





## Submitted to:

1470424 Ontario Inc. 301 Moodie Drive, Suite 100 Ottawa, Ontario K2H 9C4

TW21-1C Water Supply Assessment
Proposed Residential Development
Creekside 2 - Village of Richmond
2770 Eagleson Road

Ottawa, Ontario

December 14, 2021 Project: 61899.03 GEMTEC Consulting Engineers and Scientists Limited 32 Steacie Drive Ottawa, ON, Canada K2K 2A9

December 14, 2021 File: 61899.03

1470424 Ontario Inc. 301 Moodie Drive, Suite 100 Ottawa, Ontario K2H 9C4

Attention: Tyler Ferguson, Land Development Manager

Re: TW21-1C Water Supply Assessment, Proposed Residential Development Creekside 2 – Village of Richmond, 2770 Eagleson, Ottawa, Ontario

Please find enclosed our hydrogeological investigation report for the above noted project based on the scope of work provided in our proposal dated February 21, 2020. This report was prepared by GEMTEC Consulting Engineers and Scientists Limited (GEMTEC).

Do not hesitate to contact the undersigned if you have any questions or require additional information.

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Enclosures

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#### 1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by 1470424 Ontario Inc. to carry out a hydrogeological investigation for a proposed residential subdivision (Creekside 2) which consists of a 25.67 hectare site (approximate) located in the northwest corner of Eagleson Drive and Perth Street within the Northeast Development Lands of the Village of Richmond in Ottawa, Ontario (refer to Figure 1, attached).

Based on the Village of Richmond Community Design Plan Amendment #181, dated March 9, 2017, development in the Western Development Lands, Northeast Development Lands and Industrial Lands shall be on the basis of communal well services. The preliminary development plan of Creekside 2 includes a total of 455 units: 74 semi-detached, 250 single family houses and 130 townhouses.

The development will require a water supply in the form of a communal well(s) to provide the source of water. The lots will be connected to a residential wastewater service and as such, an impacted assessment for septic services has not been conducted.

### 1.1 Technical Guidance

This study was carried out in general accordance with the technical requirements outlined in the Ministry of Environment and Conservation and Parks (MECP) document entitled Procedure D-5-5 Technical Guidance for Private Wells: Water Supply Assessment, or the principles of the MECP Hydrogeological Technical Information Requirements for Land Development Applications (April 1995) and the City of Ottawa document *Hydrogeological and Terrain Analysis Guidelines, March 2021*. The City of Ottawa had indicated that they will be the owner / operator of the communal well system and all wells must be constructed to their specifications and relevant sections of the City of Ottawa Official Plan. As such meetings were held with City representatives and the Rideau Valley Conservation Authority (RVCA) to discuss the proposed hydrogeological evaluation methodology and present submittals for review prior to the start of the field work.

A meeting with the City, 1470424 Ontario Inc. and the GEMTEC team was held on October 26, 2020 to review the proposed work scope and field program. On November 10, 2020, GEMTEC prepared and submitted to the City a Technical memo - Conceptual Site Model and Work Planentitled *Proposed Field Program to Support Creekside 2 Groundwater Supply Development Village of Richmond, Ottawa, Ontario.* This technical memorandum outlined the preliminary field testing program that will be carried out to support the groundwater supply assessment for the residential development of Creekside 2. The field program was developed using a preliminary Conceptual Site Model (CSM) that was established by the project team, technical specifications provided by the City of Ottawa, and common hydrogeological practices for communal well supplies.



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Following comments from the City on the technical memo, an updated memo was prepared and submitted on November 23, 2020. On November 30, 2020, an email was received by the GEMTEC team from the City that all comments had been addressed with no further comments.

As presented in the technical memo, the preferred location for the communal well within the development layout was provided on Figure A2.1 and the other test well location was located approximately 100 m to 300 m away (to be determined in the field). At the time of this investigation, the preferred location was based on the site infrastructure design and development fabric. An updated site infrastructure design (November 2021) is provided on Figure A2.2 which shows the location of the communal well located along Eagleson Drive in the southeast corner of the property. This proposed communal well is located approximately 120 metres from the test well location, as described in this report. As this revised location is proximal to the test well locations and the Nepean Aquifer is regionally extensive with similar hydrogeological properties, it is expected that comparable results in terms of groundwater quantity and quality will be obtained during communal well drilling in this area.

## 1.2 Study Objectives and Scope of Work

The purpose of this Hydrogeological and Water Supply Assessment is to evaluate the potential for the use of a communal well(s) system to support the water requirements of the proposed Creekside 2 development including groundwater quantity and quality. As such, the scope of work for the assessment included:

- Development of geological and hydrogeological framework and conceptual site model
- Evaluation of Water Demand and Potential Aguifer Yield
- Completion of a baseline water quality sampling program of private wells
- Completion of a Hydrogeological Investigation
  - Drill shallow and deep test wells
  - o Instrument on and off-site wells with water level data recorders
  - Complete a 72-hr pump test to determine potential well yields, water quality and communal well location siting
- Data Evaluation and Reporting

This report is arranged into seven sections, including this introduction. Section 2 provides background information on the physical setting of the Site from a regional perspective. Section 3 discusses the methods used to complete the site-specific hydrogeological investigation with Section 4 presenting the results of this assessment and the specific hydrogeological characteristics. Section 5 presents an evaluation of the impacts in terms of quantity and quality. Section 6 provides the conclusions and recommendations of the report. Section 7 provides closure, limitations and references. Figures and tables referred to in the text are provided in Appendices at the back of this report.



#### 2.0 SITE BACKGROUND

#### 2.1 Data Sources

The Ministry of the Environment, Conservation and Parks (MECP) Water Well Information System was downloaded from the online platform in September 2020 to provide insight into the geology and hydrogeology of the Richmond area. The distribution of water wells contained within the database are illustrated as yellow circles on Figures A1 and A2 (figures refenced A# are provided in Appendix A). As illustrated, there is a wealth of domestic water well data in the area west and south of the Site where individual wells were drilled for many of the residential subdivisions. In the agricultural areas north and east of Richmond, the density of water well data is significantly lower.

The Ministry's Permit to Take Water dataset was also downloaded from the MECP website and the only long-term active permits within the Richmond area are the municipal wells: Kings Park Wells 1 and 2, and Richmond West Well 1 and 2 (Figure A3). Permits exist in the database for short term takings such as pumping tests or construction dewatering, but these permits are not expected to impact the groundwater levels on the Site. The High Park Well located west of the Site (Figure A1) does not have a permit to take water but is a communal well of interest in this project.

A set of digital elevation model (DEM) tiles were downloaded from the Province's *Land Information Ontario* website to characterize the ground surface topography in the area (Figure A3). Specifically, the Digital Raster Acquisition Project Eastern Ontario (DRAPE) from 2019 was used to represent the ground surface in the area.

## 2.2 Site Description and Topography

The proposed development (the Site) is in situated at the northwest corner of Eagleson Drive and Perth Street within the Northeast Development Lands of the Village of Richmond. The Site is bounded to the north by agricultural land, and to the south by a rural commercial zone. To the west is a municipal drainage swale, then residential development along Shea Road. On the west side of Shea Road is an existing village residential zone. The site is currently used as agricultural lands.

Topography within the study area is relatively flat and slopes towards the Jock River, with elevations ranging from approximately 95 m asl in the northwest to 90 m asl adjacent to the Jock River and flood plains.

Surface drainage is interpreted to follow the local topographic features. A number of small creeks and streams occur in the study area including the municipal drainage swale that drain into the Jock River, a tributary to the Rideau River that flows through the Village of Richmond (see Figure A3).



## 2.3 Regional Geology

The Site is located within the Ottawa Valley Clay Plains physiographic region (Chapman and Putnam, 1984) which is characterized by clay plains with minor sand and gravel zones (see Figure A4).

Beneath the Study Area, the surficial geologic units consist of fine-grained clays, silty sand, and till that overlie limestone and sandstone bedrock. Minor amounts of sand and gravel were also noted. The Paleozoic-aged bedrock units of the Ottawa area were characterized by Williams (1991) in an Ontario Geological Survey report.

## 2.3.1 Overburden Geology

Overburden beneath the Site consists predominately of clay, till and lesser sands. The lowermost overburden sequence in the area is a glacial till, deposited during the late Wisconsin ice advance and retreat approximately 12,000 years ago. Overlying the till in many areas is glaciolacustrine silts and clays that were deposited when the area was isostatically depressed due to the weight of the glaciers, and marine seawater inundated the area forming the Champlain Sea. Thick layers of clay were deposited before the land surface rebounded, and the sea retreated to the east, down the St. Lawrence River valley. The ice sheet retreated northward, and large volumes of meltwater drained into the Ottawa area, in some places leaving behind sands and gravels on top of the marine silts and clays.

Figure A4 illustrates the surficial geology mapped in the area, which is mapped as glaciomarine silt and clay across much of Richmond, with a small area of sand and gravel mapped at surface west of the Richmond West municipal wells.

#### 2.3.2 Paleozoic Bedrock Formations

Beneath the Site, the uppermost bedrock formation is a limestone unit that is interpreted to be part of the Oxford and March Formations, which are collectively referred to as the Beekmantown Group (Figure A5). The depth to the top of bedrock is shown on Figure A6.

The uppermost formation beneath the Site is the **Oxford Formation**, which is described as a dolostone with shaly and sandy interbeds that are up to 30 cm thick (Williams, 1991). The formation is characterized by light to medium brownish to greenish grey dolostone and is estimated to be approximately 30 m thick in the Richmond area.

The Oxford Formation is underlain by the **March Formation**, an interbedded grey quartz sandstone, dolomitic quartz sandstone, and blue-grey sandy dolostone and dolostone. The unit represents a transition zone between the Oxford Formation dolostones above, and the Nepean Formation sandstone below. Dolostones of the March Formation are lithologically similar to the overlying Oxford Formation, making them difficult to distinguish using drill cuttings. Within the



Richmond area, the March Formation is estimated to be approximately 8 to 9 m thick (Paterson Group, 2011).

The underlying **Nepean Formation** is a quartz sandstone that is thinly bedded to massive and well sorted (see Figure A7 for interpreted depth to Nepean Formation). The sandstone is variable in colour and can be white to light grey, brown, reddish brown and green. It underlies the March Formation beneath the Site, and the upper Nepean Formation contact is marked by the lowermost unit of (sandy) dolostone. Locally, the Nepean Formation is described as cream coloured, coarsegrained sandstone with a weathered grey and irregular brown stained colour (Paterson Group, 2011).

## 2.4 Regional Hydrostratigraphy

There are no mapped overburden aquifers in the Richmond area and surrounding area; the only aquifers beneath the Site are the upper Oxford and March formation dolostones, and the underlying Nepean Formation sandstone. The water levels in the upper and lower bedrocks aquifers are similar, with groundwater levels lying only a few metres below ground surface.

The water level elevations reported in all water wells that are completed in bedrock are illustrated on Figures A8 to A12. The water levels recorded in the March and Oxford formations are denoted with circles, and the water levels for wells completed in the Nepean Formation are denoted by black squares and circles. The labels denote the static water level noted on the drillers log at the time the well was drilled. Water levels were collected from a wide variety of time periods from the 1960s to 2019 and represent water levels collected in spring when levels are at their highest and summer when levels are at their lowest. They water levels are useful for identifying broad trends across an area, but cannot be relied upon to provide the exact water level at any given point on the map. In general, water levels in the Richmond area lie 2 to 4 metres below ground surface and within 1 m in the low-lying areas along the Jock River (Figure A12). A three-dimensional view of surficial and bedrock geology across the site are illustrated on Figures A13 and A14.

## 2.5 Regional Groundwater Quality

In general, the groundwater quality from private wells in the Oxford and Nepean formations within the Village of Richmond is considered potable and good quality. Elevated concentrations of iron, hardness, sodium and total dissolved solids (TDS) and hydrogen sulphide occur locally (Golder, 2003, 2017; JWEL, 1991 and Geofirma, 2020). The identified elevated concentrations which can be locally present are typically within the range that can be treated by conventional water treatment systems.



#### 3.0 STUDY METHODOLOGY

## 3.1 Groundwater Supply Investigation

## 3.1.1 Test Well Siting and Monitoring Well Network

A total of four bedrock test wells were advanced on-site from January 7 to January 15, 2021 by Air Rock Drilling Ltd. under well contractor license number 1119. Well grouting inspections were carried out by GEMTEC staff during the sealing of the well casings in all test wells. The test wells were completed in pairs, at two potential production well locations. Each well cluster includes a shallow bedrock well completed in the Oxford and March Formation (Beekmantown Group) and deep bedrock well completed in the Nepean Formation.

In addition to the four on-site bedrock test wells, groundwater level monitoring was completed in three private homeowner wells (A274440, A260995, A274380), one commercial well (TW2 – A138253) and a series of overburden monitoring wells installed as part of the geotechnical investigation (GEMTEC, 2021); refer to Detailed Site Plan Figure 1 for well locations.

## 3.1.2 Permit To Take Water (PTTW) Application

GEMTEC prepared and submitted a Category 2 PTTW application to the Ministry of the Environment, Conservation and Parks (MECP) required for groundwater pumping greater than 50,000 litres per day. The PTTW application was approved and issued by the MECP on March 3, 2021 (PTTW Number 7422-BYQNKJ). Groundwater pumping in excess of 50,000 litres per day was carried out in accordance with the permit requirements.

#### 3.1.3 Hydraulic Testing

Pumping tests were completed at test well TW21-1C to assess the groundwater quality and quantity. Following well drilling, a preliminary pumping test was completed on February 2, 2021. The test well TW21-1C was pumped at a rate of approximately 340 litres per minute for a period of 2.5 hours, for a total groundwater discharge of approximately 49,000 litres. Groundwater quality samples were collected at the end of the pumping tests and submitted to Paracel Laboratories for 'subdivision package' and 'heavy metal' parameters.

A step test was completed at TW21-1C on March 12, 2021 in order to assess the performance of the well, prior to conducting a long-duration pumping test. The test well TW21-21C was pumped for three one-hour intervals at rates of approximately 680 litres per minute, 910 litres per minute and 1,060 litres per minute.

A 72-hour constant rate pumping test was completed at TW21-1C on March 15 to March 18, 2021. The pumping test was conducted by Aardvark Drilling Inc. using a 30Hp downhole pump, installed at a depth of 64.5 metres. The test well was pumped at a rate of approximately 910 litres per minute and groundwater discharge monitored using a calibrated flow meter and totalizer



(Seametrics model #IP117S-126). The groundwater was discharged to ground surface approximately 400 metres from the test well in accordance with permit requirements.

## 3.1.4 Groundwater Sampling

Groundwater samples from TW21-1C were collected during the February 2, 2021 short duration pumping test and from March 15-18, 2021 during the 72-hour pumping test. The groundwater samples were collected in laboratory supplied bottles and prepared/preserved in the field in accordance with the industry standard sampling, handling and preservation procedures required by the laboratory. All water samples, including samples for metal analysis, were unfiltered. The groundwater samples were subsequently submitted to Paracel laboratories in Ottawa, Ontario for the following parameters:

- February 2, 2021 (short duration pumping test) and March 16/17/18, 2021 (24-hour, 48-hour and 72-hour samples)
  - "Subdivision Package": total coliform, E. coli, fecal coliform, heterotrophic plate count, electrical conductivity, pH, hardness, total dissolved solids, alkalinity, fluoride, chloride, nitrate, nitrite, sulphate, ammonia, total kjeldahl nitrogen, dissolved organic carbon, phenols, hydrogen sulphide, true colour, turbidity, calcium, manganese, magnesium, potassium and sodium.
  - 'Heavy Metals": aluminum, antimony, arsenic, barium, boron, cadmium, chromium, chromium VI, copper, lead, mercury, selenium, uranium, and zinc.
- March 18, 2021 (72-hour sample)
  - Volatile Organic Compounds (VOCs), Petroleum Hydrocarbons (PHCs) and pesticides/herbicides.

Field parameters were measured at periodic intervals during the pumping tests. The measured field parameters and equipment used during the pumping test are provided in Table 3.1.

Table 3.1 - Field Equipment Overview

Field Parameters	Manufacturer	Model No.
Total and Free Chlorine	Hach	DR 900
pH, temperature, conductivity, total dissolved solids, dissolved oxygen and oxygen reduction potential	Horiba <sup>1</sup>	Horiba U-52 <sup>1</sup>
Turbidity	Hanna	HI 98703



Field Parameters	Manufacturer	Model No.
Colour (filtered <sup>2</sup> and unfiltered)	Hach	DR 900

Notes: 1. Rental equipment from Maxim Environmental and Safety Inc. Calibrated by Maxim Environmental and checked/re-calibrated daily with standard solutions provided by Maxim.

2. Groundwater samples field filtered using 0.45 micron filters.

### 3.1.5 Borehole Geophysics

Downhole geophysical surveys were completed in four test wells (Figure 1) at the Site. The surveys were completed to characterize rock units within each test well. Surveys were focused on logging structures within the shallower Nepean formation (upper ~50 m) and the deeper Oxford / March formation (beyond ~50 m). Surveys logged rock units within each formation to characterize stratigraphy, fractures, joints, bedding, foliations, faults, etc. Downhole probes included both optical and acoustic imaging televiewers, and an additional probe (40GRP-1000) to log gamma, 16" normal resistivity, 64" normal resistivity, single point resistance, and spontaneous potential measurements.

Test wells were drilled in two different locations on the site and consisted of a shallow and deep well at each location. Shallow wells were contained within the upper 50 metres (Nepean formation) at each location, and deeper wells were cased to approximately 55 metres (below ground surface) and extended to depths of approximately 110 – 120 metres.

In completing the downhole program, geophysical surveys were conducted over a 3-day period from February 3 - 6, 2021. Equipment for the surveys required a 500 metre winch and data logger system, coupled with Mount Sopris ALT probes that included the following:

- QL40-ABI (acoustic televiewer);
- QL40-OBI (optical televiewer); and
- 40GRP-1000 probe.

Optical and acoustic televiewer data was collected and combined with gamma and resistivity logs generated by the 40GRP-1000 probe. Each of the probes are discussed in the following subsections.

#### 3.1.6 Televiewers

Televiewer logging instruments are used to obtain high-resolution and oriented images of borehole walls for a variety of investigation types. These instruments function to provide in-situ and relatively undisturbed measurements of rock units where core recovery is difficult/unreliable, costly, or otherwise unavailable. Televiewer surveys are often used as standalone data sets, to provide supplemental information for drill programs, and/or as a quality control measure during characterization studies. For this investigation, data sets from both optical and acoustic



televiewers were used to image test wells to collect structural information in near surface formations to better understand the similarities and differences between these rock units.

A generalized schematic of the optical and acoustic televiewer probes deployed downhole is displayed in Figure D1, Appendix D.

## 3.1.7 Acoustic Televiewers

Downhole surveys at each test well were completed using the optical and acoustic televiewer, the 40GRP-1000 probe, a data logger, a winching system, and tripod positioned over each of the test wells. To initiate each of the surveys, probes were positioned over test wells, zeroed at ground surface, and lowered to full depth. Data collection was completed during ascent (under tension), which provided a more controlled data collection stream without the hang-ups that can occur as probes descend under the force of gravity. This is a necessity for the televiewers as they require centralizers to keep the probes positioned correctly in the boreholes, and during descent, these probes often get hung-up on borehole wall irregularities. During data collection, acoustic, optical, and 40GRP-1000 data records were acquired at a rate of approximately 1.5 m/min to ensure adequate sampling rates

## 3.2 Offsite Domestic Well Water Quality

The offsite water quality was assessed through sampling domestic private wells in the Creekside Phase 1 residential development, sampling Creekside Phase 1 test wells and a review of available hydrogeological reports for the adjacent commercial development, all of which are located west of the Site (Figure 1). The domestic water supply wells in the Creekside 1 development are completed in the limestone bedrock of the Oxford Formation, with well depths in the range of 25 to 66 metres.

Information letters were delivered in November 2020 to all residents within the Creekside Phase 1 residential development and homeowner sampling was completed between December 2020 and May 2021. A total of 19 homeowners voluntarily participated in the sampling program. Field testing for turbidity, pH, total dissolved solids, electrical conductivity, temperature and total chlorine was carried out at the time of sampling. Groundwater samples were collected from untreated taps (e.g. outdoor tap or pressure tank bypass) after running the cold water for a minimum of ten minutes. The samples were preserved in laboratory supplied bottles using established sampling protocols. The water samples were submitted to Paracel Laboratories Ltd. for 'subdivision package' parameters.

Water quality information from the commercial development was reviewed to assess the background water quality in the Nepean aquifer. The following background reports reviewed include:



- Hydrogeological Study, Proposed Development Part of Lot 26, Concession 4 Geographic Township of Goulbourn, City of Ottawa (Richmond Village), Ontario, report by Golder Associates report number: 1418381-1000, Rev.2, September 2017.
- Hydrogeological Report and Terrain Analysis, Proposed Commercial Development Phase
   Richmond Village Square, Ottawa, Ontario, report by Paterson Group Inc.,
   Report:PH4188-LET.01, March 24, 2021.

Elevated chloride concentrations were noted during the Creekside 1 water quality sampling and further investigated by GEMTEC under a separate cover, titled "Investigation of Potential Chloride Sources – Creekside Subdivision Phase 1, Village of Richmond, Ottawa, Ontario" and dated May 31, 2021. The investigation is currently ongoing and under review by the MECP. Follow-up water quality sampling has been completed at numerous times since May, 2021 and reported under separate cover.

#### 4.0 RESULTS AND DISCUSSION

## 4.1 Geologic Characterization

Beneath the Site, the geologic units consist of a fine-grained clays, silty sand and till that overlie limestone and sandstone bedrock. The Paleozoic-aged bedrock units of the Ottawa area were characterized by Williams (1991). A description of the geological site conditions is presented in this section based on local and recent on-site drilling data.

#### 4.1.1 Overburden

The overburden geology was characterized on-site during the TW21-1C Water Supply Assessment completed by GEMTEC (Draft report dated Dec 11, 2020).

The fieldwork for this investigation was carried out between July 3 and 20, 2020. During that time, a total of 26 boreholes were advanced using a track mounted hollow stem auger drill rig supplied and operated by CCC Geotechnical and Environmental Drilling of Ottawa, Ontario.

Details for the boreholes advanced are provided below:

- 21 boreholes, numbered 20-01A, 20-02 to 20-04, 20-05A, 20-06, 20-07A, 20-08, 20-09, 20-10A, 20-11 to 20-15, 20-16A, 20-17, 20-18A, 20-19, 20-20, 20-21, and 20-25 were advanced to depths ranging from about 6.1 to 10.4 metres below ground surface.
- 6 boreholes, numbered 20-01B, 20-05B, 20-07B, 20-10B, 20-16B, and 20-18B were advanced adjacent to boreholes 20-01A, 20-05A, 20-07A, 20-10A, 20-16A, and 20-18A, respectively, for the installation of shallow monitoring wells and/or obtaining relatively undisturbed Shelby tube samples.



Well screens were sealed in the overburden at all borehole locations, except borehole 20-05B, to measure the groundwater levels and for hydraulic conductivity testing. The record of borehole sheets and monitoring well logs are provided in Appendix B.

From the investigation the overburden beneath the Site consists predominately of clay, till and lesser sands. The lowermost overburden sequence in the area is a glacial till, deposited during the late Wisconsin ice advance and retreat approximately 12,000 years ago. Overlying the till in many areas is glaciolacustrine silts and clays that were deposited when the area was isostatically depressed due to the weight of the glaciers, and marine seawater inundated the area forming the Champlain Sea. Thick layers of clay were deposited before the land surface rebounded, and the sea retreated to the east, down the St. Lawrence River valley. The ice sheet retreated northward, and large volumes of meltwater drained into the Ottawa area, in some places leaving behind sands and gravels on top of the marine silts and clays.

Figure A4 illustrates the surficial geology mapped in the area, which is mapped as glaciomarine silt and clay across much of Richmond, with a small area of sand and gravel mapped at surface west of the Richmond West municipal wells.

Based on detailed geotechnical studies (25 boreholes by GEMTEC, 7 boreholes by others), the overburden generally comprises deposits of silty clay and glacial till over bedrock. A layer of sand was also noted at two of the borehole locations. Native deposits of silty clay were encountered in all of the boreholes. Where fully penetrated, the silty clay extends to depths ranging from about 2.6 to 8.4 metres below ground surface.

Grain size distribution tests were undertaken on four selected samples of the weathered silty clay crust from boreholes 20-06, 20-13, 20-14, and 20-20. The results are summarized in Table 4.1.

Table 4.1 – Summary of Grain Size Distribution Test (Weathered Crust)

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
20-06	2	08 – 1.4	0	2	45	53
20-13	3	1.5 – 2.1	0	1	38	61
20-14	3	1.5 – 2.1	0	2	41	57
20-20	3	1.5 – 2.1	0	2	37	61

A deposit of glacial till was encountered below the silty clay and clayey silt in boreholes 20-01, 20-02, 20-04, 20-07 to 20-12, 20-15, and 20-17 to 20-21. The glacial till was not fully penetrated



in the boreholes but was proven to depths ranging from about 5.3 to 10.4 metres below ground surface (elevation ranging from about 83.3 to 88.8 metres).

Two grain size distribution test was undertaken on select samples of the glacial till from boreholes 20-15 and 20-19. The results are summarized in Table 4.2.

Table 4.2 – Summary of Grain Size Distribution Test (Glacial Till)

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
20-15	5	3.1 – 3.7	20	43	25	11
20-19	5	3.1 - 3.7	9	46	27	19

The glacial till is a heterogeneous mixture of all grain sizes, which at this Site, can be described as grey silty sand with trace to some gravel and clay to gravelly silty sand with some clay. Although not encountered in the borehole locations directly, the glacial till deposits in this area are known to contain cobbles and boulders.

A deposit of sand with trace to some gravel was encountered below the glacial till in boreholes 20-12 and 20-15. Boreholes 20-12 and 20-15 extended 1.4 and 0.8 metres into the sand, respectively. The sand deposit was not fully penetrated by the boreholes but was proven to depths of about 6.7 and 6.1 in boreholes 20-12 and 10-15, respectively (elevations of about 87.2 and 88.0 metres, respectively).

One grain size distribution test was undertaken on a sample of the sand from borehole 20-15. The results are summarized in Table 4.3.

Table 4.3 – Summary of Grain Size Distribution Test (Sand)

Location	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
20-15	8	5.5 – 5.9	1	92	2	5

## **Depth to Top of Bedrock/ Overburden Thickness**

A surface was generated to illustrate the depth to the top of bedrock (overburden thickness) beneath the Site and surrounding areas (Figure A6). The surface was created using the depth at the uppermost bedrock contact noted in each drillers log in the MECP water well database. As illustrated on Figure A6, depth to bedrock in the Richmond area ranges from less than 1 m to over 15 m, but on average bedrock lies approximately 10 m below ground surface.



Inferred bedrock was recorded in site-specific geotechnical studies that were carried out at the Site. Table 4.4 summarizes the depth and the corresponding elevations of refusal and bedrock surface at the borehole locations.

Table 4.4 – Bedrock Surface Summary (Various geotechnical studies)

Borehole	Ground Surface Elevation (metres)	Depth to Bedrock (metres)	Bedrock Surface Elevation (metres)
20-07	93.8	6.5	87.3 <sup>1</sup>
13-2	94.0	11.8	82.2 <sup>2</sup>
13-4	93.6	12.3	81.3
13-8	-	13.6	-
13-9	-	11.8 <sup>2</sup>	-
13-5	93.5	11.9	81.6
13-6	93.7	7.4	86.3
15-1	93.7	12.3	81.4
15-2	93.6	10.9	82.7

Notes: 1 – Bedrock surface inferred from auger refusal

During the previous investigations, the limestone bedrock was encountered in boreholes 13-4 and 13-8 at depths of about 12.3 and 13.6 metres below ground surface. Refusal to dynamic cone penetration testing was encountered in boreholes 13-2 and 13-5 at depths of about 11.8 and 11.9 metres below ground surface. Based on the geotechnical study of the Site, the overburden thickness ranges in thickness from 6.5 to 13.6 metres, averaging 11 metres.

## 4.1.2 Bedrock

A total of four bedrock test wells were advanced on-site between January 7 and January 15, 2021. The construction details of the test wells are summarized in Table 4.5 below.

<sup>2 -</sup> Bedrock surface inferred from dynamic cone penetration testing

Table 4.5 – Summary of Test Well Construction Details

Test Well ID	Well Tag #	Geological Formation	Casing Diameter (m)	Casing Depth (m BGS)	Screen/Open Interval (m BGS)	Total Depth (m BGS)
TW21-1B	A313189	Oxford	0.152	15.8	15.8 – 48.8	48.8
TW21-1C (PUMPING WELL)	A313115	Nepean	0.203	57.3	57.3 – 122.2	122.2
TW21-2B	A313190	Oxford	0.152	15.2	15.2 – 45.7	45.7
TW21-2C	A313188	Nepean	0.152	57.3	57.3 – 109.1	109.1

As presented earlier, beneath the Site, the uppermost bedrock formation is a limestone unit that is interpreted to be part of the Oxford and March Formations, which are collectively referred to as the Beekmantown Group (Figure A5).

### TW21-1B and TW21-2B Oxford Formation

The **Oxford Formation**, which is described as a dolostone with shaly and sandy interbeds that are up to 30 cm thick (Williams, 1991). The formation is characterized by light to medium brownish to greenish grey dolostone and is estimated to be approximately 30 m thick in the Richmond area.

The Oxford Formation is underlain by the **March Formation**, an interbedded grey quartz sandstone, dolomitic quartz sandstone, and blue-grey sandy dolostone and dolostone. The unit represents a transition zone between the Oxford Formation dolostones above, and the Nepean Formation sandstone below. Dolostones of the March Formation are lithologically similar to the overlying Oxford Formation, making them difficult to distinguish using drill cuttings. Within the Richmond area, the March Formation is estimated to be approximately 8 to 9 m thick (Paterson Group, 2011).

<u>TW21-1B</u> was drilled into the Oxford formation to a total depth of 48.8 m bgs. The borehole log is presented in Appendix C and the major features are described below:

- Overburden Clay with gravel at depth of 14.02 m bgs
- Grey Limestone to a depth of 48.8 m bgs



<u>TW21-2B</u> was drilled to a depth a total depth of 45.7 m bg. The borehole log is presented in Appendix C and the major features are described below:

- Overburden Clay with some boulders and gravel to depth of 13.4 m bgs.
- White quartzite to a depth of 19.5 m bgs
- Grey limestone to a final depth of 45.7 m bgs.

## TW21-1C and TW21-2C- Nepean Formation

The underlying **Nepean Formation** is a quartz sandstone that is thinly bedded to massive and well sorted. The sandstone is variable in colour and can be white to light grey, brown, reddish brown and green. It underlies the March Formation beneath the Site, and the upper Nepean Formation contact is marked by the lowermost unit of (sandy) dolostone. Locally, the Nepean Formation is described as cream coloured, coarse-grained sandstone with a weathered grey and irregular brown stained colour (Paterson Group, 2011).

<u>TW21-1C (main pumping well)</u> was drilled into the Nepean formation to a total depth of 122.2m bgs. The borehole log is presented in Appendix C and the major features are described below:

- Overburden consisting of Clay and Hardpan to a depth of 14.63 m bgs
- Grey Limestone with trace grey sandstone to depth of 67 m bgs
- Grey Sandstone to a depth of 122 m bgs

TW21-2C was drilled into the Nepean formation to a total depth of 109.1 m bgs. The borehole log is presented in Appendix C and the major features are described below:

- Overburden consisting of Clay with trace gravel to a depth of 14 m bgs
- Grey Limestone with trace grey sandstone to depth of 68 m bgs
- Grey Sandstone to a depth of 109.1 m bgs

#### Depth to Top of Nepean Sandstone

The topography at the top of the Nepean Formation was contoured by interpolating the uppermost "sandstone" descriptor in the water well record. As illustrated on Figure A7, depth to the Nepean Sandstone lies approximately 67m bgs based on the on-site drilling results. The figure also illustrates the locations of wells that intercept the top of the Nepean Formation; several wells intersect the Nepean Formation south and west of the Site, however, there are few deep bedrock wells east and north of the Site. The topography on the top of the Nepean Formation is fairly constant across the Richmond area, increasing slightly in areas where overburden thickens east of Richmond (Figure A7).



#### **Cross-Sections**

Figures A8 to A11 are cross-sections that were generated using the information contained within the MECP water well database. The cross-section locations are illustrated on Figure A1. The bedrock surface and the top of the Nepean Formation surface described in the overlying sections are illustrated on the sections to illustrated estimated depths to the top of these surfaces. The ground surface topography represented in the 2 m DEM was also applied as the uppermost line on the cross-section.

Figure A8 is a cross-section (A-A') that runs southwest to northeast across Richmond just north of and parallel to Perth Street with the Site lying on the right side of the cross-section. The main features are as follows:

- Overburden south of the Site along cross-section A-A' is approximately 10-12 m thick and is underlain by approximately 40 to 45 m of dolostone (limestone) of the March and Oxford Formations.
- Due to the coarse nature of lithologic descriptions noted in the water well drillers logs (e.g., limestone), these two formations were not able to be reliably subdivided on the crosssections.
- As illustrated on Figure A8, the upper surface of the Nepean Formation sandstone lies approximately 50 m bgs. On-site drilling confirmed the depth to be on the order of 68 m bgs.

Figure A9 is a cross-section (B-B') that runs from the Site in the north through the Kings Park Well 2 in the central portion of the section to the southeastern reaches of the town of Richmond. The main features are as follows:

- Overburden beneath the Site is estimated to be approximately 4 m at the north end of the Site to 10 m at the south end (Figure A6), and is expected to consist of silt and clay at surface with a discontinuous fine-grained till overlying bedrock.
- The underlying Oxford and March Formation dolostone (limestone) underlie the overburden and the Nepean Formation was encountered at approximately 67 m below ground surface (Figure A7).
- As illustrated on the cross-section the domestic wells in the area are completed in both the upper limestone, as well as the lower Nepean Formation. The cross-section intersects the Jock River and a tributary of the Jock River and the difference in elevation between the riverbanks and the water level elevation are minor (< 2 to 3 m; Figure A9).

Figure A10 is a cross-section (C-C') that runs from north to south along the western reaches of the Site in the north, to the Kings Park Well 1 in the south. The main features are as follows:



- The cross-section illustrates the commercial well TW2, where a transducer is currently installed collecting background water levels, and the relationship between this well and the nearby Kings Park Well 1, approximately 1.3 km to the south.
- As illustrated on the cross-section (Figure A10), the depth to the upper surface of the Nepean Formation along the length of the cross-section is estimated to be approximately 50 to 55 m below ground surface.

Figure A11 is a cross-section (D-D') that runs from northwest to southeast through the neighbouring Creekside 1 residential development and commercial property. The main features are as follows:

- Overburden south of the Site along cross-section D-D' is approximately 8-12 m thick and is underlain by approximately 40 to 45 m of dolostone (limestone) of the March and Oxford Formations.
- Due to the coarse nature of lithologic descriptions noted in the water well drillers logs (e.g., limestone), these two formations were not able to be reliably subdivided on the crosssections.
- The cross-section illustrates two test wells in the Creekside 1 development, TW15-01 and TW15-03 and a commercial well TW2, where pressure transducers are currently installed collecting background water levels.
- As illustrated on the cross-section (Figure A11), the depth to the upper surface of the Nepean Formation along the length of the cross-section is estimated to be approximately 50 to 55 m below ground surface.

In general, water levels in the Richmond area lie 2 to 4 metres below ground surface and within 1 m in the low-lying areas along the Jock River (Figure A12).

A summary of the local scale Site conditions is presented as 3-D conceptual models on Figures A13 and A14.

## 4.1.3 Bedrock Structural Characteristics

Figure A5 illustrates the uppermost bedrock group mapped in the area, as well as the location of bedrock faults; both mapping products were generated by the Geological Survey of Canada at a regional-scale, so uncertainty exists with the exact location of the geologic contacts and faults.

## 4.2 Borehole Geophysics

Both optical and acoustic images, structural data (joints/fractures and bedding foliations), resistivity, SPR, SP, and natural gamma are included in the logs in Appendix D. Optical and acoustic images are oriented to magnetic north and horizontal (ground surface) for dip.



Two primary fractures were noted in both the upper Oxford-March and lower Nepean formations and are shown in the summary images below.

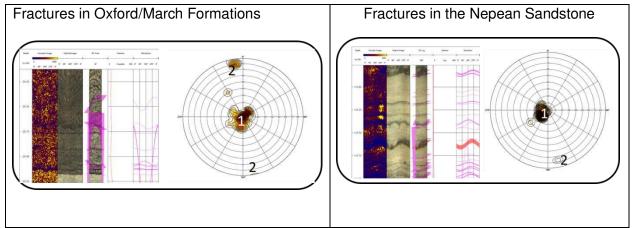


Figure D2 (Appendix D) - Illustration displaying primary fractures noted in Oxford/March and Nepean Formations.

Individual pole plots for each test hole are included in Appendix D.

Fracture set 1 represents bedding plane fractures. These fractures are relatively flat lying in both formations but the bedding in the Nepean Sandstone dips more uniformly at 5 to 10 degrees in an east – northeast direction. Fracture set 2 is sub-vertical and strikes at approximately 170 degrees but dips more prominently to the north in the deeper sandstone unit. The presence of a similarly orientated sub-vertical fracture set in both upper and lower bedrock formations may indicate a similar genesis. Fracture set 2 may transmit groundwater from the shallow limestone bedrock to the deeper sandstone unit.

Fracture apertures / fracture zones (low amplitude acoustic responses) in the Nepean Sandstone are typically wider than in the upper predominately limestone Formations which may explain why the sandstone has a much higher storage coefficient and transmissivity.

## 4.3 Water Supply Investigation

## 4.3.1 Test Well and Observation Well Network

The construction details of the test wells are summarized in Table 4.6 below. In addition to the on-site bedrock test wells, a series of off-site bedrock domestic and commercial water supply wells were used for groundwater level monitoring (refer to Detailed Site Plan, Figure 1 for well locations and Table 3.1 for well construction details). The test well and observation well records are provided in Appendix C.



Table 4.6 – Summary of Test Well Construction Details

	Test Well ID¹	Well Tag #	Geological Formation	Casing Diameter (m)	Casing Depth (m BGS)	Screen/Open Interval (m BGS)	Total Depth (m BGS)	Distance to Pumped Well (m)
-	MW20-07S	_ (1)	Overburden	0.051	2.5	2.5 – 4.0	4.0	70
Cluster	MW20-07D	_ (1)	Overburden	0.051	5.0	5.0 – 6.5	6.5	70
On-Site Well Cluster 1	TW21-1B	A313189	Oxford	0.152	15.8	15.8 – 48.8	48.8	12
S-uO	TW20-1C (PUMPING WELL)	A313115	Nepean	0.203	57.3	57.3 – 122.2	122.2	0
<b>≡</b>	MW20-15	_ (1)	Overburden	0.051	2.5	2.5 – 4.0	4.0	230
On-Site Well Cluster 2	TW20-2B	A313190	Oxford	0.152	15.2	15.2 – 45.7	45.7	225
o O	TW21-2C	A313188	Nepean	0.152	57.3	57.3 – 109.1	109.1	225
	MW20-01S	_ (1)	Overburden	0.051	2.32	2.32 – 3.84	3.84	290
Ē	MW20-01D	_ (1)	Overburden	0.051	7.68	7.68 – 9.20	9.20	290
O-Site Overburden	MW20-16S	_ (1)	Overburden	0.051	2.48	2.48 – 4.00	4.00	225
Site Ov	MW20-16D	_ (1)	Overburden	0.051	7.68	7.68 – 9.20	9.20	225
Ó	MW20-18S	_ (1)	Overburden	0.051	2.48	2.48 – 4.00	4.00	400
	MW20-19S	_ (1)	Overburden	0.051	2.48	2.48 – 4.00	4.00	340
<u>s</u>	TW15-01	A165020	Oxford	0.152	13.1	13.1 – 29.9	29.9	680
ock Wel	TW15-03	A165022	Oxford	0.152	9.4	9.4 – 28.5	28.5	615
Off-Site Bedrock Wells	Colonnade TW2	A138253	Oxford / Nepean	0.152	16.4	16.4 - 49.1	49.1	550
Ö	A274440	_(2)	Oxford	0.152	14.0	14.0 – 30.5	30.5	550

Test Well ID¹	Well Tag #	Geological Formation	Casing Diameter (m)	Casing Depth (m BGS)	Screen/Open Interval (m BGS)	Total Depth (m BGS)	Distance to Pumped Well (m)
A260995	_(2)	Oxford	0.152	12.2	12.2 – 42.7	42.7	580
A274380	_(2)	Oxford	0.152	9.75	9.75 – 25.0	25.0	560

<sup>1.</sup> Monitoring well installed as part of geotechnical investigation (GEMTEC, 2021)

## 4.3.2 TW21-1C Hydraulic Testing Results

The transmissivity and storativity of the water supply aquifer were estimated from the 72-hour pumping test drawdown data using Aqtesolv version 4.5, a commercially available software program from HydroSOLVE Inc. An analysis of the pumping test data was carried out using the Cooper-Jacob and Theis recovery methods.

Test Well TW21-1C sustained a constant pumping rate of approximately 910 litres per minute for a period of 72 hours. The maximum observed drawdown in the pumping well, TW21-1C was 44.07 metres (65% of the available drawdown). Observation wells located 10 to 725 metres from the pumping well reported water level drawdown ranging from <0.1 to 5.67 metres. Following cessation of pumping, the water level in TW21-1C recovered 95% within 2 hours.

A summary of the maximum observed drawdown, estimated transmissivity and storativity from the pumping well and observation wells are provided in Table 4.7. The drawdown and recovery plots are provided in Appendix E.

**Table 4.7: Aquifer Test Results** 

	Test Well ID¹	Geological Formation	Total Depth (m BGS)	Distance to Pumped Well (m)	Maximum Drawdown @ 72 hours (m)	T¹ Drawdown (m²/day)	T <sup>1</sup> Recovery (m²/day)	S² (-)
	MW20-07S	Overburden	4.0	70	0.31	-	-	-
ter 1	MW20-07D	Overburden	6.5	70	1.19	-	-	-
Well Cluster 1	TW21-1B	Oxford	48.8	12	5.67	58	47	3 x 10 <sup>-3</sup>
Mel	TW21-1C (PUMPING WELL)	Nepean	122.2	0	44.07	39	50	-
≥ ≡	MW20-15S	Overburden	4.0	230	<0.1	-	-	-



<sup>2.</sup> Water well ID not provided in order to protect the confidentiality of private well owners. Well information maintained by GEMTEC.

	Test Well ID <sup>1</sup>	Geological Formation	Total Depth (m BGS)	Distance to Pumped Well (m)	Maximum Drawdown @ 72 hours (m)	T¹ Drawdown (m²/day)	T <sup>1</sup> Recovery (m²/day)	S² (-)
	TW21-2B	Oxford	45.7	225	0.88	670	864	3 x 10 <sup>-4</sup>
	TW21-2C	Nepean	109.1	225	0.85	670	813	3 x 10 <sup>-4</sup>
Overburden Monitoring	MW20-01S	Overburden	3.84	290	<0.1	-	-	-
	MW20-01D	Overburden	9.20	290	0.66	-	-	-
	MW20-16S	Overburden	4.00	225	<0.1	-	-	-
	MW20-16D	Overburden	9.20	225	1.27	-	-	-
	MW20-18S	Overburden	4.00	400	<0.1	-	-	-
	MW20-19S	Overburden	4.00	340	<0.1	-	-	-
Off-Site	TW15-01	Oxford	29.9	680	<0.1	-	-	-
	TW15-03	Oxford	28.5	615	0.44	-	-	-
	Colonnade TW2	Oxford / Nepean	49.1	550	0.46 <sup>3</sup>	-	-	-
	A274440	Oxford	30.5	550	0.41 <sup>3</sup>	-	-	-
	A260995	Oxford	42.7	580	$0.40^{3}$	-	-	-
	A274380	Oxford	25.0	560	0.463	-	-	-

Notes: 1. T = transmissivity; 2. S = Storativity; 3. Residential or commercial well in-use.

The calculated transmissivity of the pumping well (TW21-1C) is 39 and 50 m²/day from drawdown and recovery, respectively. The calculated transmissivity of the observation well cluster TW21-2B (Oxford) and TW21-2C (Nepean) ranged from 670 to 864 m²/day, with a storativity of 3 x 10<sup>-4</sup>. The calculated transmissivity and storativity from the bedrock observation wells are consistent with transmissivity (362 to 755 m²/day) and storativity (1.0 x 10<sup>-2</sup> to 1.4 x 10<sup>-4</sup>) estimates from local studies of the Nepean Aquifer (Golder, 2011; Geofirma, 2021). The transmissivity estimates from the pumping well TW21-1C are an order of magnitude lower than TW21-2B and TW21-2C; however, this can be attributed to head losses in the pumped well and well efficiency and thus not representative of the aquifer properties.

## 4.3.3 Aguifer Hydraulic Connectivity

Pumping in the Nepean Sandstone caused drawdown in the upper bedrock formations and in the overburden (deep) monitoring wells that were installed in both the till and clay (with sand seams). Sub-vertical fractures that cut across both the deep and shallow bedrock Formations likely transmit groundwater to the deeper aquifer during pumping. The hydraulic connection between



the two Formations was also noted in the pump test data from the Western Development Lands, although not described in detail, the drawdown data for shallow and deep bedrock wells show a similar hydraulic response to this this study.

The drawdown in the deep monitoring wells suggest that the groundwater in the overburden is connected to the bedrock aquifer system and that the overburden will respond to pumping stresses in the deep bedrock aquifers. The drawdown in a deep overburden well MW20-16D, installed in the clay was 1.27 metres and located 225 metres from the pumping well. The clay at this location was noted to contain sand seams which likely connects to the sandy till or silty sand soils.

## 4.4 TW21-1C Water Quality Results

The results of the chemical, physical and bacteriological analyses on the water samples from test well TW21-1C is summarized in Appendix G and the laboratory results from Paracel are provided in Appendix H.

## 4.4.1 Bacteriological Parameters

Total and free chlorine measurements confirmed that total and free chlorine concentrations in the well water was non-detectable (<0.02 mg/L) at the time of bacteriological sampling during the pumping test (refer to Appendix G).

Based on water samples collected from test well TW21-1C, all samples were non-detect for total coliform, e. Coli and fecal coliform bacteria. The water quality meets the Ontario Drinking Water Quality Standards (ODWQS) maximum acceptable concentrations.

### 4.4.2 Other Health Related Parameters

No other maximum acceptable concentration limits of the ODWQS were exceeded in the 24-hour, 48-hour or 72-hour water samples collected from TW21-1C. This includes fluoride, nitrate, nitrite, heavy metals (mercury, aluminum, antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, selenium and uranium), PHCs, VOCs or pesticides/herbicides.

#### 4.4.3 Operational Guideline Exceedances

Operational related exceedances of the ODWQS were noted for hardness and these are discussed in the following section:

#### **Hardness**

The concentration of hardness in water samples obtained from TW21-1C ranged from 326 to 340 mg/L as CaCO<sub>3</sub> and is higher than the operational guideline of 80 to 100 mg/L of CaCO<sub>3</sub> as specified in the ODWQS.



Water having a hardness level above 80 to 100 mg/L as CaCO3 is often softened for domestic use. The MECP Procedure D-5-5 document states that water having a hardness value more than 300 mg/L is considered "very hard". The Ontario Ministry of the Environment publication entitled "Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines", states that water with hardness in excess of 500 mg/L is considered to be unacceptable for most domestic purposes. There is no upper treatable limit for hardness specified in MECP Procedure D-5-5.

The concentrations of hardness in all the test wells are below the reported threshold of 500 mg/L as CaCO3 as specified in the Technical Support Document for the ODWQS. The concentration of hardness observed in the test wells is considered to be reasonably treatable using a conventional water softener. Based on our experience, most water supply wells within rural eastern Ontario are equipped with water softeners.

Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water that may be of concern to persons on a sodium restricted diet. The use of potassium chloride in the water softener (which adds potassium to the water instead of sodium); could be considered as a means of keeping sodium concentrations in the water at background levels.

## 4.4.4 Aesthetic Objective Exceedances

Aesthetic objective exceedances of the ODWQS included total dissolved solids and colour. These exceedances are discussed in the following sections:

## **Total Dissolved Solids (TDS)**

The TDS levels in samples from TW21-1C during the 72-hour pumping test increased from 484 to 514 mg/L. The sample collected at 72-hours exceeds the ODWQS aesthetic objective of 500 mg/L, with a TDS of 514 mg/L. Elevated levels of TDS can lead to problems associated with encrustation and corrosion

To determine the corrosive nature of the groundwater, the Langelier Saturation Index (LSI) was calculated for the samples obtained from the test wells. These values are based on the laboratory measured TDS, pH, alkalinity, and hardness following 72-hours of pumping. The LSI was calculated to be 0.68, using a field-measured groundwater temperature of 8°C (refer to Appendix F). The calculated LSI value is between 0.5 and 2, which indicates the groundwater scale forming, but non-corrosive.

As per the "Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines", TDS levels in excess of 500 mg/L may result in excessive hardness, taste, mineral deposition or corrosion. According to the "Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Total Dissolved Solids (TDS)", published by Health Canada



(1991), TDS levels between 600 and 900 mg/L are considered to be 'fair'. At levels above 1,200 mg/L, the palatability of drinking water is 'unacceptable'. The palatability of the drinking water is considered to be acceptable.

#### Colour

The analytical laboratory results for colour are reported as 'colour' (TCU; filtered) and 'apparent colour' (ACU; unfiltered). The colour decreased from 15 TCU to 7 TCU from the 24-hour and 72-hour samples respectively. Similarly, the apparent colour decreased from 28 to 19 ACU from the 24-hour and 72-hour samples respectively.

Water having a faint yellow/brown colour can be caused by organic materials and contributed to by iron and manganese. Colour is not generally considered a health issue and the aesthetic objective is set by appearance. The elevated laboratory colour may be the result of iron and manganese, which can precipitate out of solution and increase the colour levels.

Although the laboratory-measured colour exceeded the MECP D-5-5 aesthetic objective of 5 TCU, the field-measured colour was non-detectable (less than 5 TCU). The colour decreased throughout the pumping test, along with turbidity, and is anticipated to further decrease following additional well development. The elevated laboratory colour levels are likely related to iron and manganese and based on the measured true colour at the time of sampling, the colour levels are considered to be acceptable.

## 4.4.5 Notable Parameters

A Golder (2011) study of the Nepean Aquifer in Richmond reported chloride concentrations in the 43-44 mg/L range. The 2018 Annual Monitoring Report for the Kings Park communal wells, in the Village of Richmond reported chloride concentrations in treated water of 168.8 mg/L (City of Ottawa, 2018).

During the 72-hour pump test for this study chloride was noted to increase from 94 mg/L after 24 hours of pumping to 122 mg/L after 48 hours and finally 138 mg/L at the end of the 72 hour test. The increase in chloride is still with in the range of values noted in the Kings Park Communal wells and elsewhere for the Nepean Aquifer. A study of the Nepean Aquifer in Greely (Geofirma, 2021) reported increasing chloride concentrations from 85 to 104 mg/L and 116 to 129 mg/L in two Nepean test wells.

## 4.5 Offsite Well Water Quality Results – Creekside 1

The offsite water quality was assessed by sampling 24 domestic private wells and two test wells in the Creekside 1 development, all of which are completed in limestone bedrock of the Oxford Formation (refer to Water Well Records in Appendix H)



The domestic well sampling identified five private wells and one test well localized in the southern portion of the Creekside 1 development with multiple ODWQS aesthetic objective and operational guideline exceedances. The ODWQS exceedances include chloride (366 - 837 mg/L), hardness (522 – 1110 mg/L), sodium (133 – 270 mg/L), turbidity (<0.1 - 34.4 NTU) and total dissolved solids (842 - 2080 mg/L). These exceedances were further investigated by GEMTEC under a separate cover, titled "Investigation of Potential Chloride Sources – Creekside Subdivision Phase 1, Village of Richmond, Ottawa, Ontario" and dated May 31, 2021.

The hydrogeological investigation (GEMTEC, 2021) identified a stormwater management pond in an adjacent property as a potential source of chlorides. The investigation into this impact is ongoing. Follow-up sampling of the six affected private wells completed in July 2021 found significant decreases in chloride concentrations, from 223 – 837 mg/L to 103 - 224 mg/L (Appendix I). The decreases in chloride concentrations supports the hydrogeological conceptual model presented in GEMTEC (2021), which suggests seasonal de-icing salt inputs into the local groundwater system from the adjacent stormwater management pond. Follow-up water quality sampling has been completed since July 2021 and reported under separate cover. Further testing will be required to confirm the source and appropriate mitigation measures.

With the exception of the six impacted private wells in the Creekside 1 development, the water quality in the other 18 private wells sampled, meets all the ODWQS health related, maximum acceptable concentrations and treatability limits. A summary of the water quality results is provided in Appendix I. The following operational guideline and aesthetic objective exceedances are noted:

- Operational guideline: hardness (17 / 18 wells) and organic nitrogen (1 / 18 wells)
- Aesthetic Objective: total dissolved solids (3/ 17 wells), colour (6 / 18 wells), turbidity (1 / 17 wells) and iron (2 / 18 wells).

The groundwater quality of the 17 private wells are generally consistent with the findings of the initial Creekside 1 hydrogeological investigation (Golder, 2017), with aesthetic objective exceedances of colour and total dissolved solids, and operational guideline exceedances of hardness. Some variability in the range of water quality parameters were observed as expected given the number of wells tested and the variability in private wells depths.

The investigation is currently ongoing and under review by the MECP. Follow-up water quality sampling has been completed at numerous times since May, 2021 and reported under separate cover.

### 5.0 IMPACT ASSESSMENT

Based on the results of this study the following impact assessment is presented.



## 5.1 Water Quantity

The aquifer is capable of meeting the water quantity demands of the proposed 455-unit subdivision. As part of this study a test well was pumped at approximately 2.5 times the average demand (peak rate) for the development for 72 hours. The resulting maximum drawdown in the aquifer was 44.1 metres (65% of the available drawdown) and the test well recovered quickly, less than 2 hours for 95% recovery.

It is anticipated that the final production well(s) will encounter similar aquifer hydraulics to the test wells in the proposed communal well location (See Figure A2.2 in Appendix A); however, the production wells will be 50% larger in diameter than the main test well, 305 mm versus 203 mm, and the actual operational pumping will be less than the 72 hours test duration. Based on these factors the pumping stresses on the aquifer system by the final production well(s) and resulting drawdowns will be less that those imposed during the pump test.

## 5.2 Wellhead Protection and Water Quality Impacts

The results of this study suggest that the bedrock and surficial overburden groundwater systems are more interconnected, at least local to the study area, than other past studies have shown. From a wellhead protection perspective, this would mean that more recharge and potential chemical inputs could occur in areas where the surficial soils are thin or the near surface clay is absent. Overall, this may also reduce the size of the modelled wellhead capture zones.

The aquifer may be more vulnerable to surficial contamination from reduced thickness of low permeability soils or higher permeable windows above the upper bedrock aquifer. Groundwater quality impacts from chlorides have been identified in the Creekside 1 residential subdivision (GEMTEC, 2021). The hydrogeological investigation (GEMTEC, 2021) suggests seasonal deicing salt inputs into the upper limestone bedrock from the adjacent stormwater management pond, which is excavated approximately 4 metres below ground surface. The investigation is ongoing and the source of chlorides has not been confirmed.

The impacted water supply wells in the Creekside 1 development are localized to the shallow water supply wells in the southern portion of the development. Follow-up sampling suggests that the source is seasonally active and the inputs are rapidly flushed through the aquifer system. Appropriate mitigation measures and well head protection best management practices are expected to reduce potential impacts to the shallow bedrock aquifer and the proposed deep water supply aquifer for the Creekside 2 development.

## 5.3 Hydrogeological Sensitivity

Water levels recorded as part of this investigation demonstrate that the deeper Nepean aquifer and shallow Oxford / March Formations are interconnected and that high rates of groundwater pumping from the deeper aquifer causes drawdown in the upper bedrock system. In addition, pumping from the deeper aquifer also causes drawdown in the deep overburden sediments.



However, the absence of drawdown in near surface wells installed in the clay deposits suggests that the aquifer system is still somewhat isolated from surface contamination.

Hydrogeological sensitive areas may exist where the clay is absent or it is removed from the surface by excavation. In general, the groundwater chemistry results, an absence of nitrate compounds and bacteriological parameters, also supports the water level data and suggest that the Site is not hydrogeological sensitive. However, consideration should be given to any excavations, such as storm water ponds, that could remove protective clays from the near surface at the Site. In these instances where excavations must be made, protective clay liners or geosynthetic liners should be considered.

#### 6.0 CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Conclusions

Based on the results of the hydrogeological investigation, the following conclusions and professional opinions are provided:

- The surficial geology across the Site generally consists of deposits of clay (with sand seams), till and lesser sands. The lowermost overburden sequence in the area is glacial till, overlain by glaciolacustrine silts and clays. Sand layers were also noted at two of 25 borehole locations. The Site overburden thickness ranges from approximately 6.5 to 13.6 metres, averaging 11 metres.
- The Site is not considered to be hydrogeologically sensitive based on the absence of thin soils, highly permeable soils or karst features.
- The water supply aquifers encountered at the Site includes limestone of the Oxford and March Formations (Beekmantown Group) underlain by sandstones of the Nepean Formation.
  - The Nepean sandstone lies approximately 67m bgs based on the on-site drilling results and is aquifer tested in this investigation.
  - Neighbouring water well users primarily rely on the Oxford and March Formation water supply aquifer.
  - Similar geological and hydrogeological conditions were found at both drilling and testing locations (e.g. TW21-1C; TW21-2C) located spatial 230 metres apart across the development site.
- Hydrogeological conceptual model (CSM)
  - The CSM was updated based on the on-site drilling results and hydraulic responses during the pump tests
  - The drawdown in the deep monitoring wells suggest that the groundwater in the overburden is connected to the bedrock aquifer system and that the overburden will respond to pumping stresses in the deep bedrock aquifers.



- Specifically, pumping in the Nepean Sandstone caused drawdown in the upper bedrock formations and in the overburden (deep) monitoring wells that were installed in both the till and clay (with sand seams).
- o It is likely that the sub-vertical fractures that cut across both the deep and shallow bedrock Formations can transmit groundwater to the deeper aquifer during pumping. The presence of a similarly orientated sub-vertical fracture set in both upper and lower bedrock formations may indicate a similar genesis.
- Fracture aperatures / fracture zones in the Nepean Sandstone are typically wider than in the upper predominately limestone Formations which may explain why the sandstone has a much higher storage coefficient and transmissivity.
- The measured water level drawdowns within the overburden unit during the pump tests, should be evaluated as part of the building geotechnical designs.
- The aquifer may be more vulnerable to surficial contamination from reduced thickness of low permeability soils or higher permeable windows above the upper bedrock aquifer
- The water quality available from test well TW21-1C, completed in the Nepean sandstone aquifer is safe for consumption based on the absence of health-related exceedances; however, groundwater treatment for aesthetic parameters will be required.
  - Treatment for hardness, colour and iron may be desirable and can be treated using conventional water softeners and/or manganese greensand filters.
  - Sodium concentrations exceed the warning level for persons on sodium restricted diets of 20 mg/L and the Local Medical Officer of Health should be notified.
  - Total Dissolved Solids slightly exceeded the ODWQS aesthetic objective of 500 mg/L at 514 mg/L. LSI values indicate the water is considered scale forming, but non-corrosive; some encrustation can be expected.
- The water quality of the upper bedrock water supply aquifer (Oxford/March Formations), with the exception of the localized wells in the southern portion of the Creekside 1 development, meets the ODWQS maximum acceptable concentrations and treatability limits, with aesthetic objective and operational guideline exceedances of colour, total dissolved solids, hardness and the sodium warning level.
  - Private well owners interviewed in Creekside 1 Phase 1 noted multiple groundwater quality issues, namely 'sulfur' odours, iron staining, high hardness and total dissolved solids. The groundwater quality issues are consistent with the aesthetic objective and operational guideline exceedances stated in the hydrogeological investigation (Golder, 2017). Although the sampling did not identify ODWQS for hydrogen sulphide, 'sulphur' odours were noted by 10 homeowners.
  - Multiple wells in the southern portion of the Creekside 1 development have reported intermittent elevated chlorides, total dissolved solids, sodium, hardness



and turbidity. An offsite impact is suspected as the source of the contamination. This potential source is currently being investigated.

- Impacted wells are localized to the southern portion of Phase 1 of the Creekside 1 development.
- Follow-up sampling in July 2021 found decreasing chloride concentrations in all affected wells which are within the ODWQS aesthetic objective, suggesting that the source is seasonally active and the inputs are rapidly flushed through the aguifer system.
- The investigation is currently ongoing and under review by the MECP. Follow-up water quality sampling has been completed at numerous times since May, 2021 and reported under separate cover.
- The water quality determined in the course of this investigation is representative of longterm water quality and is consistent with water quality investigations of the Nepean Aquifer in the Ottawa area (Golder, 2011; Geofirma, 2021; City of Ottawa 2018; City of Ottawa, 2020).
- The quantity of groundwater available from the proposed water supply aquifer is sufficient for the proposed development and will sustain repeated pumping at the test rate and duration at 24-hour intervals over the long term.
  - TW21-1C was pumped at a constant rate of approximately 910 litres per minute for 72 hours. The maximum drawdown observed at the end of pumping was 44.07 metres and following cessation of pumping, the water level recovered 95% within 2 hours.
  - The large drawdown observed in TW21-1C and relatively low transmissivity of the pumping well can be attributed to well inefficiencies (i.e. well losses, pump configuration, pump depth, etc.). Larger diameter production wells will reduce well inefficiencies and associated water level drawdown.
- Interference between neighbouring private drinking water wells is expected to be minimal.
  - Drawdown at neighbouring residential wells in the Creekside 1 development (Oxford/March Formations) and Colonnade commercial development (Oxford/March/Nepean Formation) during the pumping test was less than 0.5 metres.



#### 6.2 Recommendations

The following provides recommendations regarding well construction specifications and water quality:

#### 6.2.1 Well Construction Recommendations

- Future production wells should be constructed in accordance with the City of Ottawa's
  Drinking Water Facility Design Guidelines and MECP regulations, including, but not limited
  to, Ontario Reg. 903. The well bore opening should be a minimum of 0.254 metres (10
  inches) to reduce well inefficiencies.
- Well casings should be extended at least 57.3 metres (188 feet) below ground surface.
   The entire annular space between the steel casing and the overburden/ bedrock should be filled with a suitable cement or bentonite grout;
- A well grouting certification inspection should be conducted during the installation and grouting of the well casing for all future wells installed on the Site. The well grouting certification inspection should be conducted under the supervision of a professional engineer or professional geoscientist.
- The future production wells should be located proximal to TW21-1C within the proposed Communal Well location in accordance with any specific wellhead protection requirements. As the Nepean Aquifer is regionally extensive with similar hydrogeological properties, it is expected that comparable results in terms of groundwater quantity and quality will be obtained during communal well drilling at the proposed preferred location within the development area.

#### **6.2.2 Water Quality Recommendations**

- It is recommended that a water quality treatment specialist appropriately configure and size the treatment systems.
- It is recommended that homeowners and the Local Medical Officer of Health be informed that sodium concentrations exceed 20 mg/L and exceed the warning level for persons on sodium restricted diets.



#### 7.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Andrius Paznekas, M.Sc., P.Geo.

Hydrogeologist

Shaun Pelkey, M.Sc.E., P.Eng. Principal, Environmental Engineer

Stephen Livingstone, M.Sc., P.Geo.

Senior Hydrogeologist

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#### 7.2 Limitations

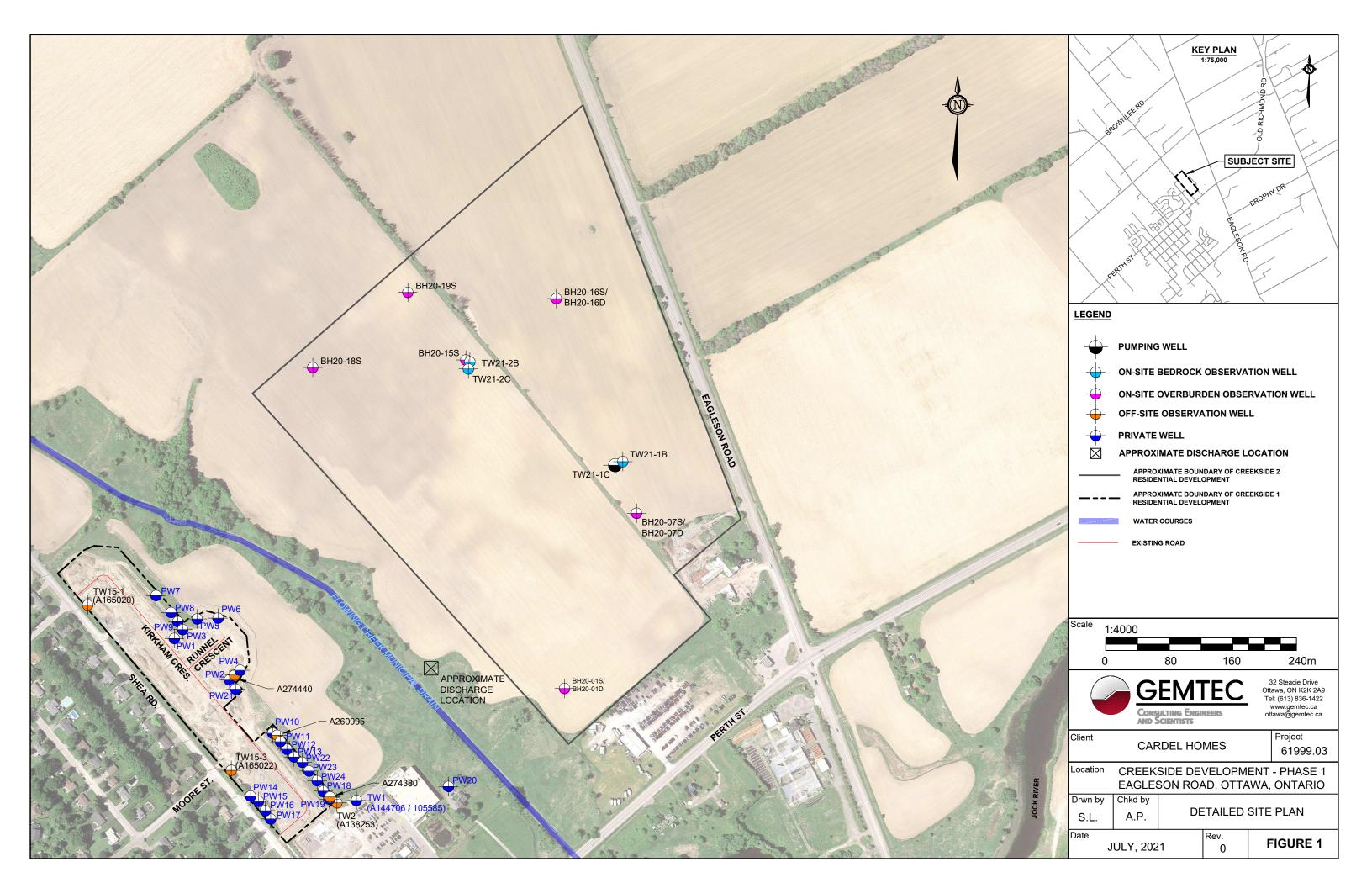
This report was prepared for 1470424 Ontario Inc. and is intended for the exclusive use of 1470424 Ontario Inc. This report may not be relied upon by any other person or entity without the express written consent of GEMTEC and 1470424 Ontario Inc. Nothing in this report is intended to provide a legal opinion.

