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REPORT

Water Report Level 1/2

Proposed Caledon Pit / Quarry

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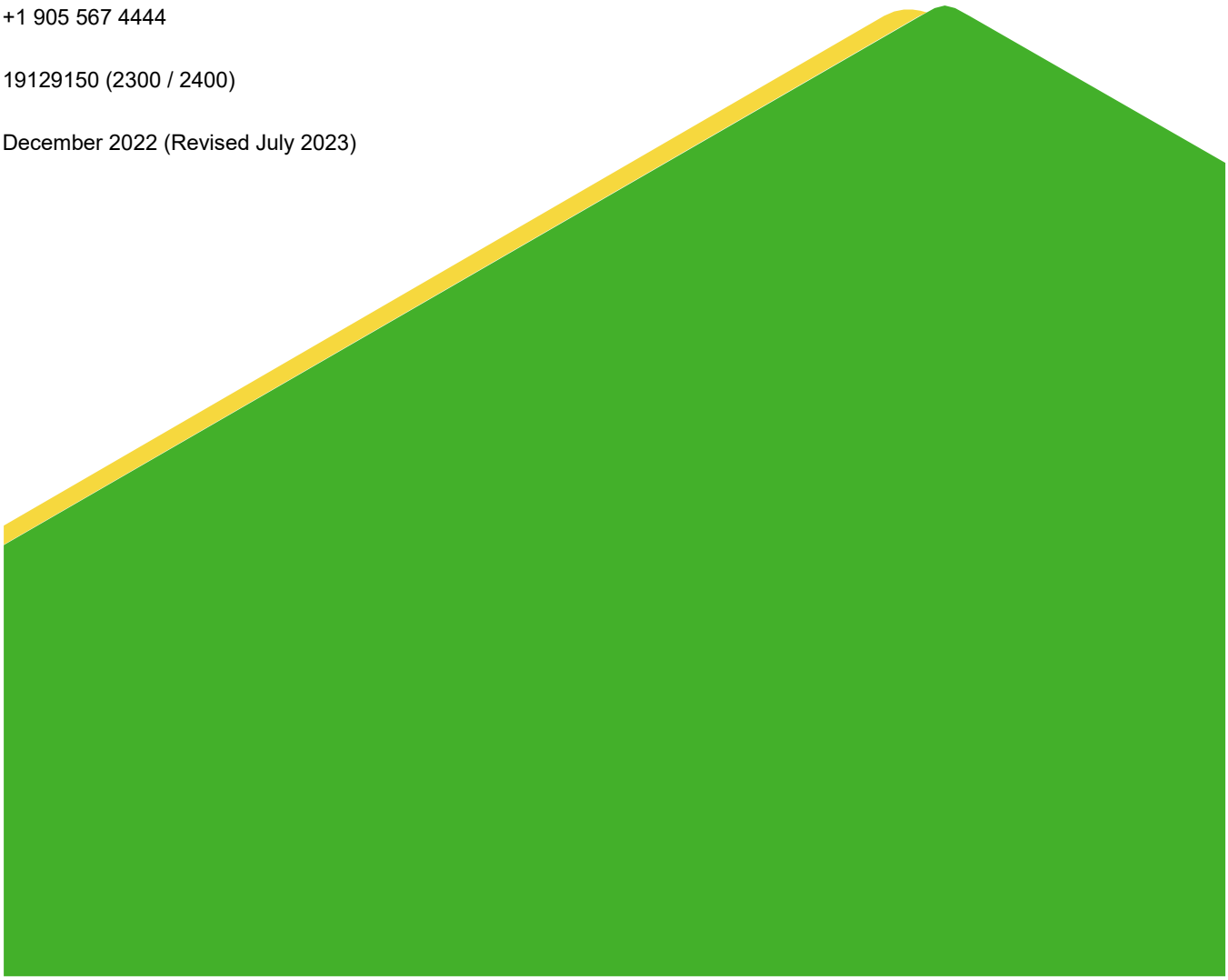

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1.0 INTRODUCTION

CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) is applying to the Ministry of Natural Resources and Forestry (MNRF) for a Class A Licence (Pit and Quarry Below Water) and to the Town of Caledon for an Official Plan Amendment and Zoning By-law Amendment to permit a mineral aggregate operation. Golder Associates Ltd. a WSP company (Golder), has been retained by CBM to complete a Water Report Level 1/2 for the proposed CBM Caledon Pit / Quarry in accordance with the Terms of Reference developed in consultation with the Development Application Review Team (DART) found in Appendix A, and the MNRF, Aggregate Resources Act Ontario Regulation 244/97.

1.1 Site and Adjacent Lands

CBM owns / controls approximately 323 hectares (ha) of land located at the northwest, northeast and southwest intersection of Regional Road 24 (Charleston Sideroad) and Regional Road 136 (Main Street). Of these lands, approximately 261 ha are proposed to be licensed under the Aggregate Resources Act and designated / zoned under the Planning Act to permit the proposed CBM Caledon Pit / Quarry (Figure 1-1). These lands are mapped as a Caledon High Potential Mineral Aggregate Resource Area (CHPMARA) in the Town of Caledon Official Plan and High Potential Mineral Aggregate Resource Area (HPMARA) in the Region of Peel Official Plan and are protected for their aggregate potential.

The remaining approximately 62 ha of land owned / controlled by CBM are not subject to the application. These lands are referred to as “CBM Additional Lands” and these lands include approximately 36 hectares of land that is located adjacent to the minor urban centre of Cataract. As part of the application, CBM is proposing to create an upland forest and meadow grassland on these lands and is exploring the potential of conveying them permanently to a public authority for long term protection.

The lands proposed to be licensed under the Aggregate Resources Act are referred to as the “Subject Site” (or “Site”) and are legally described as Part of Lots 15-18, Concession 4 WSCR and Part of Lot 16, Concession 3 WSCR (former Geographic Township of Caledon). The Site is approximately 261 ha and extraction is proposed on approximately 200 ha. These lands are referred to as the “Extraction Area”. The remaining approximate 61 hectares within the Site and outside of the Extraction Area are referred to as the “Setback / Buffer Lands”. The Setback / Buffer Lands are used to provide setbacks to surrounding land uses and natural heritage features and the majority of these lands include a 5 metre (m) visual / acoustic berm and visual plantings.

For the purpose of this assessment, “Adjacent Lands” are defined as lands within 120 m of the Site, and the “Study Area” for this assessment included all lands within 1,000 m of the Site, as well as additional lands beyond this distance, as discussed in this Report.

2.0 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed Extraction Area includes approximately 78 million tonnes (Mt) of a high quality bedrock resource and approximately 4 Mt of a high quality sand and gravel resource. Testing has confirmed that the mineral aggregate resource found on-site is suitable for the production of a wide range of construction products, including the use for high performance concrete. The bedrock resource provides some of the strongest and most durable aggregate material in Southern Ontario. The primary market area for the proposed CBM Caledon Pit / Quarry is the Greater Toronto Area, including the Town of Caledon and the Region of Peel. This site represents a close to market source of a high quality mineral aggregate resource.

2.1 Proposed Site Operations

The proposed tonnage limit for the proposed CBM Caledon Pit / Quarry is 2.5 Mt per year and on average CBM anticipates shipping approximately 2.0 Mt per year. The CBM Caledon Pit / Quarry is proposed to be operated in 7 phases, as shown on Figure 2-1. Phases 1, 2A, 3, 4, 5 are located to the northwest of the intersection of Regional Road 24 and 136. This area is referred to as the “Main Area”. Phase 2B is located to the northeast of the intersection of Regional Road 24 and 136. This area is referred to as the “North Area”. Phases 6 and 7 are located to the southwest of the intersection of Regional Road 24 and 136. This area is referred to as the “South Area”.

Operations would commence in the Main Area and Phase 1 would include the permanent processing area (crushing, screening and wash plant), aggregate recycling area and the entrance / exit for the proposed CBM Caledon Pit / Quarry. Until such time as sufficient space is opened up to establish the permanent processing area, a temporary mobile crushing and processing plant is proposed to be used in Phase 1. The entrance / exit for the CBM Caledon Pit / Quarry is proposed to be located onto Regional Road 24, approximately 775 m west of Regional Road 136. The entrance / exit is proposed to be controlled by a new traffic light and the installation of taper lanes and acceleration lanes on Regional Road 24 at CBM’s expense. The primary haul route for the proposed CBM Caledon Pit / Quarry is trucks will travel eastward on Regional Road 24 and then southward on Highway 10. The proposed haul route is an existing aggregate haul route and is designated as an aggregate haul route in the Town of Caledon Official Plan.

Access to the North Area for aggregate extraction is anticipated approximately 10 years after the start of the operations in the Main Area. There will be no processing in the North Area and aggregate extracted from the North Area is proposed to be transported to the Main Area through a proposed tunnel underneath Regional Road 136. Access to South Area is anticipated approximately 30 years after the start of the operations in the Main Area. In the South Area, CBM is proposing to permit a portable processing plant and the aggregate extracted and / or processed from the South Area is proposed to be moved to the Main Area through a proposed tunnel underneath Regional Road 24. Aside from the establishment of a 1 ha stormwater settling pond on the easternmost portion of the North Area in the initial year of operation, the North and South areas will be maintained in their current state and agricultural uses until they are required for preparation for aggregate extraction.

The CBM Caledon Pit / Quarry is proposed to operate (extraction, processing and drilling) 7:00 am to 7:00 pm Monday to Saturday, excluding statutory holidays and shipping is proposed from 6:00 am to 7:00 pm Monday to Saturday consistent with other mineral aggregate operations in Caledon. CBM is also proposing to permit limited shipping in the evening and nighttime (7:00 pm to 6:00 am) to support public authority contracts that require the delivery of aggregates during these hours to complete public infrastructure projects. These activities will be limited to only highway trucks and shipping loaders and no other operations will be permitted during evening or nighttime hours. Site preparation and rehabilitation is proposed to be permitted 7:00 am to 7:00 pm Monday to Friday.

The proposed CBM Caledon Pit / Quarry involves stripping topsoil and overburden from the Site to create perimeter berm and any excess soil will be temporarily stored in the northern portion of the Main Area or used for progressive rehabilitation of the site. The proposed Extraction Area includes extracting both sand and gravel below the water table and the site will be dewatered to allow operations in a dry state. The site will be extracted in sequence of the proposed phases (Phase 1 to 7) and following extraction of Phase 7 the permanent processing plant in Phase 1 will be removed and this will be the final area to be extracted and rehabilitated. The phasing of the proposed mineral aggregate operation has been designed to reach final extraction limits and depths within each phase so progressive rehabilitation of the side slopes can be completed.

2.2 Site Servicing

The Site, including the Main, North and South Areas, is not municipally serviced for water or sewer, and no municipal water or sewer servicing is required to support the proposed development. Potable water for workers will be supplied privately to the Site, and septic waste generated on-site will be stored in a holding tank and disposed off-site.

It is noted that there are three properties within the Main Area that currently have private wells supplying water and septic systems for domestic use. Two farms on the western portion of the Main Area (18501 Mississauga Rd. and 18667 Mississauga Rd.) and the other is a residential property on the southeastern portion of the Main Area (1420 Charleston Sideroad). There are no private water wells or septic systems currently in use on the North Area or South Area.

2.3 Proposed Site Rehabilitation

The overall goal of the final rehabilitation plan is to create a landform that represents an ecological and visual enhancement and provides future opportunities for conservation, recreational, tourism and water management. Overall, the progressive and final rehabilitation plan for the Site includes the creation of: lakes, vegetated shorelines, islands, wetlands, upland forested areas, riparian plantings adjacent to the existing watercourse, nodal shrub and tree planting on upland areas, grassland meadows and specialized habitat features for bats and turtles. The proposed rehabilitation has been designed to use all of the on-Site topsoil and overburden and does not require the importation of additional soils.

2.4 Summary

The Water Report Level 1 / 2 assessed the proposed CBM Caledon Pit / Quarry and based on the implementation of the recommendations found in Section 11 of this Report, this assessment concluded the following:

- The proposed Caledon Pit / Quarry is within the Credit Valley Source Protection Area but is not located in a wellhead protection area (WHPA) or an intake protection zone (IPZ) and there will be no impacts to municipal water supplies.
- Of the approximately 100 water supply wells evaluated a majority of the wells are located at a depth below the proposed pit / quarry floor and they will not be impacted. There are 15 residential wells that have the potential to be impacted during operations by the proposed pit / quarry development. These 15 wells are susceptible to water quantity impacts due to their location relative to the predicted zone of influence of the Site, and their relatively shallow well construction in comparison to other wells in the area.
- In all cases, these wells could be deepened to the depth of other wells in the surrounding area to restore the water supply. In the event of a water well complaint there is an established procedure that the licensee must follow which requires an immediate investigation and supply of temporary water if required. In the event, any

well was impacted by the proposed pit / quarry operation it is the licensee's responsibility to restore the water supply, at their expense.

- As part of the operation there will be an extensive on-site and off-site groundwater monitoring program and annual reports that will be submitted to the government agencies and publicly available. As a result of the proposed design of the pit / quarry, the comprehensive groundwater monitoring and reporting requirements and the water well complaint procedure, it is concluded that water supply wells in the surrounding area will be protected.
- The proposed extraction area does not contain any identified water resources on the Region of Peel Schedule A-1 (Water Resources, Systems and Features). The proposed licence area includes an identified feature in the northwest corner of the Main Area and this feature is located outside of the extraction area and will be protected.
- A small portion of Main Area, a very small portion of the North Area and the majority of the South Area is mapped as a Highly Vulnerable Aquifer on the Region of Peel Schedule A-2 (Highly Vulnerable Aquifers). This is very common for mineral aggregate resource areas, and based on the design of the operation, and the implementation of the recommendations contained this Report, the proposed Caledon Pit / Quarry does not result in additional risk to the aquifer.
- Almost all of the Rural Area in the Region of Peel including the Main Area, North Area and South Area are mapped as a Significant Groundwater Recharge Area on the Region of Peel Schedule A-3 (Significant Groundwater Recharge Area). This is very common for mineral aggregate resource areas, and based on the design of the operation, and the implementation of the recommendations contained in this report, the groundwater recharge function of the area (i.e., providing flow to the Credit River) will be maintained, and will report to the Credit River and its tributaries via quarry dewatering (operational) or groundwater inputs and lake outflows (rehabilitation).
- There are no key hydrologic features located within the proposed extraction area. There is a 0.1 ha key hydrologic feature (i.e., wetland) that will be impacted for the construction of the proposed berm and this feature is permitted to be removed in accordance with applicable policies. There are also key hydrologic features (i.e., wetland and tributary) in the northwest corner of the Main Area and these features will be protected. Taking into consideration the rehabilitation plan, there are 4.8 ha of wetland to be created and 158.3 ha lake to be created resulting in 163 ha of new key hydrologic features.
- The extraction of aggregates and creation of ponds at the Site upon rehabilitation is not predicted to have adverse impacts on the local surface water hydrology of the Credit River or the surrounding tributaries/water features with the exception of Tributary #1 and Tributary #8 via land use changes, surface water drainage alterations and / or quarry operation. The decrease in surplus and increase in groundwater drawdown, over the operational period, to the remaining adjacent tributaries/water features is predicted to have minor localized impacts to flow that will see a total decrease in flow of less than 9% of existing flows. The decrease in surplus and increase in groundwater drawdown over the operational period, at Tributaries #1 and #8 is predicted to have minor localized impacts to flow.
- Compared to existing conditions, average annual surplus over the Site footprint area increases under operational conditions by approximately 18%, while under rehabilitated conditions the surplus decreased by approximately 14%.

- Compared to existing conditions (579,290 m^3/yr), average annual infiltration decreases over the Site footprint area under operational and increases under rehabilitated conditions to 281,275 m^3/yr and 628,040 m^3/yr, respectively.
- Compared to existing conditions (312,405 m^3/yr), average annual on-Site runoff increases under operational conditions to 767,895 m^3/yr and decreases under rehabilitated conditions to 136,945 m^3/yr.
- The application includes detailed monitoring, mitigation and reporting requirements to ensure adjacent sensitive groundwater features and sensitive surface water features will be assessed as extraction proceeds to help ensure these features will be protected, improved or restored.
- With the implementation of the recommendations in this Report, sensitive surface water features and sensitive groundwater features will be protected, improved and restored during operations.
- Taking into account rehabilitation, there will be a long term enhancement to the water resources system and features.

The proposed Aggregate Resources Act Site Plans includes all of the technical recommendations from this report to ensure that the site operates in accordance with applicable provincial standards and the applicable policy requirements of the Provincial Policy Statement, Places To Grow Plan, Greenbelt Plan, Region of Peel Official Plan and Town of Caledon Official Plan.

3.0 BACKGROUND REVIEW / REGIONAL SETTING

The objective of the background review was to assemble available geoscientific information for the Site to develop an understanding of the regional and local geology, hydrogeology and hydrology, and to inform the water resources investigation plan. The review included geological and hydrogeological data, water well records and mapping from public sources, including the MNRF, the Ontario Geological Survey (OGS), the Ministry of Environment, Conservation and Parks (MECP), Ministry of Northern Development and Mines (MNDM) and Credit Valley Conservation (CVC), as well as previous geologic and hydrogeologic reports for the Site and Study Area.

3.1 Documents Reviewed

The following data sources and technical reports were identified and included in the data compilation and background review.

- OBM mapping – MNRF base data layers obtained from Land Information Ontario (LIO), 2020. Used for map generation and analysis.
- Aerial imagery – Recent aerial imagery obtained from Digital Globe, 2019. Used for map generation and analysis.
- Topography - MNRF SWOOP 1 m contour DEM data (2015) which was subsequently refined using topographic data from the Ontario Digital Terrain Model (LiDAR-Derived) GTA-Peel acquisition project Spring 2016 (released in 2023). These data were used for map generation and terrain analysis.
- Quaternary mapping - Ontario Geological Survey 2003: MRD128-Surficial Geology of Southern Ontario, MNDM. Used for map generation and analysis.
- Bedrock mapping - Ontario Geological Survey 2011: MRD126-Bedrock Geology of Southern Ontario, MNDM. Used for map generation and bedrock geology analysis.
- Amabel Formation Outcrop, Ontario Geological Survey, ARO 2018. Used for map generation and analysis.
- ARIP report #165 - Aggregate resources inventory of the Regional Municipality of Peel, southern Ontario; Ontario Geological Survey, Aggregate Resources Inventory Paper 165 – Revised, 57p. Reviewed for general information on aggregate resources in the Study Area.
- Water Well Records (WWRs) and Permits to Take Water (PTTWs) – Database obtained from MECP, first obtained in September 2019 and updated July 2022. Used to evaluate neighbouring water users in the Study Area.
- Pits and Quarries Ontario MNRF - https://www.gisapplication.lrc.gov.on.ca/PitsandQuarries/index.html - accessed September 2019. Used to identify nearby active aggregate extraction sites.
- A three-dimensional geological model of the Paleozoic bedrock of southern Ontario; report in Ontario Geological Survey, Groundwater Resources Study 19 / Geological Survey of Canada, Open File 8618. (Carter et al. 2019). Used to inform bedrock geology interpretation and development of the site conceptual and numerical model.
- Early Silurian sequence stratigraphy and geological controls on karstic bedrock groundwater-flow zones, Niagara Escarpment region and the subsurface of southwestern Ontario; report in Ontario Geological Survey, Groundwater Resources Study 13. (Brunton and Brintnell 2020). Used to inform bedrock geology interpretation and development of the site conceptual and numerical model.

- Credit Valley Source Protection Area - Assessment Report. https://ctcswp.ca/the-science/credit-valley-spa-assessment-report/ - updated 2019. Provided context to assess Source Water Protection for the Study Area.
- Credit Valley – Toronto and Region – Central Lake Ontario (CTC) Source Protection Plan. https://ctcswp.ca/the-science/credit-valley-spa-assessment-report/ - updated 2022. Provided context to assess Source Water Protection for the Study Area.
- Region of Peel WHPA Study for Municipal Residential Groundwater Systems Located within the Credit River Watershed (AquaResource 2007). Used to inform development of the site conceptual and numerical model.
- Integrated Water Budget Report - Tier 2, Credit Valley Source Protection Area (AquaResource 2009). Used to inform development of the site conceptual and numerical model.
- Orangeville, Mono, Amaranth Tier 3 Water Budget and Local Area Risk Assessment Appendix A (AquaResource 2011). Used to inform development of the site conceptual and numerical model.
- Shaws Creek Subwatershed Study - Subwatershed 17 Phase 1 Characterization Report (CVC 2014). Used to inform development of the site conceptual and numerical model.
- West Credit Subwatershed Study Characterization Report (County of Wellington 1998). Used to inform development of the site conceptual and numerical model.
- Caledon Creek and Credit River Subwatershed Study (Subwatersheds 16 & 18) - Phase 1 Characterization Report (CVC 1999). Used to characterize existing site and watershed conditions.
- Caledon Creek and Credit River Subwatershed Study (Subwatersheds 16 & 18) - Phase 3 Implementation Report (CVC 2003). Used to inform development of the site conceptual and numerical model.
- Jagger Hims Ltd. 2001. Geotechnical Drilling – Proposed Effluent Storage Ponds, Caledon Centre for Well Being/Osprey Valley Golf Course Development. File 960776.02, dated Aug 16, 2001. Boreholes incorporated into the site hydrogeological model (conceptual and numerical).
- Jagger Hims Ltd. 2003. Proposed Osprey Valley Quarry, Geologic Information. File 011228.01, dated Sept. 17, 2003. Boreholes incorporated into the site hydrogeological model (conceptual and numerical).
- MECP FOI A-2022-04920 – Freedom of Information and Protection of Privacy Act (FOI) information release from the MECP regarding Permit to Take Water (PTTW): 7541-72ZM8Z for Aquaterra Corporation Ltd., dated January 3, 2023. The PTTW and other historic documents, most notably PTTW 2007-2001 Report for the Canadian Springs Cataract Site, prepared by AECOM for Aquaterra Corporation, dated March 2012, were reviewed. A follow-up FOI request for the reports referenced in Schedule A of the current PTTW was also made to the MECP in January 2023. This follow-up request is still in progress.
- Water Resource Evaluation – Proposed Armbro-Pinchin Pit. Prepared for the Town of Caledon by Conestoga-Rovers & Associates. Ref No 3083 (1) dated July 1990. Reply Evidence - Proposed Armbro-Pinchin Pit. Prepared for the Town of Caledon by Conestoga-Rovers & Associates. Ref No 3083 (2) dated September 1994. Surface Water and Groundwater Levels - Aecon-Pinchin Pit 2012 Annual Monitoring Report. Prepared for the Town of Caledon by Conestoga-Rovers & Associates. Ref No 3083 dated 2012. Borehole and groundwater level data was incorporated into the site hydrogeological model (conceptual and numerical), in particular for the numerical model domain southwest of the Site.

- Hydrogeological Impact Assessment, Aggregate Licence Application, Lots 11-13, Concession 6 West Side, Town of Caledon, Regional Municipality of Peel. Prepared for: James Dick Construction Ltd. by Harden Environmental Services Limited. Report No. 0019 dated December 16, 2016. Borehole and groundwater level data was incorporated into the site hydrogeological model (conceptual and numerical), in particular for the numerical model domain southwest of the Site.

3.2 Climate

The Site is located approximately 21.5 km south and 10.5 km southeast of the Environment Canada (EC) Mono Centre and Orangeville MOE climate stations, respectively. The composite Orangeville MOE - Mono Centre period of record spans 60 years (1961-2021) and is a reasonably proximal dataset to characterize average climatological conditions in the vicinity of the Study Area. EC Mona Centre climate stations has a period of record from 2013 to 2023 will EC Orangeville MOE climate station has a period of record of 1961 to 2015.

Based on the composite Orangeville MOE / Mono Centre climate station data, average annual precipitation is 899 millimetres (mm) per year (mm/yr) and the average annual temperature is 6.2°C. Additional information on climate is provided in Section 7: Water Balance.

3.3 Topography

Topography for the Site and surrounding lands is presented on Figure 3-1. The dominant physiographic feature in the area is the Niagara escarpment, which runs from northwest to southeast to the east and south of the Site. The Credit River flows from northwest to southeast along the base of the escarpment east and south of the Site and into a gorge south of the Site. In the areas above the escarpment, the topography generally slopes southeast towards the escarpment and the Credit River, with some rolling hills.

Topography in the Main Area of the Site ranges from a high of 424 metres above sea level (masl) in the northwest, to lows of 407 masl in the southeast corner and 402 masl in the southwest corner, with the terrain sloping to the east, south and southwest from that central high point. Topography in the North Area of the Site ranges from a high of 415 masl along the northwest side to a low of 401 masl in the southeast corner, with the terrain again sloping to the east, south and southwest from that central high point. Topography in the South Area of the Site ranges from a high of 407 masl in the northeast corner to a low of 396 masl along the southwest side and southwest corner, with the terrain mainly sloping to the south.

Topography east of the Site slopes eastward towards the Credit River valley and topography south of the Site slopes southeastward, also towards the Credit River valley. Topography west of the Site generally slopes southward. Topography north of the Site generally slopes eastward, from a topographic high of 431 masl along Mississauga Road, to an elevation of 421 masl in north central area north of the Site, and then to an elevation of 410 masl along Main Street.

Northeast of the Site, the Credit River is at an elevation of about 380 masl, and as the river flows to the southeast. South of Cataract, it enters a gorge where the river rapidly drops to an elevation of 320 masl once it is about 2 km downstream of Cataract.

3.4 Drainage

The predominant surface water features in the vicinity of the Site include the Credit River Main and Erin Branches to the east and southwest, respectively. The Credit River Erin Branch receives the majority of drainage from the Site under existing conditions via Tributaries #1 and #8. Tributary #1 enters at the northwest corner of the Site and flows southeast and then west within the Site before it exits through the southwestern boundary. Tributary #1

continues until its convergence with Tributary #8 before ultimately flowing towards the Credit River Erin Branch to the west. The Erin Branch of the Credit River is a major tributary of the Credit River, draining a catchment area of approximately 6.239 km^2, delineated using the Ontario Watershed Information Tool (OWIT), with about 3.22 km^2 of the catchment being located within the Site boundaries.

Several unnamed tributaries of these Credit River branches exist within or proximal to the Site including: Tributary #1 and Tributaries #4-9 (Figure 3-1). Tributaries #4 and #5 are situated directly north of the Site and partially drain the north portion of the Site and the Coulterville Wetland Complex, respectively. These two tributaries converge into a single watercourse (Tributary #4), and eventually discharge through the Osprey Valley Golf Course to the Credit River 0.7 km downstream of the Site. Tributaries #6 – #9 are situated southwest of the Site and drain the surrounding Coulterville Wetland Complex and rural areas. Tributary #9 sits above the remaining tributaries and drains into Tributary #7 which flows alongside Tributary #6 on a roadside ditch before converging into a single watercourse (Tributary #8). Tributary #8 continues to flow southwest before discharging into the Erin Branch of the Credit River over 5.8 km downstream of the Site.

3.5 Geology

3.5.1 Surficial Geology

The Site is located within the eastern portion of the Guelph Drumlin Field physiographic region comprised mainly of glacial spillways, till plains, and drumlinized till plains (Chapman and Putnam 1984), and immediately west of the Niagara escarpment. The Site is entirely mapped as a glacial spillway, with the nearest drumlins mapped approximately 1 km northwest of the Site (M2226 OGS 1972) (Chapman and Putnam 1984).

Surficial geology mapping for the area (MRD128 OGS 2003) is presented on Figure 3-2, and summarized as follows (from oldest to youngest):

- Unit 3: Paleozoic Bedrock – Bedrock outcrops east and south of the Site along the steep slopes of the Niagara escarpment, at or east of the Credit River. Bedrock geology is further described in the next subsection.
- Unit 5b: Stone-Poor, Carbonate-Derived Silty to Sandy Till – Fine grained glacial till (Port Stanley Till) is mapped by the OGS at surface in the eastern and central part of the Main Area, the northeast part of the South Area, and the entirety of the North Area of the Site. This till is also mapped at surface west of the Site.
- Unit 6: Ice-Contact Stratified Deposits – Stratified deposits are not mapped on the Site, but are mapped at surface northwest of the Site, and southeast of the Site in the valley along the Credit River.
- Unit 7 / 7a: Glaciofluvial Deposits / Sandy Deposits – Glaciofluvial deposits mainly comprised of sand and gravel are mapped at surface by the OGS on the west side of the Main Area and the central portion of the South Area. These deposits are also mapped to the northeast, south and southwest, including the area of the Coulterville Wetland Complex. These deposits are also the source of sand and gravel for aggregate pit operations to the southwest of the Site and east of the Site, east of the Credit River.
- Unit 8a: Massive-Well Laminated – These unconsolidated deposits are reportedly not present on the Site but are mapped in a small area in the Credit River valley east of the Site.
- Unit 9c: Foreshore-Basinal Deposits – These deposits are mainly comprised of sand and gravel and are mapped in the south part of the South Area and shown to extend eastward into the Cataract minor urban centre.

- Unit 19: Modern Alluvial Deposits – These modern alluvial deposits are found along the Credit River east and south of the Site and Tributary #8 southwest of the Site.
- Unit 20: Organic Deposits – Organic deposits are mapped to north of the Site in parts of the Coulterville Wetland Complex and in the wooded wetland area immediately north of the Site referred to herein as the "Northwest Wetland".

Water well records and borehole data indicate that overburden thickness is relatively shallow across the Site and variable in thickness in the surrounding area. On top of the escarpment, the overburden varies from less than a metre to tens of metres thick. Bedrock is exposed along the face of the escarpment in some places and covered by a thin veneer of overburden in other places, particularly as one moves further northwest along the escarpment. In the Credit River valley east and south of the Site, the overburden varies from a few metres thick west of the river to more than 100 m thick east of the Credit River.

There are "buried" bedrock valleys inferred to be present in the area, to the east and southwest of the Site and Study Area, as noted in AquaResource (2009). This includes a large northwest-southeast trending buried valley that parallels the escarpment east of the Credit River, and a southwest-northeast trending buried valley southwest of the Site, which appears to be a former glacial meltwater channel that "emerges" and joins the aforementioned buried valley that parallels the escarpment, and drains to the southeast towards Lake Ontario.

3.5.2 Bedrock Geology

The bedrock formations in the Cataract area consist of Paleozoic sedimentary rocks of the northern Appalachian foreland basin and Michigan structural basin (Brunton et al. 2012). The bedrock strata consist of an interlayered succession of sandstones, carbonates, evaporites, shales and siltstones and exhibit a gentle regional dip to the southwest at 3 to 6 m/km. These rocks comprise the Niagara escarpment, which forms a topographic ridge that slopes steeply to the east along the face of the escarpment cross-cutting and exposing the strata, and slopes gently to the southwest generally following the dip of the strata.

The general bedrock geology in the area is presented on Figure 3-3 (MRD126 OGS, 2011) and shows the approximate location of the geological contacts between the main geologic units in plan view.

The OGS has been updating the mapping of Palaeozoic strata in southern Ontario in recent years and has revised the framework for the stratigraphy of this area. Following the revised stratigraphic framework (Carter et al. 2019), a description of the upper bedrock formations at the Site and surrounding area is provided below (from oldest to youngest).

- 55A: Queenston Formation – The Queenston Formation is a thick Upper Ordovician sequence of red and grey shales with thin siltstone, limestone and sandstone interlayers. This unit is exposed in the Credit River valley south of Cataract and is on the order of 200 m thick. It is the lowermost rock unit considered in this assessment.
- 56D: Clinton / Medina (Cataract) Group – The Clinton / Medina Group is locally comprised of the Whirlpool (sandstone), Manitoulin (shaley dolostone), Cabot Head (shale), and Fossil Hill (shaley dolostone) Formations (from oldest to youngest). This Group is of Lower Silurian age and lies unconformably atop the Queenston Formation.
    - Whirlpool Formation – The Whirlpool Formation consists of well-sorted, fine- to medium-grained sandstone with thin shale clasts and interbeds.

- Manitoulin Formation - The Manitoulin Formation consists of thinly- to medium-bedded, blue-grey to tan weathered dolostones with intermittent shaley partings.
- Cabot Head Formation - The Cabot Head Formation, readily distinguished by its grey-green colour, is a non-calcareous laminated fine-grained shale with thin interbeds of sandstone and limestone.
- Rockway, Merritton, Reynales and Fossil Hill Formations – These are dolostone and argillaceous dolostone units that are present in some local areas. As discussed in Section 4, examination of the bedrock from drill cores at the site suggest that these units are not present in the Study Area.

- 58C: Lockport Group – The Lockport Group is comprised of the Gasport (dolostone), Goat Island (dolostone) and Eramosa (dolostone) Formations (from oldest to youngest). This group lies disconformably atop the Clinton / Medina Group and forms the caprock of the Niagara escarpment cuesta.
  - Gasport Formation - The Gasport Formation is a massive to cross-bedded crinoidal dolostone with sequences of reef mound and coquina (shell bed) lithofacies. This unit was previously referred to as the Amabel Formation in older reports. **This is the main upper bedrock unit on the Site and is the primary target formation for aggregate production.**
  - Goat Island Formation – The Goat Island Formation consists of two members; the lower Niagara Falls Member and the upper Ancaster Member. The Niagara Falls Member is a finely crystalline and cross-laminated crinoidal dolostone with small reef mounds and the Ancaster Member is a chert rich, finely crystalline dolostone that is medium to ash grey in colour. This unit is found immediately west of the Site in the Study Area.
  - Eramosa Formation - The Eramosa Formation consists of three members including, from oldest to youngest, the Vinemount Member, the Reformatory Quarry Member and the Stone Road Member. The Vinemount Member is comprised of thinly bedded, fine crystalline dolostone with shaley beds that give off a distinctive petroliferous odour when broken. The Reformatory Quarry Member is described as light brown to cream coloured, pseudo-nodular, thickly bedded and coarsely crystalline dolostone. This unit also often contains mud-rich and microbial mat-bearing lithofacies that may act as aquitard materials, reducing the vertical permeability across this unit. This unit is found west of the Study Area.

3.6 Hydrogeologic Setting

The regional groundwater flow system in the Credit River Watershed is generally controlled by topographic relief and the hydraulic properties of the subsurface materials (AquaResource 2009). Areas of high permeability geologic units such as sand and gravel are typically dominated by rapid lateral movement of groundwater while low permeability units such as silt and clay are typically dominated by slow vertical movement of groundwater. Shallow groundwater moves from areas of high hydraulic head to areas of low hydraulic head, generally following topography, unless flow is modified by geologic conditions or intercepted by stream valleys that intersect the water table. In areas where rivers or streams intersect the water table, groundwater discharges and contributes baseflow to surface water features.

West of the Niagara escarpment, shallow groundwater flow follows topographic relief, and generally flows from northwest to southeast, towards the escarpment. East of the escarpment in the Credit River valley, shallow groundwater is inferred to flow mainly towards the river. In the areas east and south of the Site where the escarpment is a steep scarp face, the overburden above and below the escarpment are not hydraulically connected, and groundwater discharge (seeps) can occur in places on the escarpment face. The water table

declines dramatically across the slope of the Niagara escarpment, following the ground surface topography. Below the escarpment groundwater flow is generally towards Lake Ontario but is strongly influenced by the Credit River and the underlying buried bedrock valley (AquaResource 2009).

Deep groundwater flow in the watershed is found to generally mimic bedrock topography and the groundwater flow in the shallow overlying system. Above the escarpment, the highest water level elevations occur where bedrock elevations are highest (AquaResource 2009).

3.7 Hydrostratigraphy

Hydrostratigraphic units are derived from geologic units based on their general hydrogeologic properties. The hydrostratigraphic units identified for the Credit Valley Watershed and used in Source Water Protection studies (AquaResource 2009) and informed by the OGS 3D bedrock model for the area, were used to develop the current hydrostratigraphic model for the Study Area, as summarized in the table below.

Table 3-1: Hydrostratigraphic Units for the Study Area

Hydrostratigraphic Unit	Zone	Geologic Units Represented
Upper Sand (Aquifer)	Overburden	Sand and gravel at surface
Till (Aquitard)	Overburden	Port Stanley Till
Lower Sand (Aquifer)	Overburden	Sand and gravel below the till
Weathered Bedrock (Aquifer)	Bedrock Contact	Contact zone, upper 1-5 m of weathered bedrock
Eramosa Fm (Aquifer)	Bedrock	Eramosa Formation
Goat Island Fm (Aquifer)	Bedrock	Goat Island Formation
Gasport Fm (Aquifer)	Bedrock	Gasport Formation (upper and middle)
Shaley Dolostone (Aquitard)	Bedrock	Gasport Formation (lowermost 2 to 3 m)
Cabot Head Fm (Aquitard)	Bedrock	Cabot Head Formation
Manitoulin Fm (Aquifer)	Bedrock	Manitoulin Formation
Whirlpool Fm (Aquifer)	Bedrock	Whirlpool Formation
Queenston Fm (Aquiclude)	Bedrock	Queenston Formation

The incorporation of these units in the Conceptual Site Model is discussed in Section 5.10.

3.8 Water Users

3.8.1 MECP Water Well Record Review

The MECP Water Well Information System (WWIS) database was queried and 125 well records were identified within a 1 km radius of the Site, in addition to the monitoring wells installed by Golder for this investigation program, as described in Section 5. Two additional wells just north of the 1 km limit on the Osprey Valley Golf Course property were also included in the compilation of water well records.

The well information in the database was initially tabulated, and then each original water well record was examined and used to verify and refine the information in the MECP database, correcting or adding information if the database was found to have erroneous or missing entries. Hydrostratigraphy for each well was added to the table, in order to identify the aquifer unit(s) that each well draws groundwater from.

The water wells were categorized by aquifer into the following four categories:

- Overburden - Wells installed in the overburden only.
- Bedrock (Gasport) - Bedrock wells installed in the Gasport Formation only.
- Bedrock (below Gasport) - Bedrock wells installed below the Gasport Formation (typically targeting the Manitoulin and/or Whirlpool Formations).
- Bedrock (Gasport and Lower) - Bedrock wells penetrating multiple bedrock units, including the Gasport and the underlying Manitoulin and/or Whirlpool Formations.

A compilation of the water well record information is presented in Appendix B, Table B-1. The water well locations are shown on Figure 3-4, where they have been colour coded by purpose and symbolically coded by aquifer category.

Table 3-2: Summary of Water Wells by Purpose/Use and Aquifer Category

Well Purpose / Use	Number of Wells	Overburden	Bedrock (Gasport)	Bedrock (below Gasport)	Bedrock (Gasport and Lower)
Water Supply - Domestic	88	12	18	6	52
Water Supply - Commercial	7	2		3	2
Water Supply - Industrial	2	1			1
Water Supply - Other	3	1		1	1
Observation / Monitoring	14	6	4	4	
Recharge	9		8	1	
Dewatering	2	2			
Other	2	2			
Number of Wells	127	26	30	15	56

With reference to the table above, Figure 3-4 and Table B-1 the following is noted:

- The wells range in depth from 5.3 to 82.6 m and are, on average, approximately 28 m deep. Static water levels in the wells at the time of construction reportedly ranged from 1.5 to 24.1 m, with an average static water level of approximately 9.3 m.
- Of the 100 water supply wells, 16 wells draw groundwater from the overburden, 18 wells draw groundwater from the Gasport Formation, 10 wells draw groundwater from aquifers below the Gasport Formation, and 56 wells draw groundwater from a combination of the Gasport Formation and aquifers underlying the Gasport Formation (i.e., Manitoulin and Whirlpool Formations).
- Most bedrock water supply wells were rated for low yields, typically on the order of 10 to 25 L/min (approximately 3 to 5 imperial gallons / minute (Igal/min)).
- The two overburden water supply wells (commercial use) were rated at yields of 450 and 560 L/min (approximately 100 and 125 Igal/min).
- The majority of overburden wells are located east of the Credit River or southwest of the Site, where sand and gravel deposits are prominent.
- The majority of domestic water users above the escarpment (i.e., Cataract residents and rural residents) have wells that penetrate multiple bedrock units and draw groundwater from a combination of the Gasport Formation and underlying bedrock units.

3.8.2 Private Well Survey

A door-to-door private well survey was conducted by CBM and Golder in July 2021 at approximately 150 properties within 1 km of the Site to supplement and help verify the MECP WWIS information and confirm water users around the Site. Participation by neighbouring property owners was entirely voluntary. During the door-to-door survey, residents received an explanation of the purpose of the survey and were provided an opportunity to ask questions. The survey form was left with the residents to complete and return by self-addressed mail or email, or elect to complete the survey over the phone.

Unfortunately, there was minimal public participation in the survey with only five property owners / tenants returning surveys, all of which were from the property owners / tenants on CBM-controlled lands. Due to the limited participation, a follow-up private well survey is proposed to be carried out upon licence approval and prior to the initiation of aggregate extraction, to supplement information regarding private well use compiled from the MECP WWIS database.

3.8.3 MECP Permit to Take Water Review

A search of MECP PTTWs identified two permits within approximately 1 km of the Site.

The first is active Permit 1807-AC9P9J for irrigation and water supply at the Osprey Valley Golf Course, owned by Osprey Valley Resorts, Forgehill Equities Inc. This permit includes a water intake from the Credit River which is used to supplement two irrigation ponds (Pond 1 and Pond 3 West) on the property, and a bedrock well (WWR #4909177) that reportedly draws water from the Gasport, Manitoulin and Whirlpool formations. The intake, ponds and well are located approximately 1 to 1.5 km northeast of the Site at the base of the escarpment (Figure 3-4). A copy of the PTTW has been provided to CBM by the permit holder, including groundwater level monitoring data.

The second is active Permit 8358-CAJLV3 dated February 17, 2022, which is held by Aquaterra Corporation (Aquaterra) for the purposes of producing bottled water. This permit replaced former permit 7541-72ZM8Z

originally issued on July 20, 2007, which expired on March 31, 2017. A copy of the Aquaterra PTTW and some supporting documents were obtained through a Freedom of Information Request (FOI) request response, which was received by Golder on January 3, 2023. Upon review of the information received, a follow-up FOI request was made by Golder in an effort to obtain copies of the reports referenced in Schedule A, which form part of the current PTTW. That follow-up FOI request is still in progress.

The Aquaterra "Cataract" well (#4905439) is an overburden well that is permitted to take water at a rate of up to 364 m^3/day, unless the groundwater level at monitoring well "P8" drops below seasonal target levels, in which case the water taking is limited to 227.3 m^3/day (see Note 1, Table 3-3). Based on our review of the 2007-2011 monitoring report for the Aquaterra PTTW (AECOM, 2012) it is understood that these limitations to this water taking are intended to help ensure that surface water flows and groundwater gradients (i.e. upwelling) are maintained in tributaries to the Credit River immediately south of the Aquaterra property.

A summary of the two PTTWs provided in the table below.

Table 3-3: Summary of MECP Permits to Take Water

Permit No	Active	Easting, Northing (m)	Owner	Purpose / Use	Expiry Date	Type of Taking	Source ID	Max m3 / day	Max days / year	Max hours / day	Max L / min
1807-AC9P9J	Yes	576698, 4855364	Forgehill Equities Inc.	Commercial / Irrigation	12-31-2026	Surface and Groundwater	Pond 1	6546	210	24	4546
1807-AC9P9J	Yes	577011, 4855769	Forgehill Equities Inc.	Commercial / Irrigation	12-31-2026	Surface and Groundwater	Pond 3 West	8510	210	24	5910
1807-AC9P9J	Yes	577122, 4856078	Forgehill Equities Inc.	Commercial / Irrigation	12-31-2026	Surface and Groundwater	Credit River	6546	210	24	4546
1807-AC9P9J	Yes	577144, 4855727	Forgehill Equities Inc.	Commercial / Water Supply	12-31-2026	Surface and Groundwater	PW1	426	365	24	295
7541-72ZM8Z	Yes	578459, 4851827	Aquaterra Corporation Ltd.	Commercial / Bottled Water	02-17-2032	Groundwater	Cataract Well	364[1]	260	18	455

Notes:
1 - Water taking is limited to a maximum of 227.3 m^3/day when the average daily water level in monitoring well P8 is at or below 382.89 masl (June-August) or below 382.73 masl (September-May).

3.9 Land Use / Neighbouring Aggregate Sites

General land use designations for the Site and Study Area, based on information available from Land Information Ontario (LOI), is presented on Figure 3-5 and was supplemented by a review of the land use designations in the Tier 2 Integrated Water Budget Report for Credit Valley Source Protection Area (Figure 2-4, AquaResource 2009). Current land uses for the Site and surrounding lands are described below.

With reference to Figure 3-5, the Main and South areas of the Site are mapped as agricultural (tilled) and undifferentiated land use, while the North Area is mapped as having agricultural (tilled), (tree) plantation, and undifferentiated land use. The agricultural lands include areas of intensive and non-intensive agriculture (AquaResource 2009).

Land uses in the area surrounding the Site are mapped as a mixture of agricultural (tilled), (tree) plantation, built up, undifferentiated, and aggregate extraction use. The agricultural lands include areas of intensive and non-intensive agriculture. Other developed land uses in the surrounding area (AquaResource 2009) include a golf course (Osprey Valley Golf Course northeast of the Site), rural residential properties (various locations),

unclassified urban development (Cataract), coniferous plantations (various locations), and a landfill (east of the Credit River).

With reference to Figure 3-5 and the table below, there are eight neighbouring aggregate extraction operations, all of which are pits. Two pits (Franceschini Brothers #6524 and Lafarge Pit #3 #6525) are located above the Niagara escarpment approximately 600 m southwest of the Site in glaciofluvial sand and gravel deposits, and are licensed for below water table extraction.

At pit #6524, below water table extraction has been completed on the majority of the property (Figure 1-1, 2019 aerial imagery) creating a pit pond, which has flattened the water table locally relative to pre-extraction conditions. This pit pond is considered to have a moderating effect on groundwater levels in that vicinity relative to other areas away from the pond that are likely to exhibit higher seasonal fluctuations in the water table.

The property situated to the east of pit #6524 and north of pit #6525 is also a former aggregate site (the Pinchin Pit), which has been fully extracted and rehabilitated. It is our understanding that ownership of the former Pinchin Pit property has recently been transferred to Credit Valley Conservation (CVC).

The remaining six pits are located east of the Study Area and east of the Credit River, below the escarpment, in glaciofluvial sand and gravel deposits; three are licensed for above water table extraction, and three are licensed for below water table extraction.

The table below provides a summary of the neighbouring aggregate sites.

Table 3-4: Neighbouring Aggregate Sites

ALPS ID	6525	6524	6506	6670
Client Name	Warren Paving (Lafarge Canada Inc.)	Warren Paving (Lafarge Canada Inc.)	2004295 Ontario Inc.	Town of Caledon
Location Name	Lafarge Pit No. 3 (Pinkney)	Franceschini Brothers Pit	Caledon Pit	N/A
Current Status	ACTIVE	ACTIVE	ACTIVE	ACTIVE
Operation Type	Pit	Pit	Pit	Pit
Authorization Type	CLASS A LICENCE > 20000 TONNES	CLASS A LICENCE > 20000 TONNES	CLASS A LICENCE > 20000 TONNES	CLASS A LICENCE > 20000 TONNES
Max. Annual Tonnage	N/A	N/A	N/A	200000
Water Status	Below Water	Below Water	Below Water	Above Water
Licensed Area (Ha)	37.47	36.6	571.7	9.2
Lot	E 1/2 13	W 1/2 15	13,14,15 and 16	E 1/2 PT. LOT 15
Concession	5 WHS	5 WHS	III WHS	3 WHS
Lower Tier Municipality	CALEDON	CALEDON	CALEDON	CALEDON
Upper Tier Municipality	PEEL R	PEEL R	PEEL R	PEEL R

ALPS ID	625823	6568	608341	6619
Client Name	Lafarge Canada Inc.	Warren Paving (Lafarge Canada Inc.)	Lafarge Canada Inc.	Warren Paving (Lafarge Canada Inc.)
Location Name	Limebeer Pit	Petch Pit	Lawford Pit	N/A
Current Status	ACTIVE	ACTIVE	ACTIVE	ACTIVE
Operation Type	Pit	Pit	Pit	Pit

ALPS ID	625823	6568	608341	6619
Authorization Type	CLASS A LICENCE > 20000 TONNES	CLASS A LICENCE > 20000 TONNES	CLASS A LICENCE > 20000 TONNES	CLASS A LICENCE > 20000 TONNES
Max. Annual Tonnage	1000000	N/A	750000	450000
Water Status	Mixed Above / Below	Below Water	Above Water	Above Water
Licensed Area (Ha)	39.7	41.88	107.9	78.2
Lot	Pt. 14, 15	E 1/2 LOT 16	Pt Lot 18 & 19	17
Concession	2 WHS	2 WHS	2 WHS	2 WHS
Lower Tier Municipality	CALEDON	CALEDON	CALEDON	CALEDON
Upper Tier Municipality	PEEL R	PEEL R	PEEL R	PEEL R

3.10 Source Water Protection Considerations

The Site lies within the Credit Valley Source Protection Area, which is one of three source protection areas in the Credit Valley – Toronto and Region – Central Lake Ontario (CTC) Source Protection Region.

The Clean Water Act was established in 2006 to protect municipal sources of drinking water from contamination and over-use. Under the Clean Water Act, communities across Ontario are required to prepare a technical assessment report of municipal water sources to identify potential vulnerabilities. These reports act as the background to develop and implement source protection plans. The source protection plans, which have been approved and are in effect, contain policies that protect the municipal water supplies. The following is summarized from the Approved Assessment Report: Credit Valley Source Protection Area (CTC Source Protection Committee 2019).

With respect to municipal drinking water systems, the Site is not located within a WHPA or an IPZ. The closest municipal drinking water systems are the Alton Well Supply to the north and the Caledon Village-Alton Well Supply to the north and east-northeast. The Alton municipal wells are located approximately 3.4 km north-northwest of the Site, and the Caledon Village-Alton wells are located approximately 2.3 km north of the Site and 3.8 km east-northeast of the Site. The closest WHPA is approximately 1.9 km east-northeast of the Site and part of the Caledon Village-Alton WHPA. Since the Site is not located in an WHPA or IPZ, the project cannot potentially contribute a Significant Threat to Municipal water supplies in the area.

On a regional watershed scale, Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRA) were also reviewed. Aquifers are layers of rock or unconsolidated materials that can hold and transmit water easily. Aquifers can be considered highly vulnerable depending on the depth of the aquifer, type of material and type of overlying material. The vulnerability depends on how quickly water can move from surface to the aquifer and describes how easily a source of water can become polluted with a dangerous material.

The HVA mapping for the Study Area (Figure 3-6) is based on an aquifer vulnerability assessment, which was determined through assessment of aquifer depth and geologic setting, and provides an intrinsic vulnerability of the aquifer to sources of surface contamination. As noted on Figure 3-6, portions of the site and Study Area are mapped as a HVA (Figure 3-6). These HVA areas generally coincide with areas mapped as having coarse grain materials at surface (as shown earlier on Figure 3-2).

Drinking water threats, if present, are not considered Significant in an HVA and as such, policies in local Source Protection Plans that apply to HVAs rely on education and outreach to reduce risk to drinking water sources, as outlined in the Source Protection Plan (CTC Source Protection Committee 2022).

Significant Groundwater Recharge Areas are landscapes that allow water to recharge the aquifers below, typically at higher than average rates for the watershed. Similar to HVAs, the SGRAs are mapped where upper soils or rock are more permeable and are typically located in upland areas. The role of SGRAs is to support the protection of drinking water across a broader landscape. The entire Site and Study Area is mapped as a SGRA.

4.0 AGGREGATE RESOURCE INVESTIGATION

The objective of the aggregate resource investigation was to evaluate the quantity, quality and distribution of bedrock and sand and gravel aggregate resources on the Site, by means of a comprehensive borehole drilling and laboratory testing program.

4.1 Drilling Methodology

The borehole drilling was carried out by Choice Sonic Drilling Ltd. (CSD) of Brighton, Ontario under Golder supervision. The drilling took place over a nine month period from February to October 2020, during which time 27 boreholes, BH20-01 to BH20-27, were drilled on the Site at the locations shown on Figure 4-1.

As discussed later in Section 5.1, an additional 28 boreholes were drilled on the Site and surrounding area and completed as monitoring wells from February 2020 to March 2021. Of the additional 28 boreholes, 13 were located on or proximal to the Site and were included in the aggregate resource assessment.

The general methodology for the drilling and sample collection was as follows.

- The boreholes were drilled using a track-mounted Sonic SDC 550 drill rig and support equipment including 4x4 pickup trucks, a skid-steer, and a utility trailer equipped with low-impact tires.
- The rotasonic drilling method was used at the start of each borehole, which obtained a continuous 114 mm diameter (4 ½”) soil core through the overburden and ~1 m into competent bedrock, leaving a temporary casing in place. The overburden samples were logged and bagged for future testing as drilling proceeded.
- Once in competent bedrock, tooling was switched on the rig and the borehole was advanced into the rock by diamond drilling, obtaining HQ-sized (63.5 mm) continuous rock core. Most boreholes were drilled through the overburden and bedrock zone of interest, until shale or shaley dolostone was encountered.
- The rock cores were logged, photographed and boxed. The rock core was later split, with one half of the core sent for testing, and the other half retained for future reference.
- Upon the completion of the drilling, the open rock boreholes were left in place temporarily to allow for downhole geophysical logging and packer testing, as required.
- Once downhole testing was completed, the resource boreholes were abandoned in accordance with O.Reg. 903.

All boreholes were later surveyed by Delph and Jenkins North Ltd. of Aurora, Ontario and the results provided to Golder via CBM. Record of Borehole Logs are provided in Appendix C. A summary of the resource boreholes drilled is provided in Table 4-1. A summary of the additional boreholes drilled that were completed as monitoring wells is provided in Table 5-1 and shown on Figure 5-1, noting that 13 of those boreholes were also used in the aggregate resource assessment.

Table 4-1 - Summary of Resource Boreholes Drilled
Caledon Pit / Quarry

Borehole	Date Drilled:	Easting (m) UTM 17T	Northing (m) UTM 17T	Ground Elevation (masl)	Total Hole Depth (mbgs)	Depth of casing (mbgs)	Depth to Bedrock (mbgs)	Depth to bottom of Gasport (mbgs)	Depth to top of Cabot Head (mbgs)	Downhole Geophysics Completion	Packer Testing Completion
BH20-01(CAL)	07-Feb-20	578000.61	4853292.80	406.80	22.07	2.60	1.80	17.10	18.94	18-Feb-20	06-Mar-20
BH20-02(CAL)	10-Feb-20	577839.36	4853078.92	405.52	22.02	4.22	3.84	21.19	22.02	18-Feb-20	09-Mar-20
BH20-03(CAL)	26-Feb-20	577655.12	4852796.26	402.91	19.33	3.05	2.74	17.88	19.33	10-Mar-20	18-Mar-20
BH20-04(CAL)	18-Feb-20	577511.78	4852528.07	400.81	19.57	8.89	6.52	17.40	19.57	24-Feb-20	10-Mar-20
BH20-05(CAL)	19-Feb-20	577786.25	4852520.23	398.83	16.35	5.93	4.87	13.05	15.80	24-Feb-20	11-Mar-20
BH20-06(CAL)	20-Feb-20	578056.45	4852520.24	397.70	16.60	8.88	7.32	13.50	16.60	25-Feb-20	11-Mar-20
BH20-07(CAL)	21-Feb-20	578129.13	4853102.34	404.73	18.67	2.79	2.29	17.32	18.67	25-Feb-20	13-Mar-20
BH20-08(CAL)	24-Feb-20	577961.99	4852832.00	404.50	17.90	5.49	5.33	17.27	17.90	11-Mar-20	17-Mar-20
BH20-09(CAL)	25-Feb-20	578186.33	4852803.00	402.26	16.77	3.86	2.74	15.63	16.77	10-Mar-20	16-Mar-20
BH20-10(CAL)	17-Mar-20	577940.09	4853952.34	411.07	19.55	8.89	7.62	16.75	18.57	25-Mar-20	06-Apr-20
BH20-11(CAL)	18-Mar-20	578065.10	4854240.45	402.10	10.20	2.79	1.83	8.64	10.20	26-Mar-20	07-Apr-20
BH20-12(CAL)	23-Mar-20	577780.56	4854244.92	415.22	21.76	12.04	10.40	19.34	21.76	25-Mar-20	02-Apr-20
BH20-13(CAL)	27-Mar-20	577209.70	4854103.25	412.94	22.80	5.94	5.18	20.78	22.64	20-Apr-20	20-Apr-20
BH20-14(CAL)	02-Apr-20	577288.55	4853881.70	417.27	31.46	8.99	8.08	27.48	29.42	14-Apr-20	21-Apr-20
BH20-15(CAL)	07-Apr-20	576925.21	4854113.14	421.52	34.76	15.14	13.41	33.86	34.76	14-Apr-20	22-Apr-20
BH20-16(CAL)	15-Apr-20	576991.38	4853859.50	420.74	34.18	13.71	11.89	32.44	34.16	20-Apr-20	27-Apr-20
BH20-17(CAL)	20-Apr-20	577474.67	4853391.65	413.06	28.83	5.84	3.35	26.77	28.83	27-Apr-20	29-Apr-20
BH20-18(CAL)	23-Apr-20	577313.39	4853571.83	417.53	31.84	5.94	3.96	31.00	31.84	27-Apr-20	28-Apr-20
BH20-19(CAL)	24-Mar-20	577733.06	4853579.97	411.42	24.64	3.05	2.74	22.48	24.40	27-Apr-20	30-Apr-20
BH20-20(CAL)	30-Apr-20	577031.10	4853551.56	423.60	40.98	14.94	14.33	38.65	40.58	20-May-20	27-May-20
BH20-21(CAL)	05-May-20	576935.66	4853276.58	413.53	33.48	6.12	5.49	31.54	33.48	20-May-20	28-May-20
BH20-22(CAL)	07-May-20	576701.79	4853293.98	410.98	28.61	5.71	3.96	27.52	28.61	20-May-20	03-Jun-20
BH20-23(CAL)	11-May-20	576779.85	4853559.83	420.27	37.62	14.98	12.80	35.82	37.62	25-May-20	04-Jun-20
BH20-24(CAL)	27-May-20	577296.02	4852710.32	403.60	22.76	12.24	8.80	21.75	22.45	08-Jun-20	11-Jun-20
BH20-25(CAL)	10-Jun-20	577402.13	4852974.96	405.48	22.03	6.18	4.88	21.04	22.03	15-Jun-20	17-Jun-20
BH20-26(CAL)	11-Jun-20	577037.86	4852942.75	404.82	22.73	5.89	3.96	21.04	22.73	15-Jun-20	16-Jun-20
BH20-27(CAL)	22-Oct-20	577212.29	4853168.73	408.64	27.65	2.60	1.60	25.08	26.87	22-Oct-20	26-Oct-20

4.2 Laboratory Testing

4.2.1 Sand and Gravel Core Testing

The soil core samples were temporarily stored in an enclosed laydown area on the Site, and then transported to Golder's Materials Testing Laboratory in Whitby, which is accredited for Aggregate Testing by the Canadian Council of Independent Laboratories (CCIL) and the Ministry of Transportation Ontario (MTO).

As summarized in the table below, of the 40 resource boreholes / wells drilled on or proximal to the Site, a total 177 soil samples were collected, and of those, 71 representative samples were selected for sieve analysis. This includes 48 representative samples tested for both sieve and wash loss, and for which Fineness Modulus (FM), % Wash Loss, % Crushable Stone and Stone-to-Sand Ratio were also calculated.

Table 4-2: Summary of Sand and Gravel Core Samples Tested

Resource Assessment Boreholes	# BHs / MWs	Soil Samples	Sieve	Sieve and Wash Loss	Fineness Modulus	Wash Loss (%)	Crushable Stone (%)	Stone to Sand Ratio
BH20-01 to BH20-27	27	113	51	38	38	38	38	38
MW20-01, 02, 07, 08, 09, 10,11, 12, 14, 15, 16, 17, 18	13	64	20	10	10	10	10	10
Totals	**40**	**177**	**71**	**48**	**48**	**48**	**48**	**48**

4.2.2 Rock Core Testing

The rock core samples were also temporarily stored in an enclosed laydown area on the Site where they were photographed, and then transported to Golder's Materials Testing Laboratory in Whitby, which is accredited for Aggregate Testing by the CCIL and the MTO.

As summarized in the table below, the 477.58 m of rock core obtained from 33 resource boreholes / wells drilled on the Site were subjected to the following suite of quality tests:

- Material Finer than 75µm (LS-601)
- Sieve Analysis (LS-602)
- Absorption and Specific Gravity, Coarse Aggregate (LS-604)
- Absorption and Specific Gravity, Fine Aggregate (LS-605)
- Magnesium Sulphate Soundness, Coarse Aggregate (If Required) LS-606
- Percent Flat and Elongated Particles (LS-608)
- Petrographic Number (PN), Coarse Aggregate (LS-609)
- Organic Impurities (LS-610)
- Unconfined Freeze-Thaw Loss (LS-614)
- Micro-Deval Abrasion Loss, Coarse Aggregate (LS-618)
- Micro-Deval Abrasion Loss, Fine Aggregate (LS-619)
- Accelerated Mortar Bar Expansion (LS-620 Coarse and Fine Aggregate)

A summary of the rock core testing is provided in the table below, noting that rock quality was only tested for boreholes on the Site and not boreholes proximal to the Site.

Table 4-3: Summary of Rock Core Samples Tested

Resource Assessment Boreholes	# BHs / MWs	Core Tested (m)	Wash Loss	SG / Absorption	PN	Unconfined Freeze / Thaw	Micro-Deval Abrasion	Accel. Mortar Bar	Alkali-Carbonate Reactivity
BH20-01 to BH20-27	27	384.60	16	27	27	16	27	27	27
MW20-11, 12, 14, 15, 16, 18	6	92.98	0	6	6	0	6	6	6
Totals	**33**	**477.58**	**16**	**33**	**33**	**16**	**33**	**33**	**33**

4.3 Results

4.3.1 Sand and Gravel Resource

Based on borehole drilling and soil core logging, the distribution of sand and gravel material on the Site considered to be of interest for aggregate use is presented on Figure 4-2. Sand and gravel of significant thickness was found to be present in the South Area and in the western corner of the Main Area of the Site. This distribution is generally consistent with surficial geology mapping presented on Figure 3-2. The sand and gravel thickness increases from east to west, where it is in excess of 12 m thick in the western part of the Main and South areas.

The sieve and wash loss results for the 48 samples tested are summarized in the table below. The samples tested indicate that the sand and gravel deposit has an average Fineness Modulus of 4.15, contains 17% crushable stone on average, and has an average Stone:Sand ratio of 58:42, indicating that the material has a gradation suitable for producing a range of aggregate products.

Table 4-4: Sand and Gravel Sieve and Wash Loss Results

Full FM Value	Sand Portion FM Value	% Wash Loss	% Crushable Stone	% Stone	% Sand	Stone : Sand Ratio	Stats
1.00	0.88	7	0	0	1	0:100	Min
11.23	5.99	53	75	99	100	99:1	Max
4.15	2.87	28	17	33	67	58:42	Avg

There is estimated to be approximately 2.75 million m^3 of sand and gravel present on the Site within the two areas noted above. Based on the maximum predicted water table determined through the groundwater monitoring program and presented later in the report on Figure 5-6, approximately 75% of the sand and gravel resource is estimated to lie above the high water table on the Site, and the remaining 25% of the resource is below the high water table. Assuming an average material density of 1.65 t/m^3 and an approximate processing loss of 12.5% there is estimated to be approximately 4.00 Mt of economic sand and gravel on the Site.

4.3.2 Rock Resource

The cored boreholes were typically advanced through the entire thickness of the Gasport Formation and into the underlying Shaley Dolostone, and in some cases, were drilled through the Shaley Dolostone and into the Cabot Head Formation shale. Representative rock core photos of the main rock units encountered by the drilling program: the Gasport, Fossil Hill and Cabot Head Formations, are shown on Figure 4-3. These cores were drilled at BH20-01 located in the eastern half of the South Area, the first borehole drilled in February 2020, and are representative of these rock units on the Site.

With reference to the borehole logs in Appendix C, the thickness of the Gasport Formation on the Site encountered during drilling varied from 6.18 m to 27.04 m. The overall inferred thickness of the Gasport formation on the Site within the proposed licence area, based on contouring data from cored boreholes and monitoring wells on and proximal to the Site, is presented on Figure 4-4, and varies from approximately 3 m to 28 m. The Gasport formation is thickest in the northcentral part of the Main Area, where it forms a local topographic high (see Figure 3-1), and becomes thinner to the east and to the south. The Gasport Formation was found to be present in all boreholes drilled on the Site.

The rock core quality test results were very favourable, as all samples tested from the 33 boreholes drilled on the Site met all of the required MTO specifications for concrete aggregate.

There is estimated to be approximately 31.6 million m^3 of dolostone present on the Site within the areas shown on Figure 4-4. Based on the maximum predicted water table determined through the groundwater monitoring program and presented later in the report on Figure 5-6, approximately 8% of the dolostone bedrock resource is estimated to lie above the high water table on the Site, and the remaining 92% of the resource is below the high water table. Assuming an average material density of 2.60 t/m^3 and an approximate processing loss of 5% there is estimated to be approximately 78.24 Mt of economic dolostone on the Site.

4.3.3 Geologic Model

The resource investigation results were used (in conjunction with geologic information from the background review) to develop a geological model of the Site and Study Area. This model, based on the hydrostratigraphic units defined in Table 3-1, is illustrated in the two orthogonal geological cross-sections through the Site shown on Figures 4-5 and 4-6. Development of the geological model for the Site and its use in the development and implementation of integrated surface water-groundwater numerical model is discussed further in Section 8: Numerical Modelling.

5.0 GROUNDWATER INVESTIGATION

The overall objective of the groundwater investigation was to collect the hydrogeologic information necessary to characterize current hydrogeologic conditions on the Site and in the Study Area, in order to assess the potential impacts of the proposed Caledon Pit / Quarry on groundwater resources, groundwater users and ecological receptors. The groundwater investigation was comprised of the following key components, which are further described in the subsections below:

- Drilling and Monitoring Well Installation;
- Downhole Geophysical Logging;
- Groundwater Level Monitoring;
- Hydraulic Testing - Packer Testing;
- Hydraulic Testing - Single Well Response Tests (SWRTs);
- Hydraulic Testing - Pumping Tests;
- Groundwater Quality Assessment;
- Supplemental Investigations in the Northwest Area; and
- A Karst Assessment.

5.1 Drilling and Monitoring Well Installation

5.1.1 Methodology

Similar to the resource drilling described in Section 4, drilling and monitoring well installation at the Site and Study Area was carried out by CSD under Golder supervision. The drilling and monitoring well installation took place over a 14 month period from February to June 2020, November to December 2020, and lastly, February to April 2021. Monitoring well locations are shown on Figure 5-1.

The general methodology for the drilling and installation of monitoring wells MW20-01 to MW20-28 was as follows.

- The drilling of boreholes for the monitoring well network and resource boreholes were completed concurrently and followed the same drilling methodology. The drilling methodology was previously described in Section 4.1 (Aggregate Resource Investigation).
- Upon the completion of the drilling, the open rock boreholes were left in place temporarily to allow for downhole geophysical logging and packer testing, as required.
- Once downhole testing was completed, the boreholes were either abandoned in accordance with O.Reg. 903, or the boreholes were completed as bedrock monitoring well nests.
- Monitoring well nests (typically two per location) were installed in the 96 mm open rock borehole using 25 mm (1”) SCH40 PVC well screen and riser pipe. A sand pack was placed in the borehole annulus at each well screen interval, and bentonite pellets were placed in the borehole annulus between the screened intervals to provided hydraulic separation. The borehole annulus was then sealed to surface using bentonite pellets. Each installation was completed at surface with a lockable protective well casing.
- Additional shallow overburden monitoring wells were installed in five locations, including three locations where the shallow well was offset and installed in a separate borehole. The offset wells were drilled and installed in the overburden using the same rotasonic drilling method. The wells were installed with 25 mm (1”) SCH40 PVC well screen and riser pipe. A sand pack was placed in the borehole annulus at each well

screen interval and bentonite pellets were placed in the borehole annulus to surface. Each offset installation was completed at surface with a lockable protective well casing.

- The monitoring wells were later developed by purging, using a 13 mm inner diameter Waterra tubing with an inertial foot valve. Development was considered complete based on one of the following conditions being met: development water became clear, ten times the volume of water in the monitoring well had been pumped, or the well was pumped dry allowed to recover (fully or partially depending on recovery speed) and pumped dry again.

The general methodology for the drilling and installation of the four test pumping wells PW21-01 to PW21-04 was as follows.

- A 171 mm (6 ¾”) diameter rotasonic borehole was initially drilled through the overburden and into competent bedrock, obtaining a continuous 136 mm diameter (5 ¼”) soil and rock core. The bit and casing were left in place and the annulus was grouted to surface.
- The borehole was then advanced through the bedrock to the required depth with the rotasonic method, obtaining a continuous 114 mm diameter (4 ½”) rock core and leaving a 124 mm (4 7/8”) open borehole in the rock.
- Each installation was then completed at surface with a lockable protective well casing.

The general methodology for the drilling and installation the 15 additional monitoring wells MW21-1-1 to MW21-1-4; MW21-2-1 to MW21-2-4; MW21-3-1 to MW21-3-4 and MW21-4-1 to MW21-4-3, was as follows.

- The borehole was advanced through the overburden and bedrock to the required depth with the rotasonic method, obtaining a continuous 114 mm diameter (4 ½”) soil rock core and leaving a 124 mm (4-7/8”) open borehole in the rock.
- The well installation was completed using 50 mm (2”) SCH40 PVC well screen and riser pipe. These wells were screened across the entire bedrock interval with a sand pack and then sealed up to surface using bentonite pellets.
- Each installation was then completed at surface with a lockable protective well casing.

All boreholes and monitoring wells were later surveyed by Delph and Jenkins North Ltd. of Aurora, Ontario and the results provided to Golder via CBM.

All monitoring and pumping wells were tagged and registered with the MECP in their WWIS. The well records were submitted to the MECP by CSD on behalf of CBM, the owner of the wells.

5.1.2 Results

A summary of the boreholes drilled and monitoring well installation details is provided in Table 5-1. Monitoring well locations are shown on Figure 5-1. Record of Borehole and Monitoring Well Logs are provided in Appendix C. The wells were subsequently used for groundwater level monitoring, single well response tests, pumping tests, and groundwater quality sampling, as discussed in later subsections.

Table 5-1 - Summary of Monitoring Wells Drilled and Installed
Caledon Pit / Quarry

Well	Date Drilled	Easting (m) UTM 17T	Northing (m) UTM 17T	Elevation (masl)	Total Hole Depth (mbgs)	Depth of casing (mbgs)	Depth to Bedrock (mbgs)	Depth to bottom of Gasport (mbgs)	Depth to top of Cabot Head (mbgs)	Downhole Geophysics Completion	Packer Testing Completion	Mon Well Completion	Deep (A) Well Stickup (m)	Deep (A) Well Formation	Screen from (m)	Screen to (m)	Shallow (B) Well Stickup (m)	Shallow (B) Well Formation	Screen from (m)	Screen to (m)
MW20-01(CAL) A/B	27-Feb-20	577458.50	4852268.28	395.10	19.41	9.06	8.53	14.86	17.32	13-Mar-20	19-Mar-20	20-Mar-20	0.99	Shaley Dolostone or Cabot Head Fm	15.40	17.10	0.99	Gasport Fm	11.10	12.62
MW20-02(CAL)	02-Mar-20	577900.04	4852138.37	399.63	19.57	15.94	15.24	18.05	19.57	11-Mar-20	N/A	23-Mar-20	1.05	Shaley Dolostone or Cabot Head Fm	16.96	18.48				
MW20-03(CAL)	04-Mar-20	578243.54	4851907.30	390.67	35.97	N/A	34.44	Not present	35.66	N/A	N/A	05-Mar-20	1.00	Overburden	15.58	18.63				
MW20-04(CAL)	06-Mar-20	578264.75	4852313.19	399.46	18.50	15.08	14.33	Not present	16.54	13-Mar-20	N/A	24-Mar-20	1.04	Shaley Dolostone or Cabot Head Fm	16.11	17.63				
MW20-05(CAL) A/B	09-Mar-20	578423.10	4852712.60	399.63	14.84	2.06	1.52	10.60	13.91	20-Mar-20	25-Mar-20	25-Mar-20	1.00	Shaley Dolostone or Cabot Head Fm	12.25	13.77	1.00	Gasport Fm	4.25	5.77
MW20-06(CAL) A/B	10-Mar-20	578474.24	4852972.59	400.15	16.03	2.32	2.14	10.96	14.25	23-Mar-20	26-Mar-20	26-Mar-20	0.99	Gasport Fm	10.12	11.64	0.99	Gasport Fm	4.20	5.72
MW20-07(CAL) A/B	11-Mar-20	578359.89	4853250.44	404.07	19.45	2.74	2.13	13.20	16.40	18-Mar-20	01-Apr-20	01-Apr-20	0.77	Shaley Dolostone or Cabot Head Fm	15.11	16.63	0.77	Gasport Fm	9.74	11.26
MW20-08(CAL) A/B	13-Mar-20	578009.81	4853574.83	406.93	18.59	2.74	1.98	15.10	17.32	19-Mar-20	30-Mar-20	31-Mar-20	0.92	Gasport Fm	13.30	14.82	0.92	Gasport Fm	5.38	6.90
MW20-09(CAL)	17-Mar-20	578343.84	4854157.49	399.95	9.01	5.79	5.33	Not Present	7.48	26-Mar-20	N/A	07-Apr-20	1.01	Shaley Dolostone or Cabot Head Fm	6.85	8.37				
MW20-10(CAL) A/B	19-Mar-20	577837.95	4854407.28	411.32	21.19	12.04	10.97	16.76	19.55	24-Mar-20	08-Apr-20	08-Apr-20	0.92	Shaley Dolostone or Cabot Head Fm	18.62	20.14	0.89	Gasport Fm	14.49	16.01
MW20-11(CAL) A/B	24-Mar-20	577671.98	4853921.39	409.72	19.39	3.07	2.13	16.46	18.16	07-Apr-20	14-Apr-20	15-Apr-20	1.03	Gasport Fm	13.81	15.33	1.01	Gasport Fm	3.96	5.48
MW20-12(CAL) A/B	26-Mar-20	577271.90	4854321.42	412.43	22.65	5.94	3.66	19.80	21.66	08-Apr-20	17-Apr-20	17-Apr-20	1.02	Gasport Fm	17.09	18.62	1.01	Gasport Fm	4.42	5.94
MW20-13(CAL) A/B	08-Apr-20	576873.11	4854473.14	415.53	28.23	15.08	13.10	23.92	25.68	15-Apr-20	23-Apr-20	24-Apr-20	0.93	Shaley Dolostone or Cabot Head Fm	24.05	25.57	0.93	Gasport Fm	18.14	19.66
MW20-13 (CAL) C	08-Apr-20	576873.11	4854473.14	415.53	5.10	N/A	N/A	N/A	N/A	N/A	N/A	08-Apr-20	0.93	Overburden	3.08	4.60				
MW20-14(CAL) A/B	28-Apr-20	577575.99	4853100.42	406.71	26.35	2.74	2.29	22.40	24.50	14-May-20	26-May-20	26-May-20	0.96	Shaley Dolostone or Cabot Head Fm	22.60	24.12	1.05	Gasport Fm	14.98	16.50
MW20-15(CAL) A/B	20-May-20	576576.79	4853544.15	417.06	37.17	12.30	11.60	33.84	35.62	27-May-20	08-Jun-20	09-Jun-20	0.70	Shaley Dolostone or Cabot Head Fm	33.77	35.29	0.71	Gasport Fm	28.81	30.33
MW20-15 (CAL) C	20-May-20	576576.79	4853544.15	417.06	5.00	N/A	N/A	N/A	N/A	N/A	N/A	20-May-20	0.70	Overburden	2.74	4.27				
MW20-16(CAL) A/B	22-May-20	576784.58	4853806.76	421.40	39.77	14.90	11.90	35.52	37.28	26-May-20	10-Jun-20	10-Jun-20	1.05	Gasport Fm	34.84	36.36	1.05	Gasport Fm	16.80	18.33
MW20-17(CAL) A/B	26-May-20	576752.28	4852966.36	406.64	28.82	3.15	3.05	24.84	27.49	01-Jun-20	02-Jun-20	02-Jun-20	1.05	Shaley Dolostone or Cabot Head Fm	25.64	27.16	0.99	Gasport Fm	12.75	14.27
MW20-18(CAL)	09-Jun-20	577058.36	4852658.80	404.29	28.15	12.19	11.88	23.80	26.06	12-Jun-20	15-Jun-20	15-Jun-20	1.03	Gasport Fm	12.42	13.94				
MW20-19(CAL) A/B	27-Oct-20	576906.96	4851999.96	396.98	27.39	6.20	2.14	22.05	24.48	29-Oct-20	30-Oct-20	31-Oct-20	1.07	Gasport Fm	15.95	17.47	1.07	Gasport Fm	8.00	9.52
MW20-20(CAL) A/B	29-Oct-20	576476.35	4852467.69	403.00	27.99	5.98	2.14	25.15	27.18	30-Oct-20	03-Nov-20	03-Nov-20	0.82	Shaley Dolostone or Cabot Head Fm	25.33	26.85	0.82	Gasport Fm	12.97	14.49
MW20-20(CAL) C	03-Nov-20	576476.26	4852468.33	403.00	5.00	N/A	2.14	N/A	N/A	N/A	N/A	03-Nov-20	0.96	Gasport Fm	2.42	3.95				
MW20-21(CAL) A/B	04-Nov-20	576014.37	4852839.77	415.23	39.70	15.10	12.51	36.73	38.38	05-Nov-20	06-Nov-20	07-Nov-20	1.07	Gasport Fm	33.27	34.79	1.07	Gasport Fm	15.77	17.29
MW20-22(CAL) A/B	18-Nov-20	575785.36	4851966.28	399.27	30.75	5.94	4.57	28.16	29.81	18-Nov-20	N/A	19-Nov-20	0.97	Goat Island Fm	23.47	25.00	0.97	Goat Island Fm	6.89	8.41
MW20-23(CAL) A/B	23-Nov-20	576205.53	4851555.91	395.05	26.76	12.19	11.28	23.54	25.30	24-Nov-20	N/A	24-Nov-20	0.87	Shaley Dolostone or Cabot Head Fm	22.59	24.11	0.87	Goat Island Fm	14.68	16.20
MW20-23 (CAL) C	23-Nov-20	576205.91	4851556.34	395.00	7.00	N/A	N/A	N/A	N/A	N/A	N/A	23-Nov-20	0.88	Overburden	4.57	6.09				
MW20-24(CAL) A/B	03-Dec-20	575337.66	4854341.85	437.75	37.49	20.88	20.11	37.49	N/A	04-Dec-20	N/A	04-Dec-20	0.87	Gasport Fm	33.81	35.33	0.87	Goat Island Fm	21.49	23.02
MW20-25(CAL) A/B	10-Dec-20	574853.76	4852900.48	419.02	51.82	13.39	10.52	48.93	50.67	10-Dec-20	N/A	11-Dec-20	1.56	Gasport Fm	44.03	45.55	1.55	Goat Island Fm	16.84	18.36
MW20-26(CAL) A/B	17-Dec-20	574373.86	4853638.42	438.89	66.11	15.55	12.19	64.55	66.11	18-Dec-20	N/A	21-Dec-20	1.16	Gasport Fm	55.16	56.68	1.16	Goat Island Fm	31.12	32.64
MW20-26 (CAL) C	17-Dec-20	574375.17	4853637.62	438.88	10.00	N/A	N/A	N/A	N/A	N/A	N/A	17-Dec-20	1.07	Overburden	7.26	8.78				
MW20-27(CAL) A/B	12-Feb-21	575953.96	4853770.16	431.15	52.43	31.24	28.96	50.32	51.93	17-Feb-21	N/A	18-Feb-21	0.97	Goat Island Fm	41.99	43.51	0.98	Goat Island Fm	33.85	35.37
MW20-28(CAL) A/B	22-Feb-21	576139.79	4854987.82	419.31	30.82	12.80	12.19	28.45	30.20	23-Feb-21	N/A	23-Feb-21	0.96	Gasport Fm	24.07	25.59	0.93	Gasport Fm	16.51	18.03
MW21-1-1	03-Mar-21	576882.20	4853485.00	418.94	36.27	11.89	10.06	34.30	36.27	04-Mar-21	N/A	09-Mar-21	0.86	Gasport Fm	12.80	36.27				
MW21-1-2	24-Feb-21	576909.58	4853505.06	420.58	36.00	13.11	12.19	35.36	36.00	03-Mar-21	N/A	09-Mar-21	0.90	Gasport Fm	11.89	36.00				
MW21-1-3	02-Mar-21	576965.46	4853420.30	417.51	37.49	8.84	7.32	34.90	36.58	03-Mar-21	N/A	09-Mar-21	1.07	Gasport Fm	13.11	37.49				
MW21-1-4	04-Mar-21	576866.19	4853450.60	417.83	35.96	11.89	10.97	33.53	35.66	05-Mar-21	N/A	09-Mar-21	1.01	Gasport Fm	8.84	35.96				
MW21-2-1	16-Mar-21	577279.08	4854021.09	413.40	23.47	8.99	5.79	22.71	23.32	18-Mar-21	N/A	18-Mar-21	0.93	Gasport Fm	11.89	23.47				
MW21-2-2	15-Mar-21	577260.02	4854050.91	412.64	23.47	15.39	6.10	20.96	22.88	17-Mar-21	N/A	18-Mar-21	0.96	Gasport Fm	8.99	23.47				
MW21-2-3	11-Mar-21	577349.69	4854098.46	410.76	23.77	5.64	2.74	18.98	20.62	17-Mar-21	N/A	18-Mar-21	0.93	Gasport Fm	15.39	23.77				
MW21-2-4	16-Mar-21	577297.52	4854001.66	413.86	26.52	12.19	4.27	23.64	25.60	17-Mar-21	N/A	19-Mar-21	0.87	Gasport Fm	5.64	26.52				
MW21-3-1	30-Mar-21	577871.84	4852814.09	403.69	21.03	5.79	4.57	17.07	19.50	31-Mar-21	N/A	01-Apr-21	0.96	Gasport Fm	12.19	21.03				
MW21-3-2	30-Mar-21	577920.27	4852838.38	404.87	21.03	5.79	3.66	17.96	20.20	01-Apr-21	N/A	02-Apr-21	0.84	Gasport Fm	5.79	21.03				
MW21-3-3	30-Mar-21	577935.55	4852730.93	405.12	19.20	8.84	8.23	18.90	19.20	31-Mar-21	N/A	02-Apr-21	1.06	Gasport Fm	5.79	19.20				
MW21-3-4	29-Mar-21	577837.91	4852827.25	403.16	19.20	5.94	3.35	16.16	18.45	31-Mar-21	N/A	01-Apr-21	1.03	Gasport Fm	8.84	19.20				
MW21-4-1	22-Mar-21	577793.12	4854211.47	415.22	23.77	11.89	8.84	19.86	22.60	22-Mar-21	N/A	24-Mar-21	0.97	Gasport Fm	5.94	23.77				
MW21-4-2	22-Mar-21	577790.26	4854247.25	415.07	23.77	11.89	9.14	19.52	22.40	22-Mar-21	N/A	24-Mar-21	0.83	Gasport Fm	11.89	23.77				
MW21-4-3	23-Mar-21	577813.86	4854182.83	414.78	21.64	9.25	9.14	19.58	21.64	23-Mar-21	N/A	25-Mar-21	0.92	Gasport Fm	11.89	21.64				
PW21-1	08-Mar-21	576890.23	4853478.69	418.76	38.41	12.19	10.97	34.42	36.58	08-Mar-21	N/A	08-Mar-21	0.66	Gasport Fm	12.19	38.41				
PW21-2	17-Mar-21	577286.29	4854027.50	413.07	25.15	12.19	4.27	22.56	24.38	18-Mar-21	N/A	17-Mar-21	0.84	Gasport Fm	12.19	25.15				
PW21-3	31-Mar-21	577875.55	4852797.50	405.45	21.34	8.84	6.10	18.68	21.00	01-Apr-21	N/A	31-Mar-21	0.57	Gasport Fm	8.84	21.34				
PW21-4	23-Mar-21	577802.09	4854214.36	415.08	21.64	9.25	8.84	19.60	21.49	23-Mar-21	N/A	23-Mar-21	0.75	Gasport Fm	9.25	21.64				

5.2 Downhole Geophysical logging

5.2.1 Methodology

The downhole geophysical logging of resource boreholes and monitoring wells at the proposed Caledon Pit / Quarry Site was carried out by Golder personnel over a 14 month period from February to June 2020, November to December 2020, and lastly, February to April 2021, as the drilling of boreholes and installation of monitoring wells progressed. The overall objective of downhole geophysical logging was to help characterize the subsurface stratigraphy and hydrostratigraphy at the Site and Study Area, by helping to identify geological contacts and rock types, and potential water bearing zones in the bedrock.

A description of the geophysical logging methods used is provided below.

Natural Gamma

The natural gamma log provides a measurement that is proportional to the natural radioactivity of the soil and rock formations in the borehole and is recorded in counts per second (cps). The gamma log is typically responds to soil and/or rock material within a 25 to 30 cm radius from the borehole. The gamma log is principally used for lithologic identification and stratigraphic correlation.

Natural gamma logging employs a sodium iodide (NaI) scintillation detector. The gamma-emitting radioisotopes that naturally occur in geologic materials (such as clays, shales, gypsum and some crystalline rocks) are potassium^{40} and nuclides in the uranium^{238} and thorium^{232} decay series. Potassium^{40} occurs with all potassium bearing minerals including k-feldspars and clays. Uranium^{238} is typically associated with dark shales, clays and uranium mineralization. Thorium^{232} is typically associated with biotite, sphene, zircon and other heavy minerals. In the current study, the natural gamma response is inferred to be proportional to the clay content of the soils and the shale content of the sedimentary rocks.

Apparent Conductivity

The apparent conductivity log is a measure of the electrical conductivity of the soil and rock in the borehole. The apparent conductivity tool works by electromagnetic induction, transmitting a focussed primary electromagnetic signal into the soil and rock around the borehole, and measuring the secondary magnetic field induced within the soil or rock. The transmitter and receiver coils are configured so that the tool is “focussed” approximately 30 cm into the formation, to minimize the influence of the borehole itself. Because it works by electromagnetic induction, it also responds to metal, and it cannot penetrate through a metal casing. Apparent conductivity is measured in units of milliSiemens / metre (mS/m).

Apparent conductivity is primarily a function of clay / shale content, water content and the dissolved ion concentration in the pore fluid. When clays are saturated, the adsorbed ions can become partially dissociated and available for ionic conduction. Since clay particles have a relatively large surface area, the presence of small amounts of clay can significantly increase apparent conductivity.

Typically, the apparent conductivity of sediments and sedimentary rocks correlates to the natural gamma response. However, when the pore fluid contains elevated dissolved solids, as in the case of some groundwater contaminant plumes, the apparent conductivity will increase irrespective of the natural gamma response. In the current study, the apparent conductivity response is related to the clay content of the soils and the shale content of the sedimentary rocks.

Optical Televiewer (OBI)

The optical televiewer produces is a continuous spatially-oriented 360° image of the borehole wall at a millimetre scale, acquired using an optical imaging system as the probe is slowly moved along the borehole. The optical borehole imaging (OBI) tool also records telemetry during logging, so that the azimuth of the scan and the deviation of the borehole can be measured during logging. The tool is centralized and requires that the borehole be either dry or the borehole fluid is clear, in order to have good visibility.

The resulting borehole images are used to help identify rock type and structures in the borehole, including fractures, vugs and voids. In the current study, the optical televiewer is used to delineate rock contacts, rock type and identify potential permeable structures in the rock.

Acoustic Televiewer (ABI)

The acoustic televiewer produces an image of the borehole wall at a millimetre scale, acquired using an ultrasonic pulse from a source that scans the borehole wall as the logging probe is slowly moved along the borehole. The acoustic borehole imaging (ABI) tool also records telemetry so that the azimuth of the scan and the deviation of the borehole can be measured during logging. The reflection is uniformly “bright” wherever the borehole wall is solid and smooth. The reflected pulses are scattered wherever a fracture or other irregular opening intersects the borehole wall. Planar features such as fractures produce a linear feature in the borehole image such that the strike and dip of the feature can be estimated.

Software used to analyze the fracture images automatically corrects for the effects of borehole deviation and local magnetic declination, giving fracture orientation with respect to true north. Strike and dip are determined by matching a template to the apparent shape of a fracture. The accuracy of this measurement depends on the degree to which the shape of the feature represents that predicted for a planar feature and by the degree of damage and/or erosion during the drilling process associated with the point where the fracture intersects the borehole wall. The tool is centralized and requires that the borehole be fluid filled (but not clear) in order to have good ultrasonic signal transmission.

The resulting borehole acoustic images are used to help identify rock type and structures in the borehole, including fractures, vugs and voids, and also provides a “caliper” log of borehole diameter. In the current study, the acoustic televiewer is used to delineate rock contacts, rock type and identify potential permeable structures in the rock.

Heat Pulse Flowmeter

The heat pulse flowmeter measures the rate of vertical flow within a borehole. It is typically measured under both static conditions and under dynamic conditions using a low flow pump to induce water flow into the borehole from the surrounding formation. The probe consists of a metal grate that, upon start of the test, heats up a slug of water. The slug of heated water moves up or down the borehole where there is vertical flow. Two highly sensitive thermistors located above and below the metal grate measure the direction of flow as well as the time it takes the heated water to move a known distance through a known borehole volume, and records the flow rate.

The testing is done at regular fixed intervals within the borehole. In the current study, the heat pulse flowmeter is used to identify permeable features in the rock.

Equipment

The following field equipment was used to carry out the downhole geophysical logging:

- Mount Sopris Instruments (MSI) wireline winch;
- Advanced Logic Technology (ALT) Matrix logging box;
- Acoustic Televiewer- Model QL40 ABI-2G;
- Natural Gamma - Model QL40 GAM / 2PGA;
- Apparent Conductivity – Model 2PIA-1000;
- Optical Televiewer – Model QL40 OBI-2G;
- Heat Pulse Flow Meter – Model HFP-2293;
- Laptop computer with Logger (ALT) software;
- Borehole wireline tripod and wheel;
- 2KW Generator;
- Grundfos 2” submersible pump and controller;
- Power Line Conditioner and Power bar; and
- Tool kit consisting of tools necessary for troubleshooting and maintaining equipment.

5.2.2 Results

Details of the boreholes that were geophysically logged are summarized in Table 5-2, and their locations are shown on Figures 4-1 and 5-1. The processed downhole geophysical log results are provided in Appendix D at two scales, a “summary” scale and a “detailed” scale.

The downhole geophysical logs were helpful in identifying the following subsurface features:

- Stratigraphic / geologic contacts, using natural gamma, apparent conductivity, and/or televiewer logs;
- Fractures within the bedrock, using televiewer logs; and
- Water bearing zones in the bedrock using televiewer and/or heat-pulse flowmeter logs.

These features were used to refine borehole logs, inform packer testing interval selection, and help the design of monitoring well screen intervals. The downhole geophysical logs were also helpful in confirming geologic contacts in the previously drilled boreholes (Jagger Hims Ltd. 2001, 2003).

Table 5-2 - Summary of Boreholes and Monitoring Wells Geophysically Logged
Caledon Pit / Quarry

Borehole / Monitoring Well	Easting (m) UTM 17T	Northing (m) UTM 17T	Elevation (masl)	Total Hole Depth (mbgs)	Downhole Geophysics Completion	Open Hole / Cased Hole	Natural Gamma	Apparent Conductivity	Televiewer	Heat Pulse Flowmeter
BH20-01(CAL)	578000.61	4853292.80	406.80	22.07	18-Feb-20	Open	Y	Y	OBI (optical)	-
BH20-02(CAL)	577839.36	4853078.92	405.52	22.02	18-Feb-20	Open	Y	Y	OBI (optical)	-
BH20-03(CAL)	577655.12	4852796.26	402.91	19.33	10-Mar-20	Open	Y	Y	OBI (optical)	-
BH20-04(CAL)	577511.78	4852528.07	400.81	19.57	24-Feb-20	Open	Y	Y	OBI (optical)	-
BH20-05(CAL)	577786.25	4852520.23	398.83	16.35	24-Feb-20	Open	Y	Y	OBI (optical)	-
BH20-06(CAL)	578056.45	4852520.24	397.70	16.60	25-Feb-20	Open	Y	Y	OBI (optical)	-
BH20-07(CAL)	578129.13	4853102.34	404.73	18.67	25-Feb-20	Open	Y	Y	OBI (optical)	-
BH20-08(CAL)	577961.99	4852832.00	404.50	17.90	11-Mar-20	Open	Y	Y	OBI (optical)	-
BH20-09(CAL)	578186.33	4852803.00	402.26	16.77	10-Mar-20	Open	Y	Y	OBI (optical)	-
BH20-10(CAL)	577940.09	4853952.34	411.07	19.55	25-Mar-20	Open	Y	Y	OBI (optical)	-
BH20-11(CAL)	578065.10	4854240.45	402.10	10.20	26-Mar-20	Open	Y	Y	OBI (optical)	-
BH20-12(CAL)	577780.56	4854244.92	415.22	21.76	25-Mar-20	Open	Y	Y	OBI (optical)	-
BH20-13(CAL)	577209.70	4854103.25	412.94	22.80	20-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-14(CAL)	577288.55	4853881.70	417.27	31.46	14-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-15(CAL)	576925.21	4854113.14	421.52	34.76	14-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-16(CAL)	576991.38	4853859.50	420.74	34.18	20-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-17(CAL)	577474.67	4853391.65	413.06	28.83	27-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-18(CAL)	577313.39	4853571.83	417.53	31.84	27-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-19(CAL)	577733.06	4853579.97	411.42	24.64	27-Apr-20	Open	Y	Y	OBI (optical)	-
BH20-20(CAL)	577031.10	4853551.56	423.60	40.98	20-May-20	Open	Y	Y	OBI (optical)	-
BH20-21(CAL)	576935.66	4853276.58	413.53	33.48	20-May-20	Open	Y	Y	OBI (optical)	-
BH20-22(CAL)	576701.79	4853293.98	410.98	28.61	20-May-20	Open	Y	Y	OBI (optical)	-
BH20-23(CAL)	576779.85	4853559.83	420.27	37.62	25-May-20	Open	Y	Y	OBI (optical)	-
BH20-24(CAL)	577296.02	4852710.32	403.60	22.76	08-Jun-20	Open	Y	Y	OBI (optical)	-
BH20-25(CAL)	577402.13	4852974.96	405.48	22.03	15-Jun-20	Open	Y	Y	OBI (optical)	-
BH20-26(CAL)	577037.86	4852942.75	404.82	22.73	15-Jun-20	Open	Y	Y	OBI (optical)	-
BH20-27(CAL)	577212.29	4853168.73	408.64	27.65	22-Oct-20	Open	Y	Y	OBI (optical)	-
MW20-01(CAL) A/B	577458.50	4852268.28	395.10	19.41	13-Mar-20	Open	Y	Y	OBI (optical)	Y
MW20-02(CAL)	577900.04	4852138.37	399.63	19.57	11-Mar-20	Open	Y	Y	ABI (acoustic)	-
MW20-03(CAL)	578243.54	4851907.30	390.67	35.97	N/A	-	-	-	-	-
MW20-04(CAL)	578264.75	4852313.19	399.46	18.50	13-Mar-20	Open	Y	Y	OBI (optical)	-
MW20-05(CAL) A/B	578423.10	4852712.60	399.63	14.84	20-Mar-20	Open	Y	Y	OBI (optical)	Y
MW20-06(CAL) A/B	578474.24	4852972.59	400.15	16.03	23-Mar-20	Open	Y	Y	OBI (optical)	Y
MW20-07(CAL) A/B	578359.89	4853250.44	404.07	19.45	18-Mar-20	Open	Y	Y	OBI (optical)	Y
MW20-08(CAL) A/B	578009.81	4853574.83	406.93	18.59	19-Mar-20	Open	Y	Y	OBI (optical)	Y
MW20-09(CAL)	578343.84	4854157.49	399.95	9.01	26-Mar-20	Open	Y	Y	OBI (optical)	-
MW20-10(CAL) A/B	577837.95	4854407.28	411.32	21.19	24-Mar-20	Open	Y	Y	OBI (optical)	Y
MW20-11(CAL) A/B	577671.98	4853921.39	409.72	19.39	07-Apr-20	Open	Y	Y	OBI (optical)	Y
MW20-12(CAL) A/B	577271.90	4854321.42	412.43	22.65	08-Apr-20	Open	Y	Y	OBI (optical)	Y
MW20-13(CAL) A/B	576873.11	4854473.14	415.53	28.23	15-Apr-20	Open	Y	Y	OBI (optical)	Y
MW20-13 (CAL) C	576873.11	4854473.14	415.53	5.10	N/A	-	-	-	-	-
MW20-14(CAL) A/B	577575.99	4853100.42	406.71	26.35	14-May-20	Open	Y	Y	OBI (optical)	Y
MW20-15(CAL) A/B	576576.79	4853544.15	417.06	37.17	27-May-20	Open	Y	Y	OBI (optical)	Y
MW20-15 (CAL) C	576576.79	4853544.15	417.06	5.00	N/A	-	-	-	-	-
MW20-16(CAL) A/B	576784.58	4853806.76	421.40	39.77	26-May-20	Open	Y	Y	OBI (optical)	Y
MW20-17(CAL) A/B	576752.28	4852966.36	406.64	28.82	01-Jun-20	Open	Y	Y	OBI (optical)	Y
MW20-18(CAL)	577058.36	4852658.80	404.29	28.15	12-Jun-20	Open	Y	-	-	-
MW20-19(CAL) A/B	576906.96	4851999.96	396.98	27.39	29-Oct-20	Open	Y	Y	OBI (optical)	Y
MW20-20(CAL) A/B	576476.35	4852467.69	403.00	27.99	30-Oct-20	Open	Y	Y	OBI (optical)	Y
MW20-20(CAL) C	576476.26	4852468.33	403.00	5.00	N/A	-	-	-	-	-
MW20-21(CAL) A/B	576014.37	4852839.77	415.23	39.70	05-Nov-20	Open	Y	Y	OBI (optical)	Y
MW20-22(CAL) A/B	575785.36	4851966.28	399.27	30.75	18-Nov-20	Open	Y	Y	OBI (optical)	-
MW20-23(CAL) A/B	576205.53	4851555.91	395.05	26.76	24-Nov-20	Open	Y	Y	OBI (optical)	-
MW20-23 (CAL) C	576205.91	4851556.34	395.00	7.00	N/A	-	-	-	-	-
MW20-24(CAL) A/B	575337.66	4854341.85	437.75	37.49	04-Dec-20	Open	Y	Y	OBI (optical)	-
MW20-25(CAL) A/B	574853.76	4852900.48	419.02	51.82	10-Dec-20	Open	Y	Y	OBI (optical)	-
MW20-26(CAL) A/B	574373.86	4853638.42	438.89	66.11	18-Dec-20	Open	Y	Y	ABI (acoustic)	-
MW20-26 (CAL) C	574375.17	4853637.62	438.88	10.00	N/A	-	-	-	-	-
MW20-27(CAL) A/B	575953.96	4853770.16	431.15	52.43	17-Feb-21	Open	Y	Y	OBI (optical)	-
MW20-28(CAL) A/B	576139.79	4854987.82	419.31	30.82	23-Feb-21	Open	Y	Y	OBI (optical)	-
MW21-1-1	576882.20	4853485.00	418.94	36.27	04-Mar-21	Open	Y	Y	OBI (optical)	Y
MW21-1-2	576909.58	4853505.06	420.58	36.00	03-Mar-21	Open	Y	Y	-	-
MW21-1-3	576965.46	4853420.30	417.51	37.49	03-Mar-21	Open	Y	Y	-	-
MW21-1-4	576866.19	4853450.60	417.83	35.96	05-Mar-21	Open	Y	Y	-	-
MW21-2-1	577279.08	4854021.09	413.40	23.47	18-Mar-21	Open	Y	Y	OBI (optical)	Y
MW21-2-2	577260.02	4854050.91	412.64	23.47	17-Mar-21	Open	Y	Y	-	-
MW21-2-3	577349.69	4854098.46	410.76	23.77	17-Mar-21	Open	Y	Y	-	-
MW21-2-4	577297.52	4854001.66	413.86	26.52	17-Mar-21	Open	Y	Y	-	-
MW21-3-1	577871.84	4852814.09	403.69	21.03	31-Mar-21	Open	Y	Y	OBI (optical)	Y
MW21-3-2	577920.27	4852838.38	404.87	21.03	01-Apr-21	Open	Y	Y	-	-
MW21-3-3	577935.55	4852730.93	405.12	19.20	31-Mar-21	Open	Y	Y	-	-
MW21-3-4	577837.91	4852827.25	403.16	19.20	31-Mar-21	Open	Y	Y	-	-
MW21-4-1	577793.12	4854211.47	415.22	23.77	22-Mar-21	Open	Y	Y	OBI (optical)	Y
MW21-4-2	577790.26	4854247.25	415.07	23.77	22-Mar-21	Open	Y	Y	-	-
MW21-4-3	577813.86	4854182.83	414.78	21.64	23-Mar-21	Open	Y	Y	-	-
PW21-1	576890.23	4853478.69	418.76	38.41	08-Mar-21	Open	Y	Y	OBI (optical)	Y
PW21-2	577286.29	4854027.50	413.07	25.15	18-Mar-21	Open	Y	Y	OBI (optical)	Y
PW21-3	577875.55	4852797.50	405.45	21.34	01-Apr-21	Open	Y	Y	OBI (optical)	Y
PW21-4	577802.09	4854214.36	415.08	21.64	23-Mar-21	Open	Y	Y	OBI (optical)	Y
JHL-BH1(CAL)	577246.61	4854243.60	410.20	19.70	14-Apr-21	Open	Y	Y	-	-
JHL-BH16(CAL)	577894.81	4854252.89	411.53	19.90	25-Mar-21	Open	Y	Y	-	-
JHL-BH17(CAL)	578028.61	4854138.05	408.11	18.85	25-Mar-21	PVC Cased	Y	Y	-	-
JHL-BH18(CAL)	578153.75	4854324.05	400.69	9.20	25-Mar-21	PVC Cased	Y	Y	-	-
JHL-BH19(CAL)	577482.68	4854486.38	414.13	24.50	25-Mar-21	Open	Y	Y	-	-
Unknown BH2(CAL)	577689.54	4854266.72	?	?	14-Apr-21	Open	Y	Y	-	-

5.3 Groundwater Level Monitoring

The objectives of the groundwater level monitoring program were to assess current hydrogeologic conditions, seasonal water level fluctuations, support the interpretation of groundwater flow direction on the Site and in the Study Area, support the analysis of groundwater-surface water interaction, and support the impact assessment.

5.3.1 Methodology

Groundwater monitoring began in June 2020 and the scope of monitoring expanded as new monitoring wells were installed and developed during the next 14 months of the hydrogeologic investigation. Monitoring wells were equipped with a Van Essen TD-Diver pressure transducer / logger, following well development. The loggers were generally installed in the screened interval, each with a range suitable for the range of water levels that may be encountered, and programmed to record water levels on a 15-minute interval.

Loggers were typically downloaded quarterly, with manual water levels also collected quarterly at each download event using a water level tape.

Pressures observed by the logger were then corrected using a barometric pressure logger (Van Essen Baro-Diver) deployed on the Site. Water levels below the reference point were then calculated by matching the water level to the manual water level at the time it was observed and to the hydrograph of previous water level data. Groundwater levels were converted to elevations using the surveyed elevation (Delph and Jenkins North Ltd. of Aurora, Ontario) of the lower lip of each monitoring well monument.

The groundwater monitoring program results, presented in Appendix E, include the following.

- Groundwater levels at the monitoring locations as shown on Figure 5-1. Hydrographs presented in Figures E-1 to E-9 include the following:
  - MW20-01 to MW20-28, installed in 2020 for this study;
  - PW21-1 to PW21-4 and MW21-1-1 to MW21-4-3, installed in 2021 for this study;
  - Historic boreholes BH1 to BH3, BH7, and BH16 to BH19 were included in the groundwater level monitoring program (manual measurements only); and
  - Osprey Valley Golf Course groundwater level data as collected by their monitoring program, at the locations shown on Figure E-10.

Well completion details for the wells installed as part of this study are summarized in Table E-1. Borehole and well records are discussed in Section 5.1 and provided in Appendix C.

5.3.2 Results

The groundwater head elevations monitored as part of this program are presented as hydrographs in Appendix E with wells grouped geographically and by monitor type (i.e., by aquifer). The figures present data collected between the start of monitoring (summer 2020 or the time of installation if later) up to the end of 2021, noting that the monitoring program is ongoing. Figures 5-2 to 5-5 show contoured groundwater heads in the Gasport Formation in April, June, September and December 2021. The maximum predicted water table measured over a 12 month period from January to December 2021 is presented on Figure 5-6.

The groundwater monitoring network was designed to observe vertical gradients within the overburden and upper bedrock system by including vertically nested wells.

Vertical gradients observed across the monitoring well network in the Study Area are presented on Figure 5-7, noting that the Gasport Formation along the southeast and southern portion of the Study Area was of limited in thickness, and as such, it was not practical to install a vertical well nest in the bedrock at some locations. However, it is reasonable to infer that the vertical hydraulic gradients in those areas, which are proximal to the escarpment and the Credit River Valley, are most likely to be downward.

With reference to the above noted figures and the hydrographs presented in Appendix E, we note the following.

- Most groundwater levels showed approximately two to three metres of seasonal fluctuation during the monitoring period.
- Figures presenting seasonal groundwater head in the Gasport Formation (Figures 5-2 to 5-5) show similar patterns of groundwater head and horizontal groundwater flow in all four seasons. The seasonal rise and fall of groundwater levels appears to have little affect on groundwater head distribution and or the direction of horizontal groundwater flow, as the dominant influence is inferred to be topography.
- Horizontal groundwater flow is generally from the northwest to the east, southeast and south, and parallels topography from high to low elevation, particularly to the east, southeast and south of the Study Area towards the Niagara escarpment and Credit River valley.
- The highest observed heads in the Gasport Formation were in the northwest part of the Study Area (observed at MW20-24 and MW20-26). The lowest heads are consistently observed southernmost part the Study Area (MW20-03).
- With reference to Figure 5-6, the maximum water table elevation at the Site during the monitoring period closely matches the head distribution observed in the Gasport Formation in April and December 2021. The maximum water table elevation in the Main Area was observed to vary from 420.7 masl at MW20-16 in the north, to 393.5 masl at MW20-18 in the southwest. The maximum water table elevation in the North Area was observed to vary from approximately 407 masl near MW20-11 in the northwest, to 397.3 masl at MW20-09 in the southeast. The maximum water table elevation in the South Area was observed to vary from 405.3 masl at MW20-08 in the northeast, to 391.0 masl at MW20-02 in the south.
- In general, the seasonal trend observed throughout the Study Area during the observation period showed a smooth steady decline in the summer months (2020 and 2021), concurrent with warm weather and active plant growth, which presumably reduces the water available for infiltration and recharge. The summer and early fall period is followed by an increase in groundwater levels in the late fall, concurrent with cooler temperatures and most vegetation becoming dormant, making more water available for recharge. This is followed by the winter period in which groundwater levels further decline, as the ground is frozen and precipitation is stored in the snow pack. This period was followed by the spring freshet, and a corresponding rise in groundwater levels due to increased infiltration and recharge.
- Rapid increases in groundwater levels were observed in response to significant precipitation and / or snow melt events at a number of monitoring locations including MW20-06A/B, MW20-07A/B, MW20-14A/B, MW20-17A/B, MW20-18, MW20-20C, MW20-23A/B/C, and MW20-27A/B.
- Vertical hydraulic gradients at the Site and to east towards the escarpment are predominantly downward or neutral, consistent with this relative topographic high being a groundwater recharge area. To the west and southwest of the Site, vertical hydraulic gradients are a mixture of upward, neutral and downward, generally

consistent with areas of rolling topography, with areas of relatively low topography frequently exhibiting upward vertical gradients.

- Groundwater heads in the southernmost part of the Site and Study Area (i.e., MW20-01, 02, 04, 18 and 19), where the topography is relatively low, exhibit a lower horizontal hydraulic gradient. This is also an area of neutral and/or upward vertical hydraulic gradients. The overburden in this area (MW20-01 and MW20-02) consists mainly of sand and gravel overlying the bedrock with somewhat higher hydraulic conductivities based on the packer testing results at BH20-02, MW20-01, and MW20-18, as discussed in Section 5.4. (Note that MW20-02 was omitted from the packer testing program, as the bedrock thickness in that location was insufficient for testing.)
- A number of wells exhibited rapid short term fluctuations in water level, presumably in response to pumping by neighbouring groundwater users, including wells MW20-01A, MW20-05A, MW20-12A/B, MW20-13A, MW20-15A/B, MW20-22A/B, MW20-25A/B, and MW20-26A/B.

5.4 Hydraulic Testing – Packer Testing

The objective of the packer testing program was to obtain hydraulic testing data to support the derivation of hydraulic properties of the rock within the Study Area, including hydraulic conductivity (transmissivity / thickness) and inferred hydraulic pressures (heads).

5.4.1 Methodology

Packer testing was carried out by Golder staff with support from CSD from March 2020 to November 2020 in BH20-01 to BH20-27 and in MW20-01 to MW20-21, as the boreholes were drilled and following the completion of downhole geophysical logging, and prior to well installation. Boreholes drilled north and west of the Study Area further away from the Site (e.g., MW20-22 to MW20-28) were excluded from the packer testing program due to their distance from the Site and reduced relevance of the data, noting that SWRTs were carried out in these more distanced monitoring wells to estimate hydraulic properties in those areas.

The procedures for data collection are summarized in the following sections.

Equipment

Packer testing in the open boreholes was completed using a wireline packer tool in both single packer and straddle packer configurations. A list of equipment used downhole is provided in Table 5-3, and a list of equipment used at surface is provided in Table 5-4.

Table 5-3: List of Downhole Equipment for Packer Testing

Item Name	Manufacturer	Item Description
Packers (x3)	RST	RST-H Packer, packers with sliding heads, 5.7 cm deflated diameter, 0.635 m and 1.0 m bladder lengths
Test Tubing within interval	Various	1.9 cm diameter threaded steel pipe, 1.52 m length segments
Test Tubing above tool	Boart Longyear	HQ rods, inner diameter = 77.8 mm, outer diameter = 88.9 mm
Pressure transducer for real time monitoring	Van Essen Diver and RST	RST and Van Essen loggers with direct read cables for real time monitoring in test tubing above interval

Item Name	Manufacturer	Item Description
Interval pressure transducer	In Situ Inc.	Absolute pressure monitoring in test interval for data analyses. Pressure Range: 1000 psi
Solid coupling	Custom	Solid coupling to separate injection interval from observation interval within the test interval

Table 5-4: List of Surface Equipment for Packer Testing

Item Name	Manufacturer	Item Description
Packer inflation lines	Misc.	Manifold to operate packer inflation, 8.0 MPa pressure rating
Nitrogen pressure regulator	Victor SR4J-580	Pressure regulator for controlling pressure outflow from nitrogen cylinder used for packer inflation.
Nitrogen cylinders	Praxair Canada Inc., Mississauga, Ontario	Compressed nitrogen gas cylinder for packer inflation and activation of shut-in tool by pressurizing the inflation pressure vessel.
Flow Totalizer	Inflatable Packers International	Flow totalizer to measure.

Figure F-1a (Appendix F) shows the configuration of the tool for straddle packer testing, in which three packers are employed. One packer is used to seal the tool to the HQ rods, and two are used to isolate the interval in the borehole. Depending on the test interval, the length of the tool can be varied by adding additional lengths of steel tubing. A solid stem coupling is placed between the tubing outlet in the interval and interval pressure transducer to ensure that head losses occurring between the tool's tubing and the interval are not observed by the interval pressure transducer.

Figure F-1b shows the configuration of the tool for single packer testing, in which two packers are used. One packer is used to seal the rods to the tool, and another is used to establish the top of the interval in the borehole. In this configuration, the bottom of the borehole is the lower limit of the test interval.

Test Interval Selection

In general, test intervals were selected to isolate and characterize the hydraulic conductivity of the key formations encountered on Site; the upper and lower Gasport Formation and the underlying Shaley Dolostone and Cabot Head Formation. Typically, the resource boreholes advanced into the Shaley Dolostone were tested in two intervals (upper and lower) spanning the open rock borehole using the straddle packer configuration. The boreholes drilled for monitoring well installation within the Site and immediate Study Area were typically tested in three intervals: two straddle packer tests in the Gasport Formation, and one test in either the Shaley Dolostone unit or the Cabot Head Formation.

Occasionally, an additional test was completed on a feature or stratum of interest, and in a small number of cases, no test was completed where fractured rock was encountered that prevented an adequate packer seal.

Packer Testing

As noted above, the packer testing was carried out by Golder staff, with drill rig operation support and water supply provided by CSD. A driller and helper were on site each day to support testing operations. To coordinate with the borehole drilling, geophysical surveys, and site access, packer testing was completed in two mobilizations as follows.

- First Mobilization - MW20-01 to MW20-18, and BH20-01 to BH20-1 from March 4 to June 17, 2020.
- Second Mobilization - MW20-19 to MW20-21, and BH20-27 from October 23 to November 6, 2020.

The following describes the typical methodology for hydraulic testing at each location.

- The drill rig and containers of fresh water were mobilized to the borehole location by CSD.
- Flow totalizer calibration was checked daily typically by pumping ~25L into graduated buckets and comparing to the totalizer. Results were consistently within 1L.
- HQ rods were lowered to a depth calculated to test the target interval and confirmed by measuring the length of rods in the test tubing string and the height above ground surface.
- The packer testing tool was assembled piece by piece as it was lowered into the borehole.
- Packers were positioned by landing the bit stop on the HQ bit at the end of the rods.
- A transducer equipped for real time monitoring was placed in the test tubing.
- Packers were inflated by connecting the packers using 6.35 mm nylon inflation line to the regulator and gradually increasing pressure to the selected pressure. The inflation pressure was selected by calculating hydrostatic pressure at the lowest point on the tool plus the pressure required for the packer to contact the borehole wall (~150 psi), plus the maximum anticipated test differential pressure (typically 20 psi), plus a factor of safety (100 psi), within the recommended operating range by the manufacturer.
- To check for leaks in the nitrogen system following inflation, the nitrogen pressure was monitored for 5 minutes at the surface pressure gauge and checked occasionally throughout the test to ensure little or no loss of pressure.
- Following inflation, a packer circumvention test was conducted by pumping water, typically at a high rate (>30L/min) into the borehole outside of the isolated interval, until the borehole either filled to surface or for an adequate time (typically two minutes) to test the seal of the packers to the borehole wall. During the test, the real time data in the test tubing was monitored to observe if packer bypass was taking place. In cases where packers had not seated properly, a large instantaneous displacement was observed. In some cases, small amounts of gradual bypass took place. These are discussed in more detail later in the report and commented upon in Table F-1.
- Interval pressure stabilization phase - after the packers were fully inflated, 30 minutes of pressure stabilization and recovery was monitored.
- After 30 minutes, typically a 15 L slug of fresh water was inserted into the test tubing as rapidly as possible.

- Slug Injection Recovery (SIR) phase was monitored until full recovery was observed or for a maximum of 30 minutes.
- After 30 minutes of the SIR phase, the % recovery was calculated. If the recovery was 80-100% and there was available depth to water level for a constant rate test, then a Constant Rate Injection (CRI) test was conducted. If recovery was low or there was little depth to water level below top of rods (and therefore a CRI test would overflow the rods and not provide useful data), then an additional 30 minutes of recovery from the SI or until full recovery was observed.
- When a CRI test was performed, it was performed at atmospheric pressure to improve accuracy of pressure and flow rate observations. CRI tests were typically performed for 30 minutes. An initial flow rate was selected for the test based on the speed of the SIR and depth to water. Flow rate was adjusted during the first 10 minutes to maximize displacement in the test tubing, without over topping the rods. Flow rates varied between 1 and 81 L/minute for CRI tests.
    - Because of difficult access routes to most of the testing locations, most tests were limited to the volume of a 1000 L tote. This meant that for some high flow rate tests, the duration was less that 30 minutes.
    - In some cases where finding a flow rate that would not over top the test tubing within the 30 minutes, was difficult, a separate rate finding phase of the test was allowed before the CRI test was started.
- Following each CRI test, recovery was monitored until the water level had recovered to static or a maximum duration of 30 minutes.
- After monitoring recovery, packers were deflated and the tool was removed from the borehole.
- After planned testing on each borehole was complete, either a monitoring well was constructed or the borehole was abandoned in accordance with O.Reg. 903.

Test Analysis

In carbonate rock settings, it is expected that there will be a wide range of possible bulk hydraulic conductivity encountered during testing. For the duration of tests that were completed for this program, it is expected that near borehole conditions dominate the test response. Two flow models were commonly applied to matching the test interval pressure responses:

- Wellbore storage with a homogeneous formation model; and
- Wellbore storage with a two-shell composite model with a change in hydraulic conductivity away from the borehole wall modelled as either a skin (thin inner zone) or a larger inner zone typically representative of a conductive fracture and an outer zone representative of the rock matrix.

In most cases, the approach was to apply wellbore storage with a homogenous flow model as the test response was dominated by undisturbed formation response. Wellbore storage is discussed further below.

Packer test analyses were carried out with HydroBench® (Version 4.7.0.0), an internally-developed software package designed to analyse different types of hydrogeological tests. HydroBench® allows for the analysis of constant rate, variable rate, constant head, pulse, and slug tests. Multi-step superposition is available (e.g., a recovery phase following a variable rate period). In addition, the software includes the pressure deconvolution approach to analyse slug and pulse test data (Chakrabarty and Enachescu 1997). Both homogeneous and composite flow models may be used to interpret the data and the flow geometry may also be matched to infer the

local connectivity of a fracture network. HydroBench® also includes the derivative of pressure (i.e., rate of pressure change) with respect to the natural logarithm of time (Gringarten 2008) that has shown to significantly improve the diagnostic and quantitative analysis of slug tests and constant rate pumping tests (Spane and Wurstner 1993). Transmissivity normalised plots (Enachescu et al. 2004) are included in the software package and allow comparing different phases of a hydrogeological test by normalising the pressure response.

The analysis approach followed a systematic, hierarchical workflow to minimize uncertainty:

- Select input parameters.
- Determine static interval pressure by extrapolation of the test interval pressure response during the pressure stabilization phase.
- Review data in transmissivity normalized plots for consistency between phases and for order of magnitude transmissivity.
- Transmissivity was derived by matching on the log-log plot to both the pressure and pressure derivative and semi-log pressure to each test phase and match on the entire simulation plot. Where the pressure and pressure derivative data suggest a transitional period based on the shape and slopes of the log-log derivative of the interval pressure response, HydroBench was set to fit to transmissivity with a borehole skin or a two-shell composite model.

Hydraulic parameters were derived as follows:

- Transmissivity was derived from the pressure match to the extrapolated radial flow acting period of the derivative data on the log-log plot.
- Bulk hydraulic conductivity was estimated by dividing the transmissivity by the interval length.
- Static interval pressure for the purposes of the analyses was derived by the extrapolation of the pressure recovery phase in semi-logarithmic coordinates towards infinite elapsed time in HydroBench.

Input Parameters

Wellbore Storage

Wellbore storage is the response of the test zone to the change in pressure as a result of the compressibility of the fluid in the system (test interval + test tubing), the packer tool, and the rock formation within the interval. Wellbore storage is identified with an early unit slope of the pressure change derivative plotted on the log-log plot.

Wellbore storage C (m^3/Pa) is calculated by the equation below

$$C = \frac{\pi * r_u^2}{\rho * g}$$

where:

r_u is the equivalent test tubing radius = 0.039 m (assuming all boreholes are near vertical)

ρ is the density of water at 10°C = 1000 kg/m^3

g is the earth gravity acceleration = 9.81 m/s^2

Applying these values, C = 5x10^{-7} m^3/Pa, which was applied for all slug test analyses.

Skin Zone

Skin is a dimensionless term that is used to quantify the hydraulic properties of the rock around a borehole which may be enhanced by an increased fracturing caused by drilling or reduced by drilling debris and/or mud invasion. The skin magnitude correlates to the ratio of the change in permeability as a factor to the thickness of the skin relative to the borehole diameter. Diagnostic tools are used to identify the hydraulic properties (transmissivity and radial thickness) of the “skin zone” based on the shape and the slopes of the semi-log derivative of the specific drawdown on the log-log plot produced in HydroBench. A negative skin value corresponds to an increase in transmissivity within the skin zone. A positive skin value corresponds to a decrease in transmissivity within the skin zone. The effects of the skin are then separated from the portion of the data that is primarily influenced by the undisturbed rock properties. HydroBench applies skin thickness and magnitude as fitting parameters to the simulation match which influences the shape of the pressure derivative.

Storativity

Storativity is an input parameter in HydroBench, which is directly correlated with skin effect and cannot be uniquely determined from a single hole test. While storativity directly impacts skin, it has less of an impact on the determination of transmissivity.

Storativity is calculated using the following equation:

$$S = \rho * g * \emptyset * c_t * h$$

where:

ρ is the density of water

g is the acceleration of gravity

ø is the formation effective porosity

c_t is the total compressibility in 1/Pa

h is the length of the test interval in m

A typical range of total porosity for dolostone is 0% to 20% (Freeze and Cherry 1979). Effective porosity in the Study Area was assumed to be within the typical published range of porosity (5 to 10%).

Total compressibility is the compressibility of the formation on a pore volume basis plus the formation water based on the definition above. Total compressibility was assumed at $2x10^{-9}$ 1/Pa, which is approximately the average range of total compressibility for this type of aquifer (Woessner and Poeter 2020). Given these assumptions, a storativity of $2x10^{-5}$ was applied for all tests.

5.4.2 Results

Packer testing summary results are presented in Figures F-2 and F-3 and Table F-1, with detailed results presented in Figures F-4 to F-100. Four plots for each test are presented in the detailed plots, including:

- Pressure Sequence – Plot of pressure versus time.
- Test pressure match plot – Plot of test pressure versus time with the simulation match produced by HydroBench. HydroBench simulates the test pressure response based on the input parameters.

- Transmissivity Normalized Plot – Displays transmissivity versus time in log-log scale as a visual tool for evaluating similar formation responses related to the flow model and enables the comparison of transmissivity from multiple test phases.
- Pressure and pressure derivative log-log plot – Plot of test pressure and pressure derivative versus time on a log-log scale with the simulation match produced by HydroBench.

Hydraulic testing was completed in 97 intervals in 44 boreholes. Four boreholes were not tested because the length of the borehole below the top of bedrock was insufficient for the use of the tool. Transmissivity values were estimated to be in the range of 1 $x10^{-8}$ to $7x10^{-2}$ m^2/s with hydraulic conductivities in the range of $5x10^{-9}$ to $2x10^{-2}$ m/s.

The estimated hydraulic conductivities from the packer testing program are summarized by formation / rock unit in Table 5-5.

Table 5-5: Summary of Packer Test Hydraulic Conductivity Results by Formation / Rock Unit

Formation / Rock Unit	Number of Tests	Minimum k (m/s)	Maximum k (m/s)	Geometric Mean k (m/s)
Gasport	81	$2x10^{-8}$	$2x10^{-2}$	$1x10^{-5}$
Shaley Dolostone	1	-	-	$3x10^{-7}$
Shaley Dolostone / Cabot Head	14	$5x10^{-9}$	$2x10^{-4}$	$8x10^{-7}$
Cabot Head	1	-	-	$5x10^{-8}$

Seventy-nine (79) tests were analyzed using a wellbore storage with a homogeneous formation model and 18 tests were analyzed using a wellbore storage with a two-shell composite model or a homogeneous formation and a borehole skin model to best fit the observed response to each test, as noted in Table F-1. The following observations are made based on the packer testing results:

- Results of packer tests performed in the Gasport Formation varied significantly, ranging from $2x10^{-8}$ m/s to $2x10^{-2}$ m/s. Results ranging by six orders of magnitude demonstrate the heterogeneity of the Gasport Formation in this area. The range of hydraulic conductivities observed in the Gasport Formation are within the range (Freeze and Cherry 1979) of expected values for carbonate rocks, ranging from fine grained unfractured dolostone to weathered, fractured, or vuggy dolostone.
- The results of packer tests performed in the Shaley Dolostone unit and the Cabot Head ranged from $5x10^{-9}$ m/s to $2x10^{-4}$ m/s. The range of hydraulic conductivity results observed in the Shaley Dolostone are generally within the expected range based on their lithology, however, some of the hydraulic conductivity results are higher than expected presumably due to fractures observed in portions of the Shaley Dolostone, which increases its permeability.
- In general, the hydraulic conductivity of the Shaley Dolostone was observed to be approximately one order of magnitude lower than that of the overlying portion of the Gasport Formation.

- Packer test depth (of the center point of the packer test interval) was plotted versus hydraulic conductivity on Figure F-2. While hydraulic conductivity is observed to vary by 5 or more orders of magnitude at a given depth, there is a decreasing trend in hydraulic conductivity with increasing depth below ground surface, which is consistent with expectation that weathering increases the hydraulic conductivity of carbonate rocks.
- Figure F-3 presents a histogram of hydraulic conductivity results, grouped by order of magnitude of results. The hydraulic conductivity of both the Gasport Formation and the Shaley Dolostone conform reasonably well to a normal distribution, which supports conceptualizing the aquifer with a geometric mean hydraulic conductivity and variability (higher and lower hydraulic conductivity in areas).

5.5 Hydraulic Testing - Single Well Response Tests (SWTRs)

Single well response tests are widely used to measure the hydraulic conductivity of subsurface soils and rocks in the vicinity of a well. As part of this assessment, SWRTs were conducted at virtually all the groundwater monitoring wells at the Site (Figure 5-1), including wells screened in the overburden, the upper and lower parts of the Gasport Formation, and the Shaley Dolostone at the base of the Gasport Formation. The testing helped provide good spatial assessment (vertically and laterally) of the hydraulic properties across the Site.

5.5.1 Methodology

The SWRTs were carried out by Golder staff over several events in 2020 and 2021, following monitoring well development. Single well response tests were analyzed to estimate the hydraulic conductivity of each subsurface interval tested.

The SWRTs were conducted in the monitoring wells installed in 2020 (MW20-01 to MW20-28), pumping wells installed in 2021 (PW21-1 to PW21-4), and monitoring wells associated the pumping wells (MW21-1 series to MW21-4 series). The well locations are shown on Figure 5-1.

The methodology for well development and single well response testing is outlined below and was generally as follows.

Monitoring Well Development

- Water was purged from the well using a 13 mm inner diameter Waterra tubing with an inertial foot valve.
- Development was considered complete based on one of the following conditions being met: development water became clear, ten times the volume of water in the monitoring well had been pumped, or the well was pumped dry and allowed to recover (fully or partially depending on recovery speed) and then pumped dry again.

Pumping Well Development

- Well development was completed using the drill rig to flush the borehole with fresh water immediately following drilling.

Single Well Response Testing

- Single well response testing method selection was informed by speed of water level recovery during well development.

- In slow recovering monitoring wells, a logger was deployed near the bottom of the well after the well was pumped dry for the second time. The recovery was monitored using a logger set to a low reading frequency to allow for multiple days of recovery to be recorded if needed and analyzed as a rising head test. The logger was downloaded and the test considered completed when water level recovery reached at least 95%.
- In monitoring wells with an intermediate recovery speed, a Waterra purge rising head test or a physical slug test were performed as described below.
  - Waterra purge rising head test: The monitoring well was allowed to recover following development. Static water levels were confirmed prior the test by measuring manual water levels until the water level had stabilized for 5 minutes (and compared to the water level prior to development). A logger was then placed below the water level and set to a high recording frequency, to optimize the collection of data for a period of minutes or hours. The static water level was monitored for several minutes to observe any minor water level trends. The Waterra pump was then used to rapidly purge the well. The volume purged from the well was measured in a graduated bucket. The Waterra pump was then removed from the monitoring well and recovery was monitored using the logger and manual water levels. The logger was downloaded and the test considered completed when recovery exceeded 95%.
  - Physical slug test: The monitoring well was allowed to recover following development. Static water levels were confirmed prior the test by measuring manual water levels until the water level had stabilized for 5 minutes (and compared to the water level prior to development). A logger was then placed below the water level and set to a high reading frequency, to allow for the collection of data for a period of minutes or hours. The static water level was monitored for several minutes to observe any minor water level trends. A slug of known volume was then lowered quickly to displace the water in the well and a falling head test was monitored using the logger and manual water level measurements. Typically, when recovery exceeded 95%, the slug was rapidly removed from the well and recovery was monitored until 95% was exceeded. Where there was uncertainty if the logger had shifted during the insertion and removal of the slug, the test was repeated.
- Where rapid recovery from well development was identified, a pneumatic displacement rising head test was performed. A pneumatic displacement rising head test was conducted by sealing the top of the riser pipe off with the test apparatus, and then using air pressure to displace groundwater in the riser pipe out through the well screen. The pressure in the system is monitored using pressure transducers at two locations in the riser pipe: in the water column at a known depth, and in the air space above the water column. Typically, pressure in the riser pipe was allowed to equilibrate for 5 minutes. Air pressure is then suddenly released, and the transient response is observed as a rising head test. This test method provided more instantaneous displacement and a better fit with theoretical displacement than traditional tests using a physical slug to displace the water in fast recovering wells. Implementing a pneumatic method is consistent with the Butler's recommendation for testing high k aquifers (1998). In some cases, where the monitoring well recovered rapidly, the well head geometry or a water level in the well screen made it impossible complete a pneumatic rising head test. In these cases, a physical slug test or a Waterra purge rising head test were conducted.
- The method of testing MW20-20B differed from the methods described above, as the well exhibited flowing (artesian) conditions. In this case, the hydrostatic head was measured by tightening the J-plug down to stop flow and allowing the well to pressurize, while monitoring pressure in the well using a transducer at a known depth. The J-plug was then removed and the well was allowed to flow. The flow rate was then measured using a spout, a graduated bucket, and a stopwatch. During the flow rate measurement, the head was also noted.

- Monitoring well MW20-05B was not tested due to it's water level being consistently below the well screen (i.e., a dry well).

Single Well Response Testing Analysis

Analysis of the single well response tests was performed using the following methodology.

- Monitoring well details were confirmed based construction details to establish the screen length, well diameter, borehole diameter, sand pack length, stick up, and materials used in well construction.
- Field notes and logger files were reviewed and a test hydrograph was plotted.
- A conceptual model of the well was developed, including identifying if the well was confined or unconfined, determining aquifer thickness, and estimating well penetration, based on a review of the borehole log and downhole geophysical data.
- It was assumed that the tested interval was homogenous, isotropic, and no borehole skin affected the test.
- An effective radius correction was applied if the water level entered the sand pack during the test and if the water level was in the well screen interval during the majority of the test.
- These parameters were entered into AQTESOLV (Version 4.50) and an analytical solution was applied to calculate a hydraulic conductivity for the test.
    - Where test results were overdamped (displacement consistently fell toward the static level), the Bouwer Rice (1976) (confined or unconfined, depending on well model) solution was applied.
    - Where test results were underdamped (displacement oscillated around the static level), Springer-Gelhar (1991) solution was applied for unconfined wells and the Butler-Zhan (2004) solution for confined wells.
- As noted above, MW20-20B (Figure G-38) was tested that approximated steady state flow from the well with known drawdown and geometry, which can be analyzed using methods described in Powers (2007).

5.5.2 Results

The single well response tests and results are summarized by formation in Table 5-6 below, with detailed results presented in Appendix G. Appendix G includes a summary table of individual SWRTs (Table G-1), results of the SWRTs by elevation (Figure G-1), a histogram of SWRT results screened in the Gasport Formation (Figure G-2), and SWRT analysis (Figures G-3 to G-77).

Table 5-6: Single Well Response Test Hydraulic Conductivity by Formation / Unit

Formation / Rock Unit	Number of Observations	Minimum K (m/s)	Maximum K (m/s)	Geometric Mean K (m/s)
Overburden	5	$1.4x10^{-6}$	$4.8x10^{-4}$	$1x10^{-5}$
Goat Island	8	$3.5x10^{-8}$	$3.2x10^{-4}$	$6x10^{-6}$
Gasport	46	$1.9x10^{-8}$	$5.1x10^{-4}$	$5x10^{-6}$
Gasport / Shaley Dolostone	3	$9.9x10^{-7}$	$2.4x10^{-5}$	$7x10^{-6}$

Formation / Rock Unit	Number of Observations	Minimum K (m/s)	Maximum K (m/s)	Geometric Mean K (m/s)
Shaley Dolostone	8	$7.1x10^{-9}$	$5.5x10^{-5}$	$1x10^{-6}$
Shaley Dolostone / Cabot Head	4	$4.5x10^{-6}$	$2.4x10^{-5}$	$1x10^{-5}$

The following observations are made with respect to the results of the SWRTs:

- The SWRTs performed on wells screened in the Gasport Formation ranged from $2x10^{-8}$ m/s to $5x10^{-4}$ m/s, which is typical of lithologies ranging from a middle value for unfractured dolostone to a middle value of weathered dolostone (Freeze and Cherry 1979). This is consistent with the lithological observations at the Site.
- The eight SWRTs performed in the Goat Island Formation, matched the range and geometric mean of the Gasport Formation very closely. This suggests that the two formations are likely to act as a single hydrogeological unit in the vicinity of the Site.
- The 12 SWRTs performed on wells screen partially or entirely in the Shaley Dolostone (but not in the Gasport Formation), had a geometric mean of $2x10^{-6}$ m/s, which is similar to, but somewhat lower than, the hydraulic conductivity of the Gasport Formation. This is consistent with the field observation of many horizontal fractures in the Shaley Dolostone which contribute to higher hydraulic conductivity than might otherwise be expected for this unit (Freeze and Cherry 1979).
- The depth below ground surface of the SWRTs varied according to the stratigraphy and variability in the thickness of the overburden and bedrock units. To assess the data for potential trends, SWRT depth was plotted as a function of hydraulic conductivity on Figure G-1. A wide range of hydraulic conductivities were observed for all rock units with no obvious correlation to depth.
- A histogram of hydraulic conductivities for the Gasport Formation is presented on Figure G-2, shows a bi-modal distribution. One group of hydraulic conductivity results is clustered at ~10^{-7} m/s responses and the second group is clustered at ~10^{-5} m/s, noting that there is considerable overlap. This bi-modal distribution suggests that some wells tested include a hydraulically active feature (such as a fracture or vuggy bed) and others do not, and when not, the well response is representative of the (lower) hydraulic conductivity of relatively intact rock. The short test interval length (a typical screen length of 1.52 m) supports the assertion that some tests capture a hydraulically active feature, while others do not.
- The results of SWRTs in the overburden were generally consistent with published hydraulic conductivities for the soil materials observed during drilling at those locations.

5.6 Hydraulic Testing - Pumping Tests

Once the groundwater monitoring program at the Site and Study Area was established and underway, additional wells were installed in the spring of 2021 in four areas of the Site (see Section 5.1), and pumping tests were conducted in the summer and early fall of 2021.

The objective of the pumping tests was to further assess the hydraulic behavior of these areas, including the degree of connectivity of fractures within the bedrock, the hydraulic connection between aquifer units, and the

potential connection to surface water features in the area. Two pumping tests were carried out in the Main Area of the Site (at PW21-1 and PW21-2), one pumping test in the South Area (at PW21-3, using MW21-3 as the pumping well), and one pumping test in the North Area (at PW21-4), at the locations shown on Figure 5-1.

The four tests together provided good spatial coverage across the Site and helped assess the hydraulic properties of the aquifers over a relatively large area in comparison to packer testing and SWRT methods, which inherently provide a more localized measurement.

5.6.1 Methodology

In general, a 96-hour constant rate pumping test was conducted at each location, with each test registered in the MECP Environmental Activity and Sector Registry (EASR). A notification letter was delivered to the private well owners within the potential zone of influence of the test one week prior to the start of each test. The tests were completed at separate times, with non-pumping periods between the tests to allow time for water levels to recover to “static” conditions between successive tests. Pumped water was managed to ensure that it was not “recirculated” back into the local groundwater system during the test. Tracer tests were also conducted by Worthington Groundwater (Worthington) during the pumping tests to support the karst assessment. Results of the tracer testing is provided in Section 5.9.

The well group installed specifically for each pumping test was comprised of a pumping well surrounded by four monitoring wells, positioned as follows relative to the pumping well: one 10 m upgradient, two 30 m cross-gradient, and one 100 m downgradient, with the groundwater gradient inferred from groundwater monitoring data for that area. Note that at the PW21-4 location, the existing borehole BH16 was used as one of the monitoring wells. The wells installed for the pumping tests were advanced through the Gasport Formation and into the top of the Shaley Dolostone, and in some cases, the wells extended through the thin Shaley Dolostone into the Cabot Head Formation. At the test location PW21-3, preliminary testing of the wells indicated that MW21-3-1 was in fact more permeable than the originally planned pumping well, and as such, it was used as the pumping well for that test, in order to maximize the pumping rate achievable.

Groundwater levels were monitored at the pumping well, offset wells, and other monitoring wells in the area using data loggers and manual measurements prior to, during and following the pumping test. For each test, the loggers were set to collect water level measurements every 5 minutes throughout the test. Loggers in wells that were part of the (long-term) monitoring network and proximal to the test area, were temporarily reprogrammed to record water levels at the same 5-minute interval.

The pumping tests were conducted by Ontario Water Well Services Inc. (OWWS), who supplied and operated the equipment to pump and discharge the water. The pumps were equipped with a check valve to ensure water could not flow back into the well. Flow was monitored using a flow meter and totalizer. Discharge water was pumped to a low-lying area away from the pumping well and outside of the expected area of influence of the tests. Upon installation of the pump, a brief test was conducted to identify a proposed flow rate and confirm the selection of pump, and size the discharge hose.

At the start of each constant rate test, the water levels in the pumping well were monitored frequently and adjustments were made to the pumping rate to ensure that the pumping rate was maximized, but to avoid drawdown reaching the pump intake during the tests.

The following mitigation measures were also in place during the testing: in the unlikely event that the aquifer test negatively impacted any nearby private wells, the pumping rate would be reduced, or a temporary water supply would be provided to the impacted parties for the duration of the test; and in the event that erosion or scouring

was observed at the discharge point, the flow dissipation system would be modified and the affected area rehabilitated. Neither mitigation measure was required during any of the four pumping tests.

5.6.2 Test Analysis

The constant rate pumping tests were then analyzed following a typical analysis workflow for multi-well aquifer tests. This included a data check and the plotting of hydrographs for each well following the same methodology described in Section 5.3.1. Static groundwater elevations were selected at each well based on an examination of the water levels before and after the constant rate test. These groundwater elevations were used to calculate the observed drawdown at each well.

Flow rates for the constant rate tests were generally very low and close to the minimum flow rate of the pumps available, making it difficult to maintain constant flow rates, and therefore maintain a consistent rate of drawdown. As such, the water level recovery data (i.e., from the point in time when the pump was shut off at the end of the pumping period) was selected for analysis of hydraulic parameters, as it provided a consistent response to the average pumping rate during the constant rate test. Analysis of the recovery part of the test is a very common practice in pumping test assessments, as it typically provides a “cleaner” data set than the drawdown part of the test.

Recovery data versus time was plotted for the pumping well and monitoring wells within 100 m of the pumping well, and the Cooper-Jacob straight line method was implemented to estimate transmissivity, and where possible, storativity (Jacob 1944, Cooper and Jacob 1946, Kruseman and de Ridder 1994), as described below. Where storativity was calculated at multiple monitoring wells, the storativity results are presented as a range. The hydraulic conductivity of the test interval was then calculated by dividing the transmissivity by the aquifer interval length.

A plot of drawdown versus distance, where drawdown was observed at the monitoring wells, was also prepared for each test, to estimate the extent of the zone of influence.

Cooper-Jacob Straight-Line Method

When time is plotted in log scale versus recovery, a straight-line recovery period can be identified. Based on the slope of this line, the bulk transmissivity of the confined bedrock aquifer can be estimated using the Cooper-Jacob (1946) approximation as follows:

$$T = \left(\frac{2.303}{4\pi}\right) \times \left(\frac{Q}{\Delta S}\right)$$

Where: Q = pumping rate (m^3/day)

ΔS = slope of the observed recovery hydrograph per log cycle

The average pumping rate is calculated, and based on a fit to the recovery data, the average bulk transmissivity of the bedrock aquifer is calculated.

Where an unconfined aquifer model is selected, the Cooper-Jacob Straight-Line method can be applied using the modified method proposed by Cooper (1944) and presented by Kruseman and de Ridder (1994). The method addresses two differences in an unconfined aquifer:

1) Change in storage: addressed by selecting a quasi-steady state portion of the aquifer test for analysis, where changes to storage have a minimal affect on observed water levels; and

2) Change in saturated aquifer thickness: addressed using a geometric correction for saturated aquifer thickness (Kruseman and de Ridder 1994).

$$s' = s - \left(\frac{s^2}{2xD}\right)$$

Where: s' = corrected drawdown

s = observed drawdown

D = the initial saturated aquifer thickness

The corrected drawdown or recovery data can then be analyzed using the Cooper-Jacob Straight-Line method, as in a confined case.

Where drawdown is observed at a monitoring well, it is possible to estimate the aquifer storativity (Cooper and Jacob 1946). Based on the slope of the recovery data at the monitoring well in the semilogarithmic recovery plot, the storativity (S) of the bedrock aquifer can be estimated as follows:

$$S = 2.2459T\left(\frac{t}{r^2}\right)$$

Where: T = transmissivity

t/r^2 = time/radius^2 value when observed drawdown = 0 m

When applied with corrected drawdown in an unconfined aquifer, the same method can be applied to estimate specific yield.

5.6.3 Results

The 2021 constant rate pumping test results at the four locations within the Site are summarized in Table 5-7. Hydrographs, drawdown versus distance plots, and recovery versus time plots for the four tests are provided on Figures H-1 to H-10 in Appendix H, as follows:

- Figure H-1 – PW21-1 - Groundwater Elevation Monitoring
- Figure H-2 – PW21-1 - Drawdown Versus Distance
- Figure H-3 – PW21-1 - Recovery Versus Log Time
- Figure H-4 – PW21-2 - Groundwater Elevation Monitoring
- Figure H-5 – PW21-2 - Corrected Recovery Versus Log Time
- Figure H-6 – MW21-3-1 - Groundwater Elevation Monitoring
- Figure H-7 – MW21-3-1 - Drawdown Versus Distance
- Figure H-8 – MW21-3-1 - Corrected Recovery Versus Log Time
- Figure H-9 – PW21-4 - Groundwater Elevation Monitoring
- Figure H-10 – PW21-4 - Corrected Recovery Versus Log Time

5.6.3.1 PW21-1

PW21-1 is located in the northwestern part of the Main Area of the Site. The constant rate pumping test was conducted in this area from September 20 to 24, 2021 and registered under EASR permit 1000140598.

During the first four hours of the test, the pumping rate was adjusted to establish an optimal rate to “stress” the aquifer without drawing the water level down to the pump intake. After noting moderate drawdown in the early portions of the test, the rate was increased from 23 L/min to 34 L/min, then later to 45 L/min. Shortly after the increase to 45 L/min, cascading was observed in the well (when the water level dropped below ~12 mbgs), and the water level began to decline rapidly. The pumping rate was then decreased to 34 L/min, and then further to 23 L/min to prevent the water level from reaching the pump intake, and the pumping rate was maintained at 23 L/s for the reaming duration of the test.

The overall average pumping rate during the test was ~21.7 L/s, and this average rate was used in the analysis of the recovery data. A significant precipitation event (63 mm) occurred on September 21 and 22, 2022 during pumping portion of the test, as indicated on the hydrograph (Figure H-1).

Pumped groundwater from PW21-1 was discharged approximately 320 m southwest of the pumping well in a forested area downgradient of the pumping well, which was approximately 30 m from Tributary #1, to allow for the attenuation of any sediment in the water, should the water eventually reach this stream. Water level monitoring locations during the test included wells and surface water stations within approximately 500 m of the pumping well.

Pumping Well (PW21-1) Response

A water level response to pumping at PW21-1 was observed at MW21-1-1, 2, 3 and 4 and at MW20-15A, B and C. No response to pumping was observed at any surface water stations or mini-piezometers at those stations. The water levels observed at those locations during the test are presented on Figure H-1 in Appendix H.

Drawdown in the pumping well occurred rapidly at the start of the test and increased each time that the pumping rate was increased. Two hydraulic features appear to have controlled the performance of the well (at approximately 12 and 30 mbgs). When the water level declined below ~12 mbgs, cascading was heard in the well and the water level declined rapidly. This is consistent with the dynamic heat pulse flowmeter geophysical logging results for this well (pumped at 4 L/min in the well casing, causing upward flow), which showed that the main water producing zone in this well is a fracture located at ~12 mbgs, and below this elevation the flow is downward to a fracture at ~30 mbgs (see the PW21-2 geophysical logs in Appendix D).

Water levels during the test also showed minor fluctuations due to small fluctuations in the pumping rate; these pumping rate fluctuations were apparently a result of minor sand accumulation in the pump that occurred during the test. The total drawdown observed at the pumping well at the end of the test was 15.4 m.

Bedrock Aquifer Response

The background static water level trends during the aquifer test were influenced by the 63 mm of rainfall during the test on September 21 and 22, 2022 (precipitation recorded at the Georgetown meteorology station). In response to the precipitation event, some bedrock water levels were observed to increase by 1 to 1.5 m during the aquifer test (MW20-14, MW20-16, MW20-17, and MW20-27), while others showed little or no response (0 to 0.5 m) (MW20-11, MW20-12, MW20-15, and BH2). Due to the influence of the precipitation event during the test, static water levels in the pumping well (PW21-1) and nearby monitoring wells (MW21-1-1 to MW21-1-4), were 1.1 m higher, on average, following the pumping test than they were before the test.

A plot of drawdown versus distance for this test is presented on Figure H-2. Observed drawdown in the bedrock aquifer ranged from 2.8 m (at MW21-1-3, 100 m from PW21-1) to 6.7 m (at MW21-1-1, 11 m from PW21-1) (and no drawdown was observed at MW20-15 or BH2). Based on this response, the drawdown cone in the bedrock aquifer during this test is estimated to have extended approximately 210 m from PW21-1, with approximately 1.0 m of drawdown inferred to have occurred at that distance. The drawdown versus distance plot showed some heterogeneity in the bedrock aquifer, as the drawdown at MW21-1-2 was higher than predicted (6.7 m observed, 2.2 m more than expected) and lower than predicted at MW21-1-4 (2.9 m observed, 1.6 m less than expected) based on a straight-line projection on the drawdown plot.

Overburden Aquifer Response

No response to pumping at PW21-1 was observed in overburden monitoring wells.

Surface Water Response

No response to pumping at PW21-1 was observed at surface water monitoring stations.

Estimate of Aquifer Properties

As shown on Figure H-3, the recovery water levels at PW21-1, MW21-1-1, and MW21-1-3 plot along a similar slope on the semi-log recovery plot. Based on the slope of this line and an average pumping rate of 21.7 L/min, the average bulk transmissivity of the bedrock aquifer is estimated to be approximately 2 m^2/day.

Based on a test interval thickness of 26.2 m for this well, the estimated hydraulic conductivity of the bedrock in this area is $1x10^{-6}$ m/s, which is close the low end of the range of hydraulic conductivity for fractured or karstic dolostone, and close to the high end of the range of unfractured dolostone (Freeze and Cherry 1979). Water level recovery from the aquifer test varied significantly in the monitoring wells relative to PW21-1. This further suggests there are heterogeneities in the transmissivity of the bedrock aquifer within the area of influence of the test. Based on the slope of the recovery data at MW21-1-1, and MW21-1-3 in the plot, the storativity (S) of the bedrock aquifer is estimated to be between $5x10^{-5}$ to $1x10^{-4}$.

5.6.3.2 PW21-2

PW21-2 is located in the northeastern part of the Main Area of the Site. A constant rate pumping test was conducted in this area from August 10 to 14, 2021 and registered under EASR permit 1000139090.

The average pumping rate during the test was very low, approximately 2.2 L/min. With the pump operating at such a low rate, small variations in the pumping rate caused the water levels in the pumping well to fluctuate significantly during the test. Additionally, during the night of August 12 to 13, 2022, the pump inadvertently shut down, allowing partial recovery.

Pumped groundwater from PW21-2 was discharged approximately 380 m to the southeast of the well, in a forested area downgradient of the pumping well.

Pumping Well (PW21-2) Response

The water levels at the locations monitored during the test are presented on Figure H-4 in Appendix H. Drawdown at PW21-2 occurred rapidly at the start of the test and in response to variations in the pumping rate. Total drawdown at the end of the test was 5.5 m.

Bedrock Aquifer Response

In the area around PW21-2, the aquifer water level was below the top of bedrock and the aquifer is conceptualized as an unconfined aquifer in this area. Static groundwater levels in the area before, during and

after the pumping test showed a slow steady decline of about 0.9 cm/day due to dry conditions. No response to pumping was noted any monitoring wells around PW2-2, as seen on Figure H-4.

Overburden Aquifer Response

No response to pumping PW21-2 was noted in overburden monitoring wells.

Surface Water Response

No response to pumping PW21-2 was noted at surface water monitoring stations.

Estimate of Aquifer Properties

The recovery water levels for PW21-2 are shown on Figure H-5. Using an average pumping rate of 2.2 L/min, the bulk transmissivity of the bedrock aquifer is estimated to be 0.2 m^2/day. Based on a test thickness of 19.5 m for this well, the apparent hydraulic conductivity of the bedrock in this area is $9x10^{-8}$ m/s, which is lower than typically expected for dolostone (Freeze and Cherry 1979).

Since no drawdown was observed any the monitoring wells, the area of influence of the test is likely to be less than 10 m and no estimate of specific storage was possible.

5.6.3.3 MW21-3-1

MW21-3-1 is located in the central part of the South Area of the Site. Based on the single well response testing conducted at PW21-3 and the MW21-3 series wells immediately prior to the pumping test, MW21-3-1 was selected as a better option for the aquifer test in this area due to its more permeable characteristics. The constant rate pumping test was conducted in this area from August 23 to 27, 2021 and registered under EASR 1000137926.

The average pumping rate during the test was very low, approximately 1.7 L/min. With the pump operating at such a low rate, small variations in the pumping rate caused the water levels to fluctuate significantly during the test.

Pumped groundwater from MW21-3-1 was discharged approximately 340 m to the south of the well, in a forested area downgradient of the pumping well.

Pumping Well (MW21-3-1) Response

The water levels at the locations monitored during the test are presented on Figure H-6 in Appendix H, for locations that responded to pumping during the aquifer test. Drawdown occurred rapidly at the start of the test and in response to variations in the pumping rate. Total drawdown at the end of the test was 4.1 m.

Bedrock Aquifer Response

In the area around MW21-3-1, the aquifer water level was below the top of bedrock and as such, the aquifer is conceptualized as an unconfined aquifer in this area. Static water levels in the bedrock aquifer were relatively consistent in the area of the MW21-3-1 during the aquifer test. Responses to the aquifer test were observed in the monitoring wells within 35 m of the pumping well, ranging between 0.49 m (observed at PW21-3, 11 m from MW21-3) and 0.10 m (observed at MW21-3-4, 34 m from MW21-3-1), as shown on Figures H-6 and H-7.

Overburden Aquifer Response

No response to pumping at MW21-1-3 was noted in overburden monitoring wells.

Surface Water Response

No response to pumping at MW21-1-3 was noted at surface water monitoring stations.

Estimate of Aquifer Properties

As shown on Figure H-8, the corrected recovery water levels at MW21-3-1 and PW21-3 plot along a similar slope on the semi-log corrected recovery plot. Based on the slope of this line and an average pumping rate of 1.7 L/min, the average bulk transmissivity of the bedrock aquifer in this area is interpreted to be approximately 2 m^2/day.

Based on a test interval thickness of 12.9 m, the apparent hydraulic conductivity of the bedrock is $1x10^{-6}$ m/s, which is close the low end of the range of hydraulic conductivity for fractured or karstic dolostone, and close to the high end of the range of unfractured dolostone (Freeze and Cherry 1979).

Based on the slope of the corrected recovery data, the specific yield (Sy) of the bedrock aquifer in this area is estimated to be $4x10^{-3}$.

5.6.3.4 PW21-4

PW21-4 is located in the central part of North Area of the Site. A constant rate pumping test was conducted from September 8 and 12, 2021 and registered under EASR 1000140595.

Due to the low yield of this well, an alternate testing method was employed. A float was attached to the pump to cycle pumping on and off and maintain a relatively constant water level, similar to the configuration of a constant head test. The testing resulted in an average pumping rate of 0.12 L/min.

Pumped groundwater from PW21-4 was discharged approximately 300 m to the northeast of the well, in a forested area downgradient of the pumping well.

Pumping Well (PW21-4) Response

Water levels during the test are presented on Figure H-9 in Appendix H, for wells that responded to pumping during the test. Drawdown occurred rapidly at the start of the test and in response to variations in the pumping rate. The drawdown maintained during the test was 7.4 m, with the water level proximal to the base of the Gasport Formation.

Bedrock Aquifer Response

In the area around PW21-4, the aquifer water level was below the top of bedrock and as such, the aquifer is conceptualized as an unconfined aquifer in this area. The bedrock aquifer water levels declined steadily during a dry period in the late summer when the aquifer test was conducted, including in the area of around PW21-4. Water level changes varied by location, with an average decline of 0.9 cm/day during the test in the surrounding monitoring wells (within 100 m). No response to pumping at PW21-4 was noted in the monitoring wells.

Overburden Aquifer Response

No response to pumping at PW21-4 was noted in overburden monitoring wells.

Surface Water Response

No response to pumping at PW21-4 was noted at surface water monitoring stations.

Estimate of Aquifer Properties

The recovery water levels for PW21-4 are shown on Figure H-10. Using an average pumping rate of 0.12 L/min, the bulk transmissivity of the bedrock aquifer is approximately $7x10^{-3}$ m^2/day. Based on a test interval thickness of

8.8 m, the apparent hydraulic conductivity is $9x10^{-9}$ m/s, which is lower than typically expected for the observed dolostone lithology (Freeze and Cherry 1979), and lower than the hydraulic conductivity estimated in the Main and South Areas of the site, where the other three pumping tests were conducted.

Since no drawdown was observed in the monitoring wells, the area of influence of the test is likely to be less than 10 m and no estimate of specific storage was possible.

5.6.3.5 Summary

The results of the four 96-hour pumping tests conducted in the late summer and early fall of 2021 in the Main, South and North Areas of the Site are summarized in Table 5-7. Due to the low permeability of the bedrock, the tests could only be conducted at low pumping rates (1.7 to 21.7 L/min), and the permeability of the rock in the North Area was so low, that a constant rate test was not possible, so a constant head test was conducted at an estimated pumping rate of ~0.1 L/min.

The transmissivity estimated from the tests were low, ranging from $7x10^{-3}$ m^2/day (PW21-4) to 2 m^2/day (PW21-1 and MW21-3-1) and the estimated hydraulic conductivity of the bedrock ranged from $9x10^{-9}$ m/s (PW21-4) to $1x10^{-6}$ m/s (PW21-1 and MW21-3-1). The hydraulic conductivity at PW21-4 was lower than all but one of the 97 packer tests and lower than all but one of the 72 SWRTs in bedrock at the Site. These responses highlight the low permeability and heterogeneity of the Gasport Formation.

The pumping test results in conjunction with the other hydraulic tests (packer tests and SWRTs) support the interpretation that while there are local zones of increased permeability in the bedrock on a scale of 10's of metres, these zones are generally not very interconnected and the rock mass as a whole is not very permeable on a scale of hundreds of metres.

Table 5-7: Summary of 2021 Pumping Test Results

Test Location	Pumping Well	Test Pumping Rate (L/min)	Final Drawdown (m)	Estimated Zone of Influence (m)	Aquifer Model	T (m^2/day)	K (m/s)	S / Sy
Main Area (West)	PW21-1	21.7	15.4	210	Confined	2	$1x10^{-6}$	$5x10^{-5}$ to $1x10^{-4}$
Main Area (East)	PW21-2	2.2	5.0	<10	Unconfined	0.2	$9x10^{-8}$	N/D
South Area	MW21-3-1	1.7	4.2	<10	Unconfined	2	$1x10^{-6}$	$4x10^{-3}$
North Area	PW21-4	0.1	7.4	<10	Unconfined	$7x10^{-3}$	$9x10^{-9}$	N/D

An important caveat to the general hydraulic behavior of the bedrock noted above is that a fracture zone was encountered in the upper 1 to 2 m of bedrock during the installation of many of the bedrock wells, requiring that a surface casing be set into the top of the rock in order to allow rock coring to continue. This upper zone and the overburden immediately overlying it forms a "contact aquifer" zone, that is in many instances more permeable than the underlying bedrock.

The presence of a contact aquifer is a commonly recognized as an important hydrogeological unit (Carter et al. 2019) in this hydrogeologic environment, and is a component of regional groundwater flow models in this area. The potential presence of a contact aquifer zone was later assessed during a supplemental investigation conducted in the northwest part of the Main Area in the late summer of 2022 (see Section 5.8), and was incorporated into the numerical groundwater flow model used in this assessment (see Chapter 8).

5.7 Groundwater Quality

The objective of the groundwater quality testing program was to assess groundwater quality on the Site and within the Study area, in order to establish baseline water quality conditions and to assess the potential for water quality issues that may arise when water collected from quarry dewatering is discharged to the environment.

5.7.1 Methodology

The methodology for the groundwater sampling program was as follows.

- All monitoring wells installed as part of the hydrogeologic investigation were developed and completed with dedicated groundwater water sampling equipment (tubing and Waterra foot-valves).
- Each well was purged and then sampled. Field parameters (including pH, electrical conductivity, and temperature) were recorded after each purge volume, to ensure water chemistry had stabilized prior to sampling.
- The water samples were collected in pre-supplied laboratory bottles, placed in ice-packed coolers, and delivered to the Bureau Veritas (BV) Labs in Mississauga following standard Chain of Custody protocols.
- The samples were analysed at BV Labs for the RCAP groundwater suite (which includes general chemistry, nutrients, inorganics and metals), as well as benzene, toluene, ethylbenzene and xylene (BTEX) and petroleum hydrocarbons (PHC) F1 to F4.
- Analytical results were compared to:
  - Table 2: Full Depth Generic Site Condition Standards [SCS] in a Potable Groundwater Condition - Coarse Grained Sediments - Residential / Parkland / Institutional Use from the MECP *Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act*, dated July 1, 2011;
  - Ontario Drinking Water Quality Standards (ODWS) from the MECP *Safe Drinking Water Act*, dated January 1, 2020; and
  - Provincial Water Quality Objectives (PWQO) from *Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy*, reprinted February, 1999.

Water quality sampling was carried out by Golder field personnel on February 17, 2021, June 21 to 28, 2021 and on July 24, 2021. Groundwater sampling was conducted at monitoring wells MW20-01 to MW20-28 at the locations shown on Figure 5-1.

5.7.2 Results

Water quality results are summarized in Appendix I, Table I-1, with MECP Table 2, ODWS and PWQO criteria presented along side the data for comparison purposes. A full set of analytical results from the laboratory, including chain of custody and certificates of analysis, are provided in Appendix I.

In general, the water quality was in the typical range expected for groundwater in this hydrogeologic setting. There were some exceedances of ODWS and MECP Table 2 criteria, such as total dissolved solids, hardness, aluminum, iron, manganese, and sulphate. There were also a number of occasional exceedances of the PWQO, notably for aluminum and iron, and occasionally for boron, cadmium, cobalt, copper, lead, molybdenum, phosphorous, silver, vanadium, and zinc.

The groundwater samples were analysed for dissolved metals (not total metals) for comparison to MECP Table 2 and ODWS, and as such, the groundwater samples for metals were field filtered. It should be noted that the PWQO are intended to be compared to total metal concentrations, which may be higher than dissolved metal concentrations. The comparison to the PWQO is nonetheless considered to be helpful in understanding the potential quality of excess water collected during pit / quarry operations that may be discharged from the Site to surface water, such as the Credit River.

There were also several locations that exhibited one or more elevated parameters presumed to be related to anthropogenic activities, including elevated chloride and sodium (MW20-11B and MW20-15A), elevated PHCs (MW20-17B and MW20-19B) and trace detections of one or more BTEX parameter (MW20-13B, MW20-14B, and MW20-16B).

5.8 Northwest Investigation

Following the completion of the initial field investigations in 2020 and 2021, a supplemental investigation was carried out from July to September of 2022 in the northwest part of the Main Area of the Site proximal to a portion of the Coulterville Wetland Complex near Tributary #1, referred to as the “Northwest Wetland”, as shown on Figure 5-8.

The primary objective of the northwest investigation was to collect additional hydrogeological and hydrologic data to refine the site conceptual model and calibrate the numerical model in that area, thereby increasing confidence in model predictions and in the assessment of potential for hydrogeologic impacts to occur in that area. A secondary objective was to assess the hydraulic characteristics of contact aquifer zone (the uppermost part of the bedrock and overburden immediately overlying it) at the Site.

The northwest investigation included:

- Installation of, and monitoring at additional surface water stations (SW17 – SW20) and mini-piezometers (MP17 – MP20);
- Construction of additional boreholes with downhole geophysical logging, and the construction of additional monitoring wells (MW22-01, MW22-02A/B/C and MW22-03) and another test pumping well (PW22-1);
- Shallow soil coring at SC22-01 to SC22-10, and grain size analysis to assess surficial soil permeability;
- SWRTs in the new monitoring wells; and
- An additional 96-hour constant rate pumping test at PW22-1 in the Northwest Wetland area.

Detailed results and supporting data acquired during the northwest investigation are provided in Appendix J (additional hydrogeologic results) and Appendix L (additional surface water station results are included as an addendum to the Surface Water Flow appendix).

5.8.1 Surface Water Station Installation

5.8.1.1 Methodology

Four additional surface water stations (SW17 – SW20) and mini-piezometers (MP17 – MP20) were installed to support the evaluation of potential impacts of quarry dewatering on water levels and ecological features in the Northwest Wetland, at the locations shown on Figure 5-8. Water level loggers were installed in the mini-piezometers at each of the monitoring locations and programmed to record water levels on a 15-minute interval. Additionally, the previously installed surface water stations SW14 and MP14 were also included in the evaluation as this station sits downstream of SW17/MP17 on Tributary #1 near the Northwest Wetland.

The elevations of the surface water stations (i.e., staff gauges) and mini piezometers were surveyed on October 6, 2020 (SW14 and MP14) and on September 29, 2022 (SW17 to SW20 and MP17 to MP20) and are referenced to the Canadian Geodetic Vertical Datum of 1928 (1978 adjustment) datum. A list of the monitoring stations, their locations and their installation dates are provided in Table 5-8.

Table 5-8: Surface Water Monitoring Locations

Station Name	Zone	Northing (m)	Easting (m)	Installation Date	Measurements
SW14 / MP14 (1)	17	4855098	578165	October 06, 2020 (2)	Water Level
SW17 / MP17 (1)	17	4853803	576488	August 5, 2022 (2)	Water Level
SW18 / MP18 (1)	17	4853993	576396	August 5, 2022 (2)	Water Level
SW19 / MP19 (1)	17	4854106	576226	August 5, 2022 (2)	Water Level
SW20 / MP20 (1)	17	4853890	576819	August 5, 2022 (2)	Water Level

Notes:

(1) The approximate locations of these monitoring stations are shown on Figure 6-1 described in Section 6 below.

(2) Refers to the installation date for the surface water monitoring stations.

5.8.1.2 Results

The primary objective of groundwater and surface water monitoring performed as part of the Northwest Wetland investigation was to better understand groundwater surface water interaction. The detailed results from these surface water stations are included in the Groundwater - Surface Water Interaction section of this report (Section 6.8), for the available period of record (August to October 2022).

The surface water and shallow groundwater monitoring results at SW14/MP14 to SW20/MP20 are summarized as follows:

- Observed shallow groundwater heads were consistently below the surface water head (when present) and below ground surface during the monitoring period, indicating downward vertical gradients in the shallow subsurface;
- Surface water was not observed at SW18 or SW20; and
- Surface water levels were observed to decline at SW17 and SW19 following installation suggesting the water was evaporating or infiltrating following a 45 mm of rainfall several weeks prior. Both locations did not have consistently present surface water by the end of August and through the remainder of the monitoring period.

In summary, these surface water monitoring locations were either perched or completely dry during the August to October 2022 period of record, and were not supported by groundwater.

5.8.2 Drilling and Well Construction

5.8.2.1 Methodology

Supplemental drilling in the northwest investigation was undertaken between August 2 and August 10, 2022 by CSD under Golder supervision, in a manner similar to that described in Section 5.1.1, noting the following.

- All boreholes were advanced with rotasonic methods through the overburden and into the bedrock, similar to the installation of the PW21 and MW21 series wells.
- Monitoring wells (MW22-01, MW22-02 and MW22-03) were constructed in manner similar to the MW20 series monitoring wells.
- MW22-01 was installed as an offset overburden well to the existing bedrock well nest at MW20-16A/B, located along the southeast part of the Northwest Wetland area, approximately 90 m southwest of SW20/MP20.
- MW22-02A/B/C was installed as a nested bedrock well (MW22-02A/B) and an offset overburden well (MW22-02C) approximately 270 m north of existing well MW20-15A/B and approximately 40 m west of SW17/MP17, on the west side of the Northwest Wetland area.
- MW22-03A/B was installed as a nested overburden well approximately 390 m northwest of MW22-02A/B/C and approximately 30 m west of SW19/MP19, on the west side of the Northwest Wetland Area.
- The new monitoring wells were developed in the same manner as earlier monitoring wells in the program, as described in Section 5.5.1.
- Pumping well PW22-1 was installed adjacent to existing monitoring well MW20-15A/B. PW22-1 was constructed using 4” PVC screen and riser pipe, with filter sand installed around the screen, and bentonite in the remaining annulus. The well screen was designed so that the bottom of screen was aligned with the base of the Shaley Dolostone and the screen spanned entire bedrock aquifer (Shaley Dolostone and Gasport Formation) and the upper contact aquifer zone.
- Pumping well PW22-1 was developed by CSD using an air compressor to air lift water from the well for a period of 4 hours, achieving approximately 5 m of drawdown during development.

5.8.2.2 Results

The stratigraphy encountered during drilling is summarized below and was generally consistent with the earlier drilling at MW20-15A/B and MW20-16A/B. Borehole logs and well completion details for the new wells are provided in Appendix J.

Overburden

- Overburden thickness in the area varied from 10.4 m (at PW22-1) to 19.1 m (at MW22-03).
- The shallow overburden in the area was found to be comprised of variable layers of sediments, primarily sandy silt to silty sands, with dense till layers and gravelly layers in places.
- Below a depth of approximately 6 m, the overburden stratigraphy generally became more consistent and was found to be comprised of silty clay till and sandy silt till to the top of bedrock.

- A gravel lens was encountered at MW22-02 just above the top of bedrock, in the contact aquifer zone.

Bedrock

- The bedrock at PW22-1 and MW22-02 was comprised of the Gasport Formation underlain by the Shaley Dolostone and Cabot Head Formation. The Gasport Formation was found to be 22.56 m thick at PW22-1 and 24.69 m thick at MW22-02.

5.8.3 Downhole Geophysical Logging

Downhole geophysical logging was performed in the open boreholes at PW22-01 (natural gamma, apparent conductivity) and MW22-02 (natural gamma, apparent conductivity, optical televiewer and heat pulse flow meter) in a manner similar to that conducted at earlier boreholes, as described in Section 5.2.1.

The results of the geophysical logging are presented in Appendix J and were used mainly to delineate bedrock stratigraphic contacts between the Gasport Formation, the Shaley Dolostone and the Cabot Head. Additionally, the heat pulse flow meter log at MW22-02 identified a hydraulically active feature in the Gasport Formation at approximately 29 mbgs.

5.8.4 Soil Coring and Grain Size Analysis

The objective of the shallow soil coring program was to assess shallow soil stratigraphy in the wooded wetland area, in order to better understand its hydraulic properties. A total of 10 locations were cored (SC22-01 to SC22-10), as shown on Figure 5-8.

5.8.4.1 Methodology

Soil cores were collected and analyzed using the following methodology.

- Sites were selected to maximize the spatial observations of shallow soils, but avoid coring in areas of ponded water.
- Soil cores were advanced using a 7 cm diameter soil auger with extension rods to a depth of 2.5 mbgs, where possible, or to refusal. Where soil augers reached refusal on gravel or a cobble, a step-off hole was attempted until it reached the target depth or refusal. If two refusals, were encountered within 0.5 mbgs, a third soil core was attempted until it reached the target depth or refusal.
- Soil samples at each test location were described and photographed, and then the samples were bagged by lithology. Where sample quantity permitted, the soil samples were divided in half. Half was submitted to the materials lab for testing and half was retained for future reference. Where soil quantity did not permit the splitting of samples, the sample was retained and not tested.
- Lab analysis included sieve and hydrometer analysis to prepare soil grain size distributions and soil moisture content analysis, as presented in Appendix J. An empirical method suitable for the soil type was applied to the grain size distribution of each sample to provide an empirical estimate of the saturated hydraulic conductivity of the soil. Where a sample was logged as a sand, the Hazen Method (Hazen 1911) was applied and where a finer grained soil sample was observed, the Terzaghi Method was applied (Woessner and Poeter 2020).

5.8.4.2 Results

Results of the soil coring program are summarized in Table 5-9 and hydraulic conductivity based on the Hazen Method (Hazen 1911) are presented in Table 5-10. The following observations are made about of the results of the soil coring program.

- Refusal was encountered at all borehole locations between depths of 0.5 to 1.8 mbgs on cobbles or gravel.
- Observed lithologies included: Sand and Gravel, Sand, Sandy Silt, Silt, and Sandy Clay. These shallow overburden lithologies varied significantly between locations. This variability is consistent with shallow overburden observations in the borehole drilling program (Sections 5.1.2 and 5.8.2.2);
- Till was encountered at four of the 10 soil coring locations; and
- Hydraulic conductivity estimates for the 21 samples analyzed ranged from $1x10^{-8}$ to $3x10^{-5}$ m/s. These values are consistent when compared to literature values for similar lithologies.

Table 5-9: Soil Coring Results - Northwest Investigation

SC ID	From (mbgs)	To (mbgs)	Description	Sample Number	Comment
SC-01	0.00	0.23	Sandy Silt, Topsoil, no odour, no staining	1	
	0.23	1.04	Sand, some silt, no odour, no staining	2	Refusal on cobble/gravel
	1.04	1.17	medium to coarse sand, trace gravel and silt, no odour, no staining	3	Refusal on cobble/gravel
SC-02	0.00	0.22	Silt, Topsoil, no odour, no staining	1	
	0.22	0.48	Fine to medium Sand, some silt, no odour, no staining	2	Refusal on cobble/gravel x 3, returned with shovel - cobbles in sand
SC-03	0.00	0.30	Silt, Topsoil, no odour, no staining	1	
	0.30	1.19	Fine to medium Sand, some silt, coarsing downward, no odour, no staining	2	Refusal on cobble/gravel x 2
SC-04	0.00	0.33	Sandy Clay, Topsoil, no odour, no staining	1	
	0.33	0.41	Sandy Clay, no odour, no staining	2	
	0.41	0.84	Sand, some clay, trace gavel, coarsing downward, no odour, no staining	2	Refusal on cobble/gravel x 2
SC-05	0.00	0.25	Sandy Silt, Topsoil, no odour, no staining	1	
	0.25	0.69	Fine to medium Sand, some silt, trace gravel, no odour, no staining	2	Refusal on cobble/gravel x 2
SC-06	0.00	0.33	Clay Topsoil, no odour, no staining	1	
	0.33	1.83	Clayey Sand Till, some silt, trace gravel, soft reworked clay, no odour, no staining	2	Refusal on cobble/gravel. Ground past cobble at 0.3m.
SC-07	0.00	0.30	Silty Clay, Topsoil, no odour, no staining	1	
	0.30	0.51	Clay, some Sand, no odour, no staining	2	
	0.51	1.47	Sandy Clay Till, soft reworked clay, no odour, no staining	3	
	1.47	1.57	Sand and Gravel, hard, some clay, no odour, no staining	4	Refusal on cobble/gravel
SC-08	0.00	0.20	Sandy Silt, Topsoil, no odour, no staining	1	
	0.20	0.69	Silt Till, some sand, very dense, no odour, no staining	2	Refusal on cobble/gravel
SC-09	0.00	0.30	Sandy Silt, Topsoil, no odour, no staining	1	
	0.30	0.79	Silt Till, some sand, trace clay and gravel, very dense, no odour, no staining	2	Refusal on cobble/gravel x 2
	0.00	0.15	Sandy Silt, Topsoil, no odour, no staining	1	

SC ID	From (mbgs)	To (mbgs)	Description	Sample Number	Comment
SC-10	0.15	1.27	Sand and Silt, dense, silty on top and coarsing downward, becoming trace gravel near bottom, no odour, no staining	2	Refusal on cobble/gravel x 2

Table 5-10: Hydraulic Conductivity Estimates - Northwest Investigation

Borehole Number	Sample Number	Easting (m)	Northing (m)	Ground Elevation (masl)	From (mbgs)	To (mbgs)	D10 (mm)	k (m/s)
SC 22-01	1	576228	4854048	421	0.00	0.23	0.0014	1E-08
	2				0.23	1.04	0.0039	2E-07
	3				1.04	1.17	0.052	3E-05
SC 22-02	1	576331	4853948	421	0.00	0.22	0.0018	2E-08
	2				0.22	0.48	0.0016	3E-08
SC 22-03	1	576423	4853861	420	0.00	0.30	0.0014	1E-08
	2				0.30	1.19	0.01	1E-06
SC 22-04	1	576252	4854147	420	0.00	0.33	0.0014	1E-08
	2				0.33	0.84	0.0014	1E-08
SC 22-05	1	576354	4854102	420	0.00	0.25	0.0014	1E-08
	2				0.25	0.69	0.0016	3E-08
SC 22-06	2	576460	4854012	420	0.33	1.83	0.0096	9E-07
SC 22-07	2	576574	4853921	420	0.30	0.51	0.0014	1E-08
	3				0.51	1.47	0.0014	1E-08
	4				1.47	1.57	0.022	5E-06
SC 22-08	1	576687	4854009	421	0.00	0.20	0.0013	2E-08
	2				0.20	0.69	0.0015	2E-08
SC 22-09	1	576751	4853945	421	0.00	0.30	0.0015	2E-08
	2				0.30	0.79	0.0014	1E-08
SC 22-10	1	576810	4853878	421	0.00	0.15	0.0014	1E-08
	2				0.15	1.27	0.007	5E-07

Notes:
Light grey indicates final weight measurement at 10% - 20%. Therefore, k may be lower than estimated.
Ground surface elevation estimated from 1m SWOOP topography.
Viscosity of water is similar in field and lab testing.
The median value is assumed for the Terzaghi coefficient for particle shape (700) (Woessner and Poeter 2020).
Typical porosity values were assumed: 30% for sand and 40% for dense fine materials (Woessner and Poeter 2020).

5.8.5 Hydraulic Testing (SWRTs)

5.8.5.1 Methodology

Single well response tests were performed at the new monitoring wells MW22-01, MW22-02A/B/C and MW22-03A/B using the same methods described in Section 5.5.1, including Waterra purge rising head tests and pneumatic rising head tests.

To maximize the collection of hydraulic conductivity data in the shallow subsurface, the mini-piezometers MP17 to MP20 were included in the SWRT program. However, the groundwater levels in the mini-piezometers were too low to perform rising head tests, as such a “pour in” falling head test method was used, measuring the static water level and then adding a known quantity of potable water to mini-piezometer to cause a known head increase. Water level recovery was then monitored.

5.8.5.2 Results

Results of the SWRT program are summarized in Table 5-11 and individual test results are presented in Appendix J on Figures J-1 to J10. With reference to these figures and the table, the following observations are noted.

- Three SWRTs were conducted in bedrock wells, and the hydraulic conductivity ranged from $8x10^{-6}$ (at MW22-02B) to $2x10^{-5}$ m/s (at PW22-01 and MW22-02A), consistent with previous bedrock hydraulic conductivity test results.
- The other seven SWRTs were performed on overburden wells or mini-piezometers, and the hydraulic conductivity ranged from $3x10^{-9}$ m/s (at MW22-03B) to $5x10^{-6}$ (at MW22-01). Generally, the overburden tests yielded lower hydraulic conductivity results, with a geometric mean of $8x10^{-8}$, consistent with the range of hydraulic conductivities for the fine grained lithologies encountered.
- It is noted that the three mini-piezometers tested (MP17, MP18 and MP19) were not well developed and had not reached a static water level at the time of testing. Nonetheless, the SWRT results at these locations are considered to be generally indicative of hydraulic conductivity. MP14 and MP20 were found to be dry, and could not be tested.

Table 5-11: Single Well Response Test Results - Northwest Investigation

MW ID	Screen Top (mbgs)	Screen Bottom (mbgs)	Screen Mid-point (masl)	Aquifer Model	Screened Unit	k (m/s)	Comment
PW22-01	10.36	34.14	394.50	Confined	Dolostone	$2x10^{-5}$	
MW22-01	4.11	7.16	415.76	Unconfined	Silty Sand	$5x10^{-6}$	
MW22-02A	34.75	36.27	384.30	Confined	Dolostone	$2x10^{-5}$	
MW22-02B	12.80	15.85	405.48	Confined	Dolostone	$8x10^{-6}$	
MW22-02C	3.96	5.49	415.27	Unconfined	Silty Sand and Gravel Till	$2x10^{-8}$	
MW22-03A	12.80	15.85	407.54	Confined	Silty Sand Till	$2x10^{-7}$	

MW ID	Screen Top (mbgs)	Screen Bottom (mbgs)	Screen Mid-point (masl)	Aquifer Model	Screened Unit	k (m/s)	Comment
MW22-03B	4.57	6.10	416.53	Unconfined	Silty Sand and Gravel Till	$3x10^{-9}$	
MP14				Unconfined	Silty Sand and Gravel Till		Dry
MP17	0.90	1.10	417.88	Unconfined	Silty Sand Till (BH Log MW22-02)	$1x10^{-8}$	Development and overall aquifer trend affected static level during the test.
MP18	1.35	1.55	419.07	Unconfined	Overburden (no BH log)	$1x10^{-7}$	
MP19	1.01	1.21	419.60	Unconfined	Overburden (no BH log)	$2x10^{-7}$	
MP20				Unconfined	Sand, some silt		Dry

5.8.6 Hydraulic Testing - Pumping Test

A 96-hour pumping test was conducted at PW22-1 between August 23 and August 30, 2022, registered under EASR permit 1000187242.

A short duration test was conducted initially on August 23, 2022 to select a suitable pumping rate, followed by the constant rate test beginning on the morning on August 24, 2022. However, an equipment failure led to the pump shutting down on the evening of August 24, 2022. The faulty equipment was replaced, and the test was reinitiated on August 26, 2022.

The pumping rate was increased during the test from an initial rate of 75 L/min to 84 L/min (the maximum rate of the pump). An average pumping rate of 80.4 L/min was assumed in the subsequent analysis. The pump was shut down on August 30, 2022 and recovery was monitored until September 7, 2022.

Pumped groundwater from PW22-1 was discharged approximately 340 m to the southeast of the well and approximately 50 m from Tributary #1, to allow for the attenuation of any sediment in the water before it reached a surface water feature. Soil conditions at the time of the test were very dry and all of the discharged water evaporated or infiltrated. When the pump was shut down on August 30, 2022, the discharge area had wetted an irregular area reaching approximately 30 m toward the Tributary #1 and approximately 20 m in width.

Water level monitoring, as described in Section 5.6, included the wells and surface water locations shown on Figure 5-8.

Water level observations during the test are presented on Figures J-11, J-12 and J-13, showing hydrographs of all wells influenced by the pumping test (J-11), and additionally (to establish background water levels) bedrock wells not influenced by the pumping test (J-12), and surface water and overburden groundwater levels not influenced by the pumping test (J-13).

Pumping Well (PW22-1) Response

- Drawdown in the pumping well occurred rapidly at the start of the test and each time that the pumping rate was increased.
- During the test water levels repeatedly stabilized and, after time, began to recover slowly. This is attributed to the well continuing to develop during the test and becoming more efficient. In response to increasing well efficiency, the pumping rate was repeatedly increased during the test.
- Total drawdown in the pumping well at the end of the test was 26.2 m.

Bedrock Aquifer Response

- Following the typical seasonal trend, bedrock water levels fell steadily during the late summer of 2022 (as discussed in Section 5.3), including in the area of the PW22-1. To quantify this trend, bedrock monitoring wells proximal to PW22-1 but outside of the area of influence of the test were plotted on Figure J-12. A steady and consistent declining trend of 1.2 cm/day was noted from the start of July through the test period observation period in September 2022.
- This trend, superimposed on the affects of the pumping test data and left uncorrected, caused overestimation of drawdown, and underestimation of recovery. The pumping test data was therefore corrected to remove this trend and the corrected data was analysed, as noted in the relevant figures.
- The pumping zone of influence in the bedrock aquifer is estimated to extend approximately 500 m from PW22-1 with approximately 0.2 m of drawdown estimated at that distance (Figure J-14).
- The distance drawdown plot (Figure J-14) shows that the pumping well drawdown plots on a straight line with the drawdown noted in observation wells.
- The drawdown observed in the bedrock aquifer was plotted on Figure J-15 by:
  - Applying a correction for the background aquifer trend;
  - Averaging observations of bedrock drawdown, where drawdown was observed;
  - Assuming that the observed drawdown of 12.02 m at a distance of 11 m from the production well (observed at MW20-15) occurred symmetrically around the pumping well; and
  - Interpolating between that drawdown and surrounding monitoring wells.
- Drawdown in the bedrock aquifer occurred uniformly, with little directional preference. The apparent horizontal hydraulic gradient between the pumping well and the monitoring wells to the northwest (MW22-02), northeast (MW20-16), and east (PW21-1) was very similar.
- Drawdown in the bedrock aquifer observed by monitoring wells ranged from 0.3 m (at MW21-1-3, 408 m away) to 12.5 m (at MW20-15B, 9 m away).
- Water levels in the bedrock well nest MW20-15A/B responded differently to the aquifer test, despite being the equidistant to PW22-1 and within the screen interval of PW22-1. MW20-15B (shallower) responded more quickly to pumping in PW22-1 and had more total drawdown (12.5m versus 11.5m) than MW20-15A (deeper), suggesting a better hydraulic connection to the pumping well. However, MW20-15A recovered significantly more quickly than MW20-15B, which could be explained by a connection to another hydraulic feature allowing it to recover more quickly. These variable responses reflect the heterogeneity of the bedrock aquifer.

Overburden Aquifer Response

- Water levels in the overburden aquifer system were monitored at nine locations within 670 m of the pumping well during the aquifer test, with water levels shown on the hydrographs on Figure J-13.
- Similar to the bedrock aquifer, a seasonal declining water level trend was observed in the overburden.
- Responses to pumping (changes in water levels) were observed at two locations MW20-15C and MW22-03A. MW20-15C is located 9 m from PW22-01 and showed 1.1 m of drawdown. MW22-03A is located 660 m to the northwest of PW22-01 in a confined portion of the overburden aquifer approximately 3 m above the top of bedrock, where 0.3 m of drawdown was observed.
- Water levels in the remaining overburden monitoring wells, generally shallow wells, showed no response to pumping.
- These observations are overall consistent with a semiconfined aquifer.

Surface Water Response

- Surface water stations SW14, SW18, and SW20 were dry throughout the test period, as shown on hydrograph Figures L-21, L-18, and L-20 in Appendix L, respectively.
- Throughout the observation period, there was a strong downward hydraulic gradient at the surface water locations, and the gradient did not change during the test.
- Surface water stations SW17 and SW19 (shown on hydrograph Figures L-17 and L-19 in Appendix L, respectively) observed low and declining water levels at the start of the observation period, consistent with the trend observed in the bedrock and the overburden. Both surface water stations became dry during the observation period (SW17 on August 27 and SW19 on August 30), but this appears to be due to the aforementioned overall declining water level trends and is not considered to be related to the pumping test.Surface water levels during the test did not change in response to pumping.
- Mini-piezometers MP17, MP18 and MP19 at the surface water stations proximal to the pumping test also showed no response to the pumping (Figures L-17, L-18 and L-19), indicating a lack of hydraulic connection between the stream bed and the underlying aquifer.

Estimate of Aquifer Properties

As shown on Figure J-16, the recovery of PW22-1 and MW20-15B plot along a similar slope on the semi-log plot. Based on the slope of this line and an average pumping rate of 80.4 L/min, the bulk transmissivity of the confined bedrock aquifer is interpreted to be approximately 4.5 m^2/day.

Based on an aquifer thickness of 23.8 m, the apparent hydraulic conductivity is $2x10^{-6}$ m/s, which is close the low end of the range of hydraulic conductivity for fractured or karstic dolostone, and close to the high end of the range of unfractured dolostone (Freeze and Cherry 1979).

Notably, the recovery from the aquifer test varied significantly in the monitoring wells (the multiple slopes, steeper and shallower than that of the PW22-1). This suggests significant heterogeneities in the transmissivity of the bedrock aquifer within the area of influence of the aquifer test.

Based on the slope of the recovery data at MW20-15B in the composite plot, the storativity of the bedrock aquifer is estimated to be approximately $1x10^{-4}$.

When compared to the previous pumping tests (summarized in Table 5-7), the results of this aquifer test are fairly consistent with the test performed at PW21-1 in 2021 (320 m to the east of PW22-01). The transmissivity and hydraulic conductivity of PW22-1 are the same order of magnitude as the results of the PW21-1 aquifer test. The storativity calculated based on the MW22-1 aquifer test is $1x10^{-4}$, which is also within the range observed during the PW21-1 aquifer test.

The zone of influence of this pumping test was larger than that of previous tests, which suggest that the contact aquifer is more continuous than the bedrock aquifer and provides a larger zone of aquifer connectivity.

5.8.7 Summary

Key findings of the supplemental groundwater and surface water investigation of the Northwest Wetland area in 2022 are as follows.

- The new surface water / mini-piezometer monitoring stations and existing monitoring stations in this area were found to have perched conditions or were completely dry during the August to October 2022 period of record and were not supported by groundwater.
- Near surface soils were found to be variable in composition but were generally comprised of fine-grained material that yielded low hydraulic conductivity estimates using the Hazen (1911) method.
- Single Well Response Tests in the shallow overburden also yielded low hydraulic conductivities.
- The 96-hour pumping test had a relatively large zone of influence in the bedrock aquifer, presumably due to the connection of the pumping well to the contact aquifer zone at the top of the bedrock. Despite this wide area of connection, surface water monitoring stations and mini-piezometers did not respond to the pumping test.
- Overall, these results suggest that the Northwest Wetland area is a perched water system relative to the deep overburden and bedrock aquifers.

5.9 Karst Assessment

A karst assessment was carried out by Worthington Groundwater (Worthington) as part of the overall hydrogeologic investigation. The report is provided in Appendix K and included the following tasks:

- An examination of topography and aerial imagery of the Site and Study Area;
- An on-site investigation of closed depressions and surface flows;
- Tracer test investigations during the 2021 pumping tests;
- An evaluation of and correlation with other hydrogeologic data sets; and
- A review of the HGS groundwater-surface water numerical modelling results.

The karst investigation found that the dolostone aquifer on the Site and in the Study Area is typical of carbonate aquifers where there is fairly thin overburden, which allows substantial recharge to enter the bedrock. Such distributed recharge results in pervasive dissolution of fractures, with most enlarged fractures having apertures of 0.1 mm - 3 mm. This results in the aquifer having a predictable response to large-scale stresses such as quarry development. The investigation did not identify any indicators in the data that would suggest the presence of underground dissolution conduits or caves in the Study Area.

5.10 Conceptual Site Model

Existing available geologic, hydrogeologic and hydrologic data (described in Section 3), in conjunction with site-specific data collected as part of the field investigations and monitoring programs (described in Sections 4, 5, 6 and 7) were utilized to develop the Conceptual Model (CSM) for the Site.

Aquifer System

The aquifer system within the Site and Study Area is conceptualized to be comprised of the following main hydrostratigraphic units:

- Upper Sand (Aquifer)
- Till (Aquitard)
- Lower Sand (Aquifer)
- Weathered Bedrock (Aquifer)
- Eramosa Fm (Aquifer)
- Goat Island Fm (Aquifer)
- Gasport Fm (Aquifer)
- Shaley Dolostone (Aquitard)
- Cabot Head Fm (Aquitard)
- Manitoulin Fm (Aquifer)
- Whirlpool Fm (Aquifer)
- Queenston Fm (Aquiclude)

A three-dimensional representation of the aquifer system for the Site was constructed using Leapfrog Geo, a geological modelling tool, and incorporated all available borehole data sources from previous studies and the current site-specific investigations, as well as the most current available high resolution topographic data, and linework representing surface water features. Details of the representation of the CSM as a numerical model is provided in the Numerical Modelling Report (Appendix Q).

Hydrologic Boundaries

The lowest hydrostratigraphic unit at the Site and Study Area considered in the CSM is the Queenston Formation, a shale unit of extensive thickness, which is conceptualized to be an aquiclude (no-flow boundary). For the purposes of conceptualizing the flow system, the CSM encompasses three sub-watersheds (No.15, No.17, No.18) within the larger Credit Valley watershed (CVC 2021), where the sub-watershed boundaries are considered to be groundwater flow divides (no-flow boundaries).

Hydraulic Properties

The results of the hydrogeologic investigation, including core logging, geophysical logging, hydraulic testing at different scales, and the karst assessment, have together demonstrated that the hydrogeologic system at the Site can be represented as an Equivalent Porous Medium (EPM). This EPM representation is considered applicable to the current hydrogeologic environment, as groundwater flow occurs through a combination of overburden soils,

and carbonate and shale sedimentary bedrock, in which the scale of flow and groundwater head observations are much greater than the size of individual fractures, where present, within the hydrostratigraphic units.

Based on site-specific data (where available) and published data sources, the hydraulic conductivity of the hydrostratigraphic units are conceptualized to be in the following ranges.

Table 5-12: Hydraulic Conductivity Ranges for CSM Hydrostratigraphic Units

Hydrostratigraphic Unit	Hydraulic Conductivity Range (m/s)	Information Source
Upper Sand (Aquifer)	$1x10^{-3}$ to $1x10^{-5}$	Site and published data
Till (Aquitard)	$1x10^{-6}$ to $1x10^{-8}$	Site and published data
Lower Sand (Aquifer)	$1x10^{-3}$ to $1x10^{-5}$	Site and published data
Weathered Bedrock (Aquifer)	$1x10^{-4}$ to $1x10^{-7}$	Site and published data
Eramosa Fm (Aquifer)	$1x10^{-8}$ to $1x10^{-10}$	Published data
Goat Island Fm (Aquifer)	$1x10^{-6}$ to $1x10^{-7}$	Published data
Gasport Fm (Aquifer)	$1x10^{-6}$ to $1x10^{-8}$	Site and published data
Shaley Dolostone (Aquitard)	$1x10^{-7}$ to $1x10^{-9}$	Site and published data
Cabot Head Fm (Aquitard)	$1x10^{-8}$ to $1x10^{-9}$	Site and published data
Manitoulin Fm (Aquifer)	$1x10^{-5}$ to $1x10^{-6}$	Published data
Whirlpool Fm (Aquifer)	$1x10^{-6}$ to $1x10^{-7}$	Published data
Queenston Fm (Aquiclude)	$1x10^{-8}$ to $1x10^{-9}$	Published data

Hydraulic Heads, Flows and Vertical Gradients

With reference to Section 5.3 and its associated figures, tables, and appendices, we note the following with respect to hydraulic heads, flows and vertical gradient at the Site.

- Horizontal groundwater flow is generally from the northwest to the east, southeast and south, and parallels topography from high to low elevation, particularly to the east, southeast and south of the Study Area towards the Niagara escarpment and Credit River valley.
- Most groundwater levels showed approximately two to three metres of seasonal fluctuation during the monitoring period.
- Seasonal groundwater heads in the Gasport Formation show similar patterns in all four seasons. The seasonal rise and fall of groundwater levels appears to have little affect on groundwater head distribution and or the direction of horizontal groundwater flow, as the dominant influence is inferred to be topography.

- Vertical hydraulic gradients at the Site and to east towards the escarpment are predominantly downward or neutral, consistent with this relative topographic high being a groundwater recharge area. To the west and southwest of the Site, vertical hydraulic gradients are a mixture of upward, neutral and downward, generally consistent with areas of rolling topography, with areas of relatively low topography frequently exhibiting upward vertical gradients.

Sources and Sinks

With reference to Sections 3.4, 5.8 and 6.0 there are limited surface water features on the Site itself, but there are several features in the immediate surroundings, including the Credit River and its tributaries, the Coulterville Wetland Complex (and Northwest Wetland) and the Cataract Southwest PSW. While the Credit River is generally conceptualized to be a groundwater sink, the tributaries and wetlands are conceptualized to potentially act a source and / or sink to groundwater, depending on the season and climatic inputs (i.e., temperature and precipitation).

Water Budget

The water budget for the Site and Study Area is presented in detail in Section 7 and the reader is referred there for further details.

6.0 SURFACE WATER INVESTIGATIONS

6.1 CVC Regulated Area and Floodplain Mapping

According to the CVC geospatial data mapping, the northwestern corner of the Site (i.e., where Tributary #1 crosses into the Site) lies within the “Generic Regulation Mapping” area within the Credit River watershed. The proposed extraction area does not contain any identified water resources on the Region of Peel Schedule A-1 (Water Resources, Systems and Features). However, the proposed licence area includes an identified feature (i.e., Tributary #1) in the northwest corner of the Main Area which is located outside of the extraction area and will be protected.

There is currently no floodplain mapping available from CVC as their geospatial data mapping tool is still in the process of being developed. However, based on available topographic data within the area, the areas nearest to the Credit River range from elevations of 401 to 403 masl, while the average bank elevation of the Credit River adjacent to the Site was 378.5 masl. With consideration of the elevation difference as well as a minimum distance of 450 m from the Site to the Credit River, potential impacts due flooding within the Credit River can be considered negligible.

6.2 Hydrology and Hydrologic Setting

The Site is partially located within Sub-watershed 18 (i.e., the Credit River Melville to Forks Sub-watershed; CVC 1999) which is part of the Credit River Watershed, west of the Main Branch of the Credit River near Cataract and Coulterville. It should be noted that Sub-watershed 18 and the surface water station catchments detailed in Section 7 below are not in complete agreement with each other. This is potentially due to a difference in base mapping resolution by OWIT, which was utilized for catchment delineation compared to what was used for the Sub-watershed Plan completed in 1999. There are several surface water features within the vicinity of the Site such as the Credit River which flows directly outside of the northern and eastern property boundaries. There is one tributary of the Credit River Erin Branch in the west corner of the Site, one tributary of the Main Branch sitting directly outside of the northwest portion of the Site, and several unnamed tributaries of the Erin Branch sitting distantly from the west portion of the Site (Figure 6-1). The Coulterville Wetland Complex sits along the north edge of the Site boundary and continues further north away from the Site. Agricultural fields are located throughout the Site, as well as rural residences on all sides of the Site.

As detailed in the “Phase 1 Report – Characterization” (CVC 1999), the streamflow response in the watercourses within sub-watershed 18 can be attributed to dampened sustained flow year-round. The specific characteristics that impose a major influence on the above flow response in sub-watershed 18 include “significant closed drainage systems, limited municipal drainage, significant floodplain storage, high percentage of forest cover, the prevalence of high infiltration soils, and the presence of aggregate extraction activities” (CVC 1999). The combination of limited municipal drainage and presence of hummocky topography, associated with the Singhampton Moraine and large wetland areas, have resulted in large areas with either no surface drainage outlet or restricted outlets. These areas are classified as closed drainage systems and due to the presence of highly permeable soils, a reduction in surface water runoff to flow within the sub-watershed occurs after precipitation due to the high recharge rates to groundwater aquifers (CVC 1999).

Several unnamed tributaries to the Main and Erin Branches of the Credit River are situated within the vicinity of the Site. The following unnamed tributaries (excluding Tributary #1) sit outside the proposed licence boundary, as seen in Figure 6-1:

- Tributary #4 originates in a rural pond west of Main Street approximately 0.5 km north of the Site and flows through a culvert under Main Street and reports to the Credit River through the Osprey Valley Golf Course;
- Tributary #5 originates in the Coulterville Wetland Complex approximately 0.78 km north of the Site and flows east into Tributary #4 at the Osprey Valley Golf Course;
- Tributary #6 originates west of Shaws Creek Road approximately 2.1 km west of the Site and flows southeast into Tributary #8 north of Charleston Sideroad;
- Tributary #7 originates in the Coulterville Wetland Complex approximately 1.2 km west of the Site and flows southeast into Tributary #6 at Shaws Creek Road;
- Tributary #8 originates in a rural field approximately 0.5 km southwest of the Site and flows southwest towards the Erin Branch of the Credit River; and,
- Tributary #9 originates in a small wetland west of Shaws Creek Road approximately 1.9 km west of the Site and flows east into Tributary #7.

Tributary #1 originates in the Coulterville Wetland Complex approximately 0.9 km north of the Site and flows through the northwestern corner of the Site. Tributary #1 then follows along the proposed extraction limit before flowing into a residential pond with an adjacent small wetland feature downstream. During periods of low flow, Tributary #1 drains and disappears within this wetland feature while during high seasonal flows, it has been observed that Tributary #1 drains past the wetland feature towards a roadside ditch along Mississauga Road before infiltrating within a local depression east of Mississauga Road, thus, not crossing the roadway. No culvert crossing exists at Mississauga Road proximal to Tributary #1 and no defined channel is present on the west side of the road. As Tributary #1 flows through the proposed licensed boundary, it was considered a water feature of interest for the potential impact assessment study.

To further identify and characterize the surface water features present on site (i.e., watercourses, waterbodies, and/or drainage features), Ministry of Natural Resources mapping, along with information collected during site visits conducted between May 2020 to December 2021 were reviewed.

6.3 Monitoring Stations

Surface water monitoring stations were installed along various watercourses / drainage pathways around the vicinity of the proposed quarry area.

A list of the monitoring stations, their locations and their installation dates are provided in Table 6-1.

Table 6-1: Surface Water Monitoring Locations

Station Name	Zone	Northing	Easting	Installation Date	Measurements	Description of Monitoring Location
SW1 (1)	17	4853149	573961	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Cobble channel leading to culvert under roadway
SW2 (1)	17	4853750	574434	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Heavily vegetated channel leading to culvert under roadway

Station Name	Zone	Northing	Easting	Installation Date	Measurements	Description of Monitoring Location
SW3 (1)	17	4852964	574761	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Small partially defined channel at roadside ditch with culvert
SW4 (1)	17	4853846	575863	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Wide vegetated floodplain
SW5 (1)	17	4854878	576744	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Small, vegetated channel at culvert
SW6 (1)	17	4851678	576045	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Heavily vegetated roadside ditch channel
SW7 (1)	17	4851688	576055	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Heavily vegetated roadside ditch channel
SW8 (1)	17	4850401	575678	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Wide, deep channel at box culvert
SW9 (1)	17	4850628	579128	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Sand/cobble channel leading to culvert
SW10 (1)	17	4851870	578239	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Ponded feature leading to a culvert
SW11 (1)	17	4854781	576842	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Small, vegetated channel leading to a culvert
SW12 (1)	17	4853488	578154	May 01, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Culvert draining agricultural field with no channel.
SW13 (1)	17	4855098	578165	October 06, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Golf course pond with a siphon discharge structure
SW14 / MP14 (1)	17	4853501	576562	October 06, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Silt/sand channel near wetland feature
SW15 / MP15 (1)	17	4852785	576024	October 06, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Vegetated channel
SW16 / MP16 (1)	17	4851406	576368	October 06, 2020 (2) October 12, 2021 (3)	Water Level and Water Temperature	Wide vegetated floodplain
SW17 / MP17 (1)	17	4853803	576488	August 05, 2022 (2)	Water Level	Wide channel near wetland feature

Station Name	Zone	Northing	Easting	Installation Date	Measurements	Description of Monitoring Location
SW18 / MP18 (1)	17	4853993	576396	August 05, 2022 (2)	Water Level	Wide area of organic deposits
SW19 / MP19 (1)	17	4854106	576226	August 05, 2022 (2)	Water Level	Wide channel in wetland feature
SW20 / MP20 (1)	17	4853890	576819	August 05, 2022 (2)	Water Level	Wide area of organic deposits

Notes:

(1) The approximate locations of these monitoring stations are shown on Figure 6-1.

(2) Refers to the installation date for the water level monitoring stations.

(3) Refers to the installation date for the water temperature monitoring stations.

Several surface water monitoring station catchments flow into one another, as follows. Within the Tributary #1 catchment, SW19 drains into SW18 and then SW18 and SW20 drain into SW17, which reports to SW14. Further down gradient, SW4, SW14 and SW15 all drain into SW16. From there, SW1, SW2, SW3, SW6, SW7 and SW16 all drain into SW8. Although, these catchments technically include upstream stations, not all catchments contribute flow or have direct surface connection to each other. For example, the flows at Tributary #1 do not flow across Mississauga Road and therefore do not report directly over the surface to SW16. Also, flows were never observed/recorded manually during the monitoring period, although stations up gradient that were instrumented were found to flow perennially when the data was examined. Therefore, although catchments are connected by topography, surface water flow in the area often infiltrates and does not report to surface water features down gradient.

6.4 Surface Water Levels

Surface water stations (SW1 to SW16) and drive-point piezometers (MP14 to MP16) were installed to assess seasonal streamflow regimes in the watercourses / drainage pathways around the Site. Water level transducer loggers and manual staff gauges were installed at each of these monitoring locations excluding the staff gauges at the drive-point piezometers. The loggers were programmed to record water levels on a 15-minute interval. The elevations of the staff gauges and drive-point piezometers were surveyed on May 1, 2020 (SW1 to SW12) and October 06, 2020 (SW13 to SW16 & MP14 to MP16) and referenced to the Canadian Geodetic Vertical Datum of 1928 (1978 adjustment) datum. Water levels were manually recorded at the staff gauge locations concurrently during each site visit to verify continuous water level measurements recorded with the logger.

The ranges in water levels for monitoring stations are presented in Table 6-2 below. These water level ranges are based on the continuous logger data.

Table 6-2: Maximum and Minimum Water Levels at SW1-SW16 and MP14-MP16

Surface Water Monitoring Stations	Period of Record						
	2020			2021			Range of Water Levels (m)
	Min. WL (m)	Max. WL (m)	Avg. WL (m)	Min. WL (m)	Max. WL (m)	Avg. WL (m)	
SW1 (1)	0.11	0.24	0.14	0.12	0.42	0.19	0.32
SW2 (1)	0.00	0.17	0.04	0.00	0.24	0.10	0.24
SW3 (1)	0.09	0.16	0.13	0.00	0.19	0.11	0.18
SW4 (1)	0.00	0.17	0.02	0.00	0.12	0.03	0.17
SW5 (1)	0.00	0.19	0.05	0.00	0.37	0.08	0.37
SW6 (1)	0.00	0.40	0.05	0.00	0.62	0.17	0.62
SW7 (1)	0.00	0.36	0.03	0.00	0.71	0.13	0.71
SW8 (1)	0.32	0.75	0.49	0.22	0.76	0.50	0.54
SW9 (1)	0.29	0.37	0.31	0.27	0.42	0.34	0.15
SW10 (1)	0.00	0.33	0.05	0.00	0.04	0.00	0.33
SW11 (1)	0.00	0.16	0.05	0.00	0.19	0.08	0.19
SW12 (1)	0.00	0.00	0.00	0.00	0.02	0.00	0.02
SW13 (1)	0.41	0.72	0.61	0.10	0.64	0.33	0.62
SW14 (1)	0.00	0.12	0.01	0.00	0.23	0.09	0.24
SW15 (1)	0.10	0.16	0.13	0.02	0.25	0.15	0.22
SW16 (1)	0.00	0.01	0.00	0.00	0.05	0.00	0.05
MP14 (1)	-0.89	0.08	-0.54	-0.91	0.22	-0.09	1.13
MP15 (1)	0.07	0.32	0.22	0.13	0.45	0.28	0.37
MP16 (1)	-0.94	-0.86	-0.92	-0.94	0.16	-0.74	1.10

Note: (1) Survey datum is based on Realtime Can-Net Network Observations (UTM Zone 17 CSRS 2010, Elevations are CGVD 1928, 1978 Adjustment).

As detailed in Table 6-2 above, variations in water level relative to the base of the watercourse bed at the surface water stations were observed to range from 0.02 m to 0.71 m over the period of record, with the minimum and maximum variations occurring at SW12 and SW7, respectively. Variations in subsurface water level at the three MP stations were observed to range from 0.37 m to 1.13 m over the period of record, with the minimum and maximum variations occurring at MP15 and MP14, respectively.

Figures L1 to L16 in Appendix L show the continuous water level data for each monitoring station. Generally, water level records at the surface water stations are marked by low water levels during the summer and early fall. Winter water levels generally remained low, marked with high water events likely caused by short melt events. Water levels through the spring were moderate to high following the freshet. Water levels in the fall were marked with responses to large precipitation events.

6.5 Stream Flow

Instantaneous flow measurements were collected at all surface water monitoring stations. The measurements were collected from May 2020 to December 2021. Measurements were collected through standard velocity-area methods, using a wading rod, measuring tape and stream velocity meter. Velocity was measured at 60% of water depth, except when water depth exceeded 0.75 m, in which case velocity was measured at both 20% and 80% of water depth. Instantaneous flow measurements for all stations are summarized in Table 6-3.

Table 6-3: Instantaneous Flow Measurements

Surface Water Station	Flow (L/s)						
	Period of Record						
	May. 01, 2020	Jul. 30, 2020	Dec. 10, 2020	Mar. 16, 2021	Jun. 09, 2021	Sep. 08, 2021	Dec. 14, 2021
SW1	16.12	0.53	11.87	53.38	10.27	8.08	47.31
SW2	0.03	Dry	Stagnant	Frozen	<0.05 (1)	Dry	0.34
SW3	0.95	0.07	Stagnant	0.98	0.16	Stagnant	1.74
SW4	Stagnant	Dry	Dry	Dry	Dry	Dry	Stagnant
SW5	5.47	Dry	1.06	9.99	Dry	Dry	14.95
SW6	14.18	Dry	Dry	49.10	Dry	Dry	21.61
SW7	1.40	Dry	Dry	13.94	Dry	Dry	72.21
SW8	14.67	2.56	Frozen	Frozen	4.77	16.29	121.73
SW9	31.67	18.26	19.16	21.21	16.21	27.64	11.12
SW10	0.40	Dry	Dry	Dry	Dry	Dry	Dry
SW11	0.95	Dry	0.96	0.31	0.78	3.58	4.27
SW12	Dry	Dry	Dry	Dry	Dry	Dry	Dry
SW13	- (3)	- (3)	Frozen	Frozen	- (2)	0.25	0.43
SW14	- (3)	- (3)	Dry	8.41	0.01	Dry	10.64
SW15	- (3)	- (3)	0.40	1.20	0.71	0.06	2.16
SW16	- (3)	- (3)	Dry	Dry	Dry	Dry	Dry

Note: L/s = Liters per second
(1) On the June 09, 2021 field visit at SW2, the flow in the channel was too shallow to record with the flow meter, so a visual estimate was recorded.
(2) On the June 09, 2021 field visit at SW13, no flow was measured due to the configuration of the pond outlet and high water levels in the river.
(3) Flow measurement was not recorded as stations had not been installed yet.

The instantaneous flow measurements along Tributaries #1 to #9 or other waterbodies surrounding the Site (SW1-SW16) can be seen in Figures L1 to L16 in Appendix L.

Stage discharge relationships were created for each surface water station using cross-sectional survey data collected by Golder which were incorporated into short-reach hydraulic models (HEC-RAS) to develop theoretical rating curves with the exception of SW4 and SW16 where no flow was observed and was dry throughout the period. These curves were calibrated using the observed spot flow measurements. The relationships were used to developed continuous flow records for these monitoring stations. Continuous flow estimates above the maximum manually measured flows are reported with lower confidence. Similar to the continuous water level record, the continuous flow record at all stations is marked by low flows during the summer and early fall. Winter flows generally remained low, marked with high flow events likely caused by short melt events. Flows through the spring were moderate to high following the freshet. Flows in the fall were marked with responses to large precipitation events.

Flow at SW13 was difficult to measure depending on the level of the pond. The outlet of SW13, where flow is captured, is situated at the bottom of a slope downstream of an Osprey Valley Golf Course Pond and the water level in the pond is controlled by a siphon discharge structure. The two ponds adjacent to SW13 do not receive substantial surface water runoff and are primarily fed by groundwater inflow. The single flow observed at SW10, captured during installation, was the only time within the period of record that the water level was high enough to cause flow in the culvert that connects the two ponds. At SW10, the staff gauge was installed in the pond at a lower elevation than the culvert invert. Flow conditions between the ponds was observed to be intermittent. Flow conditions at SW12 were usually dry due to the small catchment size contributing to the surface water station as well as the high permeability of the soil within the catchment that resulted in reduced runoff.

6.5.1 Historical Credit River Flow

Historic flows at the Credit River were analyzed to characterize the seasonal trends as well as how the flow within the river has changed over the years. As detailed in Figure 6-2, seasonal trends in the Credit River adjacent to the Site over the last 20 years are marked by low flows during mid summer to mid fall. Winter flows generally remained low but were higher in comparison due to the likely presence of high flow events likely caused by short melt events. Flows through the spring were high following the freshet. Flows in the fall were low to moderate even though large precipitation events were common, which suggests that the influence of precipitation events on flow in the Credit River can vary monthly. Overall, these trends are similar to the trends viewed in the tributaries entering the Credit River adjacent to the Site. Additionally, flows from Island Lake (at the headwaters of the Credit on the west side of Orangeville) are controlled to manage assimilative capacity for Orangeville's WWTP effluent. A summary of the maximum, minimum and average monthly flows over the 20-period are displayed in Table 6-4 below.

Table 6-4: Monthly Historic Flows Observed at the Credit River at Cataract WSC Flow Gauge

Period of Record	Monthly Historic Flows Measured at the Credit River at Cataract WSC Flow Gauge			Historical Total Annual Precipitation (mm)
	Minimum (m^3/s)	Maximum (m^3/s)	Average (m^3/s)	
2002	0.82	2.84	1.47	751.7
2003	0.62	1.92	1.26	863.7
2004	1.09	3.65	1.83	902.2
2005	1.14	4.98	1.97	1013.4
2006	0.93	4.66	2.32	1139
2007	0.83	3.15	1.62	759.1
2008	1.39	5.86	2.43	1405.1
2009	1.39	4.53	2.61	1032.3
2010	1.35	3.57	1.94	1132.2
2011	1.17	4.31	2.21	1075.6
2012	1.21	3.32	1.91	789.7
2013	1.54	5.60	2.47	1071.7
2014	1.50	7.07	2.30	902.5
2015	1.04	2.77	1.59	773.8
2016	1.04	3.89	1.72	727.9
2017	1.56	4.13	2.40	1033.9
2018	1.18	4.81	2.26	1089.8
2019	1.17	4.72	2.27	935.8
2020	1.20	3.57	1.90	951.1
2021	0.93	2.11	1.42	776.2
Average Annual Flow over Period (m^3/s)	**2.0**			**956.3**

As detailed in Figure 6-2 and Table 6-4 above, annual flow within the Credit River remained within +/- 25% of the average annual flow over the 20-year period with various dips and rises over the average annual flow with the lowest annual flow occurring in 2003. Over the last two years, the flow was found to be below the average annual and was the second lowest over the 20-year period in 2021.

As seen in Figure 6-2, there is a strong correlation between average annual precipitation and average annual flow in the Credit River. For the majority of the last 20 years when annual precipitation was above or below the average annual of 956 mm, the average annual flow in the river responded similarly to its average annual flow of 2.00 m^3/s. The only exceptions occurred in 2010, 2014, and 2019. It is likely that other factors such as previous years precipitation, localized precipitation events, rates of evaporation due to temperature or fluctuating groundwater recharge were the cause of the exceptions.

6.5.2 Low Flow

The Credit River flows are monitored by the Water Survey of Canada (WSC) and the CVC. These monitoring stations are typically accurate at estimating mid to high flows, however, depending on the channel geometry, low flow estimates can vary. Additional flows were collected by Golder to assess this variance and to confirm the low flow estimates by the WSC and CVC gauges as they represent periods when the river or surrounding surface water system may be vulnerable to impacts caused by changes in stream flow. To evaluate low flows in the Credit River for comparison purposes with the WSC and CVC gauges, low flow measurements were collected during the summer months at three locations of the Credit River within the vicinity of the Site. The following three low flow locations are within the Main Branch of the Credit River and the West Credit River, as seen in Figure 6-3.

- Low Flow Location #1: Situated on the Main Branch of the Credit River, downstream side of the Charleston Sideroad, approximately 0.3 km upstream of the WSC “Credit River at Cataract (Station ID: 02HB001)” flow gauge. This location is approximately 4.5 km upstream of the confluence with the West Credit River.
- Low Flow Location #2: Situated on the Main Branch of the Credit, north side of Forks of the Credit Road, downstream of the Dominion Street bridge along the Credit River, approximately 4.3 km downstream of the WSC “Credit River at Cataract (Station ID: 02HB001)” flow gauge and 0.07 km downstream of the confluence with the West Credit River.
- Low Flow Location #3: Situated on the West Credit River, along the upstream side of the Forks of the Credit Road, approximately 0.32 km upstream of the confluence with the Main Credit River.

Within the vicinity of these low flow locations detailed above, there is one WSC and two CVC flow gauges including the Credit River at Cataract (Station ID: 02HB001), Credit River at The Grange Side Rd. (Station ID: 8200005, located 3.9 km downstream of the confluence with the West Credit River), and the West Credit River at 10th Line (Station ID: 8150006, located 3.5 km west of the confluence with the Main Credit River), respectively. As seen in Figure 6-3, Low Flow Location #1 is nearest to the Credit River at Cataract flow gauge, Low Flow Location #2 sits between the Credit River at Cataract and the Credit River at The Grange Side Rd. flow gauges, and Low Flow Location #3 sits nearest to the West Credit River at 10th Line flow gauge. However, as noted by the CVC upon receiving the data, the dynamics upstream of the Credit River at The Grange Side Rd. station changed at some point during the winter of 2019/2020. They suspect that this occurred as a result of the heavy rain event in January 2020, though they were not certain. The result of this is that a significant amount of flow now moves around this station in a separate braid. Therefore, flows provided at this station represent partial flow for the river.

To perform a comparative analysis of the low flow measurements at the WSC and CVC flow gauges and the Golder low flow locations, flows at each of these gauges will either be prorated to match catchment size of the nearest Low Flow Locations or directly compared to the low flows taken at that time. For the purposes of this study, the flow at Low Flow Location #2 was prorated using the upstream Credit River at Cataract flow gauge due to the partial flow record at the Credit River at The Grange Side Rd. flow gauge. A summary of the catchment areas at each location are provided in Table 6-5 below.

Table 6-5: Summary of Catchment Areas for Each Flow Location

Flow Locations	Catchment Areas (km^2) [1]
“Credit River Near Cataract” Flow Gauge	204.97
“West Credit River at 10th Line” Station Flow Gauge	93.78
“Credit River at the Grange Rd.” Flow Gauge	334.53
Low Flow Location #1	204.53
Low Flow Location #2	328.02
Low Flow Location #3	108.95

Note:

(1) Catchment areas were delineated using OWIT.

A comparison of the manual flow measurements captured at each low flow location against the average daily original and prorated discharge measurements from the WSC and CVC flow gauges is summarized in Table 6-6.

Table 6-6: Comparison of Manual Low Flows at Low Flow Locations and Pro-rated Flows at WSC and CVC Flow Gauges

Low Flow Locations	Measured Flows (m^3/s)	Measurement Date	
		August 31, 2020	August 24, 2021
Location #1	Manual Measured Low Flow	1.05	0.78
	Average Daily Discharge at Credit River Near Cataract Flow Gauge [1]	1.06	0.85
	% Difference to Manual Flow	+1	+9
Location #2	Manual Measured Low Flow	1.76	1.49
	Average Daily Discharge at Credit River Near Cataract Flow Gauge [1]	1.06	0.85
	Prorated Average Daily Discharge [2]	1.70	1.36
	% Difference	-4	-9
Location #3	Manual Measured Low Flow	0.61	0.58
	Average Daily Discharge at West Credit River at 10th Line Station Flow Gauge [3]	1.14	0.98
	Prorated Average Daily Discharge [4]	1.32	1.14
	% Difference	+116	+97

Notes:

(1) Daily flow data was taken from the WSC “Credit River Near Cataract (ID: 02HB001)” flow gauge (no prorating necessary as catchment difference is less than 1%).

(2) Daily flow data was taken from the WSC “Credit River Near Cataract (ID: 02HB001)” flow gauge and prorated using the relationship between catchment area and flow.

(3) Daily flow data was taken from the CVC West Credit River at 10th Line (ID: 8150006) flow gauge.

(4) Daily flow data was taken from the CVC West Credit River at 10th Line (ID: 8150006) flow gauge and prorated using the relationship between catchment area and flow.

As detailed in Table 6-6, a comparison of manual low flow measurements at Low Flow Locations #1 - #3 to pro-rated daily discharge data from nearby WSC and CVC flow gauges was completed, and it was found that measurements were within +/- 10% of each other with the exception of Low Flow Location #3. For Low Flow Locations #1 and #2, it was considered acceptable to see potential errors in measurements of +/-15%, noting that pro-rating the WSC gauge flow data could also lead to potential error due to the assumption that all areas contribute flow to the channel of the Credit River equally across the entire catchment of the gauge station. A +/- 10% difference in flows at Low Flow Location #1 and #2 demonstrates that the low flows recorded at the WSC gauge station during August 31, 2020 and August 24, 2021 were representative of actual flows within the reach of the Main Credit River nearest the Site. However, the pro-rated CVC gauge flows at Low Flow Location #3 are 90% greater than the manual flows recorded in August of 2020 and 2021. This indicates that the West Credit River is a potential losing reach between the West Credit River at 10th Line flow gauge and Low Flow Location #3. A comparison of the original (not prorated) flows at the West Credit River at the 10th Line flow gauge to the manual flows record by WSP show that the upstream flows are greater than 60% compared to downstream. Additionally, the potential for measurement errors is possible as it is difficult to properly characterize low flow conditions in wide shallow rivers with gravelly substrate due to potential gauge underflow. Due to suspected gauge underflow, shallow bypass channels in the gravelly substrate, and additional measurement discrepancies at Low Flow Location #3 and a changing cross section, all future assessment of low flows along the West Credit River will be based on the measurements taken at a chosen substitute location.

6.5.3 Baseflow

The baseflow at each station was estimated using BFLOW and the results are plotted on Figures L1 to L16 in Appendix L. It is important to note that the BFLOW results are not physically based and represent digital low pass filter results. For the purpose of this assessment, the proportion of runoff to interflow and baseflow as a percentage of the total flow was assumed to be based on the number of low pass filter steps completed. Noting that interflow and baseflow (i.e., the movement of water above and below the groundwater table, respectively), in the context of these calculations, were assumed to be represented by the second and third filter steps in the analysis, respectively. The number of filter steps completed are represented by the suffix number displayed at the end of BFLOW (i.e., BFLOW1 represents a total of one filter step completed for the BFLOW process which will be used as a basis to represent runoff). The proportion of runoff / interflow / baseflow as a percentage of the total flow at each station is summarized in Table 6-7.

Table 6-7: Assumed Proportions of Runoff / Interflow / Baseflow at the Surface Water Monitoring Stations

Surface Water Stations	BFLOW Low Pass Filter Steps					
	BFLOW1 (Runoff)		BFLOW2 (Interflow)		BFLOW3 (Baseflow)	
	Avg. Flow (L/s)	Proportion (%)	Avg. Flow (L/s)	Proportion (%)	Avg. Flow (L/s)	Proportion (%)
SW1	6.5	35.1	4.1	22.5	7.8	42.4
SW2	$6.1x10^{-5}$	96.2	$6.1x10^{-5}$	3.7	$8.6x10^{-8}$	$5x10^{-5}$
SW3	0.3	51.5	0.2	28.1	0.1	20.4
SW4 (1)	-	-	-	-	-	-
SW5	2.6	81.7	0.5	17	0.04	1.3
SW6	3.1	47.8	1.8	27.3	1.6	24.9
SW7	2.5	50	1.3	25.9	1.2	24.2
SW8	3.0	23	2.7	21.1	7.2	55.9
SW9	1.5	7.4	1.3	6.4	17.1	86.2
SW10	$4.9x10^{-4}$	100	0.0	0	0.0	0
SW11	0.9	41.2	0.6	28.8	0.6	30
SW12	$6.1x10^{-4}$	100	0.0	0	0.0	0
SW13	1.1	17.9	1.7	27.2	3.4	54.9
SW14	1.4	36	0.9	22.7	1.6	41.3
SW15	0.4	51.1	0.2	21.1	0.2	27.8
SW16 (2)	-	-	-	-	-	-

Note:

(1) No flows have been observed at SW4.

(2) Based on the rating curve of SW16 and continuous water level data, there was no flow recorded in the vicinity of the surface water station.

The results of the BFLOW analysis show that the majority of the watercourses surrounding the Site were minorly fed by baseflow, typically during the late fall and winter months, with surface runoff the dominant water source, particularly during the spring freshet and precipitation events. While many of these watercourses can be classified as drainage paths beside roadways or low-lying areas with high soil permeability as described in Section 3.5, some watercourses (i.e., SW1, SW8, SW9, SW13, SW14) were found to have a larger proportion of baseflow.

It should be noted that at location SW14, it appears that the high proportion of flow attributed to baseflow may be skewed by perched water table conditions during wet periods, which results in a sustained water level in the watercourse, and thus reports as baseflow when water level data is analysed using the BFLOW3 low pass filter. As noted on the hydrograph of the SW14/MP14 pair on Figure L14, shallow vertical hydraulic gradients at this location are neutral or downward throughout the period of record, suggesting this location is not in fact baseflow dominated.

Although, many surface watercourses surrounding the site may be only minorly fed by baseflow, the watercourses that produce the more permanent stream flow have a larger contribution of baseflow. Due to the more permanent nature of these watercourses, they produce a larger contribution of flows to the Credit River than the watercourses that respond mainly to large precipitation events. As detailed in the "Phase 1 Report – Characterization" (CVC 1999), the mainstem of Sub-watershed 18 is largely controlled by groundwater flows with a percentage of groundwater versus surface runoff in stream flow being greater than 60%. An analysis of flows recorded at the WSC "Credit River at Cataract" flow gauge using BFLOW showed that 69% of the flow within the river between 1998 – 2021 was contributed by baseflow. Evidence of this can be seen at the surface water stations detailed above. As a note, the period of the BFLOW analysis was limited to 2020 and 2021, therefore, the proportion of runoff to interflow and baseflow may vary from year to year.

6.6 Water Temperature

Water temperature (Tidbit) loggers were installed at each of the surface water monitoring stations. The continuous water temperature data is displayed on Figures M1 to M4 in Appendix M for each surface water monitoring station over the period of October 2021 to October 2022. Water temperatures at SW1 to SW16 followed a typical seasonal trend, where temperatures warm through the spring as air temperatures consistently remain above 0 °C. This warming continues until mid-summer when daily air temperatures begin to drop. The temperatures drop rapidly through the fall and remain around 0 °C through the winter until the spring freshet.

The instantaneous maximum and daily average maximum recorded at each surface water monitoring station and are summarized in Table 6-8 below.

Table 6-8: Instantaneous and Daily Average Maximum Water Temperatures at SW1-SW16

Surface Water Monitoring Stations	Surface Water Temperatures (°C)	
	Instantaneous Maximum (°C)	Daily Average Maximum (°C)
SW1 (1)	21.62	19.64
SW2 (1)	26.52	22.06
SW3 (1)	23.87	21.01
SW4 (1)	25.51	22.85
SW5 (1)	22.73	19.99
SW6 (1)	*32.05* (2)	21.89
SW7 (1)	27.82	22.52

Surface Water Monitoring Stations	Surface Water Temperatures (°C)	
	Instantaneous Maximum (°C)	Daily Average Maximum (°C)
SW8 (1)	23.89	23.47
SW9 (1)	22.08	22.87
SW10 (1)	23.69	19.32
SW11 (1)	23.87	21.32
SW12 (1)	34.76	22.70
SW13 (1)	28.84	27.08
SW14 (1)	26.82	21.88
SW15 (1)	22.97	19.01
SW16 (1)	28.83	23.28

Note:

(1) Instantaneous and daily average maximum temperature readings were measured over the period of October 2021 to October 2022.

(2) Instantaneous maximum temperature reading at SW6 likely represents a dry event where air temperature was measured.

These instantaneous maximum water temperature measurements at the surface water stations occurred during June to August. As seen on Figure M4, the surface water station at Osprey Valley Golf Course (SW13) displays the greatest fluctuation in temperature throughout the year, particularly summer 2022, while SW15, just west of the Site displays the narrowest range of temperatures. Given that SW13 is a pond with a relatively slow discharge rate, it is expected that SW13 would exhibit more temperature fluctuations as the water is stagnant for much of the year. SW15 remains relatively dry throughout most of the year and is encompassed by heavy ground vegetation that may result in shading.

A comparison of daily averaged air temperatures over the same period, as seen on Figures M1-M4, showed that the majority of water temperature at surface water stations would be below or similar to air temperatures during the summer, spring, and fall months and then slightly above freezing during the winter. SW13 was the only surface water station that showed water temperatures over the average daily air temperatures during the summer of 2022. SW13 is a large pond with minimal canopy cover so it is more likely to act as a heat sink.

6.7 Water Quality Monitoring Program

Surface water quality was collected at five surface water monitoring locations within the various tributaries of the Main and Erin Branches of the Credit River surrounding the Site.

A list of the surface water quality collection locations and the conditions at sampling are provided in Table 6-9.

Table 6-9: Surface Water Quality Collection Locations and Sampling Conditions

Station Name	Zone	Northing	Easting	Condition at Sampling			
				June 8, 2021	September 8, 2021	December 14, 2021	March 24, 2022
SW8	17	4851688	576054	Sampled	Sampled	Sampled	Sampled
SW9	17	4850400	575677	Sampled	Sampled	Sampled	Sampled
SW10	17	4850628	579128	Sampled	Dry	Dry	Sampled
SW11	17	4851869	578238	Sampled	Sampled	Sampled	Sampled
SW13	17	4853488	578153	Sampled	Sampled	Sampled	Sampled

The approximate locations of these monitoring stations are shown on Figure 6-1.

The surface water quality monitoring program has been conducted at the five surface water monitoring stations listed above for four quarterly events for the analysis of metals, nutrients, and general chemistry.

These five stations were selected from a subset of the stream flow monitoring stations in an attempt to maximise the value of each monitoring station by selecting stations downstream of the proposed quarry that were either isolated (i.e., no other station sits on the same watercourse) or were the furthest downstream station on a shared watercourse. These stations were also selected because they typically have surface water present through a large portion of the year.

An overview of the water quality samples collected on a quarterly basis at locations SW8 to SW11 and SW13 over the year of monitoring is provided in the section below. The water quality parameters being tested for the program are provided in the list below.

- Hardness (CaCO3)
- In-Situ General Chemistry (i.e., pH, temperature, conductivity, dissolved oxygen, turbidity)
- Total Ammonia-N
- Total Phosphorus
- Alkalinity (Total as CaCO3)
- Dissolved Chloride (Cl-)
- Nitrite (N)
- Nitrate (N)
- Nitrate + Nitrite (N)
- Total Kjeldahl Nitrogen (TKN)
- Total Suspended Solids
- Total Oil & Grease

- Total Metals

6.7.1 Baseline Water Quality Results

The sampling results for the parameters outlined above are shown in Table N1 in Appendix N. The analyzed parameters were compared to the PWQO. Laboratory certificates of analysis are provided in Appendix O.

The water quality results are summarized as follows:

- pH was found to be consistently within the PWQO range of 6.5 – 8.5 at each station during the monitoring period with the exception of an exceedance of pH (8.7) at SW9 during the September 8, 2021 monitoring event.
- Concentrations of total phosphorus were found to be slightly elevated above the PWQO value of 0.03 mg/L during the monitoring period at SW8 during the June 8, 2021 and September 8, 2021 monitoring events and at SW11 during each monitoring event.
- Similarly, concentrations of total iron were found to be slightly elevated above the PWQO value of 300 µg/L during the monitoring period at SW8 during the June 8, 2021 and September 8, 2021 monitoring events and at SW11 during the June 8, 2021 monitoring event.
- All other parameter concentrations were below the PWQO.

6.8 Groundwater – Surface Water Interaction

Groundwater and surface water interaction forms an important part of water movement on the Site and in the Study Area. The combined groundwater-surface water monitoring network (Figure 6-4) has collected valuable data to support the observation of groundwater-surface water interaction at key locations within the Study Area. Focus areas for the observation of groundwater-surface water interaction are discussed in the subsections below, include:

- The Provincially Significant Wetlands (PSW) located in the south part of the South Area (SW10 / MW20-03);
- The Coulterville Wetland Complex proximal to the Site including the Northwest Wetland and Tributary #1 area located to the northwest and west of the Main Area (SW4 / MW20-27, SW14/MP14, SW17/MP17, SW18/MP18, SW19/MP19 and SW20/MP20);
- The area immediately east of the South Area (SW12 / MW20-08); and
- The area to the west and southwest of the Main and South Areas along several tributaries that ultimately report to the Credit River (SW15/MP15 and SW16/MP16 / MW20-23).

At each location the head of the surface water feature, surface water feature elevation, and nearby groundwater heads are plotted, as presented on Figures 6-5 to 6-9. Additionally, field observations provide some additional insight into groundwater-surface water interaction in the Study Area.

In August 2022, a supplemental investigation was carried out in the Northwest Wetland, which is located directly northwest of the Main Quarry on Tributary #1, where additional surface water monitoring stations were installed, and additional monitoring began. The additional monitoring locations include the installation of surface water stations SW17/MP17 to SW20/MP20, instrumented with staff gauges and mini-piezometers (August to October 2022 data are presented in Figures L-17 to L-20). Surface water and shallow groundwater locations in this area

were influenced by 45 mm of precipitation in seven days in mid July, shortly before the start of monitoring at these locations (as reported at Mono Centre, ON, EC Climate ID#6157000).

6.8.1 Groundwater-Surface Water Interaction at Surface Water Stations

SW10

As noted in Section 6.5, SW10 is installed at the culvert between two surface water features, mapped as PSW. Surface water head and nearby groundwater heads are plotted on Figure 6-5. The following observations were made:

- It was noted during field visits that the ground surface at the culvert where SW10 was installed is somewhat higher than the lowest ground surface in either pond, and as a result, this culvert does not capture the lower water levels in the wetlands;
- It was noted during field visits that surface water is present in the wetland features more often than it was measurable at SW10, but water levels were very low during periods of particularly low precipitation;
- MW20-02 is located approximately 40 m northeast of SW10, approximately cross-gradient to groundwater flow and is screened 14 m below the surface water feature; and
- Groundwater head observed at MW20-02 is typically 2 m lower than the observed surface water head, when surface water could be observed. In the portion of the wetland near SW10, surface water is infiltrating and groundwater does not support this surface water feature (i.e., the wetland feature is supported by a localized perched water table).

SW14

Surface water station SW14 is located on Tributary #1, downstream of the Northwest Wetland. Groundwater head is monitored in the shallow subsurface by a mini-piezometer (MP14). Groundwater head is also monitored by the well nest at MW20-15 approximately 50 m away from SW14, and deeper in the aquifer system, however this data is too deep in the aquifer system to be comparable with the data collected at SW14. The data are plotted on Figure 6-6 and the following observations are noted:

- Throughout the observation period, when surface water levels were present, the surface water levels were higher than the groundwater levels, except for a period in April and May of 2021;
- When surface water is present, shallow groundwater levels are consistently within 5cm of the surface water levels;
- When Tributary #1 is dry, shallow groundwater levels fall below ground surface, typically by 0.5 to 1 m; and,
- These observations suggest that in this location, Tributary #1 is not often supported by groundwater, particularly during the driest portions of the year.

SW17

Surface water station SW17 is located approximately 230 m to the northwest of the Site and adjacent to the Northwest Wetland. Groundwater head is monitored in the shallow subsurface by a mini-piezometer (MP17). The data are plotted on Figure L-17. The following observations are noted:

- Surface water was present during the beginning of the investigation, following significant precipitation in July. Surface water levels declined, and the feature became dry, from the end of August 2022 onward;

- Shallow groundwater head observed at MP17 ranged from 1.4 – 1.9 m lower than the observed surface water level, when surface water could be observed; and
- In this area, surface water is infiltrating and the surface water feature is not supported by groundwater during the observation period.

SW18

Surface water station SW18 is located approximately 420 m to the northwest of the Site and within the Northwest Wetland. Groundwater head is monitored in the shallow subsurface by a mini-piezometer (MP18). The data are plotted on Figure L-18. The following observations are made:

- Surface water was not observed during the observation period; and
- Shallow groundwater head ranged from 0.3 – 1.4 mbgs;
- Shallow groundwater head responded rapidly to a rain event in late September, showing rapid groundwater recharge in this area; and
- In this area, the surface water feature is not supported by groundwater discharge, during the observation period.

SW19

Surface water station SW19 is located approximately 620 m to the northwest of the Site and within the Northwest Wetland. Groundwater head is monitored in the shallow subsurface by a mini-piezometer (MP19). The data are plotted on Figure L-19. The following observations are noted:

- Surface water was present during the beginning of the investigation, following significant precipitation in July. Surface water levels declined, and the feature became dry, from the middle of August 2022 onward (with the exception of small amounts of standing surface water that coincide with late August rainfall);
- Shallow groundwater head observed at MP19 ranged from 0.2 – 0.5mbgs; and
- In this area, surface water infiltrates and the surface water feature is not supported by groundwater discharge, during the observation period.

SW20

Surface water station SW20 is located approximately 80m from the Site and within the easternmost portion of the Northwest Wetland. Groundwater head is monitored in the shallow subsurface by a mini-piezometer (MP20). The data are plotted on Figure L-20. The following observations are made:

- Conditions at SW20 were dry during the whole monitoring period with no significant response to any precipitation events;
- Shallow groundwater head observed at MP20 was typically 1.3 mbgs; and,
- In this area and during this observation period, the absence of surface water and groundwater head below ground surface show that there is no groundwater supported surface water feature at this location.

SW4

Surface water station SW4 is located on Tributary #8, directly west of the Northwest Wetland, on Mississauga Road and sits within an evaluated wetland feature. No nearby overburden groundwater head observation point is available. The nearest groundwater monitoring point is MW20-27B, approximately 120 m southeast and screened 34 mbgs, in the shallow bedrock, which is not comparable with surface water for purposes of assessing groundwater surface water interaction. SW4 data are plotted on Figure L-4. The following observations are noted:

- Surface water is intermittent at this location. During the monitoring period, it was present from spring (May to early June 2020 and late March to late April 2021) as well as in winter (early December 2021 to January 2021); and
- The infrequent presence of surface water suggests that Tributary #8 is likely not supported by groundwater in this area.

SW12

As noted in Section 6.5, SW12 is located at a culvert along the edge of the proposed licensed boundary of the South Quarry adjacent to Main Street. This culvert drains a small portion of the surrounding farmland and exhibits no channelization of flow downstream. Surface water head and nearby groundwater levels are plotted on Figure 6-7. The following observations are made:

- Surface water is rarely present at this location, exhibiting dry conditions for the entirety of the year with the exception of pooling near the culvert following large precipitation or snow melt events. During the monitoring period, surface water was only present briefly following precipitation events during winter (early January 2021 to March 2021);
- For the entirety of the period, groundwater levels were below the ground surface in the area of SW12. Whenever surface water is present there is a downward gradient, suggesting infiltration takes place;
- This supports the assessment of low runoff potential in the area; and
- These observations suggest that at this location, SW12 is not supported by groundwater.

SW15

Surface water station SW15 is located southwest of the Main Quarry on Tributary #8 downstream of an evaluated wetland feature. Surface water and shallow groundwater head are plotted on Figure 6-8. It is noted that:

- Surface water is continuously present in this location throughout the monitoring period;
- Shallow groundwater head is consistently greater than surface water head in this area, typically by approximately 0.1 m; and
- It is probable that shallow groundwater discharge at this location supports Tributary #8.

SW16

Surface water station SW16 is located northwest of the intersection of Charleston Sideroad and Shaws Creek Sideroad. Surface water and shallow groundwater levels are plotted on Figure 6-9. It is noted that:

- Measurable surface water was rarely observed at this location during the monitoring period;
- Groundwater was typically approximately 1 m below ground surface at this location;

- Certain precipitation and melt events (such as late March 2021 and early December 2021) cause rapid increases in groundwater levels and brief presence of surface water at these locations;
- The rapid increases in groundwater head suggest event based rapid groundwater recharge is taking place in this area; and,
- Based on the groundwater levels generally below ground surface and the infrequent presence of surface water, groundwater does not support a surface water feature at this location.

6.8.2 Tributary #1 Infiltration

As discussed in Section 6.2, Tributary #1 (Trib. 1) is an ephemeral feature, noted to be flowing at times and dry at others. Downstream of SW14, when Tributary #1 is flowing, it travels 500 m southeast to Trib. 1 Pond, as shown on Figure 6-4. During field visits, Trib. 1 Pond was frequently observed to flow into the Trib. 1 Wetted Feature 10 m to the southeast of the pond. During site visits during times of the year with higher surface water levels, flow was observed from the Trib. 1 Wetted Feature through approximately 450 m of ditches along Mississauga Road to the Local Depression where it infiltrated. Further, it is noted that there is no culvert in this area to convey surface water from the northeast side of Mississauga Road to the southwest side and there is no channelized feature to the southwest of Mississauga Road. Groundwater monitoring wells (MW20-17B and MW20-18) screened in the shallow bedrock in this area showed greater water level increases associated with event-based groundwater recharge. These observations suggest that a significant portion of the surface water in Tributary #1 infiltrates in this part of the Study Area and contributes to groundwater recharge.

6.8.3 Surface Water Losses

Observations during field investigations over the period of record as well as surface water flow estimates detailed in the hydrographs suggests that the surface water features in the vicinity of the Site are experiencing a loss in runoff volumes due to the presence of high infiltration soils as detailed in the “Phase 1 Report – Characterization” (CVC 1999). These observations are supported by the loss of flow between surface water stations on the same tributaries or drainage features as well as minimal to no channelization of drainage features. A summary of average monthly and annual flows of the surface water stations along the same tributaries, drainage features, or watersheds is provided in Table 6-10 below.

Table 6-10: Average monthly and annual flow estimates within the surrounding Tributaries.

Month	Average Monthly and Annual Flow Estimates (L/s) [1]							
	Tributary #6		Tributary #7 & #9			Tributary #1 and #8		
	SW1 [2]	SW7 [3]	SW2 [2]	SW3 [2]	SW6 [3]	SW14 [2]	SW15 [2]	SW16 [3]
January	29.0	1.0	0.03	0.80	1.70	2.38	0.28	0.00
February	67.0	0.00	0.01	0.65	12.3	2.32	0.46	0.00
March	66.0	20.0	0.09	1.89	66.4	10.0	0.75	0.00
April	29.0	2.00	0.06	0.59	21.3	3.24	0.72	0.00
May	11.0	1.00	0.03	0.18	4.78	0.51	0.77	0.00
June	3.00	0.00	<0.01	0.13	0.05	0.00	0.52	0.00

Month	Average Monthly and Annual Flow Estimates (L/s) [1]							
	Tributary #6		Tributary #7 & #9			Tributary #1 and #8		
	SW1 [2]	SW7 [3]	SW2 [2]	SW3 [2]	SW6 [3]	SW14 [2]	SW15 [2]	SW16 [3]
July	4.00	0.00	0.01	0.31	0.00	0.90	0.75	0.00
August	1.00	0.00	0.00	0.60	0.00	0.01	0.14	0.00
September	3.00	0.00	0.01	1.01	0.00	0.48	1.03	0.00
October	12.0	1.00	0.03	0.72	1.10	4.80	1.40	0.00
November	17.0	6.00	0.05	0.47	0.08	5.05	1.06	0.00
December	43.0	34.0	0.09	1.21	14.6	8.75	1.49	0.00
Annual	**23.8**	**5.42**	**0.03**	**0.71**	**10.2**	**3.21**	**0.78**	**0.00**

Note:

[1] Flows are based on continuous logger data in conjunction with the stage-discharge curves developed for each station.

[2] Denotes the furthest upstream surface water stations including SW2, SW3, SW14, and SW15 which are all the furthest upstream station on their respective tributaries or drainage features.

[3] Denotes the furthest downstream surface water station.

Within Tributary #6, similar observations were detailed between upstream and downstream surface water stations as SW1 showed an average annual flow of 23.8 L/s with consistent standing water while further downstream, SW7 showed a smaller average annual flow of 5.42 L/s with stretches of dry conditions during from summer to winter of 2020 and the summer of 2021. Flow conditions in SW1 and SW7 also showed similar responses to high precipitation and freshet events, however, during periods of low volume events, SW1 showed consistent flow while SW7 went dry.

As seen in Figure 7-2, SW14 and SW15 both reside within the catchment of SW16, based on OWIT delineations, and are shown to receive moderate flow through the year, however, SW16, which is characterized by a wide vegetated valley, shows dry conditions over the period of record. As detailed above, Tributary #1 disappears before Mississauga Road at two locations including the Trib. 1 Wetted Feature or a local depression further downstream depending on the season while consistent flow from SW15 has been observed to drain into Tributary #8 within the vicinity of SW16 before infiltrating into the wide floodplain.

Within Tributary #7 and #9, the aforementioned losing response between upstream and downstream conditions was not observed. SW6 showed an average annual flow of 10.2 L/s and exhibited periods of dry conditions from June to December in both 2020 and 2021. SW2 showed a lower average annual flow of 0.03 L/s and showed periods of dry conditions during similar periods to SW6. While SW3 showed an average annual flow of 0.71 L/s and was only dry once during the fall of 2021. While all stations showed similar responses to precipitation and freshet events, SW6 saw a substantially higher contribution of flow, which is to be expected as SW2 and SW3 are much further upstream than SW6 and collect less drainage area.

Additionally, the lack of channelization in various areas near the Site suggests that surface runoff from the Site is either internally draining (infiltrating) or flowing un-channelized, overland across the drainage area before

contributing to the Credit River. Areas such as these include the catchment of SW12 and sections of the proposed North, South, and Main quarries that do not drain to an identified drainage feature. As evidenced by the dry conditions seen at SW12 throughout the period of record, the majority of surplus is understood to infiltrate and report as baseflow to surrounding surface water features (e.g., the Credit River).

6.8.4 Springs and Seeps

Initial reconnaissance visits to the Site were made by Golder personnel from February to April 2020, to assess site conditions and property access points, to finalize proposed drilling, monitoring well, and surface water station locations, and to assess the Study Area for the potential presence of springs and seeps. Areas assessed for springs and seeps included the Site, portions of the Coulterville Wetland Complex to the northwest proximal to the Site, and the Niagara escarpment immediately south of the community of Cataract, which was accessed via the network of walking trails in and around Forks of the Credit Provincial Park. The Niagara escarpment area east of the Site was also assessed for springs and seeps by Golder personnel in June 2022, which was accessed via Osprey Valley Golf Course Lands, and the network of walking trails.

No seeps or springs were identified on any areas of the Site, or the Coulterville Wetland Complex, either during initial reconnaissance visits, or subsequent trips to site to perform surface water and / or groundwater monitoring.

The Niagara escarpment east of the Site does not exhibit a well-defined crest, as the Gasport Formation thins and then pinches out to the east of Site, and the underlying Cabot Head shales are more susceptible to erosion and have formed a relatively gentle soil-covered slope down towards the Credit River in that area. No seeps or springs were identified in this area during the June 2022 site reconnaissance visit.

Reconnaissance of the Niagara escarpment area south of Cataract was initially made on March 5, 2020 via the walking trail network, to observe geologic, hydrologic and hydrogeologic conditions, and assess the area for springs and seeps. One seep was identified along the walking trail at the location noted on Figure 6-10 as Waypoint #263, in a location where a concrete box culvert had been installed under the former rail bed, suggesting that this was a persistent seepage location along the escarpment. The flow rate of the seep at the time of the initial visit was low, <1 L/min. No other seeps were identified during this initial reconnaissance visit.

A follow-up reconnaissance visit was recently made on December 12, 2022 and covered generally the same areas as the initial visit. The trails walked and observation stations (Waypoints) along the route are shown on Figure 6-10. Observations from this visit are summarized as follows.

- Conditions were ideal for spotting ground seeps, as there was no leaf canopy to obscure views, there was a light snow cover of 2 to 5 cm, air temperatures were near freezing, making seeps readily visible as areas where (relatively warm) groundwater seepage had melted snow on the ground. Additionally, groundwater levels in December are generally at or very near seasonal high levels.
- There were several points along the trail that allowed for excellent views of the south face of the escarpment, as shown in the photographs on Figure 6-11. Based on a review of topographic mapping for the area and available borehole data, the approximate positions of geologic units have been projected on the escarpment photographs, which provides geologic context, as seepage is most likely to occur at the base of the Gasport Formation and then deeper in the gorge, from within the Manitoulin / Whirlpool Formations.
- The walking trail is at an elevation of about 390 masl in this area, which corresponds generally to the expected elevation of the base of the Gasport Formation in this area. The escarpment exposed above the trail was comprised of limestone with a near-vertical slope, consistent with exposure of the Gasport Formation.

- Below the walking trail, the slope was less steep and based on elevation, this portion of the escarpment is inferred to be the outcrop of the Shaley Dolostone / Cabot Head Formation, down to an elevation of approximately 370 masl (the approximate elevation of the current rail line). Below 370 masl to 350 masl at the base of the gorge, is inferred to be the outcrop of the Manitoulin and Whirlpool formations.
- The same seep observed previously in March 2020 was again identified as shown in the photographs on Figure 6-12 and was flowing at a similarly low rate of <1 L/min. There was no evidence of seepage flowing down the face of the Gasport exposure in this area, so it is presumed that the seepage was originating from the base of the Gasport, at trail level.
- There were no other seeps noted from the Gasport Formation along the trails walked, but a 100 mm steel pipe buried beneath the walking trail was observed at Waypoint #259 and a 300 mmm steel culvert was observed buried beneath the old rail bed at Waypoint #266 (observed from Waypoint #264), as shown in the photographs on Figure 6-13. Both pipes appeared to be drains installed in the former rail bed to facilitate surface water runoff when the old rail line was active.
- Some seepage was also observed at the base of the gorge from within the Manitoulin and Whirlpool Formations, below the rapids and just above the level of the river, as seen from the bridge (Waypoint #270). This area of the gorge was posted with signage at the time of the site visits indicating that this area was not accessible to the public for safety reasons.
- Reports by others recently obtained by Golder in January 2023 through FOI requests and public domain sources describe past hydrogeologic investigations further to the southwest along the Credit River gorge related to the Aquaterra PTTW (AECOM 2012) and the Pinchin Pit development (CRA 1994). These studies included seep investigations and indicated the presence of seeps further to the southwest at lower elevations in the Credit River gorge, which were observable along the rail line at elevations of approximately 370 masl and lower.
- The 2012 AECOM report based on hydrogeologic monitoring data from 2007-2011 concluded that the Aquaterra water taking was not resulting in a change in groundwater gradients and was not having an impact on streamflow in the tributaries to the Credit River. While more recent data was not available to Golder at this time, a follow-up FOI request has been made to the MECP in an effort to obtain and evaluate more recent hydrogeologic monitoring data for this area.

7.0 SURFACE WATER BALANCE

Ten surface water balance assessments related to the 261 ha pit / quarry development were carried out to assess the potential hydrological impacts of the proposed pit / quarry development with respect to loss in surplus, including potential impacts to downstream surface water features. The assessment included the existing, operational (i.e., Phases 1-7), and rehabilitated conditions within the Site boundary, as well as the pit / quarry's potential impact on six of the surface water monitoring station watershed areas, as well as three internally draining catchments that overlap with the Site. The three internally draining catchment areas do not report to any channelized surface water features in the area and either internally drain or flow across the surrounding surfaces towards the Credit River. These catchments focus solely on the remaining area within the licence boundary.

7.1 Methodology

The Meteorological Service Data Analysis and Archive division of Environment Canada (EC) provides monthly water budget summaries for meteorological stations with greater than 20 years of meteorological data. These water budgets include monthly values for all parts of the water budget (rainfall, snowmelt, potential evaporation, etc.) for each of the years in the historic record, as well as average monthly values over the entire record.

The water balance assessment presented herein is based on composite meteorological data from the EC Thornthwaite water budgets (Environment Canada Orangeville – Mono Centre station [ID 6155790] between 1961 – 2021), watershed boundaries, land use data, and the existing soil types. The meteorological data set used in this assessment was derived by combining daily observations of Orangeville MOE (6155790, 1961 – 2015) and Mono Centre (6157000, 2015 – 2021).

The Thornthwaite method describes water flux in a unit area of soil on a monthly basis based on a balance of precipitation (rainfall and snowmelt), evapotranspiration (ET), soil storage, and surplus.

The water budget can be summarized as follows:

$$P = S + ET + R + I$$

Where: P = precipitation;

S = change in soil water storage;

ET = evapotranspiration;

R = surface runoff; and,

I = infiltration (infiltration below the root zone and available for groundwater recharge).

The various water budget components associated with catchment areas are typically presented in millimetres (mm) per time step over their respective sub-catchments and represent the amount of water per unit of watershed area.

The water budget model combines accumulated rainfall and snowmelt to estimate total precipitation. Rainfall represents precipitation when monthly mean temperatures are greater than 0 °C. Snowmelt is initiated when snow is on the ground and monthly mean temperatures are greater than 0 °C. Hence, snowmelt is based on the depletion of snow storage (accumulated precipitation during periods of sub-zero temperatures). Composite precipitation data collected at the Orangeville – Mono Centre monitoring station (1961 – 2021) indicated a mean annual precipitation (P) of 899 mm/year.

The potential or maximum ET is estimated, in this case, by the empirical Thornthwaite equation (using average monthly temperature and hours of daylight) and represents the amount of water that would be evaporated or transpired under saturated soil-water scenarios. The actual ET is the total evapotranspiration for the period of study based on evapotranspiration demand, available soil-water storage, and the rate at which soil water is drawn from the ground (as defined by an established drying curve specific to the soil type). Winter-time sublimation was not considered in any of the scenarios (including existing conditions) in the water balance analysis, however, we have estimated that the sensitivity of the water balance results to our assumption of no sublimation is minimal. The mean annual potential ET for the Site is approximately 582 mm/year based on data provided by EC.

Annual water surplus is the difference between P and the actual ET assuming year to year changes in soil moisture storage are negligible. The water surplus represents the total amount of water available for either surface runoff (R) or groundwater infiltration (I) on an annual basis. On a monthly basis, surplus water remains after actual evapotranspiration has been removed from the sum of rainfall and snowmelt, and maximum soil or snowpack storage is exceeded. Maximum soil storage is quantified using a Water Holding Capacity (WHC) specific to the soil type and land use. WHC is defined as the difference in soil moisture content between the field capacity and wilting point and is assigned across the site based on soil type and vegetation cover.

7.2 CVCA – Meteorological Comparison

In a letter addressed to Golder from July 9, 2021, the Credit Valley Conservation Authority (CVC) reviewed the proposed TOR (Golder, June 2021) for the CBM Caledon Quarry and provided comments for consideration in the Water Report. It was recommended that the meteorological data received from Environment Canada Orangeville MOE meteorological station be verified using the CVC Waste Management Facility meteorological station at 1795 Quarry Drive, Town of Caledon. The precipitation and temperature data from both stations were compared over their available shared record (i.e., 2004 – 2020, only including data on days both stations were reporting) and the average monthly results are provided below in Table 7-1. A correlation plot between both stations is shown on Figure 7-1.

Table 7-1: Comparison of MET Data Collected by CVC and EC at Nearby Stations (2004 – 2020)

Month	CVC Caledon (2004 – 2020)		EC Orangeville MOE - Mono Centre (2004 – 2020)		Missing Days Shared Between Stations
	Temperature (°C)	Precipitation (mm)	Temperature (°C)	Precipitation (mm)	
Jan	-7.1	11	-7.3	31	26
Feb	-6.2	9	-6.4	21	23
Mar	-1.5	17	-1.6	26	24
Apr	4.8	40	4.9	49	13
May	12.5	72	12.3	73	1
Jun	17.3	64	17.2	78	1
Jul	20.2	64	20.0	82	2
Aug	18.8	55	18.8	71	3
Sep	15.0	57	15.1	65	2
Oct	8.2	67	8.3	71	4
Nov	2.3	41	2.5	52	8
Dec	-3.5	14	-3.6	39	25
Total	**6.7 Avg.**	**512**	**6.7 Avg.**	**657**	**132**

Note: (1) The average shared missing days per month between the CVC Waste Management Facility and the EC Orangeville MOE – Mono Centre stations daily precipitation records were estimated over the period of 2004 -2020.

Table 7-1 above displays the average monthly air temperatures within the vicinity of the Site between 2004 and 2020 which yielded almost identical results. However, the total annual precipitation observed at both stations showed a difference of 145 mm. As seen on Figure 7-1, the majority of precipitation points between both stations are similar in value, however, larger precipitation events were recorded at the EC meteorological station which may consist of isolated precipitation events. In total, 132 days on average per year were missing from the shared precipitation record of data. It is possible that precipitation events that occurred over two or more days were not accounted for in the above analysis as both stations needed to have data recorded on the same day. Regardless of this, the usage of the Orangeville MOE – Mono Centre meteorological station is sufficient for the purposes of the surface water balance.

7.2.1 Catchment Delineation

The water balance evaluation was performed for the CBM owned property as a whole, including the area of proposed extraction and licensed pit / quarry areas. Additionally, water balance evaluations were performed for each surface water monitoring station catchment that crossed the Site as well as internally draining catchments within the proposed licensed pit / quarry areas using watersheds delineated by OWIT, available topographic mapping, and site boundary data as seen on Figures 7-2 (i.e., existing catchments) and 7-3 (i.e., operational catchments). Land uses under existing, operational (i.e., Phases 1-7), and rehabilitated conditions were taken from desktop delineations using SOLRIS V3, estimates from the Operational Plan, and the *Final Rehabilitated Landform and Ecological Enhancement Areas* shown on Site Plans prepared by MHBC.

7.2.2 Surface Water Balance Scenarios

Under existing conditions, the Site catchment is composed of sections of wetlands/marshes along the east side of Mississauga Road within the Main Area with sections of forest along Charleston Sideroad between the Main and South Areas, along the west side of Main Street adjacent to the Main Area, and along the east side of the North Area. A small area of rural development is located near the southeast corner of the Main Area and the south corner of the South Area. Sections of moderately rooted agriculture, pasture, and meadow dominate the remaining sections of the Site. Additionally, the downstream surface water feature watersheds are composed of forests, wetlands, ponds, roadways, moderately rooted agricultural fields, pasture/meadow, rural development, and existing aggregate sites.

Under operational conditions (i.e., Phases 1 – 7), the portions of the Site designated for aggregate extraction will be stripped, blasted, and/or backfilled to form the proposed pit / quarry areas as seen on Figure 2-1. This will leave sections of setbacks between the pit / quarry and Tributary #1/Northwest Wetland to the west/northwest as well as between various residential buildings to the southwest, southeast, and east. The operational condition considers only the pit / quarry extraction areas at each phase to be dewatered. For the purpose of the surface water balance, groundwater inflow from upgradient locations and groundwater flow to downgradient locations were not considered in the analysis, however, these elements are a part of the groundwater and surface water model detailed in Section 8.0.

Rehabilitated conditions were also considered in this study to determine the water surplus after pity / quarry operations have ceased and the pit / quarry is rehabilitated. The rehabilitated condition is based on the *Final Rehabilitated Landform and Ecological Enhancement Areas* shown on Site Plans prepared by MHBC and considers the majority of the pit / quarry area to be flooded as lakes with additional sections of wetland, islands, meadow, woodlands, grasslands, and forested swamps.

7.2.3 Surface Water Balance Parameters

Soils at the Site are primarily silty sand to sandy silt within the Site area. Fine sandy loam was assumed to be the operational conditions soil type for the proposed pit /quarry based on borehole drilling results. Surrounding land uses within the nearby watersheds will also use silt loam as the soil type for water balance purposes. The maximum soil storage is quantified using a Water Holding Capacity (WHC) that is based on guidelines provided in Table 3.1 of the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (MOE 2003), (MOE manual). The WHC represents the total amount of water that can be stored in the soil capillaries and is defined as the water content between the field capacity and wilting point (the practical maximum and minimum soil water content, respectively).

WHCs are specific to the soil type and land use, whereby values typically range from approximately 10 mm for bedrock to 400 mm for mature forest over silt loam. For temperate region watersheds, soil storage is typically relatively stable year-round, remaining at or near field capacity with the exception of the typical mid- to late-summer dry period. As such, the change in soil storage is a minor component in the water budget, particularly at an annual scale. Surplus water remains in the system after actual ET has been removed (ET demand is met) and the maximum WHC is exceeded (soil-water storage demand is met).

The surplus data obtained from ECCC for the respective water holding capacities was split into an infiltration component by first applying an infiltration factor based on Table 3.1 from the MOE *SWM Manual* (MOE 2003) and then infiltration was subtracted out of surplus to obtain the runoff component. The infiltration factors were based on a sum of site-specific topography, surficial soil type and vegetative cover factors as presented in Table P-1 of Appendix P.

The water balance analyses were developed under the following assumptions:

- WHCs were chosen based on Table 3.1 in the MOE *SWM Manual* (2003) corresponding to the fine sandy loam soil type, existing land uses and operational/rehabilitation conditions for the Site-Wide, surface water station, and internally draining catchment water balances.
  - Forested Swamp (Wetland / Mature Forest): 250 mm WHC with a null (i.e., 0%) infiltration factor due to observed standing water in the area during the majority of the year resulting in a negligible drawdown, or upward gradient (existing, operational, and rehabilitation conditions).
  - Forested Area (Mature Forest): 300 mm WHC and 0.70 infiltration factor (existing, operational, and rehabilitation conditions).
  - Moderately Rooted Agricultural Land / Meadow (Tilled / Pasture & Shrubs): 150 mm WHC and a 0.65 infiltration factor (existing and operational conditions)
  - Impervious Built-Up Areas (Roadways): 3 mm WHC with a null (i.e., 0%) infiltration factor (existing, operational, and rehabilitation conditions).
  - Quarry Extraction Area (Dewatered Quarry): 10 mm WHC with a null (i.e., 0%) infiltration factor due to upward gradients and dewatering.
  - Till / Rehab Area (Stripped Area): 100 mm WHC and a 0.70 infiltration factor (operational conditions)
  - Post-Agricultural Land / Meadow / Grassland (Pasture & Shrubs): 150 mm WHC and a 0.65 infiltration factor (rehabilitation conditions)
  - Pervious Built-Up Area (Urban Lawn): 75 mm WHC and a 0.70 infiltration factor (existing, operational, and rehabilitation conditions).

- For the open water areas (lake, local pond, quarry sump, wet meadow, and marsh), it was assumed surplus equals the difference between the annual precipitation and annual lake evaporation, which was estimated using the NOAA-GLERL Great Lakes Evaporation Model by the National Oceanic and Atmospheric Administration (NOAA) for Lake Ontario (664 mm) over the same period as the water budget (1961 – 2020) (NOAA 2021). With the unavailability of recent pan evaporation data from local meteorological stations, lake evaporation estimates from Lake Ontario were deemed to be representative of evaporation conditions within the region.
- Net surplus was estimated by multiplying the estimated monthly surplus (mm/month) for the assumed WHC by the associated drainage area. Annual evapotranspiration and surplus values were obtained from the meteorological data from the Orangeville MOE – Mono Centre ECCC Meteorological Station based on the WHC assigned to each land use area.
- Runoff was calculated as the difference between surplus and infiltration.

7.3 Surface Water Balance Results

Average annual water balance assessments were carried out on i) a site-wide basis; for the portions of the site contributing to ii) the SW8 sub-watershed, iii) the SW10 sub-watershed, iv) the SW11 sub-watershed, v) the SW12 sub-watershed, vi) the SW14 sub-watershed, vii) the SW16 sub-watershed, viii) the South Area Internally Draining Catchment (SQ), ix) the Main Area Internally Draining Catchment (MQ), x), and the North Area Internally Draining Catchment (NQ). The results for the existing, operational (i.e., Phases 1 – 7), and rehabilitated scenarios are presented in this section for each of the ten assessments.

7.3.1 Existing Conditions

Based on the results of the assessment, the average annual existing water balance was estimated on a site-wide and watercourse/internally draining sub-watershed basis as summarized in Table 7-2, and as detailed in Tables P-2 to P-11, Appendix P.

Table 7-2: Existing Average Annual Water Balance Results – Site Wide & Watercourse / Internally Draining Catchments

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Average Annual Volume m^3/yr				
	Precipitation (P)	Evapotranspiration (ET)	Surplus (S)	Infiltration (I)	Runoff (R)
Site-Wide (1)	2,352,760	1,462,000	891,700	579,290	312,405
SW8	15,622,150	9,429,920	5,868,160	3,420,735	2,447,425
SW10	237,040	147,870	89,070	52,185	36,885
SW11	254,740	159,560	95,135	61,295	33,840
SW12	57,110	34,640	22,460	12,700	9,760
SW14	1,268,060	805,270	461,030	222,140	238,890
SW16	5,331,290	3,273,410	2,001,720	1,138,370	863,350

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Average Annual Volume m^3/yr				
	Precipitation (P)	Evapotranspiration (ET)	Surplus (S)	Infiltration (I)	Runoff (R)
South Area	103,800	64,270	39,530	25,695	13,835
Main Area	417,730	260,020	157,600	104,015	53,585
North Area	271,560	168,560	102,970	67,305	35,665

Note: (1). Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

Based on the ten assessments, the proportion of evapotranspiration, infiltration, and runoff to precipitation for each assessment is summarized in Table 7-3 below for the existing condition.

Table 7-3: Existing Average Annual Water Balance Precipitation Breakdown – Site Wide & Watercourse / Internally Draining Catchments

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Precipitation Breakdown		
	% Evapotranspiration	% Infiltration	% Runoff
Site-Wide (1)	62	25	13
SW8	60	22	16
SW10	62	22	16
SW11	63	24	13
SW12	61	22	17
SW14	64	18	19
SW16	61	21	16
South Area	62	25	13
Main Area	62	25	13
North Area	62	25	13

Note: (1). Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

7.3.2 Operational Conditions (Phases 1 – 7)

Based on the results of the assessment, the average annual operational (at the end of Phase 7) water balance was estimated on a site-wide and watercourse/internally draining sub-watershed basis as summarized in Table 7-4, and as detailed in Tables P-2 to P-11, Appendix P. A summary of the water balance results for Phases 1 – 7 is detailed in Table P-12 in Appendix P.

Table 7-4: Operational (Phase 7) Average Annual Water Balance Results – Site Wide & Watercourse / Internally Draining Catchments

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Average Annual Volume m^3/yr				
	Precipitation (P)	Evapotranspiration (ET)	Surplus (S)	Infiltration (I)	Runoff (R)
Site-Wide (1)	2,352,760	1,304,300	1,049,170	281,275	767,895
SW8	14,106,400	8,806,810	5,290,155	3,050,075	2,240,075
SW10	459,230	274,100	184,795	85,145	99,655
SW11	254,460	159,340	95,055	61,140	33,915
SW12	23,320	13,720	9,595	4,340	5,255
SW14	1,252,620	795,660	455,185	218,230	236,955
SW16	3,815,530	2,388,370	1,423,720	767,710	656,005
South Area	28,460	17,620	10,840	7,045	3,795
Main Area	57,650	35,790	21,840	14,370	7,470
North Area	127,700	79,430	48,240	31,685	16,555

Note:

(1) Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

Based on the ten assessments, the proportion of evapotranspiration, infiltration, and runoff to precipitation for each assessment is summarized in Table 7-5 below for the operational condition.

Table 7-5: Operational Average Annual Water Balance Precipitation Breakdown – Site Wide & Watercourse / Internally Draining Catchments

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Precipitation Breakdown		
	% Evapotranspiration	% Infiltration	% Runoff
Site-Wide (1)	55	33	12
SW8	62	16	22
SW10	60	22	19
SW11	63	13	24
SW12	59	23	19
SW14	64	19	17
SW16	63	17	20

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Precipitation Breakdown		
	% Evapotranspiration	% Infiltration	% Runoff
South Area	62	13	25
Main Area	62	13	25
North Area	62	13	25

Note:

(1) Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

7.3.3 Rehabilitated Conditions

Based on the results of the assessment, the average annual rehabilitated water balance was estimated on a site-wide and watercourse/internally draining sub-watershed basis as summarized in Table 7-6, and as detailed in Tables P-2 to P-11, Appendix P.

Table 7-6: Rehabilitated Average Annual Water Balance Results – Site Wide & Watercourse / Internally Draining Catchments

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Average Annual Volume m^3/yr				
	Precipitation (P)	Evapotranspiration (ET)	Surplus (S)	Infiltration (I)	Runoff (R)
Site-Wide (1)	2,352,770	1,587,850	764,990	628,040	136,945
SW8	14,106,400	8,806,810	5,290,155	3,050,075	2,240,075
SW10	459,230	275,120	184,115	84,755	99,365
SW11	254,460	159,340	95,055	61,140	33,915
SW12	23,320	13,720	9,595	4,340	5,255
SW14	1,252,620	795,660	455,185	218,230	236,955
SW16	3,815,530	2,388,370	1,423,720	767,710	656,005
South Area	28,460	17,970	10,475	7,315	3,160
Main Area	57,650	36,640	20,970	14,315	6,655
North Area	127,700	79,970	47,680	31,650	16,030

Note:

(1) Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

Based on the ten assessments, the proportion of evapotranspiration, infiltration, and runoff to precipitation for each assessment is summarized in Table 7-7 below for the rehabilitated condition.

Table 7-7: Rehabilitated Average Annual Water Balance Precipitation Breakdown – Site Wide & Watercourse / Internally Draining Catchments

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Precipitation Breakdown		
	% Evapotranspiration	% Infiltration	% Runoff
Site-Wide (1)	67	27	6
SW8	62	22	16
SW10	60	18	22
SW11	63	24	13
SW12	59	19	23
SW14	64	17	19
SW16	63	20	17
South Area	63	26	11
Main Area	64	25	12
North Area	63	25	13

Note:

(1). Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

7.3.4 Summary of Surface Water Balance Results

A summary of the annual water balance assessments considering surplus, infiltration, and runoff for the existing, operational, and rehabilitated conditions is provided in Table 7-8 and Table 7-9.

Table 7-8: Water Balance Summary - Surplus

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered		
	Surplus (m^3/yr)		
	Existing Conditions	Operational Conditions (End of Phase 7)	Rehab Conditions
Site-Wide (1)	891,700	1,049,170	764,990
SW8	5,868,160	5,290,155	5,290,155
SW10	89,070	184,795	184,115
SW11	95,135	95,055	95,055
SW12	22,460	9,595	9,595
SW14	461,030	455,185	455,185

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered		
	Surplus (m^3/yr)		
	Existing Conditions	Operational Conditions (End of Phase 7)	Rehab Conditions
SW16	2,001,720	1,423,720	1,423,720
South Area	39,530	10,840	10,475
Main Area	157,600	21,840	20,970
North Area	102,970	48,240	47,680

Note:

(1) Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

Table 7-9: Water Balance Summary – Infiltration and Runoff

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered					
	Existing Conditions		Operational Conditions (End of Phase 7)		Rehab Conditions	
	Infiltration (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)	Runoff (m^3/yr)	Infiltration (m^3/yr)	Runoff (m^3/yr)
Site-Wide (1)	579,290	312,405	281,275	767,895	628,040	136,945
SW8	3,420,735	2,447,425	3,050,075	2,240,075	3,050,075	2,240,075
SW10	52,185	36,885	85,145	99,655	84,755	99,365
SW11	61,295	33,840	61,140	33,915	61,140	33,915
SW12	12,700	9,760	4,340	5,255	4,340	5,255
SW14	222,140	238,890	218,230	236,955	218,230	236,955
SW16	1,138,370	863,350	767,710	656,005	767,710	656,005
South Area	25,695	13,835	7,045	3,795	7,315	3,160
Main Area	104,015	53,585	14,370	7,470	14,315	6,655
North Area	67,305	35,665	31,685	16,555	31,650	16,030

Note:

(1) Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

Under operational conditions (at the end of Phase 7), Site-wide surplus is anticipated to increase by 18%, representing a decrease in evapotranspiration due to land use changes as well as the dewatering of the pit / quarry extraction area. For analysis purposes, the Site-wide water balance only accounted for evaporation of ponded water within the pit / quarry sump and the remainder of the extraction area was modelled as dry rock. It is assumed precipitation on these areas will drain by gravity towards the pit / quarry sump. Evapotranspiration will

decrease as a result of the large area now covered by exposed rock with very reduced capacity to store water for evaporation, and most surplus represented as runoff. Direct infiltration is expected to decrease to 281,275 m^3 per year as the surplus from the pit / quarry will be pumped to a sump pond. This will effectively increase the total runoff from the Site to 767,895 m^3/yr. It is important to note that under operational conditions, the increase in runoff is not due to the addition of new water, instead, it represents a change in the path the water takes to the ultimate receiving body (i.e., the Credit River). Under existing conditions, infiltration contributes to local groundwater, which discharges to the Main and Erin Branches of the Credit River. Under operational conditions surplus water will be captured and either reinfiltrated into the overburden aquifer via the groundwater infiltration trench mitigation system (as discussed in Section 8 and Appendix S) or else discharged off-site to the Osprey Valley Golf Course irrigation pond system. Therefore, the only change in total surplus is attributed to relatively minor differences in evapotranspiration from the different land uses.

Under rehabilitated conditions, the components of the water balance will continue to function very similarly to operational conditions, however the non-backfilled sections of the pit / quarry will be flooded and the newly vegetated features such as islands, wetlands, grasslands, woodlands, and meadow will be added. Existing lands outside of this rehabilitated area will either remain or become pasture and shrubs. Surplus on the Site is projected to a decrease by 14% (compared to existing). Surplus Site runoff will be conveyed to the North Area where it will leave the Site as either evaporation, recharge to the groundwater system, or discharge off-site to the Osprey Valley Golf Course irrigation pond system. The infiltration is expected to increase to 628,040 m^3/yr and the runoff will decrease to 136,945 m^3/yr.

A summary of the changes compared to existing conditions in surplus on a site-wide and surface water station / internally draining watershed basis under operational and rehabilitated conditions is detailed in Table 7-10 below.

Table 7-10: Water Balance Changes in Surplus Due to Catchment and Land Use Change

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered	
	Operational Conditions (Phase 7)	Rehabilitated Conditions
	Surplus (%)	
Land Use Changes		
Site Wide (1)	+18	-14
Catchment Loss & Land Use Changes		
SW8	-10	-10
SW10	107	107
SW11	-0.08	-0.08
SW12	-57	-57
SW14	-1.27	-1.27
SW16	-29	-29
South Area	-73	-74

Site / Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered	
	Operational Conditions (Phase 7)	Rehabilitated Conditions
	Surplus (%)	
Main Area	-86	-87
North Area	-53	-54

Note:

(1) Site-wide refers to the whole proposed licence boundary (i.e., the proposed extraction area + setbacks) as seen in Figure 6-1.

7.4 Proposed Off-Site Discharge Location

The proposed main off-site discharge location for surplus water collected from the combined extraction parcels of the Caledon Pit / Quarry is to the irrigation pond system at the Osprey Valley Golf Course via a pipeline, as shown on Figure 7-4, where water will be used for irrigation when needed, with excess water stored and later discharged through the existing pond system to the Credit River.

With this proposed discharge route in mind, preliminary estimates for the maximum discharge to the Osprey Valley Golf Course were found to range from 10,000 – 530,000 m^3/year over the expected period of the pit / quarry operations. The maximum average annual water discharge rate over the pit / quarry operational life is expected to be approximately 18 L/s.

Discharge rates could potentially range from 0 – 100 L/s depending on precipitation and season, as such, a settling / holding pond will be constructed in Year 1 of operation and used to store water, in order to mitigate peak flows that would ultimately be directed to the irrigation pond system. If applicable, limits to pit / quarry discharge rates may vary by season. Potential discharge limits will be identified and approved in consultation with the MECP through a future Industrial Sewage Works (ISW) Environmental Compliance Approval (ECA).

There is also an option to re-infiltrate an additional 200,000 to 400,000 m^3 / year of groundwater via the groundwater infiltration trench mitigation system (as discussed in Section 8 and Appendix S), if needed, to manage surplus water, and reduce the quantity of water discharged to the Osprey Valley Golf Course irrigation pond system.

Because no water will be discharged from the proposed pit / quarry directly to the Credit River, there are no significant changes expected to the flows or thermal characteristics of the Credit River.

8.0 GROUNDWATER AND SURFACE WATER MODELLING

A fully integrated groundwater-surface water numerical model was developed for the project based on the Conceptual Site Model (CSM) presented in Section 5.10. The numerical model was used to assess the potential effect of the proposed Caledon Pit / Quarry on local and regional groundwater and surface water conditions through all Operational Phases and post-Rehabilitation. The modelling included predicting changes to groundwater elevations and to flow rates in nearby surface water features, and estimating inflows during the various stages of pit / quarry development, relative to background (existing) conditions. Given the emphasis on the potential for groundwater and/or surface water impacts, a coupled surface water/groundwater (SW/GW) modelling approach was applied. Numerical modelling was also used to evaluate options to mitigate groundwater-surface water impacts where a potential for impacts to occur during operations was identified. A detailed description of the groundwater-surface water modelling assessment is provided in Appendix Q.

The numerical model was constructed using HydroGeoSphere (HGS), a finite element modelling package developed jointly by the University of Waterloo, Laval University, and Aquanty (Aquanty, 2016). This entails constructing a 3D numerical model of the proposed pit / quarry and surrounding regional groundwater flow system, with the addition of a 2D grid that represents the surface flow domain (which is coincident with the top of the 3D model domain). In addition to its basis as a fully integrated, groundwater-surface water code, HGS was selected for this modelling simulation given its capabilities to efficiently discretize local features around the Site and Study Area within a larger footprint around the Site, in order to calibrate to water elevations and water balances within the surrounding region.

The 3D model domain is regional in scale and encompasses three sub-watersheds (No.15, No.17, No.18) within the larger Credit Valley watershed (Figure 8-1). To represent the hydrostratigraphy and the CSM within the HGS model, a total of 26 numerical layers were used. Whereas this is greater than the number of hydrostratigraphic units present in the model domain, the additional number of layers was adopted in this model to allow for increased resolution of vertical hydraulic heads within the model domain, as well as to capture vertical variability in the overburden sequence. The distribution of hydrostratigraphic units within these layers and the hydraulic conductivity values applied to each unit are described in Appendix Q.

The HGS model was calibrated to current conditions based on the average, long-term hydraulic heads observed at on-Site groundwater monitoring wells and surface water stations, water level information obtained from consultant reports (CRA 1990, 1994, 2012), MECP water well records, and long-term average flow rates at CVC surface water monitoring stations. The model was also calibrated transiently to the four-day constant rate pumping test conducted on-Site in the fall of 2022 as part of the Northwest Investigation. The calibrated current condition model served as a basis for predictive model simulations to assess the potential impacts of proposed pit / quarry development on future groundwater levels and surface water flows. Eight predictive model simulations were completed, representing Operational Phases 1 to 7, and post-Rehabilitation conditions.

It should be noted that the water modelling simulations assumed that the 1.4 ha area underlying the proposed Pit / Quarry Office and Quality Control Lab in the southeast corner of the Main Area would be extracted during Operational Phase 1, although this area is no longer planned for extraction. As such, the HGS model is conservative, and slightly overpredicts drawdown and dewatering in this area now that this part of the Main Area is no longer planned for extraction.

8.1 Water Management and Discharge Plan

CBM's proposed Operational Plan for the Site, along with the HGS model results described in this section and Appendix Q were used to support the development of a Water Management and Discharge Plan for the proposed Pit / Quarry (Appendix R) which includes the following:

- Proposed off-site discharge location to the Osprey Valley Golf Course irrigation pond system (also see Section 7.4);
- Proposed groundwater infiltration trench mitigation system (detailed in Appendix S);
- Water inflow predictions and water management strategy;
- Water generation estimates by Quarry Area and Operational Year;
- Water consumption and discharge estimates by Quarry Area and Operational Year;
- Pit / quarry sumps and transfer of water between pit / quarry parcels;
- Water discharge and flows; and
- Final rehabilitated pond water levels.

8.2 Groundwater Mitigation System

Initial HGS model simulations indicated that pit / quarry dewatering during the later stages of operations (Phases 4 to 7) would likely result in a decline in groundwater levels in the water table aquifer that would extend southward and to the southwest of the licence area. If so, these predicted changes in groundwater levels could potentially impact natural features, groundwater users, and influence groundwater levels beneath existing aggregate pit #6525 (Lafarge Pit #3). In order to mitigate the potential impact of these predicted changes in groundwater levels during the operational phases of the proposed CBM Caledon Pit / Quarry, groundwater mitigation measures were developed by Golder and then implemented in the HGS modelling simulations for Operational Phase 3 to 7, to assess their effectiveness. The groundwater mitigation measures developed are described in Appendix S (Mitigation System Description) and further discussed in Section 9 (Impact Assessment).

The mitigation measures consist of the installation and operation of six infiltration trench zones along a 1,900 m alignment along the west side of the Main Area and the west and south side of the South Area, in the setback area between the licence limit and the limit of extraction. Water collected in the pit / quarry from dewatering will be reintroduced into the groundwater system through these infiltration trench zones to maintain the groundwater levels west and south of the licence area to levels within their current typical range. Additionally, a slurry wall will be installed in the overburden between the infiltration trenches and the extraction limit, in order to minimize the flow of groundwater back into the pit / quarry from the injection trench. The weathered upper bedrock zone along the proposed slurry wall alignment will be grouted to reduce the permeability of this zone and further reduce the inflow of groundwater into the pit / quarry and help sustain existing groundwater levels outside of the licence area.

The numerical simulations for Operational Phases 3 to 7 discussed in the subsections below include the implementation of the following groundwater mitigation system elements:

- Phase 3 – Implementation of the slurry wall / grouting of the weathered bedrock zone on the west side of the Main Area prior to the start of Phase 3 extraction.

- Phases 4 and 5 – Implementation of the infiltration trench system (Trench Zones 1 and 2) on the west side of the Main Area prior to the start of Phase 4 and 5 extraction.
- Phase 6 and 7 – Implementation of the second slurry wall / grouting of the weathered bedrock zone and the second phase of the infiltration trench system (Trench Zones 4 to 6) prior to the start of Phase 6 and 7 extraction.

The numerical simulation for the post-Rehabilitation scenario includes the removal of the slurry wall in the overburden in the southwest corner of the South Area (adjacent to Trench Zones 4 and 5), to reinstate hydraulic connection between the South Area and the lands to the south and southwest of the Site.

A summary of the modelled mitigation system configurations implemented for each of the eight forecast simulations is presented in Table 8-1 below.

Table 8-1: Groundwater Mitigation System Configurations

Phase	Operational Year	Slurry Wall / Grout Zone	Infiltration Trench Zone / Constant Head (masl)
End of Phase 1	End of Year 8	N/A	N/A
End of Phase 2	End of Year 13	N/A	N/A
End of Phase 3	End of Year 17	West side of Main Area	N/A
End of Phase 4	End of Year 22	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5
End of Phase 5	End of Year 26	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5
End of Phase 6	End of Year 32	West side of Main Area West and south side of South Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5 Trench Zone 3: 395.5 Trench Zone 4: 393.0 Trench Zone 5: 392.0 Trench Zone 6: 394.0
End of Phase 7	End of Year 38	West side of Main Area West and south side of South Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5 Trench Zone 3: 395.5 Trench Zone 4: 393.0 Trench Zone 5: 392.0 Trench Zone 6: 394.0
Post-Rehabilitation	Year 39+	Slurry wall removed along Trench Zones 4 and 5	N/A

8.3 Simulated Head and Drawdown

The simulated hydraulic head and water table drawdown for Operational Phases 1 to 7 and post-Rehabilitation with mitigation in place for Phases 3 to 7 are shown on Figures 8-2A to H.

The general simulated groundwater flow direction across the Site in each unit remained consistent with the current condition; groundwater flow is southeast across the Site toward the Credit River and bedrock valley.

The extent of water table drawdown during operation is largest during Phase 3, prior to the implementation of the mitigation system in the Main Area, and Phase 5, prior to the implementation of the mitigation system in the South Area. Once the mitigation system is implemented in the model, the extent of the simulated water table drawdown does not extend past the infiltration trench zones along the west and south sides of the extraction area.

The least drawdown occurs to the northwest, north and east of the Site where fine grained material is present, which provides a significant degree of hydraulic isolation between the shallow overburden and the underlying Gasport Formation, where dewatering mainly occurs during operations. The progressive rehabilitation of the pit / quarry walls during operation provides further hydraulic isolation between the pit / quarry operation and the surrounding environment, helping to minimize drawdown and dewatering requirements

Upon rehabilitation, the residual change in groundwater heads within subsurface units predicted to be affected by pit / quarry dewatering beyond the limits of the Site is very limited in extent. Further discussion of the potential impact to bedrock and overburden aquifers during pit / quarry operations and upon rehabilitation is provided in Sections 9.2 and 9.3.

8.4 Surface Flow

A summary of the simulated changes in surface water flow at the 16 surface water monitoring stations for Operational Phases 1 to 7 and Rehabilitation is shown on Figure 8-3. Surface water stations SW1 to SW4, SW6 to SW10, SW13, and SW16 are simulated to experience average reductions in flows of less than 10% relative to current conditions. SW11 is simulated to experience a reduction of 15% during Phase 2 but recovers during the subsequent phases showing a simulated reduction of 6 to 7% in Phases 3 to 7. Similarly, SW15 experienced a 14% simulated reduction in Phase 4, but shows a reduction of 8 to 9% in subsequent phases.

The HGS model predicts that SW14 will experience a simulated reduction in flow of 16% (during Phases 3 and 4), and 12 to 14% during Phases 5 to 7. The largest predicted reduction in flows occurs at SW5; ranging from 14% to 23% throughout the pit / quarry development; this reduction represents a maximum simulated change of 0.6 L/s. Further discussion of these predicted reductions in flow and their potential impact to surface water resources is provided in Section 9.1.

8.5 Pit / Quarry Inflow

The steady state simulated groundwater inflow during Phase 1 to 7 of operation, for each area (Main, North, South) is summarized in Table 8-2 below.

Overall, the total simulated inflow to all areas of the pit / quarry during operations ranges from 14.3 L/s to 133.6 L/s. The majority of the simulated inflow is in the Main Area of the pit / quarry, with inflows up to 81.3 L/s during Phase 6 of the operation. During Phase 7 of operation, the majority of the simulated inflow is in the South Area, with an inflow of 77.5 L/s

Upon rehabilitation, the maximum water level in the Main Pond will be controlled by an outflow to the North Pond at an approximate elevation of 400 masl, and the maximum water level in the North Pond will be controlled by an

outflow to the Osprey Valley Golf Course irrigation pond system at an approximate elevation of 399 masl. The simulated elevation of the South Pond is predicted to be 393.5 masl and will be internally contained, with no surface water outflow. The simulated steady state outflow from the Main and North Ponds to the Osprey Valley Golf Course irrigation pond system is estimated to be approximately 12 L/s.

Table 8-2: Simulated Pit / Quarry Inflow at Each Phase of Development

Phase	Main Area Simulated Groundwater Inflow (L/s)	North Area Simulated Groundwater Inflow (L/s)	South Area Simulated Groundwater Inflow (L/s)	Total Groundwater Inflow (L/s)
1	14.3	0.0	0.0	14.3
2	17.9	2.8	0.0	20.7
3	17.4	2.9	0.0	20.3
4	25.3	2.9	0.0	28.2
5	70.5	2.9	0.0	73.4
6	81.3	2.9	7.7	91.9
7	53.6	2.5	77.5	133.6

Note: 1 - The inflows include the surplus applied to the pit / quarry area.

A sensitivity analysis was done on predicted pit / quarry inflows by varying the hydraulic conductivity of the slurry wall / weathered zone grouting to assess the variability of pit / quarry inflows for each of the operational phases. The results are summarized in Table 8-3.

Table 8-3: Sensitivity of Hydraulic Barrier Performance to Hydraulic Conductivity

Phase	Low K Barrier: $1x10^{-6}$ m/s, % change				Low K Barrier: $1x10^{-8}$ m/s, % change			
	Main Area	South Area	North Area	Total Inflow	Main Area	South Area	North Area	Total Inflow
3	0%		0%	0%	0%		0%	0%
4	0%		0%	0%	0%		0%	0%
5	8%		0%	8%	-2%		0%	-1%
6	9%	0%	0%	8%	-1%	0%	0%	-1%
7	8%	6%	0%	7%	-1%	-1%	0%	-2%

Note: 1 – The inflows include the surplus applied to the pit / quarry area.

The simulated pit / quarry inflow is more sensitive to an increase in the hydraulic conductivity of the slurry wall / weathered zone grouting to $1x10^{-6}$ m/s, with the increase in total pit / quarry inflow ranging from 7 to 8% when the hydraulic conductivity is increased by an order of magnitude. The largest predicted increase (9%) occurs in the inflow to the Main Area during Operational Phase 6. The reduction of predicted water inflow when the hydraulic conductivity of the slurry wall / weathered zone grouting is reduced to $1x10^{-8}$ m/s is relatively small, ranging from 1

to 2% when the hydraulic conductivity is decreased by an order of magnitude. The water table drawdown is not affected by the increase and decreasing the hydraulic conductivity of the slurry wall / grouting alignment.

9.0 IMPACT ASSESSMENT

This section provides an assessment of the potential for impacts to water resources as a result of the proposed Caledon Pit / Quarry project, including surface water resources, groundwater resources, and water users in the Study Area. As this ARA licence is for below water table extraction of aggregates, there is potential for water resources impacts to occur. In addition to meeting the MNRF requirements, this assessment also considers the applicable provisions of the Greenbelt Plan, Source Water Protection, and the Caledon Official Plan, as well as how the proposed development may be affected by climate change. The impact assessment also includes a proposed groundwater and surface water monitoring plan, a groundwater mitigation plan, as well as a complaints response plan, should a water-related compliant be received by a neighbouring water user.

It is important to again note that initial groundwater-surface water numerical modelling simulations with the HGS numerical model indicated that pit / quarry dewatering during later the stages of operations (Phases 4 to 7) would likely result in a decline in groundwater levels in the water table aquifer that would extend southward and to the southwest of the licence area. In order to mitigate the potential impact of these predicted changes in groundwater levels during the operational phases, groundwater mitigation measures were developed by Golder, as described in Appendix S, and implemented in the HGS modelling simulations for Operational Phase 3 to 7, to assess their effectiveness.

The proposed groundwater mitigation measures consist of the installation and operation of six infiltration trench zones along a 1,900 m alignment along the west side of the Main Area and the west and south side of the South Area, in the setback area between the licence limit and the limit of extraction. Water collected in the pit / quarry from dewatering will be reintroduced into the groundwater system through these infiltration trench zones to maintain the groundwater levels west and south of the licence area to levels within their current typical range. Additionally, a slurry wall will be installed in the overburden between the infiltration trenches and the extraction limit, in order to minimize the flow of groundwater back into the pit / quarry from the injection trench. The weathered upper bedrock zone along the proposed slurry wall alignment may be grouted to reduce the permeability of this zone and further reduce the inflow of groundwater into the pit / quarry and help sustain existing groundwater levels outside of the licence area.

As previously discussed, the numerical simulations for Operational Phases 3 to 7 in the subsections below include the implementation of the following groundwater mitigation system elements.

- Phase 3 – Implementation of the slurry wall / grouting of the weathered bedrock zone on the west side of the Main Area prior to the start of Phase 3 extraction.
- Phases 4 and 5 – Implementation of the infiltration trench system (Trench Zones 1 and 2) on the west side of the Main Area prior to the start of Phase 4 and 5 extraction.
- Phase 6 and 7 – Implementation of the second slurry wall / grouting of the weathered bedrock zone and the second phase of the infiltration trench system (Trench Zones 4 to 6) prior to the start of Phase 6 and 7 extraction.

The numerical simulation for the post-Rehabilitation scenario includes the removal of the slurry wall in the overburden in the southwest corner of the South Area (adjacent to Trench Zones 4 and 5), to reinstate hydraulic connection between the South Area and the lands to the south and southwest of the Site.

The impacts to surface water flows described in Section 9.1.2, as well as potential impacts to groundwater aquifers described in Section 9.2 and water users described in Section 9.3, are the predicted residual impacts

with the proposed groundwater mitigation measures assumed to be in place during Phase 3 to 7 of pit / quarry operations.

With respect to the potential impacts of off-Site water discharge, there are several means and contingencies available to manage the rate and timing of off-Site discharges throughout the four seasons to ensure that pit / quarry operational dewatering requirements can be met without the risk of impact to downstream receiving bodies / receptors.

- Model simulations show that it is possible to re-infiltrate an additional 200,000 to 400,000 m^3 / year of surplus pit / quarry water via the groundwater infiltration trench mitigation system. The system infiltrates below the frost line and will be operated year-round. There is sufficient unsaturated zone thickness available throughout the year to re-infiltrate this additional water without causing flooding.
- The golf course can also manage surplus water if it is not needed for irrigation by storing the water and / or allowing it to flow though its pond system and discharge via their subaqueous discharge pipe to the Credit River.
- There is also an option to further increase on-Site storage of surplus water by allowing the North Area to flood sooner, i.e., once the extraction of that area is completed at the end of Phase 2B, which would provide an additional 376,000 m^3 of on-Site water storage.

9.1 Surface Water Resources

9.1.1 Potential Impacts to Surface Water

The Site sits within the catchments of several tributaries to the Credit River (Erin and Main Branches) and drainage courses including Tributaries #1, #4, and #8 (SW14, SW11, and SW8/SW16, respectively) as well as the catchment areas of SW10 and SW12. The total catchments of these tributaries and drainage features as well as their change in catchment area due to pit / quarry operations is detailed in Table 9-1 below.

Table 9-1: Surface Water Station / Internally Draining Catchment Losses

Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered		
	Existing Conditions	Operational / Rehab Conditions	
	Catchment Area (km^2) (1)		% Change in Catchment Area
SW8	17.397	15.709	-9.7%
SW10	0.264	0.511	+93.7%
SW11	0.284	0.283	-0.1%
SW12	0.064	0.026	-59.2%
SW14	1.412	1.395	-1.2%
SW16	5.937	4.249	-28.4%
South Quarry	0.116	0.032	-72.7%
Main Quarry	0.465	0.064	-86.2%

Surface Water Monitoring Stations / Internally Draining Catchments	Scenarios Considered		
	Existing Conditions	Operational / Rehab Conditions	
	Catchment Area (km^2) [1]		% Change in Catchment Area
North Quarry	0.302	0.142	-53.0%
Erin Branch of the Credit River	108.739	107.381	-1.2
Main Branch of the Credit River	218.421	219.779	+0.6

Note:

[1] Catchment areas were delineated using OWIT and were manipulated based on available topography data and site boundary data.

As seen in Table 9-1 above, the proposed aggregate extraction will remove a portion of each tributary/drainage catchment area at the monitoring stations by the end of Phase 7, with the exception of the SW10 catchment, which will substantially gain catchment area. Under the assumption that a perimeter berm and/or ditches would be placed along the licence extraction boundary during full quarry development, flow from the southeastern portion of the catchment of SW8/SW16 (Tributary #8) near Cataract (as seen on Figures 7-2 and 7-3) would be intersected by the berm and contribute to the catchment of SW10. Therefore, the catchment of SW10 is expected to increase from 0.264 to 0.511 km^2 (approximately 95%). Minimal changes were found to occur at Tributary #4 (SW11) as only a small section of the catchment will be lost due to pit / quarry operations. Minimal changes were found to occur within Tributary #1 (SW14). Significant decreases in catchment area were noted at SW12 due to proposed aggregate excavation, however, this area is typically dry for the majority of the year and directs small amounts of flow away from the agricultural fields within the property. Changes were also seen in Tributary #8 (SW8 and SW16) with one of the highest losses in catchment area. The internally draining catchment areas of the three small sections within the pit / quarry, were seen to have decreases in catchment area during operations. The loss in infiltration within these catchments will eventually be mitigated under operational conditions once the groundwater infiltration trenches are in operation in the Main and South Areas, and under rehabilitated conditions when the lakes formed in each of the three pit / quarry areas will recharge groundwater levels.

As detailed in Table 9-1 above, the total catchment of the Erin and Main Branches of the Credit River downstream of the Site, before their confluence, was found to be 108.739 km^2 and 218.421 km^2, respectively, provided by OWIT, and under full extraction, the pit / quarry as a whole would divert approximately 1.36 km^2 from the catchment of the Erin Branch to the Main Branch through the capture of runoff within the pit / quarry and the discharge of effluent to the east. The pit / quarry area accounts for approximately 0.8% of the catchment of the Main Branch of the Credit Rivers at the confluence with the Erin Branch (with a total catchment area of 327.160 km^2). Ultimately, all surplus within these tributaries and drainage features will report to the Credit River through surface or sub-surface pathways.

Similar to the changes in catchment area detailed above, the water balance assessments on surface water station catchment basis suggest that overall, there is a decrease in water surplus going to Tributaries #1, #4, and #8 with exception of an increase in surplus to SW10, under operational conditions. Additionally, as detailed in Table P-12 in Appendix P, changes and impacts to each catchment will differ with respect to the operational phases. For instance, the surface water station catchments of SW8, SW14, and SW16 as well as the Main and North Area

internally draining catchments will begin to experience a decrease in water surplus during Phase 1 while SW11 will experience a loss during Phase 2, SW12 and the south area internally draining catchments in Phase 5, and ultimately, SW10 in Phase 7. However, it should also be noted that these changes will to some degree be offset during the operational period as a result of the groundwater infiltration system, which will effectively infiltrate collected water back into these catchments.

On a site-wide basis, average annual surplus will increase by approximately 18% from 891,630 to 1,049,025 m^3 per year for the Site under operational conditions (noting that this surplus will be ultimately be conveyed to the Credit River via discharge to the golf course irrigation pond system). On a site-wide basis, rehabilitated conditions are expected to have a lower annual surplus compared to existing conditions, with a decrease of 14%. Although the pit / quarry area is expected to detain the runoff to the Credit River and its tributaries by capturing various amounts of their catchments, the surplus from the pit / quarry area is expected to be maintained, and will ultimately report to the Credit River and its tributaries via dewatering (operational) or groundwater inputs and lake outflows (rehabilitation). Also, during large flooding events, the storage available in the pit / quarry area under operational conditions and the relatively slow dewatering rate range, described above, will favourably reduce peak flows in the Credit River by a small percentage.

Additionally, there are no key hydrologic features located within the proposed extraction area, however, a 0.1 ha key hydrologic feature (i.e., a small wetland near the north corner of the Main Area) will be affected by the construction of the proposed berm and this feature is permitted to be removed in accordance with applicable policies. There are also key hydrologic features (i.e., an evaluated wetland and Tributary #1) in the northwest corner of the Main Area and these features will be protected. Taking into consideration the rehabilitation plan, there are 4.8 ha of wetland to be created and 158.3 ha lake to be created resulting in 163 ha of new key hydrologic features that will compensate any lost habitat.

9.1.2 Flow Changes at Surface Water Stations

As detailed in Section 8.0, the results of the groundwater and surface water model yielded overall predicted percent changes in average flow for the operational and rehabilitation period. The changes in average flow at each station and the potential for these flow changes to impact water resources are presented and discussed in Table 9.2 below.

Table 9-2: Predicted Changes to Flow at Surface Water Stations

SW Station	Current Catch-ment Area (km2)	Average Measured Flow (L/s)	Average Simulated Flow (L/s)	Simulated Max Operational Flow Change		Simulated Post-Rehab Flow Change		Potential for Impact	Discussion
				L/s	%	L/s	%		
SW1	1.32	16.00	24.45	-0.04	-0.1%	-0.01	-0.1%	No	SW1 is located upstream and away from the proposed extraction area. It connects into the SW6 catchment. The flow observations showed responses to high precipitation and freshet events, however during dry periods this station had consistent flow. The proposed extraction is expected to have no impact on flows at SW1, as predicted changes in flow are negligible.
SW2	2.21	0.03	0.00	0.00	0.0%	0.00	0.0%	No	SW2 is located upstream and away from the proposed extraction area and is dry most of the year. It connects into SW8 catchment. Observed flows are very low, with only minimal flow occurring following large precipitation or melt events. The proposed extraction is expected to have no impact on flows at SW2, as predicted changes in flow are negligible.
SW3	0.35	0.68	1.06	-0.02	-2.2%	-0.01	-0.8%	No	SW3 has small catchment area and is located on Tributary 9 and is observed to have very low intermittent flow. It connects into SW8 catchment. The proposed extraction is expected to have no impact on flows at SW3, as predicted changes are negligible.
SW4	0.22	0.00	0.02	0.00	-5.5%	0.00	-1.9%	No	SW4 has a very small catchment area and is observed to be dry or stagnant with effectively no flow. It connects into SW15 catchment. The proposed extraction is expected to have no impact on flows at SW4, as predicted changes to flow are small.
SW5	0.35	3.20	2.46	-0.57	-23.0%	-0.21	-8.4%	Low	SW5 is a small catchment area north of the Site that discharges to the golf course. It typically flows from December to May and is predicted to experience a maximum average flow reduction of ~0.6 L/s during operation, and a 0.2 L/s flow reduction post rehabilitation. The predicted changes in flow are not expected to reduce the wetted period, or impact sensitive ecological features, so the potential for impacts is considered to be low.
SW6/7	7.73	10.17	2.41	-0.06	-2.5%	-0.02	-0.9%	No	SW6 is located on Tributary 7 with no loss of catchment. It is observed to have intermittent flow and experiences regular dry periods. SW7 is located in the downstream of Tributary 6 with no loss of catchment. It has

SW Station	Current Catch-ment Area (km2)	Average Measured Flow (L/s)	Average Simulated Flow (L/s)	Simulated Max Operational Flow Change		Simulated Post-Rehab Flow Change		Potential for Impact	Discussion
				L/s	%	L/s	%		
									intermittent flow and experiences regular dry periods. The proposed extraction is not expected to impact flows at SW6 or SW7, as predicted changes are negligible.
SW8	17.40	11.25	119.98	-3.88	-3.2%	-0.79	-0.7%	No	Flows are observed at SW8 from March to June and it is otherwise stagnant throughout the rest of the year. The hydrograph and BFLOW model suggest little baseflow is occurring. The HGS model predicts significantly higher flow to occur at this station than has been observed in the field during the period of record, suggesting the model may also overestimate flow reductions. Field observations combined with the low average flow reductions predicted by the HGS model (3.2%) indicate low or no impacts at SW8.
SW9	1.81	20.23	62.71	-2.25	-3.6%	0.19	0.3%	No	Perennial flows are observed at SW9 but it has no catchment proximal to the proposed extraction area. The HGS model predicts significantly higher flow to occur at this station than has been observed in the field during the period of record, suggesting the model may also overestimate flow reductions. Field observations combined with the low average flow reductions predicted by the HGS model (3.6%) indicate low or no impacts at SW9.
SW10	0.26	0.00	0.00	0.00	0.0%	0.00	0.0%	No	SW10 is generally dry most of the year and has almost no response to precipitation events. This station is the only station that gains catchment area as a result of the proposed extraction. This station is expected to see negligible changes to flow, and is not expected to be impacted by the proposed extraction.
SW11	0.28	1.94	1.45	-0.22	-15.2%	-0.05	-3.6%	Low	SW11 is situated directly north of the Main Area, is predicted to see maximum localized impacts to flow during Phase 2 of operations (i.e. North Area extraction). This drainage feature is ephemeral with flows occurring from November to June. While there are predicted changes to flow (a maximum reduction of 0.2 L/s), the potential for impact is considered low, as the predicted reduction is not expected to change the overall function of the feature.
SW12	0.06	0.00	0.00	0.00	0.0%	0.00	0.0%	No	SW12 is generally dry all year round and has no observed response to precipitation. The function of this drainage feature is not expected to change, and no impacts are predicted as a result of the proposed extraction.
SW13	0.16	9.79	18.23	-1.71	-9.4%	-1.50	-8.3%	No	SW13 receives drainage from the Osprey Valley Golf Course ponds and irrigation system and is observed to flow from March to June. While the

SW Station	Current Catch-ment Area (km2)	Average Measured Flow (L/s)	Average Simulated Flow (L/s)	Simulated Max Operational Flow Change		Simulated Post-Rehab Flow Change		Potential for Impact	Discussion
				L/s	%	L/s	%		
									HGS model predicts a flow reduction during operations and post-rehabilitation, the model does not account for the transfer of surplus water to the irrigation system. Because this catchment will receive the surplus pit / quarry water during operation and post-rehabilitation, no impacts are predicted to occur as a result of extraction.
SW14	1.41	2.50	6.20	-0.99	-15.9%	-0.59	-9.5%	Low	The HGS model at SW14 predicts higher flow to occur at this station than has been observed in the field during the period of record. The HGS model also predicts SW14 to experience a flow reduction during operations of 16% and of 10% post-rehabilitation. Field observations indicate that SW14 is part of an ephemeral water feature that sits within a perched water table and showed periods of dry conditions over the available record. This predicted reduction in flow is not expected to reduce the wetted period or significantly alter the hydraulic function of this feature, and based on field observations and consideration of the HGS model predictions, there are low or no impacts predicted at SW14.
SW15	0.73	0.65	5.03	-0.70	-14.0%	-0.23	-4.6%	Low	The HGS model at SW15 predicts higher flow to occur at this station than has been observed in the field during the period of record. The HGS model also predicts SW15 to experience a reduction of 14% compared to existing conditions and a reduction of 5% post-rehabilitation. SW15 is a perennial feature located in a wetland. This predicted reduction in flow should it occur would not significantly alter the hydraulic function of this feature. Based on field observations and consideration of the HGS model predictions, there are low or no impacts predicted at SW15.
SW16	5.94	0.00	0.00	0.00	0.0%	0.00	0.0%	No	Flow observations at SW16 were dry for all events with some stagnant water in the area during some events. Although extraction will remove some catchment area from this station, the flow conditions are not expected to change, and no impacts to flow are predicted as a result of the proposed extraction.

Notes: (1) Surface water features and the respective catchments can be seen on Figure 6.1
(2) Negative catchment areas in the extraction area represents a catchment that gains drainage area as a result of aggregate extraction.

The extraction of aggregates under the seven operational phases and creation of ponds at the Site upon rehabilitation are not predicted to have adverse impacts on the local surface water hydrology with respect to loss in flow (i.e., a result of groundwater drawdown and overall surplus reduction) at surface water stations SW10 and SW12. As described in Table 9-2, field observations show both stations to be predominantly dry, and modelled results predict no flow throughout the seven operational phases and the rehabilitation phase.

9.2 Groundwater Aquifers

9.2.1 Potential Impacts to Aquifers during the Operational Period

The potential impact to aquifers during the operational period was assessed by examining the simulated water table elevation and predicted drawdown of groundwater relative to current conditions, for each of the seven phases of pit / quarry operations (Figure 2-1) as follows:

- Figure 8-2A: Phase 1 Simulated Water Table Elevation and Drawdown
- Figure 8-2B: Phase 2 Simulated Water Table Elevation and Drawdown
- Figure 8-2C: Phase 3 Simulated Water Table Elevation and Drawdown (Partial Main Area Mitigation in Place)
- Figure 8-2D: Phase 4 Simulated Water Table Elevation and Drawdown (Main Area Mitigation in Place)
- Figure 8-2E: Phase 5 Simulated Water Table Elevation and Drawdown (Main Area Mitigation in Place)
- Figure 8-2F: Phase 6 Simulated Water Table Elevation and Drawdown (Main and South Area Mitigation in Place)
- Figure 8-2G: Phase 7 Simulated Water Table Elevation and Drawdown (Main and South Area Mitigation in Place)

These figures, when viewed sequentially, present the predicted changes in the water table drawdown over time as a result of pit / quarry operations, and have been used to identify where, when and to what extent impacts to aquifers is expected to occur during the operational period.

- Phase 1 – At the end of Operational Phase 1, the extent of water table drawdown is almost entirely within the footprint of the licence area. Drawdown is predicted to be more pronounced to the south of the active extraction area, where the overburden is primarily comprised of (more permeable) sand and gravel material.
- Phase 2 – At the end of Operational Phase 2, the water table drawdown has expanded slightly southward, and expanded northward and eastward from the Main Area adjacent to the area of active extraction, and eastward from the North Area adjacent to the area of active extraction.
- The slurry wall / grout zone of the groundwater mitigation system is implemented in the setback along the western side of the Main area prior to the start of Phase 3.
- Phase 3 – At the end of Operational Phase 3, the water table drawdown has expanded slightly southward and shifted northwestward from the Main Area adjacent to the area of active extraction. Drawdown in the North Area remains largely unchanged from Phase 2.
- The infiltration trenches of the groundwater mitigation system are implemented in the setback along the western side of the Main Area prior to the start of Phase 4.

- Phase 4 – At the end of Operational Phase 4, the water table drawdown has contracted slightly southward and northeastward from the Main Area as a result of progressive rehabilitation and has shifted slightly northwestward adjacent to the area of active extraction. Drawdown in the North Area remains largely unchanged from Phase 2. The effectiveness of the groundwater mitigation system in reducing drawdown to the west of the licence area is quite evident, as there is only a slight area of drawdown.
- Phase 5 – At the end of Operational Phase 5, the water table drawdown has expanded slightly southward within the licence area. The effectiveness of the groundwater mitigation system in reducing drawdown to the west of the licence area is again quite evident, as there is only a slight area of drawdown. Progressive rehabilitation of the prior phases of extraction continues to help mitigate drawdown around the Main Area, as the area of drawdown is further reduced to the north and east of the Main Area, and around the North Area.
- The second phase of the groundwater mitigation system is implemented in the setback along the western and southern sides of the South Area prior to the start of Phase 6, while the first phase of the mitigation system remains active in the Main Area.
- Phase 6 – At the end of Operational Phase 6, the water table drawdown has expanded eastward from the South Area where active extraction has taken place, although the magnitude of the drawdown in that area is relatively low, on the order of 1m. The effectiveness of the second phase of the groundwater mitigation system in reducing drawdown to the west of the licence area is quite evident, as there is essentially no drawdown to the south or southwest, where the system was implemented in the South Area.
- Phase 7 – At the end of Phase 7, water table drawdown is largely unchanged eastward from the South Area. The effectiveness of the second phase of the groundwater mitigation system in reducing drawdown to the west of the licence area is again quite evident, as there is essentially no drawdown to the south or southwest, where the system was implemented in the South Area. Progressive rehabilitation of the prior phases of extraction continues to help mitigate drawdown around the Main Area.

Cataract Southwest PSW

It is noted that while the Cataract Southwest PSW is located approximately 430 m from the area of extraction, no direct impacts (i.e., removal) to the PSW as a result of the proposed extraction are anticipated.

With the proposed infiltration trench system and slurry wall in place to mitigate the potential effects of pit / quarry dewatering, groundwater-surface water modelling simulations indicate that groundwater levels can generally be maintained beneath the PSW areas during all operational periods of the pit / quarry within current levels. It should also be noted that the variation in groundwater levels observed in this area under existing conditions as noted in CRA (2012) and those measured by Golder as part of this assessment together show that groundwater levels have varied by more than 2.5 m over the past three decades and typically vary from 1 to 2 m seasonally.

The HGS groundwater-surface water model as calibrated to current conditions, also indicates that the current vertical hydraulic gradients in the aquifer underlying the PSW area are predominantly neutral or downwards, and that these gradients will not change during operations with the proposed mitigation system in place. This suggests that these wetland features, which have formed in topographic lows within this outwash sand and gravel area, are significantly supported by precipitation events, and are not predominantly reliant on groundwater.

9.2.2 Potential Impacts upon Rehabilitation

The potential impact to aquifers post-rehabilitation, once dewatering activities have ceased and the Main, North and South areas are allowed to fill with water, was assessed by examining the simulated water table elevation

and predicted drawdown of groundwater as presented on Figure 8-2H. The zone of residual water table drawdown of ~1 m is predicted to be very limited in extent and does not impact any PSW features.

There is no drawdown predicted beneath the Cataract Southwest PSW post-rehabilitation (on average) and no predicted change in vertical hydraulic gradients, which will remain neutral or downward. Therefore, no residual impacts to this PSW are predicted.

9.2.3 Potential Impacts to Springs and Seeps

With respect to the seeps observed along the Niagara escarpment south of Cataract, the maximum predicted water table drawdown in this area during any phase of operation is <0.5 m and post-rehabilitation, there is no residual drawdown in this area. As such, there is no predicted impact to springs and seeps along the escarpment south of Cataract.

9.3 Water Users

9.3.1 Water Supply Wells

To assess the potential for impacts to water well users identified in Section 3.8, a screening process was developed and applied to identify any wells in the Study Area that had the potential to have their static water level reduced by 10% or more AND have <10 m of remaining available water column for use, as a result of the proposed aggregate extraction operations.

- Any wells that met the criteria of >10% predicted water column reduction and <10 m of water column remaining were included for further consideration in the impact assessment.
- Those wells for which the predicted water column reduction was less than 10% and/or had >10 m of predicted water column remaining were removed from further consideration.

The methodology used conservative assumptions in predicting the potential water column reduction at these wells. A table detailing the calculations and results of the screening process is presented in Appendix S, Table S-1. It should be noted that these are predicted residual impacts with the proposed groundwater mitigation measures assumed to be in place during Phase 3 to 7 of pit / quarry operations. In additional to the wells identified in Section 3.8, three additional properties close to the Site, designated A, B, and C (see Figure 9-1), for which there was no well record were also added to the screening process, assuming that these properties likely have a (non-registered) water well for domestic use.

Results

As shown on Figure 9-1, of the approximately 100 water supply wells and property locations considered in the assessment, more than 80% of the wells have a negligible likelihood to be impacted by the proposed pit / quarry operation.

The screening process also identified 15 water wells that have potential to be impacted, as they are within the predicted zone of drawdown at one or more phases of the pit / quarry operation, are relatively shallow and / or have relatively little available water column from which to draw water. The maximum predicted drawdown at these wells mainly occurred during the later stages of operation (either Phase 6 or Phase 7). These wells are summarized in Table 9-3 and shown on Figure 9-1.

Table 9-3: Water Well Impact Assessment Results

Well ID	Well Use	Distance from Site (m)	Well Depth (m)	Static Water Level (m)	Water Column (m)	Aquifer Unit	Predicted Max Drawdown (m)	Reduction During Operation	Reduction Post-Rehab	Potential for Well Impact
4905228	Domestic	141	8.5	6.1	2.4	Bedrock (Gasport)	3.4	100%	78%	Significant
4900879	Domestic	213	13.7	9.5	4.2	Bedrock (Gasport)	1.2	29%	20%	Significant
4900878	Domestic	171	15.2	9.3	5.9	Bedrock (Gasport)	1.5	25%	17%	Significant
4900947	Domestic	175	12.8	3.1	9.7	Bedrock (Gasport)	3.3	34%	16%	Significant
4903132	Domestic	352	10.1	4.0	6.1	Bedrock (Gasport)	1.7	27%	15%	Moderate
4900946	Domestic	417	15.8	10.0	5.8	Overburden	0.7	13%	-1%	Moderate
4908162	Domestic	157	15.2	7.8	7.4	Bedrock (Gasport)	1.4	18%	-2%	Low
4905272	Domestic	356	13.7	4.5	9.2	Bedrock (Gasport and Lower)	2.2	24%	14%	Low
4905365	Domestic	356	29.9	20.6	9.3	Bedrock (Gasport and Lower)	2.1	23%	14%	Low
4907244	Domestic	222	20.1	11.5	8.6	Bedrock (Gasport)	1.1	13%	-2%	Low
4903810	Domestic	284	13.1	3.0	10.1	Bedrock (Gasport and Lower)	2.4	24%	12%	Low
4907589	Domestic	142	15.2	3.7	11.5	Bedrock (Gasport and Lower)	3.6	31%	14%	Low
4903189	Domestic	475	15.2	5.4	9.8	Bedrock (Gasport and Lower)	1.4	15%	8%	Low
4900948	Domestic	229	13.7	2.5	11.2	Bedrock (Gasport and Lower)	2.8	25%	13%	Low
4906635	Domestic	186	21.6	10.5	11.1	Bedrock (Gasport)	1.3	12%	9%	Low

Notes:

1. Well ID - as identified in the WWIS.
2. Well Use - as identified in the WWIS.
3. Distance from Site (m) - measured from the reported well location to the nearest Site boundary.
4. Well Depth (m) - well depth as reported in the WWIS.
5. Static Water Level (m) - inferred water level based on the HGS numerical groundwater model calibrated to current conditions.
6. Water Column (m) - height of water column in the well based on the static water level and well depth.

7. Aquifer Unit - aquifer(s) from which the well draws groundwater from.
8. Predicted Max Drawdown (m) - maximum predicted drawdown in the well during any phase of operation.
9. Reduction During Operation – predicted maximum % reduction in the static water level in the well during any phase of operation.
10. Reduction Post-Rehab – predicted maximum % reduction in the static water level in the well post-rehabilitation.
11. Potential for Well Impact – assessment of the potential for impact to the water user based on the predicted reduction in static water level.
12. The assumed potential wells at properties A, B and C were assumed to be typical of the most common design of water supply wells in this area: fully penetrating wells screened across the Gasport Formation and the Manitoulin/Whirlpool Formations aquifers.

The 15 wells initially identified by the screening process as having the potential to be impacted and were further assessed based on their well geometry, formation from which they draw water, distance from the extraction activities, available drawdown, and predicted drawdown as a result of pit / quarry operations. Based on this well-specific assessment, their potential for impact was further classified as significant, moderate or low, as shown on Table 9-3 and Figure 9-1. These categories of wells are discussed further below.

Significant Potential

There are four wells drawing water from the upper bedrock (Gasport Formation) that are within 220 m of the site for domestic supply (see Figure 9-1) which have significant potential to be impacted. Under existing conditions, these wells are inferred to have on average only 5.5 m of available water column, and are predicted to experience, on average, 2.4 m of drawdown during Phases 6 or 7.

- Two of the wells are located in Coulterville at the intersection of Main Street and Charleston Sideroad (ID 4900878 and 4900879), proximal to the South Area, where there is predicted to be a maximum drawdown in the Gasport Formation of approximately 1 m during Phase 7.
- Two of the wells are located in Cataract closest to the extraction limit, immediately to the east of the South Area (ID 4900947 and 4905228), where there is predicted to be a maximum drawdown in the Gasport of approximately 3.5 m during Phase 6.

These four wells could be deepened to match the depth of other wells in the same area, in the event that well interference is experienced during pit / quarry operations.

Moderate Potential

There are two wells considered to have a moderate potential for impact are in Cataract, between 350 and 450m from the pit/quarry footprint.

- Water well 4900946 is located in the southern portion of Cataract, screened in the overburden and has an available water column of approximately 6 m, and is expected to experience a maximum reduction of available water column (13%) during phase 5 of extraction.
- Water well 4903132 is located in the northern portion of Cataract. The well is 10 m deep, screened in the upper bedrock (Gasport Formation), and is predicated to experience a maximum drawdown of 2 m during Phase 6.

These two wells could be deepened to match the depth of other wells in the same area, in the event that well interference is experienced during pit / quarry operations.

Low Potential

- There are nine remaining wells that met the initial assessment screening criteria: 4908162, 4907244, 4900948, 4903810, 4903189, 4905365, 4905272, 4906635, and 4907589, but upon further assessment have a low potential for impact as a result of pit / quarry operations. These wells are between 140 and 480 m from the Main Area and South Area and are predicted to only lose 10 to 30% of their current available water column under predicted maximum drawdown. Six of the wells are located in Cataract and experience their minimum water levels during Phase 6. Two are located south of the South Area and experience their minimum water levels during Phase 5. The final well is located to the northwest of the Main and North Areas, on Osprey Valley Golf Course owned lands, and is not in use. These wells are considered to have a lower potential for impact, because they have either a maximum drawdown less than 1.5 m or 7 m of water column remaining.

Post-Rehabilitation

Post-rehabilitation, all of the wells identified by the impact assessment screening and subsequent well-specific assessment will see a recovery as static groundwater levels return to their long-term levels. Any wells that would be impacted by the rehabilitated condition would be impacted to a greater degree during the operational phase, and therefore mitigations put in pace during operations (for example well deepening) will be sufficient to mitigate impacts in the post-rehabilitation phase. As such, there is expected to be no long-term impact to water users post-rehabilitation.

Summary

Of the approximately 100 water supply wells evaluated in this assessment, six wells are considered to have the potential to be impacted during operations by the proposed pit / quarry development. These six wells are susceptible to impacts due to their location relative to the predicted zone of influence of the Site, and their relatively shallow well construction in comparison to other wells in the area. In all cases, these wells could be deepened to the depth of other wells in the surrounding area to restore the water supply, if the proposed pit / quarry operations is found to have resulted an unacceptable decline in their water level.

9.3.2 Well Complaints Response Plan

A Well Complaints Response Plan, presented in Appendix S, will be implemented by CBM to address well interference issues. The plan is intended to help ensure CBM can promptly respond to and remedy, if necessary, potential water supply impacts to any neighbouring private water well user should their water supply be affected by the future proposed Caledon Pit / Quarry aggregate operation.

9.3.3 Private Well Survey

An initial door-to-door private well survey was conducted in July 2021 in an effort to supplement and help verify the MECP WWIS information. However, there was no public participation in the survey. A follow-up private well survey within 1,000 m of the licence area is proposed upon licence approval and prior to the initiation of aggregate extraction, to confirm details regarding individual water well users. Survey participation will again be voluntary. The objective of the survey would be to confirm water use and well construction details with individual property owners, confirm the static water level in the well, confirm or update the impact assessment, and potentially monitor groundwater levels in the well, if agreed by the property owner.

9.3.4 Other Wells

The WWIS database search also identified 25 wells with purposes other than water supply, including 14 monitoring wells, nine recharge (or injection) wells, and two unused dewatering wells (excluding wells installed by

CBM from 2020 to 2022 for the purposes of this Water Resources Assessment). The function of dewatering and recharge wells will not be affected quarry dewatering, so no impact is predicted. Twelve of the 14 monitoring wells are expected to continue to be able to observe the groundwater levels throughout the predicted scenarios. Two of the monitoring wells, located at the snow dump on Charleston Sideroad, between the Main Quarry and South Quarry, are predicted to be above the groundwater level throughout extraction (all Phases 1 to 7), and become operable again once the Site has been rehabilitated. If monitoring groundwater levels and chloride below the snow dump is required, it is predicted that these will be adversely impacted.

9.3.5 Osprey Valley Golf Course – PTTW 1807-AC9P9J

There are no predicted impacts to the water supply well at the Osprey Valley Golf Course, as the maximum predicted drawdown in their supply well during dewatering operations (conservatively estimated) is negligible, about 2% of the available water column and less than 0.5 m.

There are also no predicted impacts to water quantity at their intake along the Credit River, which is outside of the area of influence of quarry dewatering.

It is also noted that the golf course has expressed interest to the licensee to receive surplus water from the proposed Caledon pit / quarry operations into their irrigation system via a connection to their existing infrastructure, which would reduce or potentially eliminate the need in future for the golf course to take water directly from the Credit River for irrigation.

9.3.6 Aquaterra Corporation – PTTW 8358-CAJLV3

The maximum predicted drawdown relative to current conditions was simulated for all operational phases and post-rehabilitation for the following wells on the Aquaterra property: Well 4905439 (Cataract Well), Well 4903950 (CD or Canada Dry Well - not used), Monitoring Well P8; and Monitoring Well P6. The model results are summarized in Table 9-4 below, which predicts the maximum water table drawdown at the Cataract Well during any operational phase to be 0.57m, and upon rehabilitation, the residual water table change at the well is predicted to be negligible.

Noting that historic monitoring data available for Well P8 for the 21-year period of 1990 to 2011 (CRA 2012, AECOM 2012) indicates that the groundwater level observed at P8 has varied by 2.73 m from 381.77 to 384.50 masl, the predicted reduction in groundwater levels during the proposed pit / quarry operational period is unlikely to impact the performance of the Cataract Well.

Table 9-4: Maximum Predicted Drawdown at the Aquaterra Wells

Well ID	4905439	4903950	P8[3]	P6
Description	Cataract Well	CD Well (not used)	Monitoring Well	Monitoring Well
Easting (m)	578459	578514	578454	578294
Northing (m)	4851827	4851832	4851795	4851460
Elevation (masl)	391.72	389.99	388.68	395.96
Water Level[1] (masl)	384.43	383.29	383.64	385.61
Water Depth (m bgs)	7.30	6.70	5.04	10.34
Drawdown[2] Phase 1 (m)	0.33	0.24	0.36	0.26
Drawdown Phase 2 (m)	0.17	0.13	0.41	0.30

Well ID	4905439	4903950	P8[3]	P6
Drawdown Phase 3 (m)	0.48	0.35	0.50	0.37
Drawdown Phase 4 (m)	0.01	0.01	0.00	-0.03
Drawdown Phase 5 (m)	0.57	0.42	-0.41	0.14
Drawdown Phase 6 (m)	-0.18	-0.13	-0.22	-0.17
Drawdown Phase 7 (m)	-0.03	0.00	-0.09	-0.05
Drawdown Rehabilitation (m)	-0.02	0.00	-0.07	-0.06

Notes:

1. Simulated groundwater level (current conditions).
2. Simulated groundwater drawdown at end of operational phase.
3. Measured groundwater level at P8 varied by 2.73 m from 381.77 to 384.50 masl from 1990 to 2011.

The 2012 AECOM report based on hydrogeologic monitoring data from 2007-2011 concluded that the Aquaterra water taking did not result in a change in groundwater gradients and was not having an impact on streamflow in the tributaries to the Credit River. While more recent data was not available to Golder at this time, a follow-up FOI request has been made to the MECP in an effort to obtain and evaluate more recent hydrogeologic monitoring data for this area.

Based on the magnitude of the predicted change in the water table elevation due to the proposed pit / quarry operations and post-rehabilitation, there are no water quantity impacts predicted at the Cataract Well or at the downgradient tributaries to the Credit River.

With respect to water quality, the proposed pit / quarry is not expected to impact water quality at the Cataract Well (or elsewhere), as the proposed aggregate operations will follow all applicable environmental standards and employ current industry best practices. This includes strict protocols for the handling of fuel on site, on-site storage and servicing of machinery, and the use and storage of hazardous substances. A technical report on Source Water Protection prepared for the Ontario Ministry of Natural Resources (MNR) by Blackport and Golder (2006), noted that there had been no documented instances of adverse impacts to groundwater quality as a result of normal operational activities associated with aggregate extraction in Ontario.

Pit / quarry water that will be used to maintain groundwater levels via the infiltration trench system will be operated in accordance with a Permit To Take Water and Environmental Compliance Approval under the Ontario Water Resources Act, and as such, operation of this mitigation system is not expected to impact groundwater quality, relative to current baseline groundwater conditions (see Section 5.7). Upon rehabilitation, the proposed pit / quarry will be rehabilitated to a natural condition, including lakes, wetlands, grasslands and wooded areas; a final land use that is not considered to impact groundwater quality (Golder 2010).

9.4 Source Water Protection

The proposed Caledon Pit / Quarry is within the Credit Valley Source Protection Area but is not located in a WHPA or IPZ and as such there will be no impacts to municipal water supplies.

The proposed extraction area does not contain any identified water resources on the Region of Peel Schedule A-1 (Water Resources, Systems and Features). The proposed licence area includes an identified feature in the northwest corner of the Main Area and this feature is located outside of the extraction area and will be protected.

A small portion of Main Area, a very small portion of the North Area and the majority of the South Area is mapped as a Highly Vulnerable Aquifer on the Region of Peel Schedule A-2 (Highly Vulnerable Aquifers). Almost all of the Rural Area in the Region of Peel including the Main Area, North Area and South Area are mapped as a Significant Groundwater Recharge Area on the Region of Peel Schedule A-3 (Significant Groundwater Recharge Area). This is very common for mineral aggregate resource areas, and based on the design of the operation, and the implementation of the recommendations contained in this report, the proposed Caledon Pit / Quarry does not result in additional risk to the aquifer and the groundwater recharge function of the area will be maintained.

9.5 Greenbelt Plan

The scope of this Water Report Level 1 /2 is considered to meet the requirements set forth in the Greenbelt Plan (2017) as summarized in the table below.

Table 9-5: Greenbelt Plan Requirement Checklist

Greenbelt Plan Requirement	Caledon Pit / Quarry Project
4.3.2 Non-Renewable Resource Policies For lands within the Protected Countryside, the following policies shall apply: 1. Non-renewable resources are those non-agriculture-based natural resources that have a finite supply, including mineral aggregate resources. Aggregates, in particular, provide significant building materials for our communities and *infrastructure*, and the availability of aggregates close to market is important for both economic and environmental reasons. 2. Activities related to the use of non-renewable resources are permitted in the Protected Countryside, subject to all other applicable legislation, regulations and official plan policies and by-laws. The availability of mineral aggregate resources for long-term use shall be determined in accordance with the PPS, except as provided below. 3. Notwithstanding the policies of section 3.2, within the Natural Heritage System, *mineral aggregate operations* and wayside pits and quarries are subject to the following: a) No new *mineral aggregate operation* and no new wayside pits and quarries, or any ancillary or accessory use thereto, shall be permitted	Meets requirement as a valuable non-renewable aggregate resource close to market (Water Report Section 4).
3.2.4 Key Hydrologic Areas *Key hydrologic areas* are areas which contribute to the *hydrologic functions* of the Water Resource System. These areas maintain ground and surface water quality and quantity by collecting, storing and filtering rainwater and overland flow, recharge aquifers and feed downstream tributaries, *lakes*, *wetlands* and discharge areas. These areas are also sensitive to contamination and feed *key hydrologic features* and drinking water sources. *Key hydrologic areas* include: • *Significant groundwater recharge areas*; • *Highly vulnerable aquifers*; and • *Significant surface water contribution areas*.	Meets requirement, as hydrogeologic functions are protected and where possible, improved or restored (Water Report Sections 5 to 11).

Greenbelt Plan Requirement	Caledon Pit / Quarry Project
For lands within a *key hydrologic area* in the Protected Countryside, the following policies apply: 1. *Major development* may be permitted where it has been demonstrated that the *hydrologic functions*, including groundwater and surface water quality and quantity, of these areas shall be protected and, where possible, improved or restored through: a) The identification of planning, design and construction practices and techniques; b) Meeting other criteria and direction set out in the applicable *watershed planning* or *subwatershed plan*; and c) Meeting any applicable provincial standards, guidelines and procedures. 2. Section 3.2.4.1 does not apply to *major development* that is a new or expanding building or structure for *agricultural uses*, *agriculture-related uses* or *on-farm diversified uses* where the total impervious surface does not exceed 10 per cent of the lot.	

9.6 Caledon Official Plan

The scope of this Water Report Level 1 / 2 is considered to meet the requirements set forth in the Town of Caledon Official Plan (2018) as summarized in the table below.

Table 9-6: Caledon Official Plan Requirement Checklist

Town of Caledon Official Plan Requirement	Caledon Pit / Quarry Project
5.11.2.4.15 - The Water Resources Study required by Section 5.11.2.4.2(g) shall identify all sources of water and their functions and analyze and assess the impact of the application on each of those water resources and shall satisfactorily demonstrate that there will not be unacceptable impacts and shall address the following: *a) The quantity and quality of mineral aggregate resource located below the water table;* *b) That the removal of the mineral aggregate resource and the subsequent rehabilitation of the lands will satisfy the applicable performance measures in Sections 3.2.5.13 and 5.11.2.2.6 of this Plan;* *c) That measures to protect water resources will be implemented in the design and operation of fuel storage and handling systems, machinery storage and servicing and the use and storage of potential contaminants on the site. The storage of fuel and other potential contaminants on-site may be restricted if necessary to protect water resources; and,* *d) That an appropriate monitoring program will be implemented and that the results of this monitoring program will be provided to*	Requirements met through Impact Assessment and Conclusions (Water Report Section 9 and 11.1). a) Met through Aggregate Resource Assessment (Water Report Section 4). b) 3.2.5.13 Met through Water Resource Assessment (Water Report Sections 5 through 9). 5.11.2.2.6 met through Natural Environment Report (under separate cover) c) Met through Recommendations (Water Report Section 11.2). d) Met through Monitoring Plan (Water Report Section 9.8).

Town of Caledon Official Plan Requirement	Caledon Pit / Quarry Project
the Town of Caledon, the Region of Peel, the Niagara Escarpment Commission where applicable and the applicable Conservation Authorities.	
5.11.2.4.16 - The Water Resources Study required by Section 5.11.2.4.2(h) shall identify all sources of water and their functions and analyze and assess the impact of the application on each of those water resources and shall satisfactorily demonstrate that there will be no unacceptable impacts and shall address the following: *a) That the removal of the mineral aggregate resource and the subsequent rehabilitation of the lands will satisfy the applicable groundwater performance measures in Sections 3.2.5.13 and 5.11.2.2.6 of this Plan;* *b) That measures to protect water resources will be implemented in the design and operation of fuel storage and handling systems, machinery storage and servicing and the use and storage of potential contaminants on the site. The storage of fuel and other potential contaminants on-site may be restricted if necessary to protect water resources; and,* *c) That an appropriate monitoring program will be implemented and that the results of this monitoring program will be provided to the Town of Caledon, the Region of Peel, the Niagara Escarpment Commission where applicable and the applicable Conservation Authorities.*	Requirements met through Impact Assessment and Conclusions (Water Report Section 9 and 11.1). a) 3.2.5.13 Met through Water Resource Assessment (Water Report Sections 5 through 9). 5.11.2.2.6 met through Natural Environment Report (under separate cover) b) Met through Recommendations (Water Report Section 11.2). c) Met through Monitoring Plan (Water Report Section 9.8).

9.7 Climate Change Considerations

Canada's Changing Climate Report (Bush and Lemmen 2019), identifies climate change as one of the defining challenges of the 21st century, and summarizes the story of Canada's changing climate in the following key messages:

- Canada's climate has warmed and will warm further in the future, driven by human influence.
- Both past and future warming in Canada is, on average, about double the magnitude of global warming.
- Oceans surrounding Canada have warmed, become more acidic, and less oxygenated, consistent with observed global ocean changes over the past century.
- The effects of widespread warming are evident in many parts of Canada and are projected to intensify in the future.
- Precipitation is projected to increase for most of Canada, on average, although summer rainfall may decrease in some areas.

- The seasonal availability of freshwater is changing, with an increased risk of water supply shortages in summer.
- A warmer climate will intensify some weather extremes in the future.
- The rate and magnitude of climate change under high versus low emission scenarios project two very different futures for Canada.

Taking Action on Climate Change in Toronto Region (TRCA 2022) provides specific insight on how climate change is expected to change the hydrologic cycle in the GTA over the lifetime of the proposed Caledon Pit / Quarry project, by increasing mean annual temperature, mean annual precipitation, hot and cold extremes and dry weather.

Mean annual temperature is projected to increase from 7.3°C (1971-2000) to a range of 9.8°C to 15.8°C under high emissions scenario (TRCA 2022). These temperature increases are expected to increase across all seasons. These changes in temperature will not only increase the temperature of surface waters, but they will also increase the potential evapotranspiration in the Study Area. This will increase the water losses to the atmosphere and dry up seasonal surface water features more quickly and potentially for longer durations.

Changes to mean precipitation are projected to increase from 986 mm (1971-2000) to a projected range of 1,015 to 1,292 mm under the high emissions scenario (TRCA 2022). These changes to mean precipitation will reintroduce water back into the surface water systems, however these increases will likely not be distributed evenly over the year or even typical precipitation events. Precipitation increases will most likely be realized through more frequent and intense storms that may cause flooding and reduce overall infiltration and soil water storage because available surface waters may have less time to infiltrate or be absorbed.

The number of extreme heat days (above 30°C and 35°C) are expected to increase from around 11 days and 1 day (1971-2000), respectively, to 52 and 14 days, respectively, under a high emissions scenario. While the number of days below -20°C is expected to decrease from around 10 days (1971-2000) to 0 to 3 days under high emissions scenario (TRCA 2022). These changes to dry and cold periods will likely cause more surface water features to dry or experience extreme lows, while warmer winter weather may produce drier spring freshets, limiting aquatic environments that rely on spring snow melt water levels.

In general, the Project may not see significant mean average changes to their water handling, since increased precipitation may be balanced but increased evaporation (annually). However, the frequency and intensity of the wet and dry events may significantly change the water handling throughout the year, with increased precipitation events that are capable of flooding or the increase of extended dry periods.

Based on this information, the Project has the potential to benefit the receiving water system by containing large precipitation events and controlling the release of these waters over a prolonged period. This can be accomplished when an intense rainfall event falls on the operating or flooded pit / quarry and the water volumes are pumped out or drain by gravity (through flooded pit / quarry outlets or infiltration) over a period of weeks or months. This has the potential to decrease peak flows and increase typical or low flows in the receiving water system.

Another potential benefit of the Project with respect to mitigation of extreme precipitation events as a result of climate change is the control / stability of local groundwater levels that the Project will create, both during operations and upon post-rehabilitation. The dewatering of the pit / quarry during operations will inherently

stabilize the local groundwater table, and during a period of high precipitation events, may help maintain infiltration capacity in the shallow subsurface, allowing precipitation in infiltrate, rather than cause flooding.

Upon post-rehabilitation, the Main and North Ponds will have engineering water level controls, which will help prevent an excessive rise in the groundwater table, that could again lead to flooding during high precipitation events. While the South Pond does not have an outlet structure, groundwater modelling has demonstrated that the South Pond water level is effectively controlled by the water level in the Main Pond, and as such, the South Pond also helps control and stabilize the local water table and has sufficient retention capacity to contain major precipitation events.

In summary, the proposed Caledon Pit / Quarry project will not be adversely impacted as a result of climate change and may in fact be beneficial in mitigating the potential climate change impacts of extreme precipitation events, as the Project will provide a degree of hydraulic control on the surface water and groundwater systems in the Study Area, both during operations and post-rehabilitation.

9.8 Proposed Monitoring Program

The proposed groundwater and surface water monitoring program is summarized in Table 9-6 (on-site locations) and Table 9-7 (off-site locations). It is comprised of monitoring wells and well nests (MW), surface water stations (SW), and surface water / mini-piezometer stations (SW/MP); mainly of wells and stations that are part of the current monitoring program and Site investigations, but additional locations have been added in areas where enhanced monitoring will augment the understanding of hydrogeological and hydrologic conditions on the Site and in the Study Area. The locations of the various monitors are presented on Figure 9-2, a described further in the subsections below.

9.8.1 On-Site Monitoring

The proposed on-site groundwater monitoring program is comprised of the on-site monitoring wells installed during the 2020 hydrogeologic investigation and part of the current monitoring program. These wells are within the proposed setback area, so they would remain in place for the duration of the pit / quarry operations, if needed.

Additionally, a monitoring well from each of the four pumping test areas (two in the Main Area, one in the North Area and one in the South Area, will be added to the monitoring program, with the understanding that these wells would be decommissioned and removed during the operational period, as aggregate extraction proceeds, as they are within the planned extraction area. These wells are already in place and the additional water level data collected there will enhance the monitoring of hydrogeologic conditions as aggregate extraction advances.

Also added to the on-site monitoring program will be the wells installed during the 2022 supplemental investigation in the Northwest Wetland area; these wells are located within the planned setback area, so they would remain in place for the duration of the pit / quarry operations, if needed.

Seven new monitoring well nests, MW-IT01A/B to MW-IT07A/B, will be added in the setback area adjacent to the proposed infiltration trench system in the Main and South areas. Each well nest location will consist of a monitor in the Gasport Formation (A) and a monitor in the overburden (B). Water levels will initially be monitored in these wells to establishing baseline groundwater levels, and later to inform the operation of the infiltration trench system. Initially, groundwater levels will be monitored by loggers set to record on 15-min intervals, with quarterly logger downloads and quarterly manual measurements, for the purposes of establishing baseline groundwater levels. Later, specific monitoring requirements will be developed to inform the operation of the infiltration trench system, the details of which will be approved by the MECP based on the Permit to Take Water and Environmental

Compliance Approval to be obtained by the Applicant prior to the implementation of groundwater mitigation measures.

The proposed on-site surface water monitoring locations include existing station SW14/MP14, located in the proposed setback on the west side of the Main Area, as well as two new stations in that area SW22/MP22 and SW23/MP23 at the pond and wetted feature associated with Tributary #1.

Lastly, a new surface water station, SW26 will be installed at a future point in time at the planned outlet of the proposed Settling Pond, where water will be conveyed via a pipe to the Osprey Valley Golf Course once the pond and pipe have been permitted, constructed and is operational. Specific monitoring requirements of the water discharged from the Settling Pond will be as approved by the MECP based on the PTTW and ECA to be obtained by the Applicant prior to the initiation of any off-site discharge, and is expected to include water quality, temperature, and flow.

Additional information regarding scope and frequency for each type of monitor is provided in the table notes below.

Table 9-7: On-Site Groundwater and Surface Water Monitoring Program

Name	Type	Easting	Northing	Monitoring Scope
MW20-01 A/B	Mon Well	577459	4852268	Water level[1]
MW20-07 A/B	Mon Well	578360	4853250	Water level[1]
MW20-08 A/B	Mon Well	578010	4853575	Water level[1]
MW20-09	Mon Well	578344	4854157	Water level[1]
MW20-10 A/B	Mon Well	577838	4854407	Water level[1]
MW20-11 A/B	Mon Well	577672	4853921	Water level[1]
MW20-12 A/B	Mon Well	577272	4854321	Water level[1]
MW20-14 A/B	Mon Well	577576	4853100	Water level[1]
MW20-15 A/B	Mon Well	576577	4853544	Water level[1]
MW20-15 C	Mon Well	576577	4853544	Water level[1]
MW20-16 A/B	Mon Well	576785	4853807	Water level[1]
MW20-17 A/B	Mon Well	576752	4852966	Water level[1]
MW20-18	Mon Well	577058	4852659	Water level[1]
MW21-1-1	Mon Well	576882	4853485	Water level[1,4]
MW21-2-1	Mon Well	577279	4854021	Water level[1,4]
MW21-3-1	Mon Well	577872	4852814	Water level[1,4]
MW21-4-1	Mon Well	577793	4854211	Water level[1,4]
MW22-01	Mon Well	576782	4853808	Water level[1]
MW22-02 A/B	Mon Well	576478	4853794	Water level[1]

Name	Type	Easting	Northing	Monitoring Scope
MW22-03 A/B	Mon Well	576201	4854078	Water level[1]
PW22-01	Mon Well	576574	4853535	Water level[1]
MW-IT-01A/B	Mon Well	577009	4852710	Water level[5]
MW-IT-02A/B	Mon Well	577201	4852518	Water level[5]
MW-IT-03A/B	Mon Well	577346	4852373	Water level[5]
MW-IT-04A/B	Mon Well	577529	4852386	Water level[5]
MW-IT-05A/B	Mon Well	577617	4852199	Water level[5]
MW-IT-06A/B	Mon Well	577896	4852218	Water level[5]
MW-IT-07A/B	Mon Well	578068	4852434	Water level[5]
SW14/MP14	SW/MP	578165	4855098	Water level and temperature[2]
SW22/MP22	SW/MP	576800	4853125	Water level and temperature[2]
SW23/MP23	SW/MP	576840	4853050	Water level and temperature[2]
SW26	SW	578155	4854320	To be determined by MECP PTTW and ECA Approvals[3]
SW27	SW	578340	4854105	Water Level and Temperature[2,3]

Notes:

1. Groundwater level to be monitored by logger set to record on 15-min intervals, with quarterly logger downloads and quarterly manual measurements.
2. Surface water level and temperature to be monitored by logger set to record on 15-min intervals, with quarterly logger downloads and quarterly manual measurements.
3. Water discharge from the Settling Pond to be monitored as per requirements to be approved by the MECP based on the Permit to Take Water and Environmental Compliance Approval to be obtained by the Applicant prior to the initiation of any off-site discharge.
4. These wells only need to be monitored until they are required to be decommissioned in accordance with MECP requirements to allow for on-site operations.
5. Groundwater level to be monitored as per requirements to be approved by the MECP based on the Permit to Take Water and Environmental Compliance Approval to be obtained by the Applicant prior to the implementation of groundwater mitigation measures.

9.8.2 Off-Site Monitoring

The proposed off-site groundwater monitoring program is comprised of 15 of the 19 off-site monitoring well nests that were installed during the 2020 hydrogeologic investigation and are currently part of the existing groundwater monitoring program. These off-site locations encompass all existing well nests that are within approximately 1,500 m of the Site. The current groundwater monitoring program and predictive modelling for the operational and post-rehabilitation period indicates that these wells will provide very good spatial coverage within the Study Area, and will allow to the licensee to monitor baseline conditions and assess the potential for any impacts to groundwater as a result of the proposed Caledon Pit / Quarry development. These well nests are all located on lands owned or under the control of the licensee.

The proposed off-site surface water monitoring locations include nine existing surface water stations installed in 2002 as part of the surface water investigations (SW4, SW5, SW8, SW10, SW11, SW12, SW13, SW15/MP15 and SW16/MP16), as well as four new surface water stations that were installed in the summer of 2022 as part of the supplemental investigation in the Northwest Wetland area (SW17/MP17, SW18/MP18, SW19/MP19 and SW20/MP20), which are to be added to the long-term monitoring network to enhance the monitoring of this wetland area.

To further enhance monitoring in the vicinity of the PSW area to the northwest of SW10, station SW21/MP21 (a surface water station / mini piezometer pair) is proposed to be installed in a deep portion of the wetland feature and at the wetland's edge, respectively, to enhance long term monitoring in that area.

Two additional stations, SW22/MP22 and SW23/MP23 (surface water station / mini piezometer pair) are also proposed to be installed in the pond and wetted feature along Tributary #1 immediately west of the Main Area downstream of SW14/MP14, to further enhance monitoring of these features.

New surface water monitoring is also proposed to be installed at the two culverts under the rail line east of the North Area (SW24 and SW25), both of which discharge to CVC-controlled lands, and the culvert from the southeast corner of the South Area beneath Charleston Sideroad (SW27).

Together, these monitoring enhancements will allow for improved understanding of the flow regime, surface water and groundwater interactions in the receiving water bodies.

Additional information regarding scope and frequency for each type of monitor is provided in the table notes below.

Table 9-8: Off-Site Groundwater and Surface Water Monitoring Program

Name	Type	Easting	Northing	Monitoring Scope
MW20-02	Mon Well	577900	4852138	Water level[1,3]
MW20-03	Mon Well	578244	4851907	Water level[1,3]
MW20-04	Mon Well	578265	4852313	Water level[1,3]
MW20-05 A/B	Mon Well	578423	4852713	Water level[1,3]
MW20-06 A/B	Mon Well	578474	4852973	Water level[1,3]
MW20-13 A/B	Mon Well	576873	4854473	Water level[1,3]
MW20-13 C	Mon Well	576873	4854473	Water level[1,3]
MW20-19 A/B	Mon Well	576907	4852000	Water level[1,3]
MW20-20 A/B	Mon Well	576476	4852468	Water level[1,3]
MW20-20 C	Mon Well	576476	4852468	Water level[1,3]
MW20-21 A/B	Mon Well	576014	4852840	Water level[1,3]
MW20-22 A/B	Mon Well	575785	4851966	Water level[1,3]
MW20-23 A/B	Mon Well	576206	4851556	Water level[1,3]
MW20-23 C	Mon Well	576206	4851556	Water level[1,3]

Name	Type	Easting	Northing	Monitoring Scope
MW20-27 A/B	Mon Well	575954	4853770	Water level[1,3]
SW4	SW	574760	4852963	Water level and temperature[2,4]
SW5	SW	575863	4853846	Water level and temperature[2,4]
SW8	SW	576054	4851688	Water level and temperature[2,3]
SW10	SW	579128	4850628	Water level and temperature[2,3]
SW11	SW	578238	4851869	Water level and temperature[2,4]
SW12	SW	576842	4854781	Water level and temperature[2,4]
SW13	SW	578153	4853488	Water level and temperature[2,3]
SW15/MP15	SW/MP	576562	4853501	Water level and temperature[2,3]
SW16/MP16	SW/MP	576024	4852785	Water level and temperature[2,3]
SW17/MP17	SW/MP	576488	4853803	Water level and temperature[2,3]
SW18/MP18	SW/MP	576396	4853993	Water level and temperature[2,3]
SW19/MP19	SW/MP	576226	4854106	Water level and temperature[2,3]
SW20/MP20	SW/MP	576819	4853890	Water level and temperature[2,3]
SW21/MP21	SW/MP	578215	4851865	Water level and temperature[2,3]
SW24	SW	578193	4854455	Water level and temperature[2,4]
SW25	SW	578089	4854497	Water level and temperature[2,4]

Notes:

1. Groundwater level to be monitored by logger set to record on 15-min intervals, with quarterly logger downloads and quarterly manual measurements.
2. Surface water level and temperature to be monitored by logger set to record on 15-min intervals, with quarterly logger downloads and quarterly manual measurements.
3. Located on lands / owned controlled by the licensee.
4. Located on railroad right-of-way. Monitoring to be completed subject to permission by the applicable public authority.
5. Water quality to be sampled and monitored 2x / year (April and September) for: Hardness (CaCO3), General Chemistry (i.e., pH, temperature, conductivity, dissolved oxygen, turbidity), Total Ammonia-N, Total Phosphorus, Alkalinity (Total as CaCO3), Dissolved Chloride (Cl-), Nitrite (N), Nitrate (N), Nitrate + Nitrite (N), Total Kjeldahl Nitrogen (TKN), Total Suspended Solids, Total Oil & Grease, Total Metals.

10.0 CUMULATIVE EFFECTS ASSESSMENT

A cumulative effects assessment was completed for the proposed Caledon Pit / Quarry generally following the guidance provided in *Cumulative Effects Assessment (Water Quality and Quantity) Best Practices Paper for Below-Water Sand and Gravel Extraction Operations in Priority Subwatersheds in the Grand River Watershed* (GRCA 2010). This guidance document provides a framework by which a technical study may meet the best-practices of a cumulative effects assessment, which has been followed herein, and is considered to be applicable to both pits and quarries.

Based on the assessment of cumulative effects outlined below, the proposed Caledon Pit / Quarry Project is not predicted to have a significant cumulative effect on the subwatershed, Erin Branch or Credit River Watershed.

10.1 Initial Assessment

The following initial assessment has been completed for the proposed Caledon Pit / Quarry Project.

Table 10-1: Initial Assessment to Evaluate Potential for Cumulative Effects

Initial Assessment	Caledon Pit / Quarry Project
Proximity to licensed above- and below-water aggregate extraction operations and the potential for overlapping cumulative effects including changes to surface water drainage patterns and water balance.	There are two pits located above the Niagara escarpment approximately 600 m southwest and downgradient of the Site, west of the Credit River. With groundwater mitigation measures in place during Operational Phases 3 to 7, the potential for an overlapping cumulative effect is low. There are six pits located east of the Study Area and east of the Credit River, which are outside of the subwatershed. There is no potential for overlapping cumulative effects with these other aggregate sites east of the Credit River.
Proximity to licence applications for proposed above- and below- water extraction operations	The authors are not aware of other aggregate licence applications proximal to the Study Area.
Degree of environmental degradation existing within the subwatershed, if available (e.g., ground water/surface water quantity and quality, impacts on natural features and functions, ecosystem health)	The impact assessment (Section 9) did not identify significant environmental degradation within the subwatershed.
Potential impacts on the level of stress that the proposed below-water aggregate extraction operation may have on the subwatershed.	The impact assessment (Section 9) did not identify an unacceptable increase in stress to the subwatershed as a result of this proposed aggregate extraction.
Proximity to municipal water wells and intakes, if the information is available	The Site is within the Credit Valley Source Protection Area but is not located in a WHPA or an IPZ, therefore the Project will not impact municipal water supplies.

Initial Assessment	Caledon Pit / Quarry Project
Vulnerability of the groundwater resources in the subwatershed and the potential impact that the proposed below-water aggregate extraction operation may have on vulnerability (if any).	A small portion of Main Area, a very small portion of the North Area and the majority of the South Area is mapped as a Highly Vulnerable Aquifer on the Region of Peel Schedule A-2 (Highly Vulnerable Aquifers). Based on the design of the operation, and the implementation of the recommendations contained this Report, the proposed Caledon Pit / Quarry does not result in additional risk to the aquifer. Almost all of the Rural Area in the Region of Peel including the Main Area, North Area and South Area are mapped as a Significant Groundwater Recharge Area on the Region of Peel Schedule A-3 (Significant Groundwater Recharge Area). Based on the design of the operation, and the implementation of the recommendations contained in this report, the groundwater recharge function of the area (i.e., providing flow to the Credit River) will be maintained, and will report to the Credit River and its tributaries via quarry dewatering (operational) or groundwater inputs and lake outflows (rehabilitation).
Other activities or features in the study area that could significantly affect or rely on groundwater resources.	Osprey Valley Golf Course (commercial / irrigation) – PTTW 1807-AC9P9J – The proposed pit /quarry is not considered to have a cumulative effect on this water taking, as the two activities (i.e. water taking upstream from the Credit River for irrigation and dewatering the pit / quarry southwest of the golf course and discharging collected water to the Credit River) do not appear to have overlapping zones of influence. Aquaterra Corporation (bottled water) – PTTW 8358-CAJLV3 – With groundwater mitigation measures in place during Operational Phases 3 to 7, the potential for an overlapping cumulative effect is low.

10.2 Local Scale Cumulative Effects

The following potential for local scale cumulative effects have been considered and assessed for the Caledon Pit / Quarry Project.

Table 10-2: Local Scale Cumulative Effects

Local Scale Cumulative Effects	Caledon Pit / Quarry Project
Characterize the existing conditions at the site and in the vicinity of the site, and during the extractive and rehabilitation stages.	The Water Report meets the required characterization scope.
Assess the potential impacts to groundwater and surface water resources from the proposed below water sand and gravel extraction operation relative to the impacts of existing above - and below water sand and gravel extraction operations for all development stages.	The Water Report meets the required impact assessment scope (Section 9)
Establish monitoring requirements to identify and distinguish between individual and cumulative effects.	The Water Report includes a proposed monitoring program (Section 9.8) and recommends a follow-up Private Well Survey be conducted prior to the start of aggregate extraction operations (Section 11.2).
Establish a mitigation and implementation plan, as appropriate.	The impact assessment (Section 9) does not predict significant cumulative impacts to water resources with mitigation in place.
The cumulative impact assessment should consider impacts from both a spatial and a temporal perspective.	This Water Report considered temporal and spatial impacts on the Local Scale and did not predict significant impacts to water resources (Section 9).
Temporal impacts may occur where potential operations overlap in time and duration. The applicant should assess cumulative effects resulting from existing conditions and potential impacts that could reasonably be expected to occur in the future due to other aggregate operations.	This is discussed in Section 10.3.

10.3 Watershed / Subwatershed Cumulative Effects

The following potential for Watershed/Subwatershed cumulative effects have been considered and assessed for the Caledon Pit / Quarry Project.

Table 10-3: Watershed/Subwatershed Scale Cumulative Effects

Watershed/Subwatershed Scale Cumulative Effects	Caledon Pit / Quarry Project
The appropriate scale for this assessment is typically the quaternary-level watersheds. A broader scale approach may be encouraged if the proposed aggregate operation drains directly to a higher-level watershed or if reasonably-anticipated potential cumulative effects are likely to occur at a broader scale.	The groundwater modelling (Section 8) carried out as part of the Water Report used an appropriate scale to assess potential effects, and the Impact Assessment (Section 8) did not predict there to be impacts at the that scale during any phase of proposed operation.
Through a hydrogeological assessment, each successive applicant for a below-water extraction licence or licence amendment, will be encouraged to provide information and analyses that will place the impacts of their proposal into the subwatershed context.	The Impact Assessment (Section 9) and Cumulative Effects Assessment (Section 10) satisfies this requirement.

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

Based on this water resources assessment, present for following conclusions regarding the proposed Caledon Pi / Quarry project.

- The proposed Caledon Pit / Quarry is within the Credit Valley Source Protection Area but is not located in a WHPA or IPZ and there will be no impacts to municipal water supplies.
- Of the approximately 100 water supply wells evaluated the majority of the wells are located at a depth below the proposed pit / quarry floor and they will not be impacted. There are 15 residential wells that have the potential to be impacted during operations by the proposed pit / quarry development. These 15 wells are susceptible to water quantity impacts due to their location relative to the predicted zone of influence of the Site, and their relatively shallow well construction in comparison to other wells in the area.
- In all cases, these wells could be deepened to the depth of other wells in the surrounding area to restore the water supply. In the event of a water well complaint there is an established procedure that the licensee must follow which requires an immediate investigation and supply of temporary water if required. In the event, any well was impacted by the proposed pit / quarry operation it is the licensee's responsibility to restore the water supply, at their expense.
- As part of the operation there will be an extensive on-site and off-site groundwater monitoring program and annual reports that will be submitted to the government agencies and publicly available. As a result of the proposed design of the pit / quarry, the comprehensive groundwater monitoring and reporting requirements and the water well complaint procedure, it is concluded that water supply wells in the surrounding area will be protected.
- The proposed extraction area does not contain any identified water resources on the Region of Peel Schedule A-1 (Water Resources, Systems and Features). The proposed licence area includes an identified feature in the northwest corner of the Main Area and this feature is located outside of the extraction area and will be protected.
- A small portion of Main Area, a very small portion of the North Area and the majority of the South Area is mapped as a Highly Vulnerable Aquifer on the Region of Peel Schedule A-2 (Highly Vulnerable Aquifers). This is very common for mineral aggregate resource areas, and based on the design of the operation, and the implementation of the recommendations contained this Report, the proposed Caledon Pit / Quarry does not result in additional risk to the aquifer.
- Almost all of the Rural Area in the Region of Peel including the Main Area, North Area and South Area are mapped as a Significant Groundwater Recharge Area on the Region of Peel Schedule A-3 (Significant Groundwater Recharge Area). This is very common for mineral aggregate resource areas, and based on the design of the operation, and the implementation of the recommendations contained in this report, the groundwater recharge function of the area (i.e., providing flow to the Credit River) will be maintained, and will report to the Credit River and its tributaries via quarry dewatering (operational) or groundwater inputs and lake outflows (rehabilitation).
- There are no key hydrologic features located within the proposed extraction area. There is a 0.1 ha key hydrologic feature (i.e., wetland) that will be impacted for the construction of the proposed berm and this feature is permitted to be removed in accordance with applicable policies. There are also key hydrologic

features (i.e., wetland and tributary) in the northwest corner of the Main Area and these features will be protected. Taking into consideration the rehabilitation plan, there are 4.8 ha of wetland to be created and 158.3 ha lake to be created resulting in 163 ha of new key hydrologic features.

- The extraction of aggregates and creation of ponds at the Site upon rehabilitation is not predicted to have adverse impacts on the local surface water hydrology of the Credit River or the surrounding tributaries/water features with the exception of Tributary #1 and Tributary #8 via land use changes, surface water drainage alterations and / or quarry operation. The decrease in surplus and increase in groundwater drawdown, over the operational period, to the remaining adjacent tributaries/water features is predicted to have minor localized impacts to flow that will see a total decrease in flow of less than 9% of existing flows. The decrease in surplus and increase in groundwater drawdown over the operational period, at Tributaries #1 and #8 is predicted to have minor localized impacts to flow.
- Compared to existing conditions, average annual surplus over the Site footprint area increases under operational conditions by approximately 18%, while under rehabilitated conditions the surplus decreased by approximately 14%.
- Compared to existing conditions (579,290 m^3/yr), average annual infiltration decreases over the Site footprint area under operational and increases under rehabilitated conditions to 281,275 m^3/yr and 628,040 m^3/yr, respectively.
- Compared to existing conditions (312,405 m^3/yr), average annual on-Site runoff increases under operational conditions to 767,895 m^3/yr and decreases under rehabilitated conditions to 136,945 m^3/yr.
- The application includes detailed monitoring, mitigation and reporting requirements to ensure adjacent sensitive groundwater features and sensitive surface water features will be assessed as extraction proceeds to help ensure these features will be protected, improved or restored.
- With the implementation of the recommendations in this Report, sensitive surface water features and sensitive groundwater features will be protected, improved and restored during operations.
- Taking into account rehabilitation, there will be a long-term enhancement to the water resources system and features.

11.2 Recommendations

The results of this assessment provide the basis for the following technical recommendations to be included in the Aggregate Resources Act Site Plans for the proposed Caledon Pit / Quarry.

Operational Plan

- The Aggregate Resources Act Site Plans shall identify the maximum groundwater table elevation based on groundwater levels monitored over a 12 month period from January to December 2021, as illustrated on Figure 5-6 and described below:
  - Main Area – ranges from 420.7 to 393.5 masl (north to southwest)
  - North Area – ranges from 407.0 to 397.3 masl (northwest to southeast)
  - South Area – ranges from 405.3 to 391.0 masl (northeast to south)

- Prior to below water extraction, the licensee shall complete a follow-up door-to-door survey of private wells for properties within 1,000 m of the licence area, to supplement and verify the MECP WWIS information, to confirm neighbouring water users and confirm baseline conditions prior to below water extraction commencing. Landowner participation in this private well survey is voluntary.
- Prior to below water extraction, the licensee shall obtain and operate in accordance with a Permit To Take Water and Environmental Compliance Approval under the Ontario Water Resources Act to permit the water management activities needed to operate the pit / quarry. These activities include:
  - Pumping, collection, storage and discharge of pit / quarry water;
  - Operation of a groundwater infiltration trench; and
  - Construction and operation of an aggregate wash plant.
- The approved monitoring programs defined in the Permit to Take Water and/or Environmental Compliance Approval shall, at a minimum, include all groundwater and surface water monitoring requirements as outlined below:
  - On-site monitoring shall include the wells, surface water stations and mini-piezometers listed in Table 9-6, and shall include the scope and frequency specified in Table 9-6; and
  - Off-site monitoring shall include the wells, surface water stations and mini-piezometers listed in Table 9-7, and shall include the scope and frequency specified in Table 9-7, subject to landowner approval.
- In the event of a well complaint (domestic / farm wells) the licensee shall implement the Well Complaint Response Protocol as specified in Appendix S.
- The licensee shall submit an annual water resources monitoring report to MNRF, MECP, Town of Caledon and CVC. The annual report shall also include a summary of any water related complaint and the actions taken by the licensee to address the issue.
- During operations, the sump in each pit / quarry area shall be located near the lowest point of elevation on the current pit / quarry floor. The position of the sump at a given point in time will be dictated by direction of extraction and elevation of the base of the current pit / quarry floor within each quarry area, and shall generally be as follows:
  - Main Area - the sump shall be located in the most southwestern area of the current pit / quarry floor, at the point of lowest elevation;
  - North Area - the sump shall be located in the most southwestern area of the current pit / quarry floor, at the point of lowest elevation; and
  - South Area - the sump shall be located in the most southeastern area of the current pit / quarry floor, at the point of lowest elevation.
- Subject to an agreement with the Osprey Valley Golf Course, the licensee shall construct a discharge pipe from the licence area to the irrigation system infrastructure at the golf course to convey the water from the settling pond to the golf course for irrigation, with the excess water stored or discharged through the existing pond system to the Credit River.

- Subject to an agreement with the Region of Peel the licensee shall construct piping under Main Street and Charleston Sideroad for the transfer of water from the Main and South Areas to the North Area.
- The licensee shall construct a slurry wall / grout zone prior to the start of Phase 3 and infiltration trenches prior to the start of Phase 4 as a groundwater mitigation system in the west setback of the Main Area, and similarly, a slurry wall / grout zone and infiltration trenches in the west and south setback of the South Area prior to the start of Phase 6. Water to supply the infiltration trenches shall be collected from the pit and quarry sumps during operations and stored in an up to 1 to 2 ha sized pond located in the Main Area or North Area. The system shall be operated in accordance with the Permit To Take Water and Environmental Compliance Approval under the Ontario Water Resources Act.
- An aggregate washing operation may be established in the Main Area utilizing up to a 1 to 2 ha sized pond for the storage of wash water in a closed-loop system. Wash water will be sourced from the pit / quarry sump, and top-up water will be added to the wash pond as needed during operations, in order to maintain sufficient water for the operation. Aggregate washing operations shall be completed in accordance with the Permit To Take Water and Environmental Compliance Approval under the Ontario Water Resources Act.
- All fuel storage and handling on site shall be completed in accordance with applicable TSSA Standards. The on-site storage and servicing of machinery shall be carried out in accordance with established best practices and is protective of the environment. The use and storage of hazardous substances shall follow applicable workplace hazardous materials regulations, including O.Reg. 860/93, as amended.

Rehabilitation Plan

- Once operations in the North Area, South Area and Main Area have been completed and the rehabilitated landform has been created, pumping will cease and allowed to flood and form the Main, North and South ponds. The Main, North and South pond water levels post-rehabilitation are predicted to reach a level of approximately ~400, ~399 and ~393.5 masl, respectively.
  - The South pond would be self contained and not require an overflow outlet;
  - The Main pond overflow shall be directed via a culvert under Main Street to the North pond with its outlet invert at ~400 masl; and
  - The North pond overflow shall be directed via main outlet to the Osprey Valley Golf Course irrigation pond system with its outlet invert at ~399 masl.
- All rehabilitated pond levels and outlets will be passive and not require pumping.

