M174 (Figure 3) displays a prominently open fracture with what appears to be rounded stones at a depth between 35.62 to 35.68 m bgs (below ground surface) suggesting turbulent flow conditions.

Leachate contamination, as measured by 1,4-dioxane, has not been found in either of the two deep head wells, however, 1,4-dioxane has been detected in some up-gradient wells (e.g., M121, M64-2, M178R-2 and M178R-3). Pumping tests indicated hydraulic connections between M187 (pumping well) and M64-2, M185-1, M185-2, and M179 (draw-down wells). These hydraulic connections do not imply karst connections, particularly since the plume has not entered the deep karst. However, an additional monitoring location in this area is warranted.

5.3 Shallow Karst Conduit System

The leachate plume has been detected on the western flank of the groundwater trough at M178R-2 and M178R-3 but not in wells which appear to be located in or close to the shallow karst conduit system (M176 and M179). The pumping test at M187 showed hydraulic connectivity to M179 (M176 was not monitored during the pumping test).

The overall efficiency of this karst system is not known but appears to be less than that of the deep conduit system. Karst features, in the form of shallow sinkholes and solutionally widened joints occur along the trough between M179 and M176 and, possibly immediately north of M176.

However, it appears that this shallow karst conduit is not as well developed to the north/northwest of M179. This is indicated by an absence of surface karst features and the presence of seasonally high water levels in wells to the north and west including M178R-2, M178R-3 and M167 which experience artesian heads. As noted above, artesian conditions at these wells suggest they are not directly controlled by the karst otherwise the karst would serve as a drain, preventing or significantly reducing heads at these locations.

In any case, it does not appear that plume has entered the shallow karst system. The reason for this lack of connection is not known but could involve bedrock structure (*e.g.*, fault offsets affecting bedding and jointing frequencies) or simply a lack of opportunity to expand the karst in the up-gradient direction.

5.4 Epikarst System

Epikarst refers to the solutional enhancement of the upper usually 5 m or so in carbonate bedrock either exposed at surface or beneath shallow overburden (Ford and Williams 2007). It is particularly pronounced in rocks with thin to medium bedding such as the Verulam. This is demonstrated in the well logs by a fairly dense set of horizontal fractures in the upper section as shown at M166, M167 and M168 for example having 0.46 m, 0.38 m and 1.07 m, respectively of overburden. In comparison, M173 and M174 with 9.14 m and 9.75 m of overburden show significantly less fracture density in the upper bedrock. In areas of shallow soils, this epikarst system would form the major component of BluMetric's shallow groundwater system[5].

Flow in the epikarst zone is a function of interconnectedness within the zone as well as leakage into underlying conduits. It functions only during high water table conditions, principally during snowmelt and can be further complicated by seasonal ice. When it is functioning, water in the epikarst can both discharge at the surface or capture surface water, often only short distances apart. The sinkholes observed south of M179, for example, represent discrete entry points to the epikarst (and shallow karst conduit).

Sampling of surface discharges from the epikarst in the vicinity of M178R showed detectable levels of 1,4-dioxane. These discharges may reflect high heads in the intermediate bedrock aquifer in this area serving, in part as a 'back-flush' mechanism and limiting the southward expanse of the leachate plume.

6.0 CONCLUSIONS

Based on preliminary work, we have identified the existence of three karst conditions within the CAZ including a deep and shallow conduit system and an upper epikarst system. These three systems exhibit a range of efficiencies (hydraulic conductivities) resulting in a complex hydrogeological setting.

The shallow karst conduit system is less efficient than the deep conduit system. Although there appears to be some hydraulic connection between the two systems, as shown by pumping tests between M187 and M179, there is no evidence to indicate that the karst conduits are directly connected.

Karst conduits drain portions of the southwestern and central portions of the CAZ but do not appear to be influencing water levels in the area of the leachate plume. The plume appears to be contained within an area of higher heads that may serve to restrict connections to the down-gradient karst.

The unnamed creek east and southeast of the CAZ appears to be losing water to local karst underlying the channel. It is not known if this forms part of the shallow conduit system within the central CAZ.

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[5] Over the entire Site, the shallow groundwater system would include a combination of the epikarst and overburden.

7.0 RECOMMENDATIONS

Groundwater conditions within the CAZ are well monitored and the leachate plume appears to be well understood. Of particular importance is the absence of the plume in monitoring wells within or adjacent to the karst (especially M187, M174, M176 and M179). However, pumping tests have indicated hydraulic connections between M187 and M64-2 and between M187 and M178R-2/-3; and leachate has been detected at M64-2 and M178R-2/-3. Hence, a priority for additional monitoring within the CAZ, from the perspective of the karst, is to monitor potential plume encroachment on the karst, particularly south and southwest of these two wells.

In addition, further definition of the hydrologic characteristics of wells located between the plume and the karst should be undertaken. Water levels are currently measured only a few times per year, however the influence of the karst on water levels requires more frequent monitoring, particularly throughout the spring freshet and during heavy rain events.

7.1 Given the identified hydraulic connection between M187 and M64-2 a new sentry monitoring well should be located between these two wells;

7.2 Water level data loggers (including temperature and conductivity) should be installed in M179, M186, M187 M188, M190, new well M194 located adjacent to the western sinkhole, and the new well proposed in 7.1, above. The loggers should be maintained for at least a two-year period. Analyses should focus on event characteristics including during spring melt and through significant rainfall events to examine water level responses (rising and falling heads and well-to-well relationships). The need to continue the use of loggers should be re-examined after the two-year period; and

7.3 The unnamed creek southeast of the CAZ should be Investigated during the spring freshet period (generally late March/early April) to observe flow dynamics. Specifically, observations should be made of any recharge to the stream via soil seepage and bedrock springs. Field measurements of temperature and specific conductance will allow rapid separation of soil seepage/snowmelt flows from bedrock contributions. Observations should also be made of potential losing (sinking) conditions, particularly in the area of the “meadow” noted above.

8.0 LITERATURE SOURCES

BluMetric. January 2016. Hydrogeological investigation in the area of the proposed Contaminant Attenuation Zone, Waste Management Richmond Landfill site. Report to Waste Management of Canada Corporation.

BluMetric. January 2016. Site conceptual model update and Contaminant Attenuation Zone Delineation, Waste Management Richmond Landfill site. Report to Waste Management of Canada Corporation.

BluMetric. April 2016. Hydrogeological investigation in the area of the proposed Contaminant Attenuation Zone, Waste Management Richmond Landfill site. Report to Waste Management of Canada Corporation.

Ford, D.C. and P. Williams. 2007. *Karst Hydrogeology and Geomorphology*. John Wiley & Sons Ltd, West Sussex, England.

Respectfully submitted,

Daryl W. Cowell, P.Geo. (#0791)
December 14, 2016

FIGURES

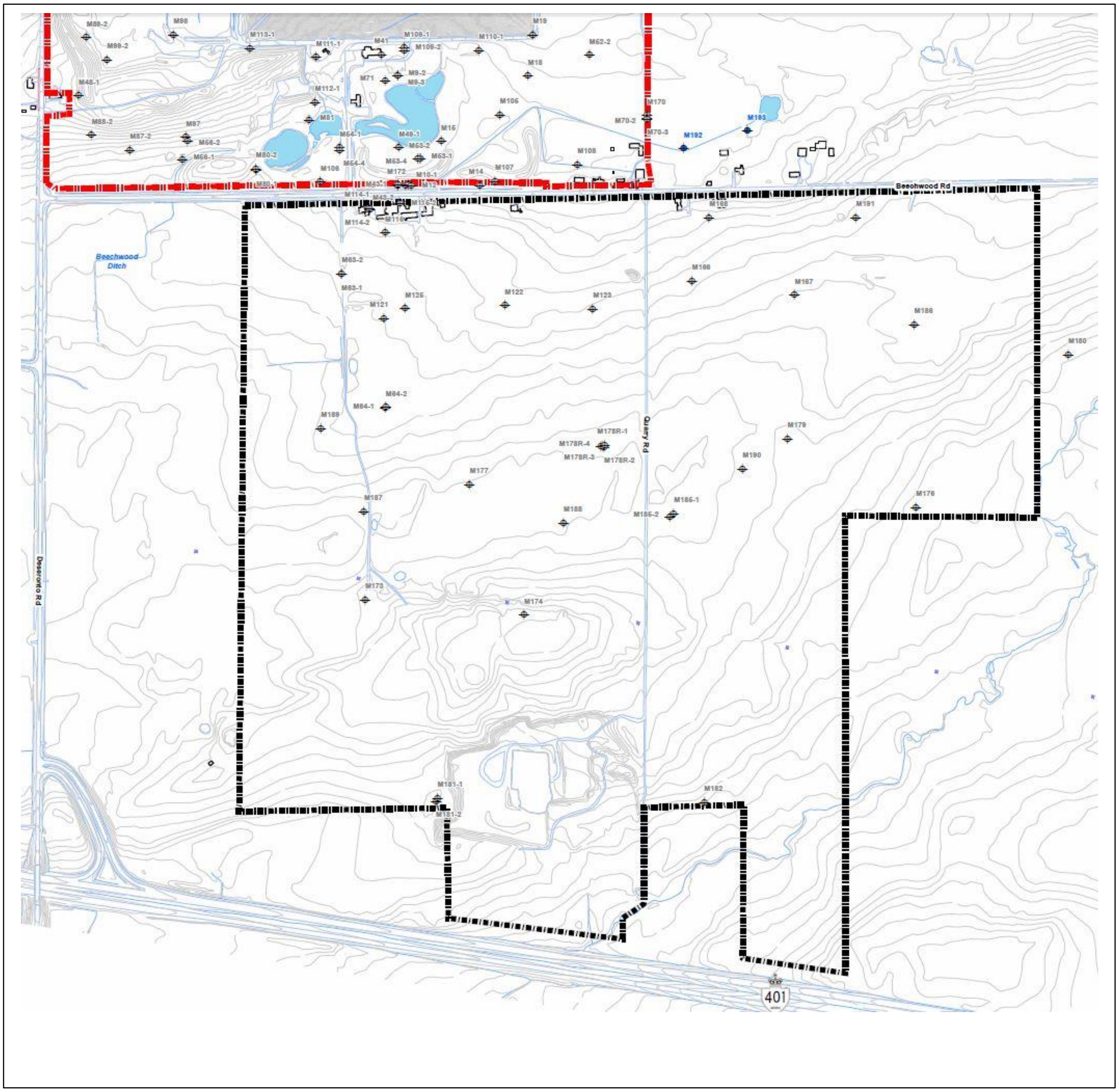


Figure 1. Location of the CAZ, monitoring wells and the unnamed creek to the southeast of the CAZ (BluMetric April 2016).

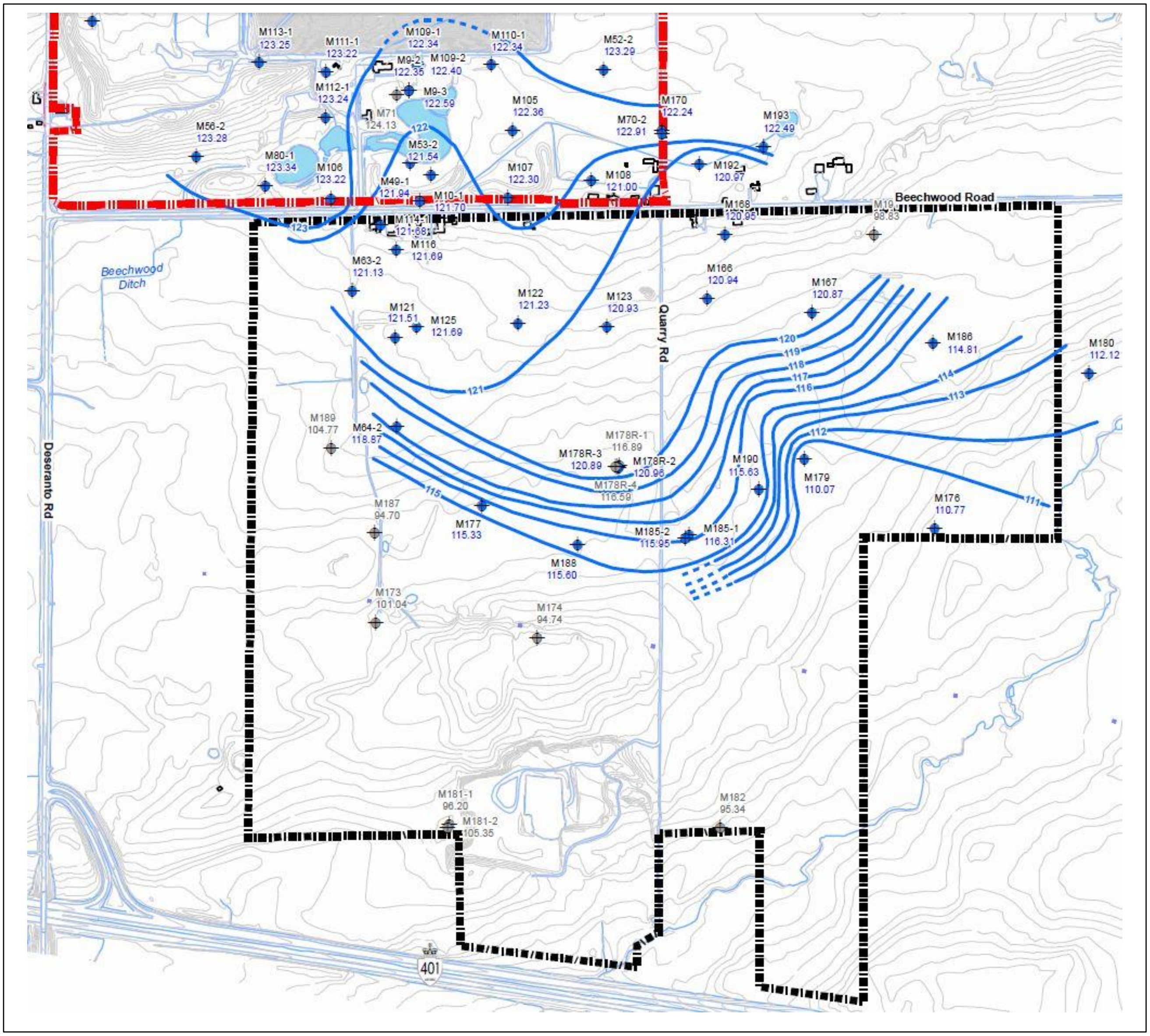


Figure 2. Potentiometric surface including location of the groundwater “trough”.

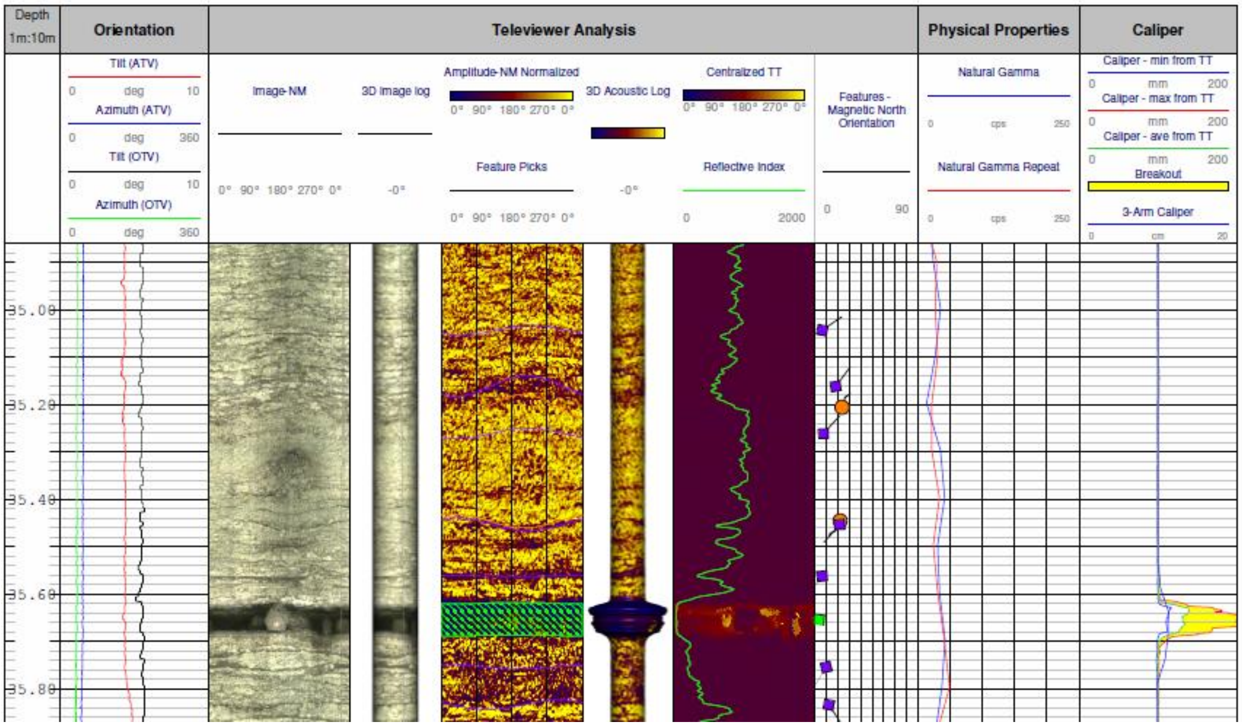


Figure 3. Excerpt from DGI log of the lower section of well M174.

PHOTOS

Photo 1. Main streamsink at downstream end of ephemeral channel west of monitoring well M187. The dug-out cattle pond is immediately beyond the hedge row in upper photo.

Photo 2. Evidence of dynamic karst in the form of a small collapse type sinkhole within the streamsink area of the western karst.

Photo 3. Small, barely perceptible closed depression in field along the groundwater trough northeast of monitoring well M179.

Photo 4. Solutionally widened joint serving as seasonal recharge to the epikarst zone at the southern end of the groundwater trough 10 to 20 m south of M179.

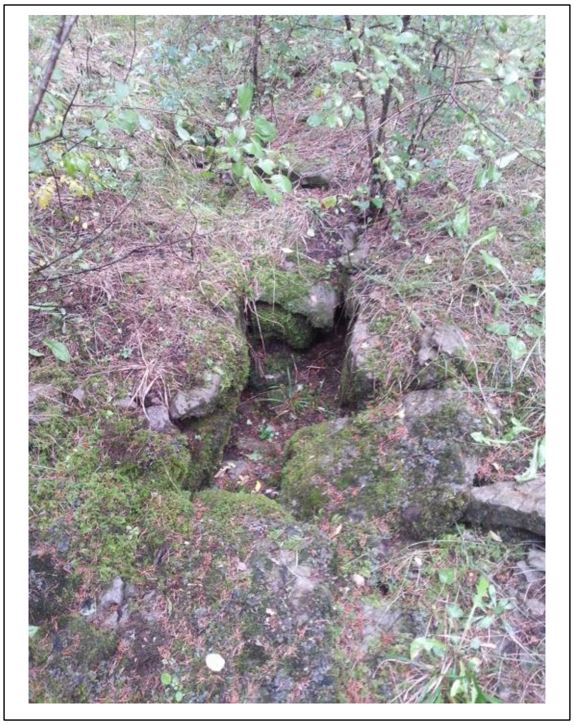


Photo 5. Deeper epikarst recharge depression along joints in the vicinity of Photo 4 (photo by Brad McCallum).

Photo 6. Dry creek bed in open meadow zone of the unnamed creek southeast of the CAZ.

Photo 7. Possible sinkpoint in the bed of the unnamed creek within the open meadow area.

APPENDIX A

Preliminary Karst Assessment
(Daryl W. Cowell & Assoc. Inc.)

A2: Supplementary Stream Survey Report, June 13, 2017

WASTE MANAGEMENT RICHMOND LANDFILL
(NAPANEE ONTARIO)
PRELIMINARY KARST ASSESSMENT
SUPPLEMENTARY STREAM SURVEY

Submitted to:

BluMetric Environmental Inc.
4 Cataraqui Street
The Woolen Mill, The Tower
Kingston, ON K7K 1Z7

On Behalf of:

Waste Management of Canada Corporation
1271 Beechwood Road
R.R.#6 Napanee, ON K7R 3L1

Submitted by:

Daryl W. Cowell & Associates Inc.
27 Rita Crescent, RR1, Tobermory, ON N0H 2R0
Ph: 519.596.8187
Email: dcowell@amtelecom.net

June 13, 2017

WASTE MANAGEMENT RICHMOND LANDFILL

(NAPANEE ONTARIO)

PRELIMINARY KARST ASSESSMENT SUPPLEMENTARY STREAM SURVEY

1.0 INTRODUCTION

Daryl W. Cowell & Associates was retained in 2016 by BluMetric Environmental Inc. (BluMetric) to undertake a preliminary karst assessment of lands south of the Richmond Landfill on behalf of Waste Management (WM). The work was focused on an area between Beechwood Road and Highway 401, approximately 8 km west of Napanee, Ontario. This encompasses an area referred to as the Contaminant Attenuation Zone (CAZ) which is currently being monitored to characterize the nature and extent of leachates associated with the Richmond Landfill located north of Beechwood Road.

The "Preliminary Karst Assessment" (PKA) report was completed and submitted on December 14, 2016 and concluded that two karst conduit systems occurred within the CAZ – a deep karst within the southwestern CAZ and a shallow karst in the southeastern CAZ. Both are oriented in the direction of the local piezometric surface (southeast) and up-gradient of a small unnamed creek that flows southwesterly.

The creek was not flowing at the time of the PKA (October 18-19, 2016) and hence it was not possible to determine the degree to which it may or may not be connected to the karst. As a result, recommendation #7.3 in the PKA report identified the need to undertake further site investigations, as such: *"The unnamed creek southeast of the CAZ should be investigated during the spring freshet period (generally late March/early April) to observe flow dynamics. Specifically, observations should be made of any recharge to the stream via soil seepage and bedrock springs. Field measurements of temperature and specific conductance will allow rapid separation of soil seepage/snowmelt flows from bedrock contributions. Observations should also be made of potential losing (sinking) conditions, particularly in the area of the "meadow" noted above."*

The primary purpose of this recommendation and the current report is to evaluate potential karst connections between the unnamed creek and the karst interpreted within the CAZ. Of particular interest is the potential for the karst within the CAZ to be connected to the stream. This would be reflected in two ways: karst water discharge to the creek in the form of bedrock-sourced springs and/or recharge of surface creek waters into an underlying karst conduit system.

This report should be read in combination with the PKA report in order to fully appreciate the context.

2.0 METHODS

The stream survey was undertaken on March 22, 2017. It was timed to coincide with the spring freshet, to the degree possible, in order to observe runoff, spring and seepage conditions when groundwater levels are at or near their highest elevations. The winter of 2016-2017 did not produce a significant snowfall accumulation, a heavy snowfall occurred one-week prior to the survey. March 21, 2017 was a particularly warm and sunny day (~ +9^{o}C) which activated snowmelt and surface runoff. Although it turned very cold overnight with air temperatures in the range of -15^{o}C, the creek continued to flow (partial ice cover) as the previous day's warming was sufficient to warm the upper soil profile as witnessed by the presence of two soil seepages/springs. The air temperature remained around -11^{o}C during the course of the field study.

The survey was conducted with support from BluMetric's staff including Francois Richard and Mike Lloyd. Mr. Shawn Trimper and Victor Castro of the Kingston office of the Ontario Ministry of Environment and Climate Change attended the survey as did Mr. Chris Prucha and William McDonough of Waste Management Corporation.

The creek was accessed at its crossing with the gas pipeline right-of-way then was walked in the downstream direction (southwest) to the small pond located at the power line right-of-way. These are shown on Figure 1 along with the 10 stations where field measurements were taken. The line tracing the creek channel on Figure 1 was taken from the Ontario Base Map 1:20,000 scale data and does not correspond directly to the site level information (e.g., location of Station 1).

The stream survey included observations of upstream-downstream flow dynamics (estimated change[1]), identification of any spring or seepage recharge to the channel[2], identification of possible sinkpoint locations, and water chemistry. Chemistry data including pH, specific conductance (µS/cm), dissolved oxygen (mg/L) and temperature (^{o}C) were measured directly in-stream using a YSI portable field meter (Model No. 556).

3.0 RESULTS

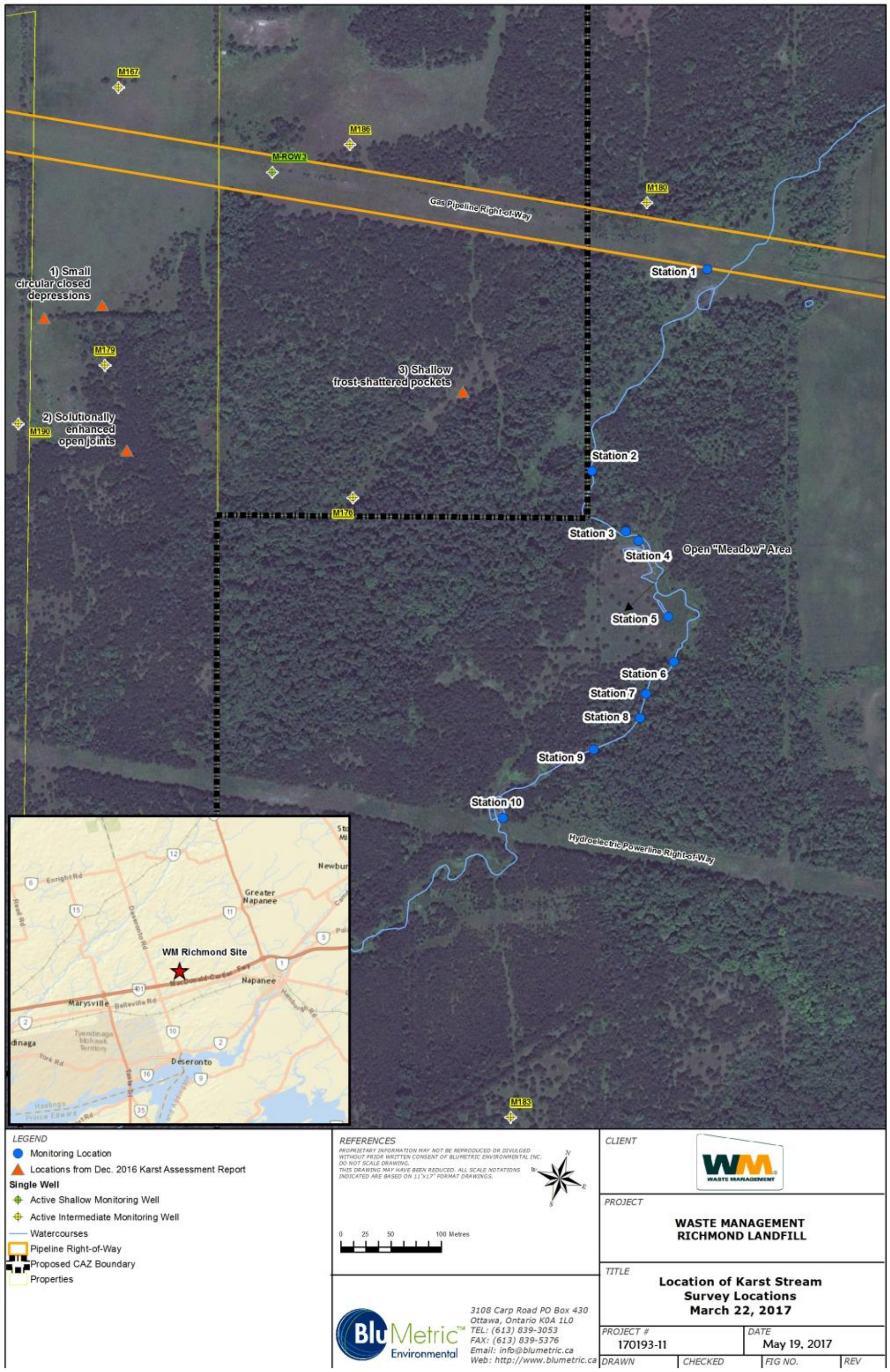
The stream measurement locations are presented in Figure 1 and the water chemistry results are shown in Table 1. The water measurement stations include:

Station 1: upstream station at gas pipeline ROW at culvert discharge into small pond;
Station 2: main channel in forested area downstream of wetland;
Station 3: main channel immediately upstream of open "meadow" consisting of shallow soil over bedrock;
Station 4: possible small soil spring within a meter of the main channel bank;
Station 5: possible sinkpoint on bedrock plain described in PKA report

[1] No direct flow measurements were made. Flow was visually estimated based on speed and cross-section dimensions and discussed in-field. The purpose was to determine, to the extent possible, whether the stream reach was gaining or losing flow .

[2] Discrete recharge points tributary to the channel. It was not possible to directly observe small seepages within the channel.

- **Fisheries effects on location, species and timing;**



– no flow observed but some water ponded under frozen surface;
Station 6: possible small soil spring within 2 m of main channel;
Station 7: main channel immediately downstream of shallow bedrock area;
Station 8: small side channel likely diverting water from main channel in the shallow bedrock area;
Station 9: main channel between shallow bedrock area and downstream pond; and
Station 10: main channel in outlet of small downstream pond at power line ROW.