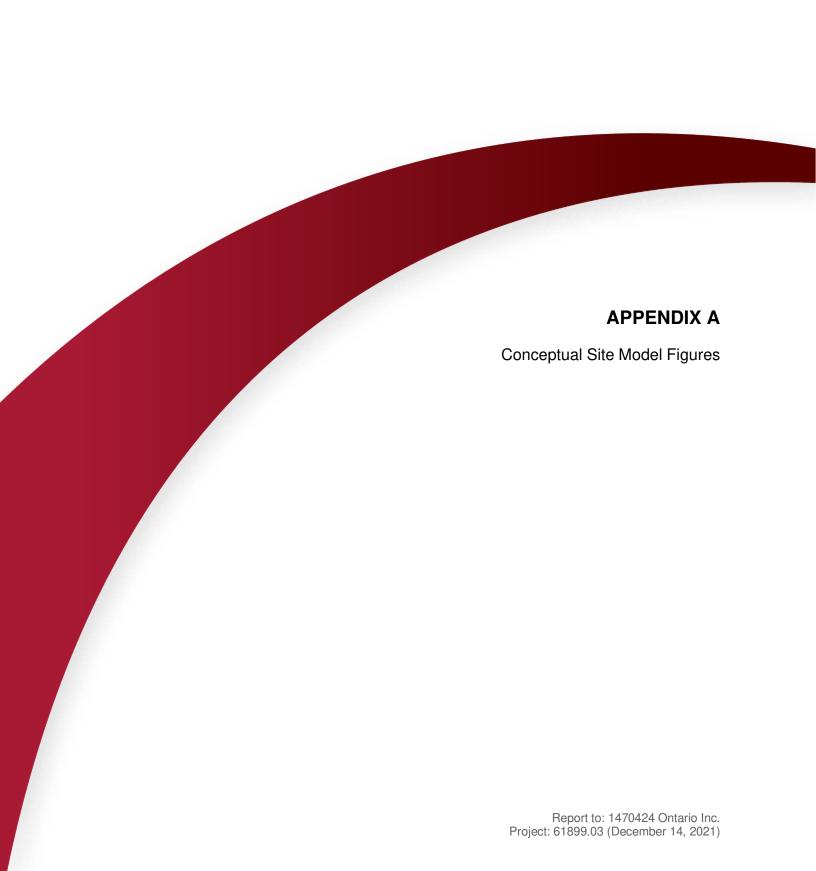
The investigation undertaken by GEMTEC with respect to this report and any conclusions or recommendations made in this report reflect the best judgments of GEMTEC based on the Site conditions observed during the investigations undertaken at the date(s) identified in the report and on the information available at the time the report was prepared. This report has been prepared for the application noted and it is based, in part, on visual observations made at the Site, subsurface investigations at discrete locations and depths and laboratory analyses of specific chemical parameters and material during a specific time interval, all as described in the report. Unless otherwise stated, the findings contained in this report cannot be extrapolated or extended to previous or future site conditions, portions of the Site that were unavailable for direct investigation, subsurface locations on the Site that were not investigated directly, or chemical parameters, materials or analysis which were not addressed.

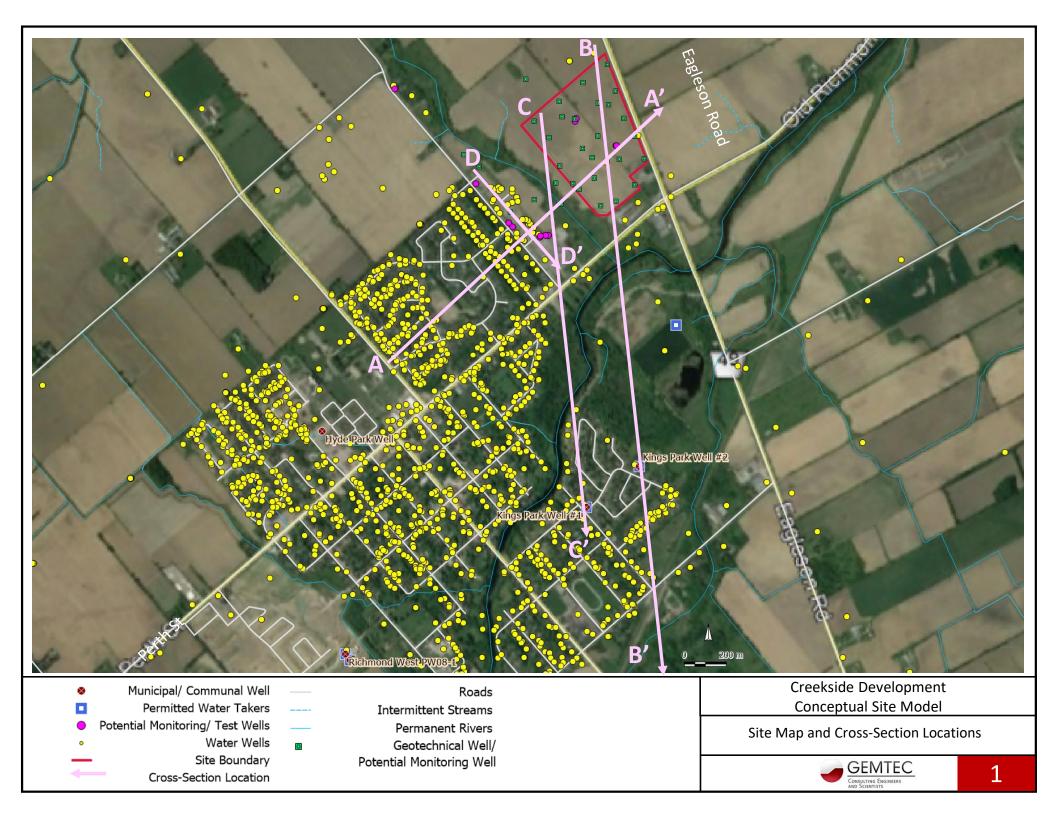
Should new information become available during future work, including excavations, borings or other studies, GEMTEC should be requested to review the information and, if necessary, reassess the conclusions presented herein.

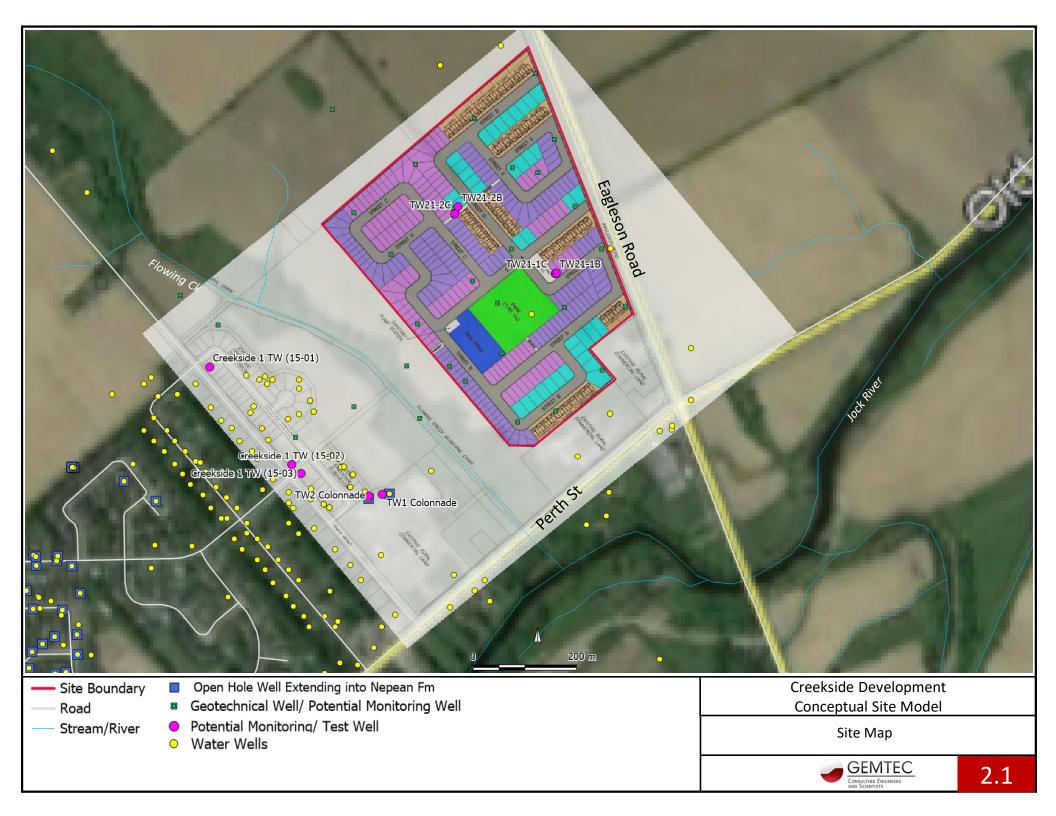


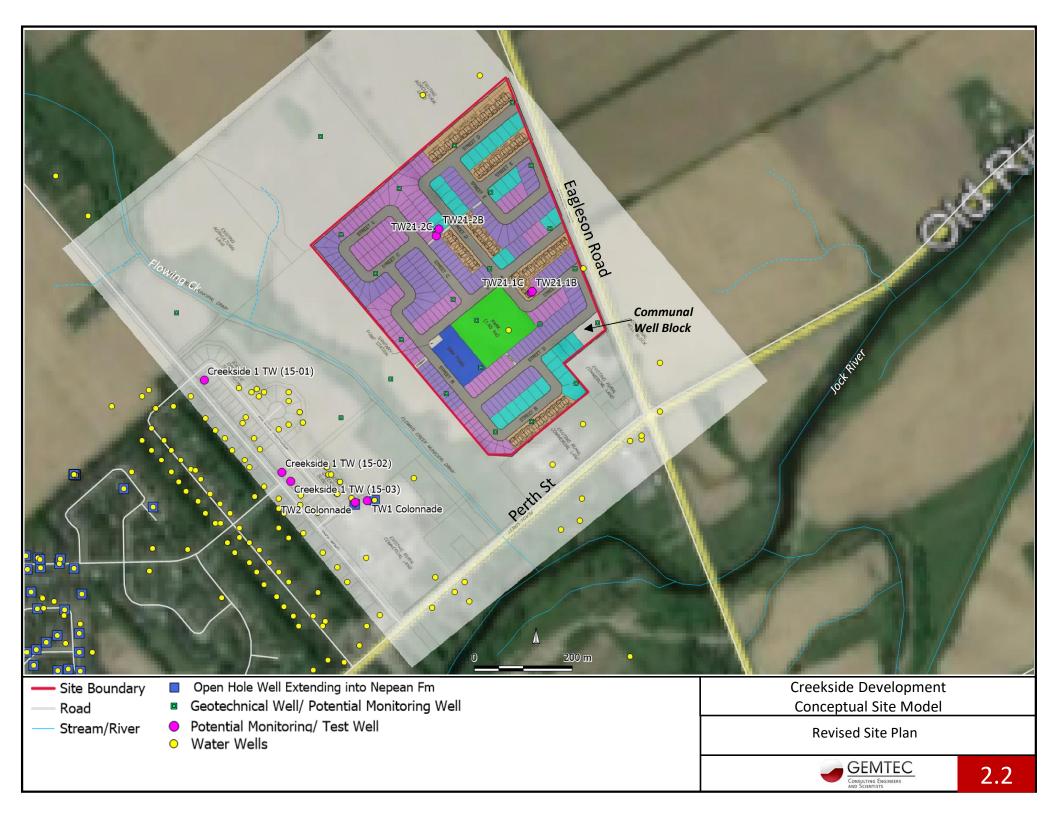
Report to: 1470424 Ontario Inc. Project: 61899.03 (December 14, 2021)

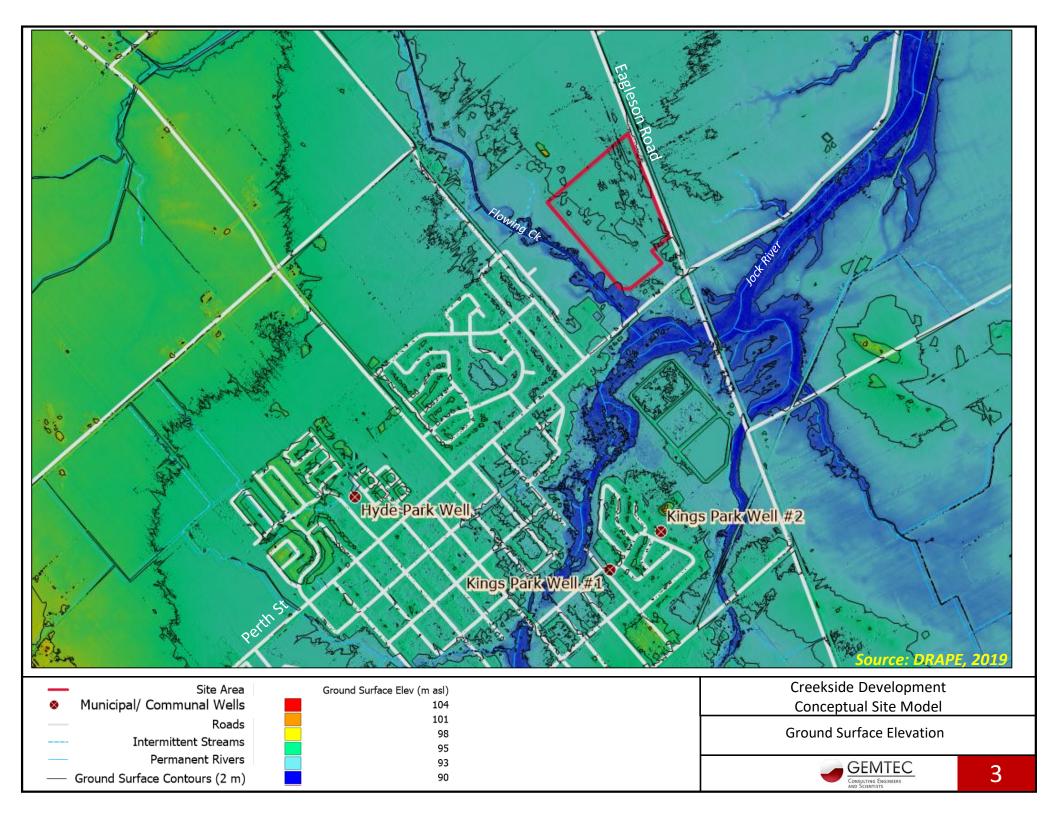


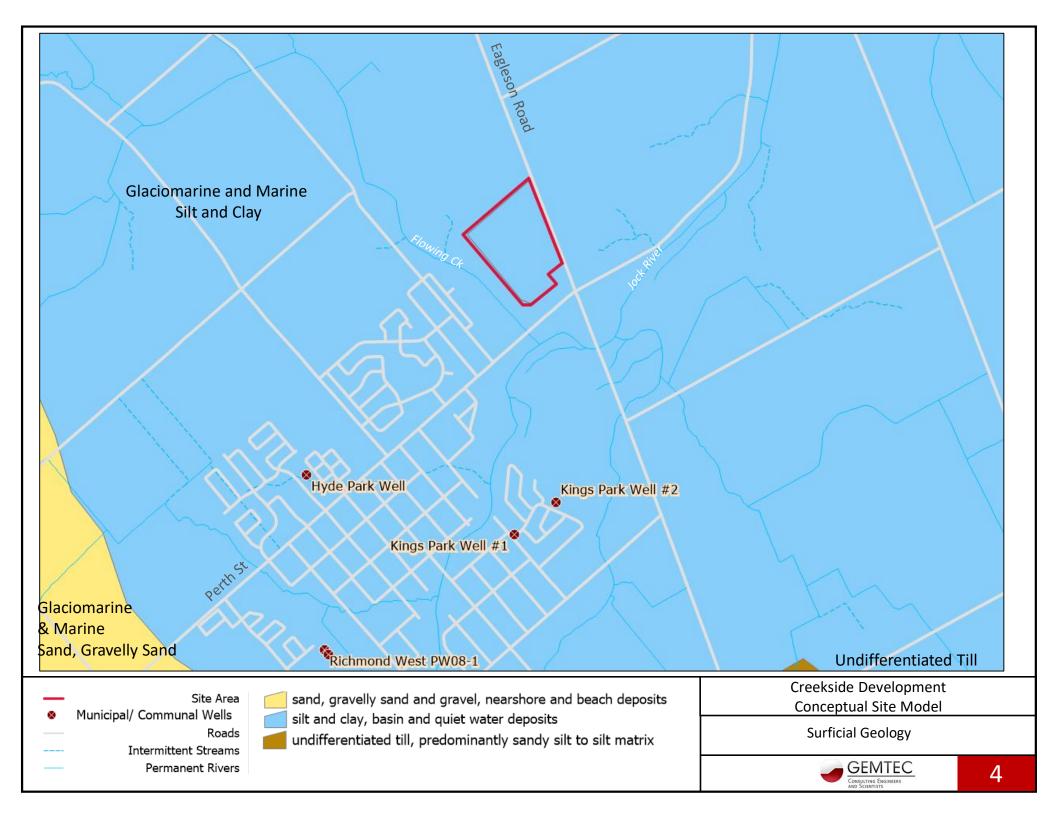


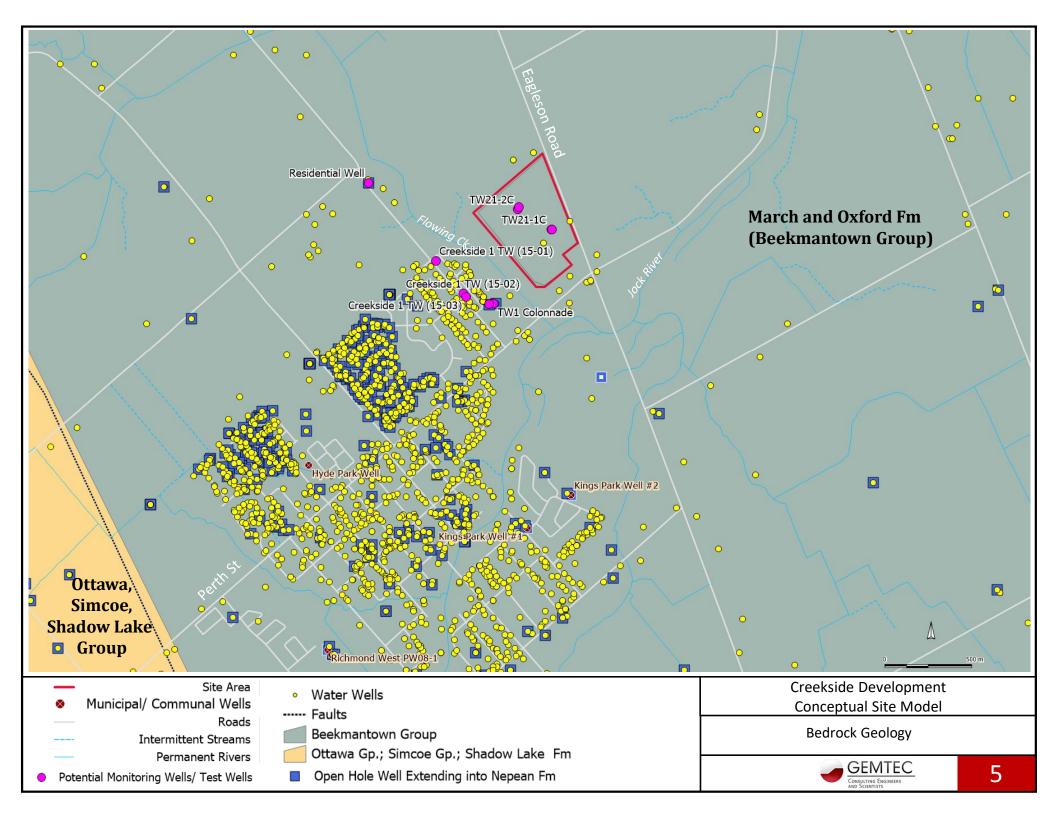


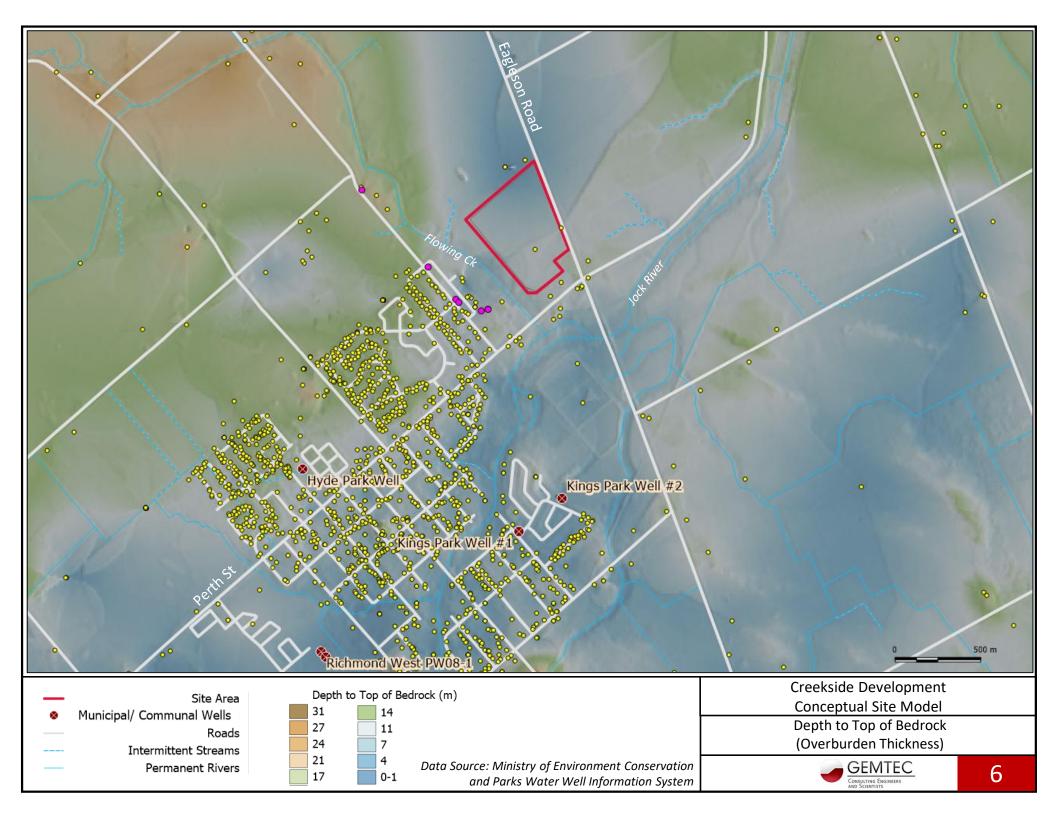


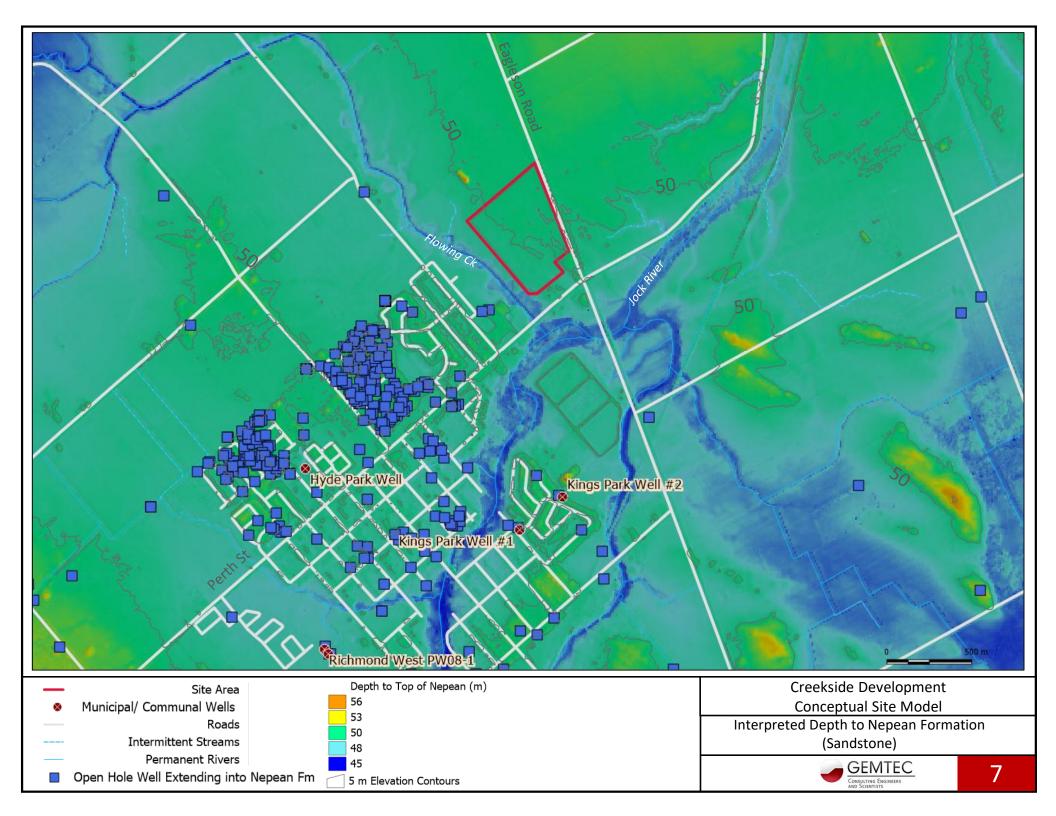


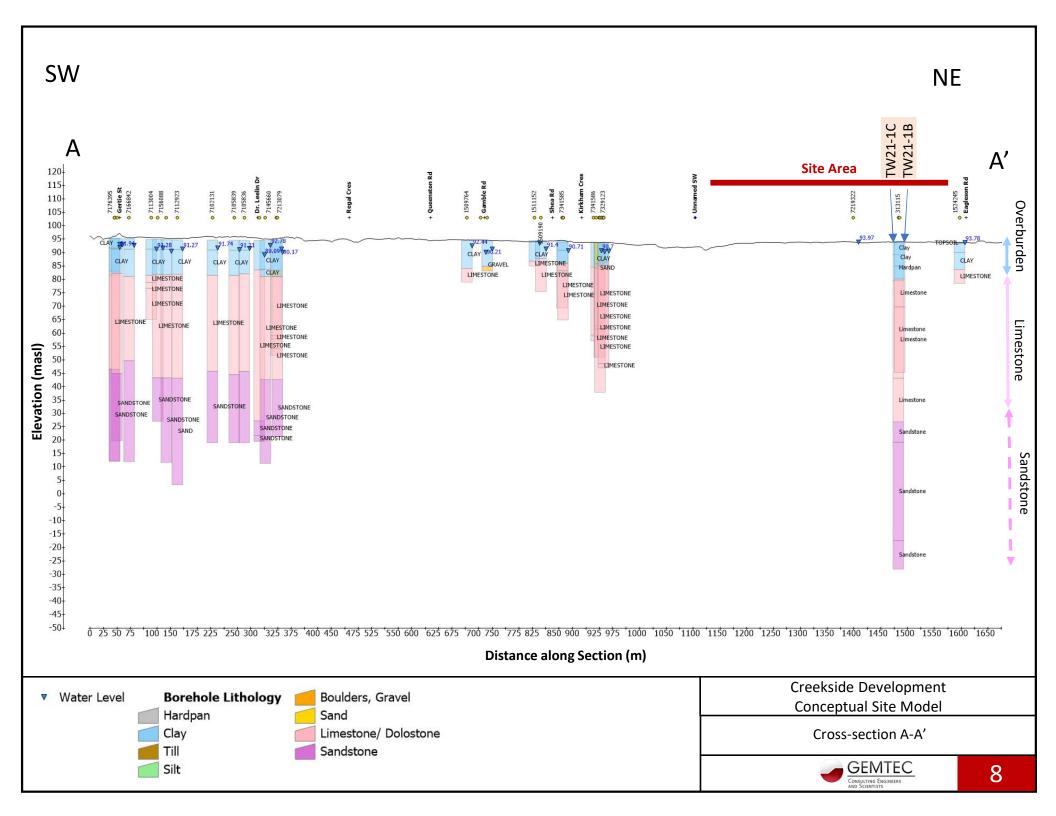


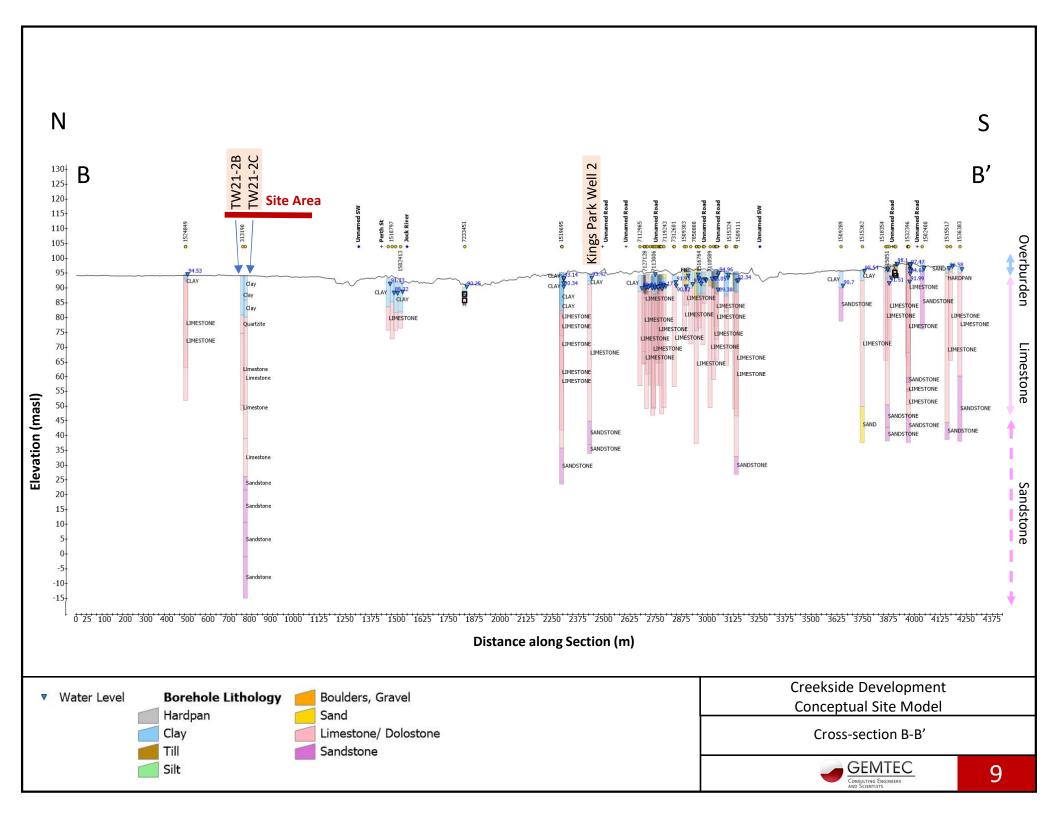


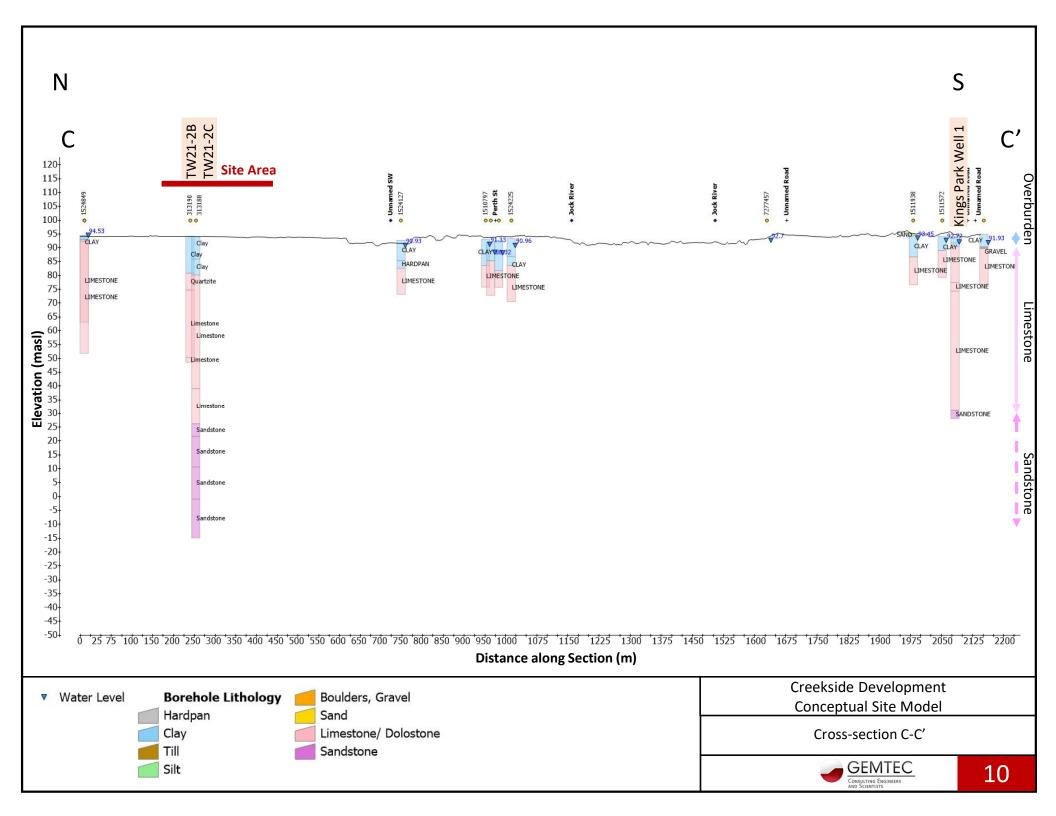


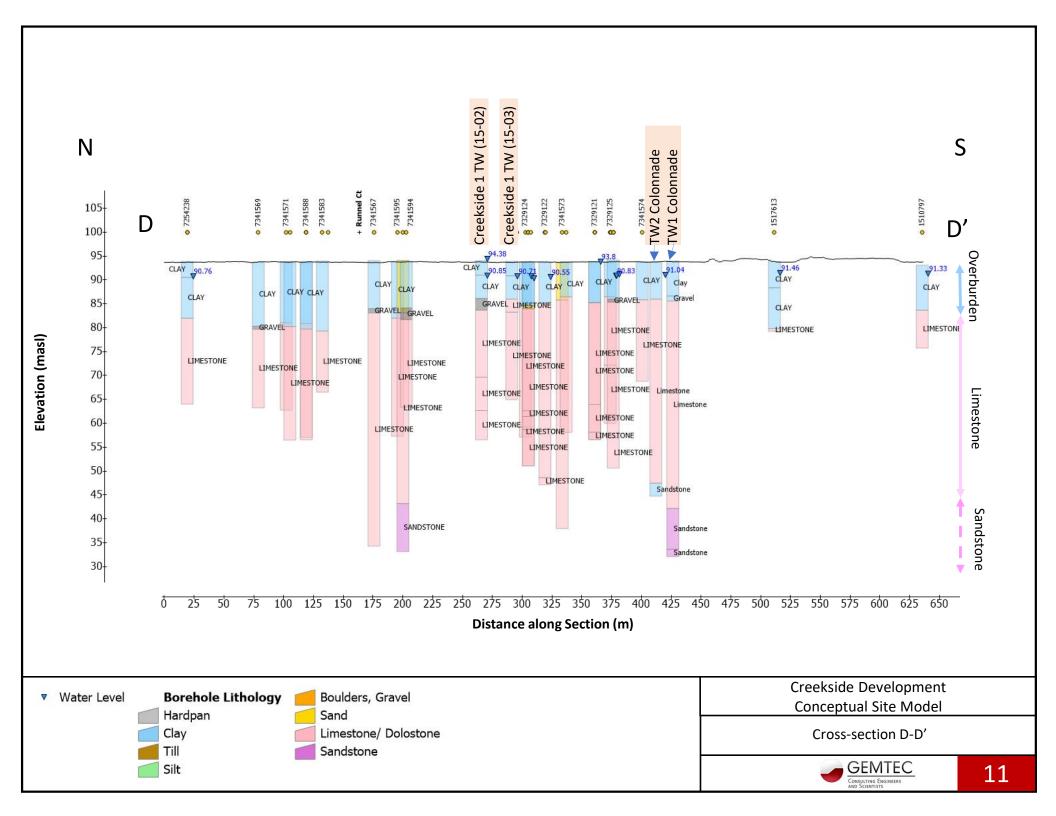


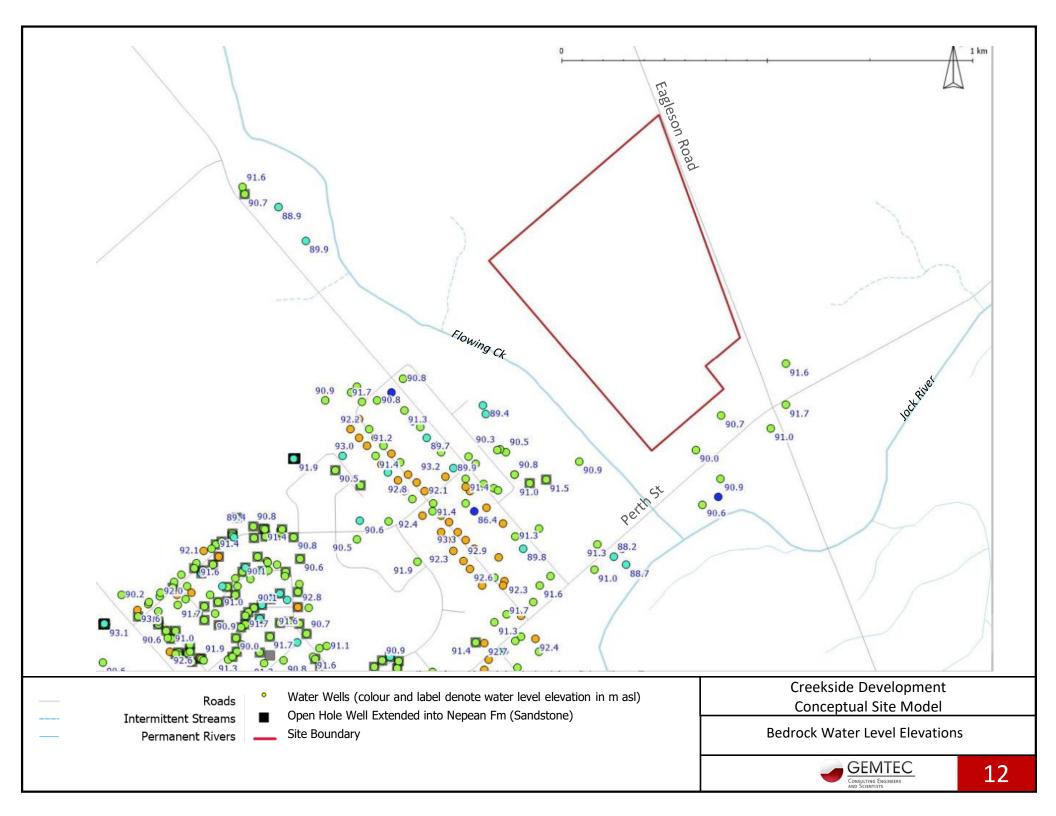


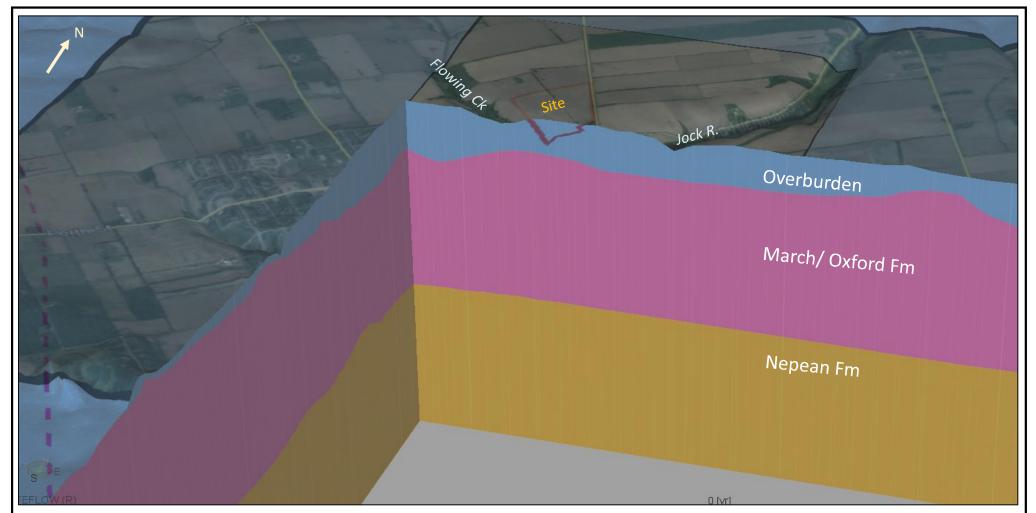










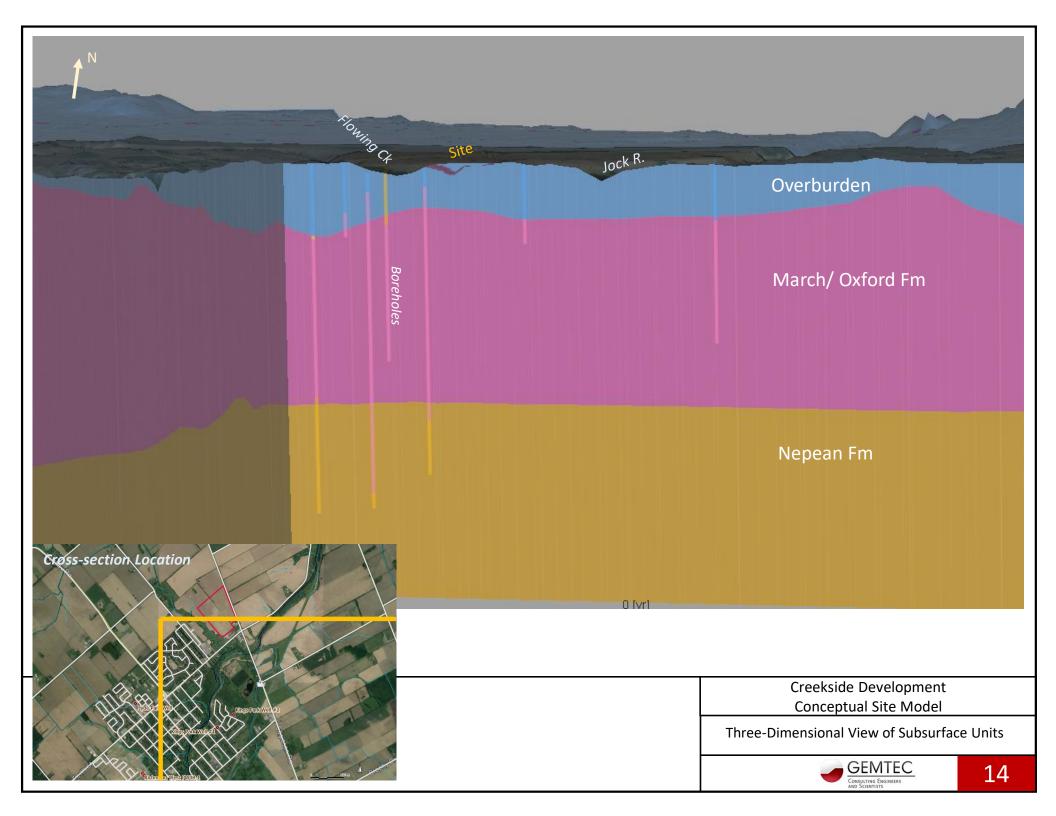




Creekside Development Conceptual Site Model

Three-Dimensional View of Subsurface Units







CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 16 2020

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CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 16 2020

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CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

Consulting Engineers and Scientists

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 16 2020

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CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

**GEMTEC** 

CONSULTING ENGINEERS AND SCIENTISTS

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 17 2020

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SHEAR STRENGTH (Cu), kPA PENETRATION SHEAR STRENGTH (Cu), kPA RESISTANCE (N), BLOWS/0.3m + NATURAL ⊕ REMOULDED SOIL PROFILE SAMPLES DEPTH SCALE METRES BORING METHOD ADDITIONAL LAB. TESTING PIEZOMETER OR STANDPIPE INSTALLATION STRATA PLOT RECOVERY, mm BLOWS/0.3m WATER CONTENT, % ELEV. ▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m DESCRIPTION DEPTH (m) 90 50 60 70 80 Ground Surface 93.44 Above Ground Protector & Bentonite TOPSOIL SS 150 6 Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST) Soil Cuttings 2 SS 405 6 МН 3 SS 510 ٠ **1** Bentonite 2 4 SS 610 5 50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe 3 Power Auger 5 SS 610 6 Stiff, grey SILTY CLAY SS 610 wн 6 WH 7 SS 610 5 Soil Cuttings WH 8 SS 610 6 Φ + End of borehole GEO - BOREHOLE LOG 61899.04\_BOREHOLE LOGS\_R0\_2020-07-17.GPJ GEMTEC 2018.GDT 11-30-20 7 8 10 GROUNDWATER OBSERVATIONS DEPTH (m) (m) 20-09-30 0.3 💆 93.1 12

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 3 2020

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1					2	SS	460	10												
									1											$\nabla$
2					3	ss	405	6	•	1			<b>-1</b> (	<b>}</b>						Bentonite
_																				
	(QO				4	SS	610	5	•											Filter Sand
3	10mm								-											50 mm diameter, 1.52
	Power Auger Stem Auger (210mm OD)				5	ss	610	4												metre length, slotted SCH 40
	Power			9 <u>0.07</u> 3.66				ľ	<b>.</b>											PVC Pipe
4	Hollow St	Stiff to very stiff, grey SILTY CLAY		0.00		00	240													
	위				6	SS	310	1												
5										<b>⊕</b> : :					<del>         </del>					
				88.40 5.33					-									::+:		
		Very loose to loose, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)			7	ss	405	2	•											
6		boulders (GLACIAL TILL)							1											
					8	ss	355	5	•											
ŀ		End of borehole	Ø /\\	87.02 6.71					-											KOT
7																				
8																				
9																				
10																			-	
11																			-	GROUNDWATE OBSERVATION:
																				DATE DEPTH (m)
																				20-09-30 1.7 💆
12				<u> </u>															L	
	(	SEMTEC																	LOGG	GED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 15 2020

1		ДОН -	SOIL PROFILE	<u> </u>	1		SAN	MPLES		●¦	PEN	ETRA ISTAN	TION NCE (N	), BLO	WS/0.3	S⊦ n +1	HEAR S	AL (	NG I ∌RI	EMOU	), KPA LDED	₽ NG NG	PIEZOMETE
METRES	COUTTING CIVID CO	AING ME	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	▲¦	DYN RES	AMIC ISTAN	PENE NCE, B	TRATIO	ON 0.3m	w			ONT W ⊖	ENT, 9	% ⊢∣w <sub>L</sub>	ADDITIONAL LAB. TESTING	OR STANDPIP INSTALLATI
i	2	Š R		STR	(m)	Ž		Ä	BLC		10	2	20 3	30	40	50 6	50 	70 	80	0 9	0	~ _	
0		H	Ground Surface TOPSOIL	1. 1. 1. 1. 1.	93.58 93.45 0.13																	-	Above Ground
			Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		0.13	1	SS	205	18			•											Protector & Bentonite
1			G.166.1)			2	ss	100	9		•												Soil Cuttings
2						3	SS	455	5				l	- 0									Bentonite
2		Jmm OD)				4	SS	610	4														Filter Sand
3	Power Auger	Stem Auger (210mm OD)								-												-	50 mm diameter, 1.52 metre length,
	2	Hollow Stem	Firm to stiff, grey SILTY CLAY		8 <u>9.92</u> 3.66	5	SS	610	2	-						(	<b>)</b>						slotted SCH 40 PVC Pipe
4		ゴ	THIN IO SUII, GIEY SILTT OLAT								Φ.	Φ:						#					
5						6	SS	610	WH							0.							Soil Cuttings
											÷ •			+									
6			End of borehole		87.48 6.10						⊕	1				†:::: <u>:</u>							
7																							
8																							
9																						-	
10																							
11																							GROUNDWATI OBSERVATIOI
																							DATE DEPTH (m) 20-09-30 2.1 ∑
12		$\lfloor   floor$			L																		
		G	SEMTEC																			LOGO	GED: ML
			SULTING ENGINEERS SCIENTISTS																				CKED: WAM

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jul 16 2020

	QQ	SOIL PROFILE				SAM	MPLES		● PE RE	NETRA SISTAI	TION NCE (N	), BLOV	/S/0.3m	HS 1 + r	IEAR ST NATURA	RENG ∖L⊕F	TH (Cu REMOU	), kPA LDED	ا ي	
MEIRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ DY RE	NAMIC SISTAI	PENE NCE, B	TRATIO LOWS/0	N ).3m	W <sub>F</sub>	WATEF	R CON' W	TENT, 9	% ⊢∣w <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
4	<u> </u>		ST				<u>«</u>	В	1	0 2	20 ;	30 4	0 5	ο ε	0 7	0 8	30 9	0 	$\sqcup$	
٥		Ground Surface TOPSOIL	11.1.1	93.58 93.45 0.13															-	600
1		Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		0.13																
2	er																			
3	Power Aug	56																		Soil Cuttings
	Po	NO ADOLO		8 <u>9.92</u> 3.66																
4		Firm to stiff, grey SILTY CLAY		3.66																
					1	TP	610	PM												
·  -		End of borehole		88.22 5.36					.⊕ ⊕		+	+								
6		Soil stratigraphy inferred from BH 20-5A																		
7																				
8																				
9																				
0																				
1																				
2																				

GEMTEC

Consulting Engineers
and Scientists

GEO - BOREHOLE LOG 61899.04\_BOREHOLE LOGS\_R0\_2020-07-17.GPJ GEMTEC 2018.GDT 11-30-20

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 14 2020

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE	PLOT	ELEV.	E		MPLES								m +	HEAR S NATUR WATE	AL ⊕	RE NTE	MOU	LDED	ADDITIONAL LAB. TESTING	PIEZOMETE OR STANDPIPE
M	BORING	DESCRIPTION	STRATA PLOT	DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m		YNAM ESIST 10	ANO 20		RATIO OWS/		W 50		— \ 70	<i>N</i> ⊖ 80	g	⊣ w <sub>∟</sub>	ADDII LAB. T	INSTALLATIO
0 -	Ī	Ground Surface		93.72				٣	:::	1:::	Ť						1:::	Ť				
		TOPSOIL  Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)	<u> </u>	93.52 0.20	1	ss	180	14		•												Above Ground Protector & Bentonite
1					2	SS	355	5	•			<b>D</b>		1							МН	Soil Cuttings
2					3	SS	610	5	•													Bentonite
	(O) mm				4	SS	610	5	•					<b>D</b>								Filter Sand
3	Power Auger				5	ss	610	5	•													50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
4	Po Hollow Stem	Stiff, grey SILTY CLAY		8 <u>9.91</u> 3.81	6	SS	610	WH														
										A					:+:							
5					7	66	610	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		<b>⊕</b>						+						Soil Cuttings
6					8	SS	610						0								_	
-		End of borehole		87.17 6.55																		
7																						
8																						
9																						
10																						
11																					-	GROUNDWATE OBSERVATION
																						DATE DEPTH (m)  20-09-30 2.0   ✓
12																						
		GEMTEC ONSULTING ENGINEERS ND SCIENTISTS																			LOG	GED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 20 2020

METRES	BORING METHOD	SOIL PROFILE	PLOT	ELEV.	ER		PLES,						WS/0.3r	n +1	NATUR.	R CON	REMOL	JLDED	ADDITIONAL LAB. TESTING	PIEZOMETEF OR STANDPIPE
ME	ORING	DESCRIPTION	STRATA PLOT	DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	1		PENE NCE, B			W <sub>i</sub> 50 6			30	W <sub>L</sub>	ADDI LAB. 1	INSTALLATIO
_	<u> </u>	Ground Surface	.v.	93.80			_	<u> </u>	'			::::	+0 :	1::::	1	70 8	::::	1::::		<del>                                     </del>
0		TOPSOIL	1,17, 1 WWW	93.65																Above Ground Protector &
		Stiff to very stiff, grey brown SILTY CLAY, with sand seams			1	SS	205	10												Bentonite
		(WEATHERED CRUST)							1											
1					2	SS	405	6	•											
0					3	ss	610	5	•		l		<b>1</b>							
2																				Soil Cuttings
	n OD)				4	SS	610	4												\ \Z\2
3	ler 210mr								-											\[ \sqrt{2}
	Power Auger em Auger (21			90.45 3.35	5	SS	610	6												
	Power Auger Stem Auger (210mm OD)	Very loose to compact, grey SILTY SAND, some gravel, with cobbles and		3.35	Ľ	33	010	ļ .												
4	Hollow S	boulders (GLACIAL TILL)							1::::									:::::		50
	물				6	SS	205	9												Bentonite
									1											· .
5					7	SS	205	3	•											Filter Sand
				1																
					8	ss	25	9		<b>}</b>										50 mm diameter, 1.52 metre length.
6																				metre length, slotted SCH 40 PVC Pipe
				87.27	9	ss	100	26			•									
Ī		Auger refusal End of borehole		87.27 6.53																
7																				
8																				
9																				
٥																				
10															: : : :					
11																			-	GROUNDWATER OBSERVATIONS
																				DATE DEPTH (m)
																				20-09-30 2.6 💆
12																				
	_	SEMTEC  DISULTING ENGINEERS	•		_				•		•	•	•				•	•		GED: ML

CLIENT: Cardel Homes

1 OF 1 SHEET: PROJECT: Geotechnical & Hydrogeological Investigation CGVD28 DATUM: JOB#: 61899.04

BORING DATE: Jul 17 2020 LOCATION: See Site Plan, Figure 1 SHEAR STRENGTH (Cu), kPA PENETRATION SHEAR STRENGTH (Cu), kPA RESISTANCE (N), BLOWS/0.3m + NATURAL + REMOULDED ETHOD SOIL PROFILE SAMPLES PIEZOMETER

$\neg$	DESCRIPTION	ATA	ELEV. DEPTH	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ DY RE	NAMIC SISTAI	PENE NCE, BI	TRATIC LOWS/	0.3m	W	WATE			., ,,   W <sub>L</sub>	ADDITIONA LAB. TESTIN	OR STANDPIPE INSTALLATIOI
DEPTH SCA METRES BORING MET		STRATA PLOT	(m)	ž		Ä	BLO	1	0 2	20 3	30 4	10 5	50 6	60 T	70 I	80 I	90	^ _	
- 0	Ground Surface TOPSOIL	121 1x - 11	93.80																Above Ground Protector &
	Stiff to very stiff, grey brown SILTY		93.65 0.15																Protector & Bentonite
	CLAY, with sand seams (WEATHERED CRUST)																		
- 1																		-	Soil Cuttings
GO	( <u>GO</u> 1																		
er 210mr	210mr																		Bentonite
Power Auger	uger (																	1	$\nabla$
Pow Stem A	Stem A																		Filter Sand
s wollo	Hollow Stem Auger (210mm OD)																		50 mm
3   일	<b>-</b>		90.45																50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	Very loose to compact, grey SILTY		90.45 3.35																PVC Pipe
4	Very loose to compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)																		
	End of borehole		89.53 4.27																Soil Cuttings
	Soil stratigraphy inferred from BH 20-7A																		
5																			
6																		1	
7																			
8																		_	
9																			
10															1:::			1	
																			GROUNDWATER
- 11																			OBSERVATIONS DATE DEPTH
																			20-09-30 2.1 <u>V</u>
- 12																			
	CEMTEC	1						::::	::::	::::	::::		: : : :	::::	1:::	:   : :		160-	
	GEMTEC Consulting Engineers																		GED: ML CKED: WAM

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 CGVD28 BORING DATE: Jul 6 2020

į	HOP	}	SOIL PROFILE		1		SAN	//PLES	_	● PE RE	NETR SIST	ATION NCE (	N), BLC	)WS/	/0.3m	+1	IATUR	TRENG AL ⊕ F	REMOL	J), kPA JLDED	   ₽   Q	
METRES	BORING METHOD		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	DY	NAMI	C PENI	ETRAT BLOWS	ION	<b></b>			R CON W			ADDITIONAL LAB. TESTING	PIEZOMETE OR STANDPIPE
7 ≥	30RIN		DESSIAI NON	TRAT	DEPTH (m)	≥S	}	RECO	SLOW:			20	30	40	50	W <sub>F</sub>		_		W <sub>L</sub> 90	ADI	INSTALLATIO
	Ī	+	Ground Surface	S	93.70				Т		1:::	<u> </u>	:   : : :	+		::::	<u> </u>		1::::	1::::		
0		┪	TOPSOIL		0.10																-	Above Ground Protector & Filter Sand
			Stiff to very stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)			1	SS	355	9	-												Filter Sand
1						2	ss	405	5	•												
																						Bentonite $\underline{\underline{\hspace{-0.2cm} \sum}}$
2						3	SS	610	5													 i:
	í	n OD)				4	ss	610	5						0							Filter Sand
3	$\simeq$	er (210mm OD								-											-	50 mm diameter, 1.52 metre length,
	ě.	Stem Auger			9 <u>0.04</u> 3.66						⊕ : :								: : : -	-		metre length, slotted SCH 40 PVC Pipe
4	l	Hollow St	Firm, grey SILTY CLAY			5	ss	610	WH	1			φ									
		_																				
5						6	TP	610	PM	-											-	
					88.06 5.64															::+:		Soil Cuttings
6			Very loose grey SILTY SAND, some gravel, with cobbles (GLACIAL TILL)						-	-												
			End of borehole		86.99 6.71	7	SS	150	2	•												
7			End of boreflore		0.71																-	
8																					-	
9																						
10																						
11																						GROUNDWATE OBSERVATION
																						DATE DEPTH (m)  20-09-30 1.8 ∑
12																						
		G	SEMTEC	•		-				•	•		•					•		•	LOGG	GED: ML
			ISULTING ENGINEERS SCIENTISTS																		CHEC	KED: WAM

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 CGVD28 BORING DATE: Jul 17 2020

S ALE	THOD	SOIL PROFILE	T <sub>F</sub>	1		SAN	IPLES	1	● PE RE	NETR/ SISTA	ATION NCE (N	), BLOV	WS/0.3n	HR 1 + r	EAR S NATUR	TRENG AL ⊕ F	REMOL	u), kPA JLDED	₽ NG NG	PIEZOMETER
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	▲ DY	/NAMIC ESISTA	PENE NCE, B	TRATIC LOWS/	ON 0.3m	W <sub>F</sub>		R CON	TENT,	% ⊢∣w <sub>L</sub>	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
,	B		STE	(m)	_		2	BLG		10	20 ;	30 4	40 5	io 6	0 7	70 8	30	90		
0		Ground Surface TOPSOIL		93.81	1	SS	205	8												Above Ground Protector & Bentonite
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)			_	33	203		-											
1					2	SS	610	9		) : : : : : ) : : : : :	: : : : : : : : : : : : : : : : : : :	0	<del> </del>							Soil Cuttings
2					3	ss	610	7	•											Bentonite
	=																			Filter Sand
	mm OD				4	SS	535	4	•											
3	Power Auger Stem Auger (210mm OD)				5	ss	610	3	•											50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	Power tem Aug					33	010	-	-											50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
4	Hollow S	Stiff, grey SILTY CLAY		8 <u>9.85</u> 3.96					<b></b>				1							
									-	Φ				:: <del>   </del>						
5					6	ss	610	1												
										Φ				#						
6		Compact, grey SILTY SAND, some		88.09 5.72																
6		Compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)			7	ss	355	15												
-		End of borehole		87.10 6.71																6
7																				
8																				
9																				
10																				
11																				GROUNDWATER OBSERVATIONS
																				DATE DEPTH (m) 20-09-30 2.2 \( \subseteq \text{ \subseteq} \)
12																				

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 13 2020

S	ТНОБ	SOIL PROFILE	Ŀ			SAM	IPLES		● PE RE	NETR SISTA	ATION NCE (	I N), BL	.OWS	/0.3m	SH + N	EAR S' IATUR/	TRENG AL ⊕ F	REMO	Cu), kPA ULDED	ING ING	PIEZOMETE
DEP IN SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m			C PEN NCE,	ETRA BLOW	TION 'S/0.3i	m 5(	W <sub>F</sub>		₩ —		, %   W <sub>L</sub> 90	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
0		Ground Surface TOPSOIL	174 18. 14	93.68																	Above Ground
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		93.48 0.20	1	SS	100	11		•											Protector & Bentonite
4		CLAY (WEATHERED CRUST)																			
1					2	SS	75	9													I 150
					3	SS	405	5	•		H			<b>0</b>							
2																					
					4	SS	610	4	•												1 bu
3																					
					5	SS	610	4	•				d								Soil Cuttings
4		Firm to stiff, grey SILTY CLAY		8 <u>9.87</u> 3.81	6	SS	610	1												-	
	0mm OD)					00	010	-													
5	(2 ge											+									
	Power Auger em Auger (21								: :⊕:				+	-::::							
	Power Au Hollow Stem Auger				7	SS	610	WH							С	}					
6	Hol								<b>□</b> □ ⊕					-	-						
										•					+						
7				86 36	8	SS	610	1	•				::								Bentonite
		Loose, grey SILTY SAND, some gravel, with cobbles and boulders		86.36 7.32																	Filter Sand
8		(GLACIAL TILL)			9	SS	405	3	•											-	50 mm
																					diameter, 1.52 metre length, slotted SCH 40
9				04.54	10	SS	610	4	•	0											PVC Pipe
		Compact, grey SILTY SAND, some gravel, with cobbles and boulders		8 <u>4.54</u> 9.14	11	SS	455	28													
		gravel, with cobbles and boulders (GLACIAL TILL)																			Soil Cuttings
10	$\perp$	Fad of basebal		83.32 10.36	12	SS	610	27		0:											Notes:
		End of borehole		10.36																	Monitoring well blocked at 2.1m depth
11																				1	
9 11 11																					
12																					
	(-	SEMTEC	•	•							1	1	- (					1		LOGG	GED: ML

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 14 2020

ا ا	THO	SOIL PROFILE	T <sub>F</sub>			SAN	IPLES		● PE RE	NETR SISTA	ATION NCE (N	N), BLC	WS/0.3	m +1	NATUR	AL ⊕	REMOI	u), kPA JLDED	IA NG NG	PIEZOMETE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ D'	/NAMI	C PENE	TRATI	ON /0.3m	w		R CON		% —  w <sub>L</sub>	ADDITIONAL LAB. TESTING	OR STANDPIPI INSTALLATIO
3	BOR		STRA	(m)	N		REC	BLO		10 I	20 	30	40 	50 (	60 1	70 i	30 I	90	₹₹	
0	+	Ground Surface TOPSOIL	74 1 <sup>N</sup> . 7f	93.68 93.48 0.20																Above Ground Protector &
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.20																Bentonite
1		,																		Soil Cuttings
2	m OD)																			Bentonite
	uger r (210m																			Filter Sand
ľ	Fower Auger Hollow Stem Auger (210mm OD)																			
3	llow Ste																			50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	Ĭ			8 <u>9.87</u> 3.81																PVC Pipe
4		Firm to stiff, grey SILTY CLAY		3.01																
																				Soil Cuttings
5		End of borehole		88.50 5.18																
		Soil stratigraphy inferred from BH 20-10A		0.10																
6																				
7																				
8																				
9																				
10																				
11																			1	GROUNDWATE OBSERVATION
																				DATE DEPTH (m) 20-09-30 2.1 ∑
12																			-	
	(	SEMTEC	•	•		1	1			1	1	1	1	1		1	1 1	1	LOGO	GED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 10 2020