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Signature Page

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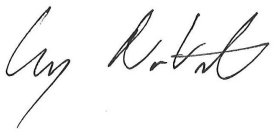

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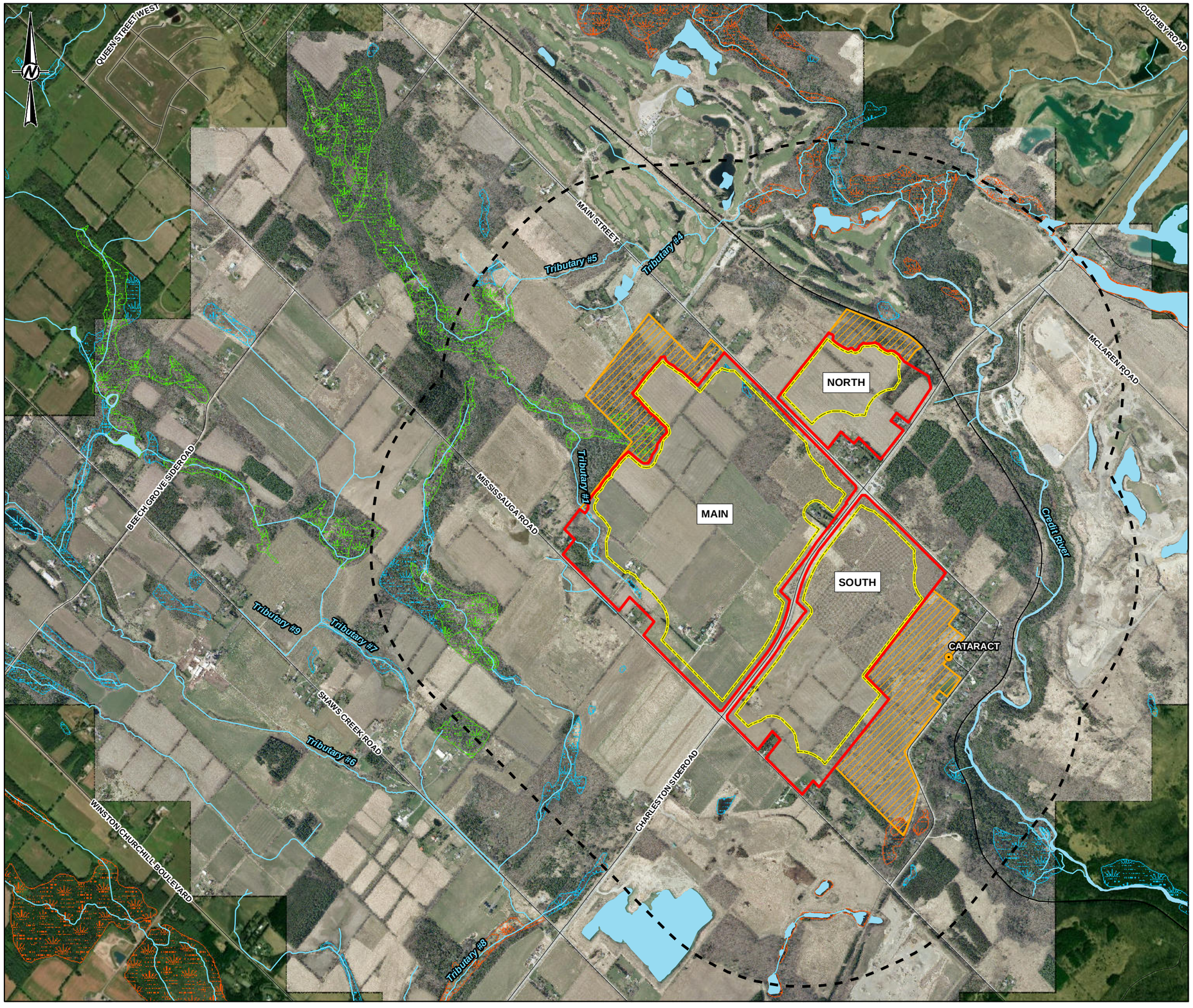
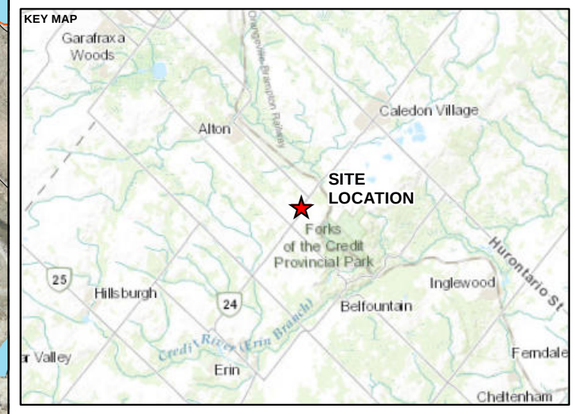
FIGURES



LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- 1 km LICENCE BOUNDARY BUFFER
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY
- ADDITIONAL LANDS OWNED / CONTROLLED BY CBM

KEY MAP



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2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENCE AND LIMIT OF EXTRACTION PROVIDED BY MHBC JUNE 2023
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

TITLE

STUDY AREA

CONSULTANT

GOLDER
MEMBER OF WSP

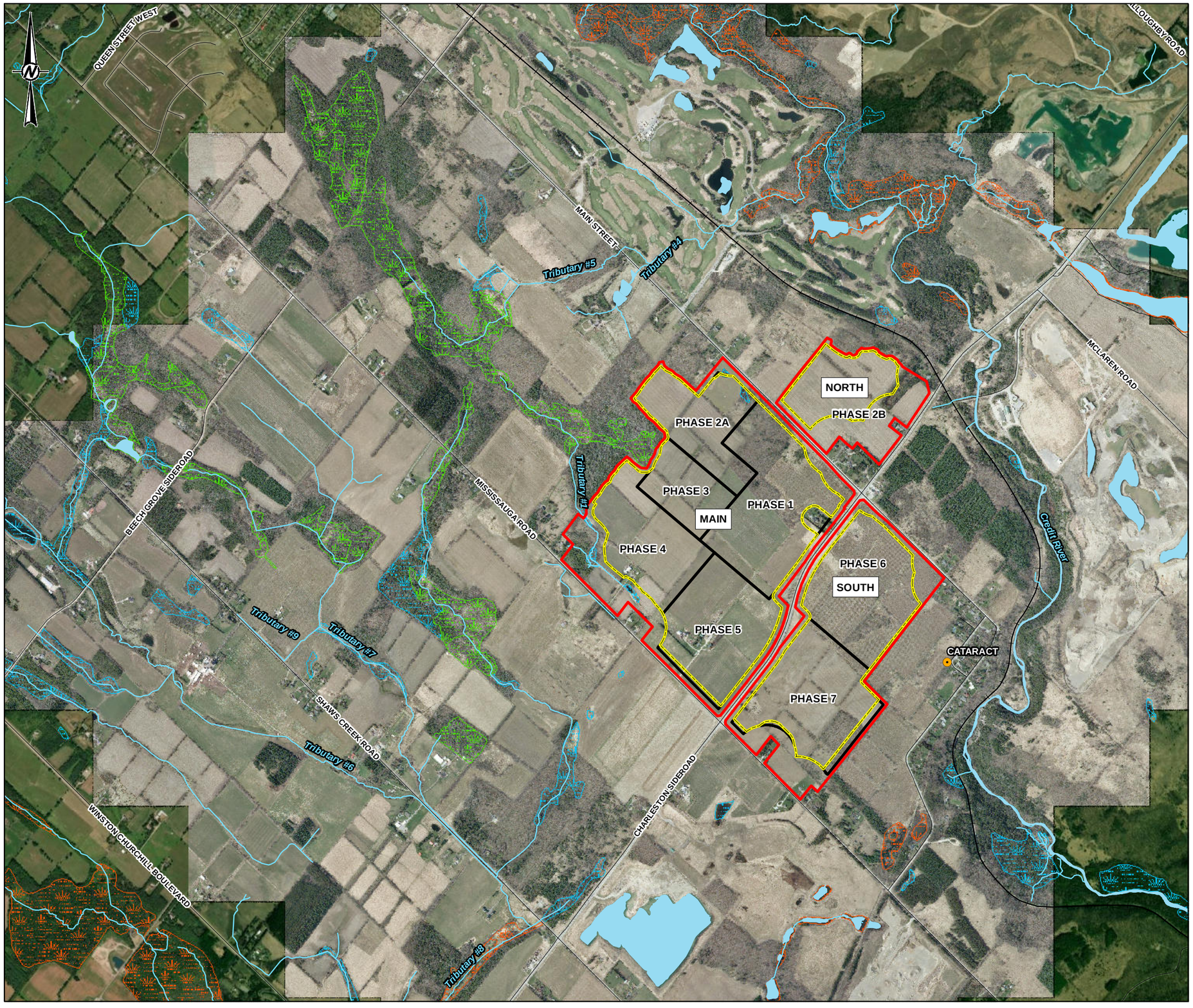
YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	1-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

0 25mm

PATH: S:\Clients\Votoranim_Cimentos\Long_Par_5_Caledon\99_PRO\11\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0001_1.mxd PRINTED ON: 2023-07-18 AT: 7:55:10 PM



LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- EXTRACTION PHASE

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
   SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENCE AND LIMIT OF EXTRACTION PROVIDED BY MHBC JUNE 2023
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

TITLE

OPERATIONAL PHASES

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	2-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

0 25mm

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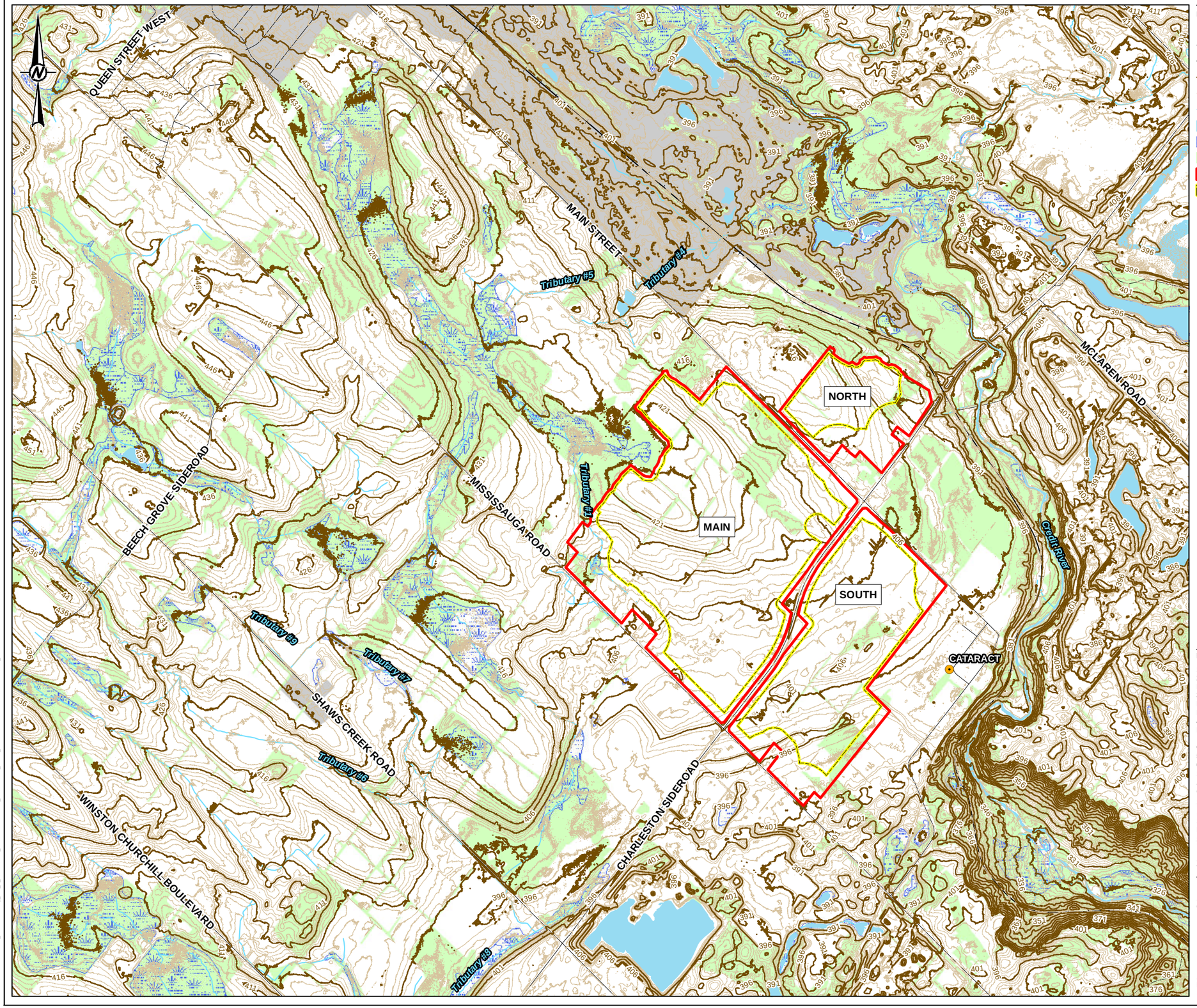


LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- CONTOUR (5 m INTERVAL)
- CONTOUR (1 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA OBTAINED FROM THE MRNF LIO APRIL 2020
2. TOPOGRAPHY OBTAINED FROM THE MNRF LIO ONTARIO DIGITAL TERRAIN MODEL (LIDAR-DERIVED), GTA-PEEL ACQUISITION PROJECT SPRING 2016.
3. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
4. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
5. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
6. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

TITLE

TOPOGRAPHY AND DRAINAGE

CONSULTANT

GOLDER
MEMBER OF WSP

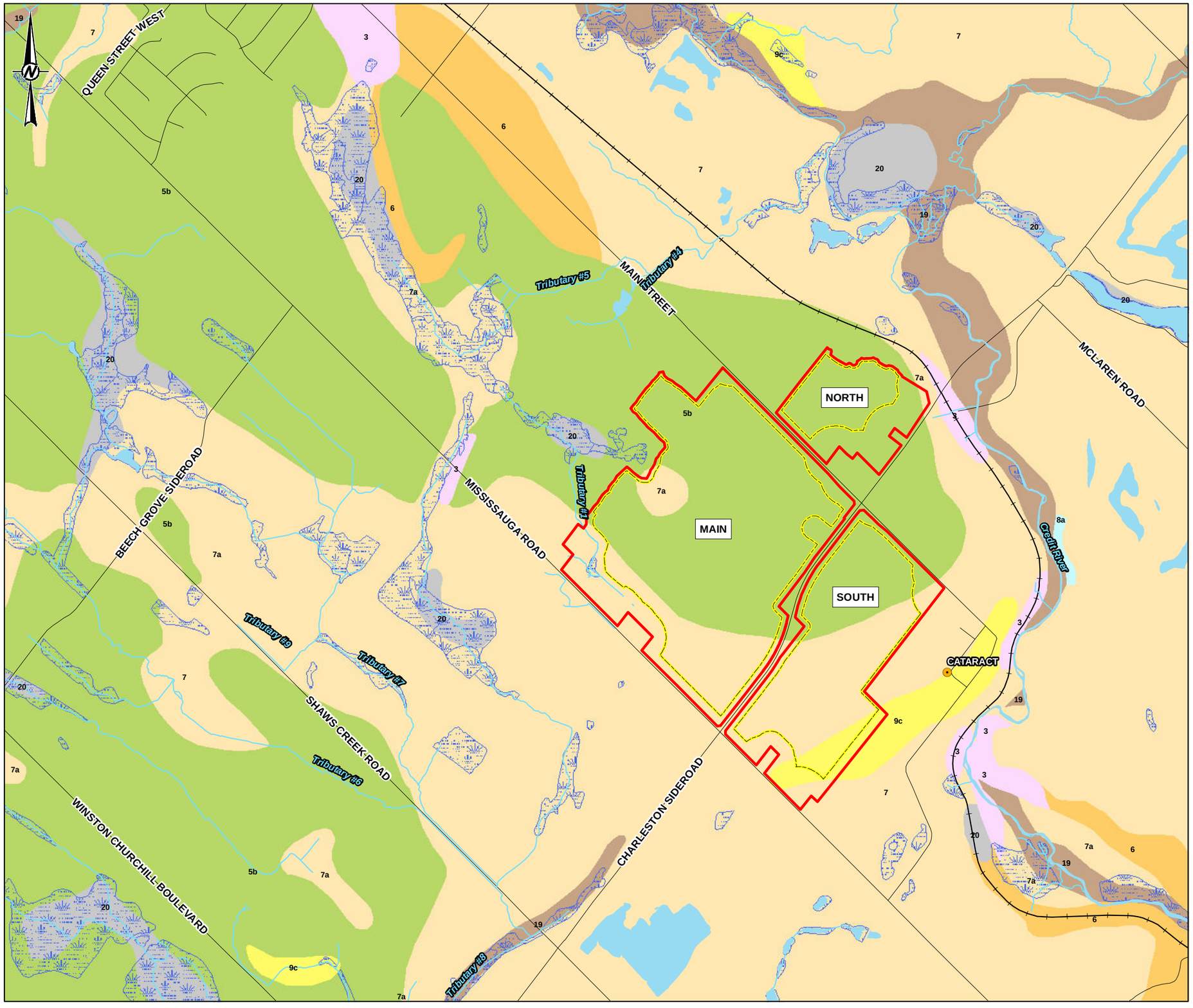
YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	3-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votoranim_Cimentos\Long_Pat_S_Caledon\99_PRO\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0003_1.mxd PRINTED ON: 2023-07-18 AT: 8:16:37 PM



LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

SURFICIAL GEOLOGY

- 3: PALEOZOIC BEDROCK
- 5B: STONE-POOR, CARBONATE-DERIVED SILTY TO SANDY TILL
- 6: ICE-CONTACT STRATIFIED DEPOSITS
- 7: GLACIOFLUVIAL DEPOSITS
- 7A: SANDY DEPOSITS
- 8A: MASSIVE-WELL LAMINATED
- 9C: FORESHORE-BASINAL DEPOSITS
- 19: MODERN ALLUVIAL DEPOSITS
- 20: ORGANIC DEPOSITS

0 500 1,000
1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. ONTARIO GEOLOGICAL SURVEY 2003: MRD128-SURFICIAL GEOLOGY OF SOUTHERN ONTARIO, (MNDM)
4. LICENCE AND LIMIT OF EXTRACTION PROVIDED BY MHBC JUNE 2023
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
SURFICIAL GEOLOGY FROM OGS (2003)

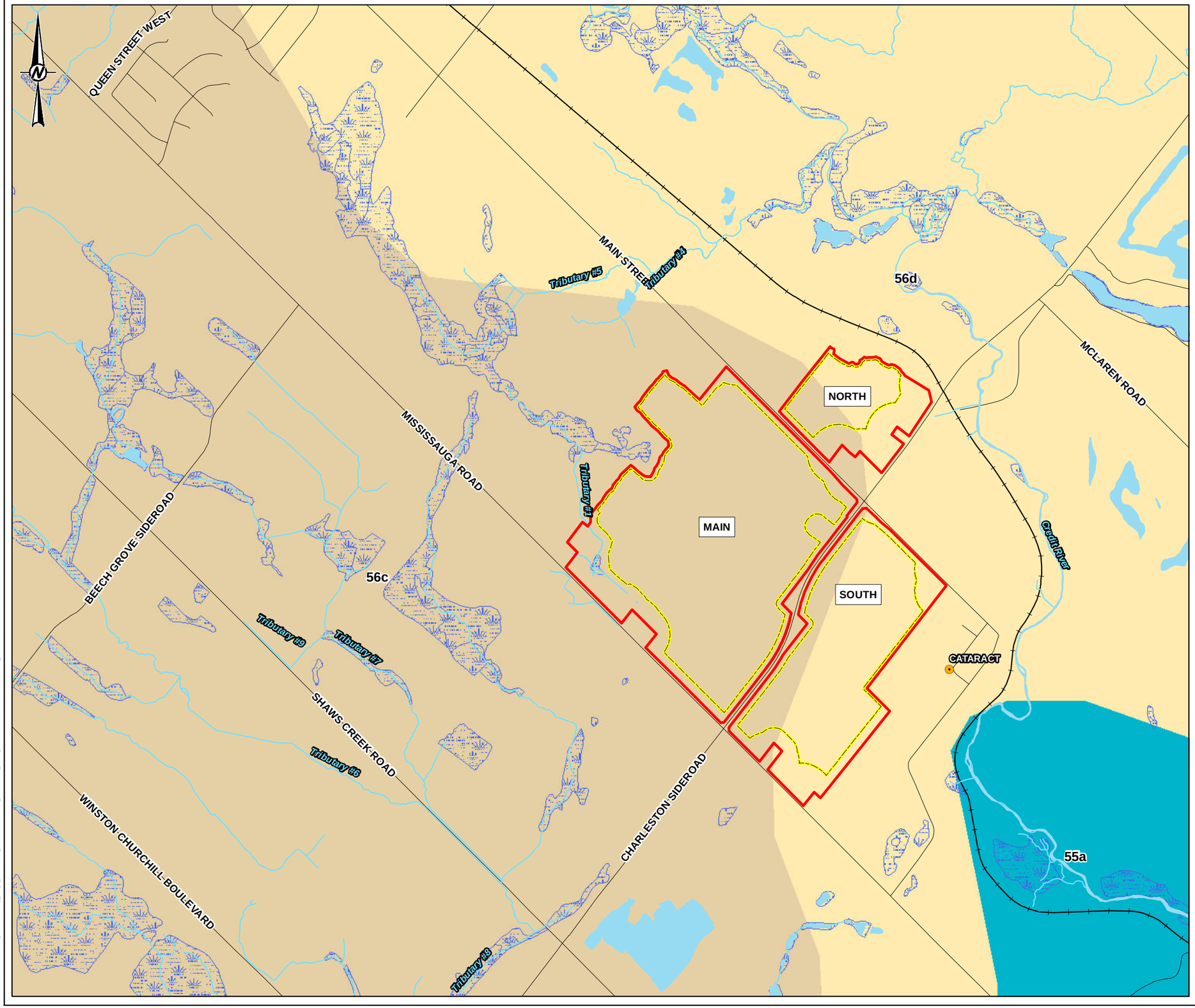
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	3-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: S:\Clients\Vaxarantin_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0003_2.mxd PRINTED ON: 2023-07-18 AT: 8:23:05 PM



LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

BEDROCK GEOLOGY

- 56C GASPORT FM
- 56D FOSSIL HILL FM / CABOT HEAD FM / MANITOULIN FM / WHIRLPOOL FM
- 55A QUEENSTON FM

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. ONTARIO GEOLOGICAL SURVEY 2011: MRD126-REV1-BEDROCK GEOLOGY OF ONTARIO, (MNDM)
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

TITLE

BEDROCK GEOLOGY FROM OGS (2011)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	3-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

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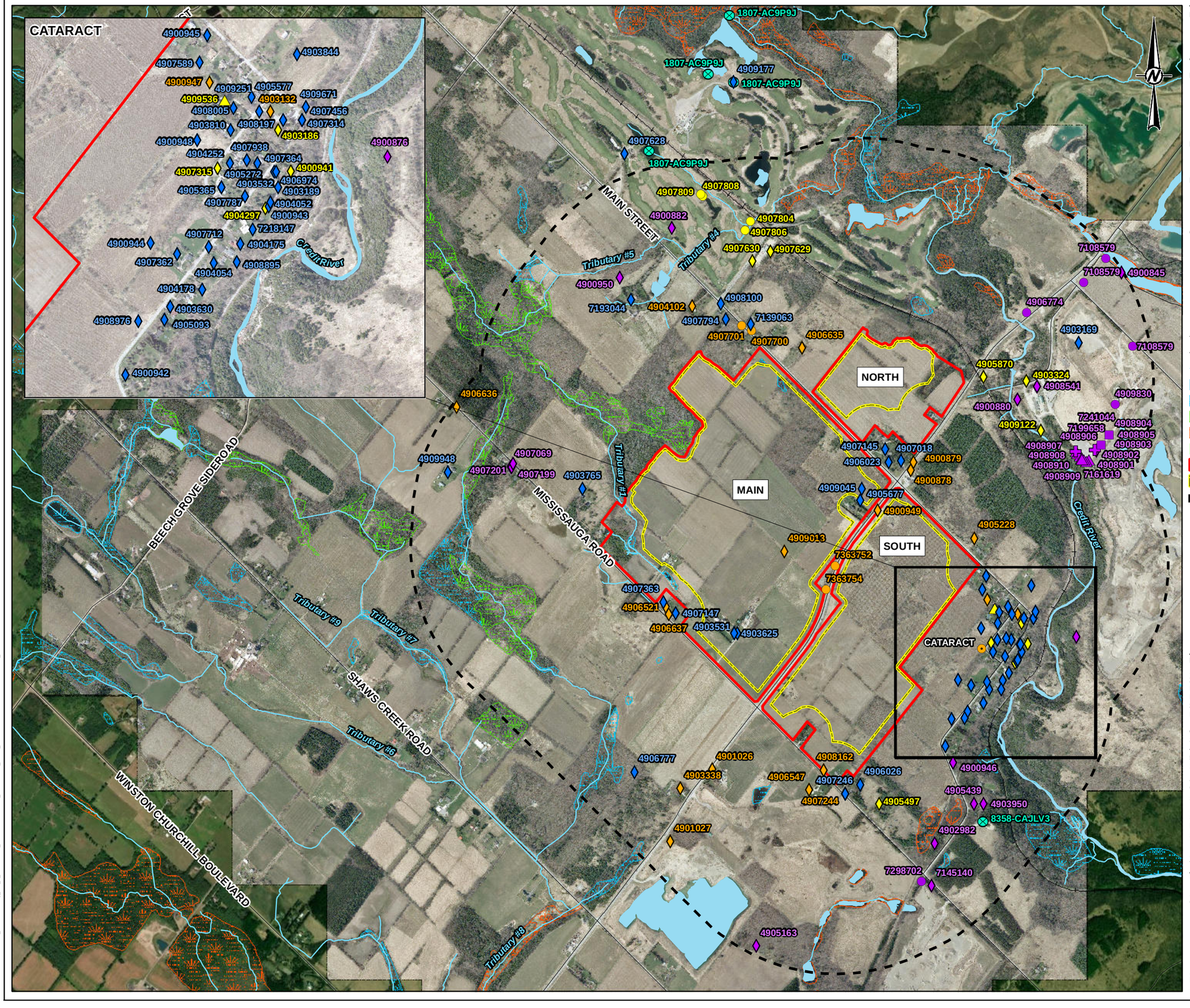

LEGEND

- TOWN/VILLAGE
- PERMIT TO TAKE WATER

WATER WELL RECORD BY AQUIFER CLASSIFICATION

BEDROCK (BELOW GASPORT)

- Observation Wells
- Recharge Well
- Water Supply

BEDROCK (GASPORT AND LOWER)

- Water Supply

BEDROCK (GASPORT)

- Observation Wells
- Water Supply

OVERBURDEN

- Dewatering
- Observation Wells
- Other Status
- Recharge Well
- Water Supply

- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- WOODED AREA
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- 1 km LICENCE BOUNDARY BUFFER

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
WATER WELL RECORDS AND PERMITS TO TAKE WATER

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	VP
APPROVED	GWS

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	3-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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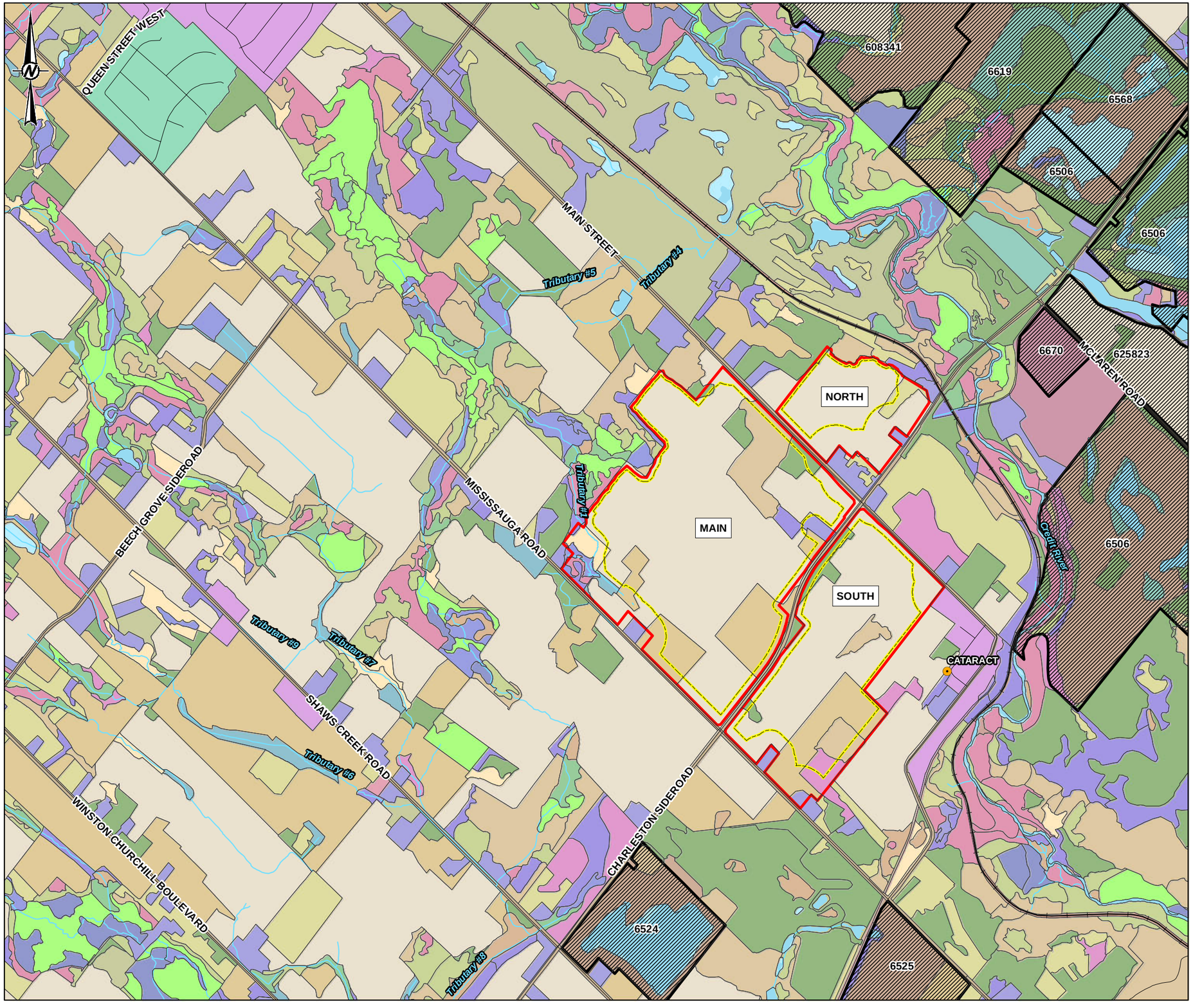

LEGEND

- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- ACTIVE AGGREGATE SITE

LAND USE

- ACTIVE AGGREGATE
- CONIFEROUS FOREST
- CONIFEROUS PLANTATION
- CONIFEROUS SWAMP
- CONSTRUCTION
- CULTURAL MEADOW
- CULTURAL SAVANNAH
- CULTURAL THICKET
- CULTURAL WOODLAND
- DECIDUOUS FOREST
- DECIDUOUS SWAMP
- FLOATING-LEAVED SHALLOW AQUATIC
- GENERAL URBAN
- INACTIVE AGGREGATE
- INTENSIVE AGRICULTURE
- LANDFILL
- MAJOR TRAIL
- MANICURED OPEN SPACE
- MARSH
- MIXED FOREST
- MIXED PLANTATION
- MIXED SWAMP
- NON-INTENSIVE AGRICULTURE
- OPEN AQUATIC
- RAILROAD
- REGIONAL ROAD
- RURAL DEVELOPMENT
- SHRUB FEN
- SUBMERGED SHALLOW AQUATIC
- THICKET SWAMP
- TREED BLUFF
- WET MEADOW

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. LANDUSE OBTAINED FORM THE CREDIT VALLEY CONSERVATION AUTHOIRTY OPEN DATA PORTAL NOVEMBER 2022.
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

TITLE

NEIGHBOURING LAND USES / OTHER AGGREGATE SITES

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	3-5

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0003_5.mxd PRINTED ON: 2023-07-18 AT: 8:40:25 PM

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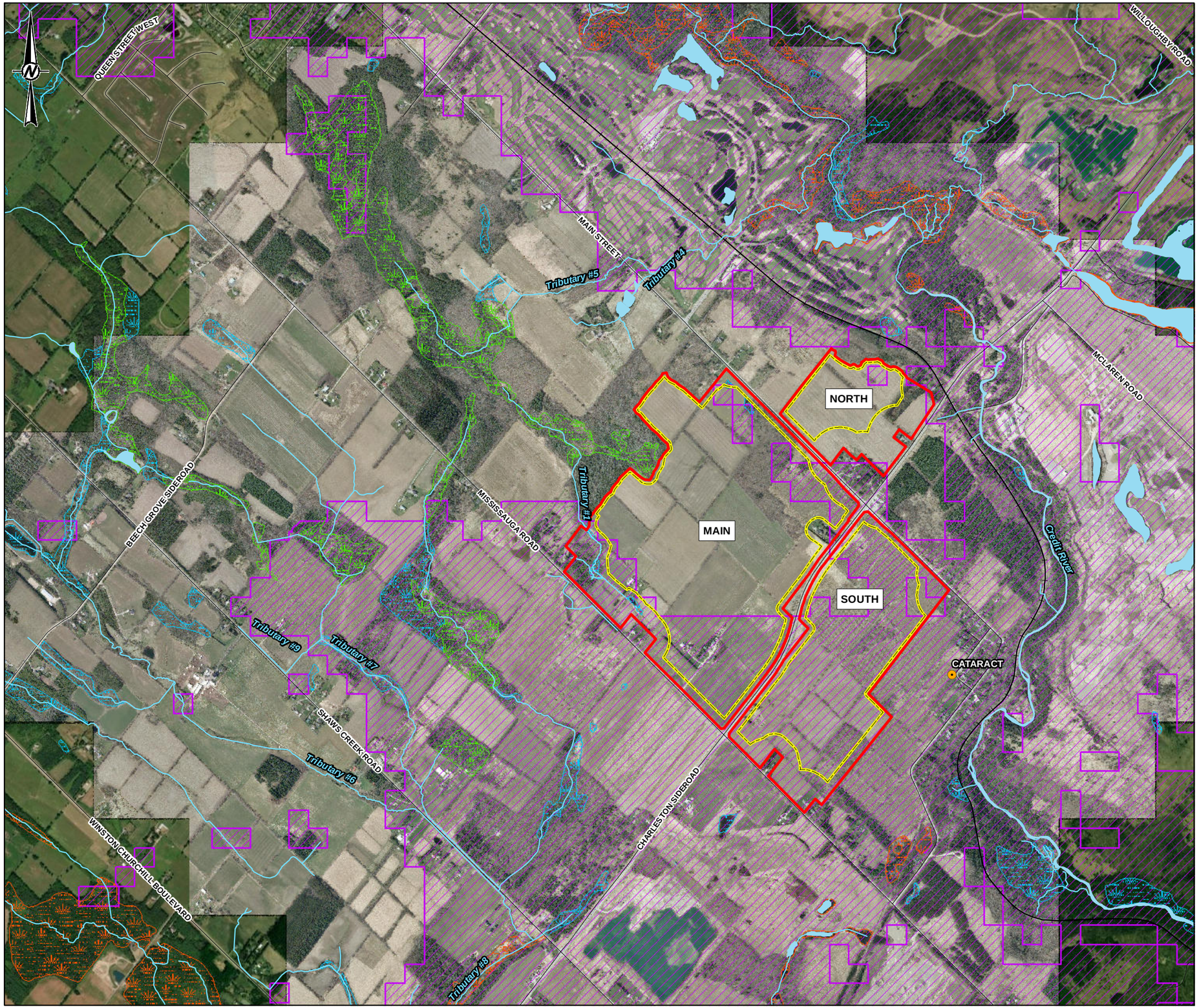

LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- HIGHLY VULNERABLE AQUIFERS

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
HIGHLY VULNERABLE AQUIFERS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	3-6

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0003_6.mxd PRINTED ON: 2023-07-18 AT: 8:46:05 PM

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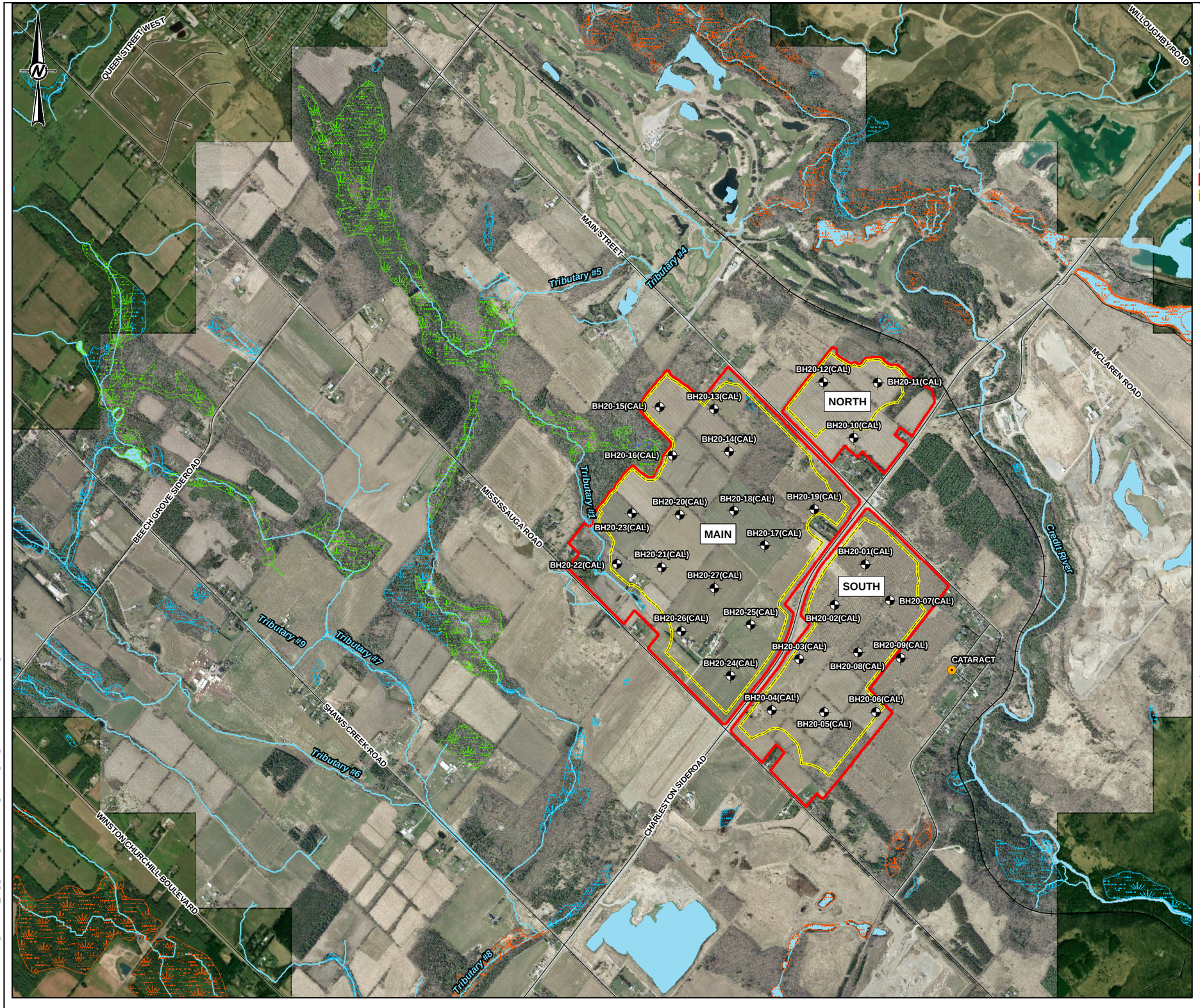
25mm
0



LEGEND

- TOWN/VILLAGE
- BOREHOLE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
BOREHOLE LOCATIONS - RESOURCE DRILLING

CONSULTANT
GOLDER
MEMBER OF WSP

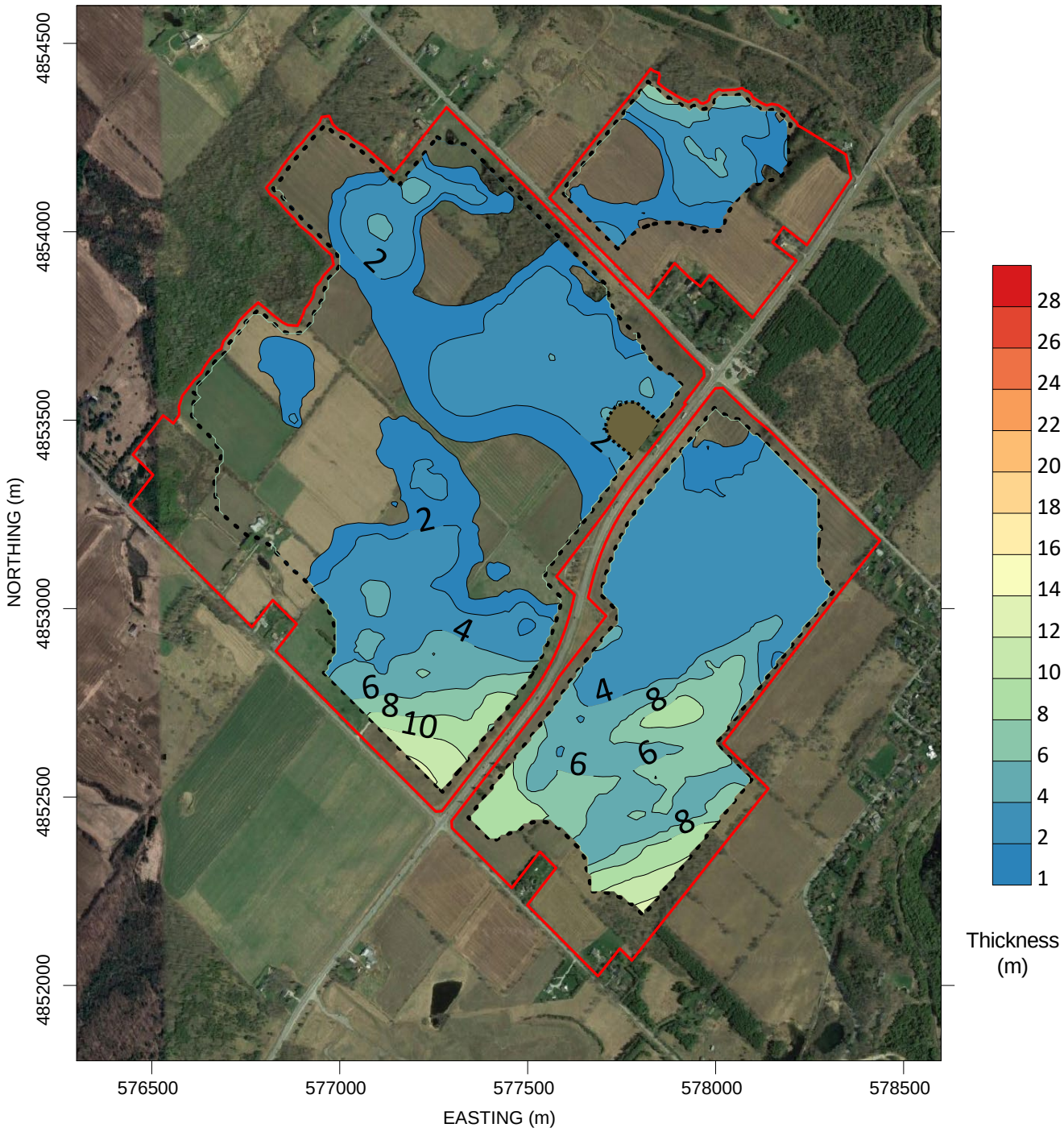
YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	4-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votoram\m_Cmerton\Long_Pur_5_Caledon\99_PRO\19129150\40_PROD\0036_Water_Resources\19129150-0036-CHO004_1.mxd PRINTED ON: 2023-07-19 AT: 4:34:39 PM



LEGEND

NOTE

CLIENT
CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

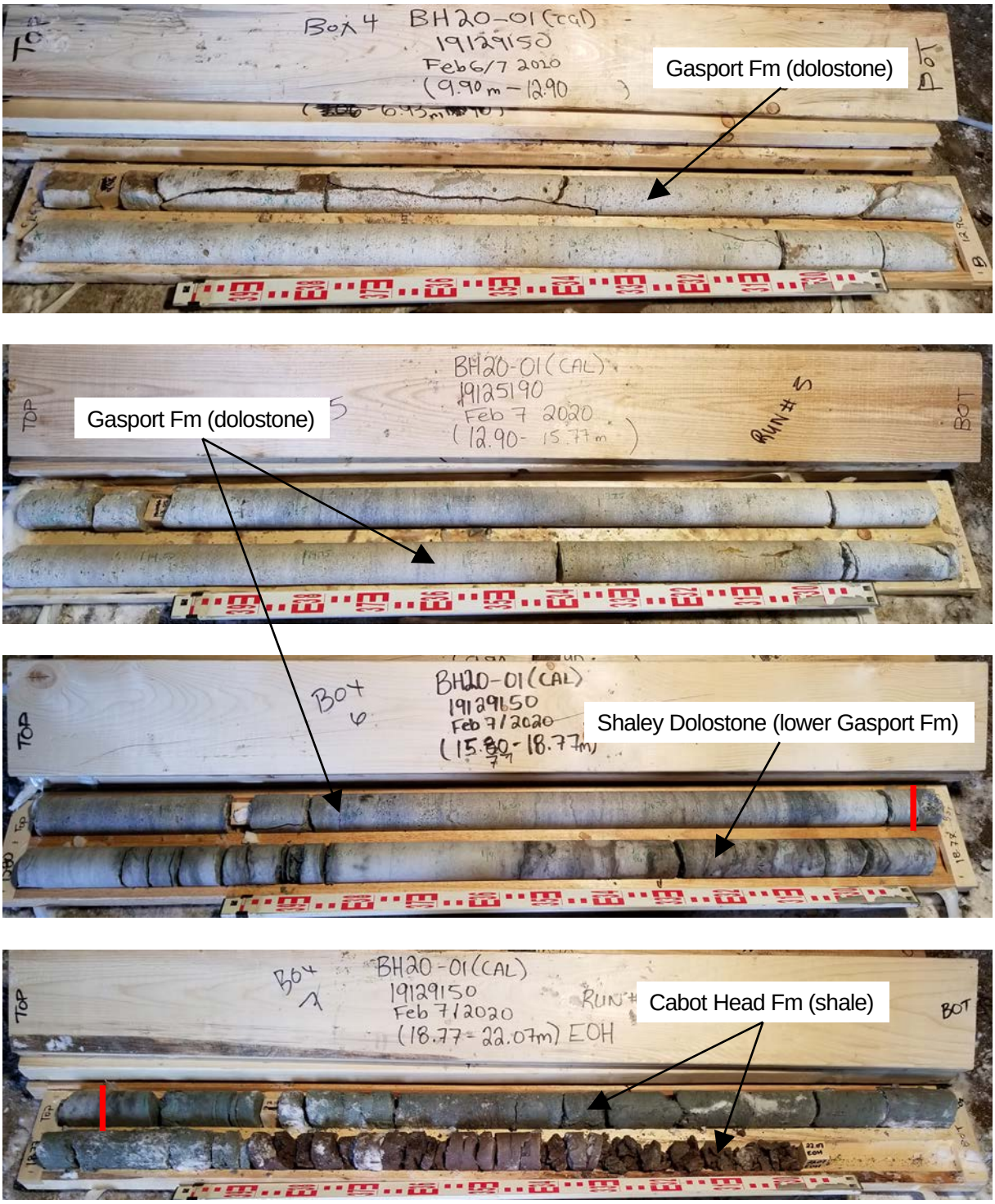
PROJECT
Caledon Pit / Quarry
Water Resources Report

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-04-26
PREPARED	HW
DESIGN	GWS
REVIEW	GRP
APPROVED	GWS

TITLE
Inferred Sand and Gravel Thickness
Determined from Resource Borehole Drilling

PROJECT No. **19129150**
Rev. **B**
FIG. **4-2**



LEGEND

Geologic Contact

NOTE

1. Borehole drilled February 6-7, 2020
2. Logged and photographed by Golder field staff

CLIENT
CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

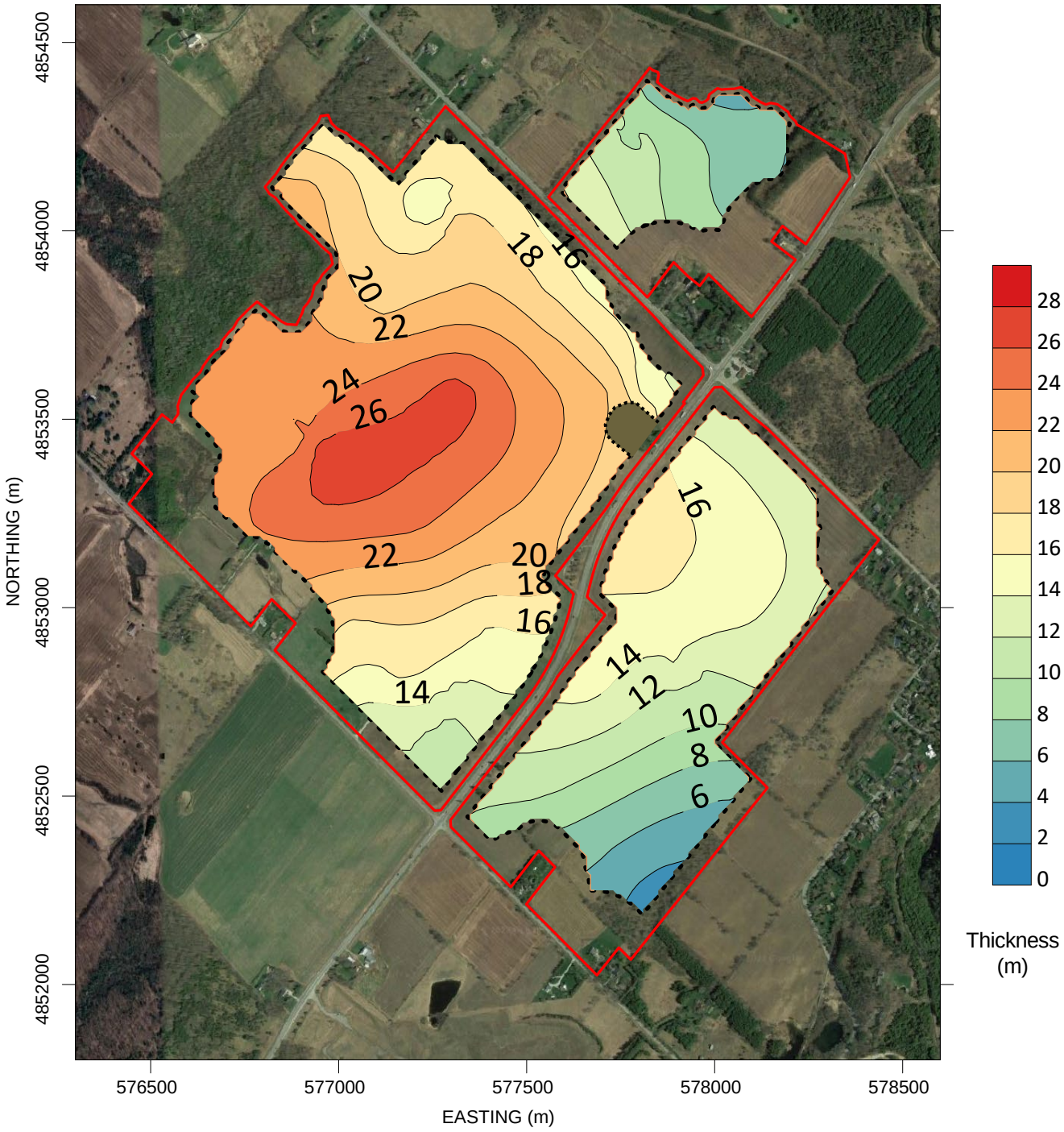
PROJECT
Caledon Pit / Quarry
Water Resources Report

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-11-12
PREPARED	AL
DESIGN	GWS
REVIEW	GRP
APPROVED	GWS

TITLE
Example HQ Rock Core
Caledon Borehole BH20-01(CAL)

PROJECT No. **19129150** | Rev. **A** | FIG. **4-3**



LEGEND

NOTE

CLIENT
CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

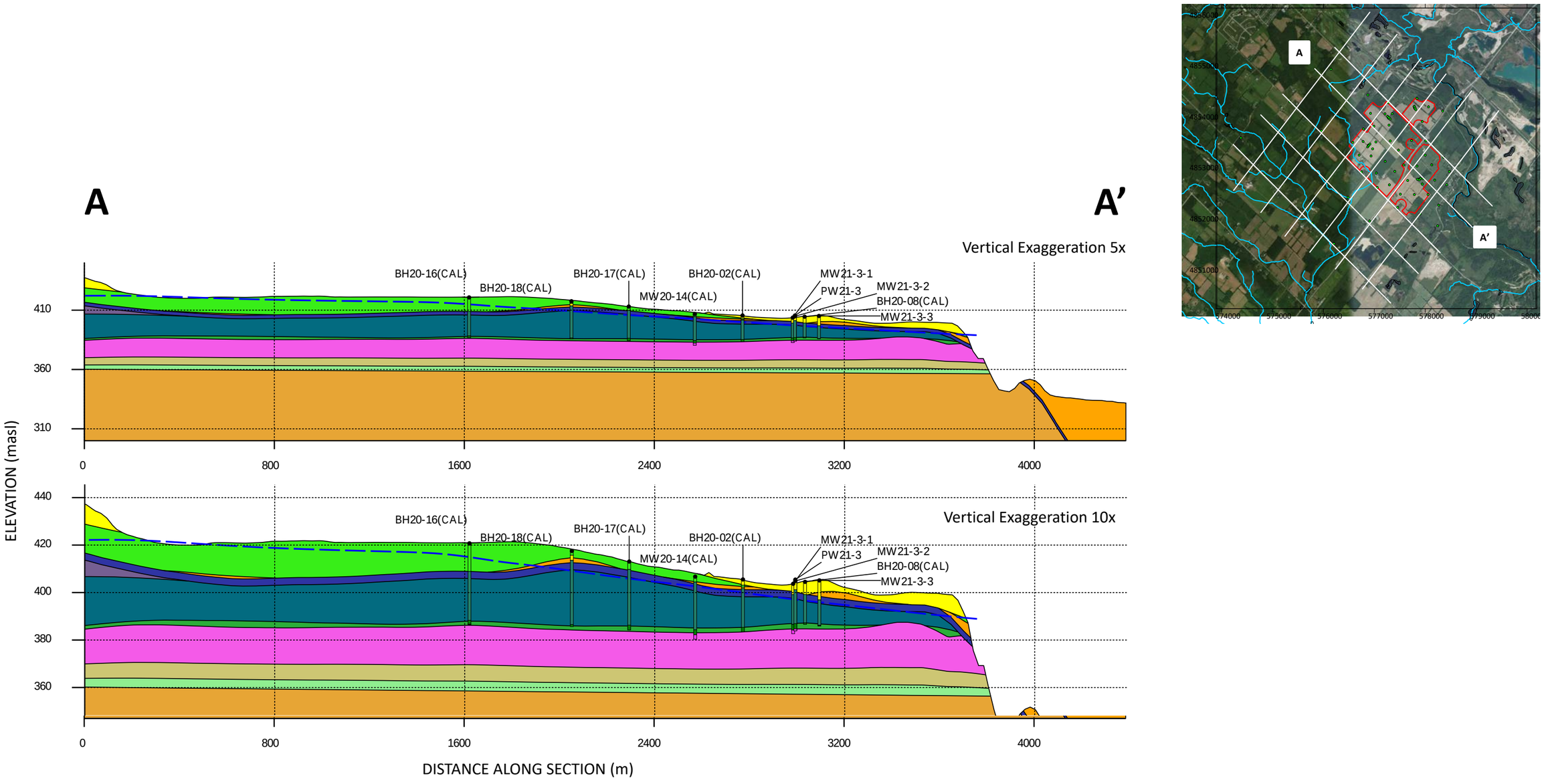
PROJECT
Caledon Pit / Quarry
Water Resources Report

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-04-26
PREPARED	HW
DESIGN	GWS
REVIEW	GRP
APPROVED	GWS

TITLE
Inferred Gasport Formation Thickness
Determined from Resource Borehole Drilling

PROJECT No. **19129150**
Rev. **B**
FIG. **4-4**



LEGEND

- Eramosa Formation (Dolostone)
- Goat Island Formation (Dolostone)
- Gasport Formation (Dolostone)
- Shaley Dolostone
- Cabot Head Formation (Shale)
- Manitoulin Formation (Shaley Dolostone)
- Whirlpool Formation (Sandstone)
- Queenston Formation (Shale
- Lower Sand/ Channel Sediment
- Till
- Upper Sand
- Weathered Bedrock
- Average Water Level (Site Wells)

CLIENT
CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

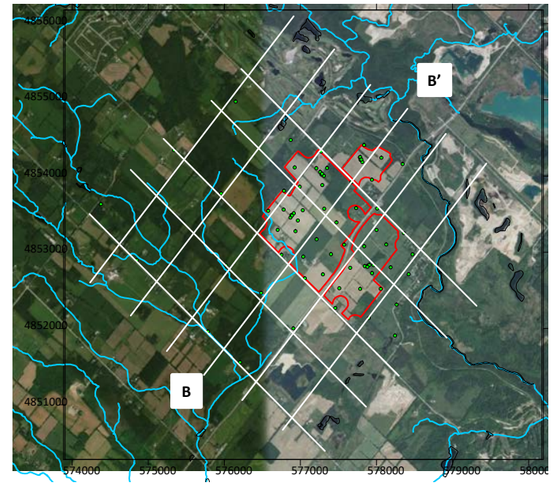
CONSULTANT
GOLDER
MEMBER OF WSP

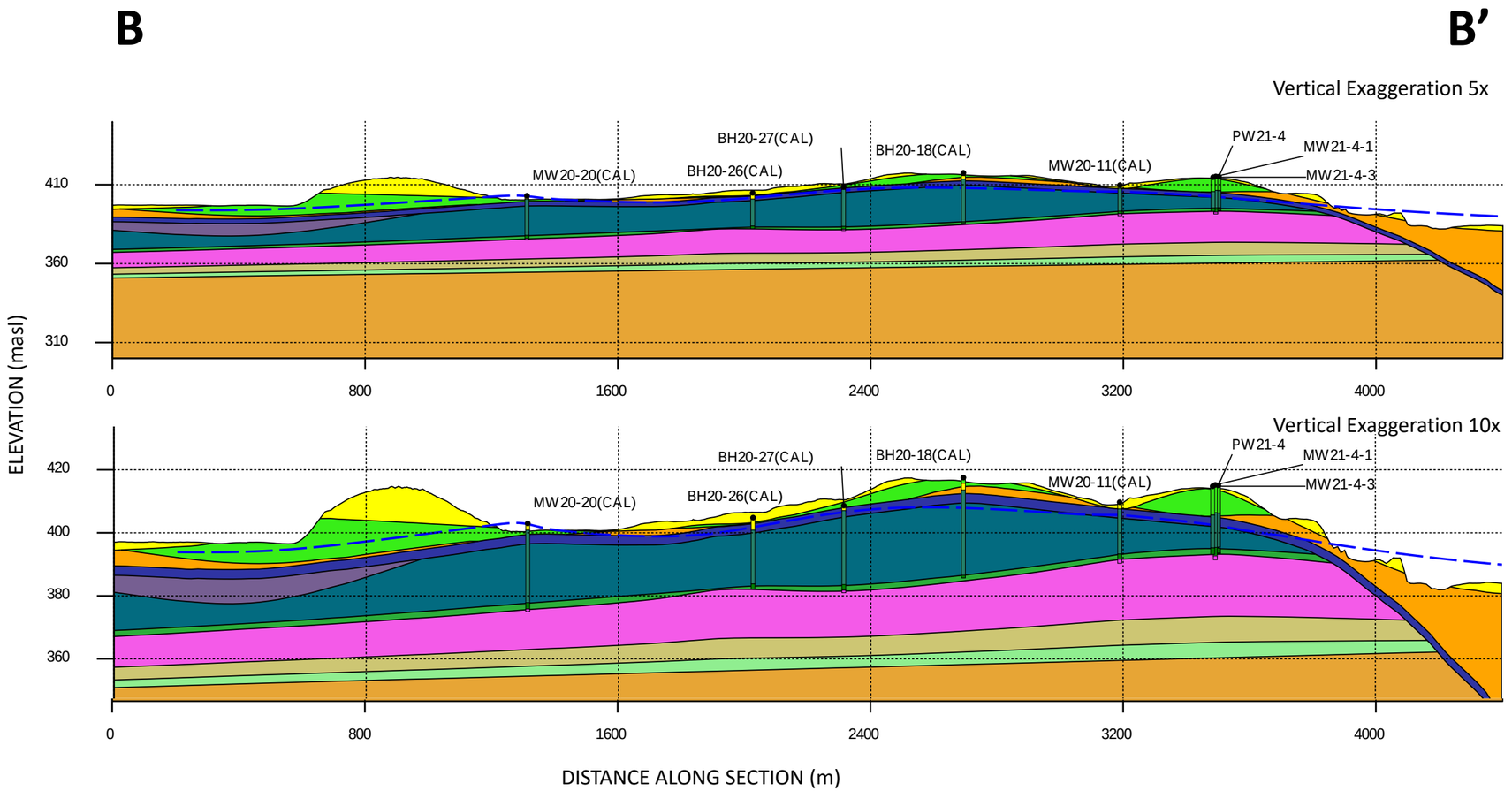
YYYY-MM-DD	2022-11-12
PREPARED	HW
DESIGN	GWS
REVIEW	GRP
APPROVED	GWS

PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
Northwest - Southeast Cross-section
Caledon Pit / Quarry Geologic Model

PROJECT No. 19129150 | Rev. A | FIG. 4-5





LEGEND

- Eramosa Formation (Dolostone)
- Goat Island Formation (Dolostone)
- Gasport Formation (Dolostone)
- Shaley Dolostone
- Cabot Head Formation (Shale)
- Manitoulin Formation (Shaley Dolostone)
- Whirlpool Formation (Sandstone)
- Queenston Formation (Shale
- Lower Sand/ Channel Sediment
- Till
- Upper Sand
- Weathered Bedrock
- Average Water Level (Site Wells)

CLIENT
CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

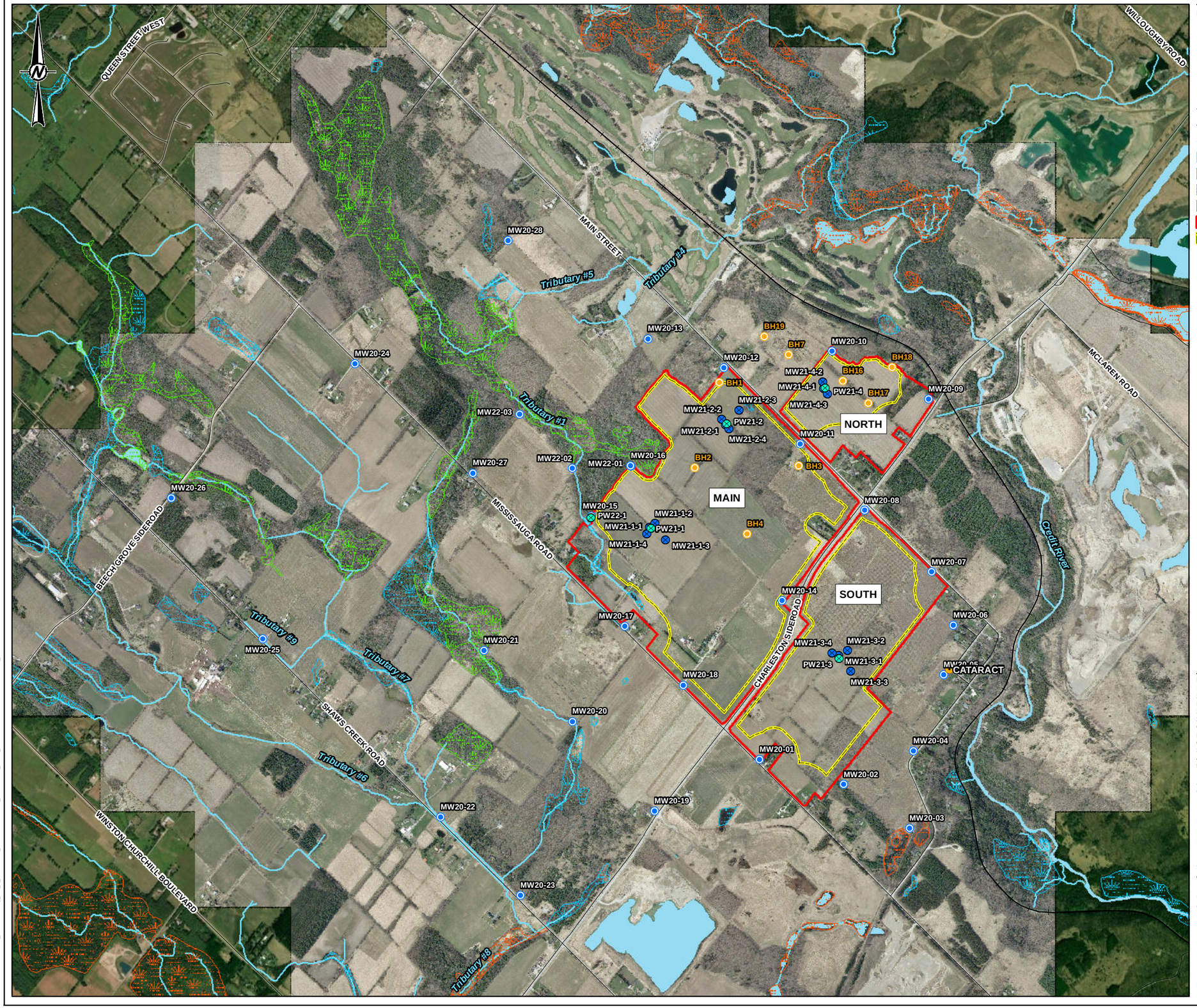
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-11-12
PREPARED	HW
DESIGN	GWS
REVIEW	GRP
APPROVED	GWS

PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
Southwest – Northeast Cross-section
Caledon Pit / Quarry Geologic Model

PROJECT No. 19129150 | Rev. A | FIG. 4-6



LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- MONITORING WELL (PUMPING TEST)
- TEST WELL
- HISTORICAL MONITORING WELL
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021..
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

WELL LOCATIONS - GROUNDWATER MONITORING AND AQUIFER TESTING PROGRAM

CONSULTANT

GOLDER
MEMBER OF WSP

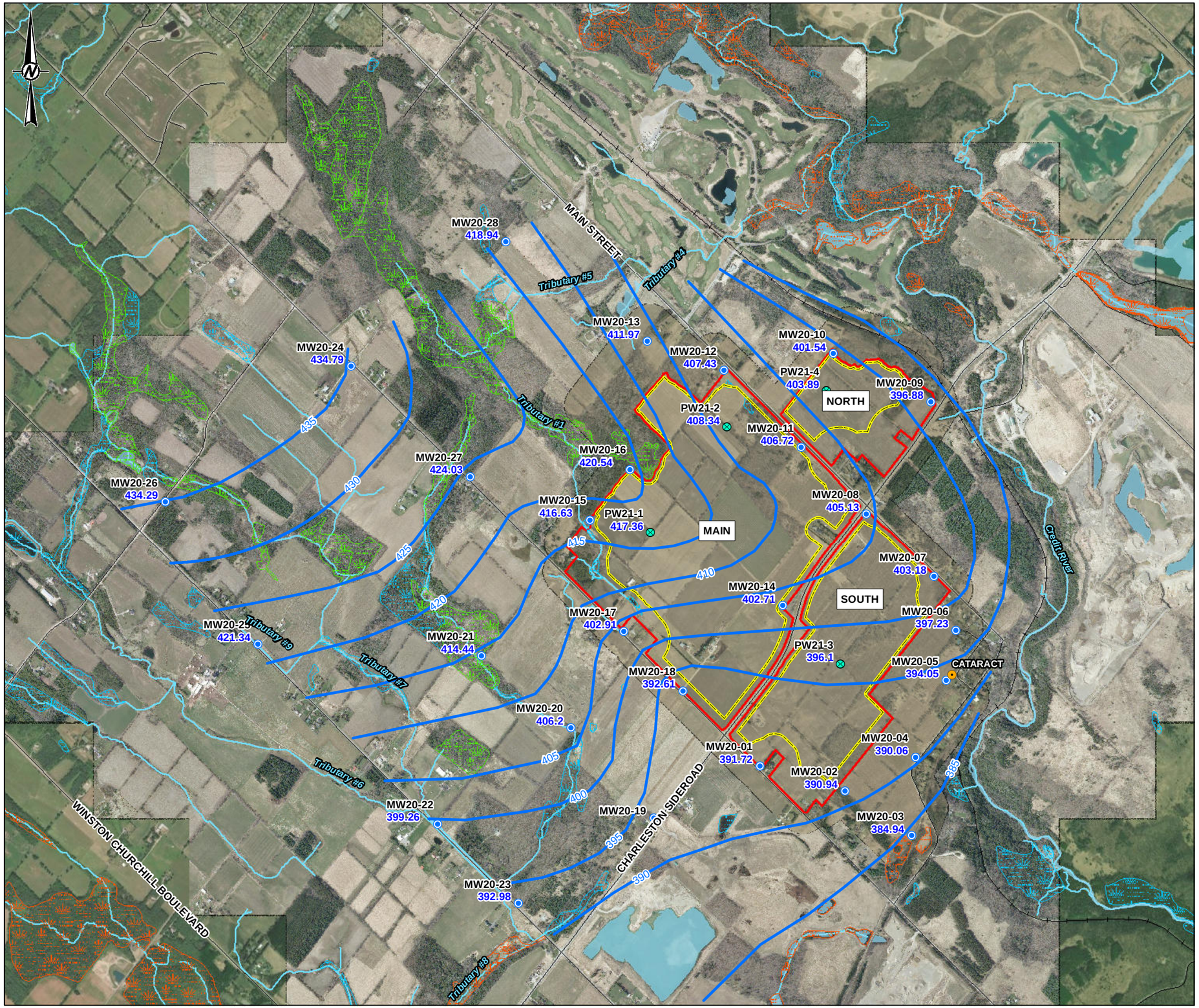
YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	5-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votorantim_Cementos\Long_Pat_5_Caledon\99_PRO\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0005_1.mxd PRINTED ON: 2023-07-19 AT: 11:32:17 AM



LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- TEST WELL
- GROUNDWATER CONTOUR
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- 434.26 WATER LEVEL GASPORT FORMATION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

GROUNDWATER ELEVATIONS APRIL 2021 - GASPORT FORMATION

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	5-2

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25mm
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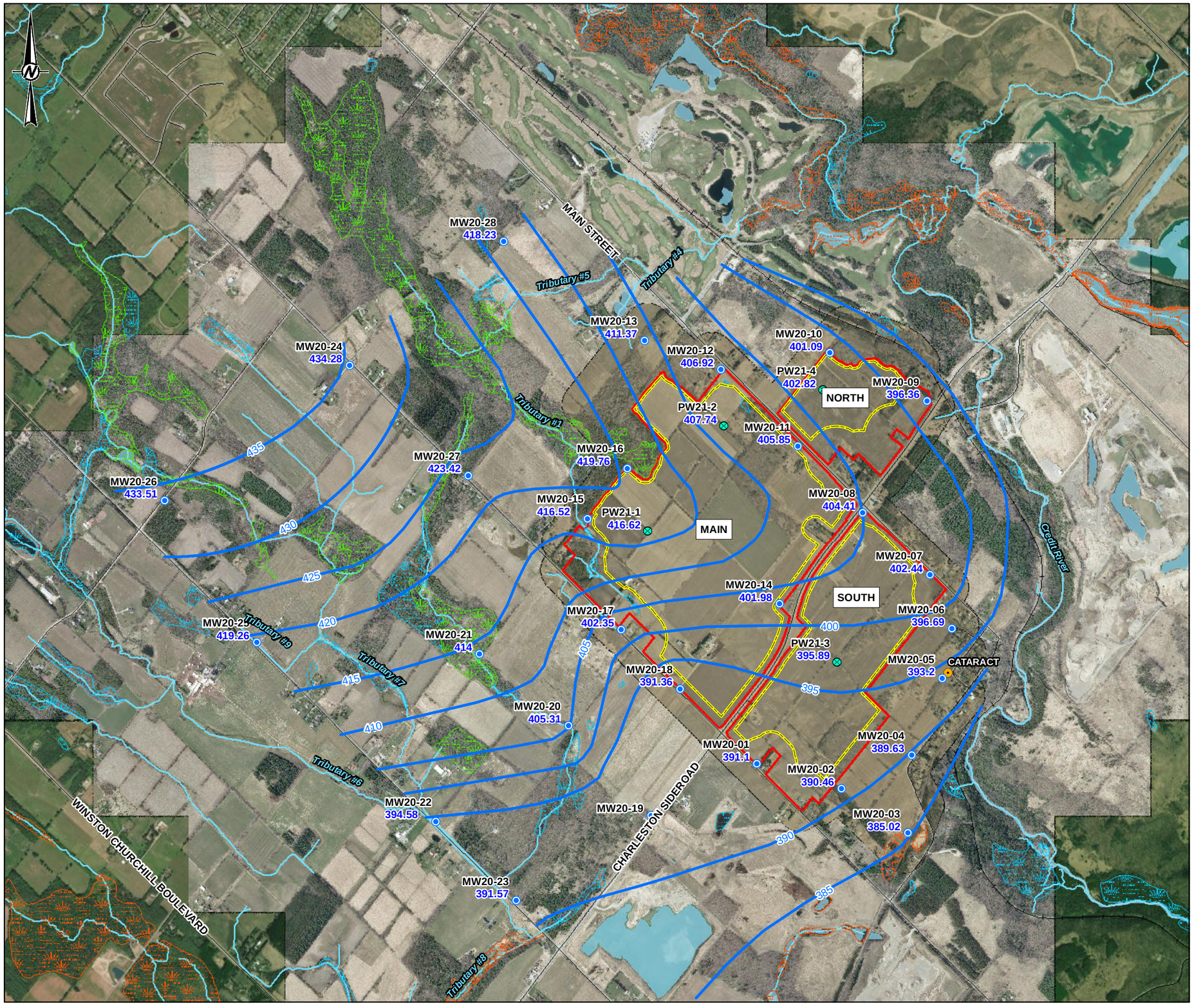

LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- TEST WELL
- GROUNDWATER CONTOUR
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- 434.26 WATER LEVEL GASPORT FORMATION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
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4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

GROUNDWATER ELEVATIONS JUNE 2021 - GASPORT FORMATION

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	5-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

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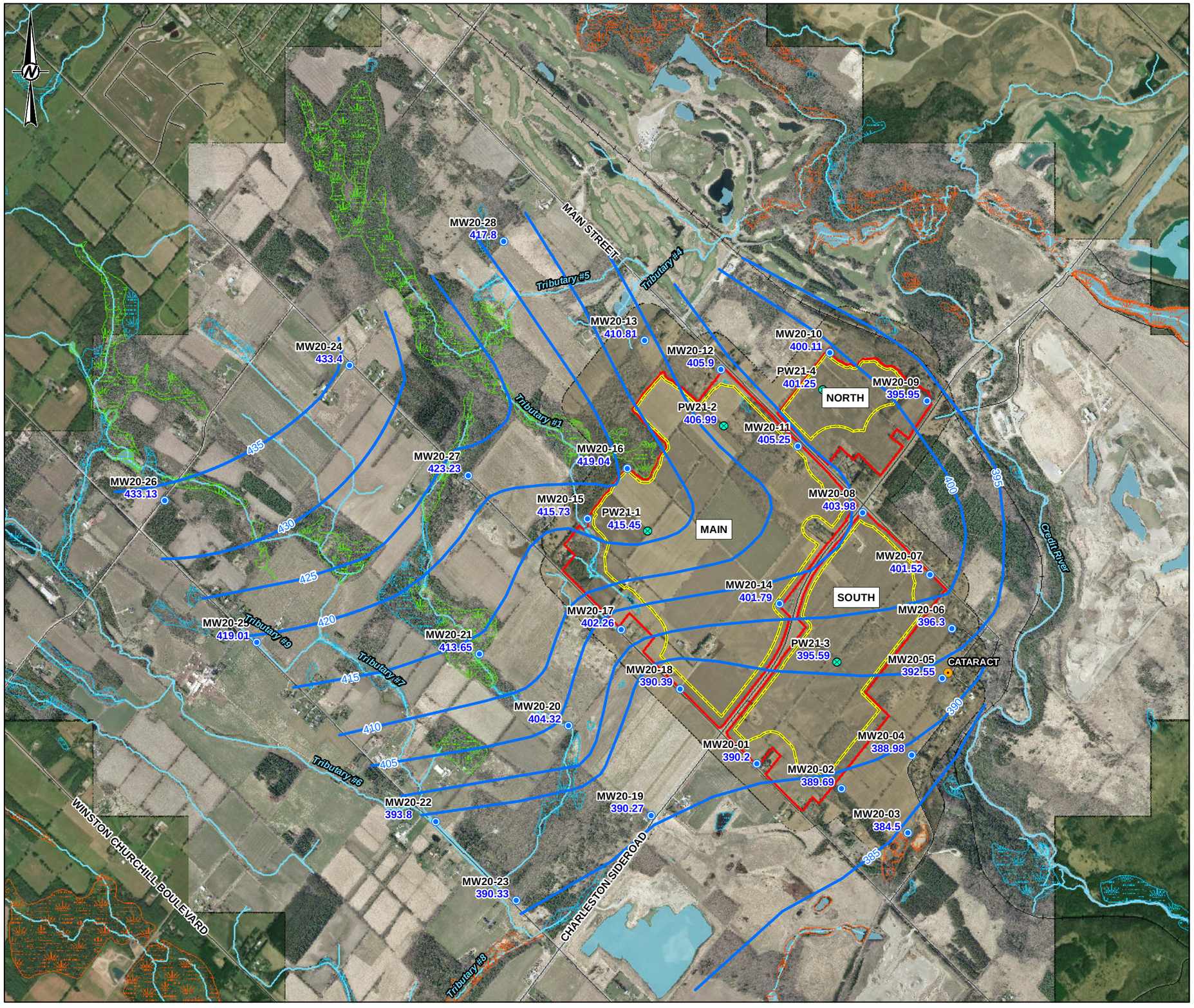

LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- TEST WELL
- GROUNDWATER CONTOUR
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- 434.26 WATER LEVEL GASPORT FORMATION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
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4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

GROUNDWATER ELEVATIONS SEPTEMBER 2021 - GASPORT FORMATION

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	5-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
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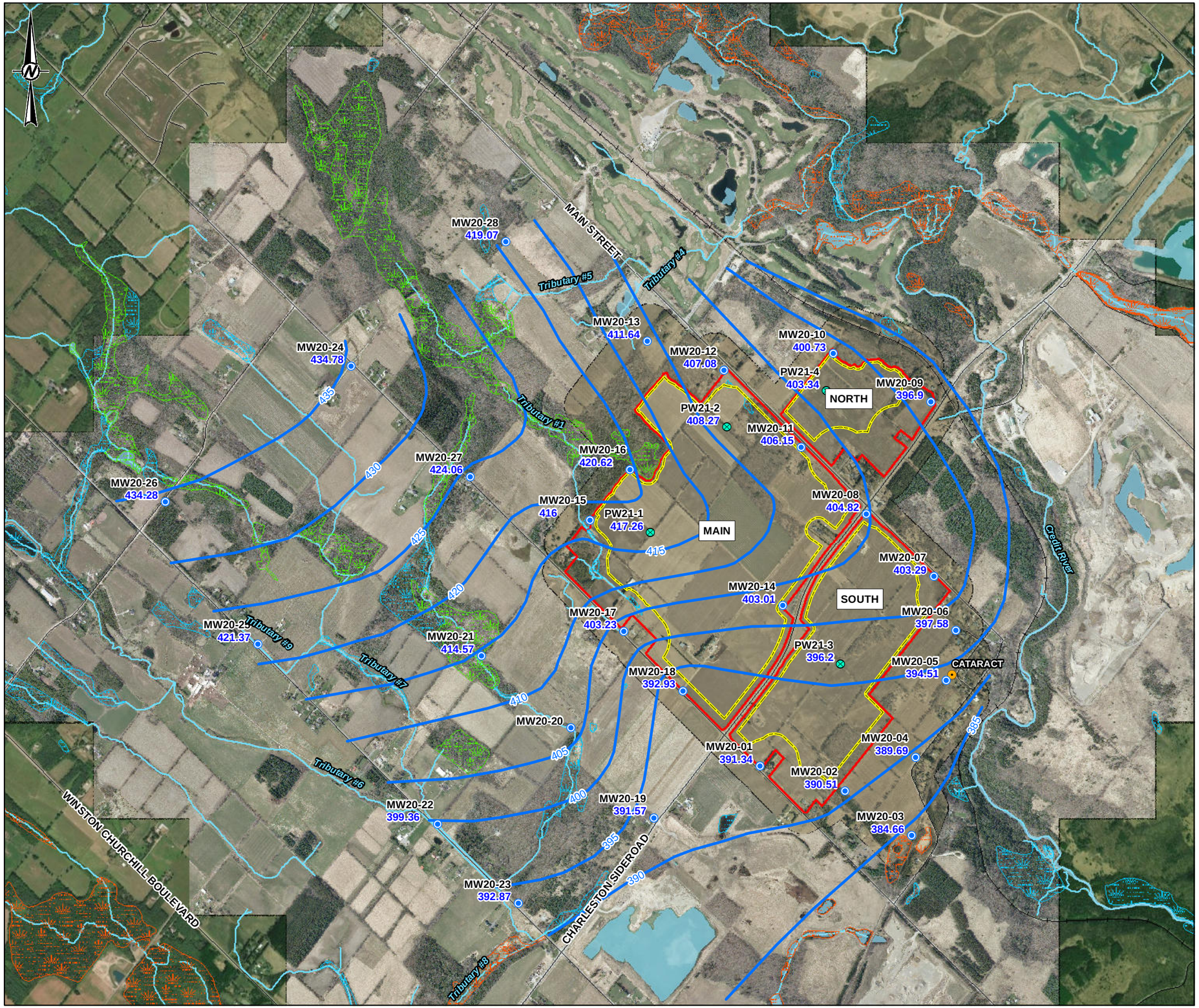

LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- TEST WELL
- GROUNDWATER CONTOUR
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- 434.26 WATER LEVEL GASPORT FORMATION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
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4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

GROUNDWATER ELEVATIONS DECEMBER 2021 - GASPORT FORMATION

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	5-5

PATH: S:\Clients\Votorantim_CementosLong_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0005_5.mxd PRINTED ON: 2023-07-19 AT: 11:59:26 AM

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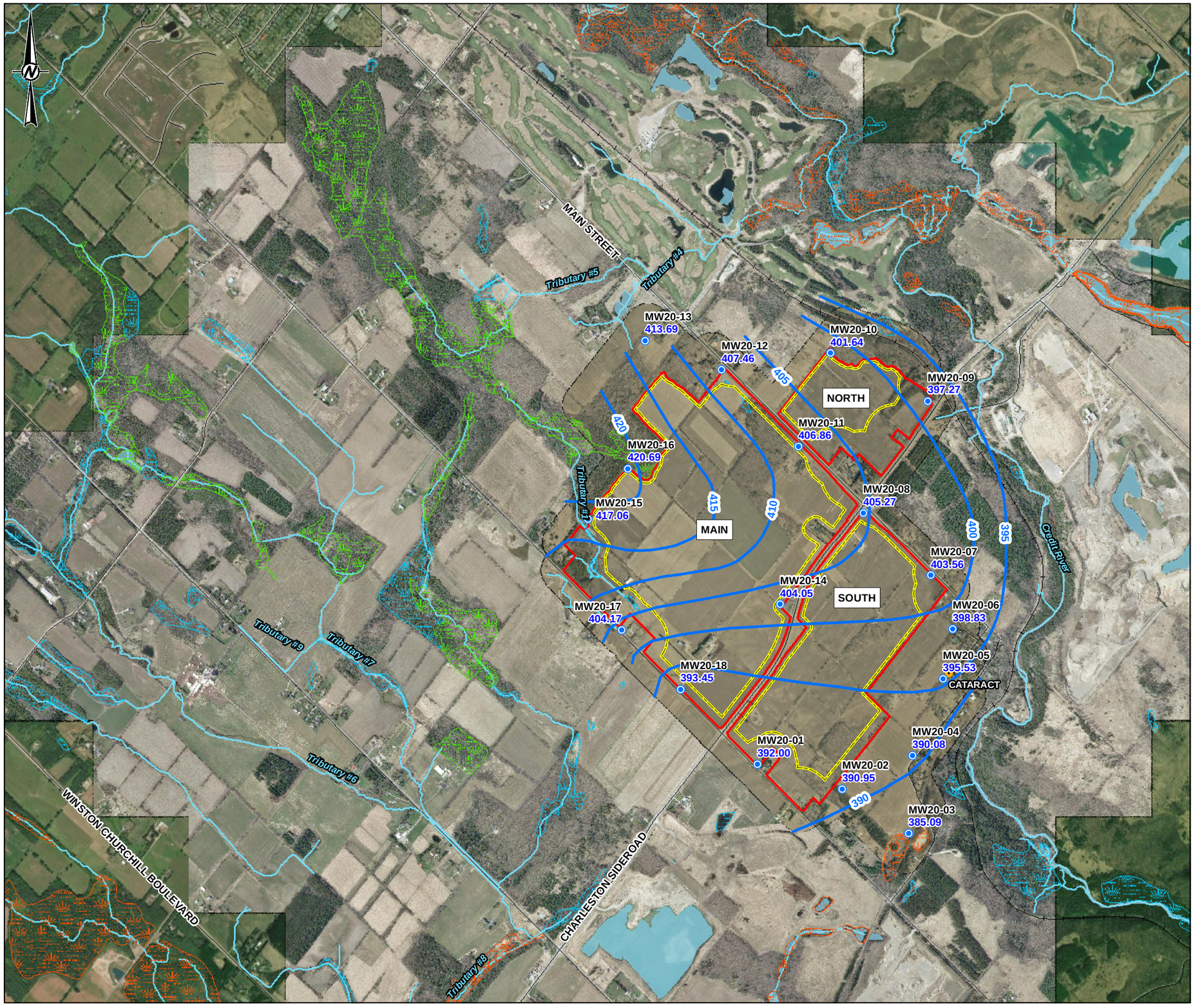

LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- 2021 MAXIMUM GROUNDWATER HEAD
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- 434.26 MAXIMUM PREDICTED WATER TABLE ELEVATION

0 500 1,000

1:20,000 METRES

NOTE(S)

1. HIGH WATER TABLE PREPARED BASED ON THE MAXIMUM GROUNDWATER HEAD OBSERVATION AT EACH MONITORING WELL NEST DURING THE 2021 GROUNDWATER MONITORING PROGRAM. FIGURE TO BE READ WITH ACCOMPANYING REPORT.

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2021, SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

MAXIMUM PREDICTED WATER TABLE

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	5-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

0 25mm

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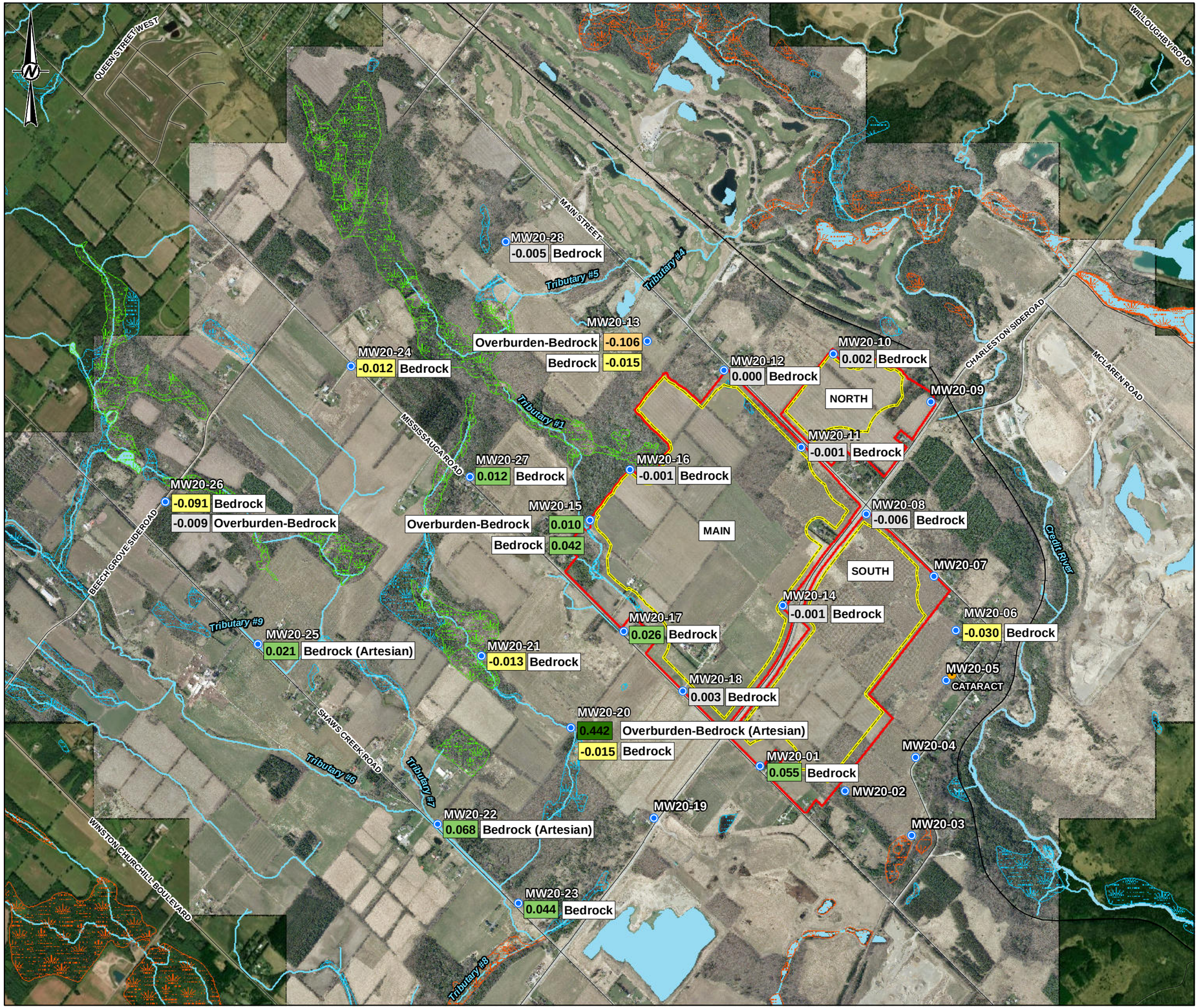

LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

VERTICAL HYDRAULIC GRADIENTS

- -0.106 / -0.015 — DOWNWARD GRADIENT < -0.100 m/m
- -0.001 / 0.055 — NEUTRAL GRADIENT > -0.01 AND < 0.01 m/m
- 0.442 — UPWARD GRADIENT > 0.100 m/m

0 500 1,000
1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

TITLE
TYPICAL 2021 VERTICAL HYDRAULIC GRADIENTS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0006	0.0	5-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0005_7.mxd PRINTED ON: 2023-07-19 AT 12:08:43 PM



LEGEND

- MONITORING WELL
- MONITORING WELL (PUMPING TEST)
- TEST WELL
- DISCHARGE LOCATION
- HISTORICAL MONITORING WELL
- SOIL CORE LOCATIONS
- SURFACE WATER LOCATIONS
- WATERCOURSE
- ROAD
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- NORTHWEST WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- NORTHWEST INVESTIGATION AREA

0 100 200 300

1:5,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
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SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT

CALEDON PIT / QUARRY

TITLE

NORTHWEST INVESTIGATION AREA

CONSULTANT

GOLDER
MEMBER OF WSP

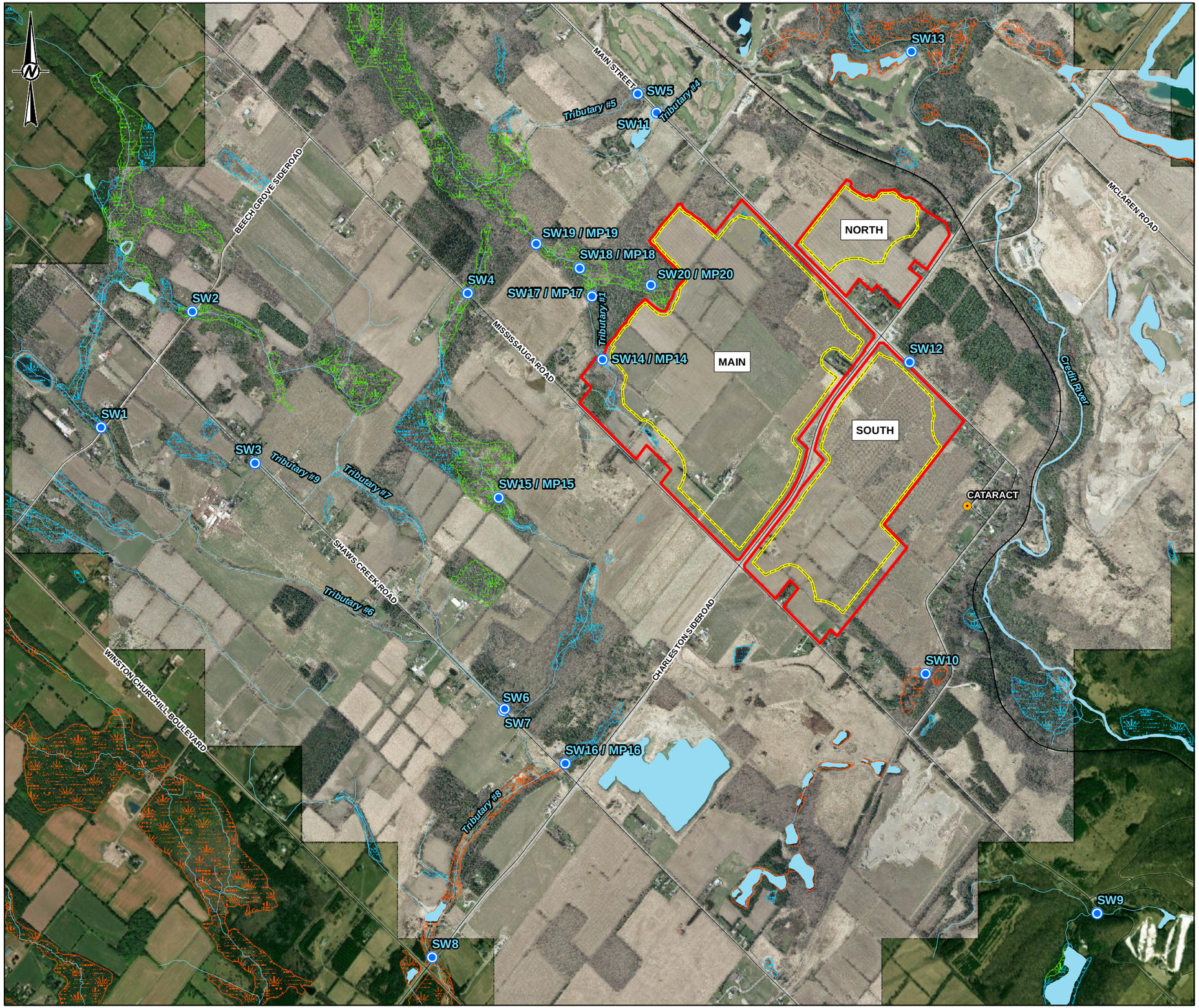
YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	PM
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0006	0.0	5-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0005_8.mxd PRINTED ON: 2023-07-19 AT: 12:13:06 PM



LEGEND

- TOWN/VILLAGE
- SURFACE WATER STATION
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT/ QUARRY

TITLE
SURFACE WATER LOCATIONS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	SO
PREPARED	SO
REVIEWED	MR
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	6-1

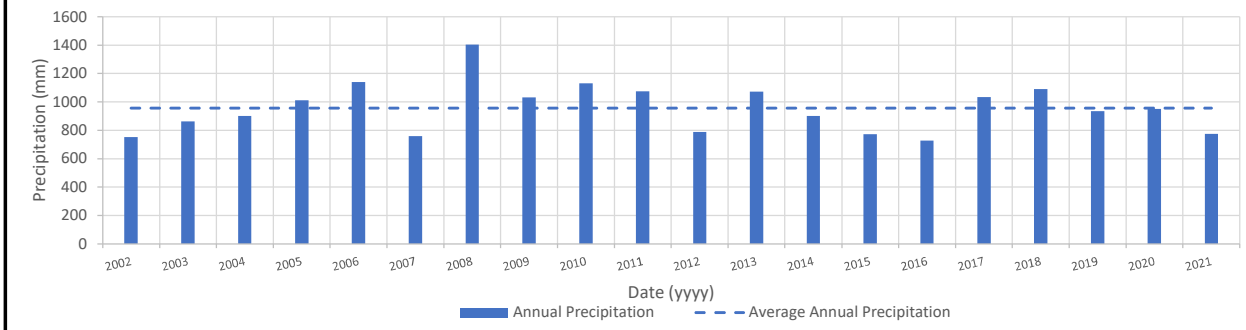
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votoramin_Cementos\Long_Pat_5_Caledon\99_PRO\19129150\40_PRO\0036_Water_Resources\19129150-0036-CHI-0006_1.mxd PRINTED ON: 2023-07-19 AT: 1:33:18 PM

Historical Flows at the EC Credit River at Cataract Flow Gauge Adjacent to VCNA Caledon Quarry (2002 - 2021) | FIGURE 6-2

A



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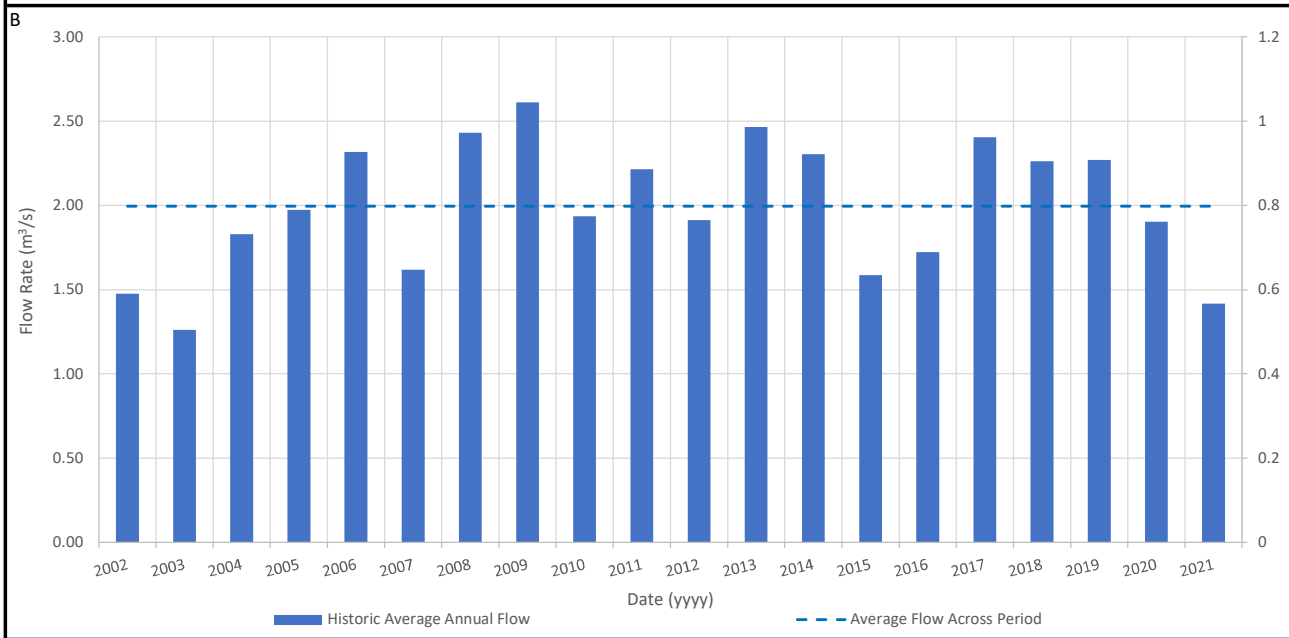

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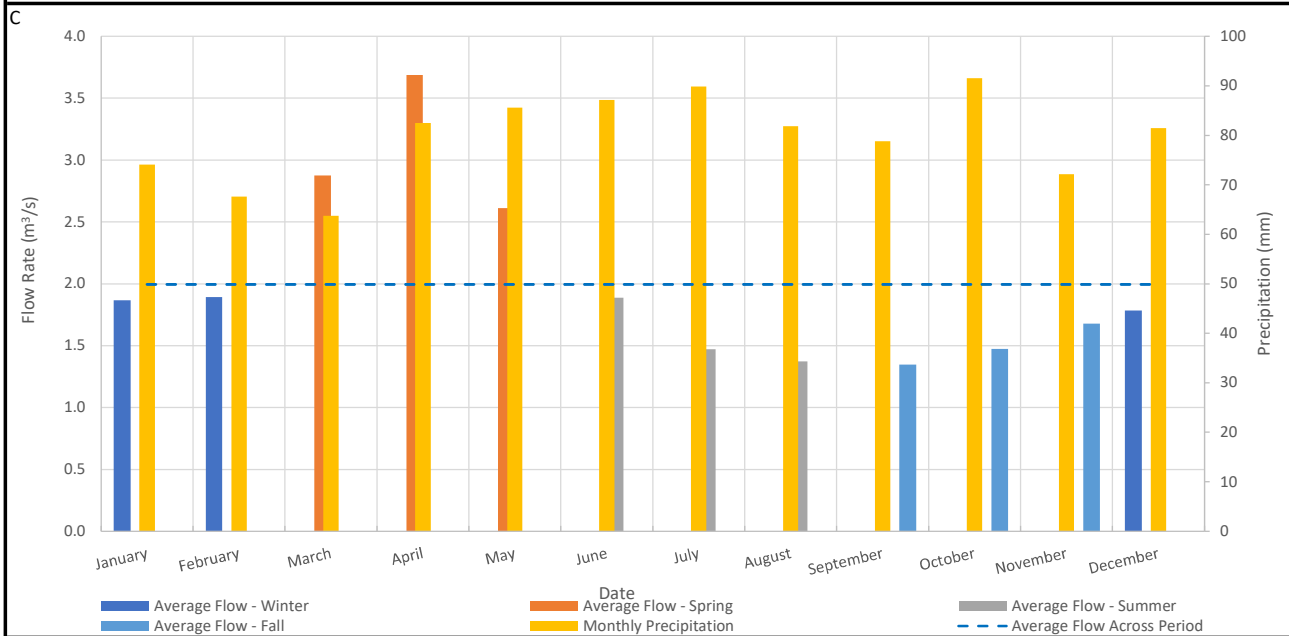

A. Total Daily Precipitation (Orangeville - Mono Centre, ON, EC Climate ID#6157000) **B. Annual Flow Rate** **C. Seasonal Flow Rate**

PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV



LEGEND

- TOWN/VILLAGE
- LOW FLOW STATION
- CVC FLOW GAUGE
- EC FLOW GAUGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000 1,500

1:30,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT/ QUARRY

TITLE

SURFACE WATER LOW FLOW STATION LOCATIONS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	SO
PREPARED	SO
REVIEWED	MR
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	6-3

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PROJ\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0006_3.mxd PRINTED ON: 2023-07-19 AT: 1:42:58 PM

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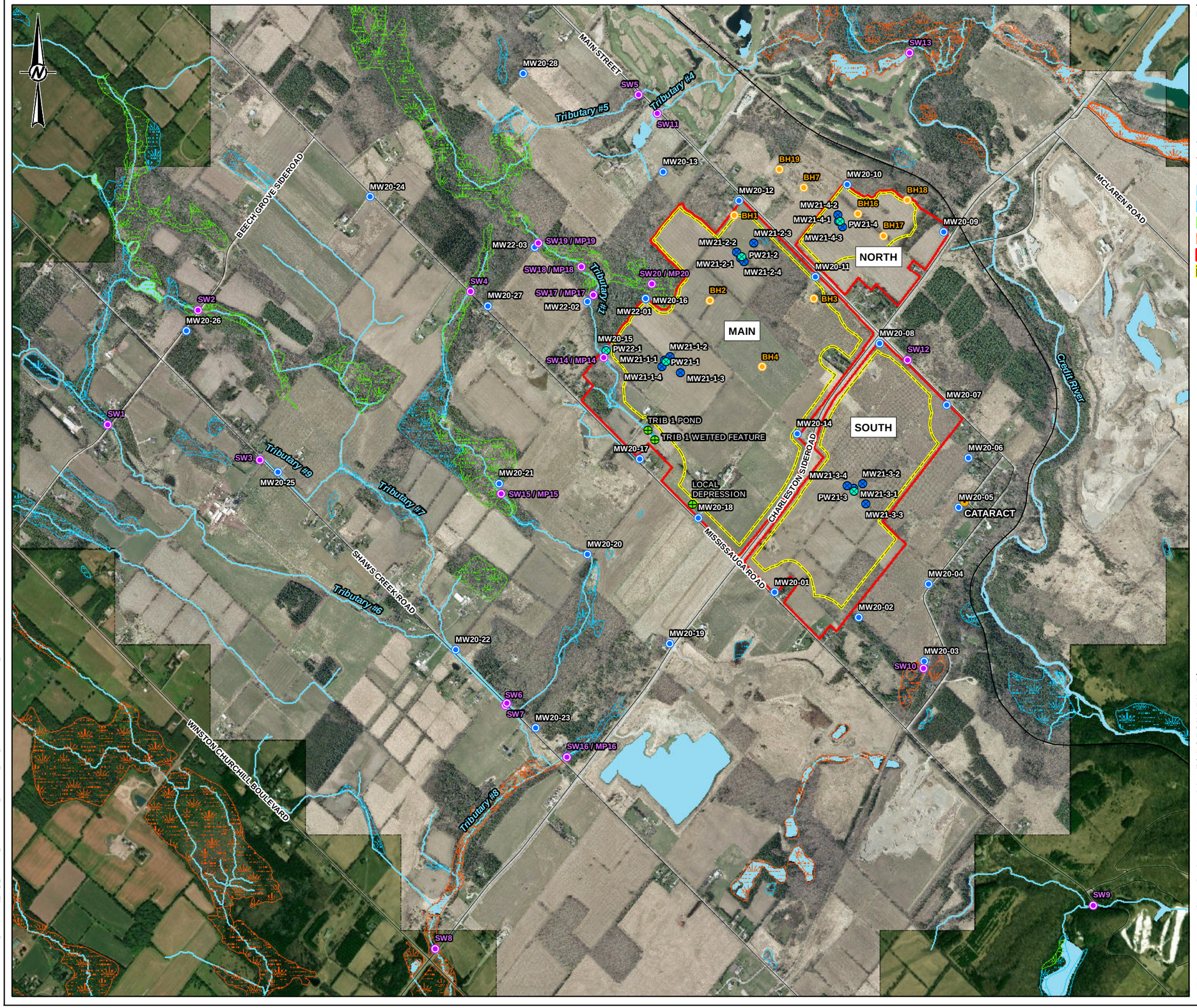
0 25mm



LEGEND

- TOWN/VILLAGE
- MONITORING WELL
- MONITORING WELL (PUMPING TEST)
- TEST WELL
- HISTORICAL MONITORING WELL
- SURFACE WATER STATION
- TRIBUTARY #1 ANNOTATION
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

TITLE
GROUNDWATER SURFACE WATER MONITORING NETWORK

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	6-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

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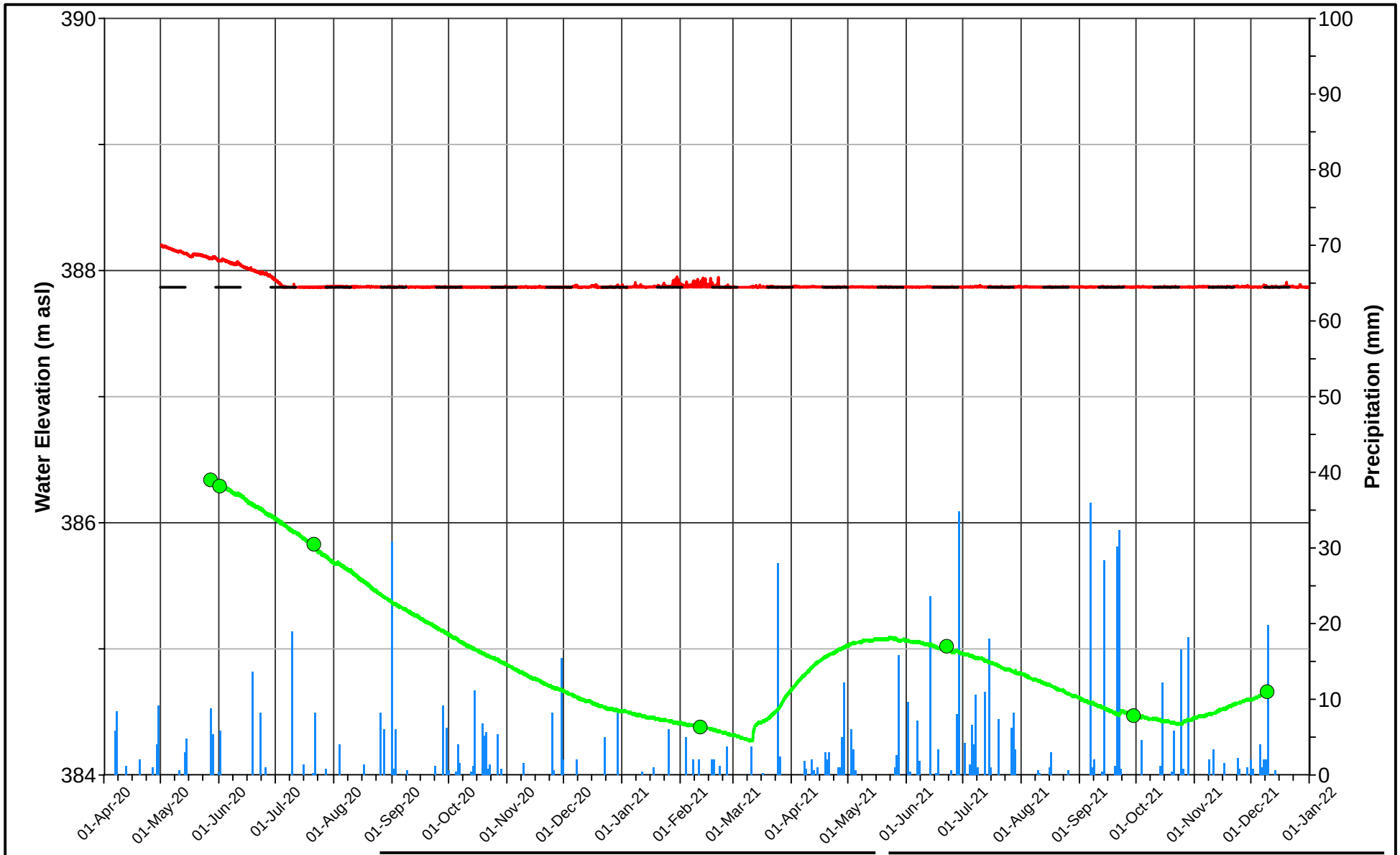


SW-10
MW20-02
MW20-03
Surface Water Logger Elevation

Note:
1) To be read with accompanying report.
2) Precipitation data from Environment and Climate Change Canada (Georgetown WWTP Station)

GOLDER
MEMBER OF WSP

DATE	December 2022
DESIGN	VRP
REVIEW	PGM
APPROVED	GWS

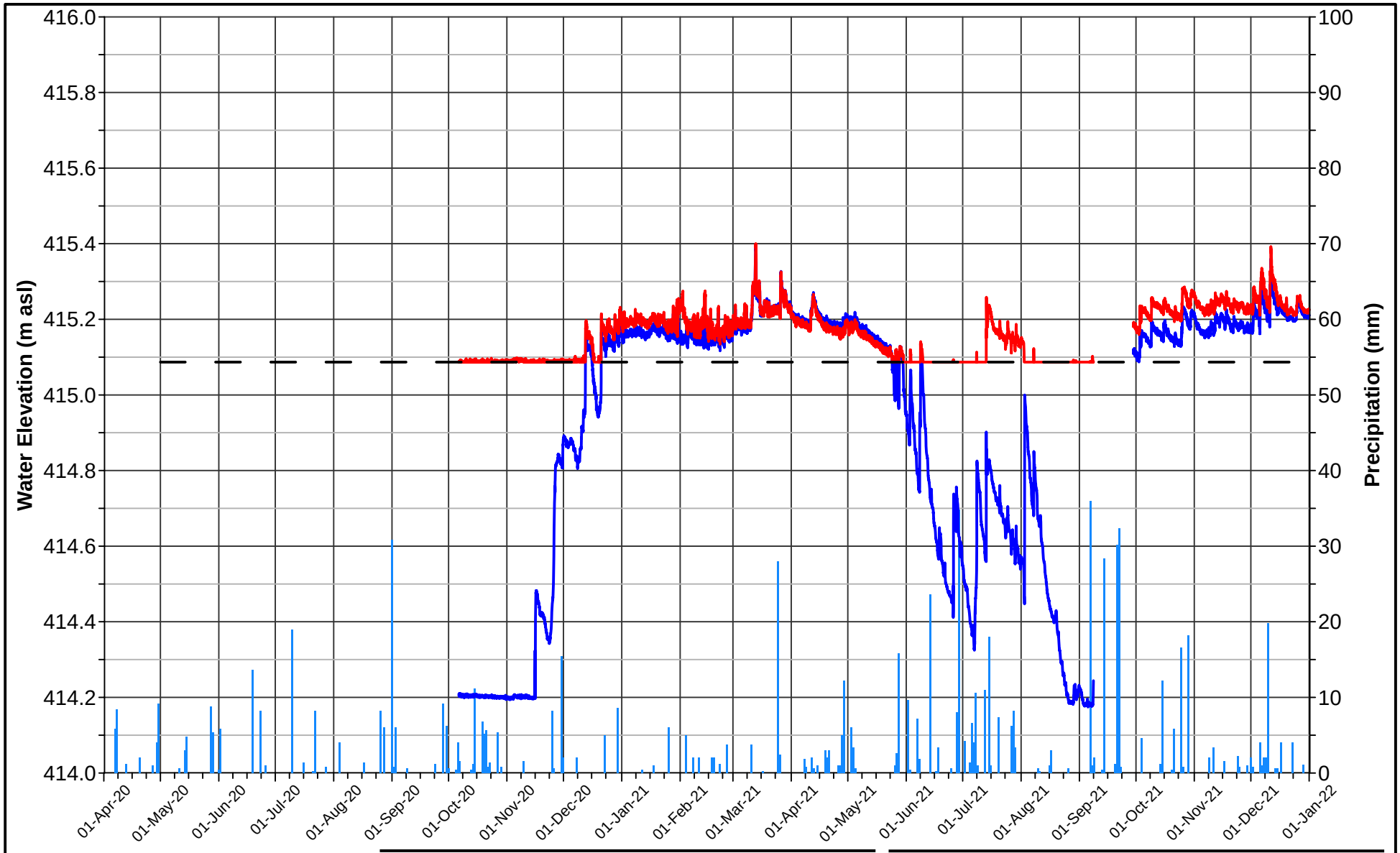
PROJECT

CBM CALEDON QUARRY

TITLE

SW10 GROUNDWATER-SURFACE WATER INTERACTION ELEVATION HYDROGRAPHS

PROJECT NO.	REV	FIGURE
19129150	A	6-5



Note:
1) To be read with accompanying report.
2) Precipitation data from Environment and Climate Change Canada (Georgetown WWTP Station)

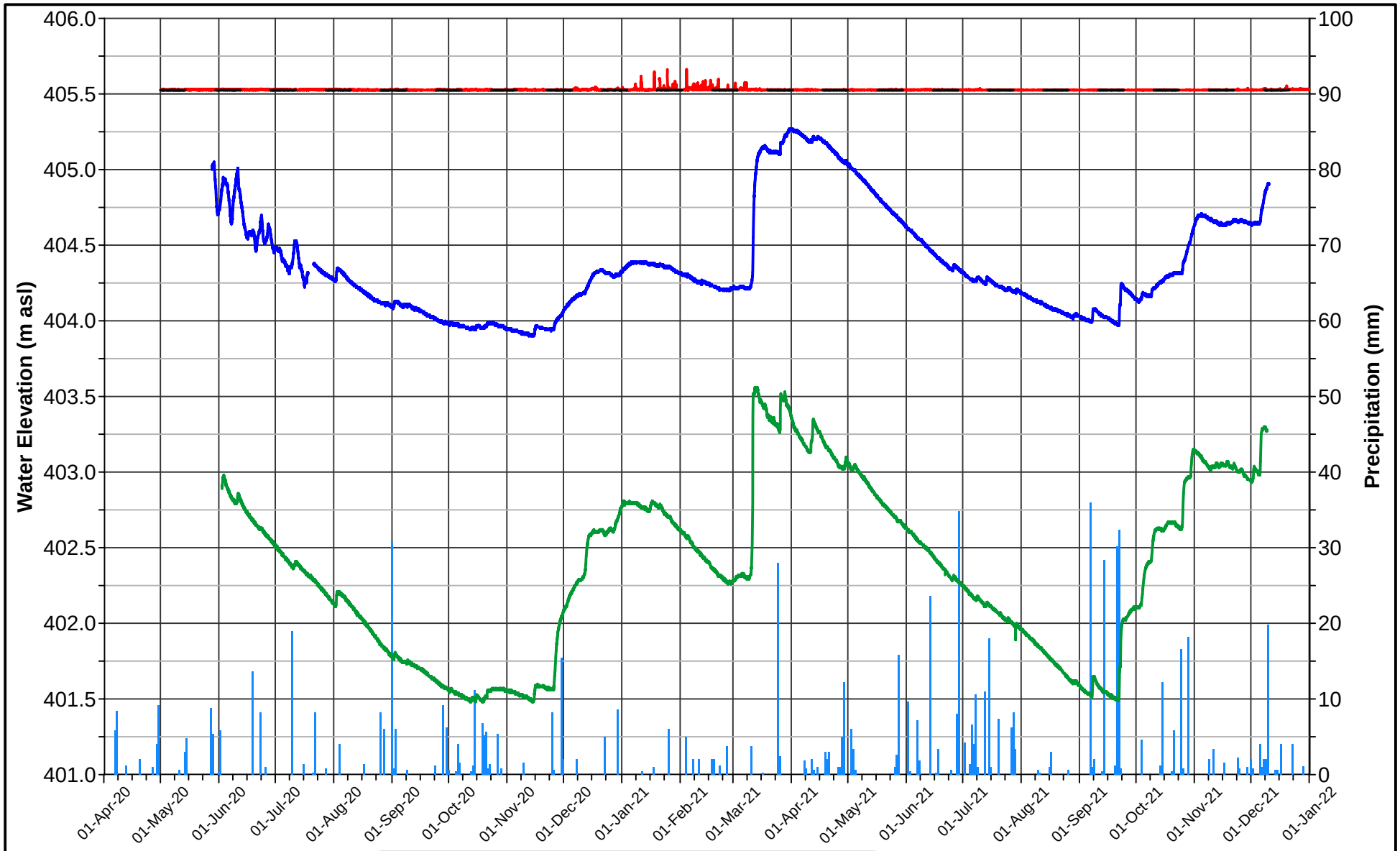
GOLDER
MEMBER OF WSP

DATE	December 2022
DESIGN	VRP
REVIEW	PGM
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
SW14 GROUNDWATER-SURFACE WATER INTERACTION ELEVATION HYDROGRAPHS

PROJECT NO.	REV	FIGURE
19129150	A	6-6



Note:
1) To be read with accompanying report.
2) Precipitation data from Environment and Climate Change Canada (Georgetown WWTP Station)

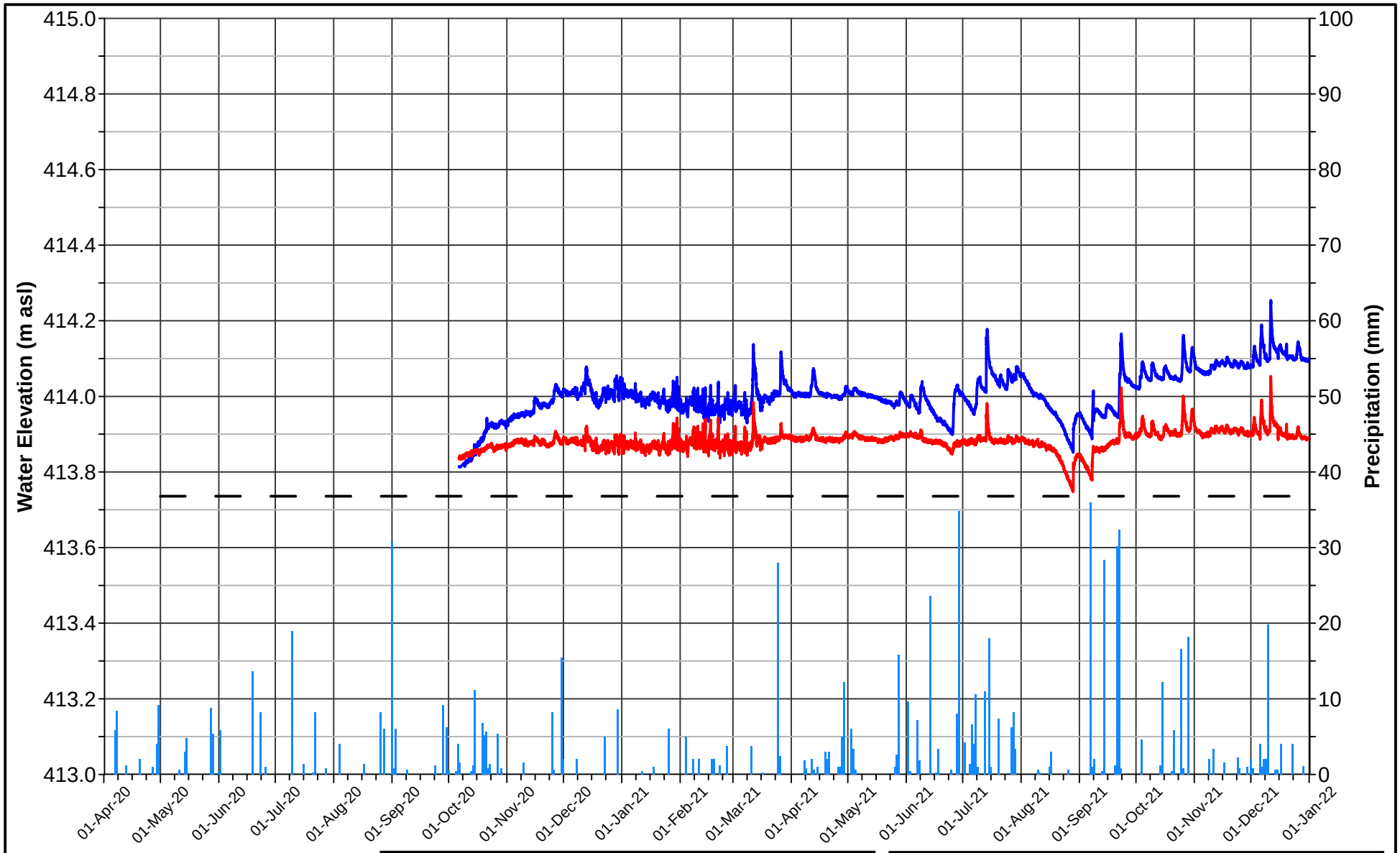
GOLDER
MEMBER OF WSP

DATE	December 2022
DESIGN	PGM
REVIEW	GWS
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
SW12 GROUNDWATER-SURFACE WATER INTERACTION ELEVATION HYDROGRAPHS

PROJECT NO.	REV	FIGURE
19129150	A	6-7



Note:
1) To be read with accompanying report.
2) Precipitation data from Environment and Climate Change Canada (Georgetown WWTP Station)

GOLDER
MEMBER OF WSP

DATE	December 2022
DESIGN	VRP
REVIEW	PGM
APPROVED	GWS

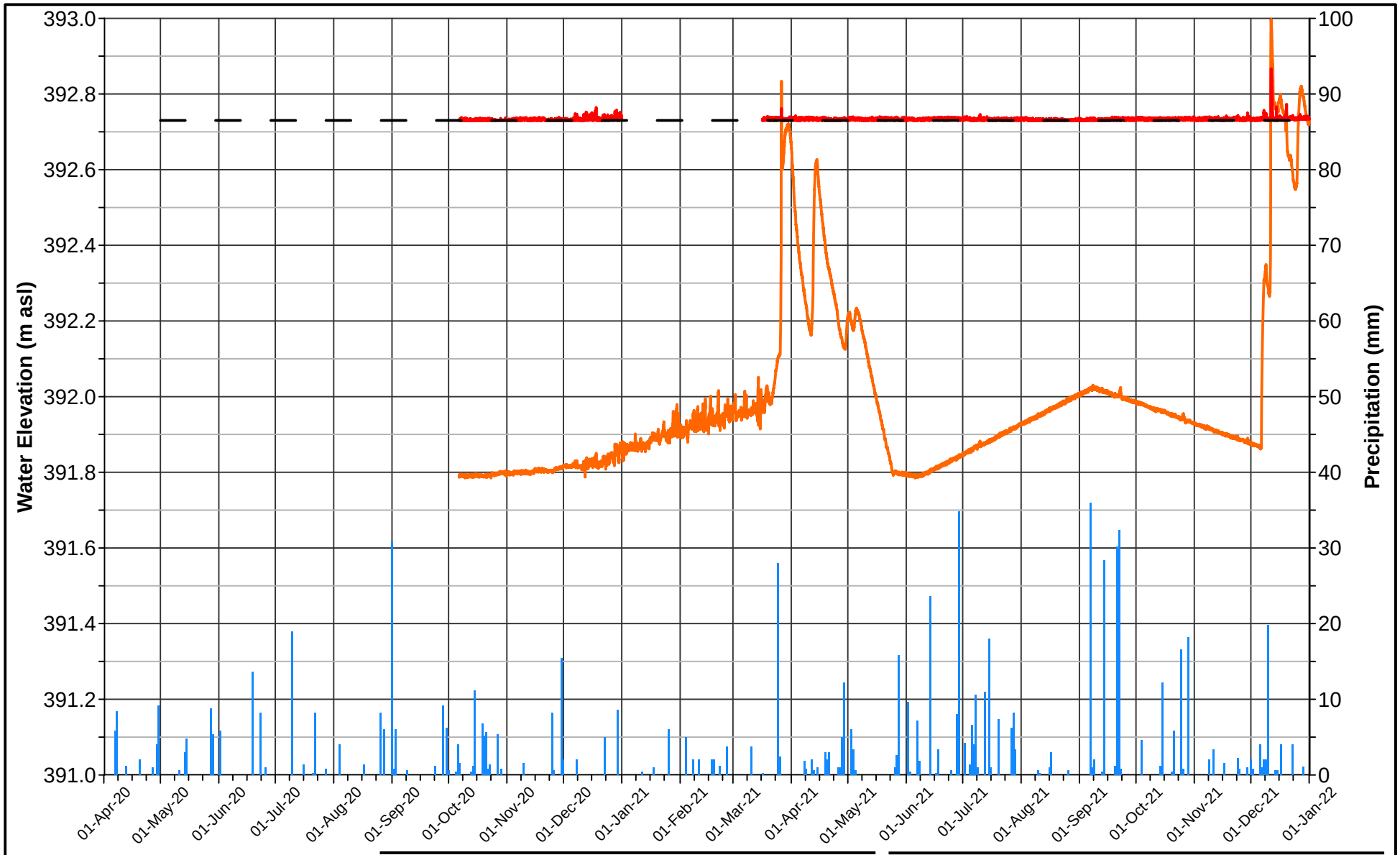
PROJECT

CBM CALEDON QUARRY

TITLE

SW15 GROUNDWATER-SURFACE WATER INTERACTION ELEVATION HYDROGRAPHS

PROJECT NO.	REV	FIGURE
19129150	A	6-8



Note:
1) To be read with accompanying report.
2) Precipitation data from Environment and Climate Change Canada (Georgetown WWTP Station)

GOLDER
MEMBER OF WSP

DATE	December 2022
DESIGN	VRP
REVIEW	PGM
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
SW16 GROUNDWATER-SURFACE WATER INTERACTION ELEVATION HYDROGRAPHS

PROJECT NO.	REV	FIGURE
19129150	A	6-9



LEGEND

NOTES

Traverse #1 completed on March 5, 2020
Traverse #2 completed on December 12, 2022

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

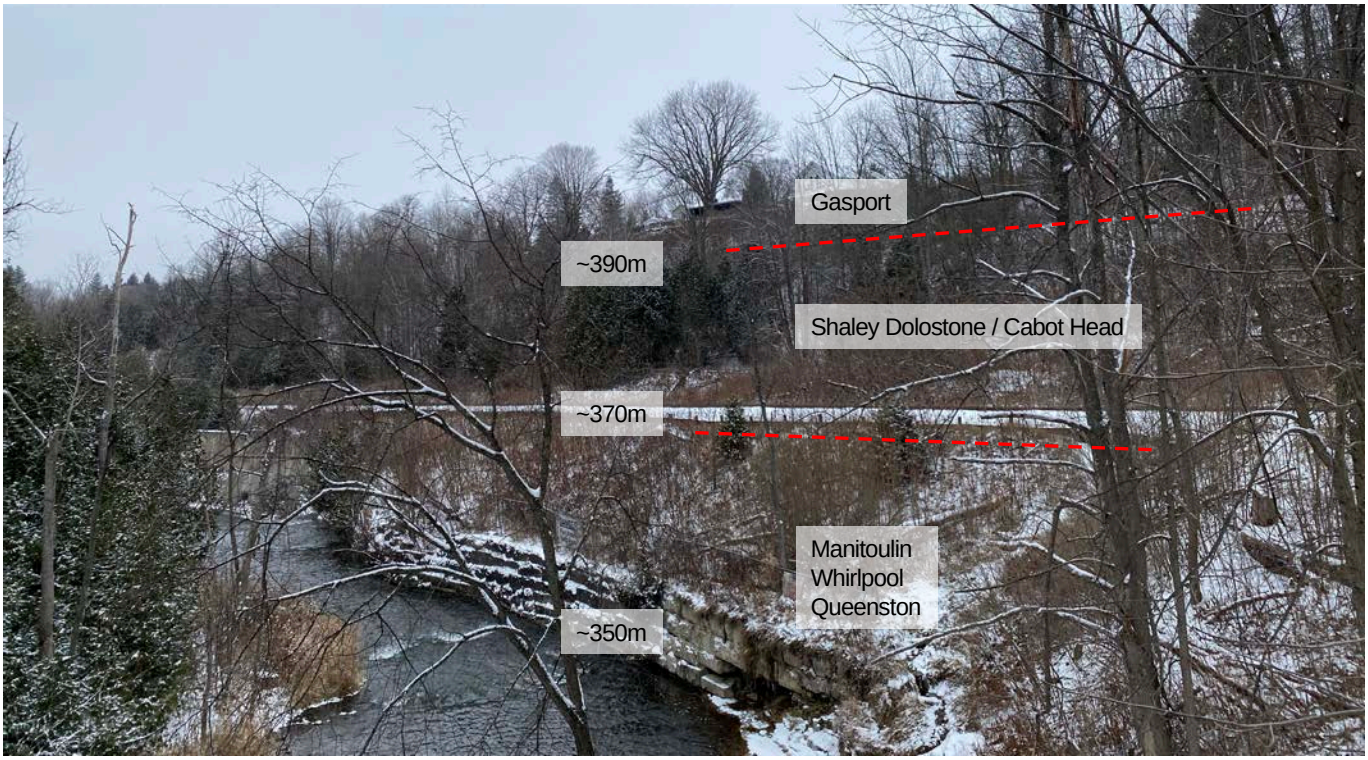
CONSULTANT
GOLDER
MEMBER OF WSP

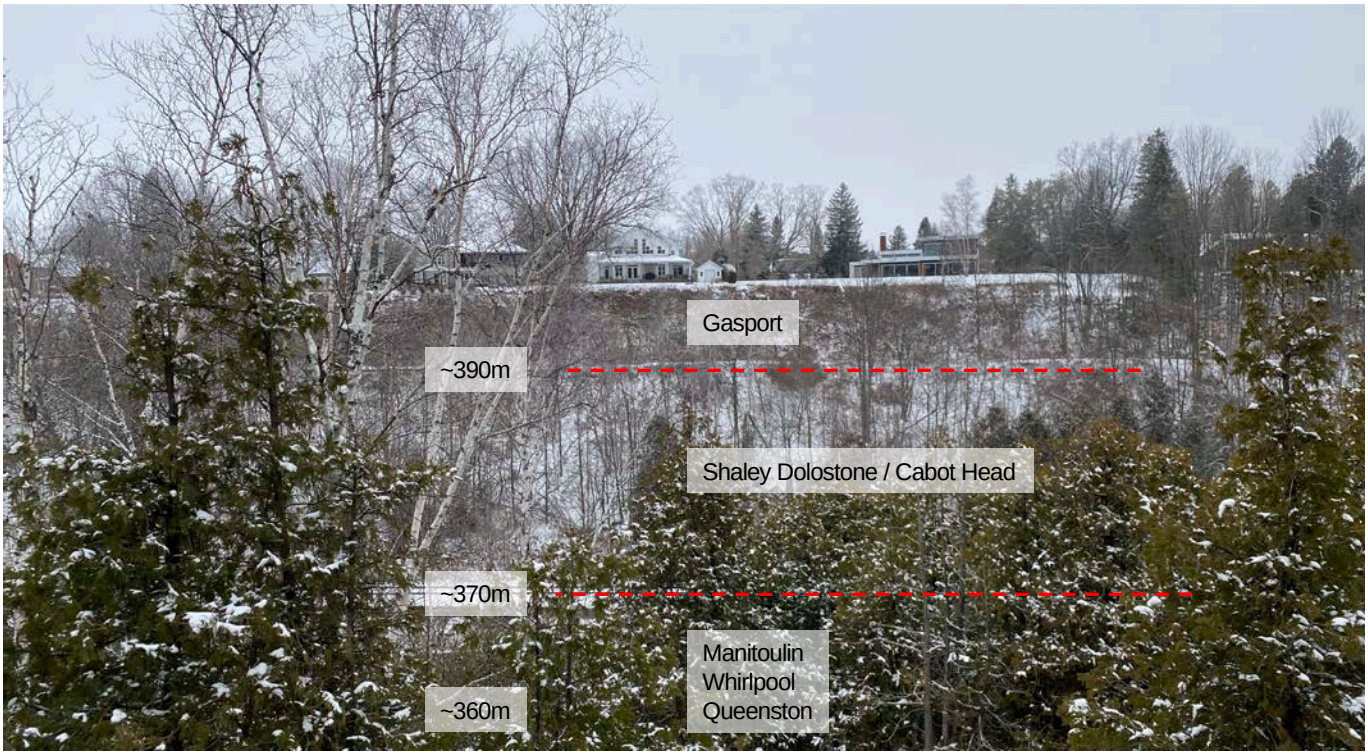
YYYY-MM-DD	2022-11-xx
PREPARED	GWS
DESIGN	GWS
REVIEW	PGM
APPROVED	GRP

PROJECT
CALEDON PIT AND QUARRY

TITLE
CATARACT SEEP RECONNAISSANCE - TRAVERSE ROUTE AND WAYPOINTS

PROJECT No.	Rev.	FIGURE
19129150	0	6-10





LEGEND

Approximate Geologic Contact

NOTE

Approximate geologic contacts are projected from borehole drilling and water well record data from the Site and Cataract area

CLIENT

CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

PROJECT

Caledon Pit / Quarry

Water Report Level 1 / 2

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-12-12
PREPARED	GWS
DESIGN	GWS
REVIEW	GRP
APPROVED	GRP

TITLE

Cataract Seep Reconnaissance

Bedrock Geology

PROJECT No. **19129150**

Rev. **0**

FIG. **6-11**





LEGEND

Approximate Geologic Contact

NOTE

CLIENT
CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

PROJECT
Caledon Pit / Quarry
Water Report Level 1 / 2

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-12-12
PREPARED	GWS
DESIGN	GWS
REVIEW	GRP
APPROVED	GRP

TITLE
Cataract Seep Reconnaissance
Seepage from base of Gasport at Waypoint #263

PROJECT No. **19129150**
Rev. **0**
FIG. **6-12**





LEGEND

Approximate Geologic Contact

NOTE

Approximate geologic contacts are projected from borehole drilling and water well record data from the Site and Cataract area

CLIENT

CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

PROJECT

Caledon Pit / Quarry

Water Report Level 1 / 2

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-12-12
PREPARED	GWS
DESIGN	GWS
REVIEW	GRP
APPROVED	GRP

TITLE

Cataract Seep Reconnaissance

Pipe Observed at Waypoint #259 and Culvert at Waypoint #266

PROJECT No. **19129150**

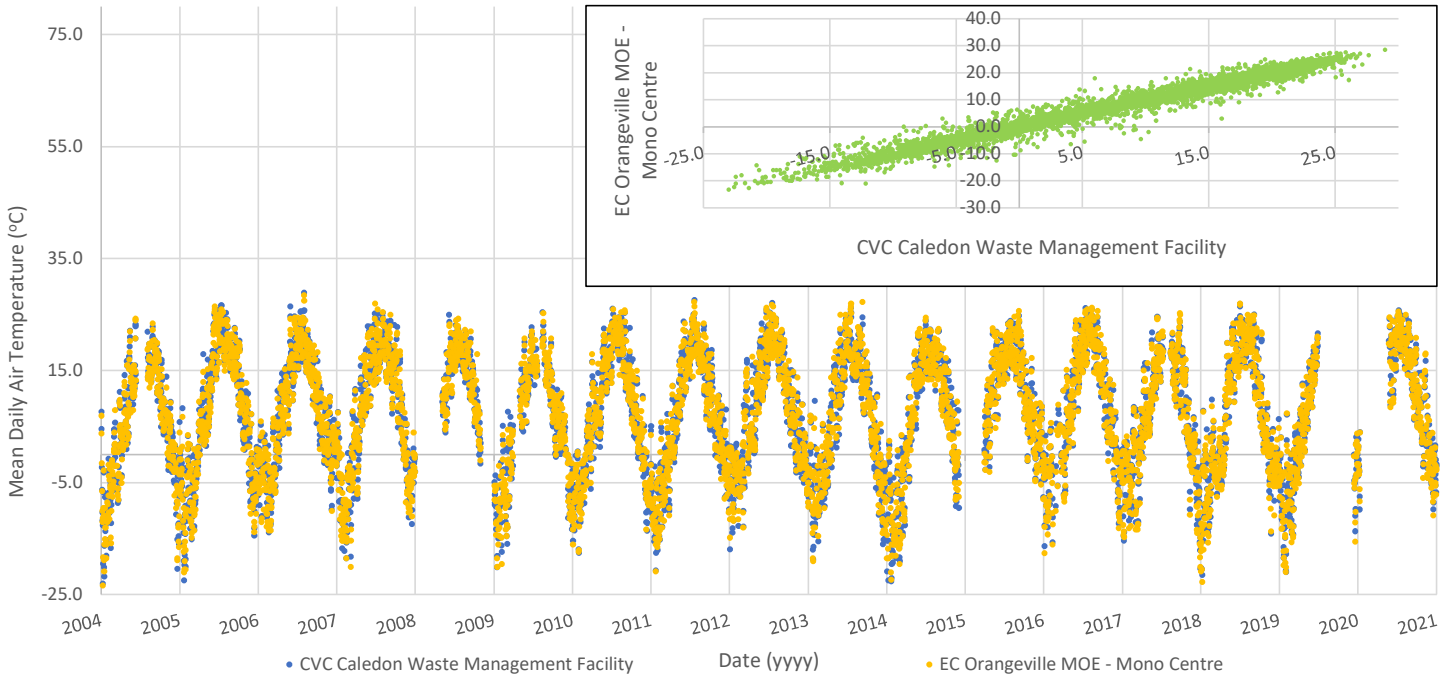
Rev. **0**

FIG. **6-13**

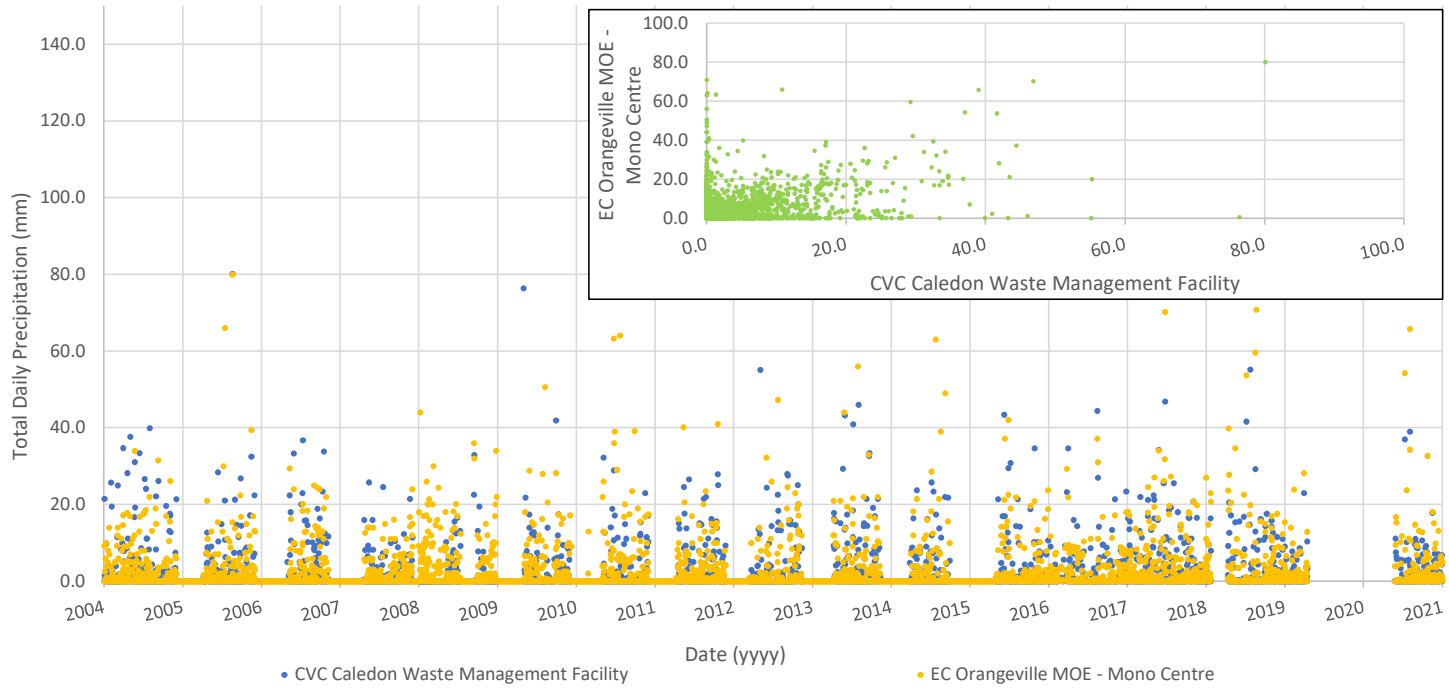
Meterological Correlation Plot Between the CVC Caledon Waste Management Facility and EC Orangeville MOE / Mono Centre MET Stations (2004 - 2020)

FIGURE 7-1

B



C



A. Mean Daily Air Temperature **B. Total Daily Precipitation**

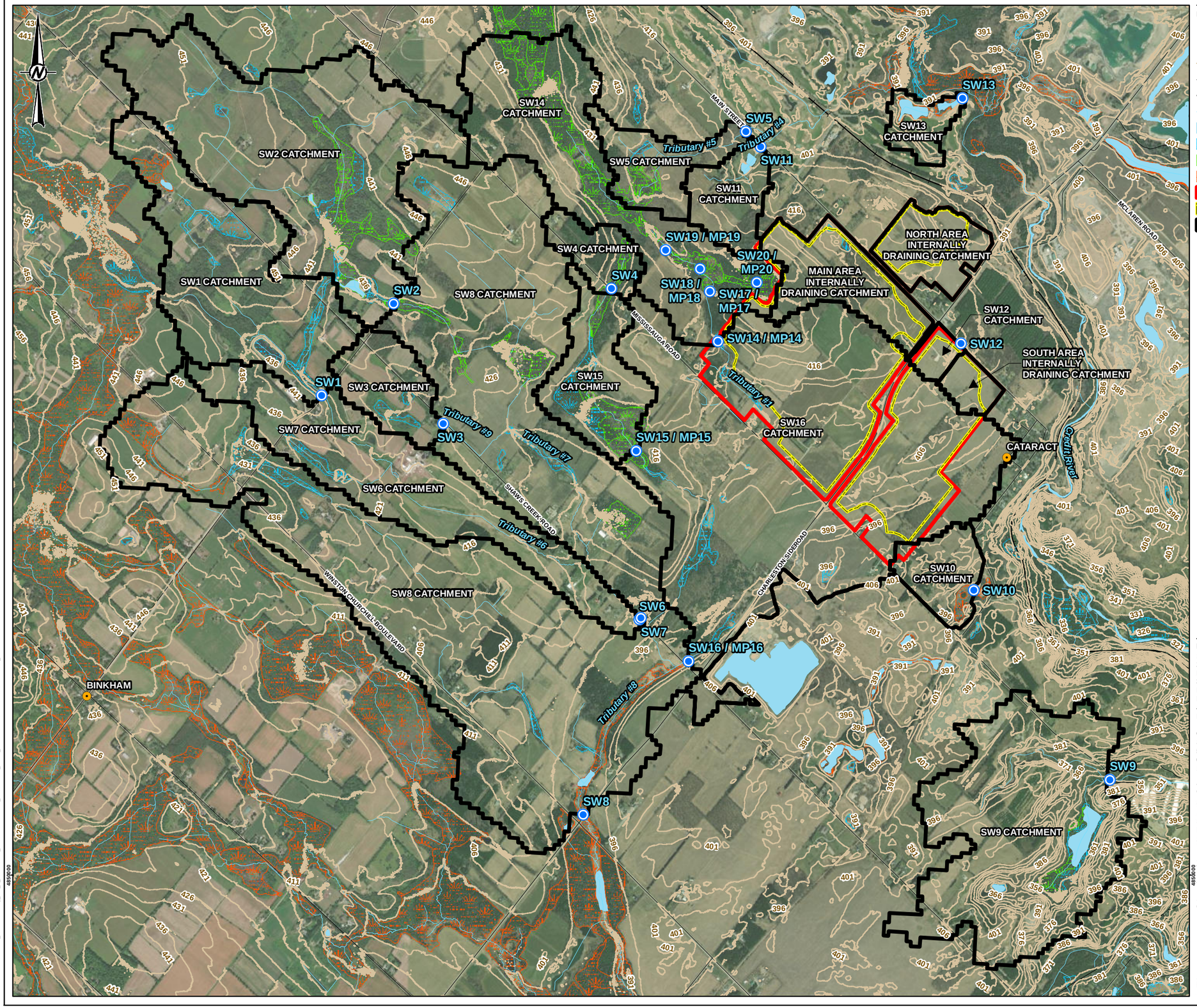
PROJECT: 19129150

DATE: April 2023

GOLDER
MEMBER OF WSP

DRAWN: MR

CHECK: CDV / GWS



LEGEND

- TOWN/VILLAGE
- SURFACE WATER STATION
- CONTOURS (5 m INTERVAL)
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- CATCHMENT AREA

0 500 1,000 1,500

1:25,000 METRES

REFERENCE(S)

1. BASEDATA OBTAINED FROM THE MRNF LIO APRIL 2020
2. TOPOGRAPHY OBTAINED FROM THE MNRF LIO ONTARIO DIGITAL TERRAIN MODEL (LIDAR-DERIVED), GTA-PEEL ACQUISITION PROJECT SPRING 2016.
3. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
4. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
5. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
6. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
SURFACE WATER STATION CATCHMENTS AND TOPOGRAPHY - EXISTING

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	SO
PREPARED	SO
REVIEWED	MR
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	7-2

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\9)_PRO\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0007_2.mxd PRINTED ON: 2023-07-19 AT 2:08:23 PM

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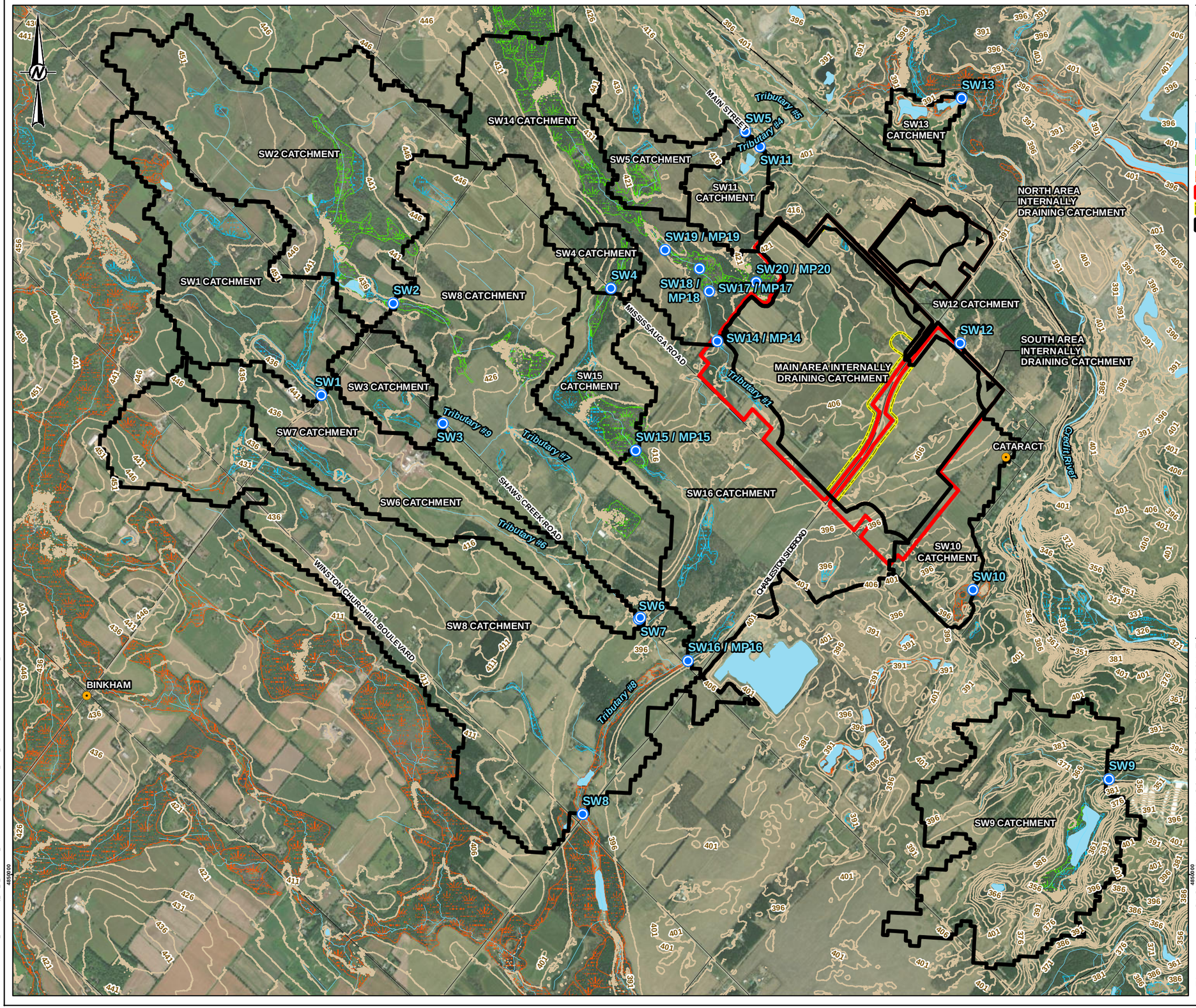


LEGEND

- TOWN/VILLAGE
- SURFACE WATER STATION
- CONTOURS (5 m INTERVAL)
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION
- CATCHMENT AREA

0 500 1,000 1,500

1:25,000 METRES

REFERENCE(S)

1. BASEDATA OBTAINED FROM THE MRNF LIO APRIL 2020
2. TOPOGRAPHY OBTAINED FROM THE MNRF LIO ONTARIO DIGITAL TERRAIN MODEL (LIDAR-DERIVED), GTA-PEEL ACQUISITION PROJECT SPRING 2016.
3. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
4. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
5. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
6. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
SURFACE WATER STATION CATCHMENTS AND TOPOGRAPHY - OPERATIONAL

CONSULTANT
GOLDER
MEMBER OF WSP

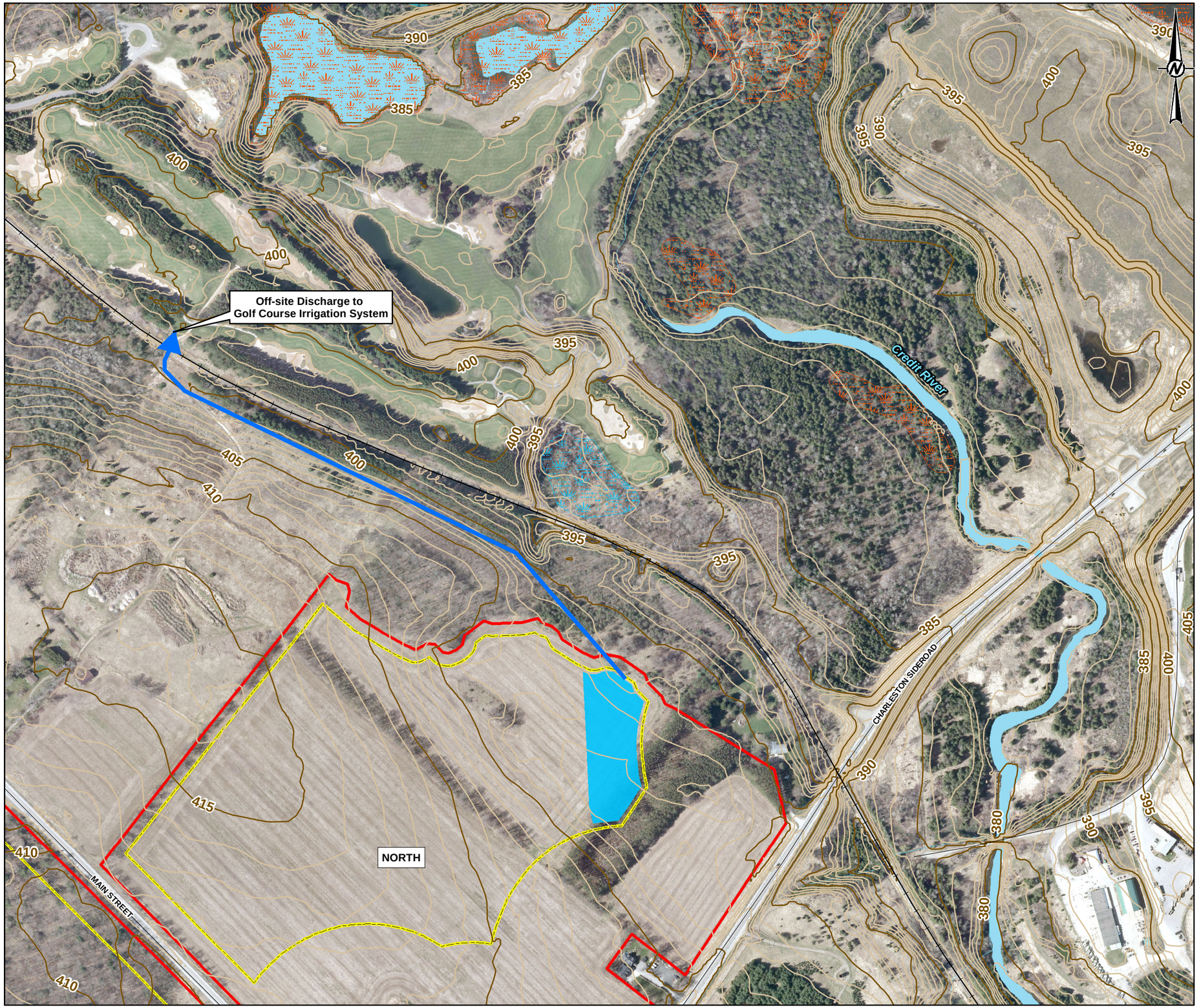
YYYY-MM-DD	2023-07-19
DESIGNED	SO
PREPARED	SO
REVIEWED	MR
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	7-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\99_PRO\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0007_3.mxd PRINTED ON: 2023-07-19 AT 2:38:25 PM



LEGEND

- ROAD
- RAILWAY
- CONTOUR 5 m INTERVAL
- CONTOUR 1 m INTERVAL
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 100 200

1:4,500 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

TITLE
PROPOSED OFF-SITE DISCHARGE LOCATION

CONSULTANT
GOLDER
MEMBER OF WSP

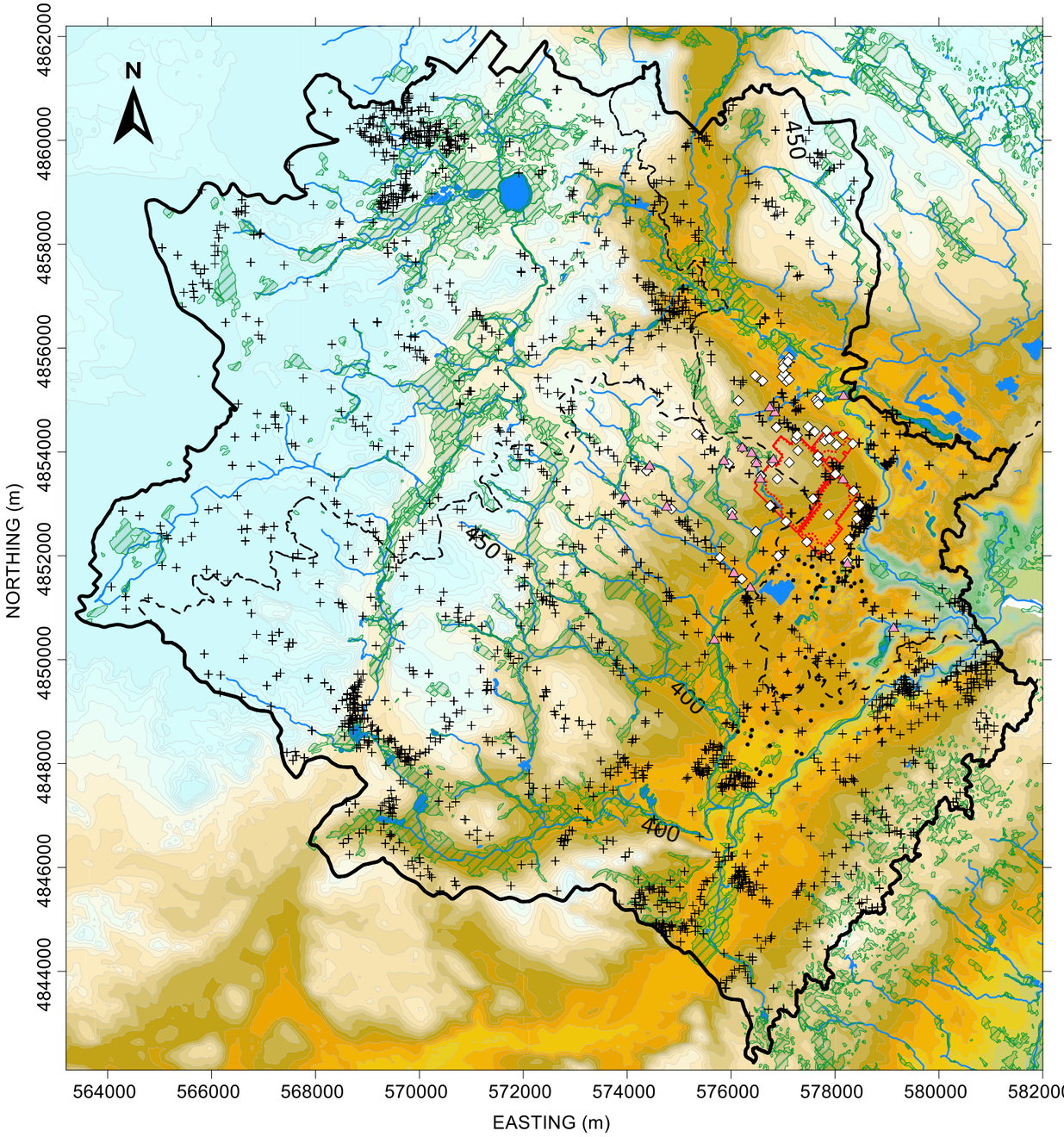
YYYY-MM-DD	2023-08-04
DESIGNED	CGE
PREPARED	SO
REVIEWED	PM
APPROVED	HM

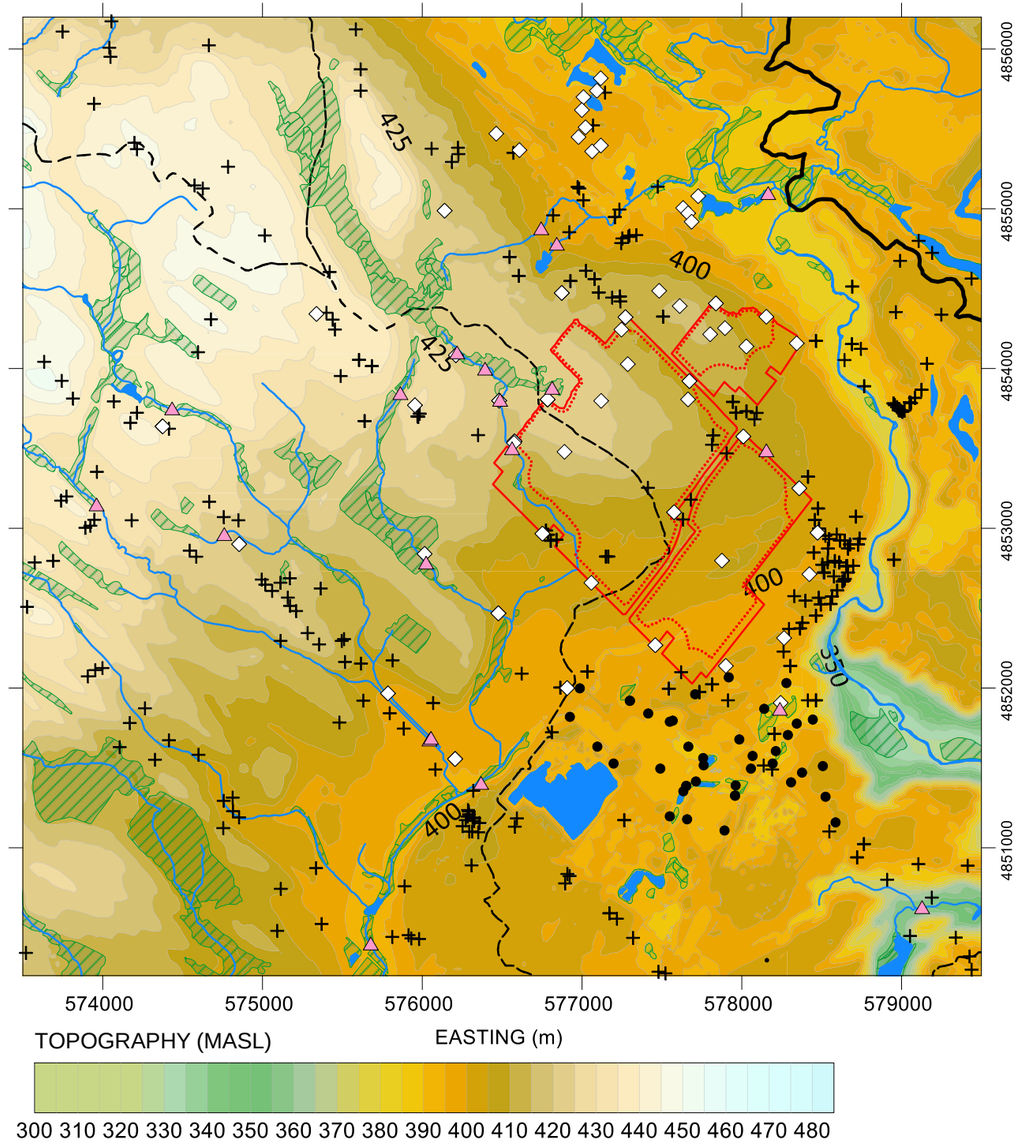
PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0006	0.0	7.4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Votorantim_Cimentos\Long_Par_5_Caledon\9)_PRO\19129150\40_PROD\0036_Water_Resources\19129150-0036-CH-0007_4.mxd PRINTED ON: 2023-08-04 AT 12:33:54 PM





LEGEND

- LAKES
- RIVERS/ STREAMS
- WETLAND
- MODEL DOMAIN
- CVC SUBWATERSHED
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- MECP WWR WELL LOCATION
- SITE GROUNDWATER MONITORING LOCATION
- SITE SURFACE WATER MONITORING LOCATION
- ADDITIONAL GROUNDWATER MONITORING LOCATION[6]

NOTES

1. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
2. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
3. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
4. Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2020).
5. Quarry license and limit of extraction provided by MHBC (2022)
6. Additional groundwater monitoring points from CRA (2012) and Harden (2016) reports

CLIENT
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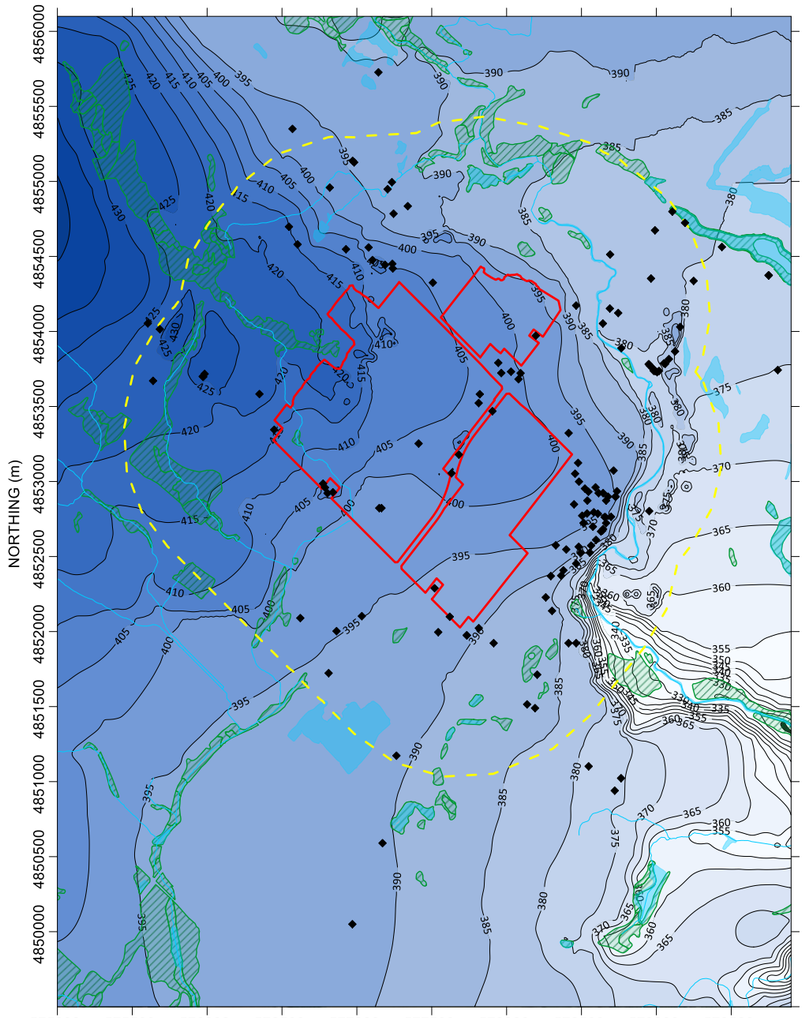
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

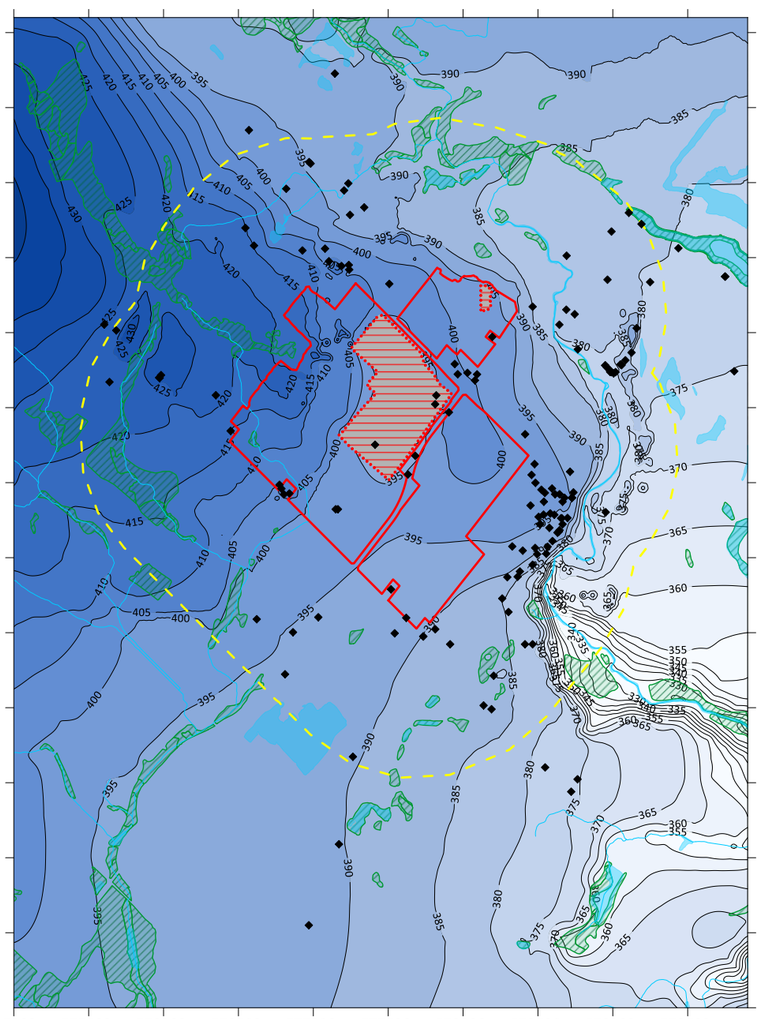
TITLE
STUDY AREA AND MODEL DOMAIN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-1

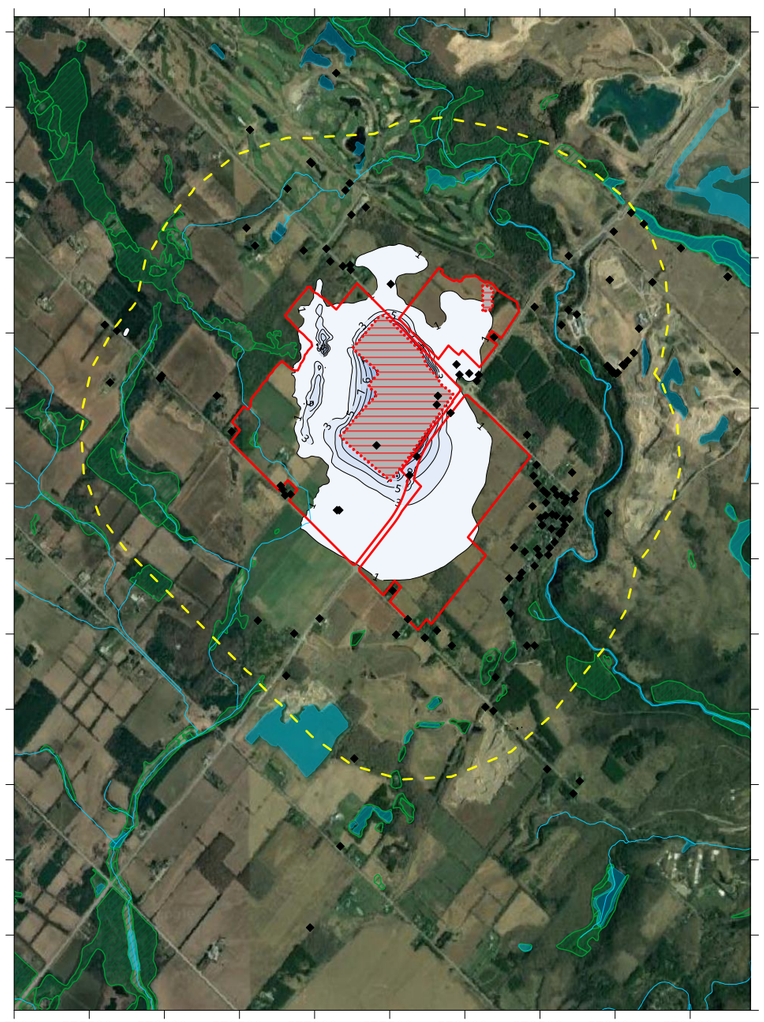
CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 1 SIMULATED WATER TABLE (masl)



PHASE 1 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic water table elevation is shown at a contour interval of 5m
2. Simulated water table drawdown is shown at a contour interval of 2m.
3. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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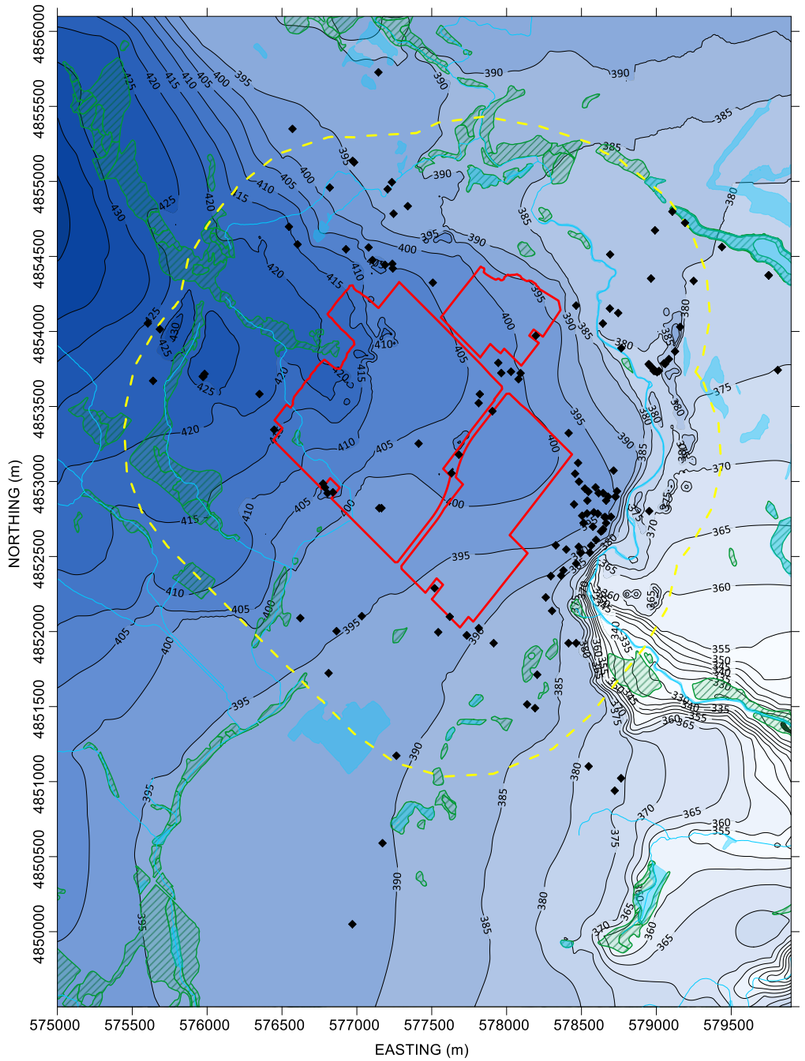
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

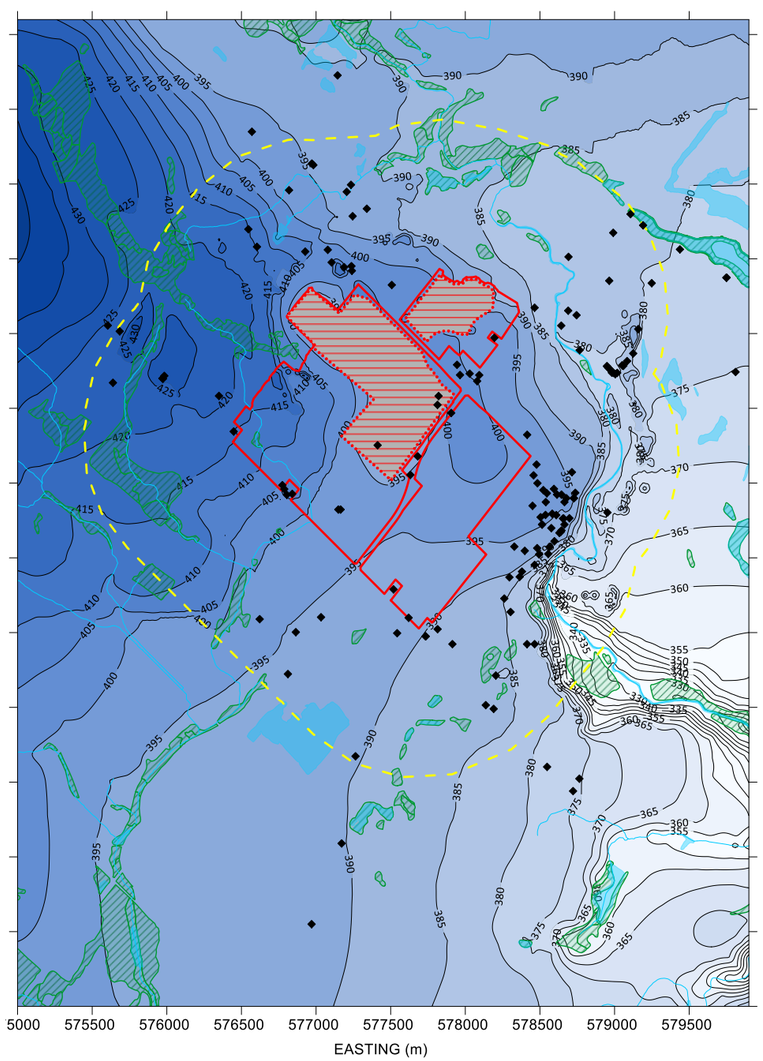
TITLE
PHASE 1 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2A

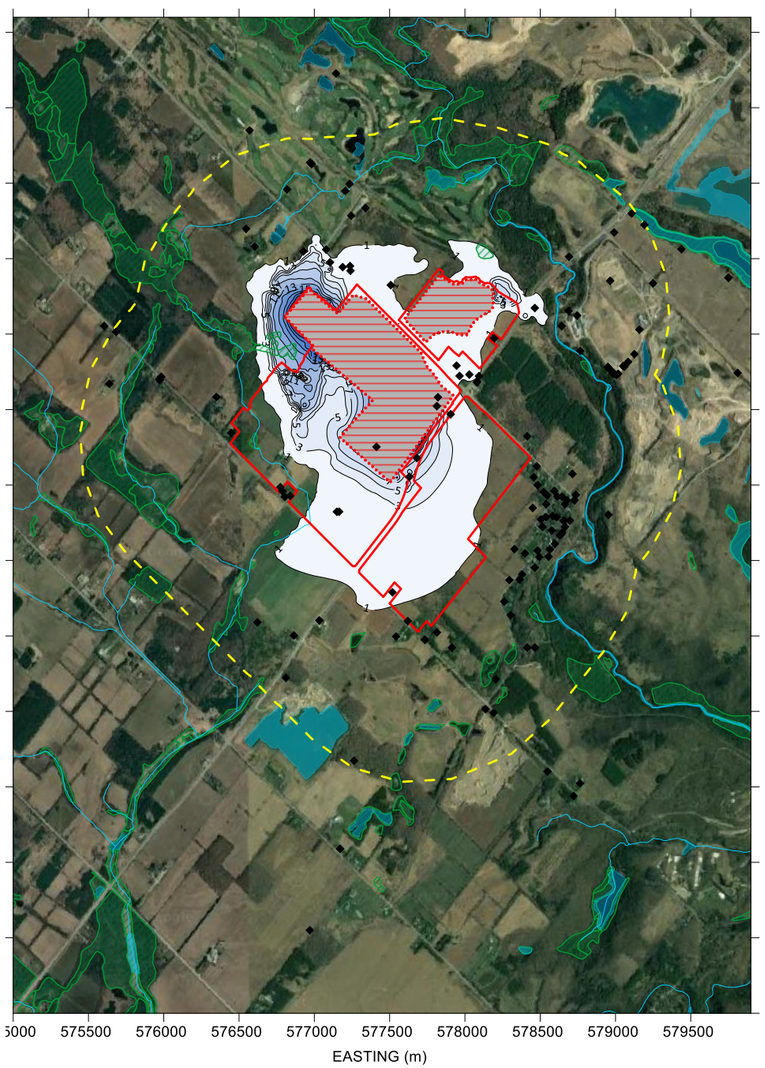
CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 2 SIMULATED WATER TABLE (masl)



PHASE 2 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic water table elevation is shown at a contour interval of 5m
2. Simulated water table drawdown is shown at a contour interval of 2m.
3. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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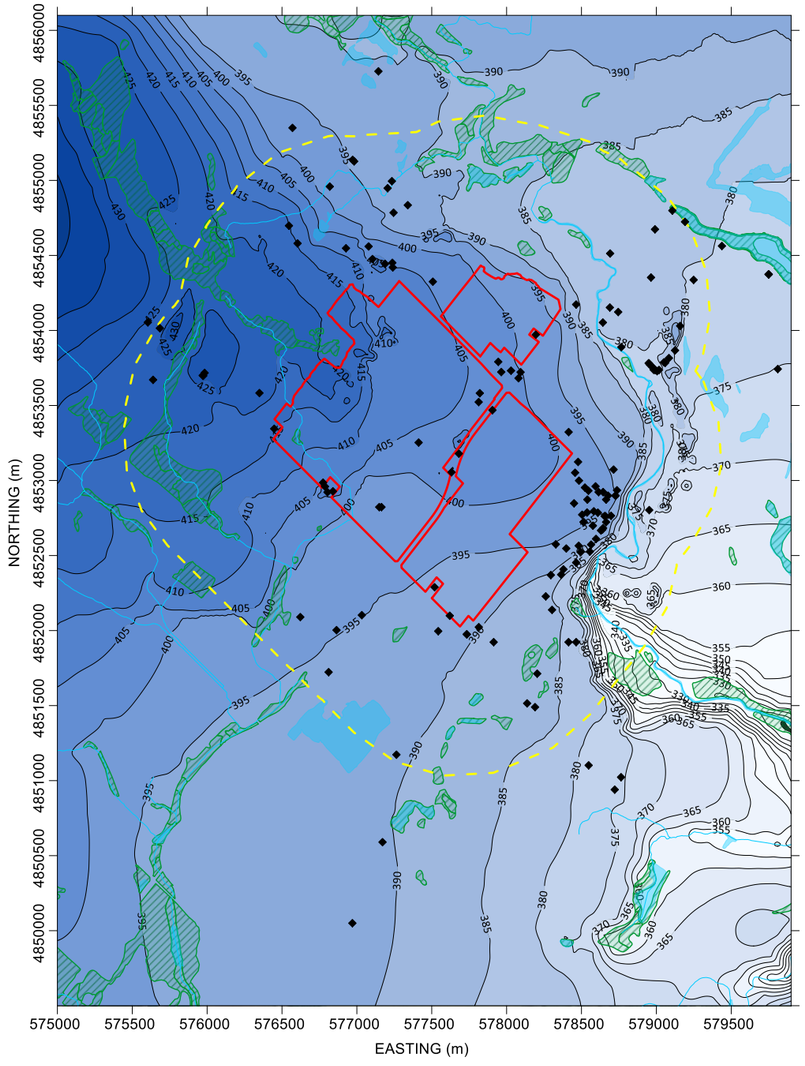
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

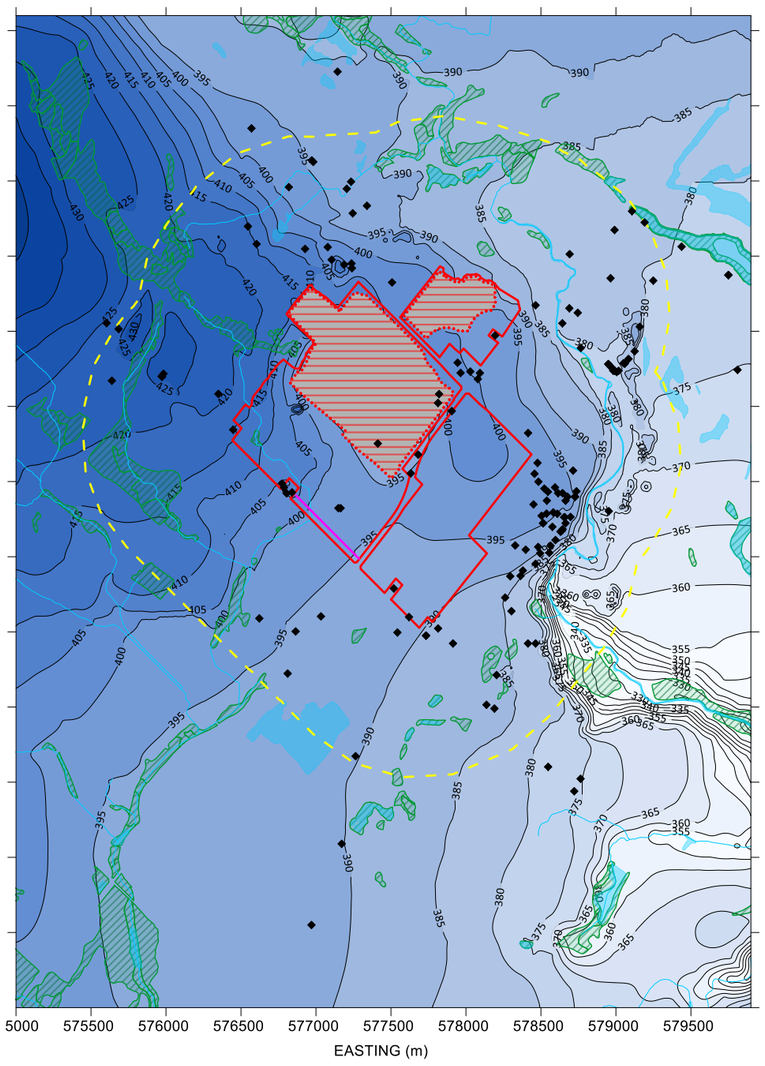
TITLE
PHASE 2 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2B

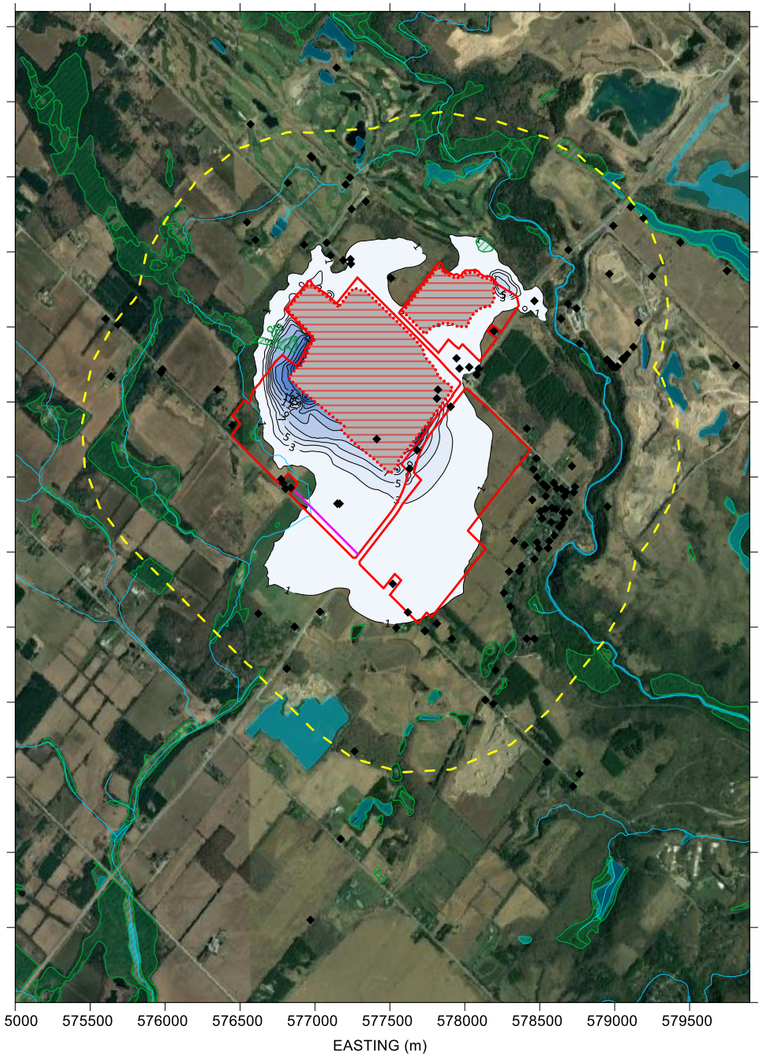
CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 3 SIMULATED WATER TABLE (masl)



PHASE 3 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic water table elevation is shown at a contour interval of 5m
2. Simulated water table drawdown is shown at a contour interval of 2m.
3. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

CLIENT
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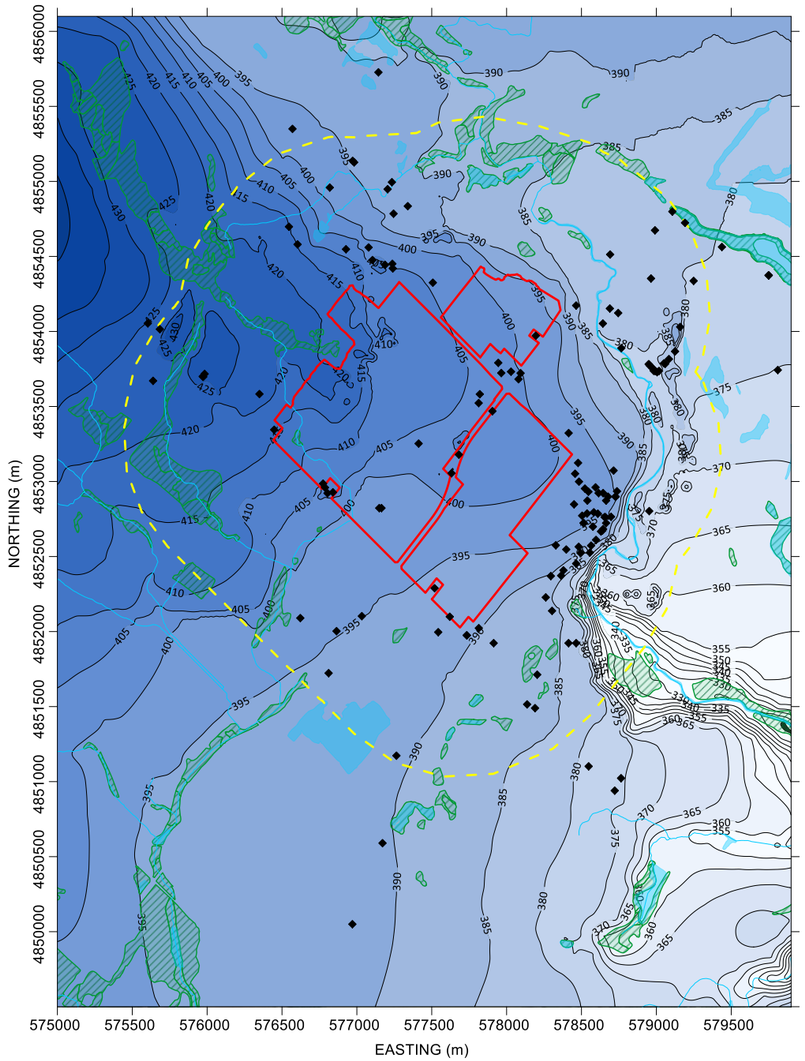
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

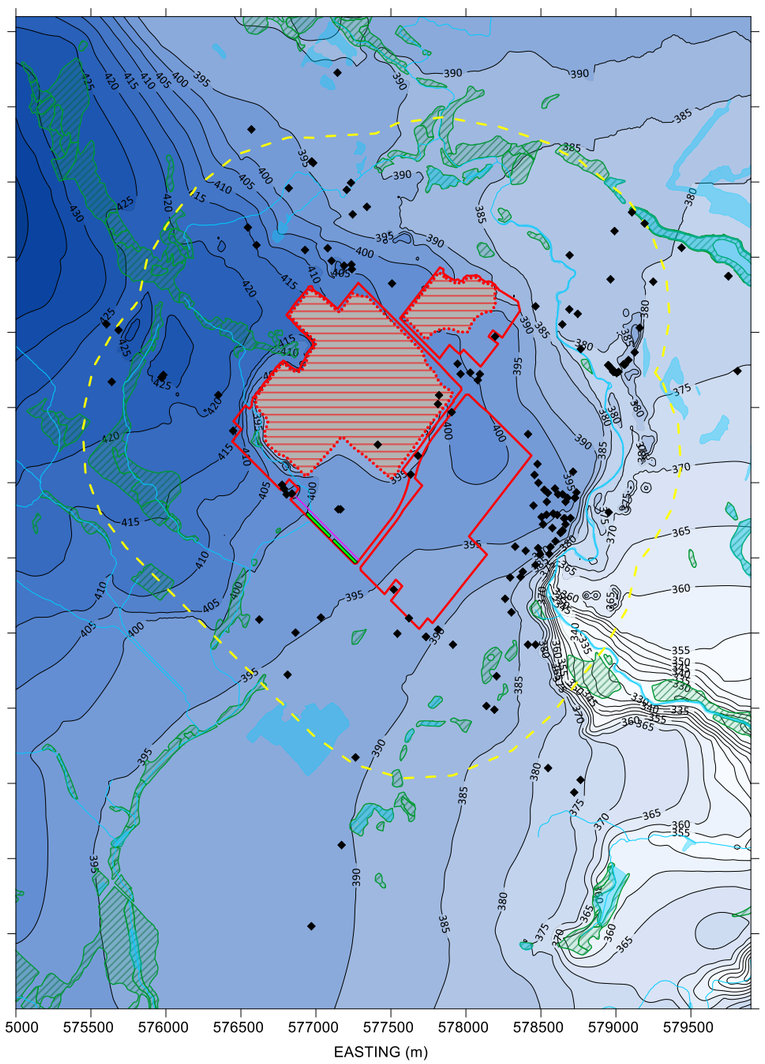
TITLE
PHASE 3 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2C

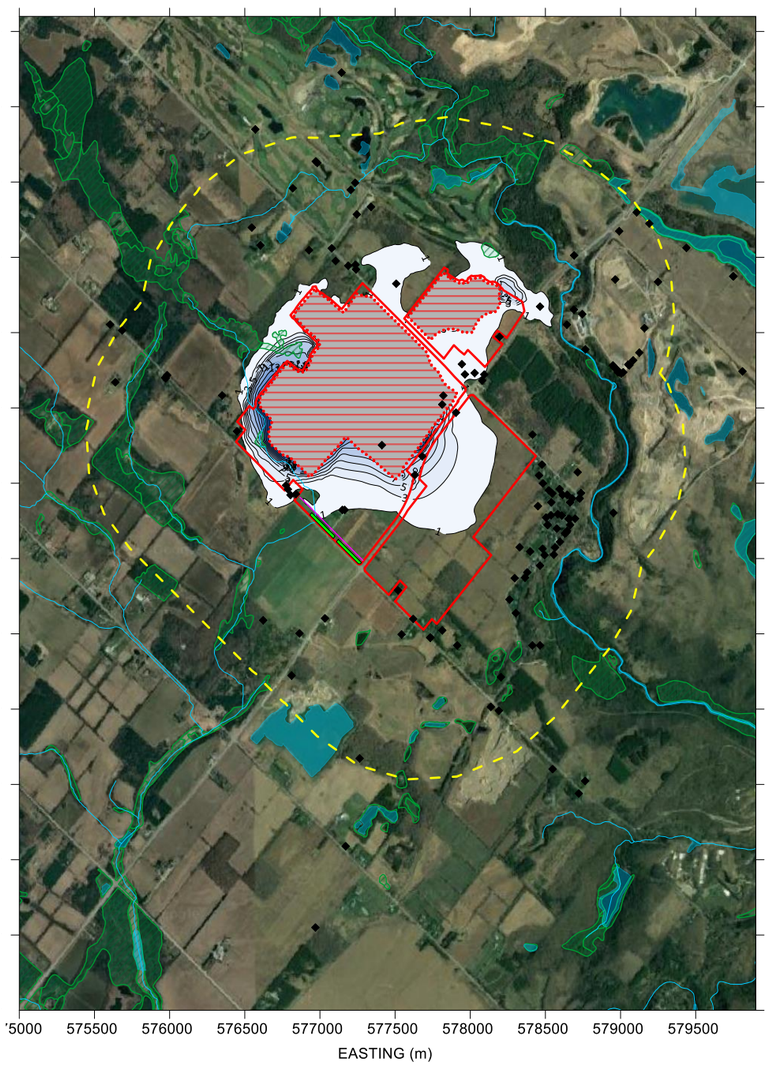
CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 4 SIMULATED WATER TABLE (masl)



PHASE 4 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic water table elevation is shown at a contour interval of 5m
2. Simulated water table drawdown is shown at a contour interval of 2m.
3. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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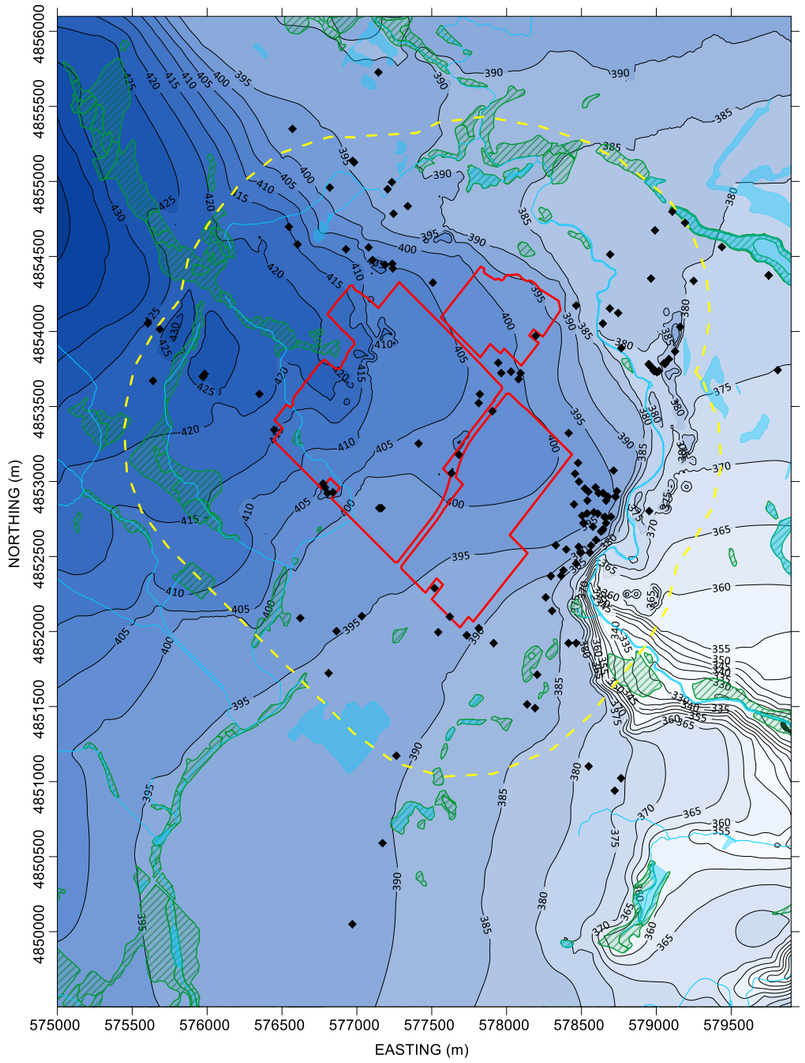
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

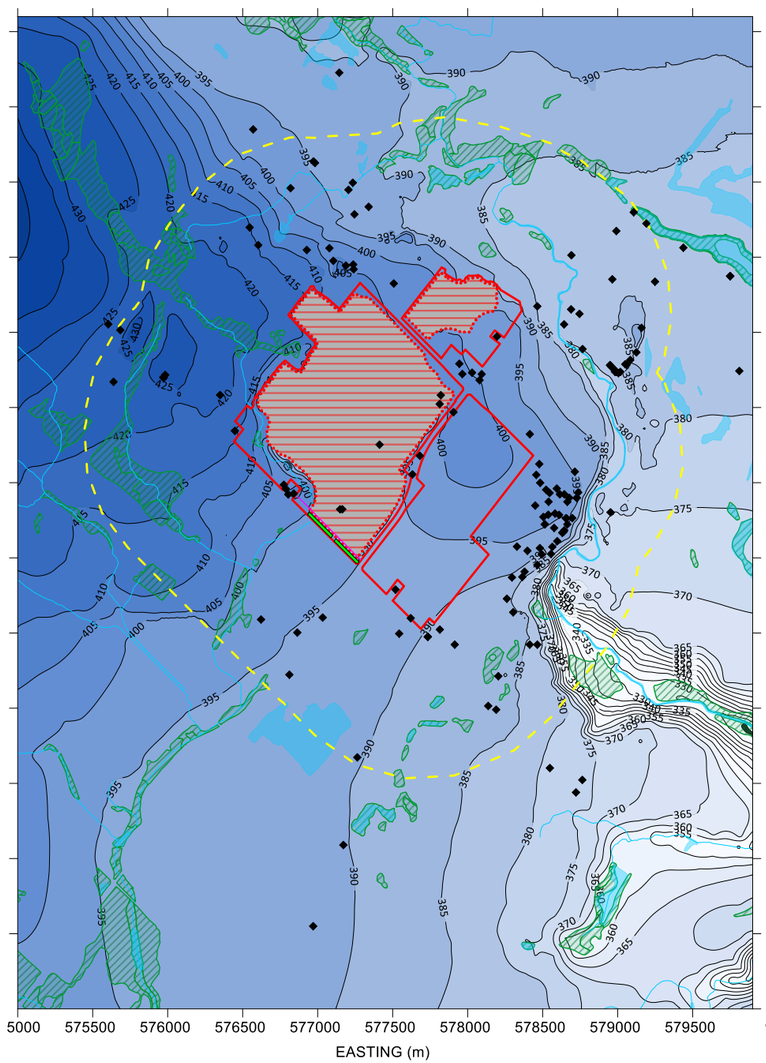
TITLE
PHASE 4 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2D

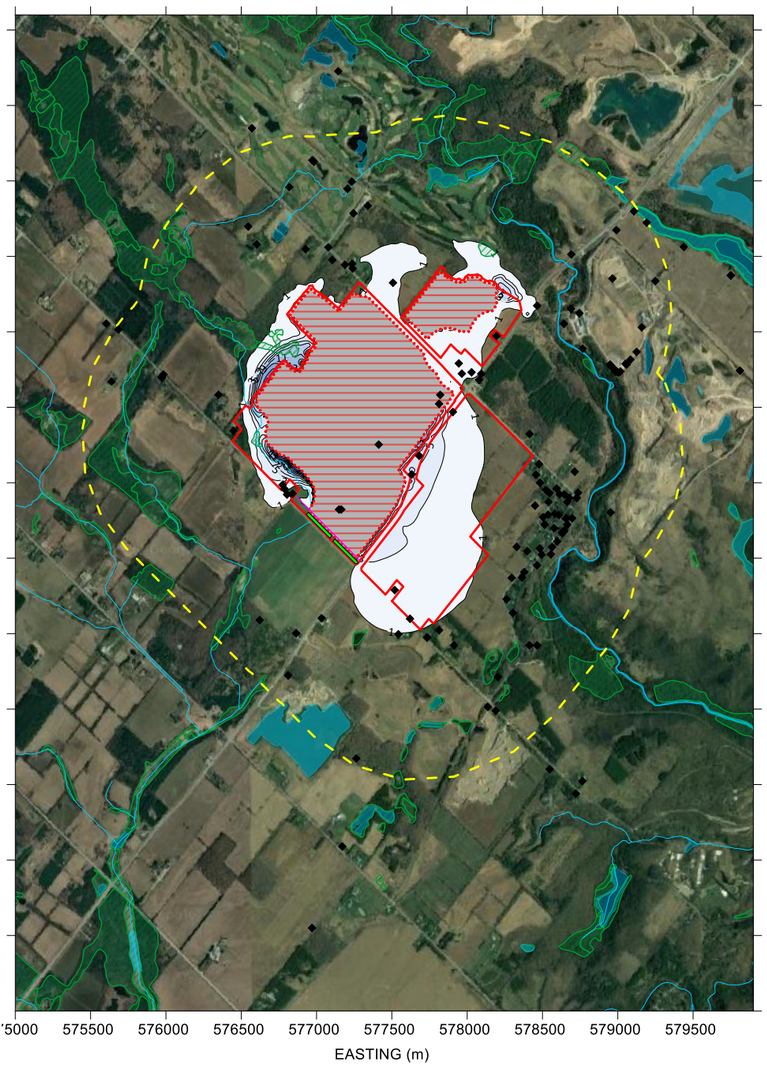
CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 5 SIMULATED WATER TABLE (masl)



PHASE 5 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic water table elevation is shown at a contour interval of 5m
2. Simulated water table drawdown is shown at a contour interval of 2m.
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4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

CLIENT
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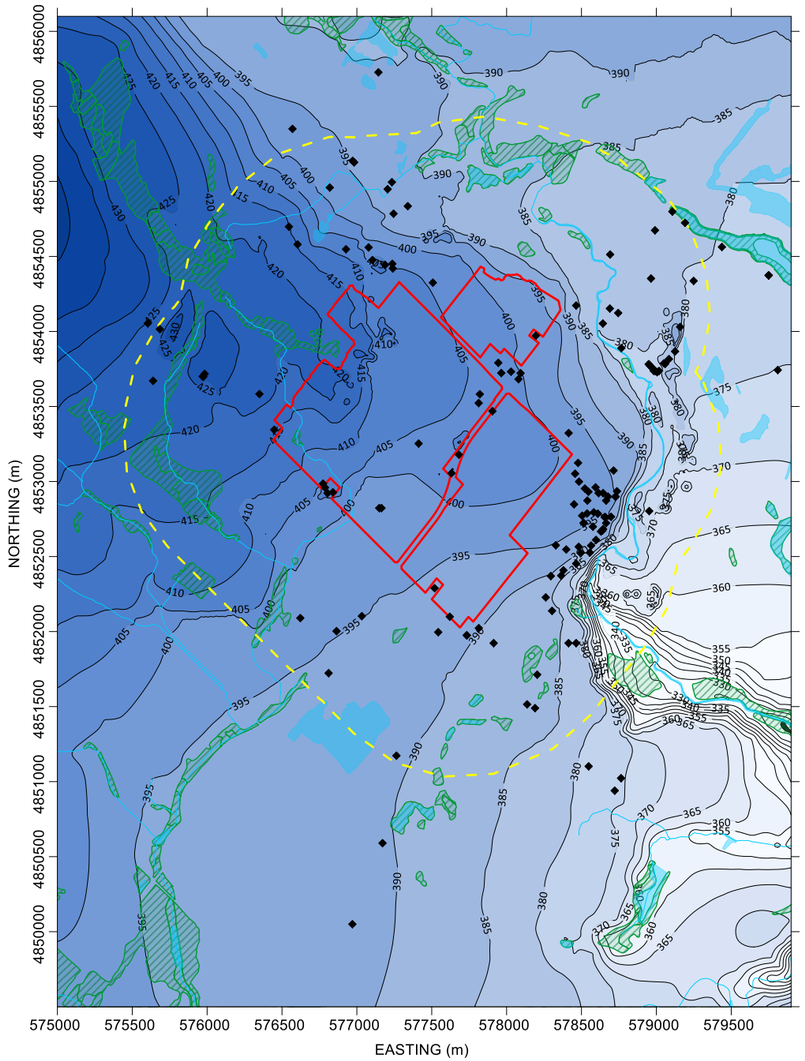
YYYY-MM-DD	2023-03-24
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

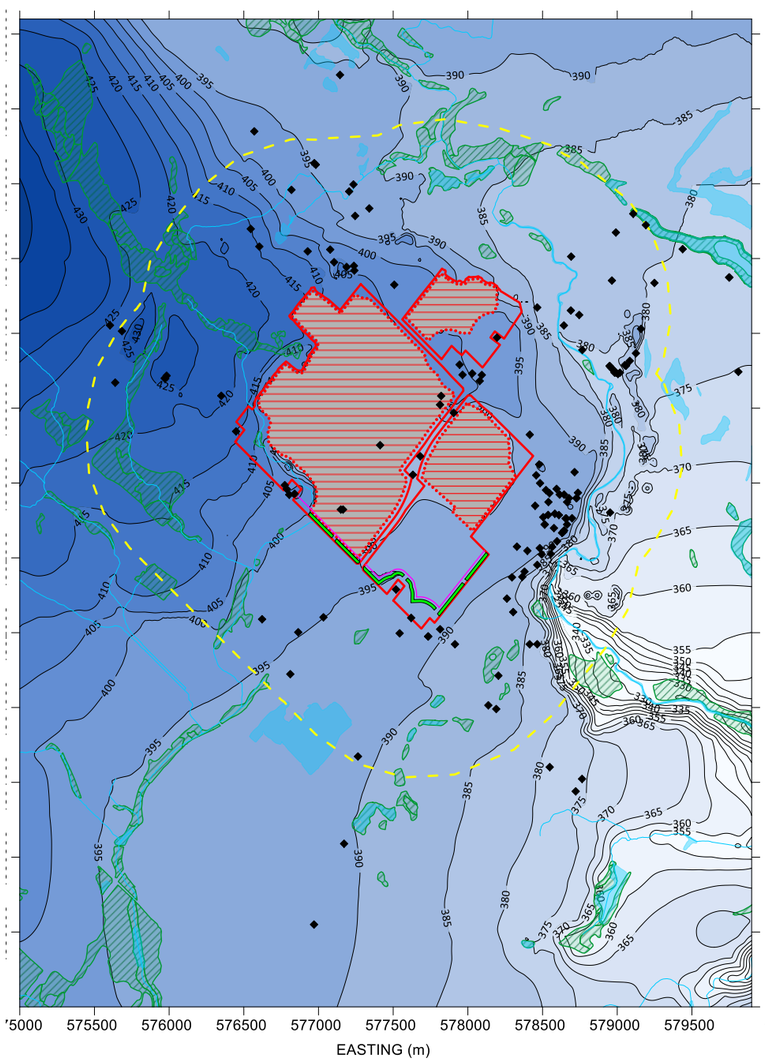
TITLE
PHASE 5 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2E

CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 6 SIMULATED WATER TABLE (masl)



PHASE 6 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic water table elevation is shown at a contour interval of 5m
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4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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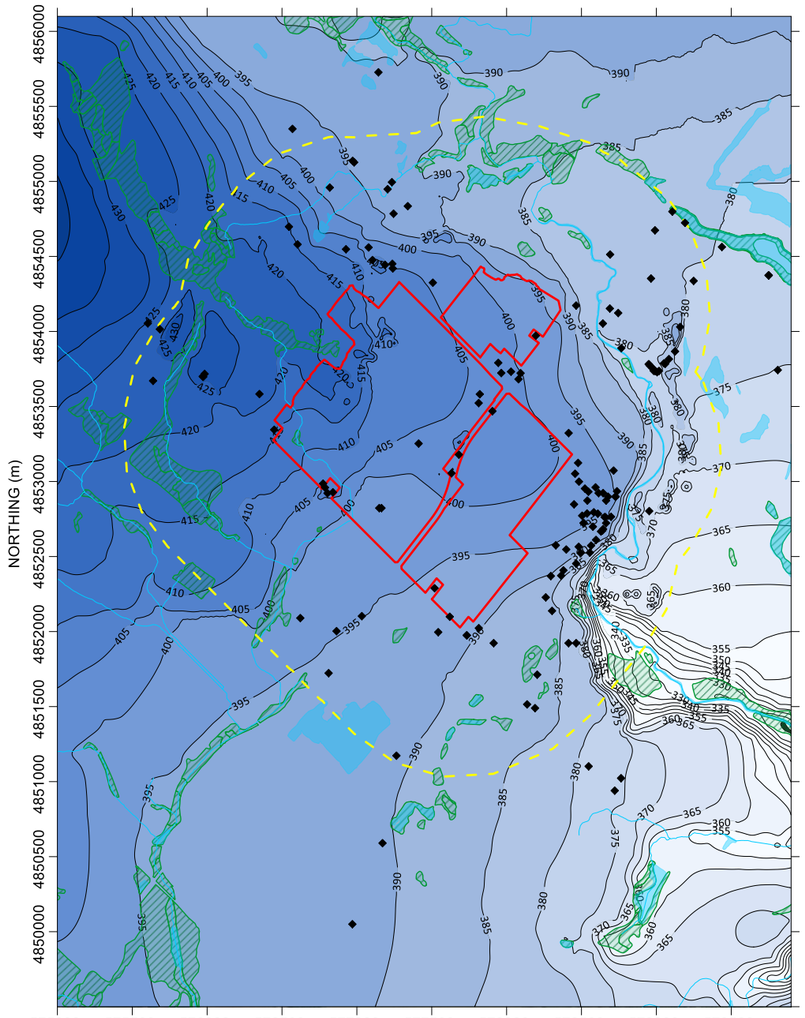
YYYY-MM-DD	2023-03-24
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

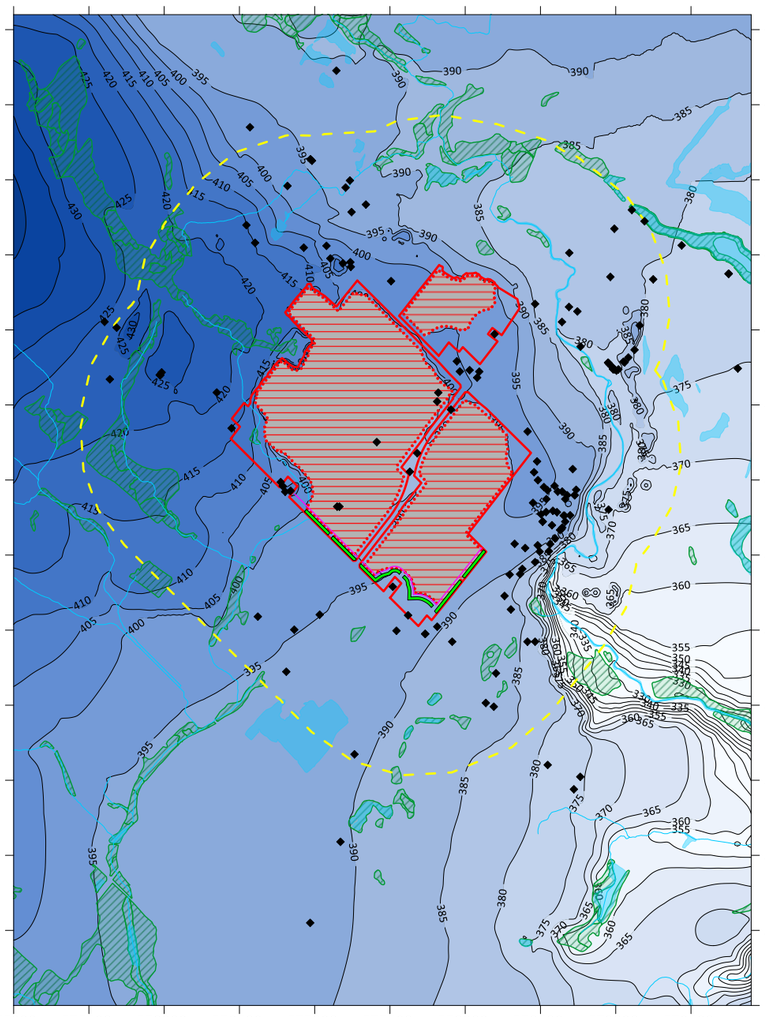
TITLE
PHASE 6 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2F

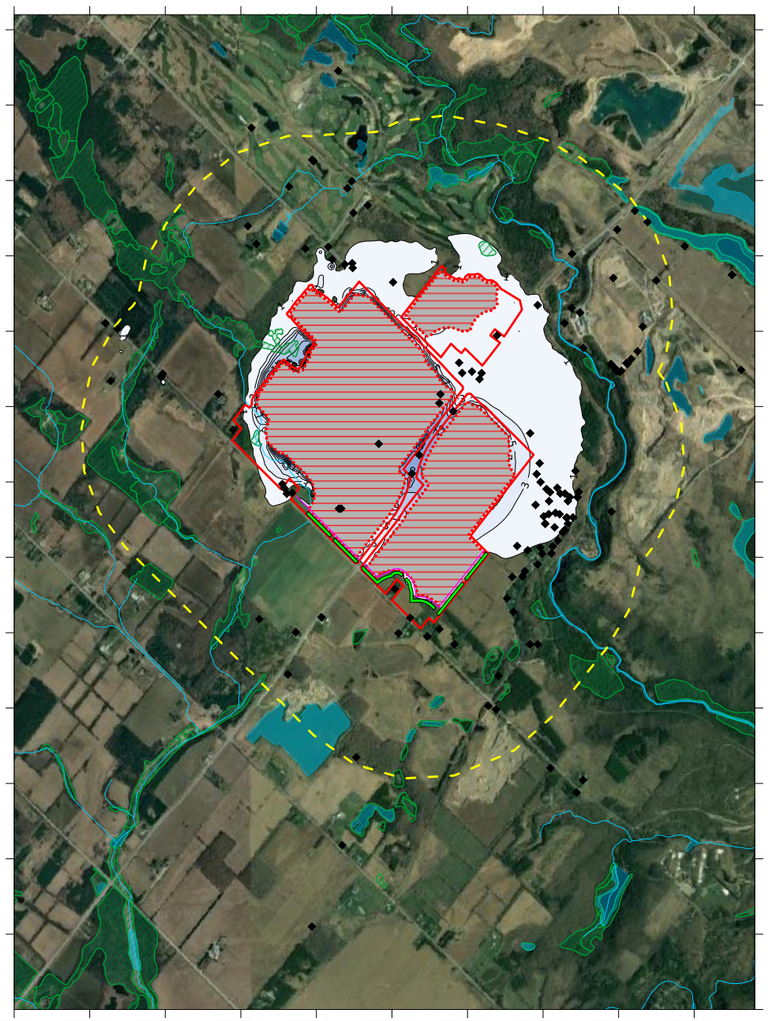
CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



PHASE 7 SIMULATED WATER TABLE (masl)



PHASE 7 SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

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4. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

CLIENT
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GOLDER
MEMBER OF WSP

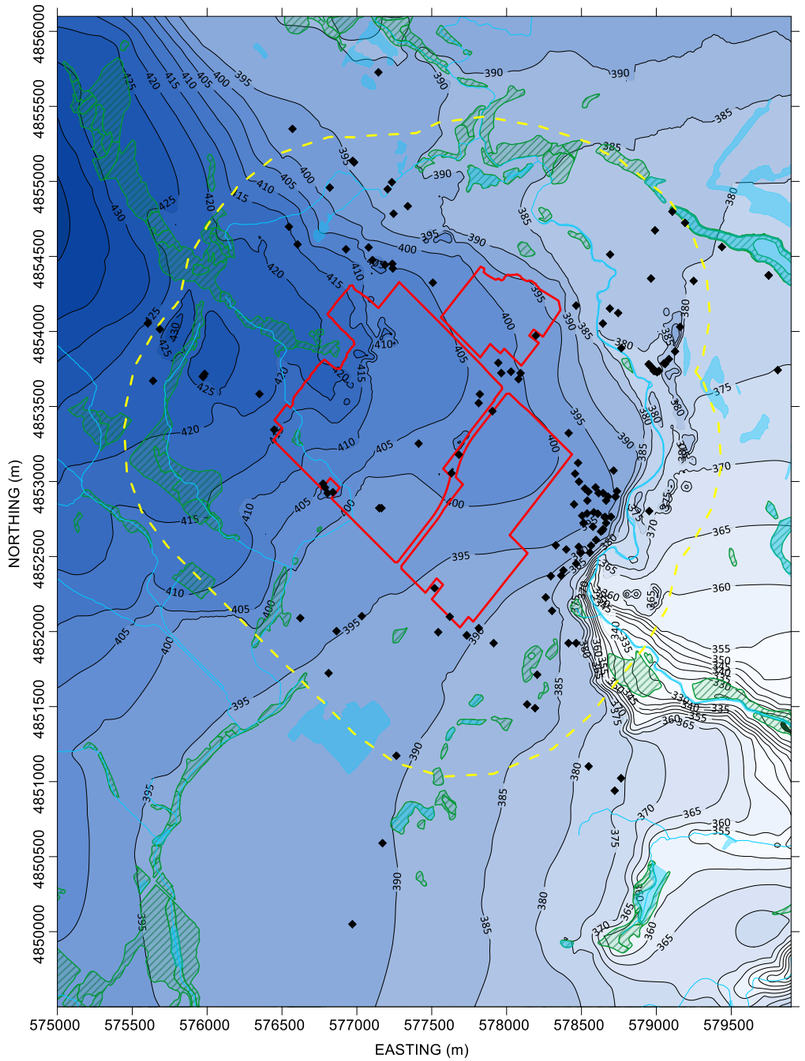
YYYY-MM-DD	2023-05-10
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

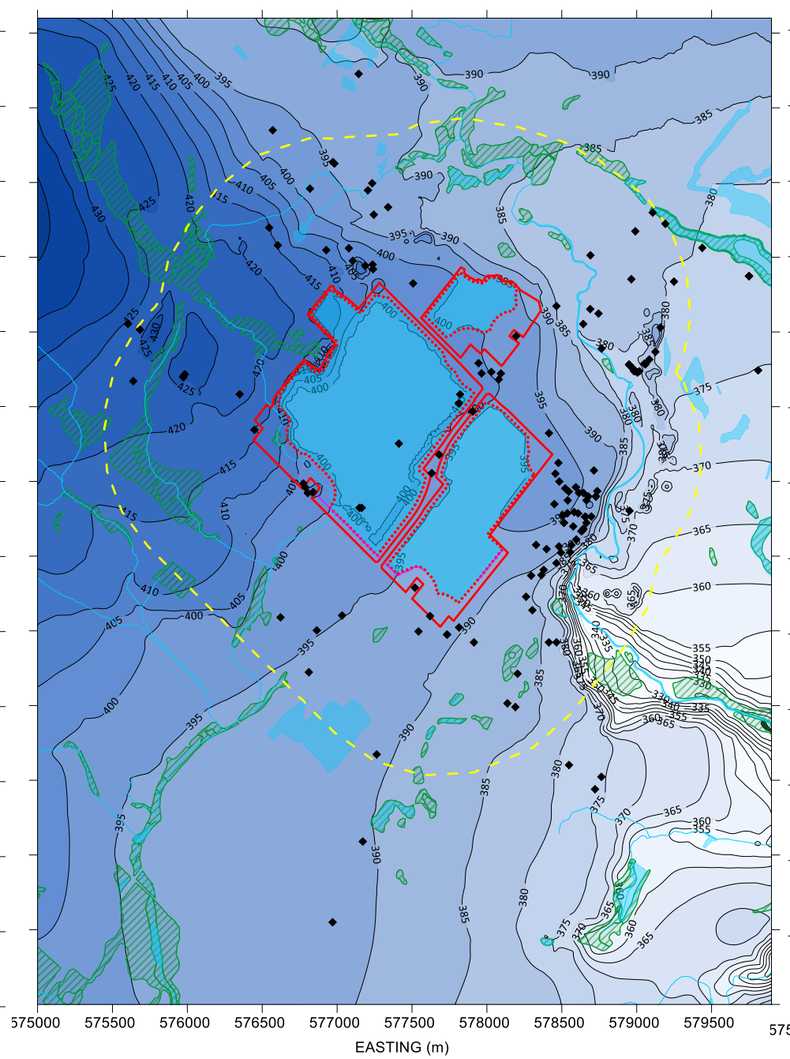
TITLE
PHASE 7 SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2G

CURRENT CONDITIONS SIMULATED WATER TABLE (masl)



REHABILITATION SIMULATED WATER TABLE (masl)



REHABILITATION SIMULATED WATER TABLE DRAWDOWN (m)



SIMULATED WATER TABLE ELEVATION (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

SIMULATED WATER TABLE DRAWDOWN (m)

-17 -15 -13 -11 -9 -7 -5 -3 -1 1 3 5 7 9 11 13 15 17

LEGEND

- LAKES
- RIVERS/ STREAMS
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
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7	33 to 38

NOTES

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CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
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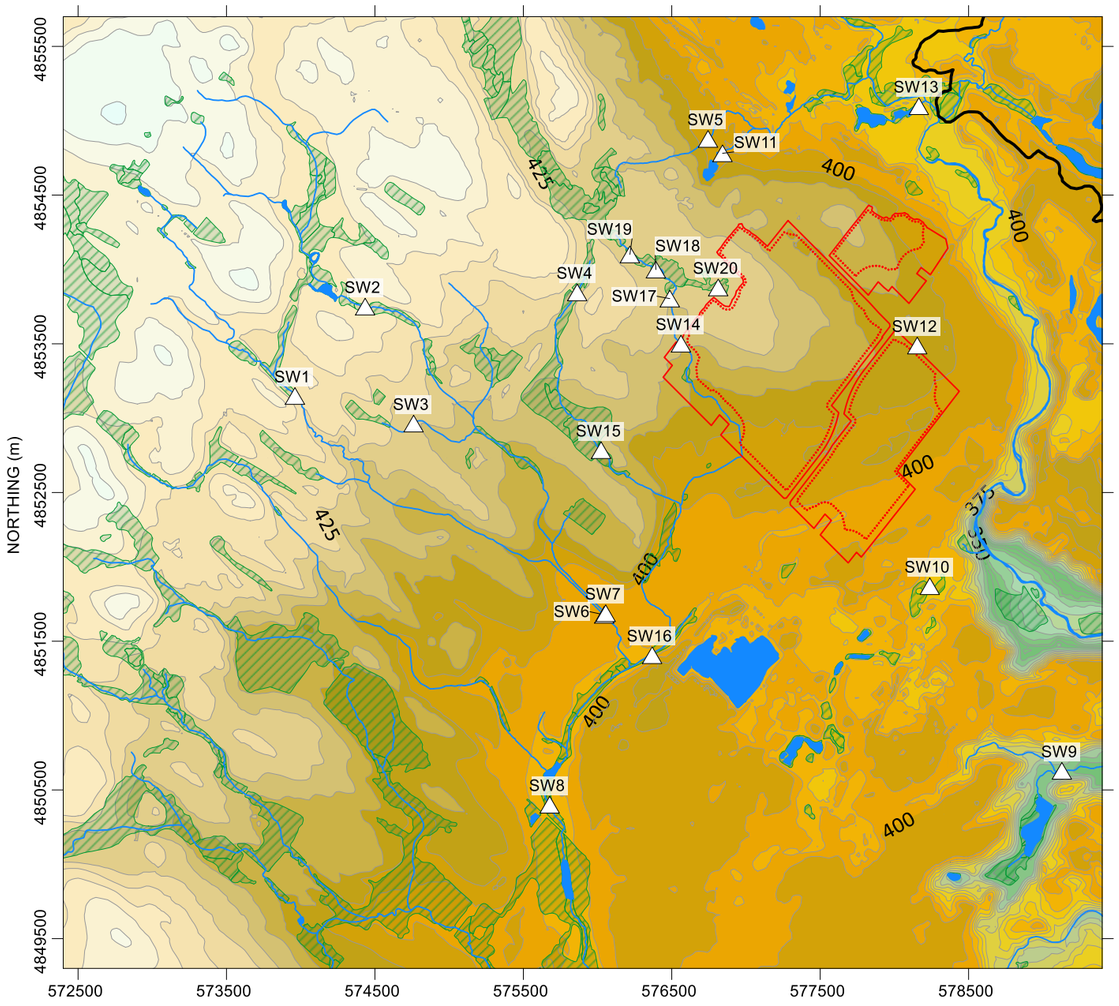
YYYY-MM-DD	2023-05-10
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
REHABILITATION SIMULATED WATER TABLE ELEVATION AND DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-2G

SURFACE WATER MONITORING STATIONS



CURRENT CONDITIONS TOPOGRAPHY (MASL)

300 315 330 345 360 375 390 405 420 435 450 465 480

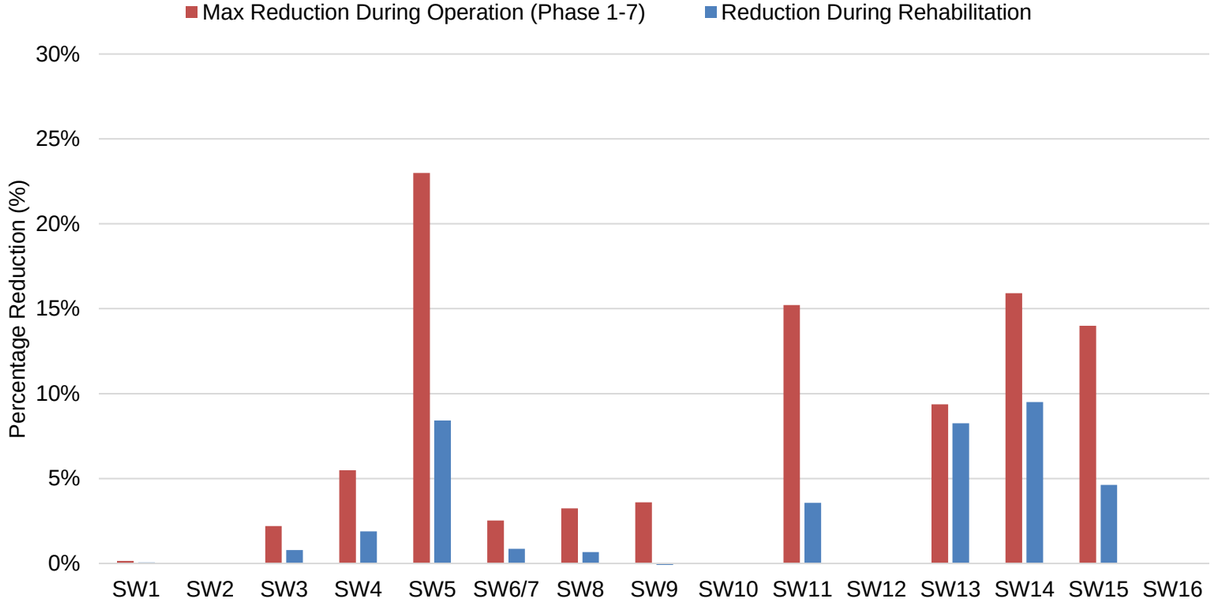
NOTES:

1. Simulated surface water flows for phases 1-7 and rehabilitation represent long term average (steady state) values
2. Several surface water stations have a current conditions simulated flow of 0.00 L/s (SW2, SW10, SW12 and SW16), and continue to have a simulated flow of 0.00 L/s throughout quarry operation and rehabilitation

SIMULATED REDUCTION IN SURFACE WATER FLOW THROUGH VARIOUS QUARRY PHASES AND AT REHABILITATION

Station	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Rehab
SW1	0%	0%	0%	0%	0%	0%	0%	0%
SW2	0%	0%	0%	0%	0%	0%	0%	0%
SW3	0%	-1%	-1%	-2%	-2%	-2%	-1%	-1%
SW4	0%	-2%	-2%	-5%	-4%	-4%	-3%	-2%
SW5	-2%	-18%	-12%	-23%	-16%	-16%	-14%	-8%
SW6/7	0%	-1%	-1%	-3%	-2%	-2%	-1%	-1%
SW8	-2%	-3%	-3%	-2%	-3%	-1%	-1%	-1%
SW9	-2%	-3%	-3%	0%	-4%	1%	0%	0%
SW10	0%	0%	0%	0%	0%	0%	0%	0%
SW11	-1%	-15%	-6%	-7%	-6%	-6%	-6%	-4%
SW12	0%	0%	0%	0%	0%	0%	0%	0%
SW13	-6%	-9%	-8%	-7%	-7%	-7%	-9%	-8%
SW14	-1%	-8%	-16%	-16%	-14%	-14%	-12%	-10%
SW15	-1%	-5%	-5%	-14%	-9%	-9%	-8%	-5%
SW16	0%	0%	0%	0%	0%	0%	0%	0%

SIMULATED PERCENT REDUCTION IN SURFACE WATER FLOW: MAXIMUM DURING OPERATION, AND REHABILITION PHASES



LEGEND

- LAKES
- RIVERS/ STREAMS
- WETLAND
- SITE PROPERTY BOUNDARY
- EXTRACTION EXTENTS
- SURFACE WATER MONITORING STATION

ADDITIONAL MAP NOTES

4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
6. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
7. Quarry license and limit of extraction provided by MHBC (2022)

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

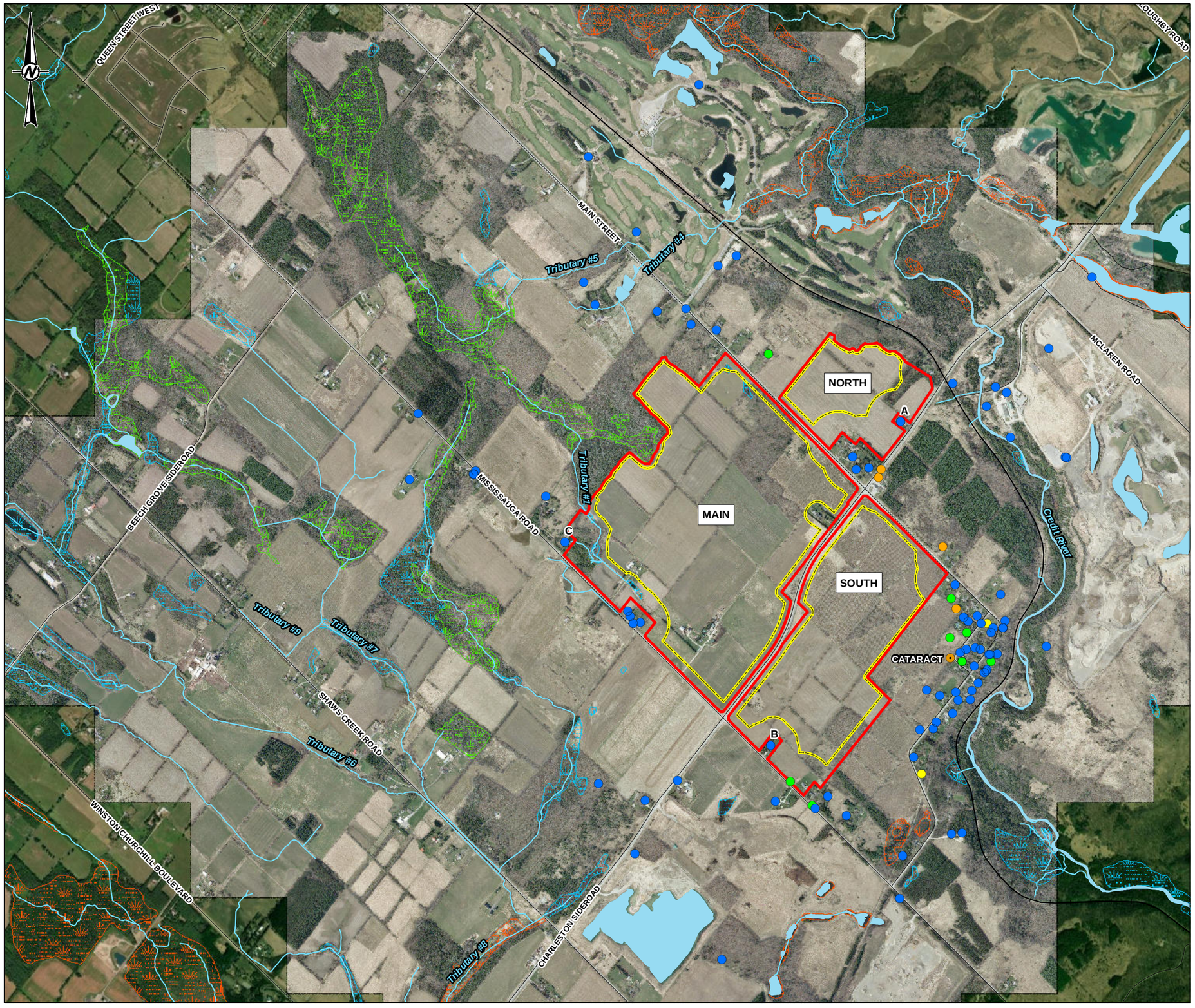
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2024-05-10
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY

TITLE
SIMULATED CHANGE IN SURFACE WATER FLOW AT MONITORING STATIONS

PROJECT No. 19129150 | Rev. 0 | FIGURE 8-3



LEGEND

- TOWN/VILLAGE

POTENTIAL FOR IMPACT TO WATER USER

- NEGLIGIBLE POTENTIAL
- LOW POTENTIAL
- MODERATE POTENTIAL
- SIGNIFICANT POTENTIAL
- NON-WATER SUPPLY WELL
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

TITLE
WATER SUPPLY WELL IMPACT ASSESSMENT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-19
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	9-1

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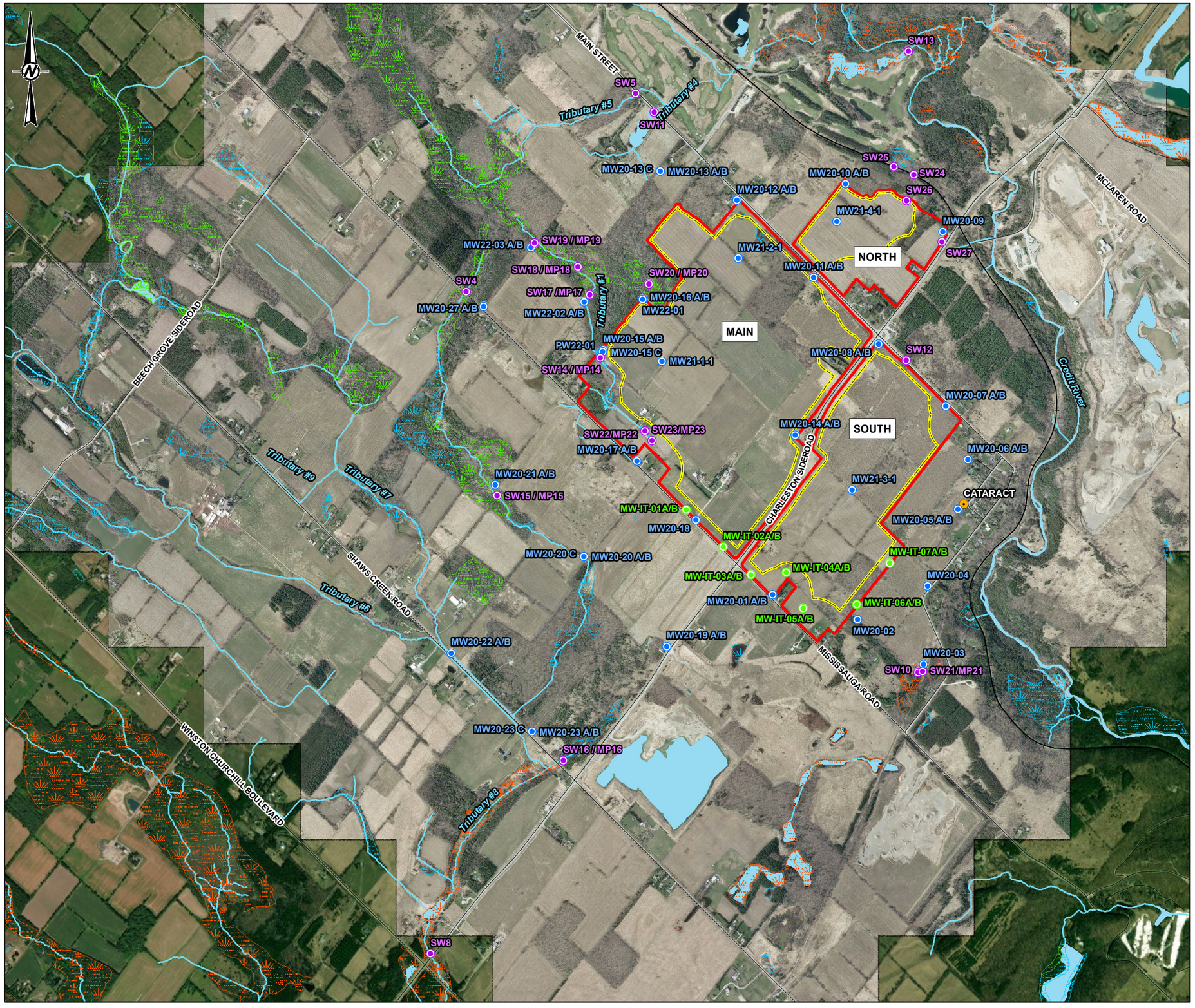

LEGEND

- TOWN
- INFILTRATION TRENCH MONITORING WELL
- MONITORING WELL
- SURFACE WATER STATION
- ROAD
- RAILWAY
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENSE AND EXTRACTION LIMIT PROVIDED BY MHBC IN JUNE 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

TITLE
PROPOSED MONITORING PROGRAM

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-24
DESIGNED	CGE
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	9-2

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APPENDIX A

Terms of Reference

TECHNICAL MEMORANDUM

DATE August 24, 2022 **Project No.** 19129150

TO David Hanratty, PGeo
CBM Aggregates

CC Jennifer Deleemans, Mike Lebreton

FROM Heather Melcher **EMAIL heather_melcher@golder.com**

PROPOSED CBM CALEDON QUARRY TERMS OF REFERENCE – WATER RESOURCES AND NATURAL ENVIRONMENT

Golder Associates Ltd. (Golder) has been retained by CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada) to complete technical studies to accompany an application to the Ministry of Natural Resources and Forestry (MNRF) for a new Class A Quarry Below Water licence under the *Aggregate Resources Act* (ARA) (project). The assessment will also be used for a Planning Act approval and application for Town of Caledon Official Plan and Zoning By-law amendment. Furthermore, these studies will provide an assessment of the application taking into consideration the applicable in-effect policies contained in the relevant Provincial Plans, Region of Peel Official Plan and Town of Caledon Official Plan.

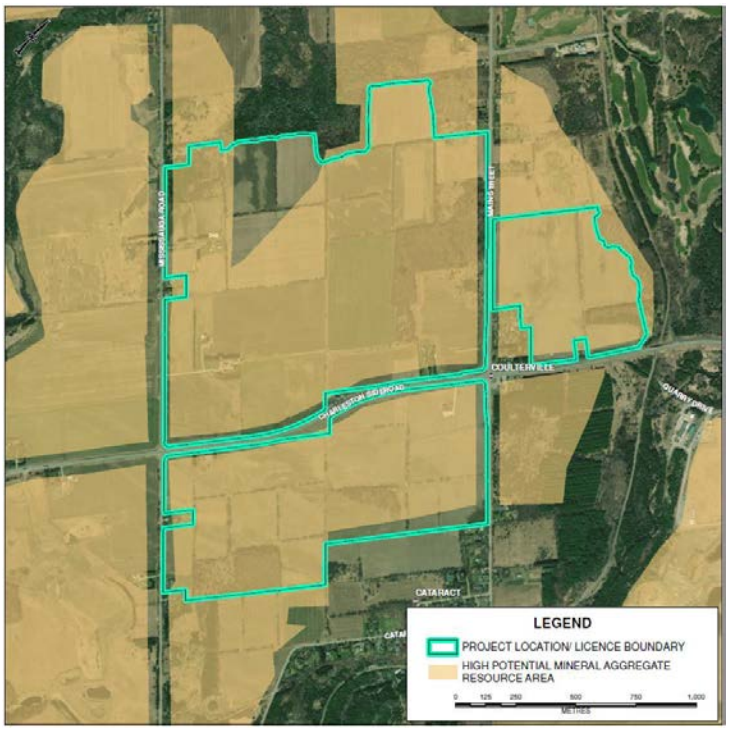


Figure 1: Proposed CBM Caledon Quarry Location

Golder Associates Ltd.
6925 Century Avenue, Suite #100 Mississauga, Ontario, L5N 7K2 Canada T: +1 905 567 4444 +1 905 567 6561

Golder and the G logo are trademarks of Golder Associates Corporation

The properties to be licensed are located on Charleston Sideroad and Mississauga Road, Town of Caledon, Region of Peel, Ontario (site). The site is approximately 262.4 hectares (ha) in size (Figure 1).

This Terms of Reference (TOR) includes a summary of the assessment and deliverables associated with the water resources and natural environment components.

On June 2, 2021, CBM submitted to Credit Valley Conservation (CVC), the Town of Caledon, and the Region of Peel an earlier version of this TOR document, as requested during a meeting held on April 22, 2021. Comments were received from CVC on the TOR on July 9, 2021. Comments were also recently received from the Region of Peel on July 11, 2022. Golder has incorporated these comments into this TOR document, where applicable.

1.0 WATER RESOURCES

Groundwater and surface water resource investigations will be undertaken in accordance with the Technical Reports and Information Standards published by the MNRF in August 2020, with the following technical reports being prepared by qualified persons upon completion of the investigations.

Maximum Predicted Water Table Report

This report will detail how the maximum predicted water table is identified in metres above sea level, relative to the proposed depth of excavation at the site, and will be determined by monitoring the groundwater table for a minimum of one (1) year to account for seasonal variations and influences due to precipitation.

Water Report Level 1 and 2 (combined)

Level 1 – This assessment will determine the potential for impacts to groundwater and surface water resources and their uses (including water wells, groundwater aquifers, surface water courses and bodies, springs, discharge areas) and will identify if the site is in a Wellhead Protection Area for Quantity (WHPA-Q) under the Clean Water Act. If so, the report will identify applicable source water protection policies and mitigation measures that will be implemented.

Level 2 – Where the Level 1 assessment has identified a potential for impacts from the site on groundwater and/or surface water resources and their uses, an impact assessment will be carried out to determine the significance of the effect and the potential for mitigation. The assessment will address the potential effects of the operation on groundwater and surface water features located within the zone of influence, including but not limited to:

- Water wells (includes all types e.g., municipal, private, industrial, commercial, geothermal and agricultural);
- Springs (e.g., place where ground water flows out of the ground);
- Aquifers;
- Surface water courses and bodies (e.g., lakes, rivers, brooks); and
- Wetlands.

The assessment will include (but not be limited to) the following:

- A description of the physical setting including local geology, hydrogeology, and surface water systems;
- Any proposed water diversion, discharge, storage and drainage facilities;
- A water budget (e.g., how water is managed on-site);
- The possible positive or negative impacts that the proposed site may have on the water regime;
- Monitoring and mitigation plan(s); and
- Technical supporting data in the form of tables, graphs and figures.

Greenbelt Plan Considerations

The scope of the planned groundwater and surface water investigations will also address key hydrologic areas and features, as described in the Greenbelt Plan (2017). Key hydrogeologic areas are areas which contribute to the hydrologic functions of the Water Resource System. These areas maintain ground and surface water quality and quantity by collecting, storing and filtering rainwater and overland flow, recharge aquifers and feed downstream tributaries, lakes, wetlands and discharge areas. These areas are also sensitive to contamination and feed key hydrologic features and drinking water sources.

Key hydrologic areas include:

- Significant groundwater recharge areas;
- Highly vulnerable aquifers; and
- Significant surface water contribution areas.

Key hydrologic features within these areas include:

- Permanent and intermittent streams;
- Lakes (and their littoral zones);
- Seepage areas and springs; and
- Wetlands.

For lands within a key hydrologic feature in the Protected Countryside, it is noted that development or site alteration is permitted for aggregate extraction, subject to the non-renewable resource policies set out in Section 4.3.2 of the Greenbelt Plan.

Caledon Official Plan Considerations

The scope of the planned groundwater and surface water investigations will also address the requirements for development within valley and stream corridors as set out in Section 3.2.5 of the Town of Caledon Official Plan (2018). This includes the following considerations:

- The quality and quantity of surface water entering valley and stream corridors are to be maintained, and, where appropriate, enhanced and restored.

- Restoration and enhancement of valley and stream corridors is encouraged. Where appropriate, a riparian habitat zone will be maintained or established on lands abutting watercourses and waterbodies.
- Management and restoration of valley and stream corridors will adhere to the Town's ecosystem principle, goals, objectives, policies and performance measures.

Other Considerations

The groundwater and surface water investigations will be undertaken at the scales necessary to characterize groundwater and surface water conditions potentially impacted by the proposed quarry, including the immediate site, zone of influence and surrounding subwatershed scales, where information is available and relevant to the assessment of impacts.

The predicted zone of influence of the quarry will ultimately be determined through the hydrogeologic and surface water assessments, and as such, a pre-defined maximum zone of influence is not assumed. Justification of the proposed extent and scale of the investigation and analysis undertaken will be provided in the Water Report.

The impact assessment will evaluate the potential for cumulative impacts of the proposed quarry where information for the assessment of cumulative impacts is available and relevant to the impact assessment, including groundwater quantity, groundwater users and total groundwater use in the broader subwatershed).

The study will also assess the potential impact of the quarry in relation to future climate change, including a drought scenario, if considered applicable.

1.1 Hydrogeologic Investigation

The hydrogeologic investigation is a key component of the overall program to support the licence application. The hydrogeologic investigation program integrates with the surface water and natural environment studies. The key components of the hydrogeologic investigation are summarized below.

A karst assessment will also be completed as part of the hydrogeologic investigation which will include: an investigation of closed depressions and surface water flows, tracer tests and conductivity profiling in wells during the planned pumping tests, an evaluation of the proportions of surface water and groundwater flows in the study area, and an assessment of evidence potentially indicative of preferential flow in the bedrock aquifer.

1.1.1 Initial Activities

A detailed background review of hydrogeological information will be carried out initially, including the following:

- LIO SWOOP Topographic Data;
- OGS Surficial geology;
- OGS Bedrock geology;
- OGS Drift thickness;
- MECP Water Well Records;
- MECP PTTWs;
- AquaResource Integrated Water Budget Report - Tier 2, Credit Valley Source Protection Area;

- Information from previous site investigations Credit Valley Conservation (CVC) Subwatershed Study Reports;
- CVC Source Protection Area and CTC Source Protection Region Assessment Reports; and
- Other websites with information on water taking activities and natural features in the study area.

Published geological data for the area provides an initial understanding of the distribution of overburden on the site, the depth to bedrock, the thickness of the Gasport (formerly Amabel) Formation and approximate elevation of the base of the Gasport (formerly Amabel) Formation, and an initial understanding of groundwater elevations across the area.

The hydrogeological information compiled during the background review will be presented as a series of maps and will establish a framework for the refinement and finalization of the field investigations.

Initial activities will also include site reconnaissance of the area to help verify information obtained during the background review and support finalization of the field investigations.

A survey of private wells within 1 km of the site will also be undertaken.

1.1.2 Monitoring Well Installation and Testing

Twenty-eight monitoring well locations will be drilled, to an approximate depth of 30 m (assumed 5 m of overburden, on average, and 25 m of rock). All locations in the monitoring network will be surveyed for location and elevation. Further details of the proposed monitoring well network are provided in Attachment A.

Drilling, Core Logging and Photography

The drilling will be carried out under Golder supervision using Choice Sonic Drilling Ltd. (CSD), obtaining 100 mm continuous core through the overburden and HQ-sized (63.5 mm) continuous core in the bedrock. All cores will be logged and photographed. Overburden core will be bagged, and rock core will be boxed (1.5 m boxes holding a total of 3 m of core per box).

Following coring, the rock boreholes will be reamed to 120 mm to facilitate monitoring well installation. A surface casing will be installed into the top of rock to provide access for geophysical logging and hydraulic (packer) testing, and for monitoring well installation.

Geophysical Logging

Geophysical logging will be carried out immediately following the coring of the drillholes, and will consist of collecting natural gamma, conductivity, heat pulse flowmeter (static and low pumping conditions), and optical televiewer (OTV) logs. The field work and analysis will be carried out in house by Golder staff using in house equipment. Results will be compiled and processed relatively quickly and used to help plan the hydraulic (packer) testing program. All data will be processed and presented using WellCAD.

Hydraulic (Packer) Testing

Upon completion of geophysical logging, the boreholes will be packer tested. We will complete up to three interval tests per borehole using straddle packers (nominally spaced at 5 m), testing from the bottom of the hole up to the highest level possible within the water column. Using the geological and hydrogeological information obtained

from coring and geophysics, the tests will be conducted within appropriate geologic intervals (i.e., within the Gasport (formerly Amabel) or within the underlying strata).

Monitoring Well Installation and Instrumentation

Each of the 28 boreholes will be completed with two piezometers. The piezometers will typically have 1.5 m well screens and be 32 mm in diameter. The wells will be constructed by a licensed well driller using filter sand, bentonite pellets and grout, and completed at surface with a lockable protective casing and registered in the MECP system with a well tag.

We understand that it is important to obtain hydraulic information in the Gasport (formerly Amabel), and underlying Clinton and Cataract Groups, and propose that each piezometer nest target two of the three zones, to provide overall coverage of hydraulic heads in all three zones (i.e., 56 piezometers will provide the ability to have about 18 monitors in each of these three zones).

Single-well Hydraulic Testing

All piezometers will be developed, and single well response tests completed in the piezometer. This will be carried out by using dedicated water level loggers, which will be left in place for the groundwater monitoring program. Hydraulic conductivity will be estimated from the tests, and used as input to the hydrogeological assessment, and groundwater-surface water modelling.

Water Quality Sampling

All wells will be completed with dedicated water sampling equipment (tubing and Waterra foot-valves) for groundwater sampling. The wells will be purged and then sampled following standard collection and sample handling protocols. All 56 piezometers will be sampled for general chemistry, nutrients, inorganics and metals (RCAP suite), and 28 of the wells will also be sampled for BTEX and PHC F1-F4. The analytical work will be carried out by BV Labs (formerly Maxxam Analytics) in Mississauga.

Analysis and Reporting

The data collected during the drilling and testing, and water sampling will be compiled and used to inform other investigations and be incorporated into the combined Water Report Level 1/2 and a Maximum Predicted Water Table Report.

1.1.3 Groundwater Monitoring Program

The groundwater monitoring program will take place from the point of drilling the wells until submission of the licence application package to the MNRF and include monitoring of the 56 piezometers at the 28 proposed monitoring well locations, in addition to monitoring springs and seeps located in areas along the Credit River, the Niagara Escarpment and the Alton Forest complex.

All wells and piezometers will be equipped with water level loggers, programmed to record at 15 minute intervals. Loggers will be downloaded quarterly, and manual water level measurements made to correlate to the logger data. A barologger station will be set up at the site to provide barometric corrections to the logger data. Hydrographs will be compiled on a quarterly basis.

Analysis and Reporting

The data collected during the groundwater monitoring program will be compiled and used to inform other investigations, provide important hydrogeological inputs to groundwater-surface water modelling and support the

hydrogeological impact assessment. The overall results will be incorporated into the Level 1 and 2 Water Report and . Maximum Predicted Water Table Report.

1.1.4 Pumping and Tracer Tests

Based on the data obtained during the monitoring well and resource investigations described above, locations to conduct pumping / tracer tests will be selected on the property. Up to four tests, if required, will be completed depending on the nature of hydrogeologic conditions on the site.

Combined pumping and tracer tests will help establish the transmissivity of the rock, as well as assess the potential connectivity of fractures in the rock mass to various natural environment features in the area. Four pumping / tracer tests will be performed, each of 96 hours in duration, as described below.

Install Pumping Wells and Offset Monitoring Wells

Once the number and location of the test areas have been determined, a 150 mm diameter pumping well will be installed at each test location (cased through the overburden and open in the bedrock), to an assumed depth of 30 m (assumed 5 m through overburden and 25 m in the rock). Up to four offset wells nests will also be installed at each location to the same assumed maximum depth, completing the open holes with two-level 32 mm diameter piezometers, in a manner similar to the other monitoring wells. Pumping and offset observation wells will be MECP registered and tagged.

Obtain Category 2 PTTW

Golder will prepare and submit EASR applications on behalf of VCNA for permits to take water (PTTW) for each of the four planned 96 hour tests.

Conduct Four (96 hour) Pumping and Tracer Tests

Once the pumping and offset observation wells have been installed and permits obtained, pumping and tracer tests will be carried out. An ecologically friendly tracer such as fluorescein would be introduced in one or more observation wells prior to the start of pumping, and the pumping well water monitored using a fluorometer or other appropriate device to detect the potential presence of traced water at the pumping well. Pumped water will be managed to ensure that it is not recirculated into the groundwater system during the test.

Groundwater levels at the pumping well, offset wells, and other monitoring wells will be monitored using data loggers and/or manual measurements during the test. Levels would also be monitored prior to the test for a minimum of 48 hours and immediately following the test for a period of 7 days, to monitor the recovery data.

It is proposed that the four tests will be completed a minimum of 3 weeks apart, which should allow time for water levels to recover to ambient between successive tests.

Analysis and Reporting

The data collected during the pumping / tracer tests will be compiled and used to inform other investigations, provide important hydrogeological inputs to groundwater-surface water modelling and support the hydrogeological impact assessment. The overall results will be incorporated into the Level 1/2 Hydrogeological Study Report.

1.1.5 Integrated Groundwater / Surface Water Modelling

An integrated, fully-coupled groundwater / surface water model will be developed to simulate current conditions and estimate future water quantity impacts as a result of quarrying. The modelling will be undertaken using the computer program HydroGeoSphere (HGS).

HGS has been successfully applied in water resource and mining applications at the watershed and subwatershed scale in Ontario and worldwide. Of particular note, HGS was given a comparatively favourable review in the MNRF-sponsored document *Integrated Surface and Groundwater Model Review and Technical Guide* (AquaResource, 2011).

HGS is a three-dimensional numerical code that can dynamically consider all major components of the hydrologic cycle, including: precipitation, evapotranspiration, snowmelt, overland flow, infiltration, unsaturated zone flow, and saturated groundwater flow. HGS may model flow within bedrock using an equivalent porous media (EPM) approach or a discrete fracture network; however, at the scale of this analysis we assume that an EPM approach is sufficient. HGS' fully inclusive treatment of the hydrologic system allows for a seamless and robust simulation of flow and water level behaviour within the watershed, including at quarries, streams, wetlands and within the subsurface.

The model will be constructed on the basis of both publicly available data and the results of the site-specific geology and water resources field assessments, including: Digital Elevation Model (DEM) topography, government mapping and databases (e.g., Ministry of Environment, Conservation and Parks [MECP], Water Well Information System [WWIS] and Permit To Take Water [PTTW] databases), background data/reporting including CVC source water protection modelling, climate data, subcatchment delineations and water budgets, drilling data including geologic picks and hydrostratigraphic unit characterization, geophysical testing, packer testing, pumping tests, spring reconnaissance and measured groundwater levels and surface water levels / flows. The model will be calibrated to field observations in both steady-state (long-term average) and transient settings at appropriate time scale(s).

The modelling assessment will consider the following base simulations:

1) Existing Conditions (calibrated model)

2) Full Build-Out Operations (maximum extraction and dewatered state)

3) Full Rehabilitation (all rehabilitative measures, including backfilling and flooding, in-place)

The modelling will examine potential impacts under both average annual steady-state and transient (likely monthly) conditions for each scenario. Modelled effects will include drawdown and flow changes at key receptors including PTTW permit holders, private water wells, wetlands, streams and the Credit River as well as any interaction with pre-existing source protection plans and policies. The modelling may also include, at a relatively coarse scale, other major water users within the zone of influence and will thus be able to address cumulative impacts.

After the base scenarios have been finalized, a sensitivity analysis will be performed to better understand potential upper and lower bounds to potential impacts.

1.1.6 Impact Assessment and Hydrogeological Reporting

The results of the various geological and hydrogeological field investigations, monitoring, pumping and tracer testing, and integrated groundwater-surface modelling will be brought together to complete a hydrogeologic impact assessment. The hydrogeologic impact assessment and its supporting studies will inform the natural environment studies and provide the basis for preparing the combined Level 1 and 2 Water Report and a Maximum Predicted Water Table for a Class A, Quarry Below Water licence application under the Aggregate Resources Act.

If the assessment identifies a potential for impacts, mitigation measures and/or an adaptive management plan, if required, will be identified in the report.

1.2 Surface Water Resources Assessment

A surface water monitoring program and impact assessment will be completed for the site and surrounding catchment areas. The impact assessment and reporting for these tasks will be combined with the results of the hydrogeological assessment in the combined Water Report Level 2 and a Maximum Predicted Water Table Report.

1.2.1 Background Review

Golder will complete a background review of the available information pertaining to the site and surround area that may be within the zone of influence of the proposed quarry. The information reviewed will consist of:

- Aerial photographs and topographic, physiographic and geologic mapping;
- Water Survey or Canada and Credit Valley Conservation stream gauging data;
- Meteorological data from local CVC gauges (i.e., 1795 Quarry Drive, Town of Caledon, etc.);
- Ontario source water protection mapping;
- Published water resources reports; and
- Any existing permits or monitoring reports from the site.

Any additional work to fill data gaps identified as part of the background review will be included in a separate scope and budget.

1.2.2 Field Monitoring

A stream monitoring network will be established on the watercourses that drain the site and the areas of the proposed numerical model extents. We have assumed this will include 14 - 16 monitoring stations on tributaries to the Credit River. The exact number of stations and locations will be determined through the initial field reconnaissance that will be completed with the hydrogeology and natural environment component leads.

Manual water level (staff gauges) and flow measurements will be conducted at each station quarterly for a period of two years. Pressure transducers will be deployed at each station to develop a water level record for each station at 15-minute intervals. A barologger will also be installed at the site to provide atmospheric pressure compensation for the water level transducer data. Two on-site stations will be paired with mini-piezometers to better understand surface groundwater interactions in the area. Field monitoring will be continued following the development of the impact assessment to continue the understanding and characterisation of the watercourses.

No stream flow monitoring stations are proposed on the main channel of the Credit River at this time. Publicly available government stream gauge data will be relied upon to provide water level and flow data from the Credit River. Available baseflow data will be supplemented by completing low flow monitoring in the Credit River at three locations, to evaluate the baseflow contributions in the project study area. Two low flow monitoring events are currently proposed.

The surface water monitoring will also include a one-year of quarterly water quality monitoring program. This program will include the analysis of metals, nutrients and general chemistry at five watercourse stations surrounding the Site. The five sampling locations will be selected from a subset of the stream flow monitoring stations in an attempt to maximise the value of each monitoring station by selected stations that more likely maintain water and flow year-round (avoiding stations that have dry conditions most of the year). The five stations will be remain consistent throughout the sampling year. Turbidity and total suspended solids (TSS) will also be collected at these five stations to develop a turbidity / TSS relationship that can be used to estimate TSS from real-time measurements.

1.2.3 Cross Sectional Surveys

To develop a reliable stage-discharge rating curves (rating curves) at the surface water stations, cross sectional surveys will be collected and used to develop small local hydraulic models, which will in turn be used to interpolate and extrapolate the rating curves somewhat beyond the range of measured flows. It is recommended that approximately four detailed cross sectional surveys be completed at each surface water station to capture key hydraulic controls. Surveys are to be completed at upstream and downstream locations for each of the water level logger installations. The cross sectional surveys are typically distributed along the stream profile to capture the station equipment and key hydraulic characteristics (i.e., pools, riffles and control features), with the feature controlling the downstream water levels being most important to capture. The cross sectional surveys are expected to extend over the stream banks and on to the floodplain, to capture the total flow cross section under a flood event.

All survey data will be tied into a local benchmark which is permanently secured above the anticipated high water level. The water level logger installation will be surveyed to the benchmark upon installation and once each year to identify any settling, heave or other movement of the logger stations.

1.2.4 Rating Curve Development

The cross-sectional survey data will be collected and incorporated into a hydraulic model to develop theoretical rating curves which will be calibrated to measured flows.

Rating curves will be developed for each water level monitoring station in a hydraulic modelling package (i.e., HEC-RAS or equivalent) using the manual flow and water level measurements and cross sectional survey data collected during the monitoring program. The hydraulic model will utilize the cross sectional surveys at each station to generate a theoretical rating curve that will be calibrated using the measured flows and water levels collected over the monitoring period. Typically, the HEC-RAS modelled results are utilized to extrapolate the upper end of the rating curve, while field measured points better served to populate the lower and mid sections of the curve.

The Water Survey of Canada operates flow stations and already provides continuous flow data for the Credit River (downstream of Charleston Sideroad, and others further up and downstream), meaning that Golder will not need to develop rating curves and flow hydrographs for the stations on the Credit River.

1.2.5 Water Balance

An annual water balance will be developed for the drainage areas contributing to the quarry and monitoring station catchments using Thornthwaite water budgets available from Meteorological Services of Canada under the existing, operational and rehabilitated conditions. The results of the water balances will be used to help assess the potential impacts that the proposed extraction and rehabilitation activities may have on the existing local hydrologic cycle. Meteorological Services of Canada data will be compared to local CVC station data.

Results of the Thornthwaite water balance will also be used to verify the recharge distributions developed using the integrated numerical model.

1.2.6 Water Level Hydrographs

Continuous water level and flow data will be processed on a monthly basis to confirm data quality and equipment accuracy. This will allow Golder to identify, and correct, any variations or potential issues with the monitoring stations, or equipment, early to reduce the risk of lost data.

The continuous water level record will be used with the rating curves to develop a continuous flow record which will be presented in flow hydrographs. Flow hydrographs will be created for the continuous water level stations. The flow hydrograph records will be further analysed to provide an estimate of baseflow, flow duration statistics, peak flows and totals of monthly and annual discharge at each location. This information will be used to calibrate and verify the HGS existing conditions model.

1.2.7 Stream Temperature Monitoring

Through their review of an earlier version of this TOR document, CVC requested continuous temperature monitoring be completed at the 14 – 16 surface water stations located on tributaries to the Credit River. Dedicated water temperature loggers will be installed to collect continuous daily temperature measurements. Monitoring of these loggers will be completed as part of the quarterly surface water monitoring program outlined in Section 1.2.2.

1.2.8 Impact Assessment and Reporting

The data collected will be analysed in conjunction with the background information and integrated with the hydrogeological and natural science studies. The impact assessment will consider potential effects of the proposed extraction on the surface water features on the site, and up to the distance of the expected groundwater drawdown zone (nine stream flow monitoring stations have been assumed within this drawdown). Potential effects will be estimated for two future scenarios including full development of the proposed quarry (i.e., the last day of extraction) and rehabilitated conditions (i.e., the residual effects of the development following completion of rehabilitation to a flooded quarry lake or partially backfilled and flooded excavation).

Reporting will be completed in conjunction with the hydrogeology discipline and will include the following:

- Documented field data
- Present rating curves and water level / flow hydrographs as well as monthly and annual total volumes
- Present WSC gauge flows on the Credit River as well as monthly and annual total volumes

- Quantify expected project effects on surface water resources by comparing projected post-development to pre-development flow rates. This information will be provided to the Natural Environment discipline for assessment of the significance of changes to the natural environment

2.0 NATURAL ENVIRONMENT ASSESSMENT

Golder will undertake a work program for a Natural Environment Report (NER) in order to evaluate the natural features in the vicinity of the site. Golder will assess the potential impacts of the proposed below water extraction on those features and their ecological functions and, if necessary, recommend measures to prevent or mitigate negative impacts on any significant features.

This study will provide an assessment of the application taking into consideration the applicable in-effect policies contained in the relevant Provincial Plans, Region of Peel Official Plan and Town of Caledon Official Plan.

2.1 Background Review

A background information search and literature review will be completed to gather data about the local area and identify significant natural features, as defined under the Provincial Policy Statement, Greenbelt Plan, Region of Peel (Core Areas, Natural Features and Corridors and Potential Natural Features and Corridors), and Town of Caledon (Environmental Policy Areas), and species at risk (SAR) that have been reported as occurring, or potentially occurring in the local landscape, including the following resources:

- Natural Heritage Information Centre (NHIC) database maintained by the Ontario Ministry of Natural Resources and Forestry (MNRF)
- Species at Risk Public Registry
- Species at Risk in Ontario (SARO) List
- Atlas of Breeding Birds of Ontario (OBBA)
- Bat Conservation International (BCI) range maps
- Ontario Butterfly Atlas
- Atlas of the Mammals of Ontario
- Ontario’s Reptile and Amphibian Atlas
- Land Information Ontario (LIO)
- MNRF LIO Aquatic Resources Area Layer
- MNRF Fish On-Line
- DFO Aquatic Species at Risk Maps
- eBird species range maps
- Town of Caledon Official Plan

- Region of Peel Official Plan
- Information available from CVC (e.g., fish collection records, wetland mapping)
- Credit River Watershed Natural Heritage System Final Summary Report
- Existing aerial photography.

To develop an understanding of the ecological communities, wildlife habitat and potential natural heritage features in the study area, MNRF LIO data were used to create base layer mapping for the study area. A geographic query of the NHIC database was conducted to identify element occurrences of any natural heritage features, including wetlands, Areas of Natural and Scientific Interest (ANSIs), life science sites, rare vegetation communities, provincially rare species (ranked S1-S3 by the NHIC) and other natural heritage features within 1 km of the site.

2.1.1 SAR Screening

A SAR screening will be completed conducted for species listed under the *Endangered Species Act* (ESA) (Ontario 2007) per the Species at Risk in Ontario (SARO) List (O. Reg. 230/08), as well as those listed under the *Species at Risk Act* (SARA).

An assessment will be conducted to determine which SAR had potential habitat in the study area**.** Species with ranges overlapping the study area, or recent occurrence records in the vicinity, will be screened by comparing their habitat requirements to habitat conditions in the study area, as interpreted from aerial imagery.

The potential for the species to occur will be determined through a probability of occurrence. A ranking of low indicates no suitable habitat availability for that species in the study area and no specimens identified. Moderate probability indicates more potential for the species to occur, as suitable habitat appeared to be present in the study area, but no occurrence of the species has been recorded. Alternatively, a moderate probability could indicate an observation of a species, but there is no suitable habitat in the study area. High potential indicates a known species record in the study area (based on the background data review) and good quality habitat is present.

The desktop SAR screening will be confirmed and updated through the field surveys, described below.

2.2 Field Surveys

Based on preliminary desktop review, there are limited surface water features on the site. Golder is planning limited surveys in the designated and/or mapped significant woodlands as it is anticipated, based on review of land use policies and regulations, that extraction will not be permitted within the woodlands, and a setback may be required.

The following field surveys will be completed on the site (assuming no land access in the study area will be permitted). In the case that Golder is not scoping to complete the survey in the mapped/designated significant woodlands, it has been identified below. If a feature was to be excluded from the licence or extraction boundary, field surveys were sufficient to determine potential impacts of the project, but not as detailed as if the feature was going to be removed. The field surveys have been determined based on the known habitats on the site, as determined through the desktop assessment. Species-specific surveys will target SAR identified as having a moderate or high potential to occur in the vicinity of the site, to confirm use of habitats. Observations of wildlife and vegetation during all surveys will be documented and a running list maintained for inclusion in the NER.

Species-specific surveys will also provide data for evaluation of significant wildlife habitat (SWH). All surveys will be completed using provincially-approved methods and guidelines.

- Three-season plant community assessment (using Ecological Land Classification [ELC]) and botanical inventory (spring, summer and late summer). Due to the large size of the site, the botanical inventory will be limited to dominant species in each ELC community. Based on preliminary knowledge of the site, the potential for SAR plants is anticipated to be minimal and specific surveys for rare plants will not be required. However, all rare plants observed in the field will be recorded.
- Verification of any on-site wetlands and evaluation using the Ontario Wetland Evaluation System [OWES] where necessary).
- Woodland dripline delineation. Woodlands will be assessed for significance based on the applicable in-effect policies contained in the relevant Provincial Plans, Region of Peel Official Plan and Town of Caledon Official Plan. The boundary of significant woodlands will be delineated using a handheld GPS and verified with the Town of Caledon, the Region of Peel and CVC.
- Two rounds of breeding bird surveys.
- Three rounds of nighttime anuran (frog and toad) call count surveys.
- Turtle habitat assessment.
- Qualitative aquatic/fish habitat assessment of the on-site watercourses. “Windshield” survey of the watercourses that will be monitored as part of surface water assessment. Only the portion of the watercourses that intersect a public road or access will be assessed. The Credit River will not be assessed. It is assumed that there is sufficient background fish community data available for all watercourses and a fish inventory is not required.
- Bat habitat assessment. Golder will complete an assessment for habitat suitability for maternity roosting and for hibernacula.
- Bat acoustic assessment. Golder will deploy up to seven acoustic detectors to be located throughout the site in areas identified as suitable maternity roost habitat, during the bat habitat assessment. Acoustic monitoring will not be completed in the mapped/designated significant woodlands.
- Wildlife habitat assessment, including SWH. VES will be completed using MNRF-approved protocols to search for wildlife, including mammals, amphibians, reptiles, etc. Focus will be given to habitat edges and all signs of wildlife (e.g., scat, fur, browse, etc.) will be documented.

2.3 Impact Assessment and Reporting

The data collected will be analysed in conjunction with the background data and integration with other disciplines, including hydrogeological and surface water studies. The impact assessment will consider all potential impacts of the proposed extraction on the natural environment on the site, and up to the distance of the expected groundwater drawdown zone. Where relevant, the impact assessment will evaluate wetland water balance based on guidance from Toronto and Region Conservation Authority (TRCA) documents: Wetland Water Balance Risk Evaluation (2017), Water Balance Guidelines for the Protection of Natural Features (2012), and Wetland Water Balance Monitoring Protocol (2016). The results of the desktop review, SAR screening, any consultation with

agencies, field surveys, and the impact assessment will be incorporated into a report that satisfies the requirements of both the NER, including relevant figures, under the ARA and an Environmental Impact Study (EIS) for the Town of Caledon and the Region of Peel. Mitigation measures and recommendations on suitable setbacks from natural features with appropriate rationale will also be included.

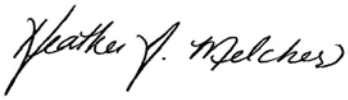
Where relevant, this study shall be shared with other technical experts completing studies for the application to avoid internal inconsistencies.

In addition, Golder will provide proactive input to the development of the site plans, including the progressive and final rehabilitation plans for the site, in consultation with the planner. It is anticipated that the analysis will also facilitate discussions of potential regional enhancement opportunities.

3.0 CLOSURE

We trust that this technical memorandum meets your current needs. Please contact the undersigned with any questions or comments.

Golder Associates Ltd.



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Attachments: Attachment A – Groundwater Monitoring Well Network Details

ATTACHMENT A

Groundwater Monitoring Well Network Details

TABLE 1 - SUMMARY OF MONITORING WELLS INSTALLED
PROPOSED CBM CALEDON QUARRY

Drilled Name:	Date Drilled:	Easting (m) UTM 17T	Northing (m) UTM 17T	Elevation (masl)	Total Hole Depth (mbgs):	Depth of casing (mbgs):	Depth to Bedrock (mbgs):	Depth to bottom of Gasport (mbgs)	Depth to top of Cabot Head (mbgs):	Downhole Geophysics Completion	Packer Testing Completion	Mon Well Completion	Deep (A) Well Stickup (m)	Deep (A) Well Formation	Screen from (m)	Screen to (m)	Shallow (B) Well Stickup (m)	Shallow (B) Well Formation	Screen from (m)	Screen to (m)
MW20-01(CAL) A/B	27-Feb-20	577458.50	4852268.28	395.10	19.41	9.06	8.53	14.86	17.32	13-Mar-20	19-Mar-20	20-Mar-20	0.99	Shaley Dolostone or Cabot Head Fm	15.40	17.10	0.99	Gasport Fm	11.10	12.62
MW20-02(CAL)	02-Mar-20	577900.04	4852138.37	399.63	19.57	15.94	15.24	18.05	19.57	11-Mar-20	N/A	23-Mar-20	1.05	Shaley Dolostone or Cabot Head Fm	16.96	18.48				
MW20-03(CAL)	04-Mar-20	578243.54	4851907.30	390.67	35.97	N/A	34.44	Not present	35.66	N/A	N/A	05-Mar-20	1.00	Overburden	15.58	18.63				
MW20-04(CAL)	06-Mar-20	578264.75	4852313.19	399.46	18.50	15.08	14.33	Not present	16.54	13-Mar-20	N/A	24-Mar-20	1.04	Shaley Dolostone or Cabot Head Fm	16.11	17.63				
MW20-05(CAL) A/B	09-Mar-20	578423.10	4852712.60	399.63	14.84	2.06	1.52	10.60	13.91	20-Mar-20	25-Mar-20	25-Mar-20	1.00	Shaley Dolostone or Cabot Head Fm	12.25	13.77	1.00	Gasport Fm	4.25	5.77
MW20-06(CAL) A/B	10-Mar-20	578474.24	4852972.59	400.15	16.03	2.32	2.14	10.96	14.25	23-Mar-20	26-Mar-20	26-Mar-20	0.99	Gasport Fm	10.12	11.64	0.99	Gasport Fm	4.20	5.72
MW20-07(CAL) A/B	11-Mar-20	578359.89	4853250.44	404.07	19.45	2.74	2.13	13.20	16.40	18-Mar-20	01-Apr-20	01-Apr-20	0.77	Shaley Dolostone or Cabot Head Fm	15.11	16.63	0.77	Gasport Fm	9.74	11.26
MW20-08(CAL) A/B	13-Mar-20	578009.81	4853574.83	406.93	18.59	2.74	1.98	15.10	17.32	19-Mar-20	30-Mar-20	31-Mar-20	0.92	Gasport Fm	13.30	14.82	0.92	Gasport Fm	5.38	6.90
MW20-09(CAL)	17-Mar-20	578343.84	4854157.49	399.95	9.01	5.79	5.33	Not Present	7.48	26-Mar-20	N/A	07-Apr-20	1.01	Shaley Dolostone or Cabot Head Fm	6.85	8.37				
MW20-10(CAL) A/B	19-Mar-20	577837.95	4854407.28	411.32	21.19	12.04	10.97	16.76	19.55	24-Mar-20	08-Apr-20	08-Apr-20	0.92	Shaley Dolostone or Cabot Head Fm	18.62	20.14	0.89	Gasport Fm	14.49	16.01
MW20-11(CAL) A/B	24-Mar-20	577671.98	4853921.39	409.72	19.39	3.07	2.13	16.46	18.16	07-Apr-20	14-Apr-20	15-Apr-20	1.03	Gasport Fm	13.81	15.33	1.01	Gasport Fm	3.96	5.48
MW20-12(CAL) A/B	26-Mar-20	577271.90	4854321.42	412.43	22.65	5.94	3.66	19.80	21.66	08-Apr-20	17-Apr-20	17-Apr-20	1.02	Gasport Fm	17.09	18.62	1.01	Gasport Fm	4.42	5.94
MW20-13(CAL) A/B	08-Apr-20	576873.11	4854473.14	415.53	28.23	15.08	13.10	23.92	25.68	15-Apr-20	23-Apr-20	24-Apr-20	0.93	Shaley Dolostone or Cabot Head Fm	24.05	25.57	0.93	Gasport Fm	18.14	19.66
MW20-13 (CAL) C	08-Apr-20	576873.11	4854473.14	415.53	5.10	N/A	N/A	N/A	N/A	N/A	N/A	08-Apr-20	0.93	Overburden	3.08	4.60				
MW20-14(CAL) A/B	28-Apr-20	577575.99	4853100.42	406.71	26.35	2.74	2.29	22.40	24.50	14-May-20	26-May-20	26-May-20	0.96	Shaley Dolostone or Cabot Head Fm	22.60	24.12	1.05	Gasport Fm	14.98	16.50
MW20-15(CAL) A/B	20-May-20	576576.79	4853544.15	417.06	37.17	12.30	11.60	33.84	35.62	27-May-20	08-Jun-20	09-Jun-20	0.70	Shaley Dolostone or Cabot Head Fm	33.77	35.29	0.71	Gasport Fm	28.81	30.33
MW20-15 (CAL) C	20-May-20	576576.79	4853544.15	417.06	5.00	N/A	N/A	N/A	N/A	N/A	N/A	20-May-20	0.70	Overburden	2.74	4.27				
MW20-16(CAL) A/B	22-May-20	576784.58	4853806.76	421.40	39.77	14.90	11.90	35.52	37.28	26-May-20	10-Jun-20	10-Jun-20	1.05	Gasport Fm	34.84	36.36	1.05	Gasport Fm	16.80	18.33
MW20-17(CAL) A/B	26-May-20	576752.28	4852966.36	406.64	28.82	3.15	3.05	24.84	27.49	01-Jun-20	02-Jun-20	02-Jun-20	1.05	Shaley Dolostone or Cabot Head Fm	25.64	27.16	0.99	Gasport Fm	12.75	14.27
MW20-18(CAL)	09-Jun-20	577058.36	4852658.80	404.29	28.15	12.19	11.88	23.80	26.06	12-Jun-20	15-Jun-20	15-Jun-20	1.03	Gasport Fm	12.42	13.94				
MW20-19(CAL) A/B	27-Oct-20	576906.96	4851999.96	396.98	27.39	6.20	2.14	22.05	24.48	29-Oct-20	30-Oct-20	31-Oct-20	1.07	Gasport Fm	15.95	17.47	1.07	Gasport Fm	8.00	9.52
MW20-20(CAL) A/B	29-Oct-20	576476.35	4852467.69	403.00	27.99	5.98	2.14	25.15	27.18	30-Oct-20	03-Nov-20	03-Nov-20	0.82	Shaley Dolostone or Cabot Head Fm	25.33	26.85	0.82	Gasport Fm	12.97	14.49
MW20-20(CAL) C	03-Nov-20	576476.26	4852468.33	403.00	5.00	N/A	2.14	N/A	N/A	N/A	N/A	03-Nov-20	0.96	Gasport Fm	2.42	3.95				
MW20-21(CAL) A/B	04-Nov-20	576014.37	4852839.77	415.23	39.70	15.10	12.51	36.73	38.38	05-Nov-20	06-Nov-20	07-Nov-20	1.07	Gasport Fm	33.27	34.79	1.07	Gasport Fm	15.77	17.29
MW20-22(CAL) A/B	18-Nov-20	575785.36	4851966.28	399.27	30.75	5.94	4.57	28.16	29.81	18-Nov-20	N/A	19-Nov-20	0.97	Goat Island Fm	23.47	25.00	0.97	Goat Island Fm	6.89	8.41
MW20-23(CAL) A/B	23-Nov-20	576205.53	4851555.91	395.05	26.76	12.19	11.28	23.54	25.30	24-Nov-20	N/A	24-Nov-20	0.87	Shaley Dolostone or Cabot Head Fm	22.59	24.11	0.87	Goat Island Fm	14.68	16.20
MW20-23 (CAL) C	23-Nov-20	576205.91	4851556.34	395.00	7.00	N/A	N/A	N/A	N/A	N/A	N/A	23-Nov-20	0.88	Overburden	4.57	6.09				
MW20-24(CAL) A/B	03-Dec-20	575337.66	4854341.85	437.75	37.49	20.88	20.11	37.49	N/A	04-Dec-20	N/A	04-Dec-20	0.87	Gasport Fm	33.81	35.33	0.87	Goat Island Fm	21.49	23.02
MW20-25(CAL) A/B	10-Dec-20	574853.76	4852900.48	419.02	51.82	13.39	10.52	48.93	50.67	10-Dec-20	N/A	11-Dec-20	1.56	Gasport Fm	44.03	45.55	1.55	Goat Island Fm	16.84	18.36
MW20-26(CAL) A/B	17-Dec-20	574373.86	4853638.42	438.89	66.11	15.55	12.19	64.55	66.11	18-Dec-20	N/A	21-Dec-20	1.16	Gasport Fm	55.16	56.68	1.16	Goat Island Fm	31.12	32.64
MW20-26 (CAL) C	17-Dec-20	574375.17	4853637.62	438.88	10.00	N/A	N/A	N/A	N/A	N/A	N/A	17-Dec-20	1.07	Overburden	7.26	8.78				
MW20-27(CAL) A/B	12-Feb-21	575953.96	4853770.16	431.15	52.43	31.24	28.96	50.32	51.93	17-Feb-21	N/A	18-Feb-21	0.97	Goat Island Fm	41.99	43.51	0.98	Goat Island Fm	33.85	35.37
MW20-28(CAL) A/B	22-Feb-21	576139.79	4854987.82	419.31	30.82	12.80	12.19	28.45	30.20	23-Feb-21	N/A	23-Feb-21	0.96	Gasport Fm	24.07	25.59	0.93	Gasport Fm	16.51	18.03



LEGEND

- MONITORING WELL
- MONITORING WELL (PUMPING TEST)
- TEST WELL
- HISTORICAL MONITORING WELL
- TOWN/VILLAGE
- WATERCOURSE
- ROAD
- WATERBODY
- WETLAND
- PRELIMINARY PROJECT LOCATION



0 500 1,000

1:15,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON QUARRY

TITLE
2020-2021 MONITORING AND PUMPING WELL LOCATIONS

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-08-26
DESIGNED	CGE
PREPARED	CGE
REVIEWED	GP
APPROVED	-

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0006	0.0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX B

MECP Water Well Record Summary

Table B-1 - Water Well Records (<1 km from Study Site)
Caledon Pit / Quarry

Well ID	Easting	Northing	Elevation (masl)	Distance from Pit / Quarry (m)	Well Depth (m)	Screen Top (m)	Screen Bottom (m)	Reported Static WL (m)	Aquifer Type	Aquifer Description	Well Purpose	Well Use	Driller ID	Date Drilled	Borehole ID	Tag Number	County	Con.	Lot
4900845	579191	4854724	395.27	991.65	11.00	10.20	11.00	6.70	1	Overburden	Water Supply	Domestic	1307	10/31/1958	10315693		PEEL	02	015
4900876	578952	4852803	402.29	638.87	13.10	11.89	13.11	7.00	1	Overburden	Water Supply	Domestic	2613	12/9/1965	10315724		PEEL	03	013
4900878	578079	4853682	410.00	91.75	15.20	6.70	15.20	7.60	2	Bedrock (Gasport)	Water Supply	Domestic	4703	6/20/1955	10315726		PEEL	03	015
4900879	578093	4853722	409.71	50.04	13.70	5.80	13.70	6.10	2	Bedrock (Gasport)	Water Supply	Domestic	3513	8/22/1956	10315727		PEEL	03	015
4900880	578643	4854053	383.99	296.56	50.90	45.70	50.90	6.10	1	Overburden	Water Supply	Domestic	4728	10/26/1956	10315728		PEEL	03	015
4900882	576819	4854959	400.46	667.84	17.70	16.46	17.68	7.30	1	Overburden	Water Supply	Domestic	4813	6/12/1965	10315730		PEEL	03	018
4900941	578697	4852765	399.57	460.16	36.60	18.30	36.60	19.80	3	Bedrock (Below Gasport)	Water Supply	Domestic	4703	7/5/1948	10315788		PEEL	04	014
4900942	578261	4852228	396.31	278.28	38.70	11.30	38.70	2.40	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4501	12/10/1951	10315789		PEEL	04	014
4900943	578639	4852673	400.45	470.68	34.10	9.80	34.10	23.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4703	9/17/1958	10315790		PEEL	04	014
4900944	578328	4852575	400.04	195.48	36.60	5.20	36.60	23.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4703	9/20/1958	10315791		PEEL	04	014
4900945	578477	4853124	402.48	66.52	18.30	6.70	18.30	4.60	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4703	9/25/1961	10315792		PEEL	04	014
4900946	578303	4852138	395.31	367.26	15.80	14.63	15.85	5.50	1	Overburden	Water Supply	Domestic	3512	5/11/1964	10315793		PEEL	04	014
4900947	578483	4852999	401.04	147.67	12.80	4.60	12.80	5.50	2	Bedrock (Gasport)	Water Supply	Domestic	3513	6/16/1966	10315794		PEEL	04	014
4900948	578450	4852848	399.92	214.09	13.70	8.20	13.70	8.50	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3406	8/26/1967	10315795		PEEL	04	014
4900949	577905	4853469	408.85	3.09	18.90	6.10	18.90	4.90	2	Bedrock (Gasport)	Water Supply	Domestic	4728	8/22/1956	10315796		PEEL	04	015
4900950	576546	4854698	416.68	564.96	5.30	4.80	5.30	1.50	1	Overburden	Water Supply	Domestic	5001	10/2/1962	10315797		PEEL	04	018
4901026	577033	4852103	398.00	410.38	19.80	8.50	19.80	6.40	2	Bedrock (Gasport)	Water Supply	Domestic / Livestock	3316	3/16/1964	10315873		PEEL	05	015
4901027	576811	4851723	397.74	835.94	12.20	10.40	12.20	3.70	2	Bedrock (Gasport)	Water Supply	Domestic	4728	9/8/1956	10315874		PEEL	05	015
4902982	578204	4851713	393.20	554.38	39.30	36.90	38.10	12.20	1	Overburden	Water Supply	Domestic	3316	12/17/1968	10317823		PEEL	04	014
4903132	578644	4852923	399.80	321.53	10.10	6.10	10.10	6.40	2	Bedrock (Gasport)	Water Supply	Domestic	3406	3/1/1968	10317972		PEEL	04	014
4903169	578964	4854353	397.65	635.37	30.80	21.30	30.80	1.80	4	Bedrock (Gasport and Lower)	Water Supply	Commerical	1315	9/20/1968	10318009		PEEL	03	015
4903186	578664	4852873	398.51	367.91	41.50	36.90	41.50	9.80	3	Bedrock (Below Gasport)	Water Supply	Domestic	1315	3/1/1969	10318026		PEEL	03	014
4903189	578664	4852723	399.93	459.81	15.20	9.80	15.20	10.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4813	4/8/1969	10318029		PEEL	04	014
4903324	578689	4854153	387.20	329.23	69.80	42.40	69.80	9.80	3	Bedrock (Below Gasport)	Water Supply	Commerical	1315	3/8/1969	10318162		PEEL	03	015
4903338	576864	4852003	397.17	600.78	16.20	13.40	16.20	4.60	2	Bedrock (Gasport)	Water Supply	Domestic	3317	7/19/1969	10318175		PEEL	05	016
4903531	577164	4852823	404.18	191.11	52.10	7.30	52.10	8.50	4	Bedrock (Gasport and Lower)	Water Supply	Domestic / Livestock	3316	12/1/1970	10318365		PEEL	04	016
4903532	578654	4852763	399.05	427.40	32.90	10.70	32.90	9.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3316	9/16/1970	10318366		PEEL	04	014
4903625	577149	4852823	403.95	180.45	25.00	8.20	25.00	7.60	4	Bedrock (Gasport and Lower)	Water Supply	Domestic / Livestock	3316	4/28/1971	10318459		PEEL	04	016
4903630	578379	4852408	399.01	265.05	24.40	10.40	24.40	9.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3316	4/23/1971	10318464		PEEL	04	014
4903765	576349	4853583	421.50	186.08	42.70	21.00	42.70		4	Bedrock (Gasport and Lower)	Water Supply	Domestic / Livestock	3316	11/20/1971	10318598		PEEL	04	018
4903810	578539	4852873	399.90	269.12	13.10	3.70	13.10	5.50	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3406	1/19/1972	10318641		PEEL	04	014
4903844	578714	4853073	400.10	297.45	27.40	5.50	27.40	4.90	4	Bedrock (Gasport and Lower)	Water Supply	Industrial	4320	6/12/1972	10318673		PEEL	03	014
4903950	578464	4851923	389.99	627.01	14.30	10.67	11.58	5.20	1	Overburden	Water Supply	Commerical	3316	9/7/1972	10318739		PEEL	04	013
4904052	578644	4852683	400.47	468.50	29.90	7.30	29.90	7.90	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4320	4/6/1973	10318841		PEEL	04	014
4904054	578494	4852523	400.33	354.20	16.80	7.30	16.80	7.60	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4320	4/3/1973	10318843		PEEL	04	014
4904102	576927	4854548	414.92	244.47	23.20	14.90	23.20	10.70	2	Bedrock (Gasport)	Water Supply	Domestic	3406	6/18/1973	10318890		PEEL	04	018
4904175	578564	4852573	399.87	427.23	27.70	10.70	27.70	10.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4320	8/5/1973	10318963		PEEL	04	014
4904178	578464	4852453	398.55	331.49	29.90	8.80	29.90	11.90	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4320	7/25/1973	10318966		PEEL	04	014
4904252	578537	4852787	400.22	320.22	43.30	6.10	43.30	22.90	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3316	12/11/1973	10319040		PEEL	04	014
4904297	578630	4852667	400.40	467.24	32.00	25.90	32.00	13.70	3	Bedrock (Below Gasport)	Water Supply	Domestic	4320	9/23/1973	10319085		PEEL	04	014
4905093	578364	4852373	397.48	269.29	24.70	10.70	24.70	6.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	3/31/1976	10319852		PEEL	04	014
4905163	577264	4851173	396.57	953.77	31.40	30.80	31.40	12.20	1	Overburden	Water Supply	Domestic	2336	6/30/1977	10319918		PEEL	05	014
4905228	578414	4853323	404.47	84.98	8.50	4.90	8.50	3.70	2	Bedrock (Gasport)	Water Supply	Domestic	3349	8/22/1976	10319983		PEEL	03	015
4905272	578514	4852723	400.08	341.25	13.70	4.90	13.70	5.20	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2918	11/15/1977	10320027		PEEL	04	014
4905365	578514	4852723	400.08	341.25	29.90	13.70	29.90	5.20	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2918	6/17/1978	10320112		PEEL	04	014
4905439	578414	4851923	391.72	587.13	12.80	8.53	12.50	3.70	1	Overburden	Water Supply	Commerical	3317	11/14/1977	10320172		PEEL	04	013
4905497	577914	4851923	398.04	197.82	82.60	39.60	82.60	22.30	3	Bedrock (Below Gasport)	Water Supply	Domestic	4320	5/30/1978	10320227		PEEL	04	014
4905577	578614	4852923	399.49	297.78	43.00	7.00	43.00	14.30	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	11/22/1979	10320304		PEEL	04	014
4905677	577814	4853523	410.02	72.50	32.00	12.50	32.00	4.90	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4320	5/19/1976	10320381		PEEL	04	016
4905870	578464	4854173	387.90	108.16	36.60	12.50	36.60	6.10	3	Bedrock (Below Gasport)	Water Supply	Domestic	3317	7/31/1981	10320544		PEEL	03	015
4906023	577964	4853723	408.53	60.07	19.50	9.80	19.50	3.70	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	6/18/1982	10320662		PEEL	03	016
4906026	577814	4852023	398.72	56.99	23.50	17.40	23.50	10.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	11/8/1982	10320665		PEEL	04	014
4906521	576787	4852960	406.29	10.61	22.90	11.00	22.90	4.90	2	Bedrock (Gasport)	Water Supply	Domestic	4778	8/2/1986	10321086		PEEL	04	019
4906547	577543	4851996	400.04	124.94	22.60	17.80	22.60	9.10	2	Bedrock (Gasport)	Water Supply	Domestic	3317	7/14/1986	10321112		PEEL	05	015
4906635	577507	4854325	415.01	156.07	21.60	8.70	21.60	7.60	2	Bedrock (Gasport)	Water Supply	Domestic	3317	3/25/1987	10321199		PEEL	03	017
4906636	575684	4854015	436.19	976.43	50.30	27.60	50.30	7.30	2	Bedrock (Gasport)	Water Supply	Domestic	3317	6/12/1987	10321200		PEEL	05	019

Well ID	Easting	Northing	Elevation (masl)	Distance from Pit / Quarry (m)	Well Depth (m)	Screen Top (m)	Screen Bottom (m)	Reported Static WL (m)	Aquifer Type	Aquifer Description	Well Purpose	Well Use	Driller ID	Date Drilled	Borehole ID	Tag Number	County	Con.	Lot
4906637	576804	4852922	405.95	41.93	22.90	6.70	22.90	5.50	2	Bedrock (Gasport)	Water Supply	Domestic	4778	11/12/1986	10321201		PEEL	05	016
4906774	578691	4854513	383.73	462.53	57.90	18.90	21.64	11.30	1	Overburden	Observation Wells	Public	1663	11/18/1987	10321335		PEEL	03	016
4906777	576622	4852090	398.39	710.48	25.30	9.10	25.30	3.70	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	9/4/1987	10321338		PEEL	05	016
4906974	578659	4852763	398.98	431.35	34.70	8.50	34.70	13.70	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4778	9/18/1988	10321535		PEEL	03	018
4907018	578029	4853732	409.42	76.70	30.20	6.01	30.20	6.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	11/23/1988	10321579		PEEL	03	016
4907069	575970	4853700	430.25	561.02	25.90	22.60	25.90	6.70	1	Overburden	Water Supply	Domestic	3132	3/2/1989	10321630		PEEL	05	018
4907145	577944	4853791	408.86	65.28	50.30	6.90	50.30	17.40	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	6/1/1989	10321706		PEEL	03	016
4907147	576840	4852928	405.77	16.86	55.20	4.30	55.20	3.70	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	6/21/1989	10321708		PEEL	04	017
4907199	575974	4853698	430.08	556.56	25.90	24.10	25.90	7.30	1	Overburden	Water Supply	Domestic	3132	9/24/1989	10321759		PEEL	05	018
4907201	575983	4853717	430.11	559.14	21.30	19.20	20.42	6.70	1	Overburden	Water Supply	Domestic	3132	9/19/1989	10321761		PEEL	05	018
4907244	577734	4851975	402.01	68.99	20.10	13.40	20.10	7.00	2	Bedrock (Gasport)	Water Supply	Domestic	4778	8/12/1989	10321804		PEEL	04	014
4907246	577734	4851975	402.01	69.18	24.70	14.00	24.70	7.00	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	4778	8/20/1989	10321806		PEEL	04	014
4907314	578727	4852899	399.99	401.90	29.00	7.60	29.00	8.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	3/29/1990	10321873		PEEL	04	021
4907315	578504	4852772	400.15	303.33	30.50	12.20	30.50	4.90	3	Bedrock (Below Gasport)	Water Supply	Domestic	2576	5/31/1990	10321874		PEEL	04	014
4907362	578398	4852547	400.21	259.39	38.40	6.10	38.40	16.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2663	8/30/1990	10321921		PEEL	04	014
4907363	576774	4852986	406.75	15.35	61.00	6.10	61.00	21.30	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2663	8/27/1990	10321922		PEEL	04	017
4907364	578609	4852786	399.89	377.74	31.10	6.70	31.10	11.60	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2918	6/27/1990	10321923		PEEL	04	014
4907456	578727	4852899	399.99	401.90	48.80	6.70	48.80	14.90	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	6/18/1990	10322015		PEEL	04	014
4907589	578457	4853052	401.91	94.67	15.20	6.10	15.20	3.40	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	5/10/1991	10322148		PEEL	04	015
4907628	576570	4855350	401.43	1113.03	24.40	7.30	24.40	2.10	4	Bedrock (Gasport and Lower)	Water Supply	Public	3406	6/28/1991	10322187		PEEL	03	018
4907629	577340	4854835	399.80	509.63	67.10	26.20	67.10	18.30	3	Bedrock (Below Gasport)	Water Supply	Commerical	3406	7/4/1991	10322188		PEEL	03	017
4907630	577245	4854785	400.03	458.00	42.70	24.70	42.70	11.60	3	Bedrock (Below Gasport)	Water Supply	Commerical	3406	7/4/1991	10322189		PEEL	03	017
4907700	577240	4854420	414.17	101.01	13.70	10.67	13.72		2	Bedrock (Gasport)	Observation Wells	Testing	1839	11/9/1992	10322259		PEEL	03	017
4907701	577188	4854444	414.43	149.20	13.70	10.67	13.72		2	Bedrock (Gasport)	Observation Wells	Testing	1839	11/9/1992	10322260		PEEL	03	017
4907712	578481	4852565	401.11	343.88	44.20	8.00	44.20	19.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	3/31/1992	10322271		PEEL	04	014
4907787	578576	4852699	400.02	404.95	36.60	6.70	36.60		4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3602	10/27/1993	10322346		PEEL	04	014
4907794	577104	4854476	411.45	214.27	33.50	10.80	33.50	7.00	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	10/27/1993	10322353		PEEL	04	017
4907804	577205	4854948	393.54	624.26	18.90	18.30	18.90	7.90	3	Bedrock (Below Gasport)	Observation Wells	Monitoring	3406	2/16/1993	10322363		PEEL	03	019
4907806	577234	4854995	393.29	668.22	19.80	17.37	18.90	8.80	3	Bedrock (Below Gasport)	Observation Wells	Not Used	3406	2/17/1993	10322365		PEEL	03	019
4907808	576982	4855127	396.15	819.60	55.50	22.30	55.50	3.00	3	Bedrock (Below Gasport)	Observation Wells	Monitoring	3406	2/22/1993	10322367		PEEL	03	020
4907809	576972	4855137	397.36	829.54	37.20	21.20	37.20		3	Bedrock (Below Gasport)	Observation Wells	Monitoring	3406	3/2/1993	10322368		PEEL	03	020
4907938	578582	4852795	400.11	350.89	43.60	6.10	43.60	21.30	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	11/4/1994	10322497		PEEL	04	014
4908005	578546	4852932	399.99	238.50	21.00	6.40	21.00	6.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	6/2/1995	10322564		PEEL	04	014
4908100	577078	4854560	412.89	274.01	27.40	8.20	27.40	5.50	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3108	1/24/1996	10322659		PEEL	04	018
4908162	577620	4852099	399.99	2.33	15.20	13.41	14.33	9.40	2	Bedrock (Gasport)	Water Supply	Domestic	1350	12/2/1996	10322721		PEEL	04	015
4908197	578677	4852899	399.94	362.32	47.20	5.50	47.20	18.90	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3317	11/4/1996	10322756		PEEL	04	014
4908541	578745	4854123	389.83	385.57	15.50	11.58	12.50	9.10	1	Overburden	Water Supply	Other	1737	9/23/1999	10323076		PEEL		
4908895	578556	4852526	397.51	415.82	42.10	10.70	42.10	10.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2576	1/7/2002	10526828		PEEL	04	014
4908901	579018	4853737	394.15	772.74	12.50	7.32	11.89	10.10	1	Overburden	Recharge Well	Industrial	1737	2/27/2001	10526834		PEEL		
4908902	579005	4853729	396.09	765.99	16.80	8.23	10.67	9.80	1	Overburden	Recharge Well	Industrial	1737	2/27/2001	10526835		PEEL		
4908903	579084	4853816	392.94	794.00	15.50	12.19	13.11	8.80	1	Overburden	Dewatering	Not Used	1737	2/26/2001	10526836		PEEL		
4908904	579125	4853867	392.90	812.85	12.50	9.14	10.06	9.40	1	Overburden	Dewatering	Not Used	1737	2/23/2001	10526837		PEEL		
4908905	579059	4853784	393.40	785.37	13.70	9.14	10.06	10.10	1	Overburden	Water Supply	Industrial	1737	2/21/2001	10526838		PEEL		
4908906	578972	4853758	393.47	722.59	15.20	9.40	14.00	8.80	1	Overburden	Recharge Well	Not Used	1737	3/6/2001	10526839		PEEL		
4908907	578950	4853781	392.28	691.76	14.60	8.80	13.72	7.60	1	Overburden	Recharge Well	Not Used	1737	3/2/2001	10526840		PEEL		
4908908	578958	4853771	392.59	703.82	15.20	8.70	10.20	7.90	1	Overburden	Recharge Well	Not Used	1737	3/1/2001	10526841		PEEL		
4908909	578982	4853746	394.99	737.46	16.50	10.36	11.28	8.80	1	Overburden	Recharge Well	Not Used	1737	3/1/2001	10526842		PEEL		
4908910	578992	4853737	395.77	750.73	16.50	10.06	14.63	9.10	1	Overburden	Recharge Well	Not Used	1737	2/28/2001	10526843		PEEL		
4908976	578295	4852370	398.40	216.23	54.30	6.10	54.30	24.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2576	4/2/2002	10526909		PEEL	04	014
4909013	577412	4853253	410.83	232.17	8.20	7.90	8.20	4.00	2	Bedrock (Gasport)	Water Supply	Domestic	7143	7/24/2002	10534190		PEEL	04	016
4909045	577821	4853582	409.25	102.85	23.80	6.10	23.80	6.70	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2576	8/21/2002	10534222		PEEL	03	016
4909122	578766	4853889	381.15	478.47	29.00	27.13	28.35	9.40	3	Bedrock (Below Gasport)	Water Supply	Municipal	7143	3/19/2003	10540557		PEEL	03	015
4909177	577144	4855727	396.20	1405.31	53.34	24.38	53.34	11.28	4	Bedrock (Gasport and Lower)	Water Supply	Commercial	2644	7/7/2003			PEEL	03	020
4909251	578594	4852961	400.00	258.41	44.80	6.10	44.80	16.80	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	7154	8/23/2003	10546522		PEEL	05	014
4909536	578523	4852953	400.08	207.15	45.70	19.00	45.70		3	Bedrock (Below Gasport)	Recharge Well	Cooling / AC	7143	9/22/2004	11177164	A004248	PEEL	04	014
4909671	578737	4852935	400.04	387.50	41.80	7.60	41.80	19.50	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	7154	3/11/2005	11323404	A020435	PEEL	03	014

Table B-1 - Water Well Records (<1 km from Study Site)
Caledon Pit / Quarry

Well ID	Easting	Northing	Elevation (masl)	Distance from Pit / Quarry (m)	Well Depth (m)	Screen Top (m)	Screen Bottom (m)	Reported Static WL (m)	Aquifer Type	Aquifer Description	Well Purpose	Well Use	Driller ID	Date Drilled	Borehole ID	Tag Number	County	Con.	Lot
4909830	579159	4854030	391.39	806.58	5.30	3.66	5.33		1	Overburden	Observation Wells	Not Used	6032	4/4/2005	11323563	A005050	PEEL		
4909948	575639	4853671	427.47	852.11	50.90	24.40	50.90	7.00	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	7154	10/21/2005	11323681	A032493	PEEL	05	019
7108579	579107	4854799	393.66	965.09	7.60	1.50	7.60		1	Overburden	Observation Wells	Monitoring	7238	6/17/2008	1002676179	A070012	PEEL	02	014
7108579	578991	4854674	399.59	797.18	12.20	6.10	12.20		1	Overburden	Observation Wells	Monitoring	7238	6/16/2008	1002676170	A070012	PEEL	02	014
7108579	579249	4854337	401.52	909.66	16.70	10.60	16.70		1	Overburden	Observation Wells	Monitoring	7238	6/20/2008	1002676233	A070012	PEEL	02	014
7139063	577237	4854451	415.24	130.76	29.60	7.60	29.60	8.50	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	2576	6/29/2009	1002932231	A079686	PEEL	03	019
7145140	578190	4851490	391.09	708.83	39.30	37.49	39.32		1	Overburden	Water Supply	Domestic	7143	5/6/2010	1002984167	A091638	PEEL	05	013
7161619	578982	4853738	395.74	741.79	17.06	10.21	15.24		1	Overburden	Recharge Well	Industrial	3406	3/17/2010	1003494944	A071538	PEEL	03	015
7193044	576604	4854580	417.19	443.69	60.40	11.30	60.40	8.70	4	Bedrock (Gasport and Lower)	Water Supply	Domestic / Livestock	1663	10/17/2012	1004216798	A116219	PEEL	04	017
7199658	578949	4853782	392.25	690.39	13.72	10.21	13.72		1	Overburden	Other Status	Injection	3406	5/29/2012	1004270103	A112253	PEEL	03	015
7218147	578597	4852611	400.00	465.36	60.40	6.10	60.35	12.10	4	Bedrock (Gasport and Lower)	Water Supply	Domestic	3406	2/7/2013	1004724172	A133928	PEEL		
7241044	579051	4853788	393.64	776.42	16.80	11.40	15.20	9.50	1	Overburden	Other Status	Purge well	7221	4/22/2015	1005342382	A173444	PEEL	03	015
7298702	578137	4851515	392.69	658.25	6.90	3.81	6.86		1	Overburden	Observation Wells	Monitoring	7282	7/19/2017	1006791550	A219078	PEEL	05	
7363752	577681	4853179	408.59	25.38	8.50	5.49	8.53		2	Bedrock (Gasport)	Observation Wells	Monitoring	7675	8/7/2020	1008374815	A294093	PEEL	04	015
7363754	577632	4853055	406.02	18.31	8.20	5.18	8.23		2	Bedrock (Gasport)	Observation Wells	Monitoring	7675	8/7/2020	1008374821	A289819	PEEL	04	015

APPENDIX C

Records of Borehole and Monitoring Well Drilling and Installation

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-01 (CAL)

SHEET 1 OF 1

LOCATION: N 4853292.8 ;E 578000.6

DRILLING DATE: Febuary 6, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		406.80																		
0		(GP/SP) gravelly SAND, some silt; brown/tan, no odor, no staining, non-cohesive, moist		0.00																		
				405.00																		
2		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		1.80																		Febuary 12, 2020
					1										BD,IR,VR BD,IR,VR BD,UN,RO BD,IR,RO							
4															BD,IR,RO BD,IR,VR BD,UN,RO							
					2										BD,UN,RO BD,UN,RO BD,IR,RO BD,IR,RO							
6															BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
					3										BD,UN,RO BD,CU,RO BD,IR,RO BD,IR,RO							
8															BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO							
					4										BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR							
10															BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR							
					5										BD,IR,RO BD,UN,VR BD,IR,VR BD,IR,VR							
12															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
															BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,SM							
14															BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR							
															BD,CU,SM							
															BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
16															BD,IR,RO							
				389.70																		
		SHALEY DOLOSTONE, bedded shaley dolostone, cream to grey		17.10	6										BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,SM							
18															BD,CU,SM BD,IR,SM BD,IR,SM BD,CU,SM							
				387.86																		
		SHALE, bedded, shale, blue green (CABOT HEAD FORMATION)		18.94											BD,IR,SM BD,IR,SM BD,IR,SM BD,IR,SM							
20					7										BD,IR,RO BD,IR,VR BD,CU,RO BD,IR,SM							
															BD,R,SM							
22				384.73																		
		BOTTOM OF HOLE		22.07																		
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL/KS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-02 (CAL)

SHEET 1 OF 1

LOCATION: N 4853078.9 ;E 577839.4

DRILLING DATE: Febuary 10, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		405.52																		
		(SP) SAND, some silt; brown, no odor, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 0.30																		
		(SP) SAND, some silt; brown, no odor, no staining, non-cohesive, moist		0.80																		
2		(SG) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, moist		403.08 / 2.44																		
		(CL) CLAYEY SILT TILL, some sand, some cobbles; brown, no odor, no staining, non-cohesive, moist		402.17 / 3.35																		
4		(SG) SAND and GRAVEL; brown, no odor, no staining, non-cohesive, moist		3.84																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light to medium grey (GASPORT FORMATION)			1										BD,IR,VR F,IR,RO BD,IR,RO							
6															F,UN,RO							
															BD,UN,RO BD,IR,VR							
					2										BD,UN,RO BD,IR,RO BD,IR,RO							
8															BD,UN,RO BD,IR,RO							
															BD,IR,RO							
10					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
12															BD,UN,RO BD,IR,VR BD,IR,RO BD,UN,RO							
					4										BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,PL,RO BD,UN,VR BD,UN,RO BD,IR,RO							
16															F,IR,RO BD,IR,VR F,IR,RO BD,IR,VR BD,UN,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,IR,RO							
					5																	
18																						
					6																	
20				385.33																		
		SHALEY DOLOSTONE, bedded shaley dolostone, brown to grey		20.19																		
22				383.50																		
		BOTTOM OF HOLE		22.02											BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR							
24																						
26																						
28																						
30																						

Febuary 11, 2020

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: KS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-03 (CAL)

SHEET 1 OF 1

LOCATION: N 4852796.3 ;E 577655.1

DRILLING DATE: Febuary 25-26, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		402.91																		
0		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist (TOPSOIL)		0.00 402.30																		
		(GP/SP) SAND and GRAVEL; light brown, no odor, no staining, non-cohesive, moist		0.61 400.17																		
2		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		2.74																		
4					1										BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO							
6					2										BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO							
8					3										BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-04 (CAL)

SHEET 1 OF 1

LOCATION: N 4852528.1 ;E 577511.8

DRILLING DATE: Febuary 13, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		400.81																		
0		(ML) SANDY SILT TILL; brown, no odor, no staining, non-cohesive, moist		0.00																		
2				398.37																		
		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, moist		2.44																		
4																						
6				394.71																		
		(GP) GRAVEL; grey, no odor, no staining, non-cohesive, moist		6.10																		
		DOLOSTONE, fresh to highly weathered, bedded dolostone, light grey (GASPORT FORMATION)		6.52																		
8																						Febuary 19, 2020
10					1										BD,IR,VR BD,IR,RO BD,IR,VR BD,CU,VR BD,IR,VR							
12					2										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO							
14					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO							
16					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
18				383.41																		
		SHALEY DOLOSTONE, bedded shaley dolostone, light and dark grey banding		17.40																		
				381.24																		
20		BOTTOM OF HOLE		19.57											BD,IR,RO BD,IR,VR BD,IR,VR BD,UN,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-05 (CAL)

SHEET 1 OF 1

LOCATION: N 4852520.2 ;E 577786.2

DRILLING DATE: Febuary 18-19, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)
0		GROUND SURFACE	398.83
		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist (TOPSOIL)	0.00
		(SP) SAND, trace gravel; brown, no odor, no staining, non-cohesive, moist	0.50
4			393.96
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)	4.87
8			
12			385.78
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey	13.05
16			383.03
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)	15.80
		BOTTOM OF HOLE	382.48 16.35

SYMBOLIC LOG

RUN No. | PENETRATION RATE min/(m) | FLUSH | COLOUR % RETURN

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN - Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

RECOVERY: TOTAL CORE % | SOLID CORE %
R.Q.D. %
FRACT. INDEX PER 0.25 m
DISCONTINUITY DATA: B Angle | DIP w.r.t. CORE AXIS | TYPE AND SURFACE DESCRIPTION | Jr | Ja | Jn
HYDRAULIC CONDUCTIVITY K, cm/sec
Diametral Point Load Index (MPa)
RMC -Q' AVG.

RUN No.	TYPE AND SURFACE DESCRIPTION
1	BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,UN,VR BD,UN,VR BD,IR,VR
2	BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR
3	BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR
4	BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,UN,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO
	BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,S BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,CU,RO BD,IR,SM BD,IR,SM BD,IR,SM BD,IR,SM

NOTES
WATER LEVELS
INSTRUMENTATION

Febuary 20, 2020

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-06 (CAL)

SHEET 1 OF 1

LOCATION: N 4852520.2 ;E 578056.5

DRILLING DATE: Febuary 19, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		397.70																		
0		(SP) SAND, some gravel; brown, no odor, no staining, non-cohesive, moist		0.00																		
				394.66																		
		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, moist		3.04																		
				393.13																		
		(GP) GRAVEL, some cobbles, some sand; brown, no odor, no staining, non-cohesive, moist		4.57																		▽ Febuary 21, 2020
				391.70																		
		(MH) CLAYEY SILT, some gravel; reddish brown, no odor, no staining, non-cohesive, moist		6.00																		
				390.38																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		7.32											BD,IR,RO							
					1										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
					2										BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
				384.20											BD,IR,VR							
		SHALEY DOLOSTONE, bedded shaley dolostone, light and dark grey banding		13.50											BD,IR,VR							
															BD,IR,RO							
					3										BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
				381.10											BD,IR,RO							
		BOTTOM OF HOLE		16.60											BD,IR,VR							
															BD,IR,VR							
															BD,UN,VR							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,RO							
															BD,UN,RO							
															BD,UN,RO							
															BD,UN,RO							
															BD,IR,VR							
															BD,IR,S							
															BD,IR,S							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							

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DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-07 (CAL)

SHEET 1 OF 1

LOCATION: N 4853102.3 ;E 578129.1

DRILLING DATE: Febuary 20, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		404.73																		
0		(SP) SAND, some gravel; brown, no odor, no staining, non-cohesive, moist		0.00																		
2				402.44																		Febuary 24, 2020
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		2.29	1										BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR							
4															BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR							
6					2										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO							
8					3										BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR							
10					4										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR							
12					5										BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR							
14					6										BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR							
16				387.41																		
18		SHALEY DOLOSTONE, bedded shaley dolostone, light and dark grey banding		17.32 386.06											BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR							
		BOTTOM OF HOLE		18.67											BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,VR BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO							
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-08 (CAL)

SHEET 1 OF 1

LOCATION: N 4852832.0 ;E 577962.0

DRILLING DATE: Febuary 20-21, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		404.50																		
0		(SM) SILTY SAND, some gravel; dark brown, no odor, no staining, non-cohesive, moist		0.00																		
2				402.06																		
		(SP) SAND, some silt, some bolders; dark brown, no odors, no staining, non-cohesive moist, boulder at 3.96m		2.44																		
4				400.53																		
		(SP) SAND, some cobbles and boulders; brown, no odors, no staining, non-cohesive, moist		3.97																		
				399.17																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		5.33																		
6																						
8																						Febuary 25, 2020
10					1										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,UN,RO							
12					2										BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,UN,VR							
14					3										BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO							
16																						
				387.23	4																	
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey and light grey banding		17.27 386.60																		
18		BOTTOM OF HOLE		17.90											BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
20																						
22																						
24																						
26																						
28																						
30																						

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN - Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-09 (CAL)

SHEET 1 OF 1

LOCATION: N 4852803.0 ;E 578186.3

DRILLING DATE: Febuary 24-25, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		402.26																		
0		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist		0.00																		
				401.04																		
		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, moist		1.22																		
2				399.52																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		2.74																		
4					1																	
					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR						▽ Febuary 25, 2020
6																						
8					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO						
10					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR						
12					5										BD,CU,RO BD,CU,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR						
14				386.63																		
		SHALEY DOLOSTONE, bedded shaley dolostone, dark grey		15.63																		
16				385.49	6										BD,IR,VR							
		BOTTOM OF HOLE		16.77											BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-10 (CAL)

SHEET 1 OF 1

LOCATION: N 4853952.3 ;E 577940.1

DRILLING DATE: March 16-17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)
0		GROUND SURFACE	411.07
		(SM) SILTY SAND TILL, some clay; brown/black, no odors, no staining, non-cohesive, moist (TOPSOIL)	0.00 410.46 0.61
2		(SM) CLAYEY SILTY SAND, some cobbles; brown, no odors, no staining, non-cohesive, moist then wet at 1.52m	
4			
			405.59
6		(SM) BOULDERS and SILTY SAND; brown, no odors, no staining, non-cohesive, wet	5.49 404.97 6.10
		(SM) CLAYEY SILTY SAND TILL and COBBLES; light brown, no odors, no staining, non-cohesive, dry	403.45 7.62
8		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)	
10			
12			
14			
16			
			394.32
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey with dark grey banding	16.75
18			
			392.50
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)	18.57
			391.52
20		BOTTOM OF HOLE	19.55
22			
24			
26			
28			
30			

SYMBOLIC LOG

RUN No. | PENETRATION RATE min/(m) | FLUSH | COLOUR % RETURN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

RECOVERY: TOTAL CORE % (80 60 40 20); SOLID CORE % (80 60 40 20)

R.Q.D. % (80 60 40 20)

FRACT. INDEX PER 0.25 m (5 10 15 20)

DISCONTINUITY DATA: B Angle (0 90 180 270); DIP w.r.t. CORE AXIS (0 30 60 90); TYPE AND SURFACE DESCRIPTION; Jr; Ja; Jn

HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})

Diametral Point Load Index (MPa) (2 4 6)

RMC -Q' AVG.

RUN No.	TYPE AND SURFACE DESCRIPTION
1	BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR
2	BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO
3	BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-11 (CAL)

SHEET 1 OF 1

LOCATION: N 4854240.5 ;E 578065.1

DRILLING DATE: March 17-18, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		402.10																		
		(SM) CLAYEY SILTY SAND TILL; black/brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 401.49																		
		(SP) SAND; brown, no odors, no staining, non-cohesive, moist		0.61 400.27																		
2		DOLOSTONE, fresh to slightly weathered, bedded dolostone, light grey (GASPORT FORMATION)		1.83	1										BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							▽ March 19, 2020
4															BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO							
6					2										BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
8				393.46	3										BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		8.64											BD,UN,RO BD,IR,RO BD,IR,RO BD,CU,RO							
10				391.90											BD,IR,RO							
		BOTTOM OF HOLE		10.20											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO							
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-12 (CAL)

SHEET 1 OF 1

LOCATION: N 4854244.9 ;E 577780.6

DRILLING DATE: March 20-23, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		415.22																		
		(SM) CLAYEY SILTY SAND; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 0.30																		
		(CL) SILTY CLAY; brown, no odors, no staining, cohesive, W ~ PL		414.00 1.22																		
2		(CH) SANDY CLAY TILL, some gravel; brown, no odors, no staining, cohesive																				
4																						
6				408.21																		
		(CL) SANDY SILTY CLAY TILL, some gravel; reddish brown, no odors, no staining, cohesive, W < PL		7.01																		
8																						▽ March 25, 2020
10				404.82																		
		DOLOSTONE, fresh to lightly weathered, bedded dolostone, light grey to light beige (GASPORT FORMATION)		10.40	1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
12																						
14					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
16																						
18					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
				395.88																		
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey to brown		19.34	4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
20																						
				393.46																		
22		BOTTOM OF HOLE		21.76											BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-13 (CAL)

SHEET 1 OF 1

LOCATION: N 4854103.2 ;E 577209.7

DRILLING DATE: March 27, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		412.94																		
0		(SC) SILTY CLAYEY SAND TILL; black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 412.03																		
		(SP/GP) Sand and GRAVEL, some clay; light brown, no odors, no staining, non-cohesive, moist		0.91 410.50																		
2		(SC) CLAYEY SAND TILL, some cobbles some gravel; light brown, no odors, no staining, non-cohesive, moist		2.44 409.89																		
		(SP/GP) SANDY GRAVEL and COBBLES; grey, no odors, no staining, non-cohesive, moist		3.05 407.76																		▽ April 2, 2020
4		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		5.18	1										BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO							
6					2										BD,CU,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,UN,RO							
8					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO							
10					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
12					5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
14					6										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
16															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
18															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
20				392.16											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		20.78 390.30											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
22		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		22.80											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
		BOTTOM OF HOLE													BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
24															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
26															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR							
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-14 (CAL)

SHEET 1 OF 2

LOCATION: N 4853881.7 ;E 577288.6

DRILLING DATE: March 30, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		417.27																		
0		(ML) SANDY SILT; dark brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 0.40																		
		(CL) SILTY CLAY TILL, some sand, some gravel, some cobbles; light brown, no odors, no staining, cohesive, W ~ PL																				
4				412.70																		
		(CL) SANDY SILTY CLAY TILL, some gravel, some cobbles; brown, no odors, no staining, cohesive, W < PL		4.57																		
8				409.19																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to light beige (GASPORT FORMATION)		8.08	1										BD,IR,RO BD,IR,RO BD,IR,SM BD,IR,RO BD,IR,RO							
10															BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-14 (CAL)

SHEET 2 OF 2

LOCATION: N 4853881.7 ;E 577288.6

DRILLING DATE: March 30, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		385.81	8										BD,IR,RO BD,IR,RO BD,IR,S BD,IR,RO BD,IR,RO BD,IR,VR							
32		BOTTOM OF HOLE		31.46											BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO							
34																						
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-15 (CAL)

SHEET 1 OF 2

LOCATION: N 4854113.1 ;E 576925.2

DRILLING DATE: April 2, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		421.52																		
0		SANDY SILT; dark brown, no odors, no straining, non-cohesive, moist (TOPSOIL)		0.08																		
2		(CL) SILTY CLAY TILL, some sand, some gravel; red brown, no odors, no staining, cohesive, W < PL																				
4																						
6																						
8																						
10																						
12				408.11																		
14		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to light beige (GASPORT FORMATION)		13.41																		
16					1										BD,IR,RO BD,IR,K BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO							
18					2										BD,IR,RO BD,IR,RO BD,IR,RO							
20					3										BD,IR,RO BD,IR,RO BD,IR,SM BD,IR,RO BD,IR,RO BD,IR,SM BD,IR,RO BD,IR,SM BD,UN,VR BD,IR,RO BD,IR,RO BD,IR,RO							
22					4										BD,UN,VR BD,UN,RO BD,IR,RO							
24															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
26					5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,SM							
28					6										BD,IR,RO BD,IR,RO							
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-15 (CAL)

SHEET 2 OF 2

LOCATION: N 4854113.1 ;E 576925.2

DRILLING DATE: April 2, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to light beige (GASPORT FORMATION)			6										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
32					7										BD,PO,RO BD,PO,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
34		SHALEY DOLOSTONE, bedded shaley dolostone, brown		387.66 33.86											BD,IR,RO BD,IR,RO BD,IR,RO							
		BOTTOM OF HOLE		386.76 34.76											BD,IR,K BD,PO,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,RO BD,IR,K BD,IR,K BD,IR,RO BD,IR,RO BD,IR,RO							
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-16 (CAL)

SHEET 1 OF 2

LOCATION: N 4853859.5 ;E 576991.4

DRILLING DATE: April 9, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		420.74																		
0		(SC) CLAYEY SAND TILL and GRAVEL; brown/black, no odor, no staining, non-cohesive, wet (TOPSOIL)		0.00																		
				0.50																		
		(SP/GP) SAND and GRAVEL; brown, no odors, no staining, non-cohesive, wet		0.75																		
2		(CL) SANDY CLAY TILL, some gravel, some cobbles; reddish brown, no odors, no staining, cohesive, W < PL																				
4																						▽ April 16, 2020
6																						
8				412.21																		
		(SC) CLAYEY SAND and GRAVEL; brown, no odors, no staining, non-cohesive, moist then wet at 10.05m		8.53																		
10																						
				408.85																		
12		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		11.89																		
14															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
16					1										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
18					2										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
20															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
					3										BD,IR,RO							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
22															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
24					4										BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,RO							
															BD,UN,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
26															BD,PO,SM							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
					5										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
28															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
					6										BD,IR,RO							
															BD,IR,RO							
30															BD,IR,RO							
		CONTINUED NEXT PAGE																				

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DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-16 (CAL)

SHEET 2 OF 2

LOCATION: N 4853859.5 ;E 576991.4

DRILLING DATE: April 9, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)			6										BD,IR,RO							
32				388.30											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		32.44	7										N,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
34				386.58											BD,IR,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		34.18											BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,VR BD,IR,RO							
		BOTTOM OF HOLE																				
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-17 (CAL)

SHEET 1 OF 2

LOCATION: N 4853391.6 ;E 577474.7

DRILLING DATE: April 16, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		413.06																		
		(SC) CLAYEY SAND; black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00																		
		(SC) CLAYEY SAND TILL, some gravel, some cobbles; brown, no odors, no staining, non-cohesive, moist		0.50 411.84 1.22																		
2		(SC/GP) CLAYEY SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive, moist		409.71																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		3.35																		
4																						
6					1										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR							▽ April 24, 2020
8					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-17 (CAL)

SHEET 2 OF 2

LOCATION: N 4853391.6 ;E 577474.7

DRILLING DATE: April 16, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR / % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
32															BD,IR,VR							
															BD,IR,RO							
															BD,IR,SM							
															BD,IR,RO							
															BD,IR,RO							
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DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-18 (CAL)

SHEET 1 OF 2

LOCATION: N 4853571.8 ;E 577313.4

DRILLING DATE: April 20, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		417.53																		
0		(SM) CLAYEY SILTY SAND TILL; brown/black, no odors, no staining, non-cohesive, wet		0.00																		
				415.70																		
2		BOULDERS and COBBLES; grey, no odors, no staining, non-cohesive, moist		1.83																		
				413.57																		
4		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		3.96																		
6					1										BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,VR BD,IR,RO							
8					2										BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO							
10					3										BD,IR,RO BD,IR,RO BD,CU,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR							
12					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
14					5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,CU,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR							
16					6										BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR							
18					7																	
20					8																	
22					9																	
24																						
26																						
28																						
30		*CONTINUED NEXT PAGE*																				

April 24, 2020

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-18 (CAL)

SHEET 2 OF 2

LOCATION: N 4853571.8 ;E 577313.4

DRILLING DATE: April 20, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		386.53	9										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO RB,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		31.00 385.69											BD,IR,VR BD,IR,RO							
32		BOTTOM OF HOLE		31.84											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,SM BD,IR,RO BD,IR,RO BD,IR,RO							
34																						
36																						
38																						
40																						
42																						
44																						
46																						
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52																						
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56																						
58																						
60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-19 (CAL)

SHEET 1 OF 1

LOCATION: N 4853580.0 ;E 577733.1

DRILLING DATE: April 23-24, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		411.42																		
		(SC) SILTY CLAYEY SAND; brown/black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00																		
				0.50																		
		(SC) SILTY CLAYEY SAND; brown/black, no odors, no staining, non-cohesive, moist		0.91																		
		(SM/GP) SILTY SAND and GRAVEL, some cobbles; golden brown, no odors, no staining, non-cohesive, moist		408.68																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		2.74																		
6					1										BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO							
8					2										BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-20 (CAL)

SHEET 1 OF 2

LOCATION: N 4853551.6 ;E 577031.1

DRILLING DATE: April 28-30, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		423.60																		
		(SC) SILTY CLAYEY SAND; brown/black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 0.31																		
2		(SC/GP) CLAYEY SAND TILL and GRAVEL, some cobbles; red, no odors, no staining, cohesive, W ~ PL																				
4																						
				418.11																		
6		(CH) SANDY CLAY TILL, some gravel; brown, no odors, no staining, cohesive, W < PL		5.49																		
8																						
10																						
12																						May 6, 2020
14				409.27																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		14.33																		
16					1										BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
18					2										BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-20 (CAL)

SHEET 2 OF 2

LOCATION: N 4853551.6 ;E 577031.1

DRILLING DATE: April 28-30, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)			6										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO							
32					7										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR							
34					8										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
36					9										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
38				384.95																		
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		38.65	10										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
40				383.02																		
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		40.58											BD,IR,RO							
		BOTTOM OF HOLE		40.98											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,K							
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-21 (CAL)

SHEET 1 OF 2

LOCATION: N 4853276.6 ;E 576935.7

DRILLING DATE: May 4-5, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		413.53																		
		(ML) SANDY SILT; dark brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 0.30																		
2		(CL) SILTY CLAY TILL, some sand some gravel;brown, no odors, no staining, cohesive, W < PL																				
4																						
				408.04																		▽ May 6, 2020
6		DOLOSTONE, fresh with some weathering, bedded dolostone, light grey to light beige (GASPORT FORMATION)		5.49																		
					1										BD,IR,RO							
8					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,PL,RO							
10					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,CU,RO BD,PL,RO BD,IR,K BD,IR,RO BD,PL,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,PL,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO							
12																						
14					4																	
16					5										BD,UN,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,CU,K BD,PL,RO BD,IR,RO BD,IR,VR							
18																						
20					6										BD,PL,VR BD,CU,RO BD,IR,K BD,PL,SM JN,IR,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,PL,RO							
22																						
24					7										BD,PL,RO BD,IR,RO BD,PL,RO BD,PL,RO BD,IR,VR BD,IR,RO BD,PL,RO BD,UN,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,PL,VR BD,PL,K BD,IR,K BD,CU,RO BD,PL,RO BD,IR,VR BD,PL,RO BD,IR,VR BD,IR,PO BD,PL,RO BD,IR,RO BD,IR,RO BD,PL,RO							
26																						
28					8																	
					9																	
30		*CONTINUED NEXT PAGE*																				

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DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS
CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-21 (CAL)

SHEET 2 OF 2

LOCATION: N 4853276.6 ;E 576935.7

DRILLING DATE: May 4-5, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh with some weathering, bedded dolostone, light grey to light beige (GASPORT FORMATION)			9										BD,IR,RO BD,IR,RO							
				381.99																		
32		SHALEY DOLOSTONE, bedded shaley dolostone, brown grey		31.54	10										BD,IR,K BD,PL,K BD,PL,RO BD,UN,RO BD,IR,K BD,PL,RO BD,IR,RO BD,IR,RO							
				380.05																		
34		BOTTOM OF HOLE		33.48											BD,UN,RO BD,IR,RO BD,IR,RO BD,PL,RO BD,PL,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,K BD,PL,RO BD,IR,RO							
36																						
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48																						
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52																						
54																						
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60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-22 (CAL)

SHEET 1 OF 1

LOCATION: N 4853294.0 ;E 576701.8

DRILLING DATE: May 6-7, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		410.98																		
		(MH) SANDY CLAYEY SILT; dark brown, no odors, no staining, cohesive W < PL (TOPSOIL)		0.00 0.36																		
2		(CL) SILTY CLAY TILL, some gravel, trace cobbles; brown, no odors, no staining, cohesive, W < PL		408.54																		
		(MH) CLAYEY SILT TILL, some sand, some gravel; brown, no odors, no staining, cohesive, W > PL		2.44 407.02																		May 8, 2020
4		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to light beige (GASPORT FORMATION)		3.96																		
6					1										BD,PL,RO BD,IR,VR BD,PL,RO							
8					2										BD,IR,RO BD,IR,RO BD,UN,RO BD,PL,SM BD,CU,RO BD,CU,PO BD,CU,RO BD,PL,VR							
10					3										BD,PL,RO BD,IR,RO BD,CU,K BD,UN,RO BD,PL,PO BD,UN,RO							
12															BD,UN,RO							
14					4										BD,IR,RO BD,UN,RO BD,IR,RO BD,PL,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,PL,RO BD,IR,RO BD,IR,RO							
16																						
18					5										BD,PL,RO BD,PL,RO BD,IR,VR BD,IR,RO BD,CU,RO							
20					6										BD,PL,RO BD,PL,RO BD,IR,RO BD,PL,RO BD,UN,RO BD,PL,RO							
22															BD,UN,RO BD,IR,RO BD,IR,K BD,PL,RO							
24					7										BD,IR,RO BD,IR,SM BD,IR,RO BD,PL,RO BD,PL,RO							
26					8										BD,PL,RO BD,CU,RO BD,PL,RO BD,PL,RO BD,PL,SM BD,PL,RO BD,PL,VR BD,PL,RO BD,PL,VR BD,PL,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,CU,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, grey to dark grey		383.46 27.52 382.37																		
28		BOTTOM OF HOLE		28.61											BD,PL,RO BD,PL,RO BD,UN,RO BD,PL,RO							
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-23 (CAL)

SHEET 1 OF 2

LOCATION: N 4853559.8 ;E 576779.8

DRILLING DATE: May 8-11, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		420.27																		
0		(SM) SILTY SAND; brown, no odor, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 0.25																		
		(MH) SANDY SILT TILL, some gravel; medium brown, no odors, no staining, non-cohesive, moist																				
2																						
4																						
6																						
8				411.77																		
		(CH) SANDY CLAY TILL, trace gravel; brown, no odors, no staining, cohesive, W ~ PL		8.50																		
10				409.60																		
		(SM) SANDY SILT TILL, some gravel; brown, no odors, no staining, cohesive W ~ PL		10.67 / 408.69																		
12		(CL) SILTY CLAY TILL, some gravel; brown, no odors, no staining, cohesive, W ~ PL		11.58 / 407.47																		
		DOLOSTONE, fresh, bedded dolostone, light grey to light beige (GASPORT FORMATION)		12.80																		
14																						
16					1										BD,PL,RO BD,PL,RO BD,PL,RO							
18					2										BD,PL,RO BD,PL,RO							
20					3										BD,PL,VR BD,PL,VR BD,UN,RO BD,UN,RO BD,CU,RO BD,UN,RO BD,PL,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,PL,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,PL,VR BD,UN,RO BD,UN,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,IR,RO BD,PL,RO BD,IR,RO BD,CU,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,PL,RO BD,PL,RO BD,IR,VR BD,PL,VR BD,PL,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,UN,RO							
22																						
24					4																	
26					5																	
28					6																	
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-23 (CAL)

SHEET 2 OF 2

LOCATION: N 4853559.8 ;E 576779.8

DRILLING DATE: May 8-11, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, light grey to light beige (GASPORT FORMATION)			6										BD,PL,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,PL,RO BD,PL,RO							
32					7										BD,CU,RO BD,PL,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,PL,RO BD,IR,RO BD,PL,RO							
34															BD,PL,RO BD,IR,RO BD,PL,RO BD,PL,RO BD,IR,RO BD,PL,RO BD,PL,RO BD,IR,RO BD,PL,RO							
36		SHALEY DOLOSTONE, bedded shaley dolostone, grey to brown		384.45 35.82 382.65	8										BD,PL,RO BD,IR,RO BD,UN,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,PL,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,PL,RO							
38		BOTTOM OF HOLE		37.62											BD,PL,RO BD,UN,RO BD,PL,RO BD,PL,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,IR,RO							
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-24 (CAL)

SHEET 1 OF 1

LOCATION: N 4852710.3 ;E 577296.0

DRILLING DATE: May 27, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		403.60																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 402.99																		
		(SP) SAND, trace gravel; brown, no odor, no staining, non-cohesive, moist		0.61 402.07																		
2		(SM/GP) SILTY SAND and GRAVEL, some cobbles; greyish brown, no odors, no staining, non-cohesive, moist		1.52																		
4				398.13																		
6		(SP/GP) SAND and GRAVEL, some cobbles, some silt; brown, no odors, no staining, moist		5.47																		
8				395.06																		
		(ML/GP) SANDY SILT and GRAVEL, some cobbles; brown, no odors, no staining, moist		8.53 8.80																		
10		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)			1										BD,IR,RO BD,IR,RO BD,IR,RO							
12															BD,IR,RO BD,IR,VR							
14					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
16															BD,IR,RO							
18					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-25 (CAL)

SHEET 1 OF 1

LOCATION: N 4852975.0 ;E 577402.1

DRILLING DATE: June 10, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		405.48																		
0		(SP) SAND, some clay, some silt; brown/black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00																		
				0.50																		
		(SP) SAND, some clay, some silt; brown/black, no odors, no staining, non-cohesive, moist		403.65																		
2				1.83																		
		(SC/GP) CLAYEY SAND TILL and GRAVEL, some cobbles; brown, no odors, no staining, cohesive, W ~ PL																				
4				400.60																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		4.88																		
6					1										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
8					2										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
10					3										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
12					4										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
14					5										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
16					6										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
18															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
20															BD,IR,RO							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
				384.44											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		21.04											BD,IR,RO							
22				383.45											BD,IR,RO							
		BOTTOM OF HOLE		22.03											BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
24															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-26 (CAL)

SHEET 1 OF 1

LOCATION: N 4852942.8 ;E 577037.9

DRILLING DATE: June 11, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		404.82																		
		(SC) CLAYEY SAND TILL; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 403.82																		
		(SM/GP) SILTY SAND and GRAVEL; grey, no odors, no staining, non-cohesive, moist		1.22 / 402.38																		
		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive,		2.44 / 400.85																		
		(SM/GP) SILTY SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive, moist		3.96																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)			1										BD,IR,RO							
					2										BD,IR,RO							
					3										BD,IR,RO; BD,UN,RO							
					4										BD,IR,RO; BD,UN,RO							
					5										BD,IR,RO							
					6										BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, grey		383.78 / 21.04 / 382.09																		
		BOTTOM OF HOLE		22.73																		

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-27 (CAL)

SHEET 1 OF 2

LOCATION: N 4853168.7 ;E 577212.3

DRILLING DATE: October 21-22, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		408.64																		
		(SP) GRAVELLY SAND; brown to red, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 0.30																		
		(SP) GRAVELLY SAND; brown to red, no odors, no staining, non-cohesive, moist		407.04 1.60																		
2		DOLOSTONE, fresh to weathered, bedded dolostone, light to medium grey (GASPORT FORMATION)			1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
4					2										BD,PO,RO BD,PO,RO BD,PO,RO FR,CU,RO FR,CU,RO BD,IR,RO BD,PL,RO							October 26, 2020
6															BD,PL,RO							
8					3										BD,IR,RO FR,PL,RO BD,IR,RO BD,IR,RO BD,IR,RO							
10					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO FR,UN,RO BD,UN,RO BD,IR,RO FR,PL,RO BD,IR,RO							
12															FR,CU,RO BD,IR,RO							
14					5										BD,R,RO BD,IR,RO FR,IR,RO BD,IR,RO FR,IR,RO FR,IR,RO FR,PL,RO BD,PL,RO BD,PL,RO BD,IR,RO							
16					6										FR,UN,RO BD,IR,RO BD,IR,RO FR,PO,RO BD,PO,RO BD,IR,RO FR,PO,RO BD,PO,RO							
18															BD,IR,RO							
20					7										FR,IR,RO FR,IR,RO FR,IR,RO BD,PL,RO BD,UN,RO BD,PO,RO							
22					8																	
24					9										BD,UN,RO BD,UN,RO FR,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO FR,UN,RO BD,PO,RO							
				383.56											BD,UN,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey to medium grey		25.08											BD,UN,RO BD,PO,RO							
26					10										BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							
				381.77											BD,PO,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		26.87 380.99											BD,PO,RO BD,PO,RO							
28		BOTTOM OF HOLE		27.65											BD,UN,RO BD,IR,RO BD,IR,RO FR,PO,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,UN,RO							
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: BH20-27 (CAL)

SHEET 2 OF 2

LOCATION: N 4853168.7 ;E 577212.3

DRILLING DATE: October 21-22, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*													BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							
32																						
34																						
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-01 (CAL)

SHEET 1 OF 2

LOCATION: N 4852268.3 ;E 577458.5

DRILLING DATE: Febuary 26-27, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		395.10																		
		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist (TOPSOIL)		0.16																		
2		(GP/SP) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, moist		392.66																		
		(SP) SAND, some gravel; brown, no odor, no staining, non-cohesive, wet		2.44																		
4				391.14																		April 19, 2021 (A) April 19, 2021 (B)
		(SM) SILTY SAND; brown, no odor, no staining, non-cohesive, wet		3.96																		
				389.61																		Bentonite
6		(GP)GRAVEL some sand some silt; brown, no odor, no staining, wet		5.49																		
8				386.57																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		8.53																		
10					1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR								Sand
12					2										BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR								Screen Sand
14				380.24	3										BD,CU,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO								Bentonite
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey with blue banding		14.86											BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR								Sand
16				377.78	4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO								Screen
18		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		17.32																		Sand Bentonite
				375.69																		
20		BOTTOM OF HOLE		19.41											BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,UN,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO								
30		*CONTINUED NEXT PAGE*																				

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DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-01 (CAL)

SHEET 2 OF 2

LOCATION: N 4852268.3 ;E 577458.5

DRILLING DATE: Febuary 26-27, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30															BD,IR,RO							
32															BD,IR,RO							
34															BD,IR,RO							
36															BD,IR,RO							
38															BD,IR,RO							
40															BD,IR,RO							
42															BD,IR,RO							
44															BD,IR,RO							
46															BD,IR,RO							
48															BD,IR,RO							
50															BD,IR,RO							
52															BD,IR,RO							
54															BD,IR,RO							
56															BD,IR,RO							
58															BD,IR,RO							
60															BD,IR,RO							

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-02 (CAL)

SHEET 1 OF 1

LOCATION: N 4852138.4 ;E 577900.0

DRILLING DATE: Febuary 28- March 2, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		399.63																		
		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist		0.00 398.11																		
2		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, moist		1.52 395.06																		
4		(SP) GRAVELLY SAND; brown, no odor, no staining, non-cohesive, moist		4.57 394.14																		
6		(GM) SILTY GRAVEL, some sand; brown/grey, no odor, no staining, non-cohesive, wet		5.49 391.10																		
8		(SP) SAND, some silt; brown, no odor, no staining, non-cohesive, wet		8.53 388.63																		Bentonite April 19, 2021
10		(GP) GRAVEL and COBBLES; red, no odor, no staining, non-cohesive, wet		11.00 388.05																		
12		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odor, no staining, non-cohesive, wet		11.58 386.53																		
14		(SM/GP) SILTY SAND and GRAVEL, some clay; reddish brown, no odor, no staining, non-cohesive, wet		13.10 384.39																		
16		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		15.24 381.58	1										BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Sand Screen Sand Bentonite
18		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		18.05 380.06																		
20		BOTTOM OF HOLE		19.57											BD,IR,SM BD,IR,SM BD,IR,SM BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,UN,VR							
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-03 (CAL)

SHEET 1 OF 2

LOCATION: N 4851907.3 ;E 578243.5

DRILLING DATE: March 3-4, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		390.67																		
0		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 389.67																		
		(SP/GP) SAND and GRAVEL, some cobbles; reddish brown, no odor, no staining, non-cohesive, moist		1.00																		
2																						
4				386.10																		
		(SP) GRAVELLY SAND; brown, no odor, no staining, non-cohesive, wet		4.57																		
6				384.57																		April 19, 2021
		(SP) SAND, some silt; reddish brown, no odor, no staining, non-cohesive, wet		6.10																		
8																						Bentonite
10																						
12																						
14																						
16																						Sand
				373.67																		
		(CH) CLAYEY SILT; golden brown, no odor, no staining, cohesive W ~ PL		17.00 / 372.99																		Screen
18		(CH) CLAY, some silt; brown/grey, no odors, no staining, cohesive, W ~ PL		17.68																		Sand
20																						
				369.24																		
		(CH) CLAY TILL, some silt; brown/grey, no odors, no staining, cohesive, W ~ PL		21.43																		
22																						
24																						Natural Backfil
26																						
28																						
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-03 (CAL)

SHEET 2 OF 2

LOCATION: N 4851907.3 ;E 578243.5

DRILLING DATE: March 3-4, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		(CH) CLAY TILL, some silt; brown/grey, no odors, no staining, cohesive, W ~ PL																				Natural Backfil
32																						
34				356.23																		
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		34.44																		
				355.01																		
36		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		35.66																		
		BOTTOM OF HOLE		35.97																		
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-04 (CAL)

SHEET 1 OF 1

LOCATION: N 4852313.2 ;E 578264.7

DRILLING DATE: March 5-6, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		399.46																		
		(SC) CLAYEY SAND TILL, some silt; dark brown, no odors, no staining, cohesive,W ~ PL		0.00 / 397.94																		
2		(SP/GP) SAND and GRAVEL, some cobbles; dark brown, no odors, no staining, non-cohesive, moist		1.52 / 395.50																		
4		(SM/GP) SILTY SAND and GRAVEL; dark brown, no odors, no staining, non-cohesive, moist		3.96 / 392.45																		
6		(SP) SAND; brown, no odors, no staining, non-cohesive, moist		7.01 / 391.46																		
8		(SM/GP) SILTY SAND and GRAVEL; brown, no odors, no staining, non-cohesive, moist		8.00 / 390.93																		Bentonite
		(SP) GRAVELLY SAND; brown, no odors, no staining, non-cohesive, wet		8.53 / 389.40																		April 19, 2021
10		(SM) SILTY SAND, some clay, some cobbles; golden brown, no odors, no staining, non-cohesive, wet		10.06 / 385.13																		
12																						
14		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey with dark grey banding		14.33 / 382.92	1										BD,IR,VR							Sand
16		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		16.54 / 380.96	2										BD,IR,VR / BD,IR,RO / BD,IR,RO / BD,IR,VR / BD,IR,VR							Screen / Sand / Bentonite
18		BOTTOM OF HOLE		18.50											BD,UN,RO / BD,UN,RO / BD,IR,RO / BD,IR,RO / BD,IR,VR / BD,IR,VR / BD,IR,VR / BD,IR,K							
20															BD,IR,K							
22															BD,IR,K							
24															BD,IR,K							
26															BD,IR,K / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO							
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-05 (CAL)

SHEET 1 OF 1

LOCATION: N 4852712.6 ;E 578423.1

DRILLING DATE: March 9, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		399.63																		
		(SC) CLAYEY SAND, some silt; brown/black, no odor, no staining, non-cohesive, wet (TOPSOIL)		0.00 / 399.02																		
		(SM) SILTY SAND, some clay; light brown, no odors, no staining, non-cohesive, wet		0.61 / 398.11																		
2		DOLOSTONE, fresh to slightly weathered, bedded dolostone, light grey (GASPORT FORMATION)		1.52																		Bentonite
					1										BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,VR / BD,IR,RO / BD,IR,VR / BD,IR,VR / BD,IR,RO / BD,IR,RO / BD,CU,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,CU,VR / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,K / BD,IR,K / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO						Sand
4																						Screen
					2																	Sand
6																						April 19, 2021 (A)
8					3																	Bentonite
10				389.03																		
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey with dark grey banding		10.60	4																	Sand
12																						Screen
				385.72	5																	Sand
14		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		13.91 / 384.79																		Bentonite
		BOTTOM OF HOLE		14.84											BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,VR / BD,IR,VR / BD,IR,VR / BD,IR,VR / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,RO / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K / BD,IR,K						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-06 (CAL)

SHEET 1 OF 1

LOCATION: N 4852972.6 ;E 578474.2

DRILLING DATE: March 10, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		400.15																		
0		(SC/GP) CLAYEY SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive, wet		0.00																		
				398.63																		
2		(SM/GP) SILTY SAND and GRAVEL; golden brown, no odors, no staining, non-cohesive, wet		1.52 398.01																		Bentonite
				2.14																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)			1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,VR BD,CU,RO							April 19, 2021 (B) Sand April 19, 2021 (A) Screen
4																						
					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO							Sand
6																						
					3										BD,IR,RO							Bentonite
8															BD,IR,RO BD,IR,RO							
															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,SM BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO							Sand Screen Sand
10				389.19																		
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey with dark grey banding		10.96	4																	
12																						
14				385.90											BD,IR,RO BD,IR,RO							Bentonite
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		14.25	5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR							
16				384.12																		
		BOTTOM OF HOLE		16.03											BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,UN,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K							
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-07 (CAL)

SHEET 1 OF 2

LOCATION: N 4853250.4 ;E 578359.9

DRILLING DATE: March 11, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		404.07																		
		(SC) CLAYEY SAND, some silt some cobbles; brown, no odirs, no staining, non-cohesive, moist (TOPSOIL)		0.00																		
		(SM/GP) SILTY SAND and GRAVEL, some cobbles; golden brown, no odors, no staining, non-cohesive, moist		0.50																		
2		DOLOSTONE, fresh to moderately weathered, bedded, dolostone, light grey to blue-grey (GASPORT FORMATION)		401.94 2.13	1										BD,IR,RO							April 19, 2021 (B) April 19, 2021 (A)
4					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR					Bentonite
6																						
8					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO							Sand
10					4										BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							Screen Sand
12				390.87																		Bentonite
14		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		13.20	5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO							Sand
16				387.67																		Screen
18		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		16.40	6										BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Sand Bentonite
				384.62																		
20		BOTTOM OF HOLE		19.45											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,UN,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,K							
30		*CONTINUED NEXT PAGE*																				

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DEPTH SCALE

1 : 150

GOLDER MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-07 (CAL)

SHEET 2 OF 2

LOCATION: N 4853250.4 ;E 578359.9

DRILLING DATE: March 11, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30															BD,IR,K							
32															BD,IR,K							
34															BD,IR,K							
36															BD,IR,K							
38															BD,IR,K							
40															BD,IR,K							
42															BD,IR,K							
44															BD,IR,K							
46															BD,IR,K							
48															BD,IR,K							
50															BD,IR,K							
52															BD,IR,K							
54															BD,IR,K							
56															BD,IR,K							
58															BD,IR,K							
60															BD,IR,K							

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-08 (CAL)

SHEET 1 OF 1

LOCATION: N 4853574.8 ;E 578009.8

DRILLING DATE: March 12, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		406.93																		
		(SM) CLAYEY SILTY SAND TILL, some cobbles; brown, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00 406.32																		
		(SM) CLAYEY SILTY SAND, some cobbles; brown, no odors, no staining, non-cohesive, wet		0.61 404.95																		
2		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		1.98	1										BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,SM BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Bentonite April 19, 2021 (B) April 19, 2021 (A) Sand Screen Sand Bentonite Sand Screen Sand Bentonite
4					2																	
6																						
8					3																	
10																						
12					4																	
14																						
				391.83	5																	
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		15.10																		
16																						
				389.61																		
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		17.32	6																	
18				388.34																		
		BOTTOM OF HOLE		18.59											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K							
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-09 (CAL)

SHEET 1 OF 1

LOCATION: N 4854157.5 ;E 578343.8

DRILLING DATE: March 17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		399.95																		
		(SC) SILTY CLAYEY SAND TILL; black/brown, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00 399.04																		
		(SP) SAND; brown, no odors, no staining, non-cohesive, moist		0.91 397.36																		
2		(CH) SANDY CLAY TILL and COBBLES, some gravel; grey/light brown, no odors, no staining, non-cohesive, moist		2.59 394.62																		Bentonite April 19, 2021
4		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		5.33 392.47	1										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR								Sand
6		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		7.48 390.94	2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,RO								Screen Sand Bentonite
8		BOTTOM OF HOLE		9.01											BD,IR,RO BD,IR,RO BD,IR,VR BD,CU,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,SM BD,IR,K								
10																						
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-10 (CAL)

SHEET 1 OF 1

LOCATION: N 4854407.3 ;E 577838.0

DRILLING DATE: March 18-19, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		411.32																		
0		(SC) SILTY CLAYEY SAND, some cobbles; brown/black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 410.71																		
		(CH) SANDY CLAY; red, no odors, no staining, cohesive, W ~ PL		0.61 409.49																		
2		(SP) GRAVELLY SAND, some cobbles; golden brown, no odors, no staining, non-cohesive, moist		1.83 408.88																		
		(SM/GP) SILTY SAND and GRAVEL, some cobbles; whitish brown, no odors, no staining, non-cohesive, moist		2.44																		
4																						
6				404.31																		Bentonite
		(SC/GP) CLAYEY SAND and GRAVEL, some cobbles; reddish brown, no odors, no staining, non-cohesive, moist		7.01																		
8																						
10				400.35																		April 19, 2021 (A) April 19, 2021 (B)
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to beige grey (GASPORT FORMATION)		10.97																		
12					1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO								
14					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO								Sand Screen Sand
16				394.56											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		16.76											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,K							Bentonite
18					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Sand Screen
				391.77																		
20		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		19.55	4										BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,UN,RO							Sand Bentonite
				390.13																		
		BOTTOM OF HOLE		21.19											BD,UN,RO BD,IR,RO BD,IR,K BD,IR,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K							
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL/CS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-11 (CAL)

SHEET 1 OF 1

LOCATION: N 4853921.4 ;E 577672.0

DRILLING DATE: March 23-24

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE	409.72																		
		(SP) GRAVELLY SAND, some cobbles; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)	0.40																		
2		(SP) GRAVELLY SAND, some cobbles; brown, no odors, no staining, non-cohesive, moist	407.59																		Bentonite
		(SM) SILTY SAND, some clay, some gravel; brown, no odors, no staining, cohesive, W ~ PL	2.13																		
4		DOLOSTONE, fresh to slightly weathered, bedded dolostone, light grey to blue grey (GASPORT FORMATION)		1										BD,IR,VR							Sand
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,RO							Screen
														BD,IR,RO							
														BD,IR,RO							
6				2										BD,IR,VR							Sand
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,VR							
8				3										BD,IR,VR							
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,RO							
10														BD,IR,VR							Bentonite
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,VR							
														BD,IR,RO							
														BD,IR,RO							
12				4										BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
14														BD,IR,RO							Sand
														BD,IR,RO							
														BD,IR,RO							Screen
				5										BD,IR,RO							
														BD,IR,RO							Sand
														BD,IR,RO							
16														BD,IR,RO							
			393.26											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey	16.46											BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							Bentonite
18			391.56	6										BD,IR,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)	18.16											BD,IR,RO							
														BD,IR,RO							
			390.33											BD,IR,RO							
		BOTTOM OF HOLE	19.39											BD,IR,VR							
20														BD,IR,VR							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
														BD,IR,RO							
22														BD,IR,RO							
														BD,CU,RO							
														BD,IR,RO							
														BD,IR,K							
														BD,IR,K							
														BD,IR,K							
														BD,IR,K							
														BD,IR,K							
24																					
26																					
28																					
30																					

Bentonite
Sand
April 19, 2021 (B)
Screen
April 19, 2021 (A)
Sand
Bentonite
Sand
Screen
Sand
Bentonite

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: KS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-12 (CAL)

SHEET 1 OF 1

LOCATION: N 4854321.4 ;E 577271.9

DRILLING DATE: March 25-26, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		412.43																		
		(ML) SANDY SILT TILL; brown, no odor, no staining, cohesive, W < PL (TOPSOIL)		0.00 0.30 411.12																		
		(ML) SANDY SILT TILL; brown, no odor, no staining, cohesive, W < PL		1.31																		
		(SP) SAND, some gravel; brown, no odors, no staining, non-cohesive, moist		1.61																		
		(ML) SANDY SILT TILL, some gravel; brown, cohesive, W < PL		408.77																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to beige (GASPORT FORMATION)		3.66	1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,UN,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO FR,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,UN,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO						Bentonite April 19, 2021 (B) Sand Screen Sand Bentonite Sand Screen Sand Bentonite
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		392.63 19.80	2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR BD,CU,VR BD,IR,RO BD,IR,RO BD,UN,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		390.77 21.66	3										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,CU,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K						
		BOTTOM OF HOLE		389.78 22.65	4																	
					5																	
					6																	

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: KS/AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-13 (CAL)

SHEET 1 OF 2

LOCATION: N 4854473.1 ;E 576873.1

DRILLING DATE: April 7-8, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		415.53																		
0		(ML) SANDY SILT; dark brown, no odors, no straining, non-cohesive, moist (TOPSOIL)		0.00 / 0.46 / 414.31																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist		1.22 / 413.55																		
2		(SP) SILTY GRAVELLY SAND; red/brown, no odors, no staining, non-cohesive, moist		1.98																		
		(SP) SAND, some silt; reddish brown, no odor, no staining, non-cohesive, moist		410.96																		April 19, 2021 (B) April 19, 2021 (A)
4		(CL) SILTY CLAY TILL, some gravel; grey/brown, no odors, no staining, cohesive, W < PL		4.57																		
6																						
8																						Bentonite
10																						
12				402.43																		
		DOLOSTONE, fresh, bedded dolostone, light grey to blue grey (GASPORT FORMATION)		13.10																		
14																						
16					1										BD,IR,RO							
					2										BD,IR,RO							Sand
18															BD,IR,RO							Screen
20					3										BD,IR,RO							Sand
22															BD,IR,RO / BD,IR,VR							Bentonite
24				391.61	4										BD,IR,RO							Sand
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		23.92											BD,IR,RO							Screen
26		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		389.85 / 25.68	5										BD,IR,RO / BD,IR,VR							Sand / Bentonite
28				387.30											BD,IR,RO / BD,IR,VR / BD,IR,K							
		BOTTOM OF HOLE		28.23											BD,IR,VR / BD,IR,RO							
30		*CONTINUED NEXT PAGE*													BD,IR,RO							

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS/AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-13 (CAL)

SHEET 2 OF 2

LOCATION: N 4854473.1 ;E 576873.1

DRILLING DATE: April 7-8, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30															BD,IR,RO							
32															BD,IR,K							
34															BD,IR,K							
36															BD,IR,K							
38															BD,IR,K							
40															BD,IR,K							
42															BD,IR,K							
44															BD,IR,K							
46															BD,IR,K							
48															BD,IR,K							
50															BD,IR,K							
52															BD,IR,K							
54															BD,IR,K							
56															BD,IR,K							
58															BD,IR,K							
60															BD,IR,K							

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS/AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-13 (CAL) - OFFSET

SHEET 1 OF 1

LOCATION: N 4854473.1 ;E 576873.1

DRILLING DATE: April 7-8, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

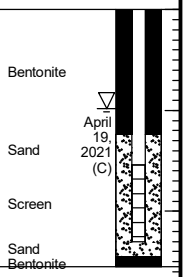
DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		415.53																		
		(ML) SANDY SILT; dark brown, no odors, no straining, non-cohesive, moist (TOPSOIL)		0.00 0.46 414.31																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist		1.22 413.55																		
2		(SP) SILTY GRAVELLY SAND; red/brown, no odors, no staining, non-cohesive, moist		1.98																		
		(SP) SAND, some silt; reddish brown, no odor, no staining, non-cohesive, moist		410.96																		
4		(CL) SILTY CLAY TILL, some gravel; grey/brown, no odors, no staining, cohesive, W < PL		4.57 410.43																		
		BOTTOM OF HOLE		5.10																		
6																						
8																						
10																						
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

NOTES WATER LEVELS INSTRUMENTATION



DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS/AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-14 (CAL)

SHEET 1 OF 2

LOCATION: N 4853100.4 ;E 577576.0

DRILLING DATE: April 27-28, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		406.71																		
		(SC) SILTY CLAYEY SAND TILL; black/brown, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00																		
				0.50																		
2		(SC) SILTY CLAYEY SAND TILL; black/brown, no odors, no staining, non-cohesive, wet		404.42																		
		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		2.29																		
4					1										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,RO							
															BD,IR,VR							
6					2										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
8					3										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
10					4										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
12															BD,IR,RO							
															BD,IR,RO							
															BD,IR,SM							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
14					5										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
16															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
18					6										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
20															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
					7										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
22															BD,UN,RO							
				384.31											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		22.40											BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
24					8										BD,iR,RO							
															BD,IR,RO							
															BD,IR,RO							
				382.21											BD,IR,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		24.50											BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
26					9										BD,IR,VR							
				380.36											BD,IR,RO							
		BOTTOM OF HOLE		26.35											BD,IR,RO							
28															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,K							
															BD,UN,RO							
															BD,IR,RO							
30															BD,IR,RO							
		CONTINUED NEXT PAGE																				

NOTES
WATER LEVELS
INSTRUMENTATION

April 19, 2021 (B)
April 19, 2021 (A)
Bentonite
Sand
Screen
Sand
Bentonite
Sand
Screen
Sand
Bentonite

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-14 (CAL)

SHEET 2 OF 2

LOCATION: N 4853100.4 ;E 577576.0

DRILLING DATE: April 27-28, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*													BD,IR,RO							
32															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,RO BD,IR,RO BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,k BD,IR,k BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K BD,IR,K							
34																						
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-15 (CAL)

SHEET 1 OF 2

LOCATION: N 4853544.2 ;E 576576.8

DRILLING DATE: May 12, 19-20, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		417.06																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.20																		
		(CH) SANDY CLAY TILL; brown, no odors, no staining, cohesive, W ~ PL																				
2				414.66																		
		(SC) CLAYEY SAND, some cobbles, some gravel; brown, no odors, no staining		2.40																		
				413.06																		
4		(SP) SAND, some gravel, some clay; brown, no odors, no staining, non-cohesive, moist		4.00																		
				412.46																		
		(CL) SILTY CLAY TILL, some sand, some gravel; brown, no odors, no staining, cohesive, W < PL		4.60																		
6																						
8																						
10																						
				405.46																		
12		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey to beige to blue grey (GASPORT FORMATION)		11.60	1										BD,IR,VR BD,IR,RO BD,IR,RO							
14					2										BD,PO,SM BD,PO,SM BD,IR,RO							Bentonite
16																						
					3										BD,PO,RO BD,PO,RO							
18															BD,IR,VR BD,UN,VR BD,IR,VR BD,UN,RO BD,CU,RO BD,IR,VR BD,IR,SM BD,PO,RO BD,IR,RO BD,UN,RO BD,UN,RO BD,PO,VR BD,PO,RO BD,IR,VR BD,PO,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,PO,RO BD,UN,RO BD,UN,RO BD,CU,RO BD,UN,RO BD,IR,SM BD,UN,RO BD,PO,RO BD,UN,RO BD,UN,SM BD,UN,RO BD,IR,SM BD,PO,RO BD,IR,VR BD,PO,RO BD,UN,RO BD,IR,SM BD,PO,RO BD,PO,SM BD,PO,RO BD,IR,VR BD,PO,SM BD,PO,SM BD,UN,SM							
20					4																	
22																						
24					5																	
26																						
					6																	
28																						Sand
					7																	Screen
30		*CONTINUED NEXT PAGE*																				

April 19, 2021 (A)
April 19, 2021 (B)

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM/CS
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-15 (CAL)

SHEET 2 OF 2

LOCATION: N 4853544.2 ;E 576576.8

DRILLING DATE: May 12, 19-20, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey to beige to blue grey (GASPORT FORMATION)			7										BD,PO,SM BD,PO,RO BD,IR,RO BD,IR,VR BD,IR,VR BD,UN,VR							Screen Sand
32					8										BD,IR,VR BD,PO,VR BD,IR,VR BD,PO,VR BD,IR,RO BD,UN,RO							Bentonite Sand
34		SHALEY DOLOSTONE, bedded shaley dolostone, grey to brown		383.22 33.84											BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,IR,RO							Screen
36		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		381.44 35.62	9										BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,PO,RO BD,PO,RO BD,IR,RO							Sand Bentonite
		BOTTOM OF HOLE		379.89 37.17											BD,PO,RO BD,IR,VR BD,PO,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,PO,RO BD,PO,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,PO,RO BD,IR,RO BD,IR,RO BD,IR,K BD,IR,RO BD,IR,RO BD,PO,K BD,PO,K BD,IR,RO BD,PO,RO BD,PO,SM BD,PO,SM BD,PO,SM BD,PO,SM BD,PO,SM BD,PO,SM BD,IR,RO BD,IR,RO BD,IR,RO BD,PO,SM BD,PO,SM BD,PO,SM BD,PO,SM BD,PO,SM							
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM/CS
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-15 (CAL) - OFFSET

SHEET 1 OF 1

LOCATION: N 4853544.2 ;E 576576.8

DRILLING DATE: May 12, 19-20, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

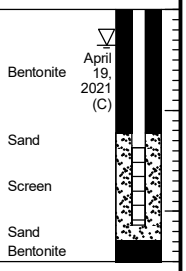
DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		417.06																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.20																		
2		(CH) SANDY CLAY TILL; brown, no odors, no staining, cohesive, W ~ PL		414.66																		
		(SC) CLAYEY SAND, some cobbles, some gravel; brown, no odors, no staining		2.40																		
4				413.06																		
		(SP) SAND, some gravel, some clay; brown, no odors, no staining, non-cohesive, moist		4.00																		
				412.46																		
		(CL) SILTY CLAY TILL, some sand, some gravel; brown, no odors, no staining, cohesive, W < PL		4.60																		
6		BOTTOM OF HOLE		5.00																		
8																						
10																						
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

NOTES
WATER LEVELS
INSTRUMENTATION



DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM/CS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-16 (CAL)

SHEET 1 OF 2

LOCATION: N 4853806.8 ;E 576784.6

DRILLING DATE: May 21, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		421.40																		
		(SM) SANDY SILT, some clay; dark brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.10																		
2		(CL) SILTY CLAY TILL, some sand, some gravel; brown, no odors, no staining, cohesive, W < PL																				April 19, 2021 (B) April 19, 2021 (A)
4																						
				415.90																		
		SAND, some silt; brown/red, no odors, no staining, non-cohesive, moist		5.70																		
6		(CL) SILTY CLAY TILL, some gravel, trace sand; grey, no odors, no staining, cohesive, W < PL																				
8																						Bentonite
10																						
				409.50																		
12		DOLOSTONE, fresh, bedded dolostone, light grey to beige grey (GASPORT FORMATION)		11.90																		
14															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
					1										BD,IR,SM							
16															BD,PO,SM							
															BD,IR,RO							
															BD,PO,SM							Sand
															BD,PO,RO							
18					2										BD,CU,RO							Screen
																						Sand
															BD,PO,RO							
															BD,IR,VR							
															BD,PO,RO							
20															BD,iR,VR							
															BD,PO,RO							
															BD,iR,VR							
					3										BD,iR,VR							
															BD,PO,VR							
22															BD,iR,RO							
															BD,PO,VR							
															BD,PO,RO							
															BD,iR,RO							
															BD,IR,SM							
															BD,iR,RO							
24					4										BD,iR,RO							
															BD,PO,RO							Bentonite
															BD,iR,VR							
															BD,PO,RO							
26															BD,IR,RO							
															BD,UN,RO							
															BD,PO,RO							
															BD,PO,VR							
					5										BD,UN,RO							
															BD,UN,RO							
															BD,IR,RO							
28															BD,UN,RO							
															BD,UN,RO							
															BD,IR,RO							
															BD,PO,SM							
					6										BD,PO,RO							
															BD,PO,RO							
															BD,PO,SM							
30															BD,PO,SM							
		CONTINUED NEXT PAGE																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-16 (CAL)

SHEET 2 OF 2

LOCATION: N 4853806.8 ;E 576784.6

DRILLING DATE: May 21, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		DOLOSTONE, fresh, bedded dolostone, light grey to beige grey (GASPORT FORMATION)			6																	
32					7																	Bentonite
34																						Sand
				385.88																		Screen
36		SHALEY DOLOSTONE, bedded shaley dolostone, grey to brown		35.52	8																	Sand
				384.12																		
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		37.28																		
38																						Bentonite
				381.63																		
40		BOTTOM OF HOLE		39.77																		
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

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DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: CS
CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-17 (CAL)

SHEET 1 OF 2

LOCATION: N 4852966.4 ;E 576752.3

DRILLING DATE: May 25-26, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		406.64																		
0		(CH) SANDY CLAY; red, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00																		
				405.12																		
2		(CH) SANDY CLAY TILL, some gravel, some silt; redish brown, no odors, no staining, cos, W ~ PL		1.52																		
				404.21																		
		(SP/GP) CLAYEY SAND and GRAVEL, some cobbles; grey, no odors, no staining, non-cohesive, moist		2.44																		
				403.60																		
4		DOLOSTONE, fresh to highly weathered, bedded dolostone, light grey (GASPORT FORMATION)		3.05	1										BD,IR,RO							April 19, 2021 (A) April 19, 2021 (B)
															BD,IR,RO							
															BD,IR,RO							
															BD,UN,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
6					2										BD,IR,RO							Bentonite
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
8															BD,IR,RO							
					3										BD,IR,RO							
															BD,IR,RO							
10															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,UN,VR							
															BD,IR,VR							
12					4										BD,IR,RO							Sand
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							Screen
															BD,IR,RO							
14															BD,UN,RO							Sand
															BD,IR,RO							
					5										BD,UN,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
16															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
18					6										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
20															BD,IR,RO							Bentonite
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
					7										BD,IR,RO							
															BD,PO,RO							
22															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
24															BD,IR,RO							
					8										BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
				381.80											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		24.84											BD,IR,RO							Sand
26															BD,IR,RO							
															BD,IR,RO							Screen
															BD,IR,RO							
															BD,IR,RO							
				379.15	9										BD,IR,RO							Sand
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		27.49											FR,IR,RO							
28															BD,IR,RO							Bentonite
															BD,IR,RO							
				377.82											BD,IR,RO							
		BOTTOM OF HOLE		28.82											BD,IR,RO							
															BD,IR,RO							
30															BD,IR,RO							
		CONTINUED NEXT PAGE																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-17 (CAL)

SHEET 2 OF 2

LOCATION: N 4852966.4 ;E 576752.3

DRILLING DATE: May 25-26, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30															BD,IR,RO							
32															BD,IR,RO							
34															BD,IR,RO							
36															BD,IR,RO							
38															BD,IR,RO							
40															BD,IR,RO							
42															BD,IR,RO							
44															BD,IR,RO							
46															BD,IR,RO							
48															BD,IR,RO							
50															BD,IR,RO							
52															BD,IR,RO							
54															BD,IR,RO							
56															BD,IR,RO							
58															BD,IR,RO							
60															BD,IR,RO							

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-18 (CAL)

SHEET 1 OF 2

LOCATION: N 4852658.8 ;E 577058.4

DRILLING DATE: June 8-9, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		404.29																		
0		(SP) CLAYEY SAND; black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 403.68																		
		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive,		0.61																		
2																						
4																						
				398.80																		
6		(SP) SAND; brown, no odors, no staining, non-cohesive, moist		5.49																		Bentonite
8				395.76																		
		(SP/GP) CLAYEY SAND and GRAVEL, some cobbles, some bolders; grey, no odors, no staining, non-cohesive, moist		8.53																		
10																						
				392.41																		
12		DOLOSTONE, fresh, bedded dolostone, light grey (GASPORT FORMATION)		11.88	1										BD,IR,RO							Sand
															BD,IR,RO							Screen
14															BD,IR,RO							Sand
															BD,IR,RO							
					2										BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
16															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,RO							
18					3										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,RO							
20															BD,IR,RO							
															BD,IR,RO							
					4										BD,IR,VR							Bentonite
															BD,IR,VR							
															BD,IR,RO							
22															BD,IR,VR							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,VR							
															BD,IR,VR							
															BD,IR,VR							
				380.49											BD,IR,VR							
24		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		23.80	5										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
				378.23											BD,IR,RO							
26		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		26.06											BD,IR,RO							
					6										BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
28				376.14											BD,IR,RO							
		BOTTOM OF HOLE		28.15											BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
30		*CONTINUED NEXT PAGE*													BD,IR,RO							

April 19, 2021

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-18 (CAL)

SHEET 2 OF 2

LOCATION: N 4852658.8 ;E 577058.4

DRILLING DATE: June 8-9, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30															BD,iR,RO							
															BD,iR,VR							
															BD,iR,RO							
32															BD,iR,RO							
															BD,iR,RO							
															BD,iR,RO							
34															BD,iR,RO							
															BD,iR,RO							
															BD,iR,RO							
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-19 (CAL)

SHEET 1 OF 2

LOCATION: N 4852000.0 ;E 576907.0

DRILLING DATE: October 27, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		396.98																		
		(SP) SAND, some silt, some gravel; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 0.30																		
2		(SP) SAND, some silt, some gravel; brown, no odors, no staining, non-cohesive, moist		394.84																		
		DOLOSTONE, fresh to highly weathered, bedded dolostone, light grey to blue grey (GASPORT FORMATION)		2.14																		
4																						Bentonite
6					1										BD,PO,RO BD,IR,SM							
															BD,CU,RO BD,PO,RO							Sept 17, 2021 (B)
8					2										BD,UN,RO BD,UN,RO FR,IR,RO BD,CU,RO BD,IR,RO							Sand Screen
10					3										BD,IR,VR BD,UN,RO BD,PO,RO BD,PO,RO BD,PO,RO FR,PO,RO BD,PO,RO BD,PO,RO FR,PO,RO FR,PO,RO							Sand
12					4										BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO FR,IR,RO BD,PO,RO FR,UN,RO							Bentonite
14															BD,PO,RO BD,PO,RO BD,UN,RO BD,PO,RO BD,PO,RO FR,CU,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							Sand Screen Sand
16					5										BD,UN,RO FR,PO,RO FR,PO,RO FR,PO,RO BD,PO,RO FR,PO,RO FR,IR,RO FR,CU,RO BD,PO,RO BD,UN,RO							
18					6										BD,PO,RO FR,IR,RO FR,PO,RO BD,PO,RO BD,UN,RO BD,PO,RO FR,IR,RO FR,PO,RO FR,PO,RO BD,PO,RO							
20															BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							
22		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		374.93 22.05	7										BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							Bentonite
24															BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		372.50 24.48	8										BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,IR,RO BD,PO,RO BD,PO,RO BD,PO,RO							
26															BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO							
				369.59	9										BD,PO,RO							
		BOTTOM OF HOLE		27.39											FR,PO,RO BD,PO,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,PO,RO BD,PO,RO BD,PO,RO							
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-19 (CAL)

SHEET 2 OF 2

LOCATION: N 4852000.0 ;E 576907.0

DRILLING DATE: October 27, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*													BD,PO,RO							
32															BD,PO,RO							
34															BD,PO,RO							
36															BD,PO,RO							
38															BD,PO,RO							
40															BD,PO,RO							
42															BD,PO,RO							
44															BD,PO,RO							
46															BD,PO,RO							
48															BD,PO,RO							
50															BD,PO,RO							
52															BD,PO,RO							
54															BD,PO,RO							
56															BD,PO,RO							
58															BD,PO,RO							
60															BD,PO,RO							

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-20 (CAL)

SHEET 1 OF 2

LOCATION: N 4852467.7 ;E 576476.3

DRILLING DATE: October 28-29, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		403.00																		
		(SM) SILTY SAND; dark brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 0.30																		
		(SP) SAND, some silt, some gravel; brown, no odors, no staining, non-cohesive, moist		400.86																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to blue grey (GASPORT FORMATION)		2.14																		
2					1										BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,UN,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,UN,RO; FR,PO,RO; BD,UN,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO							
4					2																	
6					3										FR,PO,RO; FR,IR,RO; BD,PO,RO; BD,PO,RO; FR,IR,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,UN,RO; BD,UN,RO; BD,UN,RO; FR,PO,RO; BD,PO,RO; BD,PO,RO; FR,PO,RO; BD,PO,RO; FR,CU,RO; FR,PO,RO; BD,PO,RO							Bentonite
8					4																	Sand; Screen; Sand
10					5																	
12					6										BD,IR,RO; BD,PO,VR; BD,UN,RO; BD,UN,RO; BD,PO,RO; BD,PO,RO; BD,IR,RO; BD,UN,RO; BD,UN,RO; BD,PO,RO; BD,PO,RO; BD,UN,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,IR,RO; BD,PO,RO; BD,PO,RO							
14					7																	Bentonite
16					8																	
18																						
20																						
22																						
24				377.85																		
		SHALEY DOLOSTONE, bedded shaley dolostone, medium grey		25.15	9										BD,PO,RO; BD,PO,RO; BD,PO,RO; BD,UN,RO; BD,PO,RO; BD,PO,RO; BD,IR,RO; BD,PO,RO; BD,CU,RO; BD,PO,RO; BD,PO,RO							Sand; Screen; Sand; Bentonite
26				375.82																		
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		27.18																		
28		BOTTOM OF HOLE		375.01 / 27.99											FR,IR,RO; BD,PO,RO							
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-20 (CAL)

SHEET 2 OF 2

LOCATION: N 4852467.7 ;E 576476.3

DRILLING DATE: October 28-29, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*													FR,CR,RO BD,UN,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO						
32																						
34																						
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-20 (CAL) - OFFSET

SHEET 1 OF 1

LOCATION: N 4852468.3 ;E 576476.3

DRILLING DATE: November 3, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

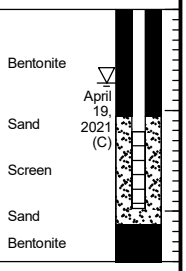
DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		403.00																		
0		(SM) SILTY SAND; dark brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00																		
				0.30																		
2		(SP) SAND, some silt, some gravel; brown, no odors, no staining, non-cohesive, moist		400.86																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to blue grey (GASPORT FORMATION)		2.14																		
4				398.00																		
		BOTTOM OF HOLE		5.00																		
6																						
8																						
10																						
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

NOTES
WATER LEVELS
INSTRUMENTATION



DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-21 (CAL)

SHEET 1 OF 2

LOCATION: N 4852839.8 ;E 576014.4

DRILLING DATE: November 3-4, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		415.23																		
		(SP) SAND, some silt; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 0.30																		
		(SP) SAND TILL, some gravel, some silt; brown, no odors, no staining, non-cohesive, moist																				
				409.74																		
		(ML) SILT TILL, some sand, some gravel; brown, no odors, no staining, non-cohesive, moist		5.49																		
				408.22																		
		(SP) SAND TILL, some gravel, some silt; brown, no odors, no staining, non-cohesive, moist		7.01																		Bentonite
				403.65																		
		(SP/GP) SAND and GRAVEL TILL; grey, no odors, no staining, non-cohesive, moist		11.58 / 402.72																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to blue grey (GASPORT FORMATION)		12.51	1										BD,PO,RO							Sand
					2										BD,PO,RO BD,UN,RO BD,PO,RO BD,CU,RO BD,PO,RO							Screen Sand
					3										BD,PO,RO BD,PO,RO BD,UN,RO BD,UN,RO							
					4										BD,PO,RO BD,IR,RO BD,CU,RO							Bentonite
					5										FR,CU,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,UN,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,IR,RO BD,CU,RO BD,UN,RO							
					6										BD,UN,RO BD,UN,RO BD,UN,RO BD,PO,RO BD,PO,RO BD,UN,RO BD,CU,RO BD,PO,RO BD,CU,RO							
30		*CONTINUED NEXT PAGE*																				

NOTES WATER LEVELS INSTRUMENTATION

April 19, 2021 (B)

April 19, 2021 (A)

Bentonite

Sand

Screen

Sand

Bentonite

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-21 (CAL)

SHEET 2 OF 2

LOCATION: N 4852839.8 ;E 576014.4

DRILLING DATE: November 3-4, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to blue grey (GASPORT FORMATION)			6										BD,PO,RO FR,IR,RO BD,PO,RO BD,PO,RO							Bentonite
32					7										BD,PO,RO FR,IR,RO RD,PO,RO							Sand
34					8										FR,PO,RO BD,PO,RO BD,PL,RO							Screen Sand
36				378.50											BD,PO,RO BD,PO,RO FR,PO,RO FR,PO,RO BD,PO,RO BD,PO,RO FR,PO,RO							
38		SHALEY DOLOSTONE, bedded shaley dolostone, dark grey		36.73	9										BD,UN,RO BD,UN,RO BD,CU,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,UN,RO BD,CU,RO BD,PO,RO							Bentonite
				376.85																		
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		38.38																		
				375.53																		
40		BOTTOM OF HOLE		39.70											BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO BD,PO,RO					
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: PM
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-22 (CAL)

SHEET 1 OF 2

LOCATION: N 4851966.3 ;E 575785.4

DRILLING DATE: November 17-18, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		399.27																		
		(SP) CLAYEY SAND; black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 398.36																		April 19, 2021 (A)
		(SM) SILTY SAND, some gravel; light brown, no odors, no staining, non-cohesive, moist		0.91 / 397.75																		April 19, 2021 (B)
2		(SP) CLAYEY SAND TILL, some gravel; brown, no odors, no staining, non-cohesive, moist		1.52																		Bentonite
4				395.01																		
		(CH) SILTY SANDY CLAY TILL; light brown, no odors, no staining, cohesive, wet		4.27 / 4.57																		
6		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey (GOAT ISLAND FORMATION)			1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Sand
8															BD,IR,RO BD,IR,VR							Screen Sand
10					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
12					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K							
14					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
16															BD,IR,RO BD,IR,RO							Bentonite
18															BD,IR,RO BD,IR,RO BD,IR,RO							
20					5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
22					6										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							Sand Screen
24																						
26		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		374.27 25.00	7										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,VR							Sand
28		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		371.11 28.16	8										BD,UN,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Bentonite
30				369.46																		
		CONTINUED NEXT PAGE																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-22 (CAL)

SHEET 2 OF 2

LOCATION: N 4851966.3 ;E 575785.4

DRILLING DATE: November 17-18, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU - Curved, UN - Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		29.81 / 368.52	8										BD,IR,RO							Bentonite
		BOTTOM OF HOLE		30.75											BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,SM BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,K							
32																						
34																						
36																						
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-23 (CAL)

SHEET 1 OF 2

LOCATION: N 4851555.9 ;E 576205.5

DRILLING DATE: November 19-23, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		395.05																		
0		(SM) SILTY SAND, some gravel, some cobbles; light brown, no odors, no staining, non-cohesive, moist		0.00																		
2				392.61																		April 19, 2021 (A)
		(SM/GP) SILTY SAND TILL and GRAVEL, some cobbles; brown, no odors, no staining, moist		2.44																		April 19, 2021 (B)
4																						
6				388.04																		Bentonite
		(CH) CLAY TILL with cobbles; red, no odors, no staining, W > PL		7.01																		
8																						
10				383.77																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey (GOAT ISLAND FORMATION)		11.28																		
12																						
14					1										BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,UN,RO BD,IR,VR BD,IR,VR							Sand
																						Screen
16					2										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-23 (CAL)

SHEET 2 OF 2

LOCATION: N 4851555.9 ;E 576205.5

DRILLING DATE: November 19-23, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*													BD,IR,RO							
32															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,Vr							
34															BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,SM							
36															BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							
38															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
40															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,UN,RO							
42															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-23 (CAL) - OFFSET

SHEET 1 OF 1

LOCATION: N 4851556.3 ;E 576205.9

DRILLING DATE: November 19-23, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH / % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		395.00																	
0		(SM) SILTY SAND, some gravel, some cobbles; light brown, no odors, no staining, non-cohesive, moist		0.00																	
2				392.56																	Bentonite; April 19, 2021 (C)
2		(SM/GP) SILTY SAND TILL and GRAVEL, some cobbles; brown, no odors, no staining, moist		2.44																	
4																					Sand; Screen
6				388.00																	Sand; Bentonite
6		BOTTOM OF HOLE		7.00																	

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DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-24 (CAL)

SHEET 1 OF 2

LOCATION: N 4854341.9 ;E 575337.7

DRILLING DATE: November 25- December 3, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		437.75																		
0		(CH) SANDY CLAY TILL, some gravel; brown/black, no odors, no staining, cohesive, W < PL		0.00																		
				435.92																		
2		(SP/GP) SAND and GRAVEL TILL; grey, no odors, no staining, non-cohesive, moist		1.83																		
				433.79																		
4		(SP) SAND, some silt, trace gravel at 7.01m to 8.53m; brown, no odors, no staining, non-cohesive, moist		3.96																		Sept 17, 2021 (B) Sept 17, 2021 (A)
6																						
8				429.22																		
		(SM) SILTY SAND TILL; brown, no odor, no staining, non-cohesive, moist		8.53																		
10				426.78																		Bentonite
		(SP/GP) SAND and GRAVEL TILL; grey, no odors, no staining, non-cohesive, moist		10.97 426.17																		
12		(CL) SILTY CLAY TILL; grey, no odors, no staining, cohesive, W < PL		11.58																		
14																						
16				421.25																		
		(GM) SILTY GRAVEL TILL; grey, no odors, no staining, non-cohesive, wet		16.50																		
18																						
20				417.64																		
		DOLOSTONE, fresh to slightly weathered, bedded dolostone, light grey/brown (GOAT ISLAND FORMATION)		20.11																		Sand
22															BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO							Screen
					1																	Sand
24															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
26					2																	Bentonite
28					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-24 (CAL)

SHEET 2 OF 2

LOCATION: N 4854341.9 ;E 575337.7

DRILLING DATE: November 25- December 3, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		DOLOSTONE, fresh to slightly weathered, bedded dolostone, light grey/brown (GOAT ISLAND FORMATION)			4										BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Bentonite
32				404.75																		
		DOLOSTONE, fresh to slightly weathered, bedded dolostone, light grey (GASPORT FORMATION)		33.00	5																	Sand
34					6										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							Screen Sand
36				400.26																		Bentonite
		BOTTOM OF HOLE		37.49																		
38															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,Vr BD,UN,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-25 (CAL)

SHEET 1 OF 2

LOCATION: N 4852900.5 ;E 574853.8

DRILLING DATE: December 7-10, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		419.02																		
0		(SC) CLAYEY SAND TILL; brown, no odors, no staining, non-cohesive, moist		0.00																		Sept 17, 2021 (A) Sept 17, 2021 (B)
2				416.28																		
		(CH) SANDY CLAY TILL; brown/grey, no odors, no staining, cohesive, W > PL		2.74																		
4																						
6																						
8																						Bentonite
10				408.50																		
		DOLOSTONE, fresh to moderately weathered, bedded, dolostone, grey (GOAT ISLAND FORMATION)		10.52																		
12																						
14					1										BD,IR,RO BD,IR,Vr BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
16					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Sand Screen
18															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Sand
20					3										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,Vr BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
22					4										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
24				394.02											BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							Bentonite
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)		25.00																		
26					5										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							
28					6										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-25 (CAL)

SHEET 2 OF 2

LOCATION: N 4852900.5 ;E 574853.8

DRILLING DATE: December 7-10, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey (GASPORT FORMATION)			6										BD,IR,RO							
32					7										BD,IR,RO							
34					8										BD,IR,RO							
36															BD,IR,RO							Bentonite
38					9										BD,IR,RO							
40					10										BD,IR,RO							
42															BD,IR,RO							
44					11										BD,IR,RO							Sand Screen
46					12										BD,IR,RO							Sand
48				370.09											BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,RO							Bentonite
50		SHALEY DOLOSTONE, bedded shaley dolostone, grey/brown		48.93 368.35											BD,IR,RO BD,UN,RO							
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		50.67 367.20											BD,IR,RO							
52		BOTTOM OF HOLE		51.82											BD,IR,RO BD,UN,RO BD,IR,RO							
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-26 (CAL)

SHEET 1 OF 3

LOCATION: N 4853638.4 ;E 574373.9

DRILLING DATE: December 14-17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		438.89																		
0		(CH) SANDY CLAY; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 438.28																		
		(SM) SILTY SAND; golden brown, no odors, no staining, non-cohesive, moist		0.61 / 437.37																		
2		(SM) SILTY SAND TILL, some cobbles; golden brown, no odors, no staining, non-cohesive, moist		1.52																		
4																						April 19, 2021 (B) April 19, 2021 (A)
6																						
8				430.05																		
		(ML) SANDY SILT TILL; brown, no odors, no staining, non-cohesive, moist		8.84																		
10																						
12				426.70																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey (ERAMOSA FORMATION)		12.19	1										BD,IR,RO							Bentonite
14																						
16					2																	
18																						
20					3																	
22																						
24					4																	
				413.99																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, black grey (ERAMOSA FORMATION)		24.90	5																	
26																						
28				410.62																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey (GOAT ISLAND FORMATION)		28.27	6																	
30																						
		CONTINUED NEXT PAGE																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-26 (CAL)

SHEET 2 OF 3

LOCATION: N 4853638.4 ;E 574373.9

DRILLING DATE: December 14-17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey (GOAT ISLAND FORMATION)			6										BD,IR,RO							Bentonite
32					7										BD,IR,RO							Sand Screen Sand
34					8										BD,IR,RO							
36															BD,IR,RO							
				401.19											BD,IR,RO							
38		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to grey brown (GASPORT FORMATION)		37.70	9										BD,IR,RO							
40					10										BD,IR,RO							
42															BD,IR,RO							
44					11										BD,UN,RO BD,UN,RO BD,IR,RO							Bentonite
46															BD,IR,RO							
48					12										BD,IR,RO							
50					13										BD,IR,RO BD,UN,RO							
52					14										BD,IR,VR BD,IR,RO BD,IR,VR BD,IR,VR BD,IR,RO							
54															BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO							Sand
56					15										BD,UN,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO							Screen Sand
58															BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							Bentonite
60		*CONTINUED NEXT PAGE*			16										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO							

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-26 (CAL)

SHEET 3 OF 3

LOCATION: N 4853638.4 ;E 574373.9

DRILLING DATE: December 14-17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
60		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, light grey to grey brown (GASPORT FORMATION)			16										BD,IR,RO							
62					17										BD,IR,RO BD,UN,RO BD,IR,RO							Bentonite
64				374.34											BD,IR,RO							
		SHALEY DOLOSTONE, bedded shaley dolostone, slate grey		64.55	18										BD,IR,RO							
66				372.78											BD,IR,RO							
		BOTTOM OF HOLE		66.11											BD,IR,RO							
68															BD,IR,RO							
70															BD,IR,RO							
72															BD,IR,RO							
74															BD,IR,RO							
76															BD,IR,RO							
78															BD,IR,RO							
80															BD,IR,RO							
82															BD,IR,RO							
84															BD,IR,RO							
86															BD,IR,RO							
88															BD,IR,RO							
90															BD,IR,RO							

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-26 (CAL) - OFFSET

SHEET 1 OF 1

LOCATION: N 4853637.6 ;E 574375.2

DRILLING DATE: December 14-17, 2020

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		438.88																		
		(CH) SANDY CLAY; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 438.27																		
		(SM) SILTY SAND; golden brown, no odors, no staining, non-cohesive, moist		0.61 / 437.35																		
2		(SM) SILTY SAND TILL, some cobbles; golden brown, no odors, no staining, non-cohesive, moist		1.52																		Bentonite; April 19, 2021 (C)
4																						
6																						Sand
8																						Screen; Sand; Bentonite
		(ML) SANDY SILT TILL; brown, no odors, no staining, non-cohesive, moist		430.04 / 8.84 / 428.88																		
10		BOTTOM OF HOLE		10.00																		
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-27 (CAL)

SHEET 1 OF 3

LOCATION: N 4853770.2 ;E 575954.0

DRILLING DATE: Febuary 9-12, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		431.15																		
0		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 430.54																		
		(SM) SILTY SAND TILL; brown, no odors, no staining, non-cohesive, moist		0.61																		
2																						
				427.19																		
4		(CH) SANDY CLAY TILL; brown, no odors, no staining, cohesive, W > PL		3.96																		
6																						
				424.14																		
		(SC) CLAYEY SAND TILL, some gravel, some silt; brown, no odors, no staining, cohesive		7.01																		April 19, 2021 (A) April 19, 2021 (B)
8																						
				421.09																		
10		(SM) SILTY CLAY TILL, some sand, some gravel; red, no odor, no straining, cohesive, W > PL		10.06																		
				419.57																		
12		(SC) CLAYEY SAND TILL, some cobbles; brown, no odors, no staining, cohesive		11.58																		
				416.52																		
14		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, wet		14.63																		Bentonite
				415.00																		
16		(ML) SILT, some sand; brown, no odors, no staining, wet		16.15																		
				413.47																		
18		(SM) SILTY SAND and GRAVEL; brown, no odors, no staining, non-cohesive, wet		17.68																		
				411.95																		
20		(GP) COBBLES and BOLDERS; grey, no odors, no staining, non-cohesive, wet		19.20																		
				409.81																		
22		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, wet		21.34																		
				404.33																		
26		(SM) SILTY SAND and GRAVEL TILL, some clay, some bolders; brown, no odors, no staining, non-cohesive, wet		26.82																		
28																						
				402.19																		
		DOLOSTONE, fresh, bedded dolostone, grey to grey blue (GOAT ISLAND FORMATION)		28.96																		
30																						
		CONTINUED NEXT PAGE																				

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-27 (CAL)

SHEET 2 OF 3

LOCATION: N 4853770.2 ;E 575954.0

DRILLING DATE: Febuary 9-12, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, grey to grey blue (GOAT ISLAND FORMATION)																				Bentonite
32					1										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,UN,RO							Sand
34					2										BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-27 (CAL)

SHEET 3 OF 3

LOCATION: N 4853770.2 ;E 575954.0

DRILLING DATE: Febuary 9-12, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
60															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
62															BD,IR,K							
															BD,IR,K							
															BD,IR,K							
															BD,IR,K							
64															BD,IR,K							
															BD,IR,K							
															BD,IR,K							
66																						
68																						
70																						
72																						
74																						
76																						
78																						
80																						
82																						
84																						
86																						
88																						
90																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-28 (CAL)

SHEET 1 OF 2

LOCATION: N 4854987.8 ;E 576139.8

DRILLING DATE: Febuary 18-22, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		419.31																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 418.70																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist then wet at 1.5m		0.61 416.87																		
		(SP/GP) SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive, wet		2.44 415.04																		
		(SM) SILTY SAND some gravel; light brown, no odors, no staining, non-cohesive, moist		4.27 413.83																		
		(SM) SILTY SAND TILL; grey, no odors, no staining, cohesive		5.48 410.78																		Bentonite
		(CH) CLAY TILL; grey, no odors, no staining, cohesive, W > PL		8.53 407.12																		
		DOLOSTONE, fresh to moderately weathered, bedded dolostone, grey (GASPORT FORMATION)		12.19	1										BD,IR,RO							
															BD,IR,RO BD,IR,VR BD,UN,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,VR BD,IR,RO BD,IR,RO							Sand Screen Sand
					2										BD,IR,VR BD,IR,VR BD,IR,VR BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO BD,IR,RO

PROJECT: 19129150

RECORD OF DRILLHOLE: MW20-28 (CAL)

SHEET 2 OF 2

LOCATION: N 4854987.8 ;E 576139.8

DRILLING DATE: Febuary 18-22, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		388.11 30.20	6										BD,IR,RO							Bentonite
		BOTTOM OF HOLE		388.49 30.82											BD,IR,RO							
32															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
34															BD,UN,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
															BD,IR,RO							
36															BD,IR,RO							
38																						
40																						
42																						
44																						
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48																						
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52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-1 (CAL)

SHEET 1 OF 2

LOCATION: N 4853485.0 ;E 576882.2

DRILLING DATE: March 2-3, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR / % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		418.94																		
0		(SM) SILTY SAND, some clay; brown/black, no odors, no staining, non-cohesive, wet		0.00																		
				417.42																		
2		(CH) SILTY SANDY CLAY TILL; brown/grey, no odors, no staining, cohesive, W > PL		1.52																		March 12, 2021
4																						Bentonite
6																						
8																						
10				408.88																		
		DOLOSTONE, fresh, bedded, dolostone, grey (GASPORT FORMATION)		10.06																		Sand
12																						
14																						
16																						
18																						
20																						Screen
22																						
24																						
26																						
28																						
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-1 (CAL)

SHEET 2 OF 2

LOCATION: N 4853485.0 ;E 576882.2

DRILLING DATE: March 2-3, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded, dolostone, grey (GASPORT FORMATION)																				
32																						Screen
34				384.64																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		34.30																		Sand
36				382.67																		Bentonite
		BOTTOM OF HOLE		36.27																		
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-2 (CAL)

SHEET 1 OF 2

LOCATION: N 4853505.1 ;E 576909.6

DRILLING DATE: Febuary 24, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		420.58																		
0		(CH) SANDY CLAY TILL; brown, no odors, no staining, cohesive (TOPSOIL)		0.00																		
				419.06																		
2		(CH) SANDY CLAY TILL; brown, no odors, no staining, cohesive, W > PL		1.52																		
4																						
6																						March 12, 2021 Bentonite
				413.26																		
8		(CH) SILTY CLAY TILL some sand; brown, no odors, no staining, cohesive, W > PL		7.32																		
10																						
12				408.39																		
		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)		12.19																		Sand
14																						
16																						
18																						
20																						
22																						Screen
24																						
26																						
28																						
30																						

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DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-2 (CAL)

SHEET 2 OF 2

LOCATION: N 4853505.1 ;E 576909.6

DRILLING DATE: Febuary 24, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)																				
32																						Screen
34																						Sand
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		385.22 35.36																		Bentonite
36		BOTTOM OF HOLE		384.58 36.00																		
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-3 (CAL)

SHEET 1 OF 2

LOCATION: N 4853420.3 ;E 576965.5

DRILLING DATE: March 1-2, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		417.51																		
		(CH) SILTY SANDY CLAY TILL; brown, no odors, no staining , W > PL		0.00																		
4				413.24																		Bentonite
		(CH) SILTY CLAY TILL some sand; brown, no odors, no staining, cohesive, W > PL		4.27																		
8				410.19																		March 12, 2021
		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)		7.32																		Sand
20																						Screen
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-3 (CAL)

SHEET 2 OF 2

LOCATION: N 4853420.3 ;E 576965.5

DRILLING DATE: March 1-2, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)																				
32																						Screen
34																						
				382.61																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		34.90																		Sand
36																						
				380.93																		Bentonite
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		36.58																		
				380.02																		
		BOTTOM OF HOLE		37.49																		
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-4 (CAL)

SHEET 1 OF 2

LOCATION: N 4853450.6 ;E 576866.2

DRILLING DATE: March 3-4, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		417.83																		
0		SILTY CLAYEY SAND TILL; brown, no odors, no staining, non-cohesive wet		0.00																		
8		(CH) SANDY CLAY TILL some gravel; brown/black, no odors, no staining, cohesive, W > PL		409.91 7.92																		
10		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)		406.86 10.97																		
30		*CONTINUED NEXT PAGE*																				

Bentonite

March 12, 2021

Sand

Screen

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-1-4 (CAL)

SHEET 2 OF 2

LOCATION: N 4853450.6 ;E 576866.2

DRILLING DATE: March 3-4, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)																				Screen
32				384.30																		Sand
34		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		33.53																		Bentonite
36		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		382.17 35.66																		
		BOTTOM OF HOLE		35.96																		
38																						
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

GTA-RCK 004 S:\CLIENTS\VOTORANTIM_CIMENTOS\LONG_PAR_5_CALEDON\02_DATA\GINT\LONG_PAR_5_CALEDON.GPJ GAL-MISS.GDT 1/13/22

PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-2-1 (CAL)

SHEET 1 OF 1

LOCATION: N 4854021.1 ;E 577279.1

DRILLING DATE: March 15-16, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		413.40																		
0		(SM) SILTY SAND LOAM; brown/black, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00																		
				412.18																		
		(SM) SILTY SAND LOAM; brown/black, no odors, no staining, non-cohesive, wet		1.22																		
2		(SM) SILTY SAND TILL, some gravel; brown, no odors, no staining, non-cohesive, moist to wet		1.52																		Bentonite
4																						March 20, 2021
				407.61																		
6		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		5.79																		Sand
8																						
10																						
12																						
14																						Screen
16																						
18																						
20																						
22																						Sand
				390.69																		Bentonite
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		22.71 390.08																		
24		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		23.47																		
		BOTTOM OF HOLE																				
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-2-2 (CAL)

SHEET 1 OF 1

LOCATION: N 4854050.9 ;E 577260.0

DRILLING DATE: March 11-15, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		412.64																		
		(SM) SILTY SANDY LOAM; brown/black, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00 0.30																		
		(SM) SILTY SANDY LOAM; brown/black, no odors, no staining, non-cohesive, wet		411.12 1.52																		
2		(SM) SILTY SAND TILL, some gravel; brown, no odors, no staining, non-cohesive, wet																				Bentonite
4																						March 20, 2021
6				406.54																		
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		6.10																		Sand
8																						
10																						
12																						Screen
14																						
16																						
18																						
20																						Sand
				391.68																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		20.96																		Bentonite
22				389.76																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		22.88 389.17																		
		BOTTOM OF HOLE		23.47																		
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-2-3 (CAL)

SHEET 1 OF 1

LOCATION: N 4854098.5 ;E 577349.7

DRILLING DATE: March 10-11, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		410.76																		
		(SM) SILTY SAND, some gravel; brown/black, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00 0.30																		
		(SM) SILTY SAND, some gravel; brown/black, no odors, no staining, non-cohesive, wet		409.24 1.52																		
2		(SM) SILTY SAND and GRAVEL, some gravel; golden brown, no odors, no staining, non-cohesive, moist		408.02 2.74																		Bentonite
		DOLOSTONE,highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)																				March 20, 2021
4																						
6																						Sand
8																						
10																						
12																						Screen
14																						
16																						
18				391.78																		Sand
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		18.98																		
20				390.14																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		20.62																		Bentonite
22																						
				386.99																		
24		BOTTOM OF HOLE		23.77																		
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-2-4 (CAL)

SHEET 1 OF 1

LOCATION: N 4854001.7 ;E 577297.5

DRILLING DATE: March 16, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		413.86																		
0		(SM) SILTY SANDY LOAM; brown/black, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00 0.30																		
		(SM) SILTY SANDY LOAM; brown/black, no odors, no staining, non-cohesive, wet		412.34 1.52																		
2		(SM) SILTY SAND TILL; brown, no odors, no staining, non-cohesive, wet to moist																				Bentonite
4				409.59																		
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		4.27																		
6																						Sand
8																						
10																						
12																						
14																						Screen
16																						
18																						
20																						
22																						
				390.22																		Sand
24		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		23.64																		
				388.26																		Bentonite
26		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		25.60 387.34																		
		BOTTOM OF HOLE		26.52																		
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-3-1 (CAL)

SHEET 1 OF 1

LOCATION: N 4852814.1 ;E 577871.8

DRILLING DATE: March 29-30, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		403.69																		
0		(SP) SAND some silt; brown, no odors, no staining, non-cohesive, moist		0.00																		
				402.17																		
2		(SP/GP) SAND and GRAVEL, some silt; brown, no odors, no staining, non-cohesive, moist		1.52																		Bentonite
4				399.12																		
		DOLOSTONE, moderately weathered, bedded dolostone, grey (GASPORT FORMATION)		4.57																		Sand
6																						April 3, 2021
8																						
10																						Screen
12																						
14																						
16																						Sand
				386.62																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		17.07																		
18																						Bentonite
				384.19																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		19.50																		
20																						
				382.66																		
		BOTTOM OF HOLE		21.03																		
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-3-2 (CAL)

SHEET 1 OF 1

LOCATION: N 4852838.4 ;E 577920.3

DRILLING DATE: March 30, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		404.87																		
0		(SM) SILTY SAND LOAM; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 0.30																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, wet		403.35 1.52																		
2		(SM/GP) SILTY SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive, moist		401.21																		Bentonite
4		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		3.66																		Sand
6																						
8																						April 3, 2021
10																						Screen
12																						
14																						
16																						Sand
18		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		386.91 17.96																		Bentonite
20		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		384.67 20.20																		
		BOTTOM OF HOLE		383.84 21.03																		
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-3-3 (CAL)

SHEET 1 OF 1

LOCATION: N 4852730.9 ;E 577935.5

DRILLING DATE: March 30, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		405.12																		
		(SM) SILTY SAND LOAM; brown, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 0.30																		
		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist		403.60 / 1.52																		
2		(SM/GP) SILTY SAND and GRAVEL, some cobbles; brown, no odors, no staining, non-cohesive, moist																				
4																						Bentonite
6																						
8				396.89																		
		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)		8.23																		Sand
10																						
12																						April 3, 2021
14																						Screen
16																						
18																						Sand
				386.22																		Bentonite
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		18.90 / 19.20																		
20		BOTTOM OF HOLE																				
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-3-4 (CAL)

SHEET 1 OF 1

LOCATION: N 4852827.3 ;E 577837.9

DRILLING DATE: March 29, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		403.16																		
		(SP) SAND and GRAVEL, some silt, some cobbles; brown/black, no odors, no staining, non-cohesive, moist (TOPSOIL)		0.00 / 401.64																		
2		(SP) SAND and GRAVEL, some silt, some cobbles; brown/black, no odors, no staining, non-cohesive, moist		1.52 / 399.81																		Bentonite
4		DOLOSTONE, moderately weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		3.35																		Sand
6																						April 3, 2021
8																						
10																						Screen
12																						
14																						
16				387.00																		Sand
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		16.16 / 384.71																		Bentonite
18		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		18.45 / 383.96																		
		BOTTOM OF HOLE		19.20																		
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-4-1 (CAL)

SHEET 1 OF 1

LOCATION: N 4854211.5 ;E 577793.1

DRILLING DATE: March 22, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		415.22																		
0		(SP) CLAYEY SAND LOAM; brown/black, no odors, no staining, cohesive (TOPSOIL)		0.00																		
				413.70																		
2		(SP) CLAYEY SAND TILL, some gravel; brown, no odors, no staining, cohesive, W > PL		1.52																		
4																						Bentonite
6																						
8				406.38																		
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		8.84																		Sand
10																						March 26, 2021
12																						
14																						Screen
16																						
18																						Sand
				395.36																		
20		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		19.86																		Bentonite
22				392.62																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		22.60																		
24				391.45																		
		BOTTOM OF HOLE		23.77																		
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-4-2 (CAL)

SHEET 1 OF 1

LOCATION: N 4854247.2 ;E 577790.3

DRILLING DATE: March 22, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		415.07																		
0		(SP) CLAYEY SAND TILL, some gravel; brown, no odors, no staining, cohesive, W > PL		0.00																		
2																						
4																						Bentonite
6																						
8				405.93																		
		DOLOSTONE, moderately weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		9.14																		
10																						Sand
12																						March 26, 2021
14																						
16																						Screen
18																						
				395.55																		
20		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		19.52																		Sand
22				392.67																		Bentonite
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		22.40																		
				391.30																		
24		BOTTOM OF HOLE		23.77																		
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW21-4-3 (CAL)

SHEET 1 OF 1

LOCATION: N 4854182.8 ;E 577813.9

DRILLING DATE: March 23, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		414.78																		
0		(SP) CLAYEY SAND LOAM; brown/black, no odors, no staining, cohesive (TOPSOIL)		0.00																		
				0.30																		
		(SP) CLAYEY SAND TILL, some gravel; brown, no odors, no staining, cohesive, W > PL																				
2																						
4																						Bentonite
6																						
8																						
				405.64																		
		DOLOSTONE, moderately weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		9.14																		
10																						Sand
																						March 26, 2021
12																						
14																						Screen
16																						
18																						
				395.20																		
20		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		19.58																		Sand
																						Bentonite
				393.14																		
22		BOTTOM OF HOLE		21.64																		
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW21-1 (CAL)

SHEET 1 OF 2

LOCATION: N 4853478.7 ;E 576890.2

DRILLING DATE: March 4-8, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR / % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		418.76																		
		(CH) SILTY SANDY CLAY TILL; light brown, no odors, no staining, cohesive, W > PL		0.00																		
				417.24																		
2		(SM) CLAYEY SILTY SAND TILL; brown/black, no odors, no staining, cohesive, W > PL		1.52																		April 19, 2021 ▽
				415.72																		
4		(CH) SILTY SANDY CLAY TILL; brown/grey, no odors, no staining, cohesive, W > PL		3.04																		
6																						
8																						
				409.92																		
		(CH) GRAVELLY SILTY CLAY TILL; brown/grey, no odors, no staining, cohesive, W > PL		8.84																		
10																						
				407.79																		
		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)		10.97																		
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW21-1 (CAL)

SHEET 2 OF 2

LOCATION: N 4853478.7 ;E 576890.2

DRILLING DATE: March 4-8, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, fresh, bedded dolostone, grey (GASPORT FORMATION)																				
32																						
34				384.34																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		34.42																		
36				382.18																		
		SHALE, bedded shale, blue green (CABOT HEAD FORMATION)		36.58																		
38				380.35																		
		BOTTOM OF HOLE		38.41																		
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW21-2 (CAL)

SHEET 1 OF 1

LOCATION: N 4854027.5 ;E 577286.3

DRILLING DATE: March 17, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		413.07																		
		(SM) SILTY SAND LOAM; brown/black, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00																		
				411.55																		
2		(SM) SILTY SAND TILL; golden brown, no odors, no staining, non-cohesive, wet		1.52																		
4				408.80																		
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		4.27																		April 19, 2021
6																						
8																						
10																						
12																						
14																						
16																						
18																						
20																						
22				390.51																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		22.56																		
24				388.69																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		24.38																		
				387.92																		
		BOTTOM OF HOLE		25.15																		
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW21-3 (CAL)

SHEET 1 OF 1

LOCATION: N 4852797.5 ;E 577875.5

DRILLING DATE: March 31, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		405.45																		
0		(SM) SILTY SAND; brown/black, no odors, no staining, non-cohesive, wet (TOPSOIL)		0.00 404.84																		
		(SP) SAND; brown, no odor, no staining, non-cohesive, moist		0.61																		
2																						
				401.79																		
4		(SM) SILTY SAND and GRAVEL; brown, no odors, no staining, non-cohesive, moist		3.66																		
				399.35																		
6		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		6.10																		
8																						
																						April 19, 2021
10																						
12																						
14																						
16																						
18				386.77																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		18.68																		
20																						
				384.45																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		21.00																		
		BOTTOM OF HOLE		21.34																		
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW21-4 (CAL)

SHEET 1 OF 1

LOCATION: N 4854214.4 ;E 577802.1

DRILLING DATE: March 23, 2021

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		415.08																		
0		(SP) CLAYEY SAND LOAM; brown/black, no odors, no staining, cohesive (TOPSOIL)		0.00 0.30																		
		(SP) CLAYEY SAND TILL, some gravel; brown, no odors, no staining, cohesive, W > PL																				
2																						
4																						
6																						
8				406.24																		
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		8.84																		
10																						April 19, 2021
12																						
14																						
16																						
18																						
				395.48																		
20		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		19.60																		
				393.59																		
22		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		21.64																		
		BOTTOM OF HOLE																				
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: AL
CHECKED: GRP