FLOW OBSERVATIONS:

In-channel flows were estimated to be in the range of 40 to 50 L/s at Station 3 and 75 to 100 L/s at the downstream end of the pond (Station 10). Although these estimates are very approximate, it was agreed by those attending the survey that flows along this reach were increasing, not decreasing.

SPRING OBSERVATIONS:

Only two small springs were observed (Stations 4 and 6), both immediately adjacent to the channel and both flowing (< 1 L/s). No significant bedrock springs were encountered and no broad areas of seepage were noted. The two springs had amongst the highest temperatures and conductivities along with the lowest dissolved oxygen levels (Table 1).

Table 1. Stream station data and UTM locations for 10 locations along the unnamed creek, Richmond Landfill site.

Station	Easting	Northing	Temp. (°C)	Conductivity (µS/cm)	DO (mg/L)	pH
1	336879	4902633	0.08	318	12.5	7.5
2	336832	4902406	0.01	313	-	7.7
3	336882	4902360	0.06	314	13.6	7.8
4 (soil seep)	336897	4902355	0.94	336	6.3	7.7
5 (sinkpoint?)	336949	4902292	0.33	330	14.0	7.8
6 (soil seep)	336968	4902251	0.49	342	11.6	8.0
7	336951	4902212	0.03	333	12.8	8.0
8	336953	4902188	0.04	337	11.9	8.1
9	336919	4902144	0.04	335	12.9	8.1
10	336854	4902051	0.53	334	13.1	8.3

CHEMISTRY:

Temperatures were close to freezing in all main channel locations (mean 0.43°C, n=6). The warmest temperatures were found in two stations interpreted to be soil springs, the possible sinkpoint, and downstream of the pond in the power line ROW.

Conductivities ranged between 313 µS/cm and 342 µS/cm generally increasing in the downstream direction with stations 4 and 6 having amongst the highest conductivities.

Dissolved oxygen concentrations in the main channel ranged between 11.9 and 14.0 mg/L with a mean of 12.97 mg/L (n=6). The two locations interpreted to be soil springs (stations 4 and 6) were the two lowest measurements.

pH continually increased in the downstream direction from 7.5 through 8.3.

4.0 DISSCUSSION

Specific conductivity and temperature are particularly valuable in characterizing karst carbonate waters.

Air temperatures within karst conduits take on that of the surrounding rock mass which, below the frost zone, is the average annual temperature of the region in which they are located. Hence, strong relative contrast in water temperatures between water derived from the bedrock aquifer compared to surface water occur, particularly during winter and summer. The average annual air temperature at the Kingston Pumping Station was 7.8°C over the period 1981 to 2010[3].

With an air temperature of -11°C and open channel water temperatures just above freezing during the survey (Table 1), the temperature data collected does not indicate the presence of discharge from the bedrock aquifer. The two springs (stations 4 and 6) were slightly warmer but not significantly and can be explained as shallow soil seeps activated during the previous day's warming. The slightly higher temperature recorded at the pond outlet is the result of warming by the sun during the morning.

Specific conductivity is a measure of a solution to conduct electricity measured in siemens per meter. It is a measure of the ionic content in a solution which, in the case of karst/carbonate waters, are dominated by calcium and bicarbonate ions. In general, the longer the residence time of water within limestone, the higher the conductivity.

Stream conductivities (and pH) generally increased in the downstream direction (Table 1) as would be expected as the water contacts carbonate rich soils and the bedrock surface. Although the two springs (stations 4 and 6) had slightly higher conductivities these levels are within 10% of the open channel water and do not suggest significant bedrock residence times.

The possible sinkpoint (station 5) had ponded water beneath and ice cover with no flow either in or out at the time of the survey. The feature is very shallow (< 25 cm deep) with no indication of a conduit at the base. However, the channel containing the sinkpoint terminates at the sinkpoint at the downstream end (Photo 7 in the PKA report), it likely does function as a minor karst recharge feature but is not connected to an efficient karst system.

The absence of significant karst discharge to the stream or recharge by the stream to the karst is corroborated by the observed flow characteristics. The stream gained approximately 35 to 50 L/s over

[3] Canadian Climate Normals: http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=kingston&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=4300&dispBack=1

an approximately 600 m reach which included at least two observed soil springs. This flow change does not indicate either significant gains from or losses to karst. In addition, no evidence of marl deposits was observed in the downstream pond which would be expected if carbonate-rich bedrock discharges were contributing to the creek[4]. Although minor flow losses to the shallow bedrock can't be ruled out, there is no evidence of significant karst inflows or losses.

5.0 CONCLUSION

The temperature and conductivity data at the time of the survey are not consistent with the presence of significant karst inflows to the unnamed creek.

The sinkpoint identified in the PKA is a minor feature that likely drains to shallow bedding planes. No other sinkholes or sinkpoints have been observed in association with the unnamed creek.

Observations of streamflow along this reach of the unnamed creek are consistent with a normal surface stream not significantly influenced by deeper karst recharge or discharge.

Although minor losses to or gains from shallow bedrock in the vicinity of the creek can't be ruled out, there is no evidence of karst interconnections with either of the two karst conduit systems within the CAZ.

6.0 RECOMENDATION

No additional karst surveys are recommended as a result of the PKA and this supplemental report. However, for due diligence purposes it is suggested that the creek be sampled for leachate analysis at the power line crossing. This should be undertaken annually approximately during the spring freshet for a two-year period and suspended afterward if results are negative.

[4] Marl is the product of degassing of CO_2 from carbonate-rich water resulting in the precipitation of calcite in quiet, open-air settings (e.g., ponds).

APPENDIX B

Borehole Logs

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: DP1-16

Easting: 335995
Northing: 4902174
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft / m)	Stratigraphy	Description	Elevation (m)	Well Construction	Rock Quality Designation (%)	Fracture Frequency/Run	Comments	K (m/sec)
-4 ft to 0		Ground Surface	116.00; 115.54				- Elev. DP1-16 116.78 m TOC - TOC s/u 1.24m	
0 to 4 ft (1 m)		***Sandy Clay*** Brown, trace gravel at bedrock surface. (soil description inferred M178R-5) - drive point refusal	115.00				- W/L elev. 115.59masl recorded Apr. 21, 2017 - bentonite gravel seal - galvinized steel riser - 0.5m x 32mm Steel screen	
4 to 6 ft		End of Borehole	114.00					

Drilled By: BluMetric Environmental Inc.
Drill Method: Drive Point
Hole Size: 1.25" (32mm)
Drill Date: November 17, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

Sheet: 1 of 1

Project No: 160143-11

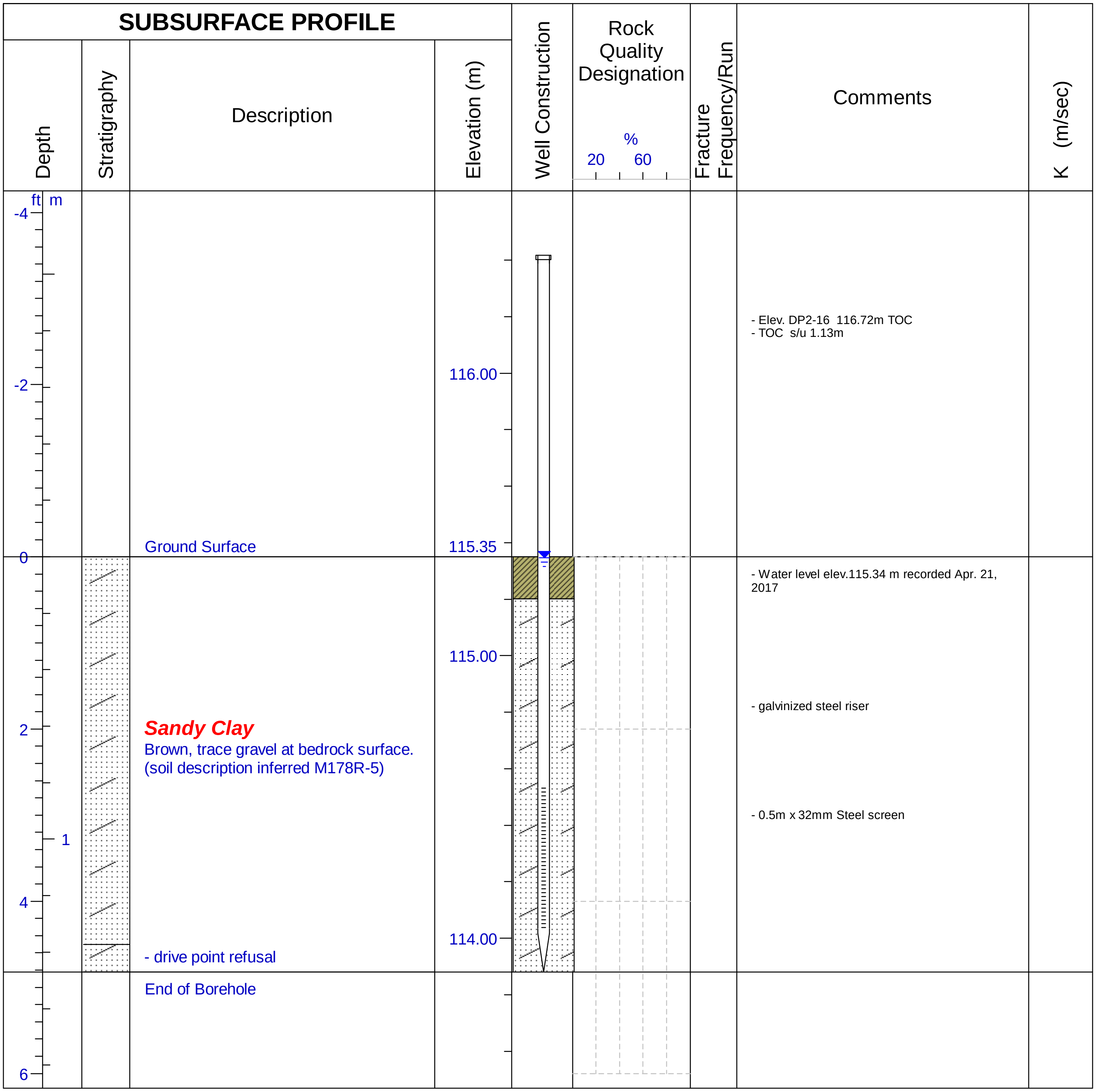
Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: DP2-16

Easting: 335989
Northing: 4902147
Field Personnel: B.McC.



Drilled By: BluMetric Environmental Inc.
Drill Method: Drive Point
Hole Size: 1.25" (32mm)
Drill Date: November 17, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

Sheet: 1 of 1

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: DP3-16

Easting: 335983
Northing: 4902121
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Description	Elevation (m)	Comments
-4				
-2			116.00	- Elev. DP3-16 116.77 m TOC - TOC s/u 1.34m
0		Ground Surface	115.43	
		Sandy Clay Brown, trace gravel at bedrock surface. (soil description inferred M178R-5)	115.00	- Water level elev.115.51m recorded Apr. 21, 2017 - galvinized steel riser - 0.5m x 32mm Steel screen
2				
	1			
4		- drive point refusal		
		End of Borehole	114.00	
6				

Column headings: Depth (ft, m); Stratigraphy; Description; Elevation (m); Well Construction; Rock Quality Designation (%: 20, 60); Fracture Frequency/Run; Comments; K (m/sec)

Drilled By: BluMetric Environmental Inc.
Drill Method: Drive Point
Hole Size: 1.25"(32mm)
Drill Date: November 17, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

Sheet: 1 of 1

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M178R-5

Easting: 335997
Northing: 4902232
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft / m)	Stratigraphy	Description	Elevation (m)	Well Construction	Rock Quality Designation (%) 20 60	Fracture Frequency/Run	Comments	K (m/sec)
-4 ft							MOE Well tag # A193460	
-2 ft							- Elev. M178R-5 117.33 m TPVC	
			117.00				- TOC s/u 0.84m	
0		Ground Surface	116.49					
							- Water level elev. 116.51m recorded Apr. 21, 2017	
			116.00				- 4" steel protective casing	
2 ft							- bentonite gravel seal	
1 m	Sandy Clay	***Sandy Clay*** Brown, trace gravel at bedrock surface						
4 ft			115.00					
6 ft	Limestone	***Limestone*** (2.29m) water bearing fracture. Auger refusal (2.44m)					1.22m x 50mm Slot 10 PVC screen within #3 silica sand pack.	
8 ft		End of Borehole	114.00					

Drilled By: GET Drilling Ltd.
Drill Method: Solid Flight Augers
Hole Size: 6" (152mm)
Drill Date: November 15, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

BluMetric™ Environmental

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M188-2

Easting: 335978
Northing: 4902068
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft / m)	Stratigraphy	Description	Elevation (m)	Well Construction	Rock Quality Designation (%) 20 60	Fracture Frequency/Run	Comments	K (m/sec)
-3								
							- Elev. M188-2 116.53 m TPVC	
-1			116.00				- TOC s/u 0.82m	
		Ground Surface	115.71					
		Silty Clay Dark brown, with trace organics.					- Water level elev. 115.75 m recorded Apr. 21, 2017	
1							- 4" dia. (100mm) protective steel casing	
			115.00				- bentonite gravel seal	
3		**Limestone** Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.					- 5.25" dia. (133mm) tri-cone to depth 11' (3.35m)	
5							-weak bedrock5' (1.52m)	
			114.00					
7 / 2							2.43m x 50mm Slot 10 PVC screen within #3 silica sand pack.	
9			113.00				- weak bedock 10' and 10'6" (3.05, 3.2m)	
11		End of Borehole						

Drilled By: GET Drilling Ltd.
Drill Method: Rotary Tri-cone
Hole Size: 5.25" (133mm)
Drill Date: November 14, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

BluMetric™ Environmental

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M194-1

Easting: 335564
Northing: 4901886
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft / m)	Stratigraphy	Description	Elevation (m)	Well Construction	Rock Quality Designation (%) 20 60	Fracture Frequency/Run	Comments	K (m/sec)
-3, -1		Ground Surface	114.86				MOE Well tag # A193462 - Elev. M194 115.60 m TOC - Elev. M194 115.55m TPVC - TOC s/u 0.74m - Screen installation May3, 2017	
1–5		***Till*** Brown, dry, fine gravel.	114.00				- casing centralizerinstalled at 1.83m - 8" dia. (203mm) HSA to depth 10' (3.02m) - 4" dia. (100mm) steel casing grouted with cement to 10' (3.02m)	
7–57 (2–16 m)		***Limestone*** Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.	113.00, 112.00, 111.00, 110.00, 109.00, 108.00, 107.00, 106.00, 105.00, 104.00, 103.00, 102.00, 101.00, 100.00, 99.00, 98.00				- centralizer - fracture or weak rock 3.8-4.1m. - fracture/weak rock4.7m - weaker bedrock or fracture 5.4m - w/l elev. m recorded 2016 - weak/fracture 8.0m - centralizer - fracture/weak bedrock 9.7m - fracture or weaker rock 10.88m - bentonite gravel seal - water encountered during run from 14.4 to 15.9m.	

Drilled By: GET Drilling Ltd.
Drill Method: Rotary Tri-cone
Hole Size: 3.87" (98mm)
Drill Date: November 15, 16, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M194-1

Easting: 335564
Northing: 4901886
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Description	Elevation (m)	Comments
60–110	19–33	***Limestone*** Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.	96.00–82.00	- W/L elev. 96.68m recorded May 25, 2017 - centralizer - lost water circulation 22.2m. - 3/8" coated bentonite pellets - fracture or weak rock 26.5m. - #0 silica sand pack - centralizer - water bearing fracture 29.3m - 5.2m x 50mm slot 10 PVC screen within #3 silica sand pack - fracture or weaker rock 31.2m.
110–118	35	End of Borehole	81.00–79.00	

Column headings: Depth, Stratigraphy, Description, Elevation (m), Well Construction, Rock Quality Designation (% 20 60), Fracture Frequency/Run, Comments, K (m/sec)

Depth scale (ft): 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118

Depth scale (m): 19, 21, 23, 25, 27, 29, 31, 33, 35

Elevation scale (m): 96.00, 95.00, 94.00, 93.00, 92.00, 91.00, 90.00, 89.00, 88.00, 87.00, 86.00, 85.00, 84.00, 83.00, 82.00, 81.00, 80.00, 79.00

Drilled By: GET Drilling Ltd.
Drill Method: Rotary Tri-cone
Hole Size: 3.87" (98mm)
Drill Date: November 15, 16, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

Project No: 170193-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M194-2

Easting: 335568
Northing: 4901889
Field Personnel: A.B.

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Stratigraphy	Description	Elevation (m)	Comments
-3 to -1			Ground Surface	115.00 / 114.78	MOE Well tag # A223924 - Elev. M194-2 115.30m TOC - Elev. M194-2 115.24m TPVC - s/u 0.52m - Screen installation May 3, 2017
1–5		Till	***Till*** Brown, dry, fine gravel.	114.00	- casing centralizerinstalled at 1.83m - 8" dia. (203mm) HSA to depth 10' (3.02m) - 5" dia. (127mm) steel casing grouted with cement to 10' (3.02m)
7–37	2–10	Limestone	***Limestone*** Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.	113.00 – 104.00	- centralizer - fracture/weak rock4.9m - weaker bedrock or fracture 5.6m - 3m x 50mm slot 10 PVC screen within #3 silica sand pack - water bearing fracture 6.4m. - bentonite gravel seal - fracture/weak bedrock8.6m. - centralizer - water bearing fracture 11.2m.

Column headings: Depth (ft, m); Stratigraphy; Description; Elevation (m); Well Construction; Rock Quality Designation (%, 20, 60); Fracture Frequency/Run; Comments; K (m/sec)

Depth scale (ft): -3, -1, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37
Depth scale (m): 2, 4, 6, 8, 10
Elevation scale (m): 115.00, 114.78, 114.00, 113.00, 112.00, 111.00, 110.00, 109.00, 108.00, 107.00, 106.00, 105.00, 104.00

Drilled By: GET Drilling Ltd.
Drill Method: Rotary Tri-cone
Hole Size: 4.5" (17.7mm)
Drill Date: Mar. 29, April 4, 2017

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: F.R.

BluMetric™ Environmental

Project No: 170193-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M194-2

Easting: 335568
Northing: 4901889
Field Personnel: A.B.

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Stratigraphy	Description	Elevation (m)	Well Construction	Rock Quality Designation (%)	Fracture Frequency/Run	Comments	K (m/sec)
39–69	13–21		***Limestone*** Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.	103.00–94.00		20, 60		- fracture/weak bedrock11.5m. - water bearing fracture 11.7m. - W/L elev. 101.67m recorded May 25, 2017 - coated bentonite pellets - fracture 15.3m. - #0 silica sand pack - centralizer - fines (muddy) encountered and flushed from hole 17.5m. - 18.4m calcite mineralization in drill cuttings. - wide fracture (19.8 - 20.0m) - fracture 20.5m	
69–77	21–23		End of Borehole	93.00–92.00					

Depth scale (ft): 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65, 67, 69, 71, 73, 75, 77

Depth scale (m): 13, 15, 17, 19, 21, 23

Elevation scale (m): 103.00, 102.00, 101.00, 100.00, 99.00, 98.00, 97.00, 96.00, 95.00, 94.00, 93.00, 92.00

Drilled By: GET Drilling Ltd.	Drill Angle: Vertical
Drill Method: Rotary Tri-cone	Azimuth: n.a.
Hole Size: 4.5" (17.7mm)	Datum: NAD83
Drill Date: Mar. 29, April 4, 2017	Checked By: F.R.

BluMetric™ Environmental

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M195

Easting: 335592
Northing: 4902084
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m)	Comments
0	Ground Surface	118.96	MOE Well tag # A216007 - Elev. M195 119.70 m TOC - Elev. M195 m 119.63TPVC - TOC s/u 0.74m - Screen installation May 3, 2017
0 – ~1.7	***Till*** Brown, dry, fine gravel.		- 8" dia. (203mm) HSA to depth 8' (2.44m) - 4" dia. (100mm) steel casing grouted with cement to 8' (2.44m)
~1.7 –	***Limestone*** Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.		- fracture or weak rock 3.4m.. - fracture/weak rock5.9 and 6m. - weaker bedrock or fracture 6.6m. - w/l elev. m recorded 2016 - weak/fracture 9.2 and 9.7m. - centralization - fracture/weak bedrock 11.4m. - bentonite gravel seal. - fracture or weaker rock 12.6 and 12.7m. - fracture/weak bedrock 12.8m. - water encountered during run from 14 and 14.5m. - weak rock/ fracture 15, 15.2 and 15.5m. - fracture or weak rock 16.5m.. - weak rock/fracture 17.3m.

Column headings: Depth (ft, m) | Stratigraphy | Description | Elevation (m) | Well Construction | Rock Quality Designation (%, 20, 60) | Fracture Frequency/Run | Comments | K (m/sec)

Elevation scale: 119.00, 118.00, 117.00, 116.00, 115.00, 114.00, 113.00, 112.00, 111.00, 110.00, 109.00, 108.00, 107.00, 106.00, 105.00, 104.00, 103.00, 102.00

Drilled By: GET Drilling Ltd.
Drill Method: Rotary Tri-cone
Hole Size: 3.87" (98mm)
Drill Date: December 19, 20, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

BluMetric™ Environmental

Project No: 160143-11

Project: Complementary CAZ Investigation

Client: Waste Management

Location: Richmond Landfill, Napanee, ON

Well ID: M195

Easting: 335592
Northing: 4902084
Field Personnel: B.McC.

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Stratigraphy	Description	Elevation (m)	Well Construction	Rock Quality Designation (%) 20 60	Fracture Frequency/Run	Comments	K (m/sec)
60		Limestone						- fracture or weaker rock 17.9 and 18m.	
62	19			100.00				- fracture or weaker rock 19.2, 19.5, 20 and 20.5m	
64								- centralizer	
66				99.00					
68	21			98.00					
70									
72				97.00				- weak rock or fracture (possible water bearing zone) 22.1m.	
74								- weak or fracture rock 22.5m.	
76	23			96.00					
78			***Limestone***	95.00				- W/L elev. 95.08m recorded May 25, 2017	
80			Light grey, lithographic fossiliferrous limestone with undulating shale partings. Stylolites are common. Numerous calcite stringers throughout. Occassional coarse crystalline zones.						
82	25			94.00					
84									
86				93.00				- coated bentonite pellets	
88	27			92.00					
90									
92				91.00				- #0 silica sand pack	
94								- centalizer	
96	29			90.00				- weak or fractured rock 29m.	
98				89.00					
100								- weak or fractured rock 30.3m.	
102	31			88.00				- 3m x 50mm slot 10 PVC screen within #3 silica sand pack	
104									
106				87.00					
108	33		End of Borehole	86.00					
110									
112				85.00					
114	35								
116				84.00					
118				83.00					

Drilled By: GET Drilling Ltd.
Drill Method: Rotary Tri-cone
Hole Size: 3.87" (98mm)
Drill Date: December 19, 20, 2016

Drill Angle: Vertical
Azimuth: n.a.
Datum: NAD83
Checked By: P.T.

BluMetric™ Environmental

APPENDIX C

Downhole Geophysical Logs
(DGI Geoscience Inc.)

ACOUSTIC and OPTICAL TELEVIEWER ANALYSIS

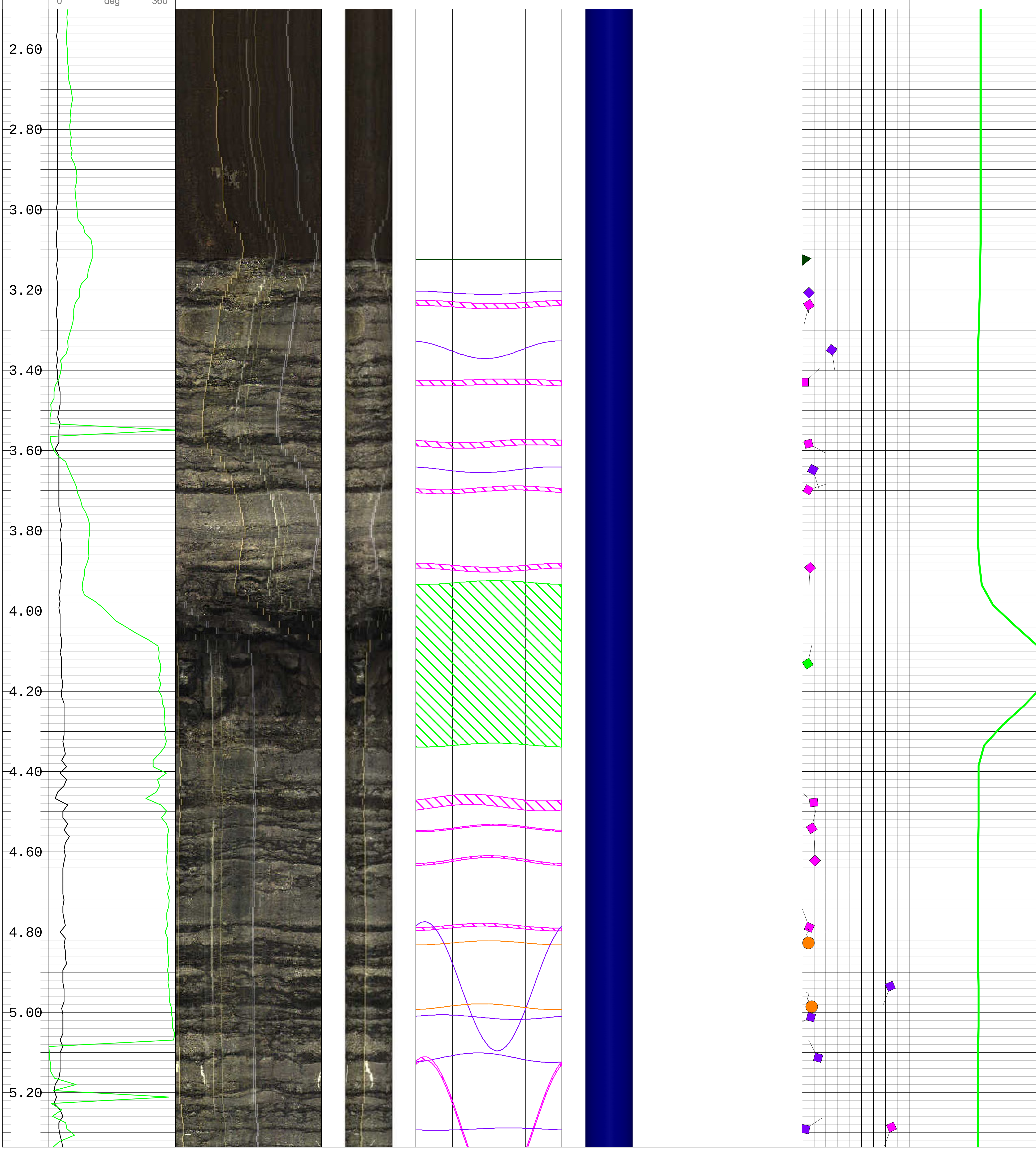
DGI GEOSCIENCE INC.