ွ	THOL	SOIL PROFILE	<b>⊢</b>	1		SAN	IPLES			INETR/ SISTA	ATION NCE (N	N), BLO	WS/0.3	⊣2 1+ m	NATUR	TRENG AL ⊕ I	REMO	ULDE	ĒD	ING ING	PIEZOMETE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	WATER CONTENT, % OF STAND									OR STANDPIPE INSTALLATIO			
_	BORIN	<del></del>		DEPTH (m)	NC	F	RECC	BLOW						νν <sub>ι</sub> 50 6	§0 ·	Ŭ	30	90 90	' <b>'</b> L	AB	IIVƏTALLATI
0	$\top$	Ground Surface		93.77						: : : :	::::			:::::	::::	1::::	:::				Above Creened
ا		TOPSOIL	<u> </u>	93.57 0.20	1	ss	125	9		<b> </b>											Above Ground Protector & Bentonite
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)							1::::												
1					2	SS	230	6									::::				Soil Cuttings
					_		200	Ľ	 												
					3	SS	640	5	1												Bantanita.
2					3	33	610	3													Bentonite
	()								1												Filter Sand
	mm O				4	SS	610	4													
3	Power Auger Stem Auger (210mm OD)								-												50 mm diameter, 1.52 : metre length, slotted SCH 40 PVC Pipe
ľ	Power Auger em Auger (21			90 11	5	SS	610	3	•												metre length, slotted SCH 40 PVC Pipe
4	w Sten	Firm, grey SILTY CLAY		9 <u>0.11</u> 3.66																	
1	Hollow				6	ss	610	WH													.·.    -
		Very loose to loose grey CLAYEY SILT, some sand, trace gravel		89.30 4.47																	
5		OILT, Some Sand, Hace graver			7	ss	405	4	•				φ							МН	
				88.28																	
		Loose to compact, grey SILTY SAND,		5.49	8	ss	205	23			•										Soil Cuttings
6		Loose to compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)																			
					9	ss	455	10		•											
ŀ		End of borehole	1717	87.06 6.71					-												
7																					
8																					
9														1::::							
10																	1:::				
,,																					CBU INDWATE
11																					GROUNDWATE OBSERVATION DATE DEPTH
																					20-09-30 2.3 <u>V</u>
12																: : : :					
ᅼ		SEMTEC						1	1::::	::::	1::::		1::::	::::	::::		1:::	:   : :			ED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 17 2020

S	모	SOIL PROFILE	<b> </b>			JAN	IPLES		● RE	SISTA	NCE	(N), I	BLOW	S/0.3m	SH + N	IATUR	AL ⊕	REMO	DUL	DED	ING ING	PIEZOMETE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	D\ ▲ RE	/NAMI	C PEN	IETR BLO	ATION	N .3m	W	WATE	R CON	ITENT		, ⊣w <sub>L</sub>	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
2	BORII		STRAI	DEPTH (m)	) N	<u> </u>	RECC	BLOW			20	30	4(		0 6	0 .	Ŭ	80	90		PBB	INSTALLATIO
0		Ground Surface		93.94						:::							::::	:::	:			About Cround
		TOPSOIL  Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.10	1	SS	100	12		•												Above Ground Protector & Bentonite
1		SEAT (WEATHERED GROST)			2	SS	355	9														Soil Cuttings
2					3	SS	610	5	•		1			10					1			Bentonite
	(0)	(QO m			4	SS	610	4														Filter Sand
3	Auger	Wery loose to loose, grey SILTY SAND, some gravel, with cobbles and				00	040		<del>                                      </del>												-	50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	Power Auger	Very loose to loose, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		90.49 3.45	5	SS	610	4	• 													PVC Pipe
4	WO IIO	boulders (GLĂCIAL TILL)			6	SS	255	4	•												-	
_					7	SS	255	5														
5				88.61 5.33																		Soil Cuttings
6		Compact, grey SAND, some gravel			8	SS	355	28	-			•										
				07.00	9	ss	455	24			•											
7		End of borehole		87.23 6.71																	_	
8																						
9																						
10																					-	
11																						GROUNDWATI
																						GROUNDWATE OBSERVATION  DATE DEPTH (m)  20-09-30 2.6 \(\sqrt{2}\)
12																						25 55 50 2.0 <u>v</u>
	(	GEMTEC	1	1	<u> </u>	<u> </u>	<u> </u>		1	1	. 1	· ·   ·					1	1			LOGG	GED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: CC JOB#: 61899.04 BORING DATE: JULy

LOCATION: See Site Plan, Figure 1

**GEMTEC** 

Consulting Engineers and Scientists

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 6 2020

	임		SOIL PROFILE				SAM	/IPLES	1	● PE RE	NETR.	ATION NCE (N	), BLOV	VS/0.3m	H2 1+ г	IEAR S	TRENG AL ⊕ F	STH (Cu REMOU	), kPA LDED	AL NG	
METRES	<b>BORING METHOD</b>		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m			C PENE NCE, BI		N ).3m 10 5	W <sub>F</sub>	<sub>P</sub>	₩		% ⊢  W <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0 -	Ť	+	Ground Surface	S	93.97				Ш		1:::		1			, 		1::::			
U			TOPSOIL  Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.08	1	SS	355	11		•										Above Ground Protector & Filter Sand Bentonite
1						2	SS	510	9		)										Soil Cuttings
2						3	SS	610	8	•	)	€	<b>}</b>							МН	Bentonite
2	á	OD)				4	SS	610	3	•											Filter Sand
3	Power Auger	Stem Auger (210mm OD				5	SS	610	2				O								50 mm diameter, 1.52 metre length, slotted SCH 40
4	Power	w Stem Aug	Firm to stiff, grey SILTY CLAY		9 <u>0.46</u> 3.51	5	33	טוט													PVC Pipe
4		Hollow												+							
5						6	SS	610	WH												
						7	SS	610	1					0							Soil Cuttings
6					07.76						1::::			::+:							
7			End of borehole		87.26 6.71										: <del>   </del> : :						<u>er v</u>
8																					
9																					
7 8 8 9																					
11																					GROUNDWATER OBSERVATIONS  DATE DEPTH 1
																					20-09-30 1.8 <u>V</u>

LOG

LOGGED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 CGVD28 BORING DATE: Jul 9 2020

METRES	BORING METHOD	SOIL PROFILE	PLOT	ELEV.	ER		JERY,									+ N	NATUR	TRENG AL ⊕	RE NTE	MOU	LDEI		ADDITIONAL LAB. TESTING	PIEZOMET OR STANDPII	TEF
ME	ORING	DESCRIPTION	STRATA PLOT	DEPTH (m)	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m		ESIST	20		TRATIO LOWS	0.3m 40		W <sub>F</sub>		 70			⊣ w o	L	ADDI LAB. 1	INSTALLAT	ΓΙΟ
_	Ш	Ground Surface	, v	93.91		$\vdash$	$\vdash$	┼	1			:::	0 	10	50	. 0	60 	, <u>, , , , , , , , , , , , , , , , , , </u>	80			+			_
0		TOPSOIL	71 17. 7.	93.91																				Above Ground Protector &	
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		0.20	1	SS	50	11																Bentonite	
									-															Soil Cuttings	
1					2	SS	50	4	•															- 0	2022
									1															Ž	70
2					3	SS	455	3	•		+			<b>-</b> K	) : : : :								MH	Bentonite	
	(00)								1															Filter Sand	
	er 210mn				4	ss	610	3	•					C	): : 									Filter Saliu	
3	Power Auger								-		: :	:::												50 mm diameter, 1.52	
	Power Auger				5	ss	610	2	•					ф										metre length, slotted SCH 40 PVC Pipe	
	Hollow	Firm to stiff, grey SILTY CLAY		9 <u>0.25</u> 3.66					1::::																
4	I	E T IIII to Sun, grey OLETT OLAT								⊕					+:									[· 2	 50
									-	Ψ.														) 2	DY.
5					6	SS	610	WH								) : : :								) (1) (2)	
																								Soil Cuttings	分子
										⊕:				+	-: :									Ď.	17.77 17.77 17.77
6				87.81 6.10							⊕ : Đ :			+:			## E								ŽŽ
		End of borehole		6.10																					
7																									
8																									
9																									
10												: : :													
,												<u>: : :</u> : :												GROUNDWA	
11																								OBSERVATION DEPTH	ION
																								20-09-30 2.2 \(\sum_{\text{DATL}}\)	<u>z</u>
12																									+
$\dashv$		GEMTEC		<u> </u>	<u> </u>				1::::	1:::	: :	:::	: : : :	1::	::	::::	[::::	1:::	:   :	111	: : :			ED: ML	_

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 10 2020

SEL	THO	$\vdash$	SOIL PROFILE				SAM	IPLES	1	● PE RE	NETR/ SISTA	ATION NCE (N	I), BLO\	NS/0.3r	SH n + N	EAR S	TRENG AL ⊕ F	TH (C	ı), kPA JLDED	NAL TING	PIEZOMETE
METRES	BORING METHOD		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	1			TRATIC LOWS/		W	,—	R CON W 		%   W <sub>L</sub> 90	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
0	Ï	Gı	ound Surface DPSOIL	ν	94.09				ш										1::::		Above Ground
			iff to very stiff, grey brown SILTY LAY (WEATHERED CRUST)		93.89 0.20	1	ss	355	8	•											Protector & Bentonite
1		Ci	LAY (WEATHERED CRUST)																		Soil Cuttings
						2	SS	0	9	-											
						3	SS	405	7	•		: : : : : : : : : : : : : : : : : : :		}							Bentonite
2	á	(00)																			Filter Sand
	uger	1 (200111				4	SS	610	6	•											I 184
3	Power Auger		ery loose to compact, grey gravelly LTY SAND, some clay, with cobbles		91.04 3.05	5	SS	355	6			0								МН	50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	č	ar MOIDL	d boulders (GLACIAL TILL)																		PVCPipe
4	=					6	ss	200	1												
						7	SS	200	26			•									
5					88.76 5.33		33	200	20												Soil Cuttings
		Lo	ose, grey SAND		5.33	8	ss	355	6	•		) 								МН	
6	-	Eı	nd of borehole		87.99 6.10																
7																					
8																					
9																					
																	1::::				
10																				-	
11																					GROUNDWATEI OBSERVATIONS
																					DATE DEPTH (m)  20-09-30 2.4
12																					25 55 50 2.4 2

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 7 2020

ွ		SOIL PROFILE	<sub> </sub>			SAN	IPLES		<b>●</b> RE	SISTA	NCE (N	I), BLO	NS/0.3r	H2 1+ m	IEAR S' NATUR/	AL ⊕ F	REMOL	JLDED	ING ING	PIEZOMETE
METRES	BORING METHOD		STRATA PLOT	ELEV.	3ER	ا س	RECOVERY, mm	BLOWS/0.3m	DY	NAMIC	PENE	TRATIC	ON			R CON	TENT,		ADDITIONAL LAB. TESTING	OR STANDPIPI
ME	ORING	DESCRIPTION	RATA	DEPTH	NUMBER	TYPE	ECO	OWS						W		<del></del>		⊢ W <sub>L</sub>	ADD	INSTALLATIO
_	B		ST	(m)			Ψ.	H H	1	0 2	20 :	30	40 !	50 6	60 7	0 8	30 !	90 <del> </del>		ļ
0	+	Ground Surface TOPSOIL	131/1/23	93.77																_
		Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST)		0.10	1	ss	310	9												Above Ground Protector & Bentonite
1		(WEATHERED CRUST)			2	SS	610	8			I - C		-1							
							-													
2					3	ss	610	5	•											
									1::::											
					4	ss	610	4	•			0								\[ \times \big  \]
3				9 <u>0.72</u> 3.05					-											\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \
		Firm to stiff, grey SILTY CLAY, trace sand seams			5	SS	610	1												Soil Cuttings
4									1	P: : : :										l 16
-	m OD)									<b>.</b>		: : : H	-							
	ger (210m								-											
5	Fower Auger Hollow Stem Auger (210mm OD)				6	TP	610	PM												
ľ	w Sten								⊕			#: : : :								
6	Hollo													+						
					7		610	\A/I I												
						SS	610	WH												Ö
7										Φ						: : : : : : : : : : : : : : : : : : :				Bentonite
										Φ:::							:::+	-		
					8		610	\A/I I	1											Filter Sand
8					°	SS	610	WH	<u> </u>											50 mm: diameter, 1.52
										⊕ ::				-						metre length, slotted SCH 40 PVC Pipe
9										Φ						::::::				
					9	SS	310	2	•			φ								Soil Cuttings
		End of borehole		83.91 9.86					-											
10																				
11																				GROUNDWATE OBSERVATION
																				DATE DEPTH (m)  20-09-30 2.6 ∑
12																				
		SEMTEC_							::::		::::		::::							

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 7 2020

∜,	THOL	SOIL PROFILE				SAM	PLES		● PE RE	NETR SISTA	ATION NCE (N	N), BLO	WS/0.3r	1+ n	IEAR S NATUR	TRENG AL + F	REMOL	u), kPA JLDED	AR NG	D.E.30. :===
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ DY RE	NAMIC SISTA	C PENE NCE, E	ETRATIONS	ON /0.3m	w		R CON	TENT,	%   w <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETEF OR STANDPIPE INSTALLATIOI
	BOR		STRA	(m)	N	'	REC	BLO	1	10	20 	30	40 5	50 6	30 T	70 8	30 I	90 	₹5	
0		Ground Surface TOPSOIL		93.77 0.10															_	Above Ground Protector &
		Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST)		00																Bentonite
1	(Q																			Soil Cuttings
	10mm C																			∑ 🔀
2	Power Auger em Auger (21																			Bentonite
	Power Auger Hollow Stem Auger (210mm OD)																			Filter Sand
3	Hollow			9 <u>0.72</u> 3.05																50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
		Firm to stiff, grey SILTY CLAY, trace sand seams																		metre length, slotted SCH 40 PVC Pipe
4																				
-		End of borehole Soil stratigraphy inferred from BH		89.50 4.27																
		20-16A																		
5																				
6																				
7																				
8																				
9																				
10																			_	
11																				GROUNDWATER OBSERVATIONS
																				DATE DEPTH (m)  20-09-30 1.5 ∑
12																				

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 CGVD28 BORING DATE: Jul 6 2020

S	THOI	SOIL PROFILE	T 5	1		SAN	IPLES		● RE	SISTA	NCE (	N), BLC	WS/0.	SH H	NATUR	TRENG AL ⊕ I	REMO	ULDI	ED	L'AL LING	PIEZOMETE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	DY A RE	NAMIO SISTA	PEN NCE.	ETRATI BLOWS	ON /0.3m	W		R CON	TENT,		$w_L$	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
1	BORII		STRAI	DEPTH (m)	ž	Ĺ	RECC	BLOW	1		20		40		Ρ'	Ŭ	30	90	"₋	PB	INSTALLATIO
0		Ground Surface		93.79							:::				::::	::::	:::				Above Creved
		TOPSOIL		93.66 0.13	1	SS	280	9													Above Ground Protector & Bentonite
		Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)						-	: : : : : : : : : : : : : : : : : : :												
1					2	SS	460	6			:::						:::				Soil Cuttings
							400														\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
									1::::												50
2					3	SS	610	7			1										Bentonite
																					Filter Sand
	m OD				4	ss	610	4	•												
3	ger (210m								1::::												50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	Power Auger em Auger (21									<b>)</b>							+				metre length, slotted SCH 40 PVC Pipe
	Power Auger Hollow Stem Auger (210mm OD)									Œ							+::::				
4	ollow											# : : :									
	T			8 <u>9.22</u> 4.57															+		
		Stiff, grey SILTY CLAY		4.57	5	ss	610	WH													
5									ļ												
																					Soil Cuttings
6		Very dense, grey SILTY SAND, some		88.07 5.72					₩						+						
		Very dense, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)																			
				87.08 6.71	6	SS	310	109		0									>>	•	
7		End of borehole		6.71																	
8																					
9																					
10																	1				
11																					GROUNDWATE
"																					GROUNDWATE OBSERVATION  DATE DEPTH
																					20-09-30 1.3 <u>V</u>
12											: : :				: : : :	1::::	: : :				
=	Ц	SEMTEC			<u> </u>				[::::	::::	1:::	:   : : :	:   : : :	: ::::	[::::		1:::	: :	:::		ED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 9 2020

	НОР	SOIL PROFILE	1 ,			SAN	IPLES		● PE RE	NETR/ SISTA	ATION NCE (N	), BLO\	NS/0.3r	n + N	EAR ST	AL +F	REMOL	JLDED	NG A	
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	l		PENE NCE, B			W <sub>F</sub>	_	W		%   w <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETE OR STANDPIPE INSTALLATIC
	T	Ground Surface	0)	93.94					: : : :	::::			::::				::::			
0 -		TOPSOIL  Stiff to very stiff, grey brown SILTY CLAY, trace sand seams		93.79 0.15	1	SS	50	9												Above Ground Protector & Bentonite
1		(WEATHERED CRUST)			2	SS	50	6	•										-	
2					3	ss	355	6			1		<del>}  </del>							
					4	ss	610	5	•											<b>1</b> 59
3		Firm to stiff, grey SILTY CLAY		90.89 3.05	5	SS	610	3					-10						-	Soil Cuttings
4																				
	Power Auger Hollow Stem Auger (210mm OD)								Φ.			T	+::::							
5	Power Auger tem Auger (21				6	SS	610	WH								:O:			-	
6	Hollow S								₫	) —				+	1				_	Bentonite
					7	SS	610	WH		9										
7									€	Φ.			+						_	
8					8	SS	610	3	•			0							-	Filter Sand
		Compact, grey SILTY SAND, some gravel, with cobbles and boulders		85.56 8.38	9	SS	405	20			•									diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
9		(GLACIAL TILL)																	-	
10	$\parallel$	End of borehole			10	SS	460	16		•										Soil Cuttings  Note:  Monitoring well blocked at
																				4.0m depth
11																			1	
12																				
		SEMTEC  INSULTING ENGINEERS  S SCIENTISTS			_	_	_	_	_	_	_	_	_	_	_	_	_	_		GED: ML

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 9 2020

S	THOL	SOIL PROFILE	<sub> </sub>			SAN	MPLES		● RE	SISTA	NCE (N	), BLO\	NS/0.3r	H8 1+ m	IEAR S' NATUR/	AL ⊕ F	REMOL	JLDED	ING ING	PIEZOMETE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	BER	TYPE	RECOVERY, mm	BLOWS/0.3m	_ DY	NAMIC	PENE	TRATIC	DN			R CON	TENT,		ADDITIONAL LAB. TESTING	OR STANDPIPI
Σ	ORIN	DESCRIPTION	IRAT/	DEPTH (m)	NUMBER	₹	ZECO.	LOWS						W <sub>I</sub>	۲.	<del></del>	20	⊢ w <sub>L</sub>	ADD LAB.	INSTALLATIO
$\dashv$	<u>в</u>	0 10 (	S				-	<u>m</u>	::::	0 2	20 ;	30 4	40 !	50 6	50 7	70 E	30 !	90		
0		TOPSOIL	11 1 <sub>2</sub> 1	93.94 93.79 0.15															-	Above Ground Protector &
		Stiff to very stiff, grey brown SILTY		0.13																Bentonite
		Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST)																		Soil Cuttings
1																				
	(do																			Bentonite
2	Power Auger Stem Auger (210mm OD																		1	∑
	Auge ger (2																			Filter Sand
I,	Power Auger em Auger (21																			50
3	ow Ste	Firm to stiff, grey SILTY CLAY		9 <u>0.89</u> 3.05																50 mm diameter, 1.52 metre length,
	Hollow	Timile Sun, grey OLETT SEAT																		metre length, slotted SCH 40 PVC Pipe
4																				[A
4					1	TP	610	PM												
																				Soil Cuttings
5									:::::	Þ: : : :			::::	-::::						
Ť		End of borehole		88.76 5.18									1							
		Soil stratigraphy inferred from BH 20-18A																		
6																				
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	G	<u>SEMTEC</u>																	LOGG	GED: ML

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation JOB#:

SHEET: 1 OF 1 DATUM: CGVD28 61899.04 BORING DATE: Jul 8 2020 LOCATION: See Site Plan, Figure 1

	9	ą	SOIL PROFILE				SAN	//PLES		● PE	NE SIS	TRA	TION ICE (N)	), BLO	NS/0.3	SH m +1	IEAR S	TRENG	STH (Cu REMOL	ı), kPA JLDED	آب آ	
METRES		BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	▲ DY RE	/NAI	MIC	PENET	TRATIO	ON 0.3m	W	WATE	R CON	ITENT,		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0			Ground Surface TOPSOIL		94.20												::::					Above Ground
			Stiff to very stiff, grey brown SILTY		0.08	1	SS	75	11		•											Protector & Bentonite
			CLAY, trace sand seams (WEATHERED CRUST)																			Soil Cuttings
1						2	SS	510	5	•												
						3	ss	610	4				<b>H</b>			0:::						Bentonite
2		(Q				_	00	010			::										_	Entonite :
		(210mm OD)			91.61 2.59	4	SS	610	8													Filter Sand
3	Power Auger	uger (21	Loose to compact, grey brown SILTY SAND, trace gravel, with cobbles and boulders (GLACIAL TILL)																		-	50 mm
	Powe	Stem Au	bodiacis (GENOINE TIEE)			5	SS	455	20		d:	•									МН	metre length, slotted SCH 40 PVC Pipe
4		Hollow	Loose to compact, grey SILTY SAND, some gravel, with cobbles and		9 <u>0.54</u> 3.66																	
+			some gravel, with cobbles and boulders (GLACIAL TILL)			6	SS	125	11		•											
						7	SS	100	10													
5							33	100	10													Soil Cuttings
6			End of borehole		88.10 6.10	8	SS	255	16			•										
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12																						
			SEMTEC																		LOGG	GED: ML
		AND	nsulting Engineers Scientists																		CHEC	CKED: WAM

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 CGVD28 BORING DATE: Jul 8 2020

nd Surface PSOIL  to very stiff, grey brown SILTY Y (WEATHERED CRUST)	STRATA PLOT	93.87 0.08	1 1 2 3 4 4 5 5	SS SS SS	100 205 610	9 7 4	l		PENE NCE, BI		W <sub>F</sub> 50 6	0 8	30 (	W <sub>L</sub>	ADDITIONAL LAB. TESTING	Above Ground Protector & Filter Sand Bentonite
to very stiff, grey brown SILTY Y (WEATHERED CRUST)	55	0.08	3 4	SS	100 205 610	7										Filter Sand Bentonite
to very stiff, grey brown SILTY Y (WEATHERED CRUST)		0.08	3 4	SS	205	7										Filter Sand Bentonite
		9 <u>0.97</u> 2.90	3	SS	610	4										Soil Cuttings
n, grey SILTY CLAY		9 <u>0.97</u> 2.90	4													Soil Cuttings
n, grey SILTY CLAY		<u>90.97</u> 2.90		SS	610	2			1111	$\nu$ :::	::::				МН	Bentonite
n, grey SILTY CLAY		9 <u>0.97</u> 2.90		33	010	2	₩:::	::::								Filter Sand
			5													50 mm
				SS	610	1	•									metre length, slotted SCH 40 PVC Pipe
							Φ			+:::						
			6	SS	610	WH										
							Φ	Ð								Soil Cuttings
			7	SS	610	WH										
of borehole		87.16 6.71														
																GROUNDWATER OBSERVATIONS
																DATE DEPTH (m)  20-09-30 1.2 ∑
	1															
			ИТЕС	ATEC												

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 7 2020

DESCRIPTION  Ground Surface  OPSOIL  Stiff to very stiff, grey brown SILTY  CLAY, trace sand seams  WEATHERED CRUST)	STRATA PLOT	ELEV. DEPTH (m) 93.88 0.10	NUMBER 2	SS TYPE	RECOVERY,		▲ D R	YNAM ESIST	IIC PETANCI	ENETF E, BLC	RATIO DWS/0		W <sub>F</sub>					⊢W <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETE OR STANDPIPI INSTALLATIO
COPSOIL Stiff to very stiff, grey brown SILTY SLAY, trace sand seams WEATHERED CRUST)	STR	93.88	1					10	20	30	) 4	0 5	0 6	0 7	70	80	0/			
COPSOIL Stiff to very stiff, grey brown SILTY SLAY, trace sand seams WEATHERED CRUST)		1			310	9					1111						9(	0		
stiff to very stiff, grey brown SILTY CLAY, trace sand seams WEATHERED CRUST)		0.10			310	9			::1:	1111	1111									Above Ground
			2	SS																Protector & Bentonite
——————————————————————————————————————					610	5	•													Soil Cutting
——————————————————————————————————————			3	ss	610	4	•		}			01								Bentonite
irm to stiff, grey SILTY CLAY			4	SS	610	3	•													Filter Sand
		9 <u>0.83</u> 3.05	5	SS	610	1						·O								50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
								Φ.												1 vo ripe
								Φ.				+:								
			6	SS	610	WH									0					Soil Cuttings
								⊕	•				#		+					
		87.17 6.71	7	SS	610	WH														
nd of borehole		6.71																		
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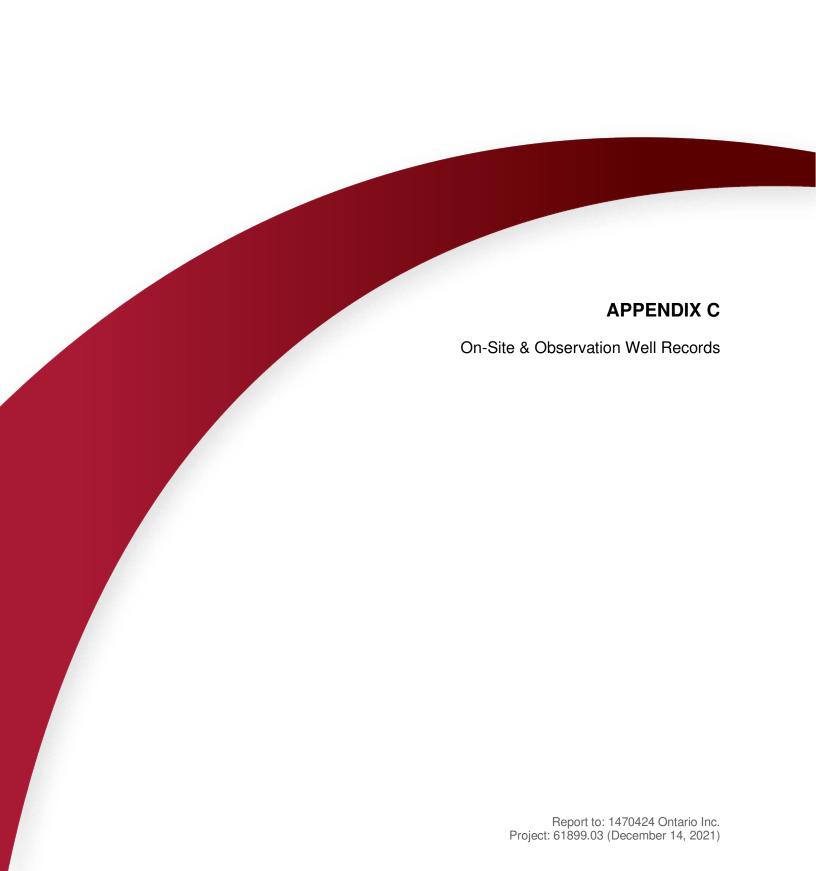
CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 CGVD28 BORING DATE: Jul 14 2020

S	THO		SOIL PROFILE	<u> </u>			SAN	MPLES		● PE RE	NETR SIST <i>A</i>	ATION NCE (I	N), BLO	//S/0.3i	m + N	EAR S	TRENG AL ⊕ I	GTH (Cu REMOU	u), kPA JLDED	NAL TING	PIEZOMETEI
DEPTH SCALE METRES	CONTEMPONICAL		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	1			TRATIONS/		W	,—	₩		⊢ W <sub>L</sub>	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIC
_	_			STI	(m)	_		₩.	ᆸ	1	0	20	30	40	50 6	0 7	70	80 !	90		
0		Н	Ground Surface TOPSOIL	74 14. 71	92.97															1	Above Ground Protector &
			Stiff to very stiff, grey brown SILTY CLAY (WEATHERED CRUST)		92.77 0.20	1	SS	205	18												Bentonite
1						2	SS	150	8												Soil Cuttings
						3	SS	510	5	•				<del> </del>							∑ Sentonite
2										-											
		0mm OD)				4	ss	610	4	•											Filter Sand
3	Auger	2	Soft to firm, grey SILTY CLAY		8 <u>9.92</u> 3.05																50 mm diameter, 1.52 metre length, slotted SCH 40
	ver	Stem Auger	Solt to littli, grey SILTT CLAT			5	SS	610	1						0						PVC Pipe
4		Hollow St								•			+								
		I								: : : <del>( </del>   : : : : : : : : : : : : : : : : : : :		# : : :									
5						6	TP	610	РМ												
											<b>∌</b> ∷∷			+:::							Soil Cuttings
6					86.87						Ð: : : :	+ : : :									
			Very loose to loose, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		86.87	7	SS	455	4	•	C										
7			End of borehole	: Al : All : A	86.26 6.71																DCS
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32 S Well Loca		Drive				Ottawa		ON		K2K	2A9	111		
Address of V	Well Loc	ation (Street Num				Township			Lot		T	Concessio	on.	
Eagl County/Dist	leson,	Perth Stre	et (NO	CIVIC)		Goulbourn				26			4	
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			Clay	Og S	Stone	Grave	el				X.	-	30 (	46 '
Grey	8	*	Limes	tone									46 ′	80 ′
Grey	- '	the state of the s	Limes	tone									80 ′	160 ′
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		10		RUV	EP O	XI- (D)		6" M	W)	20110012002				
Depth Se			Annular Type of Sea	lant Used		Volume Placed		After test of well		200,000	of designation of the	d Testing aw Down	T R	ecovery
From 52/	42 /		(Material an	d Type)		(m³/₩²) 10.9	$-\parallel$	☐ Clear and s	and free	AA-	Time (min)			Water Level (m/ft)
42 (	0/		te slurry			16.8		If pumping disco				1114	- '	49.8 "
74	- 11	Deritorii	te starty			10.6		X			1	12	1	44
					***************************************		_	Pump intake set	at (mft)	(a)	2	13.5	2	42.5
								150 Pumping rate (I/r	min CDM		3	15.3		41.2
Meth	-	Construction  Diamond	□ Put	nlic	Well U	47/2 9/40 9/50 9/50 9/50 9/50 5/50 9/50	d	Fumping rate (in	1.8		4	16.6		40
Rotary (C		nal) 🗌 Jetting	Oor	nestic	☐ Munici	ipal Dewater	ring	Duration of pum hrs +		-C* 3 x	5	17.8	1-1	38.8
Boring	- 51	☐ Driving☐ Digging	Live		☐ Test H☐ Coolin	ole	ing	Final water level	manufacture of the same of the	ping (m/ft	2000000			
Air percus	ssion ecify	140000 000 000	☐ Indi	ustrial er, specify				49.8 1	1 - 1 - 1	REL		23.1		35.4
	(	Construction Re				Status of Wel	1	If flowing give ra	te (I/min/GPI)	A)	15	27.4		28.7
Inside Diameter	Open I	Hole OR Material	Wall Thickness	Depti	n (m <b>(ff)</b>	Water Supply Replacement We	loll llo	Recommended			20	31.1		24.6
(cm/6)	Concre	ete, Plastic, Steel)	Thickness (cm/n)	From	То	Test Hole	eli	- datt	5C(	40F9	25	34.3		21.2
61/4"	Stee		.188	+2 /	52 /	Recharge Well Dewatering Well	.	(I/min/GPM)	.8	9 150 100 100	30	37.2	-	18.3
6"	Oper	n Hole		52 ′	160	Observation and Monitoring Hole		Well production	(I/min/GPA/)	-	40	42.1		13.9
						Alteration (Construction)		Distriected?	8.4	1000	50	46.3	,	9.9
						Abandoned, Insufficient Supp	. (	January III	lo		60	49.8	60	6.1"
Outside	l	Construction Re	ecord - Scr			Abandoned, Pool		Please provide	N man hale	lap of W	Vell Lo	cation	the beel	
Diameter (cm/in)	(Plastic,	Material Galvanized, Steel)	Slot No.	From	n (m/ft) To	, Abandoned, other	er,	i icase provide	a map beid	W IOIIOW	ing man	ruciions on	trie back	PH
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						Other, specify			1	Cr	10C	LESE AD W 2	ノ	
	L	Water Def	aile			Hole Diameter			1	E	H61	LES	214	
meneral contract	•	th Kind of Water:	Fresh [	Untested	De From	epth (mdt) Diame	eter	(D)	KM		KO	712	1.1	B
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(m)	n/ft)	as Other, spe		Technicia	n Inform	ation	1					0	DK.	Eh move d
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Type of Sealent Used   Wolume   Place   Wolume   Wolu			Annular Spa	ce	VI-0		Rosulta of Int	41 V;-1	d Tood:		1
40   Neat cement   10.8	From T		Type of Sealant	Used	Volume Placed	After test of we	ell yield, water was:	Dra	aw Down		
Method of Construction   Well Use   16.3   1   21.3   16.7   3   3   16.7	50 / 40	Neat ce		-		Other, sp	ecify <b>Not tester</b>	Time (min)			
Method of Construction	10 ' 0	/ Benton	ite slurry		25.2			Static	614"		26.7 "
Method of Construction   Well Use						X	701 4 21 20			1	21.2
Method of Construction							et at (n(ff))	2	16	2	17.3
Public Commission   Diagnom   Diag	Method o	f Construction		W-III			//min / GPMD	3	16.7	3	16.3
Develop   Deve	Cable Tool	☐ Diamond	Public	F-10-500 (10-50) (10-50)		2.3	resident and comp	4	17.3		15.3
Construction Record - Casing   Industrial   Coloring & Air Conditioning   Industrial   Indus	Rotary (Convent Rotary (Reverse		omesti	Munic	ipal Dewatering					100	14.4
Construction Record - Casing   Status of Well   Contractor and Well Technical Information   Contractor	Boring		☐ Irrigation	Coolin		Final water lev			20000000		-
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Steel   188	leside T				1 /	II HOWING GIVE!	ate (I/min/GPM)				
Test Hole Recharge Well Deservation and/or Mater Details Hole Diameter From To Depth (m/ft) Gas Other, specify  Water Details Hole Diameter From To Depth (m/ft) Gas Other, specify  Well Contractor and Well Technician Information  Well Contractor and Well Technician Information  Well Contractor Bould All Technician Information  Well Contractor B	Diameter (Galv	/anized, Fibreglass.	Wall Thickness	1	Water Supply Replacement Well						
Department   Dep	111 =:		11		Test Hole	1 4					
Deservation and/or Monitoring Hole   Alteration   Abandoned, Other, Specify   Abandoned, Other, Specify   Water Details   Depth (m/tt)   Gas   Other, Specify   Other, Specify   Well Contractor and Well Technician Information   Monitoring Hole   Monitoring Hole   Monitoring Hole   Monitoring Hole   Monitoring Hole   Mandoned, Other, Specify   Depth (m/tt)   Abandoned, Pror Water Quality   Abandoned, Other, Specify   Other, Spe	2/4	errort to all thomas to the		,	☐ Dewatering Well		23	-		30	
Alteration (Construction) Abandoned, Insufficient Supply Abandoned, Steel (Plastic, Galvanized, Steel)  Water Details  Water Details  Hole Diameter From To Other, specify  Other, specify  Well Contractor and Well Technician Information  Well Contractor and Well Technician (Last Name, First Name)  Responses I Licence No. Signature of Technician (Last Name, First Name)  Responses I Licence No. Signature of Technician and/or Contractor Date 20pt/filling Co.  Alteration (Construction)  Abandoned, Poor Water Cuality Abandoned, other, Specify  Other, specify  Other, specify  Well Contractor and Well Technician Information  Well Contractor and Well Technician (Last Name, First Name)  Hanna, Jeremy  Audit No. Z 3 5 5 2 5 1  Date Work Completed 2021	6" Up	en uois		ou 150	Doservation and/or	Well production	(l/mig/GPID)	40		40	
Abandoned,   Insufficient Supply   Abandoned,   Poor   Material   Pleastic, Galvanized, Steel)   Siot No.   Depth (m/tt)   Abandoned, other, specify   Other,		-			☐ Alteration	Disinfected?	4. 7	50		50	
Material					Abandoned,	NA/11 -	No	60	26!7"	60	8.6
Water Details	Outside		ecord - Screen	Denth (m/fl)	Abandoned, Poor	Please provid	Map of We	II Loca	ation		
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refound at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify 50 ′ 150 6 ′					specily	(b") Tu	121-215	,	2.00	مران	
refound at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify 50 ′ 150 6 ′					Other, specify	K		_	Noci	١٧١٠	1
refound at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify 50 ′ 150 6 ′	2,000				Hole Diameter		X IVIN	E	AGLE	-SOI	4
refound at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify 50 ′ 150 6 ′	ater found at De	pth Kind of Water:	Fresh On	tested De	pth (mt) Diameter		1.230,		ROF	DY	
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Well Contractor and Well Technician Information  Mell Contractor and Well Technician Information  Well Contractor's Licence No.  7681  Municipality and  Postal Code KOA 220  Business E-mail Address air-rock@sympatico.ca  Telephone No. (Inc. area code) Name of Well Technician (Last Name, First Name) Hanna, Jeremy  Postal Code Hanna, Jeremy  Well owner's information  Well owner's information  Date Package Delivered  Winistry Use Only  Audit No. Z 3 5 5 2 5 1  Date Work Completed  Y Y Y Y M M D D  Date Work Completed  Y Y Y Y M M D D  Received		1		tested	n 120 6"		]		gess		
r Rock Drilling Co. Ltd.  7681  Municipality and Russ Frank (Street Number/Name)  Postal Code KQA 2ZD Business E-mail Address air-rock@sympatico.ca  Relephone No. (inc. area code) Name of Well Technician (Last Name, First Name)  38382170 Hanna, Jeremy  Rephician's Licence No. Signature of Technician and/or Contractor Date 200 hites 1 34  2021 Mod Date Work Completed 2012 Mod Date 201	(11/11) []		,	nician Informa	otion	<u>N</u> .	a Chroat		Ok	aRic	hmord
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Postal Code KUA 2Z0 Business E-mail Address air-rock@sympatico.ca  Well owner's information package Delivered information pack			mo)								
Postal Code KOA 2ZO Business E-mail Address air-rock@sympatico.ca    Well owner's   Date Package Delivered information package	TOTO PRETING	With Rugger/Na	me)	M	turisinality ond	Comments:	~ 10-0	6	),	F	5
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3632 Solito No. Signature of rechinician and/of Contractor Date Suprintees 1 31 See 2021 01 14	6138382170	,o. area code) [Nar			;, rirst iname)	package		18	Audit No. Z	355	5250
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Onta	rio 🗑	Ministry Conserv	of the Envi	ronment, Parks	w Ta	ag#:A3131	88 rint Below)	1		W	ell F	Record
	ments record		Metric	mperial		A313188		Regulation	903 C	Intario Wa Page	ter Res	ources Act
	vner's Info	NAMES OF STREET OF STREET, STR				ACTOR OF THE PROPERTY.						
First Name	е		_ast Name/C			I 010 0514	E-mail Address			TE		Constructed
Mailing Ad	Idress (Street	Number/Nar	ne)	/ U424 \	Jurano	Inc.C/O GEMT Municipality	Province	Postal Code	T	Telephone I		ell Owner
Well Loc	Stacie D	rive				Ottawa	ON	K2K				
C0900000000000000000000000000000000000		n (Street Nur	nber/Name)			Township		1				
Eag	ileson/P	erth Stre		CIVIC)		Goulbourn		Lot	6	Concession	4	
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UTM Coor	awa Car dinates Zone	Easting	, No	orthing		Richmond Municipal Plan and Sublo	nt Number		Ont	NH NH	15	
	83		82	50063	OA I				Other	CYT 10/E	TO	7 00
Overburd General C	len and Bed	Irock Materi	als/Abando non Material	onment Se	aling Rec	ord (see instructions on th	e back of this form)			SIWE	LL#	21-2C
Ocheral C	Joioui	WOST COM			Ot	her Materials	Ger	neral Description			Dep From	th (m(ft))
			Clay	. 7.				1971			0 /	27
			Clay	a Sta	me	Cir Gravel		. 63			27 /	46 '
Grey			Limes			0					46	181
Grey			Limes		1/Gr	ey Soud sob	re Mix	- 4		197	181 ′	223 '
Grey			Sands	tone				9 375		a transfer	223	238 ′
Grey	n = 1500 t		Sands		1011 Day						238	274 /
Grey	1.20 - 1.00 - 1.00 at	6 727 %	Sands				200 0	· users and a	1		274	312 ′
Grey	9 (10)	4	Sands	tone	01.25		24	- 10.0	60	91. 12	312 /	358 ′
			EST	W	ELL	# 01-	ac.					
Depth S	et at (mff)		Annular Type of Sea	POR AND VIOLENCE		Volume D'	Affect / C ::	Results of We	-	The state of the s		
From	To		(Material an	nd Type)		Volume Placed (m³/t³)	After test of well yield	i, water was:		aw Down Water Leve		ecovery Water Level
188	178	Neat ce	ement			10.9	Other, specify	Not tester	(min) Static	(mŒ)	(min)	(mff)
178	0'	Benton	ite slurry			16.8	If pumping discontinu	ued, give reason:	Level	7/8"	-	9.6 '
							X	En parties of	1.	8.9	1.	8.6
							Pump intake set at (r	TEN D	2	- 19 / <b>- 9</b> + 4,	. 2	7.8
Met	hod of Cor	struction			Well Us	ie .	200 Pumping rate (I/min /	GPM))	3	9.1	3	7.8
Cable To	ool	Diamond			Comme	ercial Not used	20		4	9.1	4	7.8
Rotary (6	Conventional) Reverse)	☐ Jetting ☐ Driving		mestic estock	☐ Municip ☐ Test Ho		Duration of pumping		5	9.1	5	7.8
Boring	80 10	Digging	☐ Irrig	gation		& Air Conditioning	Final water level end		10		10	222202000
Air percu			_ Ind	ustrial ner, specify _			9.6 //	min (CDAA)	15	9.2	15	7.8
		struction R	ecord - Cas	ing		Status of Well	If flowing give rate (I/r	um/GMVI)	-	9.3	-	7.8
Inside Diameter	(Galvanized	OR Material d, Fibreglass,	Wall Thickness		n (m <b>(fi</b> ))	Water Supply Replacement Well	Recommended pum	p depth (not)	20	9.3	.20	7.8
(cm/ <del>f</del> )		Plastic, Steel)	Thickness (cm/m)	From	То	Test Hole	Recommended pum	n rato	25	9.4	25	7.8
644	Steel	2000/66	.188 (	+24	188	Recharge Well Dewatering Well	(I/min/GPM)	Prate	30,	9.4	30	7.8
6"	Open I-	lole		188	358 ′	Observation and/or	Well production (I/mir	NGPM))	40	9.5	40	7.8
						Monitoring Hole Alteration	200		50	9.6	50	7.8
						(Construction)  Abandoned,	Distrifected?		60	9.6"	60	7.8 "
	Con	struction R	ecord - Scr	een		Insufficient Supply Abandoned, Poor		Map of We	ell Loc			
Outside Diameter		terial vanized, Steel)	Slot No.		(m/ft)	Water Quality Abandoned, other,	Please provide a m				ne back	(1)
(cm/in)	(i idout, Gall	anzeu, sieel)		From	То	specify specify	(bi)					TI
					<b>)</b>	Other, specify	TWALE	2C	<i>f</i>	· - /0:	1110	2
							1		(1	10 CI BLE Port		
Motor f	d at Decir To	Water Det			1-200-201-201-201-201-201-201-201-201-20	lole Diameter	<b>D</b> 1	VAN		GLE	70	74
	_	Kind of Water		Untested	Dep From	th (m/ft) Diameter To (cm/in)		HVI		Port	40	
Water foun		Cind of Water		Untested				J-		10.		
		Other, spe		/~ -		0 50		+				
312	d at Depth	Kind of Water Other, spe	: Fresh	Untested		5D 358	180				HIF	Chrond
V	0-	ell Contracto	,	Technicia	n Informat	ion		21 2L			Rex	od
Business N	lame of Well	Contractor			The state of the s	ell Contractor's Licence No.	Porths	need			* 150	
Air Ro	ck Drilling	Co. Ltd.	ime)			7681						
8659 F	Franktown	et Number/Na Road	iiie)		Mt	nicipality <b>Richmond</b>	Comments:	00.0	· /	a .	C	
Province		stal Code	Business	E-mail Add			14400	SHW &	10	9/0	0 4	9
ON Bus Telepho		KOA 2ZO	mo of Mari		@symp		Well owner's Date information	Package Delivere			ry Use	
613838	32170	rea code) Na	Hanna	forom			package delivered	2021 1504	18	Audit No. Z	35	5251
Well Technici	ian's Licence N	lo. Signature	of Technician	n and/or Co	ntractor Da	te Submitted 4, 24	Yes Date	Work Completed	45			
. 900	_	16	~ /	1	Y	T T T W W W D D	No YY	TYPY MAN	15	Received		
0506E (2020/0	o) © Queen's	s Printer for Onta	rio, 2020 / )			Ministry's Copy						

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 16 2020

Ground Surface TOPSOIL Stiff to very stiff, grey brown SILTY CLAY, with sand seams (WEATHERED CRUST)	STRATA PLOT	93.88 93.68 0.20	1 1 2 3 3 4 5 5 6	SS SS SS SS	205 100 455 610	ES:0/SMOTB 12 7 5 9				TRATICILOWS/		W <sub>F</sub>	,—	R CONT W TO 8		% —  W <sub>L</sub> 90	ADDITIONAL LAB. TESTING	PIEZOMETEI OR STANDPIPE INSTALLATIO
TOPSOIL Stiff to very stiff, grey brown SILTY CLAY, with sand seams (WEATHERED CRUST)		93.88 93.68 0.20	3 4 5	ss ss	205 100 455 610	7 5				30	<b>4</b> 0 3	50 6			50	90	-	Protector &
TOPSOIL Stiff to very stiff, grey brown SILTY CLAY, with sand seams (WEATHERED CRUST)			3 4 5	ss ss	100 455 610	7			Į.		•							Protector &
		<del>90.07</del> 3.81	3 4 5	SS	455	5	•		ı		<b>•</b>						-	
		<del>90.07</del> 3.81	5	SS	610				<b>I</b>		<b>(b)</b>							1 24
		<u>90.07</u> 3.81	5			9						1::::				1::::		
		9 <u>0.07</u> 3.81		SS	610													Soil Cuttings
		9 <u>0.07</u> 3.81	6		3.3	4	•										-	Soil Cuttings
			i !	SS	610	2	•										_	
			7	SS	610	WH												
													: :::::::::::::::::::::::::::::::::::::					Bentonite
Very loose to compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)		88.09 5.79	8	ss	610	7		⊕							: : <del>   </del>		-	
			· ·	33	010	,												
			9	SS	50	1												Filter Sand
			10	SS	610	3	•										_	50 mm diameter, 1.52 metre length,
			11	SS	455	3	•										-	slotted SCH 40 PVC Pipe Cave
End of borehole		84.13 9.75	12	SS	310	15		•										Cave
																	-	
																		GROUNDWATE OBSERVATION: DATE DEPTH (m)
																		20-09-30 2.4 💆
Eı	nd of borehole	nd of borehole		12	12 SS 84.13 9.75	12 SS 310 nd of borehole 9.75	12 SS 310 15	12 SS 310 15	12 SS 310 15 •	12 SS 310 15 •	12 SS 310 15 • ad 15 ad	12 SS 310 15 • • • • • • • • • • • • • • • • • •	12 SS 310 15 • • • • • • • • • • • • • • • • • •	12 SS 310 15 • 84.13 9.75				

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 16 2020

يٰ إ	THOD	SOIL PROFILE				SAN	IPLES		● PE RE	NETRA SISTAI	TION ICE (N	), BLO\	WS/0.3r	18 1+ n	IEAR S' NATUR/	IKENG AL⊕F	TH (CL REMOL	I), KPA ILDED	AL NG	Dieze: :===
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	▲ DY RE	NAMIC SISTAI	PENE ICE, BI	TRATIO LOWS/	ON '0.3m	W		R CON' W	TENT,	%   W <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETEF OR STANDPIPE INSTALLATIO
_	<u>8</u>	Occupation for a	STE	(m)			22	BL	1	0 2	0 3	30 4	40 !	50 6	60 7	0 8	80 9	90		
0		Ground Surface TOPSOIL	<u> </u>	93.88 93.68 0.20																Bentonite
1	6	Stiff to very stiff, grey brown SILTY CLAY, with sand seams (WEATHERED CRUST)																		Soil Cuttings
	Power Auger Hollow Stem Auger (210mm OD)																			Bentonite
2	Power Auger em Auger (21																			$\nabla$
	Pc ow Sterr																			Filter Sand
3	문																			50 mm
																				slotted SCH 40 PVC Pipe
4		End of borehole Soil stratigraphy inferred from BH		90.04 3.84																
		20-1A																		
5																				
6																				
7																				
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٥																				
9																				
10										1111										
11																				GROUNDWATER OBSERVATIONS DATE DEPTH
																				20-09-30 2.2 <u>V</u>
12		 SEMTEC																		

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 20 2020

METRES	BORING METHOD	SOIL PROFILE	PLOT	ELEV.	ER		PLES,						WS/0.3r	n +1	NATUR.	R CON	REMOL	JLDED	ADDITIONAL LAB. TESTING	PIEZOMETEF OR STANDPIPE
ME	ORING	DESCRIPTION	STRATA PLOT	DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	1		PENE NCE, B			W <sub>i</sub> 50 6			30	W <sub>L</sub>	ADDI LAB. 1	INSTALLATIO
_	<u> </u>	Ground Surface	.v.	93.80			_	<u> </u>	'			::::	+0 :	1::::	1	70 8	::::	1::::		<del>                                     </del>
0		TOPSOIL	1,17, 1 WWW	93.65																Above Ground Protector &
		Stiff to very stiff, grey brown SILTY CLAY, with sand seams			1	SS	205	10												Bentonite
		(WEATHERED CRUST)							1											
1					2	SS	405	6	•											
0					3	ss	610	5	•		l		<b>1</b>							
2																				Soil Cuttings
	n OD)				4	SS	610	4												\ \Z\2
3	ler 210mr								-											\[ \sqrt{2}
	Power Auger em Auger (21			90.45 3.35	5	SS	610	6												
	Power Auger Stem Auger (210mm OD)	Very loose to compact, grey SILTY SAND, some gravel, with cobbles and		3.35	Ľ	33	010	ļ .												
4	Hollow S	boulders (GLACIAL TILL)							1::::									:::::		50
	물				6	SS	205	9												Bentonite
									1											· .
5					7	SS	205	3	•											Filter Sand
				1																
					8	ss	25	9		<b>}</b>										50 mm diameter, 1.52 metre length.
6																				metre length, slotted SCH 40 PVC Pipe
				87.27	9	ss	100	26			•									
Ī		Auger refusal End of borehole		87.27 6.53																
7																				
8																				
9																				
٥																				
10															: : : :					
11																			-	GROUNDWATER OBSERVATIONS
																				DATE DEPTH (m)
																				20-09-30 2.6 💆
12																				
	_	SEMTEC  DISULTING ENGINEERS	•		_				•		•	•	•				•	•		GED: ML

CLIENT: Cardel Homes

1 OF 1 SHEET: PROJECT: Geotechnical & Hydrogeological Investigation CGVD28 DATUM: JOB#: 61899.04

BORING DATE: Jul 17 2020 LOCATION: See Site Plan, Figure 1 SHEAR STRENGTH (Cu), kPA PENETRATION SHEAR STRENGTH (Cu), kPA RESISTANCE (N), BLOWS/0.3m + NATURAL + REMOULDED ETHOD SOIL PROFILE SAMPLES PIEZOMETER

$\neg$	DESCRIPTION	ATA	ELEV. DEPTH	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ DY RE	NAMIC SISTAI	PENE NCE, BI	TRATIC LOWS/	0.3m	W	WATE			., ,,   W <sub>L</sub>	ADDITIONA LAB. TESTIN	OR STANDPIPE INSTALLATIOI
DEPTH SCA METRES BORING MET		STRATA PLOT	(m)	ž		Ä	BLO	1	0 2	20 3	30 4	10 5	50 6	60 T	70 I	80 I	90	^ _	
- 0	Ground Surface TOPSOIL	121 1x - 11	93.80																Above Ground Protector &
	Stiff to very stiff, grey brown SILTY		93.65 0.15																Protector & Bentonite
	CLAY, with sand seams (WEATHERED CRUST)																		
- 1																		-	Soil Cuttings
GO	( <u>GO</u> 1																		
er 210mr	210mr																		Bentonite
Power Auger	uger (																	1	$\nabla$
Pow Stem A	Stem A																		Filter Sand
s wollo	Hollow Stem Auger (210mm OD)																		50 mm
3   일	<b>-</b>		90.45																50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	Very loose to compact, grey SILTY		90.45 3.35																PVC Pipe
4	Very loose to compact, grey SILTY SAND, some gravel, with cobbles and boulders (GLACIAL TILL)																		
	End of borehole		89.53 4.27																Soil Cuttings
	Soil stratigraphy inferred from BH 20-7A																		
5																			
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																			20-09-30 2.1 <u>V</u>
- 12																			
	CEMTEC	1						::::	::::	::::	::::		: : : :	::::	1:::	:   : :			
	GEMTEC Consulting Engineers																		GED: ML CKED: WAM

CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation

JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

SHEET: 1 OF 1 DATUM: CGVD28 BORING DATE: Jul 10 2020

SEL	THO	$\vdash$	SOIL PROFILE				SAM	IPLES	1	● PE RE	NETR/ SISTA	ATION NCE (N	I), BLO\	NS/0.3r	SH n + N	EAR S	TRENG AL ⊕ F	TH (CI REMOL	ı), kPA JLDED	NAL TING	PIEZOMETE
METRES	BORING METHOD		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	1			TRATIC LOWS/		W	,—	R CON W 		%   W <sub>L</sub> 90	ADDITIONAL LAB. TESTING	OR STANDPIPE INSTALLATIO
0	Ï	Gı	ound Surface DPSOIL	ν	94.09				ш										1::::		Above Ground
			iff to very stiff, grey brown SILTY LAY (WEATHERED CRUST)		93.89 0.20	1	ss	355	8	•											Protector & Bentonite
1		Ci	LAY (WEATHERED CRUST)																		Soil Cuttings
						2	SS	0	9	-											
						3	SS	405	7	•			<del>                                     </del>	}							Bentonite
2	á	(00)																			Filter Sand
	uger	1 (200111				4	SS	610	6	•											I 184
3	Power Auger		ery loose to compact, grey gravelly LTY SAND, some clay, with cobbles		91.04 3.05	5	SS	355	6			0								МН	50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
	č	ar MOIDL	d boulders (GLACIAL TILL)																		PVCPipe
4	=					6	ss	200	1												
						7	SS	200	26			•									
5					88.76 5.33		33	200	20												Soil Cuttings
		Lo	ose, grey SAND		5.33	8	ss	355	6	•		) 								МН	
6	-	Eı	nd of borehole		87.99 6.10																
7																					
8																					
9																					
																	1::::				
10																				-	
11																					GROUNDWATEI OBSERVATIONS
																					DATE DEPTH (m)  20-09-30 2.4
12																					25 55 50 2.4 2

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 7 2020

ွ		SOIL PROFILE	<sub> </sub>			SAN	IPLES		<b>●</b> RE	SISTA	NCE (N	I), BLO	NS/0.3r	H2 1+ m	IEAR S' NATUR/	AL ⊕ F	REMOL	JLDED	ING ING	PIEZOMETE
METRES	BORING METHOD		STRATA PLOT	ELEV.	3ER	ا س	RECOVERY,	BLOWS/0.3m	DY	NAMIC	PENE	TRATIC	ON			R CON	TENT,		ADDITIONAL LAB. TESTING	OR STANDPIPI
ME	ORING	DESCRIPTION	RATA	DEPTH	NUMBER	TYPE	ECO	OWS						W		<del></del>		⊢ W <sub>L</sub>	ADD	INSTALLATIO
_	B		ST	(m)			Ψ.	H H	1	0 2	20 :	30	40 !	50 6	60 7	0 8	30 !	90 <del> </del>		ļ
0	+	Ground Surface TOPSOIL	131/1/23	93.77																_
		Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST)		0.10	1	ss	310	9												Above Ground Protector & Bentonite
1		(WEATHERED CRUST)			2	SS	610	8			I - C		-1							
							-													
2					3	ss	610	5	•											
									1::::											
					4	ss	610	4	•			0								\[ \times \big  \]
3				9 <u>0.72</u> 3.05					-											\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \
		Firm to stiff, grey SILTY CLAY, trace sand seams			5	SS	610	1												Soil Cuttings
4									1	P: : : :										l 16
-	m OD)									<b>.</b>		: : : H	-							
	ger (210m								-											
5	Fower Auger Hollow Stem Auger (210mm OD)				6	TP	610	PM												
ľ	w Sten								⊕			#: : : :								
6	Hollo													+						
					7		610	\A/I I												
						SS	610	WH												Ö
7										Φ						: : : : : : : : : : : : : : : : : : :				Bentonite
										Φ:::							:::+	-		
					8		610	\A/I I	1											Filter Sand
8					°	SS	610	WH	<u> </u>											50 mm: diameter, 1.52
										⊕ ::				-						metre length, slotted SCH 40 PVC Pipe
9										Φ						::::::				
					9	SS	310	2	•			φ								Soil Cuttings
		End of borehole		83.91 9.86																
10																				
11																				GROUNDWATE OBSERVATION
																				DATE DEPTH (m)  20-09-30 2.6 ∑
12																				
		SEMTEC_							::::		::::		::::							

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 7 2020

∜,	THOL	SOIL PROFILE				SAM	PLES		● PE RE	NETR SISTA	ATION NCE (N	N), BLO	WS/0.3r	1+ n	IEAR S NATUR	TRENG AL + F	REMOL	u), kPA JLDED	AR NG	D.E.30. :===
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ DY RE	NAMIC SISTA	C PENE NCE, E	ETRATIONS	ON /0.3m	w		R CON	TENT,	%   w <sub>L</sub>	ADDITIONAL LAB. TESTING	PIEZOMETEF OR STANDPIPE INSTALLATIOI
	BOR		STRA	(m)	N	'	REC	BLO	1	10	20 	30	40 5	50 6	30 T	70 8	30 I	90 	₹5	
0		Ground Surface TOPSOIL		93.77 0.10															_	Above Ground Protector &
		Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST)		00																Bentonite
1	(Q																			Soil Cuttings
	10mm C																			∑ 🔀
2	Power Auger em Auger (21																			Bentonite
	Power Auger Hollow Stem Auger (210mm OD)																			Filter Sand
3	Hollow			9 <u>0.72</u> 3.05																50 mm diameter, 1.52 metre length, slotted SCH 40 PVC Pipe
		Firm to stiff, grey SILTY CLAY, trace sand seams																		metre length, slotted SCH 40 PVC Pipe
4																				
-		End of borehole Soil stratigraphy inferred from BH		89.50 4.27																
		20-16A																		
5																				
6																				
7																				
8																				
9																				
10																			_	
11																				GROUNDWATER OBSERVATIONS
																				DATE DEPTH (m)  20-09-30 1.5 ∑
12																				

CLIENT: Cardel Homes

SHEET: PROJECT: Geotechnical & Hydrogeological Investigation DATUM: JOB#: 61899.04

LOCATION: See Site Plan, Figure 1

1 OF 1 CGVD28 BORING DATE: Jul 9 2020

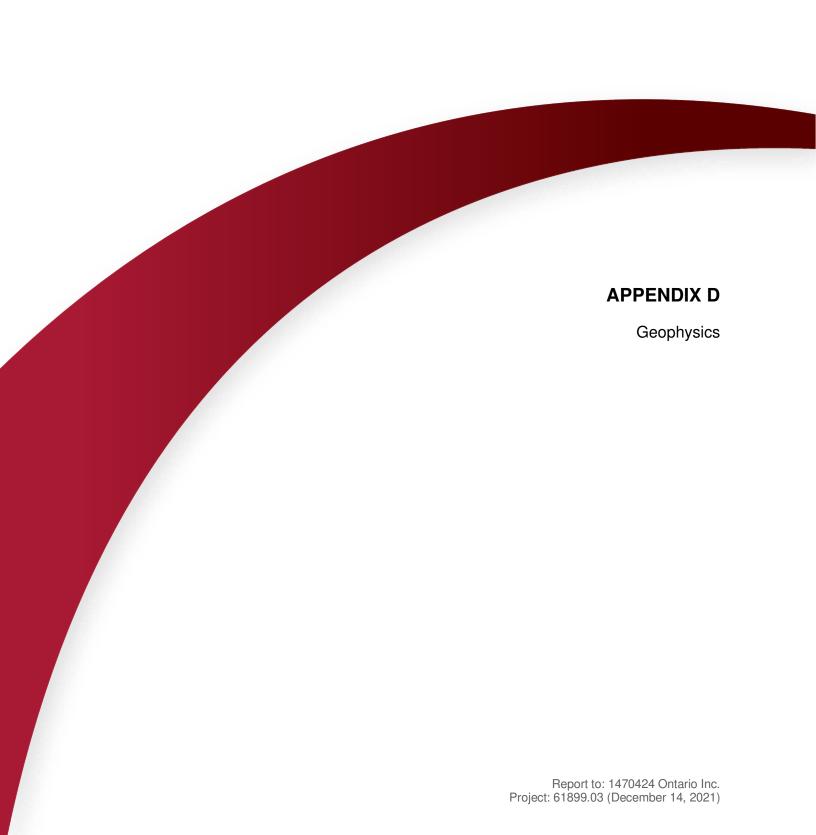
S	THOL	SOIL PROFILE	<sub> </sub>			SAN	MPLES		● RE	SISTA	NCE (N	), BLO\	NS/0.3r	H8 1+ m	IEAR S' NATUR/	AL ⊕ F	REMOL	JLDED	ING ING	PIEZOMETE
METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV.	BER	TYPE	RECOVERY, mm	BLOWS/0.3m	_ DY	NAMIC	PENE	TRATIC	DN			R CON	TENT,		ADDITIONAL LAB. TESTING	OR STANDPIPI
Σ	ORIN	DESCRIPTION	IRAT/	DEPTH (m)	NUMBER	₹	ZECO.	LOWS						W <sub>I</sub>	۲.	<del></del>	20	⊢ w <sub>L</sub>	ADD LAB.	INSTALLATIO
$\dashv$	<u>в</u>	0 10 (	S				-	<u>m</u>	::::	0 2	20 ;	30 4	40 !	50 6	50 7	70 E	30 !	90		
0		TOPSOIL	11 1 <sub>2</sub> 1	93.94 93.79 0.15															-	Above Ground Protector &
		Stiff to very stiff, grey brown SILTY		0.13																Bentonite
		Stiff to very stiff, grey brown SILTY CLAY, trace sand seams (WEATHERED CRUST)																		Soil Cuttings
1																				
	(do																			Bentonite
2	Power Auger Stem Auger (210mm OD																		1	∑
	Auge ger (2																			Filter Sand
I,	Power Auger em Auger (21																			50
3	ow Ste	Firm to stiff, grey SILTY CLAY		9 <u>0.89</u> 3.05																50 mm diameter, 1.52 metre length,
	Hollow	Timile Sun, grey OLETT SEAT																		metre length, slotted SCH 40 PVC Pipe
4																				[A
4					1	TP	610	PM												
																				Soil Cuttings
5									:::::	Þ: : : :		::::	::::	-::::						
Ť		End of borehole		88.76 5.18									1							
		Soil stratigraphy inferred from BH 20-18A																		
6																				
7																				
8																			-	
9																				
									:::::											
10																			1	
																				ODOLINOW:
11																			1	GROUNDWATE OBSERVATION DATE DEPTH
																				20-09-30 2.1 ∑
12																				
														: : : :						
	G	<u>SEMTEC</u>																	LOGG	GED: ML

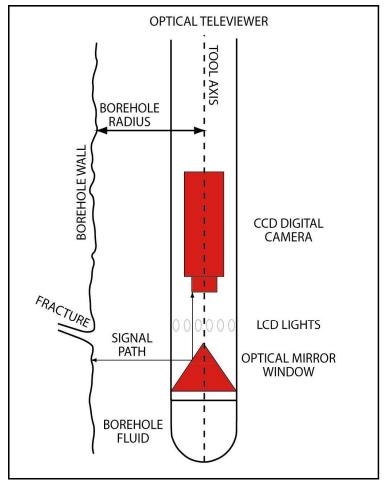
CLIENT: Cardel Homes

PROJECT: Geotechnical & Hydrogeological Investigation JOB#:

SHEET: 1 OF 1 DATUM: CGVD28 61899.04 BORING DATE: Jul 8 2020 LOCATION: See Site Plan, Figure 1

í I	BORING METHOD	}	SOIL PROFILE				SAMPLES				PENETRATION SHEAR STRENGTH (Cu), kPA + NATURAL + REMOULDED												
METRES			DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY,	BLOWS/0.3m	▲ D\										PIEZOMETER OR STANDPIPE INSTALLATION			
0		1	Ground Surface TOPSOIL		94.20						i											Above Ground	
			Stiff to very stiff, grey brown SILTY CLAY, trace sand seams		0.08	1	ss	75	11		•											Protector & Bentonite	
			(WEATHERED CRUST)								1											Soil Cuttings	
1						2	SS	510	5		1												
						3	ss	610	4							0						Bentonite	
2	į	<u>Q</u>						0.0	ļ ·	<u>                                     </u>	:											[A]	
	ٔ اِ	(210mm OD)			91. <u>61</u> 2.59	4	ss	610	8	•												Filter San	
3	Ā	ger	Loose to compact, grey brown SILTY SAND, trace gravel, with cobbles and boulders (GLACIAL TILL)							<u> </u>	<u>                                   </u>											50 mm diameter, 1.52	
ſ	i	Stem /	,		00.54	5	ss	455	20		ф <u>:</u>	•									МН	metre length, slotted SCH 40 PVC Pipe	
4	:	Hollow	Loose to compact, grey SILTY SAND, some gravel, with cobbles and		9 <u>0.54</u> 3.66						:												
			boulders (GLACIAL TILL)			6	SS	125	11														
						7	ss	100	10	-													
5											T:											Soil Cuttings	
						8	ss	255	16	-	1	•											
6		+	End of borehole		88.10 6.10						<u> </u>	:											
7											1												
											:												
8											:												
											:												
9											:												
10																							
11																						GROUNDWATER OBSERVATIONS	
																						DATE DEPTH (m)	
12																						20-09-30 2.5 💆	
12			· CNATCO								Ì												
			SEMTEC  ISULTING ENGINEERS SCIENTISTS																			GED: ML CKED: WAM	





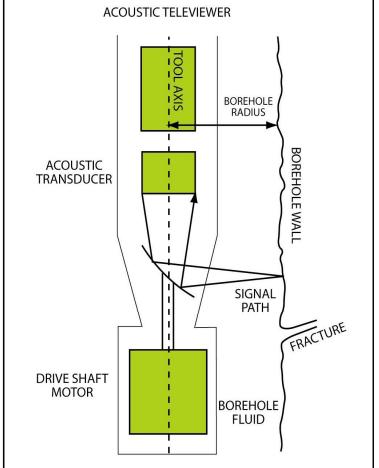


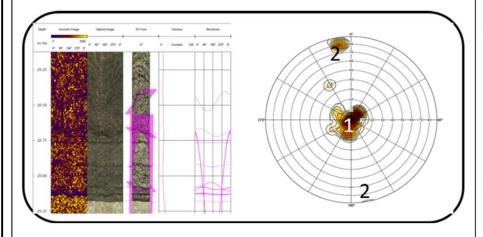
Illustration displaying a generalized schematic of the optical and acoustic televiewers deployed downhole.