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APPENDIX D

Geophysical Logs

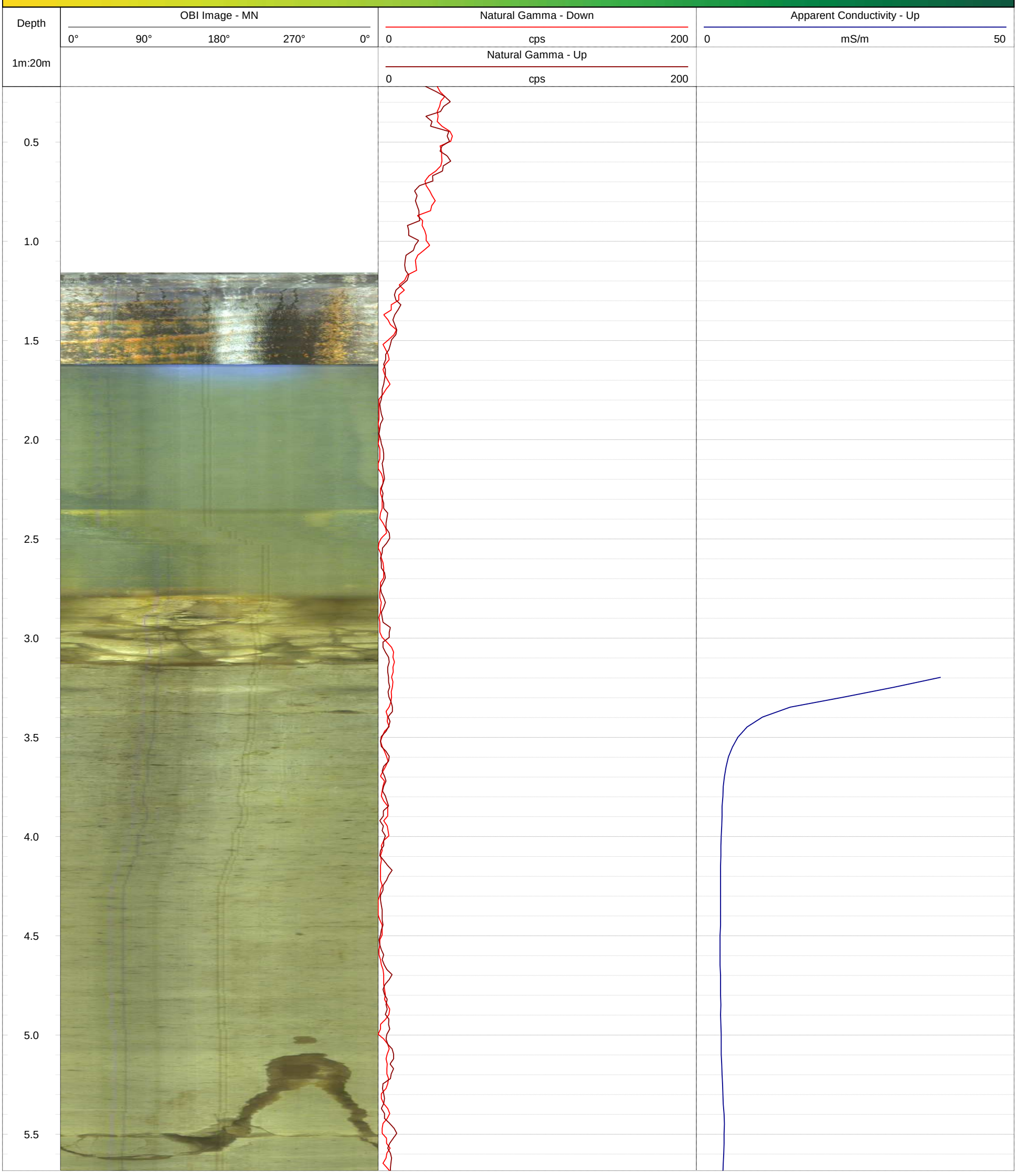
GOLDER
MEMBER OF WSP

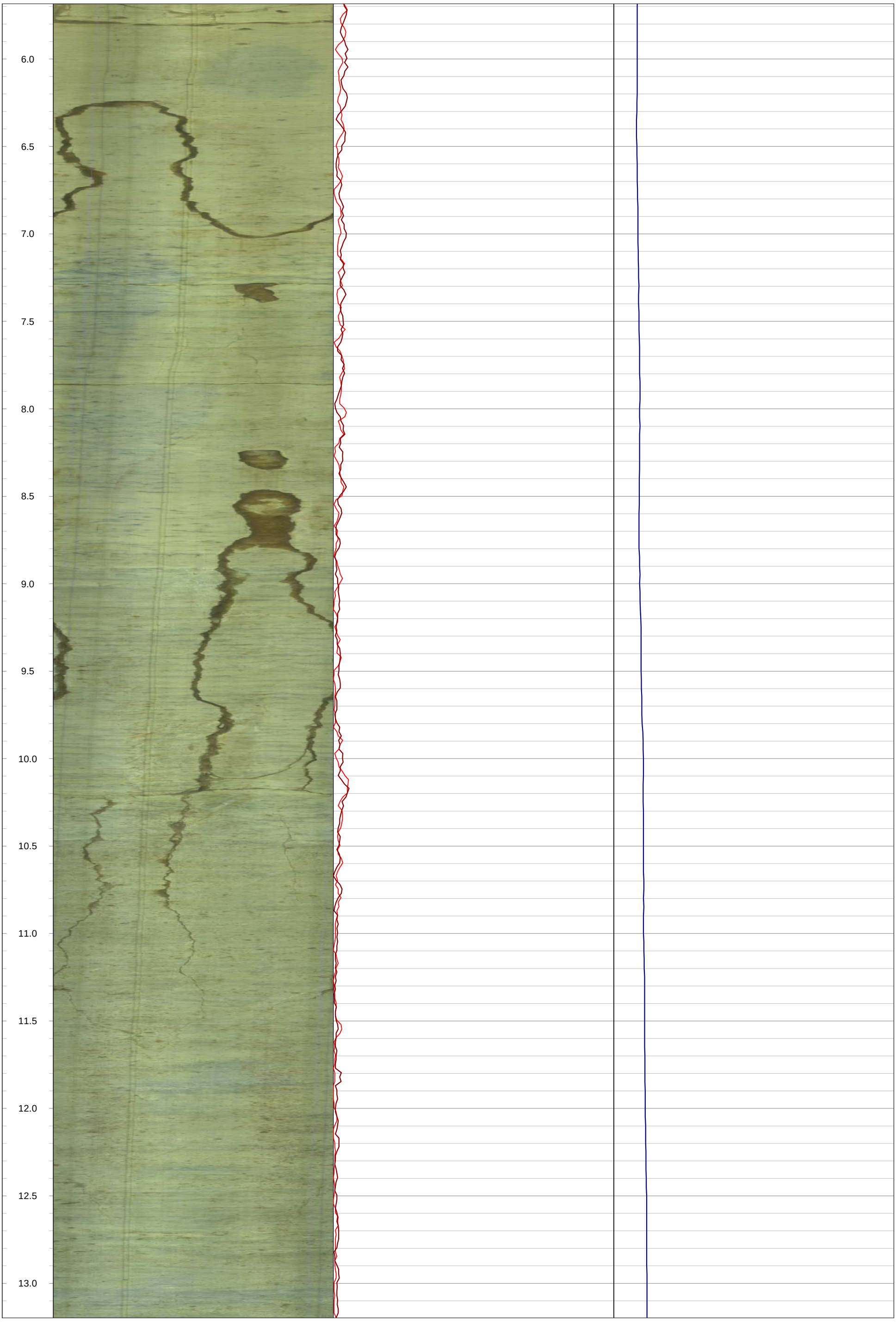
Geophysical Record of Borehole: BH20-01 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.75 m bgs	**Location:**	Caledon, Ontario
Easting:	578000.61 m	**Drilled Depth:**	22.07 m bgs	**Water Level:**	1.6 m bgs	**Log Date:**	Feb-18-2020
Northing:	4853292.80 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.80 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	CM

Notes: OBI image is opaque > 21.60m

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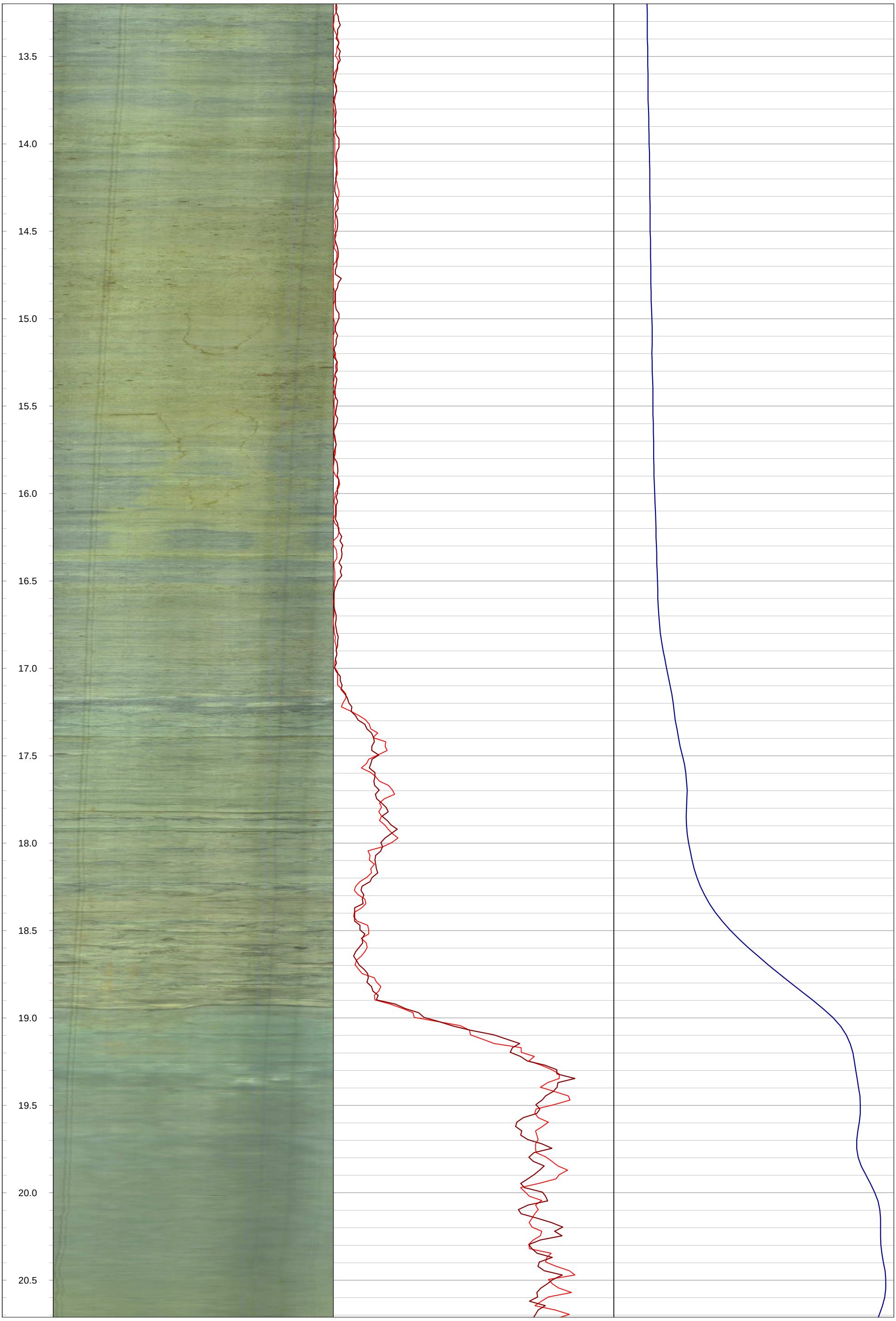
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20.0
20.5


21.0
21.5

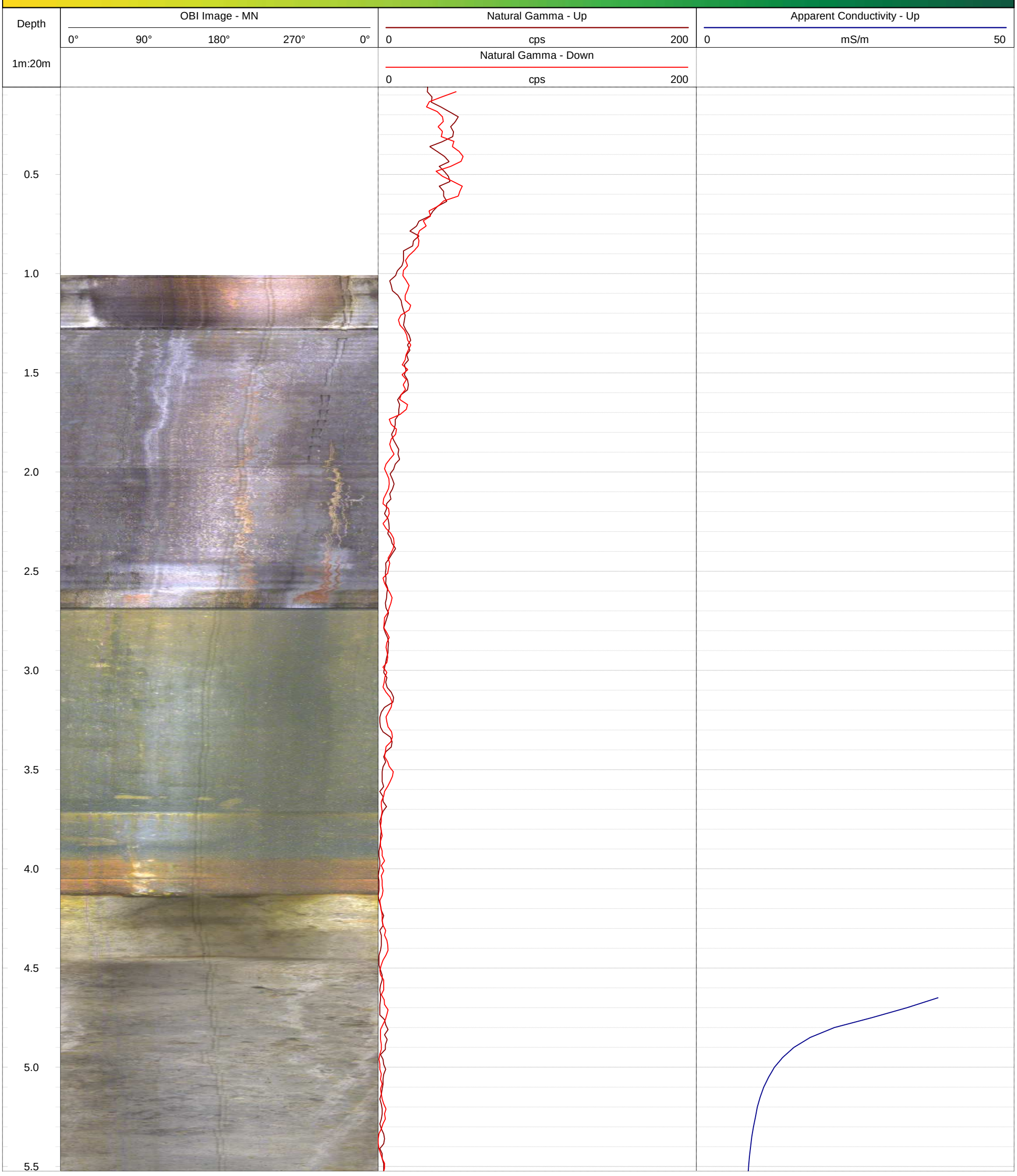
GOLDER
MEMBER OF WSP

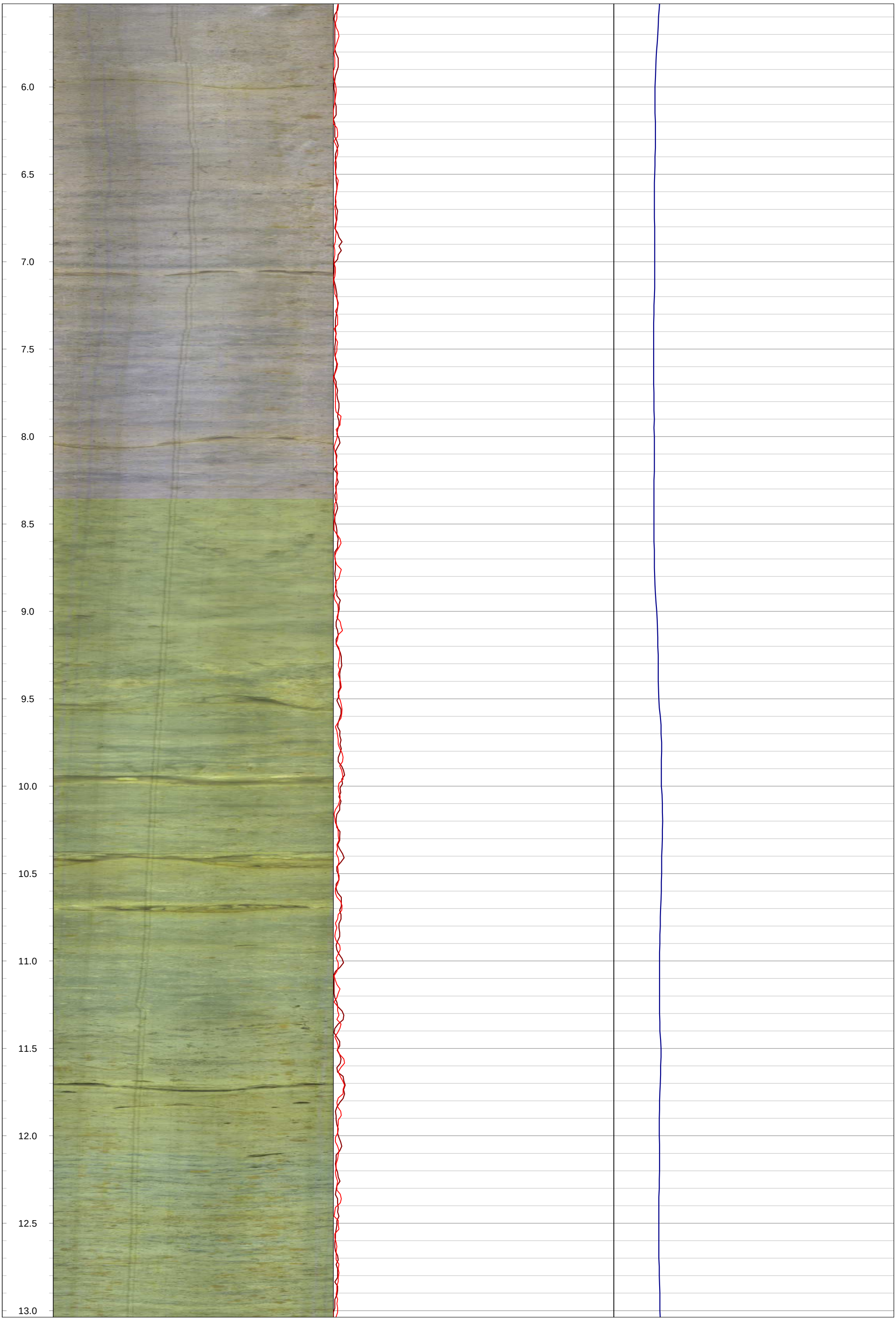
Geophysical Record of Borehole: BH20-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	4.11 m bgs	**Location:**	Caledon, Ontario
Easting:	577839.36 m	**Drilled Depth:**	22.02 m bgs	**Water Level:**	2.70 m bgs	**Log Date:**	Feb-18-2020
Northing:	4853078.92 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.52 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.61 m ags	**Logged By:**	CM

Notes:

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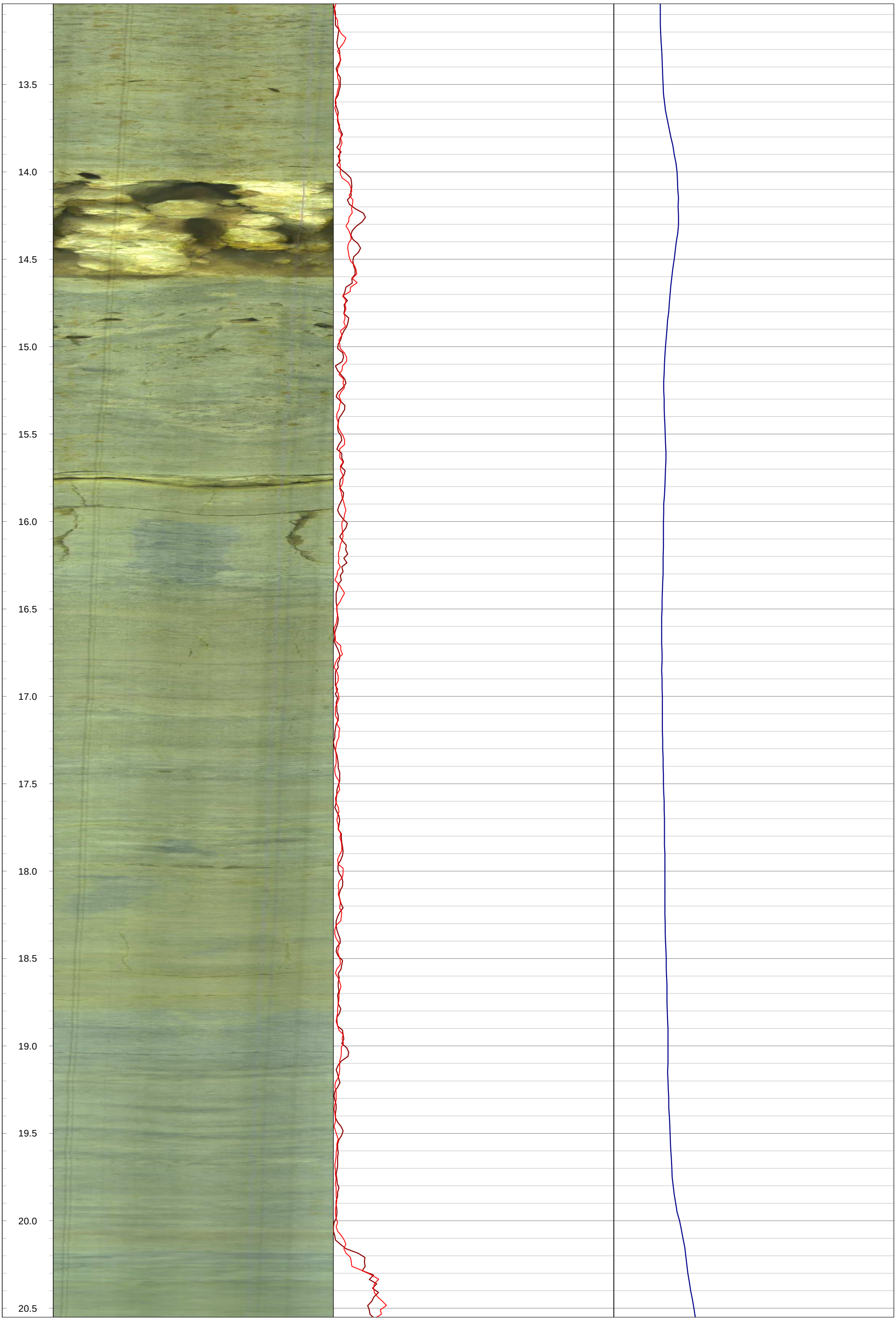
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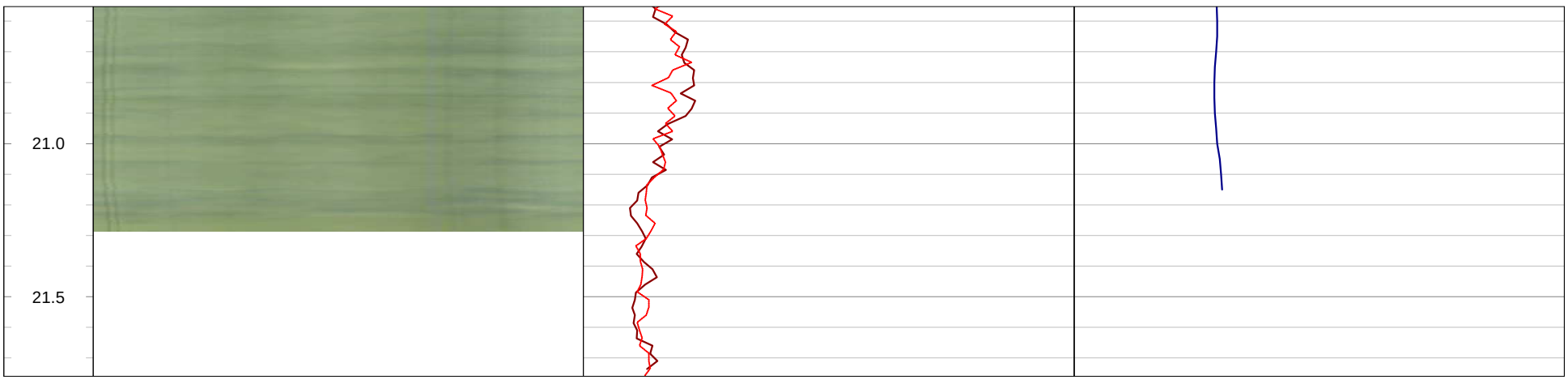

21.0
21.5

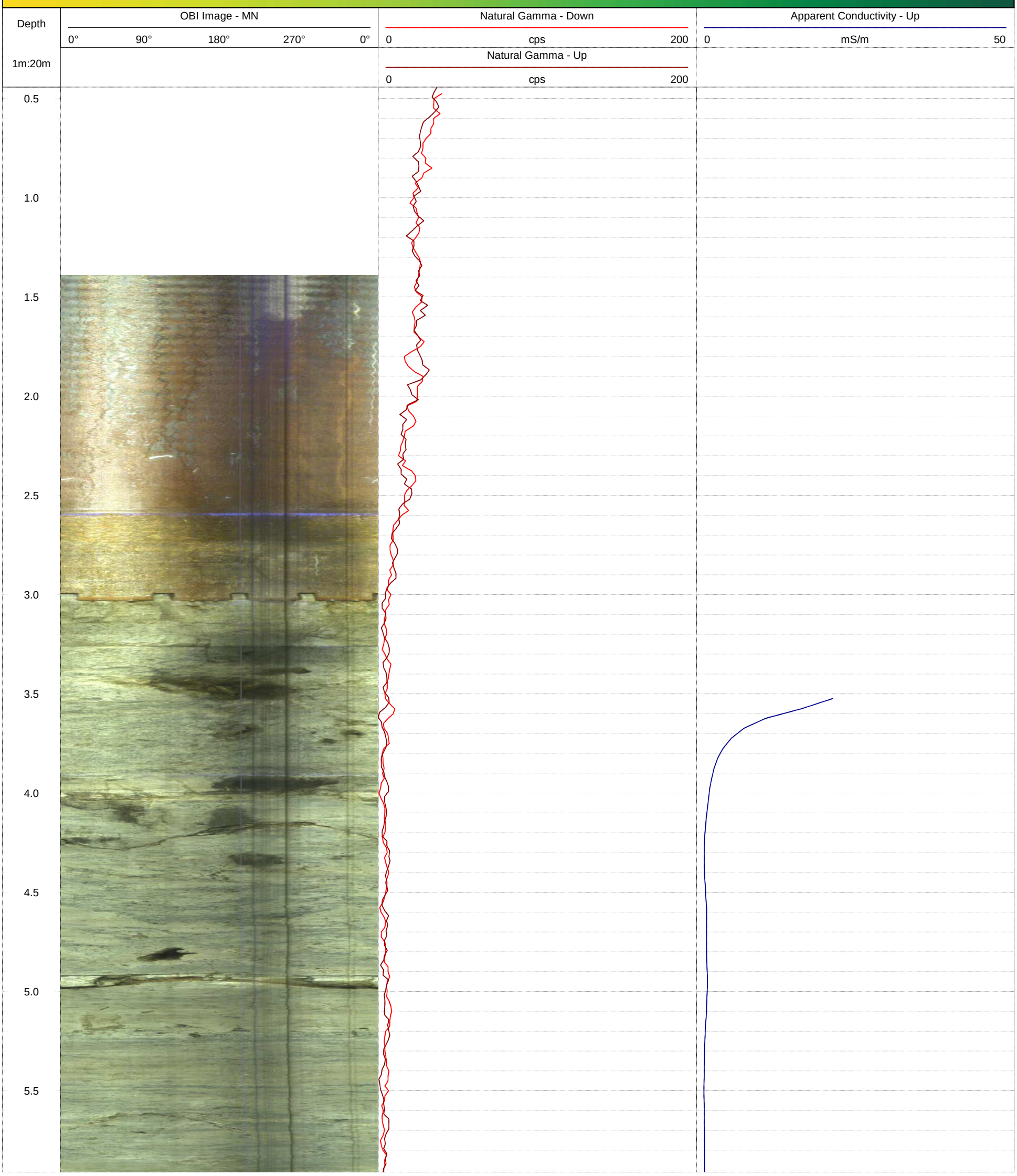
GOLDER
MEMBER OF WSP

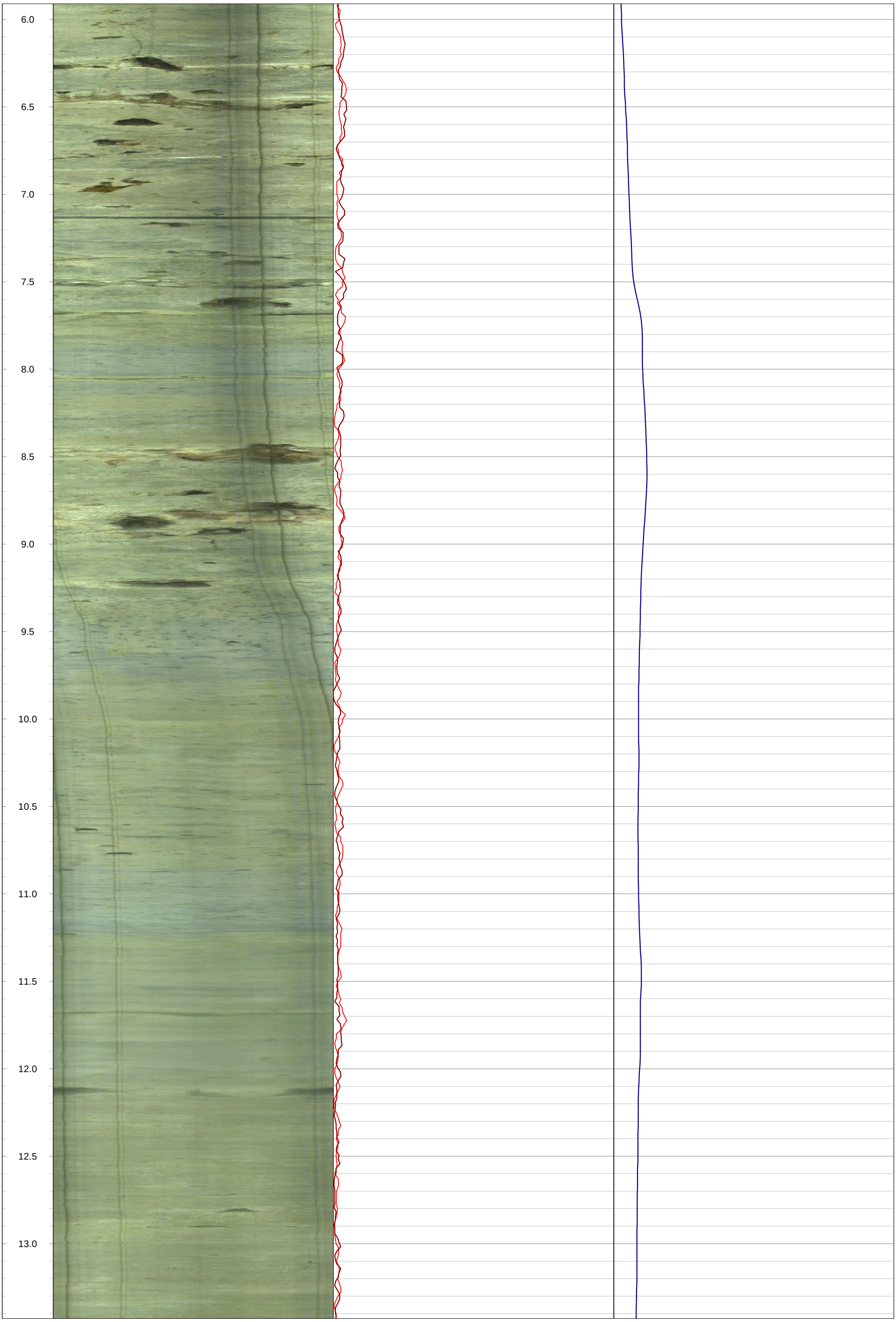
Geophysical Record of Borehole: BH20-03 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.03 m bgs	**Location:**	Caledon, Ontario
Easting:	577655.12 m	**Drilled Depth:**	19.33 m bgs	**Water Level:**	7.14 m bgs	**Log Date:**	Mar-10-2020
Northing:	4852796.26 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	402.91 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.23 m ags	**Logged By:**	CM

Notes:

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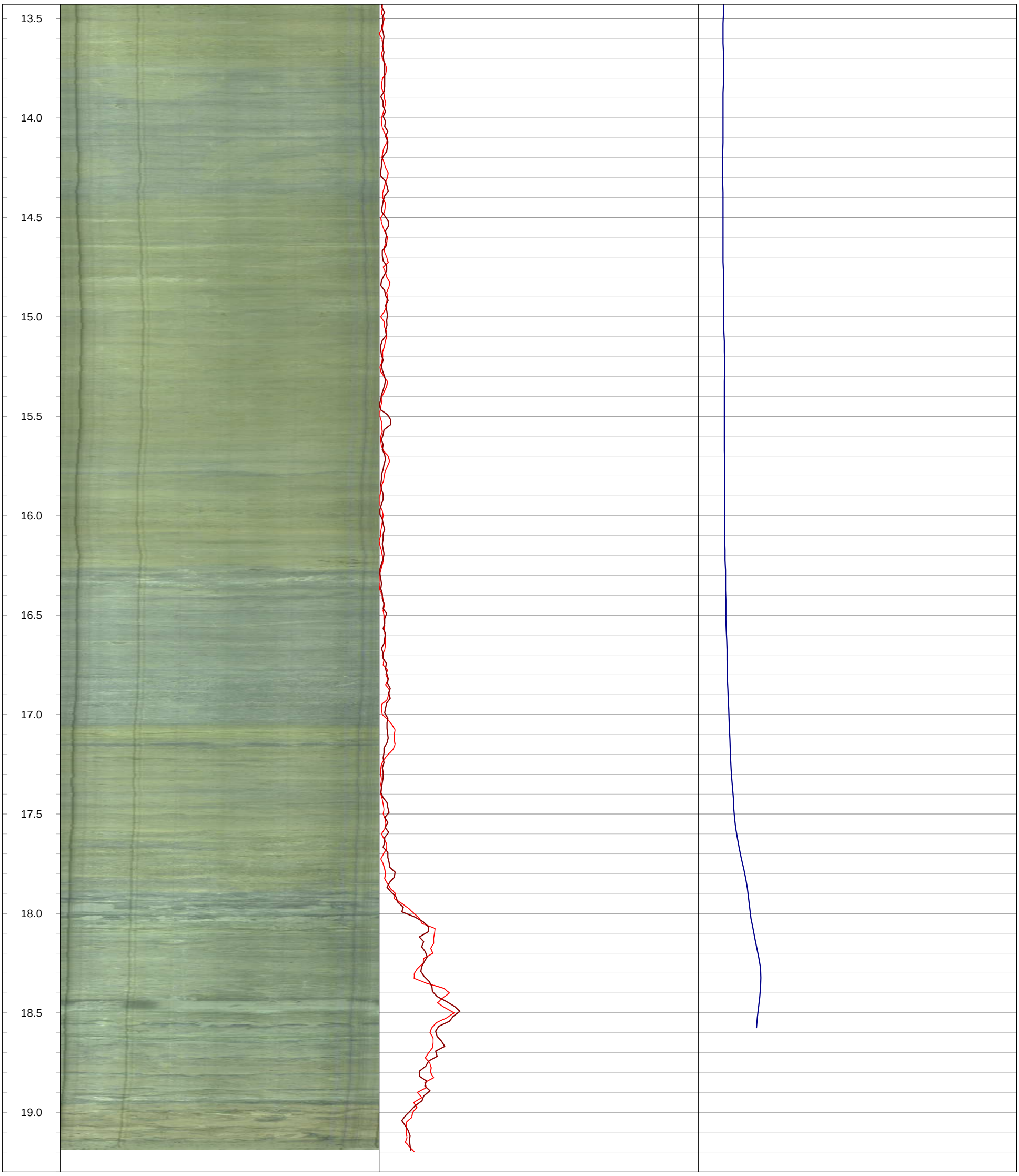
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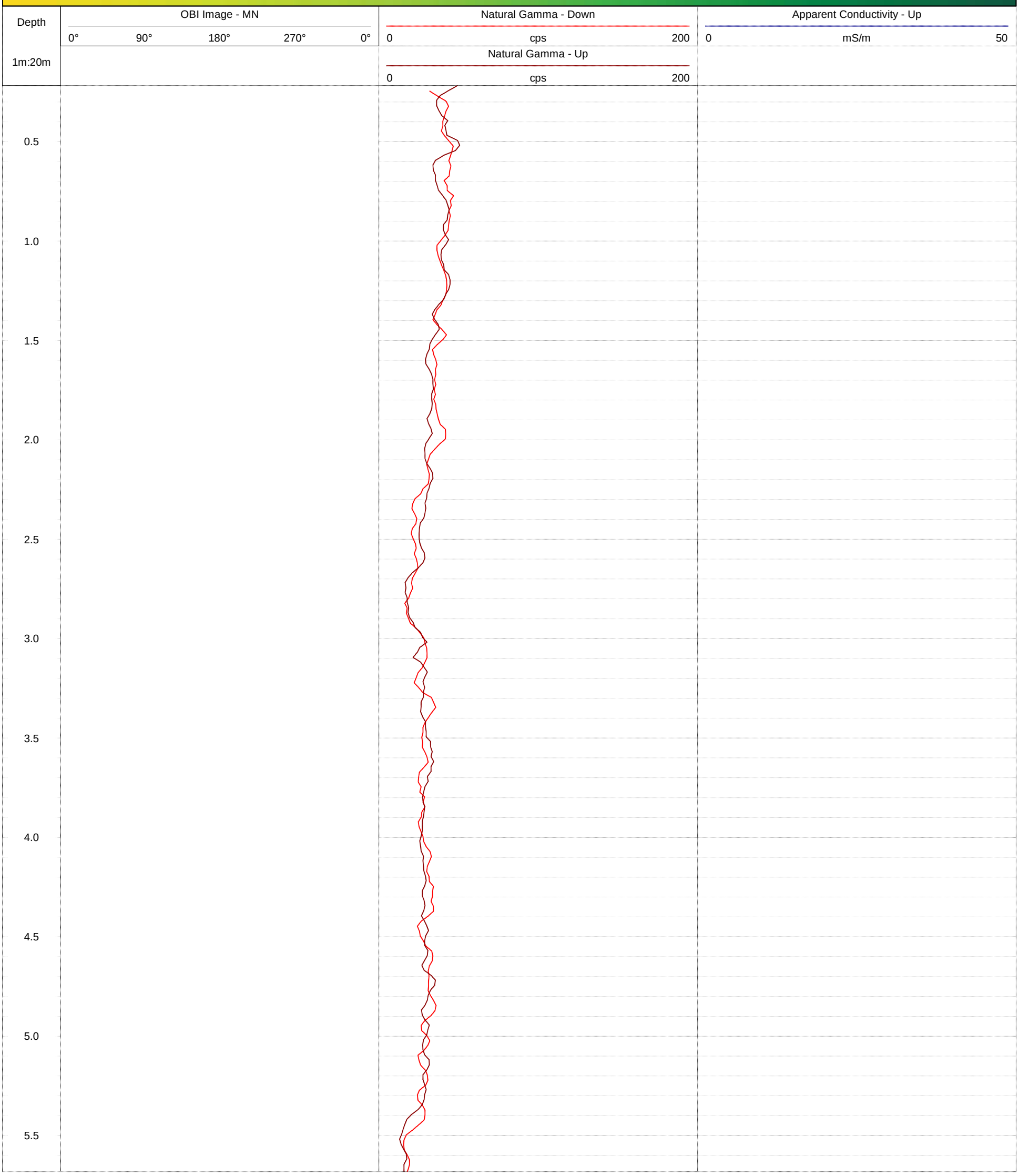
GOLDER
MEMBER OF WSP

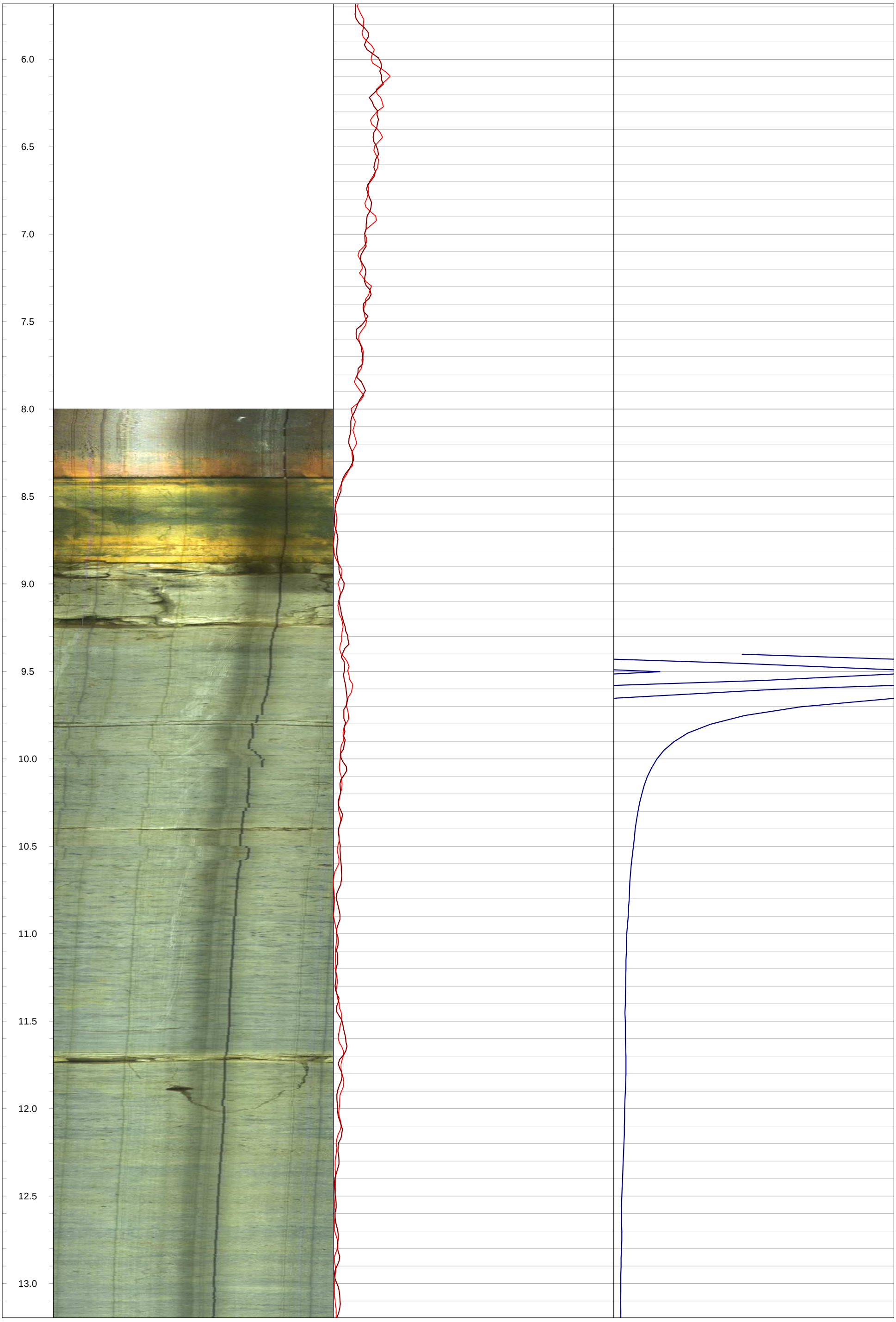
Geophysical Record of Borehole: BH20-04 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.89 m bgs	**Location:**	Caledon, Ontario
Easting:	577511.78 m	**Drilled Depth:**	19.57 m bgs	**Water Level:**	8.31 m bgs	**Log Date:**	Feb-24-2020
Northing:	4852528.07 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	400.81 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	CM

Notes:

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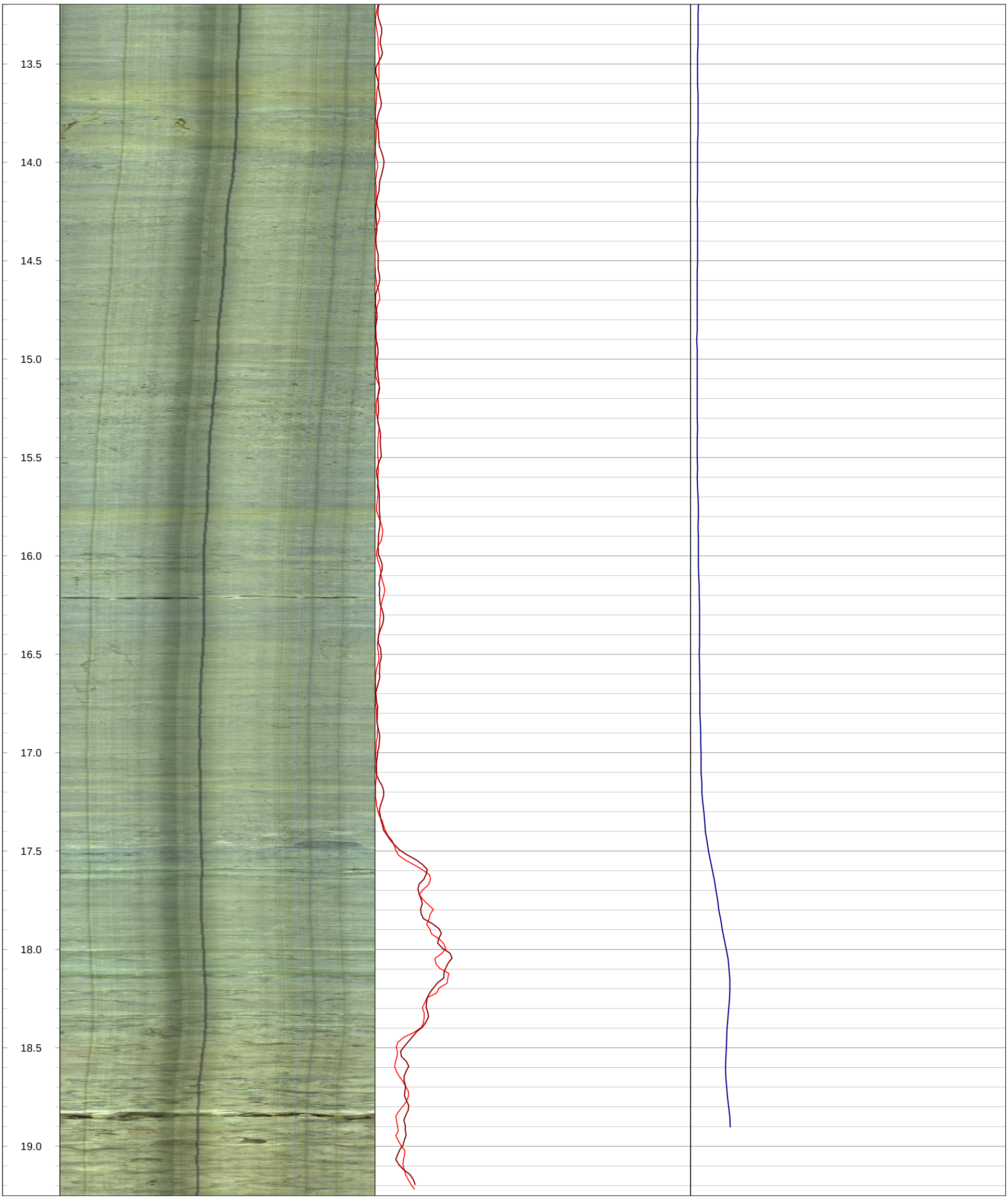
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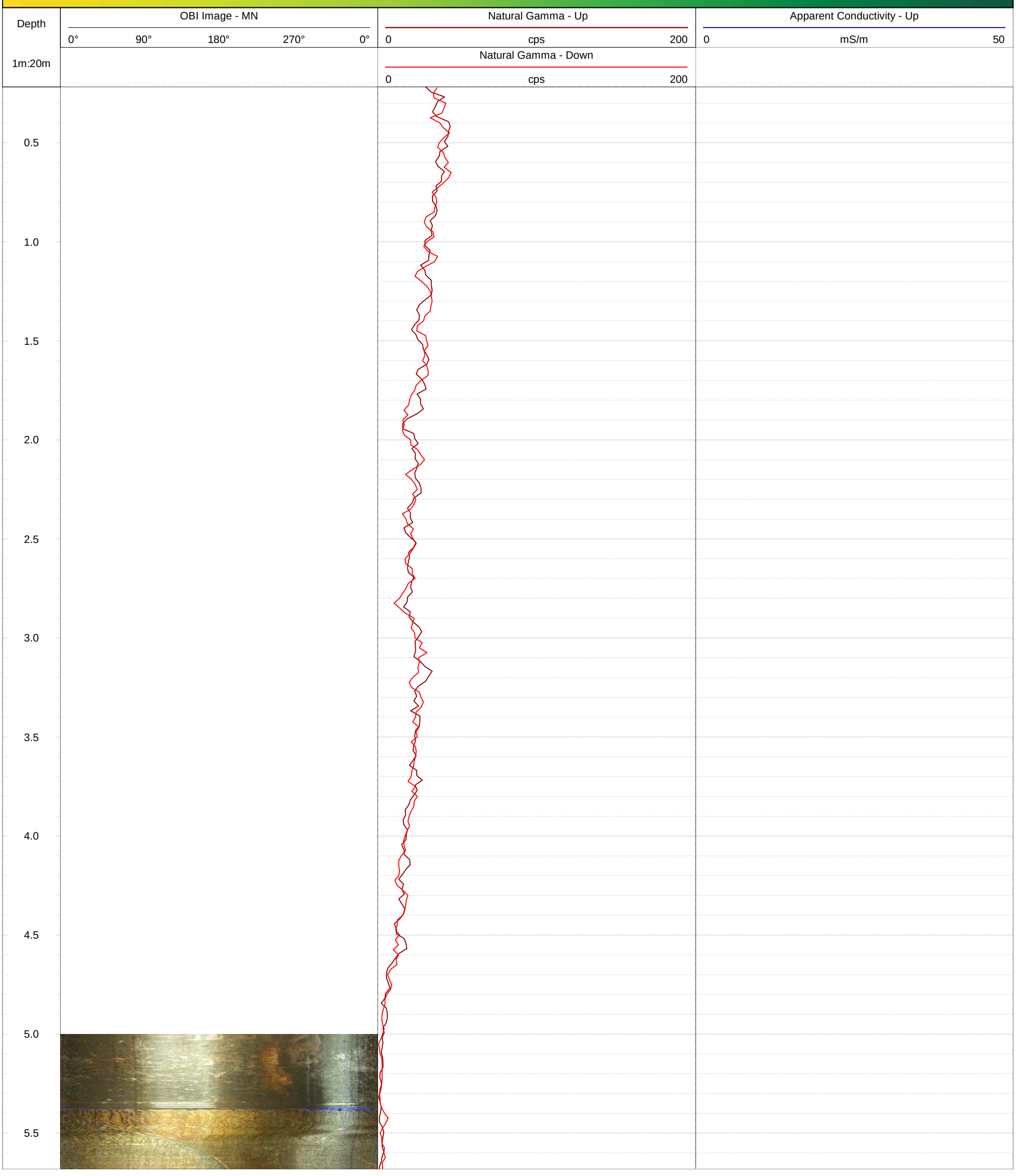
GOLDER
MEMBER OF WSP

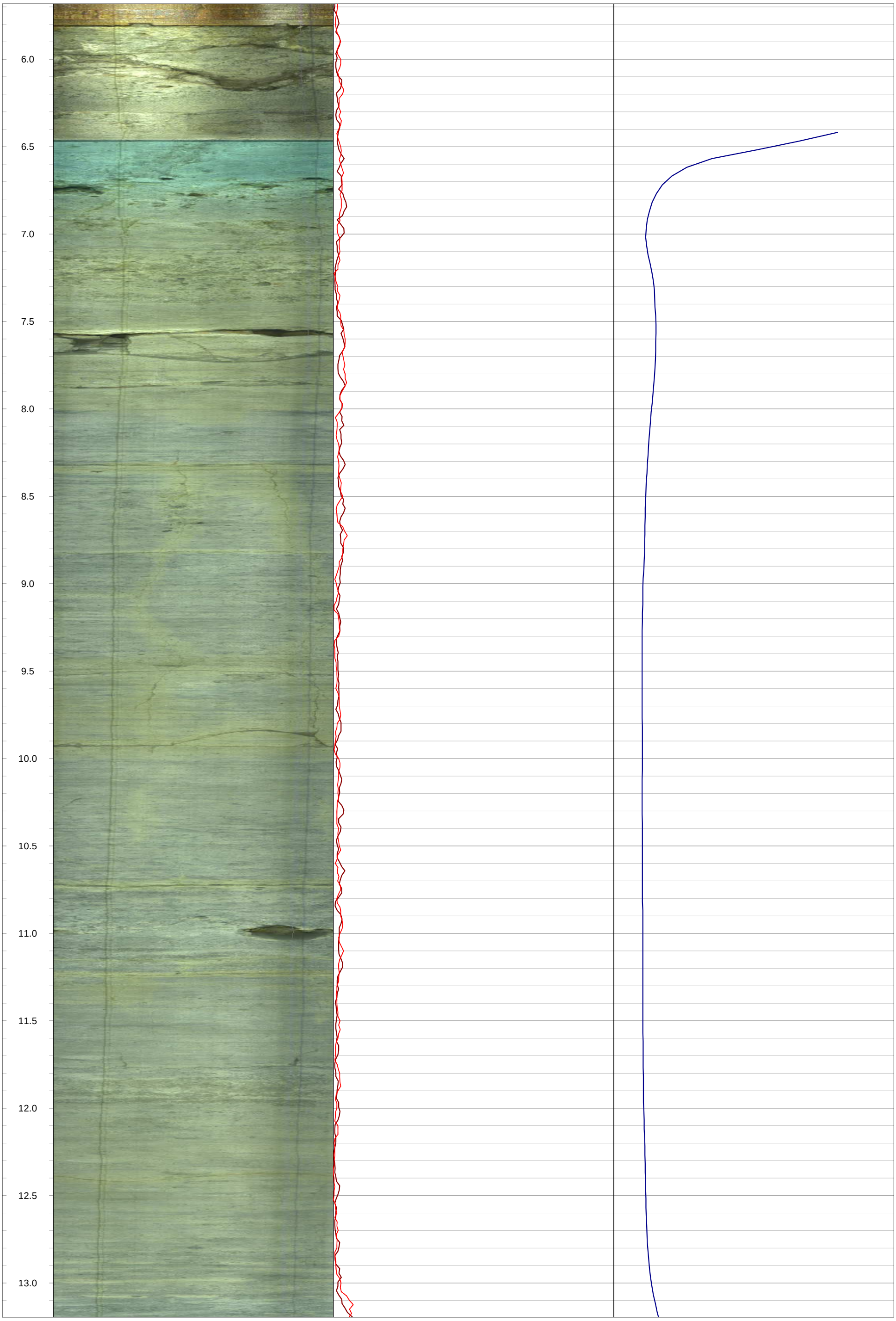
Geophysical Record of Borehole: BH20-05 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.81 m bgs	**Location:**	Caledon, Ontario
Easting:	577786.25 m	**Drilled Depth:**	16.35 m bgs	**Water Level:**	6.51 m bgs	**Log Date:**	Feb-24-2020
Northing:	4852520.23 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	398.83 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.48 m ags	**Logged By:**	CM

Notes: OBI image dark > 15.5 m bgs

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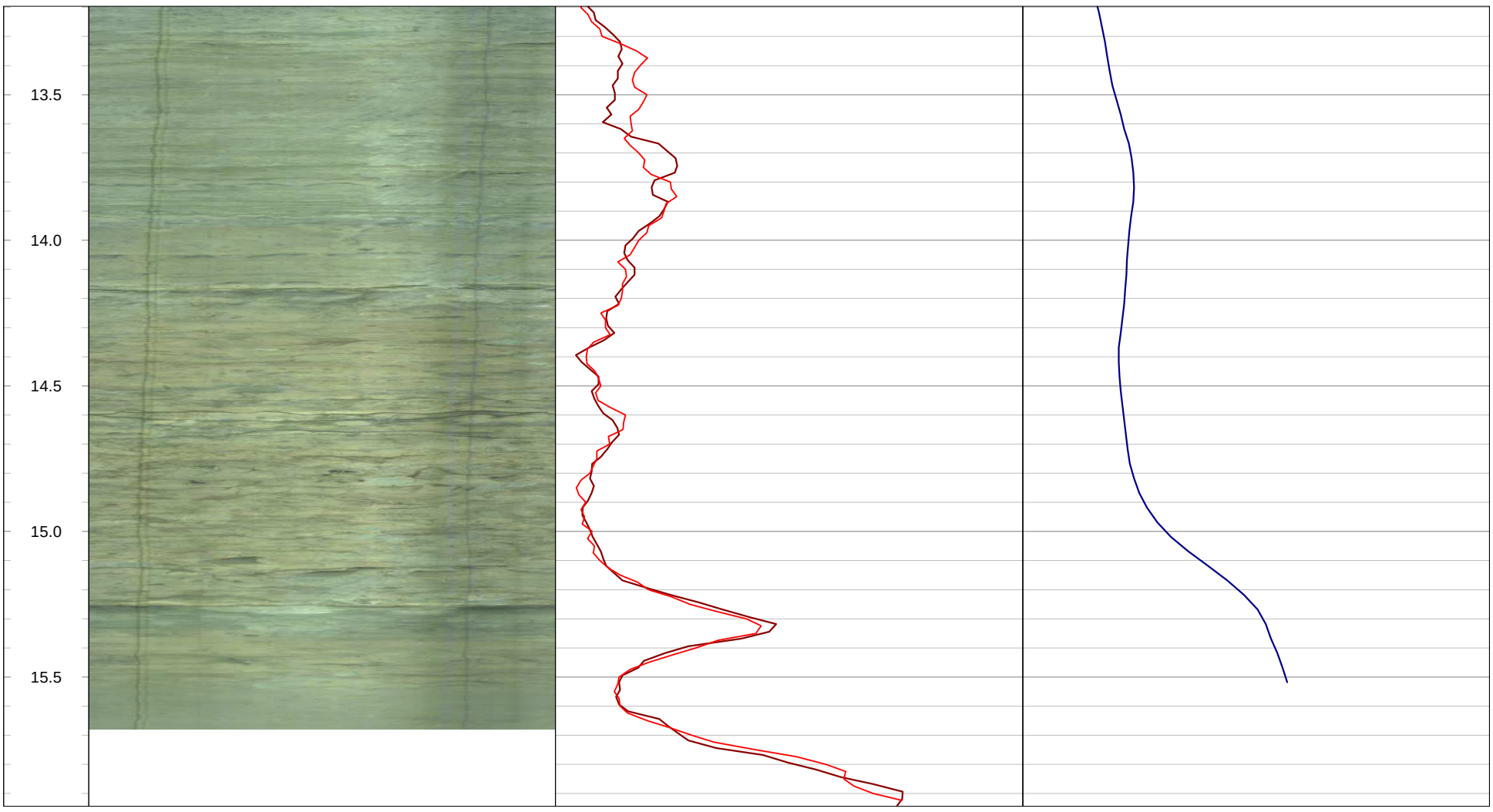
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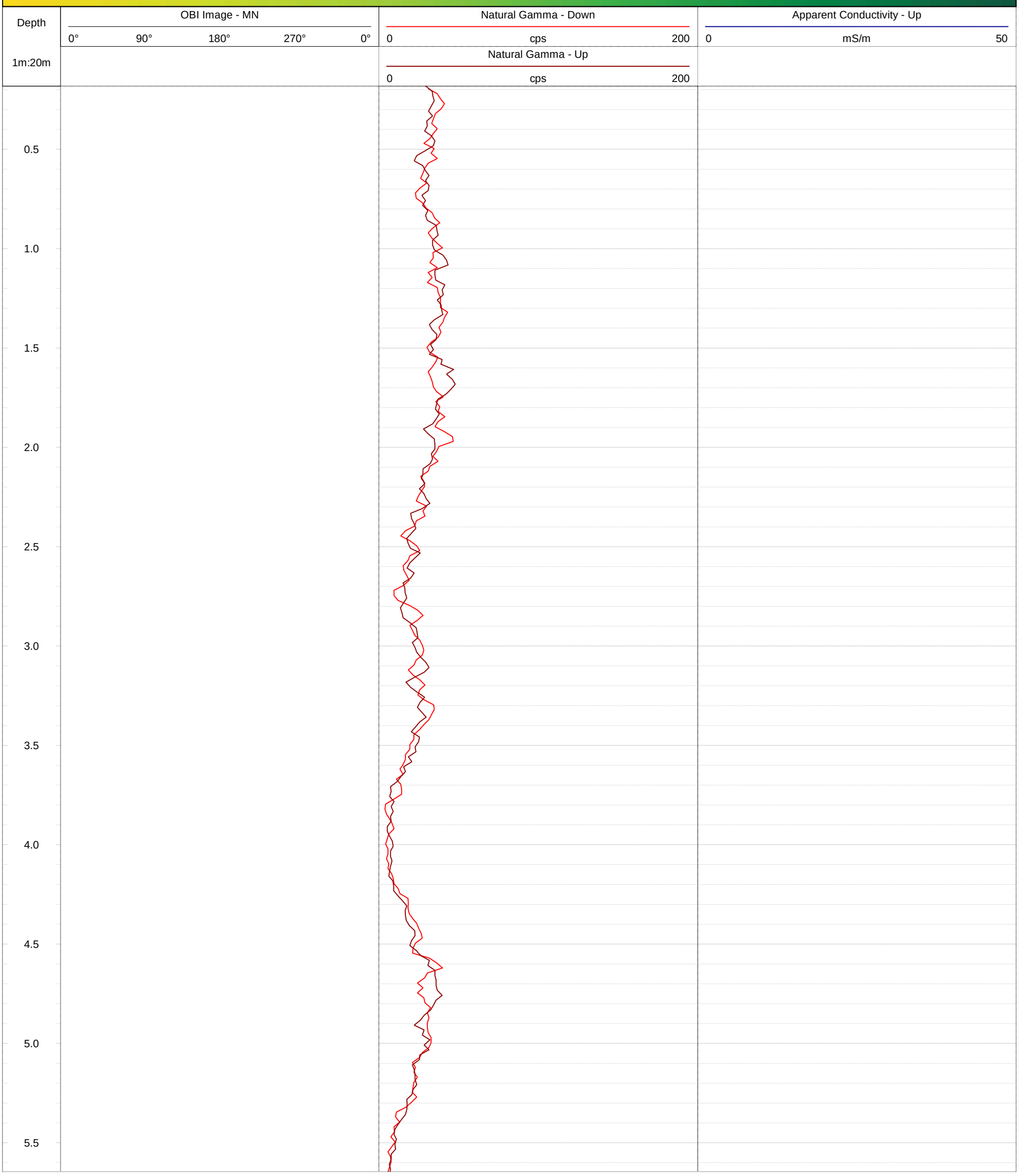
GOLDER
MEMBER OF WSP

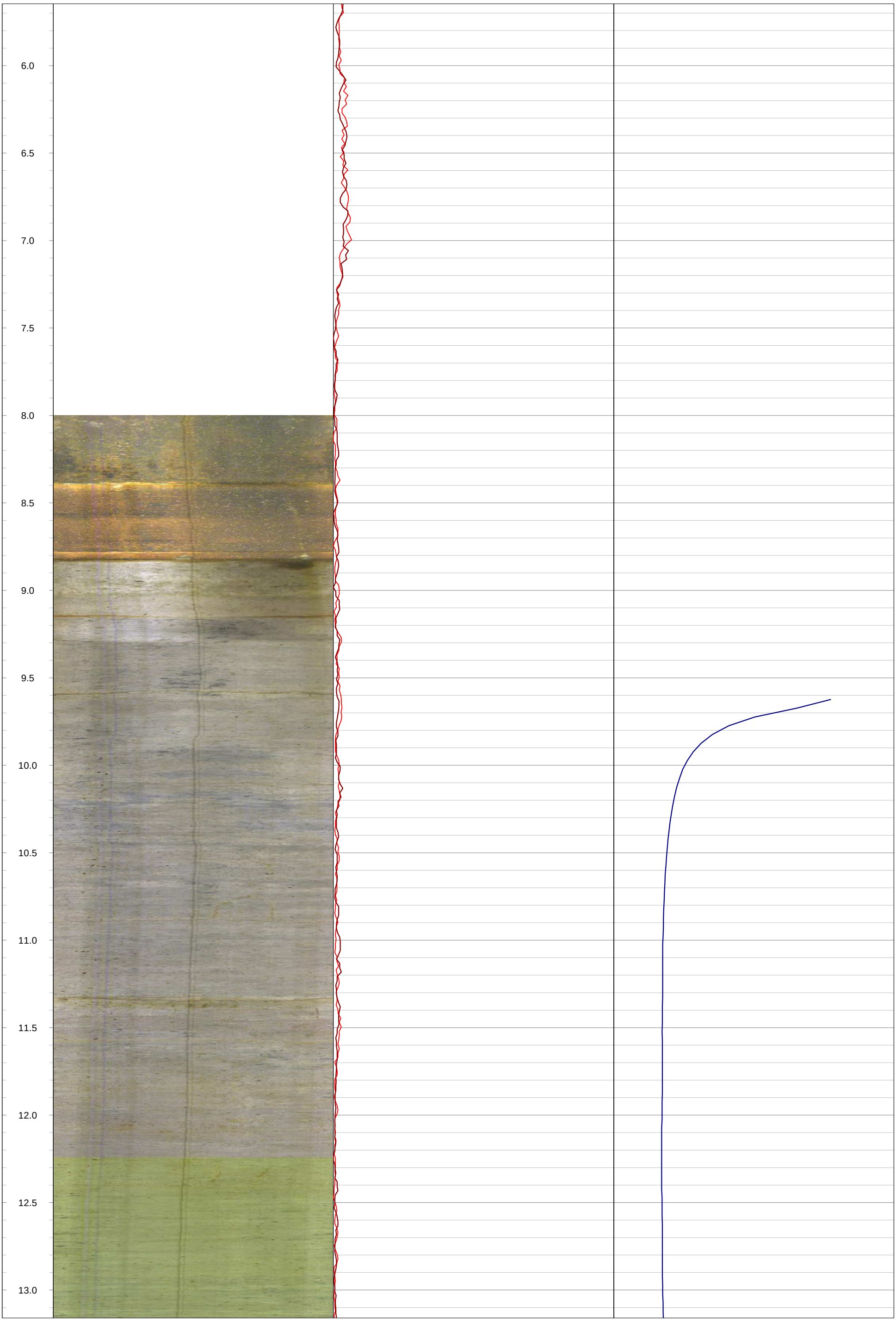
Geophysical Record of Borehole: BH20-06 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.83 m bgs	**Location:**	Caledon, Ontario
Easting:	578056.45 m	**Drilled Depth:**	16.60 m bgs	**Water Level:**	5.49 m bgs	**Log Date:**	Feb-25-2020
Northing:	4852520.24 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	397.70 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.51 m ags	**Logged By:**	CM

Notes:

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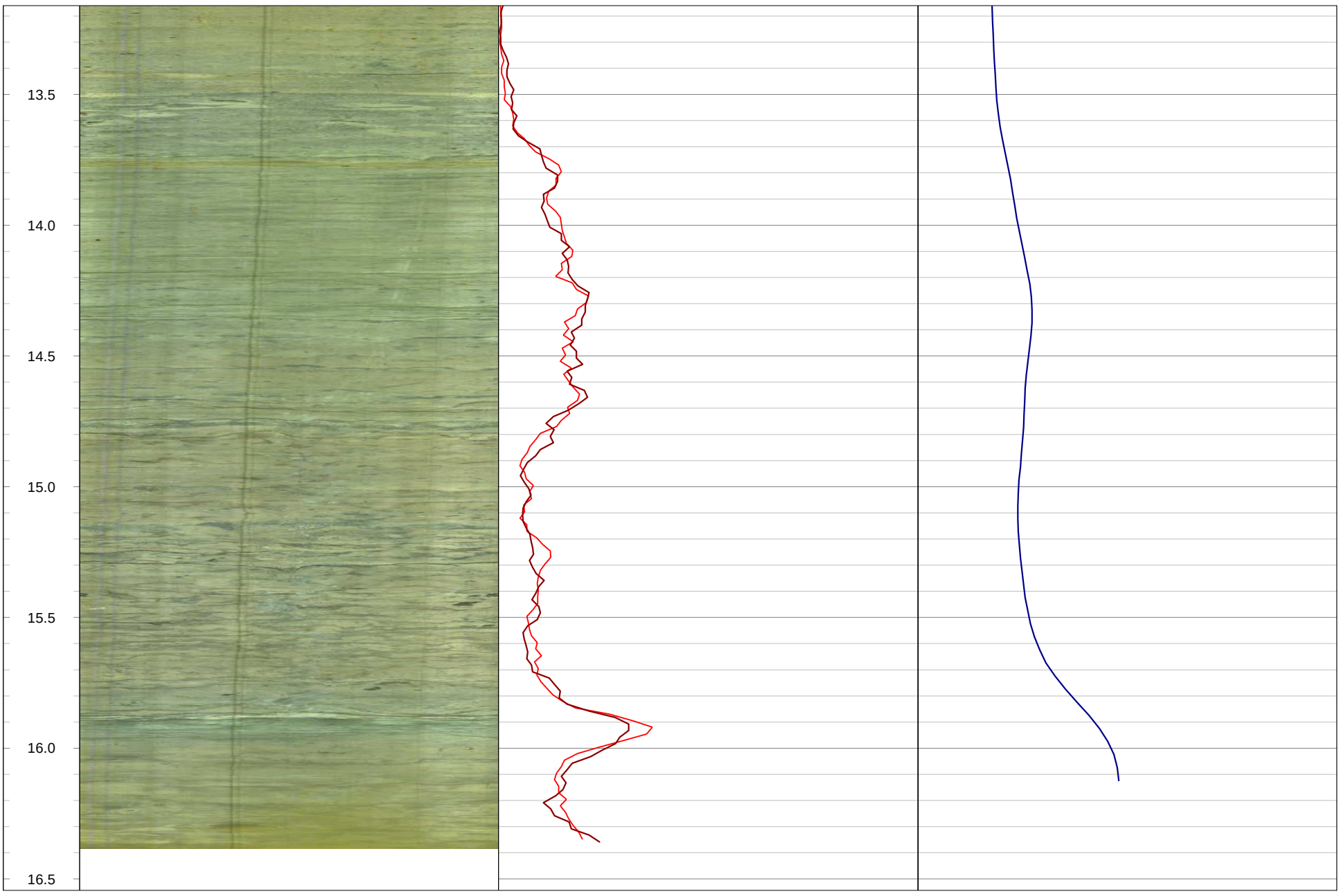
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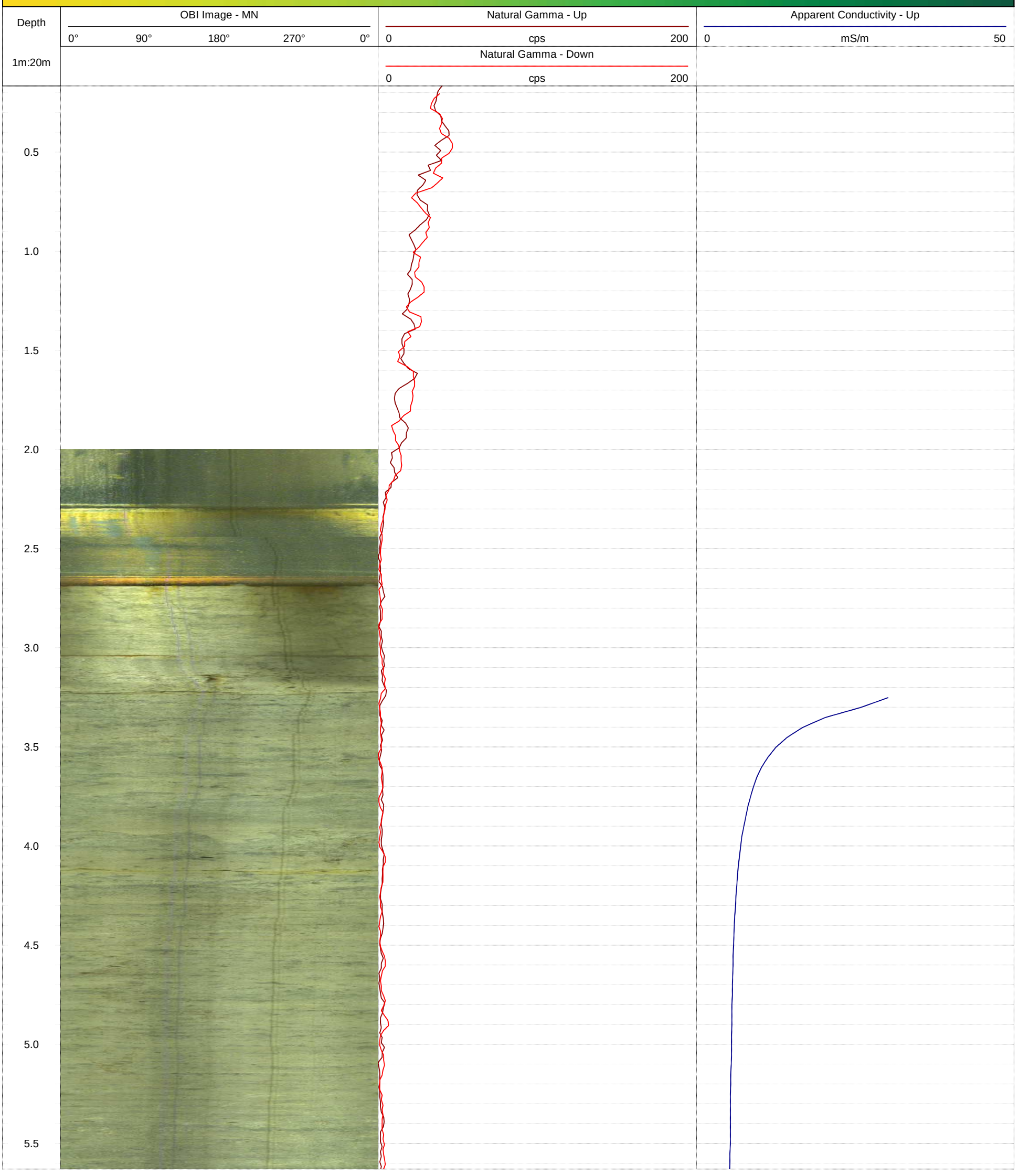
GOLDER
MEMBER OF WSP

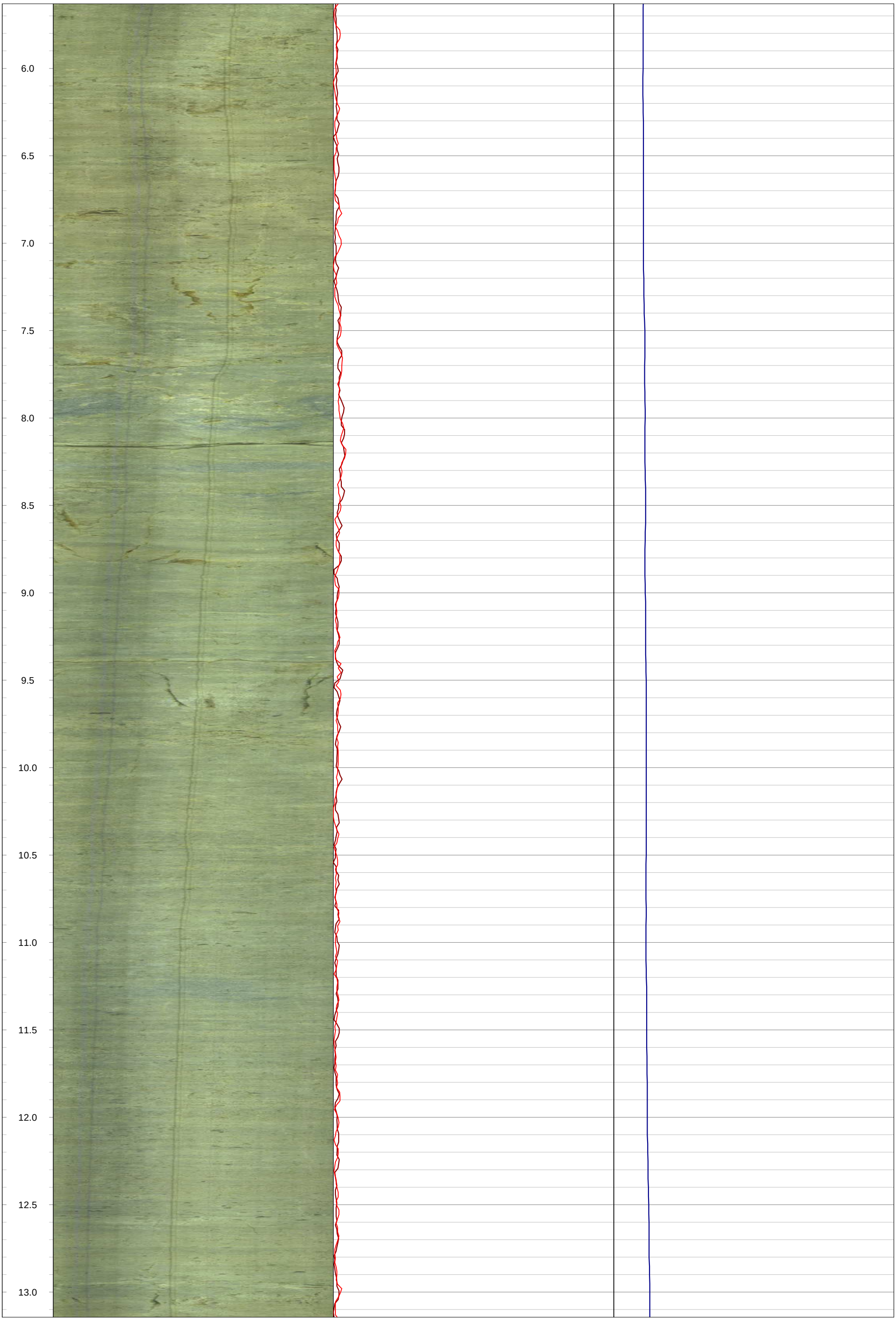
Geophysical Record of Borehole: BH20-07 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.69 m bgs	**Location:**	Caledon, Ontario
Easting:	578129.13 m	**Drilled Depth:**	18.67 m bgs	**Water Level:**	1.40 m bgs	**Log Date:**	Feb-25-2020
Northing:	4853102.34 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.73 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.50 m ags	**Logged By:**	CM

Notes: OBI image is dark >16.40 m bgs

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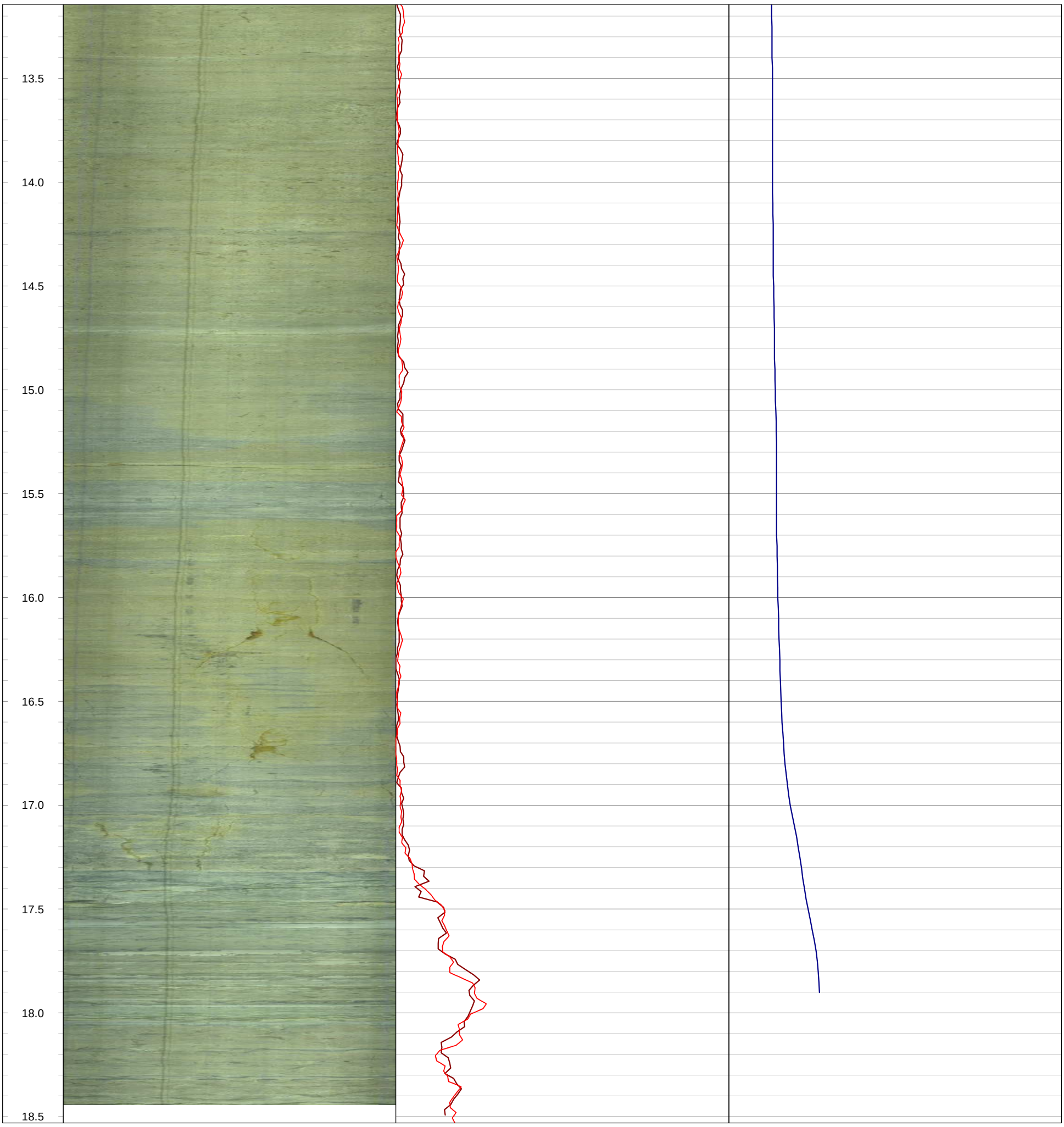
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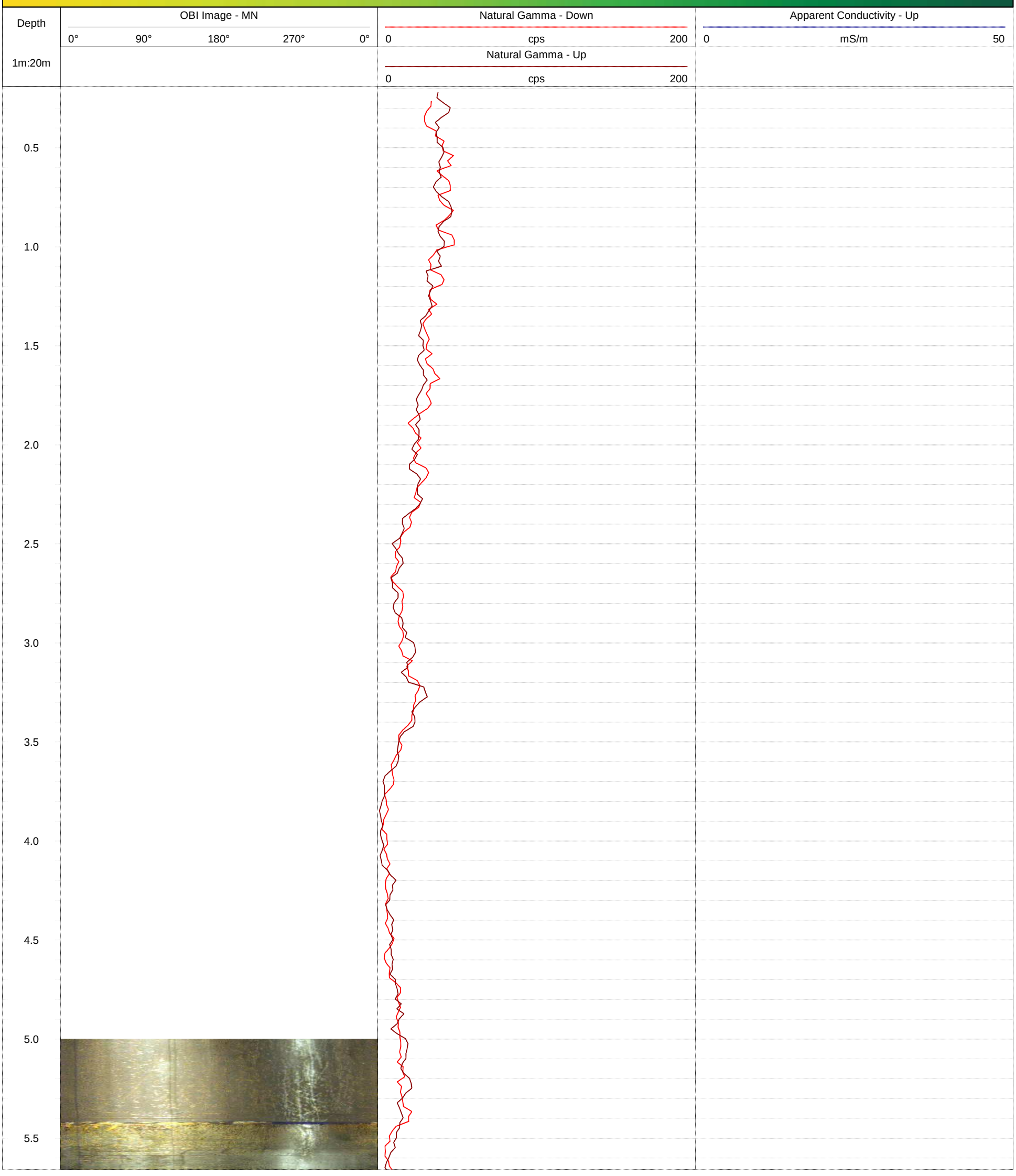
GOLDER
MEMBER OF WSP

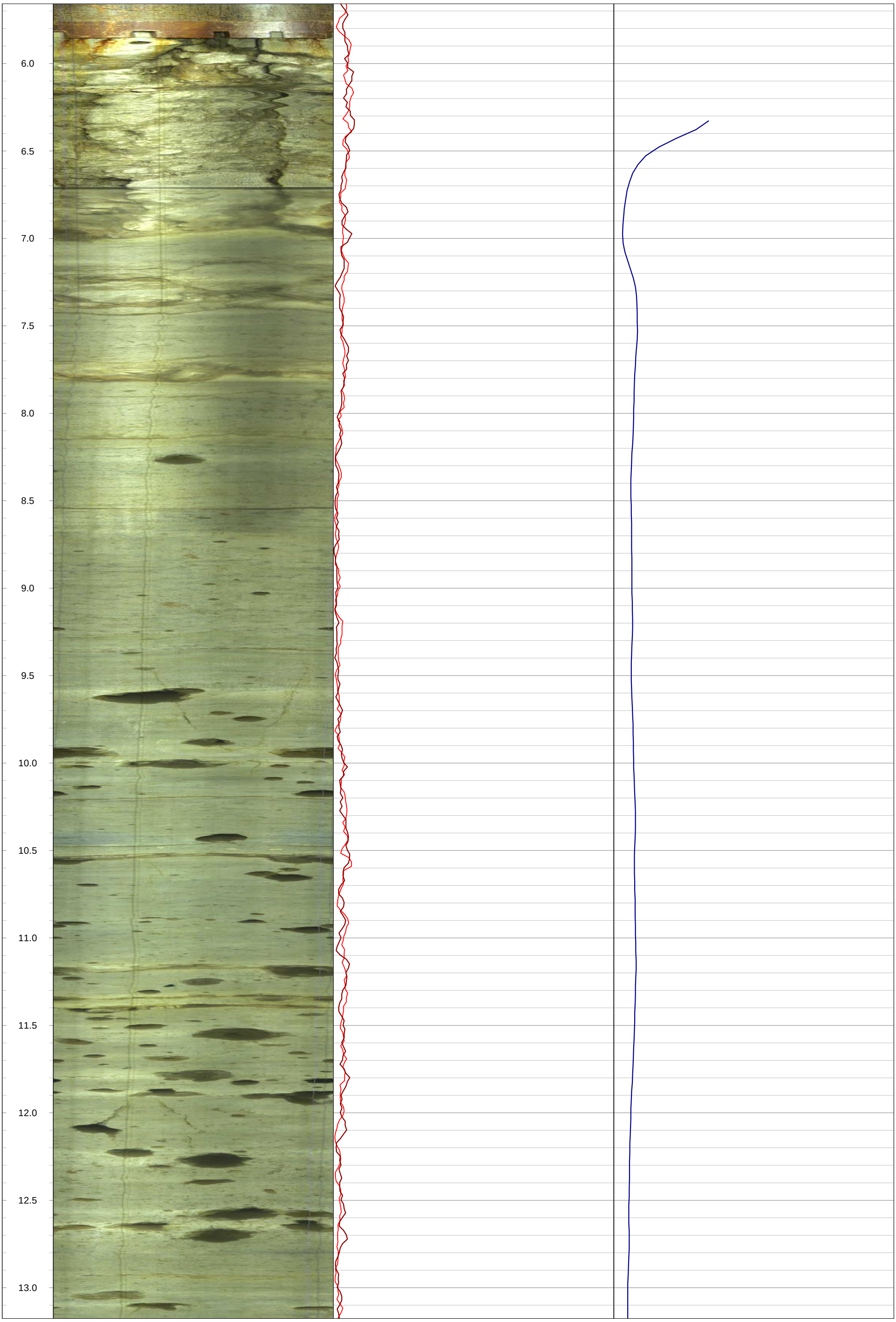
Geophysical Record of Borehole: BH20-08 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.85 m bgs	**Location:**	Caledon, Ontario
Easting:	577961.99 m	**Drilled Depth:**	17.90 m bgs	**Water Level:**	6.64 m bgs	**Log Date:**	Mar-11-2020
Northing:	4852832.00 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.50 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.44 m ags	**Logged By:**	CM

Notes:

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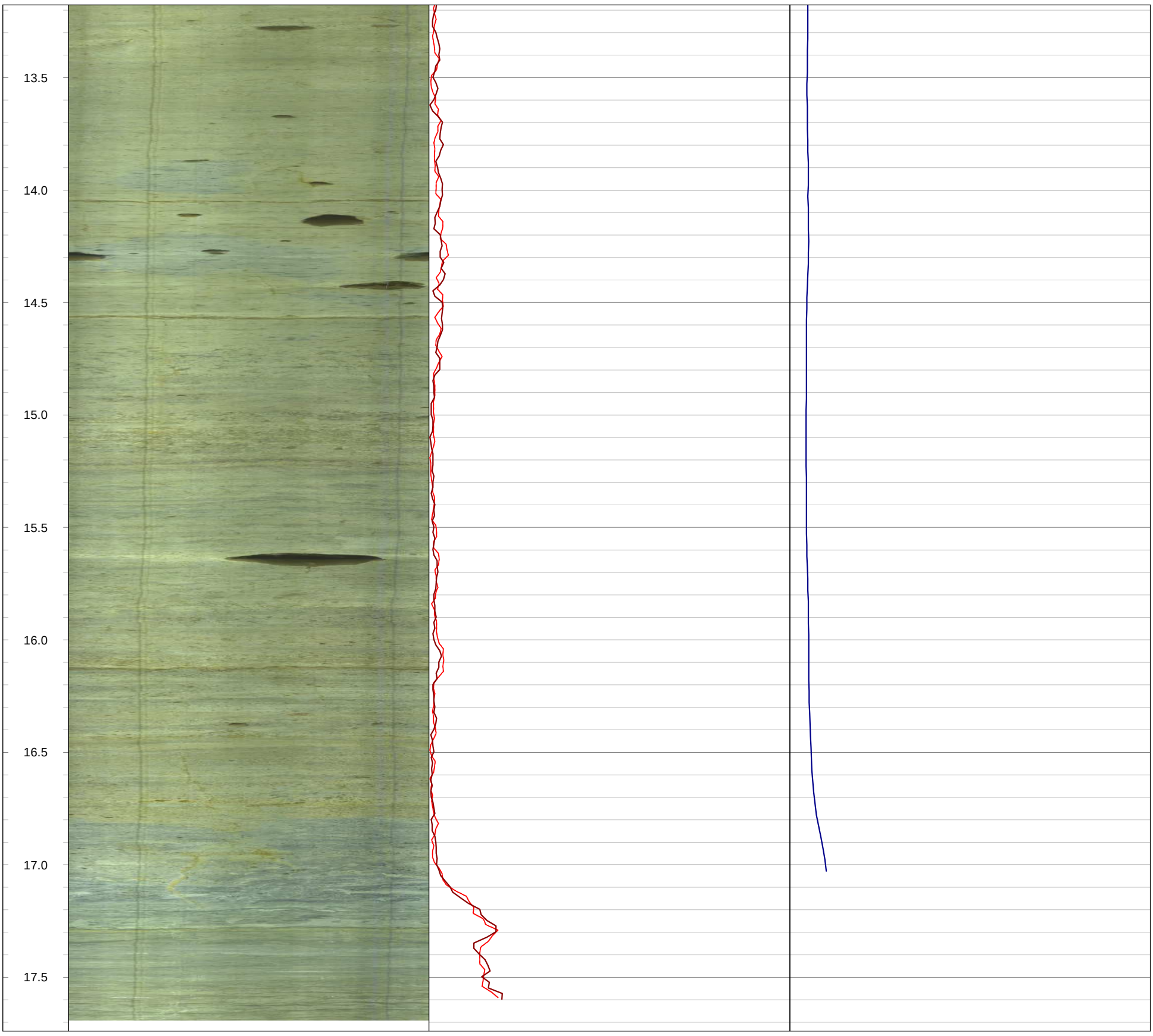
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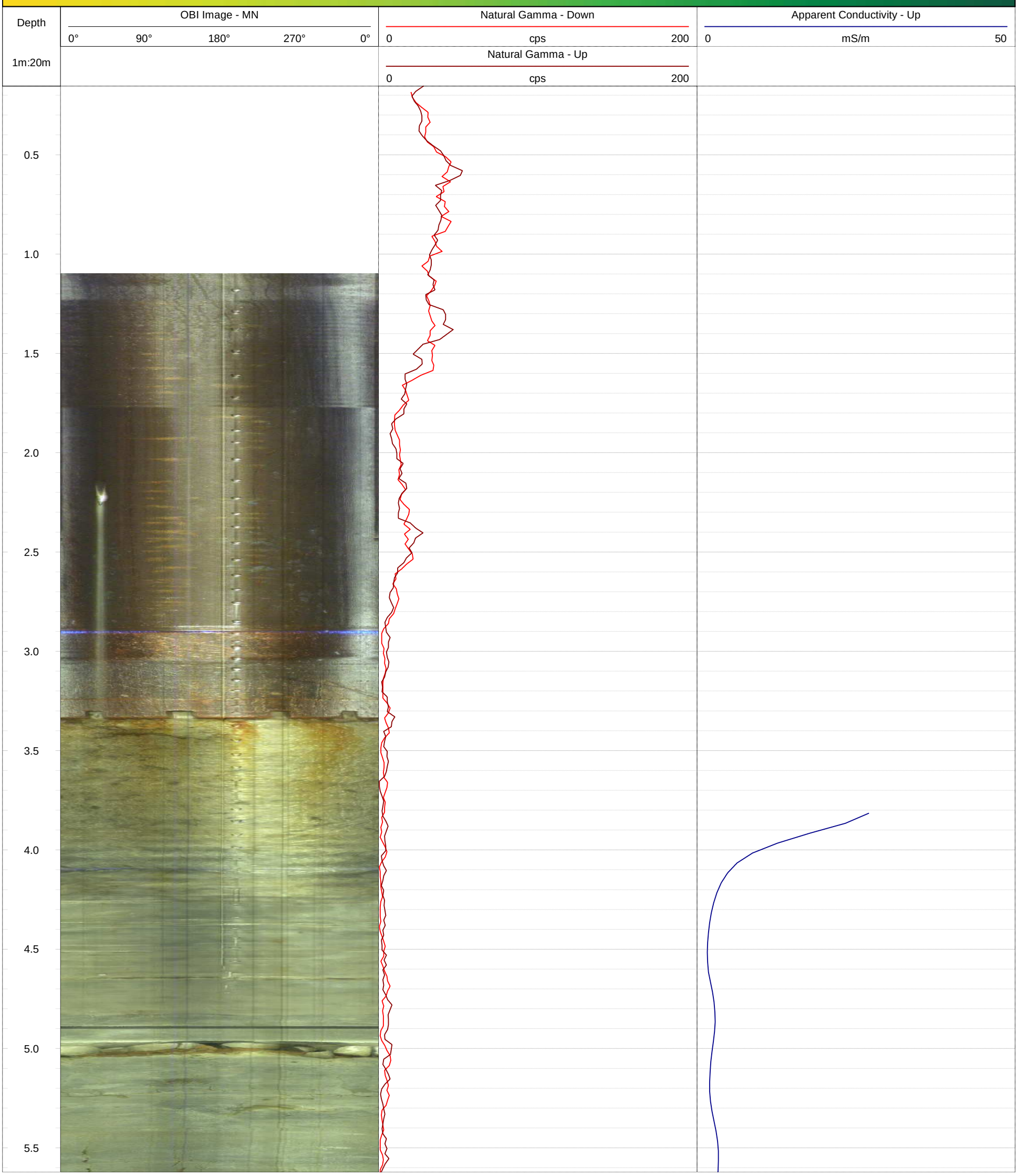
GOLDER
MEMBER OF WSP

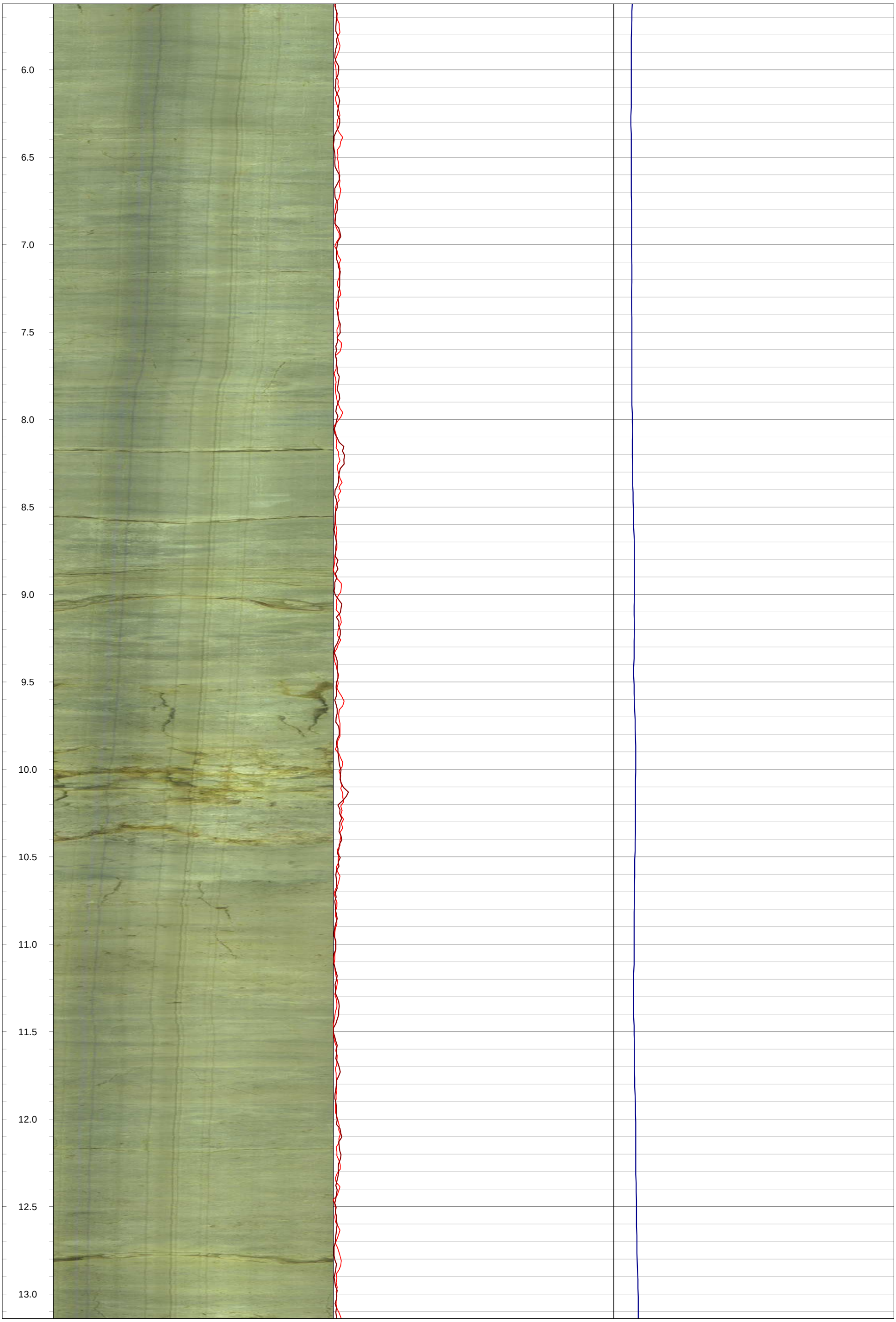
Geophysical Record of Borehole: BH20-09 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.33 m bgs	**Location:**	Caledon, Ontario
Easting:	578186.33 m	**Drilled Depth:**	16.77 m bgs	**Water Level:**	4.95 m bgs	**Log Date:**	Mar-10-2020
Northing:	4852803.00 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	402.26 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.52 m ags	**Logged By:**	CM

Notes:

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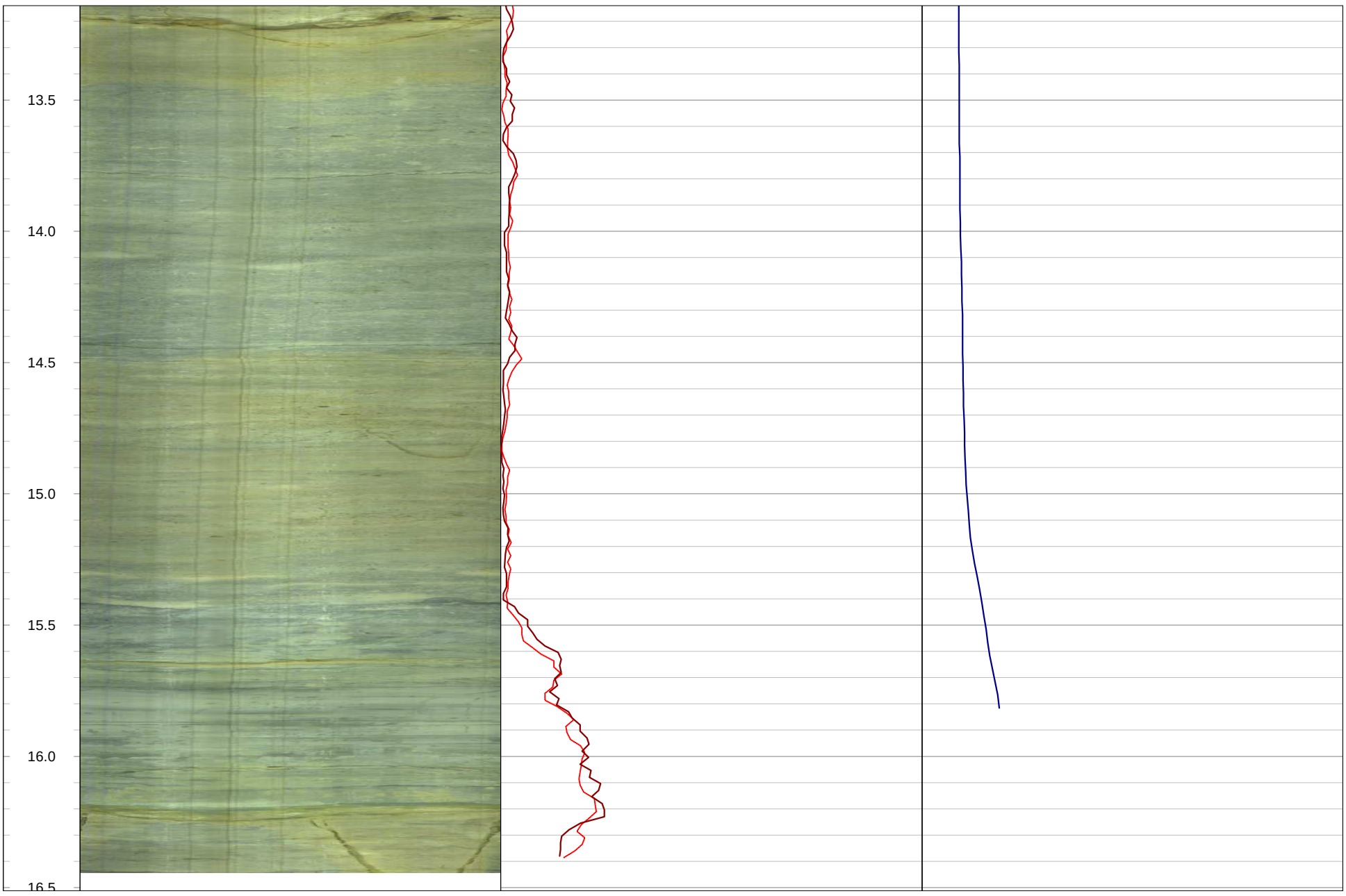
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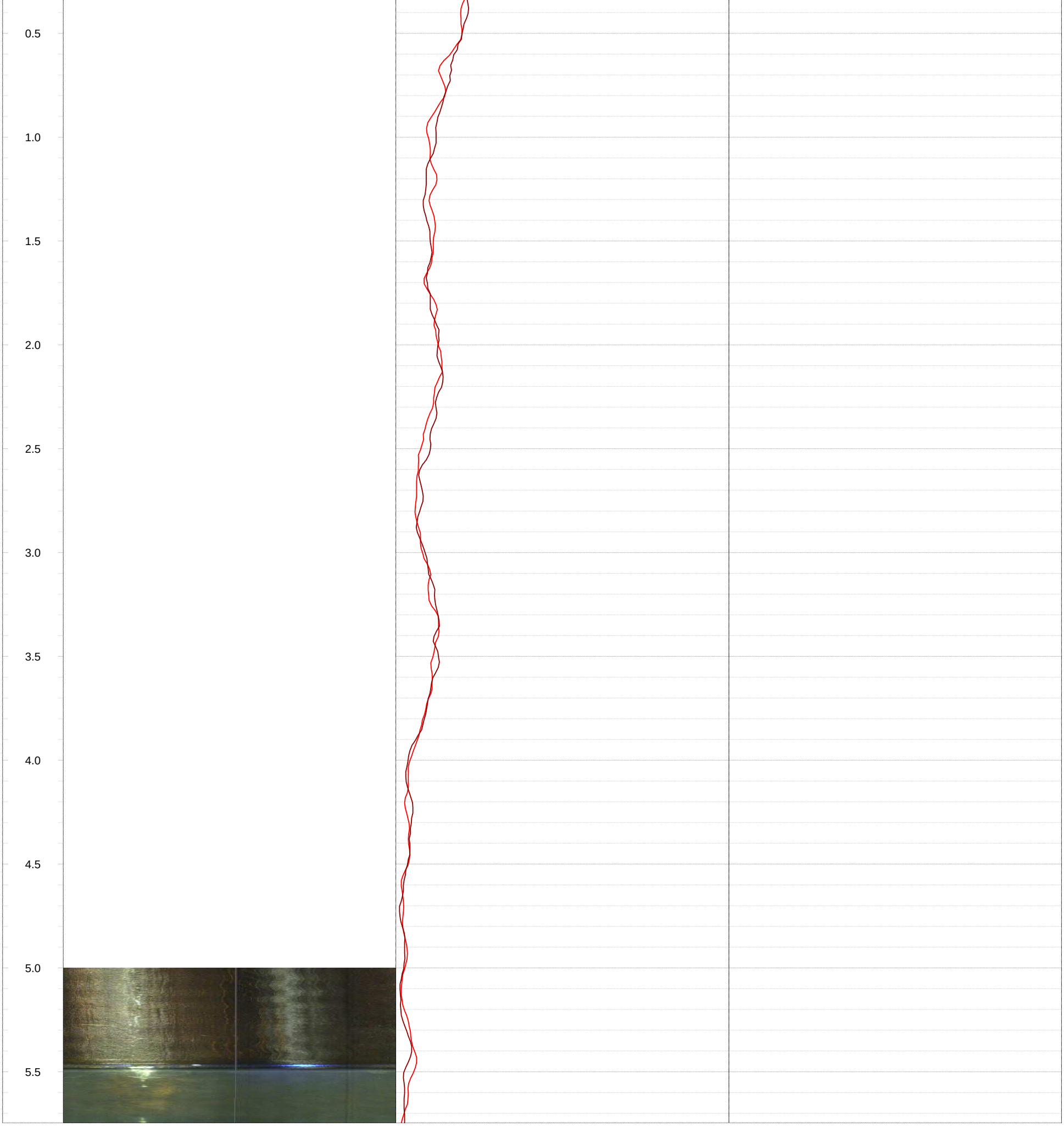
GOLDER
MEMBER OF WSP

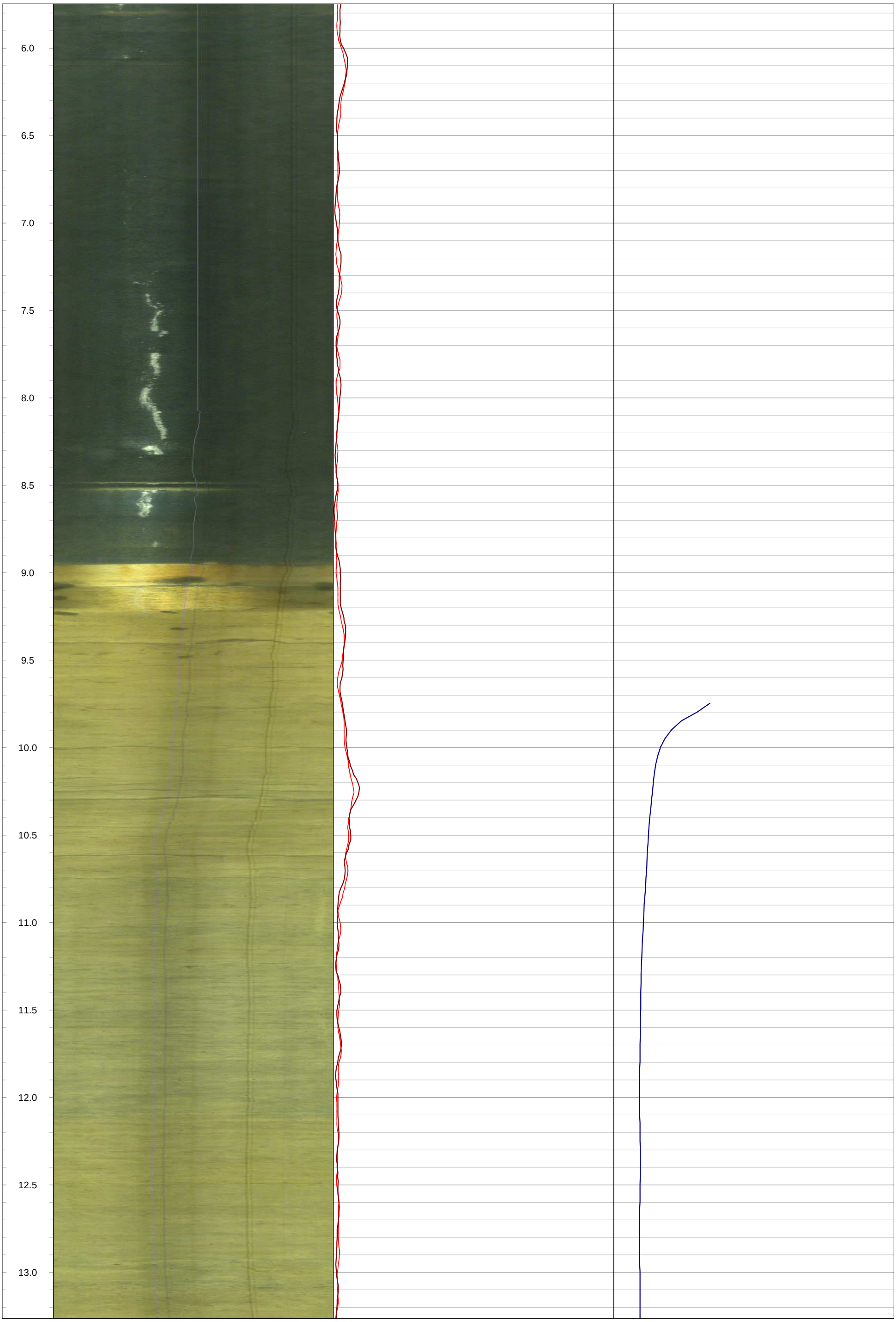
Geophysical Record of Borehole: BH20-10 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.94 m bgs	**Location:**	Caledon, Ontario
Easting:	577940.09 m	**Drilled Depth:**	19.55 m bgs	**Water Level:**	5.29 m bgs	**Log Date:**	Mar-25-2020
Northing:	4853952.34 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	411.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.40 m ags	**Logged By:**	PG

Notes:

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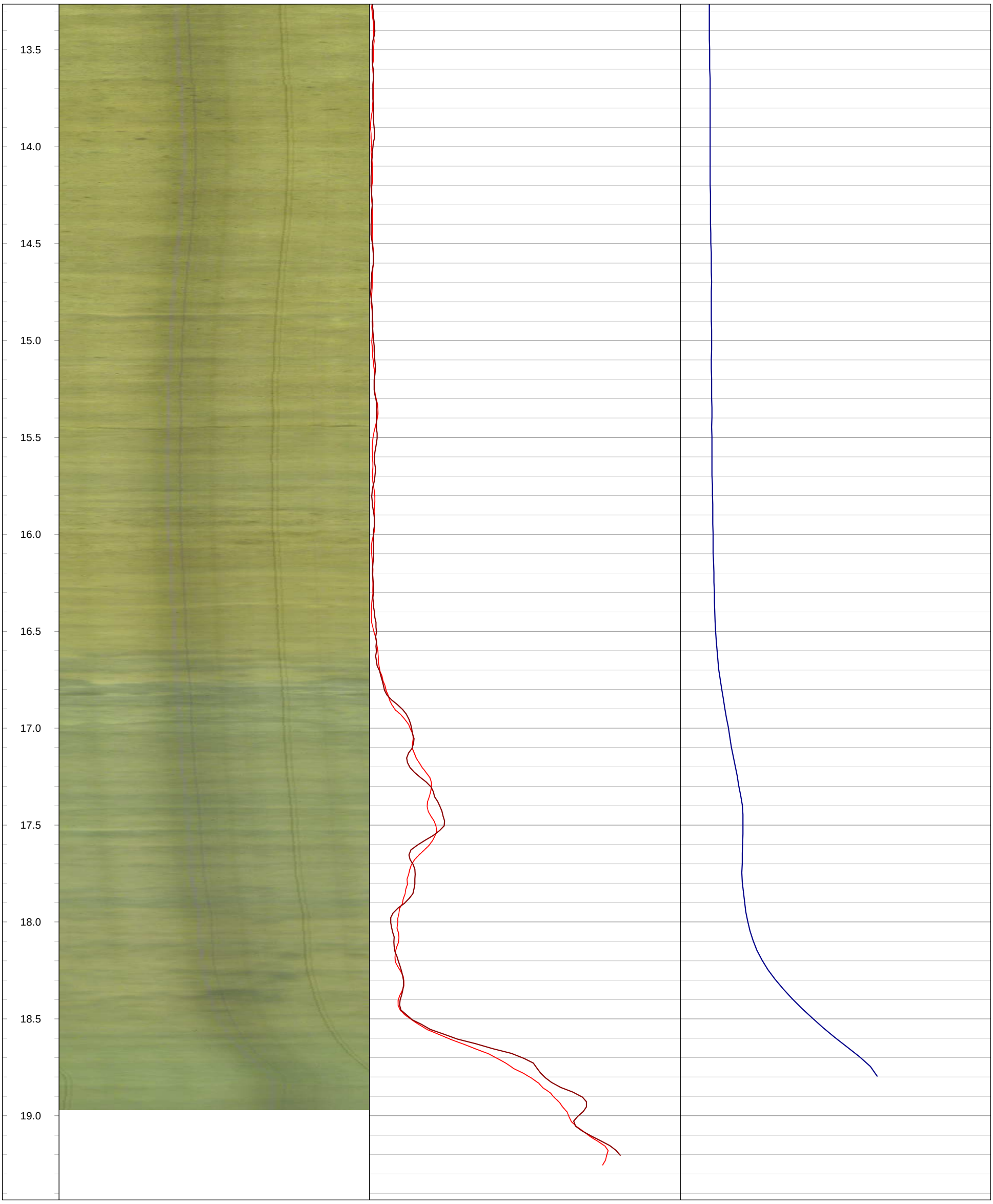
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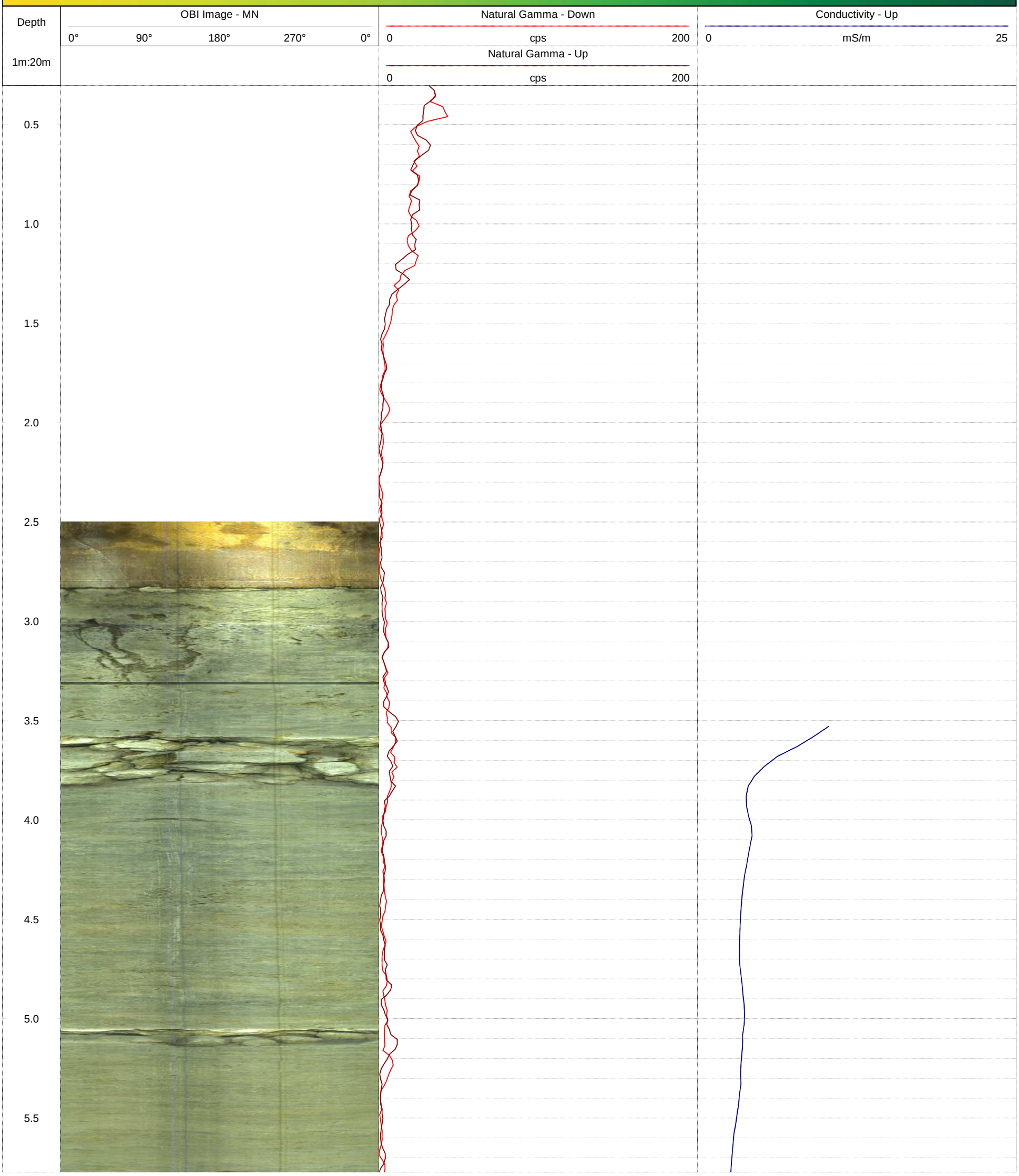
GOLDER
MEMBER OF WSP

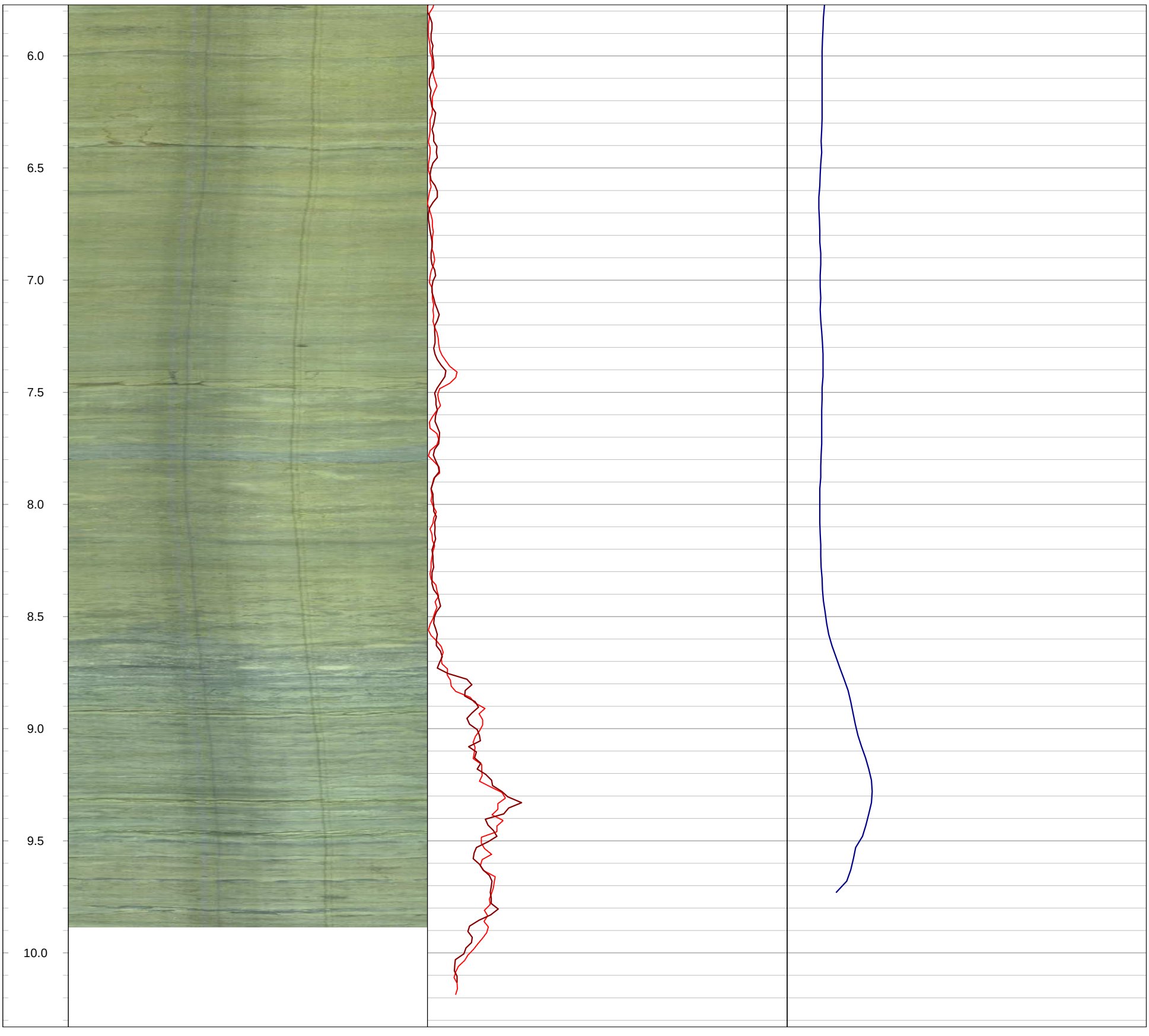
Geophysical Record of Borehole: BH20-11 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.83 m bgs	**Location:**	Caledon, Ontario
Easting:	578065.10 m	**Drilled Depth:**	10.20 m bgs	**Water Level:**	3.33 m bgs	**Log Date:**	Mar-26-2020
Northing:	4854240.45 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	402.10 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.36 m ags	**Logged By:**	PG

Notes: OBI image opaque > 9.95 m

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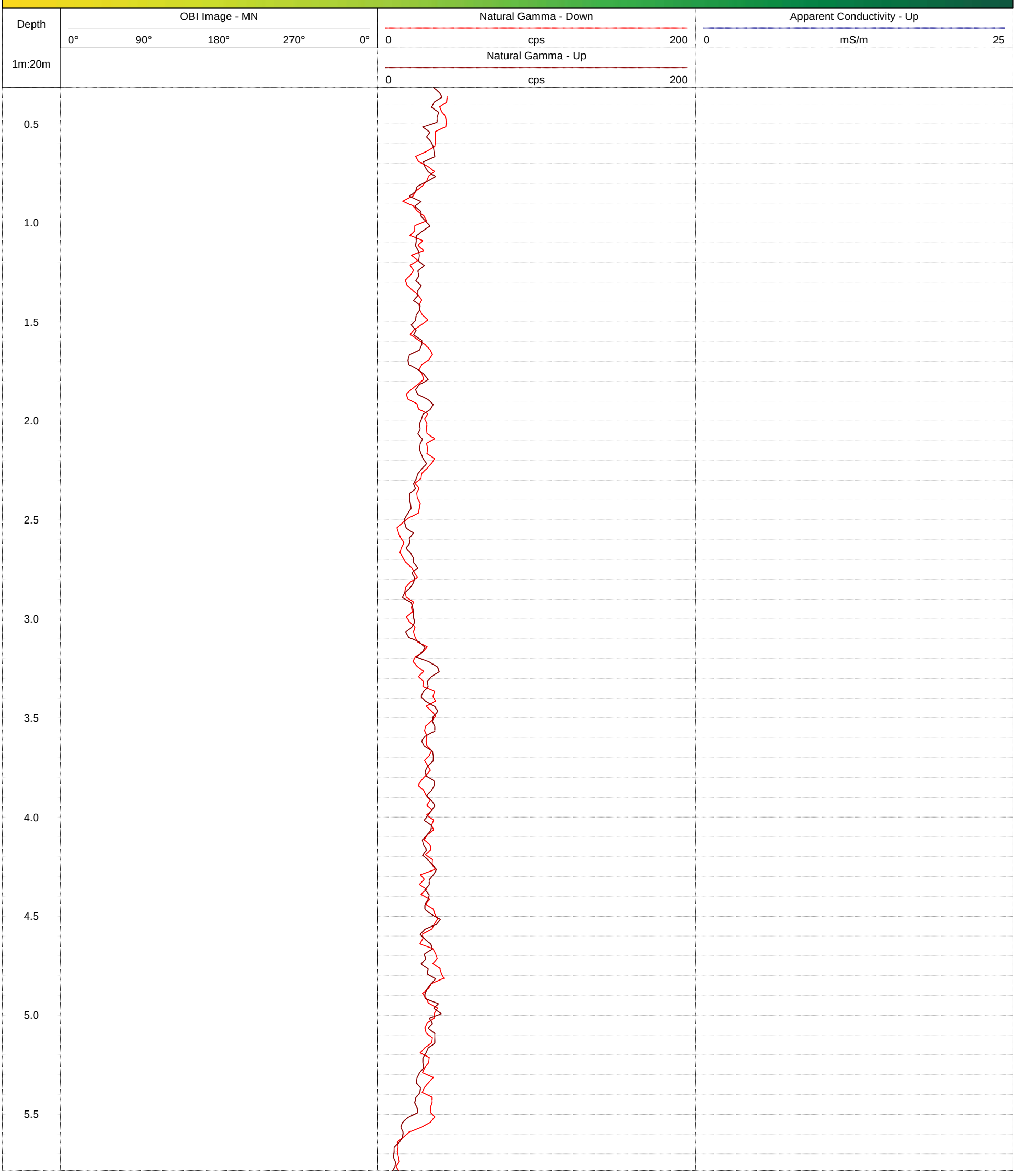
GOLDER
MEMBER OF WSP

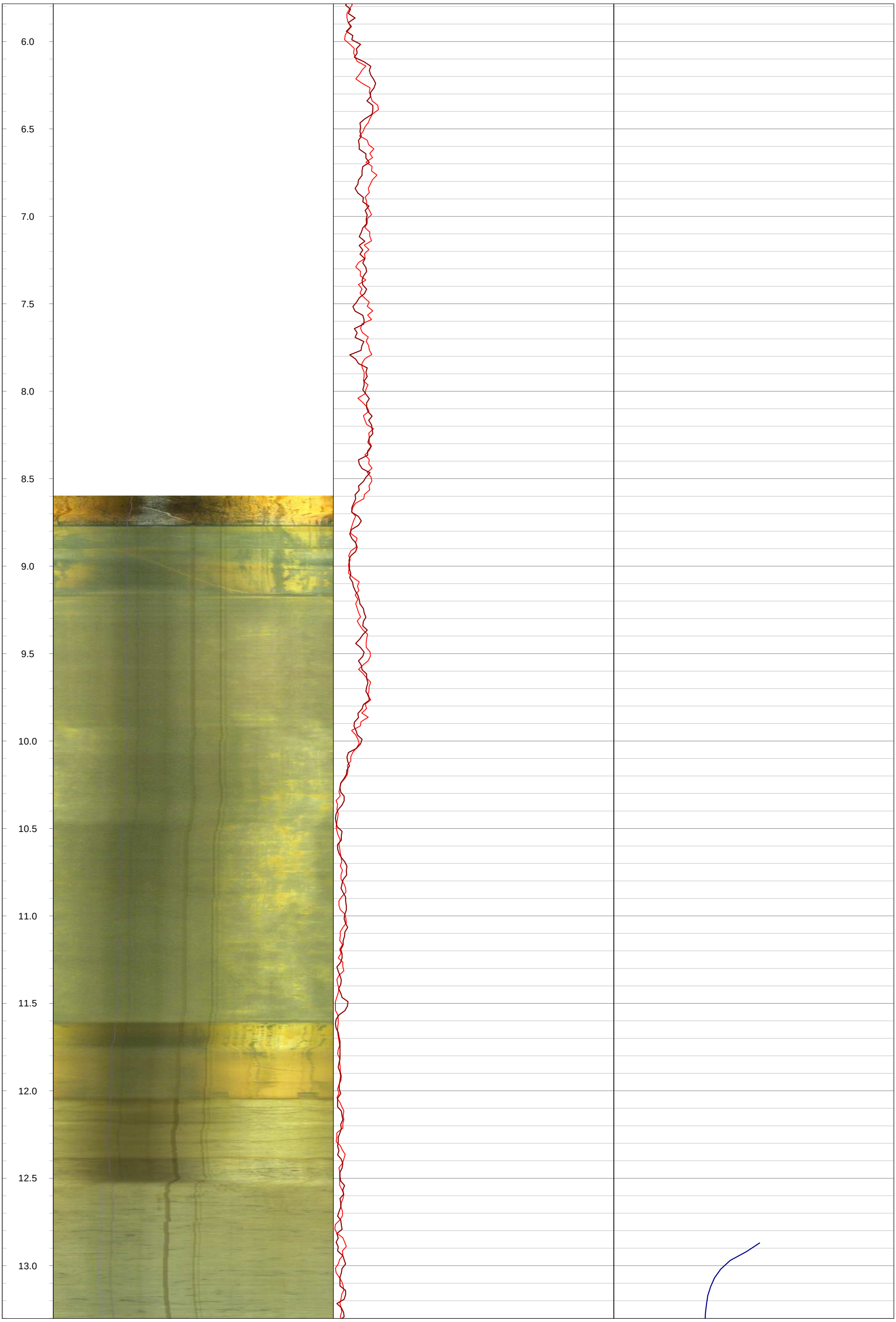
Geophysical Record of Borehole: BH20-12 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.04m bgs	**Location:**	Caledon, Ontario
Easting:	577780.56 m	**Drilled Depth:**	21.76 m bgs	**Water Level:**	8.77 m bgs	**Log Date:**	Mar-25-2020
Northing:	4854244.92 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.22 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.35 m ags	**Logged By:**	PG

Notes:

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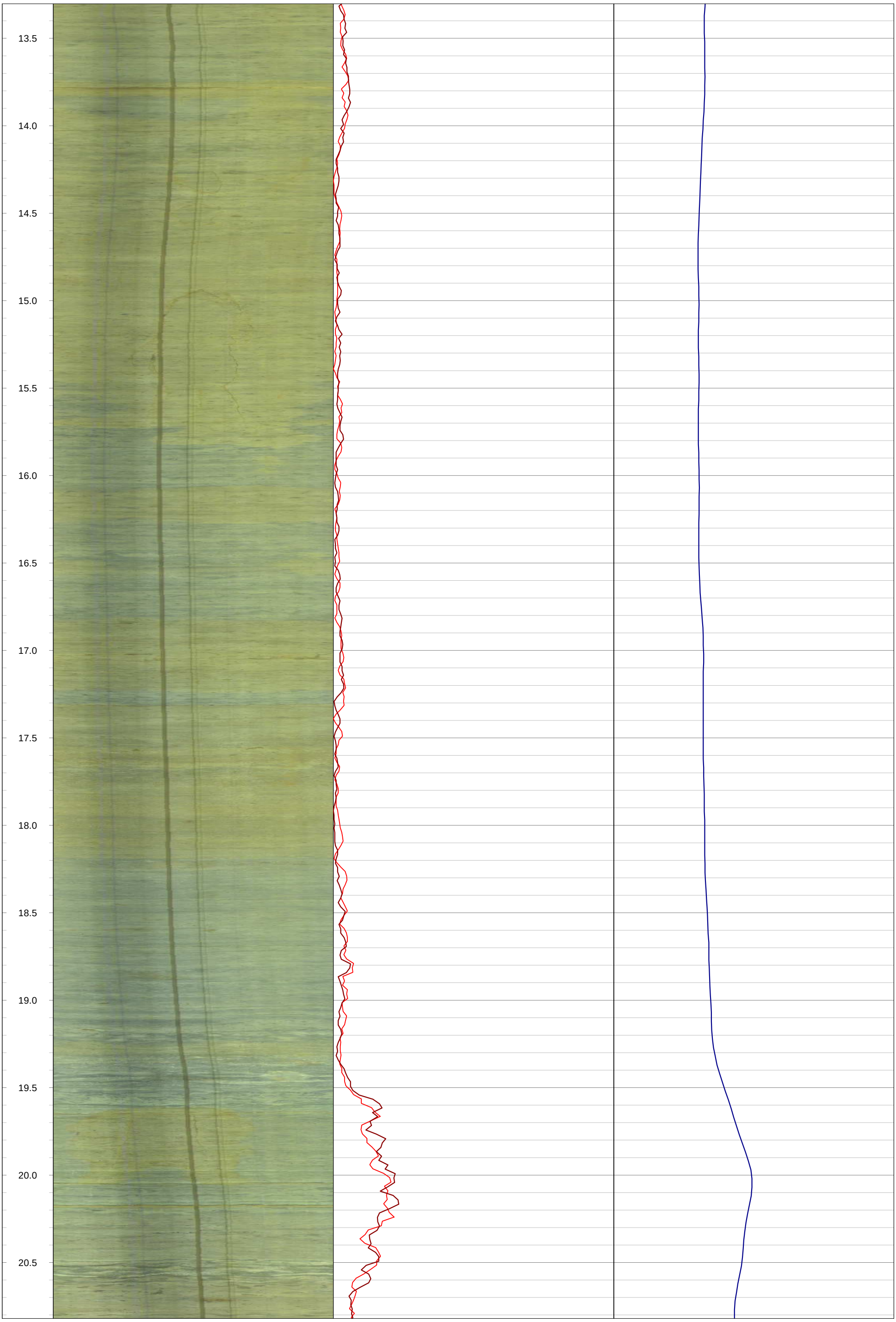
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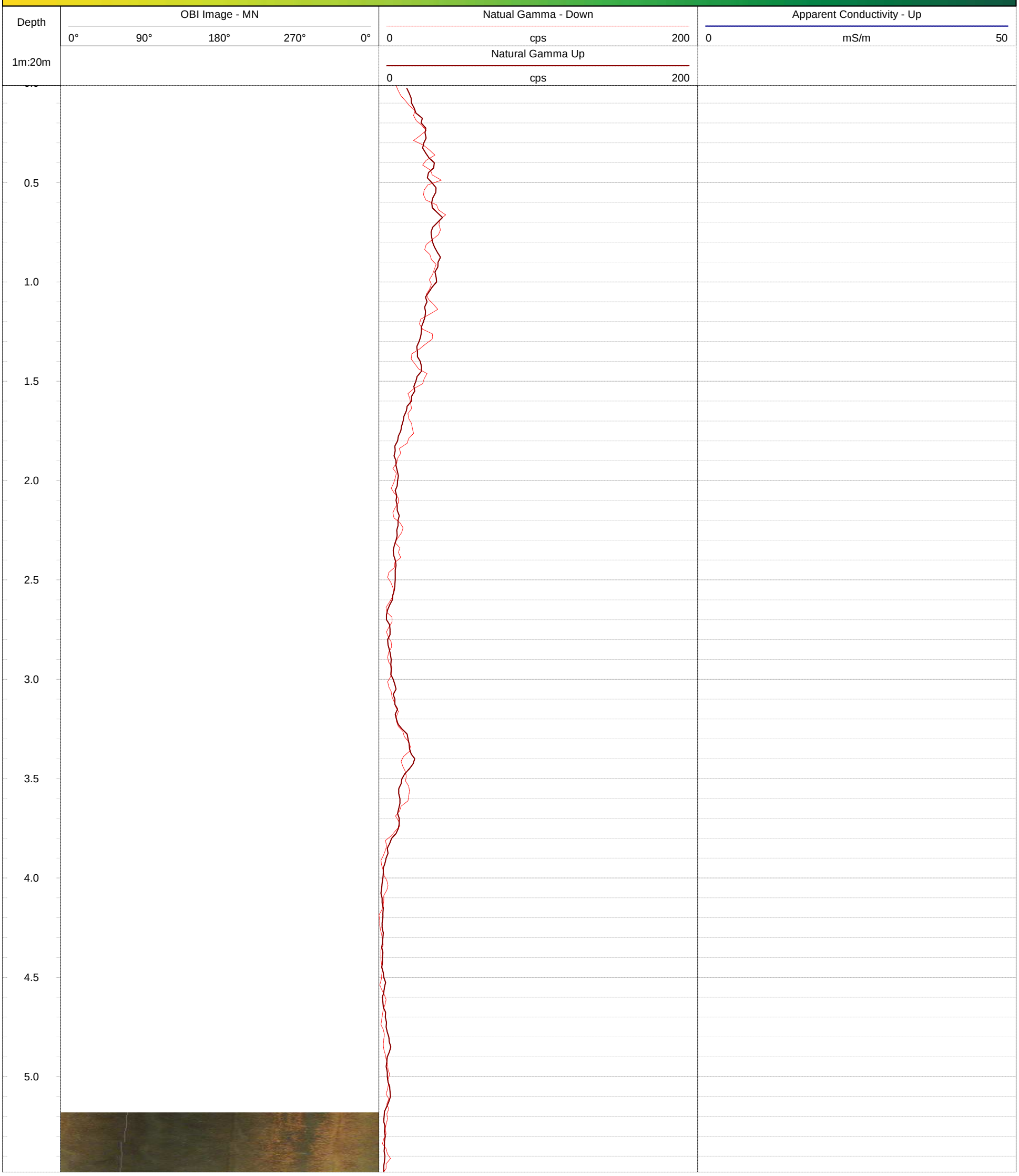
GOLDER
MEMBER OF WSP

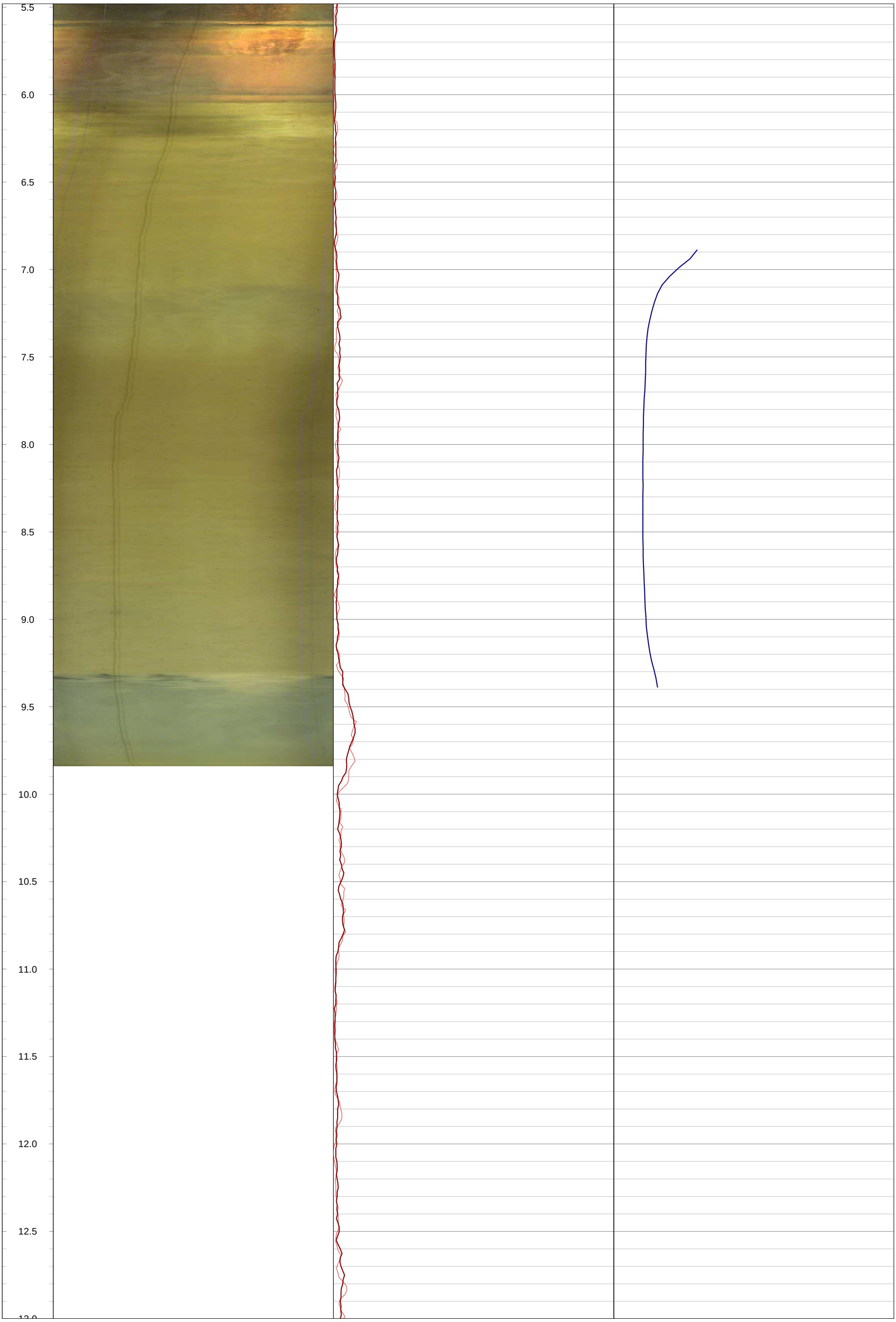
Geophysical Record of Borehole: BH20-13 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.99 m bgs	**Location:**	Caledon, Ontario
Easting:	577209.70 m	**Drilled Depth:**	22.80 m bgs	**Water Level:**	3.48 m bgs	**Log Date:**	Apr-14,20-2020
Northing:	4854103.25 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	412.94 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes: Blockage at 9.84 m. Gamma survey was completed with drill casing in place due to poor hole condtions.

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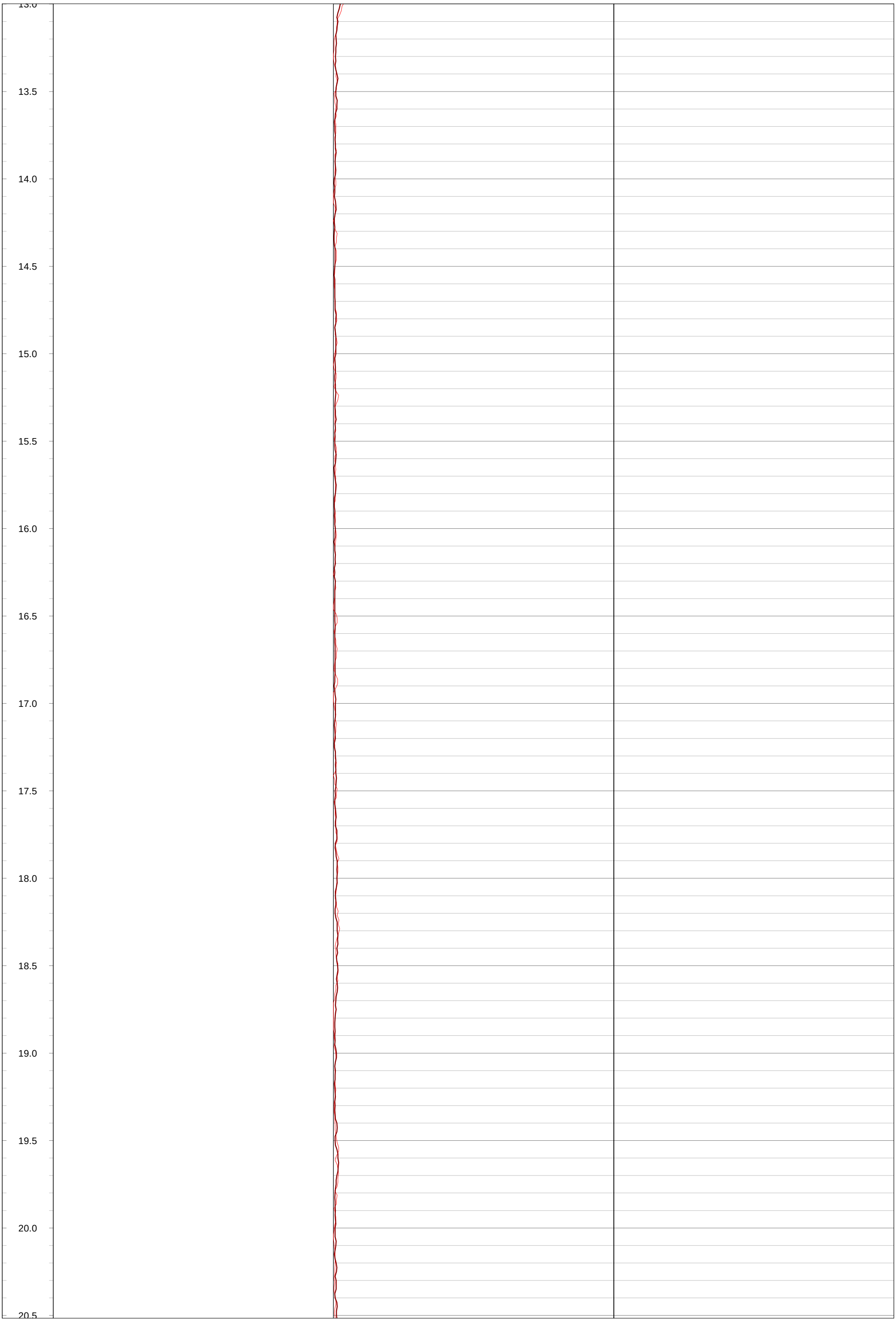
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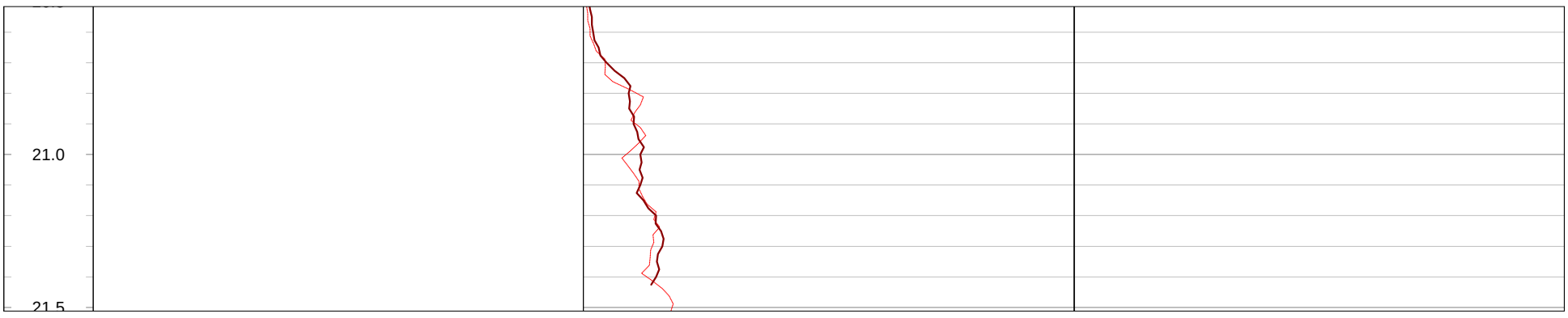
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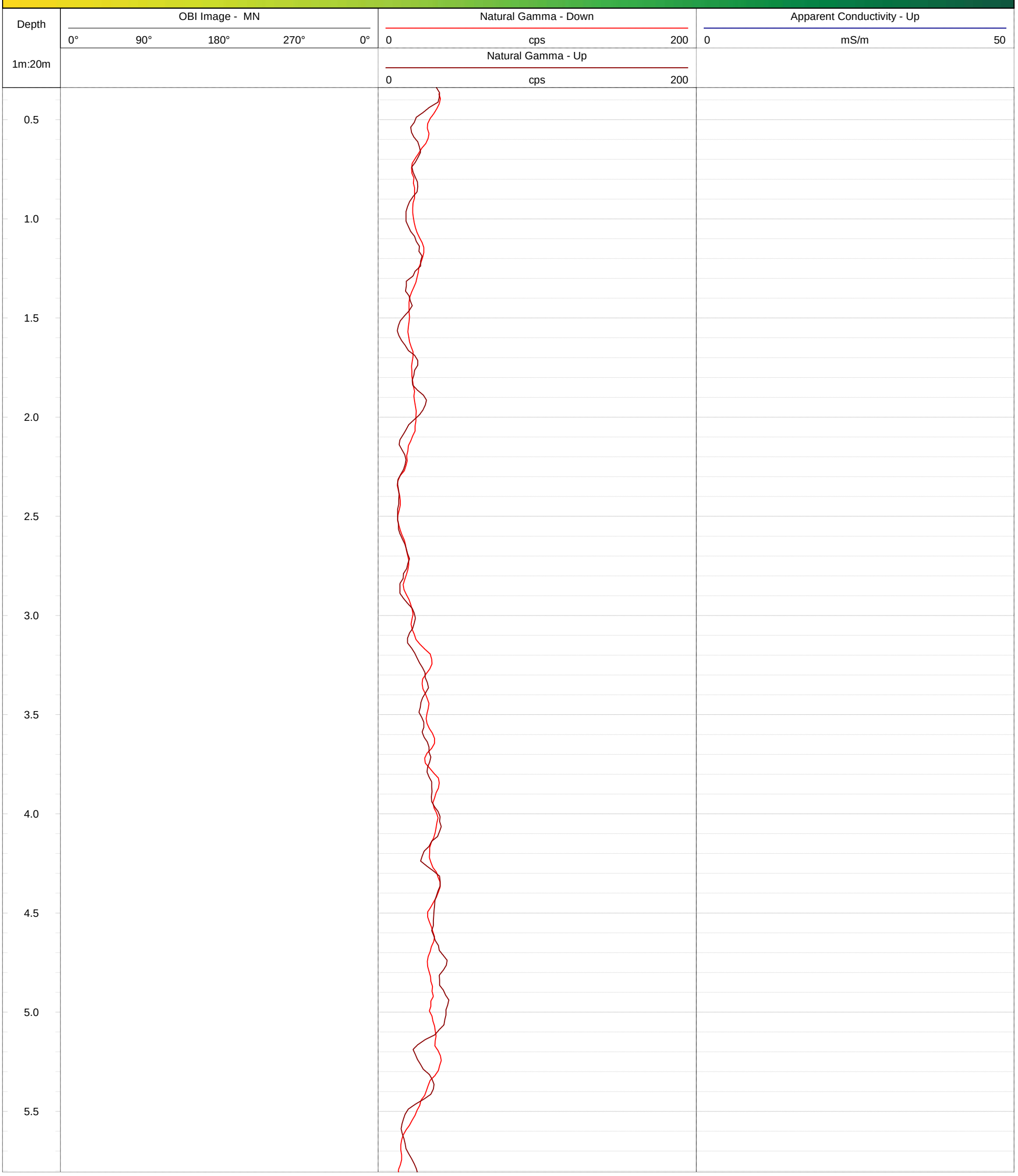
GOLDER
MEMBER OF WSP

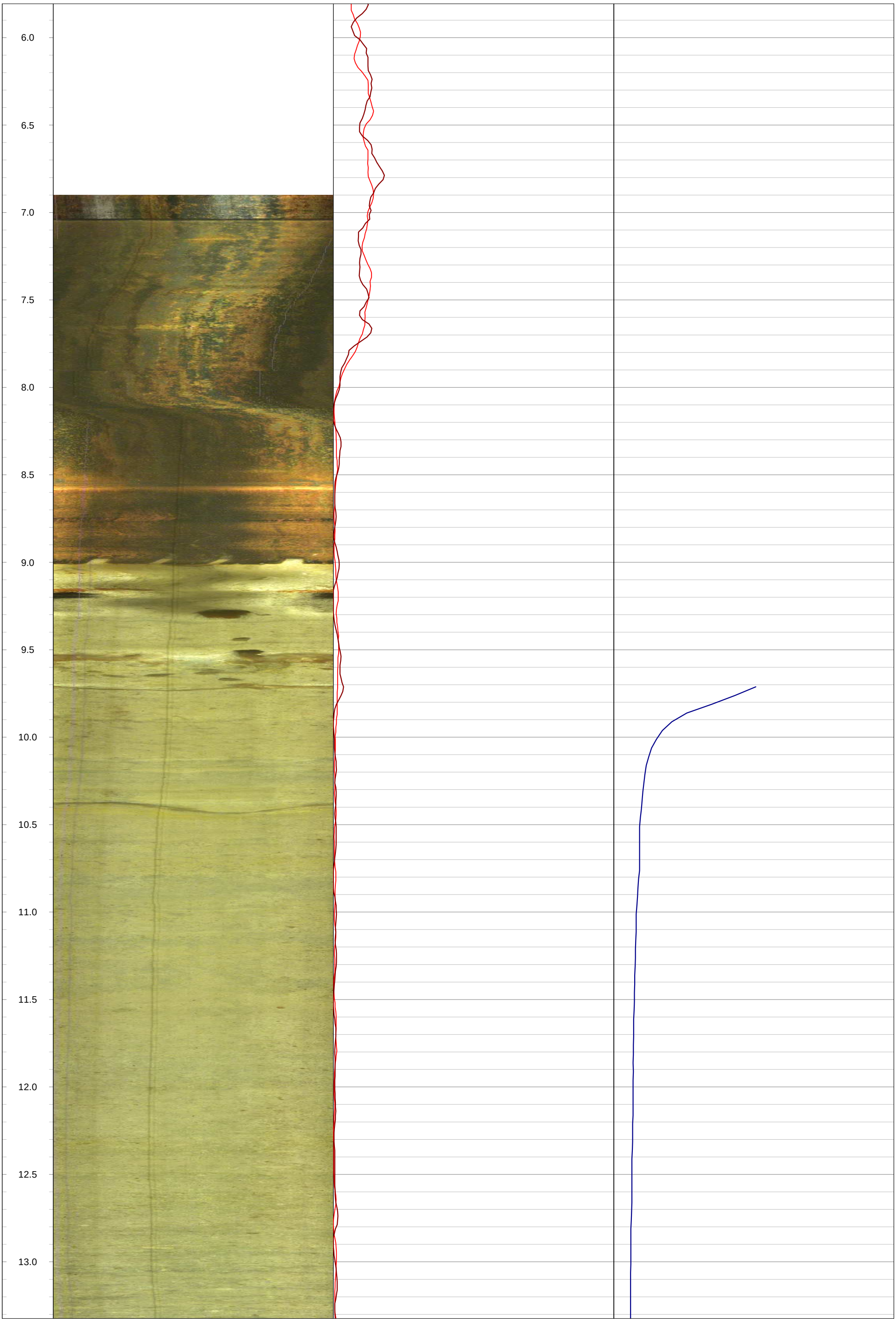
Geophysical Record of Borehole: BH20-14 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.99 m bgs	**Location:**	Caledon, Ontario
Easting:	577288.55 m	**Drilled Depth:**	31.46 m bgs	**Water Level:**	6.79 m bgs	**Log Date:**	Apr-14-2020
Northing:	4853881.70 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.27 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:

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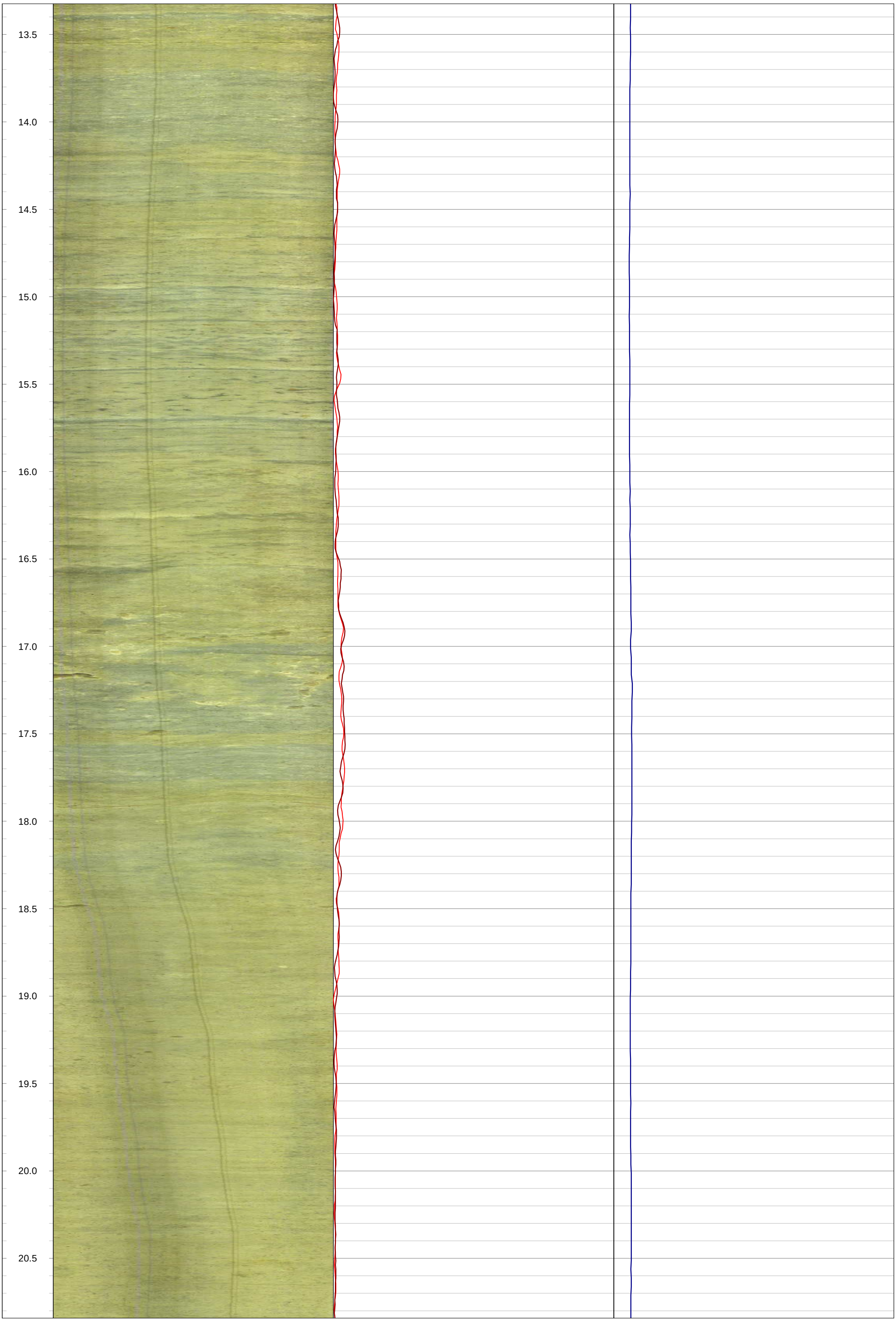
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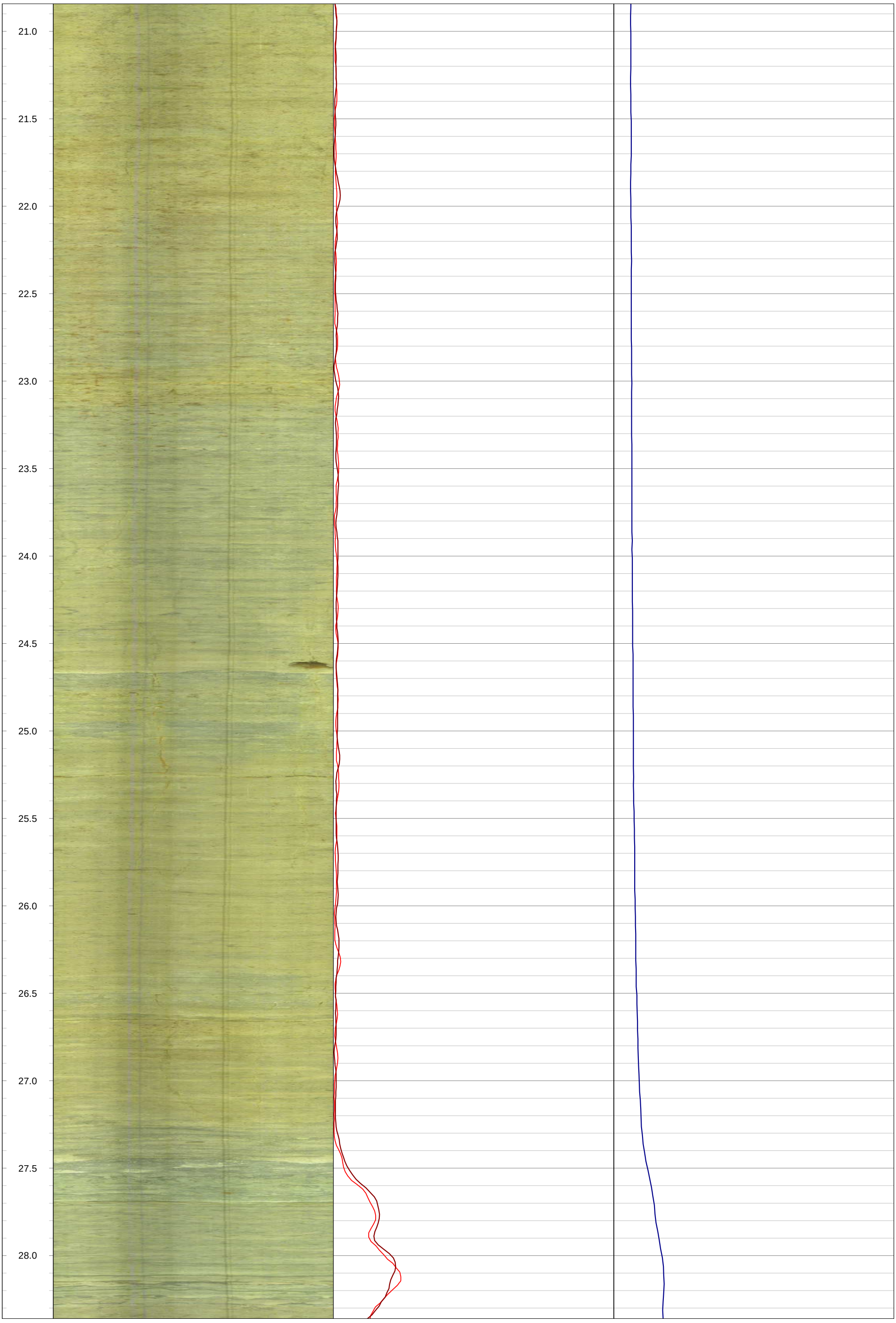
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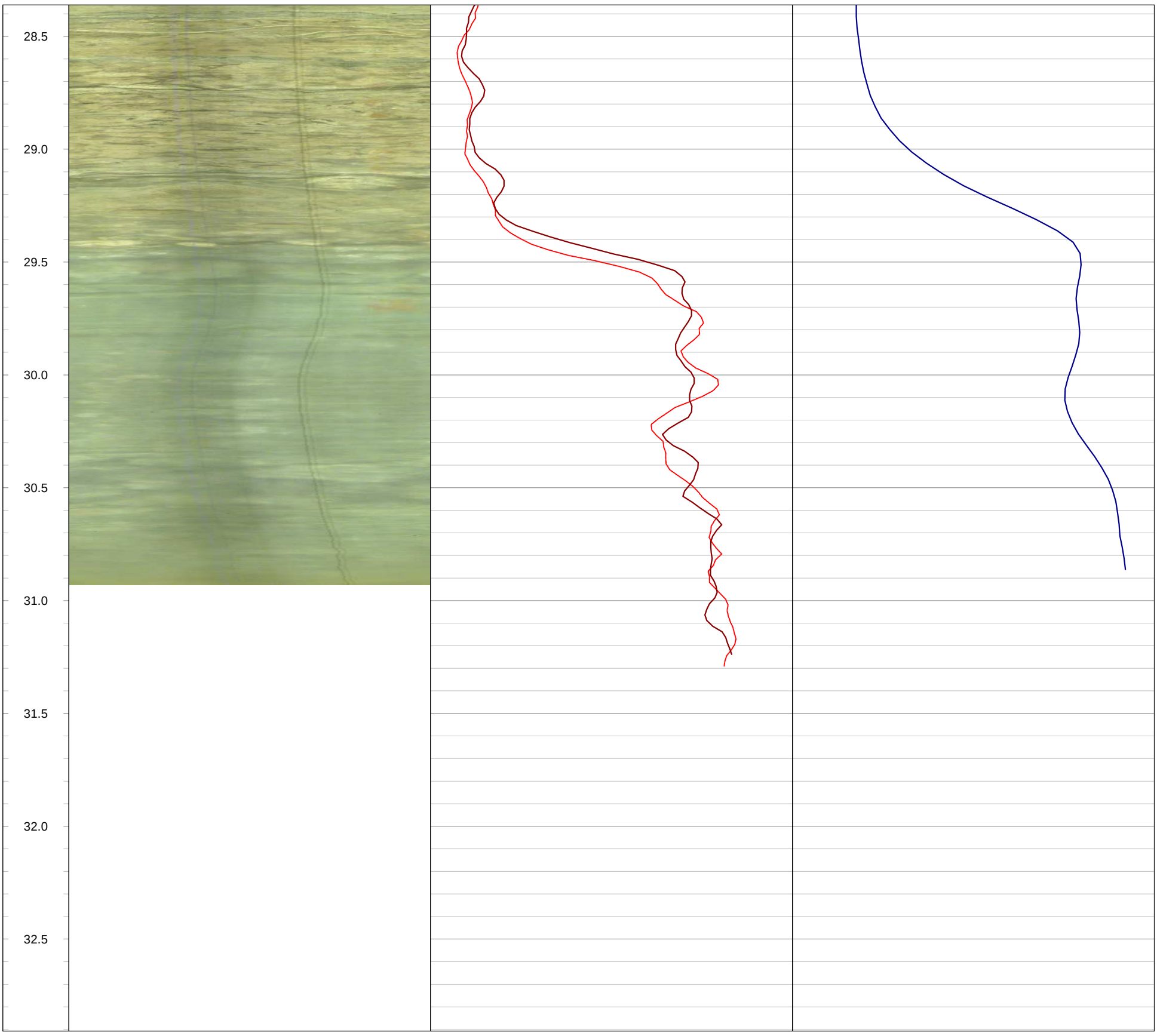
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GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-15 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.26 m bgs	**Location:**	Caledon, Ontario
Easting:	576925.21 m	**Drilled Depth:**	34.76 m bgs	**Water Level:**	3.09 m bgs	**Log Date:**	Apr-14-2020
Northing:	4854113.14 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	421.52 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.16 m ags	**Logged By:**	PG

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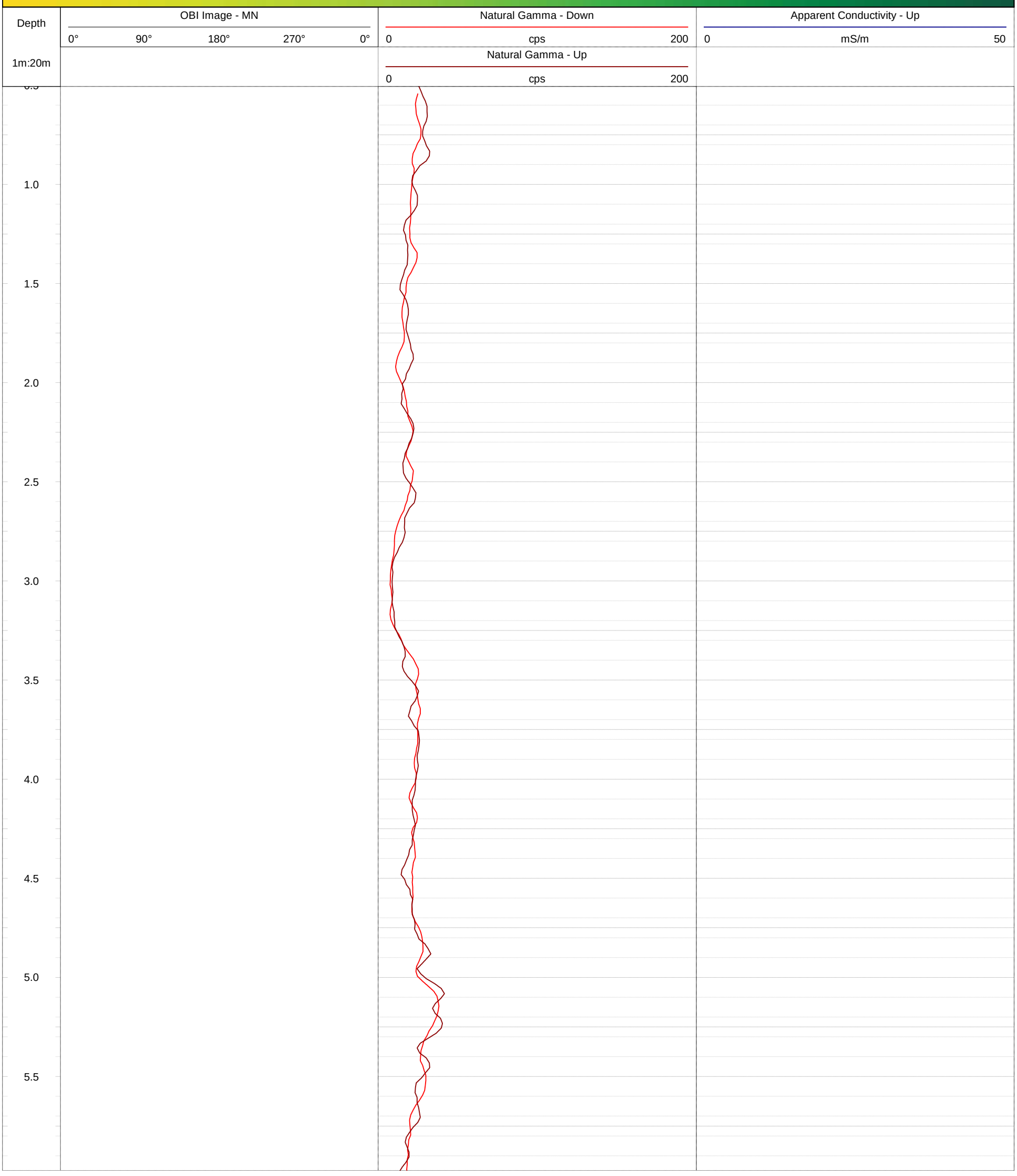

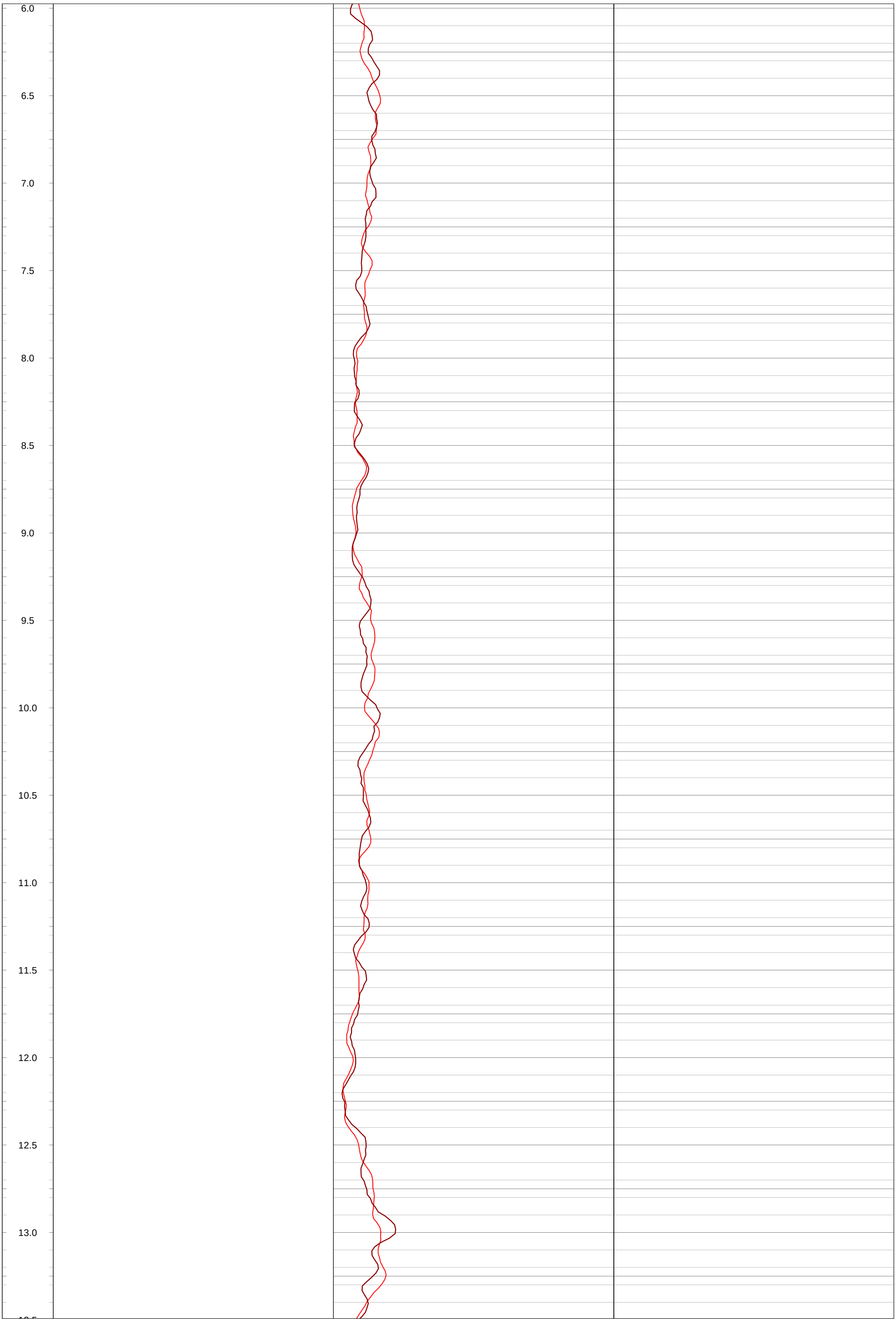
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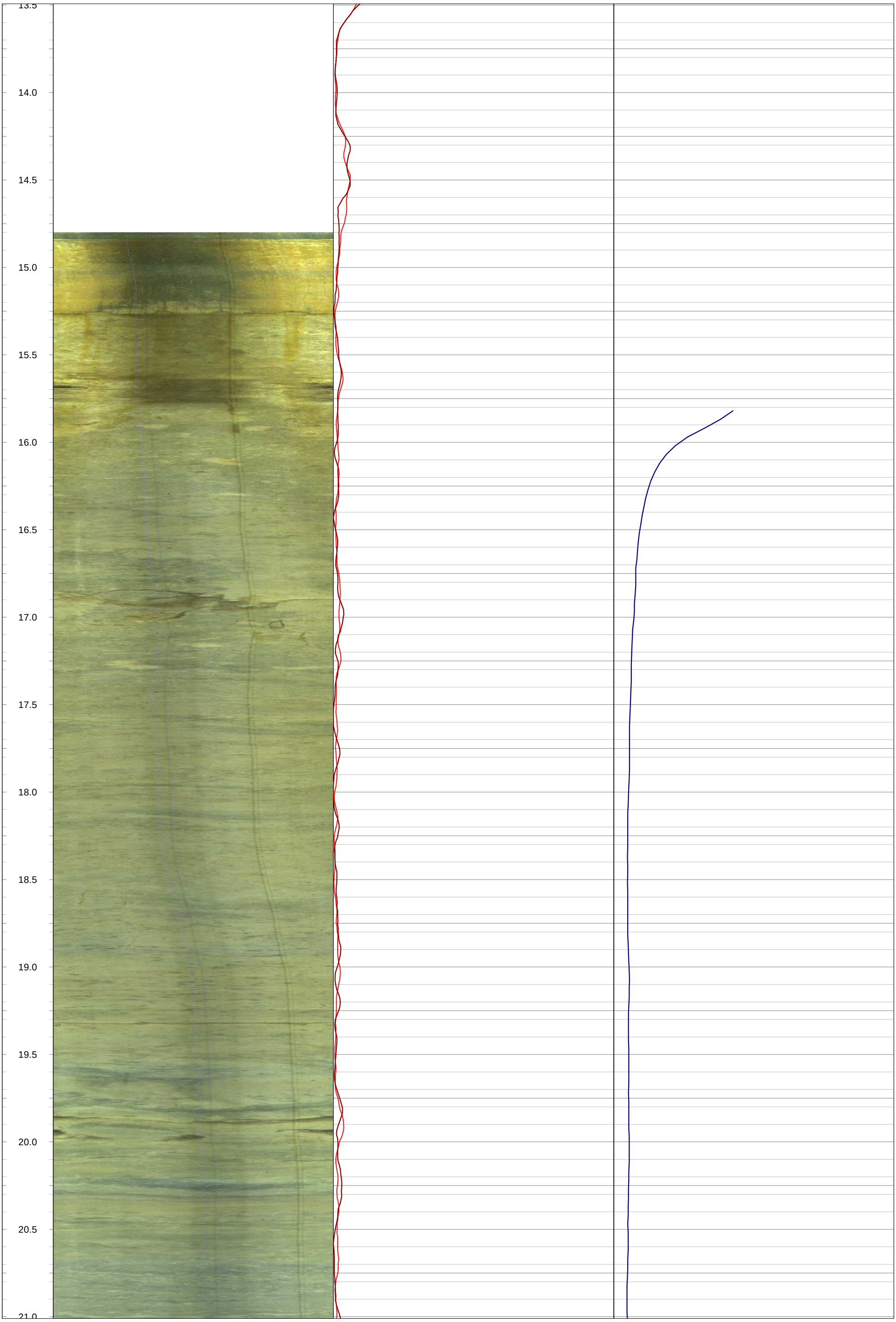
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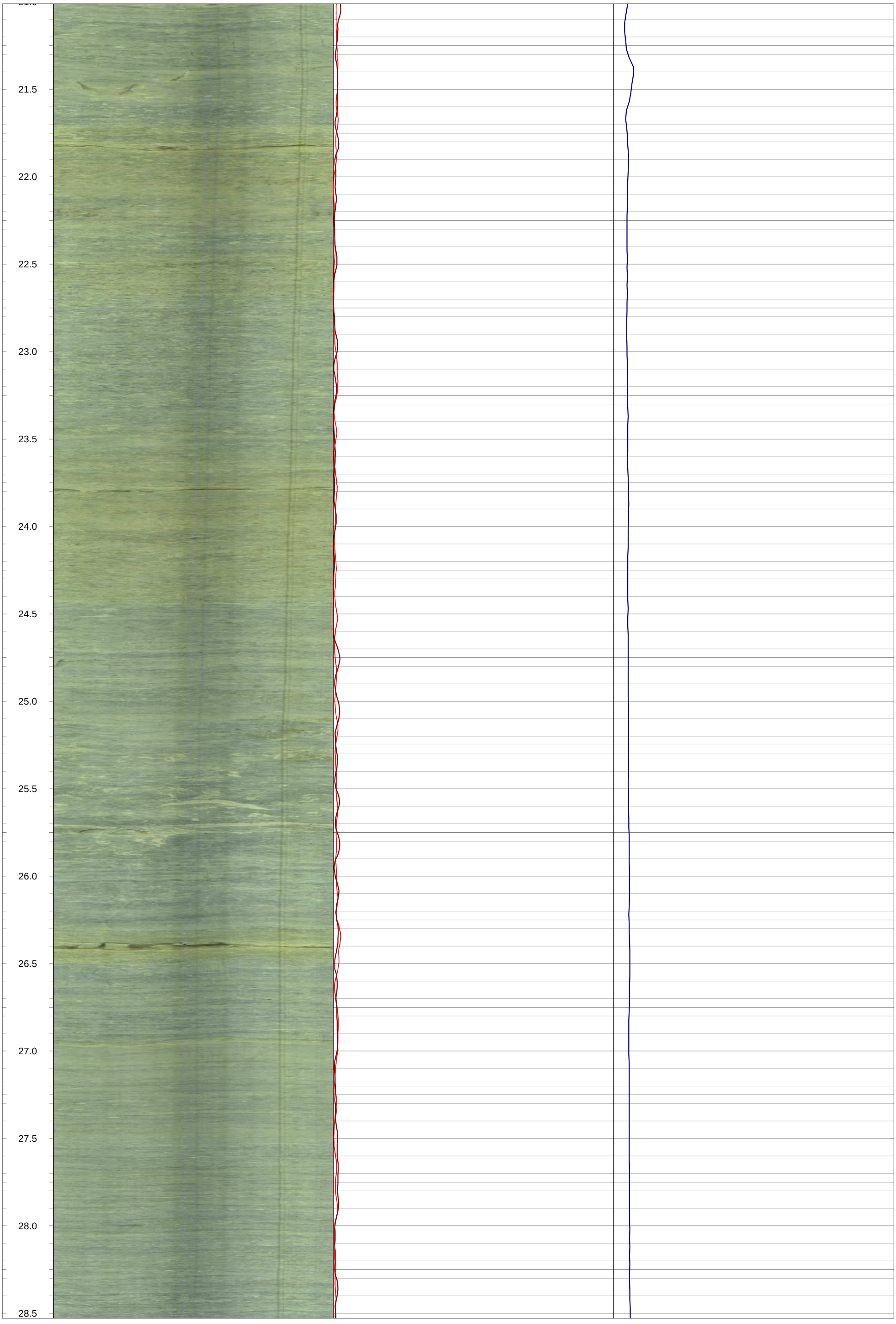
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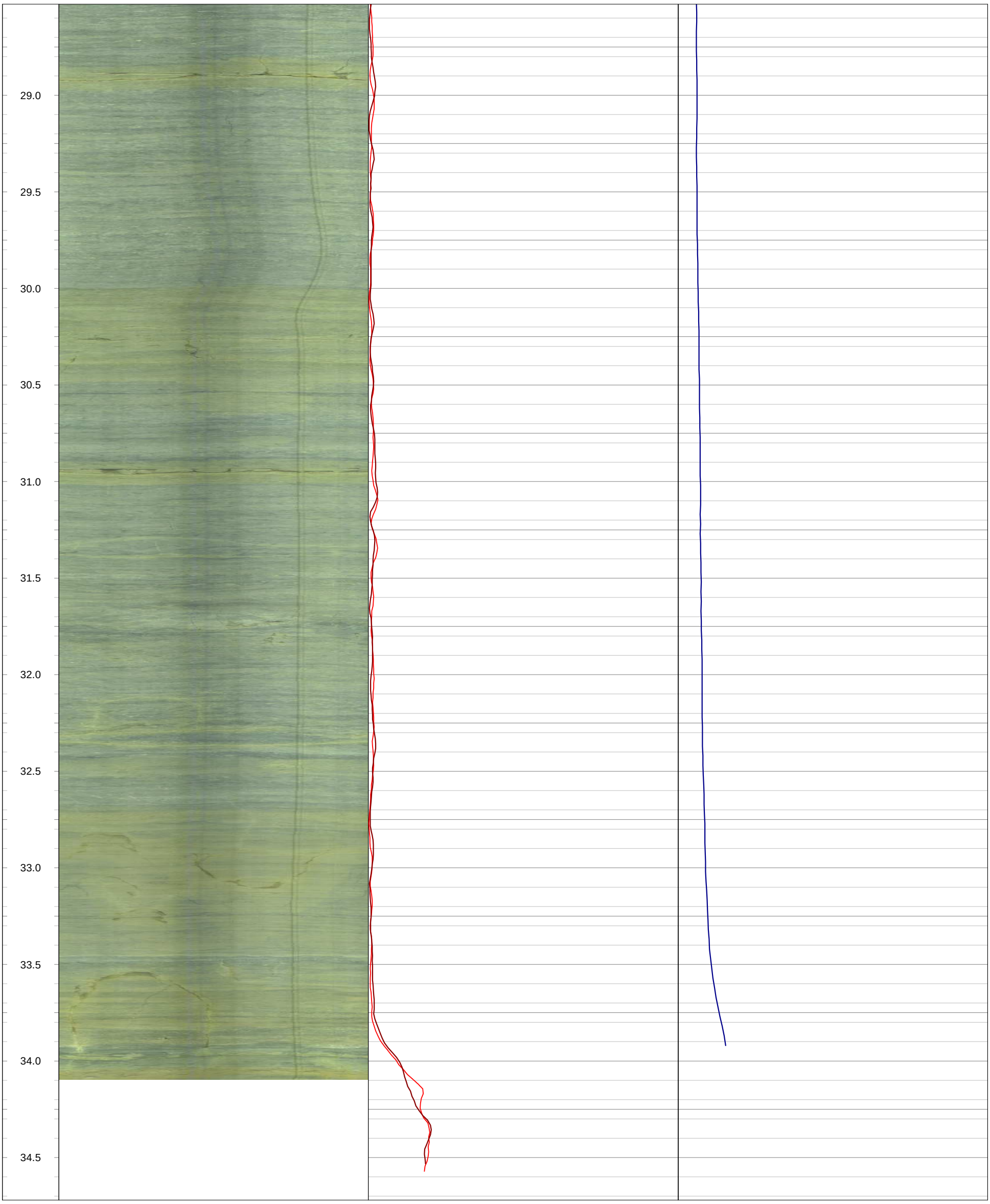
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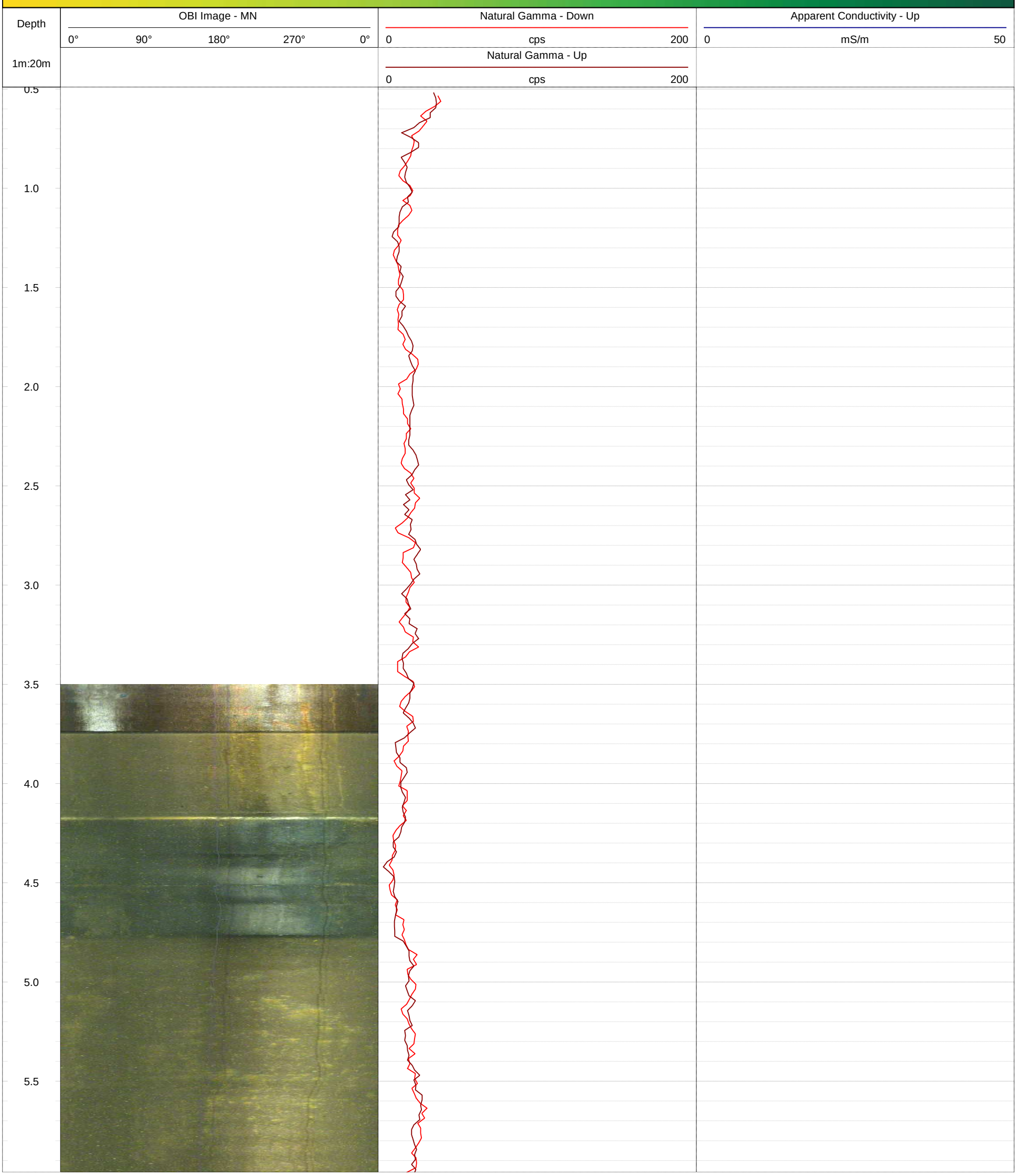
GOLDER
MEMBER OF WSP

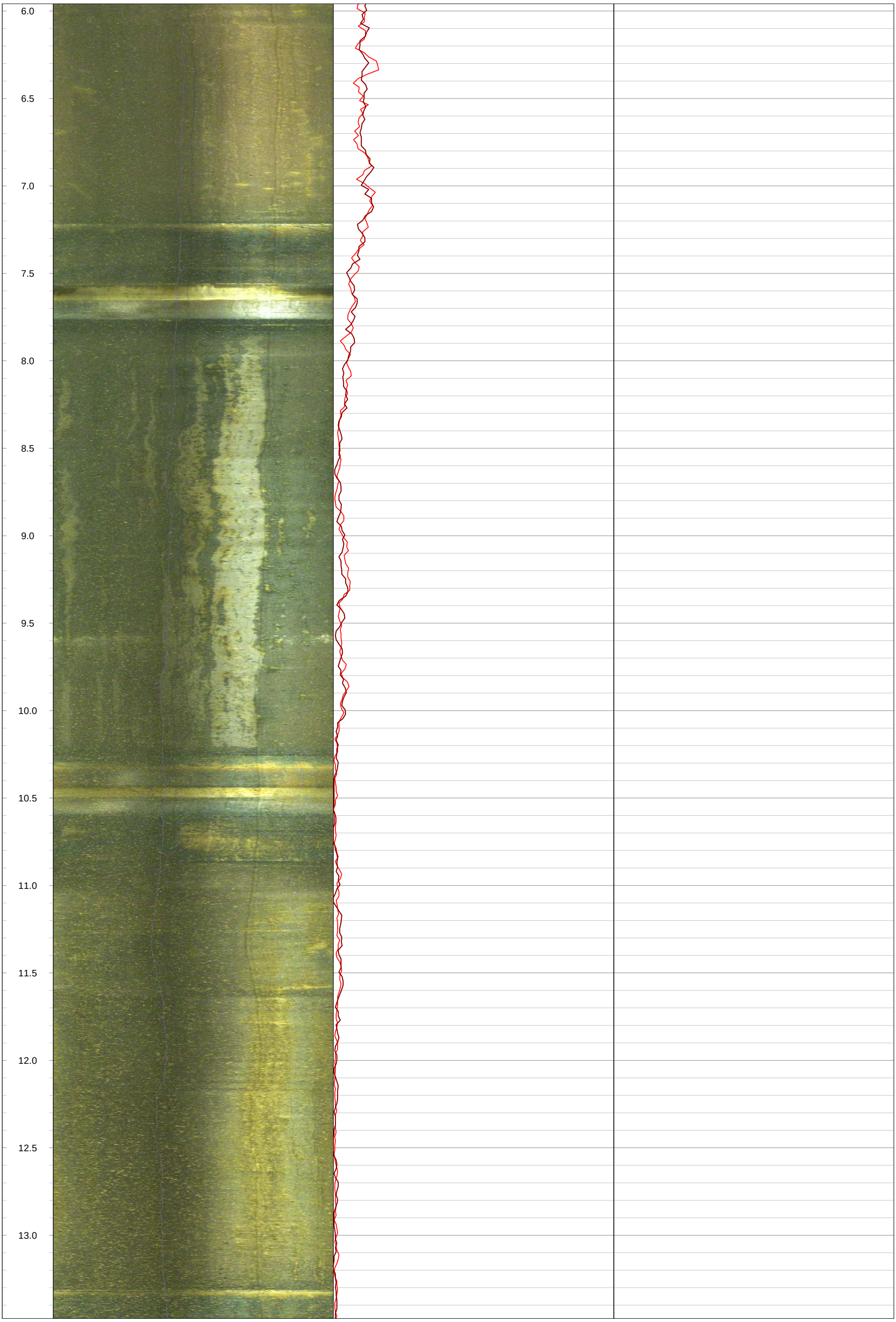
Geophysical Record of Borehole: BH20-16 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	13.76 m bgs	**Location:**	Caledon, Ontario
Easting:	576991.38 m	**Drilled Depth:**	34.18 m bgs	**Water Level:**	3.60 m bgs	**Log Date:**	Apr-21-2020
Northing:	4853859.50 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	420.74 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.17 m ags	**Logged By:**	PG

Notes:

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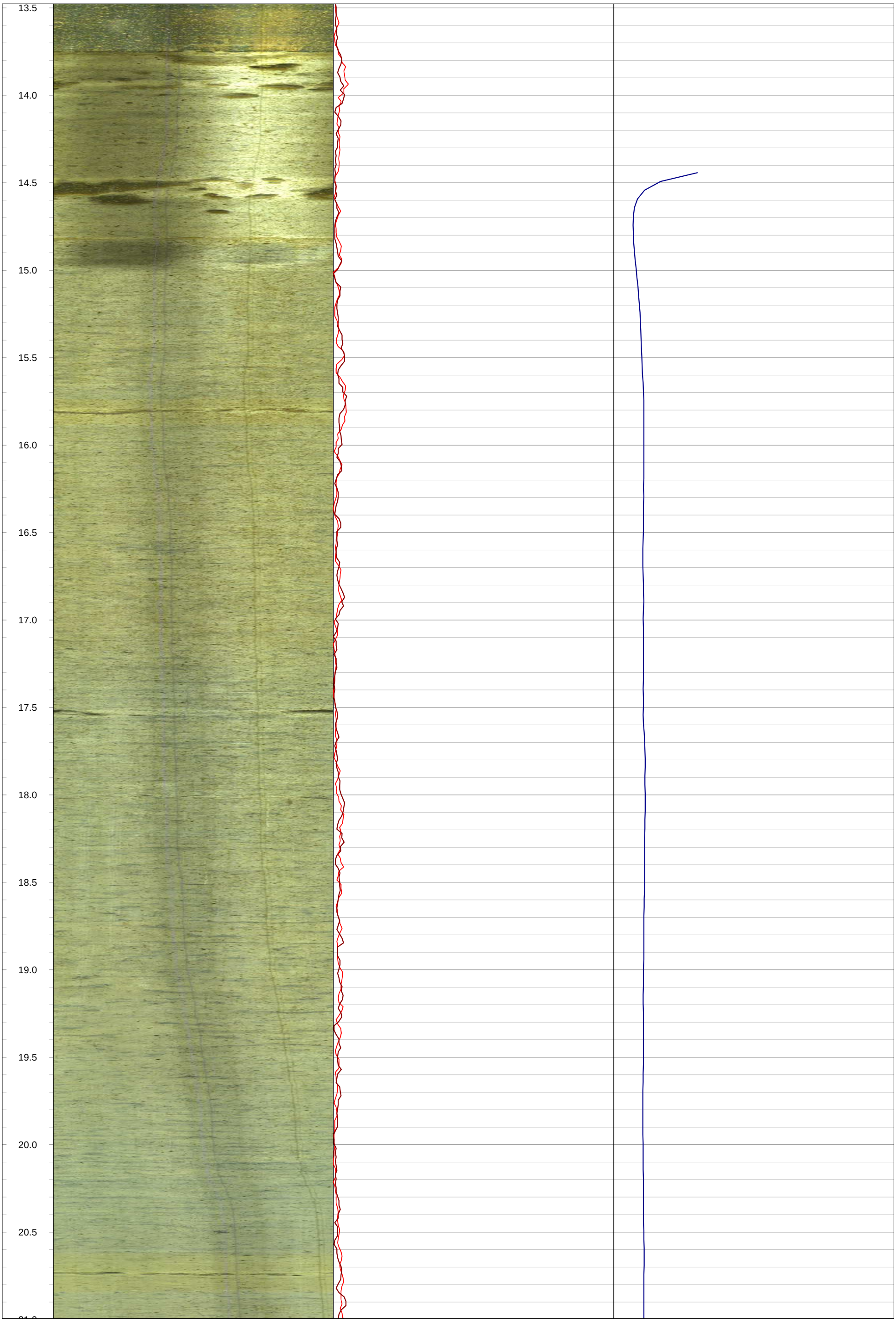
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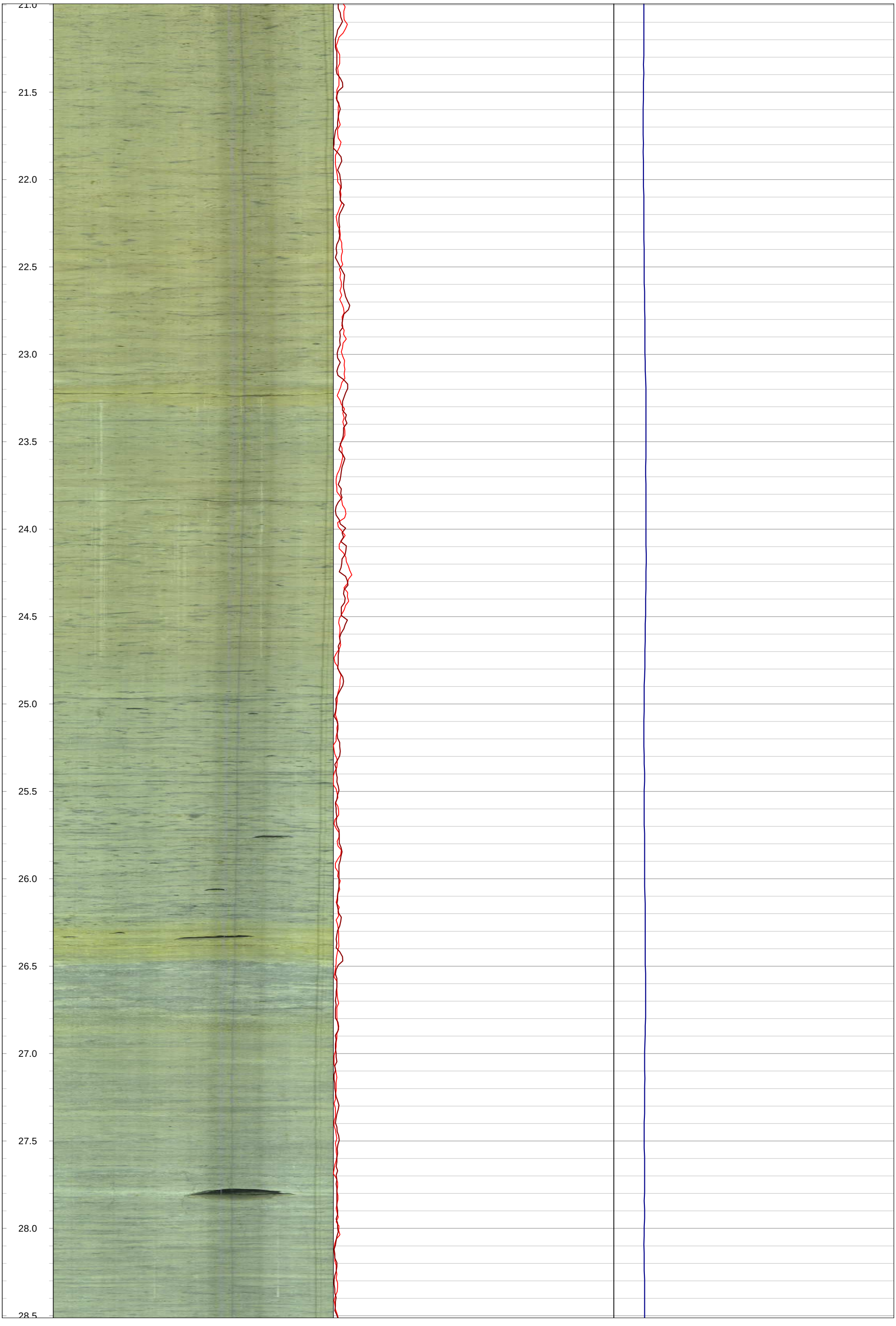
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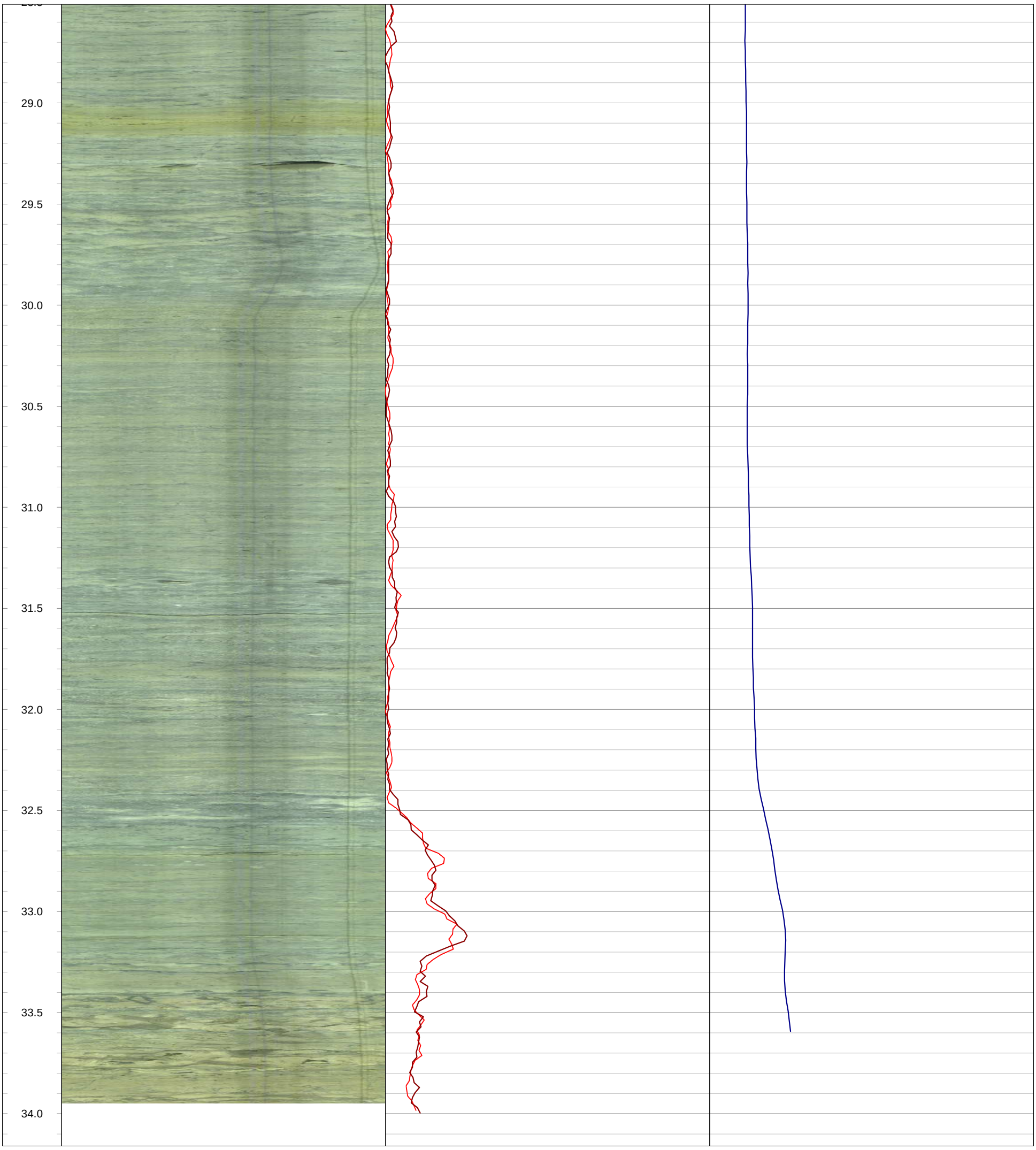
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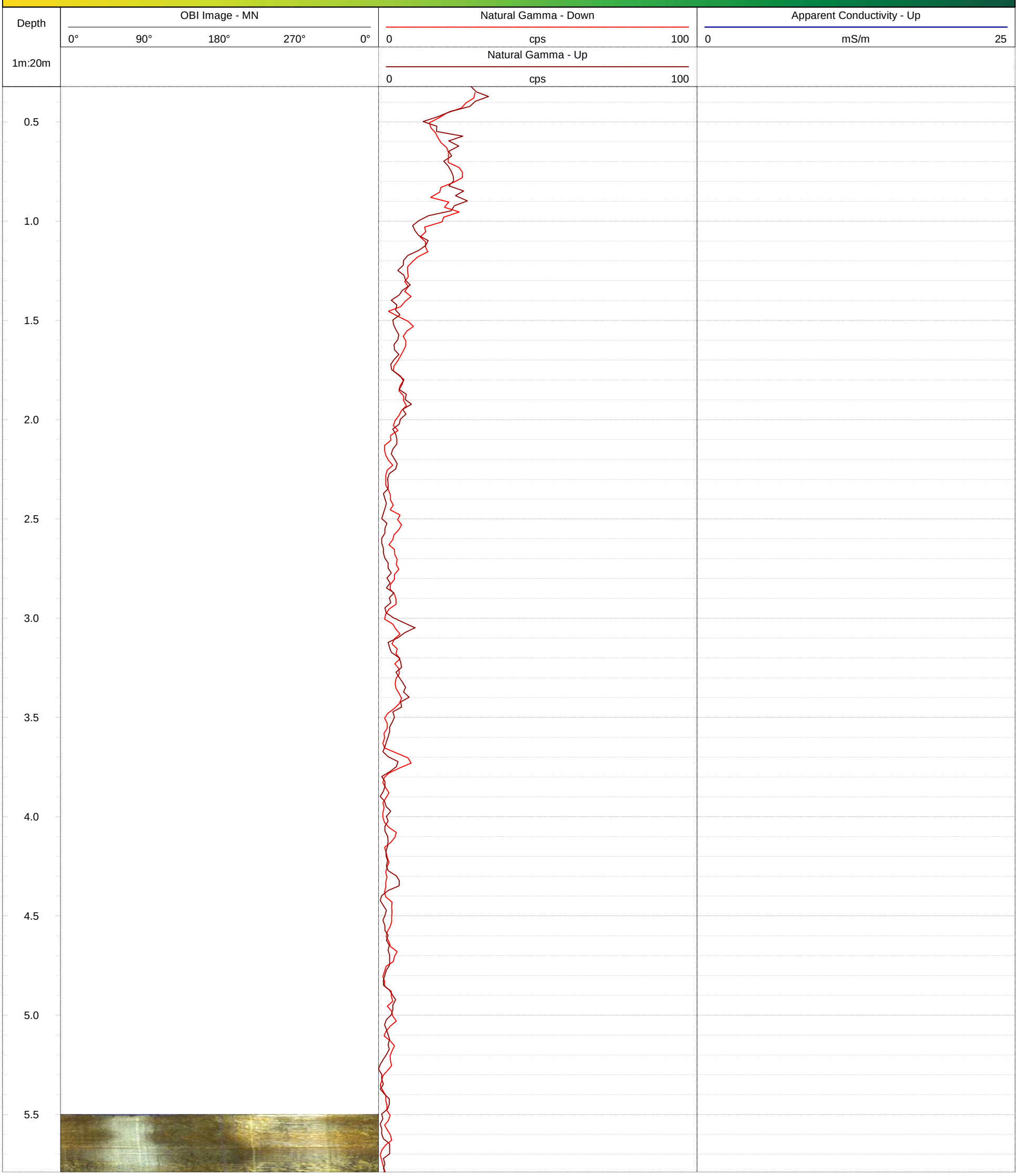
GOLDER
MEMBER OF WSP

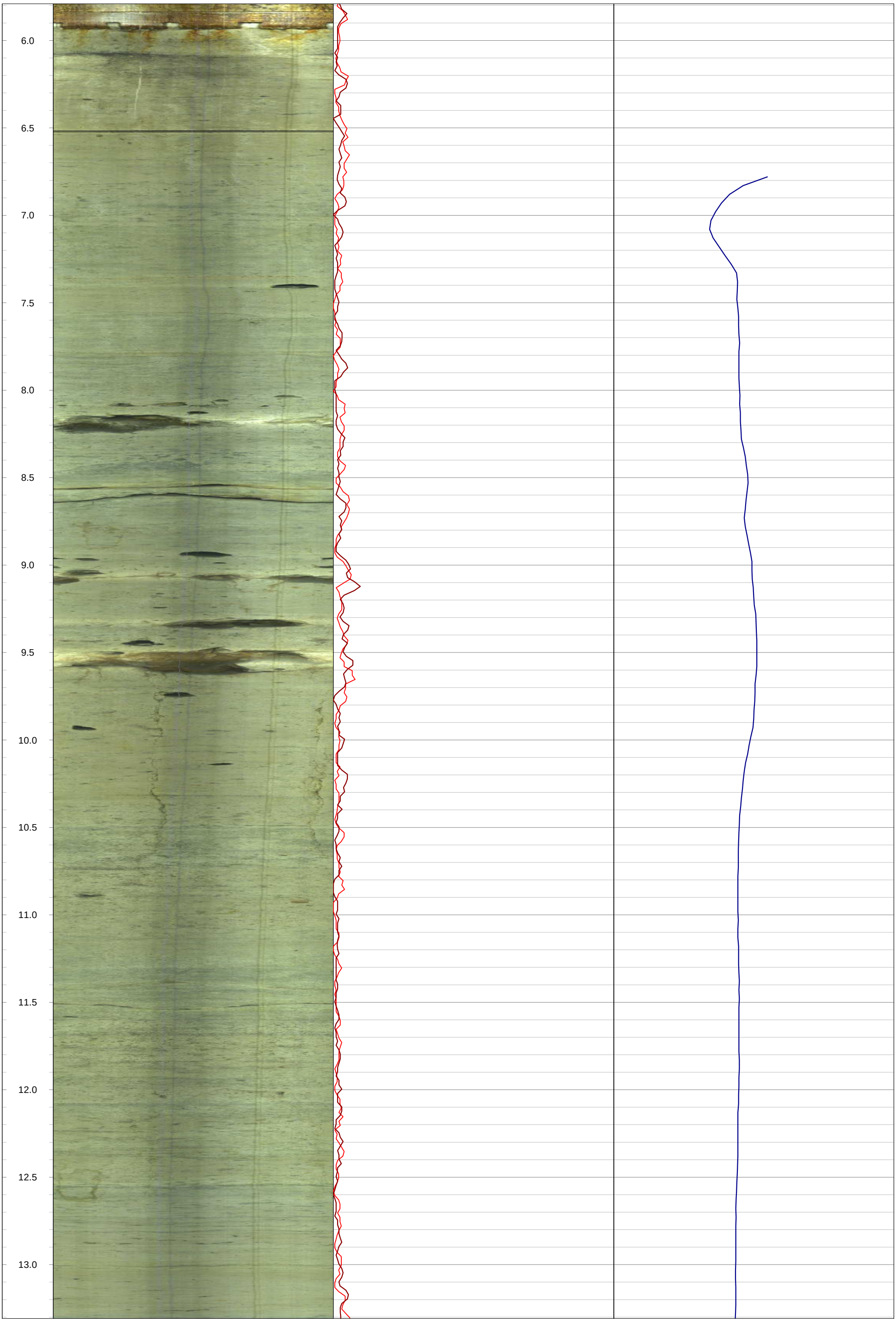
Geophysical Record of Borehole: BH20-17 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.92 m bgs	**Location:**	Caledon, Ontario
Easting:	577474.67 m	**Drilled Depth:**	28.83 m bgs	**Water Level:**	6.51 m bgs	**Log Date:**	Apr-27-2020
Northing:	4853391.65 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.06 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:

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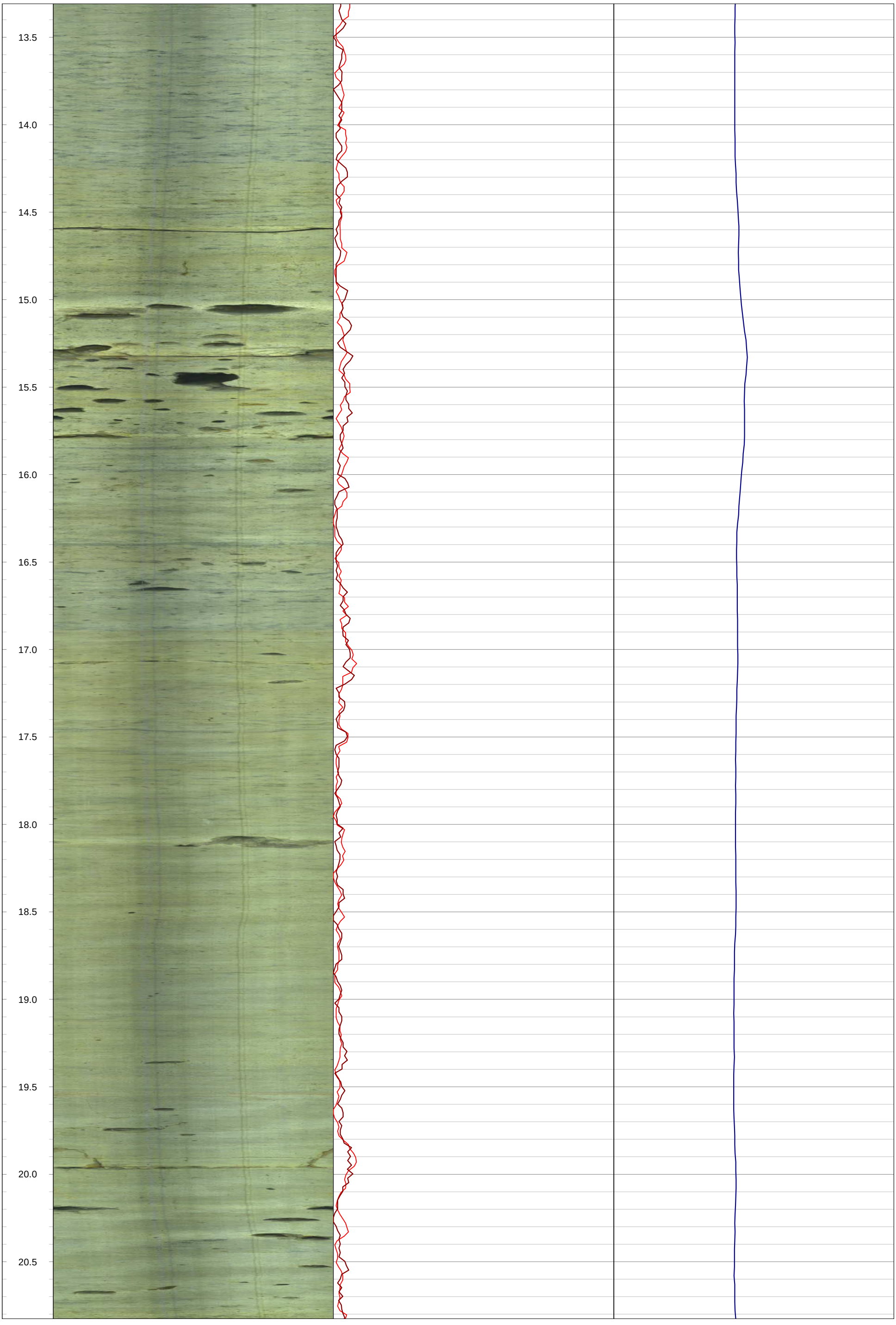
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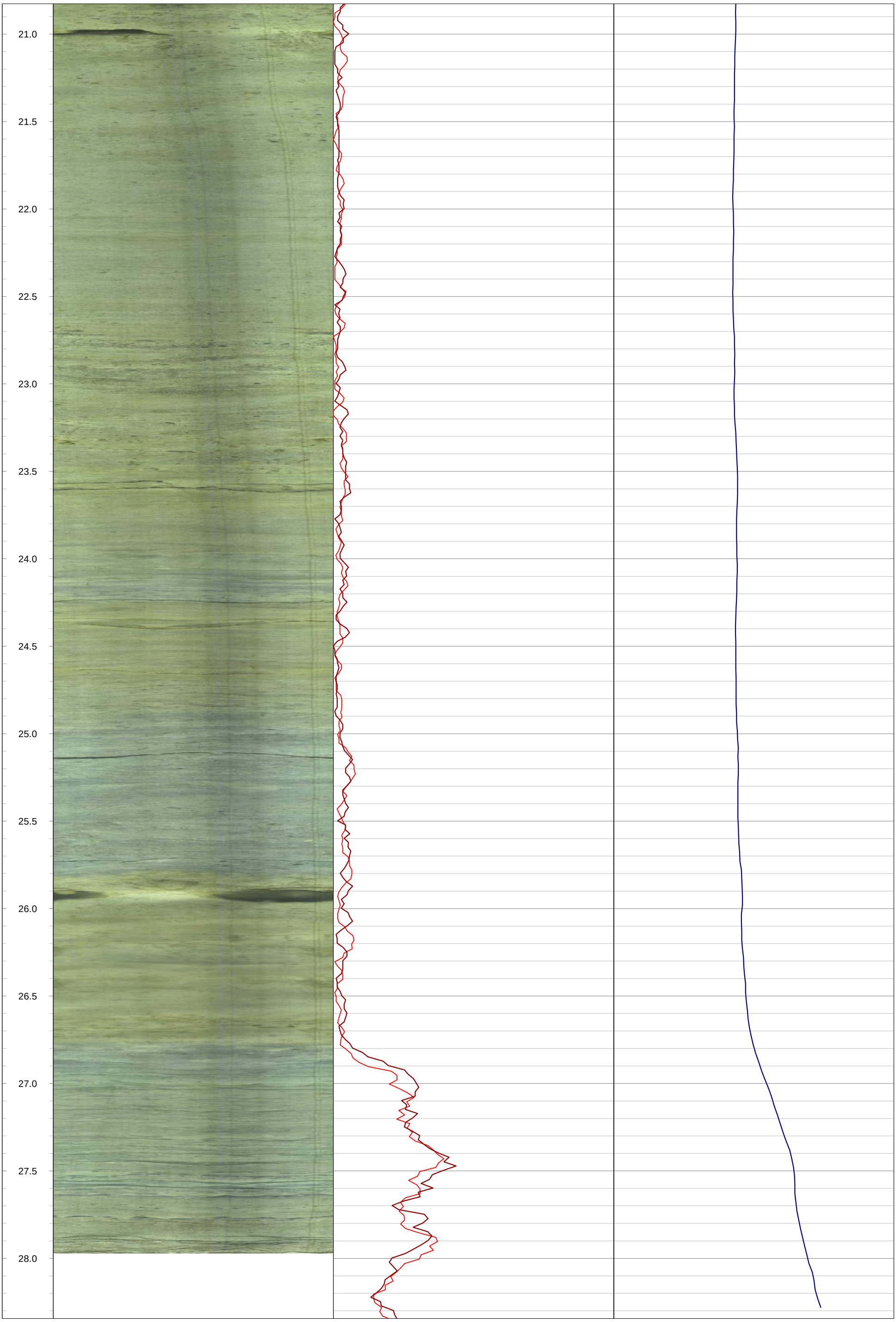
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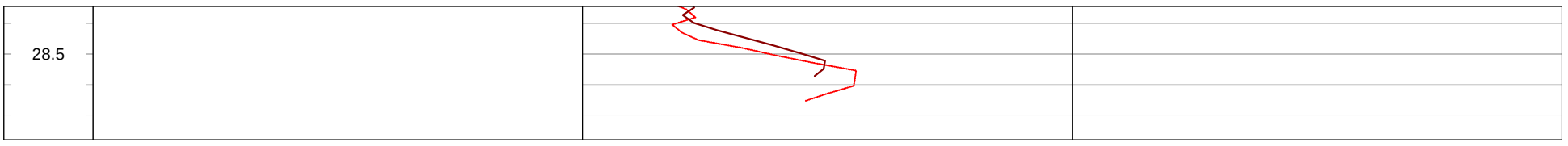

28.5

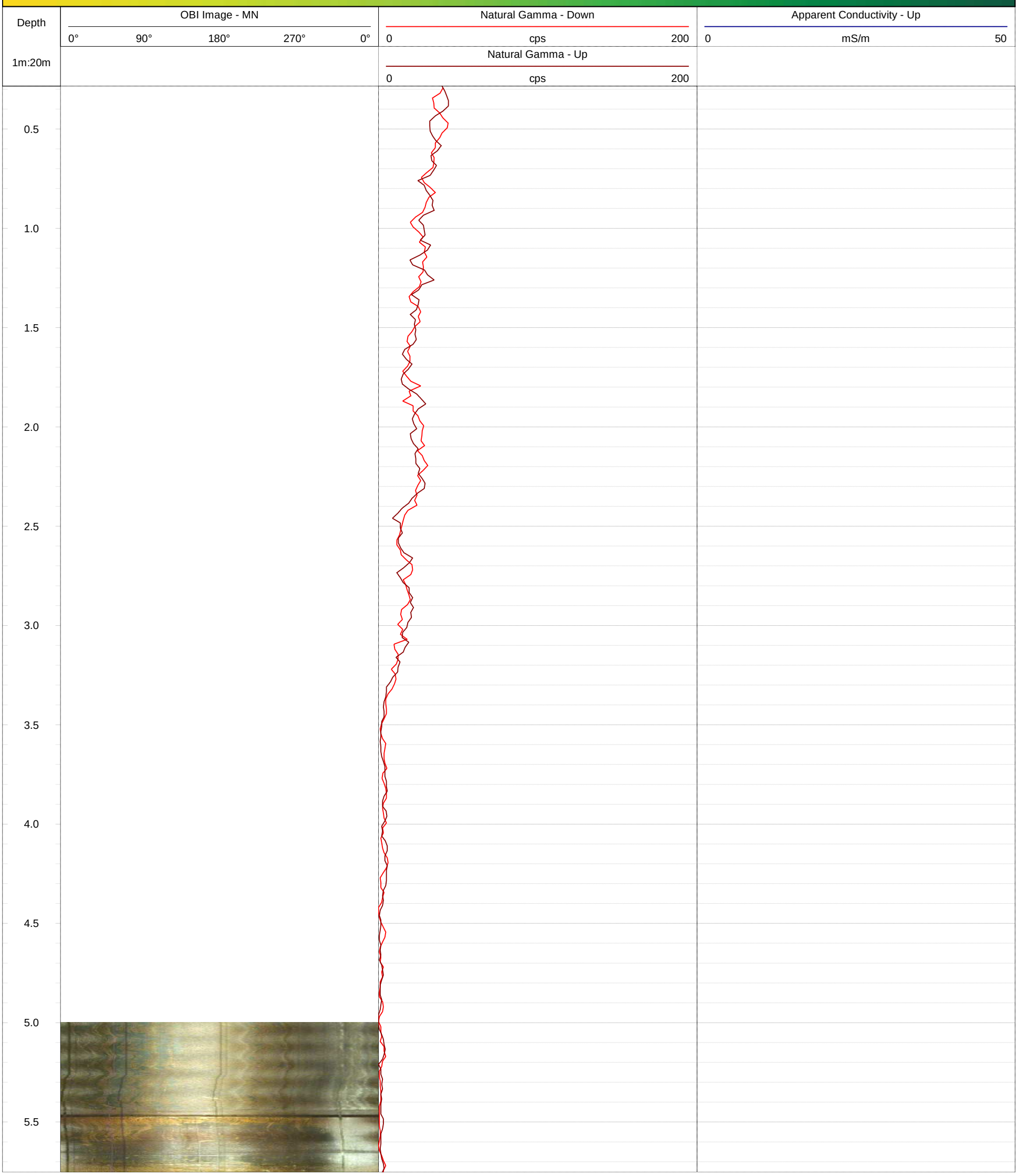
GOLDER
MEMBER OF WSP

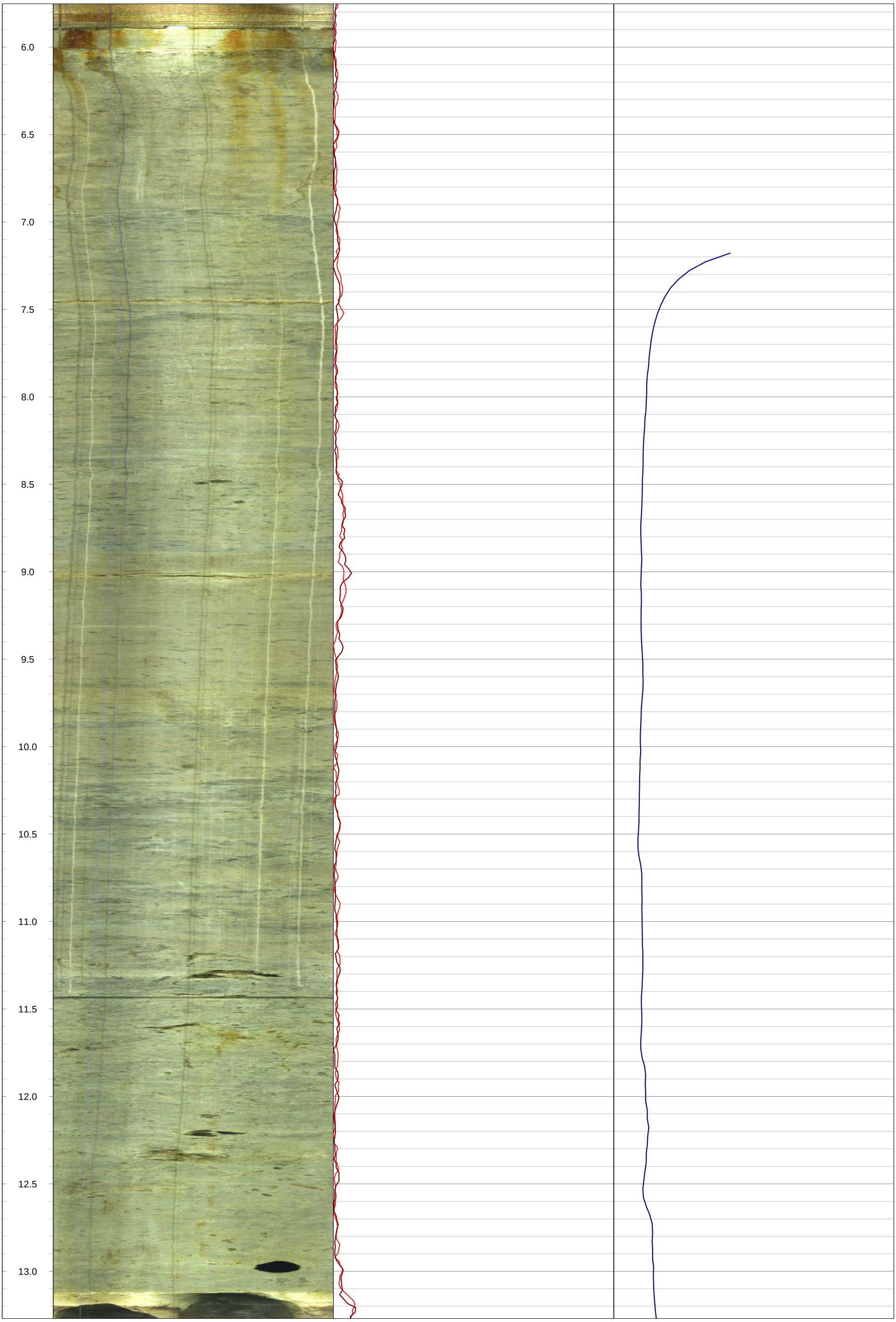
Geophysical Record of Borehole: BH20-18 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.90 m bgs	**Location:**	Caledon, Ontario
Easting:	577313.39 m	**Drilled Depth:**	31.84 m bgs	**Water Level:**	11.45 m bgs	**Log Date:**	Apr-27-2020
Northing:	4853571.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.53 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.40 m ags	**Logged By:**	PG

Notes: OBI image opaque >31 m bgs

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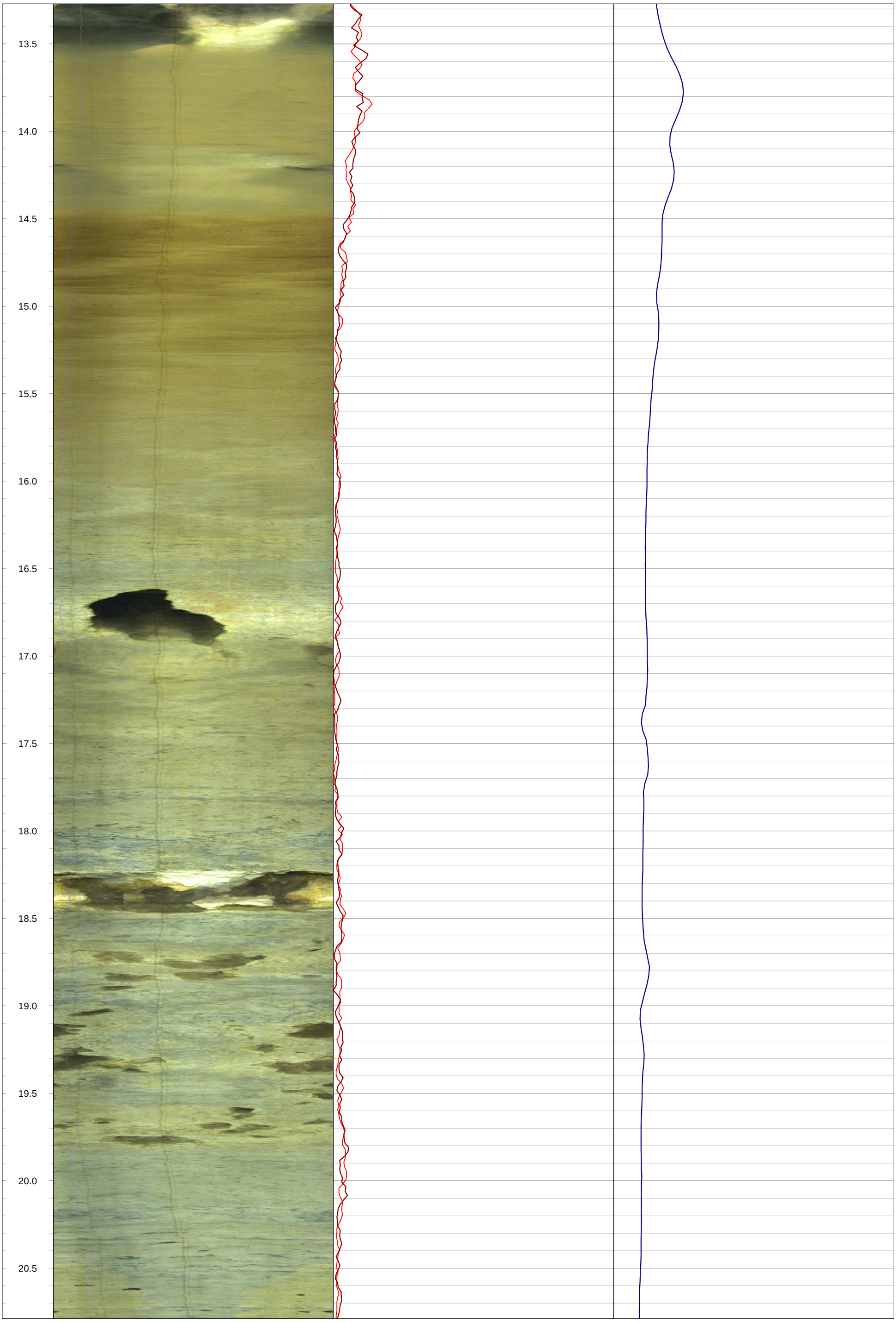
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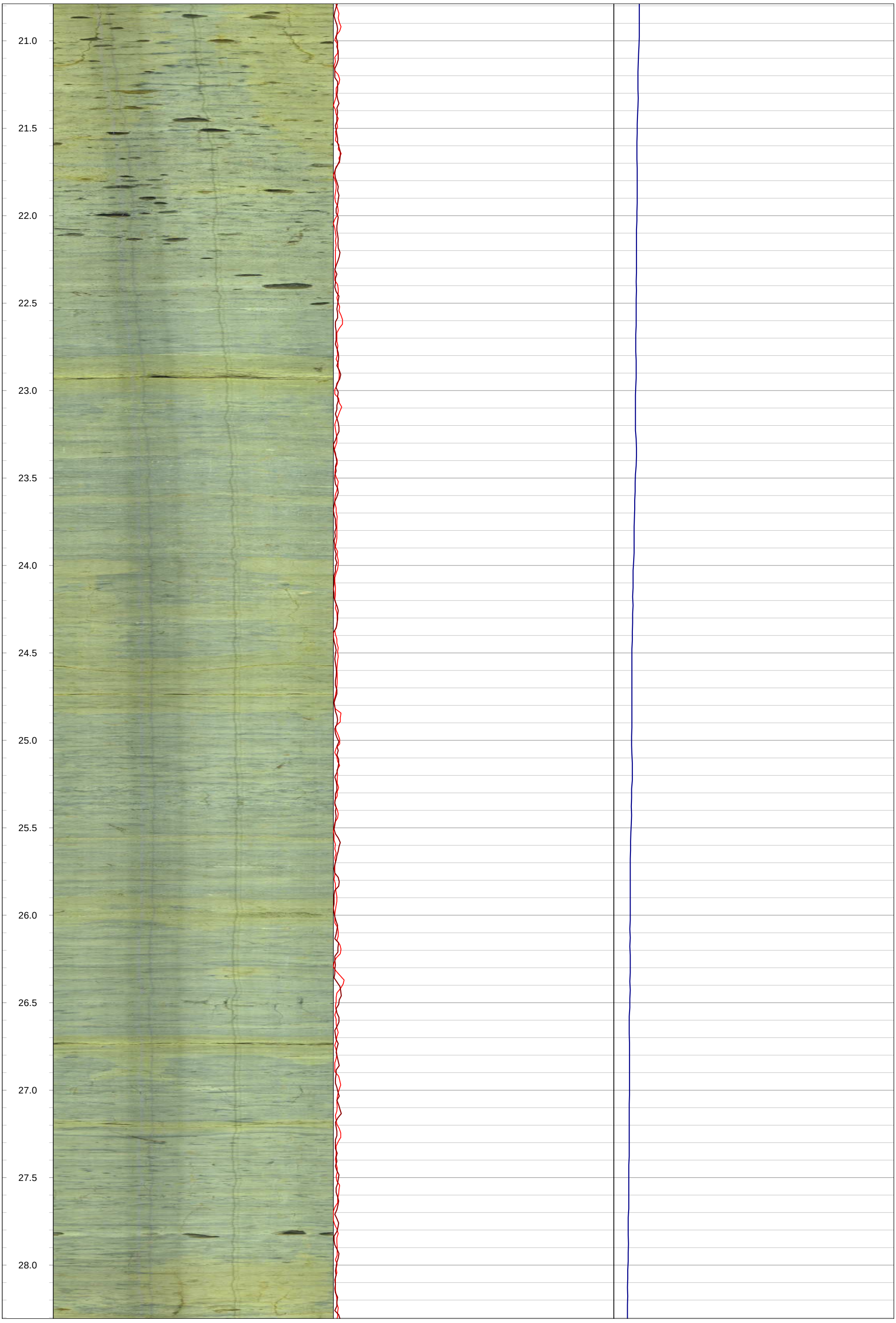
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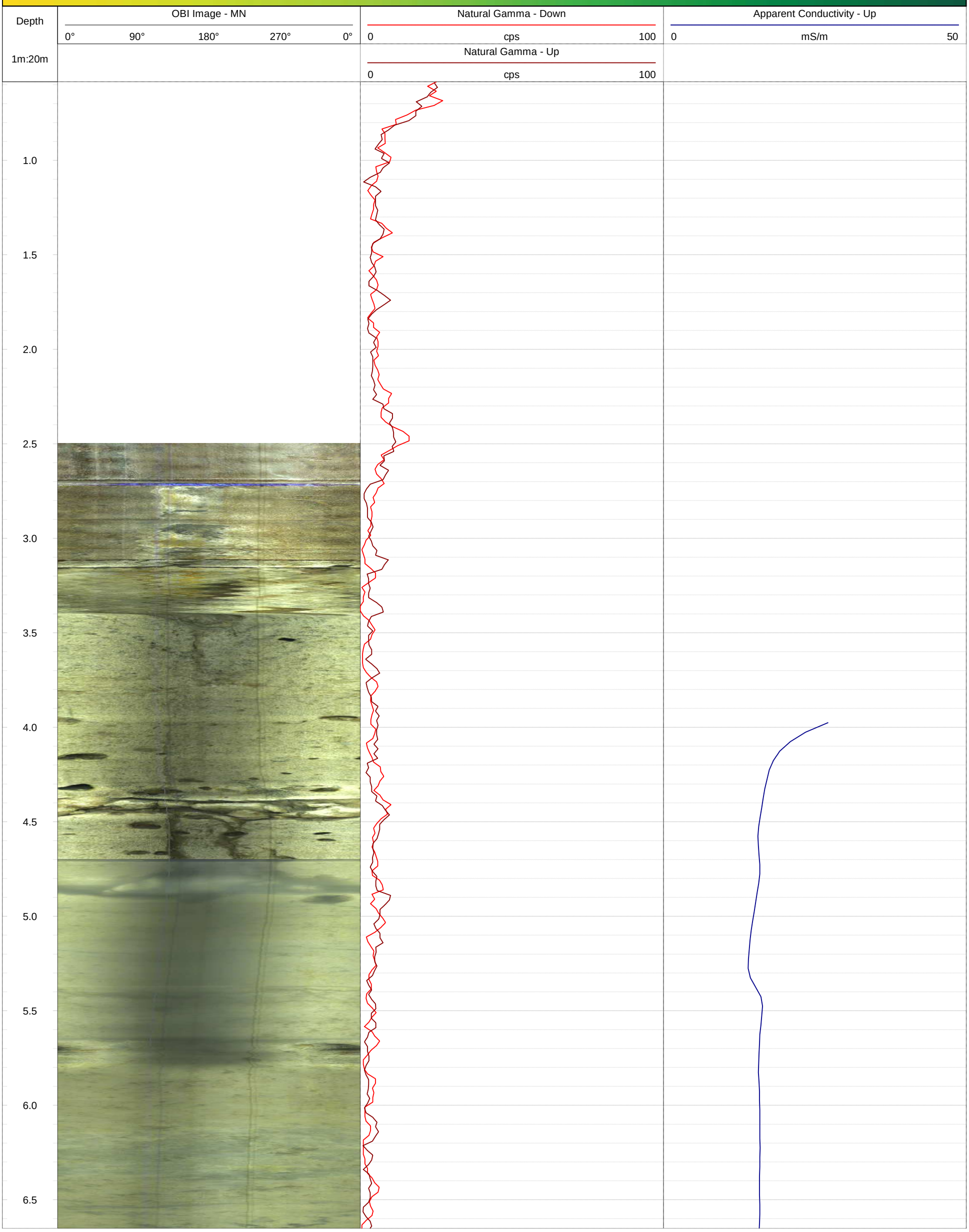
GOLDER
MEMBER OF WSP

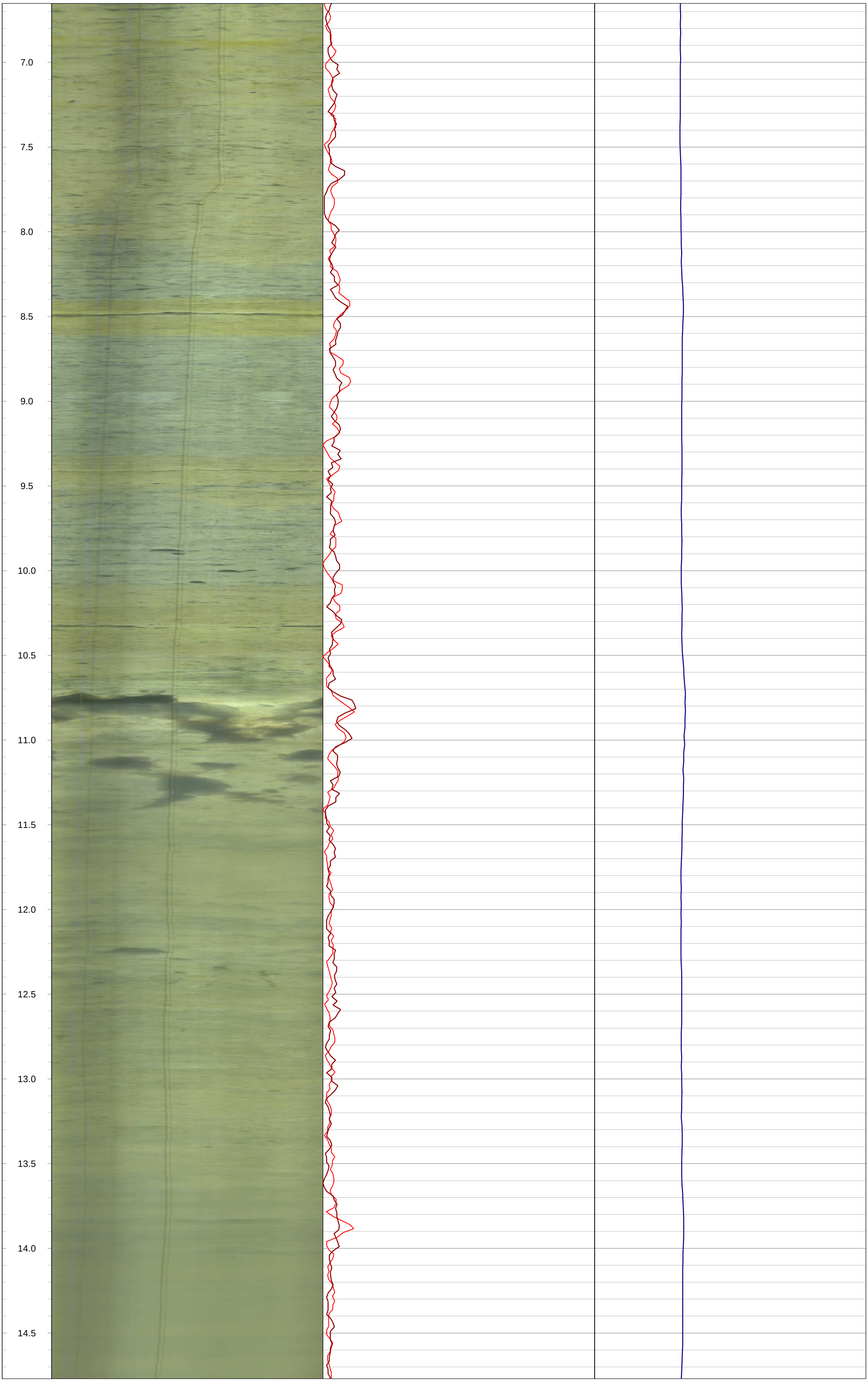
Geophysical Record of Borehole: BH20-19 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.15 m bgs	**Location:**	Caledon, Ontario
Easting:	577733.06 m	**Drilled Depth:**	24.64 m bgs	**Water Level:**	4.70 m bgs	**Log Date:**	Apr-27-2020
Northing:	4853579.97 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	411.42 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:

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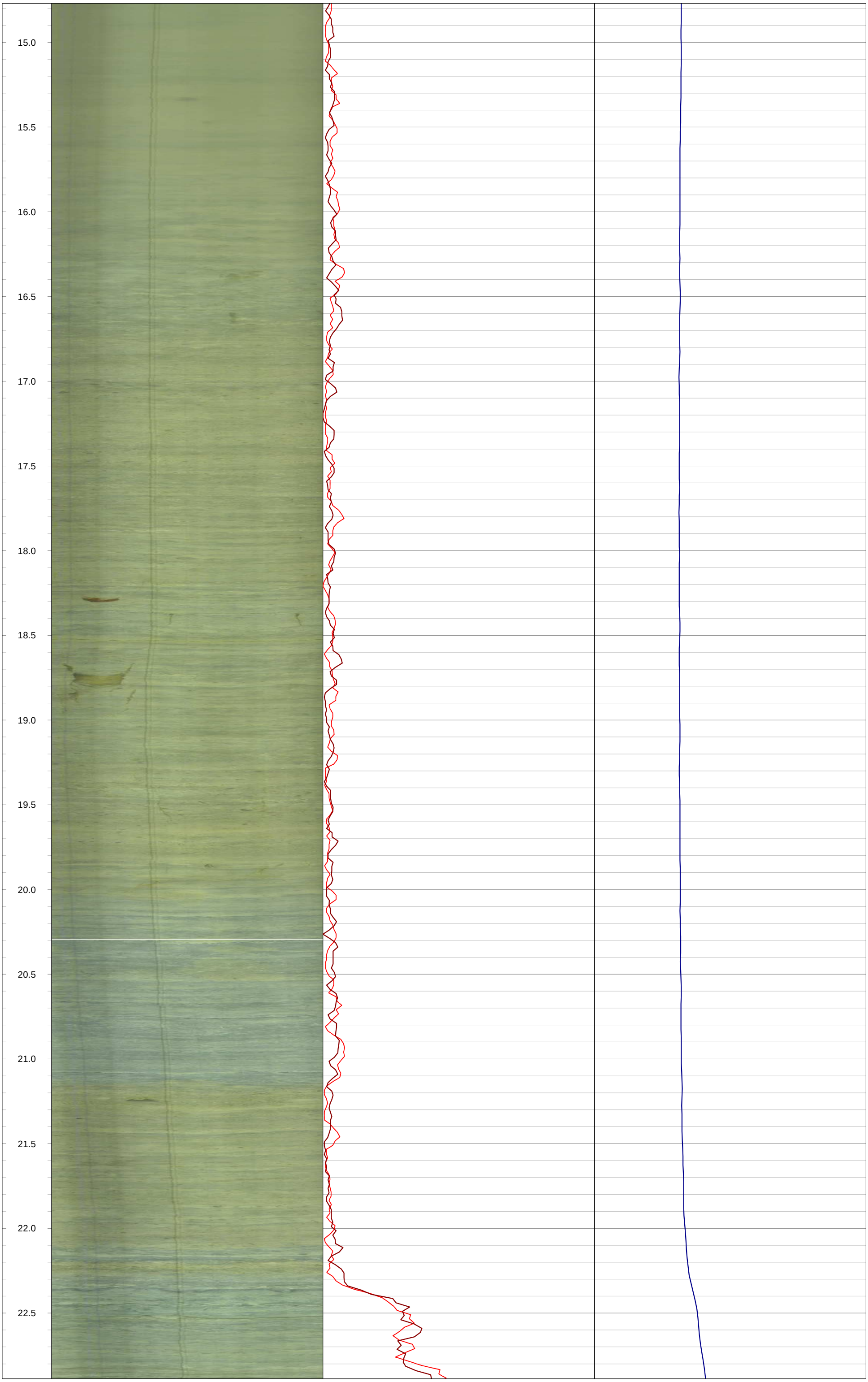
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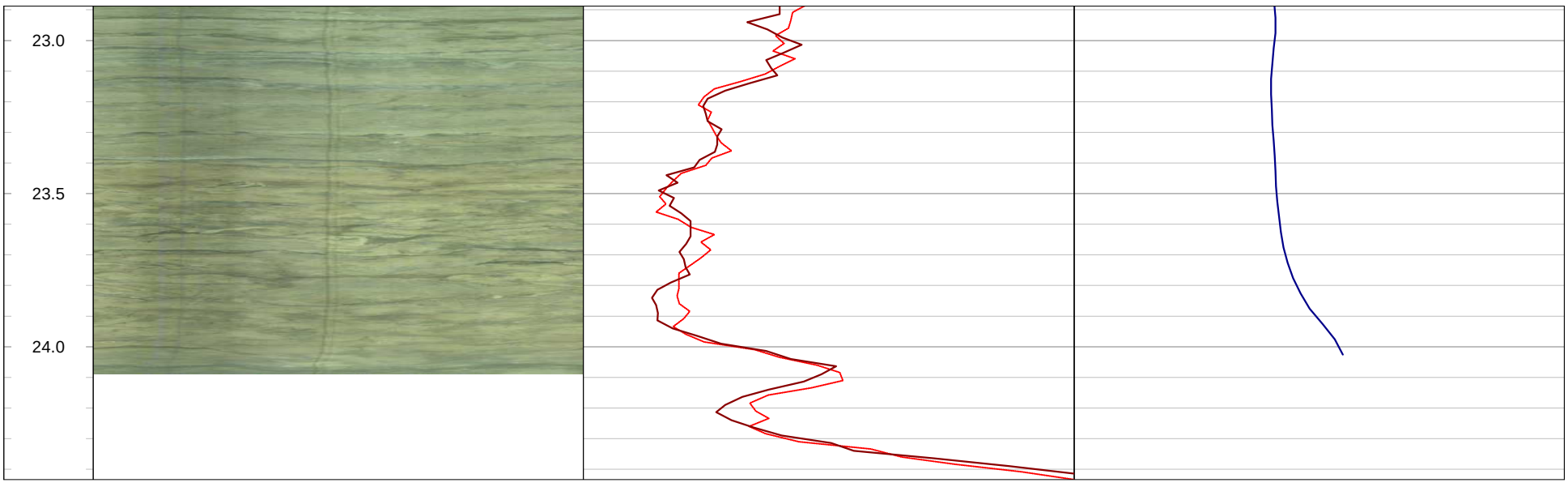
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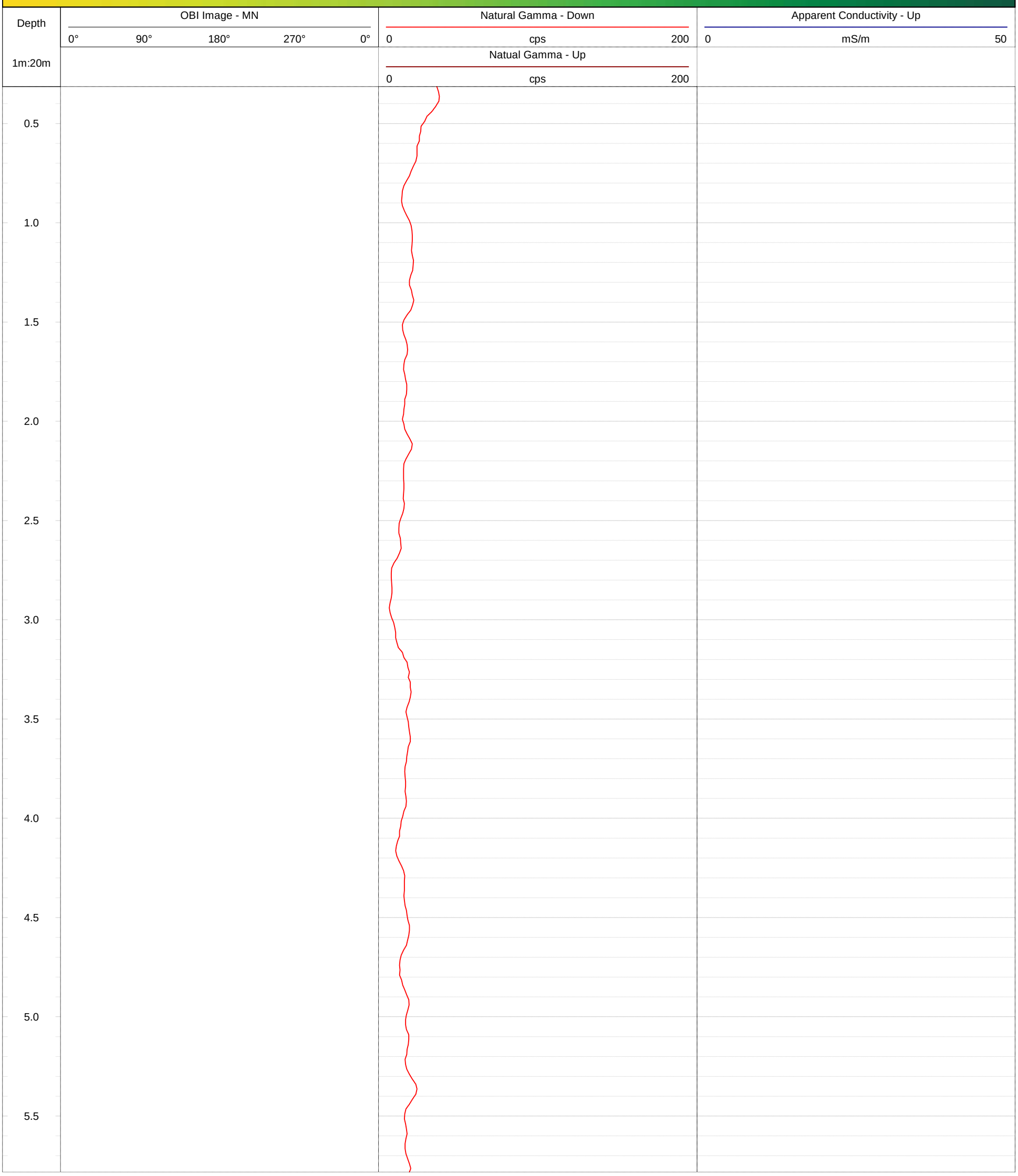
GOLDER
MEMBER OF WSP

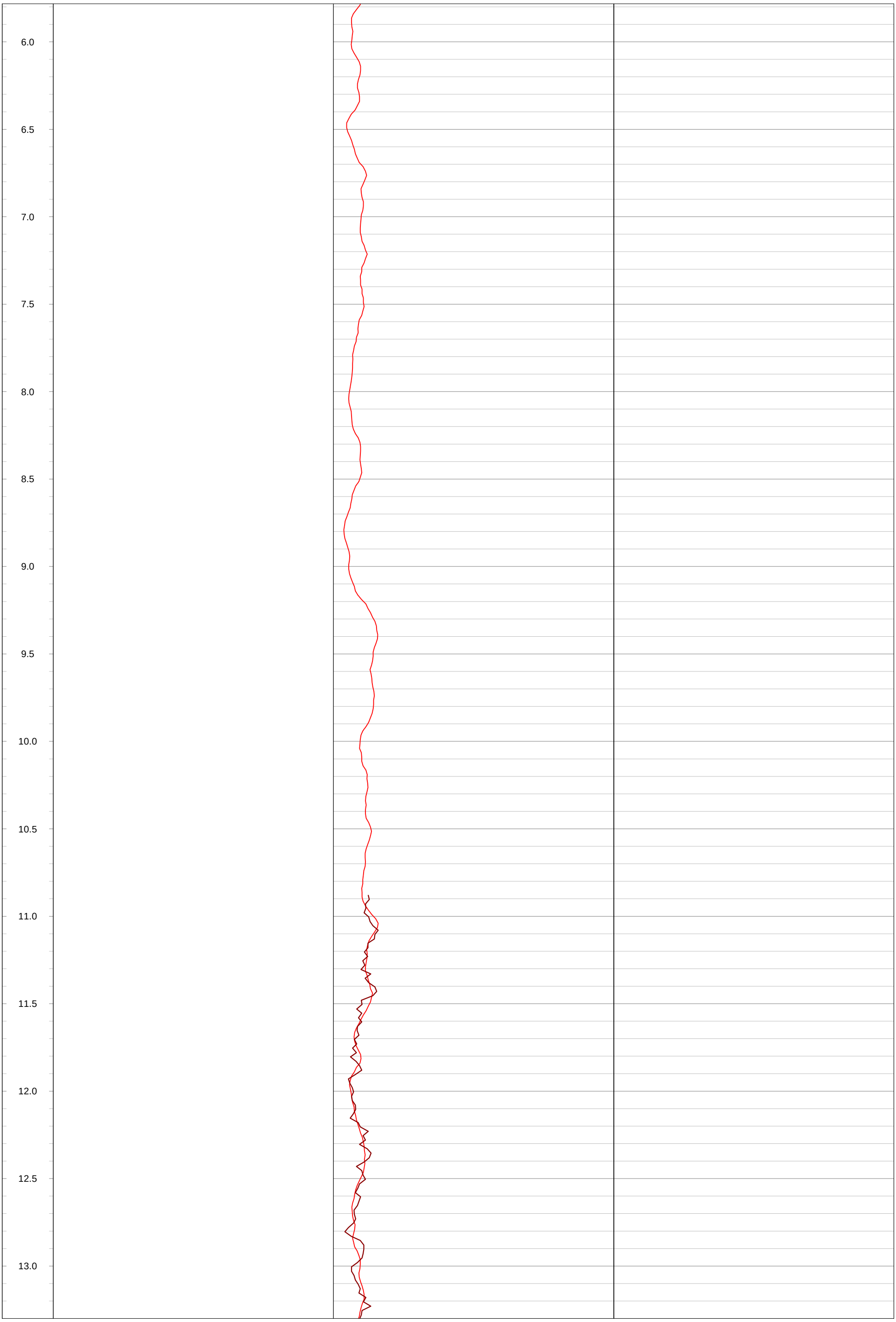
Geophysical Record of Borehole: BH20-20 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.05 m bgs	**Location:**	Caledon, Ontario
Easting:	577031.10 m	**Drilled Depth:**	40.98 m bgs	**Water Level:**	11.71 m bgs	**Log Date:**	May-20-2020
Northing:	4853551.56 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	423.60 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.39 m ags	**Logged By:**	PG

Notes: OBI image opaque > 40.78 m bgs

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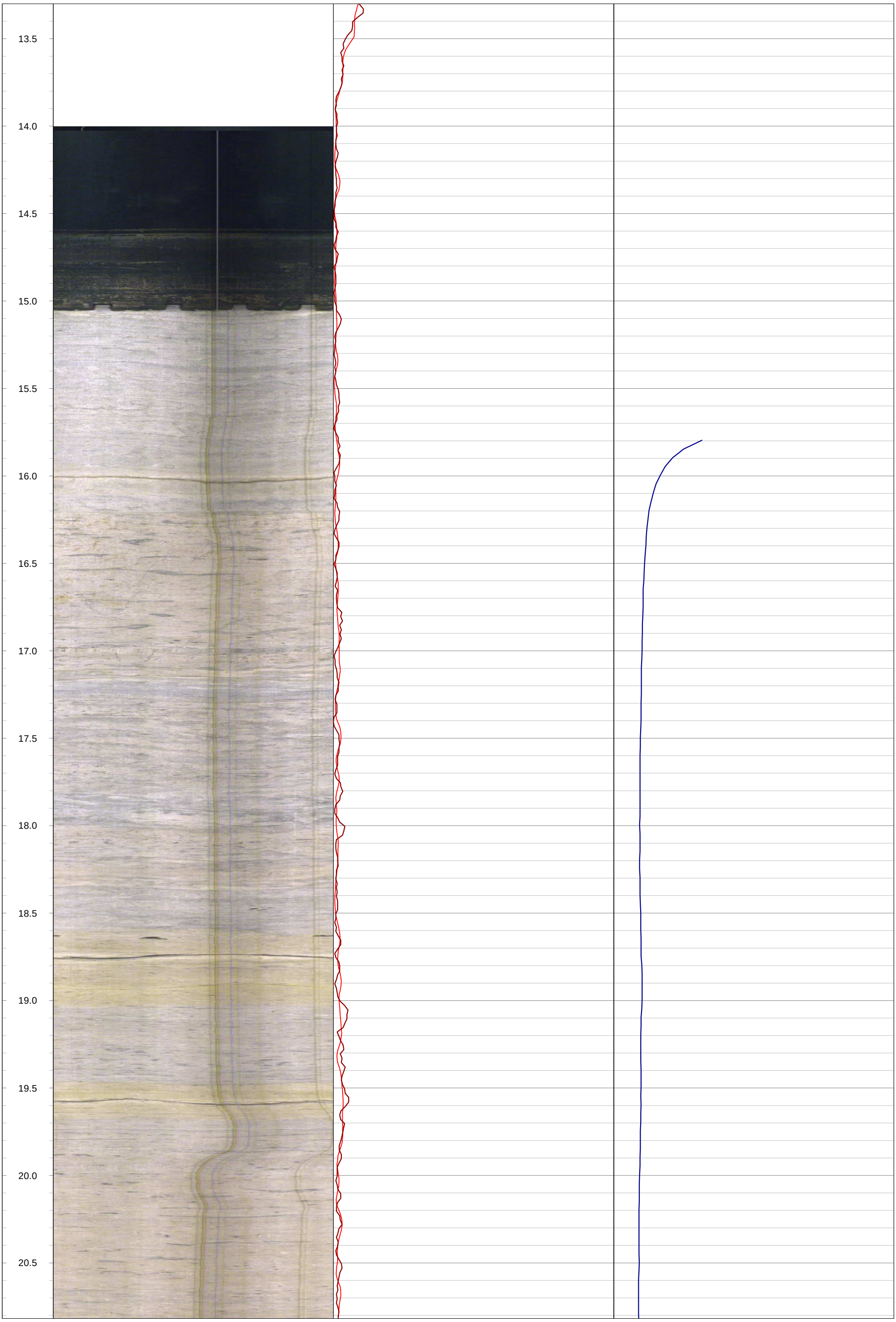
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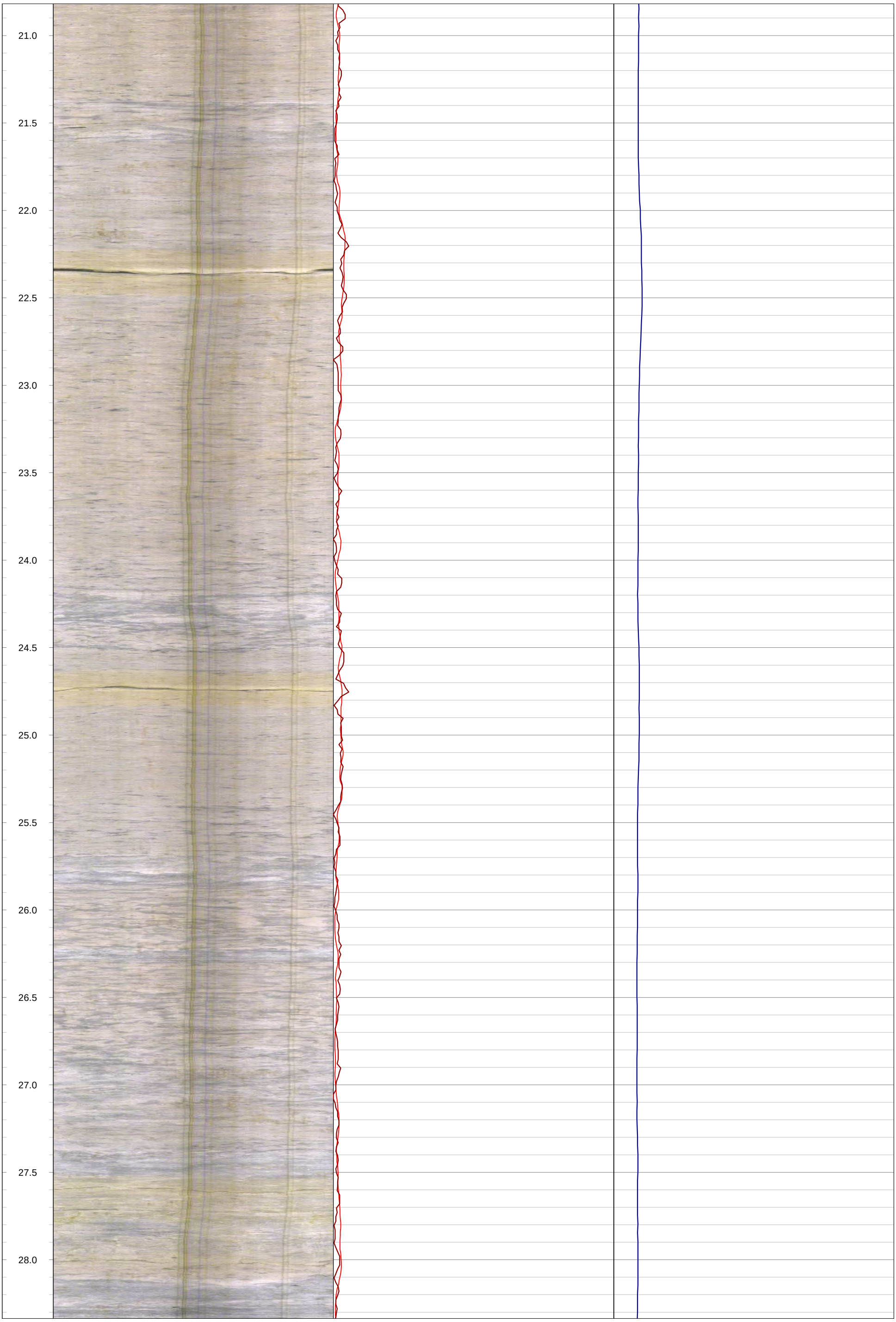
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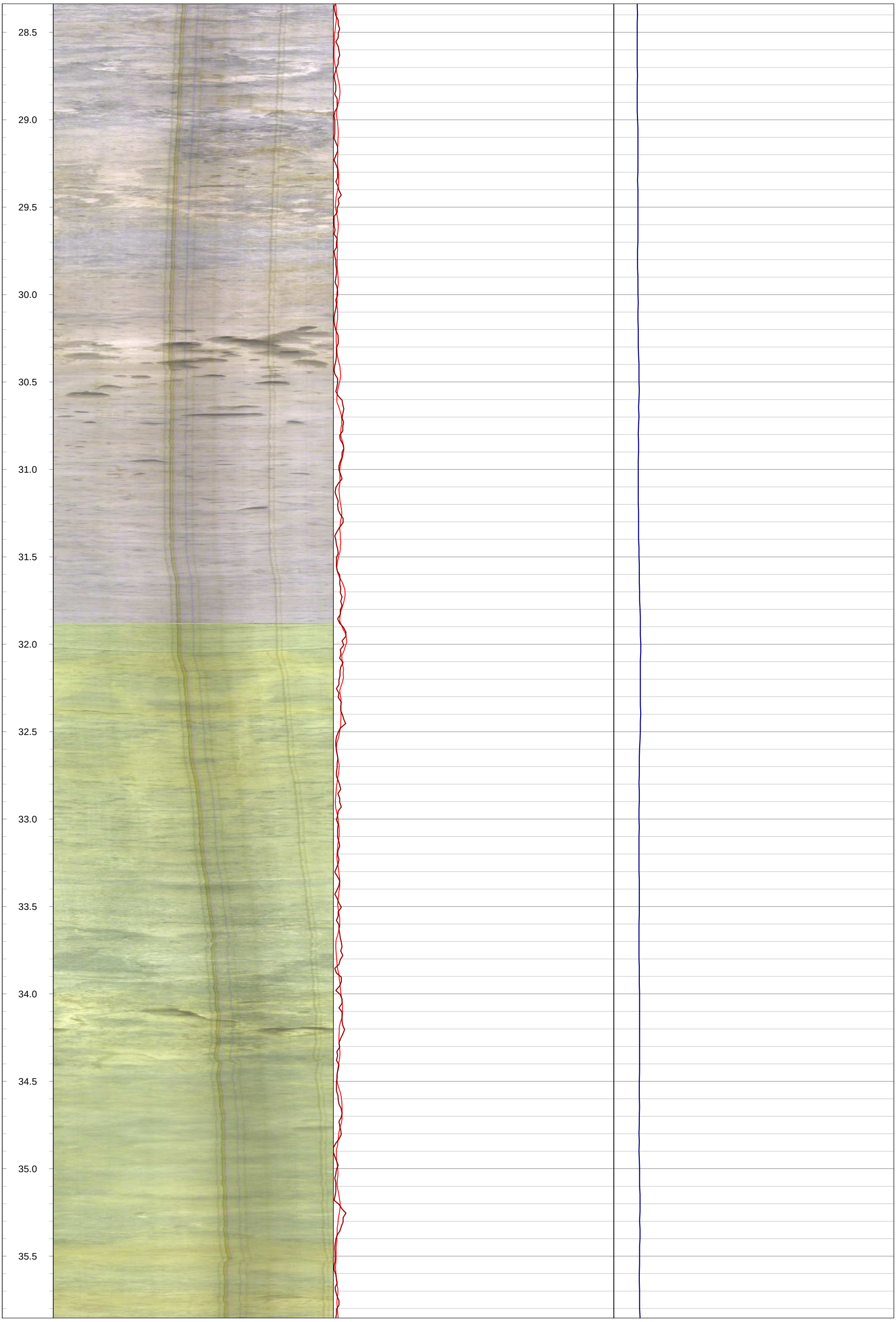
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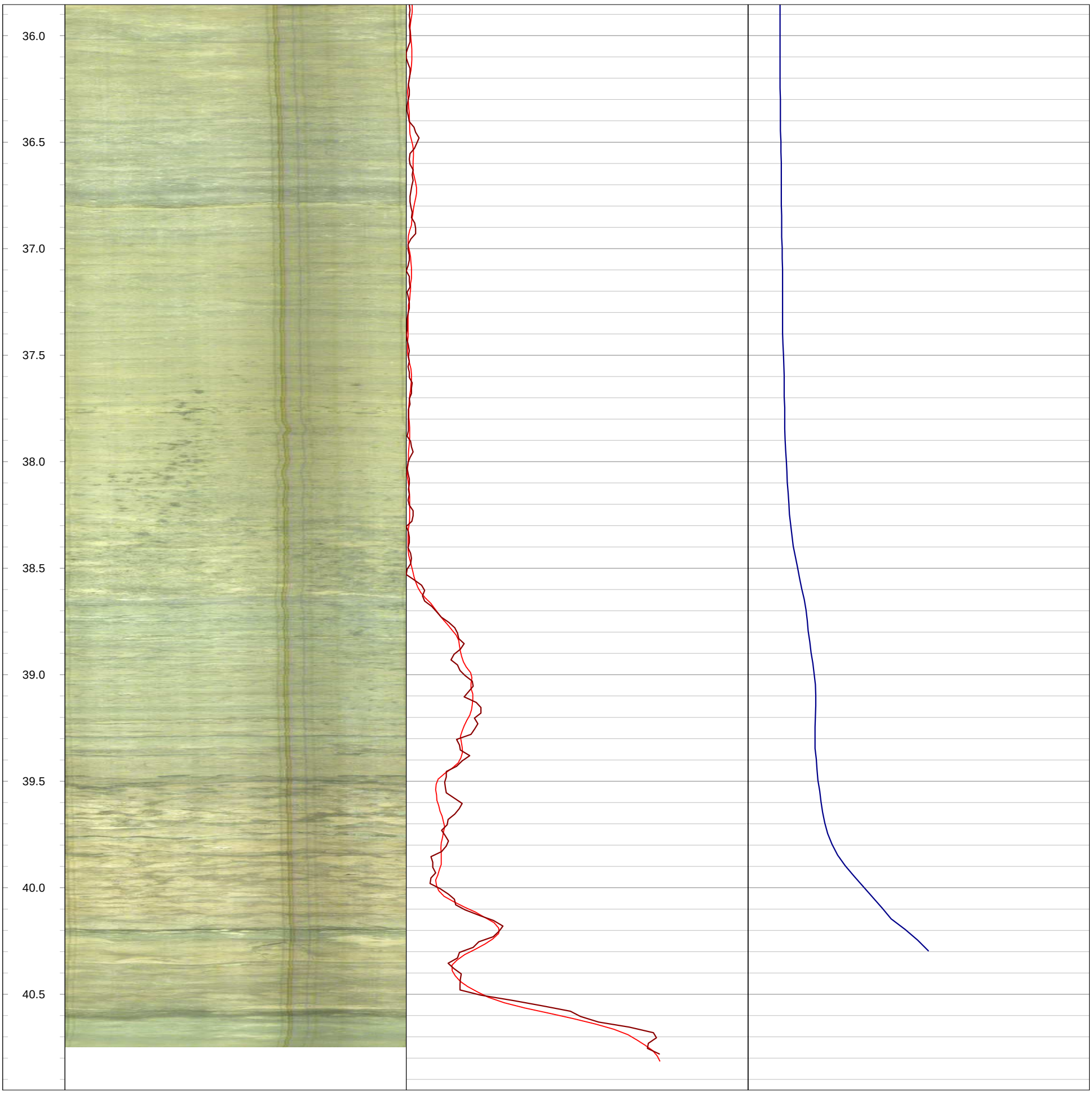
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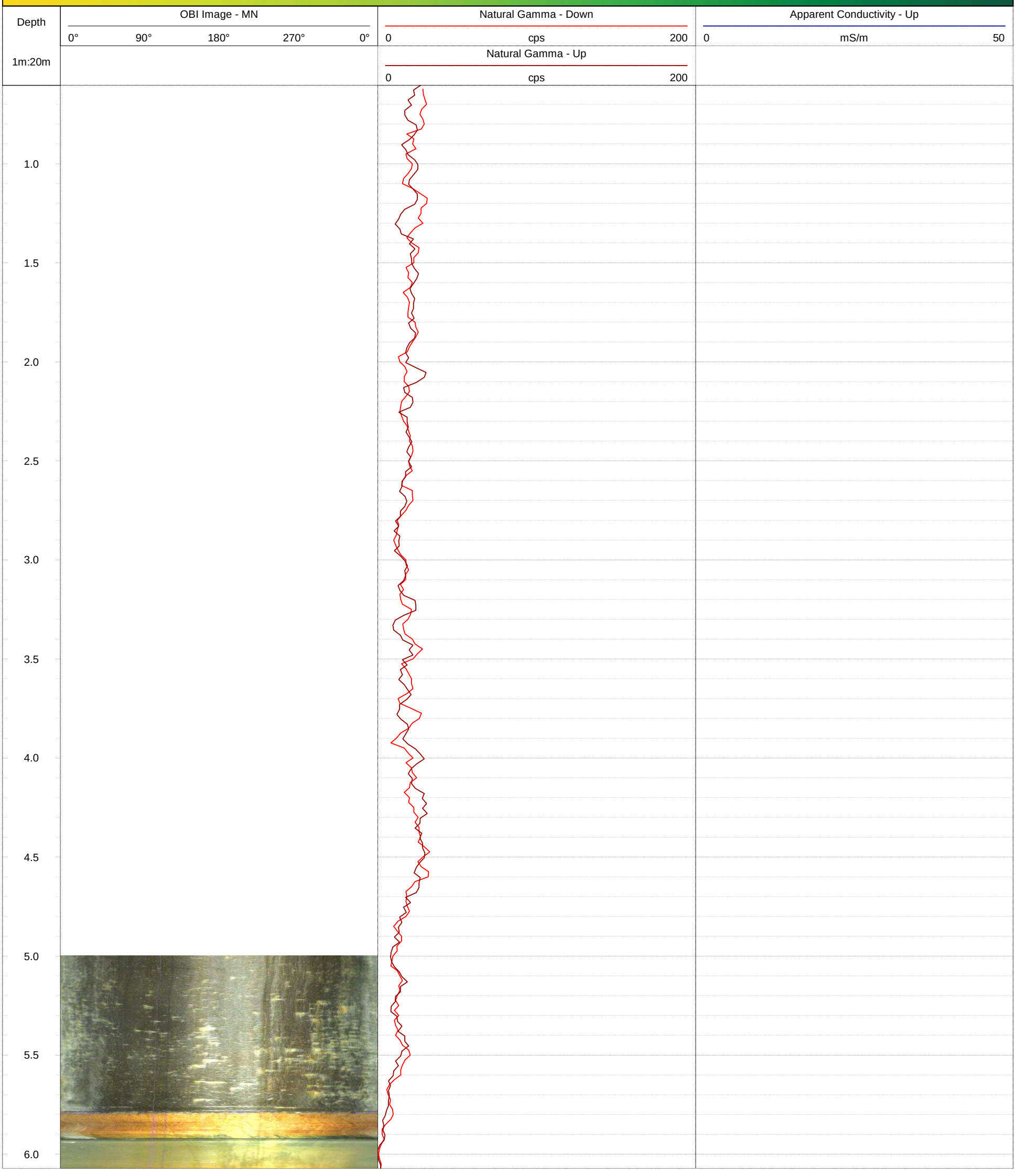
GOLDER
MEMBER OF WSP

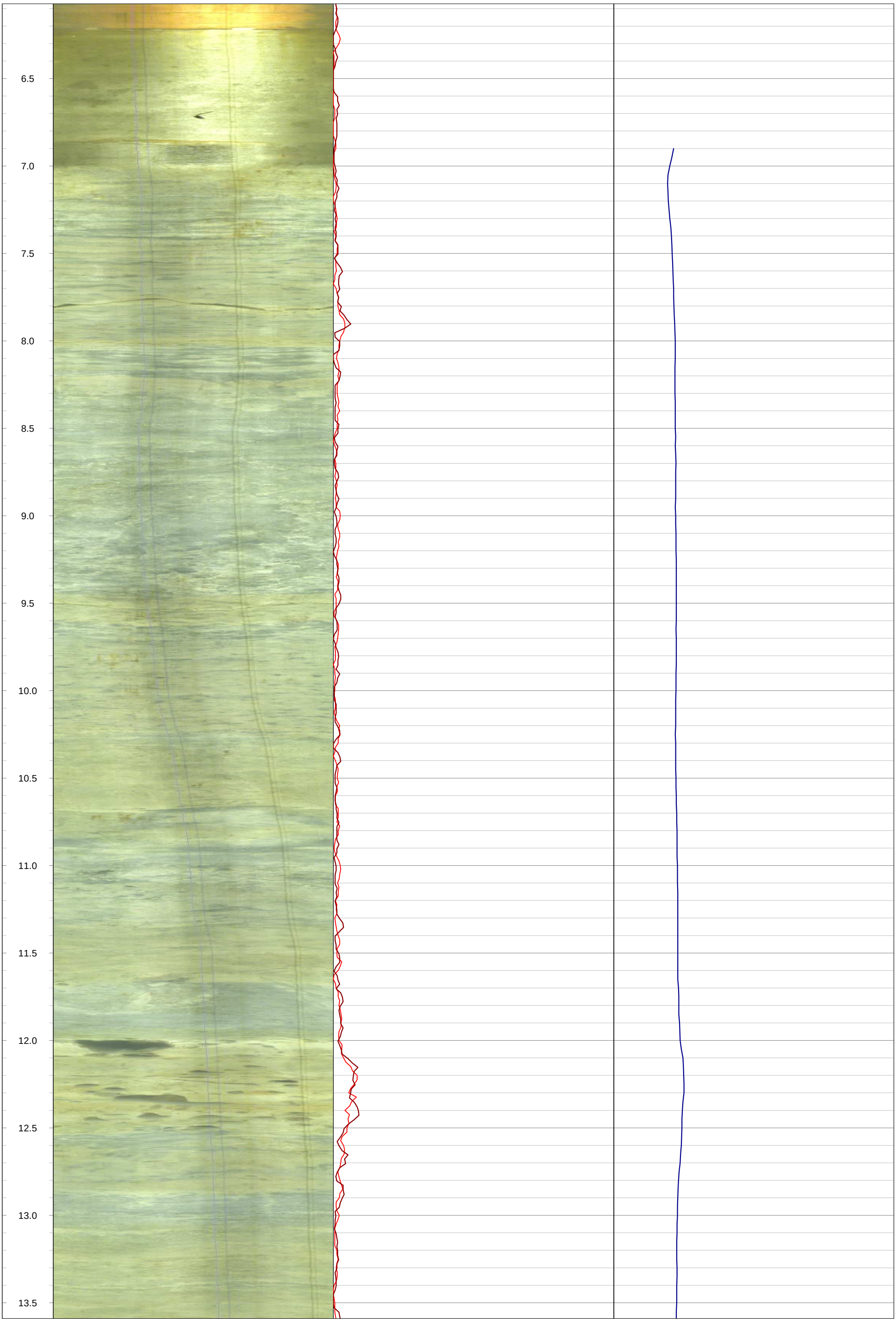
Geophysical Record of Borehole: BH20-21 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.21 m bgs	**Location:**	Caledon, Ontario
Easting:	576935.66 m	**Drilled Depth:**	33.48 m bgs	**Water Level:**	5.92 m bgs	**Log Date:**	May-20-2020
Northing:	4853276.58 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.53 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.08 m ags	**Logged By:**	CM

Notes: OBI image opaque > 33.1 m bgs

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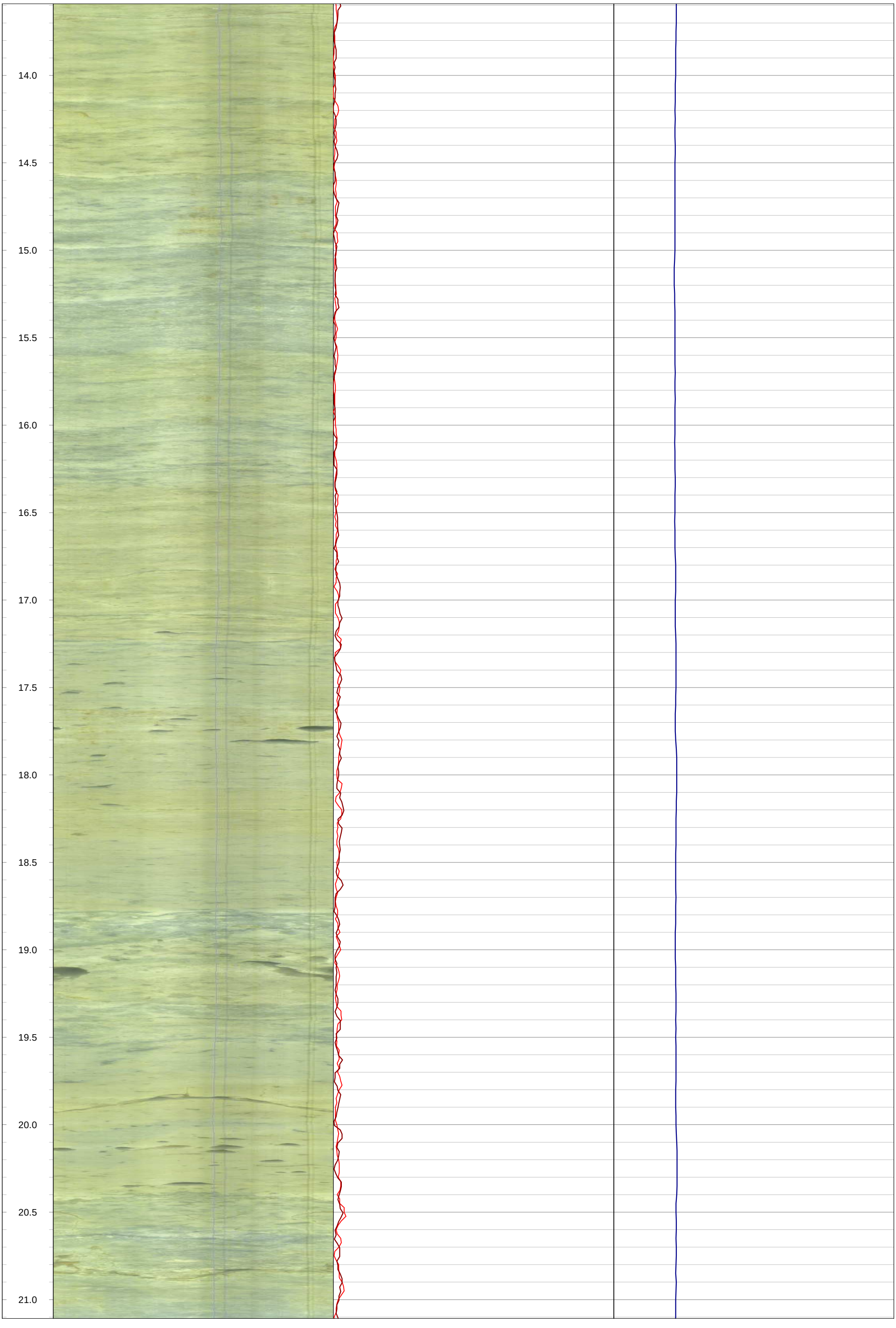
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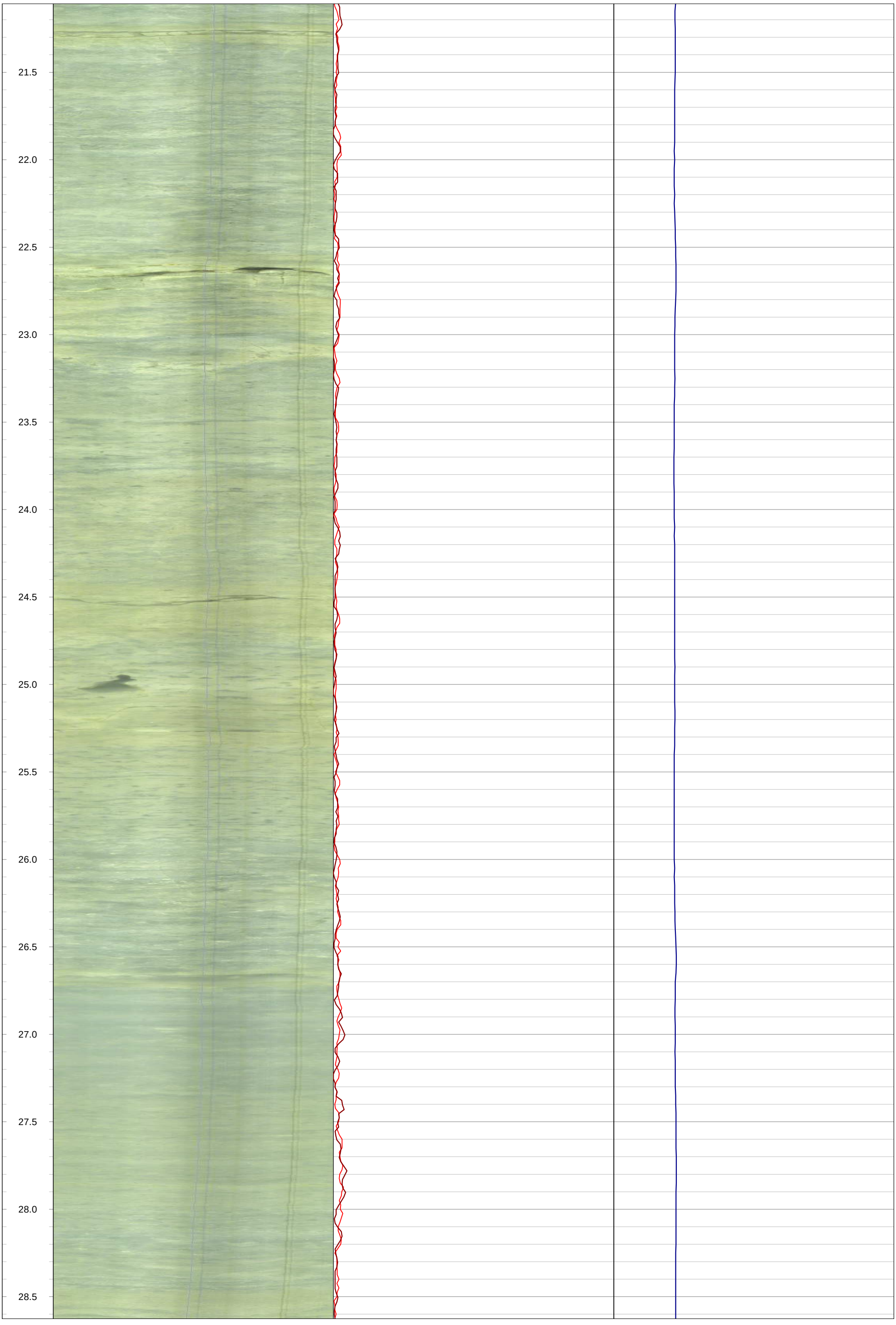
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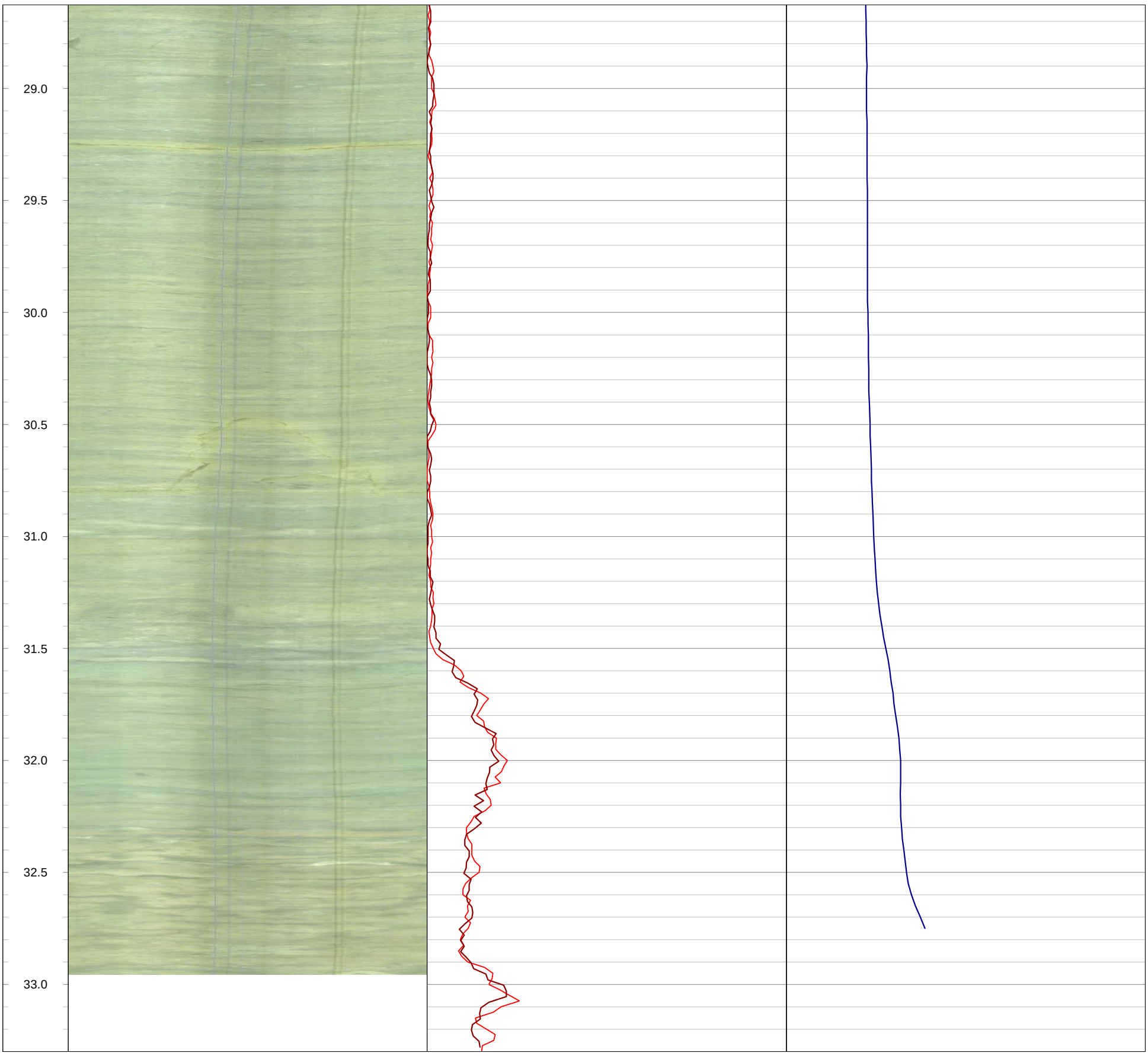
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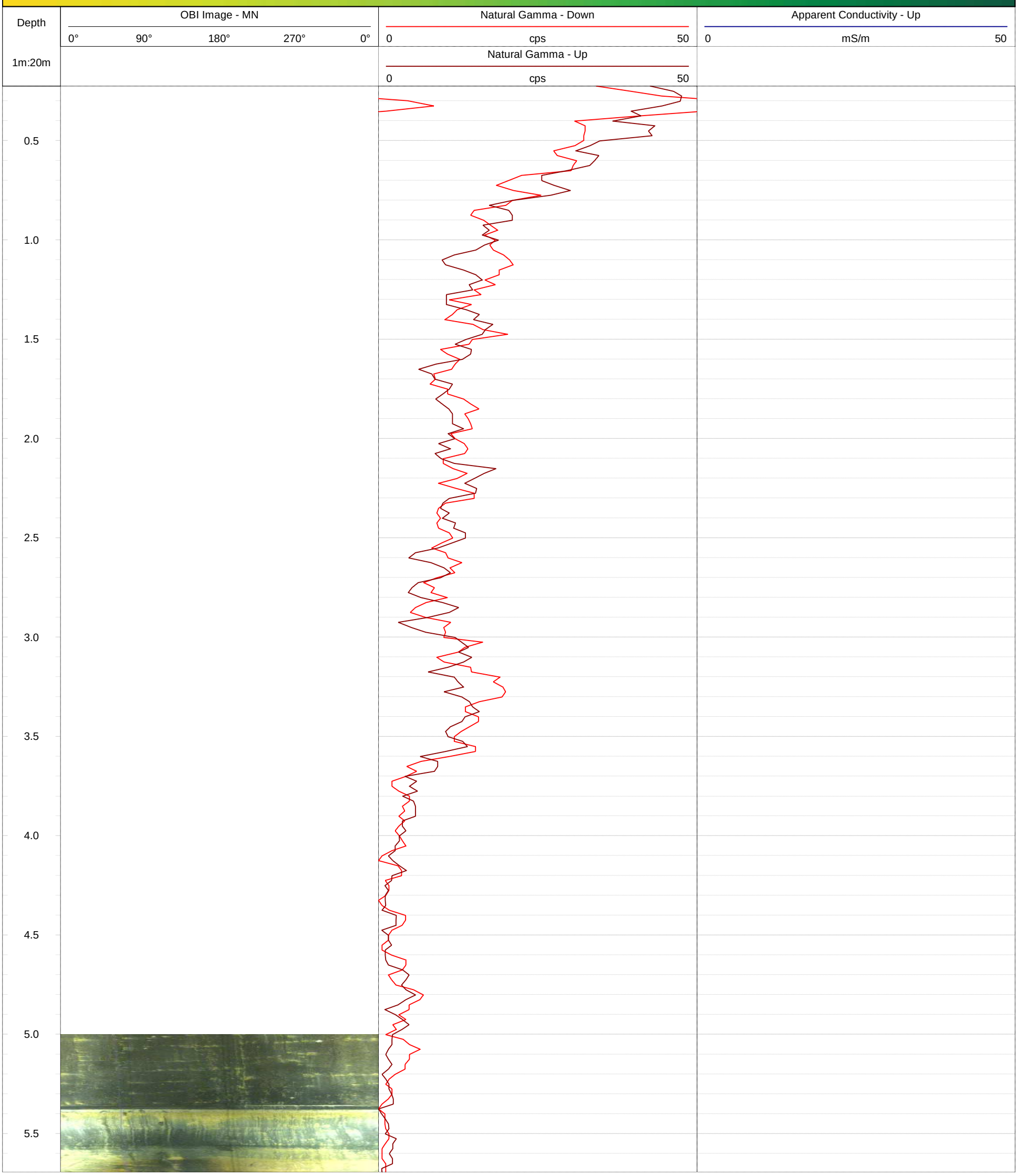
GOLDER
MEMBER OF WSP

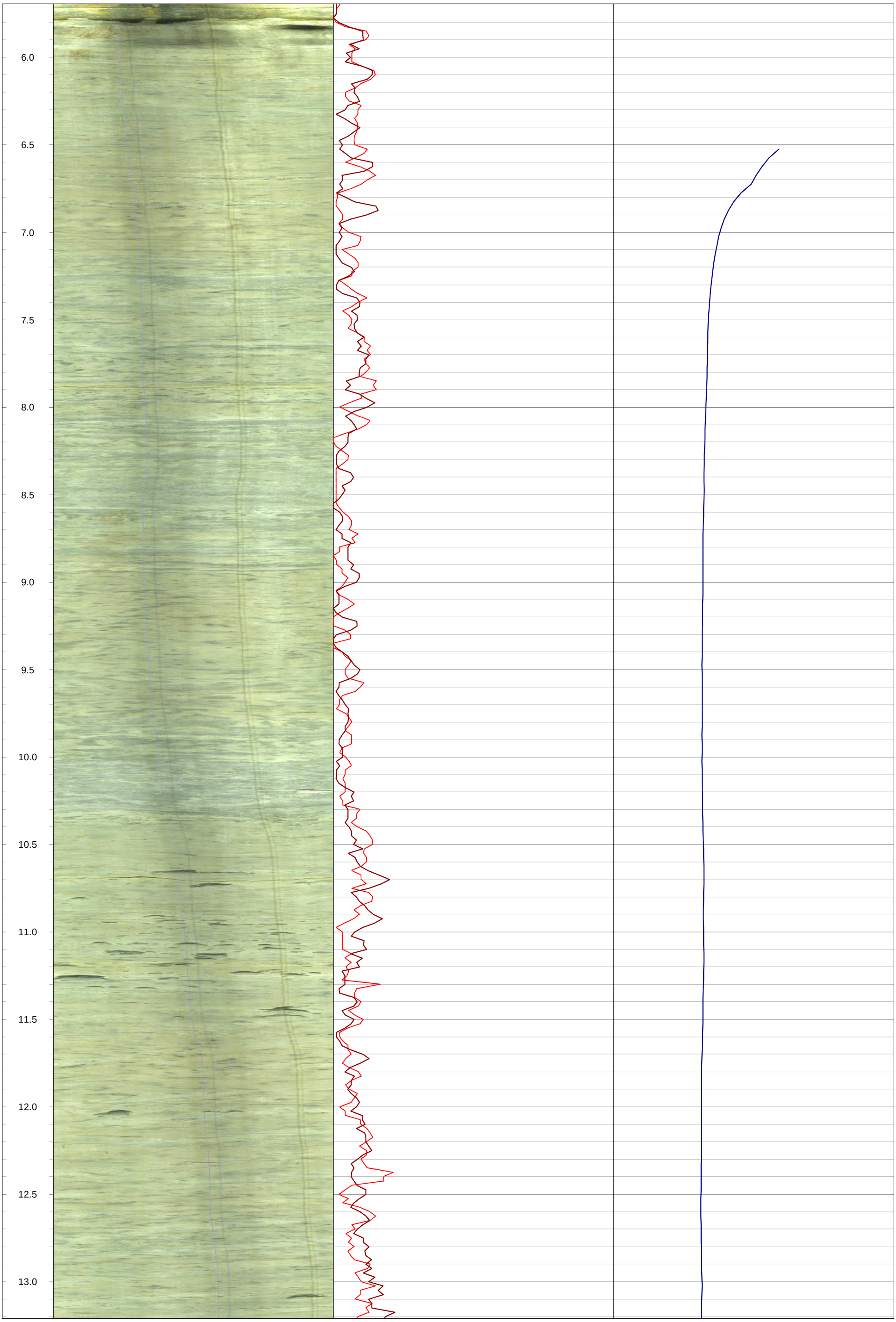
Geophysical Record of Borehole: BH20-22 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.77 m bgs	**Location:**	Caledon, Ontario
Easting:	576701.79 m	**Drilled Depth:**	28.61 m bgs	**Water Level:**	2.88 m bgs	**Log Date:**	May-20-2020
Northing:	4853293.98 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	410.98 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.47 m ags	**Logged By:**	PG

Notes:

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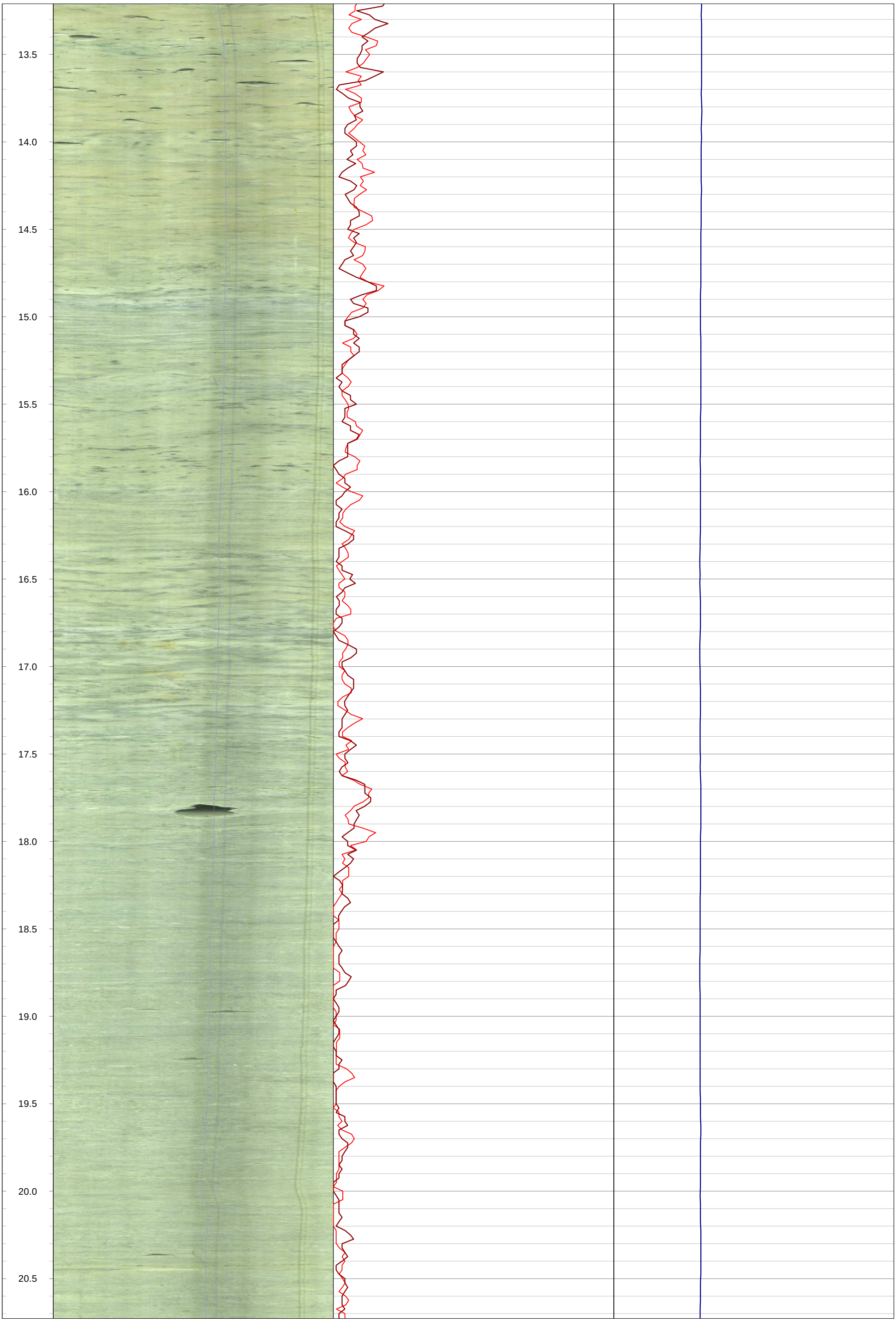
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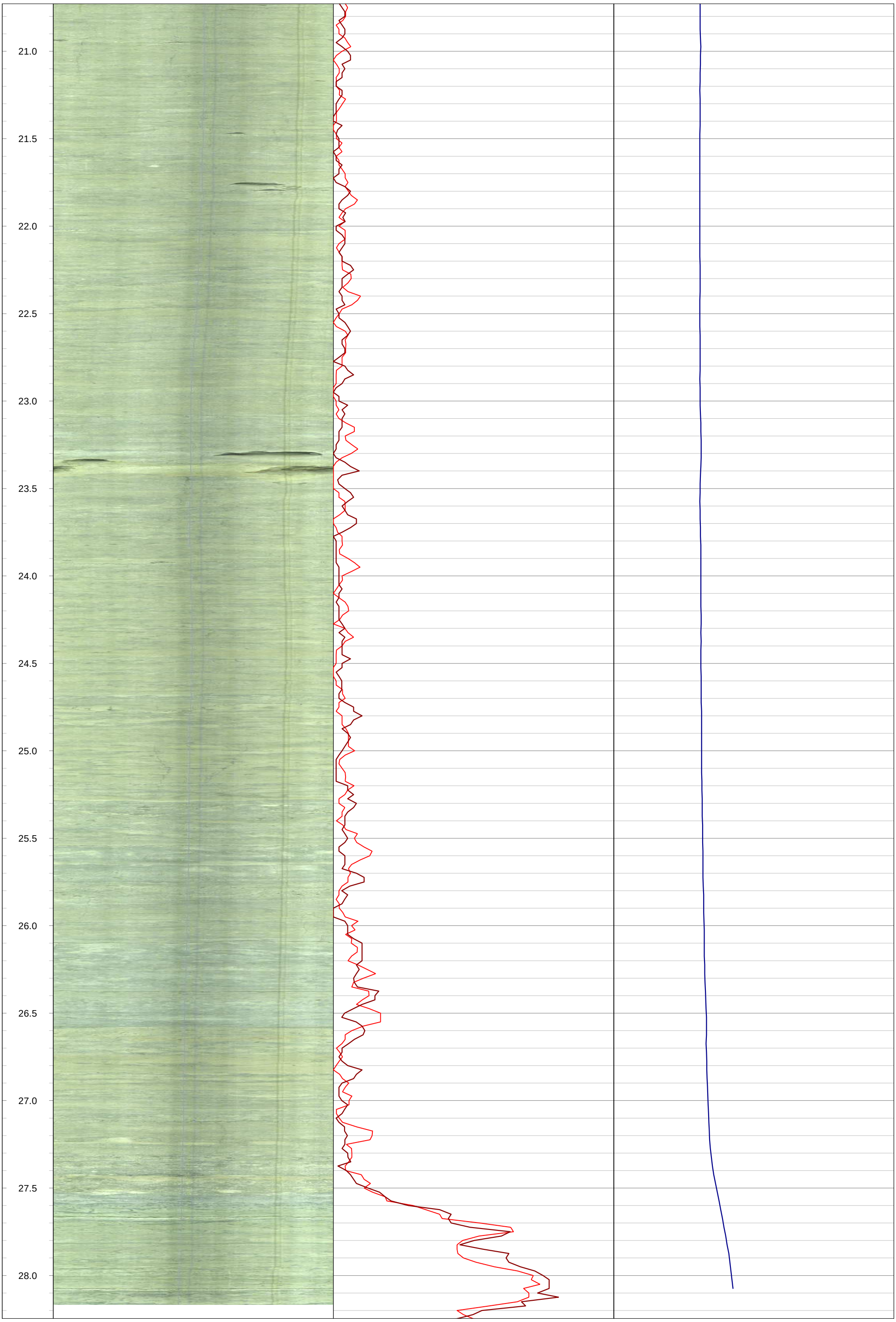
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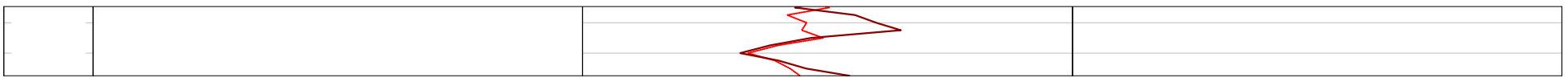


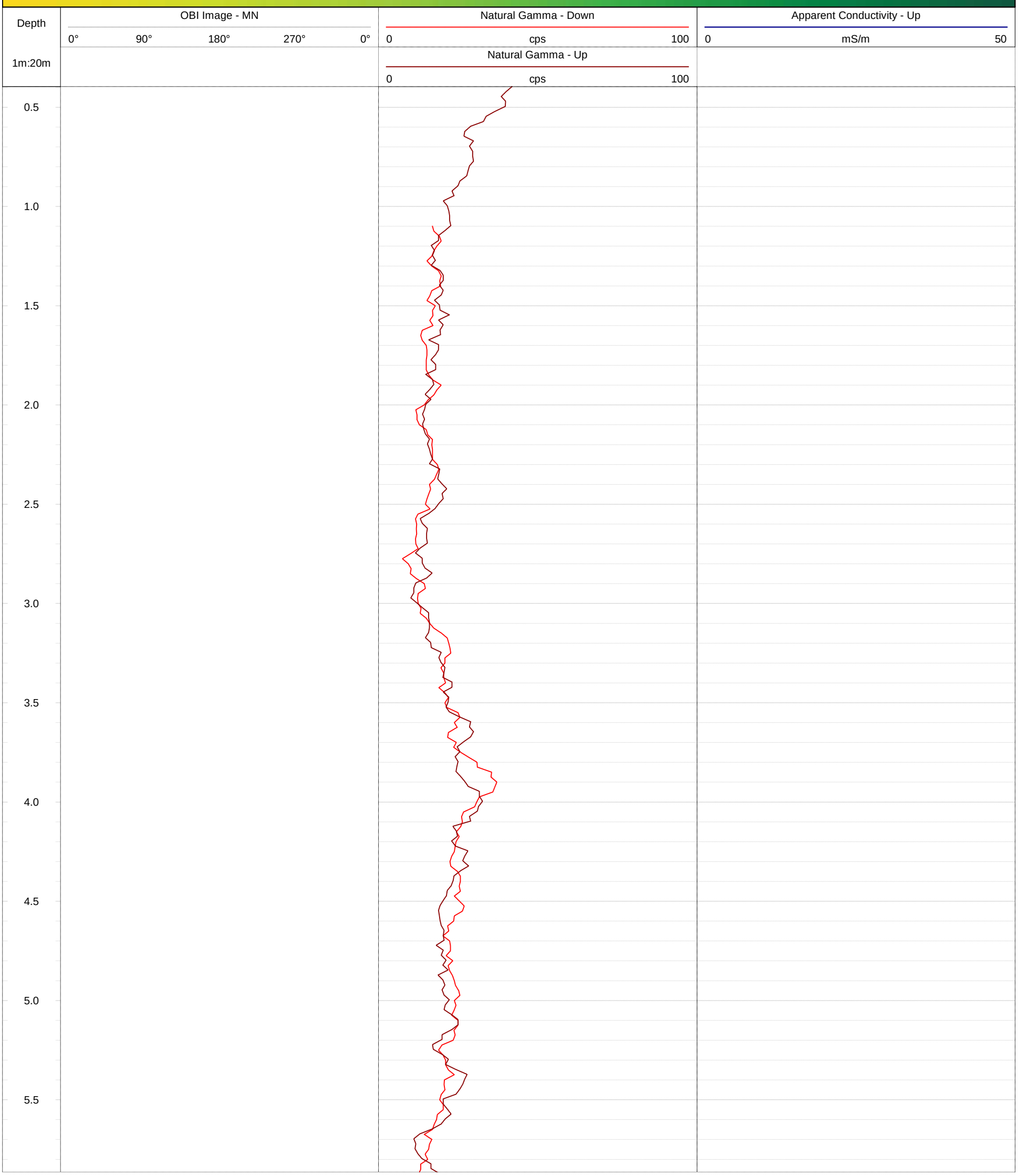
GOLDER
MEMBER OF WSP

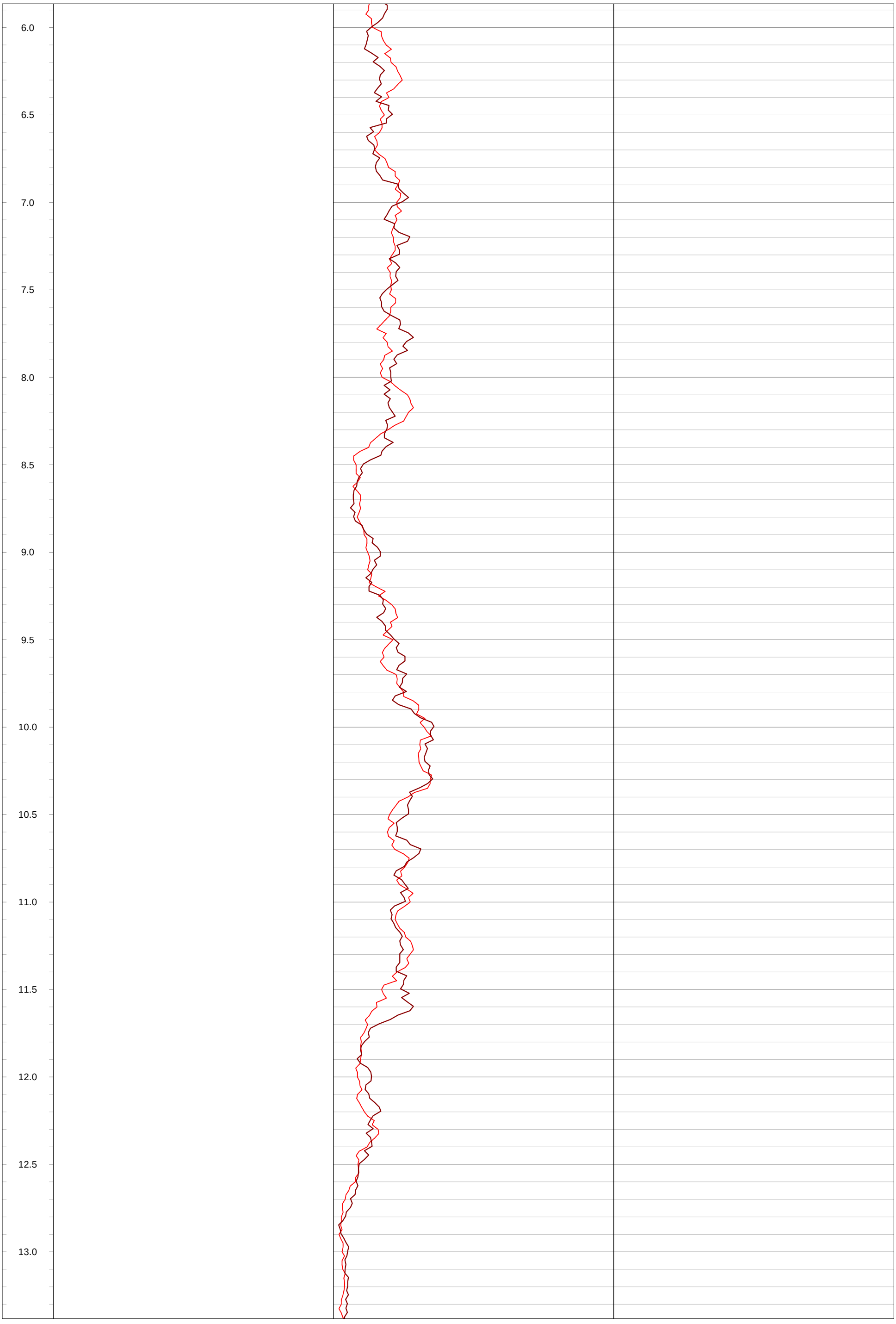
Geophysical Record of Borehole: BH20-23 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.08 m bgs	**Location:**	Caledon, Ontario
Easting:	576779.85 m	**Drilled Depth:**	37.62 m bgs	**Water Level:**	2.50 m bgs	**Log Date:**	May-25-2020
Northing:	4853559.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	420.27 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.36 m ags	**Logged By:**	PG

Notes: OBI image opaque > 37 m bgs

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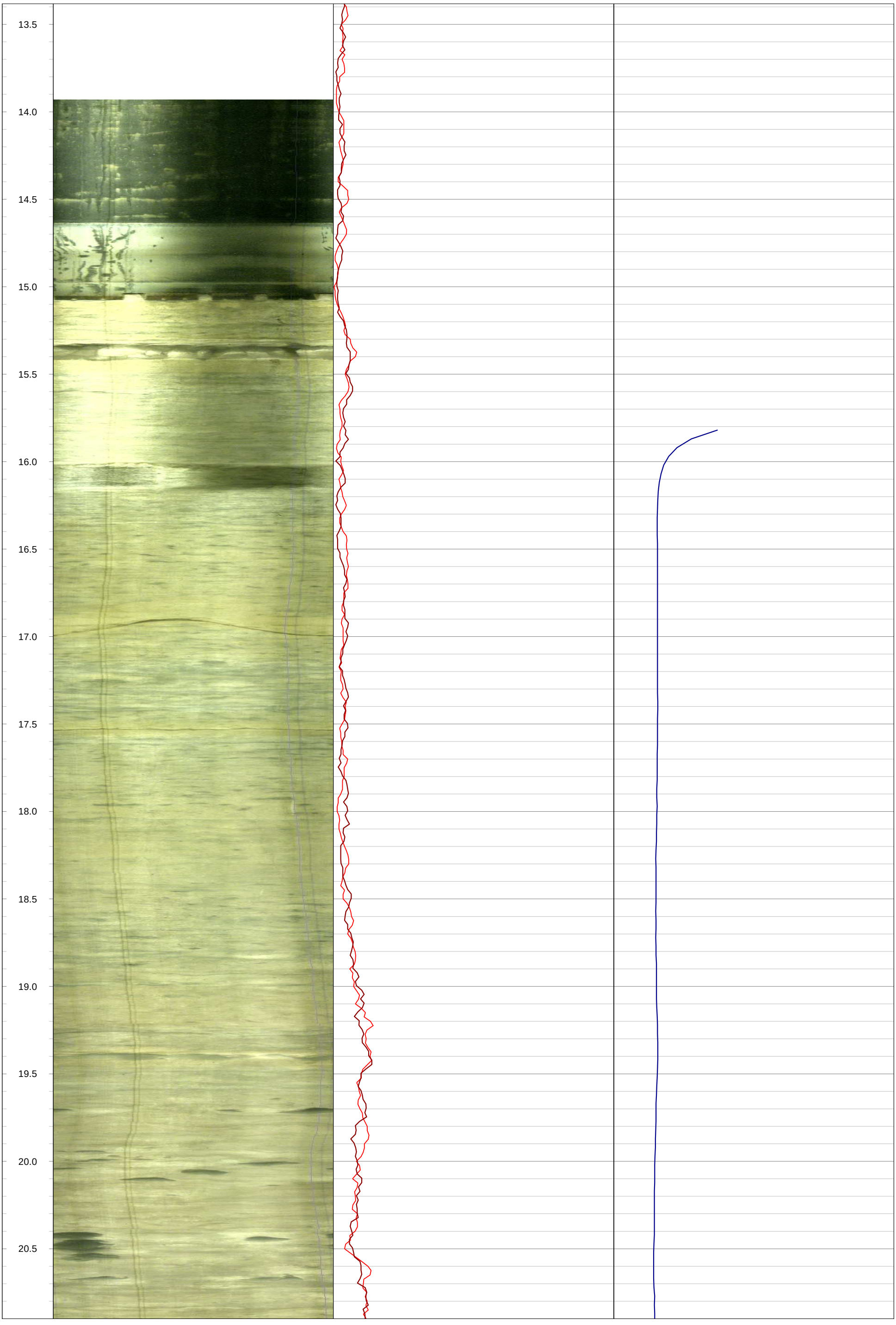
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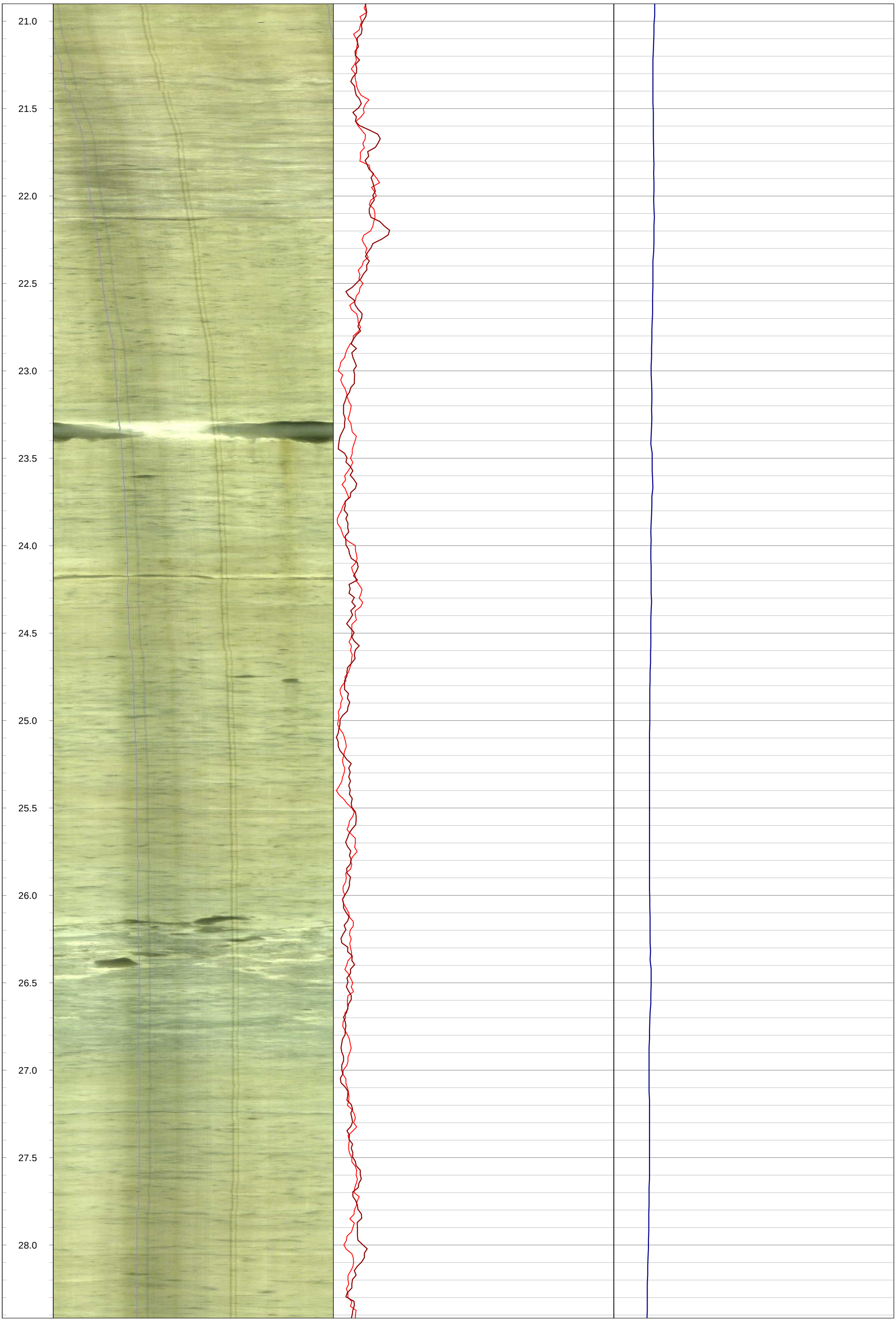
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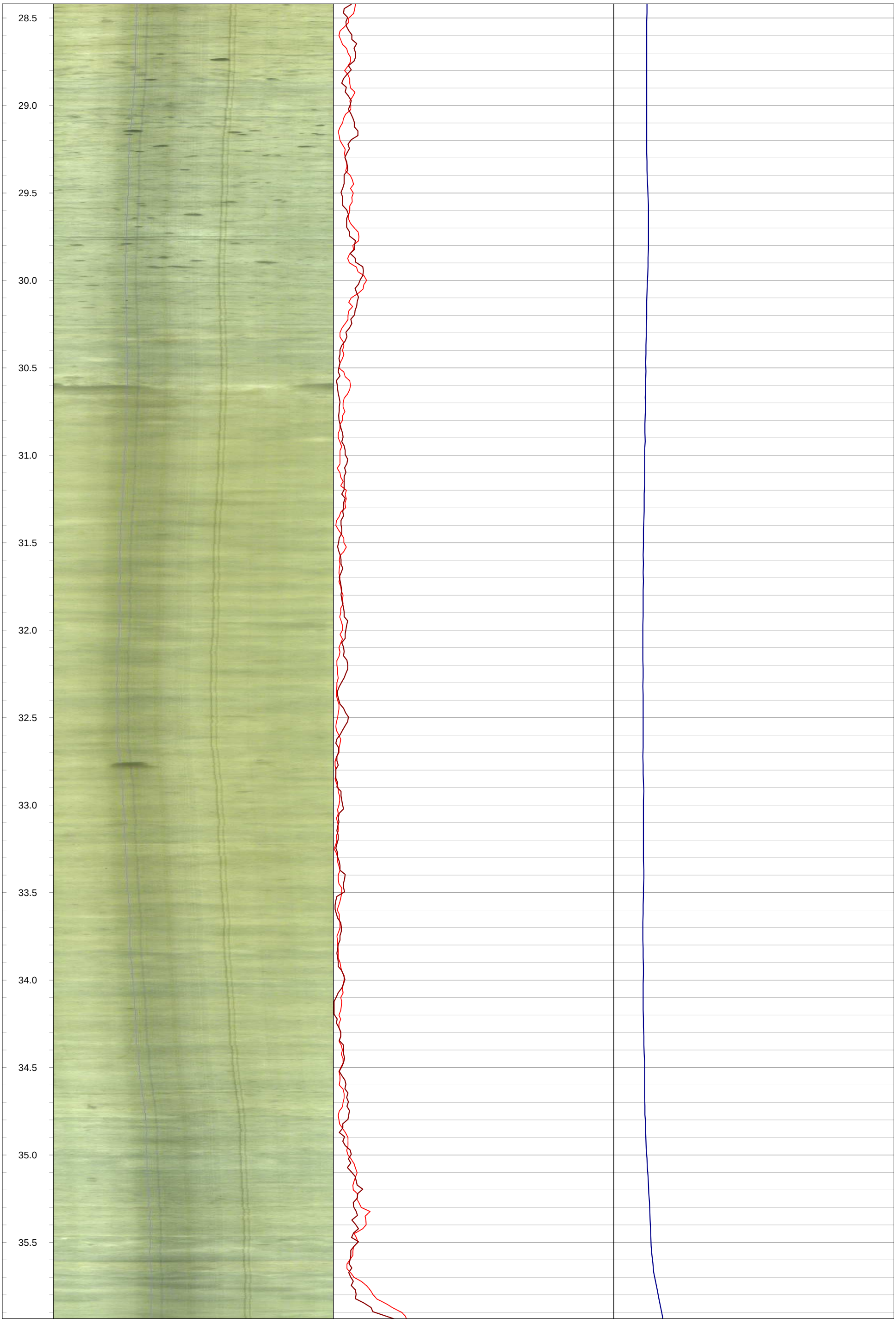
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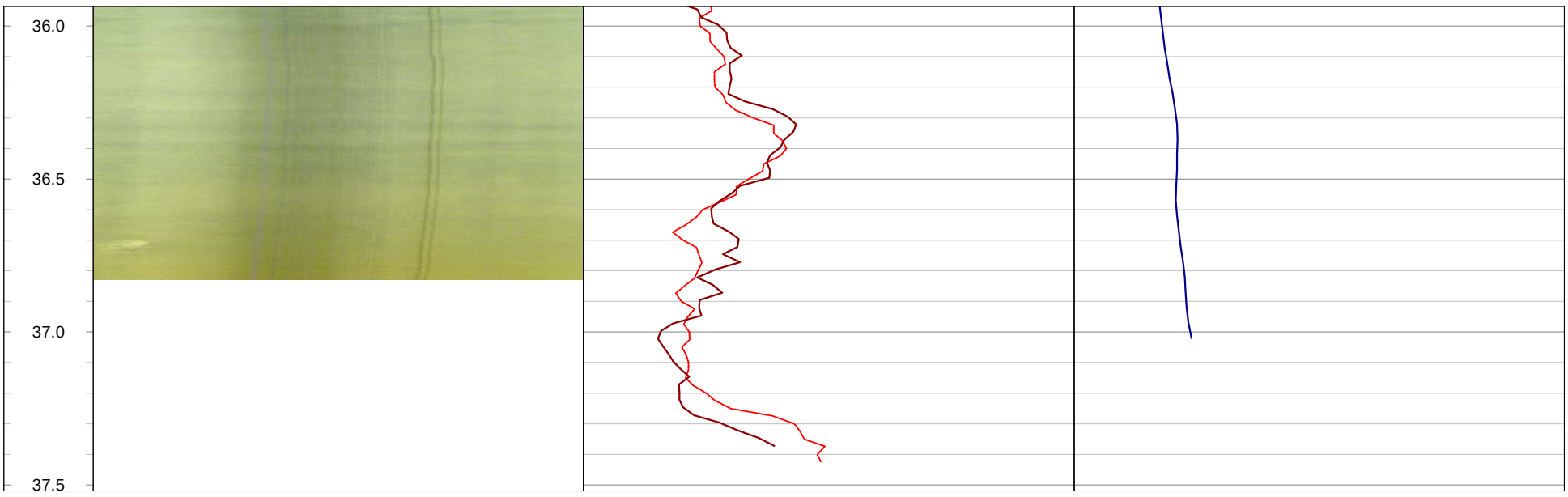
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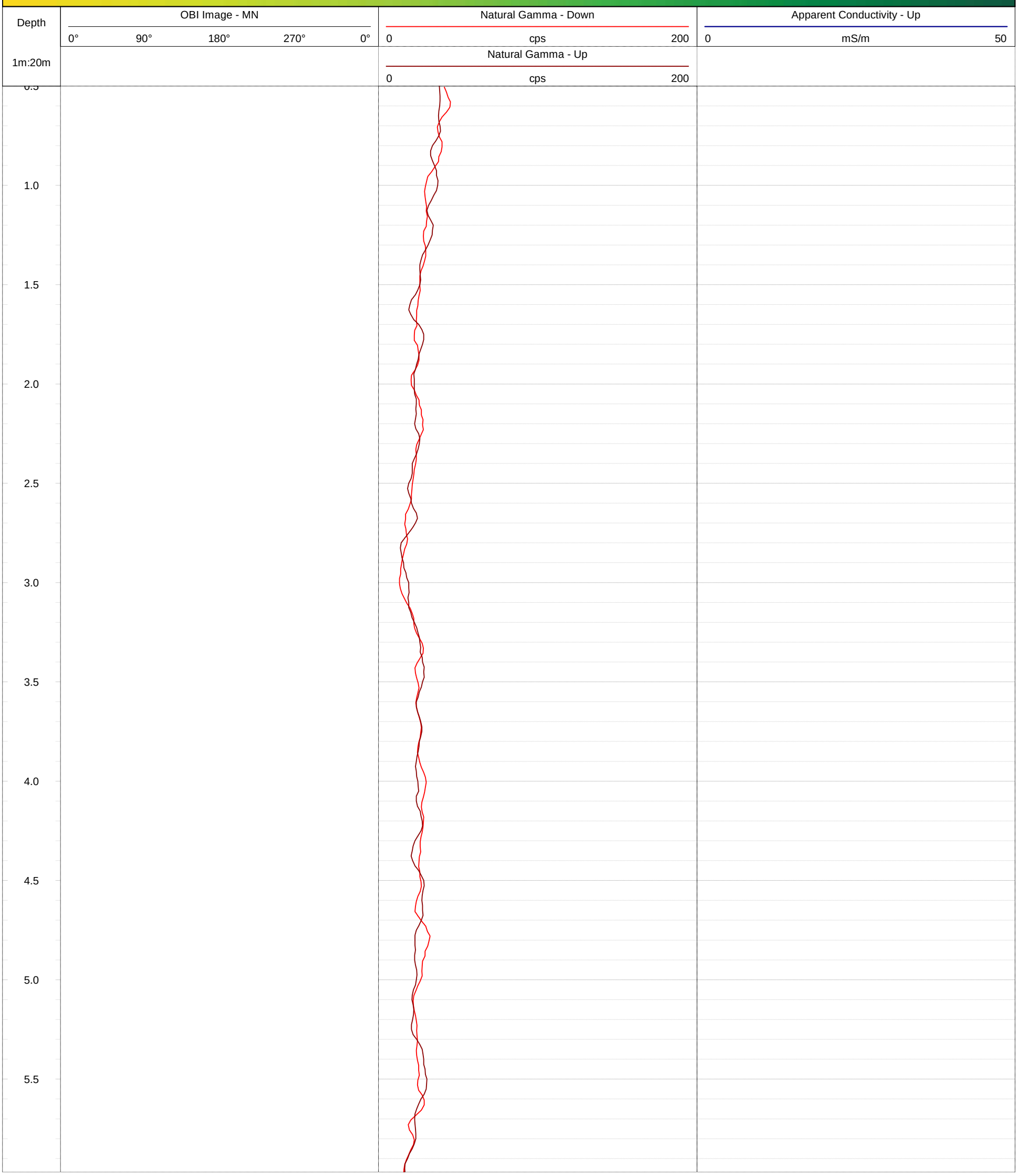
GOLDER
MEMBER OF WSP

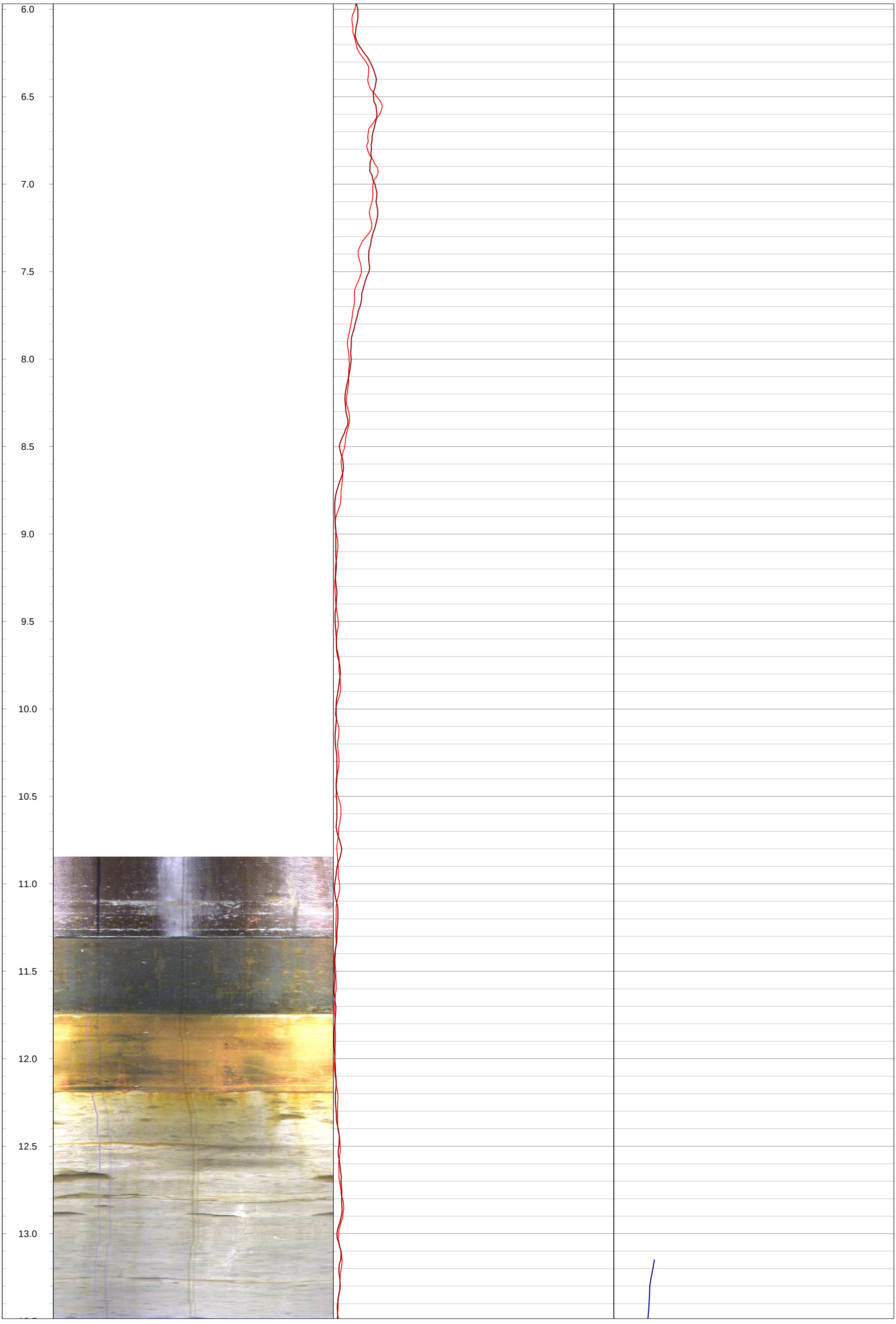
Geophysical Record of Borehole: BH20-24 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.20 m bgs	**Location:**	Caledon, Ontario
Easting:	577296.02 m	**Drilled Depth:**	22.76 m bgs	**Water Level:**	11.28 m bgs	**Log Date:**	Jun-08-2020
Northing:	4852710.32 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.60 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PG

Notes:

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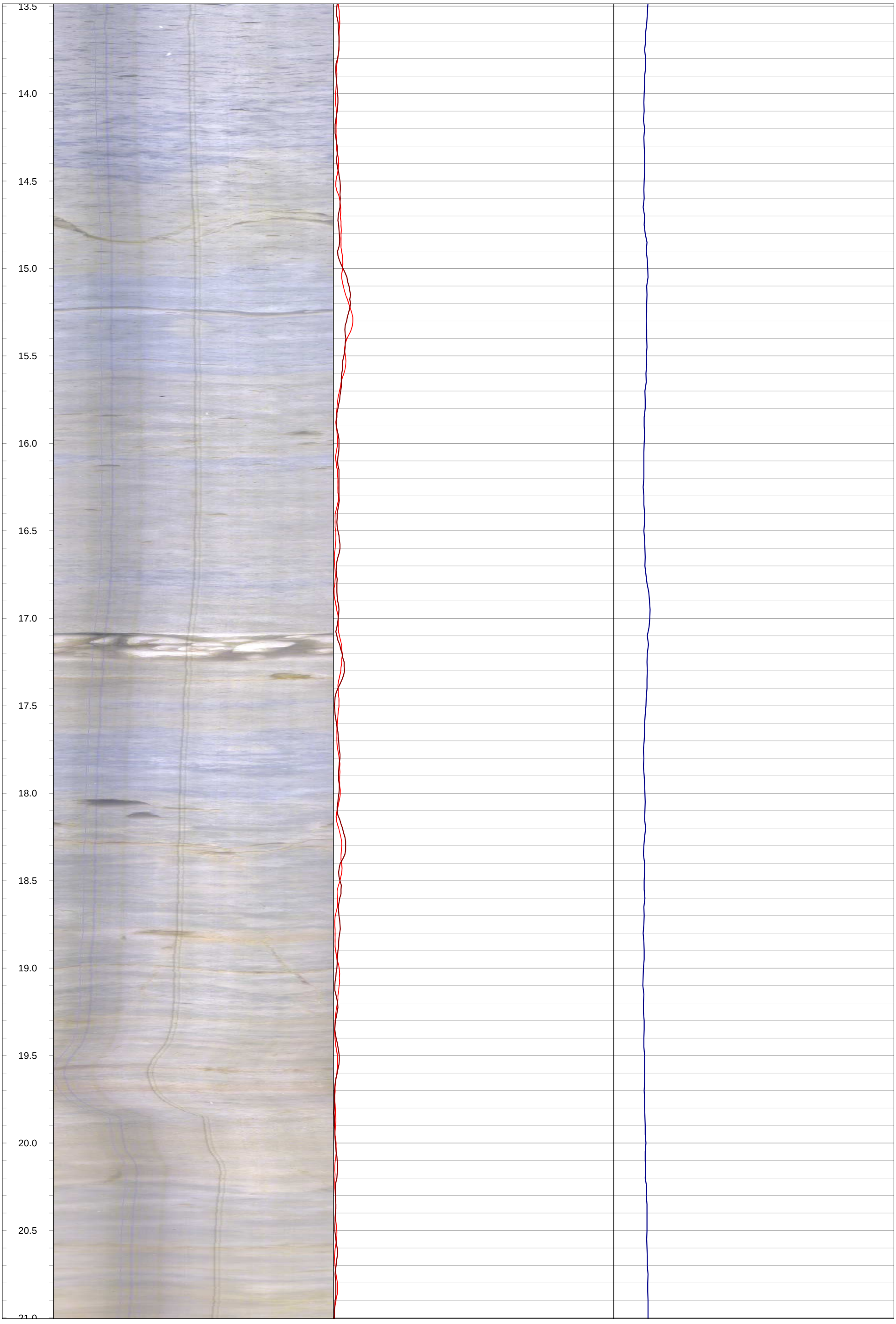
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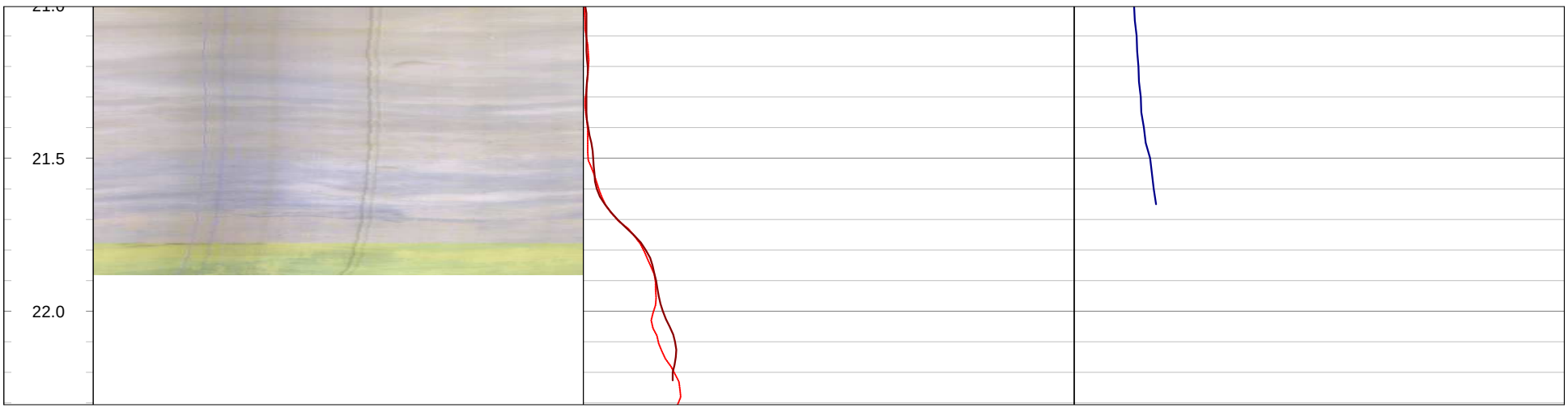
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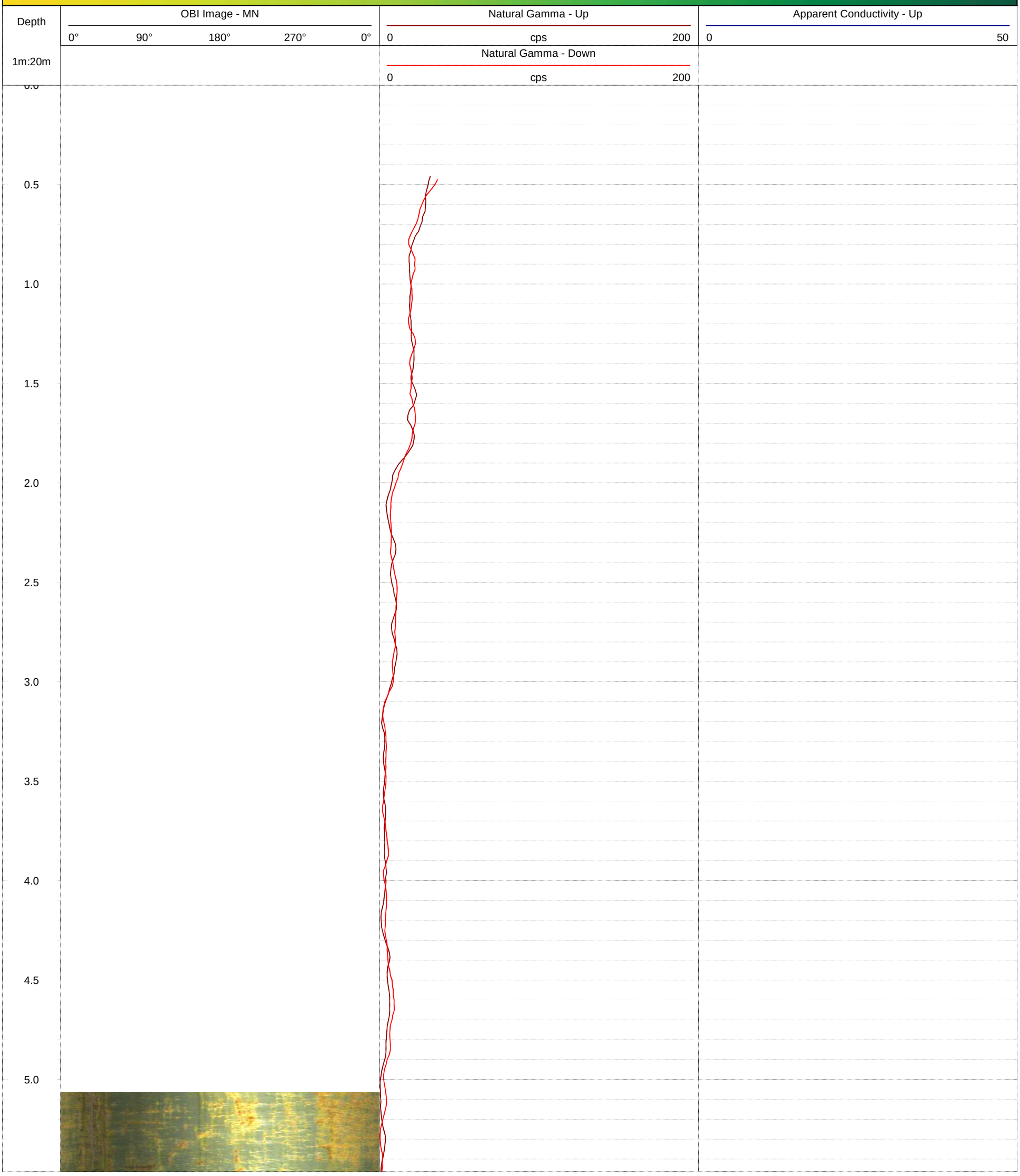
GOLDER
MEMBER OF WSP

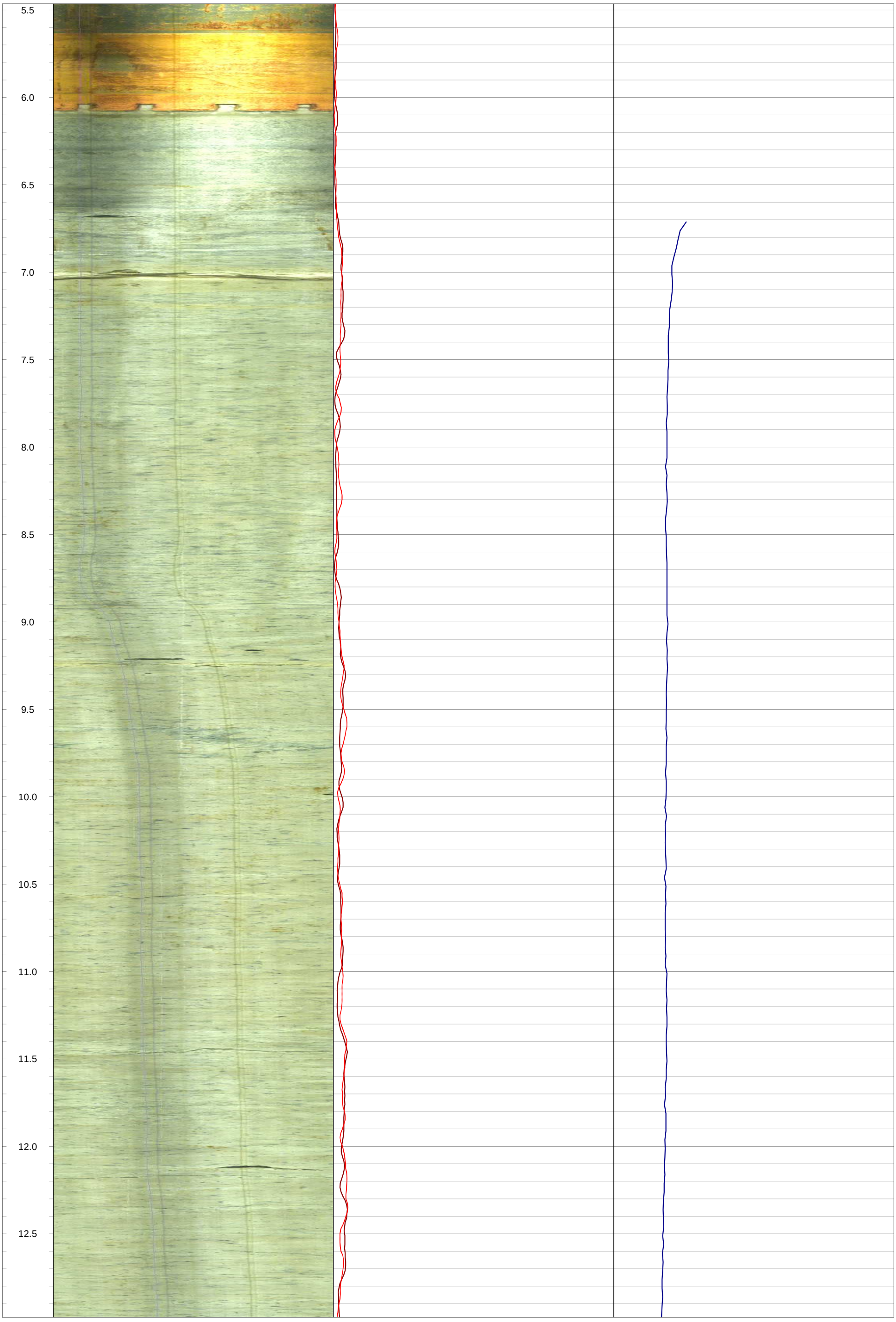
Geophysical Record of Borehole: BH20-25 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.08 m bgs	**Location:**	Caledon, Ontario
Easting:	577402.13 m	**Drilled Depth:**	22.03 m bgs	**Water Level:**	4.03 m bgs	**Log Date:**	Jun-15-2020
Northing:	4852974.96 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.48 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.22 m ags	**Logged By:**	PG

Notes:

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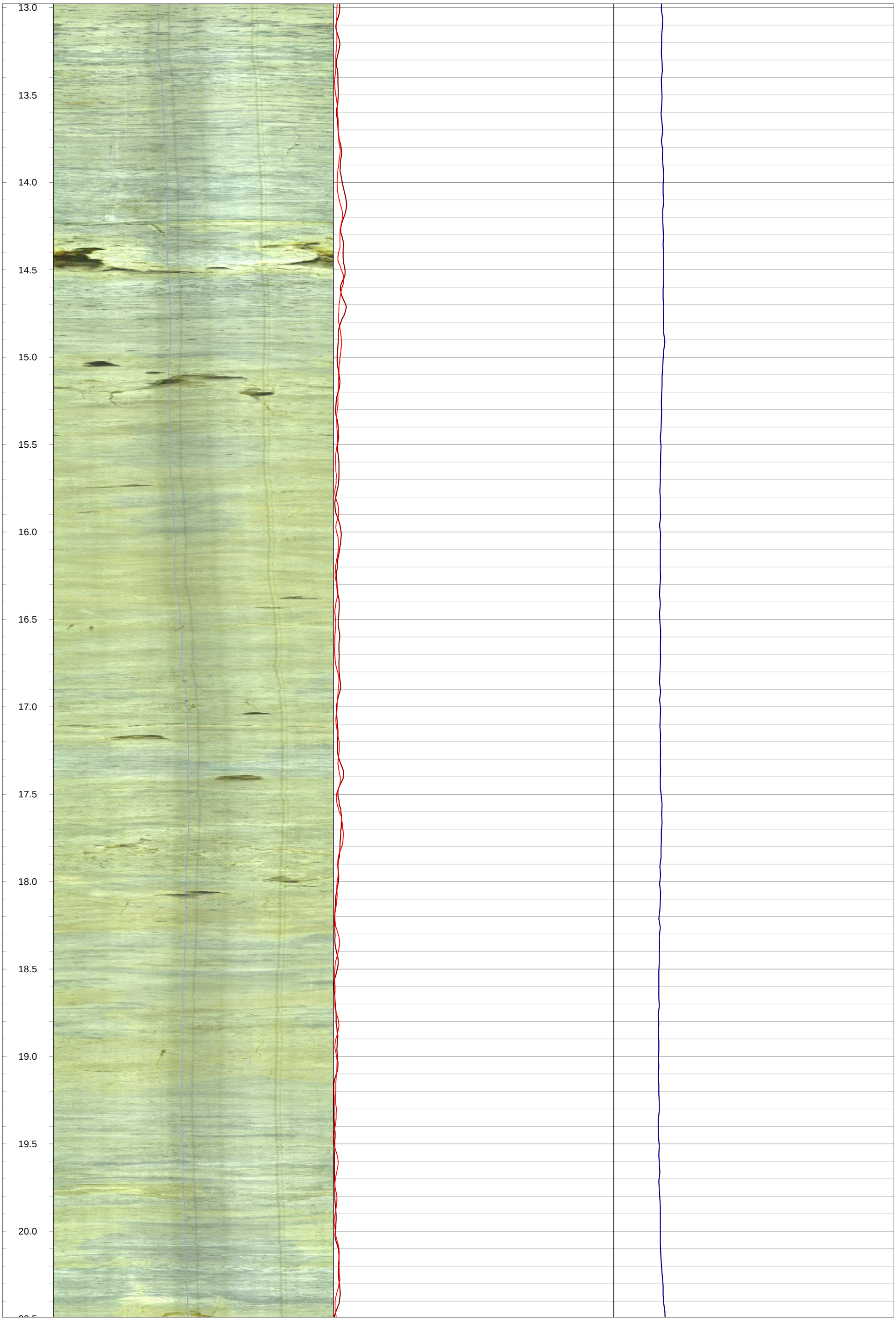
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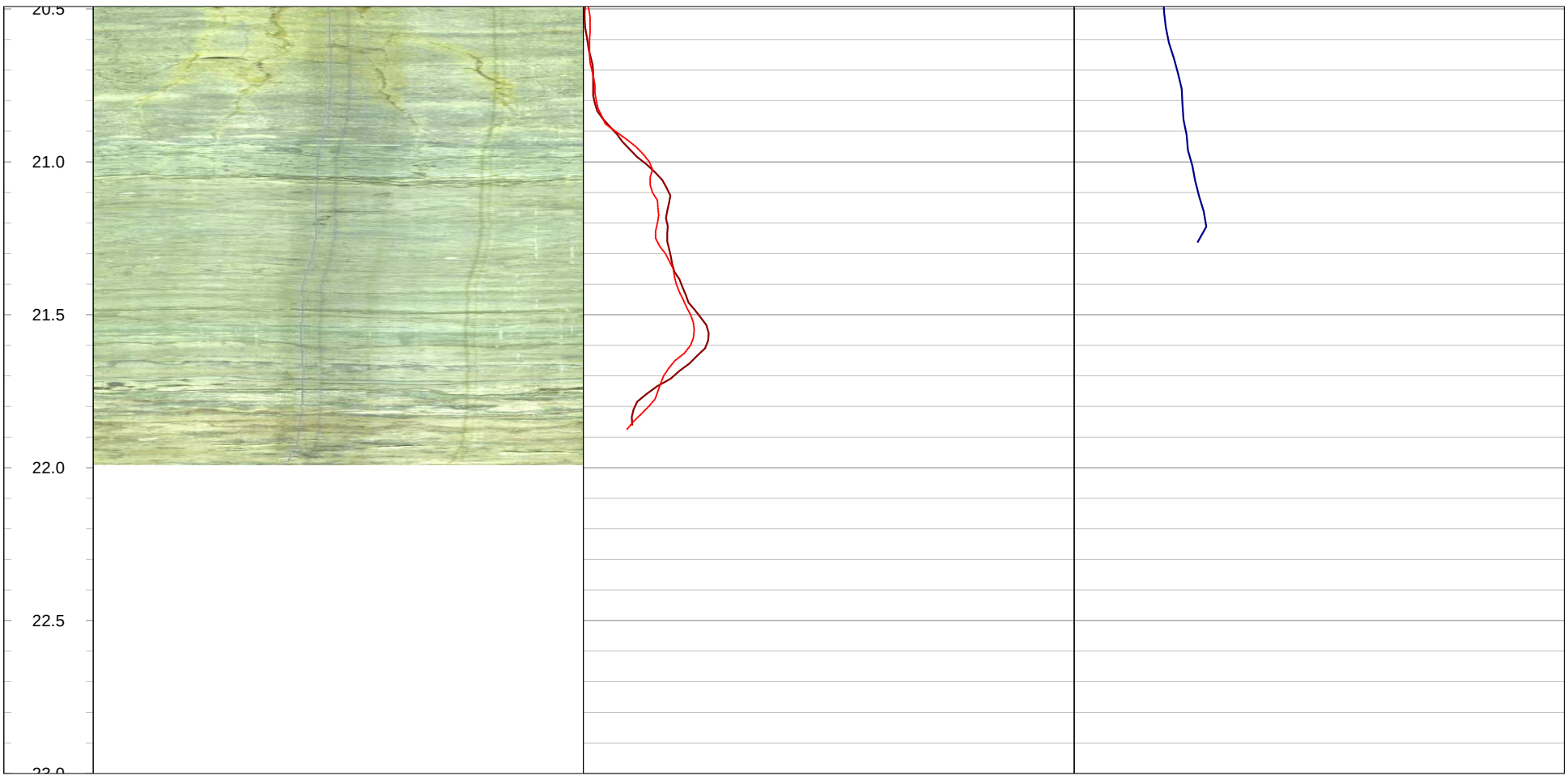
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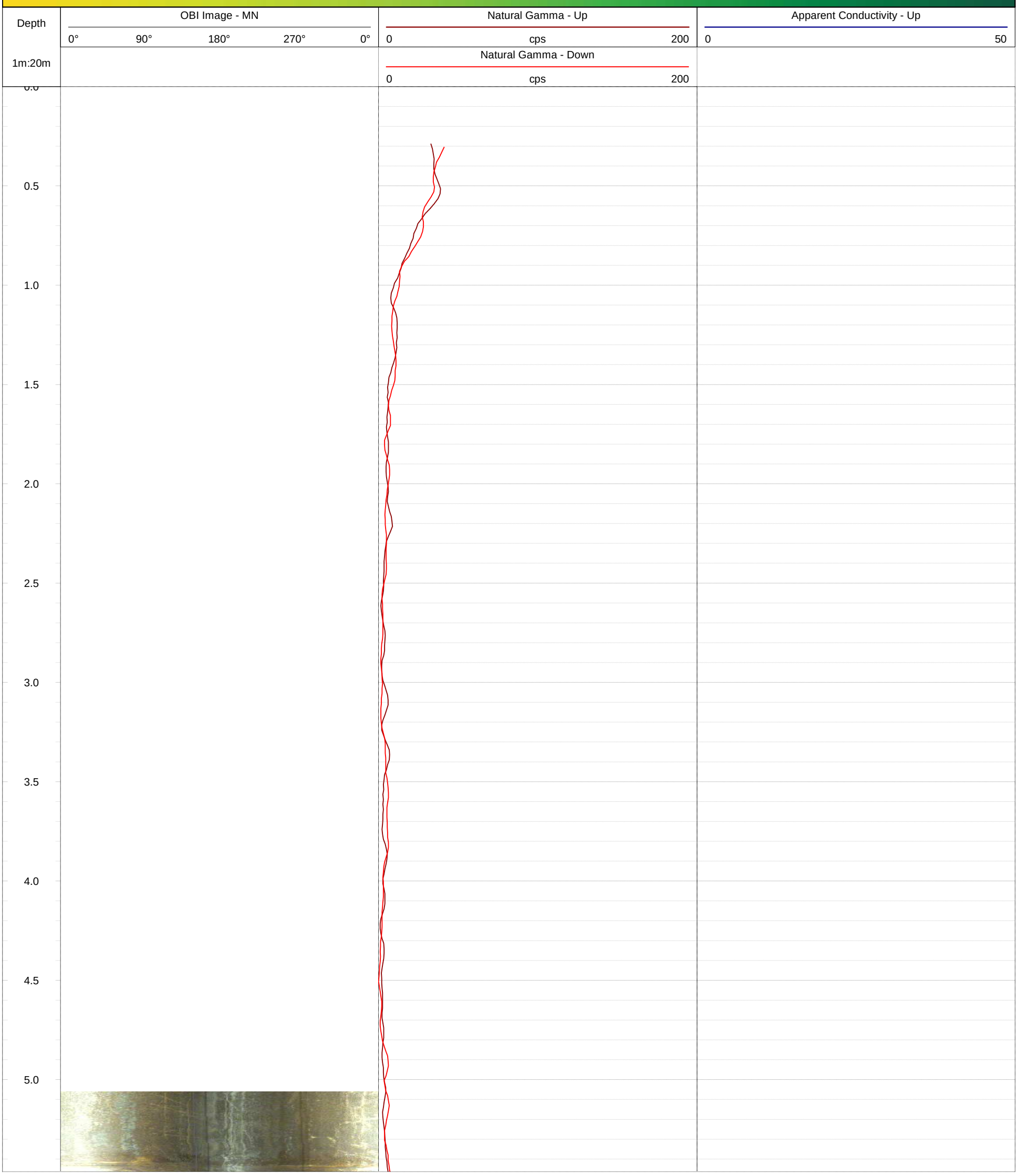
GOLDER
MEMBER OF WSP

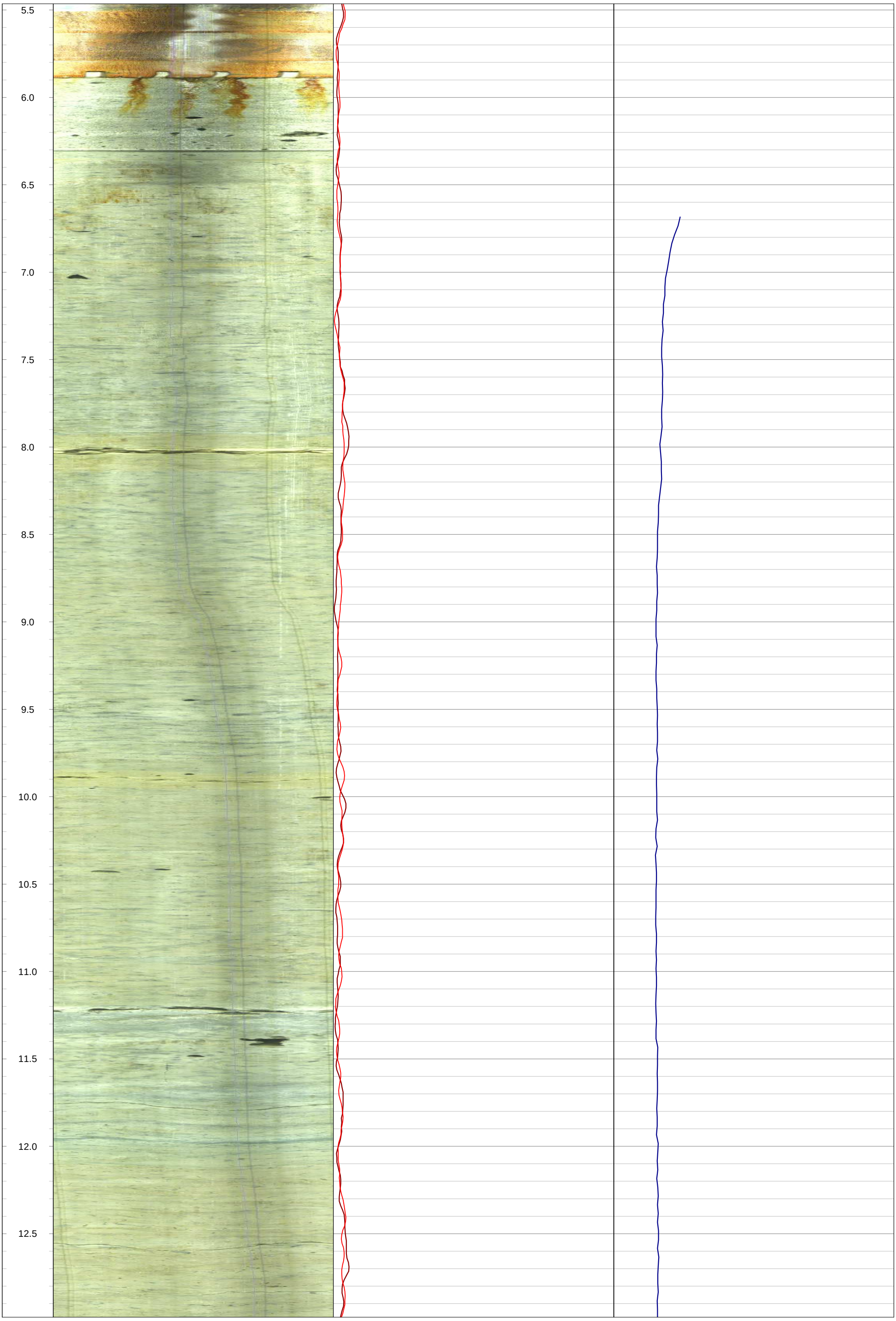
Geophysical Record of Borehole: BH20-26 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.89 m bgs	**Location:**	Caledon, Ontario
Easting:	577037.86 m	**Drilled Depth:**	22.73 m bgs	**Water Level:**	6.15 m bgs	**Log Date:**	Jun-15-2020
Northing:	4852942.75 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.82 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.39 m ags	**Logged By:**	PG

Notes:

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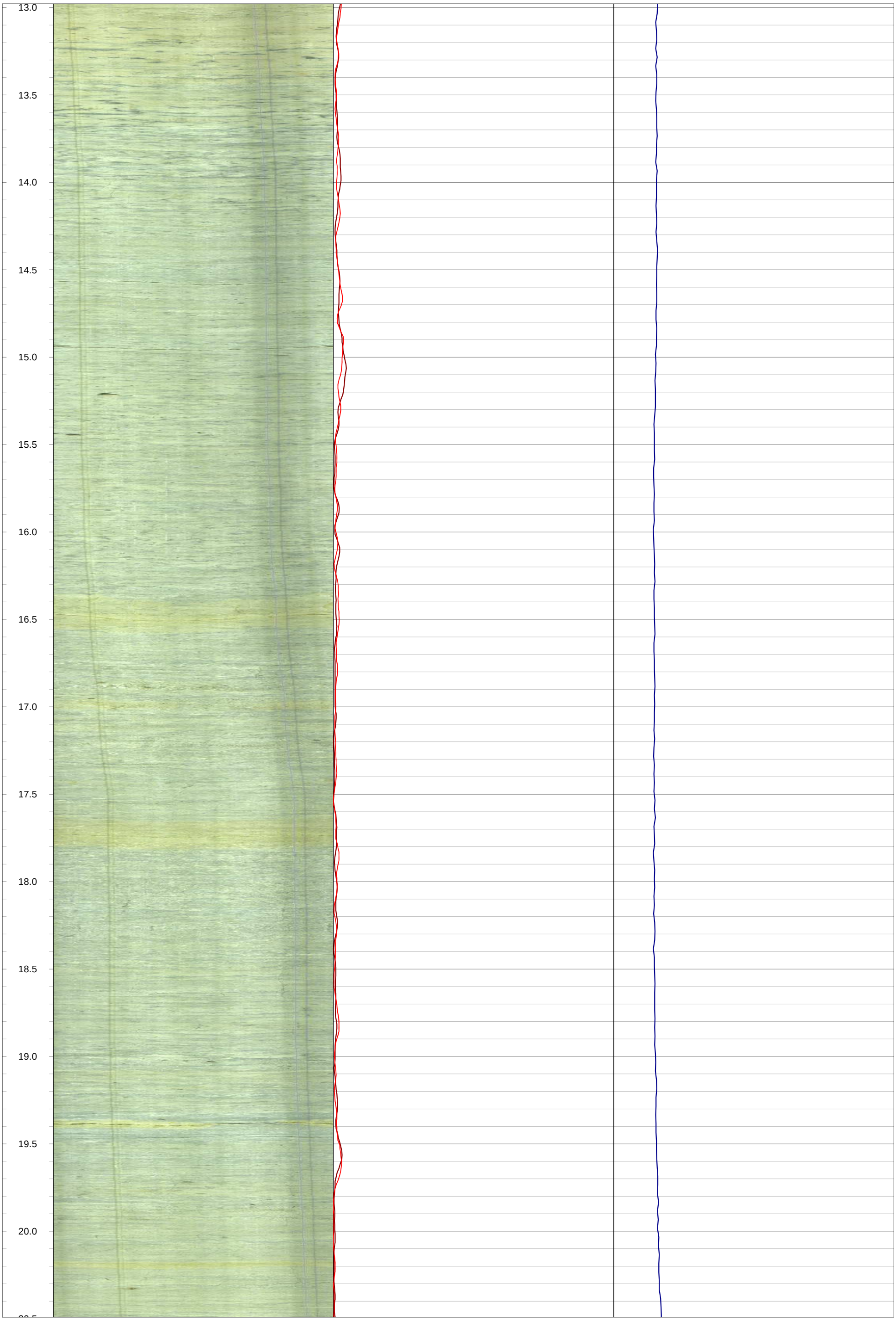
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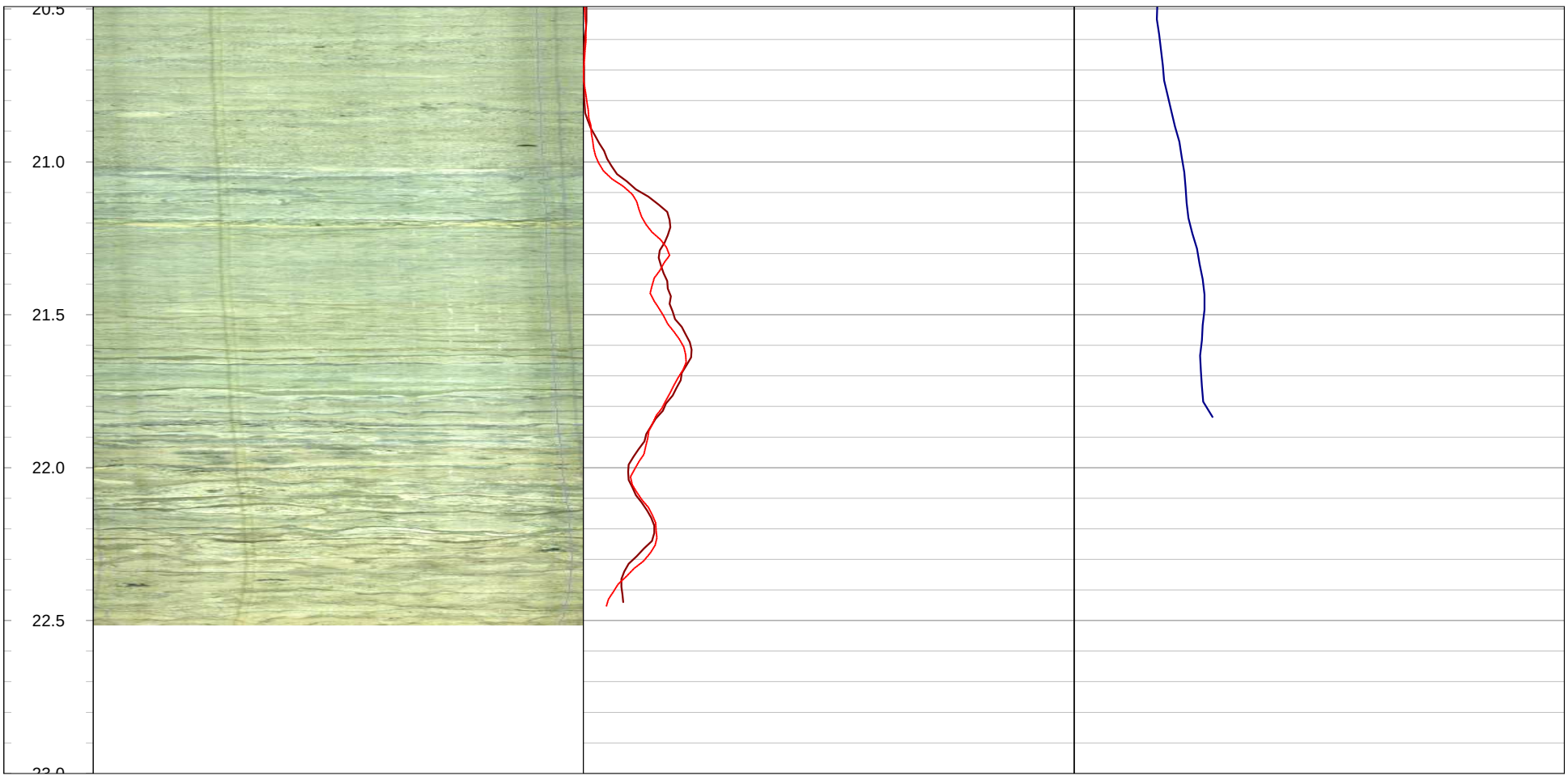
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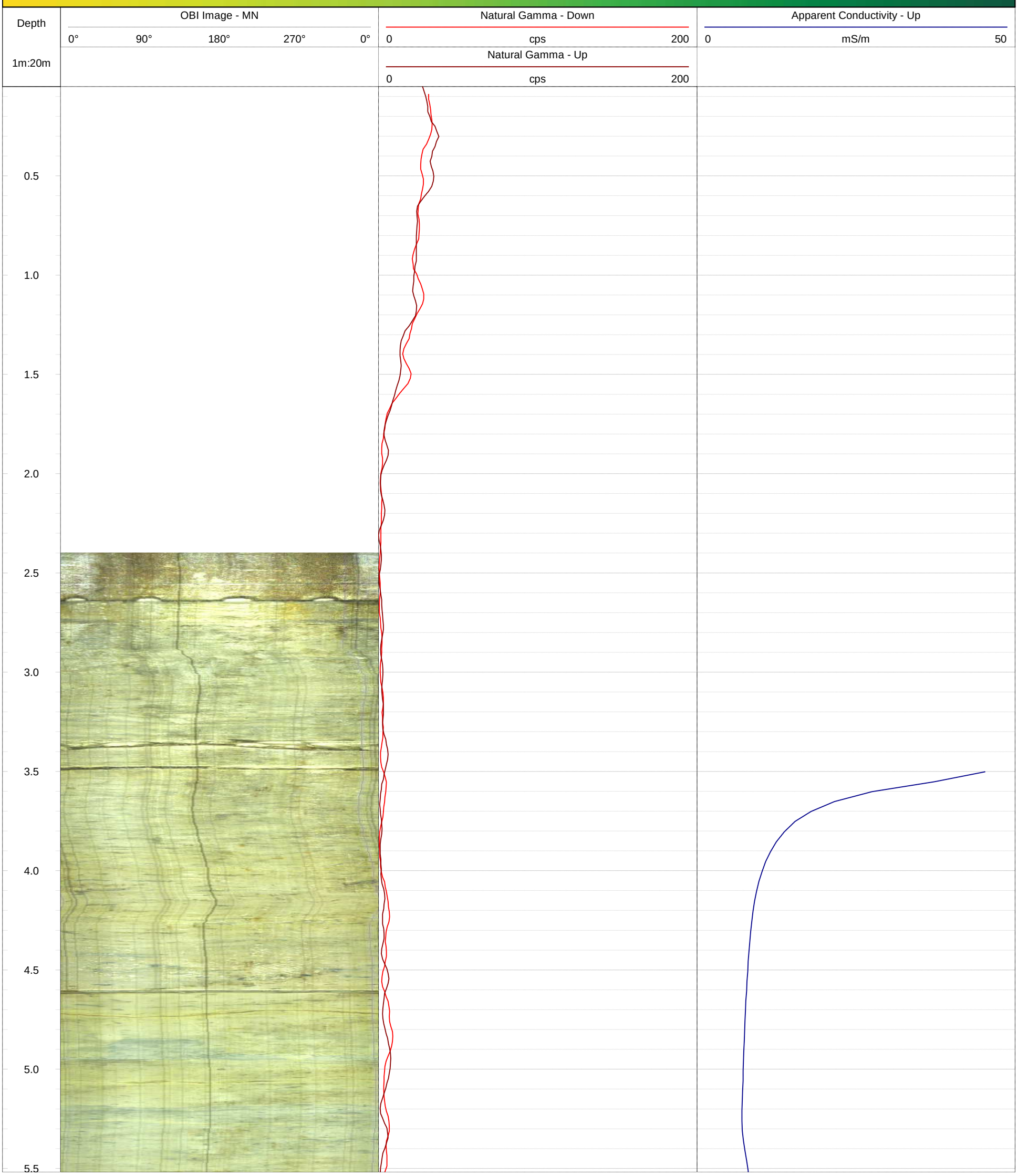
GOLDER
MEMBER OF WSP

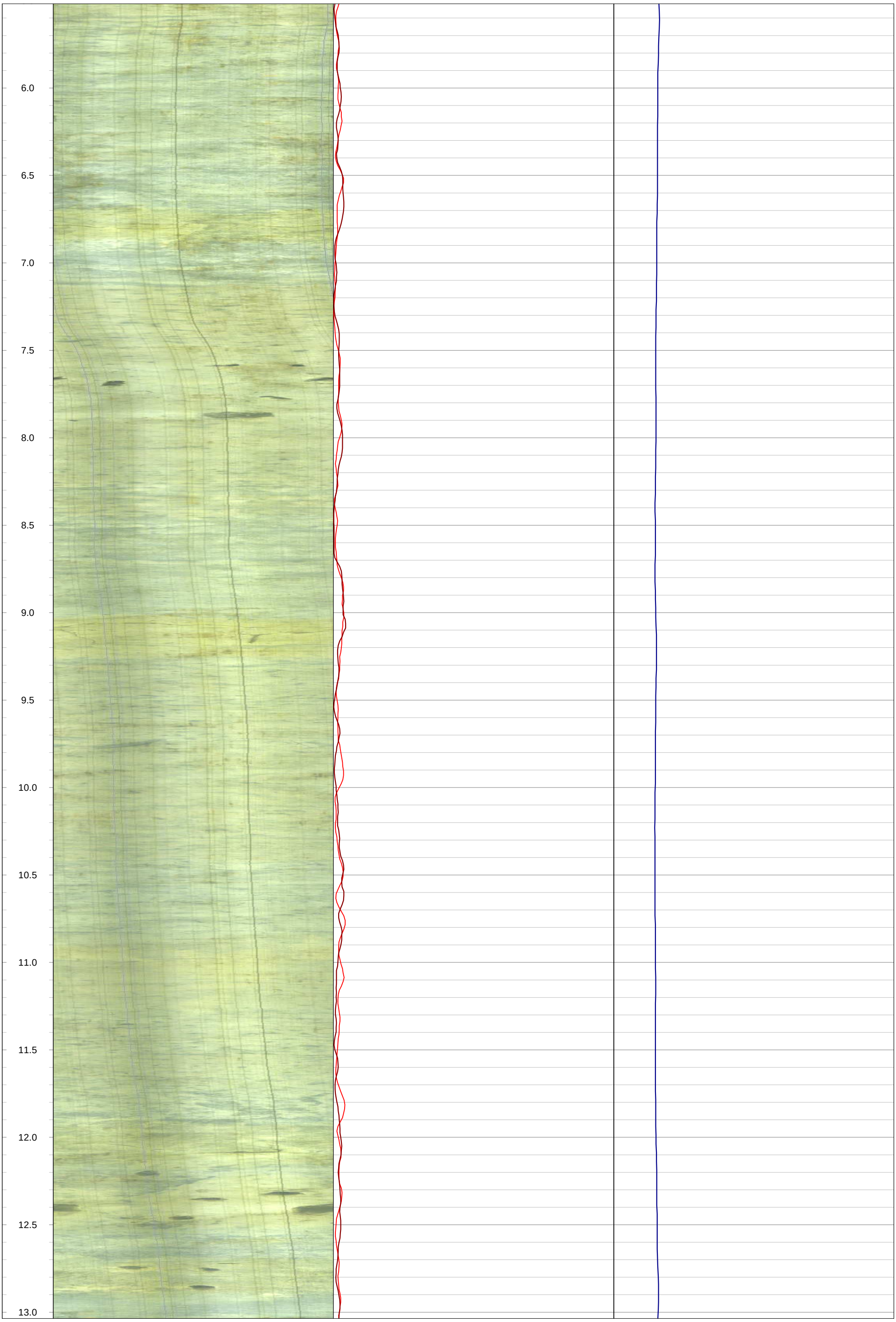
Geophysical Record of Borehole: BH20-27 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.64 m bgs	**Location:**	Caledon, Ontario
Easting:	577212.29 m	**Drilled Depth:**	27.65 m bgs	**Water Level:**	4.41 m bgs	**Log Date:**	Oct-22-2020
Northing:	4853168.73 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	408.64 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.61 m ags	**Logged By:**	CM

Notes: OBI image opaque > 25.35 m bgs

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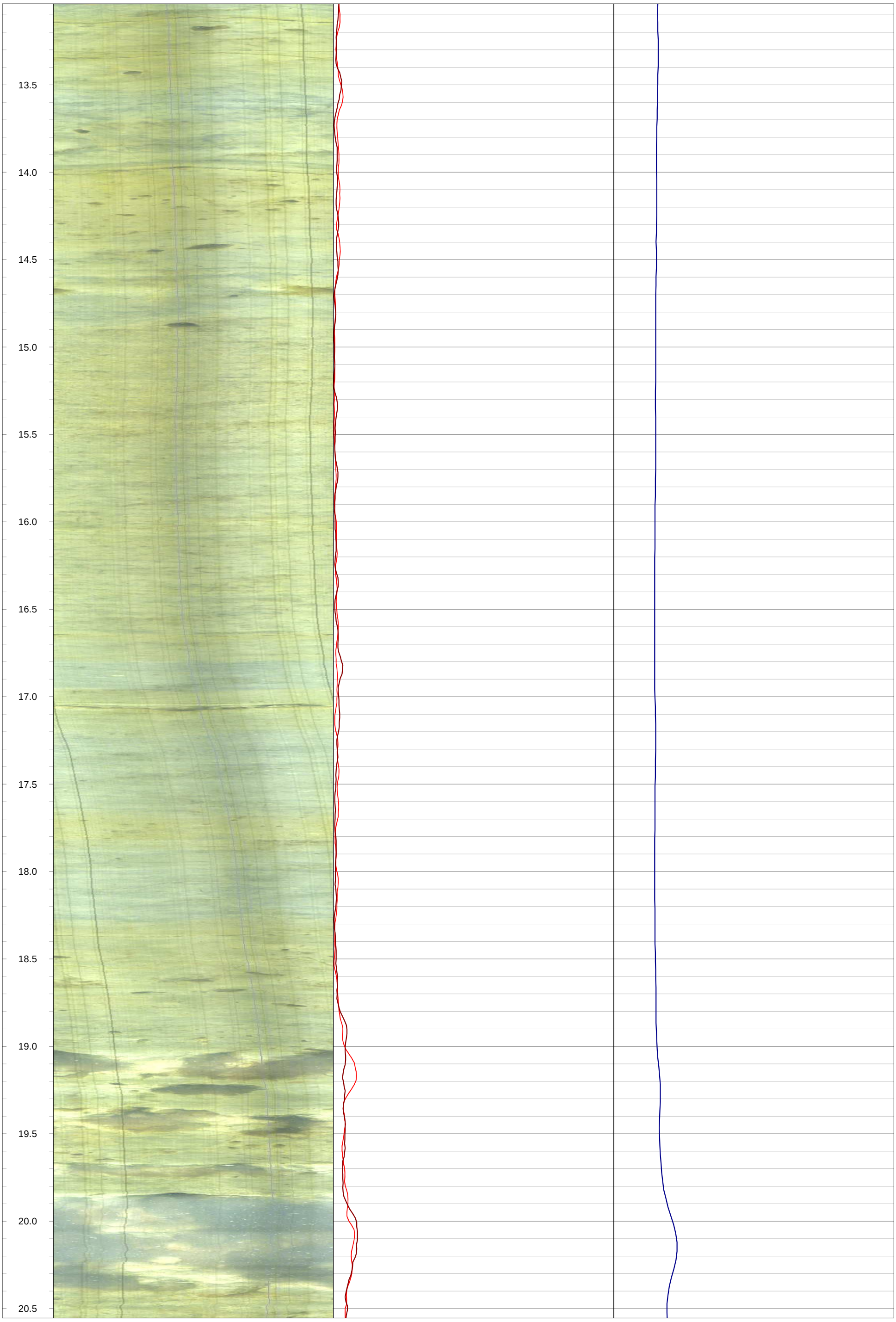
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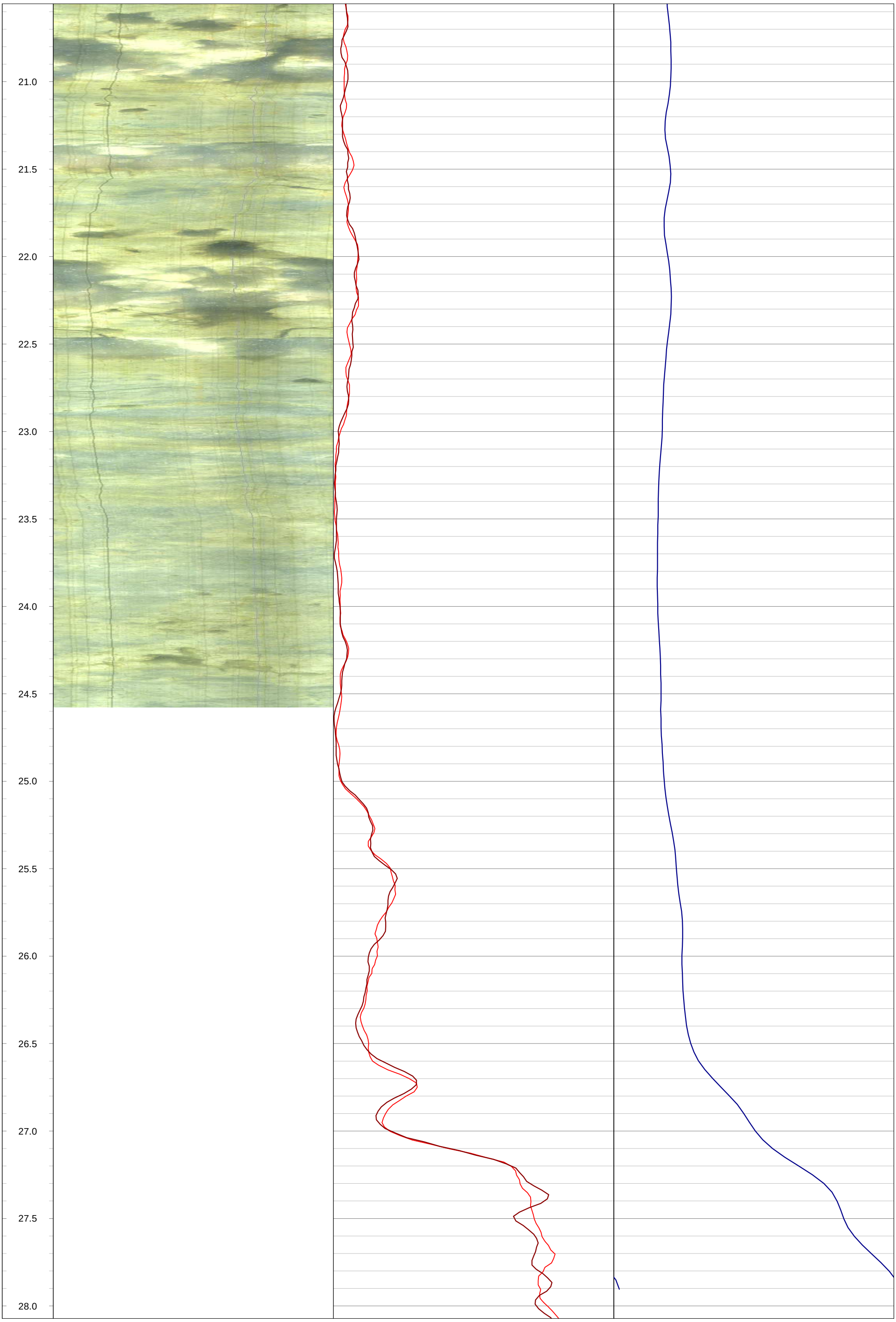
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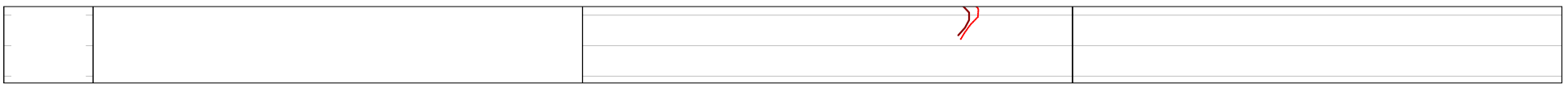


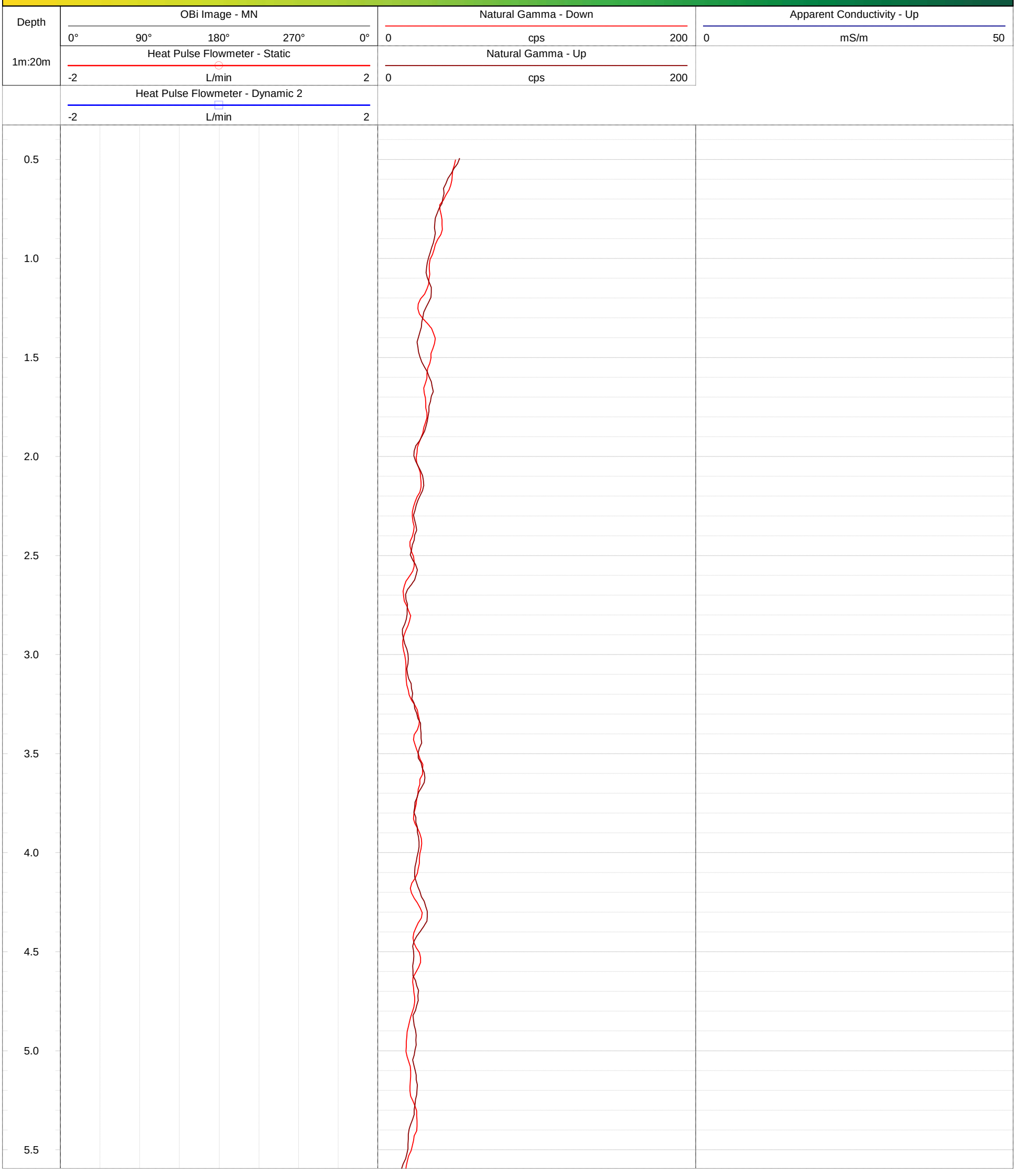
GOLDER
MEMBER OF WSP

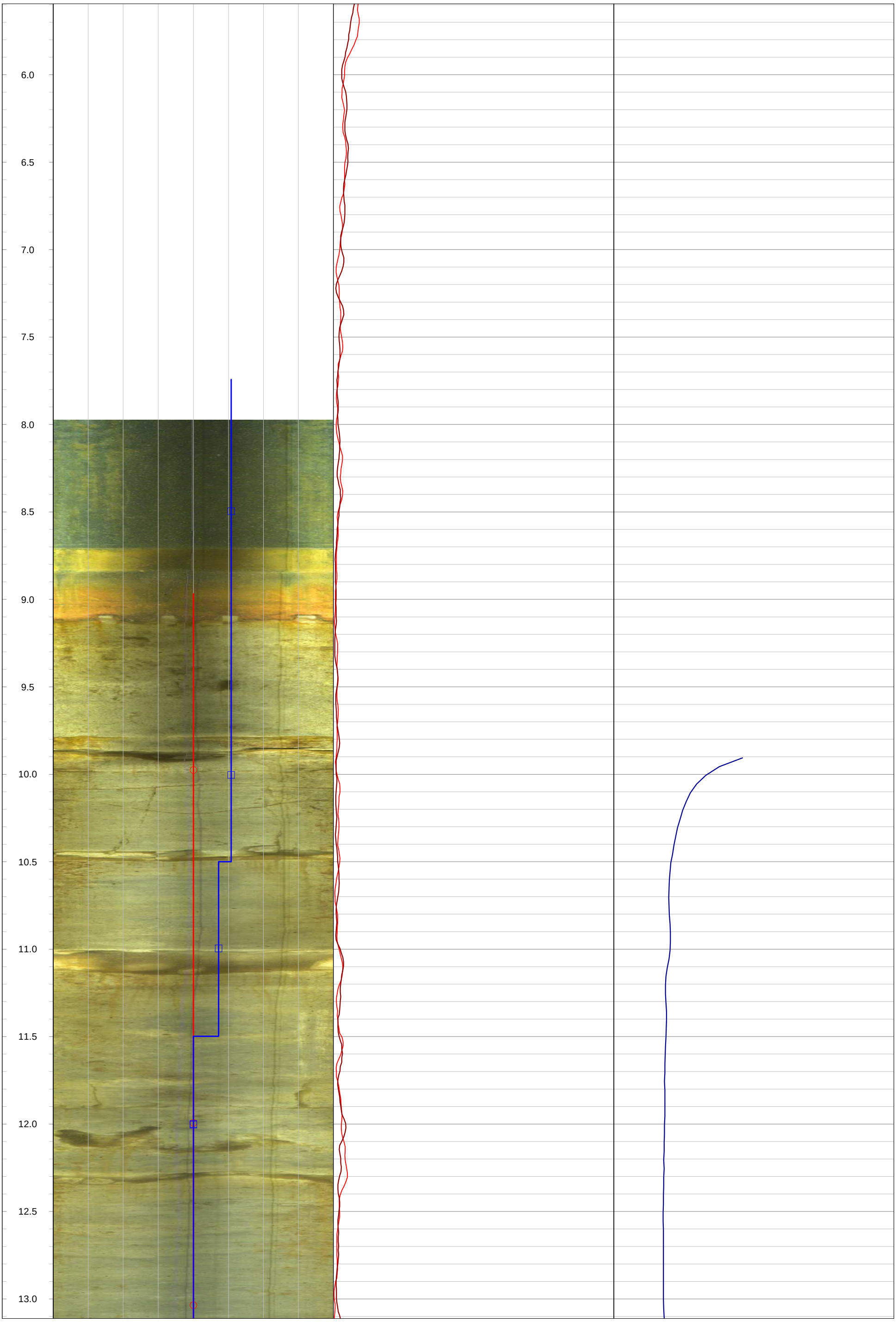
Geophysical Record of Borehole: MW20-01 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.13 m bgs	**Location:**	Caledon, Ontario
Easting:	577458.50 m	**Drilled Depth:**	19.41 m bgs	**Water Level:**	1.91 m bgs	**Log Date:**	Mar-13,16-2020
Northing:	4852268.28 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	395.10 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	CM/PG

Notes: Heat Pulse Flowmeter Dynamic pump at 6.0 m below top of casing. Pump rate approximately 2.34 L/min.