Company:	WESA	**UTM X (Easting):**	---	**Hole Diameter:**	HQ
Hole ID:	M194	**UTM Y (Northing):**	---	**Hole Type:**	RC
Acquisition date(s):	Dec. 22, 2016	**UTM Z (Elevation):**	---	**Fluid Type:**	Water
Field Personnel:	T. Bonchek	**Total Depth:**	34 m	**Witnessed by:**	---
Legal Location:	Napanee, ON	**Surveyed Depth:**	33.6 m		
Survey Day(s):	1	**Casing Depth:**	3.1 m		

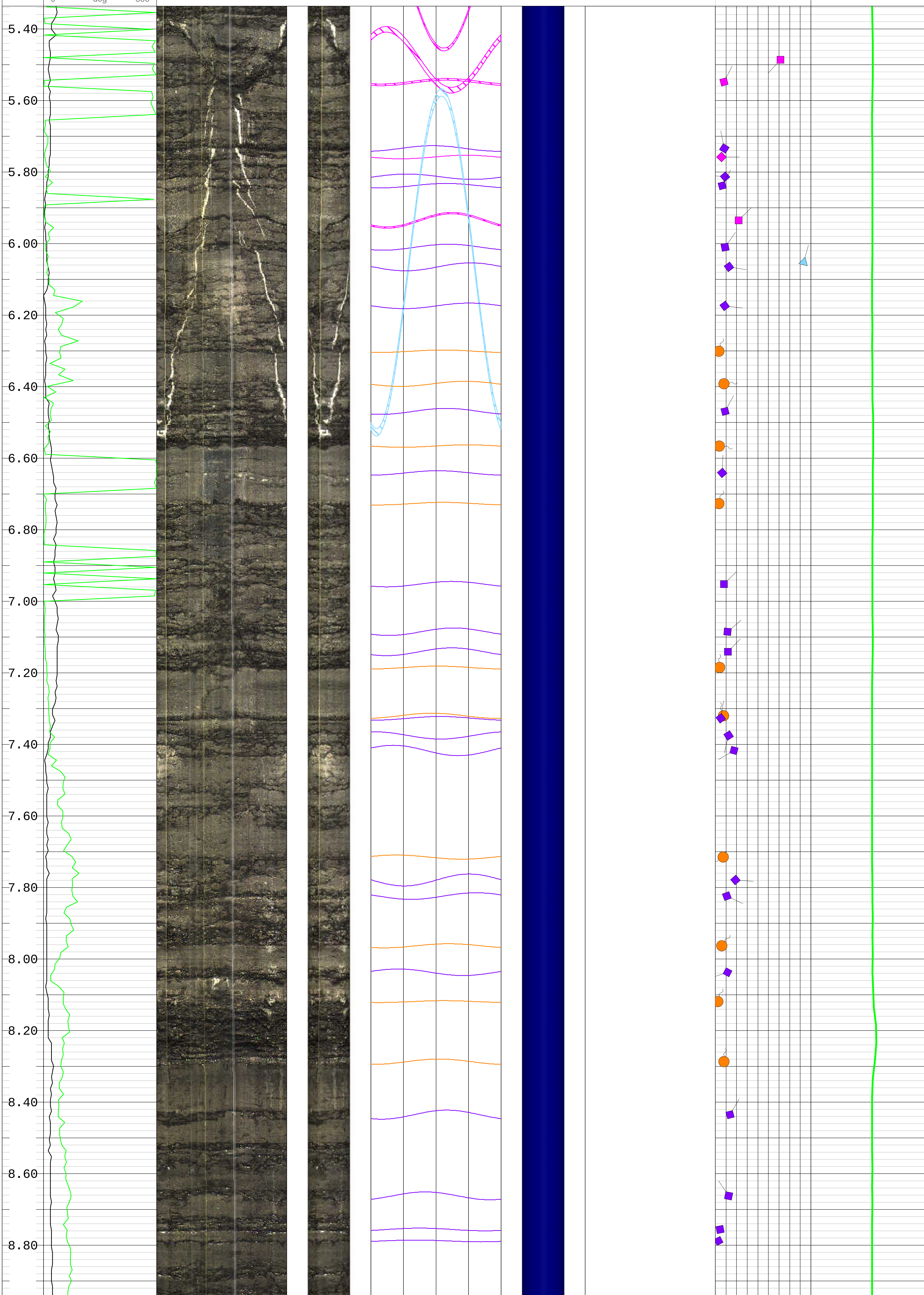
LEGEND - STRUCTURE TYPE

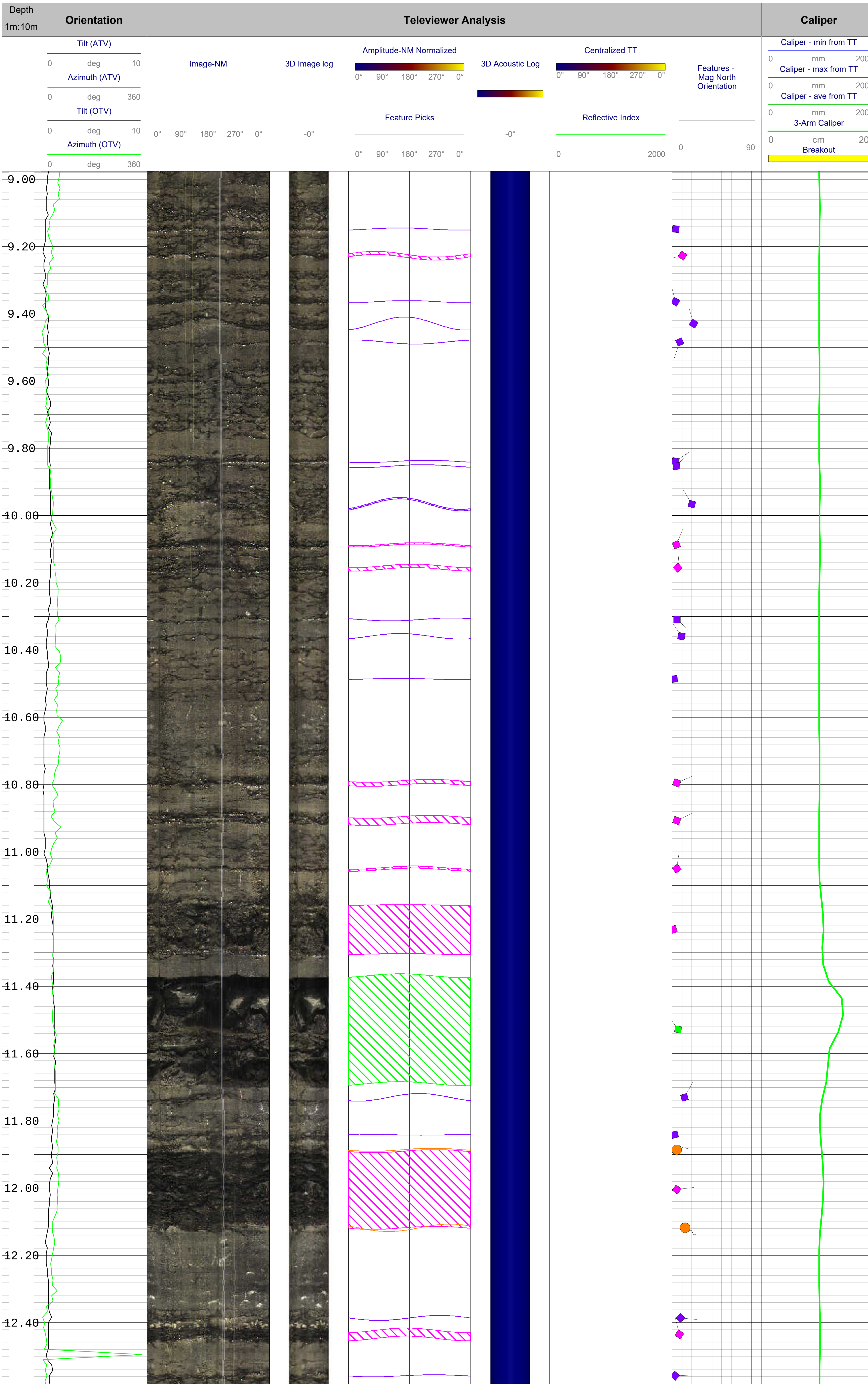
Water Level | Btm of Casing | Major Open Joint/Fracture | Partially Open Joint/Fracture | Minor Joint/Fracture | Vein - Group 1 | Lithology Contact

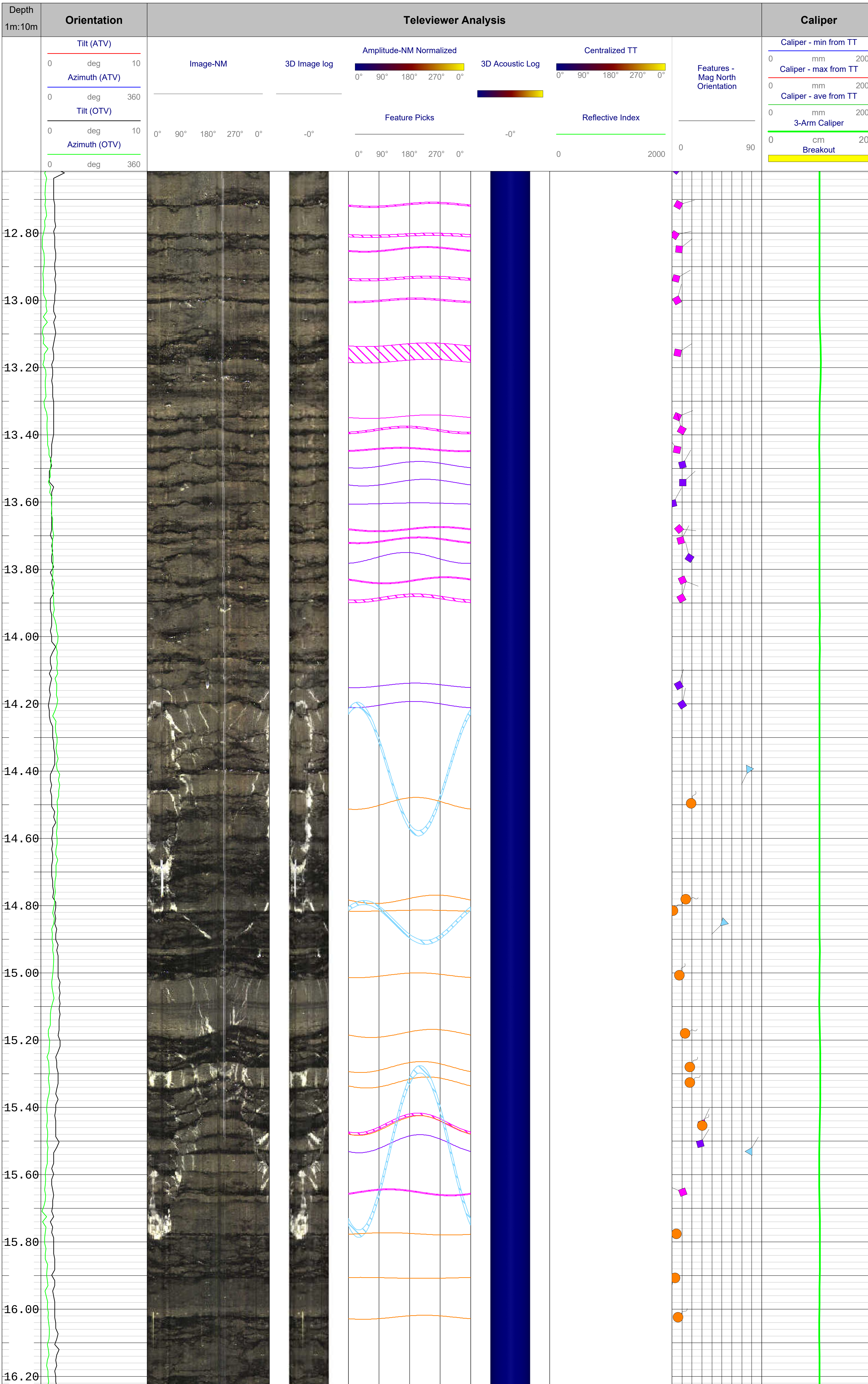
Depth 1m:10m	Orientation	Televiewer Analysis	Caliper
	Tilt (ATV) 0 deg 10; Azimuth (ATV) 0 deg 360; Tilt (OTV) 0 deg 10; Azimuth (OTV) 0 deg 360	Image-NM 0° 90° 180° 270° 0°; 3D Image log -0°; Amplitude-NM Normalized 0° 90° 180° 270° 0°; Feature Picks 0° 90° 180° 270° 0°; 3D Acoustic Log -0°; Centralized TT 0° 90° 180° 270° 0°; Reflective Index 0 2000; Features - Mag North Orientation 0 90	Caliper - min from TT 0 mm 200; Caliper - max from TT 0 mm 200; Caliper - ave from TT 0 mm 200; 3-Arm Caliper 0 cm 20; Breakout

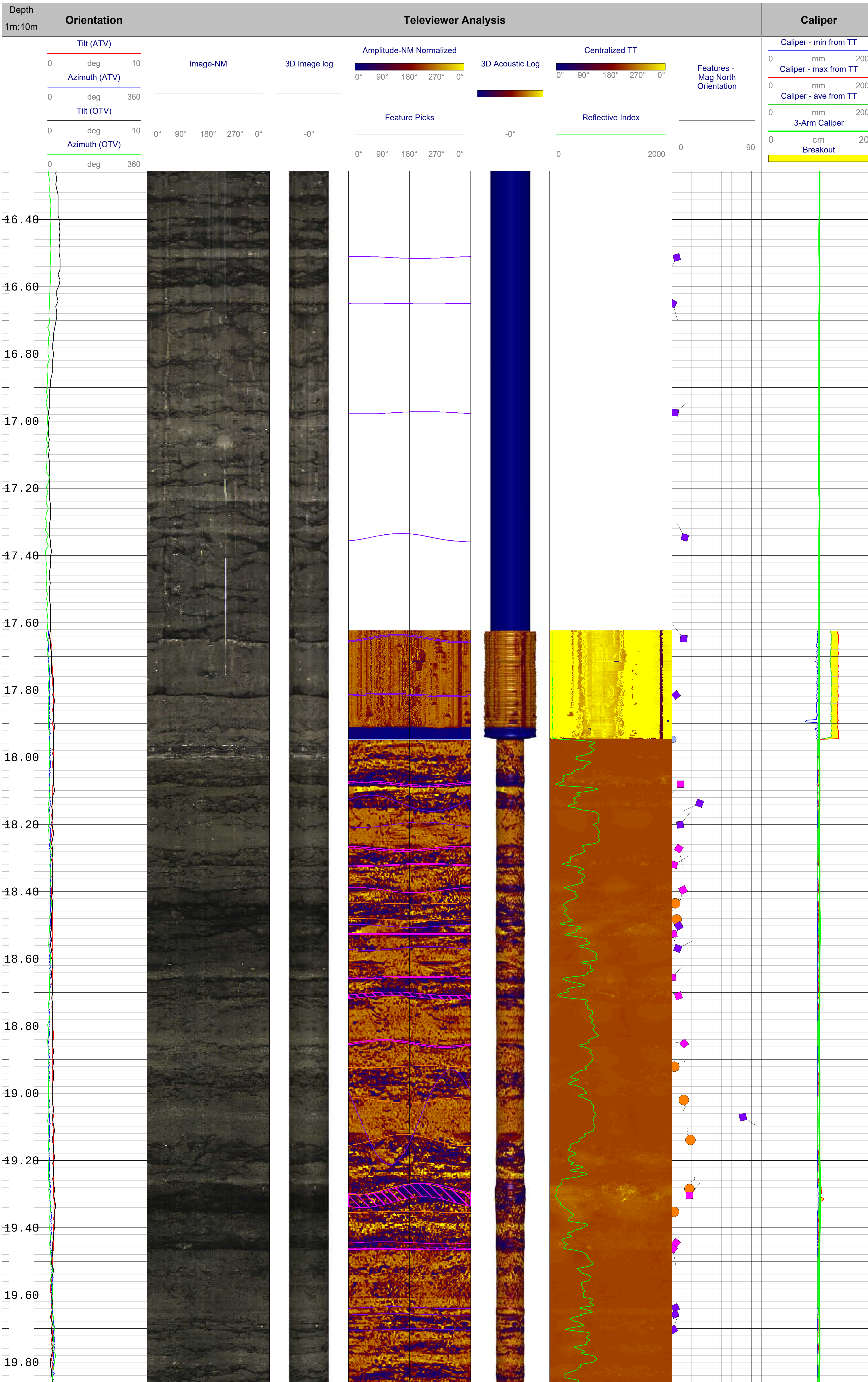


Depth 1m:10m	Orientation	Televiewer Analysis	Caliper
	Tilt (ATV) 0 deg 10 Azimuth (ATV) 0 deg 360 Tilt (OTV) 0 deg 10 Azimuth (OTV) 0 deg 360	Image-NM 0° 90° 180° 270° 0° 3D Image log -0° Amplitude-NM Normalized 0° 90° 180° 270° 0° Feature Picks 0° 90° 180° 270° 0° 3D Acoustic Log -0° Centralized TT 0° 90° 180° 270° 0° Reflective Index 0 2000 Features - Mag North Orientation 0 90	Caliper - min from TT 0 mm 200 Caliper - max from TT 0 mm 200 Caliper - ave from TT 0 mm 200 3-Arm Caliper 0 cm 20 Breakout

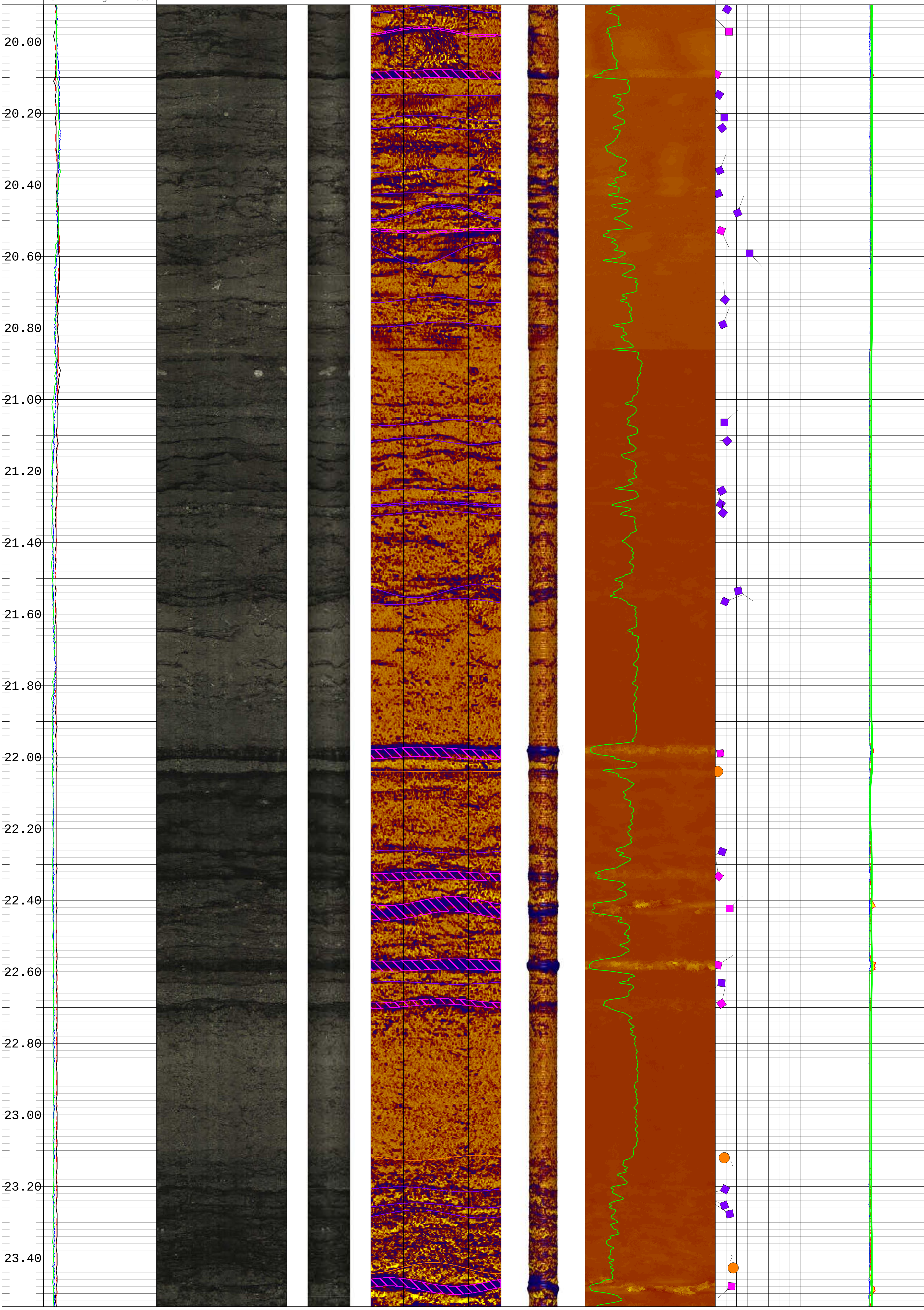


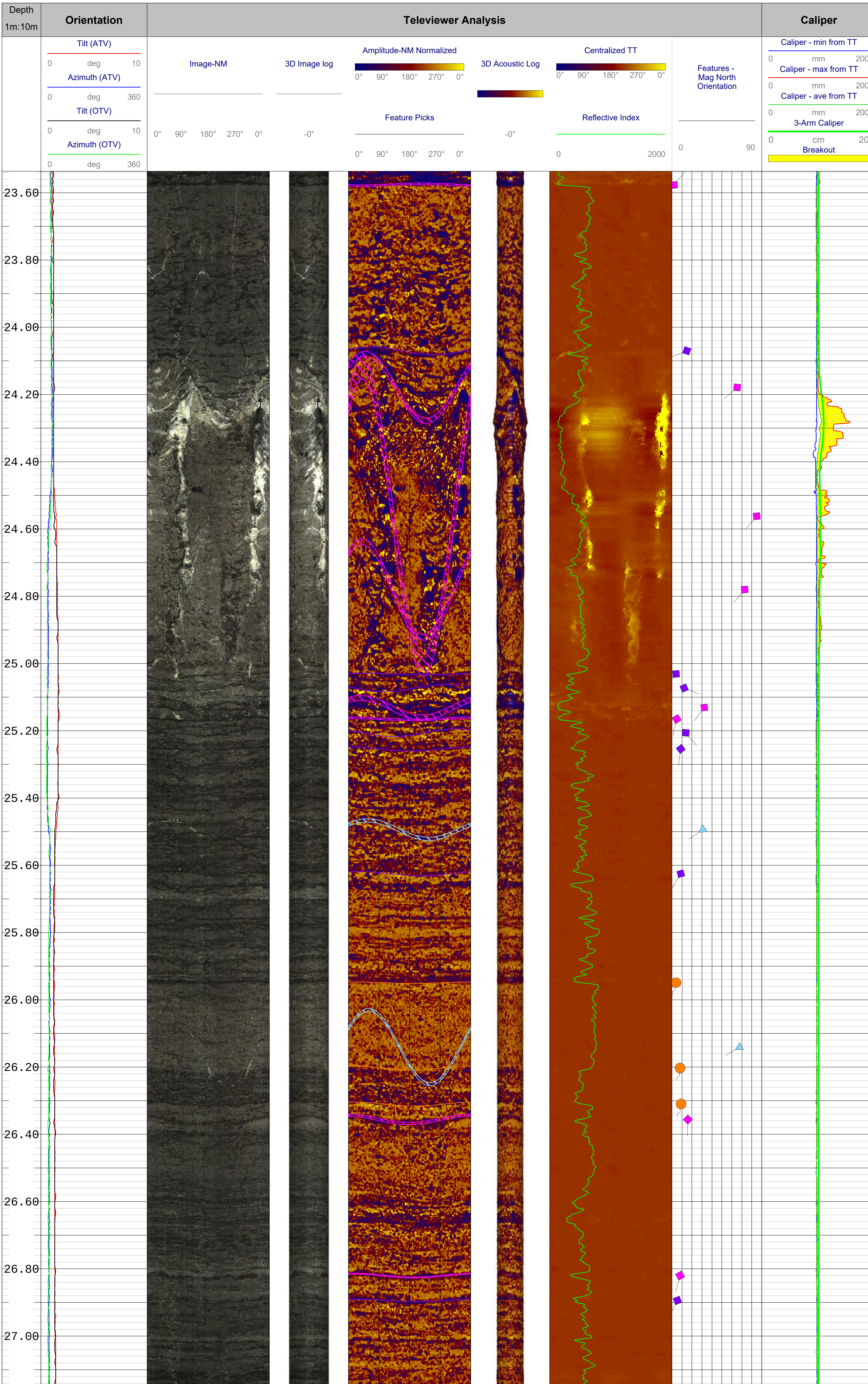

Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
9.00
9.20
9.40
9.60
9.80
10.00
10.20
10.40
10.60
10.80
11.00
11.20
11.40
11.60
11.80
12.00
12.20
12.40
12.60

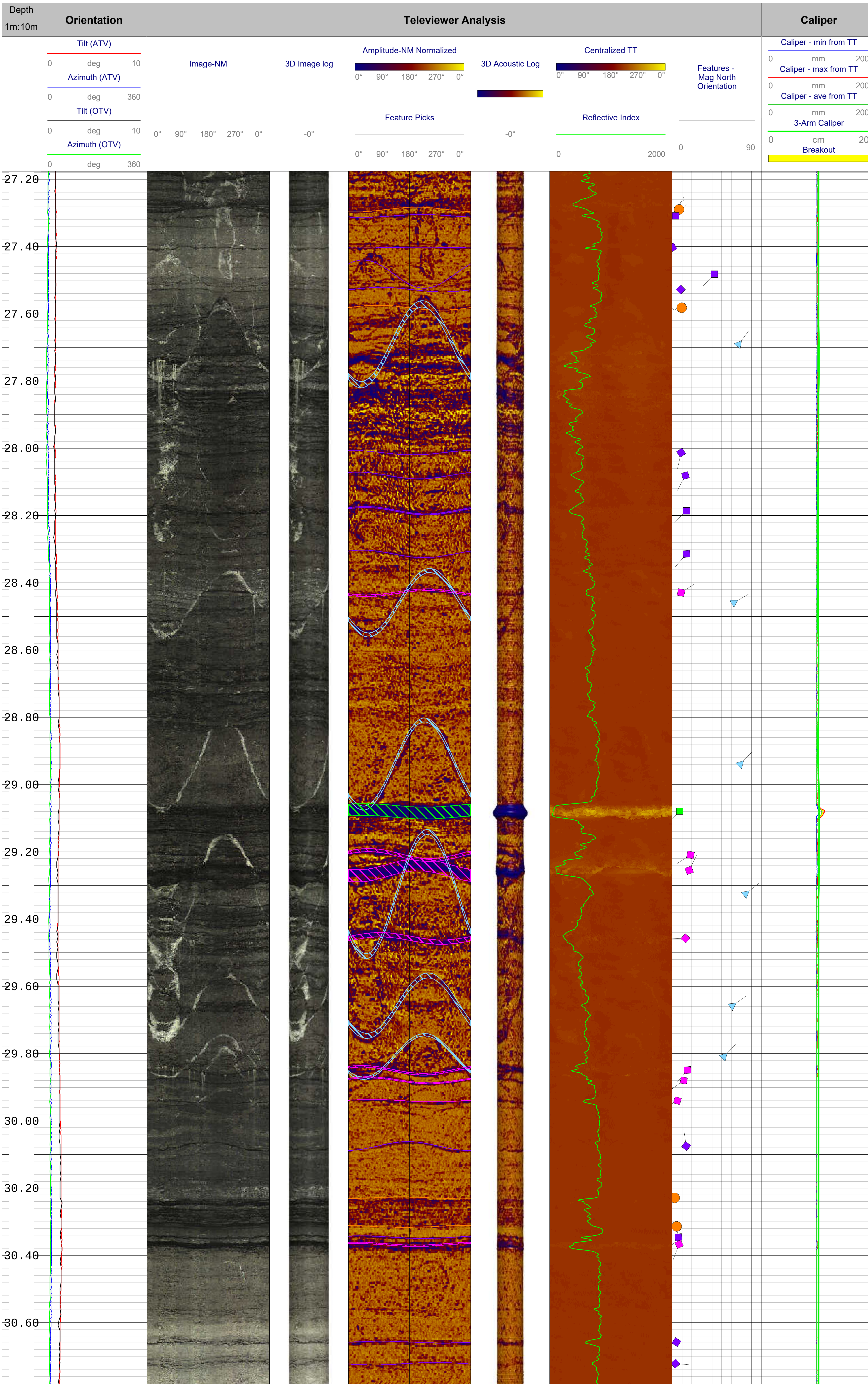

Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
12.80
13.00
13.20
13.40
13.60
13.80
14.00
14.20
14.40
14.60
14.80
15.00
15.20
15.40
15.60
15.80
16.00
16.20

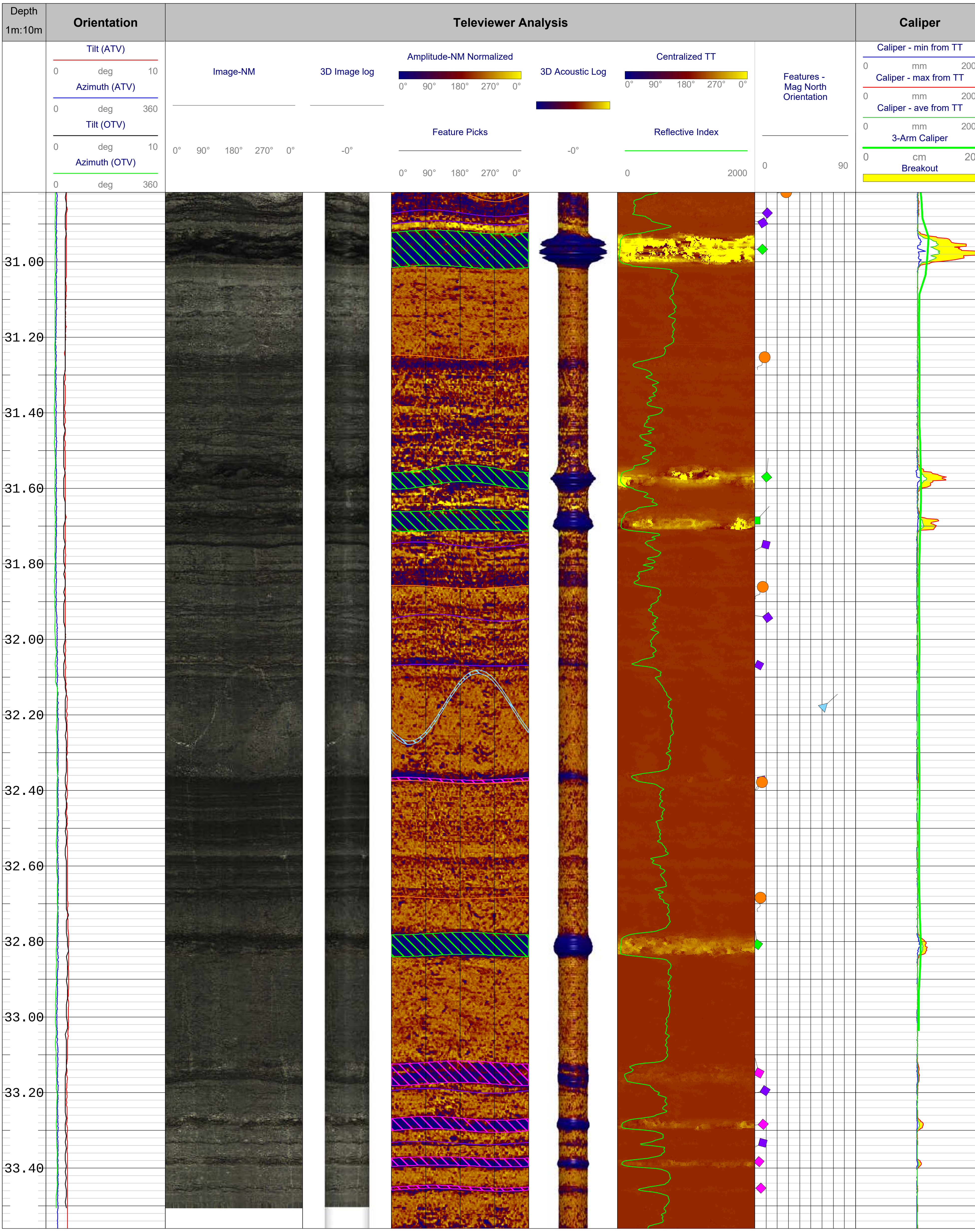

Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
16.40
16.60
16.80
17.00
17.20
17.40
17.60
17.80
18.00
18.20
18.40
18.60
18.80
19.00
19.20
19.40
19.60
19.80