Geophysics Investigation

**Optical and Acoustic Televiewer Illustrations** 



## Fractures in Oxford/March Formations



# Fractures in the Nepean Sandstone

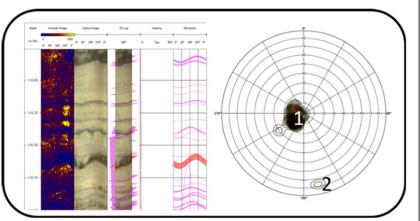
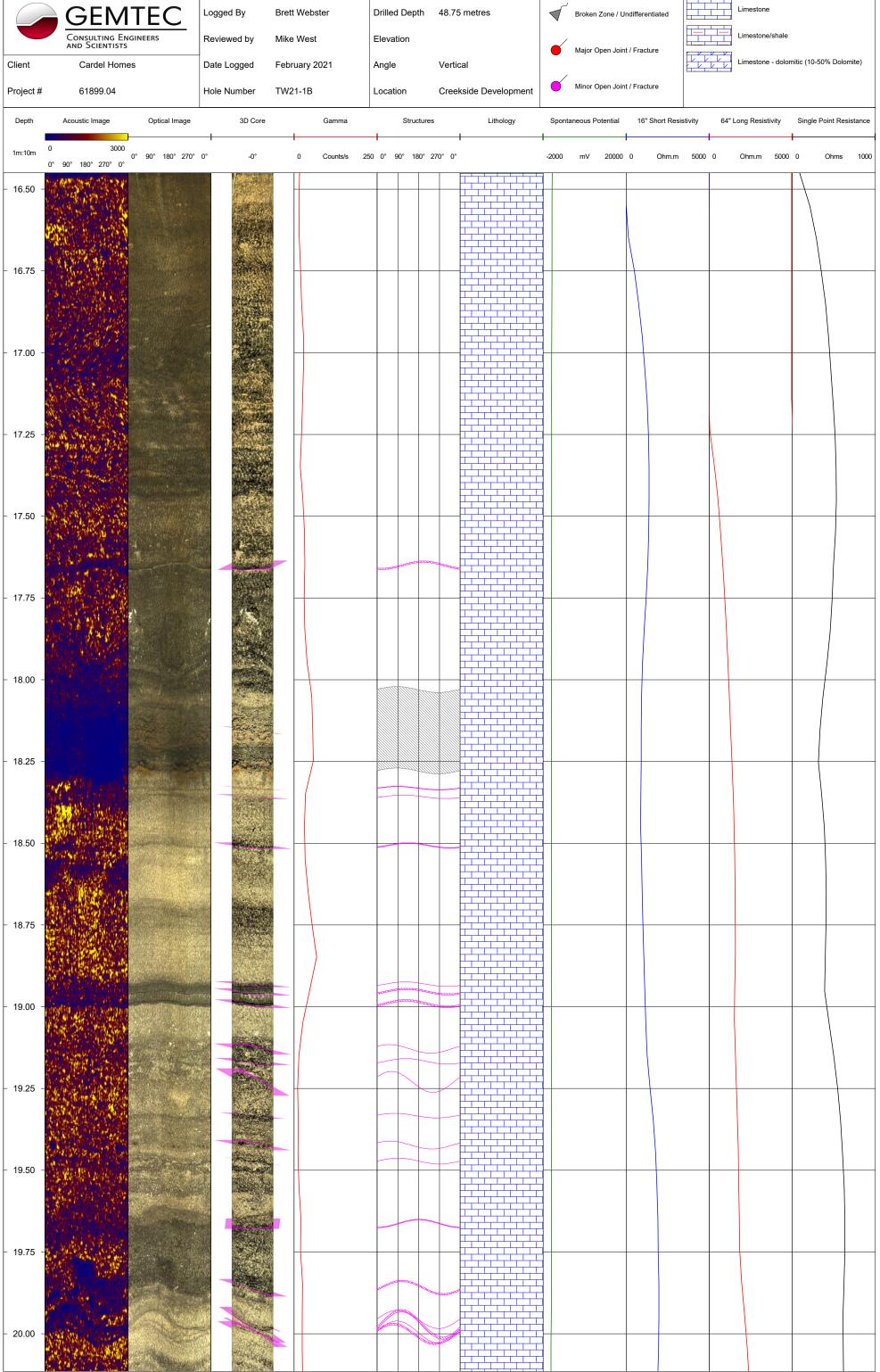


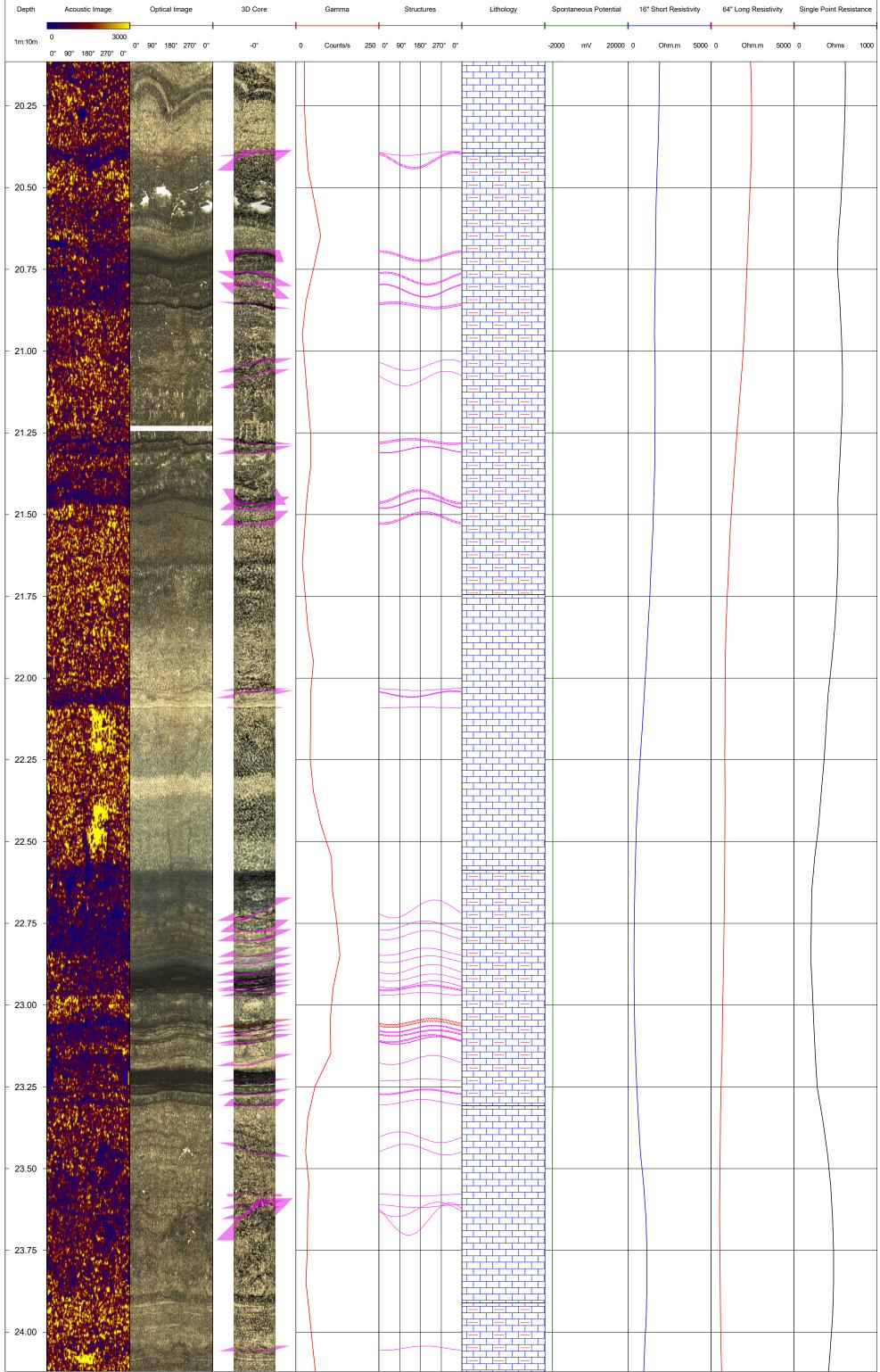
Illustration displaying primary fractures noted in Oxford/March and Nepean Formations.