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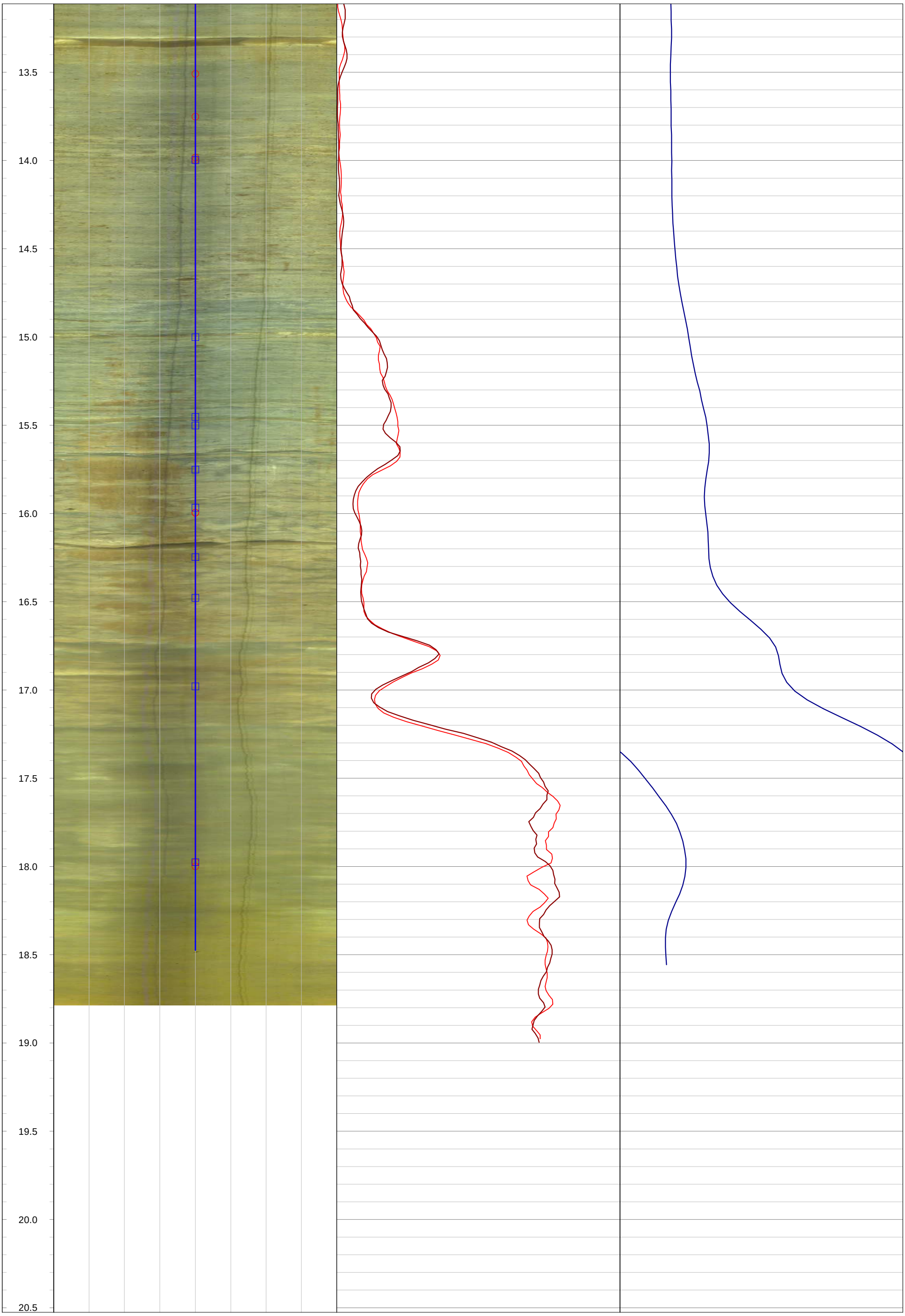
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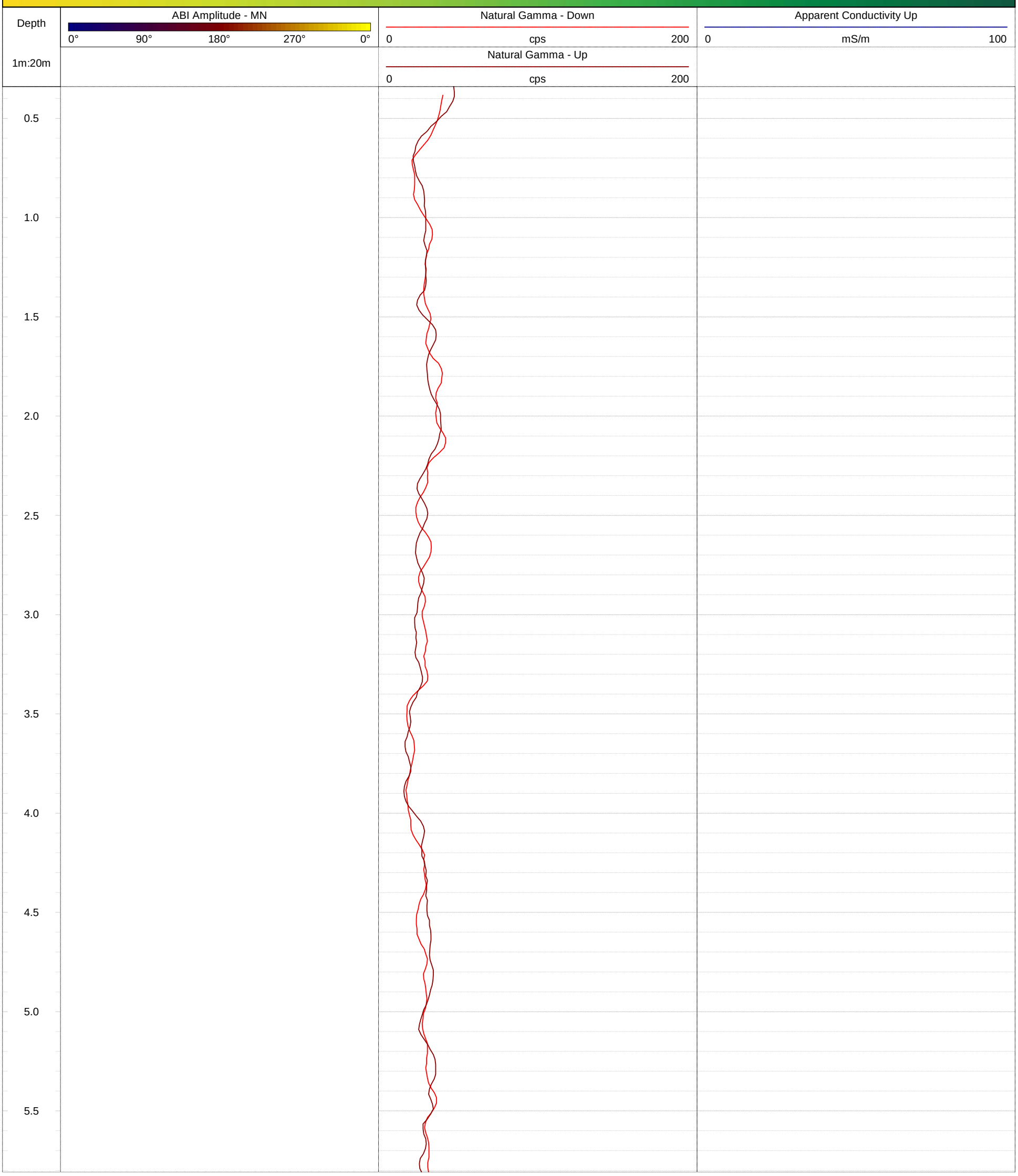
GOLDER
MEMBER OF WSP

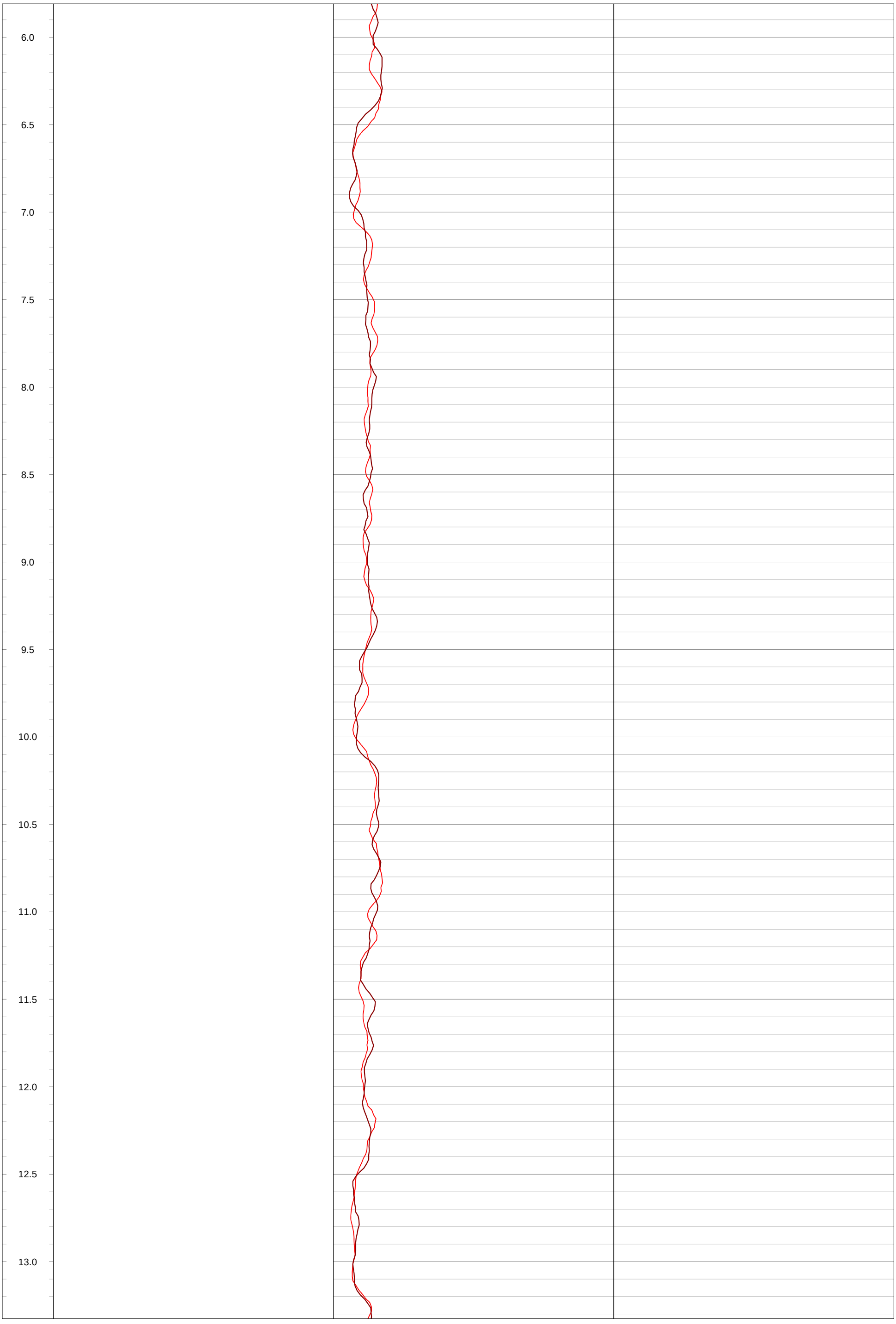
Geophysical Record of Borehole: MW20-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.91 m bgs	**Location:**	Caledon, Ontario
Easting:	577900.04 m	**Drilled Depth:**	19.57 m bgs	**Water Level:**	8.12 m bgs	**Log Date:**	Mar-11-2020
Northing:	48522138.37 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.63 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.32 m ags	**Logged By:**	CM

Notes: Poor conditions in the borehole. Casing depth is approximate.

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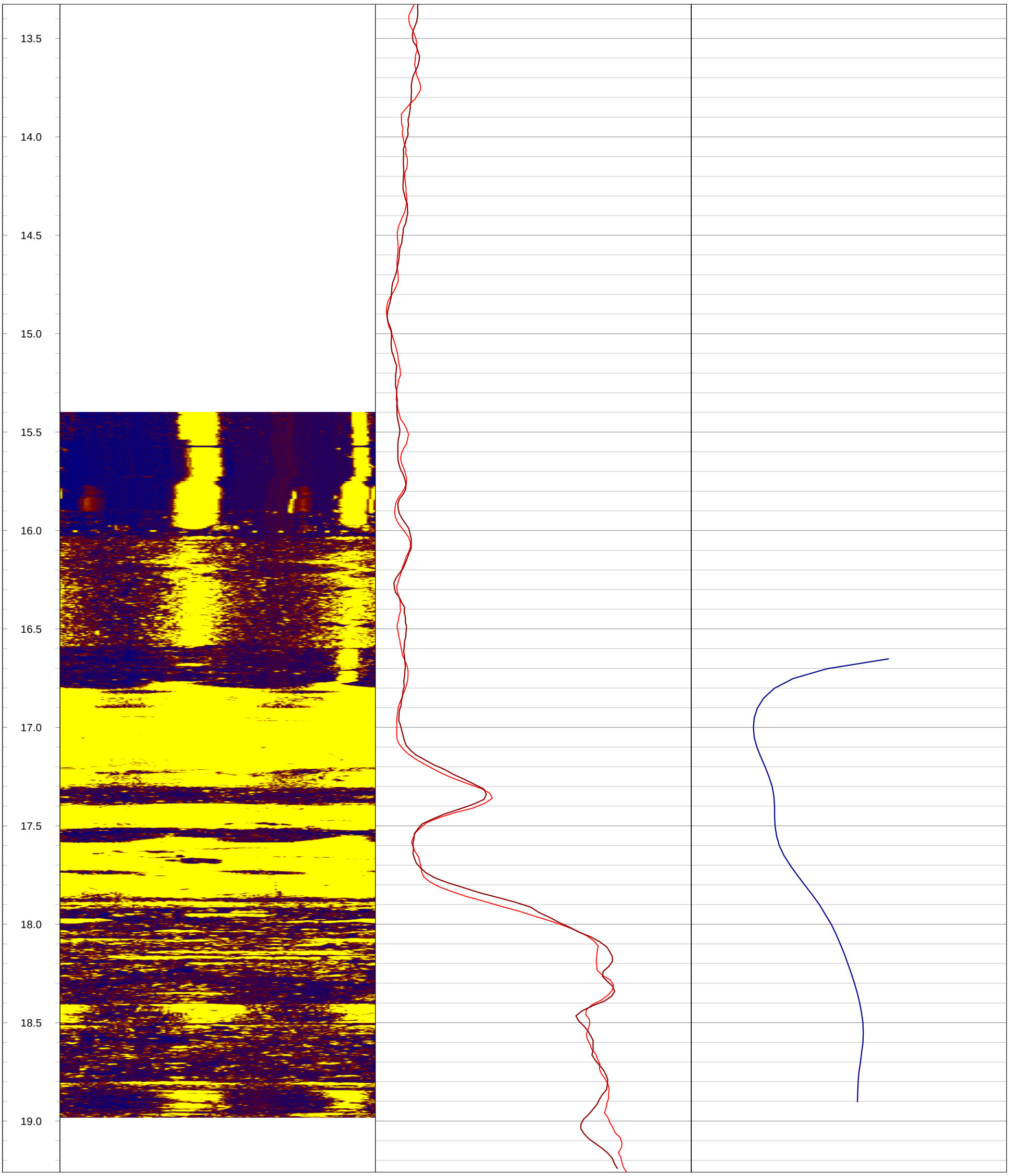
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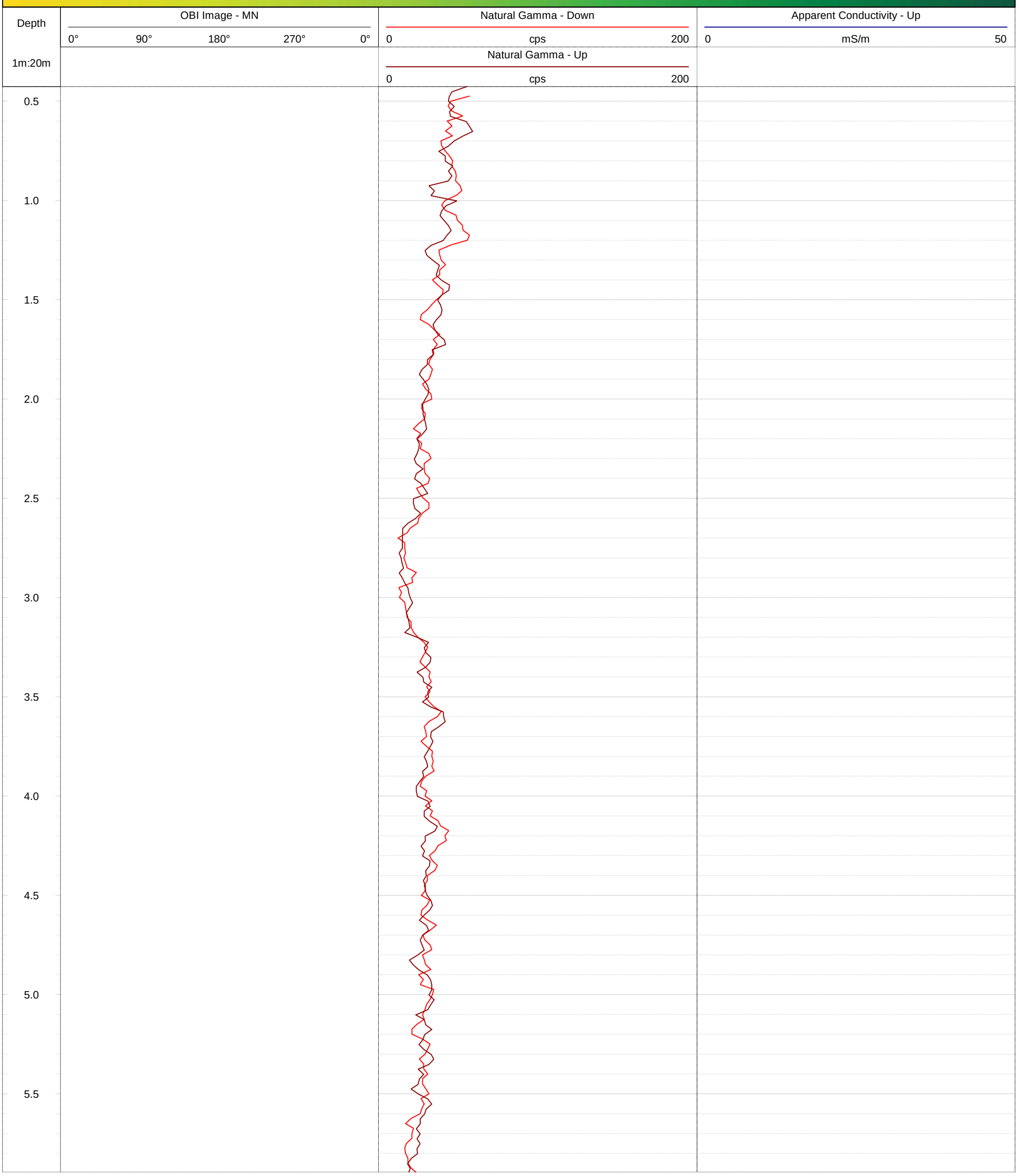
GOLDER
MEMBER OF WSP

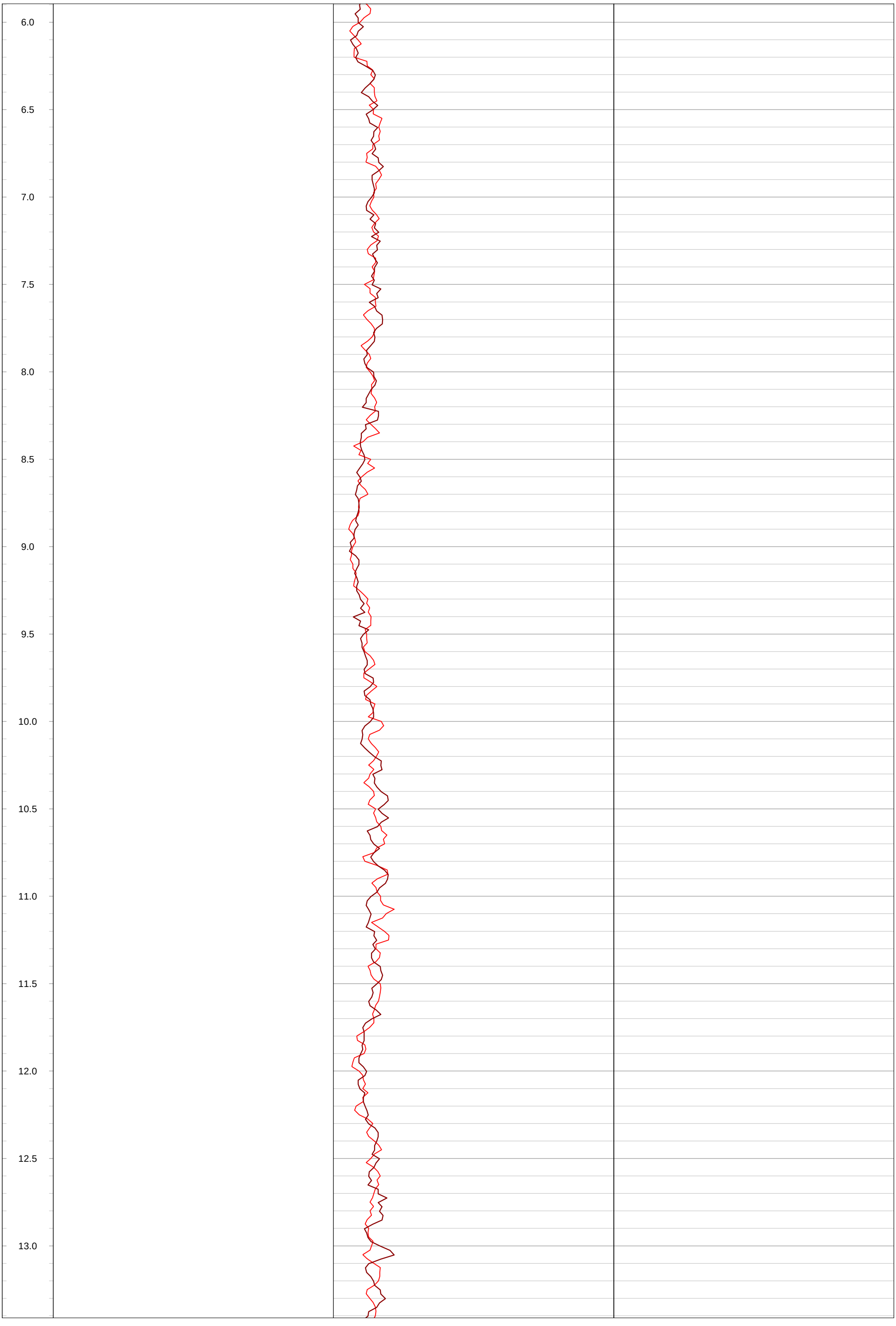
Geophysical Record of Borehole: MW20-04 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.17 m bgs	**Location:**	Caledon, Ontario
Easting:	578264.75 m	**Drilled Depth:**	18.50 m bgs	**Water Level:**	9.02 m bgs	**Log Date:**	Mar-13-2020
Northing:	4852313.19 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.46 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.23 m ags	**Logged By:**	CM

Notes:

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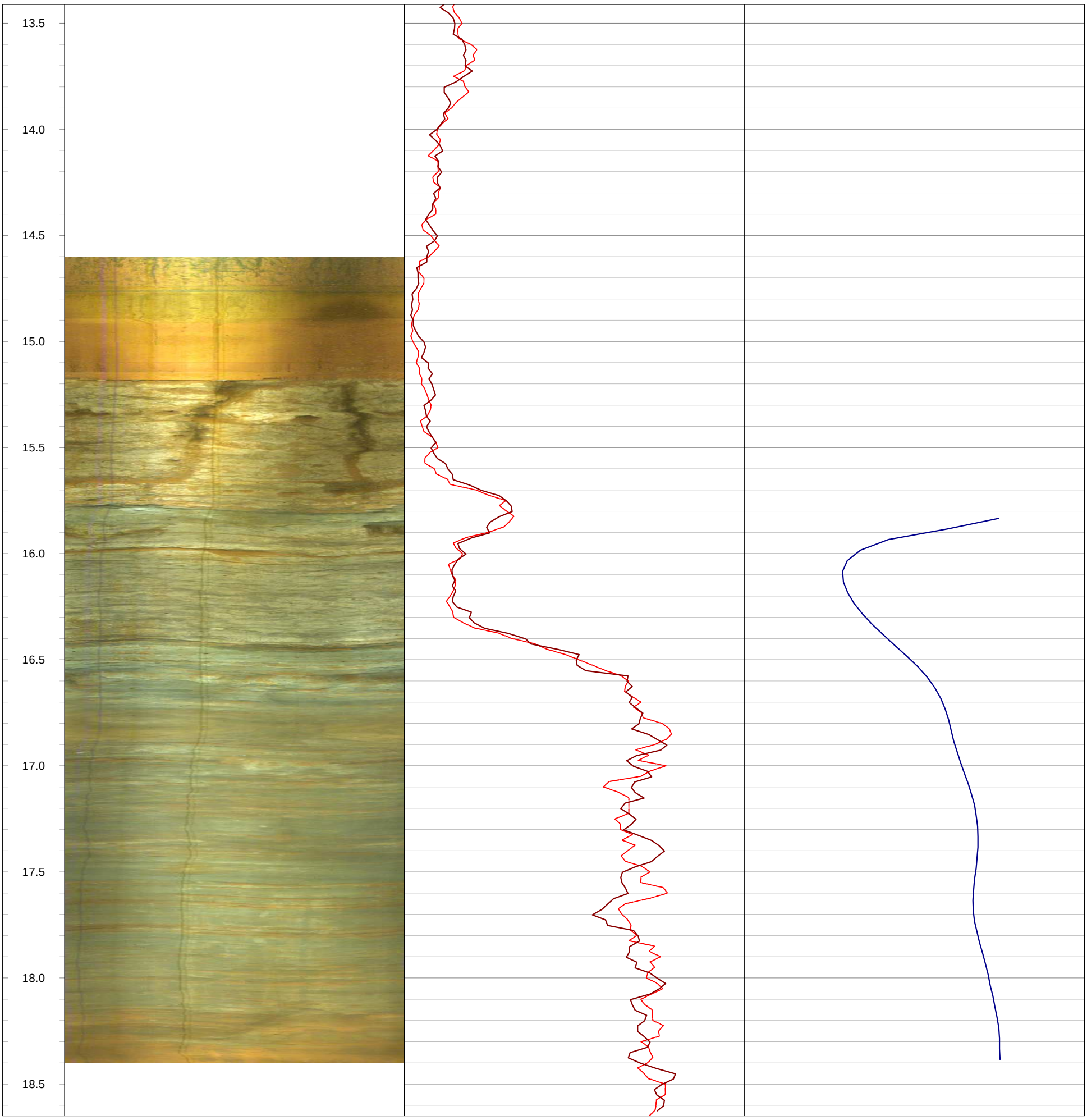
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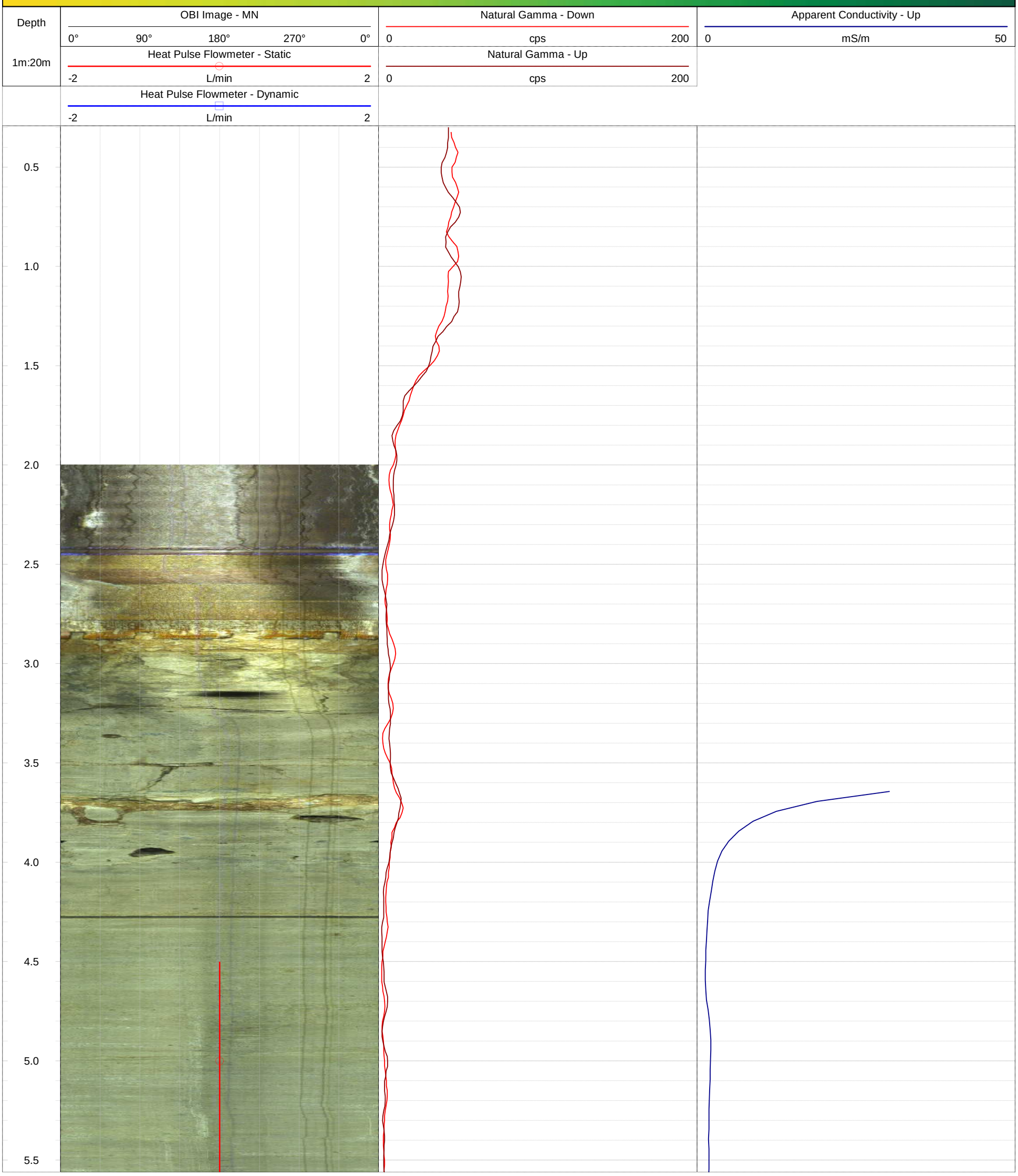
GOLDER
MEMBER OF WSP

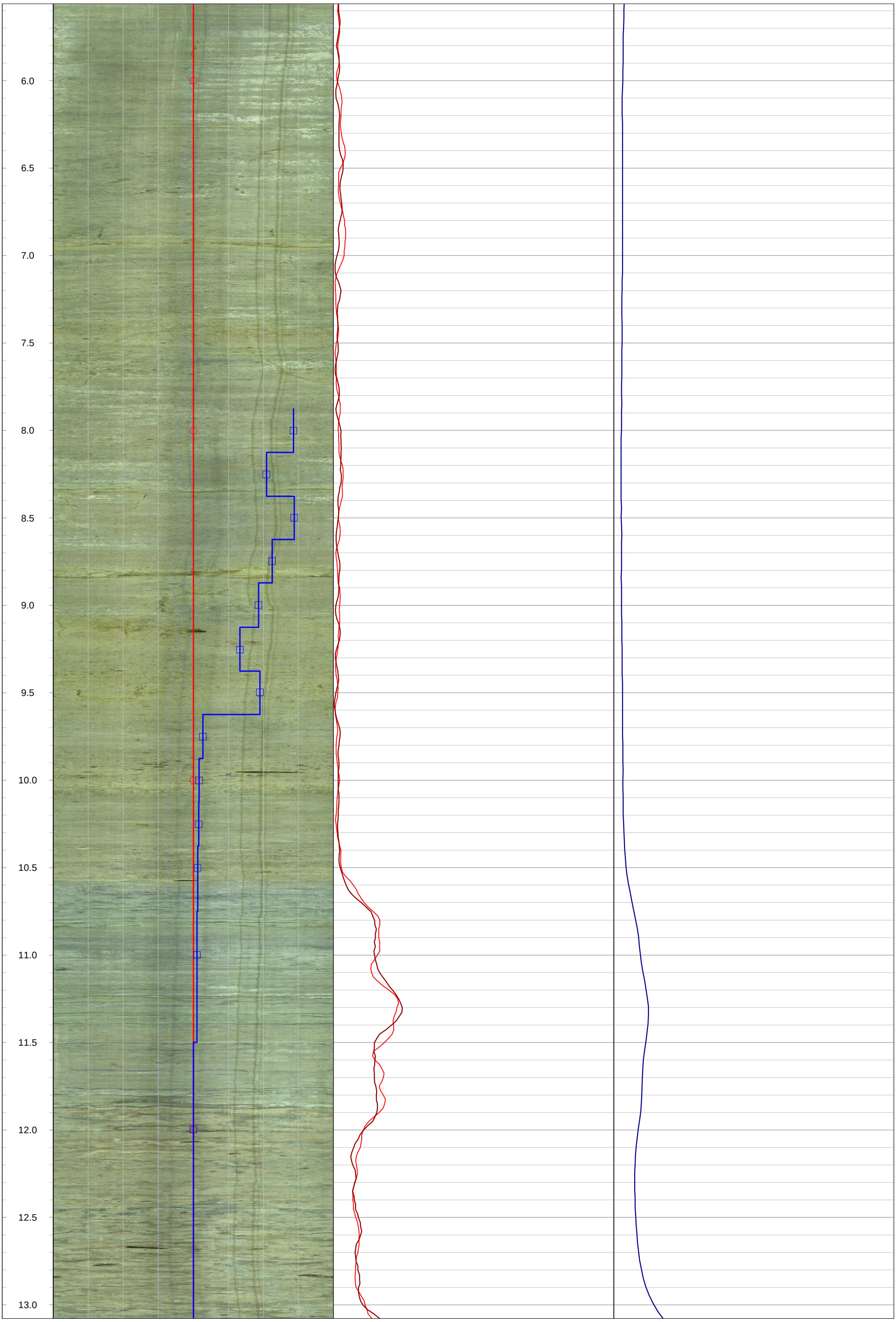
Geophysical Record of Borehole: MW20-05 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.87 m bgs	**Location:**	Caledon, Ontario
Easting:	578423.10 m	**Drilled Depth:**	14.84 m bgs	**Water Level:**	4.04 m bgs	**Log Date:**	Mar-20-2020
Northing:	4852712.60 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.63 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.38 m ags	**Logged By:**	CM

Notes: Heat Pulse Flowmeter Dynamic pump at 6.0 m below top of casing. Pump rate approximately 2.25 L/min.

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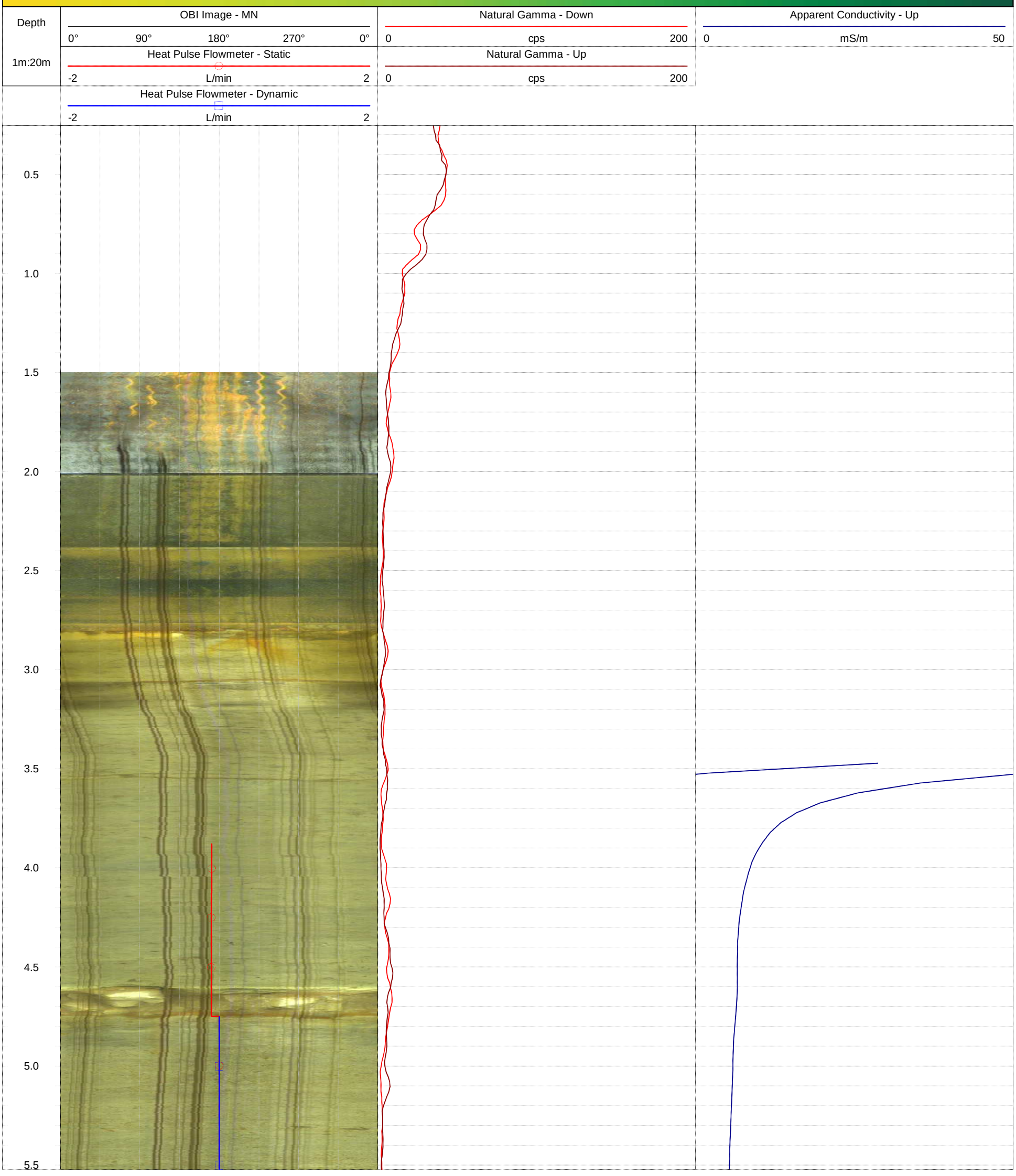
GOLDER
MEMBER OF WSP

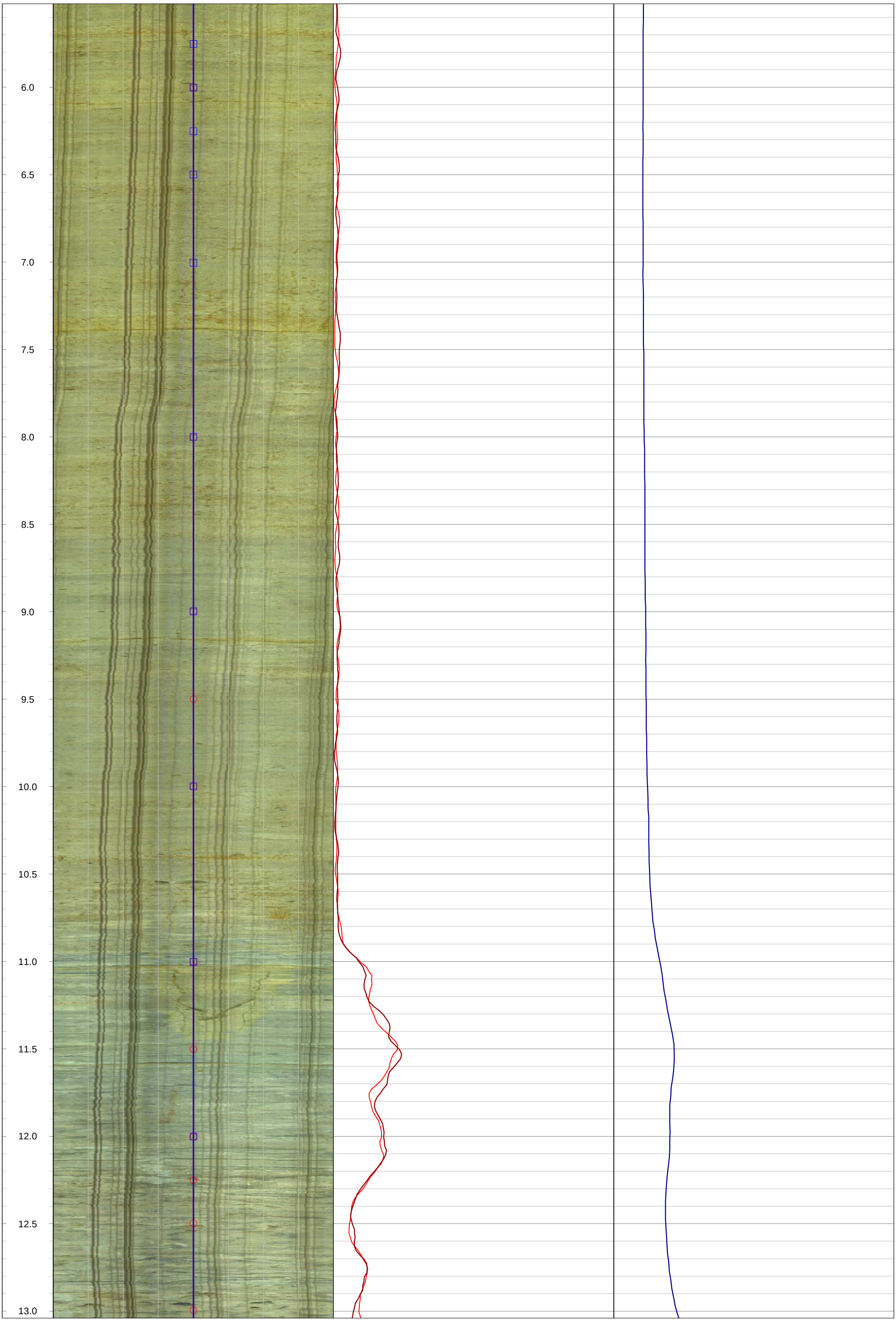
Geophysical Record of Borehole: MW20-06 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.38 m bgs	**Location:**	Caledon, Ontario
Easting:	578474.24 m	**Drilled Depth:**	16.03 m bgs	**Water Level:**	1.96 m bgs	**Log Date:**	Mar-23-2020
Northing:	4852972.59 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	400.15 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.45 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 4.0 m below top of casing. Pump rate approximately 2.75 L/min.

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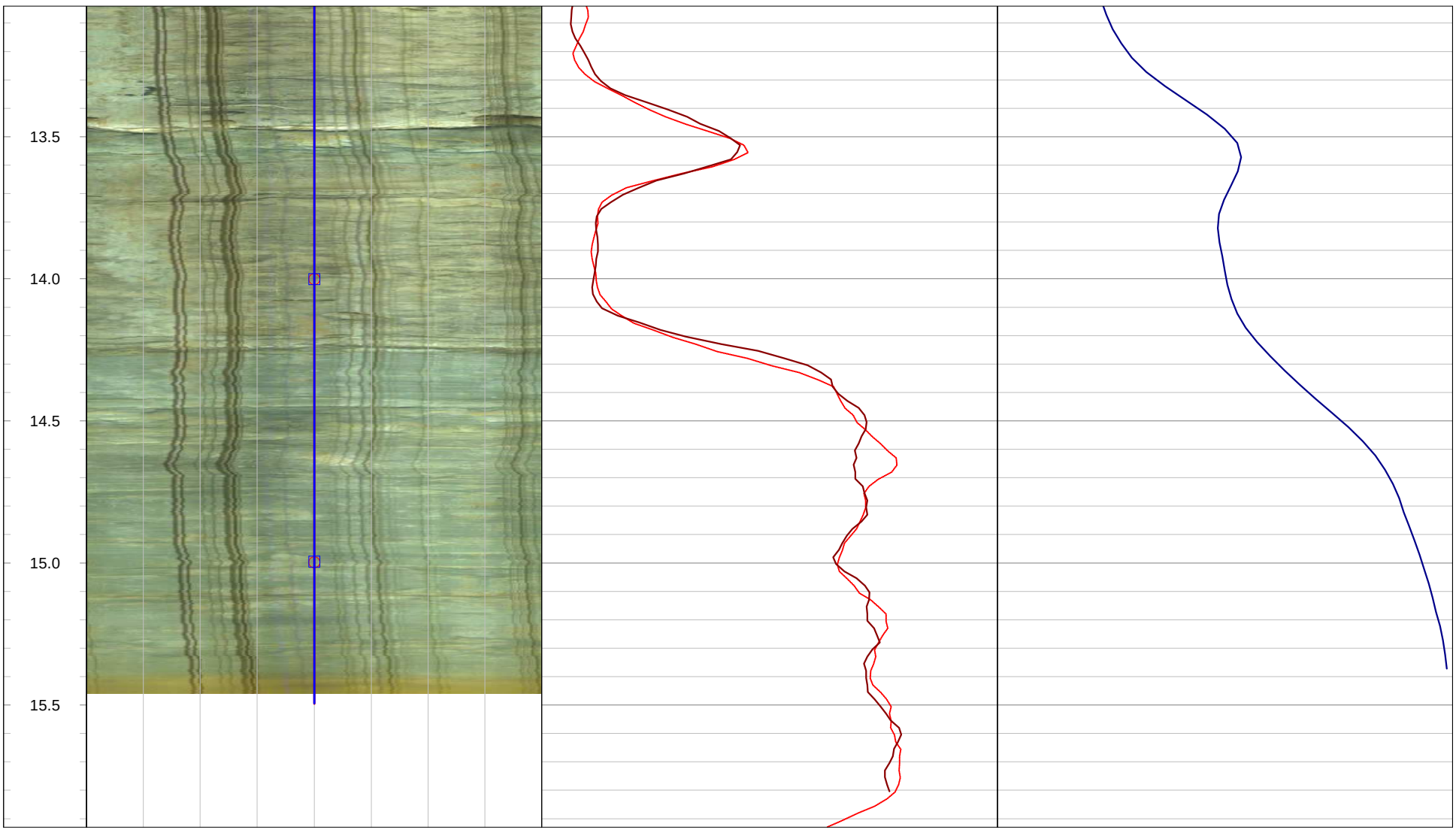
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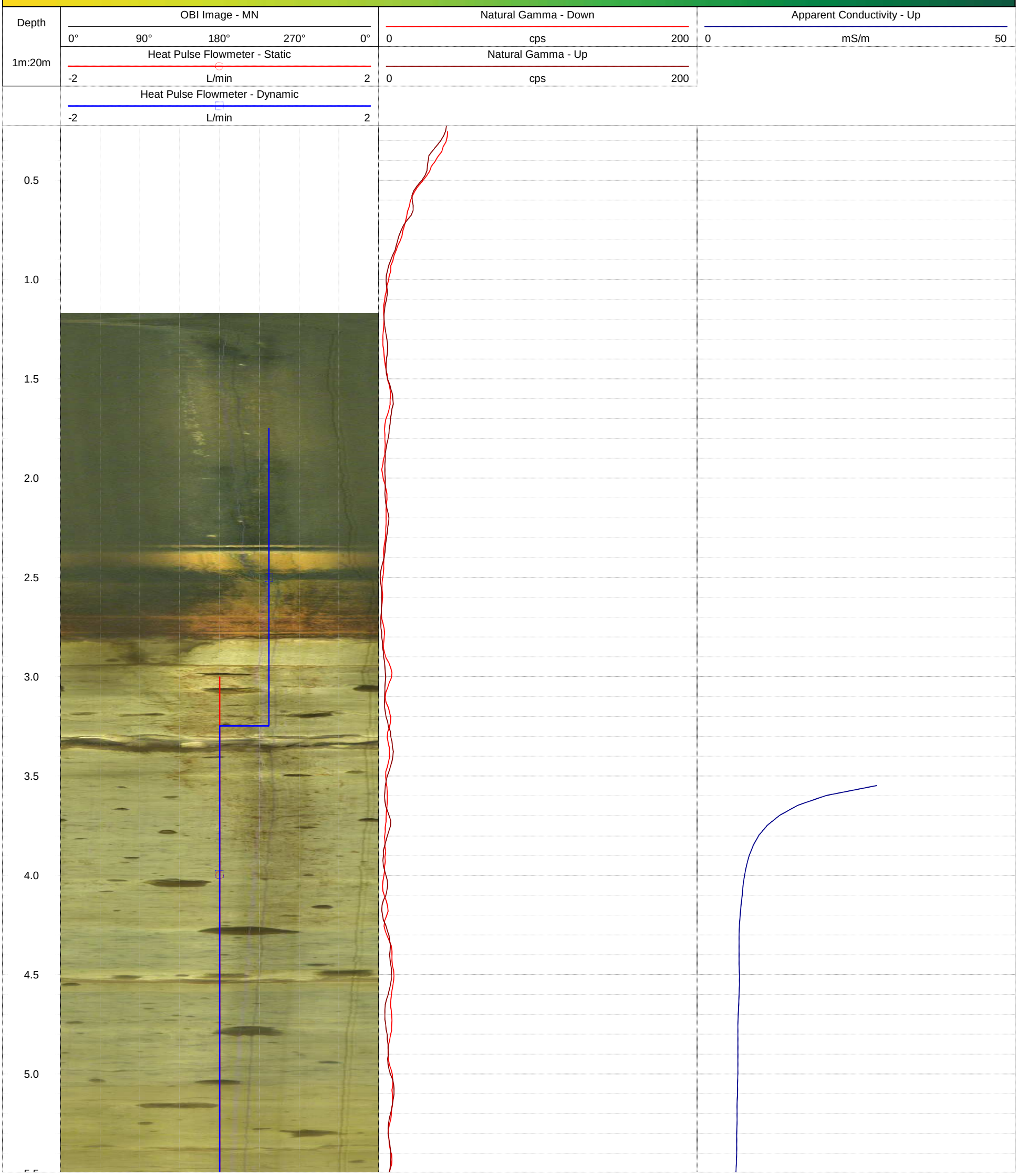
GOLDER
MEMBER OF WSP

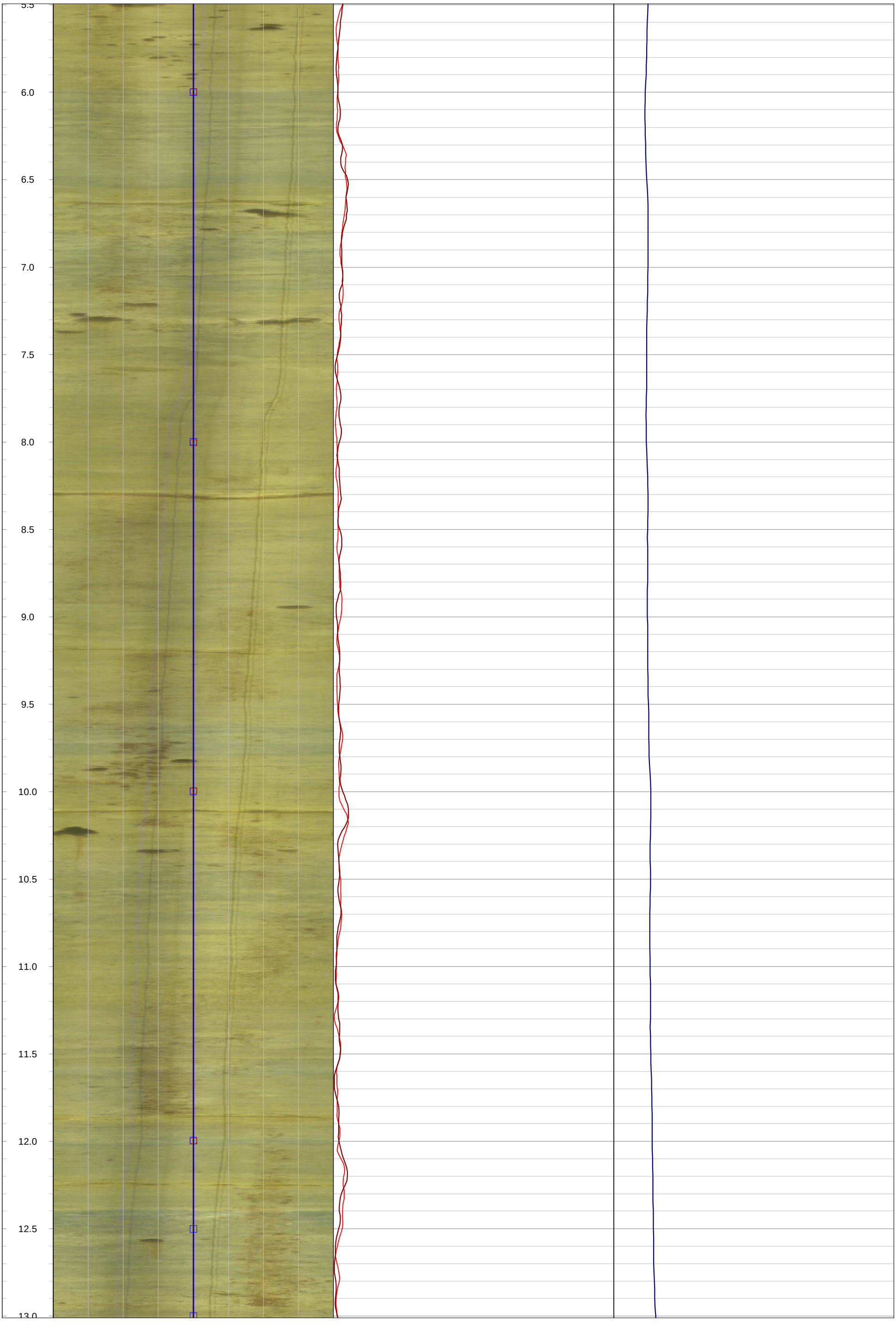
Geophysical Record of Borehole: MW20-07 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.80 m bgs	**Location:**	Caledon, Ontario
Easting:	578359.89 m	**Drilled Depth:**	19.45 m bgs	**Water Level:**	0.31 m bgs	**Log Date:**	Mar-18-2020
Northing:	4853250.44 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.45 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 2.1 m below top of casing.

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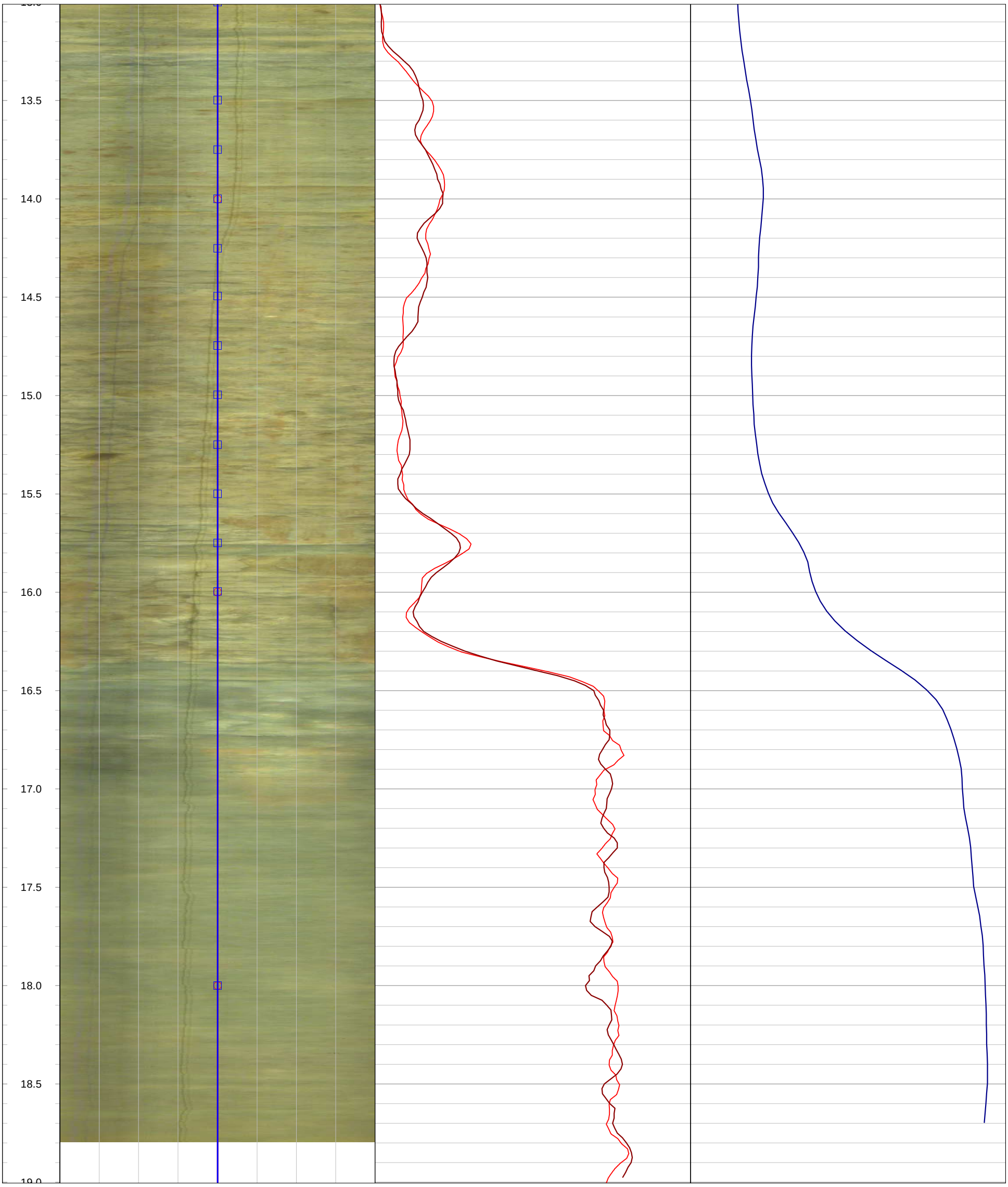
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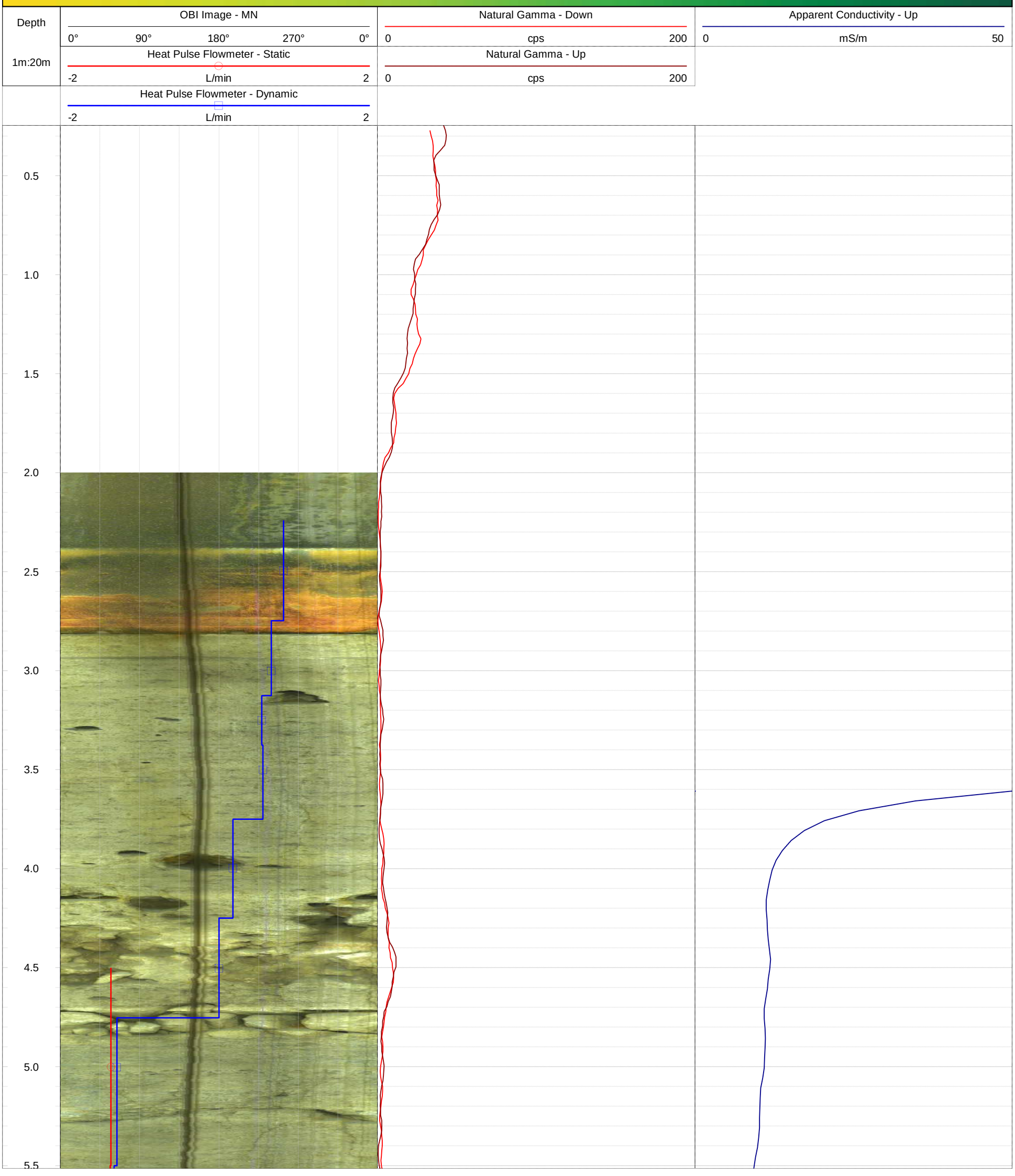
GOLDER
MEMBER OF WSP

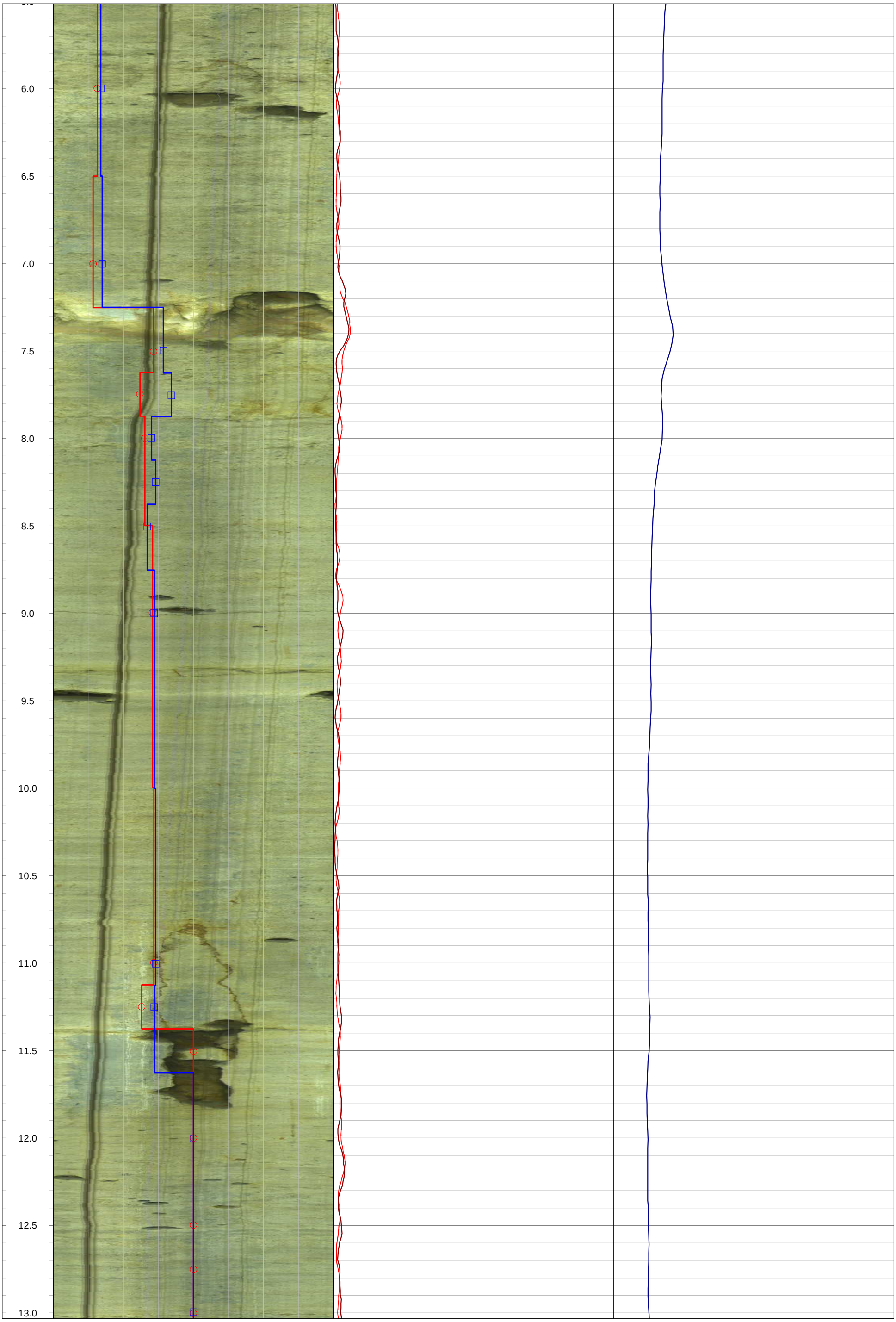
Geophysical Record of Borehole: MW20-08 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.81 m bgs	**Location:**	Caledon, Ontario
Easting:	578009.81 m	**Drilled Depth:**	18.59 m bgs	**Water Level:**	0.66 m bgs	**Log Date:**	Mar-19-2020
Northing:	4853574.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.93 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.43 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 2.1 m below top of casing.

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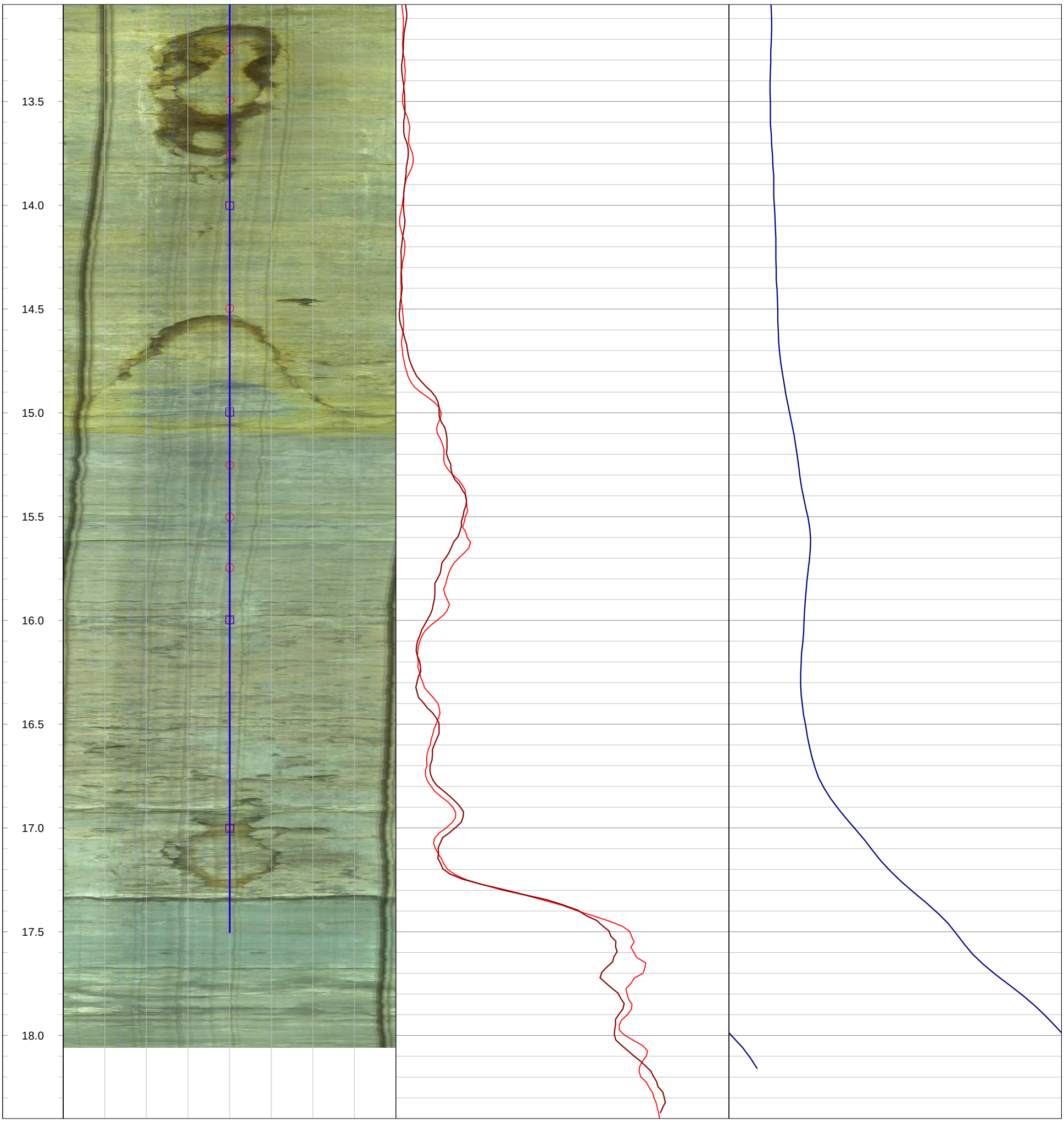
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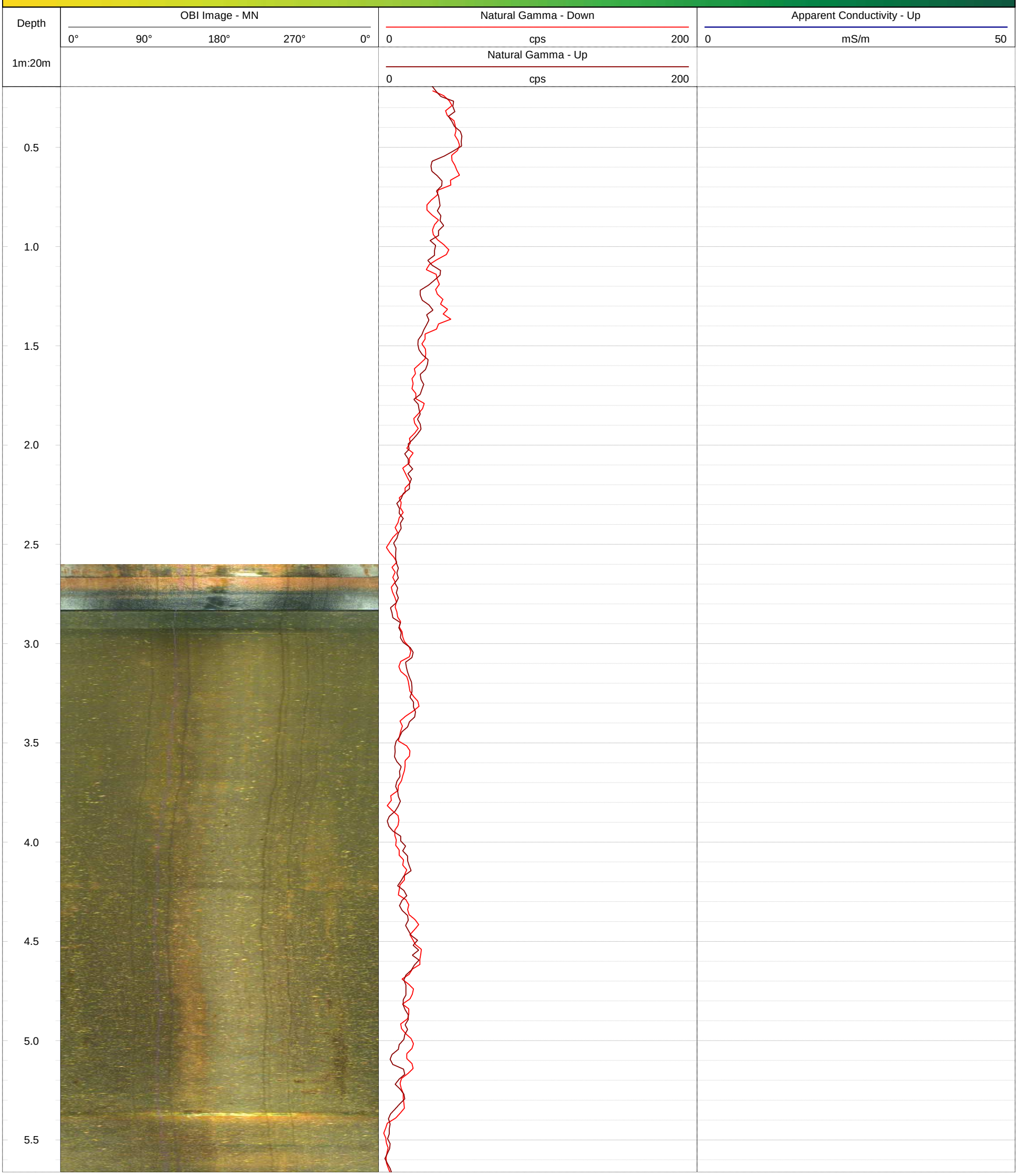
GOLDER
MEMBER OF WSP

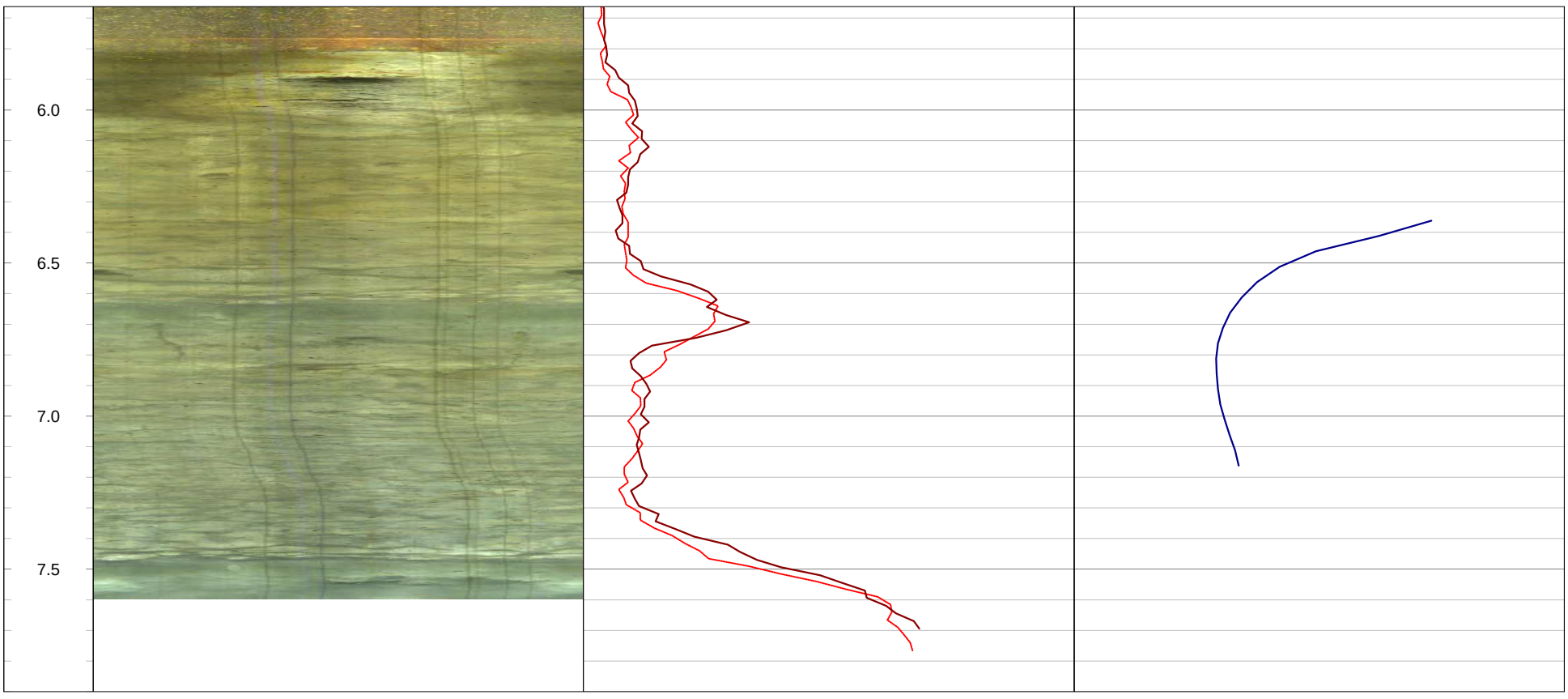
Geophysical Record of Borehole: MW20-09 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.81 m bgs	**Location:**	Caledon, Ontario
Easting:	578343.84 m	**Drilled Depth:**	9.01 m bgs	**Water Level:**	2.74 m bgs	**Log Date:**	Mar-26-2020
Northing:	4854157.49 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.95 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.49 m ags	**Logged By:**	PG

Notes: OBI image opaque > 7.65 m bgs

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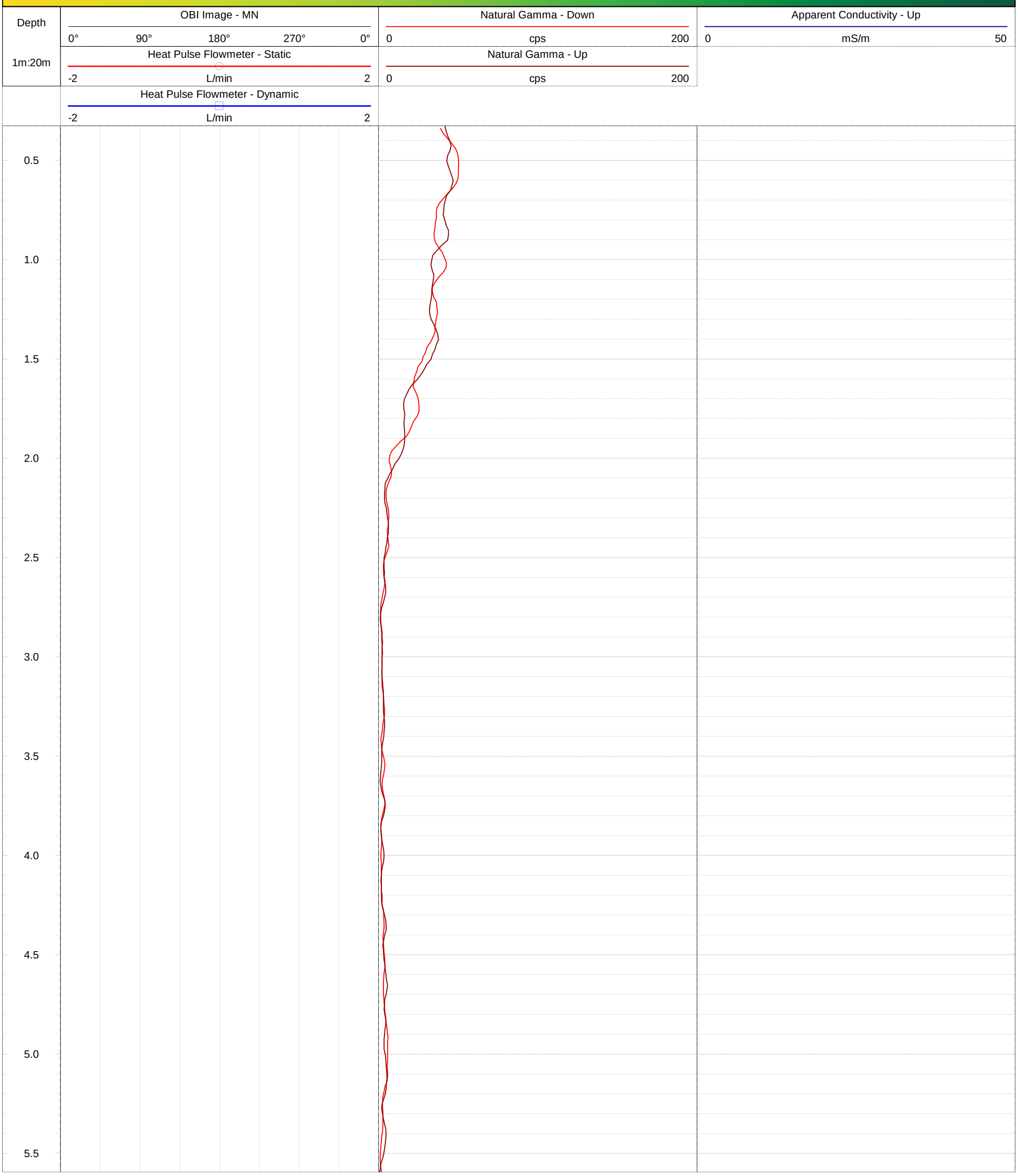
GOLDER
MEMBER OF WSP

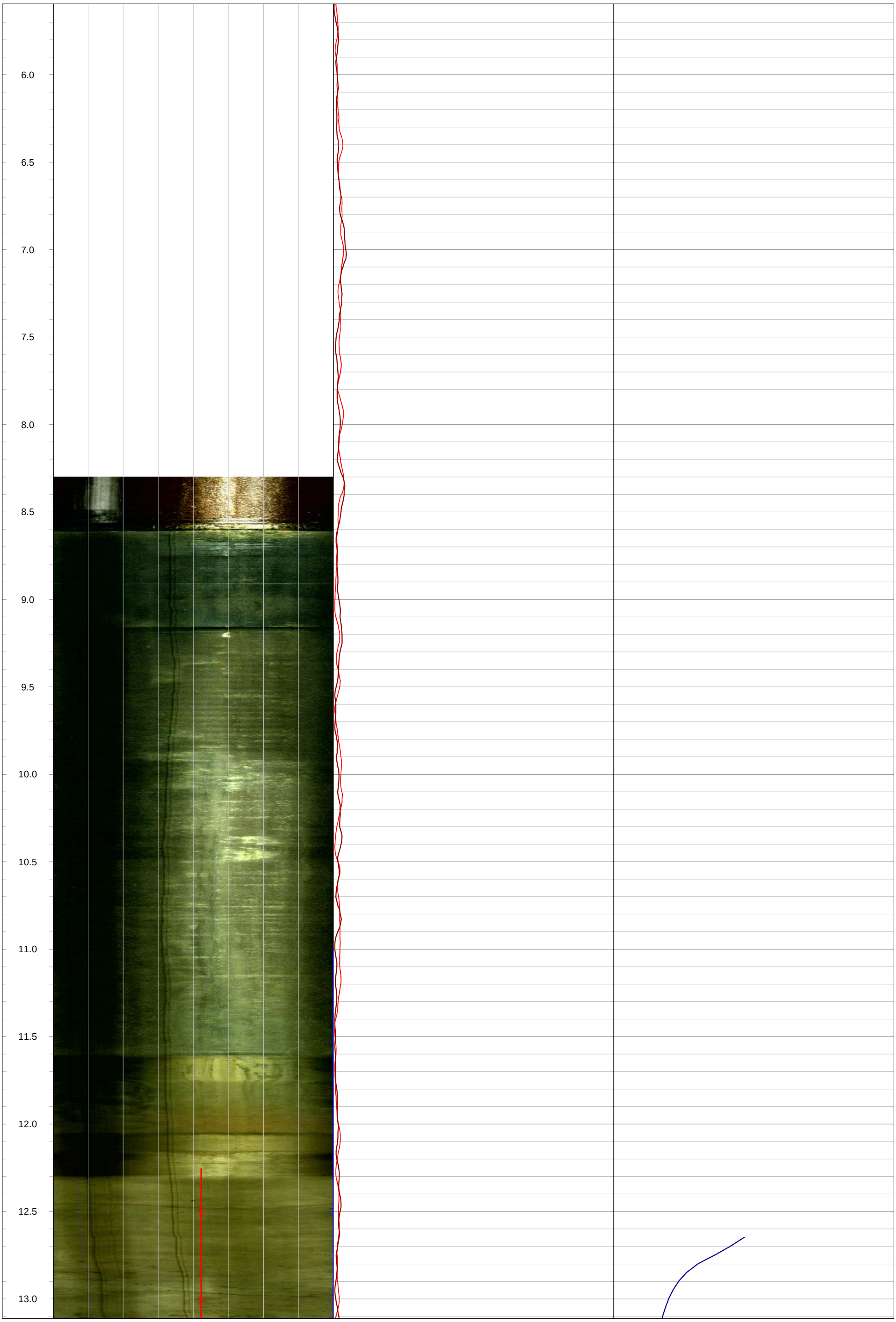
Geophysical Record of Borehole: MW20-10 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.05 m bgs	**Location:**	Caledon, Ontario
Easting:	577837.95 m	**Drilled Depth:**	21.19 m bgs	**Water Level:**	8.33 m bgs	**Log Date:**	Mar-24-2020
Northing:	4854407.28 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	411.32 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.35 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 10.5 m below top of casing. Pump rate approximately 2.72 L/min

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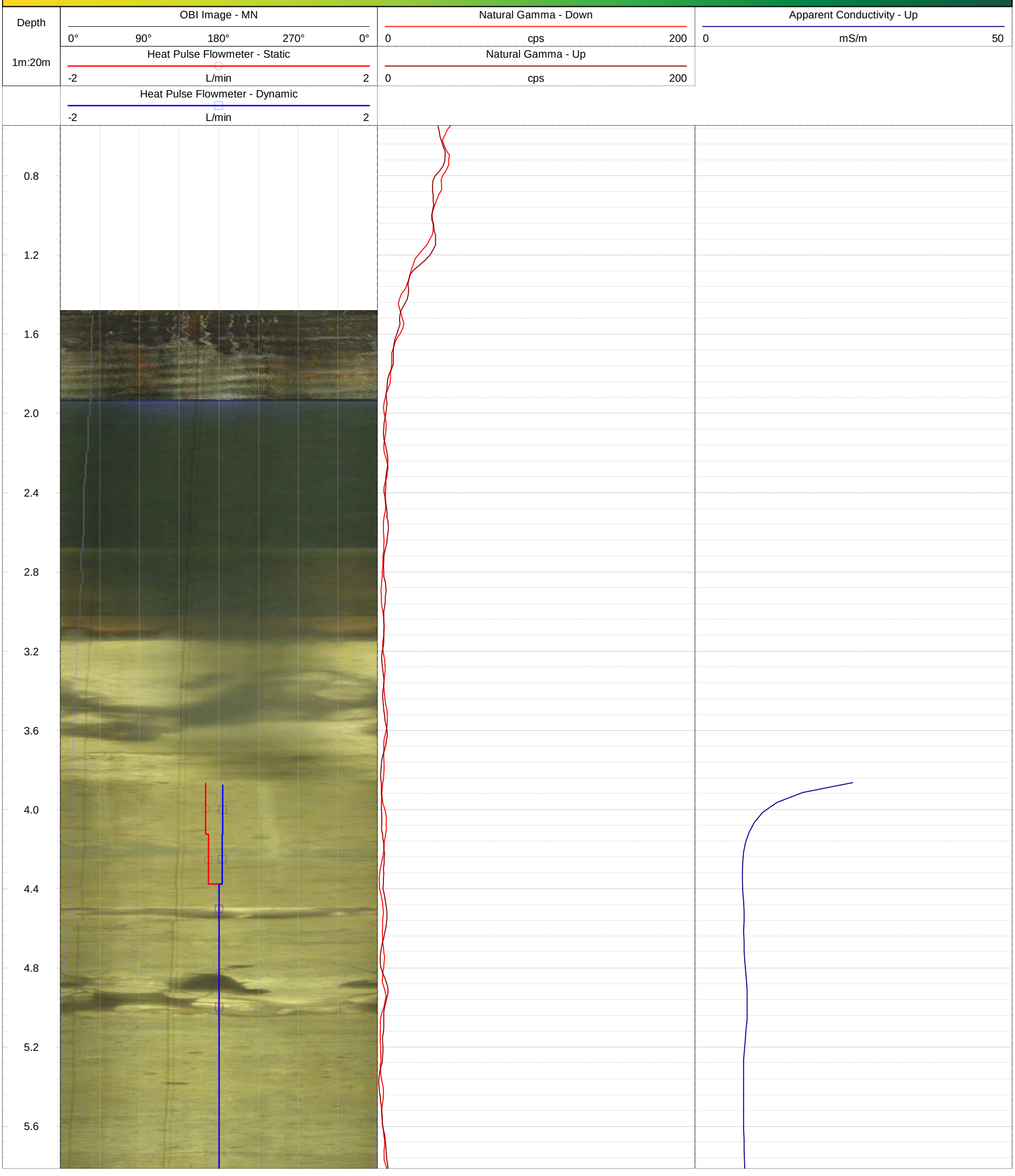
GOLDER
MEMBER OF WSP

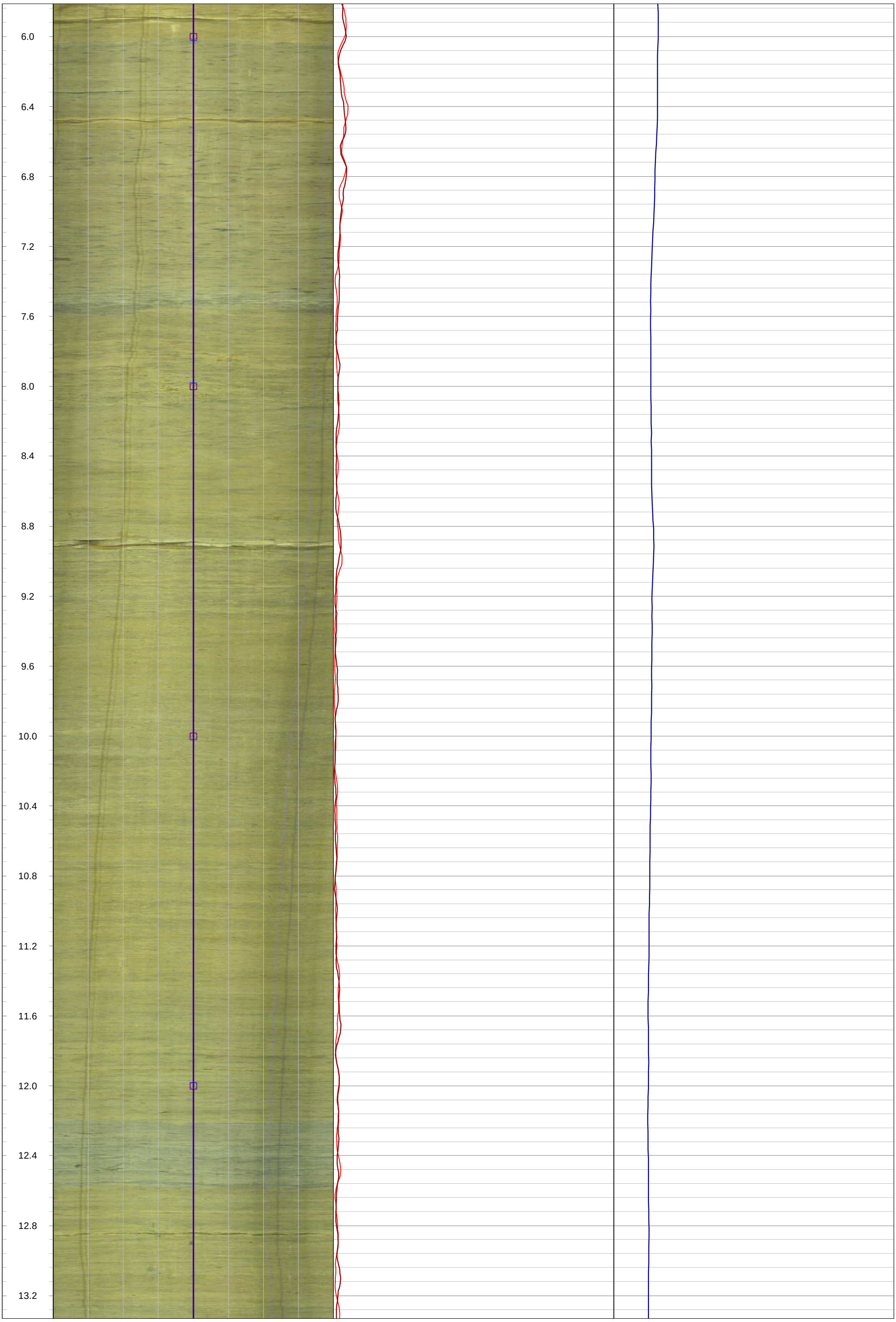
Geophysical Record of Borehole: MW20-11 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.15 m bgs	**Location:**	Caledon, Ontario
Easting:	577671.98 m	**Drilled Depth:**	19.39 m bgs	**Water Level:**	1.93 m bgs	**Log Date:**	Apr-06-2020
Northing:	4853921.39 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	409.72 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.14 m ags	**Logged By:**	PG

Notes: OBI image opaque > 18.80 m. Heat Pulse Flowmeter Dynamic pump at 3.1 m below top of casing. Pump rate approximately 2.72 L/min.

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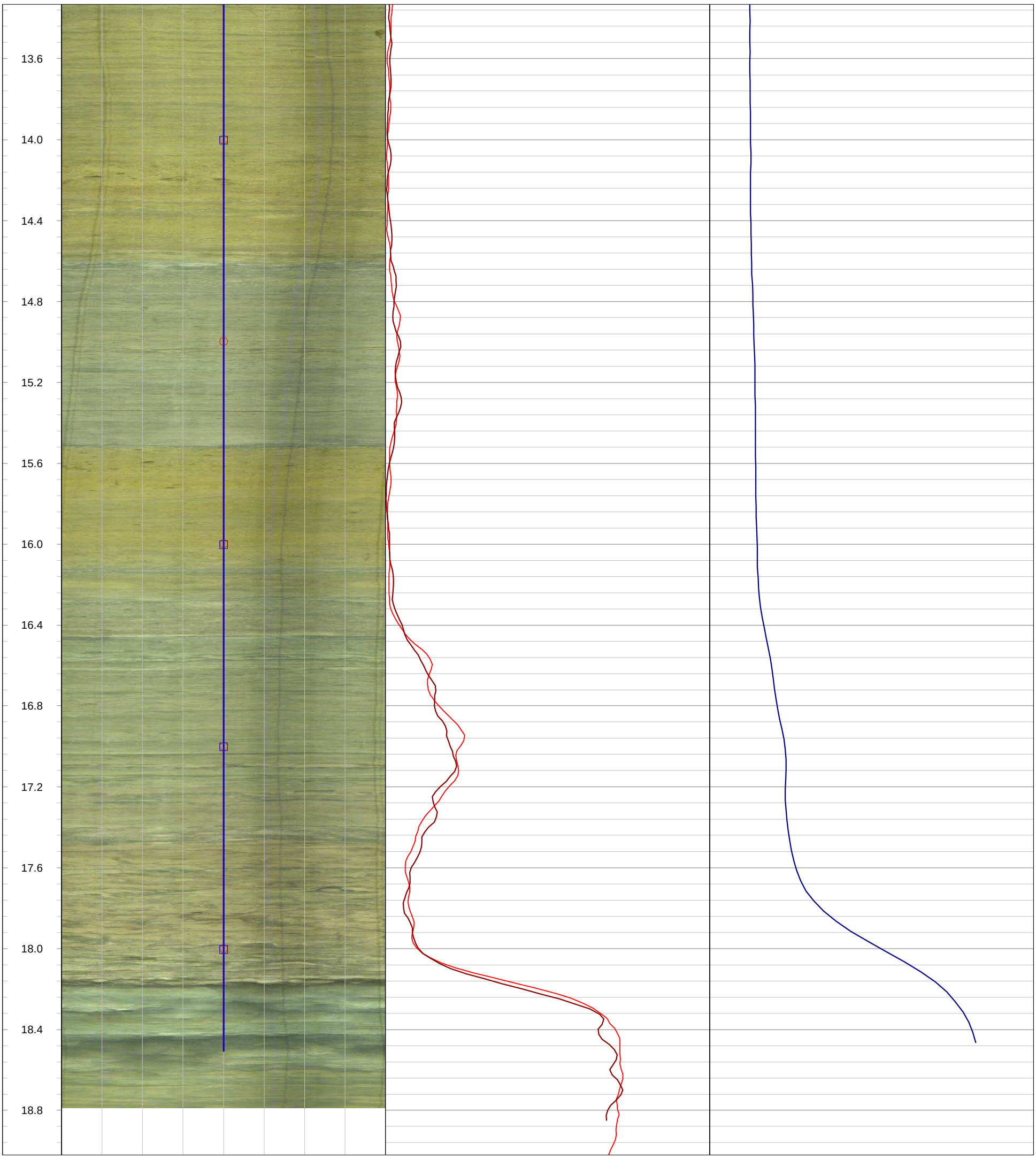
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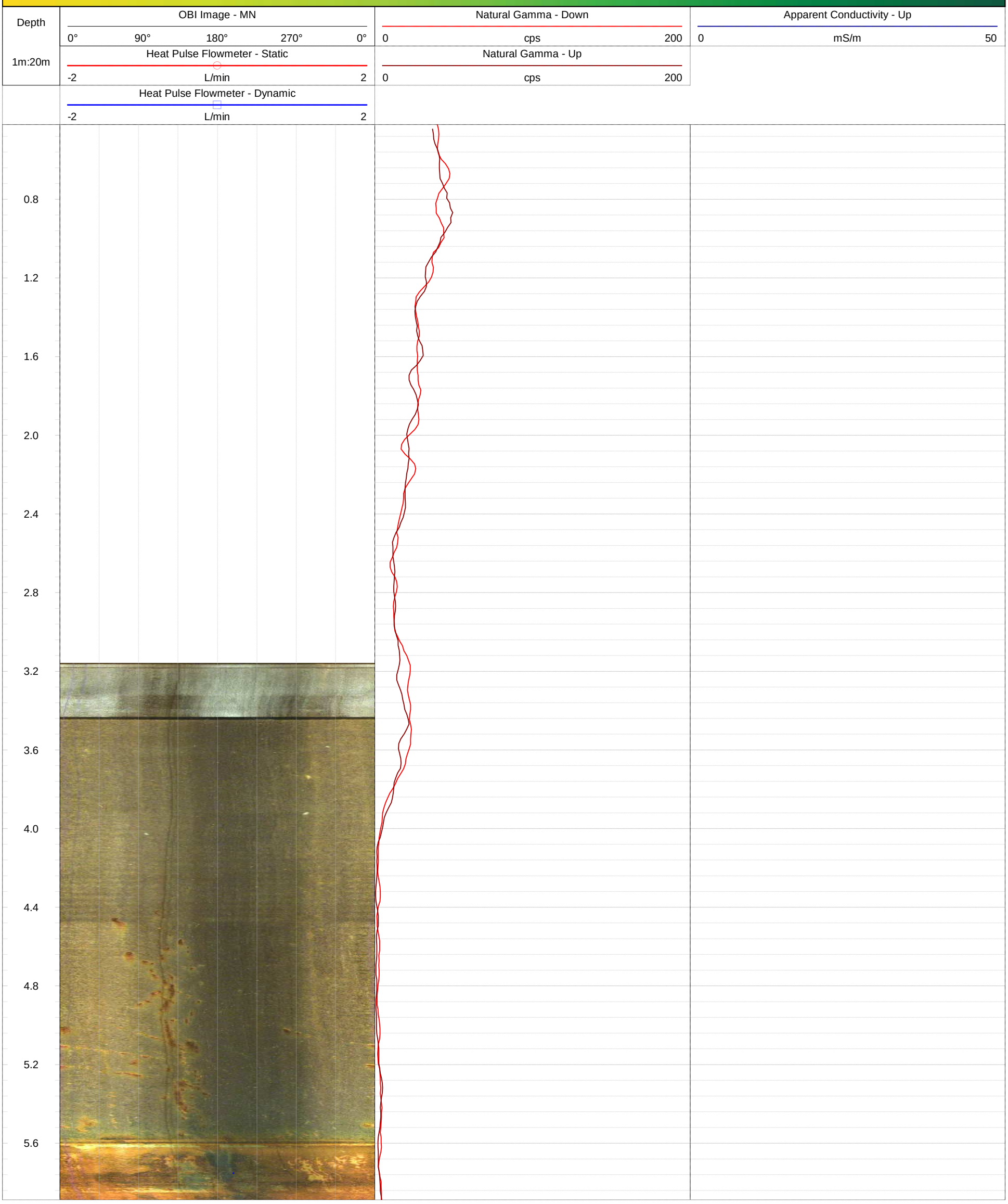
GOLDER
MEMBER OF WSP

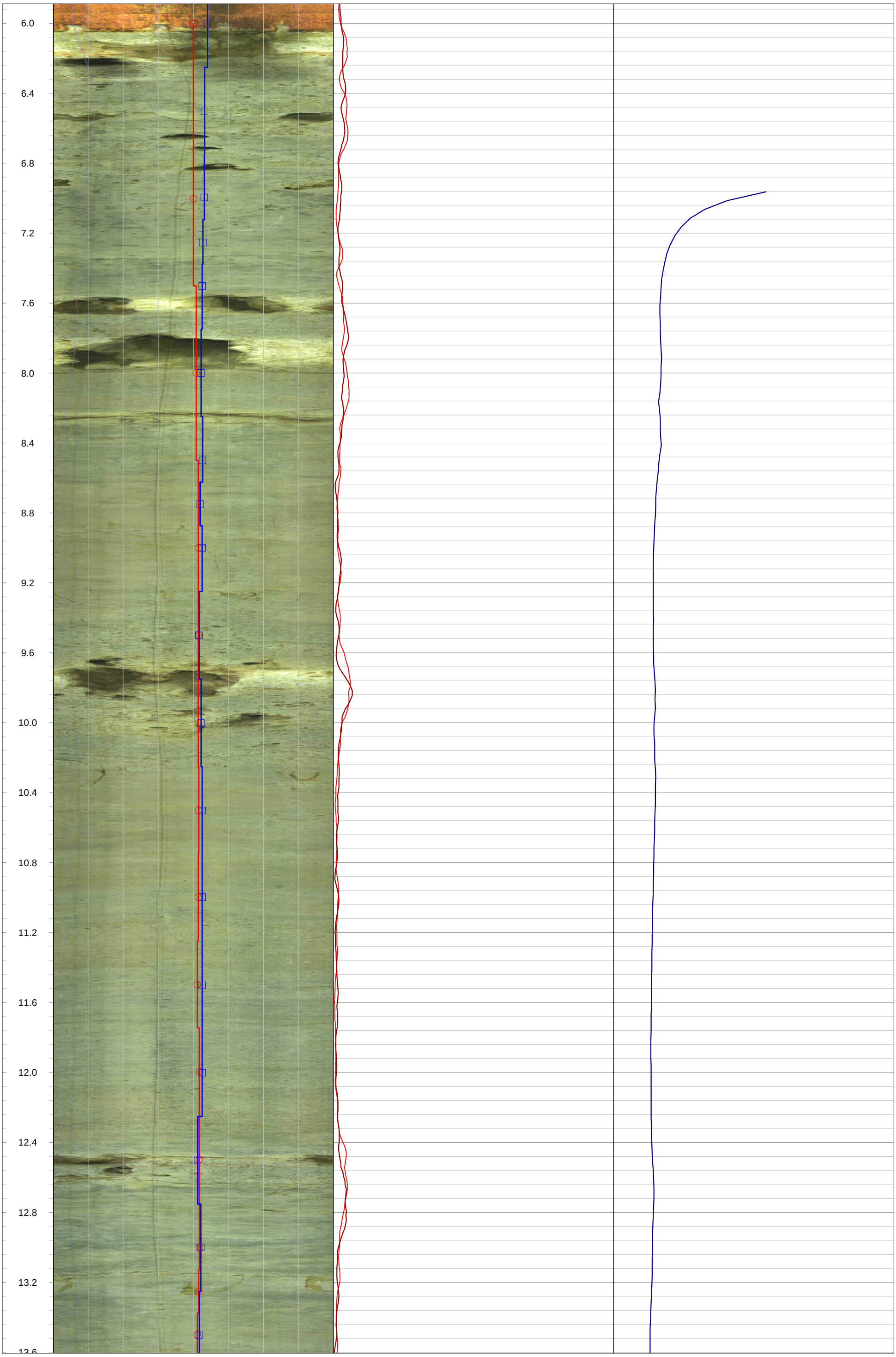
Geophysical Record of Borehole: MW20-12 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.05 m bgs	**Location:**	Caledon, Ontario
Easting:	577271.90 m	**Drilled Depth:**	22.65 m bgs	**Water Level:**	3.44 m bgs	**Log Date:**	Apr-08-2020
Northing:	4854321.42 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	412.43 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.26 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 4.5 m below top of casing. Pump rate approximately 2.30 L/min.

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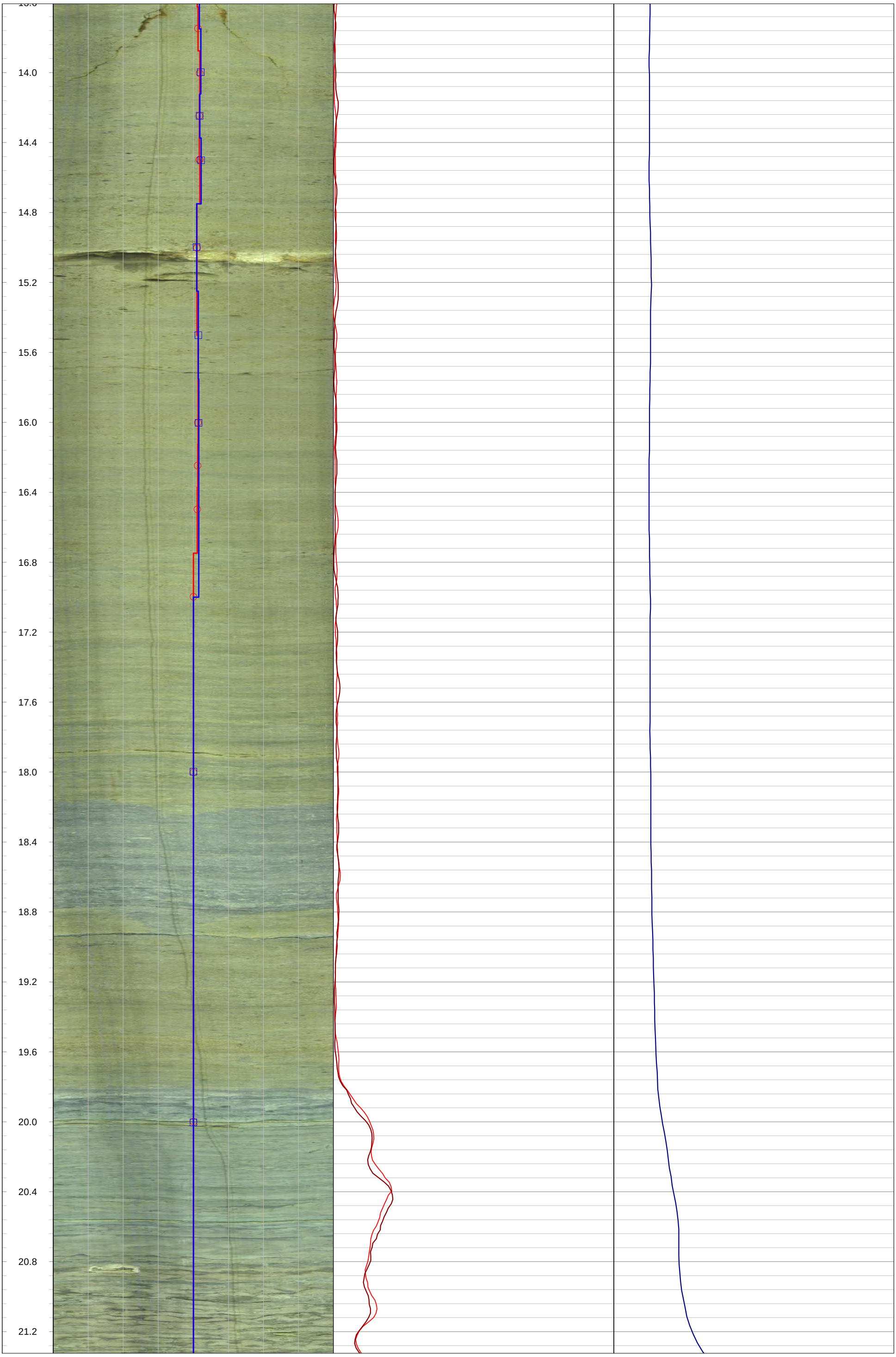
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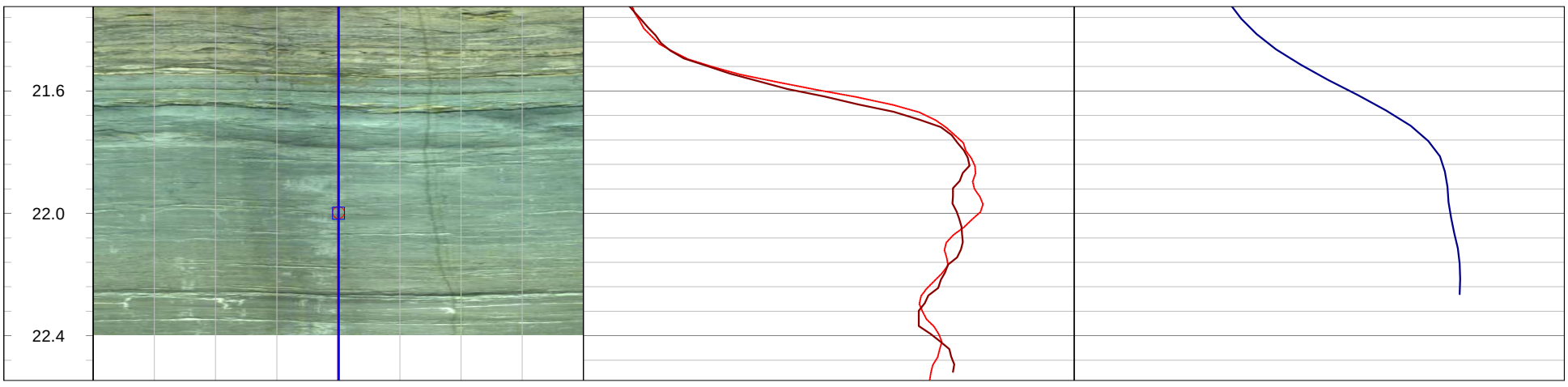
20.8
21.2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22.0
22.4

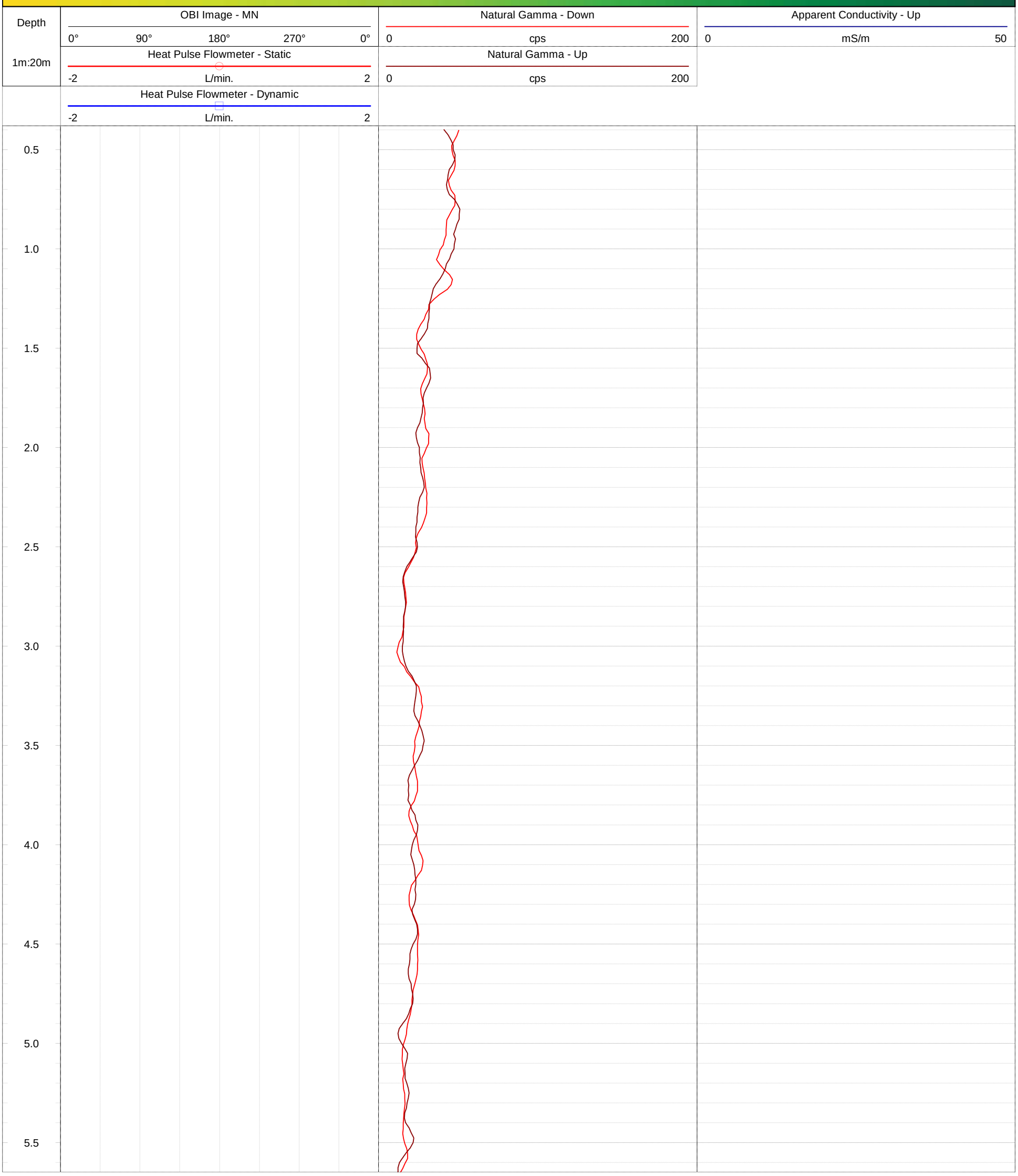
GOLDER
MEMBER OF WSP

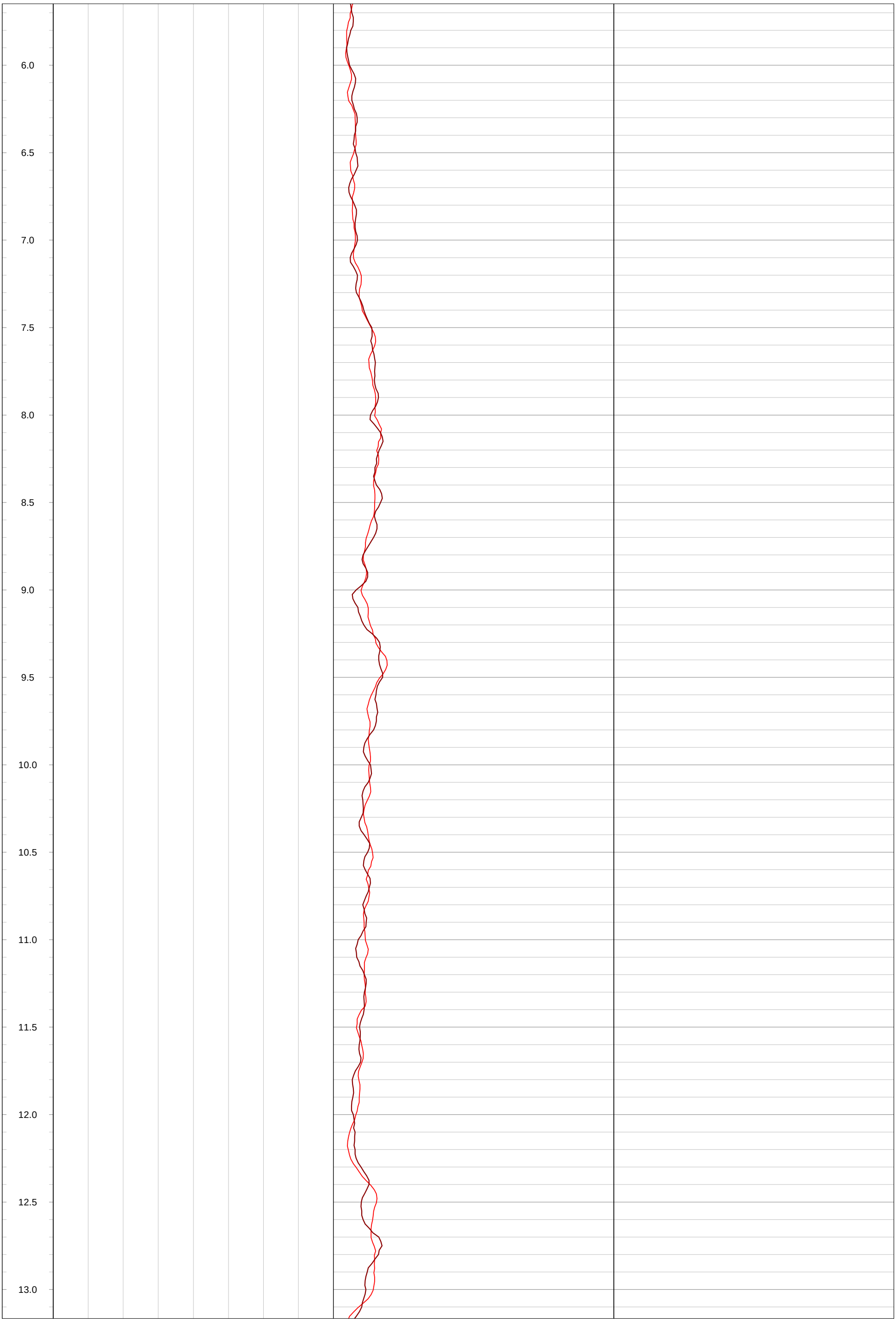
Geophysical Record of Borehole: MW20-13 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.16 m bgs	**Location:**	Caledon, Ontario
Easting:	576873.11 m	**Drilled Depth:**	28.23 m bgs	**Water Level:**	2.64 m bgs	**Log Date:**	Apr-15-2020
Northing:	4854473.14 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.53 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.28 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 6.0 m below top of casing. Pump rate approximately 1.40 L/min.

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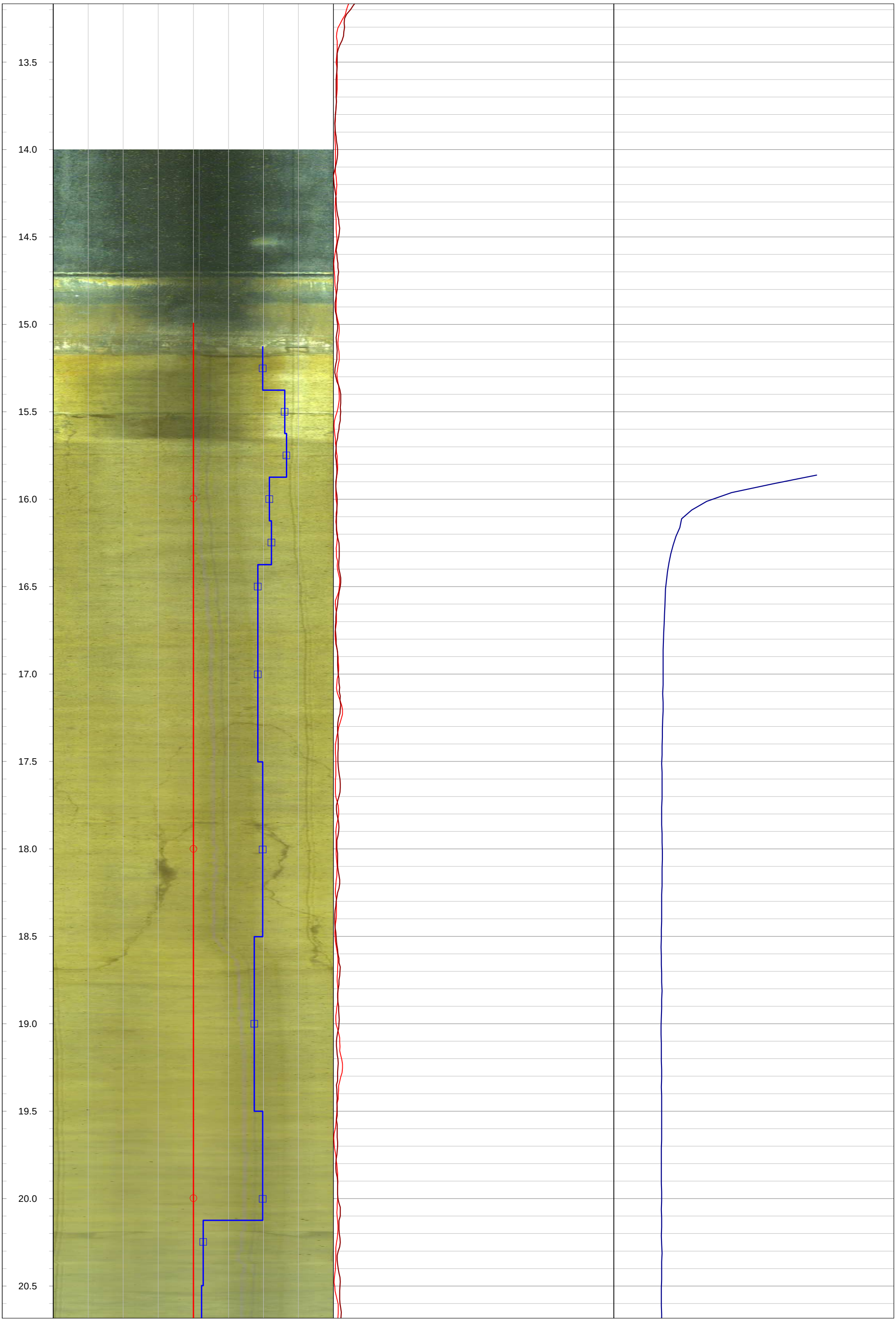
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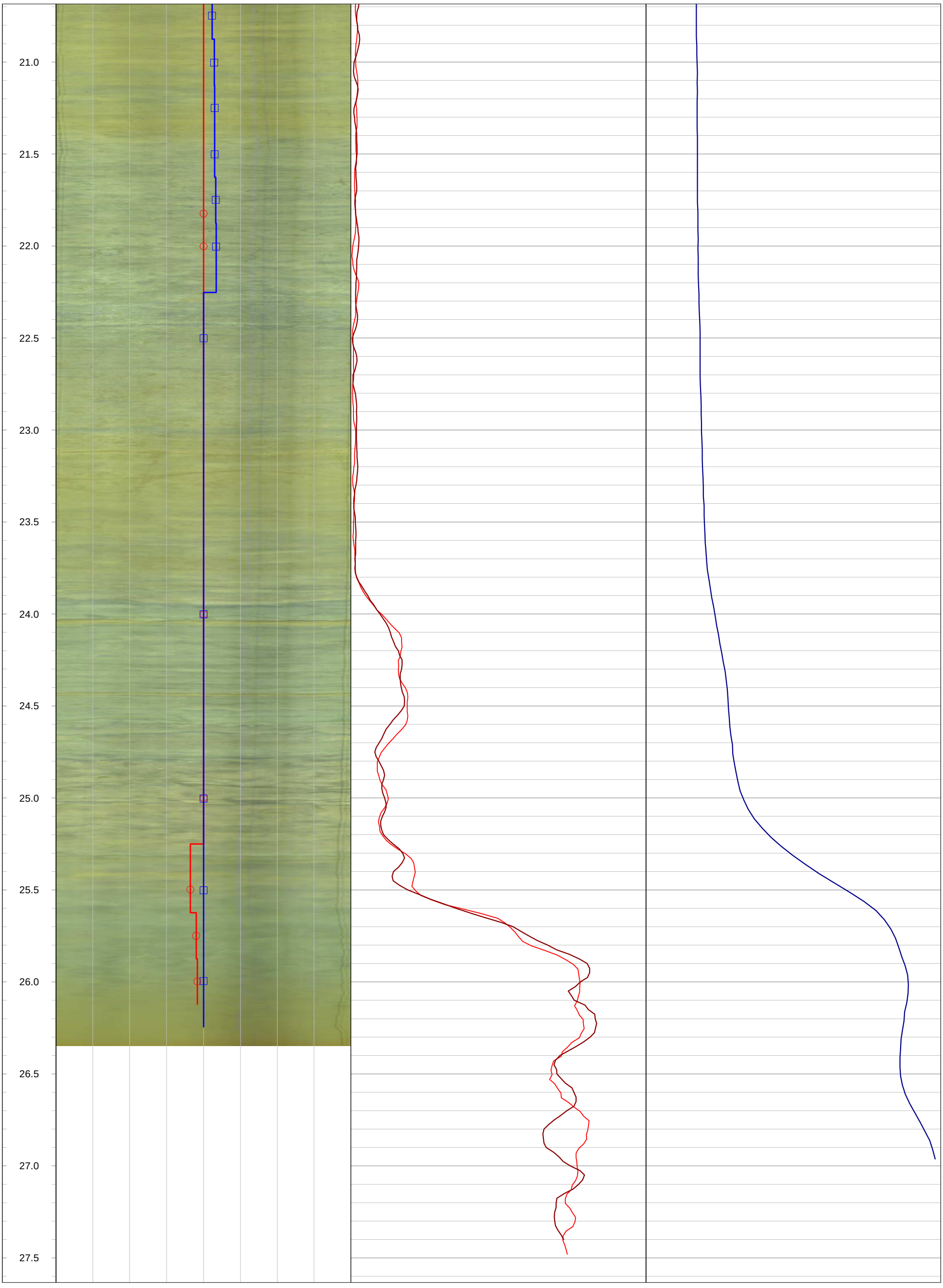
20.5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27.0
27.5

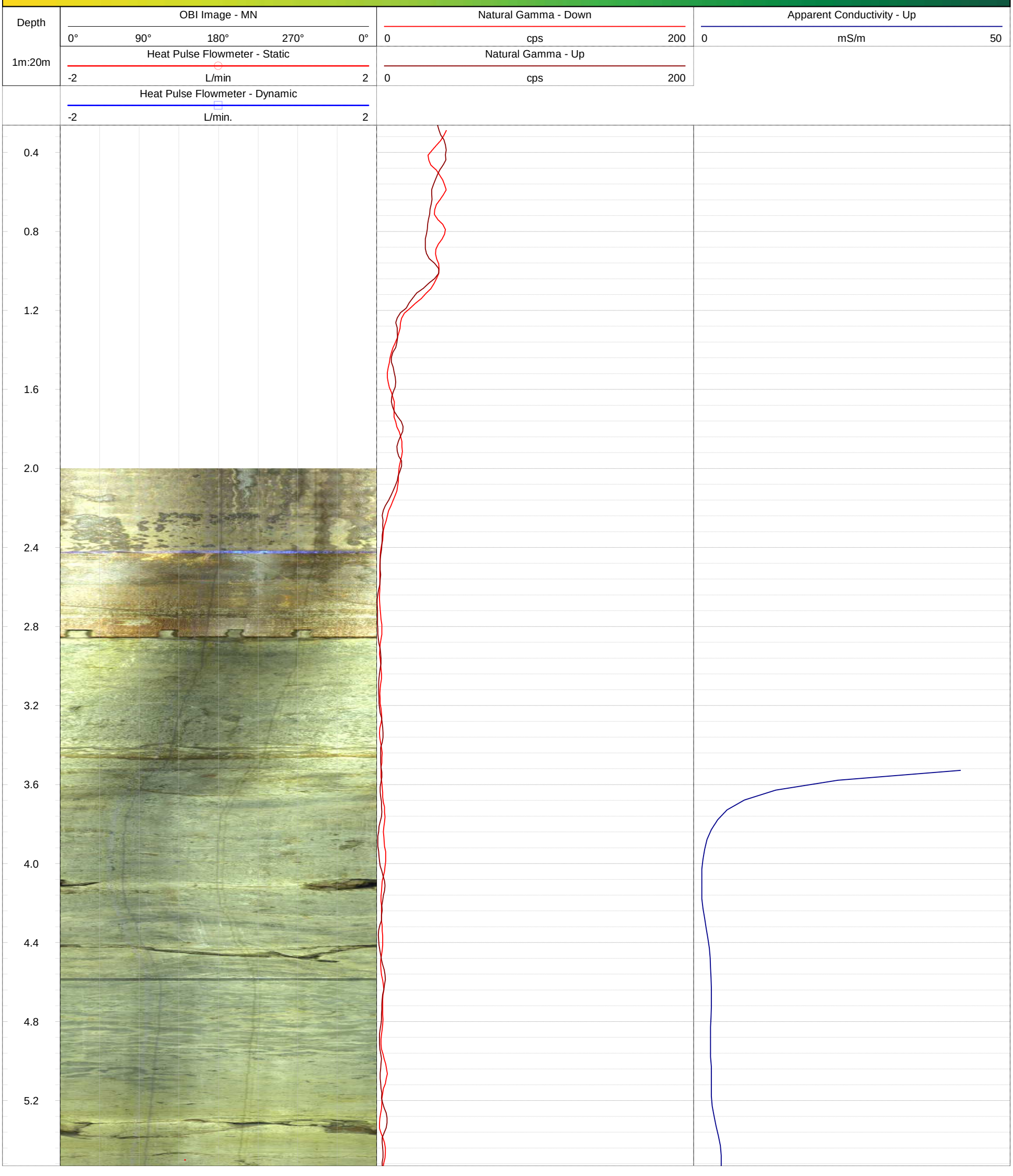
GOLDER
MEMBER OF WSP

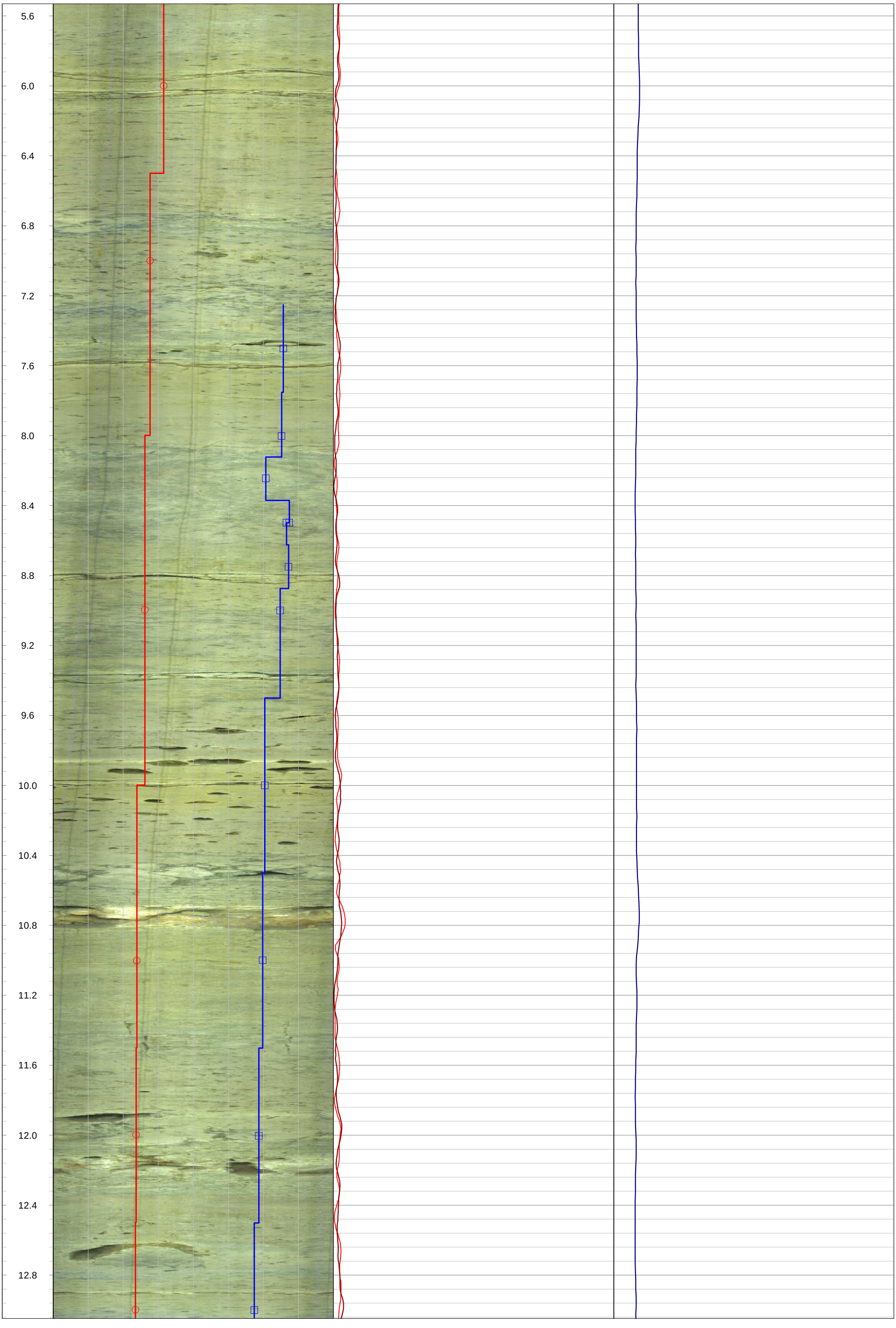
Geophysical Record of Borehole: MW20-14 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.85 m bgs	**Location:**	Caledon, Ontario
Easting:	577575.99 m	**Drilled Depth:**	26.35 m bgs	**Water Level:**	4.52 m bgs	**Log Date:**	May-14-2020
Northing:	4853100.42 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.71 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes: OBI image opaque > 25.90. Heat Pulse Flowmeter Dynamic pump at 5.0 m below top of casing. Pump rate approximately 2.63 L/min.

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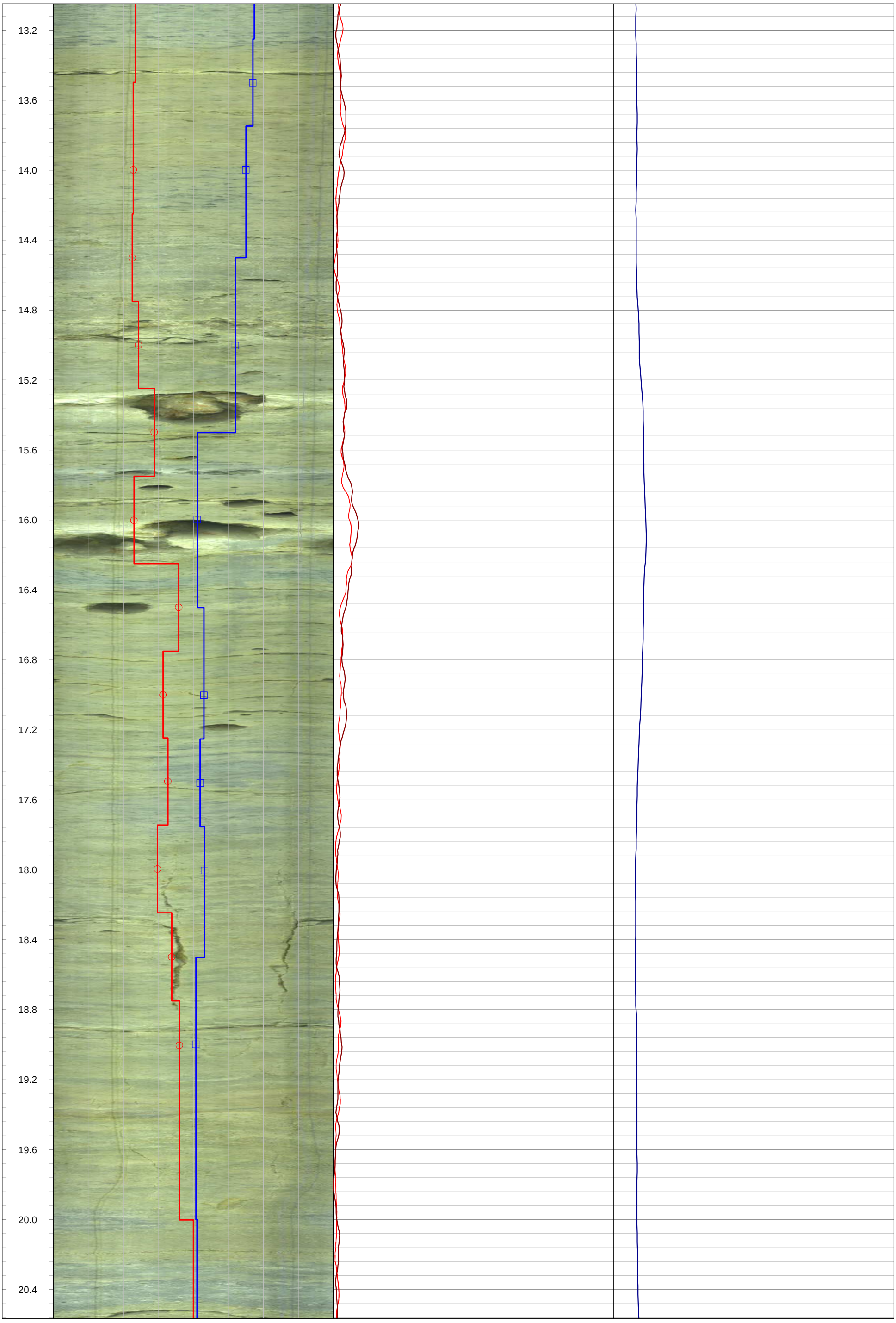
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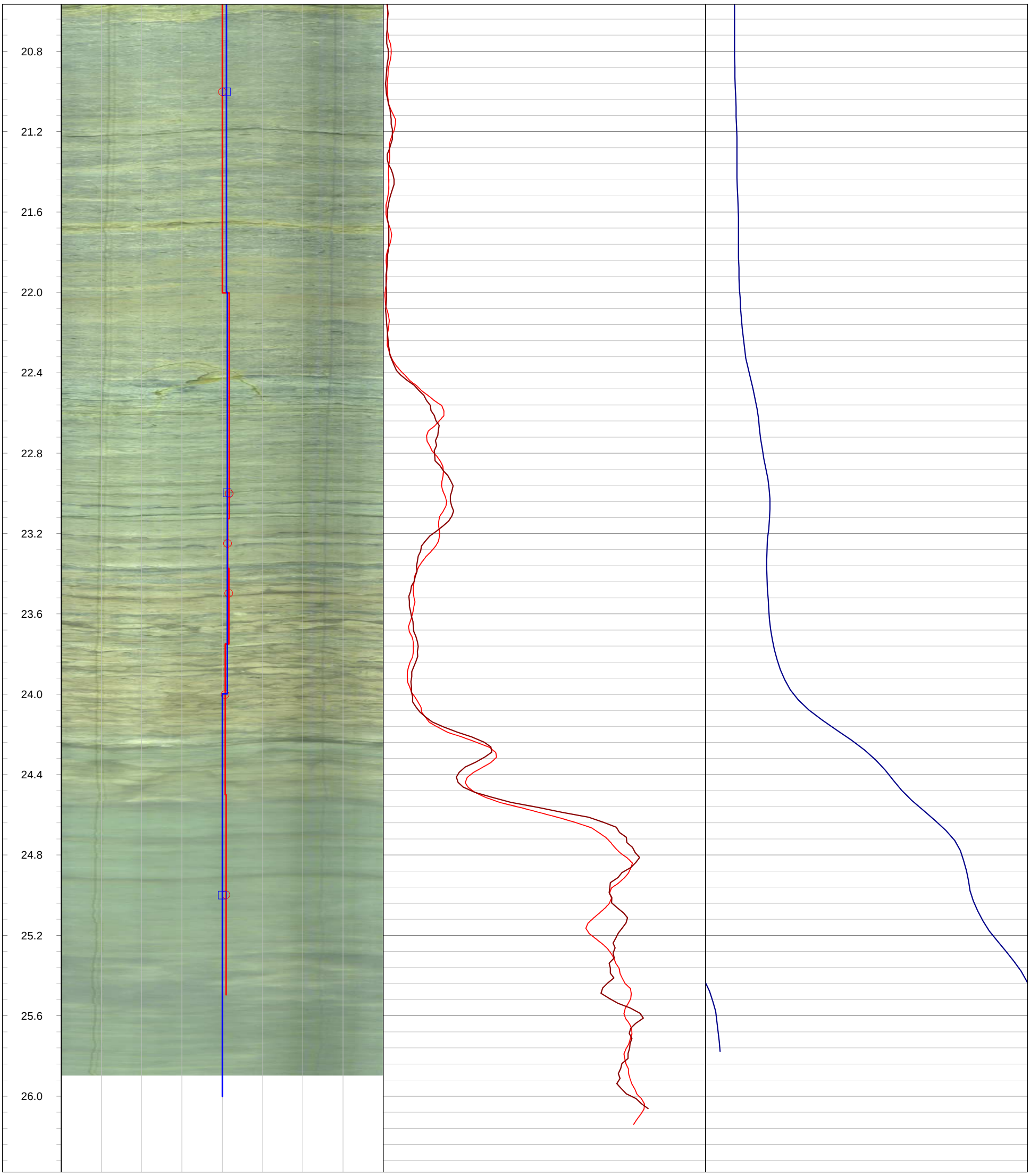
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25.6
26.0

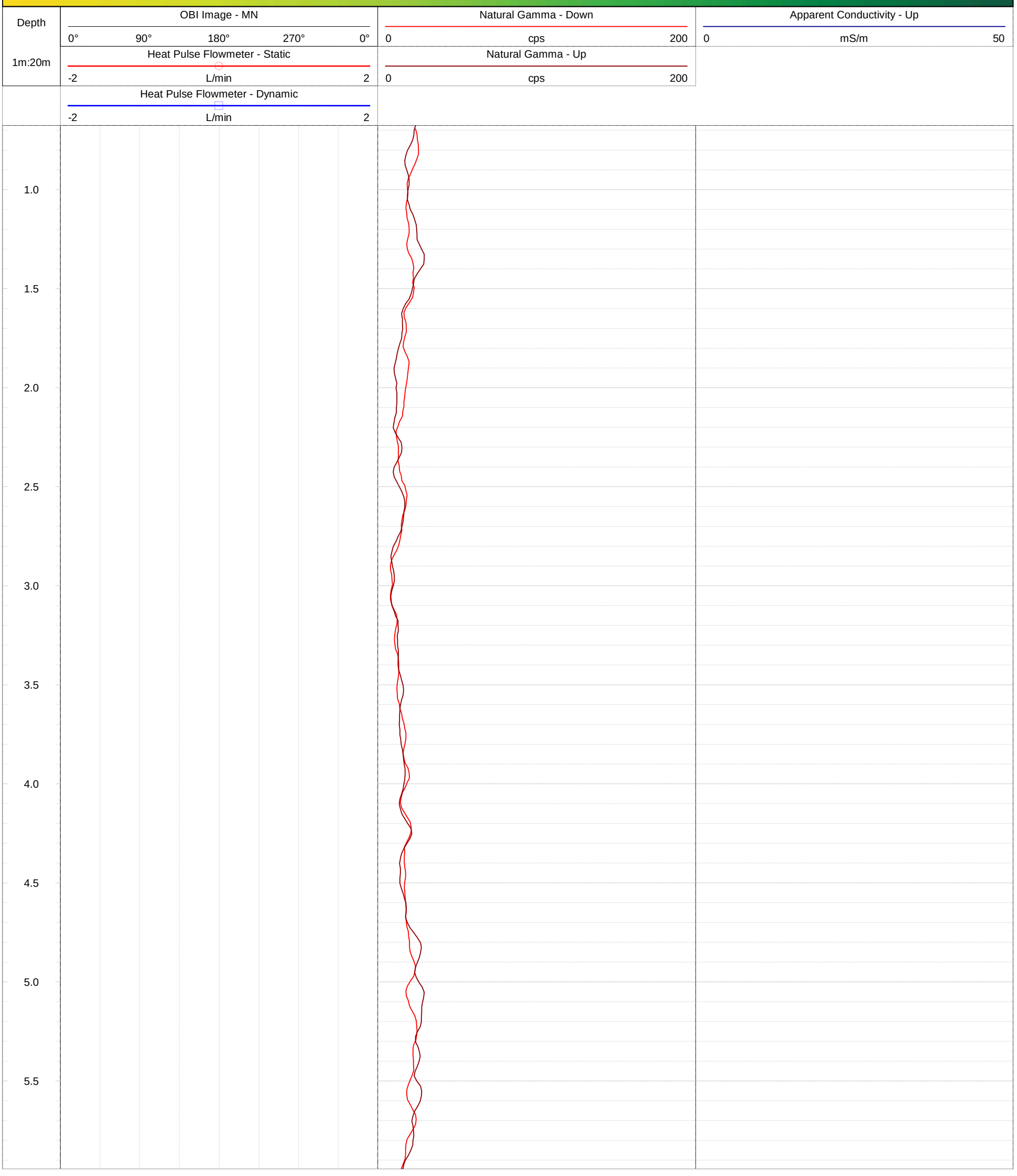
GOLDER
MEMBER OF WSP

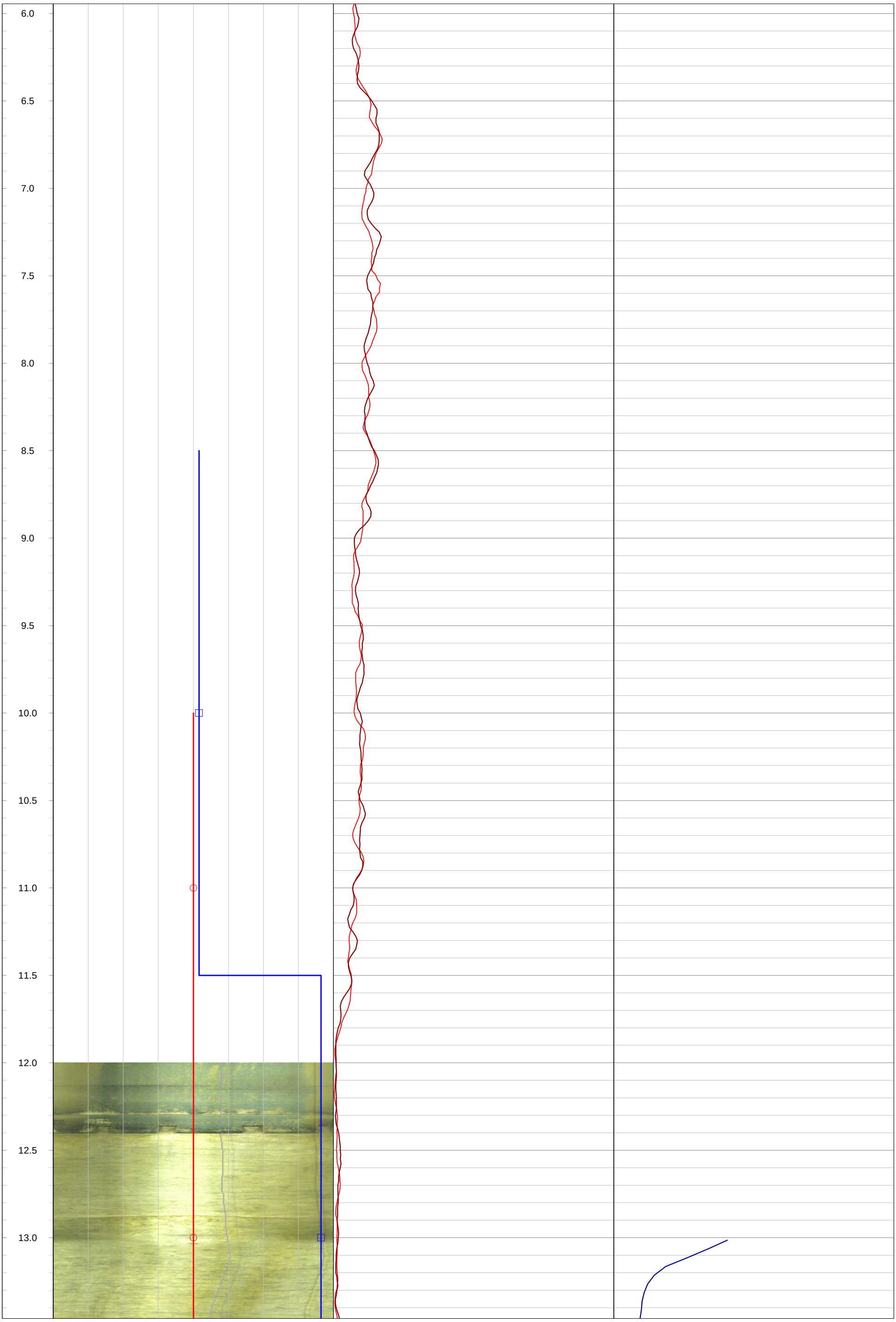
Geophysical Record of Borehole: MW20-15 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.40 m bgs	**Location:**	Caledon, Ontario
Easting:	576576.79 m	**Drilled Depth:**	37.17 m bgs	**Water Level:**	0.70 m bgs	**Log Date:**	May-27-2020
Northing:	4853544.15 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.06 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.00 m ags	**Logged By:**	PG

Notes: OBI image opaque > 36.6 m bgs

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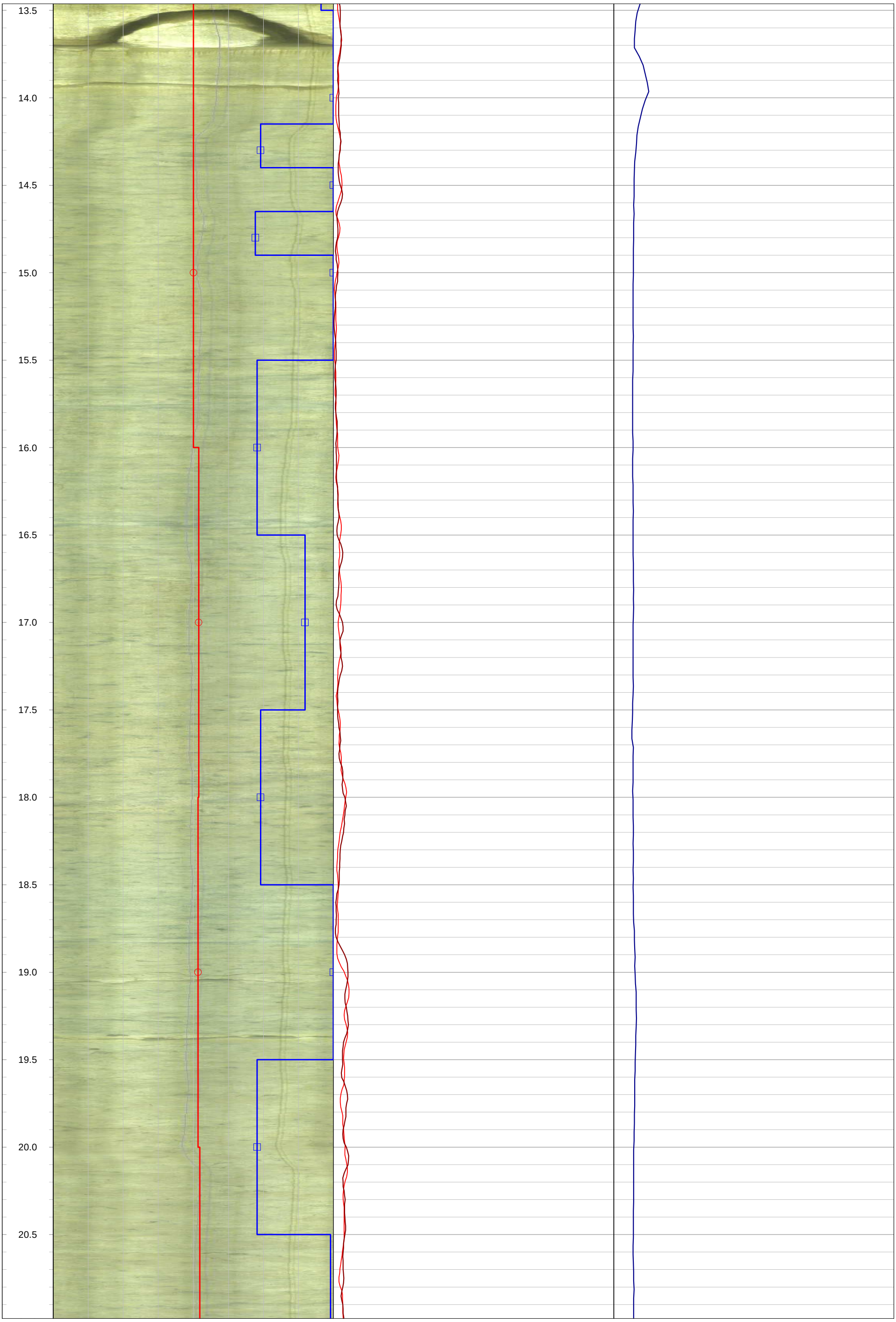
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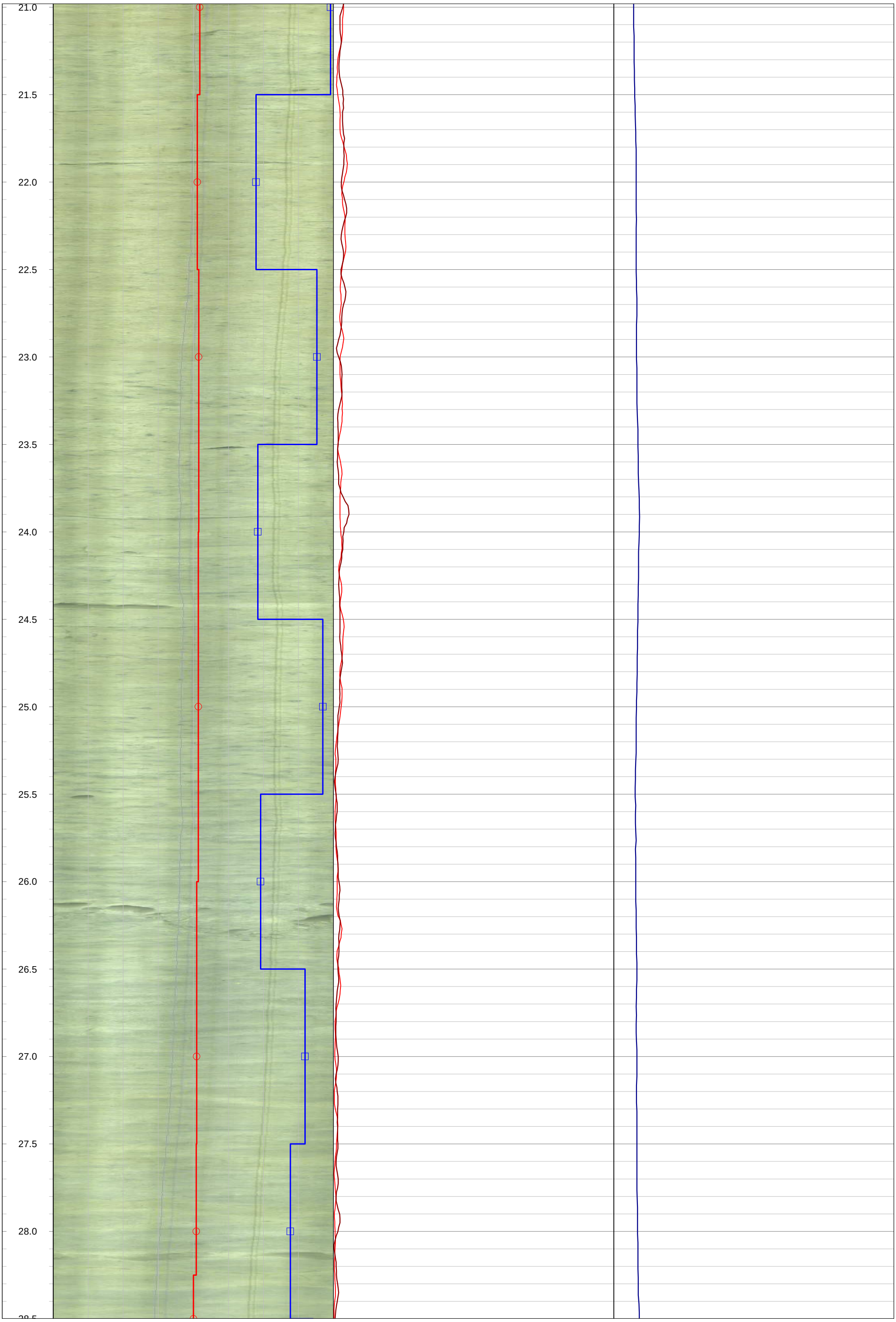
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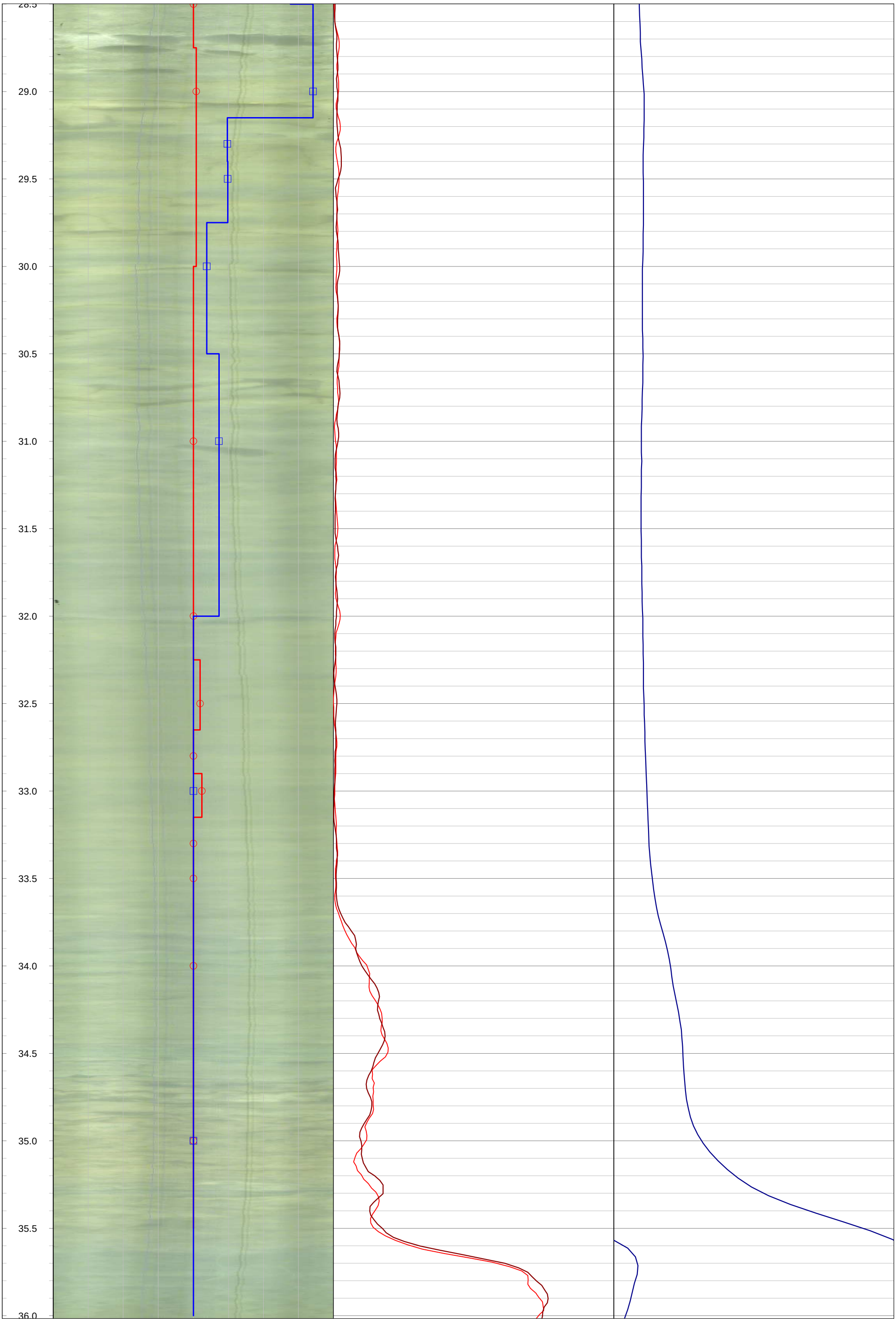
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36.0


36.5

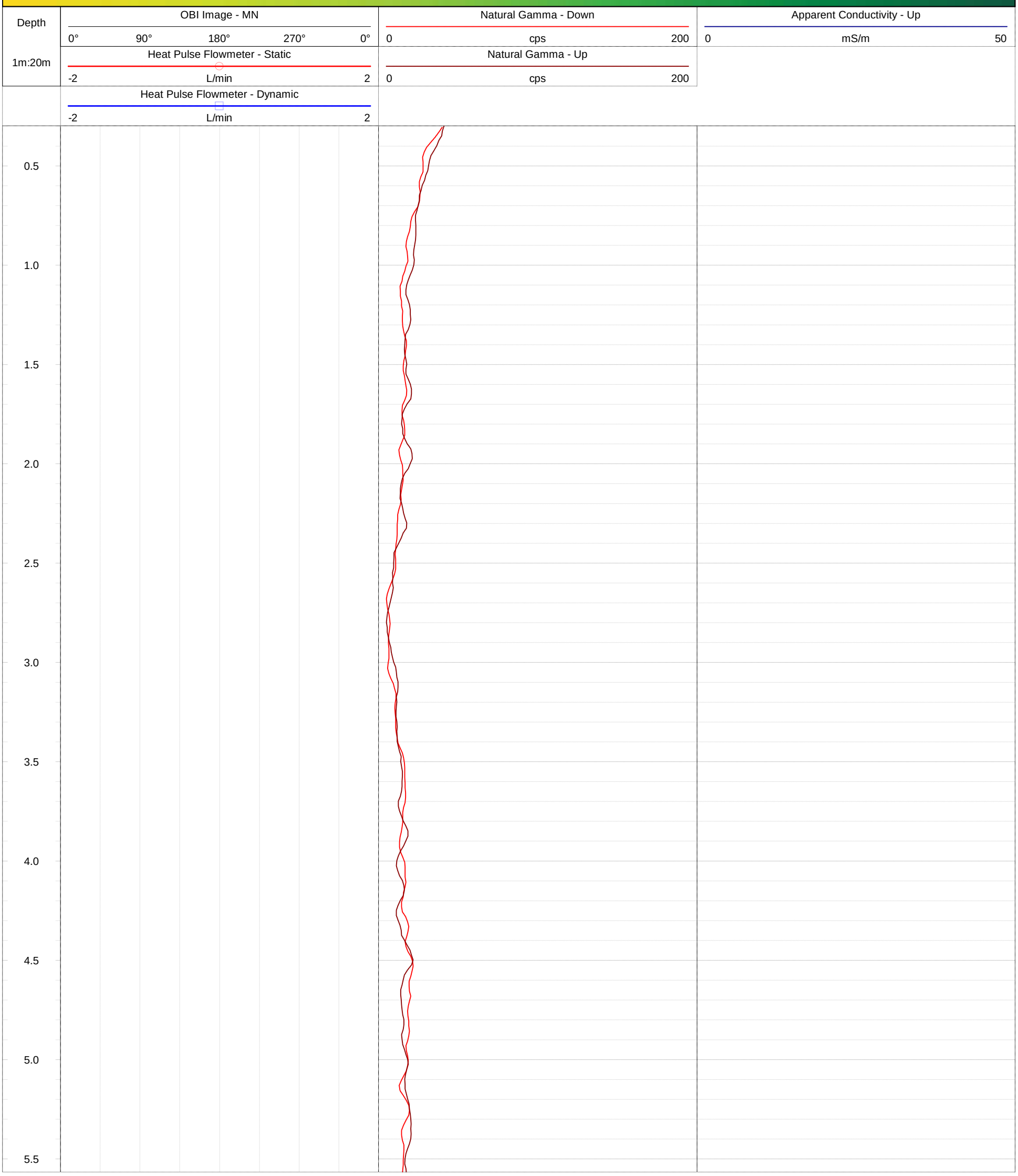
GOLDER
MEMBER OF WSP

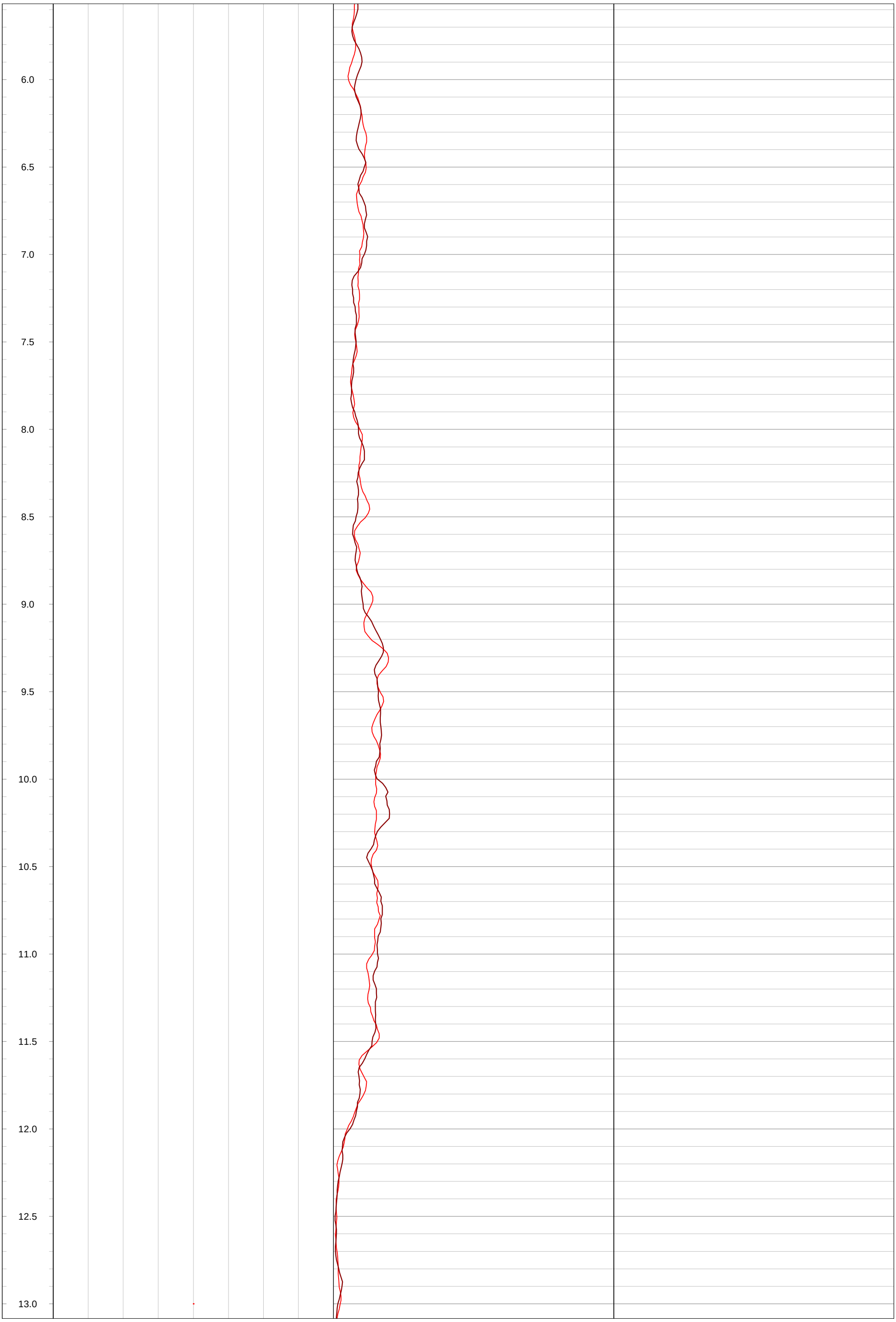
Geophysical Record of Borehole: MW20-16 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.04 m bgs	**Location:**	Caledon, Ontario
Easting:	576784.58 m	**Drilled Depth:**	39.77 m bgs	**Water Level:**	0.86 m bgs	**Log Date:**	May-26-2020
Northing:	4853806.76 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	421.40 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes: OBI image opaque > 38.60 m bgs

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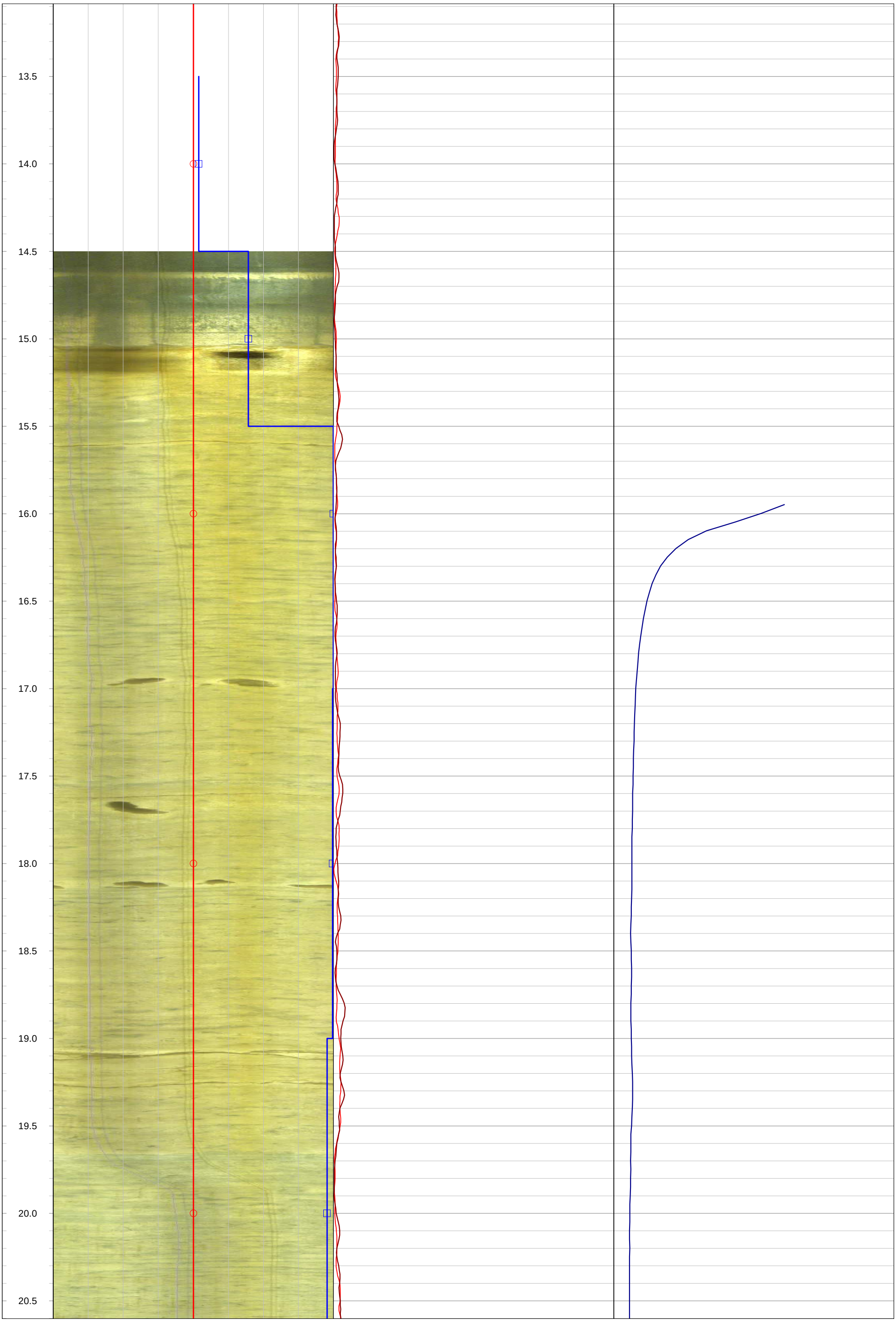
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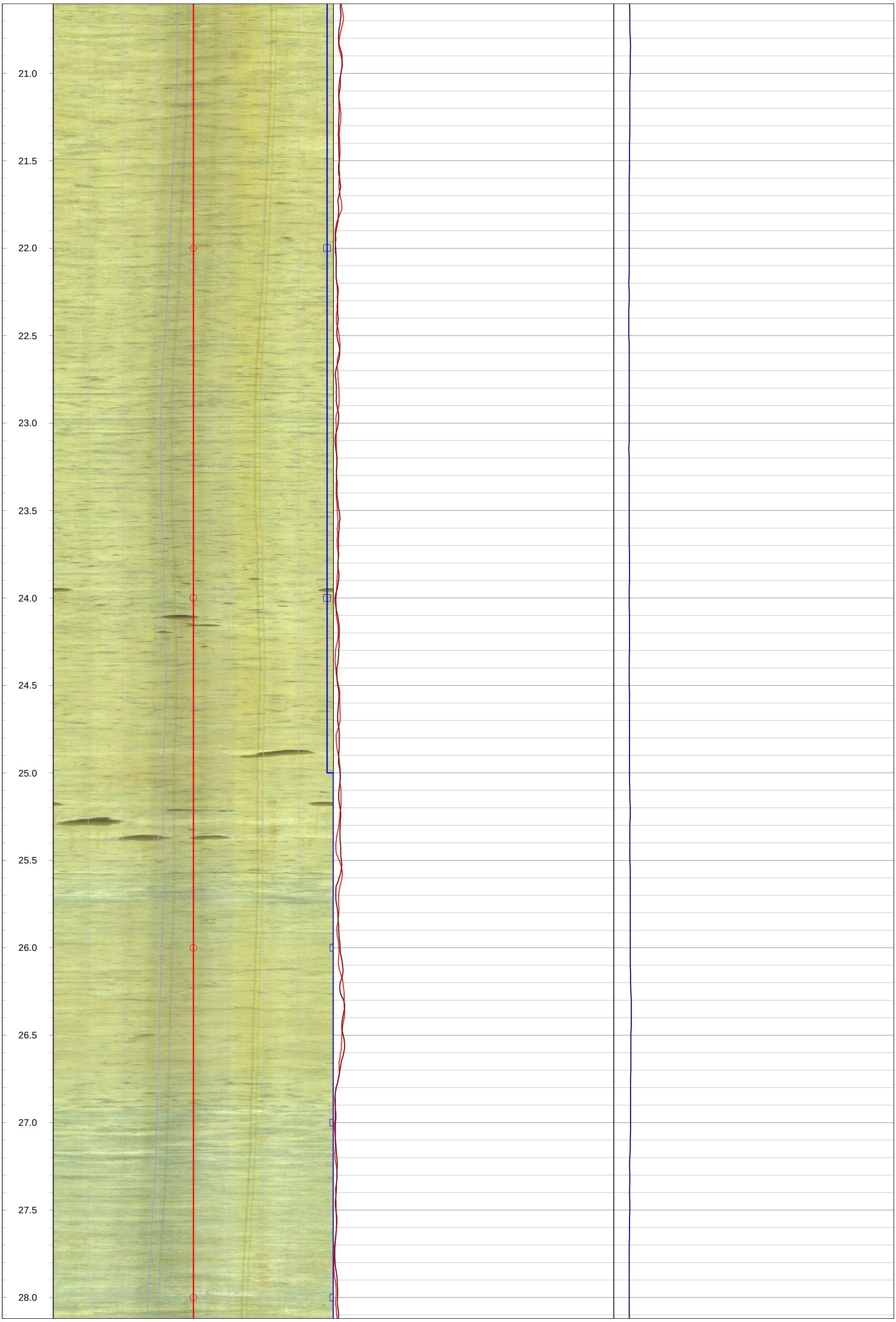
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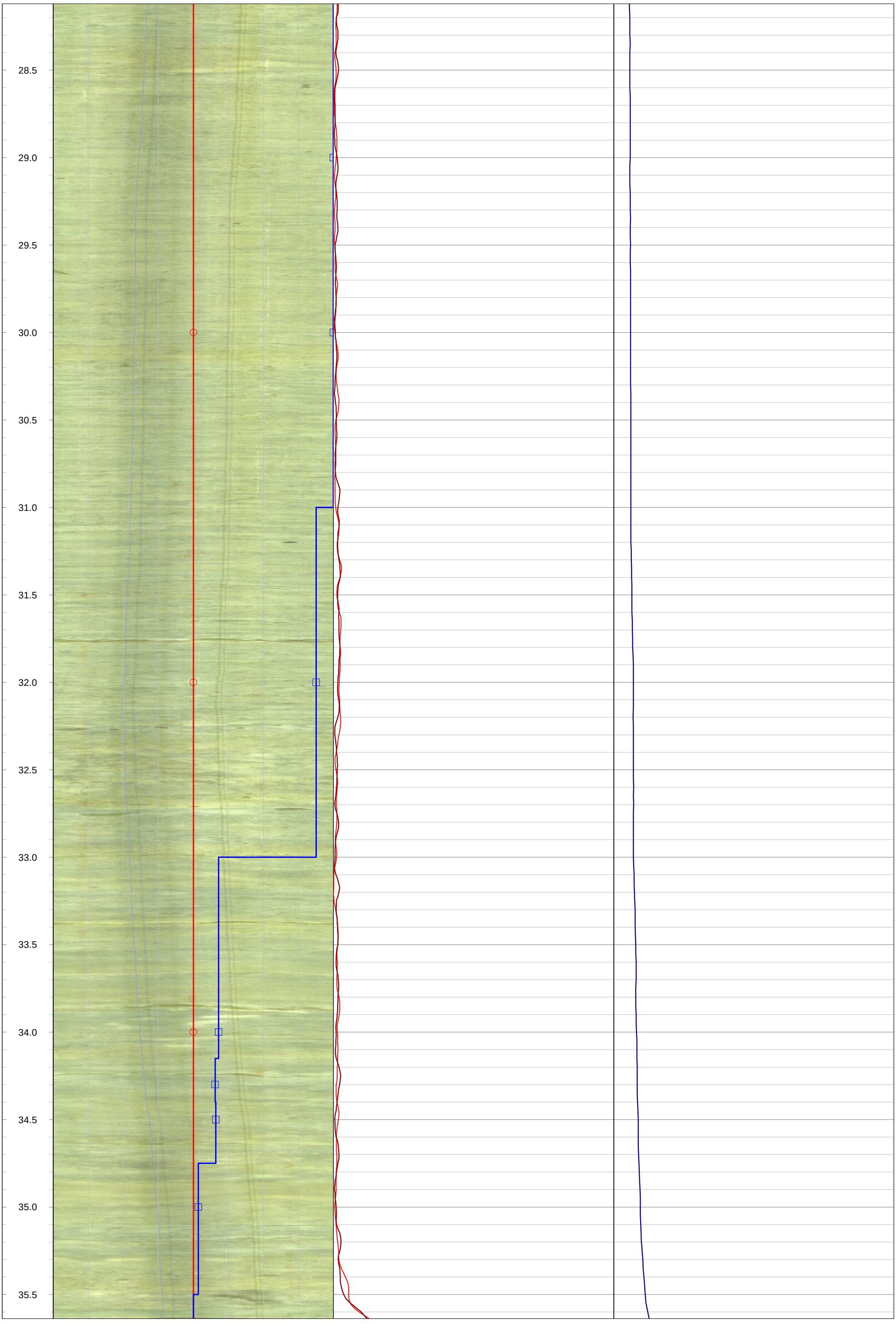
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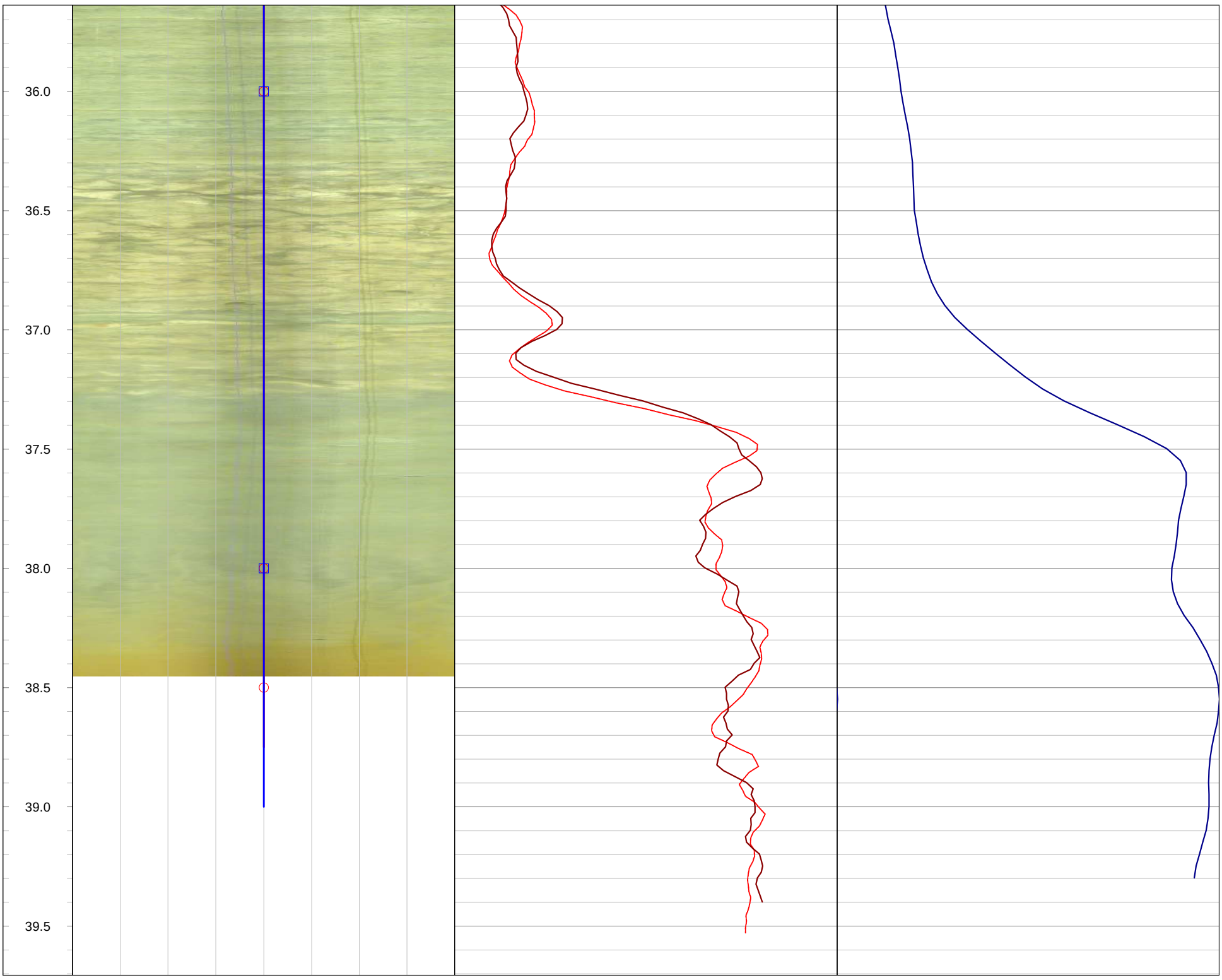
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39.5

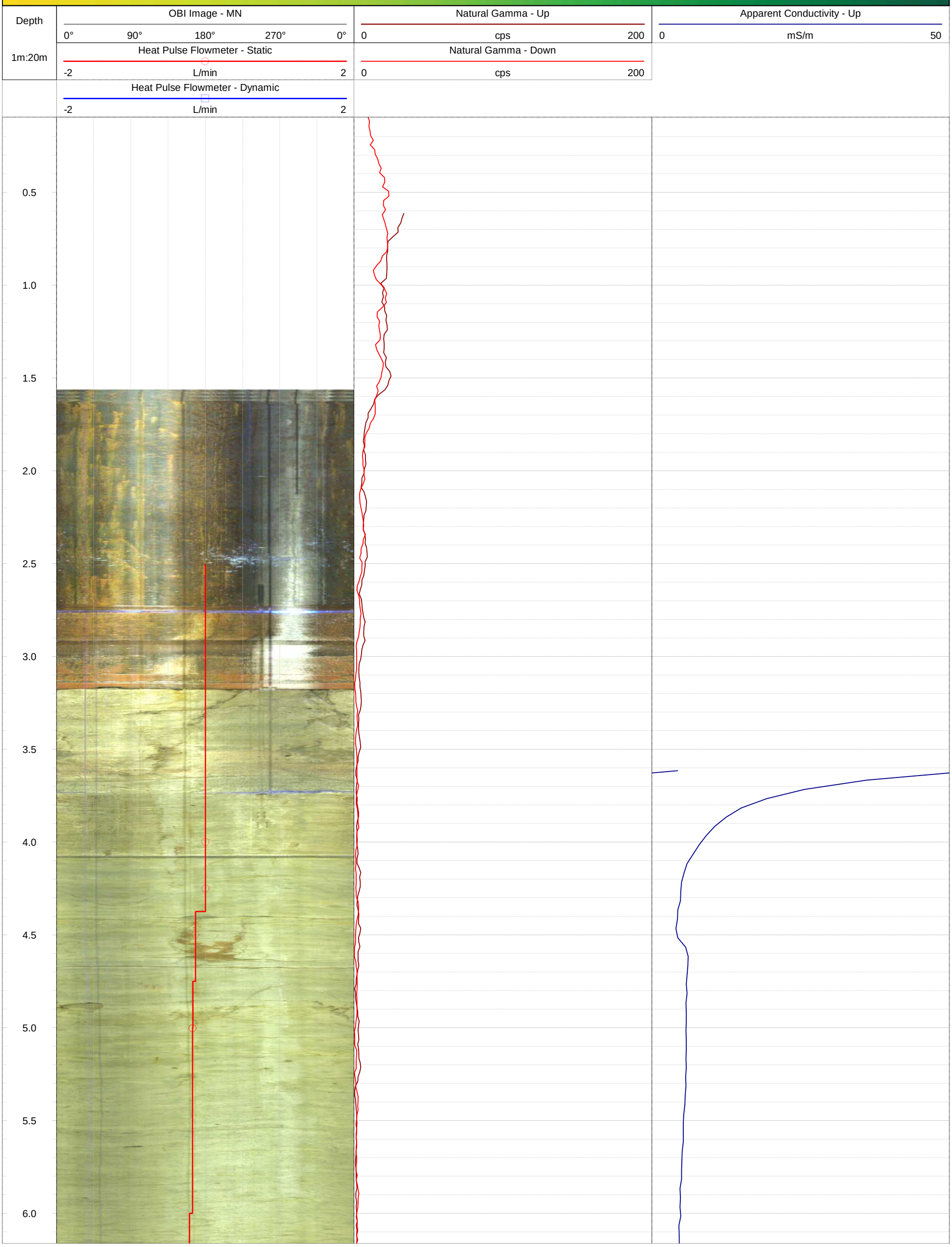
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-17 (CAL)

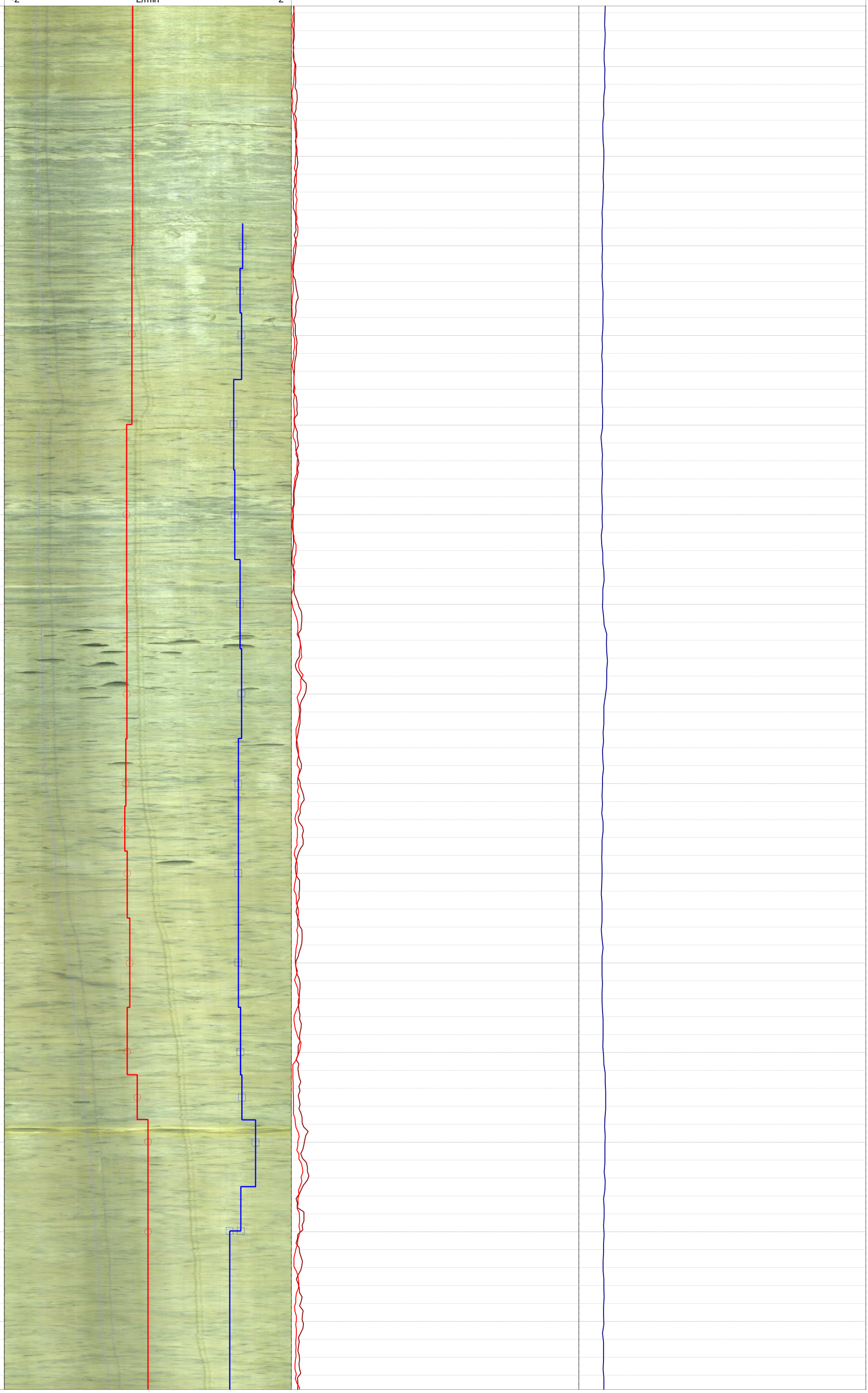
Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.18 m bgs	**Location:**	Caledon, Ontario
Easting:	576752.28 m	**Drilled Depth:**	28.82 m bgs	**Water Level:**	4.02 m bgs	**Log Date:**	May-28-2020
Northing:	4852966.36 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.64 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.05 m ags	**Logged By:**	PG

Notes: Borehole blocked at depth - logged upper portion. Heat Pulse Flowmeter Dynamic pump at 5.0 m below top of casing. Pump rate approximately 2.63 L/min.



Depth	OBI Image - MN	Natural Gamma - Up	Apparent Conductivity - Up
	0° 90° 180° 270° 0°	0 cps 200	0 mS/m 50
1m:20m	Heat Pulse Flowmeter - Static	Natural Gamma - Down	
	-2 L/min 2	0 cps 200	
	Heat Pulse Flowmeter - Dynamic		
	-2 L/min 2		



Depth

1m:20m

OBI Image - MN

0° 90° 180° 270° 0°

Heat Pulse Flowmeter - Static

-2 L/min 2

Heat Pulse Flowmeter - Dynamic

-2 L/min 2

Natural Gamma - Up

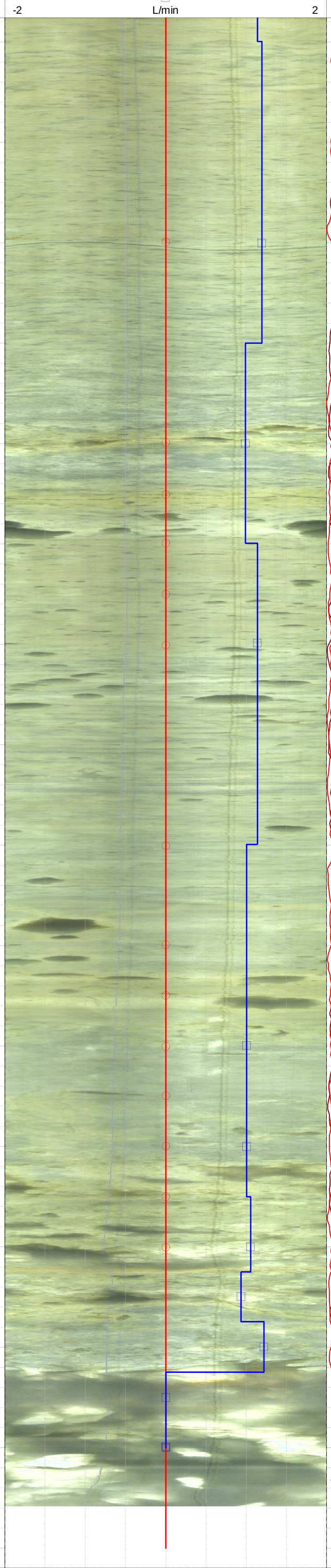
0 cps 200

Natural Gamma - Down

0 cps 200

Apparent Conductivity - Up

0 mS/m 50



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16.5
17.0
17.5
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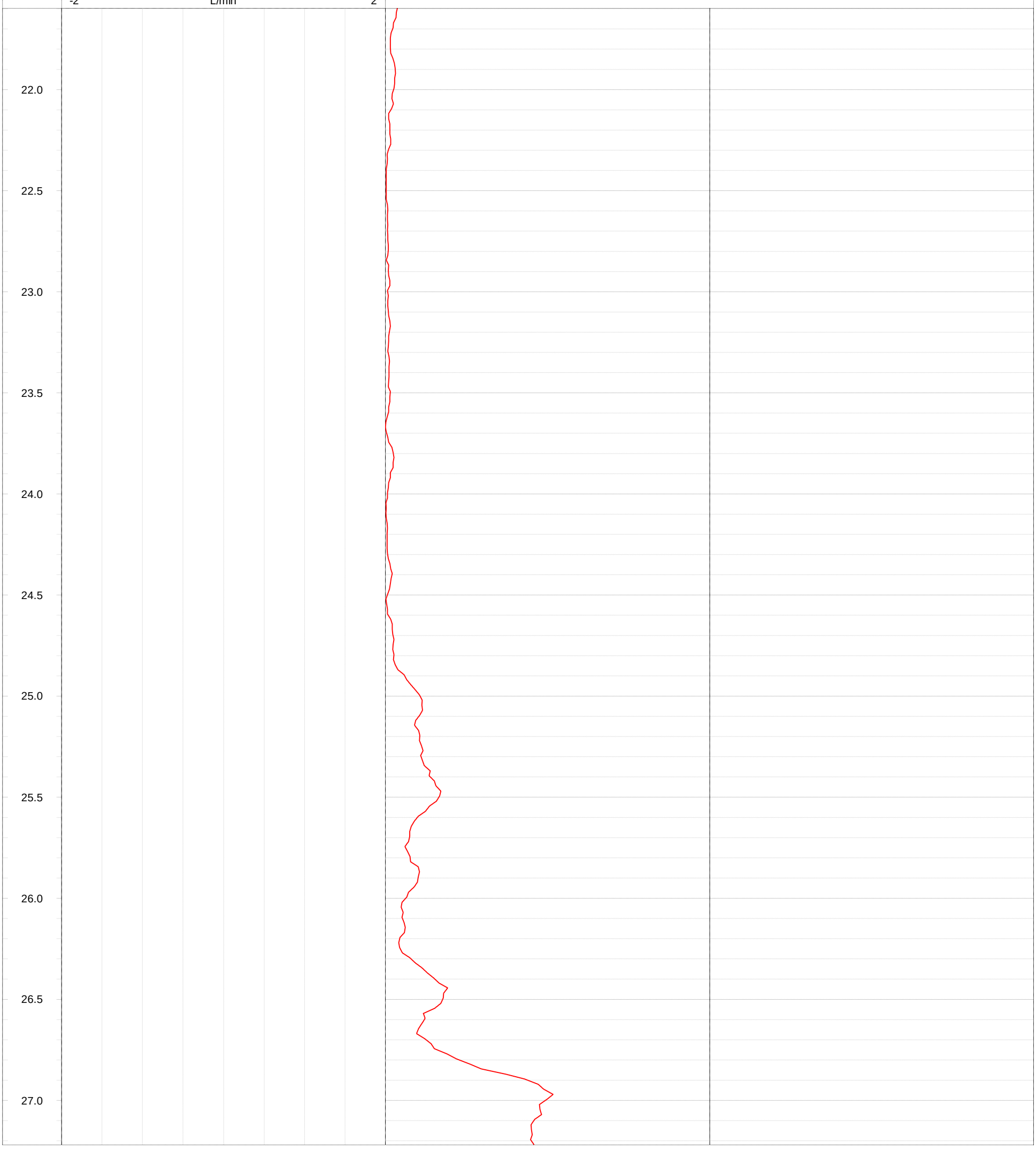
18.5
19.0
19.5
20.0
20.5
21.0
21.5

Depth	OBI Image - MN	Natural Gamma - Up	Apparent Conductivity - Up
	0° 90° 180° 270° 0°	0 cps 200	0 mS/m 50
1m:20m	Heat Pulse Flowmeter - Static	Natural Gamma - Down	
	-2 L/min 2	0 cps 200	
	Heat Pulse Flowmeter - Dynamic		
	-2 L/min 2		



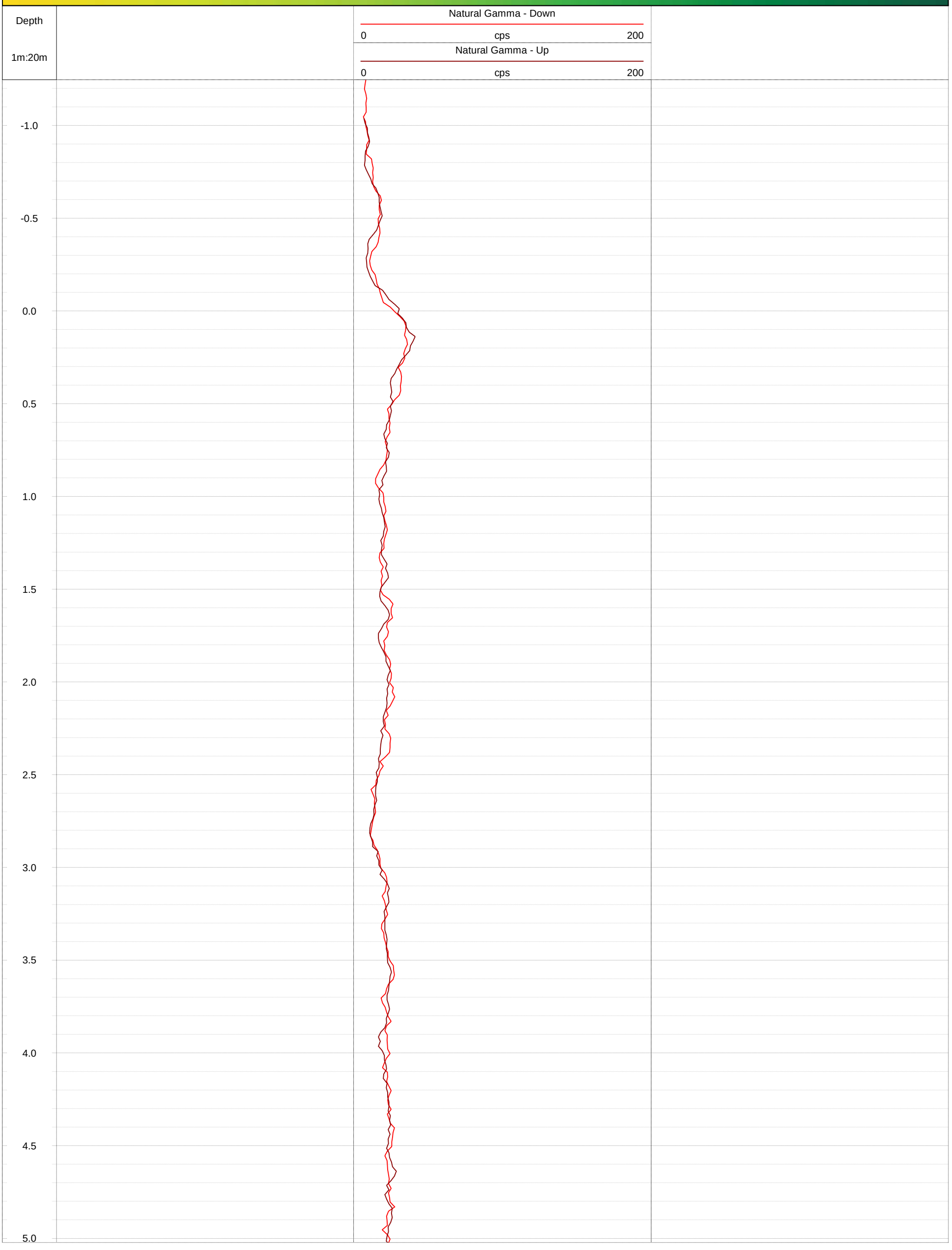
GOLDER
MEMBER OF WSP

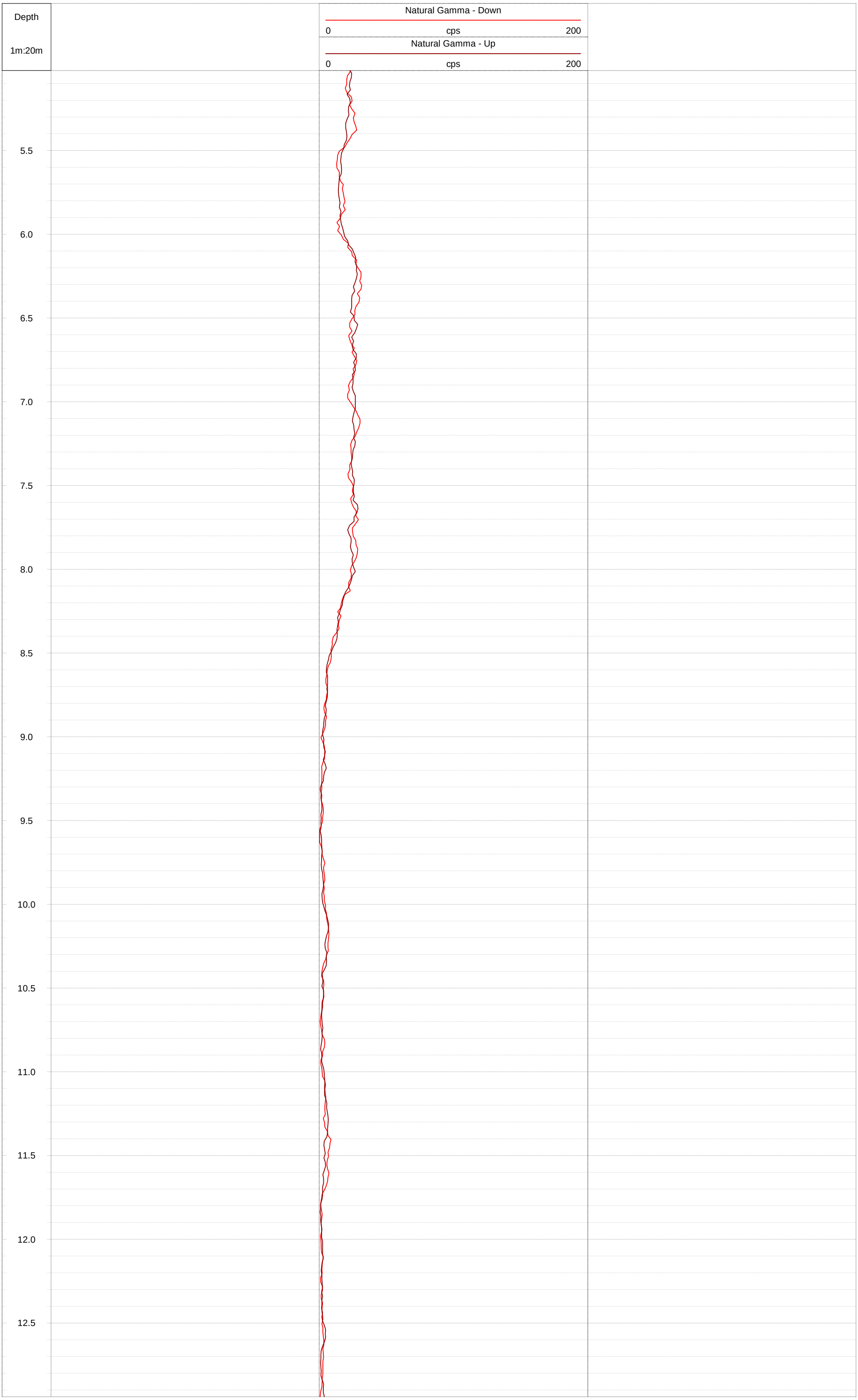
Geophysical Record of Borehole: MW20-18 (CAL)

Log Title:	Geophysical Log
Project Number:	19129150
Client:	St. Marys Cement Inc. (Canada)
Date:	October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	577058.36 m	**Drilled Depth:**	28.15 m bgs	**Water Level:**	12.41 m bgs	**Log Date:**	June-12-2020
Northing:	4852658.80 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.29 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	1.69 m ags	**Logged By:**	PG

Notes: Collapsed hole. Only Gamma logged inside the rods.

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Natural Gamma - Down
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cps
200
Natural Gamma - Up
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cps
200
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12.0
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Depth

1m:20m

Natural Gamma - Down

0 cps 200

Natural Gamma - Up

0 cps 200

13.0

13.5

14.0

14.5

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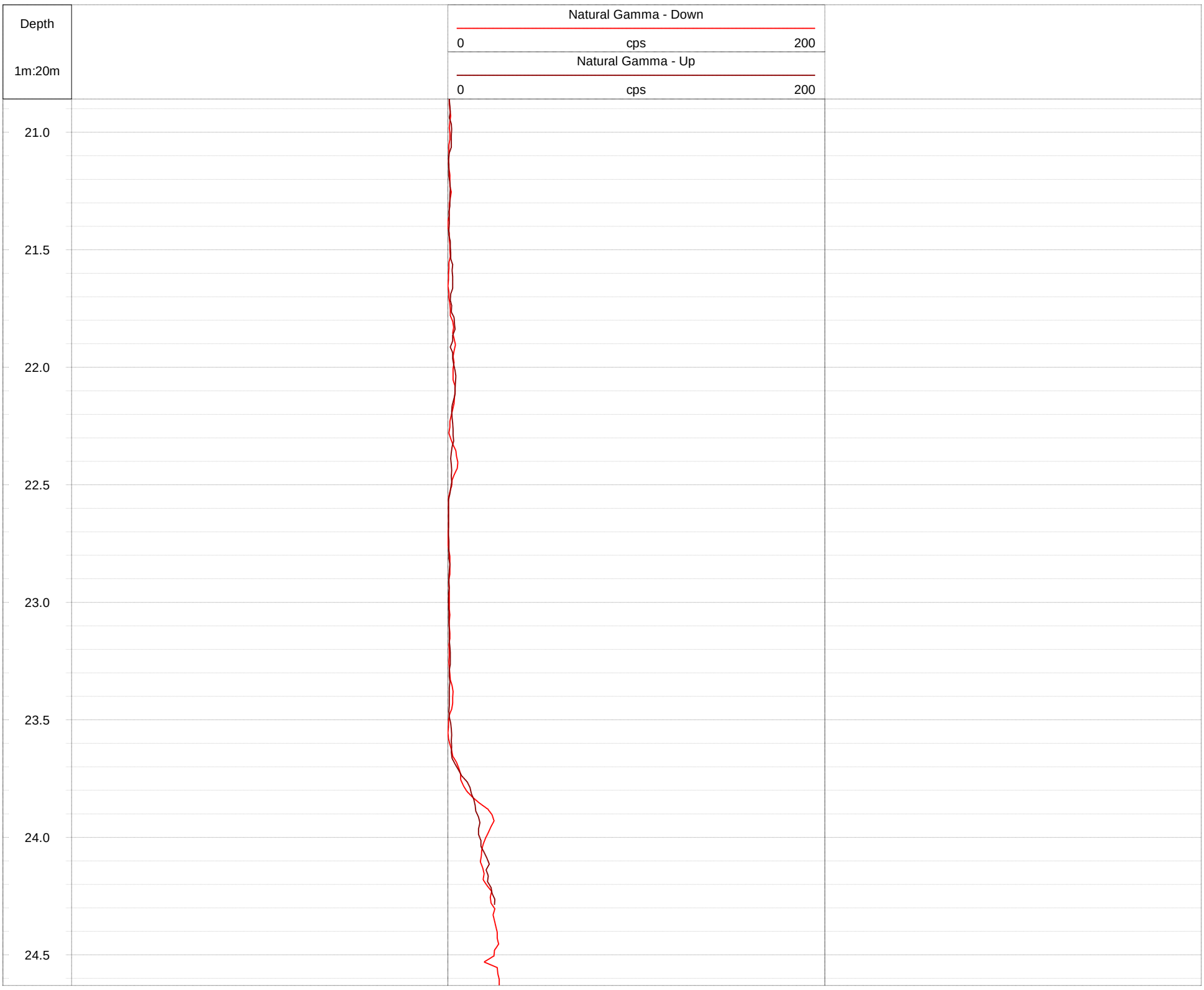
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cps
200
Natural Gamma - Up
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cps
200
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24.5

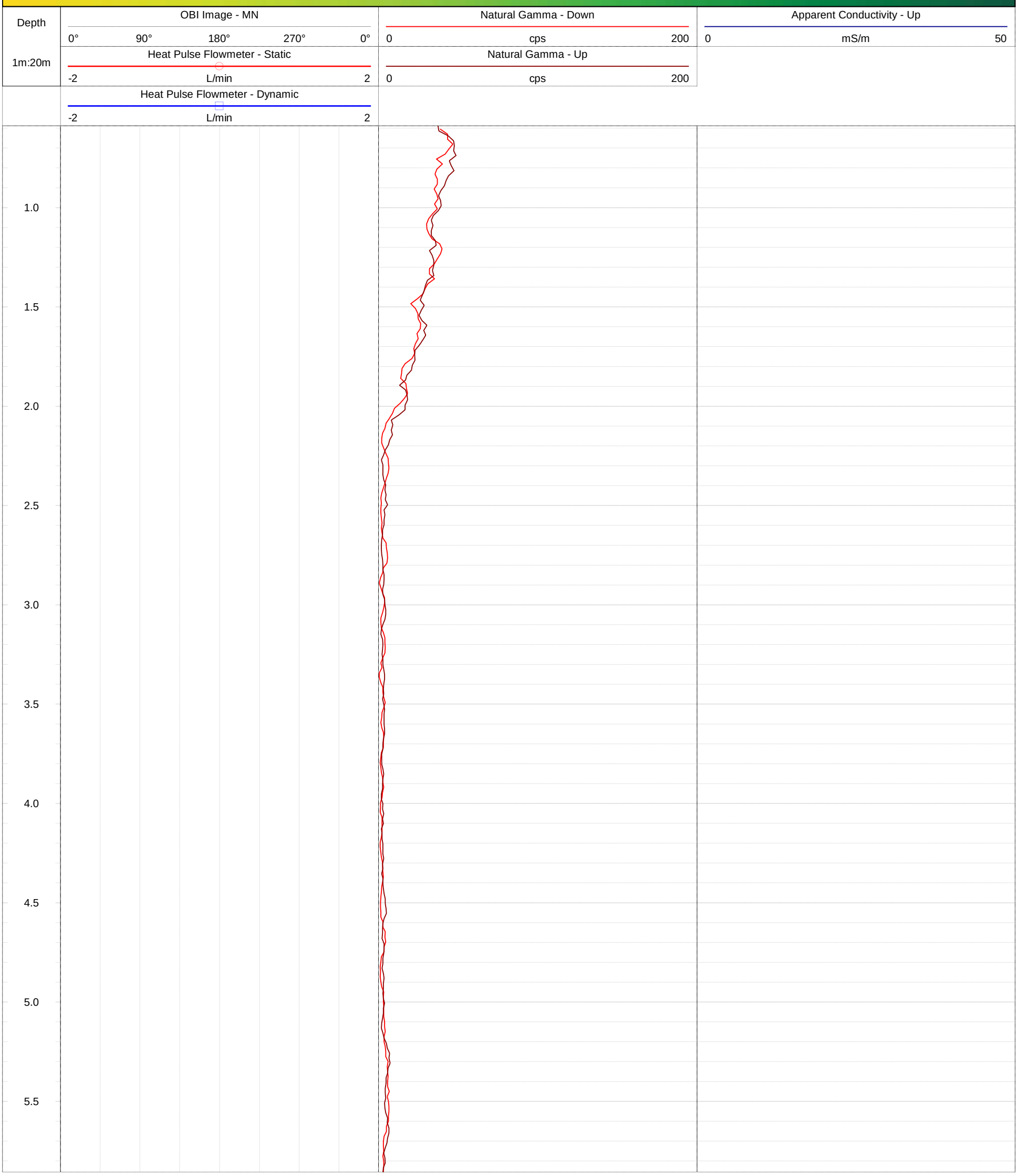
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-19 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.10 m bgs	**Location:**	Caledon, Ontario
Easting:	576906.96 m	**Drilled Depth:**	27.39 m bgs	**Water Level:**	6.47 m bgs	**Log Date:**	Oct-28-2020
Northing:	4851999.96 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	396.98 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.10 m ags	**Logged By:**	PG

Notes:



Depth

1m:20m

OBI Image - MN

0° 90° 180° 270° 0°

Heat Pulse Flowmeter - Static

-2 L/min 2

Heat Pulse Flowmeter - Dynamic

-2 L/min 2

Natural Gamma - Down

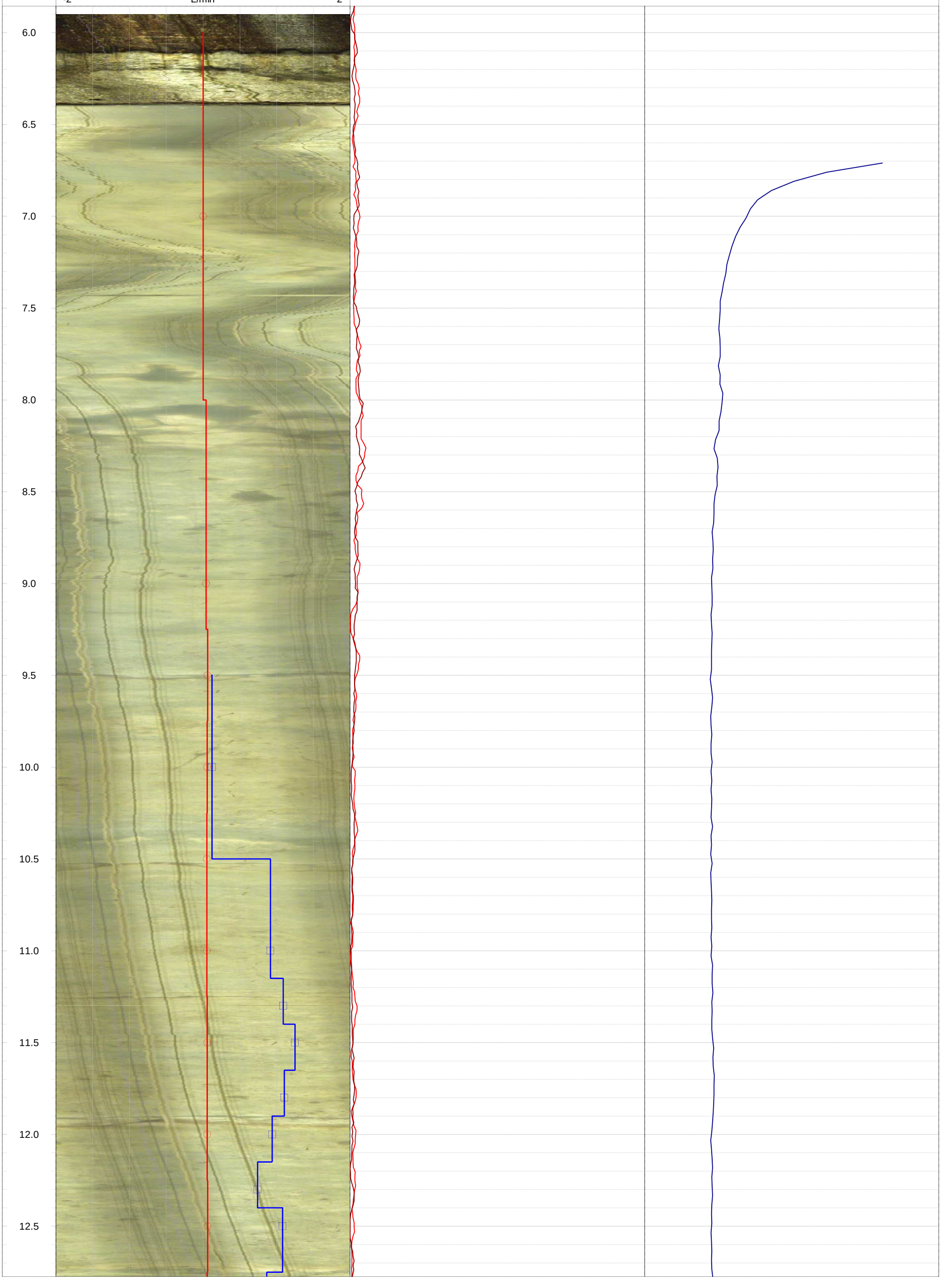
0 cps 200

Natural Gamma - Up

0 cps 200

Apparent Conductivity - Up

0 mS/m 50



Depth

1m:20m

OBI Image - MN

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Heat Pulse Flowmeter - Static

-2 L/min 2

Heat Pulse Flowmeter - Dynamic

-2 L/min 2

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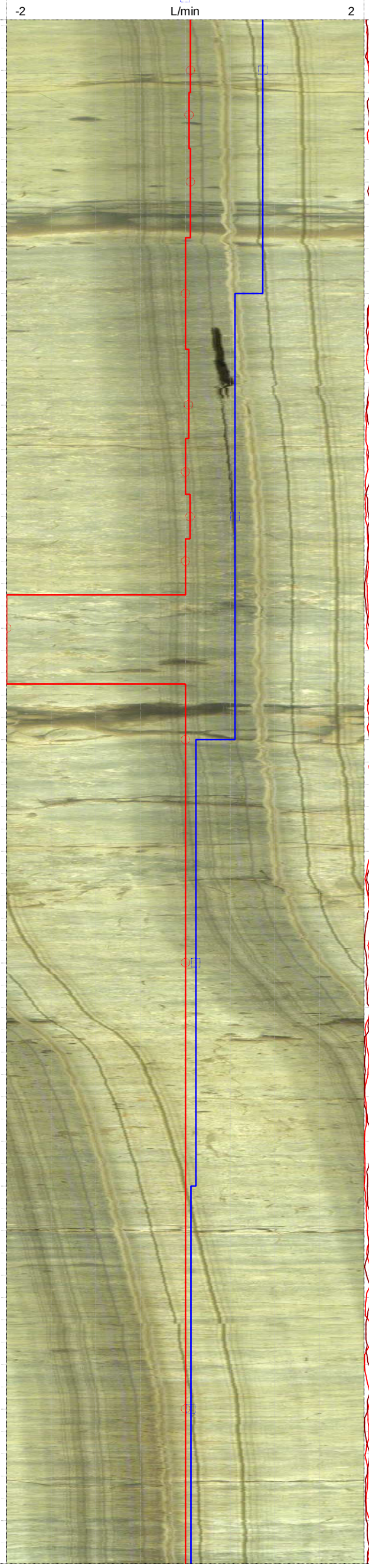
Natural Gamma - Up

0 cps 200

Apparent Conductivity - Up

0 mS/m 50



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Depth	OBI Image - MN	Natural Gamma - Down	Apparent Conductivity - Up
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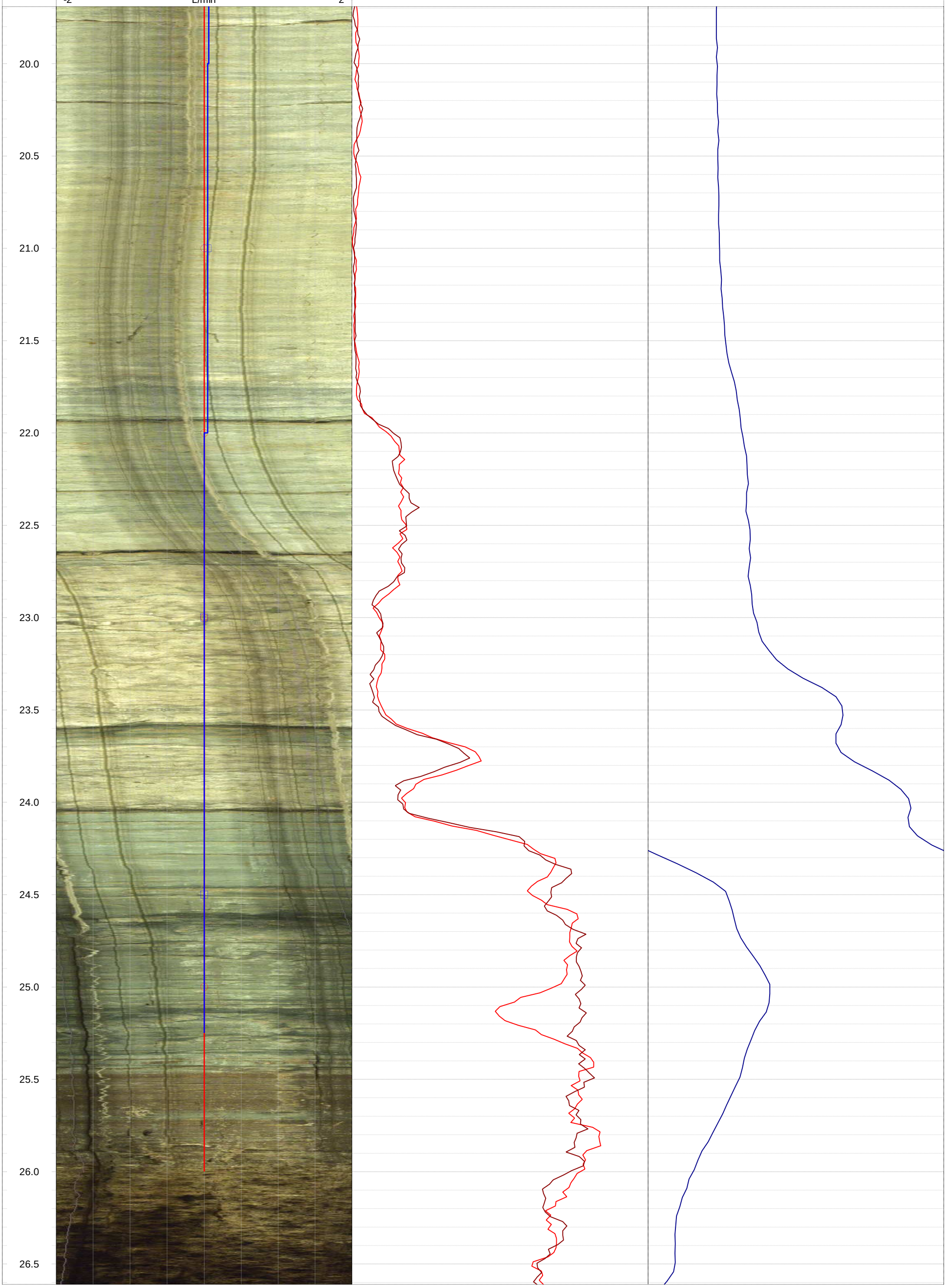
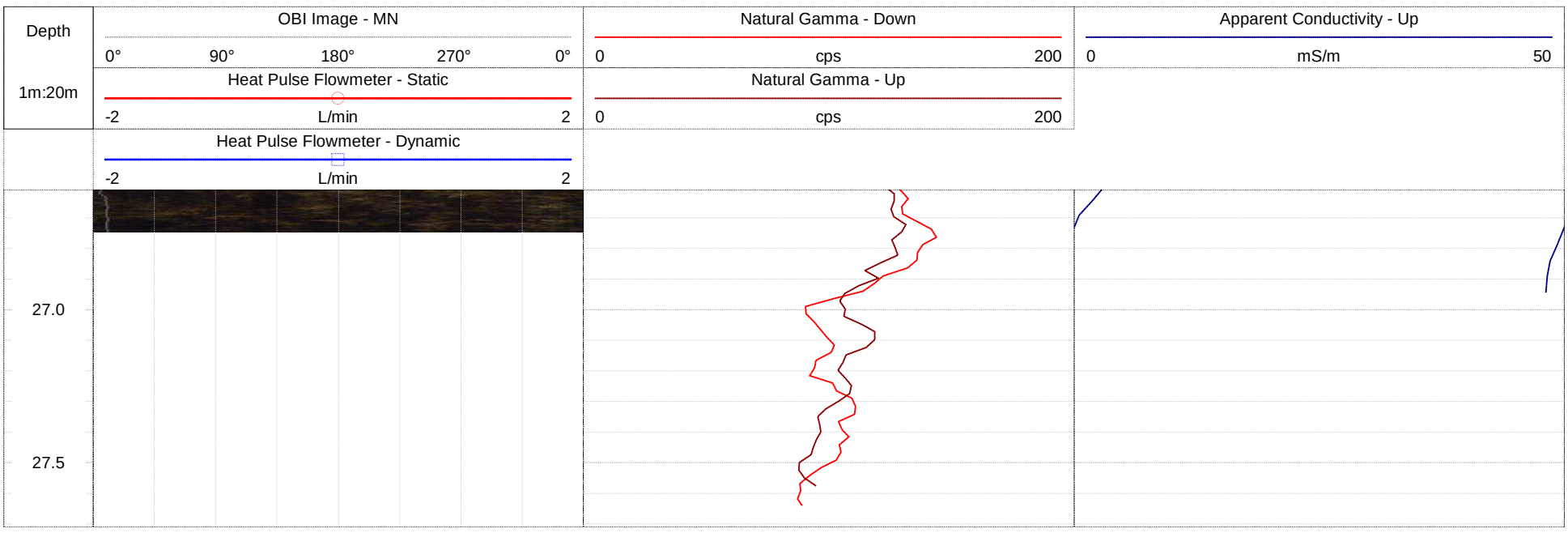
1m:20m	Heat Pulse Flowmeter - Static	Natural Gamma - Up	
	-2 L/min 2	0 cps 200	
	Heat Pulse Flowmeter - Dynamic		
	-2 L/min 2		

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Natural Gamma - Down
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Natural Gamma - Up
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Apparent Conductivity - Up
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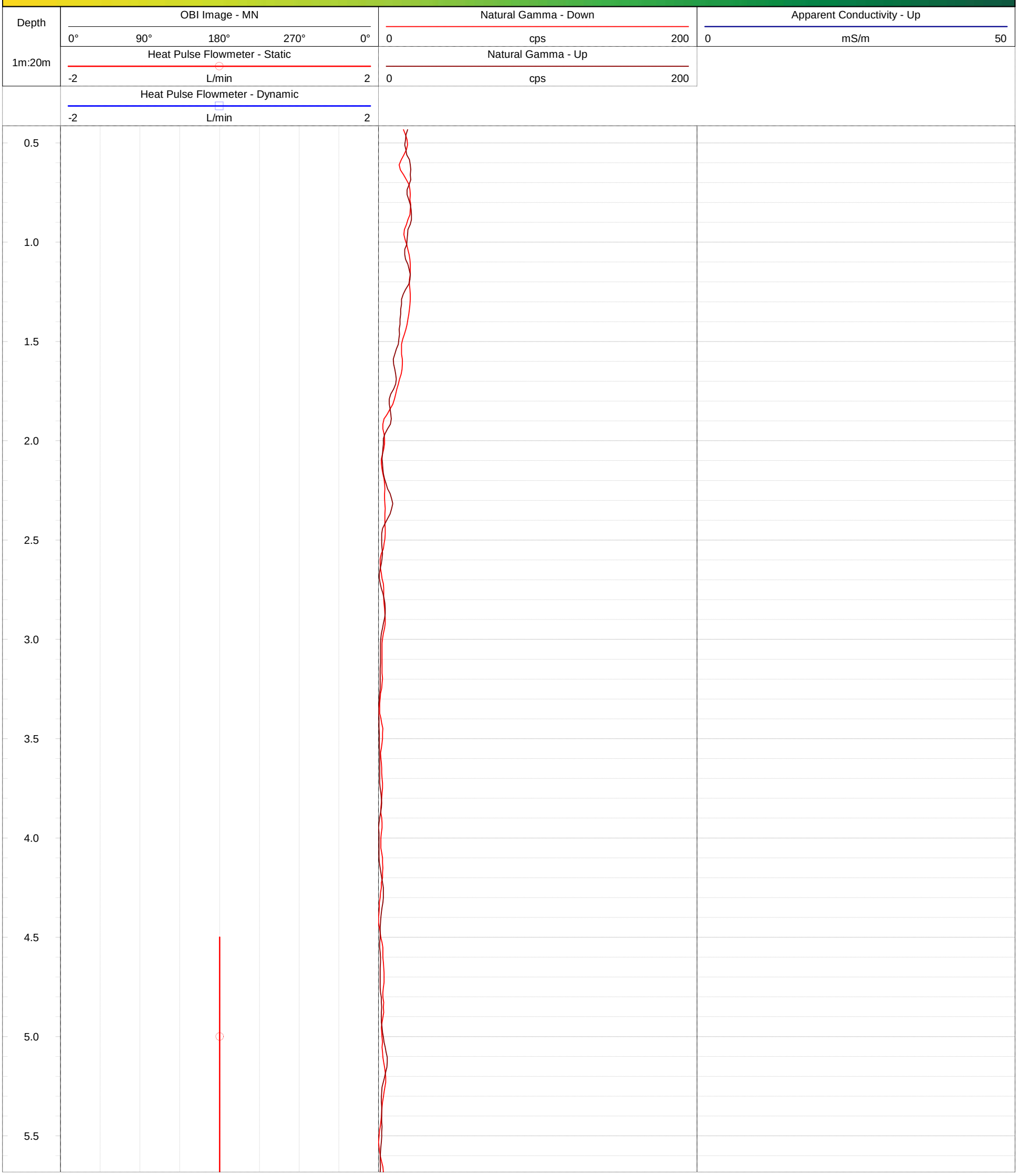
GOLDER
MEMBER OF WSP

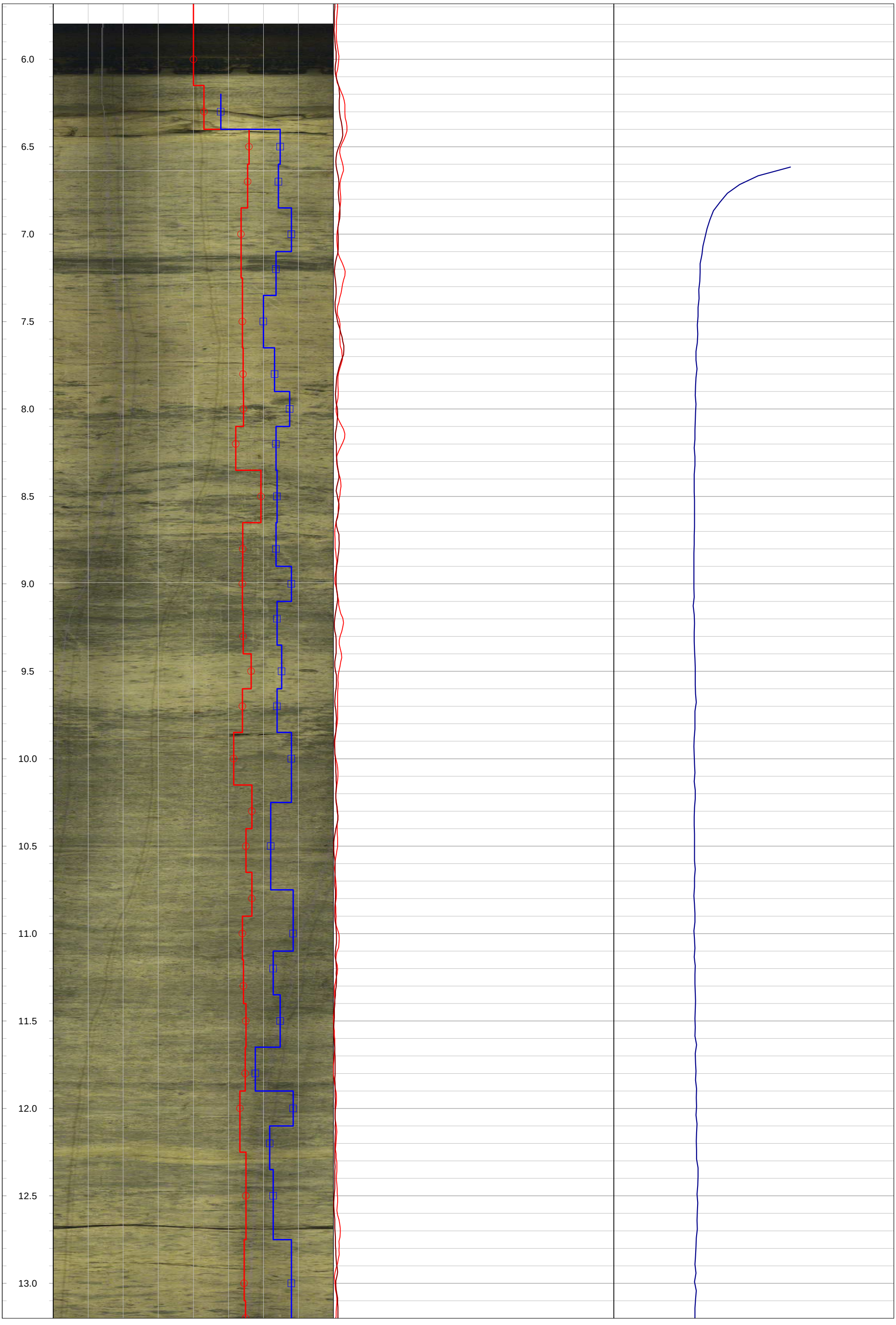
Geophysical Record of Borehole: MW20-20 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.08 m bgs	**Location:**	Caledon, Ontario
Easting:	576476.35 m	**Drilled Depth:**	27.99 m bgs	**Water Level:**	0.25 m bgs	**Log Date:**	Oct-20-2020
Northing:	4852467.69 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.00 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.25 m ags	**Logged By:**	PG

Notes:

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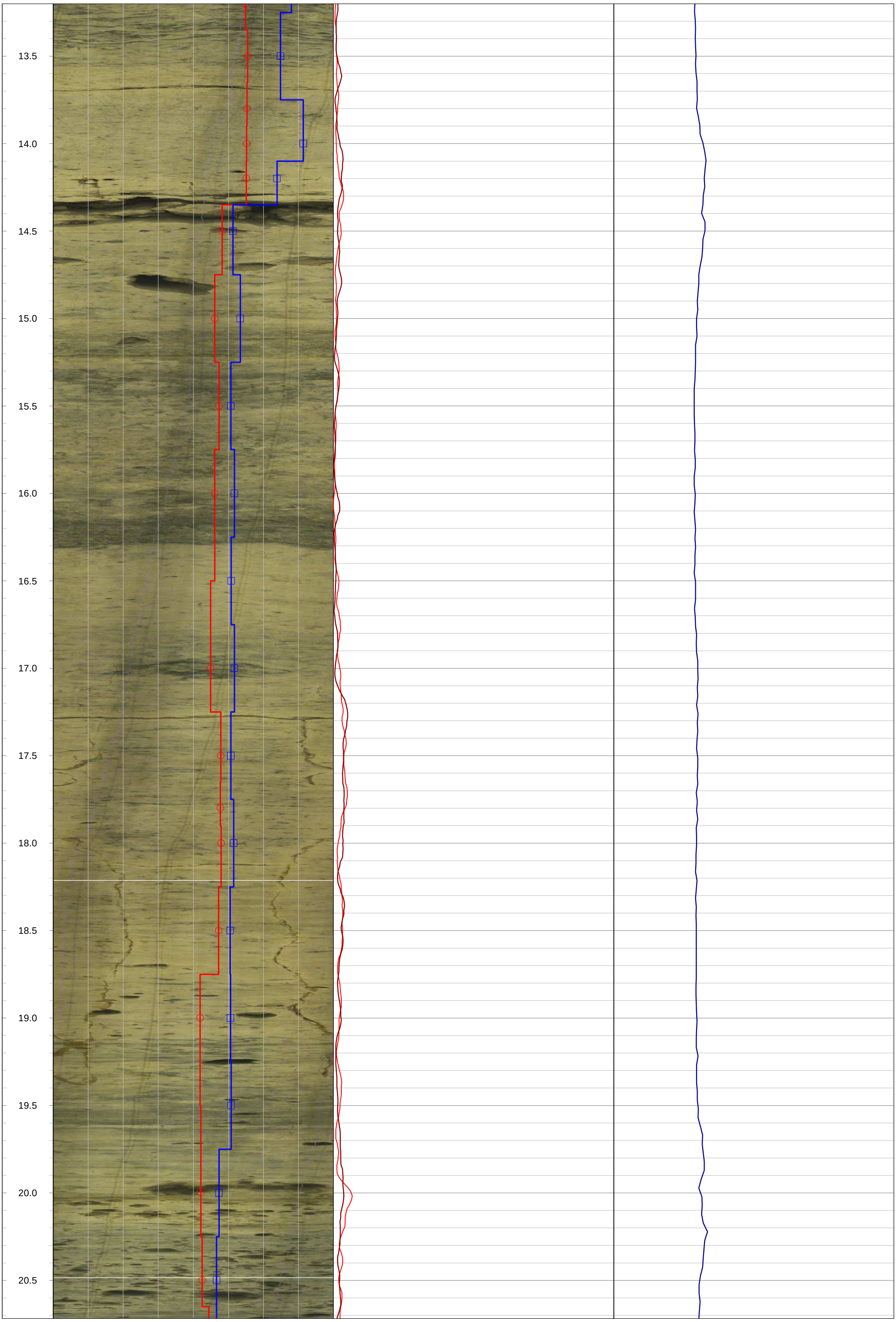
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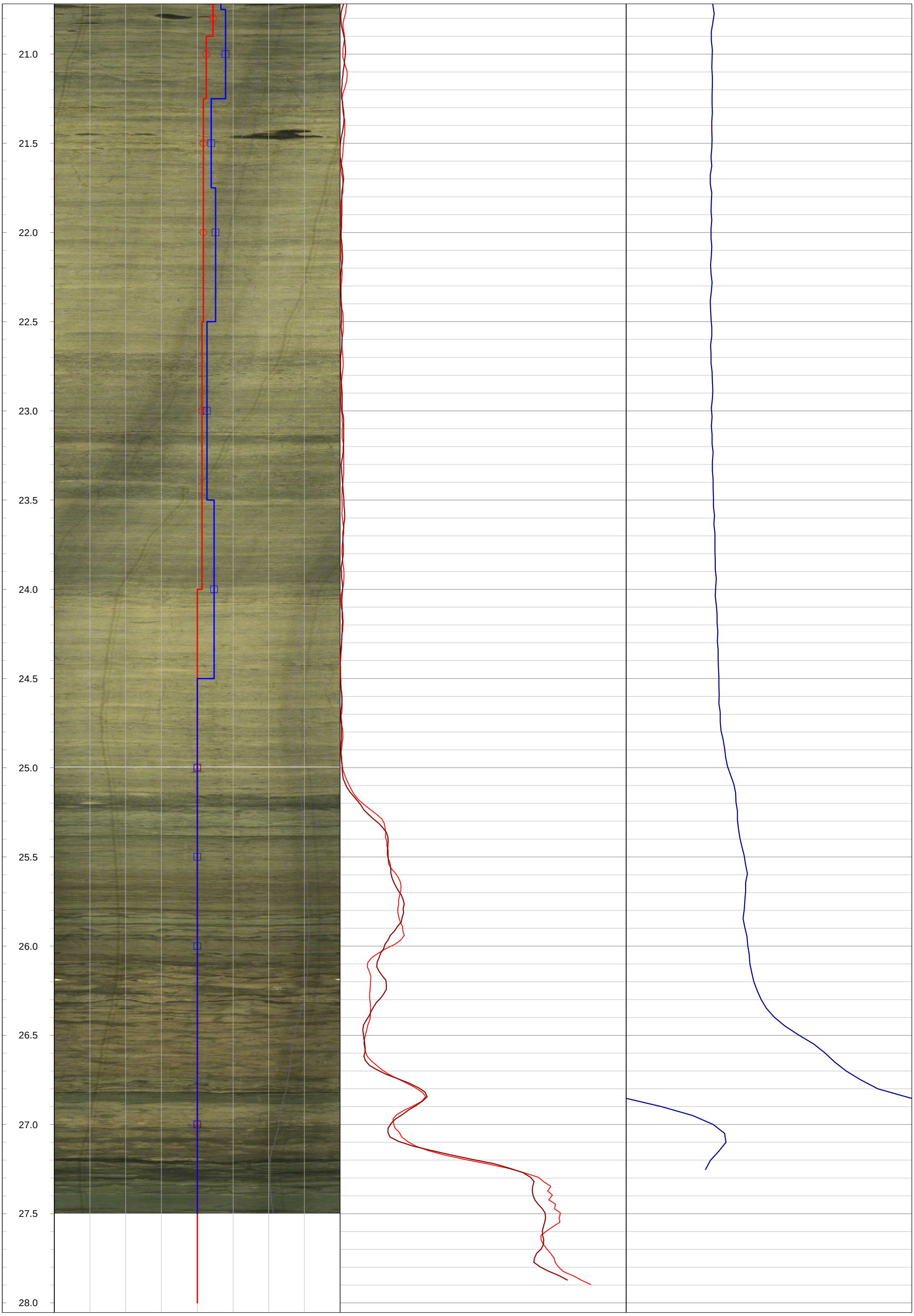
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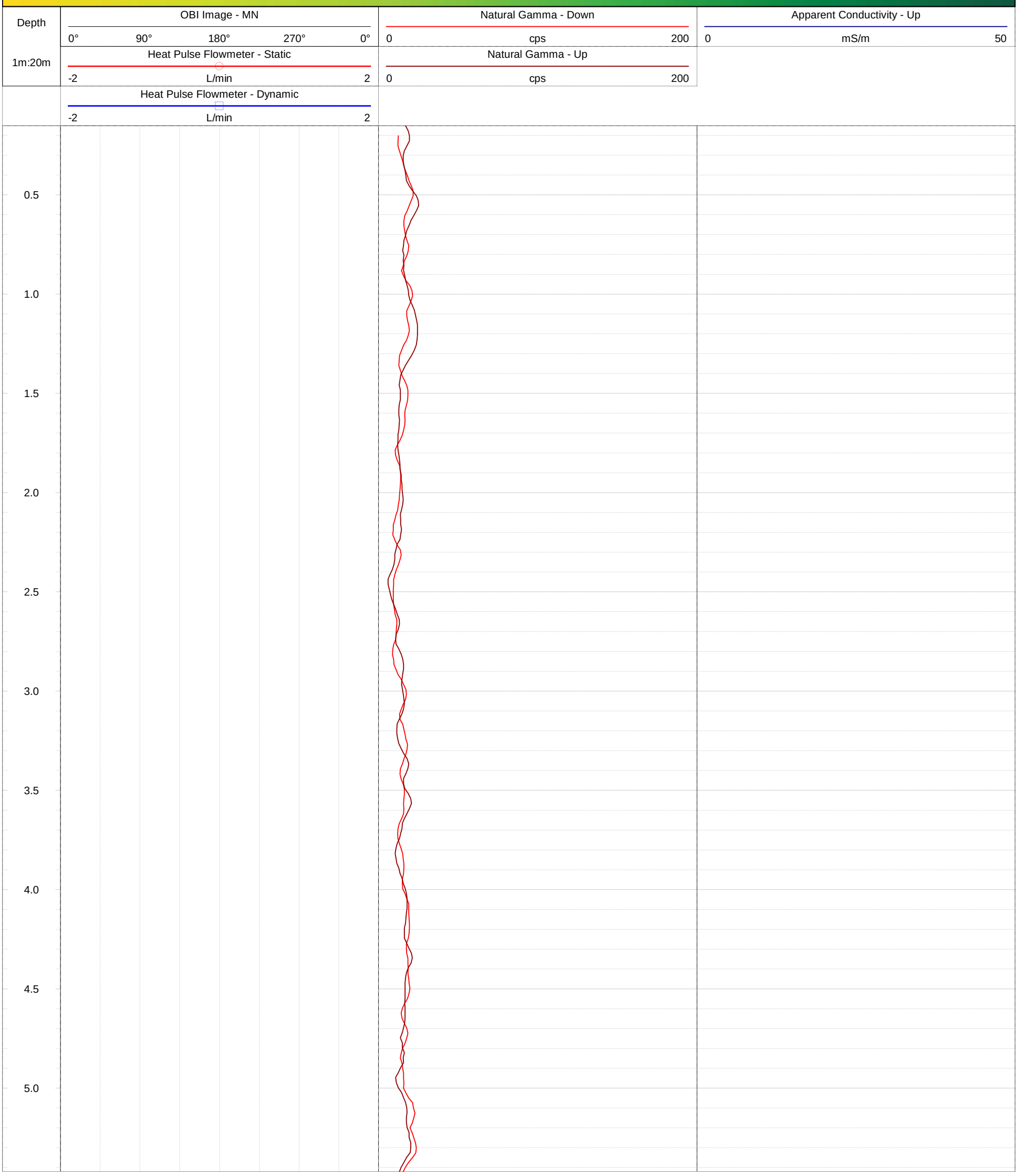
GOLDER
MEMBER OF WSP

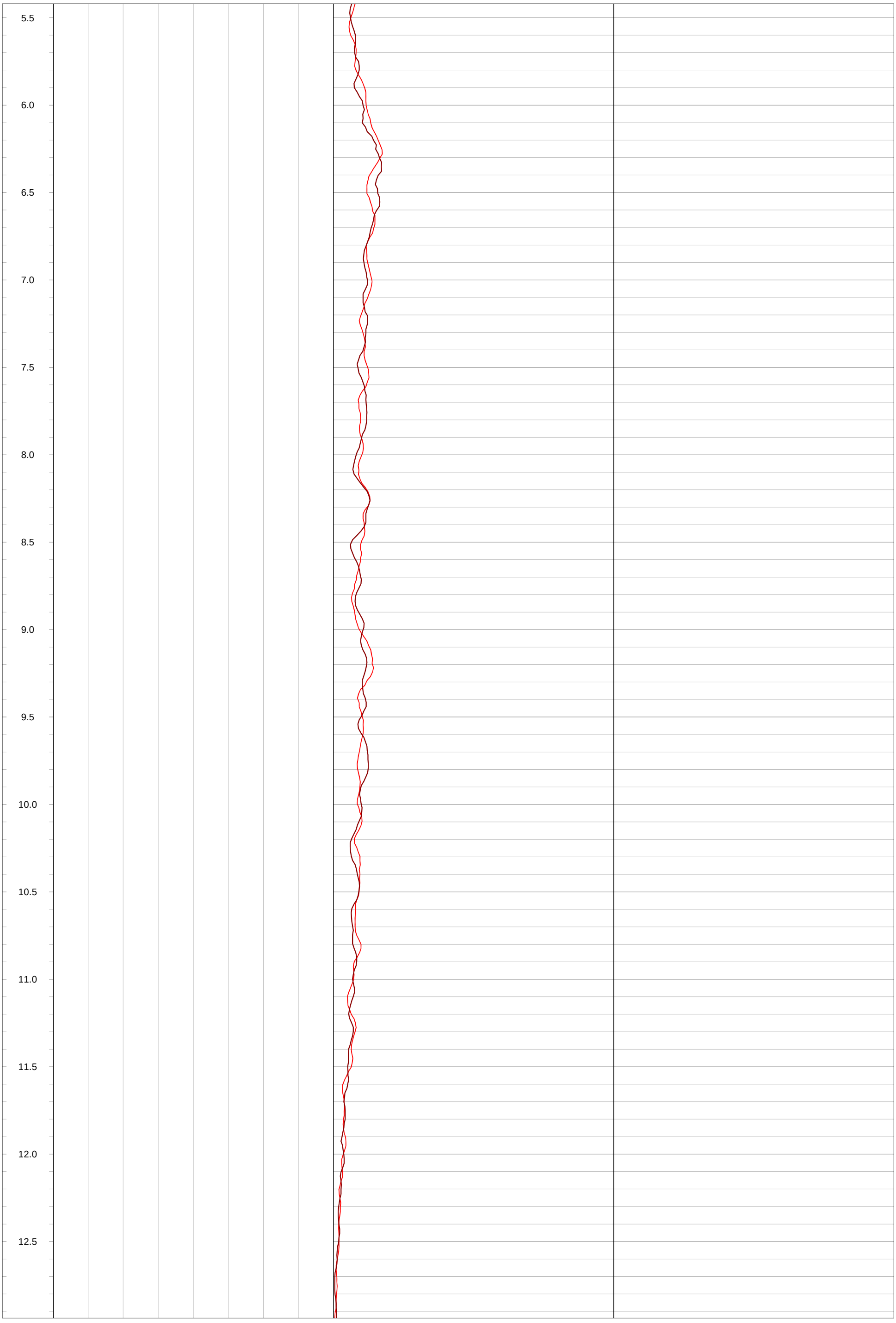
Geophysical Record of Borehole: MW20-21 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	14.98 m bgs	**Location:**	Caledon, Ontario
Easting:	576014.37 m	**Drilled Depth:**	39.70 m bgs	**Water Level:**	1.54 m bgs	**Log Date:**	Nov-5-2020
Northing:	4852839.77 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.23 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.50 m ags	**Logged By:**	PG

Notes: OBI image opaque > 38.90 m bgs

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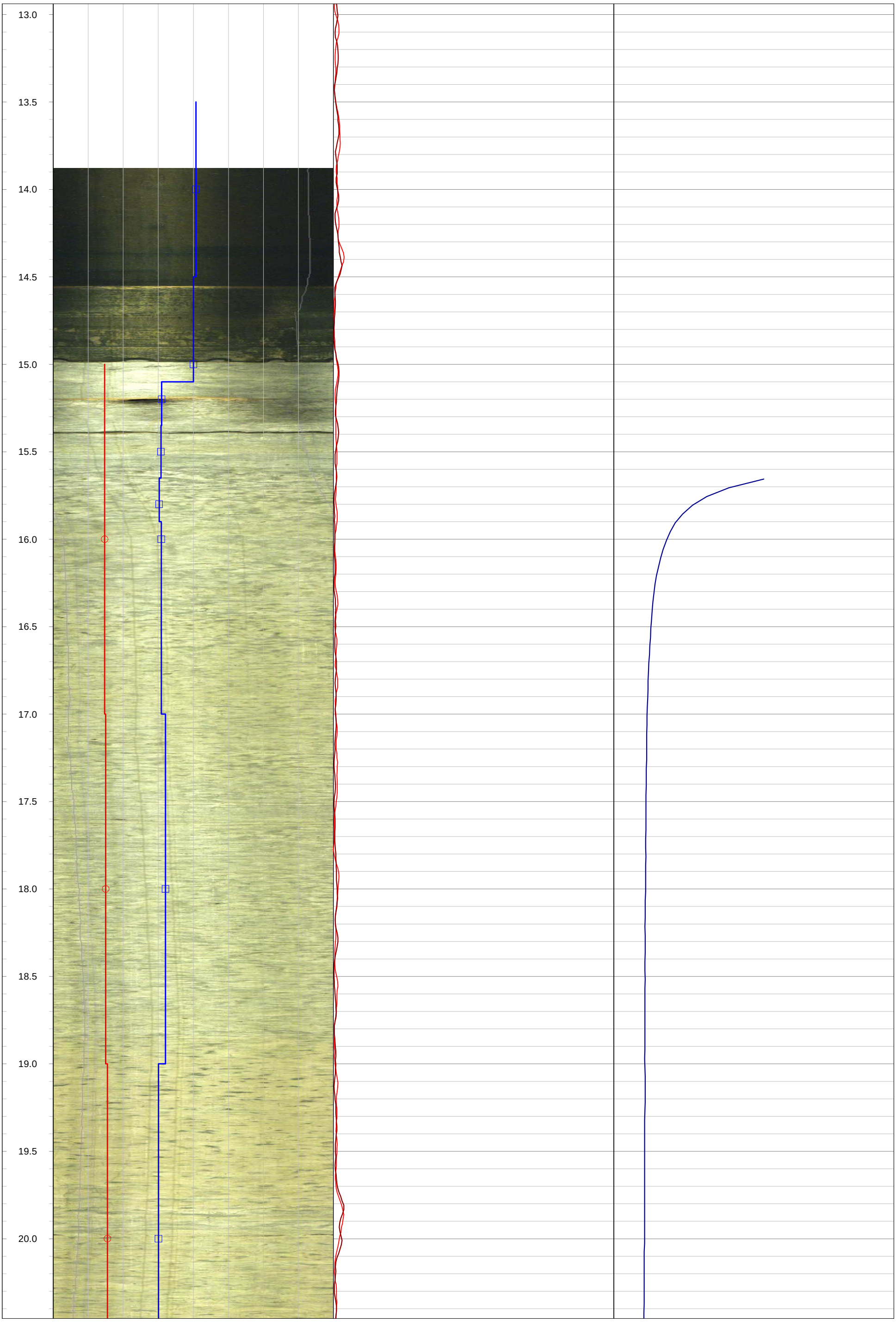
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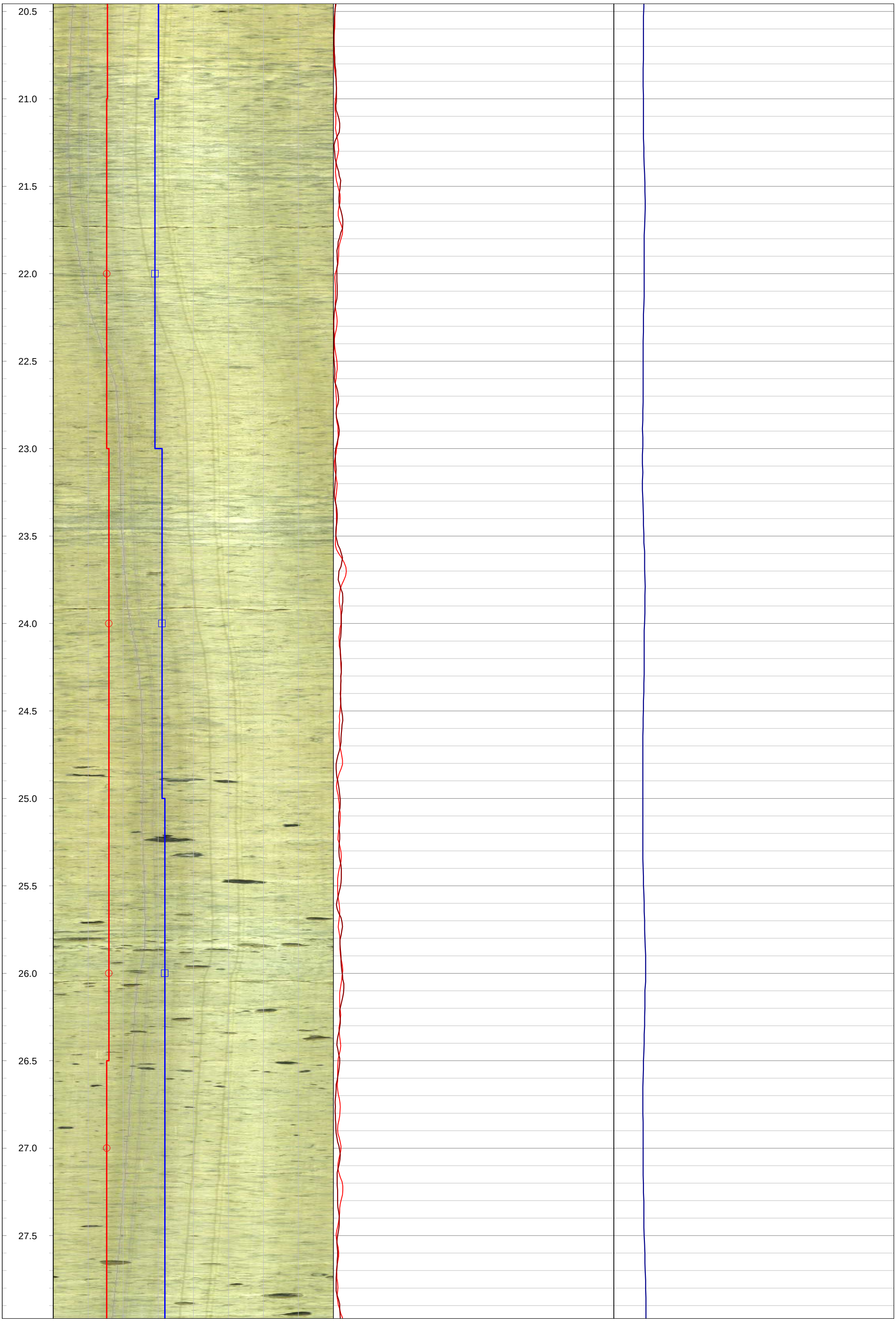
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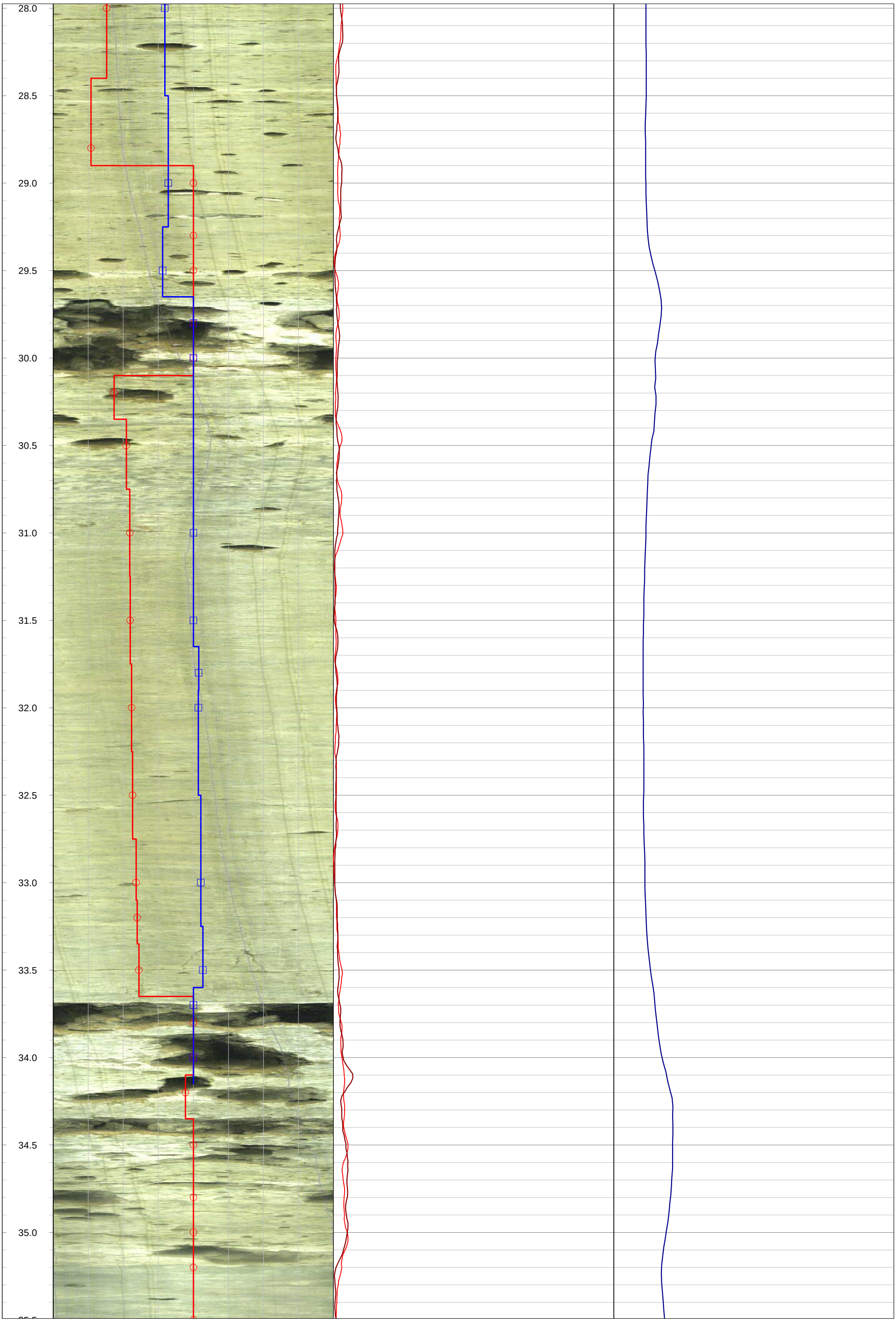
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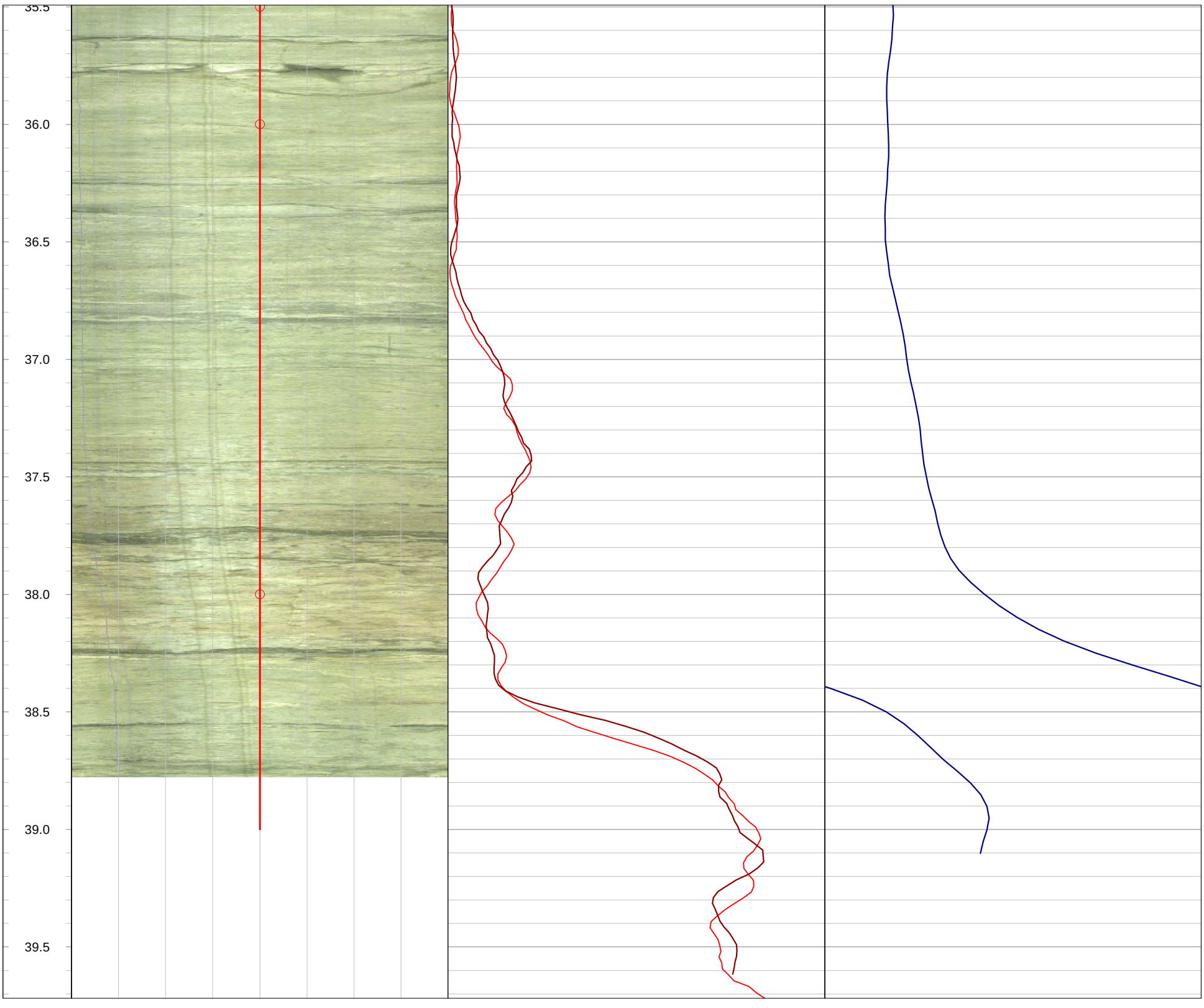
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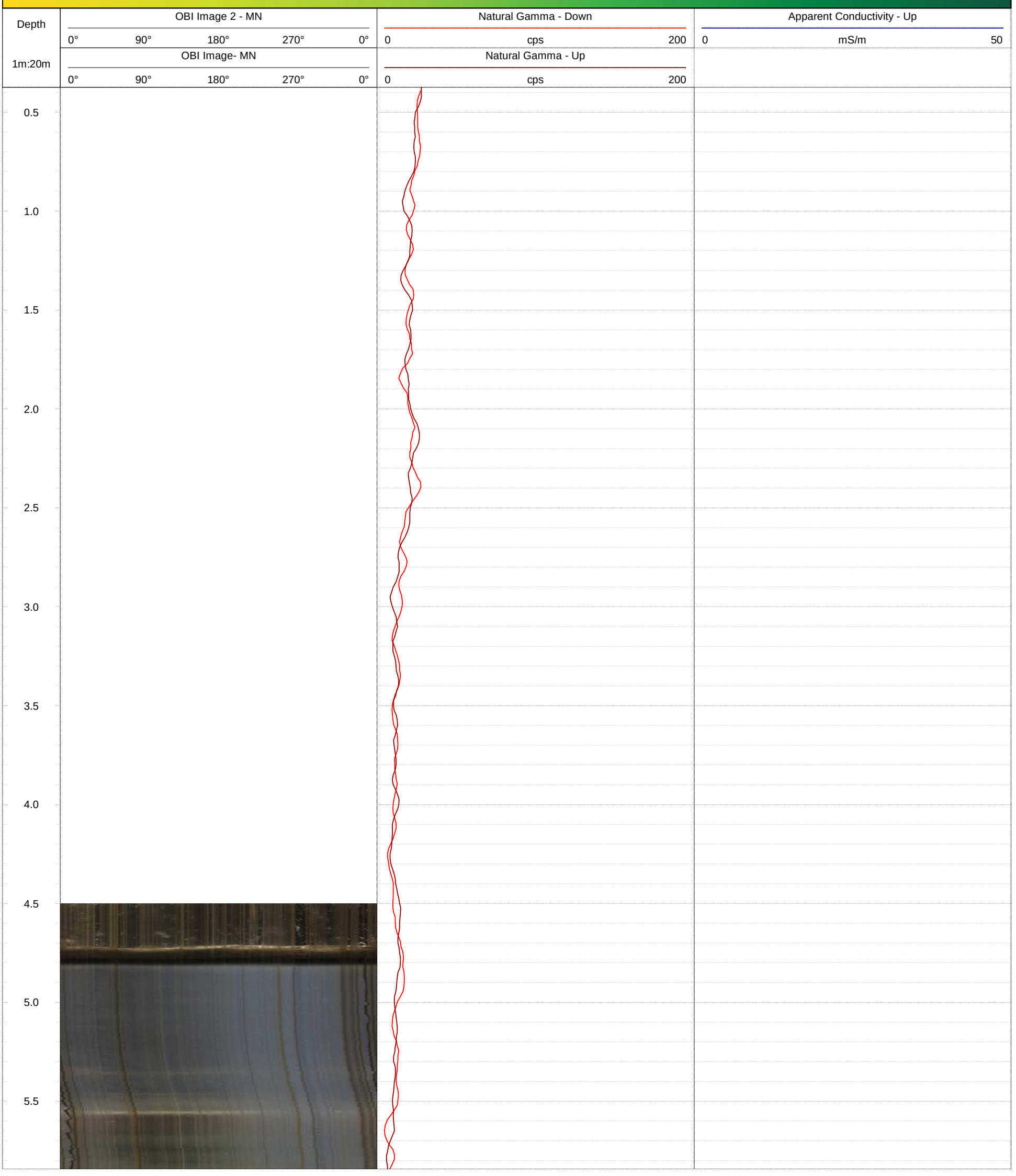
GOLDER
MEMBER OF WSP

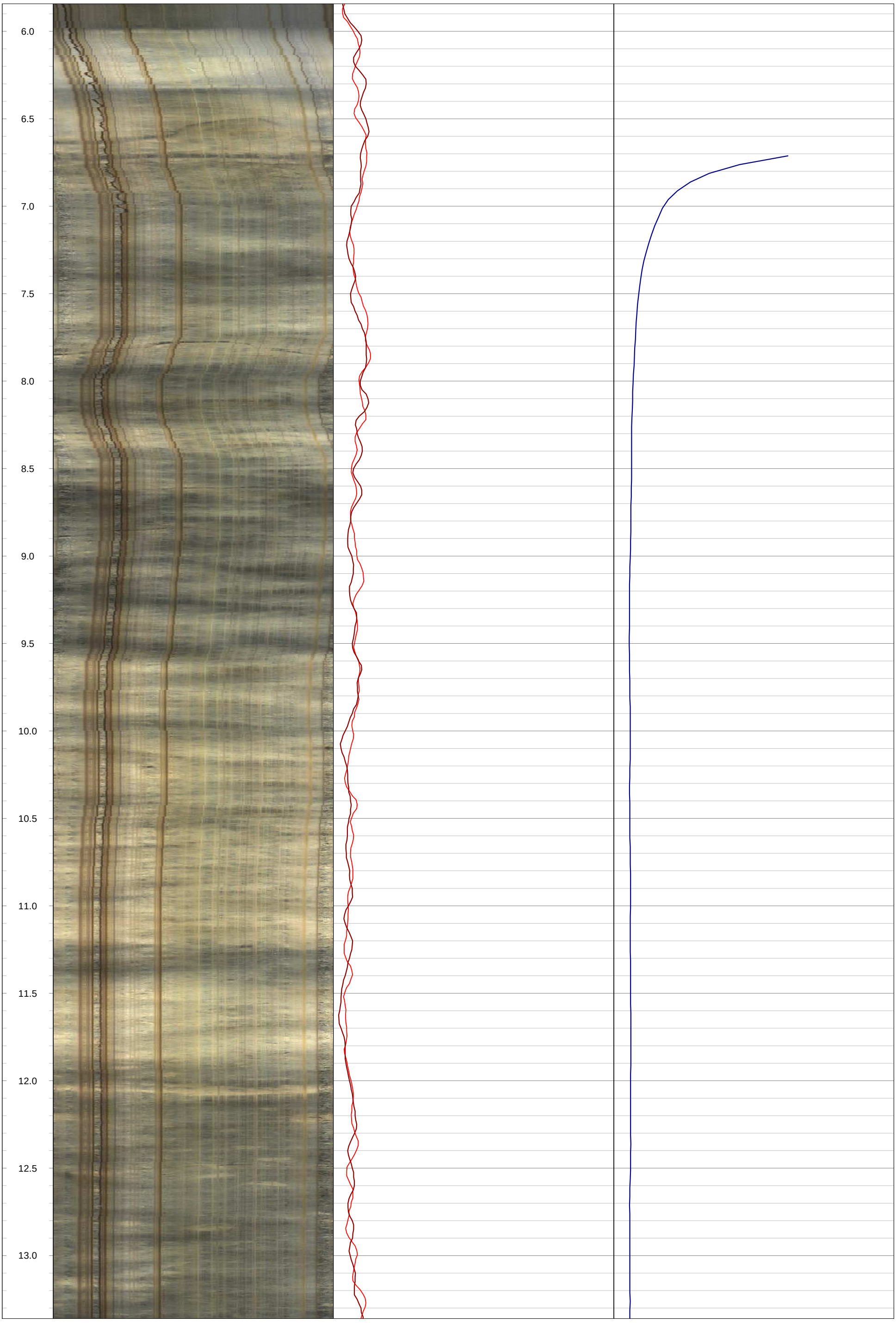
Geophysical Record of Borehole: MW20-22 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.99 m bgs	**Location:**	Caledon, Ontario
Easting:	575785.36 m	**Drilled Depth:**	30.75 m bgs	**Water Level:**	4.40 m bgs	**Log Date:**	Nov-18-2020
Northing:	4851966.28 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.27 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.30 m ags	**Logged By:**	PG

Notes: OBI image opaque > 30.5 m bgs

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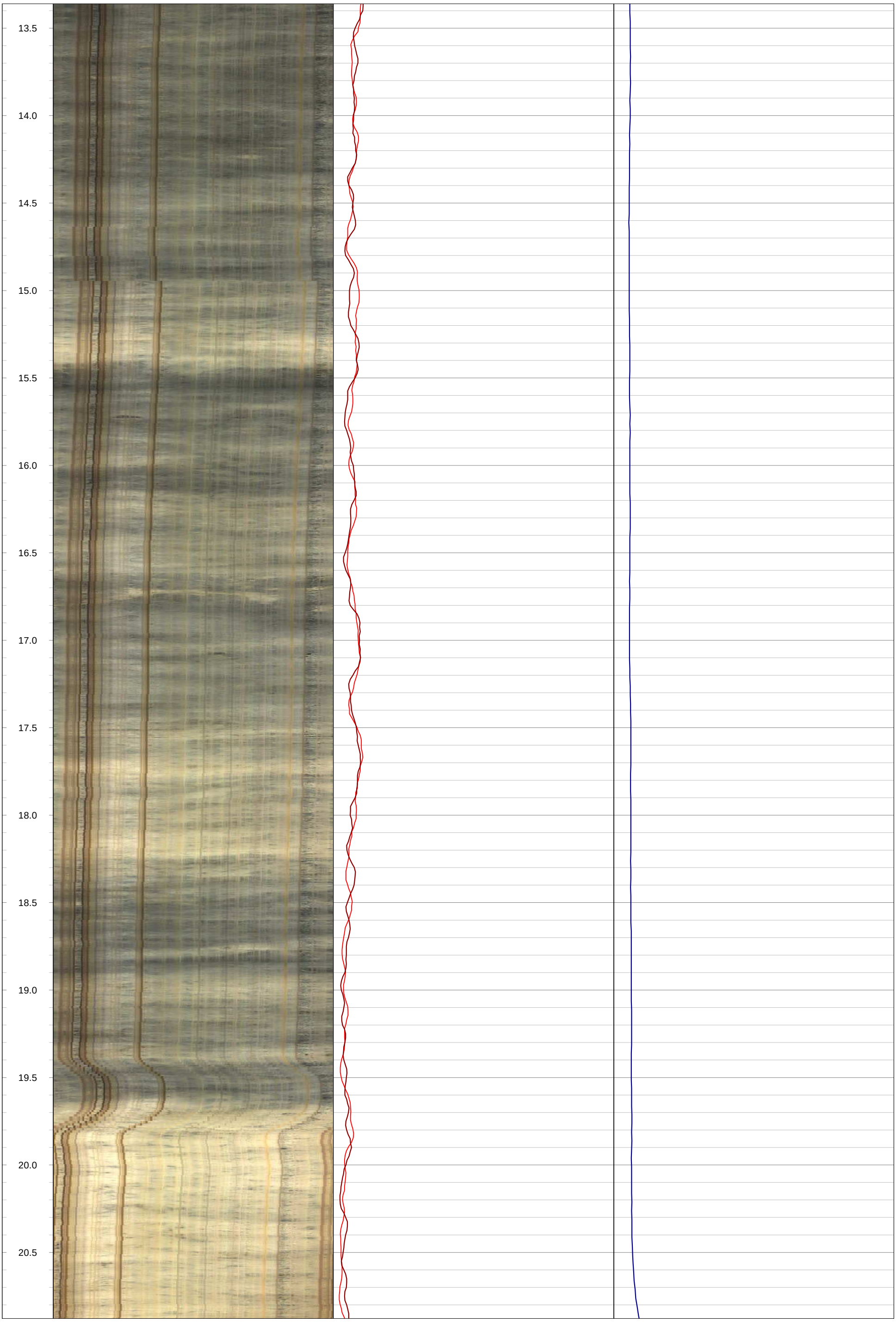
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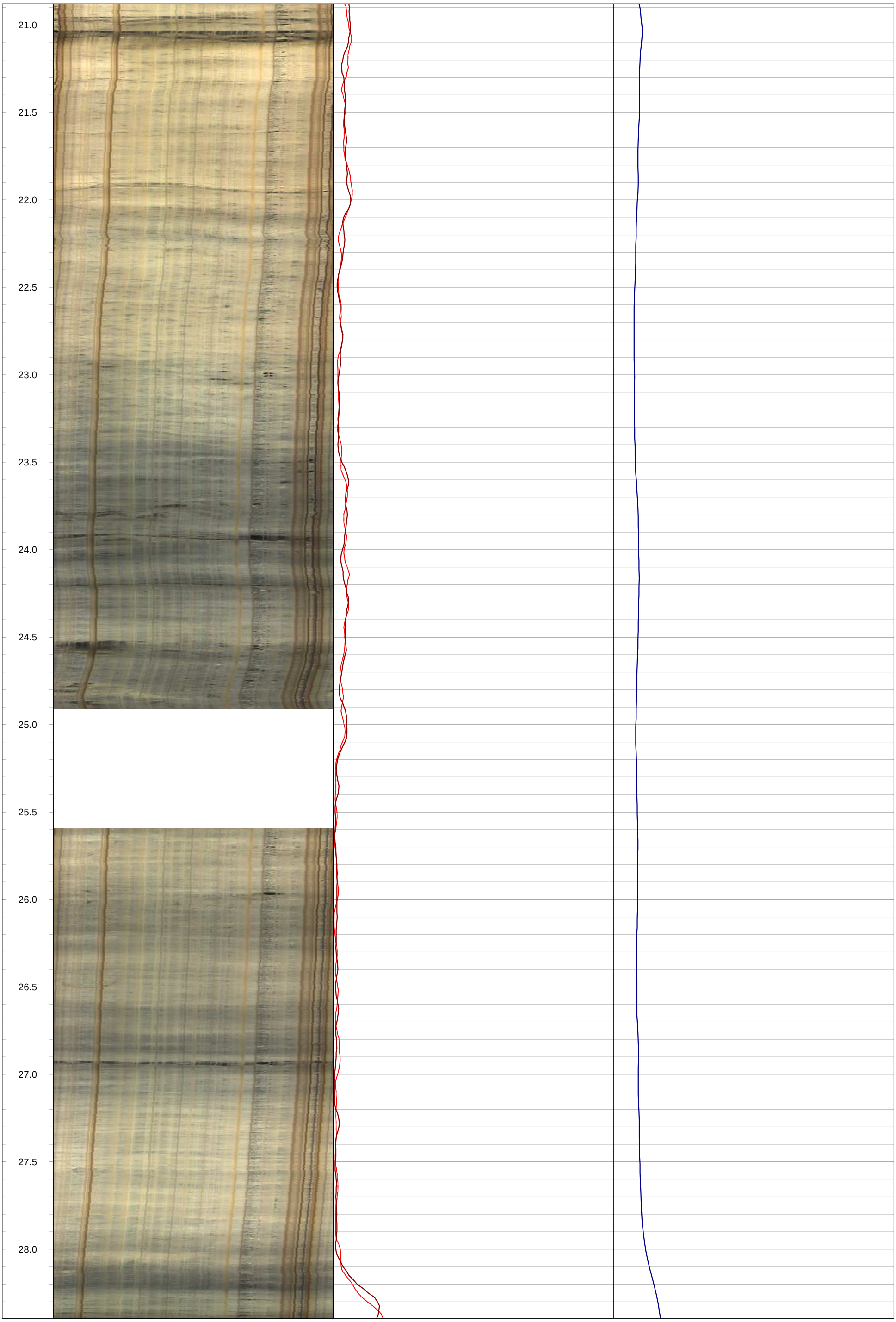
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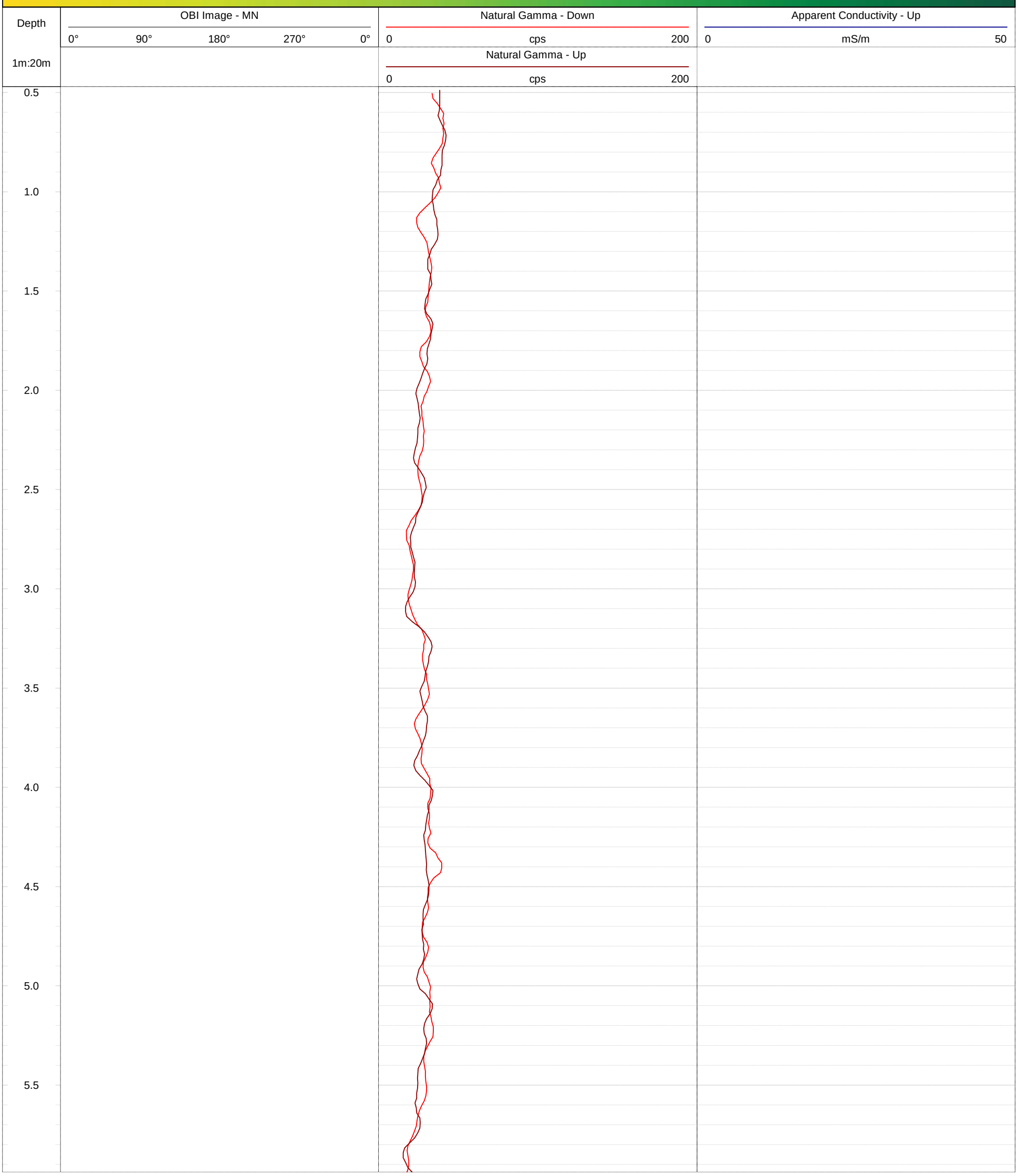
GOLDER
MEMBER OF WSP

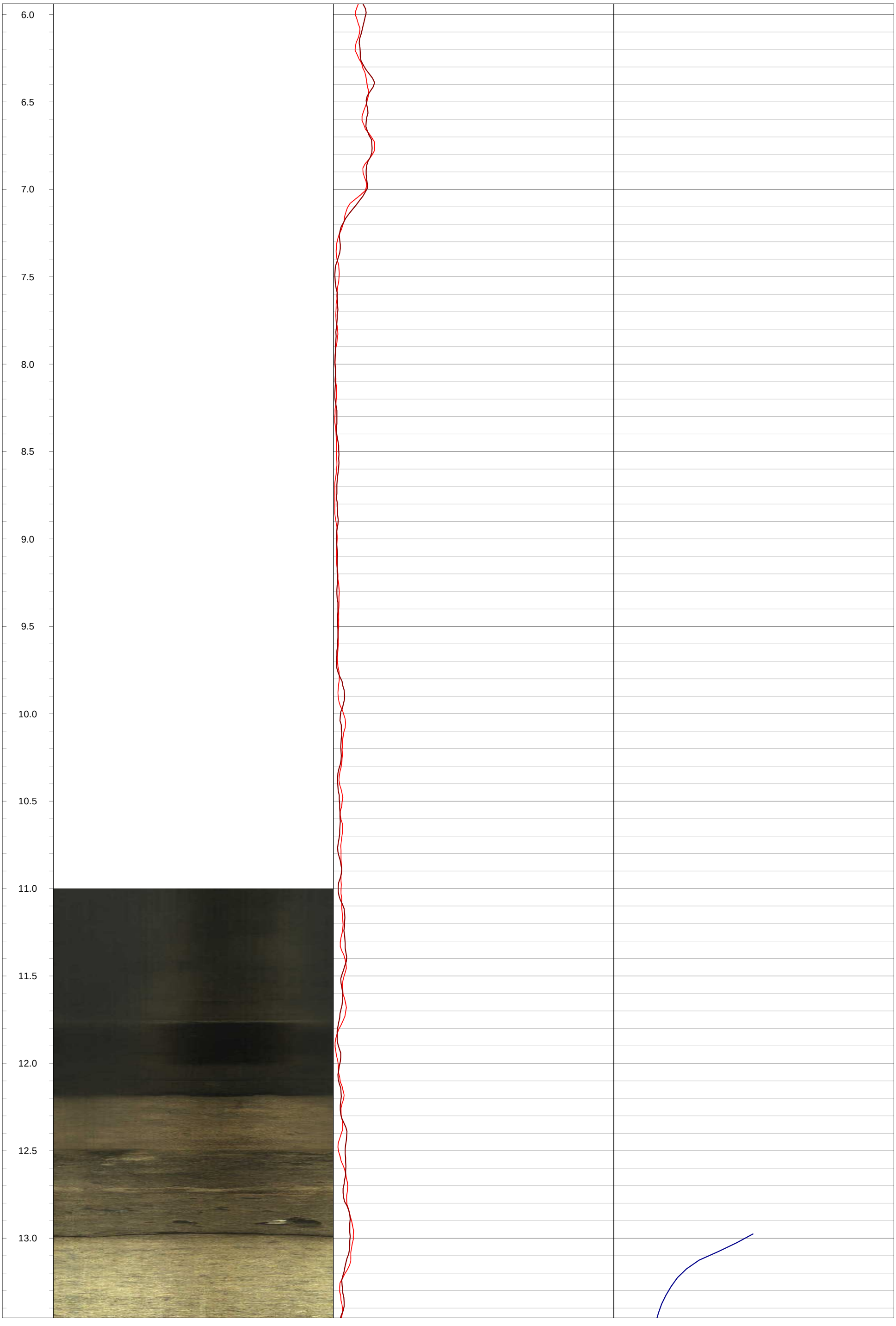
Geophysical Record of Borehole: MW20-23 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	576205.53 m	**Drilled Depth:**	26.76 m bgs	**Water Level:**	4.68 m bgs	**Log Date:**	Nov-24-2020
Northing:	4851555.91 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	395.05 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PG

Notes: OBI image opaque > 24.4 m bgs

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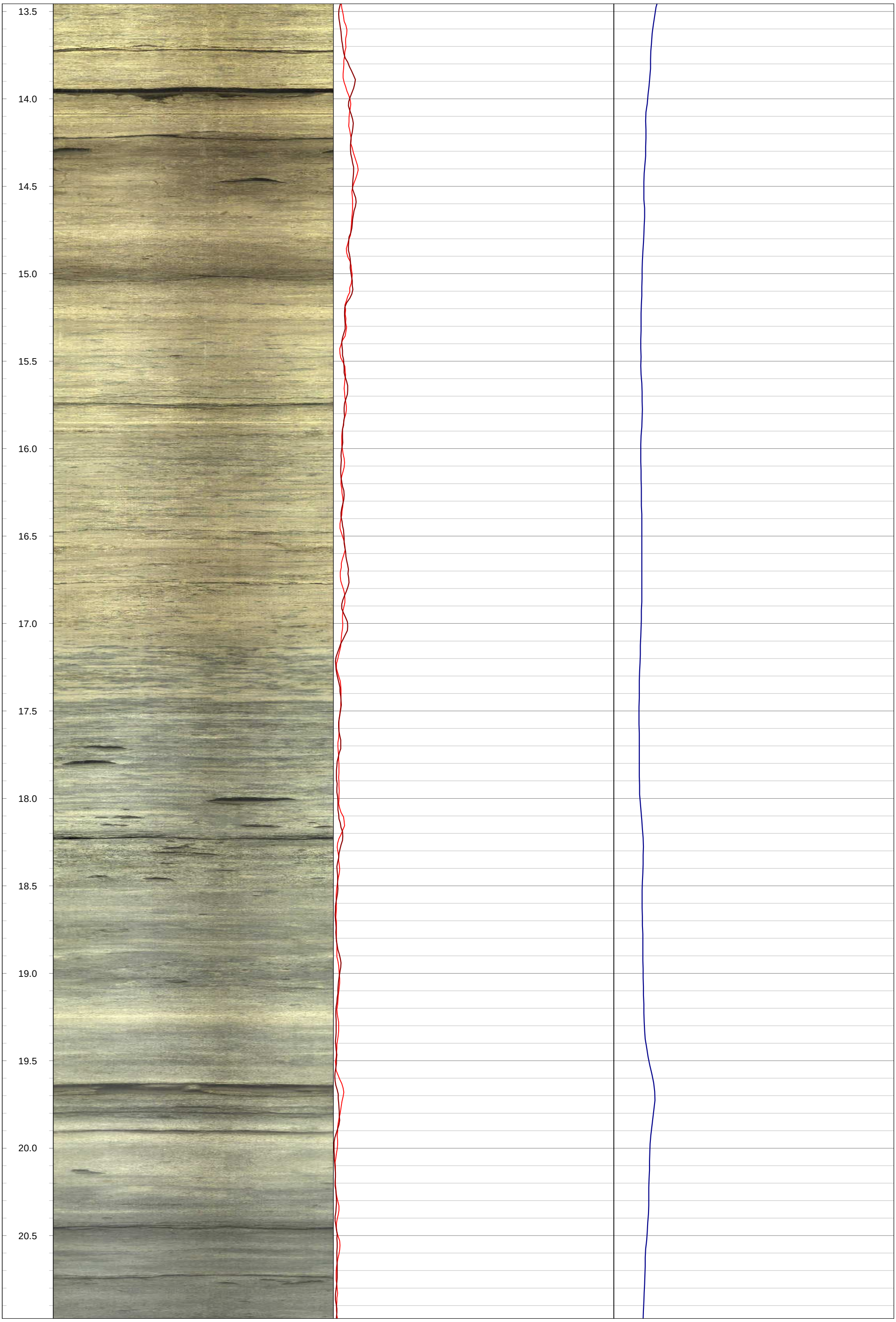
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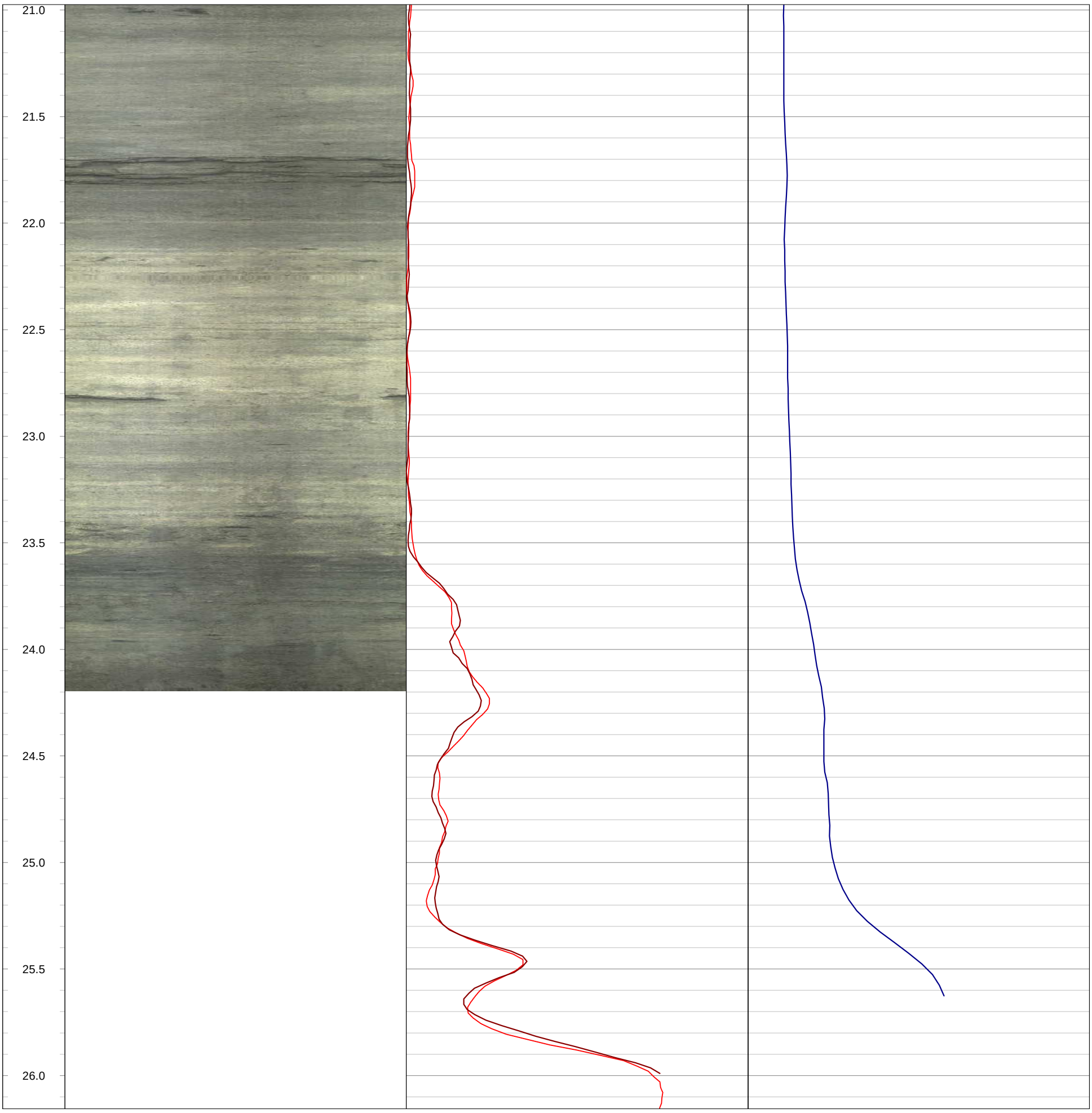
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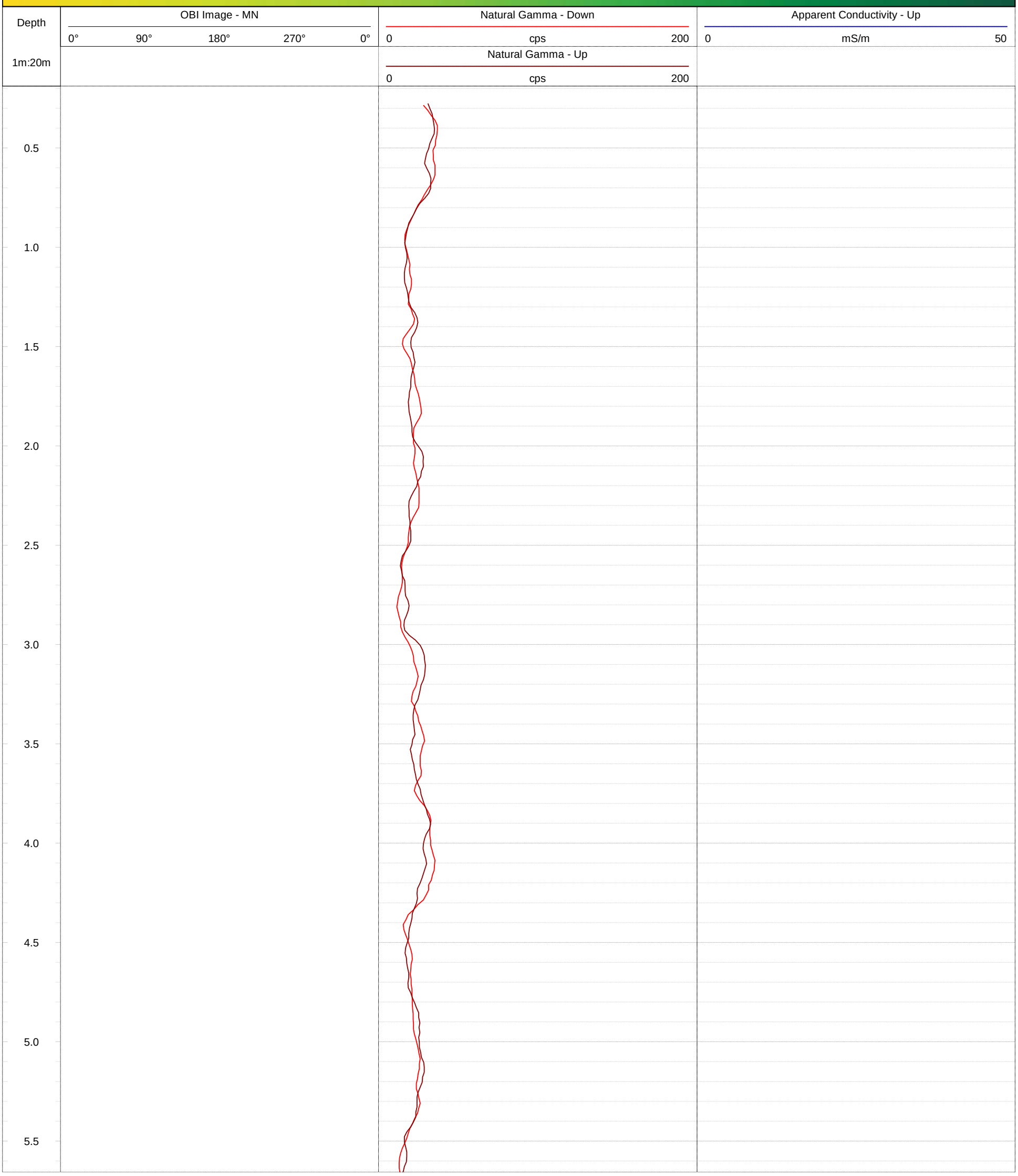
GOLDER
MEMBER OF WSP

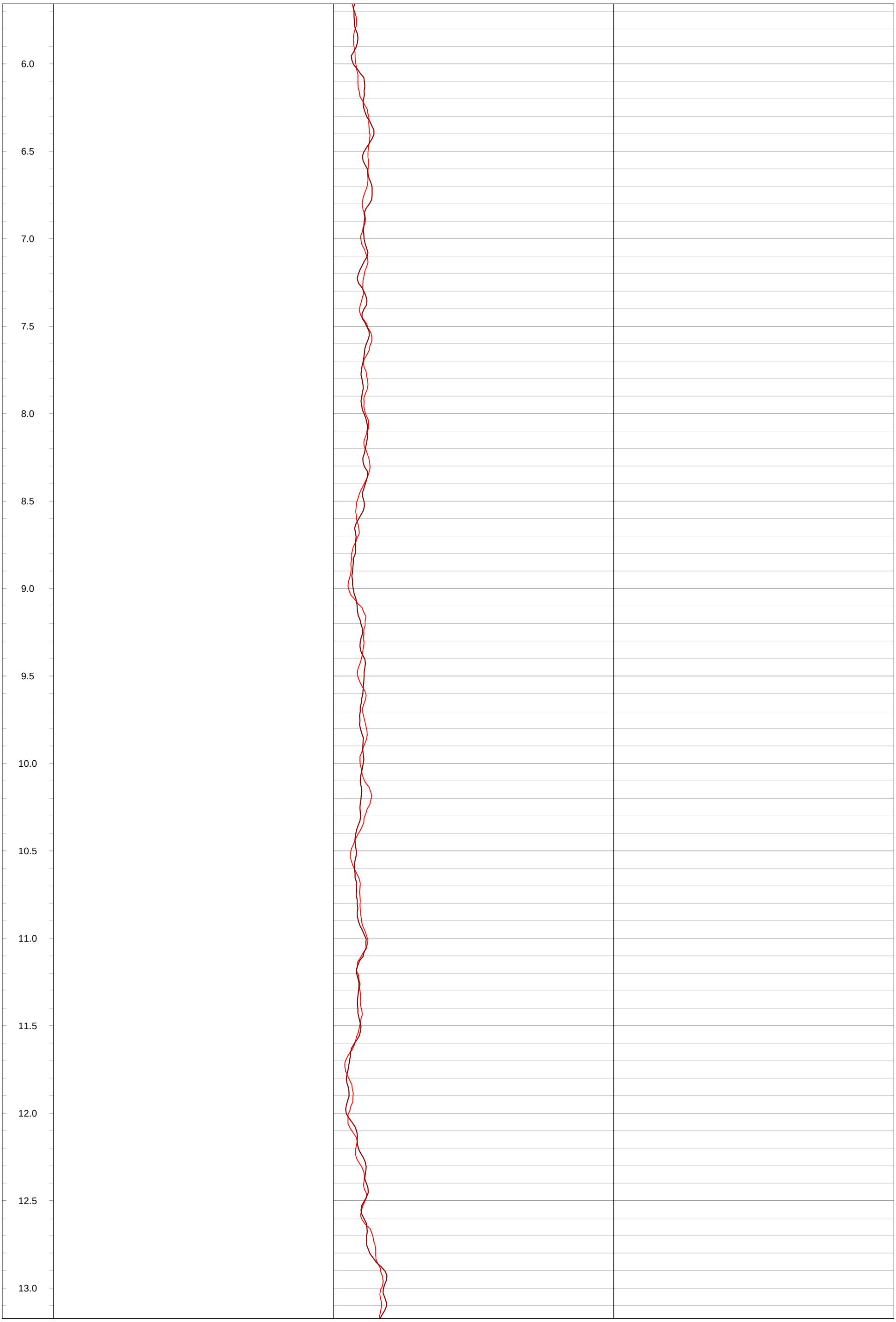
Geophysical Record of Borehole: MW20-24 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	20.98 m bgs	**Location:**	Caledon, Ontario
Easting:	575337.66 m	**Drilled Depth:**	37.49 m bgs	**Water Level:**	4.46 m bgs	**Log Date:**	Dec-04-2020
Northing:	4854341.85 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	437.75 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.51 m ags	**Logged By:**	PG

Notes: OBI Image opaque > 35 m bgs

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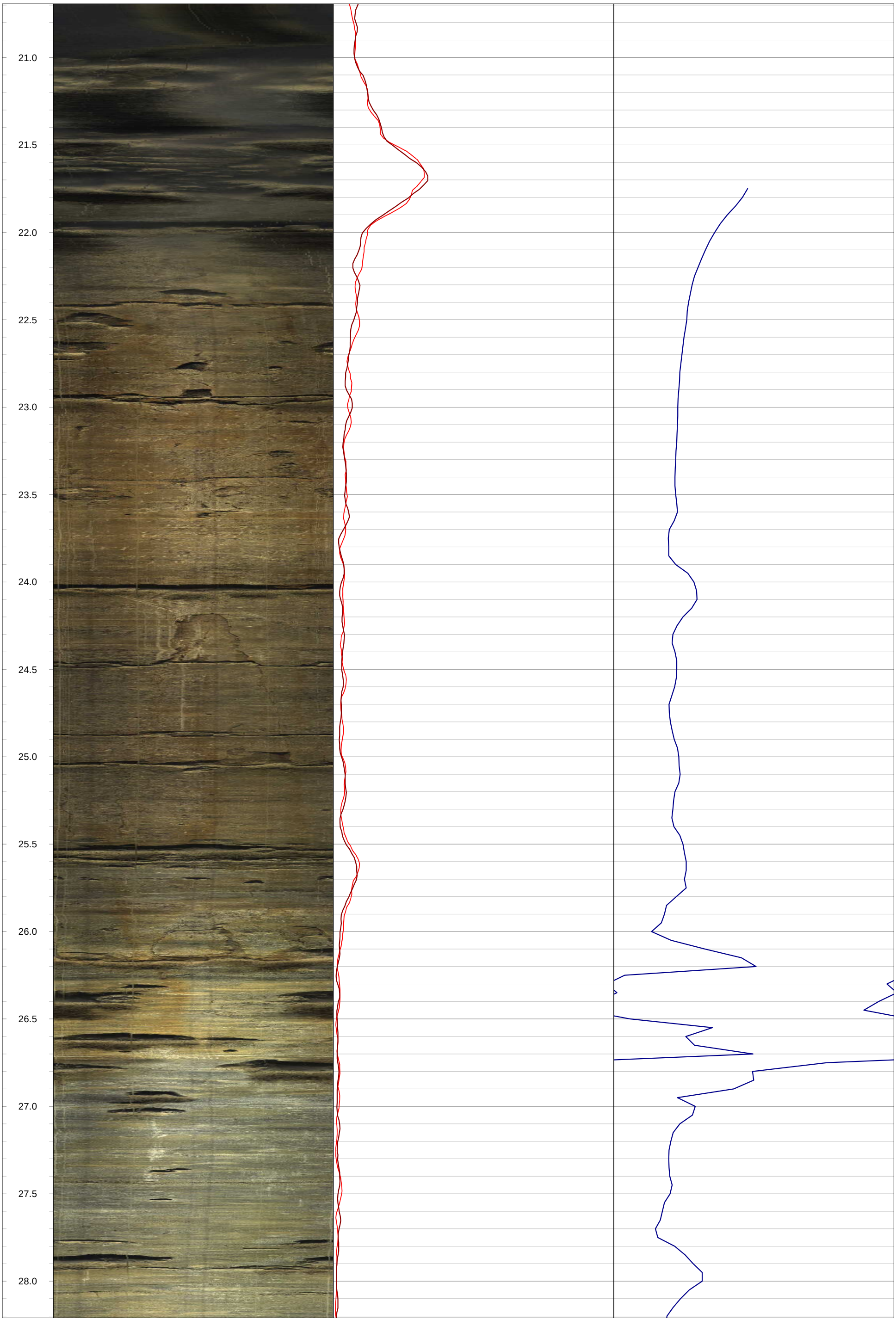
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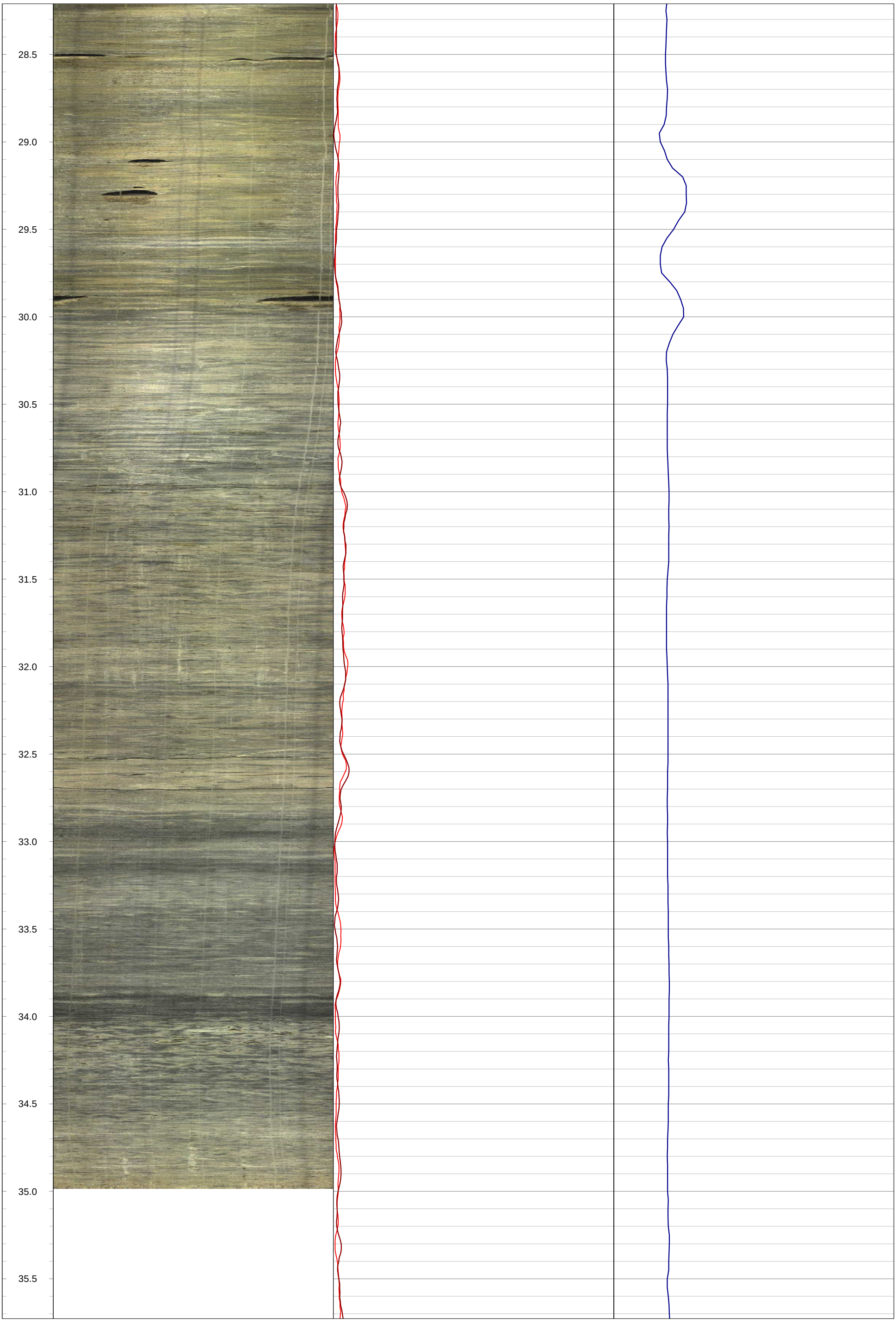
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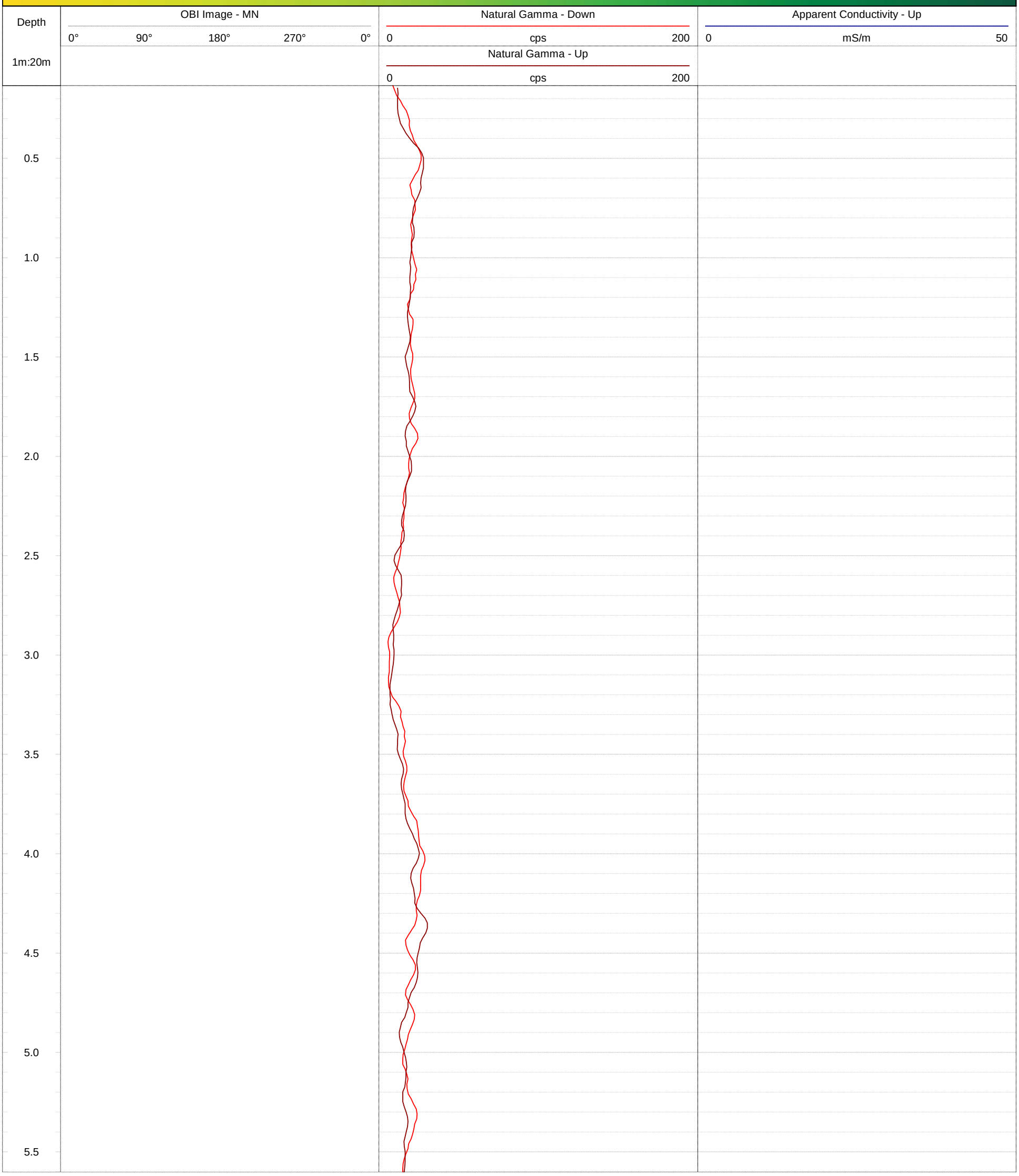
GOLDER
MEMBER OF WSP

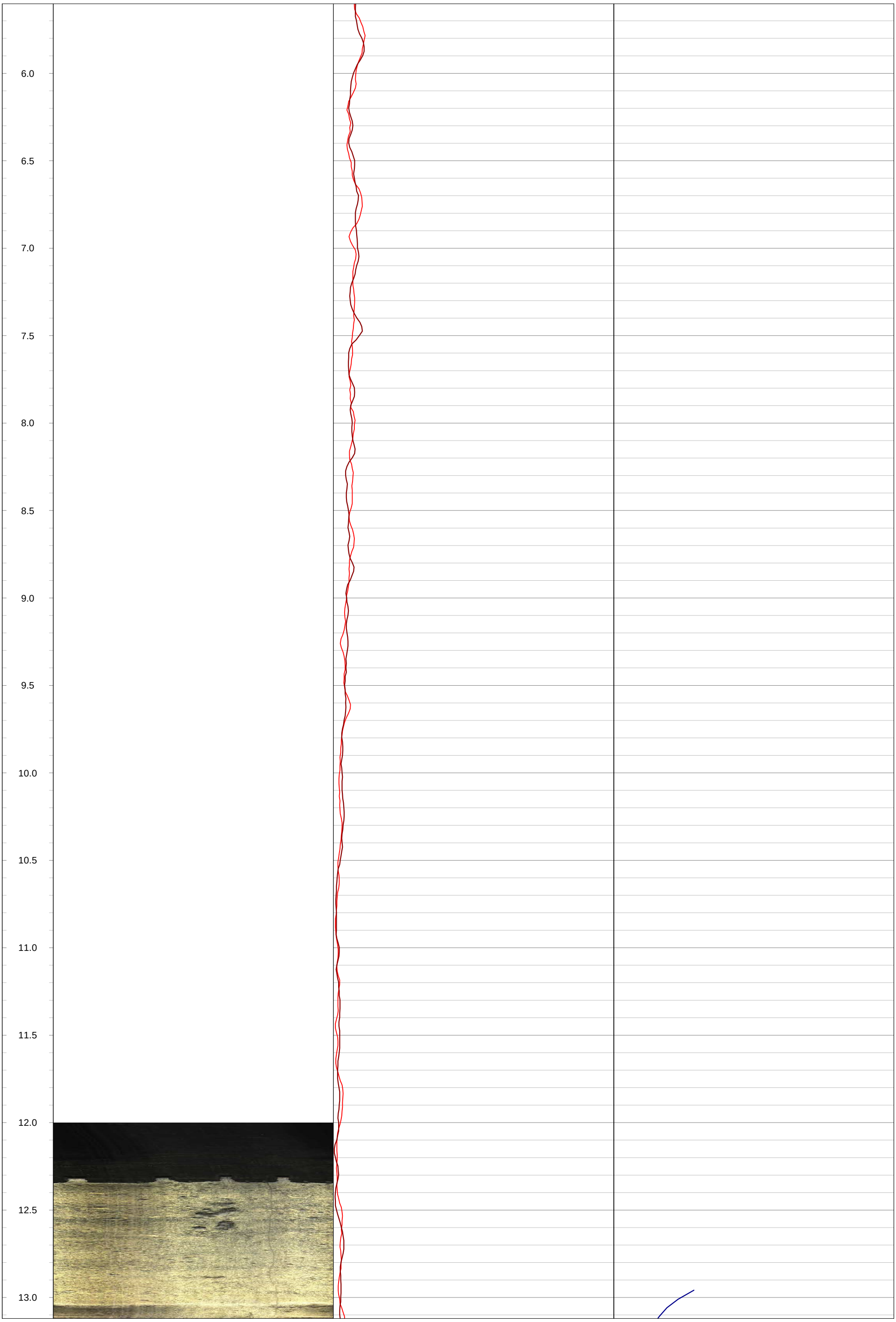
Geophysical Record of Borehole: MW20-25 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.39 m bgs	**Location:**	Caledon, Ontario
Easting:	574853.76 m	**Drilled Depth:**	51.82 m bgs	**Water Level:**	-0.83 m bgs	**Log Date:**	Dec-12-2020
Northing:	4852900.48 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	419.02 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.98 m ags	**Logged By:**	PG

Notes: Artesian well, water slowly rose up to above stick-up casing level during data acquisition. OBI image opaque > 50.2 m bgs

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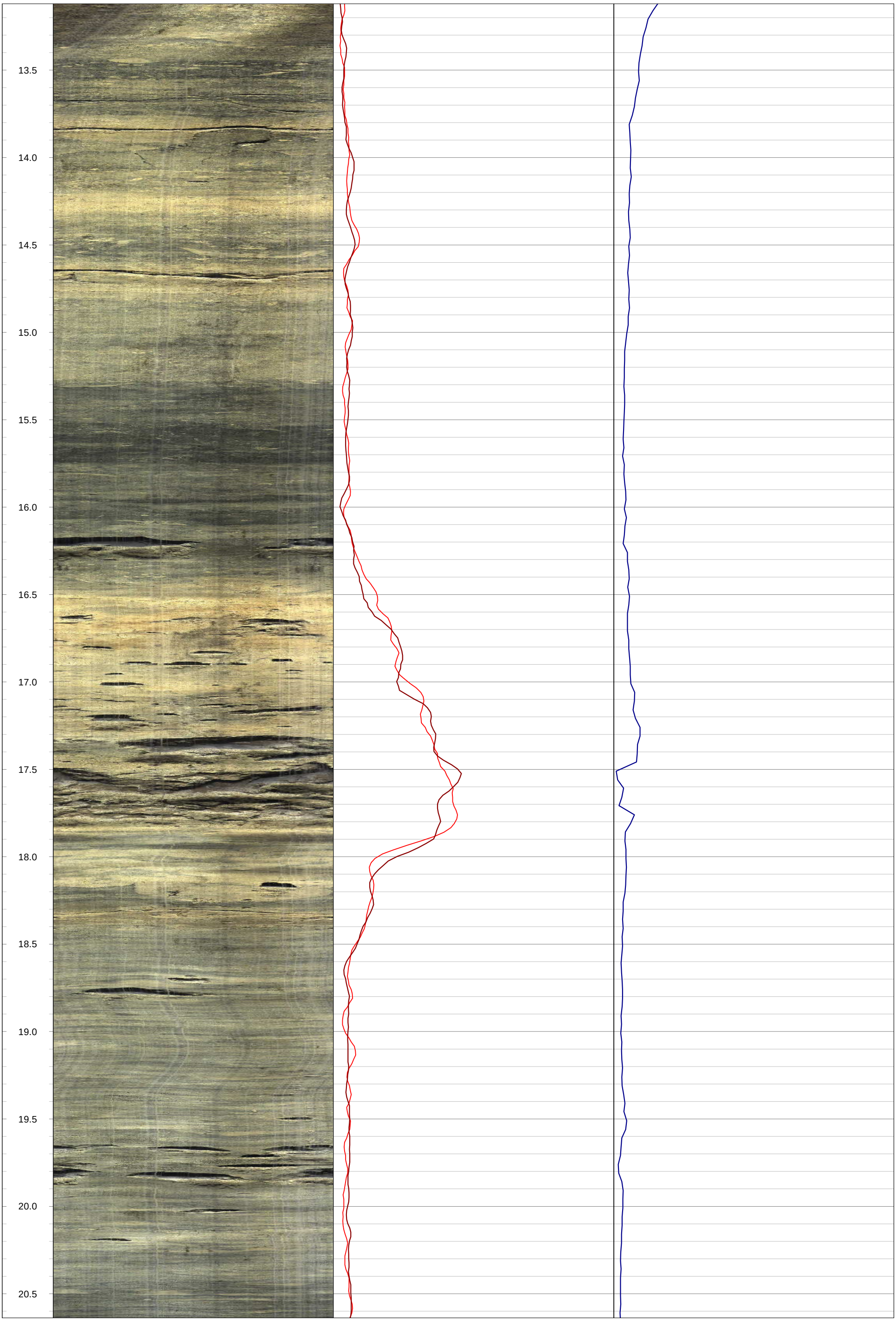
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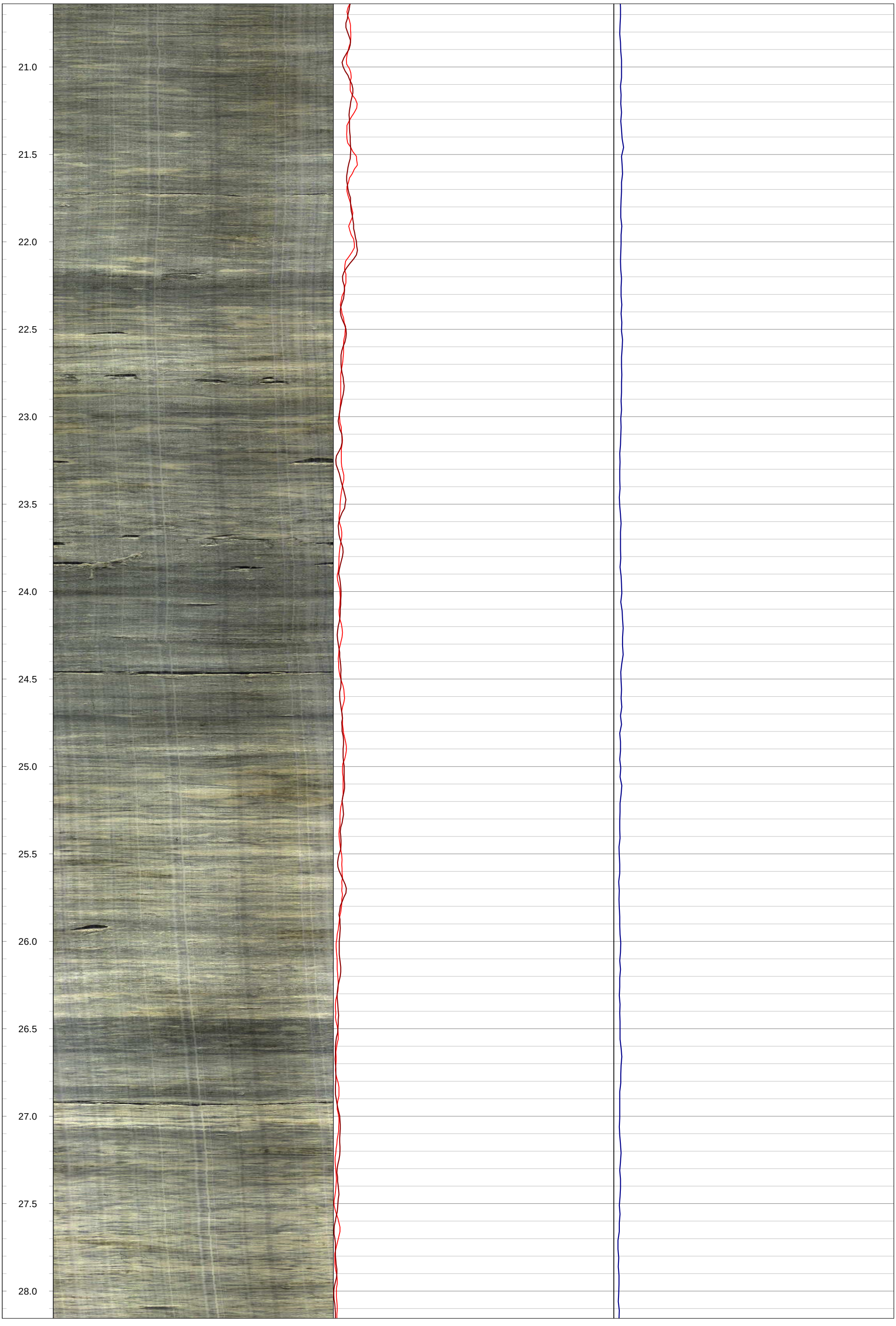
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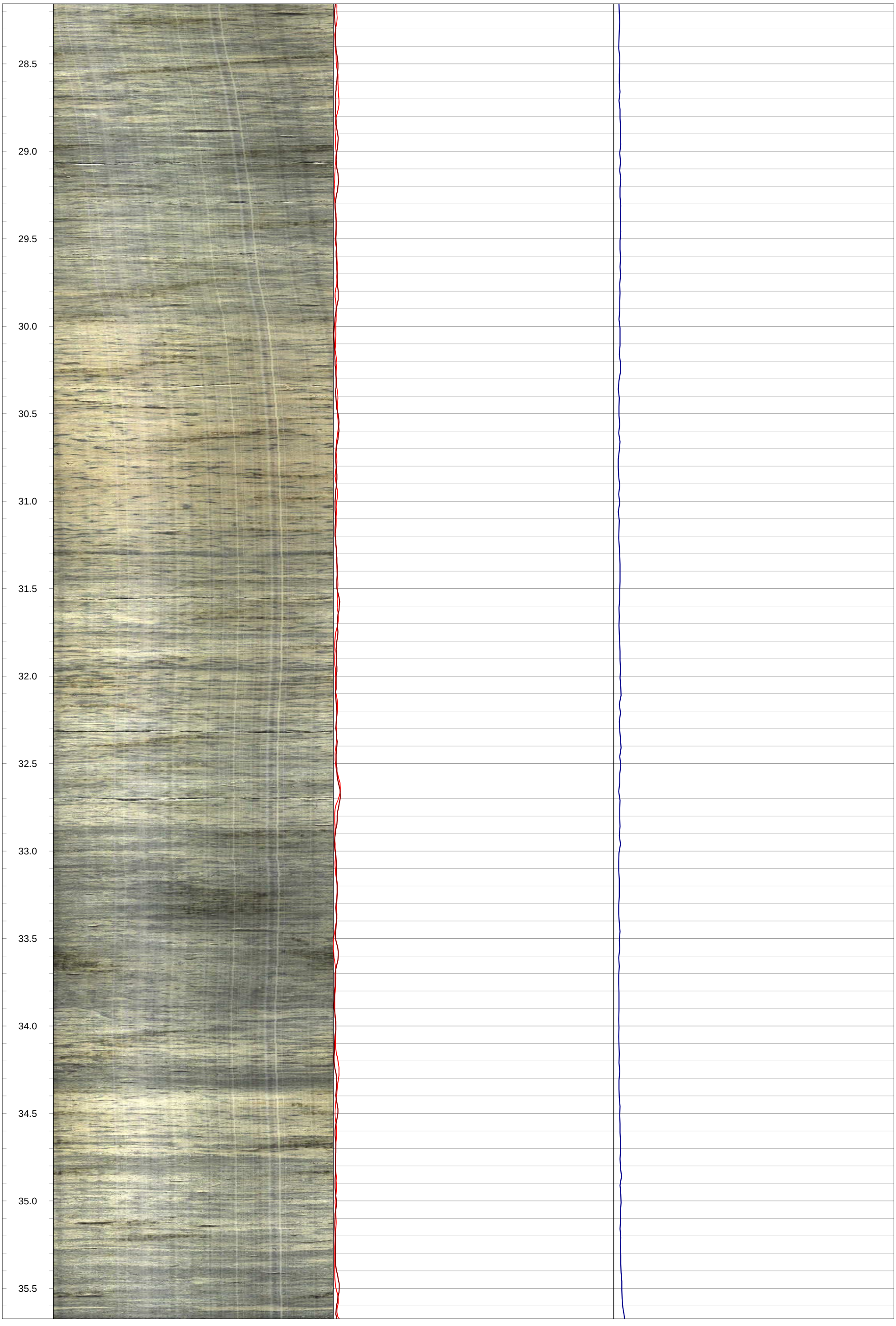
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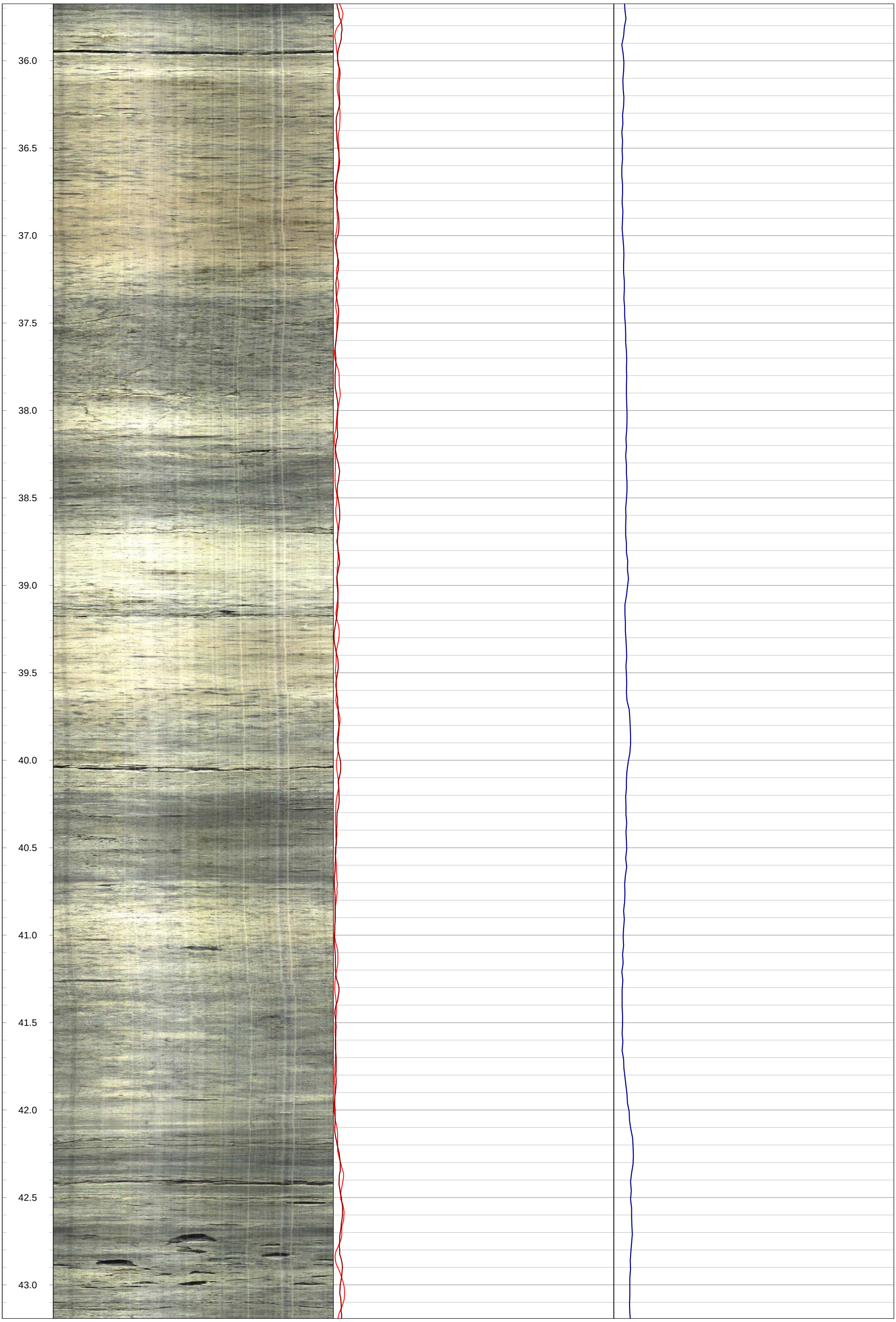
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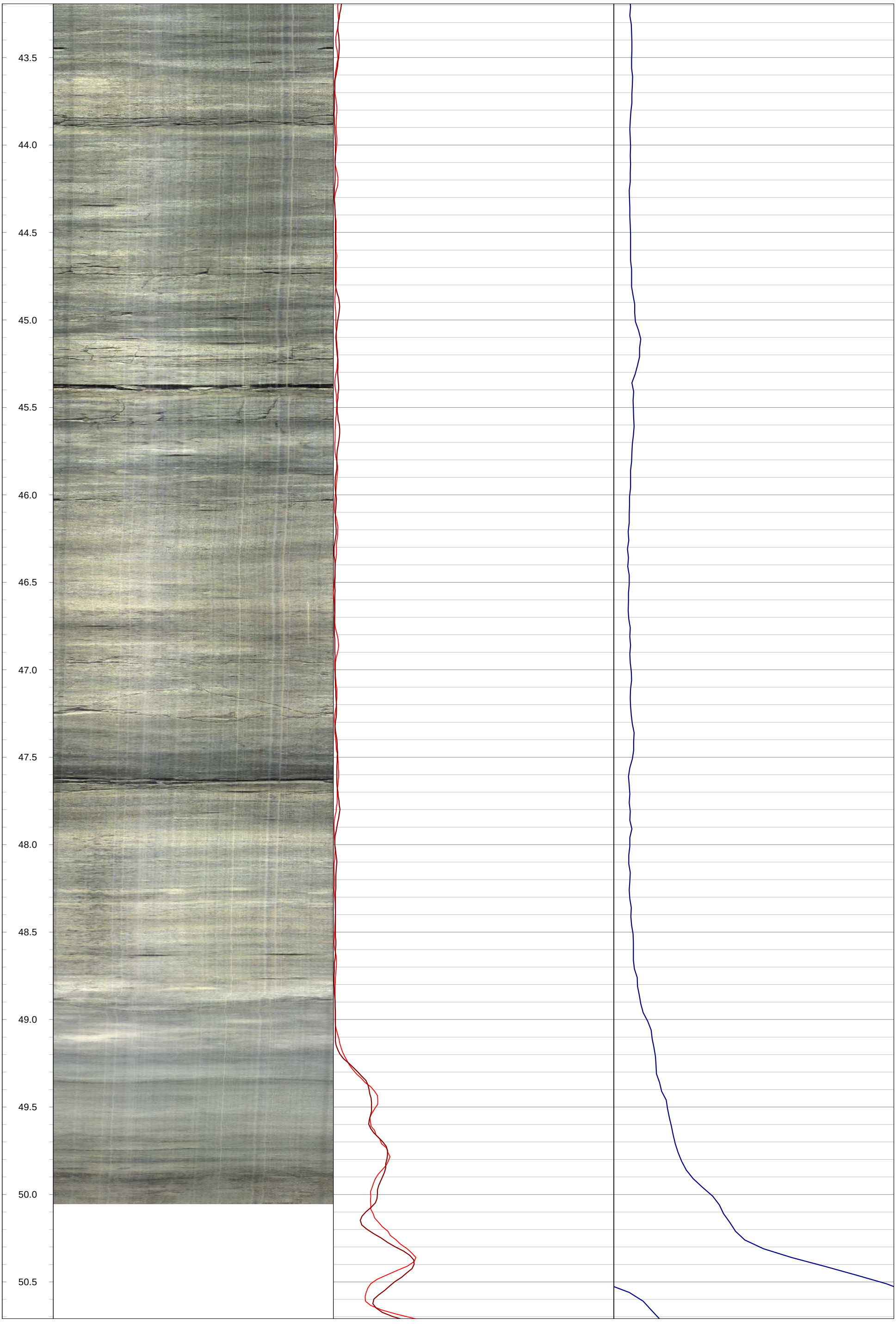
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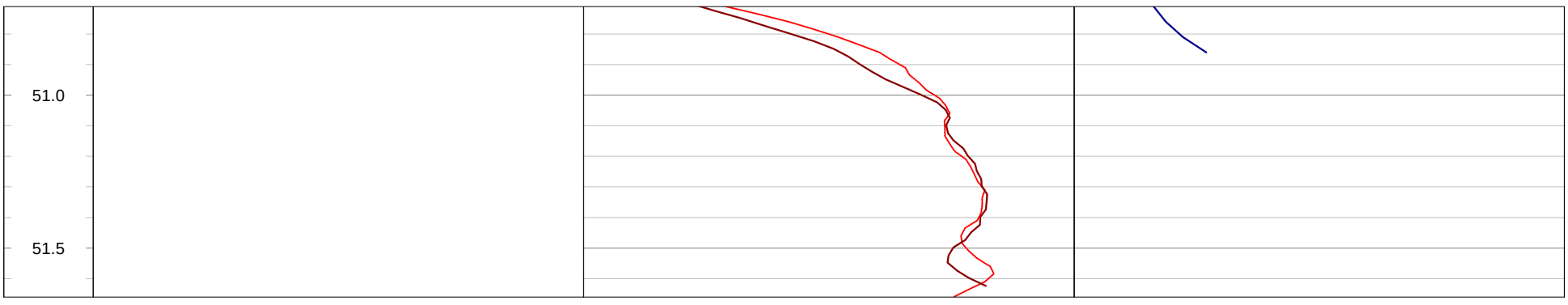
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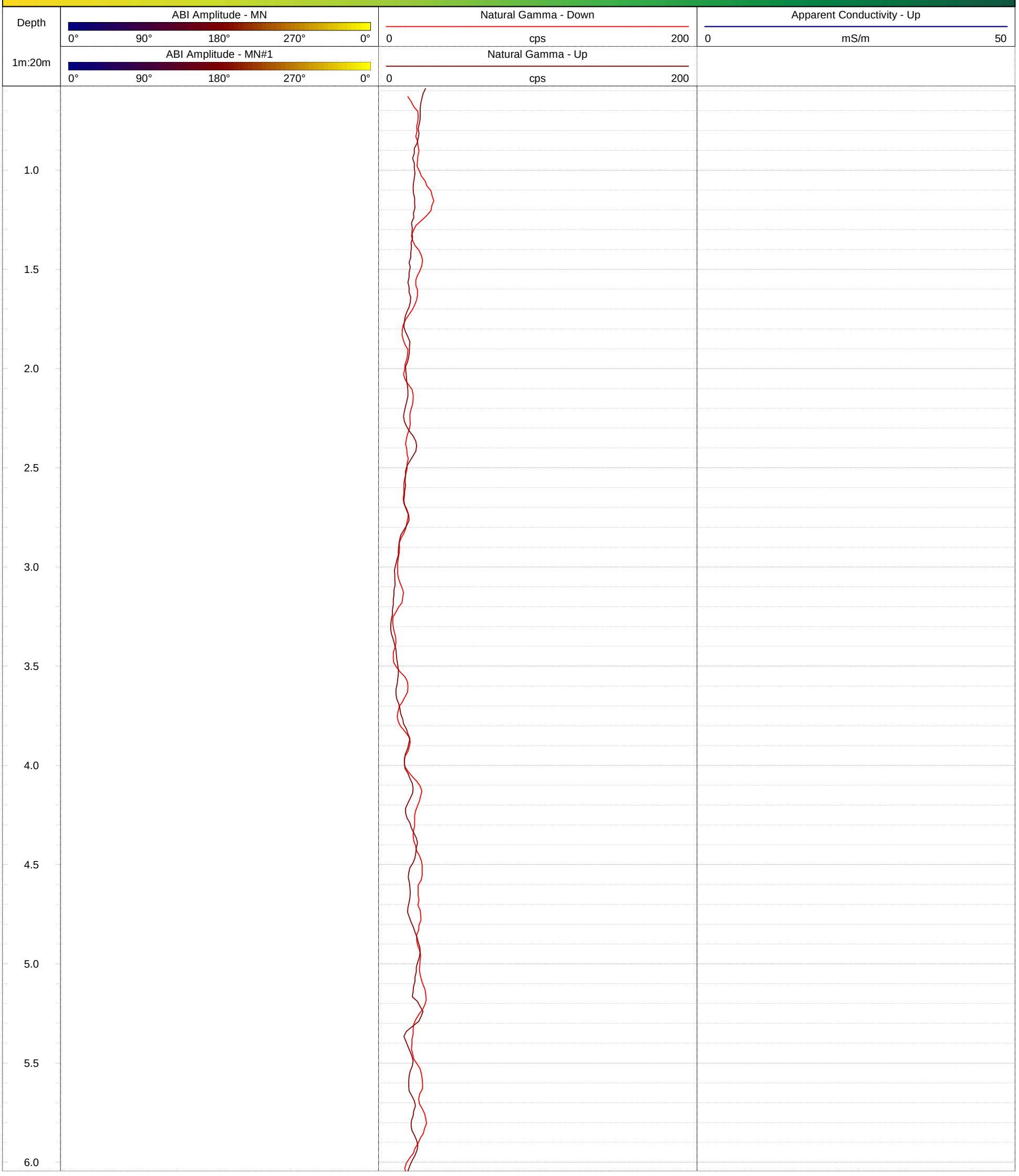
GOLDER
MEMBER OF WSP

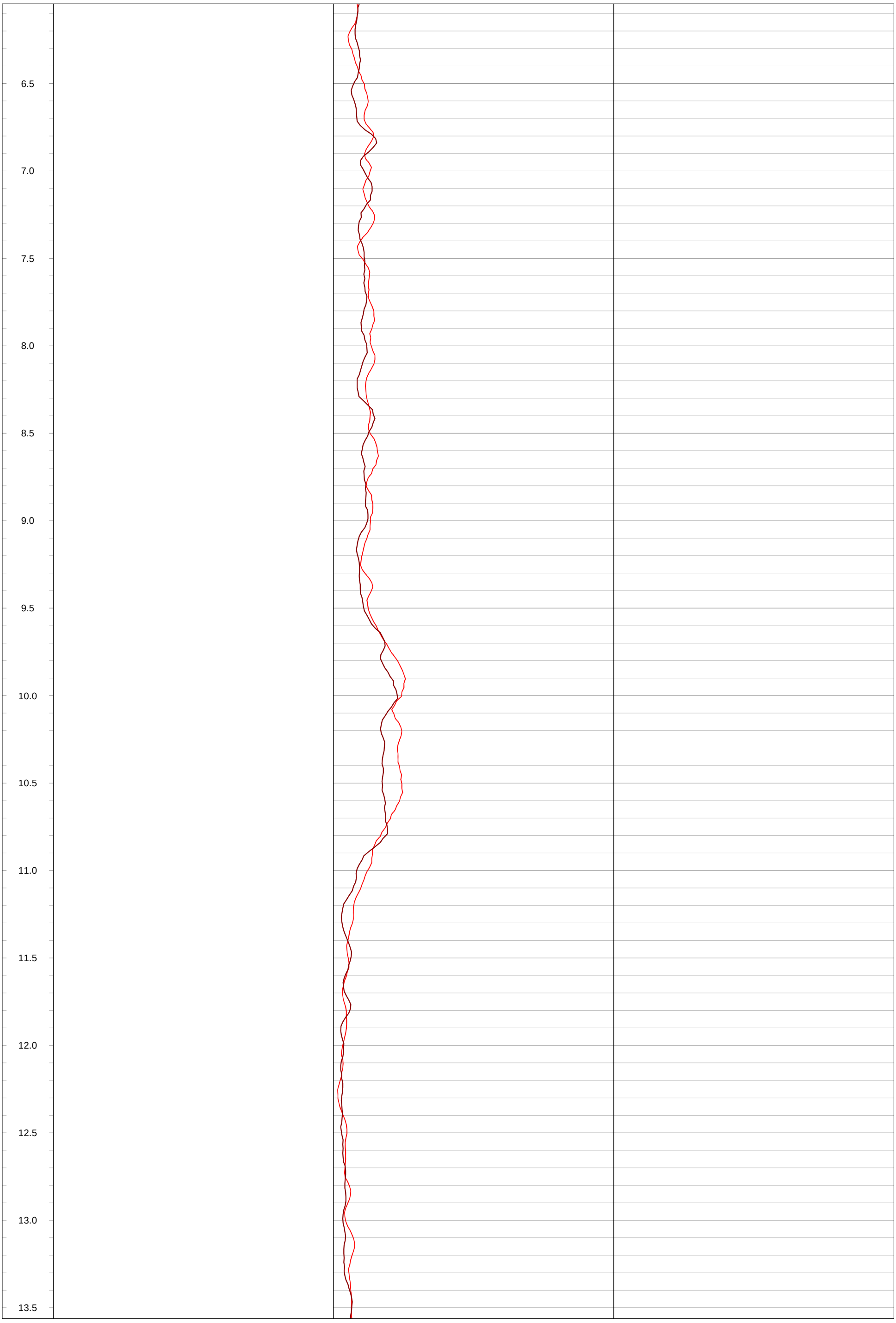
Geophysical Record of Borehole: MW20-26 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.53 m bgs	**Location:**	Caledon, Ontario
Easting:	574373.86 m	**Drilled Depth:**	66.11 m bgs	**Water Level:**	3.19 m bgs	**Log Date:**	Dec-18-2020
Northing:	4853638.42 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	438.89 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.16 m ags	**Logged By:**	PG

Notes: Optical image opaque >52.4 m bgs, collected acoustic imagery in addition to optical.