Depth 1m:10m	Orientation	Televiewer Analysis						Caliper
	Tilt (ATV) 0 deg 10 Azimuth (ATV) 0 deg 360 Tilt (OTV) 0 deg 10 Azimuth (OTV) 0 deg 360	Image-NM 0° 90° 180° 270° 0°	3D Image log -0°	Amplitude-NM Normalized 0° 90° 180° 270° 0° Feature Picks 0° 90° 180° 270° 0°	3D Acoustic Log -0°	Centralized TT 0° 90° 180° 270° 0° Reflective Index 0 2000	Features - Mag North Orientation 0 90	Caliper - min from TT 0 mm 200 Caliper - max from TT 0 mm 200 Caliper - ave from TT 0 mm 200 3-Arm Caliper 0 cm 20 Breakout




Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
23.60
23.80
24.00
24.20
24.40
24.60
24.80
25.00
25.20
25.40
25.60
25.80
26.00
26.20
26.40
26.60
26.80
27.00


Depth
1m:10m
Orientation
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Televiewer Analysis
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
27.20
27.40
27.60
27.80
28.00
28.20
28.40
28.60
28.80
29.00
29.20
29.40
29.60
29.80
30.00
30.20
30.40
30.60
30.80



Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
31.00
31.20
31.40
31.60
31.80
32.00
32.20
32.40
32.60
32.80
33.00
33.20
33.40

ACOUSTIC and OPTICAL TELEVIEWER ANALYSIS

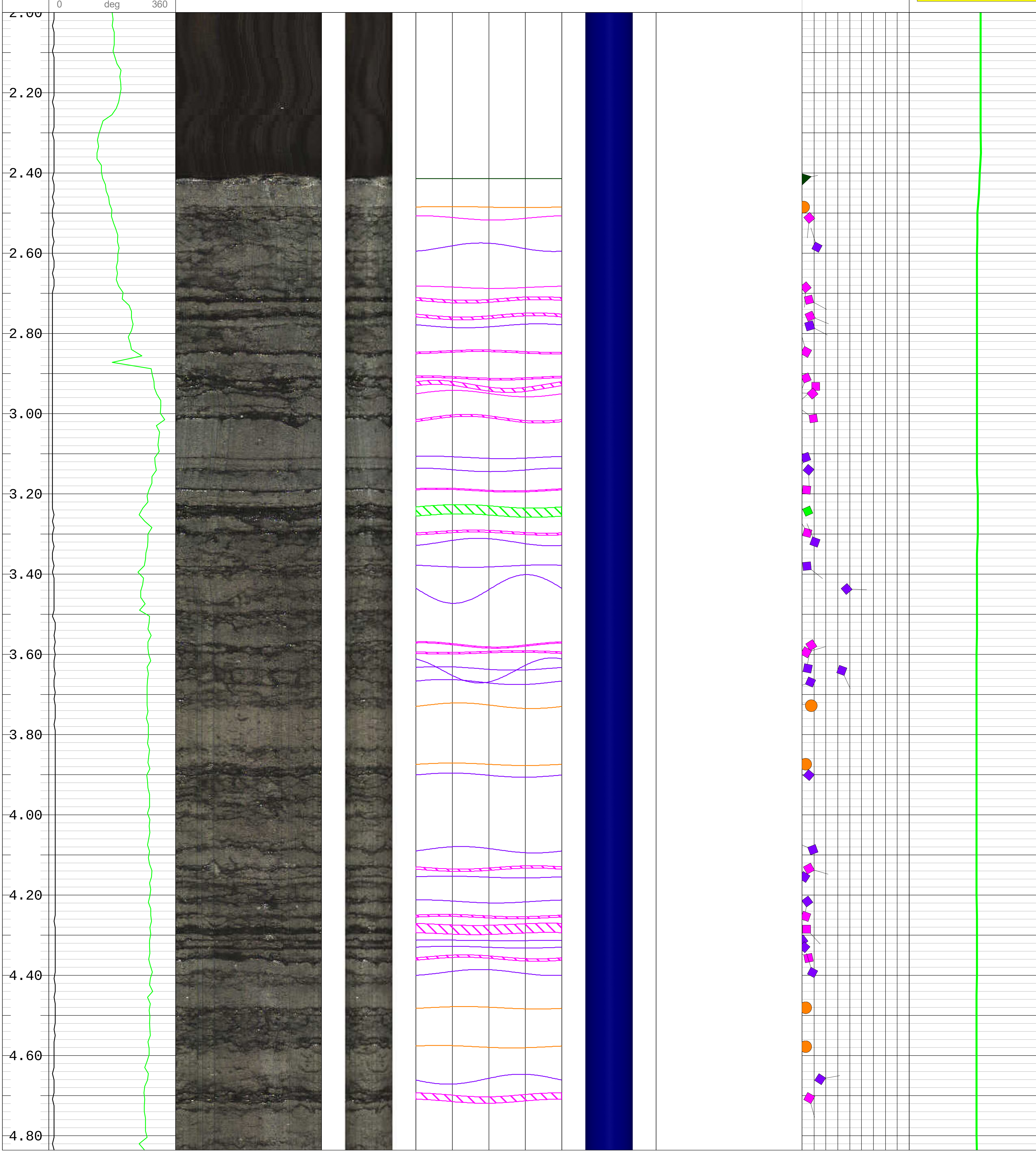
DGI GEOSCIENCE INC.

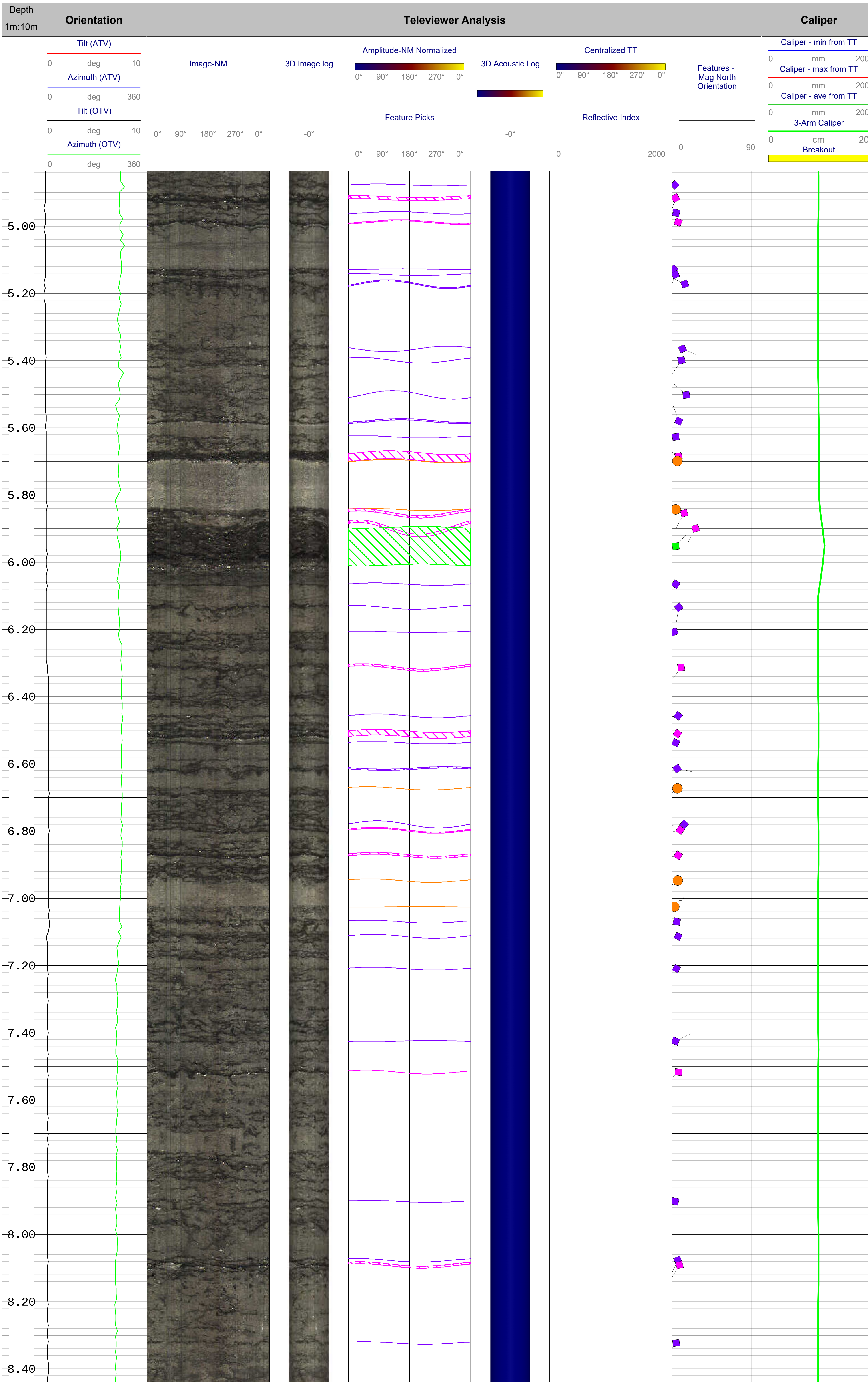
Company:	WESA	**UTM X (Easting):**	---	**Hole Diameter:**	HQ
Hole ID:	M195	**UTM Y (Northing):**	---	**Hole Type:**	RC
Acquisition date(s):	Dec. 22, 2016	**UTM Z (Elevation):**	---	**Fluid Type:**	Water
Field Personnel:	T. Bonchek	**Total Depth:**	33 m	**Witnessed by:**	---
Legal Location:	Napanee, ON	**Surveyed Depth:**	32.2 m		
Survey Day(s):	1	**Casing Depth:**	2.4 m		

LEGEND - STRUCTURE TYPE

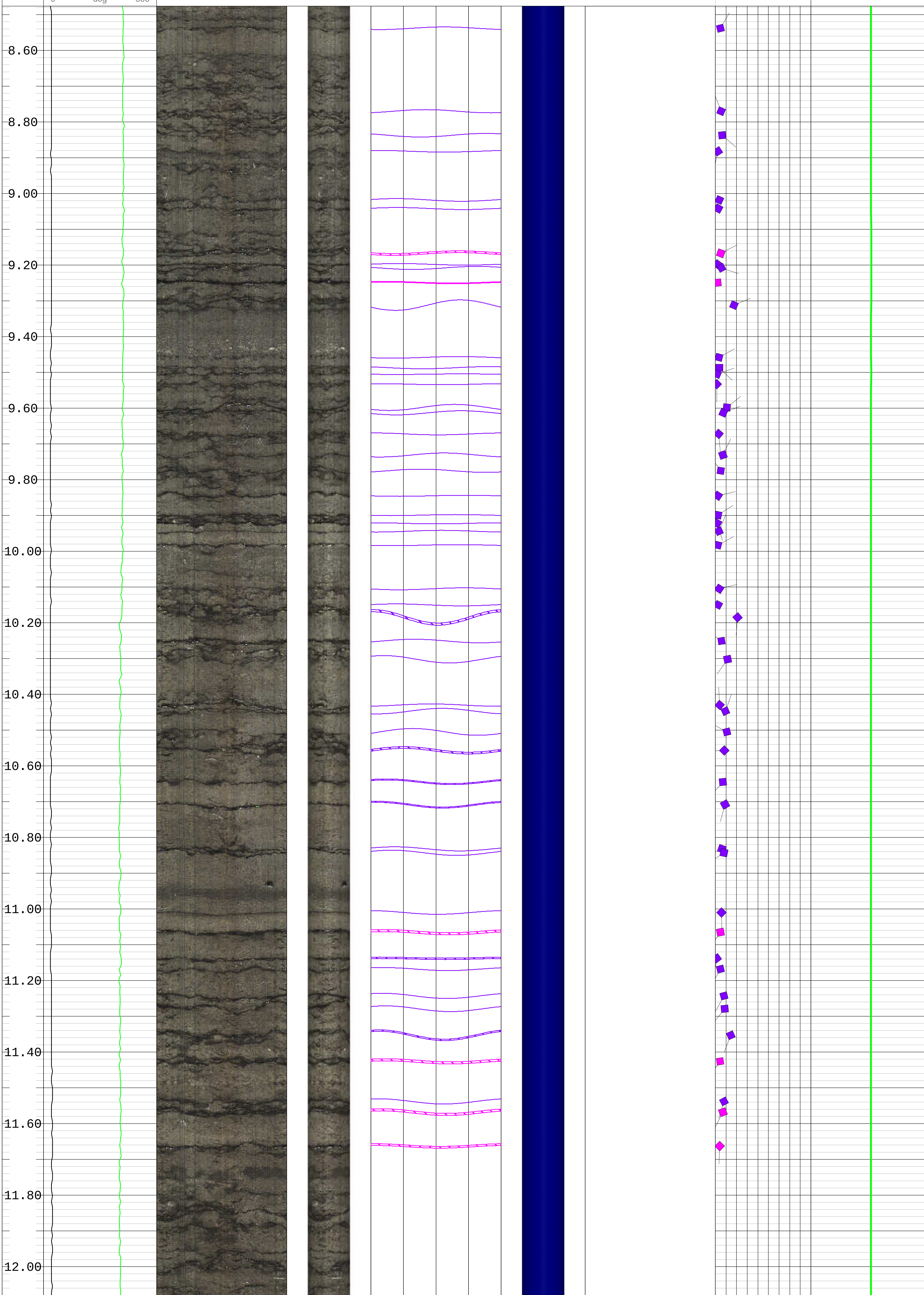
Water Level | Btm of Casing | Major Open Joint/Fracture | Partially Open Joint/Fracture | Minor Joint/Fracture | Lithology Contact

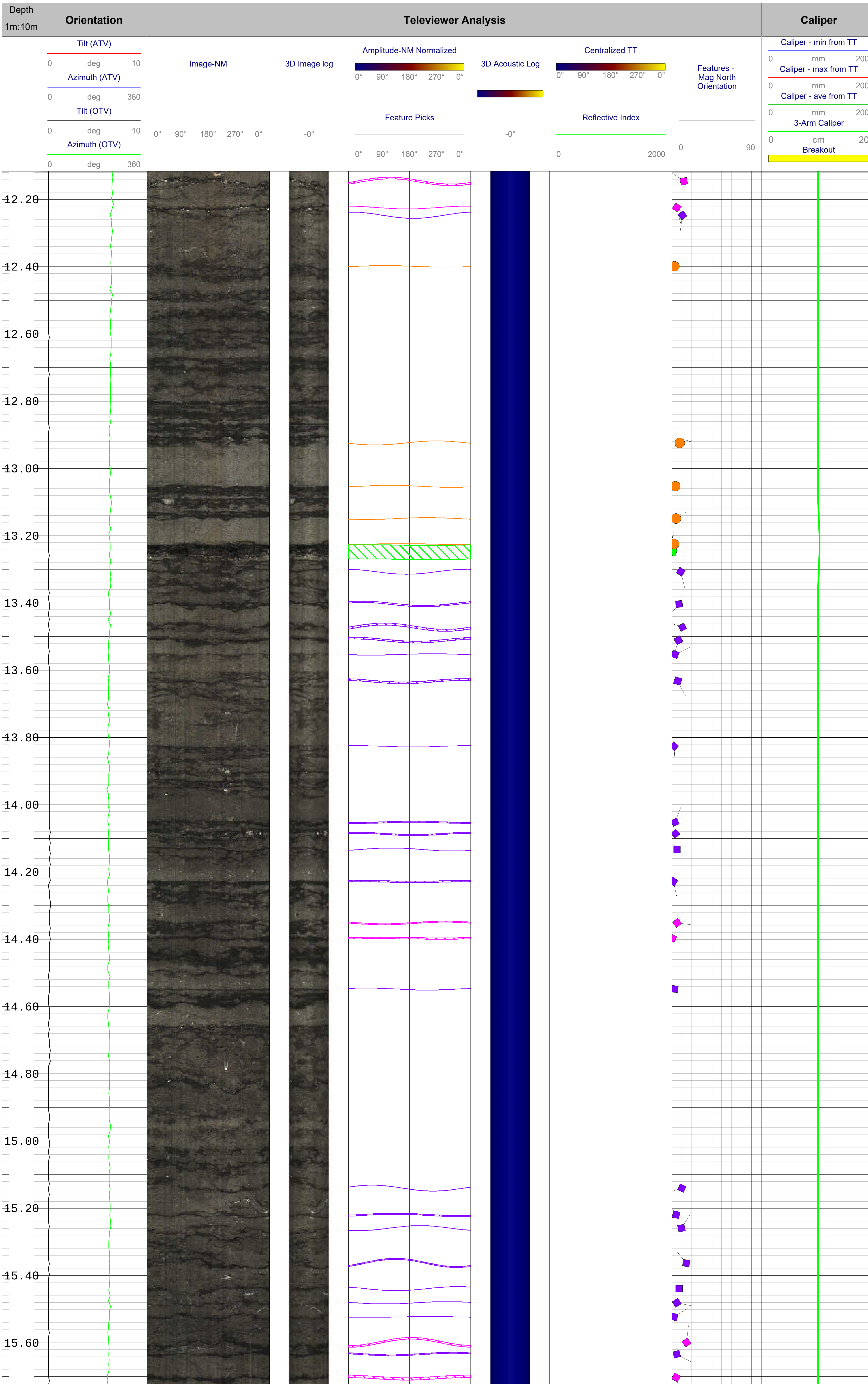
Depth 1m:10m	Orientation	Televiewer Analysis						Caliper
	Tilt (ATV) 0 deg 10; Azimuth (ATV) 0 deg 360; Tilt (OTV) 0 deg 10; Azimuth (OTV) 0 deg 360	Image-NM 0° 90° 180° 270° 0°	3D Image log -0°	Amplitude-NM Normalized 0° 90° 180° 270° 0°; Feature Picks 0° 90° 180° 270° 0°	3D Acoustic Log -0°	Centralized TT 0° 90° 180° 270° 0°; Reflective Index 0 2000	Features - Mag North Orientation 0 90	Caliper - min from TT 0 mm 200; Caliper - max from TT 0 mm 200; Caliper - ave from TT 0 mm 200; 3-Arm Caliper 0 cm 20; Breakout




Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
5.00
5.20
5.40
5.60
5.80
6.00
6.20
6.40
6.60
6.80
7.00
7.20
7.40
7.60
7.80
8.00
8.20
8.40

Depth 1m:10m	Orientation	Televiewer Analysis	Caliper
	Tilt (ATV) 0 deg 10; Azimuth (ATV) 0 deg 360; Tilt (OTV) 0 deg 10; Azimuth (OTV) 0 deg 360	Image-NM 0° 90° 180° 270° 0°; 3D Image log -0°; Amplitude-NM Normalized 0° 90° 180° 270° 0°; Feature Picks 0° 90° 180° 270° 0°; 3D Acoustic Log -0°; Centralized TT 0° 90° 180° 270° 0°; Reflective Index 0 2000; Features - Mag North Orientation 0 90	Caliper - min from TT 0 mm 200; Caliper - max from TT 0 mm 200; Caliper - ave from TT 0 mm 200; 3-Arm Caliper 0 cm 20; Breakout



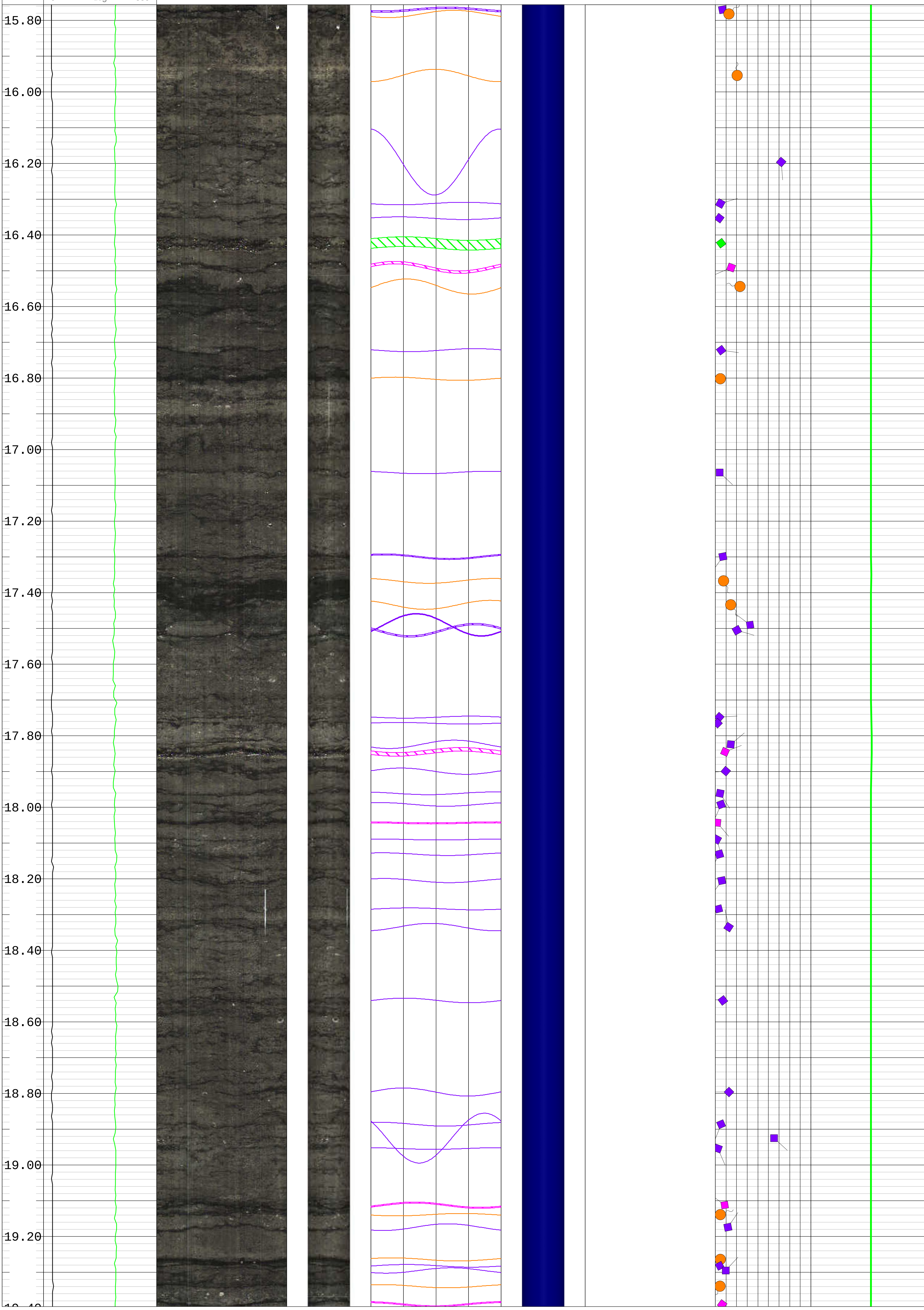

Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
12.20
12.40
12.60
12.80
13.00
13.20
13.40
13.60
13.80
14.00
14.20
14.40
14.60
14.80
15.00
15.20
15.40
15.60

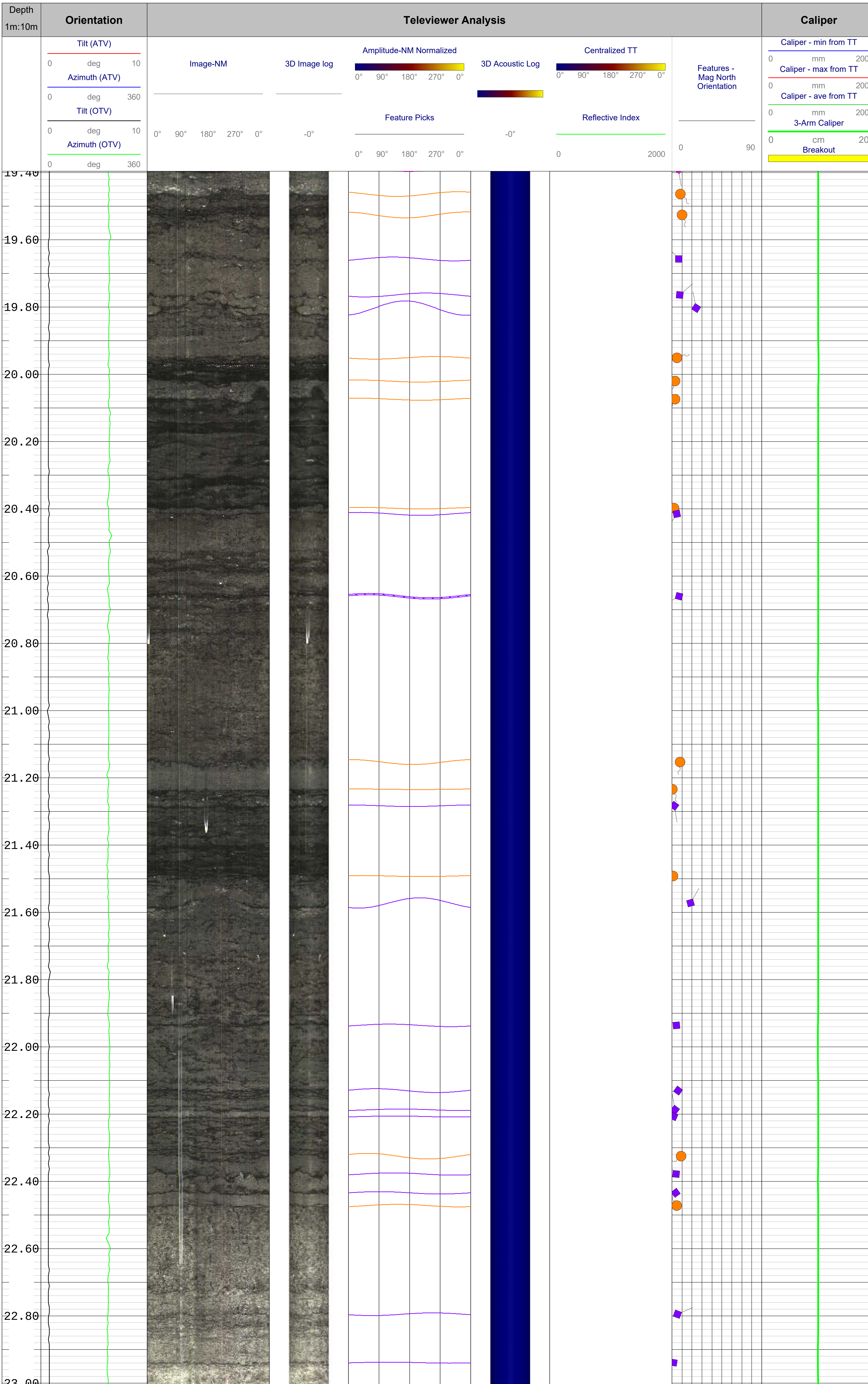
Depth 1m:10m	Orientation	Televiewer Analysis	Caliper

Orientation: Tilt (ATV) 0 deg 10; Azimuth (ATV) 0 deg 360; Tilt (OTV) 0 deg 10; Azimuth (OTV) 0 deg 360