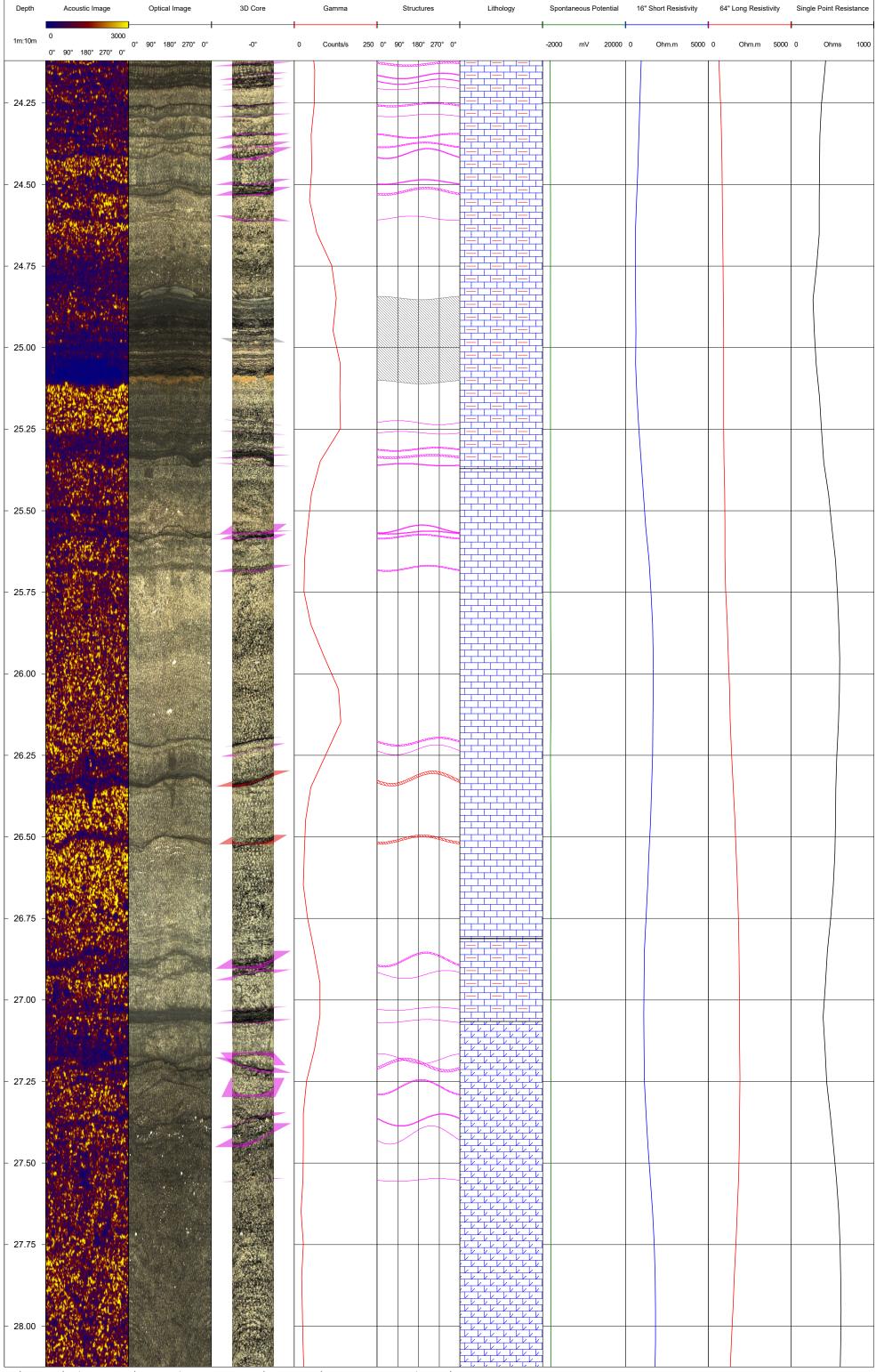
Geophysics Investigation

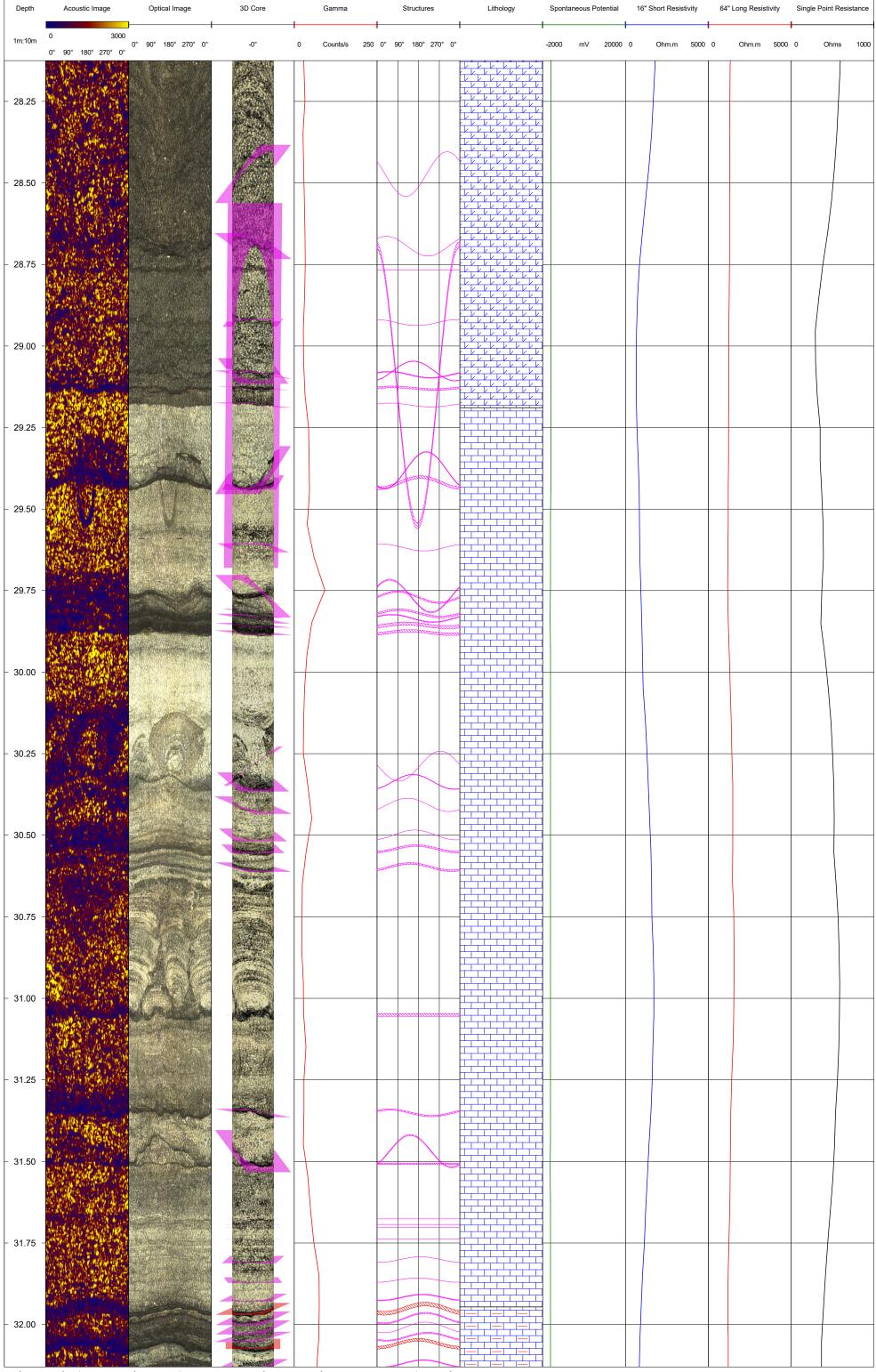
Pole Plots

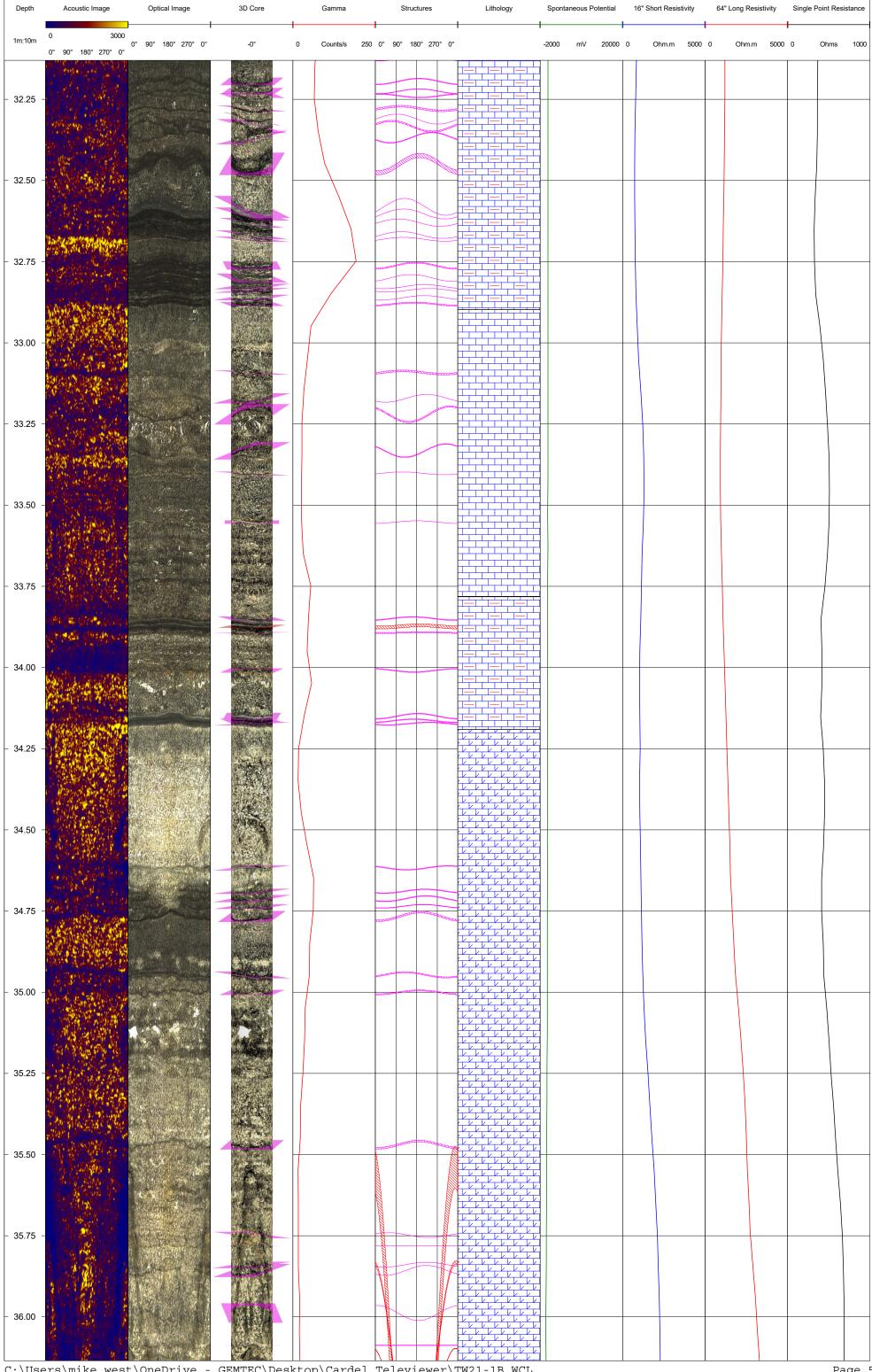


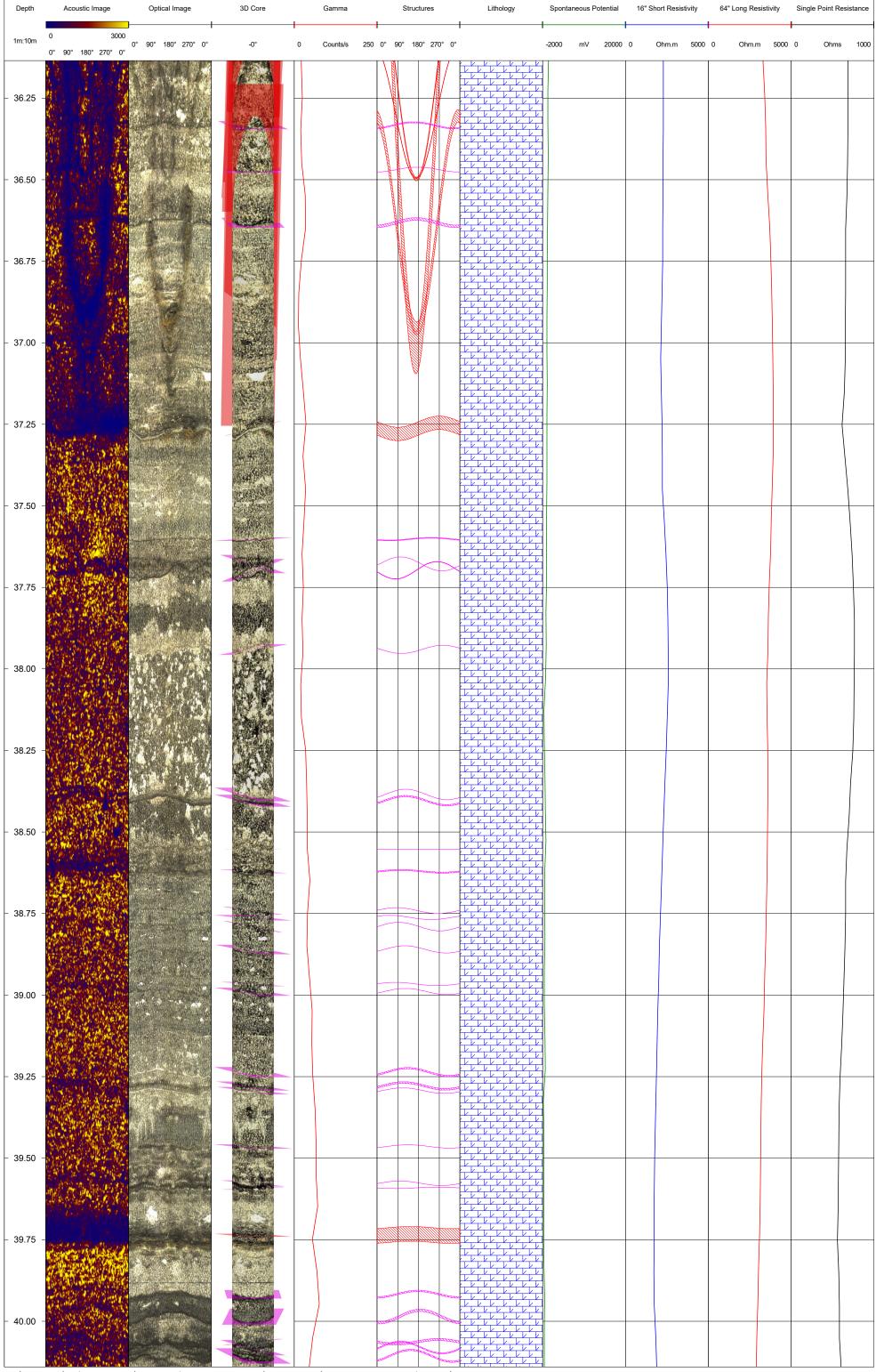


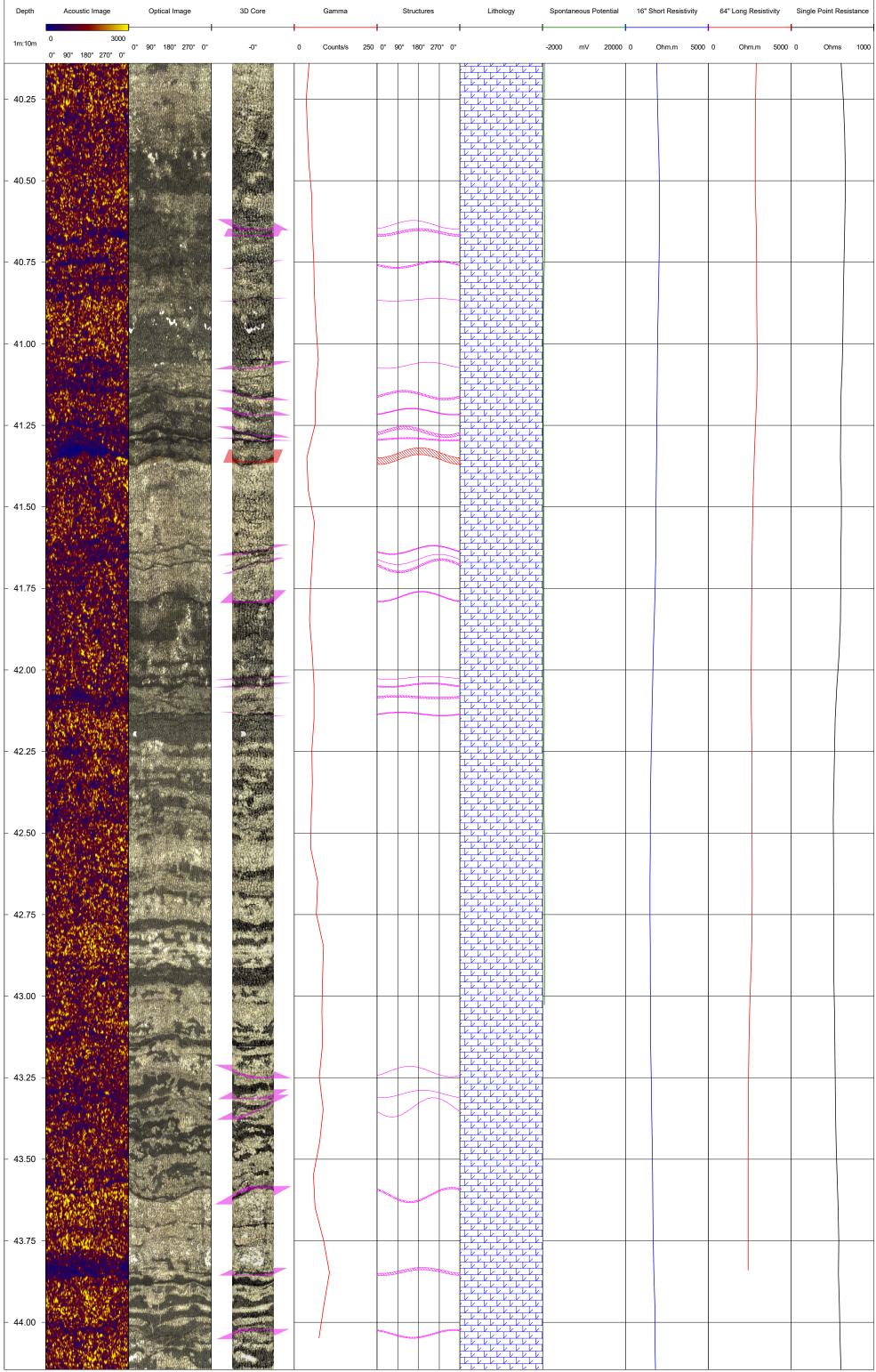


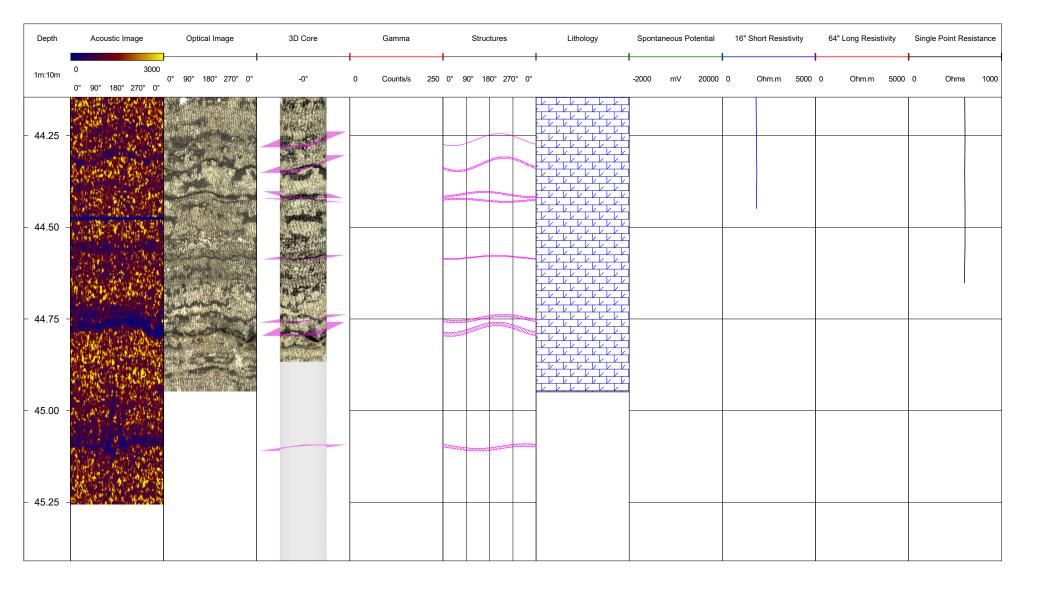


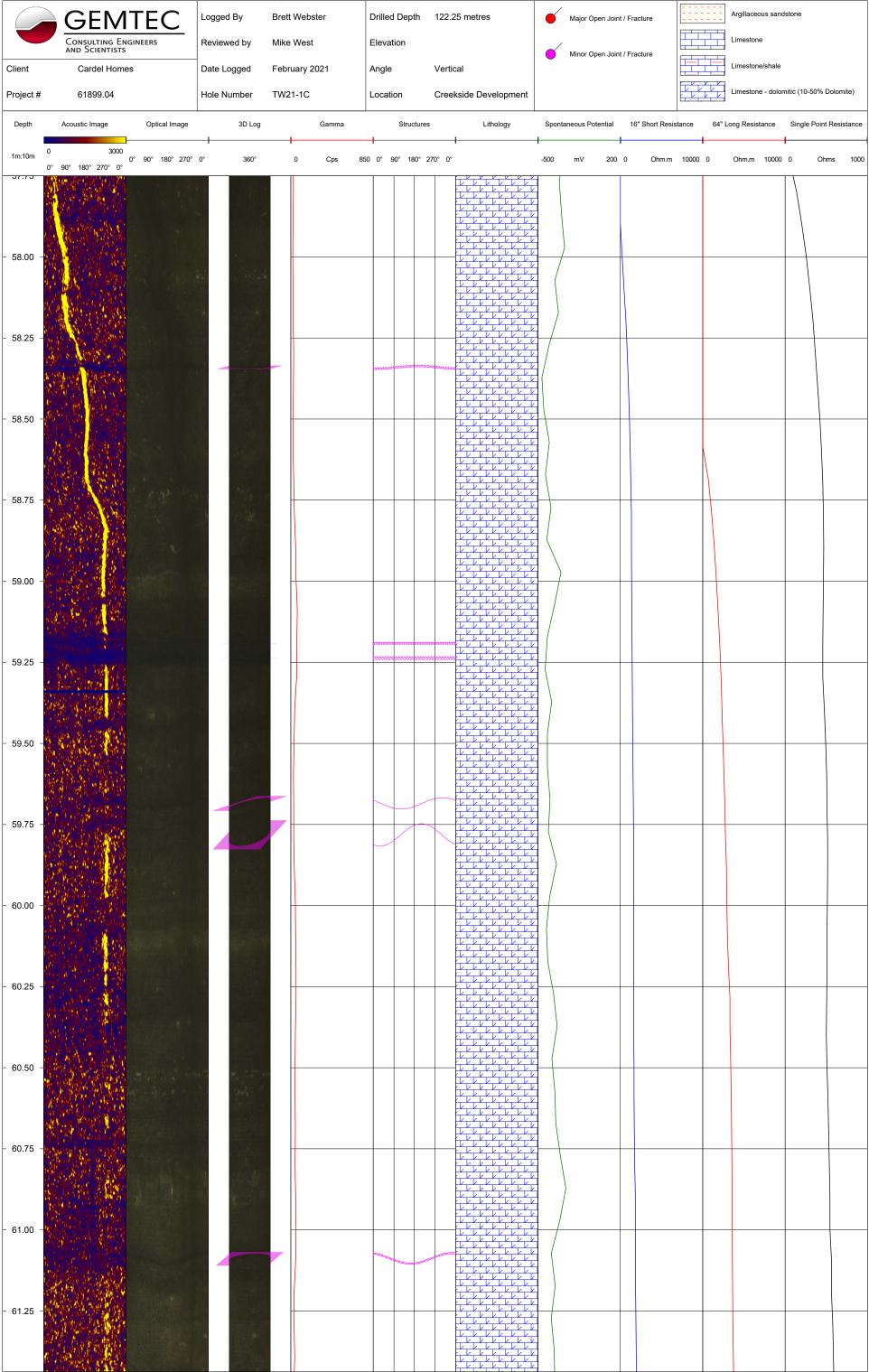


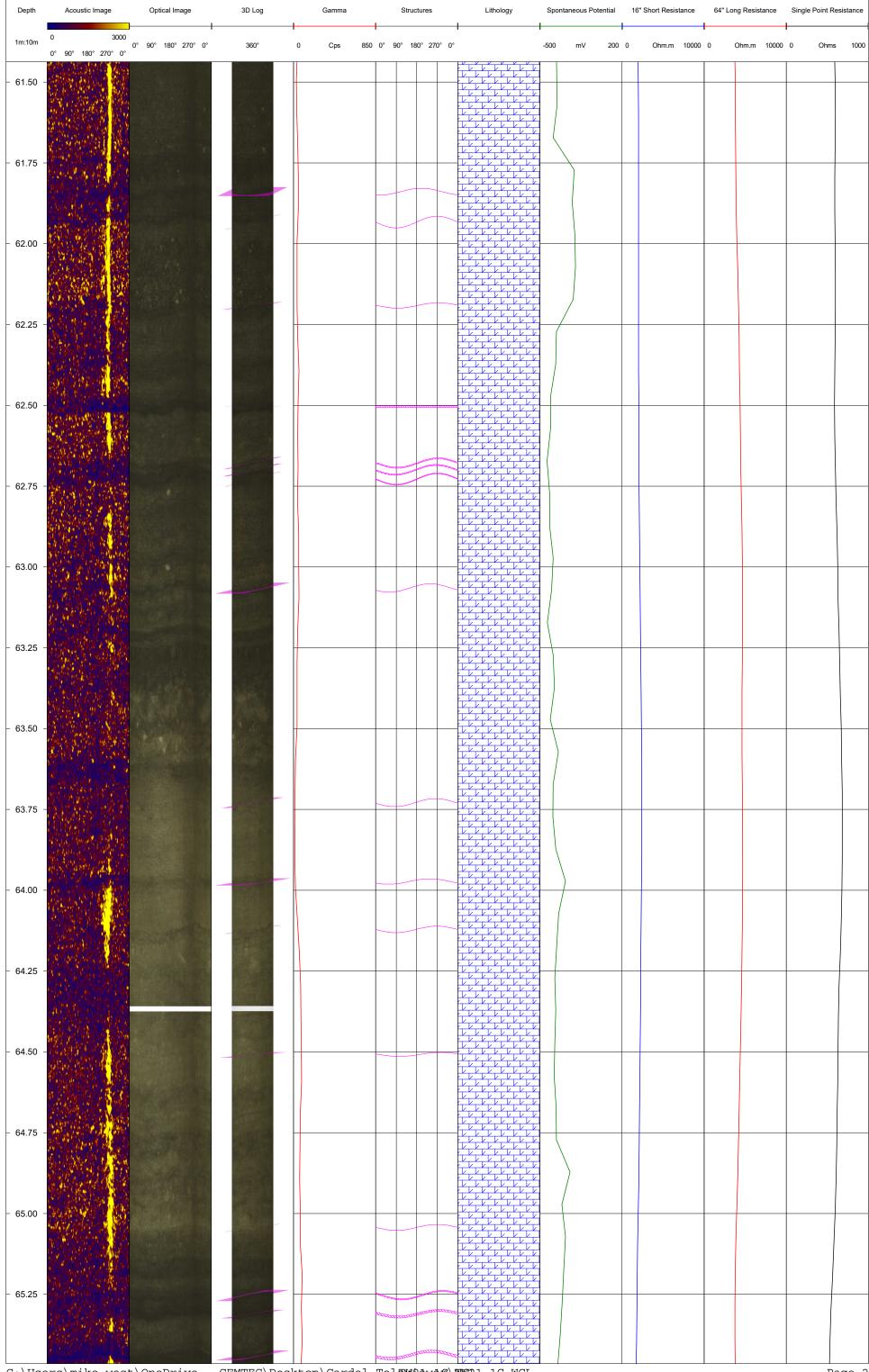


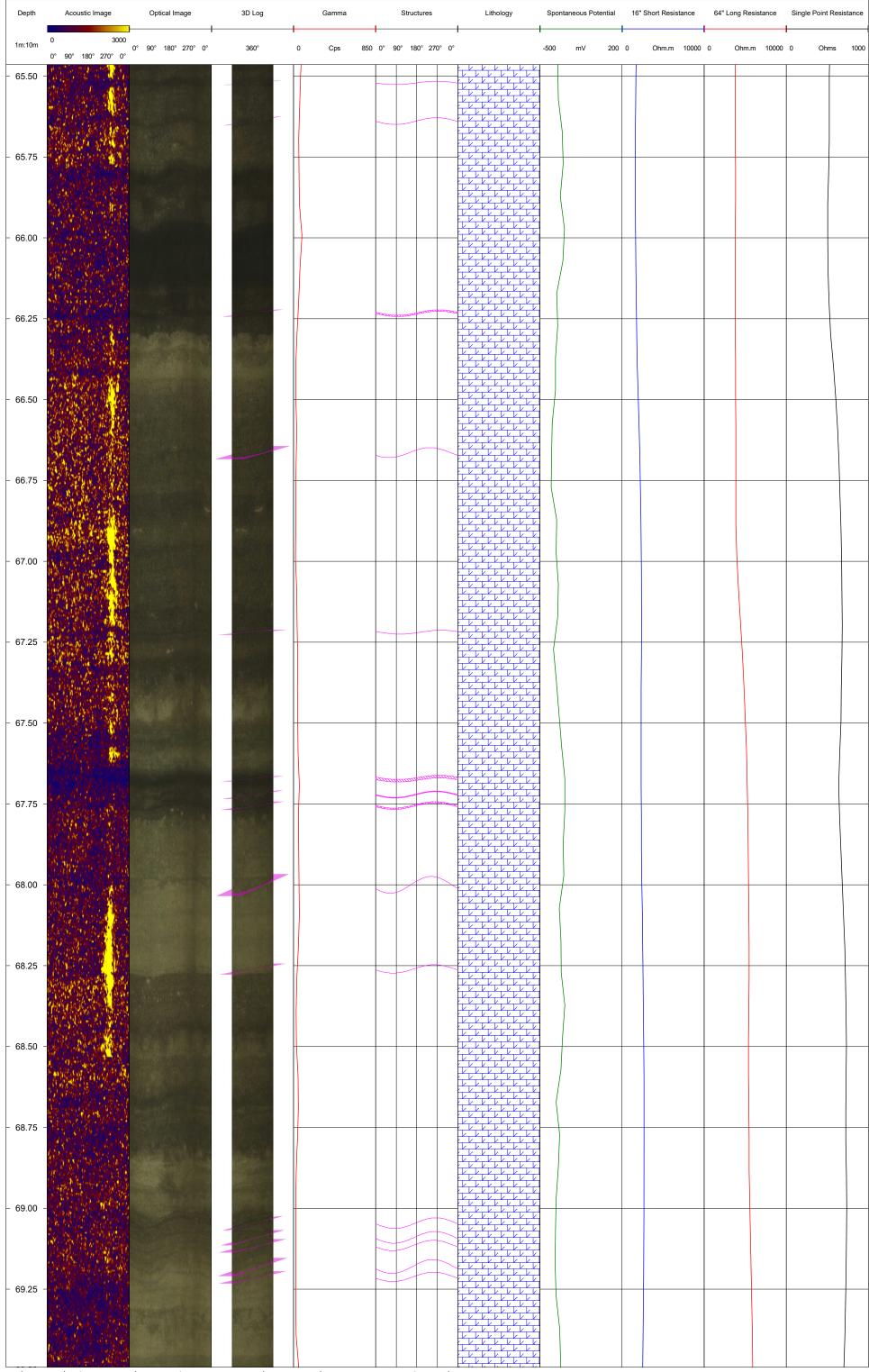


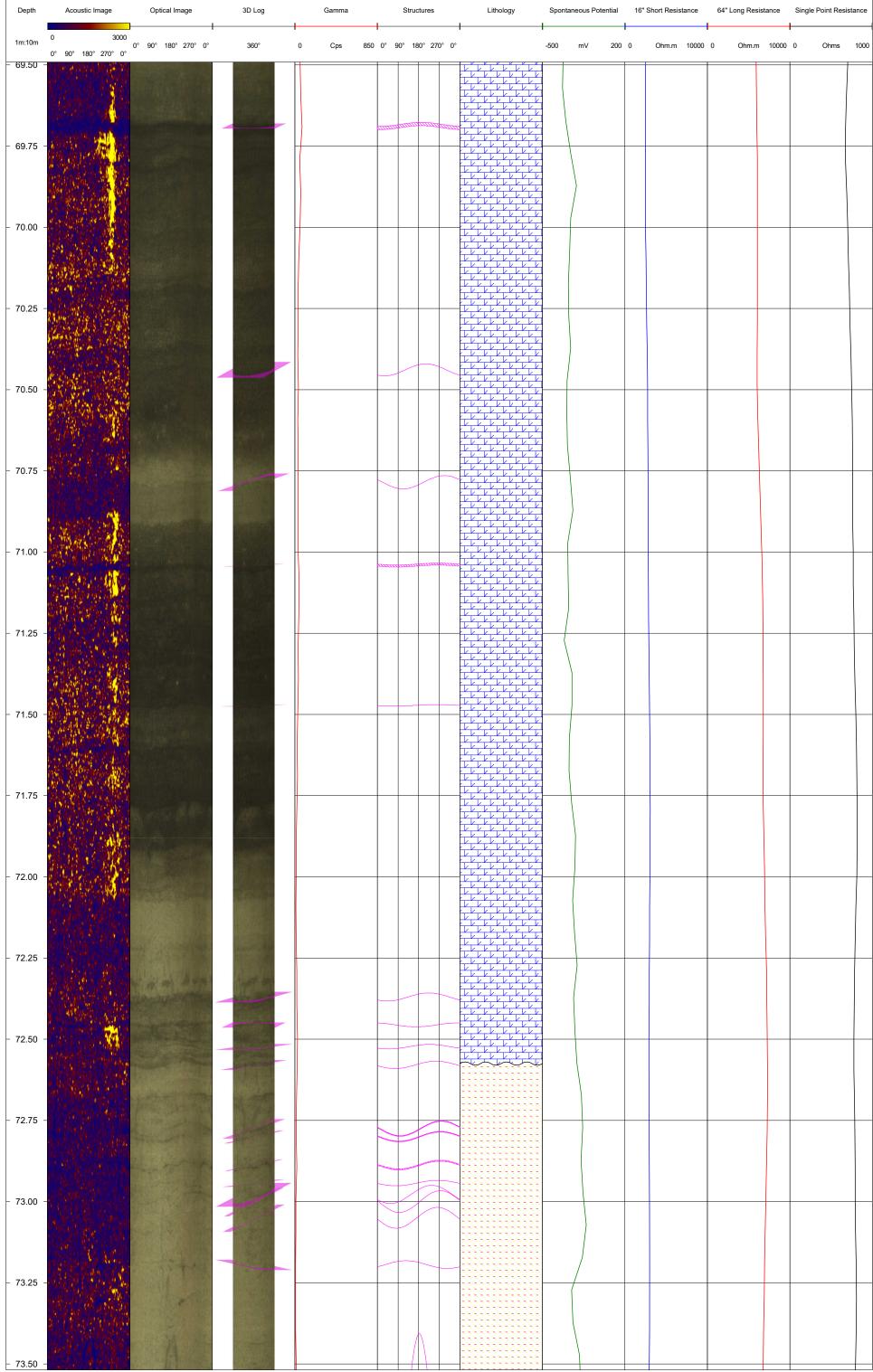


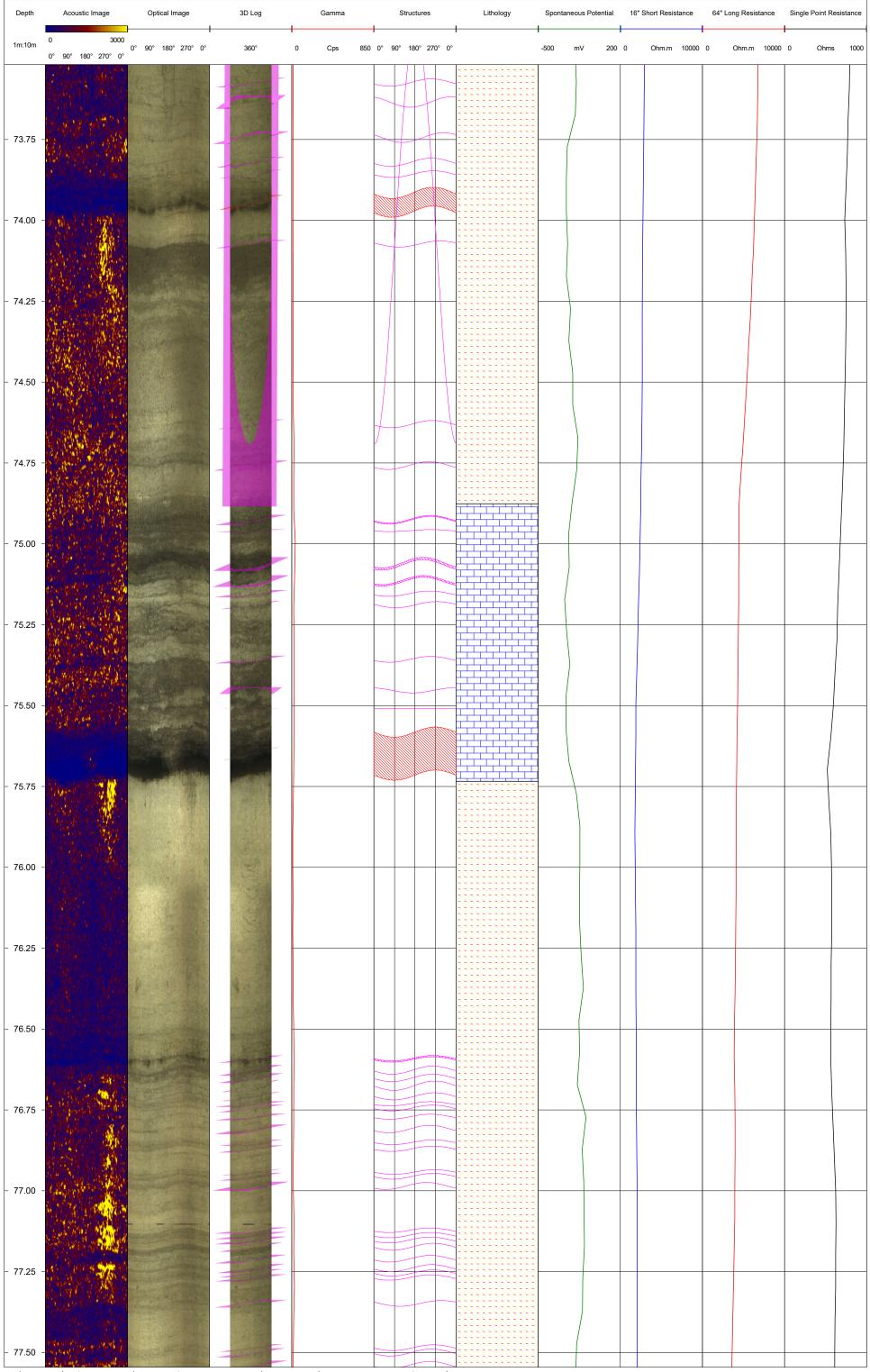


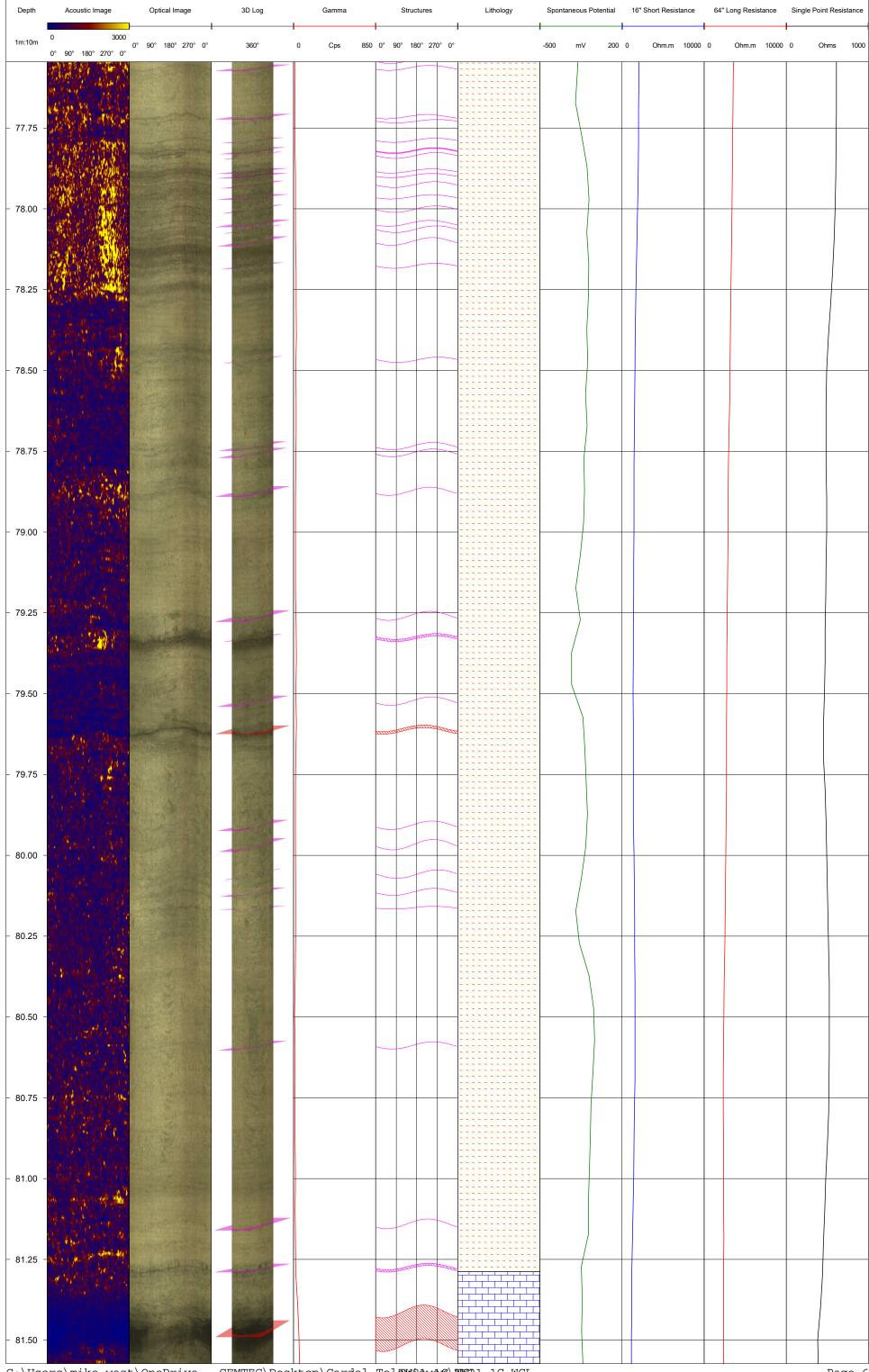


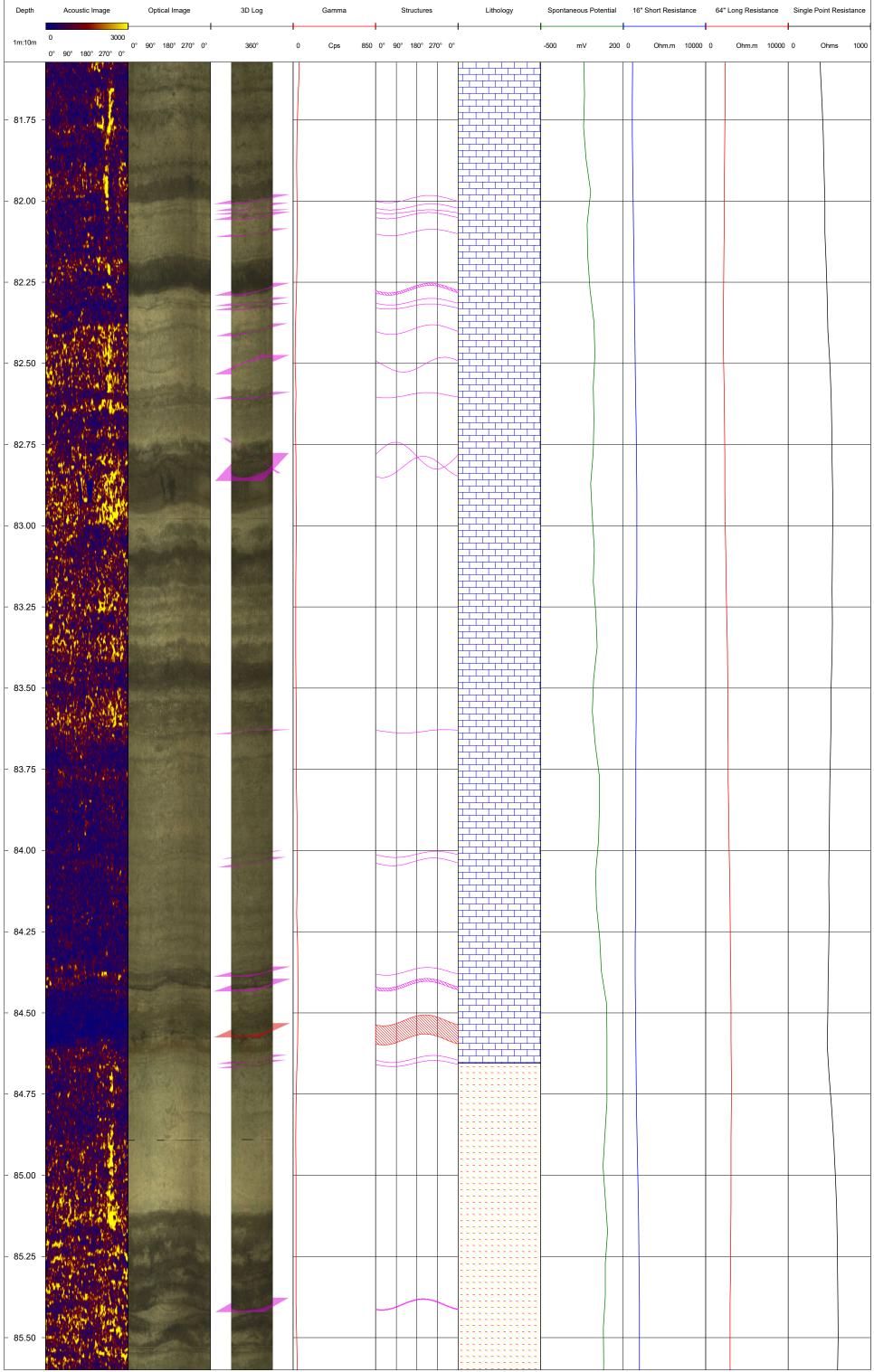


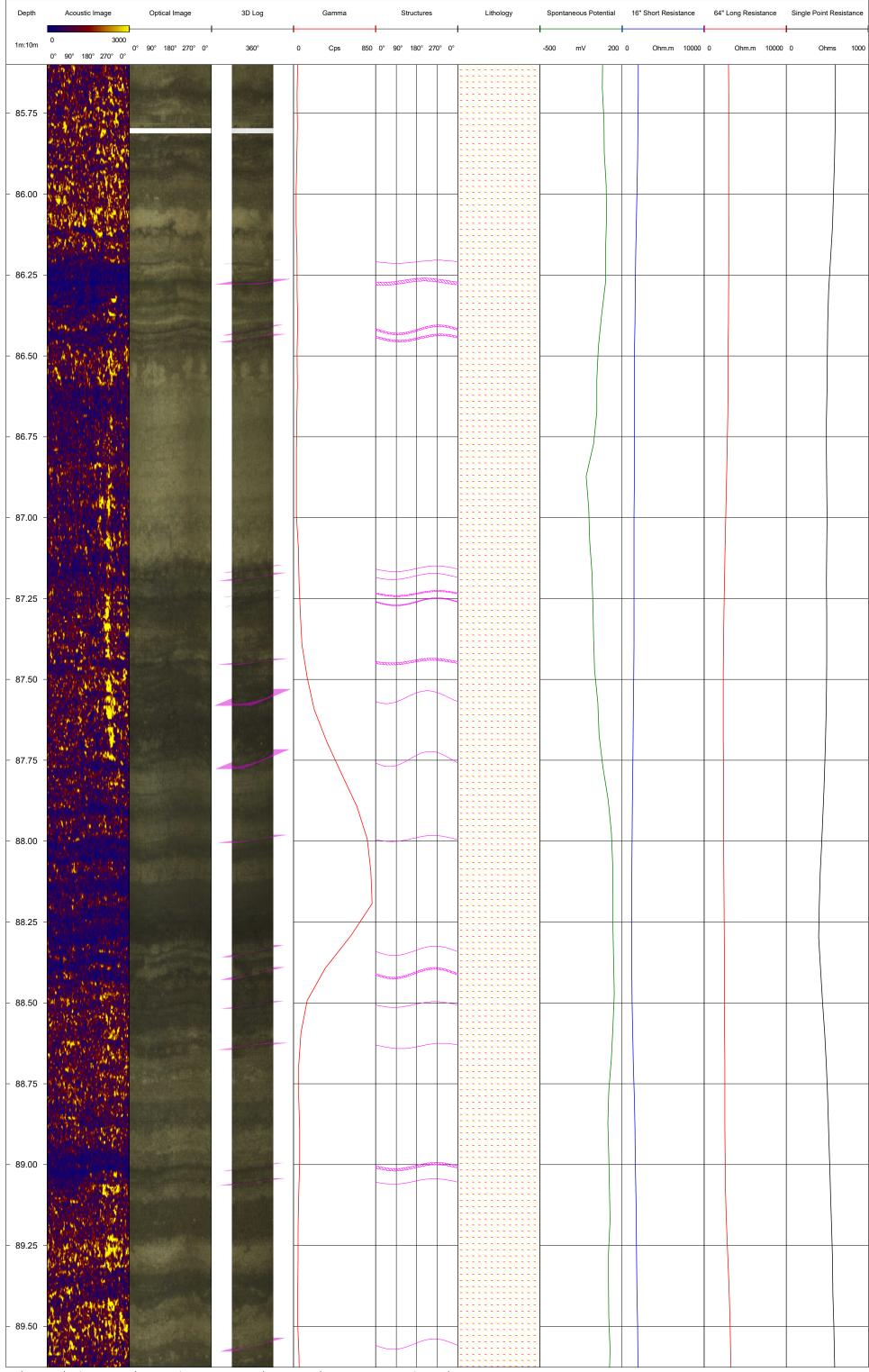


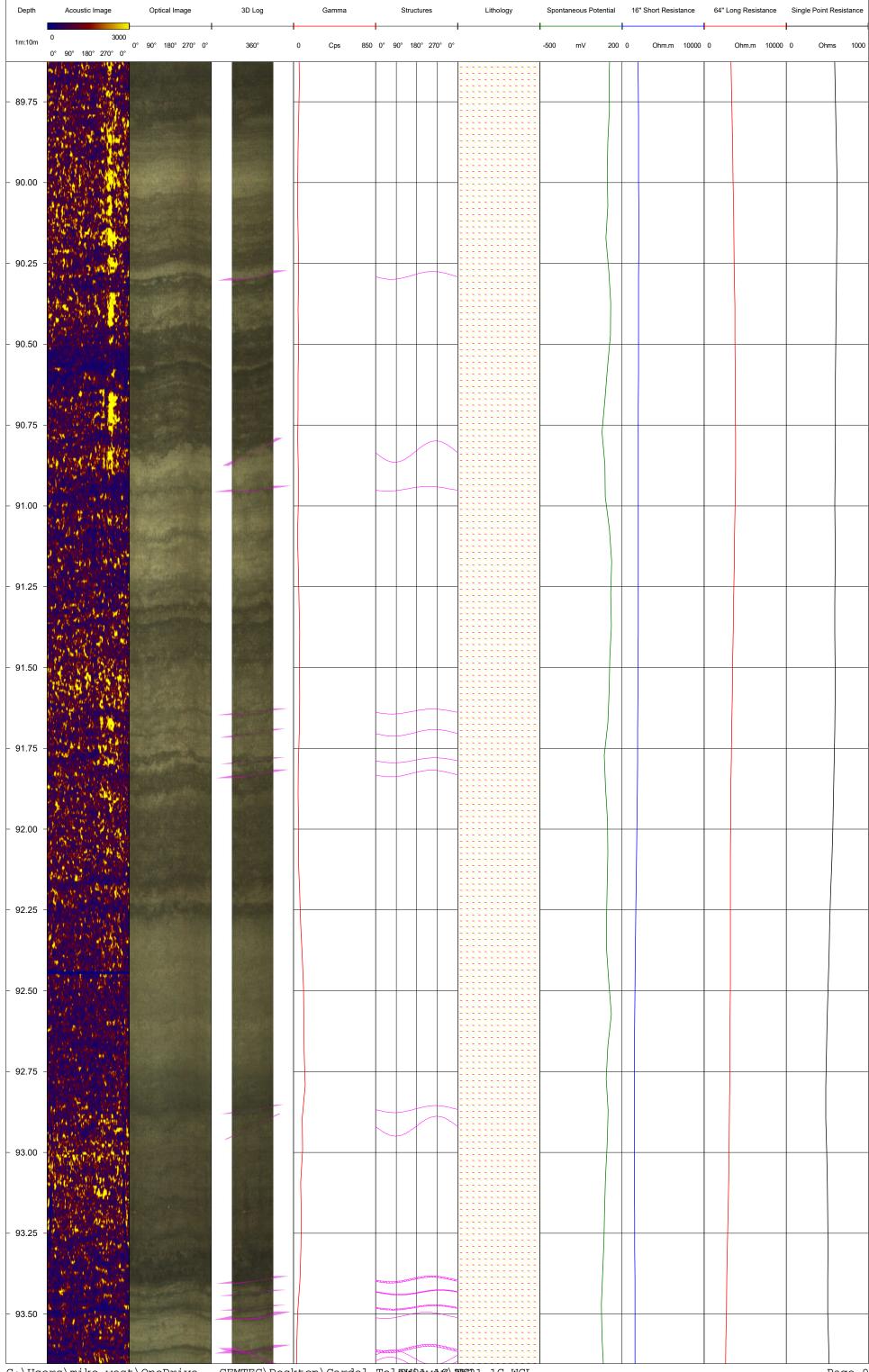


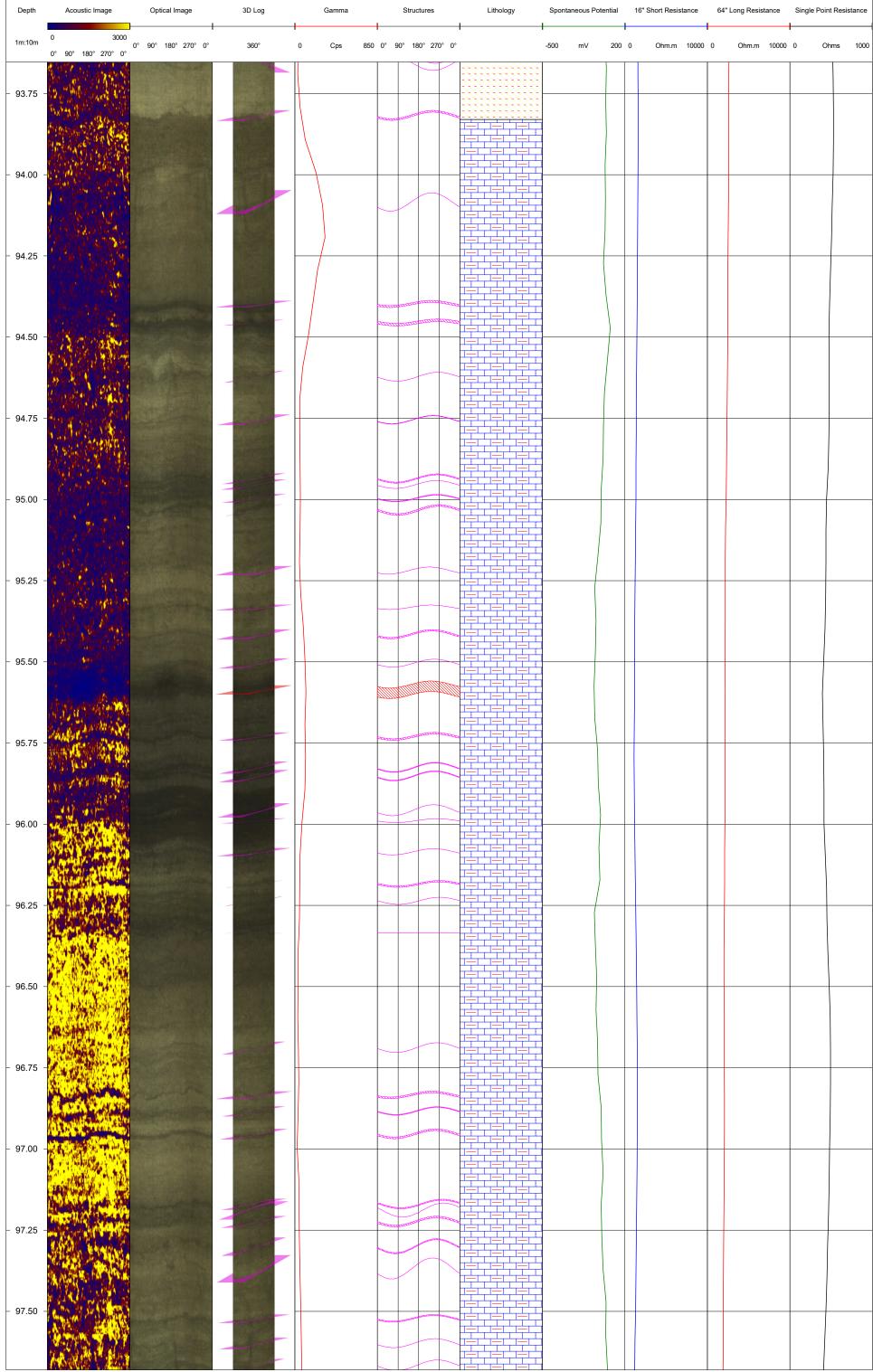


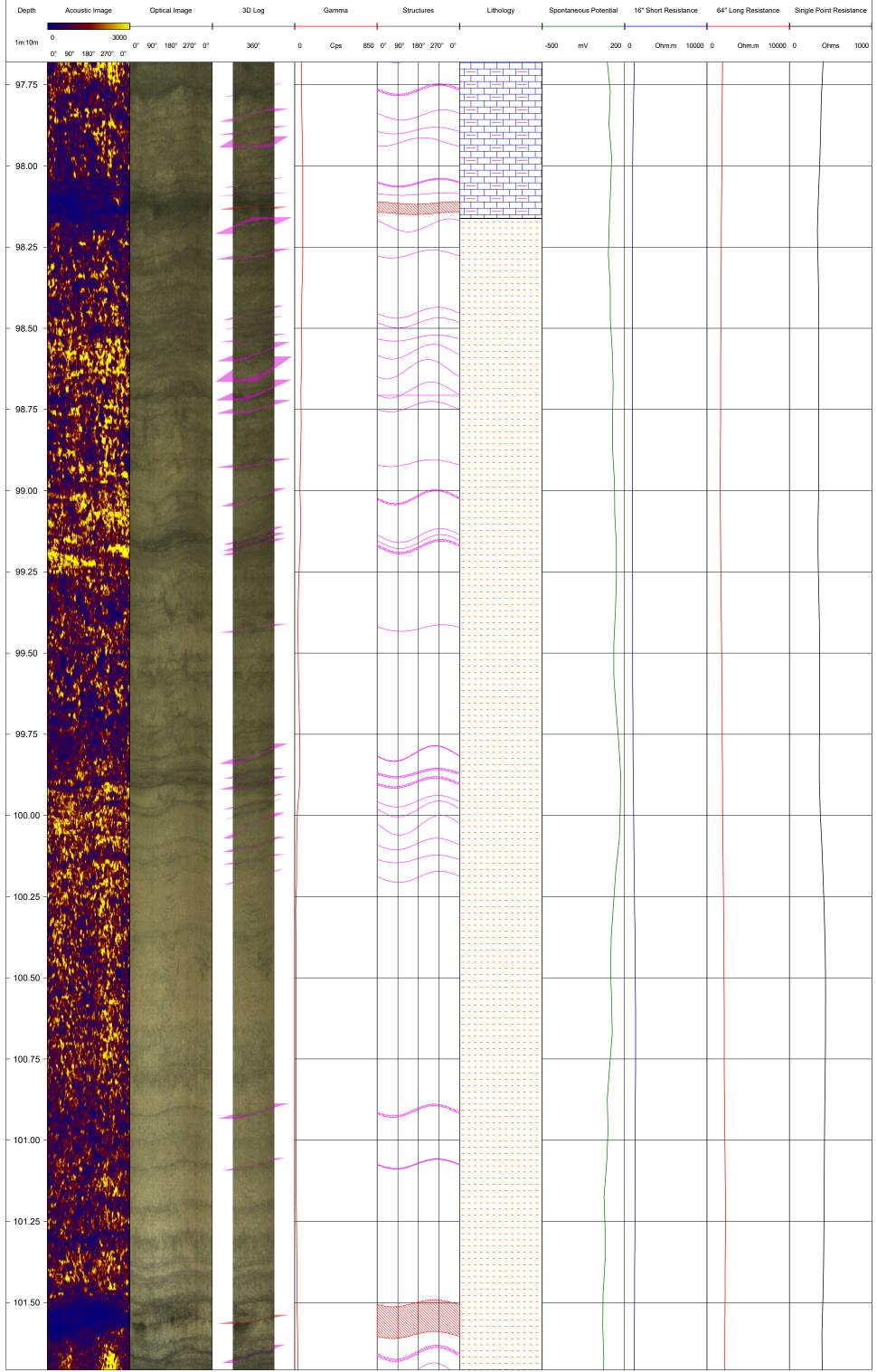


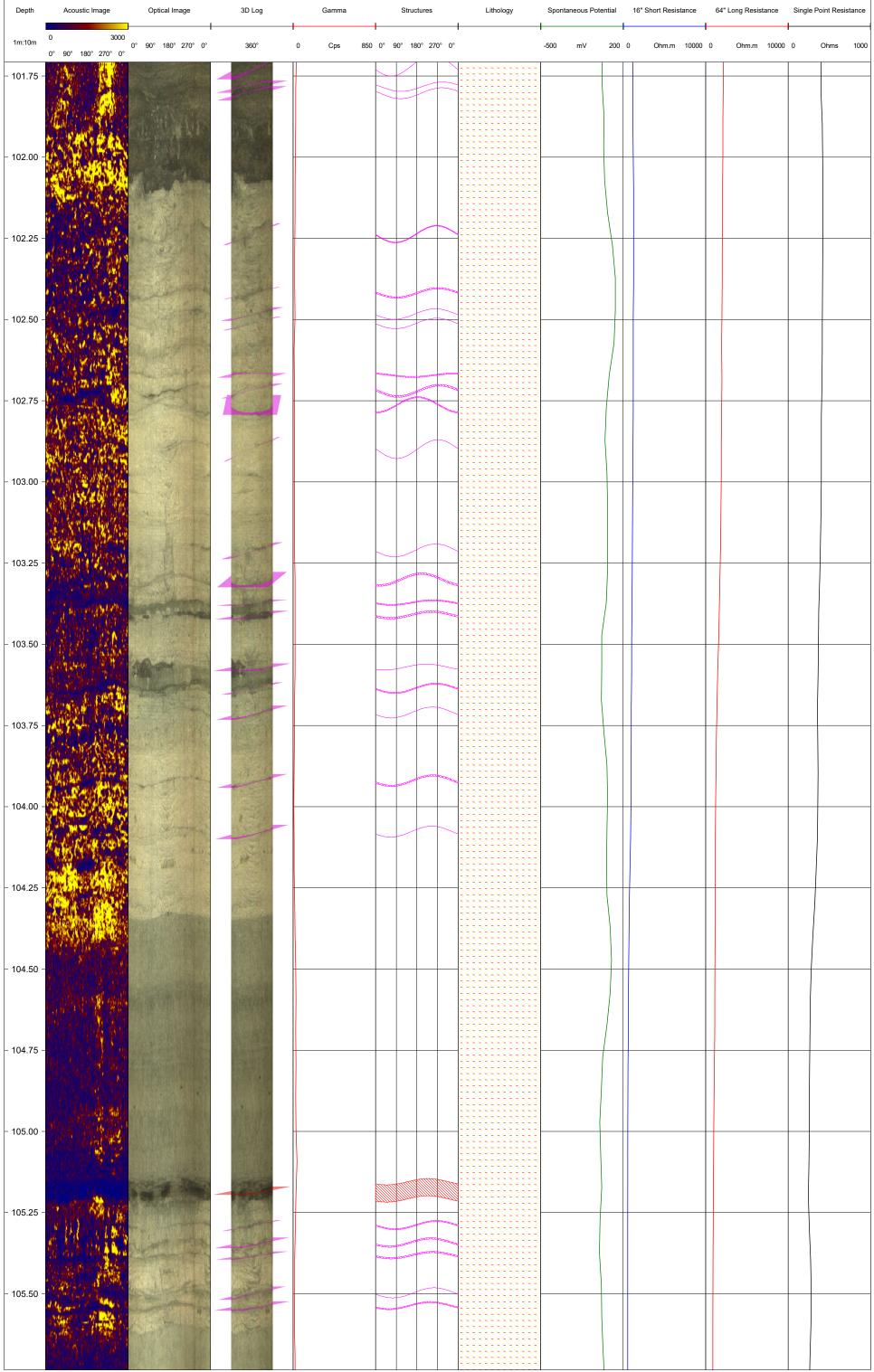


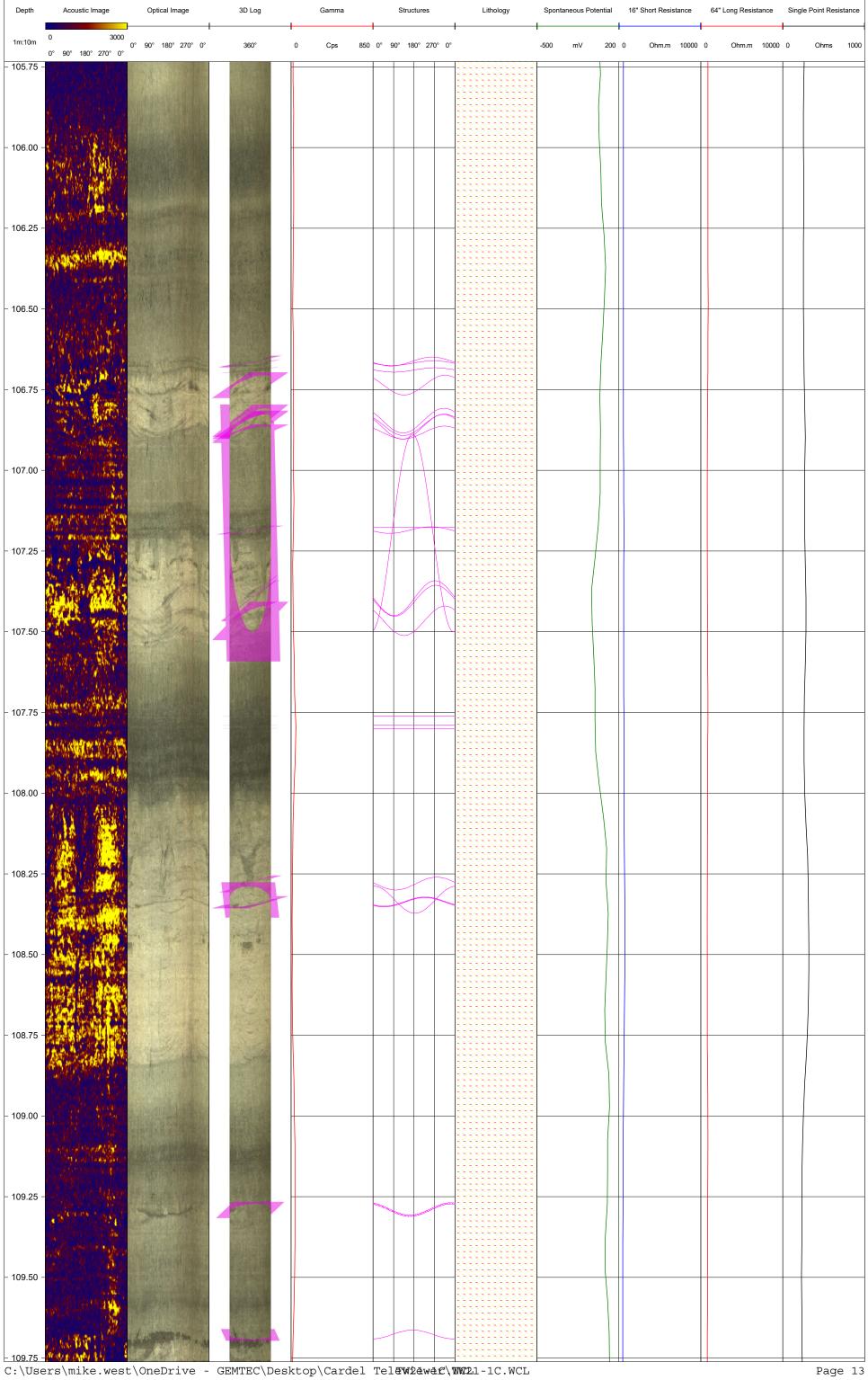


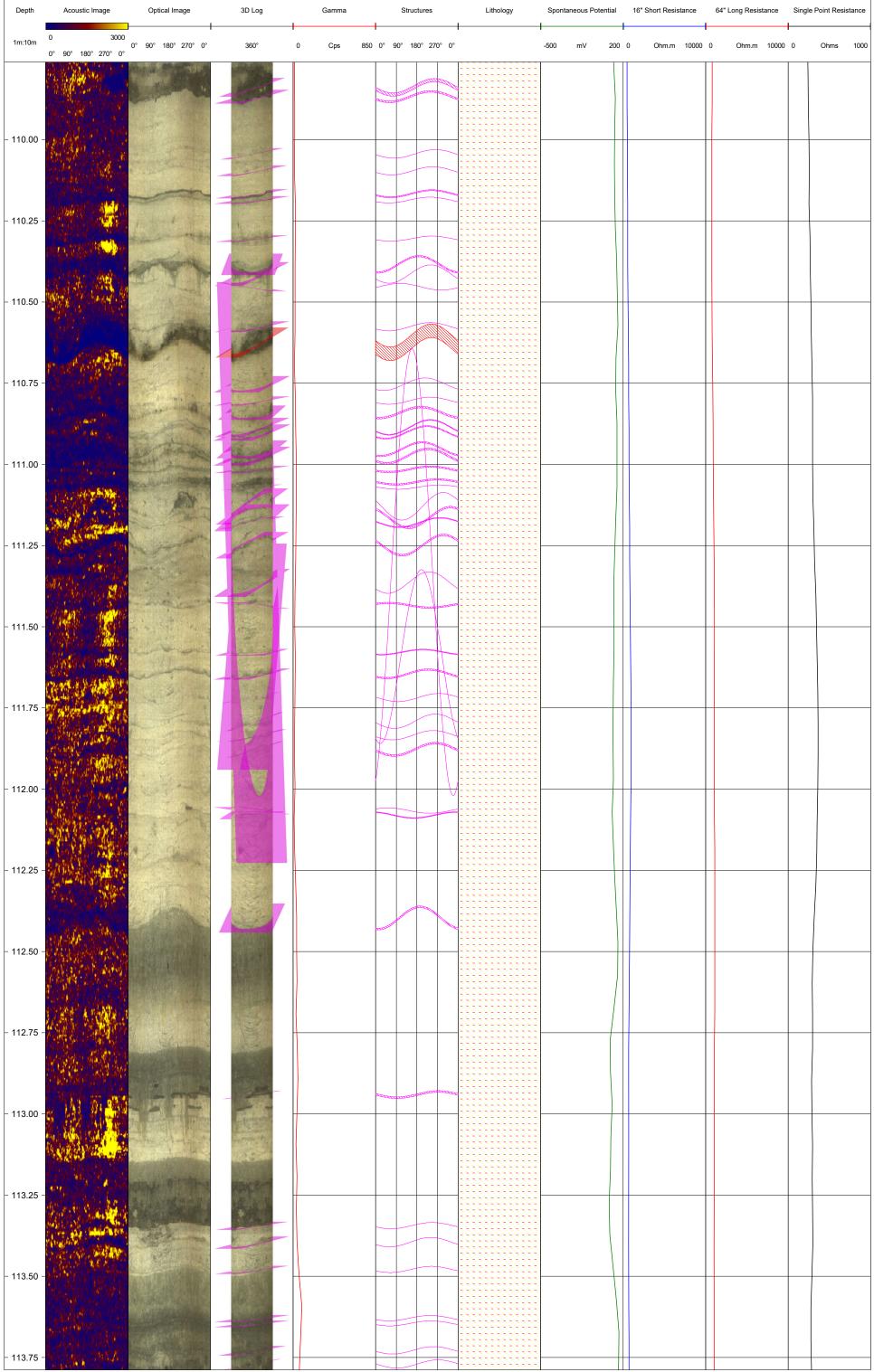


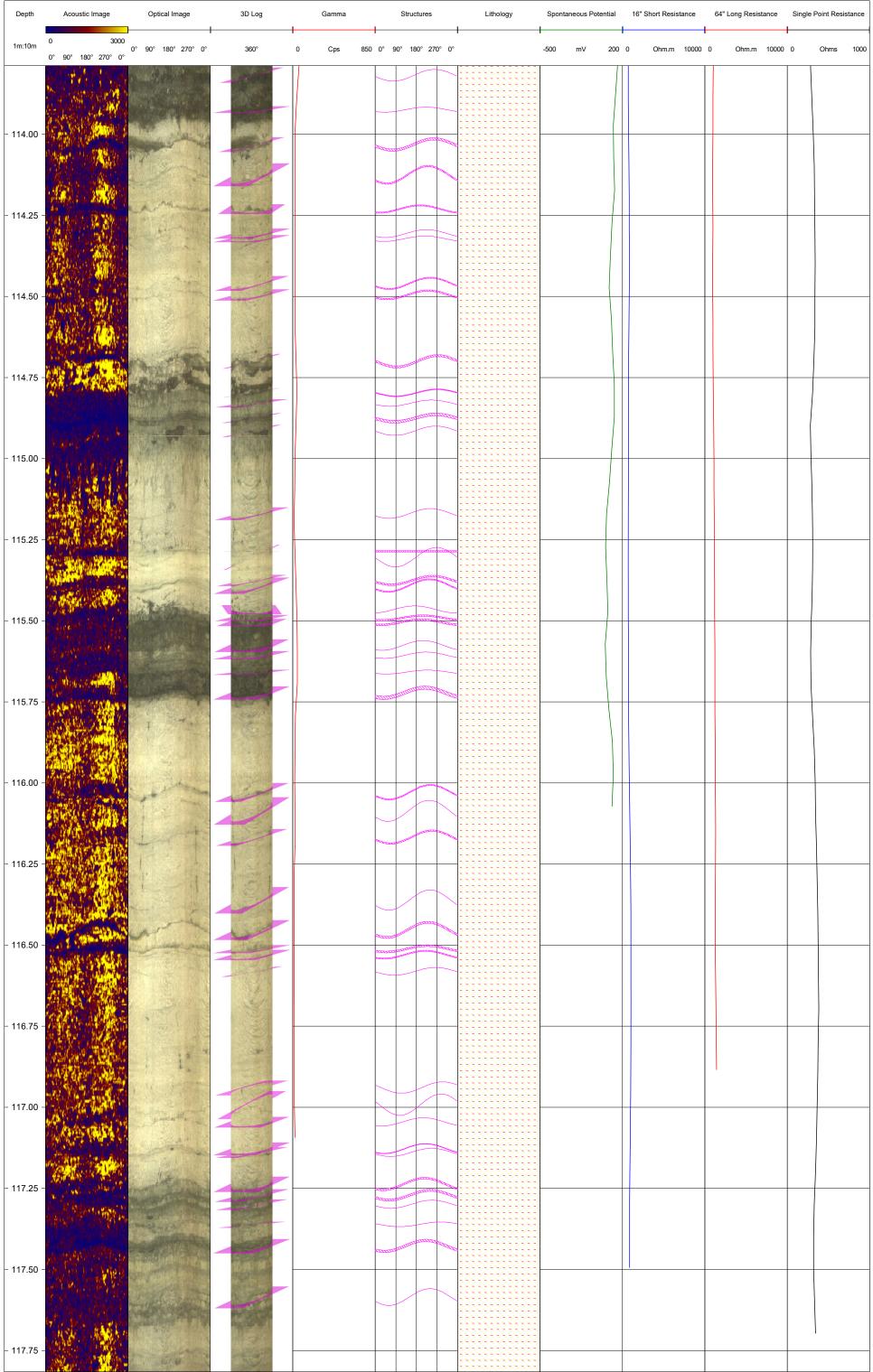


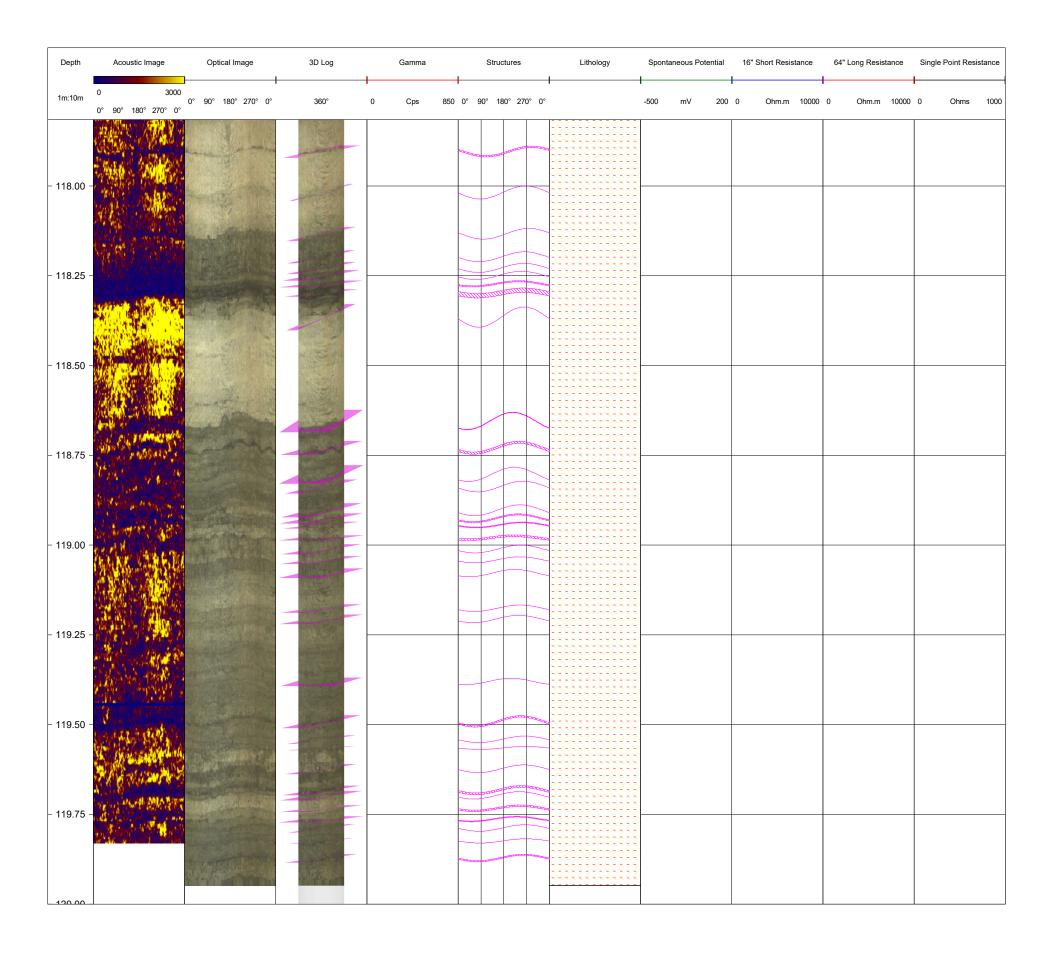


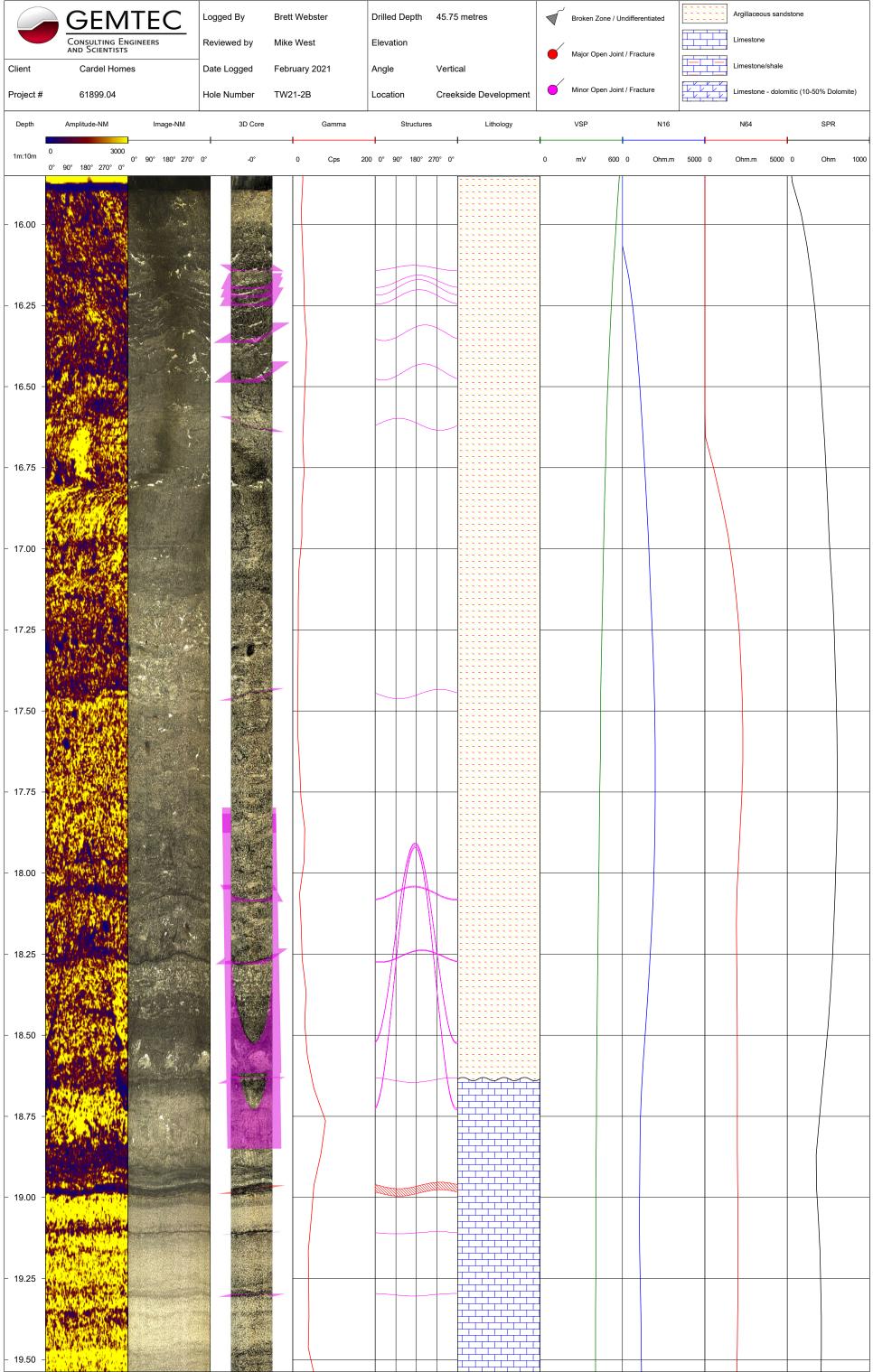


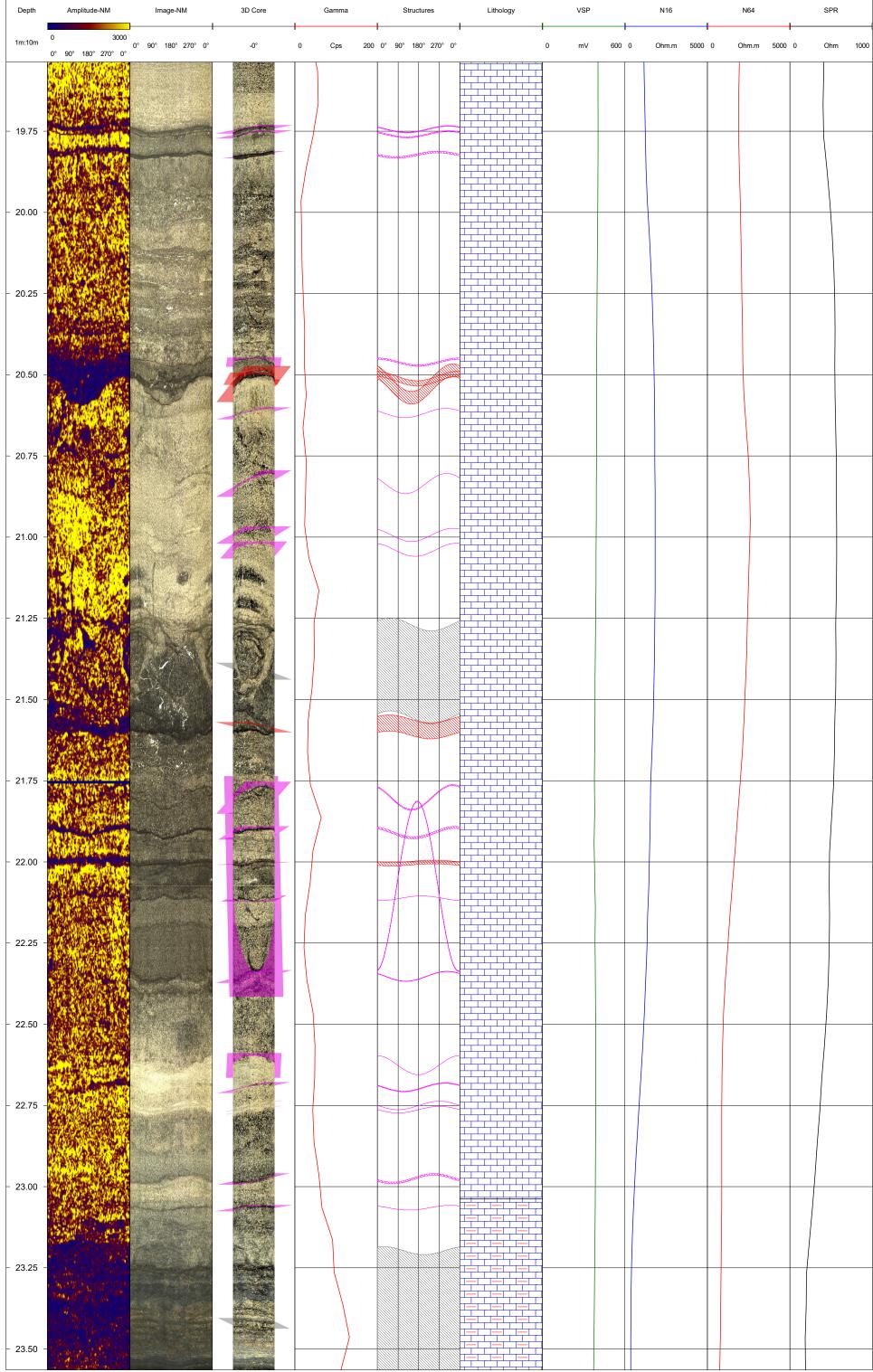


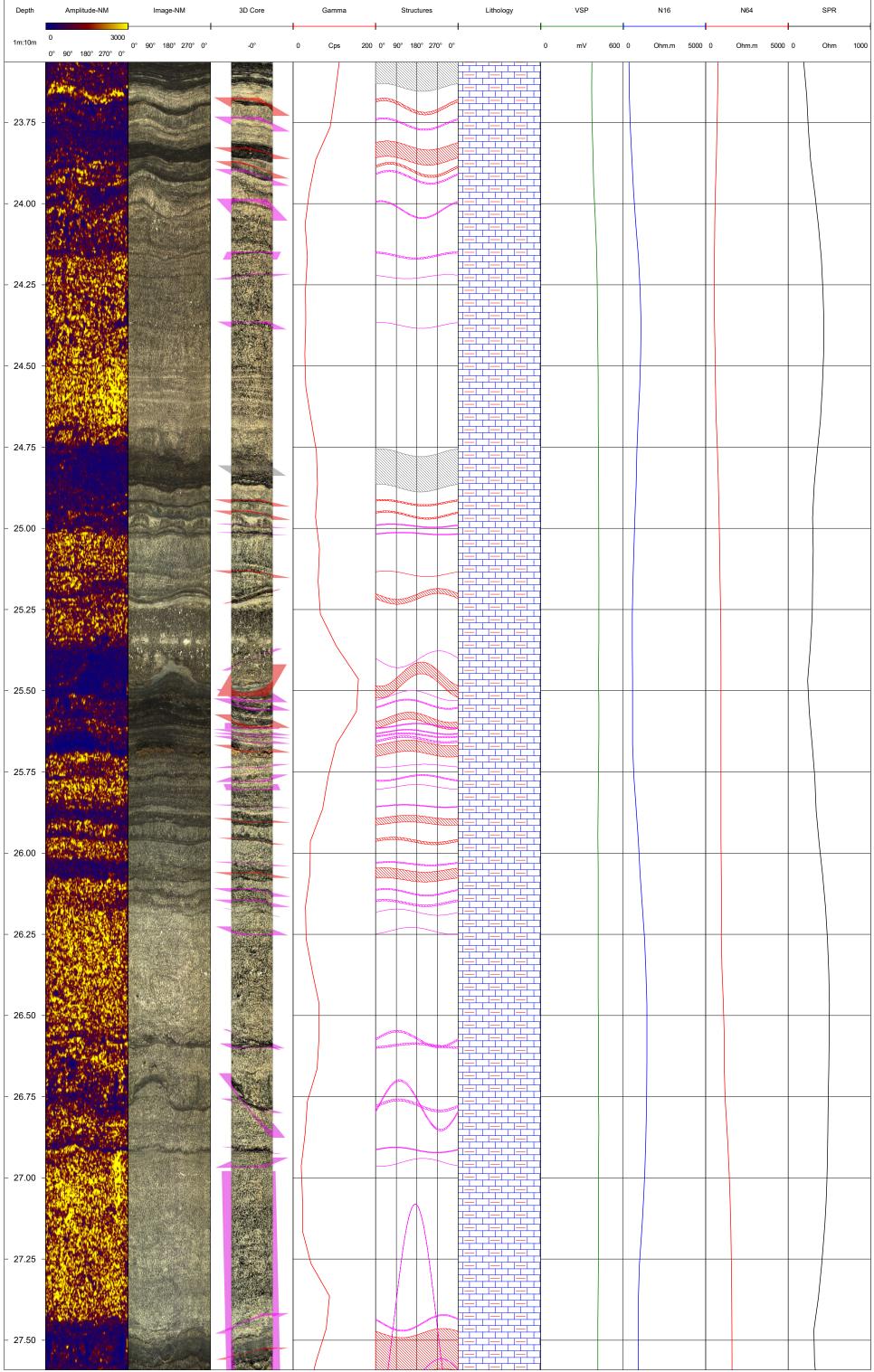


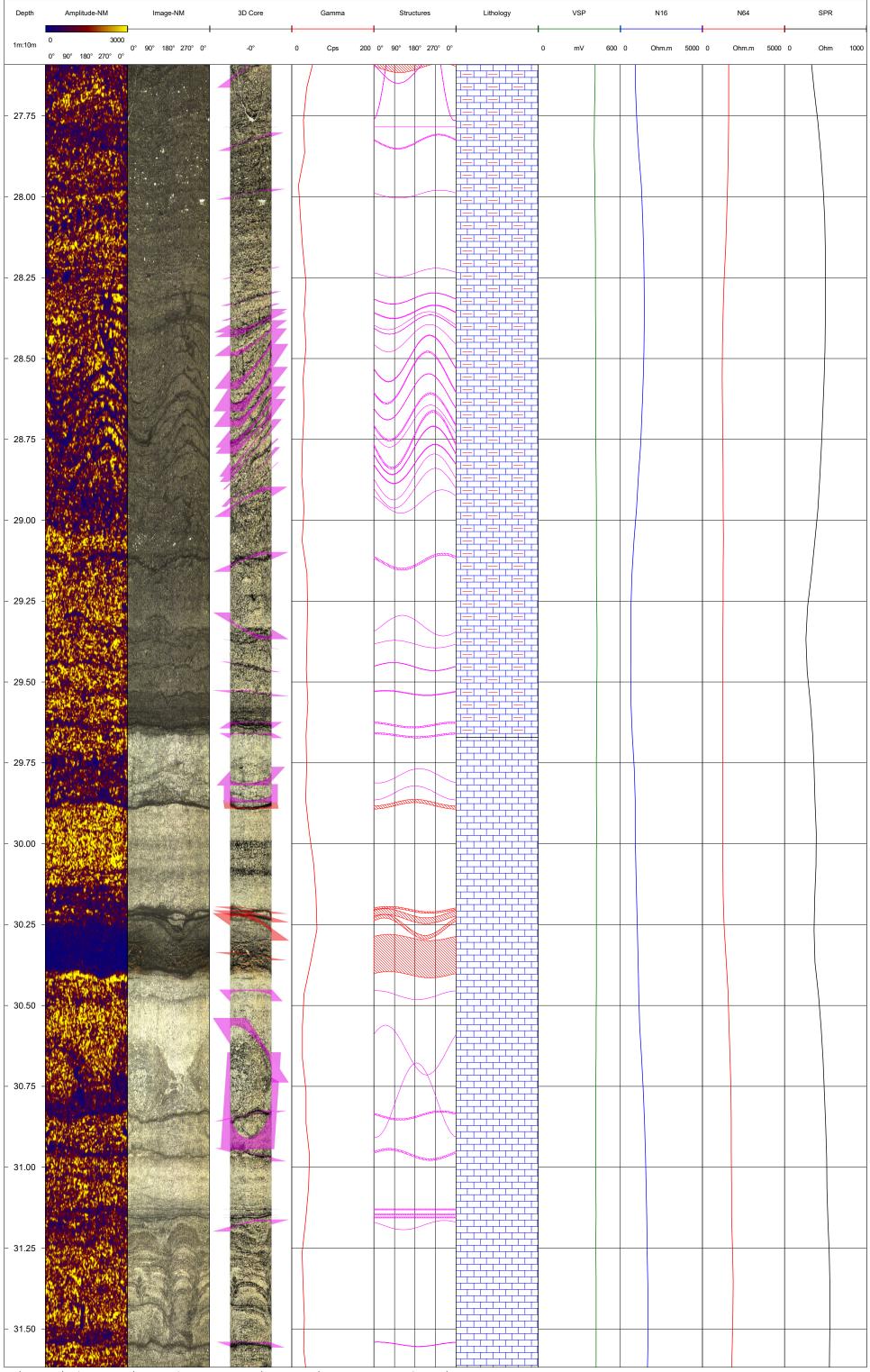


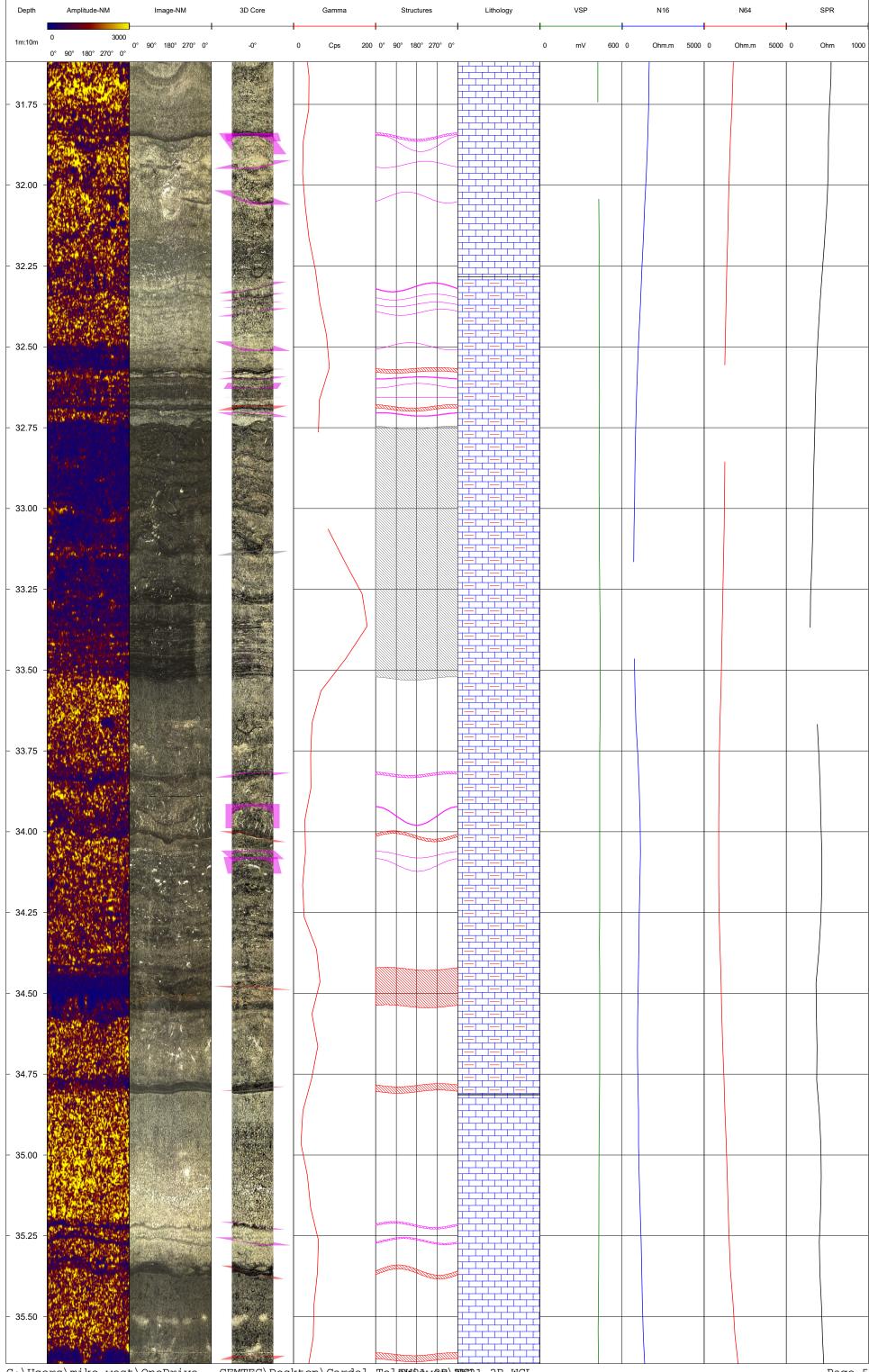


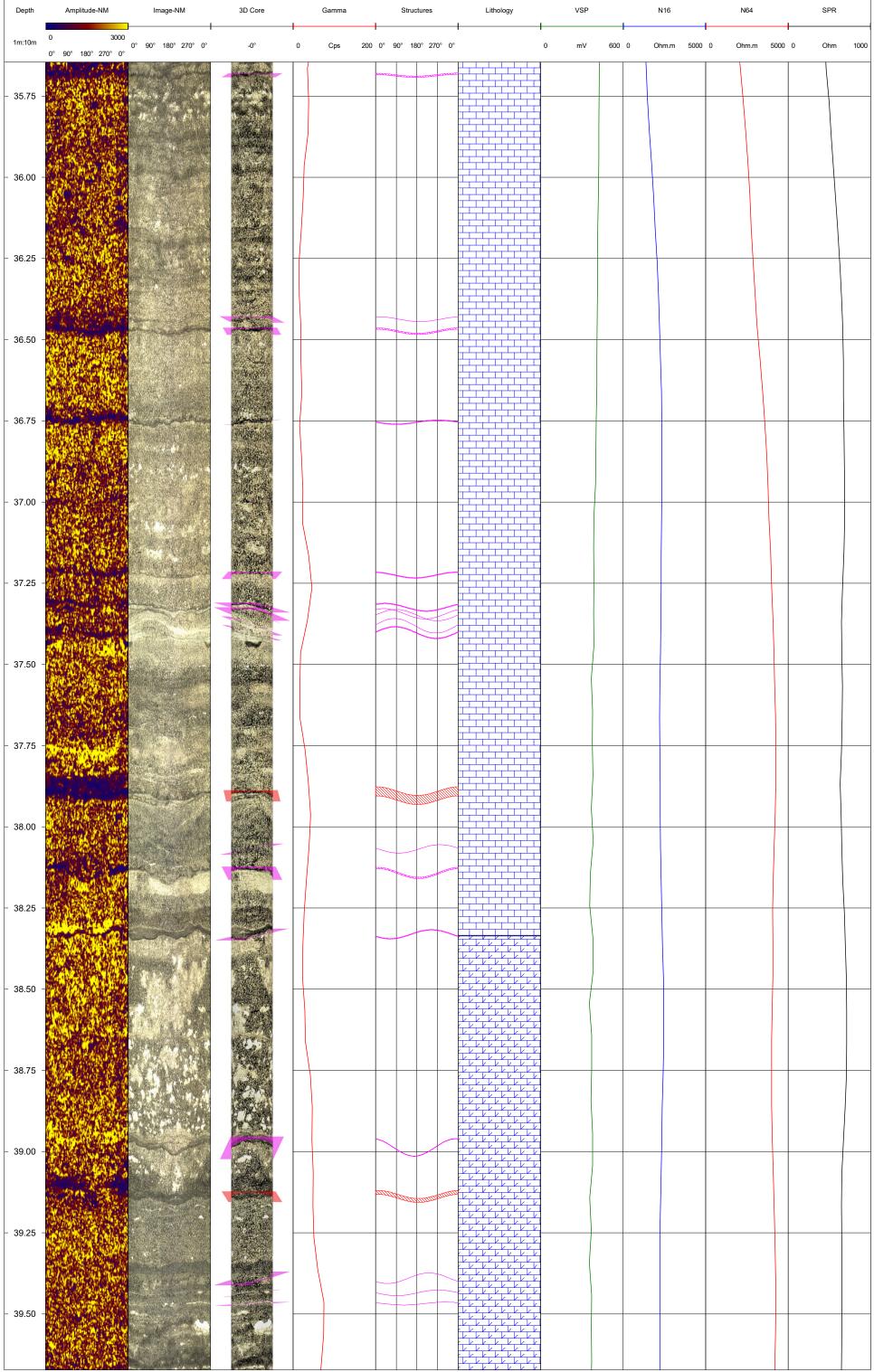


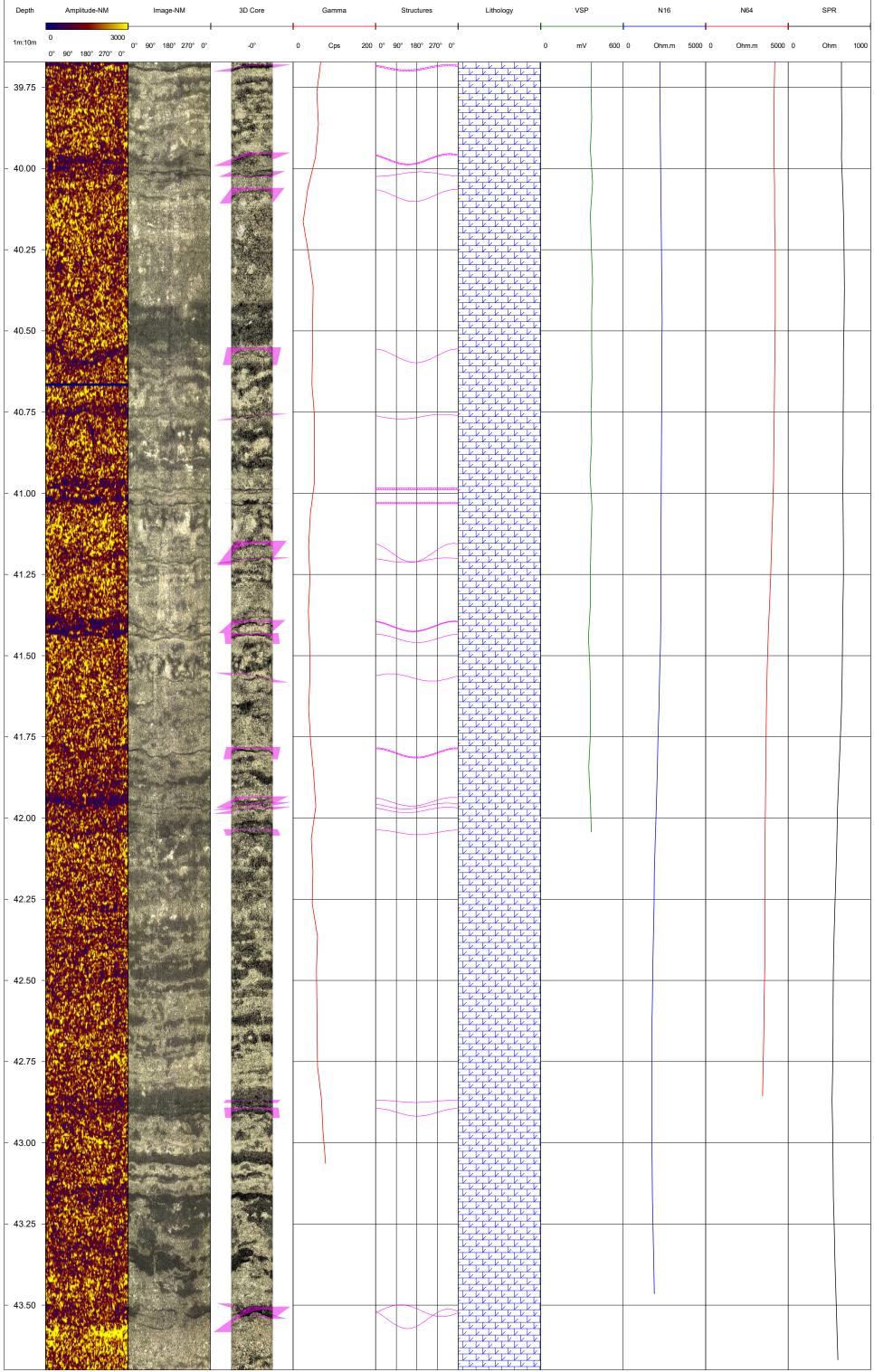


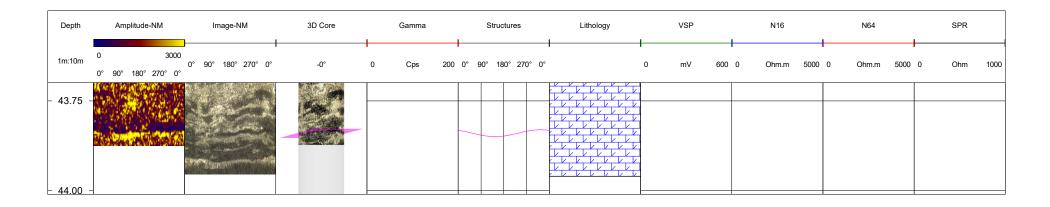


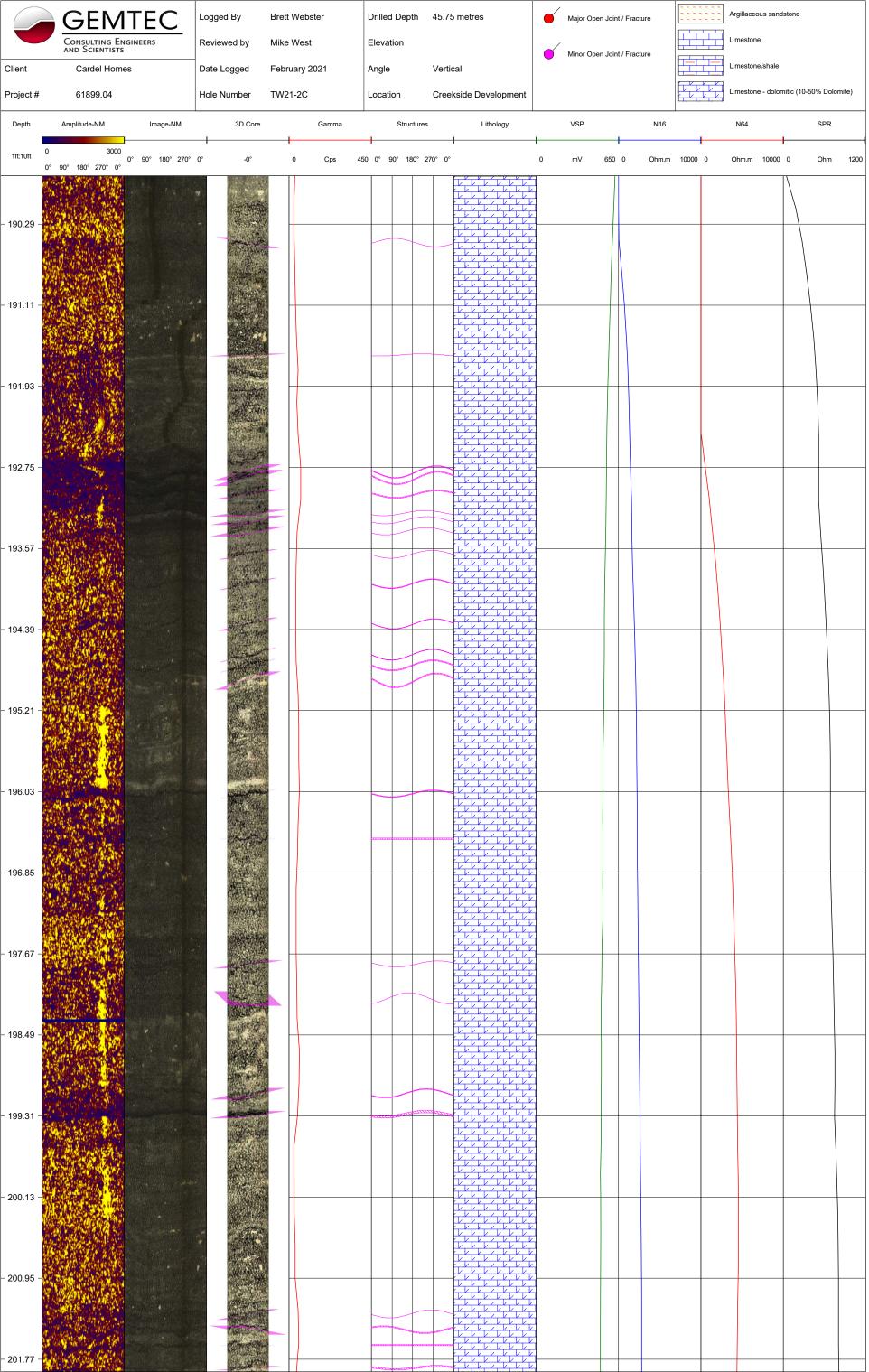


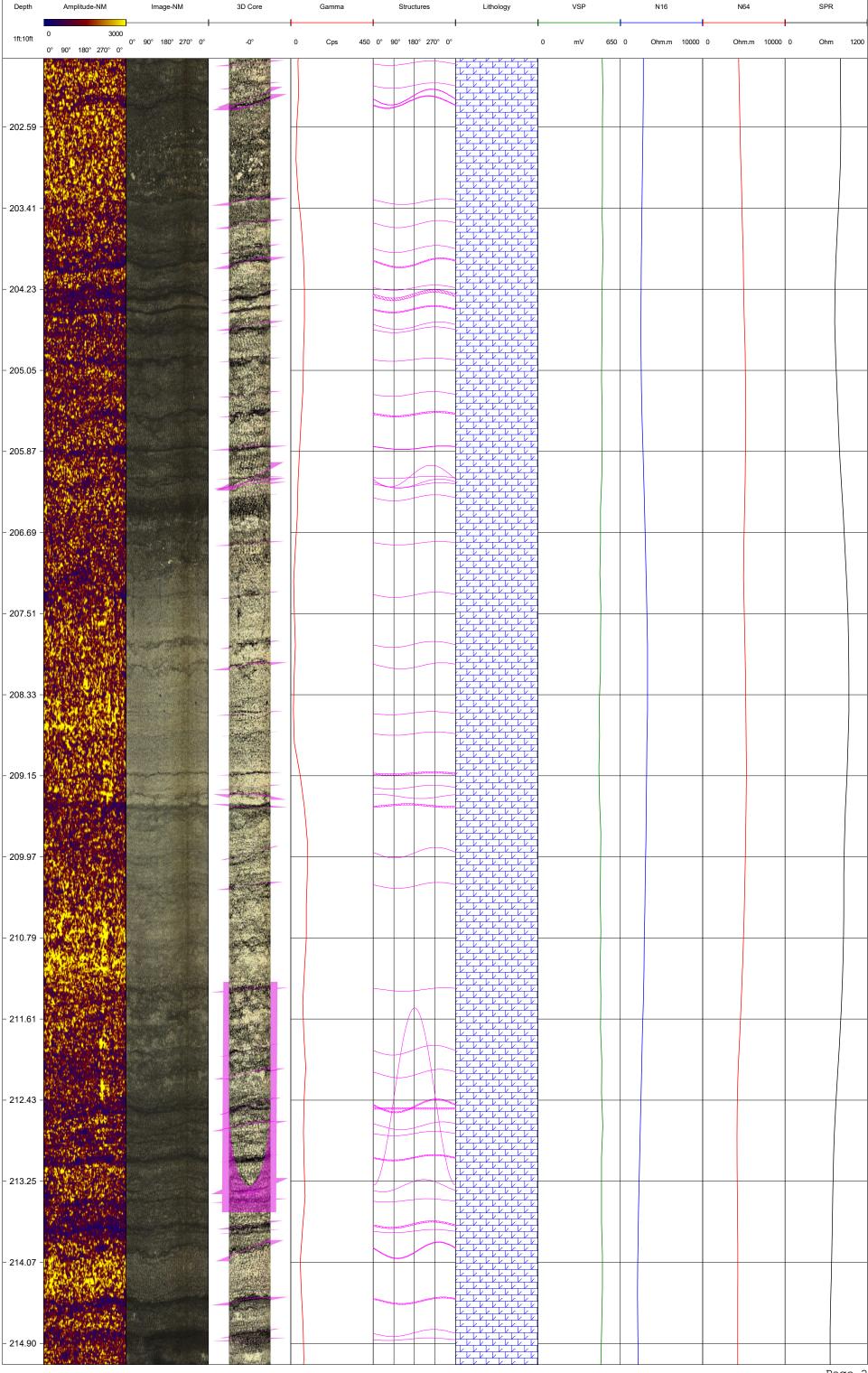


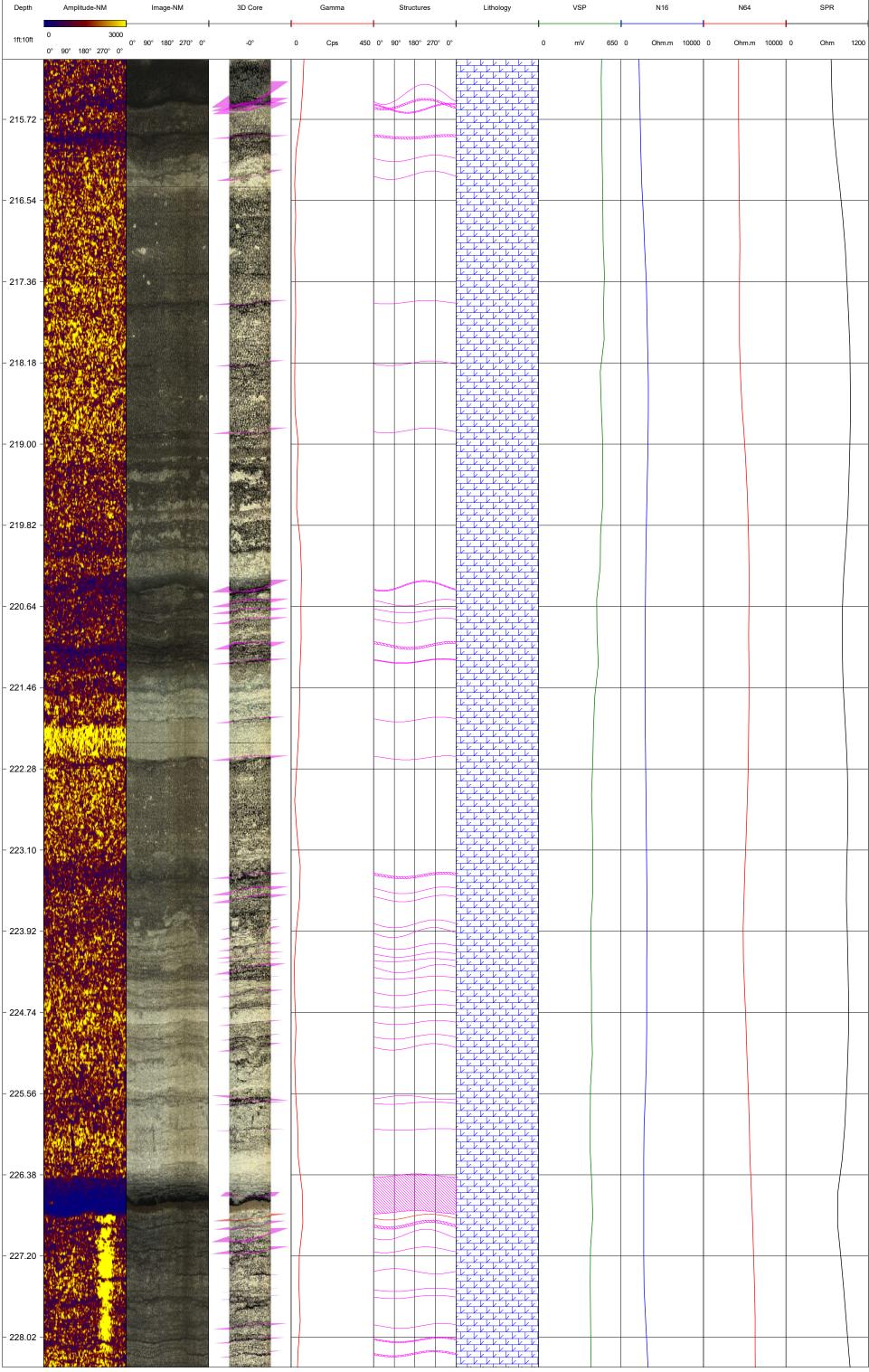


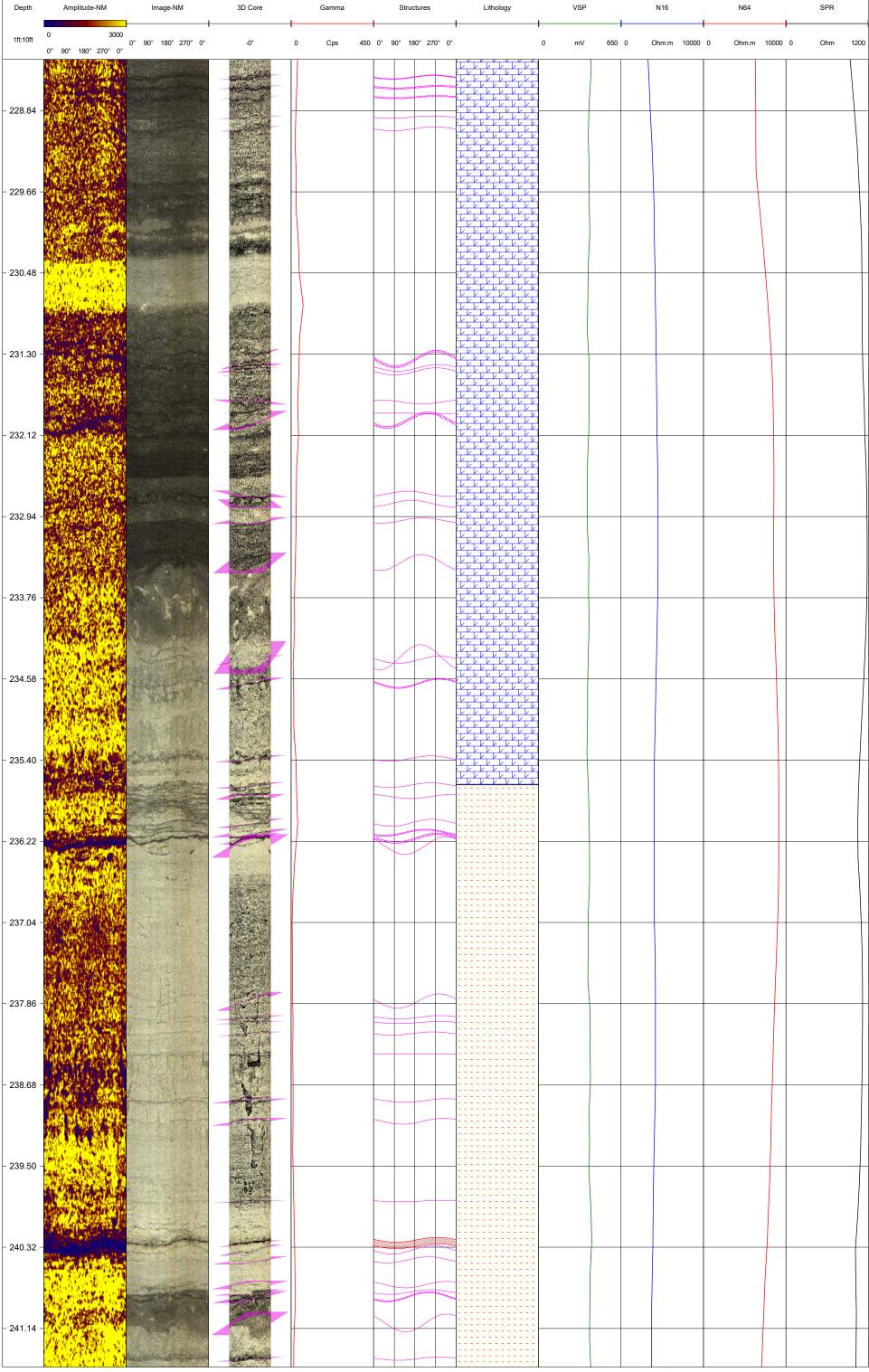


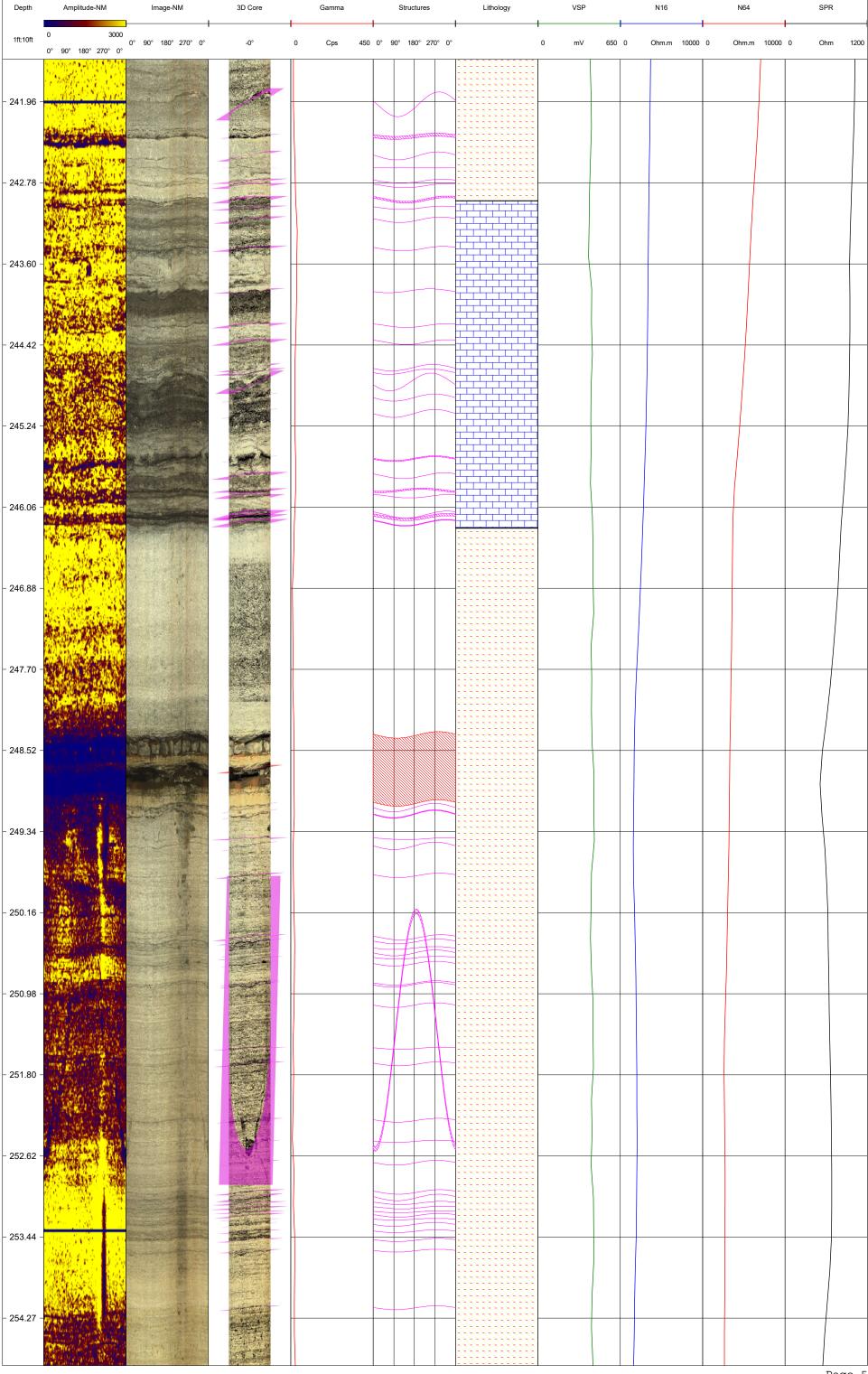


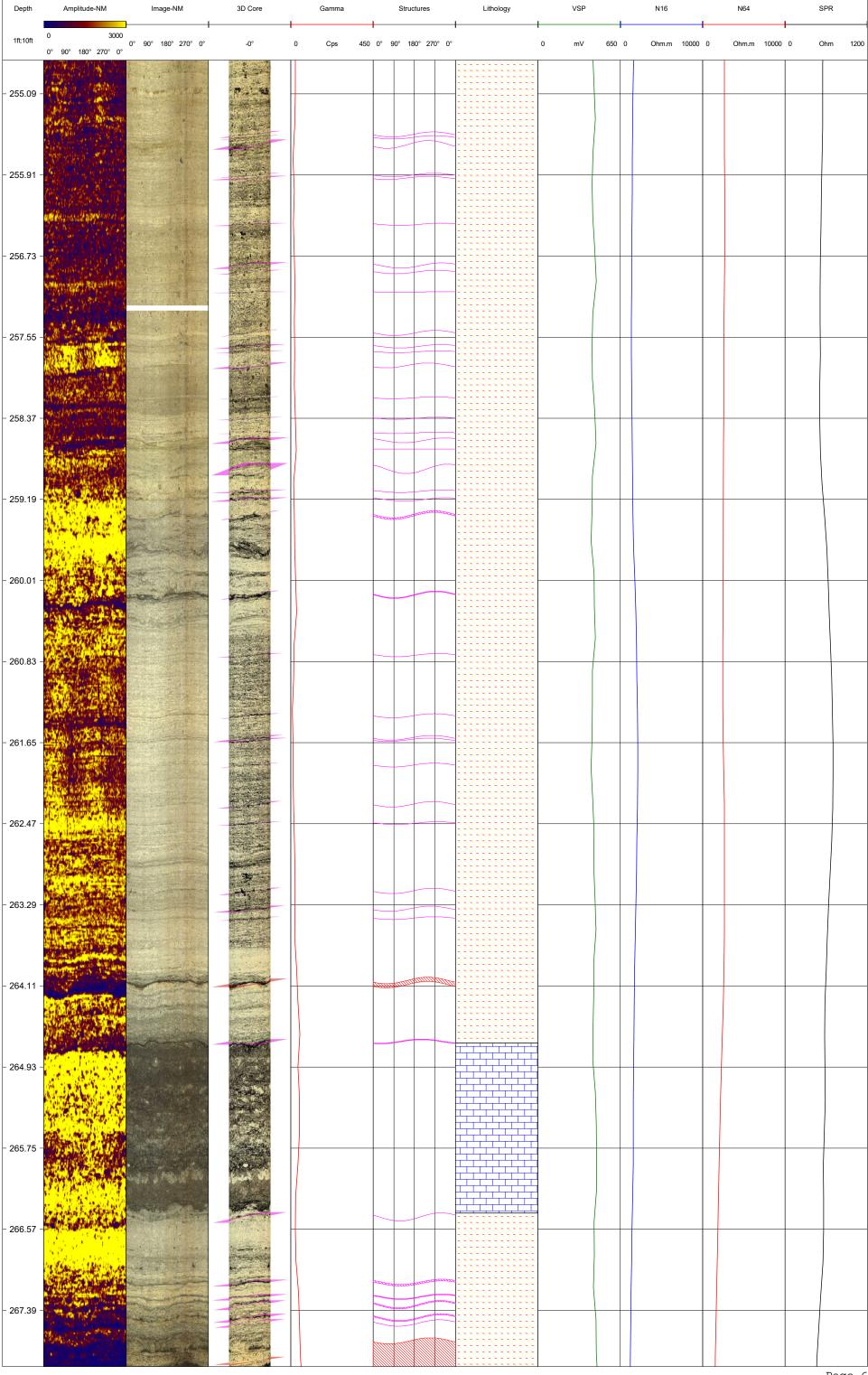


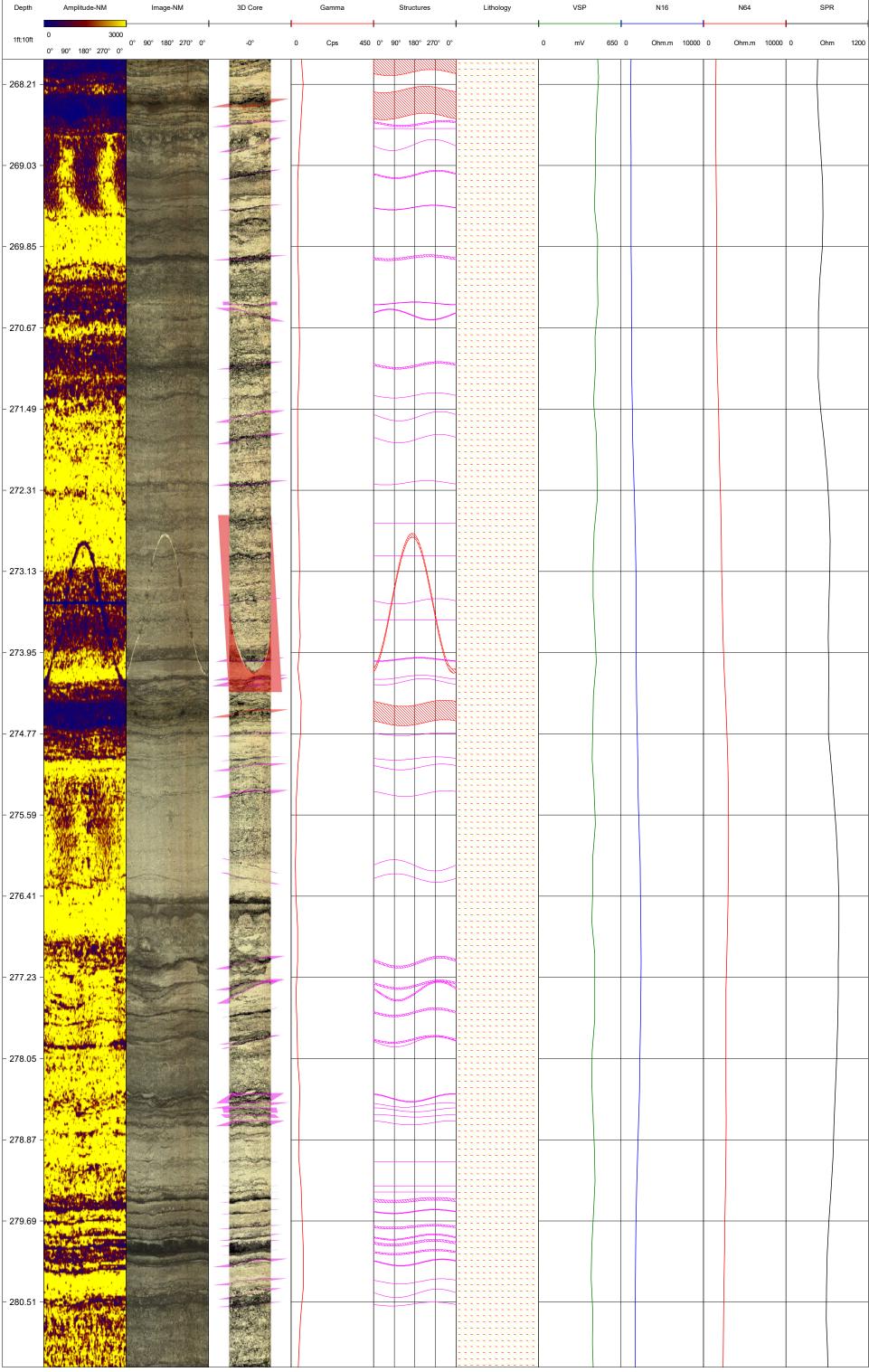


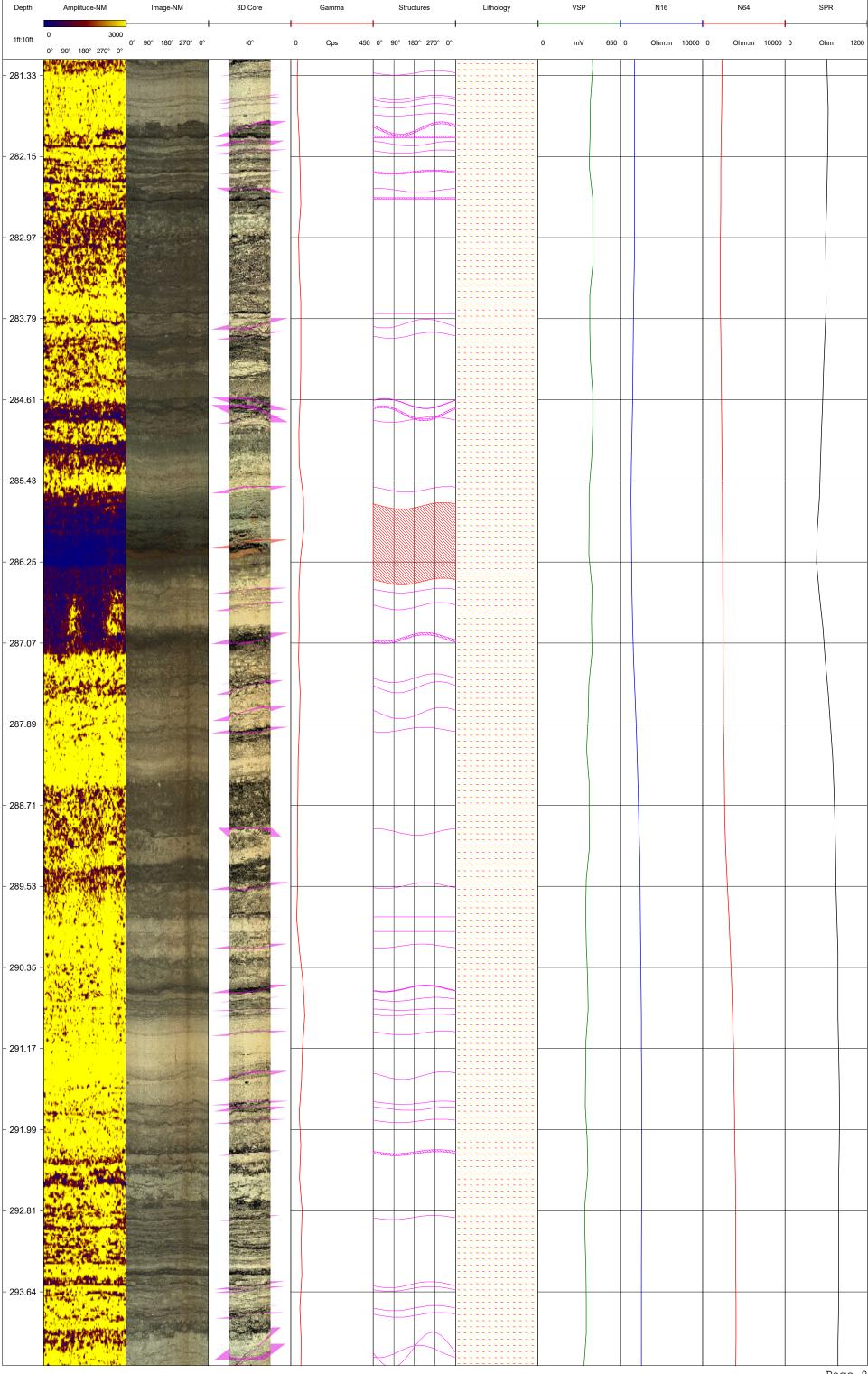


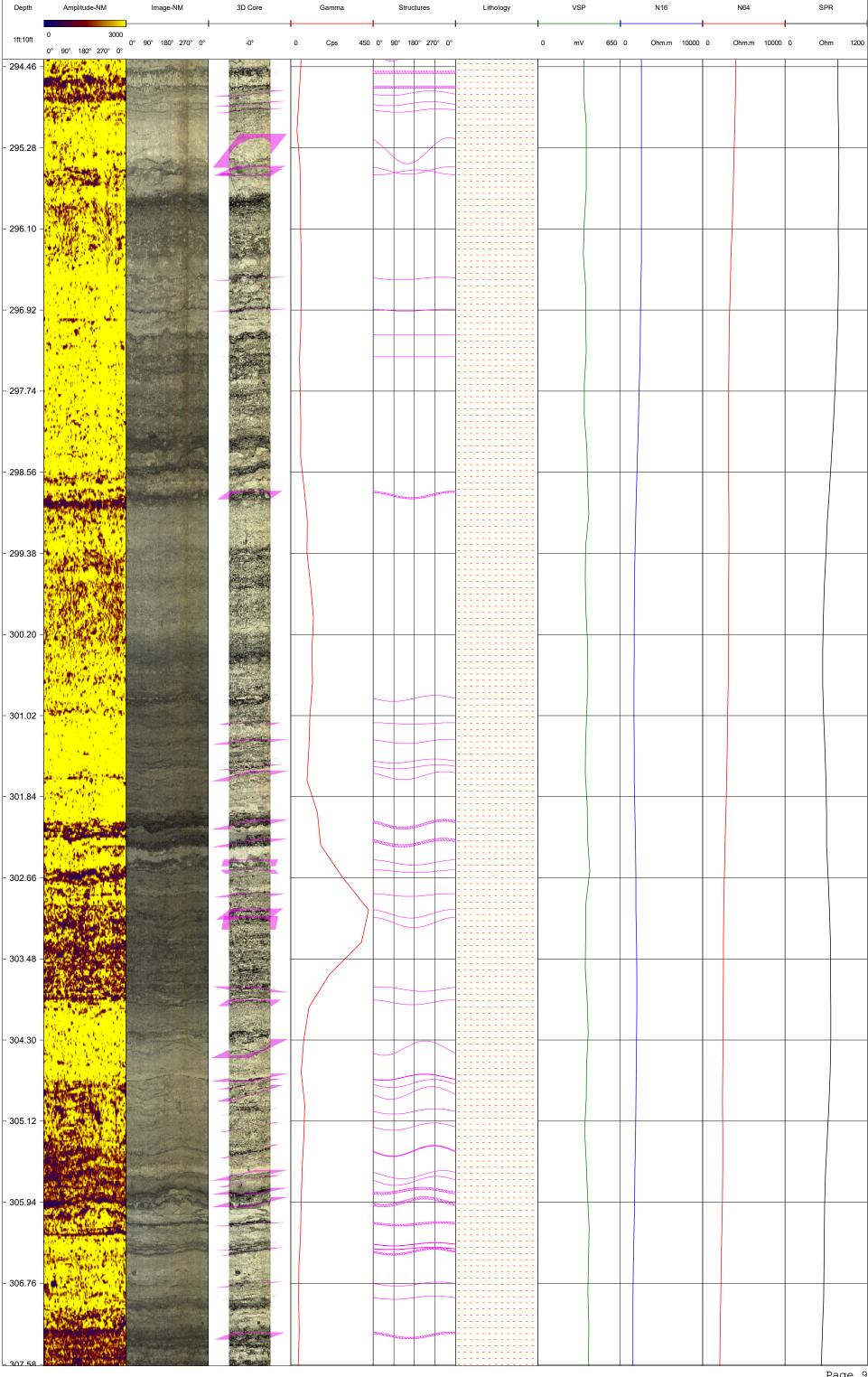


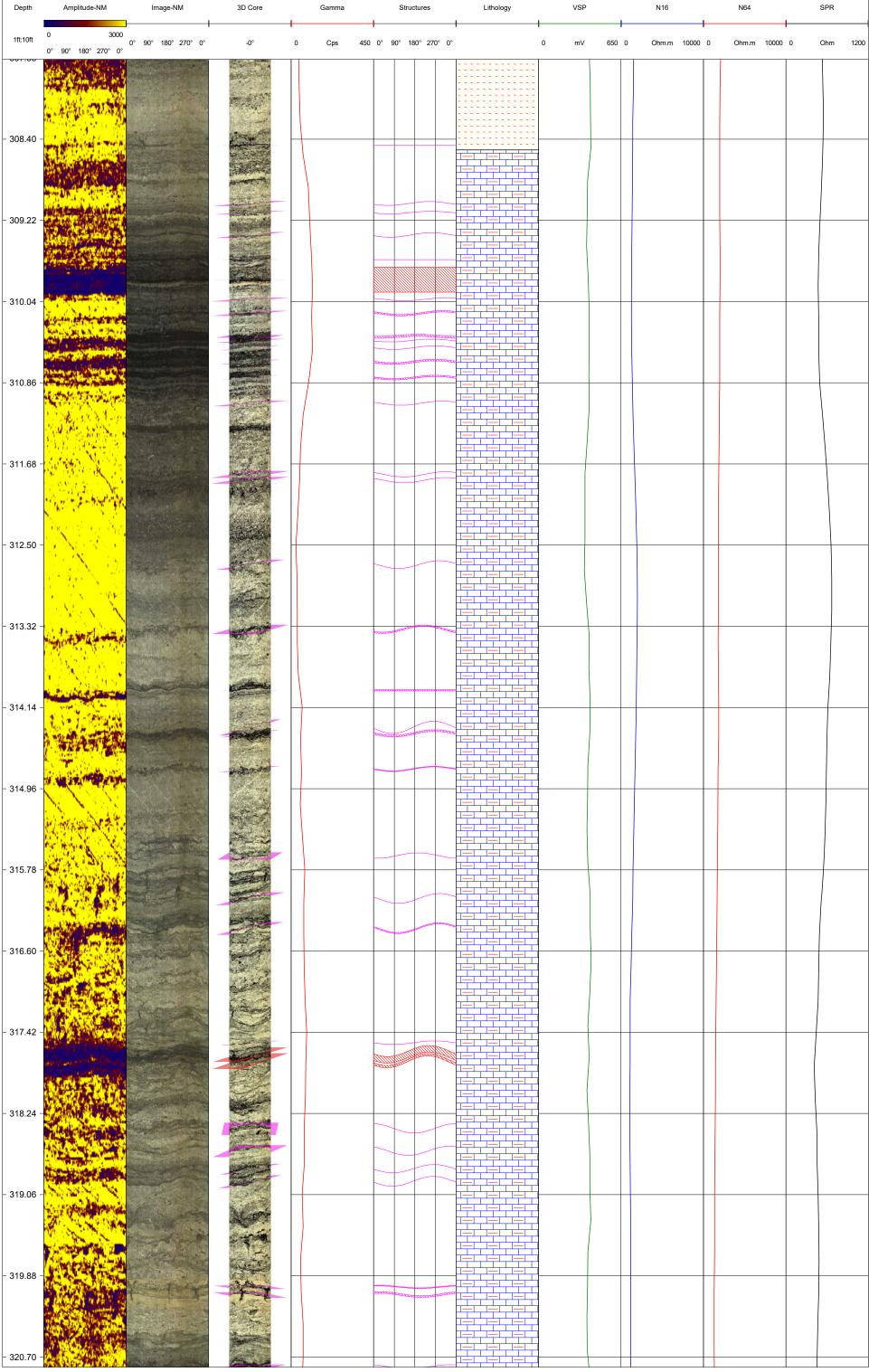


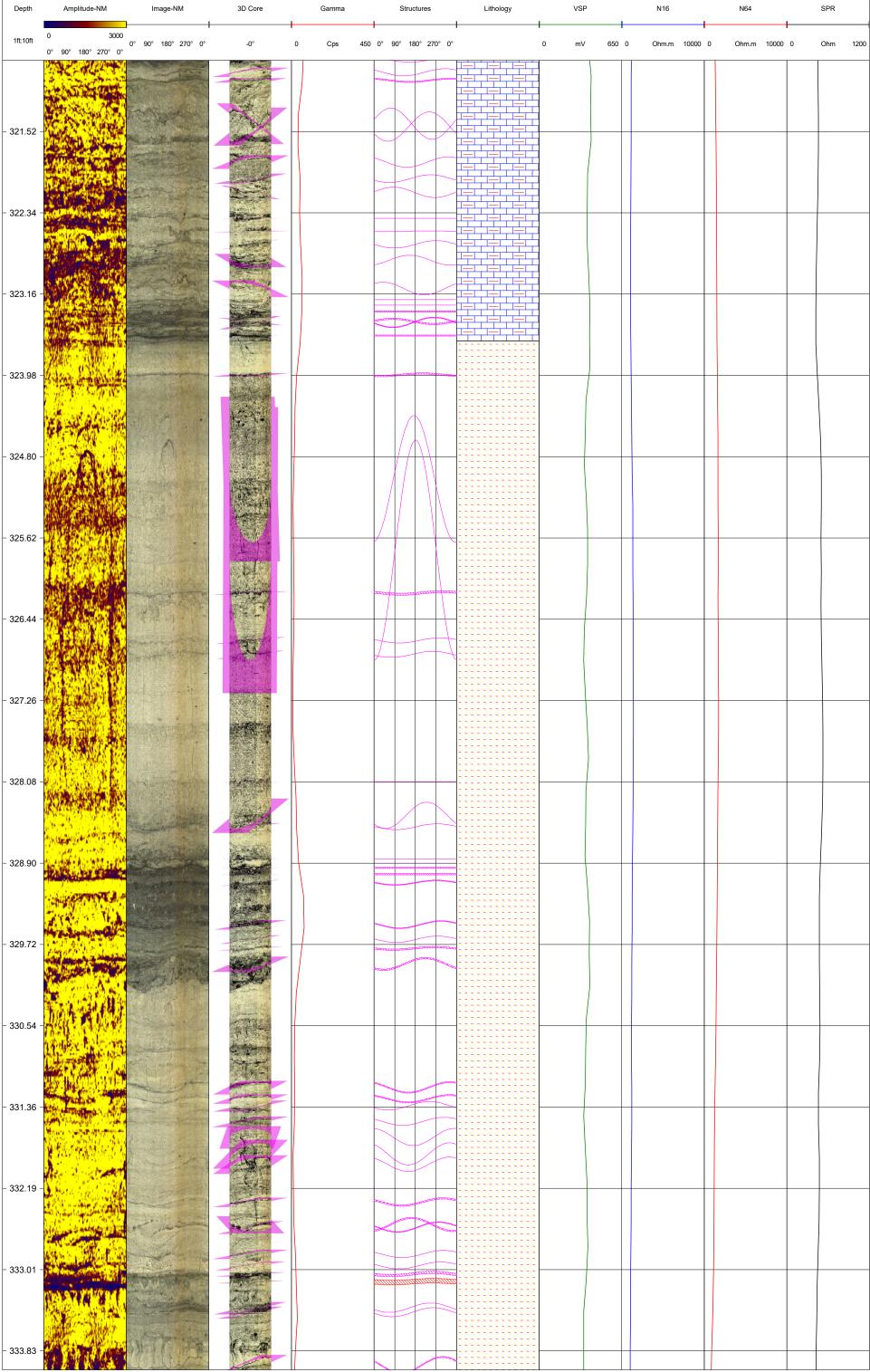


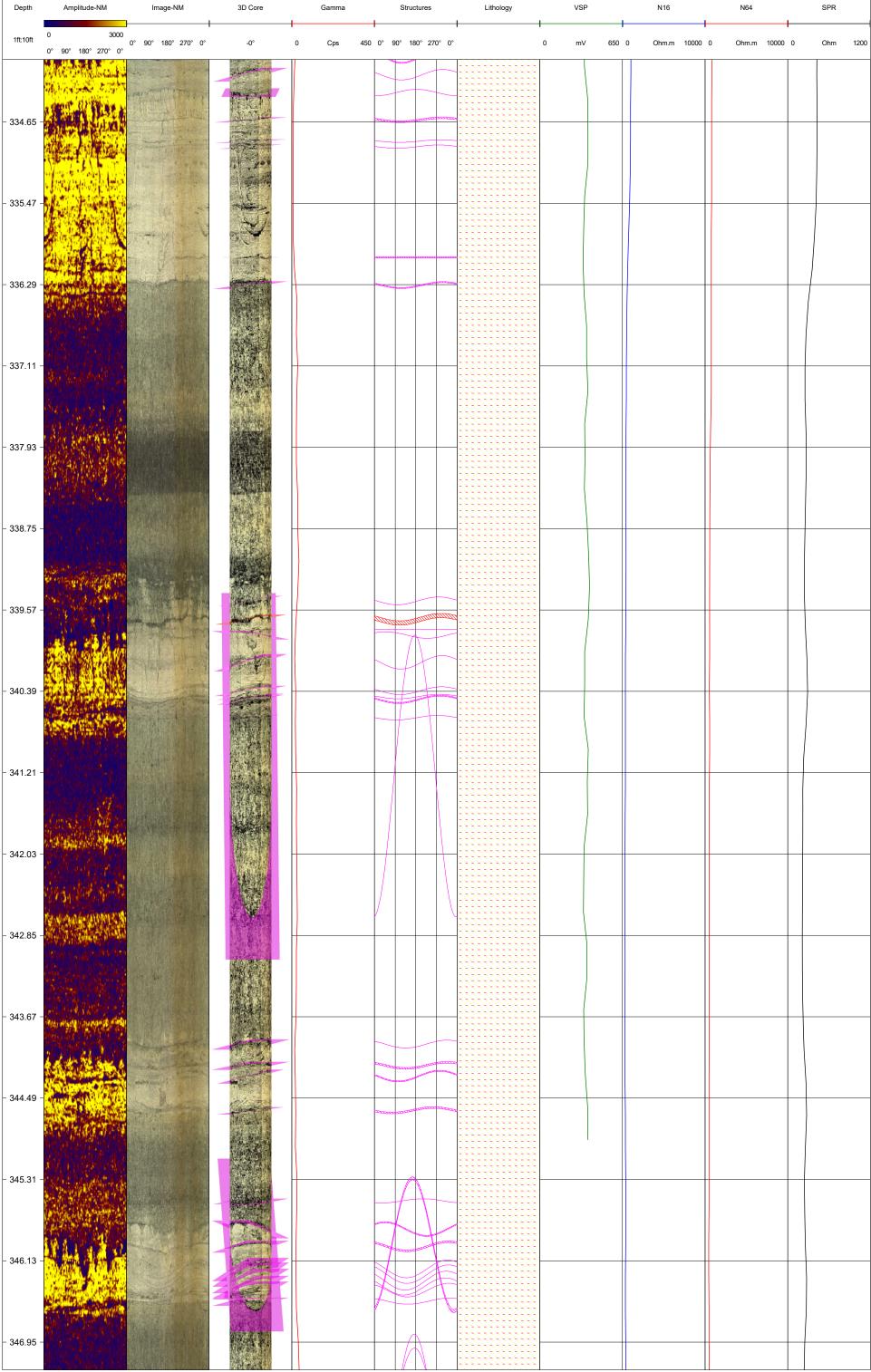


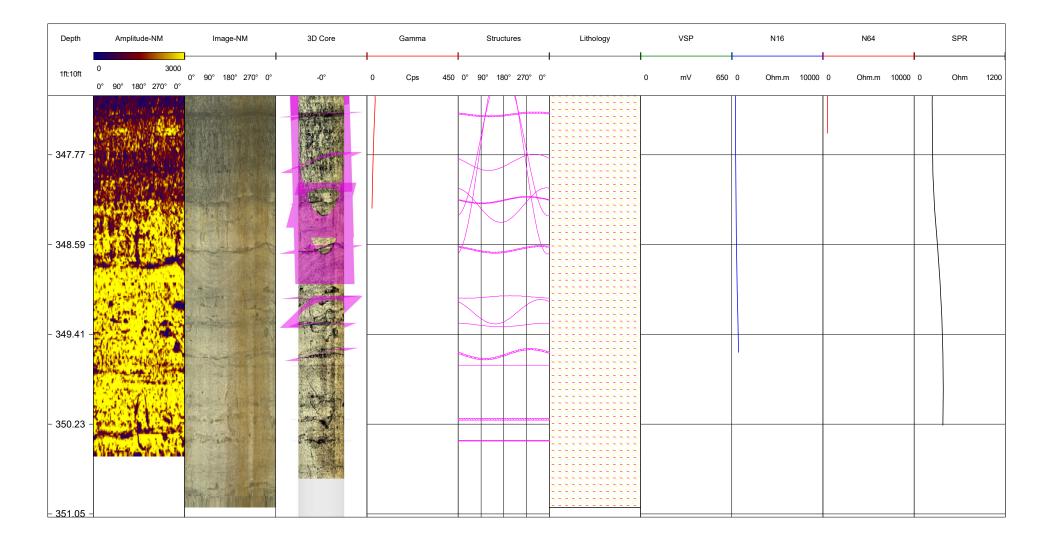




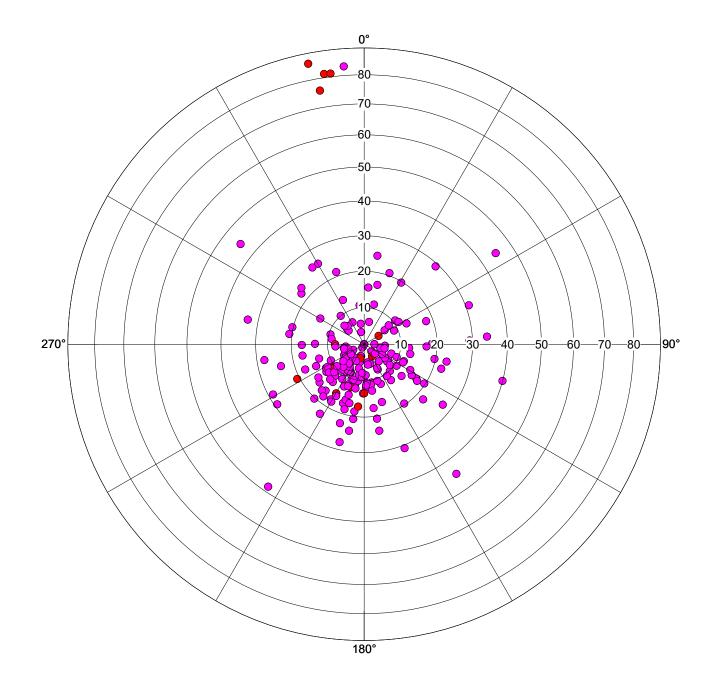






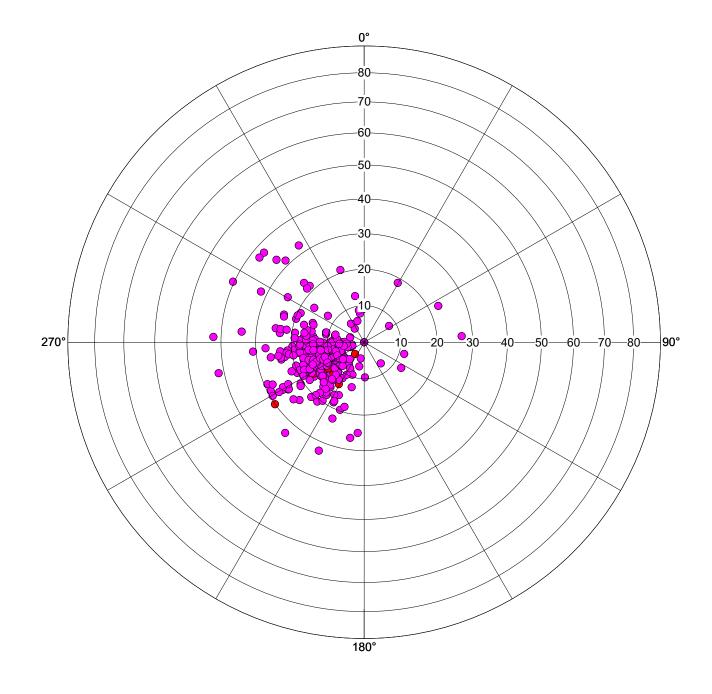


## TW21-1B

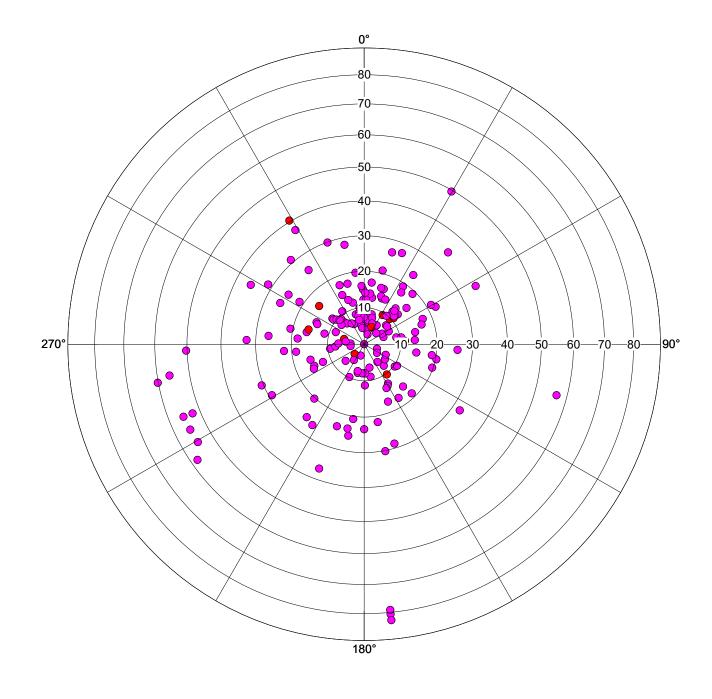


Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture

## TW21-1C



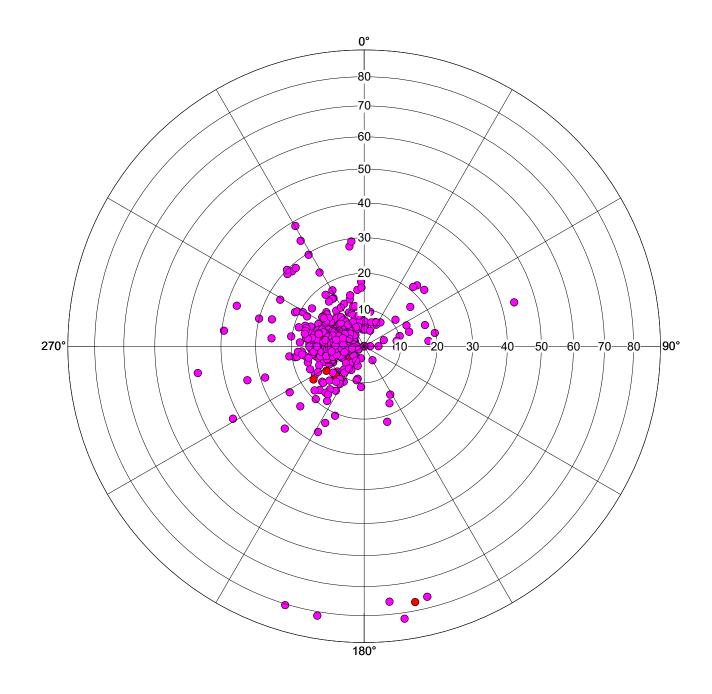
## TW21-2B

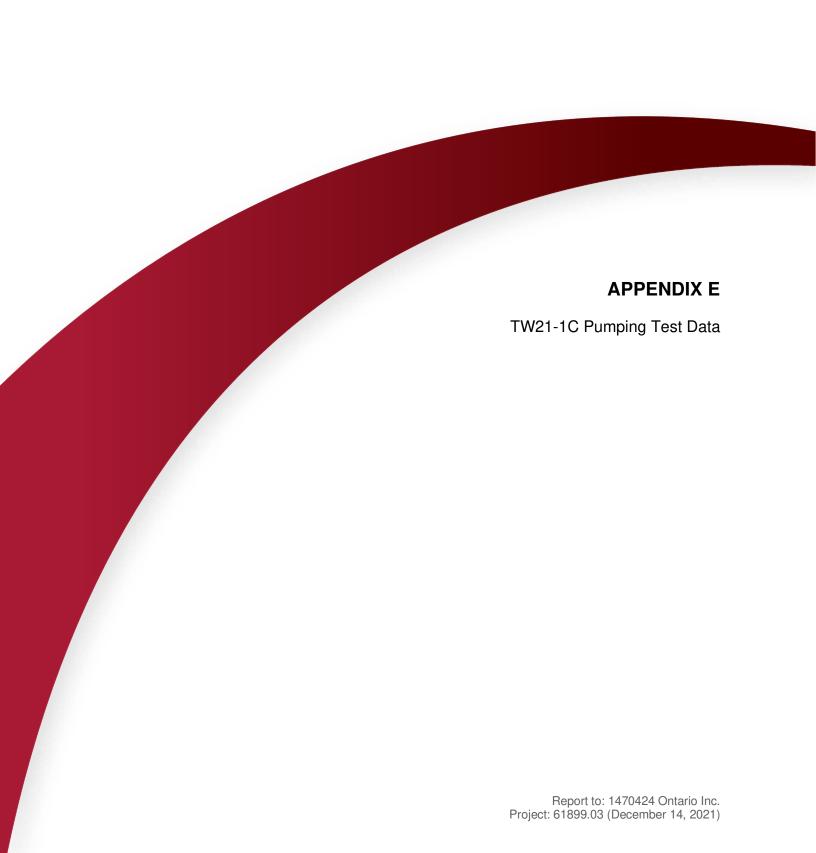


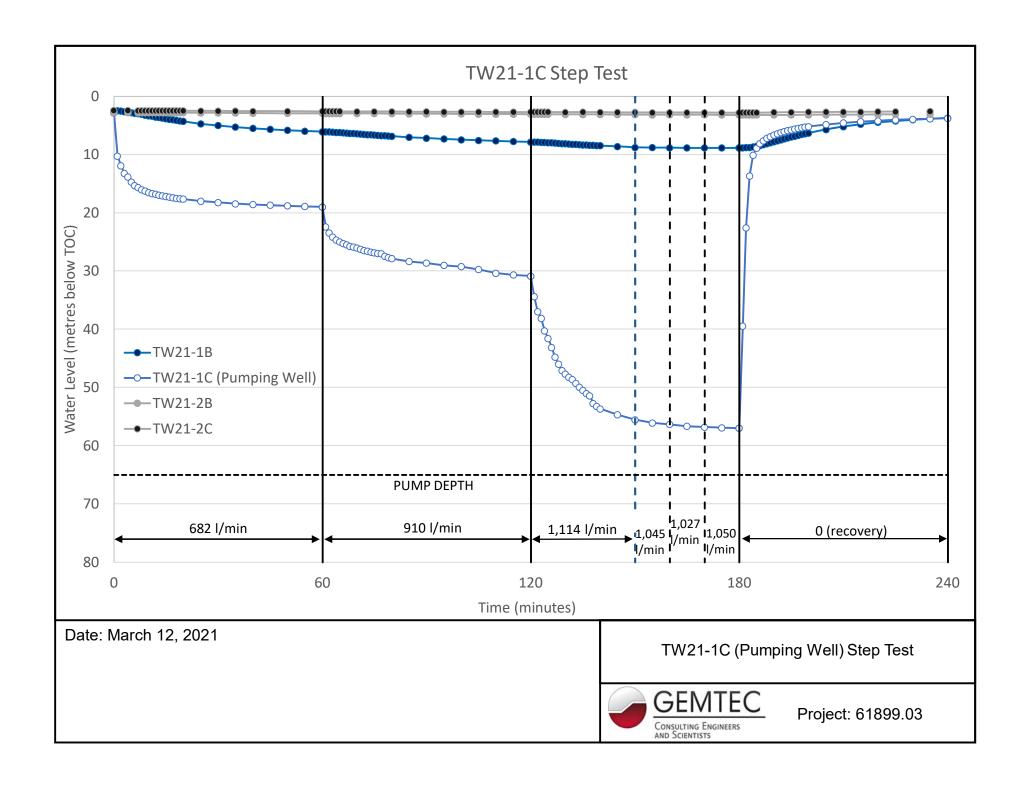
Dip Mean

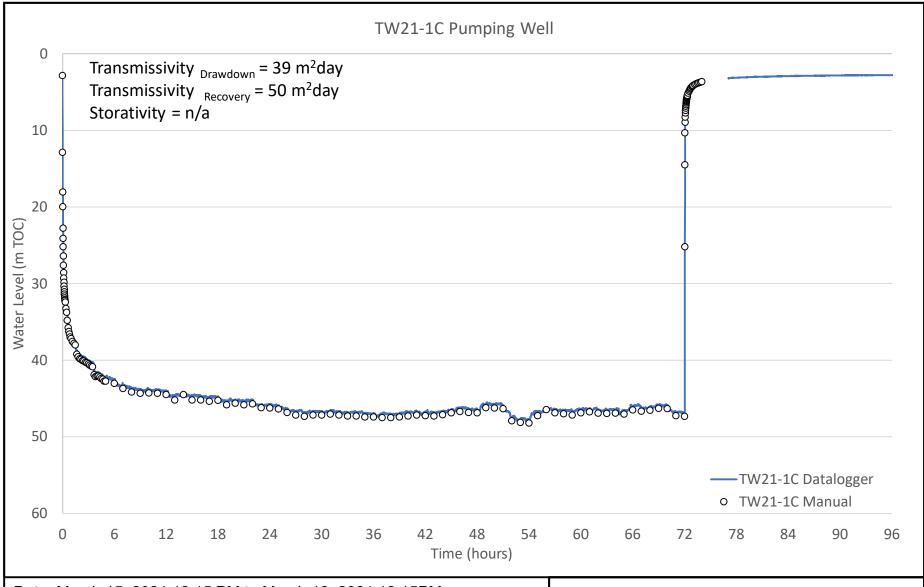
3.21

## TW21-2C





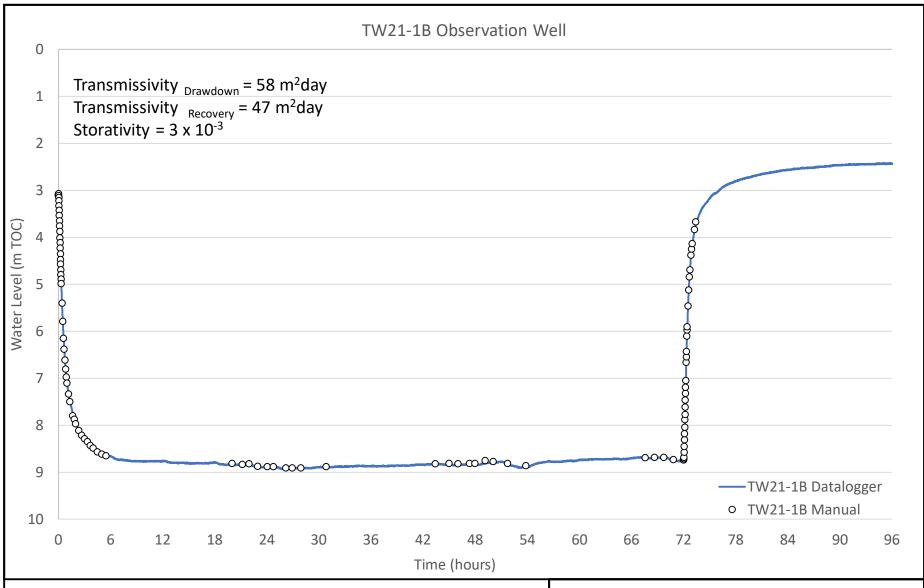




Water Level (static): 2.84 m TOC

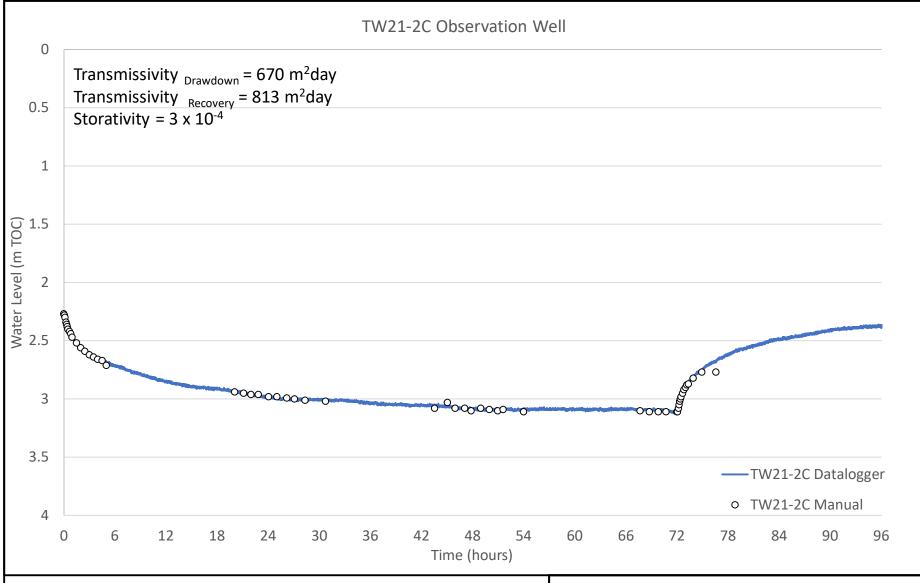
Water Level (end of test): 46.91 m TOC Water Level (2-hour recovery): 3.35 m TOC Water Level (24-hour recovery): 2.80 m TOC TW21-1C (Pumping Well) 72-Hour Pumping Test





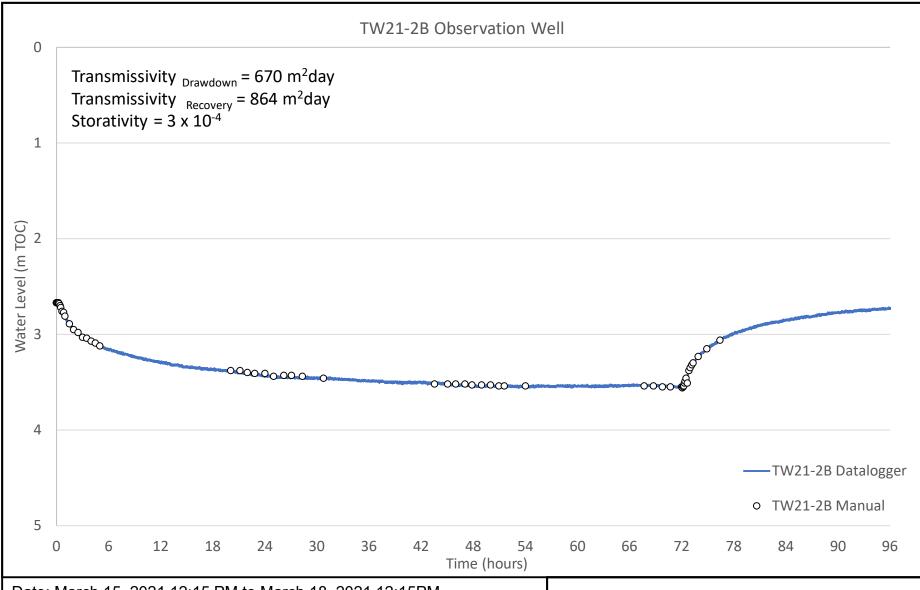
Water Level (static): 3.10 m TOC Water Level (end of test): 8.77 m TOC Water Level (2-hour recovery): 3.43 m TOC Water Level (24-hour recovery): 2.43 m TOC TW21-1B (Observation Well) 72-Hour Pumping Test





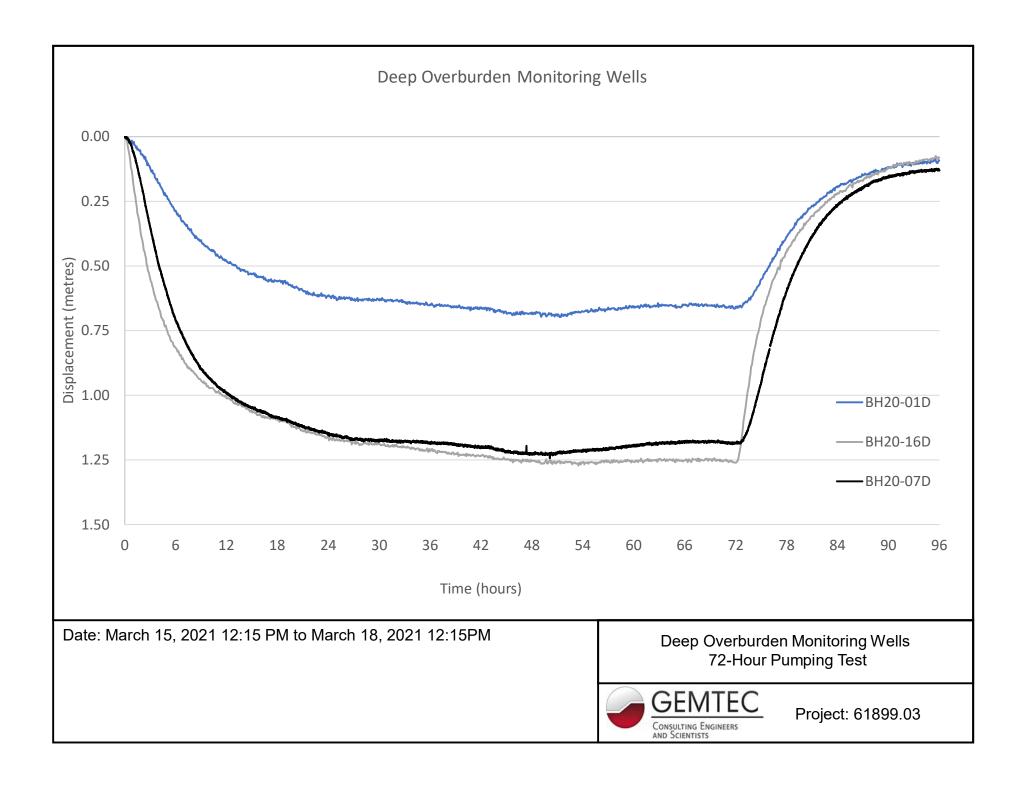
Water Level (static): 2.27 m TOC Water Level (end of test): 3.12 m TOC Water Level (2-hour recovery): 2.80 m TOC Water Level (24-hour recovery): 2.38 m TOC TW21-2C (Observation Well) 72-Hour Pumping Test

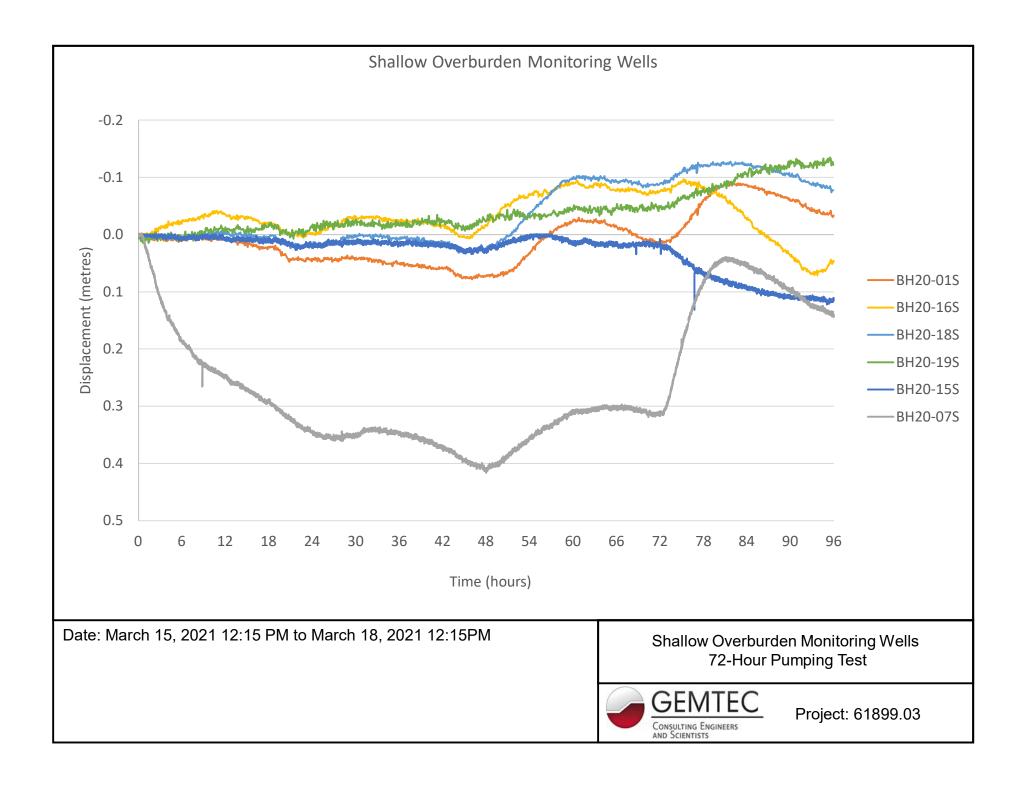


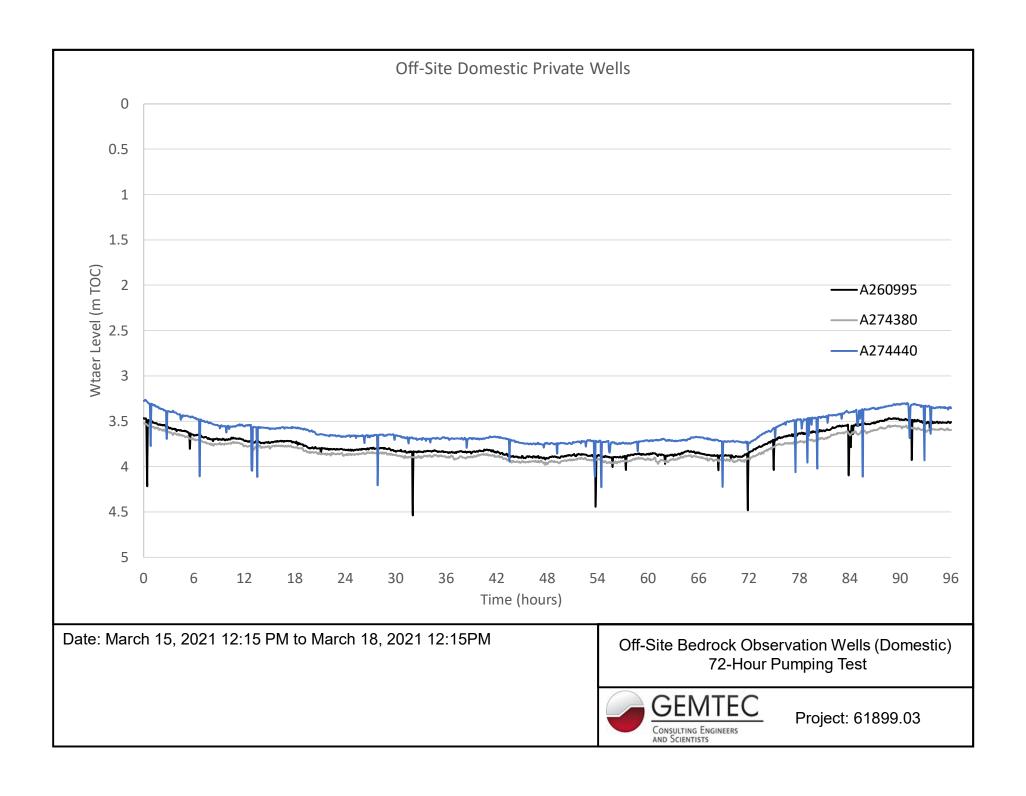


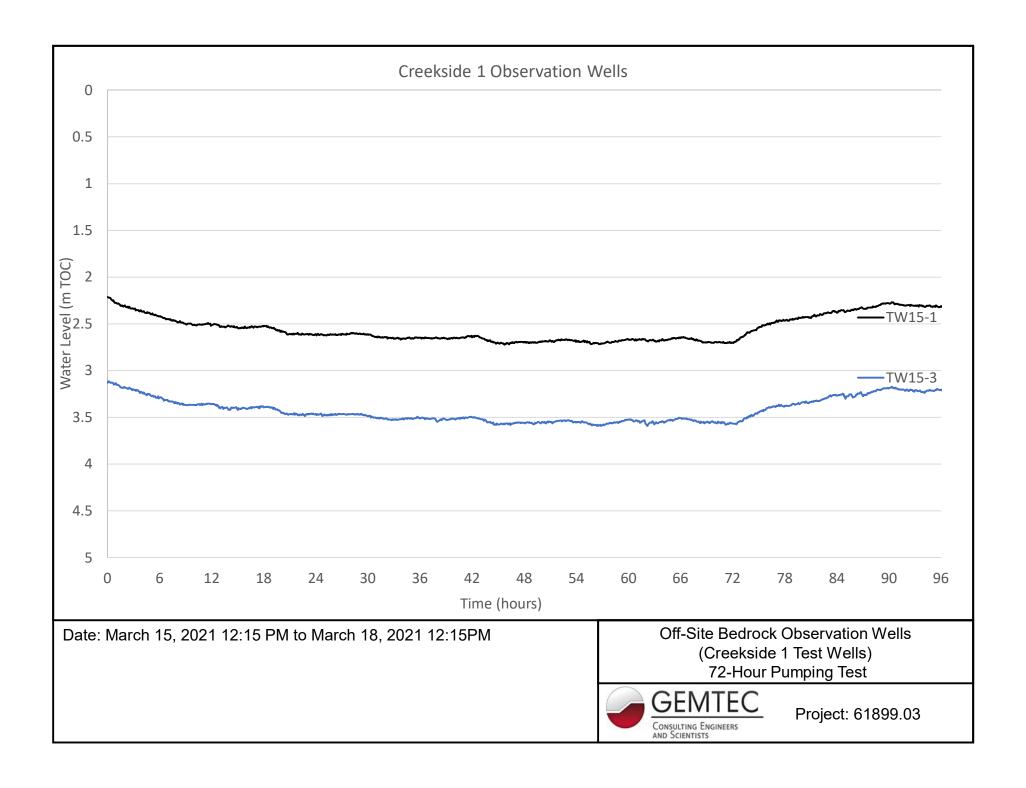
Water Level (static): 2.67 m TOC Water Level (end of test): 3.55 m TOC Water Level (2-hour recovery): 3.24 m TOC Water Level (24-hour recovery): 2.73 m TOC TW21-2B (Observation Well) 72-Hour Pumping Test













61899.03 Field Measured Water Quality Parameters

### TW21-1C Tag #A313115

Date/Time	March 15, 2021	March 16, 2021 Noon 24-hr	March 17, 2021 Noon 48-hr	March 18, 2021 Noon 72-hr