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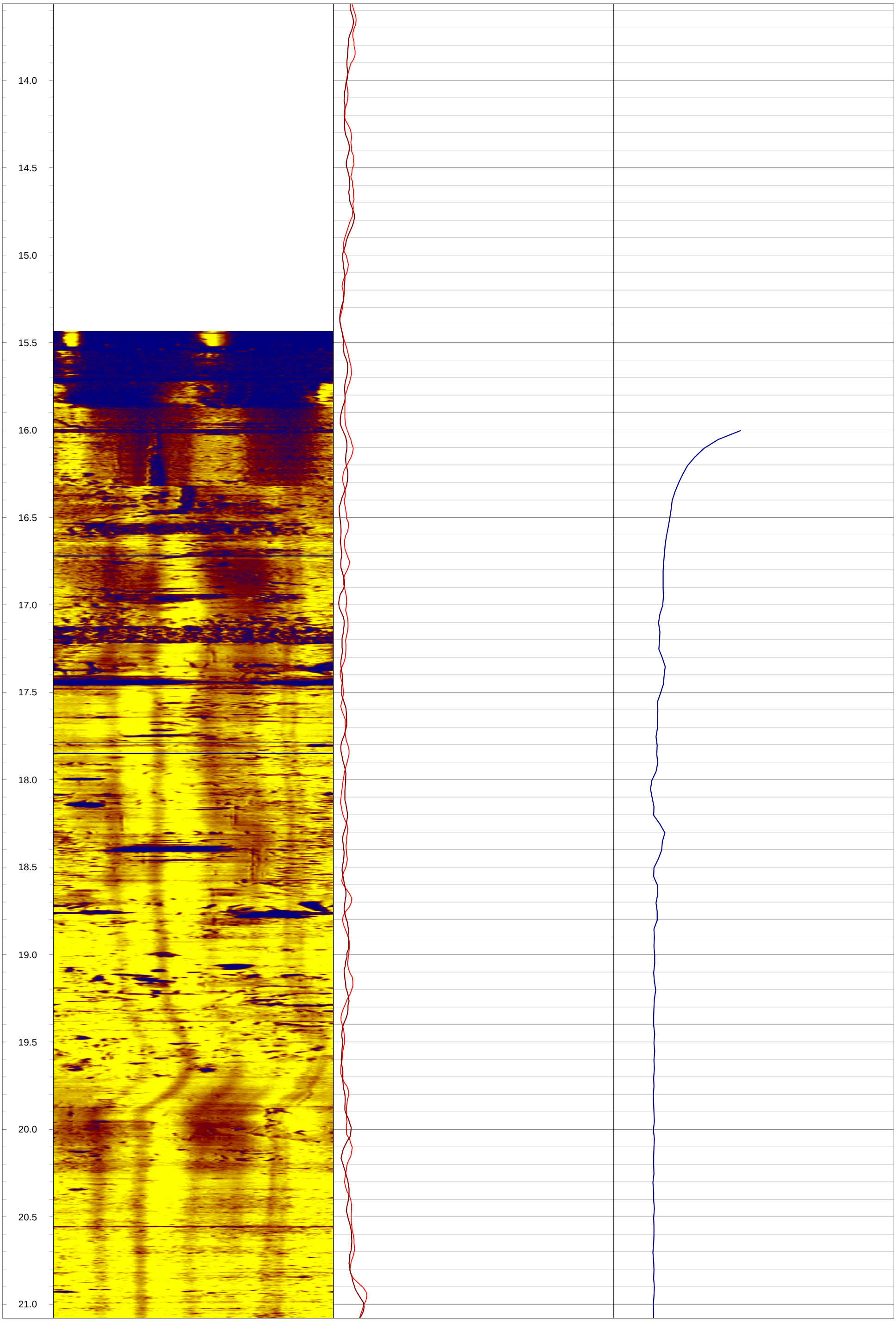
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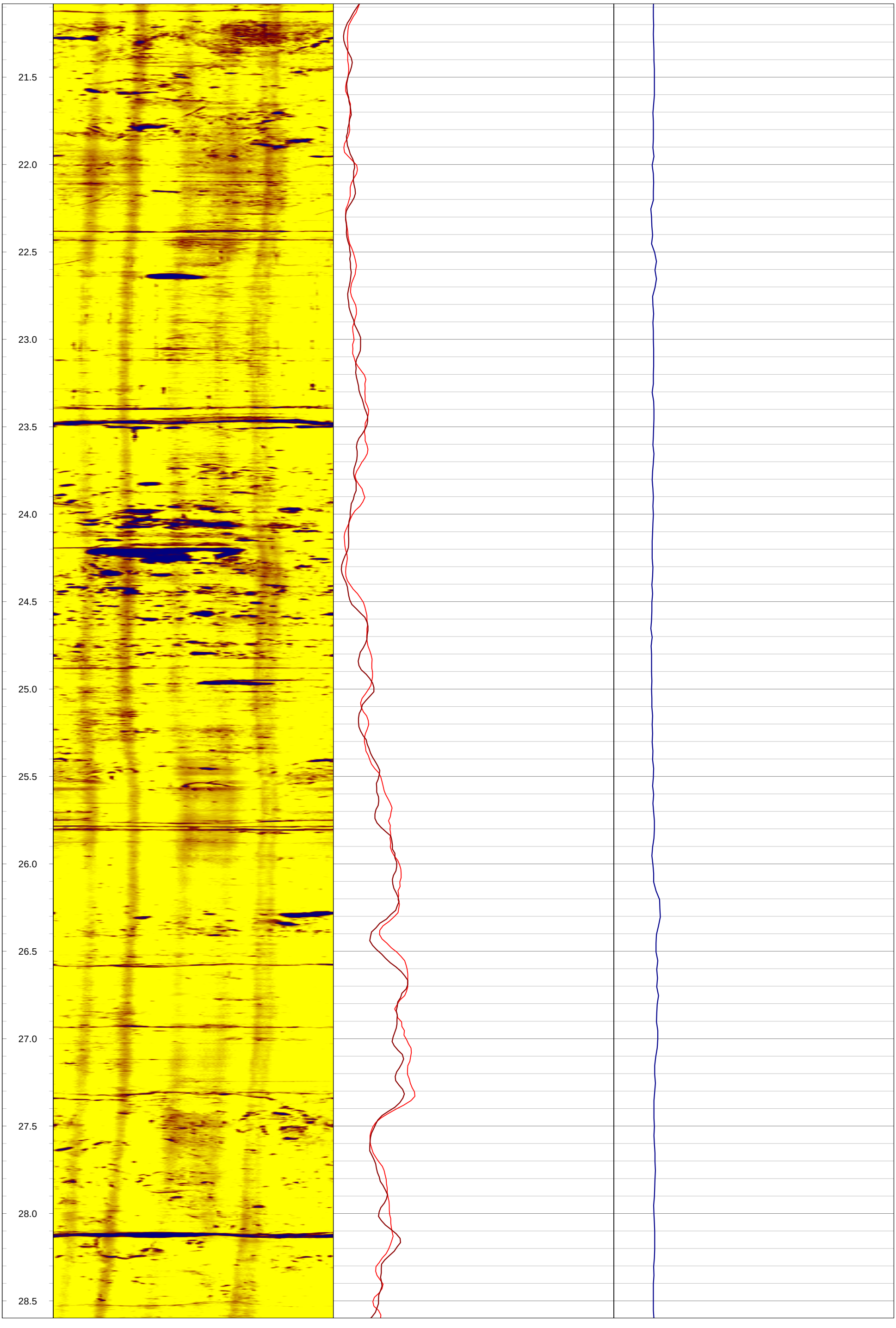
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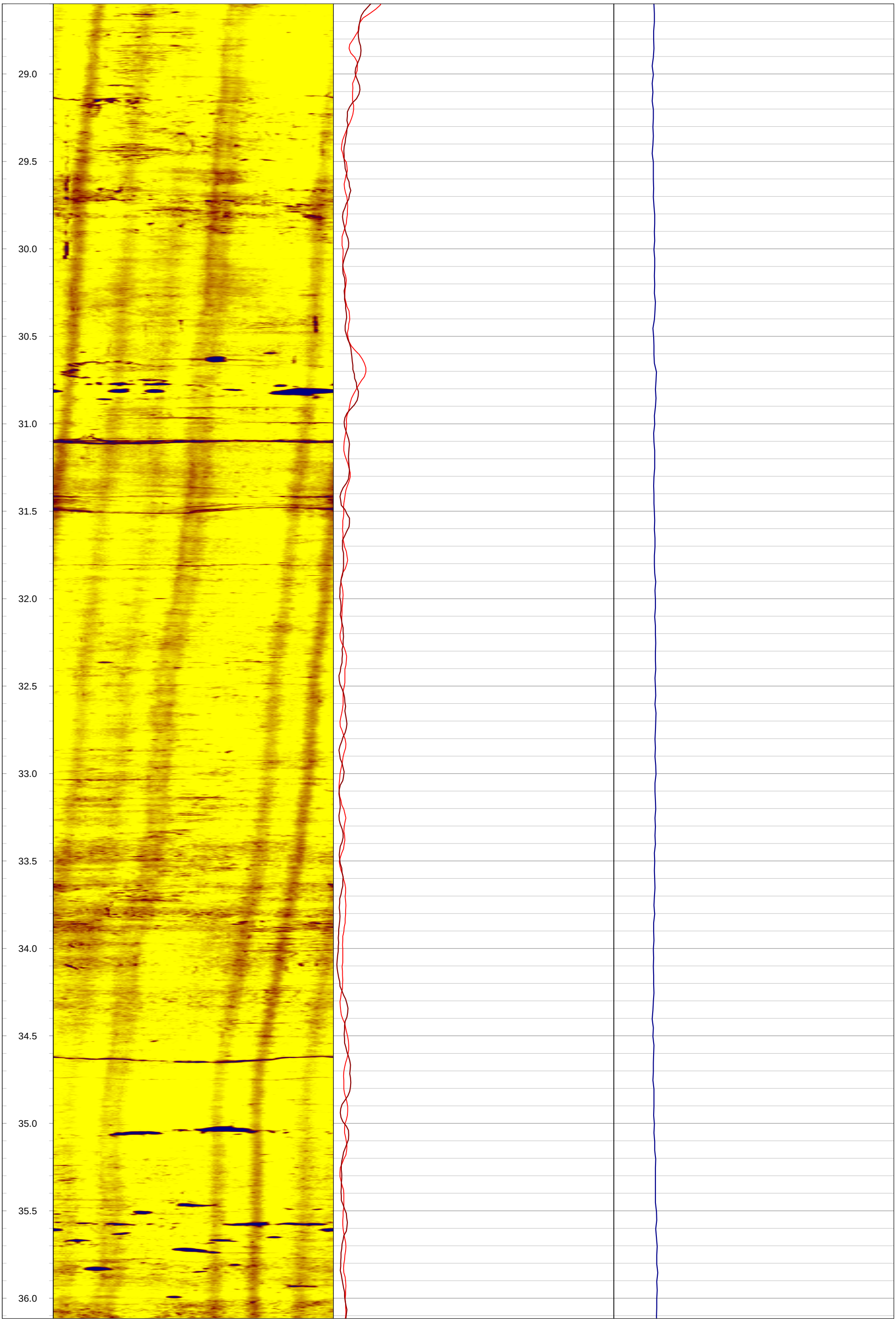
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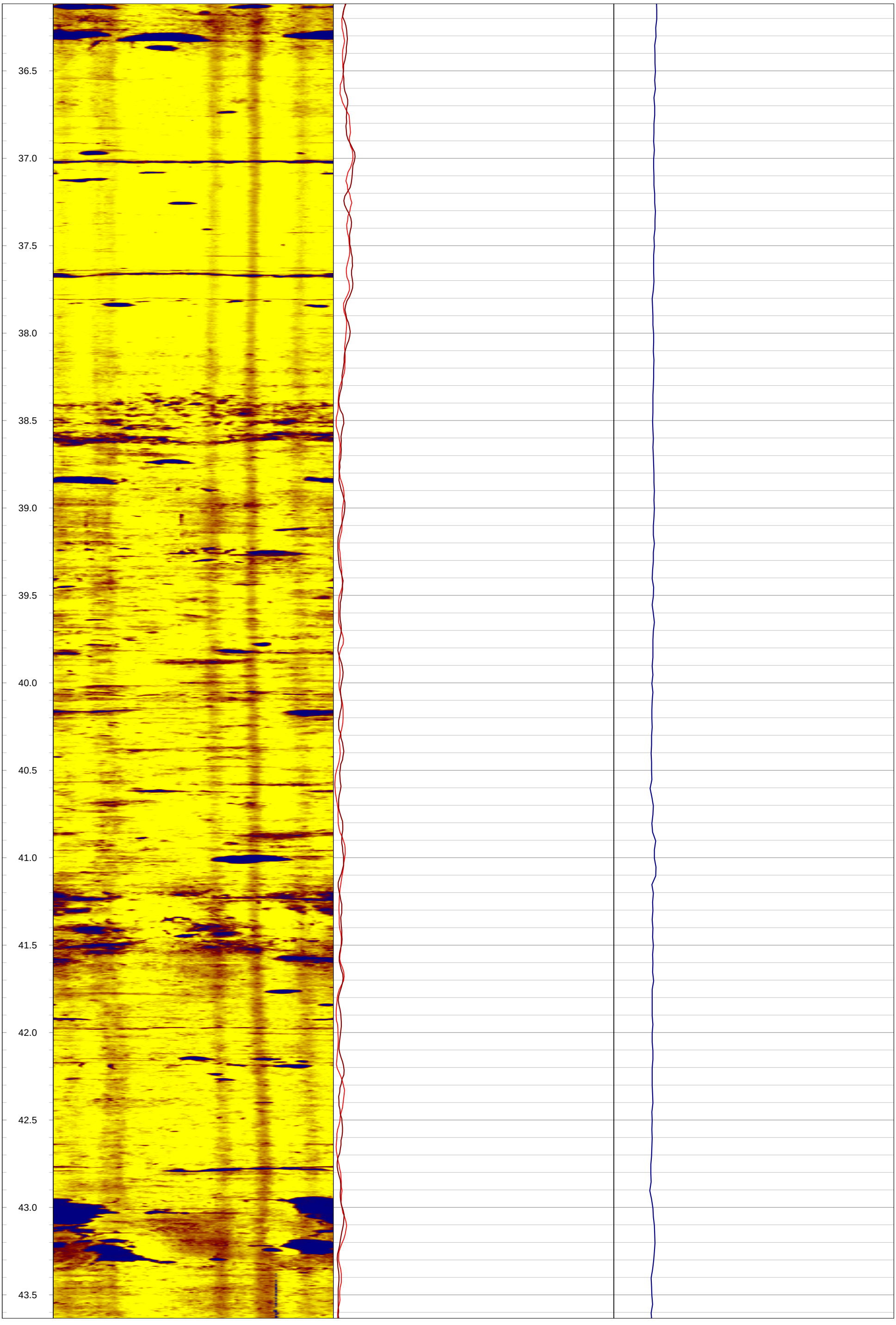
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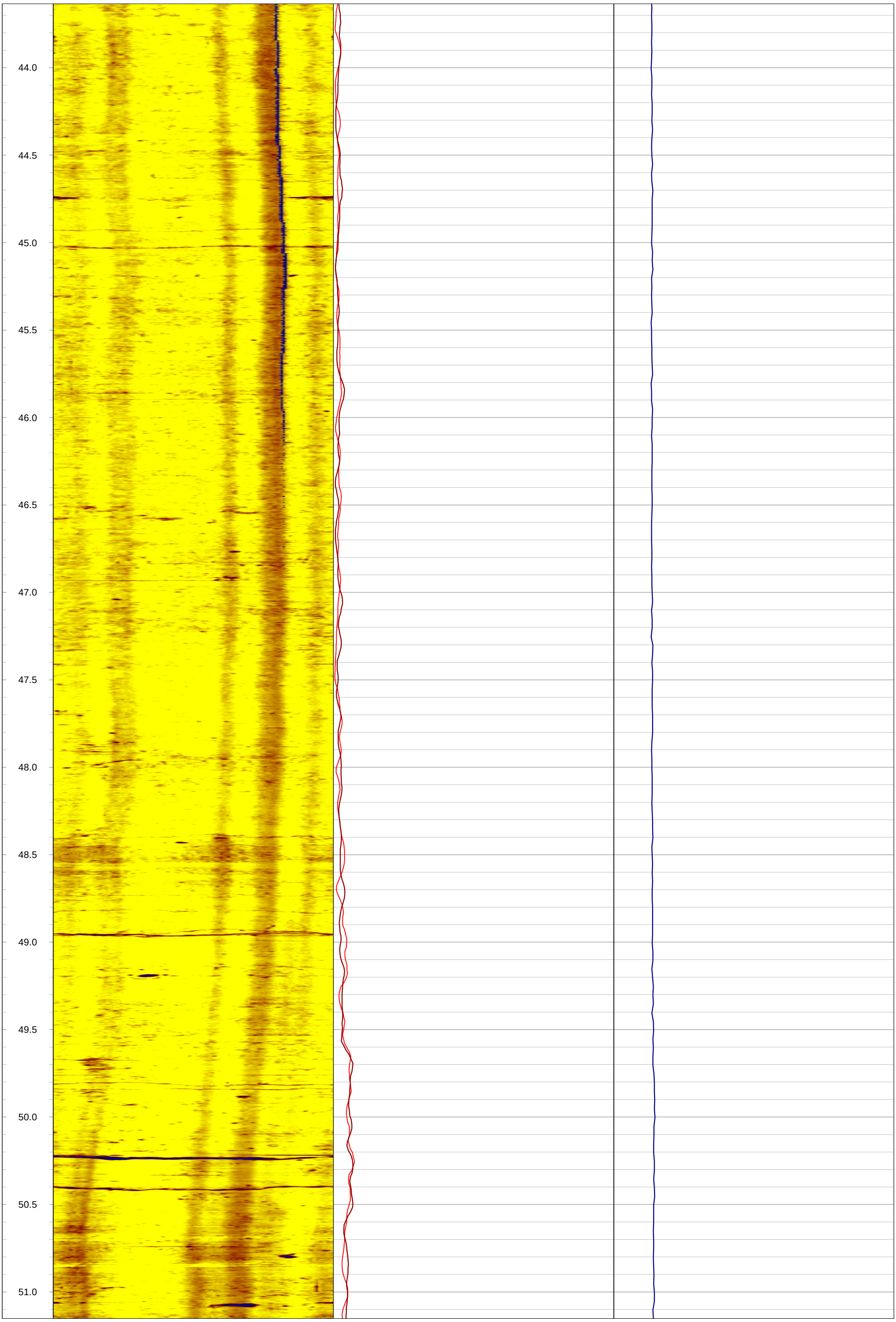
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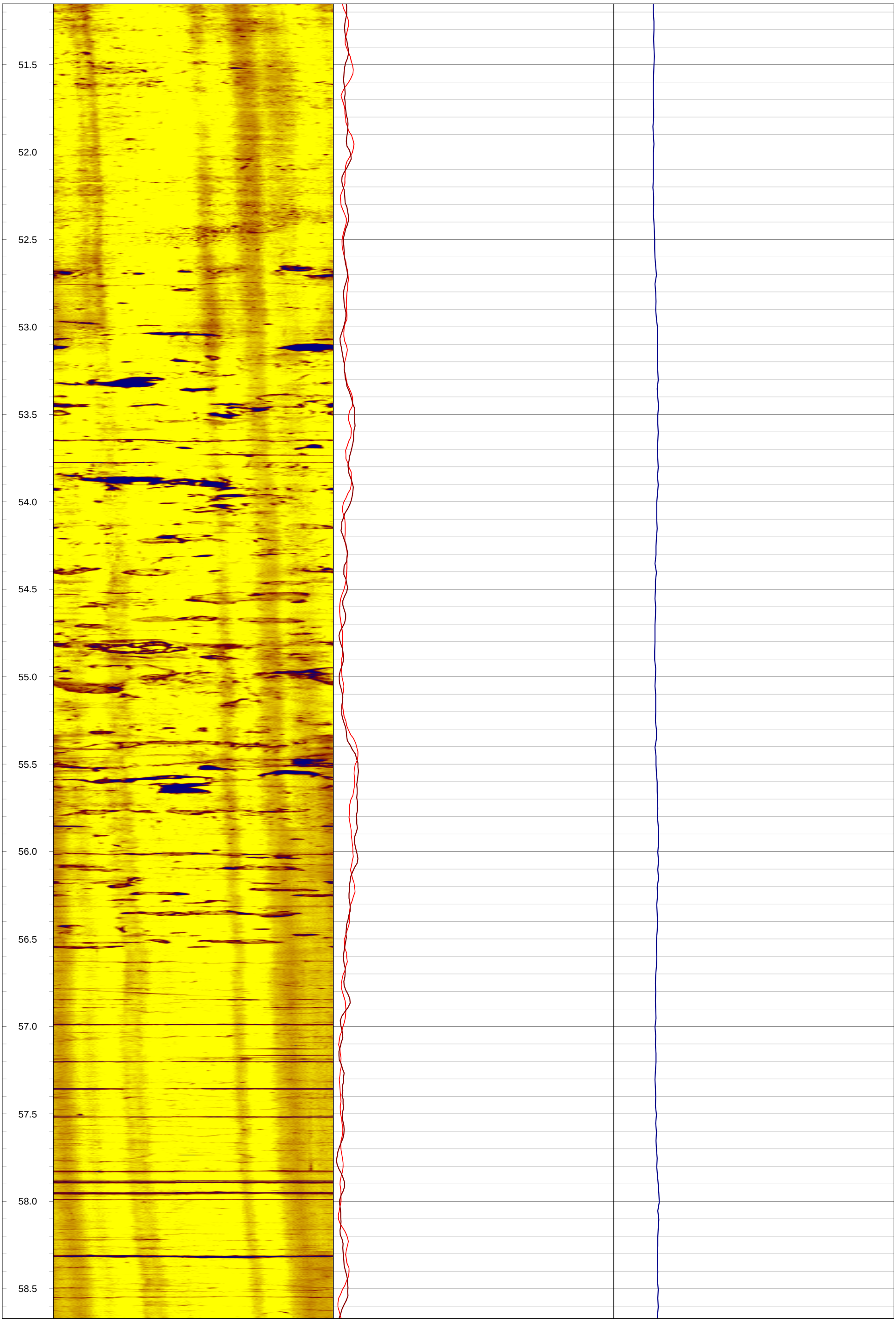
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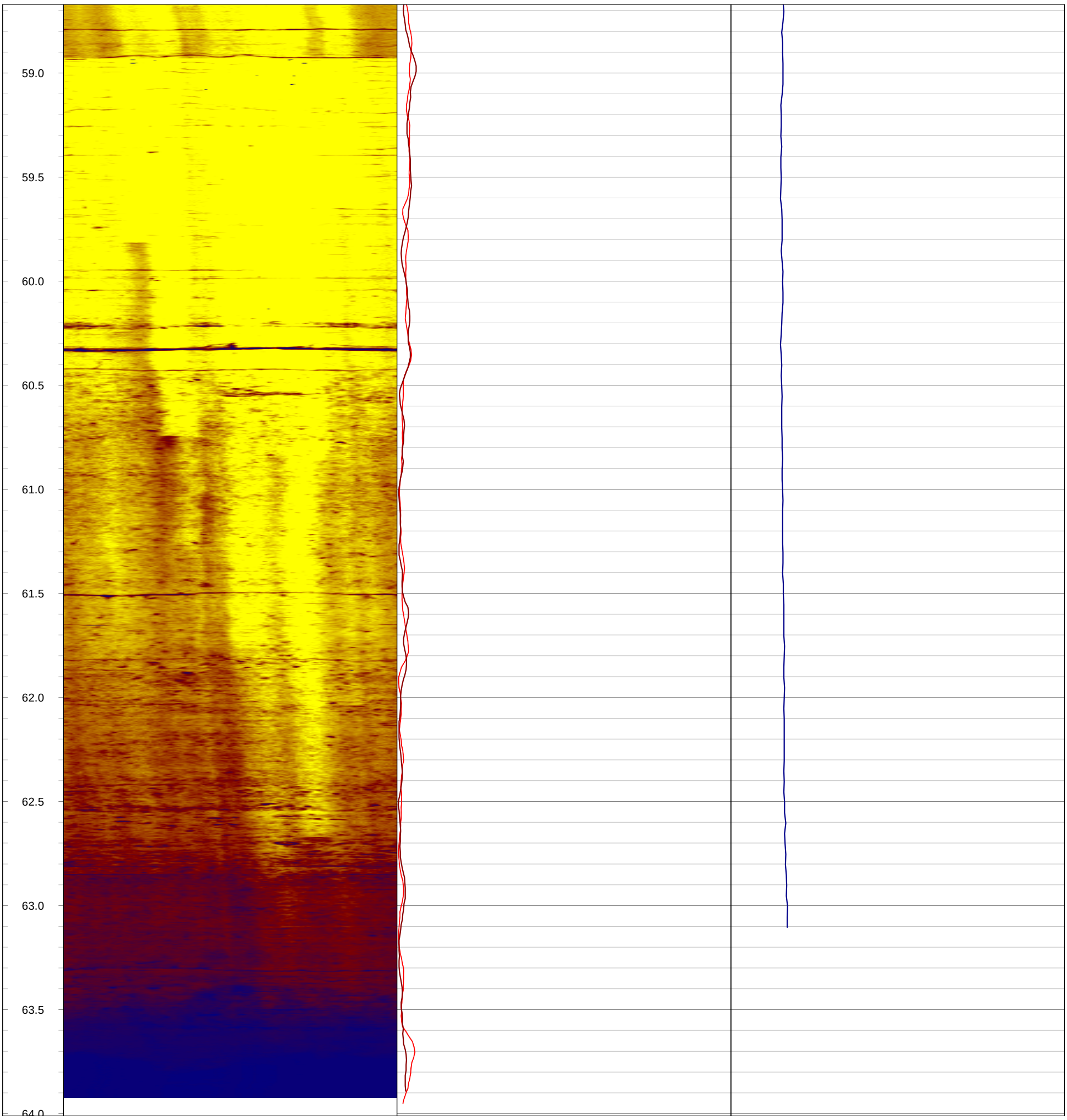
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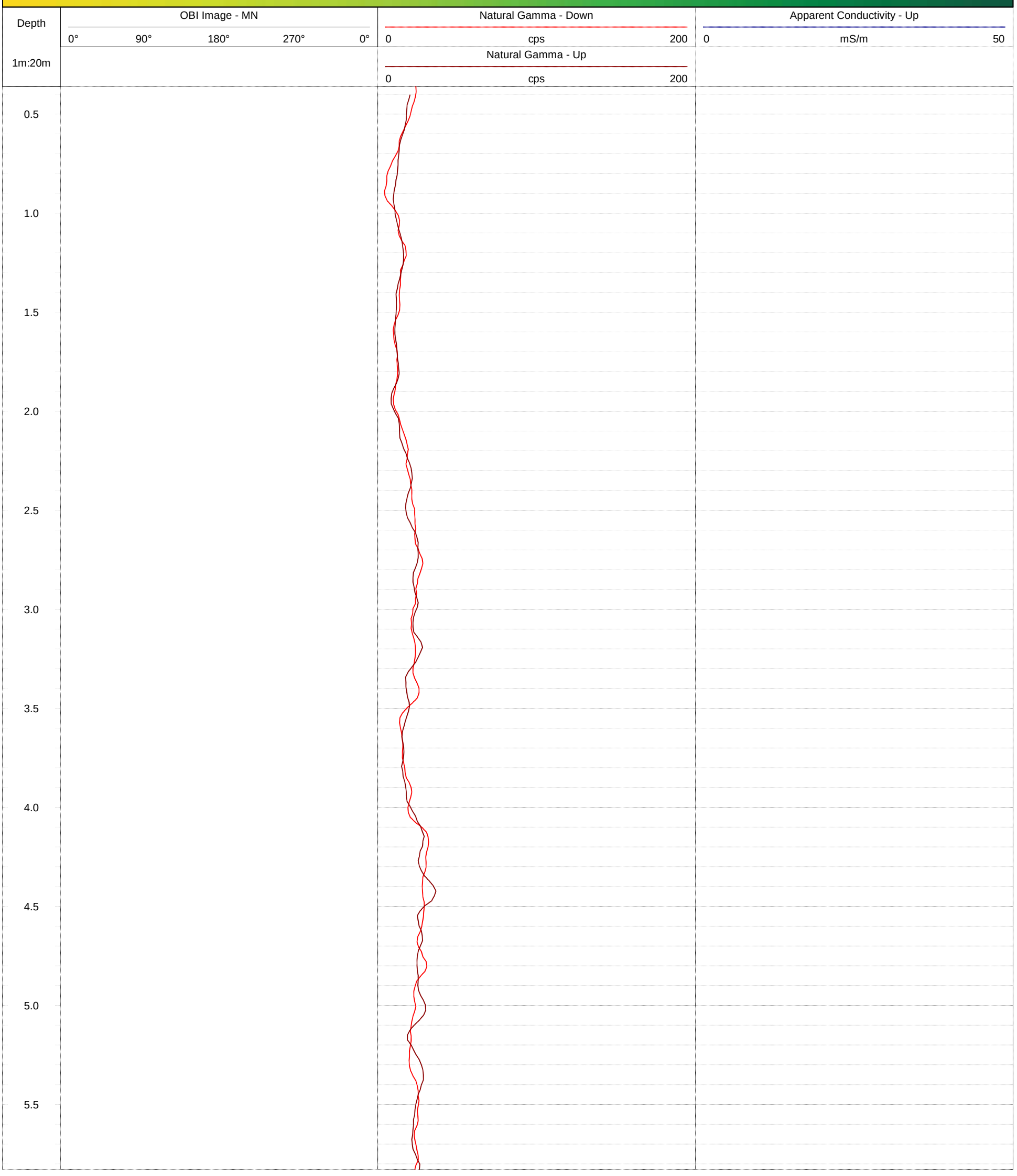
GOLDER
MEMBER OF WSP

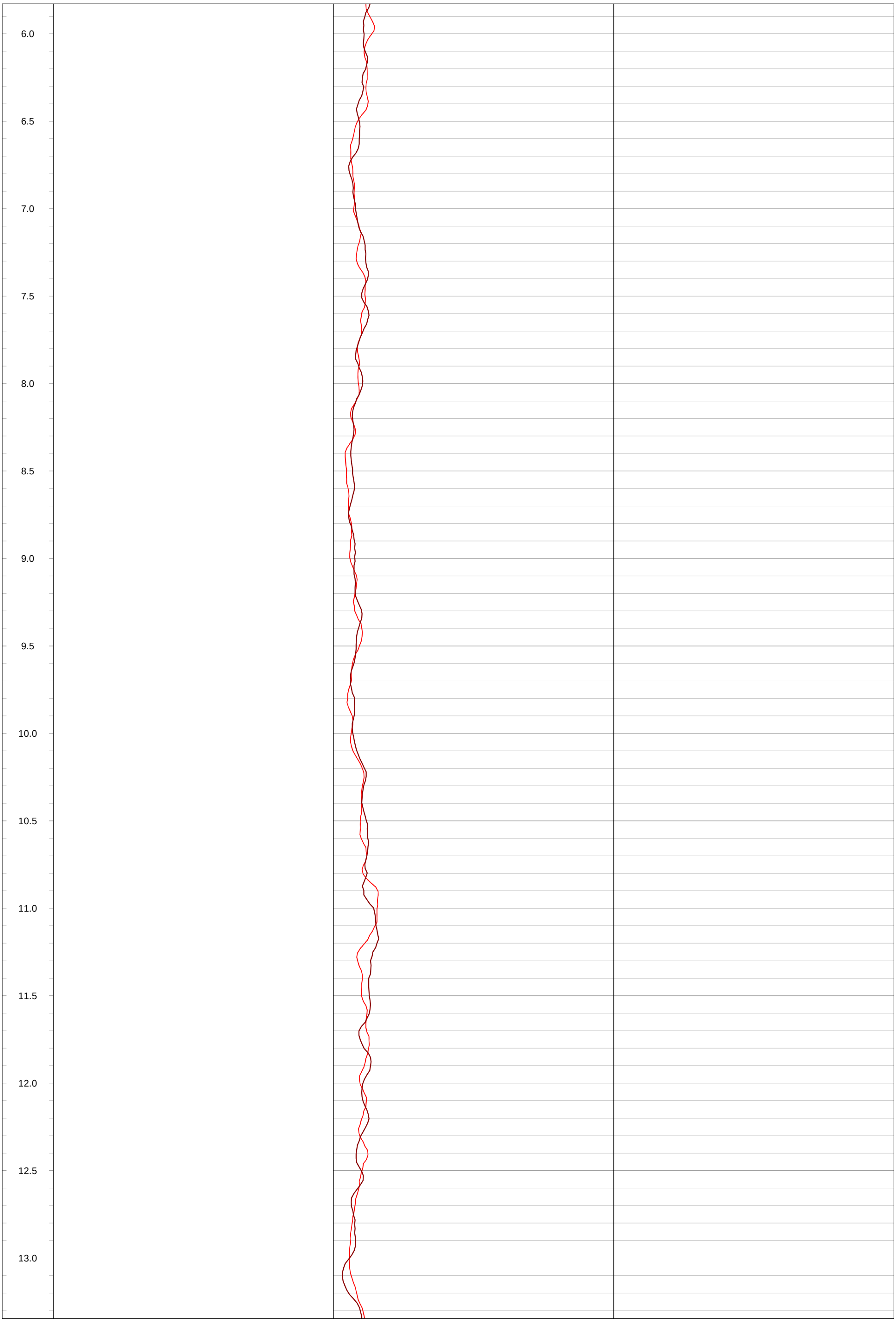
Geophysical Record of Borehole: MW20-27 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	31.60 m bgs	**Location:**	Caledon, Ontario
Easting:	575953.96 m	**Drilled Depth:**	52.43 m bgs	**Water Level:**	7.62 m bgs	**Log Date:**	Feb-17-2021
Northing:	4853770.16 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	431.15 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.30 m ags	**Logged By:**	PG

Notes: Optical image blurred > 39 m bgs

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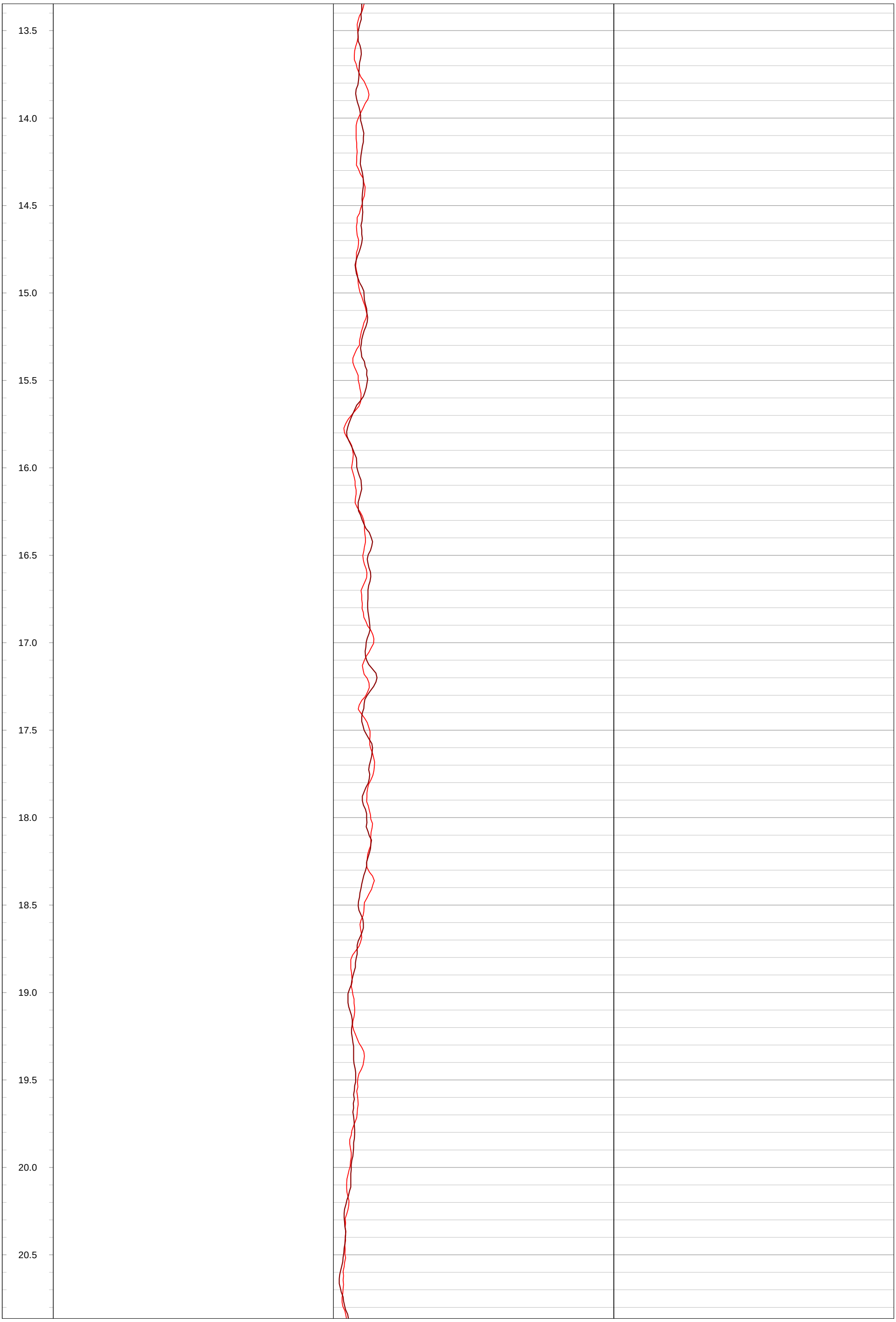
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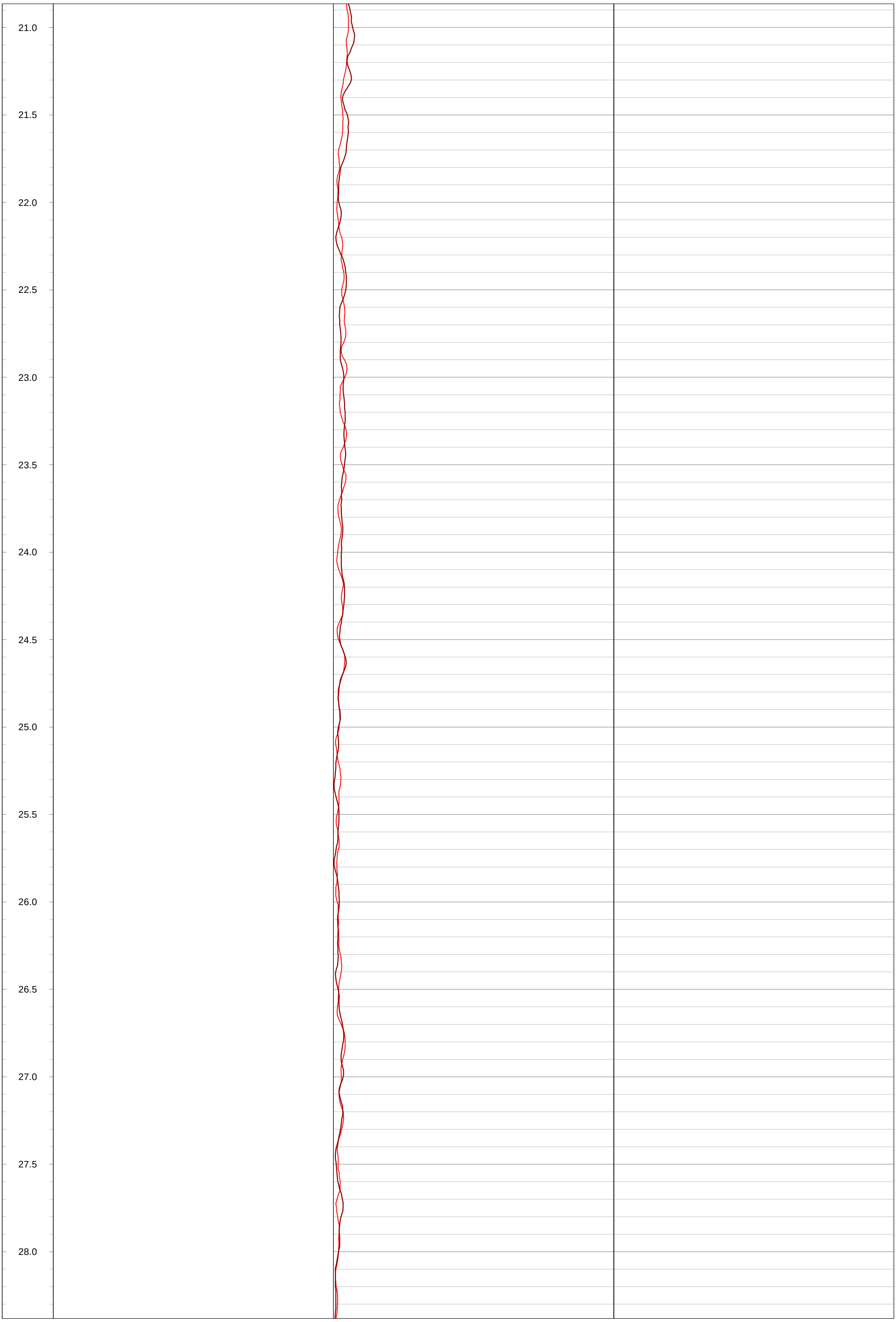
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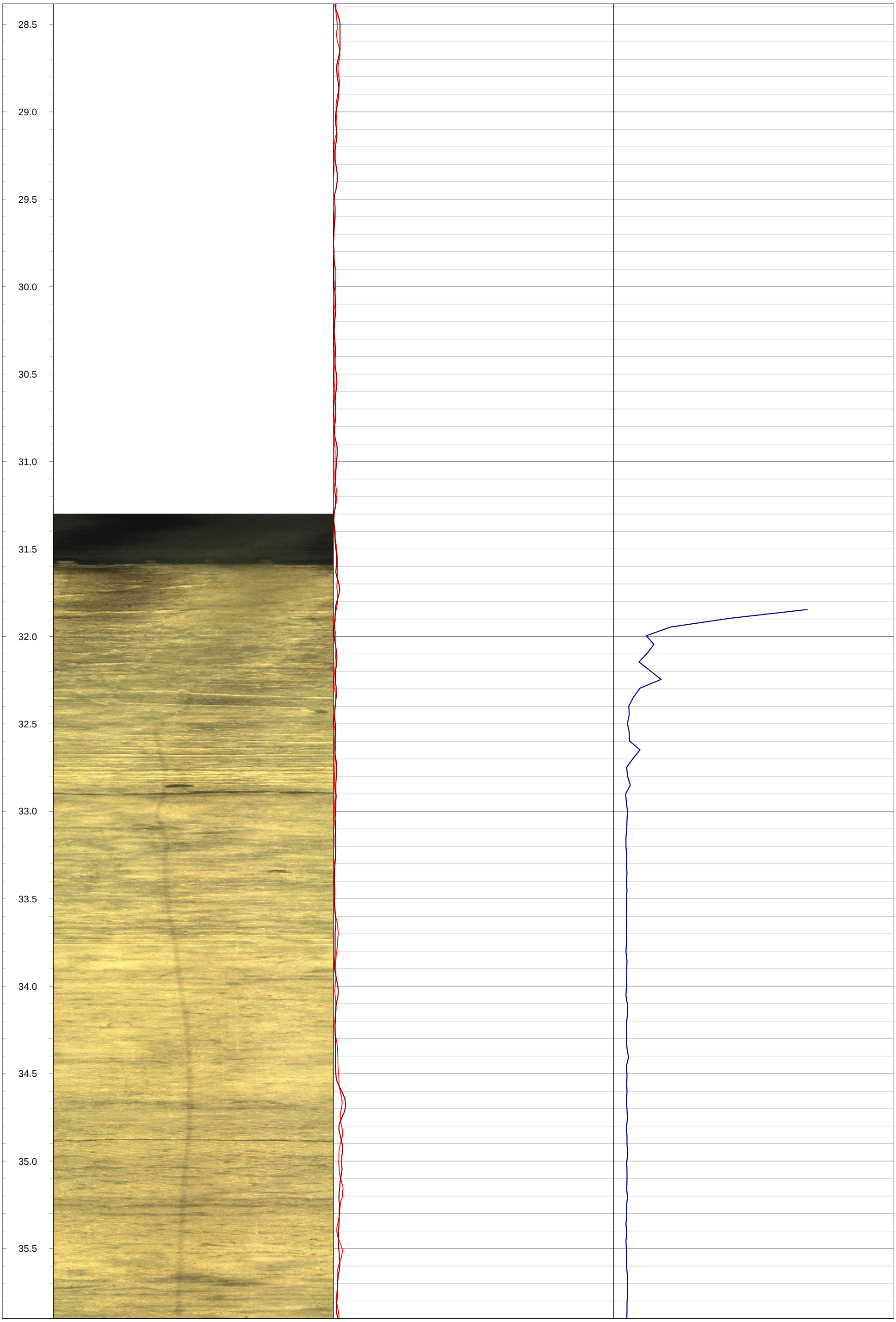
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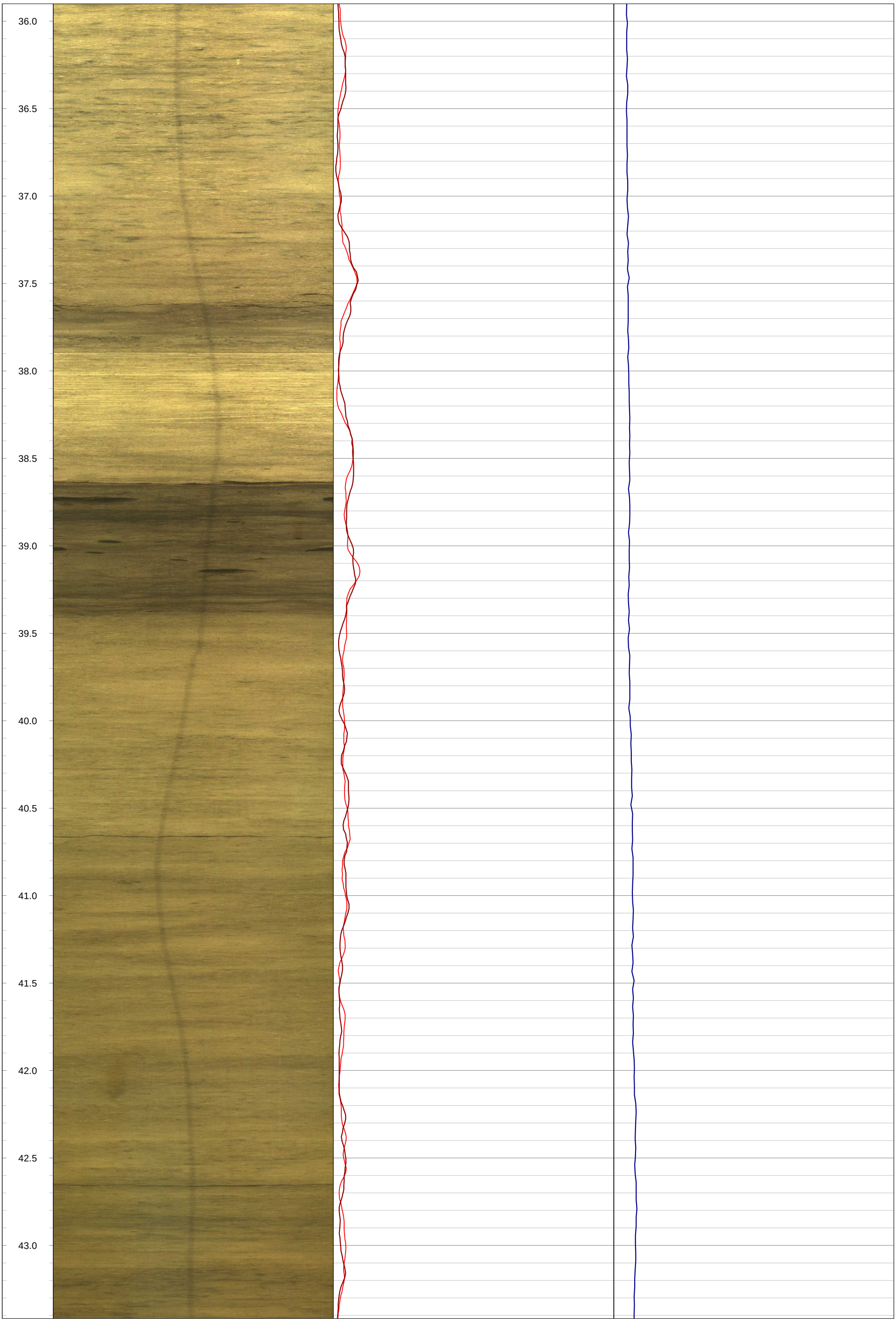
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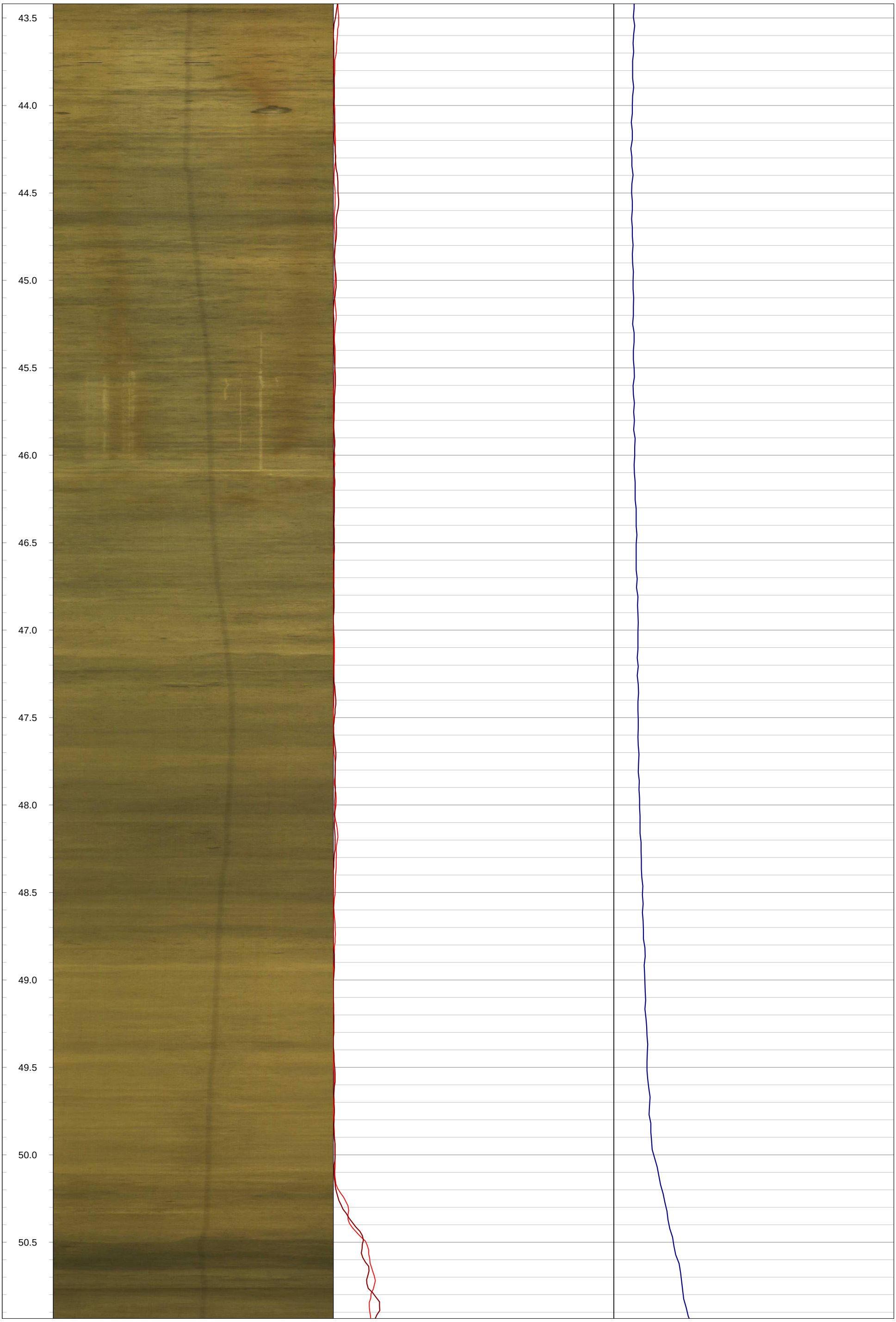
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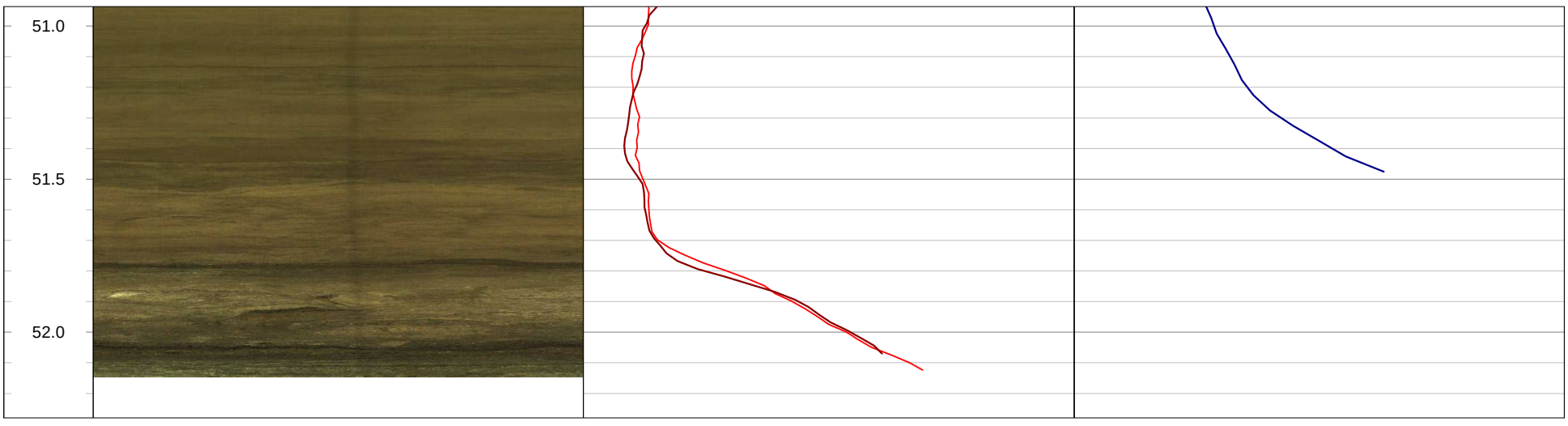
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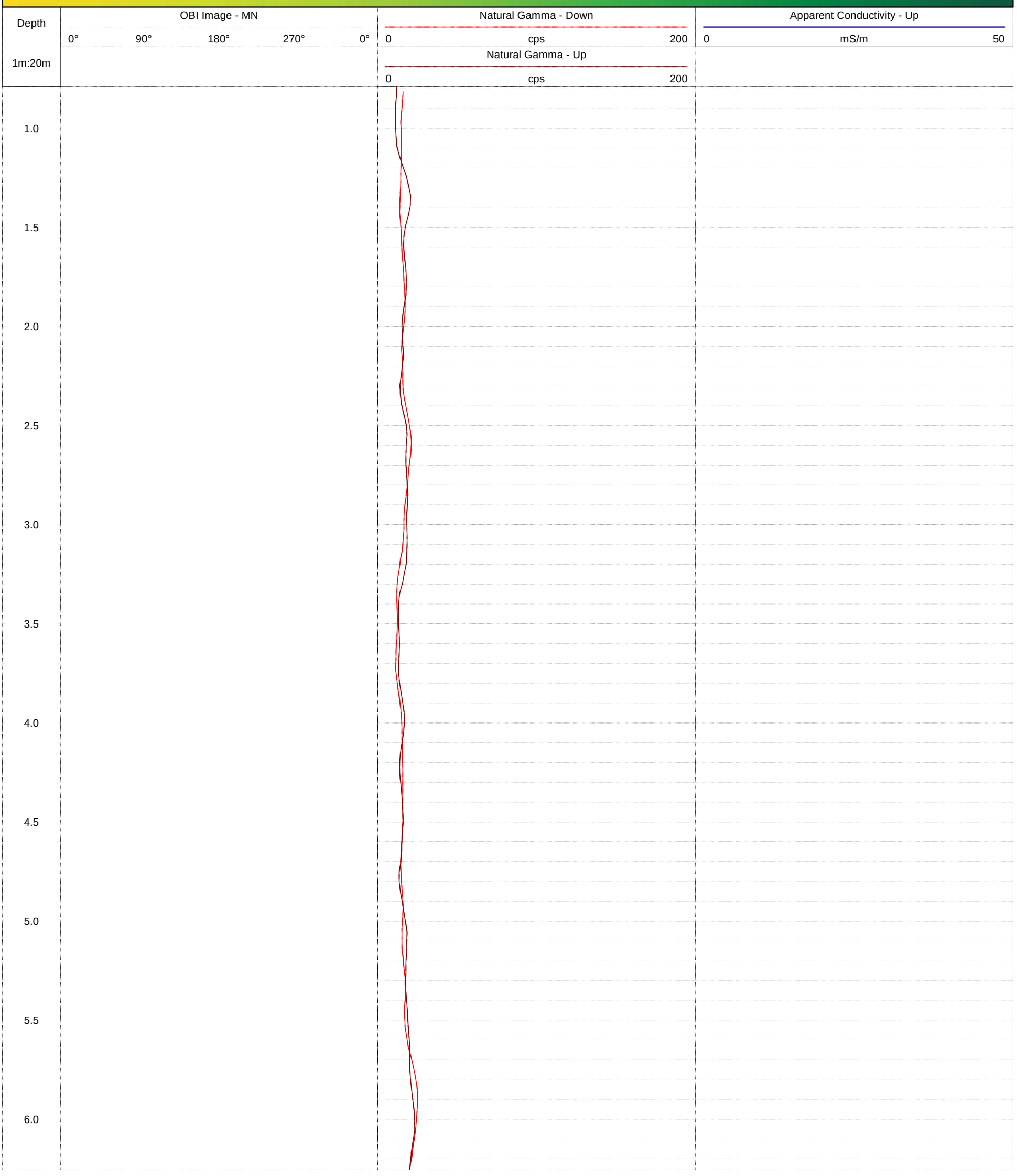
GOLDER
MEMBER OF WSP

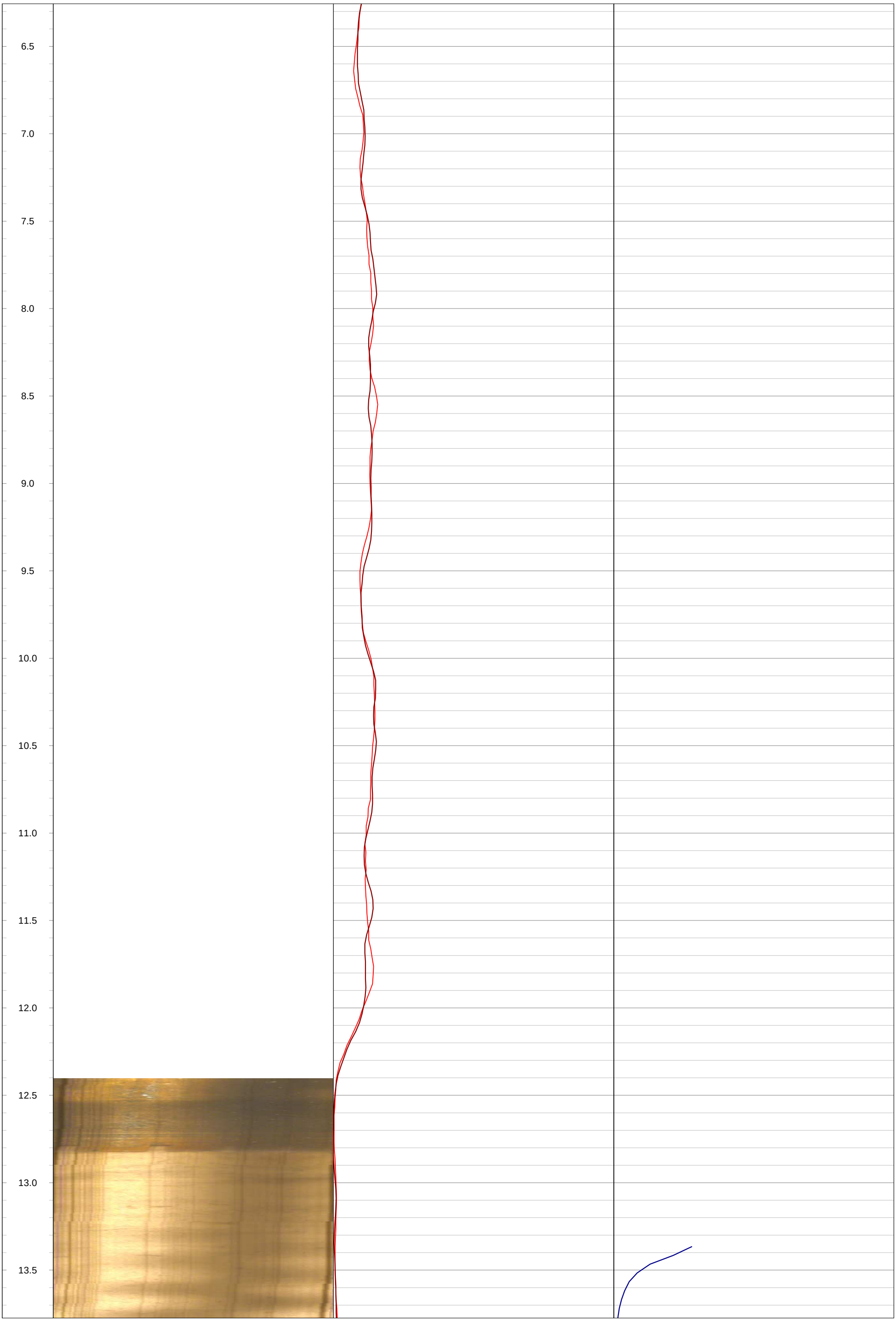
Geophysical Record of Borehole: MW20-28 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.80 m bgs	**Location:**	Caledon, Ontario
Easting:	576139.79 m	**Drilled Depth:**	30.82 m bgs	**Water Level:**	0 m bgs	**Log Date:**	Feb-23-2021
Northing:	4854987.82 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	419.31 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.23 m ags	**Logged By:**	PL

Notes:

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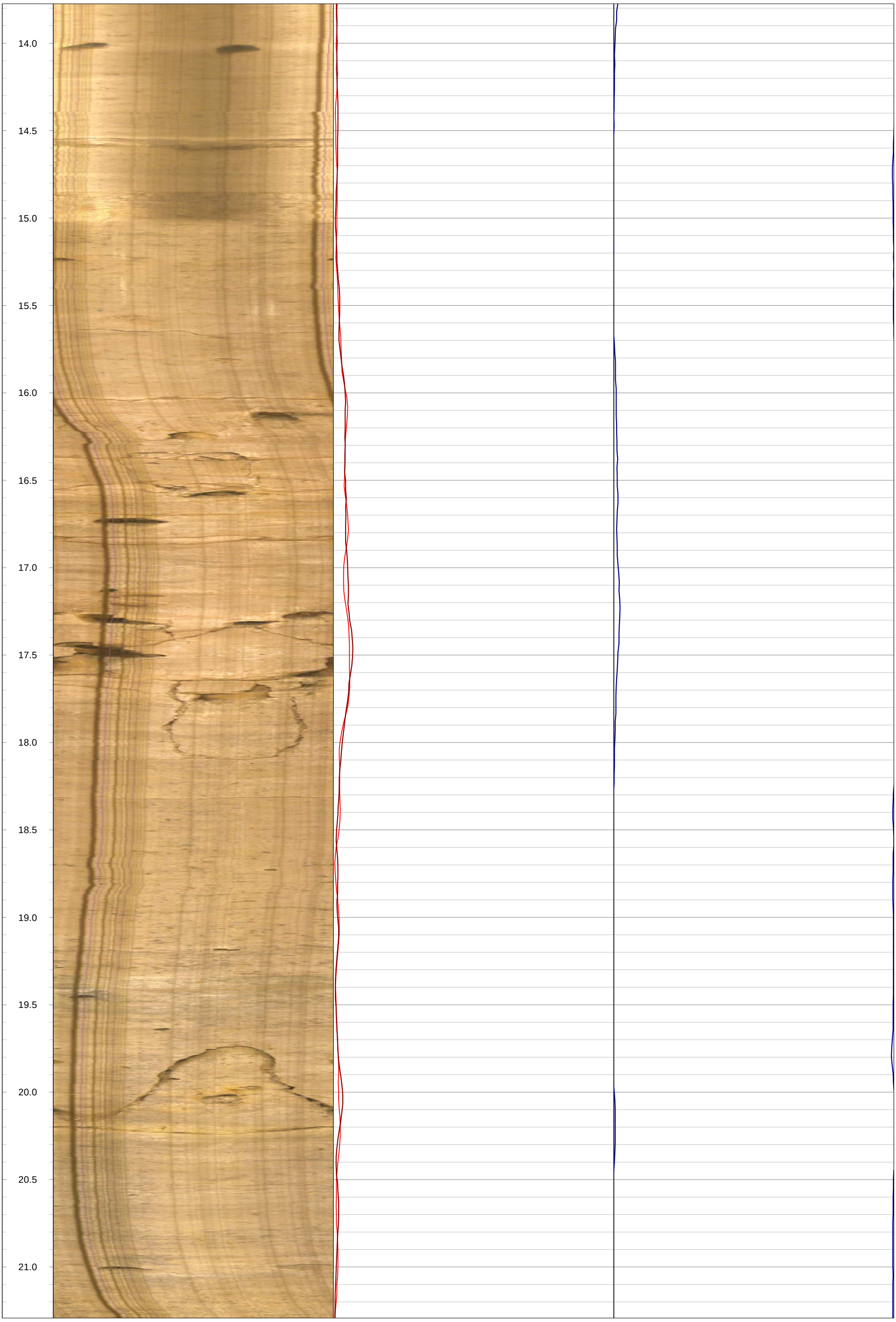
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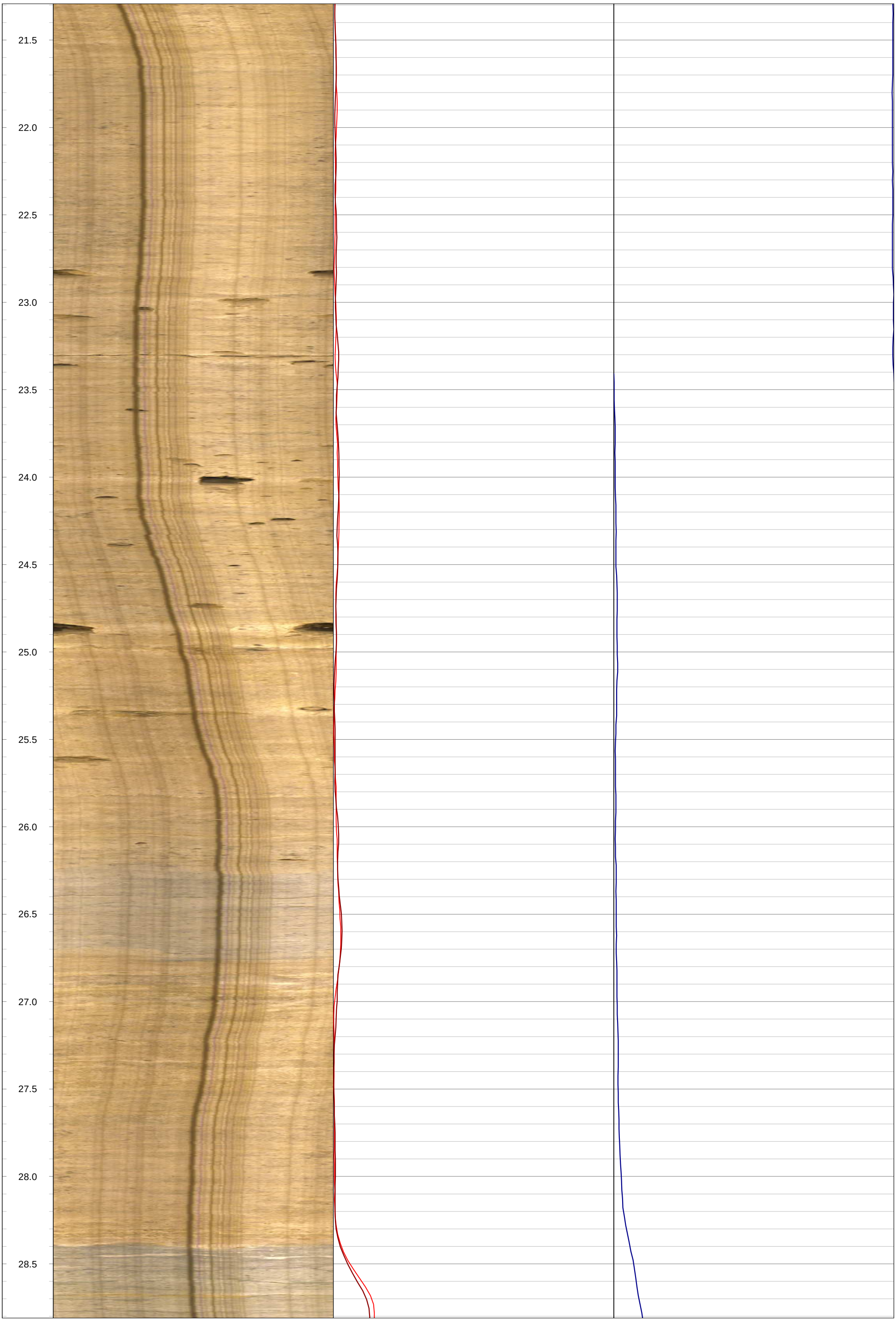
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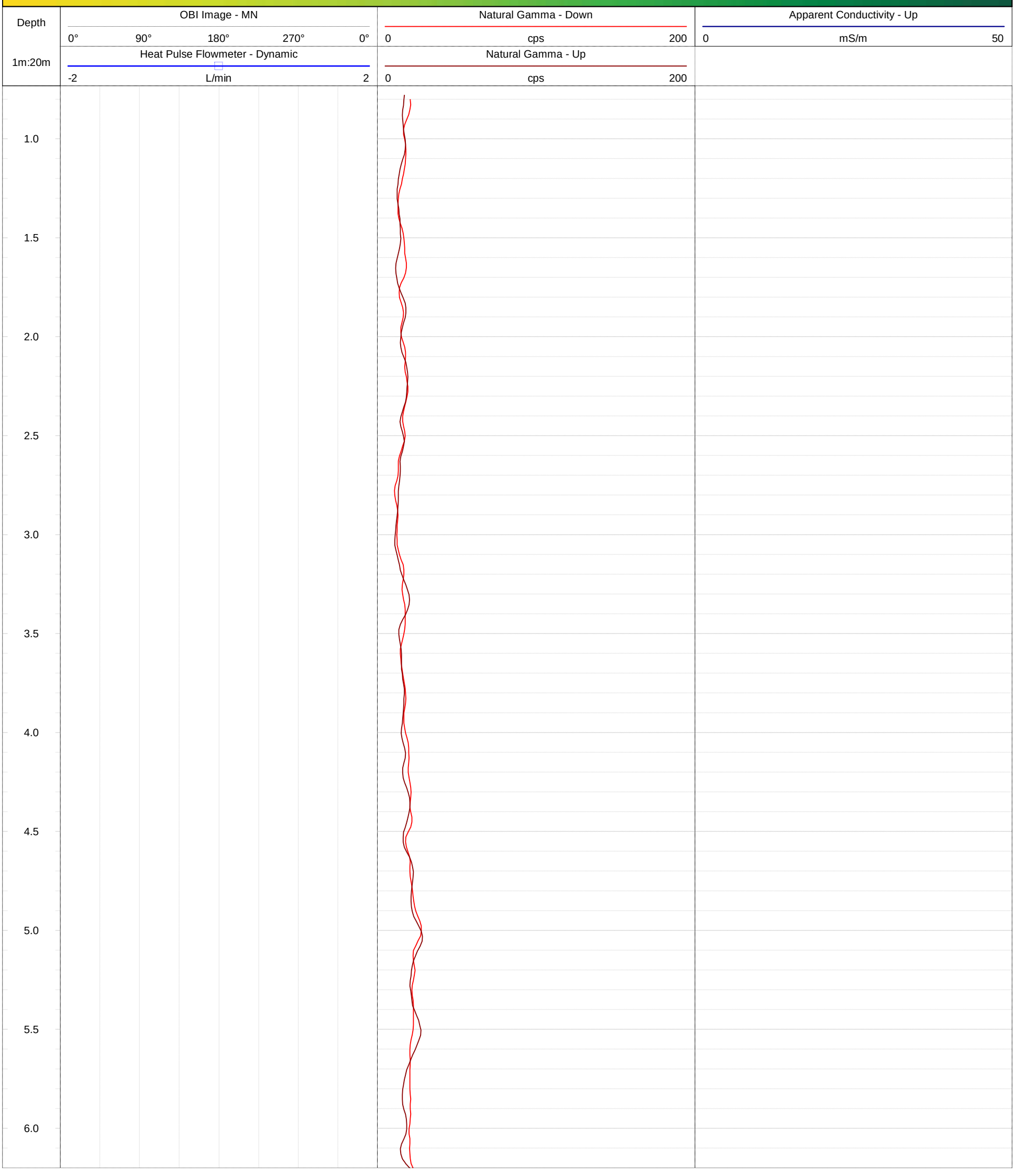
GOLDER
MEMBER OF WSP

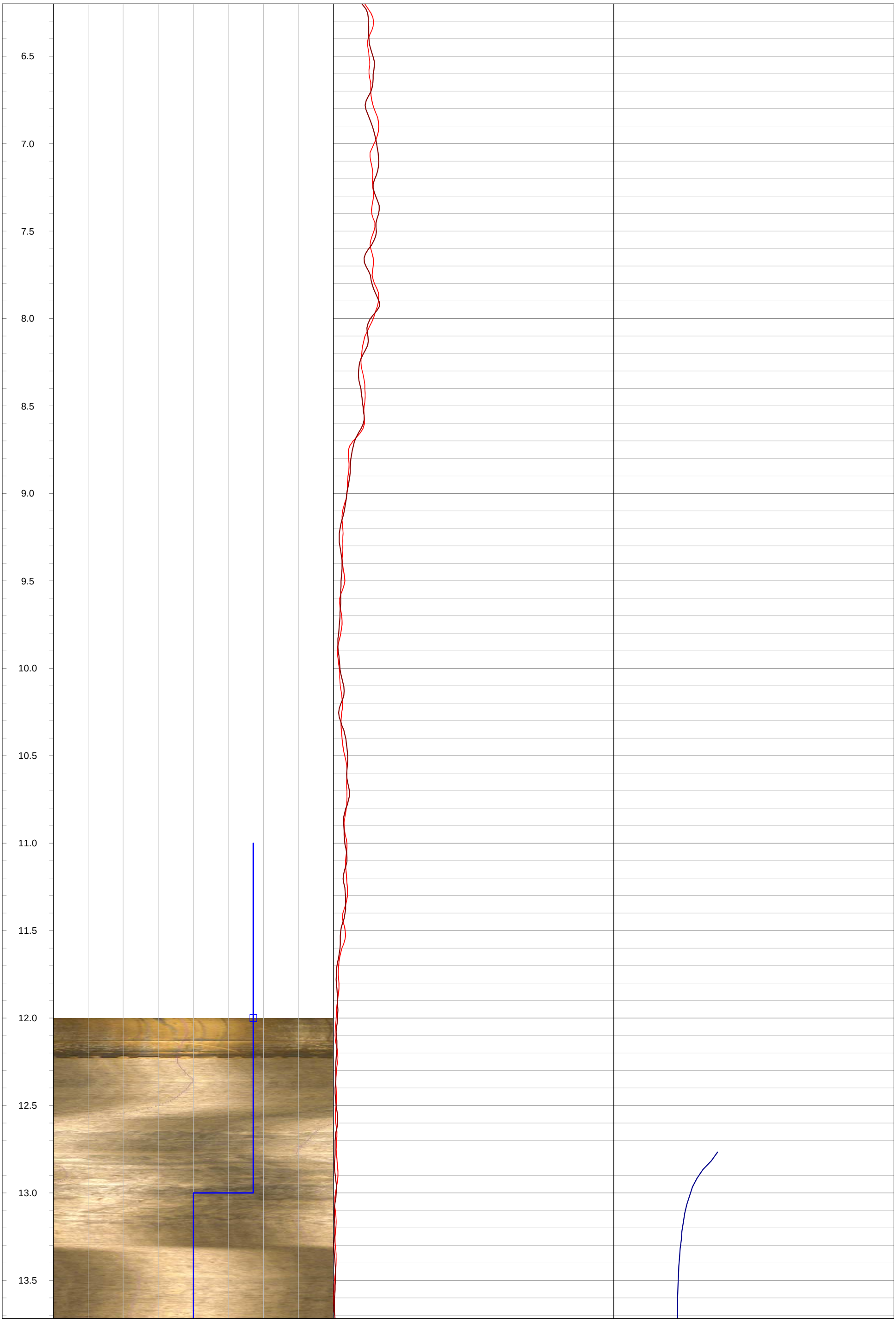
Geophysical Record of Borehole: MW21-1-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.89 m bgs	**Location:**	Caledon, Ontario
Easting:	576882.20 m	**Drilled Depth:**	36.27 m bgs	**Water Level:**	1.80 m bgs	**Log Date:**	Mar-4-2021
Northing:	4853485.00 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	418.94 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PL

Notes: OBI image blurry >30 m. Heat Pulse Flowmeter Dynamic pump at 10 m below top of collar. Pump rate approx. 2 L/min.

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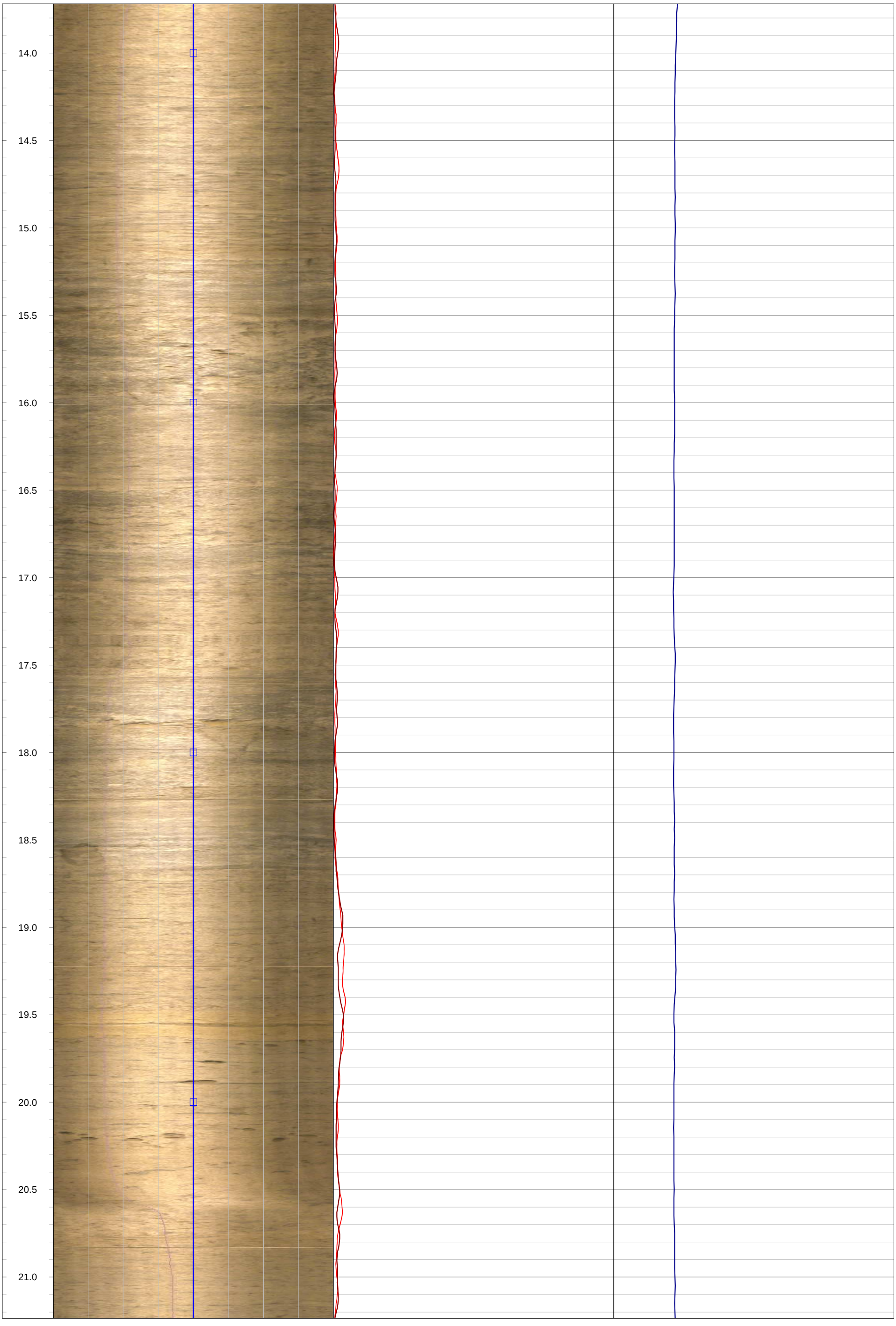
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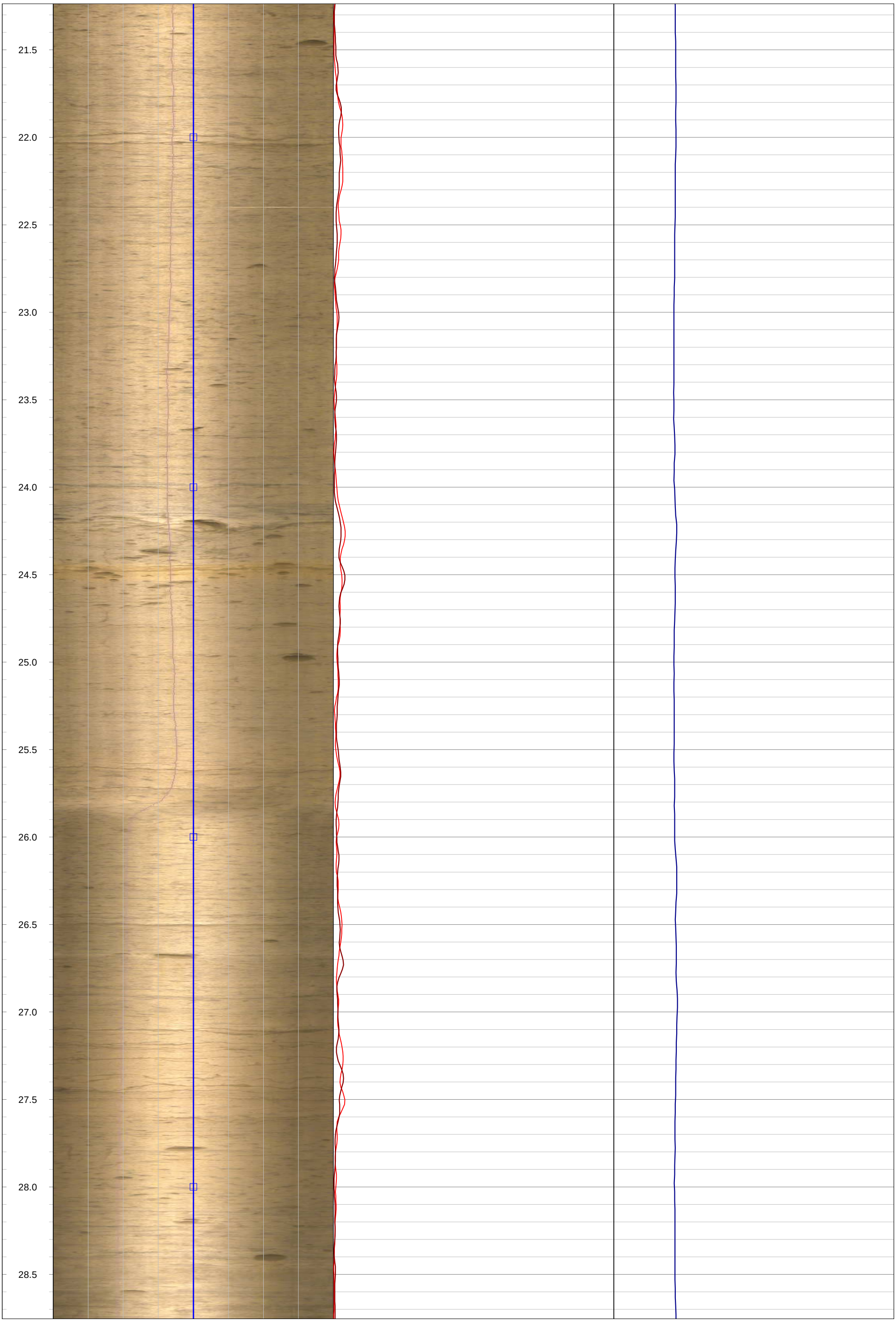
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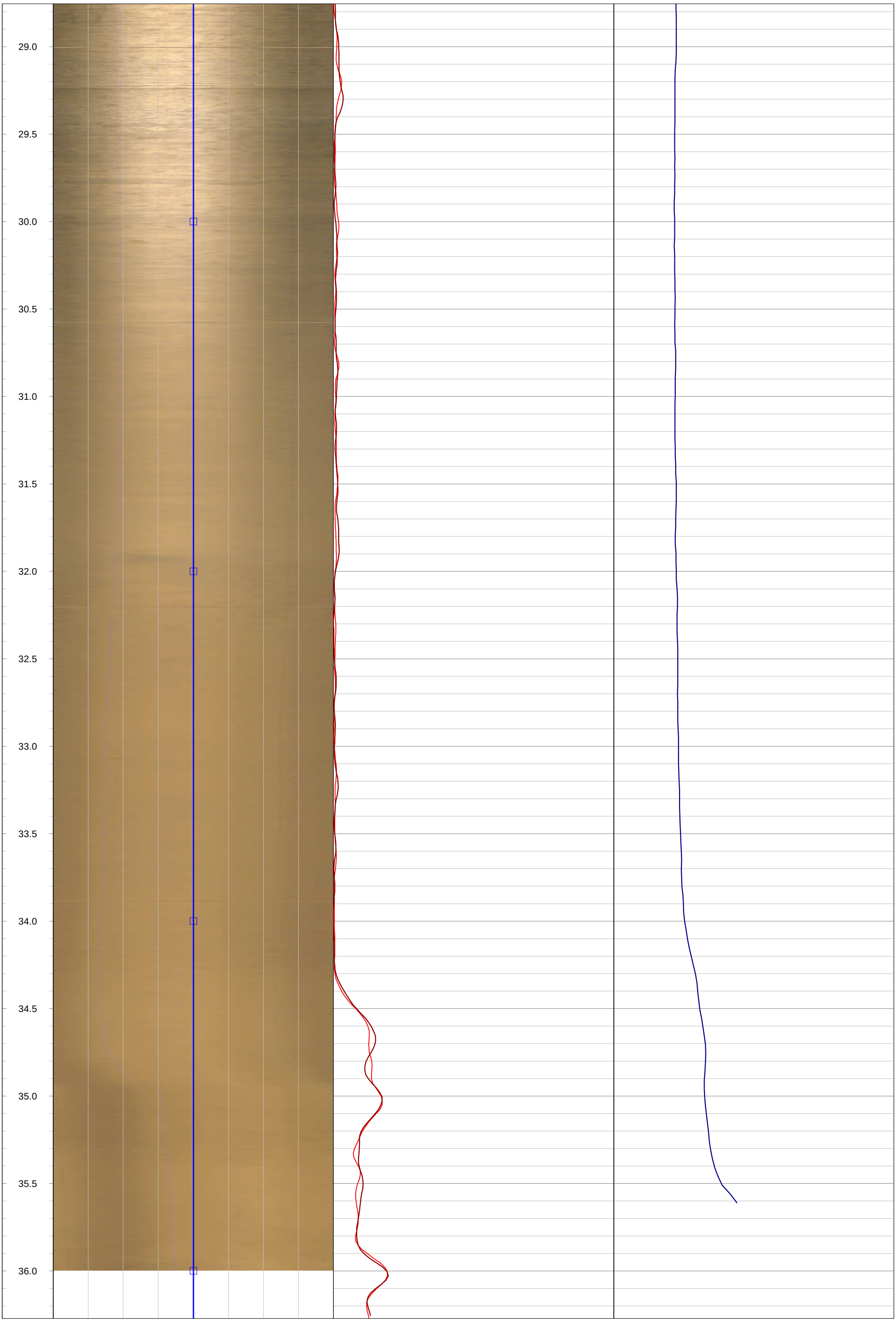
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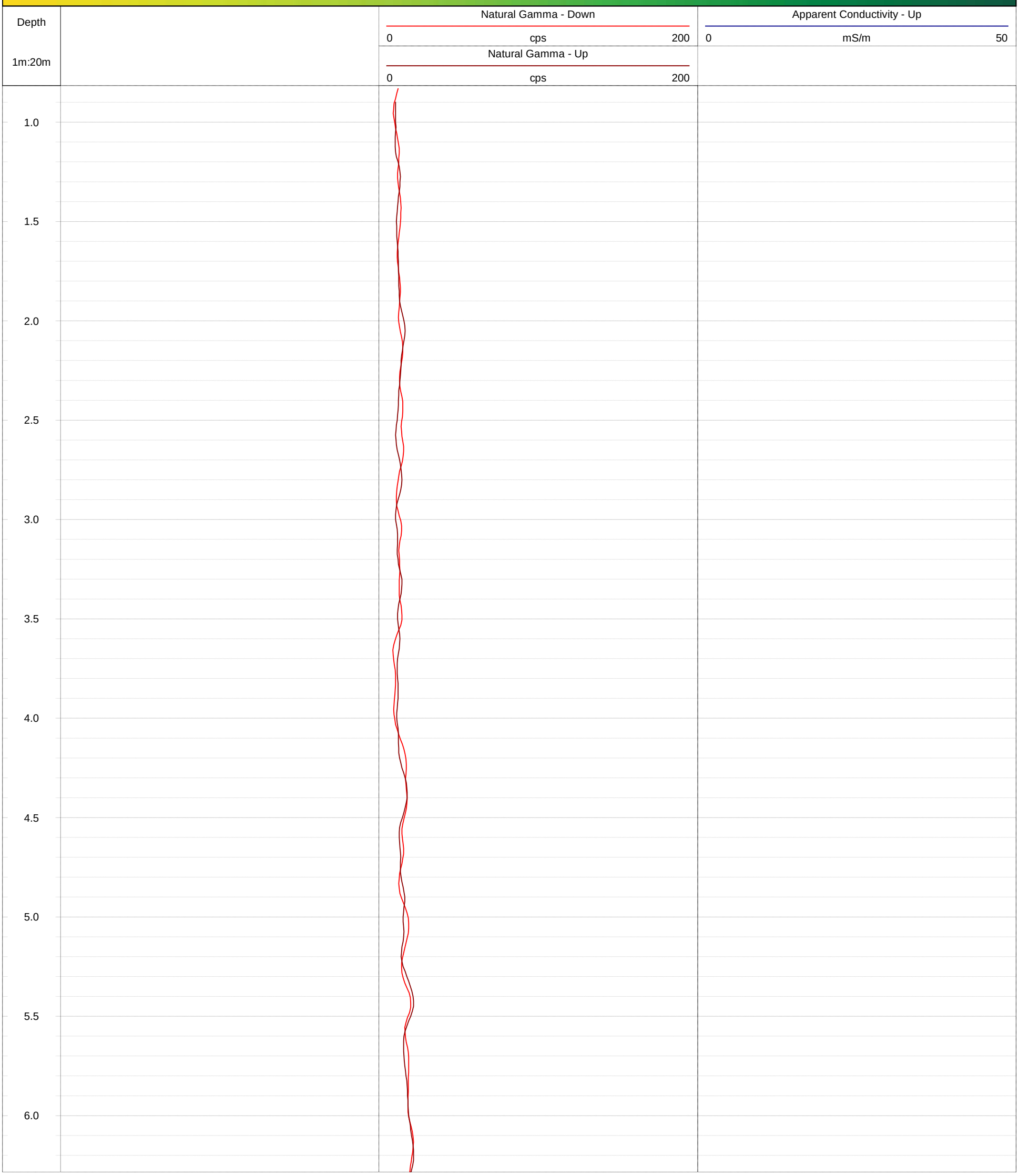
GOLDER
MEMBER OF WSP

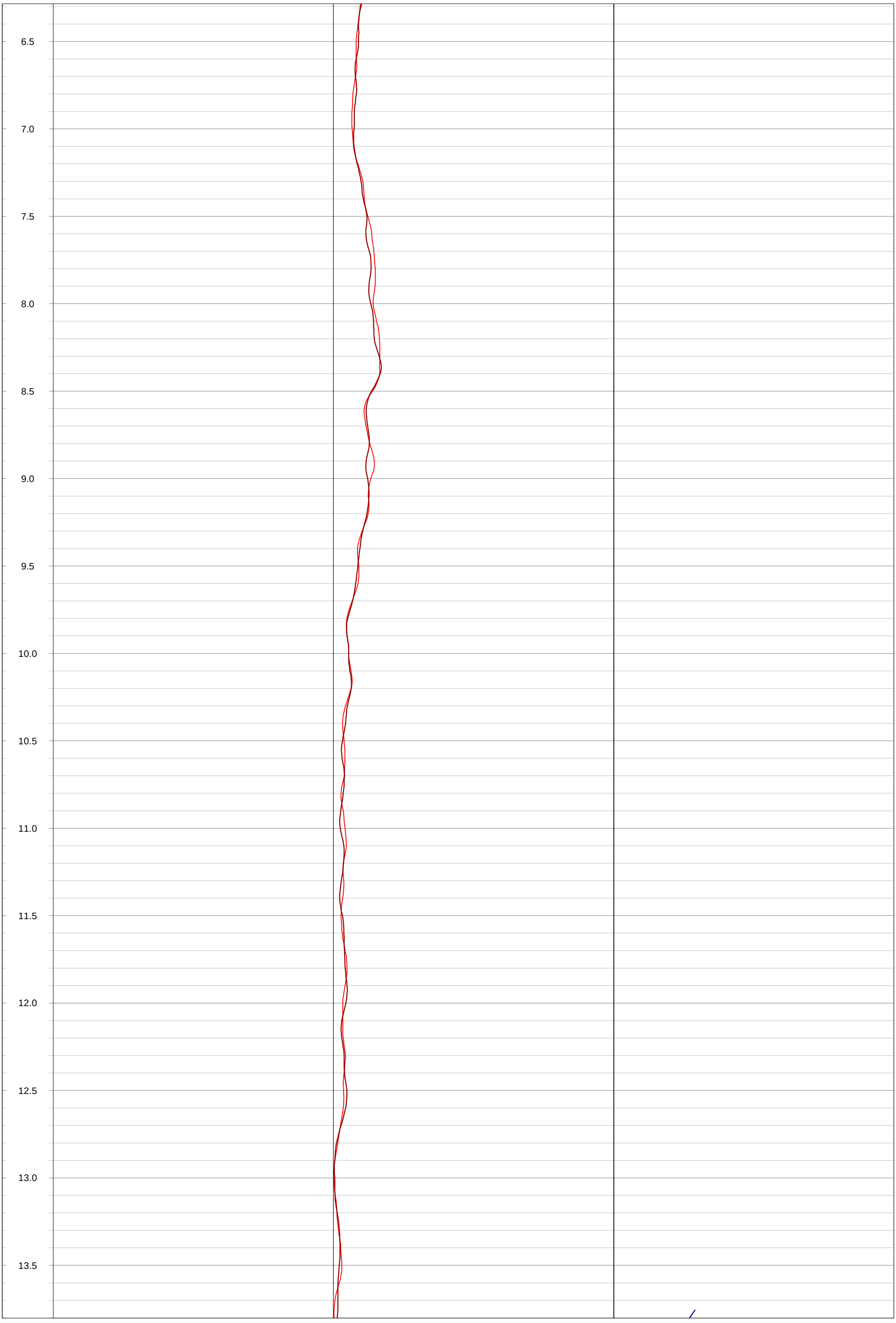
Geophysical Record of Borehole: MW21-1-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	13.11 m bgs	**Location:**	Caledon, Ontario
Easting:	576909.58 m	**Drilled Depth:**	36.00 m bgs	**Water Level:**	1.80 m bgs	**Log Date:**	Mar-3-2021
Northing:	4853505.06 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	420.58 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PL

Notes:

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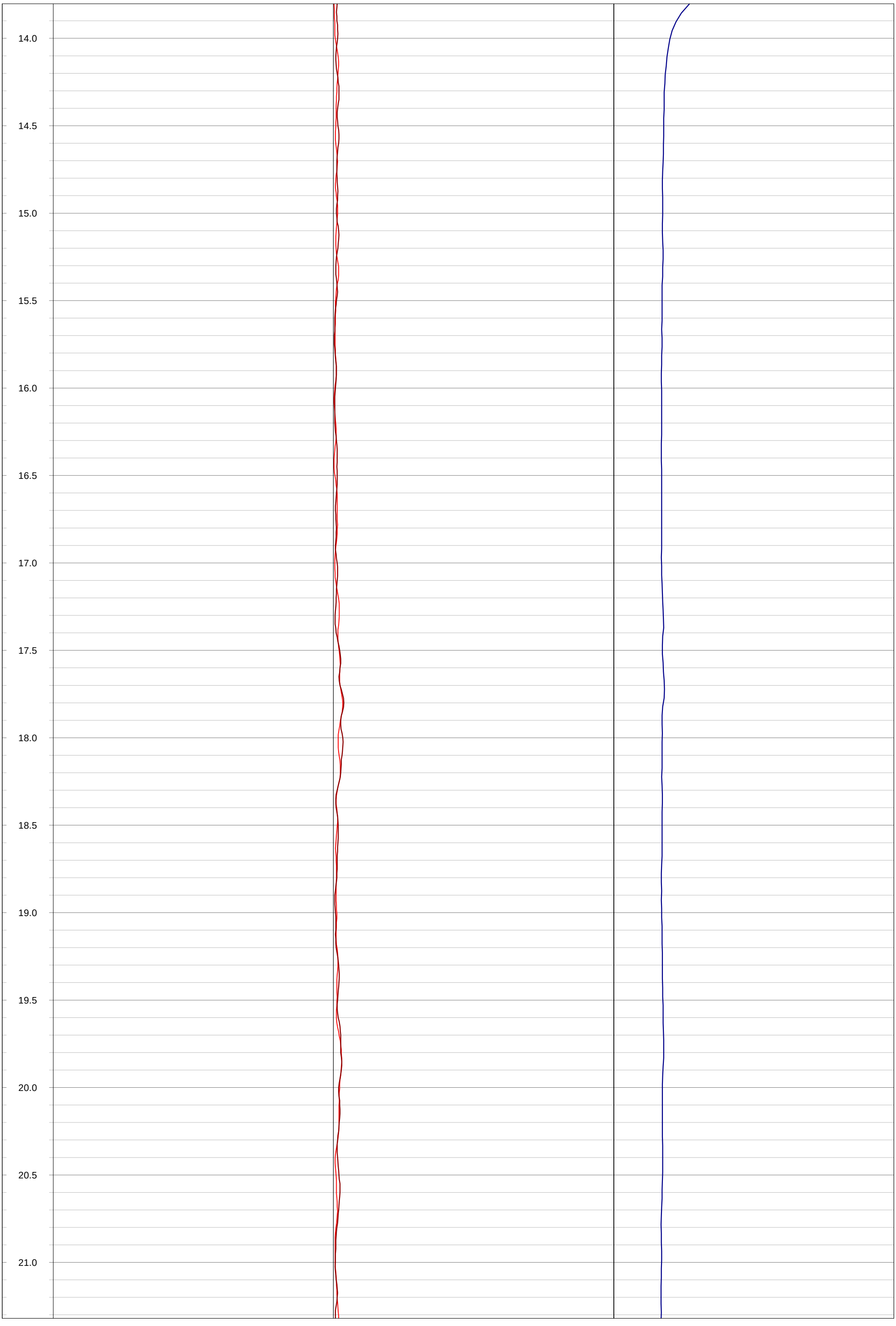
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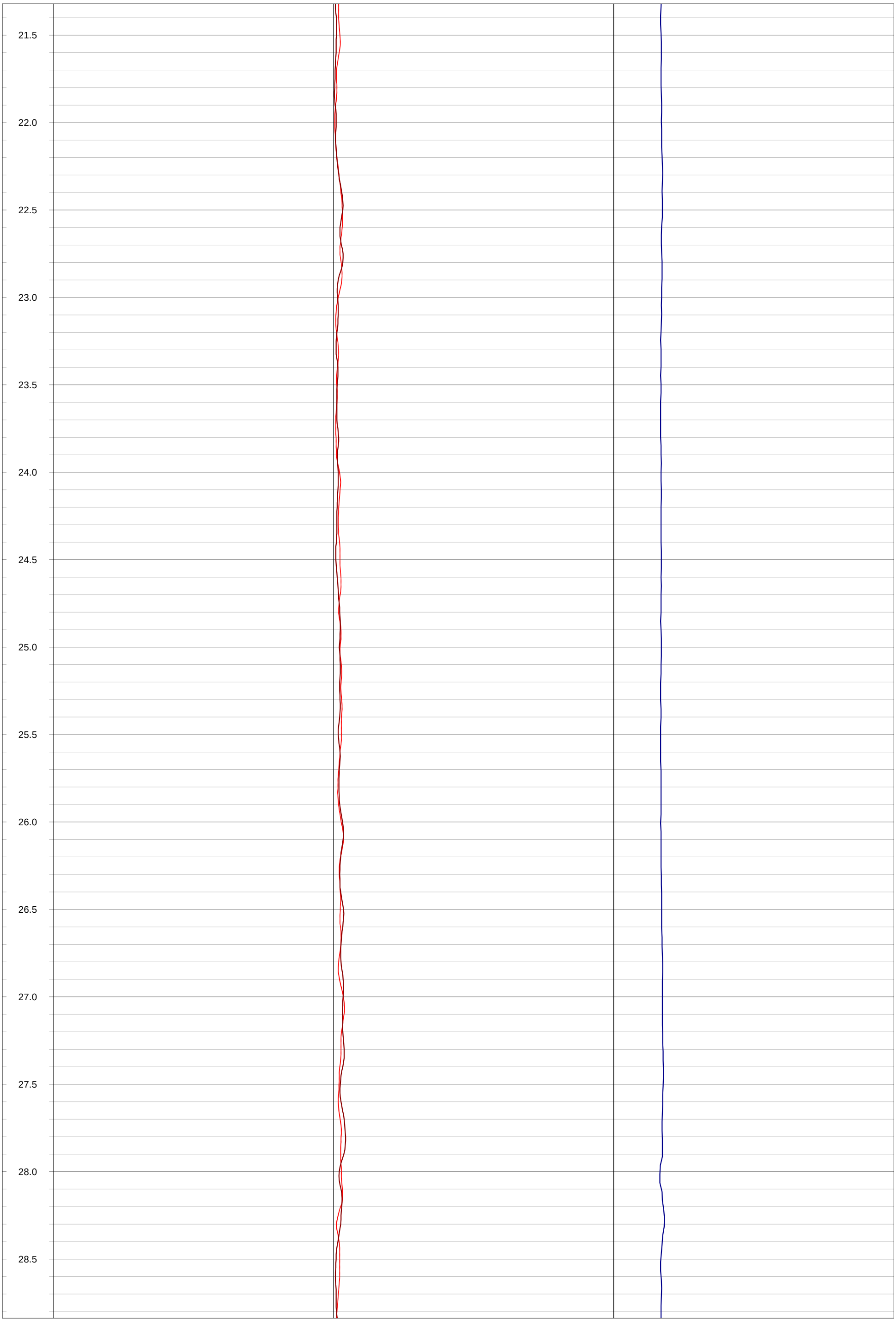
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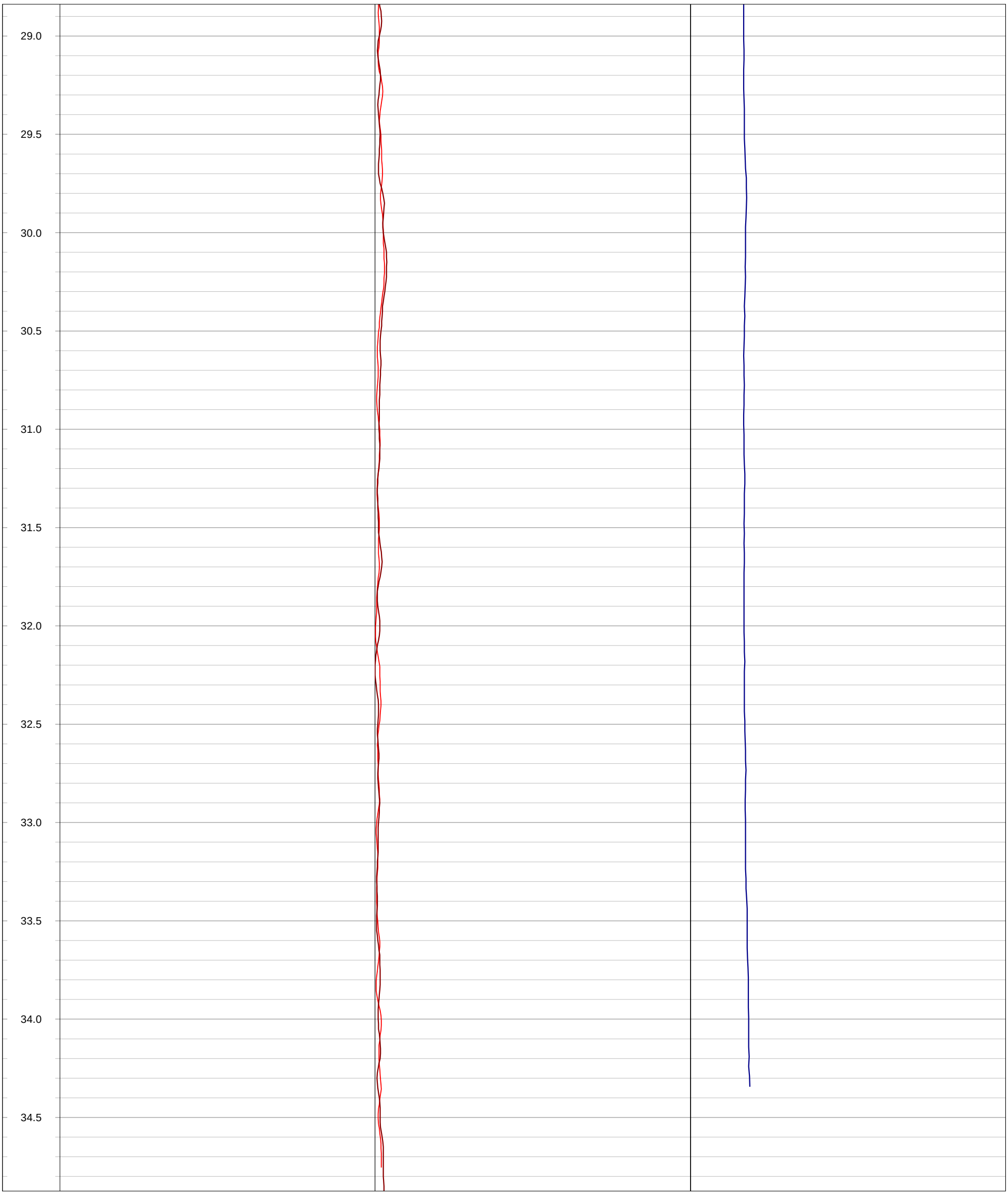
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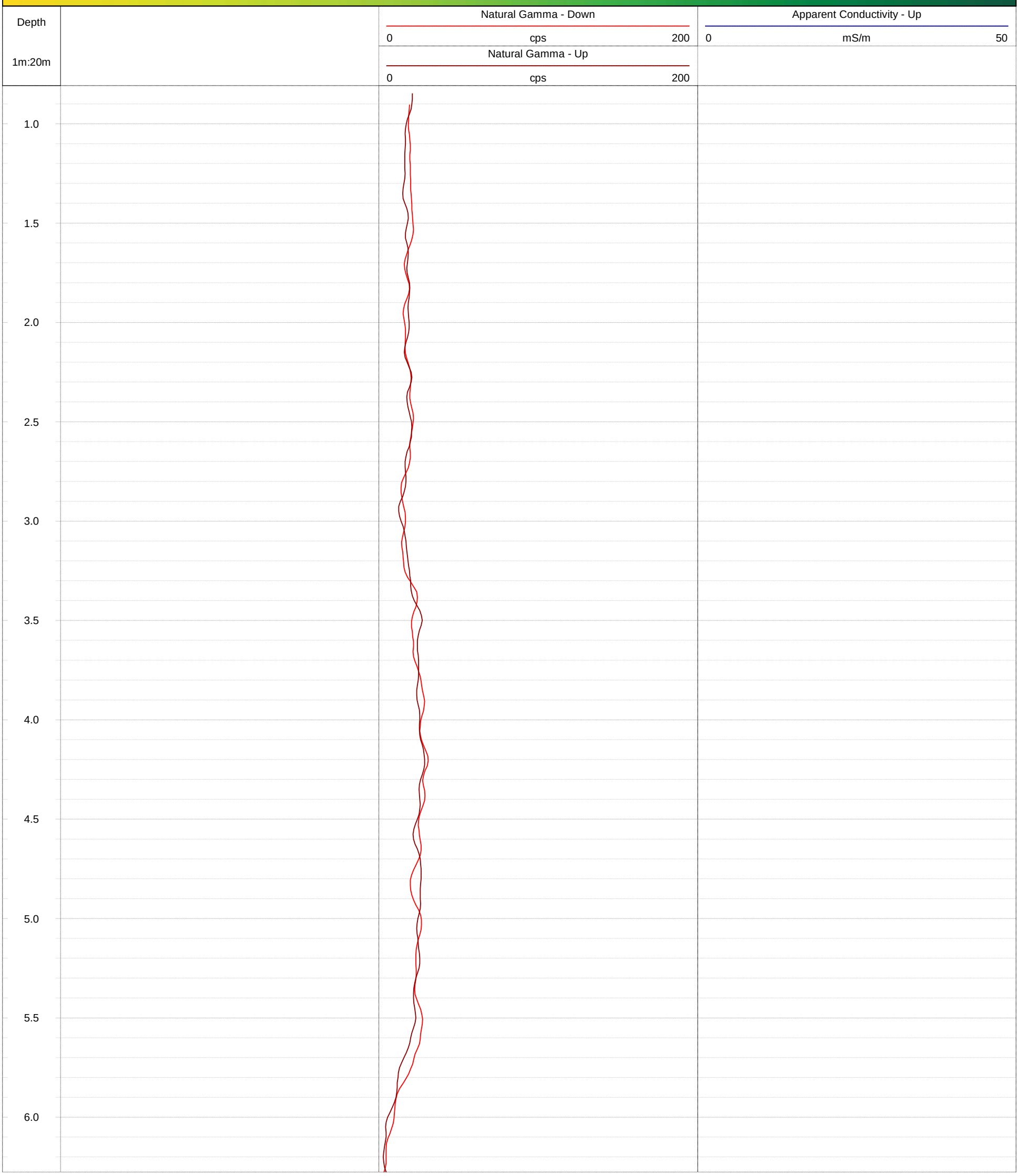
GOLDER
MEMBER OF WSP

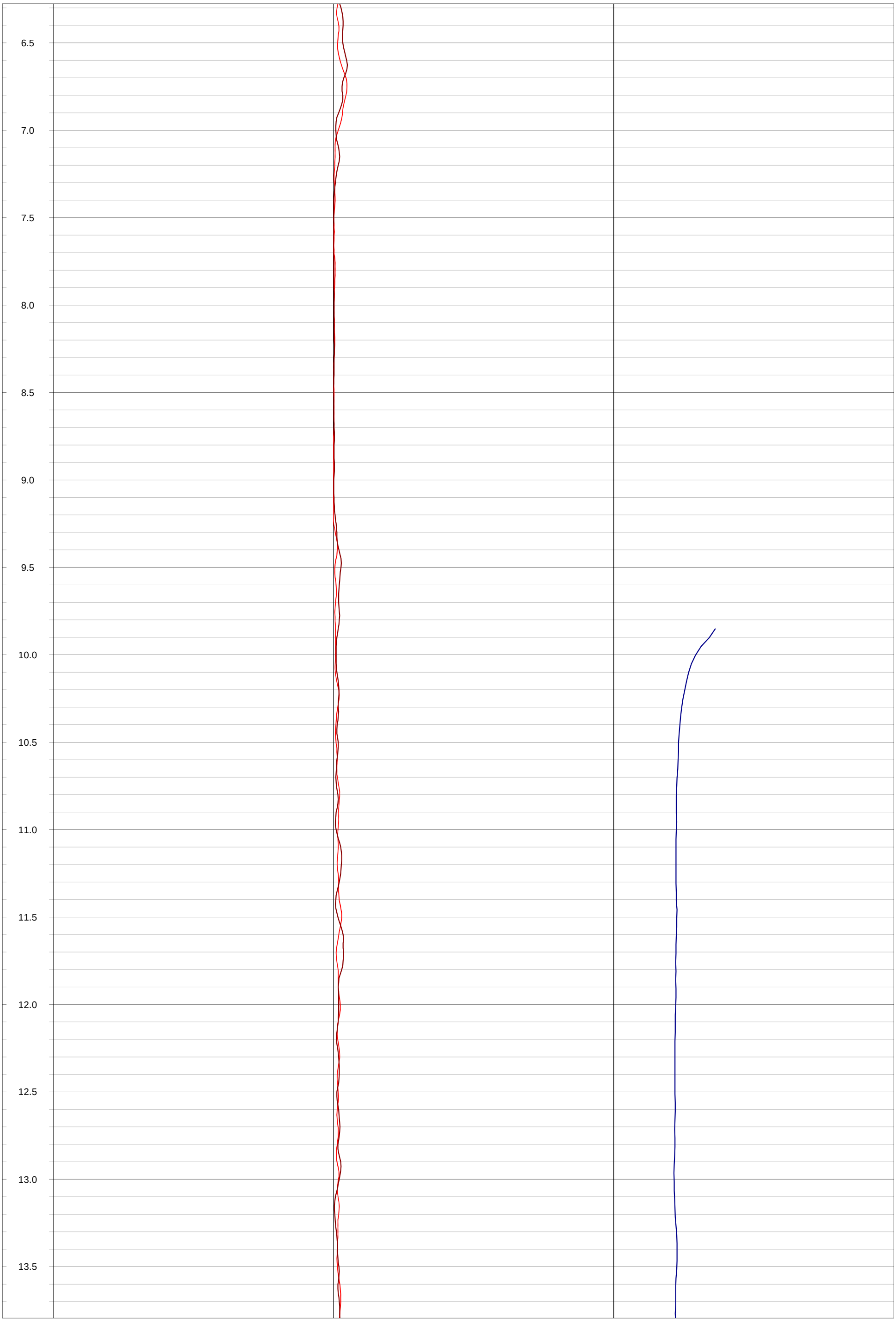
Geophysical Record of Borehole: MW21-1-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.84 m bgs	**Location:**	Caledon, Ontario
Easting:	576965.46 m	**Drilled Depth:**	37.49 m bgs	**Water Level:**	7.00 m bgs	**Log Date:**	Mar-3-2021
Northing:	4853420.30 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.51 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.13 m ags	**Logged By:**	PL

Notes:

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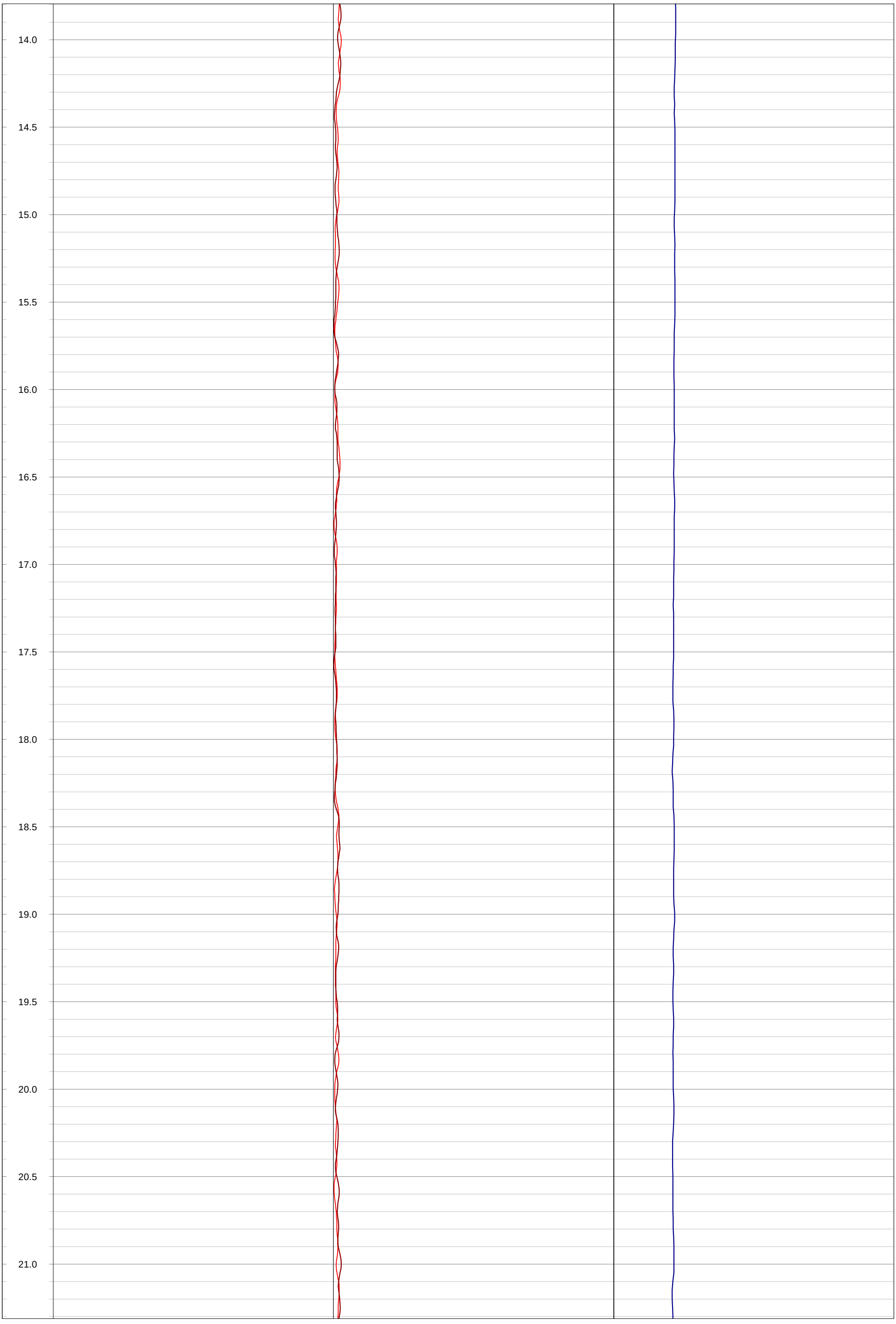
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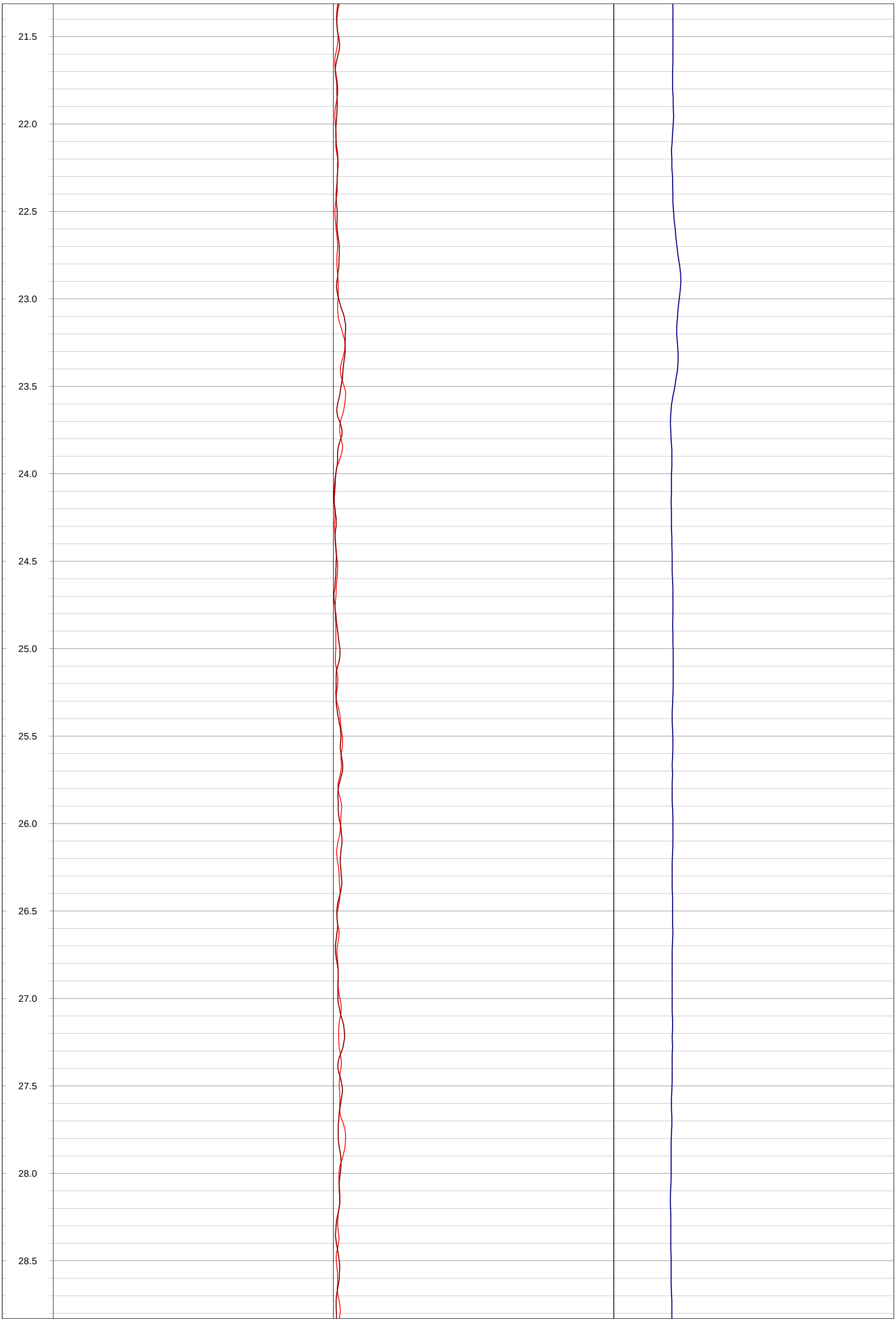
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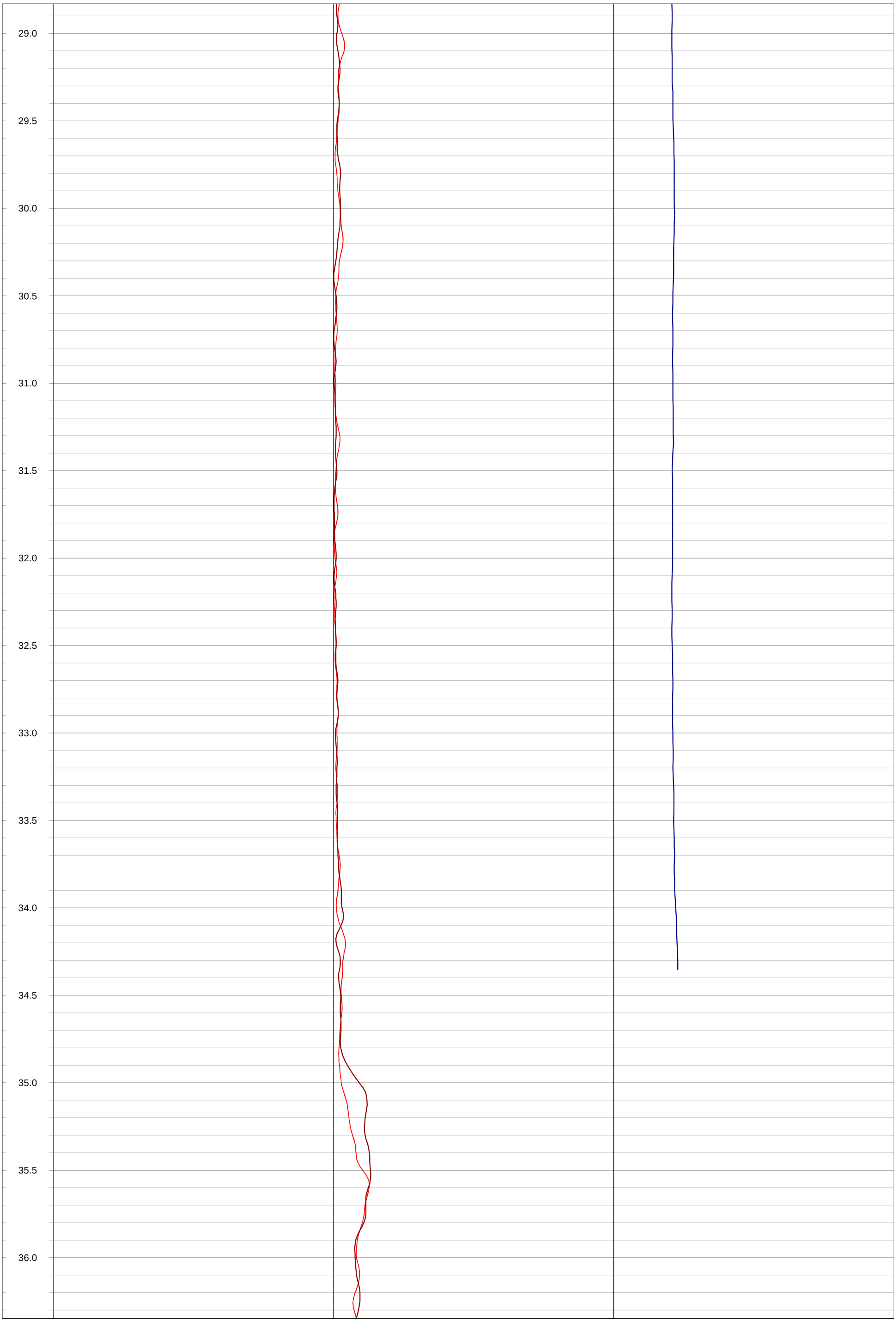
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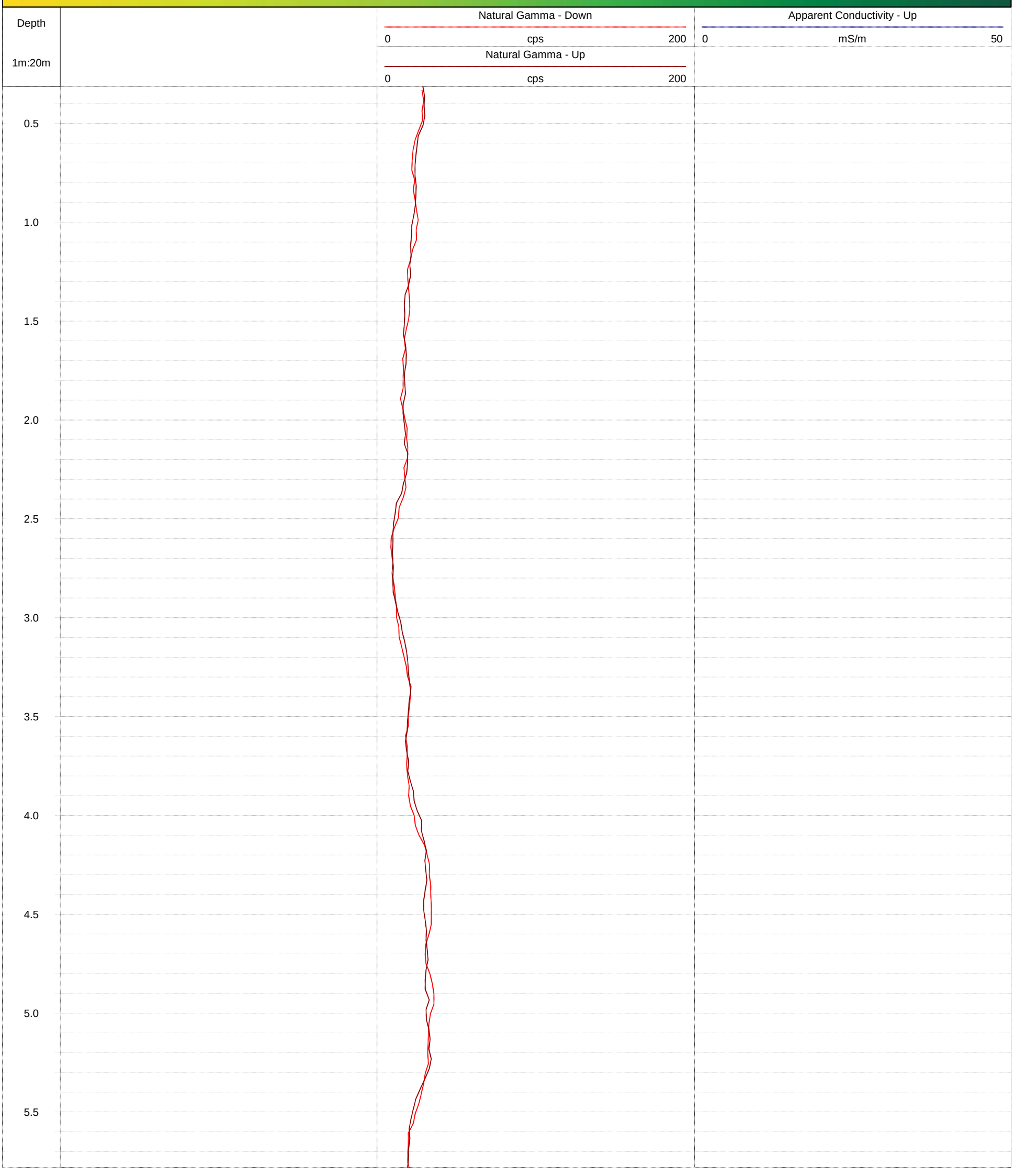
GOLDER
MEMBER OF WSP

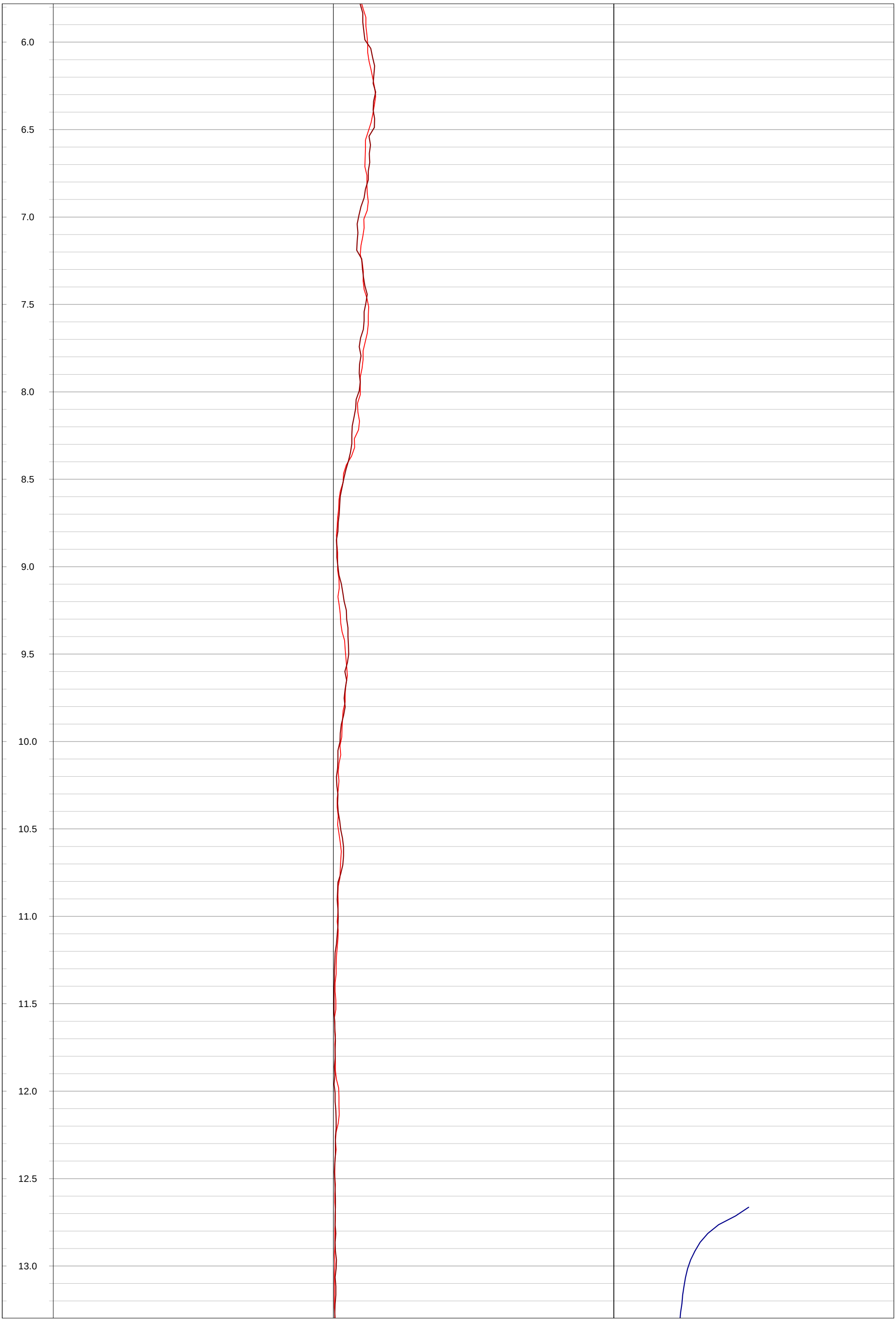
Geophysical Record of Borehole: MW21-1-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.89m bgs	**Location:**	Caledon, Ontario
Easting:	576866.19 m	**Drilled Depth:**	35.96 m bgs	**Water Level:**	1.20 m bgs	**Log Date:**	Mar-5-2021
Northing:	48533450.60 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.83 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.43 m ags	**Logged By:**	PL

Notes:

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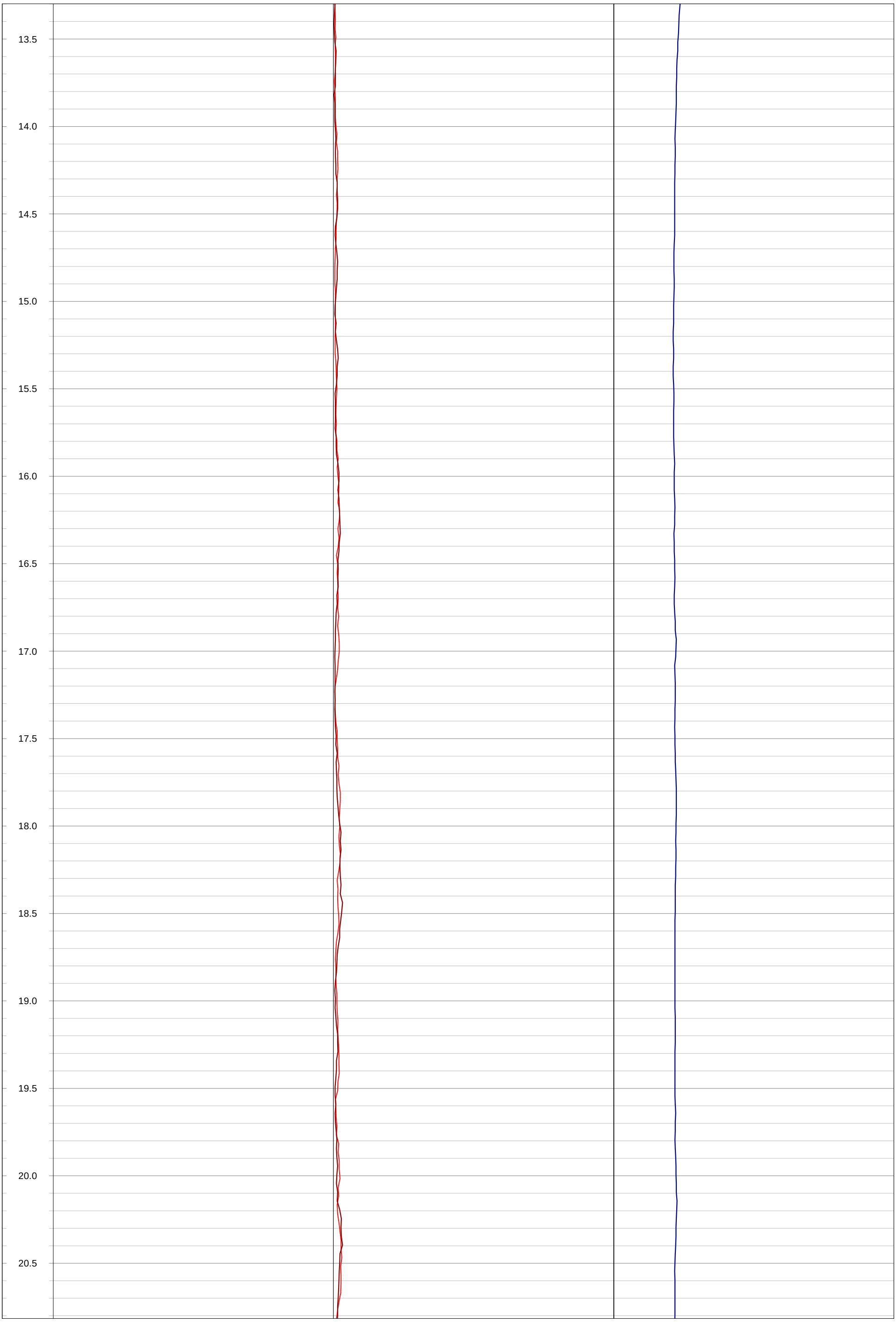
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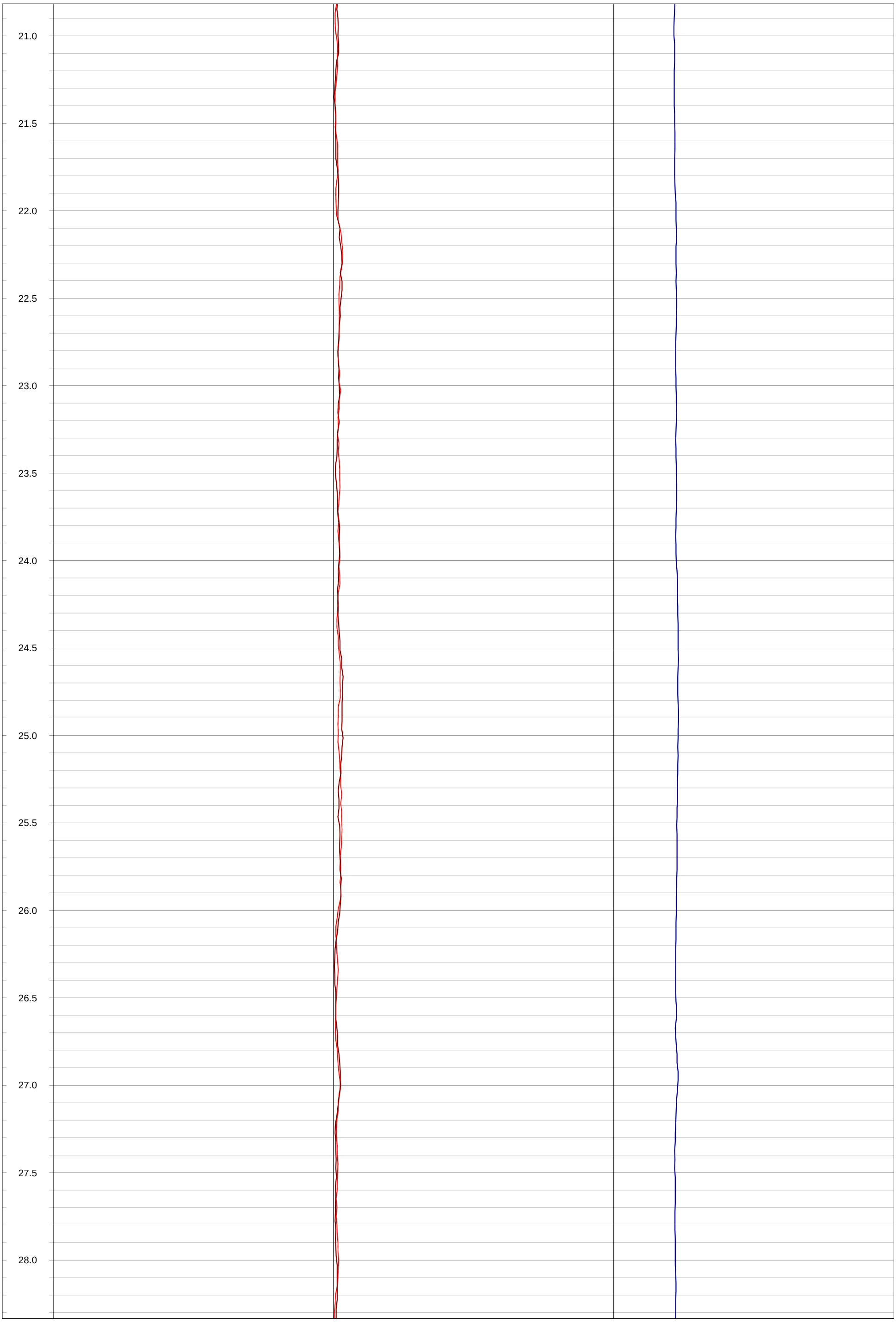
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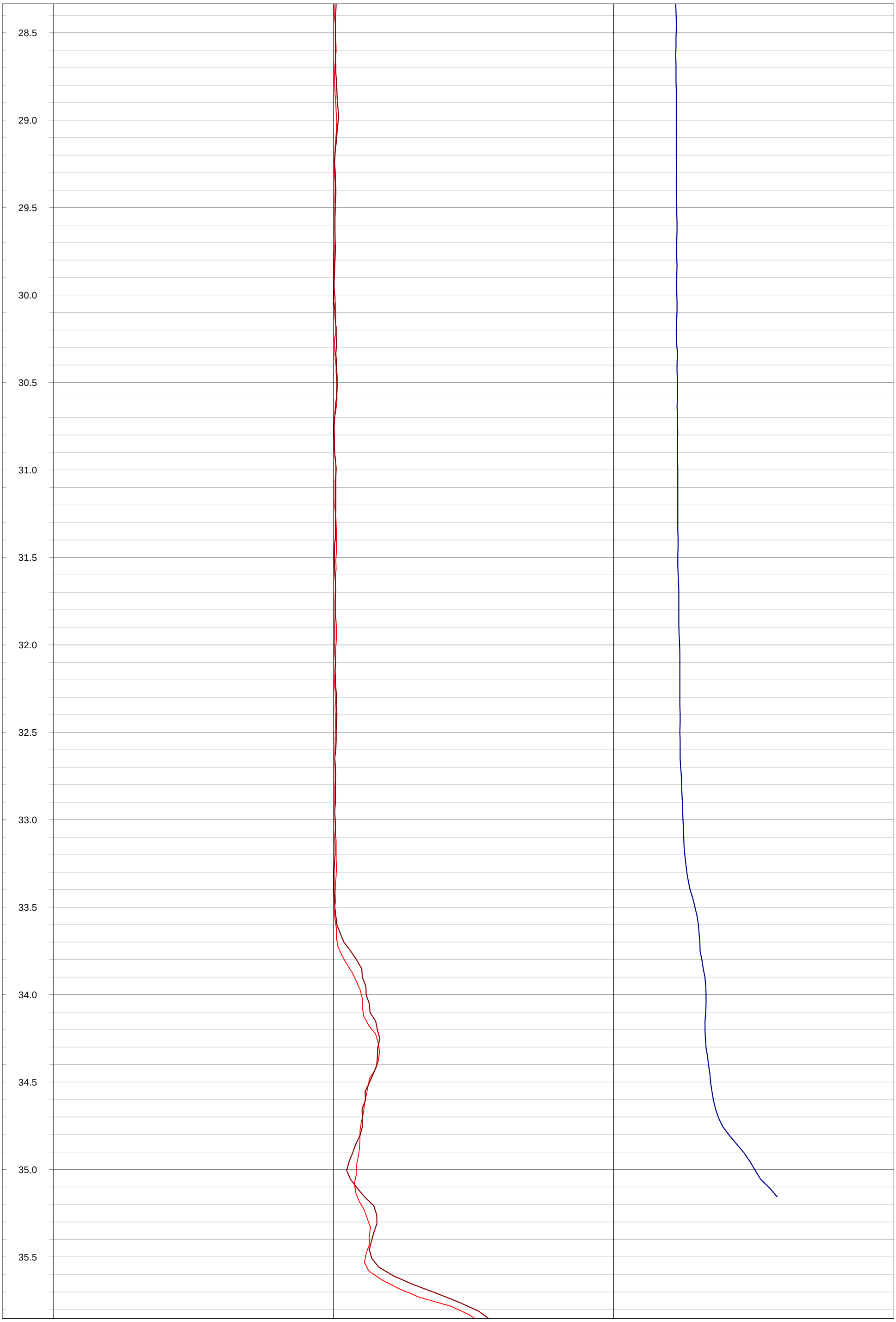
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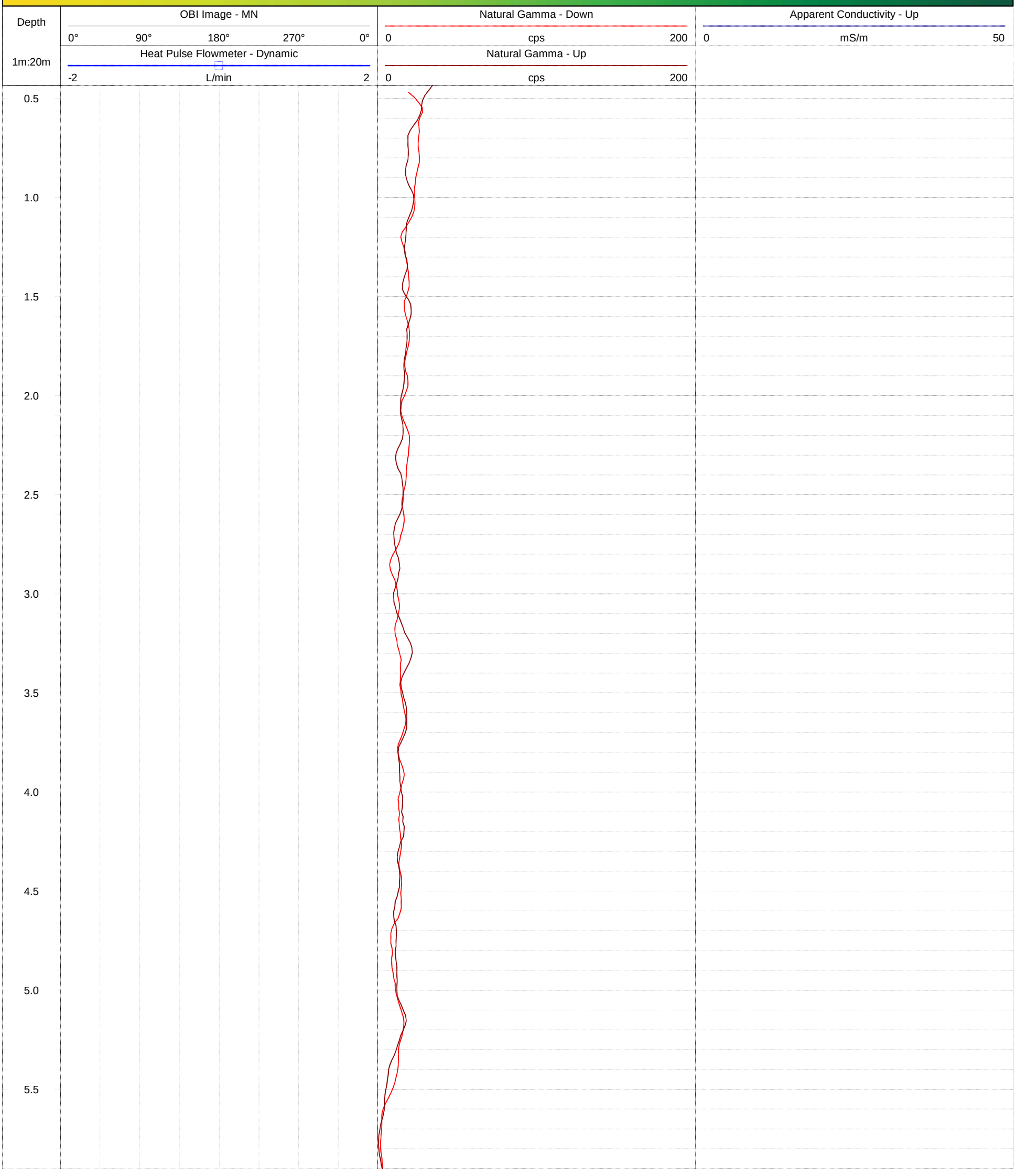
GOLDER
MEMBER OF WSP

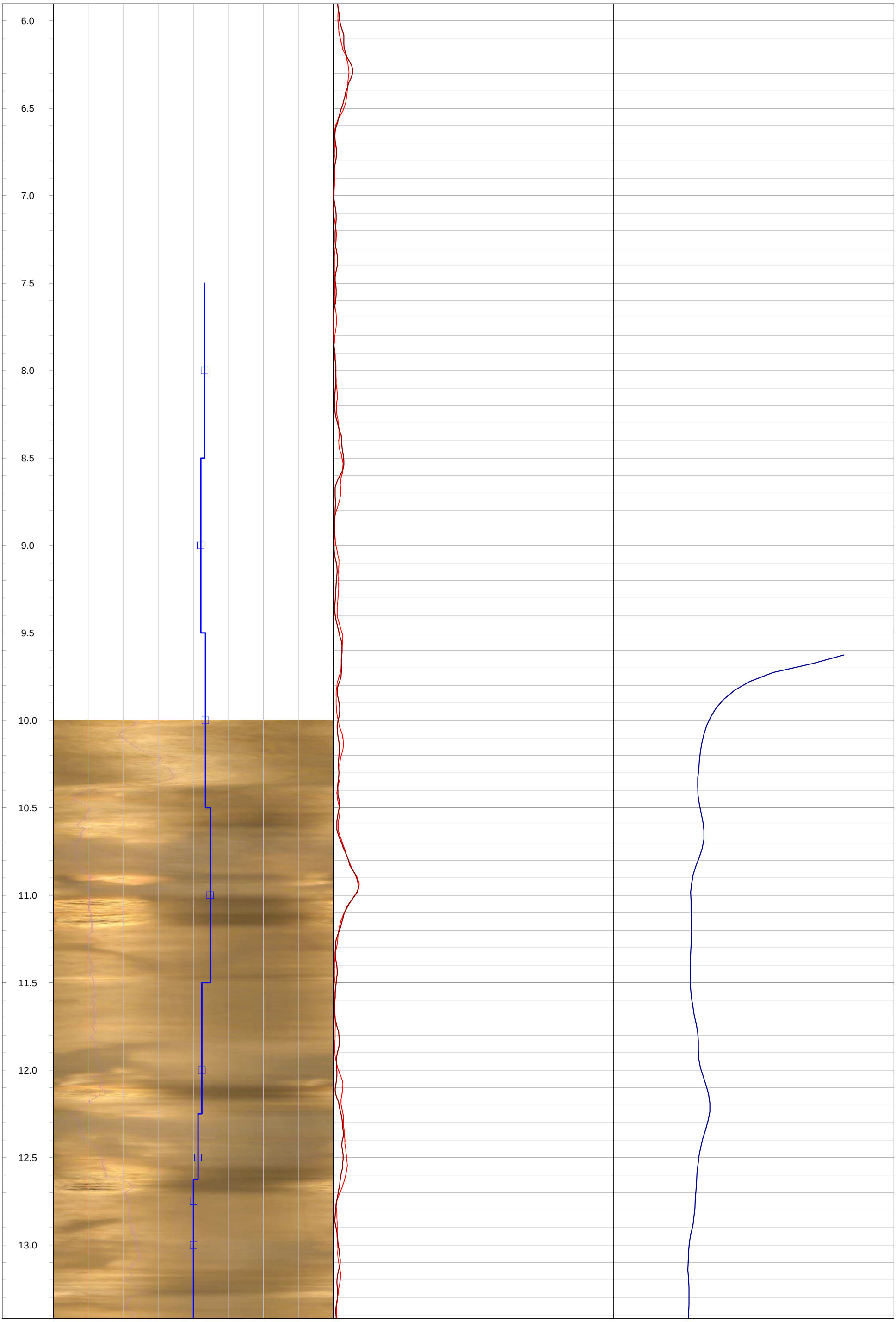
Geophysical Record of Borehole: MW21-2-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.99 m bgs	**Location:**	Caledon, Ontario
Easting:	577279.08 m	**Drilled Depth:**	23.47 m bgs	**Water Level:**	5.20 m bgs	**Log Date:**	Mar-17-2021
Northing:	4854021.09 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.40 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.21 m ags	**Logged By:**	PL

Notes: Very murky image. Tried 3 runs with same results. Heat Pulse Flowmeter Dynamic pump at 6.5 m below top of collar. Pump rate approx. 3 L/min.

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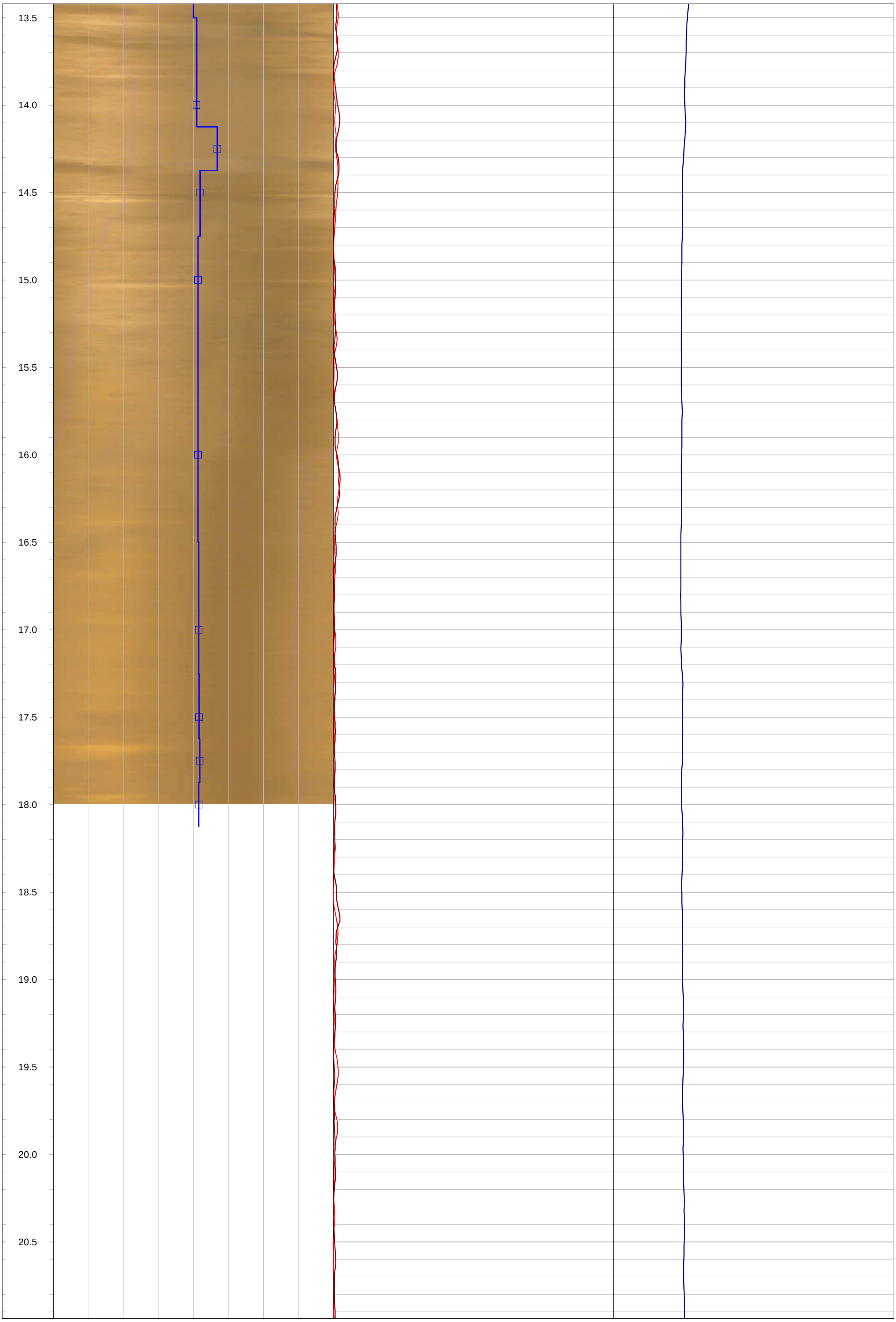
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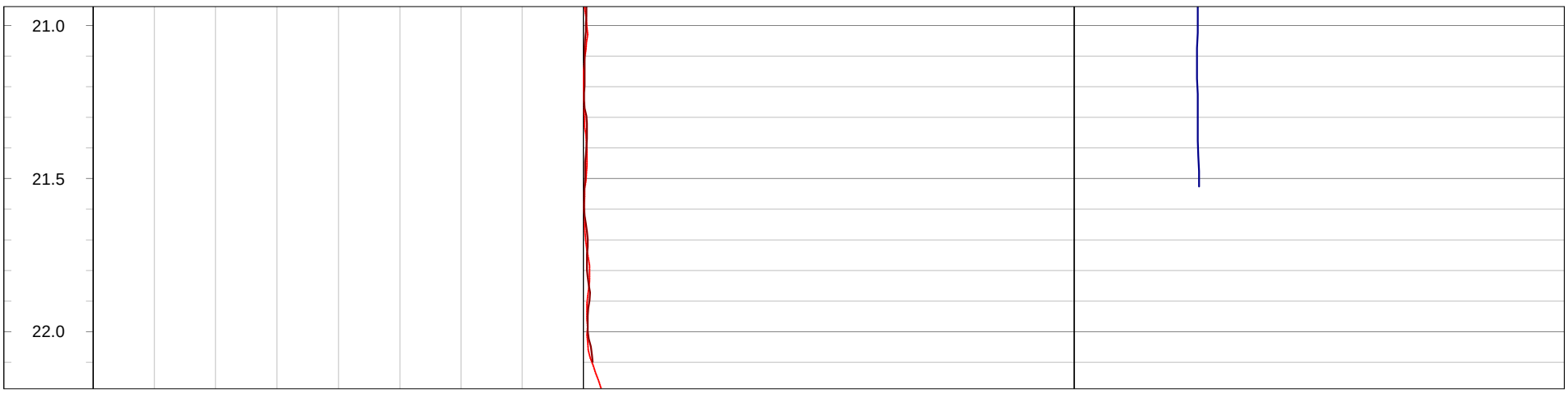
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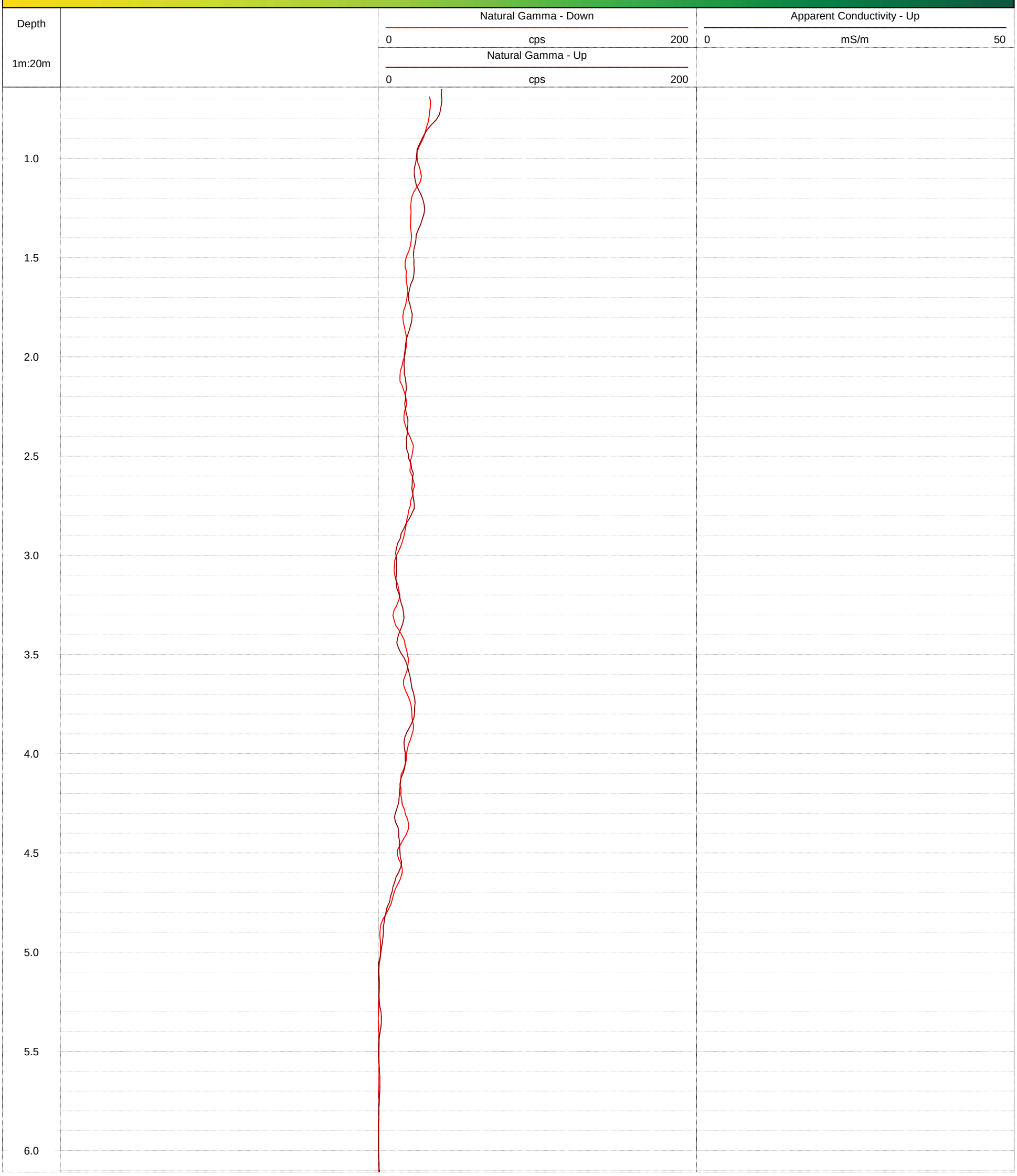
GOLDER
MEMBER OF WSP

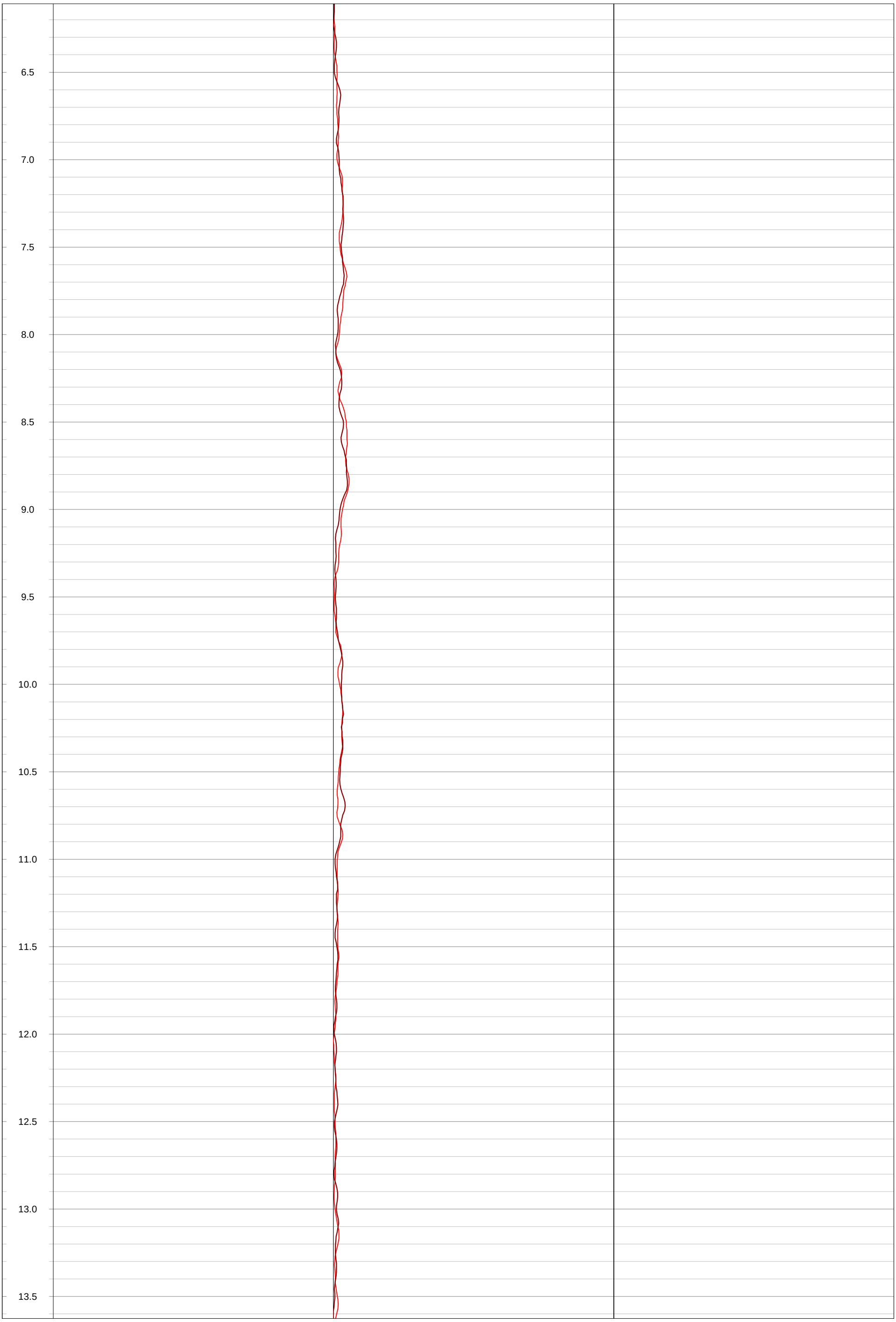
Geophysical Record of Borehole: MW21-2-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.38 m bgs	**Location:**	Caledon, Ontario
Easting:	577260.02 m	**Drilled Depth:**	23.47 m bgs	**Water Level:**	1.20 m bgs	**Log Date:**	Mar-17-2021
Northing:	4854050.91 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	412.64 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.00 m ags	**Logged By:**	PL

Notes:

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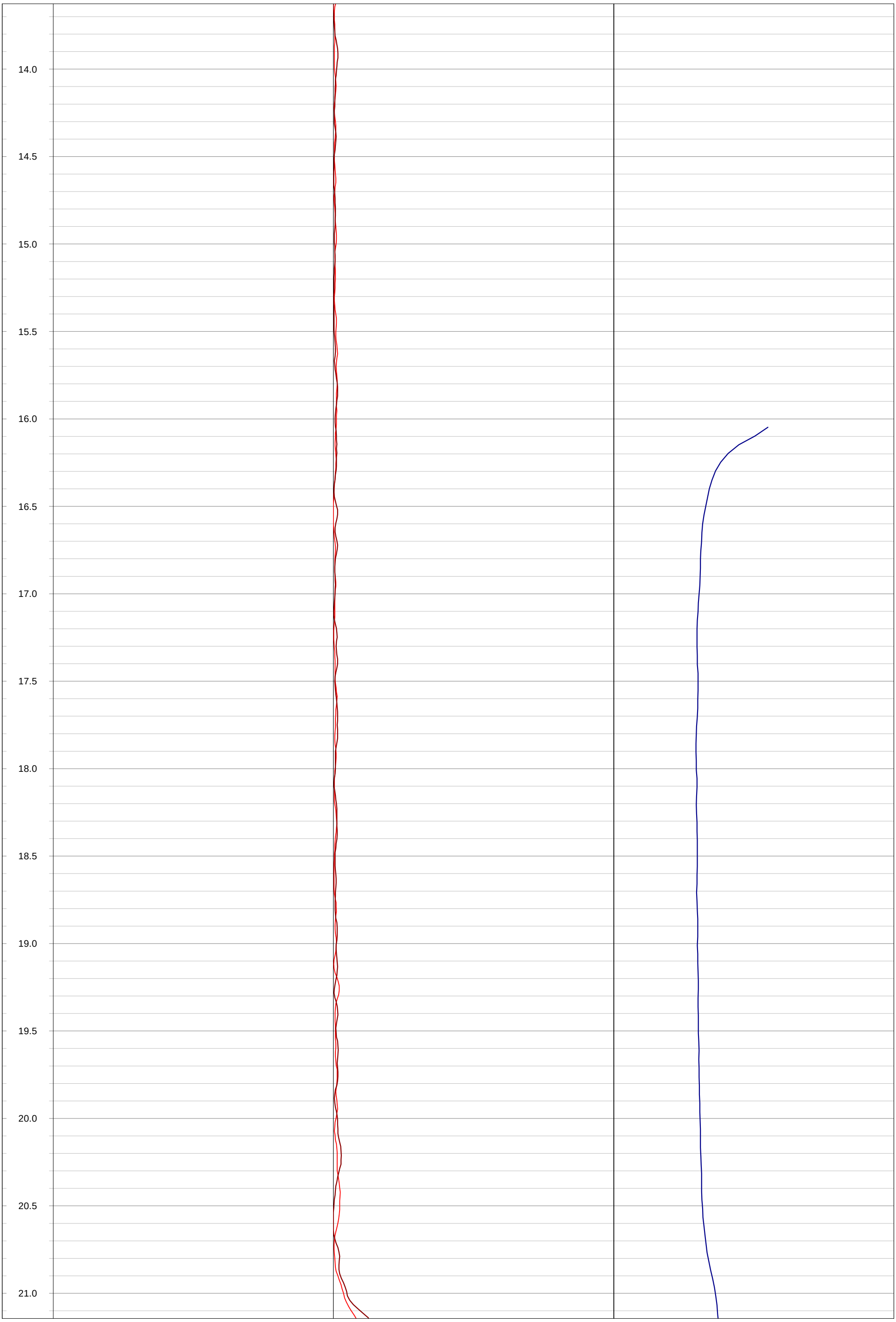
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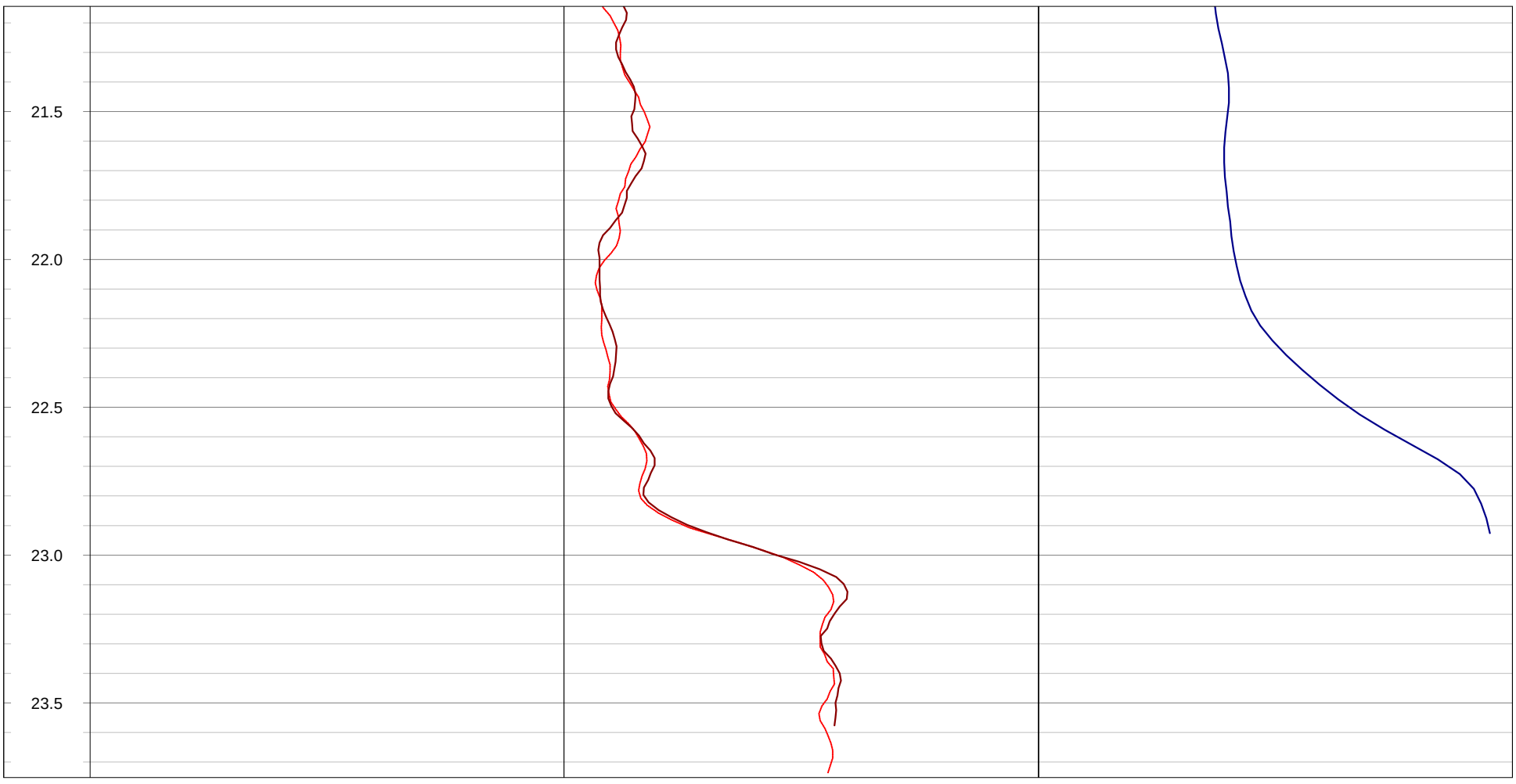
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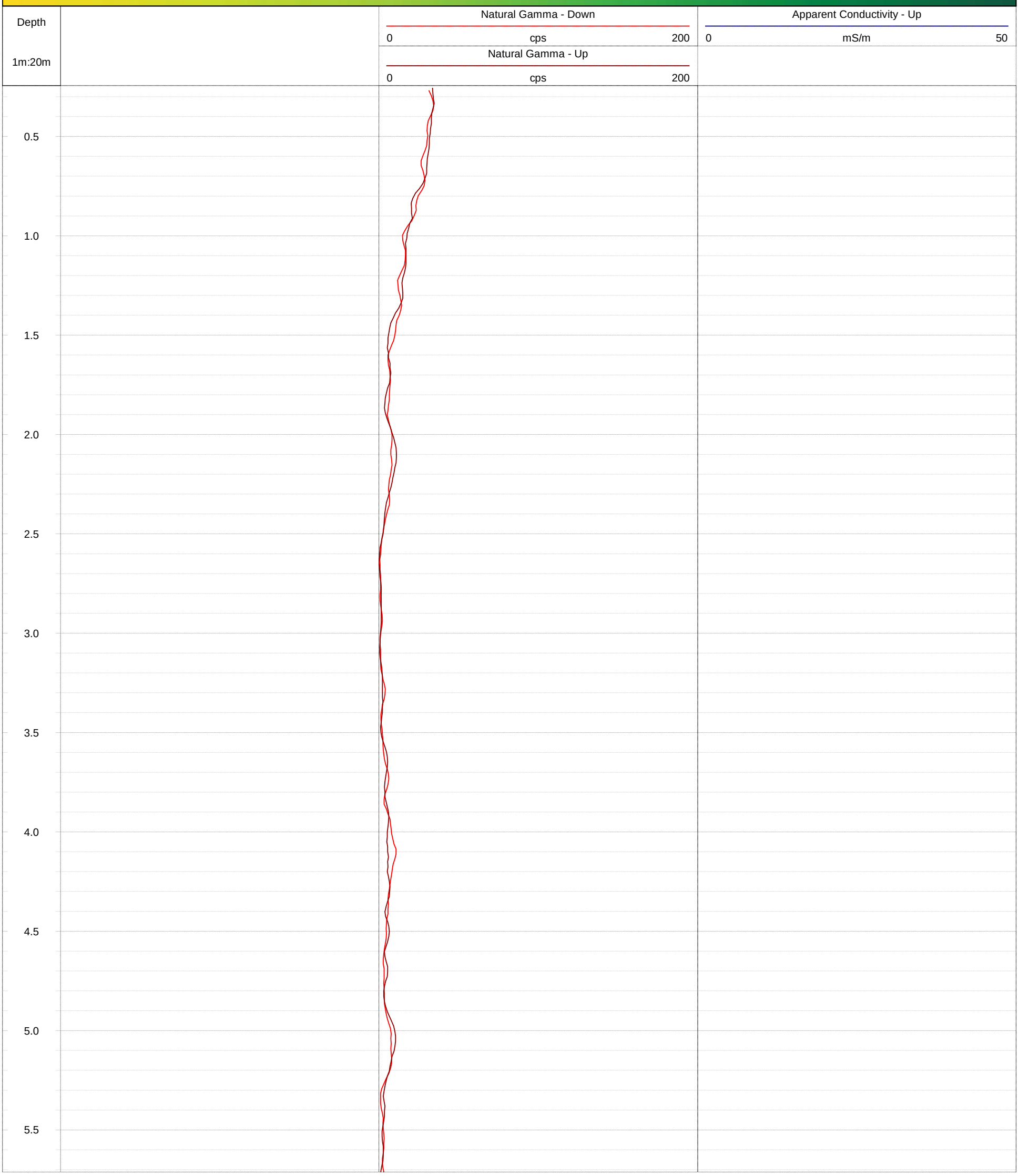
GOLDER
MEMBER OF WSP

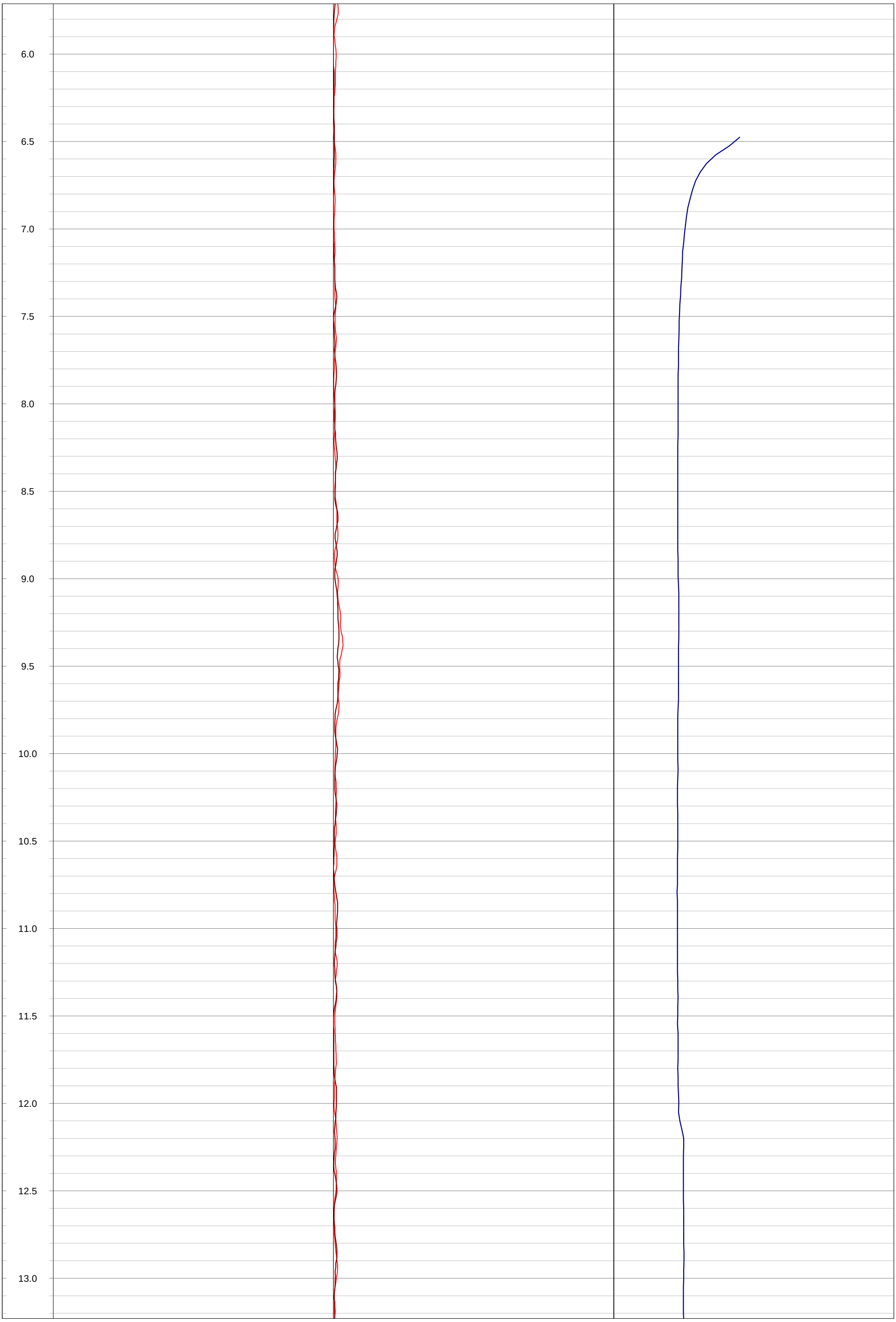
Geophysical Record of Borehole: MW21-2-3 (CAL)

Log Title:	Geophysical Log
Project Number:	19129150
Client:	St. Marys Cement Inc. (Canada)
Date:	October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.64 m bgs	**Location:**	Caledon, Ontario
Easting:	577349.69 m	**Drilled Depth:**	23.77 m bgs	**Water Level:**	3.90 m bgs	**Log Date:**	Mar-17-2021
Northing:	4854098.46 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	410.76 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.42 m ags	**Logged By:**	PL

Notes:

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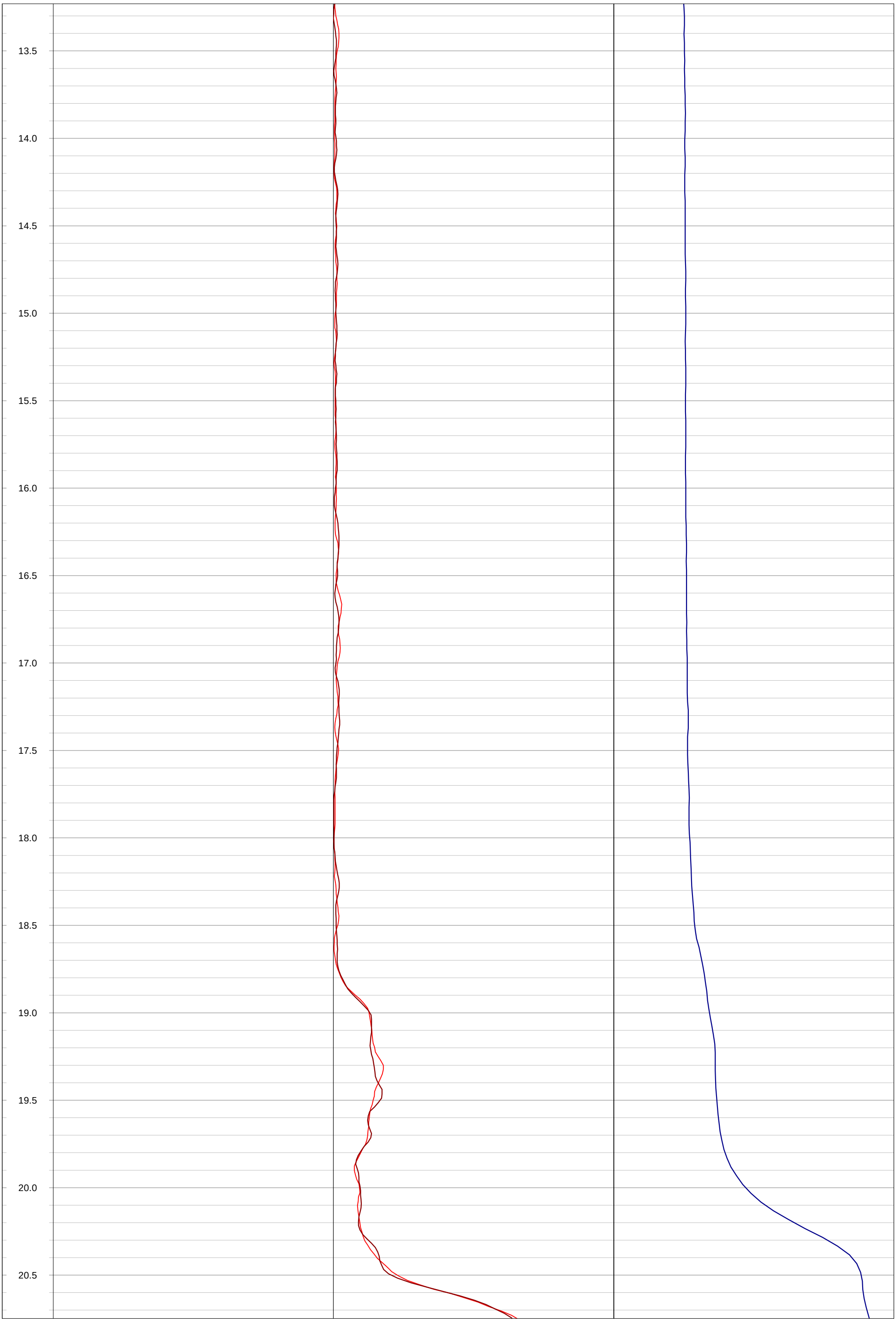
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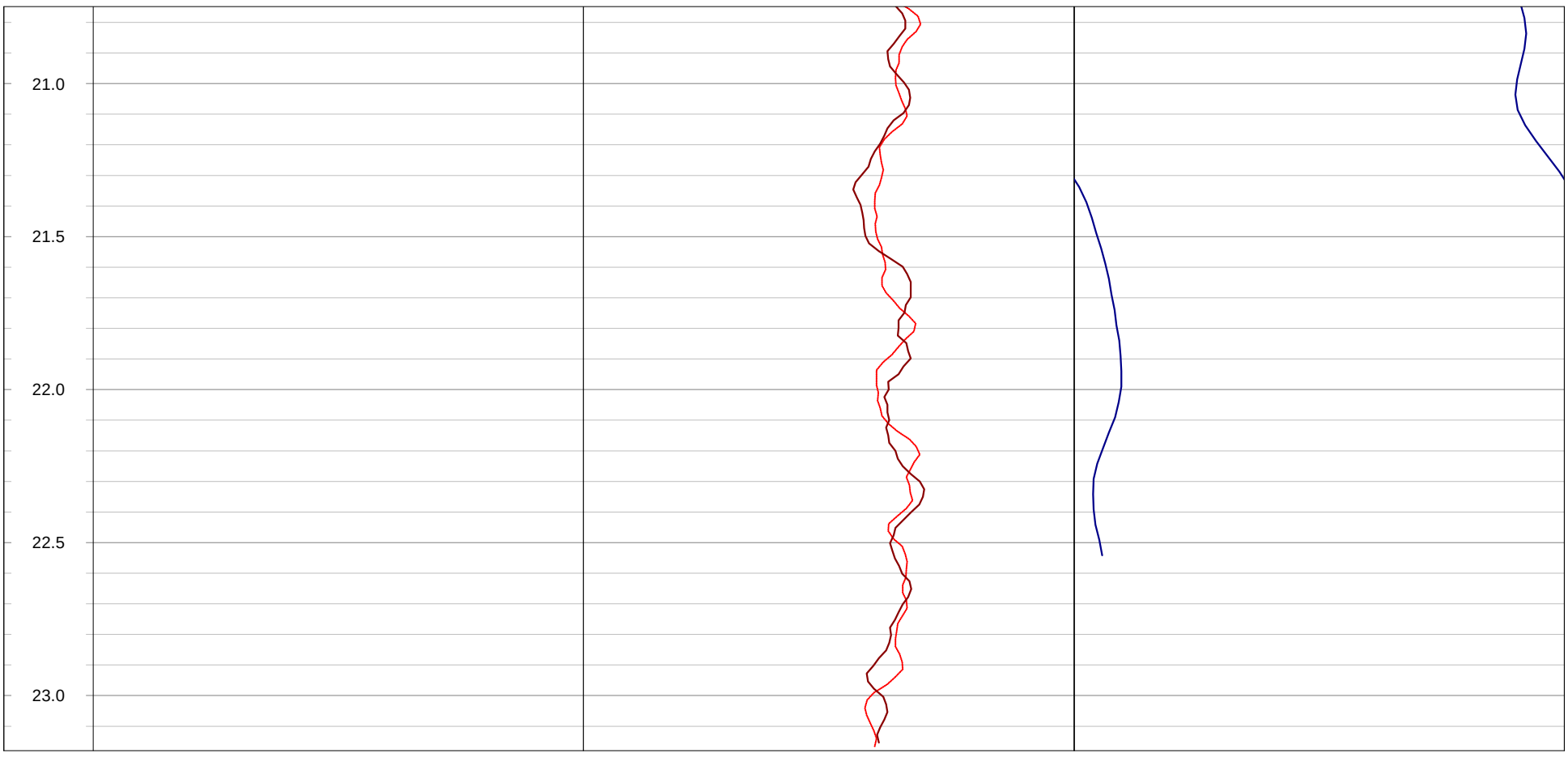
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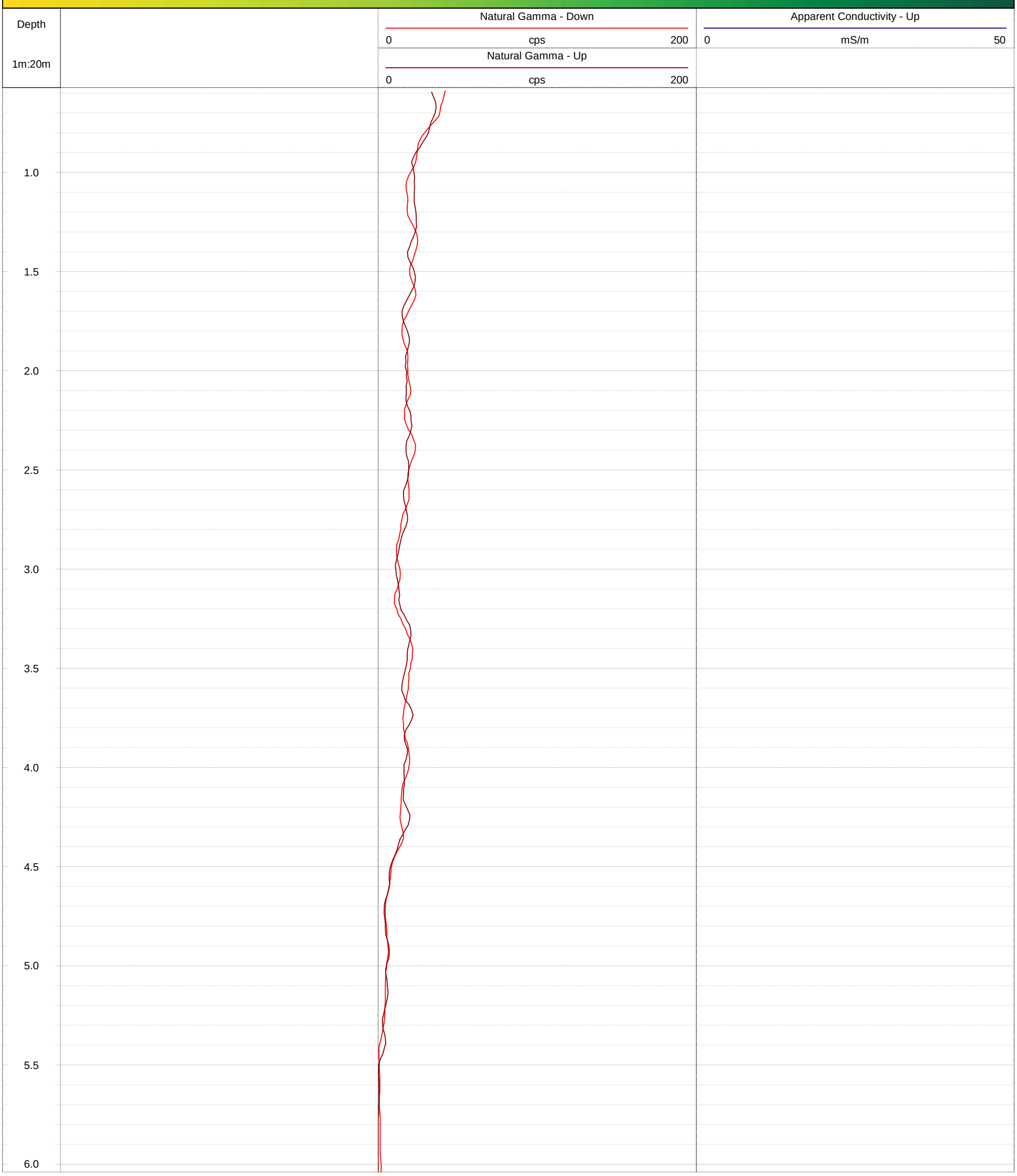
GOLDER
MEMBER OF WSP

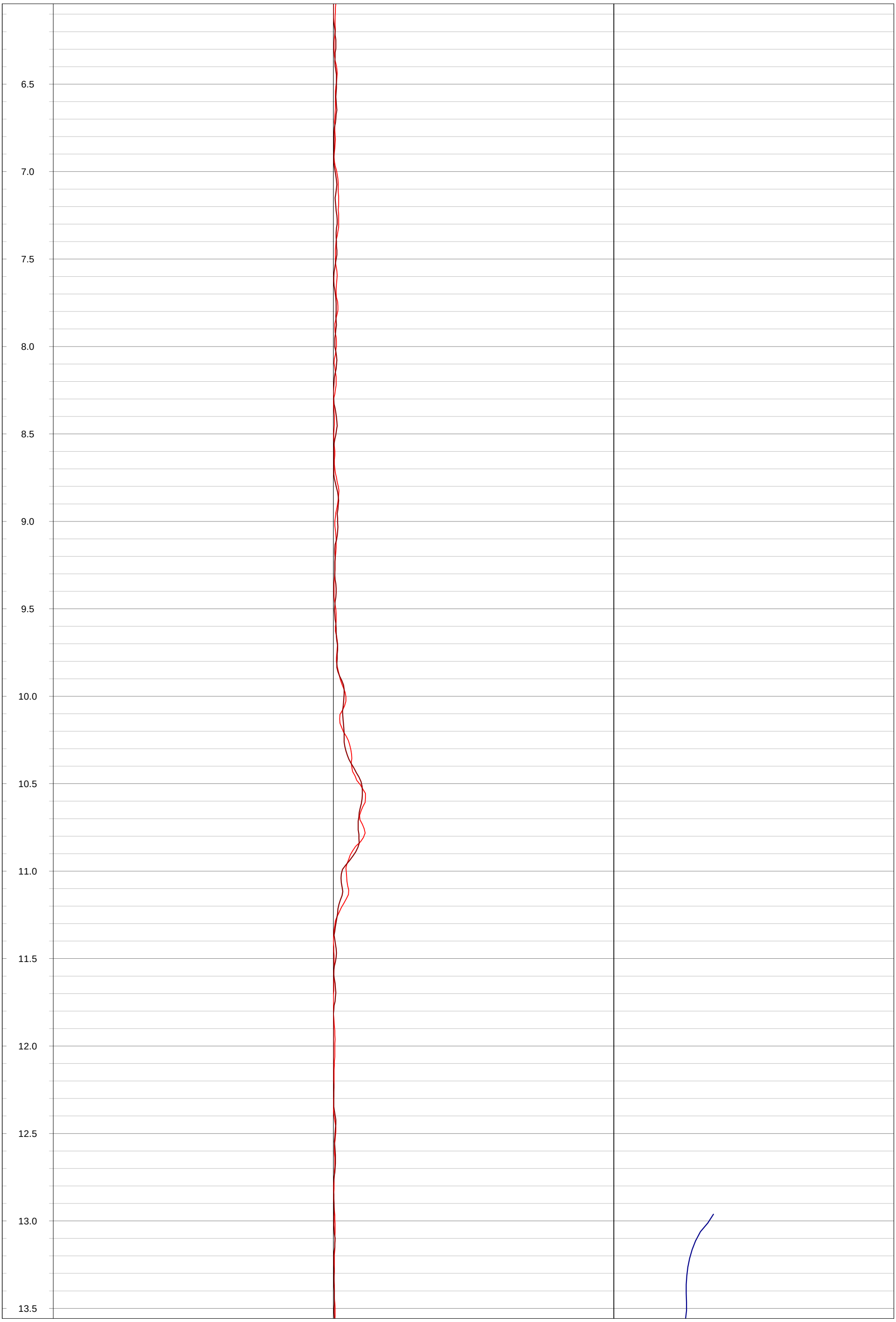
Geophysical Record of Borehole: MW21-2-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	577297.52 m	**Drilled Depth:**	26.52 m bgs	**Water Level:**	5.40 m bgs	**Log Date:**	Mar-17-2021
Northing:	4851001.66 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.86 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.09 m ags	**Logged By:**	PL

Notes:

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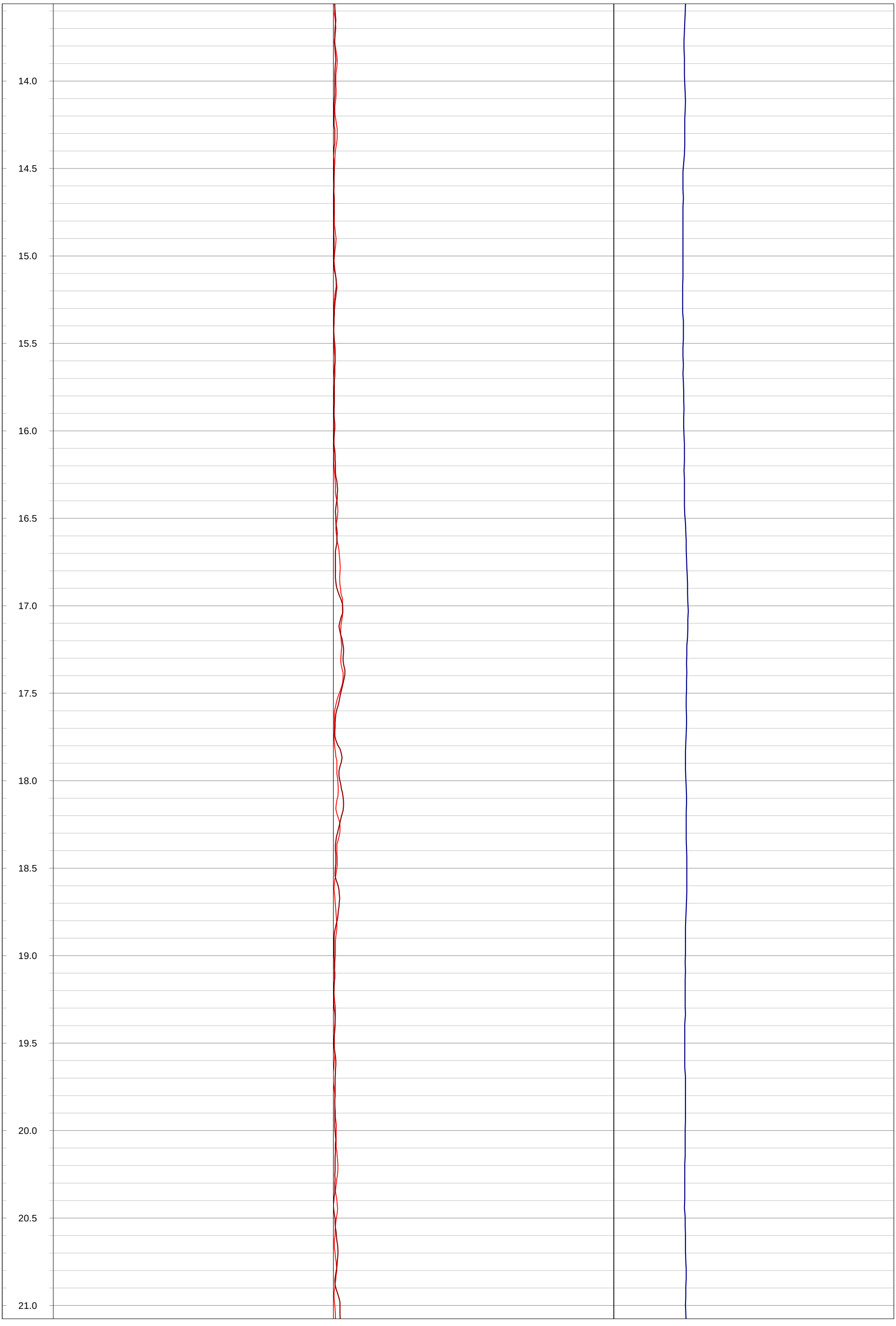
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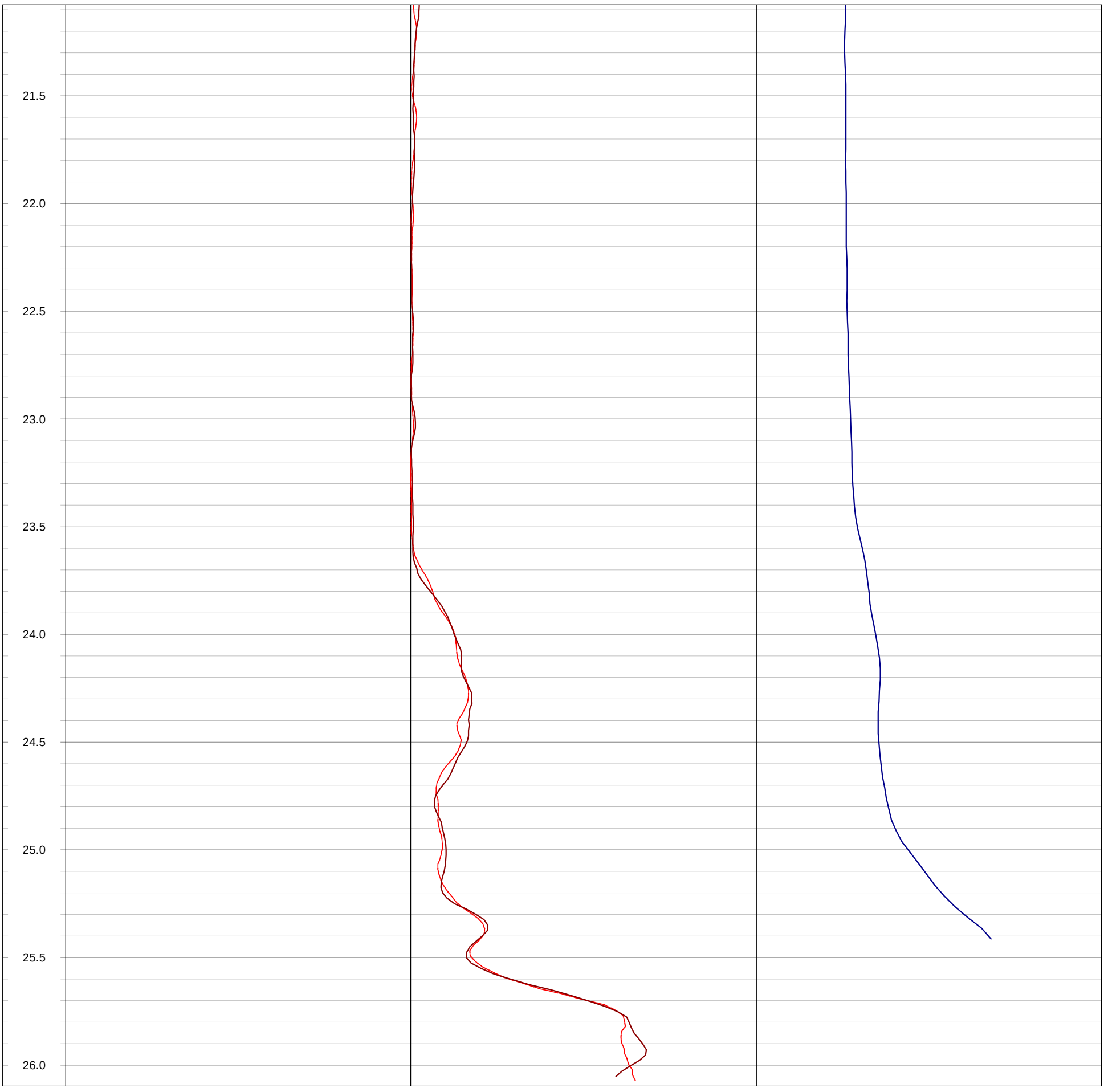
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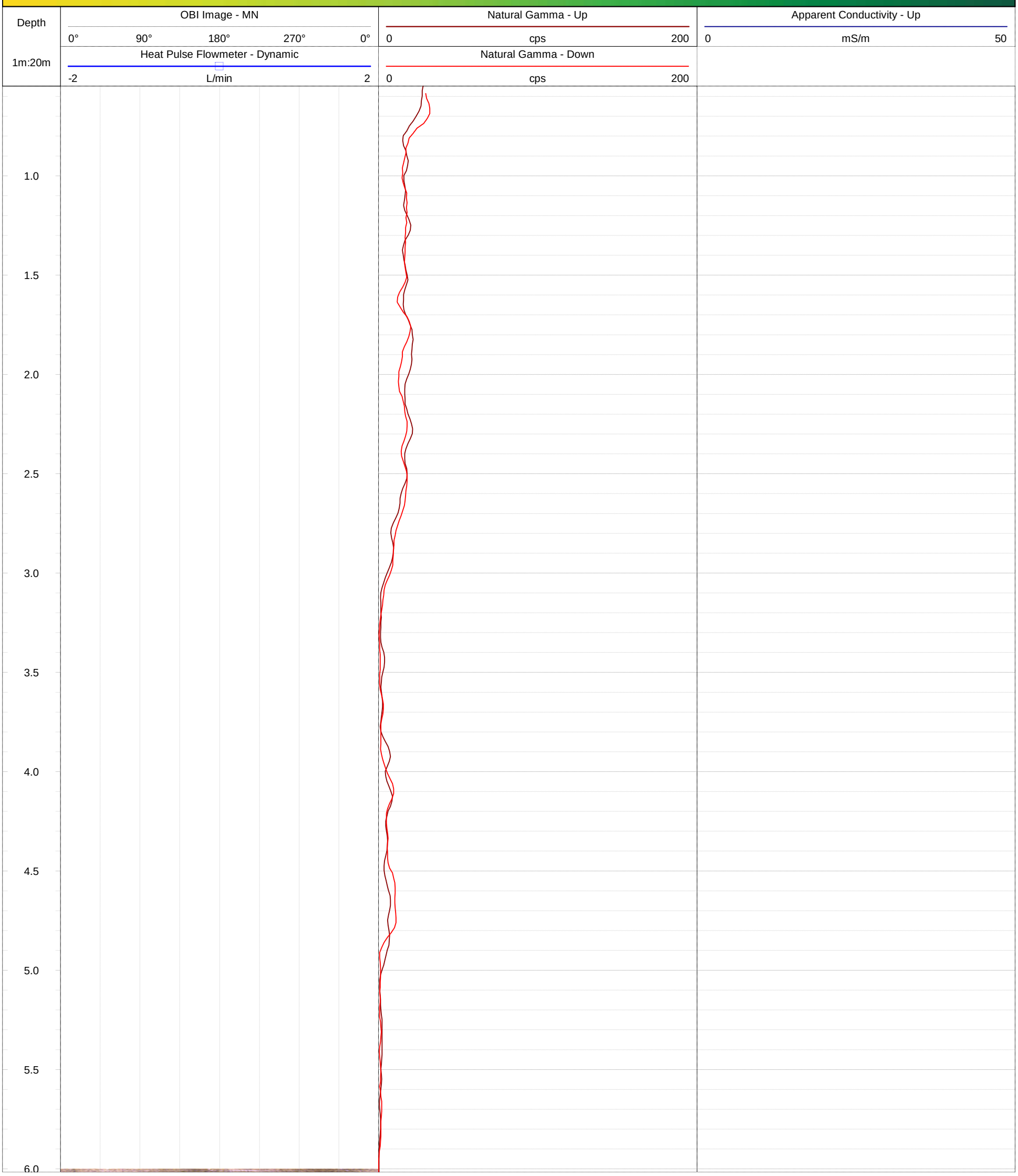
GOLDER
MEMBER OF WSP

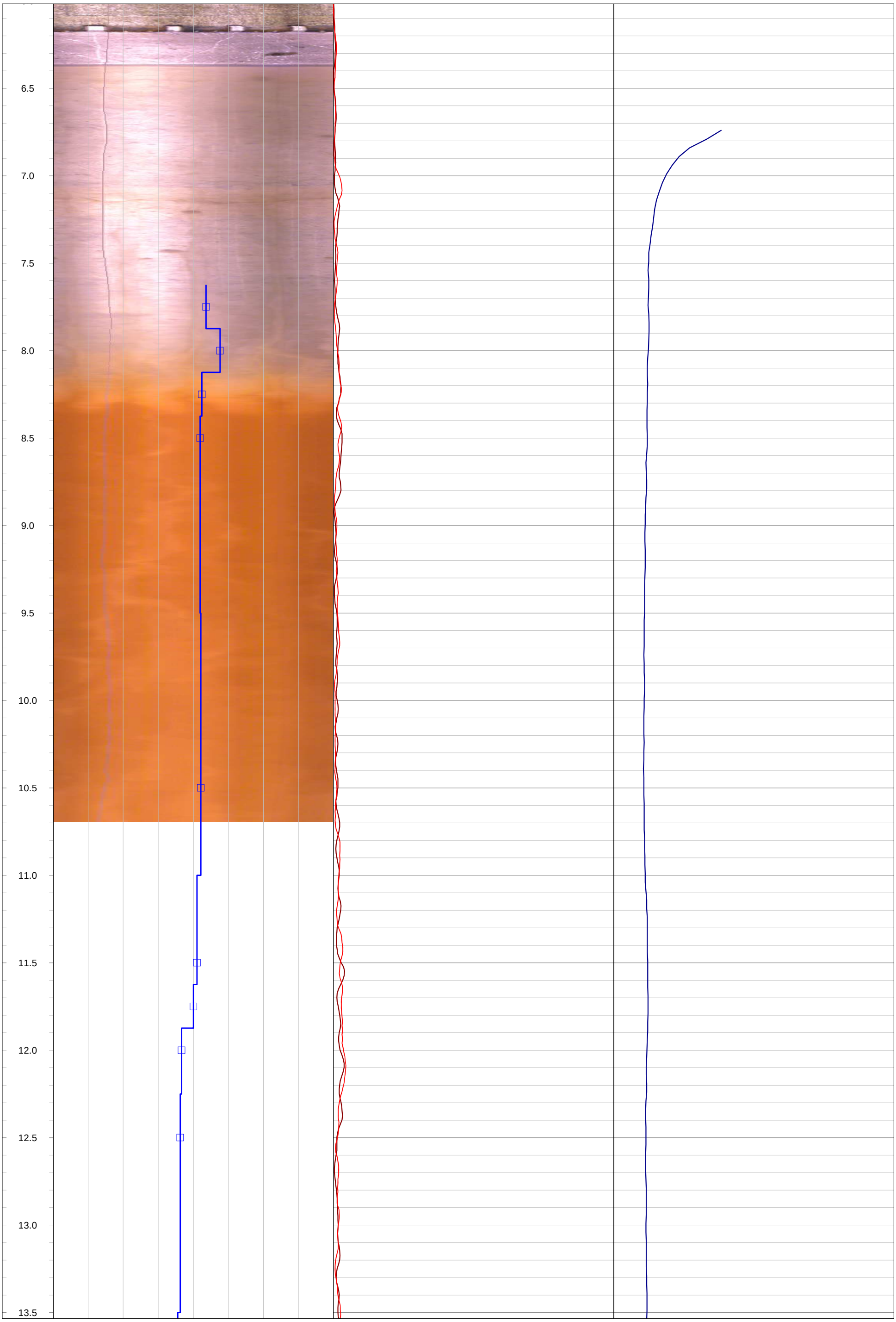
Geophysical Record of Borehole: MW21-3-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.16 m bgs	**Location:**	Caledon, Ontario
Easting:	577871.84 m	**Drilled Depth:**	21.03 m bgs	**Water Level:**	5.70 m bgs	**Log Date:**	Mar-31-2021
Northing:	4852814.09 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.69 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.12 m ags	**Logged By:**	PG

Notes: Image orange (rust?) from 8.3 to 10.7 mbgs, opaque>10.8 m bgs. Heat Pulse Flowmeter Dynamic pump at 7.3 m below top of collar. Pump rate approx. 1 L /min.

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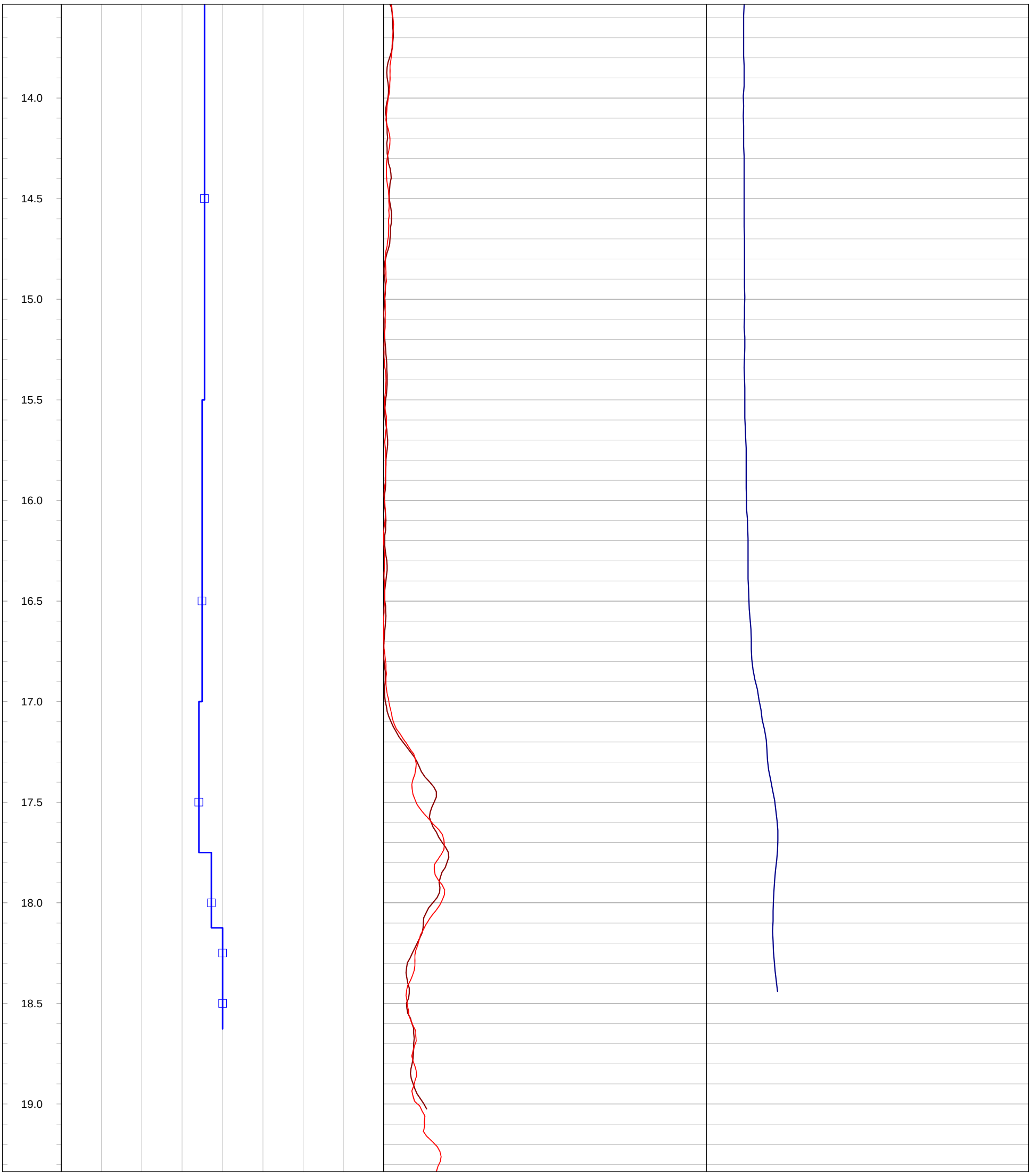
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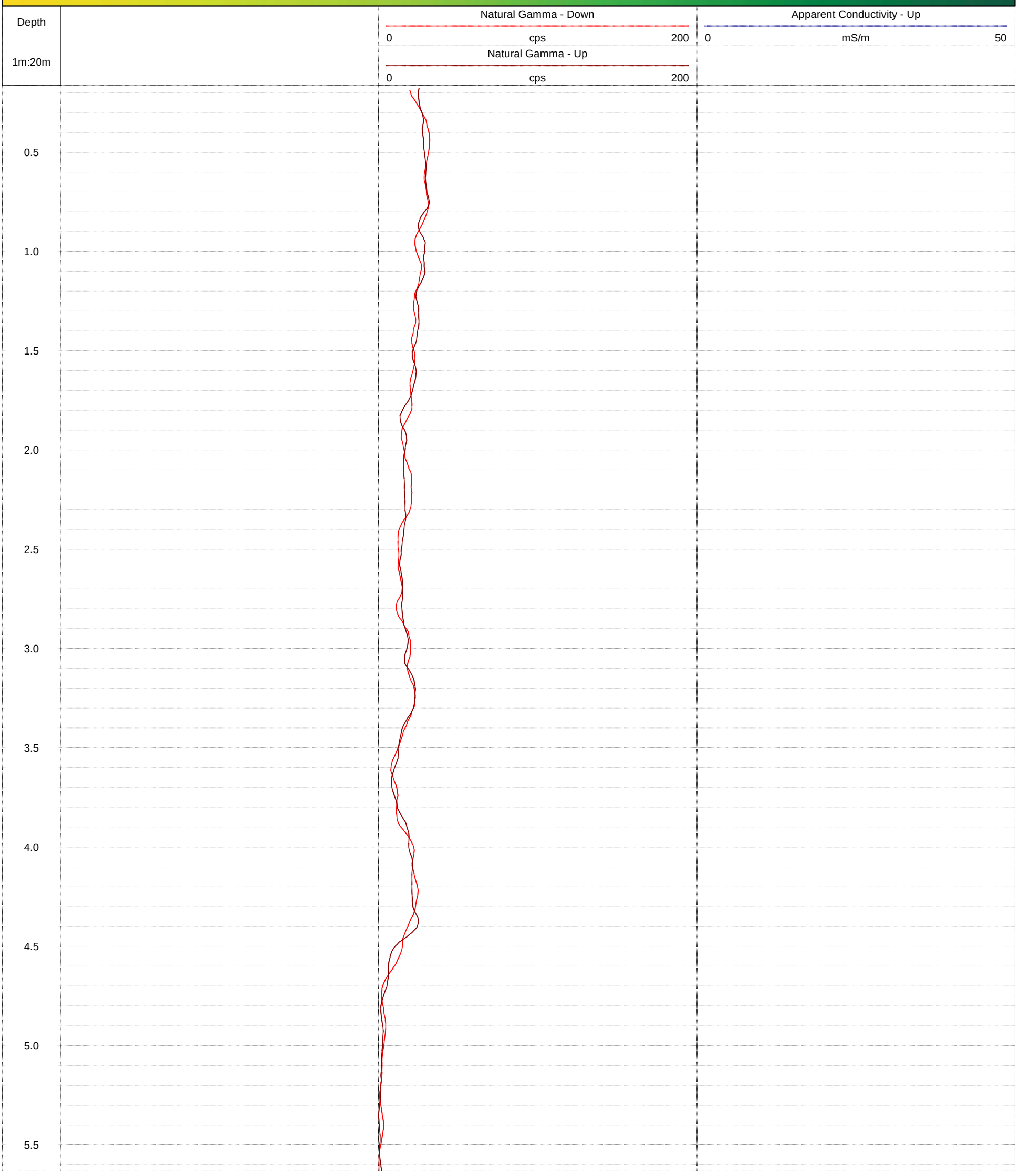
GOLDER
MEMBER OF WSP

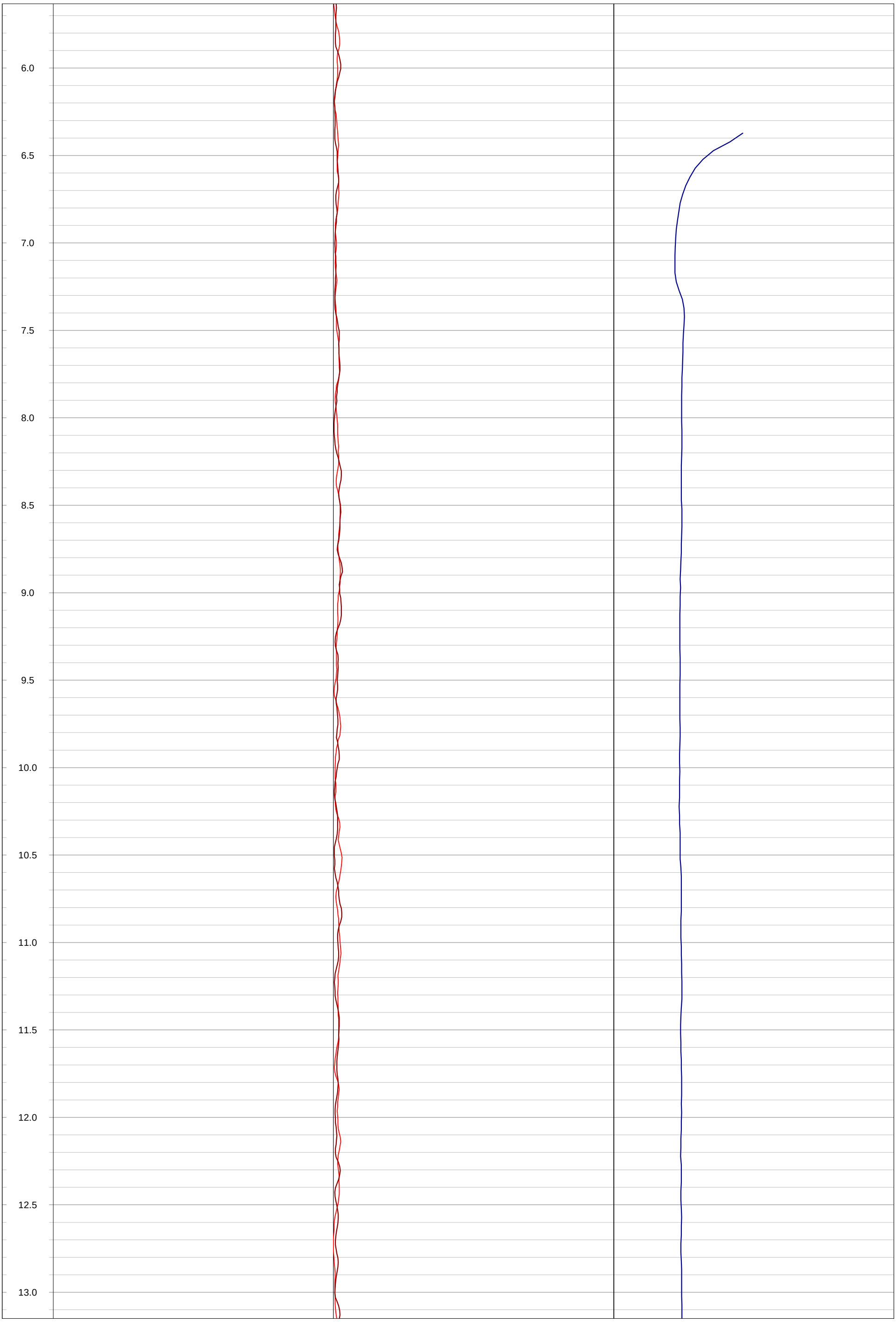
Geophysical Record of Borehole: MW21-3-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.79 m bgs	**Location:**	Caledon, Ontario
Easting:	577920.27 m	**Drilled Depth:**	21.03 m bgs	**Water Level:**	7.29 m bgs	**Log Date:**	Apr-1-2021
Northing:	4852838.38 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.87 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.50 m ags	**Logged By:**	PG

Notes:

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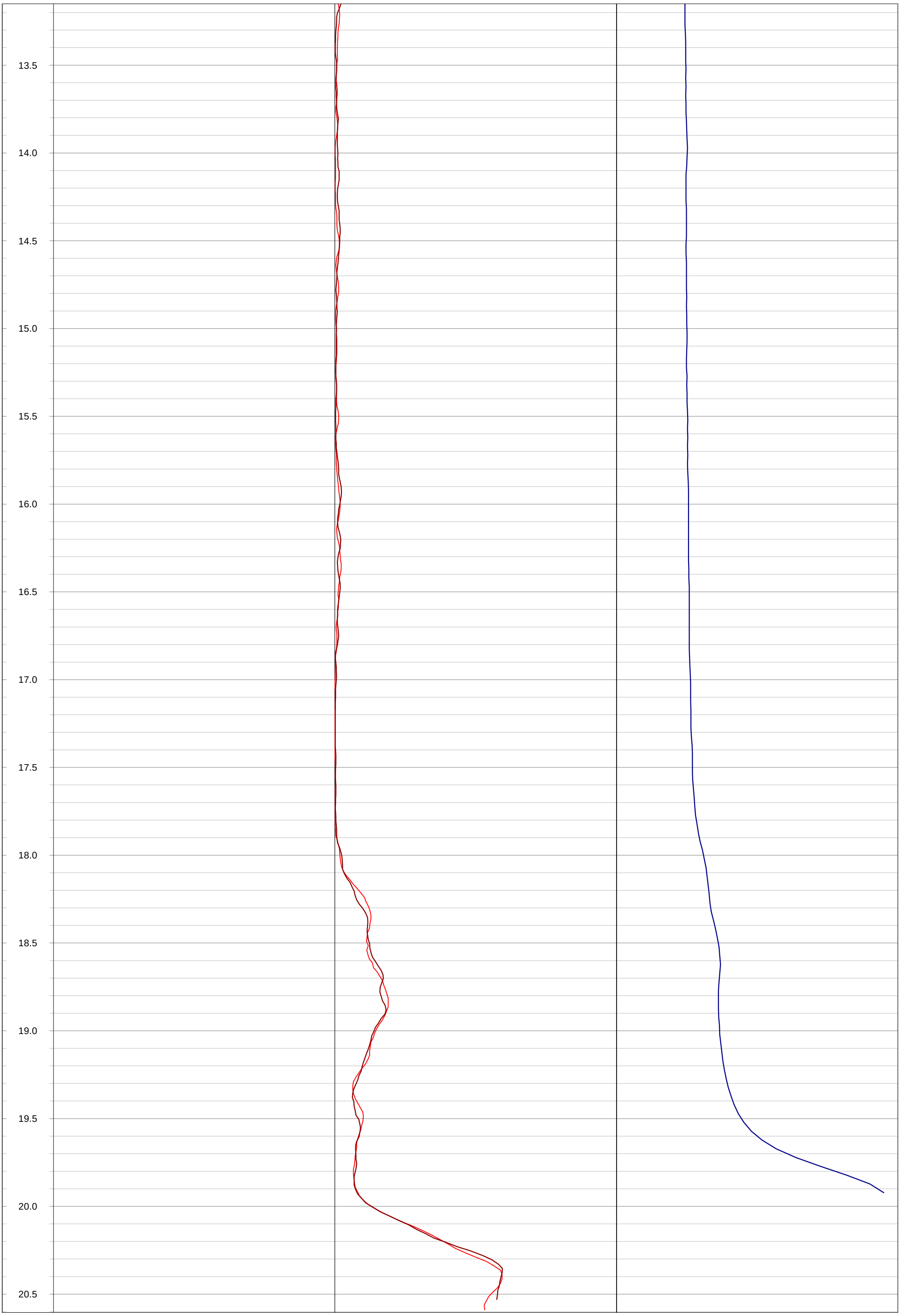
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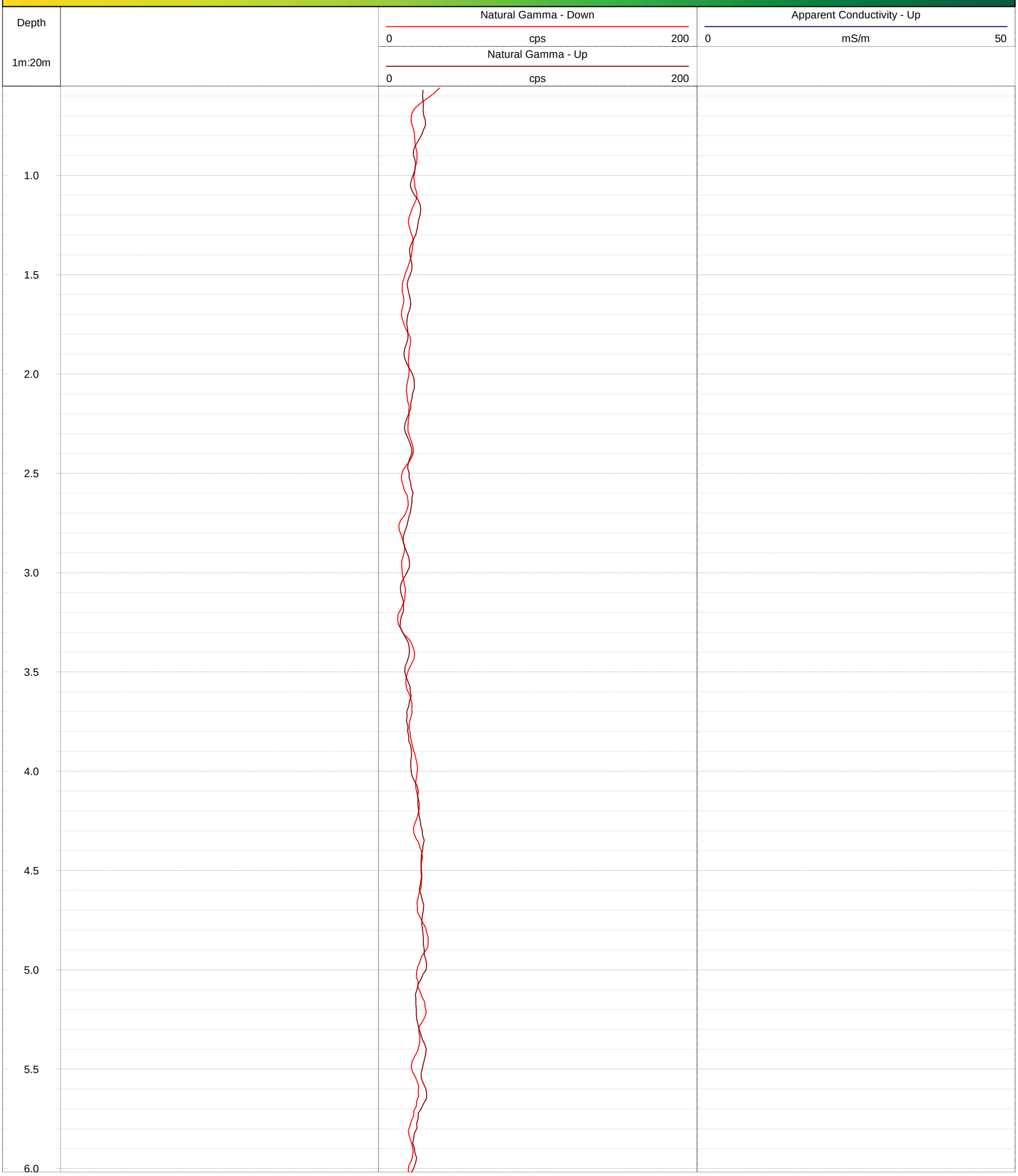
GOLDER
MEMBER OF WSP

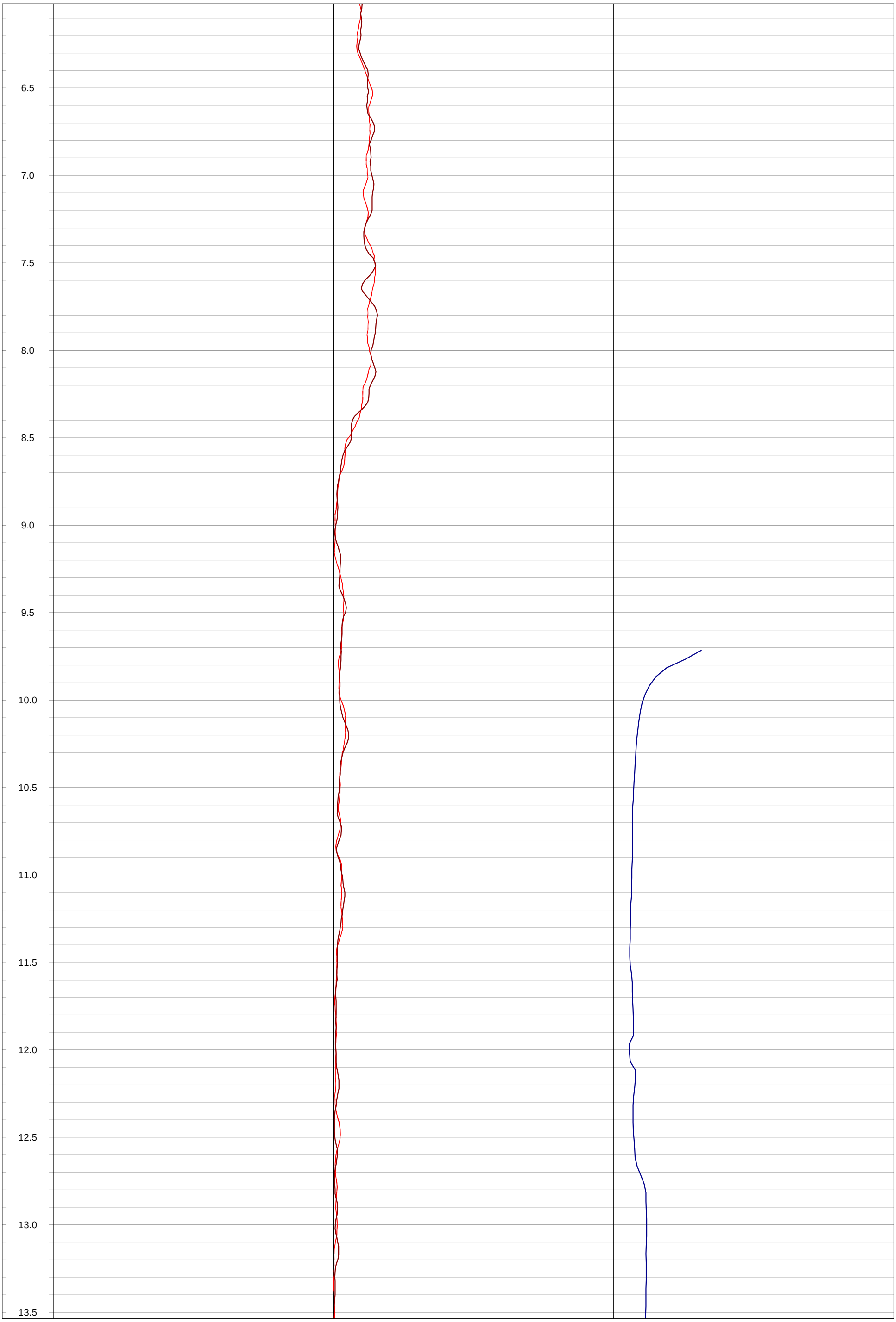
Geophysical Record of Borehole: MW21-3-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.84 m bgs	**Location:**	Caledon, Ontario
Easting:	577935.55 m	**Drilled Depth:**	19.20 m bgs	**Water Level:**	12.37 m bgs	**Log Date:**	Mar-31-2021
Northing:	4852730.93 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.12 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.13 m ags	**Logged By:**	PG

Notes:

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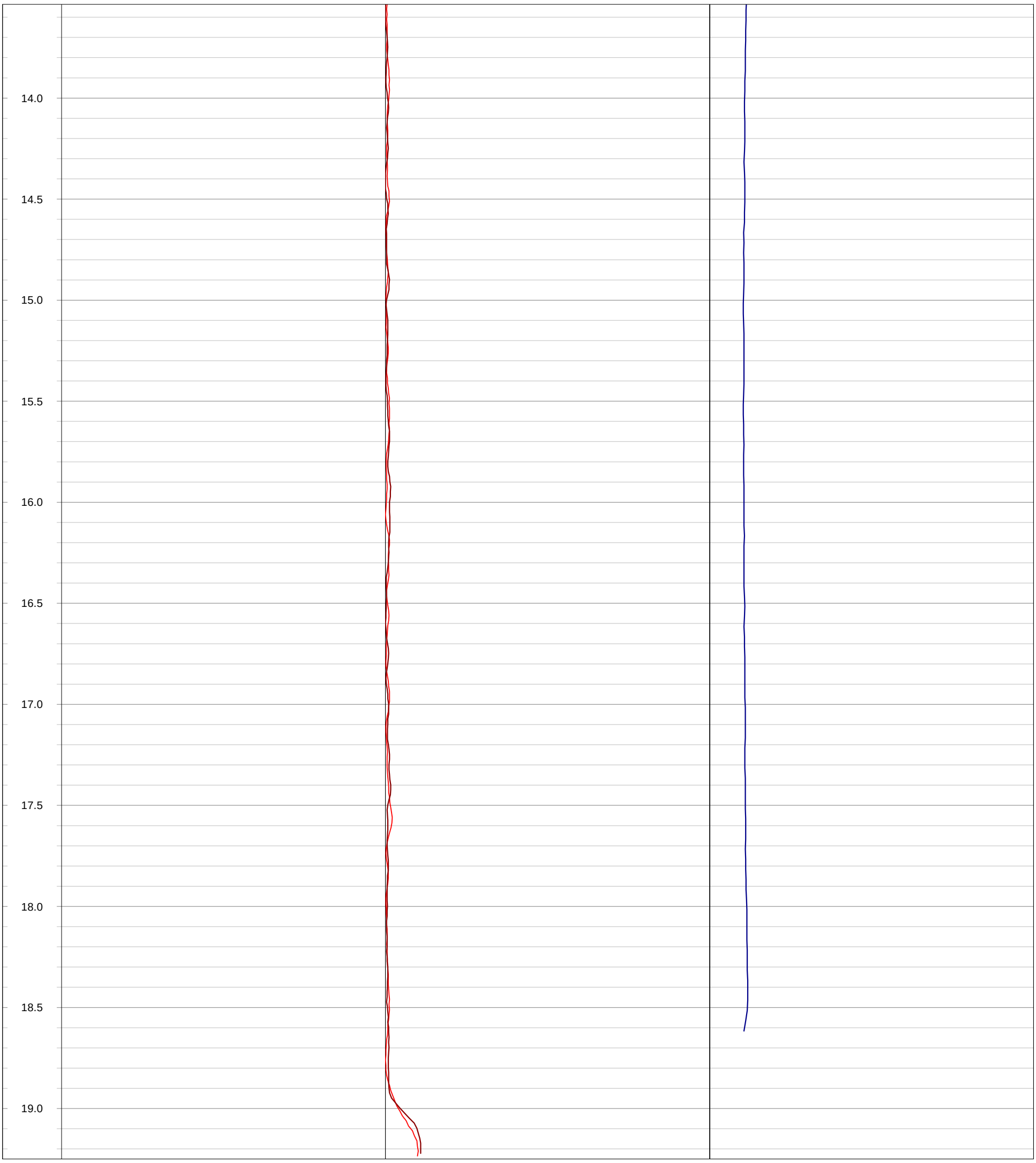
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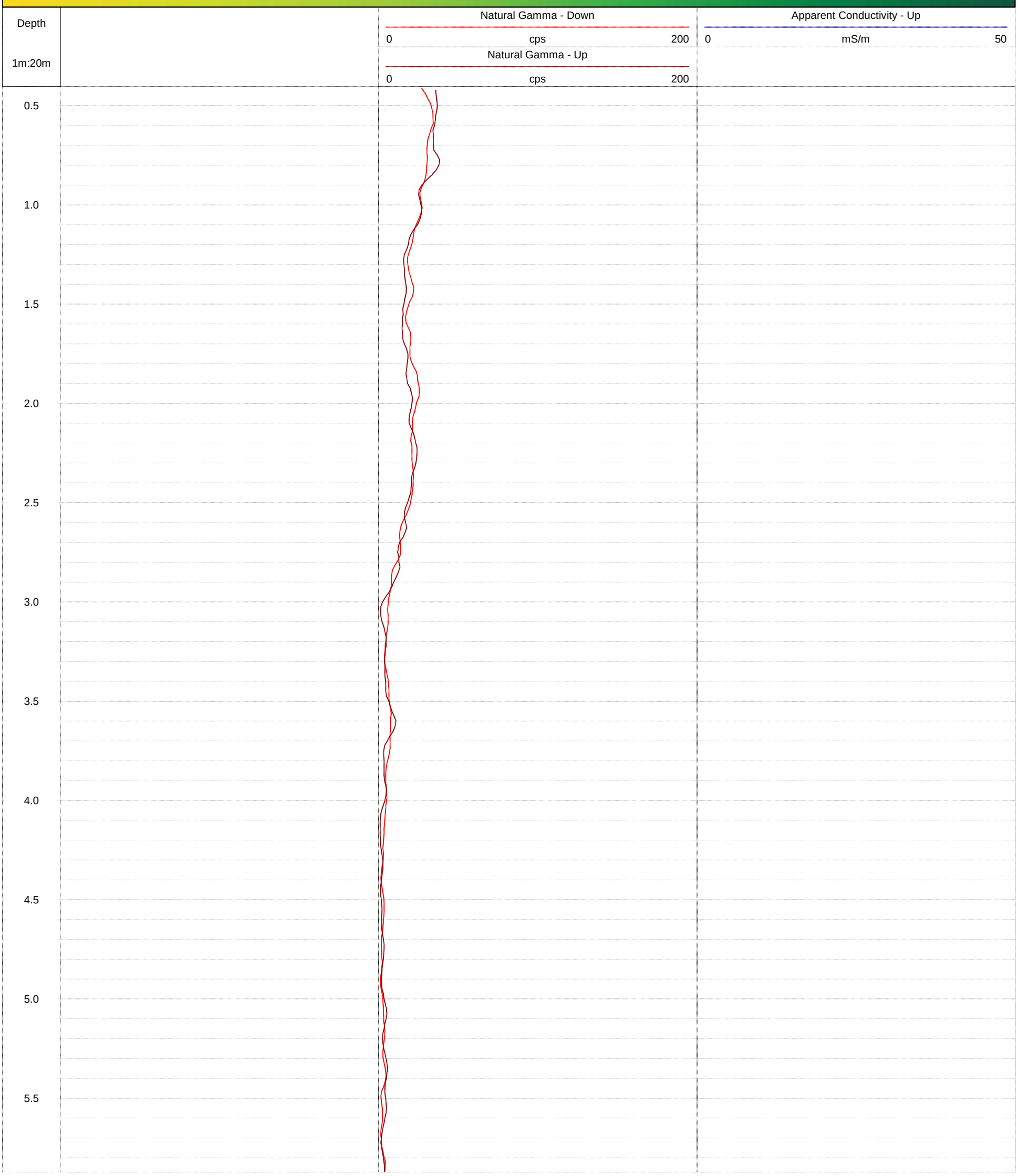
GOLDER
MEMBER OF WSP

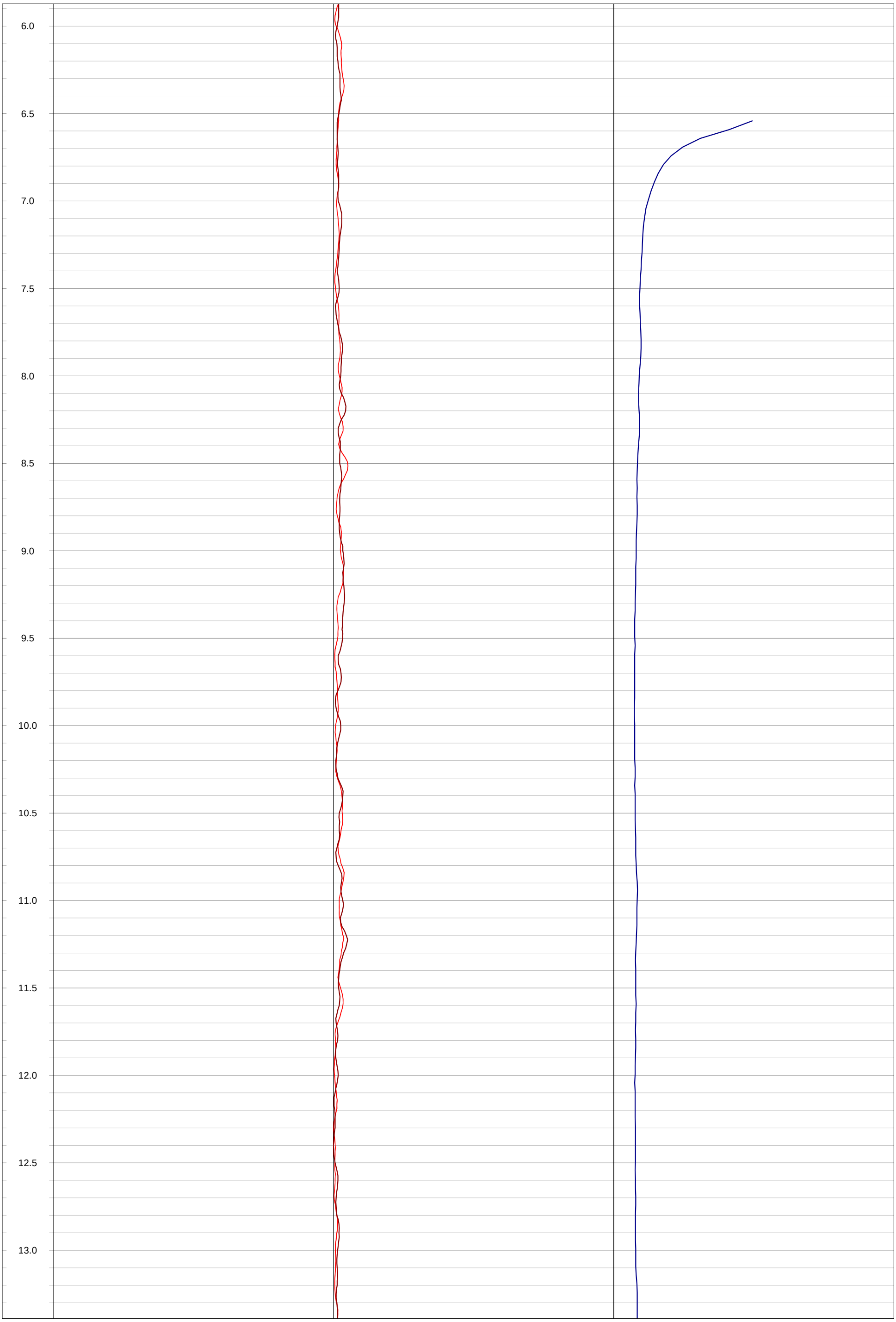
Geophysical Record of Borehole: MW21-3-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.94 m bgs	**Location:**	Caledon, Ontario
Easting:	577837.91 m	**Drilled Depth:**	19.20 m bgs	**Water Level:**	5.25 m bgs	**Log Date:**	Mar-31-2021
Northing:	4852827.25 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.16 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.27 m ags	**Logged By:**	PG

Notes:

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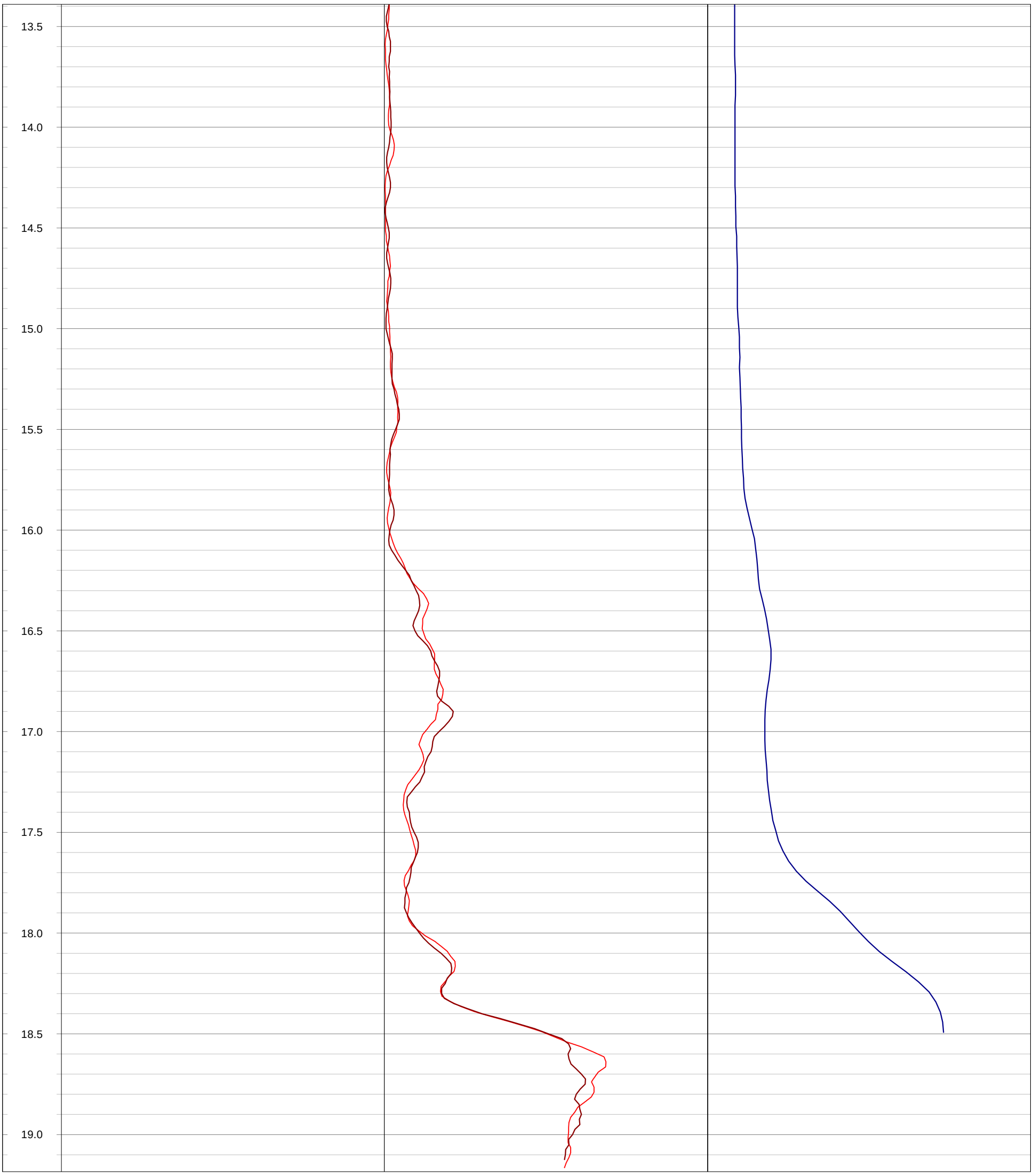
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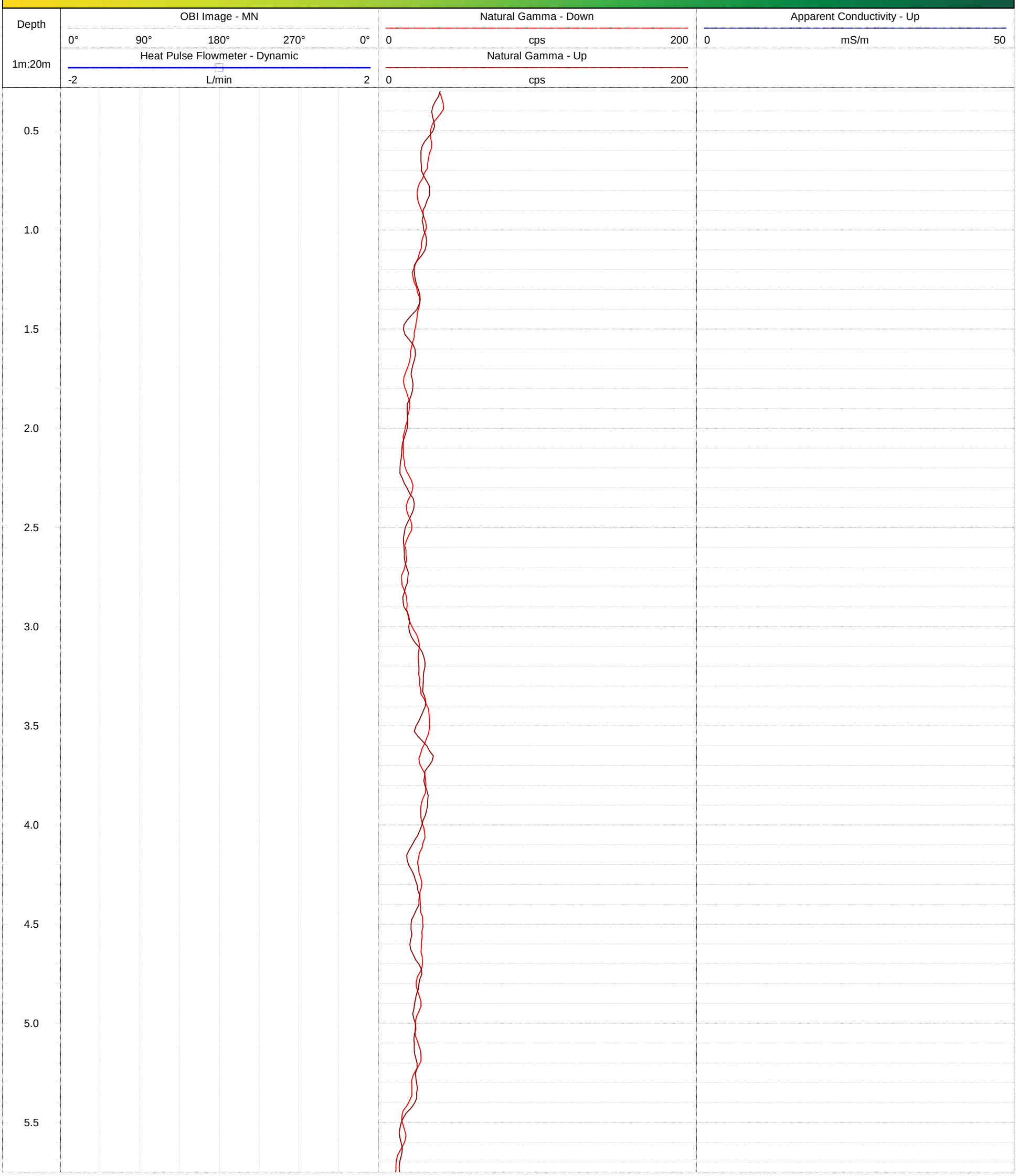
GOLDER
MEMBER OF WSP

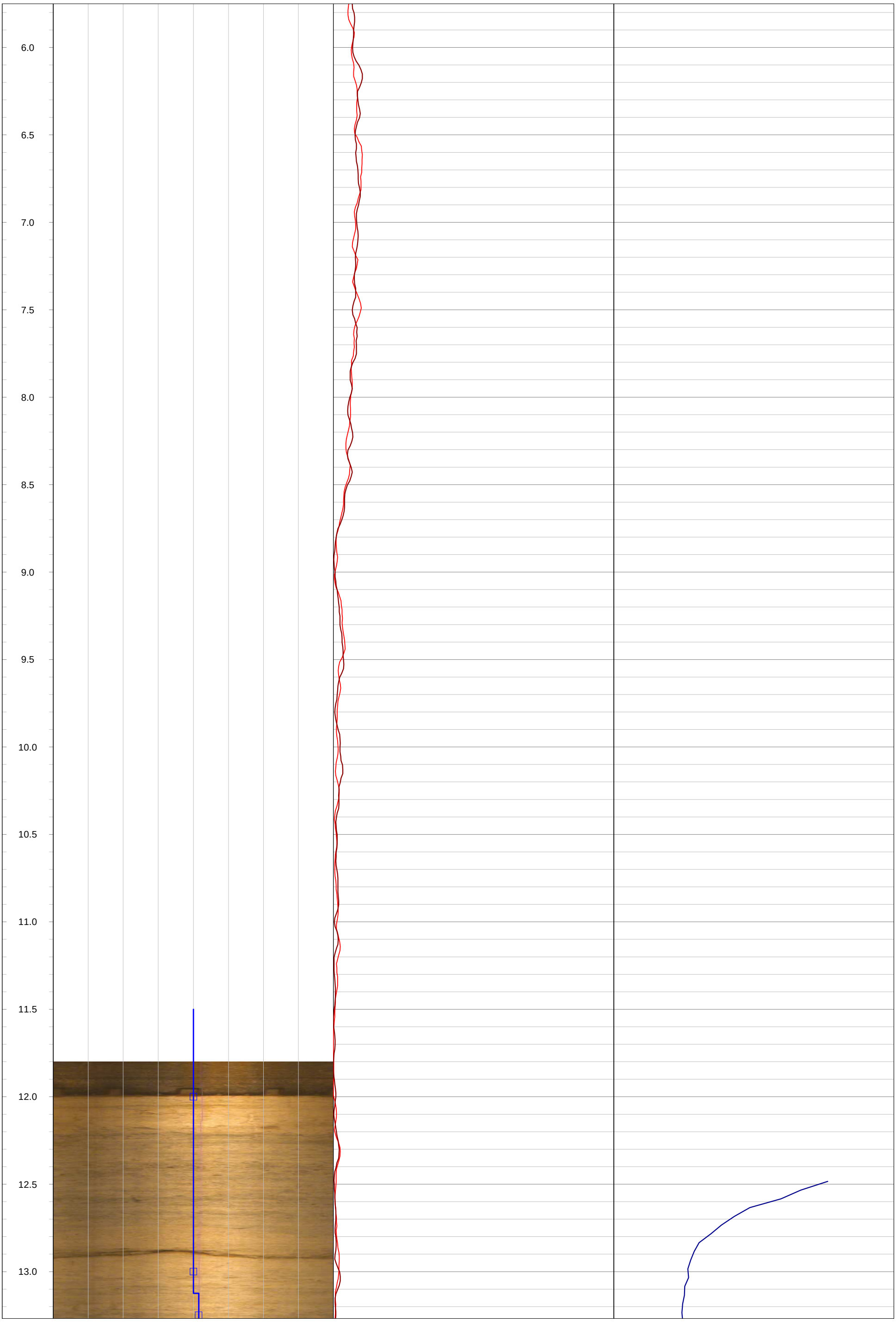
Geophysical Record of Borehole: MW21-4-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.98 m bgs	**Location:**	Caledon, Ontario
Easting:	577793.12 m	**Drilled Depth:**	23.77 m bgs	**Water Level:**	9.13 m bgs	**Log Date:**	Mar-23-2021
Northing:	4854211.47 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.22 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.37 m ags	**Logged By:**	PG

Notes: Image opaque>18.60 m bgs. Heat Pulse Flowmeter Dynamic pump between 10.8/ 11.8 m below top of collar. Pump rate adjusted between 3 L/min. to 0.6 L/min.

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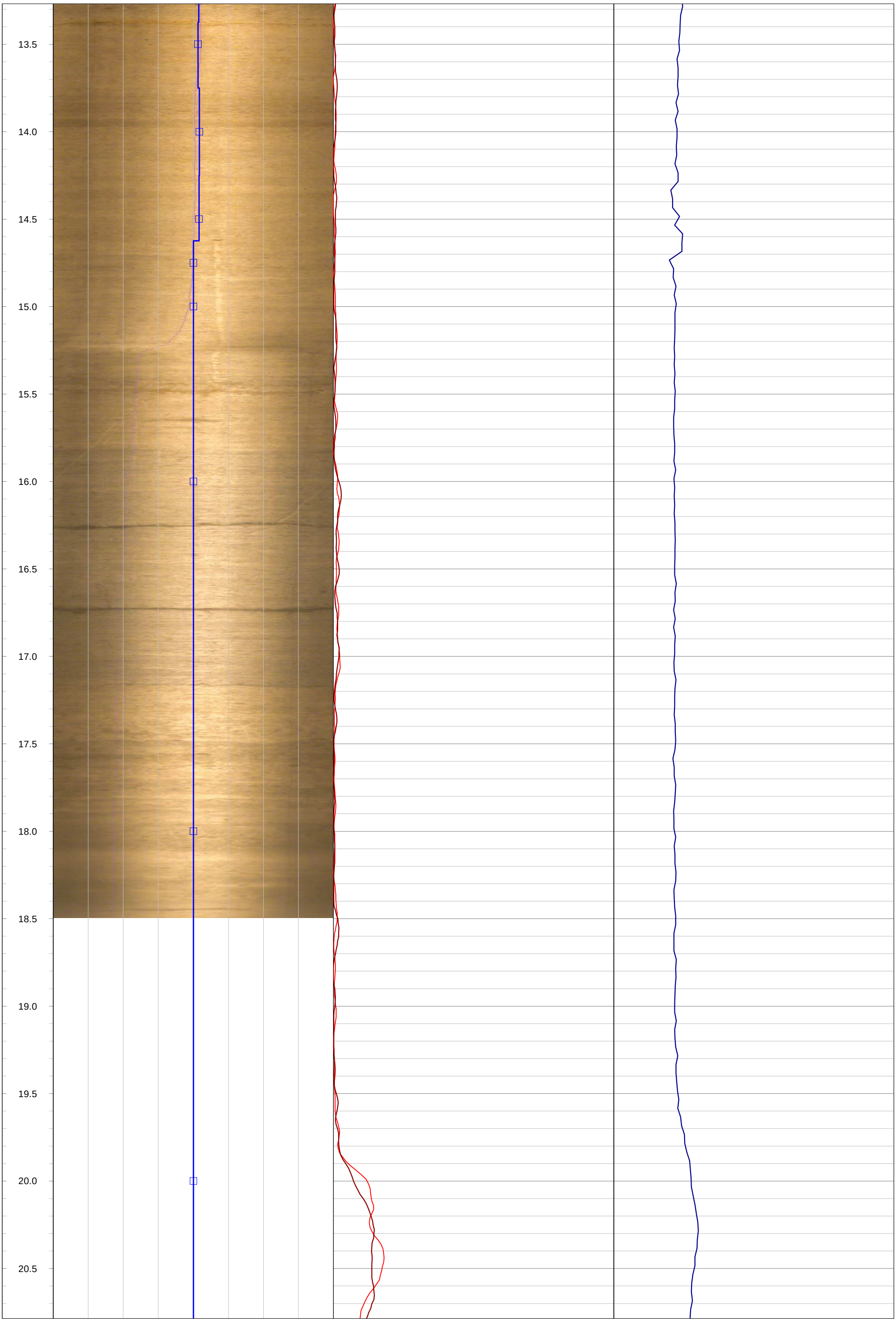
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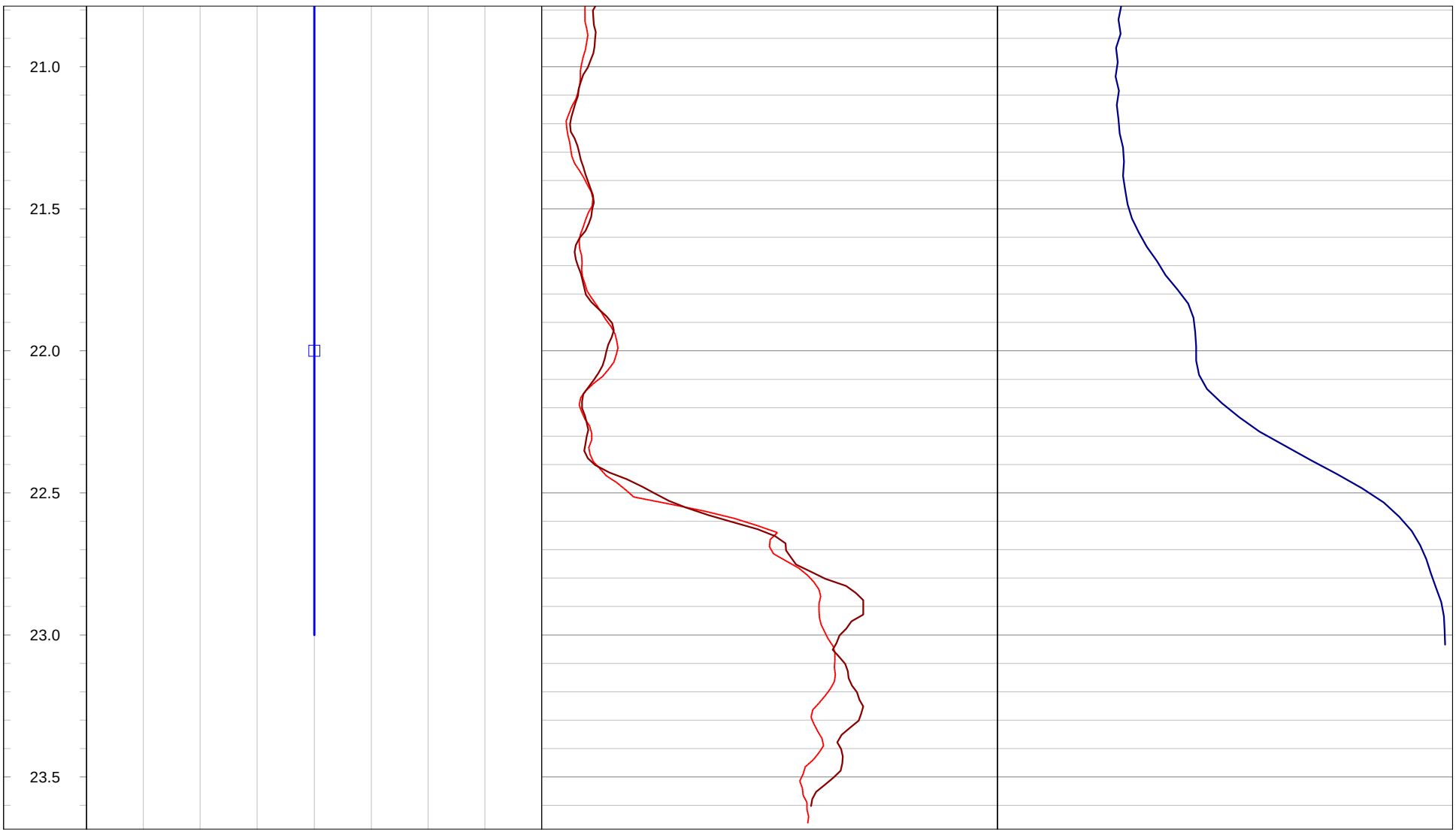
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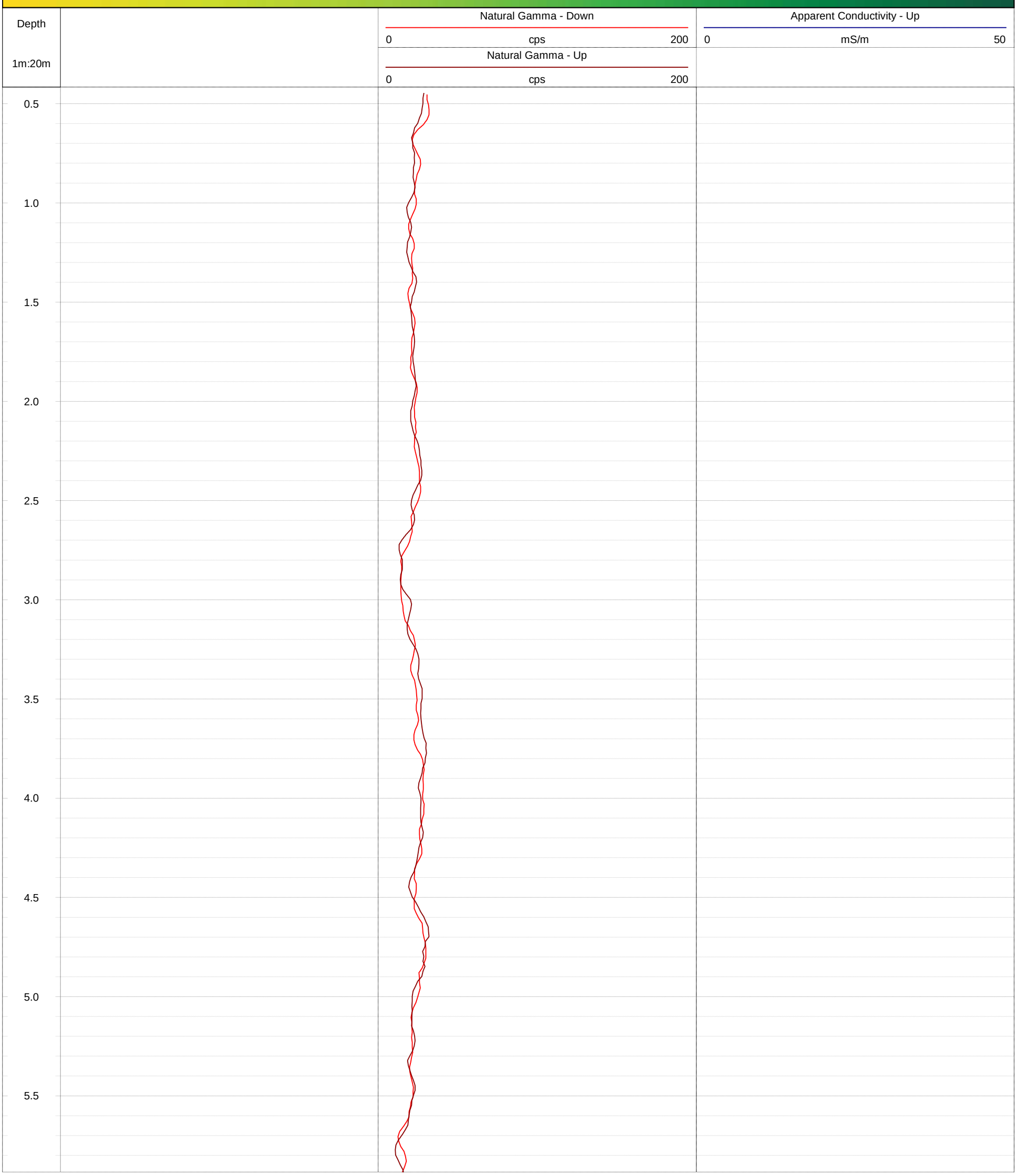
GOLDER
MEMBER OF WSP

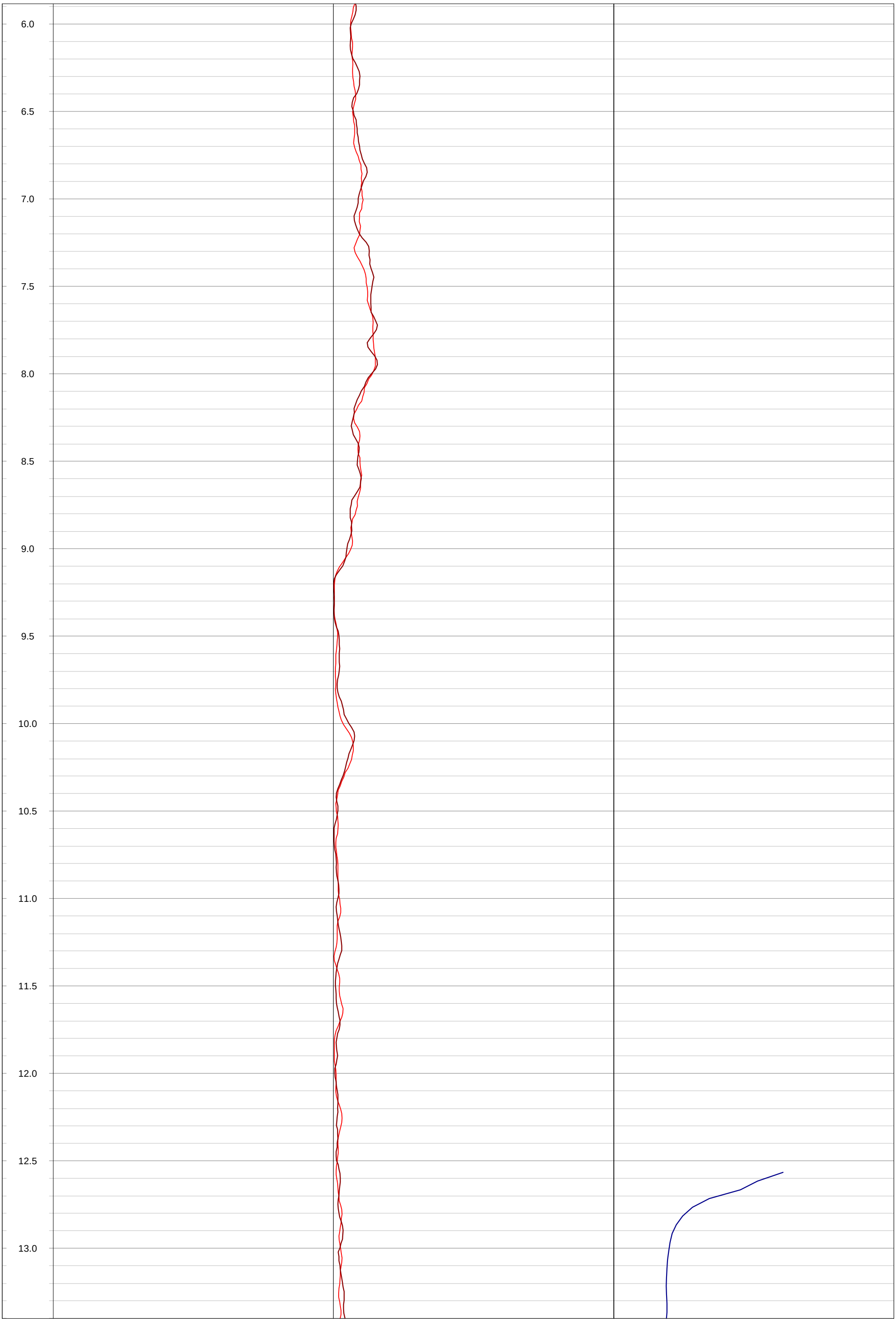
Geophysical Record of Borehole: MW21-4-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.89 m bgs	**Location:**	Caledon, Ontario
Easting:	577790.26 m	**Drilled Depth:**	23.77 m bgs	**Water Level:**	7.92 m bgs	**Log Date:**	Mar-23-2021
Northing:	4854247.25 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.24 m ags	**Logged By:**	PG

Notes:

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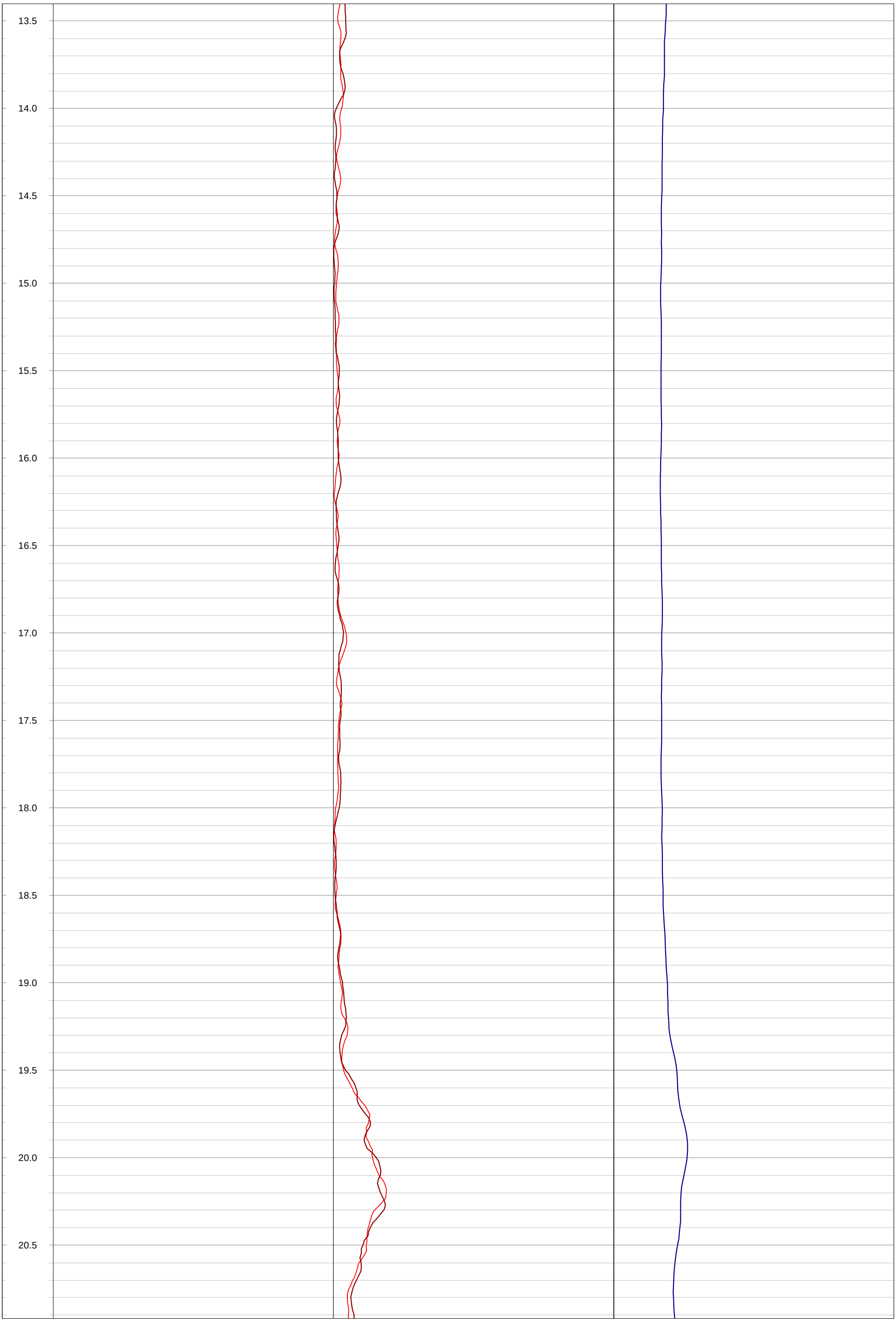
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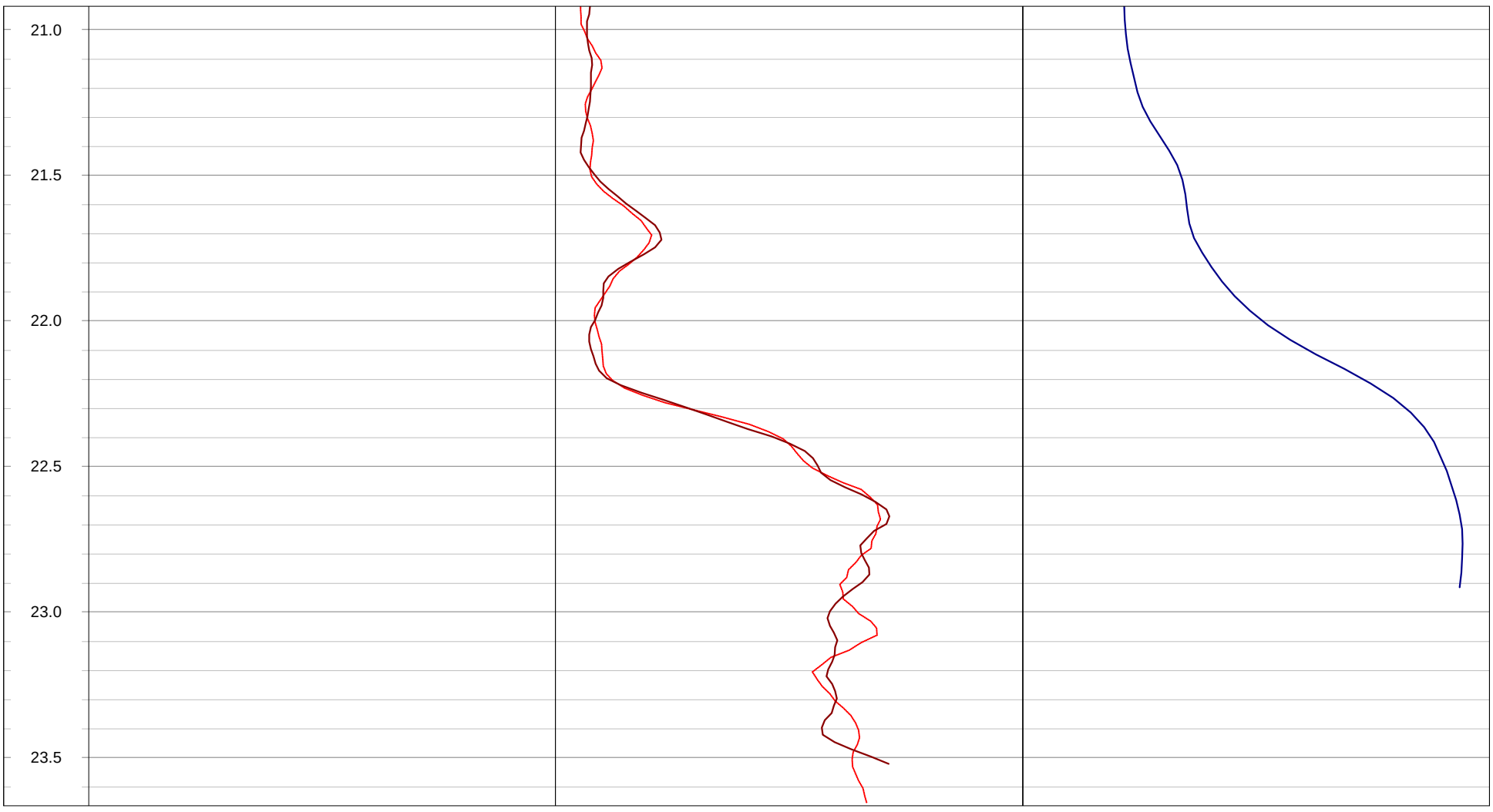
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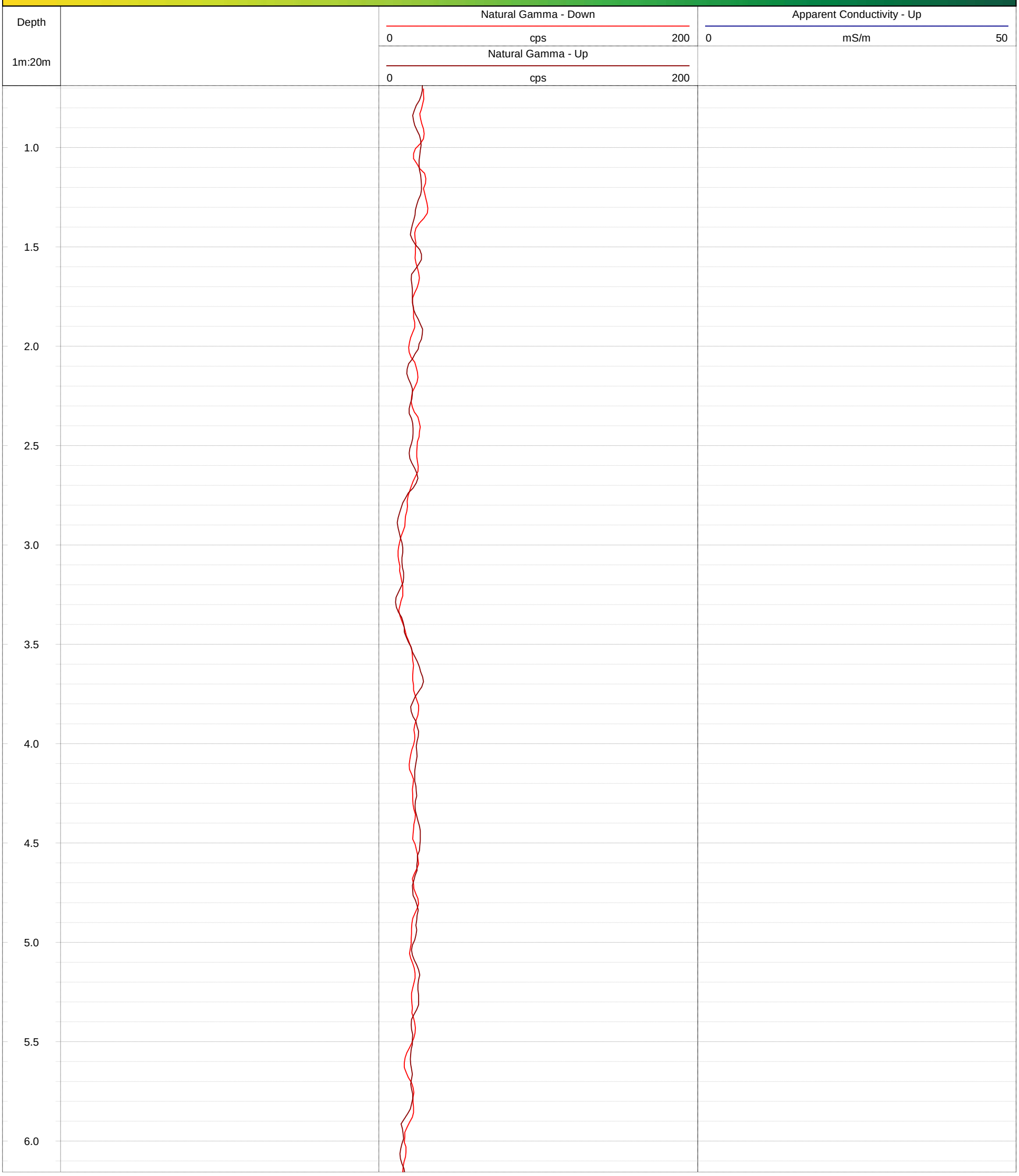
GOLDER
MEMBER OF WSP

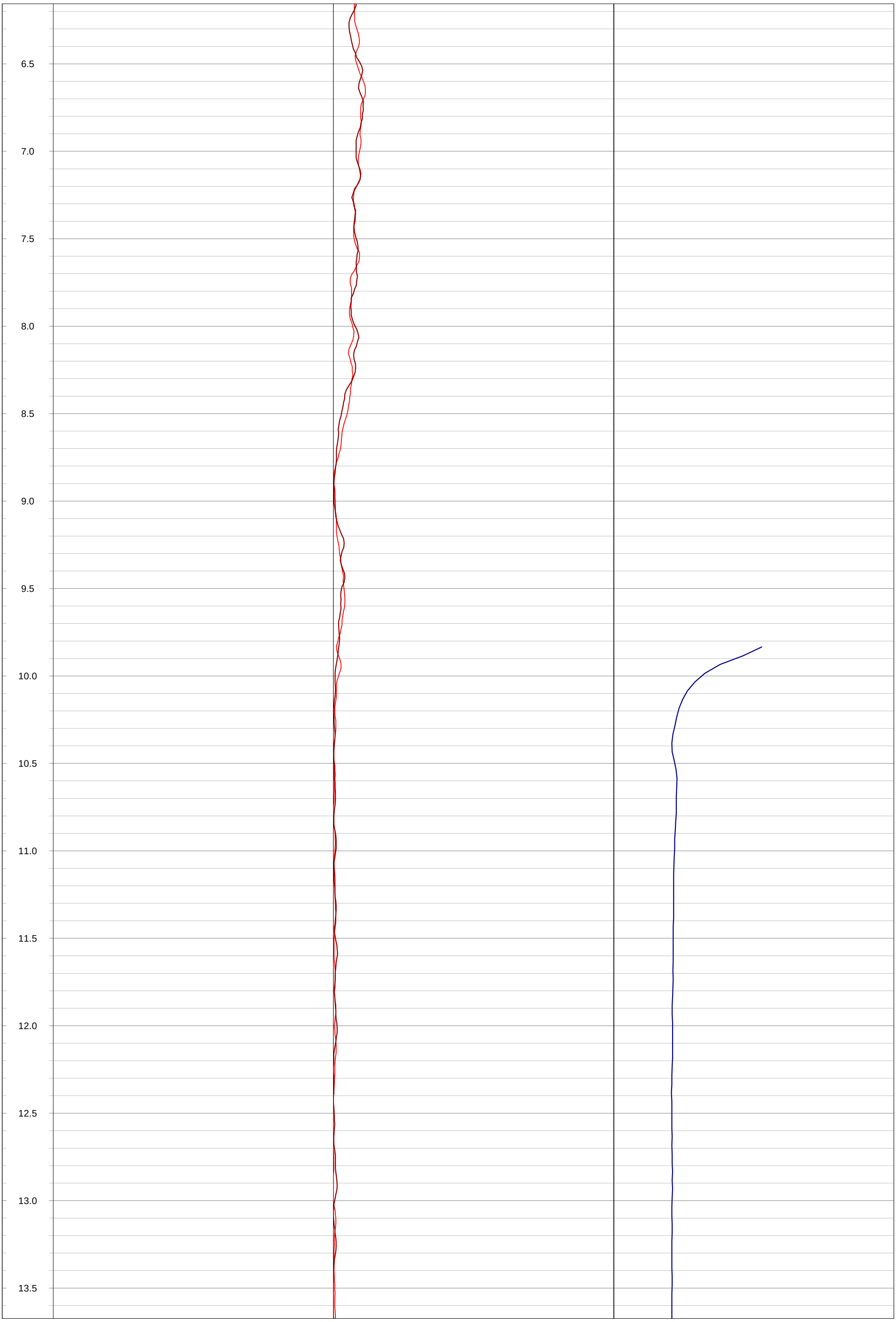
Geophysical Record of Borehole: MW21-4-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.25 m bgs	**Location:**	Caledon, Ontario
Easting:	577813.86 m	**Drilled Depth:**	21.64 m bgs	**Water Level:**	n/a	**Log Date:**	Mar-24-2021
Northing:	4854182.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	414.78 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.05 m ags	**Logged By:**	PG

Notes:

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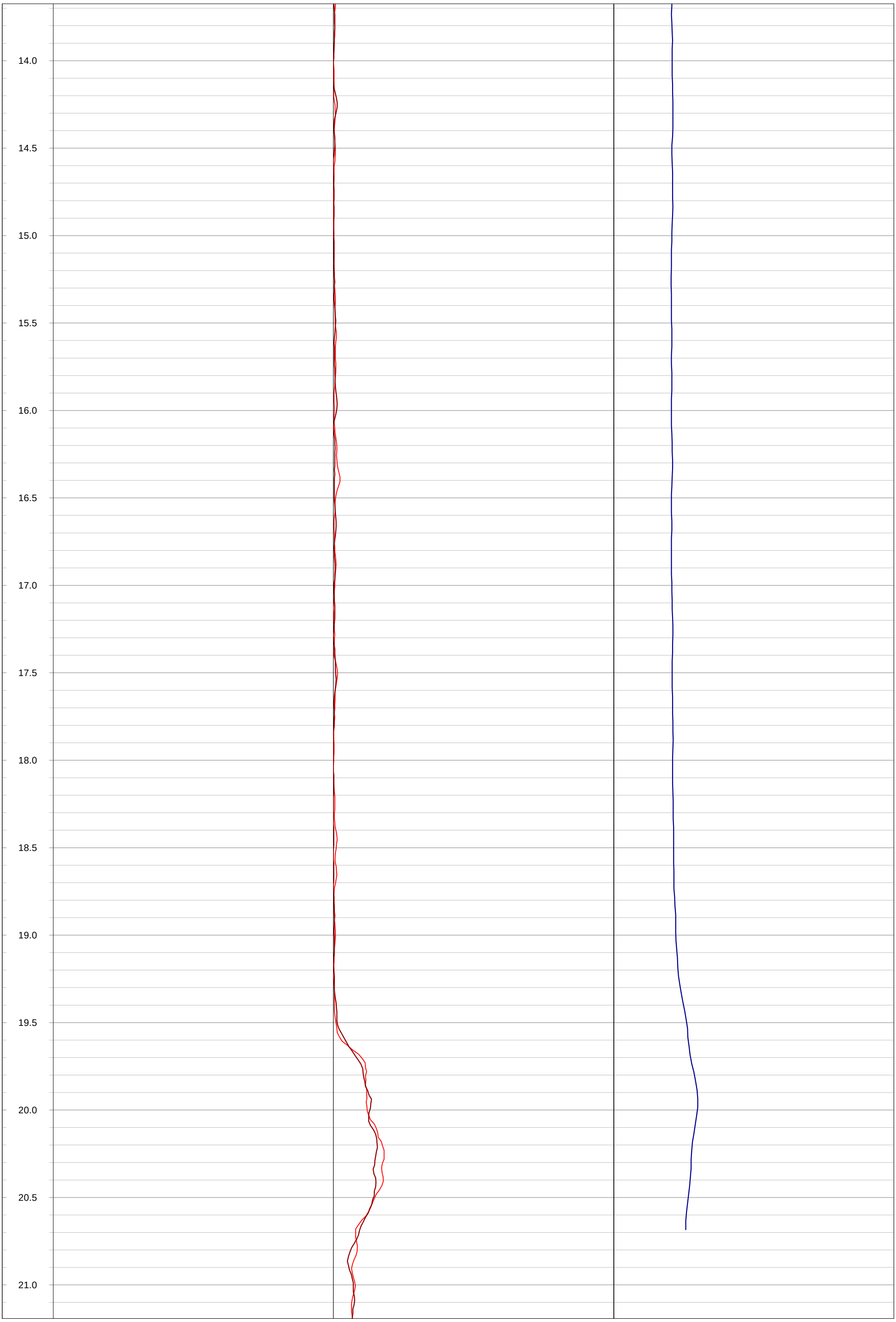
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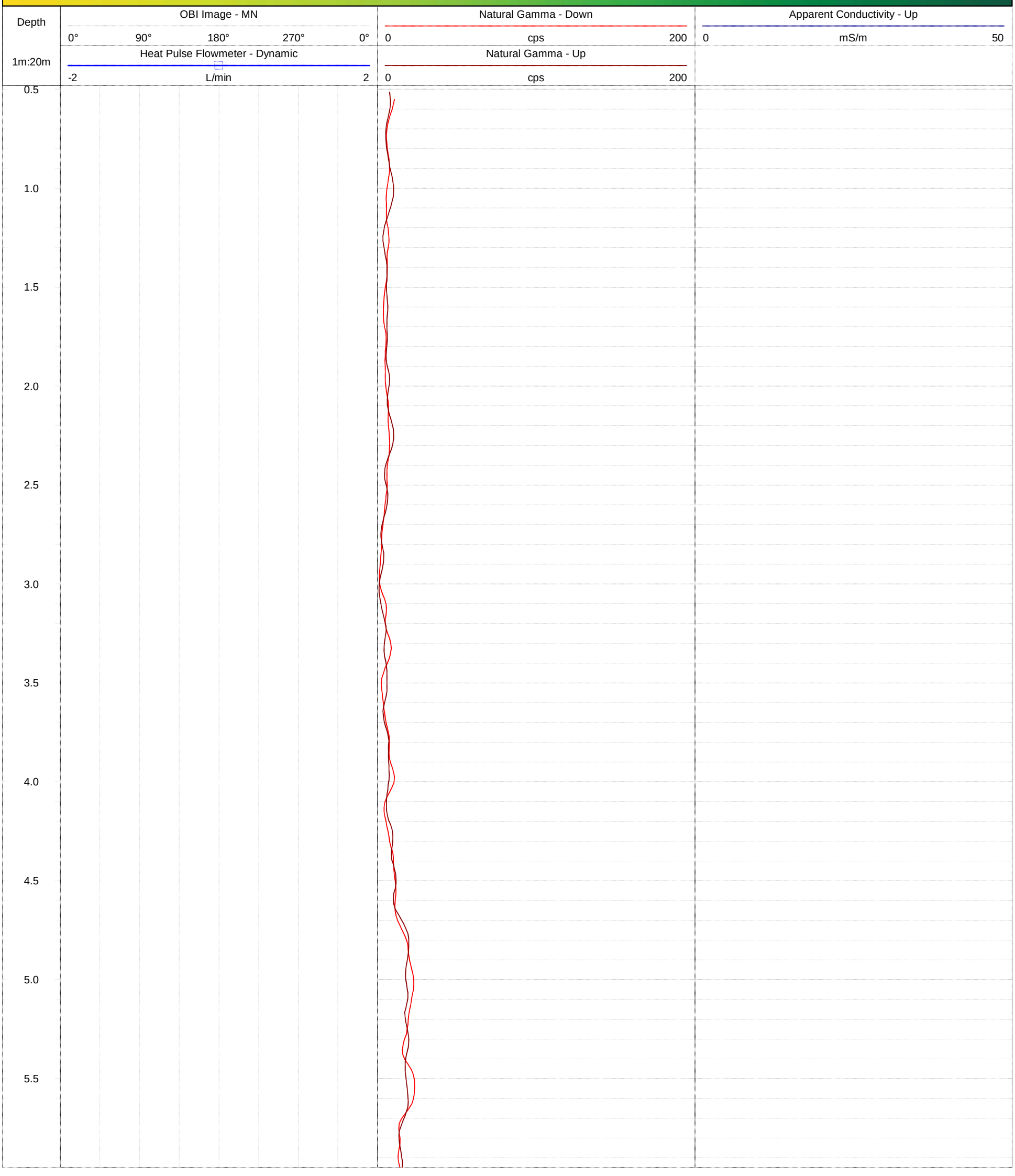
GOLDER
MEMBER OF WSP

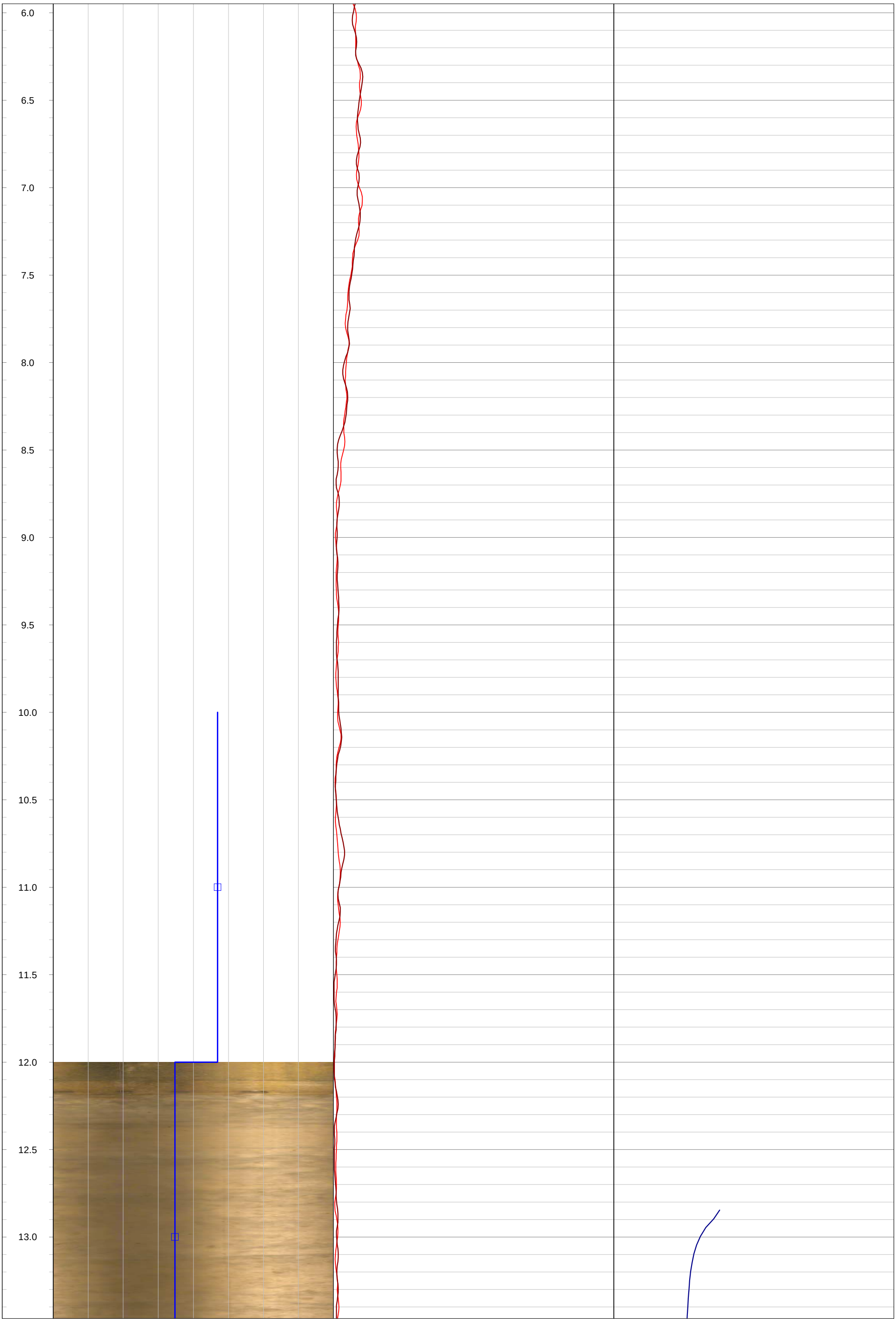
Geophysical Record of Borehole: PW21-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	576890.23 m	**Drilled Depth:**	38.41 m bgs	**Water Level:**	1.50 m bgs	**Log Date:**	Mar-9-2021
Northing:	4853478.69 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	418.76 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.18 m ags	**Logged By:**	PL

Notes: OBI image opaque>32 m bgs. Heat Pulse Flowmeter Dynamic pump at 10 m below top of collar. Pump rate approx. 4 L/min.

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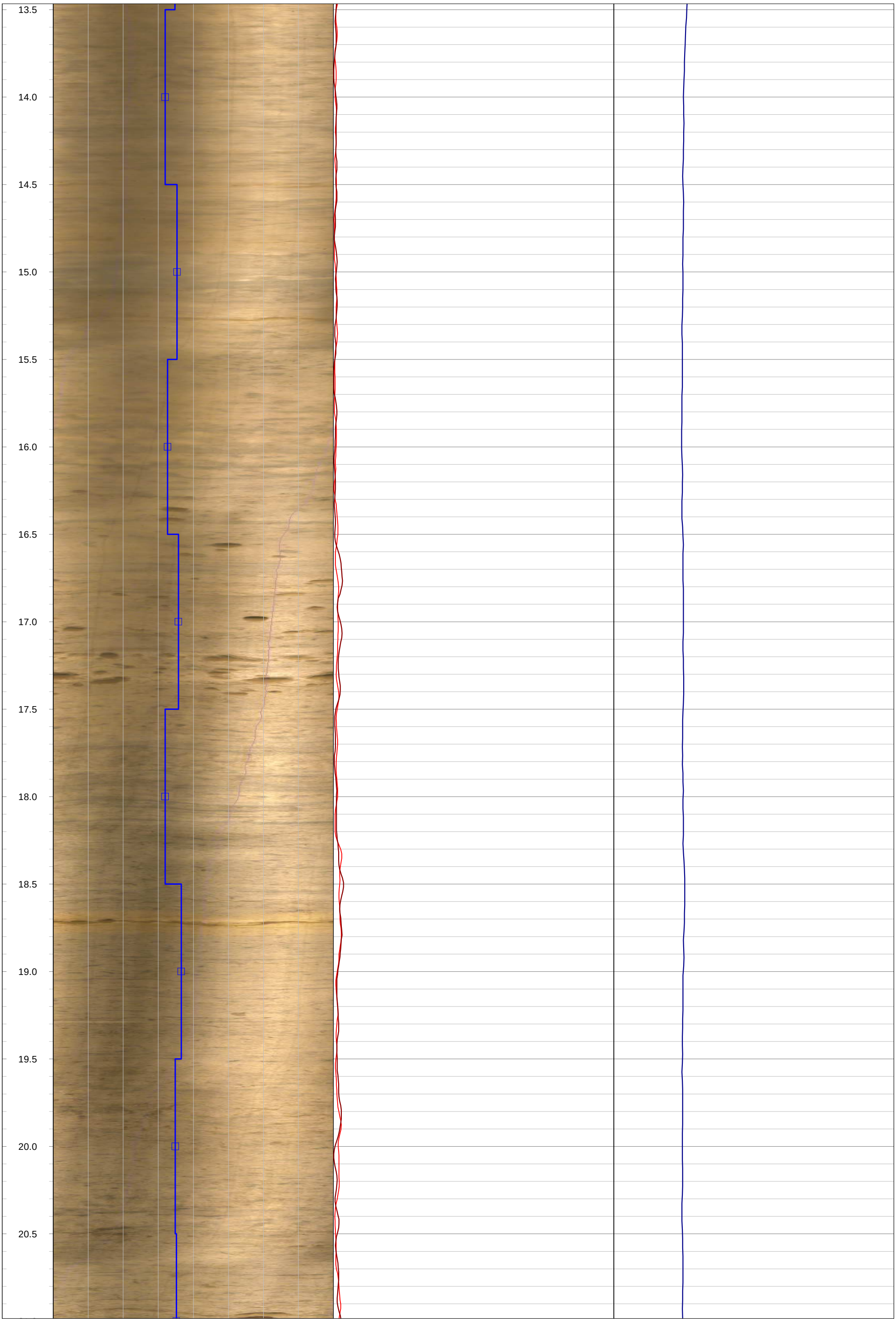
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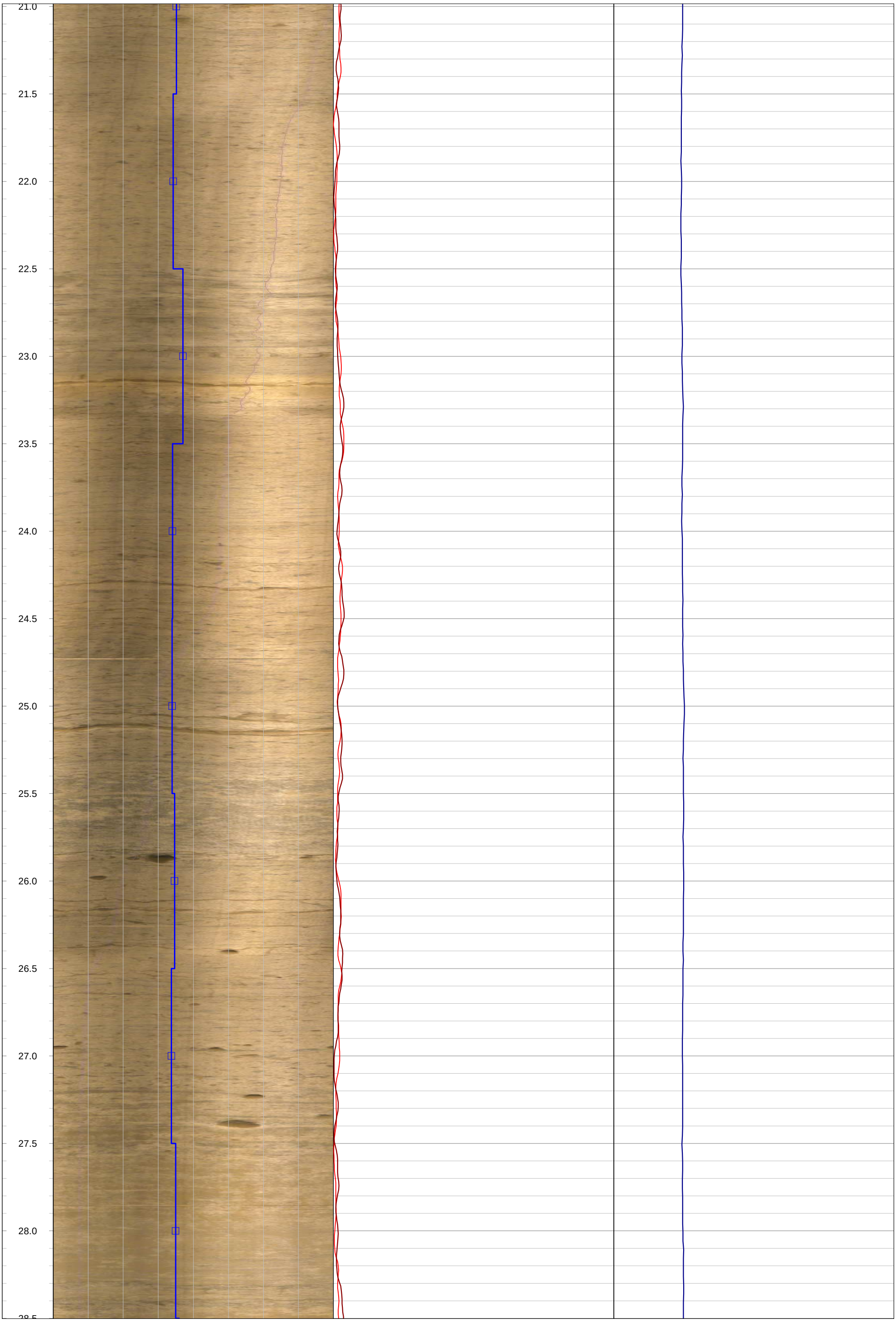
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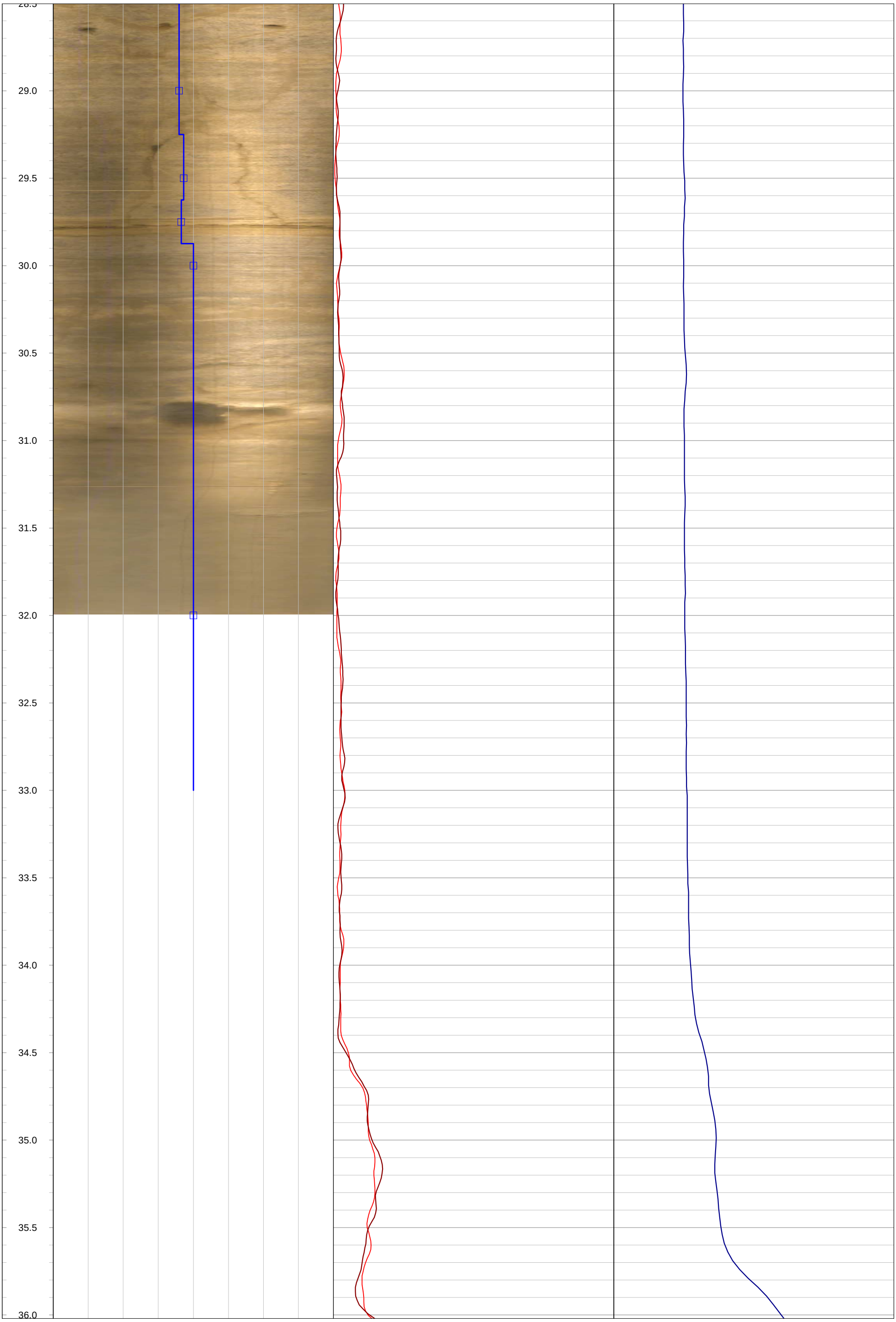
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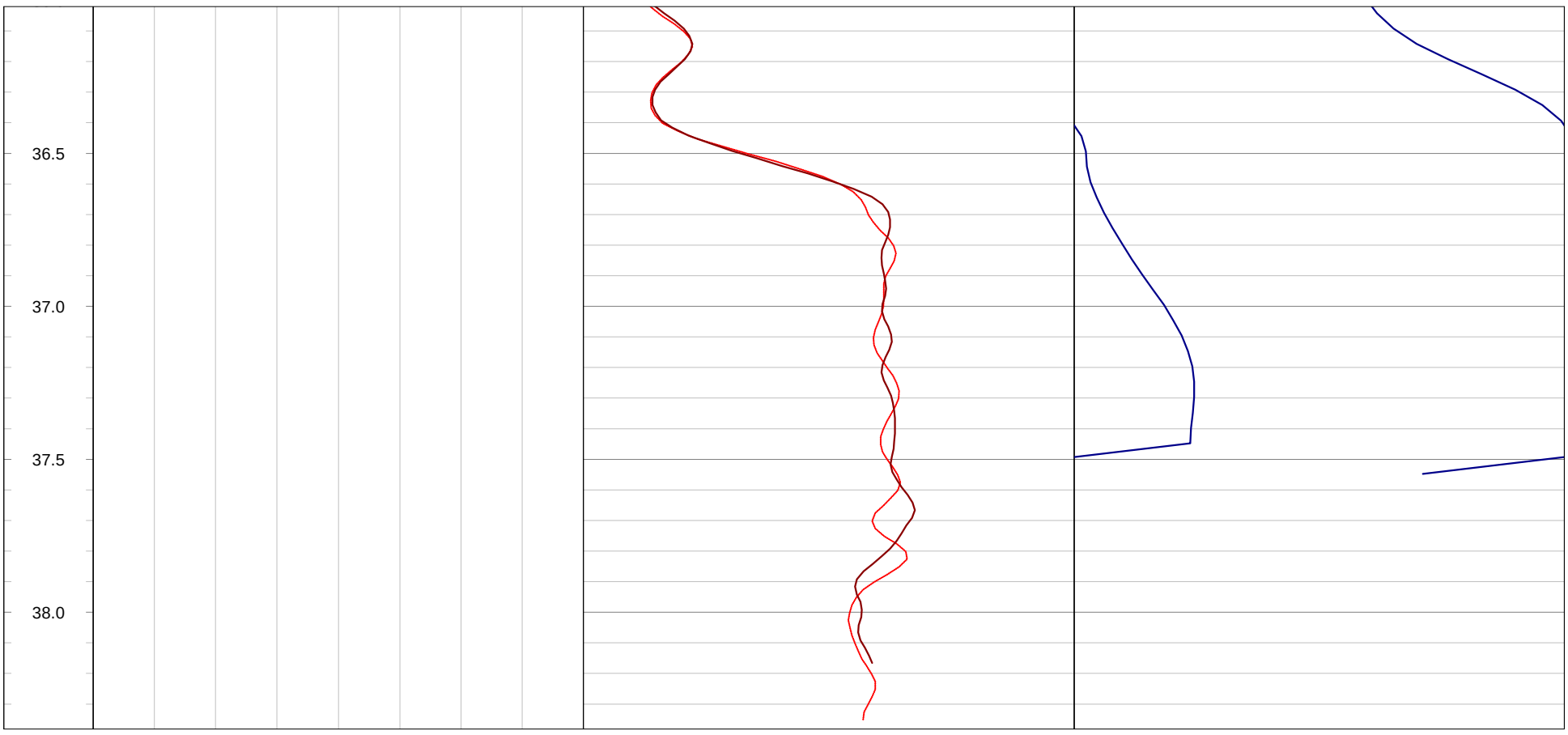
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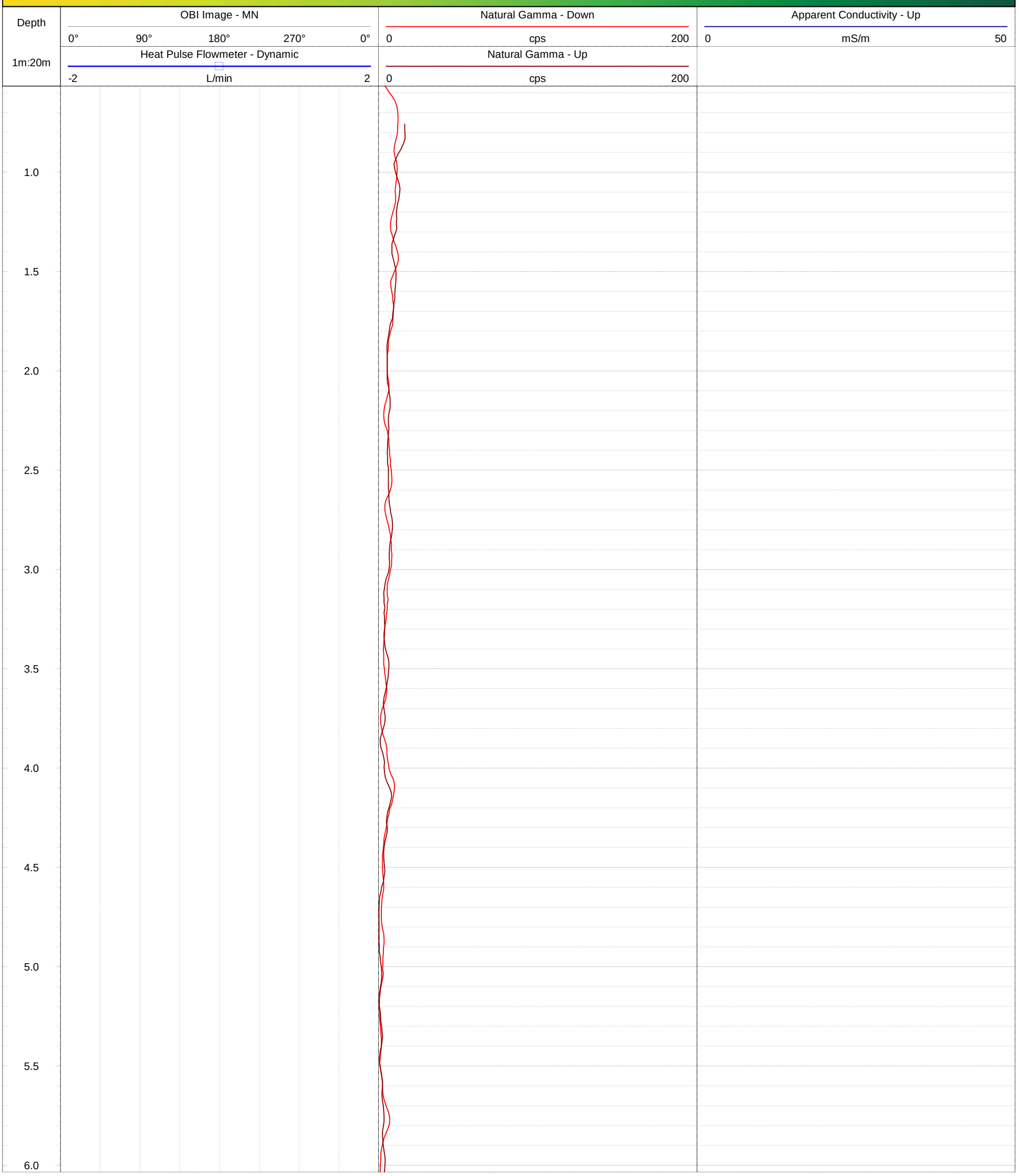
GOLDER
MEMBER OF WSP

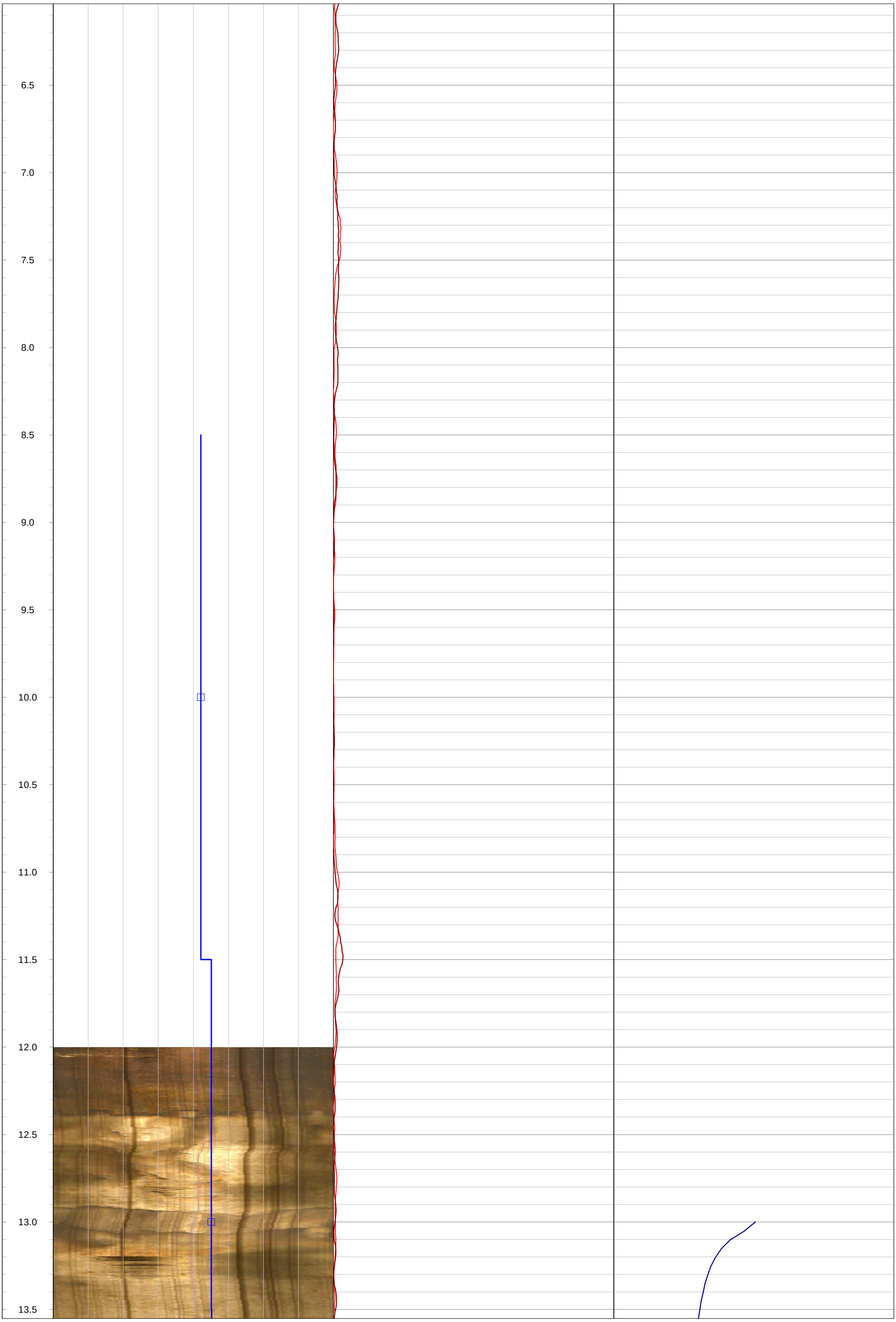
Geophysical Record of Borehole: PW21-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	577286.29 m	**Drilled Depth:**	25.15 m bgs	**Water Level:**	4.60 m bgs	**Log Date:**	Mar-18-2021
Northing:	4854027.50 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.11 m ags	**Logged By:**	PL

Notes: Heat Pulse Flowmeter Dynamic pump at 6 m below top of collar. Pump rate approx. 4 L/min.

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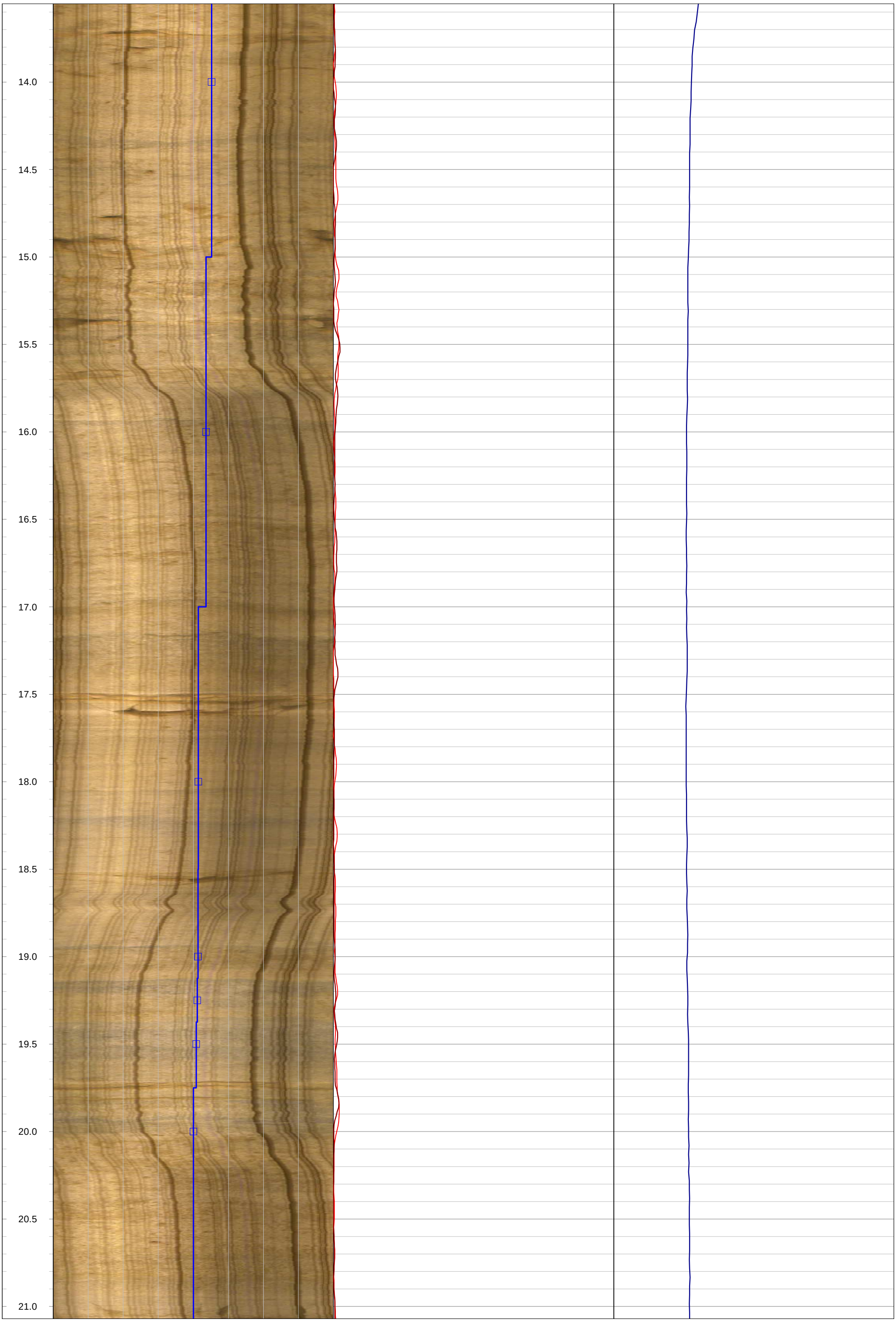
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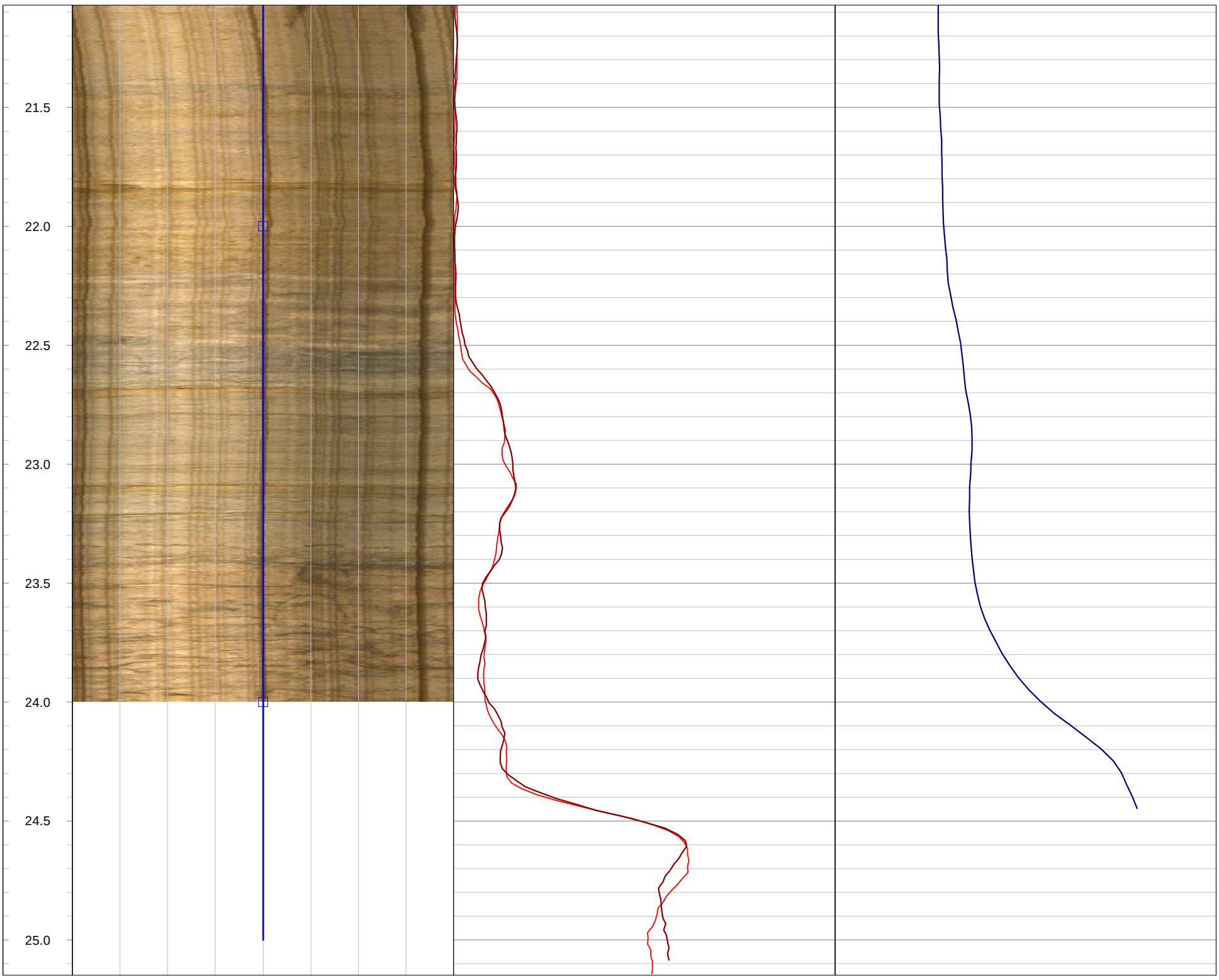
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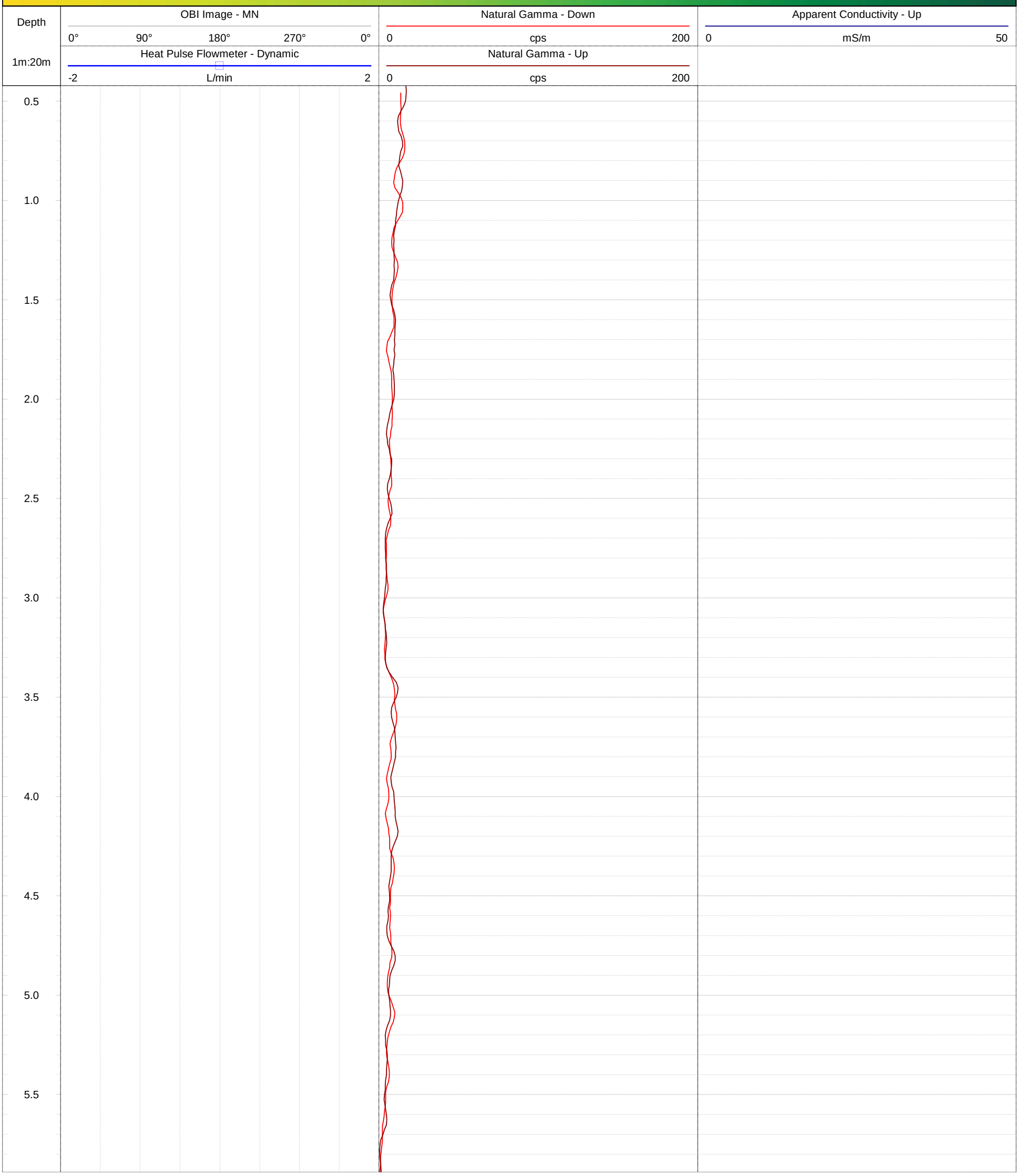
GOLDER
MEMBER OF WSP

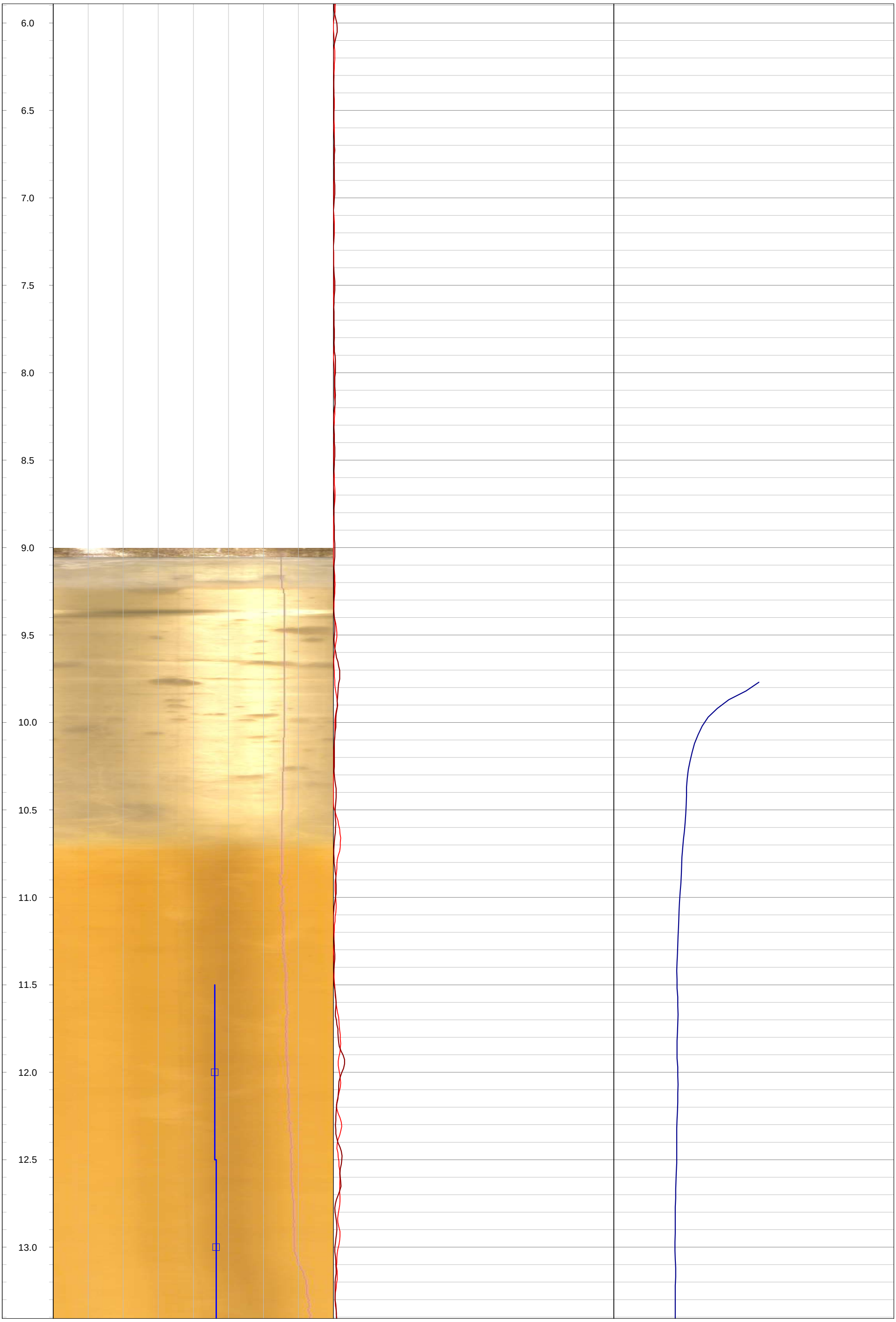
Geophysical Record of Borehole: PW21-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.20 m bgs	**Location:**	Caledon, Ontario
Easting:	577875.55 m	**Drilled Depth:**	21.34 m bgs	**Water Level:**	8.99 m bgs	**Log Date:**	Apr-01-2021
Northing:	4852797.50 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.45 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.24 m ags	**Logged By:**	PG

Notes: Image orange (rust?) 10.7 to 19.5 m bgs, opaque>19.6 m bgs. Heat Pulse Flowmeter Dynamic pump at 11 m below top of collar. Pump rate approx. 1.7 L/min.

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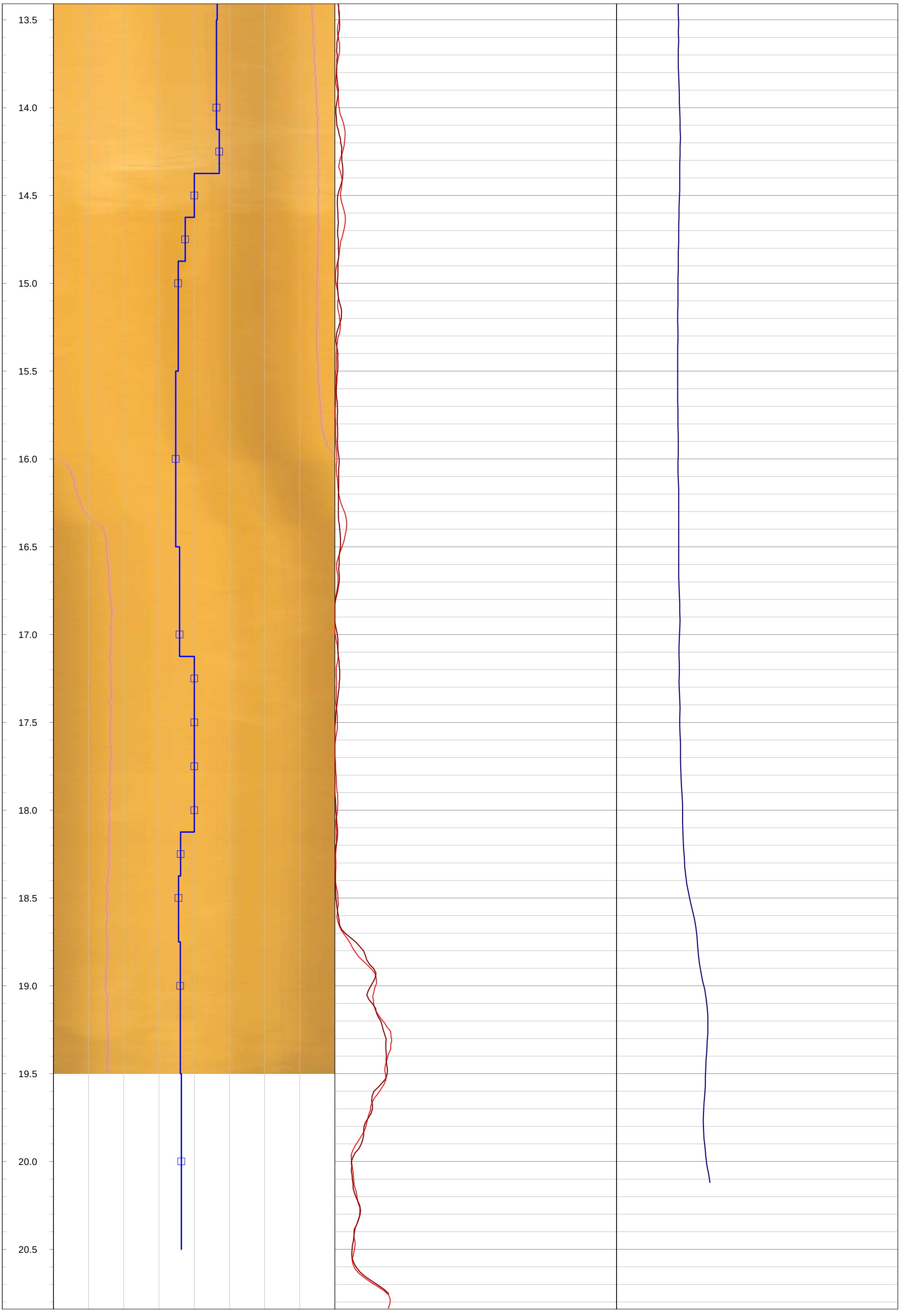
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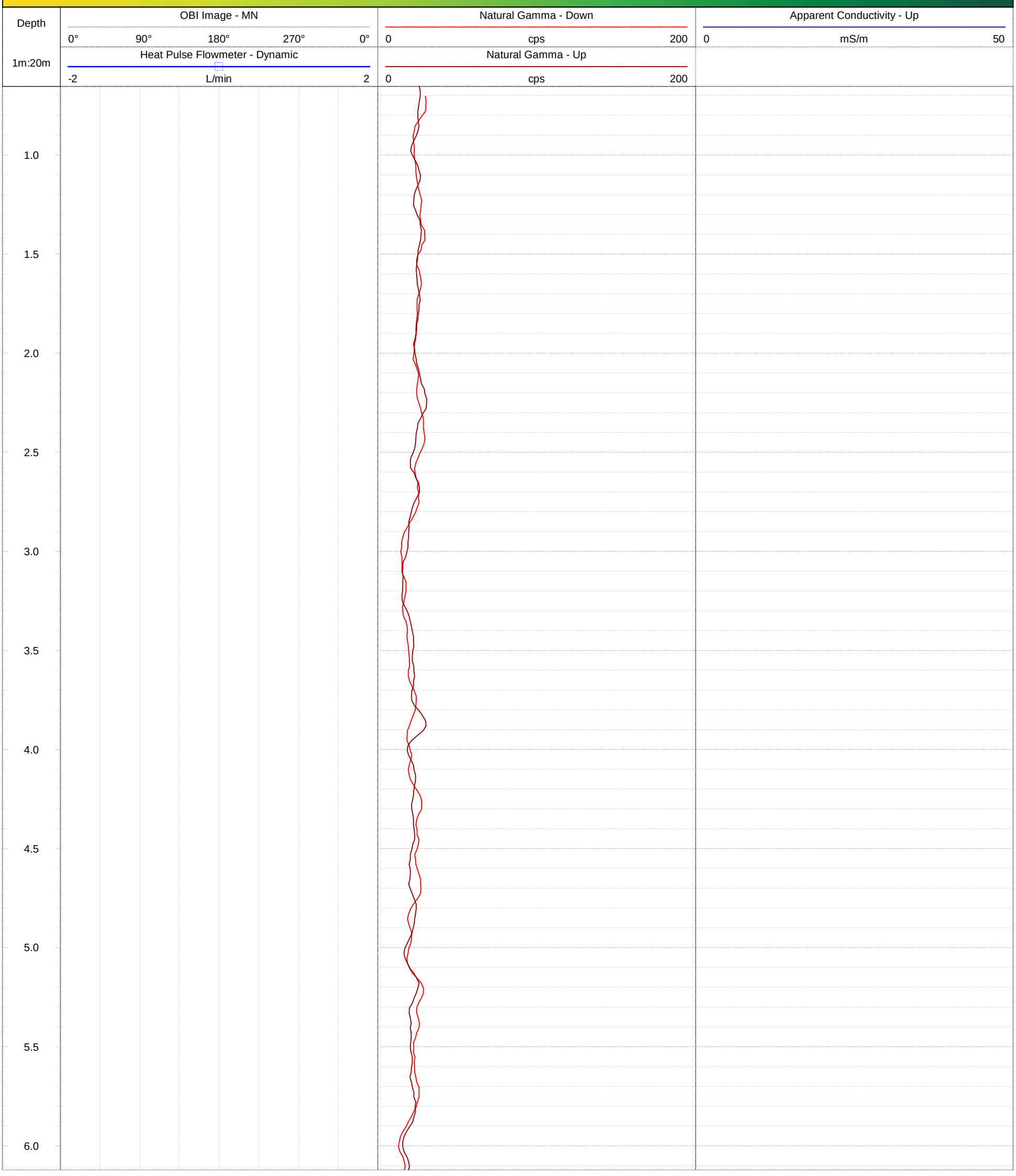
GOLDER
MEMBER OF WSP

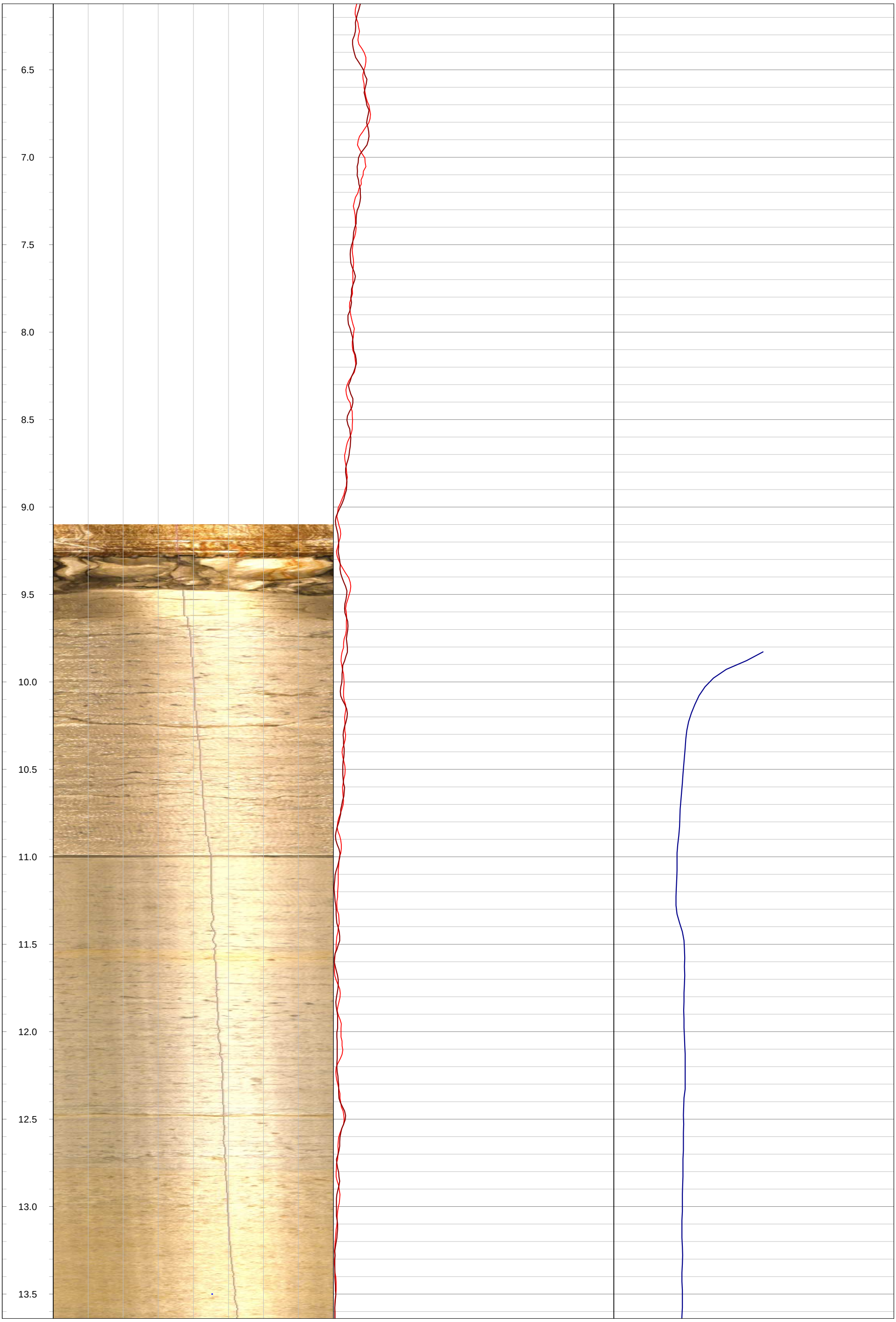
Geophysical Record of Borehole: PW21-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.25 m bgs	**Location:**	Caledon, Ontario
Easting:	577802.09 m	**Drilled Depth:**	21.64 m bgs	**Water Level:**	10.95 m bgs	**Log Date:**	Mar-24-2021
Northing:	4854214.36 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.08 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.04 m ags	**Logged By:**	PG

Notes: OBI image opaque>21.5 m bgs. Heat Pulse Flowmeter Dynamic pump at 13 m below top of collar. Pump rate approx. 2L/min.

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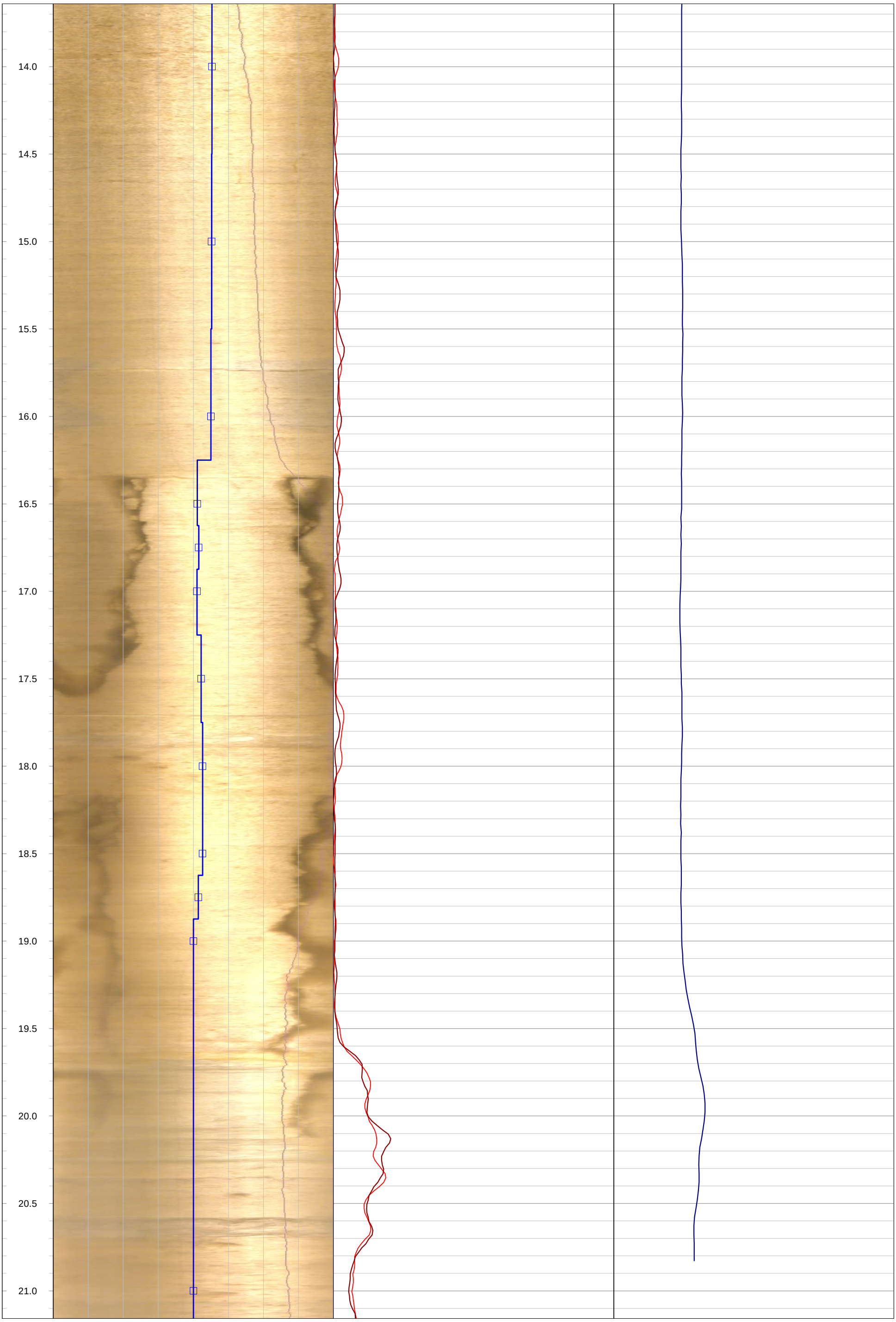
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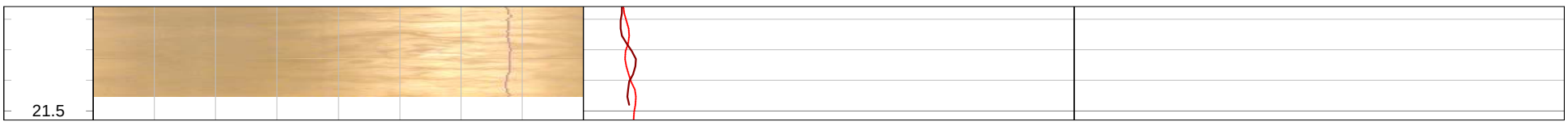

21.5

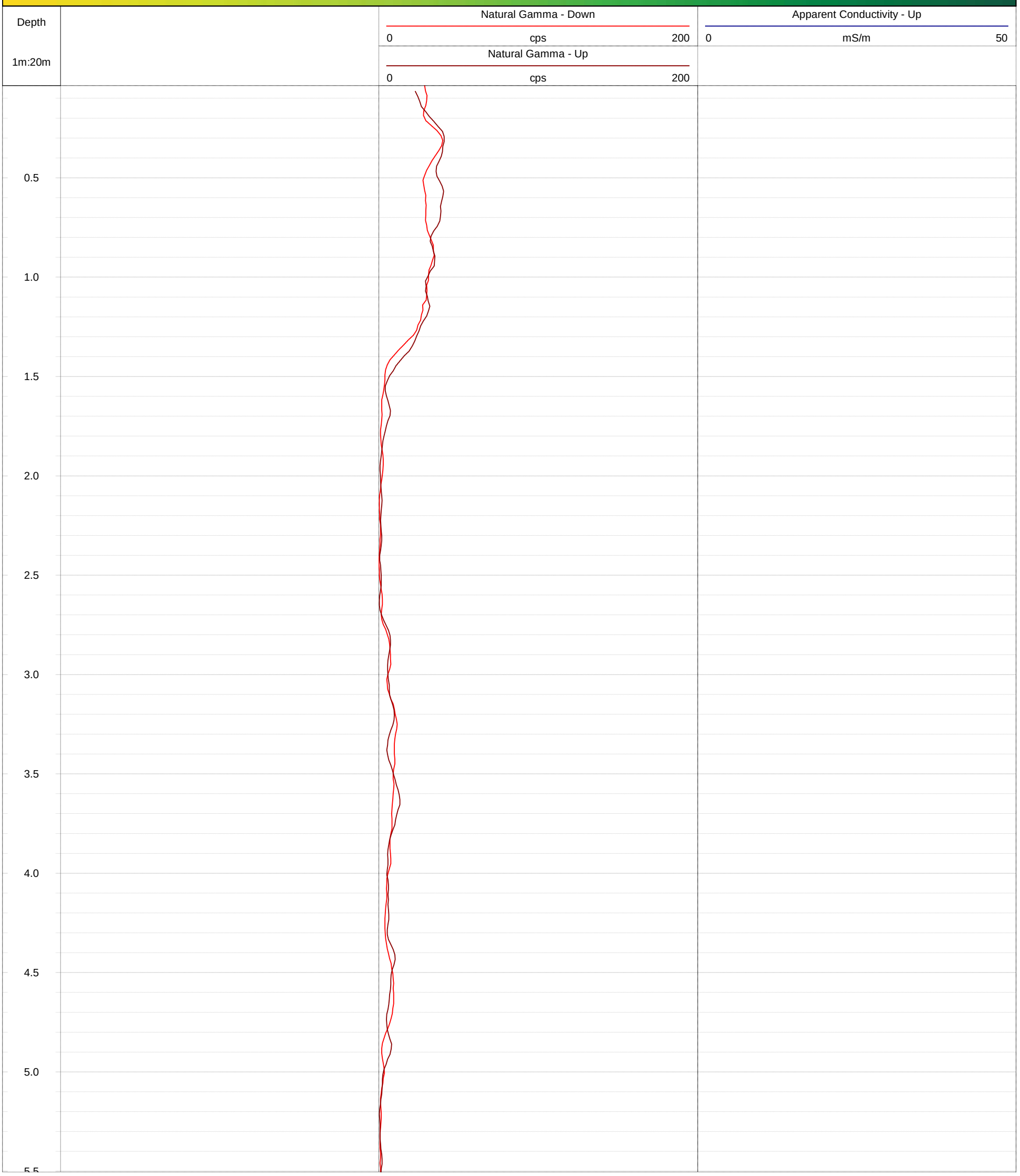
GOLDER
MEMBER OF WSP

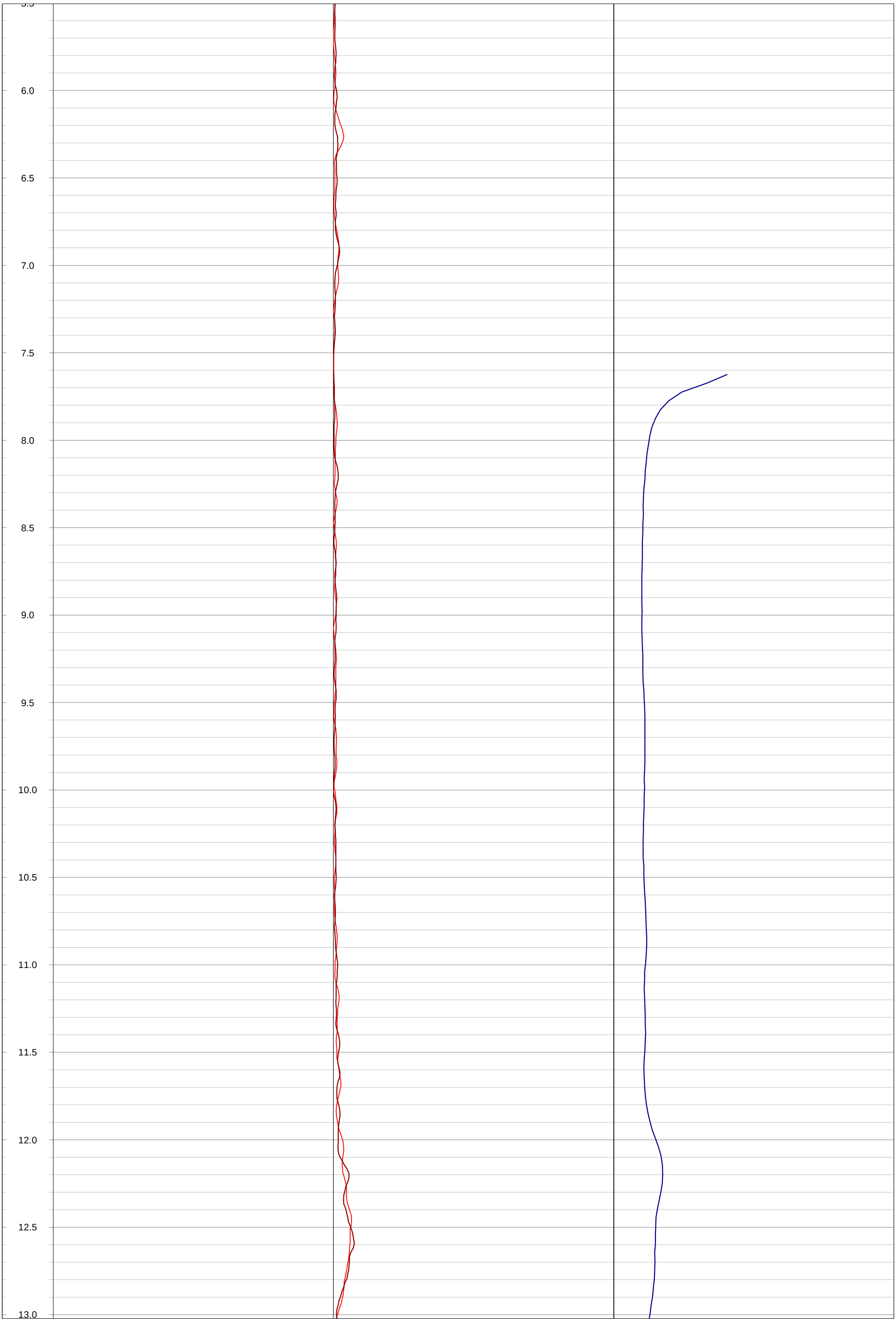
Geophysical Record of Borehole: JHL-BH1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577246.61 m	**Drilled Depth:**	19.70 m bgs	**Water Level:**	3.00 m bgs	**Log Date:**	Apr-14-2021
Northing:	4854243.60 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	410.20 m asl	**Casing Diameter:**	102 mm	**Casing Stickup:**	0.65 m ags	**Logged By:**	PG

Notes:

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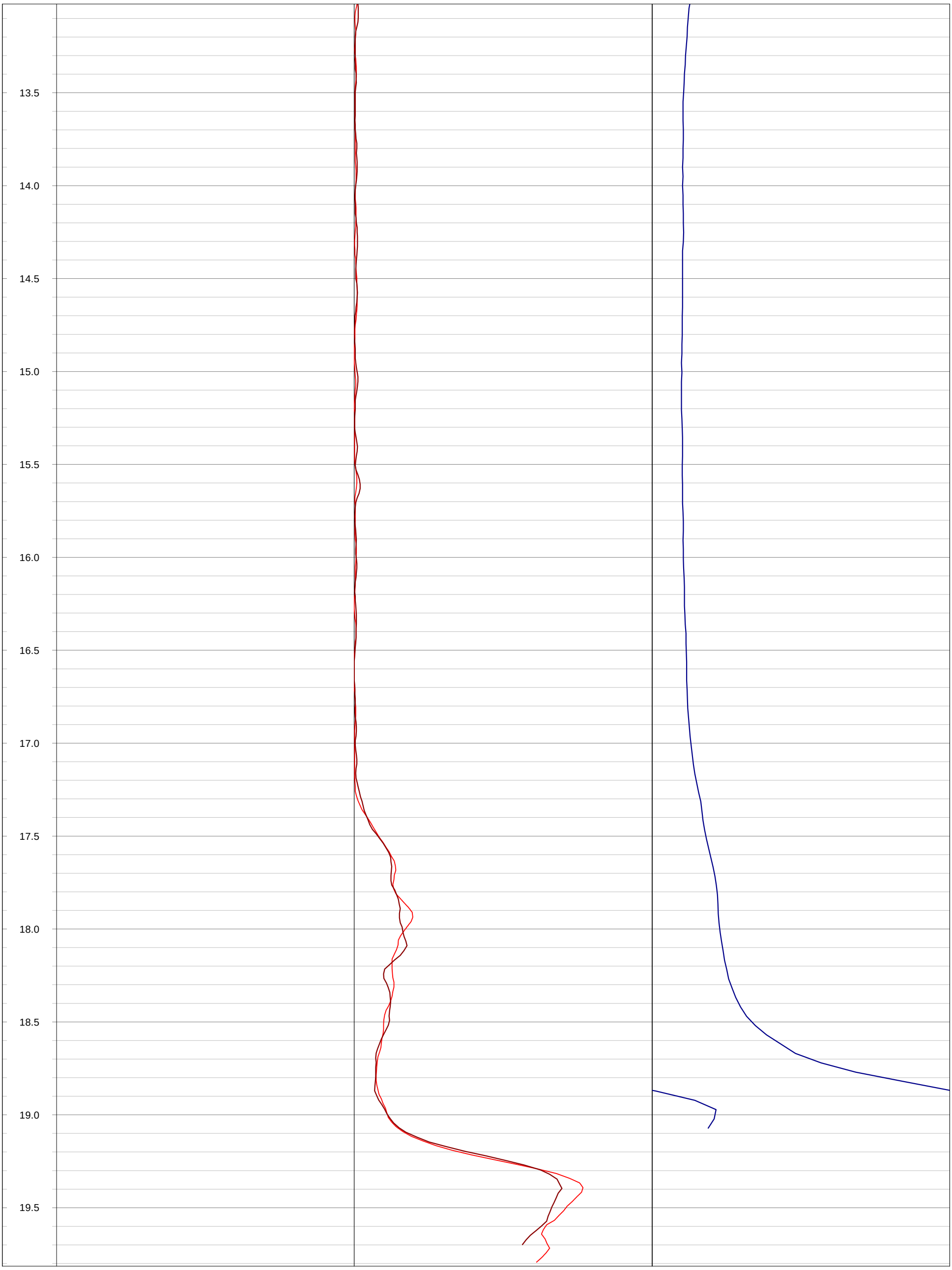
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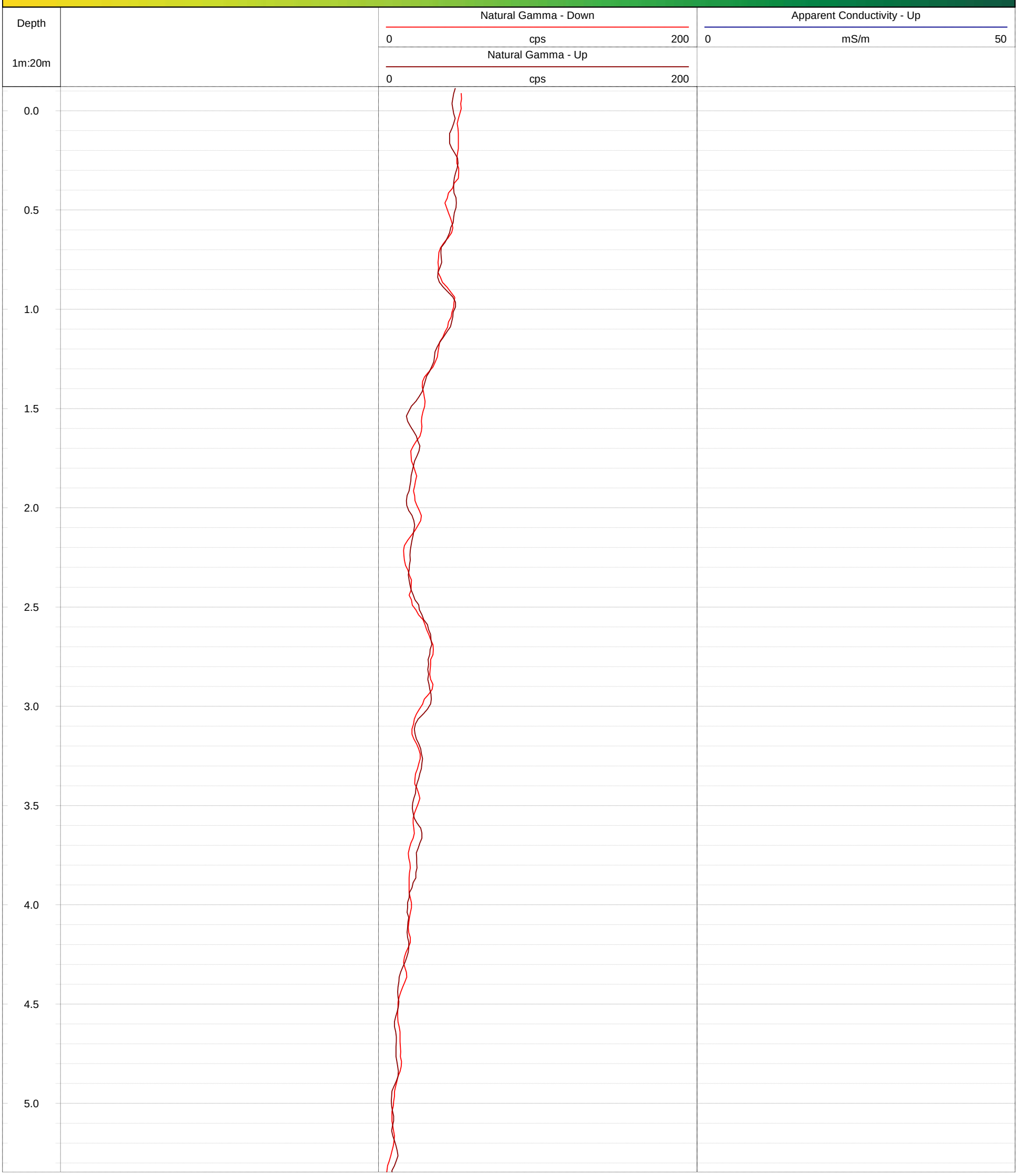
GOLDER
MEMBER OF WSP

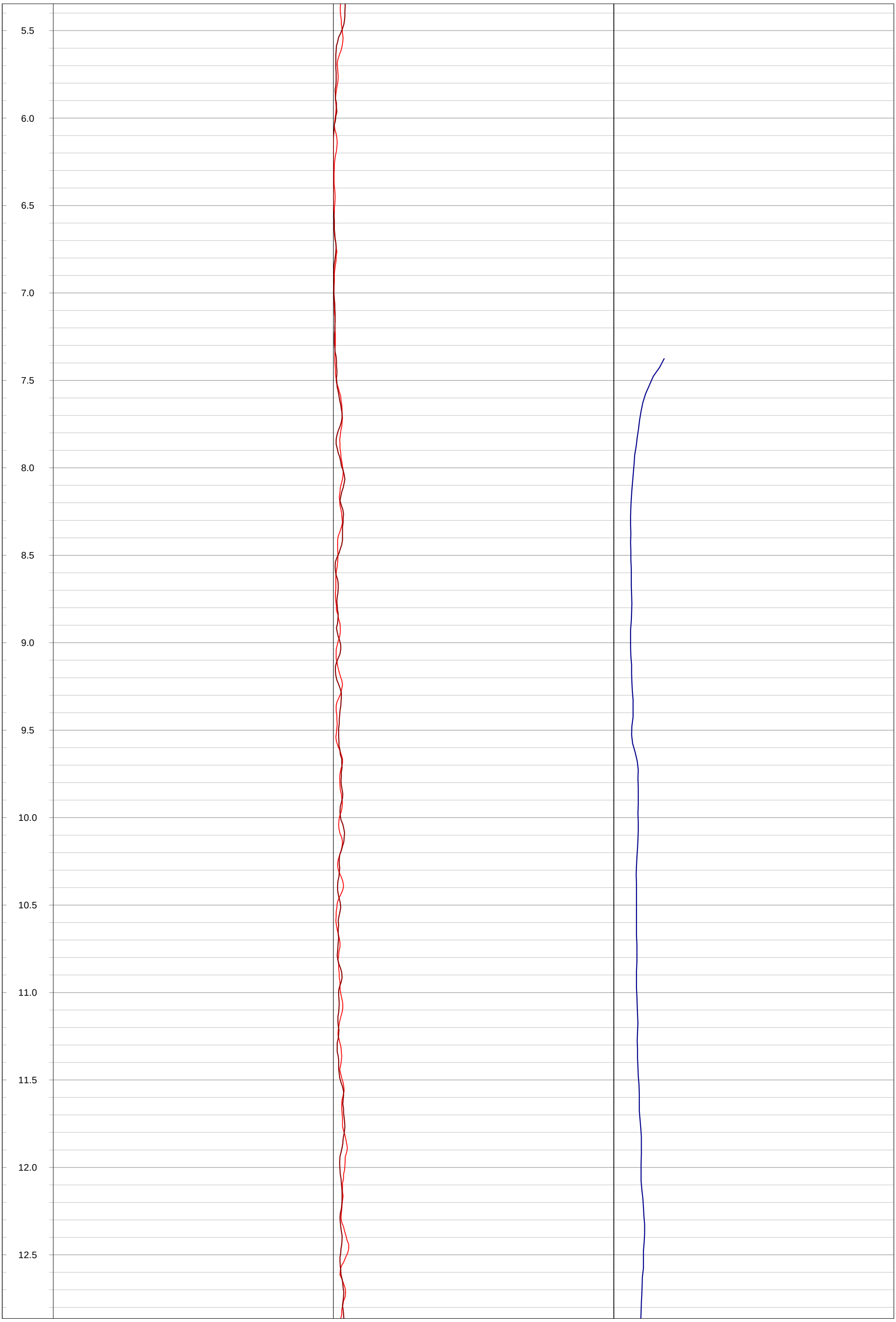
Geophysical Record of Borehole: JHL-BH16 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577894.81 m	**Drilled Depth:**	19.90 m bgs	**Water Level:**	9.69 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854252.89 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	411.53 m asl	**Casing Diameter:**	76 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:

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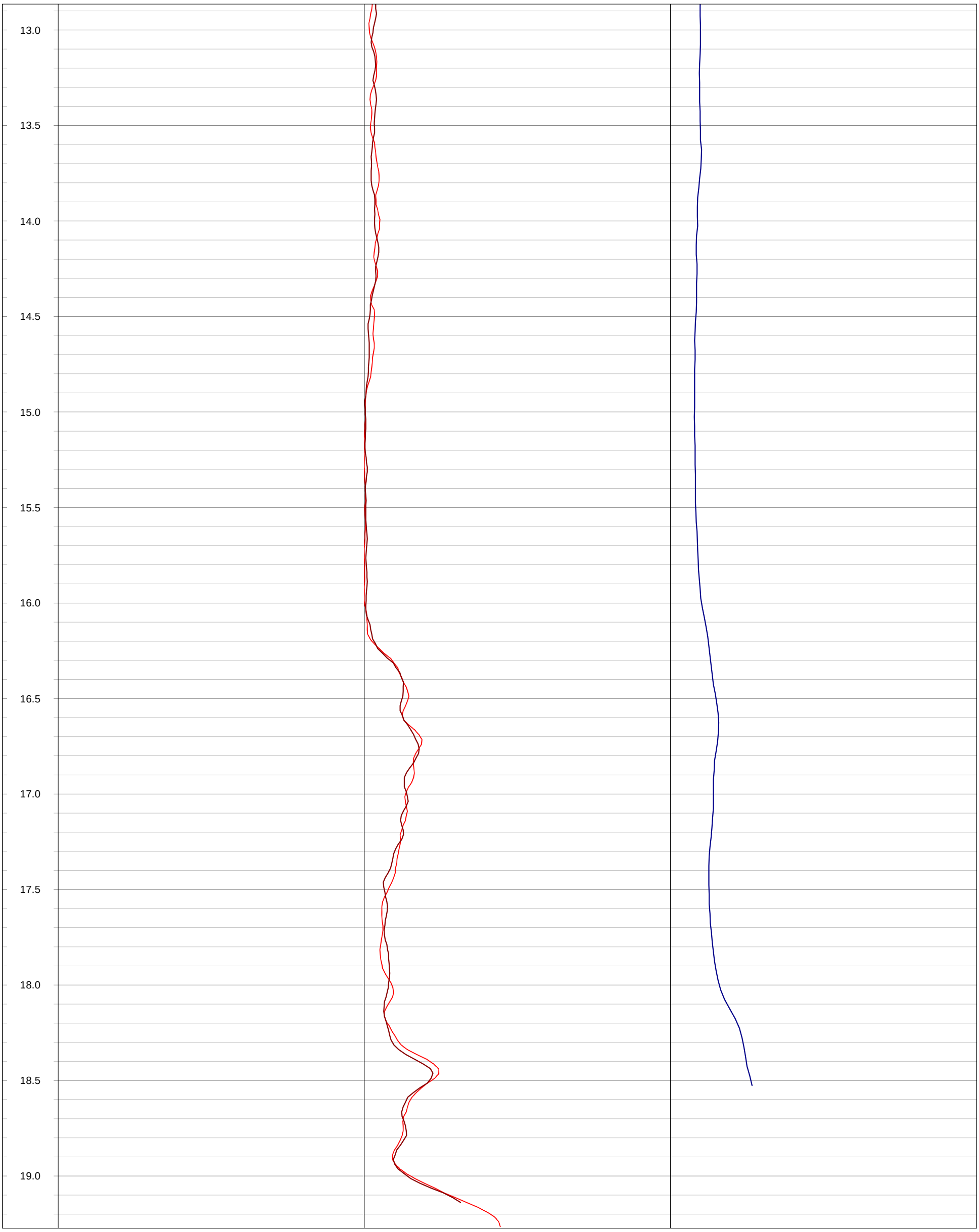
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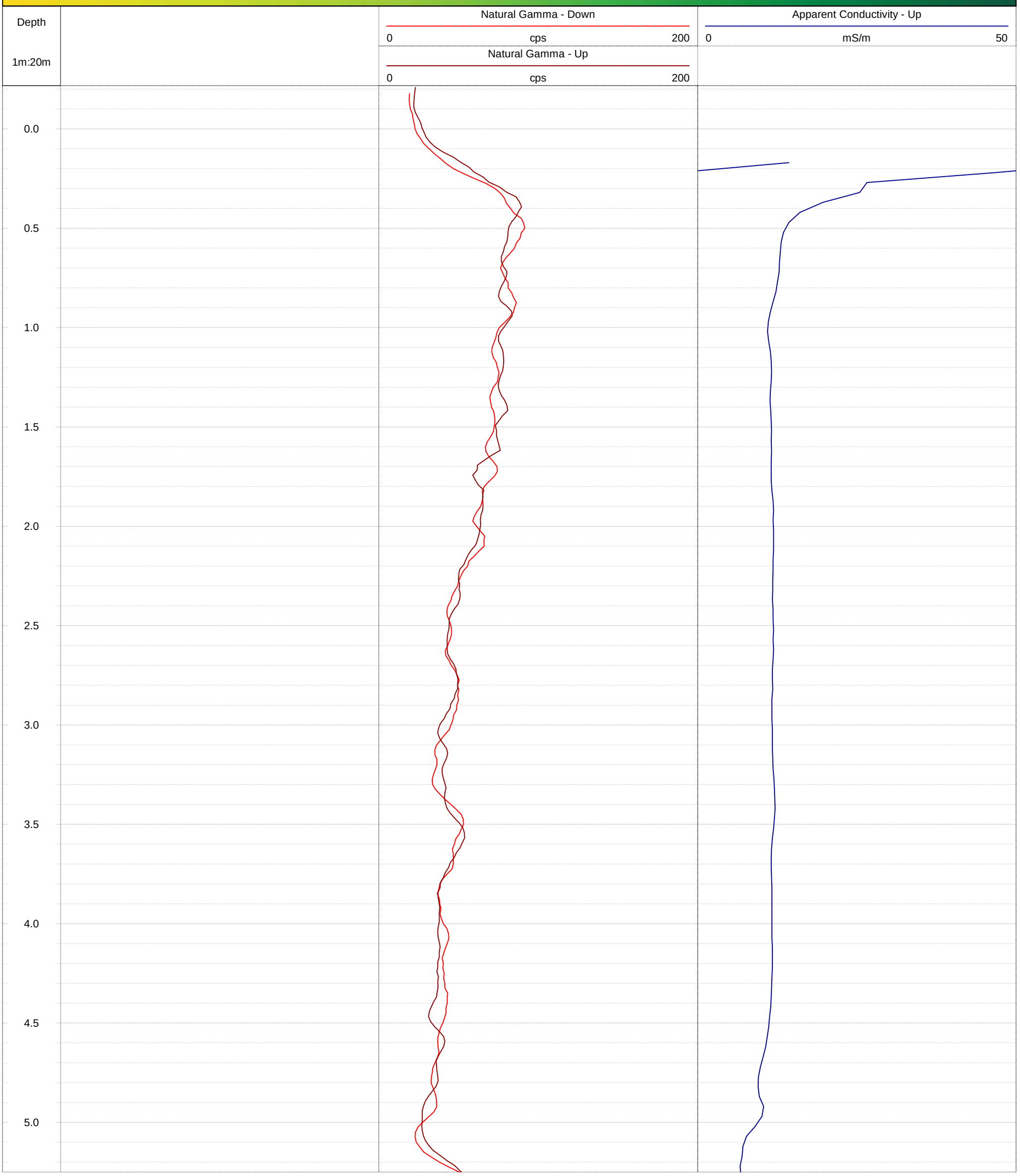
GOLDER
MEMBER OF WSP

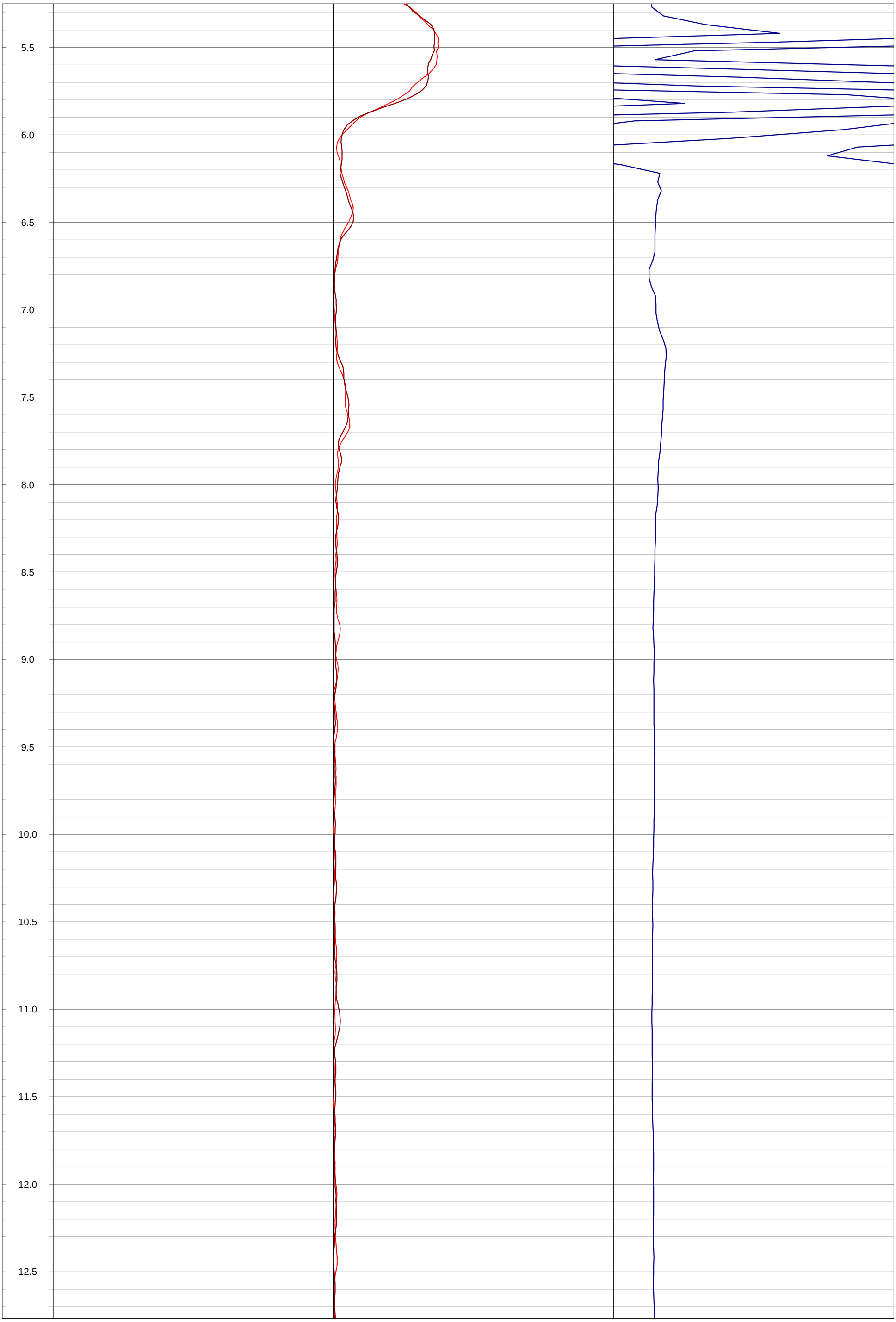
Geophysical Record of Borehole: JHL-BH17 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	578028.61 m	**Drilled Depth:**	18.85 m bgs	**Water Level:**	6.58 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854138.05 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	408.11 m asl	**Casing Diameter:**	51 mm	**Casing Stickup:**	0.87 m ags	**Logged By:**	PG

Notes: 2" I.D. PVC pipe visible at surface, suspect some remnants of a metal casing near 5.8 m bgs

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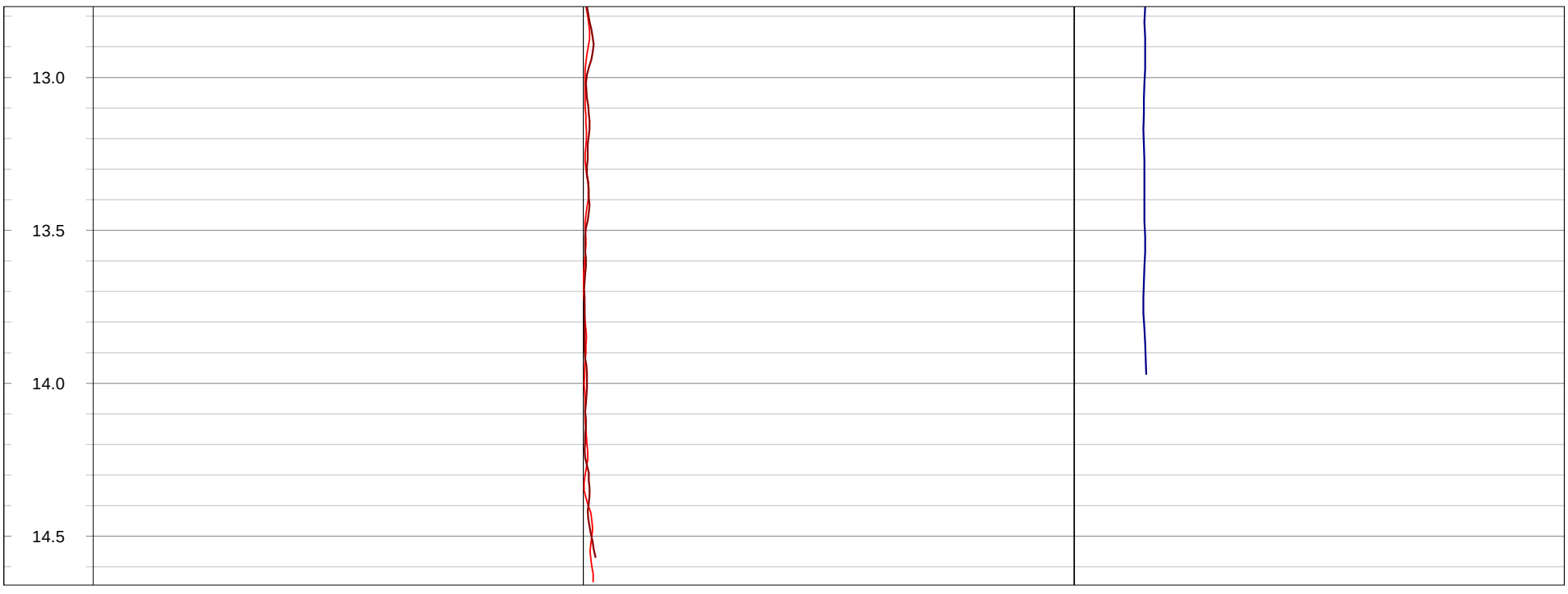
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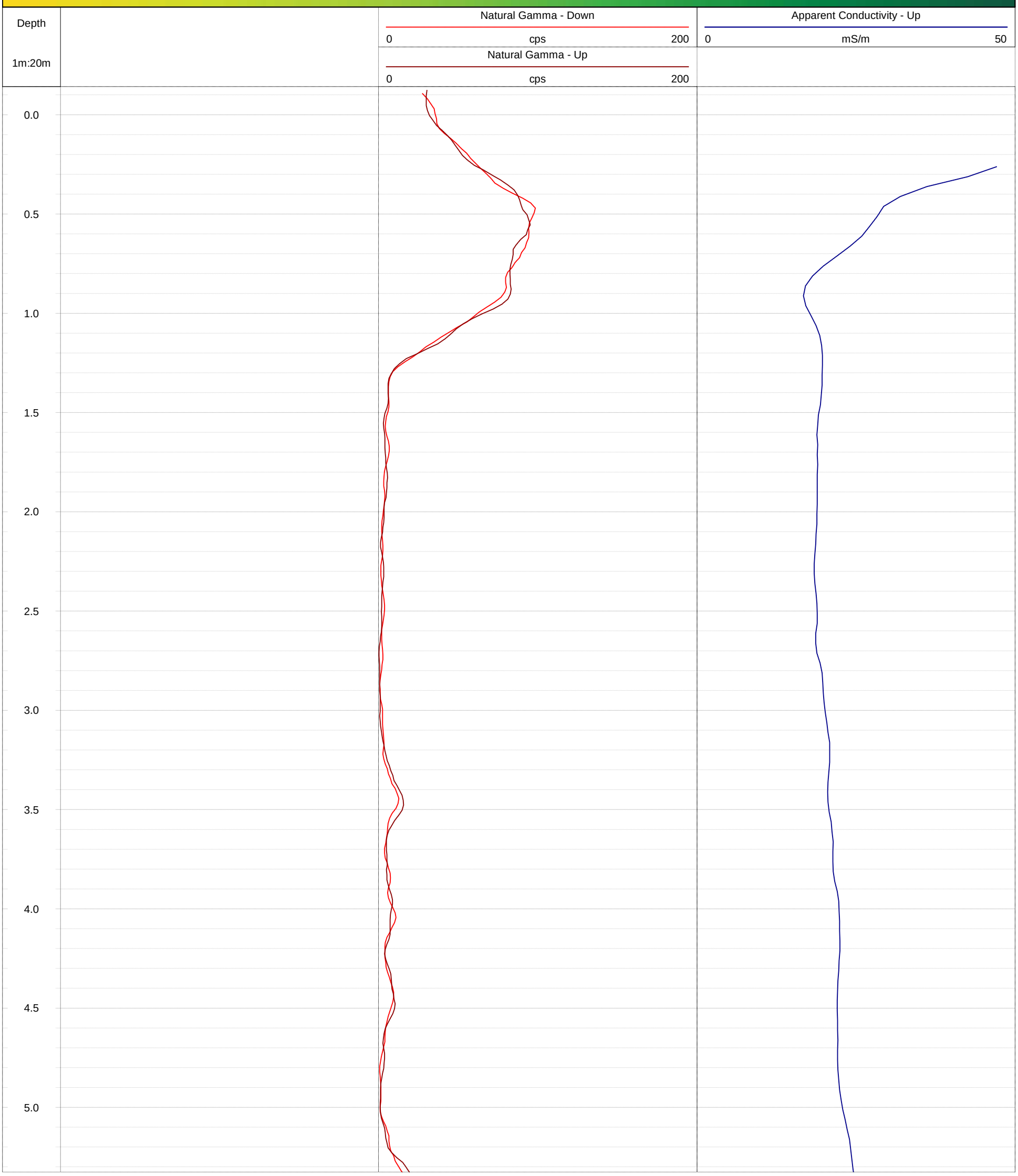
GOLDER
MEMBER OF WSP

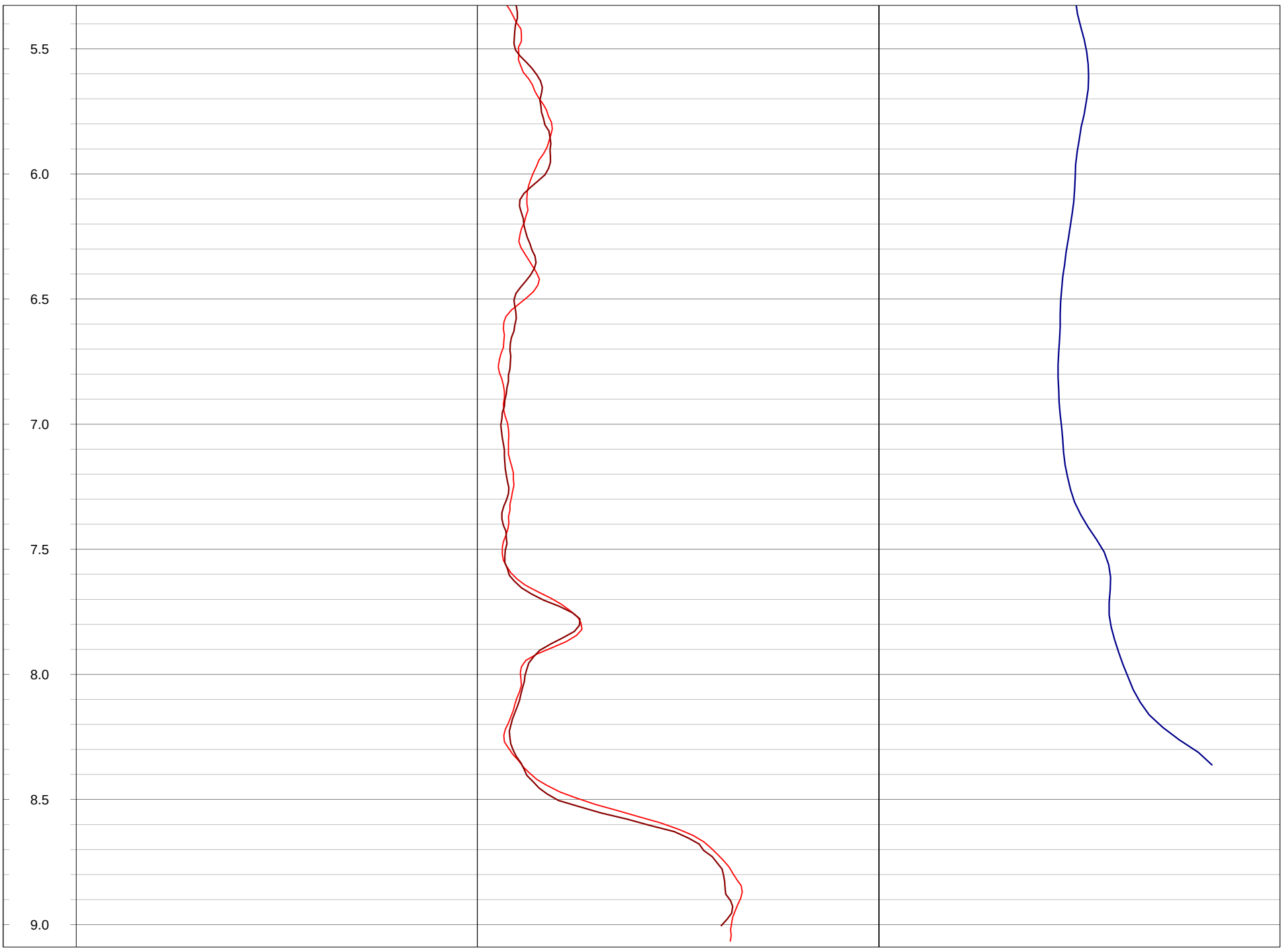
Geophysical Record of Borehole: JHL-BH18 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	578153.75 m	**Drilled Depth:**	9.2 m bgs	**Water Level:**	3.36 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854324.05 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	400.69 m asl	**Casing Diameter:**	51 mm	**Casing Stickup:**	0.79 m ags	**Logged By:**	PG

Notes: 2" I.D. PVC pipe visible at surface, possible remnants of metal casing near surface.