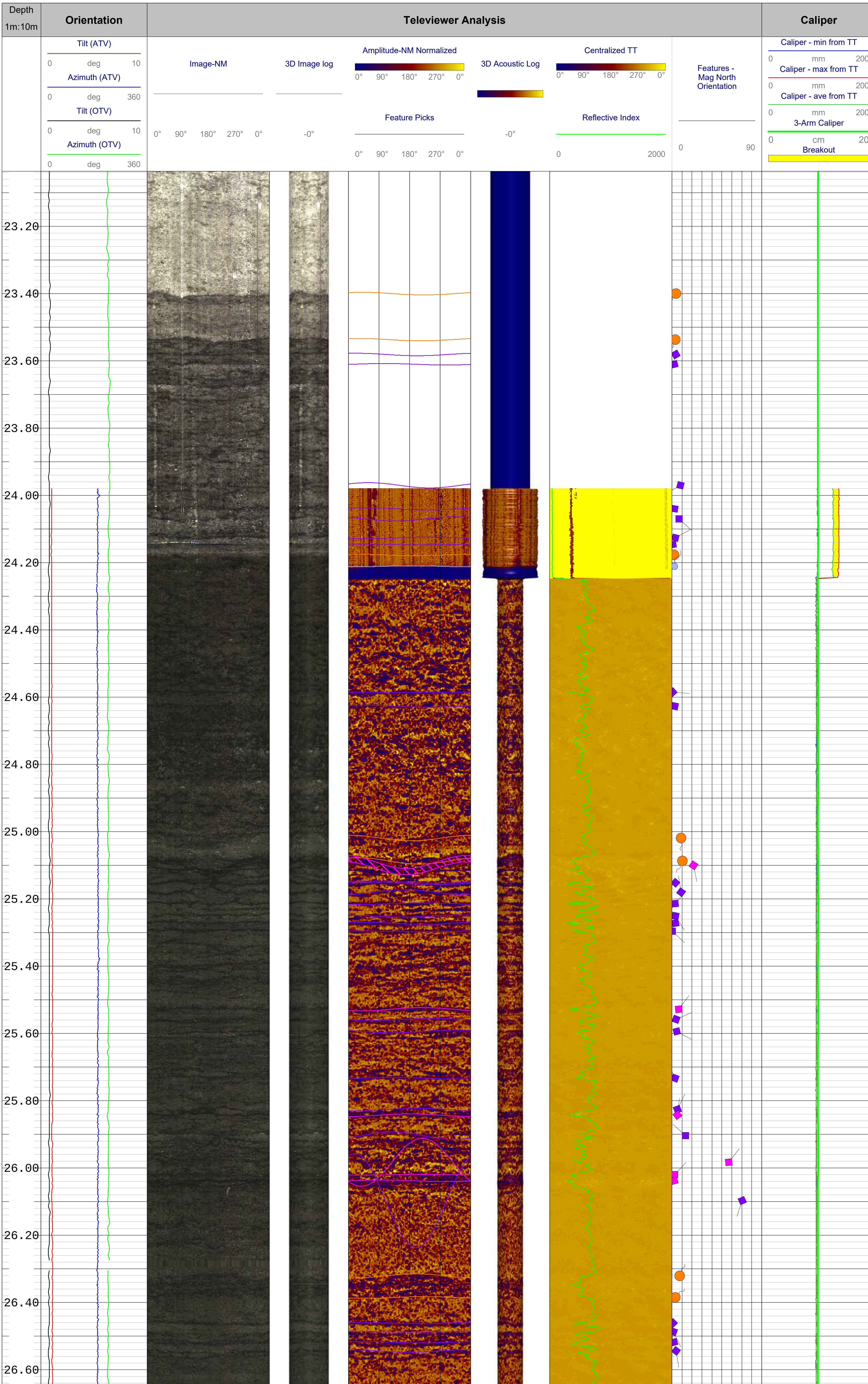
Televiewer Analysis: Image-NM 0° 90° 180° 270° 0°; 3D Image log -0°; Amplitude-NM Normalized 0° 90° 180° 270° 0°; Feature Picks 0° 90° 180° 270° 0°; 3D Acoustic Log -0°; Centralized TT 0° 90° 180° 270° 0°; Reflective Index 0 2000; Features - Mag North Orientation 0 90

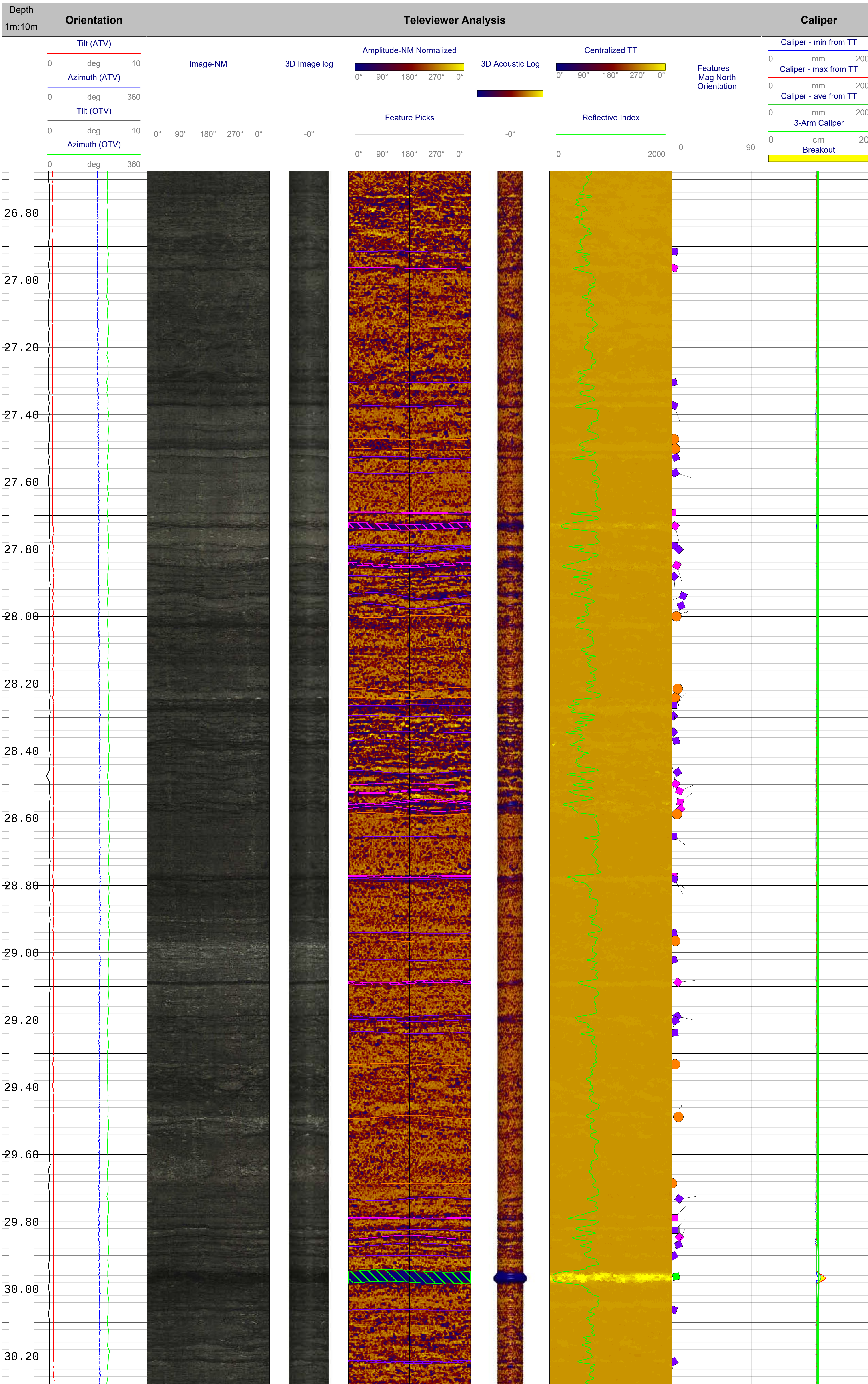
Caliper: Caliper - min from TT 0 mm 200; Caliper - max from TT 0 mm 200; Caliper - ave from TT 0 mm 200; 3-Arm Caliper 0 cm 20; Breakout

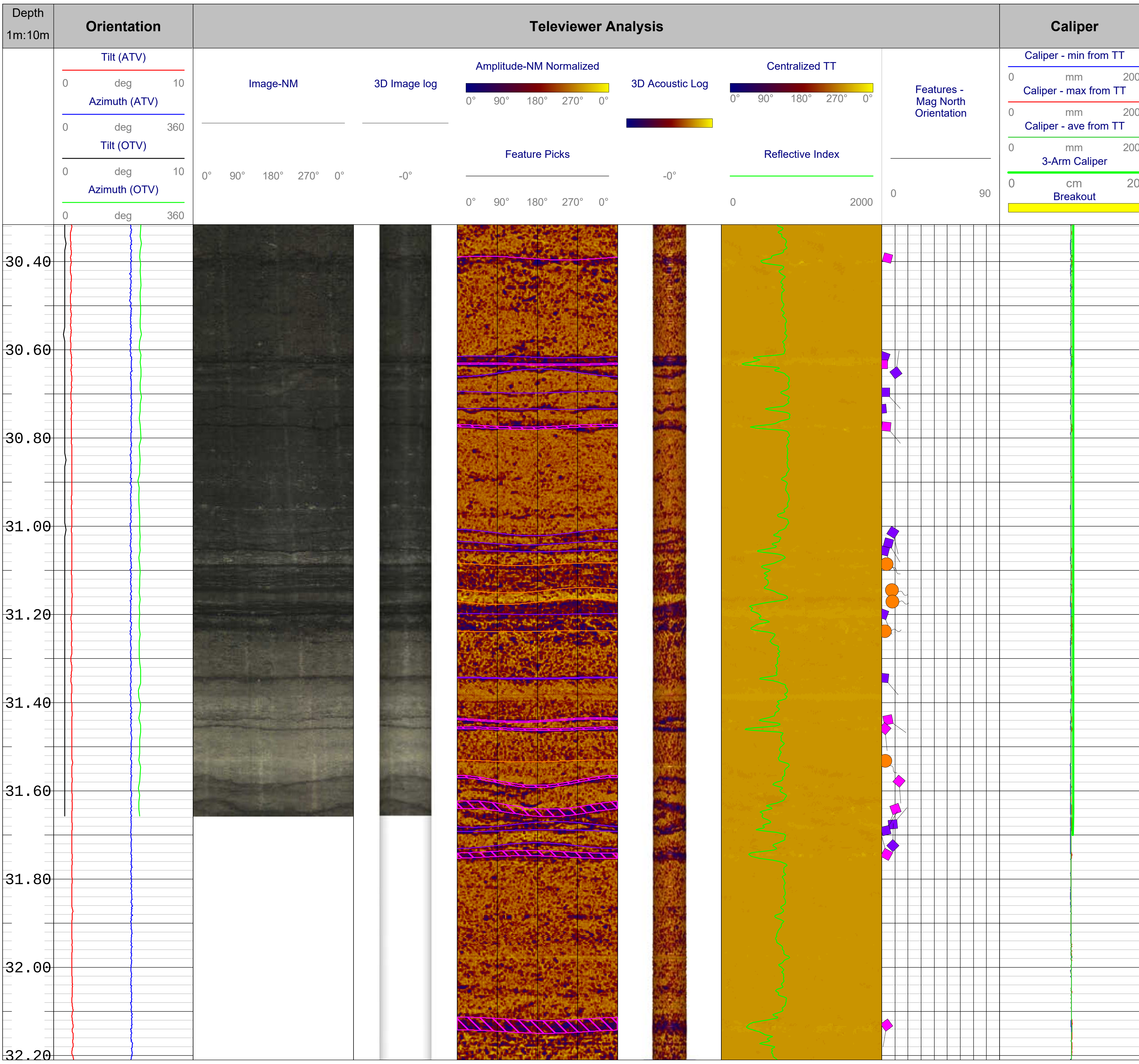




Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
19.40
19.60
19.80
20.00
20.20
20.40
20.60
20.80
21.00
21.20
21.40
21.60
21.80
22.00
22.20
22.40
22.60
22.80
23.00


Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
23.20
23.40
23.60
23.80
24.00
24.20
24.40
24.60
24.80
25.00
25.20
25.40
25.60
25.80
26.00
26.20
26.40
26.60


Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
26.80
27.00
27.20
27.40
27.60
27.80
28.00
28.20
28.40
28.60
28.80
29.00
29.20
29.40
29.60
29.80
30.00
30.20


Depth
1m:10m
Orientation
Televiewer Analysis
Caliper
Tilt (ATV)
0 deg 10
Azimuth (ATV)
0 deg 360
Tilt (OTV)
0 deg 10
Azimuth (OTV)
0 deg 360
Image-NM
0° 90° 180° 270° 0°
3D Image log
-0°
Amplitude-NM Normalized
0° 90° 180° 270° 0°
Feature Picks
0° 90° 180° 270° 0°
3D Acoustic Log
-0°
Centralized TT
0° 90° 180° 270° 0°
Reflective Index
0 2000
Features - Mag North Orientation
0 90
Caliper - min from TT
0 mm 200
Caliper - max from TT
0 mm 200
Caliper - ave from TT
0 mm 200
3-Arm Caliper
0 cm 20
Breakout
30.40
30.60
30.80
31.00
31.20
31.40
31.60
31.80
32.00
32.20

APPENDIX D

M194-1 Pumping Test Monitoring Network Summary

M194 Pumping Test Monitoring Well Network
February 14, 2017

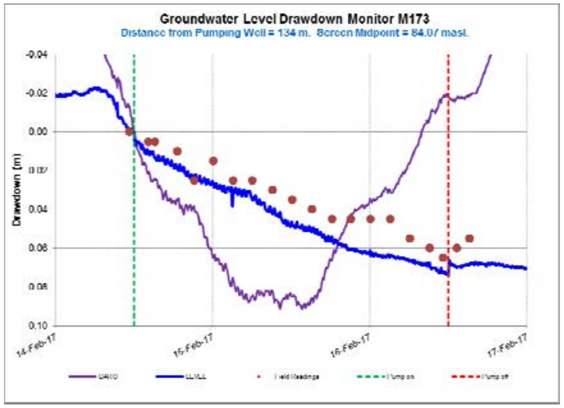
Monitor	Distance to Pumping Well (m)	Midpoint of Isolated Interval (masl)
M64-2	268	111.20
M125	460	95.65
M173	134	84.07
M174	393	88.58
M177	278	111.41
M178R-2	546	99.77
M179	891	100.58
M185-1	653	86.09
M185-2	645	101.68
M187	74	89.03
M188-1	439	85.31
M189	211	105.11
M190	795	101.74
M195	185	102.69**

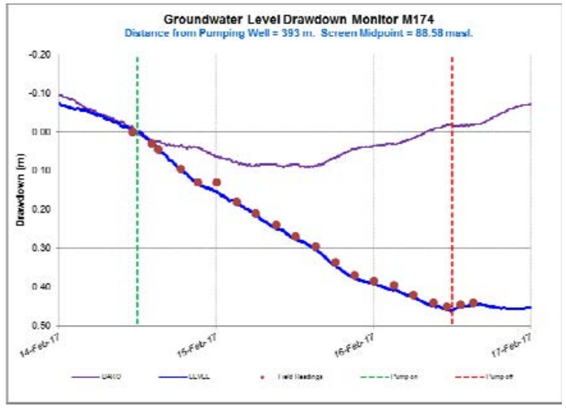
* Refers to midpoint between single packer and bottom of hole
** Refers to midpoint of borehole (test conducted on open hole)

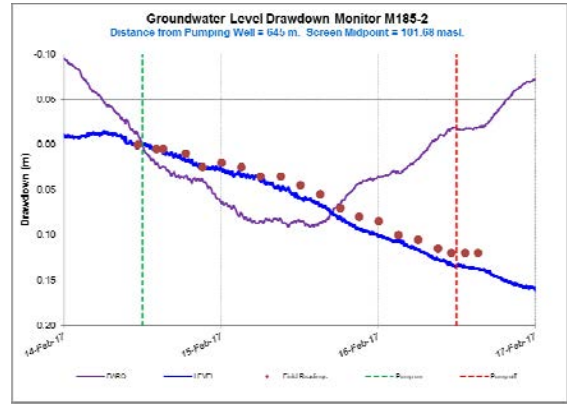
APPENDIX E

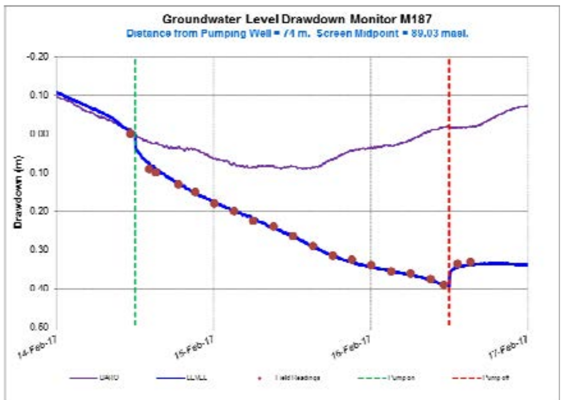
M194-1 Pumping Test Results

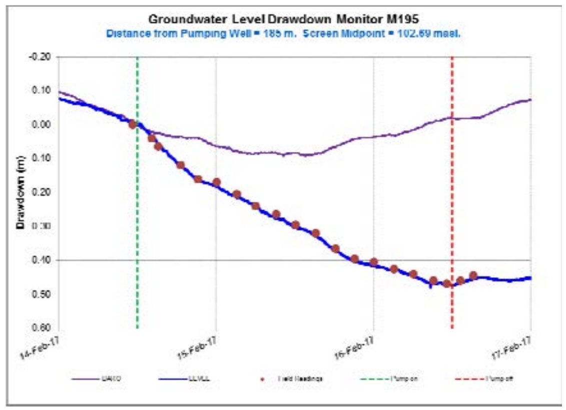
Responsive to pumping



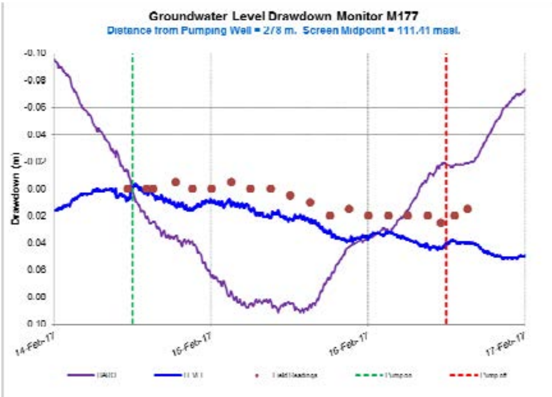


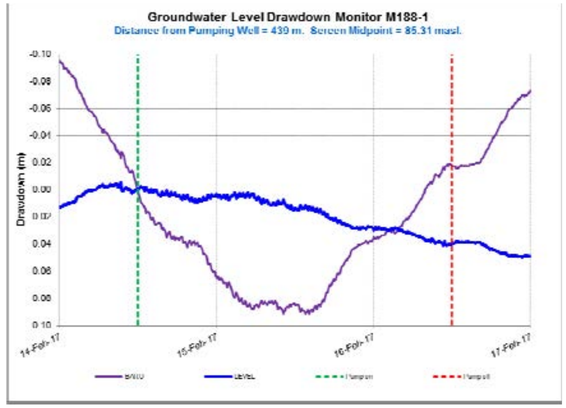


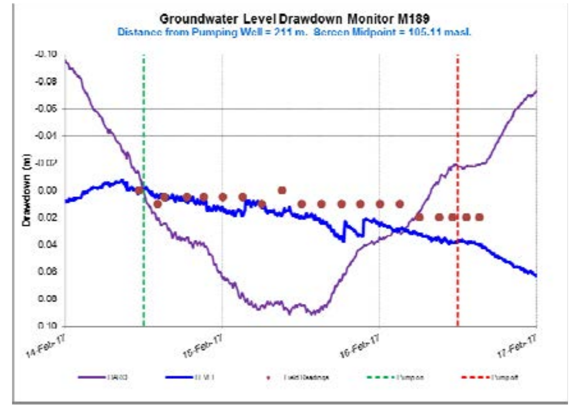




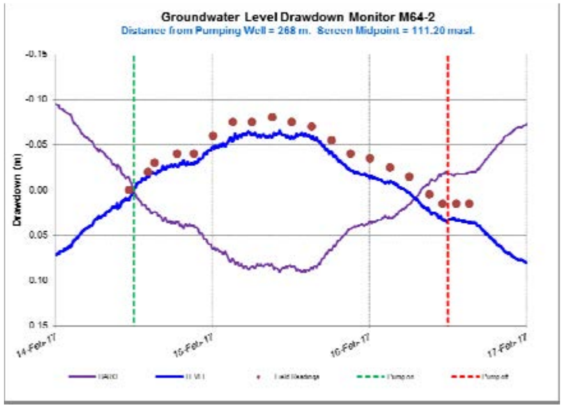
Possible response to pumping

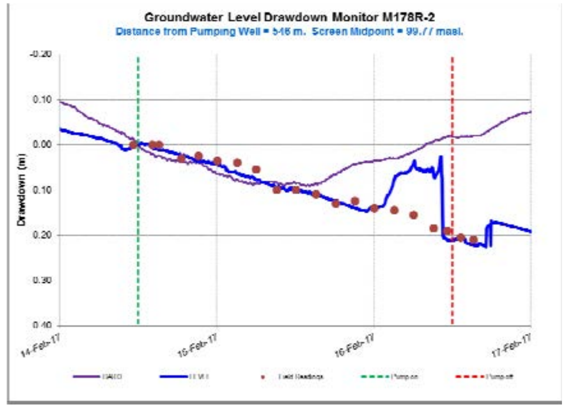


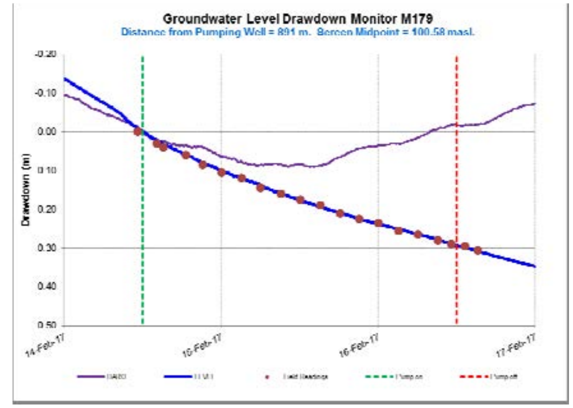


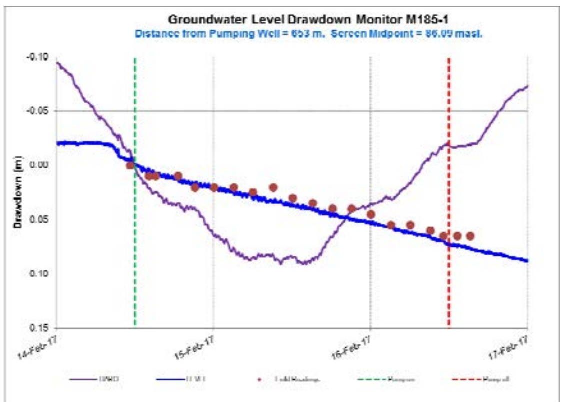


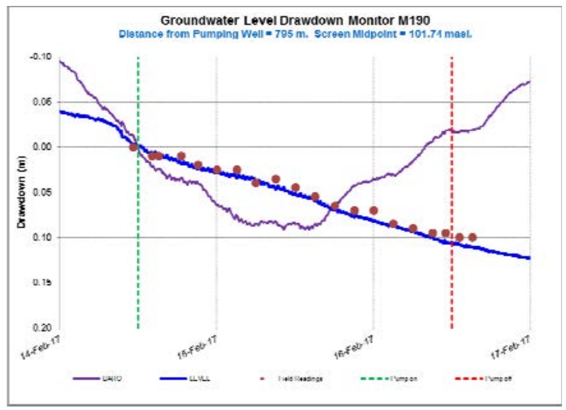
No response to pumping

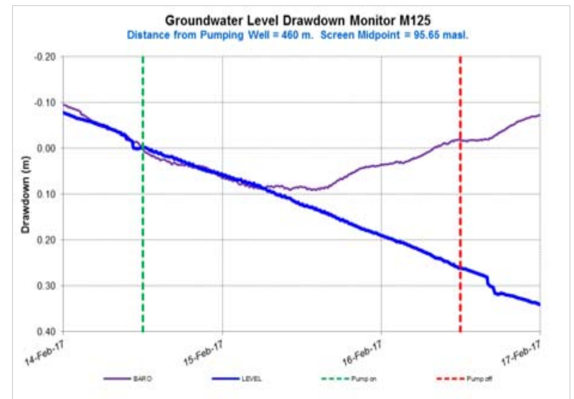












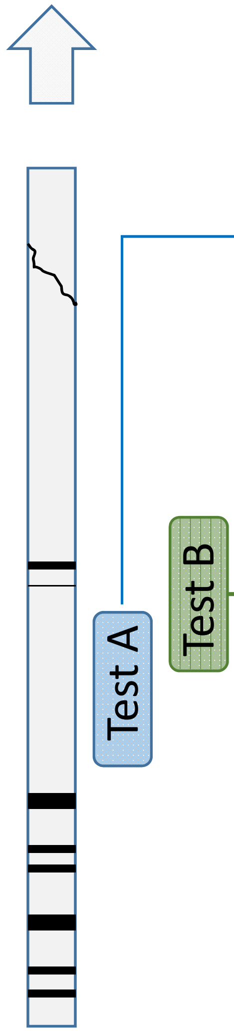
APPENDIX F

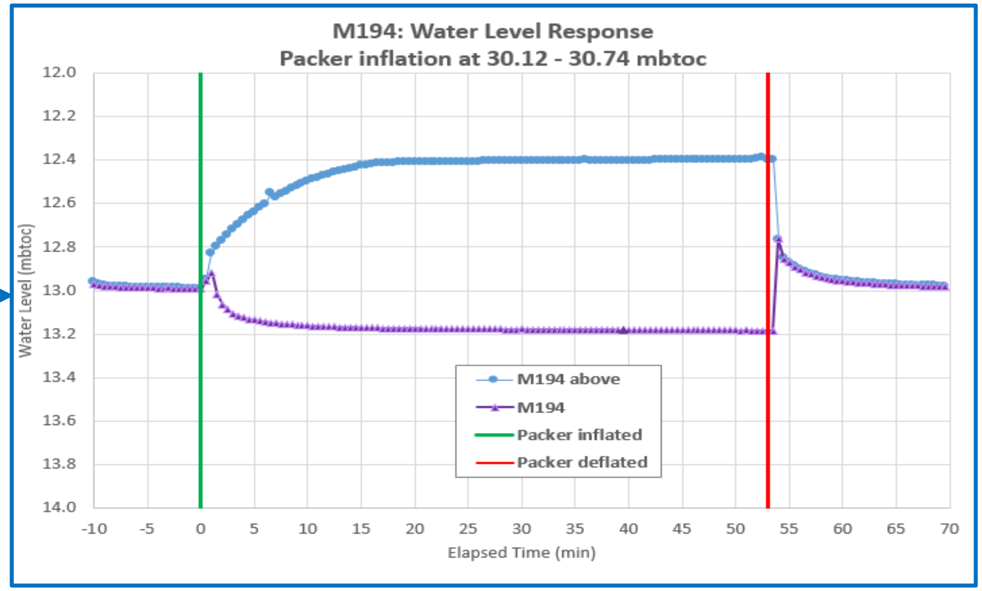
M194-1 Complementary Hydraulic Testing Results

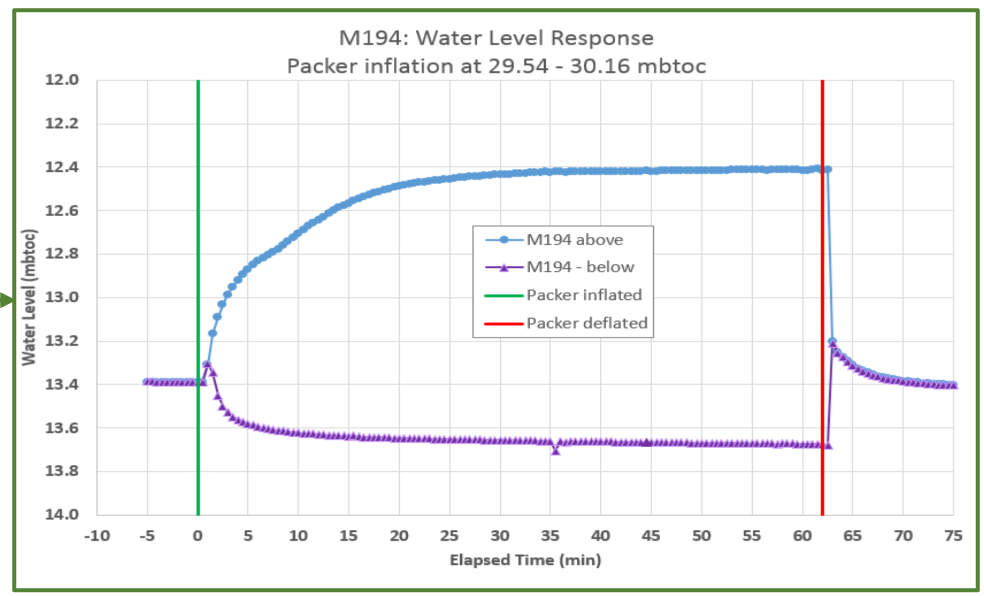
M194 well testing – Non-Pumping

1

mbgs	mbtoc
24.40	25.14
29.84	29.1
31.74	31.00
32.34	31.60
33.54	32.80
34.14	33.40