рН	6.58	7.64	7.95	7.88
Temp (°C)	7.48	8.63	9.20	8.05
EC (us/cm)	733	854	929	987
TDS (ppm)	468	546	595	633
Turbidity (NTU)	6.46	3.7	1.5	2.03
Colour (ACU - unfiltered)	-	-	5, 6, 4	22, 25, 26
Colour (TCU – filtered)	-	-	<5	<5
Free chlorine (mg/L)	-	<0.02	<0.02	<0.02
Total Chlorine (mg/L)	-	<0.02	<0.02	<0.02
DO mg/L	-	4.53	6.96	8.35
DP %	-	38.9	60.0	68.4
ORP mV	-	34	20	20
Sample Collected (Y / N)	Υ	Y	Υ	Y

### TW21-1C Water Quality Summary (1/3)

GEMTEC Consulting Engineers ar	nd Scientists Limite	:d						
PROJECT: 61899.03	T		- 1::	T	T	1		
Parameter	Units	MDL	Regulation	Regulation	Step-Test		72-Hour P-Test	l .
					TW21-1c 2106227-01	TW21-1C 24hr 2112287-01	TW21-1C 48h 2112452-01	TW21-1C 72hr 2112541-01
Sample Date (m/d/y)			ODWQS - Maximum Allowable Concentration	ODWQS Asthetic Objectives / Operational Guidelines	02/02/2021	03/16/2021	03/17/2021	03/18/2021
Microbiological Parameters								
E. Coli	CFU/100 mL	1	0 CFU/100 mL	-	ND (1)	ND (1)	ND (1)	ND (1)
Fecal Coliforms	CFU/100 mL	1	÷	-	ND (1)	ND (1)	ND (1)	ND (1)
Total Coliforms	CFU/100 mL	1	0 CFU/100 mL	-	ND (1)	ND (1)	ND (1)	ND (1)
Heterotrophic Plate Count	CFU/mL	10	÷	-	30	ND (10)	ND (10)	ND (10)
General Inorganics								
Alkalinity, total	mg/L	5	-	500 mg/L	299	287	279	279
Ammonia as N	mg/L	0.01	-	-	0.08	0.16	0.14	0.14
Dissolved Organic Carbon	mg/L	0.5	-	5 mg/L	1.2	2.8	2.4	1.7
Colour	TCU	2	-	5 TCU (5 ACU)	ND (2)	15	8	7
Colour, apparent	ACU	2	-	5 TCU (5 ACU)	47	28	24	19
Conductivity	uS/cm	5	=	-	685	876	961	1040
Hardness	mg/L		-	80 - 100 mg/L	340	326	335	334
Hq	pH Units	0.1	-	-	7.8	8.0	8.0	8.2
Phenolics	mg/L	0.001	-	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Total Dissolved Solids	mg/L	10	-	500 mg/L	400	484	500	514
Sulphide	mg/L	0.02	-	0.5 mg/L	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
Tannin & Lignin	mg/L	0.1	_	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Total Kjeldahl Nitrogen	mg/L	0.1	_	_	0.1	0.1	0.2	0.1
Turbidity	NTU	0.1	- -	5 NTU	5.8	3.4	2.9	2.0
Anions	NIO	0.1	-	3 N10	5.6	5.4	2.9	2.0
Bromide	ma/I	0.1			ND(0.1)	0.3	0.4	0.4
	mg/L		-	- 4	ND(0.1)			
Chloride	mg/L	1	-	250 mg/L	47	94	122	138
Fluoride	mg/L	0.1	1.5 mg/L	-	0.5	0.2	0.2	0.5
Nitrate as N	mg/L	0.1	10 mg/L	-	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Nitrite as N	mg/L	0.05	1 mg/L	-	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Sulphate	mg/L	1	-	500 mg/L	36	38	42	44
Metals								
Mercury	mg/L	0.0001	0.001 mg/L	€	ND (0.0001)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Aluminum	mg/L	0.001	-	0.1 mg/L	0.067	0.079	0.060	0.026
Antimony	mg/L	0.0005	0.006 mg/L	-	ND (0.0005)	ND (0.0005)	ND (0.0005)	ND (0.0005)
Arsenic	mg/L	0.001	0.01 mg/L	-	0.002	0.001	0.001	0.001
Barium	mg/L	0.001	1 mg/L	-	0.224	0.222	0.231	0.226
Boron	mg/L	0.01	5 mg/L	-	0.12	0.18	0.18	0.20
Cadmium	mg/L	0.0001	0.005 mg/L	-	ND (0.0001)	ND (0.0001)	ND (0.0001)	ND (0.0001)
Calcium	mg/L	0.1	÷	-	85.0	82.5	85.9	85.2
Chromium (VI)	mg/L	0.010	-	-	ND (1)	ND (0.010)	ND (0.010)	ND (0.001)
Chromium	mg/L	0.001	0.05 mg/L	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.010)
Copper	mg/L	0.0005	-	1 mg/L	ND (0.0005)	0.0007	ND (0.0005)	ND (0.0005)
Iron	mg/L	0.1	-	0.3 mg/L	0.5	0.3	0.3	0.3
Lead	mg/L	0.0001	0.01 mg/L	-	ND (0.0001)	ND (0.0001)	0.0001	0.0001
Magnesium	mg/L	0.2	-	-	31.0	29.1	29.4	29.4
Manganese	mg/L	0.005	-	0.05 mg/L	0.030	0.029	0.029	0.029
Potassium	mg/L	0.1	-	-	4.5	5.4	5.7	5.9
Selenium	mg/L	0.001	0.05 mg/L	-	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.001)
Sodium	mg/L	0.2	20 mg/L	200 mg/L	37.0	66.7	82.2	87.3
Uranium	mg/L	0.0001	0.02 mg/L	-	0.0006	0.0008	0.0007	0.0008
Zinc	mg/L	0.005	-	5 mg/L	ND (0.005)	0.008	ND (0.005)	0.007