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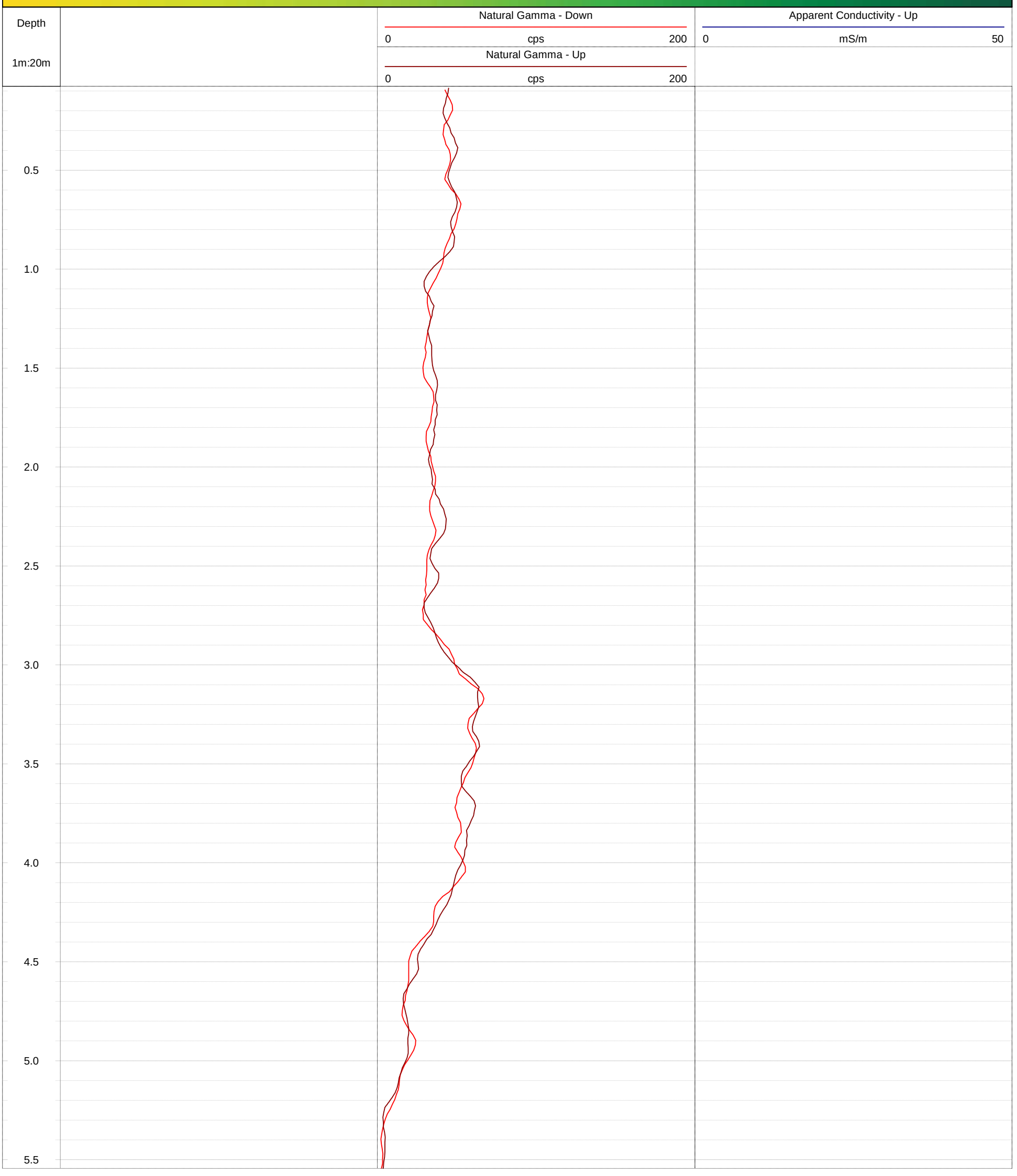
GOLDER
MEMBER OF WSP

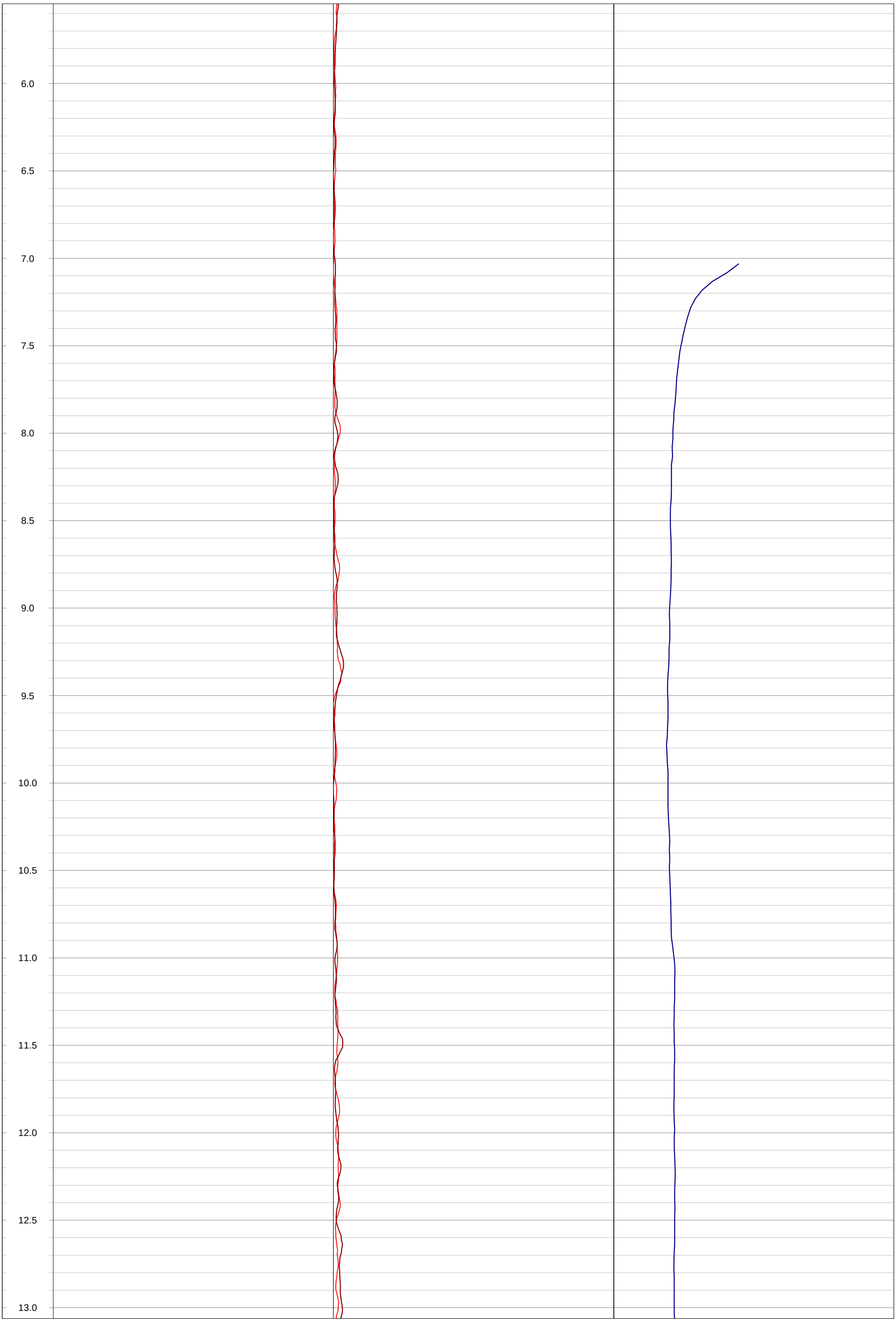
Geophysical Record of Borehole: JHL-BH19 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577482.68 m	**Drilled Depth:**	24.50 m bgs	**Water Level:**	11.00 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854486.38 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	414.13 m asl	**Casing Diameter:**	76 mm	**Casing Stickup:**	0.60 m ags	**Logged By:**	PG

Notes:

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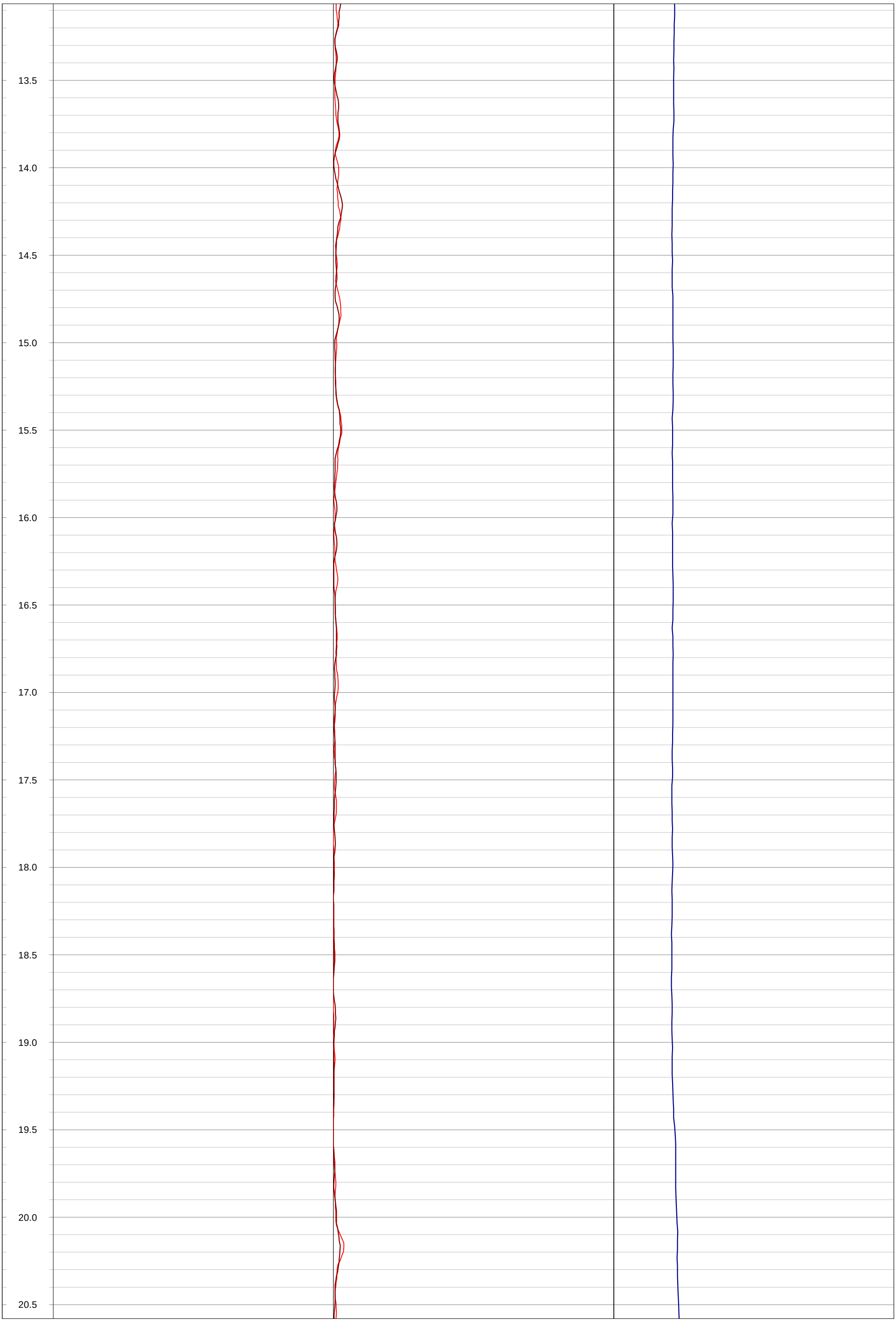
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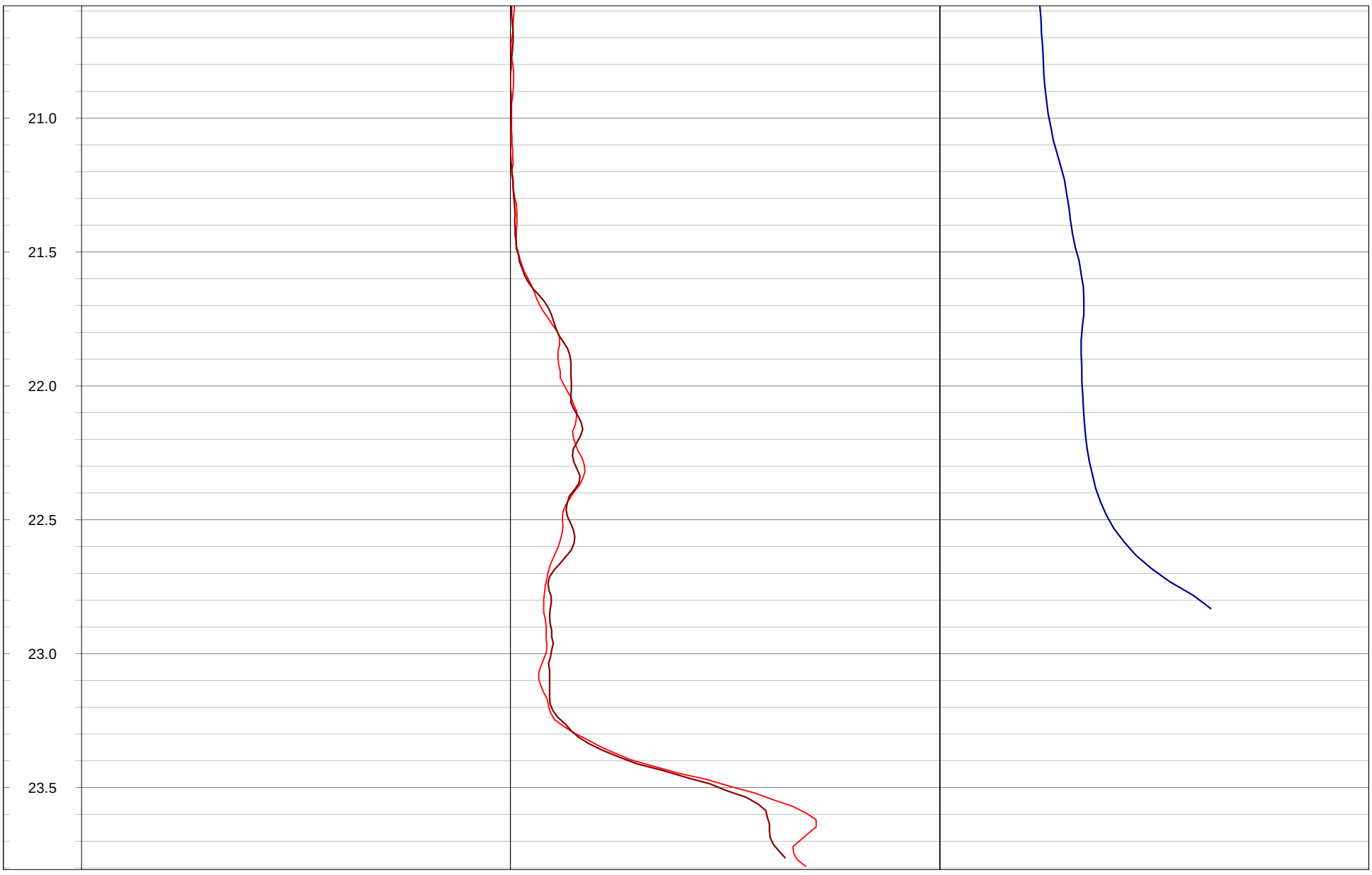
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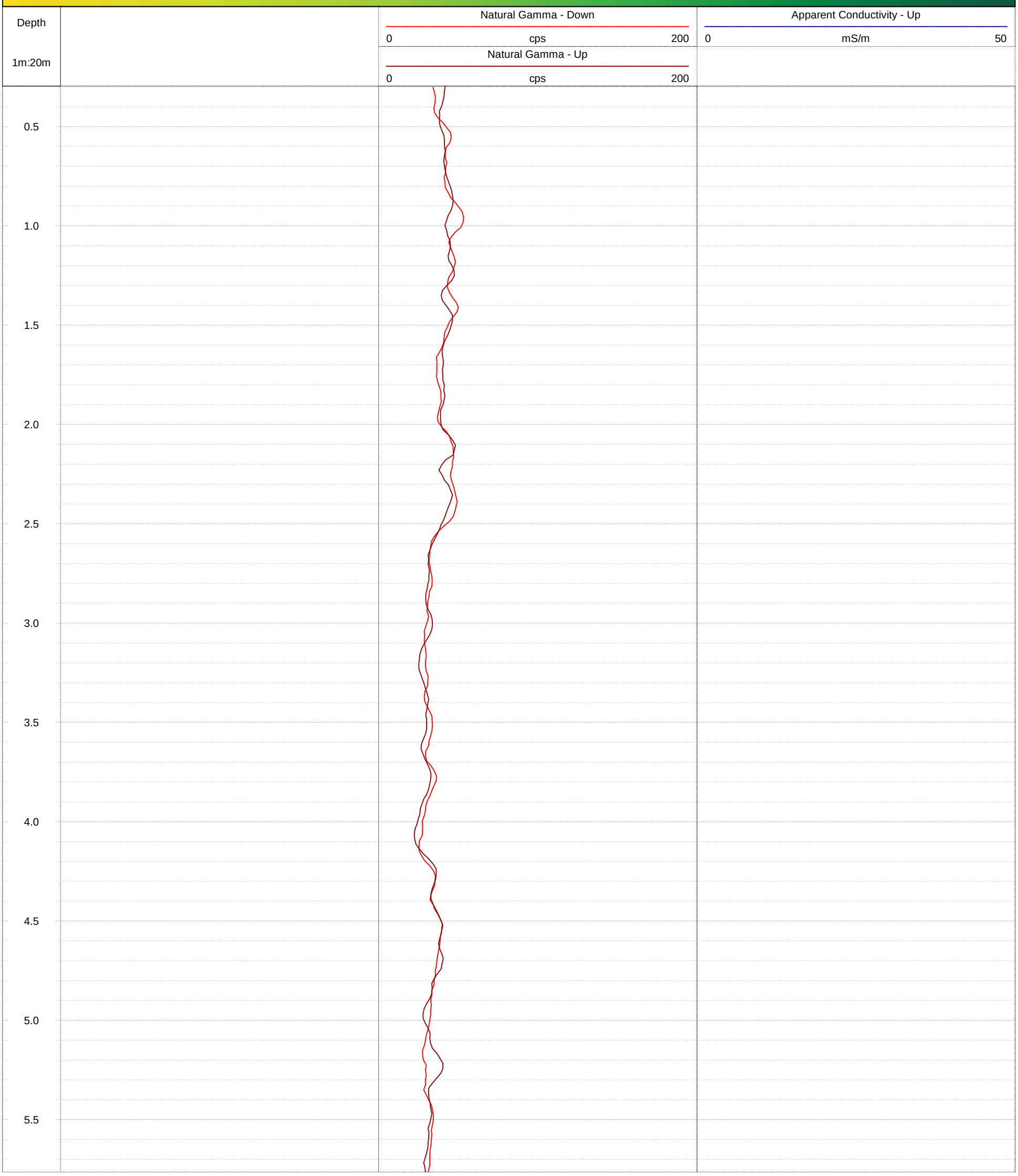
GOLDER
MEMBER OF WSP

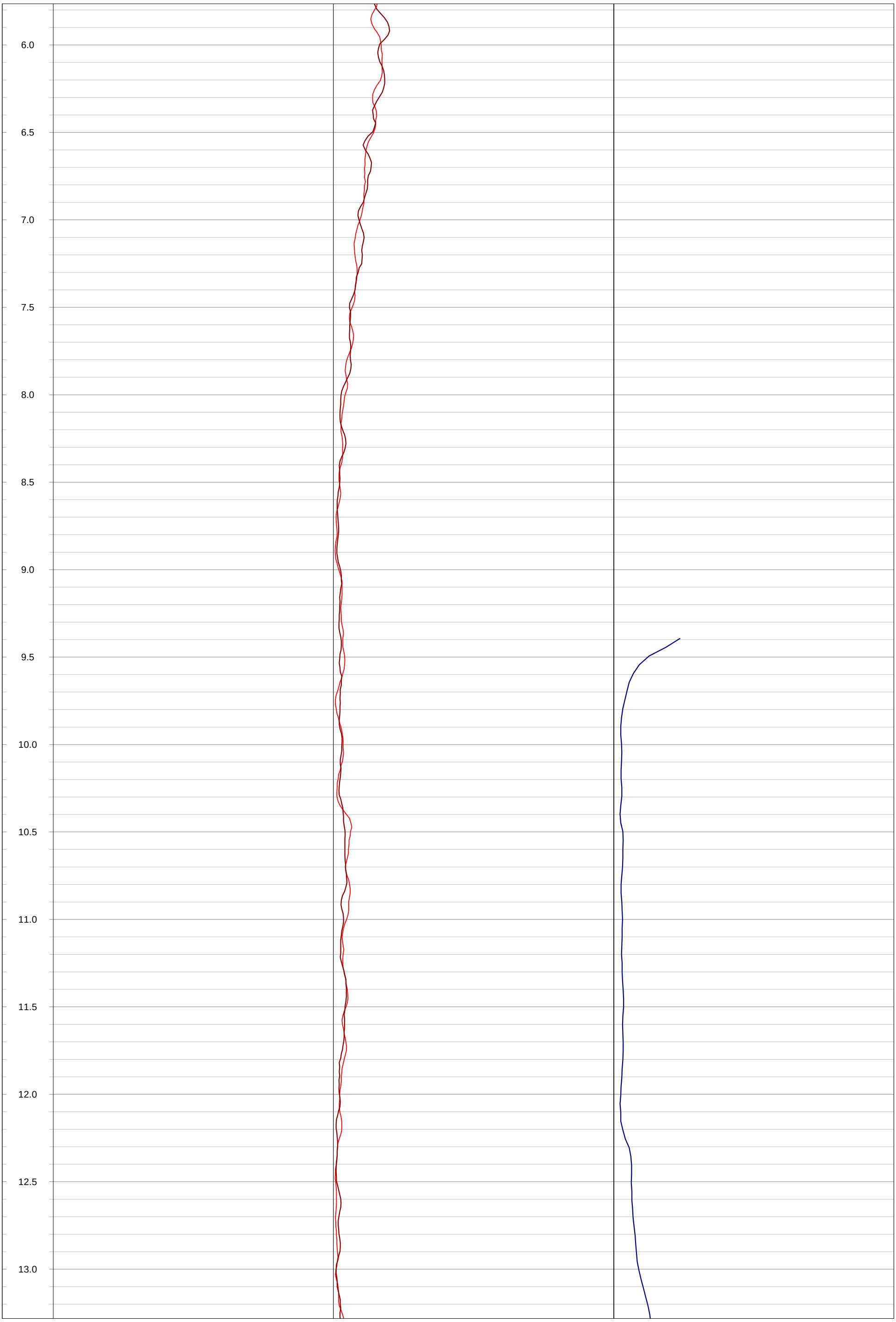
Geophysical Record of Borehole: Unknown BH2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577689.54 m	**Drilled Depth:**	n/a	**Water Level:**	11.60 m bgs	**Log Date:**	Apr-14-2021
Northing:	4854266.72 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	n/a	**Casing Diameter:**	102 mm	**Casing Stickup:**	0.40 m ags	**Logged By:**	PG

Notes:

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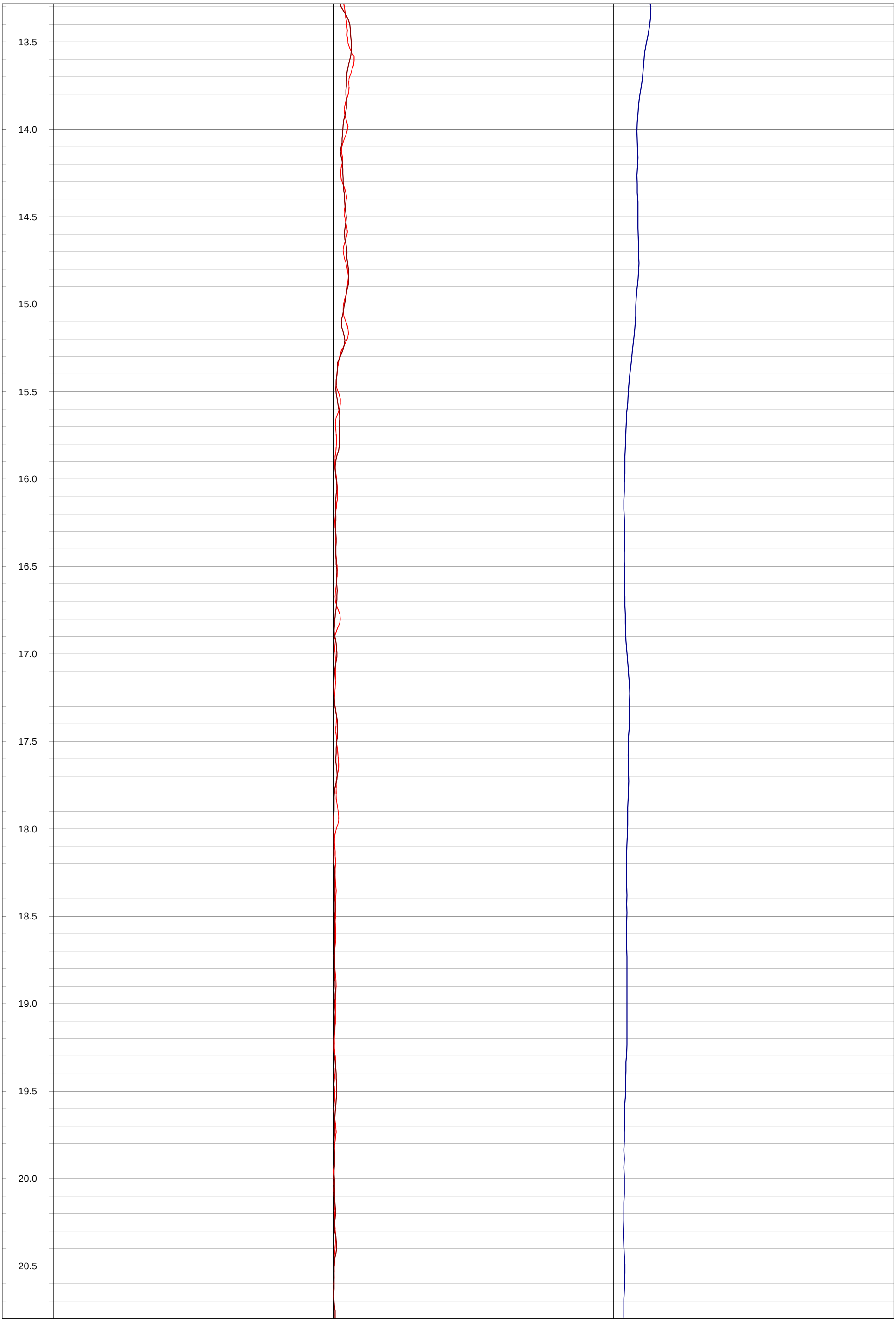
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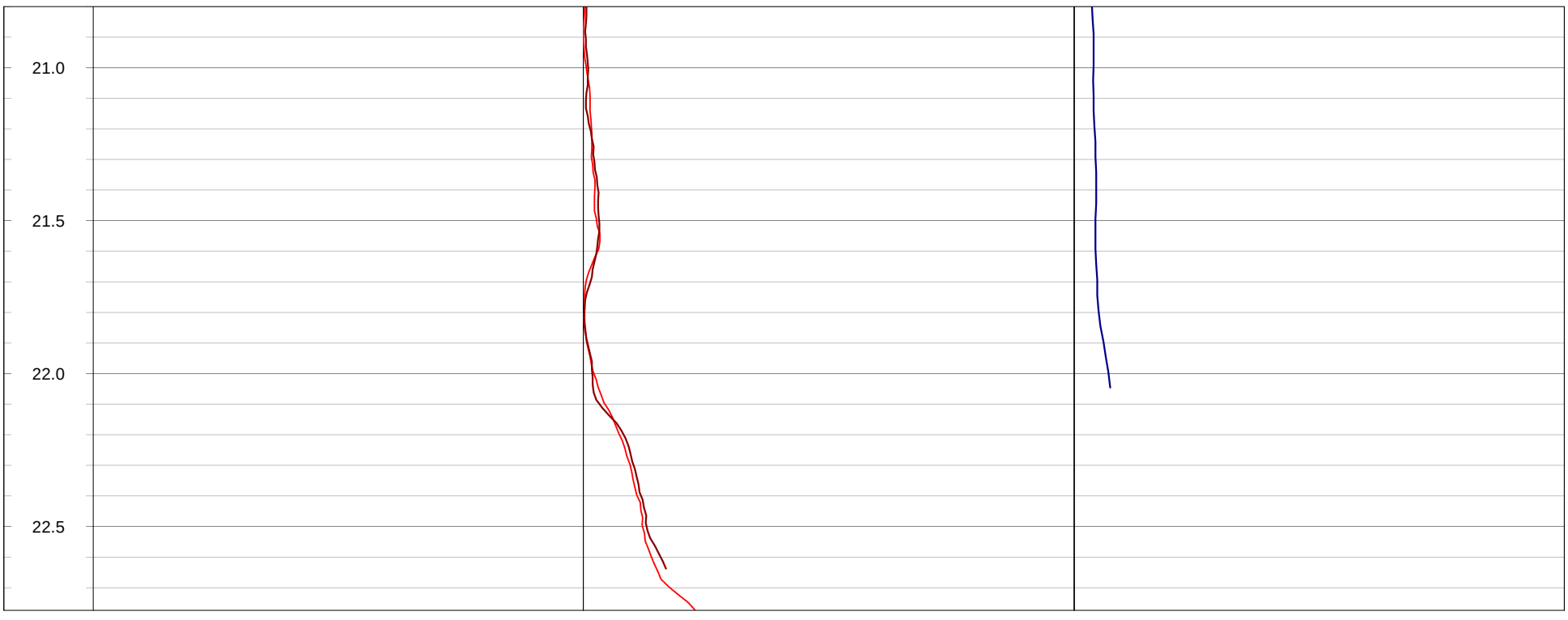
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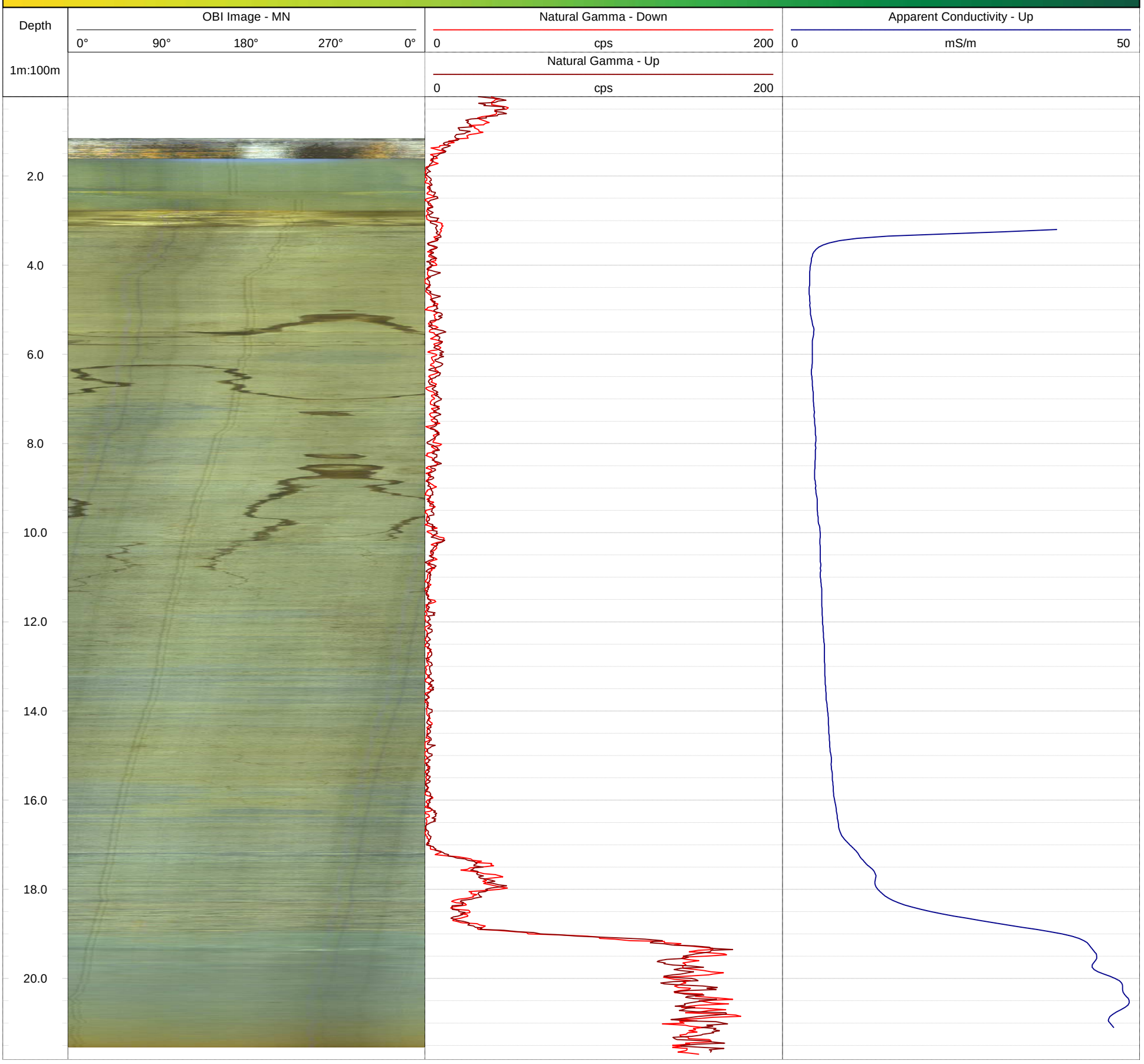
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-01 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.75 m bgs	**Location:**	Caledon, Ontario
Easting:	578000.61 m	**Drilled Depth:**	22.07 m bgs	**Water Level:**	1.6 m bgs	**Log Date:**	Feb-18-2020
Northing:	4853292.80 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.80 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	CM

Notes: OBI image is opaque > 21.60m



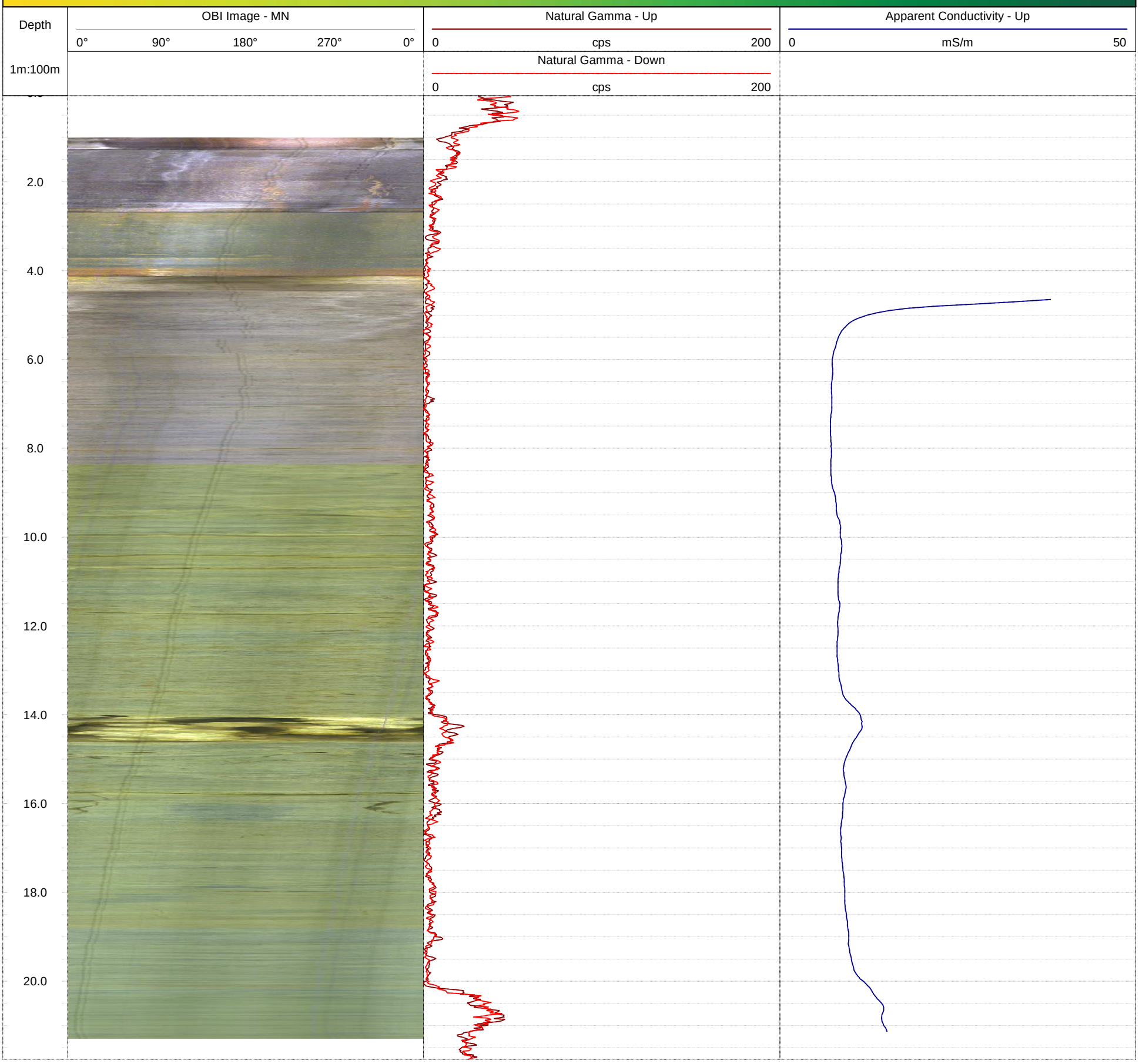
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	4.11 m bgs	**Location:**	Caledon, Ontario
Easting:	577839.36 m	**Drilled Depth:**	22.02 m bgs	**Water Level:**	2.70 m bgs	**Log Date:**	Feb-18-2020
Northing:	4853078.92 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.52 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.61 m ags	**Logged By:**	CM

Notes:



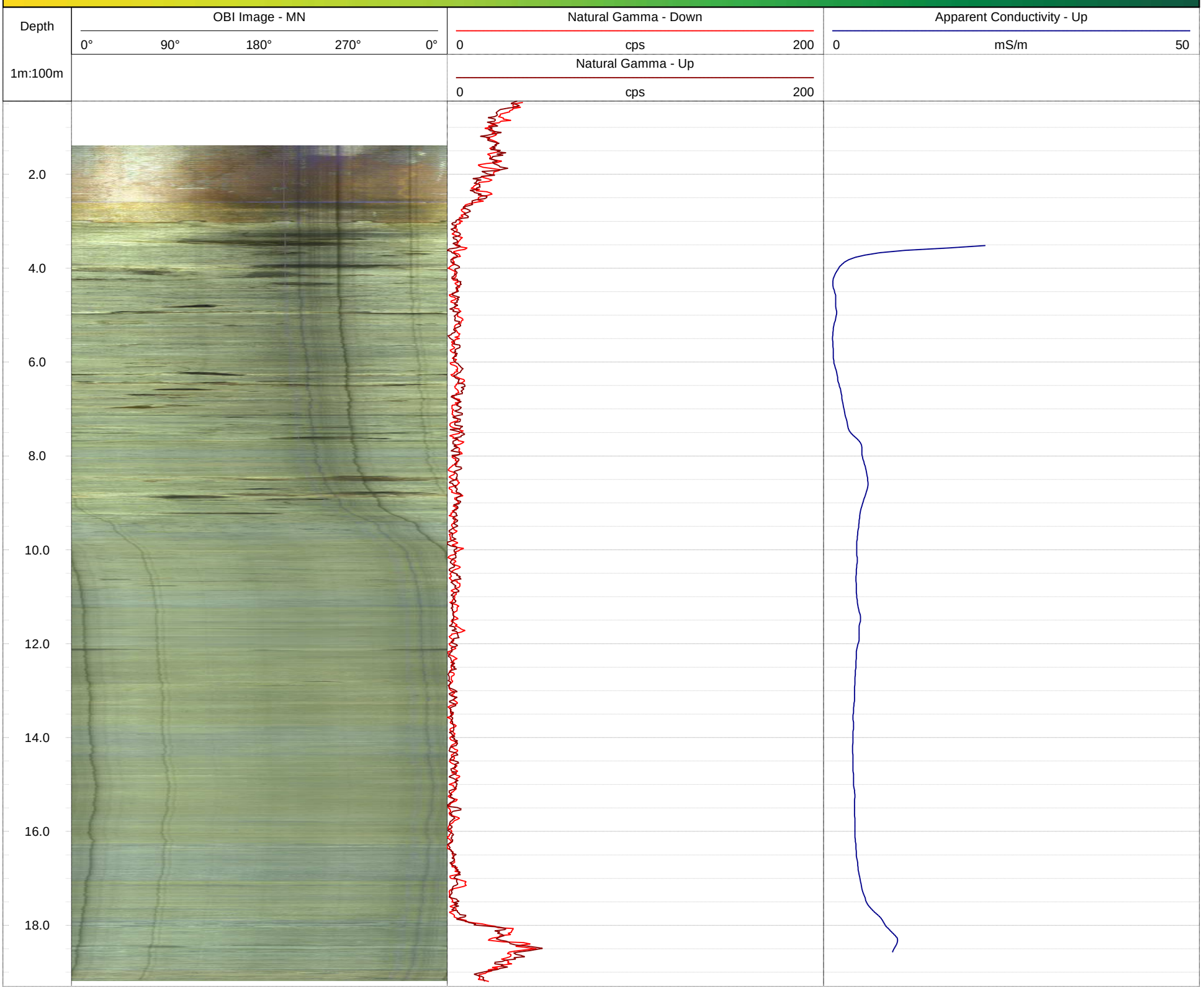
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-03 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.03 m bgs	**Location:**	Caledon, Ontario
Easting:	577655.12 m	**Drilled Depth:**	19.33 m bgs	**Water Level:**	7.14 m bgs	**Log Date:**	Mar-10-2020
Northing:	4852796.26 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	402.91 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.23 m ags	**Logged By:**	CM

Notes:



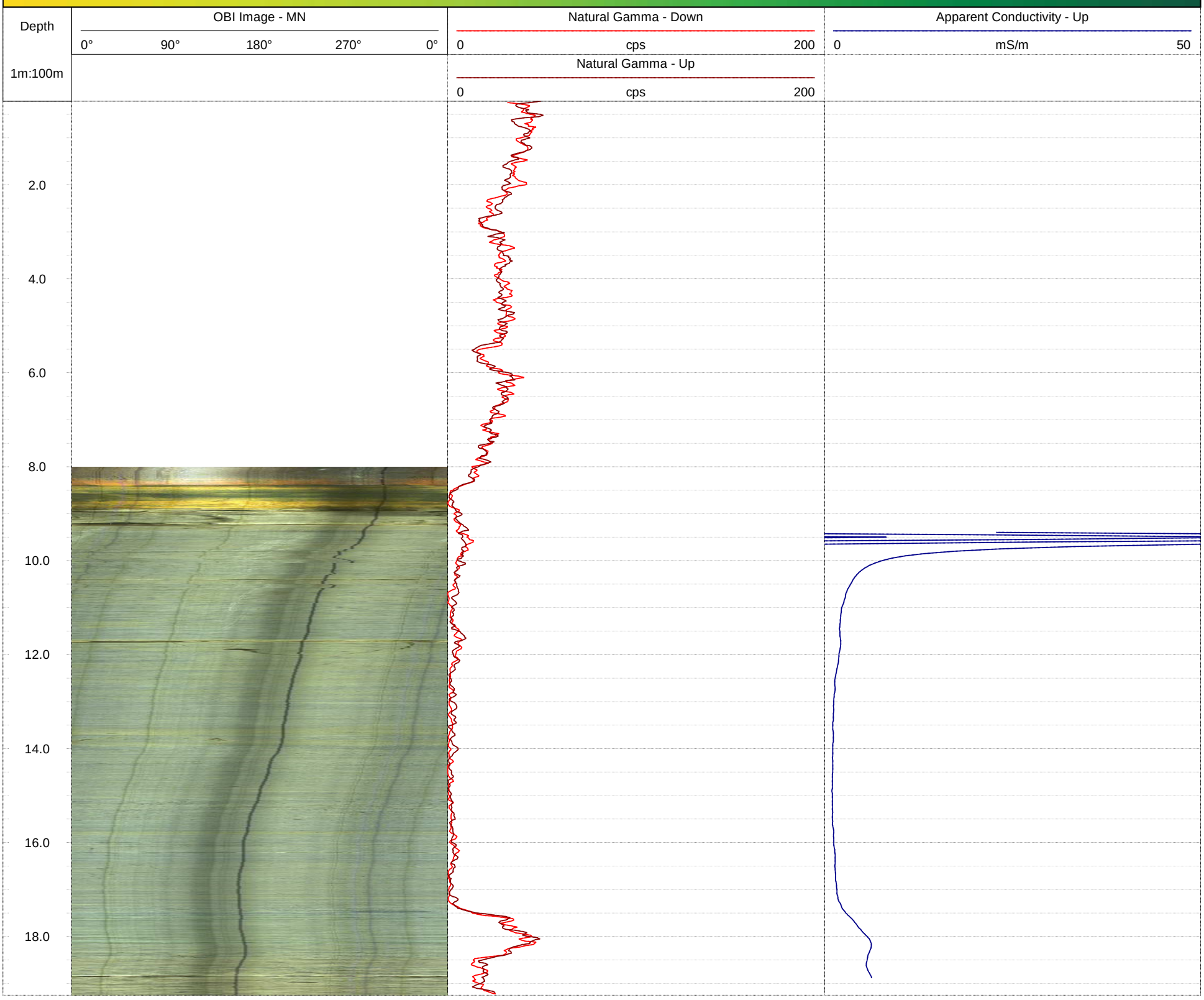
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-04 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.89 m bgs	**Location:**	Caledon, Ontario
Easting:	577511.78 m	**Drilled Depth:**	19.57 m bgs	**Water Level:**	8.31 m bgs	**Log Date:**	Feb-24-2020
Northing:	4852528.07 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	400.81 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	CM

Notes:



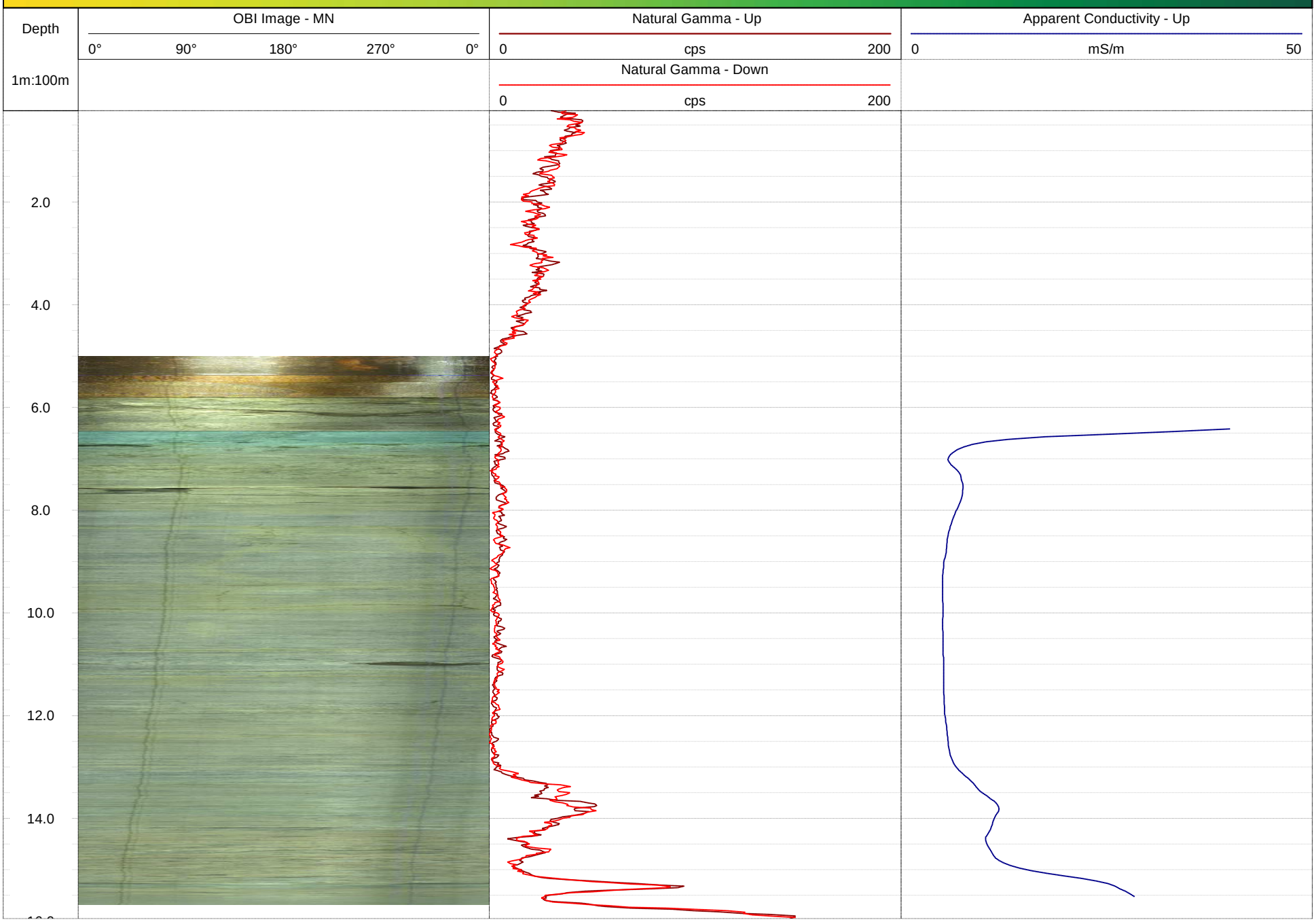
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-05 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.81 m bgs	**Location:**	Caledon, Ontario
Easting:	577786.25 m	**Drilled Depth:**	16.35 m bgs	**Water Level:**	6.51 m bgs	**Log Date:**	Feb-24-2020
Northing:	4852520.23 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	398.83 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.48 m ags	**Logged By:**	CM

Notes: OBI image dark > 15.5 m bgs



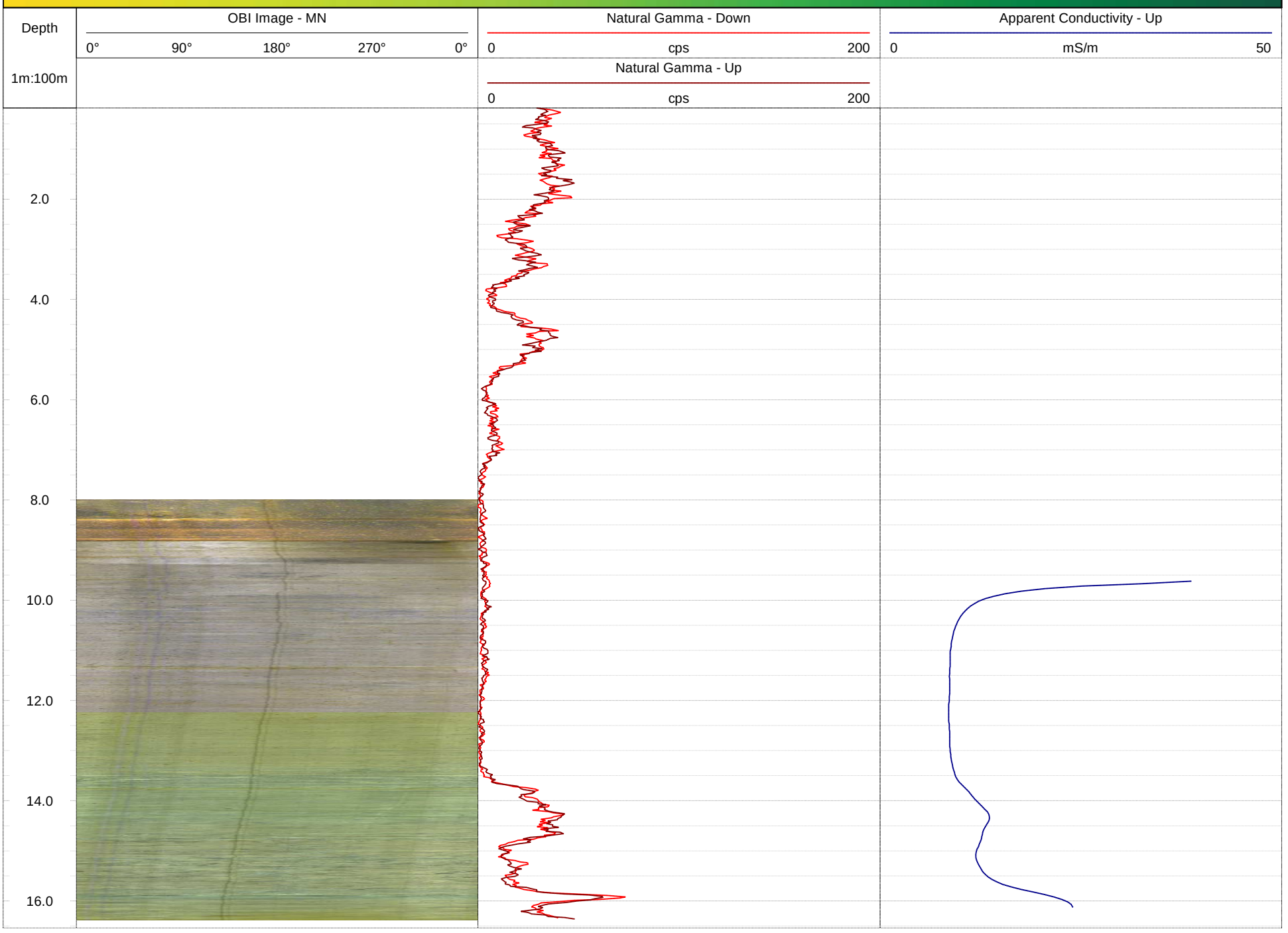
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-06 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.83 m bgs	**Location:**	Caledon, Ontario
Easting:	578056.45 m	**Drilled Depth:**	16.60 m bgs	**Water Level:**	5.49 m bgs	**Log Date:**	Feb-25-2020
Northing:	4852520.24 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	397.70 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.51 m ags	**Logged By:**	CM

Notes:



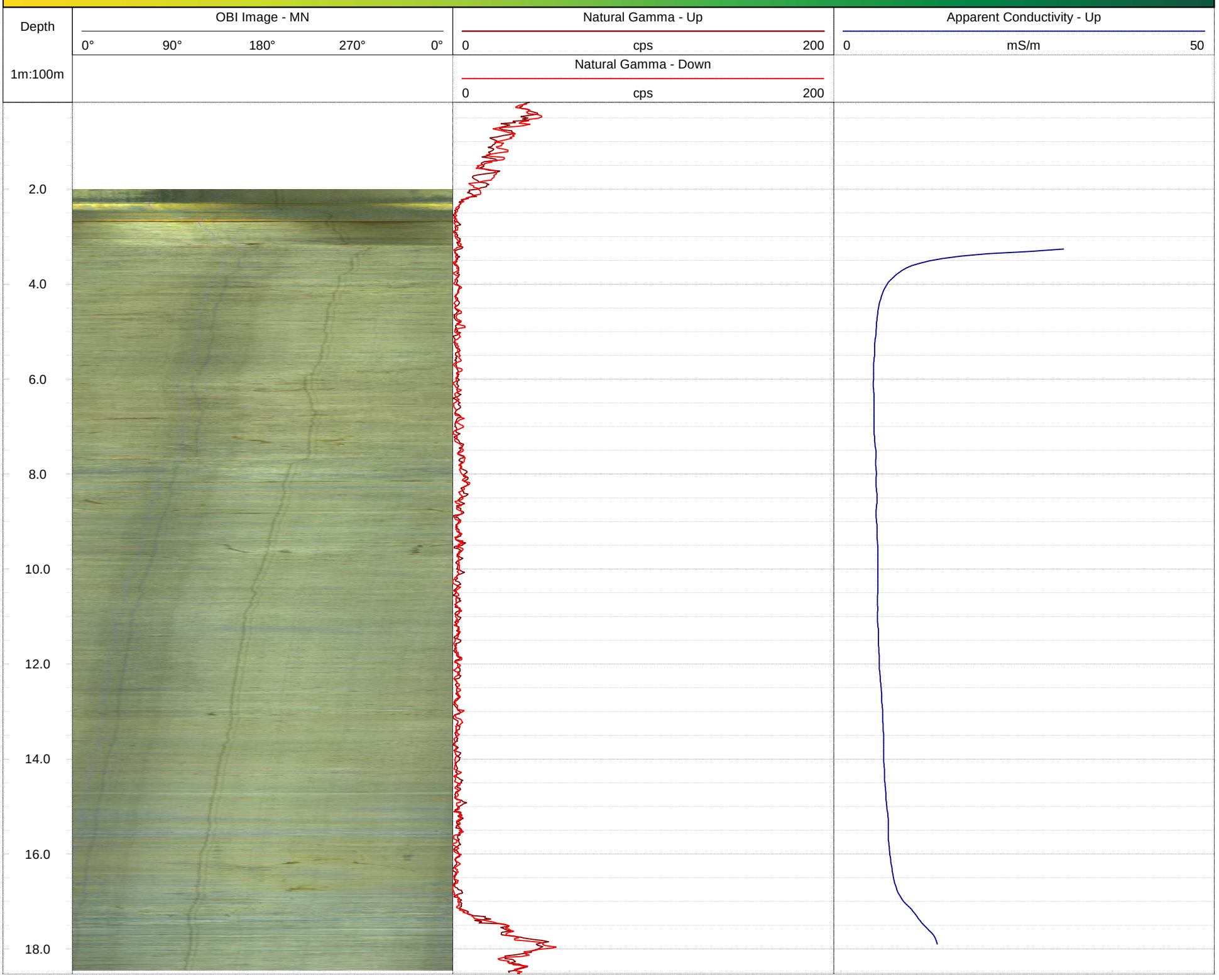
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-07 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.69 m bgs	**Location:**	Caledon, Ontario
Easting:	578129.13 m	**Drilled Depth:**	18.67 m bgs	**Water Level:**	1.40 m bgs	**Log Date:**	Feb-25-2020
Northing:	4853102.34 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.73 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.50 m ags	**Logged By:**	CM

Notes: OBI image is dark >16.40 m bgs



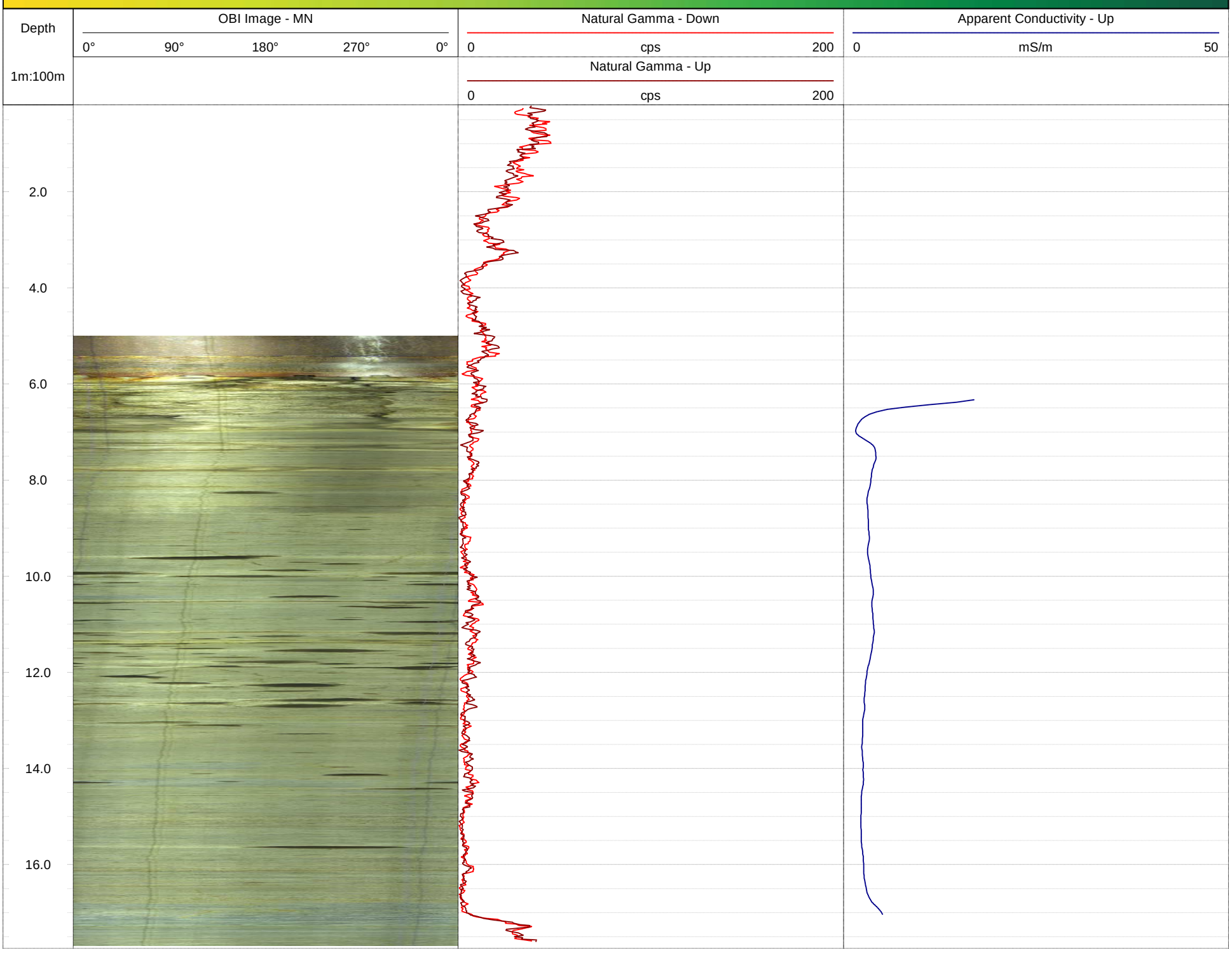
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-08 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.85 m bgs	**Location:**	Caledon, Ontario
Easting:	577961.99 m	**Drilled Depth:**	17.90 m bgs	**Water Level:**	6.64 m bgs	**Log Date:**	Mar-11-2020
Northing:	4852832.00 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.50 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.44 m ags	**Logged By:**	CM

Notes:



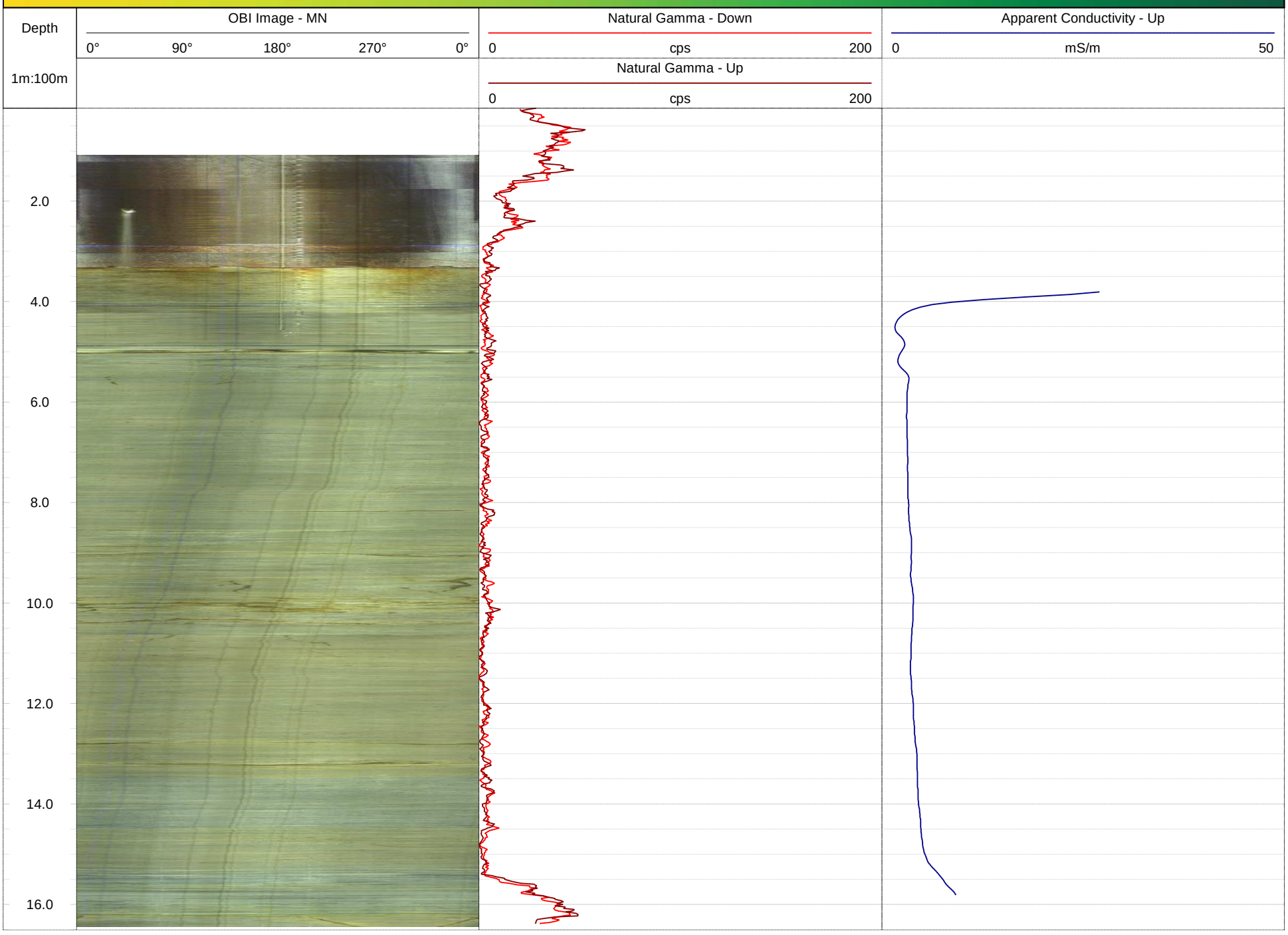
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-09 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.33 m bgs	**Location:**	Caledon, Ontario
Easting:	578186.33 m	**Drilled Depth:**	16.77 m bgs	**Water Level:**	4.95 m bgs	**Log Date:**	Mar-10-2020
Northing:	4852803.00 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	402.26 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.52 m ags	**Logged By:**	CM

Notes:



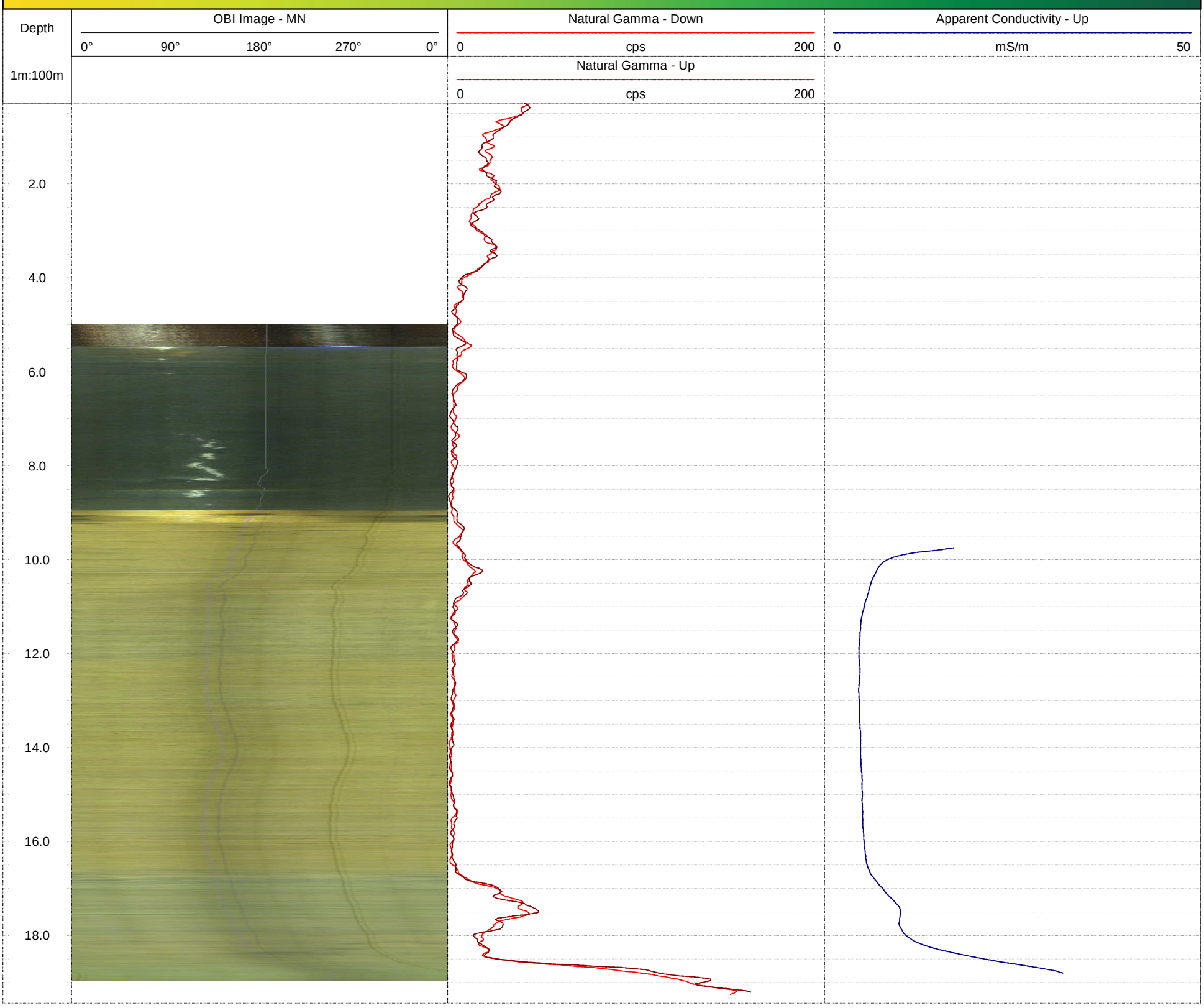
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-10 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.94 m bgs	**Location:**	Caledon, Ontario
Easting:	577940.09 m	**Drilled Depth:**	19.55 m bgs	**Water Level:**	5.29 m bgs	**Log Date:**	Mar-25-2020
Northing:	4853952.34 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	411.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.40 m ags	**Logged By:**	PG

Notes:



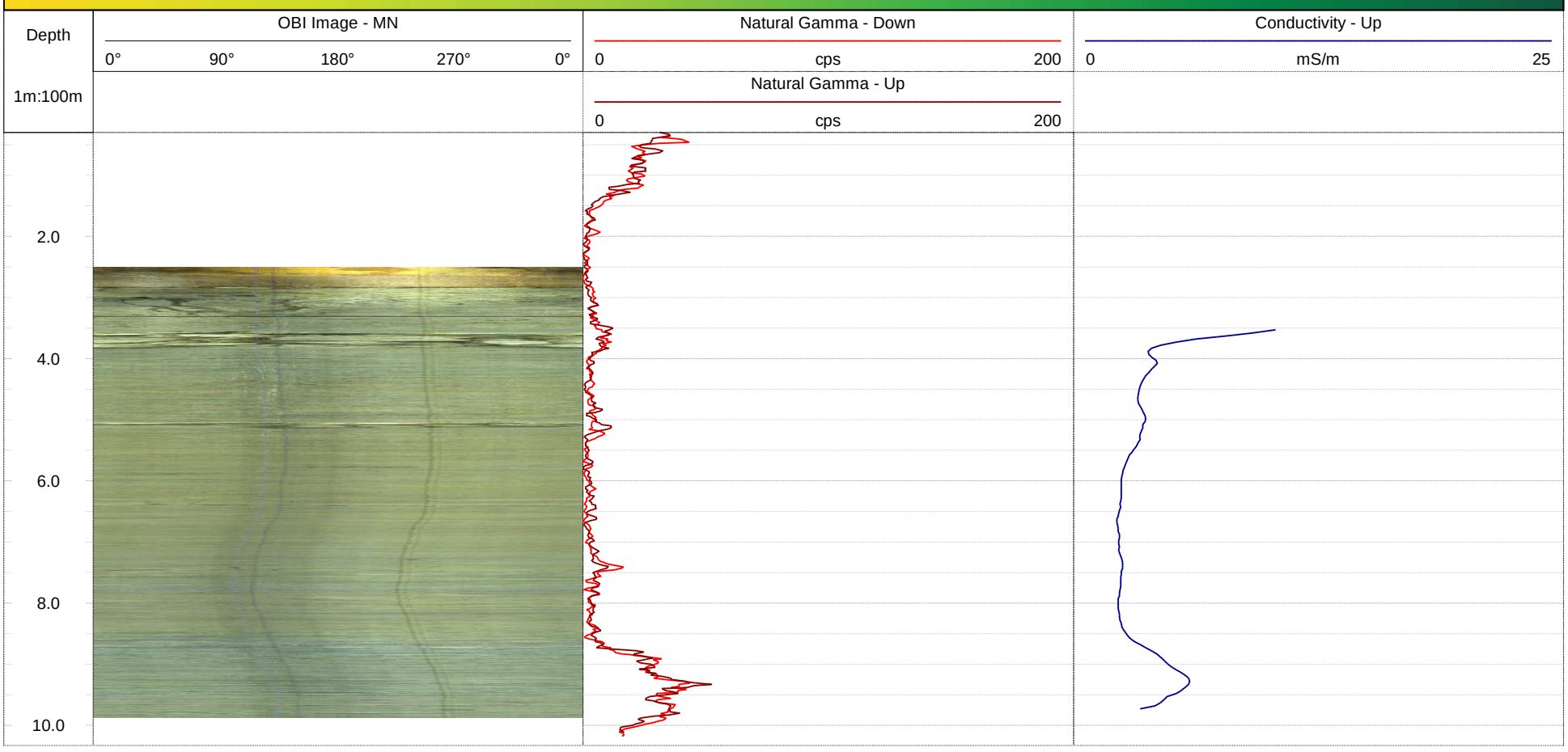
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-11 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.83 m bgs	**Location:**	Caledon, Ontario
Easting:	578065.10 m	**Drilled Depth:**	10.20 m bgs	**Water Level:**	3.33 m bgs	**Log Date:**	Mar-26-2020
Northing:	4854240.45 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	402.10 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.36 m ags	**Logged By:**	PG

Notes: OBI image opaque > 9.95 m



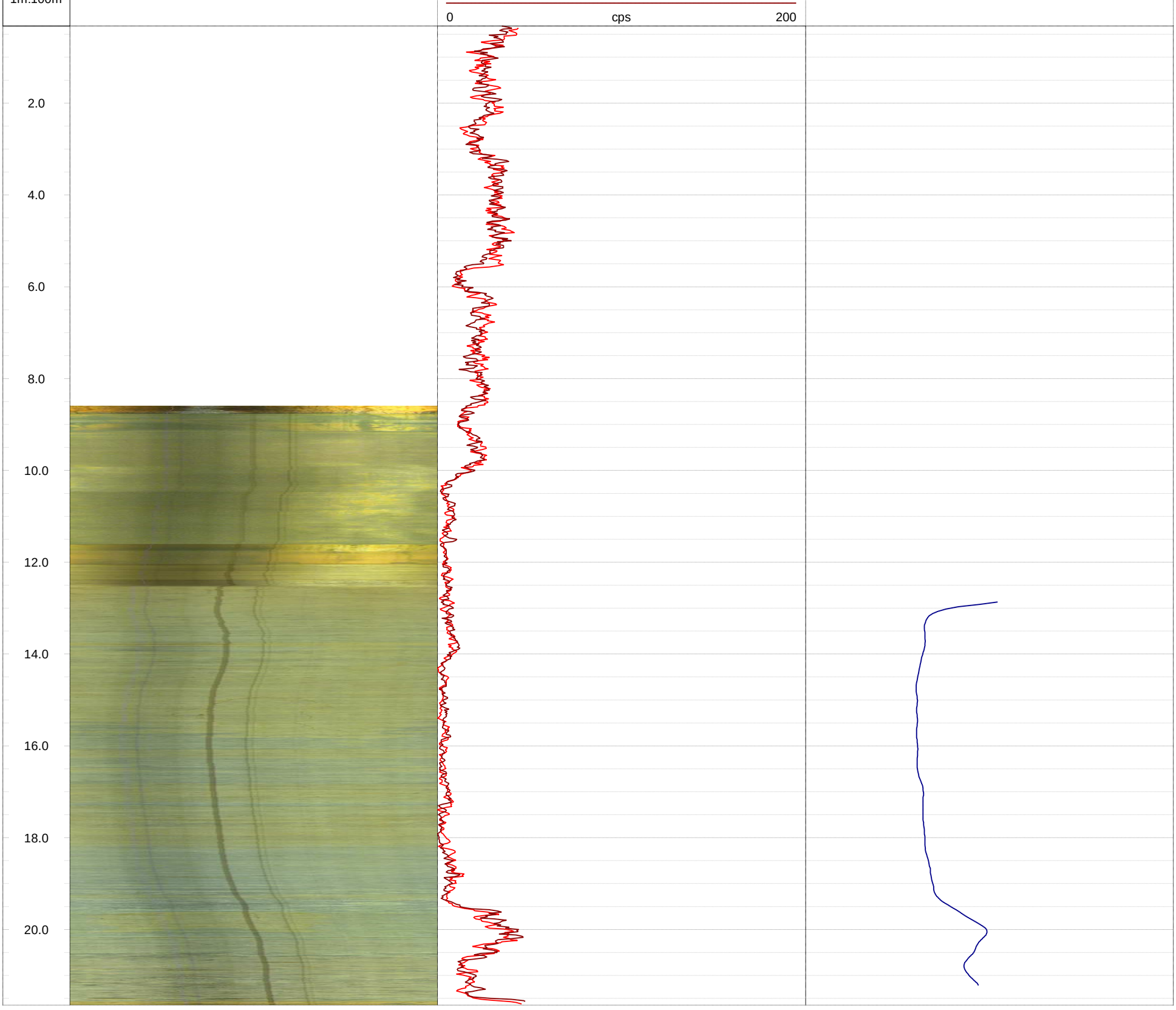
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-12 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.04m bgs	**Location:**	Caledon, Ontario
Easting:	577780.56 m	**Drilled Depth:**	21.76 m bgs	**Water Level:**	8.77 m bgs	**Log Date:**	Mar-25-2020
Northing:	4854244.92 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.22 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.35 m ags	**Logged By:**	PG

Notes:



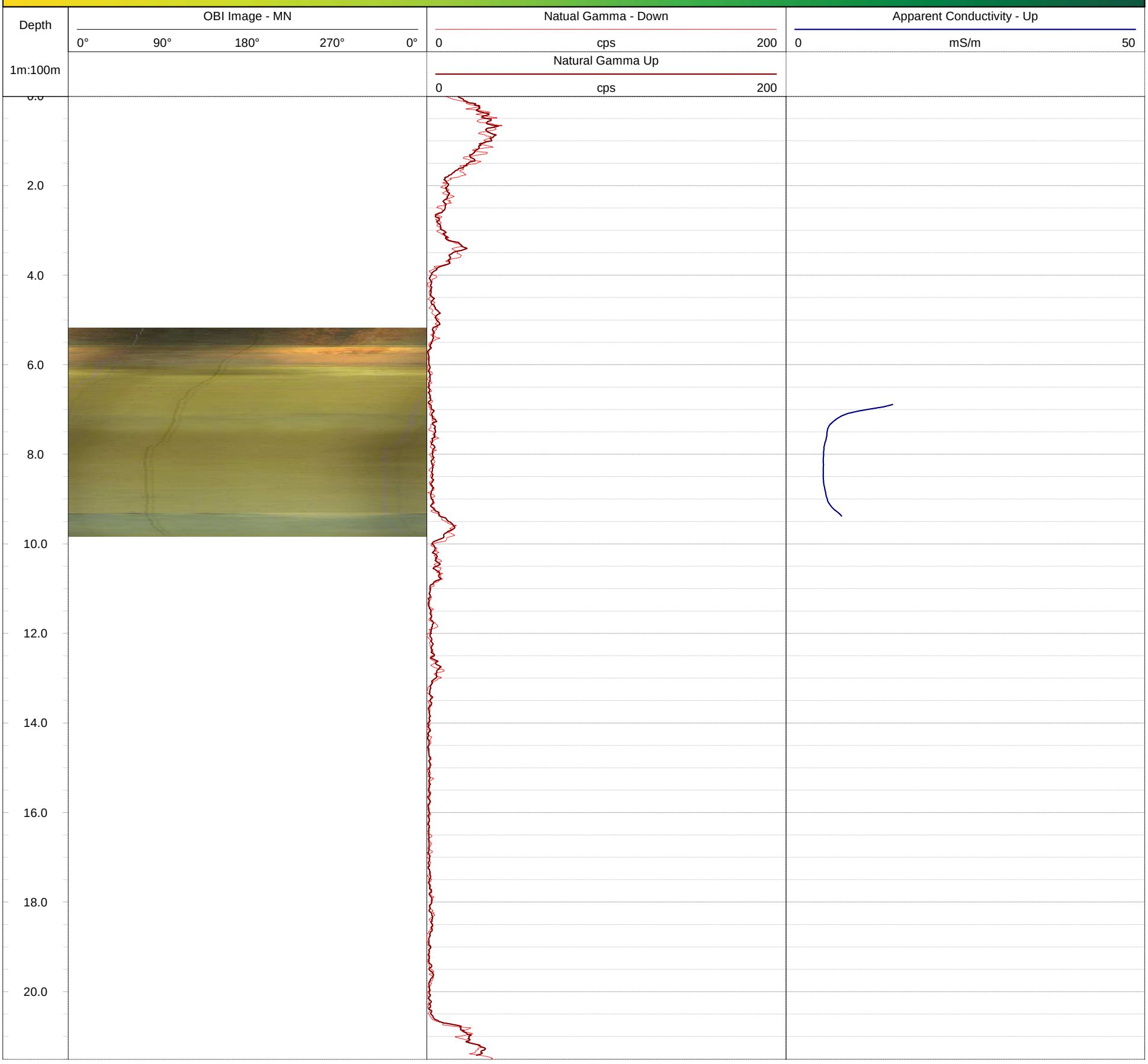
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-13 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.99 m bgs	**Location:**	Caledon, Ontario
Easting:	577209.70 m	**Drilled Depth:**	22.80 m bgs	**Water Level:**	3.48 m bgs	**Log Date:**	Apr-14,20-2020
Northing:	4854103.25 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	412.94 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes: Blockage at 9.84 m. Gamma survey was completed with drill casing in place due to poor hole condtions.



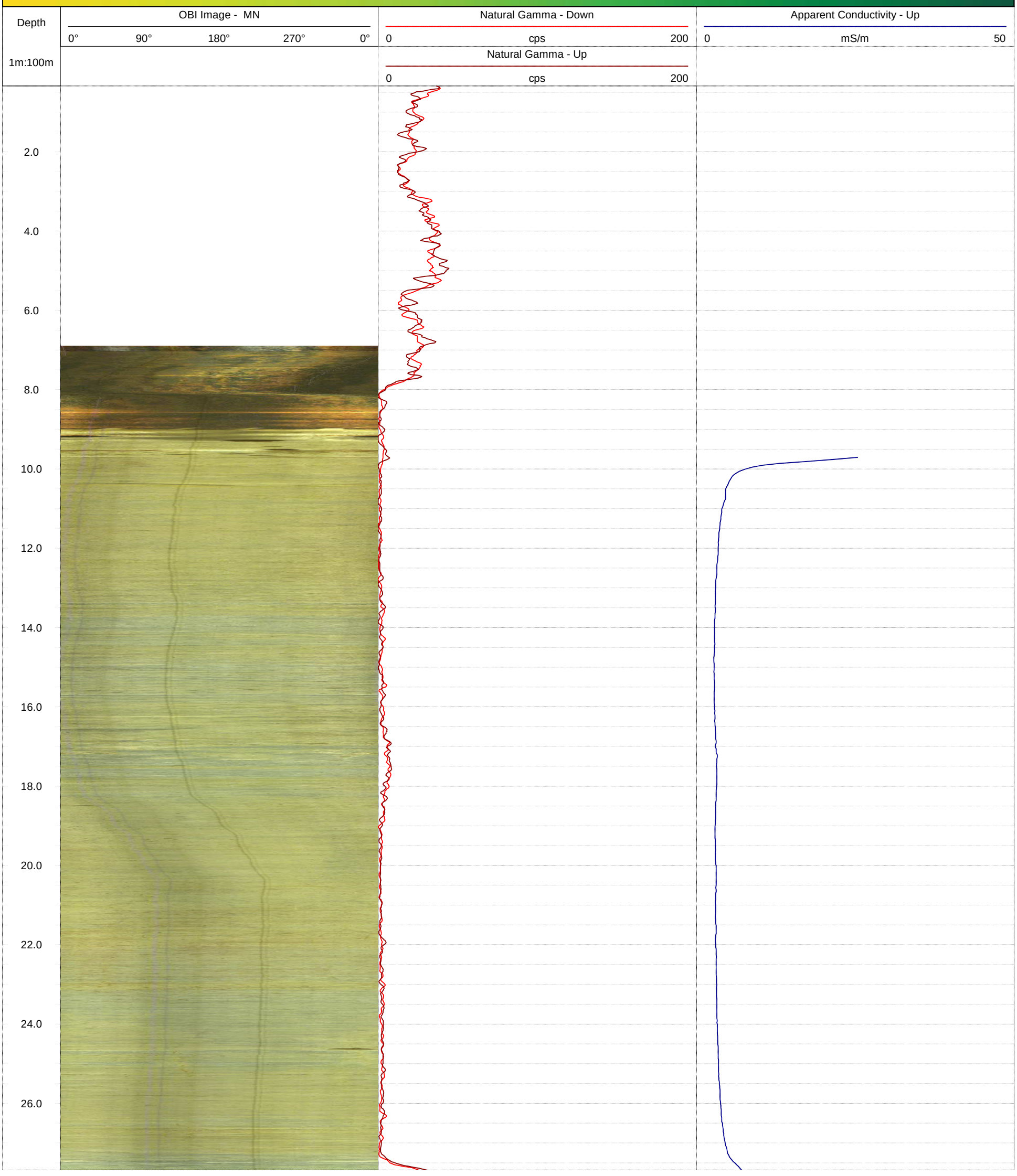
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-14 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.99 m bgs	**Location:**	Caledon, Ontario
Easting:	577288.55 m	**Drilled Depth:**	31.46 m bgs	**Water Level:**	6.79 m bgs	**Log Date:**	Apr-14-2020
Northing:	4853881.70 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.27 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:




28.0
30.0
32.0

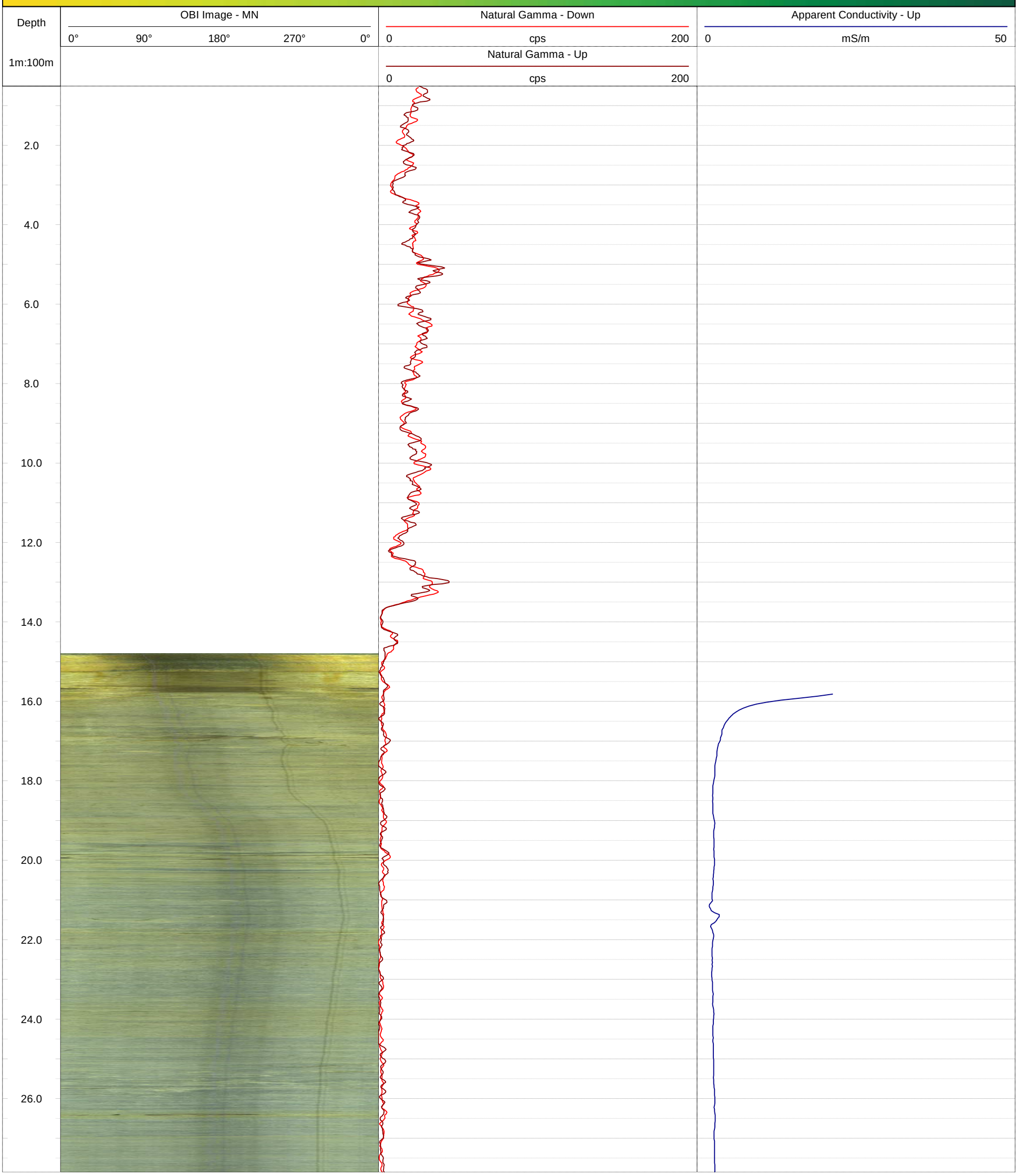
GOLDER
MEMBER OF WSP

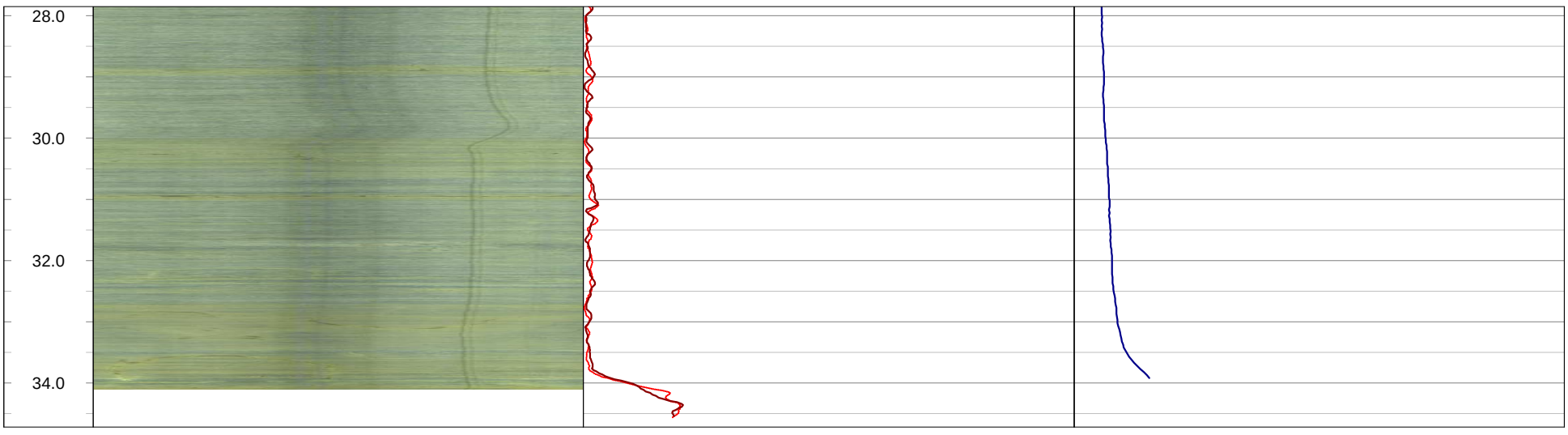
Geophysical Record of Borehole: BH20-15 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.26 m bgs	**Location:**	Caledon, Ontario
Easting:	576925.21 m	**Drilled Depth:**	34.76 m bgs	**Water Level:**	3.09 m bgs	**Log Date:**	Apr-14-2020
Northing:	4854113.14 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	421.52 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.16 m ags	**Logged By:**	PG

Notes:




28.0
30.0
32.0
34.0

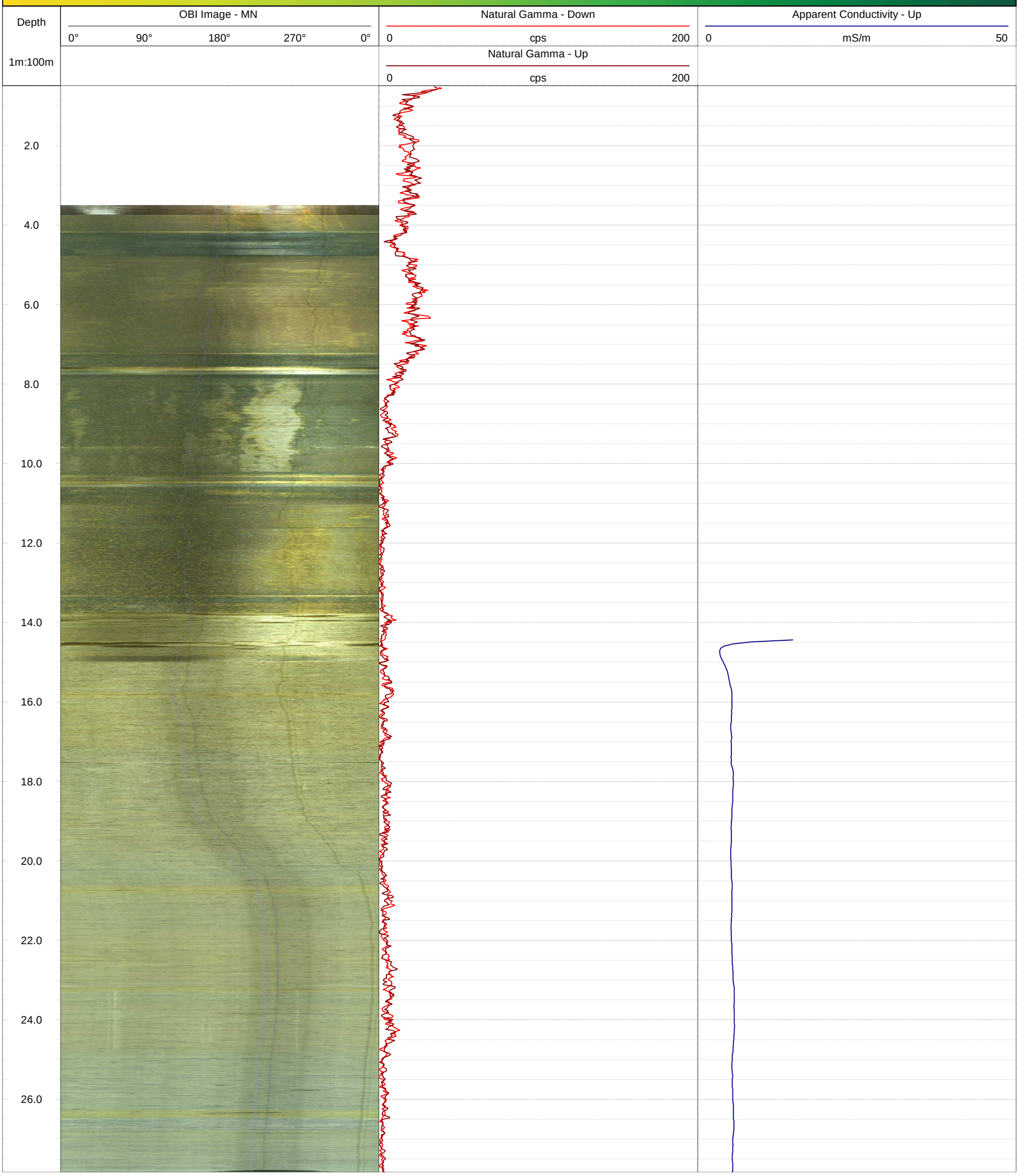
GOLDER
MEMBER OF WSP

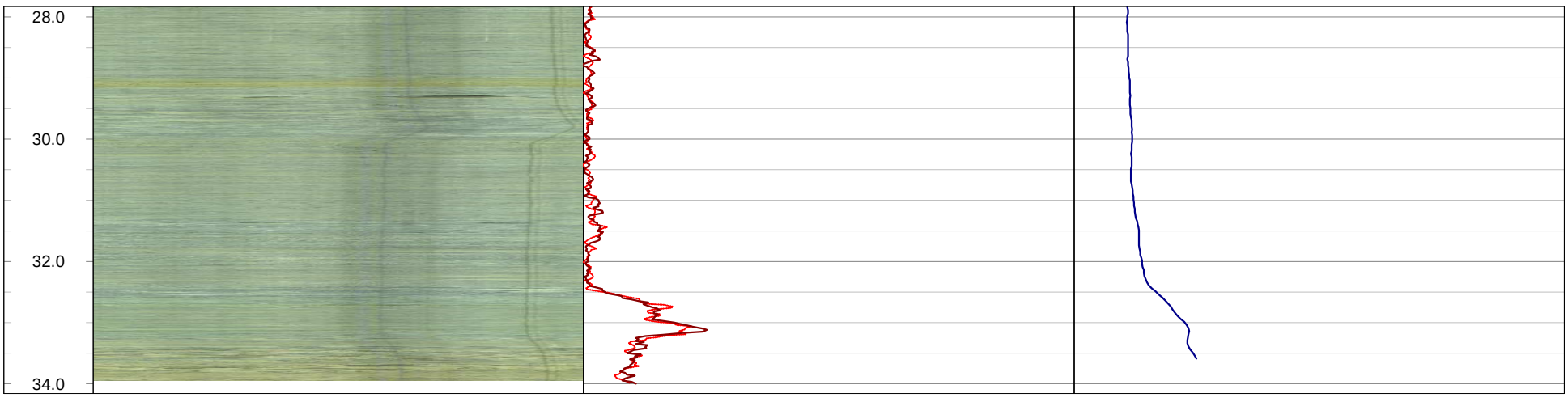
Geophysical Record of Borehole: BH20-16 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	13.76 m bgs	**Location:**	Caledon, Ontario
Easting:	576991.38 m	**Drilled Depth:**	34.18 m bgs	**Water Level:**	3.60 m bgs	**Log Date:**	Apr-21-2020
Northing:	4853859.50 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	420.74 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.17 m ags	**Logged By:**	PG

Notes:




28.0
30.0
32.0
34.0

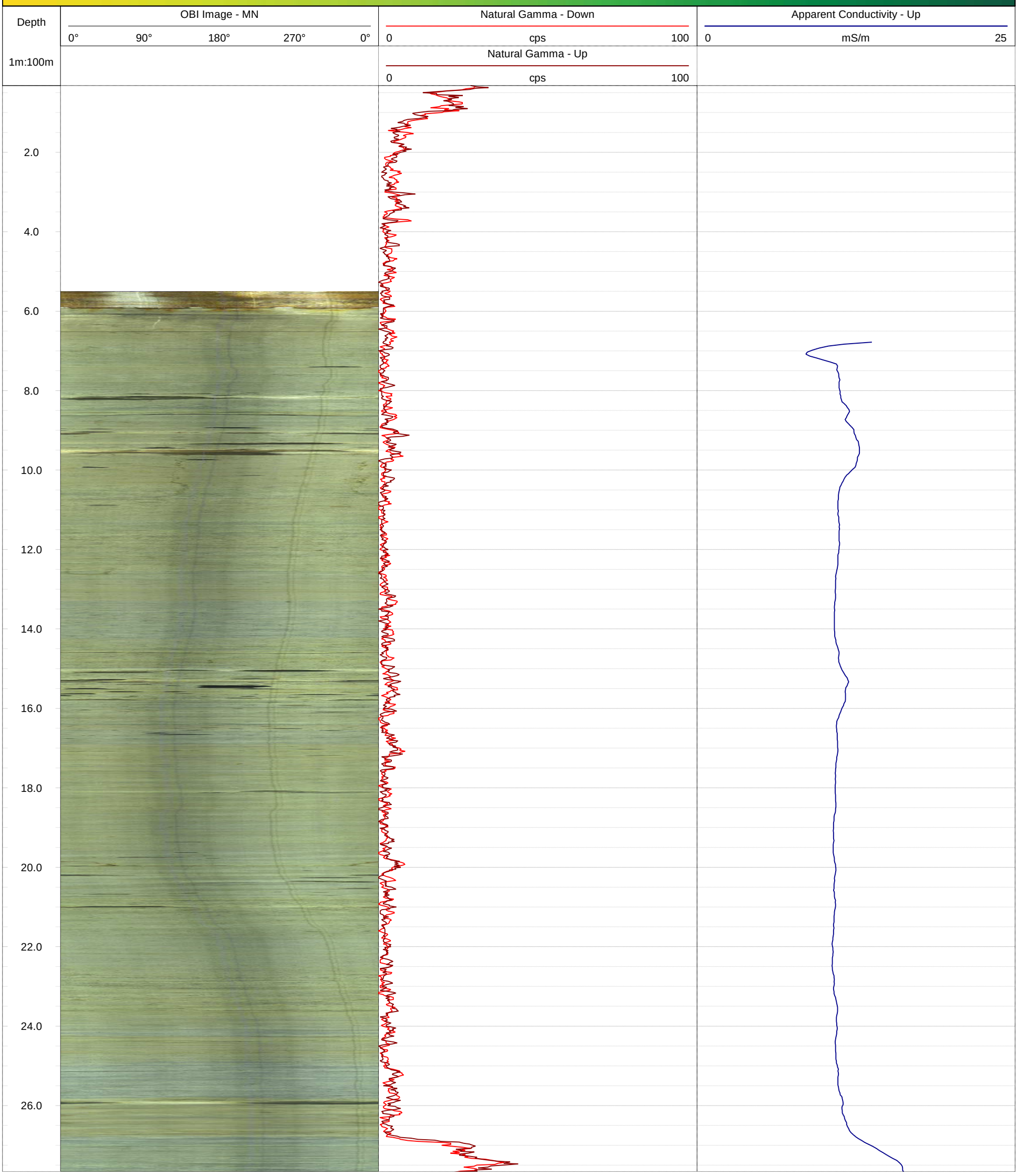
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-17 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.92 m bgs	**Location:**	Caledon, Ontario
Easting:	577474.67 m	**Drilled Depth:**	28.83 m bgs	**Water Level:**	6.51 m bgs	**Log Date:**	Apr-27-2020
Northing:	4853391.65 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.06 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:




28.0

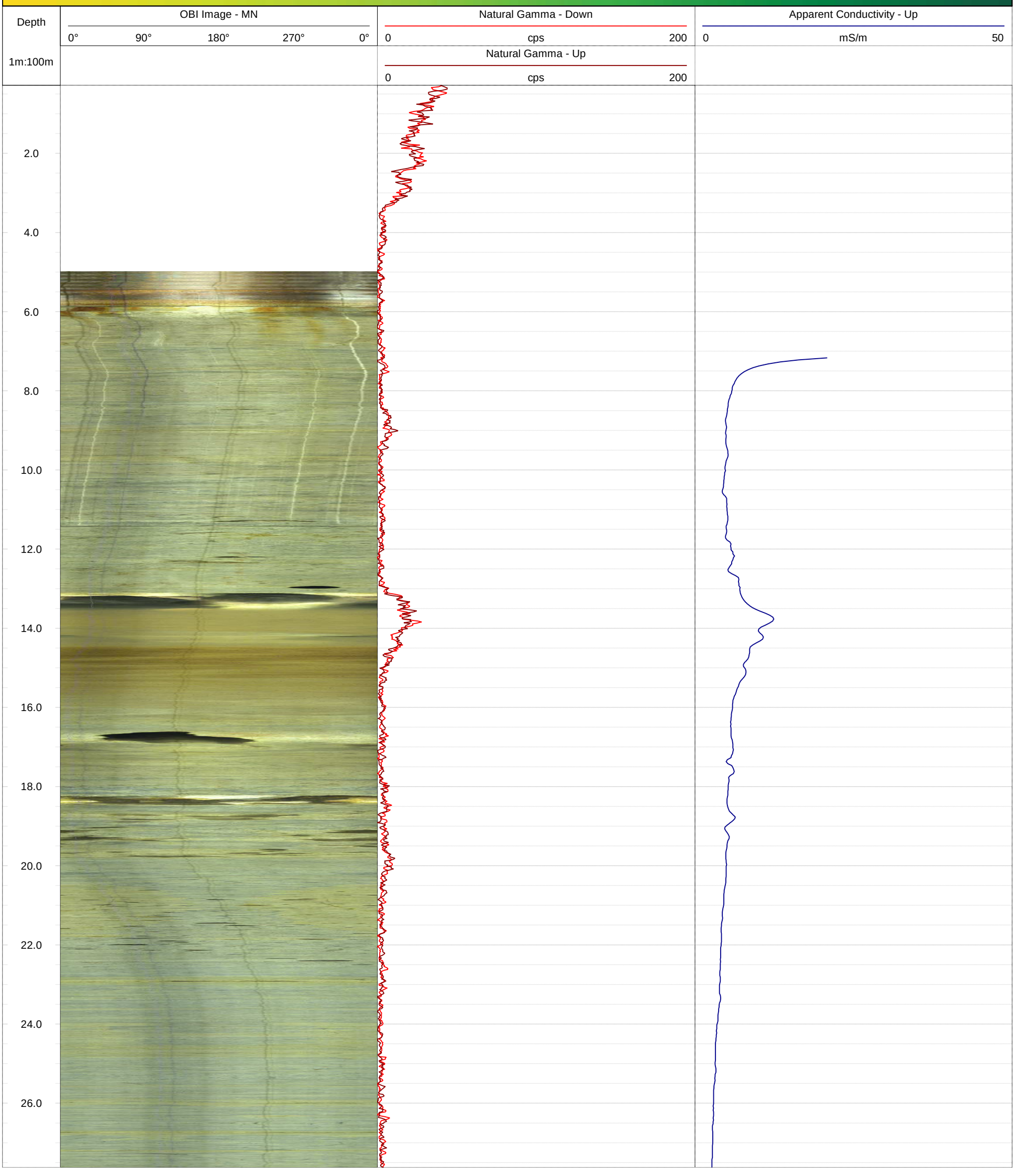
GOLDER
MEMBER OF WSP

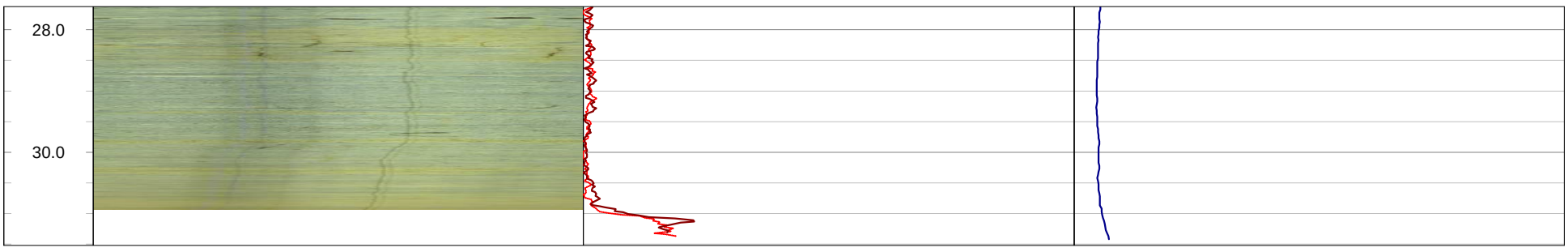
Geophysical Record of Borehole: BH20-18 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.90 m bgs	**Location:**	Caledon, Ontario
Easting:	577313.39 m	**Drilled Depth:**	31.84 m bgs	**Water Level:**	11.45 m bgs	**Log Date:**	Apr-27-2020
Northing:	4853571.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.53 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.40 m ags	**Logged By:**	PG

Notes: OBI Image opaque >31 m bgs




28.0
30.0

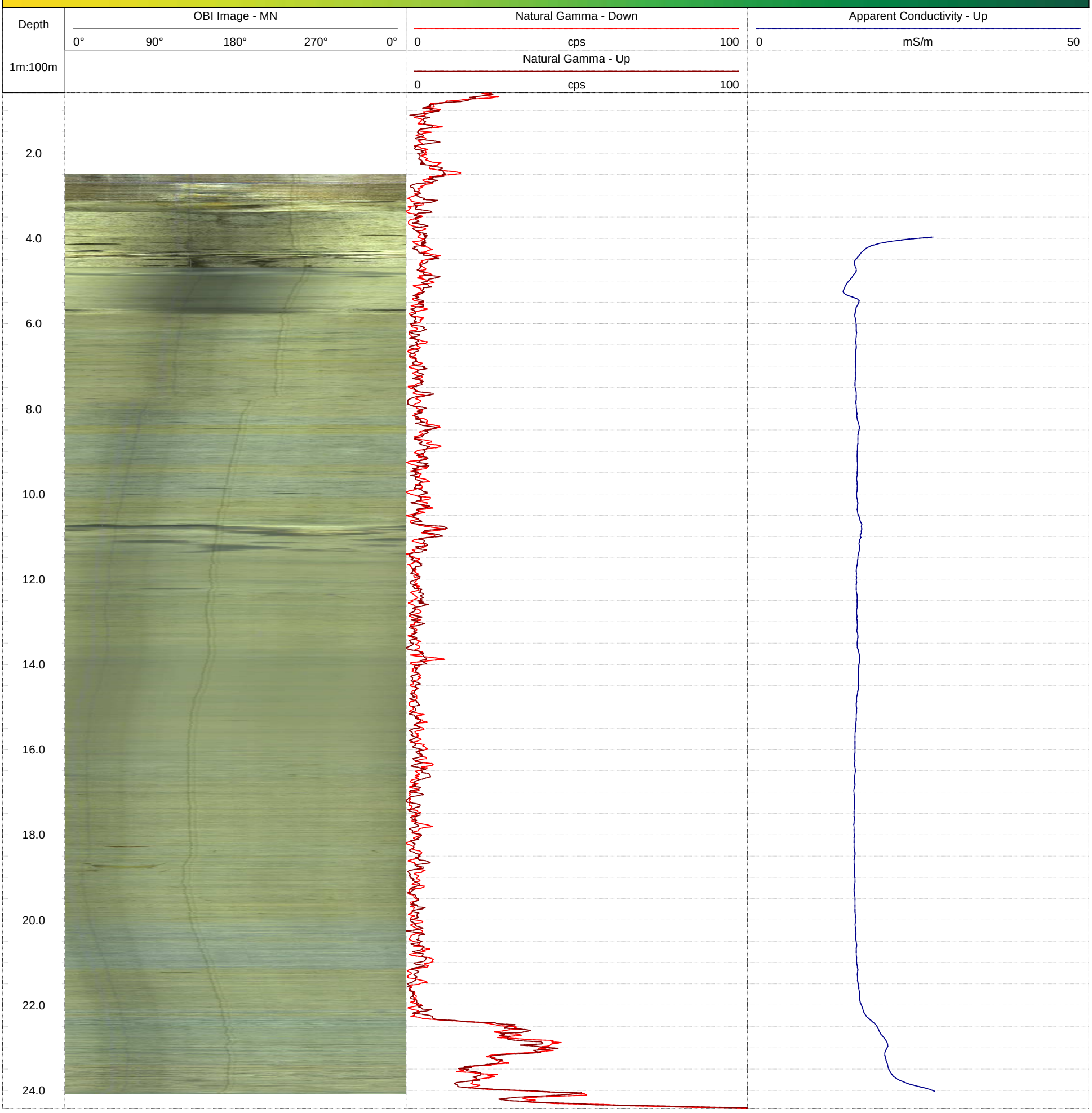
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-19 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.15 m bgs	**Location:**	Caledon, Ontario
Easting:	577733.06 m	**Drilled Depth:**	24.64 m bgs	**Water Level:**	4.70 m bgs	**Log Date:**	Apr-27-2020
Northing:	4853579.97 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	411.42 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:



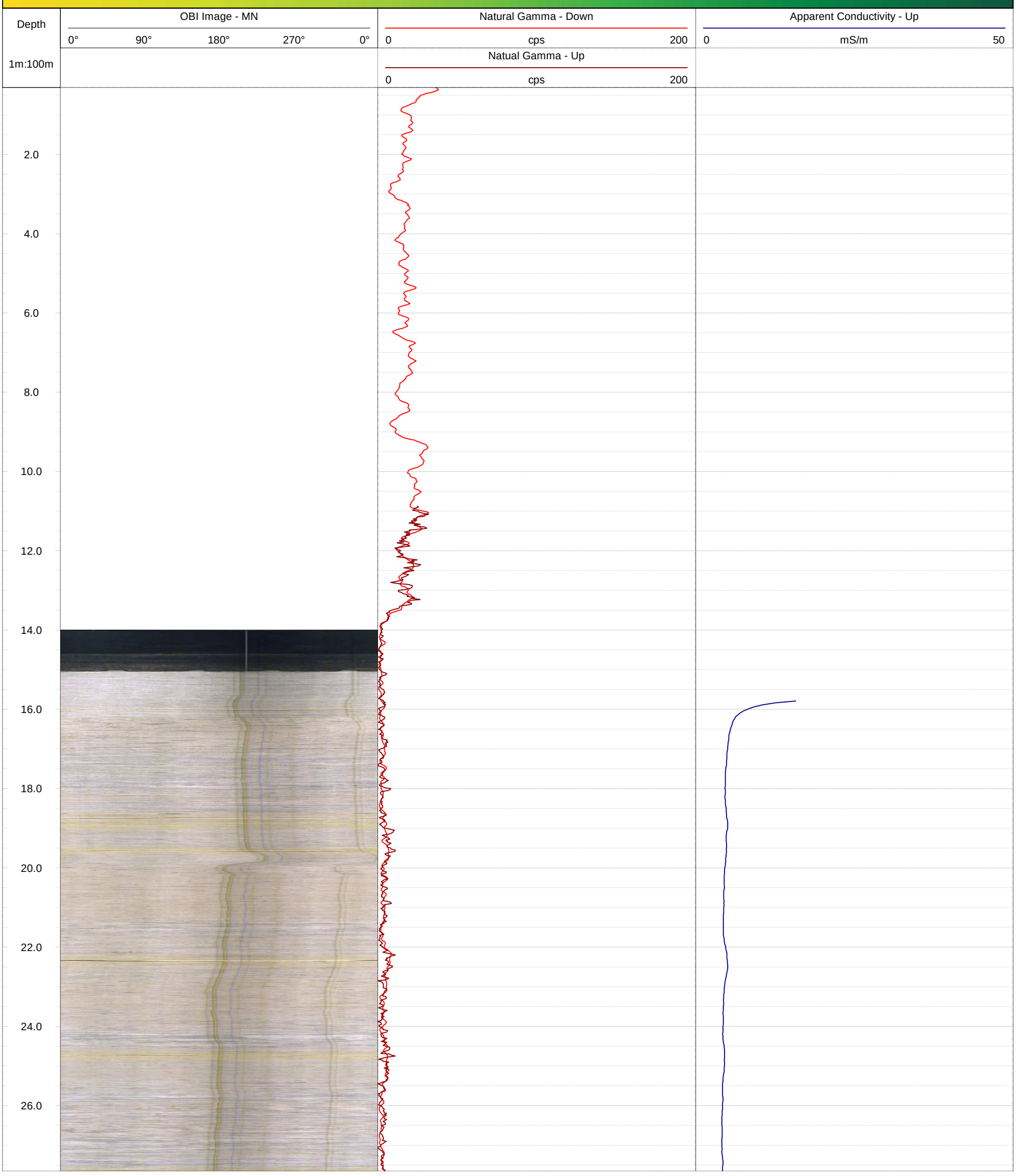
GOLDER
MEMBER OF WSP

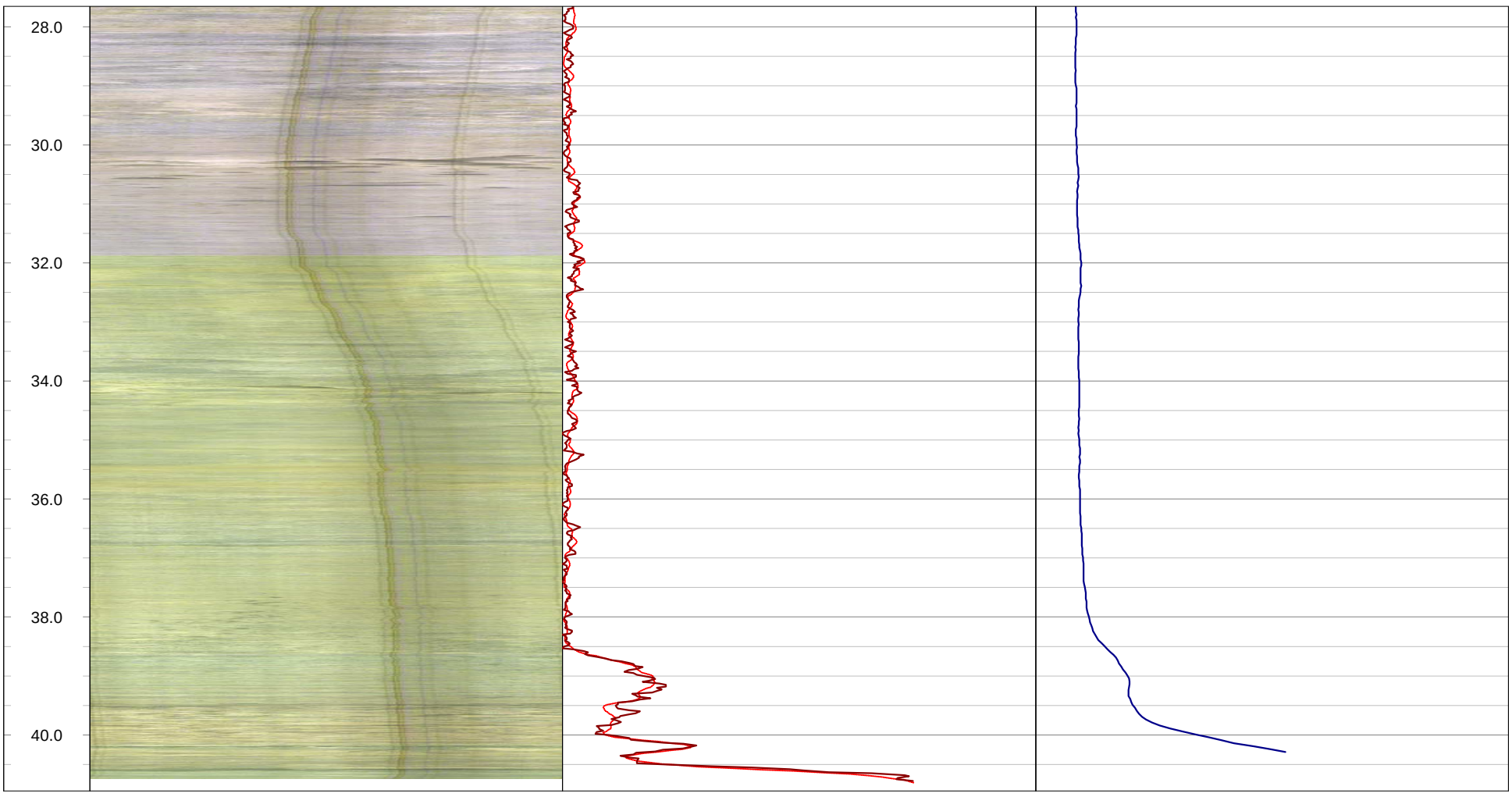
Geophysical Record of Borehole: BH20-20 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.05 m bgs	**Location:**	Caledon, Ontario
Easting:	577031.10 m	**Drilled Depth:**	40.98 m bgs	**Water Level:**	11.71 m bgs	**Log Date:**	May-20-2020
Northing:	4853551.56 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	423.60 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.39 m ags	**Logged By:**	PG

Notes: OBI image opaque > 40.78 m bgs




28.0
30.0
32.0
34.0
36.0
38.0
40.0

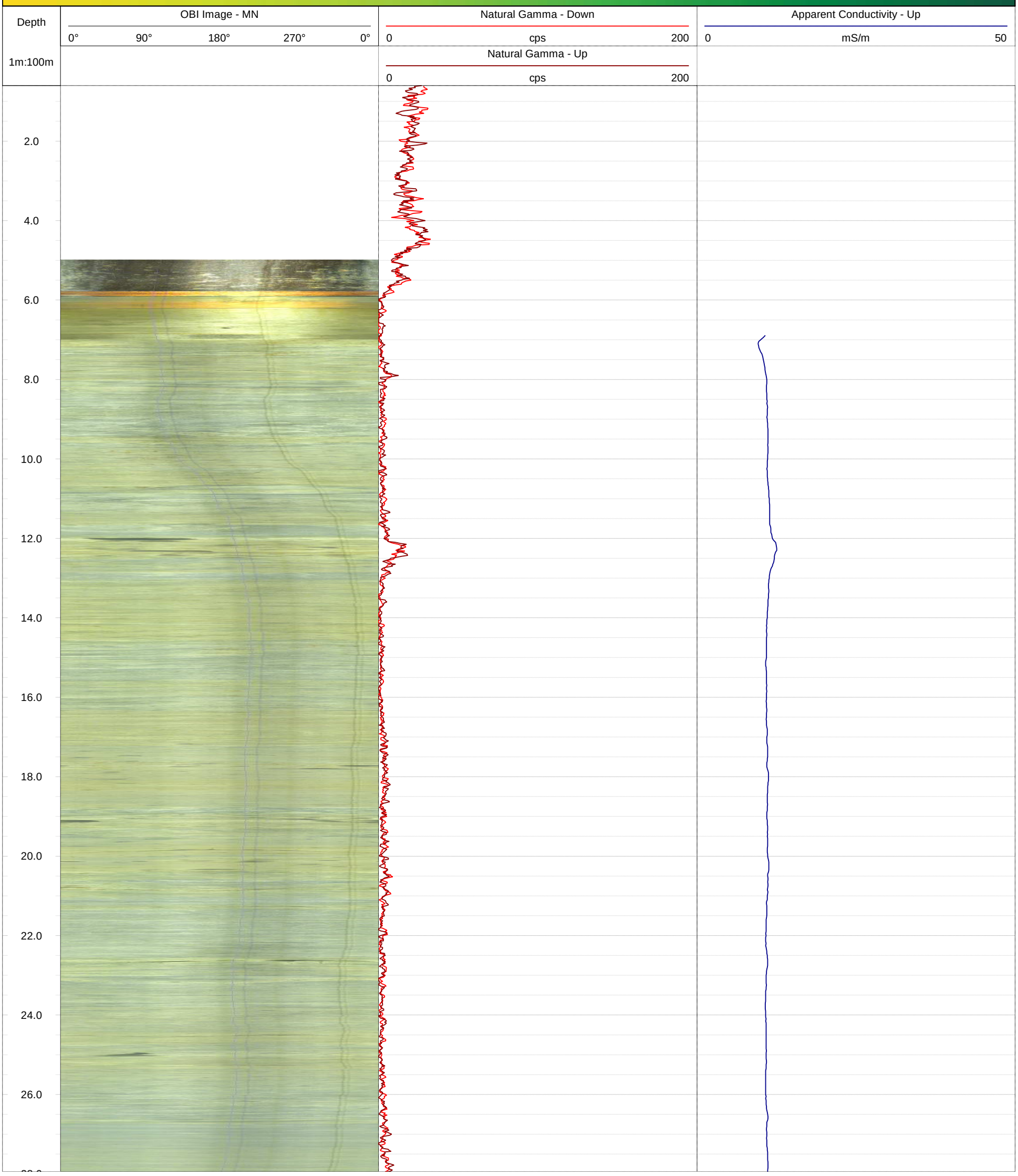
GOLDER
MEMBER OF WSP

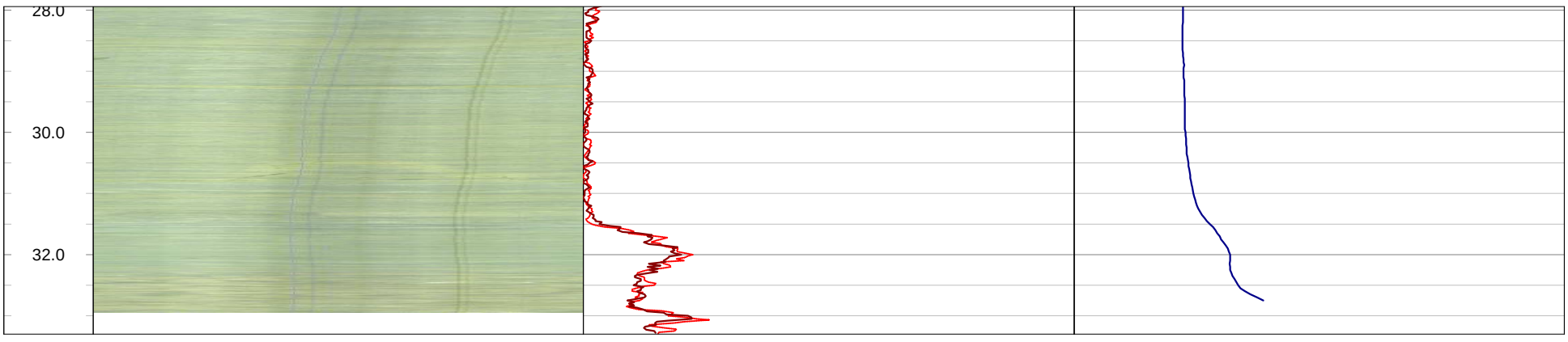
Geophysical Record of Borehole: BH20-21 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.21 m bgs	**Location:**	Caledon, Ontario
Easting:	576935.66 m	**Drilled Depth:**	33.48 m bgs	**Water Level:**	5.92 m bgs	**Log Date:**	May-20-2020
Northing:	4853276.58 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.53 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.08 m ags	**Logged By:**	CM

Notes: OBI image opaque > 33.1 m bgs




28.0
30.0
32.0

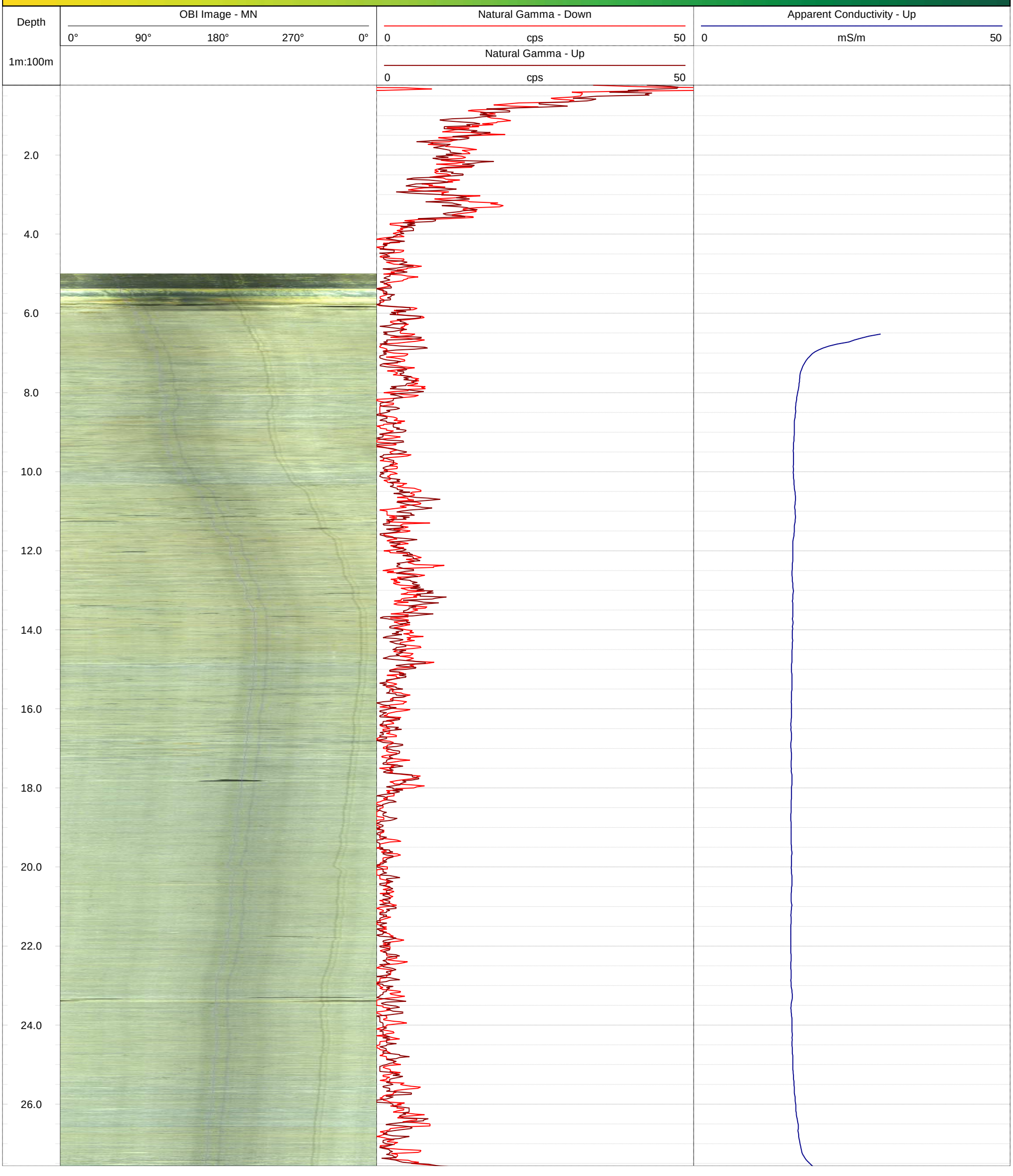
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-22 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.77 m bgs	**Location:**	Caledon, Ontario
Easting:	576701.79 m	**Drilled Depth:**	28.61 m bgs	**Water Level:**	2.88 m bgs	**Log Date:**	May-20-2020
Northing:	4853293.98 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	410.98 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.47 m ags	**Logged By:**	PG

Notes:




28.0

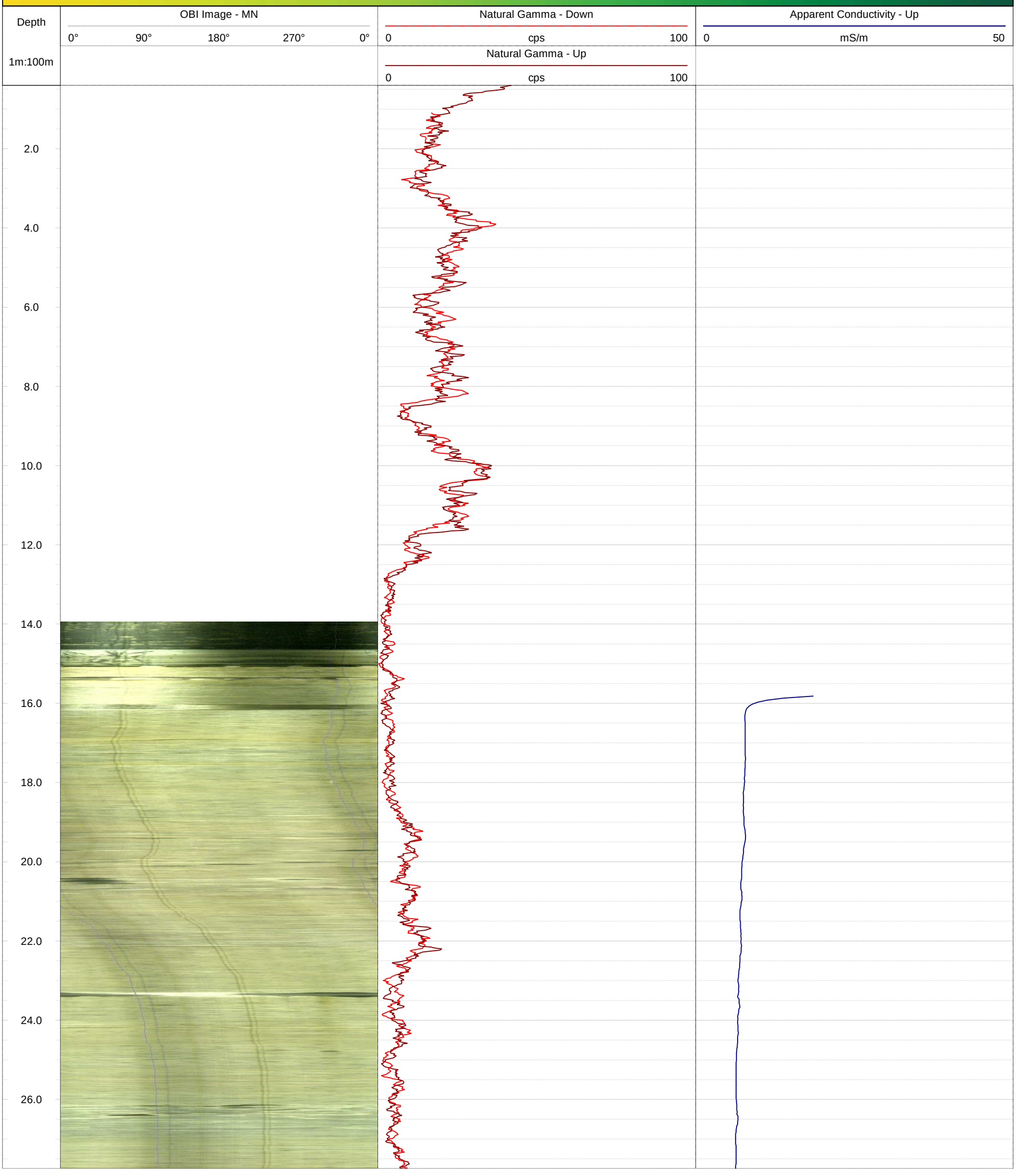
GOLDER
MEMBER OF WSP

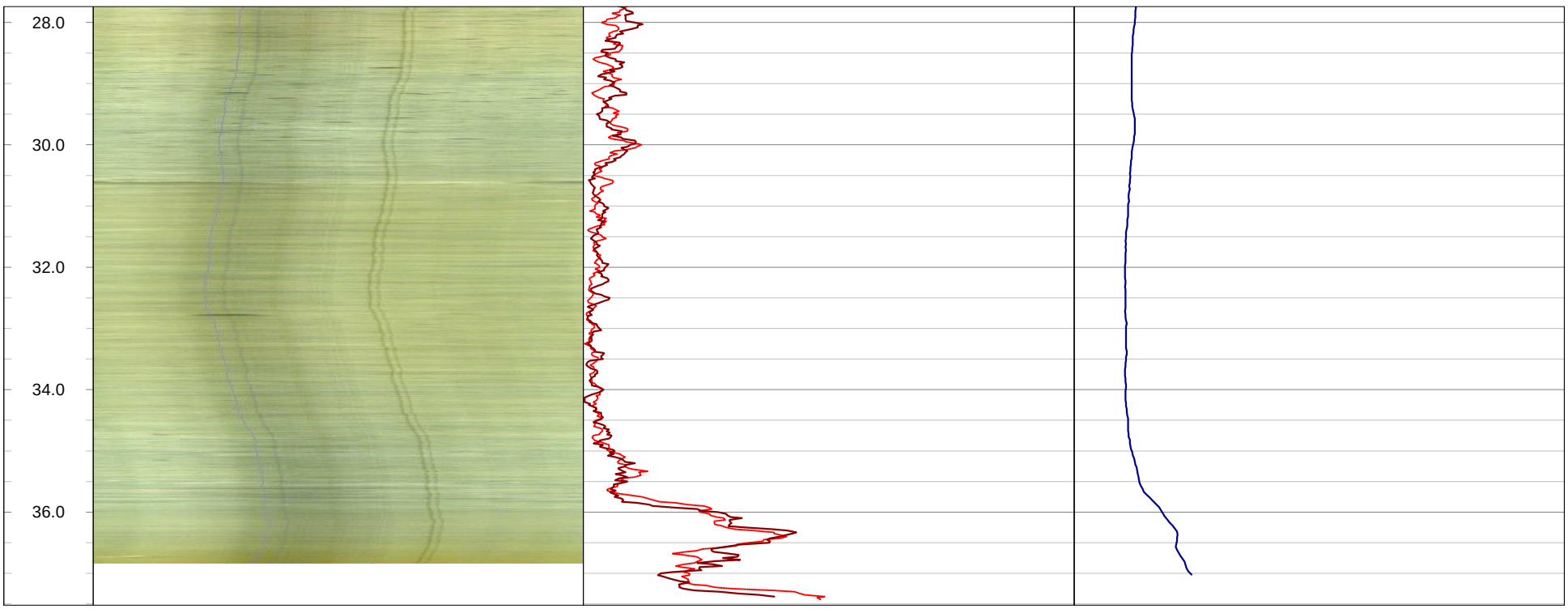
Geophysical Record of Borehole: BH20-23 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.08 m bgs	**Location:**	Caledon, Ontario
Easting:	576779.85 m	**Drilled Depth:**	37.62 m bgs	**Water Level:**	2.50 m bgs	**Log Date:**	May-25-2020
Northing:	4853559.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	420.27 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.36 m ags	**Logged By:**	PG

Notes: OBI image opaque > 37 m bgs




28.0
30.0
32.0
34.0
36.0

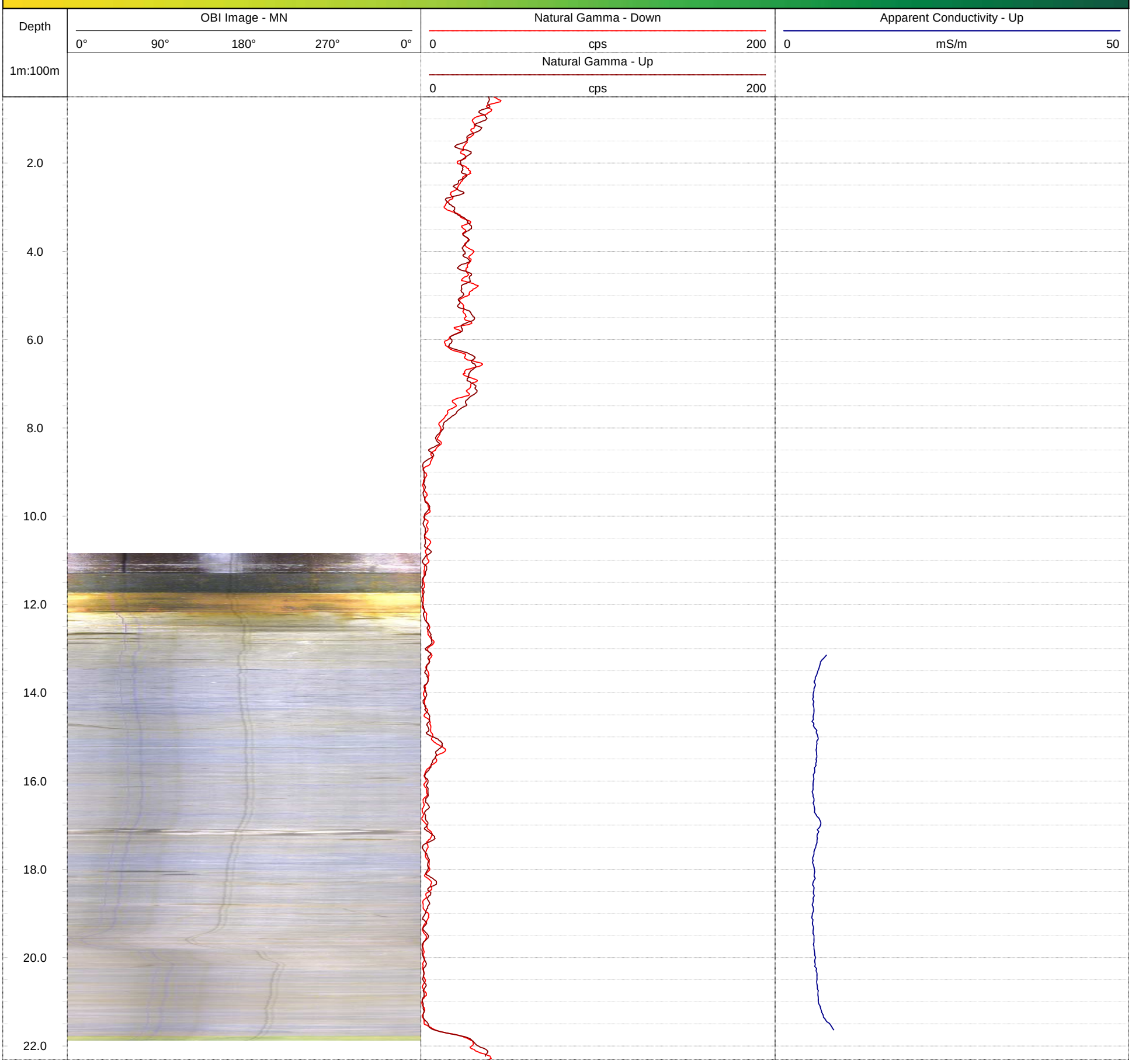
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-24 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.20 m bgs	**Location:**	Caledon, Ontario
Easting:	577296.02 m	**Drilled Depth:**	22.76 m bgs	**Water Level:**	11.28 m bgs	**Log Date:**	Jun-08-2020
Northing:	4852710.32 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.60 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PG

Notes:



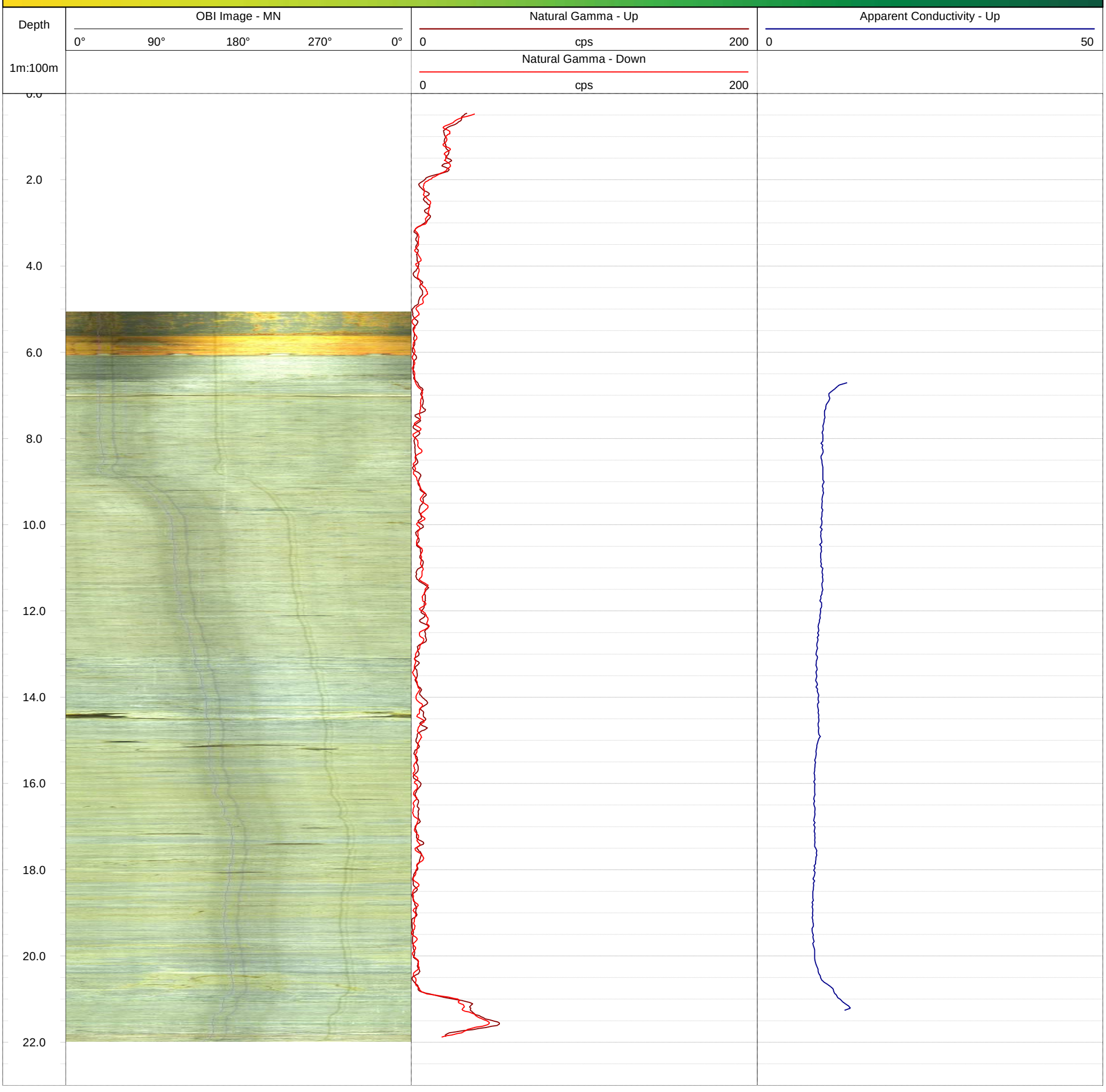
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-25 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.08 m bgs	**Location:**	Caledon, Ontario
Easting:	577402.13 m	**Drilled Depth:**	22.03 m bgs	**Water Level:**	4.03 m bgs	**Log Date:**	Jun-15-2020
Northing:	4852974.96 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.48 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.22 m ags	**Logged By:**	PG

Notes:



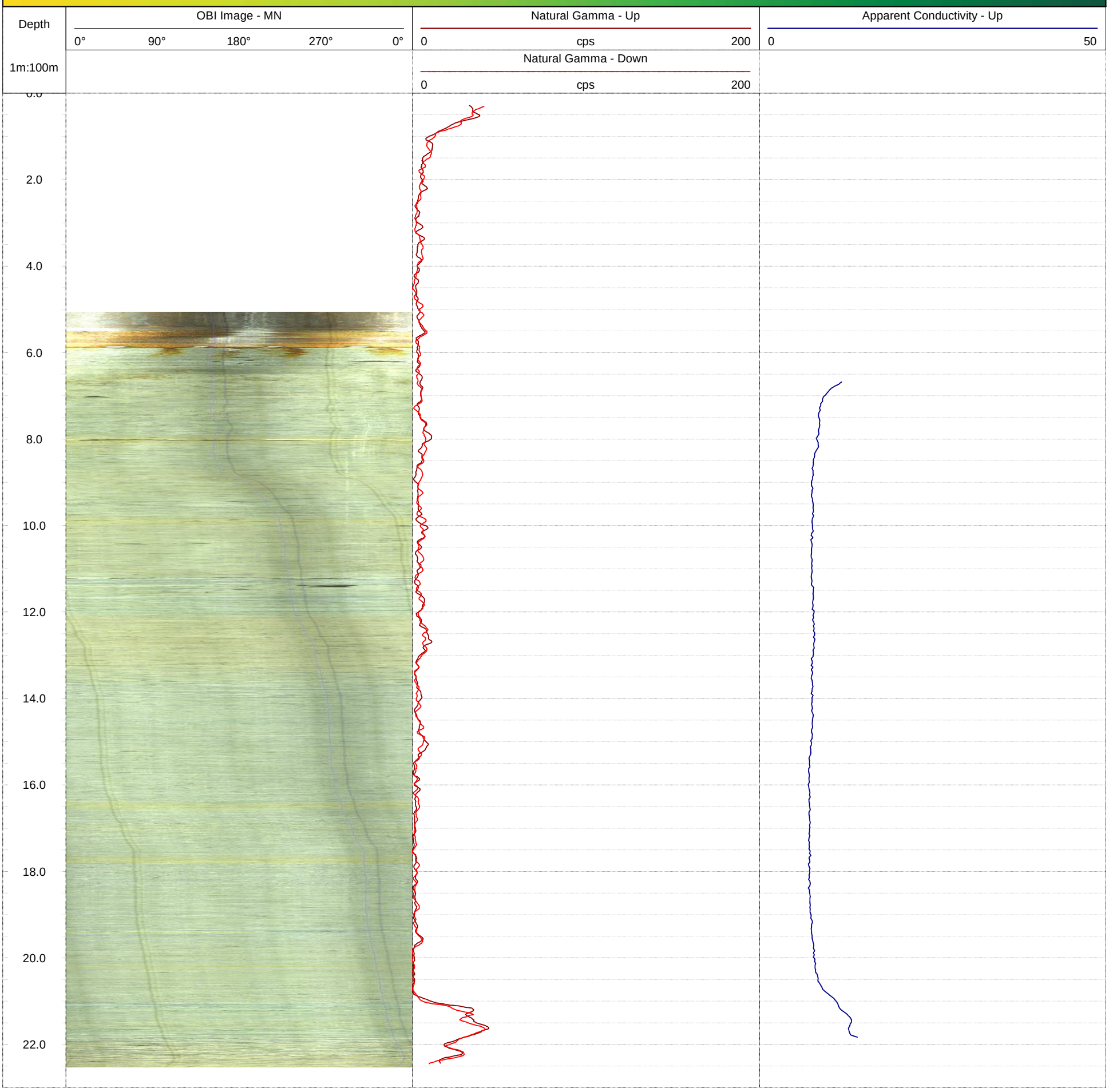
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: BH20-26 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.89 m bgs	**Location:**	Caledon, Ontario
Easting:	577037.86 m	**Drilled Depth:**	22.73 m bgs	**Water Level:**	6.15 m bgs	**Log Date:**	Jun-15-2020
Northing:	4852942.75 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.82 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.39 m ags	**Logged By:**	PG

Notes:



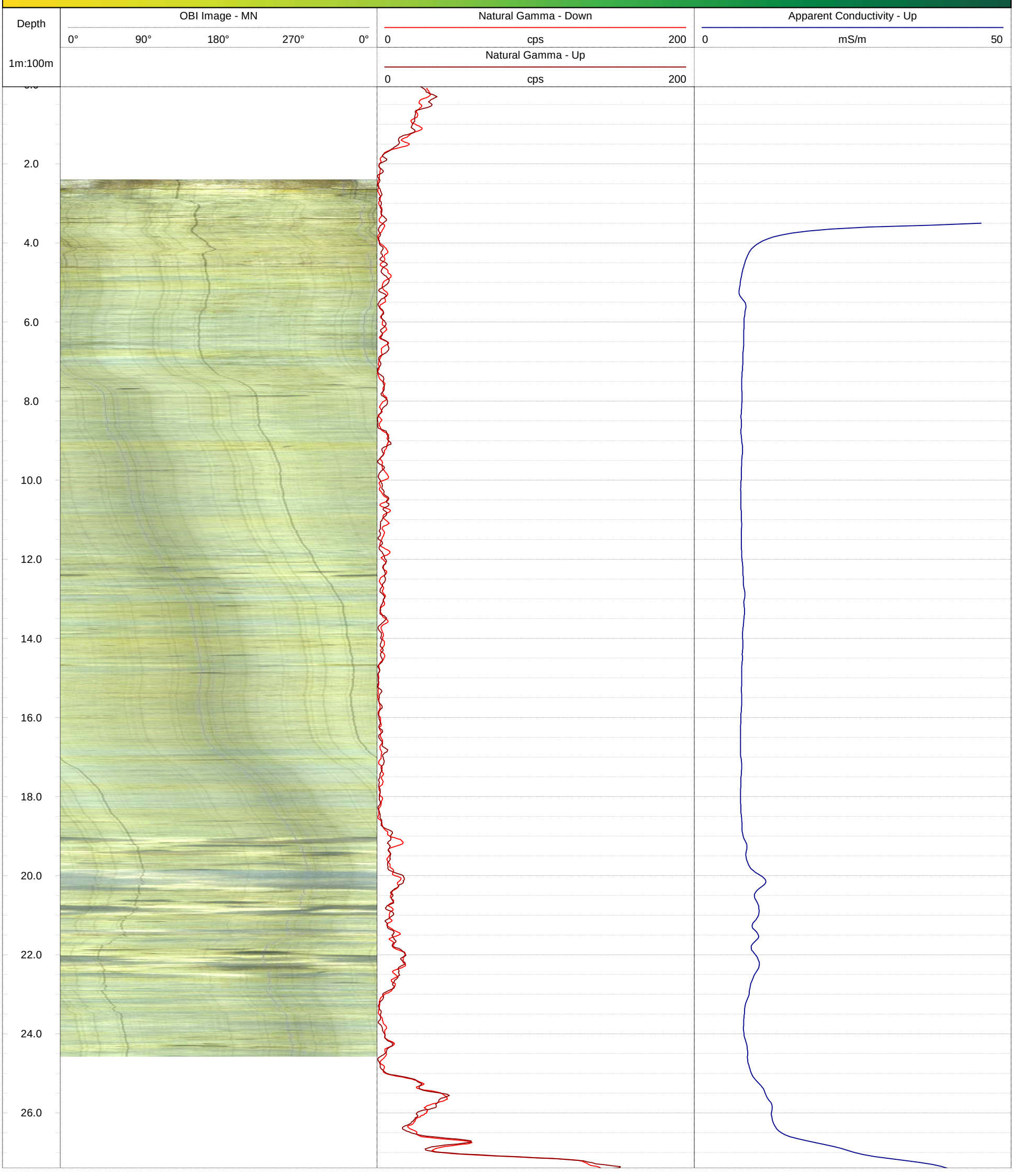
GOLDER
MEMBER OF WSP

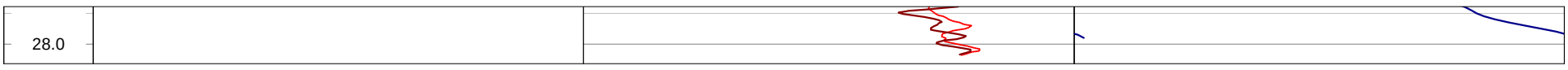
Geophysical Record of Borehole: BH20-27 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.64 m bgs	**Location:**	Caledon, Ontario
Easting:	577212.29 m	**Drilled Depth:**	27.65 m bgs	**Water Level:**	4.41 m bgs	**Log Date:**	Oct-22-2020
Northing:	4853168.73 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	408.64 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.61 m ags	**Logged By:**	CM

Notes: OBI image opaque > 25.35 m bgs




28.0

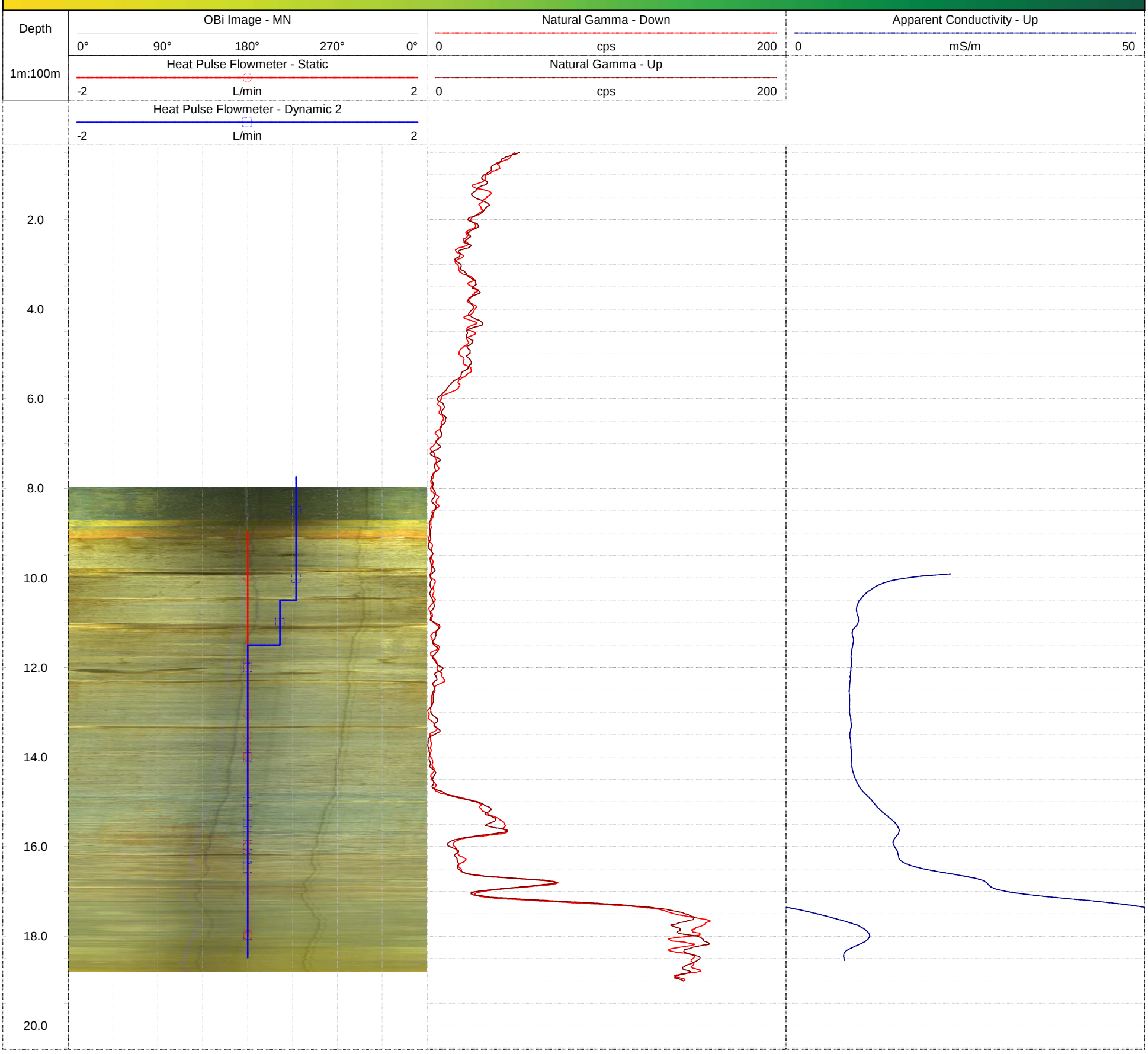
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-01 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.13 m bgs	**Location:**	Caledon, Ontario
Easting:	577458.50 m	**Drilled Depth:**	19.41 m bgs	**Water Level:**	1.91 m bgs	**Log Date:**	Mar-13,16-2020
Northing:	4852268.28 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	395.10 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	CM/PG

Notes: Heat Pulse Flowmeter Dynamic pump at 6.0 m below top of casing. Pump rate approximately 2.34 L/min.



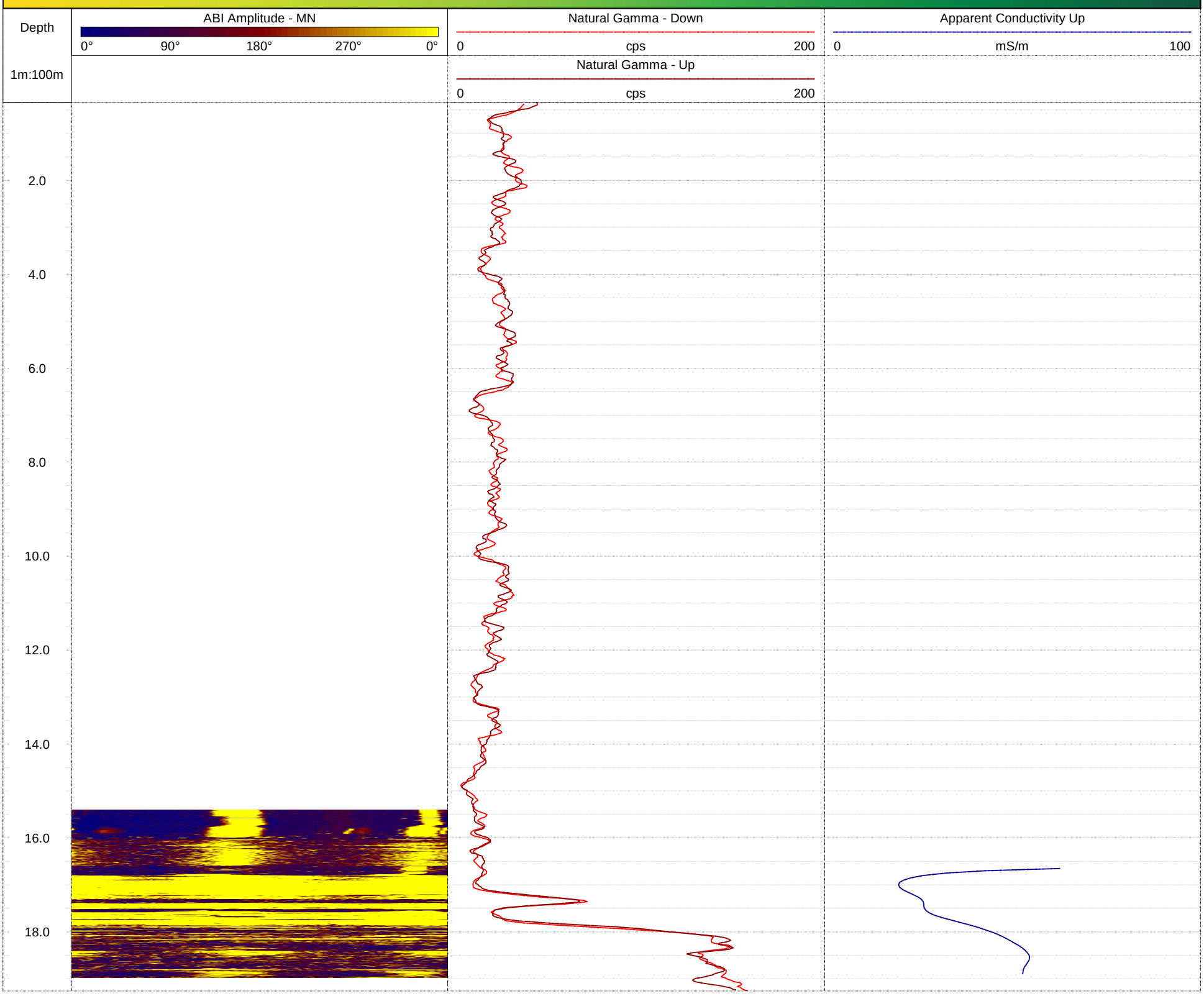
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.91 m bgs	**Location:**	Caledon, Ontario
Easting:	577900.04 m	**Drilled Depth:**	19.57 m bgs	**Water Level:**	8.12 m bgs	**Log Date:**	Mar-11-2020
Northing:	48522138.37 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.63 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.32 m ags	**Logged By:**	CM

Notes: Poor conditions in the borehole. Casing depth is approximate.



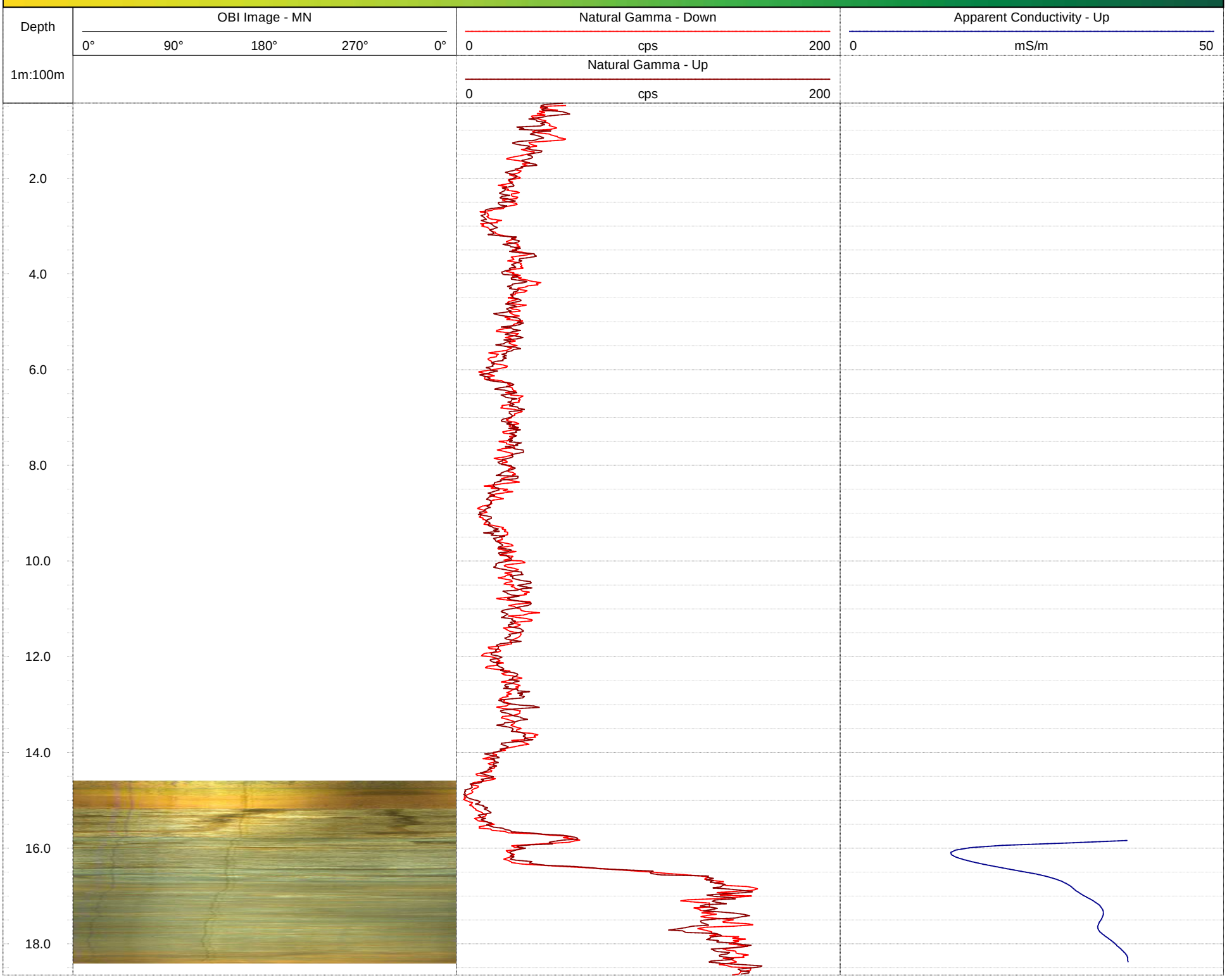
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-04 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.17 m bgs	**Location:**	Caledon, Ontario
Easting:	578264.75 m	**Drilled Depth:**	18.50 m bgs	**Water Level:**	9.02 m bgs	**Log Date:**	Mar-13-2020
Northing:	4852313.19 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.46 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.23 m ags	**Logged By:**	CM

Notes:



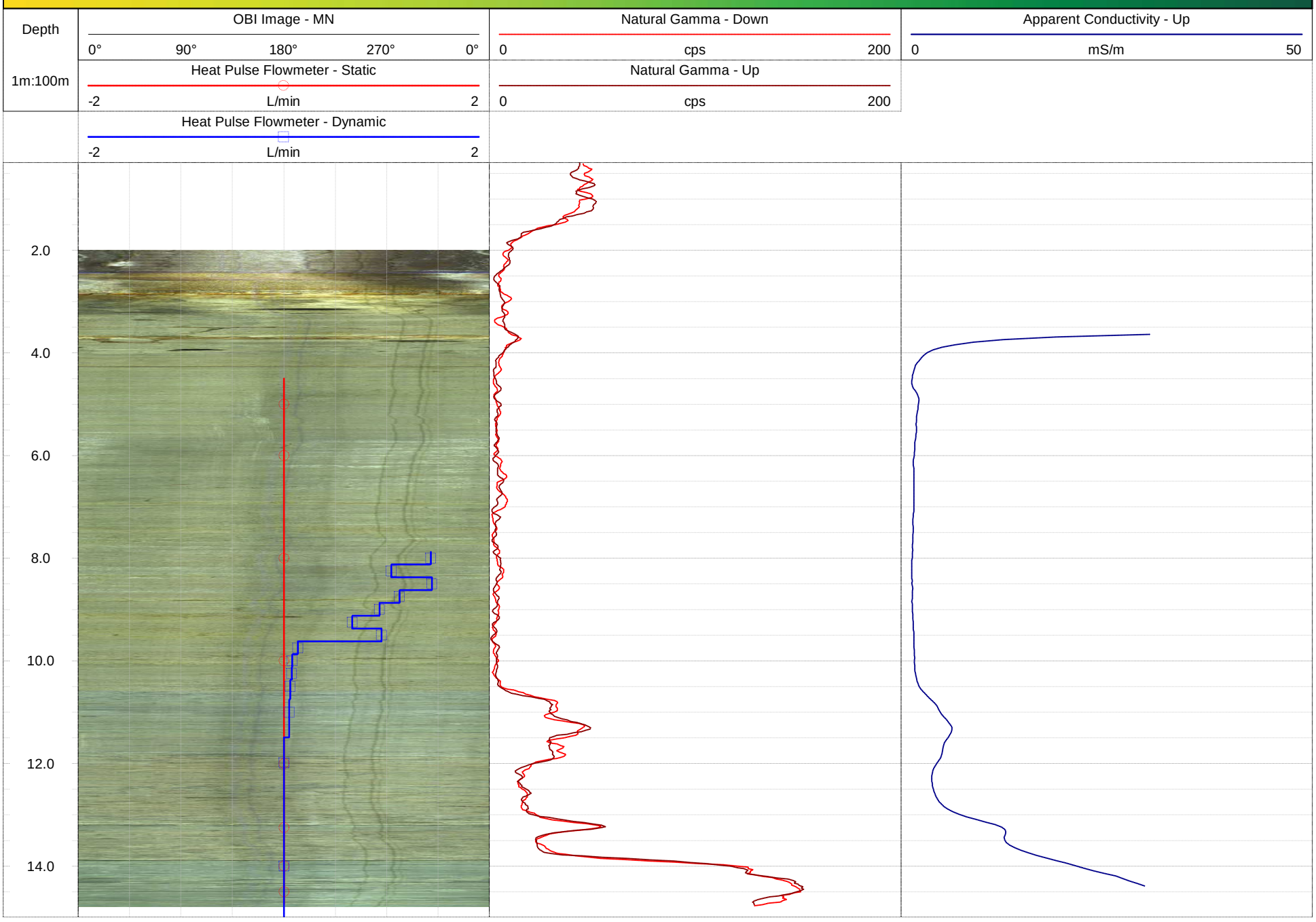
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-05 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.87 m bgs	**Location:**	Caledon, Ontario
Easting:	578423.10 m	**Drilled Depth:**	14.84 m bgs	**Water Level:**	4.04 m bgs	**Log Date:**	Mar-20-2020
Northing:	4852712.60 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.63 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.38 m ags	**Logged By:**	CM

Notes: Heat Pulse Flowmeter Dynamic pump at 6.0 m below top of casing. Pump rate approximately 2.25 L/min.



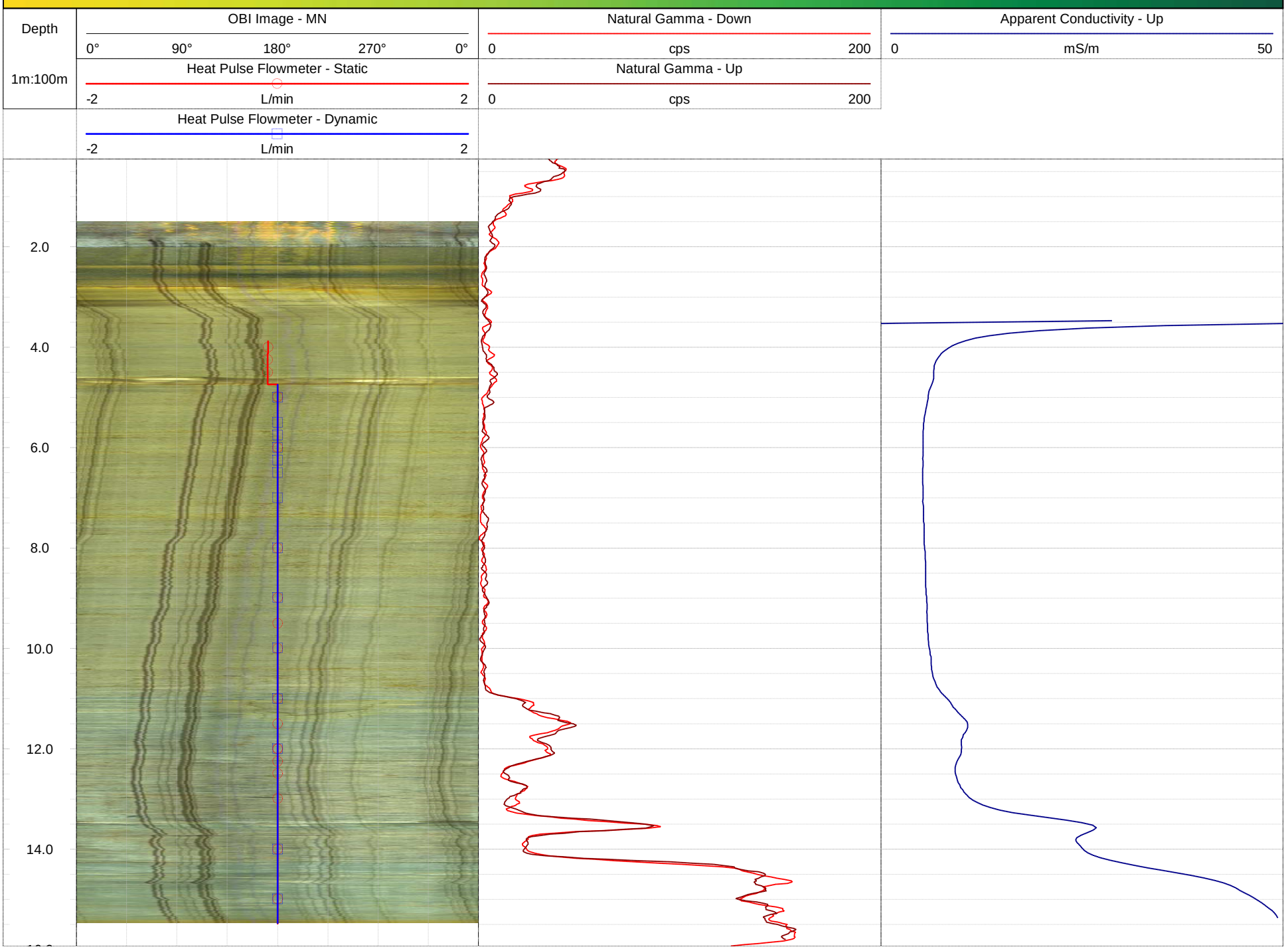
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-06 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.38 m bgs	**Location:**	Caledon, Ontario
Easting:	578474.24 m	**Drilled Depth:**	16.03 m bgs	**Water Level:**	1.96 m bgs	**Log Date:**	Mar-23-2020
Northing:	4852972.59 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	400.15 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.45 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 4.0 m below top of casing. Pump rate approximately 2.75 L/min.



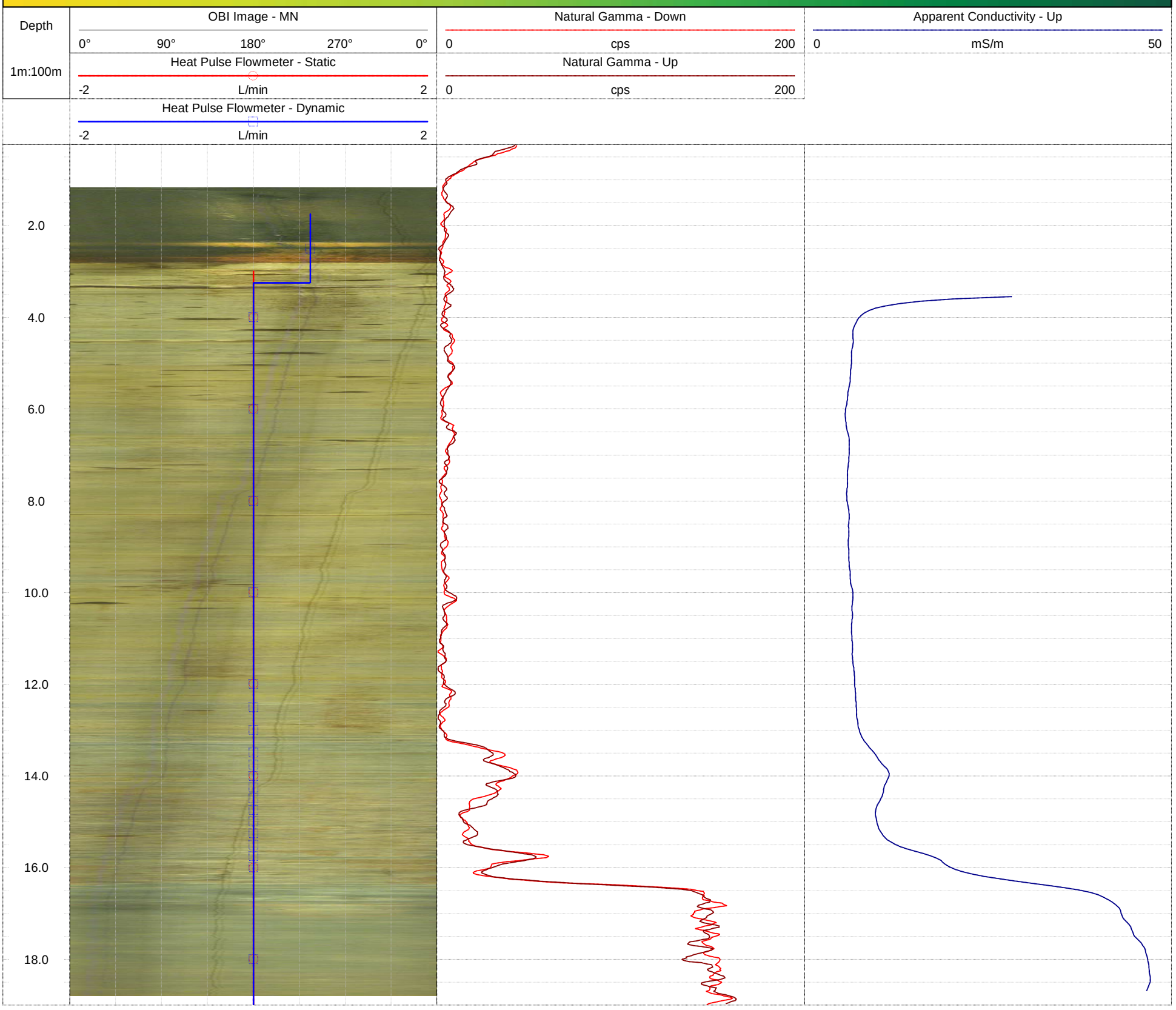
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-07 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.80 m bgs	**Location:**	Caledon, Ontario
Easting:	578359.89 m	**Drilled Depth:**	19.45 m bgs	**Water Level:**	0.31 m bgs	**Log Date:**	Mar-18-2020
Northing:	4853250.44 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.45 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 2.1 m below top of casing.



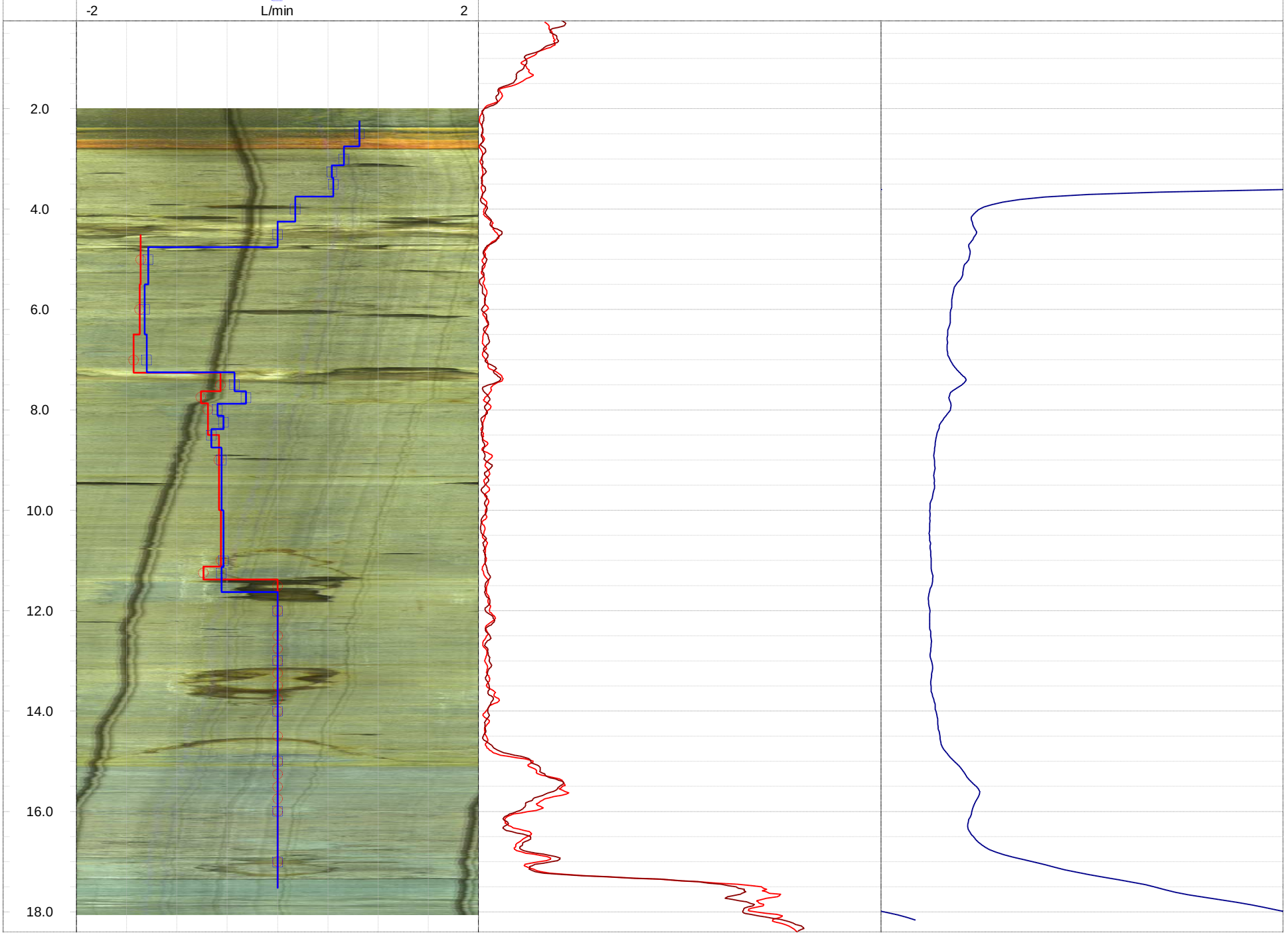
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-08 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.81 m bgs	**Location:**	Caledon, Ontario
Easting:	578009.81 m	**Drilled Depth:**	18.59 m bgs	**Water Level:**	0.66 m bgs	**Log Date:**	Mar-19-2020
Northing:	4853574.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.93 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.43 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 2.1 m below top of casing.



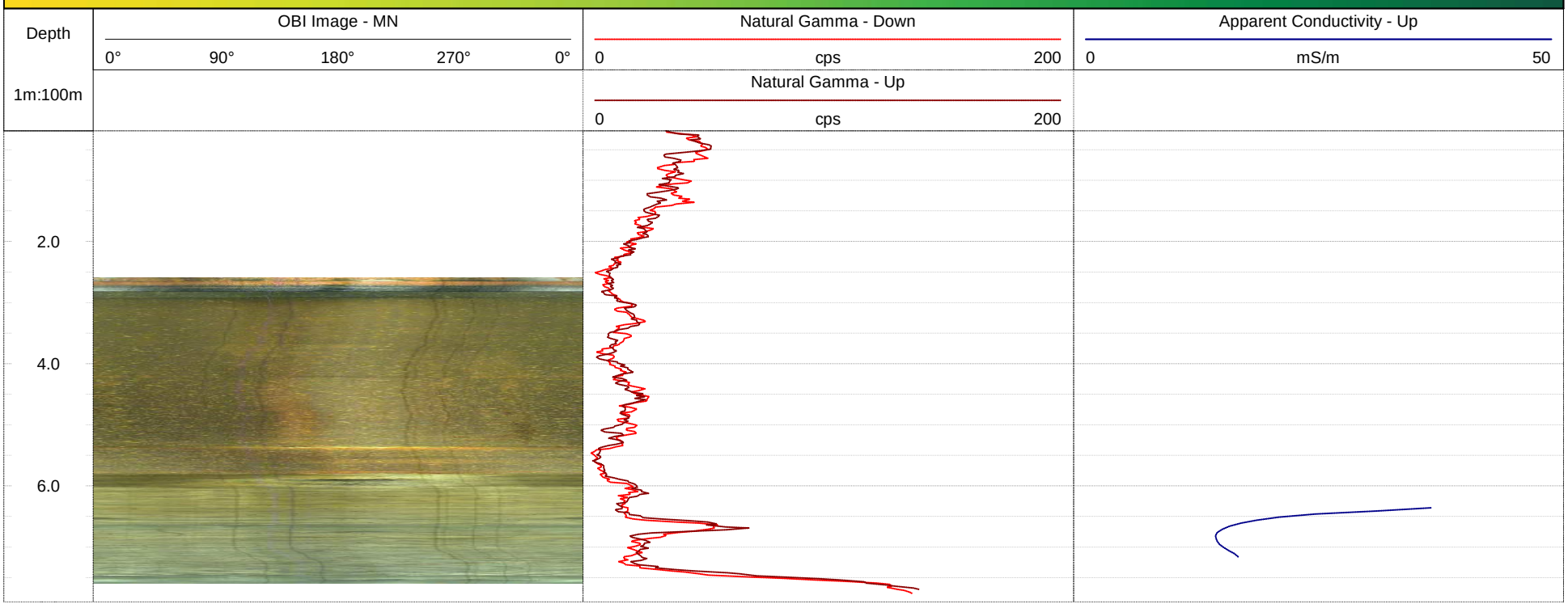
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-09 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.81 m bgs	**Location:**	Caledon, Ontario
Easting:	578343.84 m	**Drilled Depth:**	9.01 m bgs	**Water Level:**	2.74 m bgs	**Log Date:**	Mar-26-2020
Northing:	4854157.49 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.95 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.49 m ags	**Logged By:**	PG

Notes: OBI image opaque > 7.65 m bgs



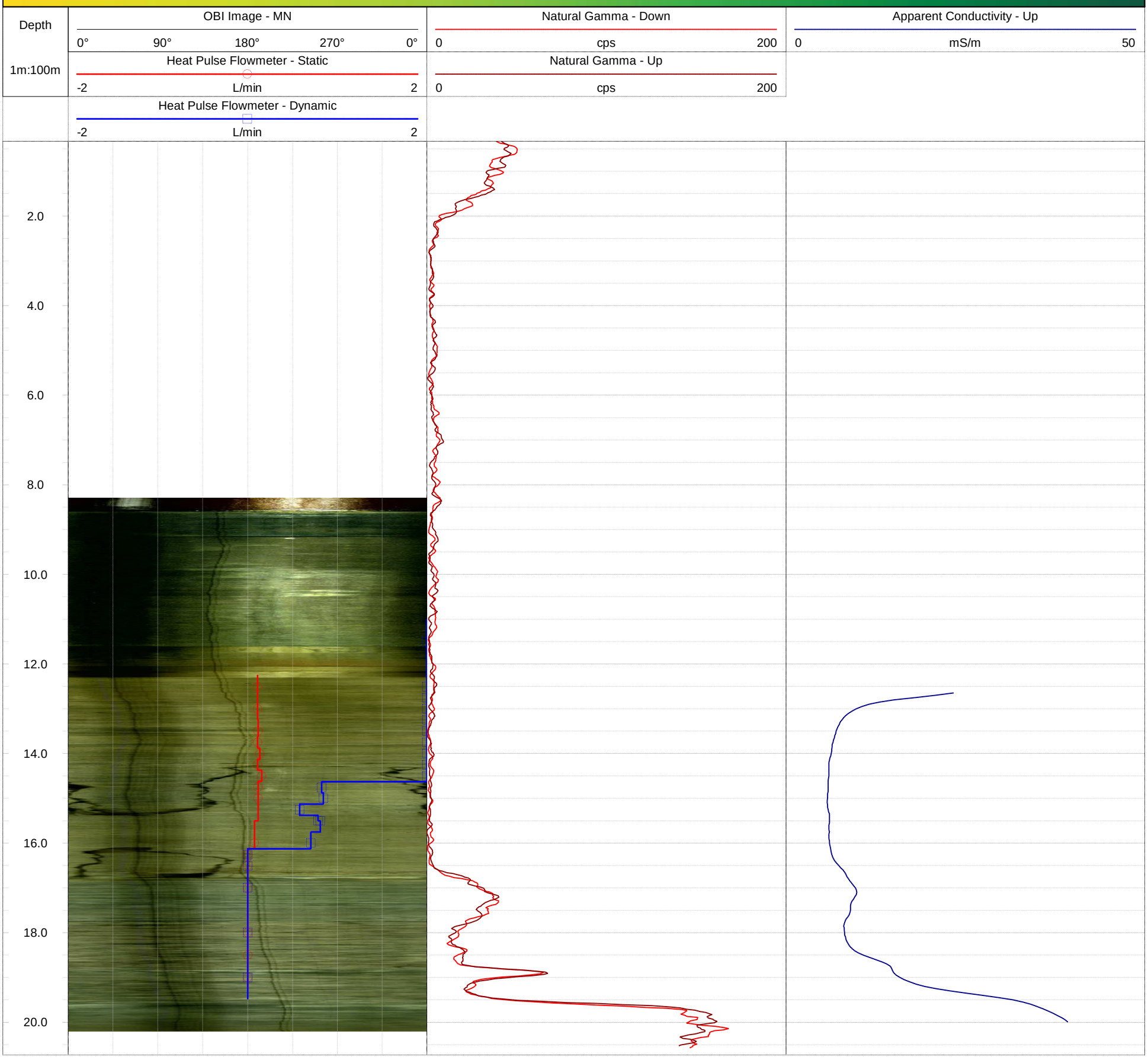
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-10 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.05 m bgs	**Location:**	Caledon, Ontario
Easting:	577837.95 m	**Drilled Depth:**	21.19 m bgs	**Water Level:**	8.33 m bgs	**Log Date:**	Mar-24-2020
Northing:	4854407.28 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	411.32 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.35 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 10.5 m below top of casing. Pump rate approximately 2.72 L/min



GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-11 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.15 m bgs	**Location:**	Caledon, Ontario
Easting:	577671.98 m	**Drilled Depth:**	19.39 m bgs	**Water Level:**	1.93 m bgs	**Log Date:**	Apr-06-2020
Northing:	4853921.39 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	409.72 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.14 m ags	**Logged By:**	PG

Notes: OBI image opaque > 18.80 m. Heat Pulse Flowmeter Dynamic pump at 3.1 m below top of casing. Pump rate approximately 2.72 L/min.



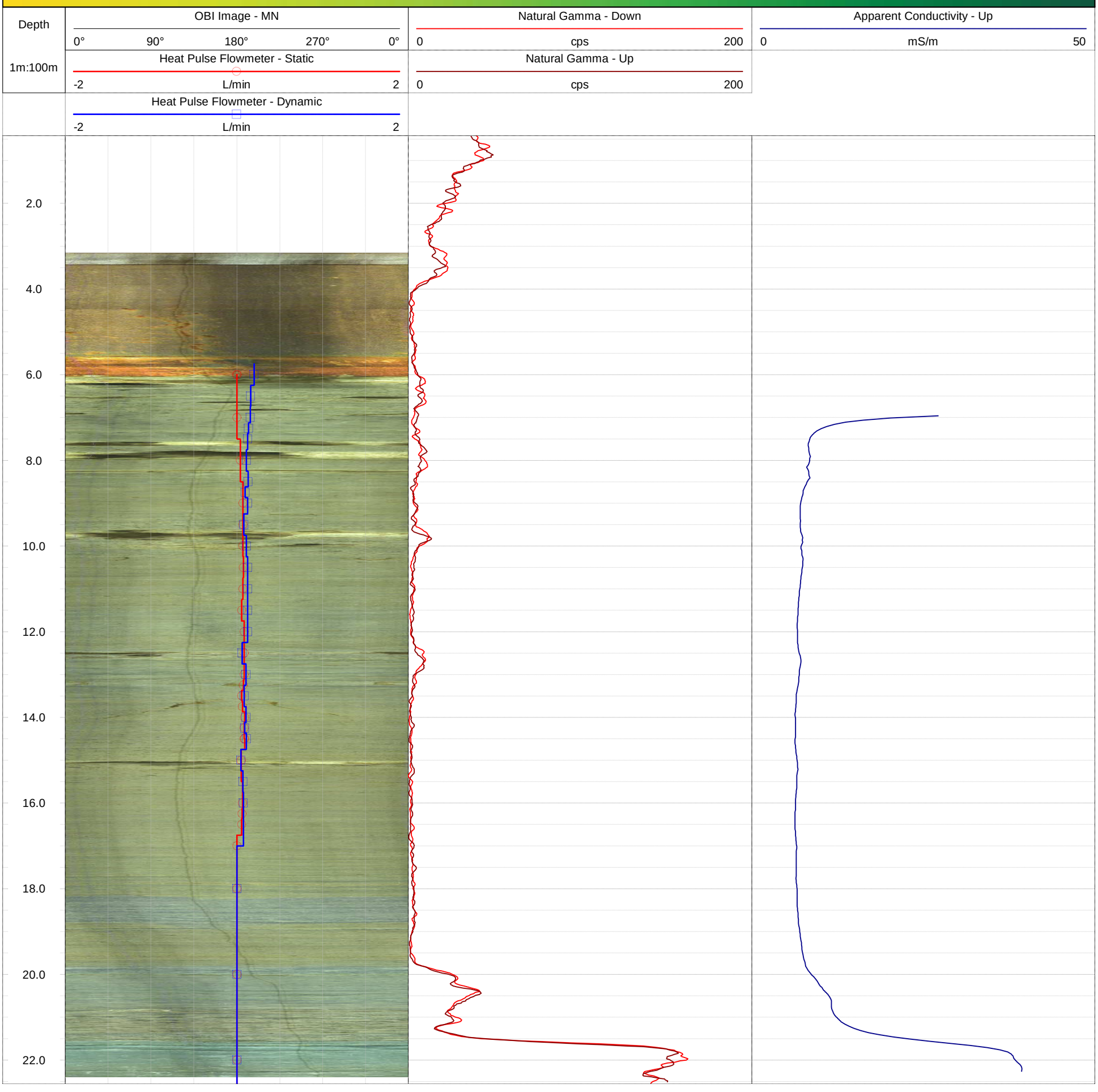
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-12 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.05 m bgs	**Location:**	Caledon, Ontario
Easting:	577271.90 m	**Drilled Depth:**	22.65 m bgs	**Water Level:**	3.44 m bgs	**Log Date:**	Apr-08-2020
Northing:	4854321.42 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	412.43 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.26 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 4.5 m below top of casing. Pump rate approximately 2.30 L/min.



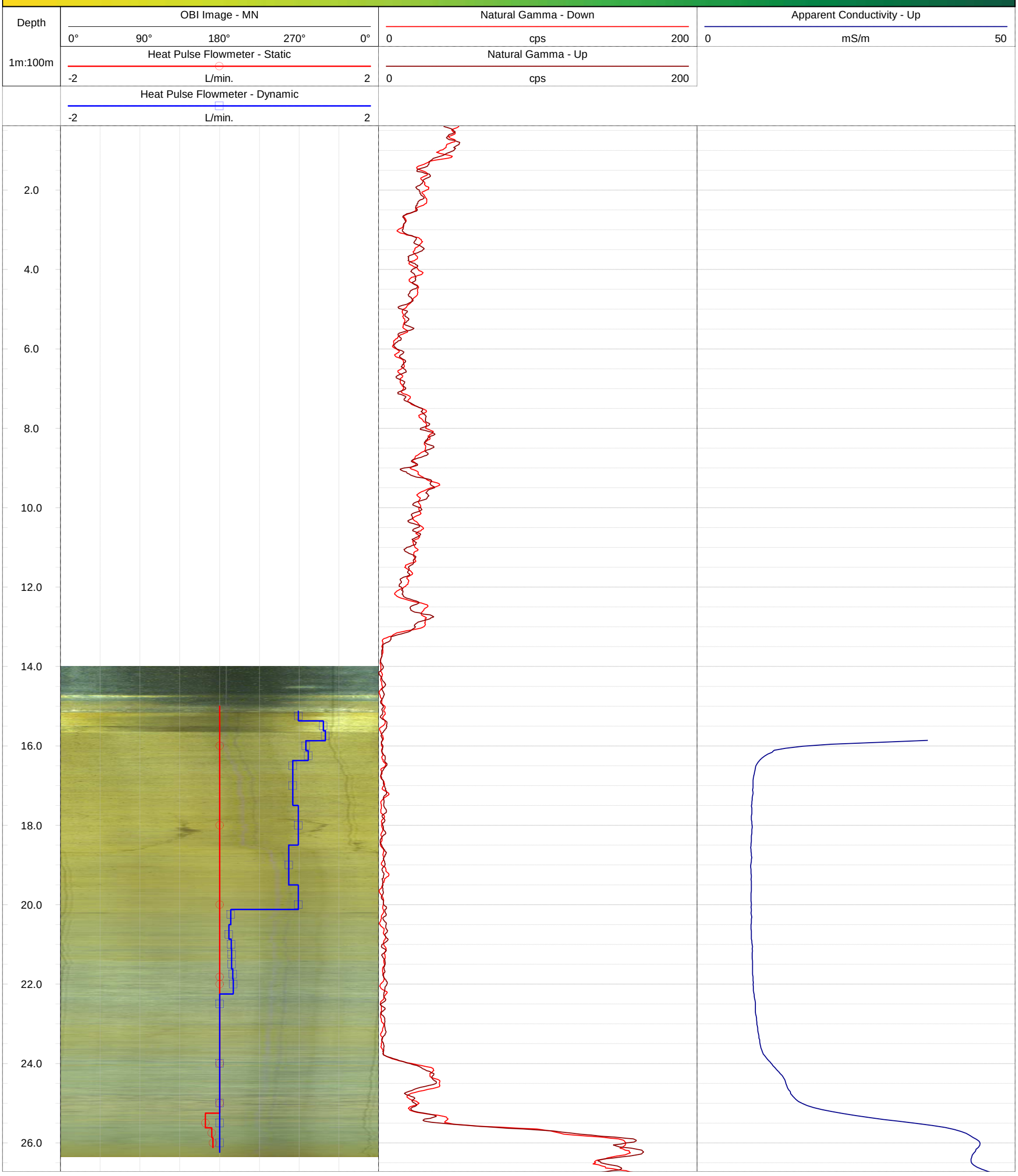
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-13 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.16 m bgs	**Location:**	Caledon, Ontario
Easting:	576873.11 m	**Drilled Depth:**	28.23 m bgs	**Water Level:**	2.64 m bgs	**Log Date:**	Apr-15-2020
Northing:	4854473.14 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.53 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.28 m ags	**Logged By:**	PG

Notes: Heat Pulse Flowmeter Dynamic pump at 6.0 m below top of casing. Pump rate approximately 1.40 L/min.





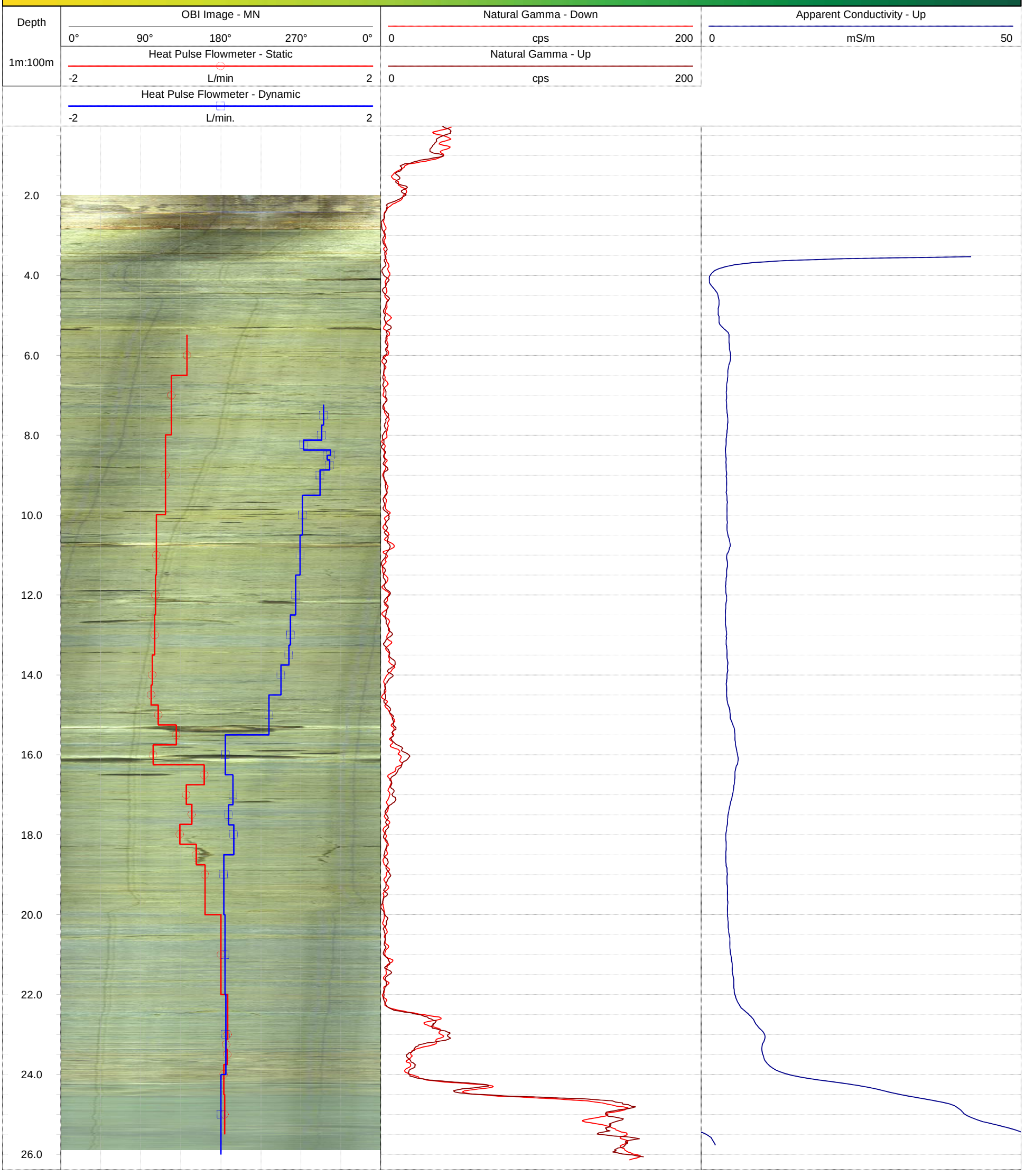
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-14 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	2.85 m bgs	**Location:**	Caledon, Ontario
Easting:	577575.99 m	**Drilled Depth:**	26.35 m bgs	**Water Level:**	4.52 m bgs	**Log Date:**	May-14-2020
Northing:	4853100.42 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.71 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes: OBI image opaque > 25.90. Heat Pulse Flowmeter Dynamic pump at 5.0 m below top of casing. Pump rate approximately 2.63 L/min.



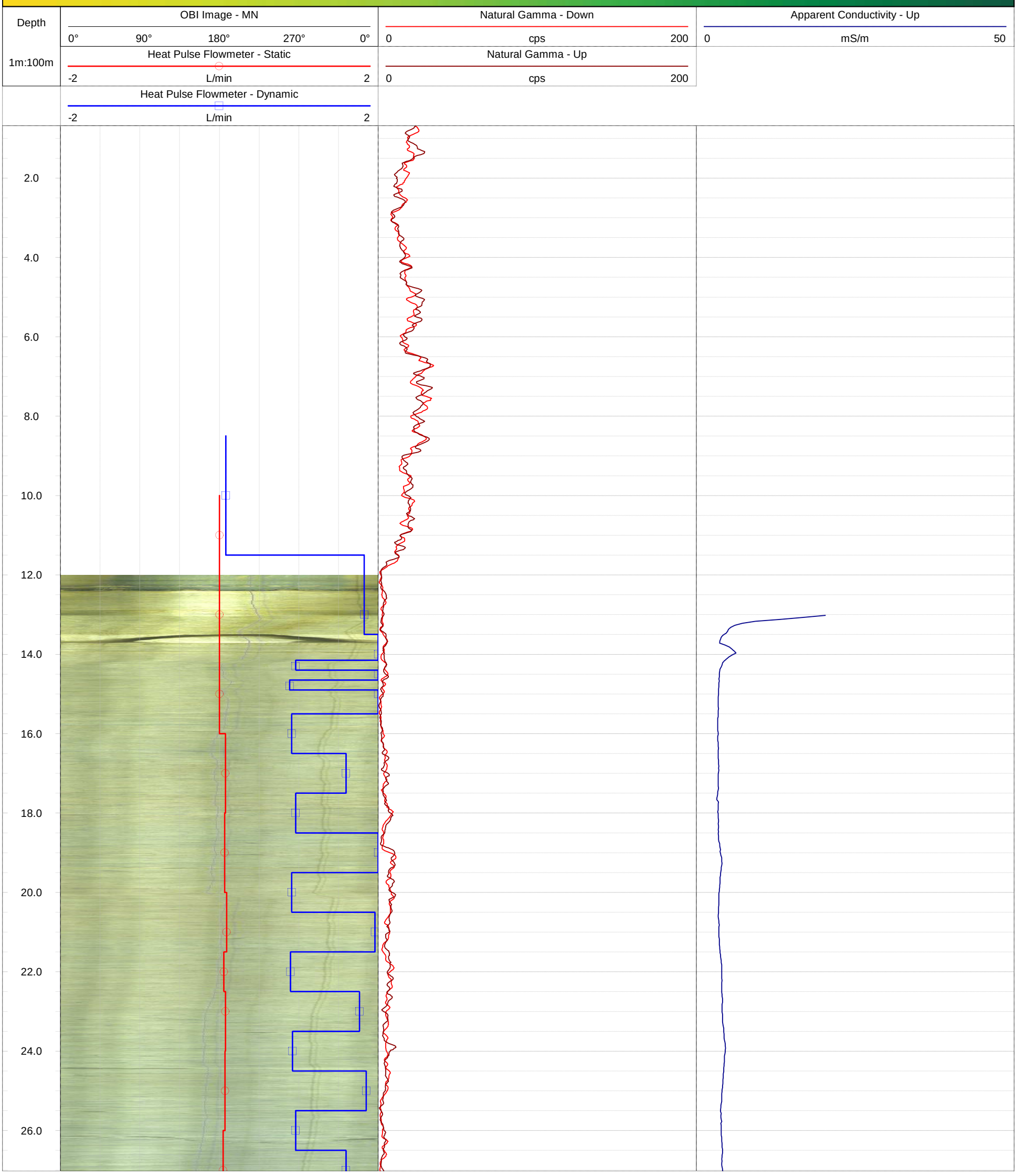
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-15 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.40 m bgs	**Location:**	Caledon, Ontario
Easting:	576576.79 m	**Drilled Depth:**	37.17 m bgs	**Water Level:**	0.70 m bgs	**Log Date:**	May-27-2020
Northing:	4853544.15 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.06 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.00 m ags	**Logged By:**	PG

Notes: OBI image opaque > 36.6 m bgs




28.0
30.0
32.0
34.0
36.0

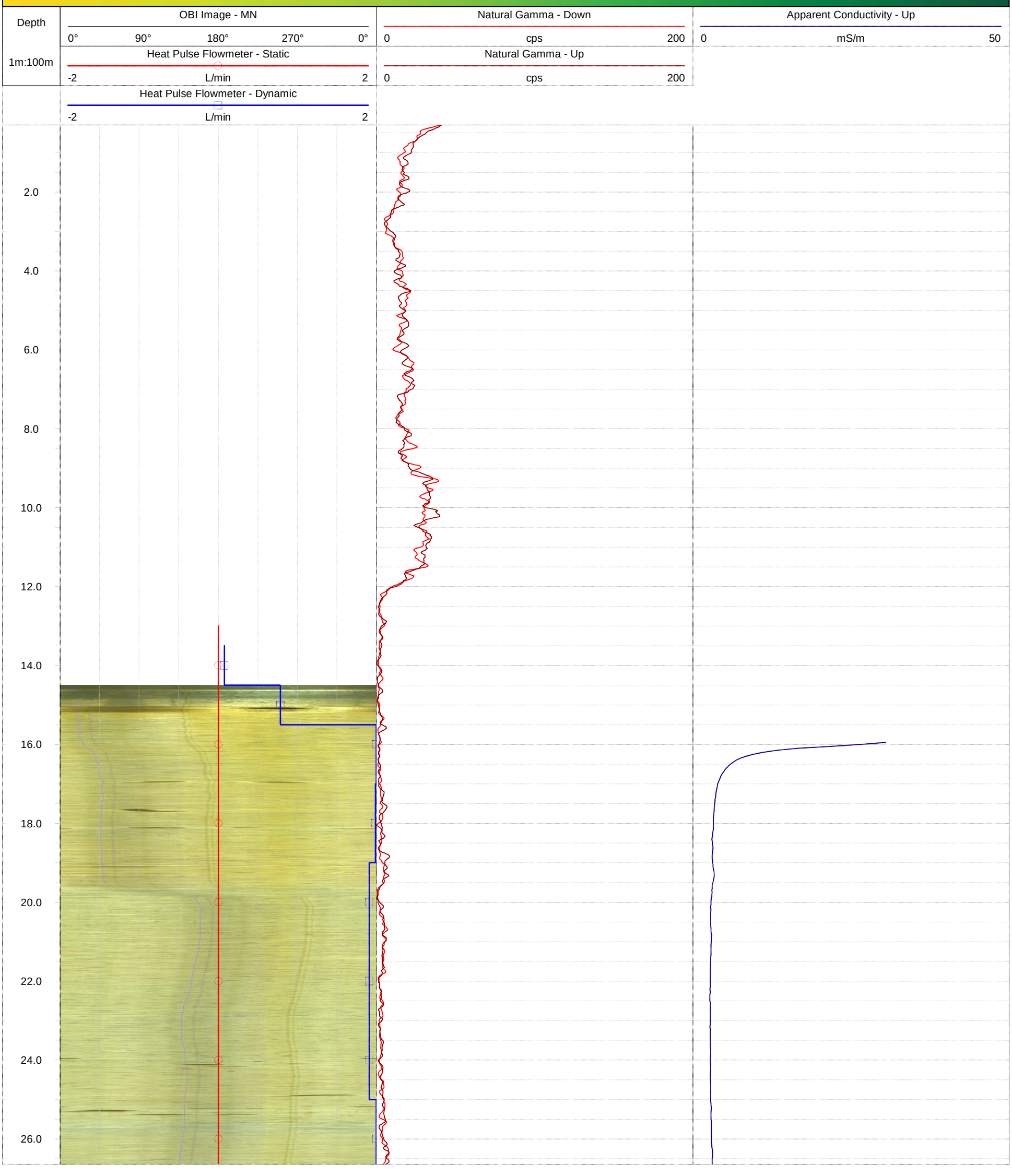
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-16 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.04 m bgs	**Location:**	Caledon, Ontario
Easting:	576784.58 m	**Drilled Depth:**	39.77 m bgs	**Water Level:**	0.86 m bgs	**Log Date:**	May-26-2020
Northing:	4853806.76 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	421.40 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes: OBI image opaque > 38.60 m bgs




28.0
30.0
32.0
34.0
36.0
38.0

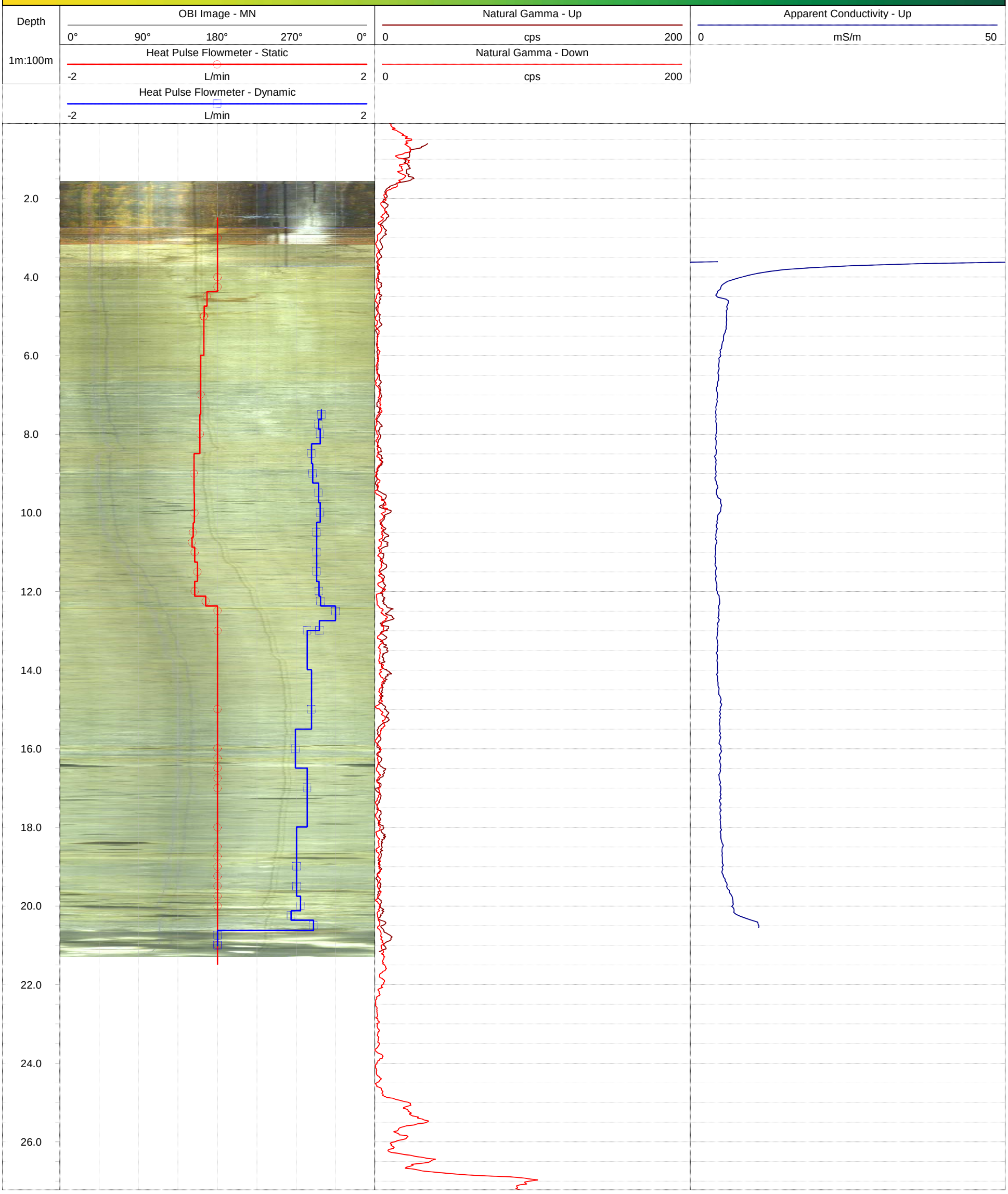
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-17 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	3.18 m bgs	**Location:**	Caledon, Ontario
Easting:	576752.28 m	**Drilled Depth:**	28.82 m bgs	**Water Level:**	4.02 m bgs	**Log Date:**	May-28-2020
Northing:	4852966.36 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	406.64 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.05 m ags	**Logged By:**	PG

Notes: Borehole blocked at depth - logged upper portion. Heat Pulse Flowmeter Dynamic pump at 5.0 m below top of casing. Pump rate approximately 2.63 L/min.



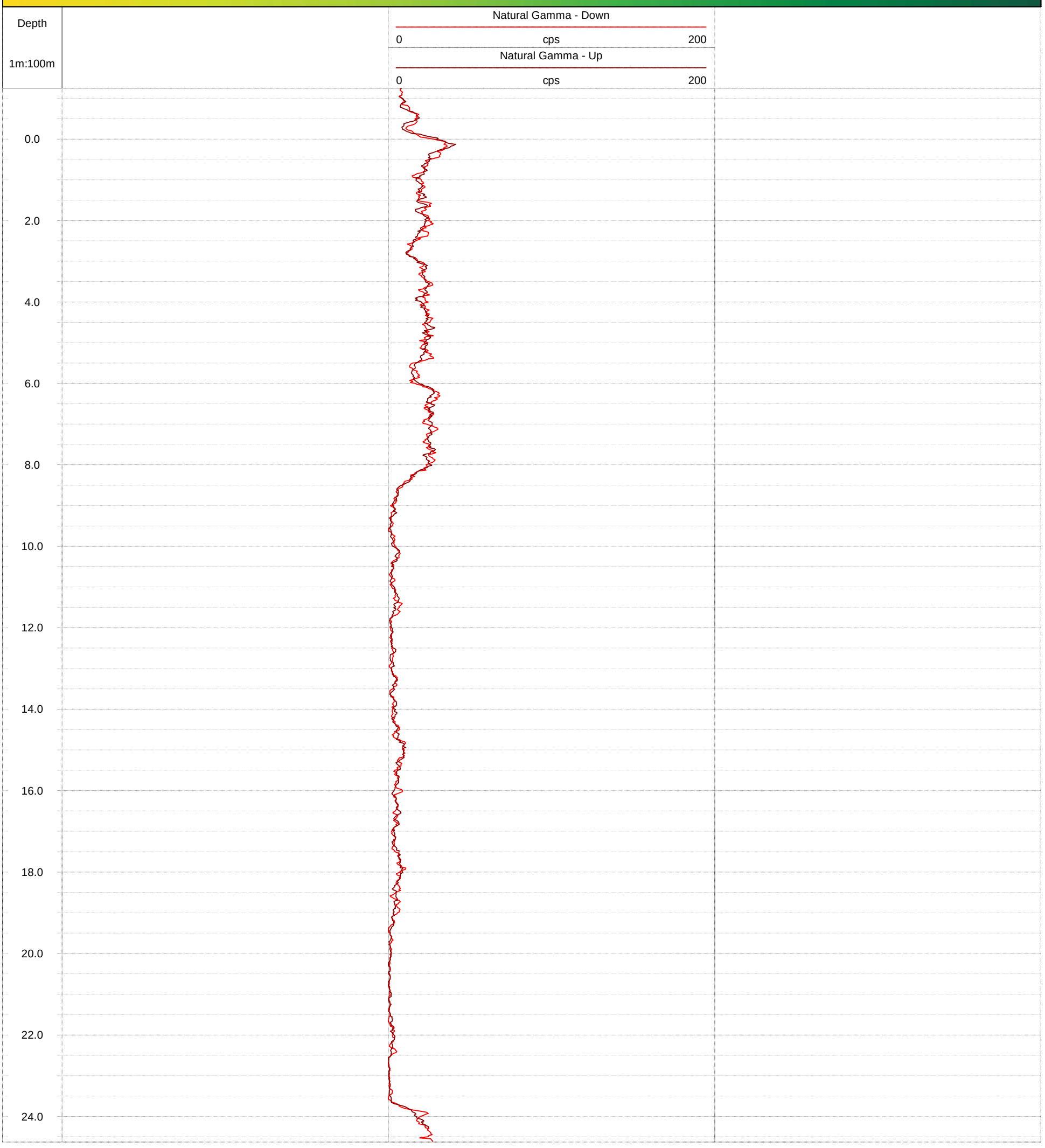
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-18 (CAL)

Log Title:	Geophysical Log
Project Number:	19129150
Client:	St. Marys Cement Inc. (Canada)
Date:	October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	577058.36 m	**Drilled Depth:**	28.15 m bgs	**Water Level:**	12.41 m bgs	**Log Date:**	June-12-2020
Northing:	4852658.80 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.29 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	1.69 m ags	**Logged By:**	PG

Notes: Collapsed hole. Only Gamma logged inside the rods.



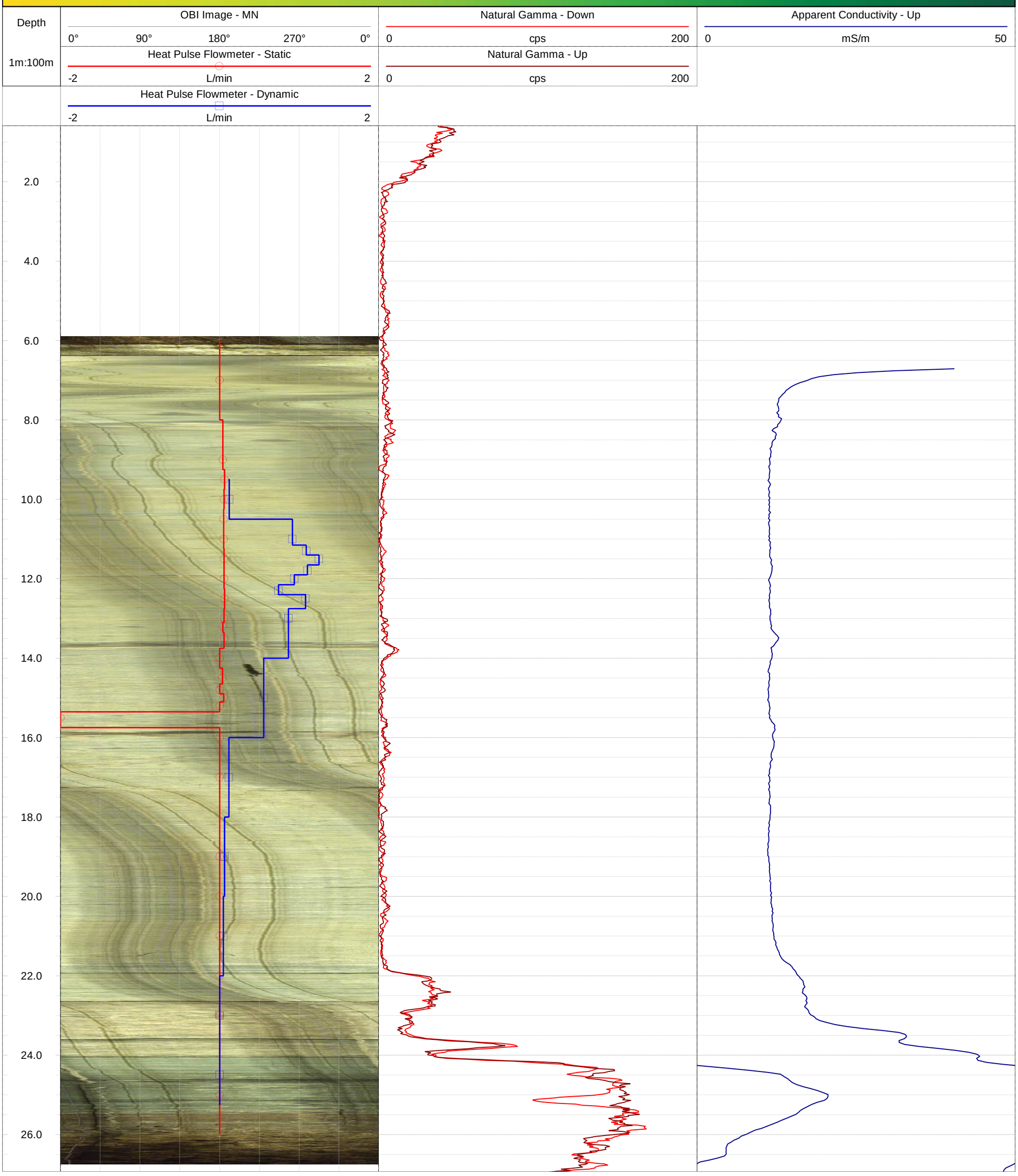
GOLDER
MEMBER OF WSP

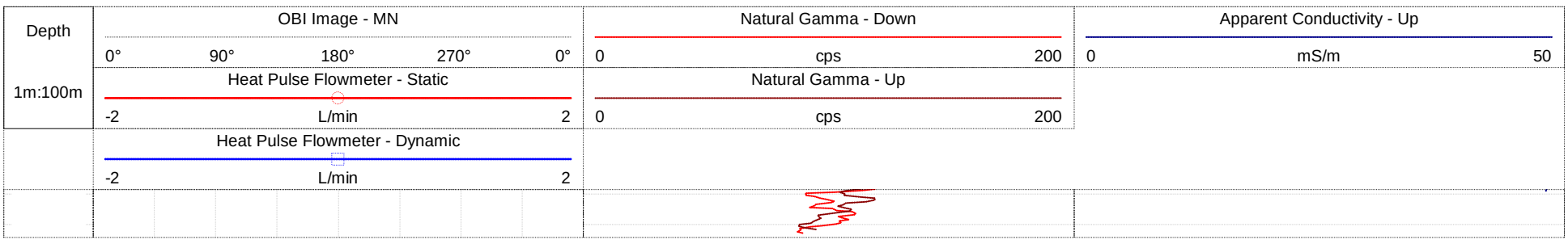
Geophysical Record of Borehole: MW20-19 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.10 m bgs	**Location:**	Caledon, Ontario
Easting:	576906.96 m	**Drilled Depth:**	27.39 m bgs	**Water Level:**	6.47 m bgs	**Log Date:**	Oct-28-2020
Northing:	4851999.96 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	396.98 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.10 m ags	**Logged By:**	PG

Notes:




Depth
1m:100m
OBI Image - MN
0°
90°
180°
270°
0°
Heat Pulse Flowmeter - Static
-2
L/min
2
Heat Pulse Flowmeter - Dynamic
-2
L/min
2
Natural Gamma - Down
0
cps
200
Natural Gamma - Up
0
cps
200
Apparent Conductivity - Up
0
mS/m
50

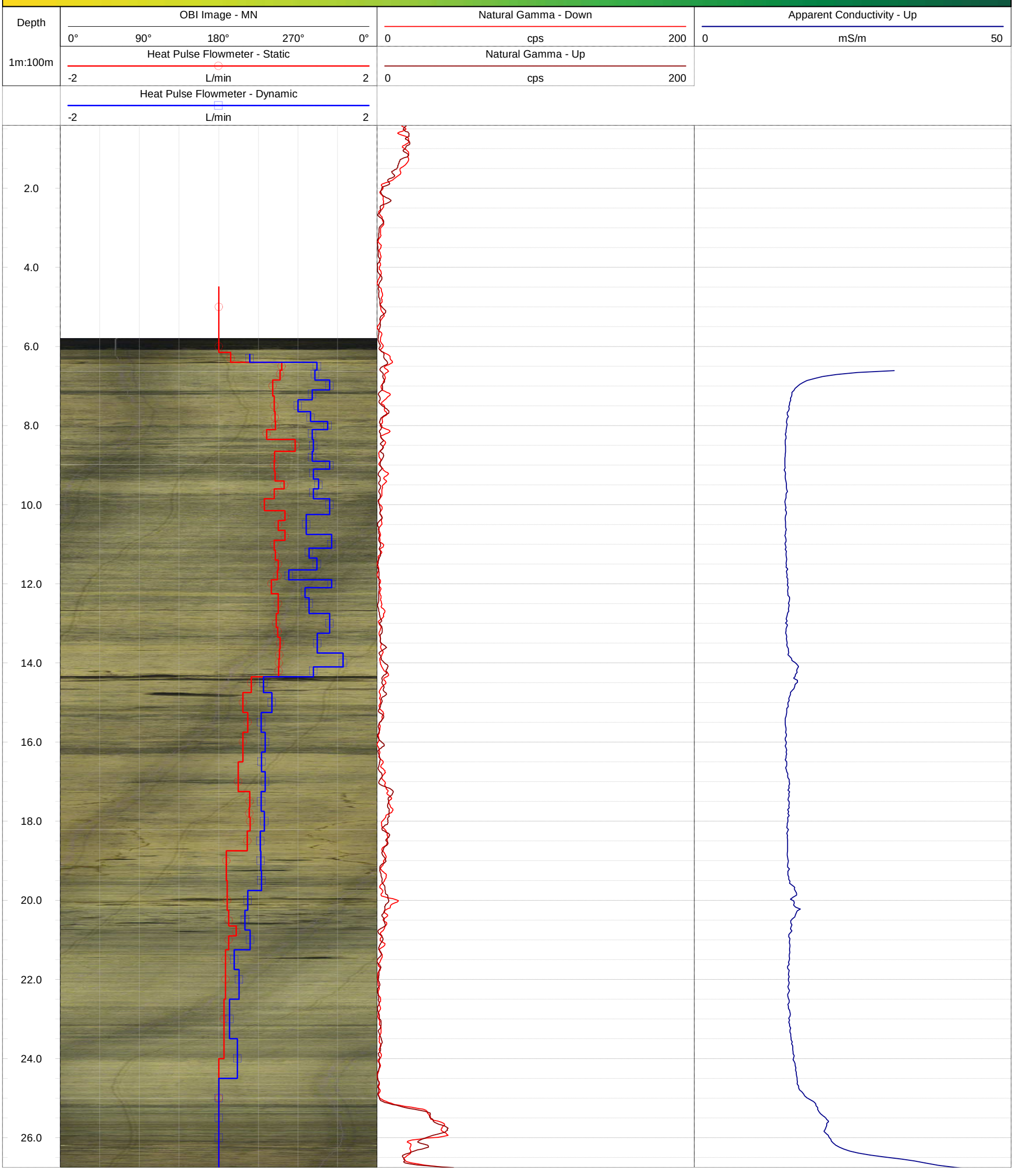
GOLDER
MEMBER OF WSP

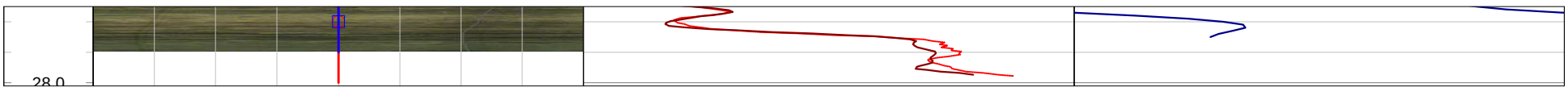
Geophysical Record of Borehole: MW20-20 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.08 m bgs	**Location:**	Caledon, Ontario
Easting:	576476.35 m	**Drilled Depth:**	27.99 m bgs	**Water Level:**	0.25 m bgs	**Log Date:**	Oct-20-2020
Northing:	4852467.69 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.00 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.25 m ags	**Logged By:**	PG

Notes:




28.0

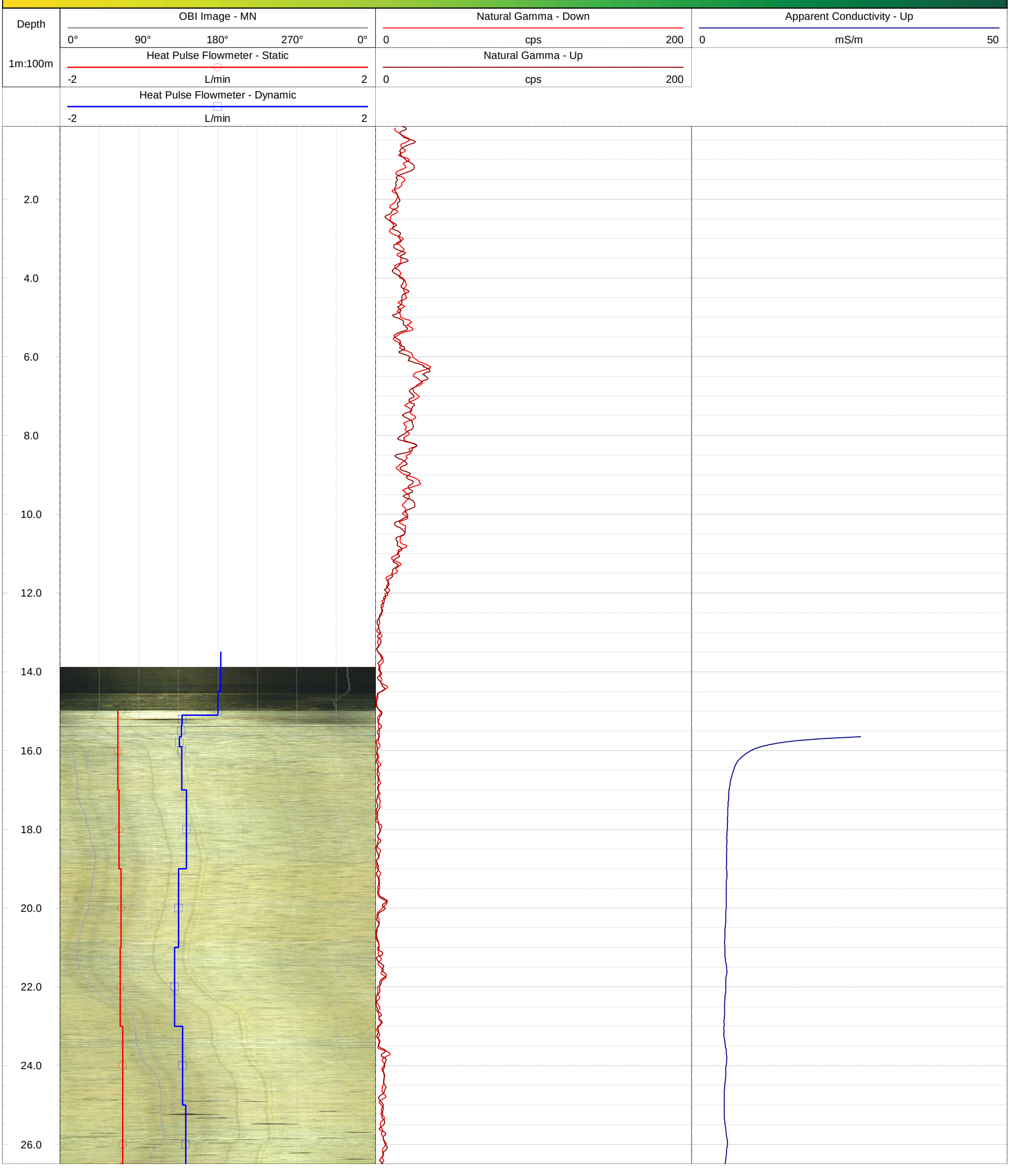
GOLDER
MEMBER OF WSP

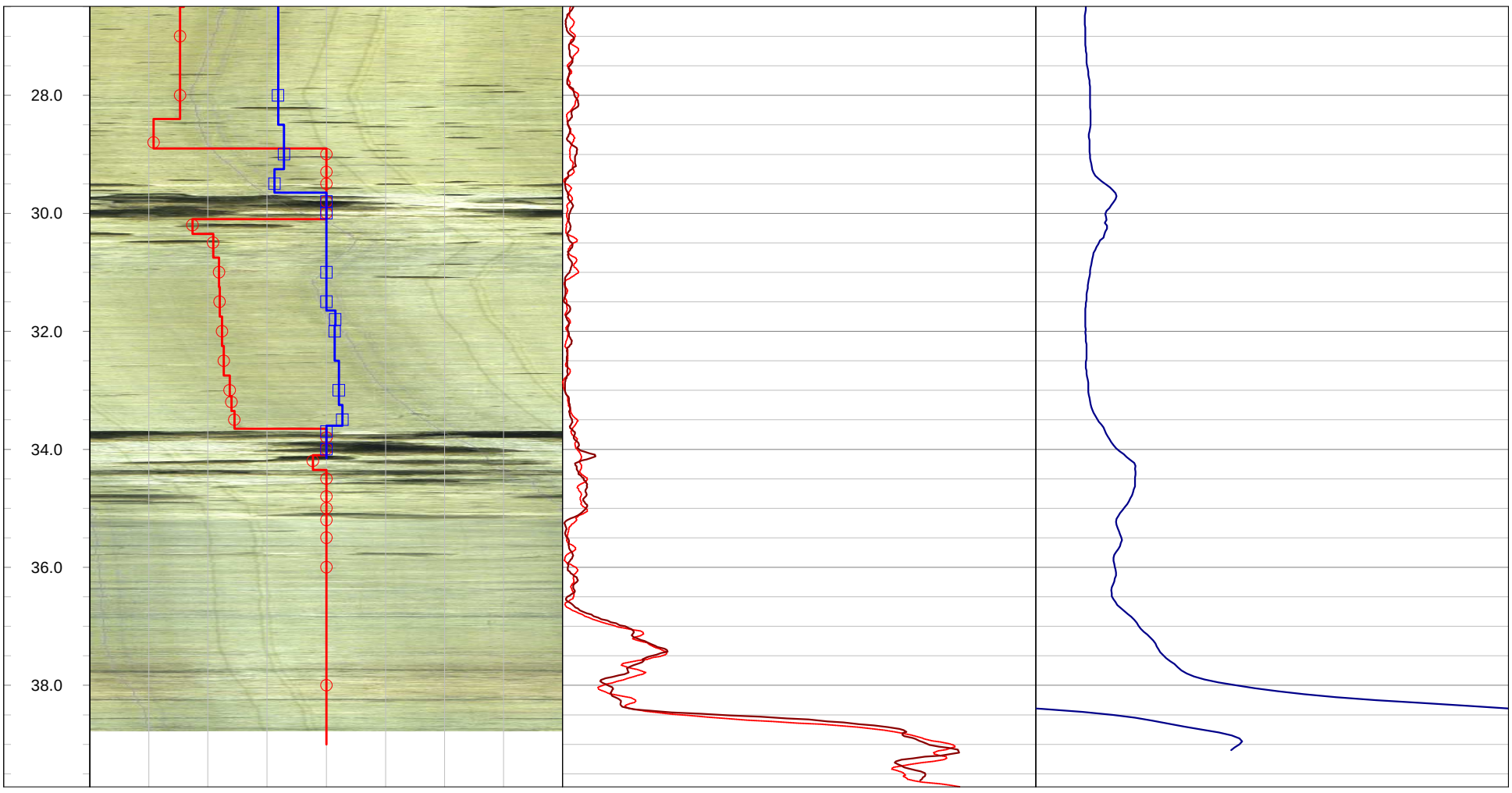
Geophysical Record of Borehole: MW20-21 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	14.98 m bgs	**Location:**	Caledon, Ontario
Easting:	576014.37 m	**Drilled Depth:**	39.70 m bgs	**Water Level:**	1.54 m bgs	**Log Date:**	Nov-5-2020
Northing:	4852839.77 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.23 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.50 m ags	**Logged By:**	PG

Notes: OBI image opaque > 38.90 m bgs




28.0
30.0
32.0
34.0
36.0
38.0

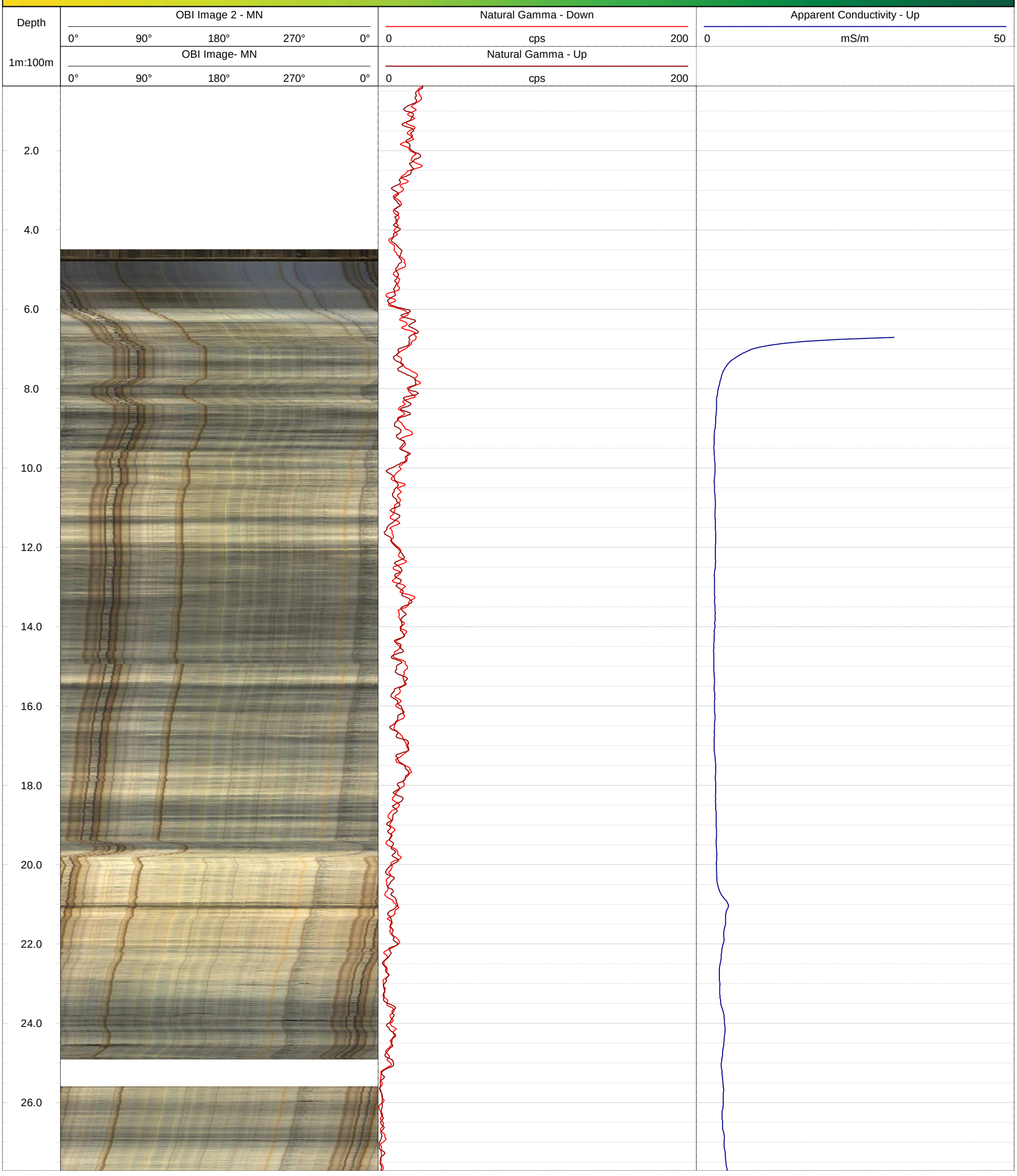
GOLDER
MEMBER OF WSP

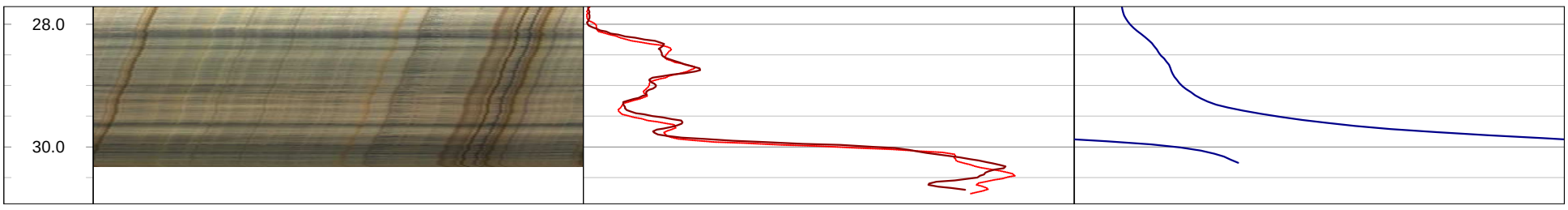
Geophysical Record of Borehole: MW20-22 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.99 m bgs	**Location:**	Caledon, Ontario
Easting:	575785.36 m	**Drilled Depth:**	30.75 m bgs	**Water Level:**	4.40 m bgs	**Log Date:**	Nov-18-2020
Northing:	4851966.28 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	399.27 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.30 m ags	**Logged By:**	PG

Notes: OBI image opaque > 30.5 m bgs




28.0
30.0

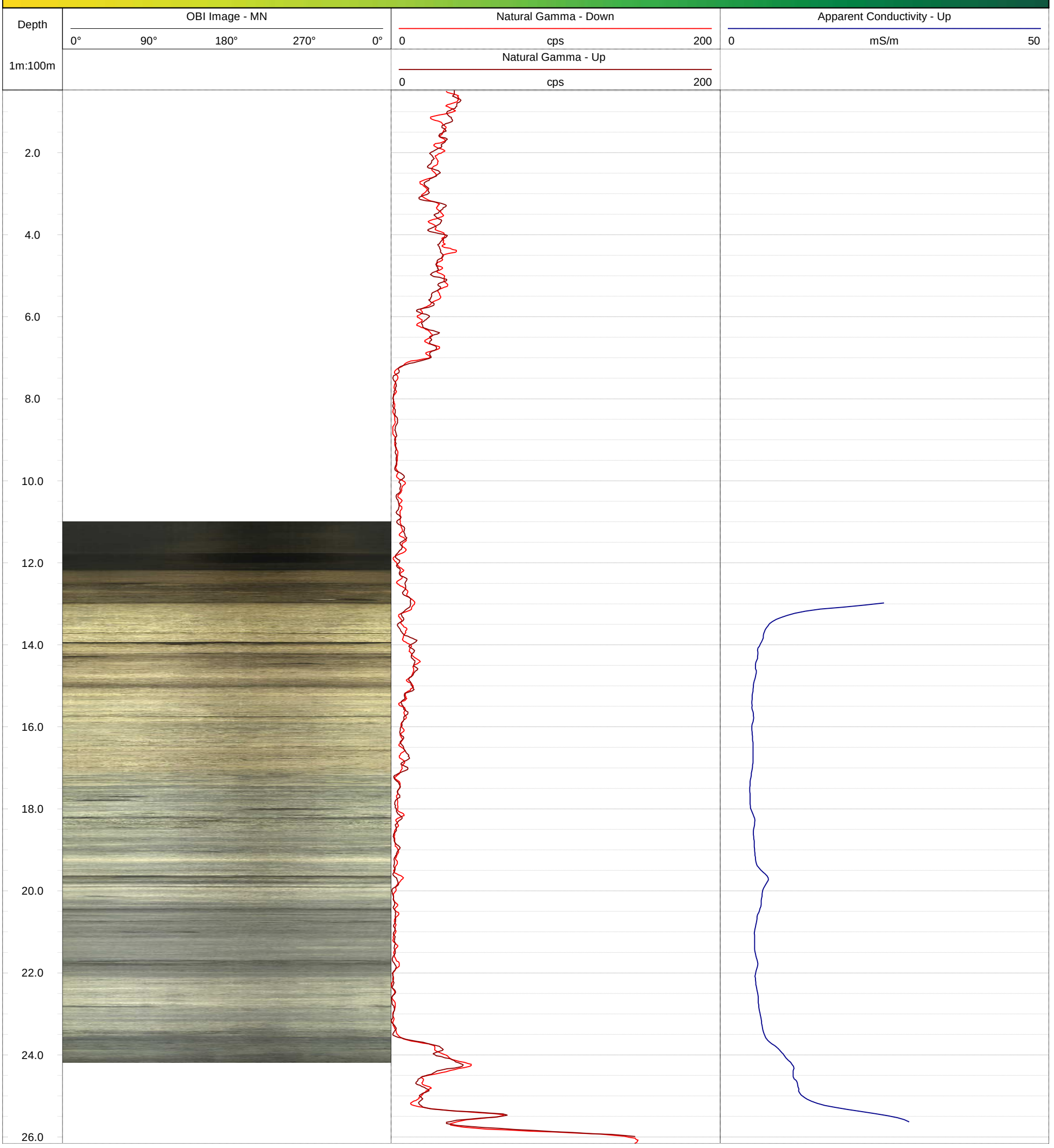
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW20-23 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	576205.53 m	**Drilled Depth:**	26.76 m bgs	**Water Level:**	4.68 m bgs	**Log Date:**	Nov-24-2020
Northing:	4851555.91 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	395.05 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PG

Notes: OBI image opaque > 24.4 m bgs



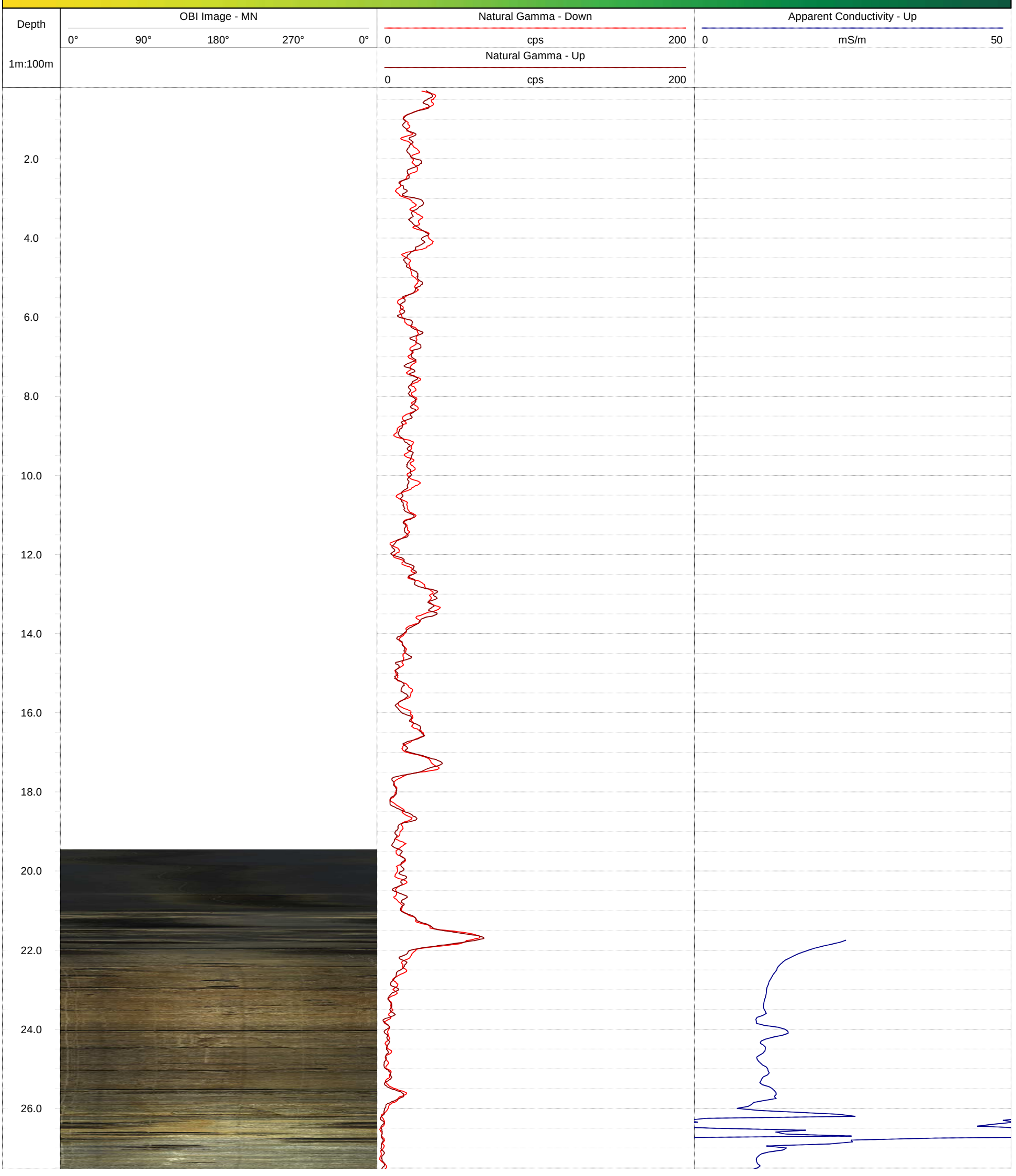
GOLDER
MEMBER OF WSP

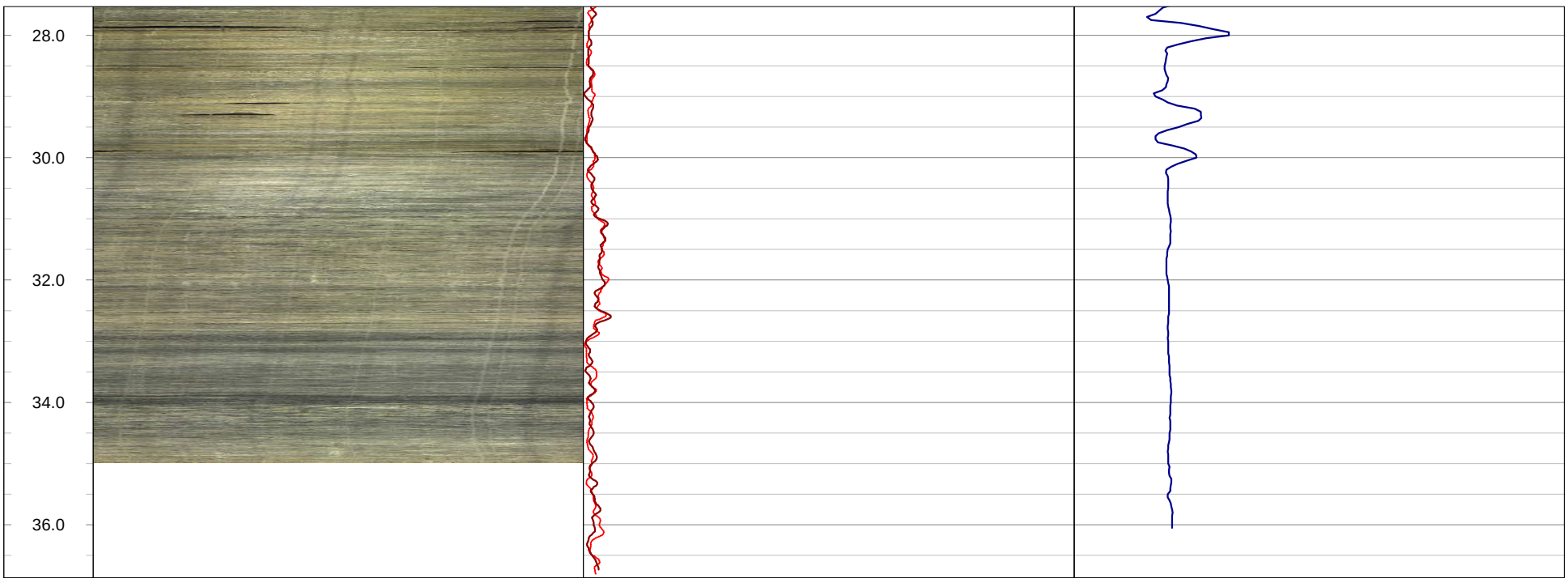
Geophysical Record of Borehole: MW20-24 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	20.98 m bgs	**Location:**	Caledon, Ontario
Easting:	575337.66 m	**Drilled Depth:**	37.49 m bgs	**Water Level:**	4.46 m bgs	**Log Date:**	Dec-04-2020
Northing:	4854341.85 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	437.75 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.51 m ags	**Logged By:**	PG

Notes: OBI Image opaque > 35 m bgs




28.0
30.0
32.0
34.0
36.0

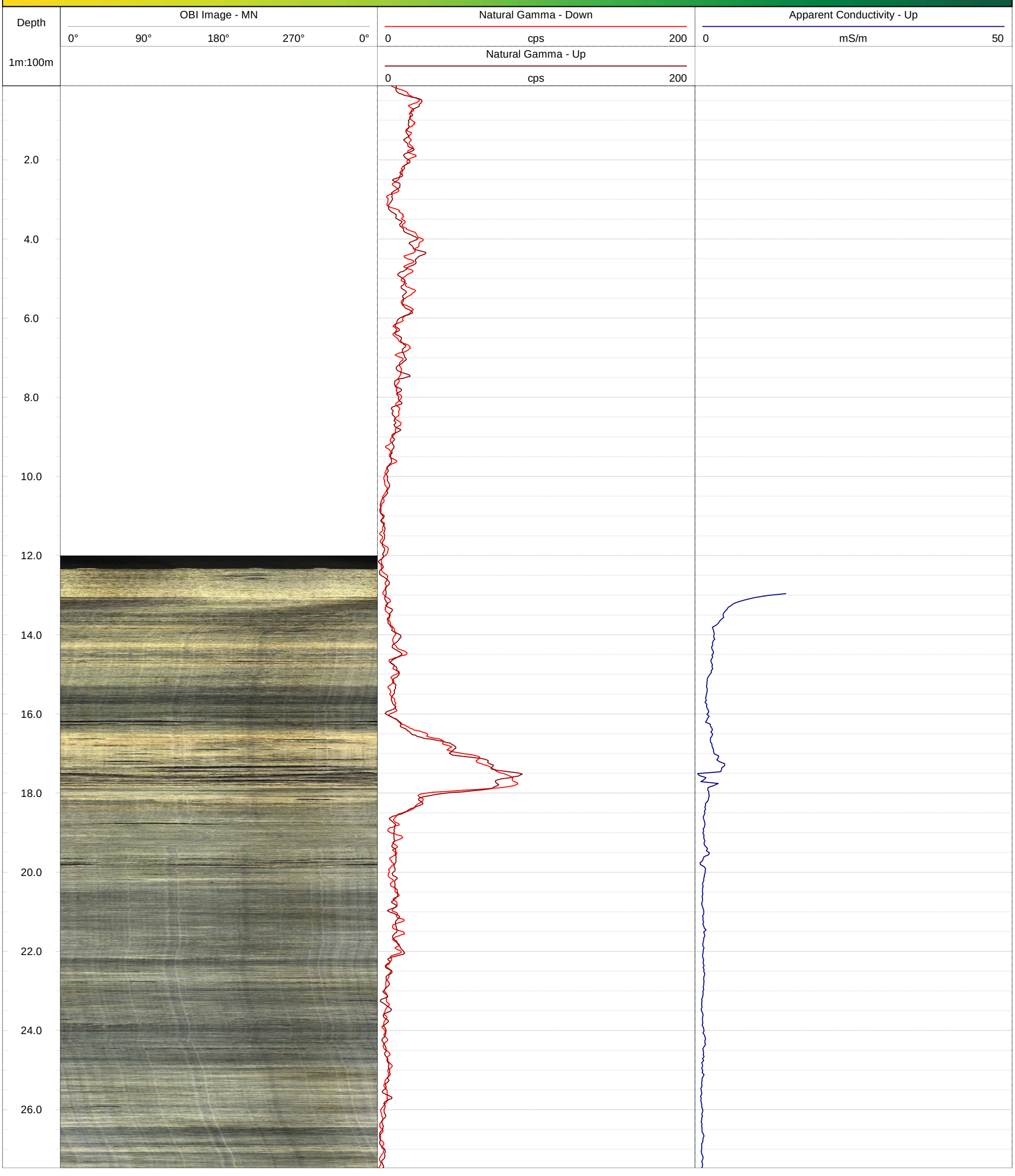
GOLDER
MEMBER OF WSP

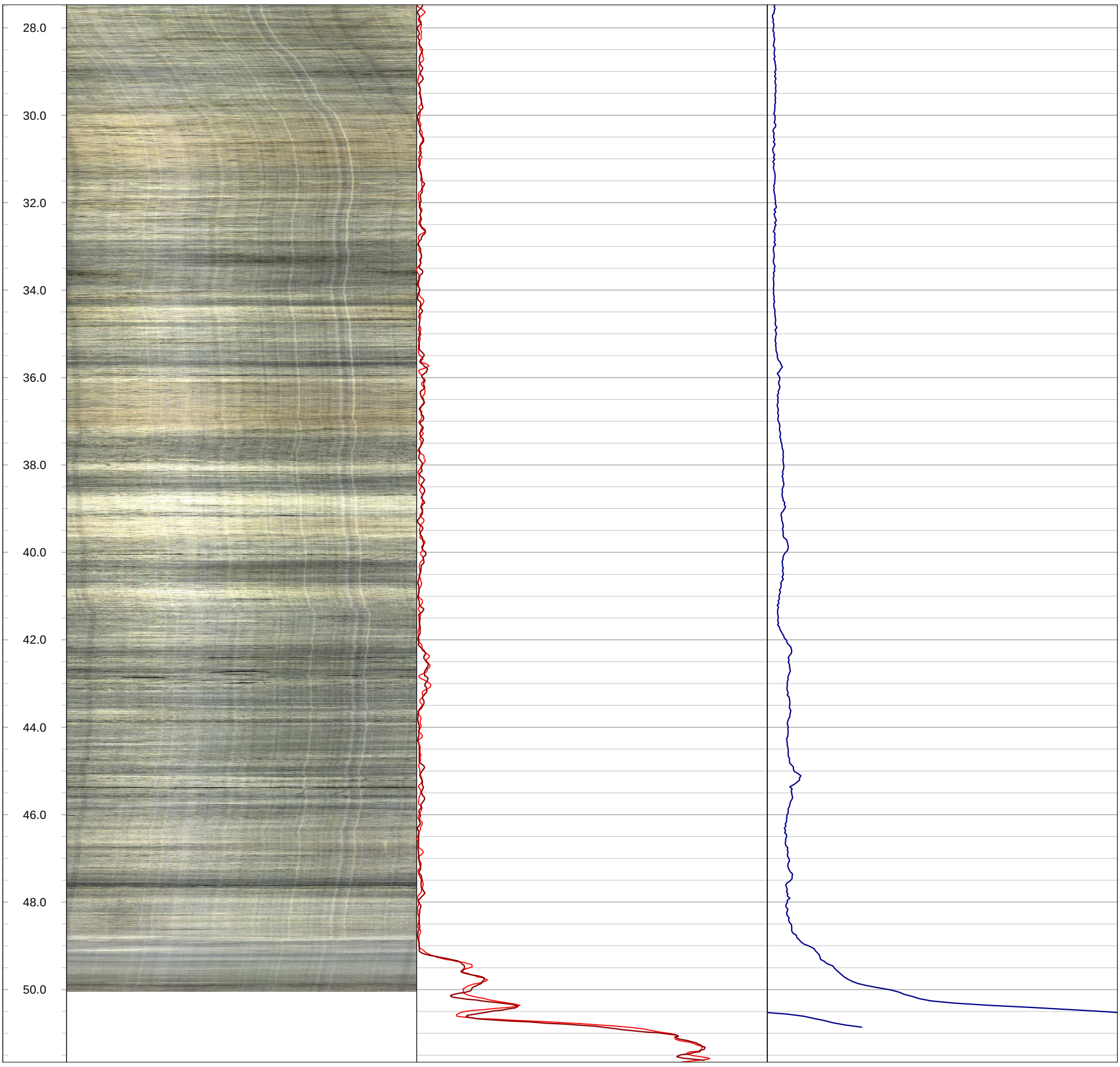
Geophysical Record of Borehole: MW20-25 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.39 m bgs	**Location:**	Caledon, Ontario
Easting:	574853.76 m	**Drilled Depth:**	51.82 m bgs	**Water Level:**	-0.83 m bgs	**Log Date:**	Dec-12-2020
Northing:	4852900.48 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	419.02 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.98 m ags	**Logged By:**	PG

Notes: Artesian well, water slowly rose up to above stick-up casing level during data acquisition. OBI image opaque > 50.2 m bgs




28.0
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34.0
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42.0
44.0
46.0
48.0
50.0

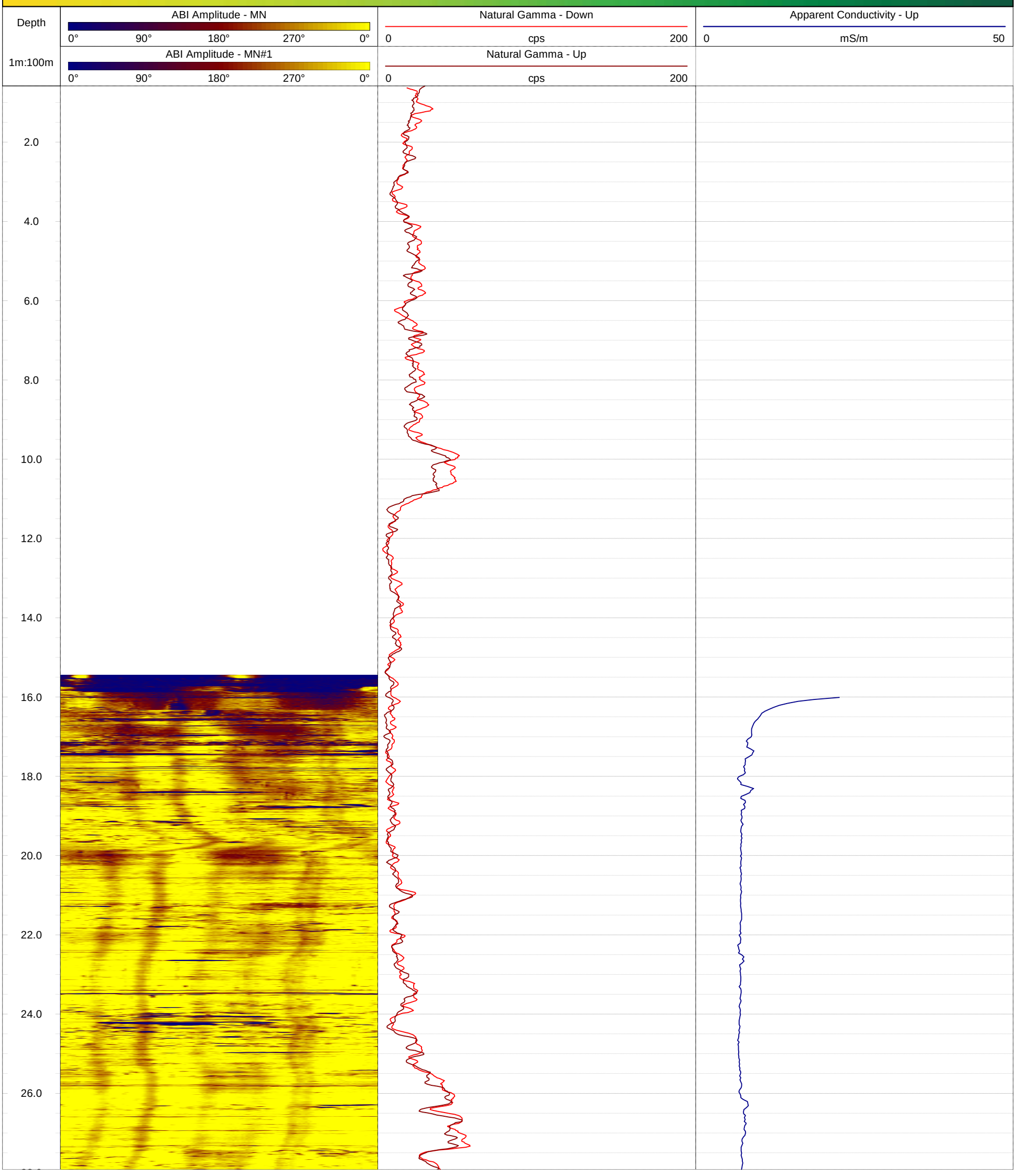
GOLDER
MEMBER OF WSP

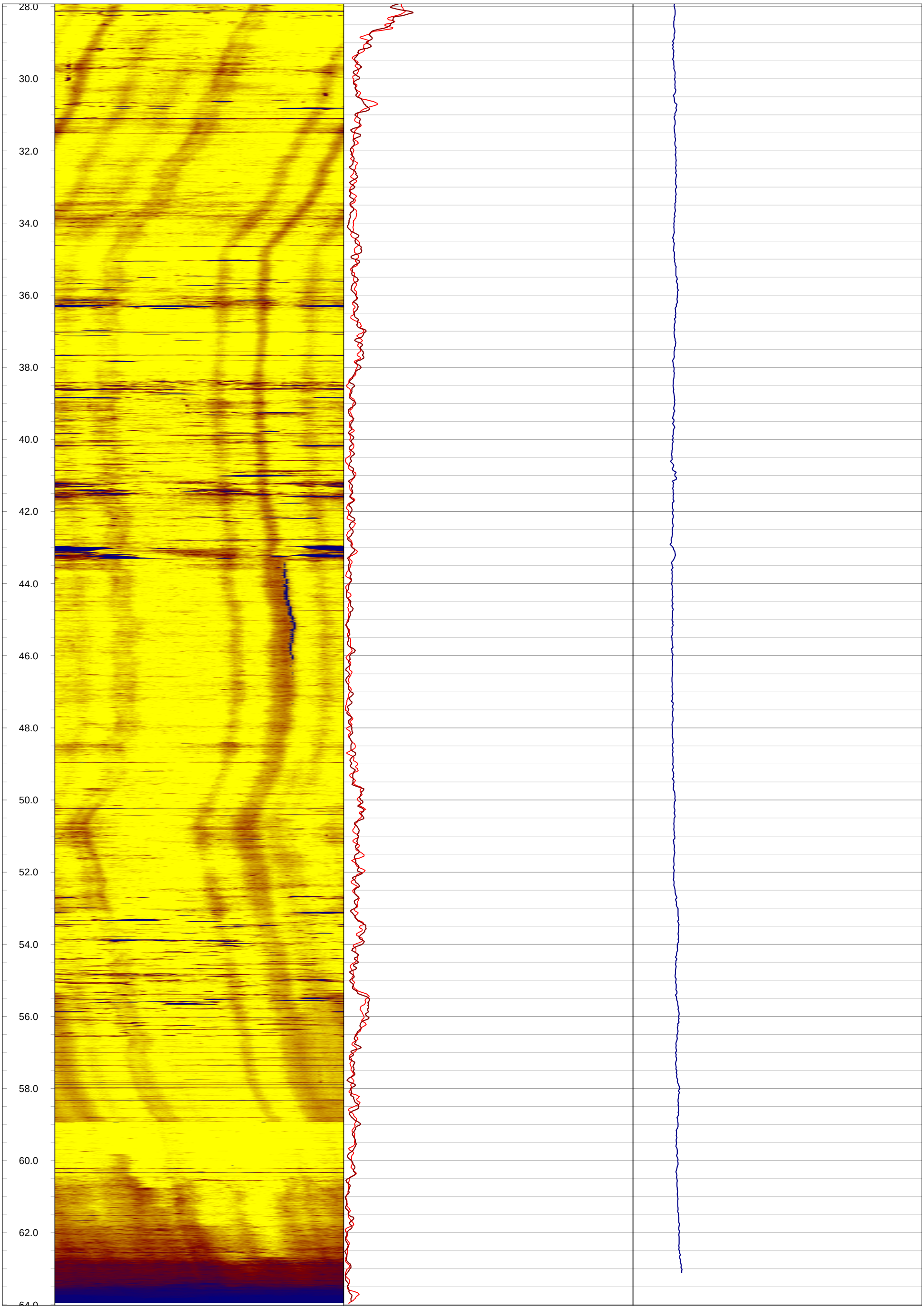
Geophysical Record of Borehole: MW20-26 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.53 m bgs	**Location:**	Caledon, Ontario
Easting:	574373.86 m	**Drilled Depth:**	66.11 m bgs	**Water Level:**	3.19 m bgs	**Log Date:**	Dec-18-2020
Northing:	4853638.42 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	438.89 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.16 m ags	**Logged By:**	PG

Notes: Optical image opaque >52.4 m bgs, collected acoustic imagery in addition to optical.




28.0
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38.0
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44.0
46.0
48.0
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52.0
54.0
56.0
58.0
60.0
62.0

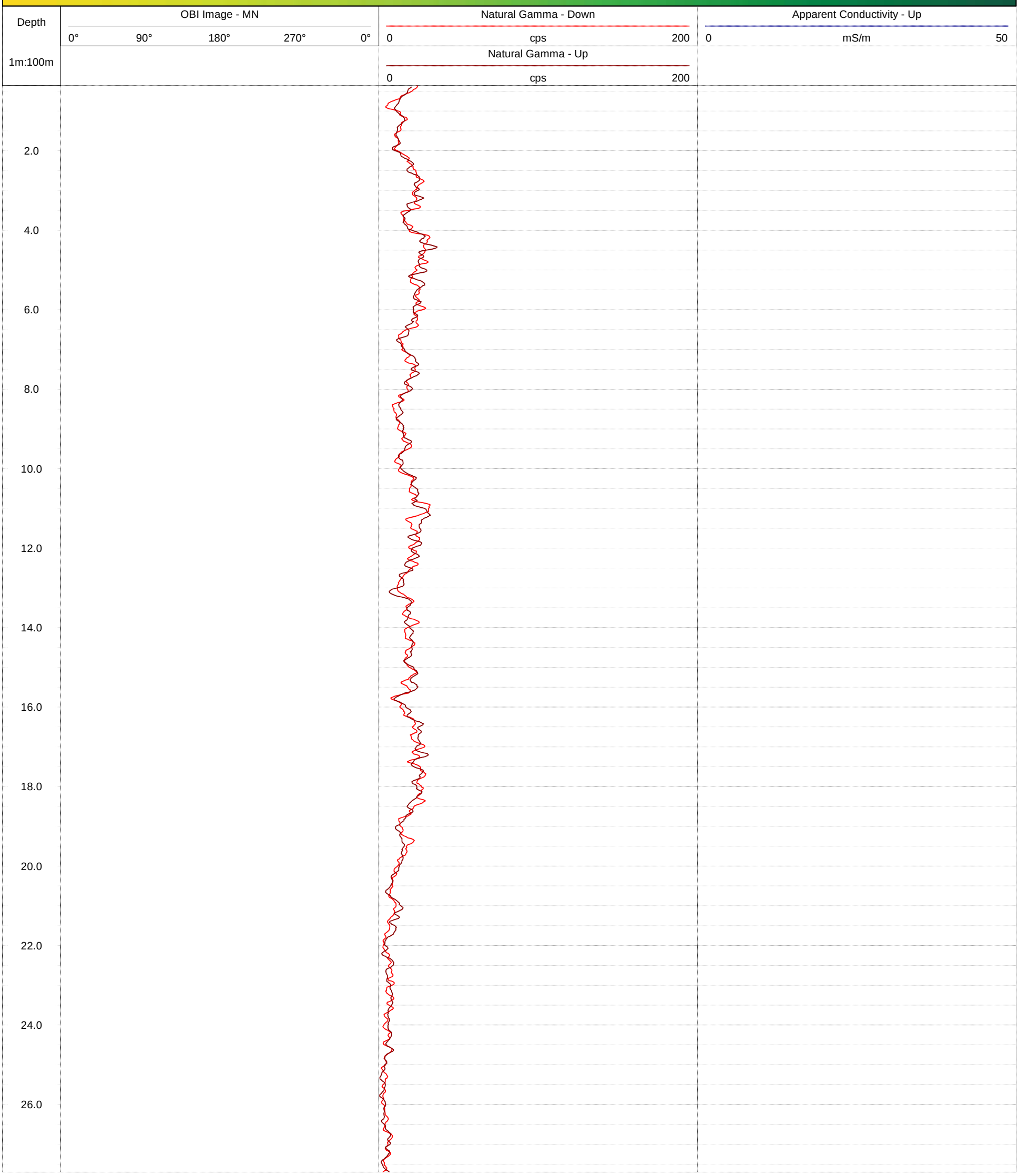
GOLDER
MEMBER OF WSP

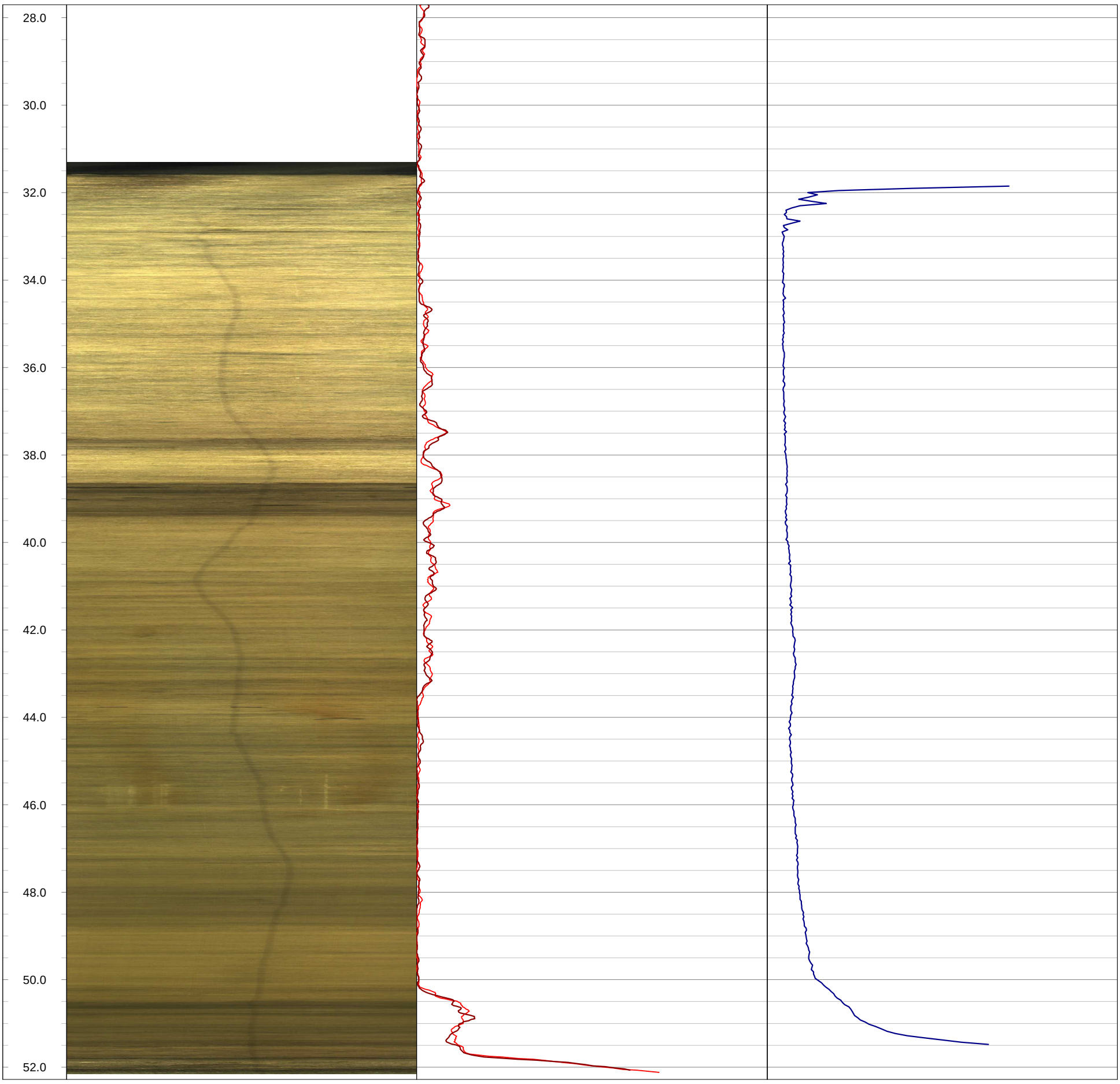
Geophysical Record of Borehole: MW20-27 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	31.60 m bgs	**Location:**	Caledon, Ontario
Easting:	575953.96 m	**Drilled Depth:**	52.43 m bgs	**Water Level:**	7.62 m bgs	**Log Date:**	Feb-17-2021
Northing:	4853770.16 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	431.15 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.30 m ags	**Logged By:**	PG

Notes: Optical image blurred > 39 m bgs




28.0
30.0
32.0
34.0
36.0
38.0
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42.0
44.0
46.0
48.0
50.0
52.0

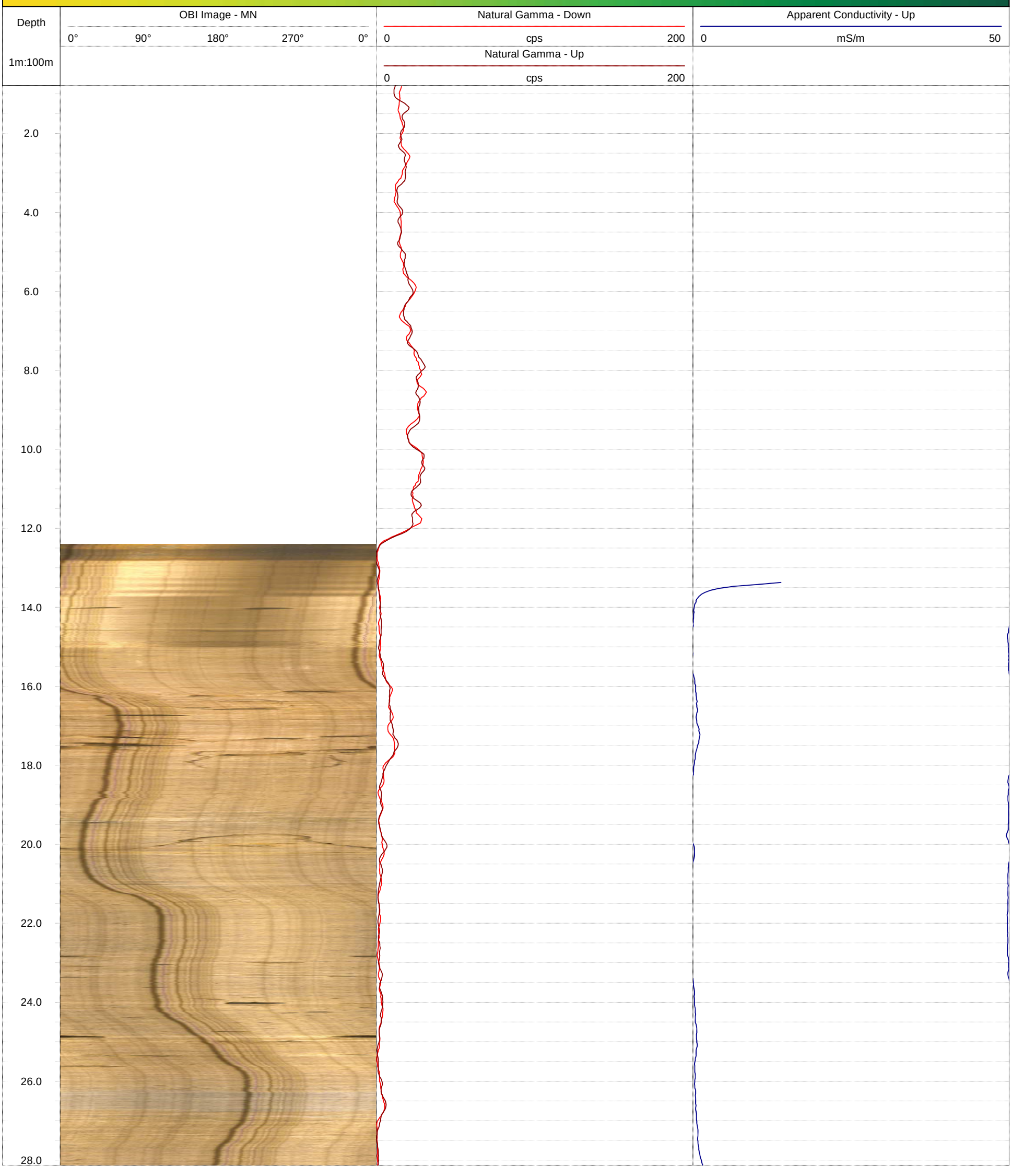
GOLDER
MEMBER OF WSP

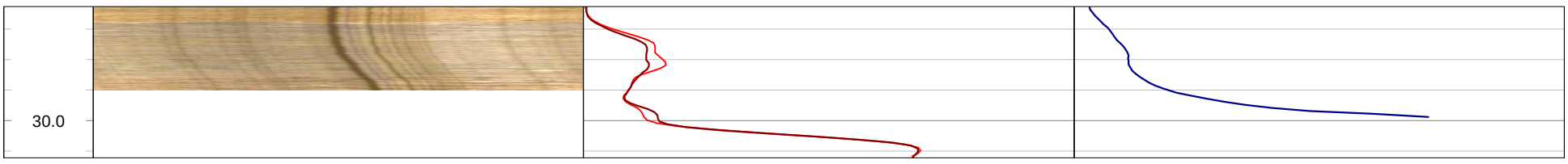
Geophysical Record of Borehole: MW20-28 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.80 m bgs	**Location:**	Caledon, Ontario
Easting:	576139.79 m	**Drilled Depth:**	30.82 m bgs	**Water Level:**	0 m bgs	**Log Date:**	Feb-23-2021
Northing:	4854987.82 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	419.31 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.23 m ags	**Logged By:**	PL

Notes:




30.0

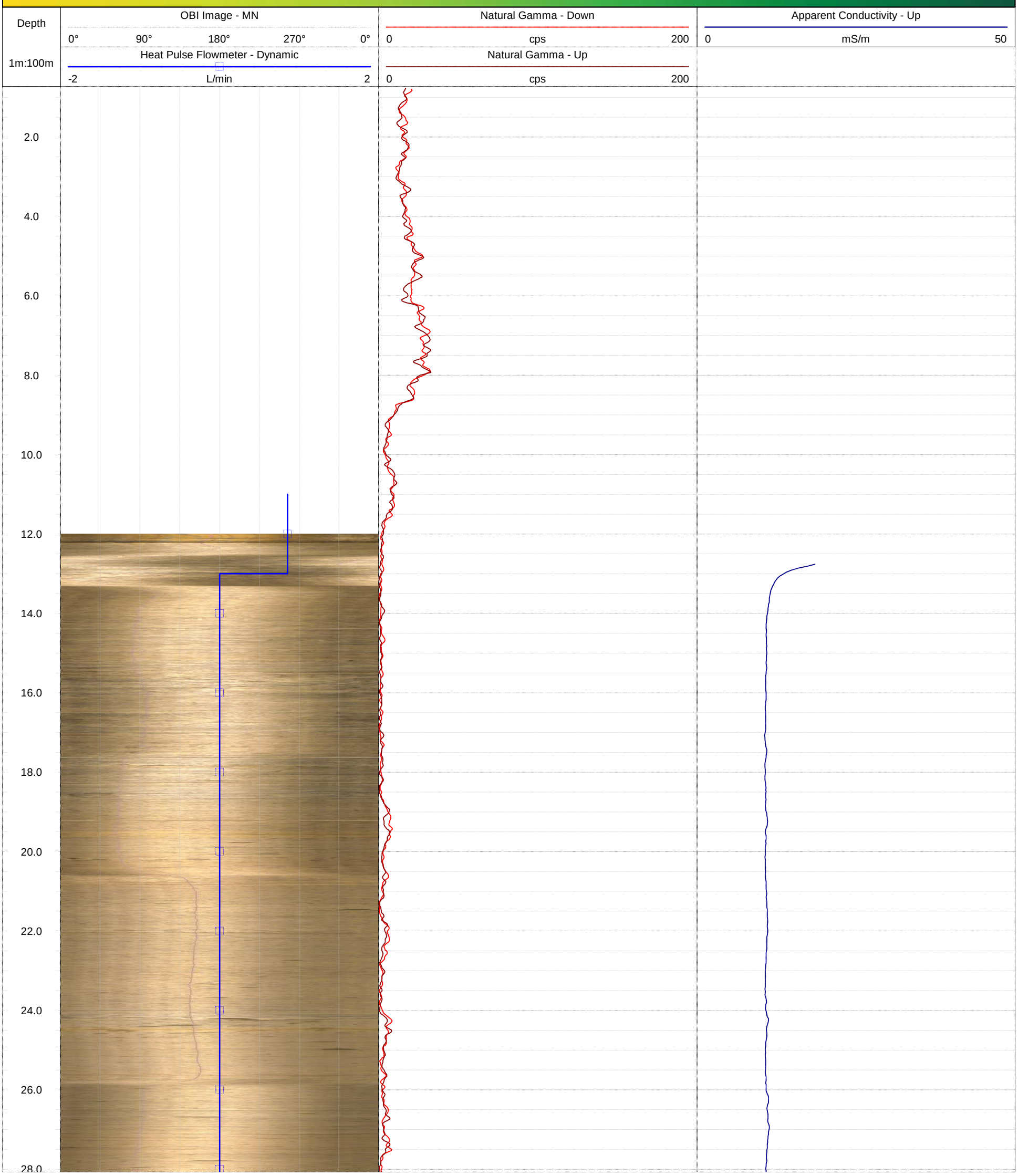
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-1-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.89 m bgs	**Location:**	Caledon, Ontario
Easting:	576882.20 m	**Drilled Depth:**	36.27 m bgs	**Water Level:**	1.80 m bgs	**Log Date:**	Mar-4-2021
Northing:	4853485.00 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	418.94 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PL

Notes: OBI image blurry >30 m. Heat Pulse Flowmeter Dynamic pump at 10 m below top of collar. Pump rate approx. 2 L/min.




30.0
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36.0

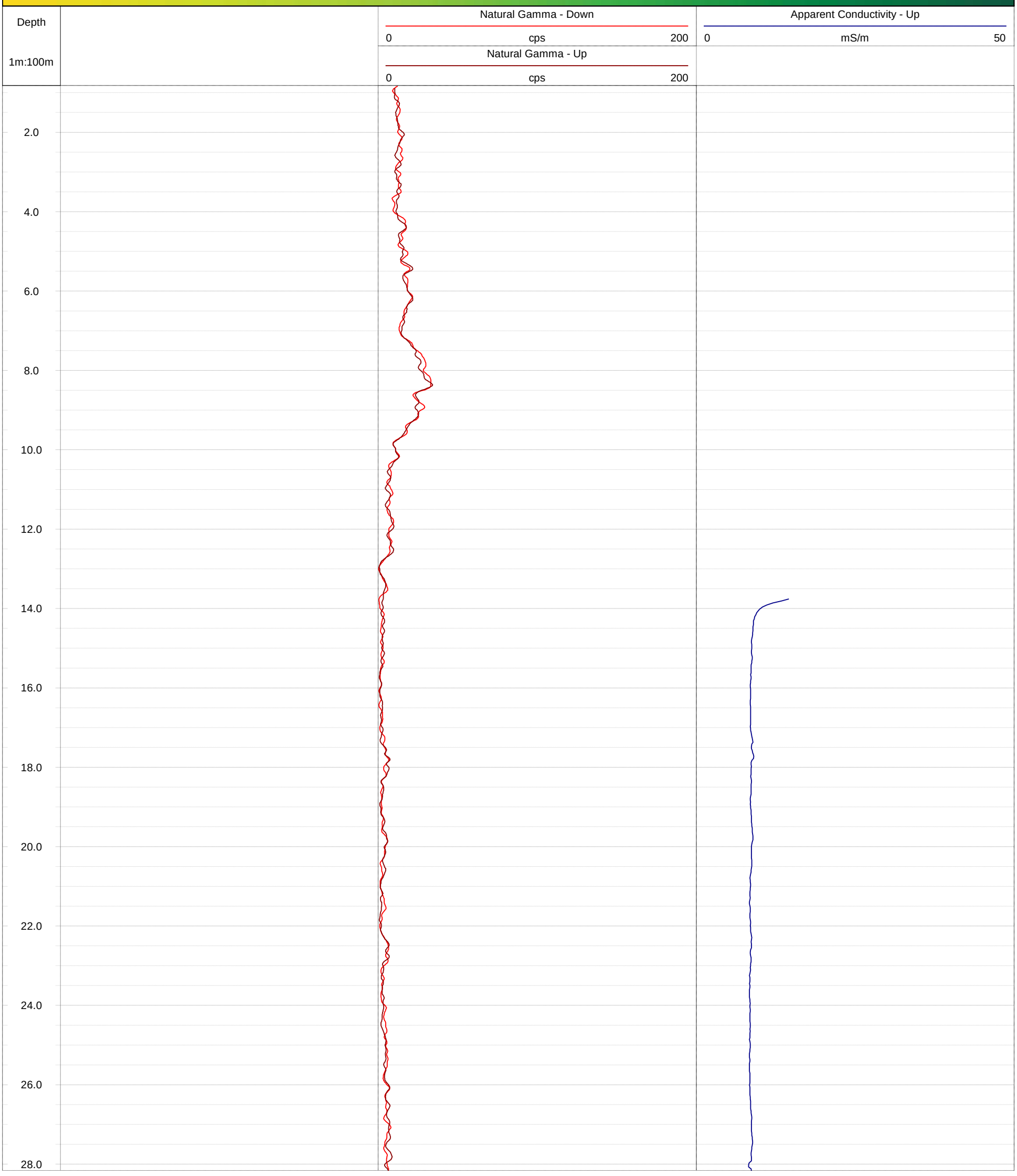
GOLDER
MEMBER OF WSP

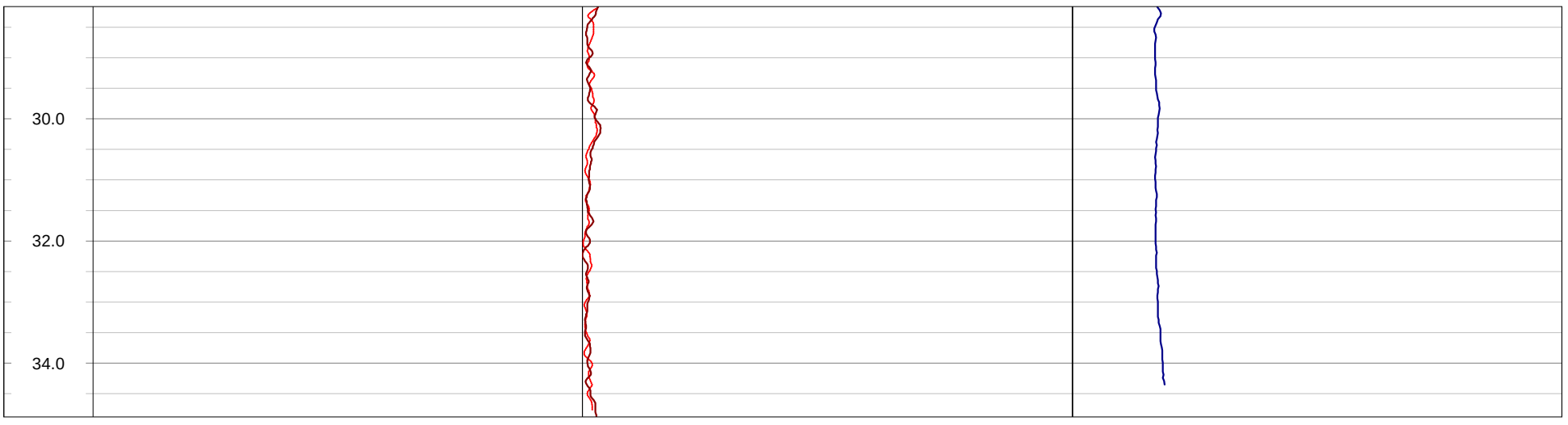
Geophysical Record of Borehole: MW21-1-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	13.11 m bgs	**Location:**	Caledon, Ontario
Easting:	576909.58 m	**Drilled Depth:**	36.00 m bgs	**Water Level:**	1.80 m bgs	**Log Date:**	Mar-3-2021
Northing:	4853505.06 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	420.58 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.20 m ags	**Logged By:**	PL

Notes:




30.0
32.0
34.0

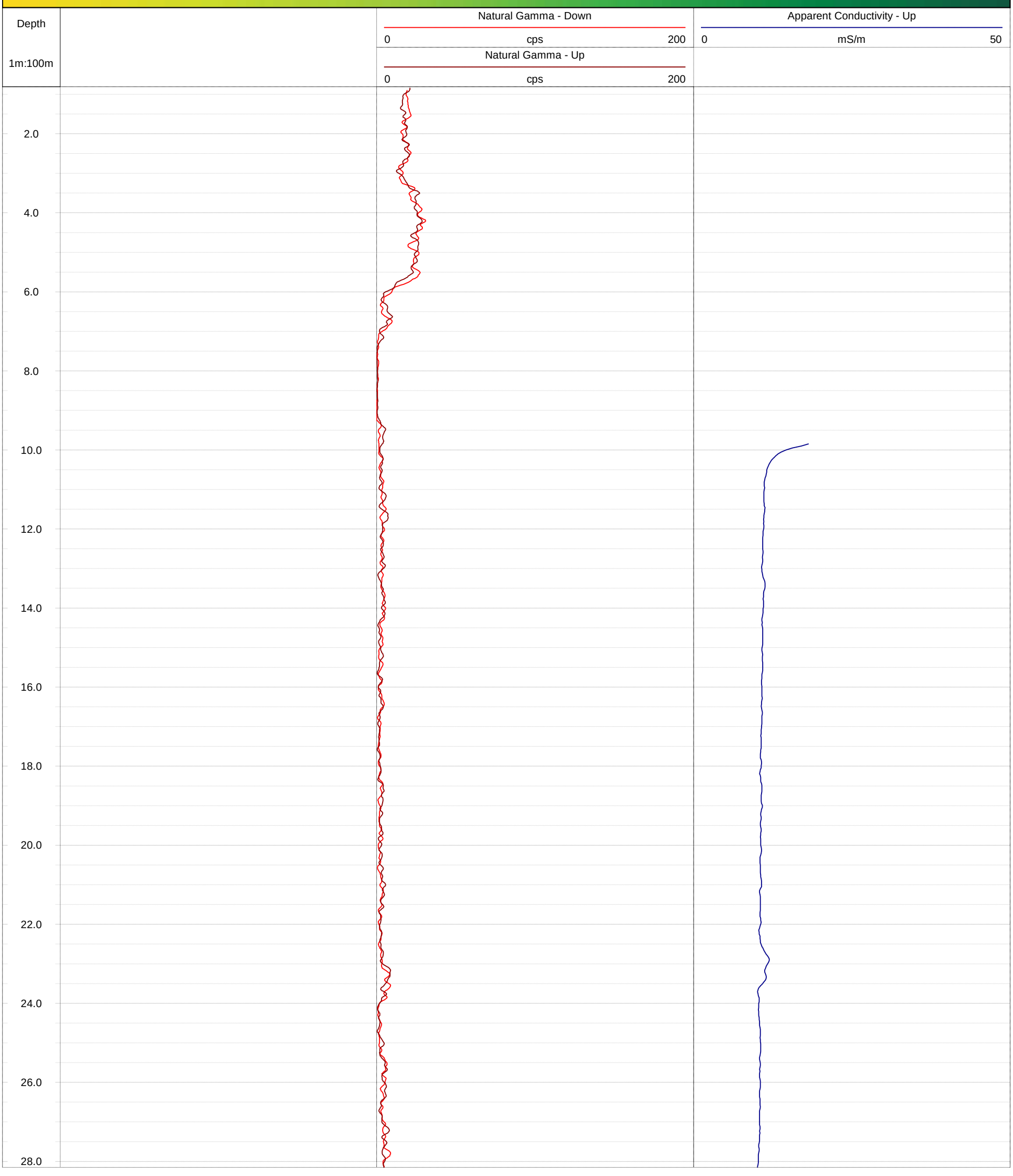
GOLDER
MEMBER OF WSP

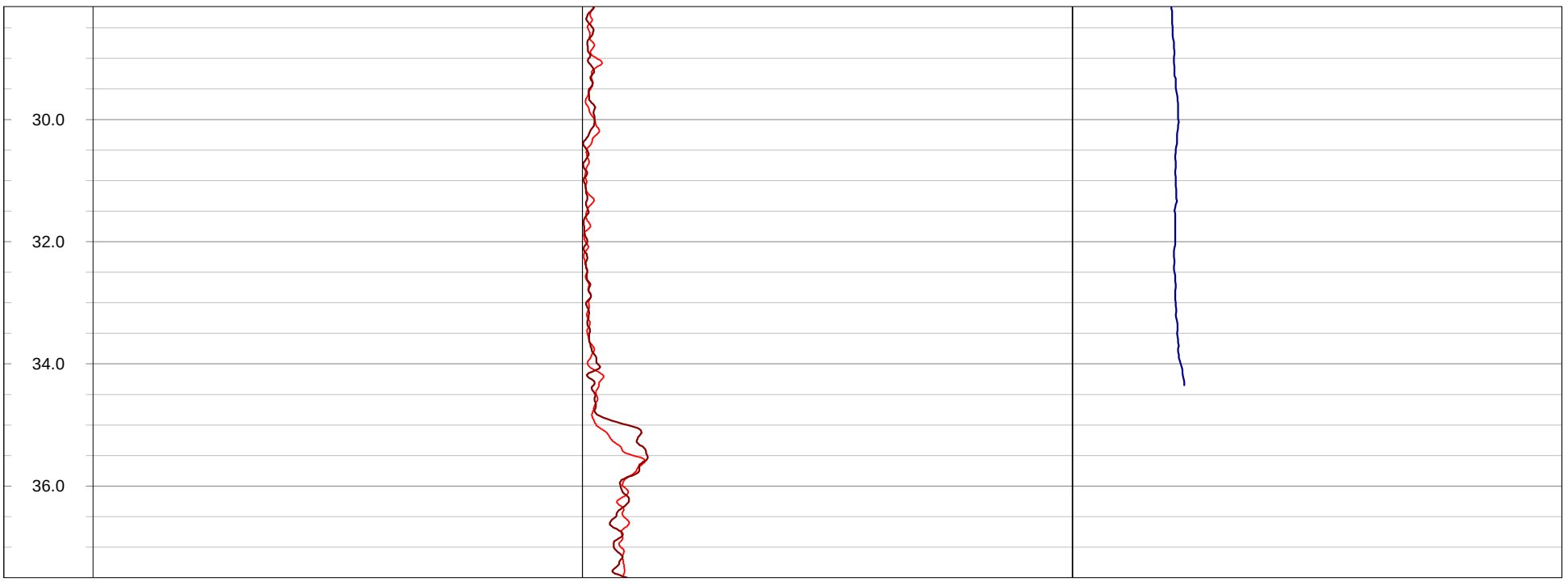
Geophysical Record of Borehole: MW21-1-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.84 m bgs	**Location:**	Caledon, Ontario
Easting:	576965.46 m	**Drilled Depth:**	37.49 m bgs	**Water Level:**	7.00 m bgs	**Log Date:**	Mar-3-2021
Northing:	4853420.30 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.51 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.13 m ags	**Logged By:**	PL

Notes:




30.0
32.0
34.0
36.0

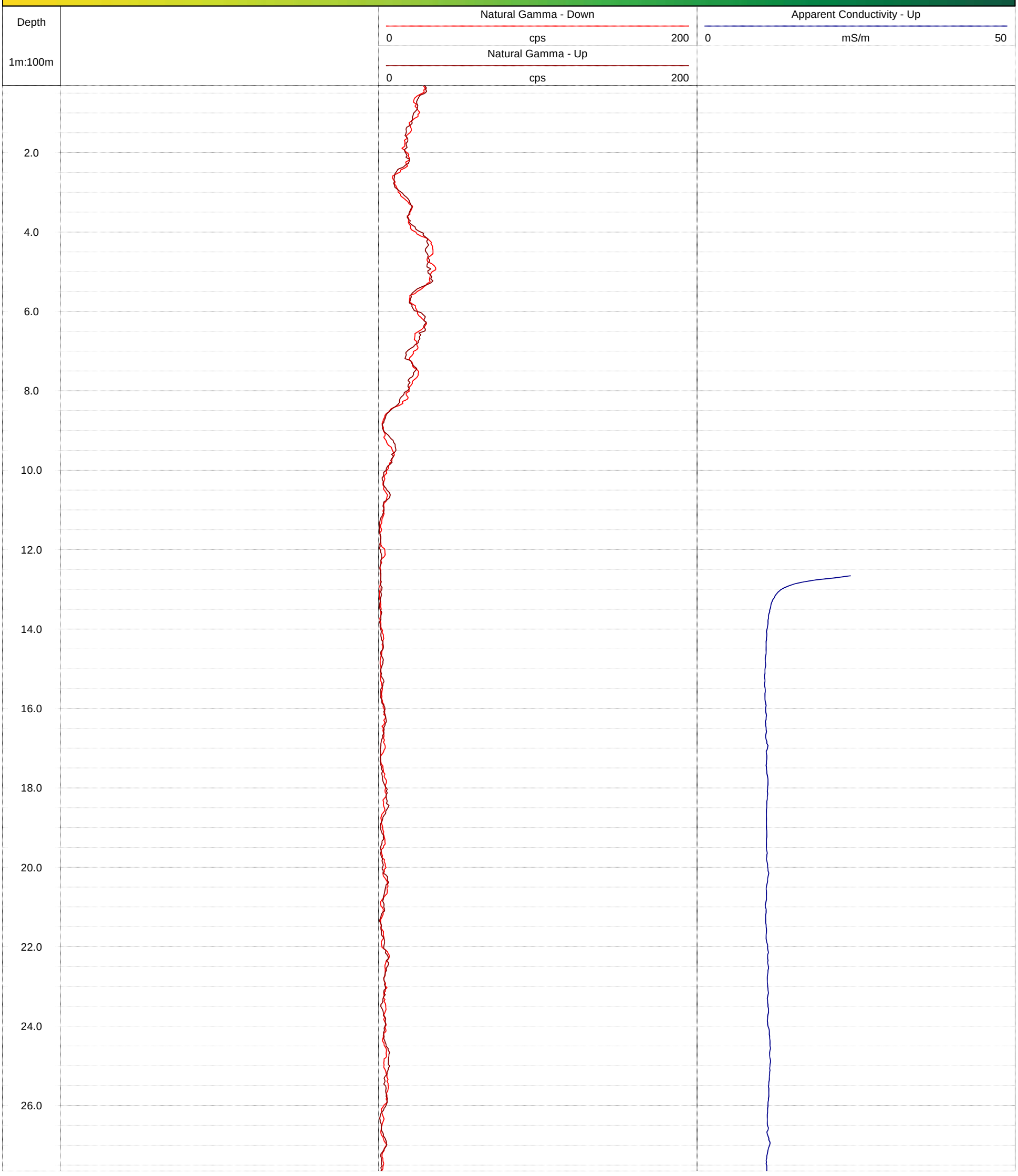
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-1-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.89m bgs	**Location:**	Caledon, Ontario
Easting:	576866.19 m	**Drilled Depth:**	35.96 m bgs	**Water Level:**	1.20 m bgs	**Log Date:**	Mar-5-2021
Northing:	48533450.60 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	417.83 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.43 m ags	**Logged By:**	PL

Notes:




28.0
30.0
32.0
34.0

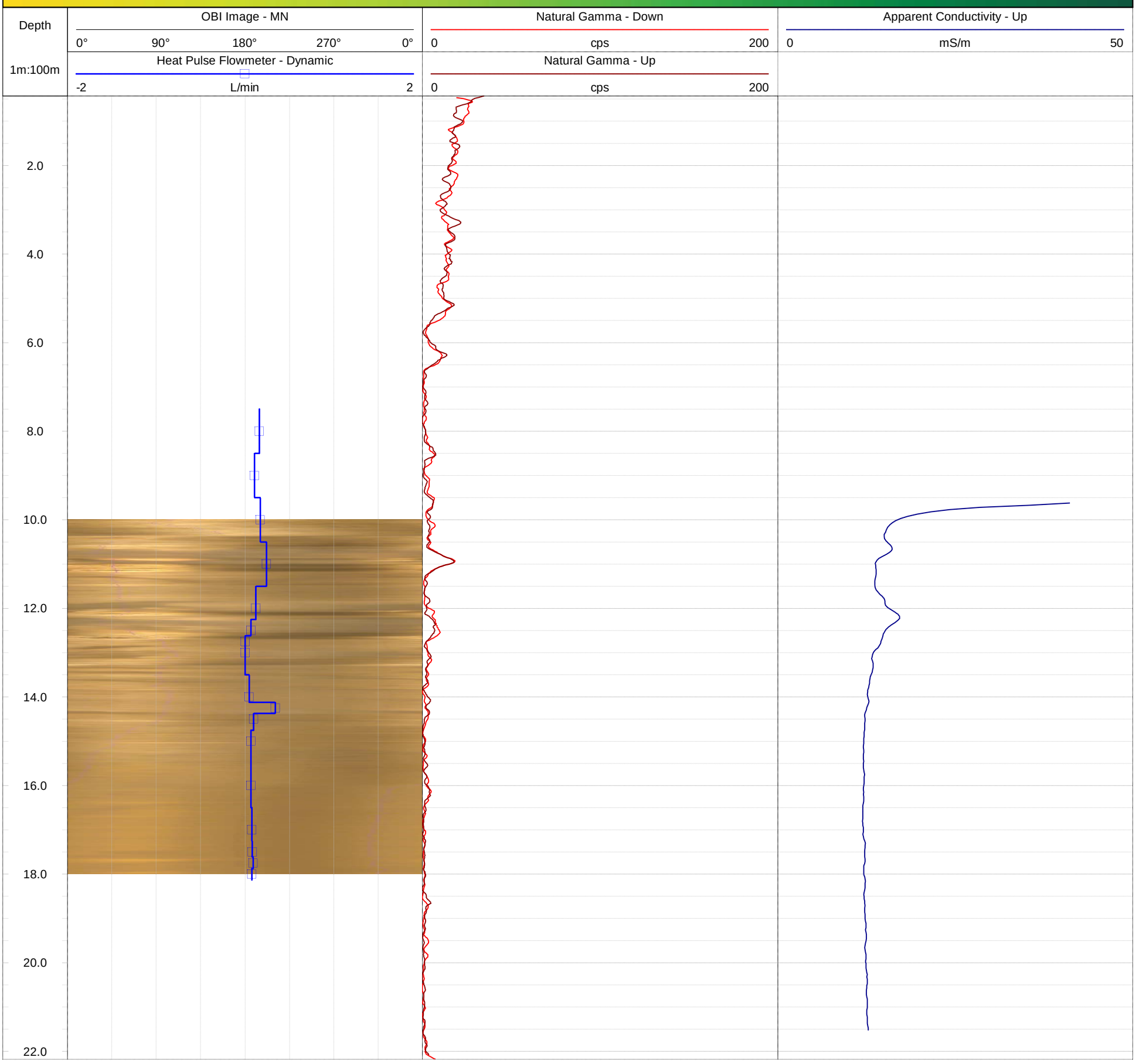
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-2-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.99 m bgs	**Location:**	Caledon, Ontario
Easting:	577279.08 m	**Drilled Depth:**	23.47 m bgs	**Water Level:**	5.20 m bgs	**Log Date:**	Mar-17-2021
Northing:	4854021.09 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.40 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.21 m ags	**Logged By:**	PL

Notes: Very murky image. Tried 3 runs with same results. Heat Pulse Flowmeter Dynamic pump at 6.5 m below top of collar. Pump rate approx. 3 L/min.



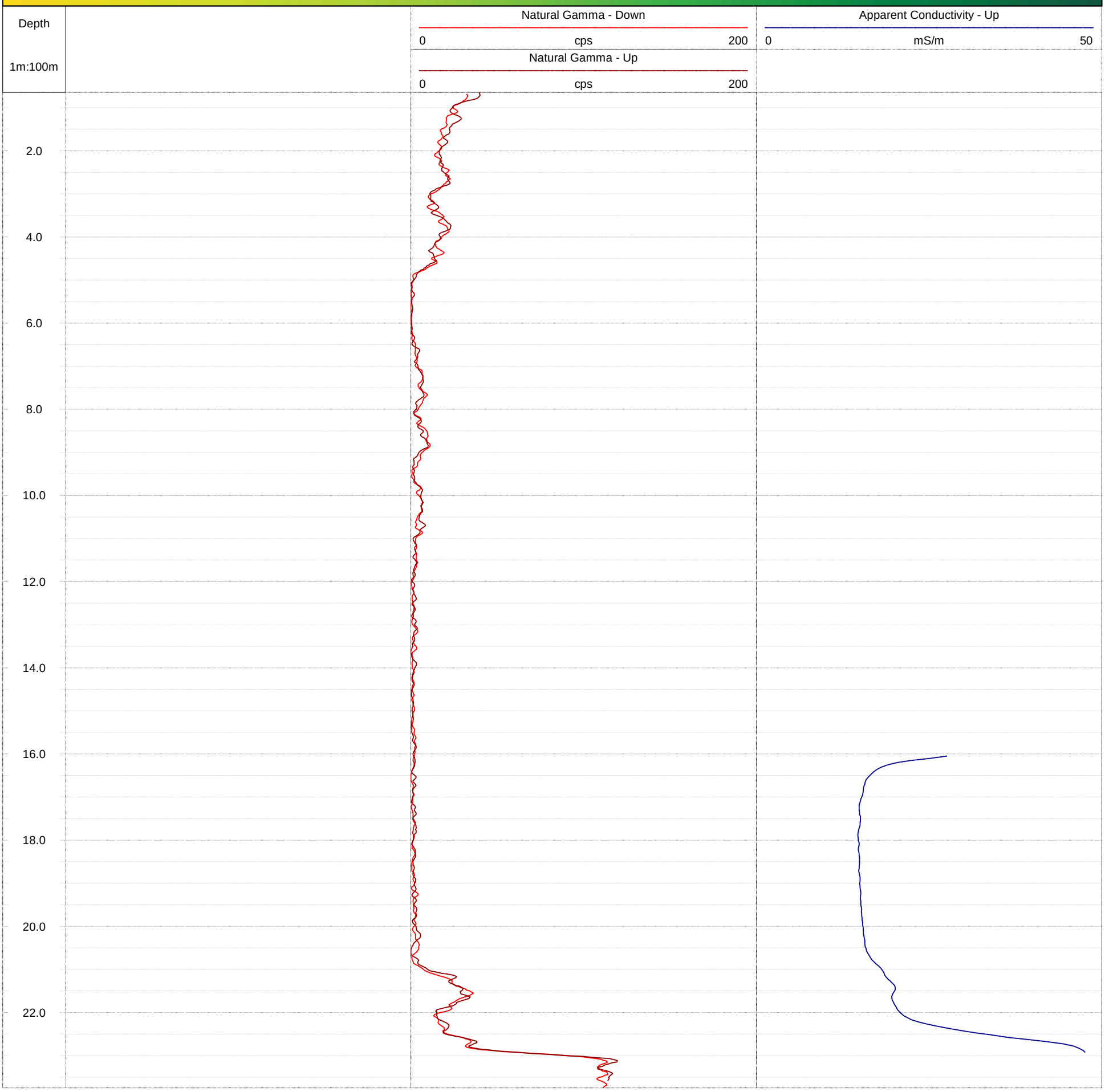
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-2-2 (CAL)

Log Title:	Geophysical Log
Project Number:	19129150
Client:	St. Marys Cement Inc. (Canada)
Date:	October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	15.38 m bgs	**Location:**	Caledon, Ontario
Easting:	577260.02 m	**Drilled Depth:**	23.47 m bgs	**Water Level:**	1.20 m bgs	**Log Date:**	Mar-17-2021
Northing:	4854050.91 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	412.64 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.00 m ags	**Logged By:**	PL

Notes:



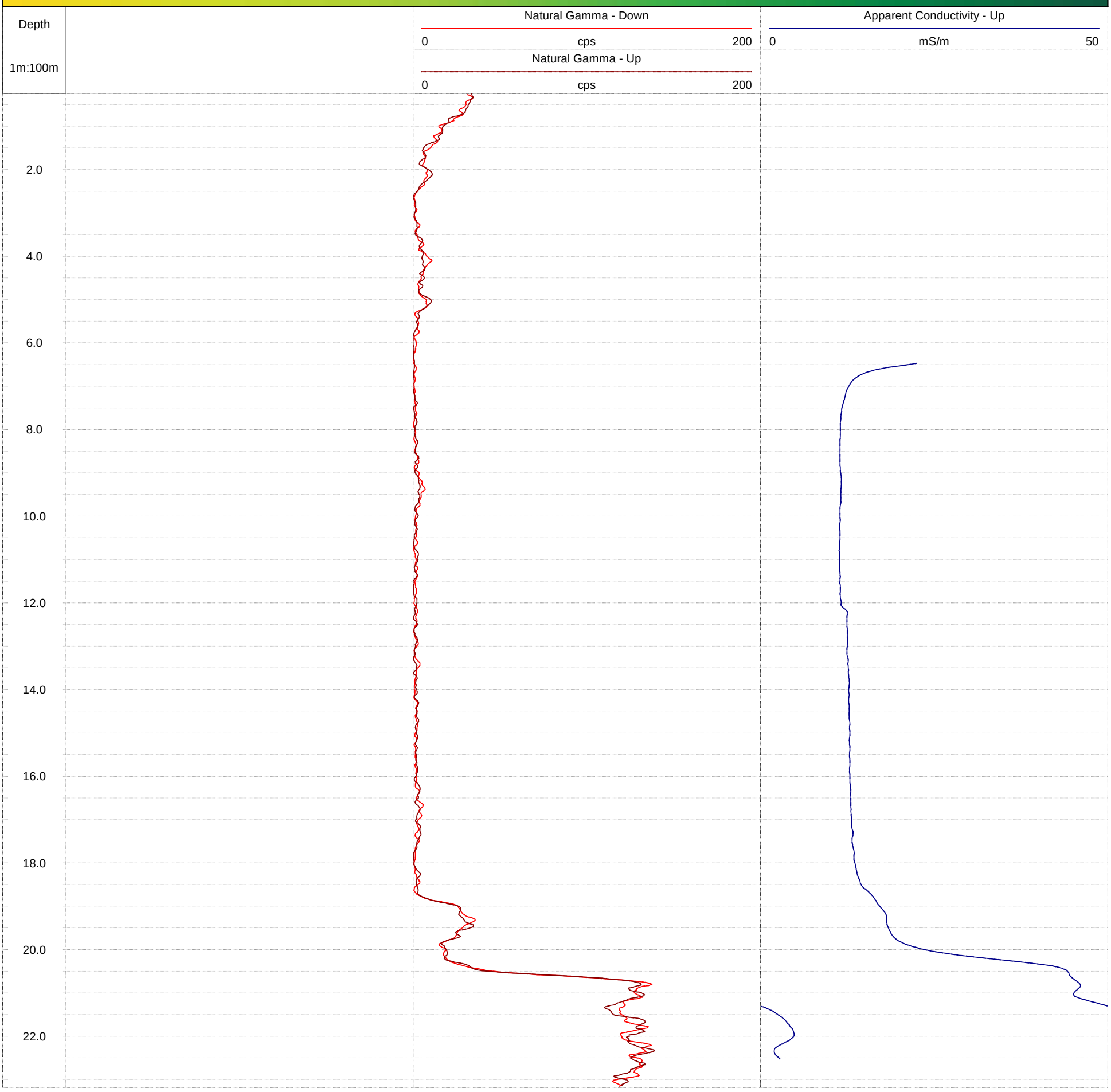
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-2-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.64 m bgs	**Location:**	Caledon, Ontario
Easting:	577349.69 m	**Drilled Depth:**	23.77 m bgs	**Water Level:**	3.90 m bgs	**Log Date:**	Mar-17-2021
Northing:	4854098.46 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	410.76 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.42 m ags	**Logged By:**	PL

Notes:



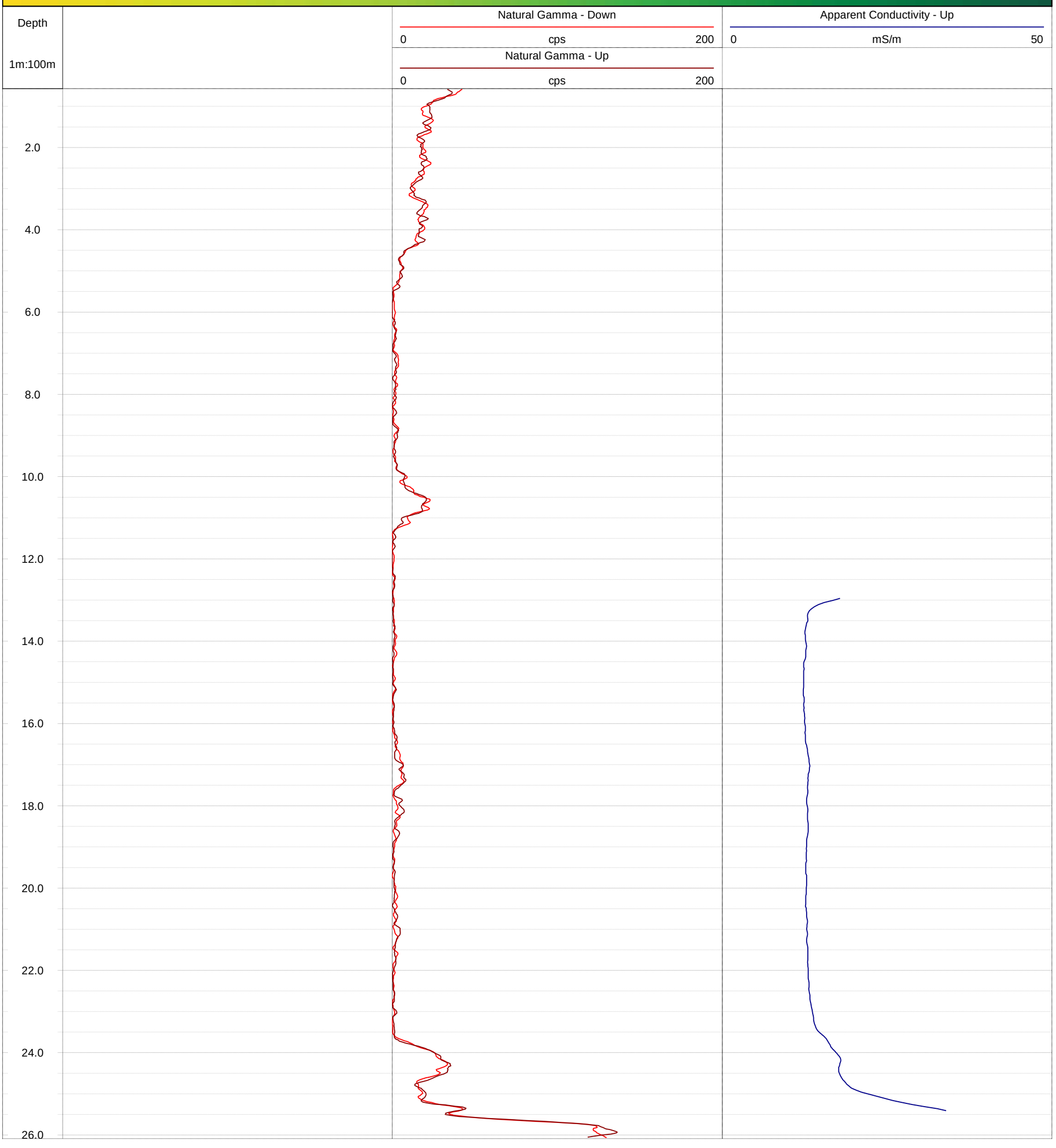
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-2-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	577297.52 m	**Drilled Depth:**	26.52 m bgs	**Water Level:**	5.40 m bgs	**Log Date:**	Mar-17-2021
Northing:	4851001.66 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.86 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.09 m ags	**Logged By:**	PL

Notes:



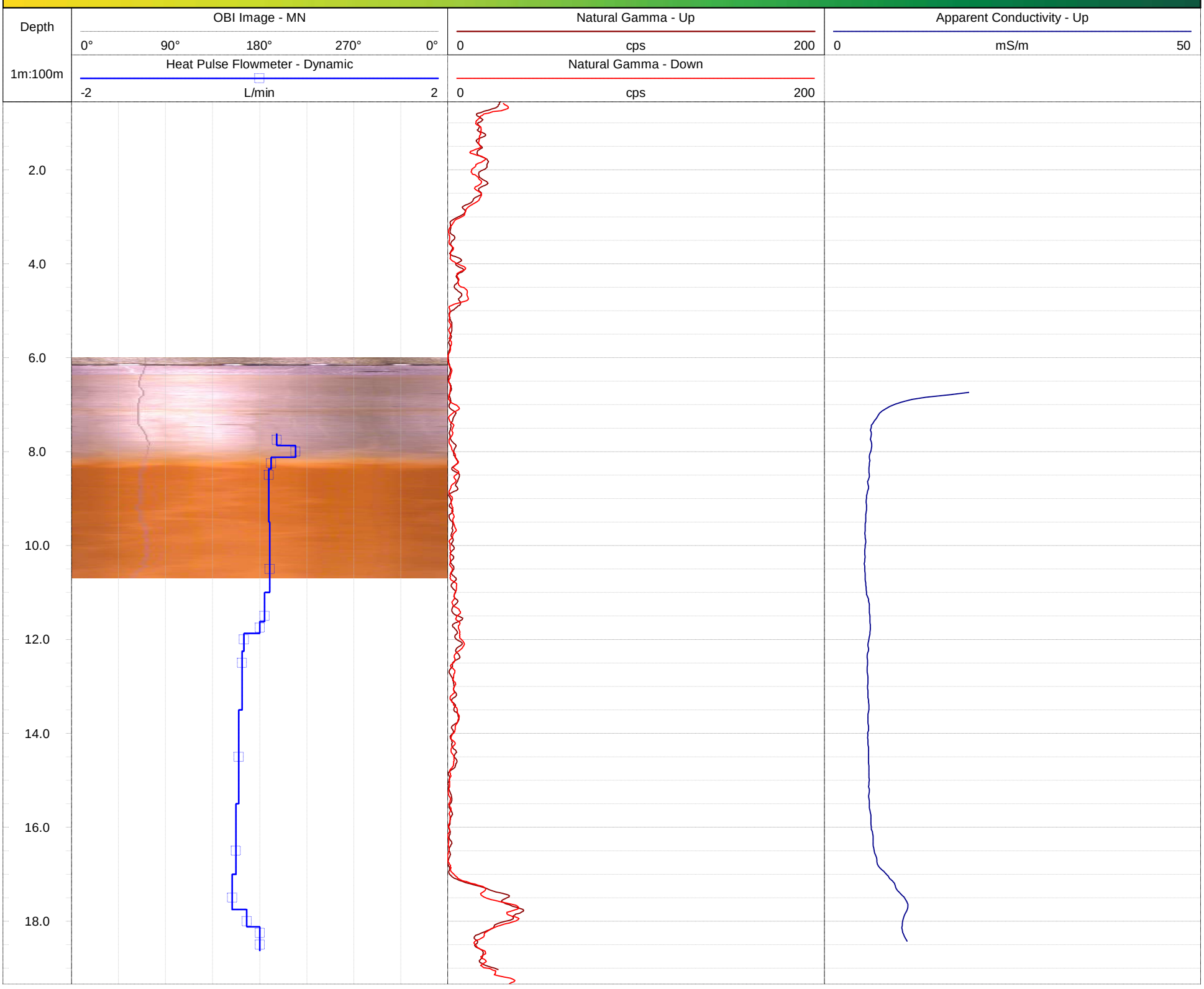
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-3-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	6.16 m bgs	**Location:**	Caledon, Ontario
Easting:	577871.84 m	**Drilled Depth:**	21.03 m bgs	**Water Level:**	5.70 m bgs	**Log Date:**	Mar-31-2021
Northing:	4852814.09 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.69 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.12 m ags	**Logged By:**	PG

Notes: Image orange (rust?) from 8.3 to 10.7 mbgs, opaque>10.8 m bgs. Heat Pulse Flowmeter Dynamic pump at 7.3 m below top of collar. Pump rate approx. 1 L /min.



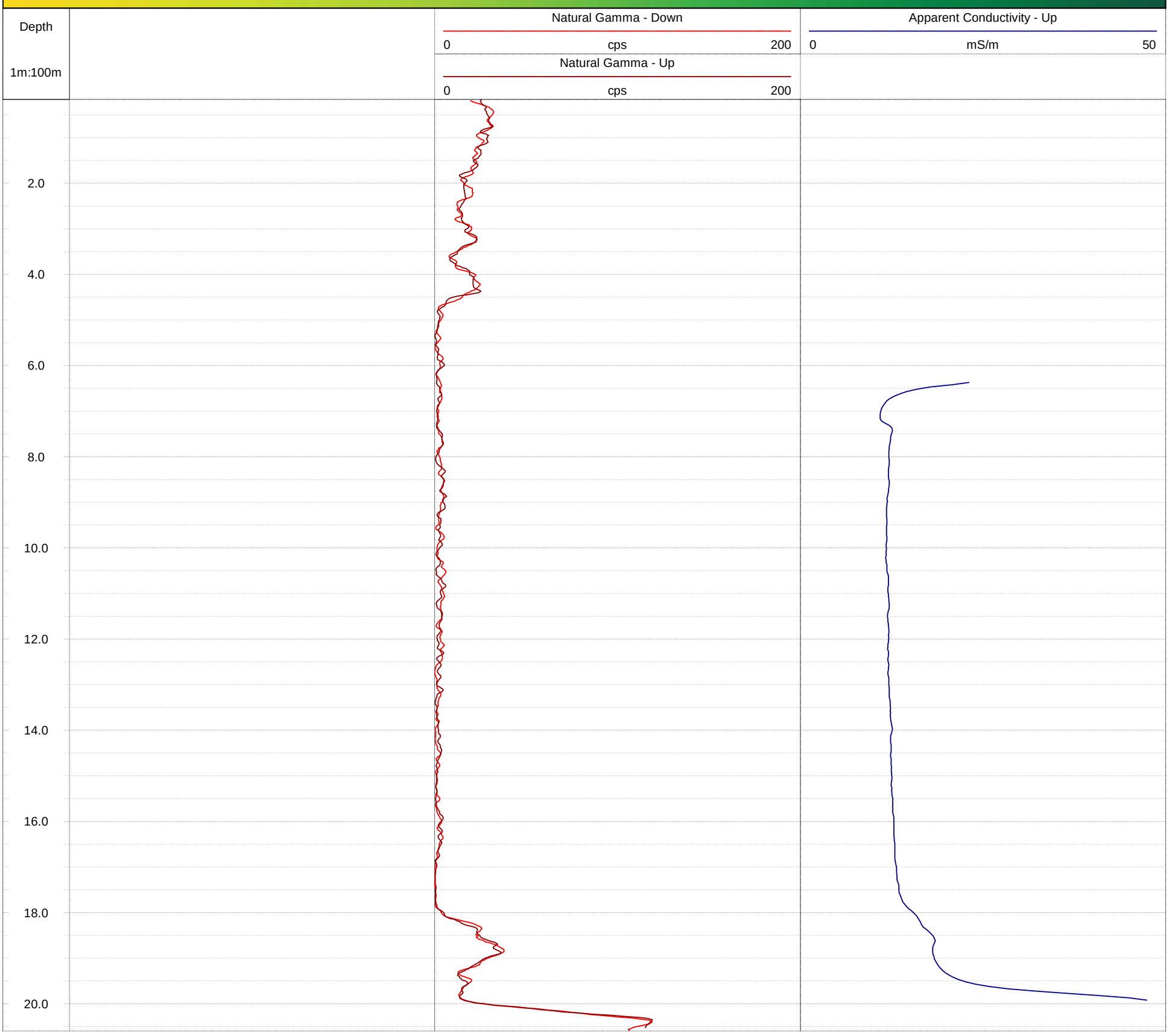
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-3-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.79 m bgs	**Location:**	Caledon, Ontario
Easting:	577920.27 m	**Drilled Depth:**	21.03 m bgs	**Water Level:**	7.29 m bgs	**Log Date:**	Apr-1-2021
Northing:	4852838.38 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	404.87 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.50 m ags	**Logged By:**	PG

Notes:



GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-3-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	8.84 m bgs	**Location:**	Caledon, Ontario
Easting:	577935.55 m	**Drilled Depth:**	19.20 m bgs	**Water Level:**	12.37 m bgs	**Log Date:**	Mar-31-2021
Northing:	4852730.93 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.12 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.13 m ags	**Logged By:**	PG

Notes:



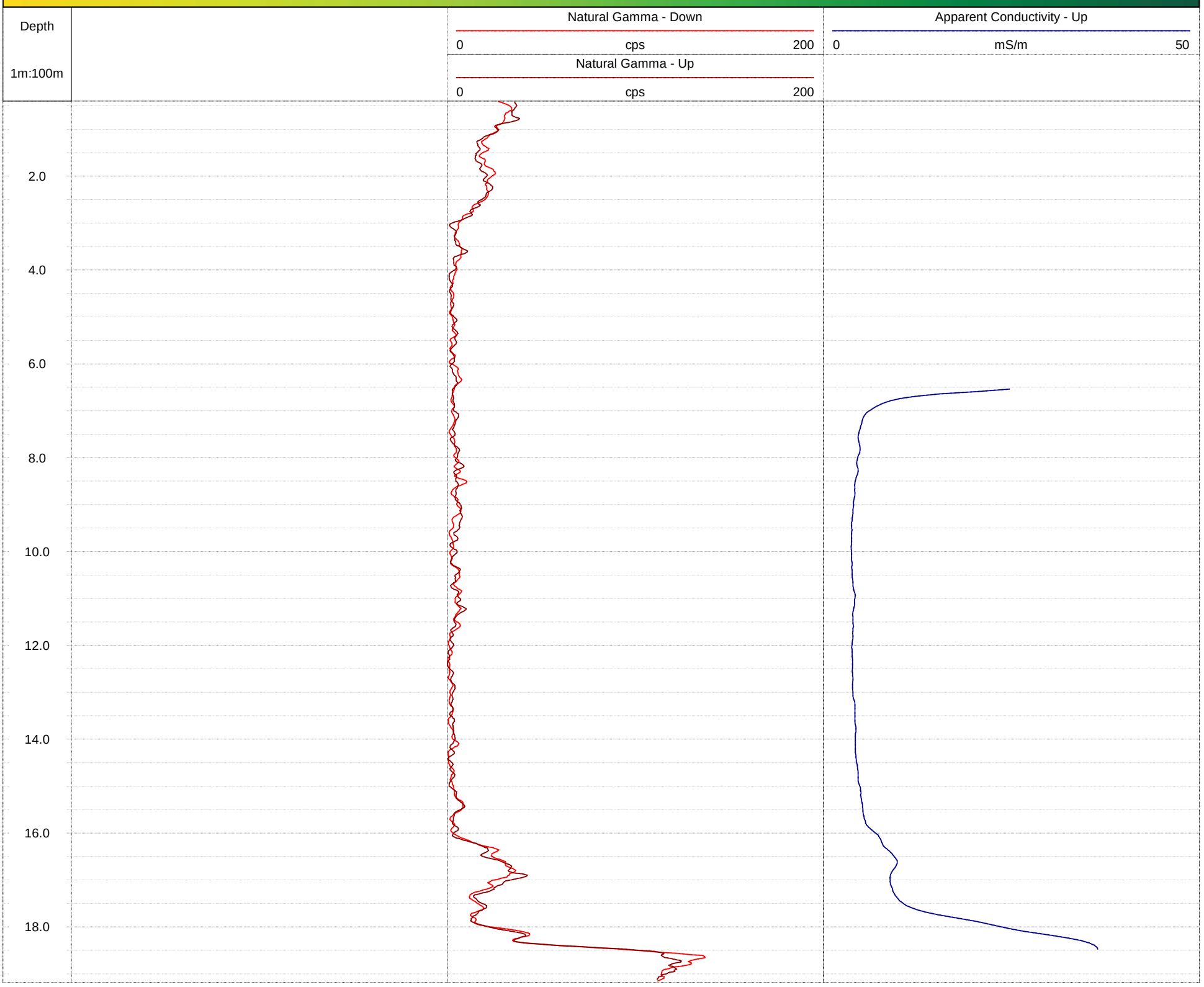
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-3-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	5.94 m bgs	**Location:**	Caledon, Ontario
Easting:	577837.91 m	**Drilled Depth:**	19.20 m bgs	**Water Level:**	5.25 m bgs	**Log Date:**	Mar-31-2021
Northing:	4852827.25 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	403.16 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.27 m ags	**Logged By:**	PG

Notes:



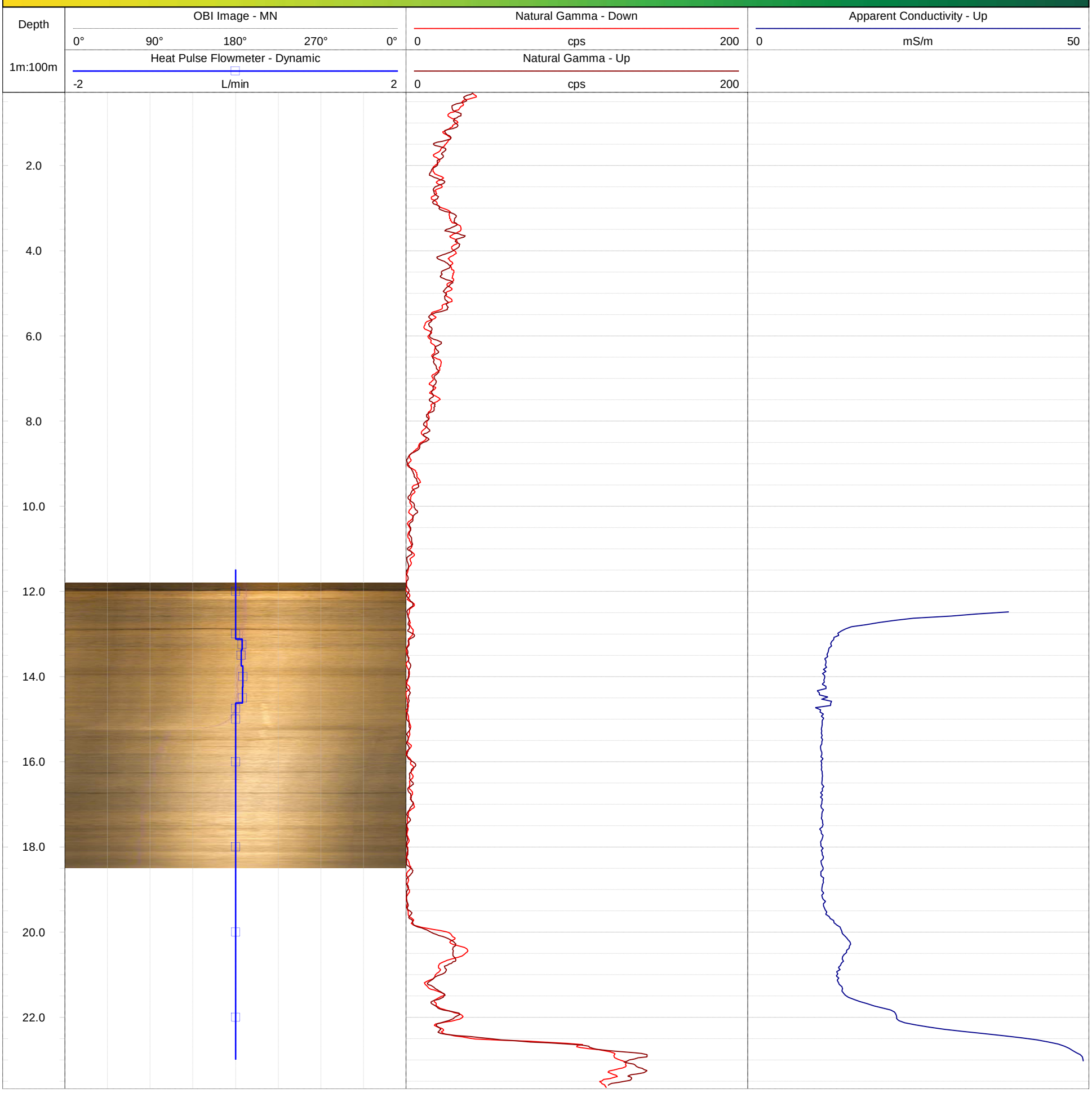
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-4-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.98 m bgs	**Location:**	Caledon, Ontario
Easting:	577793.12 m	**Drilled Depth:**	23.77 m bgs	**Water Level:**	9.13 m bgs	**Log Date:**	Mar-23-2021
Northing:	4854211.47 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.22 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.37 m ags	**Logged By:**	PG

Notes: Image opaque>18.60 m bgs. Heat Pulse Flowmeter Dynamic pump between 10.8/ 11.8 m below top of collar. Pump rate adjusted between 3 L/min. to 0.6 L/min.



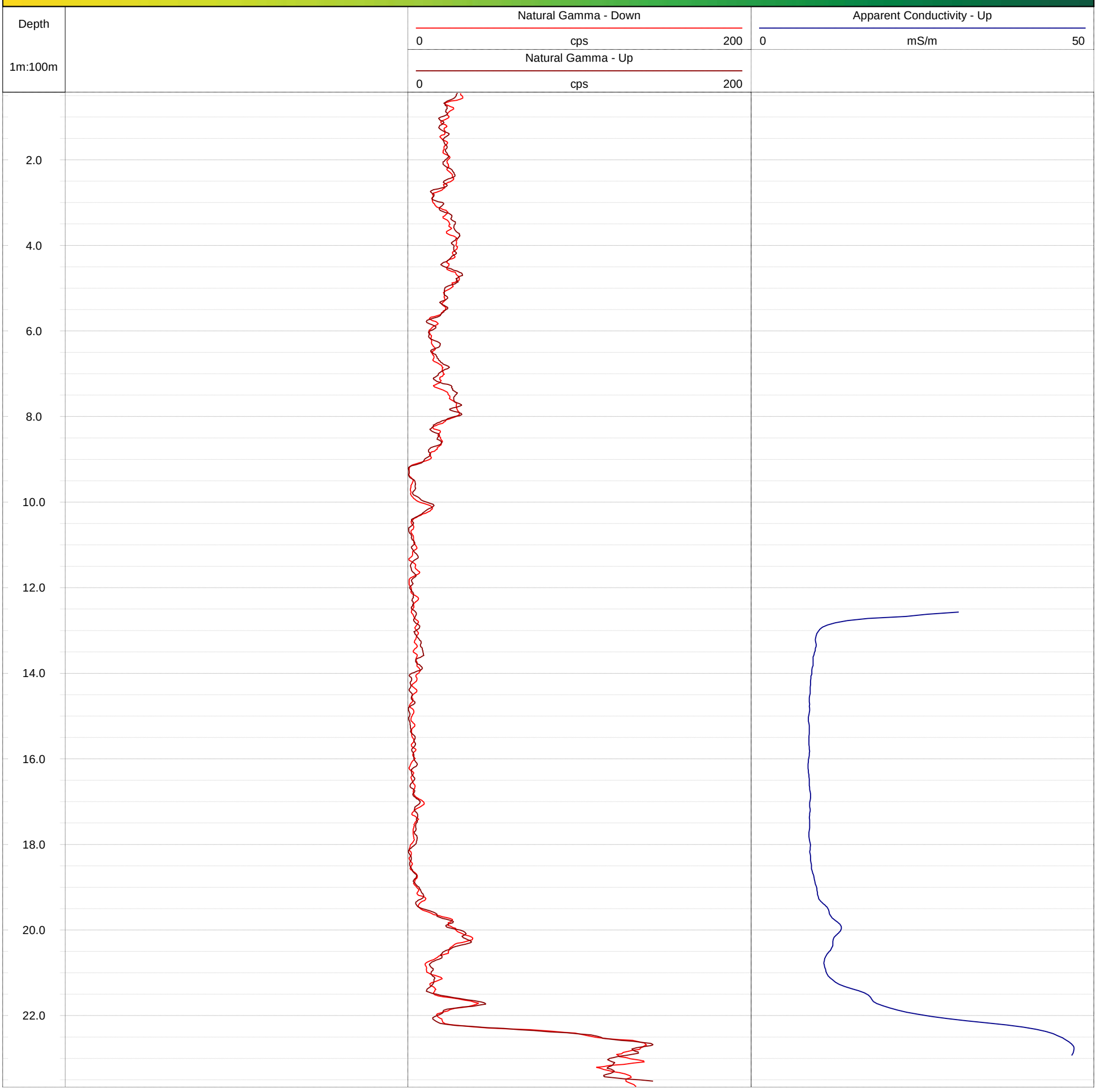
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-4-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	11.89 m bgs	**Location:**	Caledon, Ontario
Easting:	577790.26 m	**Drilled Depth:**	23.77 m bgs	**Water Level:**	7.92 m bgs	**Log Date:**	Mar-23-2021
Northing:	4854247.25 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.24 m ags	**Logged By:**	PG

Notes:



GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: MW21-4-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.25 m bgs	**Location:**	Caledon, Ontario
Easting:	577813.86 m	**Drilled Depth:**	21.64 m bgs	**Water Level:**	n/a	**Log Date:**	Mar-24-2021
Northing:	4854182.83 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	414.78 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.05 m ags	**Logged By:**	PG

Notes:



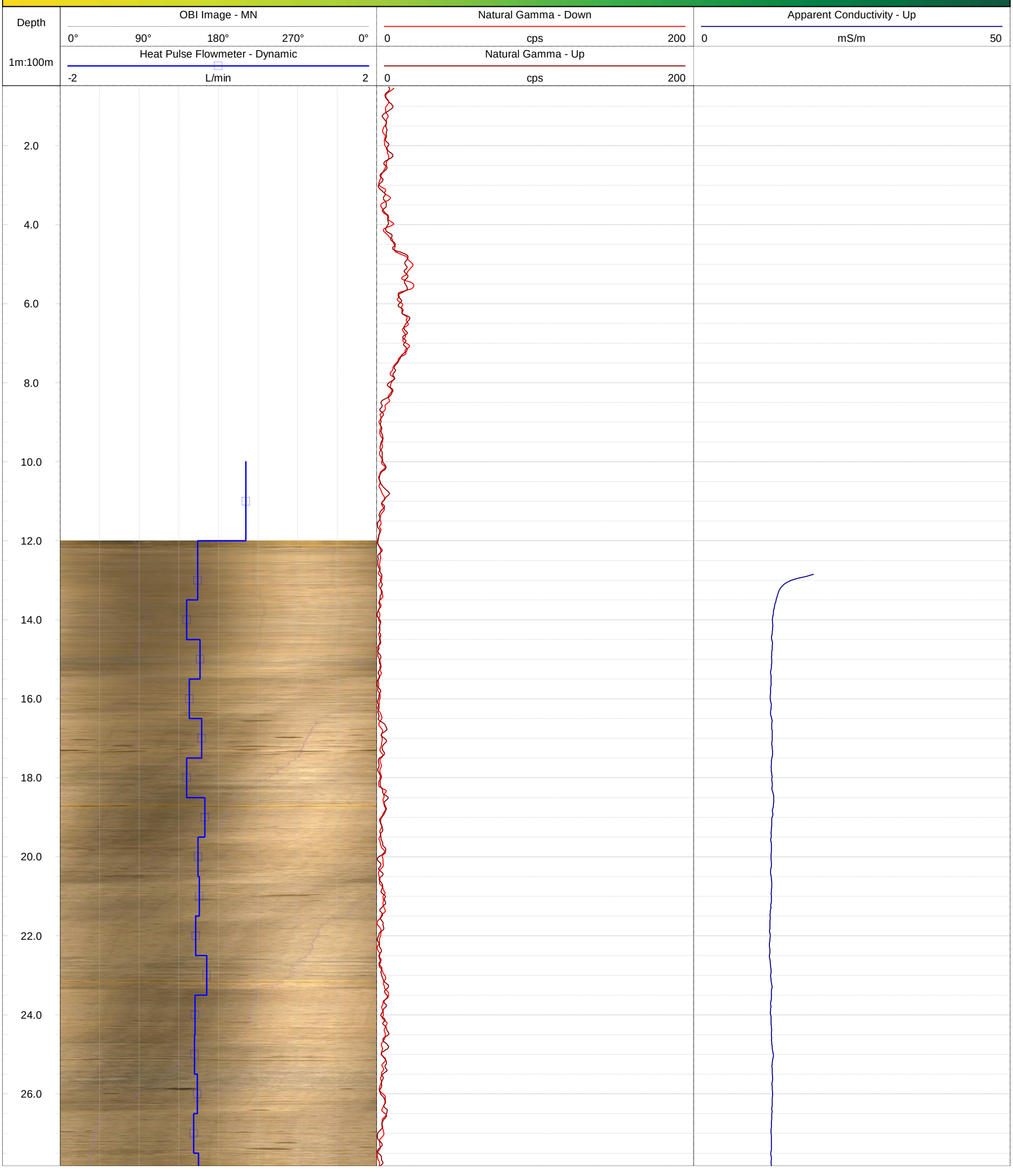
GOLDER
MEMBER OF WSP

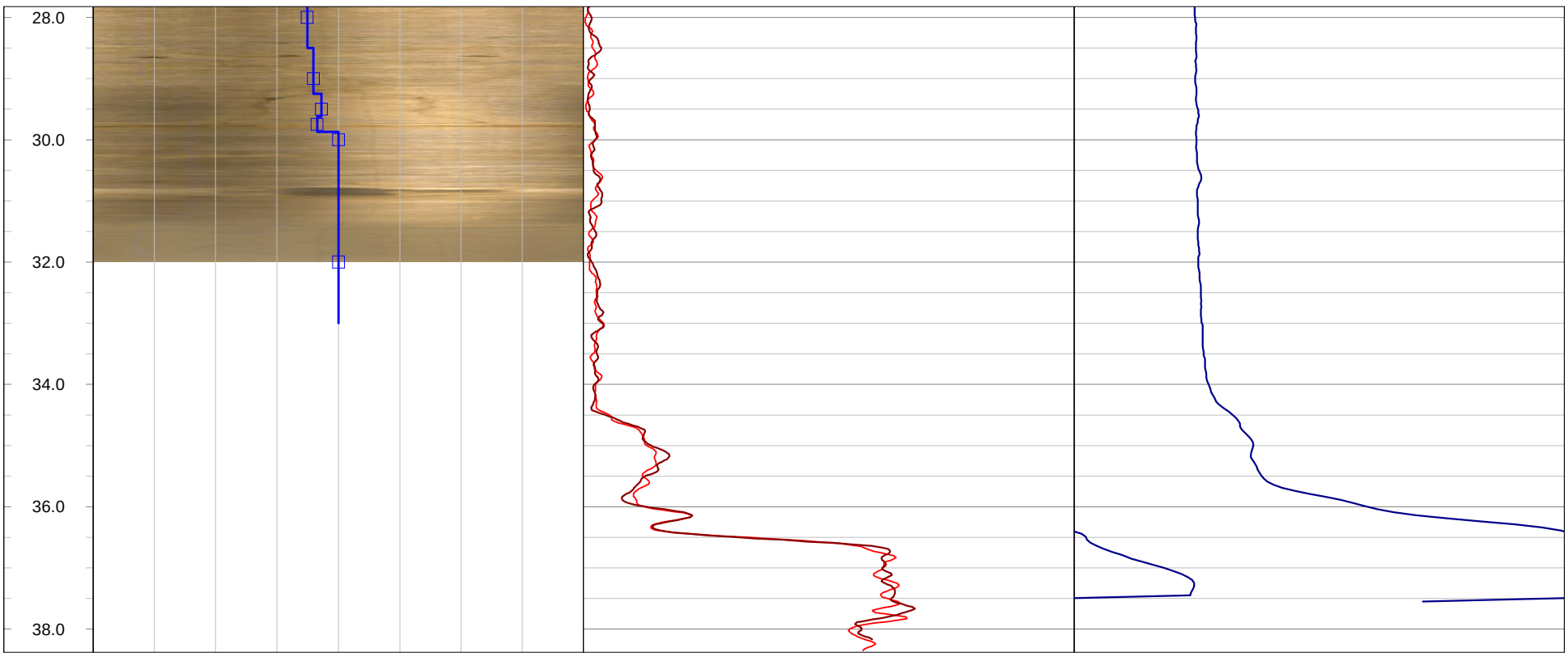
Geophysical Record of Borehole: PW21-1 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	576890.23 m	**Drilled Depth:**	38.41 m bgs	**Water Level:**	1.50 m bgs	**Log Date:**	Mar-9-2021
Northing:	4853478.69 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	418.76 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.18 m ags	**Logged By:**	PL

Notes: OBI image opaque>32 m bgs. Heat Pulse Flowmeter Dynamic pump at 10 m below top of collar. Pump rate approx. 4 L/min.




28.0
30.0
32.0
34.0
36.0
38.0

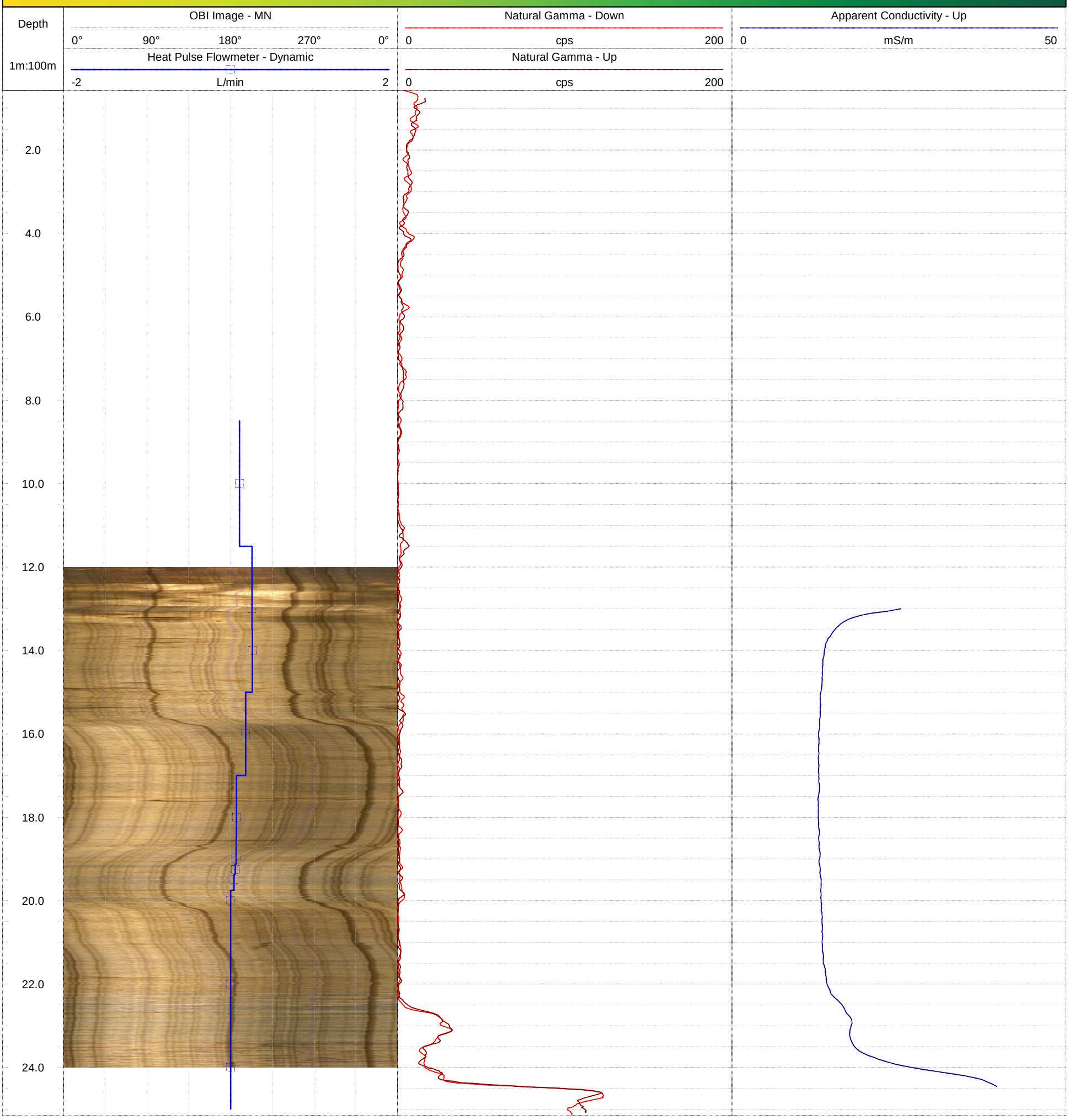
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: PW21-2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	12.19 m bgs	**Location:**	Caledon, Ontario
Easting:	577286.29 m	**Drilled Depth:**	25.15 m bgs	**Water Level:**	4.60 m bgs	**Log Date:**	Mar-18-2021
Northing:	4854027.50 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	413.07 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.11 m ags	**Logged By:**	PL

Notes: Heat Pulse Flowmeter Dynamic pump at 6 m below top of collar. Pump rate approx. 4 L/min.



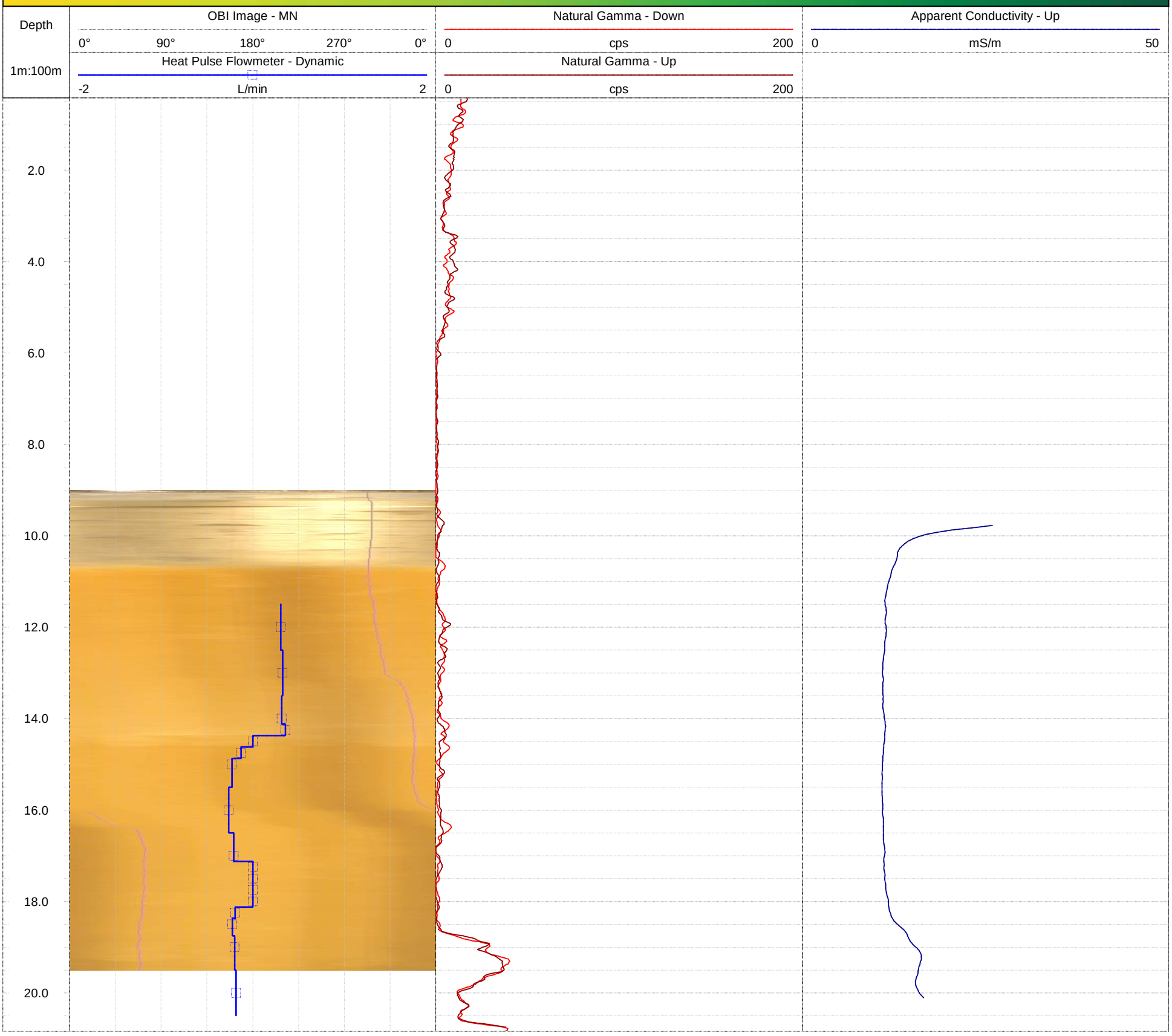
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: PW21-3 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.20 m bgs	**Location:**	Caledon, Ontario
Easting:	577875.55 m	**Drilled Depth:**	21.34 m bgs	**Water Level:**	8.99 m bgs	**Log Date:**	Apr-01-2021
Northing:	4852797.50 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	405.45 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.24 m ags	**Logged By:**	PG

Notes: Image orange (rust?) 10.7 to 19.5 m bgs, opaque>19.6 m bgs. Heat Pulse Flowmeter Dynamic pump at 11 m below top of collar. Pump rate approx. 1.7 L/min.



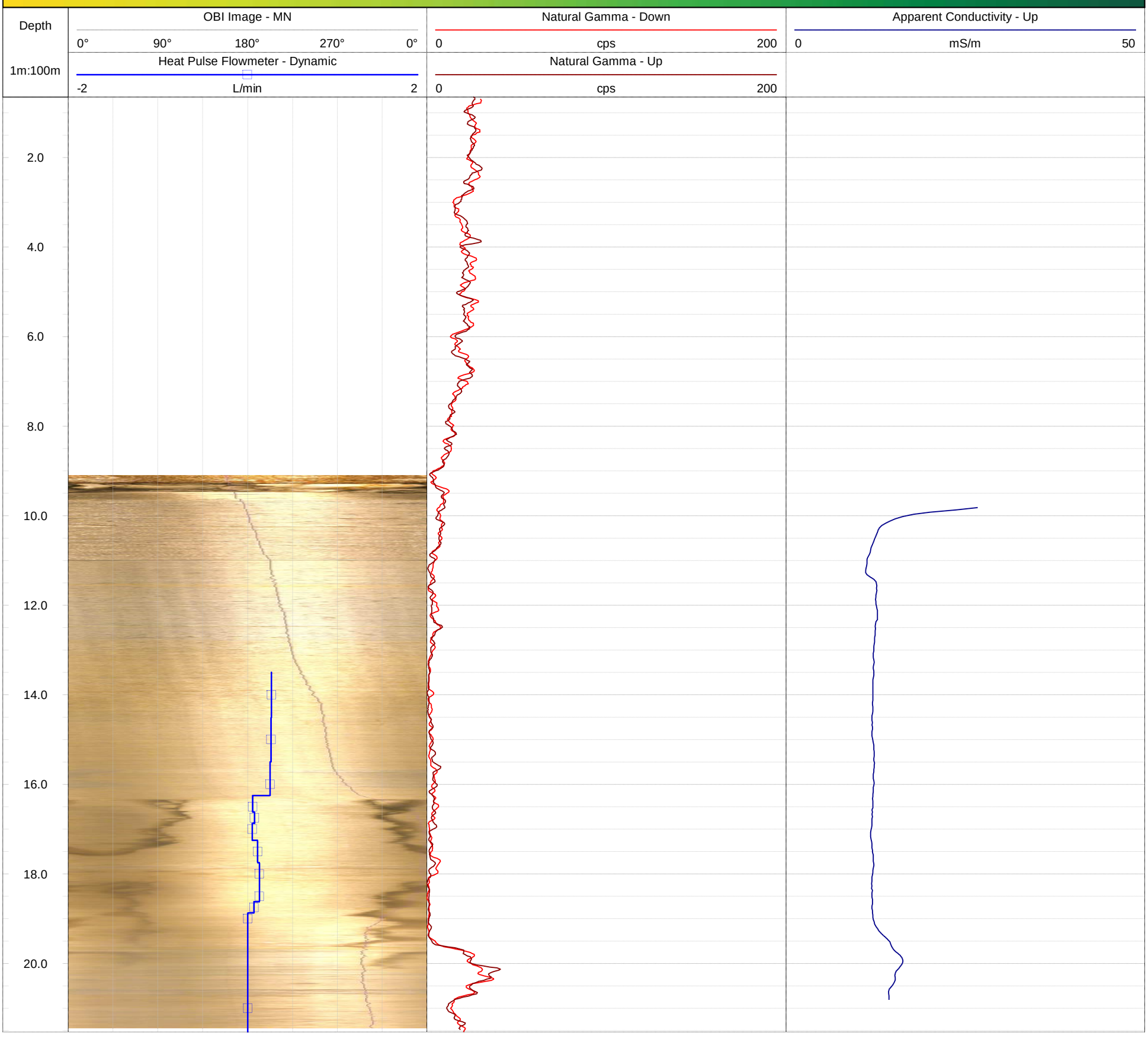
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: PW21-4 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	9.25 m bgs	**Location:**	Caledon, Ontario
Easting:	577802.09 m	**Drilled Depth:**	21.64 m bgs	**Water Level:**	10.95 m bgs	**Log Date:**	Mar-24-2021
Northing:	4854214.36 m	**Borehole Diameter:**	HQ	**Borehole Inclination:**	0 degs		
Elevation:	415.08 m asl	**Casing Diameter:**	152 mm	**Casing Stickup:**	0.04 m ags	**Logged By:**	PG

Notes: OBI image opaque>21.5 m bgs. Heat Pulse Flowmeter Dynamic pump at 13 m below top of collar. Pump rate approx. 2L/min.



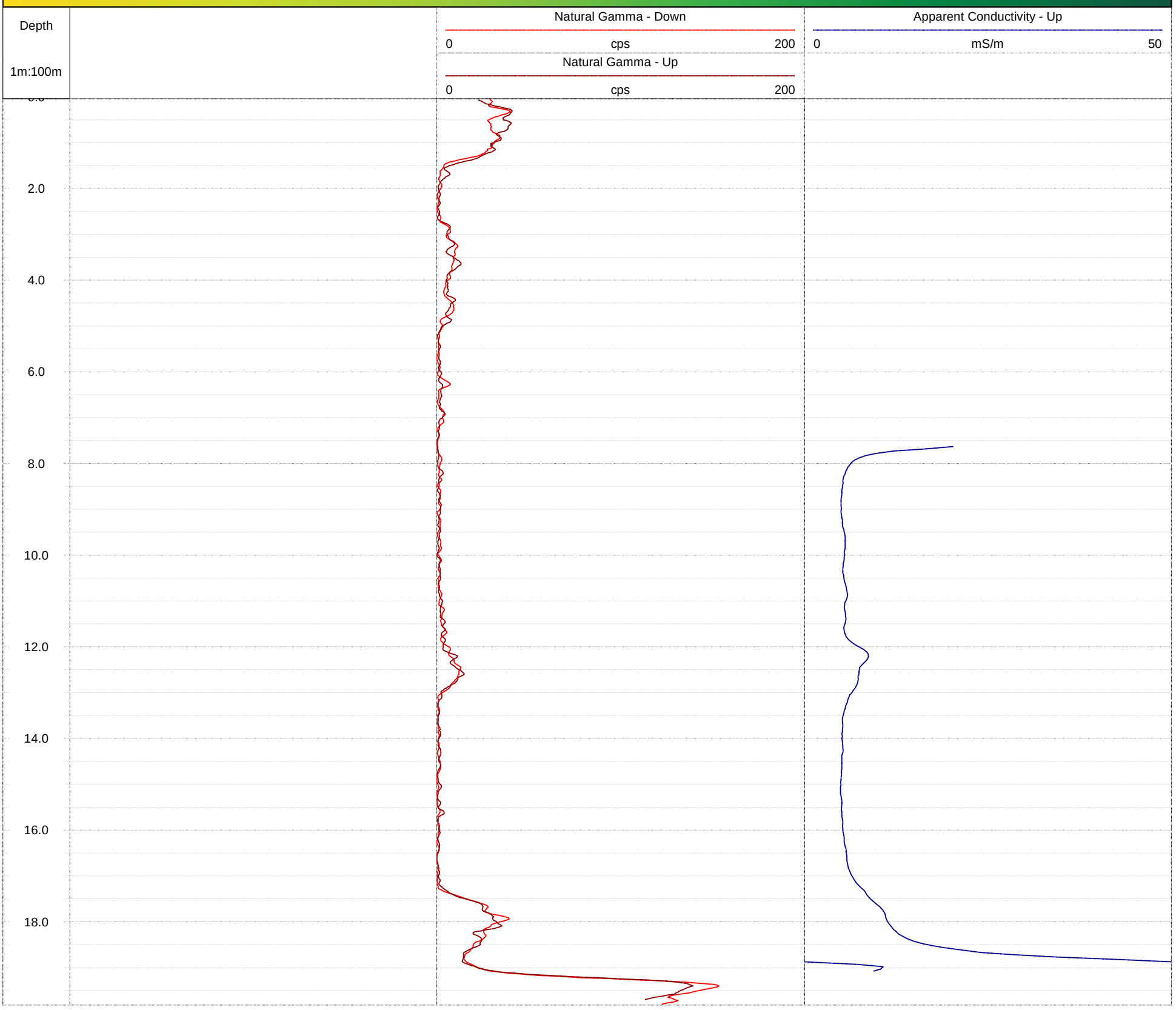
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: JHL-BH1 (CAL)

Log Title:	Geophysical Log
Project Number:	19129150
Client:	St. Marys Cement Inc. (Canada)
Date:	October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577246.61 m	**Drilled Depth:**	19.70 m bgs	**Water Level:**	3.00 m bgs	**Log Date:**	Apr-14-2021
Northing:	4854243.60 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	410.20 m asl	**Casing Diameter:**	102 mm	**Casing Stickup:**	0.65 m ags	**Logged By:**	PG

Notes:



GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: JHL-BH16 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577894.81 m	**Drilled Depth:**	19.90 m bgs	**Water Level:**	9.69 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854252.89 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	411.53 m asl	**Casing Diameter:**	76 mm	**Casing Stickup:**	0.46 m ags	**Logged By:**	PG

Notes:

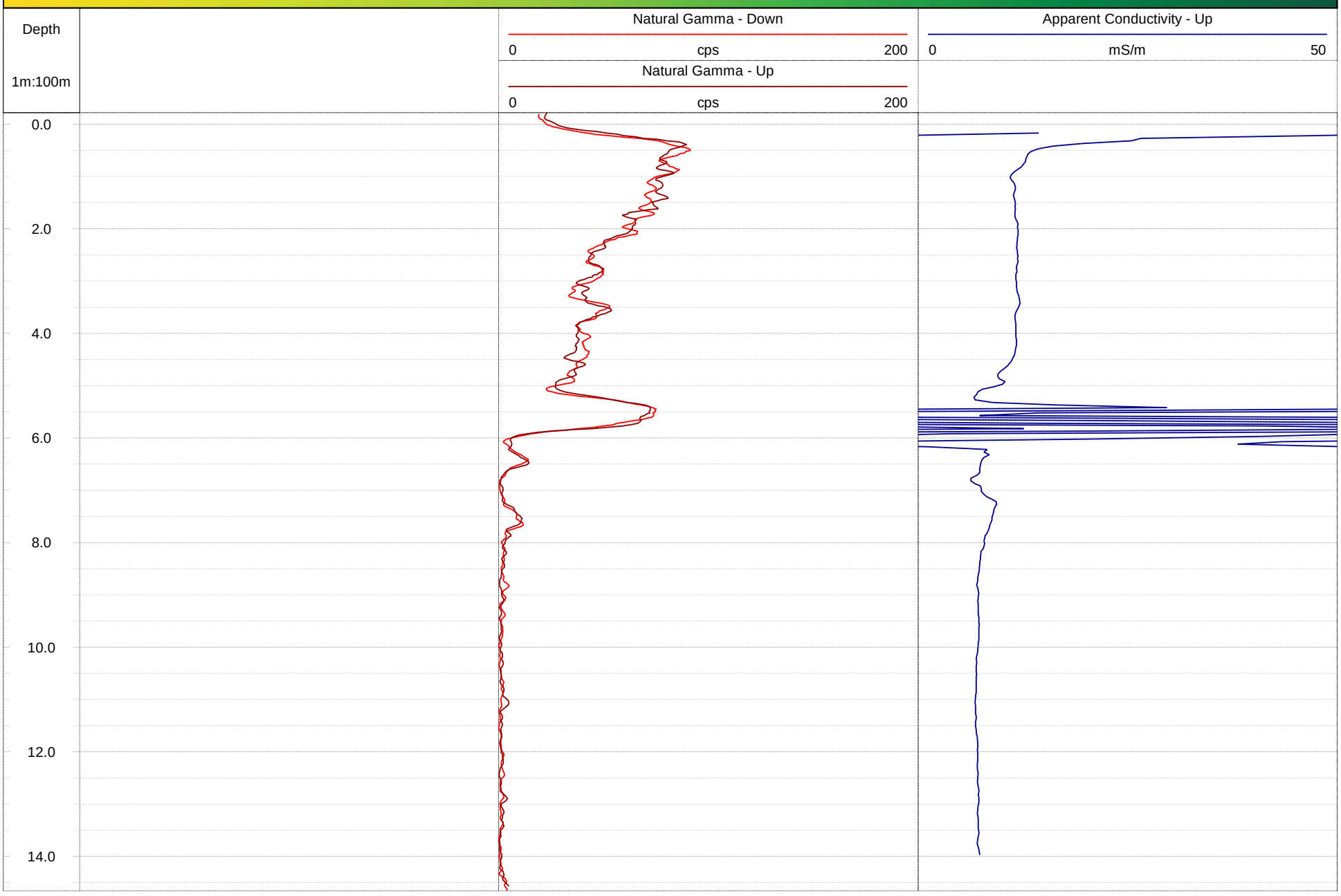


Geophysical Record of Borehole: JHL-BH17 (CAL)

Log Title:	Geophysical Log
Project Number:	19129150
Client:	St. Marys Cement Inc. (Canada)
Date:	October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	578028.61 m	**Drilled Depth:**	18.85 m bgs	**Water Level:**	6.58 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854138.05 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	408.11 m asl	**Casing Diameter:**	51 mm	**Casing Stickup:**	0.87 m ags	**Logged By:**	PG

Notes: 2" I.D. PVC pipe visible at surface, suspect some remnants of a metal casing near 5.8 m bgs



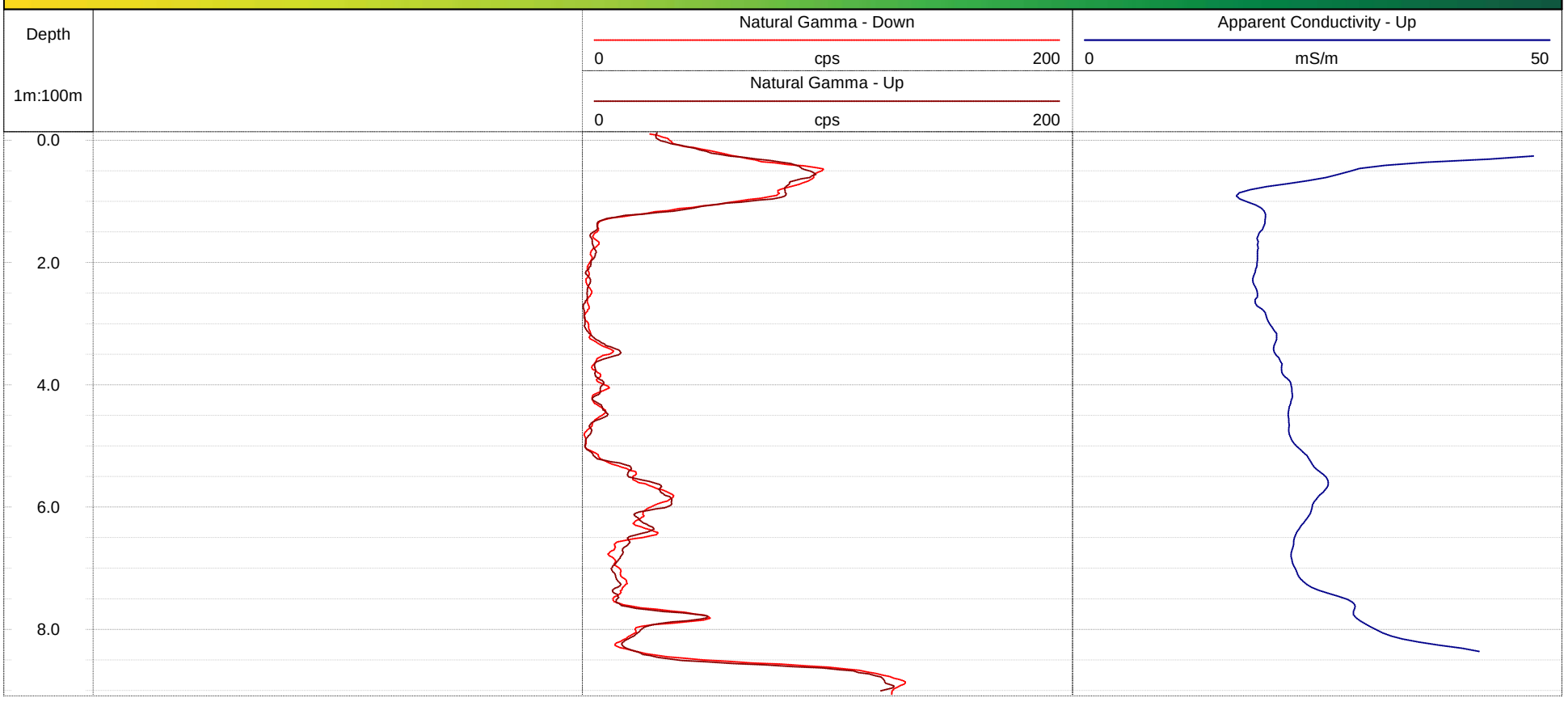
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: JHL-BH18 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	578153.75 m	**Drilled Depth:**	9.2 m bgs	**Water Level:**	3.36 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854324.05 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	400.69 m asl	**Casing Diameter:**	51 mm	**Casing Stickup:**	0.79 m ags	**Logged By:**	PG

Notes: 2" I.D. PVC pipe visible at surface, possible remnants of metal casing near surface.