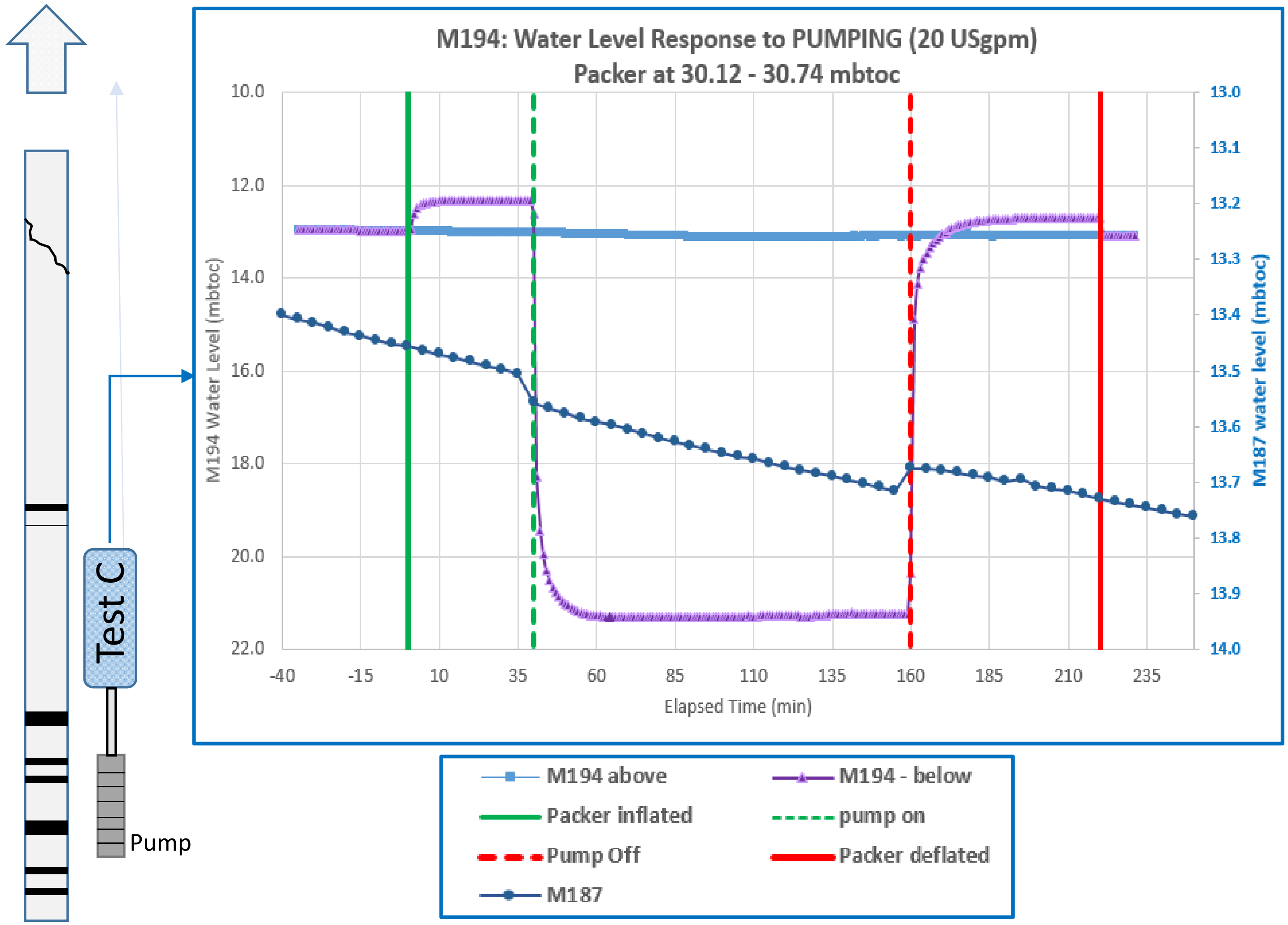






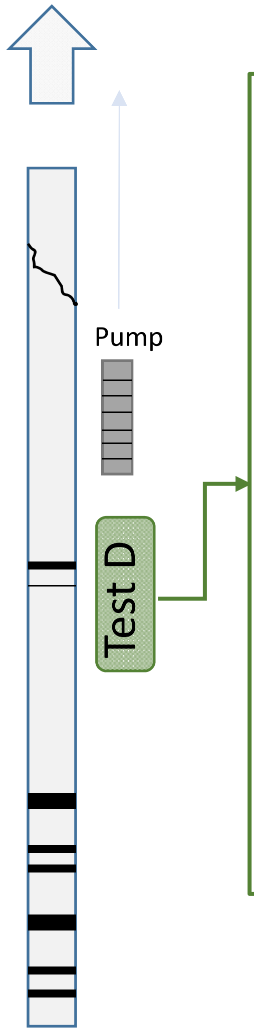
2 # M194 well testing – Pumping Below Packer at 20 USgpm

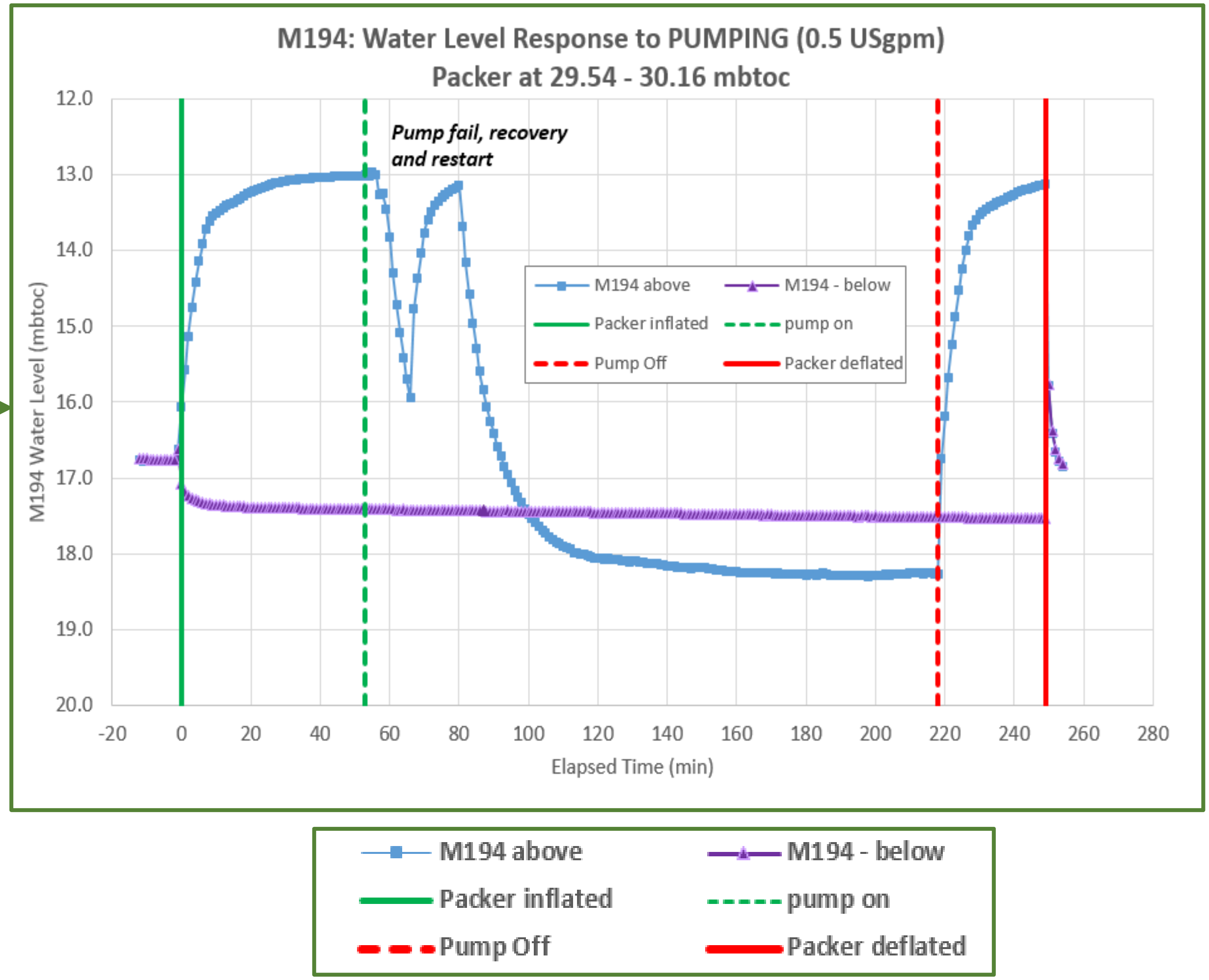
mbgs	mbtoc
24.40	25.14
29.84	29.1
31.74	31.00
32.34	31.60
33.54	32.80
34.14	33.40



3 M194 well testing – Pumping Above Packer at 0.5 USgpm

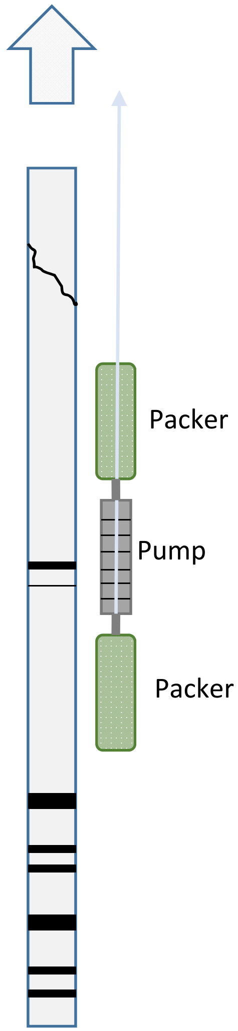
mbgs	mbtoc
24.40	25.14
29.84	29.1
31.74	31.00
32.34	31.60
33.54	32.80
34.14	33.40

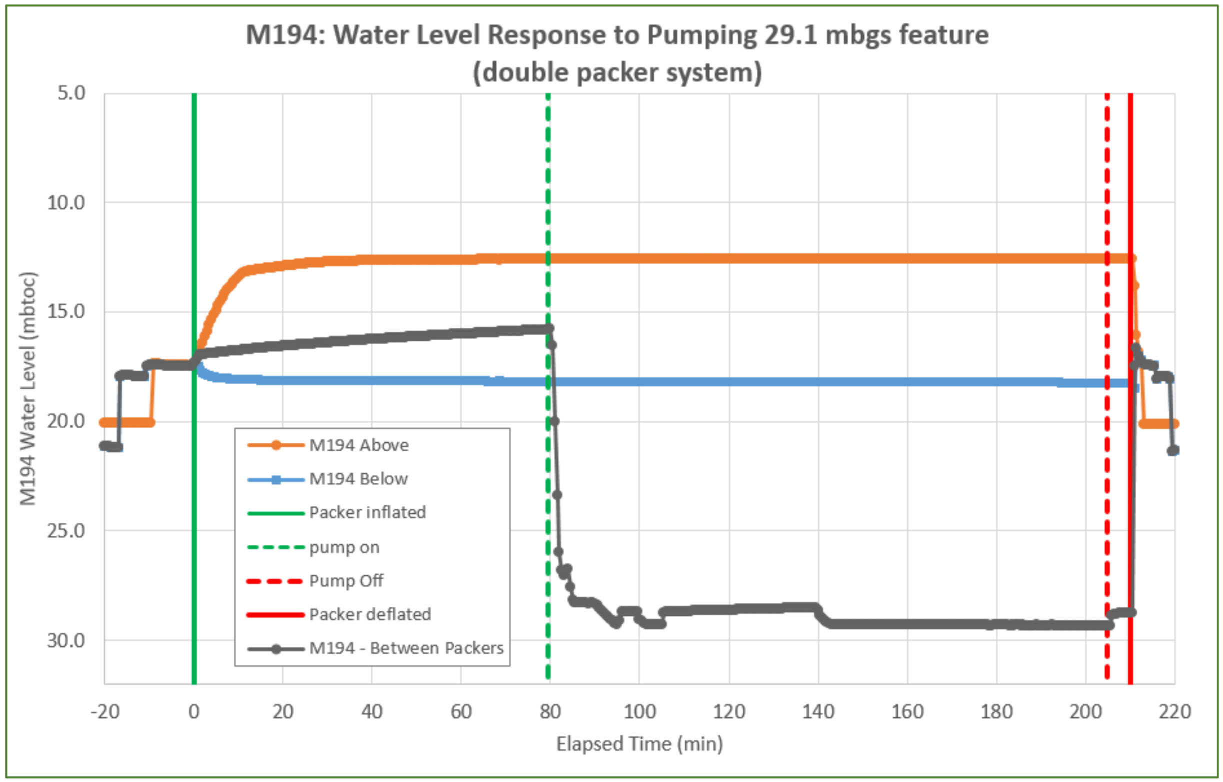




M194 well testing – Pumping Packer Zone at 29.1 mbgs

mbgs	mbtoc
24.40	25.14
29.84	29.1
31.74	31.00
32.34	31.60
33.54	32.80
34.14	33.40





APPENDIX G

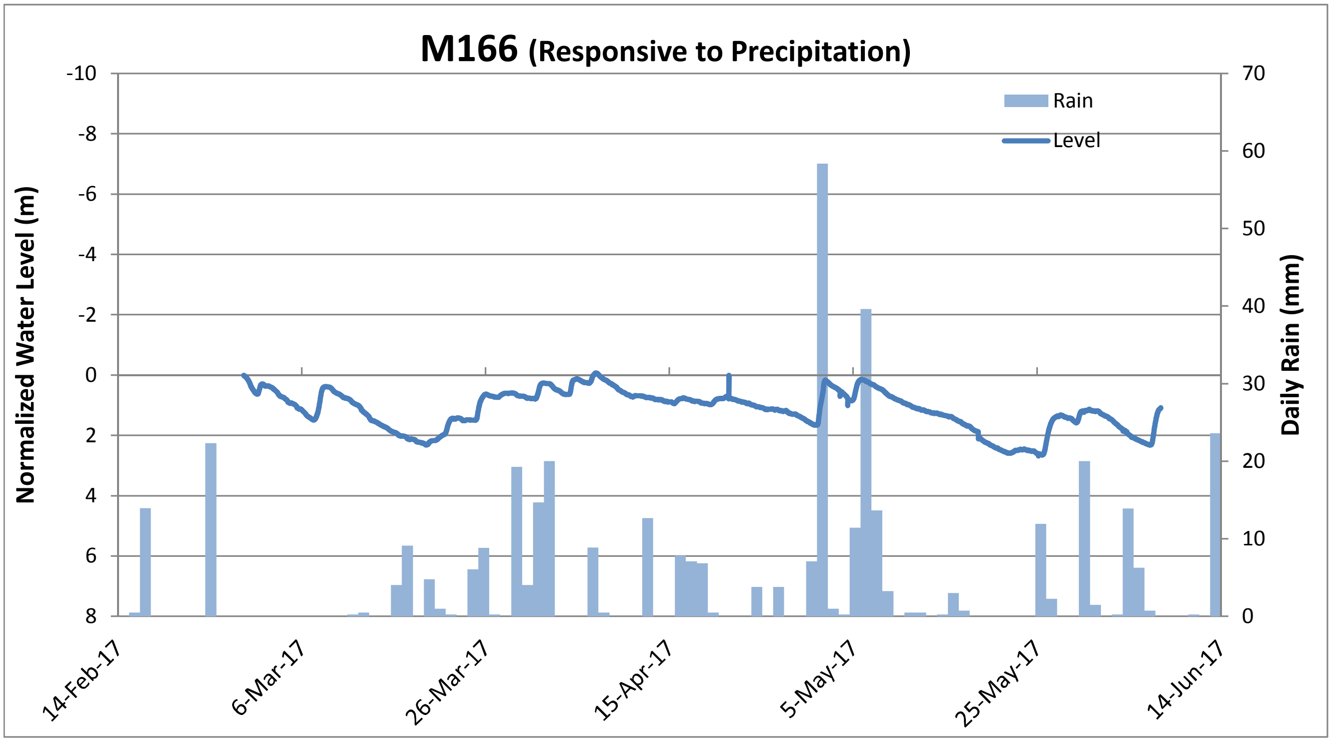
Groundwater Elevations – April 28, 2017

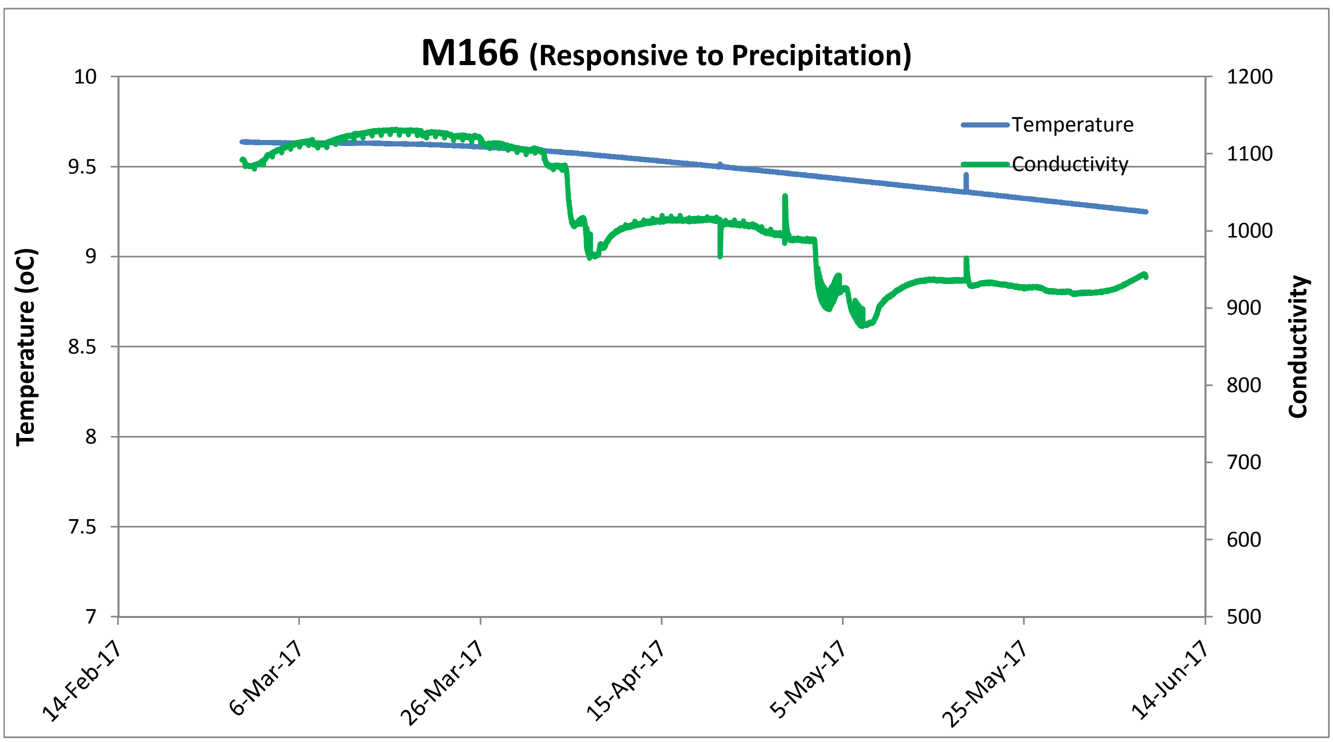
Appendix G: Groundwater Elevations - April 28, 2017

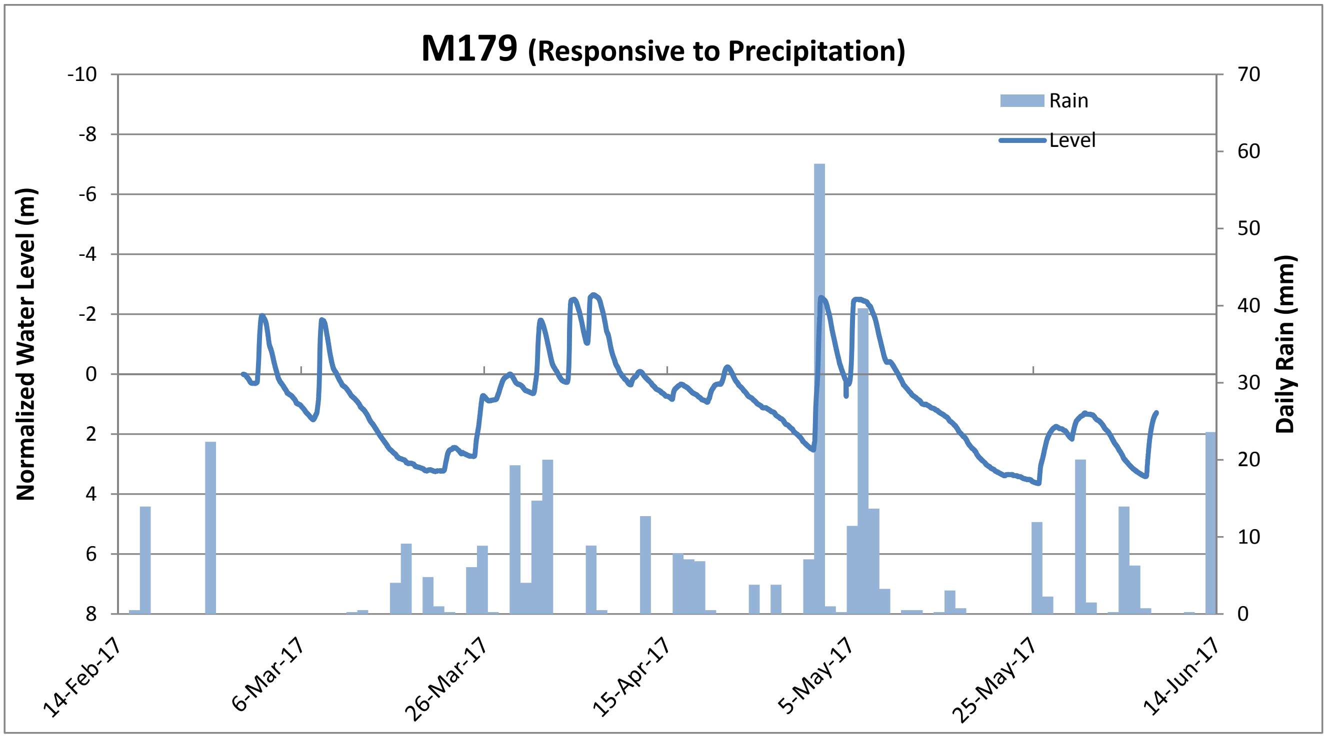
Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)	Monitoring Well	Water Level (masl)
Shallow Groundwater Flow Zone							
M12	125.62	M54-4	124.43	M83	123.25	M98	130.23
M14	127.12	M58-4	125.08	M84	121.91	M99-2	130.52
M15	125.46	M60-4	124.34	M85	120.52	M100	125.48
M18	127.42	M65-2	123.45	M86	122.74	M101	124.08
M19	Damaged	M66-2	123.21	M87-2	124.57	M102	124.19
M23	127.41	M67-2	122.78	M88-2	128.33	M103	123.93
M27	126.38	M68-4	124.25	M89-2	129.82	M104	123.33
M35	124.26	M70-3	127.33	M94-2	123.57	M114-2	123.92
M41	125.68	M77	126.59	M96	129.15	M115-2	124.74
M47-3	124.75	M80-2	123.72	M97	126.54	OW37-s	122.15
M53-4	125.39	M81	124.64				
Intermediate Bedrock Groundwater Flow Zone							
M3A-3	125.06	M71	124.43	M113-1	123.39	M178R-4	116.69
M9-2	124.28	M72	123.22	M114-1	123.13	M179	111.60
M9-3	124.58	M73	123.28	M116	123.13	M180	112.15
M10-1	123.26	M74	123.86	M121	122.85	M181-1	96.26
M46-2	122.76	M80-1	123.49	M122	122.37	M181-2	105.54
M49-1	123.56	M82-1	122.86	M123	122.05	M182	99.57
M50-3	124.33	M82-2	122.98	M125	123.11	M185-1	116.53
M52-2	123.50	M91-1	123.42	M166	122.06	M185-2	116.37
M53-2	123.03	M95-1	123.32	M167	>122.18	M186	115.89
M56-2	123.42	M105	124.31	M168	122.08	M187	96.27
M58-3	123.46	M106	123.36	M170	124.16	M188	115.63
M59-2	123.51	M107	124.21	M173	101.02	M189	104.95
M59-3	123.46	M108	122.18	M174	96.30	M190	116.16
M59-4	123.47	M109-1	124.28	M176	110.70	M191	98.40
M60-1	123.72	M109-2	124.38	M177	115.33	M192	122.09
M63-2	121.31	M110-1	124.29	M178R-1	116.92	M193	122.53
M64-2	118.95	M111-1	123.39	M178R-2	>120.29	OW1	122.71
M70-2	123.16	M112-1	123.38	M178R-3	>120.19		

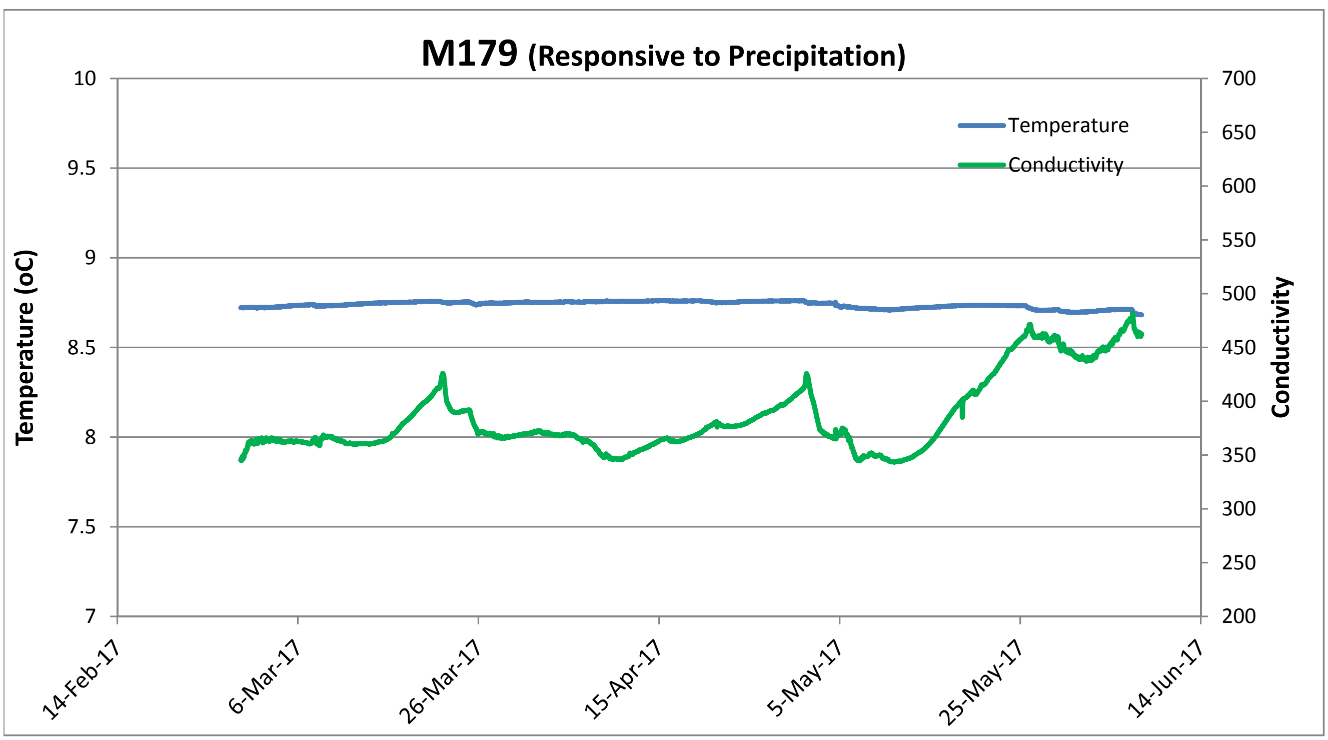
APPENDIX H

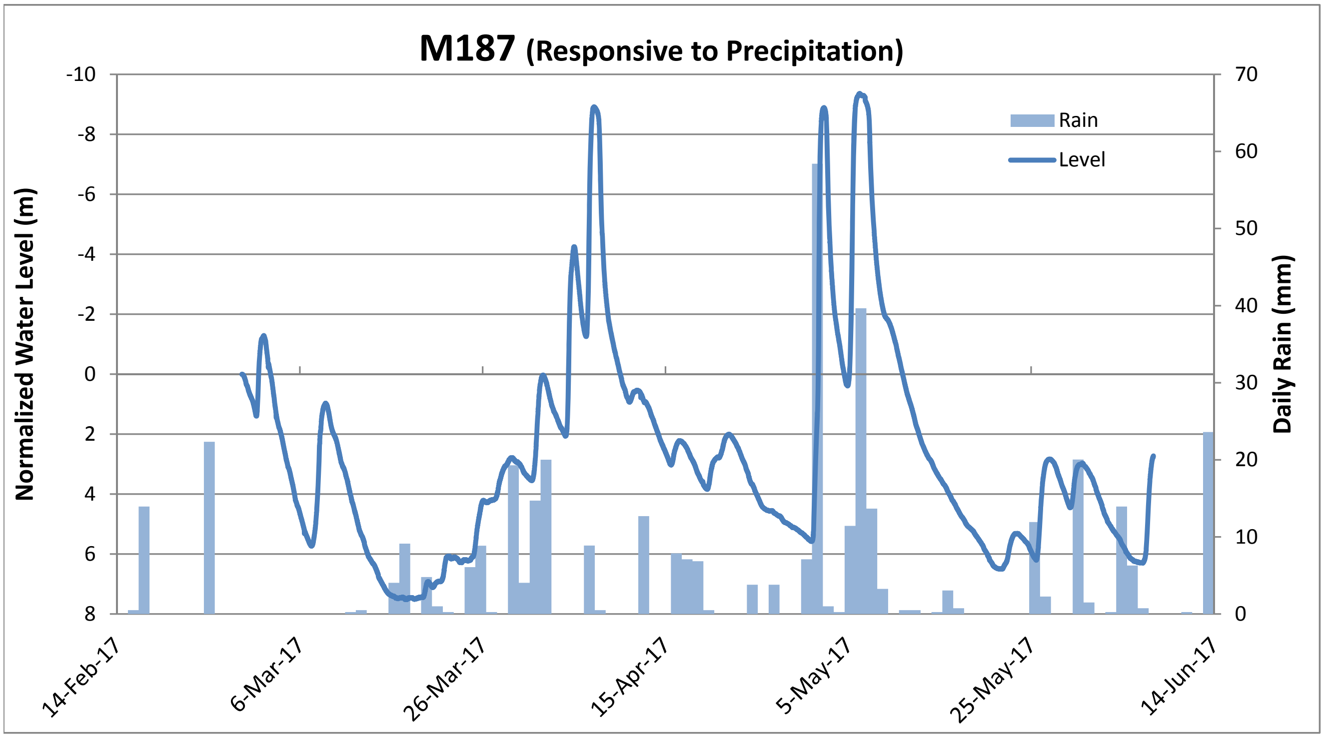
Initial Results from Multi-Parameter Data Loggers