### TW21-1C Water Quality Summary (2/3)

GEMTEC Consulting Engineers and S	scientists Limit	ed						
PROJECT: 61899.03		1		1		T		
Parameter	Units	MDL	Regulation	Regulation	Step-Test		72-Hour P-Test	T
					TW21-1c 2106227-01	TW21-1C 24hr 2112287-01	TW21-1C 48h 2112452-01	TW21-1C 72hr 2112541-01
Sample Date (m/d/y)			Ontario Drinking Water Standards - Maximum Allowable Concentration	Ontario Drinking Water Standards - Asthetic Objectives	02/02/2021	03/16/2021	03/17/2021	03/18/2021
Volatiles								
Acetone	mg/L	0.0050	-	-	-	-	-	ND (0.0050)
Benzene	mg/L	0.0005	0.005 mg/L	-	-	-	-	ND (0.0005)
Bromodichloromethane	mg/L	0.0005	0.016 mg/L	-	-	-	=	ND (0.0005)
Bromoform	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
Bromomethane	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
Carbon Tetrachloride	mg/L	0.0002	0.002 mg/L	-	-	-	-	ND (0.0002)
Chlorobenzene	mg/L	0.0005	0.08 mg/L	0.03 mg/L	-	=	=	ND (0.0005)
Chloroform	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
Dibromochloromethane	mg/L	0.0005	=	_	-	-	-	ND (0.0005)
Dichlorodifluoromethane	mg/L	0.0010	-	_	-	-	-	ND (0.0010)
1,2-Dichlorobenzene	mg/L	0.0005	0.2 mg/L	0.003 mg/L	-	-	-	ND (0.0005)
1,3-Dichlorobenzene	mg/L	0.0005	-		=	=	=	ND (0.0005)
1,4-Dichlorobenzene	mg/L	0.0005	0.005 mg/L	0.001 mg/L	-	_	-	ND (0.0005)
1,1-Dichloroethane	mg/L	0.0005	- -		=	=	=	ND (0.0005)
1,2-Dichloroethane	mg/L	0.0005	0.005 mg/L	_	_	_	_	ND (0.0005)
1,1-Dichloroethylene	mg/L	0.0005	0.014 mg/L	_	_	_	_	ND (0.0005)
cis-1,2-Dichloroethylene	mg/L	0.0005	0.011118/12					ND (0.0005)
•		0.0005	-		_	_	-	ND (0.0005)
trans-1,2-Dichloroethylene	mg/L	0.0005	-	-	-	-	-	
1,2-Dichloropropane	mg/L		-	-	-	-	-	ND (0.0005)
cis-1,3-Dichloropropylene	mg/L	0.0005	=	-	-	=	=	ND (0.0005)
trans-1,3-Dichloropropylene	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
1,3-Dichloropropene, total	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
Ethylbenzene	mg/L	0.0005	0.14 mg/L	0.0016 mg/L	-	-	-	ND (0.0005)
Ethylene dibromide (dibromoethan	mg/L	0.200	=	-	-	-	-	ND (0.200)
Hexane	mg/L	0.0010	€	=	=	=	=	ND (0.0010)
Methyl Ethyl Ketone (2-Butanone)	mg/L	0.0050	=	-	-	-	-	ND (0.0050)
Methyl Isobutyl Ketone	mg/L	0.0050	<del>-</del>	-	-	-	-	ND (0.0050)
Methyl tert-butyl ether	mg/L	0.0020	=	0.015 mg/L	-	-	-	ND (0.0020)
Methylene Chloride	mg/L	0.0050	0.05 mg/L	=	-	=	=	ND (0.0050)
Styrene	mg/L	0.0005	Ē	=	-	=	=	ND (0.0005)
1,1,1,2-Tetrachloroethane	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
1,1,2,2-Tetrachloroethane	mg/L	0.0005		-	-	-	-	ND (0.0005)
Tetrachloroethylene	mg/L	0.0005	0.01 mg/L		-	-	-	ND (0.0005)
Toluene	mg/L	0.0005	0.06 mg/L	0.024 mg/L	-	-	-	ND (0.0005)
1,1,1-Trichloroethane	mg/L	0.0005	ē	-	-	-	-	ND (0.0005)
1,1,2-Trichloroethane	mg/L	0.0005	÷	-	-	-	-	ND (0.0005)
Trichloroethylene	mg/L	0.0005	0.005 mg/L	-	-	-	-	ND (0.0005)
Trichlorofluoromethane	mg/L	0.0010	-	-	-	-	-	ND (0.0010)
Vinyl Chloride	mg/L	0.0002	0.002 mg/L	-	-	-	-	ND (0.0002)
m/p-Xylene	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
o-Xylene	mg/L	0.0005	-	-	-	-	-	ND (0.0005)
Xylenes, total	mg/L	0.0005	0.09 mg/L	0.02 mg/L	-	=	-	ND (0.0005)
Hydrocarbons			9-	-		1		<u> </u>
F1 PHCs (C6-C10)	mg/L	0.0250	-	_	-	-	-	ND (0.0250)
F2 PHCs (C10-C16)	mg/L	0.1	-	_	_	_	_	ND (0.1)
F3 PHCs (C16-C34)	mg/L	0.1	-	_	-	-	-	ND (0.1)
F4 PHCs (C34-C50)	mg/L	0.1	_		_	_	_	ND (0.1)



### TW21-1C Water Quality Summary (3/3)

Parameter	Units	MDL	Regulation	Regulation	Step-Test	72-Hour P-Test			
					TW21-1c 2106227-01	TW21-1C 24hr 2112287-01	TW21-1C 48h 2112452-01	TW21-1C 72hr 2112541-01	
Sample Date (m/d/y)			Ontario Drinking Water Standards - Maximum Allowable Concentration	Ontario Drinking Water Standards - Asthetic Objectives	02/02/2021	03/16/2021	03/17/2021	03/18/2021	
Herbicdes / Pesticides									
2,3,4,6-Tetrachlorophenol	ug/L	-	ē	=	-	=	-	<0.3	
2,4,6-Trichlorophenol	ug/L	-	ē	=	-	=	-	<0.2	
2,4-Dichlorophenol	ug/L	-	ē	=	-	=	=	<0.2	
Pentachlorophenol	ug/L	-	ē	=	-	=	=	<0.3	
Carbaryl	ug/L	-	÷	-	-	=	=	<1	
Carbofuran	ug/L	-	-	-	-	-	=	<2	
Diuron	ug/L	-	÷	-	-	-	-	<6	
Diquat	ug/L	-	÷	-	-	-	-	<0.4	
Paraquat	ug/L	-	ē	=	-	=	=	<0.2	
Alachlor	ug/L	-	ē	=	-	=	-	<0.231	
Atrazine	ug/L	-	ē	=	-	=	=	<0.231	
Azinphos-methyl (Guthion)	ug/L	-	÷	-	-	-	-	<0.173	
Chlorpyriphos (Dursban)	ug/L	-	÷	-	-	-	-	<0.173	
Desethyl atrazine	ug/L	-	-	-	-	-	-	<0.289	
Diazinon	ug/L	-	÷	-	-	-	-	<0.173	
Dimethoate	ug/L	-	÷	-	-	-	-	<0.173	
Malathion	ug/L	-	-	-	-	-	-	<0.173	
Metolachlor	ug/L	-	-	-	-	-	-	<0.116	
Metribuzin (Sencor)	ug/L	-	-	-	-	-	-	<0.116	
Phorate	ug/L	-	-	-	-	-	-	<0.116	
Prometryne	ug/L	-	-	-	-	-	-	<0.0578	
Simazine	ug/L	-	-	-	-	-	-	<0.173	
Terbufos	ug/L	-	-	-	-	-	-	<0.116	
Triallate	ug/L	-	-	-	-	-	-	<0.116	
Trifluralin	ug/L	-	-	-	-	-	-	<0.116	
Benzo(a)pyrene	ug/L	-	-	-	-	-	-	<0.01	
Decachlorobiphenyl (Surr.)	% Rec	-	-	-	-	-	-	136	
Total PCBs	ug/L	-	-	-	-	-	-	<0.06	
2,4-D	ug/L	-	-	-	-	-	=	<0.365	
Bromoxynil	ug/L	-	-	-	-	-	=	<0.0972	
Dicamba	ug/L	-	-	-	-	-	-	<0.0851	
Dichlorophenyl acetic acid (Surr.	% Rec	-	-	-	-	-	-	88.3	
Diclofop-methyl	ug/L	-	=	-	-	-	=	<0.122	
MCPA	ug/L	-	=	-	-	-	=	<6.08	
Picloram	ug/L	-	=	_	-	_	-	<0.0851	
Atrazine + N-dealkylated metabo	ug/L	_	_		_			<0.5	



### **Langelier Saturation Index Calculation**

**Project 61899.03** 

Test Well: TW21-1C 72-hr Date: March 18, 2021

### **Inputs**

pH = 8.2 Total Dissolved Solids = 514

Calcium (as  $CaCO_3$ ) = 213 Note: Ca (as  $CaCO_3$ ) = 2.5 x Ca

Alkalinity (as  $CaCO_3$ ) = 279

Temperature ( $^{\circ}$ C) = 8 (estimated)

Where Langelier Saturation Index (LSI) is defined as:  $LSI = pH - pH_S$ 

Where: 
$$pH_S = (9.3 + A + B) - (C + D)$$

And: 
$$A = \frac{(\log_{10}[TDS] - 1)}{10}$$

$$B = -13.12 \cdot \log_{10}[Temp + 273] + 34.55$$

$$C = \log_{10}[Calcium] - 0.4$$

$$D = \log_{10}[Alkalinity]$$

### **Output:**

$$A = 0.17$$

B = 2.42

C = 1.93

D = 2.45

 $pH_s = 7.52$ 

LSI = 0.68

# LSI Value -2.0 to -0.5 Serious corrosion Slight corrosion by

-2.0 to -0.5

-0.5 to 0.0

LSI = 0

0.0 to 0.5

Serious corrosion

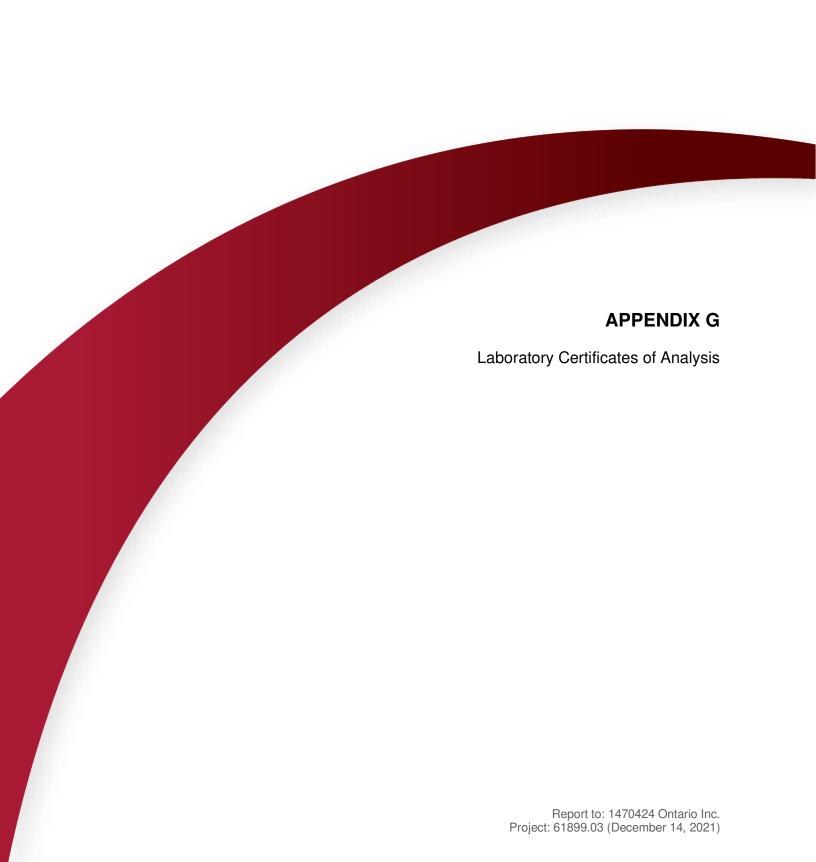
Slight corrosion but non-scale forming

Balanced but corrosion possible

Slightly scale forming and corrosive

Scale forming but non corrosive







300 - 2319 St. Laurent Blvd Ottawa, ON, K1G 4J8 1-800-749-1947 www.paracellabs.com

### Certificate of Analysis

#### **GEMTEC Consulting Engineers and Scientists Limited**

32 Steacie Drive Kanata, ON K2K 2A9 Attn: Andrius Paznekas

Client PO:

Project: 61899.03 Custody: 12097 Report Date: 23-Mar-2021 Order Date: 16-Mar-2021

Order #: 2112287

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

 Paracel ID
 Client ID

 2112287-01
 TW21-1C 24hr

Approved By:

Mark Froto

Mark Foto, M.Sc. Lab Supervisor



Order #: 2112287

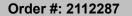
Report Date: 23-Mar-2021 Order Date: 16-Mar-2021

 Client:
 GEMTEC Consulting Engineers and Scientists Limited
 Order Date: 16-Mar-2021

 Client PO:
 Project Description: 61899.03

#### **Analysis Summary Table**

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	22-Mar-21	22-Mar-21
Ammonia, as N	EPA 351.2 - Auto Colour	18-Mar-21	18-Mar-21
Anions	EPA 300.1 - IC	18-Mar-21	18-Mar-21
Chromium, hexavalent - water	MOE E3056 - colourimetric	17-Mar-21	18-Mar-21
Colour	SM2120 - Spectrophotometric	17-Mar-21	17-Mar-21
Colour, apparent	SM2120 - Spectrophotometric	17-Mar-21	17-Mar-21
Conductivity	EPA 9050A- probe @25 °C	22-Mar-21	22-Mar-21
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	18-Mar-21	18-Mar-21
E. coli	MOE E3407	17-Mar-21	17-Mar-21
Fecal Coliform	SM 9222D	17-Mar-21	17-Mar-21
Heterotrophic Plate Count	SM 9215C	17-Mar-21	17-Mar-21
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	18-Mar-21	18-Mar-21
Metals, ICP-MS	EPA 200.8 - ICP-MS	17-Mar-21	17-Mar-21
pH	EPA 150.1 - pH probe @25 °C	22-Mar-21	22-Mar-21
Phenolics	EPA 420.2 - Auto Colour, 4AAP	17-Mar-21	17-Mar-21
Hardness	Hardness as CaCO3	17-Mar-21	17-Mar-21
Sulphide	SM 4500SE - Colourimetric	18-Mar-21	18-Mar-21
Tannin/Lignin	SM 5550B - Colourimetric	22-Mar-21	22-Mar-21
Total Coliform	MOE E3407	17-Mar-21	17-Mar-21
Total Dissolved Solids	SM 2540C - gravimetric, filtration	22-Mar-21	22-Mar-21
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	19-Mar-21	22-Mar-21
Turbidity	SM 2130B - Turbidity meter	17-Mar-21	17-Mar-21





Client: GEMTEC Consulting Engineers and Scientists Limited

Report Date: 23-Mar-2021 Order Date: 16-Mar-2021

Client PO: Project Description: 61899.03

	Client ID: Sample Date:	TW21-1C 24hr 16-Mar-21 12:00		-	
	Sample ID:	2112287-01 Drinking Water	-	-	-
Microbiological Parameters	MDL/Units	Dilliking Water		-	
E. coli	1 CFU/100 mL	ND	_	_	_
Fecal Coliforms	1 CFU/100 mL	ND	_	_	_
Total Coliforms	1 CFU/100 mL	ND	_	_	_
Heterotrophic Plate Count	10 CFU/mL	<10	_	_	-
General Inorganics	-	10			-
Alkalinity, total	5 mg/L	287	-	-	-
Ammonia as N	0.01 mg/L	0.16	-	-	-
Dissolved Organic Carbon	0.5 mg/L	2.8	-	-	-
Colour	2 TCU	15	-	-	-
Colour, apparent	2 ACU	28	-	-	-
Conductivity	5 uS/cm	876	-	-	-
Hardness	mg/L	326	-	-	-
pH	0.1 pH Units	8.0	_	_	_
Phenolics	0.001 mg/L	<0.001	_	-	-
Total Dissolved Solids	10 mg/L	484	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	-	-	-
Turbidity	0.1 NTU	3.4	-	-	-
Anions	-	<u> </u>			
Chloride	1 mg/L	94	-	-	-
Fluoride	0.1 mg/L	0.2	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	38	-	-	-
Metals	<del>'</del>		-		
Mercury	0.0001 mg/L	<0.0001	-	-	-
Aluminum	0.001 mg/L	0.079	-	-	-
Antimony	0.0005 mg/L	<0.0005	-	-	-
Arsenic	0.001 mg/L	0.001	-	-	-
Barium	0.001 mg/L	0.222	-	-	-
Boron	0.01 mg/L	0.18	-	-	-
Cadmium	0.0001 mg/L	<0.0001	-	-	-
Calcium	0.1 mg/L	82.5	-	-	-
Chromium	0.001 mg/L	<0.001	-	-	-



Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 23-Mar-2021

Order Date: 16-Mar-2021

Project Description: 61899.03

	Client ID:	TW21-1C 24hr	-	-	-
	Sample Date:	16-Mar-21 12:00	-	-	-
	Sample ID:	2112287-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Chromium (VI)	0.010 mg/L	<0.010	-	-	-
Copper	0.0005 mg/L	0.0007	-	-	-
Iron	0.1 mg/L	0.3	-	-	-
Lead	0.0001 mg/L	<0.0001	-	-	-
Magnesium	0.2 mg/L	29.1	-	-	-
Manganese	0.005 mg/L	0.029	-	-	-
Potassium	0.1 mg/L	5.4	-	-	-
Selenium	0.001 mg/L	<0.001	-	-	-
Sodium	0.2 mg/L	66.7	-	-	-
Uranium	0.0001 mg/L	0.0008	-	-	-
Zinc	0.005 mg/L	0.008	-	-	-



Order #: 2112287

Report Date: 23-Mar-2021

Order Date: 16-Mar-2021

Project Description: 61899.03

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

**Method Quality Control: Blank** 

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics			J						
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Colour, apparent	ND	2	ACU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Chromium	ND	0.001	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Sodium	ND	0.2	mg/L						
Uranium	ND	0.0001	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters			J						
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Page 5 of 8



Certificate of Analysis Report Date: 23-Mar-2021

 Client:
 GEMTEC Consulting Engineers and Scientists Limited
 Order Date: 16-Mar-2021

 Client PO:
 Project Description: 61899.03

**Method Quality Control: Duplicate** 

		Reporting		Source		%REC		RPD	
Analyte	Result	Limit	Units	Result	%REC	Limit	RPD	Limit	Notes
Anions	-								
Chloride	94.8	1	mg/L	94.2			0.6	10	
Fluoride	0.22	0.1	mg/L	0.22			0.8	10	
Nitrate as N	ND	0.1	mg/L	ND			NC	10	
Nitrite as N	ND	0.05	mg/L	ND			NC	10	
Sulphate	38.6	1	mg/L	38.3			0.8	10	
General Inorganics		•	<del>3</del> . –					-	
Alkalinity, total	282	5	mg/L	287			1.9	14	
Ammonia as N	0.258	0.01	mg/L	0.251			2.5	17.7	
Dissolved Organic Carbon	14.7	0.5	mg/L	13.3			9.8	37	
Colour	15	2	TČU	15			0.0	12	
Colour, apparent	9	2	ACU	9			0.0	12	
Conductivity	850	5	uS/cm	876			3.0	5	
pH	8.0	0.1	pH Units	8.0			0.5	3.3	
Phenolics	ND	0.001	mg/L	ND			NC	10	
Total Dissolved Solids	544	10	mg/L	528			3.0	10	
Sulphide	ND	0.02	mg/L	ND			NC	10	
Tannin & Lignin	ND	0.1	mg/L	ND			NC	11	
Total Kjeldahl Nitrogen	0.28	0.1	mg/L	0.30			6.8	16	
Turbidity	1.7	0.1	NŤU	1.6			7.2	10	
Metals									
Mercury	ND	0.0001	mg/L	ND			NC	20	
Aluminum	0.003	0.001	mg/L	0.003			0.6	20	
Antimony	0.0008	0.0005	mg/L	ND			NC	20	
Arsenic	ND	0.001	mg/L	ND			NC	20	
Barium	0.023	0.001	mg/L	0.022			3.3	20	
Boron	0.02	0.01	mg/L	0.02			3.2	20	
Cadmium	ND	0.0001	mg/L	ND			NC	20	
Calcium	38.4	0.1	mg/L	38.5			0.1	20	
Chromium (VI)	ND	0.010	mg/L	ND			NC	20	
Chromium	ND	0.001	mg/L	ND			NC	20	
Copper	0.0077	0.0005	mg/L	0.0079			2.5	20	
Iron	ND	0.1	mg/L	ND			NC	20	
Lead	0.0008	0.0001	mg/L	8000.0			4.1	20	
Magnesium	8.8	0.2	mg/L	9.4			6.8	20	
Manganese	ND	0.005	mg/L	ND			NC	20	
Potassium	2.0	0.1	mg/L	2.0			1.7	20	
Selenium	ND	0.001	mg/L	ND			NC	20	
Sodium	18.8	0.2	mg/L	19.5			3.4	20	
Uranium	0.0003	0.0001	mg/L	0.0003			3.7	20	
Zinc	0.039	0.005	mg/L	0.039			0.5	20	
Microbiological Parameters			-						
E. coli	ND	1	CFU/100 mL	ND			NC	30	
Fecal Coliforms	ND	1	CFU/100 mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100 mL	ND			NC	30	
Heterotrophic Plate Count	ND	10	CFU/mL	ND			NC	30	



Report Date: 23-Mar-2021

Order Date: 16-Mar-2021 Project Description: 61899.03

Certificate of Analysis Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

**Method Quality Control: Spike** 

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	9.74	1	mg/L	ND	97.4	85-115			
Fluoride	1.17	0.1	mg/L	0.22	94.7	79-121			
Nitrate as N	1.06	0.1	mg/L	ND	106	79-120			
Nitrite as N	1.03	0.05	mg/L	ND	103	84-117			
Sulphate	47.0	1	mg/L	38.3	86.7	74-126			
General Inorganics									
Ammonia as N	0.503	0.01	mg/L	0.251	101	81-124			
Dissolved Organic Carbon	20.6	0.5	mg/L	13.3	73.3	60-133			
Phenolics	0.028	0.001	mg/L	ND	111	69-132			
Total Dissolved Solids	96.0	10	mg/L	ND	96.0	75-125			
Sulphide	0.51	0.02	mg/L	ND	102	79-115			
Tannin & Lignin	1.1	0.1	mg/L	ND	106	71-113			
Total Kjeldahl Nitrogen	2.00	0.1	mg/L	0.37	81.8	81-126			
Metals									
Mercury	0.0033	0.0001	mg/L	ND	108	70-130			
Aluminum	46.1	0.001	mg/L	3.42	85.4	80-120			
Antimony	49.2	0.0005	mg/L	0.175	98.1	80-120			
Arsenic	49.2	0.001	mg/L	0.788	96.8	80-120			
Barium	69.7	0.001	mg/L	22.4	94.6	80-120			
Boron	64.9	0.01	mg/L	23.8	82.2	80-120			
Cadmium	46.7	0.0001	mg/L	0.0378	93.3	80-120			
Calcium	47400	0.1	mg/L	38500	89.8	80-120			
Chromium (VI)	0.209	0.010	mg/L	ND	104	70-130			
Chromium	51.5	0.001	mg/L	0.296	102	80-120			
Copper	54.0	0.0005	mg/L	7.90	92.3	80-120			
Iron	2370	0.1	mg/L	28.0	93.7	80-120			
Lead	40.0	0.0001	mg/L	0.833	78.4	80-120		Q	S-02
Magnesium	19500	0.2	mg/L	9380	101	80-120			
Manganese	50.7	0.005	mg/L	0.652	100	80-120			
Potassium	13700	0.1	mg/L	2000	117	80-120			
Selenium	46.0	0.001	mg/L	0.151	91.8	80-120			
Sodium	29600	0.2	mg/L	19500	101	80-120			
Uranium	41.8	0.0001	mg/L	0.330	83.0	80-120			
Zinc	82.1	0.005	mg/L	39.0	86.1	80-120			



Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Report Date: 23-Mar-2021

Order Date: 16-Mar-2021

Project Description: 61899.03

#### **Qualifier Notes:**

Client PO:

Sample Qualifiers:

QC Qualifiers :

QS-02: Spike level outside of control limits. Analysis batch accepted based on other QC included in the batch.

#### **Sample Data Revisions**

None

#### **Work Order Revisions / Comments:**

None

#### **Other Report Notes:**

n/a: not applicable ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery. RPD: Relative percent difference.

NC: Not Calculated



300 - 2319 St. Laurent Blvd Ottawa, ON, K1G 4J8 1-800-749-1947 www.paracellabs.com

### Certificate of Analysis

### **GEMTEC Consulting Engineers and Scientists Limited**

32 Steacie Drive Kanata, ON K2K 2A9 Attn: Andrius Paznekas

Client PO:

Project: 61899.03 Custody: 14579 Report Date: 23-Mar-2021 Order Date: 17-Mar-2021

Order #: 2112452

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

 Paracel ID
 Client ID

 2112452-01
 TW21-16 48h

Approved By:

Mark Froto

Mark Foto, M.Sc. Lab Supervisor



Order #: 2112452

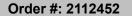
Report Date: 23-Mar-2021 Order Date: 17-Mar-2021

 Client:
 GEMTEC Consulting Engineers and Scientists Limited
 Order Date: 17-Mar-2021

 Client PO:
 Project Description: 61899.03

### **Analysis Summary Table**

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	22-Mar-21	22-Mar-21
Ammonia, as N	EPA 351.2 - Auto Colour	22-Mar-21	23-Mar-21
Anions	EPA 300.1 - IC	18-Mar-21	18-Mar-21
Chromium, hexavalent - water	MOE E3056 - colourimetric	19-Mar-21	19-Mar-21
Colour	SM2120 - Spectrophotometric	18-Mar-21	18-Mar-21
Colour, apparent	SM2120 - Spectrophotometric	18-Mar-21	18-Mar-21
Conductivity	EPA 9050A- probe @25 °C	22-Mar-21	22-Mar-21
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	18-Mar-21	18-Mar-21
E. coli	MOE E3407	18-Mar-21	18-Mar-21
Fecal Coliform	SM 9222D	18-Mar-21	18-Mar-21
Heterotrophic Plate Count	SM 9215C	18-Mar-21	20-Mar-21
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	19-Mar-21	23-Mar-21
Metals, ICP-MS	EPA 200.8 - ICP-MS	18-Mar-21	18-Mar-21
рН	EPA 150.1 - pH probe @25 °C	22-Mar-21	22-Mar-21
Phenolics	EPA 420.2 - Auto Colour, 4AAP	19-Mar-21	19-Mar-21
Hardness	Hardness as CaCO3	18-Mar-21	18-Mar-21
Sulphide	SM 4500SE - Colourimetric	18-Mar-21	18-Mar-21
Tannin/Lignin	SM 5550B - Colourimetric	22-Mar-21	22-Mar-21
Total Coliform	MOE E3407	18-Mar-21	18-Mar-21
Total Dissolved Solids	SM 2540C - gravimetric, filtration	22-Mar-21	22-Mar-21
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	19-Mar-21	22-Mar-21
Turbidity	SM 2130B - Turbidity meter	18-Mar-21	18-Mar-21





Client: GEMTEC Consulting Engineers and Scientists Limited

Report Date: 23-Mar-2021 Order Date: 17-Mar-2021

Client PO: Project Description: 61899.03

	Client ID: Sample Date: Sample ID:	TW21-16 48h 17-Mar-21 09:00 2112452-01	- - -	- - -	- - -
	MDL/Units	Drinking Water	-	-	_
Microbiological Parameters		<u> </u>	<del>'</del>		-
E. coli	1 CFU/100 mL	ND	-	-	-
Fecal Coliforms	1 CFU/100 mL	ND	-	-	-
Total Coliforms	1 CFU/100 mL	ND	-	-	-
Heterotrophic Plate Count	10 CFU/mL	<10	-	-	-
General Inorganics					
Alkalinity, total	5 mg/L	279	-	-	-
Ammonia as N	0.01 mg/L	0.14	-	-	-
Dissolved Organic Carbon	0.5 mg/L	2.4	-	-	-
Colour	2 TCU	8	-	-	-
Colour, apparent	2 ACU	24	-	-	-
Conductivity	5 uS/cm	961	-	-	-
Hardness	mg/L	335	-	-	-
рН	0.1 pH Units	8.0	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	500	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.2	-	-	-
Turbidity	0.1 NTU	2.9	-	-	-
Anions	•		•		
Chloride	1 mg/L	122	-	-	-
Fluoride	0.1 mg/L	0.2	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	42	-	-	-
Metals					
Mercury	0.0001 mg/L	<0.0001	-	-	-
Aluminum	0.001 mg/L	0.060	-	-	-
Antimony	0.0005 mg/L	<0.0005	-	-	-
Arsenic	0.001 mg/L	0.001	-	-	-
Barium	0.001 mg/L	0.231	-	-	-
Boron	0.01 mg/L	0.18	-	-	-
Cadmium	0.0001 mg/L	<0.0001	-	-	-
Calcium	0.1 mg/L	85.9	-	-	-
Chromium	0.001 mg/L	<0.001	-	-	-



Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 23-Mar-2021 Order Date: 17-Mar-2021

Project Description: 61899.03

	_				
	Client ID:	TW21-16 48h	-	-	-
	Sample Date:	17-Mar-21 09:00	-	-	-
	Sample ID:	2112452-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Chromium (VI)	0.010 mg/L	<0.010	-	-	-
Copper	0.0005 mg/L	<0.0005	-	-	-
Iron	0.1 mg/L	0.3	-	-	-
Lead	0.0001 mg/L	0.0001	-	-	-
Magnesium	0.2 mg/L	29.4	-	-	-
Manganese	0.005 mg/L	0.029	-	-	-
Potassium	0.1 mg/L	5.7	-	-	-
Selenium	0.001 mg/L	<0.001	-	-	-
Sodium	0.2 mg/L	82.2	-	-	-
Uranium	0.0001 mg/L	0.0007	-	-	-
Zinc	0.005 mg/L	<0.005	-	-	-



Client PO:

Order #: 2112452

Report Date: 23-Mar-2021

Order Date: 17-Mar-2021

Client: GEMTEC Consulting Engineers and Scientists Limited Project Description: 61899.03

**Method Quality Control: Blank** 

Analyte		Reporting		Source		%REC		RPD	
Analyte	Result	Limit	Units	Result	%REC	Limit	RPD	Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics			5						
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Colour, apparent	ND	2	ACU						
Conductivity	ND ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND ND	10	mg/L						
Sulphide	ND ND	0.02	mg/L						
Tannin & Lignin	ND ND	0.02	mg/L						
Total Kjeldahl Nitrogen	ND ND	0.1	mg/L						
Turbidity	ND ND	0.1	NTU						
•	ND	0.1	NIO						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Chromium	ND	0.001	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Sodium	ND	0.2	mg/L						
Uranium	ND	0.0001	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters			5						
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND ND	10	CFU/mL						



Order #: 2112452

Report Date: 23-Mar-2021

Order Date: 17-Mar-2021

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

**Method Quality Control: Duplicate** 

		Reporting		Source		%REC		RPD		
Analyte	Result	Limit	Units	Result	%REC	Limit	RPD	Limit	Notes	
Anions										
Chloride	94.8	1	mg/L	94.2			0.6	10		
Fluoride	0.22	0.1	mg/L	0.22			0.8	10		
Nitrate as N	ND	0.1	mg/L	ND			NC	10		
Nitrite as N	ND	0.05	mg/L	ND			NC	10		
Sulphate	38.6	1	mg/L	38.3			0.8	10		
General Inorganics	33.0		1119/ =	00.0			0.0			
Alkalinity, total	282	5	mg/L	287			1.9	14		
Ammonia as N	0.166	0.01	mg/L	0.168			1.2	17.7		
Dissolved Organic Carbon	14.7	0.5	mg/L	13.3			9.8	37		
Colour	8	2	TCU	8			0.0	12		
Colour, apparent	25	2	ACU	24			4.1	12		
Conductivity	850	5	uS/cm	876			3.0	5		
pH	8.0	0.1	pH Units	8.0			0.5	3.3		
Phenolics	ND	0.001	mg/L	ND			NC	10		
Total Dissolved Solids	544	10	mg/L	528			3.0	10		
Sulphide	ND	0.02	mg/L	ND			NC	10		
Tannin & Lignin	ND ND	0.02	mg/L	ND			NC	11		
Total Kjeldahl Nitrogen	0.28	0.1	mg/L	0.30			6.8	16		
Turbidity	3.0	0.1	NTU	2.9			2.0	10		
•	ა.0	U. I	NIU	2.9			2.0	10		
Metals										
Mercury	ND	0.0001	mg/L	ND			NC	20		
Aluminum	0.056	0.001	mg/L	0.057			2.0	20		
Antimony	ND	0.0005	mg/L	ND			NC	20		
Arsenic	ND	0.001	mg/L	ND			NC	20		
Barium	0.012	0.001	mg/L	0.012			0.7	20		
Boron	ND	0.01	mg/L	ND			NC	20		
Cadmium	ND	0.0001	mg/L	ND			NC	20		
Calcium	9.4	0.1	mg/L	9.4			0.0	20		
Chromium (VI)	ND	0.010	mg/L	ND			NC	20		
Chromium	ND	0.001	mg/L	ND			NC	20		
Copper	0.0041	0.0005	mg/L	0.0040			0.3	20		
Iron	ND	0.1	mg/L	ND			NC	20		
Lead	0.0010	0.0001	mg/L	0.0010			5.0	20		
Magnesium	2.3	0.2	mg/L	2.3			2.7	20		
Manganese	ND	0.005	mg/L	ND			NC	20		
Potassium	0.8	0.1	mg/L	0.8			0.2	20		
Selenium	ND	0.001	mg/L	ND			NC	20		
Sodium	17.1	0.2	mg/L	17.2			0.6	20		
Uranium	ND	0.0001	mg/L	ND			NC	20		
Zinc	0.008	0.005	mg/L	0.008			1.0	20		
Microbiological Parameters	0.000	0.000	mg/L	0.000			1.0	20		
E. coli	ND	1	CFU/100 mL	ND			NC	30		
			CFU/100 mL	ND ND						
Fecal Coliforms	ND ND	1					NC	30		
Total Coliforms	ND	1	CFU/100 mL	ND			NC	30		
Heterotrophic Plate Count	ND	10	CFU/mL	ND			NC	30		



Order #: 2112452

Report Date: 23-Mar-2021

Order Date: 17-Mar-2021

Project Description: 61899.03

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

**Method Quality Control: Spike** 

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	9.74	1	mg/L	ND	97.4	85-115			
Fluoride	1.17	0.1	mg/L	0.22	94.7	79-121			
Nitrate as N	1.06	0.1	mg/L	ND	106	79-120			
Nitrite as N	1.03	0.05	mg/L	ND	103	84-117			
Sulphate	47.0	1	mg/L	38.3	86.7	74-126			
General Inorganics									
Ammonia as N	0.421	0.01	mg/L	0.168	101	81-124			
Dissolved Organic Carbon	20.6	0.5	mg/L	13.3	73.3	60-133			
Phenolics	0.025	0.001	mg/L	ND	99.7	69-132			
Total Dissolved Solids	96.0	10	mg/L	ND	96.0	75-125			
Sulphide	0.51	0.02	mg/L	ND	102	79-115			
Tannin & Lignin	1.1	0.1	mg/L	ND	106	71-113			
Total Kjeldahl Nitrogen	2.00	0.1	mg/L	0.37	81.8	81-126			
Metals									
Mercury	0.0032	0.0001	mg/L	ND	108	70-130			
Aluminum	65.5	0.001	mg/L	24.2	82.6	80-120			
Antimony	54.5	0.0005	mg/L	0.436	108	80-120			
Arsenic	50.1	0.001	mg/L	0.202	99.8	80-120			
Barium	67.1	0.001	mg/L	12.4	109	80-120			
Boron	53.3	0.01	mg/L	5.80	94.9	80-120			
Cadmium	53.2	0.0001	mg/L	0.0432	106	80-120			
Chromium (VI)	0.209	0.010	mg/L	ND	104	70-130			
Chromium	54.4	0.001	mg/L	0.136	109	80-120			
Copper	54.0	0.0005	mg/L	4.05	99.8	80-120			
Iron	2460	0.1	mg/L	72.7	95.6	80-120			
Lead	46.3	0.0001	mg/L	0.954	90.6	80-120			
Magnesium	14000	0.2	mg/L	2330	116	80-120			
Manganese	56.8	0.005	mg/L	3.51	107	80-120			
Potassium	12200	0.1	mg/L	731	115	80-120			
Selenium	49.2	0.001	mg/L	0.113	98.2	80-120			
Sodium	27500	0.2	mg/L	17200	103	80-120			
Uranium	45.1	0.0001	mg/L	0.0398	90.0	80-120			
Zinc	65.4	0.005	mg/L	8.08	115	80-120			



Order #: 2112452

Report Date: 23-Mar-2021

Order Date: 17-Mar-2021

Project Description: 61899.03

#### Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

#### **Qualifier Notes:**

Sample Qualifiers:

Certificate of Analysis

QC Qualifiers :

#### **Sample Data Revisions**

None

#### **Work Order Revisions / Comments:**

None

## Other Report Notes:

n/a: not applicable ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery. RPD: Relative percent difference.

NC: Not Calculated



300 - 2319 St. Laurent Blvd Ottawa, ON, K1G 4J8 1-800-749-1947 www.paracellabs.com

# Certificate of Analysis

# **GEMTEC Consulting Engineers and Scientists Limited**

32 Steacie Drive Kanata, ON K2K 2A9 Attn: Andrius Paznekas

Client PO:

Project: 61899.03 Custody: 13283 Report Date: 24-Mar-2021 Order Date: 18-Mar-2021

Order #: 2112541

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

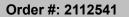
 Paracel ID
 Client ID

 2112541-01
 TW21-1C 72hr

Approved By:

Mark Froto

Mark Foto, M.Sc. Lab Supervisor



Report Date: 24-Mar-2021



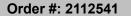
Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 18-Mar-2021 Client PO: Project Description: 61899.03

# **Analysis Summary Table**

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	22-Mar-21	23-Mar-21
Ammonia, as N	EPA 351.2 - Auto Colour	22-Mar-21	23-Mar-21
Anions	EPA 300.1 - IC	22-Mar-21	22-Mar-21
Chromium, hexavalent - water	MOE E3056 - colourimetric	19-Mar-21	19-Mar-21
Colour	SM2120 - Spectrophotometric	19-Mar-21	19-Mar-21
Colour, apparent	SM2120 - Spectrophotometric	19-Mar-21	19-Mar-21
Conductivity	EPA 9050A- probe @25 °C	22-Mar-21	23-Mar-21
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	23-Mar-21	23-Mar-21
E. coli	MOE E3407	19-Mar-21	19-Mar-21
Fecal Coliform	SM 9222D	19-Mar-21	19-Mar-21
Heterotrophic Plate Count	SM 9215C	20-Mar-21	22-Mar-21
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	19-Mar-21	23-Mar-21
Metals, ICP-MS	EPA 200.8 - ICP-MS	19-Mar-21	19-Mar-21
pH	EPA 150.1 - pH probe @25 °C	22-Mar-21	23-Mar-21
PHC F1	CWS Tier 1 - P&T GC-FID	22-Mar-21	23-Mar-21
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	23-Mar-21	24-Mar-21
Phenolics	EPA 420.2 - Auto Colour, 4AAP	19-Mar-21	19-Mar-21
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	22-Mar-21	23-Mar-21
Hardness	Hardness as CaCO3	19-Mar-21	19-Mar-21
Sulphide	SM 4500SE - Colourimetric	23-Mar-21	23-Mar-21
Tannin/Lignin	SM 5550B - Colourimetric	22-Mar-21	22-Mar-21
Total Coliform	MOE E3407	19-Mar-21	19-Mar-21
Total Dissolved Solids	SM 2540C - gravimetric, filtration	22-Mar-21	22-Mar-21
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	19-Mar-21	22-Mar-21
Turbidity	SM 2130B - Turbidity meter	19-Mar-21	19-Mar-21



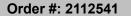


Client: GEMTEC Consulting Engineers and Scientists Limited

Report Date: 24-Mar-2021 Order Date: 18-Mar-2021

Client PO: Project Description: 61899.03

	Client ID:	TW21-1C 72hr	- 1	-	-
	Sample Date:	18-Mar-21 12:00	-	-	-
	Sample ID:	2112541-01	-	-	-
Missabialanias Damanatan	MDL/Units	Drinking Water	-	-	
Microbiological Parameters  E. coli	1 CFU/100 mL	ND			
	1 CFU/100 mL	ND	-	-	-
Fecal Coliforms	<b>+</b>	ND	-	-	-
Total Coliforms	1 CFU/100 mL	ND	-	-	-
Heterotrophic Plate Count	10 CFU/mL	<10	-	-	-
General Inorganics	5 mm/				1
Alkalinity, total	5 mg/L	279	-	-	-
Ammonia as N	0.01 mg/L	0.14	-	-	-
Dissolved Organic Carbon	0.5 mg/L	1.7	-	-	-
Colour	2 TCU	7	-	-	-
Colour, apparent	2 ACU	19	-	-	-
Conductivity	5 uS/cm	1040	-	-	-
Hardness	mg/L	334	-	-	-
рН	0.1 pH Units	8.2	-	-	-
Phenolics	0.001 mg/L	<0.001	-	-	-
Total Dissolved Solids	10 mg/L	514	-	-	-
Sulphide	0.02 mg/L	<0.02	-	-	-
Tannin & Lignin	0.1 mg/L	<0.1	-	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	-	-	-
Turbidity	0.1 NTU	2.0	-	-	-
Anions	•			•	
Chloride	1 mg/L	138	-	-	-
Fluoride	0.1 mg/L	0.5	-	-	-
Nitrate as N	0.1 mg/L	<0.1	-	-	-
Nitrite as N	0.05 mg/L	<0.05	-	-	-
Sulphate	1 mg/L	44	-	-	-
Metals					
Mercury	0.0001 mg/L	<0.0001	-	-	-
Aluminum	0.001 mg/L	0.026	-	-	-
Antimony	0.0005 mg/L	<0.0005	-	-	-
Arsenic	0.001 mg/L	0.001	-	-	-
Barium	0.001 mg/L	0.226	-	-	-
Boron	0.01 mg/L	0.20	-	-	-
Cadmium	0.0001 mg/L	<0.0001	-	-	-
Calcium	0.1 mg/L	85.2	-	-	-
Chromium	0.001 mg/L	<0.001	-	-	-





Client: GEMTEC Consulting Engineers and Scientists Limited

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Report Date: 24-Mar-2021 Order Date: 18-Mar-2021

Client PO: Project Description: 61899.03

	Client ID: Sample Date:	TW21-1C 72hr 18-Mar-21 12:00		-	-
	Sample ID:	2112541-01	_	-	-
	MDL/Units	Drinking Water	-	-	-
Chromium (VI)	0.010 mg/L	<0.010	-	-	-
Copper	0.0005 mg/L	<0.0005	-	-	-
Iron	0.1 mg/L	0.3	-	-	-
Lead	0.0001 mg/L	0.0001	-	-	-
Magnesium	0.2 mg/L	29.4	-	-	-
Manganese	0.005 mg/L	0.029	-	-	-
Potassium	0.1 mg/L	5.9	-	-	-
Selenium	0.001 mg/L	<0.001	-	-	-
Sodium	0.2 mg/L	87.3	-	-	-
Uranium	0.0001 mg/L	0.0008	-	-	-
Zinc	0.005 mg/L	0.007	-	-	-
Volatiles			•		
Acetone	0.0050 mg/L	<0.0050	-	-	-
Benzene	0.0005 mg/L	<0.0005	-	-	-
Bromodichloromethane	0.0005 mg/L	<0.0005	-	-	-
Bromoform	0.0005 mg/L	<0.0005	-	-	-
Bromomethane	0.0005 mg/L	<0.0005	-	-	-
Carbon Tetrachloride	0.0002 mg/L	<0.0002	-	-	-
Chlorobenzene	0.0005 mg/L	<0.0005	-	-	-
Chloroform	0.0005 mg/L	<0.0005	-	-	-
Dibromochloromethane	0.0005 mg/L	<0.0005	-	-	-
Dichlorodifluoromethane	0.0010 mg/L	<0.0010	-	-	-
1,2-Dichlorobenzene	0.0005 mg/L	<0.0005	-	-	-
1,3-Dichlorobenzene	0.0005 mg/L	<0.0005	-	-	-
1,4-Dichlorobenzene	0.0005 mg/L	<0.0005	-	-	-
1,1-Dichloroethane	0.0005 mg/L	<0.0005	-	-	-
1,2-Dichloroethane	0.0005 mg/L	<0.0005	-	-	-
1,1-Dichloroethylene	0.0005 mg/L	<0.0005	-	-	-
cis-1,2-Dichloroethylene	0.0005 mg/L	<0.0005	-	-	-
trans-1,2-Dichloroethylene	0.0005 mg/L	<0.0005	-	-	-
1,2-Dichloropropane	0.0005 mg/L	<0.0005	-	-	-
cis-1,3-Dichloropropylene	0.0005 mg/L	<0.0005	-	-	-
trans-1,3-Dichloropropylene	0.0005 mg/L	<0.0005	-	-	-
1,3-Dichloropropene, total	0.0005 mg/L	<0.0005	-	-	-
Ethylbenzene	0.0005 mg/L	<0.0005	-	-	-
Ethylene dibromide (dibromoethane, 1,2-)	0.200 mg/L	<0.200	-	-	-



Order #: 2112541

Report Date: 24-Mar-2021

Order Date: 18-Mar-2021

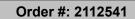
Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

	Client ID:	TW21-1C 72hr	-	-	-
	Sample Date:	18-Mar-21 12:00	-	-	-
	Sample ID:	2112541-01	-	-	-
	MDL/Units	Drinking Water	-	-	-
Hexane	0.0010 mg/L	<0.0010	-	-	-
Methyl Ethyl Ketone (2-Butanone)	0.0050 mg/L	<0.0050	-	-	-
Methyl Isobutyl Ketone	0.0050 mg/L	<0.0050	-	-	-
Methyl tert-butyl ether	0.0020 mg/L	<0.0020	-	-	-
Methylene Chloride	0.0050 mg/L	<0.0050	-	-	-
Styrene	0.0005 mg/L	<0.0005	-	-	-
1,1,1,2-Tetrachloroethane	0.0005 mg/L	<0.0005	-	-	-
1,1,2,2-Tetrachloroethane	0.0005 mg/L	<0.0005	-	-	-
Tetrachloroethylene	0.0005 mg/L	<0.0005	-	-	-
Toluene	0.0005 mg/L	<0.0005	-	-	-
1,1,1-Trichloroethane	0.0005 mg/L	<0.0005	-	-	-
1,1,2-Trichloroethane	0.0005 mg/L	<0.0005	-	-	-
Trichloroethylene	0.0005 mg/L	<0.0005	-	-	-
Trichlorofluoromethane	0.0010 mg/L	<0.0010	-	-	-
Vinyl chloride	0.0002 mg/L	<0.0002	-	-	-
m,p-Xylenes	0.0005 mg/L	<0.0005	-	-	-
o-Xylene	0.0005 mg/L	<0.0005	-	-	-
Xylenes, total	0.0005 mg/L	<0.0005	-	-	-
4-Bromofluorobenzene	Surrogate	91.9%	-	-	-
Dibromofluoromethane	Surrogate	85.9%	-	-	-
Toluene-d8	Surrogate	107%	-	-	-
Hydrocarbons			•	•	•
F1 PHCs (C6-C10)	0.0250 mg/L	<0.0250	-	-	-
F2 PHCs (C10-C16)	0.1 mg/L	<0.1	-	-	-
F3 PHCs (C16-C34)	0.1 mg/L	<0.1	-	-	-
F4 PHCs (C34-C50)	0.1 mg/L	<0.1	-	-	-

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F1 PHCs (C6-C10)	0.0250 mg/L	<0.0250	-	-	-
F2 PHCs (C10-C16)	0.1 mg/L	<0.1	-	-	-
F3 PHCs (C16-C34)	0.1 mg/L	<0.1	-	-	-
F4 PHCs (C34-C50)	0.1 mg/L	<0.1	-	-	-



Report Date: 24-Mar-2021

Order Date: 18-Mar-2021



Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

**Method Quality Control: Blank** 

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics			J						
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Colour, apparent	ND	2	ACU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NŤU						
Hydrocarbons									
F2 PHCs (C10-C16) - PAHs	0.0		mg/L						
F3 PHCs (C16-C34) - PAHs	0.0		mg/L						
F1 PHCs (C6-C10)	ND	0.0250	mg/L						
F2 PHCs (C10-C16)	ND	0.1	mg/L						
F3 PHCs (C16-C34)	ND	0.1	mg/L						
F4 PHCs (C34-C50)	ND	0.1	mg/L						
Metals									
Mercury	ND	0.0001	mg/L						
Aluminum	ND	0.001	mg/L						
Antimony	ND	0.0005	mg/L						
Arsenic	ND	0.001	mg/L						
Barium	ND	0.001	mg/L						
Boron	ND	0.01	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium (VI)	ND	0.010	mg/L						
Chromium	ND	0.001	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND ND	0.0001	mg/L						
Magnesium	ND ND	0.2 0.005	mg/L						
Manganese Potassium	ND ND	0.005	mg/L						
Selenium	ND ND	0.1	mg/L						
Sodium	ND ND	0.001	mg/L mg/L						
Uranium	ND ND	0.2	mg/L						
Zinc	ND ND	0.005	mg/L						
Microbiological Parameters	110	3.300	g, ∟						
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						
Volatiles	110	.0	5. J.IIIL						
Acetone	ND	0.0050	mg/L						
Benzene	ND	0.0005	mg/L						
	ND								
	ND	0 0005	ma/l						
Bromodichloromethane Bromoform	ND ND	0.0005 0.0005	mg/L mg/L						



Order #: 2112541

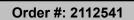
Report Date: 24-Mar-2021

Order Date: 18-Mar-2021

Client: GEMTEC Consulting Engineers and Scientists Limited Client PO: Project Description: 61899.03

# **Method Quality Control: Blank**

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Carbon Tetrachloride	ND	0.0002	mg/L					_	
Chlorobenzene	ND	0.0005	mg/L						
Chloroform	ND	0.0005	mg/L						
Dibromochloromethane	ND	0.0005	mg/L						
Dichlorodifluoromethane	ND	0.0010	mg/L						
1,2-Dichlorobenzene	ND	0.0005	mg/L						
1,3-Dichlorobenzene	ND	0.0005	mg/L						
1,4-Dichlorobenzene	ND	0.0005	mg/L						
1,1-Dichloroethane	ND	0.0005	mg/L						
1,2-Dichloroethane	ND	0.0005	mg/L						
1,1-Dichloroethylene	ND	0.0005	mg/L						
cis-1,2-Dichloroethylene	ND	0.0005	mg/L						
trans-1,2-Dichloroethylene	ND	0.0005	mg/L						
1,2-Dichloropropane	ND	0.0005	mg/L						
cis-1,3-Dichloropropylene	ND	0.0005	mg/L						
trans-1,3-Dichloropropylene	ND	0.0005	mg/L						
1,3-Dichloropropene, total	ND	0.0005	mg/L						
Ethylbenzene	ND	0.0005	mg/L						
Ethylene dibromide (dibromoethane, 1,2	ND	0.200	mg/L						
Hexane	ND	0.0010	mg/L						
Methyl Ethyl Ketone (2-Butanone)	ND	0.0050	mg/L						
Methyl Isobutyl Ketone	ND	0.0050	mg/L						
Methyl tert-butyl ether	ND	0.0020	mg/L						
Methylene Chloride	ND	0.0050	mg/L						
Styrene	ND	0.0005	mg/L						
1,1,1,2-Tetrachloroethane	ND	0.0005	mg/L						
1,1,2,2-Tetrachloroethane	ND	0.0005	mg/L						
Tetrachloroethylene	ND	0.0005	mg/L						
Toluene	ND	0.0005	mg/L						
1,1,1-Trichloroethane	ND	0.0005	mg/L						
1,1,2-Trichloroethane	ND	0.0005	mg/L						
Trichloroethylene	ND	0.0005	mg/L						
Trichlorofluoromethane	ND	0.0010	mg/L						
Vinyl chloride	ND	0.0002	mg/L						
m,p-Xylenes	ND	0.0005	mg/L						
o-Xylene	ND	0.0005	mg/L						
Xylenes, total	ND	0.0005	mg/L						
Surrogate: 4-Bromofluorobenzene	0.0731		mg/L		91.3	50-140			
Surrogate: Dibromofluoromethane	0.0686		mg/L		85.8	50-140			
Surrogate: Toluene-d8	0.0859		mg/L		107	50-140			



Report Date: 24-Mar-2021

Order Date: 18-Mar-2021



Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

**Method Quality Control: Duplicate** 

Analyte	Danult	Reporting		Source	0/ 5=0	%REC	DEE	RPD	NI-4
Analyte	Result	Limit	Units	Result	%REC	Limit	RPD	Limit	Notes
Anions			_						
Chloride	7.02	1	mg/L	7.12			1.4	10	
Fluoride	0.71	0.1	mg/L	0.73			2.9	10	
Nitrate as N	0.59	0.1	mg/L	0.60			1.6	10	
Nitrite as N	ND	0.05	mg/L	ND			NC	10	
Sulphate	24.6	1	mg/L	24.8			0.9	10	
General Inorganics		•	<b>3</b> . –					-	
Alkalinity, total	282	5	mg/L	287			1.9	14	
Ammonia as N	0.166	0.01	mg/L	0.168			1.2	17.7	
Dissolved Organic Carbon	4.0	0.5	mg/L	3.3			19.6	37	
Colour	8	2	TCU	8			0.0	12	
Colour, apparent	19	2	ACU	19			0.0	12	
Conductivity	850	5	uS/cm	876			3.0	5	
pH	8.0	0.1	pH Units	8.0			0.5	3.3	
Phenolics	ND	0.001	mg/L	ND			NC	10	
Total Dissolved Solids	544	10	mg/L	528			3.0	10	
Sulphide	ND	0.02	mg/L	ND			NC	10	
Tannin & Lignin	ND	0.1	mg/L	ND			NC	11	
Total Kjeldahl Nitrogen	0.28	0.1	mg/L	0.30			6.8	16	
Turbidity	18.7	0.1	NTU	18.6			0.5	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	0.0250	mg/L	ND			NC	30	
Metals			-						
Mercury	ND	0.0001	mg/L	ND			NC	20	
Aluminum	ND	0.001	mg/L	ND			NC	20	
Antimony	ND	0.0005	mg/L	ND			NC	20	
Arsenic	ND	0.001	mg/L	ND			NC	20	
Barium	0.023	0.001	mg/L	0.022			3.2	20	
Boron	0.06	0.01	mg/L	0.06			0.8	20	
Cadmium	ND	0.0001	mg/L	ND			NC	20	
Calcium	94.1	0.1	mg/L	93.3			0.9	20	
Chromium (VI)	ND	0.010	mg/L	ND			NC	20	
Chromium	ND	0.001	mg/L	ND			NC	20	
Copper	0.0052	0.0005	mg/L	0.0054			3.7	20	
Iron	ND	0.1	mg/L	ND			NC	20	
Lead	0.0004	0.0001	mg/L	0.0005			16.6	20	
Magnesium	26.3	0.2	mg/L	25.9			1.4	20	
Manganese	ND	0.005	mg/L	ND			NC	20	
Potassium	3.2	0.1	mg/L	3.1			2.0	20	
Selenium	ND	0.001	mg/L	ND			NC	20	
Sodium	10.7	0.2	mg/L	11.0			3.5	20	
Uranium	ND	0.0001	mg/L	0.0001			NC	20	
Zinc	0.005	0.005	mg/L	0.005			1.1	20	
Microbiological Parameters			J						
E. coli	ND	1	CFU/100 mL	ND			NC	30	
Fecal Coliforms	ND	1	CFU/100 mL	ND			NC	30	
Total Coliforms	ND	1	CFU/100 mL	1			NC	30	
Heterotrophic Plate Count	ND	10	CFU/mL	ND			NC	30	
/olatiles									
Acetone	ND	0.0050	mg/L	ND			NC	30	
Benzene	ND	0.0005	mg/L	ND			NC	30	
Bromodichloromethane	ND ND	0.0005	mg/L	ND			NC	30	
Bromoform	ND	0.0005	mg/L	ND			NC	30	
Bromomethane	ND ND	0.0005	mg/L	ND			NC	30	
Carbon Tetrachloride	ND ND	0.0003	mg/L	ND			NC	30	
		0.0002					110		



Order #: 2112541

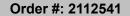
Report Date: 24-Mar-2021 Order Date: 18-Mar-2021

 Client:
 GEMTEC Consulting Engineers and Scientists Limited
 Order Date: 18-Mar-2021

 Client PO:
 Project Description: 61899.03

# **Method Quality Control: Duplicate**

		Reporting		Source		%REC		RPD	
Analyte	Result	Limit	Units	Result	%REC	Limit	RPD	Limit	Notes
Chloroform	ND	0.0005	mg/L	ND			NC	30	
Dibromochloromethane	ND	0.0005	mg/L	ND			NC	30	
Dichlorodifluoromethane	ND	0.0010	mg/L	ND			NC	30	
1,2-Dichlorobenzene	ND	0.0005	mg/L	ND			NC	30	
1,3-Dichlorobenzene	ND	0.0005	mg/L	ND			NC	30	
1,4-Dichlorobenzene	ND	0.0005	mg/L	ND			NC	30	
1,1-Dichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,2-Dichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1-Dichloroethylene	ND	0.0005	mg/L	ND			NC	30	
cis-1,2-Dichloroethylene	ND	0.0005	mg/L	ND			NC	30	
trans-1,2-Dichloroethylene	ND	0.0005	mg/L	ND			NC	30	
1,2-Dichloropropane	ND	0.0005	mg/L	ND			NC	30	
cis-1,3-Dichloropropylene	ND	0.0005	mg/L	ND			NC	30	
trans-1,3-Dichloropropylene	ND	0.0005	mg/L	ND			NC	30	
Ethylbenzene	ND	0.0005	mg/L	ND			NC	30	
Ethylene dibromide (dibromoethane, 1,2	ND	0.200	mg/L	ND			NC	30	
Hexane	ND	0.0010	mg/L	ND			NC	30	
Methyl Ethyl Ketone (2-Butanone)	ND	0.0050	mg/L	ND			NC	30	
Methyl Isobutyl Ketone	ND	0.0050	mg/L	ND			NC	30	
Methyl tert-butyl ether	ND	0.0020	mg/L	ND			NC	30	
Methylene Chloride	ND	0.0050	mg/L	ND			NC	30	
Styrene	ND	0.0005	mg/L	ND			NC	30	
1,1,1,2-Tetrachloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1,2,2-Tetrachloroethane	ND	0.0005	mg/L	ND			NC	30	
Tetrachloroethylene	ND	0.0005	mg/L	ND			NC	30	
Toluene	ND	0.0005	mg/L	ND			NC	30	
1,1,1-Trichloroethane	ND	0.0005	mg/L	ND			NC	30	
1,1,2-Trichloroethane	ND	0.0005	mg/L	ND			NC	30	
Trichloroethylene	ND	0.0005	mg/L	ND			NC	30	
Trichlorofluoromethane	ND	0.0010	mg/L	ND			NC	30	
Vinyl chloride	ND	0.0002	mg/L	ND			NC	30	
m,p-Xylenes	ND	0.0005	mg/L	ND			NC	30	
o-Xylene	ND	0.0005	mg/L	ND			NC	30	
Surrogate: 4-Bromofluorobenzene	0.0717		mg/L		89.6	50-140			
Surrogate: Dibromofluoromethane	0.0754		mg/L		94.2	50-140			
Surrogate: Toluene-d8	0.0864		mg/L		108	50-140			





Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

Report Date: 24-Mar-2021 Order Date: 18-Mar-2021

**Method Quality Control: Spike** 

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	16.7	1	mg/L	7.12	95.6	77-123			
Fluoride	1.54	0.1	mg/L	0.73	80.7	79-121			
Nitrate as N	1.60	0.1	mg/L	0.60	100	79-120			
Nitrite as N	0.914	0.05	mg/L	ND	91.4	84-117			
Sulphate	33.2	1	mg/L	24.8	84.1	74-126			
eneral Inorganics									
Ammonia as N	0.421	0.01	mg/L	0.168	101	81-124			
Dissolved Organic Carbon	13.9	0.5	mg/L	3.3	107	60-133			
Phenolics	0.025	0.001	mg/L	ND	99.7	69-132			
Total Dissolved Solids	96.0	10	mg/L	ND	96.0	75-125			
Sulphide	0.52	0.02	mg/L	ND	104	79-115			
Tannin & Lignin	1.1	0.1	mg/L	ND	106	71-113			
Total Kjeldahl Nitrogen	2.00	0.1	mg/L	0.37	81.8	81-126			
lydrocarbons									
F1 PHCs (C6-C10)	2.21	0.0250	mg/L	ND	110	68-117			
F2 PHCs (C10-C16)	1.4	0.1	mg/L	ND	86.2	60-140			
F3 PHCs (C16-C34)	3.7	0.1	mg/L	ND	95.3	60-140			
F4 PHCs (C34-C50)	2.2	0.1	mg/L	ND	89.5	60-140			
letals									
Mercury	0.0032	0.0001	mg/L	ND	108	70-130			
Aluminum	42.2	0.001	mg/L	ND	84.4	80-120			
Antimony	42.6	0.0005	mg/L	ND	85.1	80-120			
Arsenic	49.9	0.001	mg/L	0.135	99.5	80-120			
Barium	68.3	0.001	mg/L	22.5	91.7	80-120			
Boron	55.4	0.01	mg/L	9.16	92.6	80-120			
Cadmium	45.3	0.0001	mg/L	0.0603	90.5	80-120			
Calcium	20800	0.1	mg/L	9130	117	80-120			
Chromium (VI)	0.209	0.010	mg/L	ND	104	70-130			
Chromium	52.8	0.001	mg/L	0.084	105	80-120			
Copper	51.6	0.0005	mg/L	5.42	92.3	80-120			
Iron	2410	0.1	mg/L	8.3	96.1	80-120			
Lead	42.5	0.0001	mg/L	0.473	84.0	80-120			
Magnesium	36200	0.2	mg/L	25900	103	80-120			
Manganese	55.3	0.005	mg/L	3.83	103	80-120			
Potassium	12500	0.1	mg/L	732	117	80-120			
Selenium	47.7	0.001	mg/L	0.124	95.1	80-120			
Sodium	21700	0.2	mg/L	11000	107	80-120			
Uranium	46.9	0.0001	mg/L	0.128	93.6	80-120			
Zinc	50.3	0.005	mg/L	5.19	90.3	80-120			
olatiles									
Acetone	0.112	0.0050	mg/L	ND	112	50-140			
Benzene	0.0367	0.0005	mg/L	ND	91.8	60-130			
Bromodichloromethane	0.0338	0.0005	mg/L	ND	84.5	60-130			
Bromoform	0.0430	0.0005	mg/L	ND	108	60-130			
Bromomethane	0.0335	0.0005	mg/L	ND	83.6	50-140			
Carbon Tetrachloride	0.0338	0.0002	mg/L	ND	84.5	60-130			
Chlorobenzene	0.0426	0.0005	mg/L	ND	106	60-130			



Order #: 2112541

Report Date: 24-Mar-2021

Order Date: 18-Mar-2021

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

**Method Quality Control: Spike** 

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Chloroform	0.0391	0.0005	mg/L	ND	97.6	60-130			
Dibromochloromethane	0.0372	0.0005	mg/L	ND	93.0	60-130			
Dichlorodifluoromethane	0.0357	0.0010	mg/L	ND	89.3	50-140			
1,2-Dichlorobenzene	0.0400	0.0005	mg/L	ND	100	60-130			
1,3-Dichlorobenzene	0.0399	0.0005	mg/L	ND	99.8	60-130			
1,4-Dichlorobenzene	0.0398	0.0005	mg/L	ND	99.4	60-130			
1,1-Dichloroethane	0.0346	0.0005	mg/L	ND	86.4	60-130			
1,2-Dichloroethane	0.0446	0.0005	mg/L	ND	111	60-130			
1,1-Dichloroethylene	0.0302	0.0005	mg/L	ND	75.6	60-130			
cis-1,2-Dichloroethylene	0.0310	0.0005	mg/L	ND	77.6	60-130			
trans-1,2-Dichloroethylene	0.0310	0.0005	mg/L	ND	77.6	60-130			
1,2-Dichloropropane	0.0368	0.0005	mg/L	ND	91.9	60-130			
cis-1,3-Dichloropropylene	0.0396	0.0005	mg/L	ND	99.1	60-130			
trans-1,3-Dichloropropylene	0.0329	0.0005	mg/L	ND	82.3	60-130			
Ethylbenzene	0.0410	0.0005	mg/L	ND	103	60-130			
Hexane	0.0298	0.0010	mg/L	ND	74.6	60-130			
Methyl Ethyl Ketone (2-Butanone)	0.0865	0.0050	mg/L	ND	86.5	50-140			
Methyl Isobutyl Ketone	0.0835	0.0050	mg/L	ND	83.5	50-140			
Methyl tert-butyl ether	0.0847	0.0020	mg/L	ND	84.7	50-140			
Methylene Chloride	0.0323	0.0050	mg/L	ND	80.8	60-130			
Styrene	0.0432	0.0005	mg/L	ND	108	60-130			
1,1,1,2-Tetrachloroethane	0.0400	0.0005	mg/L	ND	100	60-130			
1,1,2,2-Tetrachloroethane	0.0436	0.0005	mg/L	ND	109	60-130			
Tetrachloroethylene	0.0434	0.0005	mg/L	ND	109	60-130			
Toluene	0.0440	0.0005	mg/L	ND	110	60-130			
1,1,1-Trichloroethane	0.0326	0.0005	mg/L	ND	81.4	60-130			
1,1,2-Trichloroethane	0.0354	0.0005	mg/L	ND	88.4	60-130			
Trichloroethylene	0.0365	0.0005	mg/L	ND	91.2	60-130			
Trichlorofluoromethane	0.0320	0.0010	mg/L	ND	80.0	60-130			
Vinyl chloride	0.0351	0.0002	mg/L	ND	87.8	50-140			
m,p-Xylenes	0.0941	0.0005	mg/L	ND	118	60-130			
o-Xylene	0.0393	0.0005	mg/L	ND	98.3	60-130			
Surrogate: 4-Bromofluorobenzene	0.0834		mg/L		104	50-140			
Surrogate: Dibromofluoromethane	0.0763		mg/L		95.4	50-140			
Surrogate: Toluene-d8	0.0826		mg/L		103	50-140			



Order #: 2112541

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO: Project Description: 61899.03

Report Date: 24-Mar-2021 Order Date: 18-Mar-2021

#### **Qualifier Notes:**

Sample Qualifiers:

QC Qualifiers :

#### **Sample Data Revisions**

None

#### **Work Order Revisions / Comments:**

None

#### **Other Report Notes:**

n/a: not applicable ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery. RPD: Relative percent difference.