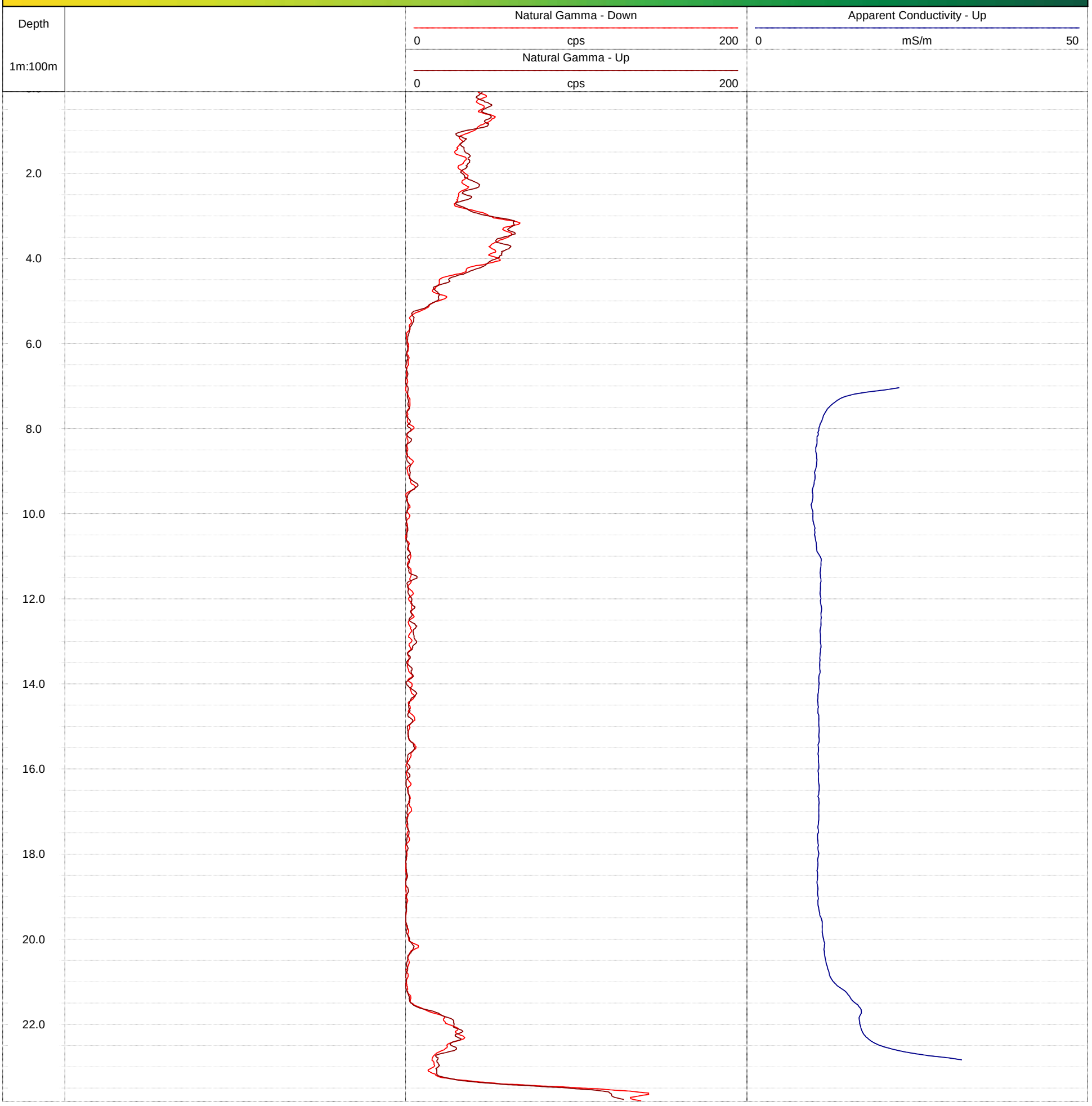
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: JHL-BH19 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577482.68 m	**Drilled Depth:**	24.50 m bgs	**Water Level:**	11.00 m bgs	**Log Date:**	Mar-25-2021
Northing:	4854486.38 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	414.13 m asl	**Casing Diameter:**	76 mm	**Casing Stickup:**	0.60 m ags	**Logged By:**	PG

Notes:



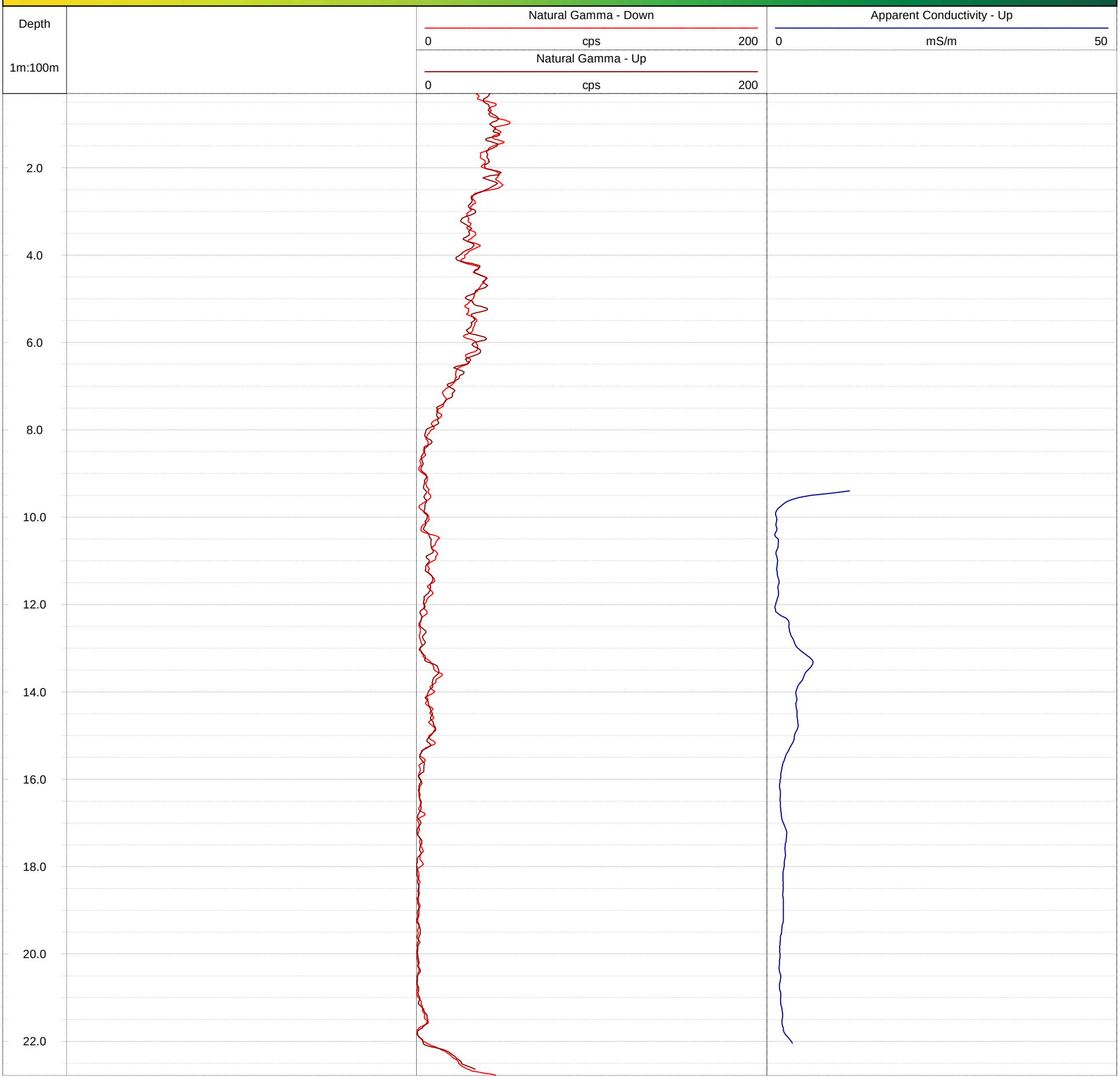
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: Unknown BH2 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: October 2021

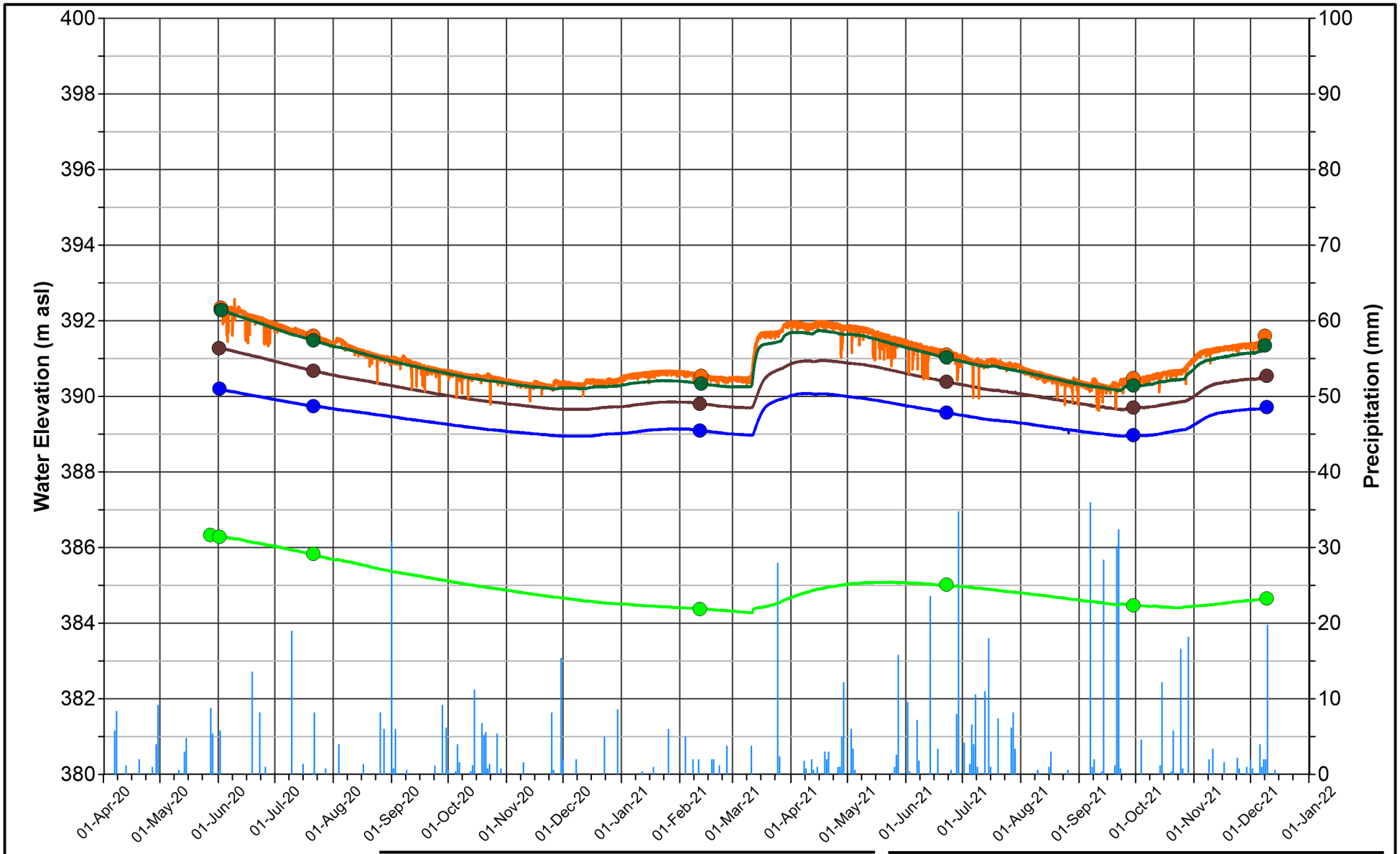
Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	n/a	**Location:**	Caledon, Ontario
Easting:	577689.54 m	**Drilled Depth:**	n/a	**Water Level:**	11.60 m bgs	**Log Date:**	Apr-14-2021
Northing:	4854266.72 m	**Borehole Diameter:**	n/a	**Borehole Inclination:**	0 degs		
Elevation:	n/a	**Casing Diameter:**	102 mm	**Casing Stickup:**	0.40 m ags	**Logged By:**	PG

Notes:



APPENDIX E

Groundwater Level Monitoring



PROJECT

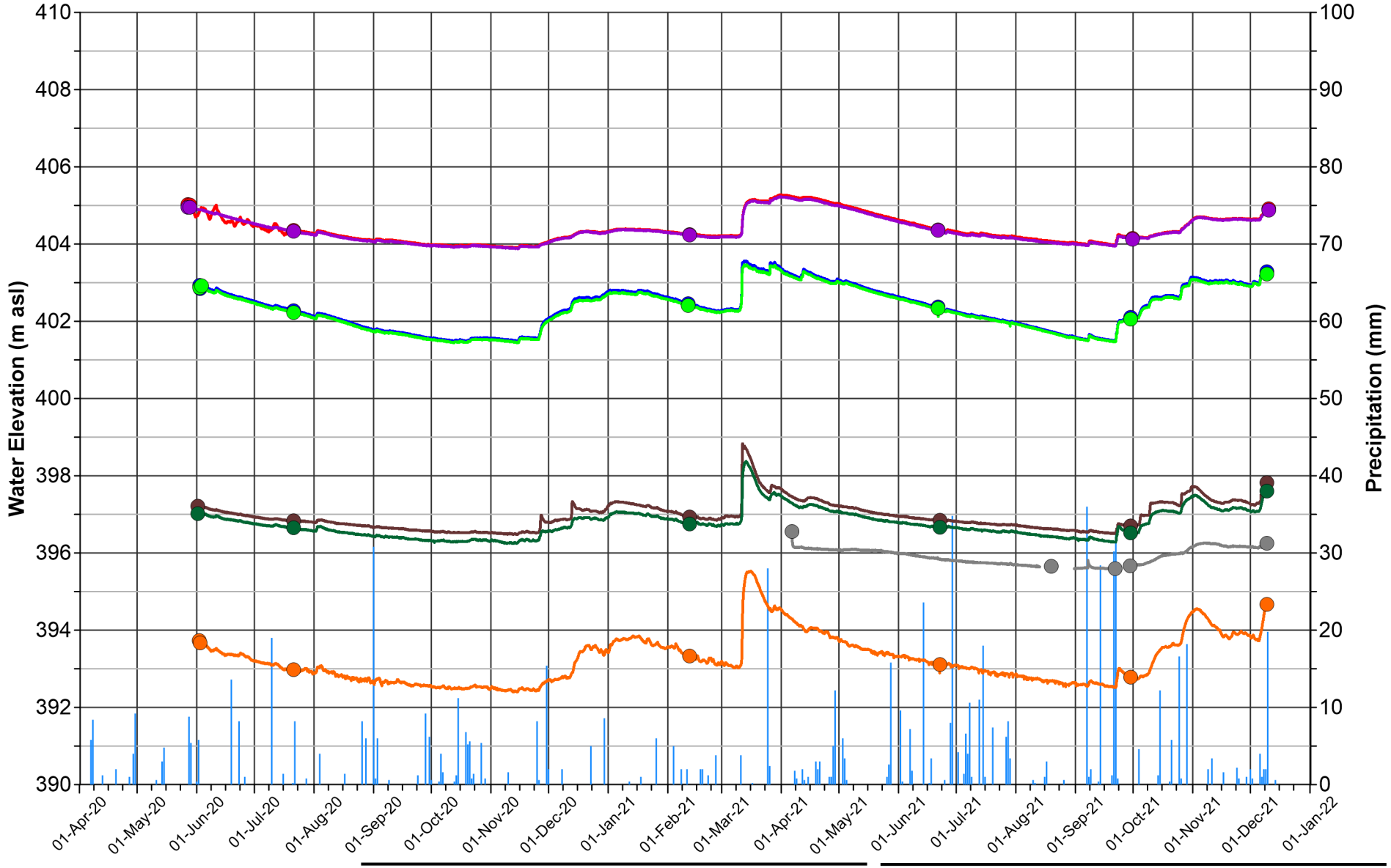
CBM CALEDON QUARRY

TITLE **GROUNDWATER MONITORING HYDROGRAPHS SOUTHERN AREA**

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT NO.	REV	FIGURE
19129150	A	E1



PROJECT

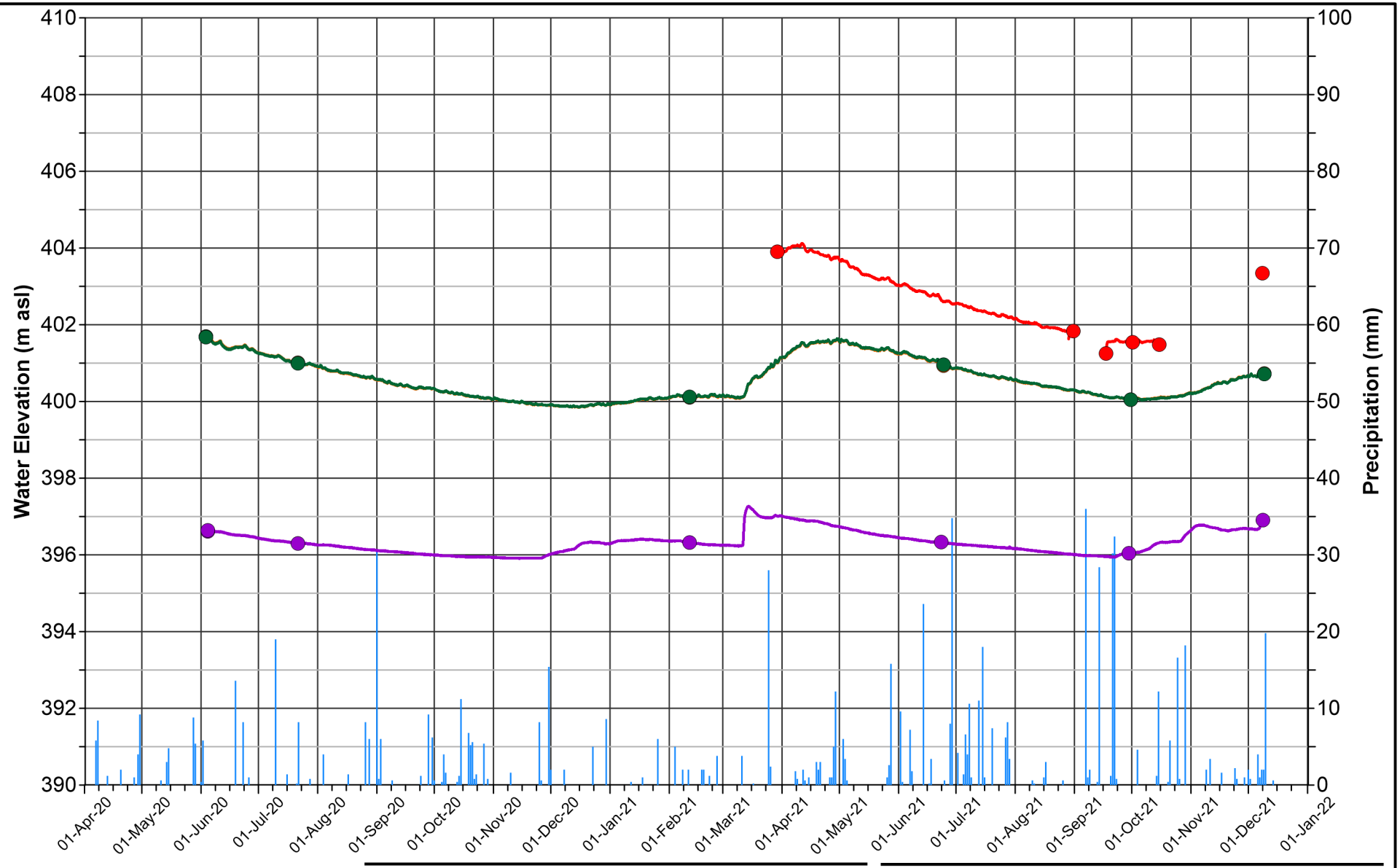
CBM CALEDON QUARRY

TITLE **GROUNDWATER MONITORING HYDROGRAPHS SOUTHEASTERN AREA**

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT NO.	REV	FIGURE
19129150	A	E2



MW20-09
MW20-10A
MW20-10B
PW21-4

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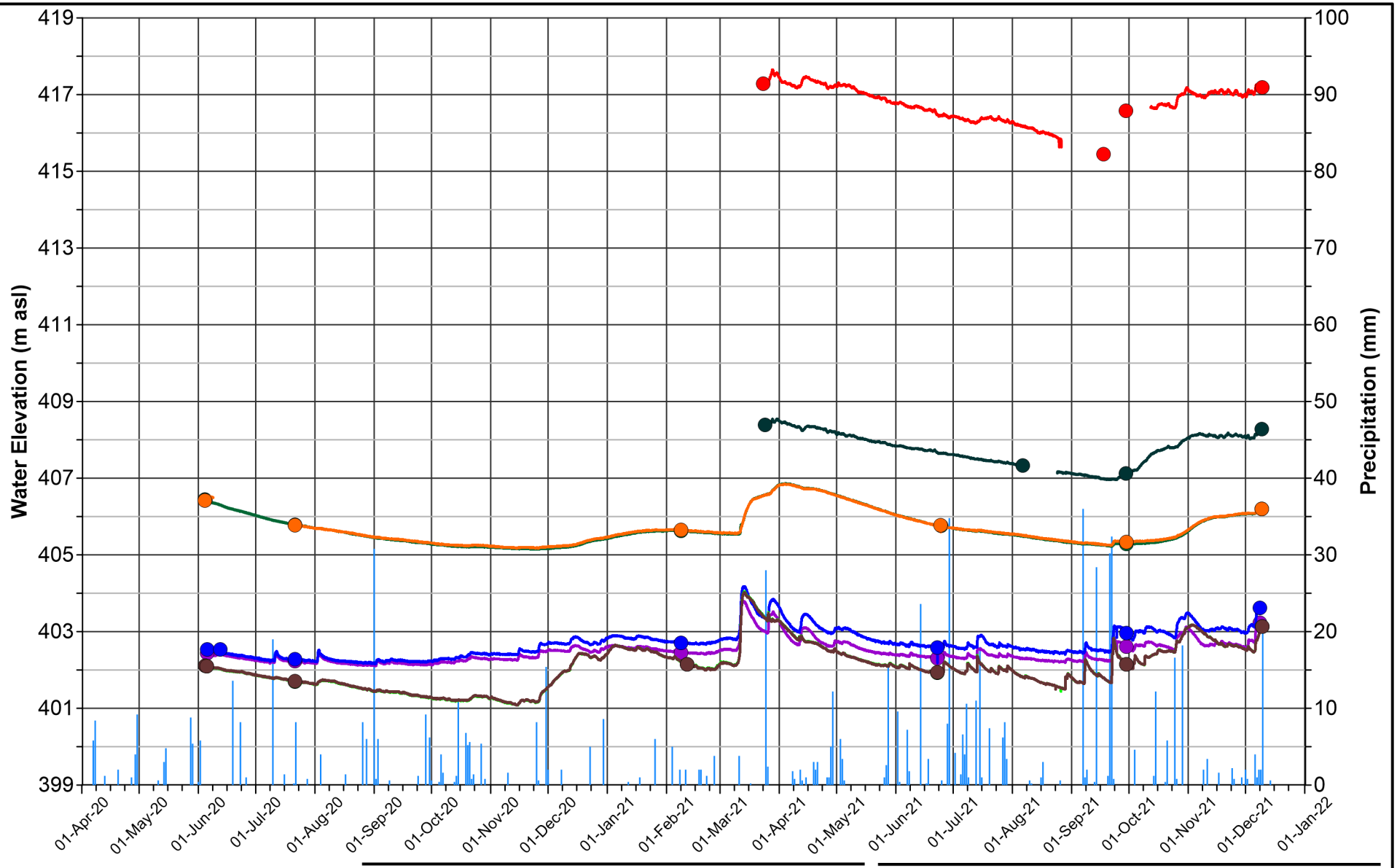
DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS EASTERN AREA

PROJECT NO.	REV	FIGURE
19129150	A	E3



MW20-11A
MW20-11B
MW20-14A
MW20-14B
MW20-17A
MW20-17B
PW21-1
PW21-2

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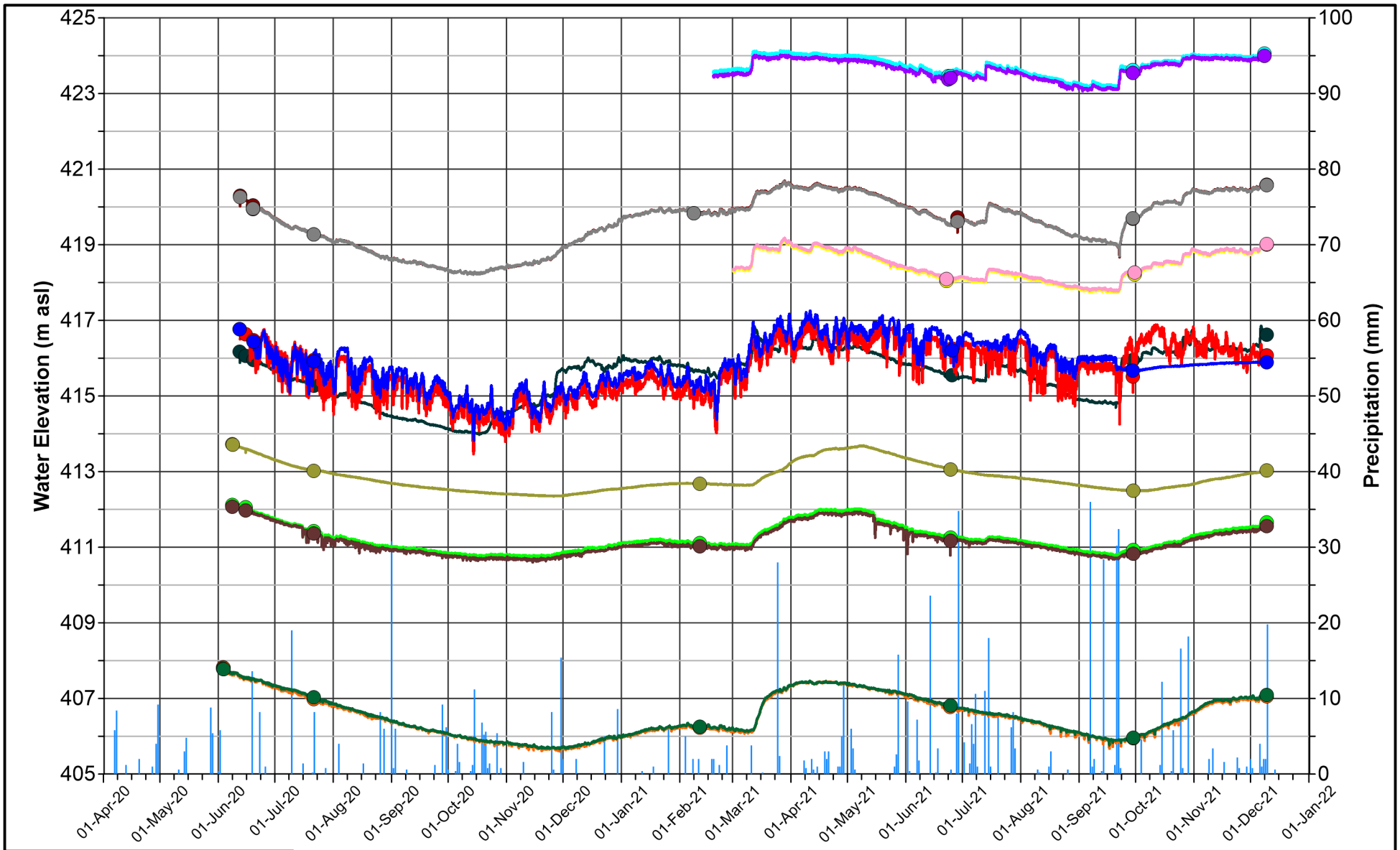
DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS CENTRAL AREA

PROJECT NO.	REV	FIGURE
19129150	A	E4



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DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS NORTHERN AREA

PROJECT NO.	REV	FIGURE
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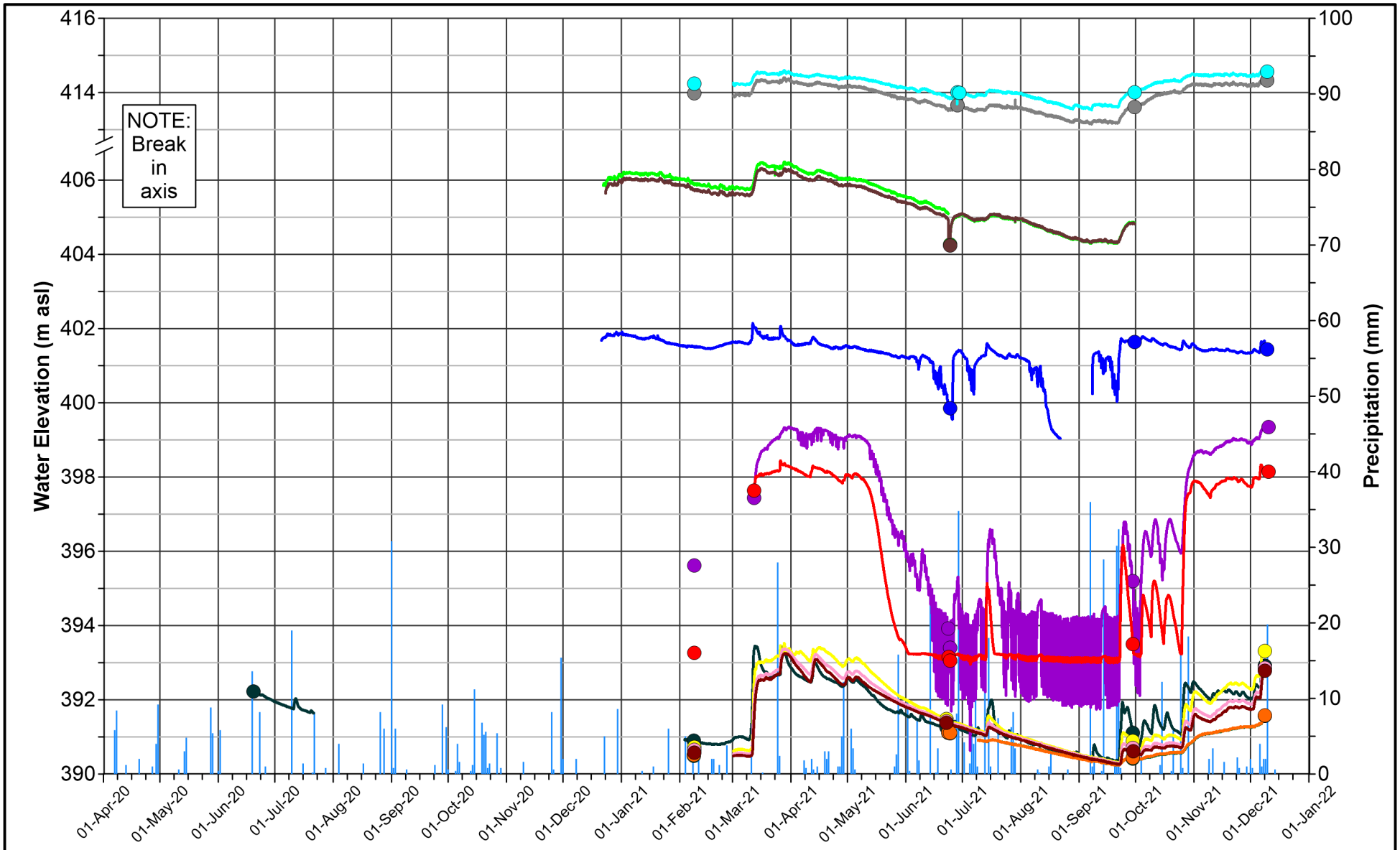

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS WESTERN AREA

PROJECT NO.	REV	FIGURE
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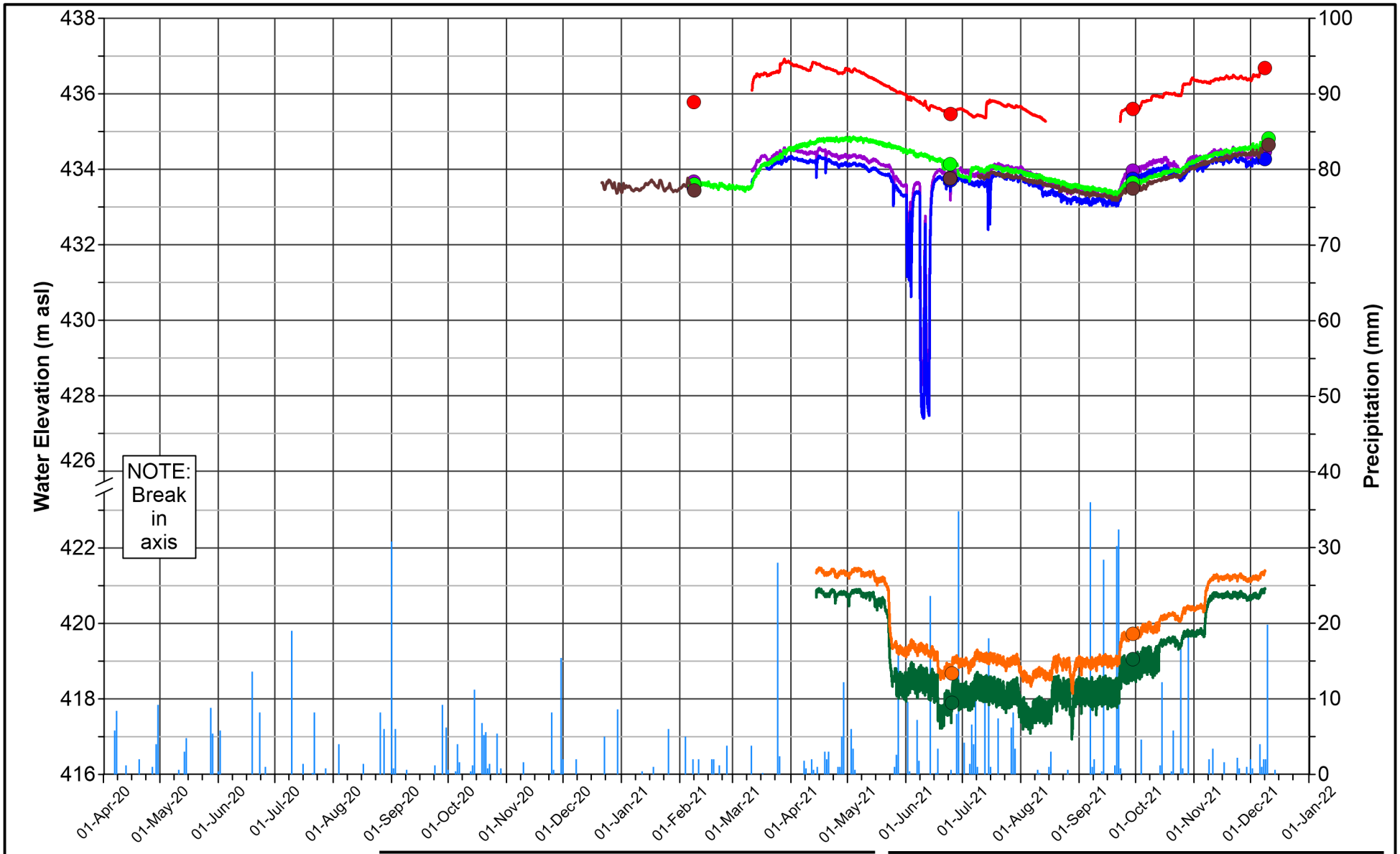

MW20-24A
MW20-24B
MW20-25A
MW20-25B
MW20-26A
MW20-26B
MW20-26C

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DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS NORTHWESTERN AREA

PROJECT NO.	REV	FIGURE
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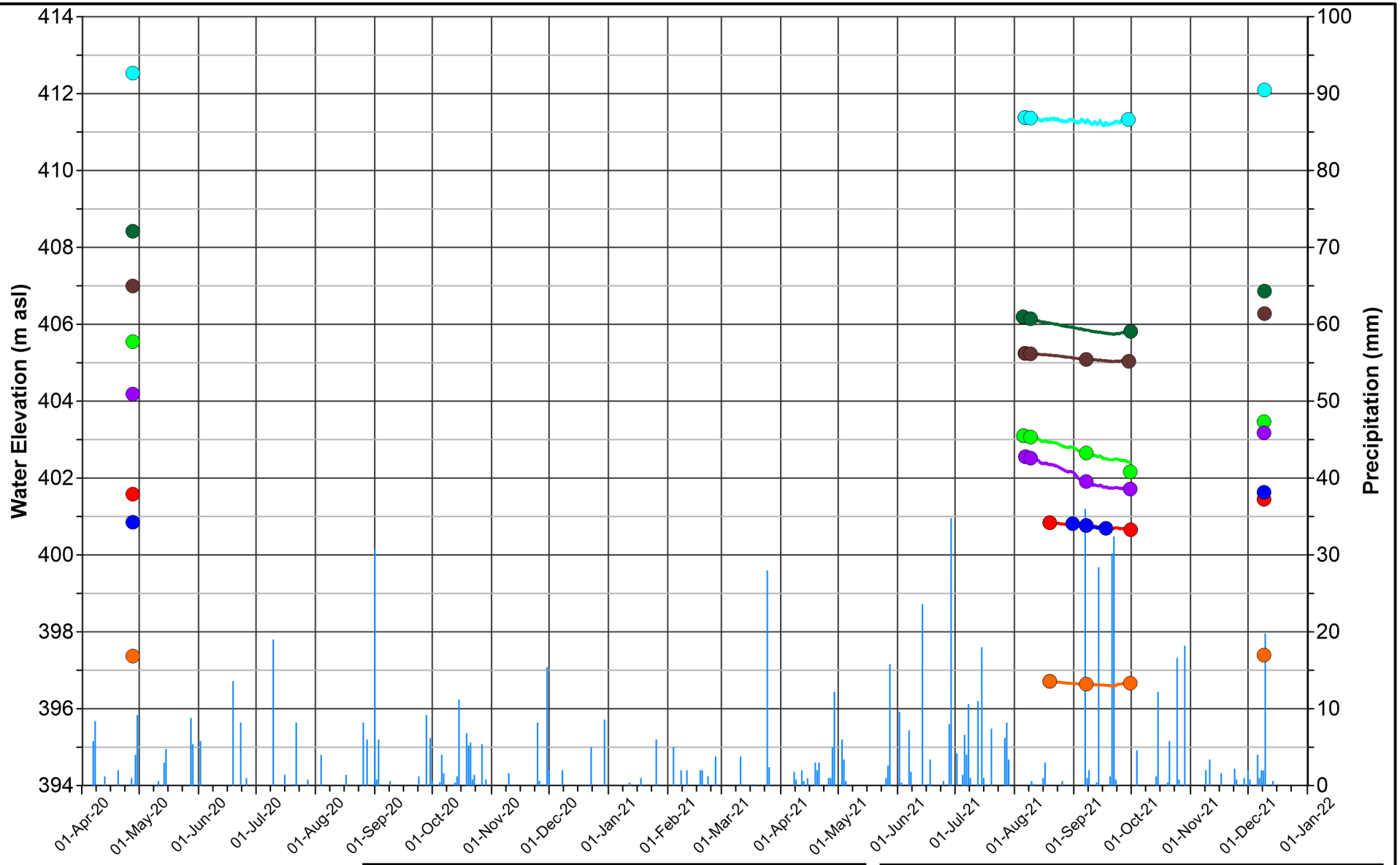

JHL-BH1
JHL-BH2
JHL-BH3
JHL-BH7
JHL-BH16
JHL-BH17
JHL-BH18
JHL-BH19

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS
JAGGER HIMS INVESTIGATION WELLS

PROJECT NO.	REV	FIGURE
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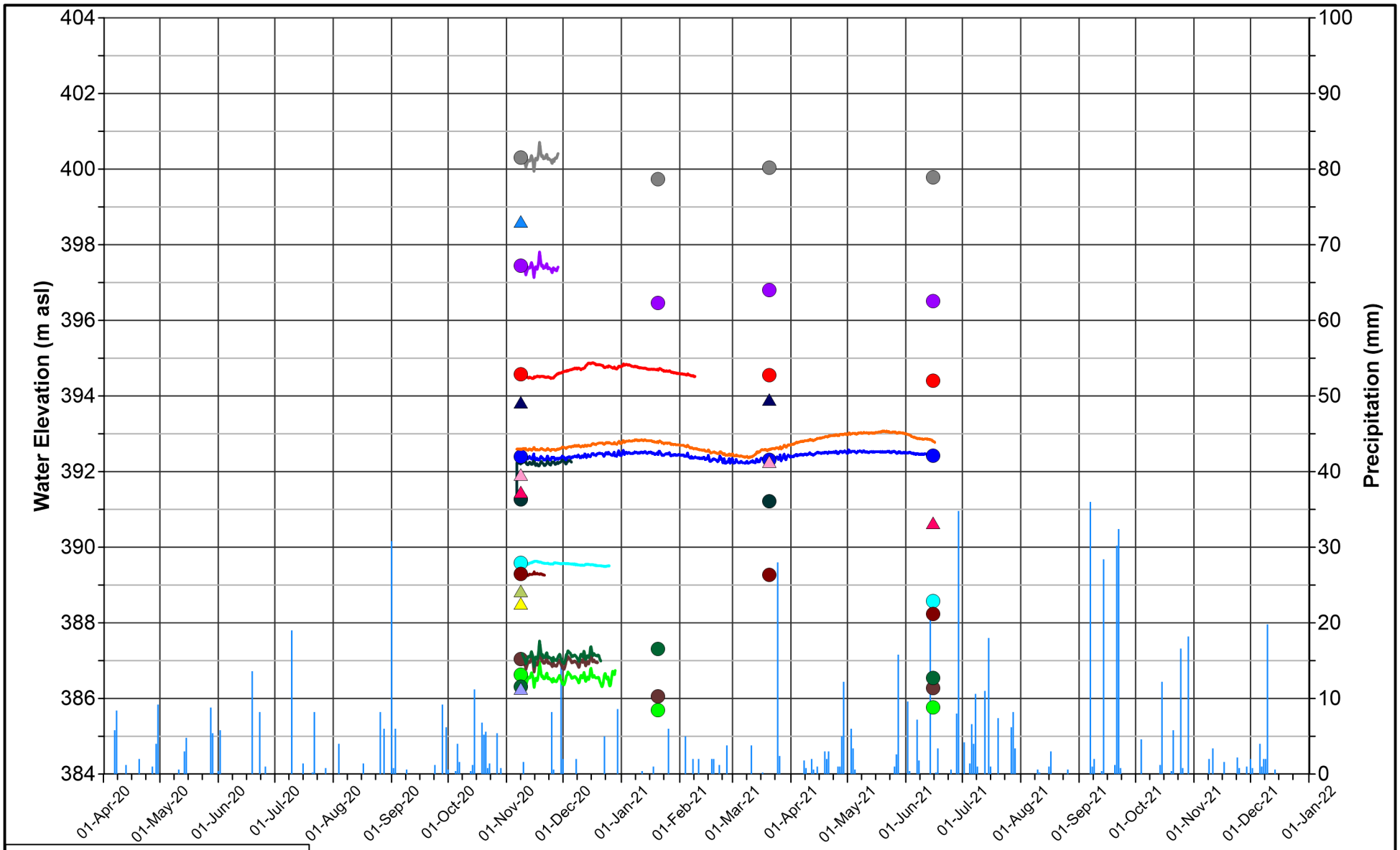


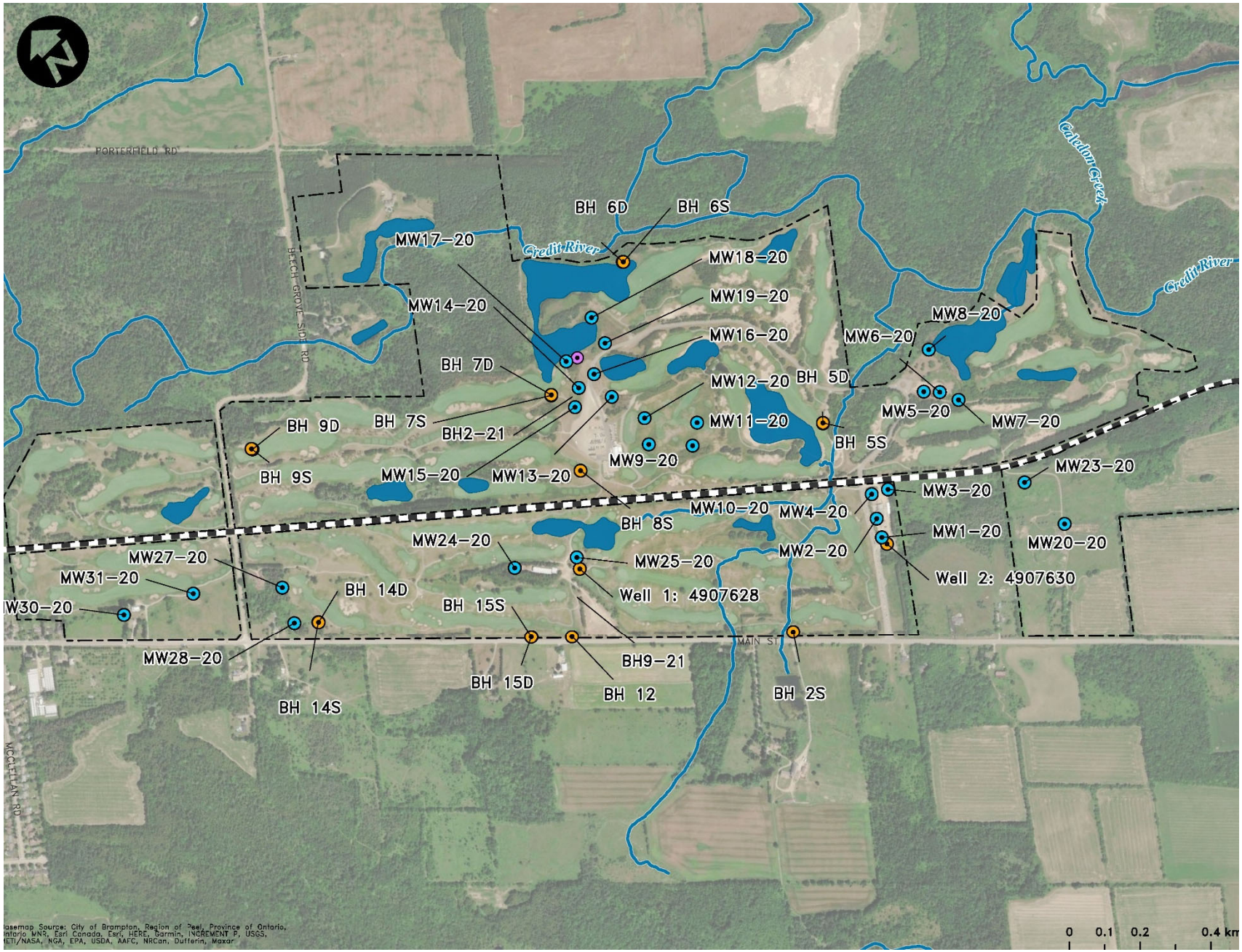
GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	GRP
APPROVED	GWS

PROJECT
CBM CALEDON QUARRY

TITLE
GROUNDWATER MONITORING HYDROGRAPHS
OSPREY VALLEY GOLF MONITORING WELLS

PROJECT NO.	REV	FIGURE
19129150	A	E9



Note: figure body from Crozier Consulting Engineers (0129-5521, dated 2021-08-26) as communicated from Osprey Valley Golf Course

CLIENT
ST.MARY'S CEMENT INC. (CANADA)

PROJECT
CALEDON QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-03-15
PREPARED	PGM
DESIGN	PGM
REVIEW	###
APPROVED	

TITLE
OSPREY VALLEY GOLF COURSE MONITORING WELL LOCATION PLAN

PROJECT NO.	PHASE	Rev.	FIGURE
19129150	2300	A	E10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

APPENDIX F

Packer Hydraulic Response Tests

Table F-1. Borehole Hydraulic (Packer) Testing Results
Caledon Quarry

BH ID	Figure Number	Top of Test Interval (mbgs)	Bottom of Test Interval (mbgs)	Interval (m)	Formation	Borehole Radius (m)	Test Tubing Radius (m)	Wellbore Storage Coefficent (m3/Pa)	Storativity (-)	Static Pressure (kPa)	Slug Injection Conductivity (m/s)	Constant Rate Injection Q (L/min)	Constant Rate Injection Conductivity (m/s)	Constant Rate Conductivity (m/s)	Selected transmissivity Selected Phase	Selected transmissivity Conductivity (m/s)	Selected transmissivity Flow Model	Comments (5)
BH20-01	F-4	4.3	11.0	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	74.5	9E-06	8	1E-05	1E-05	CRI	1E-05	Homogenous	
BH20-01	F-5	11.0	17.7	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	140.1	2E-06	(3)			SIR	2E-06	Homogenous	
BH20-01	F-6	19.5	22.1	2.6	Cabot Head Fm.	0.048	0.039	4.87E-07	5E-06	159.7	5E-08	(3)			SIR	5E-08	Homogenous	Packer bypass
BH20-02	F-7	6.1	12.7	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	83.1	2E-05	19	2E-05	2E-05	CRIR	2E-05	Homogenous	
BH20-02	F-8	12.9	19.6	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	121.0	1E-05	25	3E-05	3E-05	CRI	3E-05	Homogenous	
BH20-03	F-9	4.9	11.6	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	16.8	(2)	61	1E-04	8E-05	CRI	1E-04	Homogenous	Static water level in test interval
BH20-03	F-10	10.1	16.8	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	78.7	1E-05	18	1E-05	1E-05	CRI	1E-05	Homogenous	
BH20-04	F-11	10.7	14.3	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	15.0	(2)	51	2E-02	3E-02	CRI	2E-02	Homogenous	Static water level in test interval
BH20-04	F-12	13.5	17.0	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	41.6	1E-05	52	4E-04	4E-04	CRI	4E-04	Homogenous	
BH20-05	F-13	7.8	12.8	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	22.1	(2)	64	3E-03	4E-02	CRI	3E-03	Homogenous	
BH20-06	F-14	10.7	14.3	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	105.0	3E-07	(3)			SIR	3E-07	Homogenous	
BH20-07	F-15	4.6	11.3	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	88.2	7E-07	(3)			SIR	7E-07	Homogenous	
BH20-07	F-16	11.1	16.1	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	136.7	2E-06	2	2E-06	2E-06	CRI	2E-06	Homogenous	
BH20-08	F-17	7.0	10.5	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	28.0	2E-05	58	1E-04	9E-05	SIR	2E-05	Homogenous	
BH20-08	F-18	10.5	15.6	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	74.2	6E-06	6	6E-06	6E-06	SIR	6E-06	Homogenous	
BH20-09	F-19	5.3	10.4	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	40.4	2E-05	13	8E-06	1E-05	CRI	1E-05	Homogenous	
BH20-09	F-20	9.2	14.2	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	77.7	1E-05	16	2E-05	3E-05	CRIR	3E-05	Homogenous	
BH20-10	F-21	10.8	14.3	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	73.1	2E-06	(3)			SIR	2E-06	Homogenous	
BH20-10	F-22	13.3	16.9	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	164.5	2E-06	(3)			SIR	2E-06	Homogenous	
BH20-11	F-23	4.7	8.2	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	33.0	1E-04	58	3E-03	3E-03	CRI	3E-03	Homogenous	
BH20-12	F-24	14.1	19.2	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	102.7	3E-08	(3)			SIR	3E-08	Homogenous	
BH20-13	F-25	5.9	22.8	16.9	Gasport Fm.	0.048	0.067	1.44E-06	3E-05	143.7	9E-05	53	2E-04	2E-04	CRI	2E-04	Homogenous	Borehole integrity
BH20-14	F-26	10.8	19.1	8.2	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	100.3	8E-07	(3)			SIR	8E-07	Homogenous	
BH20-14	F-27	19.1	27.3	8.2	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	180.7	2E-06	1	9E-07	9E-07	SIR	2E-06	Homogenous	
BH20-15	F-28	17.2	23.9	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	193.5	1E-05	29	6E-06	6E-06	CRI	6E-06	Two shell composit model	
BH20-15	F-29	23.9	32.1	8.2	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	269.4	4E-06	31	2E-06	2E-06	CRI	2E-06	Two shell composit model	
BH20-16	F-30	15.5	23.7	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	199.7	2E-08	(3)			SIR	2E-08	Homogenous	Packer bypass
BH20-16	F-31	23.5	31.6	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	265.7	1E-06	(3)			SIR	1E-06	Homogenous with positive skin	
BH20-17	F-32	7.8	17.4	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	99.3	9E-06	21	7E-06	7E-06	CRIR	7E-06	Homogenous	
BH20-17	F-33	16.6	26.3	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	183.7	9E-06	30	1E-05	9E-06	CRIR	9E-06	Homogenous	Packer bypass
BH20-18	F-34	12.2	20.3	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	74.7	(4)	48	2E-04	6E-04	CRI	2E-04	Homogenous with negative skin	Small test pressure differential
BH20-18	F-35	20.6	28.7	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	169.2	5E-06	11	5E-06	4E-06	CRIR	4E-06	Homogenous	
BH20-19	F-36	5.0	13.1	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	69.7	3E-05	33	9E-05	8E-05	CRI	9E-05	Homogenous	
BH20-19	F-37	12.5	22.1	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	160.2	1E-05	22	2E-05	2E-05	CRIR	2E-05	Homogenous	
BH20-20	F-38	16.9	28.2	11.3	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	145.3	2E-07	(3)			SIR	2E-07	Homogenous	
BH20-20	F-39	27.3	38.5	11.3	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	246.2	2E-06	13	4E-06	4E-06	CRIR	4E-06	Homogenous	
BH20-21	F-40	8.3	19.5	11.3	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	125.9	9E-06	24	1E-05	1E-05	CRIR	1E-05	Two shell composit model	
BH20-21	F-41	19.5	30.8	11.3	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	231.7	4E-06	33	9E-07	9E-07	CRIR	9E-07	Two shell composit model	
BH20-22	F-42	7.6	17.4	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	130.9	2E-06	3	3E-06	2E-06	CRIR	2E-06	Homogenous	
BH20-22	F-43	16.4	26.2	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	216.0	4E-06	5	4E-06	4E-06	CRIR	4E-06	Homogenous	
BH20-23	F-44	16.9	25.1	8.2	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	207.0	4E-06	4	4E-06	4E-06	CRI	4E-06	Homogenous	
BH20-23	F-45	25.1	34.9	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	302.0	2E-06	3	1E-06	1E-06	CRIR	1E-06	Homogenous	
BH20-24	F-46	14.0	17.7	3.7	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	49.3	1E-04	40	2E-04	2E-04	CRI	2E-04	Homogenous	Static water level in packer mandrel
BH20-24	F-47	16.7	20.3	3.7	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	75.0	1E-04	32	2E-04	2E-04	CRI	2E-04	Homogenous	
BH20-25	F-48	7.9	13.1	5.2	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	75.6	4E-07	(3)			SIR	4E-07	Homogenous	
BH20-25	F-49	12.9	19.6	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	138.4	5E-06	7	4E-06	4E-06	CRI	4E-06	Homogenous with negative skin	

Table F-1. Borehole Hydraulic (Packer) Testing Results
Caledon Quarry

BH ID	Figure Number	Top of Test Interval (mbgs)	Bottom of Test Interval (mbgs)	Interval (m)	Formation	Borehole Radius (m)	Test Tubing Radius (m)	Wellbore Storage Coefficent (m3/Pa)	Storativity (-)	Static Pressure (kPa)	Slug Injection Conductivity (m/s)	Constant Rate Injection Q (L/min)	Constant Rate Injection Conductivity (m/s)	Constant Rate Conductivity (m/s)	Selected transmissivity Selected Phase	Selected transmissivity Conductivity (m/s)	Selected transmissivity Flow Model	Comments (5)
BH20-26	F-50	7.7	14.4	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	77.8	1E-07	(3)			SIR	1E-07	Homogenous	
BH20-26	F-51	13.6	20.3	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	132.4	6E-06	4	7E-06	2E-05	SIR	6E-06	Homogenous	
BH20-27	F-52	4.4	14.2	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	85.7	2E-06	5	2E-06	2E-06	CRI	2E-06	Homogenous	
BH20-27	F-53	13.8	23.5	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	169.1	3E-06	39	4E-06	4E-06	CRIR	4E-06	Two shell composit model	
MW20-01	F-54	10.9	14.5	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	113.1	5E+00	41	3E-03	2E-03	CRI	3E-03	Homogenous	Small test pressure differential
MW20-01	F-55	14.9	19.4	4.5	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	9E-06	130.8	3E-06	(3)			SIR	2E-06	Homogenous	
MW20-02		Insufficient rock to test																
MW20-03		Insufficient rock to test																
MW20-04		Insufficient rock to test																
MW20-05	F-56	4.7	8.3	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	25.7	(2)	3	4E-06	4E-06	CRI	4E-06	Homogenous	
MW20-05	F-57	6.9	10.5	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	49.2	8E-06	6	7E-06	7E-06	CRI	7E-06	Homogenous	
MW20-05	F-58	10.6	14.8	4.2	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	8E-06	87.9	5E-07	(3)			SIR	5E-07	Homogenous	Pressure oscillation
MW20-06	F-59	4.3	7.9	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	41.4	2E-05	12	3E-05	4E-05	CRI	3E-05	Homogenous	
MW20-06	F-60	7.2	10.8	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	68.3	2E-06	(3)			SIR	2E-06	Homogenous	
MW20-06	F-61	10.9	16.0	5.1	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	1E-05	115.8	2E-08	(3)			SIR	2E-08	Homogenous	
MW20-07	F-62	4.6	8.1	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	67.0	5E-07	(3)			SIR	5E-07	Homogenous with negative skin	
MW20-07	F-63	8.0	13.1	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	112.1	2E-06	2	4E-06	4E-06	CRIR	4E-06	Homogenous	
MW20-07	F-64	13.2	16.8	3.6	Shaley Dolostone	0.048	0.039	4.87E-07	7E-06	150.1	3E-07	(3)			SIR	3E-07	Homogenous	
MW20-08	F-65	4.1	9.2	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	71.3	2E-04	33	2E-03	1E-03	CRI	2E-03	Homogenous	Small test pressure differential
MW20-08	F-66	8.4	15.1	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	127.7	2E-05	19	3E-05	4E-05	SIR	2E-05	Homogenous with positive skin	
MW20-08	F-67	15.2	18.6	3.4	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	7E-06	164.4	1E-06	(3)			SIR	1E-06	Homogenous	
MW20-09		Insufficient rock to test																
MW20-10	F-68	13.9	17.4	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	71.9	1E-04	43	4E-04	3E-04	CRIR	3E-04	Homogenous	
MW20-10	F-69	16.9	21.2	4.3	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	8E-06	100.7	6E-05	36	2E-04	2E-04	CRI	2E-04	Homogenous with positive skin	
MW20-11	F-70	4.8	10.0	5.2	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	61.8	2E-05	15	2E-05	2E-05	SIR	2E-05	Homogenous	
MW20-11	F-71	9.7	16.4	6.7	Gasport Fm.	0.048	0.039	1.40E-06	1E-05	125.0	4E-06	6	5E-06	5E-06	SIR	4E-06	Homogenous	
MW20-11	F-72	16.4	19.4	3.0	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	6E-06	159.7	1E-06	(3)			SIR	1E-06	Homogenous	
MW20-12	F-73	7.5	14.2	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	90.1	1E-05	3	2E-06	8E-06	SIR	1E-05	Homogenous	
MW20-12	F-74	14.2	19.3	5.1	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	140.8	1E-05	11	1E-05	1E-05	SIR	1E-05	Homogenous	
MW20-12	F-75	19.8	22.7	2.9	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	6E-06	179.9	2E-07	(3)			SIR	2E-07	Homogenous	
MW20-13	F-76	17.0	20.6	3.6	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	166.5	3E-06	2	7E-06	2E-06	SIR	3E-06	Homogenous with negative skin	
MW20-13	F-77	20.2	23.9	3.7	Gasport Fm.	0.048	0.039	4.87E-07	7E-06	198.2	4E-06	3	7E-06	2E-06	SIR	4E-06	Homogenous with negative skin	
MW20-13	F-78	23.9	28.2	4.3	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	8E-06	229.7	3E-06	2	3E-06	2E-06	SIR	3E-06	Homogenous	Packer bypass
MW20-14	F-79	4.6	14.4	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	83.6	7E-05	43	3E-05	3E-05	CRIR	3E-05	Homogenous	
MW20-14	F-80	14.2	22.4	8.2	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	133.0	2E-05	40	6E-05	2E-05	CRI	6E-05	Homogenous	
MW20-14	F-81	22.4	26.4	4.0	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	8E-06	167.6	6E-05	23	5E-05	6E-05	SIR	6E-05	Homogenous	
MW20-15	F-82	14.3	24.1	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	221.3	2E-06	(3)			SIR	2E-06	Homogenous	
MW20-15	F-83	24.1	33.8	9.8	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	314.9	5E-06	9	1E-05	1E-05	CRI	1E-05	Homogenous with negative skin	

Table F-1. Borehole Hydraulic (Packer) Testing Results
Caledon Quarry

BH ID	Figure Number	Top of Test Interval (mbgs)	Bottom of Test Interval (mbgs)	Interval (m)	Formation	Borehole Radius (m)	Test Tubing Radius (m)	Wellbore Storage Coefficent (m3/Pa)	Storativity (-)	Static Pressure (kPa)	Slug Injection Conductivity (m/s)	Constant Rate Injection Q (L/min)	Constant Rate Injection Conductivity (m/s)	Constant Rate Conductivity (m/s)	Selected transmissivity Selected Phase	Selected transmissivity Conductivity (m/s)	Selected transmissivity Flow Model	Comments (5)
MW20-15	F-84	33.8	37.2	3.3	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	7E-06	349.5	2E-08	(3)			SIR	2E-08	Homogenous	
MW20-16	F-85	16.9	26.5	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	238.3	9E-08	(3)			SIR	9E-08	Homogenous	
MW20-16	F-86	25.8	35.4	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	324.1	2E-05	13	1E-05	1E-05	CRI	1E-05	Homogenous with positive skin	
MW20-16	F-87	35.5	39.8	4.3	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	8E-06	358.9	2E-06	(3)			SIR	2E-06	Homogenous	
MW20-17	F-88	5.0	11.7	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	64.5	2E-06	2	2E-06	2E-06	CRI	2E-06	Homogenous	
MW20-17	F-89	11.7	18.4	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	127.1	1E-05	17	8E-06	7E-06	CRI	8E-06	Homogenous with negative skin	
MW20-17	F-90	18.4	27.5	9.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	162.9	1E-05	25	3E-06	3E-06	CRIR	3E-06	Two shell composit model	
MW20-18	F-91	14.0	28.2	14.1	Gasport Fm.	0.048	0.039	4.87E-07	3E-05	43.7	2E-05	44	2E-04	2E-04	CRI	2E-04	Homogenous	Borehole integrity, Small test pressure differential
MW20-19	F-92	8.0	16.2	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	81.7	(2)	66	8E-05	7E-05	CRI	8E-05	Homogenous with negative skin	Static water level in packer mandrel
MW20-19	F-93	15.4	22.1	6.7	Gasport Fm.	0.048	0.039	4.87E-07	1E-05	149.8	2E-05	77	2E-04	1E-04	CRI	2E-04	Homogenous	
MW20-19	F-94	22.1	27.4	5.3	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	1E-05	171.2	6E-06	6	5E-06	5E-06	SIR	6E-06	Homogenous	
MW20-20	F-95	7.8	17.5	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	186.7	2E-05	7	3E-05	2E-05	SIR	2E-05	Homogenous	Transient formation pressure
MW20-20	F-96	17.0	25.2	8.1	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	254.2	9E-06	10	2E-05	2E-05	CRI	2E-05	Homogenous	Transient formation pressure
MW20-20	F-97	25.2	28.0	2.8	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	6E-06	259.4	5E-09	(3)			SIR	5E-09	Homogenous	
MW20-21	F-98	16.9	26.6	9.7	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	230.7	3E-06	(3)			SIR	3E-06	Homogenous	
MW20-21	F-99	25.6	36.7	11.2	Gasport Fm.	0.048	0.039	4.87E-07	2E-05	329.1	1E-05	81	3E-04	2E-04	CRI	3E-04	Homogenous	
MW20-21	F-100	36.7	39.7	3.0	Shaley Dolostone/ Cabot Head Fm.	0.048	0.039	4.87E-07	6E-06	363.4	4E-07	(3)			SIR	4E-07	Homogenous	

Note:
1) Results calculated as transmisivity, and conductivty calculated as k = T/interval length.
2) Slug injection recovery occurs in multiple tubing diameters. Phase not analyzed.
3) Due to slow response of formation, only a slug injection was prepared.
4) Slug injection recovery was too rapid for analysis.
5) Refer to Section 7.1 of accompanying report for discussion of comments.

Test Specific Notes to Accompany Table F-1

The packer testing report subsection provides a generalized description of field methods, analysis, and the results of the borehole hydraulic testing program. However, specific field conditions impacted the data collection and analysis methods for a number of tests, as commented in Table F-1, including:

- Small test pressure differential: Some intervals had hydraulic conductivity approaching the upper limit of the tool. To create a test pressure differential, the ability of the pumps and tubing to convey water to the interval must be relatively large to compared to the ability of the interval to conduct the water into the formation. In the following cases, only a small test pressure differential was achieved using the maximum injection rate of the tool: MW20-01 upper (0.1 m), MW20-08 upper (0.1 m), MW20-18 (0.4 m), BH20-18 upper (0.3 m). In these cases, the hydraulic conductivity can only be estimated to within an order of magnitude and should be considered a lower bound for the actual interval hydraulic conductivity.
- Static water level in test interval or packer mandrel: In cases where the static water level was in the test interval or in the packer mandrel, the testing method was modified to exclude the falling head test which would not yield valuable information and a CRI test was performed as is typically described in Section 5. Tests BH20-03 upper (WL in interval), BH20-04 upper (WL in interval), BH20-24 (water level in packer mandrel), and MW20-19 upper (water level in packer mandrel), followed this methodology. Tests with this additional source of uncertainty should only be relied upon as an order of magnitude estimate of transmissivity.
- Packer bypass: During the packer seating test when water was added (typically 5 m) to the annular space above the upper packer, a pressure response was observed in the interval indicating bypass of the upper packer for the following tests:BH20-01 lower (0.3m), BH20-16 upper (0.3m), BH20-17 lower (0.3m), and MW20-13 lower (0.2m response). The bypass of the upper packer for these tests was likely occurring through fractures in the formation. In these cases, the estimated transmissivity should be considered an upper limit.
- Borehole integrity: In two cases, borehole integrity limited the depth to which the packer testing tool could be deployed. In BH20-13 a single open hole test was performed to test the bedrock. In this case the interval length was considered to be from the bottom of casing to the end of the borehole and the casing was used as the test tubing. Most of the length of borehole MW20-18 was inaccessible due borehole instability, so a single packer tool configuration was implemented to test the borehole.
- Pressure oscillation: While testing MW20-05 lower portion, a small pressure oscillation was observed in the test interval. This may have been the result of a small nitrogen leak at the top of the test interval, resulting in small pressure oscillations as the nitrogen bubbled up the test tubing. A portion of the test interval may have experienced variable saturation and the nitrogen bubbles may have a small impact on WBS; therefore, the accuracy of the bulk transmissivity estimate of the interval should be considered an order of magnitude.
- Transient formation pressure: While testing the upper and middle portions of MW20-20, changes in the static interval pressure were noted during the test. In the upper interval (upper Gasport Formation) the static level increased approximately 1 m during the test and the middle interval (lower Gasport Formation) fell by approximately 0.3 m.

- Variable injection rate: Some CRI tests experienced variations of the pumping rate during the test, either as a result of operational decisions to avoid the water level exceeding the height of the test tubing or due to variation of the pump performance. The average pump rate and late time pressure data were applied for the analysis. In tests where the injection rate varied significantly during the CRI, SIR or CRIR phases were selected for transmissivity analysis.

Figure 3a) Typical Straddle Packer Configuration Schematic Diagram

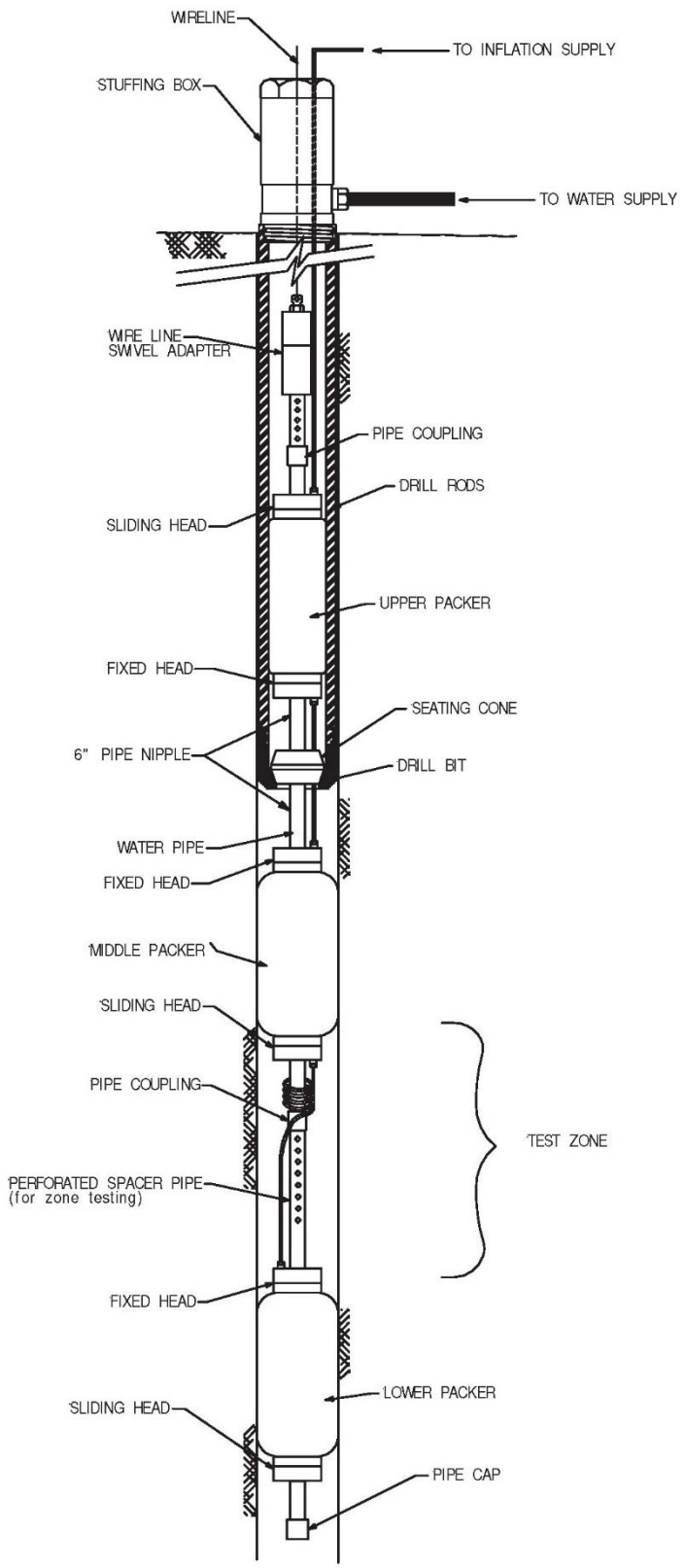
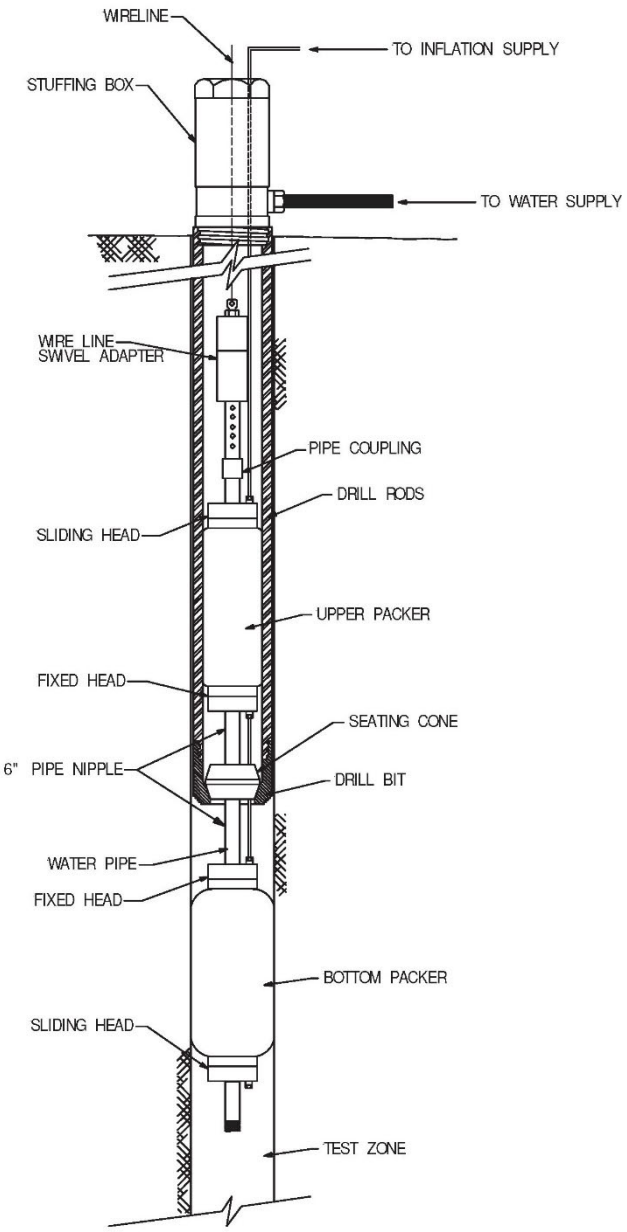


Figure 3b) Typical Single Packer Configuration Schematic Diagram



(RST Instruments Inc., 2019)

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PROJECT
CALEDON QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

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DESIGN	PGM
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TITLE
TYPICAL PACKER TESTING TOOL SCHEMATIC DIAGRAMS

PROJECT No.	PHASE	Rev.	FIGURE
19129150	**2300**	**A**	**F-1**

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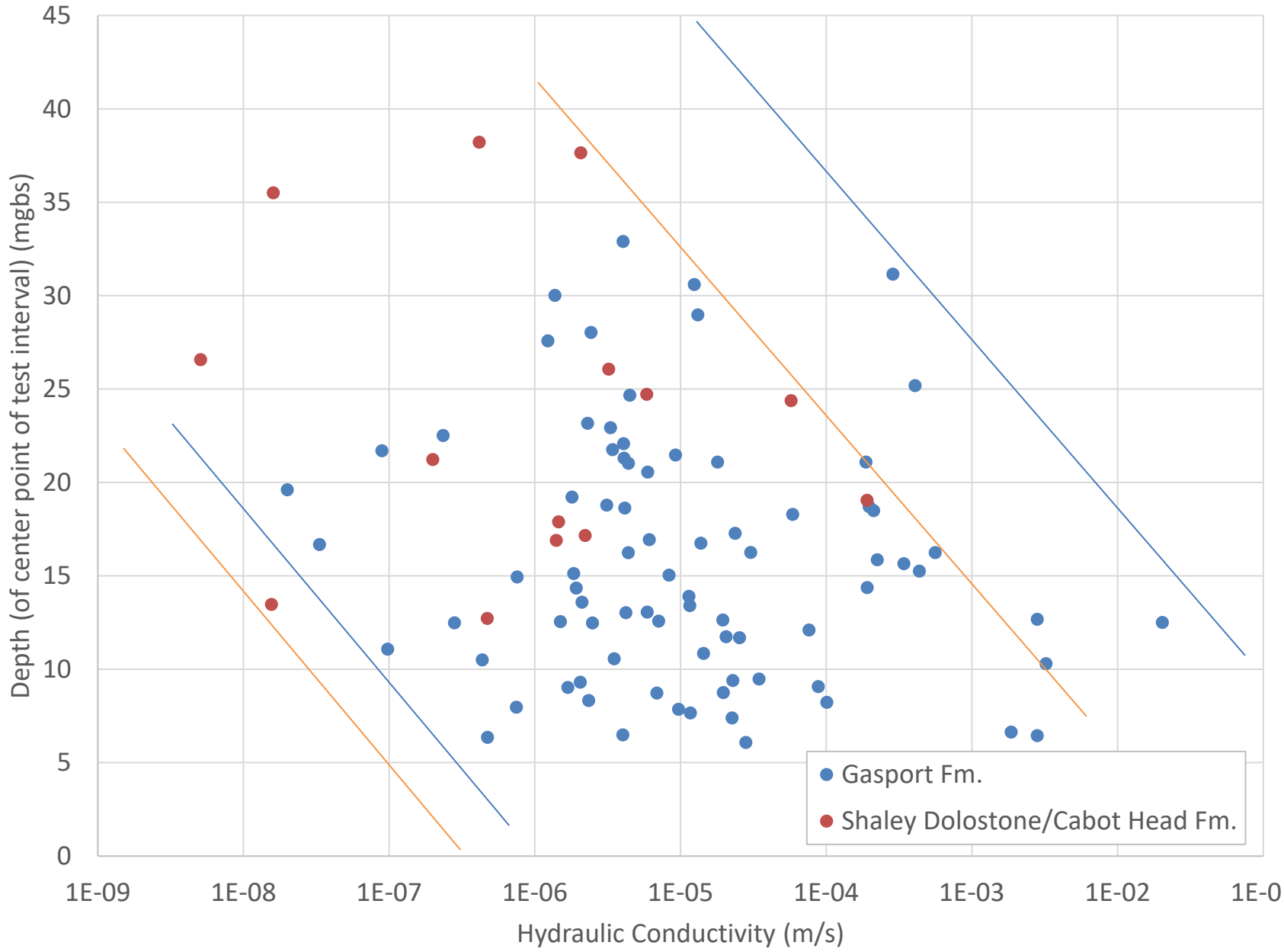

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CONSULTANT: GOLDER MEMBER OF WSP

TITLE: **PACKER TEST HYDRAULIC CONDUCTIVITY VERSUS DEPTH**

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PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-2

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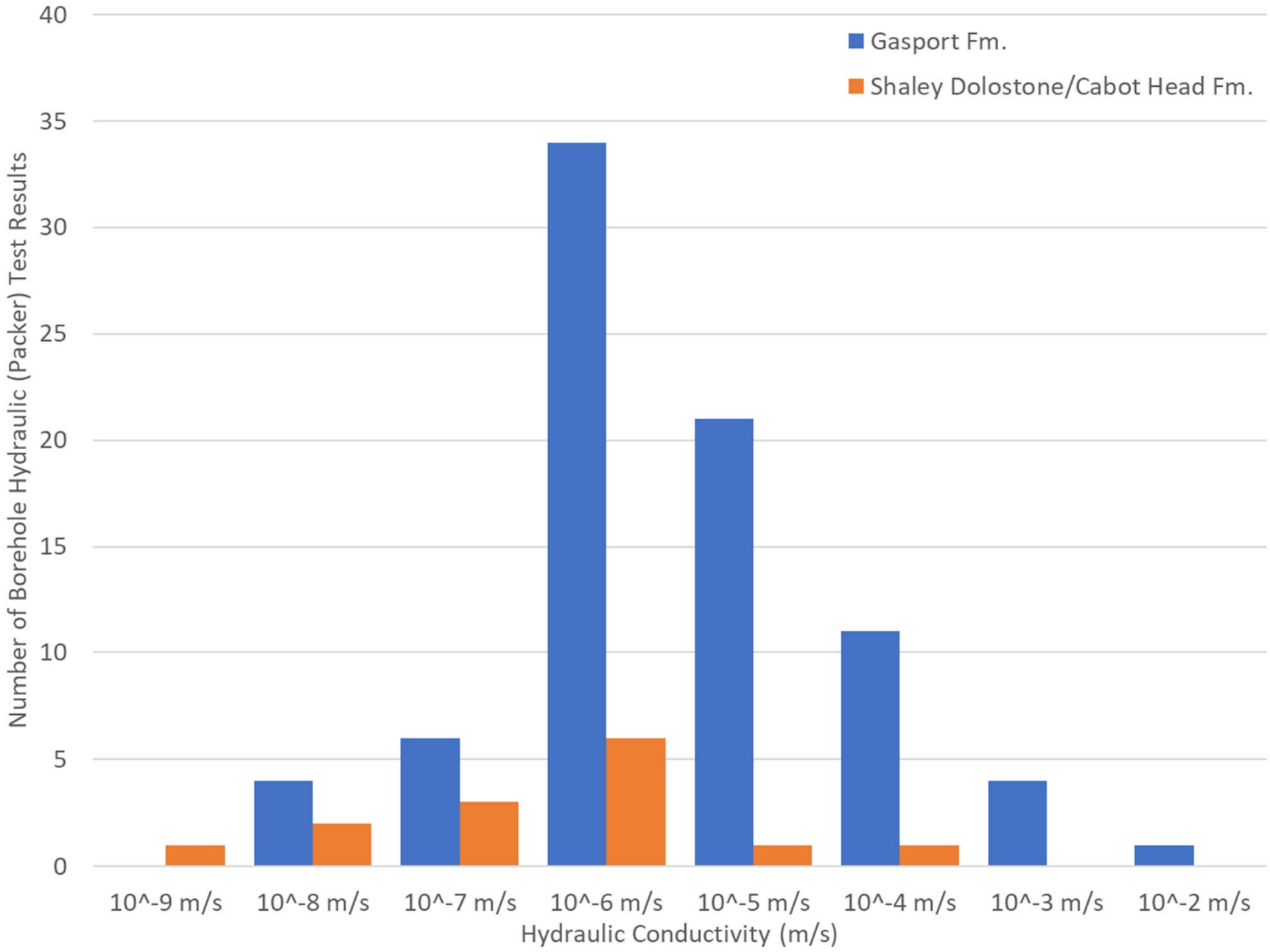

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ST.MARY'S CEMENT INC. (CANADA)

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CALEDON PIT AND QUARRY

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GOLDER
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TITLE
PACKER TEST HYDRAULIC CONDUCTIVITY HISTOGRAM

YYYY-MM-DD	2022-03-14
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PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-3

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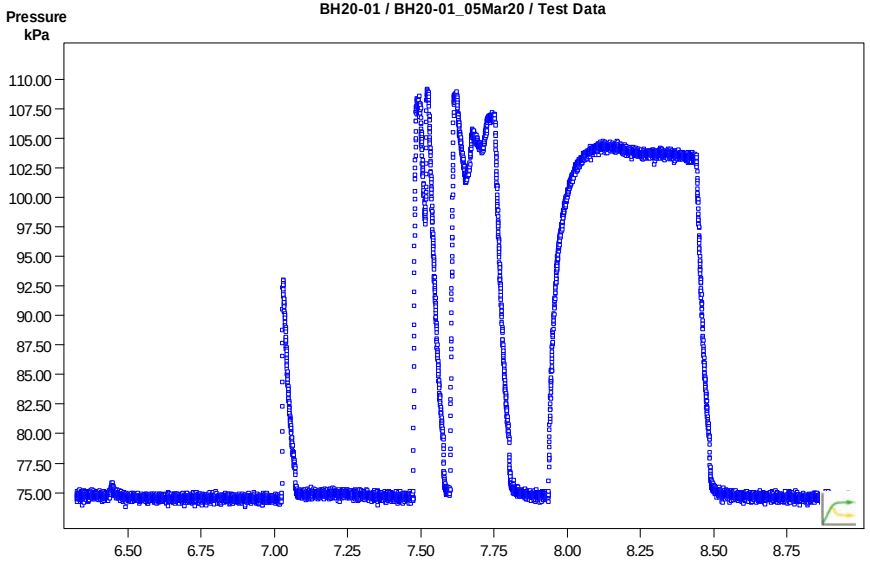

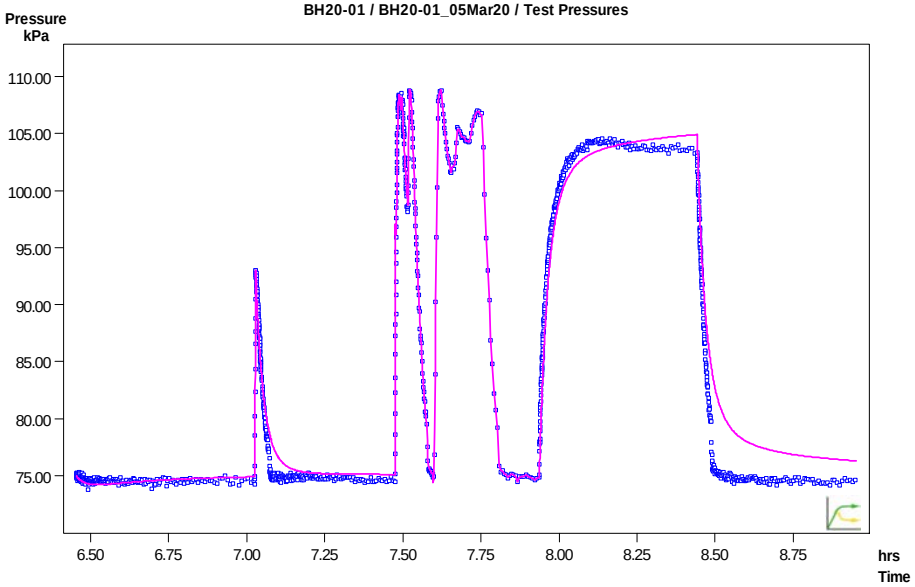

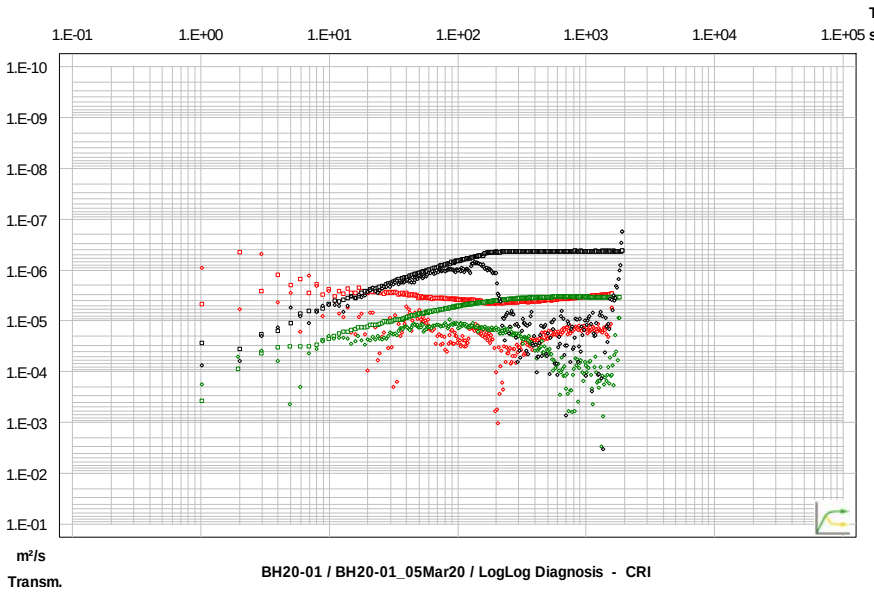

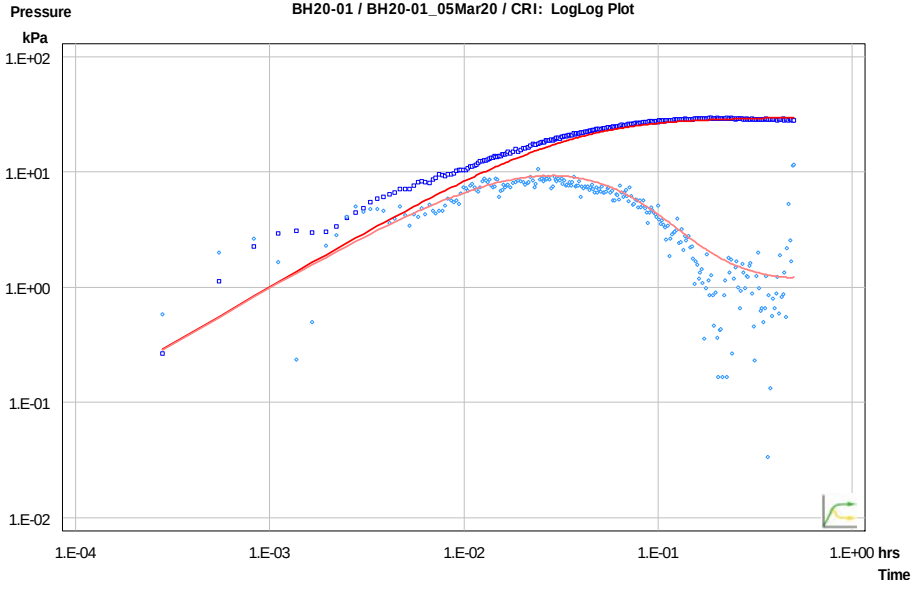

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PROJECT

CALEDON PIT / QUARRY

TITLE

PACKER TEST RESULTS BH20-01 UPPER INTERVAL (4.3 to 11.0 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-004

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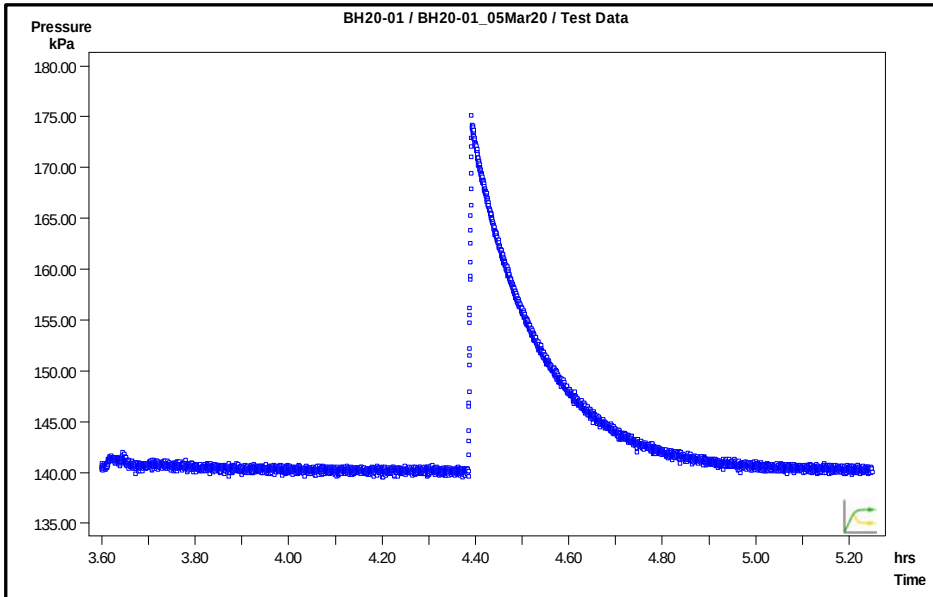

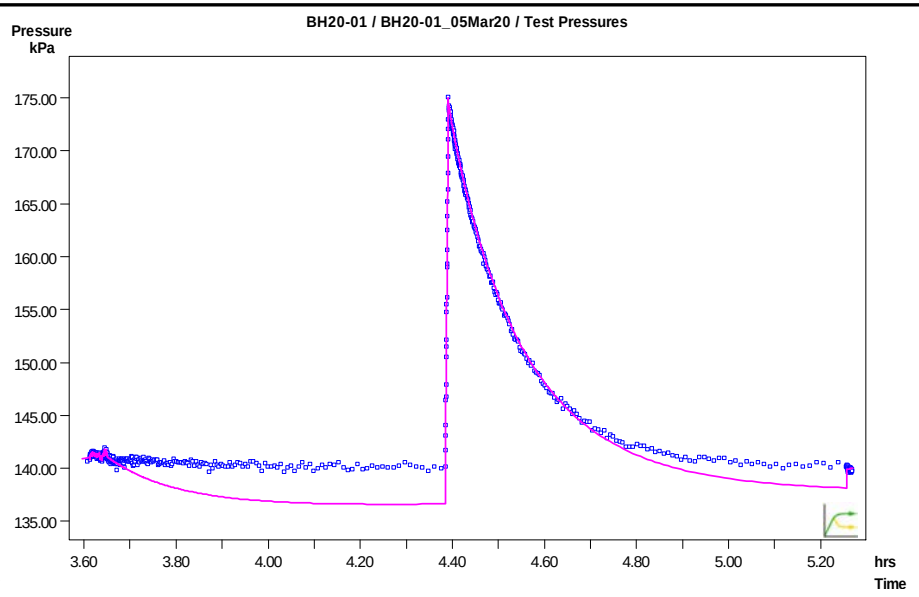

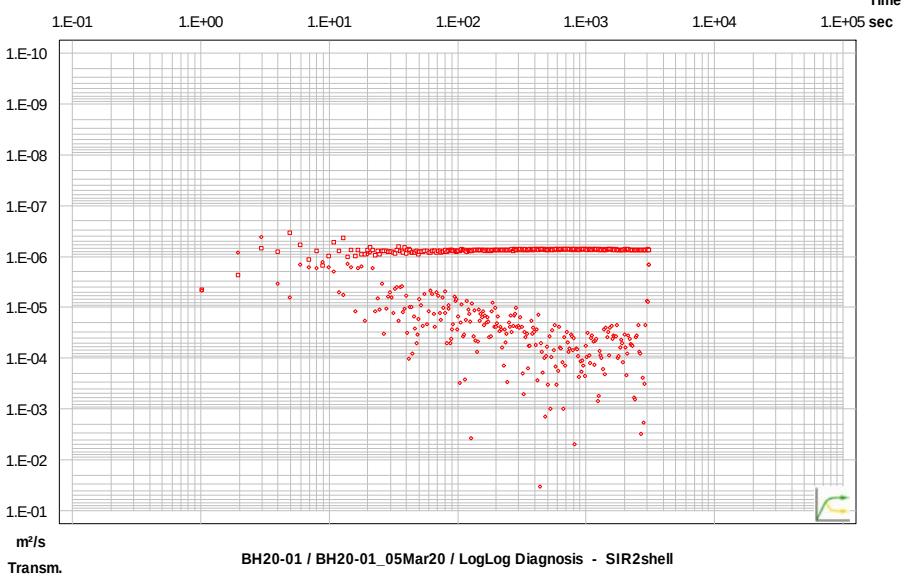

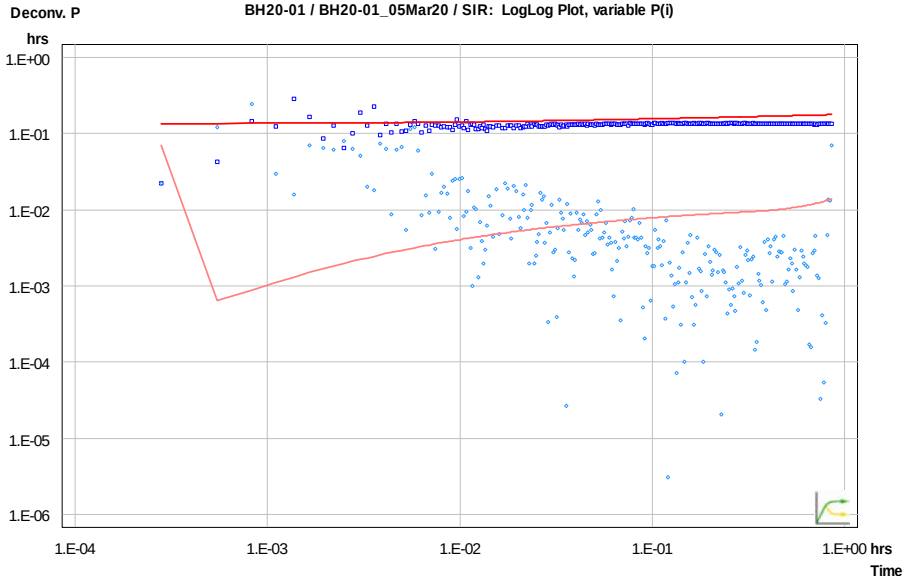

Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

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TITLE
PACKER TEST RESULTS BH20-01 MIDDLE INTERVAL (11.0 to 17.7 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-005

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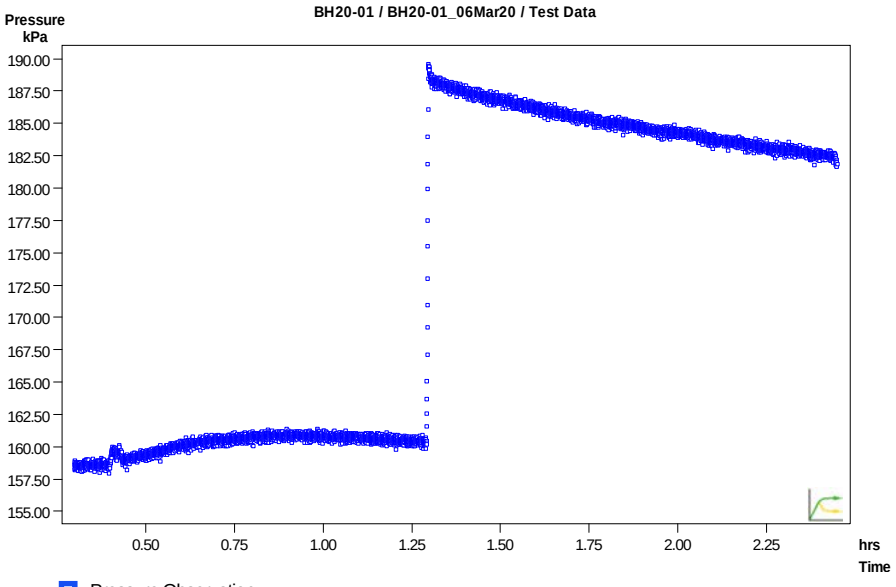

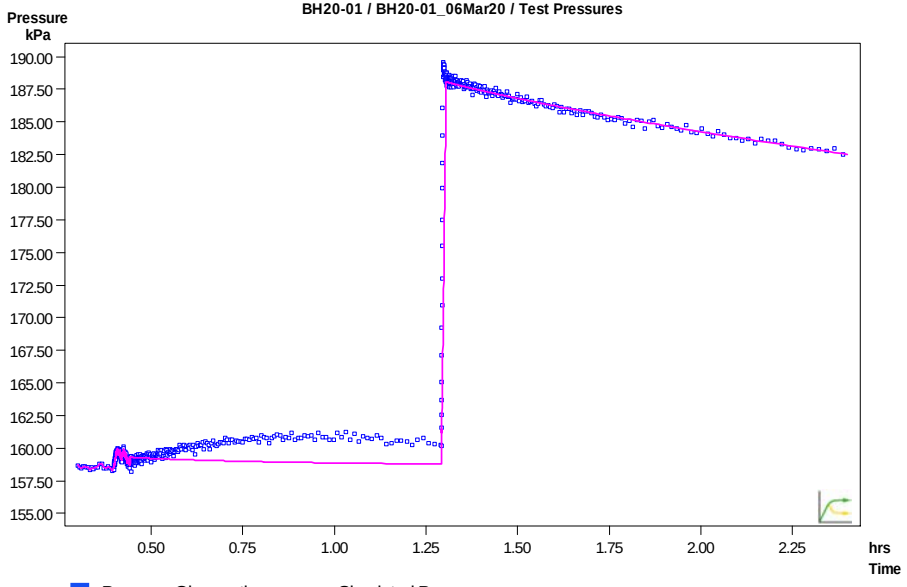

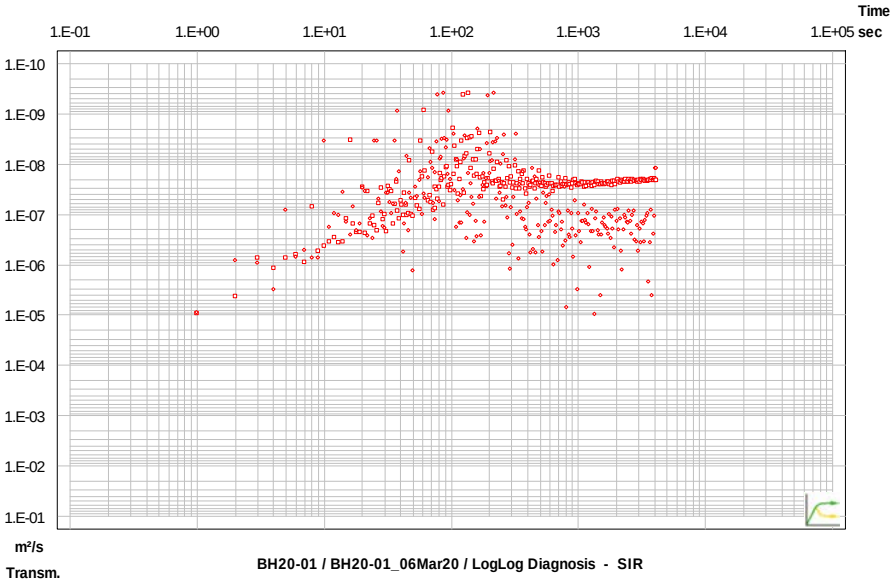

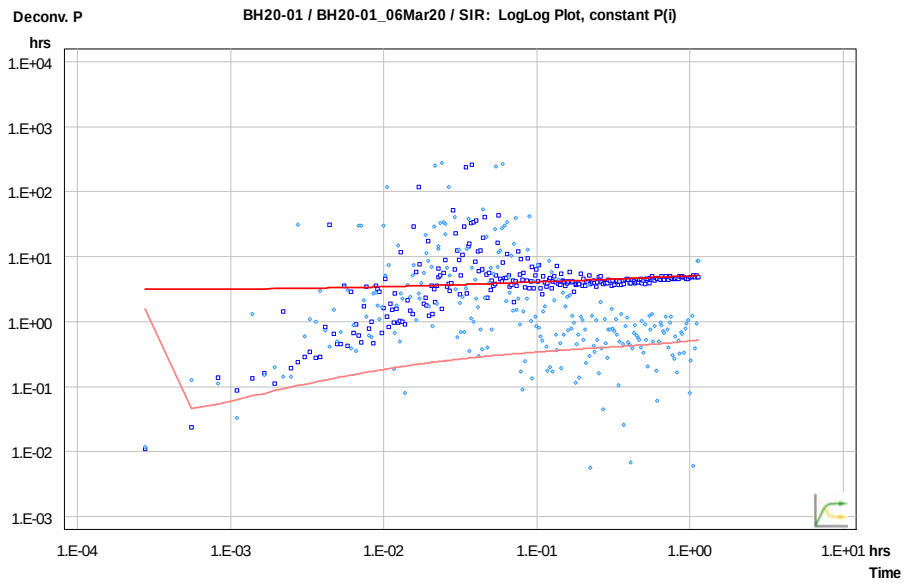

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DESIGN	ML
REVIEW	###
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TITLE

PACKER TEST RESULTS BH20-01 LOWER INTERVAL (19.5 to 22.1 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-006

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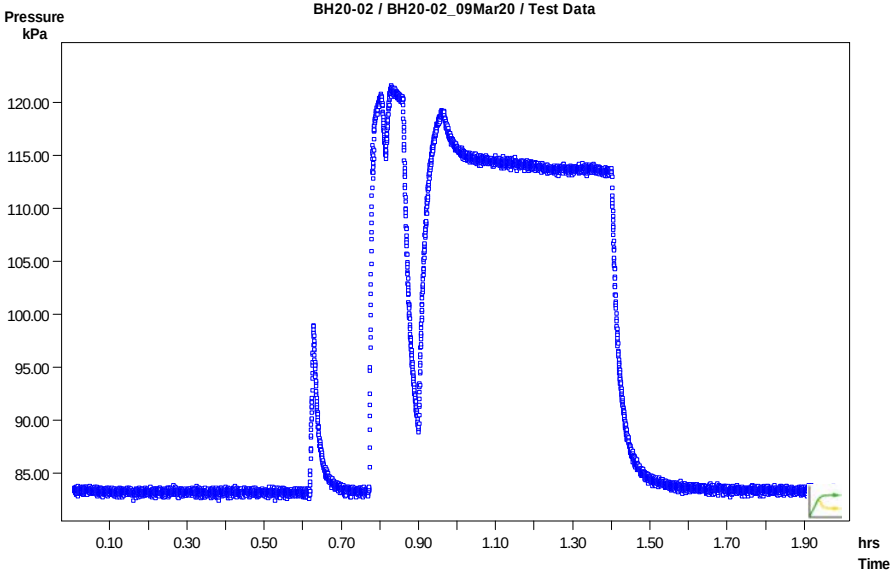

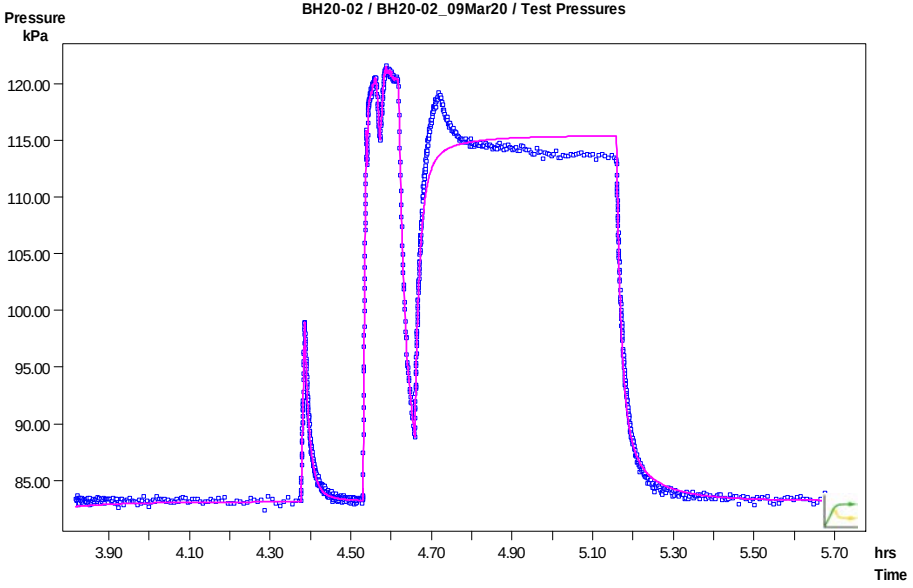

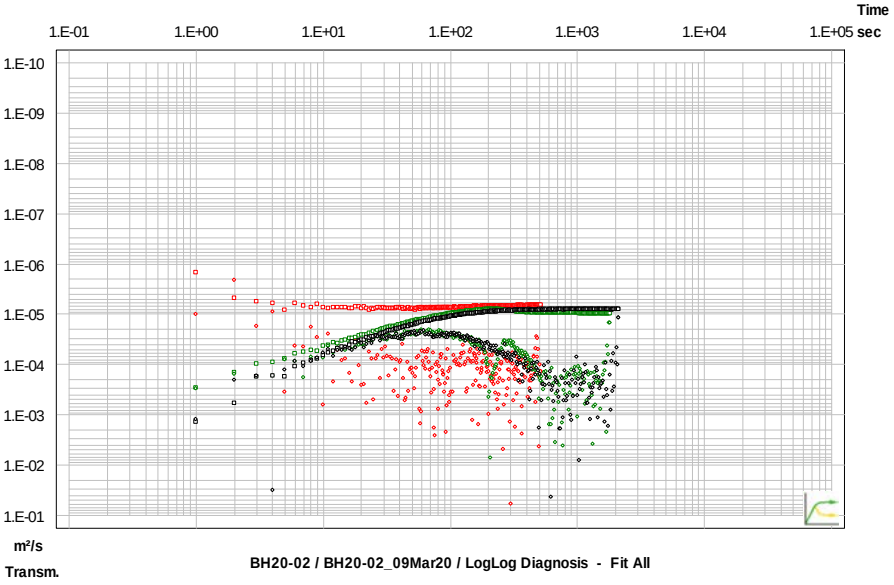

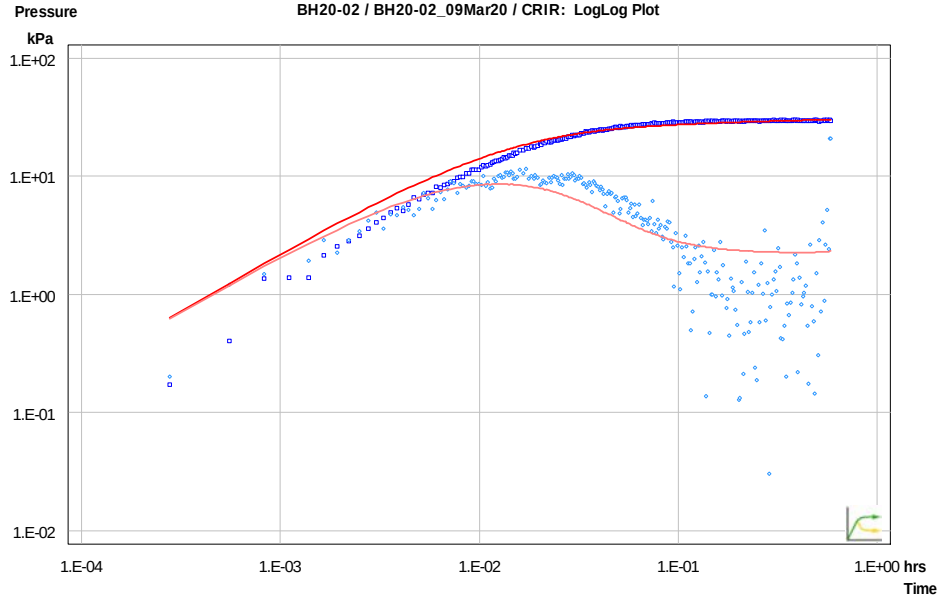

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PROJECT

CALEDON PIT / QUARRY

TITLE

PACKER TEST RESULTS BH20-02 UPPER INTERVAL (6.1 to 12.7 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
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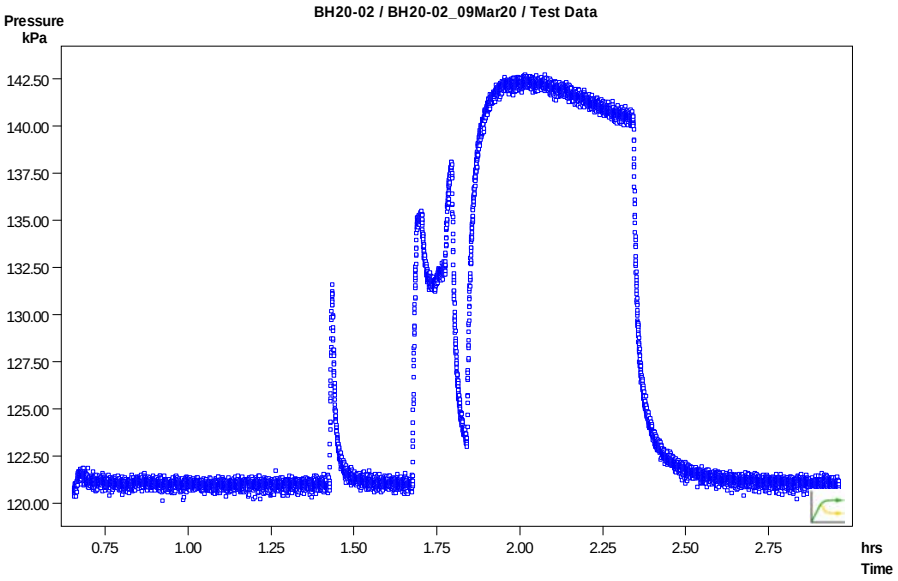
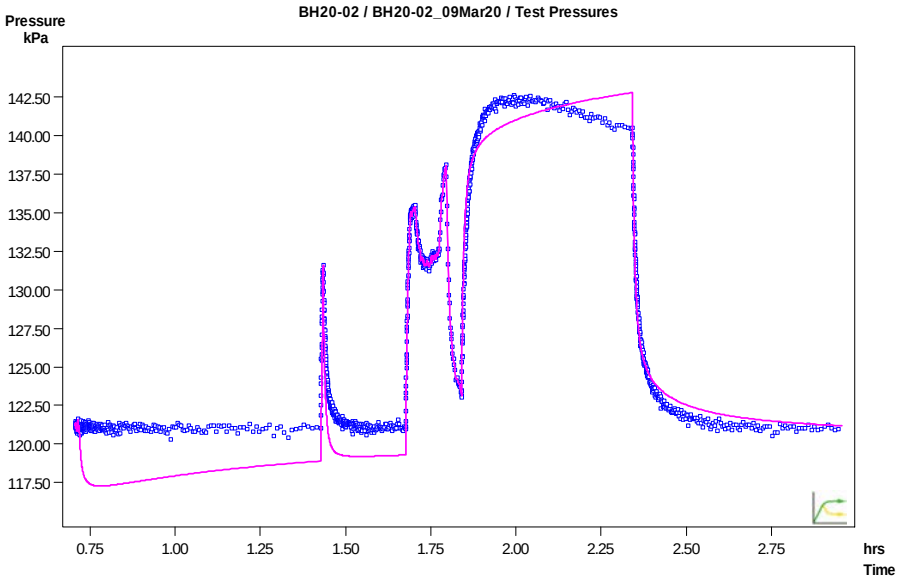
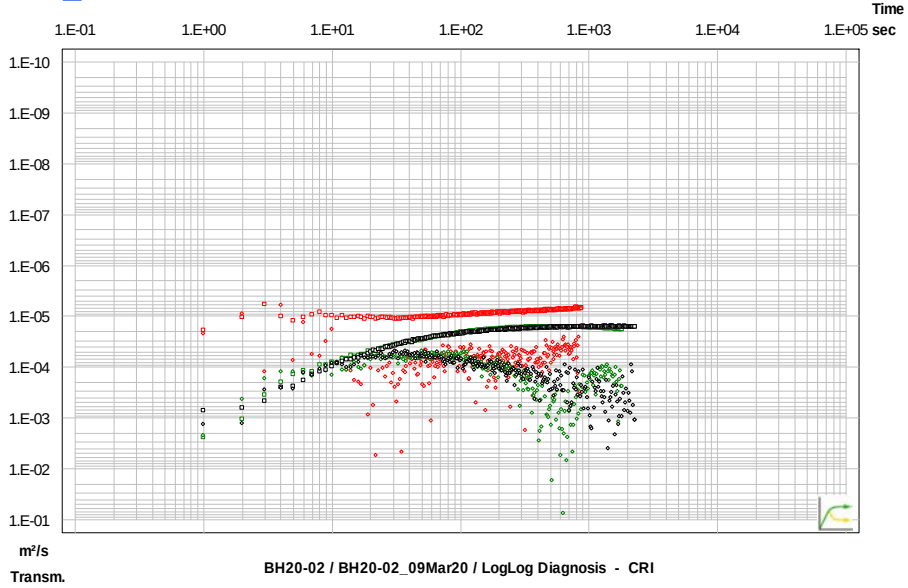
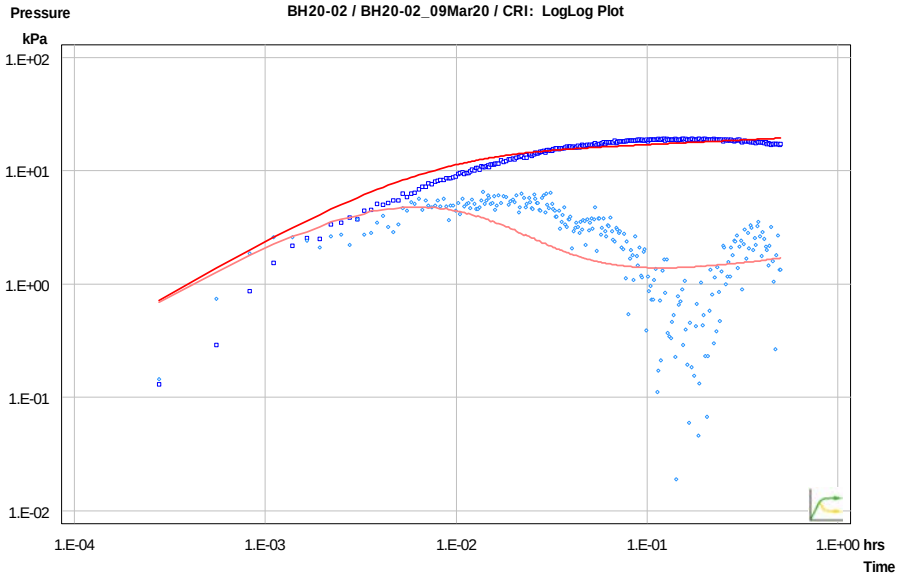








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

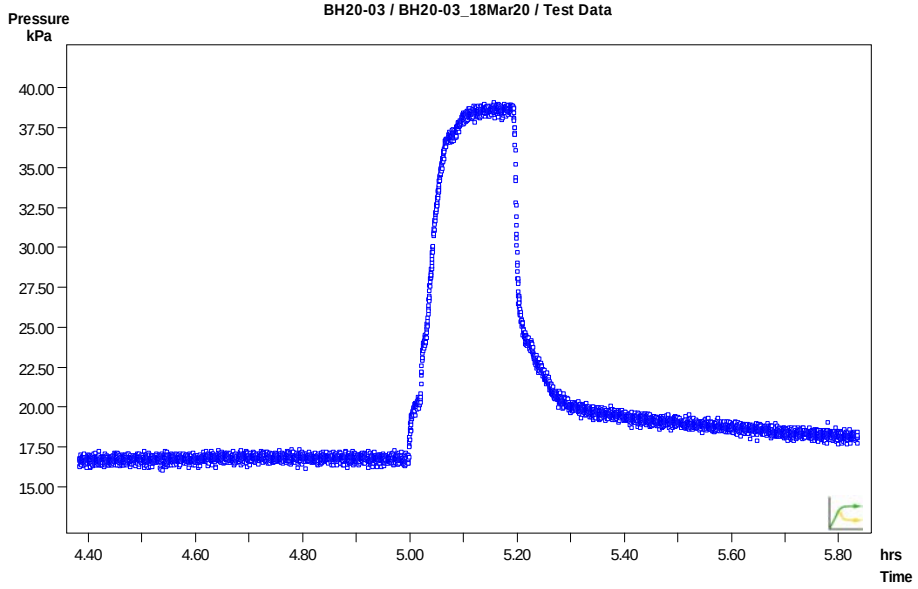
YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

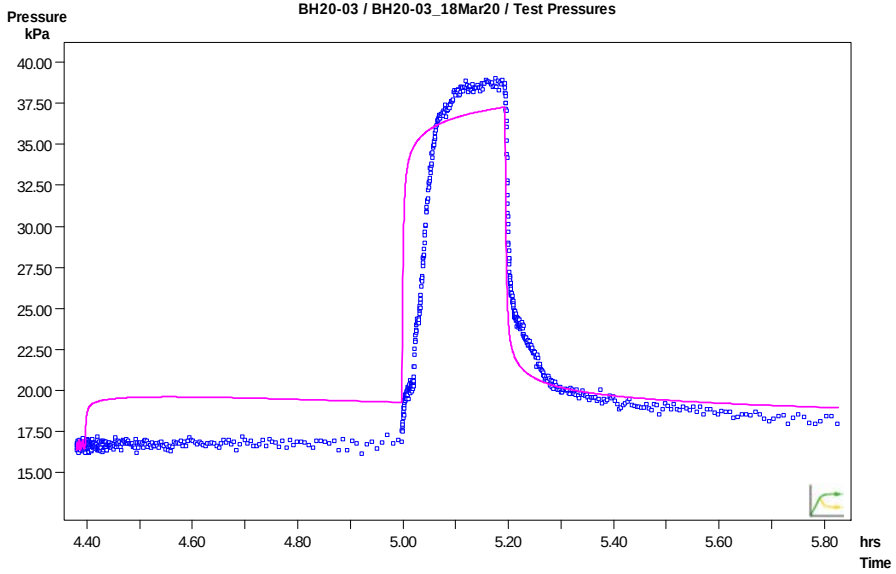
TITLE

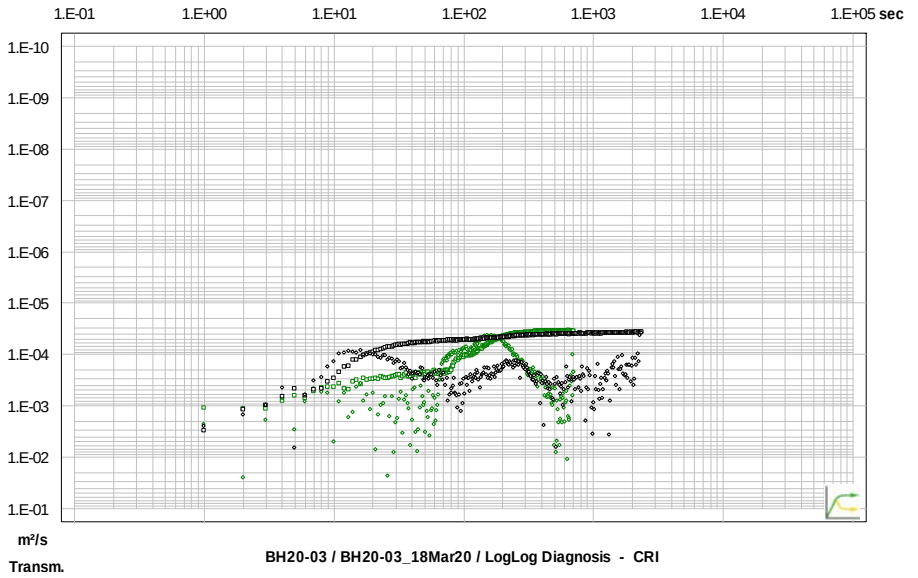
PACKER TEST RESULTS BH20-02 LOWER INTERVAL (12.9 to 19.6 mbgs)

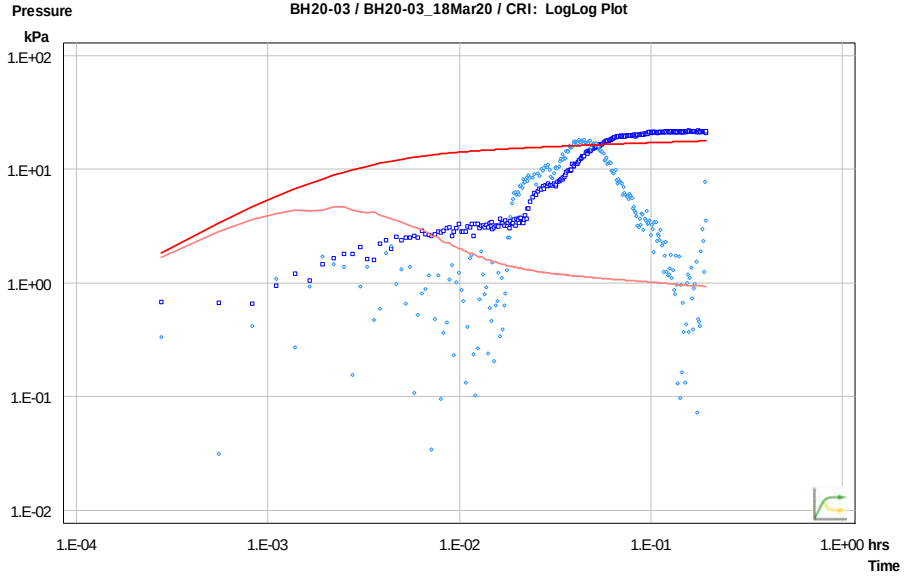
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-008

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

CALEDON PIT / QUARRY

TITLE

PACKER TEST RESULTS BH20-03 UPPER INTERVAL (4.9 to 11.6 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-009

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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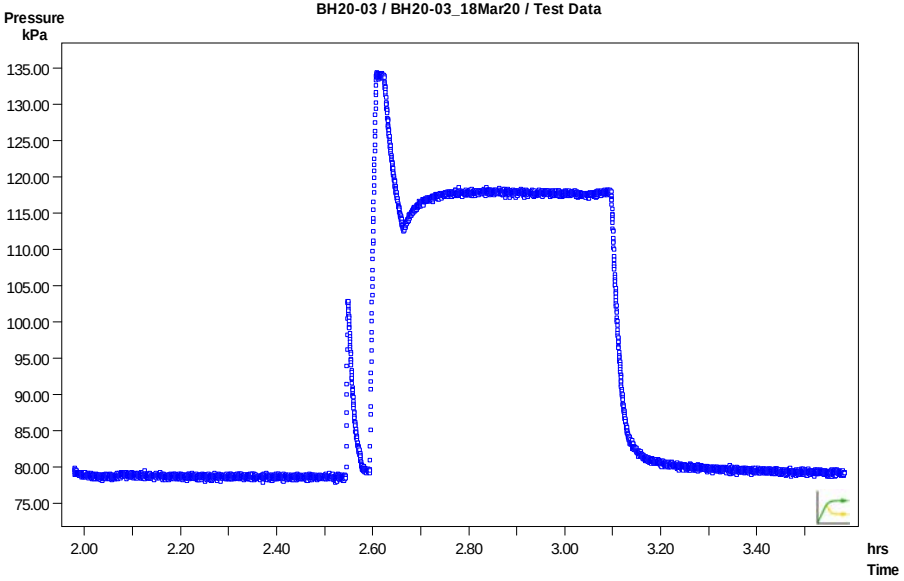

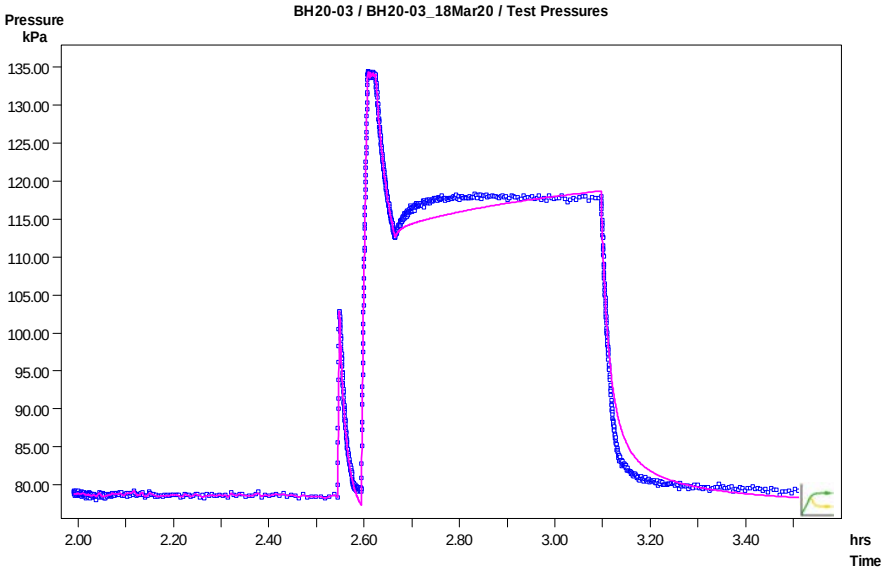

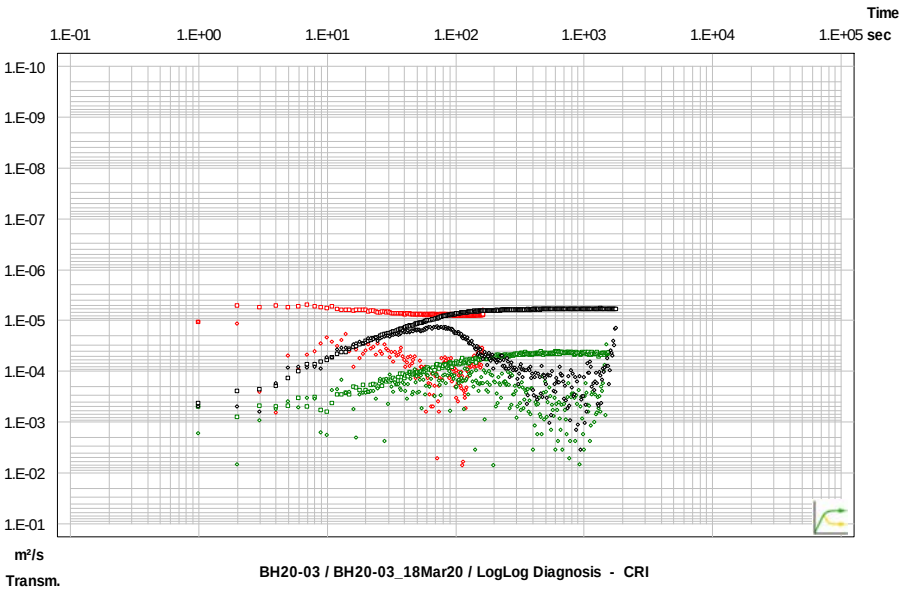

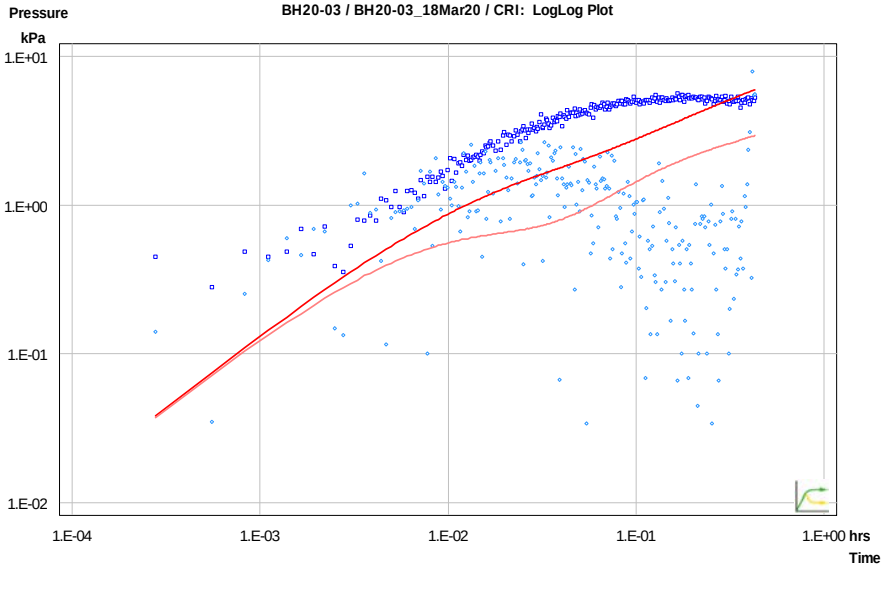

CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-17
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

CALEDON PIT / QUARRY

TITLE

PACKER TEST RESULTS BH20-03 LOWER INTERVAL (10.1 to 16.8 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-010

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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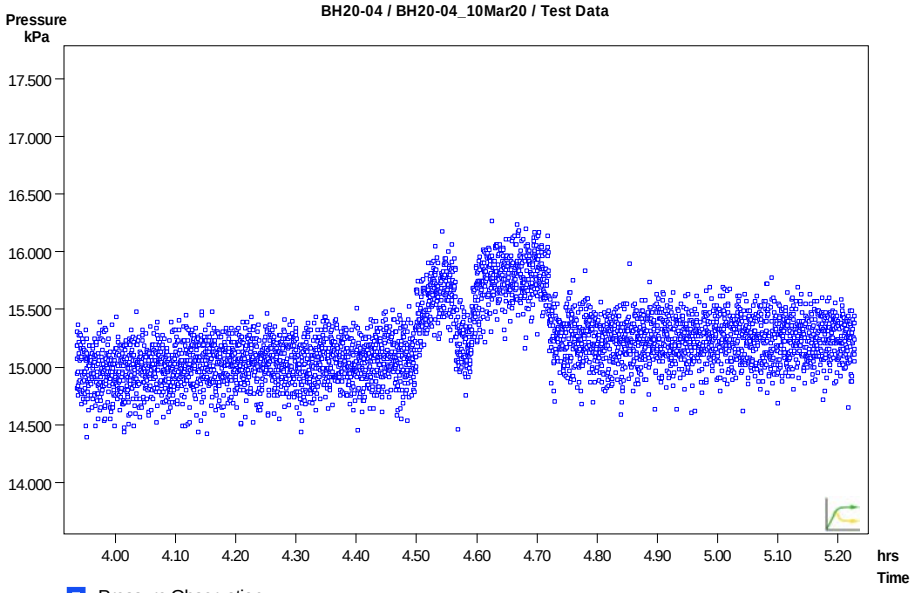

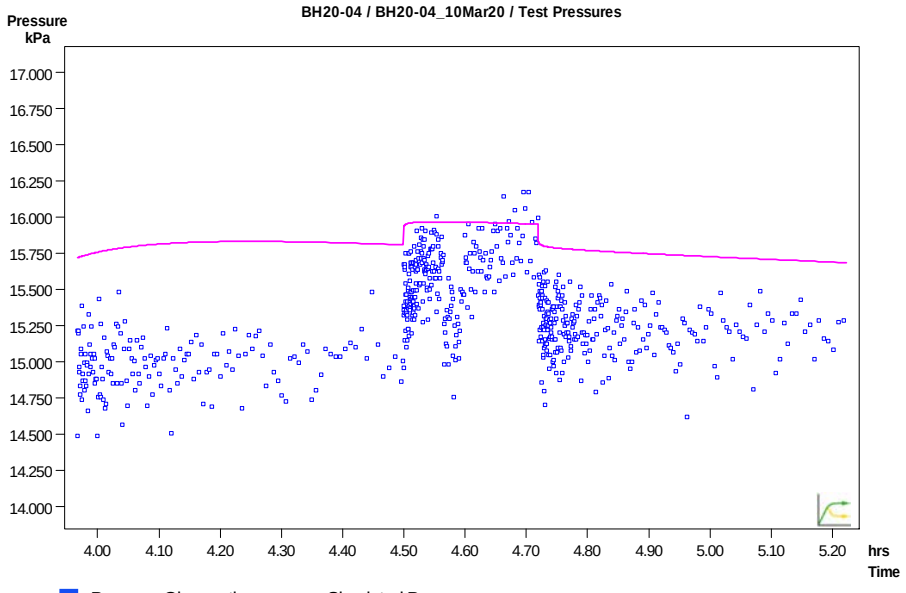

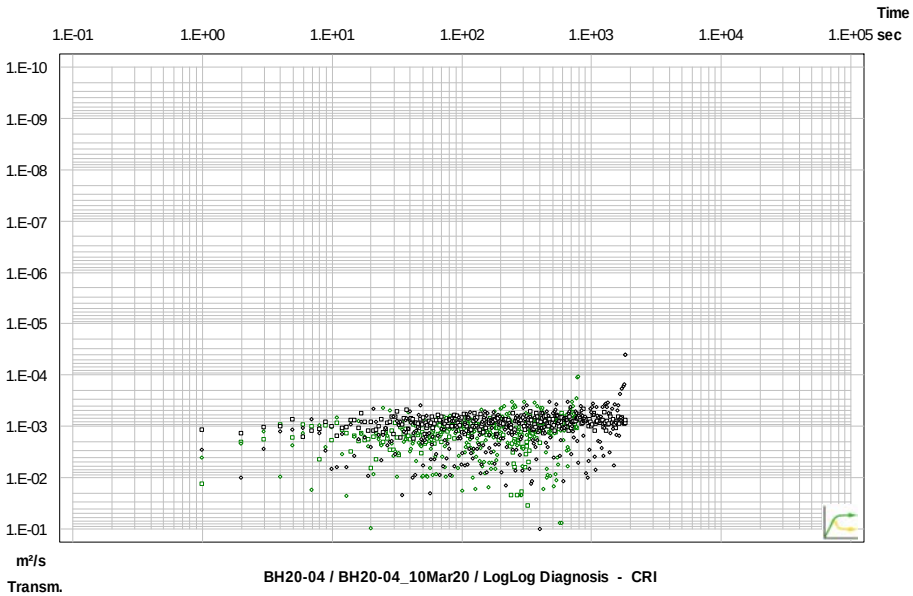

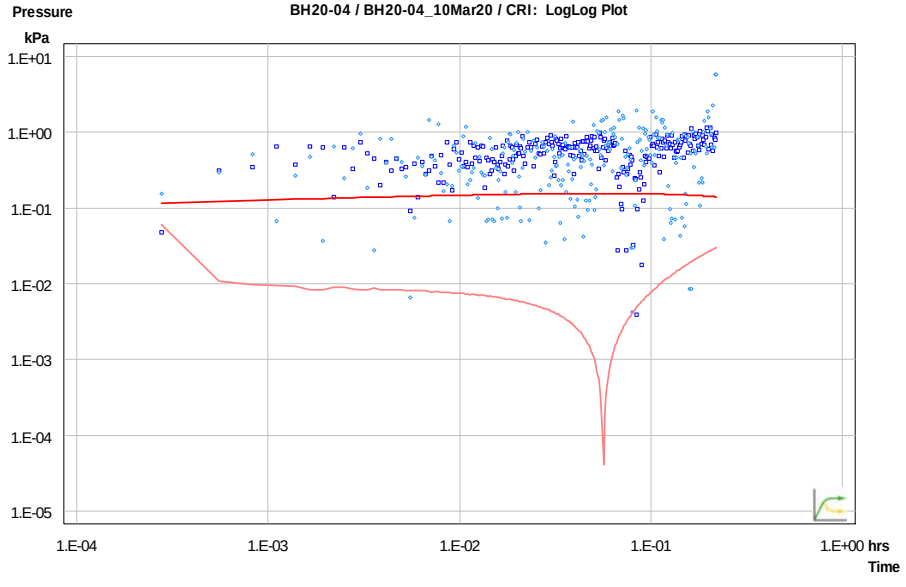

CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

CALEDON PIT / QUARRY

TITLE

PACKER TEST RESULTS BH20-04 UPPER INTERVAL (10.7 to 14.3 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-011

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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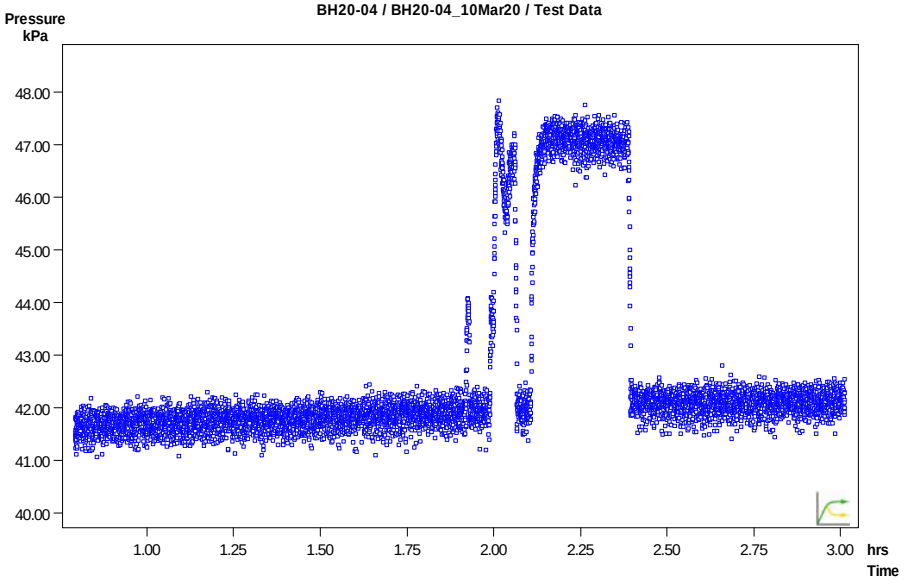
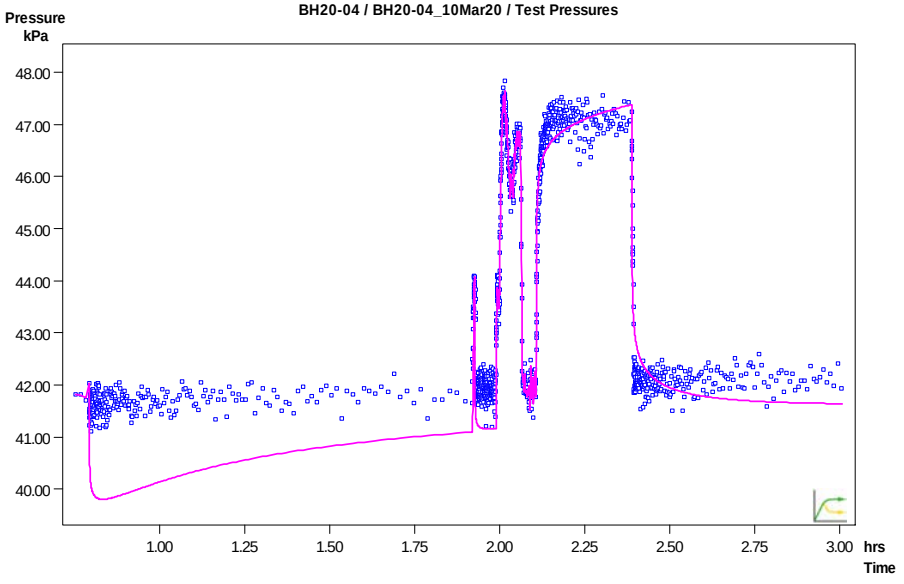
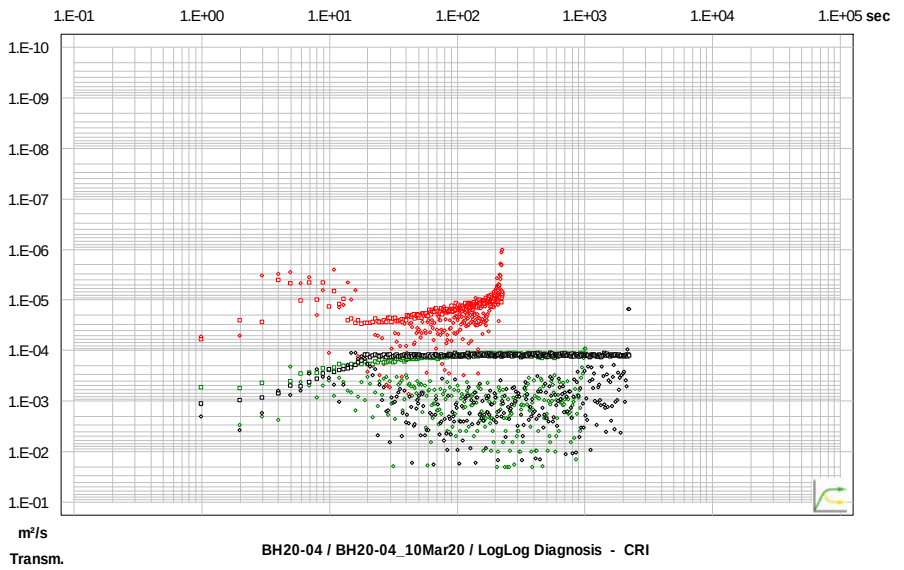
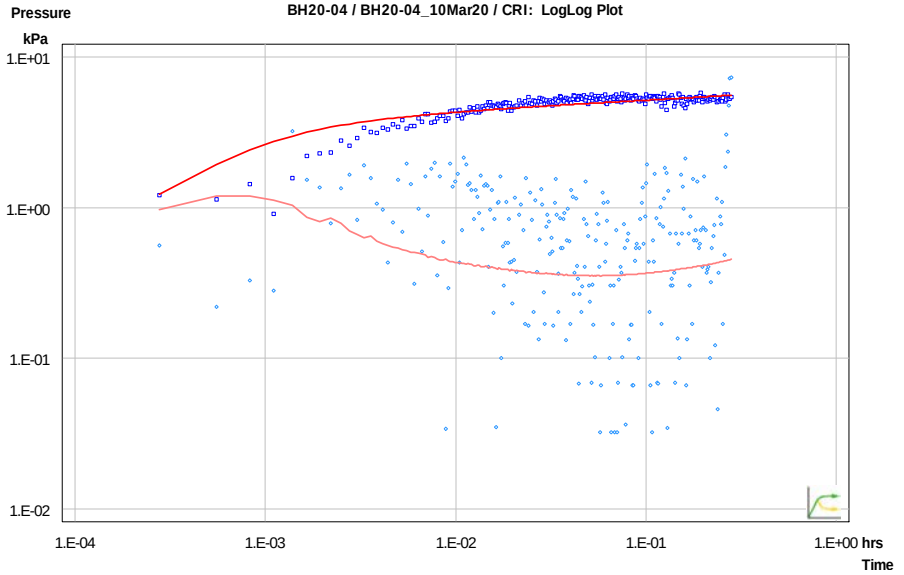








Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

CLIENT
CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT
CALEDON PIT / QUARRY

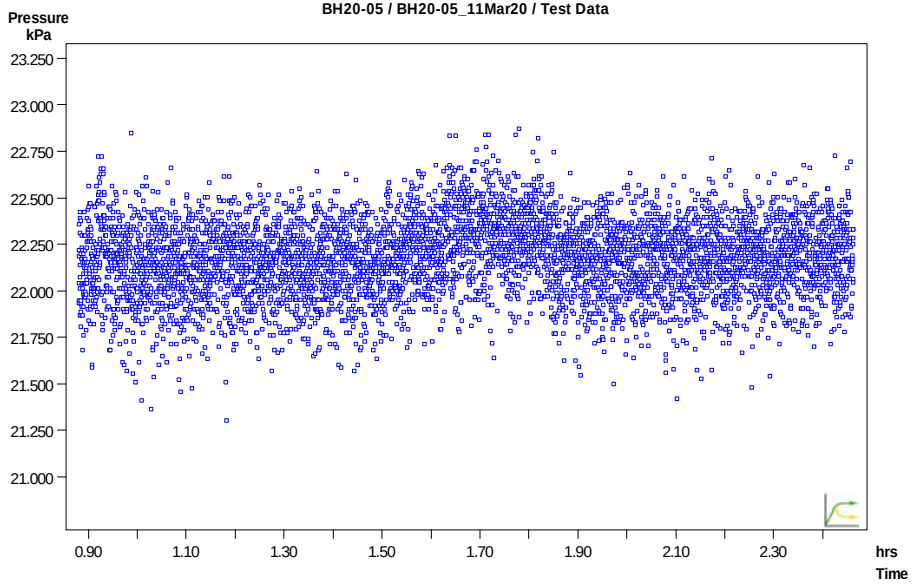
CONSULTANT
GOLDER
MEMBER OF WSP

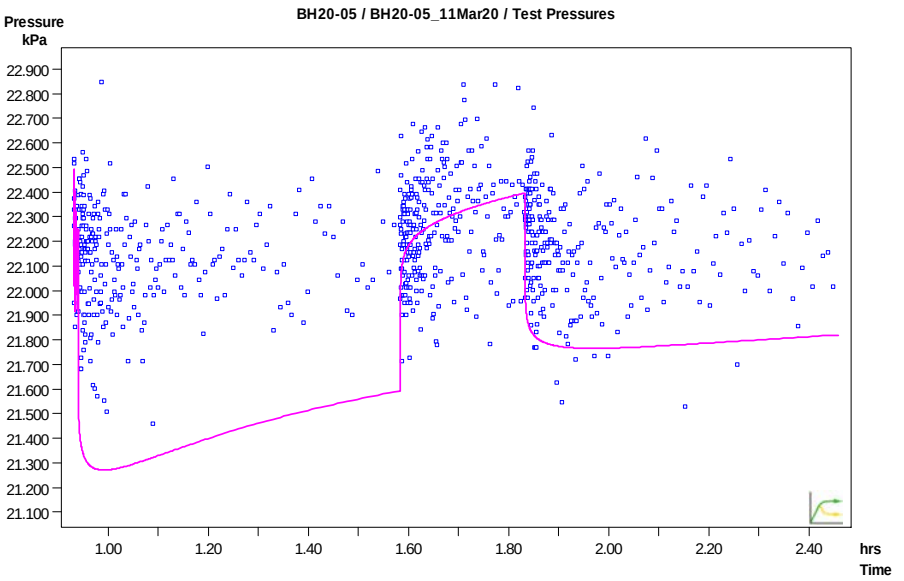
YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

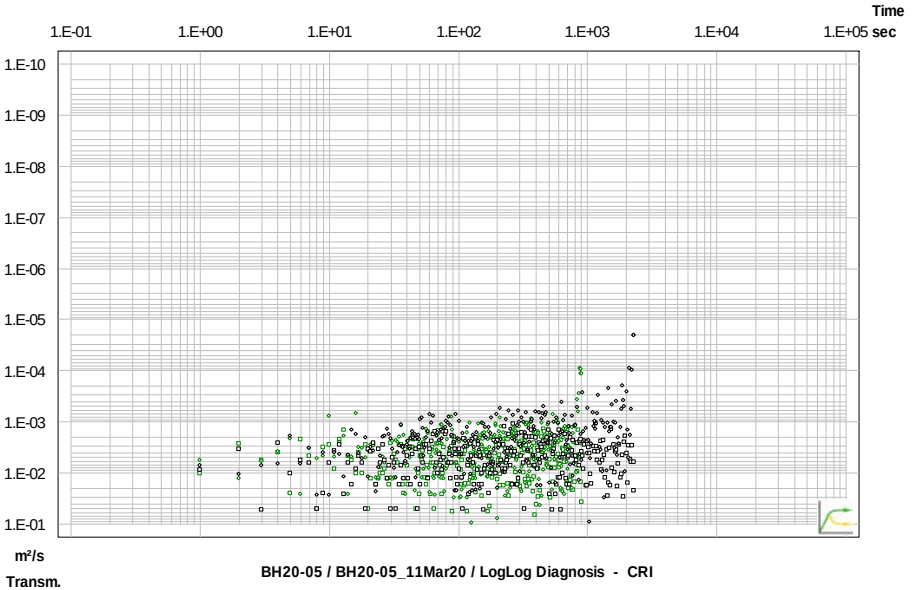
TITLE
PACKER TEST RESULTS BH20-04 LOWER INTERVAL (13.5 to 17.0 mbgs)

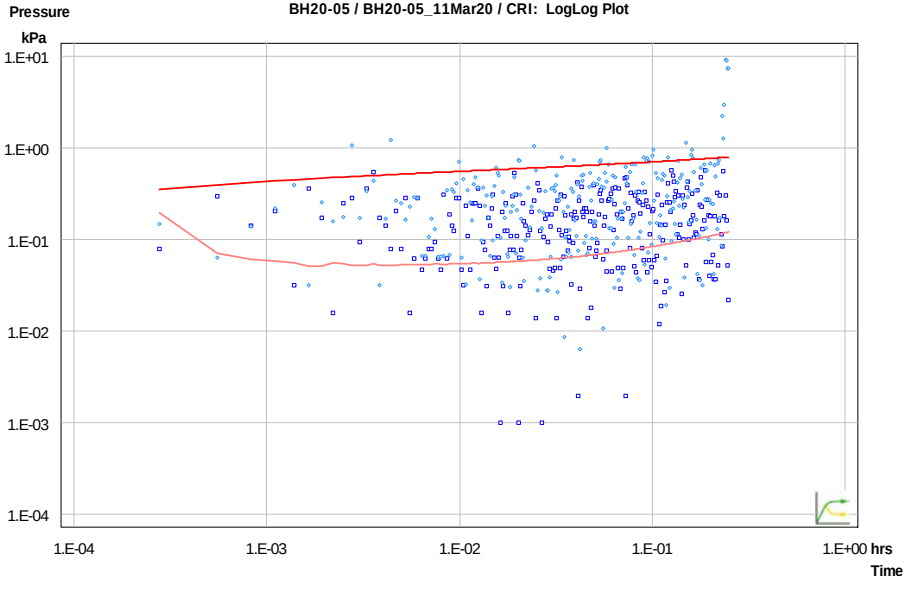
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-012

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

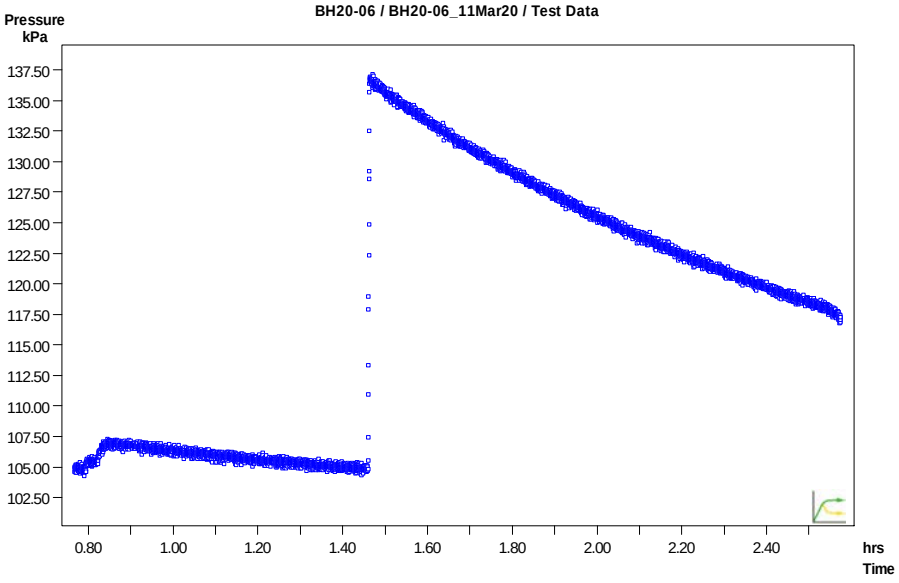
CALEDON PIT / QUARRY

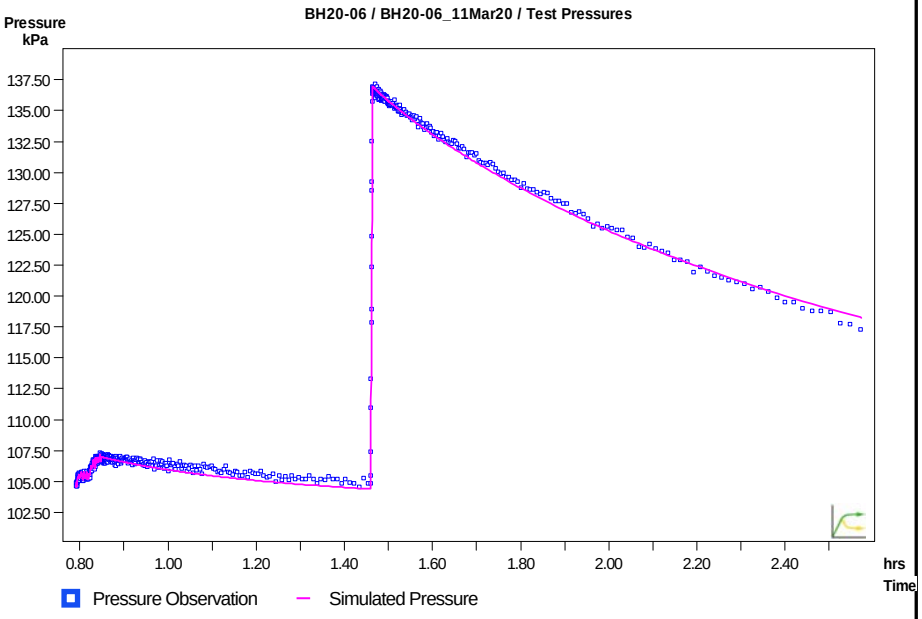
TITLE

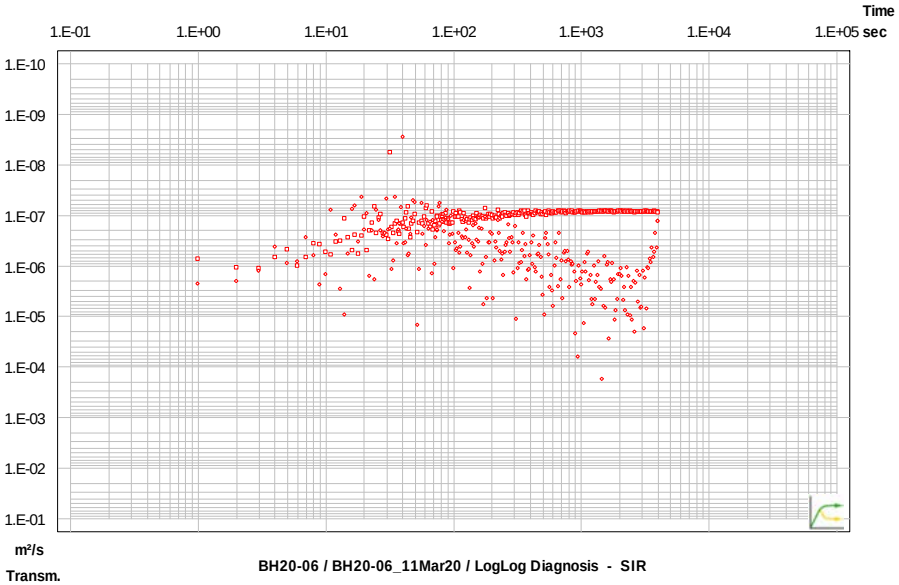
PACKER TEST RESULTS BH20-05 SINGLE INTERVAL (7.8 to 12.8 mbgs)

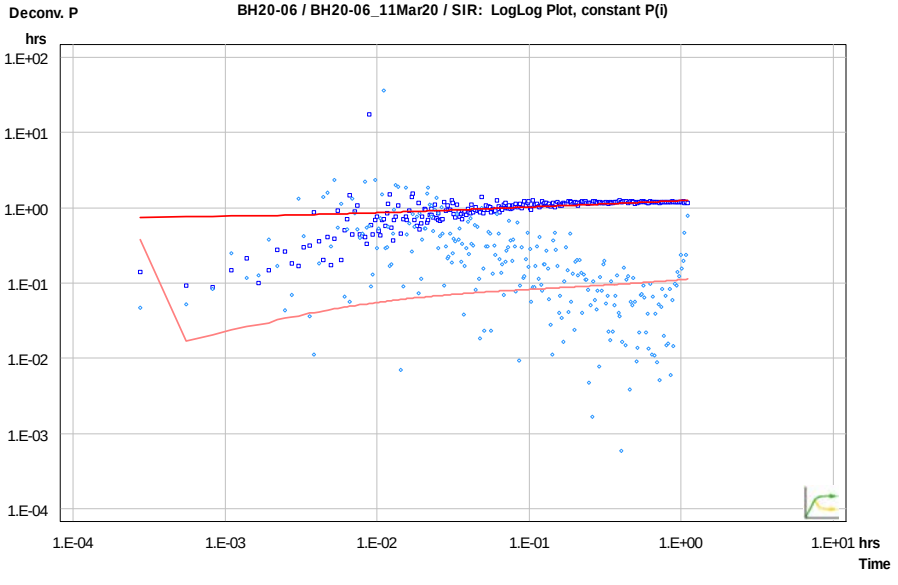
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-013

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

CALEDON PIT / QUARRY

TITLE

PACKER TEST RESULTS BH20-06 SINGLE INTERVAL (10.7 to 14.3 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-014

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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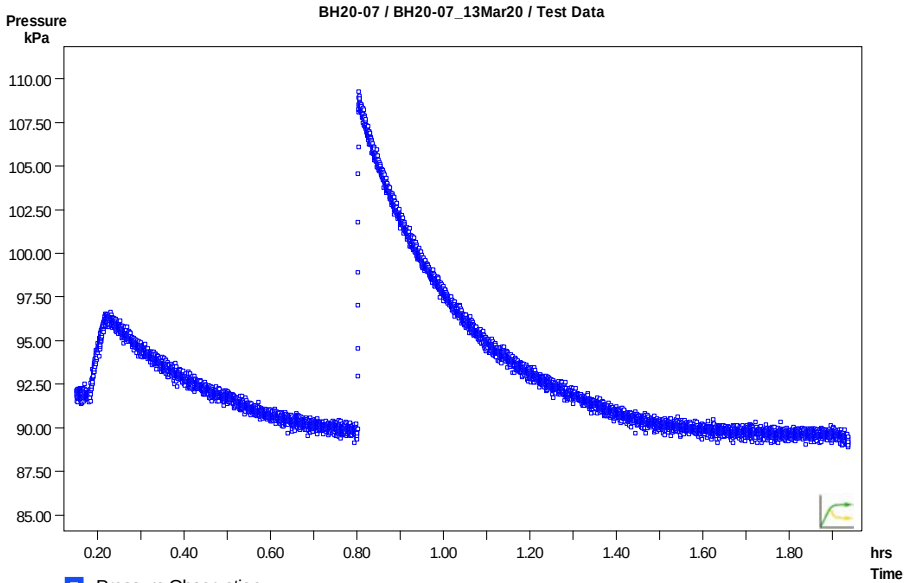
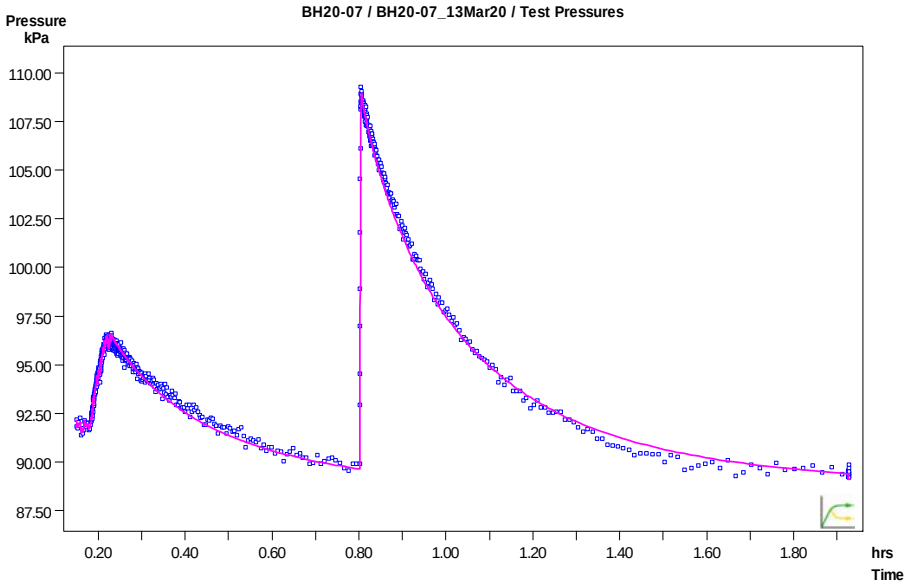
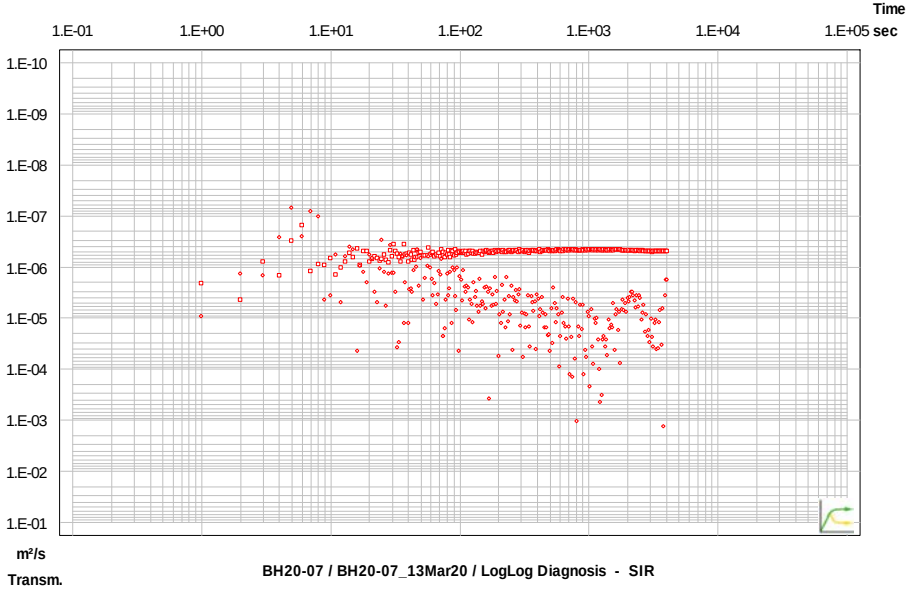
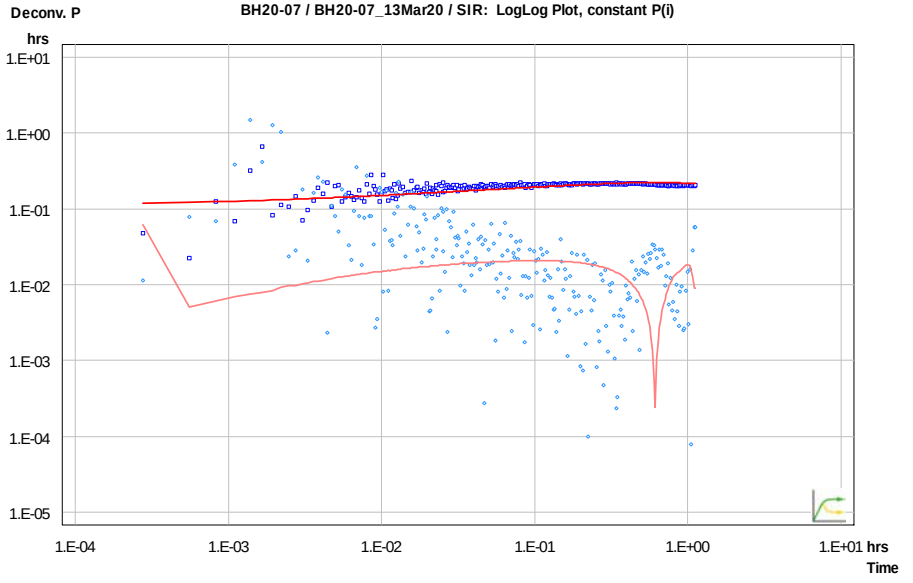








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

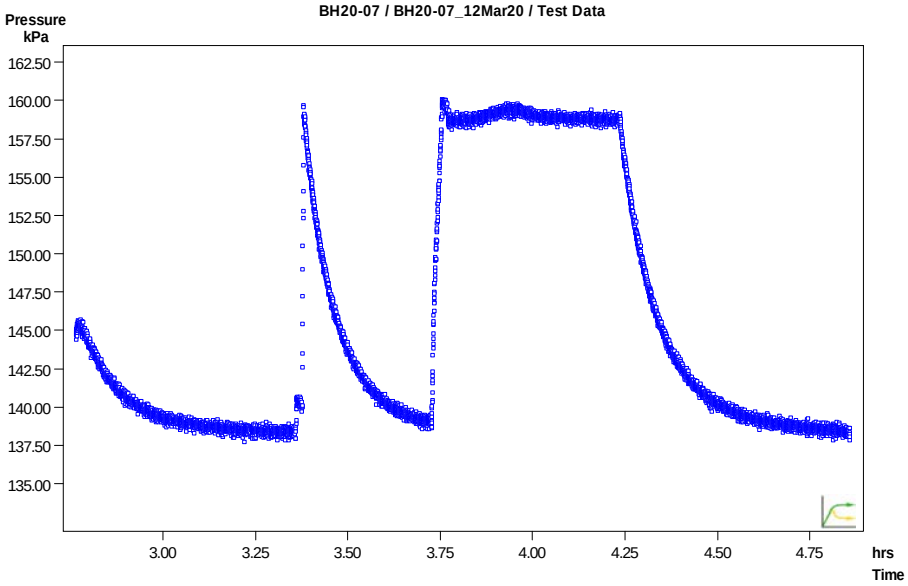
CALEDON PIT / QUARRY

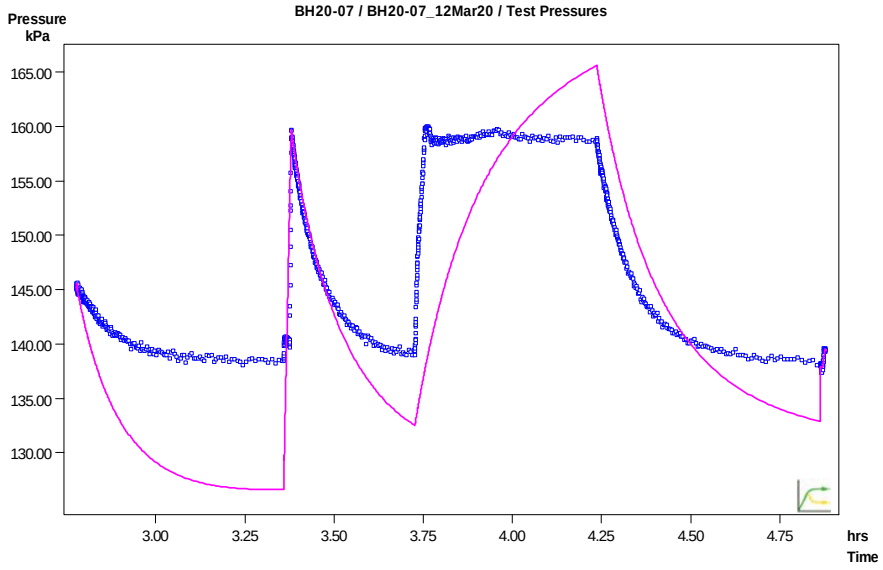
TITLE

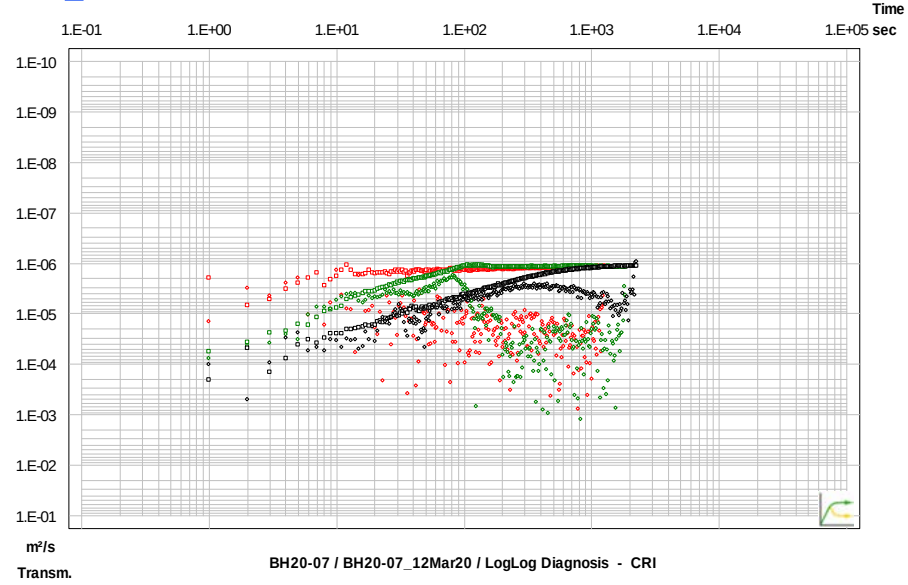
PACKER TEST RESULTS BH20-07 UPPER INTERVAL (4.6 to 11.3 mbgs)

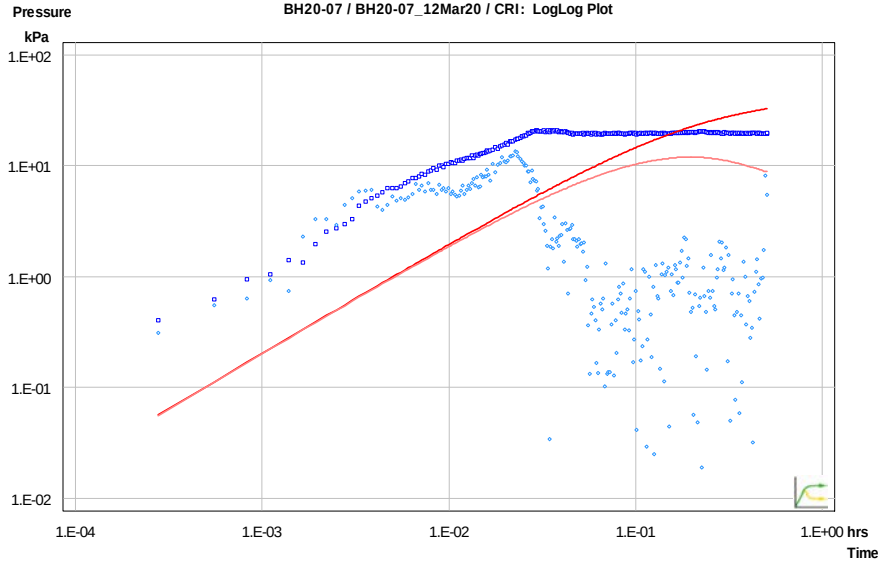
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-015

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

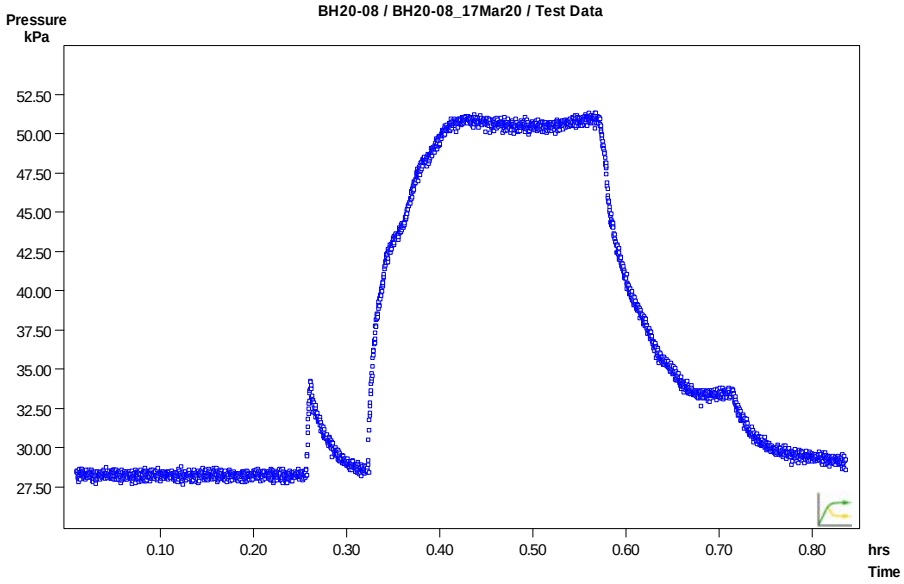
CALEDON PIT / QUARRY

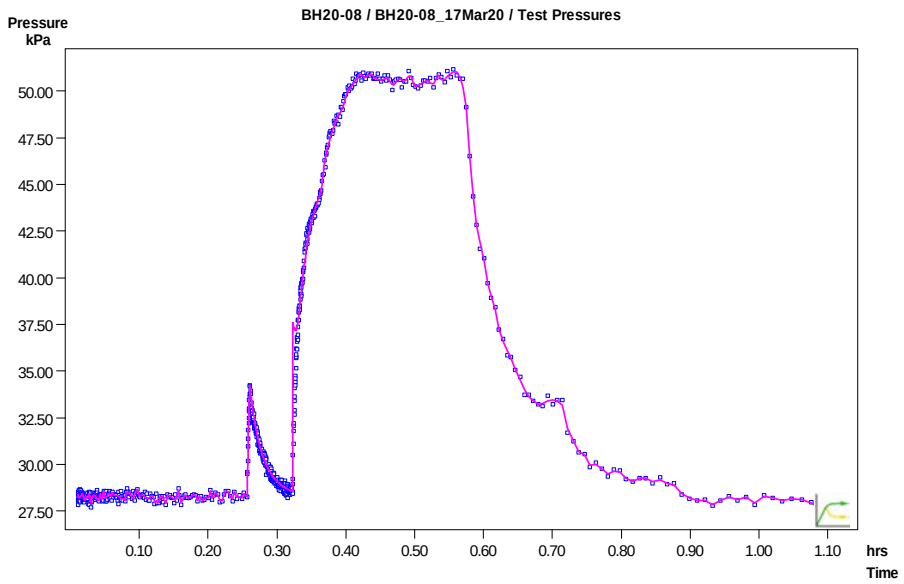
TITLE

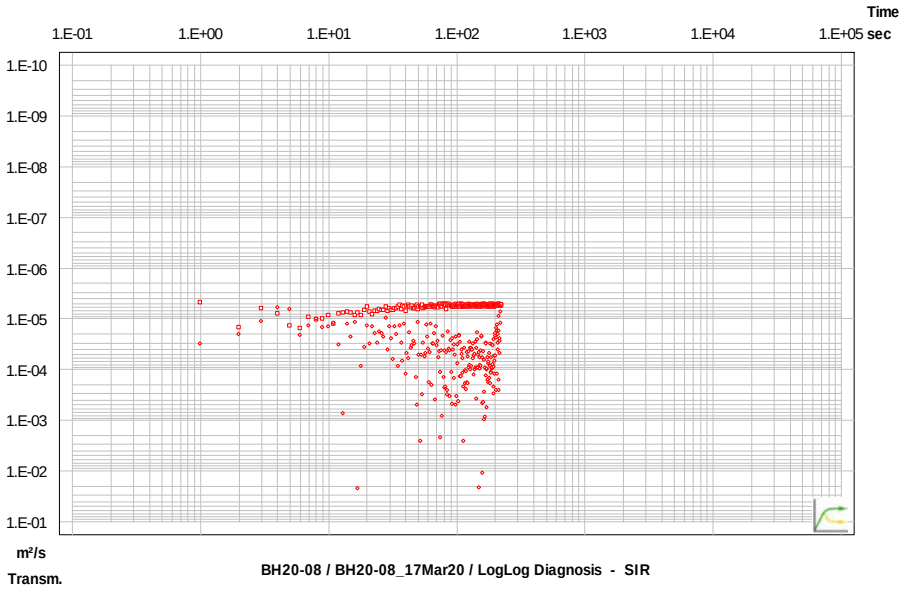
PACKER TEST RESULTS BH20-07 LOWER INTERVAL (11.1 to 16.1 mbgs)

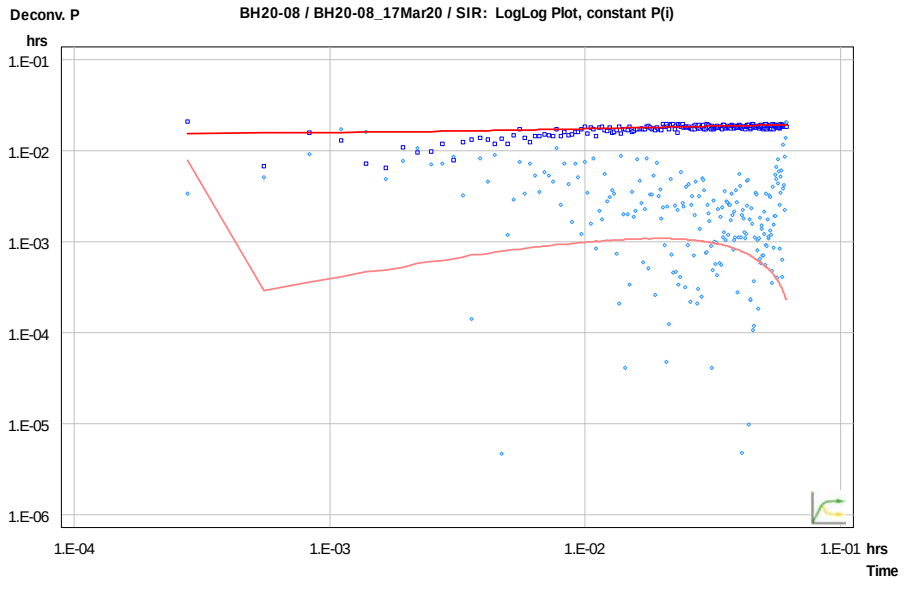
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-016

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

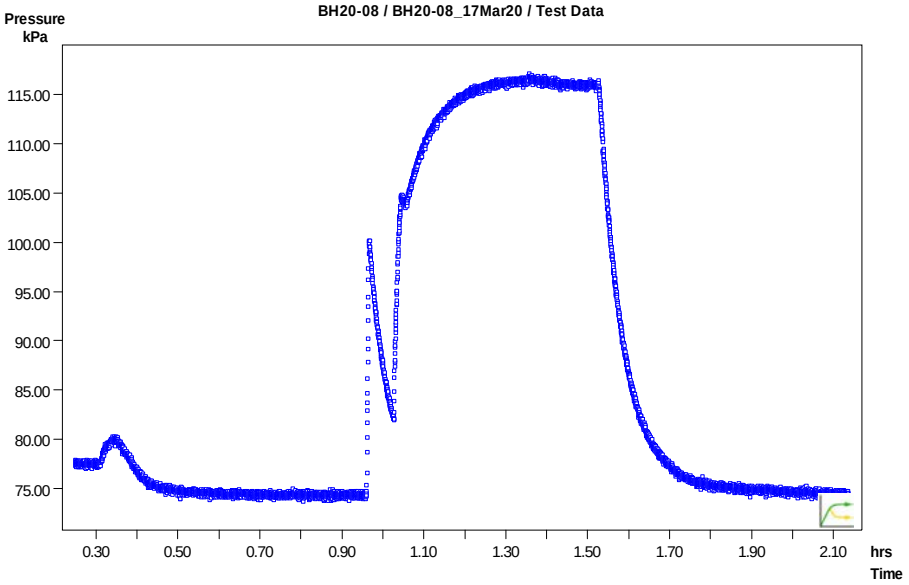
YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

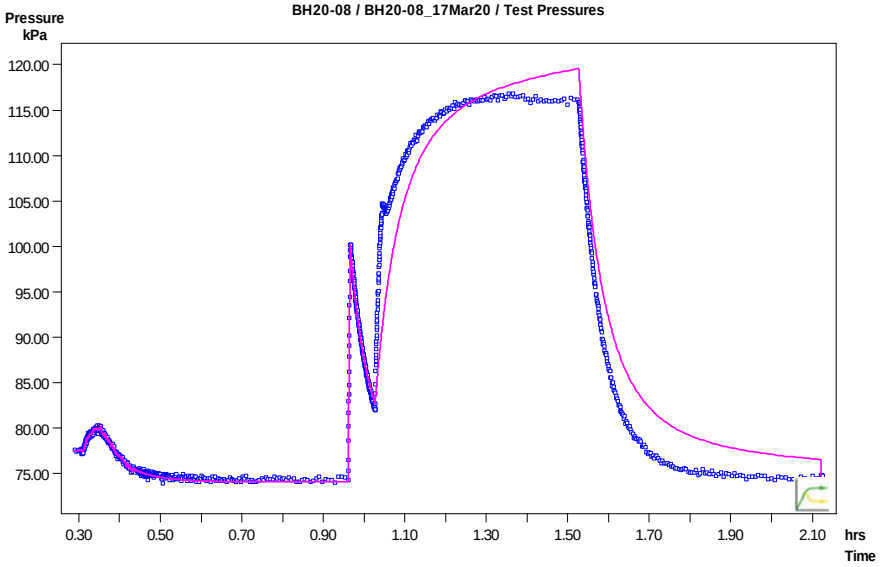
TITLE

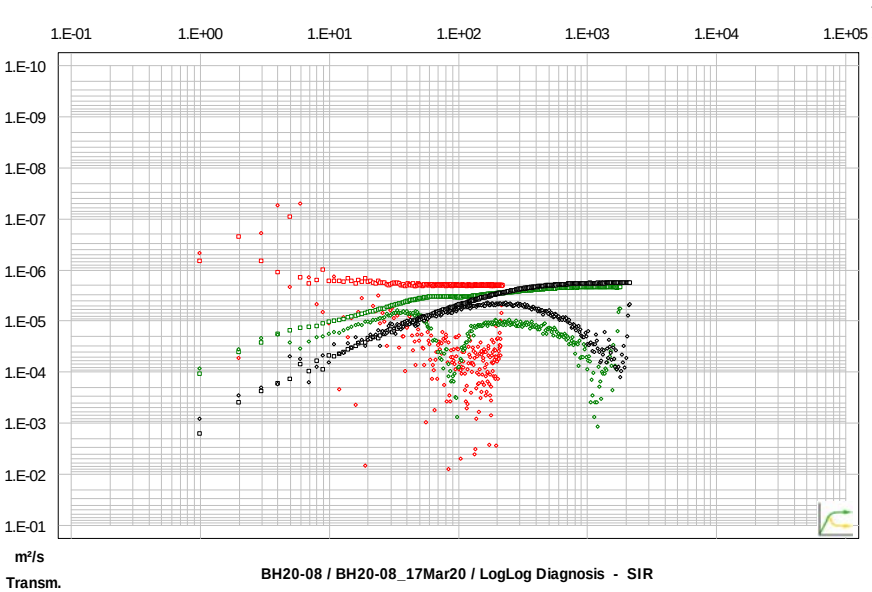
PACKER TEST RESULTS BH20-08 UPPER INTERVAL (7.0 to 10.5 mbgs)

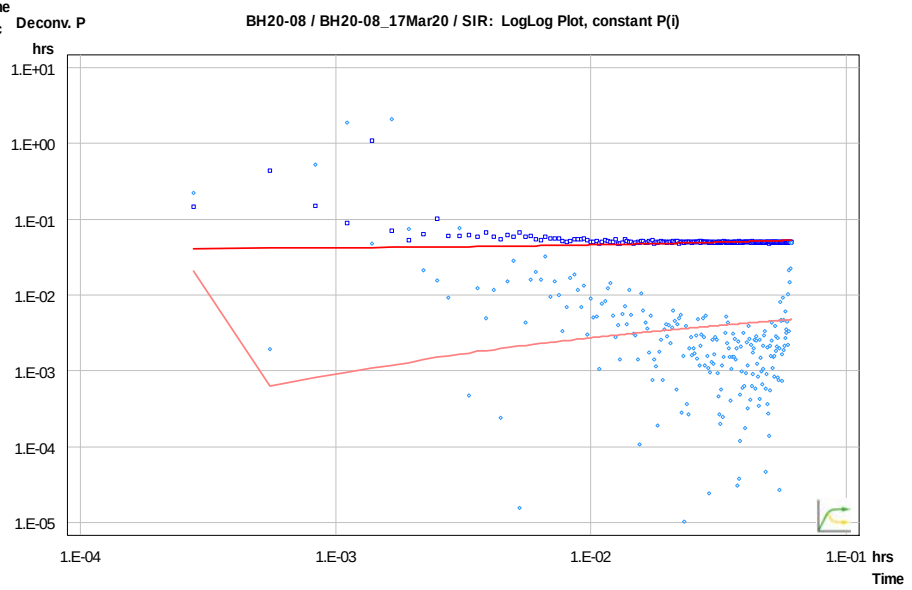
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-017

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

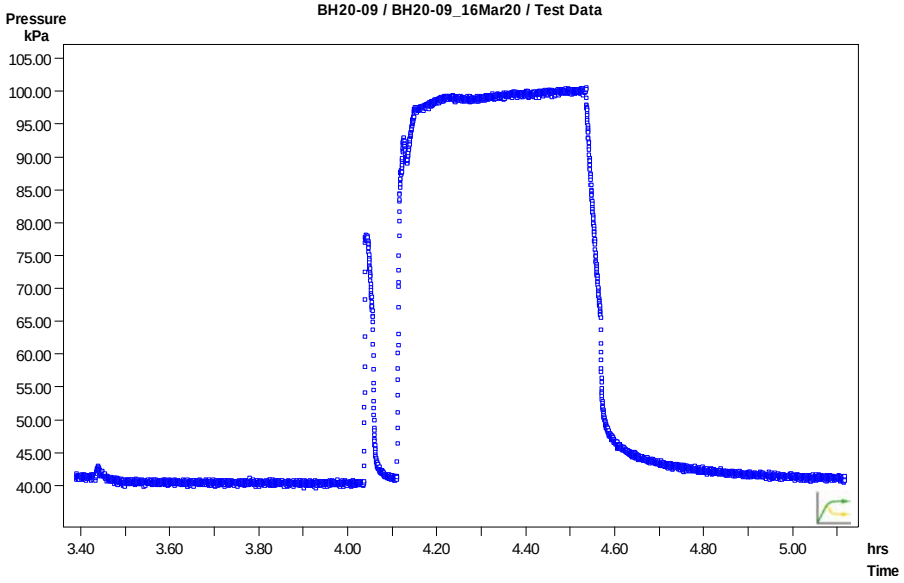
YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

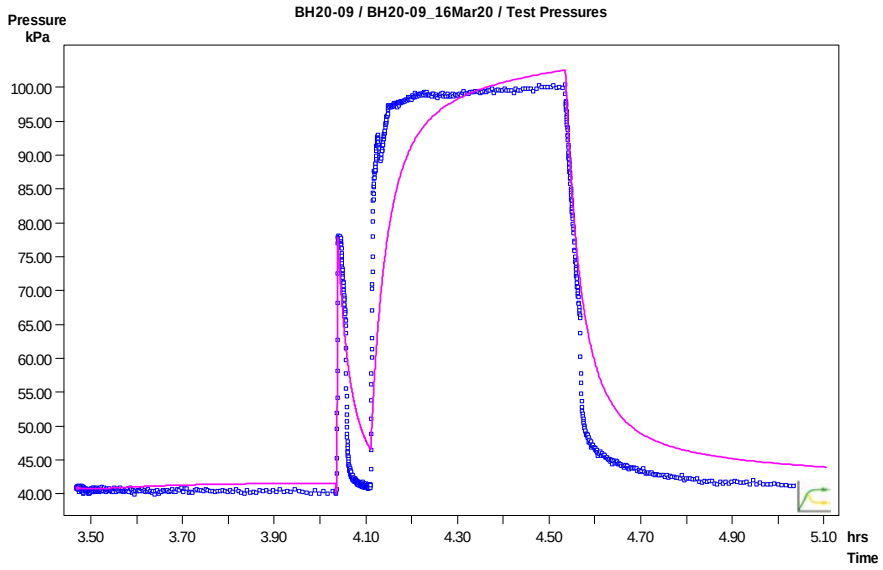
TITLE

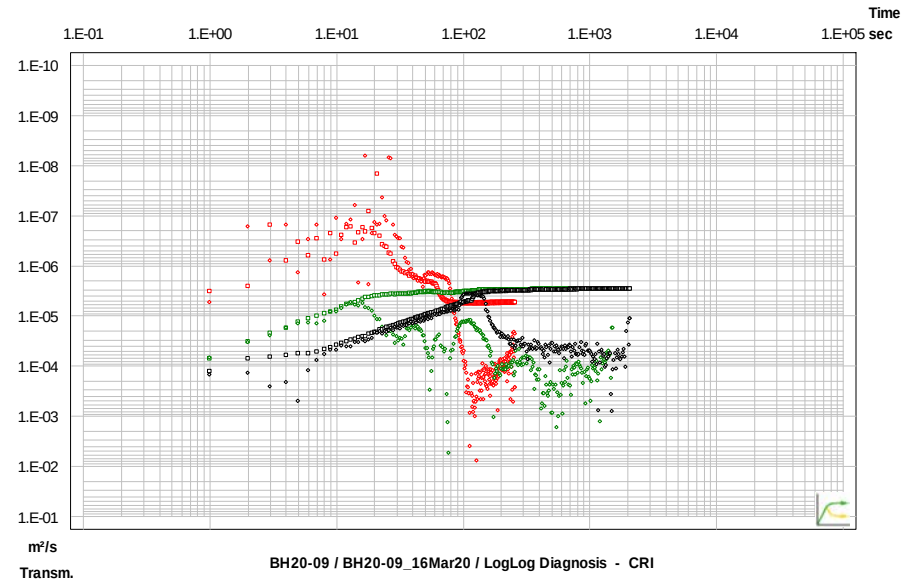
PACKER TEST RESULTS BH20-08 LOWER INTERVAL (10.5 to 15.6 mbgs)

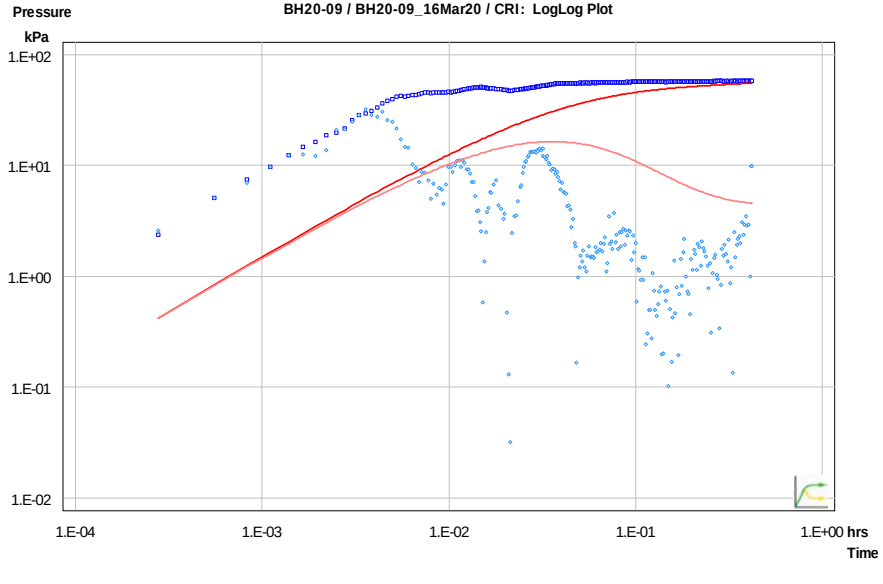
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-018

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

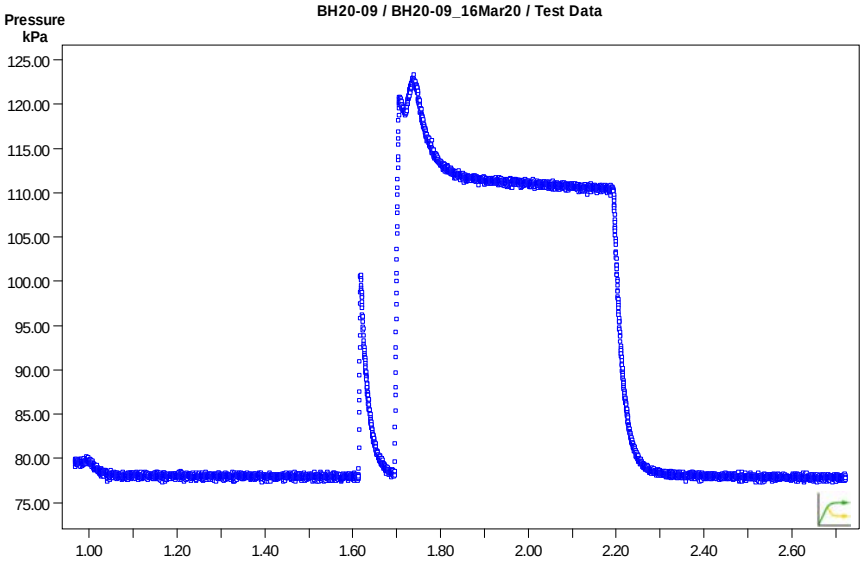
CALEDON PIT / QUARRY

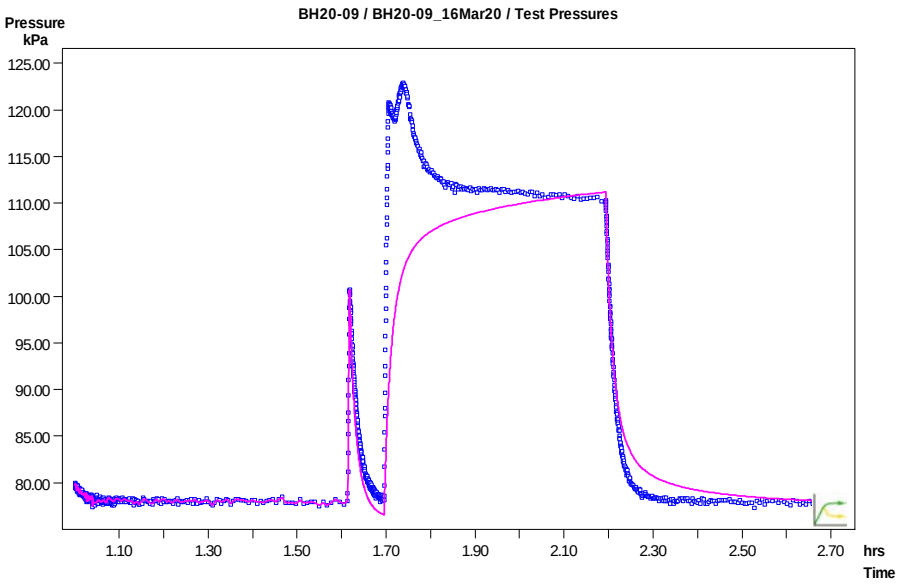
TITLE

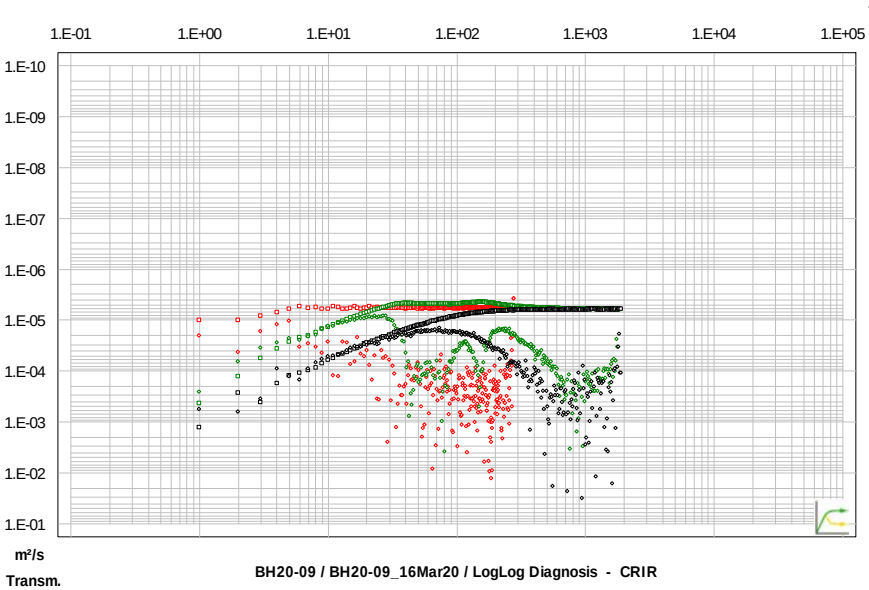
PACKER TEST RESULTS BH20-09 UPPER INTERVAL (5.3 to 10.4 mbgs)

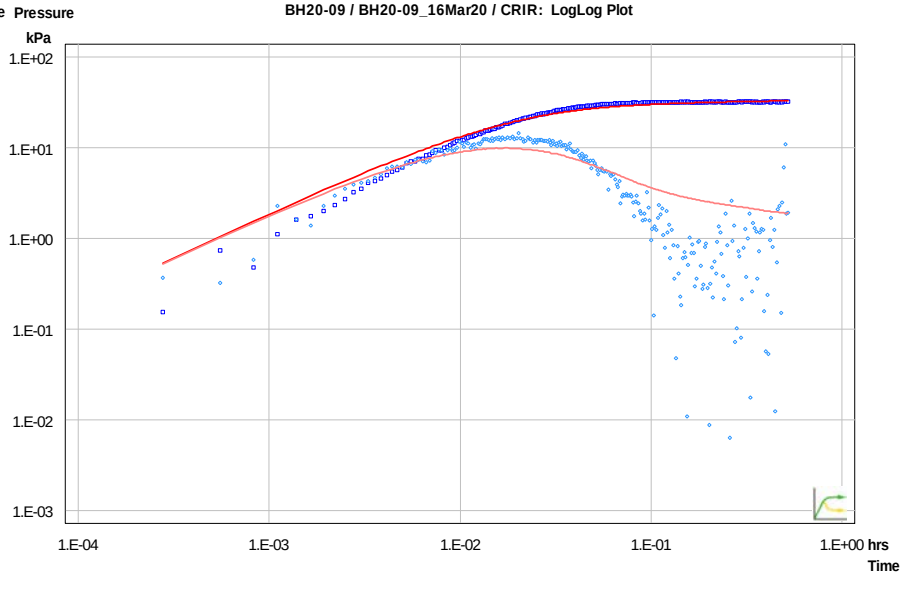
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-019

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

TITLE

PACKER TEST RESULTS BH20-09 LOWER INTERVAL (9.2 to 14.2 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-020

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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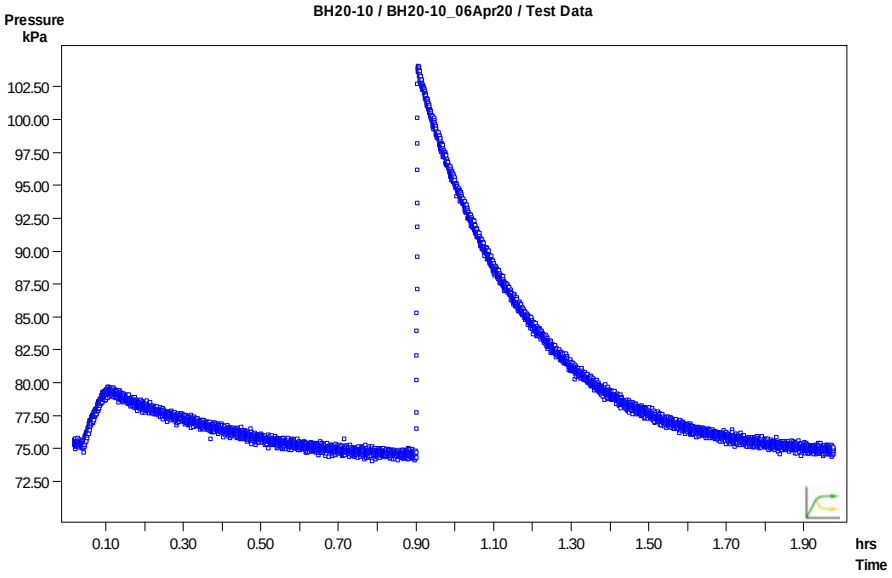
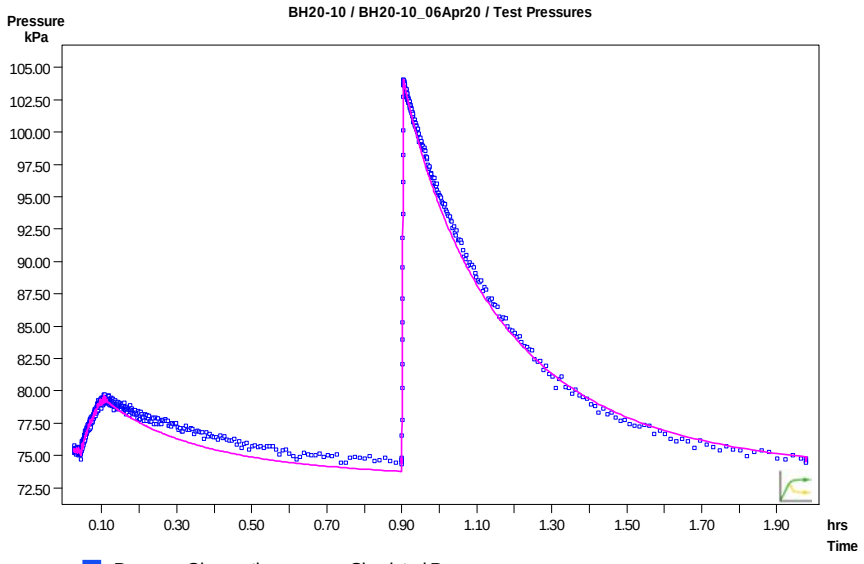
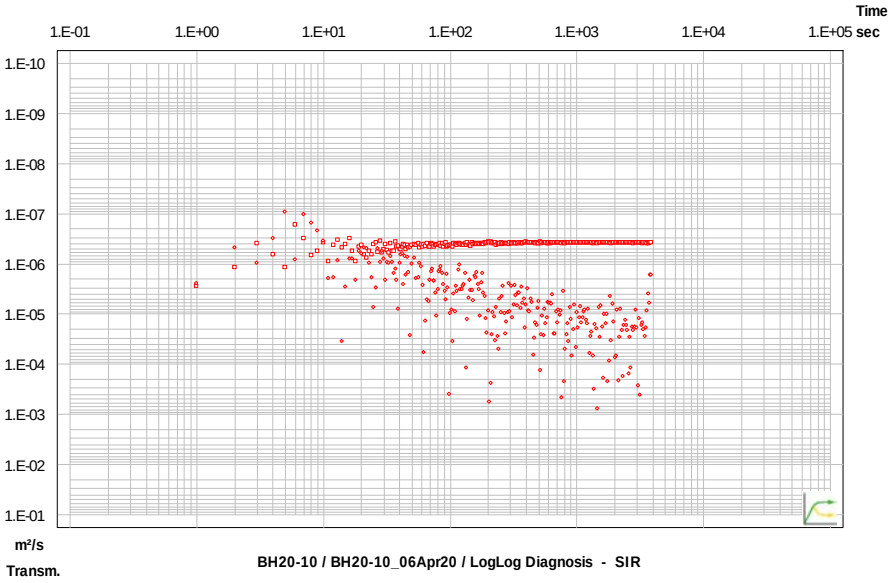
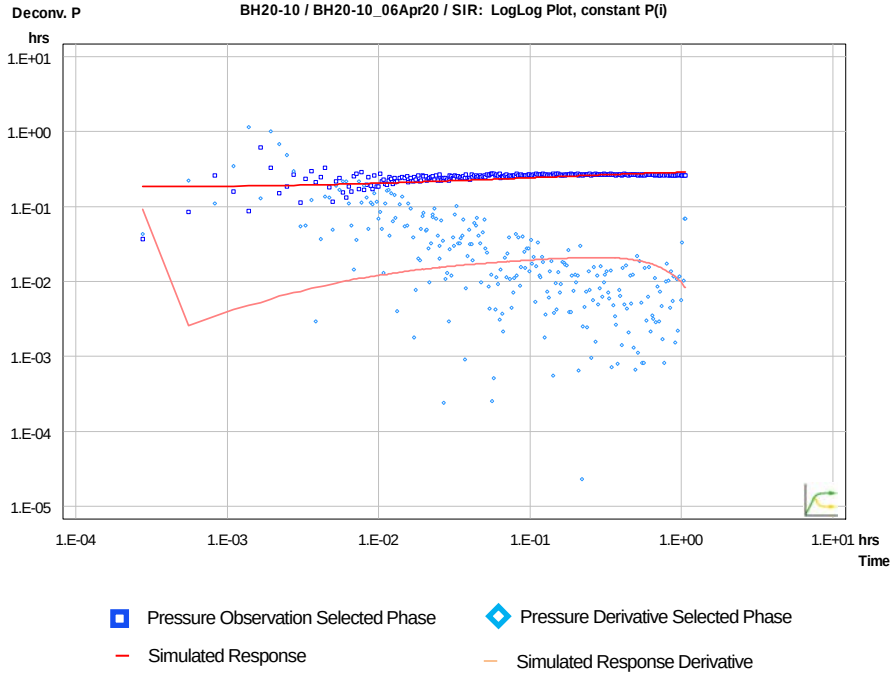








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

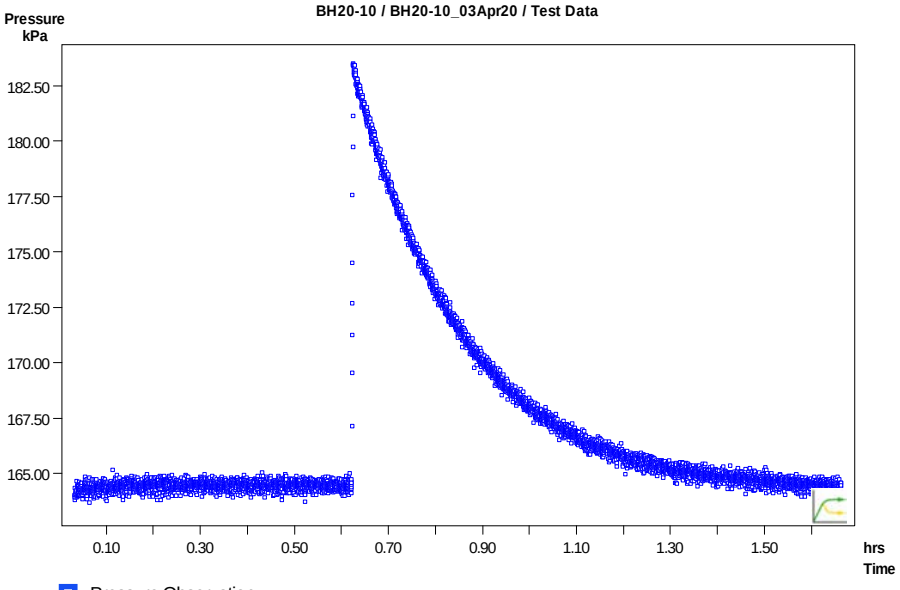
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

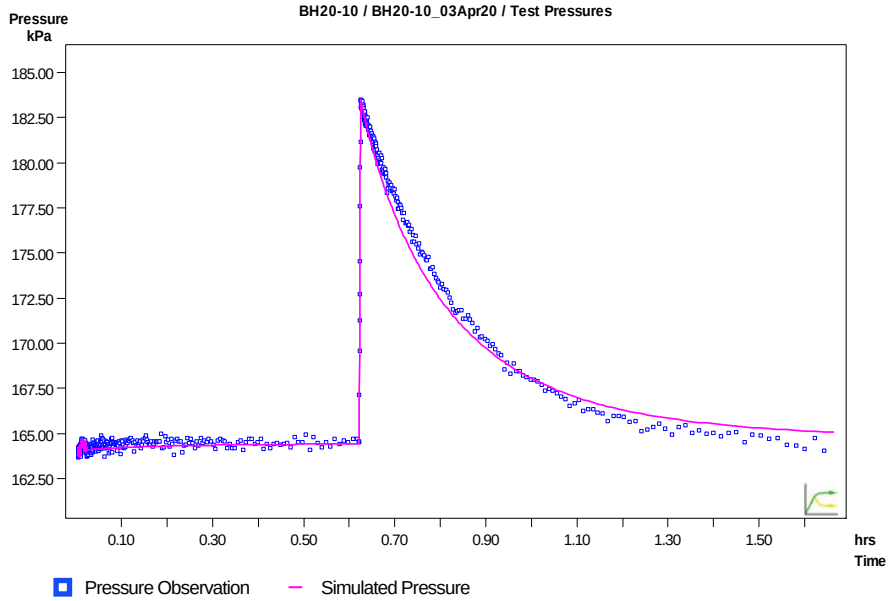
TITLE

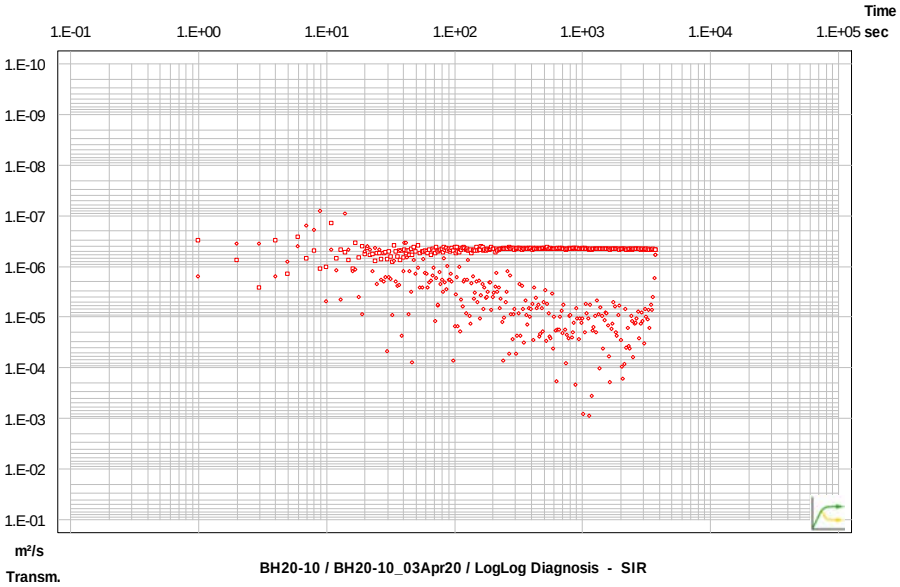
PACKER TEST RESULTS BH20-10 UPPER INTERVAL (10.8 to 14.3 mbgs)

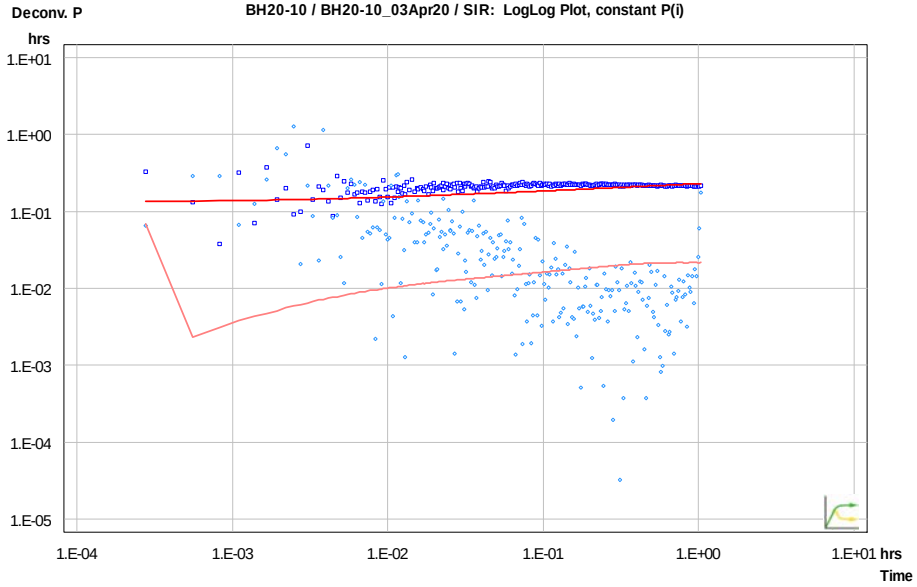
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-021

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

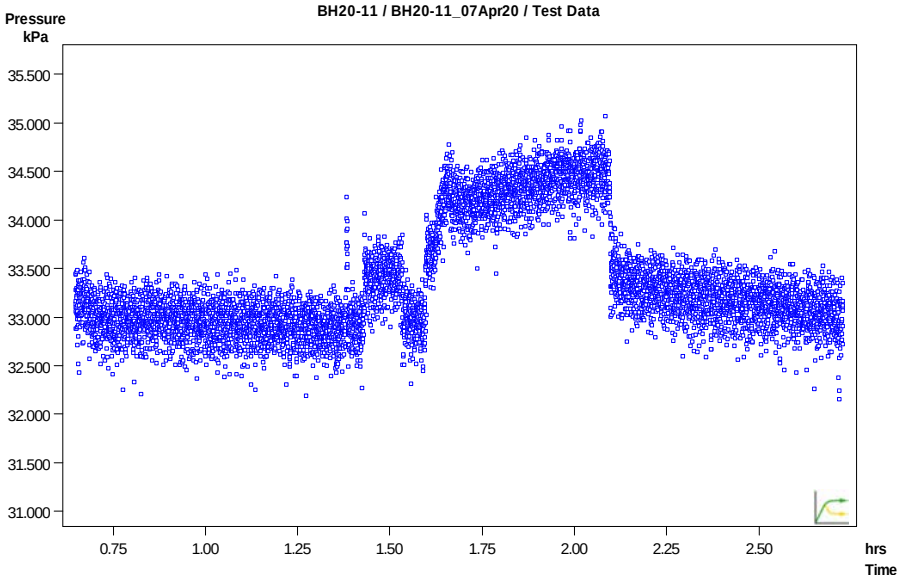
CALEDON PIT / QUARRY

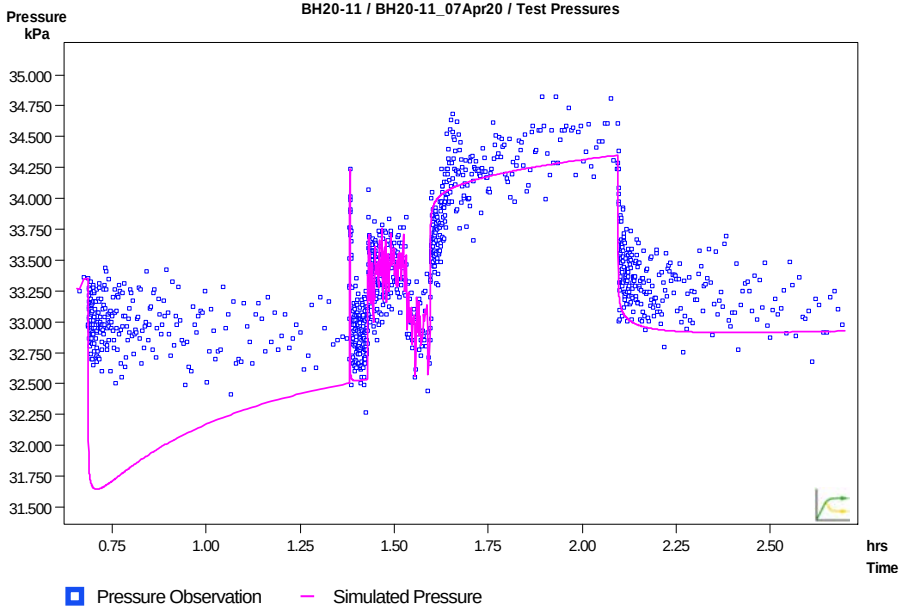
TITLE

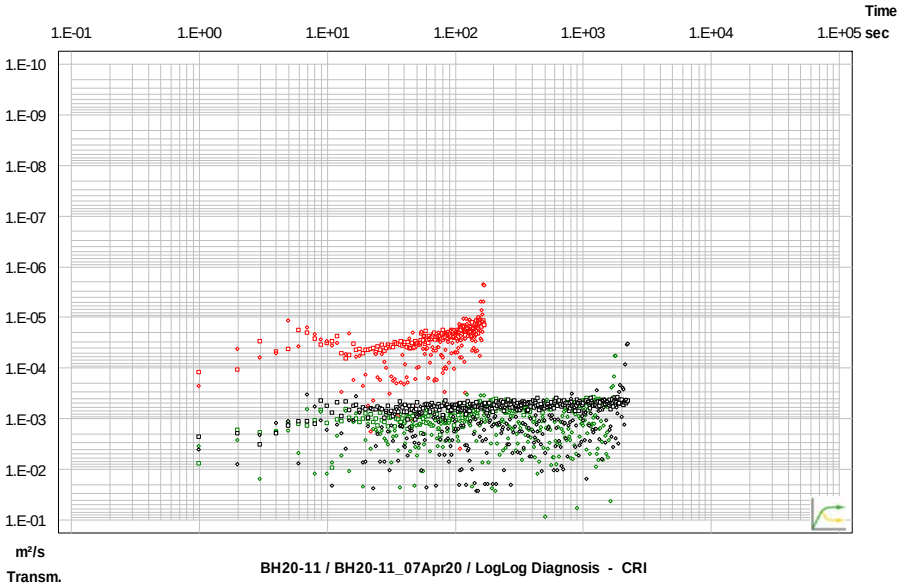
PACKER TEST RESULTS BH20-10 LOWER INTERVAL (13.3 to 16.9 mbgs)

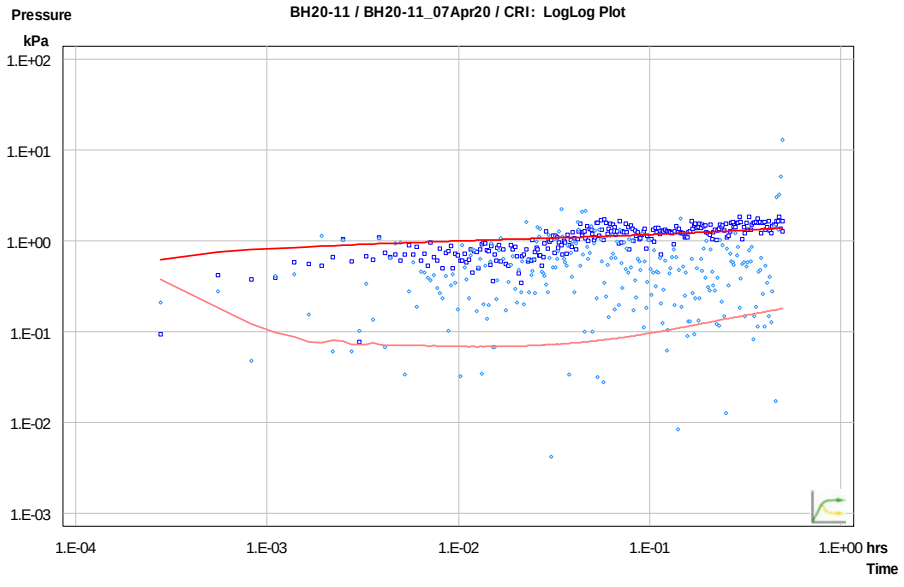
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-022

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

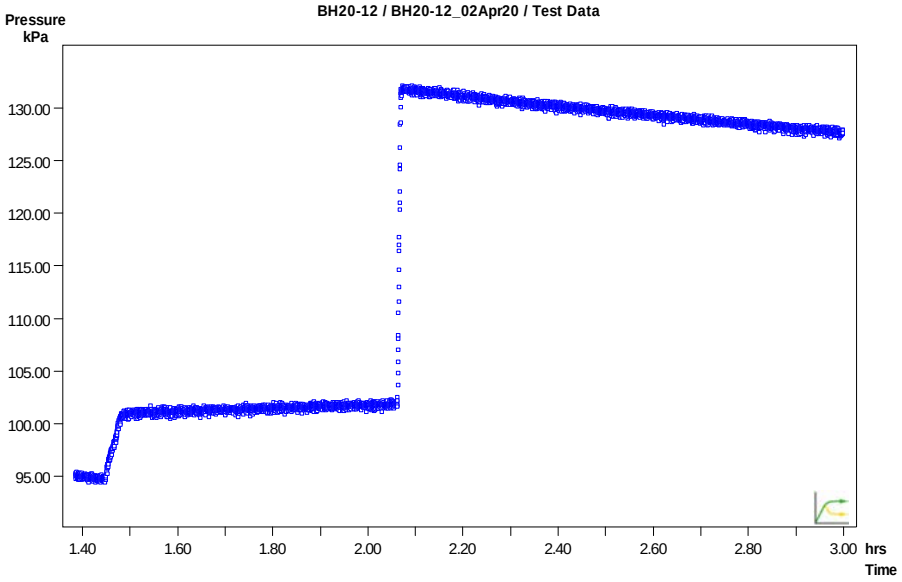
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

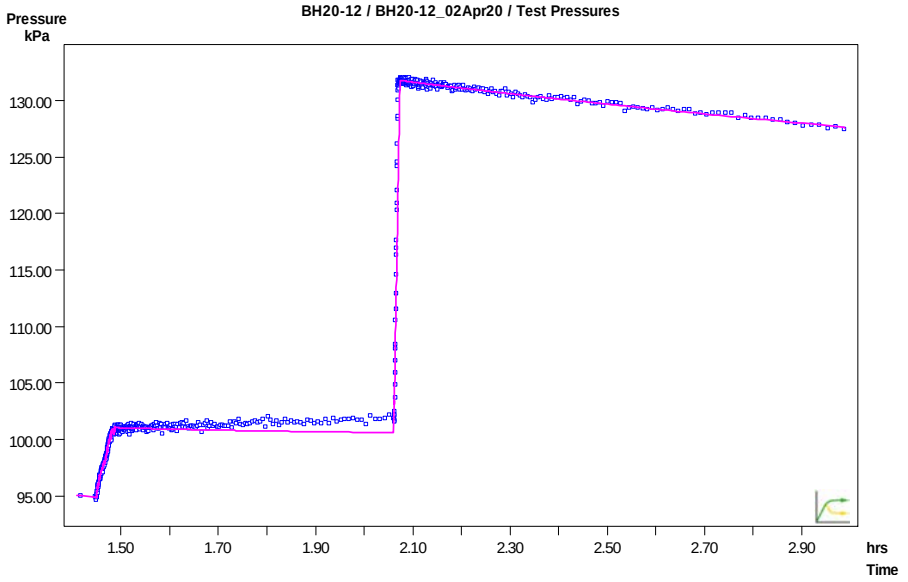
TITLE

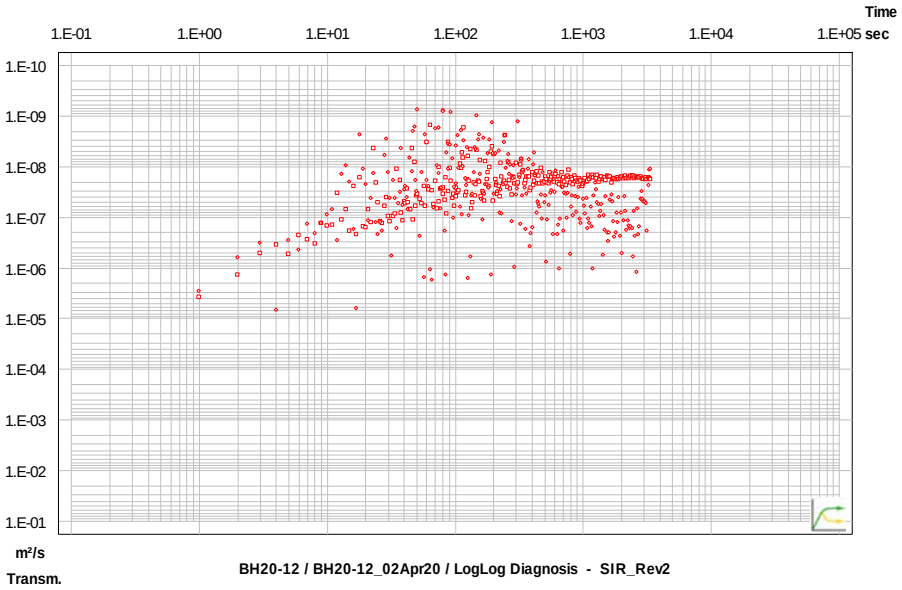
PACKER TEST RESULTS BH20-11 SINGLE INTERVAL (4.7 to 8.2 mbgs)

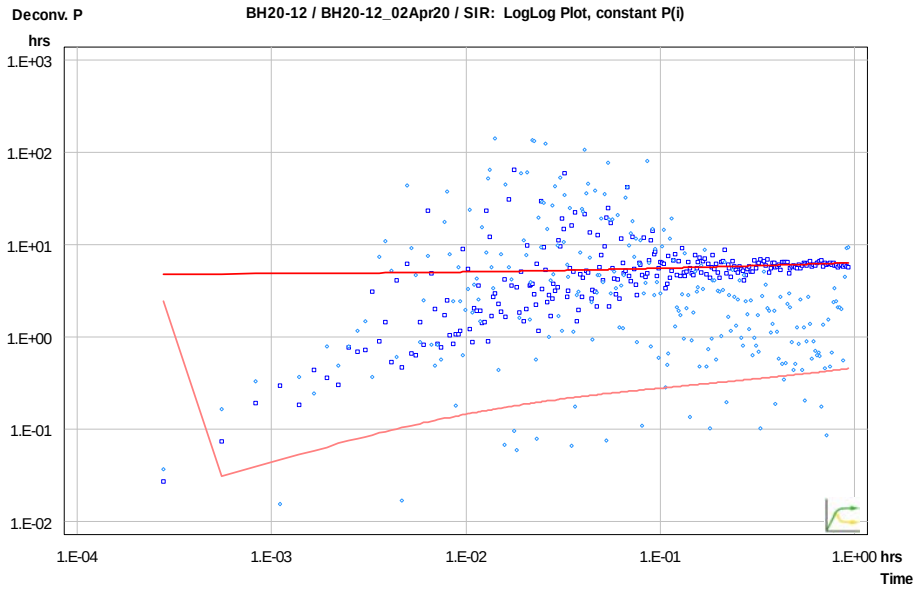
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-023

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

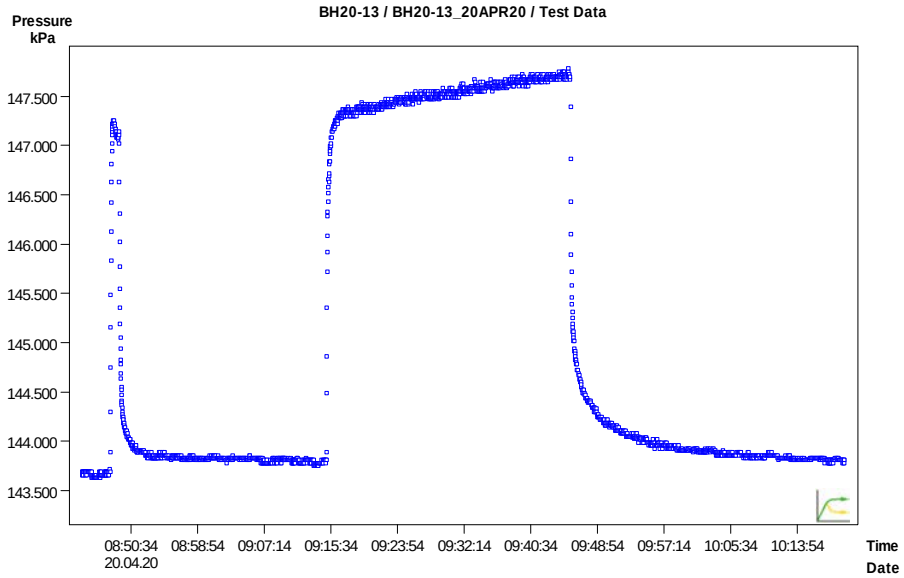
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

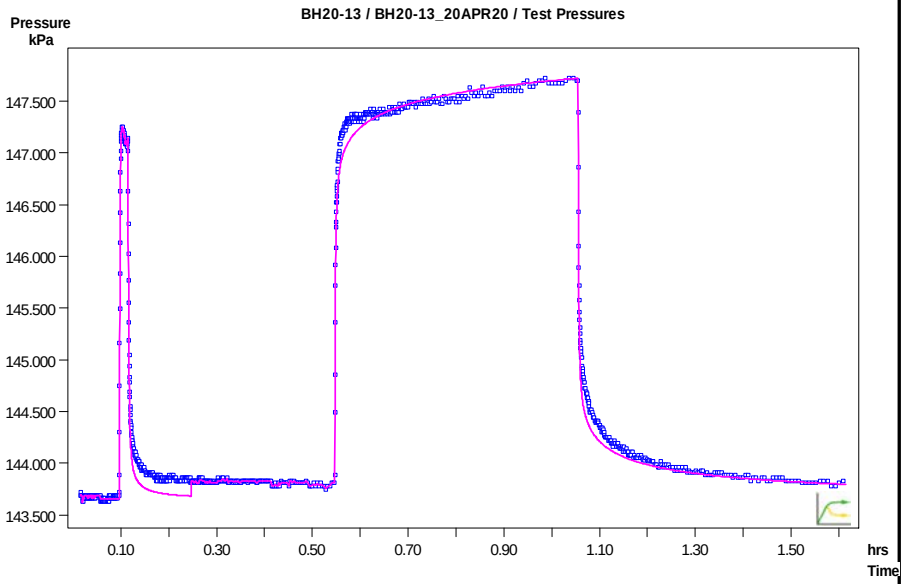
TITLE

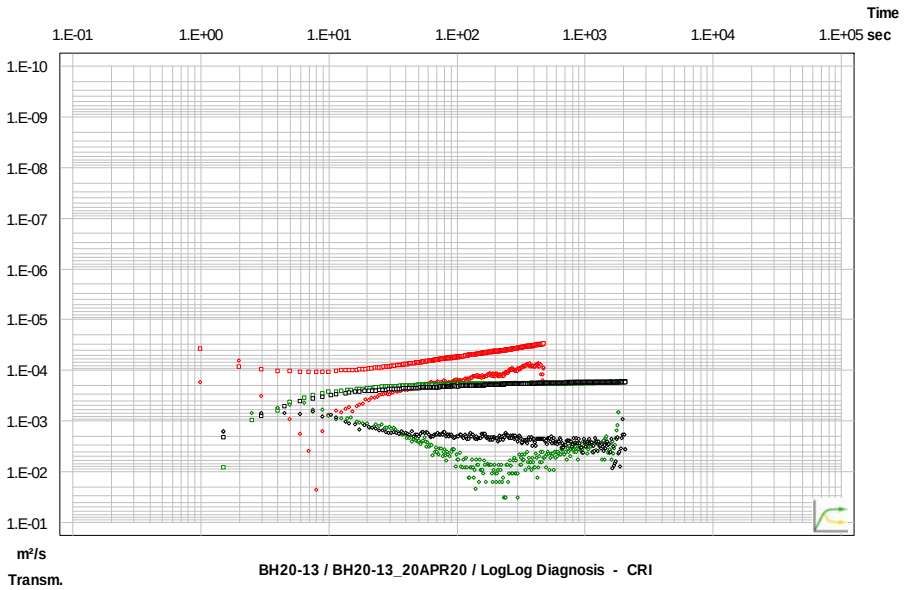
PACKER TEST RESULTS BH20-12 SINGLE INTERVAL (14.1 to 19.2 mbgs)

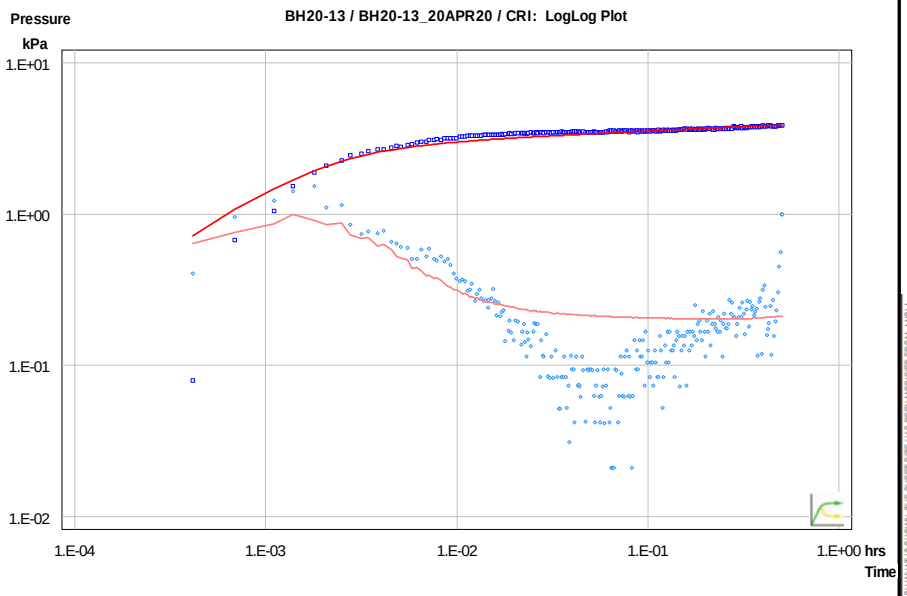
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-024

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

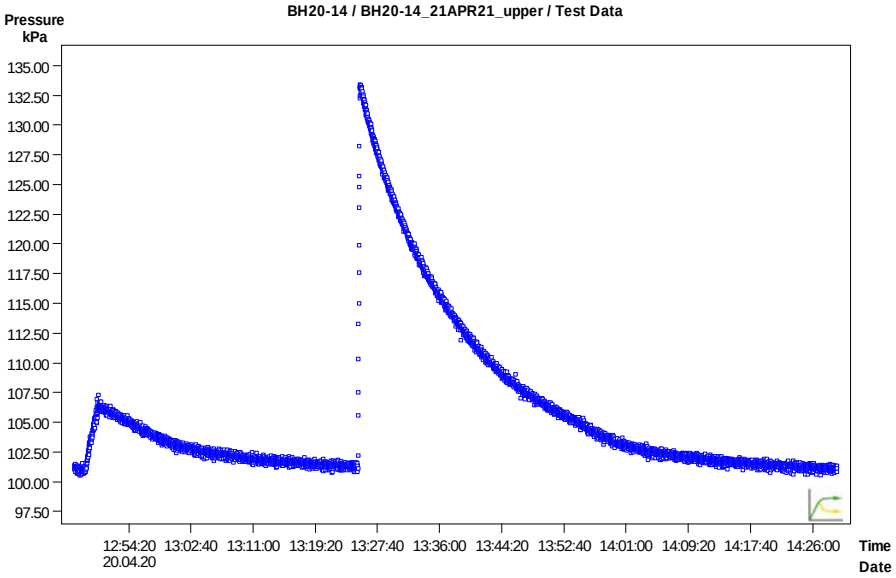
CALEDON PIT / QUARRY

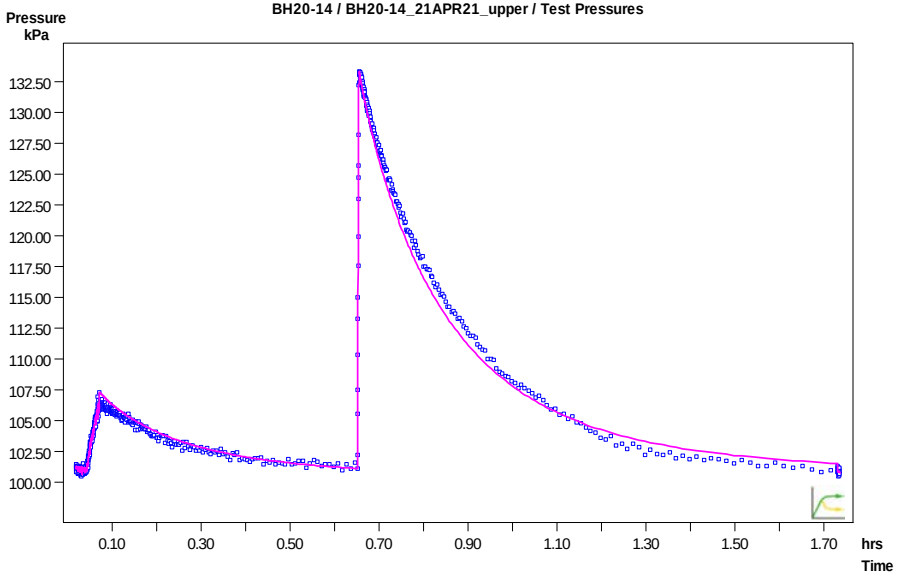
TITLE

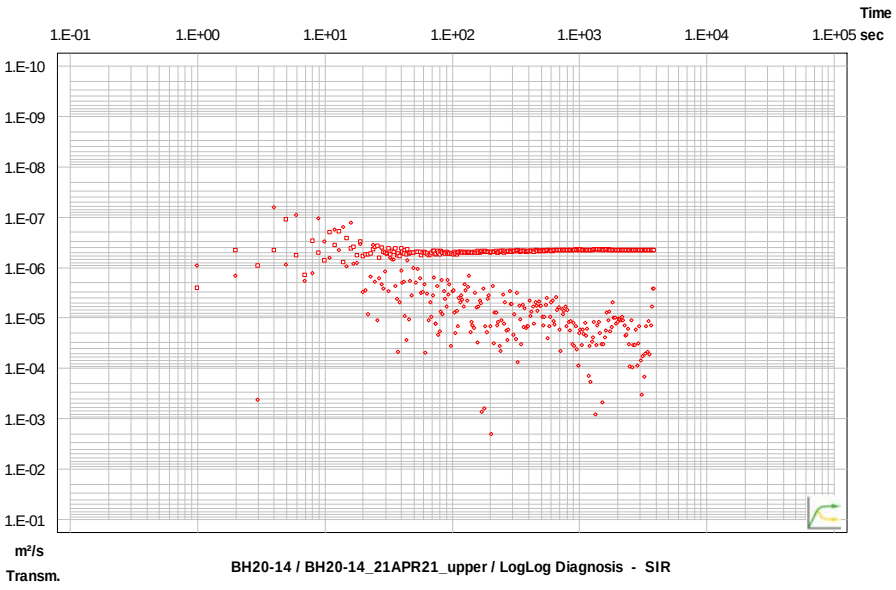
PACKER TEST RESULTS BH20-13 OPEN BOREHOLE (5.9 to 22.8 mbgs)

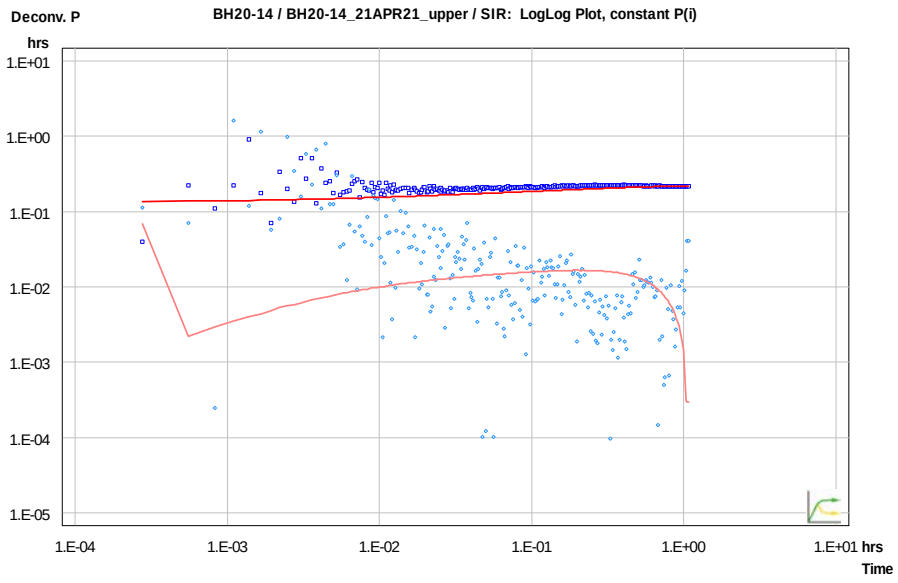
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-025

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

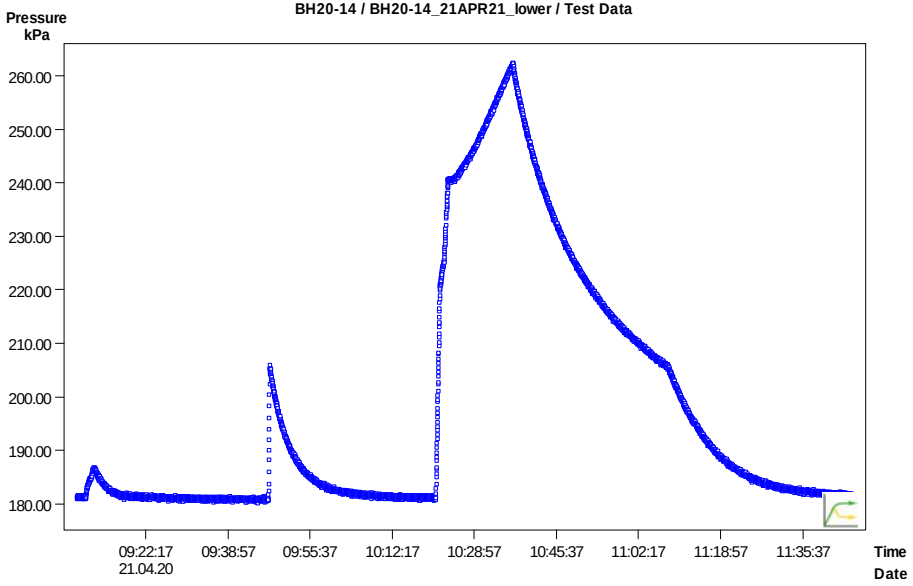
CALEDON PIT / QUARRY

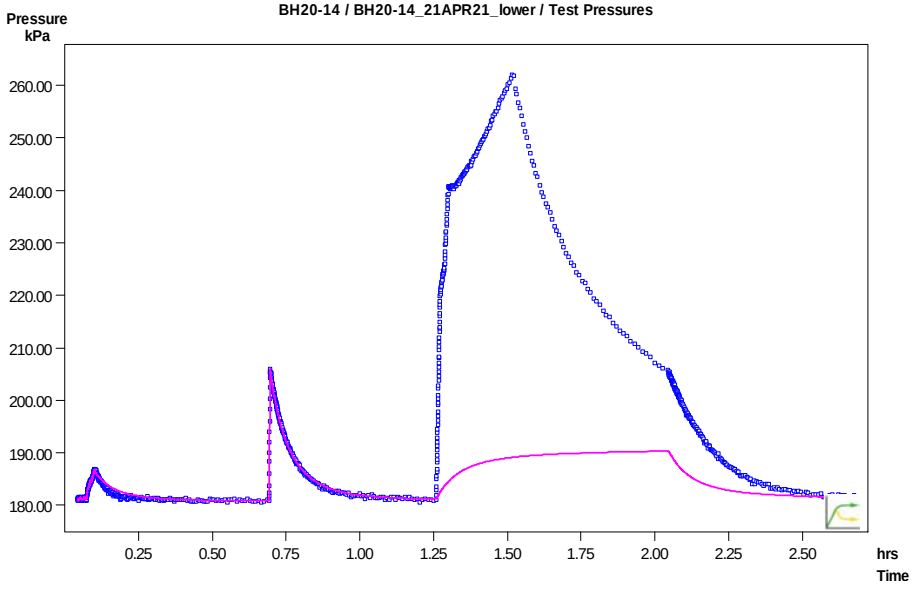
TITLE

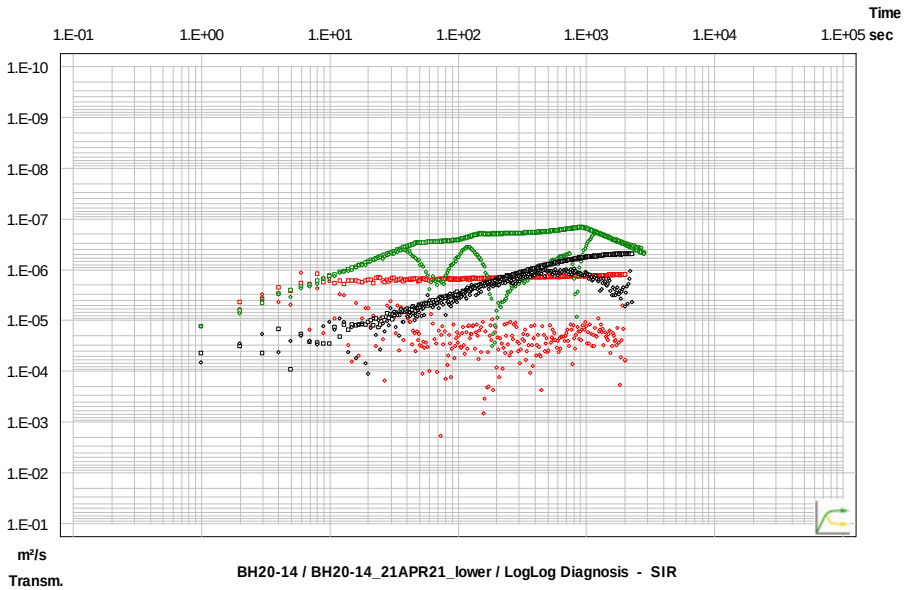
PACKER TEST RESULTS BH20-14 UPPER INTERVAL (10.8 to 19.1 mbgs)

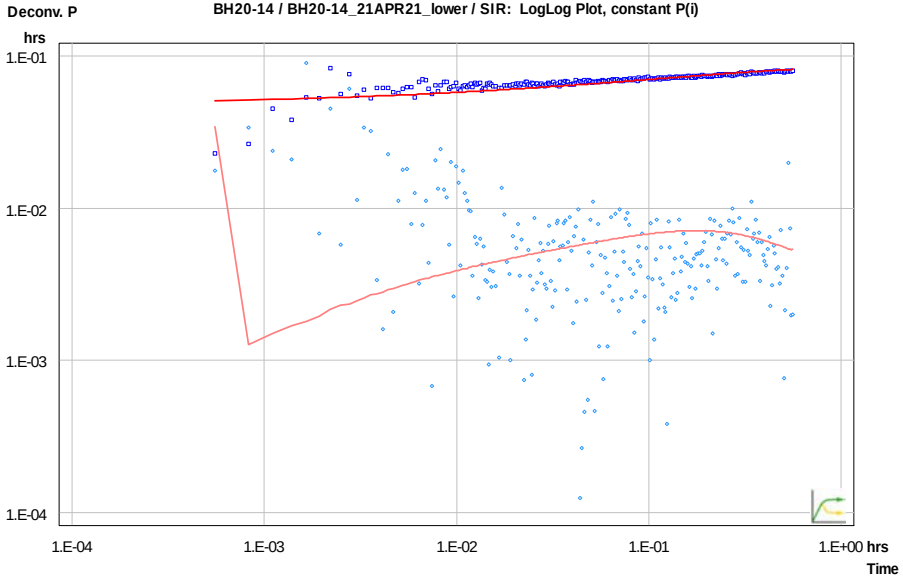
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-026

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

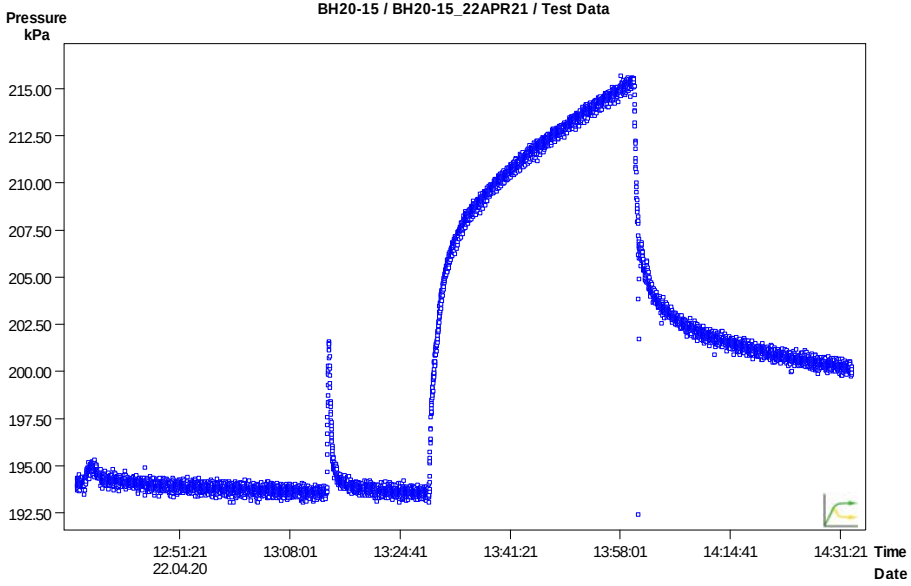
CALEDON PIT / QUARRY

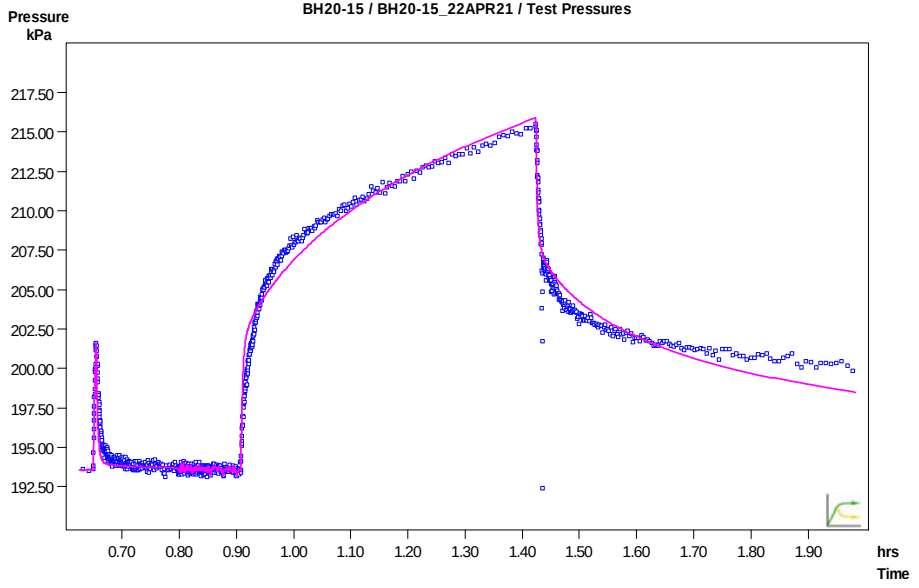
TITLE

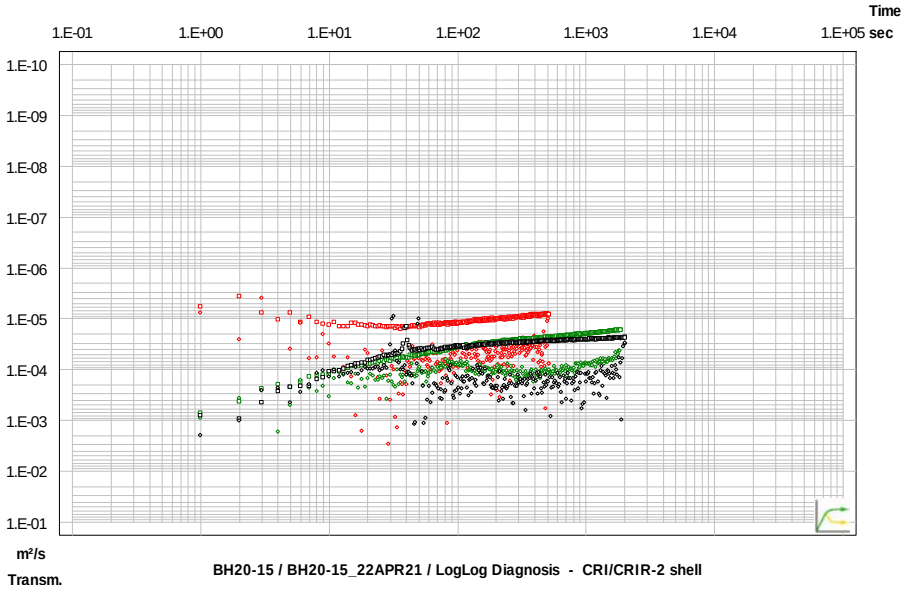
PACKER TEST RESULTS BH20-14 LOWER INTERVAL (19.1 to 27.3 mbgs)

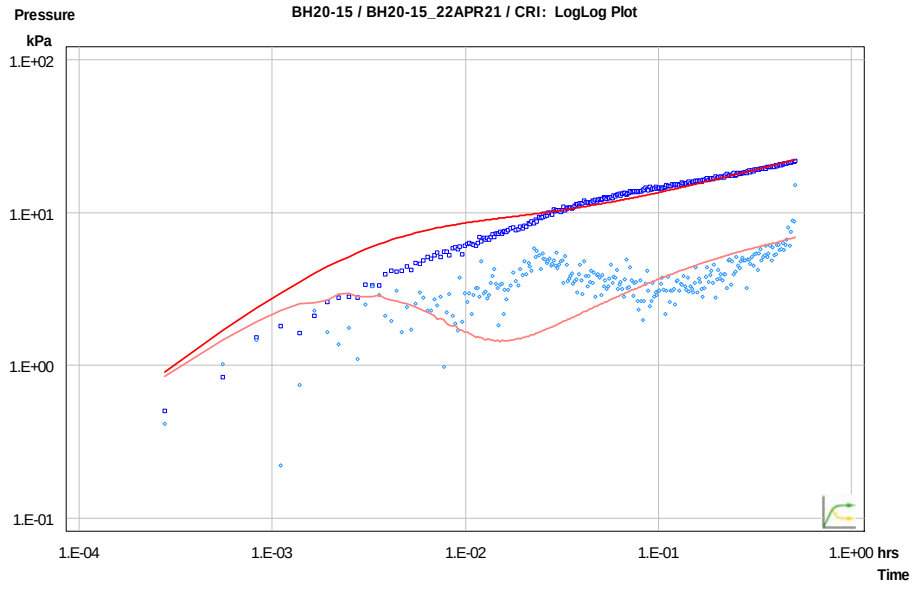
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-027

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-03-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

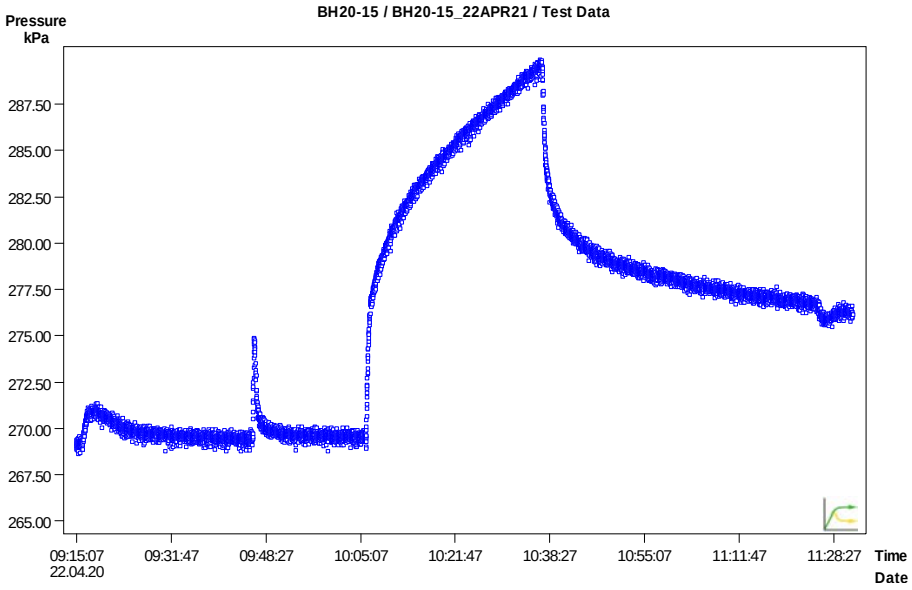
CALEDON PIT / QUARRY

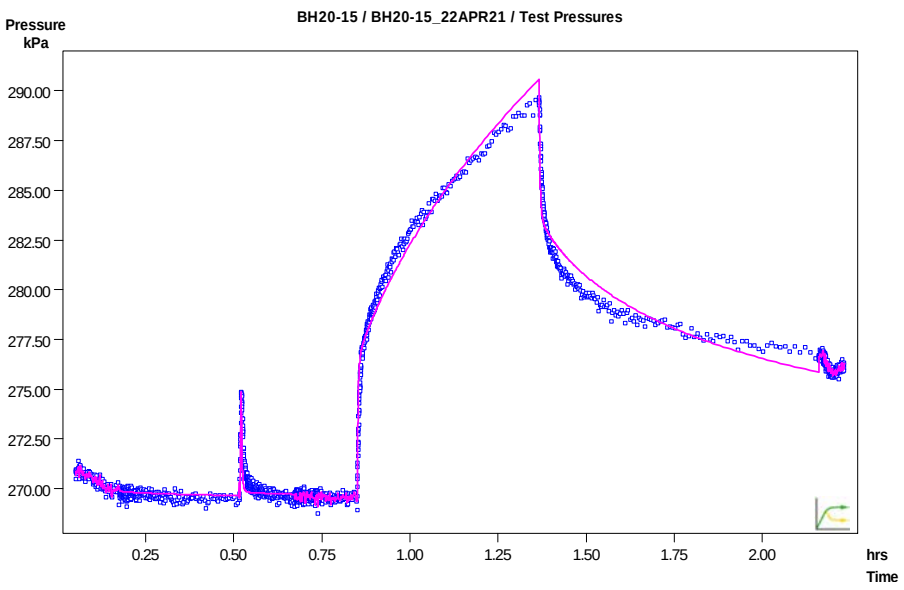
TITLE

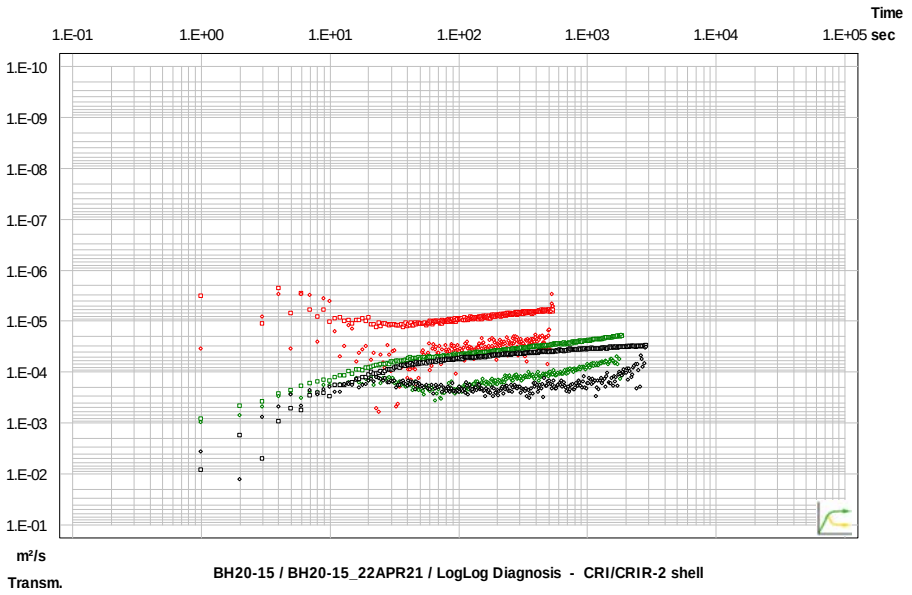
PACKER TEST RESULTS BH20-15 UPPER INTERVAL (17.2 to 23.9 mbgs)

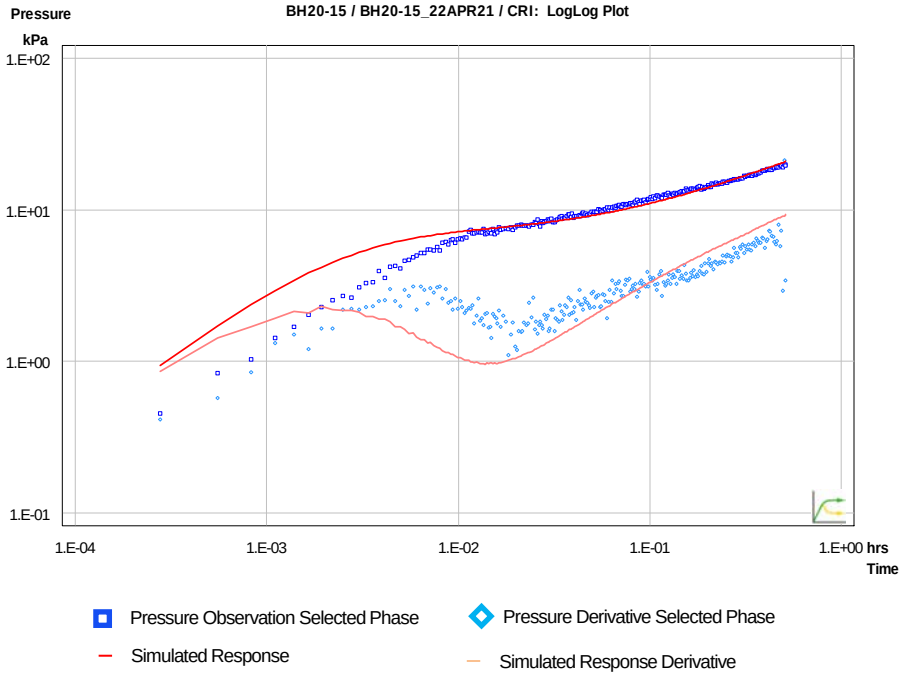
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-028

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-03-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

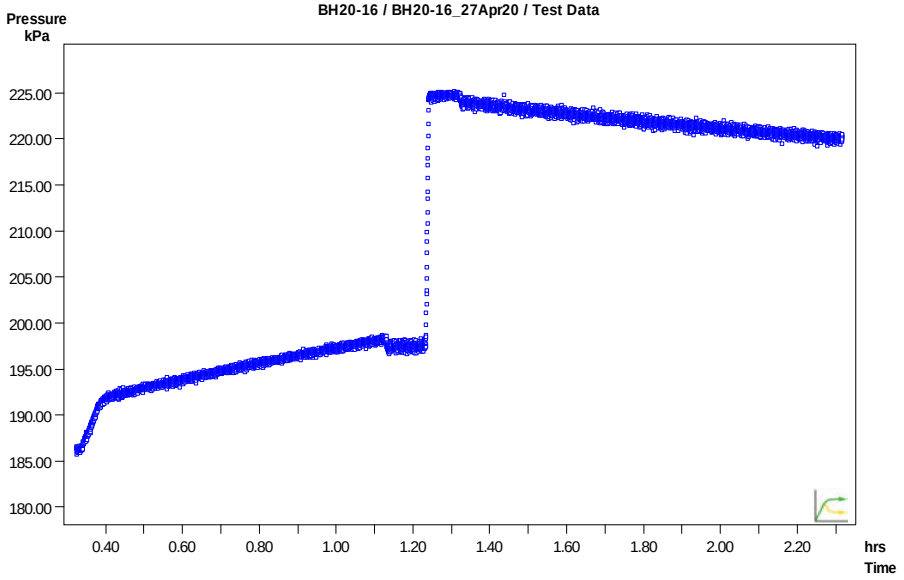
CALEDON QUARRY

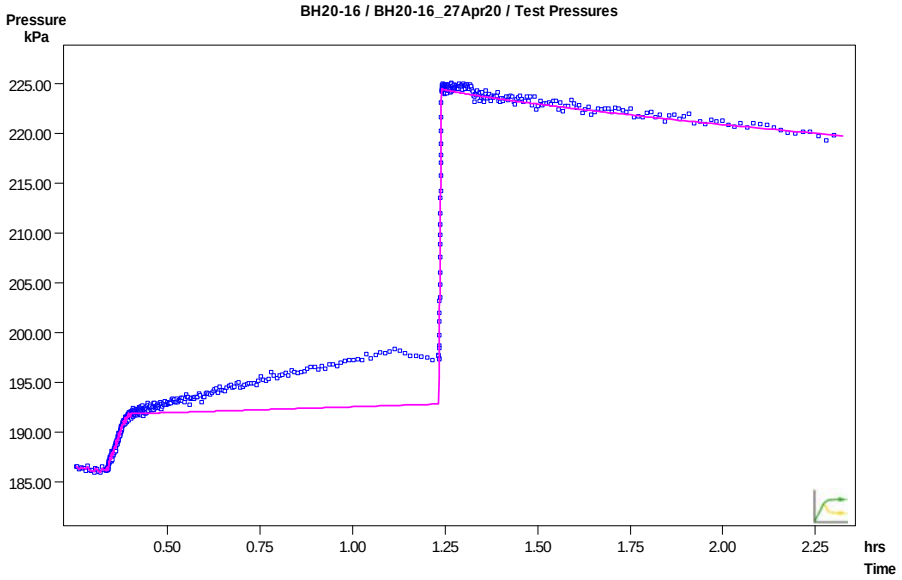
TITLE

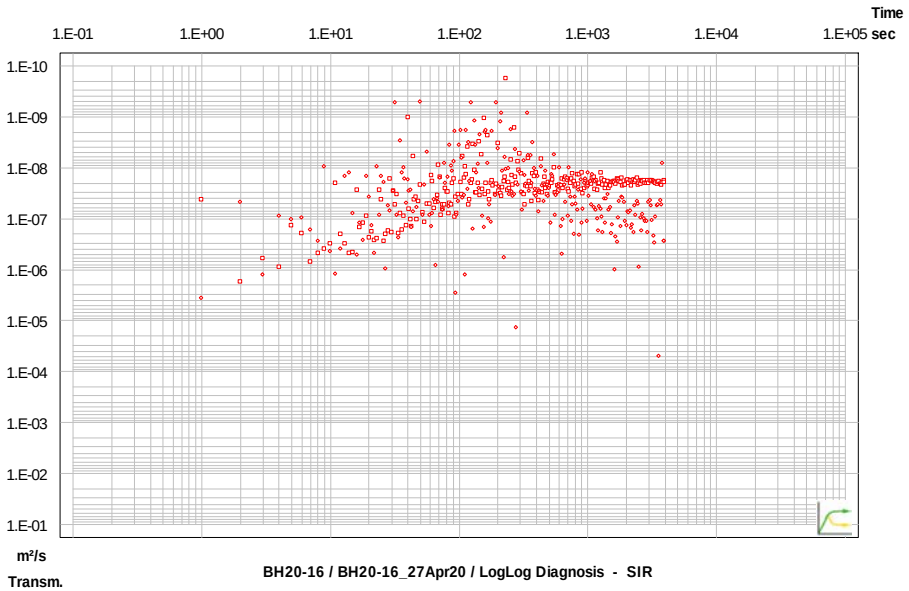
PACKER TEST RESULTS BH20-15 LOWER INTERVAL (23.9 to 32.1 mbgs)

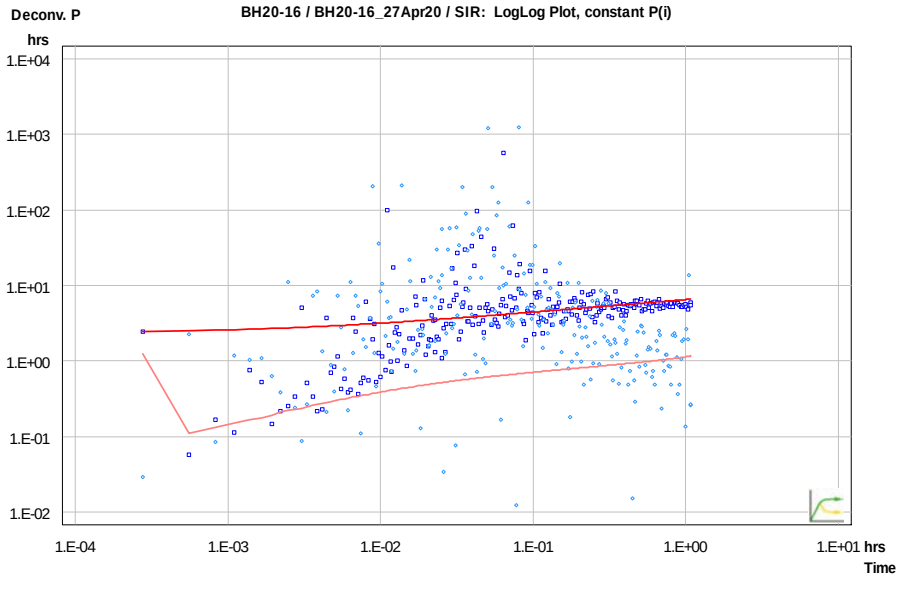
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-029

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

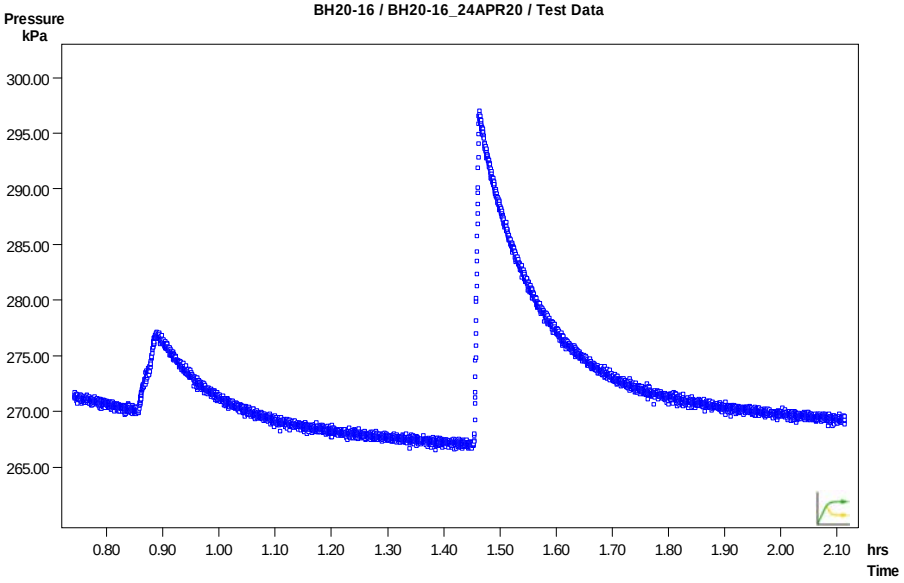
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

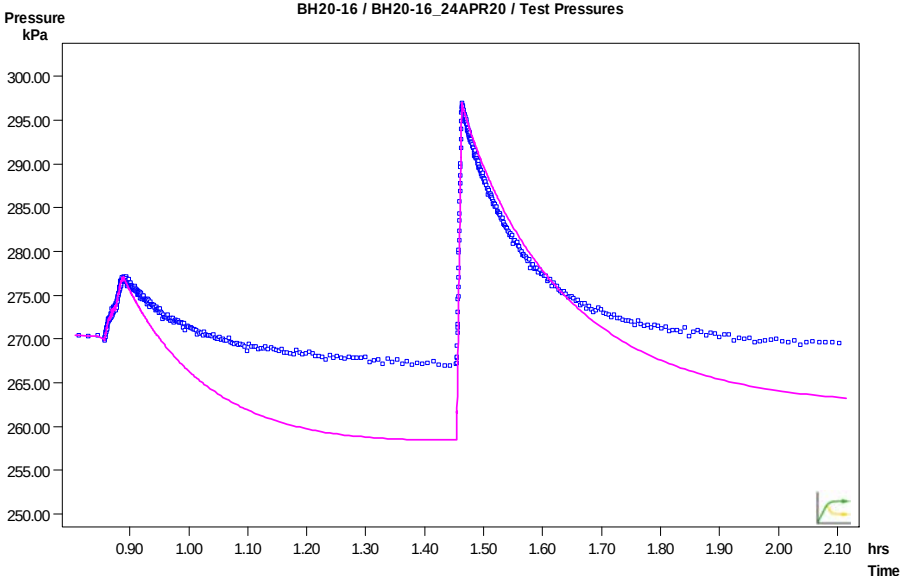
TITLE

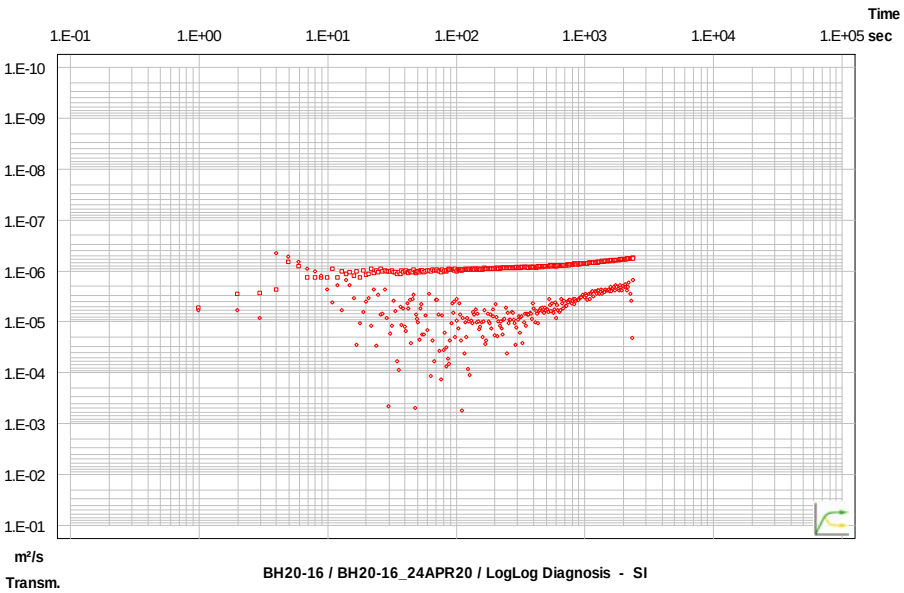
PACKER TEST RESULTS BH20-16 UPPER INTERVAL (15.5 to 23.7 mbgs)

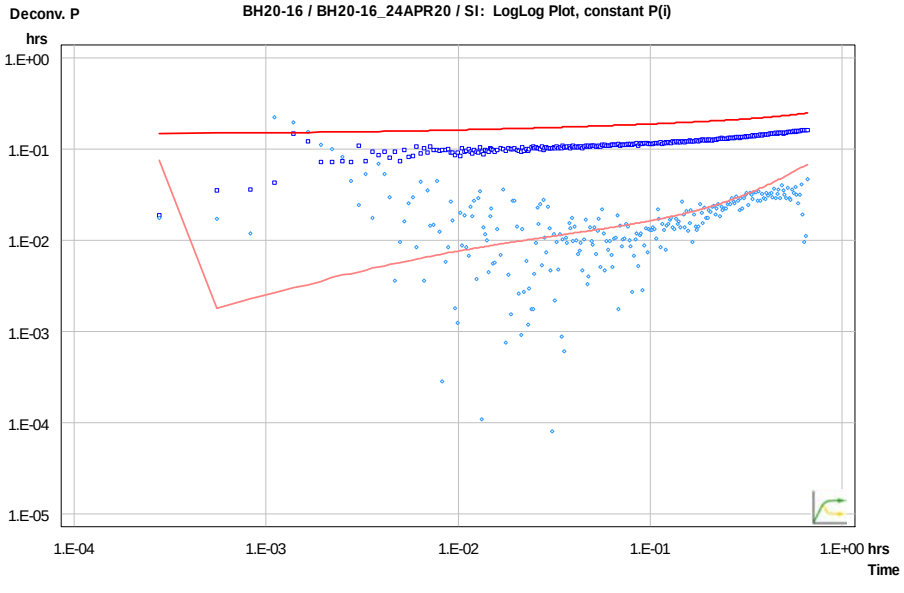
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-030

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

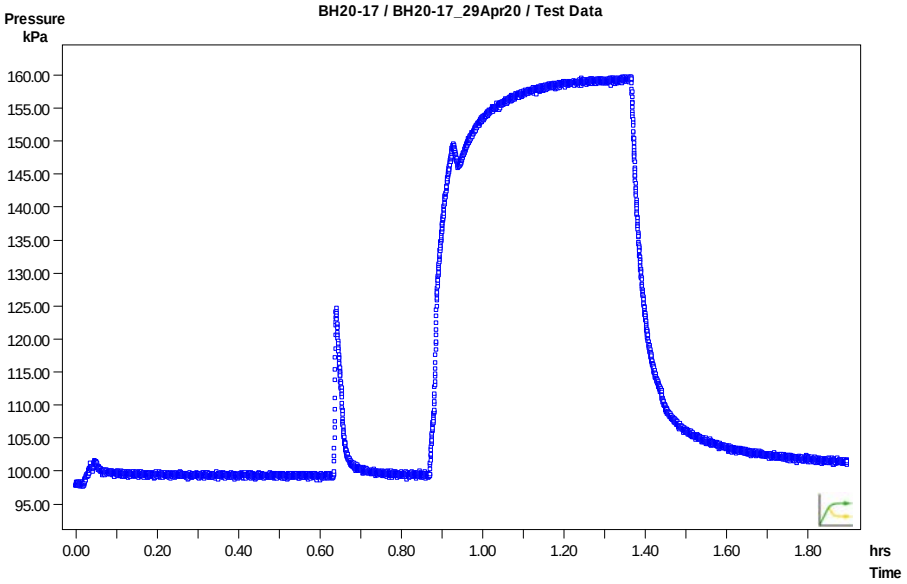
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

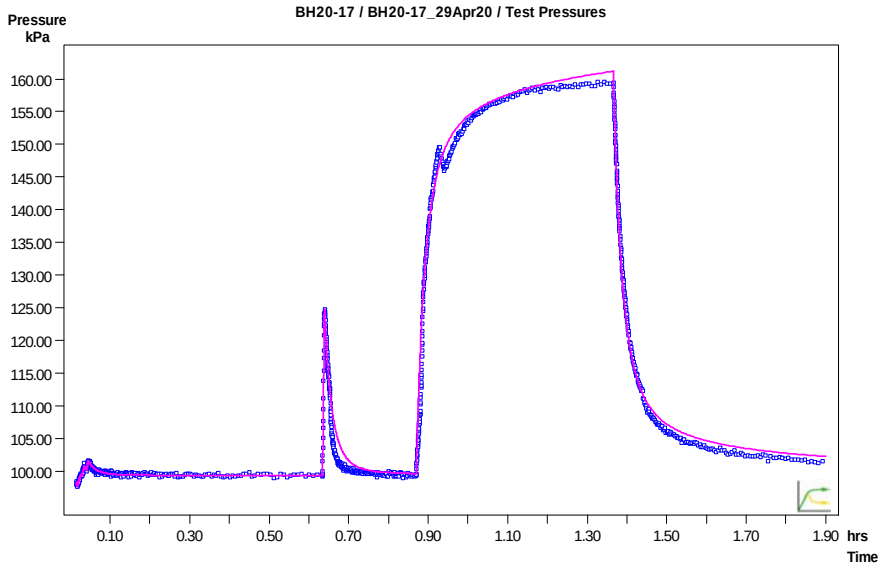
TITLE

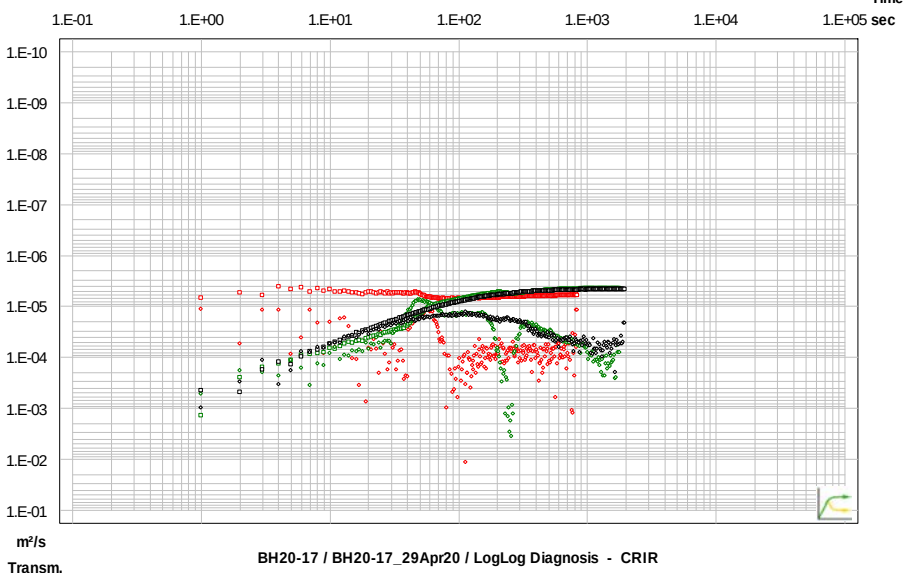
PACKER TEST RESULTS BH20-16 LOWER INTERVAL (23.5 to 31.6 mbgs)

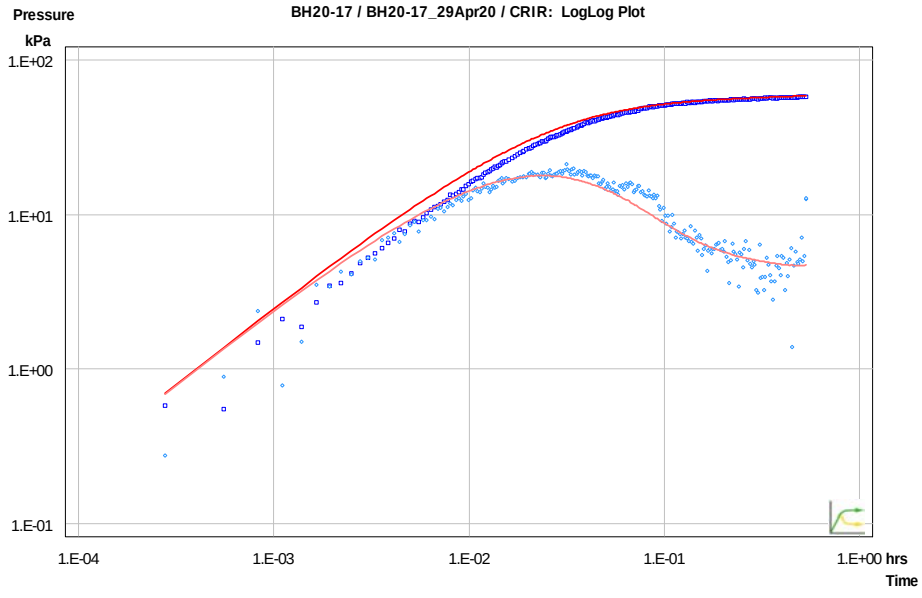
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-031

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

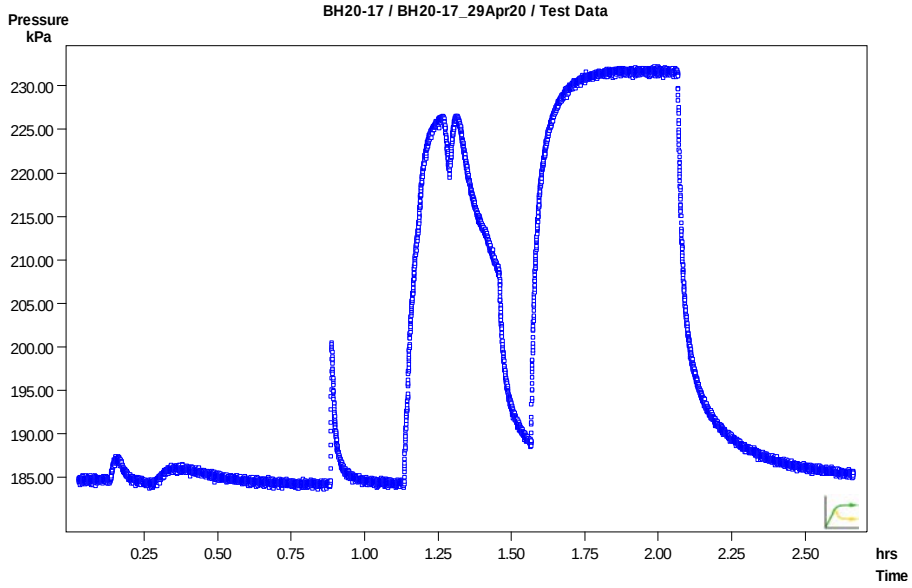
CALEDON PIT / QUARRY

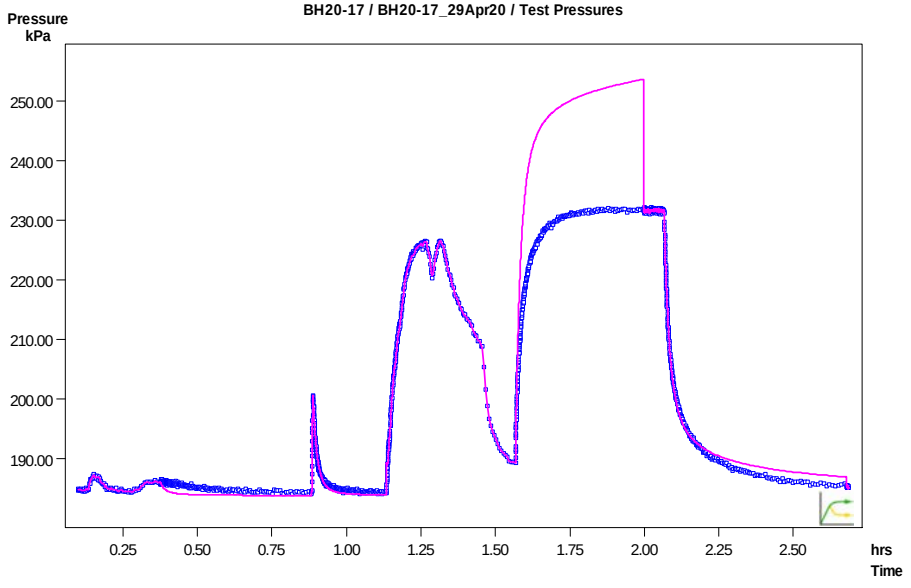
TITLE

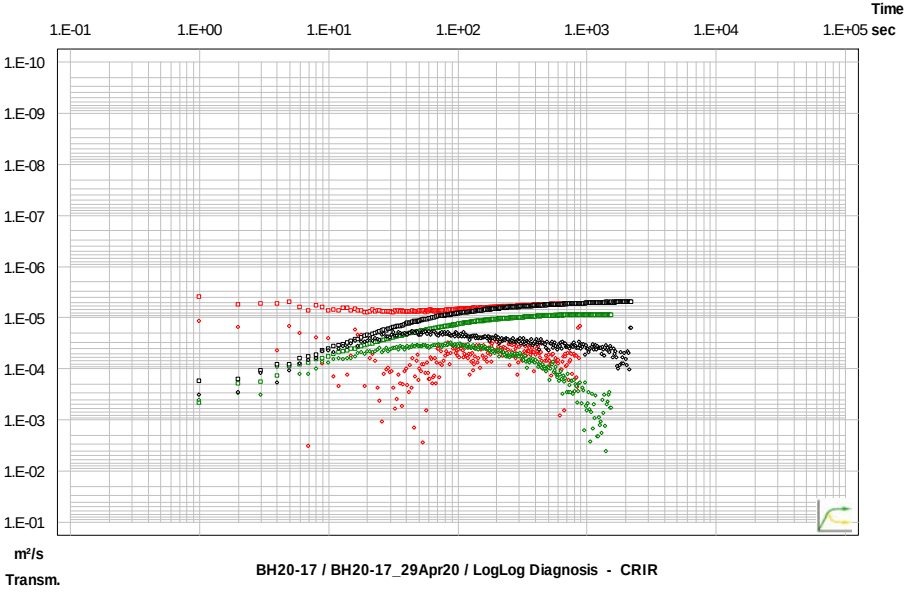
PACKER TEST RESULTS BH20-17 UPPER INTERVAL (7.8 to 17.4 mbgs)

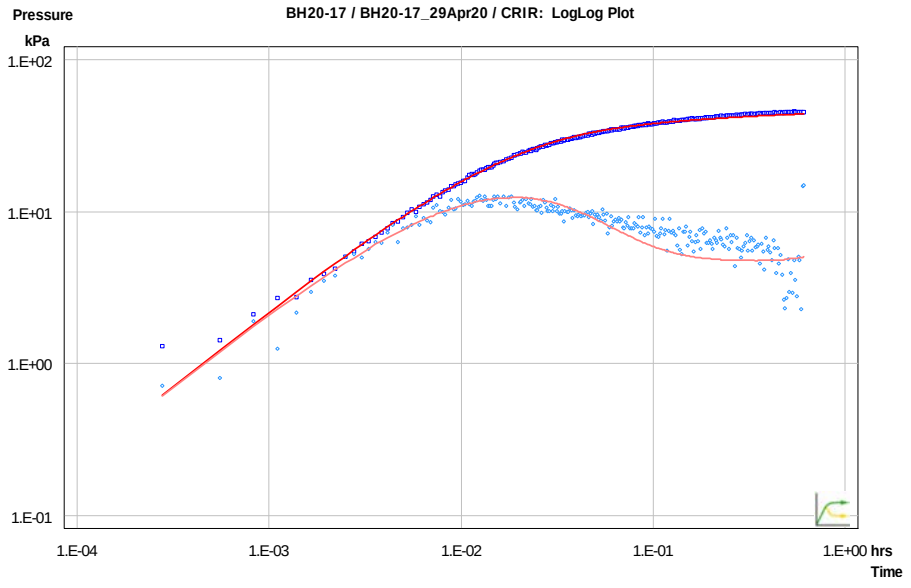
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-032

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

CLIENT
CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT
CALEDON PIT / QUARRY

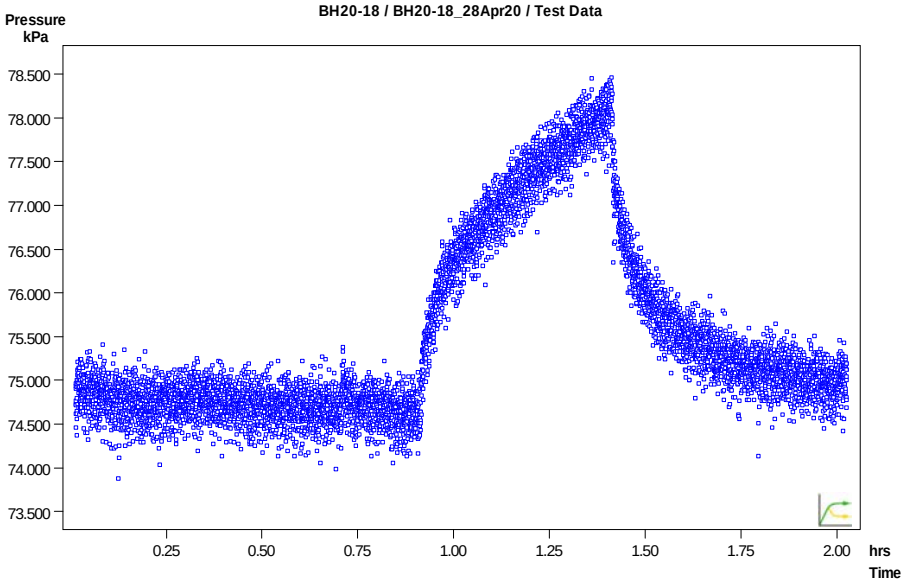
CONSULTANT
GOLDER
MEMBER OF WSP

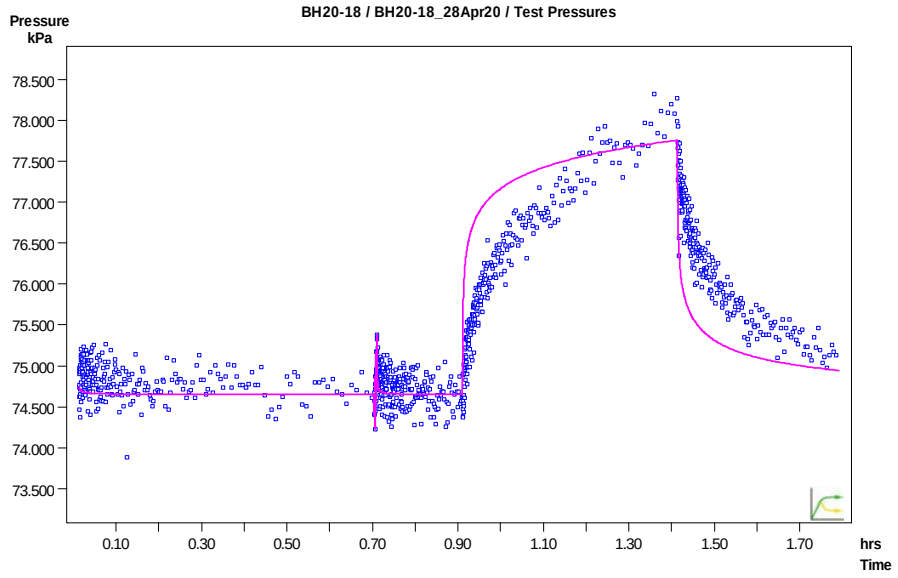
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

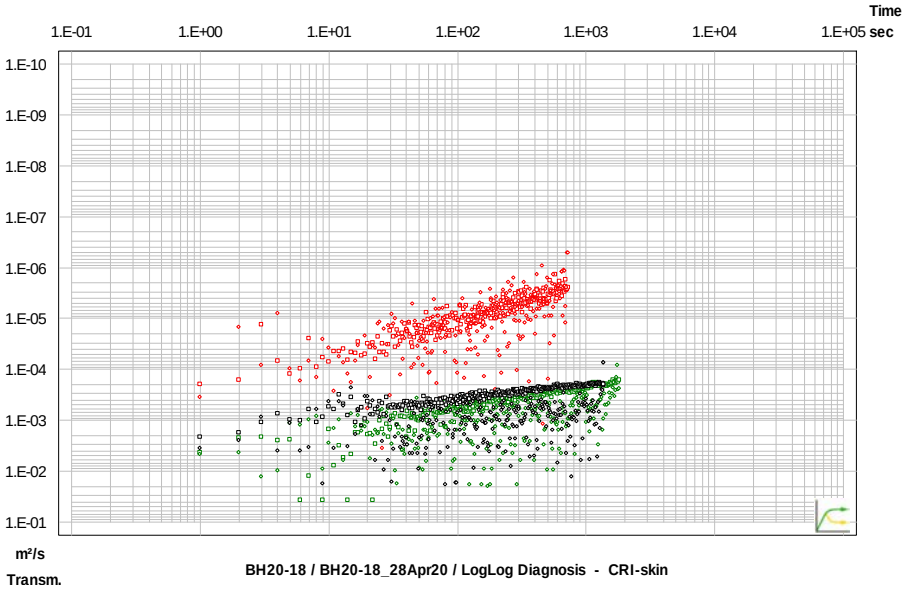
TITLE
PACKER TEST RESULTS BH20-17 LOWER INTERVAL (16.6 to 26.3 mbgs)

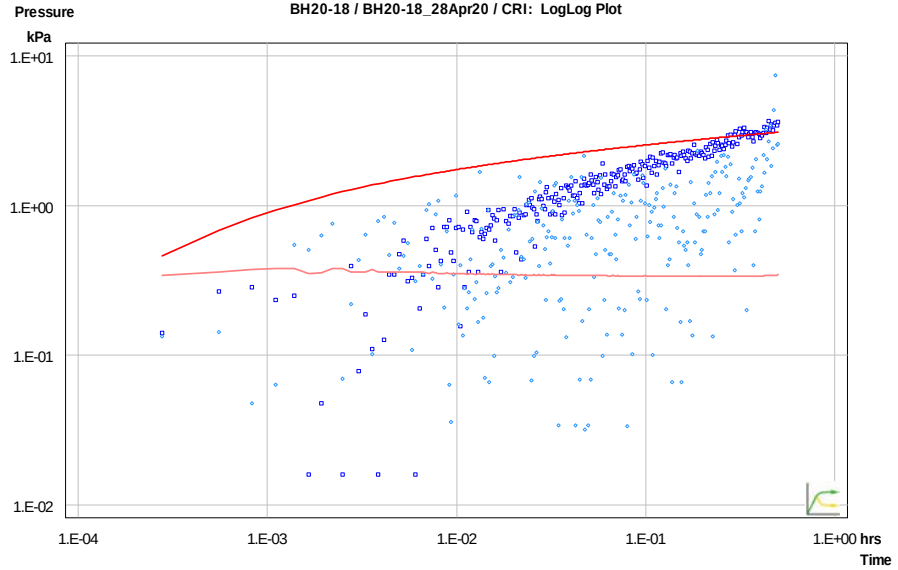
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-033

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-17
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

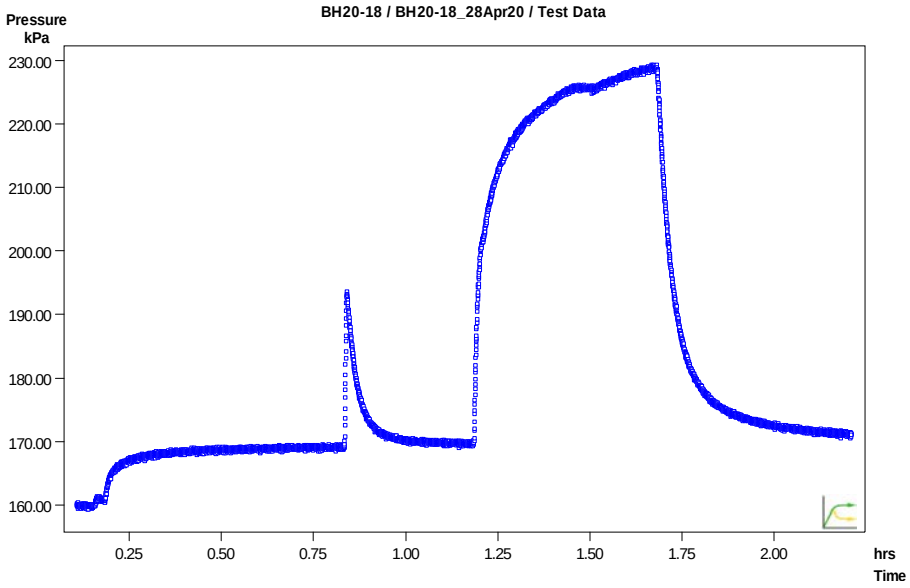
CALEDON PIT / QUARRY

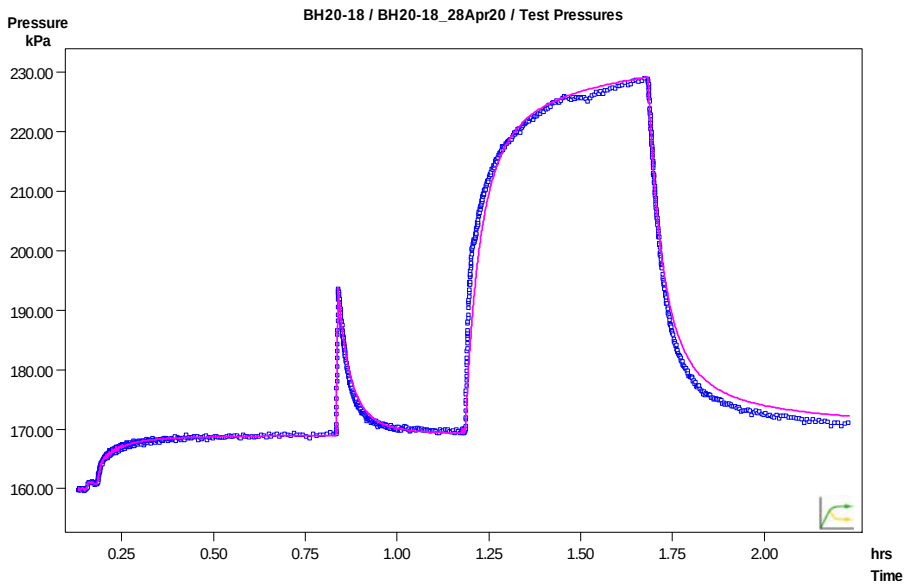
TITLE

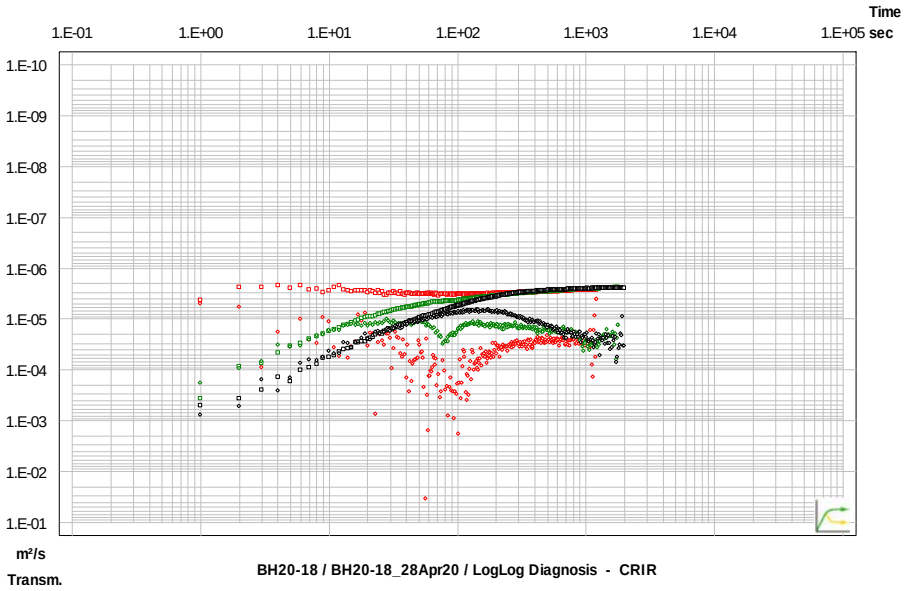
PACKER TEST RESULTS BH20-18 UPPER INTERVAL (12.2 to 20.3 mbgs)

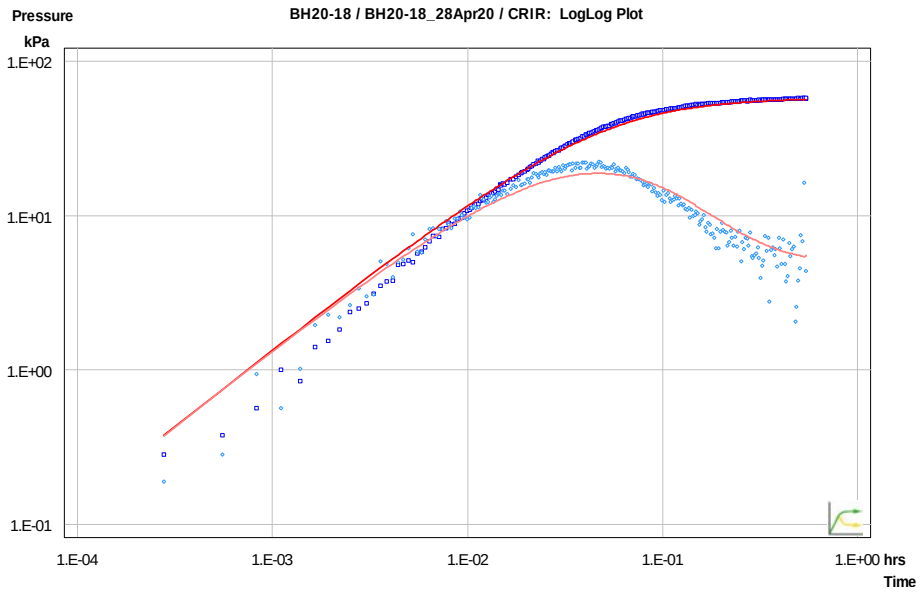
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-034

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

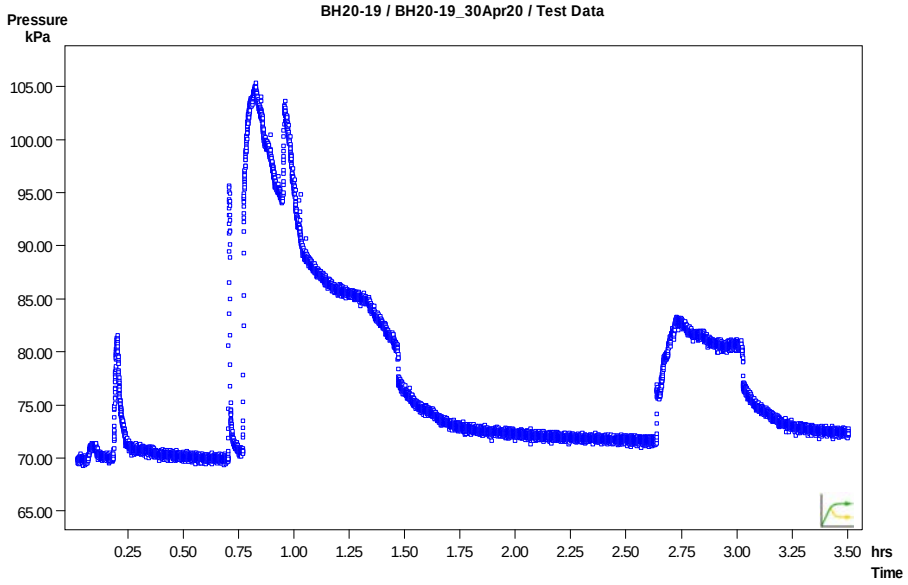
CALEDON PIT / QUARRY

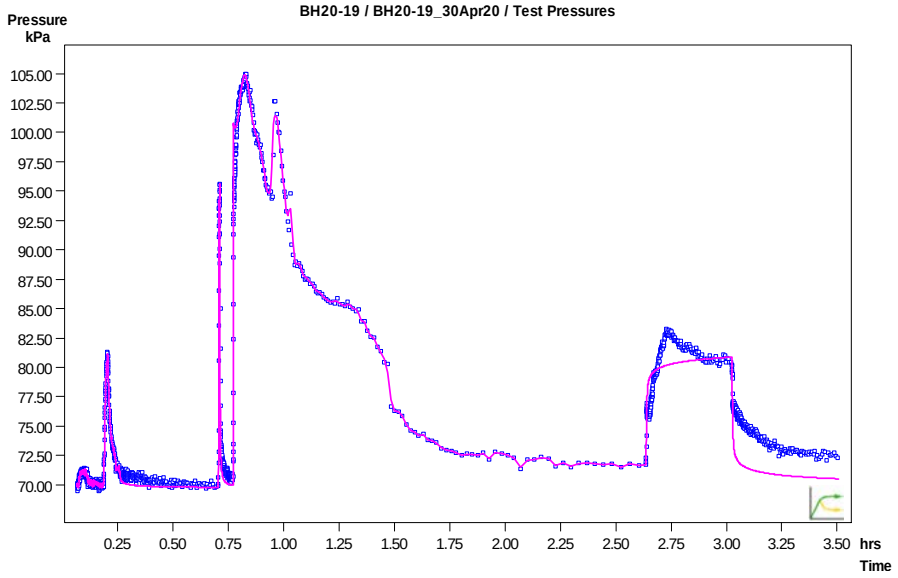
TITLE

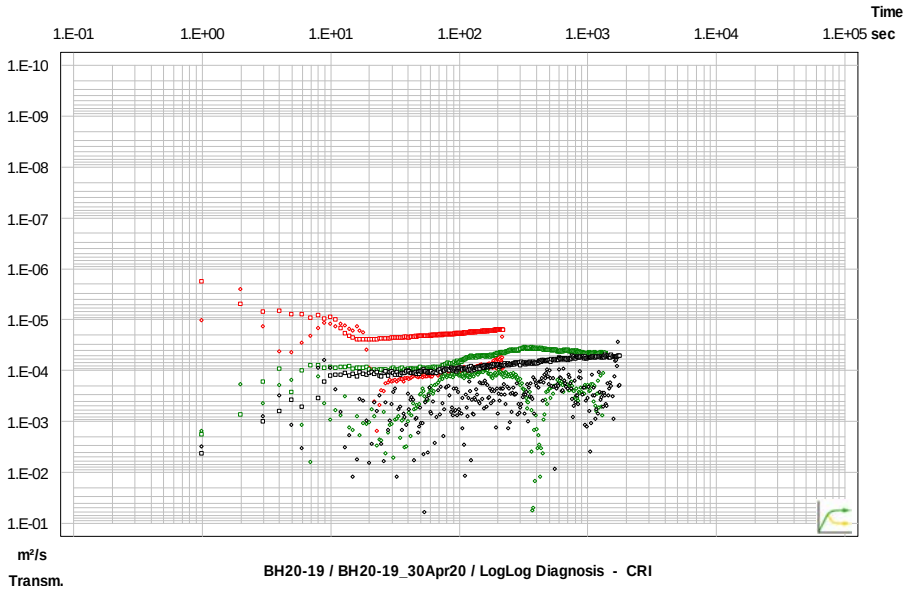
PACKER TEST RESULTS BH20-18 LOWER INTERVAL (20.6 to 28.7 mbgs)

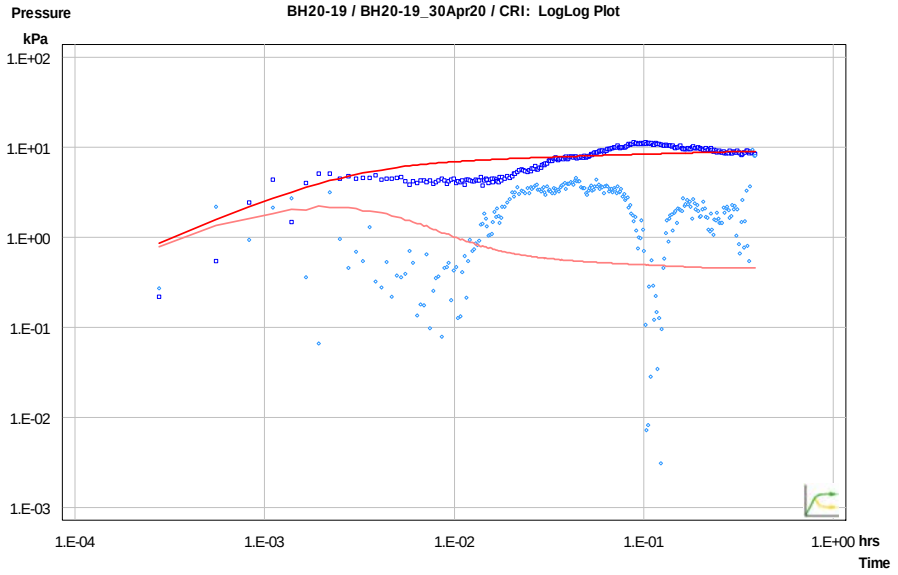
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-035

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15	
PREPARED	PGM	
DESIGN	ML	
REVIEW	###	
APPROVED		

PROJECT

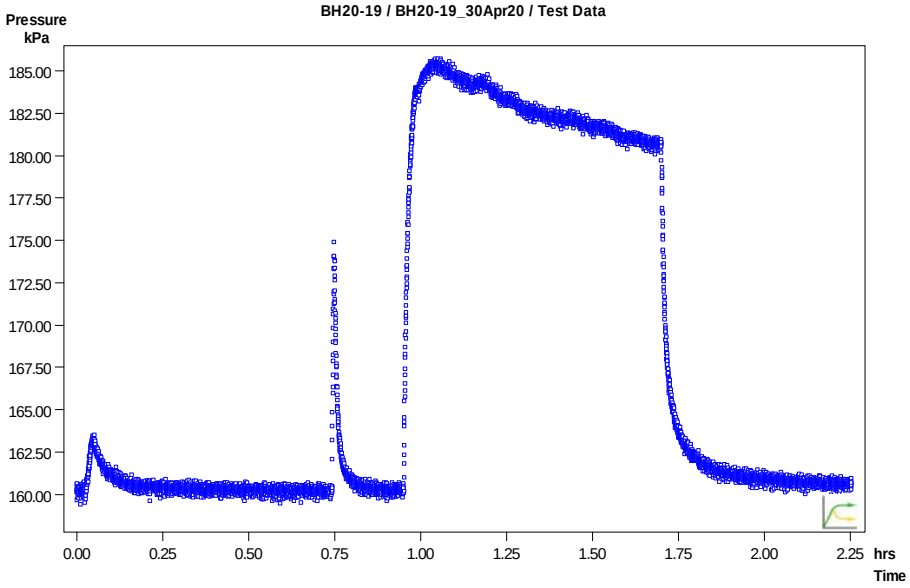
CALEDON PIT / QUARRY

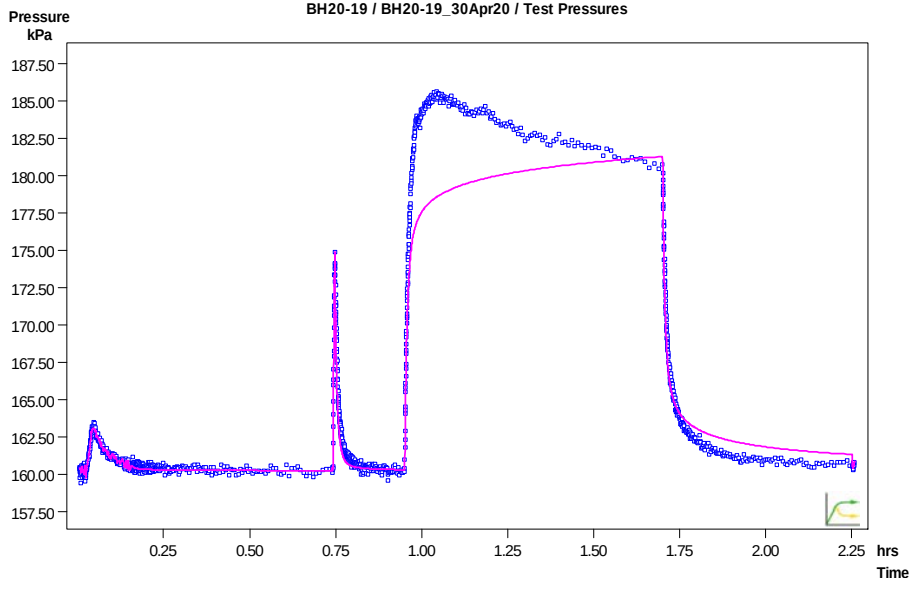
TITLE

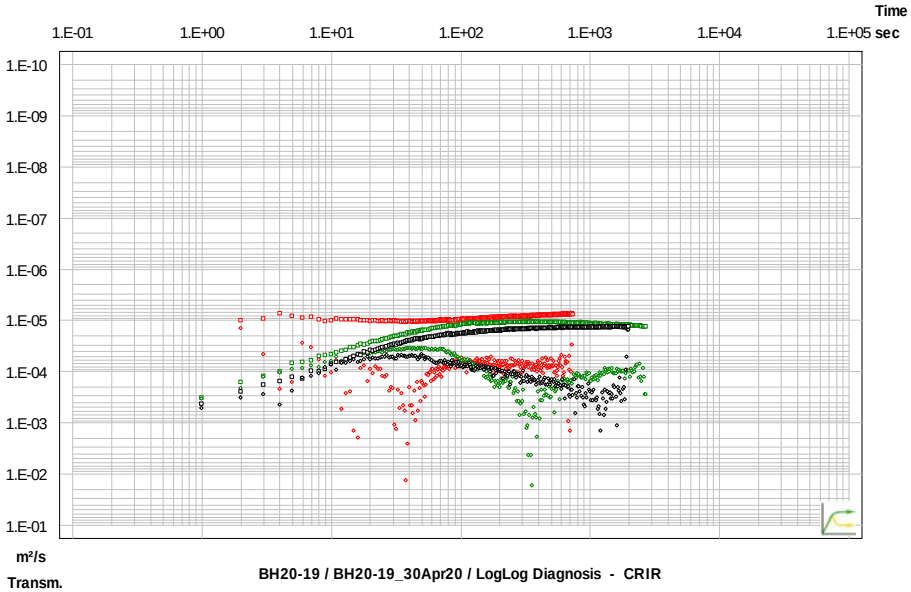
PACKER TEST RESULTS BH20-19 UPPER INTERVAL (5.0 to 13.1 mbgs)

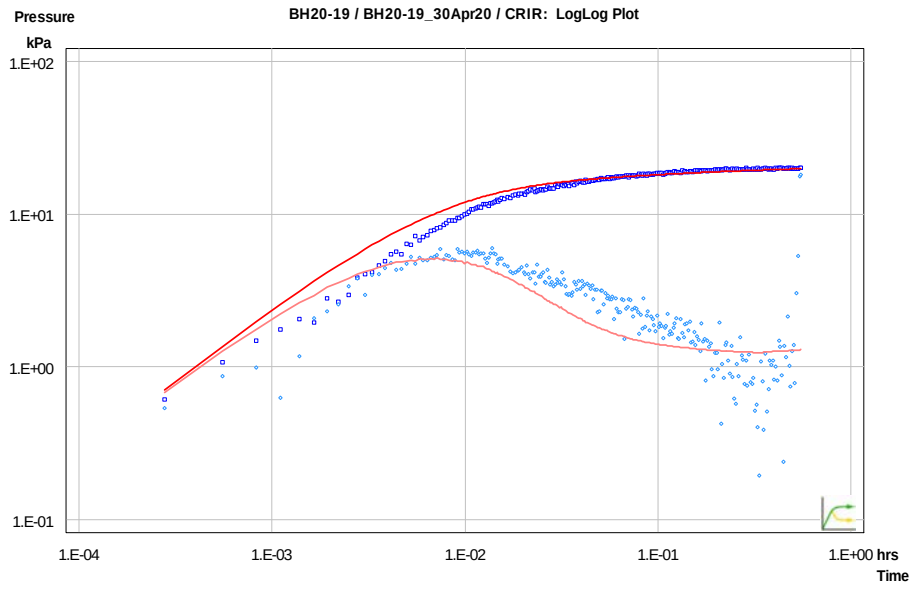
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-036

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

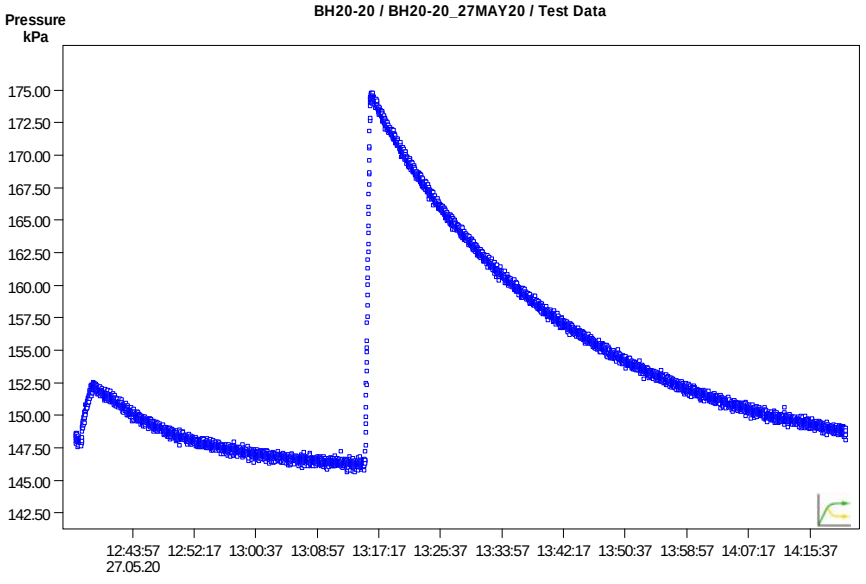
CALEDON PIT / QUARRY

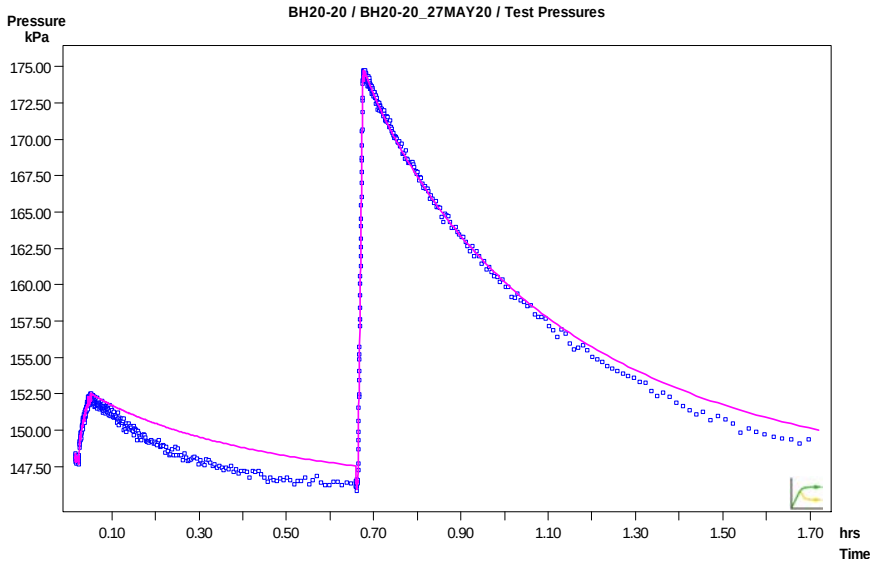
TITLE

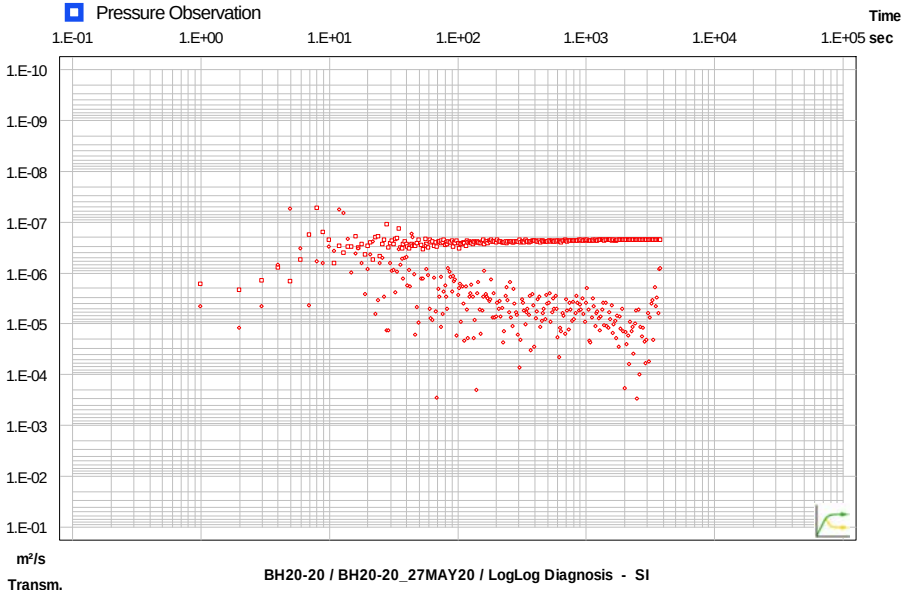
PACKER TEST RESULTS BH20-19 LOWER INTERVAL (12.5 to 22.1 mbgs)

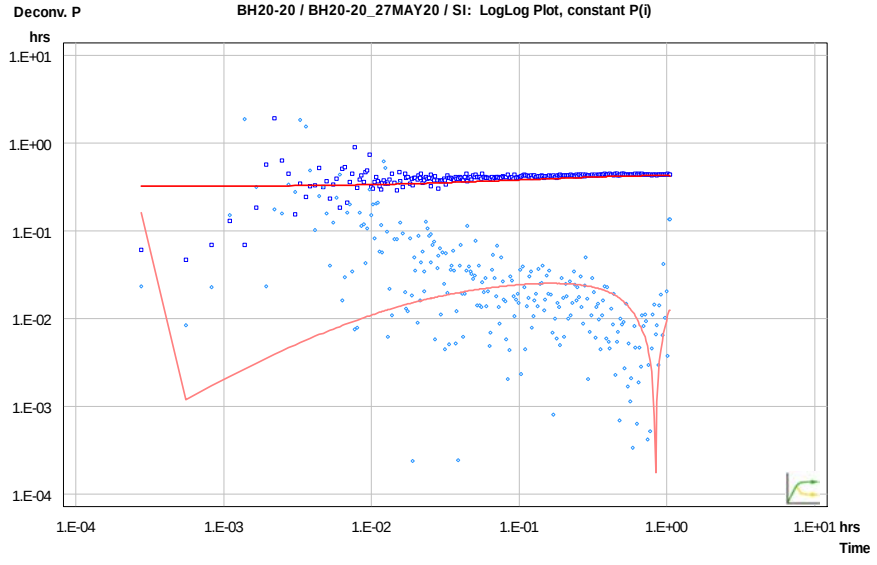
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-037

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

CLIENT
CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

	YYYY-MM-DD	2022-02-15
PREPARED		PGM
DESIGN		ML
REVIEW		###
APPROVED		

TITLE
PACKER TEST RESULTS BH20-20 UPPER INTERVAL (16.9 to 28.2 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-038

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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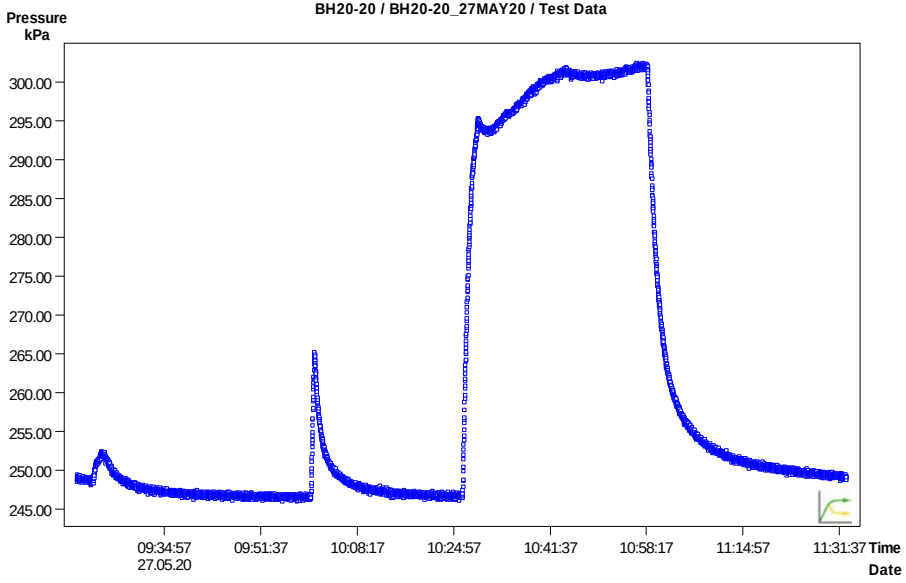
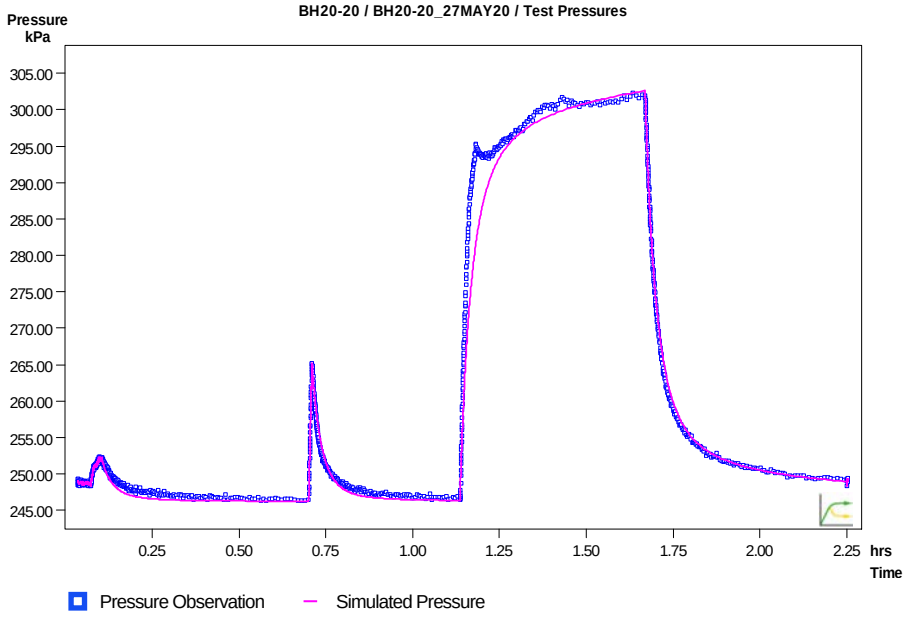
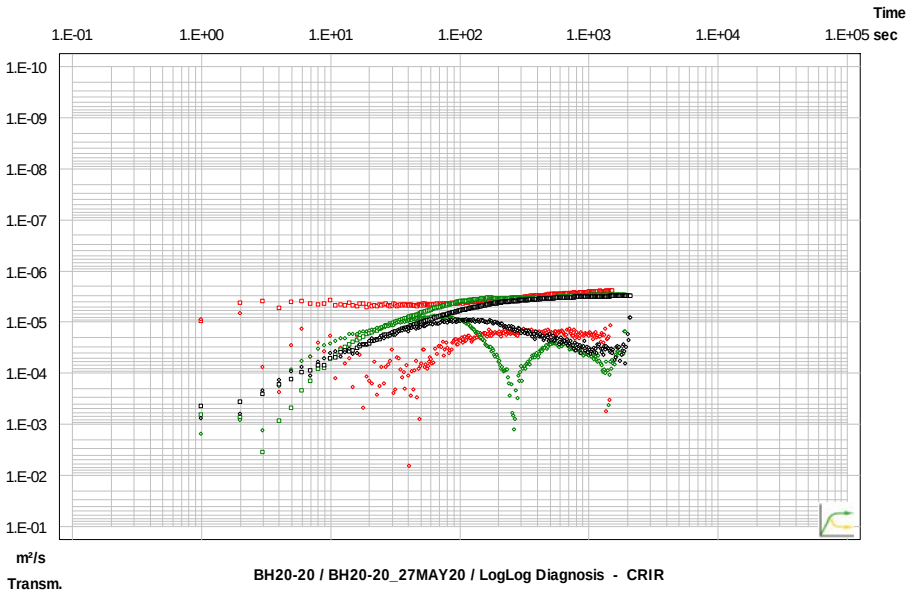
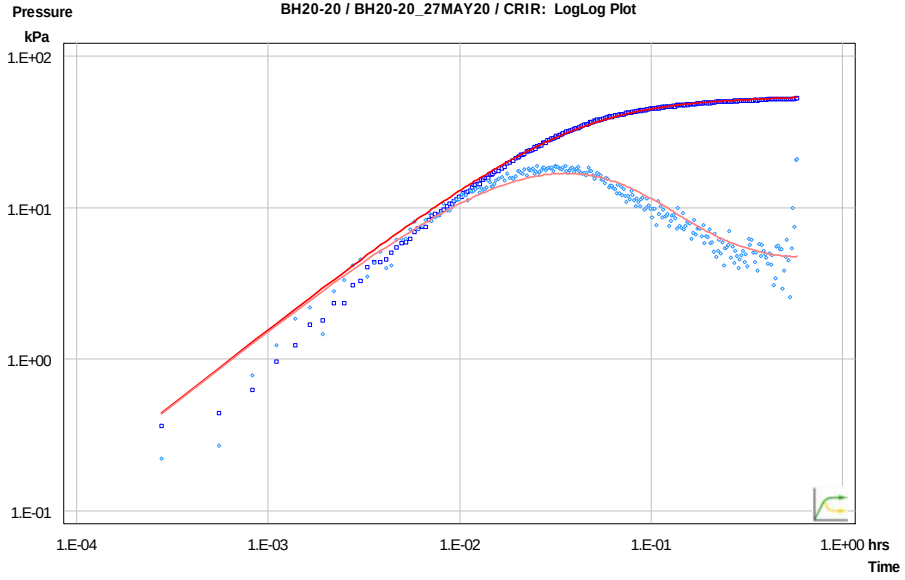








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

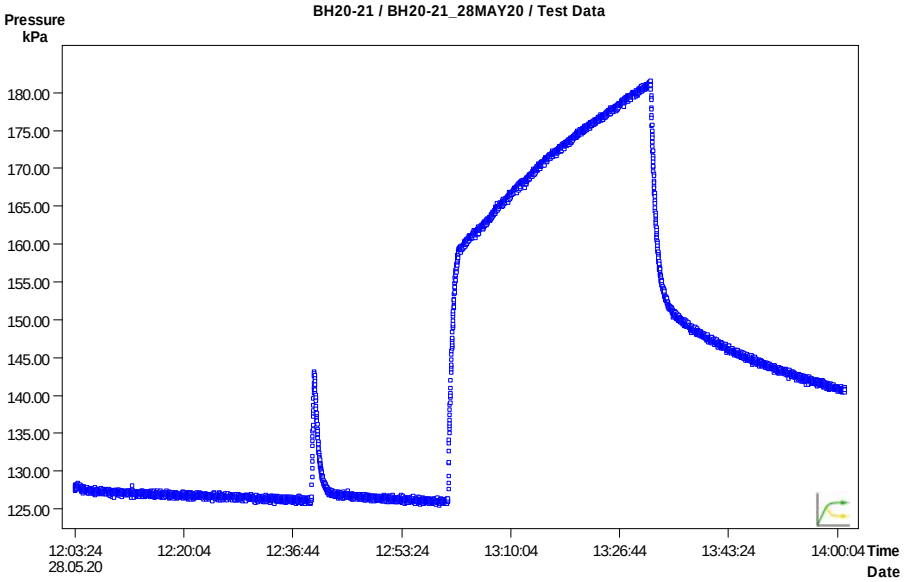
CALEDON PIT / QUARRY

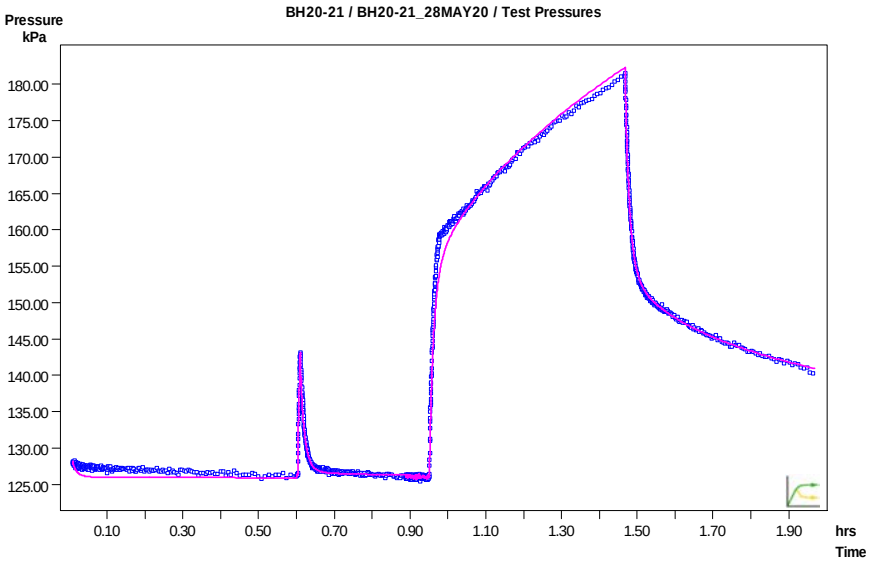
TITLE

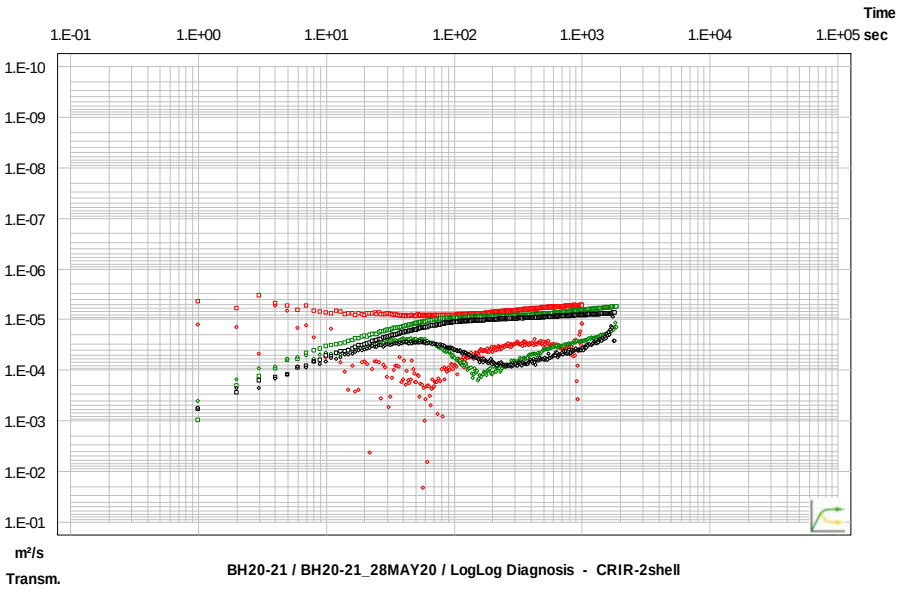
PACKER TEST RESULTS BH20-20 LOWER INTERVAL (27.3 to 38.5 mbgs)

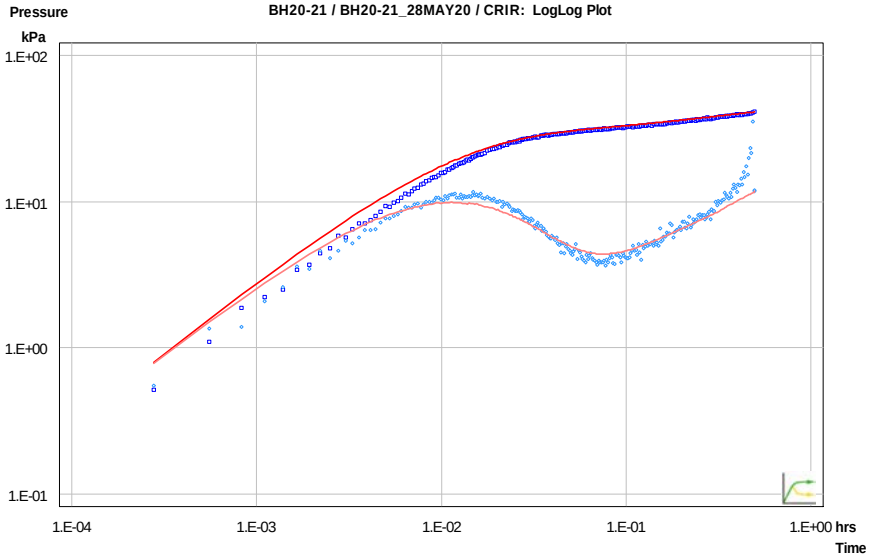
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-039

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15	
PREPARED	PGM	
DESIGN	ML	
REVIEW	###	
APPROVED		

PROJECT

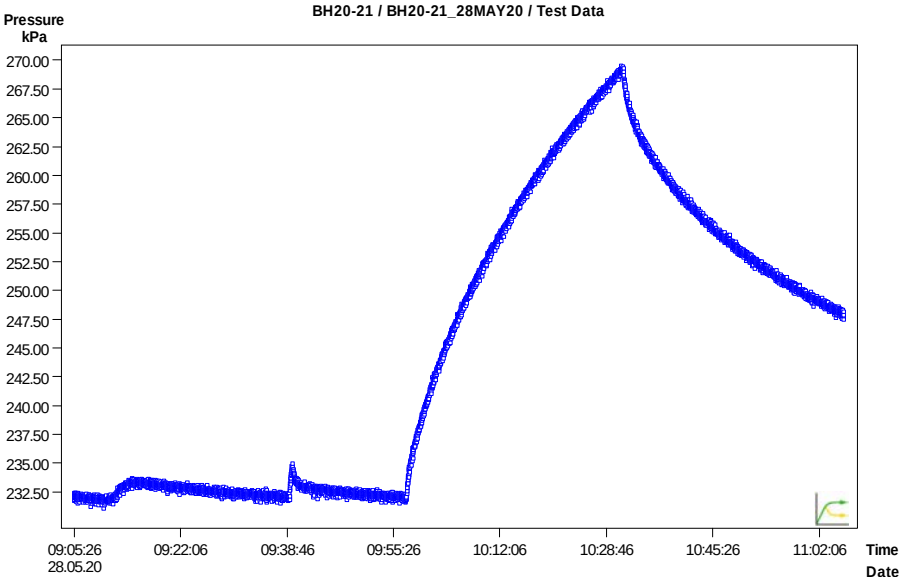
CALEDON PIT / QUARRY

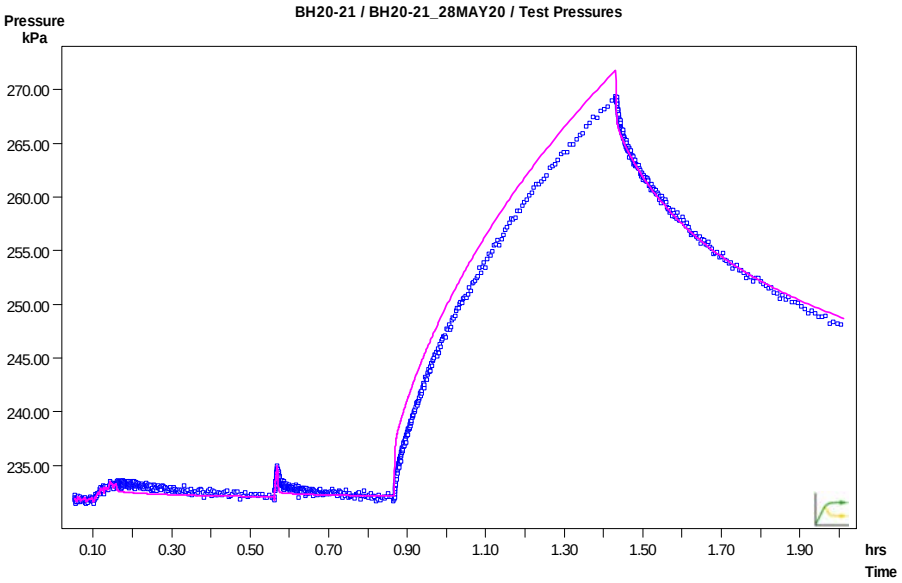
TITLE

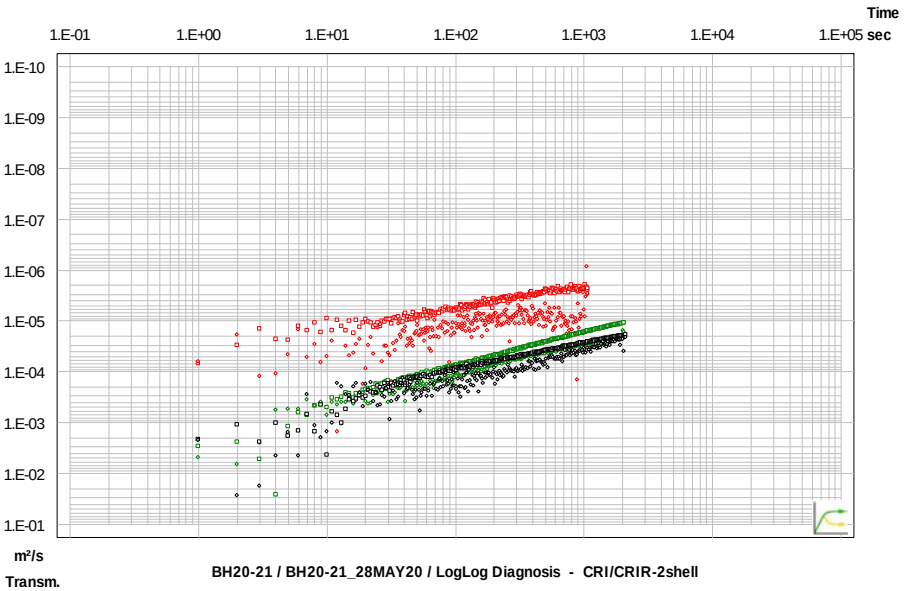
PACKER TEST RESULTS BH20-21 UPPER INTERVAL (8.3 to 19.5 mbgs)

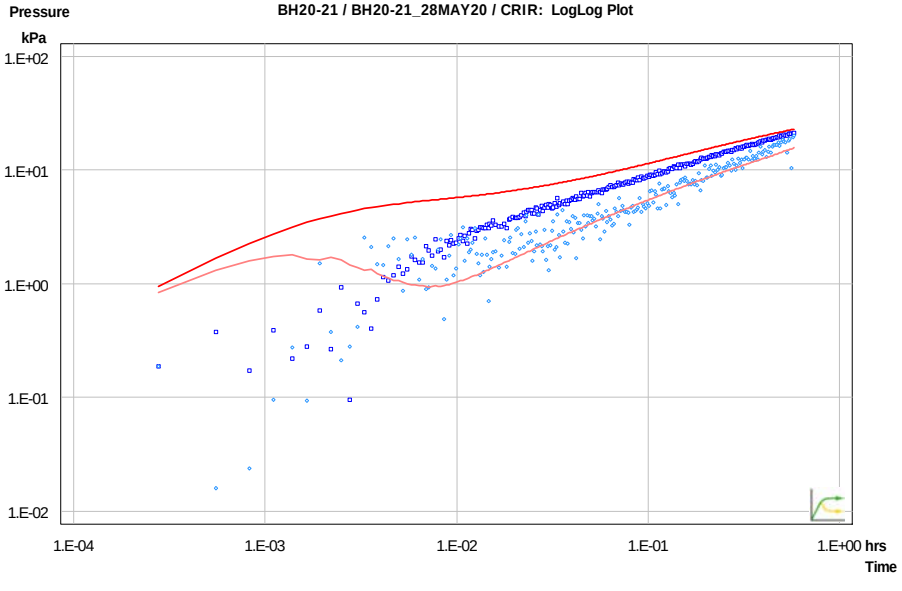
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-040

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-03-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

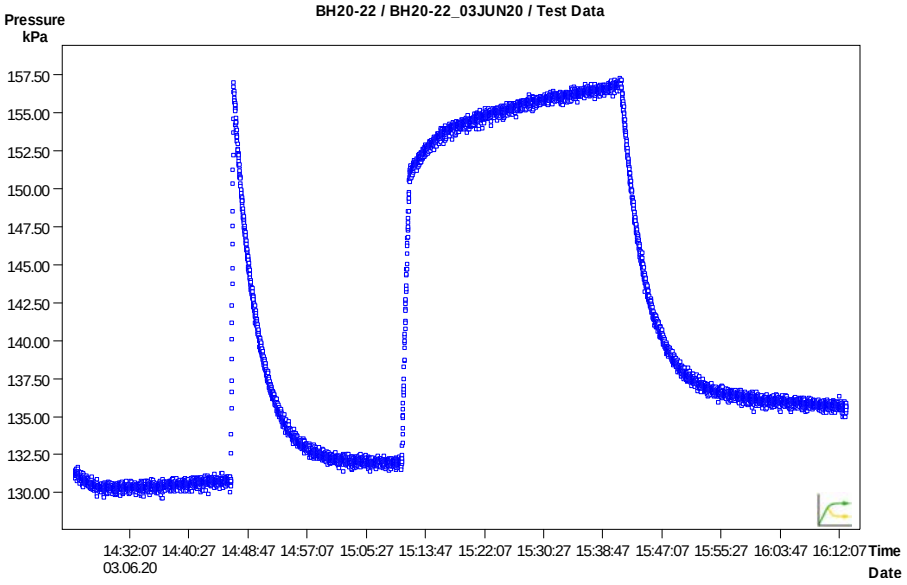
CALEDON PIT / QUARRY

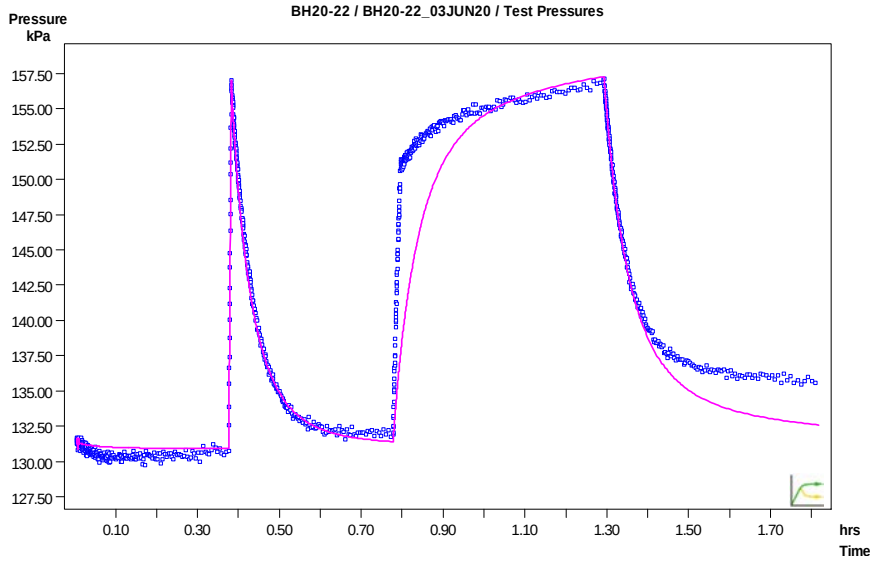
TITLE

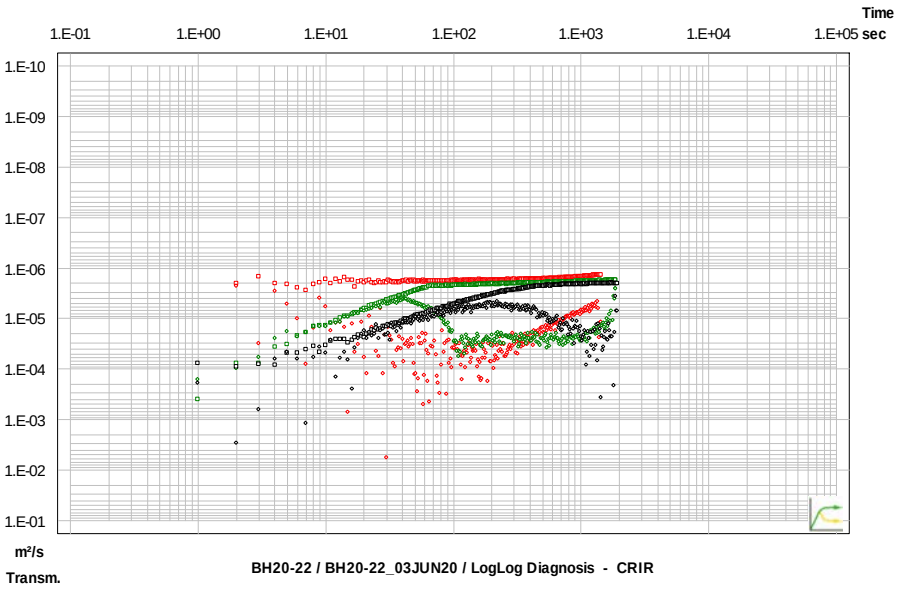
PACKER TEST RESULTS BH20-21 LOWER INTERVAL (19.5 to 30.8 mbgs)

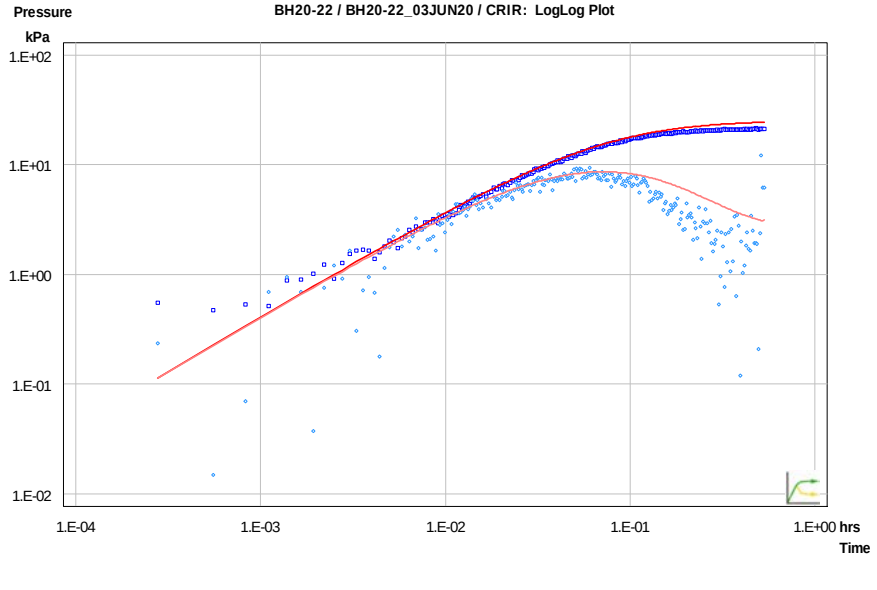
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-041

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

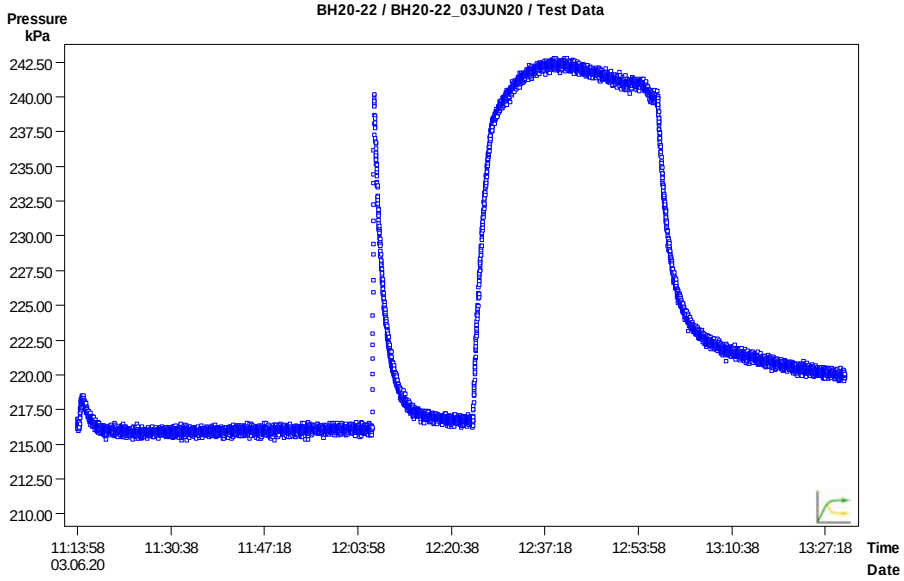
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

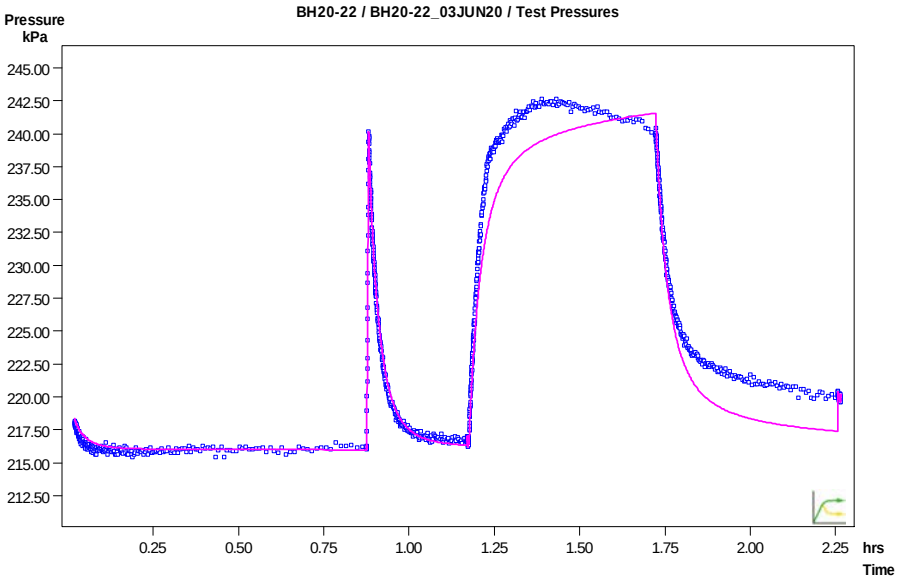
TITLE

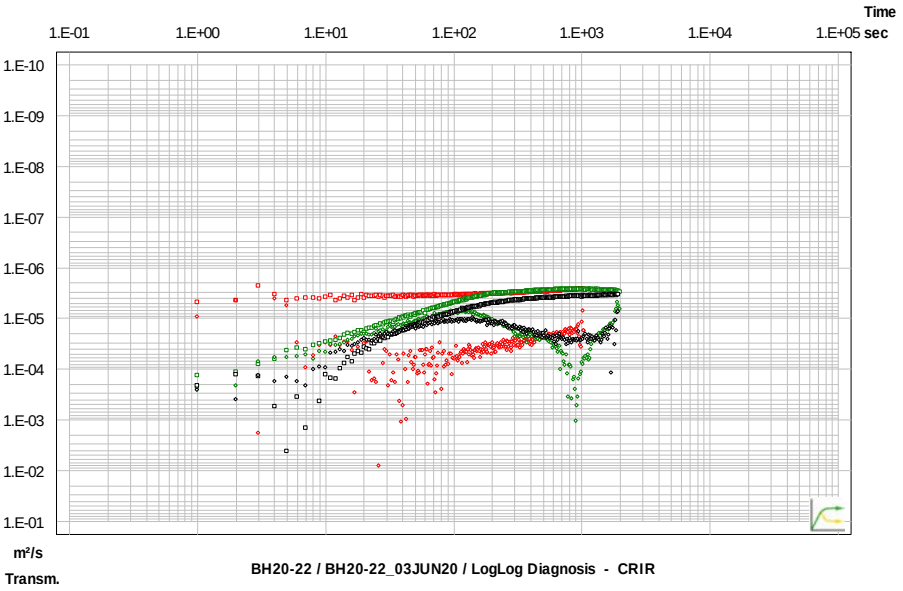
PACKER TEST RESULTS BH20-22 UPPER INTERVAL (7.6 to 17.4 mbgs)

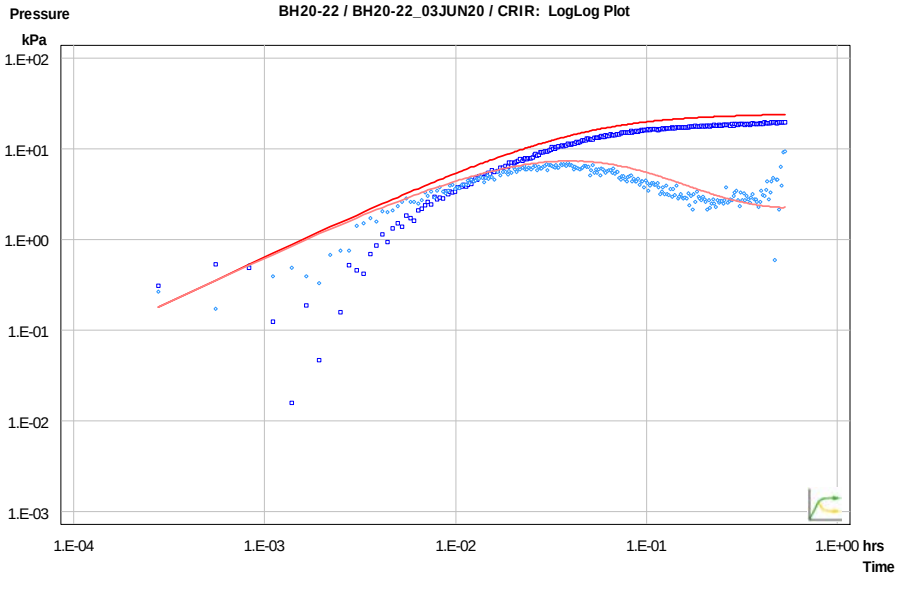
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-042

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

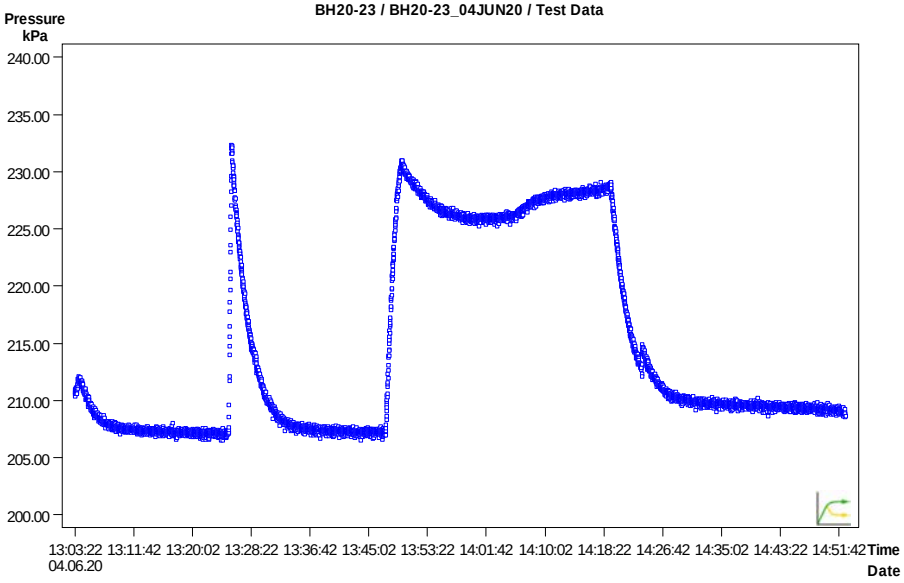
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

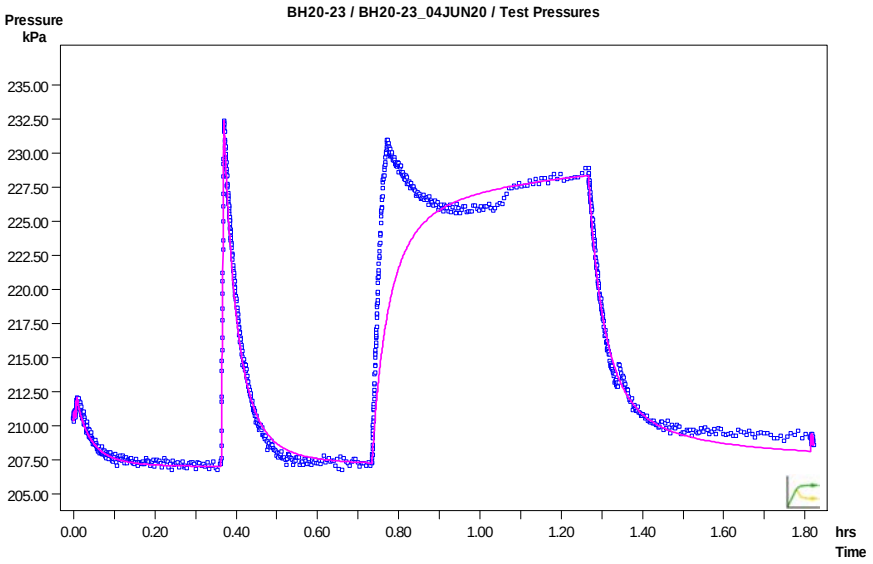
TITLE

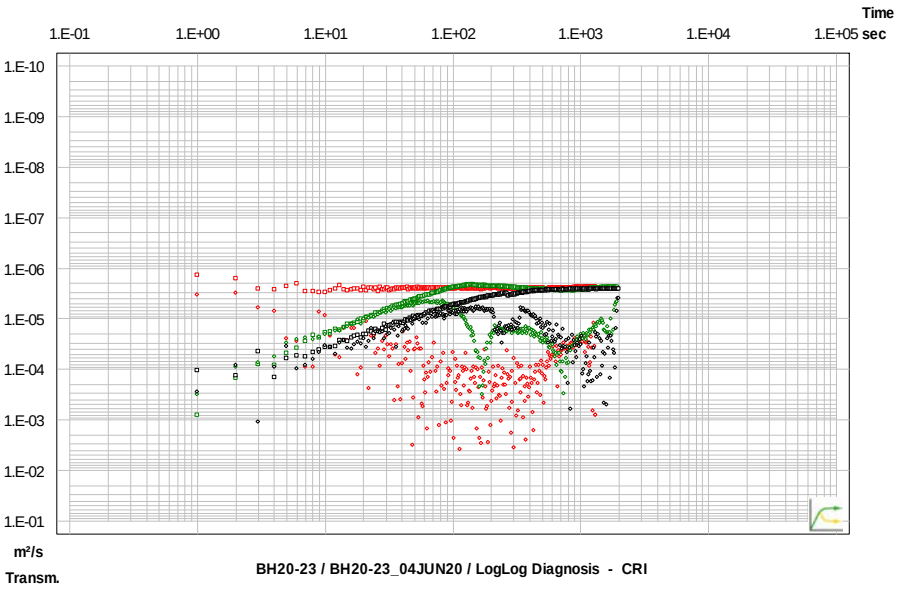
PACKER TEST RESULTS BH20-22 LOWER INTERVAL (16.4 to 26.2 mbgs)

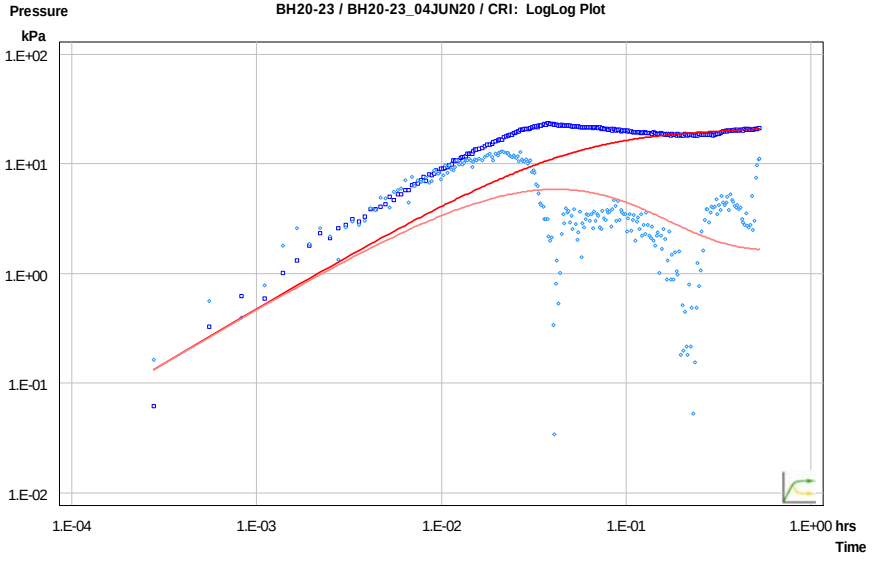
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-043

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

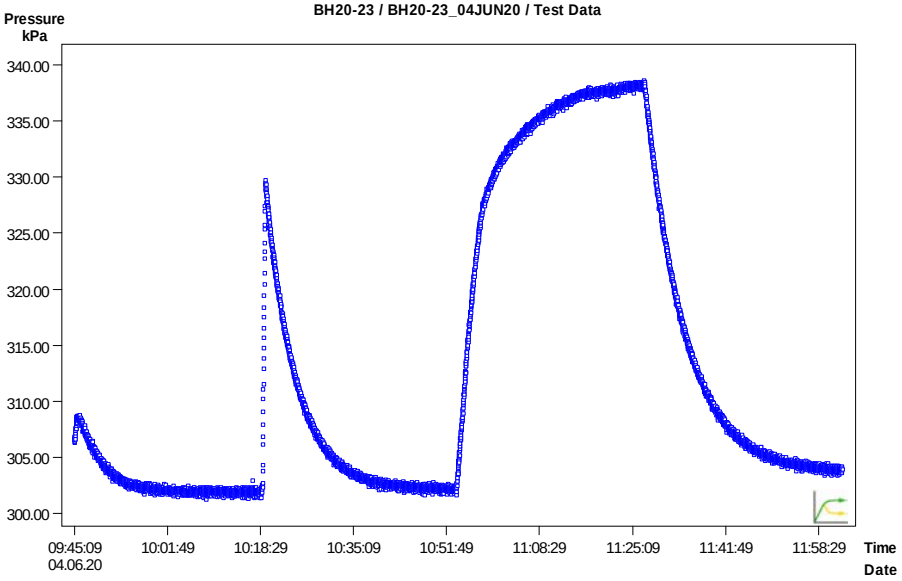
CALEDON PIT / QUARRY

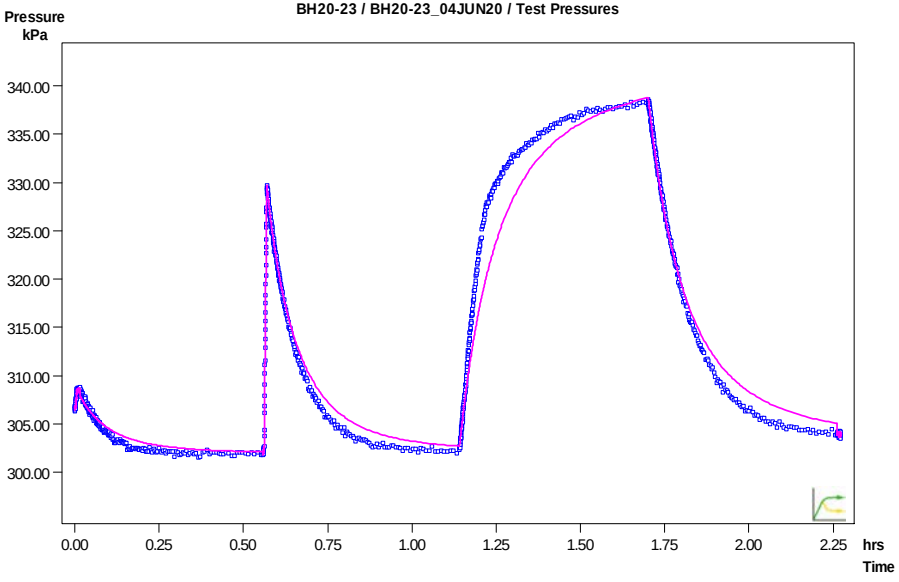
TITLE

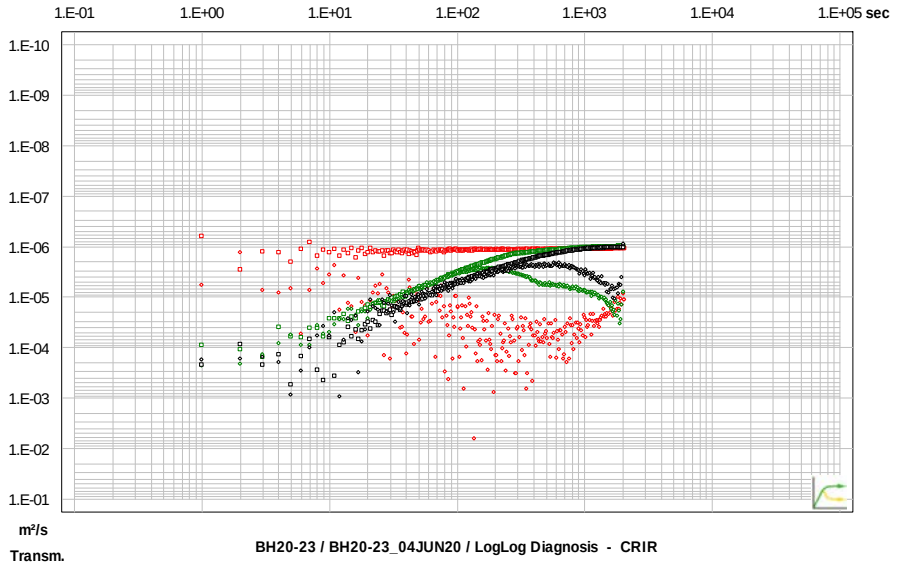
PACKER TEST RESULTS BH20-23 UPPER INTERVAL (16.9 to 25.1 mbgs)

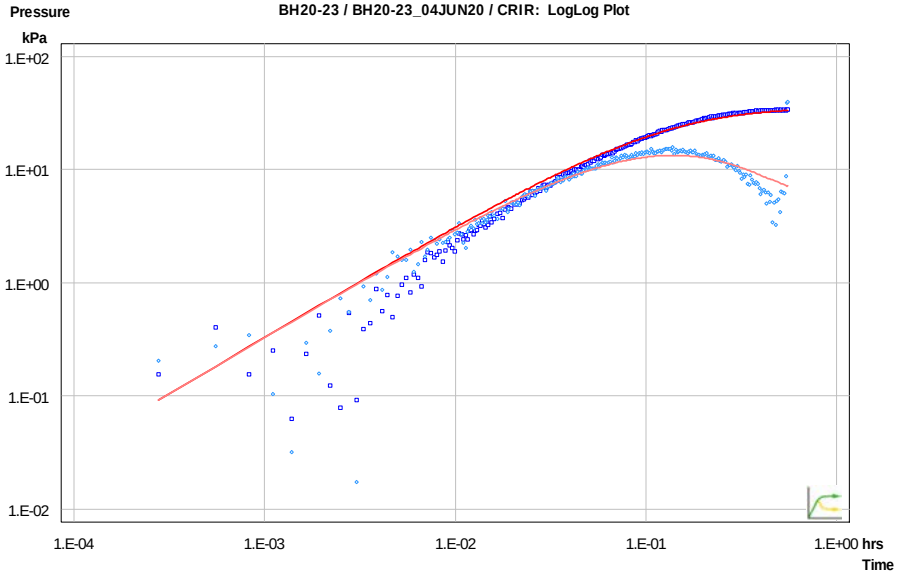
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-044

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

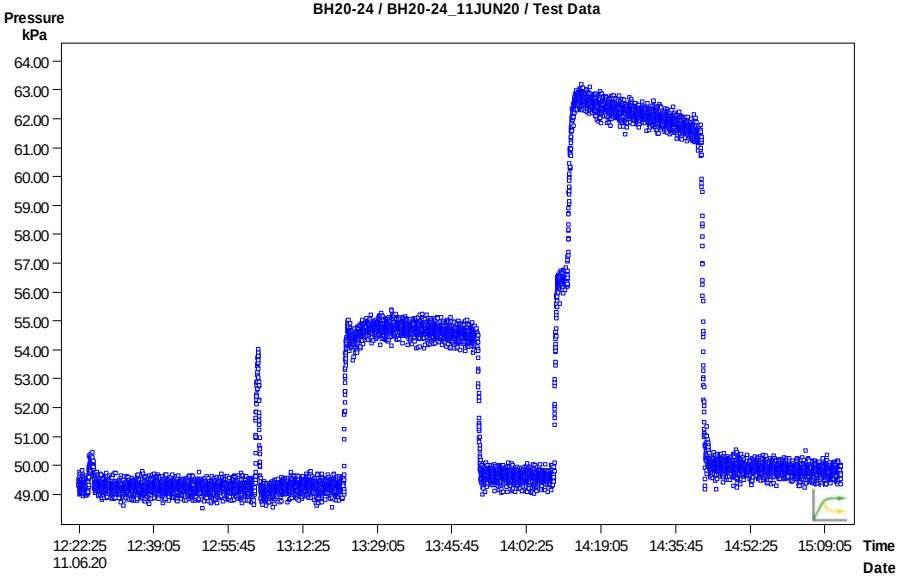
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

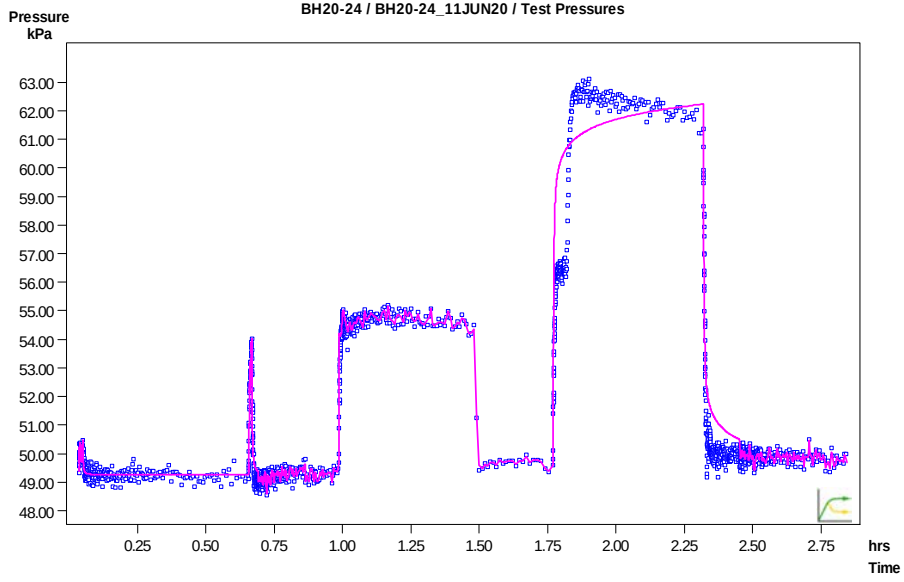
TITLE

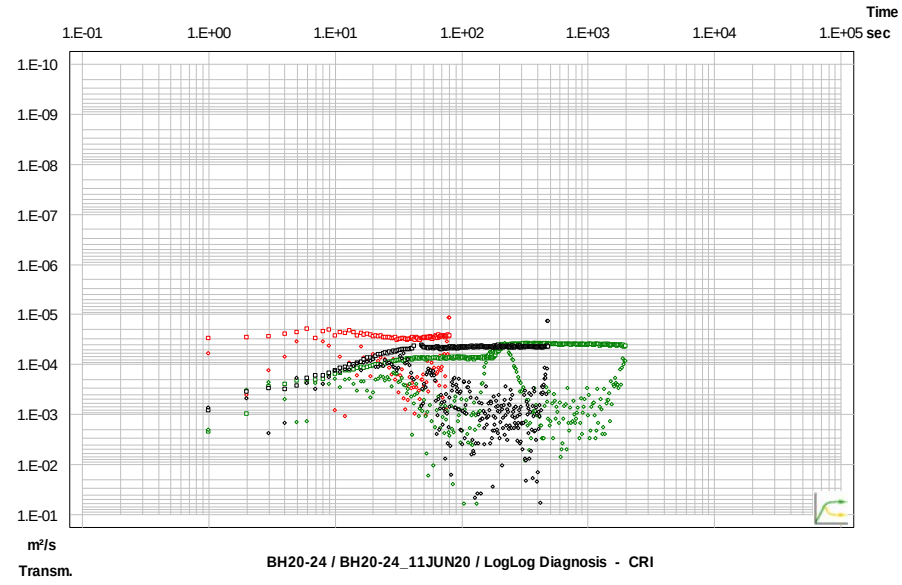
PACKER TEST RESULTS BH20-23 LOWER INTERVAL (25.1 to 34.9 mbgs)

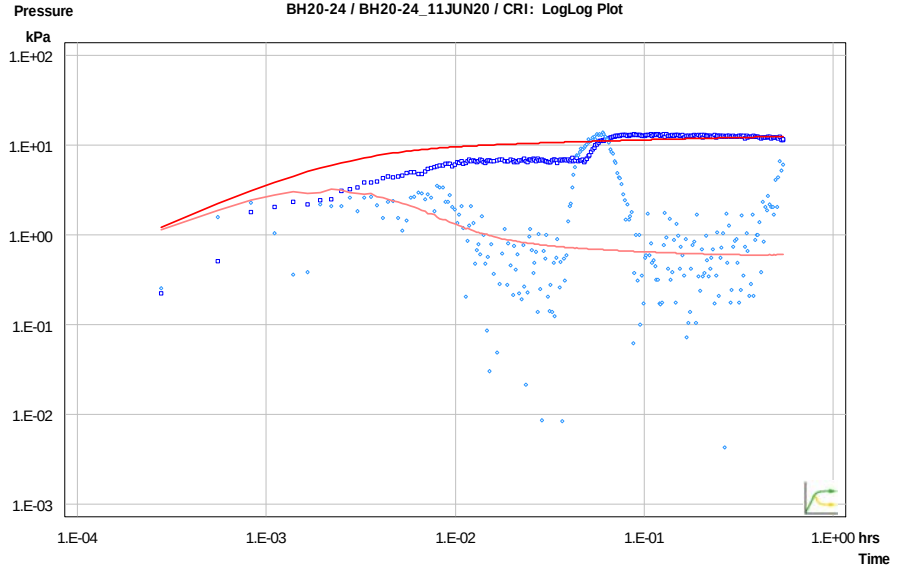
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-045

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

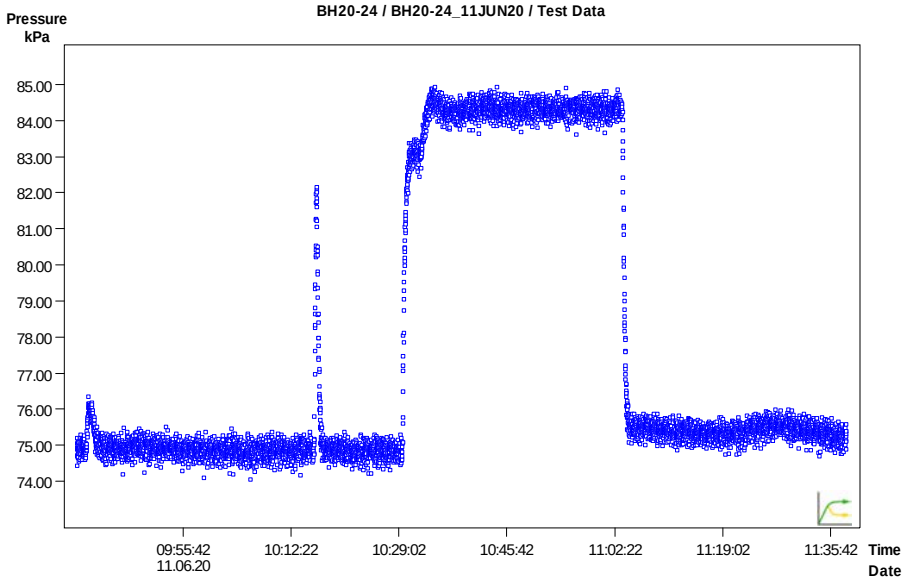
CALEDON PIT / QUARRY

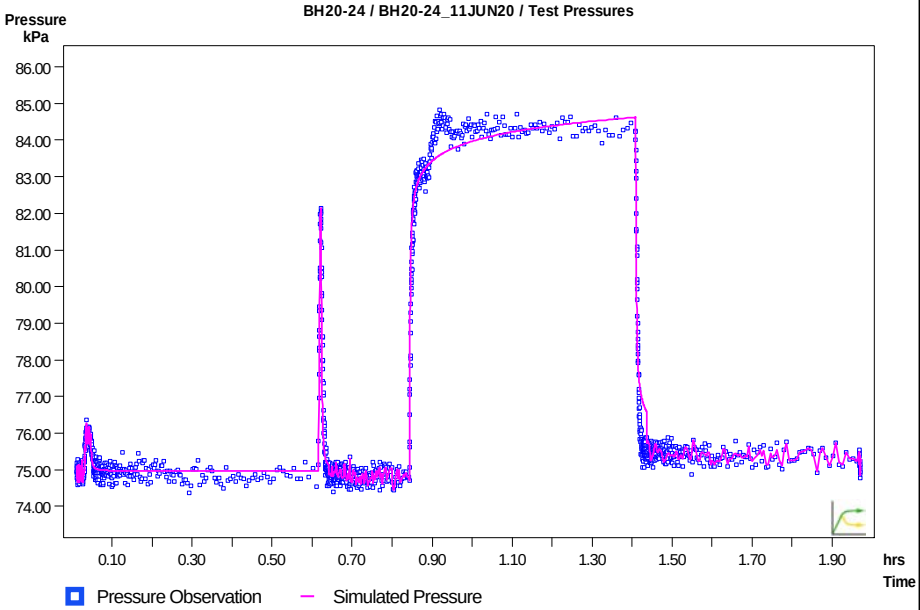
TITLE

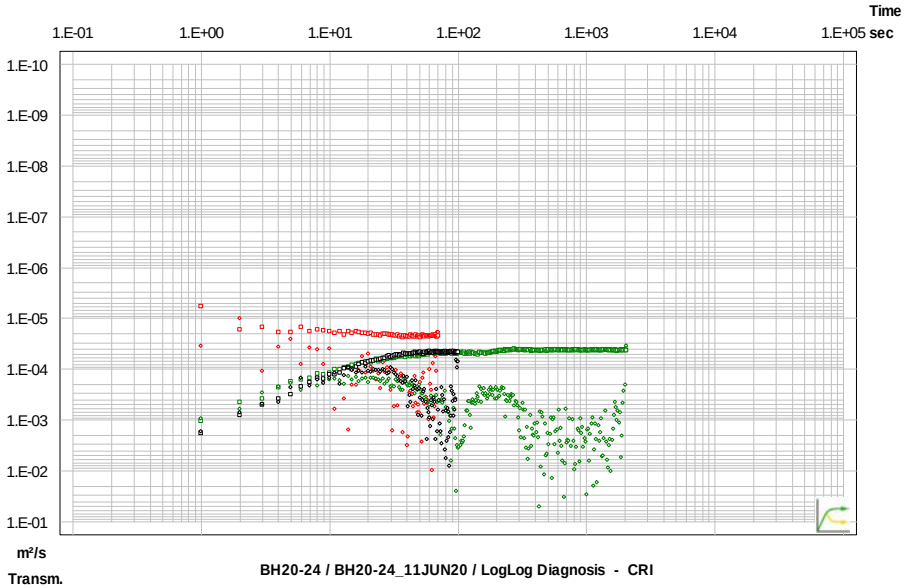
PACKER TEST RESULTS BH20-24 UPPER INTERVAL (14.0 to 17.7 mbgs)

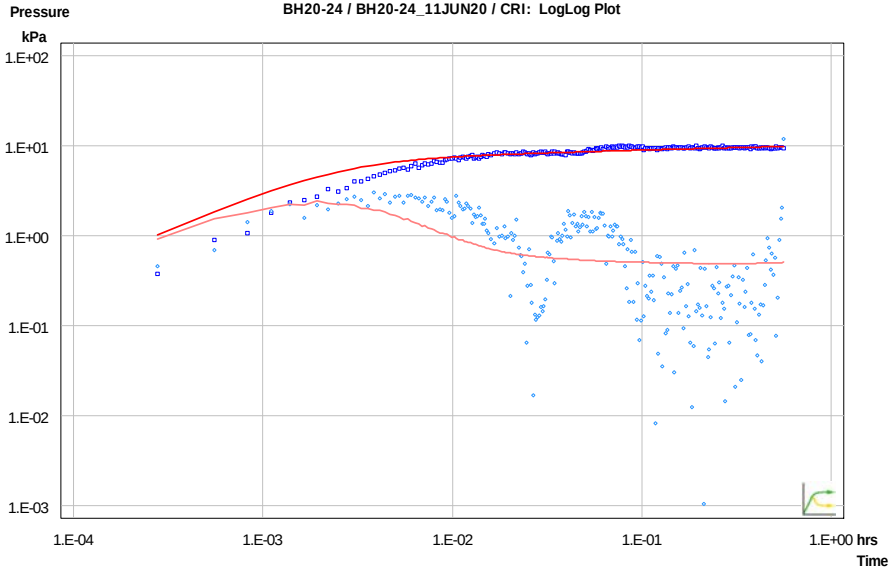
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-046

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

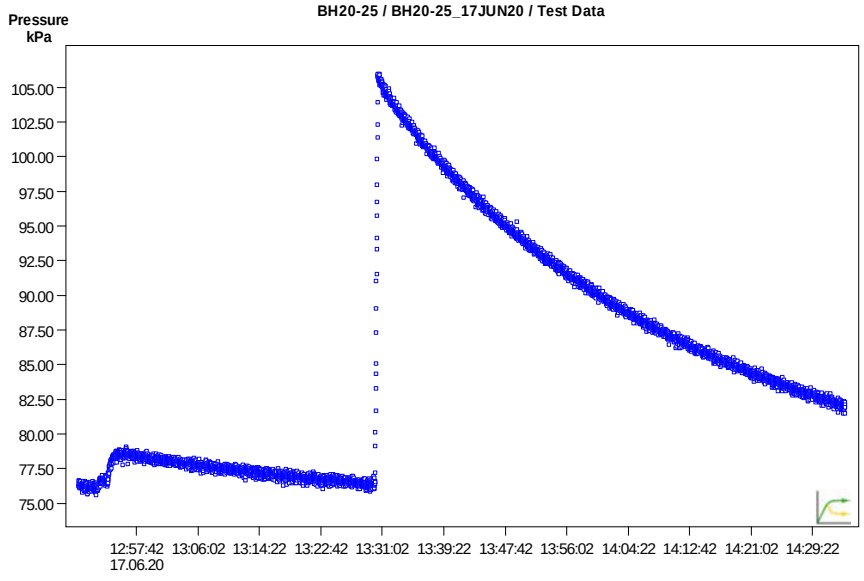
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

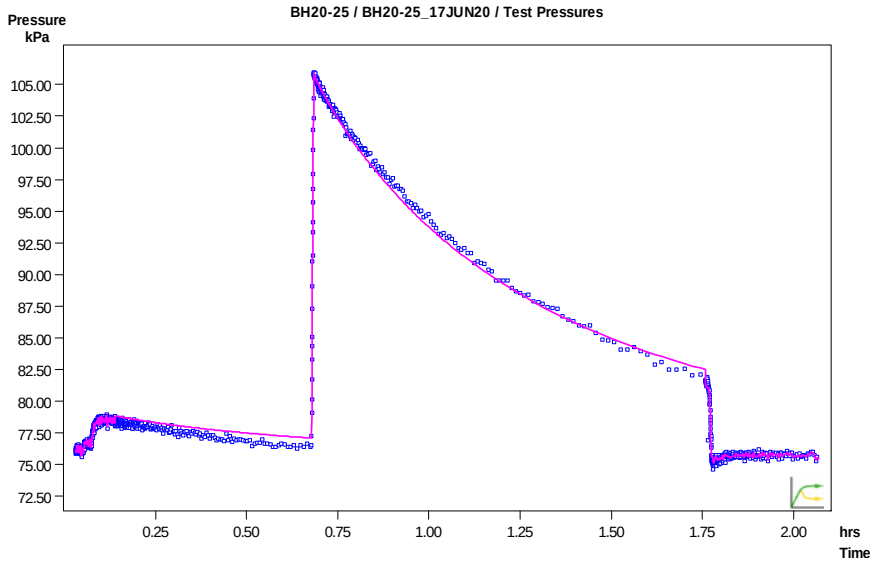
TITLE

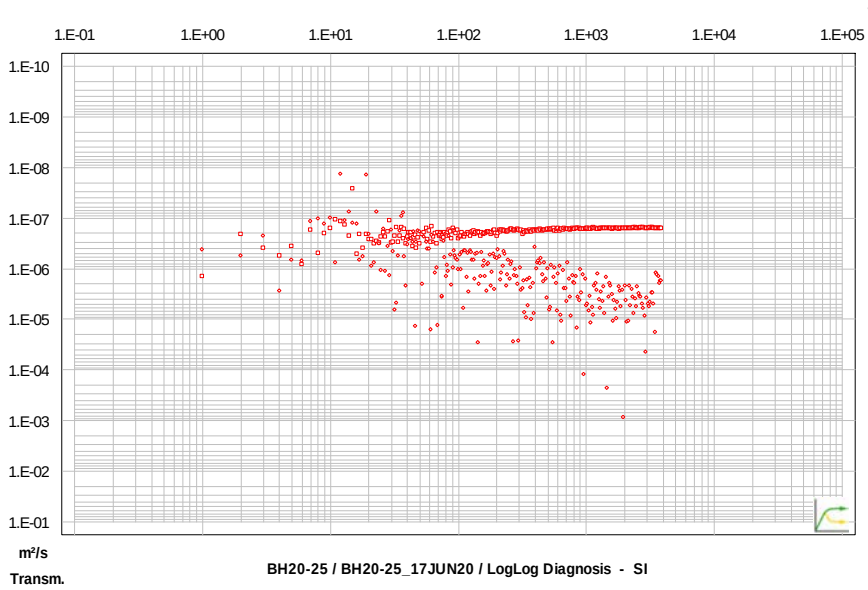
PACKER TEST RESULTS BH20-24 LOWER INTERVAL (16.7 to 20.3 mbgs)

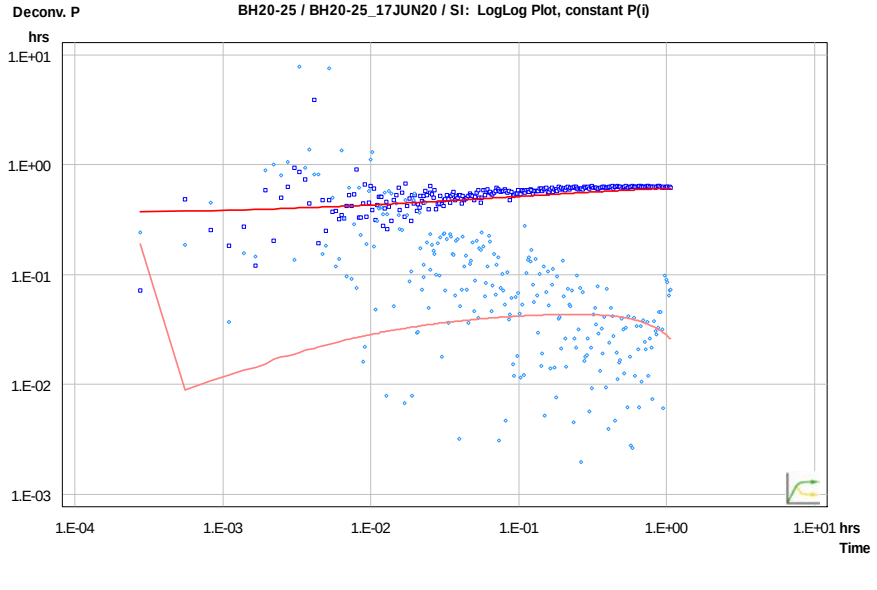
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-047

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

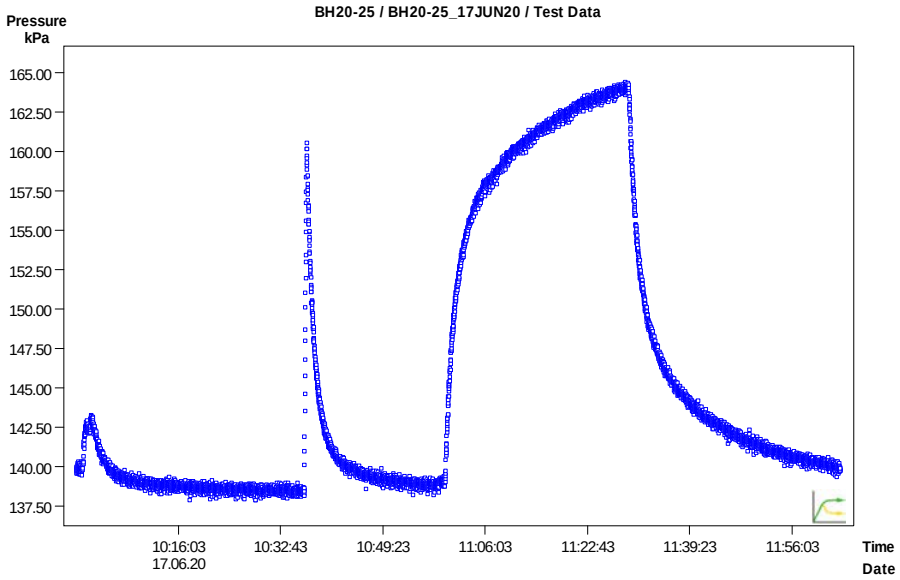
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

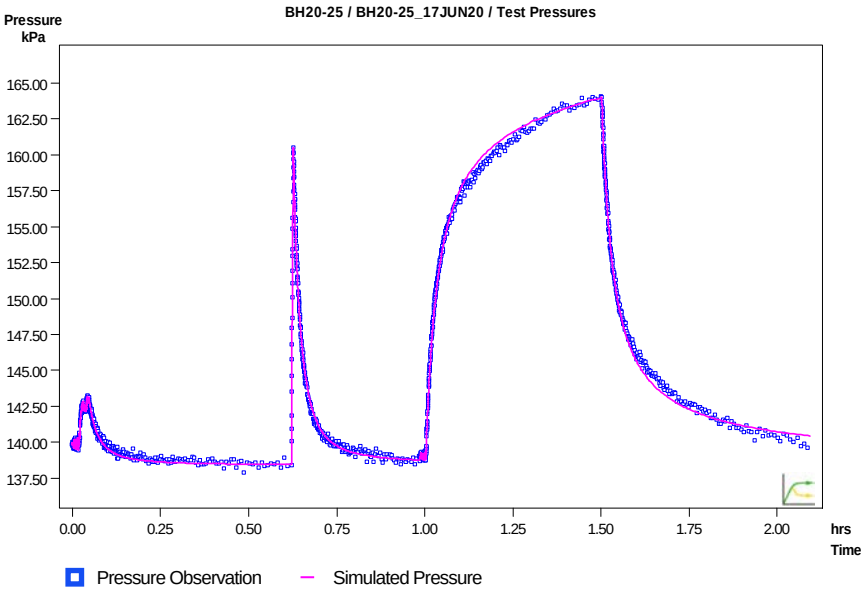
TITLE

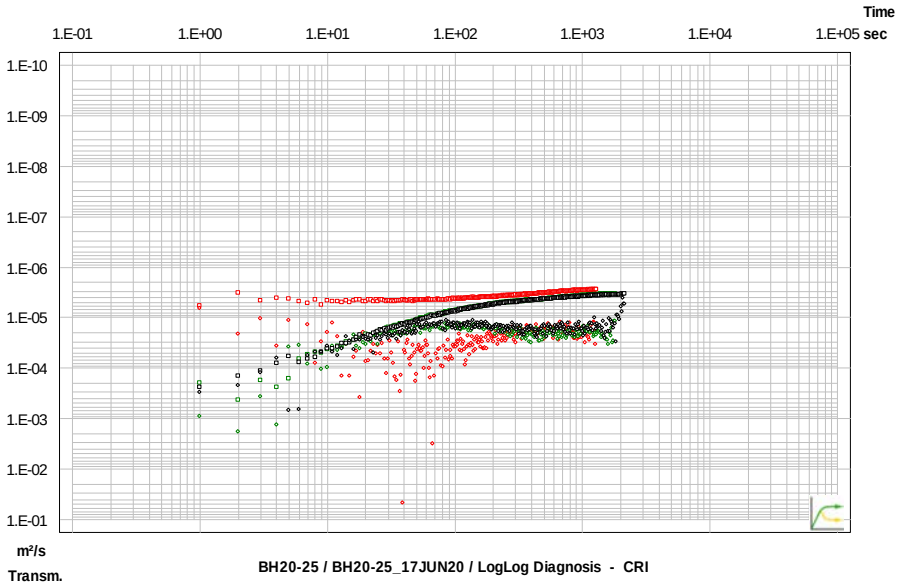
PACKER TEST RESULTS BH20-25 UPPER INTERVAL (7.9 to 13.1 mbgs)

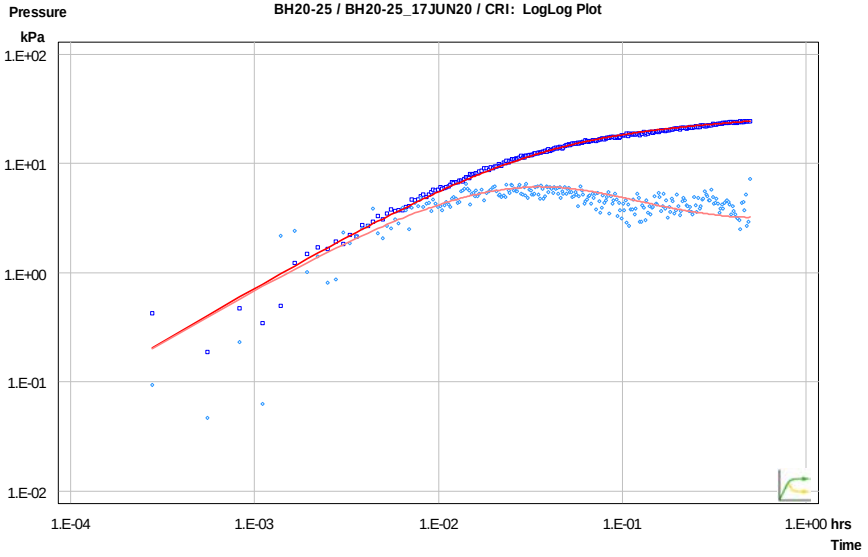
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-048

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

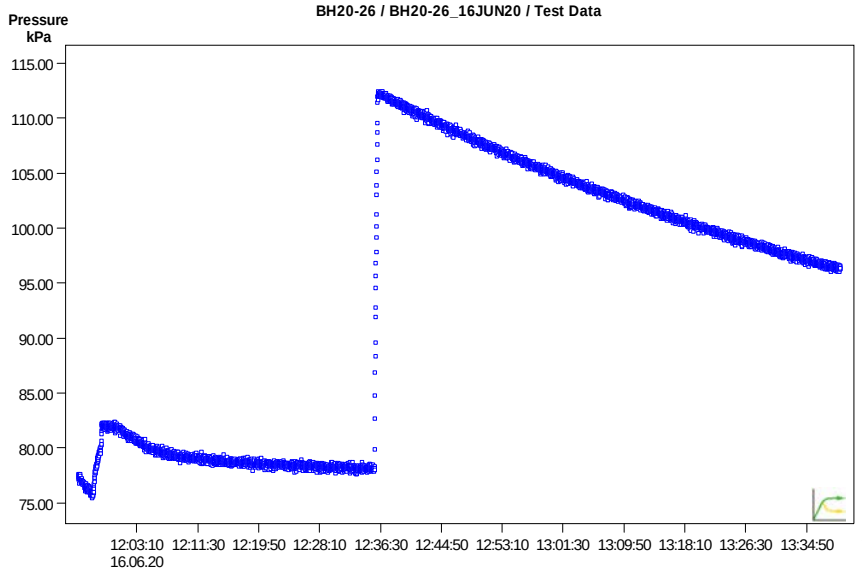
CALEDON PIT / QUARRY

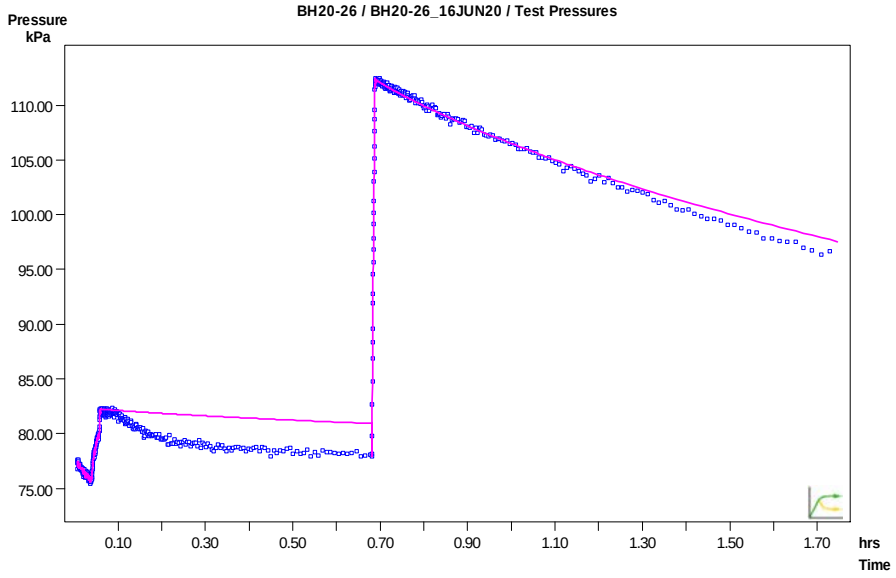
TITLE

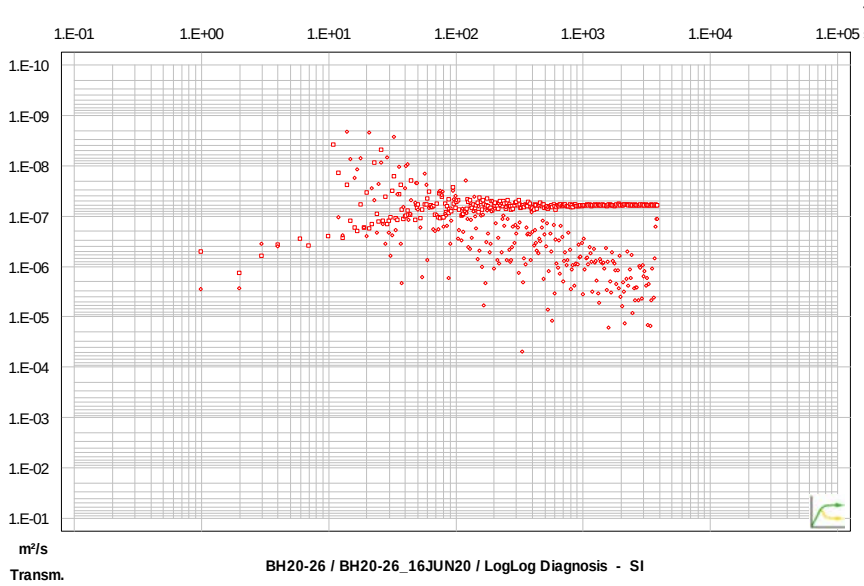
PACKER TEST RESULTS BH20-25 LOWER INTERVAL (12.9 to 19.6 mbgs)

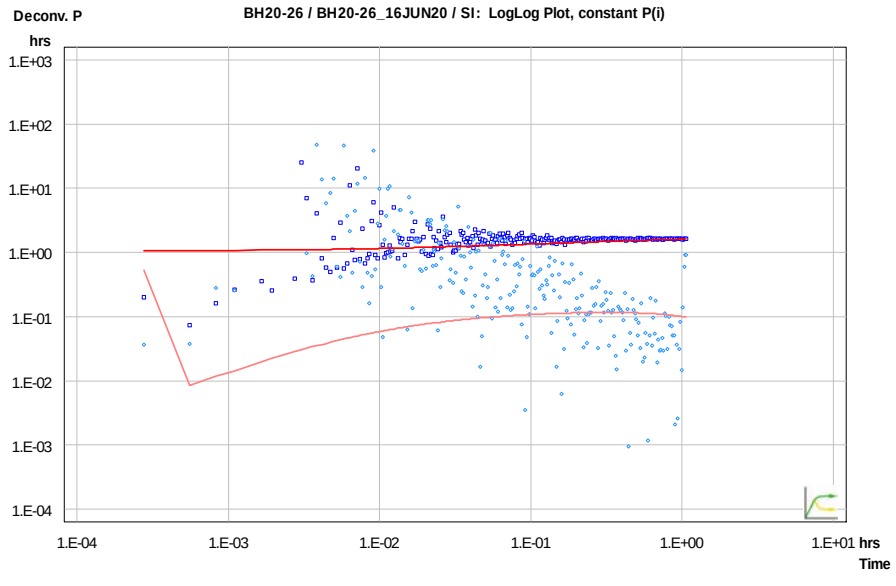
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-049

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

TITLE

PACKER TEST RESULTS BH20-26 UPPER INTERVAL (7.7 to 14.4 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-050

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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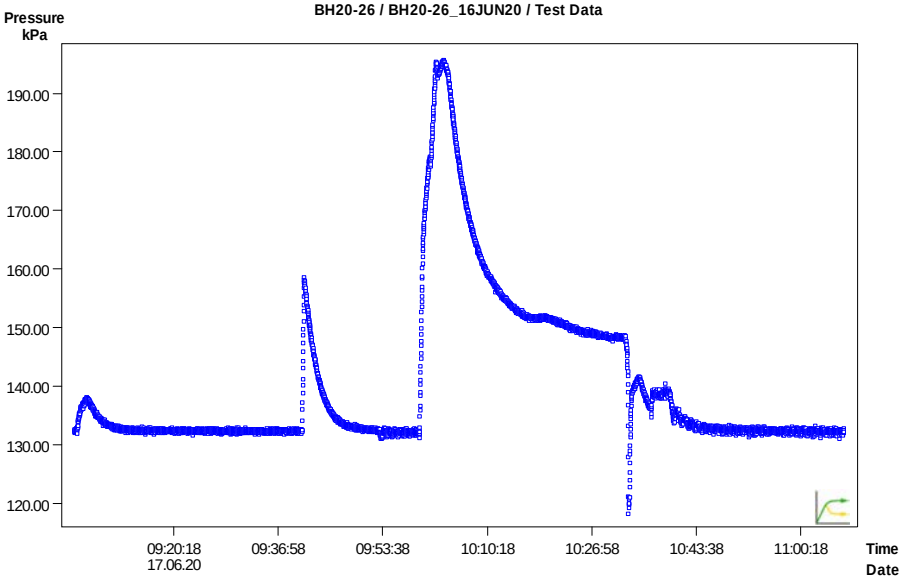
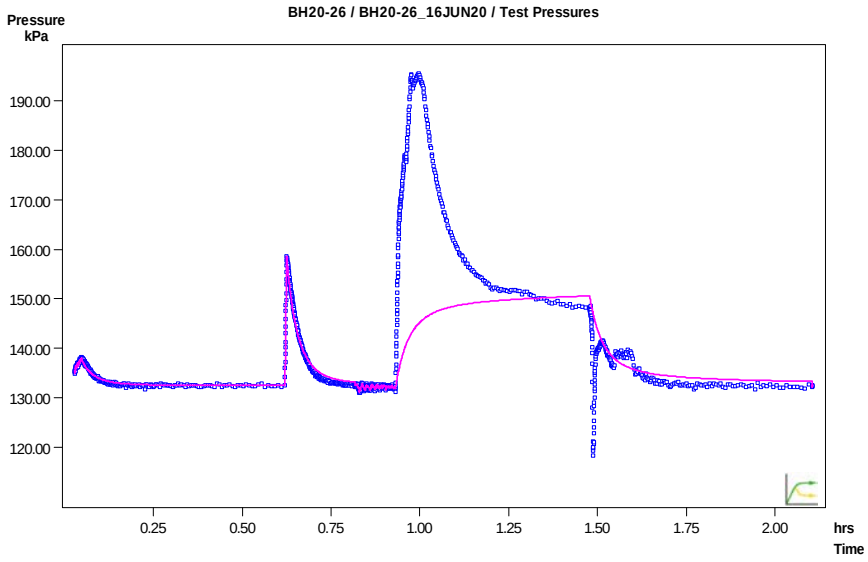
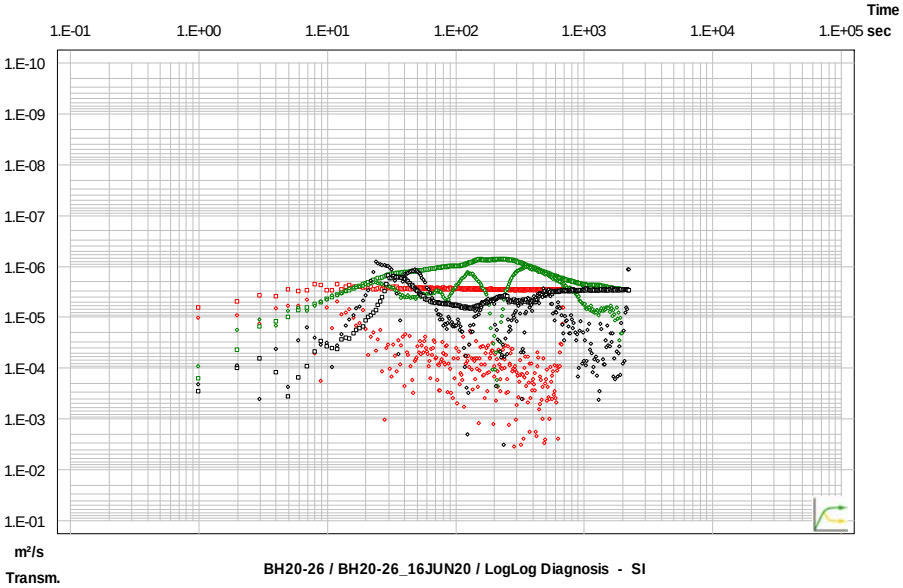
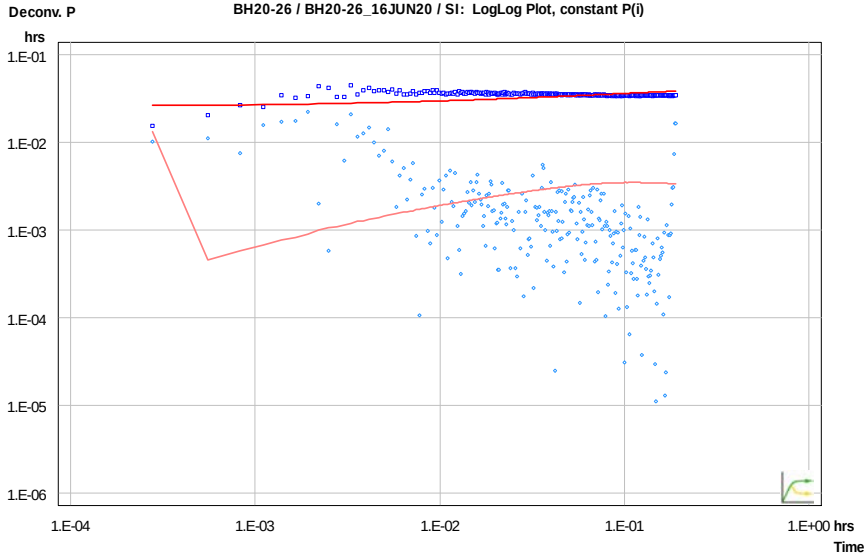








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

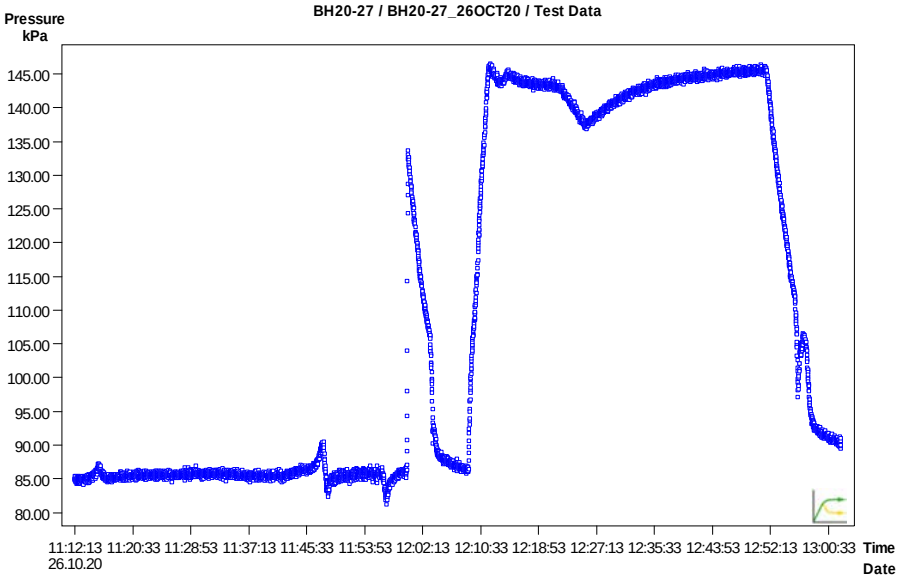
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

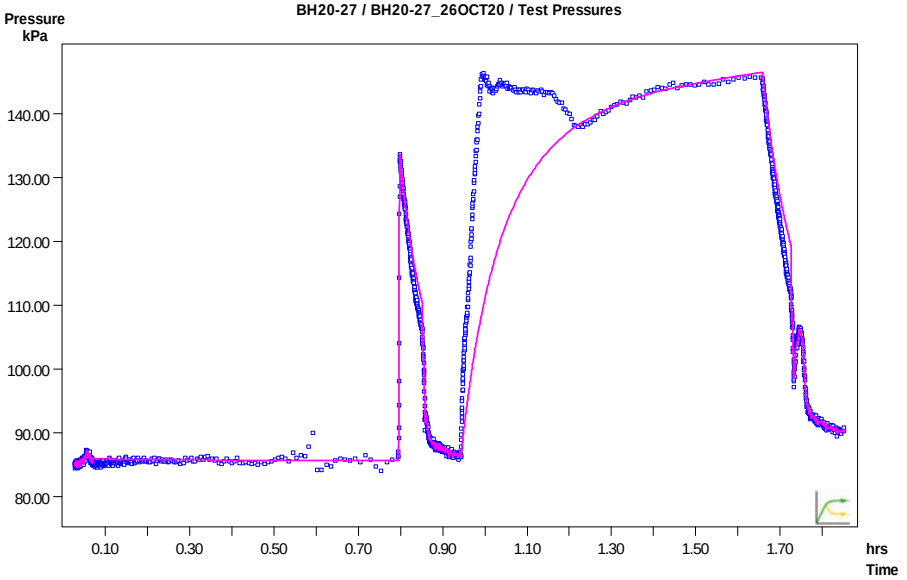
TITLE

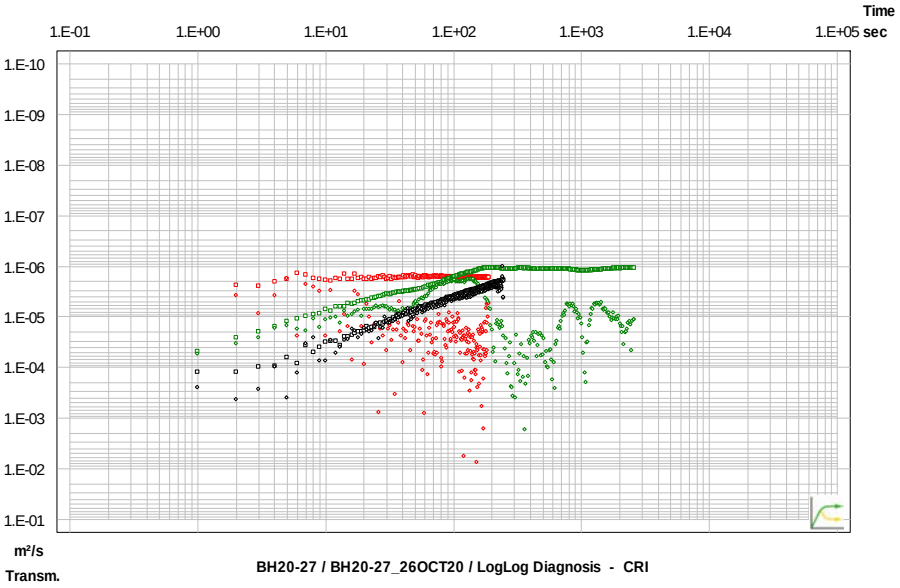
PACKER TEST RESULTS BH20-26 LOWER INTERVAL (13.6 to 20.3 mbgs)