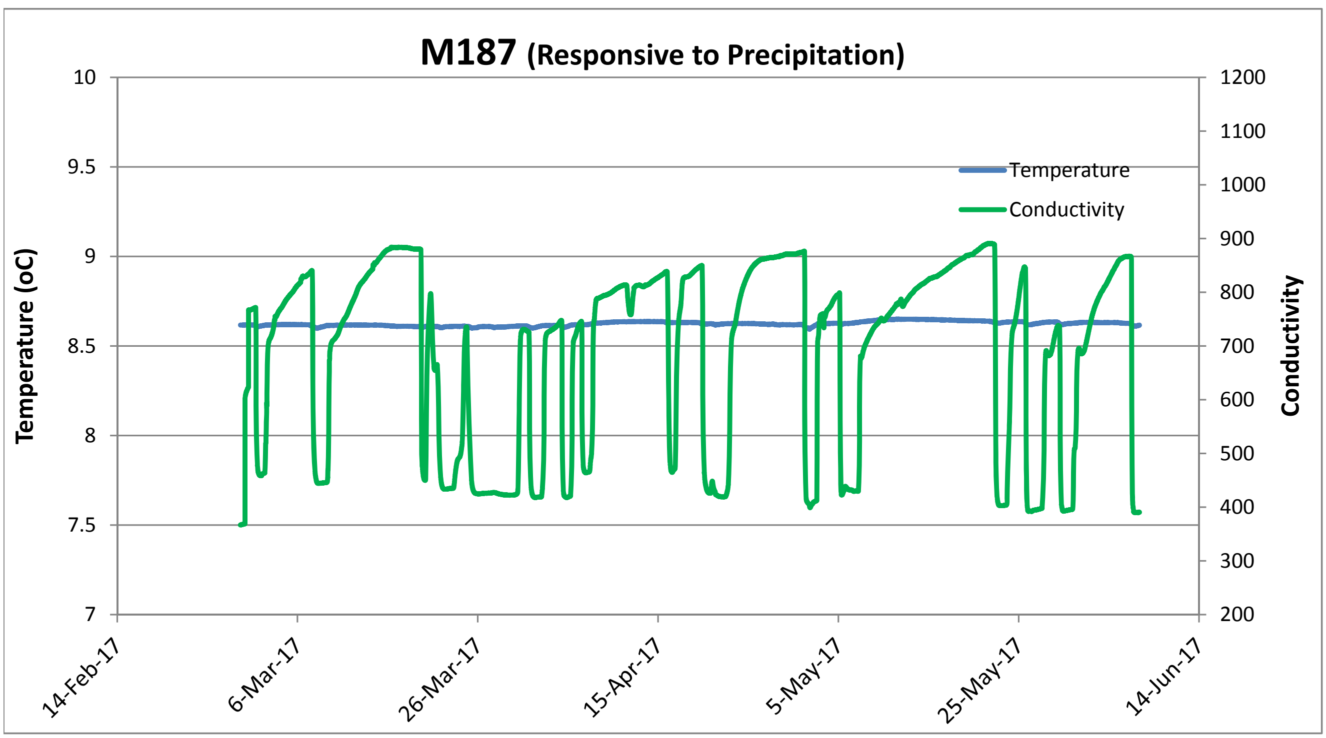

M166 (Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

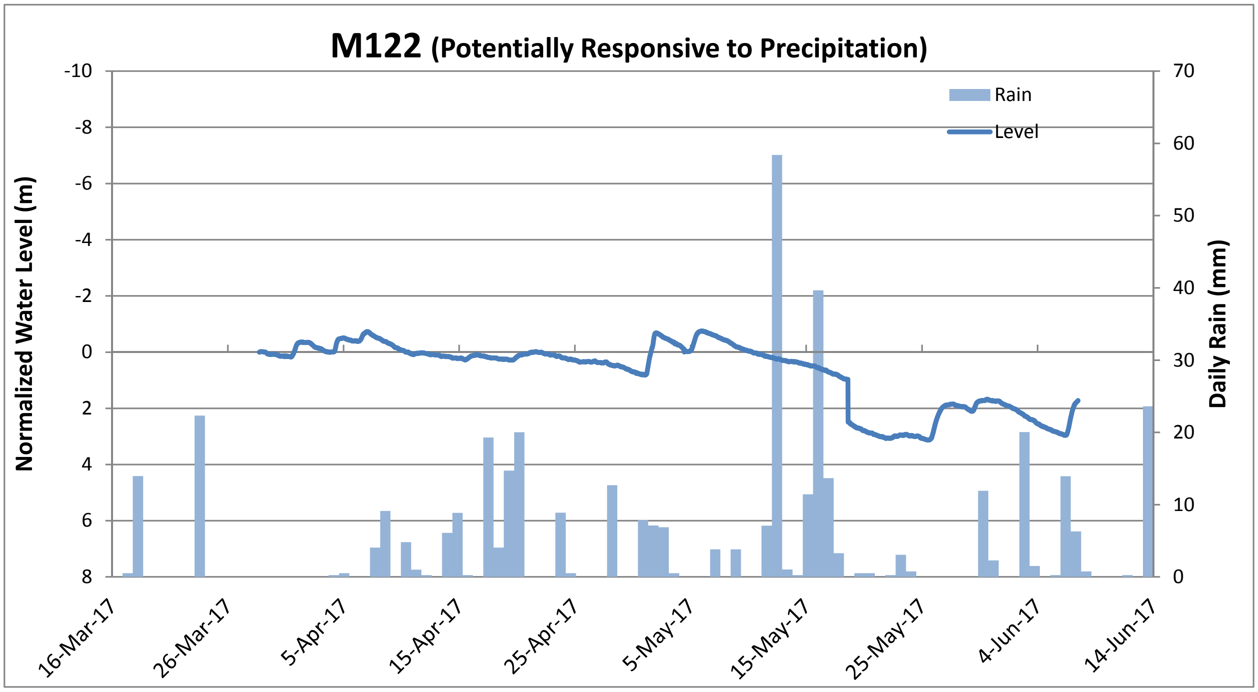

M166 (Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
10
9.5
9
8.5
8
7.5
7
1200
1100
1000
900
800
700
600
500
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

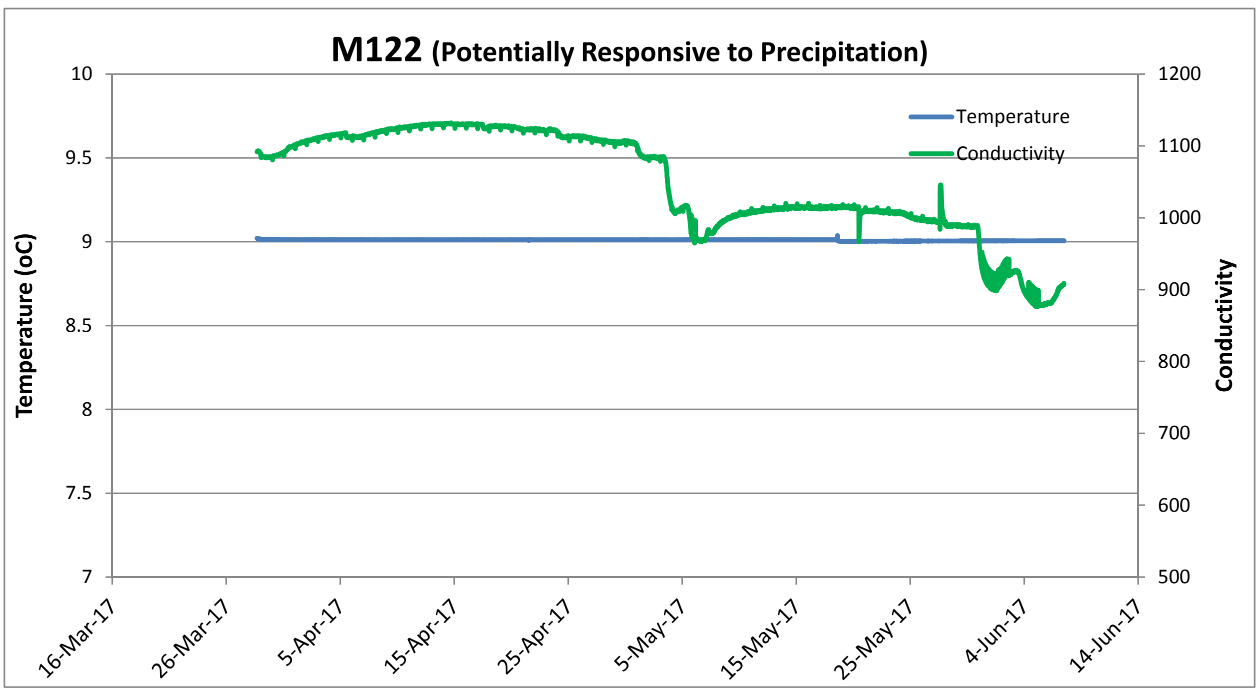

M179 (Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

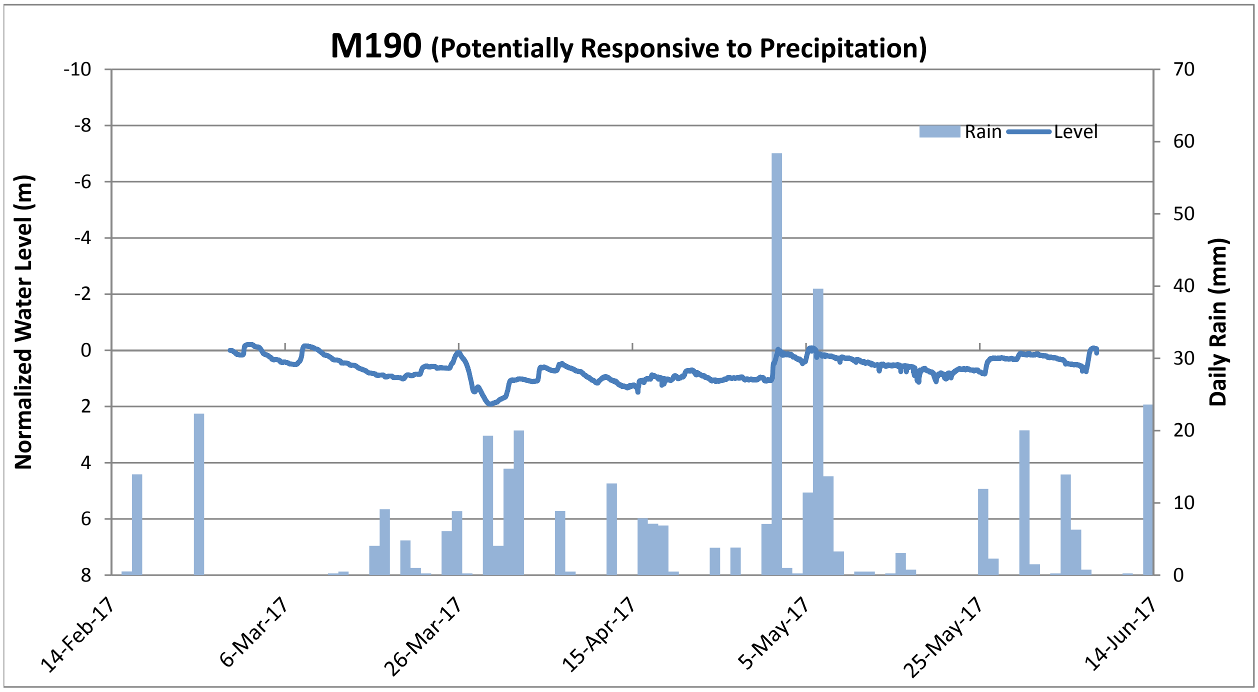

M179 (Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
10
9.5
9
8.5
8
7.5
7
700
650
600
550
500
450
400
350
300
250
200
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

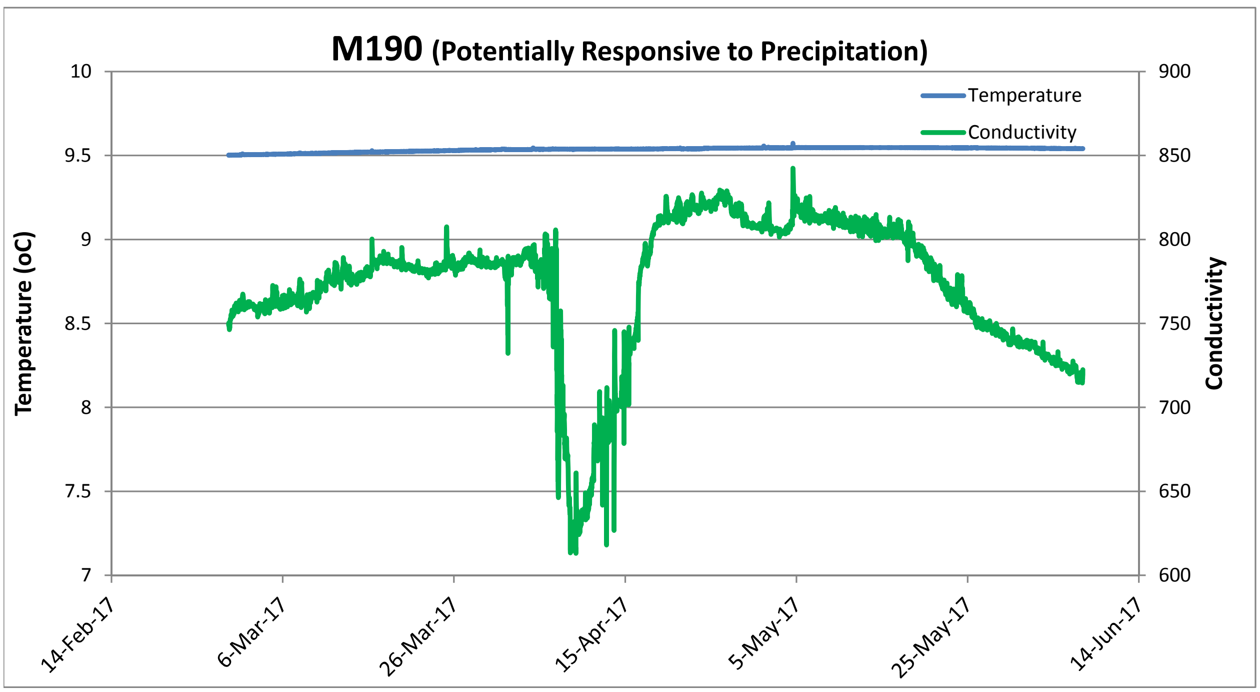

M187 (Responsive to Precipitation)
Normalized Water Level (m)
Daily Rain (mm)
Rain
Level
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

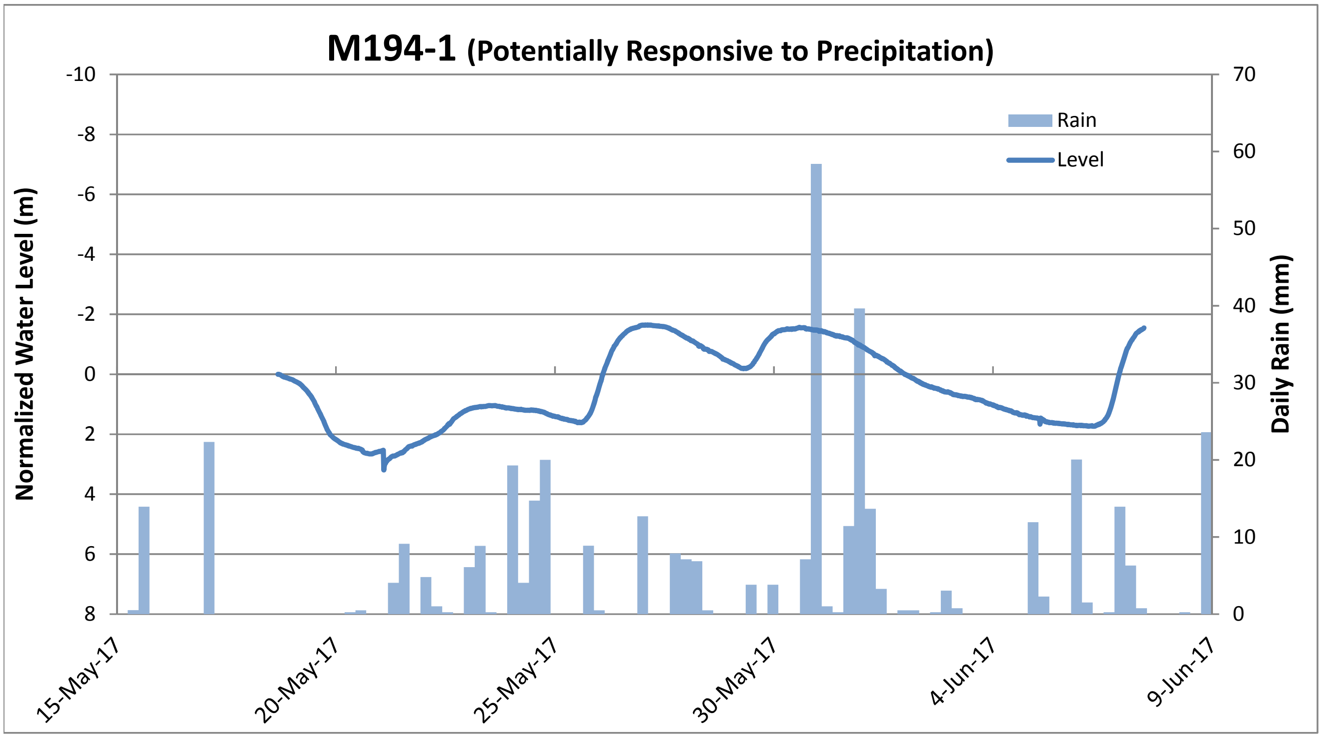

M187 (Responsive to Precipitation)
Temperature (oC)
Conductivity
Temperature
Conductivity
10
9.5
9
8.5
8
7.5
7
1200
1100
1000
900
800
700
600
500
400
300
200
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

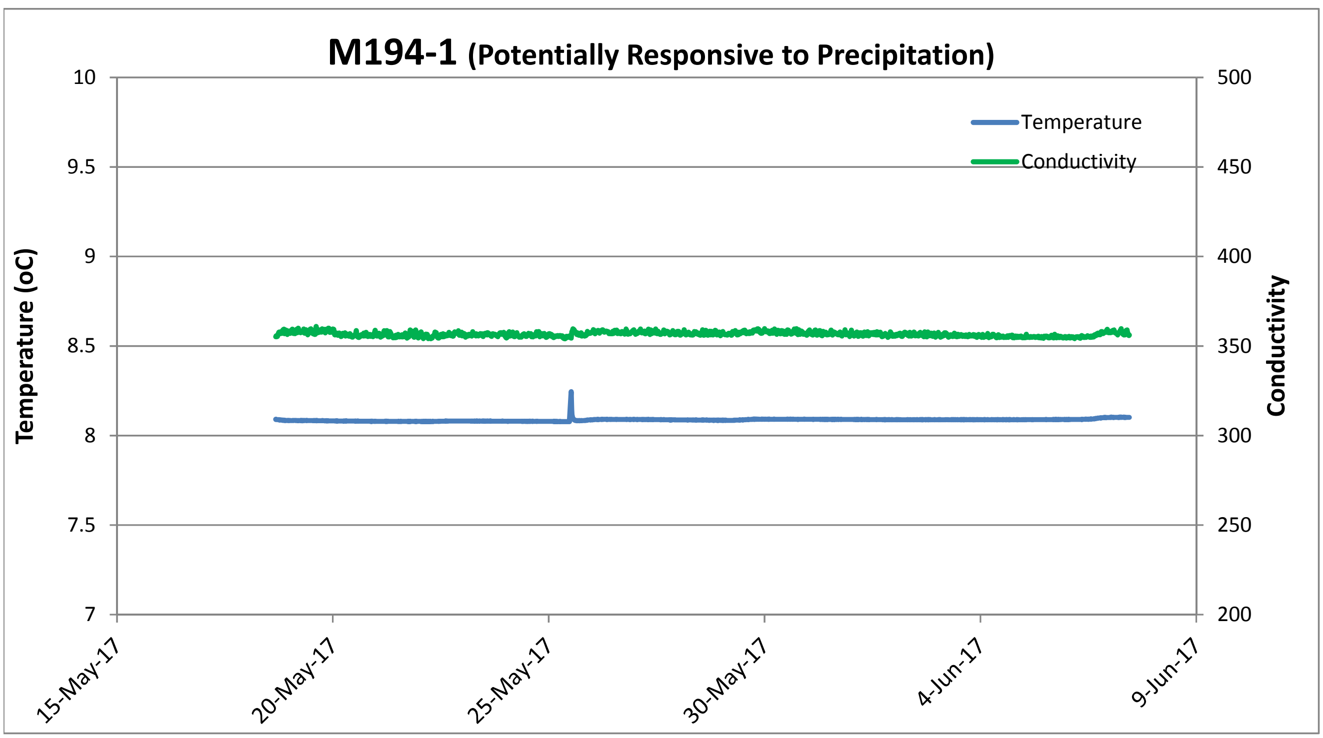

M122 (Potentially Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
16-Mar-17
26-Mar-17
5-Apr-17
15-Apr-17
25-Apr-17
5-May-17
15-May-17
25-May-17
4-Jun-17
14-Jun-17

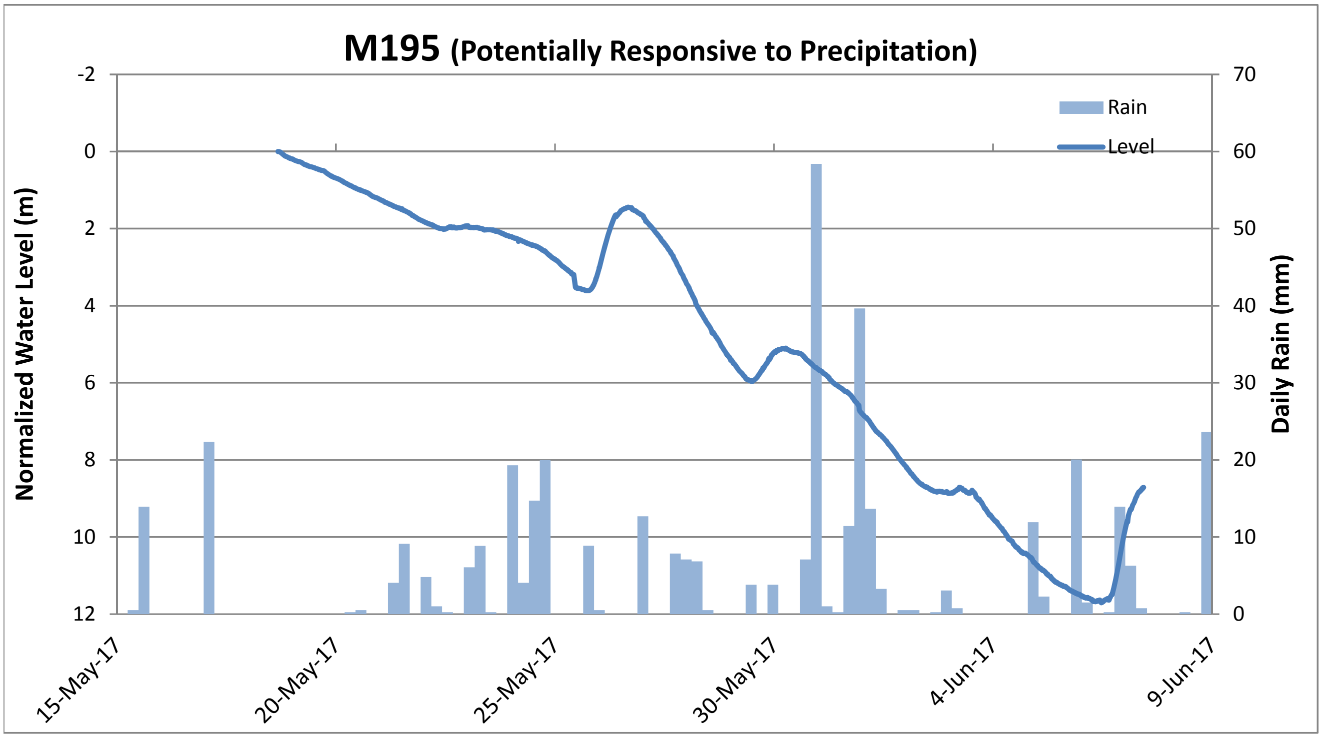

M122 (Potentially Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
10
9.5
9
8.5
8
7.5
7
1200
1100
1000
900
800
700
600
500
16-Mar-17
26-Mar-17
5-Apr-17
15-Apr-17
25-Apr-17
5-May-17
15-May-17
25-May-17
4-Jun-17
14-Jun-17


M190 (Potentially Responsive to Precipitation)
Normalized Water Level (m)
Daily Rain (mm)
Rain
Level
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

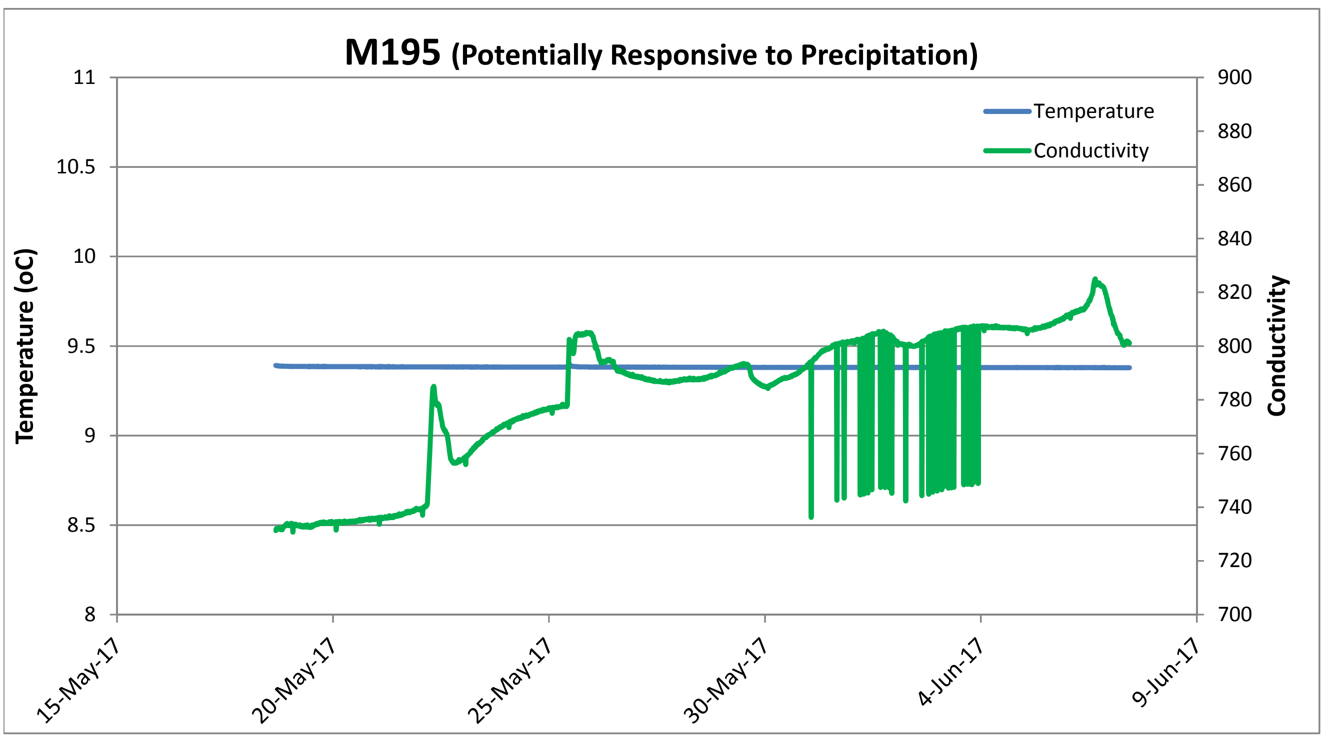

M190 (Potentially Responsive to Precipitation)
Temperature (oC)
Conductivity
Temperature
Conductivity
10
9.5
9
8.5
8
7.5
7
900
850
800
750
700
650
600
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17