NC: Not Calculated

#### CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.



300 - 2319 St. Laurent Blvd Ottawa, ON, K1G 4J8 1-800-749-1947 www.paracellabs.com

Order Date:

Report Date:

18-Mar-21

7-Apr-21

# Subcontracted Analysis

**GEMTEC Consulting Engineers and Scientists Limited** 

32 Steacie Drive Tel: (613) 836-1422 Kanata, ON K2K 2A9 Fax: (613) 836-9731

Attn: Andrius Paznekas

Paracel Report No 2113090

Client Project(s):

61899.03

Client PO:

Reference:

CoC Number: **13282** 

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID Client ID Analysis

2113090-01 TW21-1C-72hr ODWS - REG 170 Sch 24 less VOCs



Client: Dale Robertson Work Order Number: 425827

Company: Paracel Laboratories Ltd.- Ottawa PO #:

Address: 300-2319 St. Laurent Blvd. Regulation: None
Ottawa, ON, K1G 4J8 Project #: 2113090

Ottawa, ON, K1G 4J8 Project #: (613) 731-9577 / (613) 731-9064 DWS #:

 Phone/Fax:
 (613) 731-9577 / (613) 731-9064
 DWS #:

 Email:
 drobertson@paracellabs.com
 Sampled By:

Date Order Received: 3/23/2021 Analysis Started: 3/29/2021

Arrival Temperature: 7 °C Analysis Completed: 4/7/2021

#### **WORK ORDER SUMMARY**

ANALYSES WERE PERFORMED ON THE FOLLOWING SAMPLES. THE RESULTS RELATE ONLY TO THE ITEMS TESTED.

Sample Description	Lab ID	Matrix	Туре	Comments	Date Collected	Time Collected
TW21-1C-72hr	1627333	Water	None		3/18/2021	12:00 PM

### **METHODS AND INSTRUMENTATION**

THE FOLLOWING METHODS WERE USED FOR YOUR SAMPLE(S):

Method	Lab	Description	Reference
Acid Ext. Water (A41)	Garson	Determination of Acid Extractables in Water by GC-MS	Modified from SW846-8270D
Carbamates/W (A57)	Garson	Determination of Carbamate Pesticides and Diuron in Water by HPLC	Modified from SW846-8318A
Diquat/Paraquat/ Water (A70)	Garson	Determination of Diquat and Paraquat in water by HPLC	Modified from EPA 549.2
OPPest Water (A18)	Garson	Determination of Triazine Herbicides and Organophosphorus Pesticides in Water	Modified from SW846-8270 D
PAH Water SIM (A41)	Garson	Determination of PAH in Water by GC/MS	Modified from SW846-8270D
PCBs Water (A19)	Garson	Determination of Polychlorinated Biphenyls in Water by GC/ECD	Modified from SW846-8082-A
PhenoxyHerb-W (A56)	Garson	Determination of Phenoxy Acid Herbicides in Water by GC/ECD/ECD	Modified from SW846-8151A
Sched. 24 Aggregrate Grp 1 (R99)	Garson	Calculation of Schedule 24 Aggregrate Parameters	In House

### REPORT COMMENTS

Date of Issue: 04/07/2021 16:22

Not Reportable



Paracel Laboratories Ltd.- Ottawa Work Order Number: 425827

This report has been approved by:

Date of Issue: 04/07/2021 16:22

Fel Halvon

Brad Halvorson, B.Sc. Laboratory Director



Paracel Laboratories Ltd.- Ottawa Work Order Number: 425827

## **WORK ORDER RESULTS**

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

Acid Extractable Organics	Result	MDL	Units	Criteria: ODWS
2,3,4,6-Tetrachlorophenol	<0.3	0.3	ug/L	100
2,4,6-Trichlorophenol	<0.2	0.2	ug/L	5
2,4-Dichlorophenol	<0.2	0.2	ug/L	900
Pentachlorophenol	<0.3	0.3	ug/L	60

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

Carbamate Pesticides	Result	MDL	Units	Criteria: ODWS
Carbaryl	<1	1	ug/L	90
Carbofuran	<2	2	ug/L	90
Diuron	<6	6	ug/L	150

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

Date of Issue: 04/07/2021 16:22

OP Pesticides	Result	MDL	Units	Criteria: ODWS
Alachlor	<0.231	0.231	ug/L	5
Atrazine	<0.231	0.231	ug/L	~
Azinphos-methyl (Guthion)	<0.173	0.173	ug/L	20

Paracel Laboratories Ltd.- Ottawa Work Order Number: 425827

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

Date of Issue: 04/07/2021 16:22

OP Pesticides	Result	MDL	Units	Criteria: ODWS
Chlorpyriphos (Dursban)	<0.173	0.173	ug/L	90
Desethyl atrazine	<0.289	0.289	ug/L	~
Diazinon	<0.173	0.173	ug/L	20
Dimethoate	<0.173	0.173	ug/L	20
Malathion	<0.173	0.173	ug/L	190
Metolachlor	<0.116	0.116	ug/L	50
Metribuzin (Sencor)	<0.116	0.116	ug/L	80
Phorate	<0.116	0.116	ug/L	2
Prometryne	<0.0578	0.0578	ug/L	1
Simazine	<0.173	0.173	ug/L	10
Terbufos	<0.116	0.116	ug/L	1
Triallate	<0.116	0.116	ug/L	230
Trifluralin	<0.116	0.116	ug/L	45

Sample Description	TW21 - <sup>-</sup>	1C - 72hr		
Sample Date	3/18/2021	12:00 PM		
Lab ID	1627	7333		
PAH	Result	Result MDL		Criteria: ODWS
Benzo(a)pyrene	< 0.01	0.01	ua/L	0.01



Paracel Laboratories Ltd.- Ottawa Work Order Number: 425827

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

PCBs	Result	MDL	Units	Criteria: ODWS
Decachlorobiphenyl (Surr.)	136	N/A	% Rec	~
Total PCBs	<0.06	0.06	ug/L	3

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

Pesticides	Result	MDL	Units	Criteria: ODWS
Diquat	<0.4	0.4	ug/L	70
Paraquat	<0.2	0.2	ug/L	10

Sample Description	TW21 - 1C - 72hr
Sample Date	3/18/2021 12:00 PM
Lab ID	1627333

Date of Issue: 04/07/2021 16:22

Phenoxyacid Herbicides	Result	MDL	Units	Criteria: ODWS
2,4-D	<0.365	0.365	ug/L	100
Bromoxynil	<0.0972	0.0972	ug/L	5
Dicamba	<0.0851	0.0851	ug/L	120
Dichlorophenyl acetic acid (Surr.)	88.3	N/A	% Rec	~
Diclofop-methyl	<0.122	0.122	ug/L	9
MCPA	<6.08	6.08	ug/L	100
Picloram	<0.0851	0.0851	ug/L	190



Paracel Laboratories Ltd.- Ottawa Work Order Number: 425827

Sample Description	TW21 - 1	1C - 72hr		
Sample Date	3/18/2021	12:00 PM		
Lab ID	162 <sup>-</sup>	7333		
Schedule 24 Organics	Result	MDL	Units	Criteria: ODWS
Atrazine + N-dealkylated metabolites (Calc.)	<0.5	0.5	ug/L	5

#### **LEGEND**

Dates: Dates are formatted as mm/dd/year throughout this report.

[rr]: After a parameter name indicates a re-run of that parameter. If multiple re-runs exist they are suffixed by a number. Sample may not have been handled according to the recommended temperature, hold time and head space requirements of the method after the initial analysis.

MDL: Method detection limit or minimum reporting limit.

Date of Issue: 04/07/2021 16:22

% Rec: Surrogate compounds are added to the sample in some cases and the recovery is reported as a % recovered.

~: In a criteria column indicates the criteria is not applicable for the parameter row.

Quality Control: All associated Quality Control data is available on request.

Field Data: Reports containing Field Parameters represent data that has been collected and provided by the client. Testmark is not responsible for the validity of this data which may be used in subsequent calculations.

Sample Condition Deviations: A noted sample condition deviation may affect the validity of the result. Results apply to the sample(s) as received.





Ministry of the Environment

Well Tag No. (Place Sticker and/or Print Below)

A165020

Well Record

Regulation 903 Ontario Water Resources Act

asurements recorded in: Page Tag #: A165020 <u>-</u> Well Owner's Information Last Name / Organization E-mail Address First Name ☐ Well Constructed 1470424 Ontario Inc. by Well Owner Mailing Address (Street Number/Name) Municipality Province Postal Code Telephone No. (inc. area code) K2H 9C4 301 Moodie Dr. Suite 100 Nepean Ontario Well Location Address of Well Location (Street Number/Name) Township Concession TW15-01 Shea Road Goulbourn County/District/Municipality City/Town/Village Postal Code Ottawa Carleton Richmond Ontario Municipal Plan and Sublot Number UTM Coordinates Zone , Easting Northing Other NAD | 8 | 3 | 1 | 8 | 4 | 3 | 4 | 4 | 9 | 8 | 5 | 0 | 0 | 6 | 0 | 8 | 5 Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form) Depth (m/ft) General Colour Most Common Material Other Materials General Description From 0 3.35 Brown Clay Packed 3.35 11.88 Sticky Grey Clay 11.88 29.86 Medium Grey Limestone Results of Well Yield Testing Annular Space After test of well yield, water was: Type of Sealant Used (Material and Type) Draw Down Recovery Volume Placed Depth Set at (m/ft) (m³/ft³) Time Water Level X Clear and sand free Time Water Level .42m<sup>3</sup> (min) (m/ft) (m/ft) Other, specify 13.10 0 Grouted Cement & Bentonite Static If pumping discontinued, give reason: 3.11 Level 1 3.16 3.08 Pump intake set at (m/ft) 2 3.14 3.08 15,23 3.14 3.08 Pumping rate (I/min / GPM) Well Use **Method of Construction** 45.5 4 4 ☐ Public Cable Tool □ Diamond Commercial ☐ Not used 3.13 3.08 Duration of pumping ☐ Rotary (Conventional) ☐ Jetting X Domestic □ Dewatering ☐ Municipal 6 hrs + 10 min 5 3.14 5 3.08 ☐ Monitoring Rotary (Reverse) □ Driving Livestock X Test Hole ☐ Digging ☐ Boring ☐ Irrigation ☐ Cooling & Air Conditioning Final water level end of pumping (m/ft) 3.08 3.13 Air percussion ☐ Industrial 3.08 Other, specify ☐ Other, specify 15 15 If flowing give rate (I/min / GPM) 3.13 3.08 Construction Record - Casing Status of Well 20 3.13 20 3.08 Inside Open Hole OR Material Depth (m/ft) X Water Supply Wall Recommended pump depth (m/ft) Diamete (Galvanized, Fibreglass, Concrete, Plastic, Steel) Replacement Well 12.19 From To (cm/in) 3.13 3.05 Test Hole Recommended, (Vmin / GPM) 45.5 Recommended pump rate Recharge Well 3.13 27.13 0 13.10 Open ☐ Dewatering Well 40 40 3.13 Observation and/or 15.86 Stee1 .48 +.45 13.10 Well production (I/min / GPM) Monitoring Hole 50 50 3.12 Alteration Disinfected? (Construction) 3.12 X Yes No Abandoned, Insufficient Supply Construction Record - Screen Map of Well Location Abandoned, Poor Water Quality Please provide a map below following instructions on the back. Outside Depth (m/ft) Material Diamete Slot No. Abandoned, other. (Plastic, Galvanized, Steel) From (cm/in) To specify FRANK TOWN Other, specify Water Details Hole Diameter Depth (m/ft) Water found at Depth Kind of Water: ☐ Fresh Xuntested Diameter  $\begin{array}{c|c} 14 \centerdot 02 \text{(m/ft)} \quad \square \text{ Gas} & \square \text{ Other, } \textit{specify} \\ \text{Water found at Depth Kind of Water: } \quad \square \text{ Fresh } \text{ $X$} \text{ Untested} \\ \end{array}$ 0 13.10 15.86 29.25<sub>m/ft</sub> Gas Other, specify 13.10 29.86 15.55 Water found at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify Well Contractor and Well Technician Information (X) Business Name of Well Contractor Well Contractor's Licence No TW15-0. GAMBLE DR Capital Water Supply Ltd. 1 5 Business Address (Street Number/Name) Municipality Comments Box 490 Stittsville Province Postal Code Business E-mail Address Ontario  $K \mid 2 \mid S \mid 1 \mid A \mid 6$ office capital water.ca Well owner's Date Package Delivered Ministry Use Only information Bus.Telephone No. (inc. area code) Name of Well Technician (Last Name, First Name) package delivered 188470 2 |0 |1 |5 |0 |9 |1 |1 6 1 3 8 3 6 1 7 6 6 Miller, Stephen Well Technician's Licence No. Signature Date Work Completed X Yes of Technician and/or Contractor Date Submitted DEC 1 6 2015 ☐ No 0 9 7 2 0 1 5 0 9 1 2 0 1 5 0 8 1 0506E (2007/12) © Queen's Printer to Ministry's Copy

Ministry of the Environment

Well Tag No. (Place Sticker and/or Print Below)

Well Record

A165021

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Overburg General C	7	drock Materi Most Comr				<b>rd</b> (see instr er Materials		e back of this form)	eral Description			Depth (m/ft)			
Brown Clay							cked			From O	3.04				
Grey		Clay		111111111111111111111111111111111111111					cky		***************************************	3.0			
Grey		Grav	e1		Broken	Rock		Wet	•			7 <b>.</b> 9			
Grey		Lime	stone	The second secon				Sof				10.3			
Grey		Lime	stone			YYYYYYY A A A A A A A A A A A A A A A A		Bad	ly Broker	1		24.3			
Grey		Lime	stone					Med	ium			31.3	9 37.48		
***************************************					***************************************	***************************************	***************************************								
***************************************	-						***************************************								
			Annula	r Space					Results of We	Il Yiel	d Testir	g			
Depth S From	Set at ( <i>m/ft)</i>			alant Used		医囊性性 化二氯甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基	e Placed	After test of well yield.  X Clear and sand	water was:	Dr	aw Down		Recovery e Water Level		
11.27	0	Groute		ıt & Ber	ntonita	1.39	West reserved to the	Other, specify		(min)	(m/ft)	(min	化环烷 经工作的过去式和过去分词 化二氯化二氯化二氯化		
	<u> </u>	Groute	1 Ochren	ic & bei	rconrce	1.00	/ZIII	If pumping discontinu	ed, give reason:	Static Level	3.18				
										1	5.26	1	6.55		
								Pump intake set at ( 21.33		2	5.68	2	5.43		
Method of Construction Well Us			e		Pumping rate (I/min /		3	6.23	3	4.50					
Cable Tool Diamond Public Comm		☐ Commer		Not used Dewatering	36.40 Duration of pumping		4	6.53	4	4.00					
Rotary (		☐ Driving	Li	vestock	X Test Hol	е 🗌	Monitoring	_6hrs +10_		5	6.80	5	3.57		
☐ Boring  X Air perci	ussion	Digging		igation dustrial	Cooling	& Air Conditi	oning	Final water level end o		10	7.23	10	3.16		
Other, s				ther, specify _				If flowing give rate (//	Proplet and commence and an extension of the commence of the c	15	7.71	15	3.15		
Inside	Open Hol	nstruction R e OR Material	ecord - Ca Wall		ו ( <i>m/ft</i> )	Status    X Water 8	of Well Supply	Recommended pum	p depth (m/ft)	20	7.97	20	3.15		
Diameter (cm/in)		ed, Fibreglass, Plastic, Steel)	Thickness (cm/in)	From	То	Replacement Well		15.23		25		25	3.15		
27.13	Оре	en		0	11.27	Rechar	ge Well	Recommended pum (I/min / GPM) 36 . 40	p rate	30	8.00	30	3.15		
15.86	Ste	el el	.48	+.45	11.27	Observa	ation and/or	Well production (I/mii	n / GPM)	40	8.02	40	3.15		
						☐ Alteration		Disinfected?		50		50	3.15		
						(Constr	oned,	X Yes No		60	8.15	60	3.15		
Outside	C	onstruction R	ecord - Scr	1	1	☐ Abando	ient Supply oned, Poor	Please provide a map	Map of We	· · · · · · · · · · · · · · · · · · ·		, book			
Diameter (cm/in)		aterial Ivanized, Steel)	Slot No.	From	( <i>m/ft)</i>   To	1 10000	ned, other,	V	below following	1150 000	oris ori tric	DACK.			
						specify		1 2	RICHMOND	2	1				
						Other, s	specify	Propriet and Self-relations becomes a construction of the self-relations of the self-rel				T	-		
		Water Det	*************			ole Diamet									
		Kind of Water Other, spe		XUntested	Depth From	n ( <i>m/ft)</i> To	Diameter (cm/in)								
Water foun	nd at Depth	Kind of Water	: Fresh	XUntested	0	11.27	15.86					N N			
		Other, spe		Untested	11.27	37.48	15.55		TW 15-0			8			
		Other, spe		Canada de la Canad						0		3			
Business N	We ame of Well	ell Contracto Contractor	r and Well	Technicia		on Contractor's	Licence No				,	"			
Capita	al Wate	r Supply			1	5	5   8								
Business Ad Box 49		et Number/Nar	me)			icipality	110	Comments:							
Province	Po	ostal Code	1	E-mail Add	ress	tittsvi					·····				
Ontari Bus.Telepho		2 S 1 A area code) Nar	1	fice@c	capital	water.c	:a	information	ackage Delivered		Mini Audit No	stry Us			
5 1 3 8	3   6   1	7 6 6	Mille	r, Step	hen	•		Data M	1 5 0 9 1 Vork Completed				8465		
Well Technici		No. Signature	0 1/	n and/or Co	· ·	Submitted $1   5   0$	0 1 5	<u>M</u> Yes	1  5  0  8  1		DEC	16	2015		
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Ontario Ministry of the Environment and Climate Change	Well Tag No. (Place Sticker a	and/or Print Below)	Well Record Water Resources Act	
Measurements recorded in: Metric Mimperial	L N(A)		F	Page of
Well Owner's Information			,	
First Name   Last Name / Organization	acia (nc.	E-mail Address		
Mailing Address (Street Number/Name)	Municipality	Province	Postal Code Teleph	one No. (inc. area code)
Well Location	Latine La	awa er	PICTURE KE	
Address of Well Location (Street Number/Name)	Township		Lot Conce	ession
County/District/Municipality	City/Towp/Village	oun	Province	Postal Code
Otawa-Carleton	Rich	morel	Ontario	
NAD   8   3   R   434657   9005		ot Number	4 Ports	-45x7
Overburden and Bedrock Materials/Abandonment Se		ne back of this form)		
General Colour Most Common Material	Other Materials	Gener	ral Description	Depth (m/m) From 10
6" Drille	d well Alar	velan me	nt	0' 123'
		k		
	*TW 15-	02-2		
	M 1 1 4 10 Agramma		<del></del>	100
August C Not O / 12/200	115-21			
XWWK HARCHON - W TARS	H1650001			· ·
*Coffee Water Supply - 7	Tug 17/15			
Annular Space		ll	Results of Well Yield Test	ing
Depth Set at (mg) Type of Sealant Used	Volume Placed	After test of well yield, w	vater was: Draw Dov	vn Recovery
From To (Material and Type)	21 RAOS	☐ Clear and sand fre ☐ Other, specify	ee Time Water (min) (min)	Level Time Water Level (min) (mft)
3' 0' 8-00:11	26 Dr63	If pumping discontinued	f, give reason: Static Level	
2 0 prop411			1	
		Pump intake set at (m/fi	2	2
Book of a Construction	W-2 (1	Pumping rate (Vmin / GF	<sub>2M)</sub> 3 /	3
Method of Construction  Cable Tool Diamond Public	Well Use  ☐ Commercial ☐ Not used		4	4
☐ Rotary (Conventional) ☐ Jetting ☐ Domestic ☐ Rotary (Reverse) ☐ Driving ☐ Livestock	☐ Municipal ☐ Dewatering ☐ Test Hole ☐ Menitoring	Duration of pumping hrs + mi	in 3	5
☐ Boring ☐ Digging ☐ Imigation	Coaling & Air Conditioning	Final water level end of	pumping (m/it) 10	10
Air percussion industrial Other, specify Other, specify		If flowing give rate (Vmin	/GPM) 15	15
Construction Record - Casing	Status of Well		20	20
Diameter (Galvanized, Fibreglass, Thickness	(m/ft) Water Supply Replacement Well	Recommended pump d	eptin (m/ft) 25	25
(cm/in) Concrete, Plastic, Steel) (cm/in) From	☐ Test Hole ☐ Recharge Well	Recommended pump re		30
	☐ Dewatering Well	(I/min / GPM)	40	40
	Observation and/or Monitoring Hole	Well production (Vmin / G	SPM) 50	50:
	Alteration (Construction)	No No	60	60
Construction Record - Screen	Abandoned, Insufficient Supply	No No	Map of Well Location	
Outside Material Depth		Please provide a map I	below following instructions	
(cm/in) (Flastic, Garvanized, Steel) From	To Abandoned, other,		\	
Nei	Other, shecity		\	50
Mod	required/Place	menst	2215	
Water Details Water found & Depth Kind of Water: Fresh Untested	Hole Diameter	丰	1331	
(A/ft) Gas Other, specify	Depth (m/ft) Diameter From To (cm/in)	C.	HEA \	760
Water ound at Depth Kind of Water: Fresh Untested		5	"ON AFD	12
(m/ft) Gas Other, specify  Water found at Depth Kind of Water: Fresh Untested			FB.	[]
(m/ft) Gas Other, specify			2000	. \
Well Contractor and Well Technician Business Name of Well Contractor	Information     Well Contractor's Licence No.		13315 POTAD NOOPE STREET	
AIR LOCK DRULING COL	P111 (1)	1	1001	$\mathbf{Z}_i$
Rusiness Address (Street Number/Name)	Municipality	Comments:		
Province Postal Code Business E-mail Addr	ess ess			
Bus. Telephone No. (inc. area code) Name of Well Technician (La	pet Name Firet Name)	Well owner's Date Pacinformation		nistry Use Only
6138382170 DeSauln	ers lan	package delivered	Audit No	4202405
Well Technician's Licence No. Signature of Technician and/or Cor		res	k Completed	
0506E (2014/11)	型が多の手手の門 Ministry's Copy	KINO DOIL	Received © Quee	en's Printer for Ontario, 2014

Well Tag No. (Place Sticker and/or Print Below)

Well Record

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Regulation	903	Ontario	и	/a	te	۲.	Re	25	0	uı	c	es	Α	

V. C	11 11 21 11 )	nvironmen	t	A165021		Regulation	n 903	Ontario W	iter Re	sources Ac
Measure	ments recorded in:	Metric [	Imperial	Гад #: A1	65021	]		Page		_ of
Well Ov	wner's Information		A Committee of the Comm						. ****	1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
First Nam	ne	Last Name /	Organization 4 Ontario Inc.		E-mail Address			[		Constructed /ell Owner
Mailing Ad	ddress (Street Number/Na			Municipality	Province	Postal Code		Telephone		. area code)
301 M	loodie Dr. Suite	100	1	Nepean	Ontario	K  2   H   9	Q 4		1	
Well Loc			,			Lot		Concessio		
	of Well Location (Street No 02 Shea Rd.	ımber/Name		Township Goulbourn		Lot		Concessio	11	
	istrict/Municipality			City/Town/Village			Provi	nce	Posta	l Code
	a Carleton			Richmond		.,,		ario	J. J	
	rdinates Zone Easting 8 3 1 8 4 3 4			Junicipal Plan and Sub	olot Number		Other			
	den and Bedrock Mater			rd (see instructions on th	ne back of this form)					
General (		mon Materia		er Materials	•	ral Description			De <sub>l</sub> From	oth (m/ft) To
Brown	Clar				Pac	ked			0	
Grey	i				1	cky			3.04	
		el		Rock						1
Grey	100		broken	KOCK	1					1
Grey		stone			1	t				24.38
Grey		stone			1	ly Broker				
Grey	Lime	stone		AC AND SET OF SET OF SET OF SET OF SET	Med:	ium			1.39	37.48
No. 2014-11				THE RESIDENCE OF THE PARTY OF T						
					·	and their lastice and the second				
	Ì				*					
D15-0	N-1-1/(h)	Annular		V-l	After test of well yield,	Results of We		d Testing aw Down	l p	ecovery
From	Set at (m/ft) To	Type of Sea (Material ar		Volume Placed (m³/ft³)	Clear and sand fr		Time			Water Level
11.27	0 Groute	d Cemen	t & Bentonite	1.392m <sup>3</sup>	Other, specify		(min) Static	(m/ft)	(min)	(m/ft)
			0 0 001110111100	1.002	If pumping discontinue	d, give reason:	Level	3.18		
and part apparent a second					1		1	5,26	1	6.55
					Pump intake set at (n	√ft)	2	5.68	2	5.43
				i	21.33 Pumping rate (l/min / 0	CPM)	3	6.23	T = T	4.50
	hod of Construction		Well Us		36.40	J1 (VI)	4		1	4.00
Cable To Rotary (	ool Diamono Conventional) Diatting		blic Commer mestic Municipa		Duration of pumping		5	6.53		
Rotary (	Reverse) Driving Digging	Liv		e	6 hrs + 10 m	III		6.80	-	3.57
Air percu	_ 00 0	Imi		s Air Coriditioning	8.15	pomping (narry	10	7.23	10	3.16
Other, s	pecify	Ot	ner, specify		If flowing give rate (I/m	nin / GPM)	- 15	7.71	15	3.15
la stata	Construction R	,	Depth (m/ft)	Status of Well			20	7.97	20	3.15
Inside Diameter	Open Hole OR Material (Galvanized, Fibreglass,	Wall Thickness	From To		Recommended pump 15.23	aeptn (m/n)	25		25	3.15
(cm/in)	Concrete, Plastic, Steel)	(cm/in)		☐ Test Hole ☐ Recharge Well	I L	rate	30	0.00	-	
27.13	Open .		0 11.27	Dewatering Well	Recommended pump (Vmin / GPM) 36.40		7	8.00	-	3.15
15.86	Steel	.48	+.45 11.27	Observation and/or Monitoring Hole	Well production (I/min	/ GPM)	40	8.02	40	3.15
				☐ Alteration	Disinfected?		50		50	3.15
				(Construction)  Abandoned,	X Yes No		60	8.15	60	3.15
	Construction R	ecord - Scre	en	Insufficient Supply  Abandoned, Poor		Map of We				( ) v
Outside Diameter	Material (Plastic, Galvanized, Steel)	Siot No.	Depth (m/ft)	Water Quality Abandoned, other,	Please provide a map t	oelow following i	nstructi	ons on the b	ack.	
(cm/in)	(Flasho, Galvarilzed, Steel)		From To	specify	<i>N</i>					
				Other, specify	7	ICHMOND	R	<u> </u>		
				·						
	Water Det	ails	Н	ole Diameter					1	
	nd at Depth Kind of Water		XUntested Depth From	( <i>m/ft</i> ) Diameter To ( <i>cm/in</i> )						
	√ft)			11.27 15.86				2		
	n/ft)   Gas   Other, spe					TW 15-0	,	,		
	d at Depth Kind of Water		Untested 11.27	37.48 15.55			- Ø	W		
(m	n/ft)						w.	3		
Business Ma	Well Contracto ame of Well Contractor	r and Well	Technician Informati	On Contractor's Licence No.				٧)		
_	l Water Supply	Ltd.	1	5 5 8				1		
Business Ad	ddress (Street Number/Nar			icipality	Comments:					
Box 49		70		ittsville						
Province Ontari	Postal Code  K 2 S 1 A	1	E-mail Address	later co	Well owner's Date Par	ckage Delivered	11.	Minist	v Hee	Only
Bus.Telepho	ne No. (inc. area code) Nar		fice@capitalw echnician (Last Name, Fi		information	1 1		Audit No.Z	100	
5 1 3 8	3 6 1 7 6 6	Miller	r, Stephen		delivered Date Wo	5 0 9 1 ork Completed	U			3465
Well Technicia	an's Licence No. Signature	of Technician			Yes Yes			DEC	6 2	015
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Well Tag No. (Place Sticker and/or Print Below)

Well Record

Measurem	nents recor	ded in:	Metric _	Imperial	l _	A165022		Regulatio	<i>11 303</i> (	Pag		of
Well Ow	ner's Info	ormation		•	<u> </u>	ag#: A16	5022	1				
First Name	)	3		Organizatio 4 Ontar:	n		E-mail Address		, (1)			Constructed
		et Number/Na r. Suite	,		S. Carlotte	Municipality Nepean	Province Ontario	Postal Code	1	Telephone	e No. (inc	. area code)
Well Loc	ation						7 33 50 50	1:4:12				
TW15-0	)3 Shea		mber/Name	)	1	Fownship Goulbourn	Lot			Concession		
	strict/Munici Car1e				1	City/Town/Village Richmond		Provin		Posta	l Code	
UTM Coord	linates Zon	e ¡Easting	1	orthing		Municipal Plan and Sub	lot Number		Other	ariv		
		8   4   3   4   drock Materi		_1		rd (see instructions on th	e back of this form)					
General C		Most Comr				er Materials		ral Description	)		De From	oth ( <i>m/ft)</i> To
Brown		Clay				VALUE AND ADDRESS OF A DESCRIPTION OF A	Packed				0	3.04
Grey		Clay				77-114-11-11-11-11-11-11-11-11-11-11-11-11	Sticky	_			3.04	7.92
Grey							Medium Ha				7.92	10.66
Grey		Lime	stone				Badly Lay	ered & B	roke	D. Constitution of the con	10.66	28.95
			Annula	- Canan				Results of We	all Vial	d Tostin		
Depth Se	et at ( <i>m/ft</i> )		Type of Se	alant Used		Volume Placed	After test of well yield,	water was:	Dr	aw Down	Б	Recovery
9.44	0	Grouted	(Material a		tonite	(m³/ft³) •252m <sup>3</sup>	☐ Clear and sand fi☐ Other, specify	ee	(min)	(m/ft)	/ei Time (min)	Water Level (m/ft)
							If pumping discontinue	d, give reason:	Static Level	3.22		
							Pump intake set at (n	n/ft)	1	4.54	1	3.24
							9.14		2	3.91	2	3.22
		nstruction			Well Us		Pumping rate (I/min / 36.40	GPM)	3	0 71	3 4	3.22
	Conventional		Ĭ <b>X</b> Do	mestic	☐ Comme	al Dewatering	Duration of pumping	าin	5	3.71	5	3.22
☐ Rotary (F ☐ Boring	Reverse)	☐ Driving ☐ Digging	Service Management	estock gation	▼ Test Hole     Cooling	le	6 hrs + n Final water level end o		10	3.71	10	3.22
Air percu ☐ Other, sp			and the second second second second	lustrial her, <i>specify</i> _		-	3.74  If flowing give rate (I/n	oin / GPM)	15	3.71 3.72	15	3.22
	Later State Contract Contract	struction R				Status of Well			20	3.72	20	3.22
Inside Diameter (cm/in)	(Galvanize	e OR Material d, Fibreglass, Plastic, Steel)	Wall Thickness (cm/in)	From	( <i>m/ft)</i>   To	Water Supply Replacement Well	Recommended pump 9.14	depth (m/ft)	25	3.73	25	3.22
27.13		pen	· · · · · · · ·	0	9.44	☐ Test Hole ☐ Recharge Well	Recommended pump (I/min / GPM)	rate	30	3.74	30	3.22
15.86		teel	.48	+.45	9.44	Dewatering Well Observation and/or	Well production (I/min	/ GPM)	40	3.74	40	3.22
10.00		reer		. 4	J.44	Monitoring Hole  Alteration	Disinfected?		50	3.74	50	3.22
						(Construction)  Abandoned,	Yes No		60	3.75	60	3.22
Outside	I	onstruction Re	ecord - Scre	en Depth	(ma/#)	Insufficient Supply ☐ Abandoned, Poor Water Quality	Please provide a map	Map of We		<del></del>	back	
Diameter (cm/in)		aterial vanized, Steel)	Slot No.	From	To	Abandoned, other, specify	J. W	FRANK T			DGON.	
						Other, specify						and the same of th
Water found	d at Denth	Water Det Kind of Water		V I Intested		ole Diameter h ( <i>m/ft</i> ) Diameter			15-0	3		
10.66m	√ft)	Other, spe	cify		From	To (cm/in)		100		@		
		Kind of Water Other, spe		X Untested	0	9.44 15.86						
Water found	d at Depth	Kind of Water	: Fresh	Untested	9.44	28.95   15.55	TO CONTRACT OF THE PARTY OF THE			7		
(m)		Other, spe		Technicia	n Informat	ion				R		
	ame of Well				Wel	l Contractor's Licence No.				SHS		
Business Ad	ldress (Stre	et Number/Nar			1	nicipality	Comments:				•	
Box 490 Province		stal Code	Business	E-mail Addı	i	tittsville						
Ontario	o K	2   S   1   A	6 of	fice@c	apitalv	water.ca	Well owner's Date Pa	ickage Delivered			stry Use	
	ne No. <i>(inc. a</i> 8 3 6 1	rea code) Nar 7 6 6		echnician (L r, Step		First Name)	package 2 0	1 5 0 9	1 0	Audit No.Z	18	8460
		No. Signature	of Technicia	n and/or Cor	ntractor Date		∐ LXIYes	ork Completed		DEC		2015
0 0 0506E (2007/12		's Primer for Onta	7/1/2007	4	Z (	0   1   5   0   9   1   5   Ministry's Copy	No 2 0	1 5 0 8	<u> 4                                   </u>	Received	1 -	A414

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Municipality
Pictor Ca
Per First Name)

Date Submitted

Ministry's Copy

Province

Postal Code

D Queen's Printer for Opponing 2002

Business E-mail Address

CN KIA DZD air-rock@sympatico.ca

Bus.Telephone No. (inc. area code) Name of Well Technician (Last Name, First Name)

Will rechnician a Legice No. Signature of Technician and or Contractor Date Submitted

Military Use Only zit No. 2119907

Ontario	Ministry of the Environment	Tag#: A1447	Till Below)	Well Record
Measurements recorded i	n: Metric Morperial	A14470		Page of
Well Owner's Informa	ation			
Mailing Address (Street Nu Well Location Address of Well Location (S	Concourse	^ ^	E-mail Address  Province Postal Cod  Lot	Well Constructed by Well Owner le Telephone No. (inc. area code)  Concession
#5873 County/District/Municipality	SHOA KOA	D Coulbo	upn ML	Province Postal Code
UTM Coordinates   Zone   Ea	asting Northing  Northing	Municipal Plan and Sub		Ontario
The agreement and a second and	k Materials/Abandonment Sepont Common Material	aling Record (see instructions on the Other Materials	e back of this form)  General Description	Depth (m/ft)
Amen	de Audi	1211990	7-Dec 201	From To
CASINE	2 EXIEN	21124		
AMEND TAS AI	CIVIC A	PPRESS	SO ADD TAG	A144706
Depth Set at ( <i>m/ft</i> ) From To - 7 + 2	Annular Space Type of Sealant Used (Material and Type) Casing Explans	Volume Placed (m³/ft³)	Results of W After test of well yield, water was:  Clear and sand free Other, specify  If pumping discontinued, give reason	Draw Down   Recovery   Time   Water Level   (min)   (m/ft)   (min)   (m/ft)
			Pump intake set at (m/ft)	2 2
Method of Constru	offen	Well Use	Pumping rate (I/min / GPM)	3 3
Cable Tool	Diamond Public	Commercial Not used	Duration of pumping	4 4
	Jetting ☐ Domestic  Driving ☐ Livestock	☐ Municipal   ☐ Dewatering     ☐ Test Hole   ☐ Monitoring	hrs + min	5
☐ Boring ☐ ☐ Air percussion	Digging	Cooling & Air Conditioning	Final water level end of pumping (m/fi	10 10
Other, specify	Other, specify		If flowing give rate (I/min / GPM)	15 15
Inside Open Hole OR N Diameter (Galvanized, Fibr (cm/in) Concrete, Plastic	reglass, Thickness	Status of Well  Water Supply  To Replacement Well	Recommended pump depth (m/ft)	20 20 25 25
6" Stel	186 -7	Test Hole Recharge Well	Recommended pump rate (I/min / GPM)	30 30
3 3 3	(100   1	☐ Dewatering Well ☐ Observation and/or		40 40
		Monitoring Hole  Alteration	Disinfected?	50 50
		(Construction)  Abandoned,	Yes No	60 60
Outside	iction Record - Screen	Insufficient Supply  Abandoned, Poor	Map of W	ell Location
Diameter (cm/in) Material (Plastic, Galvanize	d, Steel) Slot No. Depth	(m/ft) Water Quality  To □ Abandoned, other, specify	Thease provide a map below following	I II STUCTIONS ON THE DACK.
			#5873 4	3Km
		EXTEND CASIN	5 Slaz	$\uparrow$
	ter Details of Water: Fresh Untested	Hole Diameter  Depth (m/ft) Diameter	feed	J=4Km XX
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3usiness Name of Well Contraction of Well Cont	actor LLLNCGLT mber/Name) PCHWO	Well Contractor's Licence No.  Municipality	Comments:	
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506E (2007/12) © Queen's Printe	er for Ontario, 2007	Ministry's Copy	7 COLDINA	PODEC 1 3 2013

Well Record Well Tag No. (Place Sticker andlor Print Below) **Ontario** Ministry of the Environment Tag#: A138253 Regulation 903 Ontario Water Resources Act Imperial Measurements recorded in: Metric Page Well Owner's Information Last Name / Organization First Name E-mail Address COLOMADE RETALL OPPORTUNITY by Well Owner Mailing Address (Street Number/Name) Postal Code Telephone No. (inc. area code KALE7S8613 2258118 SULTE ONT OTTAWA CONCOURSE GATE Address of Well Location (Street Number/Name)

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County/District/Municipality Township GOULBOURN City/Town/Village Postal Code Province OTTAWA RICHMONO Ontario Municipal Plan and Sublot Number Other NAD 8 3 18 434 8 06500 58 Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form) Depth (m/ft) Most Common Material Other Materials General Description From 250 CLAY STONES DEUSE BROWN LIMESTONE 25, N BROWN OCCASIONAL LAYERS OFGREY LIMESTONE SAMOSTOWE Results of Well Yield Testing Annular Space Depth Set at (m/ft) Volume Placed 3 (12) 743 After test of well yield, water was: Recovery Type of Sealant Used Draw Down (Material and Type) Clear and sand free Time Water Level Time | Water Level (m/ft) Other, specify ZEARIN (m/ft) (min) 0 30 CEMENT GROUT 8.24 Static If pumping discontinued, give reason: 37 34.5 BENTONITE 8,24 1 145 CEMENT GROUT Pump intake set at (m/ft) 2 BENTONITE SLURRY 064 100 3 umping rate (Ilmin / GPM) Method of Construction Well Use 30 ☐ Diamond Commercial
Municipal 4 Public ■ Not used Duration of pumping Rotary (Conventional)
Rotary (Reverse) ☐ Jetting Domestic Dewatering hrs + Omin 5 ☐ Driving Livestock ☐ Test Hole ☐ Monitoring Boring ☐ Digging Irrigation Cooling & Air Conditioning Final water level end of pumping (m/ft) 10 10 Air percussion 8.45 ☐ Industrial Other, specify Other, specify 15 If flowing give rate (Ilmin / GPM) **Construction Record - Casing** Status of Well 40 20 Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel) Wall Thickness Depth (m/ft) Inside Water Supply Recommended pump depth (m/ft) Replacement Well 100 25 (cmlin) From To 25 (cm/in) Test Hole Recommended pump rate (Ilmin | GPM) 30 ☐ Recharge Well 30 STEEL Dewatering Well 53°75 40 Observation and/or STEFL Well production (Ilmin I GPM) Monitoring Hole 53<sup>,75</sup> 50 50 16/ Alteration OPEN HOLE sinfected? (Construction) Yes 60 60 Abandoned. Insufficient Supply Construction Record - Screen **Map of Well Location** Abandoned, Poor Water Quality Outside Please provide a map below following instructions on the back Material (Plastic, Galvanized, Steel) Depth (m/ft) Abandoned, other, From (cmlin) specify Other, specify Water Details **Hole Diameter** Water found at Depth Kind of Water: ★Fresh Untested

(m/ft) Gas Other, specify Depth (m/ft) Diamete From (cm/in, 30 Water found at Depth Kind of Water: Fresh Untested (mlft) Gas Other, specify Water found at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify Well Contractor and Well Technician Information Business Name of Well Contractor AUNOERS WELL PERTH ss (Street Number/Name) Comments: RRHESIOE Postal Code BDA160 Business E-mail Address Well owner's information Date Package Delivered Ministry Use Only Name of Well Technician (Last Name, First Name) 2013 0730 package delivered 175248 OCT 10 2013 of Technician and/or Contractor Date Submitted Date Work Completed 104 1809 No 13081

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Ministry of the Environment, Well Record ntario Conservation and Parks Regulation 903 Ontario Water Resources Act A274440 Well Owner's Information Last Name / Organization
Cardel Homes Inc. ☐ Well Constructed First Name E-mail Address by Well Owner Province ON Mailing Address (Street Number/Name)
Suite 100-301 Moodie Drive Municipality
Oitawa Postal Code K2H<sub>1</sub>9C4 Telephone No. (inc. area code) Well Location Address of Well Location (Street Number/Name)
3 Runnel Court Township Goulbourn P/L 26 County/District/Municipality
Ottawa Carleton City/Town/Village **Richmond** Province Postal Code Ontario UTM Coordinates Zone , Easting NAD | 8 | 3 | | 18 | 4 | 3 4 5 7 1 | Municipal Plan and Süblot Number Other 5005994 4R-27894 S/L 40 Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form) Depth (matt) General Colour Most Common Material Other Materials General Description 32 Clay 32 1 40 ' Gravel Grey Limestone 40 91 Grey Limestone 100 Annular Space Results of Well Yield Testing Type of Sealant Used (Material and Type) Depth Set at (m/R) Volume Placed After test of well yield, water was: Draw Down Recovery ☐ Clear and sand free☐ Other, specify ☐ Time (min) Time | Water Level Time | Water Level Neat cemen (m/ft) (m/ft) , 23:9 4 (min) 0' 14.6" 38 Static Bentonite slurry 18.8 If pumping discontinued, give reason: 14.6 20.2 14.8 21.7 Pump intake set at (m/4) 2 2 22.4 14.6 3 3 Pumping rate (I/min / PM) Well Use Method of Construction 14.8 22.8 4 4 Diamond Commercial ☐ Not used Public Duration of pumping 1 hrs + 0 min Domestic ☐ Dewatering Rotary (Conventional) ☐ Jetting Municipal 14.6 22.8 5 5 Rotary (Reverse) ☐ Driving Livestock Test Hole ☐ Monitoring Final water level end of pumping (m/ft) 14.6 23.3 Bering □ Digging ☐ Irrigation Cooling & Air Conditioning 10 10 Air percussion Other, specify ☐ Industrial 23.4 14.8 Other, specify 15 15 f flowing give rate (Vmin / GPM) Status of Well 14.0 Construction Record - Casing 23.5 20 Inside Diameter (cm/m) Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel) Water Supply Recommended pump depth (m/tt) 14 B 23.6 Thicknes Replacement Well 80 25 To (cm/in) ☐ Test Hole 23.7 14.8 Recommended pump rate (I/min / GAM) Steel 48 .188 +21 30 Recharge Well ☐ Dewatering Well 23.8 14.6 Open Hole 46 100 40 40 Observation and/or Monitoring Hole Well production (I/min / CPM) 14.6 23.8 50 50 Alteration (Construction) 23.8 14.69 60 60 XYES No Abandoned, Insufficient Supply Map of Well Location Construction Record - Screen Abandoned, Poor Outside Diamete Please provide a map below following instructions on the Water Quality Material (Plastic, Galvanized, Ste Depth (m/ft) Slot No. Abandoned, other, To (cm/in) specify Other, specify #3 RUNNEL COURT Water Details Hole Diameter Water found at Depth Kind of Water: Fresh Diameter (cm/ia) Depth (mff) (m/fD Gas Other, specify 93/44 0 / 46 Water found at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify 100 57/8" 46 Water found at Depth Kind of Water: Fresh Untested (m/ft) Gas Other, specify -01KM Well Contractor and Well Technician Information Business Name of Well Contractor Air Rock Unilling Co. Ltd. Well Contractor's Licence No Business Audrass (Sweet Number/Name) Mufficiality ond Comments Province Business E-mail Address sympatics.ca Postati Godez D Well owner Ministry Use Only information Audit No. **Z**337536 Bus Telephone No. (inc. area code) Name of Well Technician (Last Name, First Name) 2020 M PM 0 P5 delive Yes No Date Wark Completed 04 Licence No. | Signature of Technician and/or Contractor | Date Submitted YYYMMDDD MYYY M M D D

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# **Creekside 1 Domestic Well Water Quality**

PROJECT: 100443.001													
Parameter	Units	MDL	TW15-1, TW15-2, TW15- 3 Range	PW Range	PW1	PW2	PW3	PW4	PW5	PW6	PW7	PW8	PW9
Sample Date (m/d/y)			2015 Hydrog (Golder, 2017)	2021 Sampling	12/07/2020	12/08/2020	12/07/2020	12/07/2020	12/08/2020	12/08/2020	12/15/2020	12/15/2020	12/07/2020
Microbiological Parameters													
E. Coli	CFU/100 mL	1	ND(1)	ND (1) - 1	ND (1)								
Fecal Coliforms	CFU/100 mL	1		ND (1) - 6	ND (1)								
Total Coliforms	CFU/100 mL	1	ND(1) - 2	ND (1) - 23	ND (1)								
Heterotrophic Plate Count	CFU/mL	10		ND(10) - >2000	ND (10)	40	10	30	50	30	20	ND (10)	ND (10)
General Inorganics													
Alkalinity, total	mg/L	5	226 - 268	237 - 279	250	238	243	262	249	243	258	256	246
Ammonia as N	mg/L	0.01	0.203 - 0.23	0.15 - 0.29	0.2	0.19	0.21	0.17	0.19	0.29	0.19	0.21	0.2
Dissolved Organic Carbon	mg/L	0.5	0.91 - 1.1	1.2 - 2.8	1.8	1.2	1.8	1.7	2	1.8	2	1.9	1.4
Colour	TCU	2	ND (2) - 6	2 - 14	9	4	13	5	ND (2)	2	2	4	6
Colour, apparent	ACU	2		3 - 57	21	11	20	9	3	5	4	7	18
Conductivity	uS/cm	5	839 - 967	675 - 1320	774	777	739	747	701	675	710	724	739
Hardness	mg/L		144 - 195	114 - 384	181	166	167	158	138	120	114	137	162
pH	pH Units	0.1	7.73 - 8.18	7.4 - 8.2	8	7.7	8.1	8	7.8	7.9	8.2	8.1	8.1
Phenolics	mg/L	0.001	ND (0.001) - ND(0.002)	ND(0.001) - 0.001	ND (0.001)								
Total Dissolved Solids	mg/L	10	545 - 629	260 - 670	394	380	406	370	372	364	298	344	372
Sulphide	mg/L	0.02	-	ND(0.02) - 0.03	ND (0.02)								
Tannin & Lignin	mg/L	0.1	ND(0.1) - 0.2	ND(0.1)	ND (0.1)								
Total Kjeldahl Nitrogen	mg/L	0.1	0.2 - 0.29	0.2 - 0.4	0.3	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.3
Turbidity	NTU	0.1	0.8 - 1.7	0.1 - 8.3	1.3	1	1.5	0.7	0.2	0.1	0.4	0.6	1
Organic Nitrogen (calculated)	mg/L	-	0 - 0.08	<0.10 - 0.2	0.1	0.1	0.1	0.1	<0.10	0.1	0.1	0.1	0.1
Anions	J									-		-	
Chloride	mg/L	1	104 - 118	49 - 122	79	80	73	54	62	58	49	55	65
Fluoride	mg/L	0.1	0.59 - 1.1	0.7 - 1.3	1.1	1.1	1.1	1.1	1.3	1.3	1.2	1.1	1.2
Nitrate as N	mg/L	0.1	ND(0.01)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Nitrite as N	mg/L	0.05	ND(0.08) - ND(0.1)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Sulphate	mg/L	1	40 - 61	23 - 64	37	45	34	31	29	25	31	34	36
Metals													
Calcium	mg/L	0.1	28 - 71	28.2 - 95.6	48.7	44	44.5	43	37.4	30.9	28.2	33.9	43.7
Iron	mg/L	0.1	0.13 - 0.22	0.1 - 0.6	0.2	0.2	0.3	ND (0.1)	0.1				
Magnesium	mg/L	0.2	18 - 34	10.4 - 35.2	14.5	13.6	13.5	12.3	10.8	10.4	10.5	12.7	12.9
Manganese	mg/L	0.005	ND (0.01)	ND (0.005) - 0.021	0.009	0.008	0.008	0.008	0.008	ND (0.005)	0.005	0.006	0.011
Potassium	mg/L	0.1	6 - 7	4.8 - 6.5	5.9	5.3	6	5.5	4.8	5	5.4	6.1	5.4
Sodium	mg/L	0.2	88 - 123	62.4 - 115	95.8	100	93.5	93.1	98.3	99	107	102	93
Bromide	mg/L	0.1		0.1 - 0.4	0.4	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.3
lodide	mg/L	0.1	_	0.1 0.4		0.5	0.5	0.2	0.5	0.2	0.2	0.2	0.5

GEMTEC Consulting Engineers and Sci PROJECT: 100443.001	entists Limite												
Parameter	Units	MDL	TW15-1, TW15-2, TW15- 3 Range	PW Range	PW10	PW11	PW13	Р	W17	PW21	PW22	PW23	PW24
Sample Date (m/d/y)			2015 Hydrog (Golder, 2017)	2021 Sampling	12/08/2020	12/07/2020	05/20/2021	12/07/2020	05/14/2021	07/14/2021	07/20/2021	07/20/2021	07/20/2021
Microbiological Parameters													
E. Coli	CFU/100 mL	1	ND(1)	ND (1) - 1	ND (1)	1							
Fecal Coliforms	CFU/100 mL	1	-	ND (1) - 6	ND (1)	6							
Total Coliforms	CFU/100 mL	1	ND(1) - 2	ND (1) - 23	ND (1)	23							
Heterotrophic Plate Count	CFU/mL	10	-	ND(10) - >2000	ND (10)	20	10	ND (10)	-	40	210	300	>2000
General Inorganics													
Alkalinity, total	mg/L	5	226 - 268	237 - 279	259	256	259	245	237	255	263	262	268
Ammonia as N	mg/L	0.01	0.203 - 0.23	0.15 - 0.29	0.18	0.29	0.23	0.15	0.2	0.23	0.18	0.02	0.19
Dissolved Organic Carbon	mg/L	0.5	0.91 - 1.1	1.2 - 2.8	1.6	2.4	2.2	2	ND (0.5)	1.6	2.9	2.2	2.6
Colour	TCU	2	ND (2) - 6	2 - 14	14	5	ND (2)	8	3	3	11	ND (2)	4
Colour, apparent	ACU	2	-	3 - 57	22	20	5	24	9	57	13	ND (2)	5
Conductivity	uS/cm	5	839 - 967	675 - 1320	751	683	947	900	947	802	830	837	1060
Hardness	mg/L		144 - 195	114 - 384	182	209	249	217	238	157	203	0.819 (1)	267
pΗ	pH Units	0.1	7.73 - 8.18	7.4 - 8.2	7.7	7.9	8	7.9	8	8.1	8.0	8.0	7.8
Phenolics	mg/L	0.001	ND (0.001) - ND(0.002)	ND(0.001) - 0.001	ND (0.001)	0.001	ND (0.001)	ND (0.001)	ND (0.001)				
Total Dissolved Solids	mg/L	10	545 - 629	260 - 670	386	326	504	260	504	420	432	430	518
Sulphide	mg/L	0.02		ND(0.02) - 0.03	ND (0.02)	ND (0.02)	ND (0.02)	0.03	ND (0.02)	ND (0.02)	0.02	ND (0.02)	ND (0.02)
Tannin & Lignin	mg/L	0.1	ND(0.1) - 0.2	ND(0.1)	ND (0.1)								
Total Kjeldahl Nitrogen	mg/L	0.1	0.2 - 0.29	0.2 - 0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	ND (0.1)	0.2
Turbidity	NTU	0.1	0.8 - 1.7	0.1 - 8.3	2	1.6	0.5	2.4	0.8	8.3	0.3	0.2	0.9
Organic Nitrogen (calculated)	mg/L	-	0 - 0.08	<0.10 - 0.2	0.1	<0.10	0.1	0.2	<0.10	<0.10	<0.10	<0.10	<0.10
Anions					4.5		7.2						
Chloride	mg/L	1	104 - 118	49 - 122	70	58	105	114	122	72	74	74	129
Fluoride	mg/L	0.1	0.59 - 1.1	0.7 - 1.3	1.1	0.9	0.9	0.9	0.9	1.1	0.8	0.8	0.7
Nitrate as N	mg/L	0.1	ND(0.01)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Nitrite as N	mg/L	0.05	ND(0.08) - ND(0.1)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Sulphate	mg/L	1	40 - 61	23 - 64	34	23	42	49	47	34	34	34	49
Metals	, J												
Calcium	mg/L	0.1	28 - 71	28.2 - 95.6	48.9	52.4	60.9	59.8	62	40.7	53.0	0.3	67.7
Iron	mg/L	0.1	0.13 - 0.22	0.1 - 0.6	0.3	0.3	ND (0.1)	0.3	0.1	0.6	0.2	ND (0.1)	0.1
Magnesium	mg/L	0.2	18 - 34	10.4 - 35.2	14.5	19	23.6	16.5	20.3	13.4	17.1	ND (0.2)	23.8
Manganese	mg/L	0.005	ND (0.01)	ND (0.005) - 0.021	0.008	0.007	0.01	0.009	0.009	0.009	0.010	ND (0.005)	0.013
Potassium	mg/L	0.1	6 - 7	4.8 - 6.5	5.1	5.6	6.5	5.7	5.9	5.6	6.2	0.3	5.9
Sodium	mg/L	0.2	88 - 123	62.4 - 115	91.5	62.4	113	102	115	97.8	109	175	119
Bromide	mg/L	0.1	-	0.1 - 0.4	0.2	0.1	0.2	0.3	0.4	0.3	0.2	0.2	0.3
odide	mg/L	- 0.1		0.1 - 0.4	-	-	ND (0.2)		ND (1.0)	-	-	0.2	-
	6/ L						145 (0.2)	1	145 (1.0)	_		1	

Notes: 1. PW23 was collected post-water softener and possibly other treatment systems.



# **Creekside 1 Domestic Wells - Impacted Water Quality**

# GEMTEC Consulting Engineers and Scientists Limited

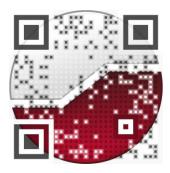
Parameter	Units	MDL	PW:	12		PW14		PV	/15		PW16		PW	18		PW19	
Sample Date (m/d/y)			01/04/2021	07/13/2021	12/07/2020	04/08/2021	07/20/2021	05/14/2021	07/14/2021	12/15/2020	04/08/2021	07/13/2021	05/20/2021	07/14/2021	12/07/2020	04/08/2021	07/13/2021
Microbiological Parameters																	
E. Coli	CFU/100 mL	1	ND (1)	-	ND (1)	-	-	ND (1)	-	ND (1)	-	-	ND (1)	-	ND (1)	-	-
Fecal Coliforms	CFU/100 mL	1	ND (1)	-	ND (1)	-	-	ND (1)	-	ND (1)	-	-	ND (1)	-	ND (1)	-	-
Total Coliforms	CFU/100 mL	1	ND (1)	-	ND (1)	-	-	ND (1)	-	ND (1)	-	-	ND (1)	-	ND (1)	-	-
Heterotrophic Plate Count	CFU/mL	10	10	-	10	-	-	-	-	90	-	-	950	-	ND (10)	-	-
General Inorganics															` '		
Alkalinity, total	mg/L	5	279	-	331	-	-	363	-	311	-	-	336	-	381	-	-
Ammonia as N	mg/L	0.01	0.23	-	0.20	-	-	0.16	-	0.05	-	-	0.25	-	0.26	-	-
Dissolved Organic Carbon	mg/L	0.5	2.8	-	1.5	-	-	ND (0.5)	-	1.8	-	-	2.4	-	2.2	-	-
Colour	TCU	2	2	-	6	162	_	7	_	3	30	_	2	-	35	-	-
Colour, apparent	ACU	2	3	-	32	21	-	8	_	4	<2	-	45	-	117	-	-
Conductivity	uS/cm	5	1320	-	2000	_	-	2150	_	1730	-	-	2620	-	3240	-	-
Hardness	mg/L		384	-	642	534	_	644	_	522	686	_	843	-	1100	1110	-
Н	pH Units	0.1	7.4	-	7.5	-	-	7.7	_	7.6	-	-	7.4	-	7.3	-	-
Phenolics	mg/L	0.001	ND (0.001)	-	ND (0.001)	_	-	ND (0.001)	_	ND (0.001)	-	-	ND (0.001)	-	ND (0.001)	-	-
Total Dissolved Solids	mg/L	10	670	-	1140	1340	_	1260	_	842	1220	_	1610	-	2030	2080	-
Sulphide	mg/L	0.02	ND (0.02)	-	ND (0.02)	-	-	ND (0.02)	_	ND (0.02)	-	-	ND (0.02)	-	ND (0.02)	-	-
Fannin & Lignin	mg/L	0.1	ND (0.1)	-	ND (0.1)	-	-	0.2	-	ND (0.1)	-	-	ND (0.1)	-	ND (0.1)	-	-
Total Kjeldahl Nitrogen	mg/L	0.1	0.4	-	0.4	_	-	0.2	_	0.2	-	-	0.4	-	0.4	-	-
Furbidity	NTU	0.1	0.4	-	2.5	34.4	_	1.2	_	ND (0.1)	-	-	11.7	-	15.2	9.7	-
Organic Nitrogen (calculated)	mg/L	-	0.17	-	0.2	-	-	0.04	-	0.15	-	-	0.15	-	0.14	-	-
Anions	Ū.																
Chloride	mg/L	1	223	112	420	447	224	430	194	366	414	182	574	103	837	739	173
luoride	mg/L	0.1	0.7	-	0.4	-	-	0.3	-	0.4	-	-	0.4	-	0.4	-	-
Nitrate as N	mg/L	0.1	ND (0.1)	-	ND (0.5)	-	-	ND (0.1)	-	0.1	-	-	ND (0.1)	-	ND (0.5)	-	-
Nitrite as N	mg/L	0.05	ND (0.05)	-	ND (0.05)	-	-	ND (0.05)	-	ND (0.05)	-	-	ND (0.05)	-	ND (0.05)	-	-
Sulphate	mg/L	1	64	-	119	-	-	119	-	107	-	-	140	-	198	-	-
Metals	, , , , , , , , , , , , , , , , , , ,																
Calcium	mg/L	0.1	95.6	-	151	125	-	151	-	54.1	158	-	189	-	243	261	-
ron	mg/L	0.1	ND (0.1)	-	0.3	2	-	0.3	-	ND (0.1)	-	-	0.8	-	1.3	0.9	-
Magnesium	mg/L	0.2	35.2	-	64.4	53.9	-	64.6	-	94.0	70.7	-	89.9	-	119	112	-
/Janganese	mg/L	0.005	0.021	-	0.037	-	-	0.046	-	0.035	-	-	0.060	-	0.076	-	-
Potassium	mg/L	0.1	6.2	-	6.8	-	-	4.7	-	8.8	-	-	8.1	-	8.0	-	-
odium	mg/L	0.2	103	111	148	139	124	178	109	133	172	125	193	99.1	215	270	125
Bromide	mg/L	0.1	0.2	-	0.1	-		ND (0.1)		0.1			0.2	-	0.3	-	-
odide	mg/L	-	-	_	-	_	-	ND (1.0)	-	-	-	_	ND (0.2)	-	-	_	-



# Creekside 1 Test Wells - Water Quality

GEMTEC Consulting			Creekside Phase 1 (Golder, 2017)											
PROJECT: 100443.001			T	W15-1 (A165020)			TW15-2 (A165021)		т	W15-3 (A165022)				
Parameter	Units	MDL		TW15-1			TW15-2			TW15-3				
			A165020	A165020	A165020	A165021	A165021	A165021	A165022	A165022	A165022			
Sample Date (m/d/y)			Sep 2015 Ptest 3 Hr	Sep 2015 Ptest 6 Hr	May-21	Sep 2015 Ptest 3 Hr	Sep 2015 Ptest 6 Hr	ABANDONED	Sep 2015 Ptest 3 Hr	Sep 2015 Ptest 6 Hr	May-21			
Microbiological Parameters														
E. Coli	CFU/100 mL	1	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	-	ND (1)	ND (1)	ND (1)			
Fecal Coliforms	CFU/100 mL	1	-	-	ND (1)	-		-			ND (1)			
Total Coliforms	CFU/100 mL	1	2	2	ND (1)	ND (1)	ND (1)	-	ND (1)	ND (1)	ND (1)			
Heterotrophic Plate Count	CFU/mL	10	-	-	-	-	-	-	-	-				
General Inorganics														
Alkalinity, total	mg/L	5	229	226	260	244	251	-	265	268	359			
Ammonia as N	mg/L	0.01	0.23	0.23	0.28	0.251	0.203	-	0.235	0.207	0.28			
Dissolved Organic Carbon	mg/L	0.5	1.8	1.1	2.0	0.91	0.91	-	1.1	1	0.9			
Colour	TCU	2	4	ND(2)	4	ND(2)	ND(2)	-	4	6	16			
Colour, apparent	ACU	2	-	-	-	-	-	-	-	-				
Conductivity	uS/cm	5	839	839	782	887	879	-	975	967	1870			
Hardness	mg/L		144	144	138	195	195	-	316	317	585			
pH	pH Units	0.1	7.75	7.73	8.1	8.24	8.18	-	8.18	8.13	7.5			
Phenolics	mg/L	0.001	ND (0.001)	ND (0.001)	ND (0.001)	ND (0.002)	ND (0.002)	-	ND (0.002)	ND (0.002)	ND (0.001)			
Total Dissolved Solids	mg/L	10	545	545	402	577	571	-	634	629	1110			
Sulphide	mg/L	0.02	-	-	ND (0.02)	-	_	-	-	-	ND (0.02)			
Tannin & Lignin	mg/L	0.1	ND (0.1)	ND (0.1)	ND (0.1)	6.4	0.1	_	0.2	0.2	ND (0.1)			
Total Kjeldahl Nitrogen	mg/L	0.1	0.2	0.2	0.4	0.29	0.25	_	0.36	0.29	0.4			
Turbidity	NTU	0.1	2.2	0.8	0.9	0.23	0.25	_	0.9	1.7	7.0			
Organic Nitrogen (calculated)	mg/L	-	0	0	0.1	0.04	0.05	_	0.12	0.08	0.12			
Anions	1116/ -		·	·	0.1	0.04	0.03		0.12	0.00	0.12			
Chloride	mg/L	1	102	104	76	108	105		122	118	382			
Fluoride	mg/L	0.1	1.1	1.1	1.0	0.91	0.91	_	0.59	0.59	0.3			
Nitrate as N	mg/L	0.1	ND (0.1)	ND (0.1)	ND (0.1)	0.91 ND (0.1)	0.91 ND (0.1)	_	ND (0.1)	ND (0.1)	0.3 ND (0.1)			
	mg/L	0.1	ND (0.1) ND (0.08)	, ,	ND (0.1) ND (0.05)	ND (0.1) ND (0.08)	, ,	_	, ,	ND (0.1) ND (0.1)	ND (0.1) ND (0.05)			
Nitrite as N			, ,	ND (0.08)	٠, ,	, ,	ND (0.08)	-	ND (0.1)		` '			
Sulphate	mg/L	1	40	40	30	45	45	-	63	61	102			
Metals											400			
Calcium	mg/L	0.1	28	28	34.7	40	40	-	72	71	136			
Iron	mg/L	0.1	0.27	0.13	0.1	0.19	0.16	-	0.22	0.22	0.6			
Magnesium	mg/L	0.2	18	18	12.5	23	23	-	33	34	59.4			
Manganese	mg/L	0.005	ND (0.01)	ND (0.01)	ND (0.005)	0.01	ND (0.01)	-	ND (0.01)	ND (0.01)	0.027			
Potassium	mg/L	0.1	7	7	5.5	6	6	-	6	6	6.7			
Sodium	mg/L	0.2	121	123	107	115	113	-	90	88	146			





civil

geotechnical

environmental

field services

materials testing

civil

géotechnique

environnementale

surveillance de chantier

service de laboratoire des matériaux