M194-1 (Potentially Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17

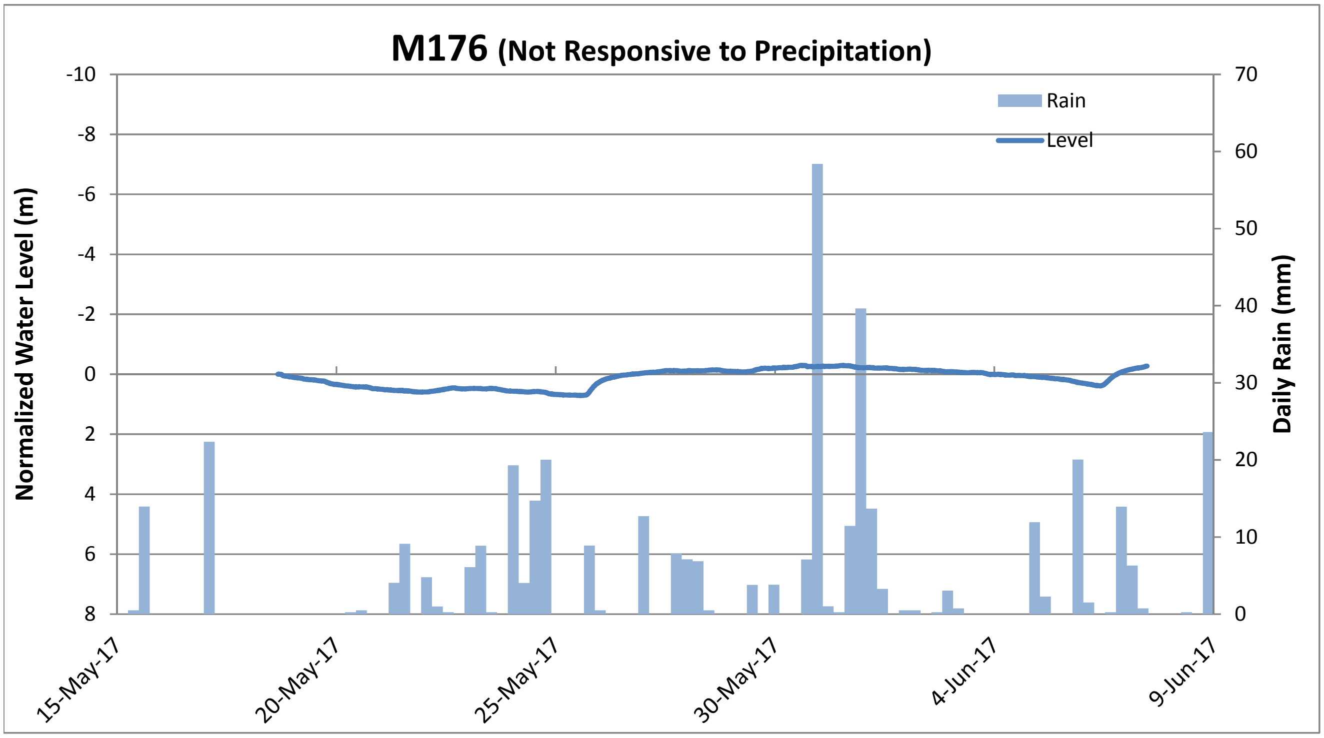

M194-1 (Potentially Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
10
9.5
9
8.5
8
7.5
7
500
450
400
350
300
250
200
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17



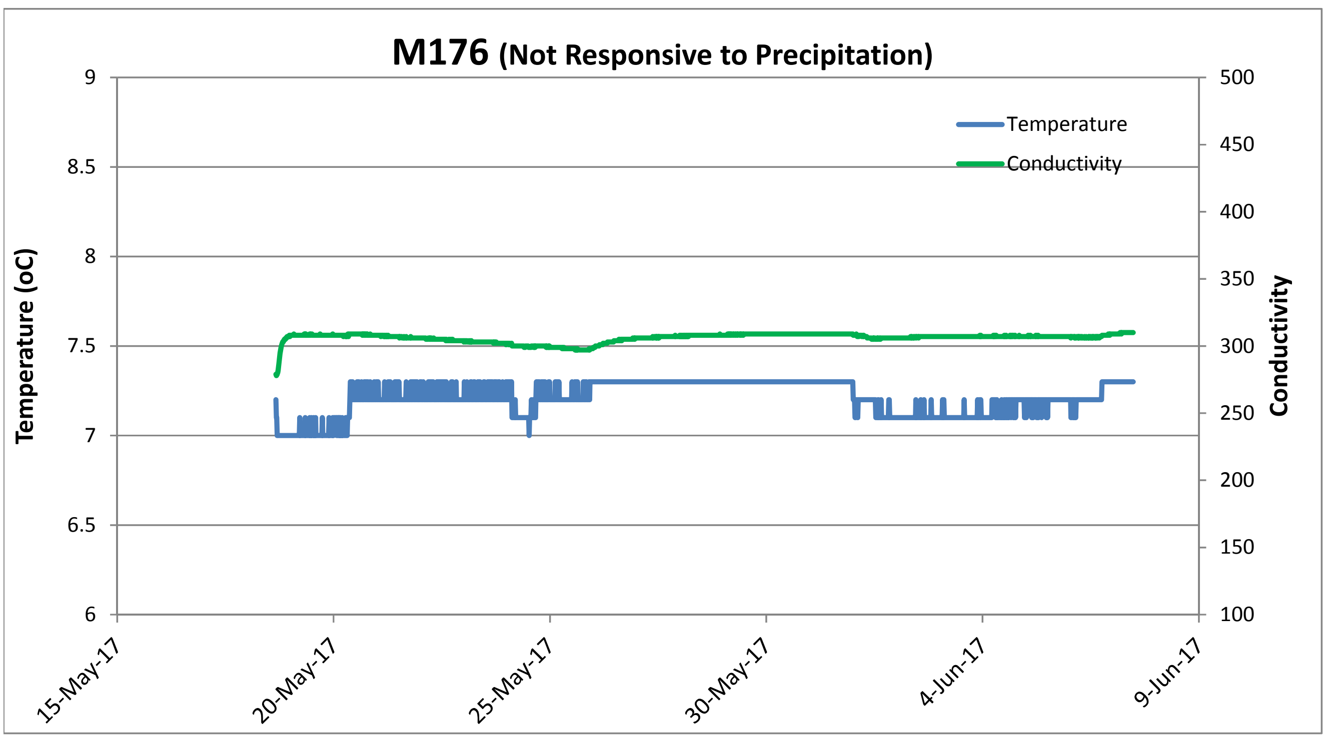
M195 (Potentially Responsive to Precipitation)
Normalized Water Level (m)
Daily Rain (mm)
Rain
Level
-2
0
2
4
6
8
10
12
70
60
50
40
30
20
10
0
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17



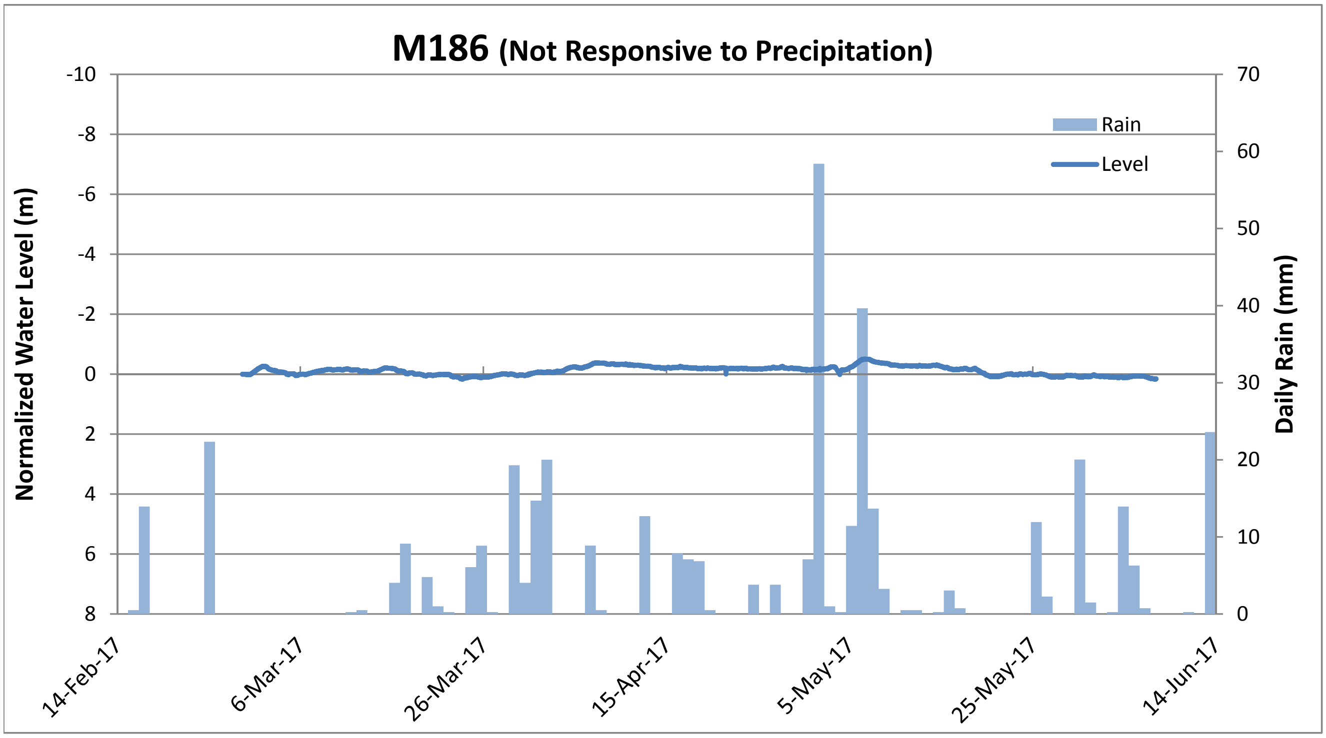
M195 (Potentially Responsive to Precipitation)
Temperature (oC)
Conductivity
Temperature
Conductivity
11
10.5
10
9.5
9
8.5
8
900
880
860
840
820
800
780
760
740
720
700
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17



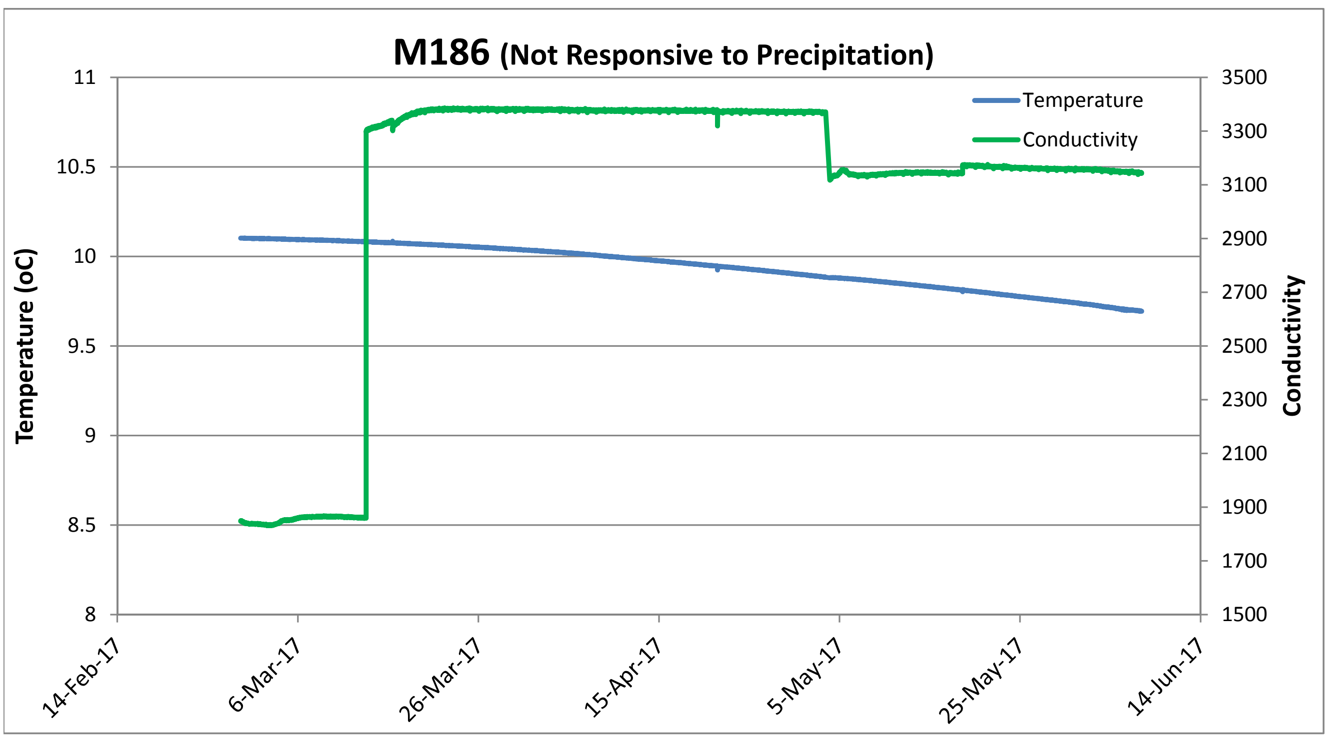
M176 (Not Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17



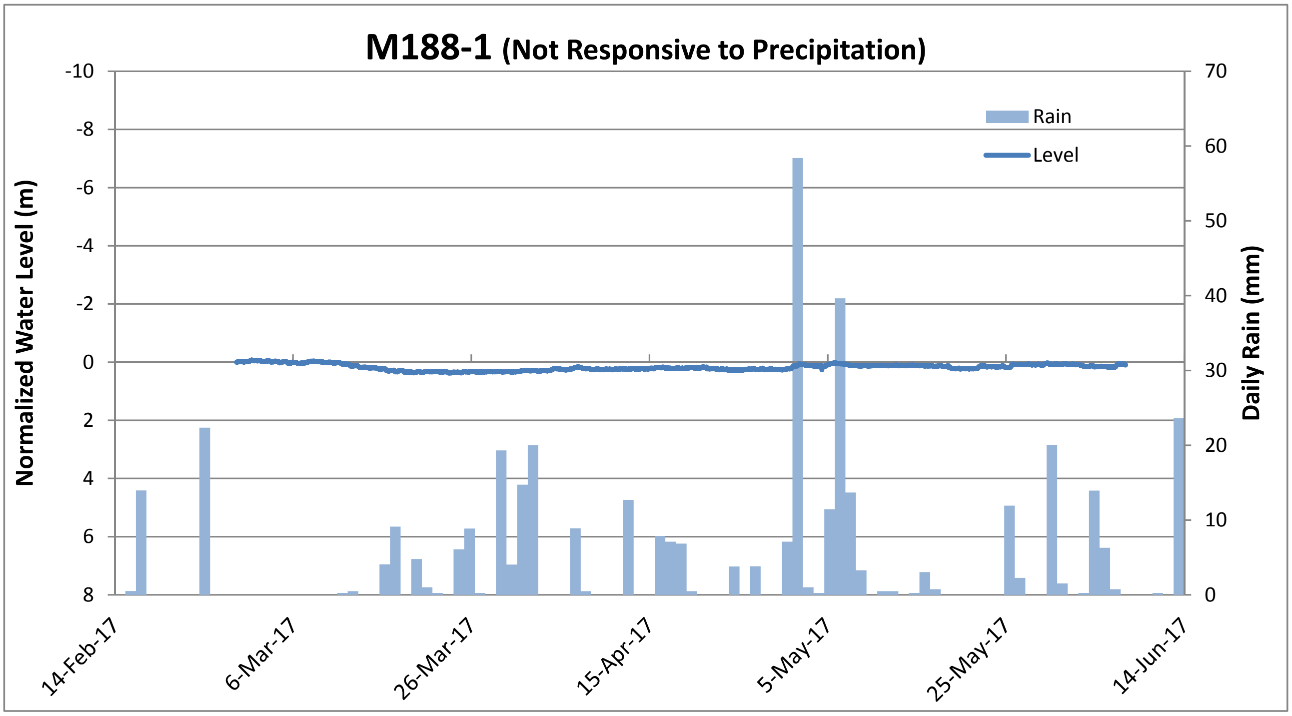
M176 (Not Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
9
8.5
8
7.5
7
6.5
6
500
450
400
350
300
250
200
150
100
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17



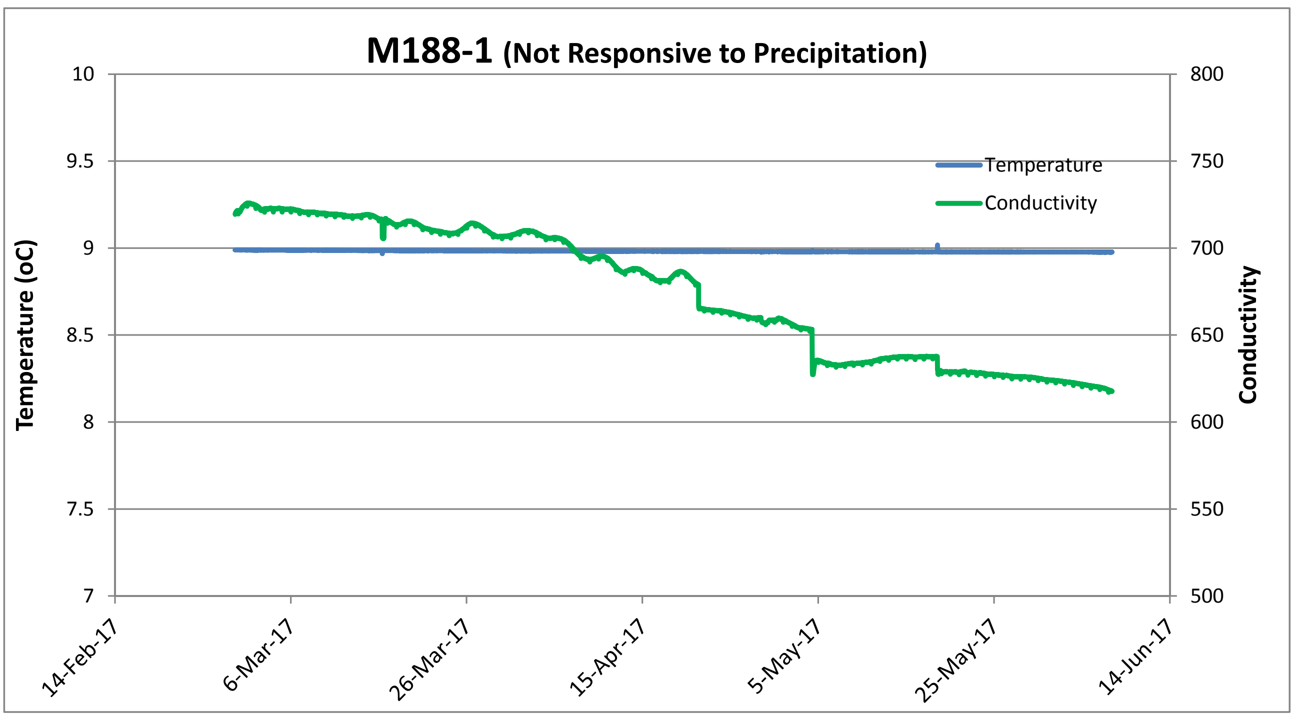
M186 (Not Responsive to Precipitation)
Normalized Water Level (m)
Daily Rain (mm)
Rain
Level
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17



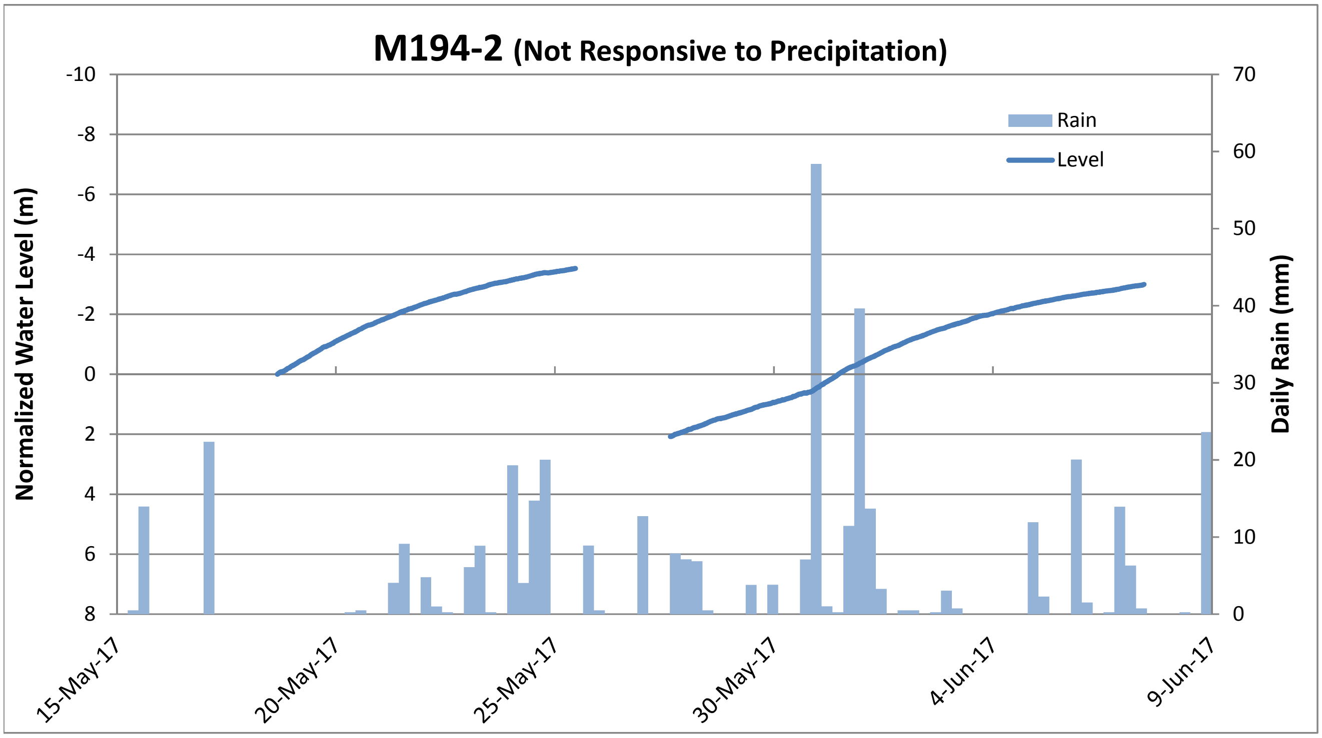
M186 (Not Responsive to Precipitation)
Temperature (oC)
Conductivity
Temperature
Conductivity
11
10.5
10
9.5
9
8.5
8
3500
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17

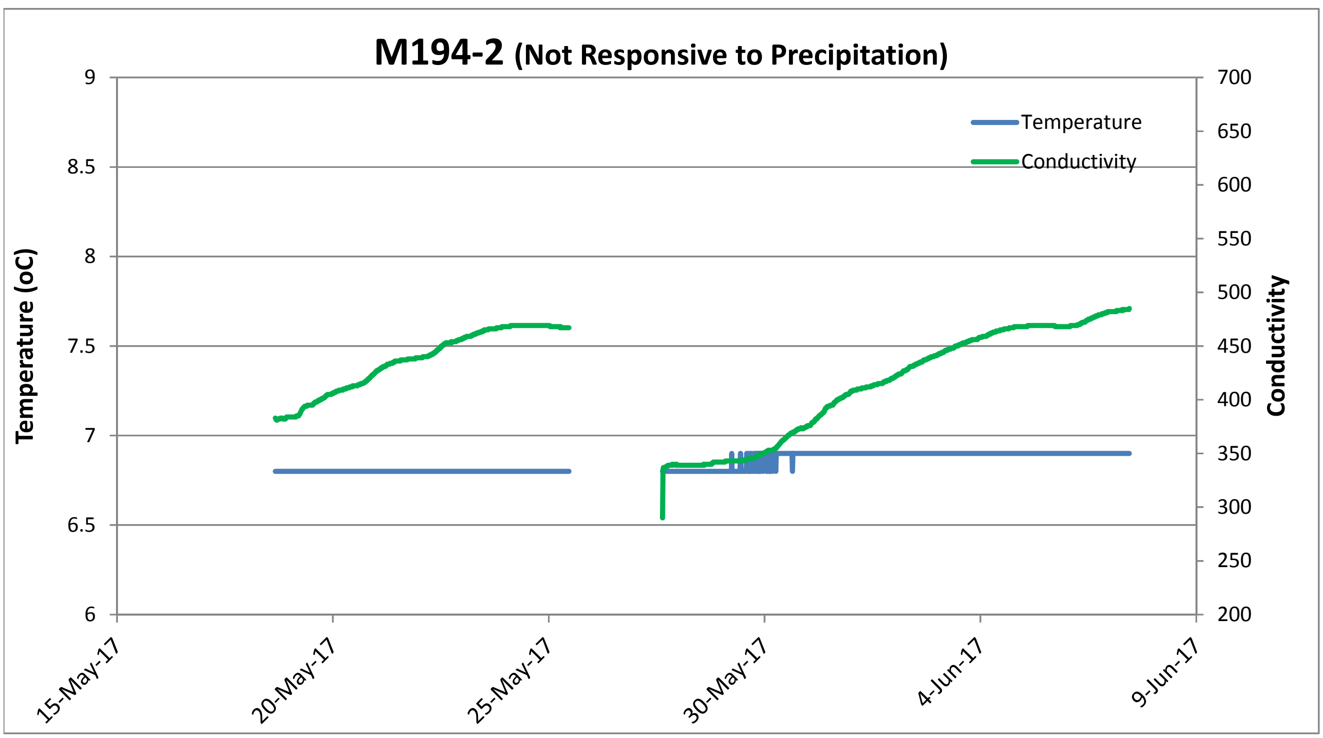


M188-1 (Not Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17



M188-1 (Not Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
10
9.5
9
8.5
8
7.5
7
800
750
700
650
600
550
500
14-Feb-17
6-Mar-17
26-Mar-17
15-Apr-17
5-May-17
25-May-17
14-Jun-17


M194-2 (Not Responsive to Precipitation)
Rain
Level
Normalized Water Level (m)
Daily Rain (mm)
-10
-8
-6
-4
-2
0
2
4
6
8
70
60
50
40
30
20
10
0
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17


M194-2 (Not Responsive to Precipitation)
Temperature
Conductivity
Temperature (oC)
Conductivity
9
8.5
8
7.5
7
6.5
6
700
650
600
550
500
450
400
350
300
250
200
15-May-17
20-May-17
25-May-17
30-May-17
4-Jun-17
9-Jun-17

BluMetric Environmental Inc.

BluMetric Offices

4-41 de Valcourt Street
Gatineau, Québec
Canada J8T 8G9
Téléphone: 819 243.7555
Télécopieur: 819 243.0167
gatineau@blumetric.ca

3108 Carp Road
PO Box 430
Ottawa, Ontario
Canada K0A 1L0
Tel: 613.839.3053
Fax: 613.839.5376
ottawa@blumetric.ca

4 Kern Road, Suite 1,
Toronto, Ontario,
Canada M3B 1T1
Tel: 416.383.0957
Fax: 416.383.0956
toronto@blumetric.ca

740, rue Notre-Dame Ouest
bureau 900
Montréal, Québec
Canada H3C 3X6
Téléphone: 514 844.7199
Télécopieur: 514 841.9111
montreal@blumetric.ca

4 Cataraqui Street
The Tower, The Woolen Mill
Kingston, Ontario
Canada K7K 1Z7
Tel: 613.531.2725
Fax: 613.531.1852
kingston@blumetric.ca

4916 – 49th Street
Yellowknife, NT
Canada X1A 1P3
Tel: 867.873.3500
Fax: 867.873.3499
yellowknife@blumetric.ca

171 Victoria Street North
Kitchener, Ontario
Canada N2H 5C5
Tel: 519.742.6685
Fax: 519.742.9810
kitchener@blumetric.ca

102-957 Cambrian Heights Drive
Sudbury, Ontario
Canada P3C 5S5
Tel: 705.525.6075
Fax: 705.525.6077
sudbury@blumetric.ca

7º Calle Poniente Bis
Pasaje 9, casa No.7,
Colonia Escalon
San Salvador, El Salvador
Teléfono: 011.503.2564.7728
Fax: 613.839.5376
sansalvador@blumetric.ca

www.blumetric.ca