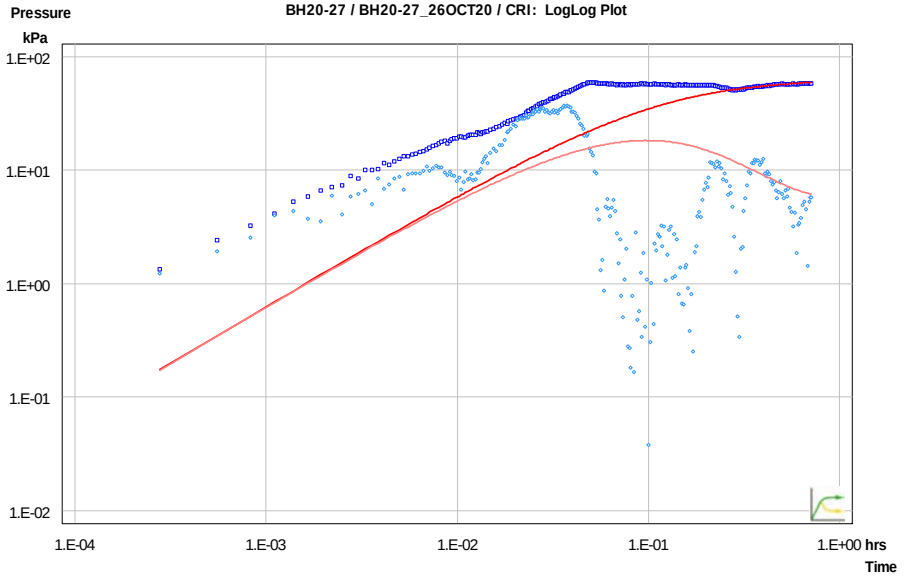
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-051

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

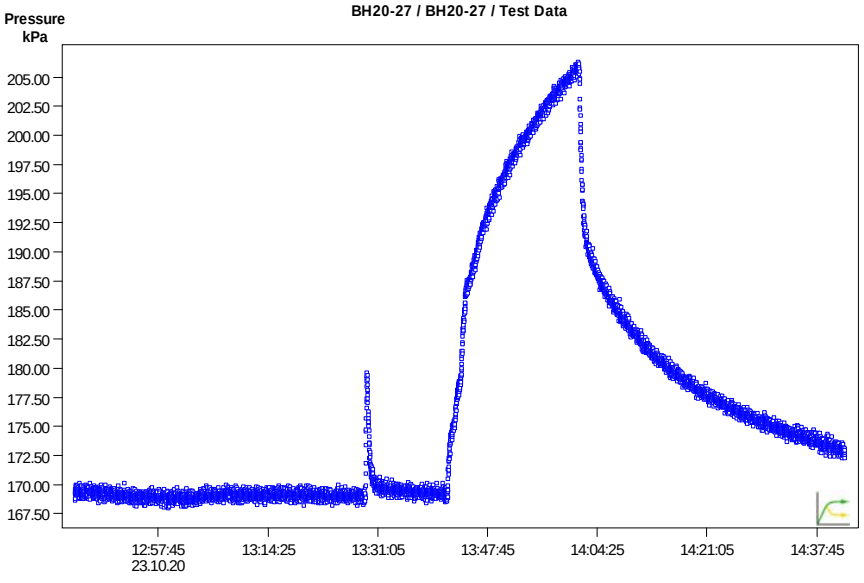
CALEDON PIT / QUARRY

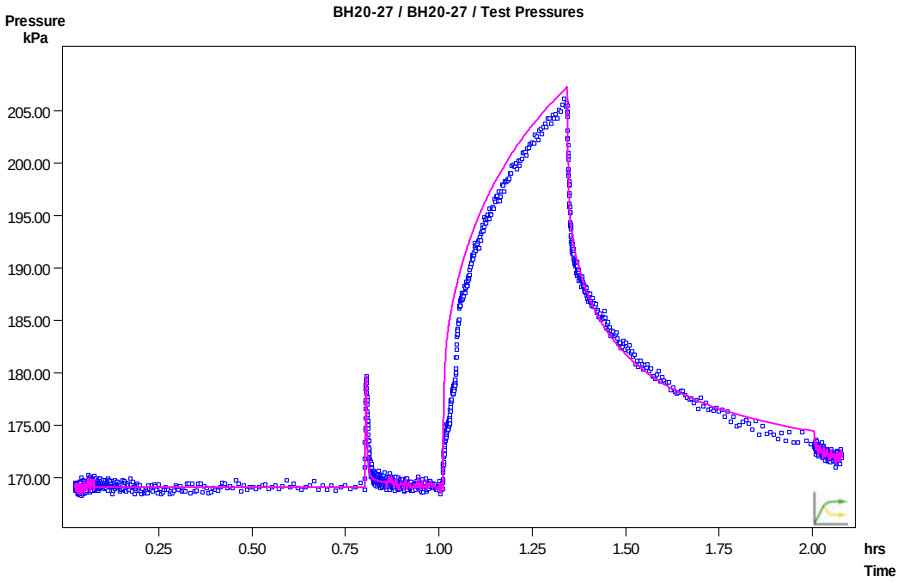
TITLE

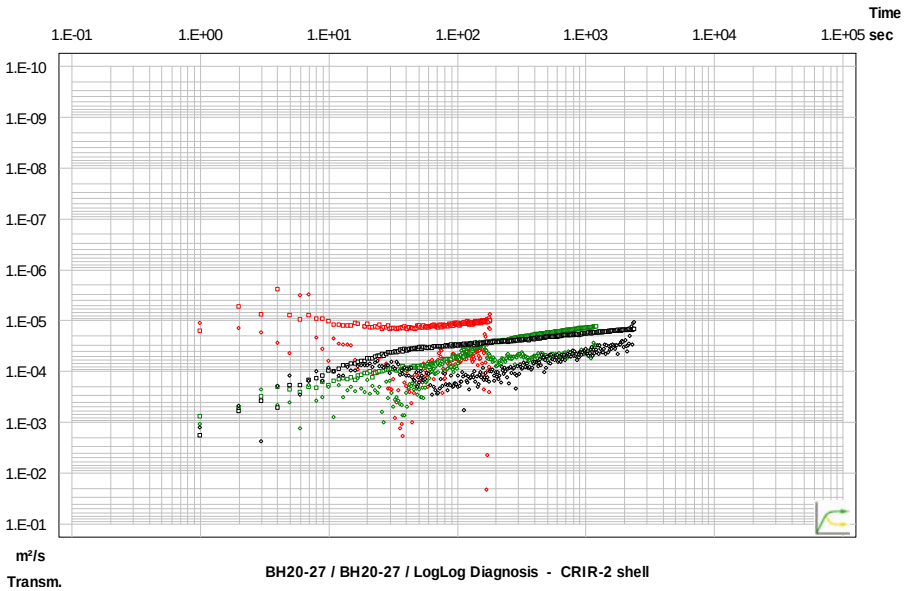
PACKER TEST RESULTS BH20-27 UPPER INTERVAL (4.4 to 14.2 mbgs)

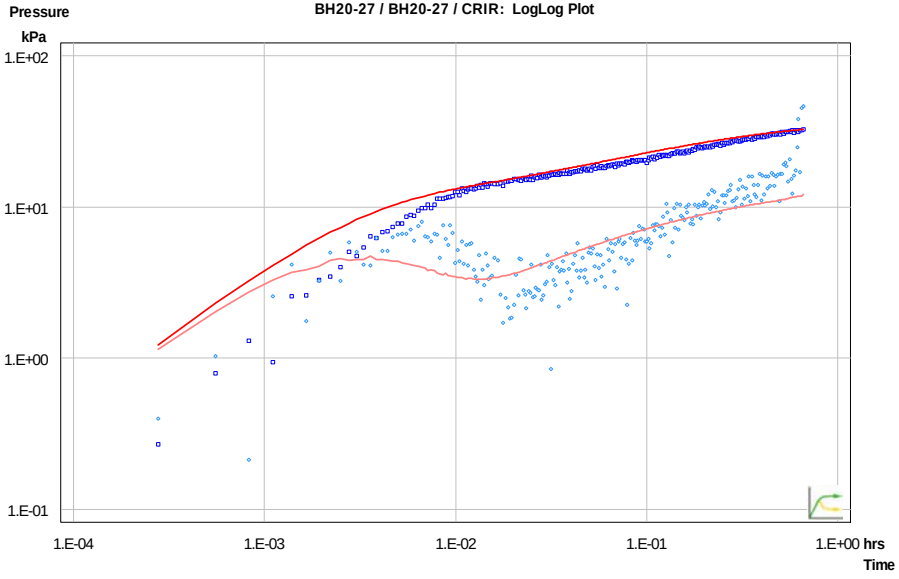
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-052

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

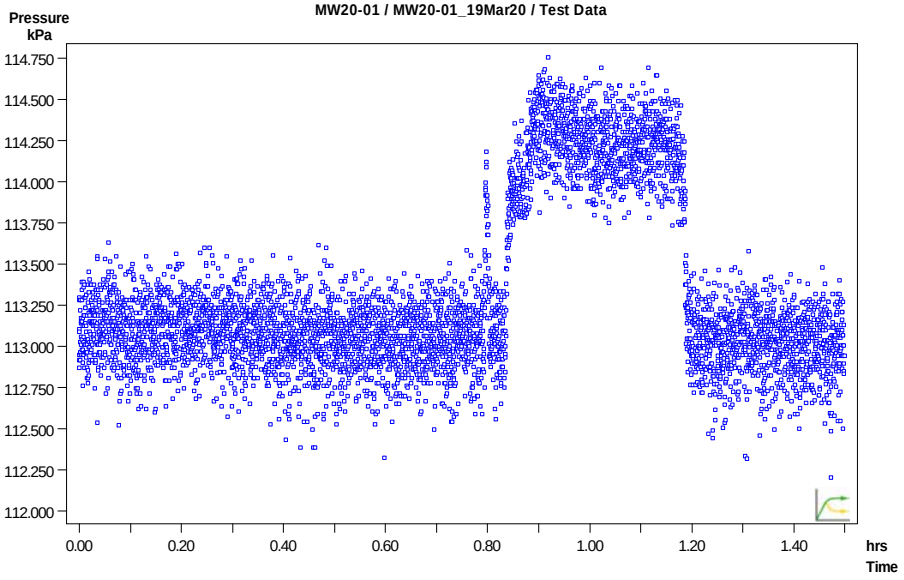
YYYY-MM-DD	2022-03-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

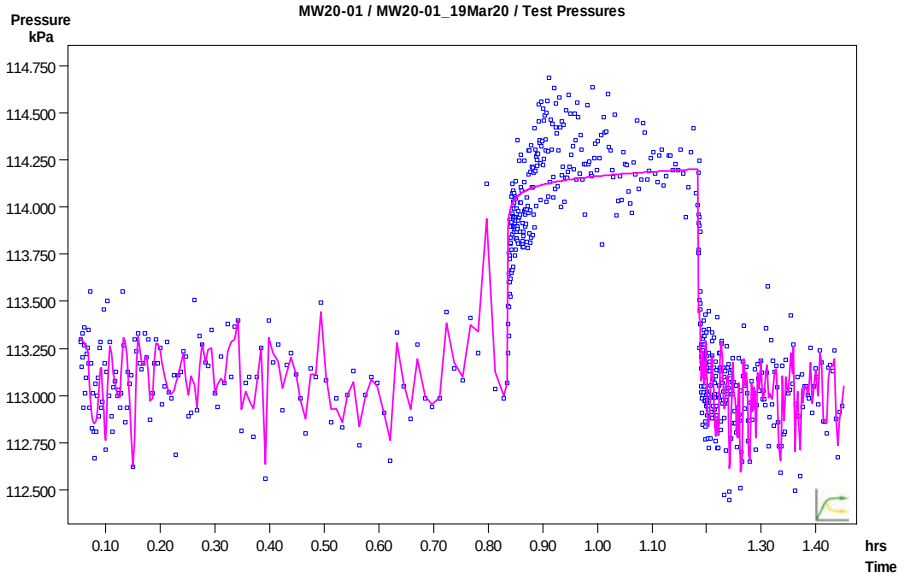
TITLE

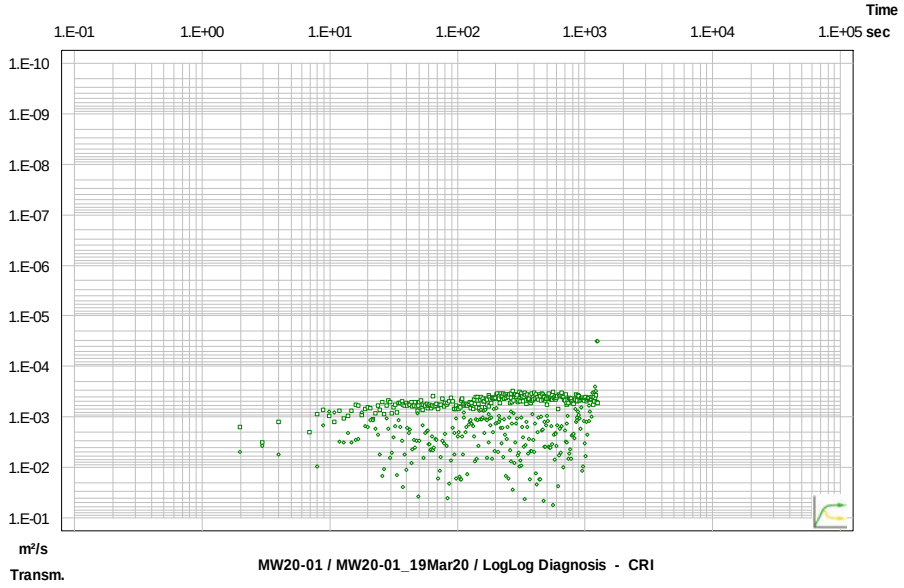
PACKER TEST RESULTS BH20-27 LOWER INTERVAL (13.8 to 23.5 mbgs)

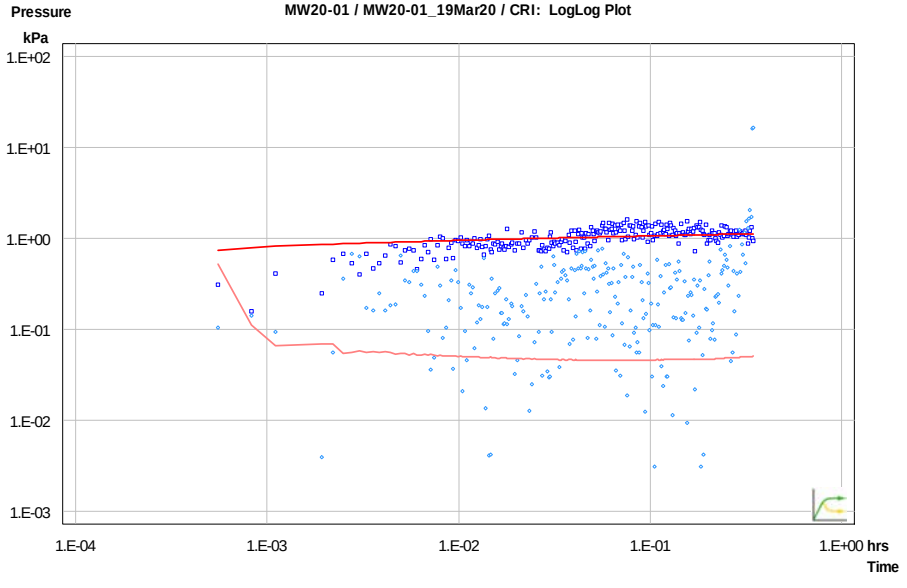
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-053

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

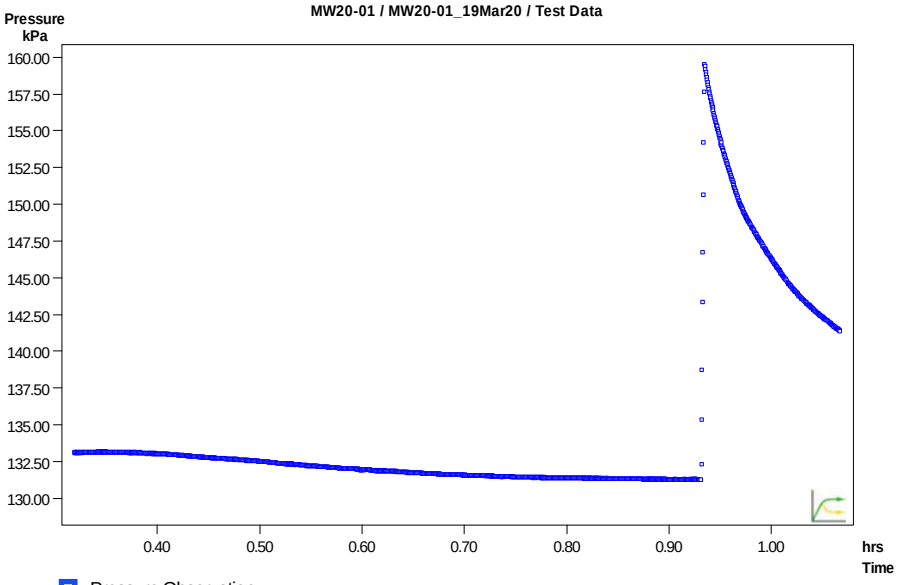
CALEDON PIT / QUARRY

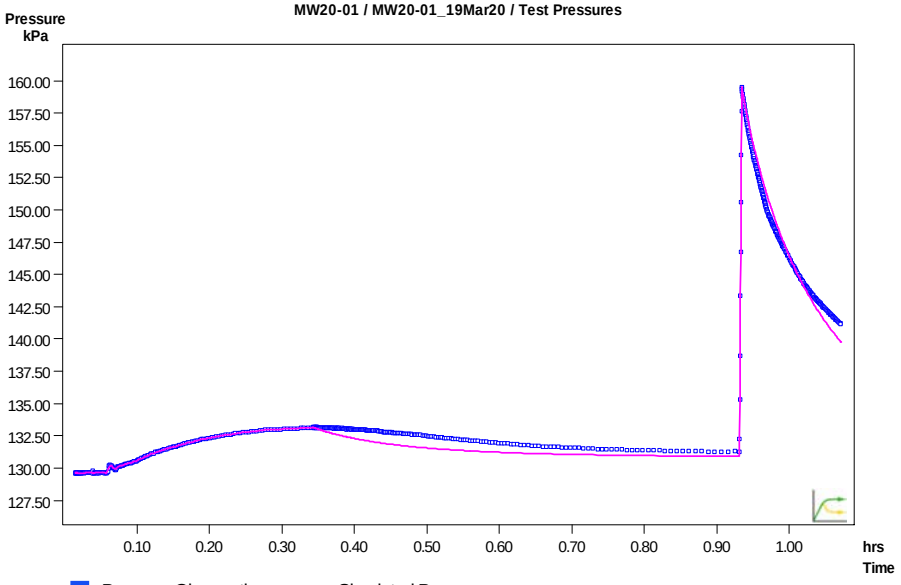
TITLE

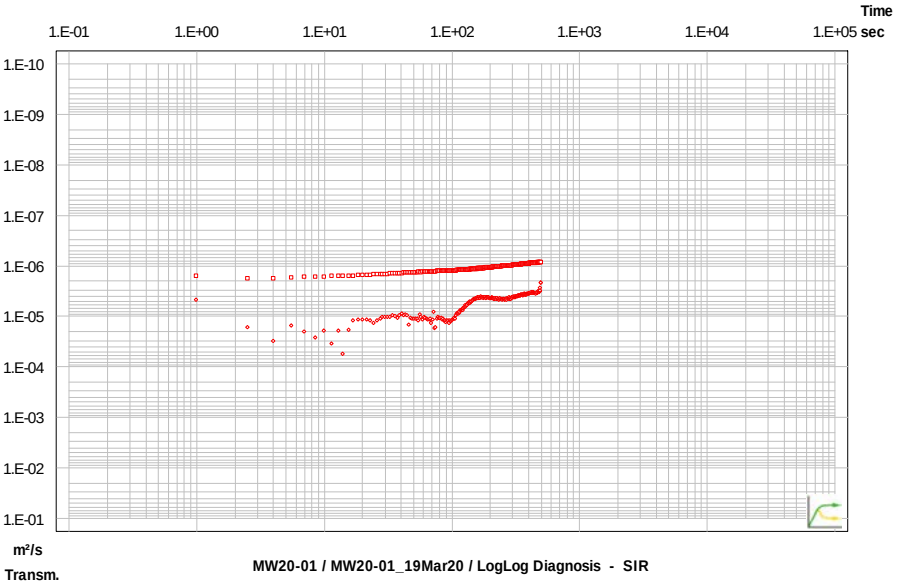
PACKER TEST RESULTS MW20-01 UPPER INTERVAL (10.9 to 14.5 mbgs)

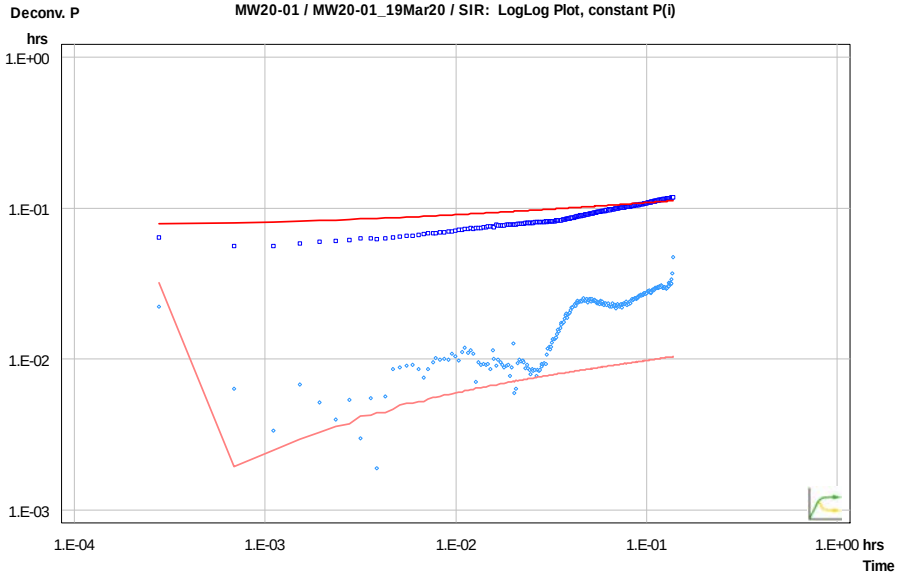
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-054

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

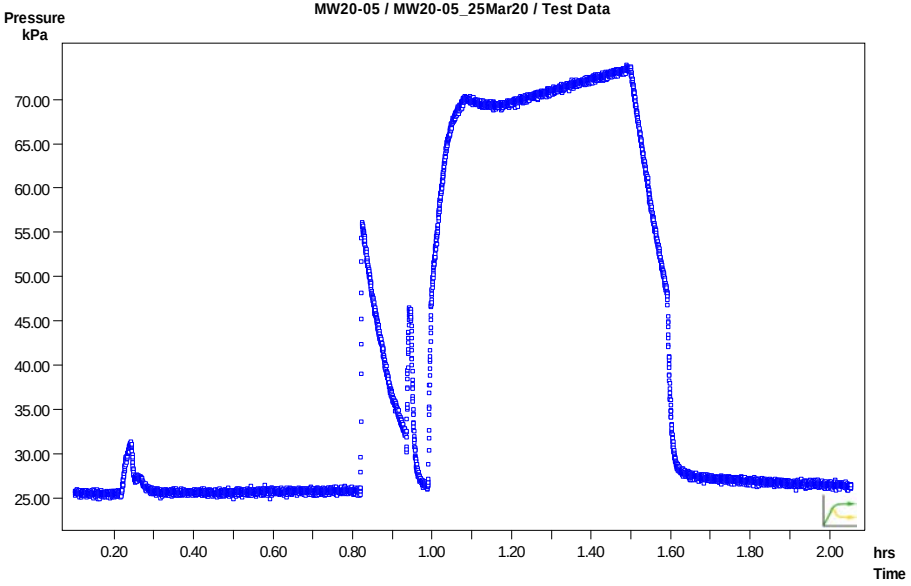
CALEDON PIT / QUARRY

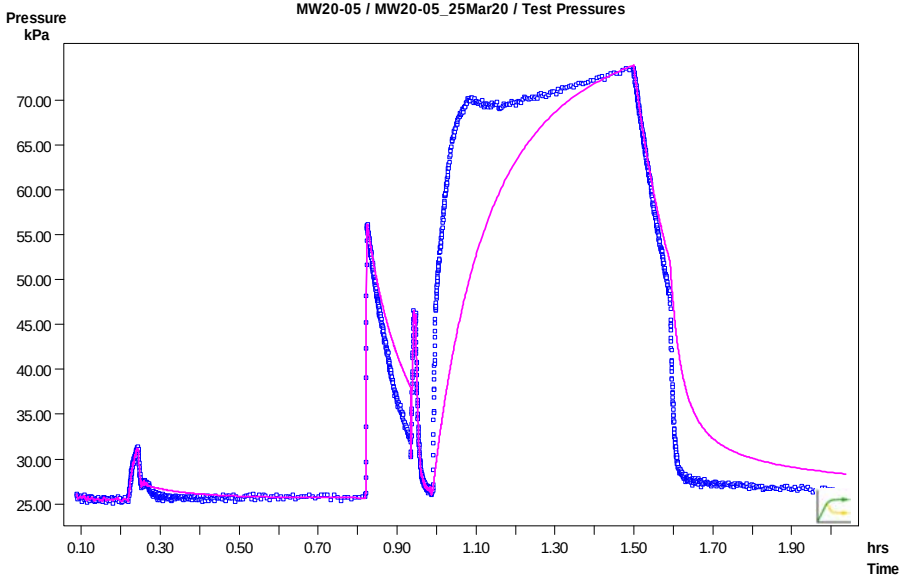
TITLE

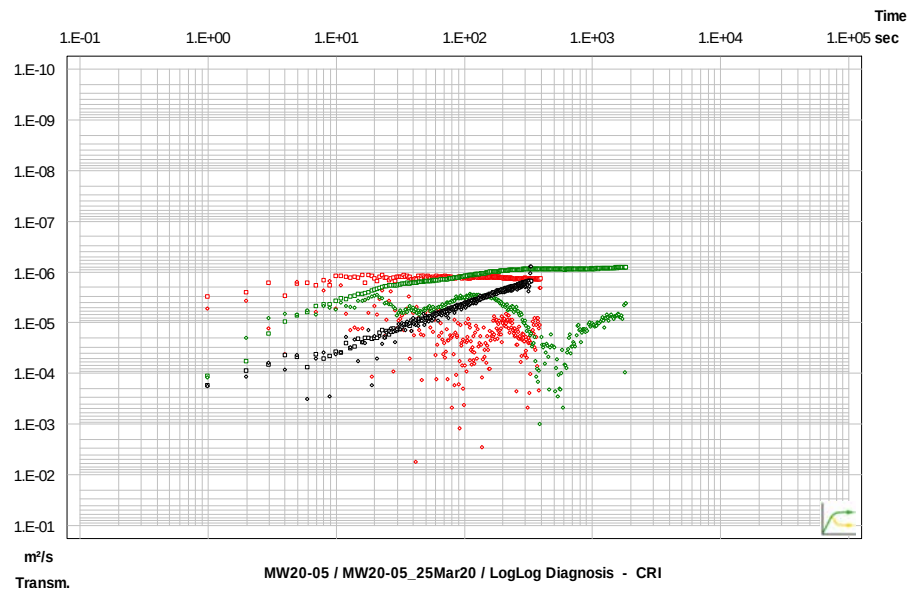
PACKER TEST RESULTS MW20-01 LOWER INTERVAL (14.9 to 19.4 mbgs)

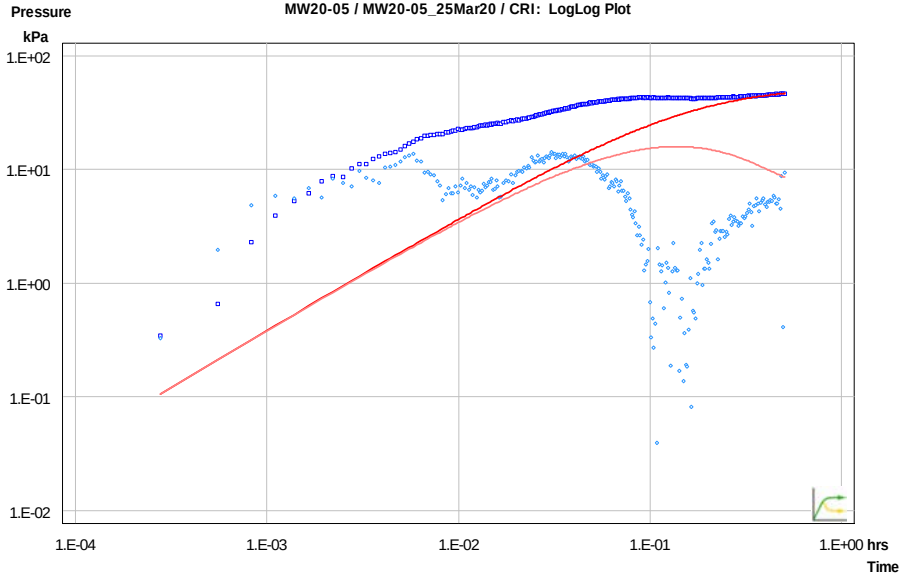
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-055

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

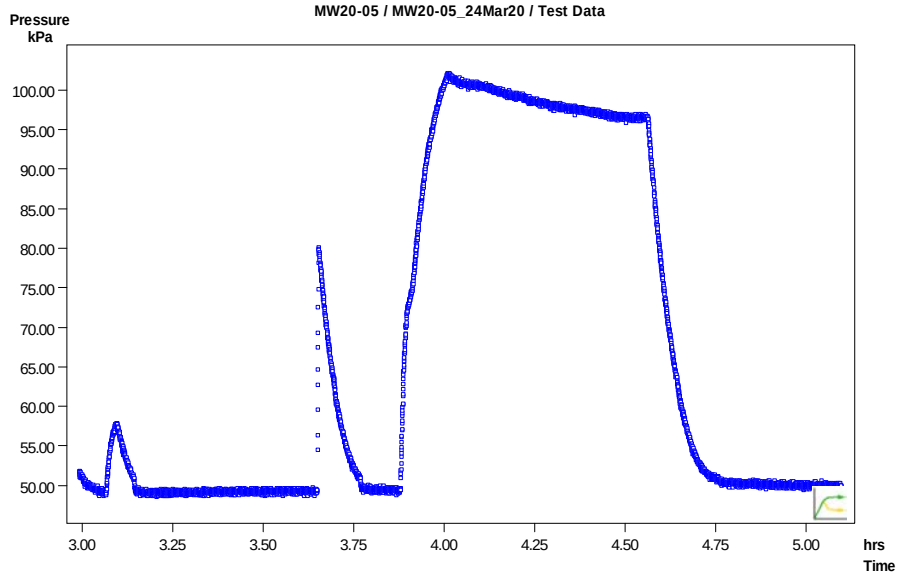
CALEDON PIT / QUARRY

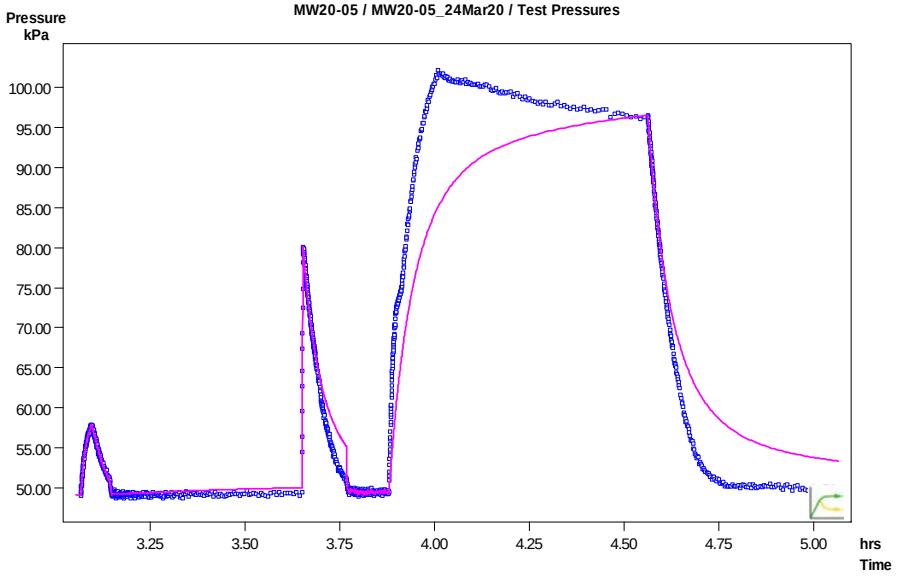
TITLE

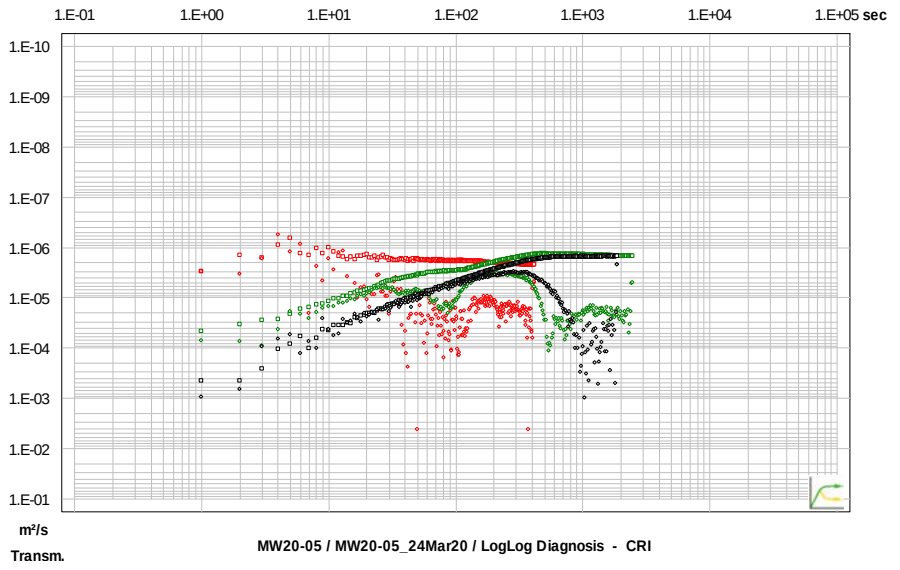
PACKER TEST RESULTS MW20-05 UPPER INTERVAL (4.7 to 8.3 mbgs)

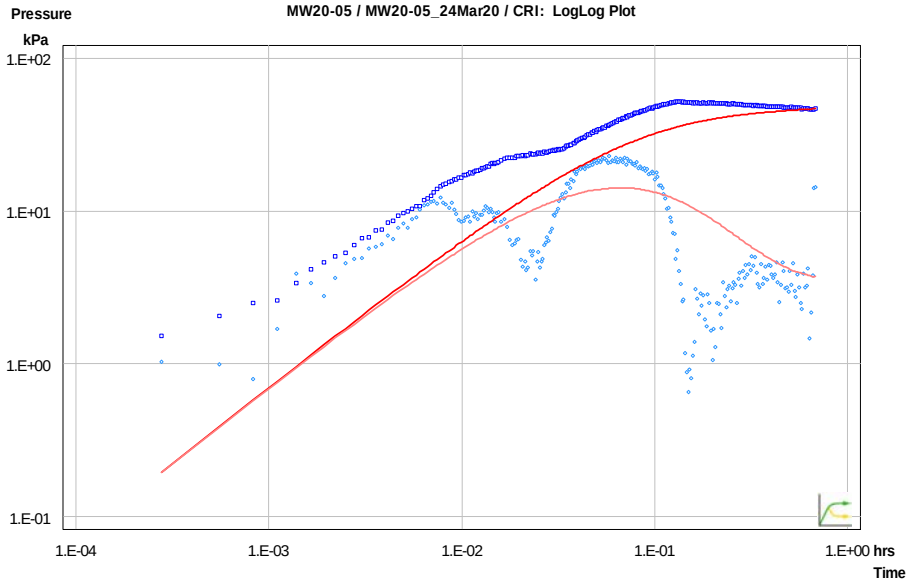
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-056

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

CLIENT
CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

TITLE
PACKER TEST RESULTS MW20-05 MIDDLE INTERVAL (6.9 to 10.5 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-057

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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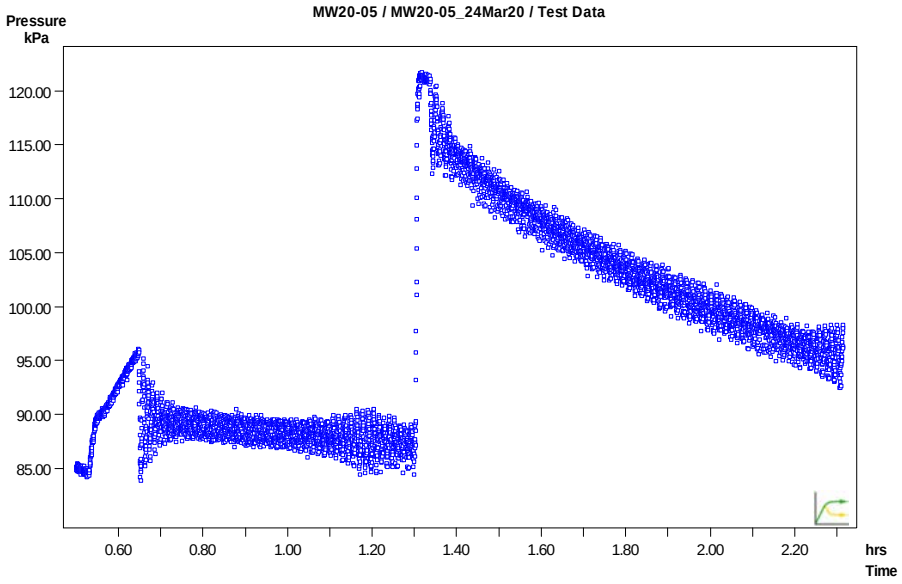
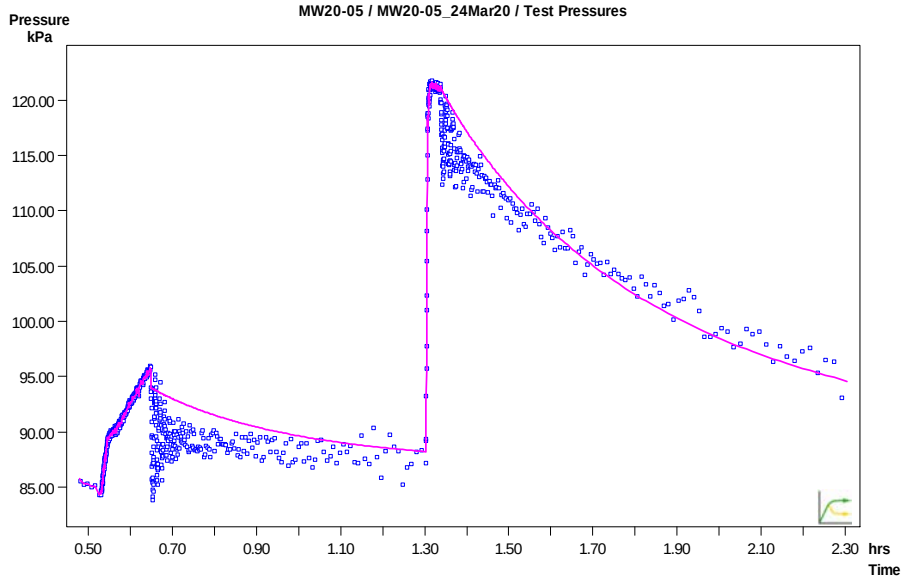
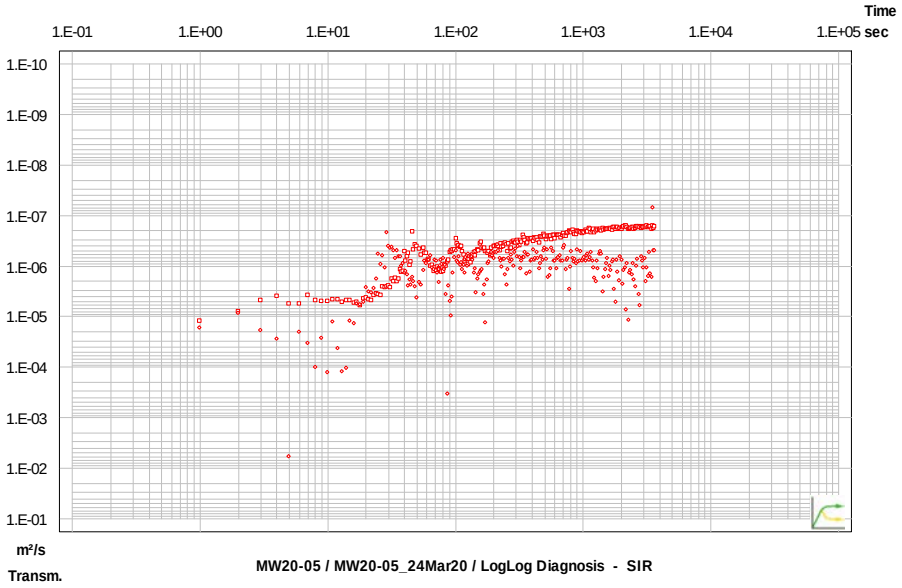
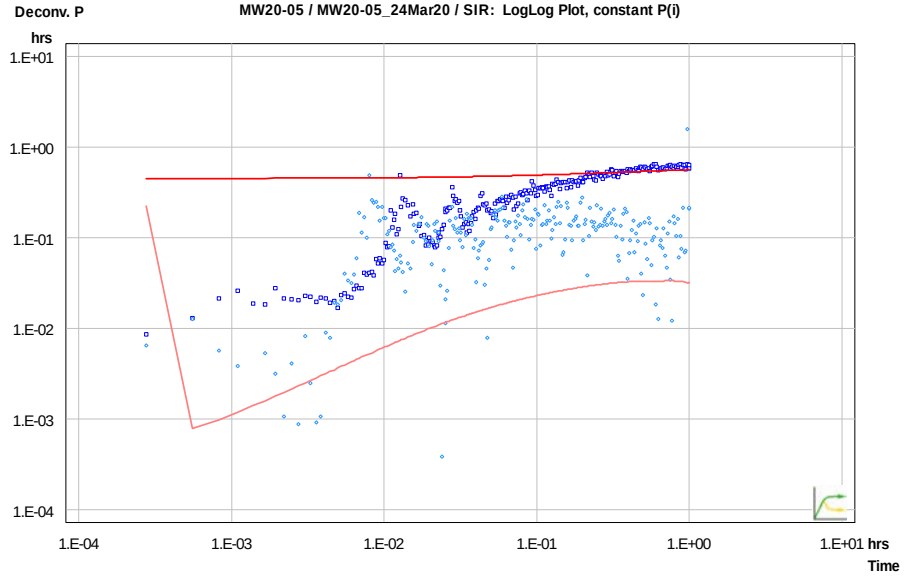








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15	
PREPARED	PGM	
DESIGN	ML	
REVIEW	###	
APPROVED		

PROJECT

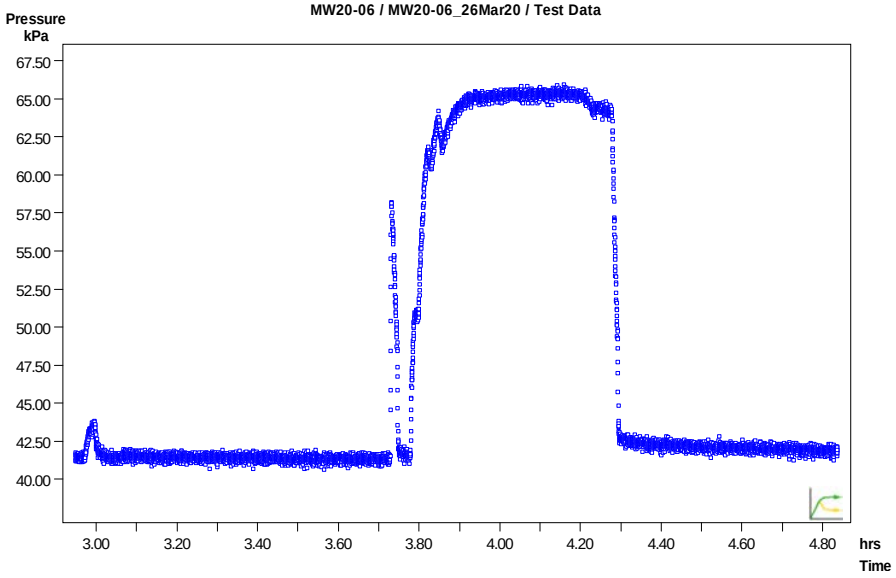
CALEDON PIT / QUARRY

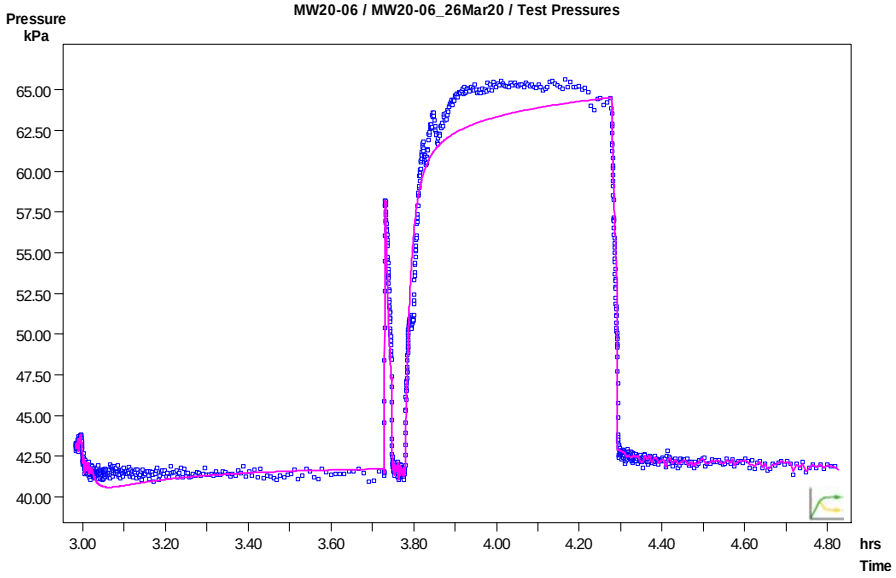
TITLE

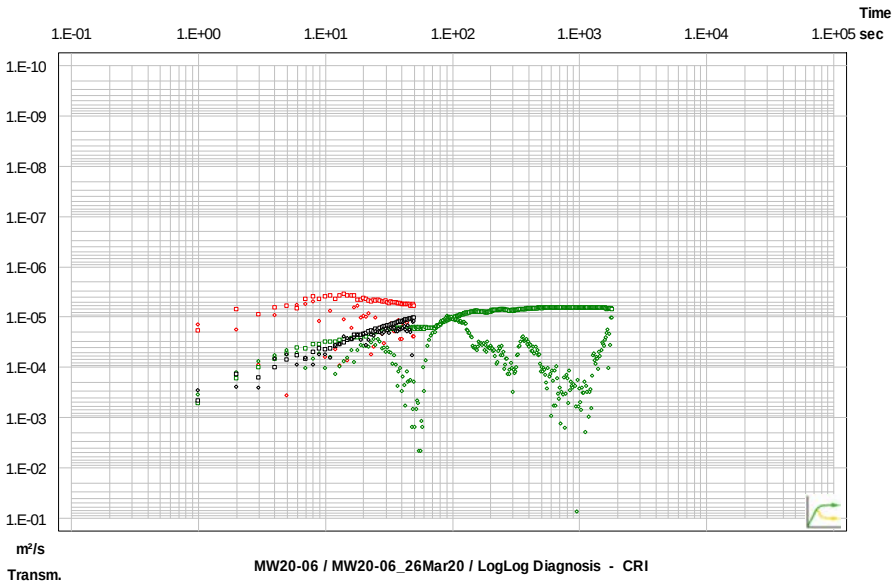
PACKER TEST RESULTS MW20-05 LOWER INTERVAL (10.6 to 14.8 mbgs)

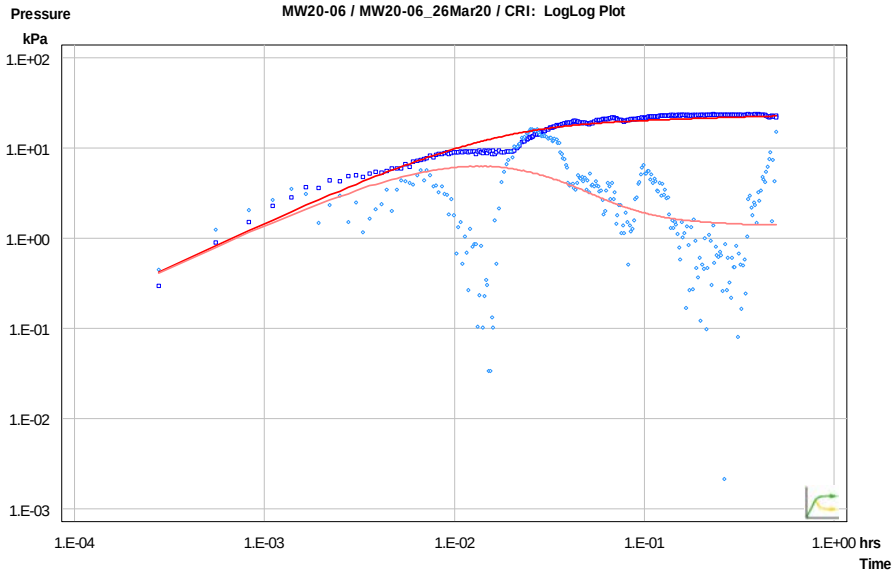
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-058

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

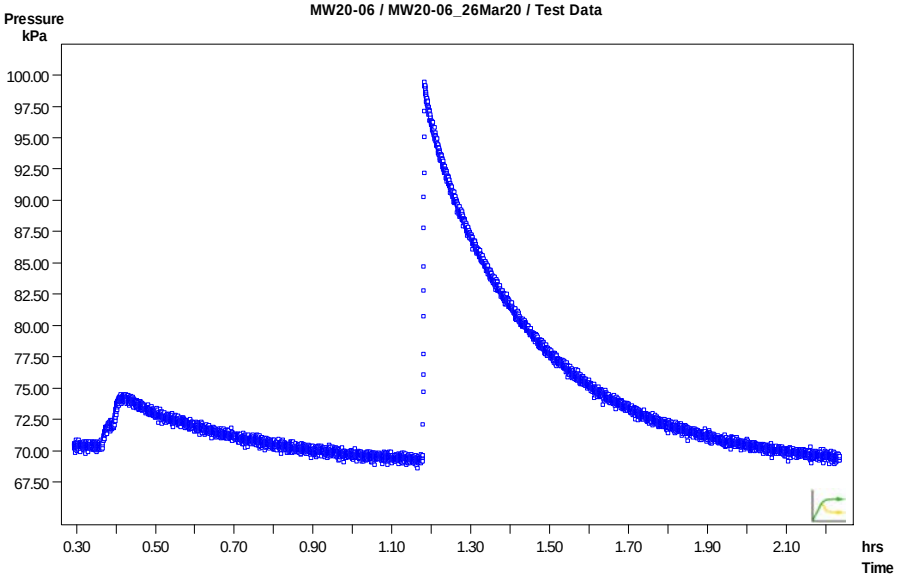
CALEDON PIT / QUARRY

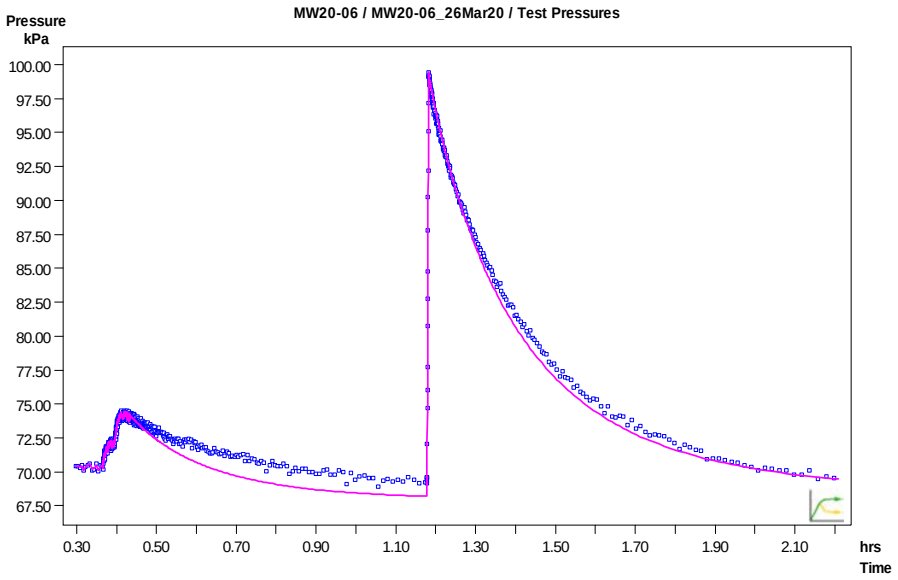
TITLE

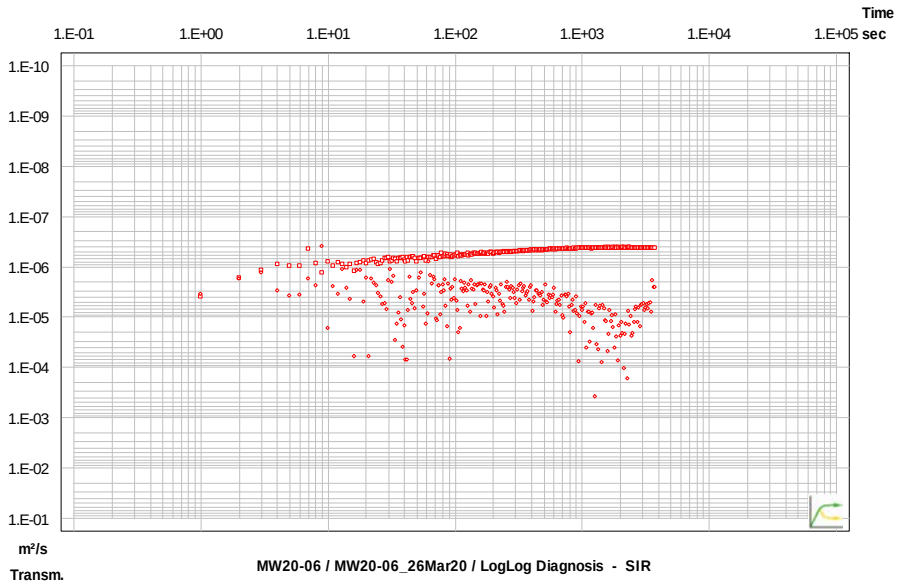
PACKER TEST RESULTS MW20-06 UPPER INTERVAL (4.3 to 7.9 mbgs)

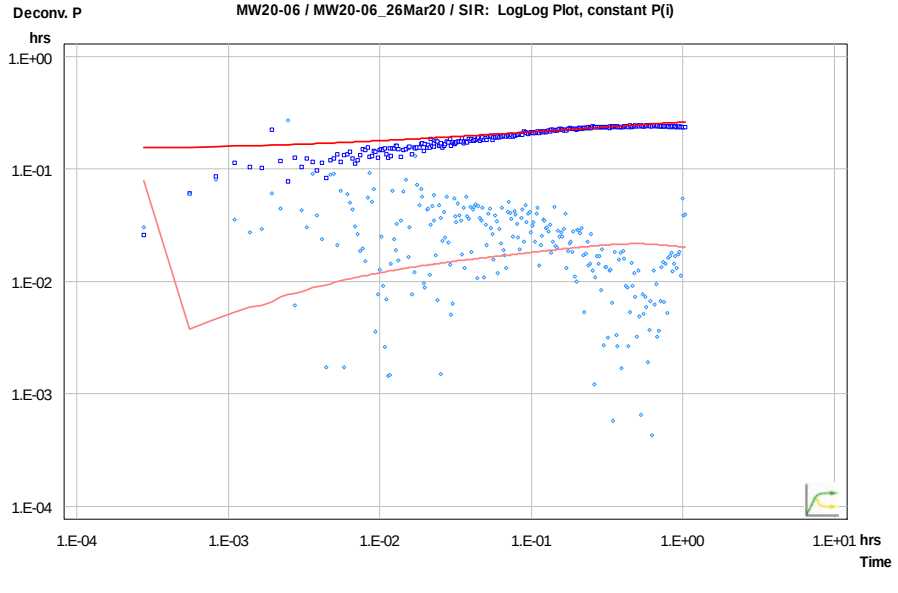
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-059

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

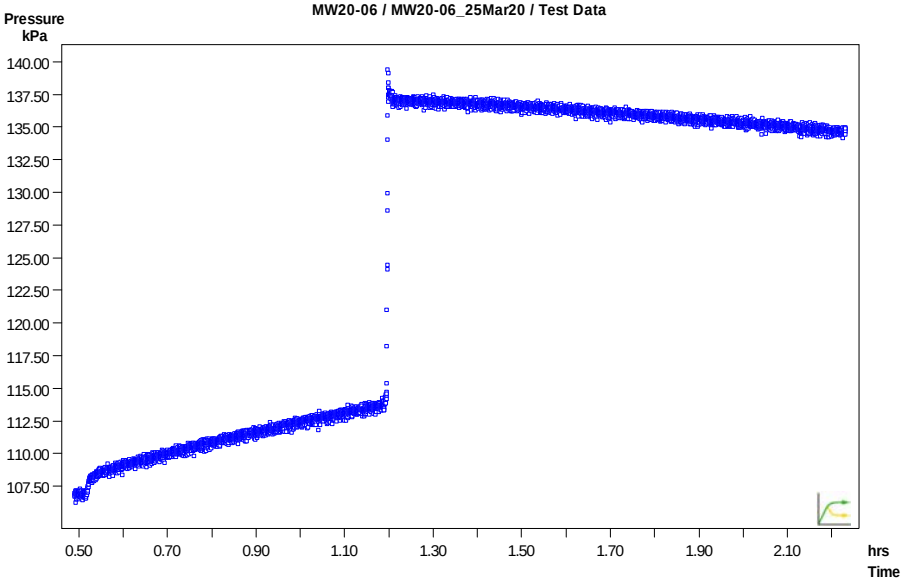
CALEDON PIT / QUARRY

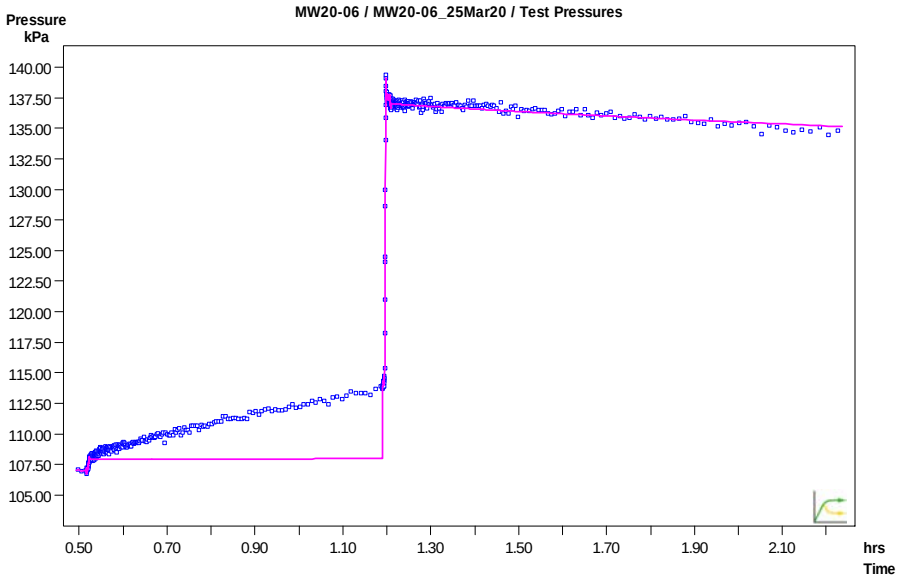
TITLE

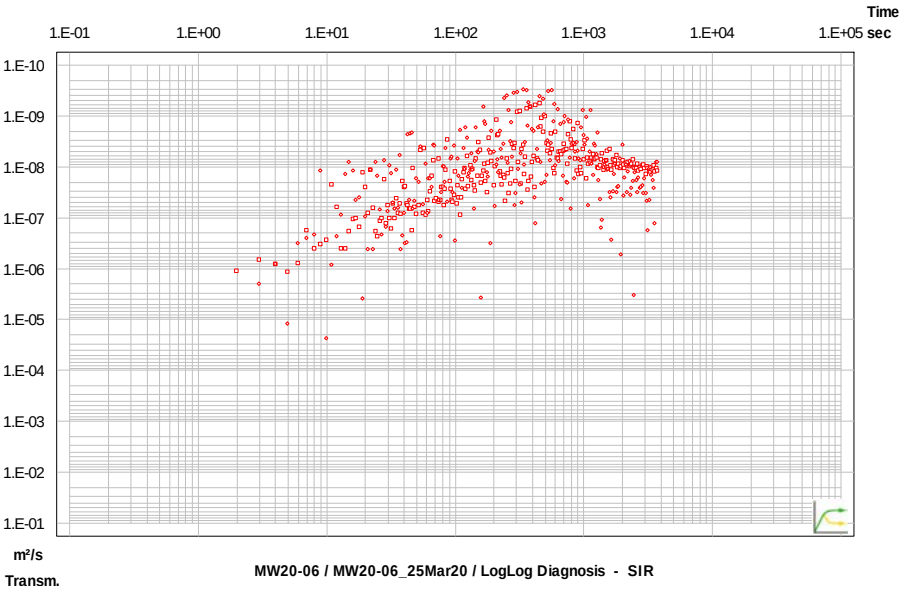
PACKER TEST RESULTS MW20-06 MIDDLE INTERVAL (7.2 to 10.8 mbgs)

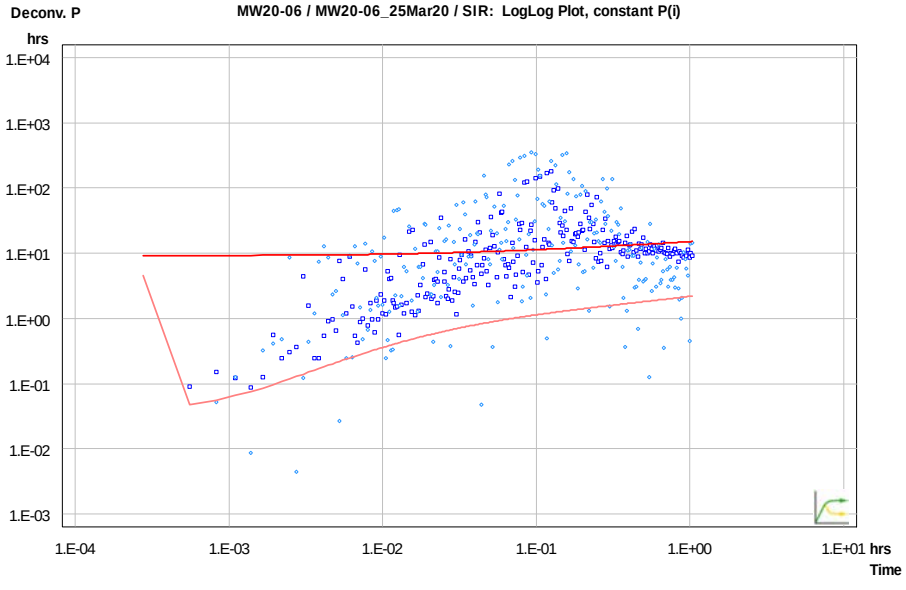
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-060

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

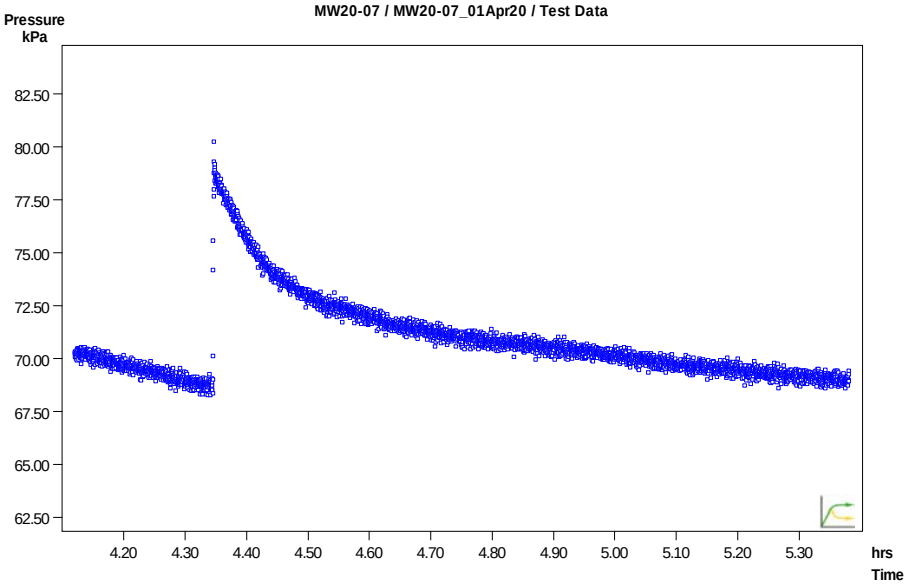
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

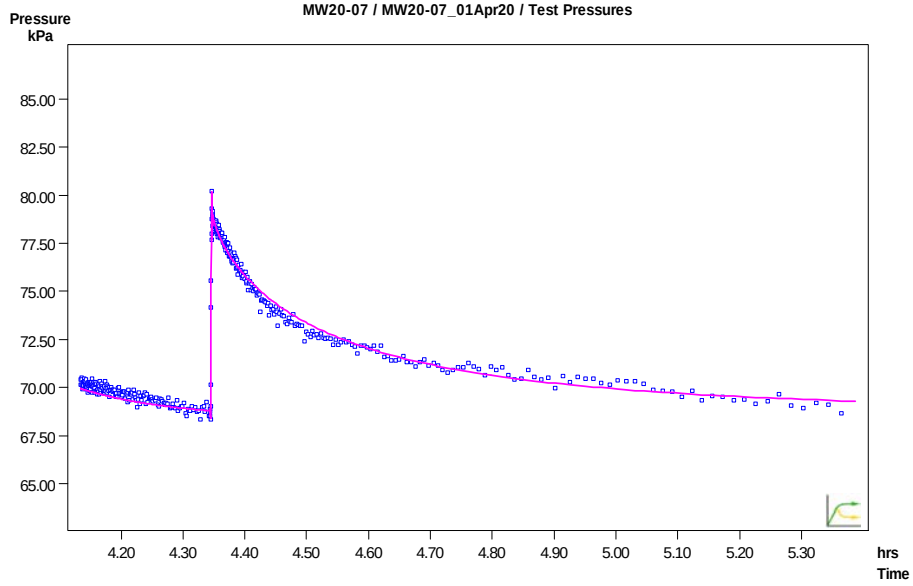
TITLE

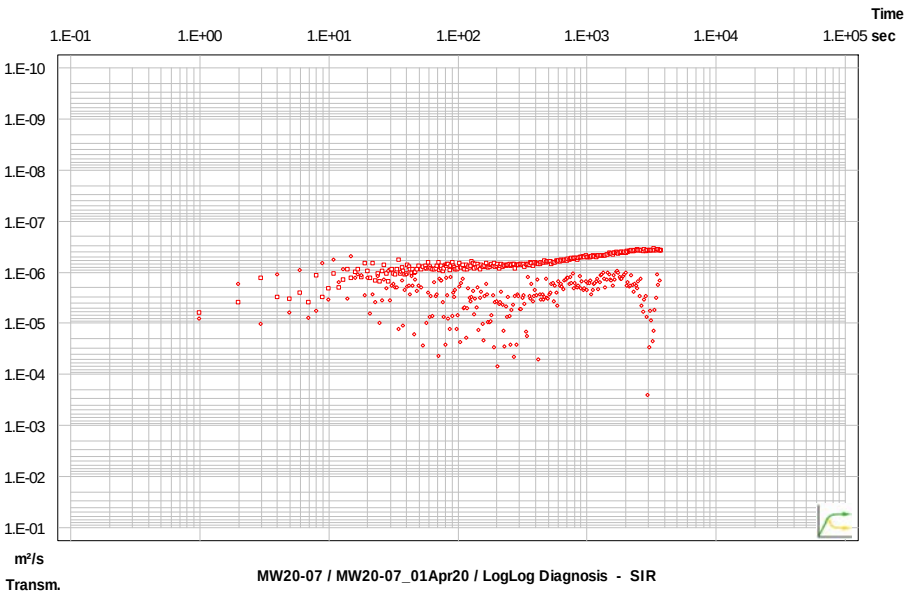
PACKER TEST RESULTS MW20-06 LOWER INTERVAL (10.9 to 16.0 mbgs)

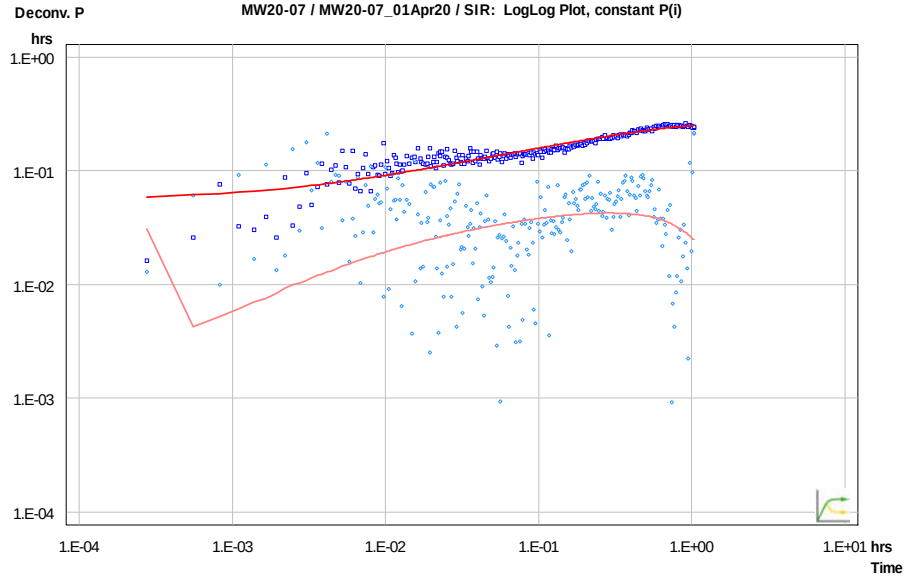
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-061

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

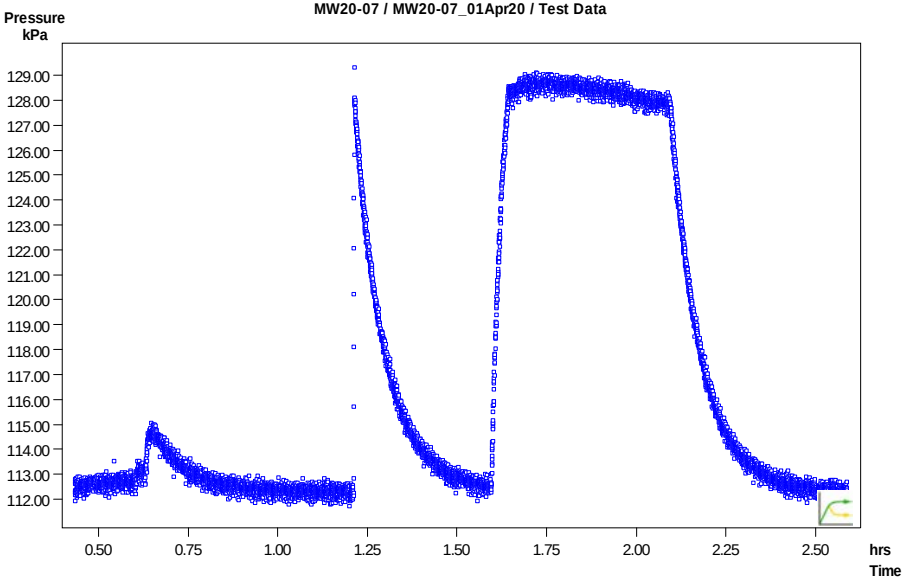
CALEDON PIT / QUARRY

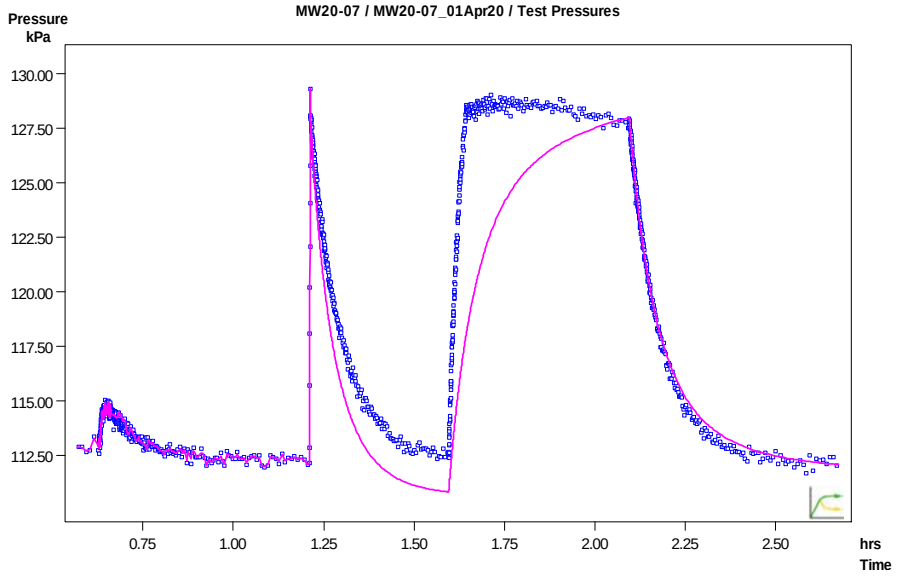
TITLE

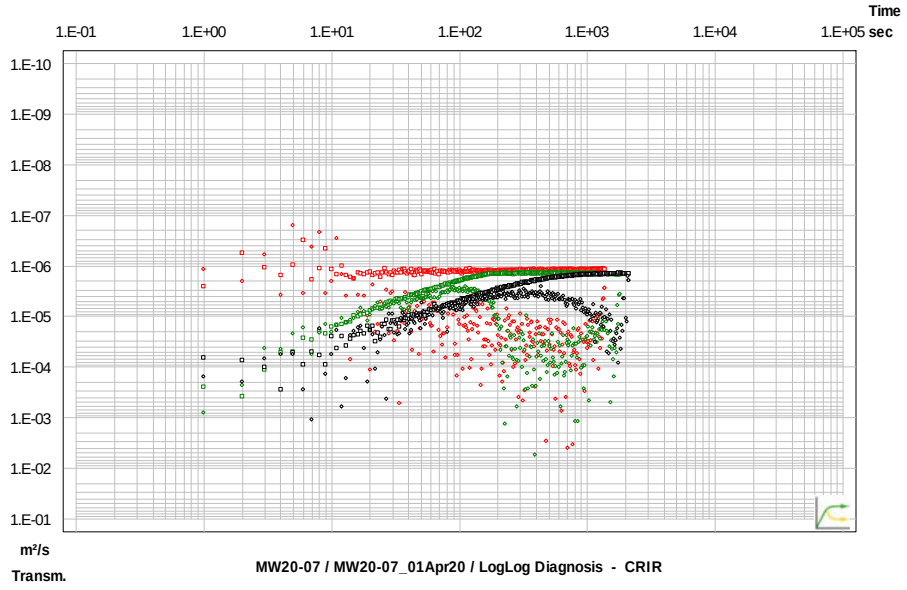
PACKER TEST RESULTS MW20-07 UPPER INTERVAL (4.6 to 8.1 mbgs)

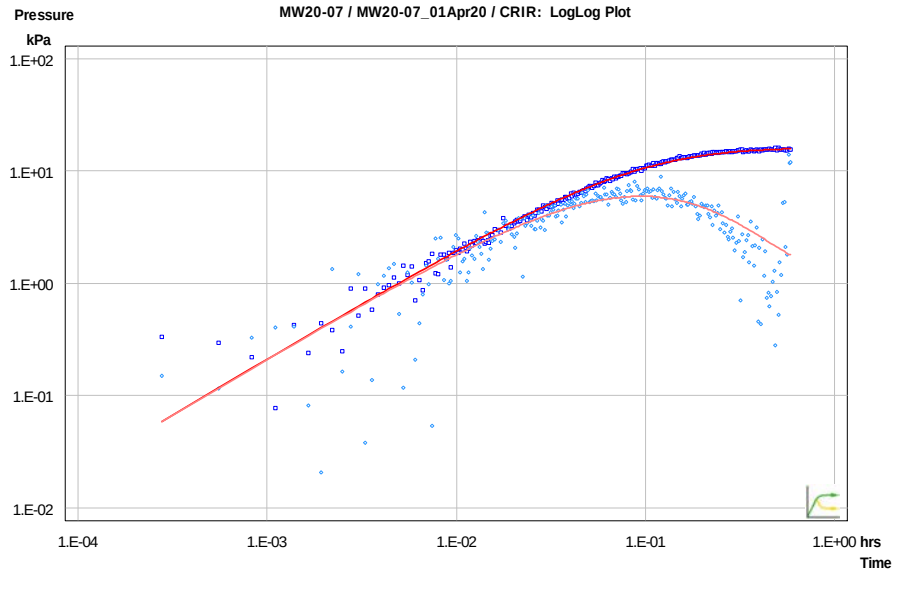
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-062

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

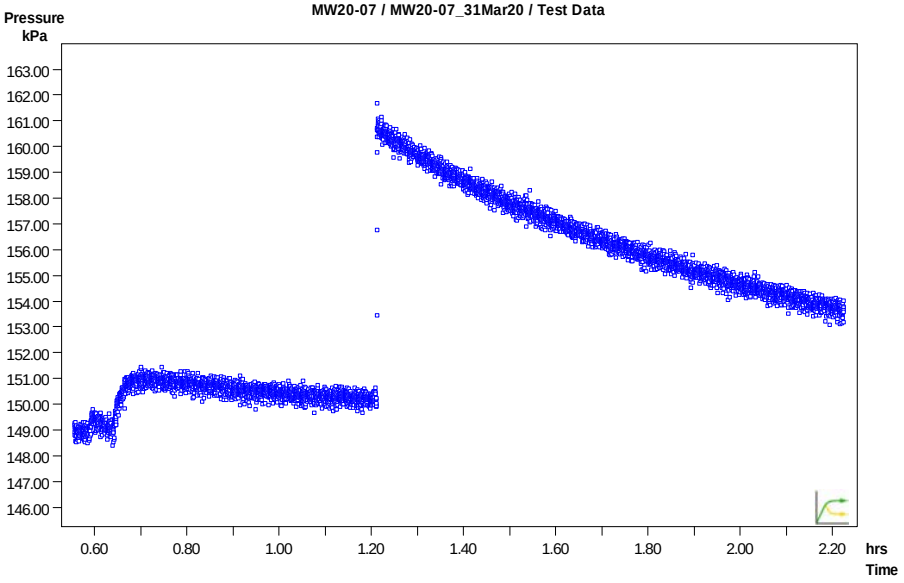
YYYY-MM-DD	2022-02-15
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

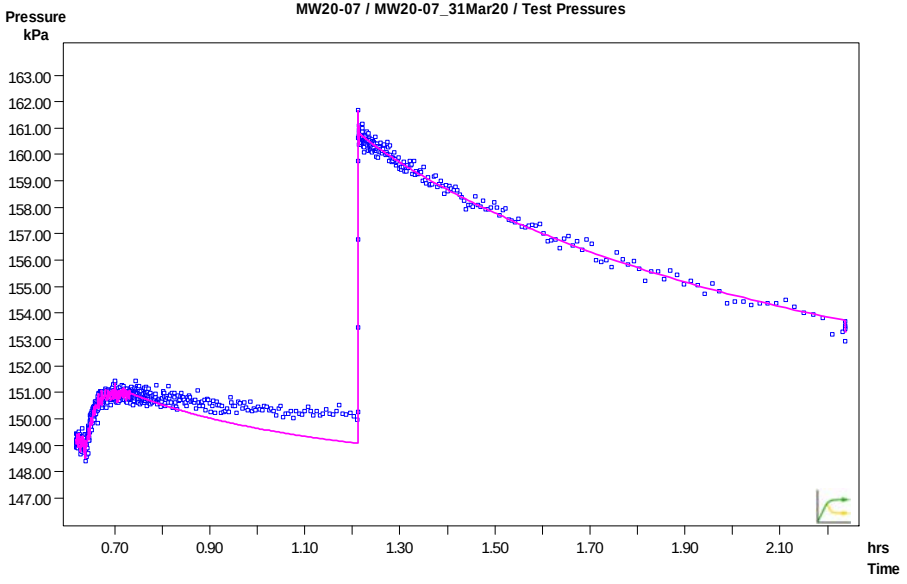
TITLE

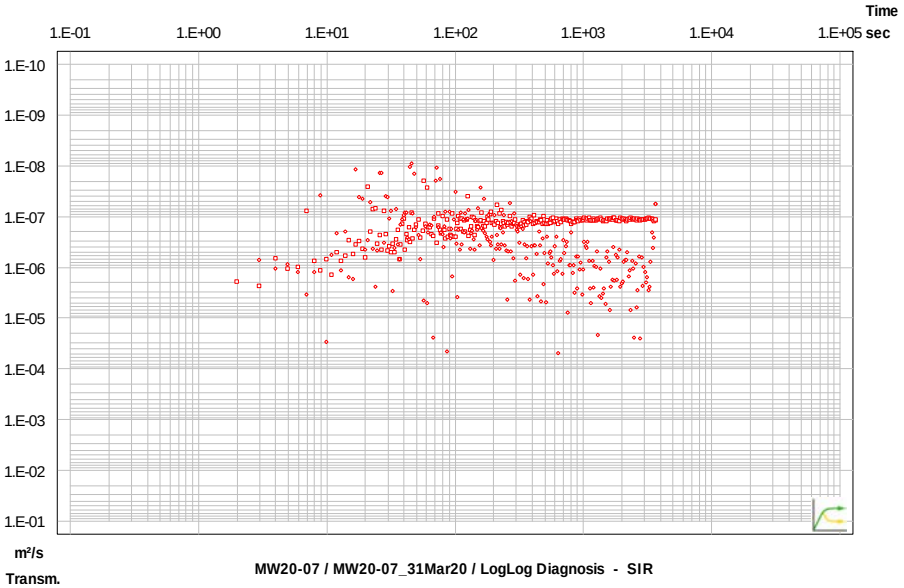
PACKER TEST RESULTS MW20-07 MIDDLE INTERVAL (8.0 to 13.1 mbgs)

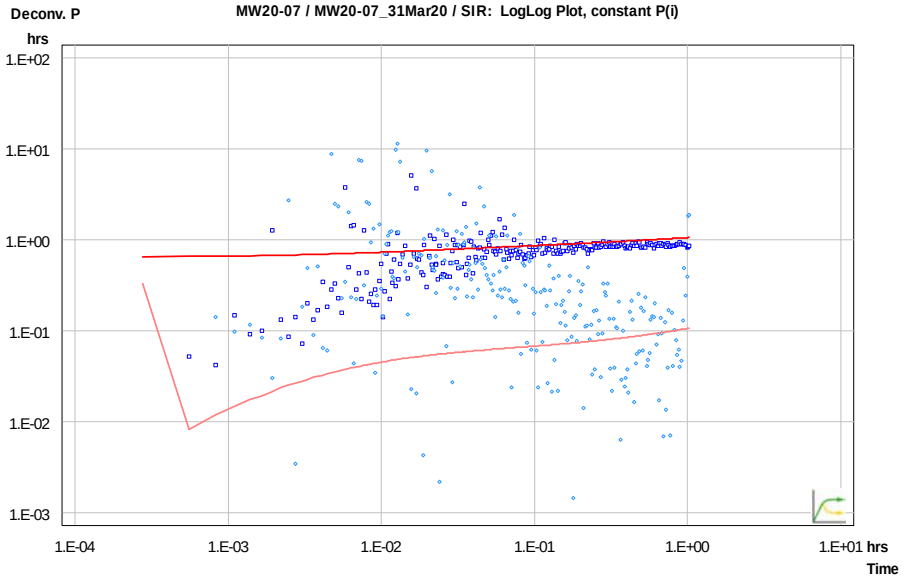
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-063

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

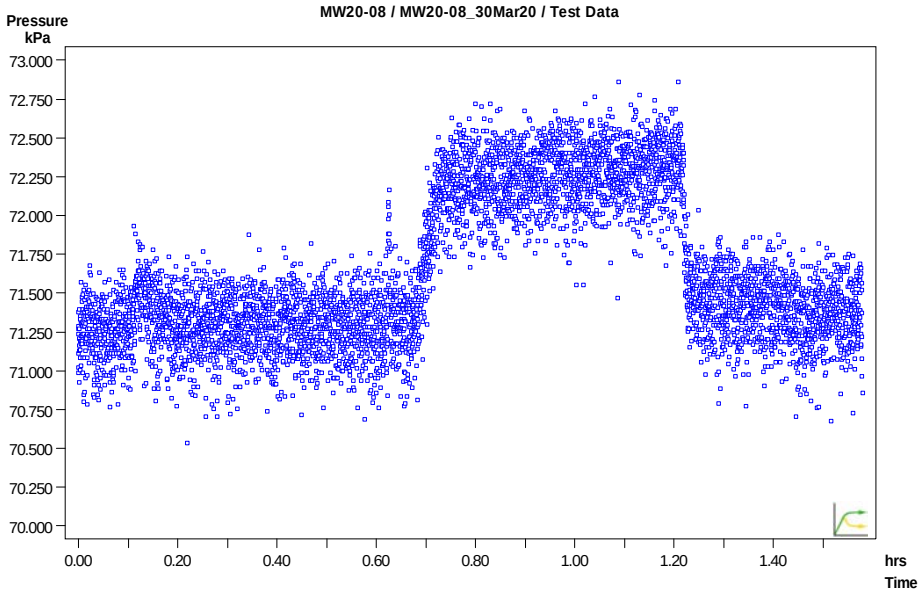
	YYYY-MM-DD	2022-02-15
PREPARED		PGM
DESIGN		ML
REVIEW		###
APPROVED		

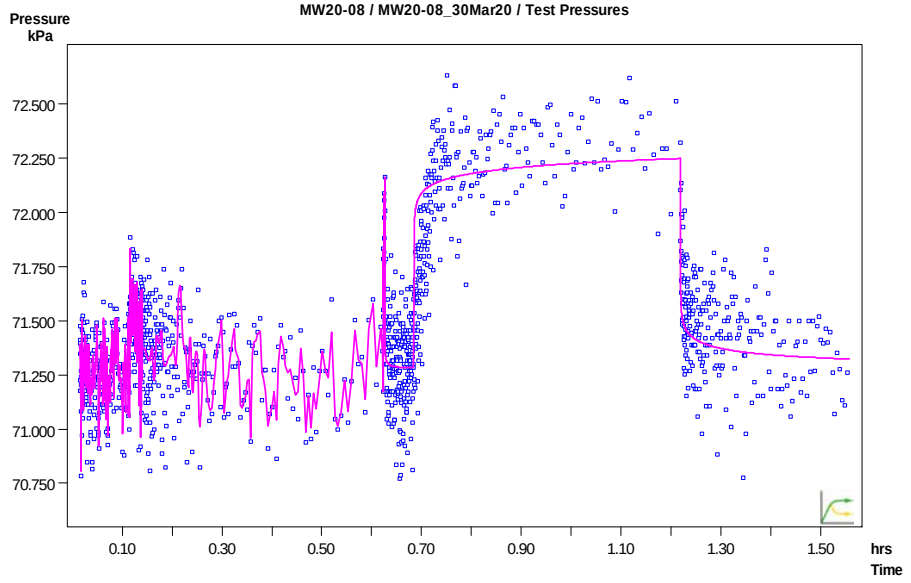
TITLE

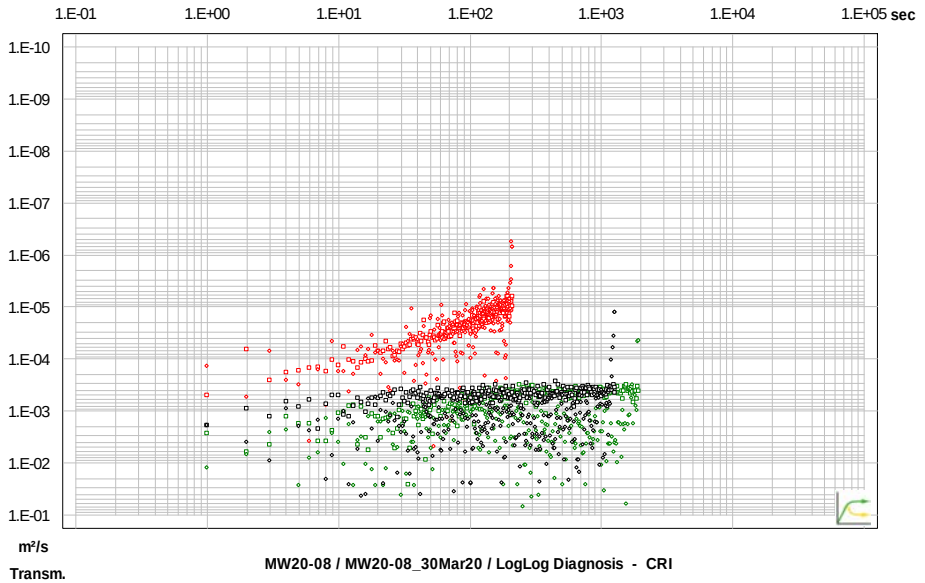
PACKER TEST RESULTS MW20-07 LOWER INTERVAL (13.2 to 16.8 mbgs)

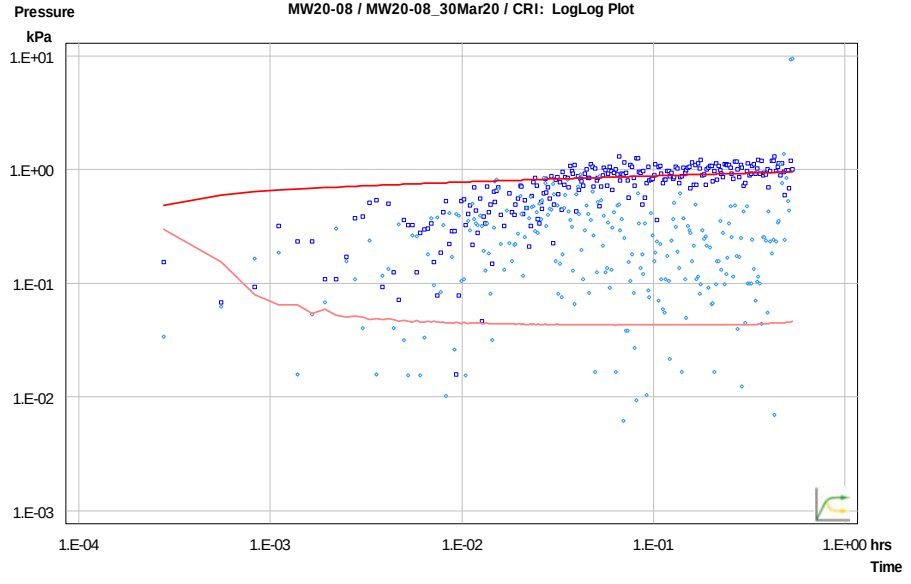
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-064

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

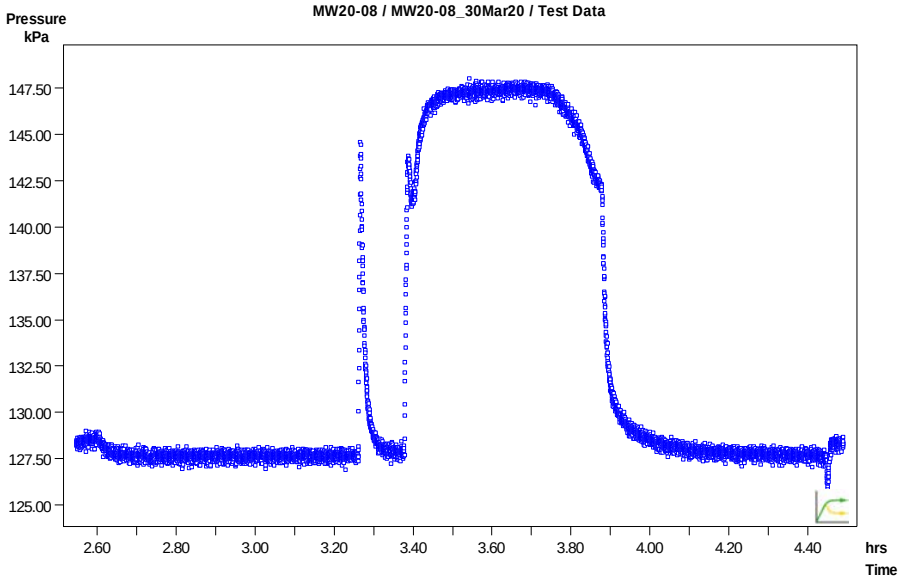
CALEDON PIT / QUARRY

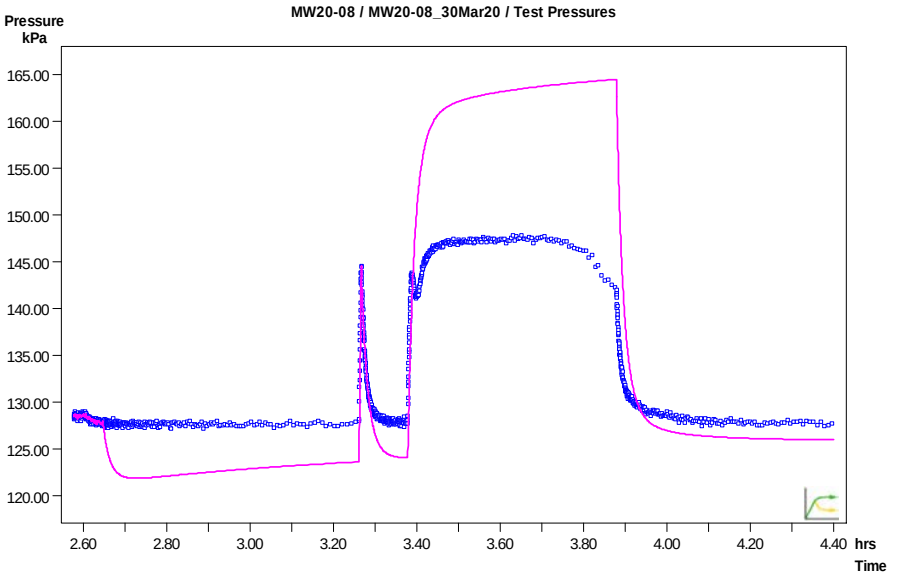
TITLE

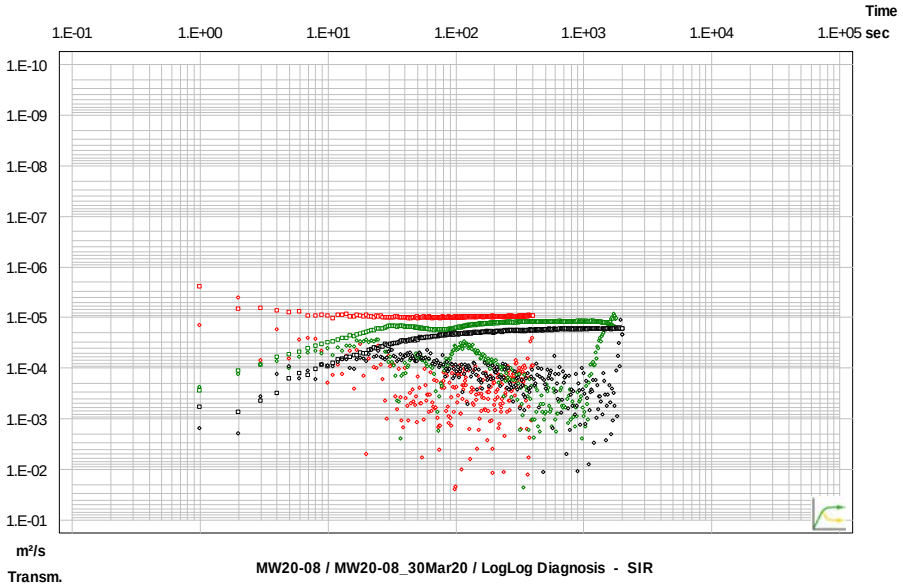
PACKER TEST RESULTS MW20-08 UPPER INTERVAL (4.1 to 9.2 mbgs)

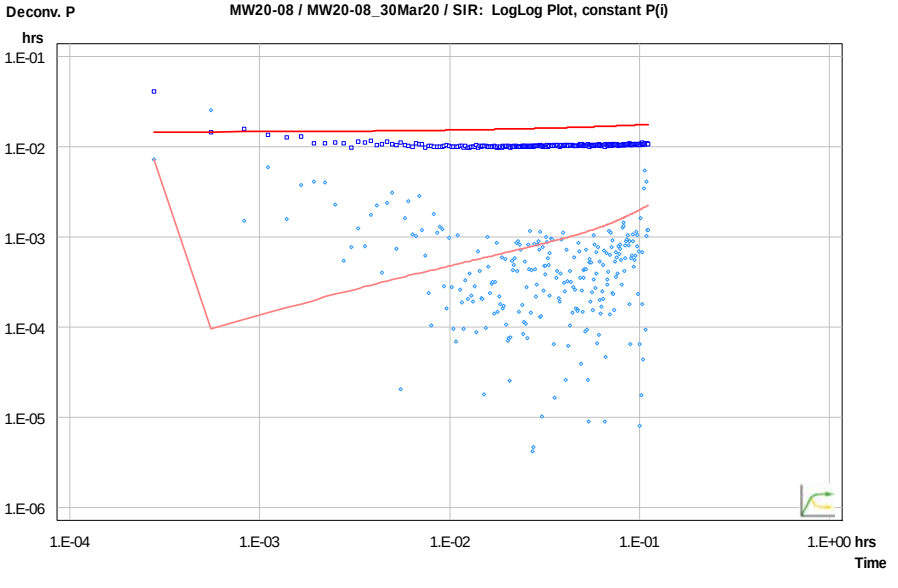
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-065

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

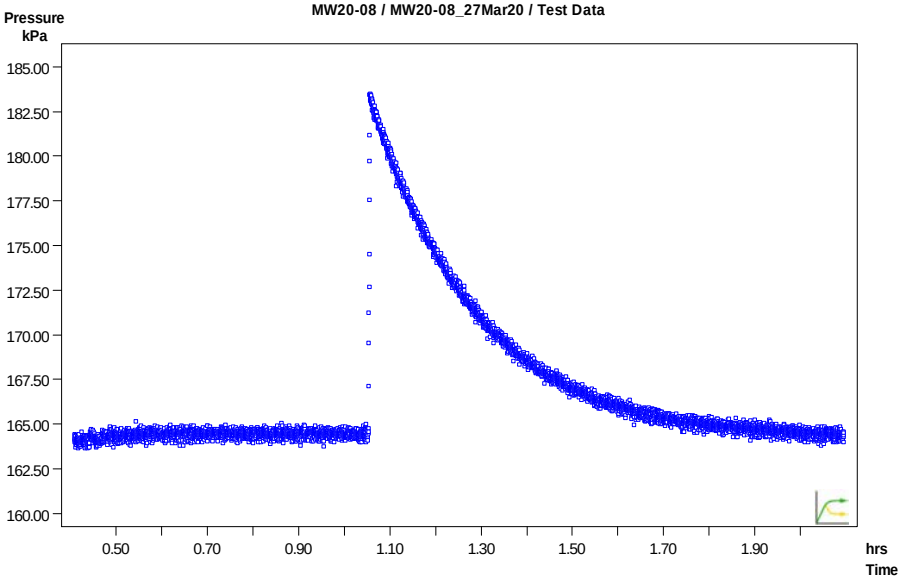
CALEDON PIT / QUARRY

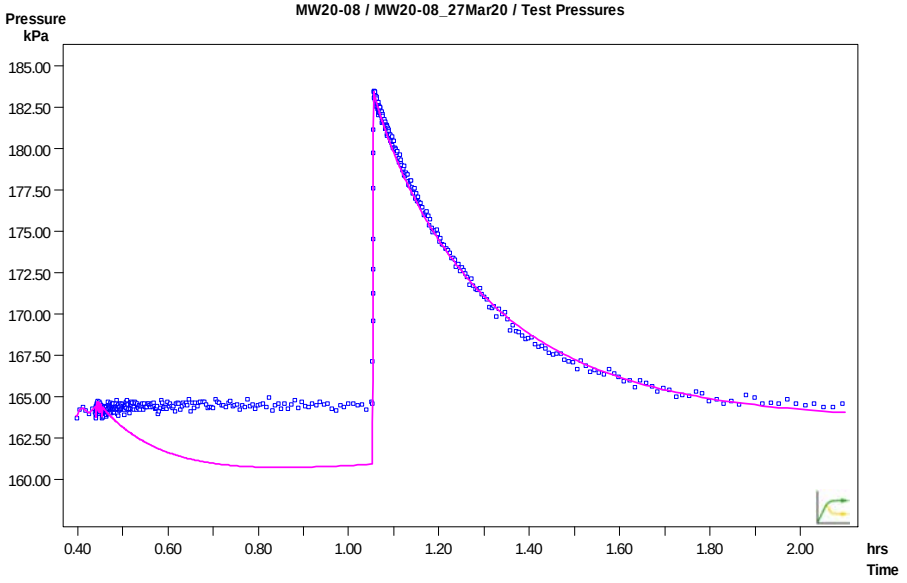
TITLE

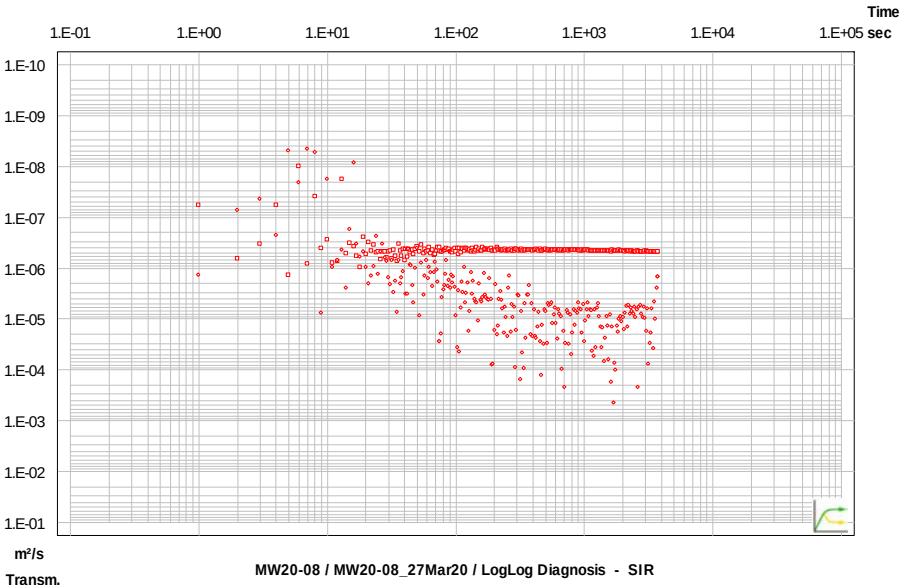
PACKER TEST RESULTS MW20-08 MIDDLE INTERVAL (8.4 to 15.1 mbgs)

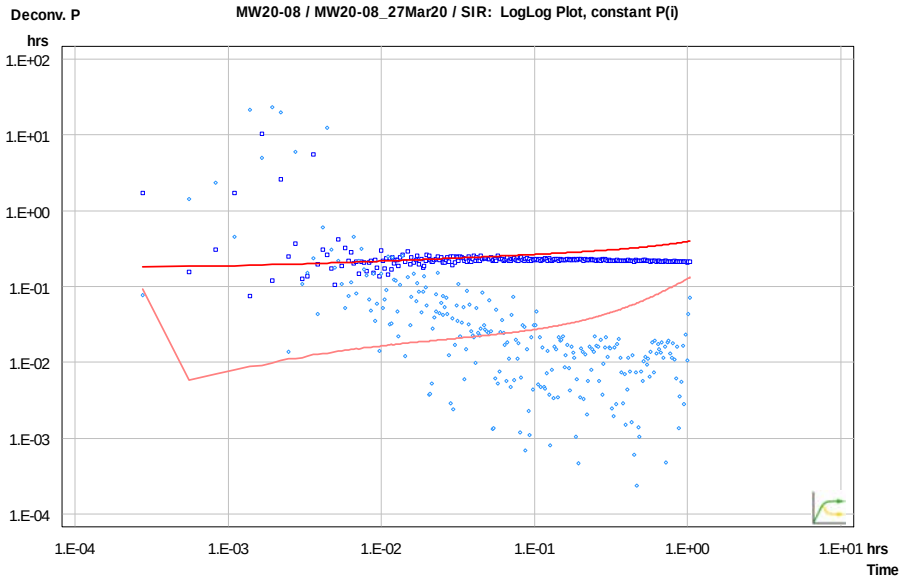
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-066

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16	
PREPARED	PGM	
DESIGN	ML	
REVIEW	###	
APPROVED		

PROJECT

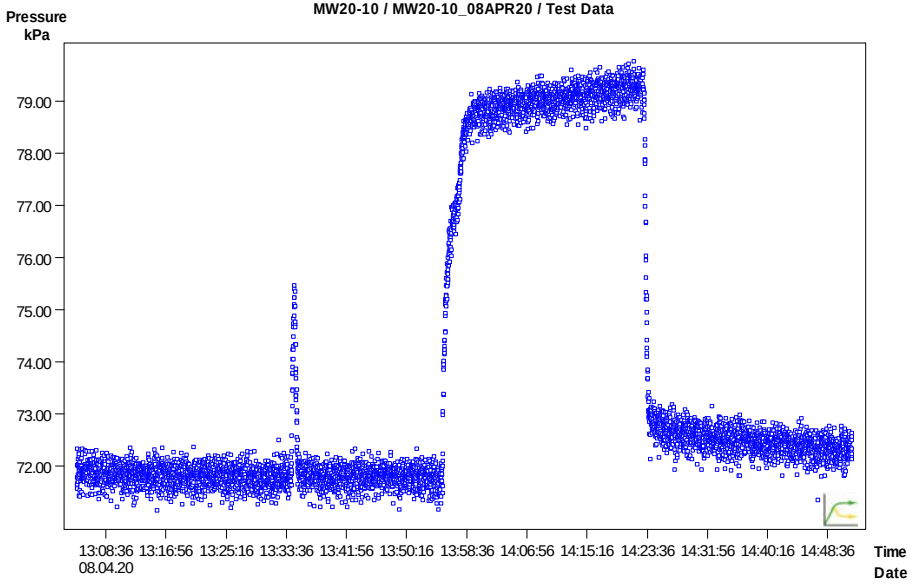
CALEDON PIT / QUARRY

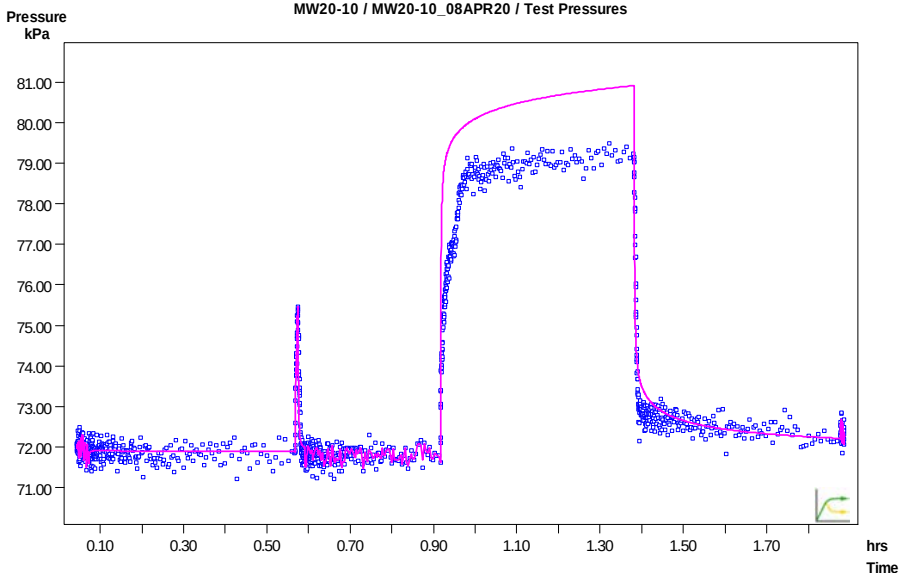
TITLE

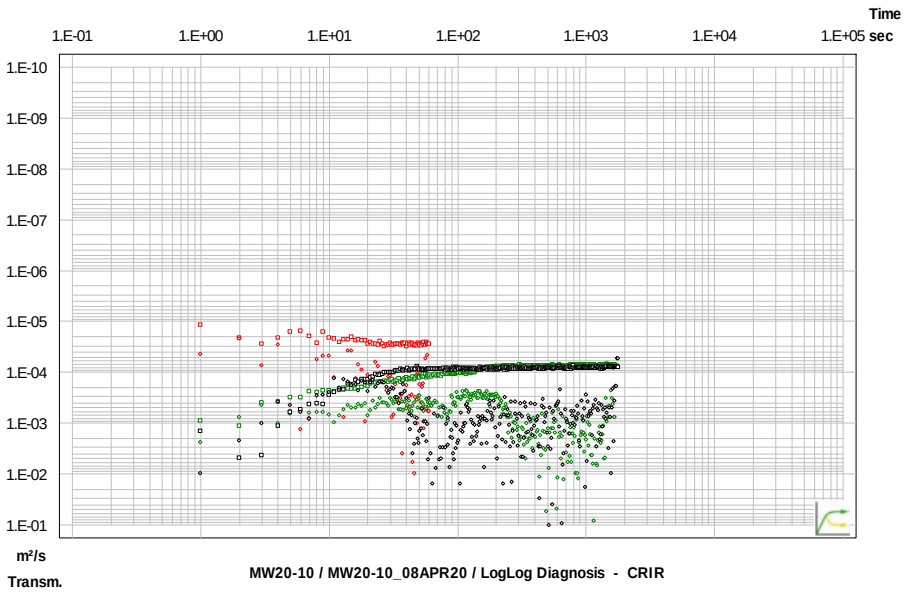
PACKER TEST RESULTS MW20-08 LOWER INTERVAL (15.2 to 18.6 mbgs)

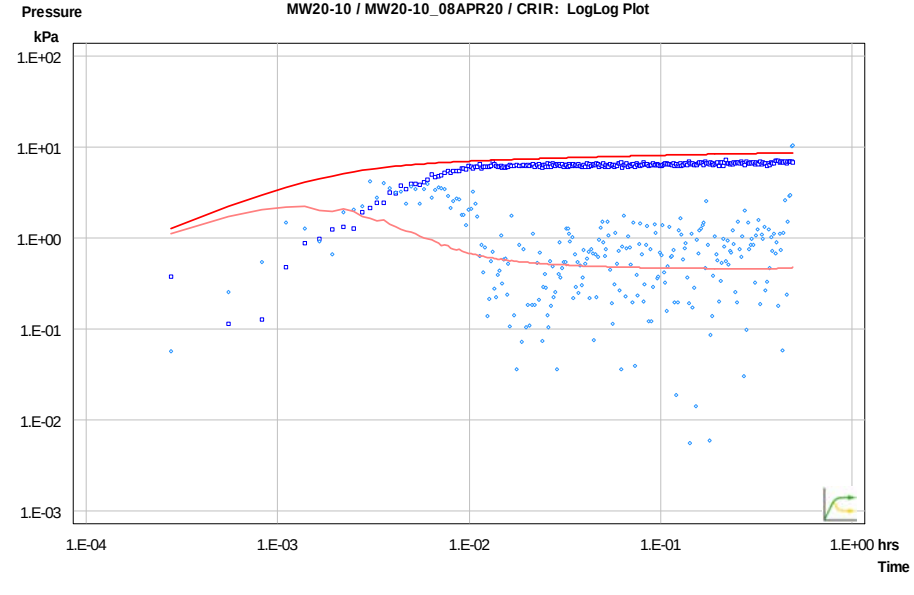
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-067

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

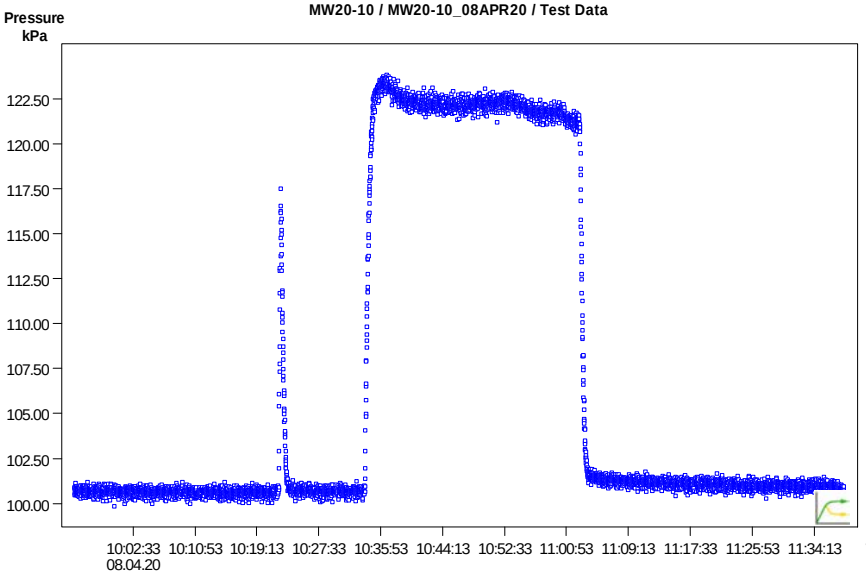
CALEDON PIT / QUARRY

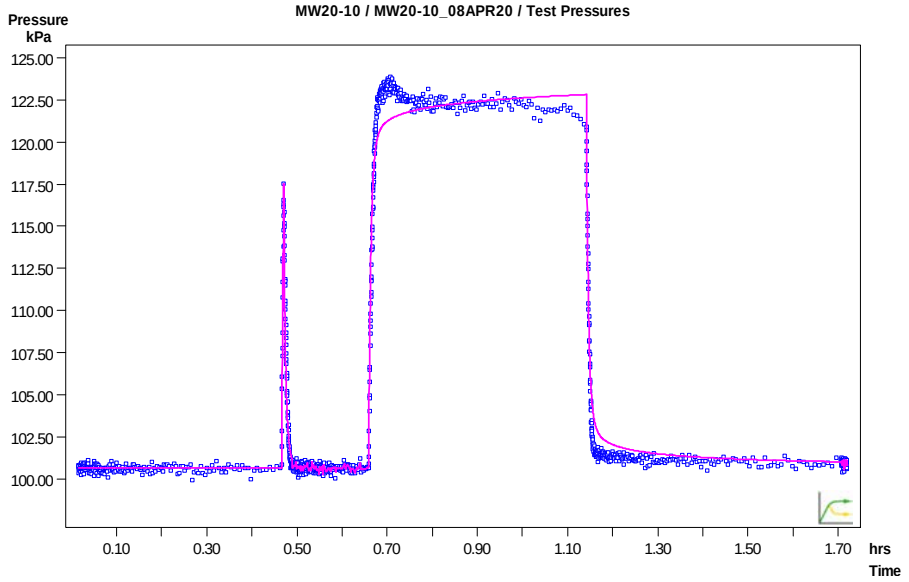
TITLE

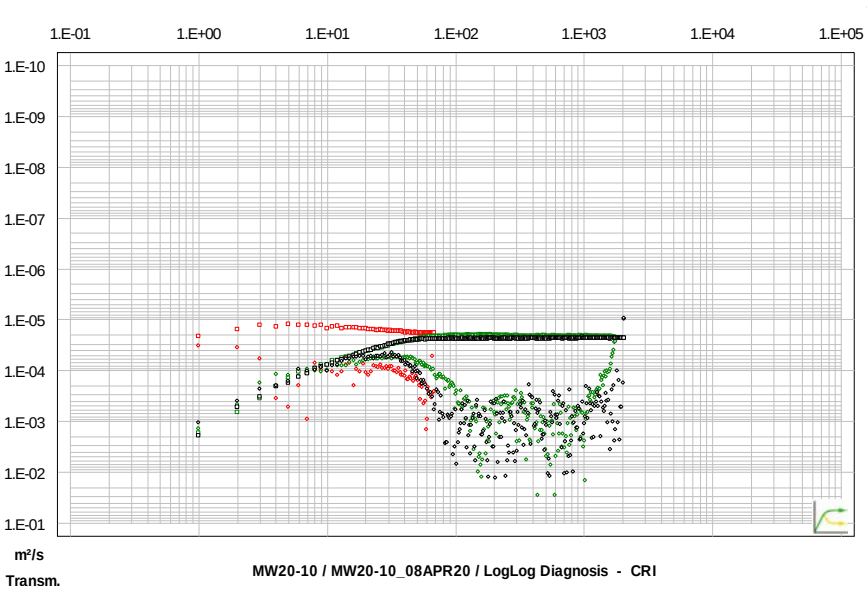
PACKER TEST RESULTS MW20-10 UPPER INTERVAL (13.3 to 17.4 mbgs)

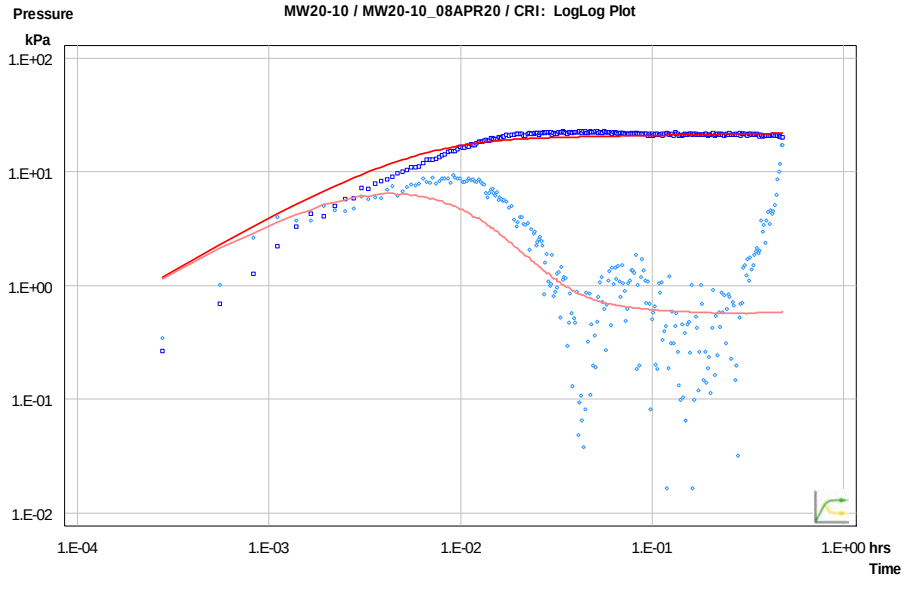
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-068

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

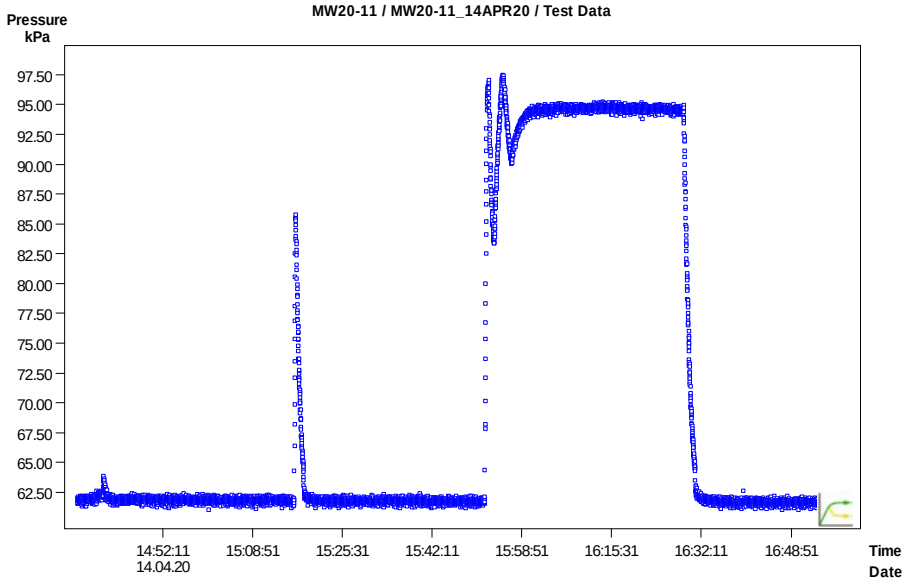
CALEDON PIT / QUARRY

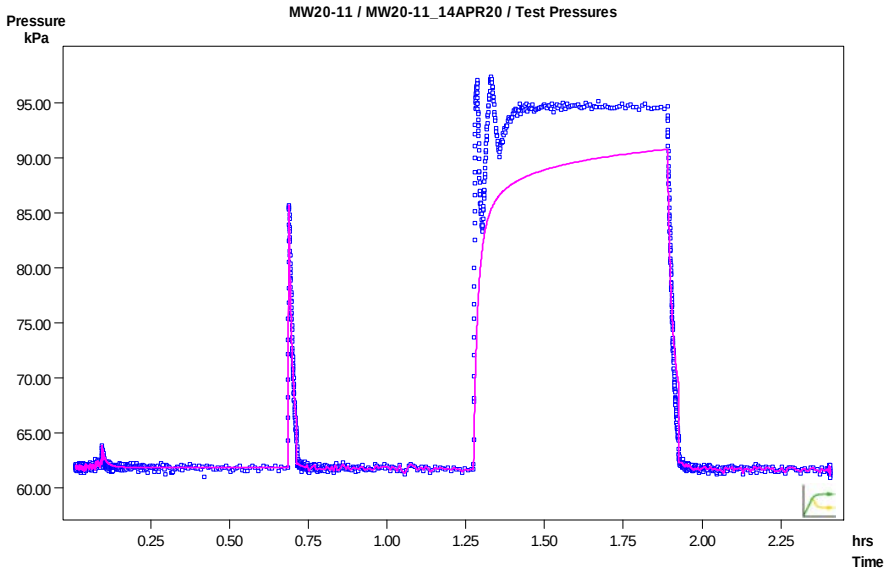
TITLE

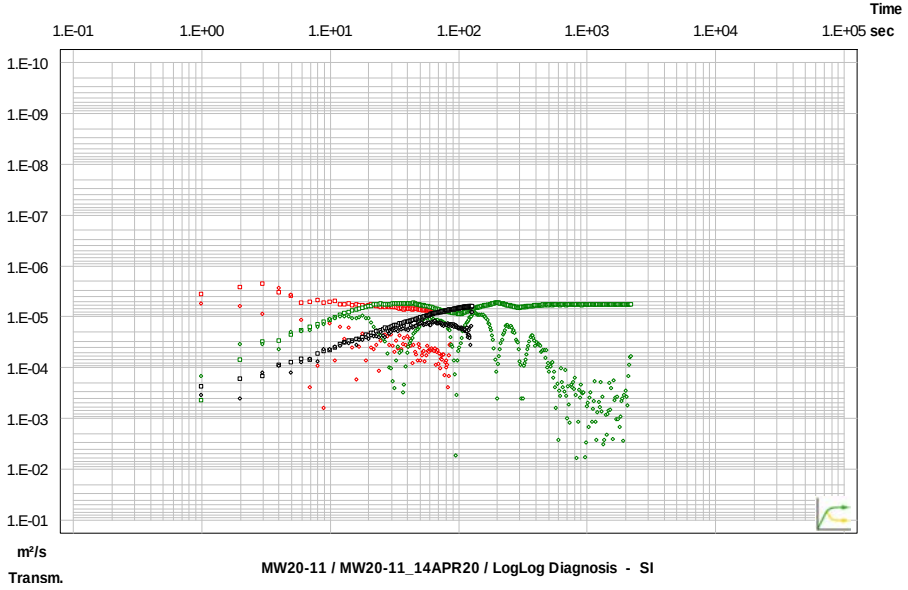
PACKER TEST RESULTS MW20-10 LOWER INTERVAL (16.9 to 21.2 mbgs)

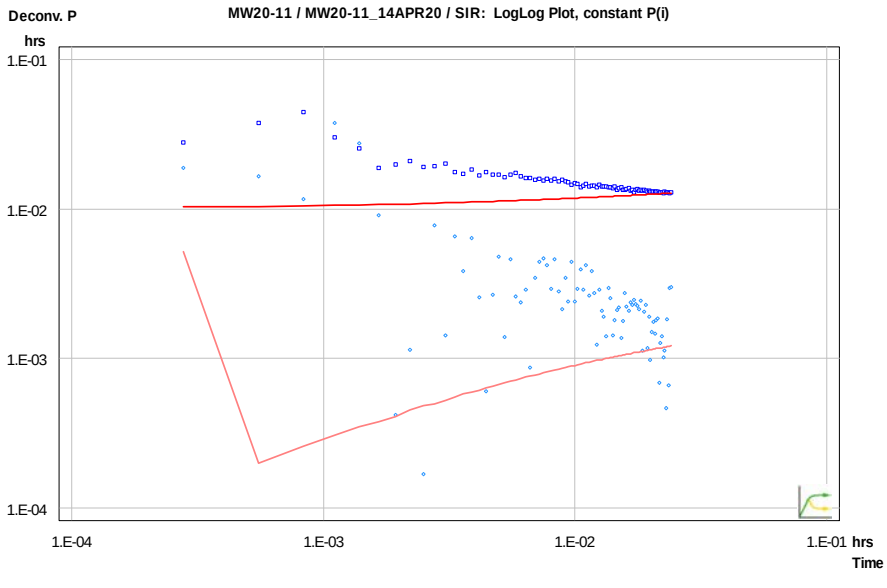
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-069

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

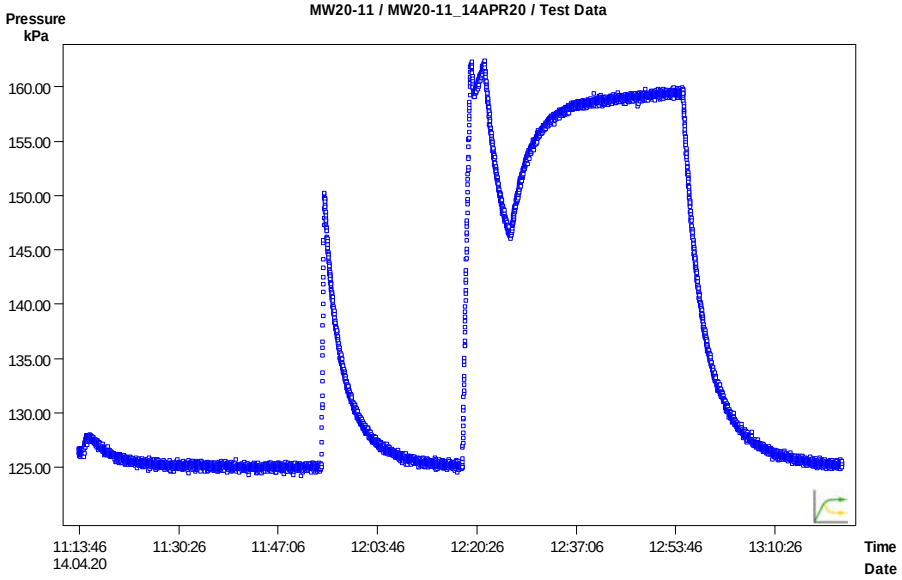
CALEDON PIT / QUARRY

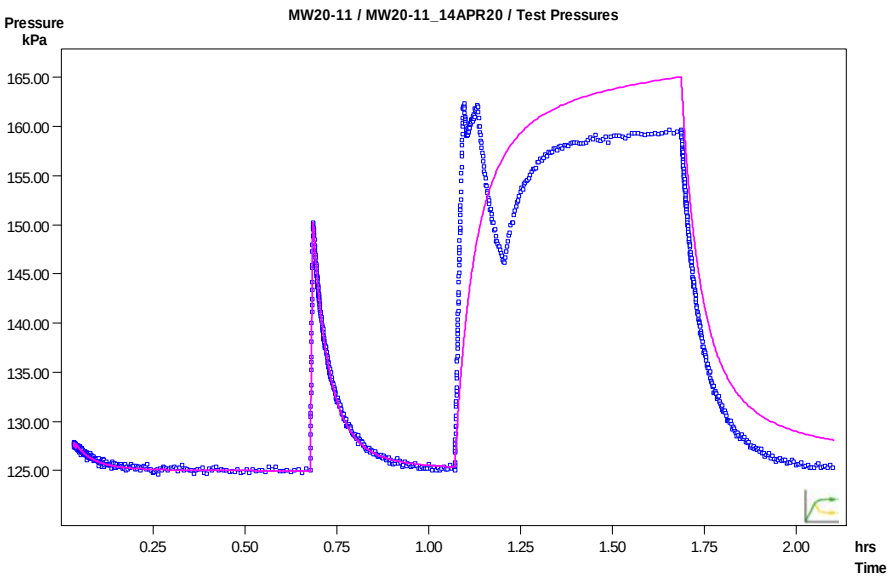
TITLE

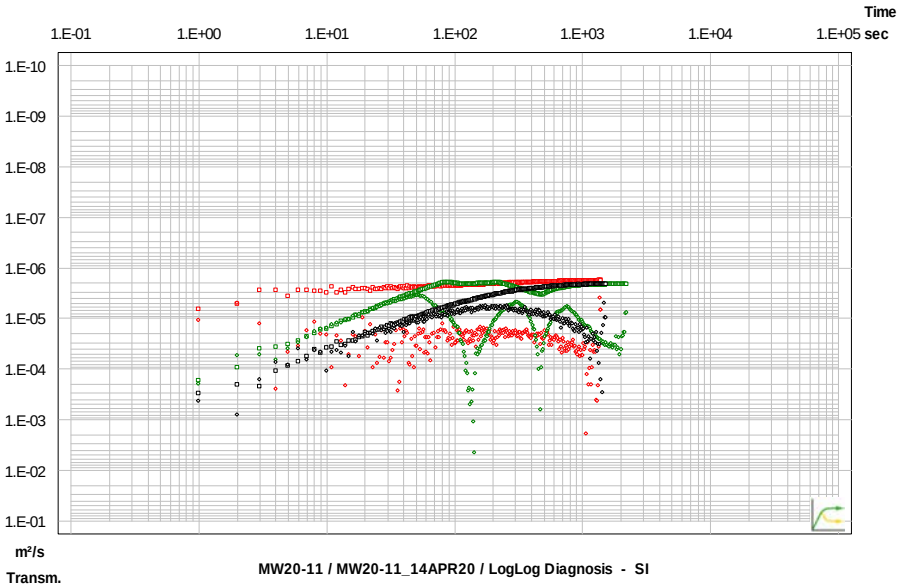
PACKER TEST RESULTS MW20-11 UPPER INTERVAL (4.8 to 10.0 mbgs)

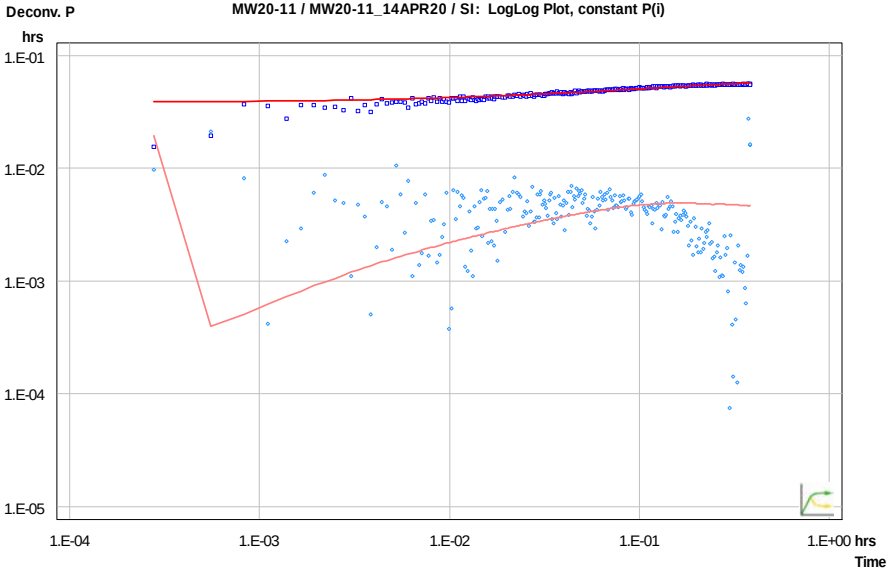
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-070

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

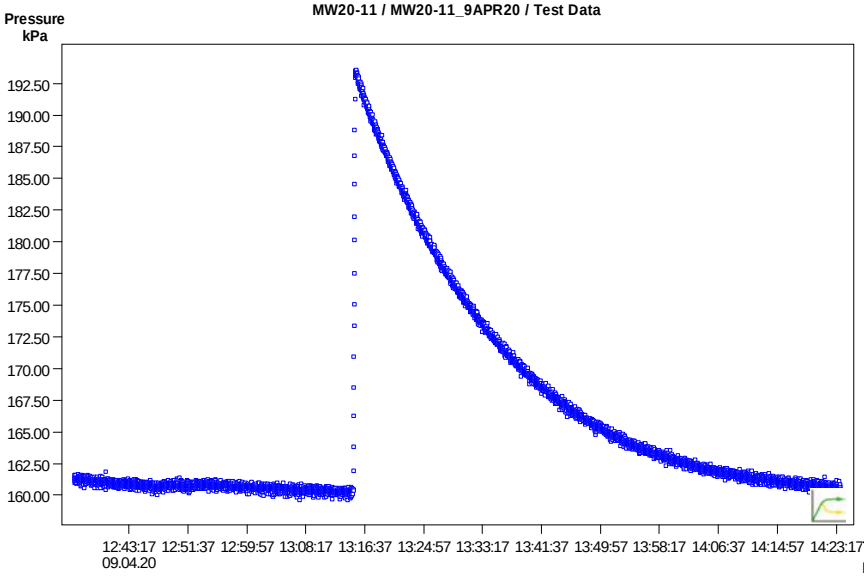
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

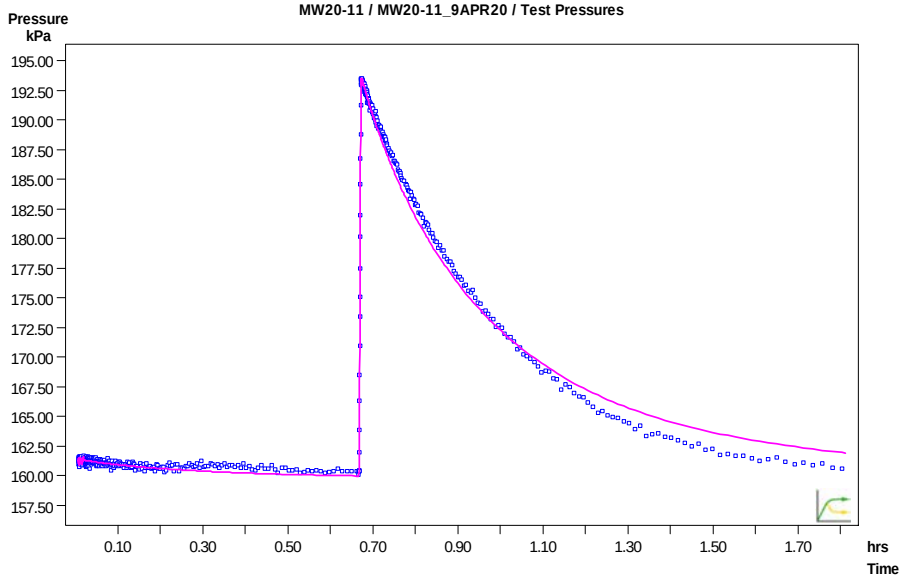
TITLE

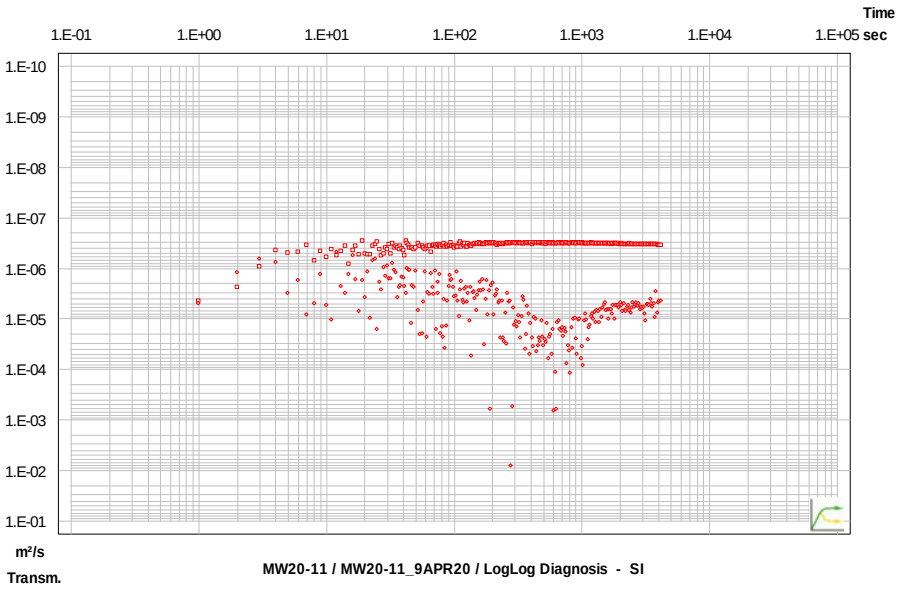
PACKER TEST RESULTS MW20-11 MIDDLE INTERVAL (9.7 to 16.4 mbgs)

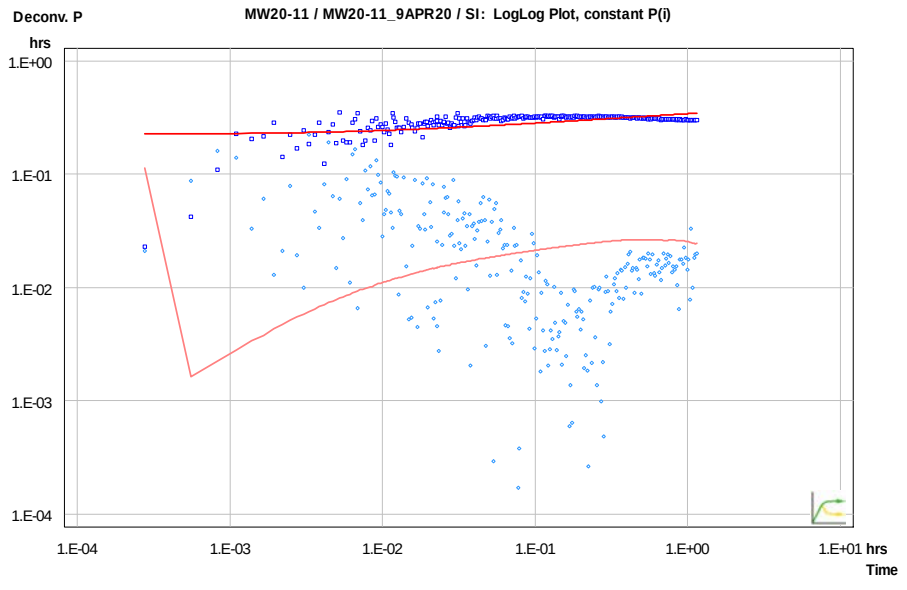
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-071

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

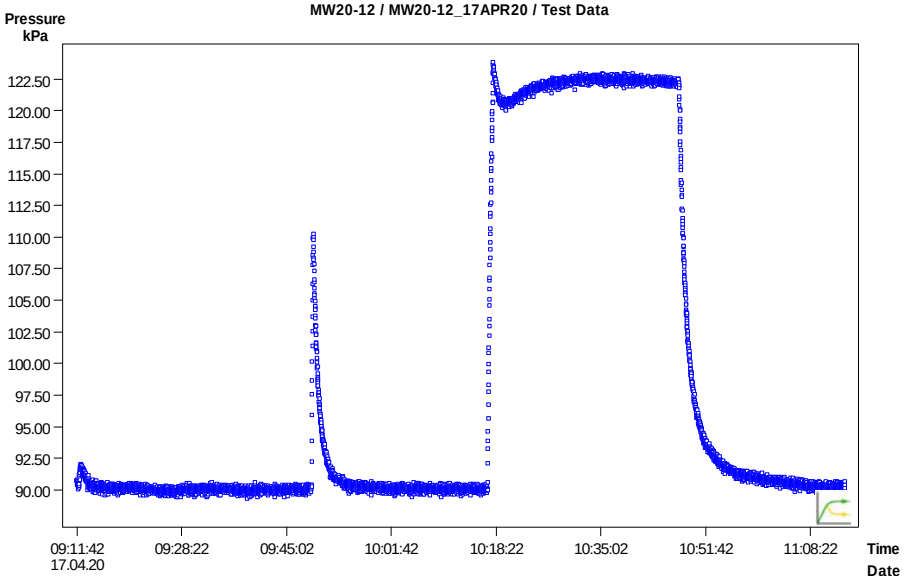
CALEDON PIT / QUARRY

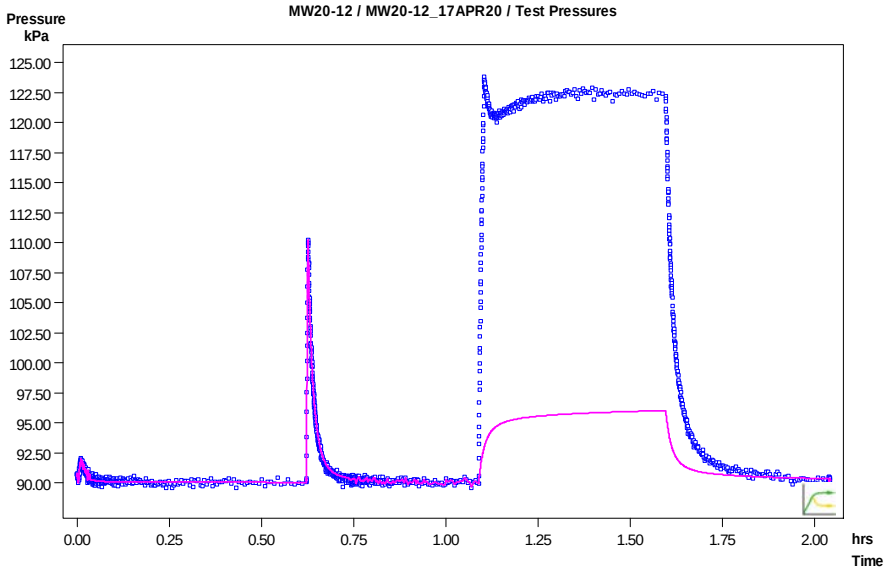
TITLE

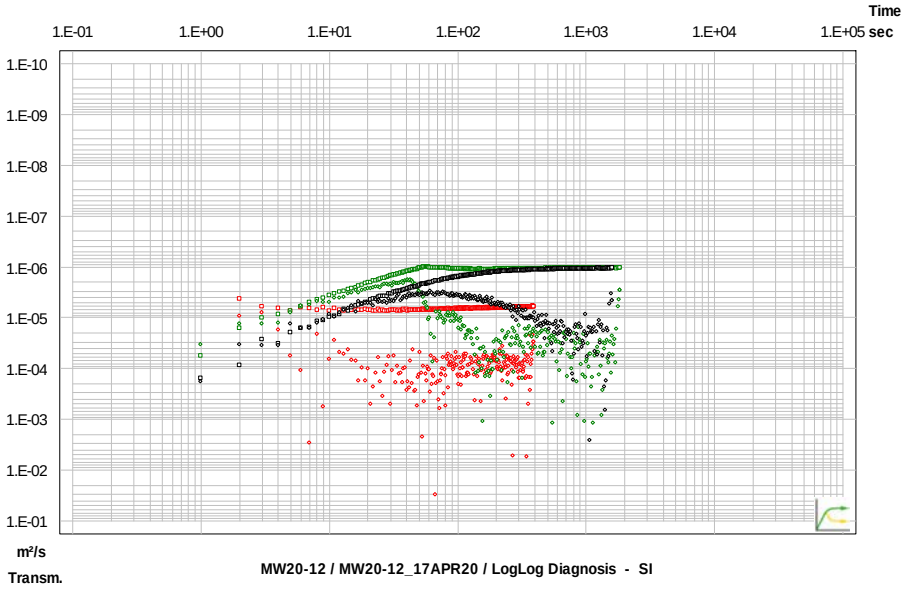
PACKER TEST RESULTS MW20-11 LOWER INTERVAL (16.4 to 19.4 mbgs)

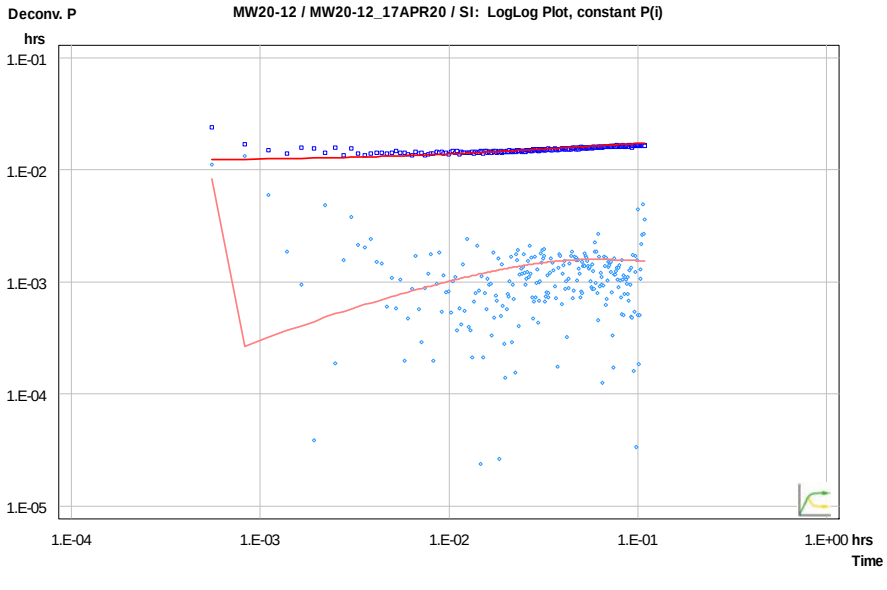
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-072

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

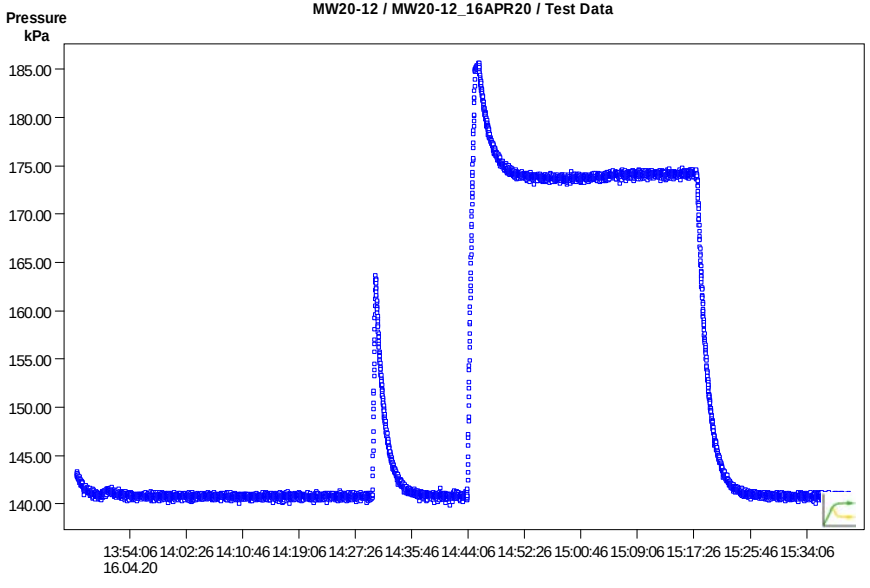
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

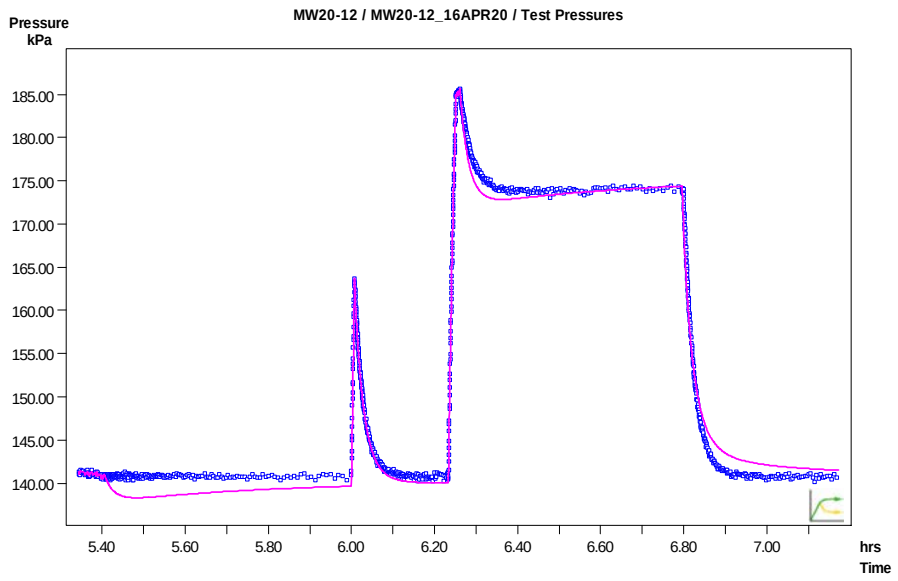
TITLE

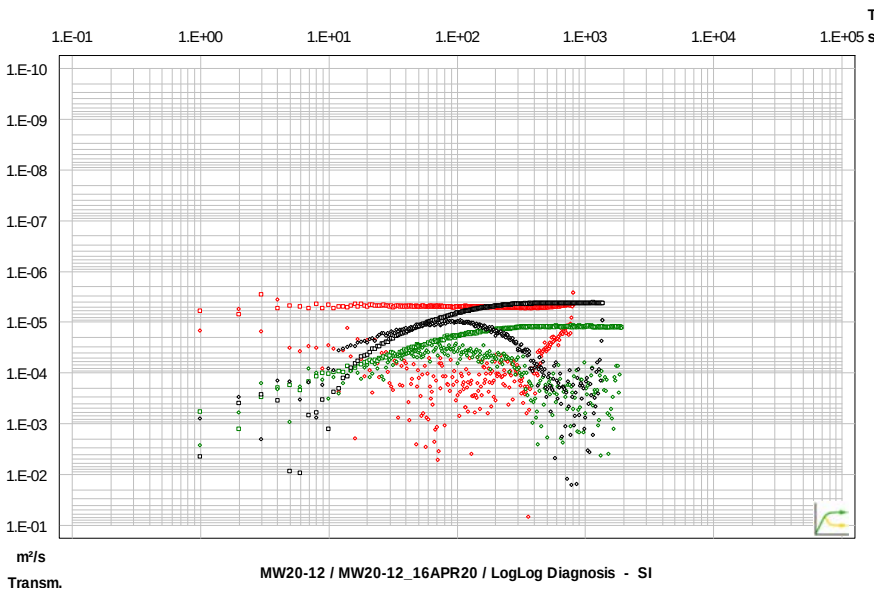
PACKER TEST RESULTS MW20-12 UPPER INTERVAL (7.5 to 14.2 mbgs)

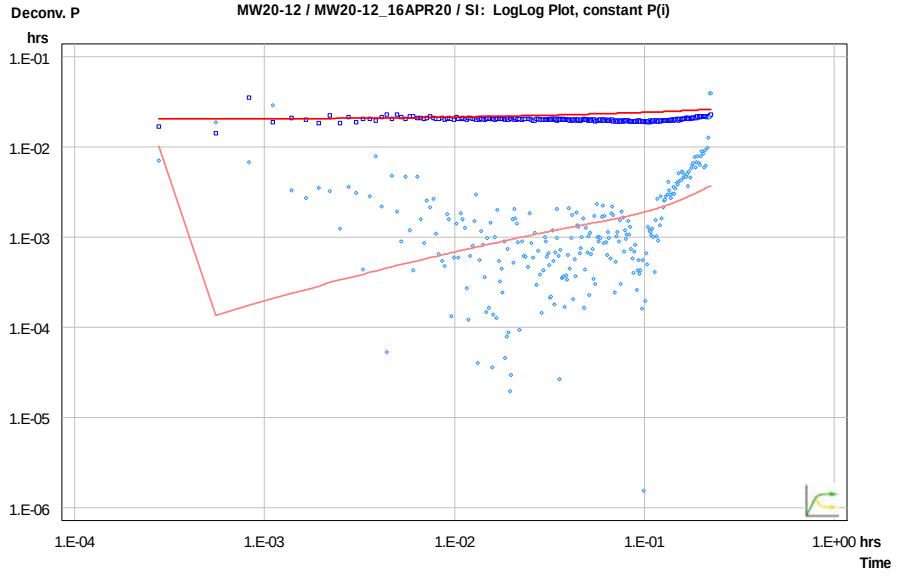
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-073

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

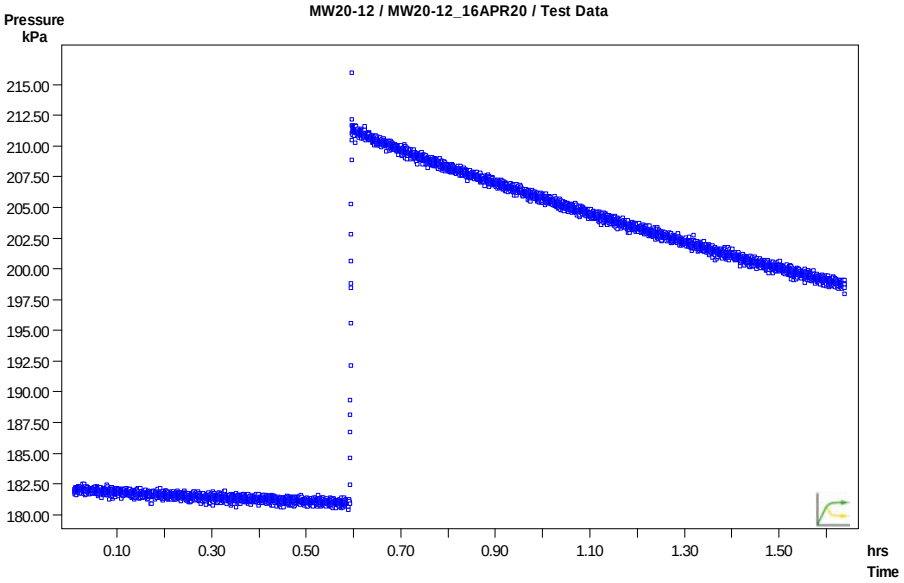
CALEDON PIT / QUARRY

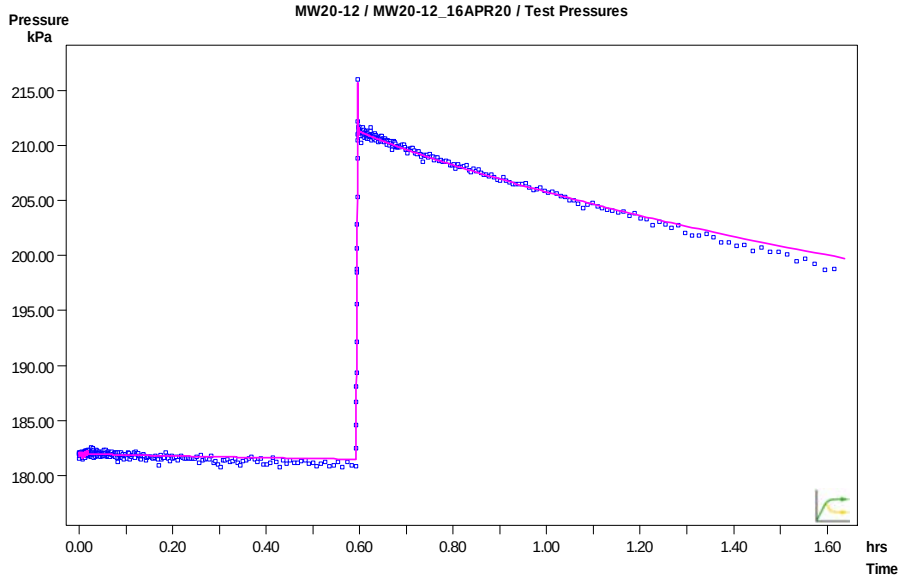
TITLE

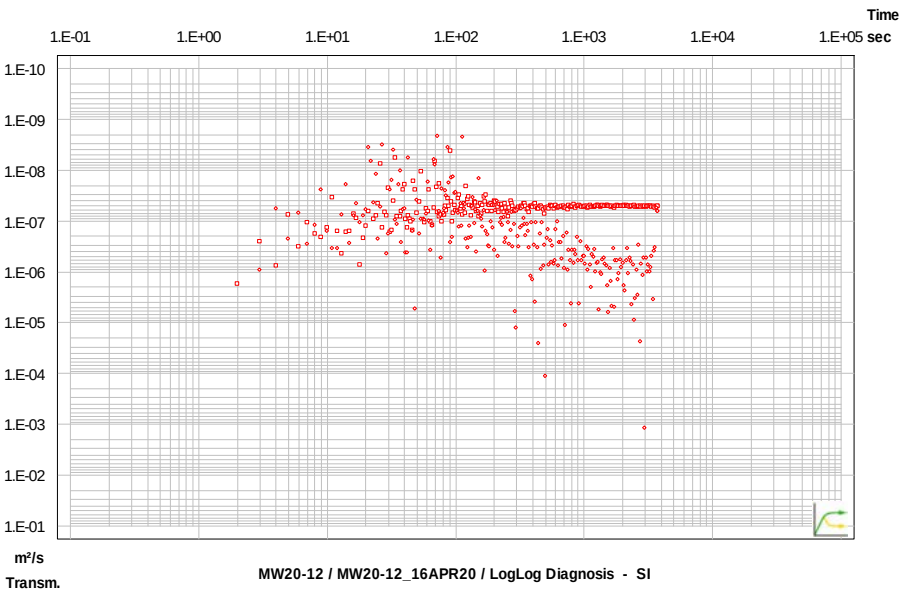
PACKER TEST RESULTS MW20-12 MIDDLE INTERVAL (14.2 to 19.3 mbgs)

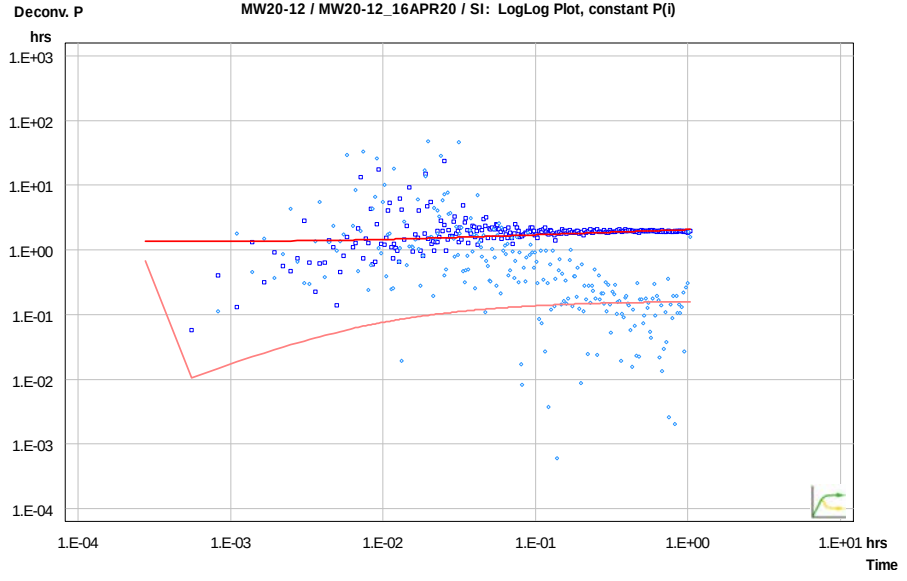
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-074

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

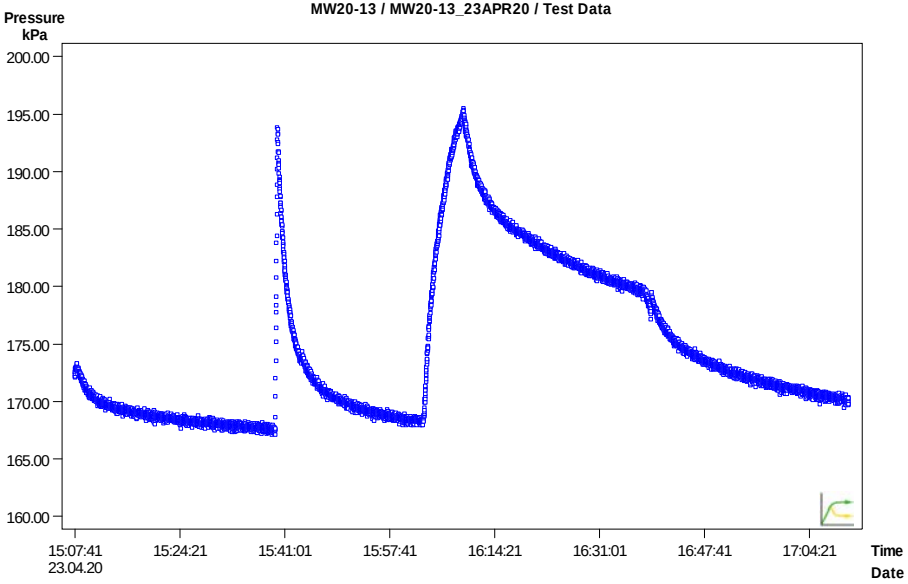
CALEDON PIT / QUARRY

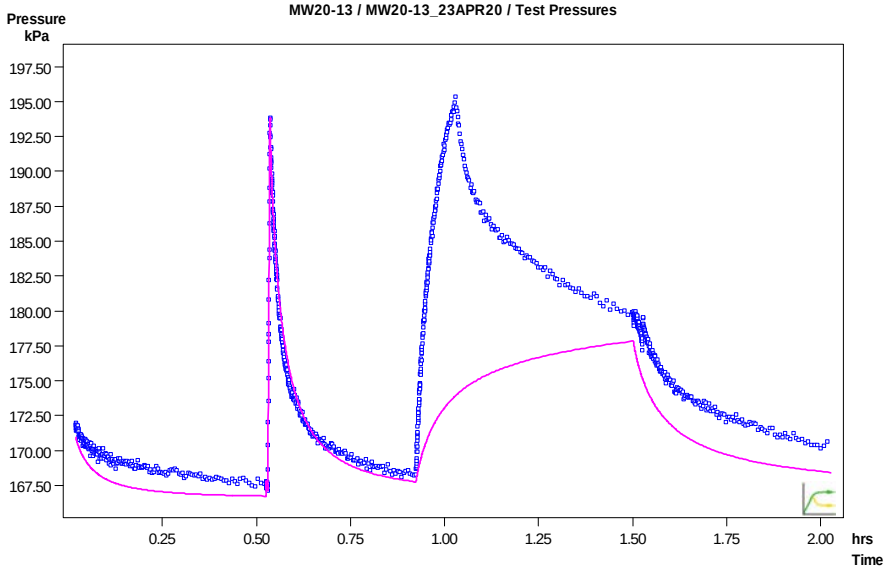
TITLE

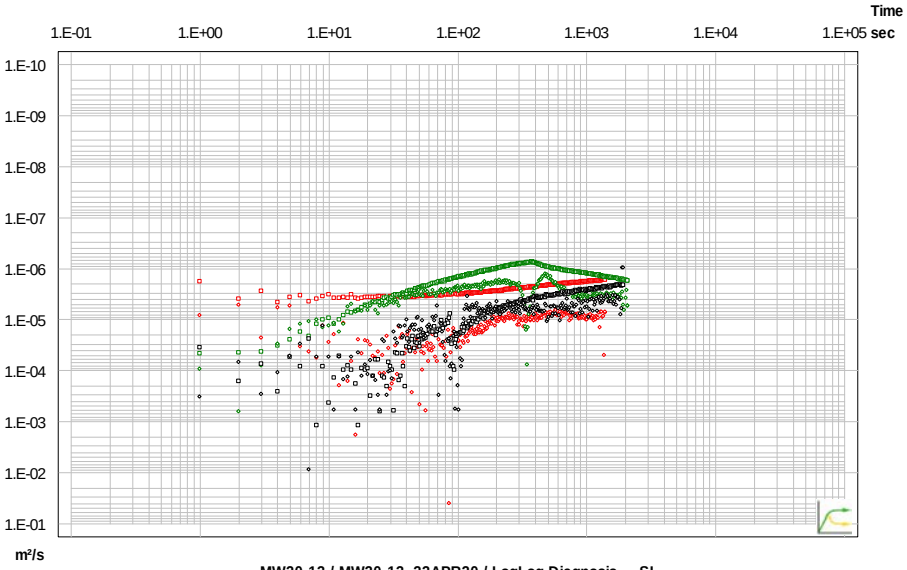
PACKER TEST RESULTS MW20-12 LOWER INTERVAL (19.8 to 22.7 mbgs)

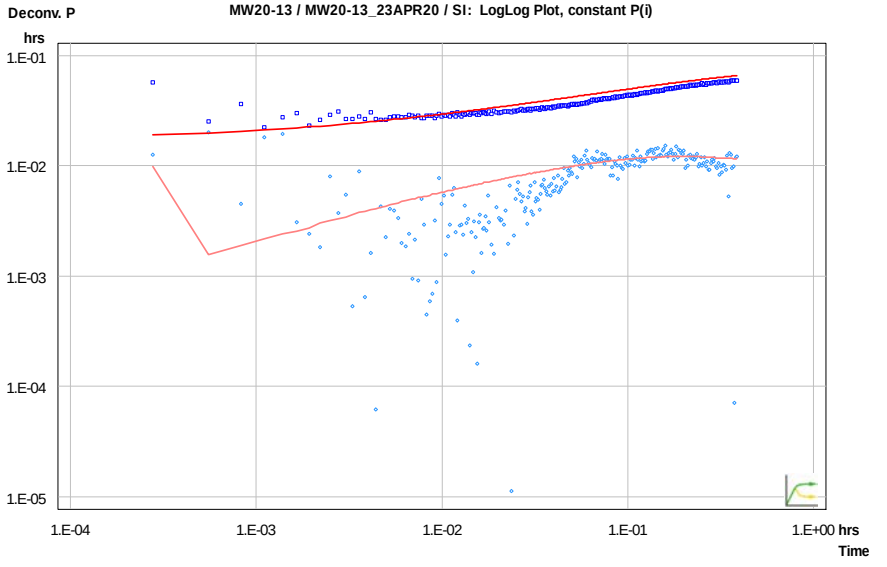
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-075

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

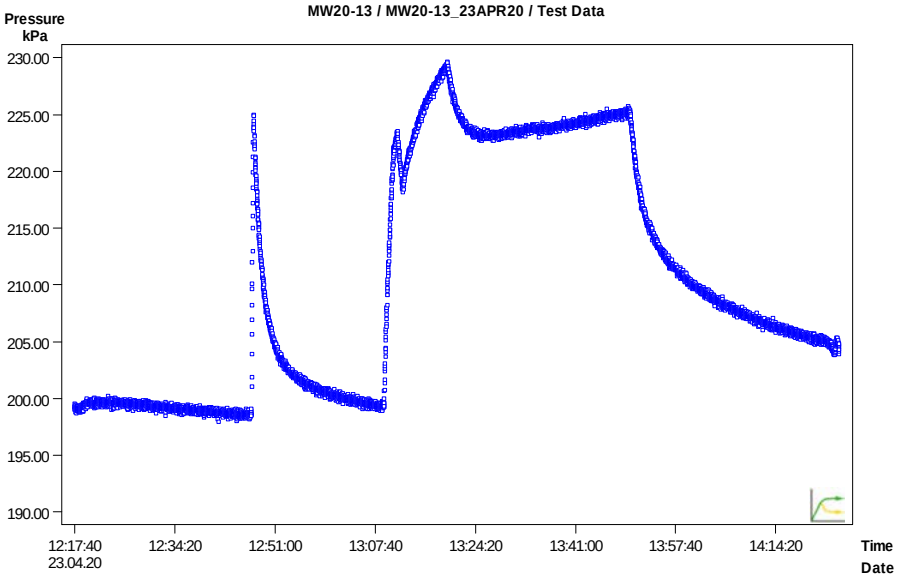
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

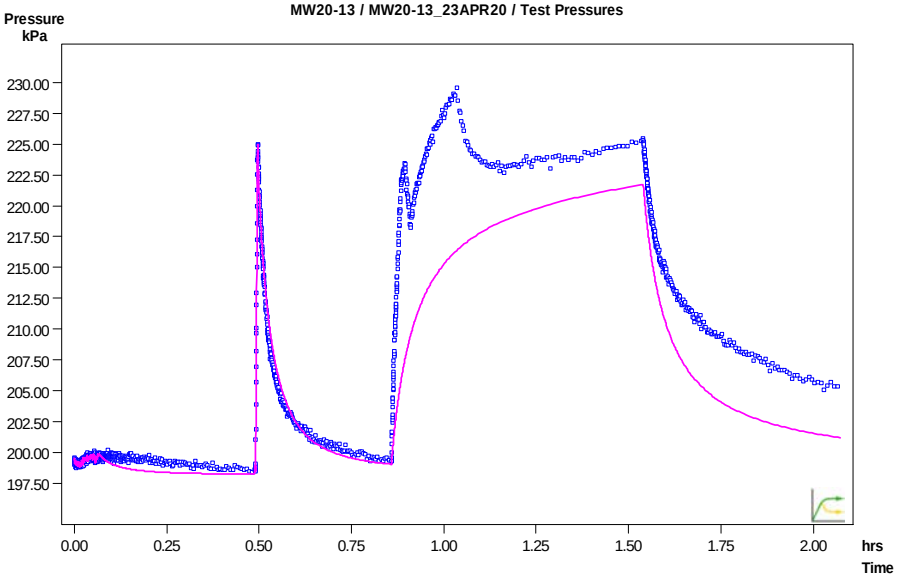
TITLE

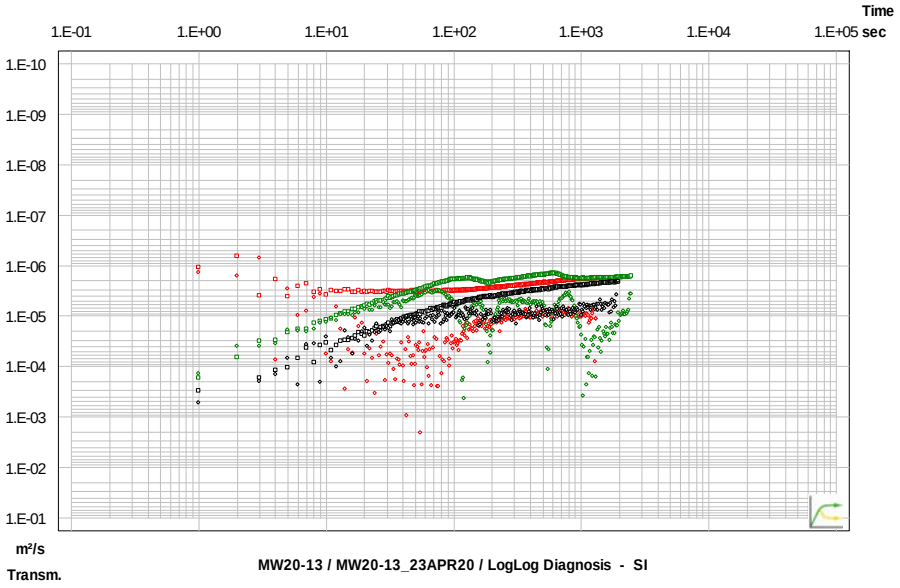
PACKER TEST RESULTS MW20-13 UPPER INTERVAL (17.0 to 20.6 mbgs)

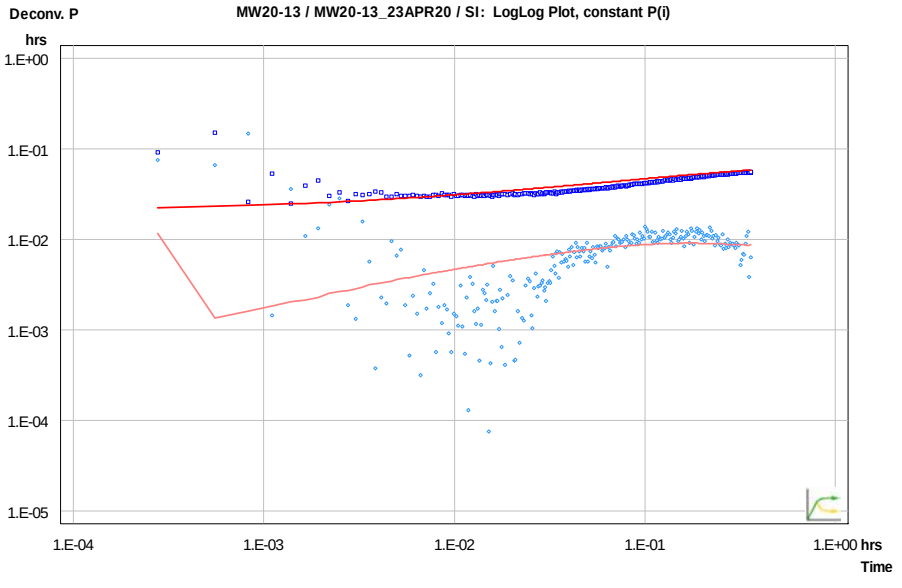
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-076

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

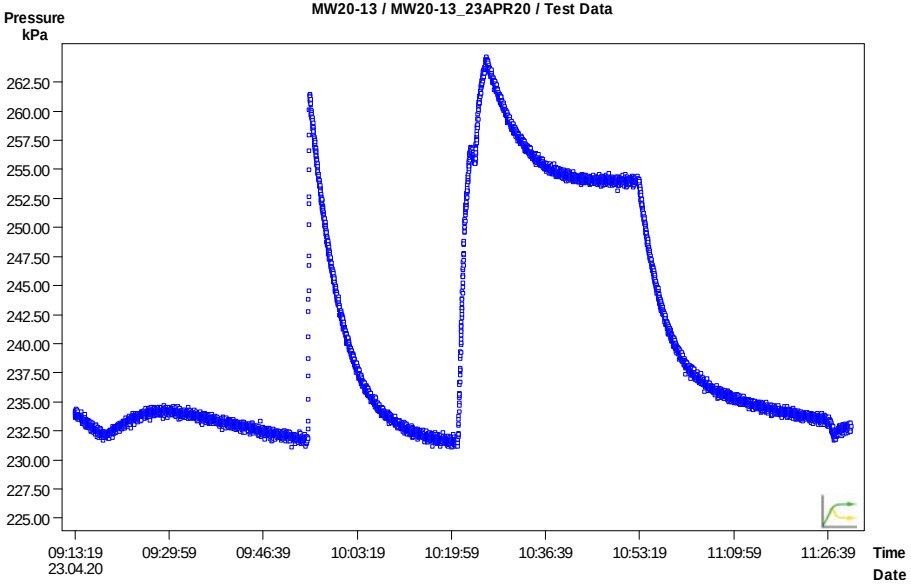
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

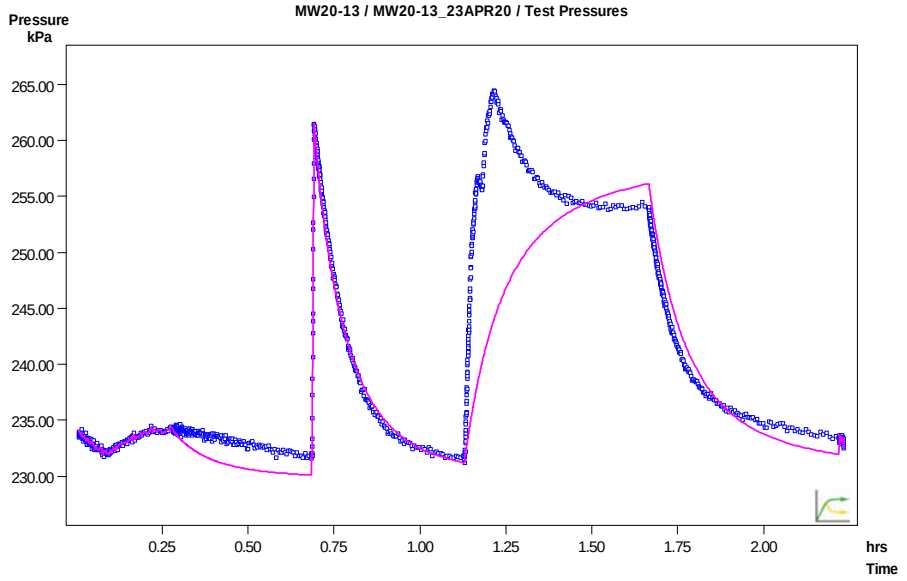
TITLE

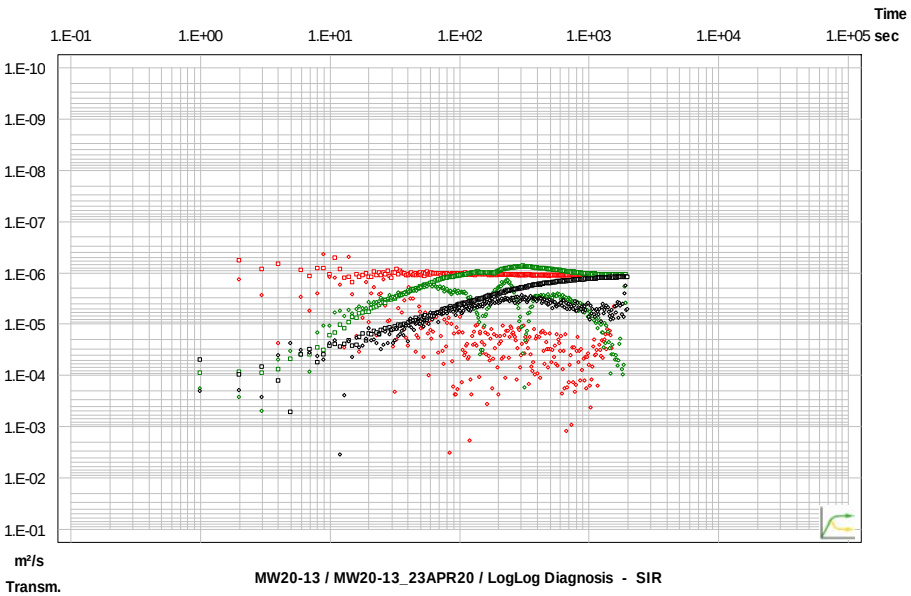
PACKER TEST RESULTS MW20-13 MIDDLE INTERVAL (20.2 to 23.9 mbgs)

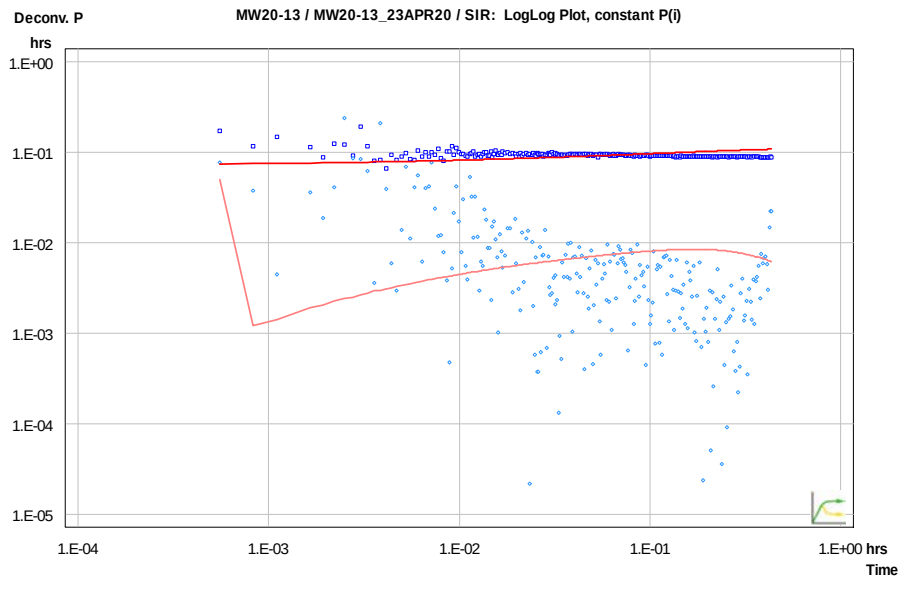
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-077

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

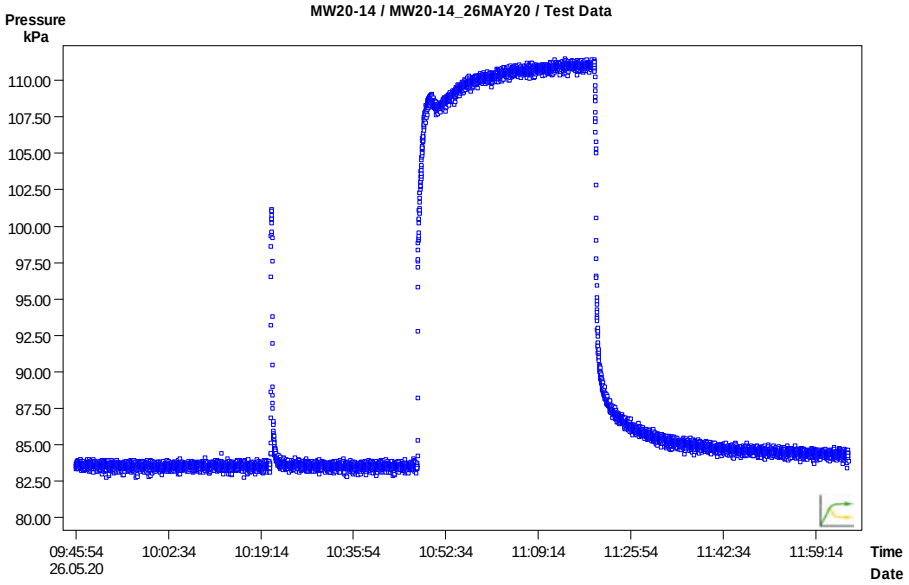
CALEDON PIT / QUARRY

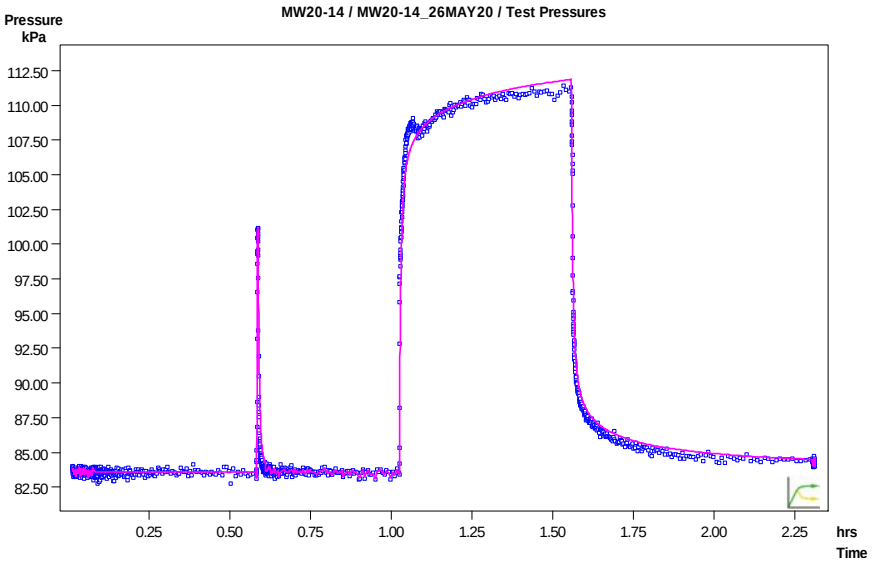
TITLE

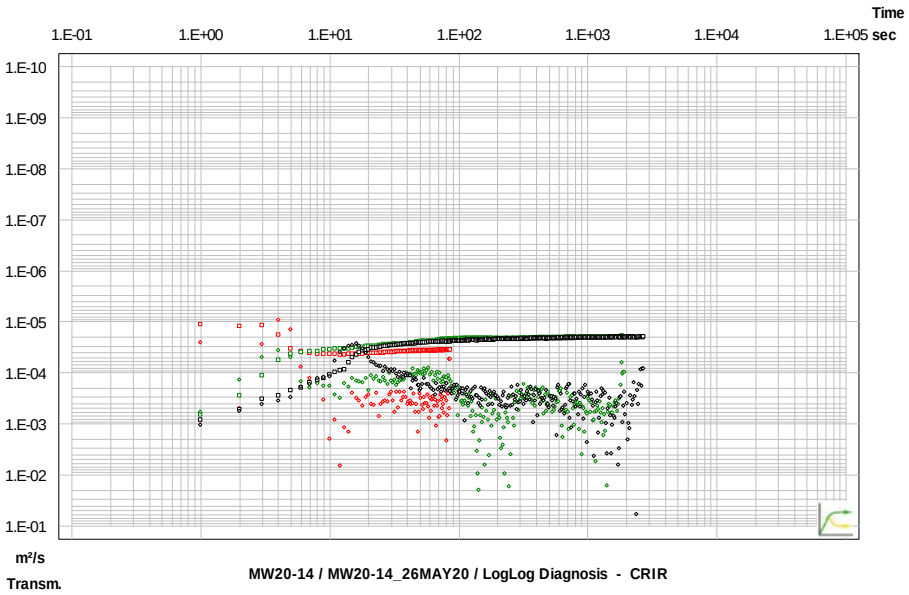
PACKER TEST RESULTS MW20-13 LOWER INTERVAL (23.9 to 28.2 mbgs)

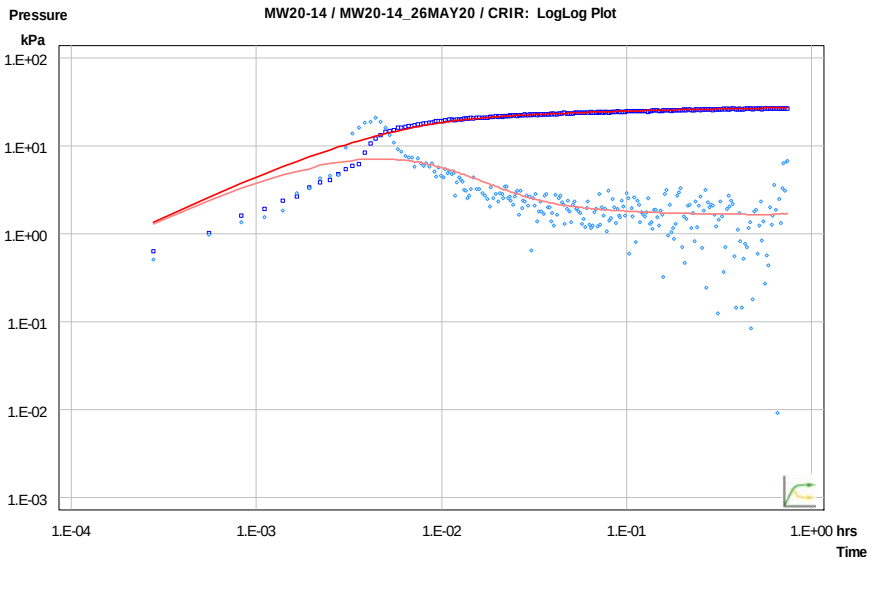
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-078

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

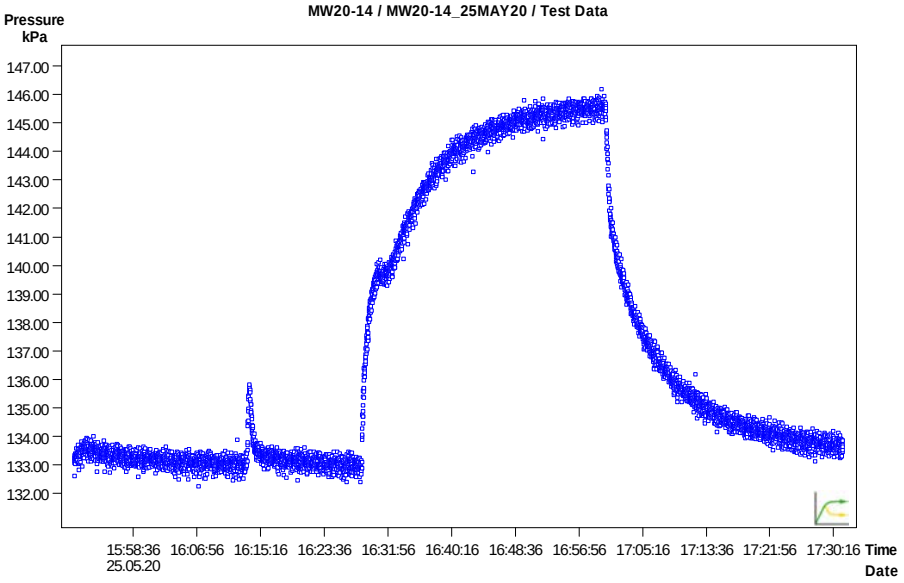
CALEDON PIT / QUARRY

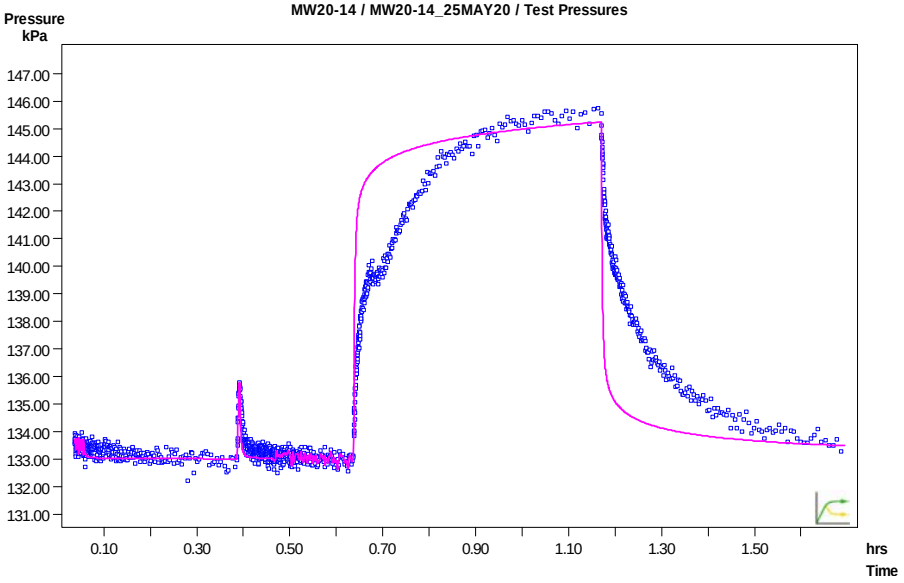
TITLE

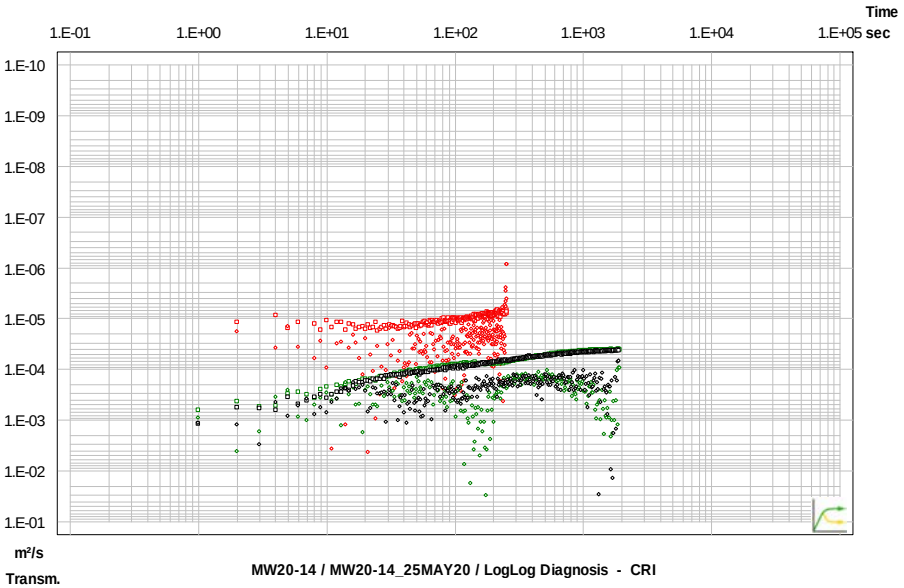
PACKER TEST RESULTS MW20-14 UPPER INTERVAL (4.6 to 14.4 mbgs)

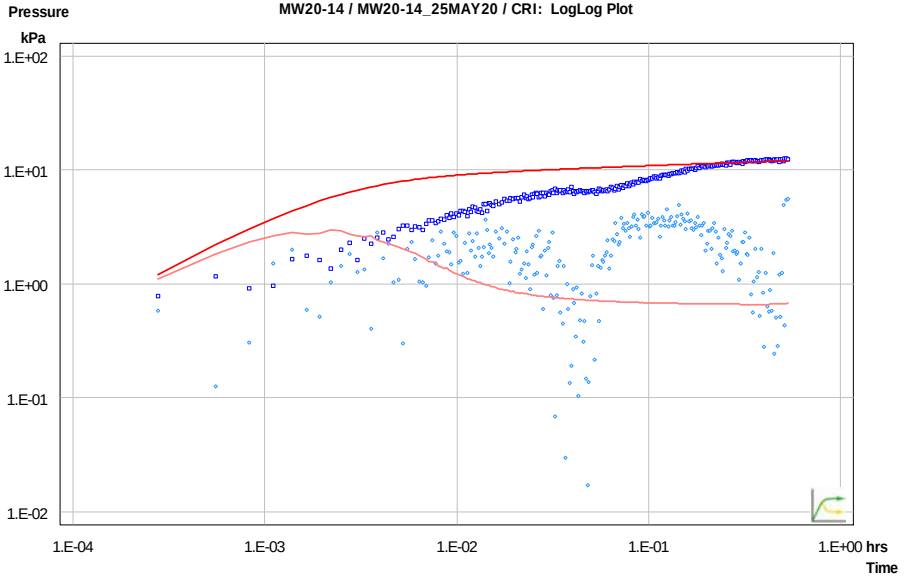
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-079

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

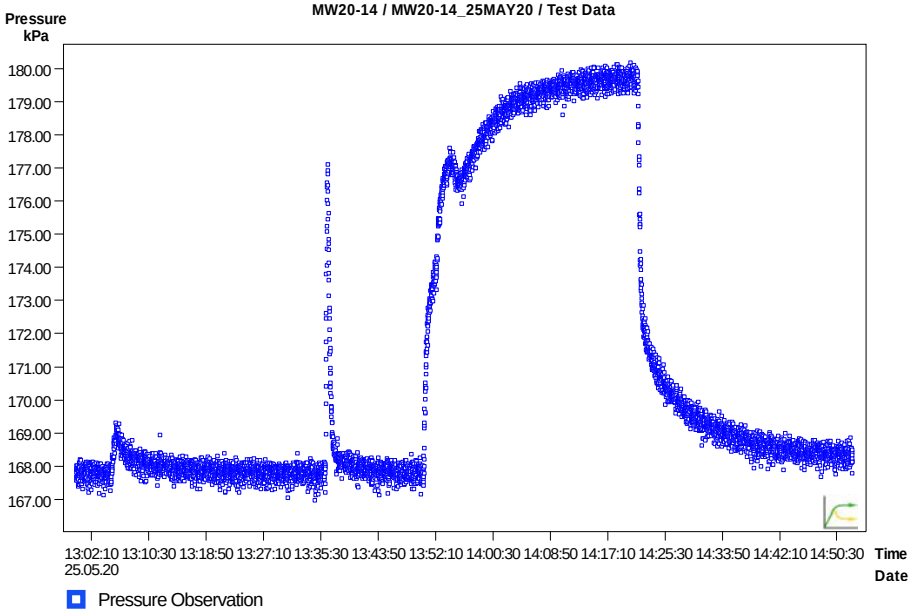
CALEDON PIT / QUARRY

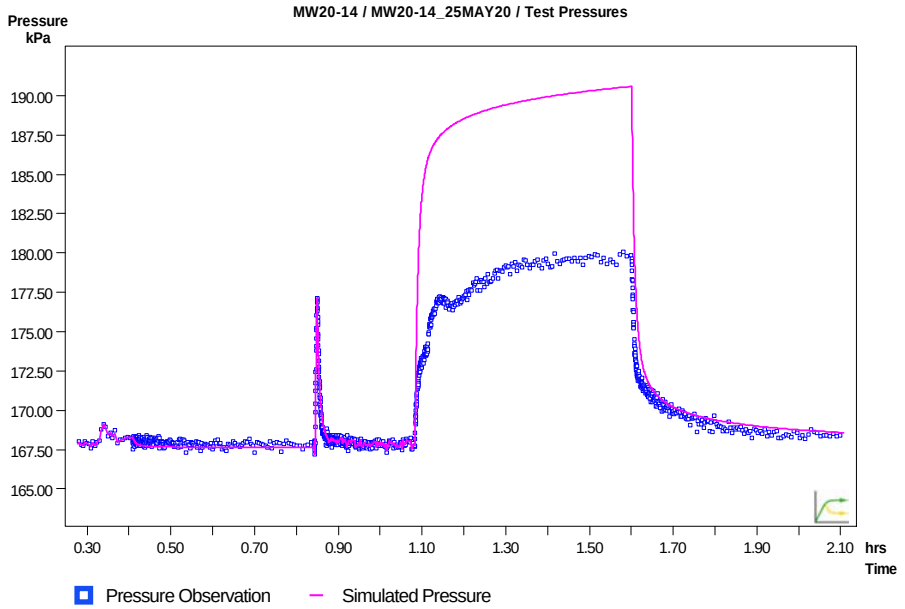
TITLE

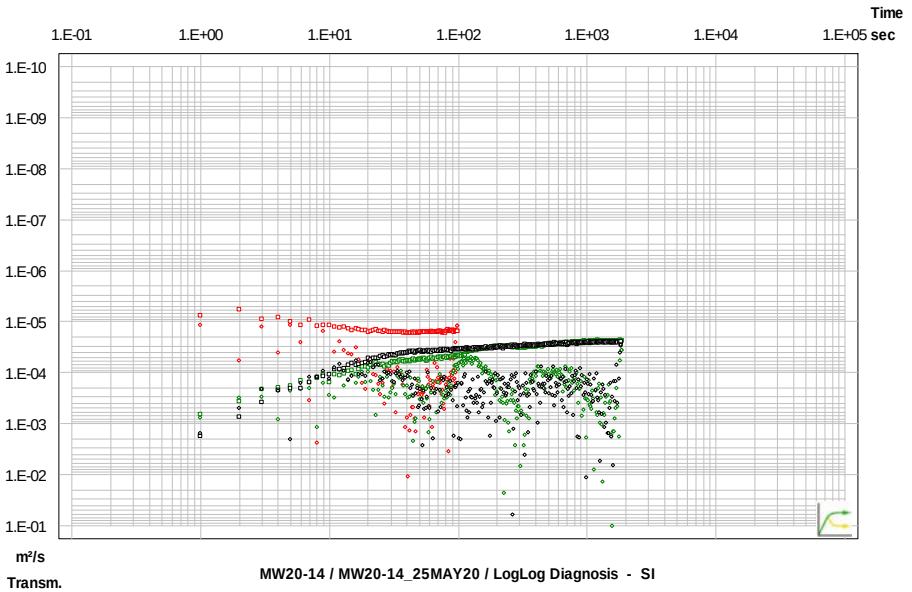
PACKER TEST RESULTS MW20-14 MIDDLE INTERVAL (14.2 to 22.4 mbgs)

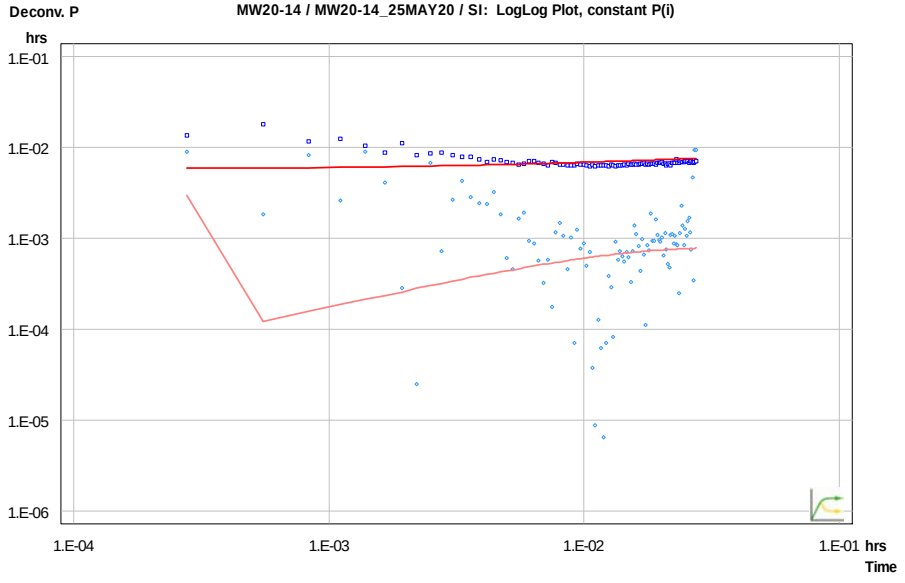
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-080

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

TITLE

PACKER TEST RESULTS MW20-14 LOWER INTERVAL (22.4 to 26.4 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-081

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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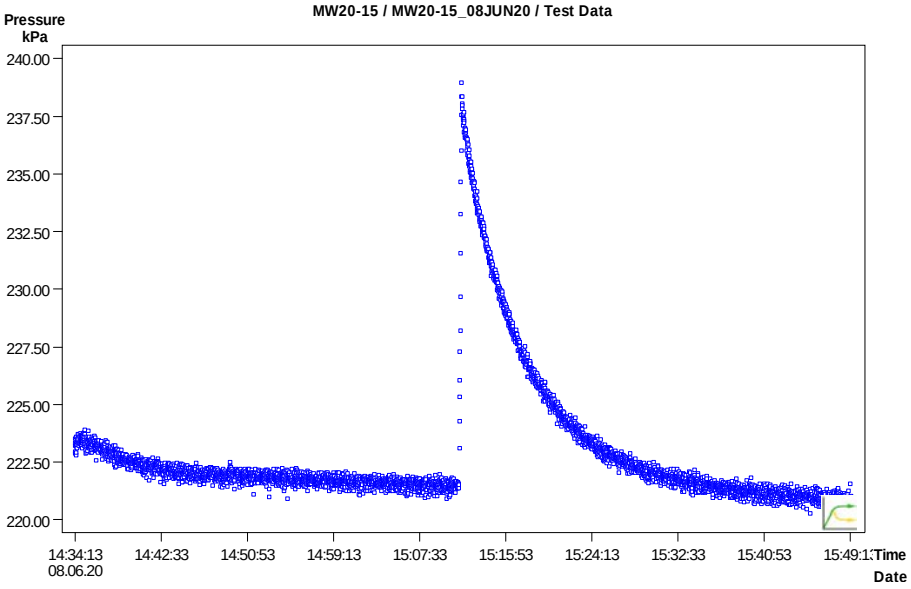
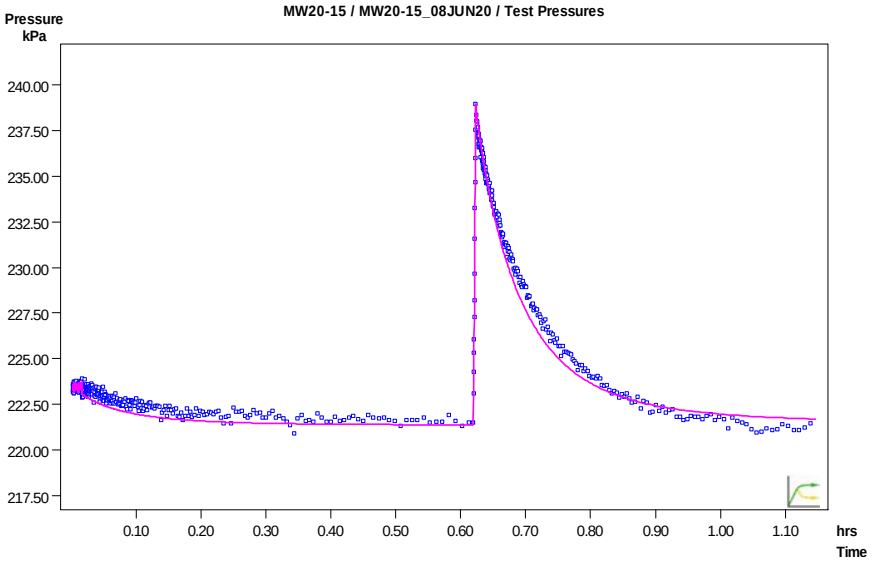
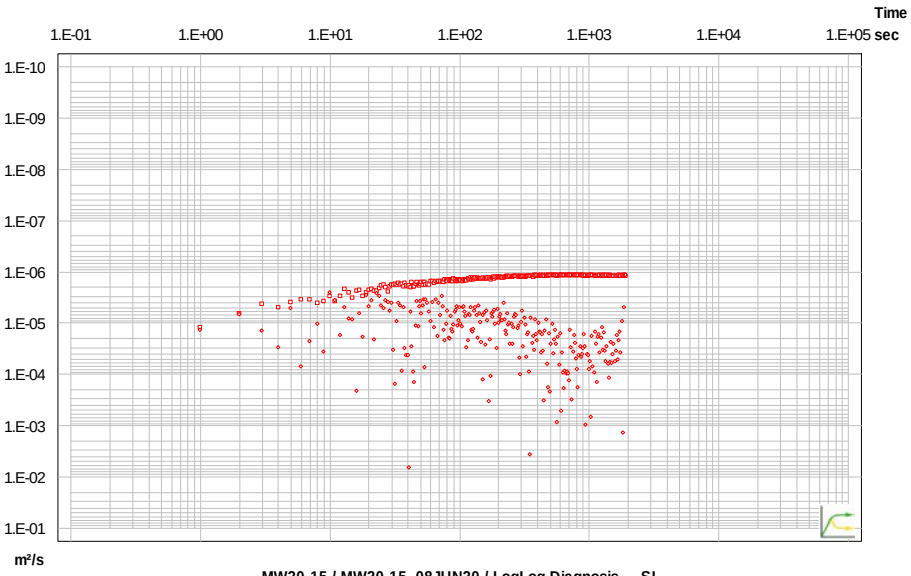
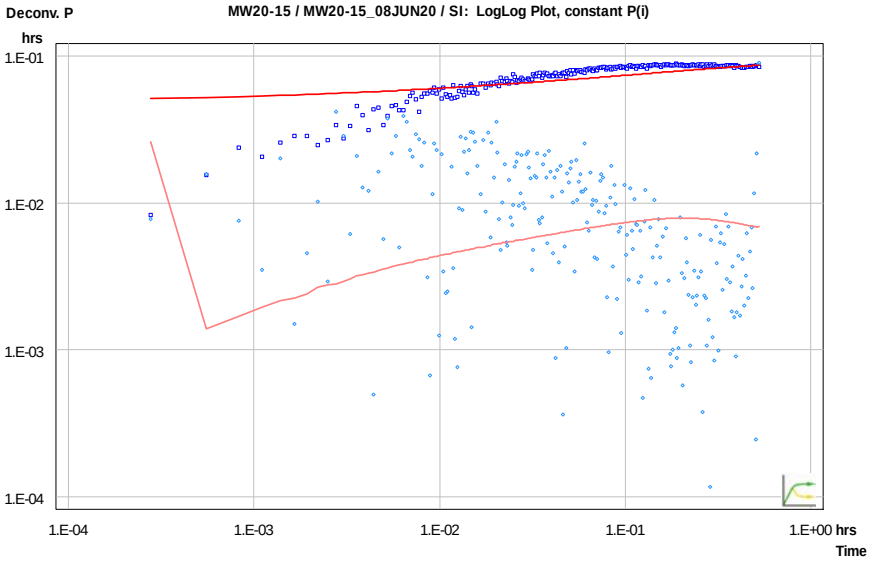








CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

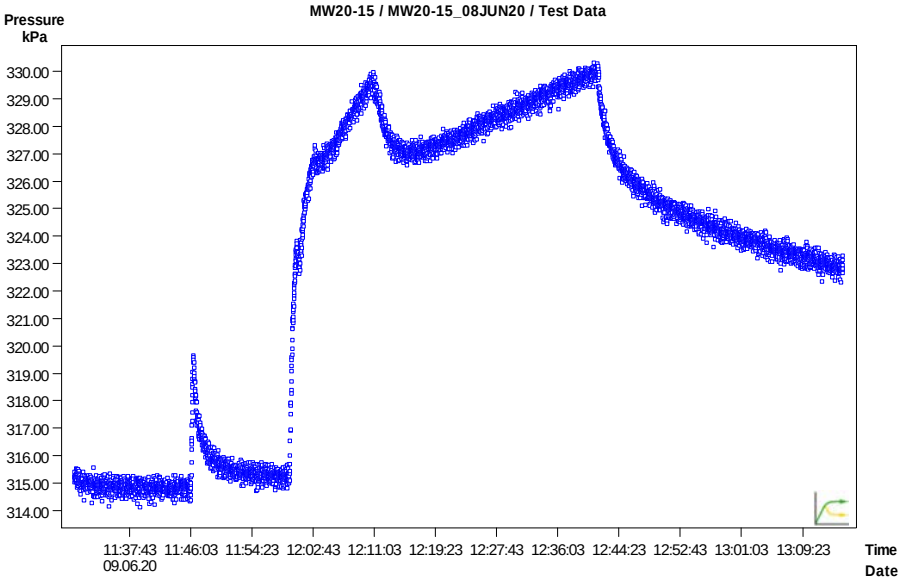
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

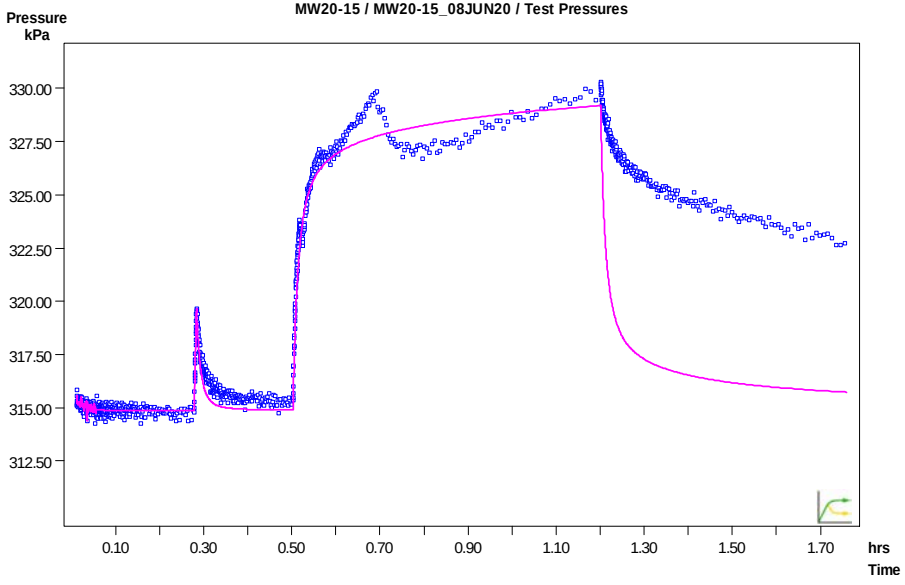
TITLE

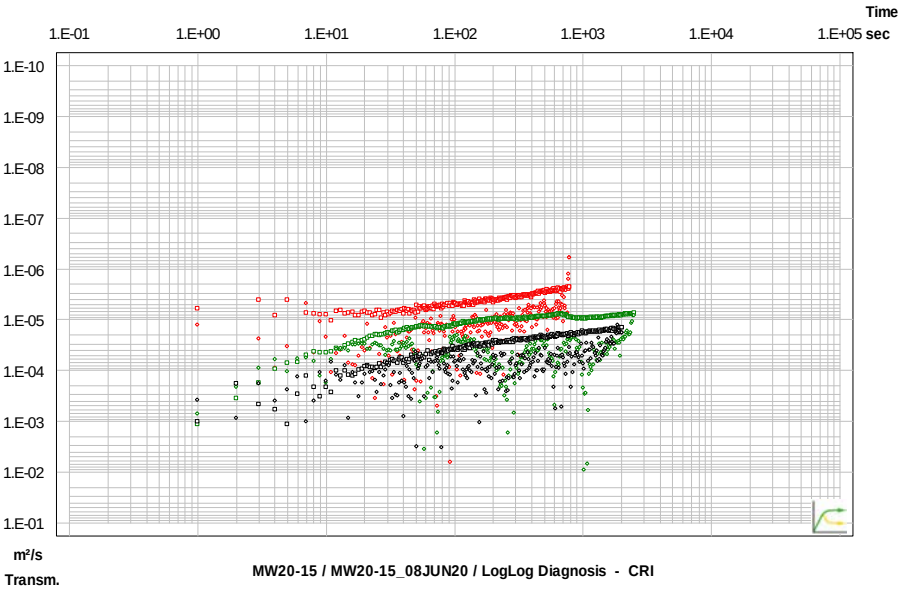
PACKER TEST RESULTS MW20-15 UPPER INTERVAL (14.3 to 24.1 mbgs)

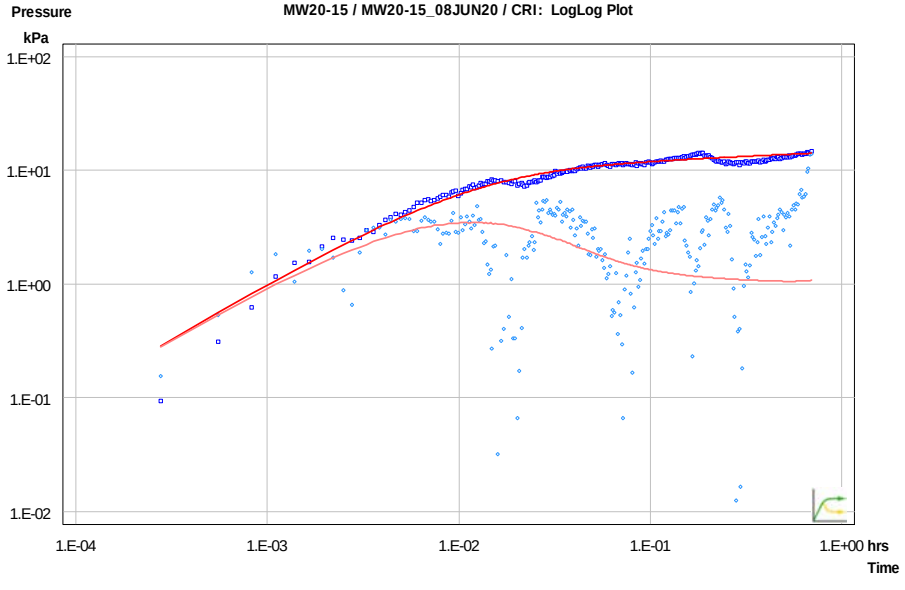
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-082

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

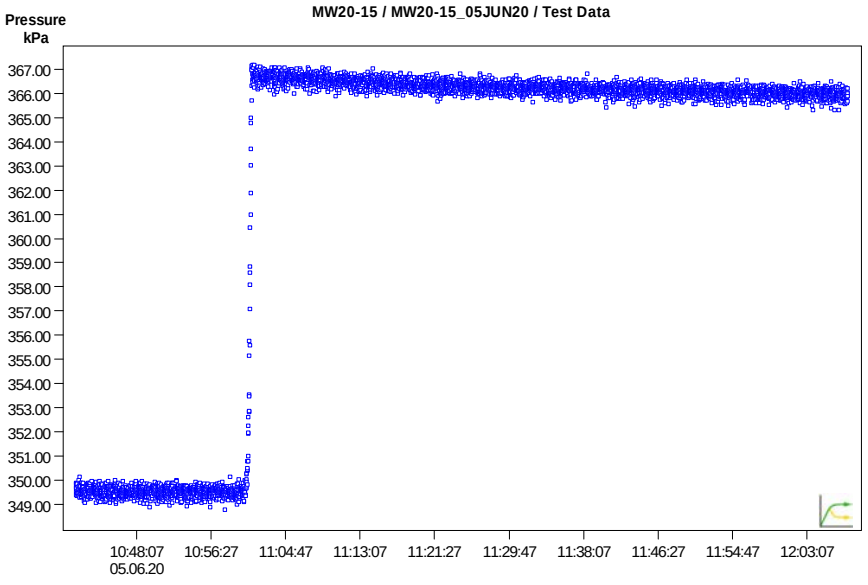
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

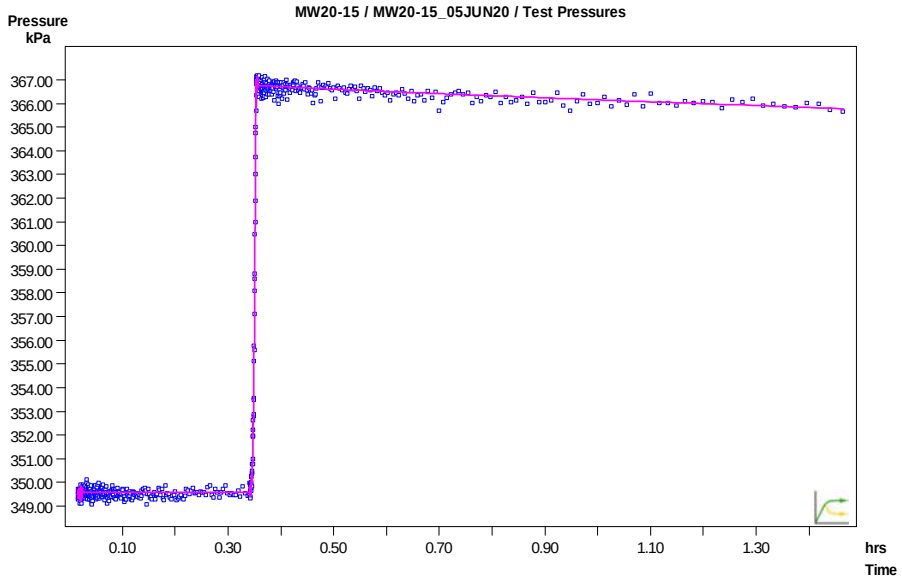
TITLE

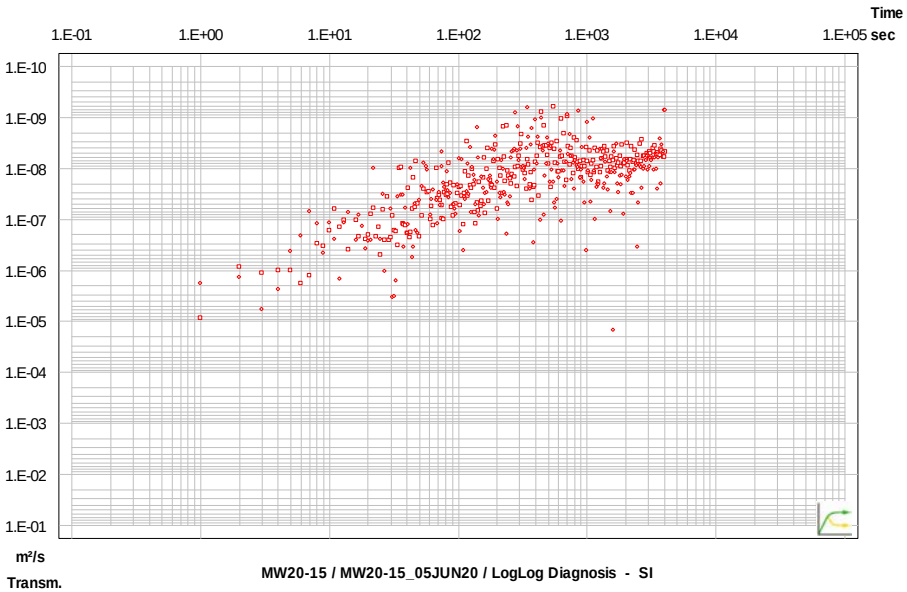
PACKER TEST RESULTS MW20-15 MIDDLE INTERVAL (24.1 to 33.8 mbgs)

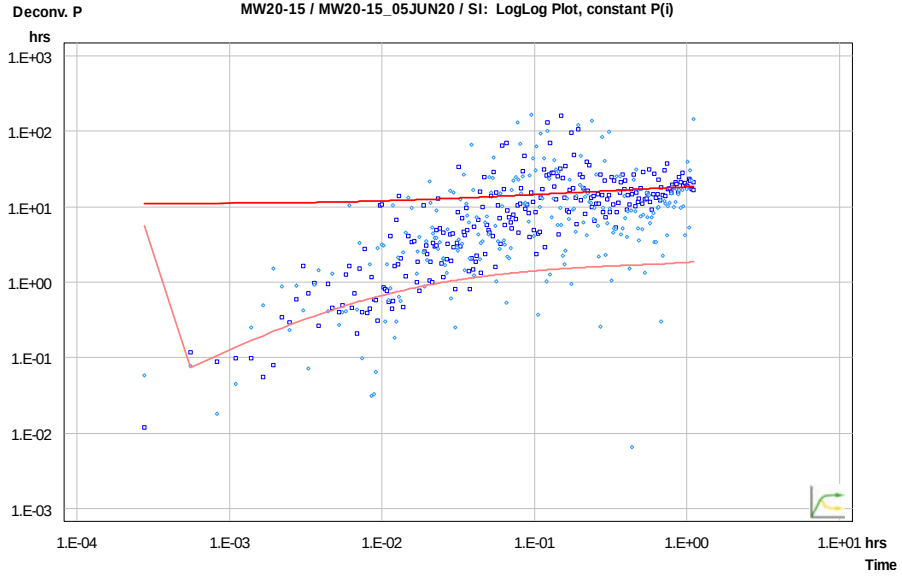
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-083

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

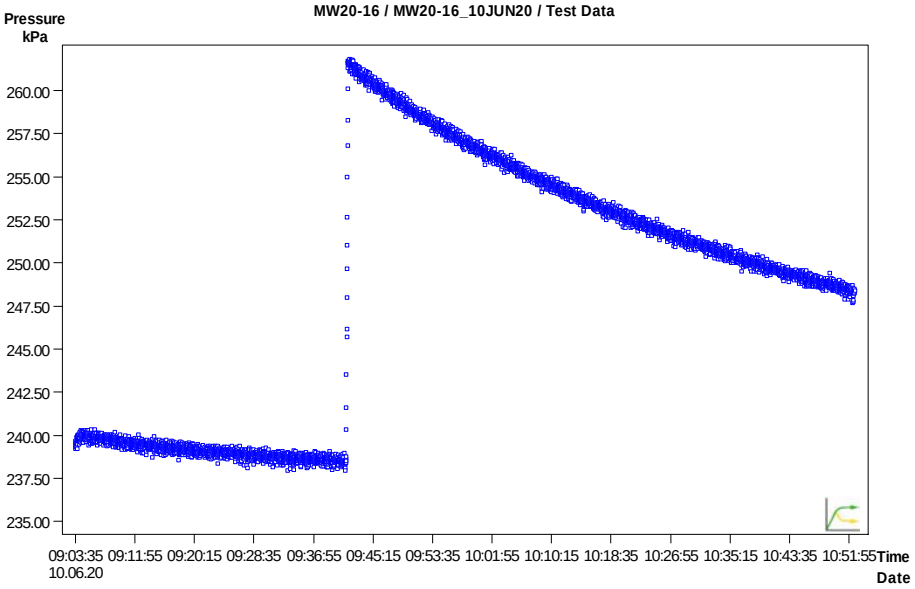
CALEDON PIT / QUARRY

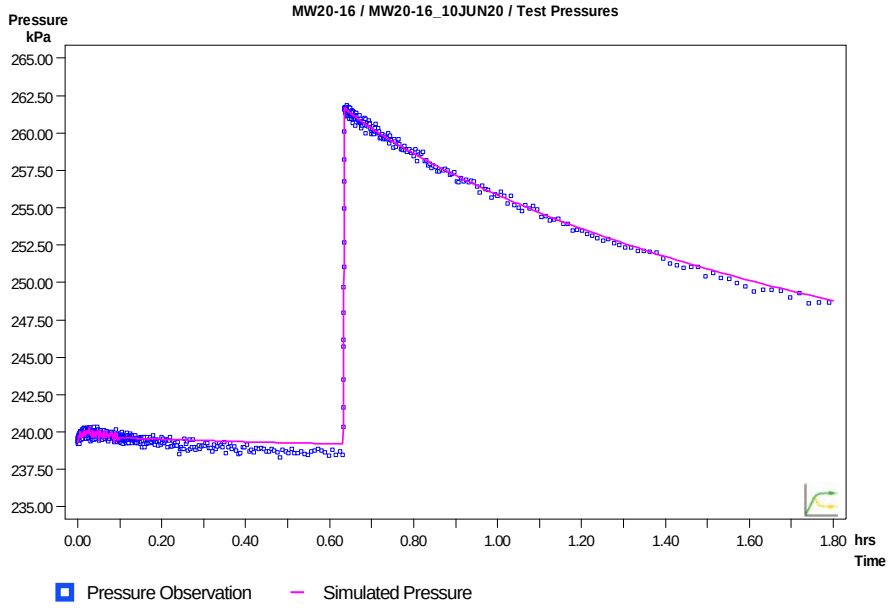
TITLE

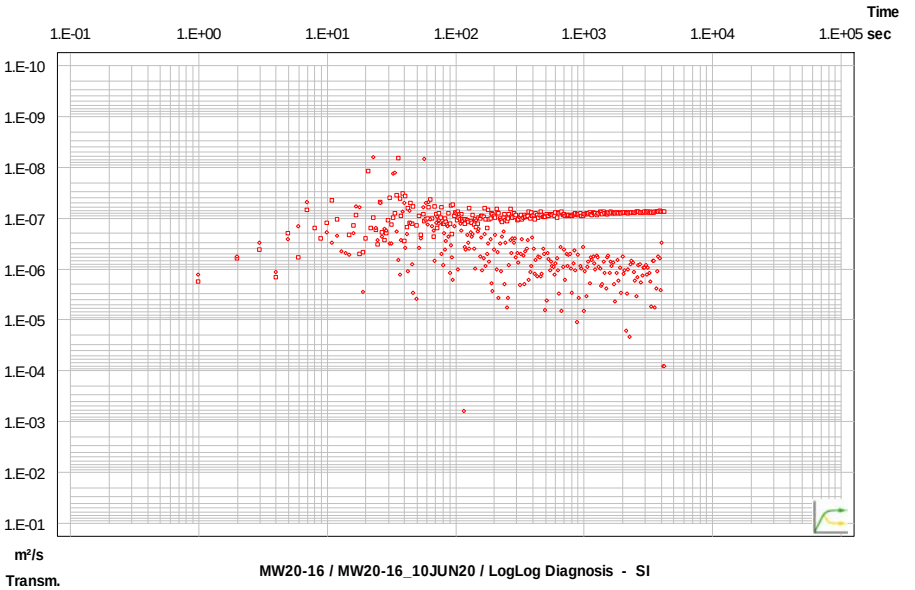
PACKER TEST RESULTS MW20-15 LOWER INTERVAL (33.8 to 37.2 mbgs)

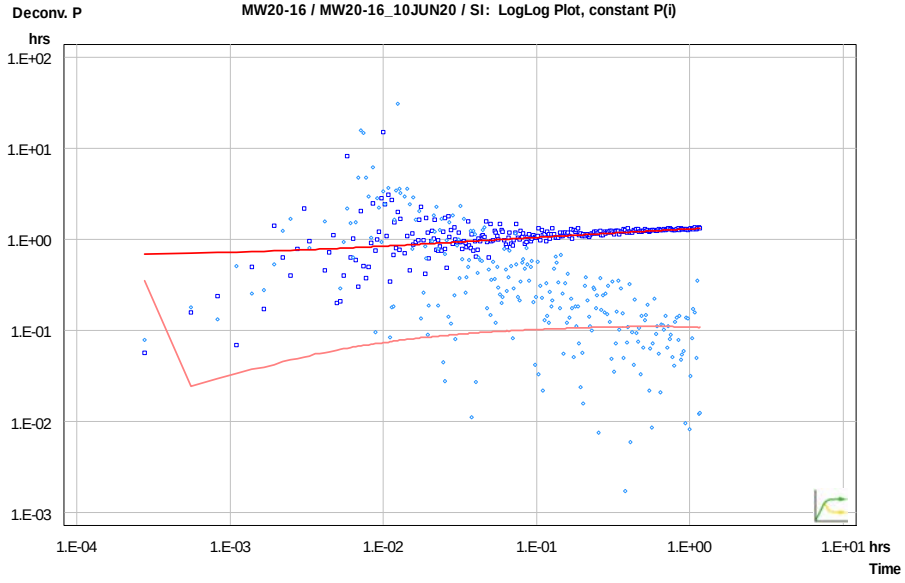
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-084

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

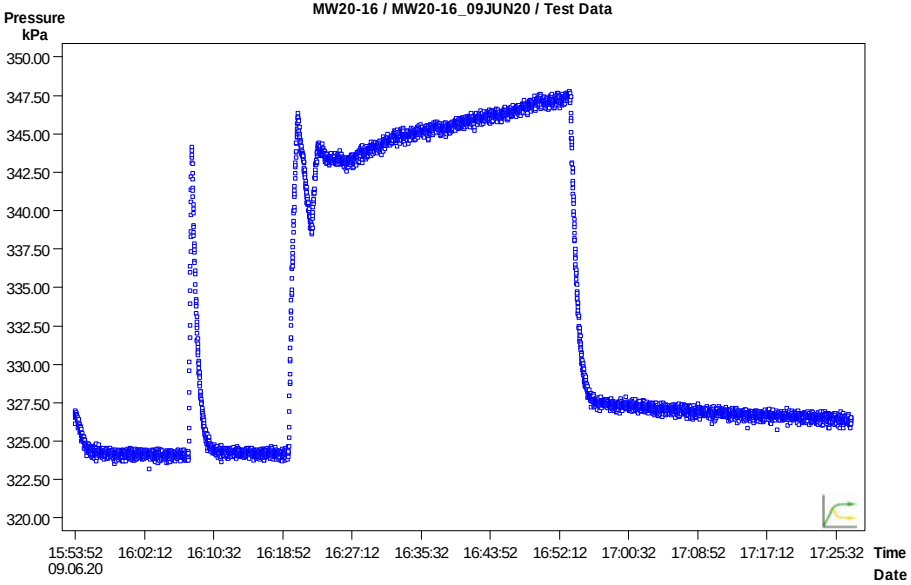
CALEDON PIT / QUARRY

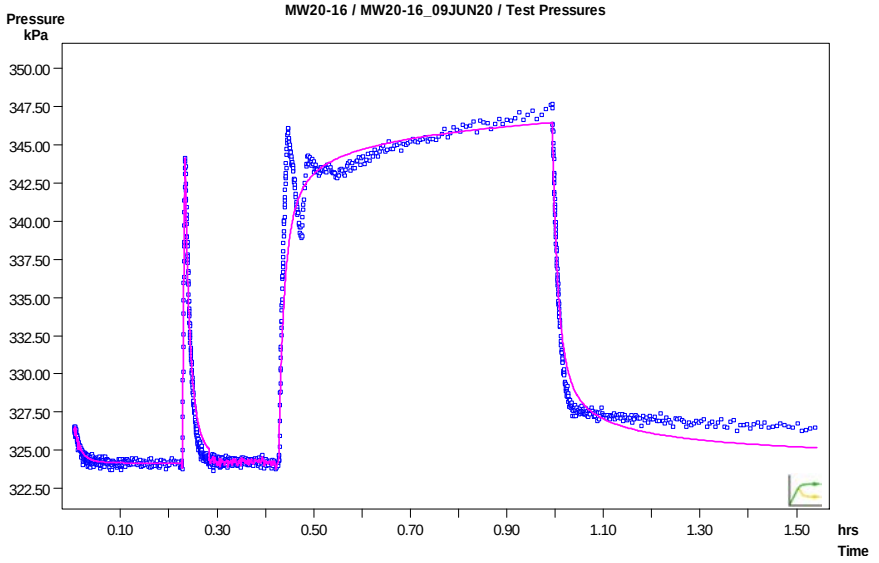
TITLE

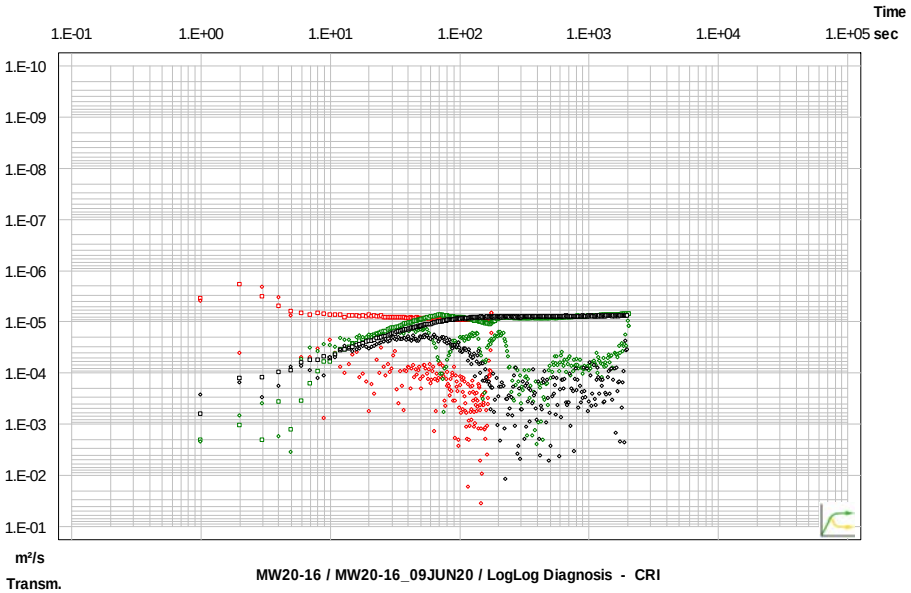
PACKER TEST RESULTS MW20-16 UPPER INTERVAL (16.9 to 26.5 mbgs)

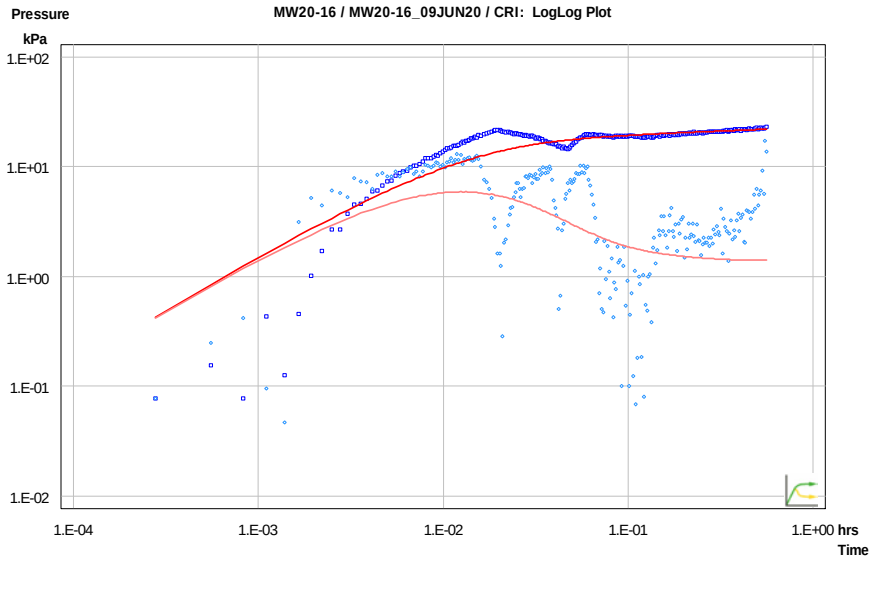
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-085

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

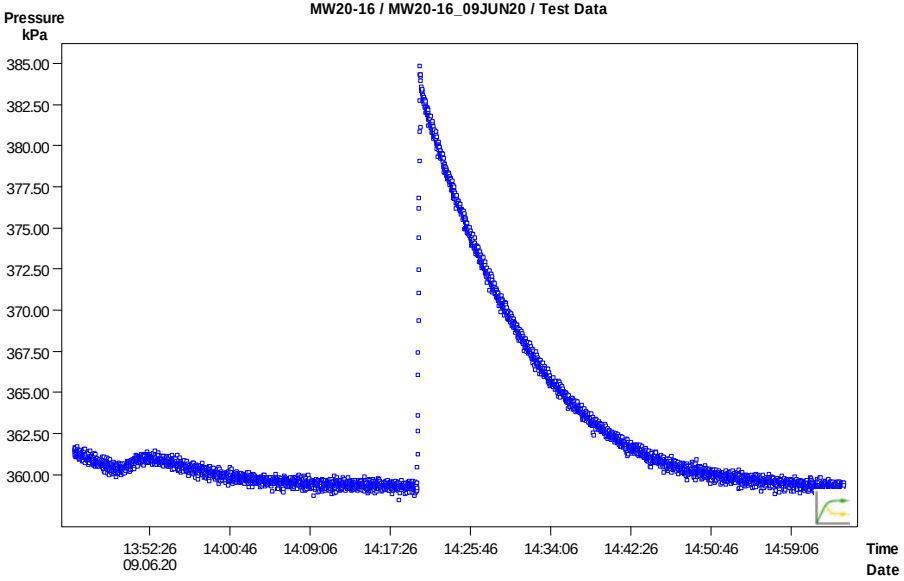
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

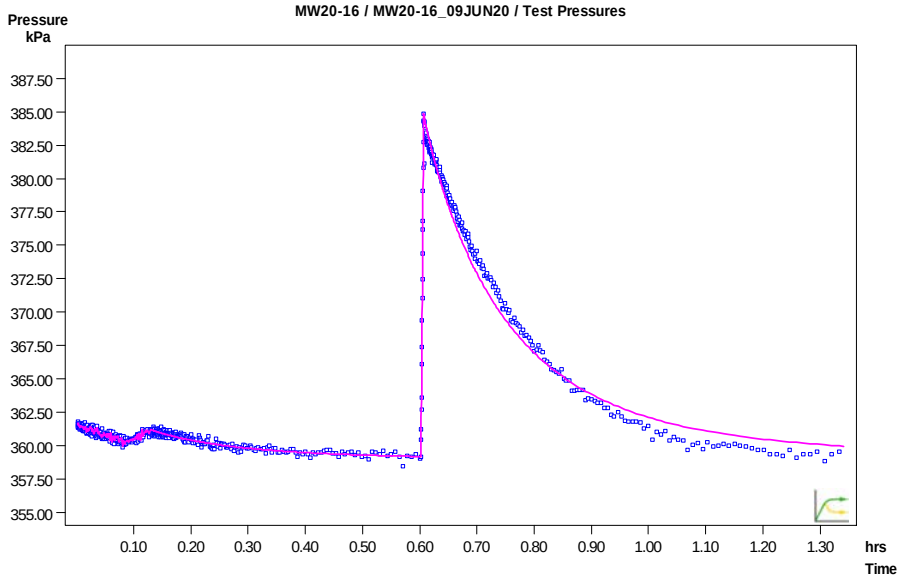
TITLE

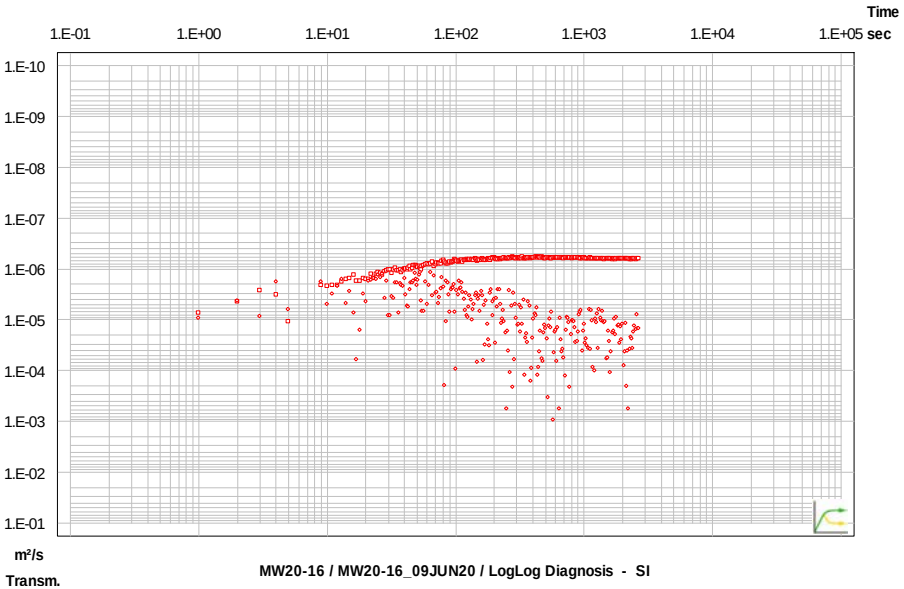
PACKER TEST RESULTS MW20-16 MIDDLE INTERVAL (25.8 to 35.4 mbgs)

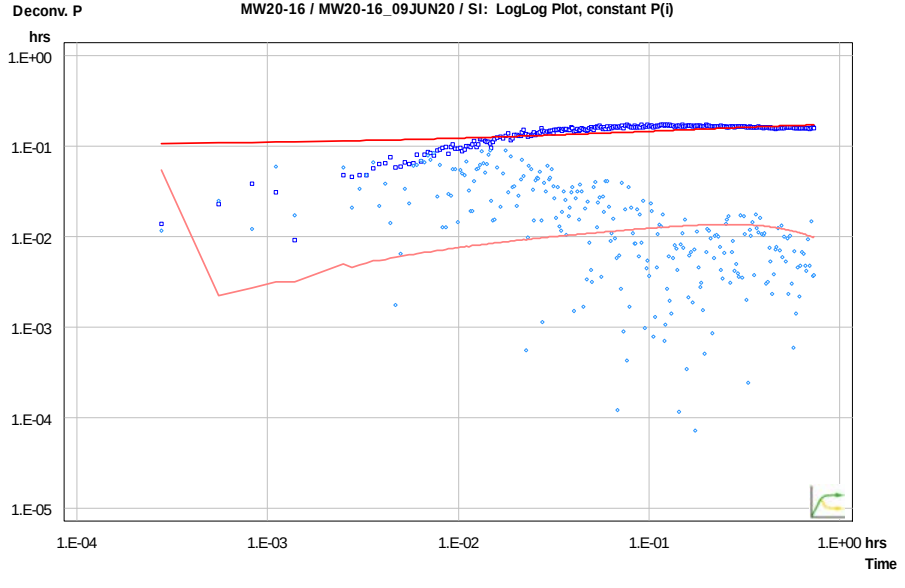
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-086

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

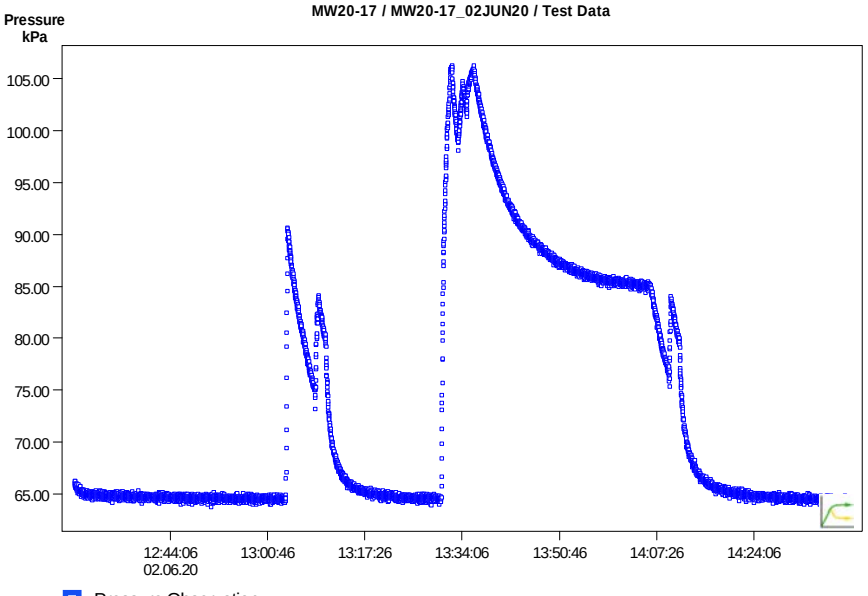
CALEDON PIT / QUARRY

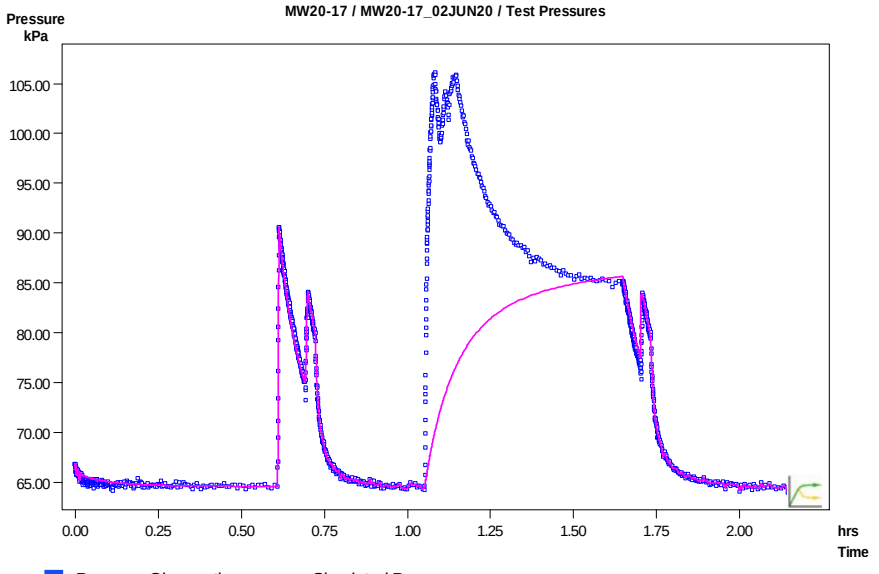
TITLE

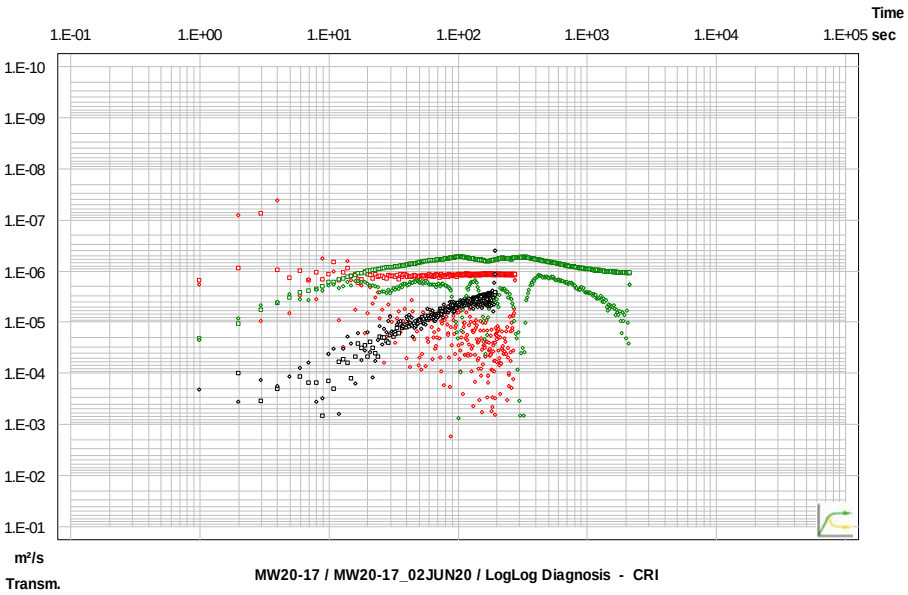
PACKER TEST RESULTS MW20-16 LOWER INTERVAL (35.5 to 39.8 mbgs)

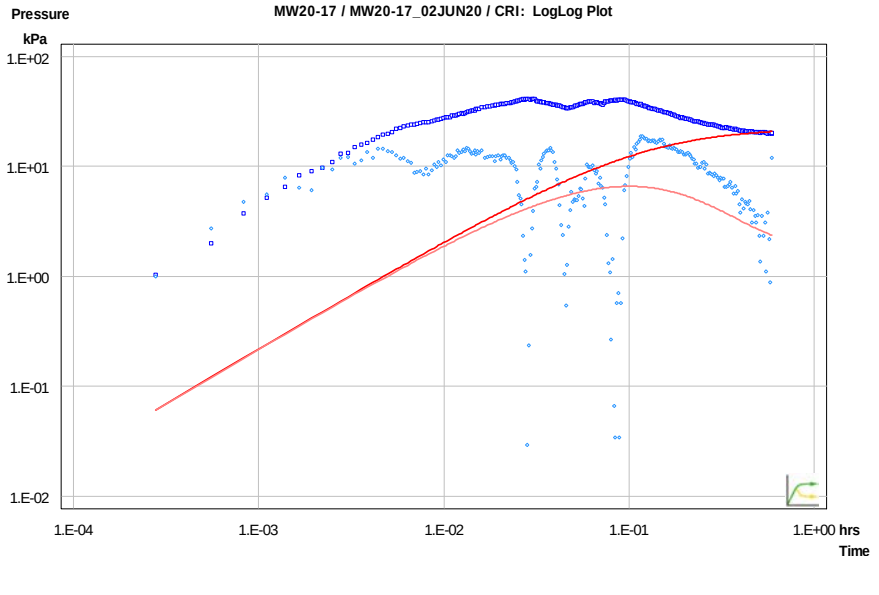
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-087

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

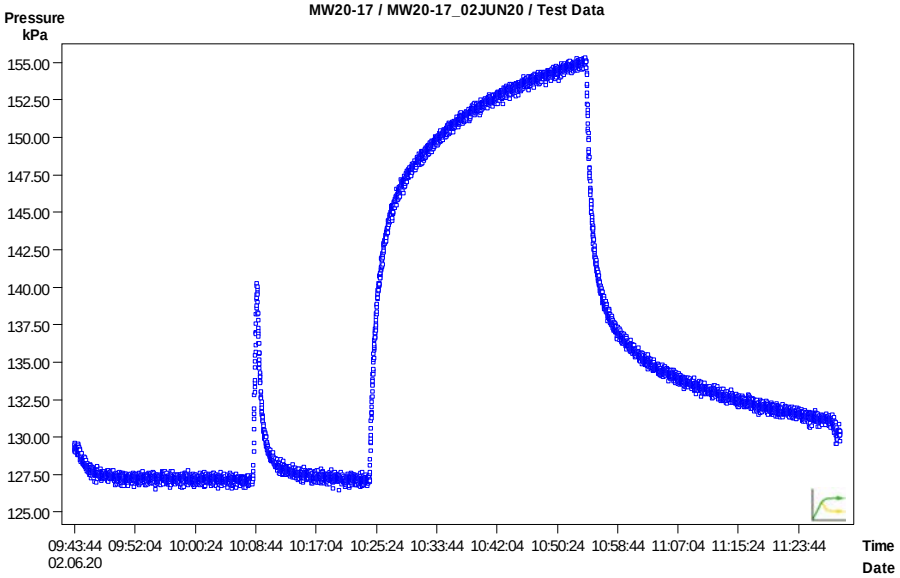
CALEDON PIT / QUARRY

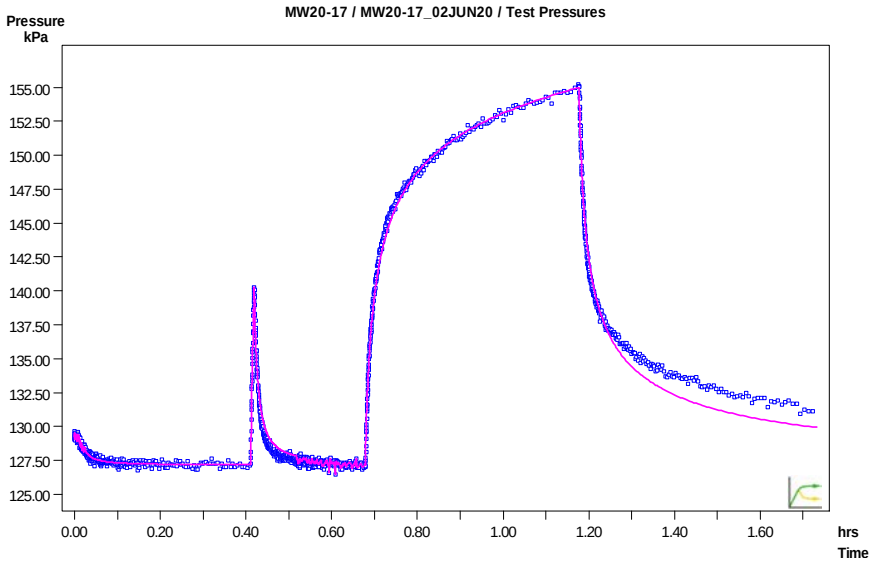
TITLE

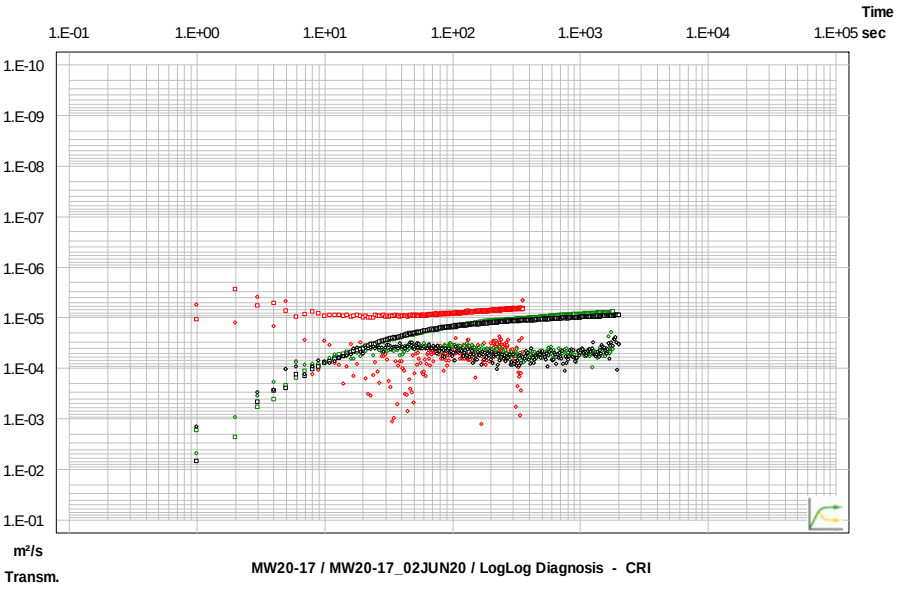
PACKER TEST RESULTS MW20-17 UPPER INTERVAL (5.0 to 11.7 mbgs)

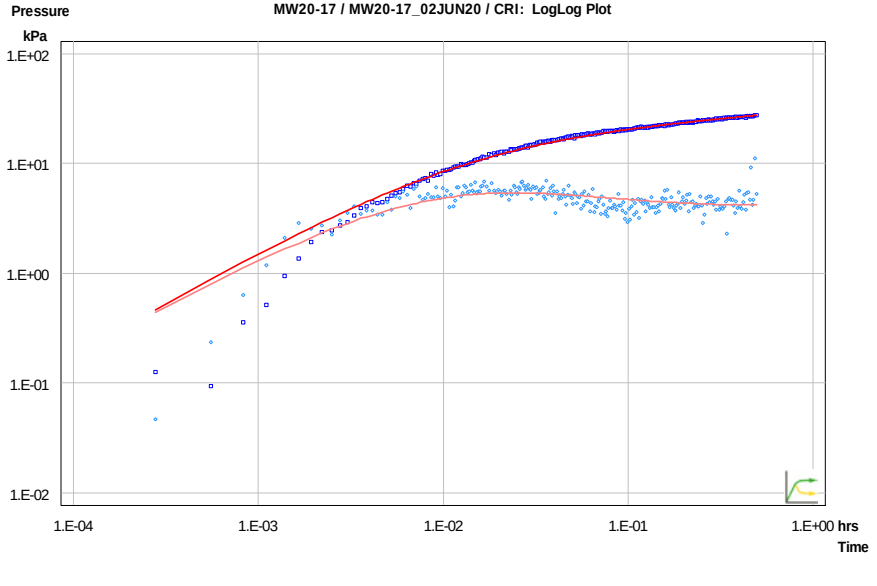
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-088

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

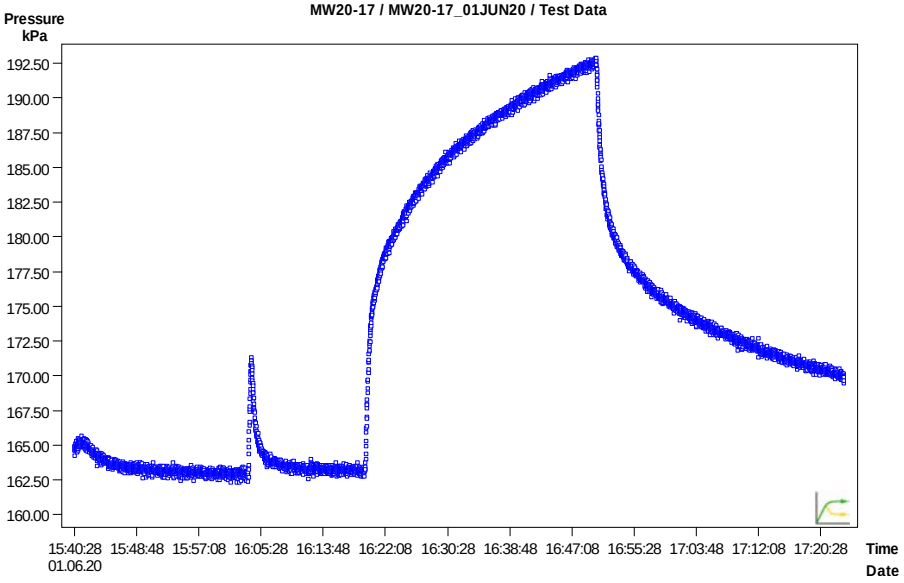
CALEDON PIT / QUARRY

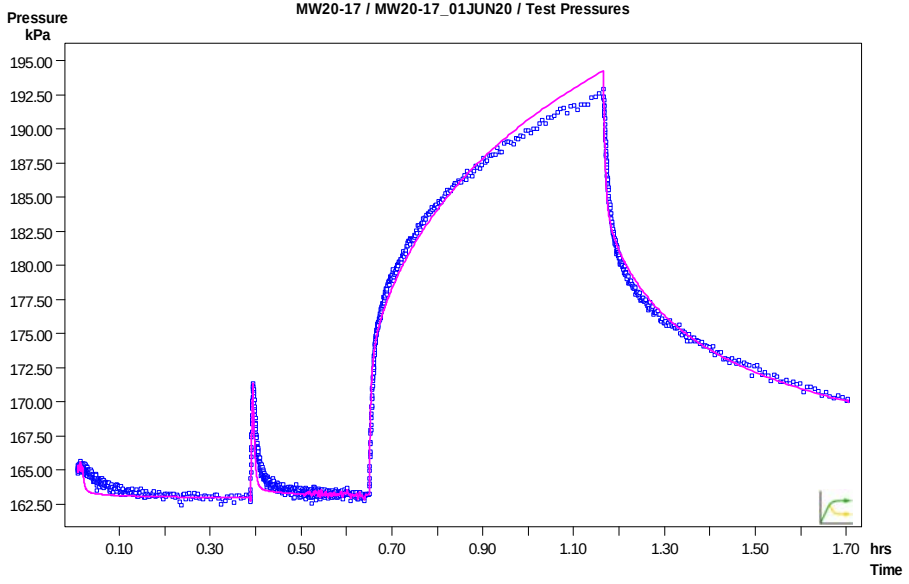
TITLE

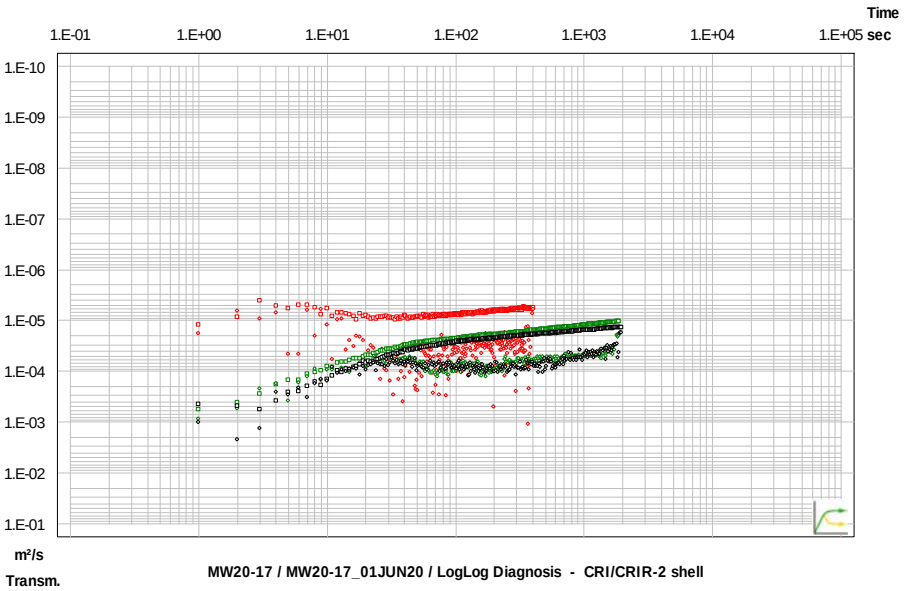
PACKER TEST RESULTS MW20-17 MIDDLE INTERVAL (11.7 to 18.4 mbgs)

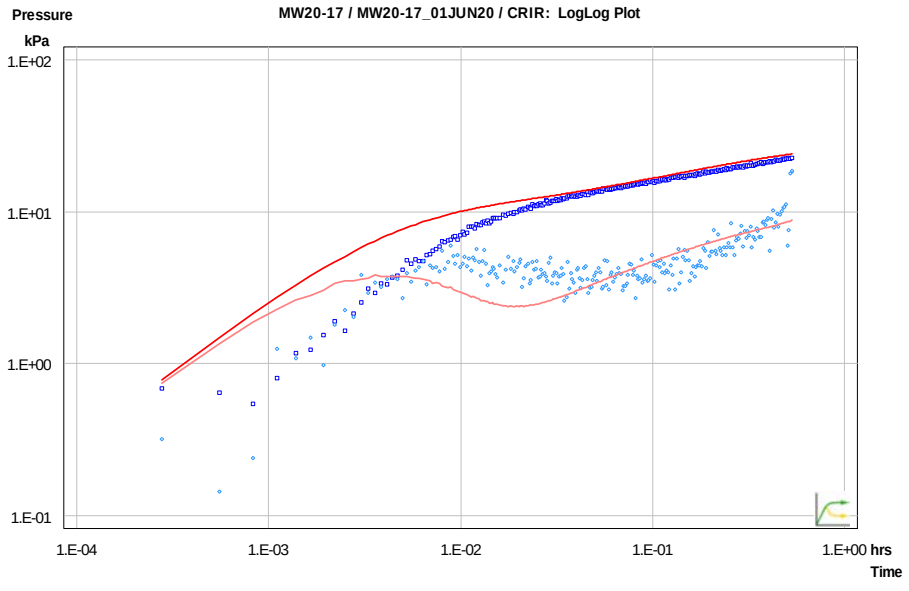
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-089

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-03-14
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

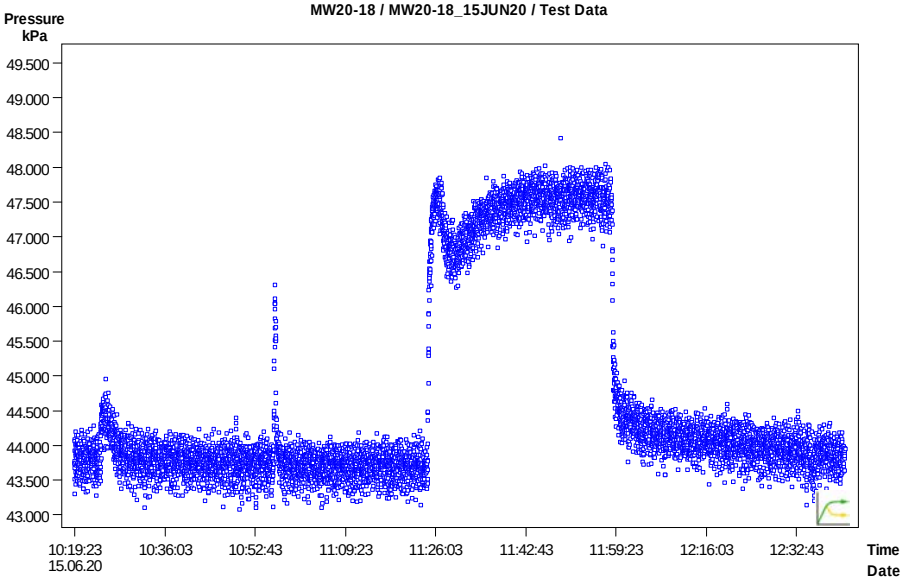
CALEDON PIT / QUARRY

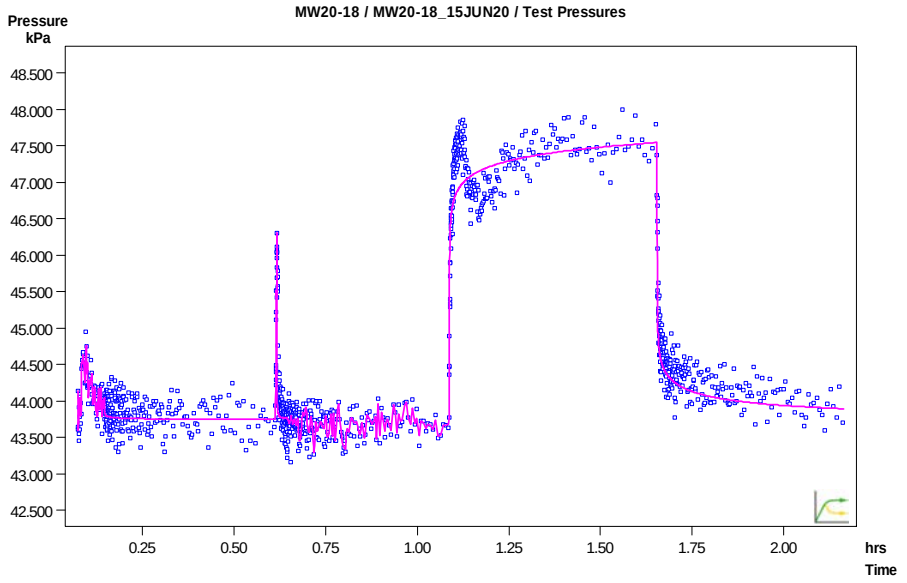
TITLE

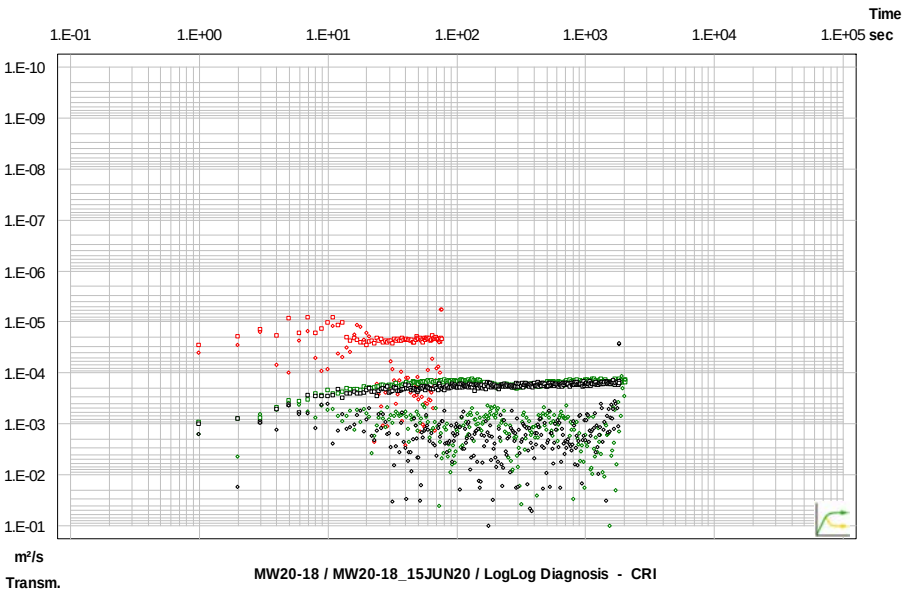
PACKER TEST RESULTS MW20-17 LOWER INTERVAL (18.4 to 27.5 mbgs)

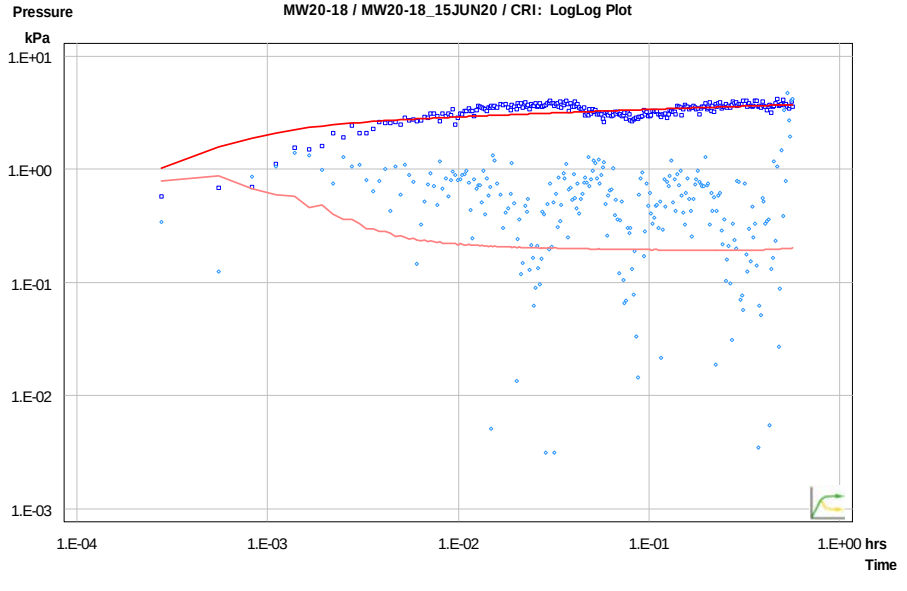
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-090

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

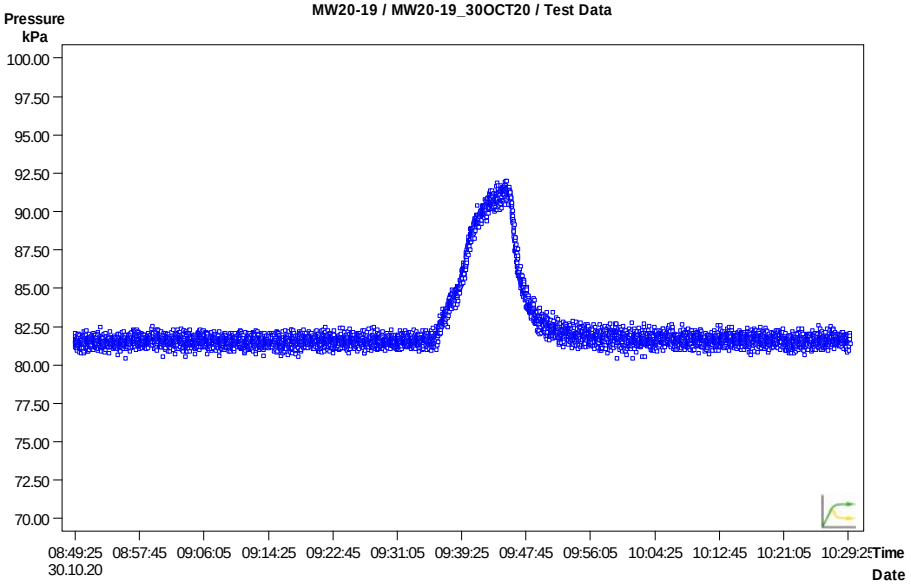
CALEDON PIT / QUARRY

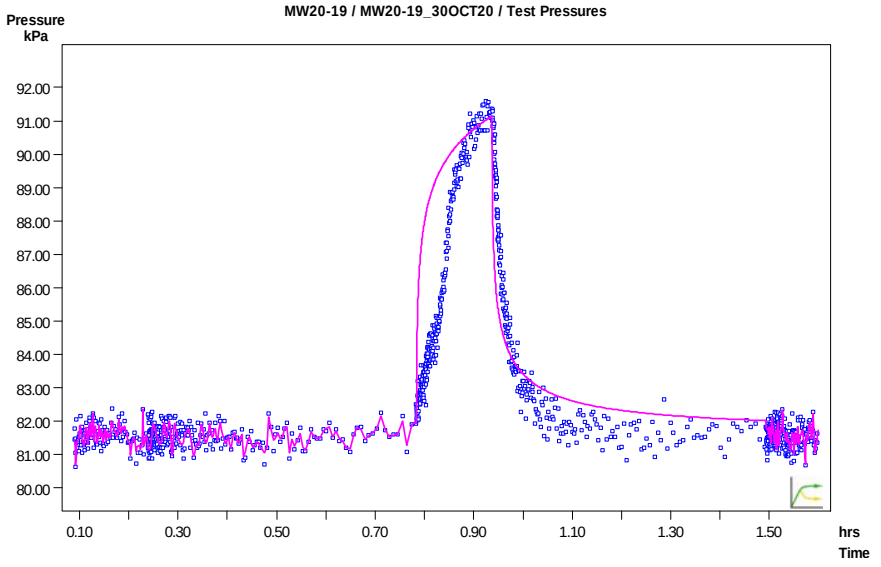
TITLE

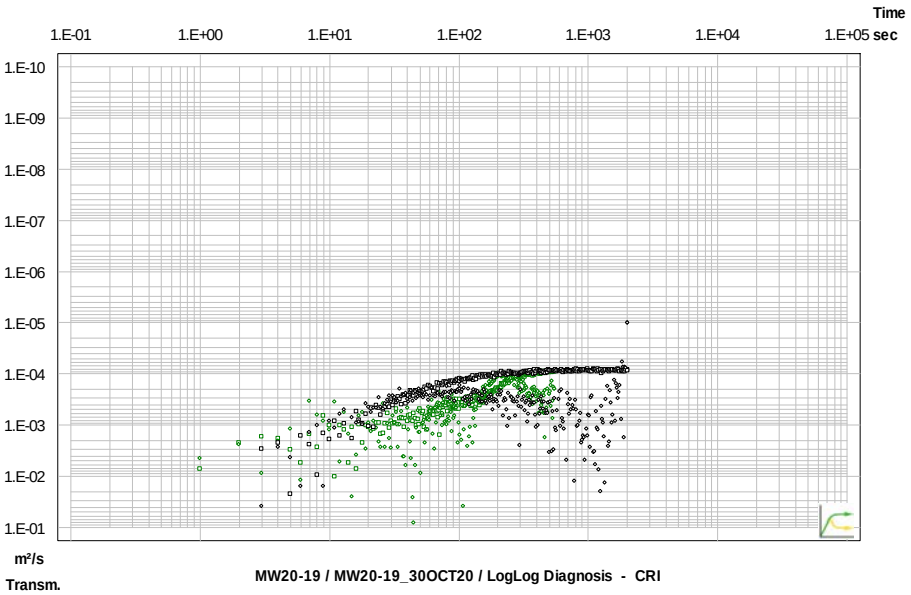
PACKER TEST RESULTS MW20-18 SINGLE INTERVAL (14.0 to 28.2 mbgs)

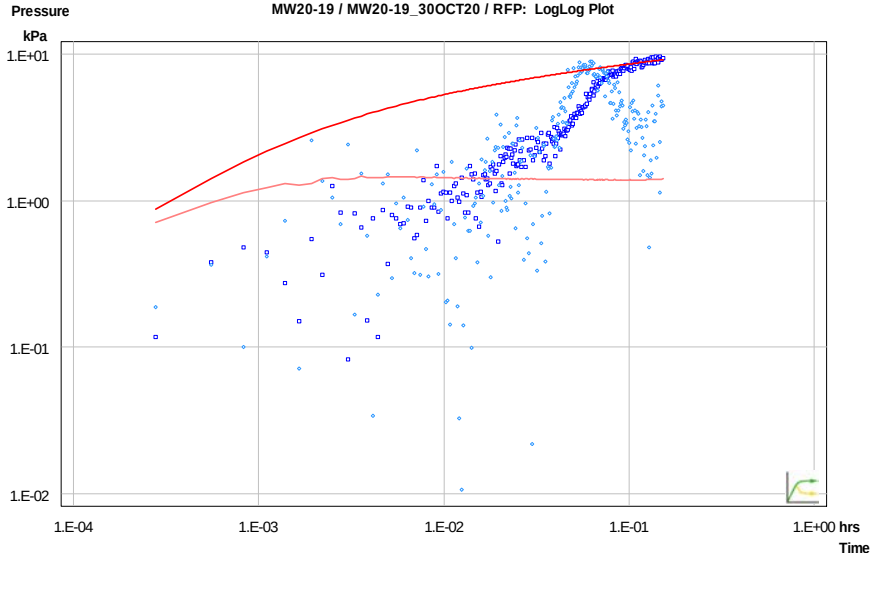
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-091

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









CLIENT

CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

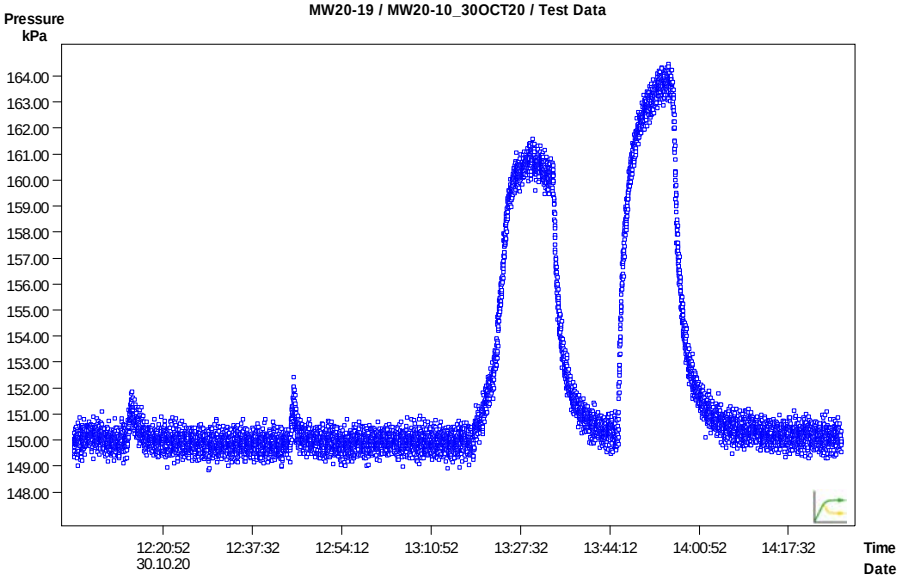
CALEDON PIT / QUARRY

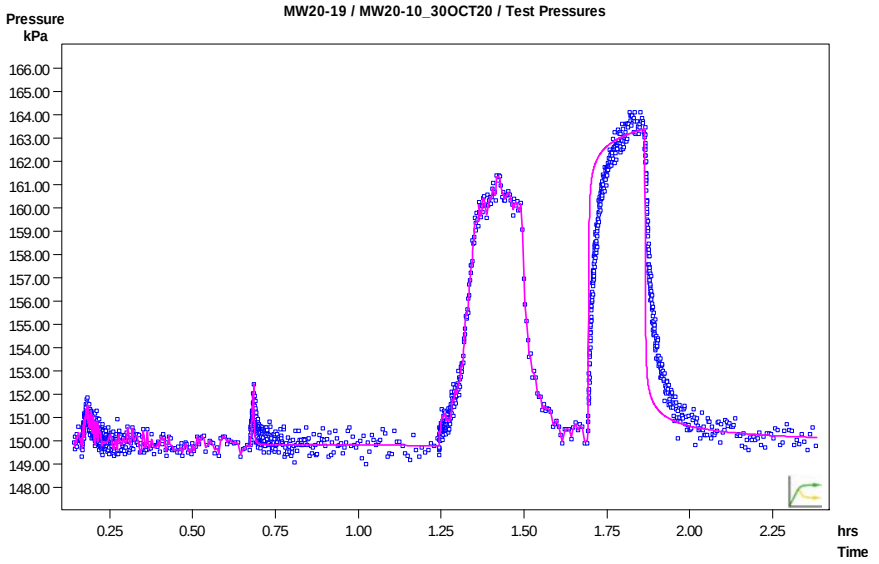
TITLE

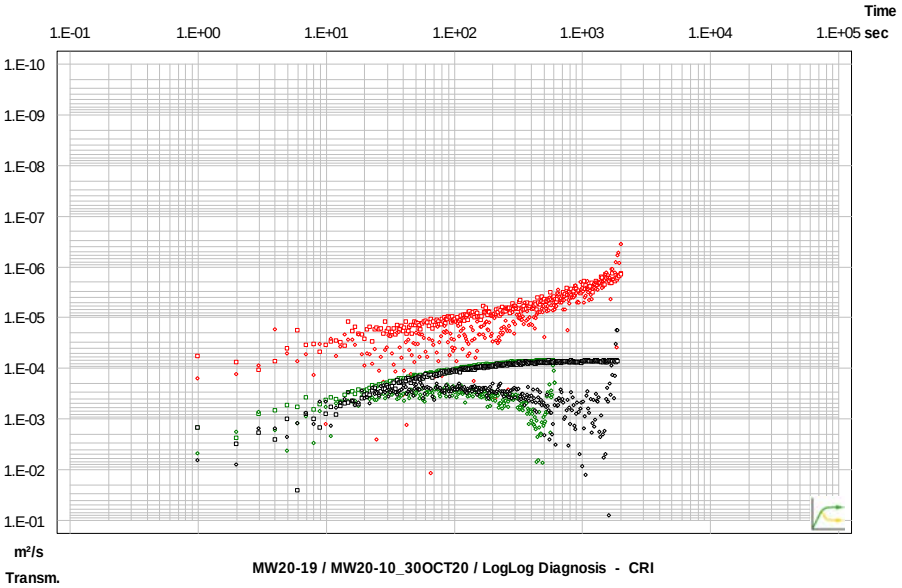
PACKER TEST RESULTS MW20-19 UPPER INTERVAL (8.0 to 16.2 mbgs)

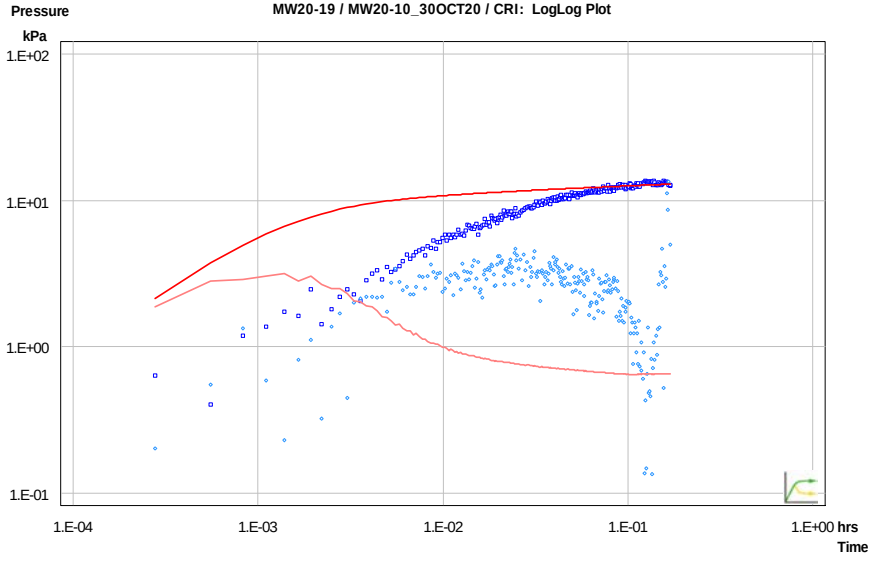
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-092

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









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CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

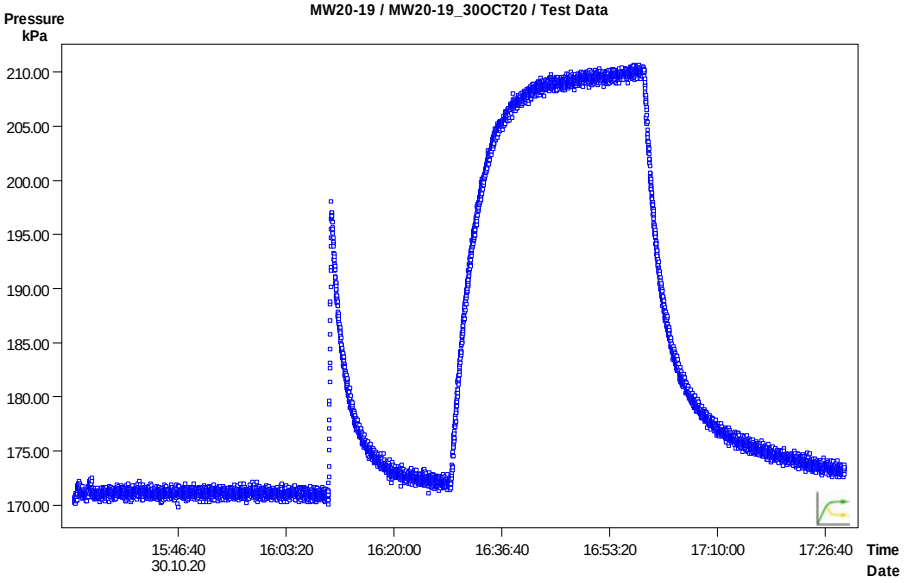
CALEDON PIT / QUARRY

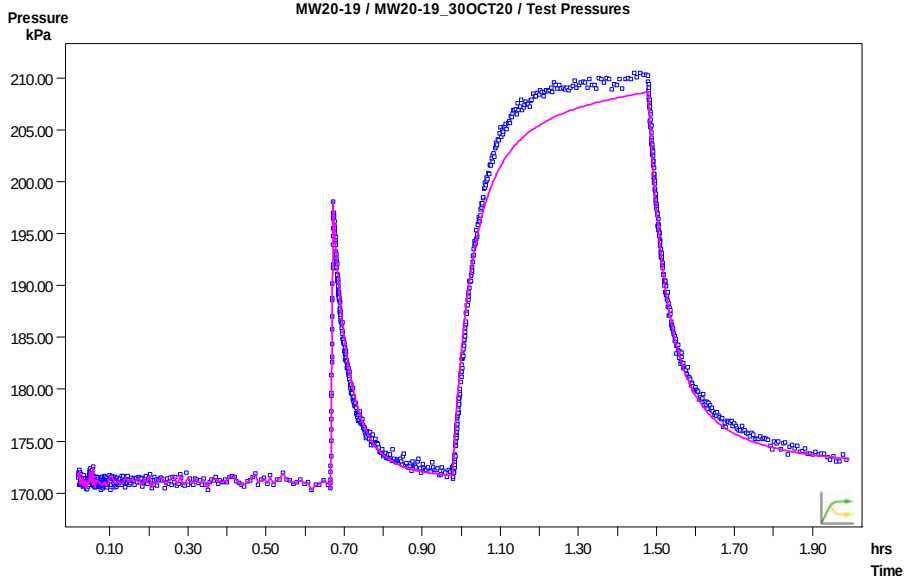
TITLE

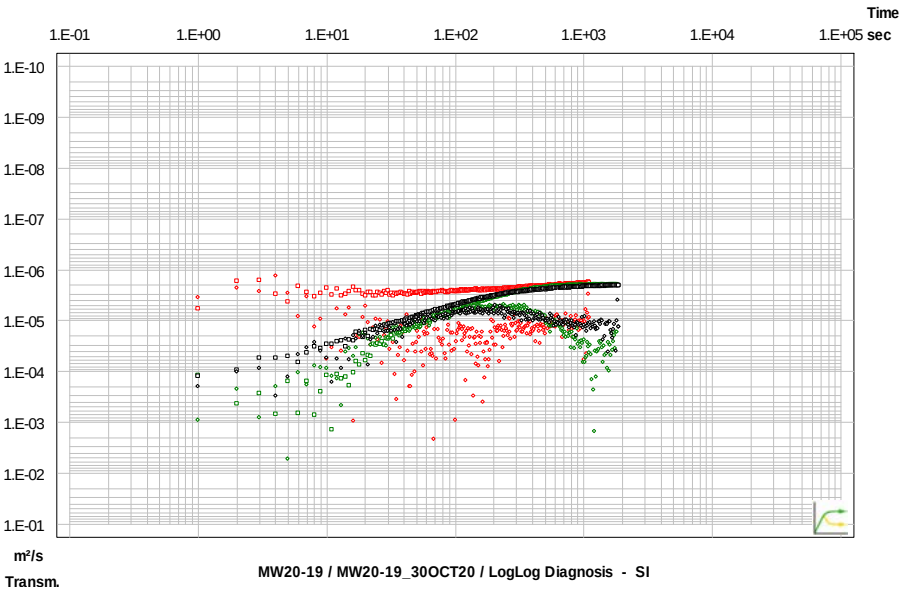
PACKER TEST RESULTS MW20-19 MIDDLE INTERVAL (15.4 to 22.1 mbgs)

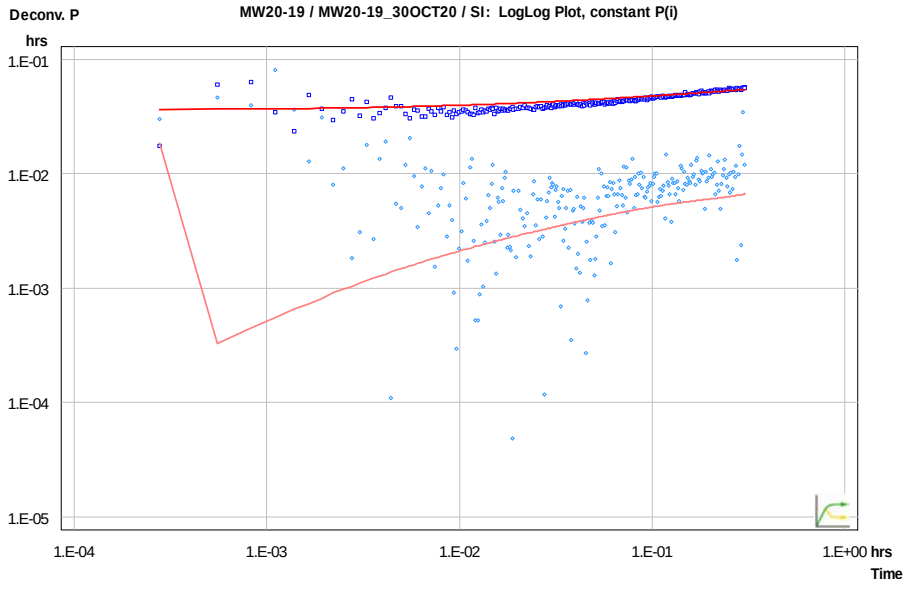
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-093

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









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PROJECT

CALEDON PIT / QUARRY

CONSULTANT

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MEMBER OF WSP

YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

TITLE

PACKER TEST RESULTS MW20-19 LOWER INTERVAL (22.1 to 27.4 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-094

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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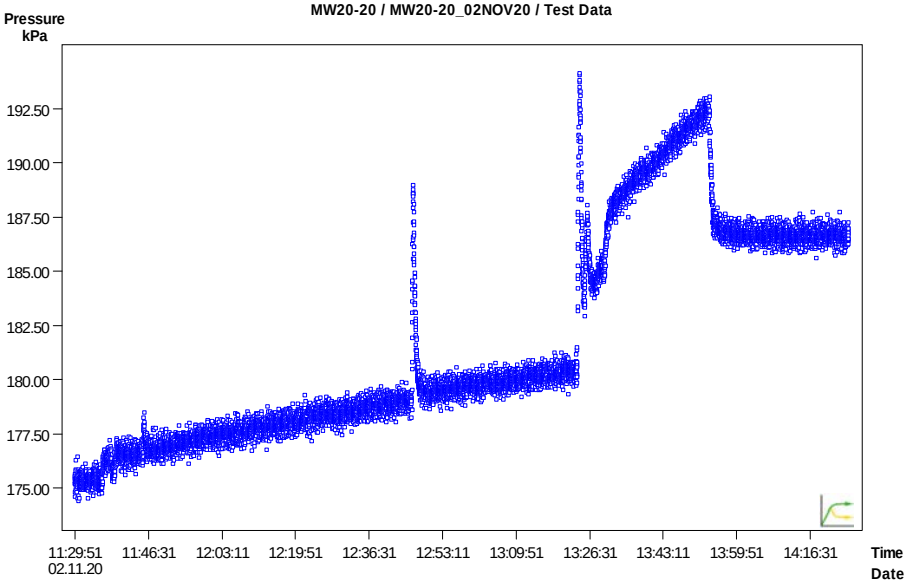

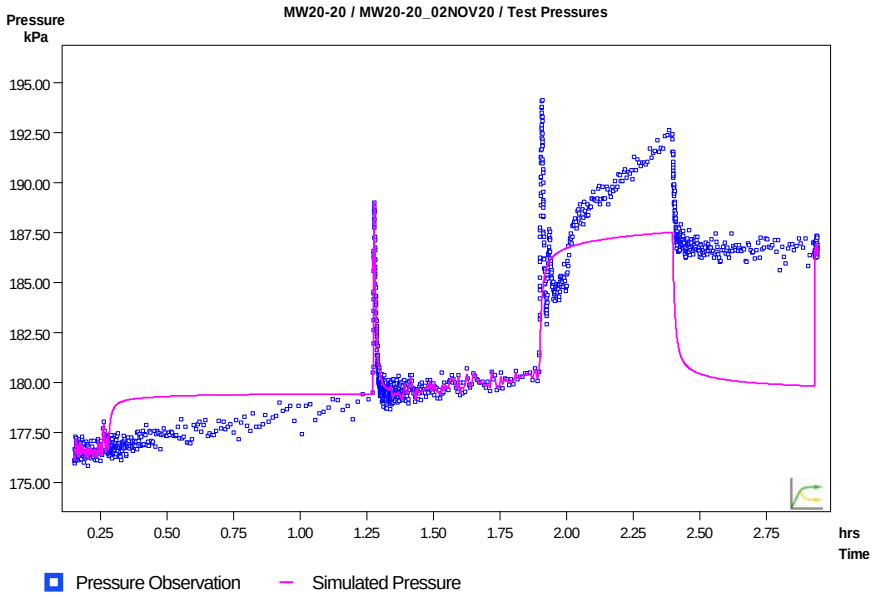

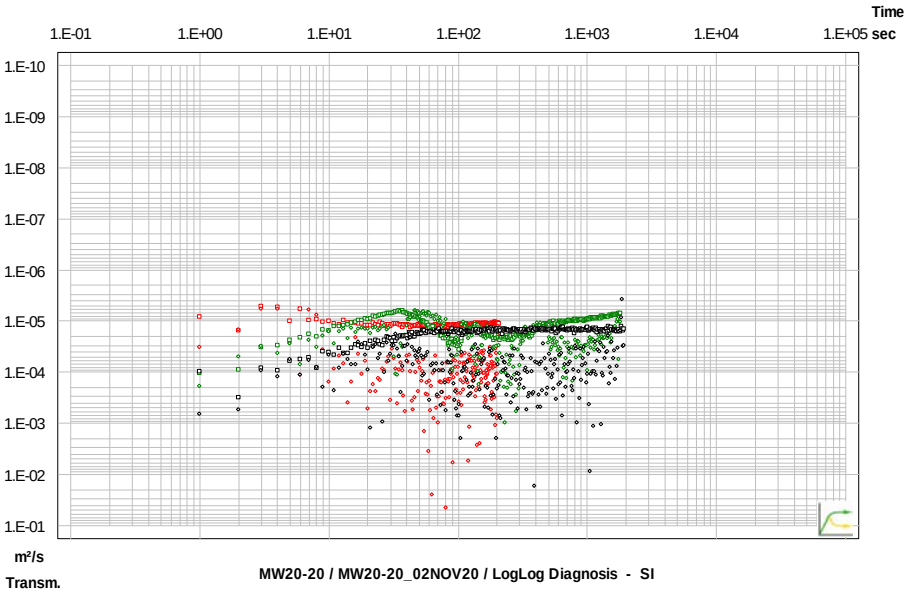

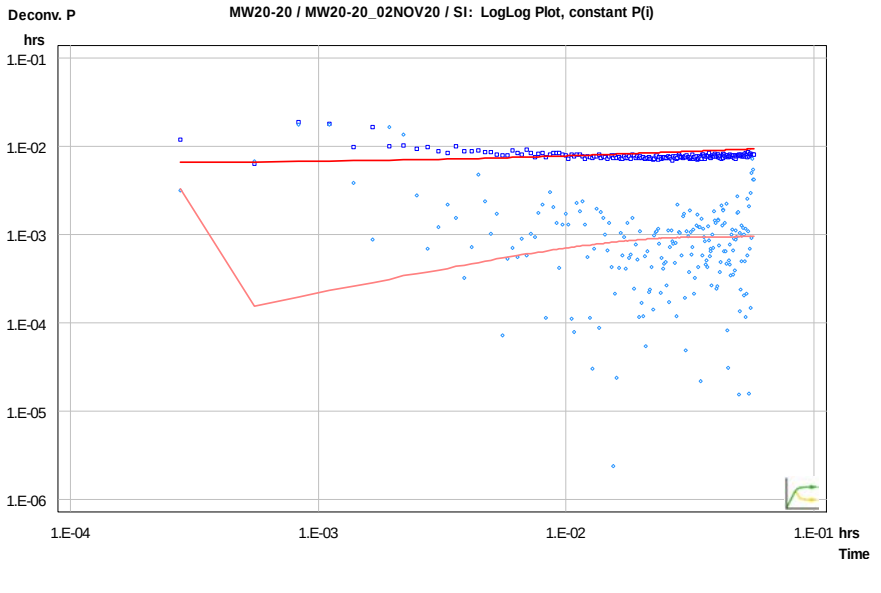

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YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

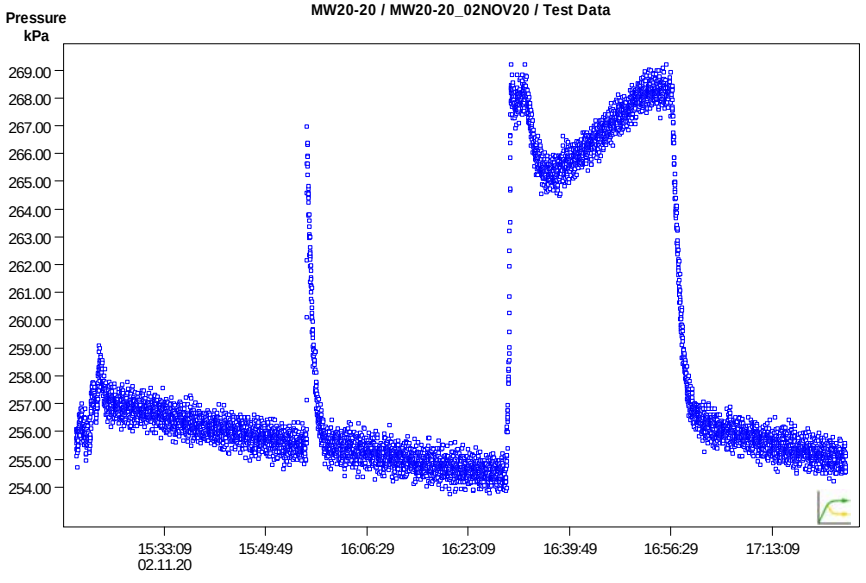
CALEDON PIT / QUARRY

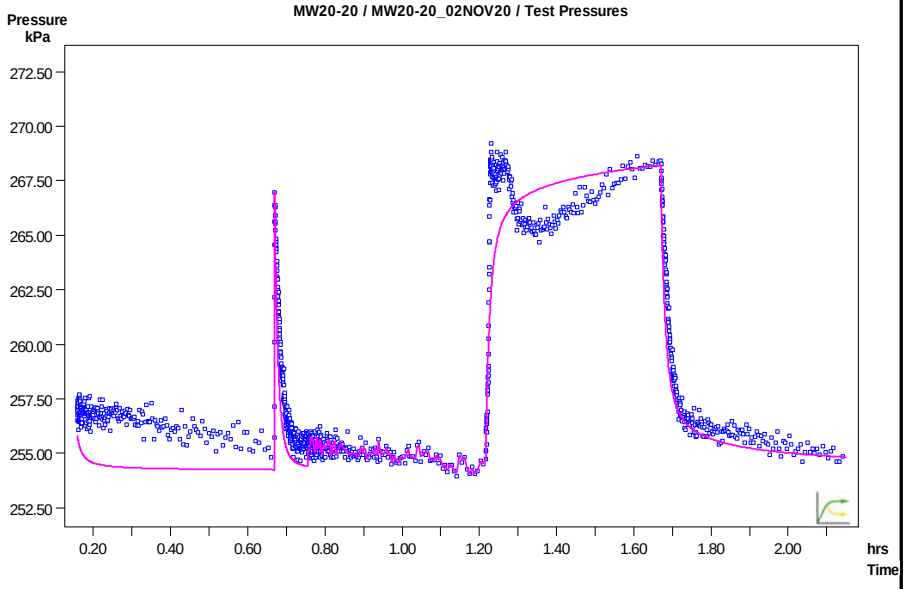
TITLE

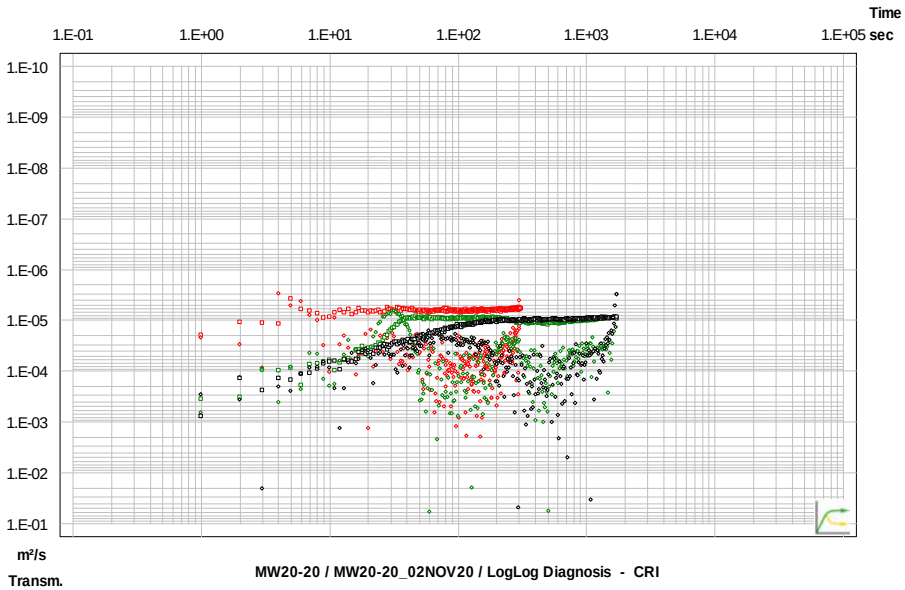
PACKER TEST RESULTS MW20-20 UPPER INTERVAL (7.8 to 17.5 mbgs)

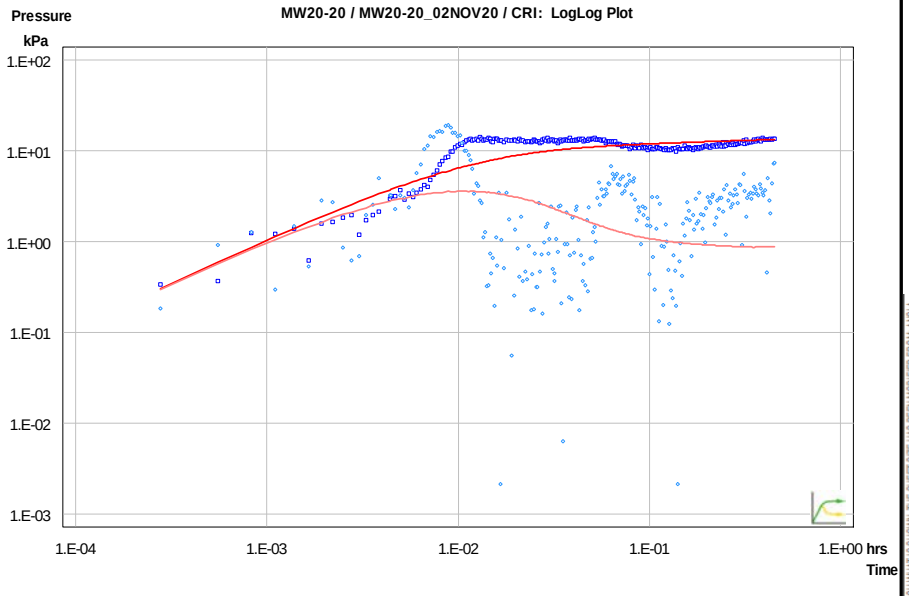
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-095

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A









MW20-20 / MW20-20_02NOV20 / LogLog Diagnosis - CRI

Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

CLIENT
CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
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YYYY-MM-DD	2022-02-16	
PREPARED	PGM	
DESIGN	ML	
REVIEW	###	
APPROVED		

TITLE
PACKER TEST RESULTS MW20-20 MIDDLE INTERVAL (17.0 to 25.2 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-096

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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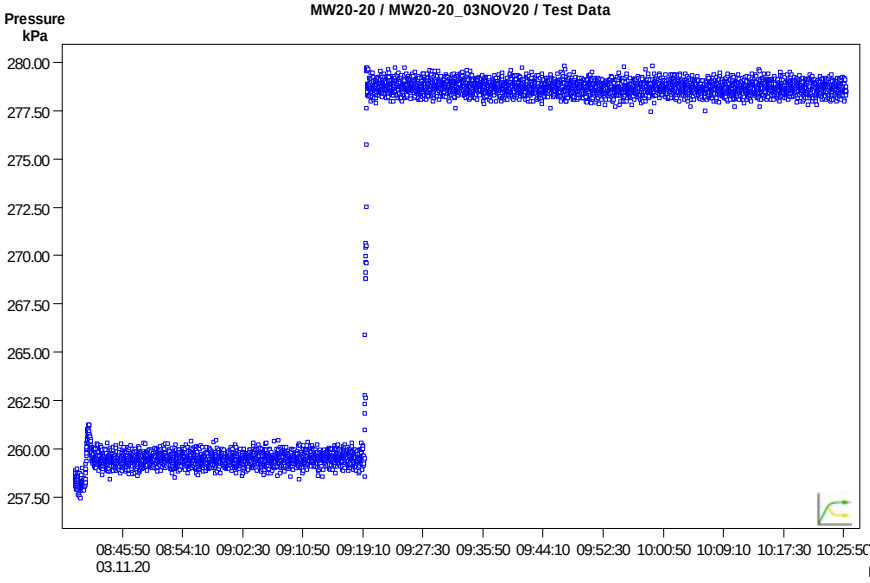

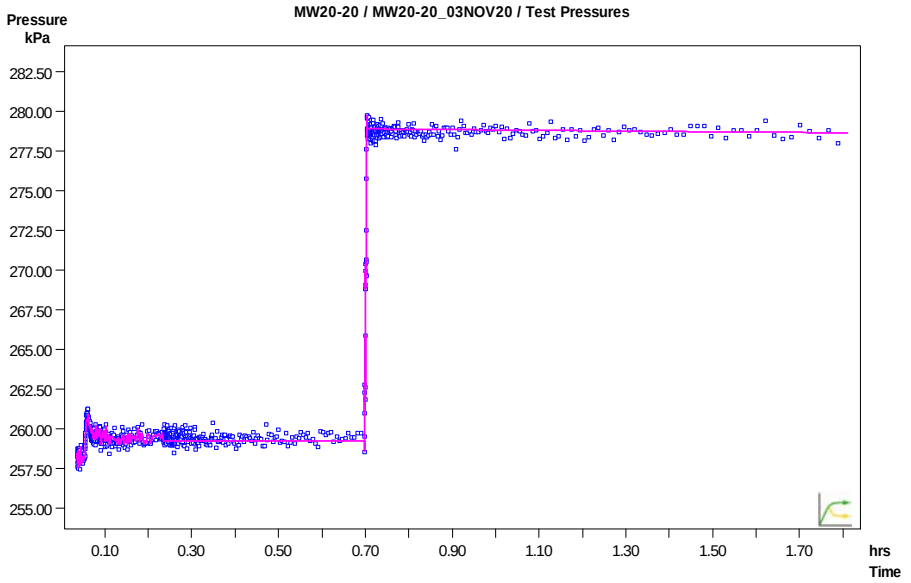

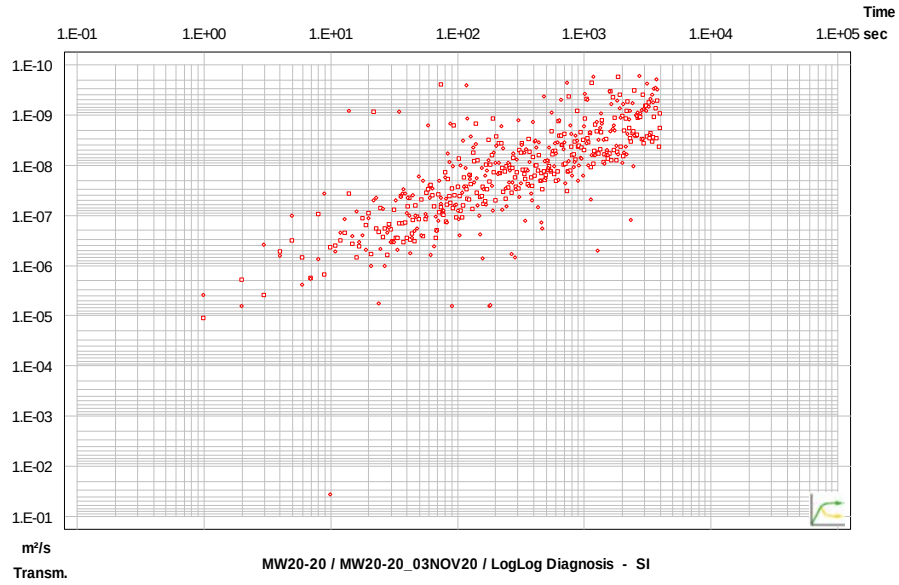

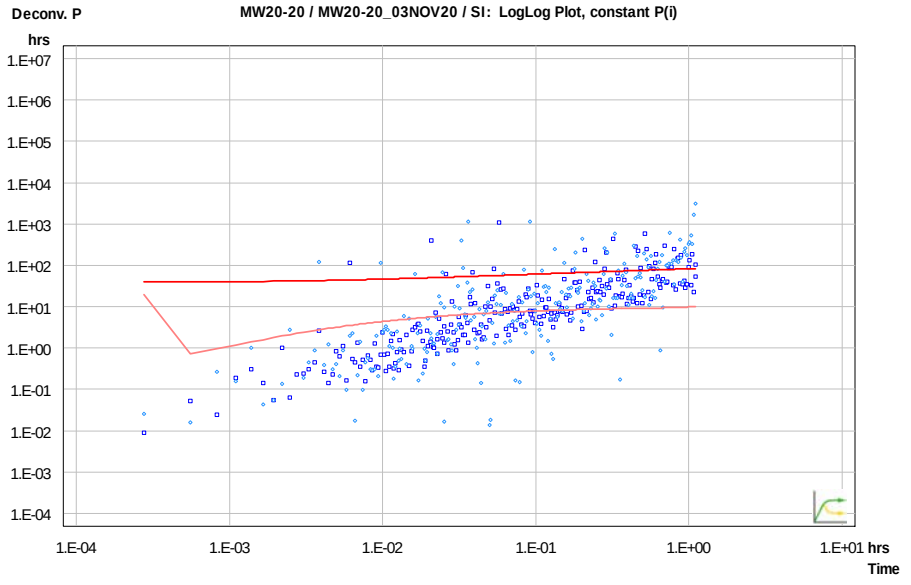

Pressure Observation SI
Pressure Derivative SI
Pressure Observation CRI
Pressure Derivative CRI
Pressure Observation CRIR
Pressure Derivative CRIR

Pressure Observation Selected Phase
Pressure Derivative Selected Phase
Simulated Response
Simulated Response Derivative

CLIENT
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PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
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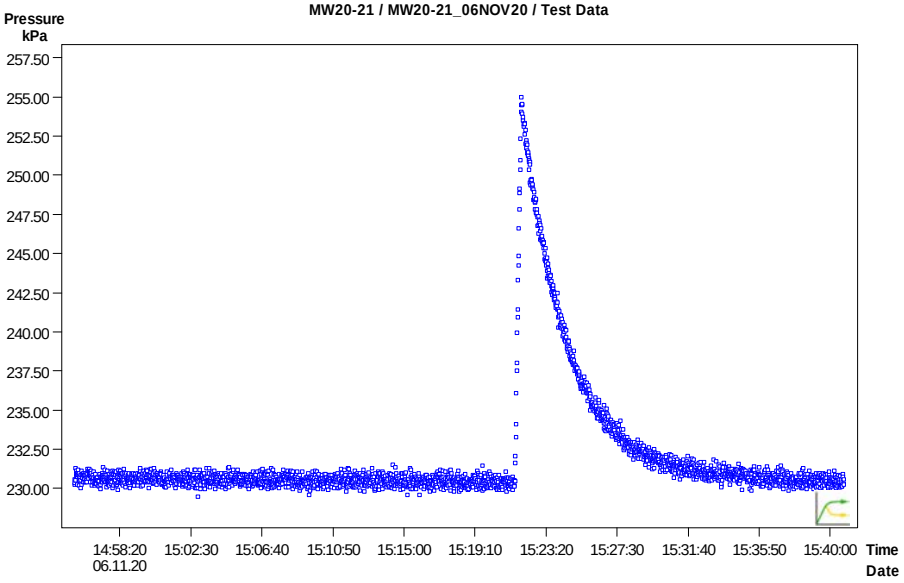
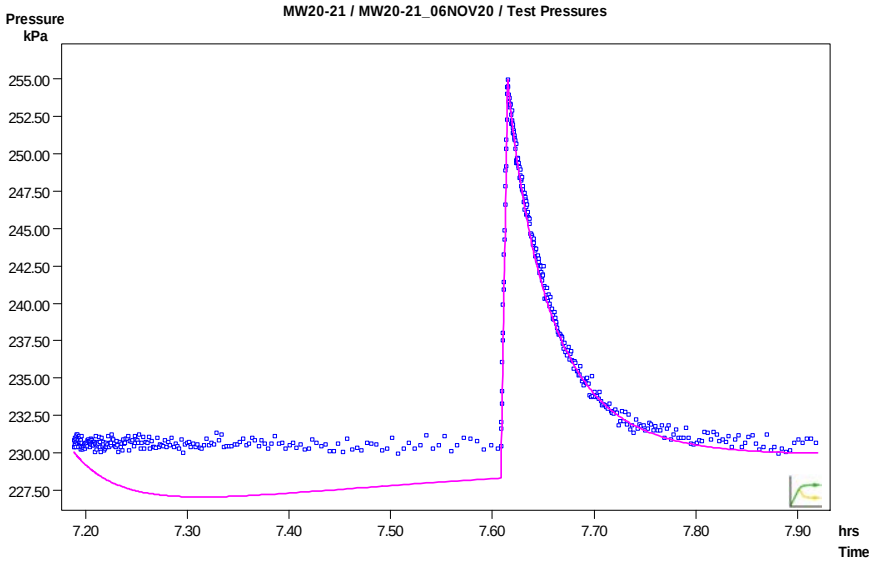
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

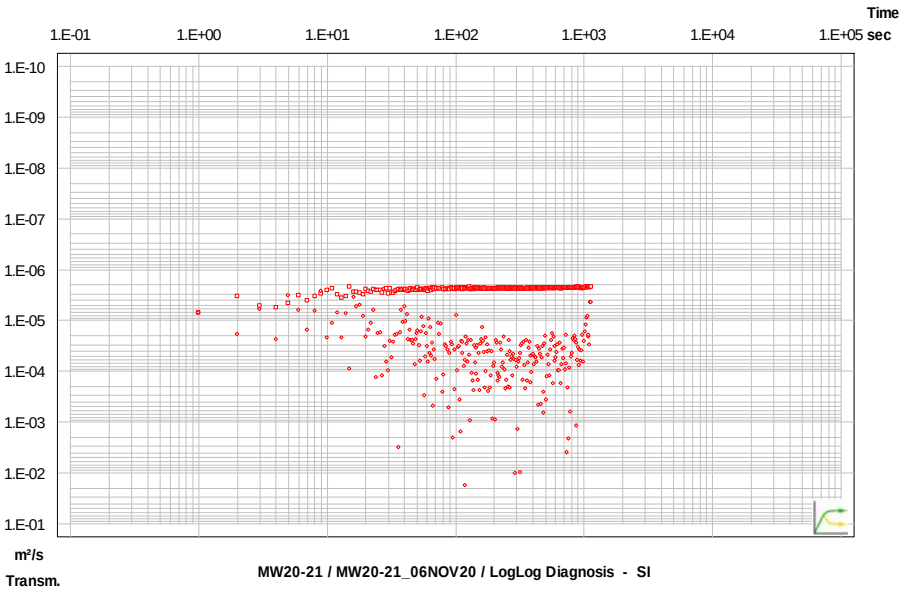
TITLE
PACKER TEST RESULTS MW20-20 LOWER INTERVAL (25.2 to 28.0 mbgs)

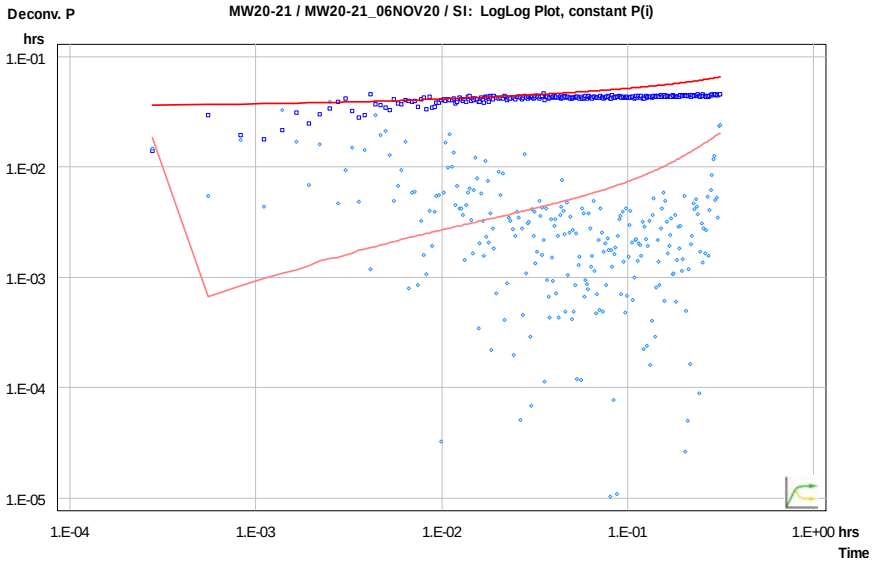
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-097

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









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YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

PROJECT

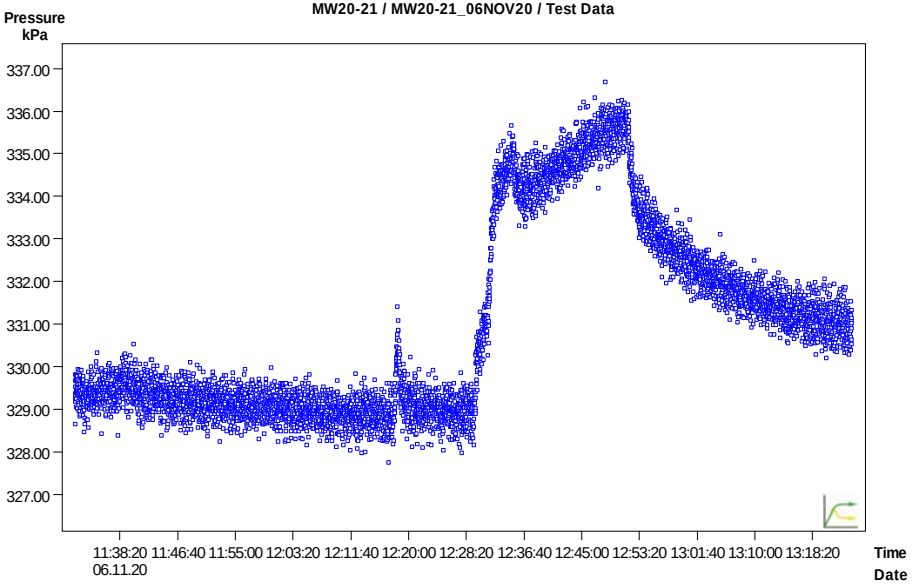
CALEDON PIT / QUARRY

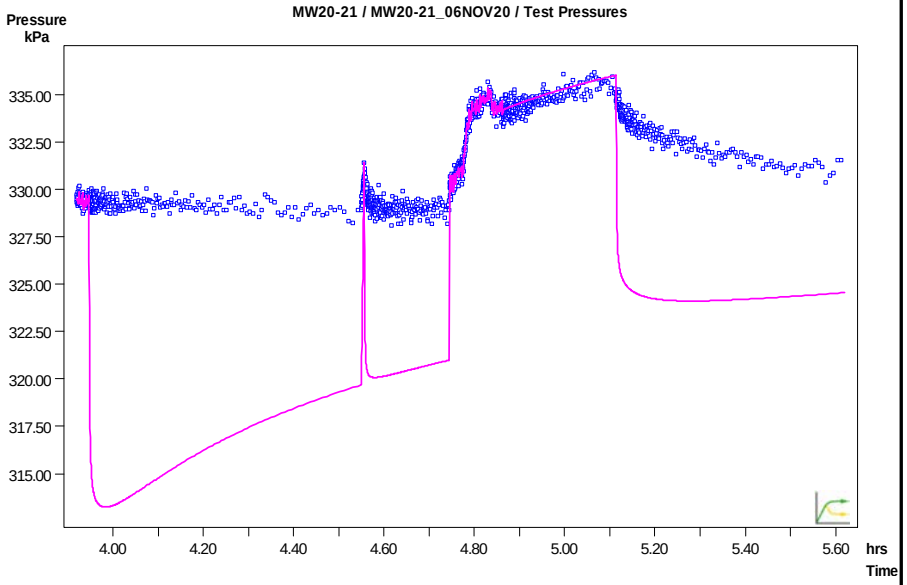
TITLE

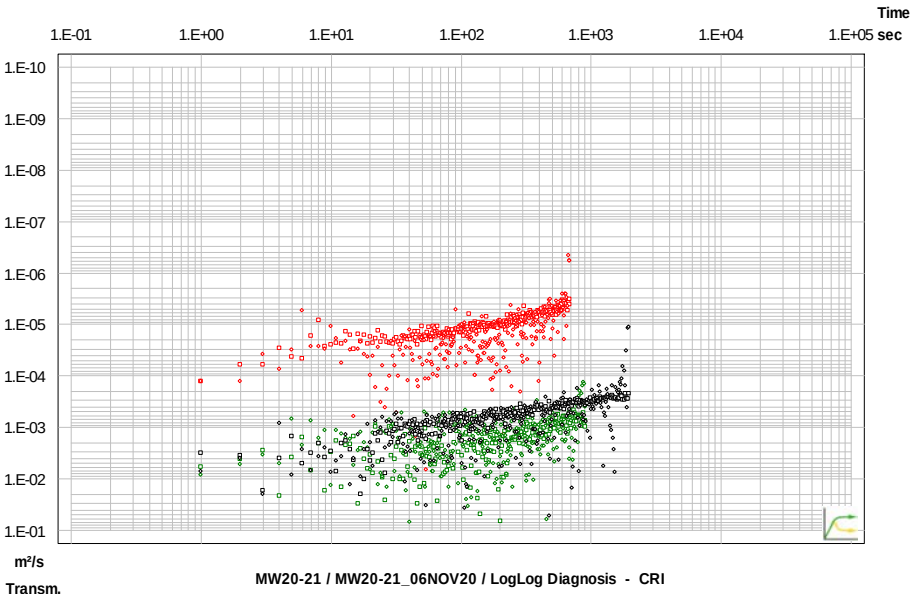
PACKER TEST RESULTS MW20-21 UPPER INTERVAL (16.9 to 26.6 mbgs)

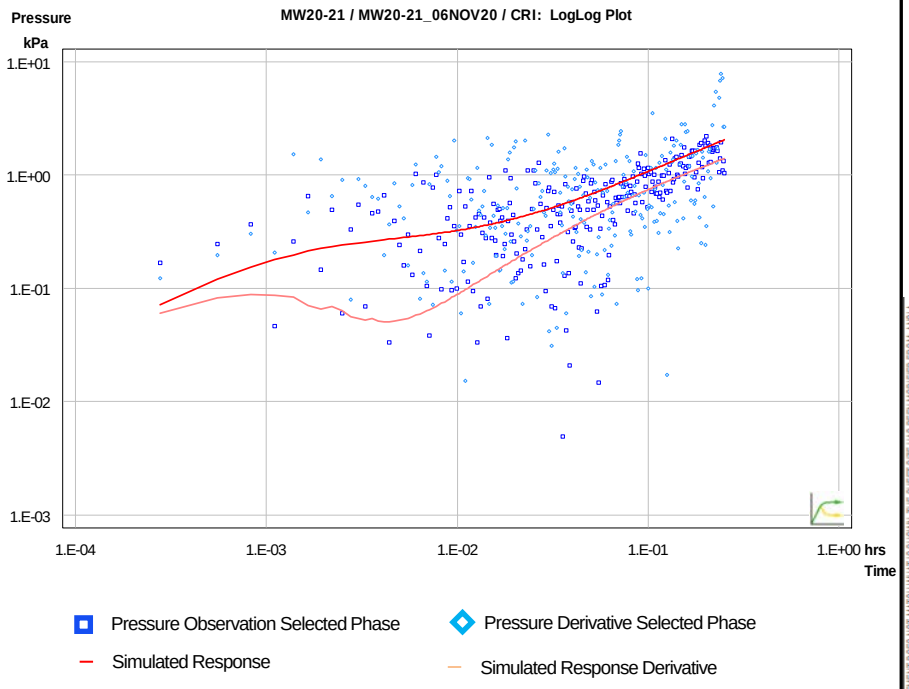
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-098

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









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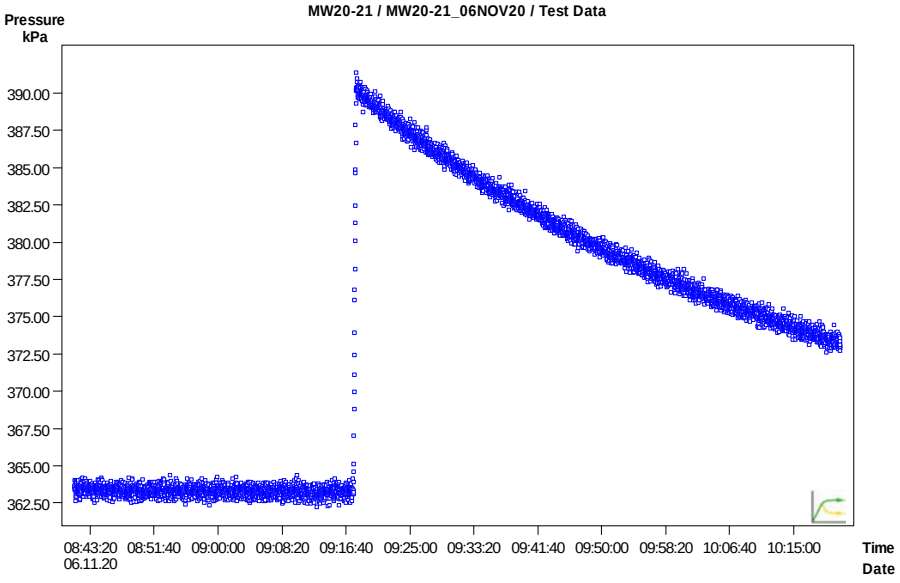
YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

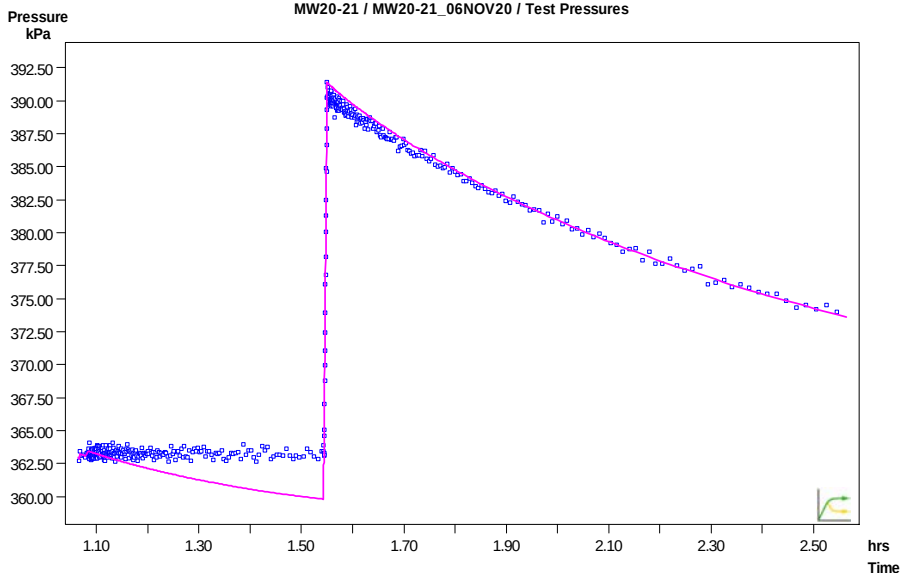
TITLE

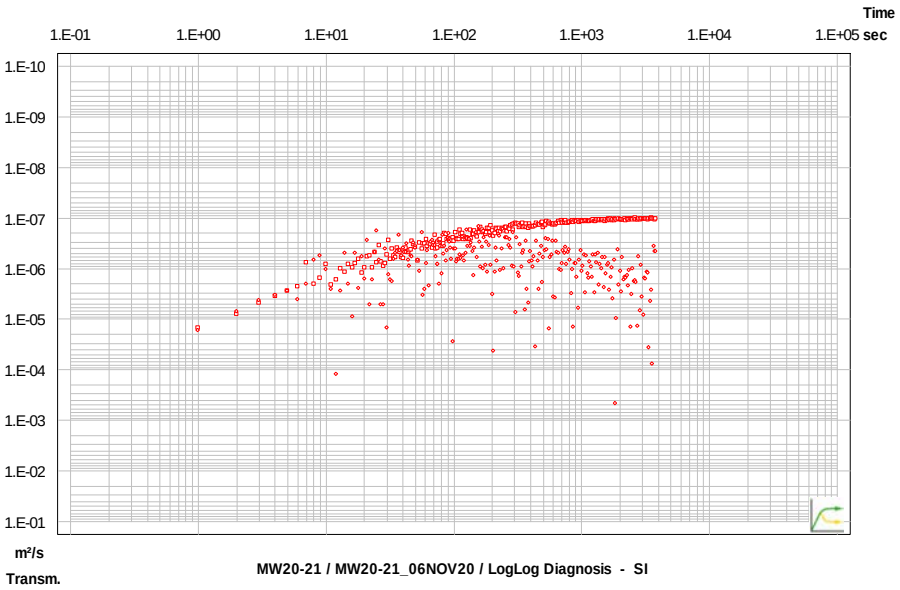
PACKER TEST RESULTS MW20-21 MIDDLE INTERVAL (25.6 to 36.7 mbgs)

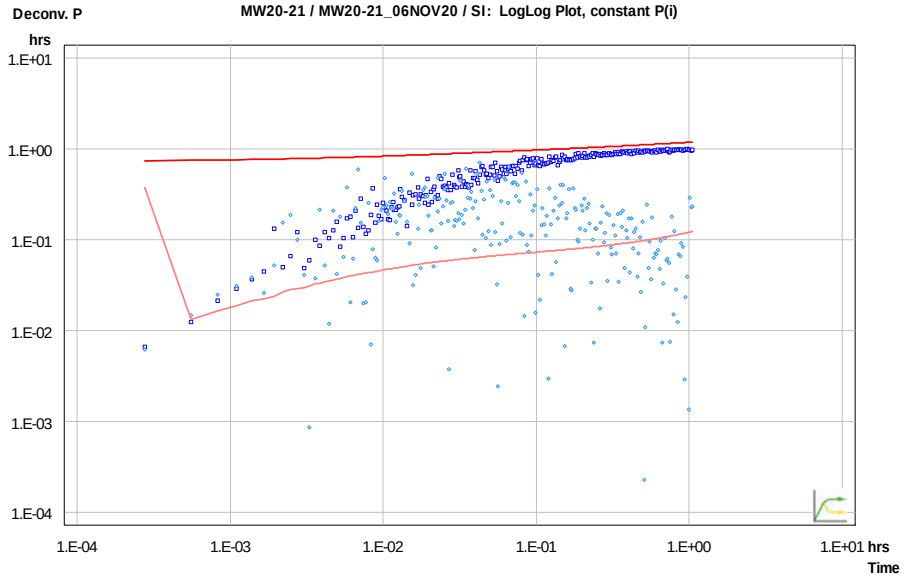
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-099

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A









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CALEDON PIT / QUARRY

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GOLDER
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YYYY-MM-DD	2022-02-16
PREPARED	PGM
DESIGN	ML
REVIEW	###
APPROVED	

TITLE

PACKER TEST RESULTS MW20-21 LOWER INTERVAL (36.7 to 39.7 mbgs)

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	F-100

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
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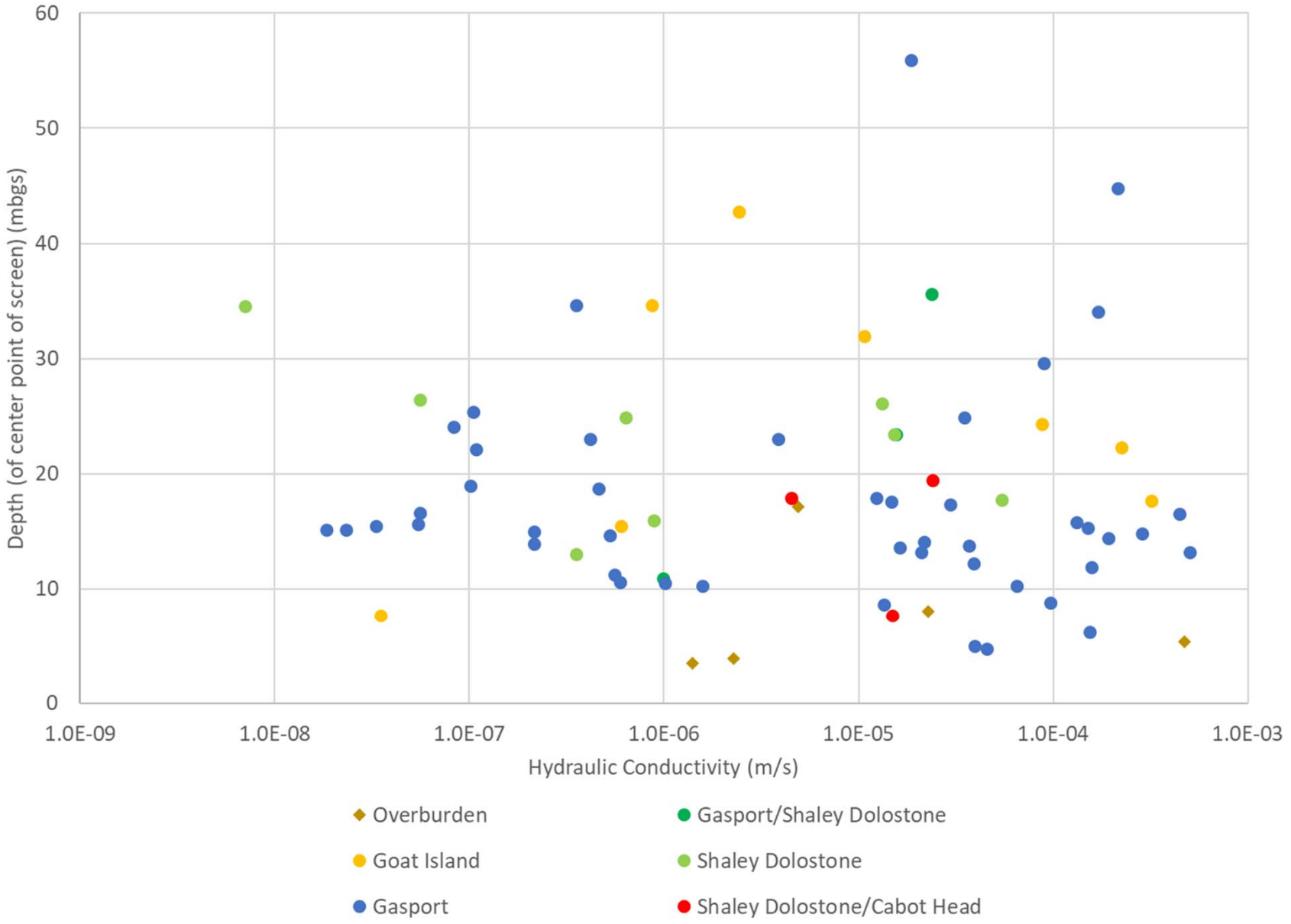
APPENDIX G

Single Well Hydraulic Response Tests

Table G-1
Caledon Quarry
Single Well Response Test Summary

MW ID	Figure Number	Top of test interval (mbgs)	Bottom of test interval (mbgs)	Depth of Test (center point mbgs)	Groundsurface Elevation (masl)	Depth of Test (center point masl)	Aquifer Model	Screened Formation	Final k (m/s)
MW20-01A	A01	17.1	18.63	17.86	395.10	377.24	Unconfined	Shaley Dolostone/Cabot Head Fm	4.5E-06
MW20-01B	A02	11.1	12.62	11.86	395.10	383.24	Unconfined	Gasport Fm	1.6E-04
MW20-02	A03	16.96	18.48	17.72	399.63	381.91	Unconfined	Shaley Dolostone	5.5E-05
MW20-03	A04	15.58	18.63	17.11	390.67	373.57	Unconfined	Overburden	4.9E-06
MW20-04	A05	16.11	17.63	16.87	399.46	382.59	Unconfined	Shaley Dolostone/Cabot Head Fm	1.7E-05
MW20-05A	A06	12.246	13.77	13.01	399.63	386.63	Unconfined	Shaley Dolostone	3.6E-07
MW20-05B		4.25	5.77	5.01	399.63	394.62	NA	Gasport Fm	NA
MW20-06A	A07	10.12	11.64	10.88	400.15	389.27	Unconfined	Gasport Fm/Shaley Dolostone	9.9E-07
MW20-06B	A08	4.2	5.72	4.96	400.15	395.19	Unconfined	Gasport Fm	4.0E-05
MW20-07A	A09	15.11	16.63	15.87	404.07	388.20	Unconfined	Shaley Dolostone	8.9E-07
MW20-07B	A10	9.736	11.26	10.50	404.07	393.57	Unconfined	Gasport Fm	1.0E-06
MW20-08A	A11	13.3	14.82	14.06	406.93	392.87	Unconfined	Gasport Fm	2.2E-05
MW20-08B	A12	5.38	6.90	6.14	406.93	400.79	Unconfined	Gasport Fm	1.5E-04
MW20-09	A13	6.85	8.37	7.61	399.95	392.34	Confined	Shaley Dolostone/Cabot Head Fm	1.5E-05
MW20-10A	A14	18.62	20.14	19.38	411.32	391.94	Unconfined	Shaley Dolostone/Cabot Head Fm	2.4E-05
MW20-10B	A15	14.49	16.01	15.25	411.32	396.07	Unconfined	Gasport Fm	1.5E-04
MW20-11A	A16	13.806	15.33	14.57	409.72	395.15	Unconfined	Gasport Fm	5.3E-07
MW20-11B	A17	3.96	5.48	4.72	409.72	405.00	Unconfined	Gasport Fm	4.6E-05
MW20-12A	A18	17.09	18.62	17.85	412.43	394.58	Unconfined	Gasport Fm	1.2E-05
MW20-12B	A19	7.825	9.35	8.59	412.43	403.85	Unconfined	Gasport Fm	1.4E-05
MW20-13A	A20	24.05	25.57	24.81	415.53	390.72	Confined	Shaley Dolostone	6.4E-07
MW20-13B	A21	18.14	19.66	18.90	415.53	396.63	Confined	Gasport Fm	1.0E-07
MW20-13C	A22	3.08	4.60	3.84	415.53	411.69	Unconfined	Overburden	2.3E-06
MW20-14A	A23	22.6	24.12	23.36	406.71	383.35	Unconfined	Shaley Dolostone	1.5E-05
MW20-14B	A24	14.98	16.50	15.74	406.71	390.97	Unconfined	Gasport Fm	1.3E-04
MW20-15A	A25	33.77	35.29	34.53	417.06	382.53	Confined	Shaley Dolostone	7.1E-09
MW20-15B	A26	28.81	30.33	29.57	417.06	387.49	Confined	Gasport Fm	9.0E-05
MW20-15C	A27	2.74	4.27	3.51	417.06	413.55	Unconfined	Overburden	1.4E-06
MW20-16A	A28	34.84	36.36	35.60	421.40	385.80	Confined	Gasport Fm/Shaley Dolostone	2.4E-05
MW20-16B	A29	16.8	18.33	17.57	421.40	403.83	Confined	Gasport Fm	1.5E-05
MW20-17A	A30	25.64	27.16	26.40	406.64	380.24	Unconfined	Shaley Dolostone	5.6E-08
MW20-17B	A31	12.75	14.27	13.51	406.64	393.13	Unconfined	Gasport Fm	1.6E-05
MW20-18	A32	12.42	13.94	13.18	404.29	391.11	Unconfined	Gasport Fm	2.1E-05
MW20-19A	A33	15.75	17.27	16.51	396.98	380.47	Unconfined	Gasport Fm	4.5E-04
MW20-19B	A34	8	9.52	8.76	396.98	388.22	Unconfined	Gasport Fm	9.7E-05
MW20-20A	A35	25.33	26.85	26.09	403.00	376.91	Confined	Shaley Dolostone	1.3E-05
MW20-20B	A36	12.97	14.49	13.73	403.00	389.27	Confined	Gasport Fm	3.7E-05
MW20-20C	A37	3.24	3.95	3.60	403.00	399.41	Unconfined	Gasport Fm	5.0E-05
MW20-21A	A38	33.27	34.79	34.03	415.23	381.20	Confined	Gasport Fm	1.7E-04
MW20-21B	A39	15.77	17.29	16.53	415.23	398.70	Confined	Gasport Fm	5.6E-08
MW20-22A	A40	23.48	25.00	24.24	399.27	375.03	Confined	Goat Island Fm	8.8E-05
MW20-22B	A41	6.89	8.41	7.65	399.27	391.62	Unconfined	Goat Island Fm	3.5E-08
MW20-23A	A42	22.59	24.11	23.35	395.05	371.70	Confined	Gasport Fm/Shaley Dolostone	1.6E-05
MW20-23B	A43	14.68	16.20	15.44	395.05	379.61	Confined	Goat Island Fm	6.1E-07
MW20-23C	A44	4.57	6.09	5.33	395.00	389.67	Unconfined	Overburden	4.8E-04
MW20-24A	A45	33.81	35.33	34.57	437.75	403.18	Confined	Gasport Fm	3.6E-07
MW20-24B	A46	21.49	23.02	22.25	437.75	415.50	Confined	Goat Island Fm	2.3E-04
MW20-25A	A47	44.03	45.55	44.79	419.02	374.23	Confined	Gasport Fm	2.2E-04
MW20-25B	A48	16.84	18.36	17.60	419.02	401.42	Confined	Goat Island Fm	3.2E-04
MW20-26A	A49	55.16	56.68	55.92	438.89	382.97	Confined	Gasport Fm	1.9E-05
MW20-26B	A50	31.12	32.64	31.88	438.89	407.01	Confined	Goat Island Fm	1.1E-05
MW20-26C	A51	7.26	8.78	8.02	438.88	430.86	Unconfined	Overburden	2.3E-05
MW20-27A	A52	41.99	43.51	42.75	431.15	388.40	Confined	Goat Island Fm	2.4E-06
MW20-27B	A53	33.85	35.37	34.61	431.15	396.54	Confined	Goat Island Fm	8.7E-07
MW20-28A	A54	24.07	25.59	24.83	419.31	394.48	Confined	Gasport Fm	3.5E-05
MW20-28B	A55	16.51	18.03	17.27	419.31	402.04	Confined	Gasport Fm	3.0E-05
PW21-1	A56	12.19	38.41	25.30	418.76	393.46	Confined	Gasport Fm	1.1E-07
MW21-1-1	A57	11.6	34.40	23.00	418.94	395.94	Confined	Gasport Fm	3.9E-06
MW21-1-2	A58	13.4	34.70	24.05	420.58	396.53	Confined	Gasport Fm	8.3E-08
MW21-1-3	A59	9.1	35.10	22.10	417.51	395.41	Confined	Gasport Fm	1.1E-07
MW21-1-4	A60	13.1	32.90	23.00	417.83	394.83	Confined	Gasport Fm	4.2E-07
PW21-2	A61	12.19	25.15	18.67	413.07	394.40	Unconfined	Gasport Fm	4.7E-07
MW21-2-1	A62	6.7	22.00	14.35	413.40	399.05	Unconfined	Gasport Fm	1.9E-04
MW21-2-2	A63	7	19.20	13.10	412.64	399.54	Confined	Gasport Fm	5.1E-04
MW21-2-3	A64	6.1	18.30	12.20	410.76	398.56	Unconfined	Gasport Fm	3.9E-05
MW21-2-4	A65	6.4	23.20	14.80	413.86	399.06	Unconfined	Gasport Fm	2.9E-04
PW21-3	A66	8.84	21.34	15.09	405.45	390.36	Unconfined	Gasport Fm	1.9E-08
MW21-3-1	A67	5.8	16.50	11.15	403.69	392.54	Unconfined	Gasport Fm	5.6E-07
MW21-3-2	A68	4.9	15.50	10.20	404.87	394.67	Unconfined	Gasport Fm	1.6E-06
MW21-3-3	A69	4.9	15.50	10.20	405.12	394.92	Unconfined	Gasport Fm	6.5E-05
MW21-3-4	A70	5.2	15.80	10.50	403.16	392.66	Unconfined	Gasport Fm	6.0E-07
PW21-4	A71	9.25	21.64	15.45	415.08	399.63	Unconfined	Gasport Fm	3.3E-08
PW21-4A	A72	8.6106	21.64	15.13	415.08	399.95	Unconfined	Gasport Fm	2.3E-08
MW21-4-1	A73	10.1	17.70	13.90	415.22	401.32	Unconfined	Gasport Fm	2.2E-07
MW21-4-2	A74	11	20.10	15.55	415.07	399.52	Unconfined	Gasport Fm	5.5E-08
MW21-4-3	A75	10.4	19.50	14.95	414.78	399.83	Unconfined	Gasport Fm	2.2E-07



CLIENT
ST.MARY'S CEMENT INC. (CANADA)

PROJECT
CALEDON PIT AND QUARRY

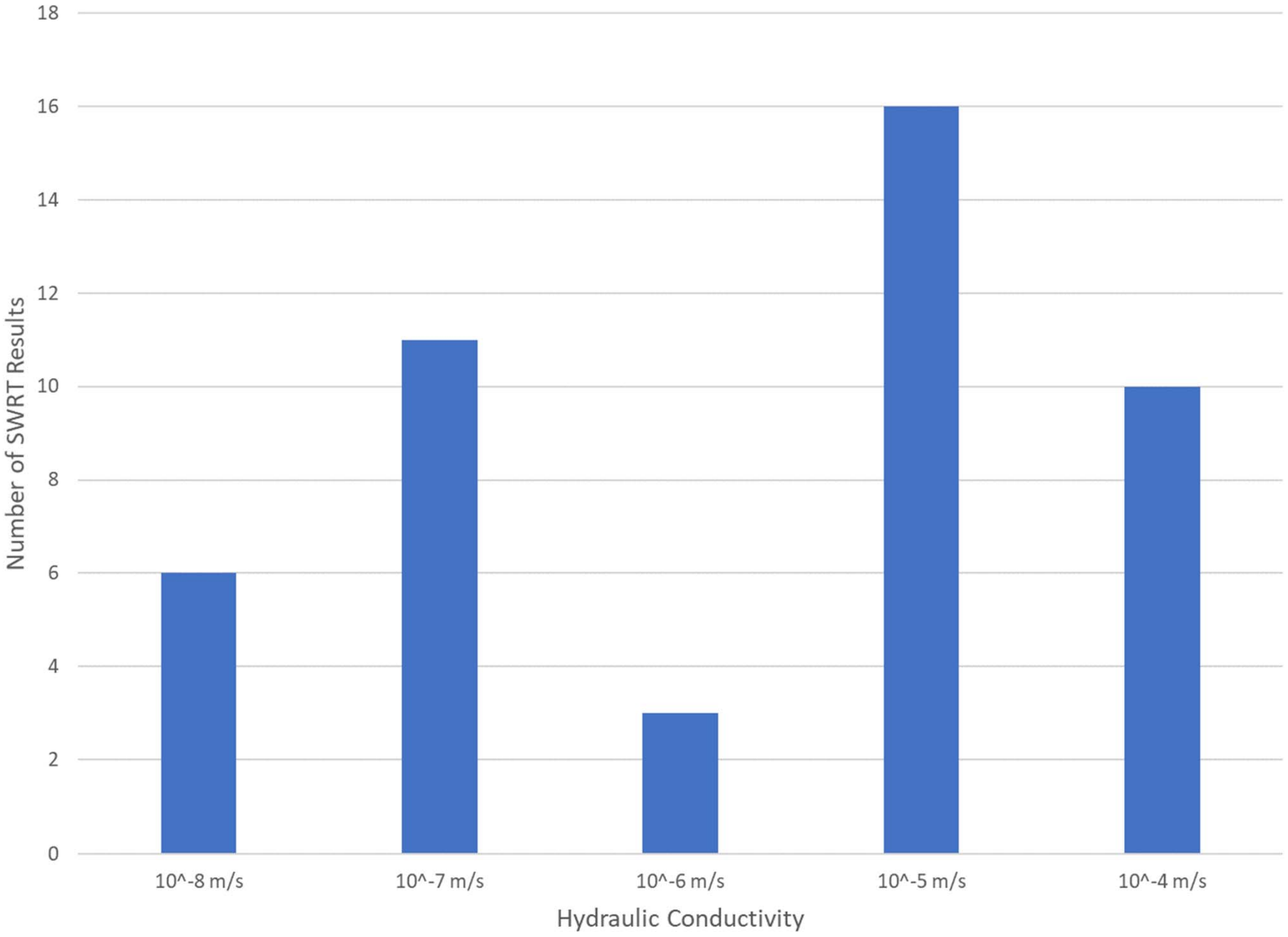
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-03-15
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	GWS

TITLE
SINGLE WELL RESPONSE TEST HYDRAULIC CONDUCTIVITY VERSUS DEPTH

PROJECT NO.	PHASE	Rev.	FIGURE
19129150	2300	A	G-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



CLIENT
ST.MARY'S CEMENT INC. (CANADA)

PROJECT
CALEDON PIT AND QUARRY

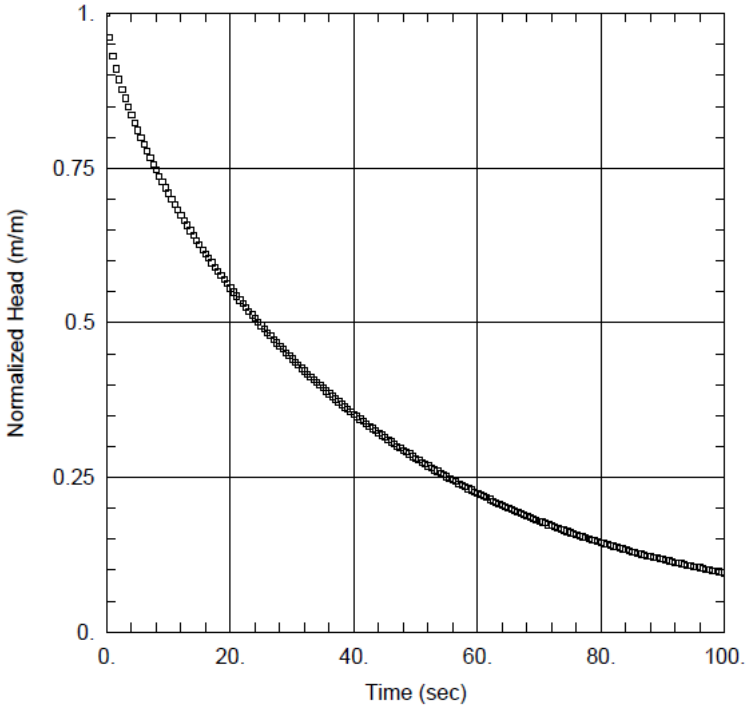
CONSULTANT
GOLDER
MEMBER OF WSP

	YYYY-MM-DD
PREPARED	2022-03-14
DESIGN	PGM
REVIEW	ML
APPROVED	GWS
	GWS

TITLE
SINGLE WELL RESPONSE TEST HYDRAULIC CONDUCTIVITY HISTOGRAM – GASPORT FORMATION

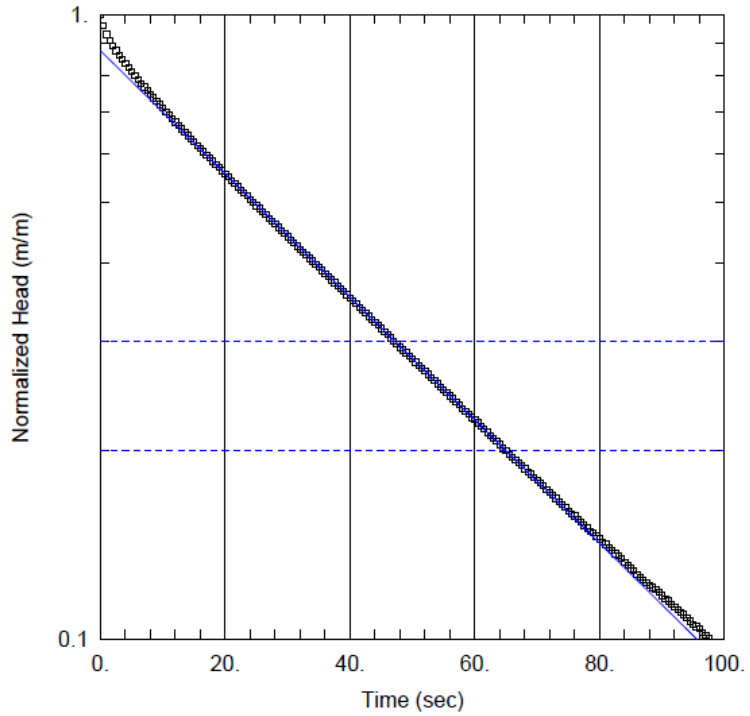
PROJECT NO.	PHASE	Rev.	FIGURE
19129150	2300	A	G-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-01A
Date of Test:	June 2, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	3.80 mbtoc
Initial Displacement:	3.37 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	17.10 to 18.63 m
Geology:	Shaley Dolostone/Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5 x 10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

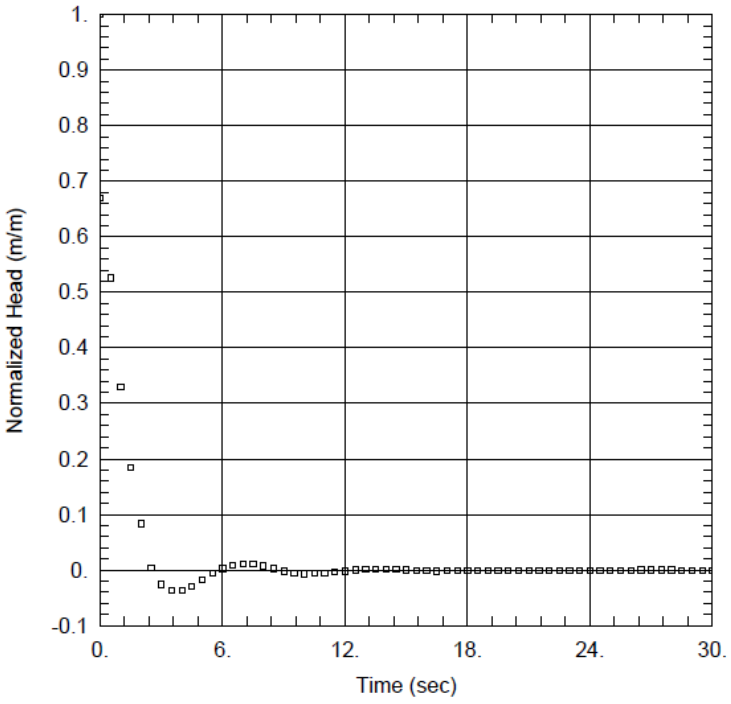
CONSULTANT
GOLDER
MEMBER OF WSP

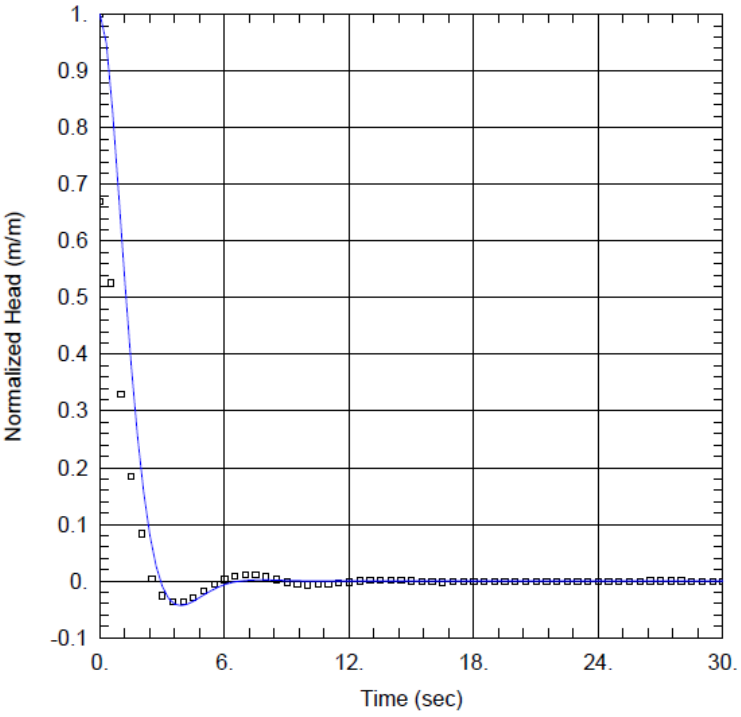
YYYY-MM-DD	2021-01-14
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-01A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-03

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A





Water Level Measurement

Solution Match Line

TEST INFORMATION:

Test Well:	MW20-01B
Date of Test:	June 2, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	2.83 mbgs
Initial Displacement:	1.93 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	11.10 to 12.62 m
Geology:	Dolostone, Gasport Fm

SOLUTION:

Solution Method:	Springer-Gelhar
Solution Type:	Inertial
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

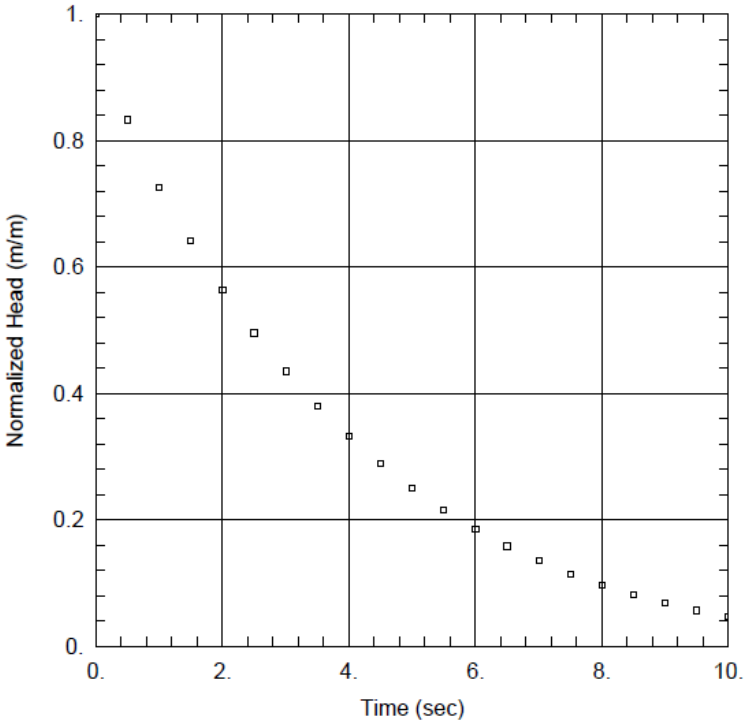
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-01-14
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-01B

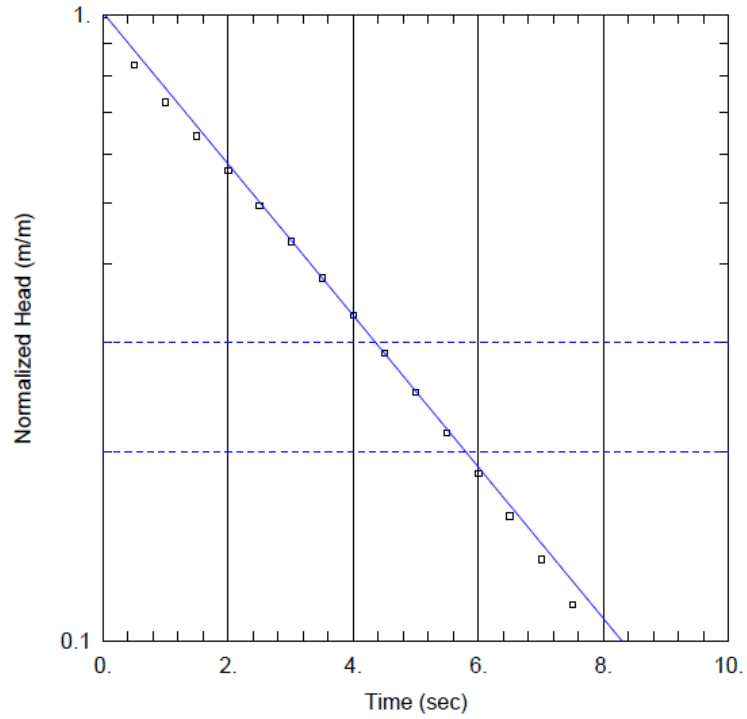
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-04

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0



TEST INFORMATION:

Test Well:	MW20-02
Date of Test:	June 1, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	8.46 mbgs
Initial Displacement:	3.01 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	16.96 m to 18.48 m
Geology:	Shaley Dolostone



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

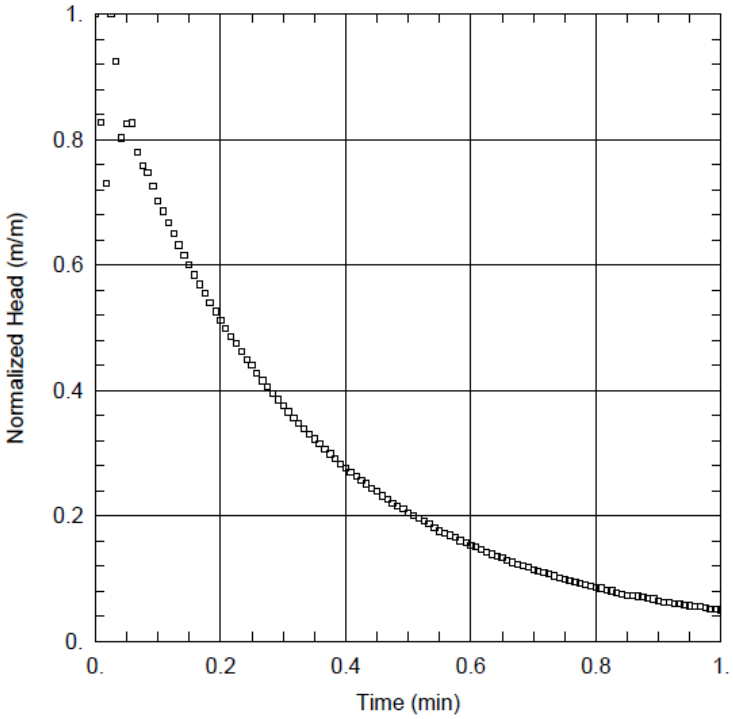
YYYY-MM-DD	2020-01-19
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-02

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-05

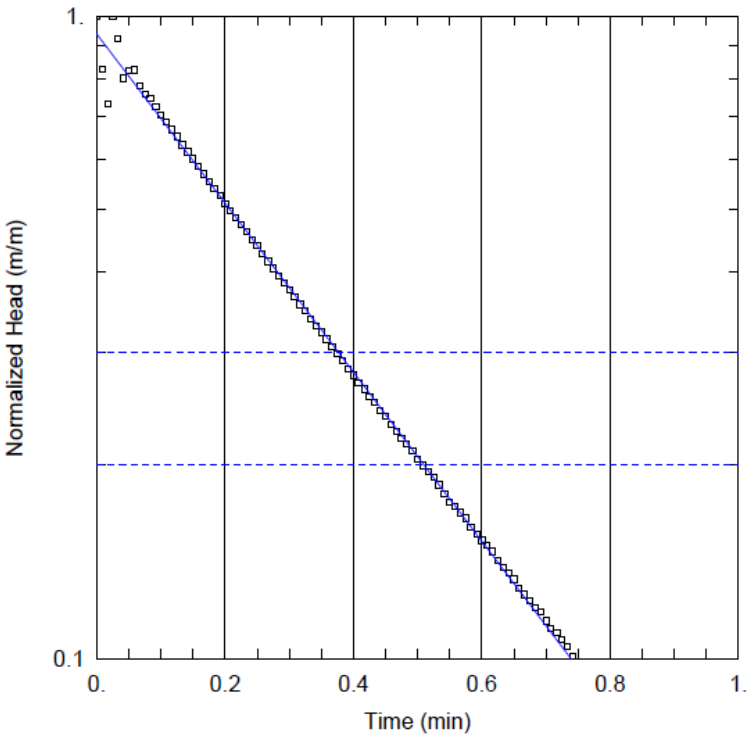
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-03
Date of Test:	June 1, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	4.52 mbgs
Initial Displacement:	1.86 m
Casing Radius:	0.013 m
Borehole Radius:	0.083 m
Well Screen Interval:	15.58 m to 18.63 m
Geology:	Overburden, Sand, some silt

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

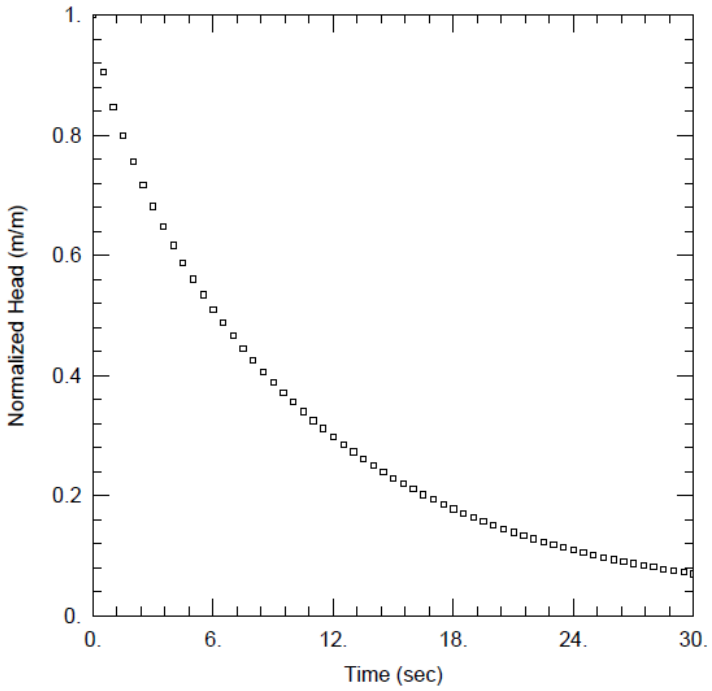
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-19
PREPARED	NU
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-03

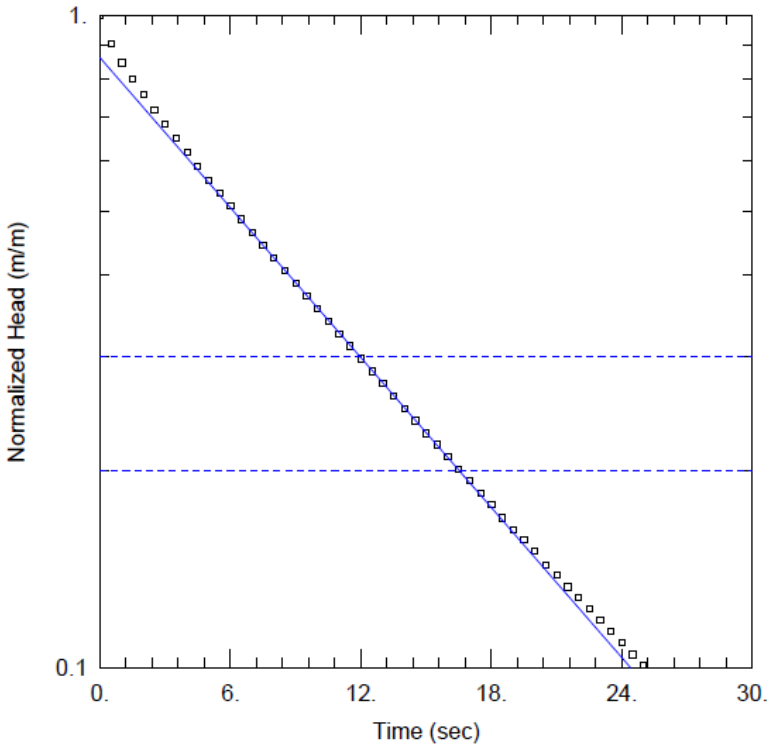
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-06

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-04
Date of Test:	June 1, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	9.40 mbgs
Initial Displacement:	2.68 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	16.11 m to 17.63 m
Geology:	Shaley Dolostone to Shale, Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

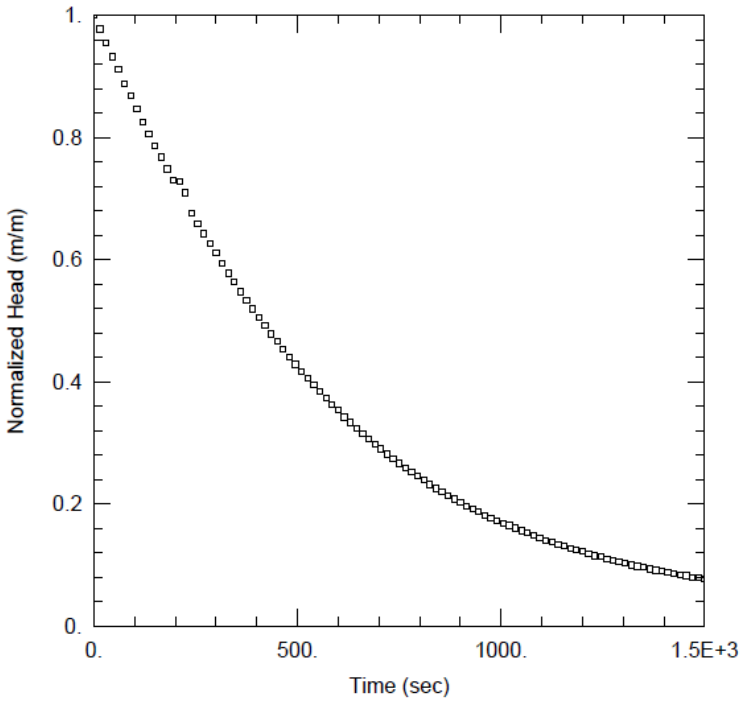
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-19
PREPARED	DB
DESIGN	DB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-04

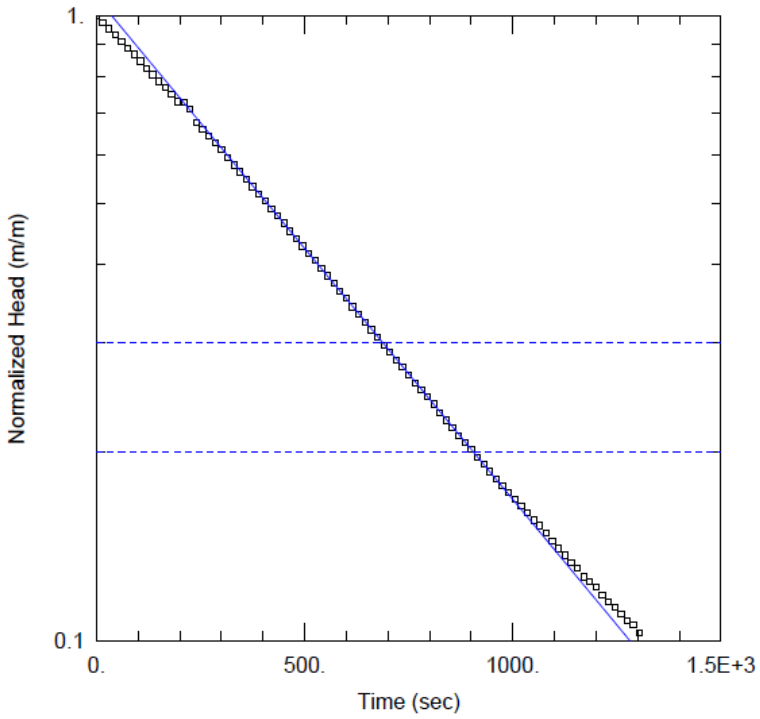
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-07

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-05A
Date of Test:	June 2, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	6.05 mbgs
Initial Displacement:	5.42 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	12.25 m to 13.77 m
Geology:	Shaley Dolostone, Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

4×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

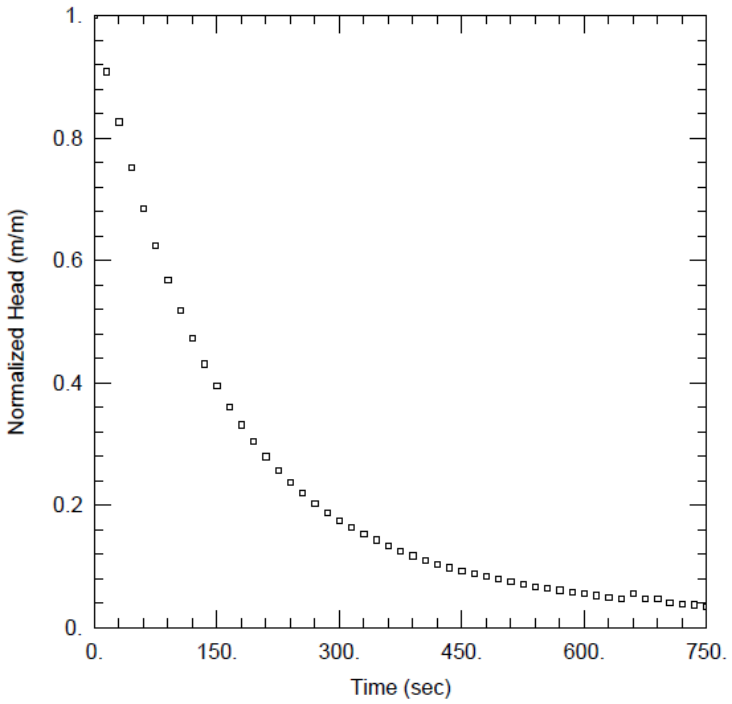
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-20
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-05A

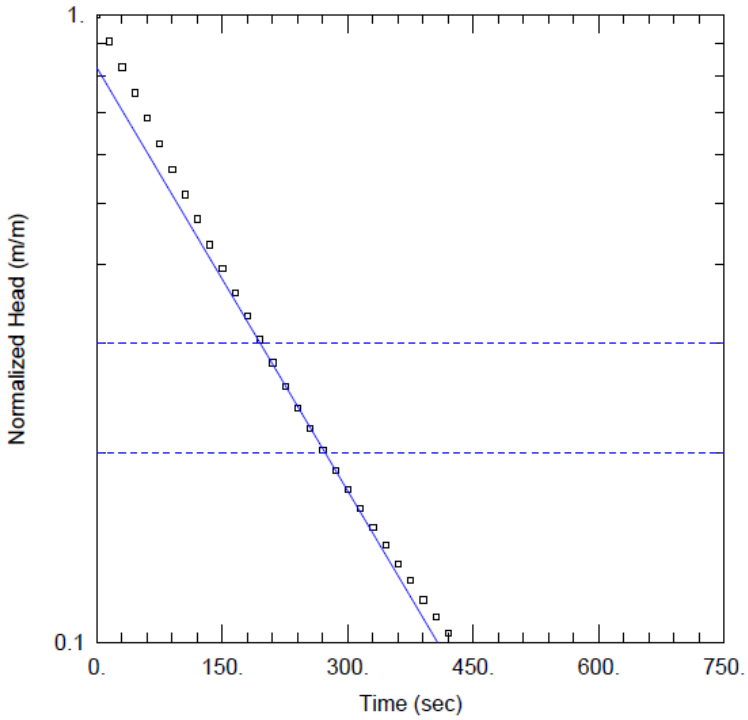
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-08

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-06A
Date of Test:	June 1, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	3.18 mbgs
Initial Displacement:	3.96 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	10.12 m to 11.64 m
Geology:	Shaley Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

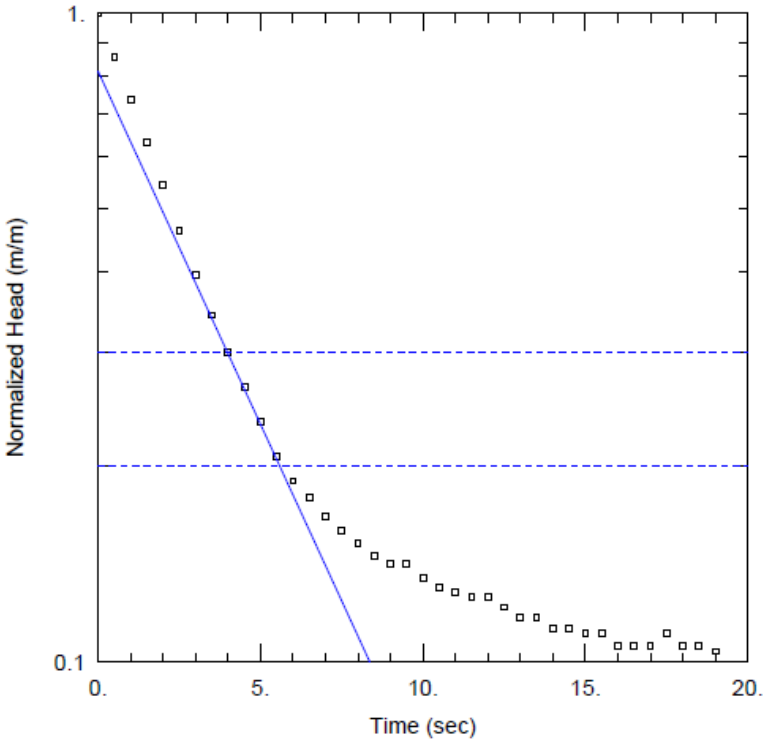
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-20
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-06A

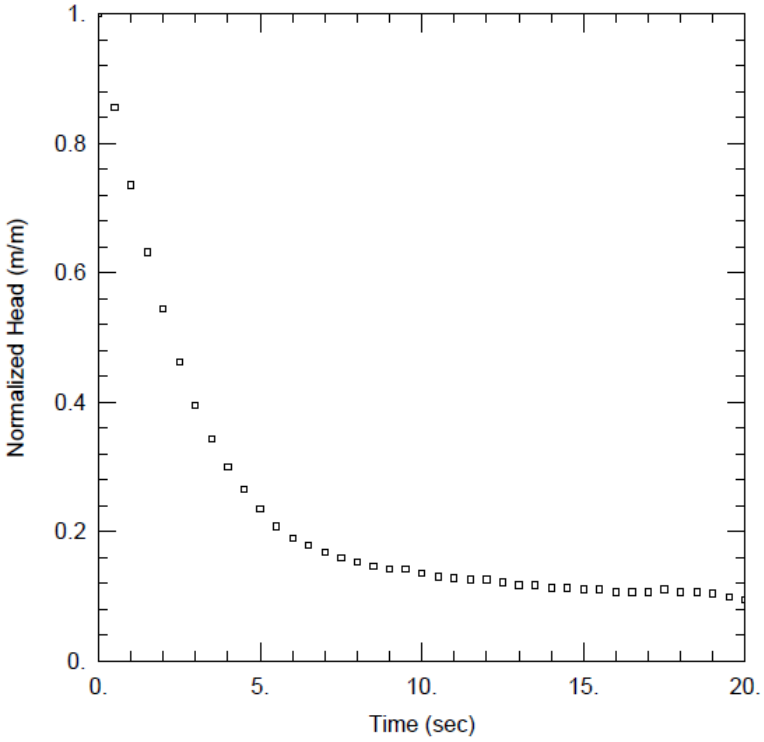
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-09

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-06B
Date of Test:	June 1, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	2.98 mbgs
Initial Displacement:	0.45 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	4.20 m to 5.72 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

4×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

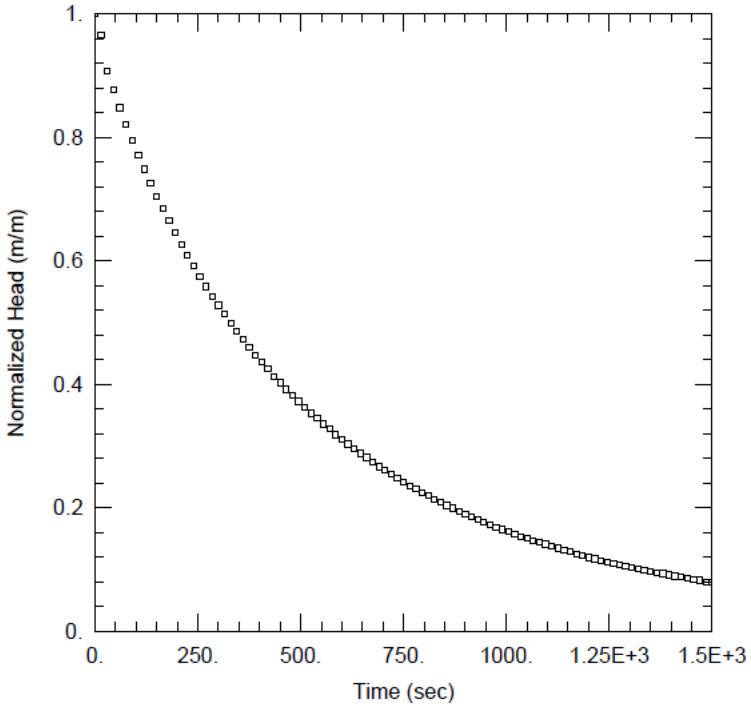
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-20
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-06B

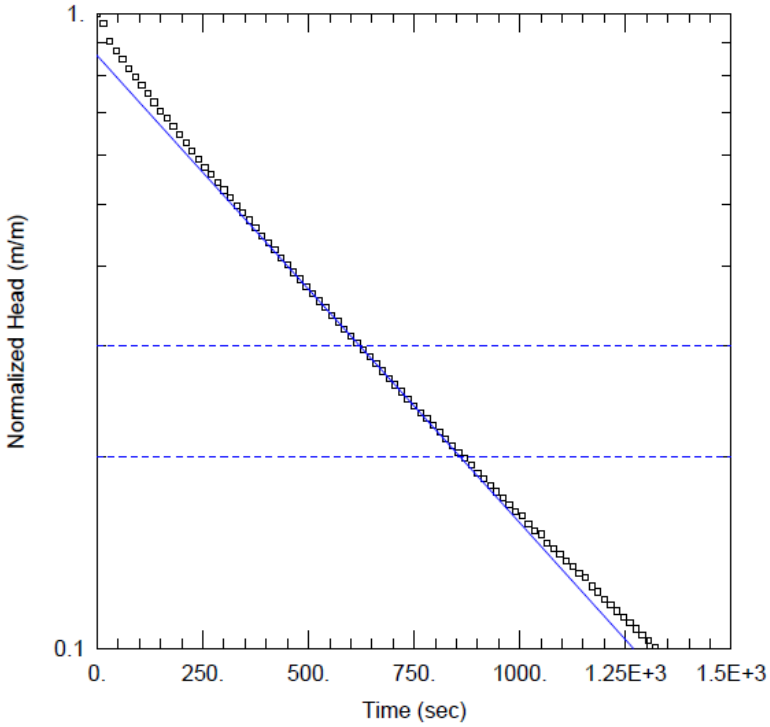
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-07A
Date of Test:	June 2, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.18 mbgs
Initial Displacement:	3.69 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	15.11 m to 16.63 m
Geology:	Shaley Dolostone, Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

9×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

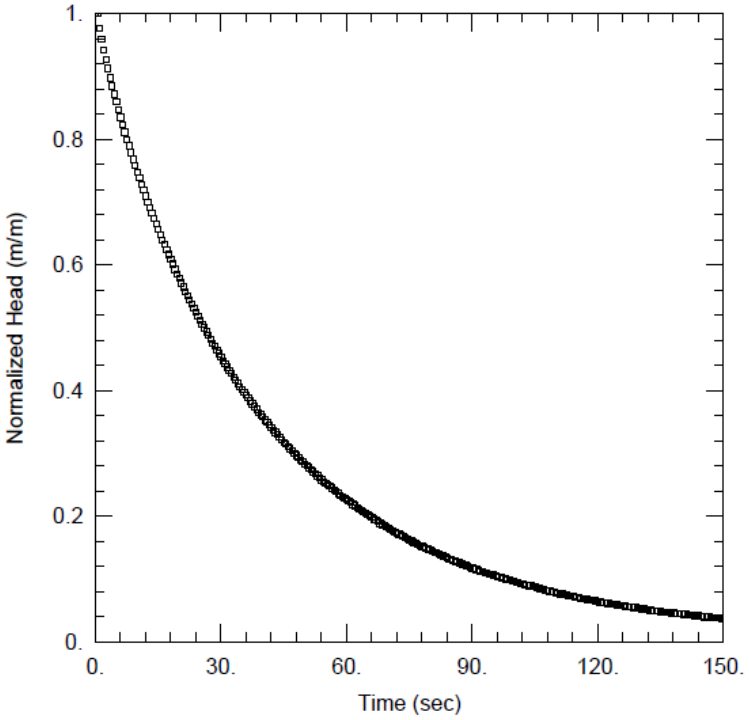
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-07A

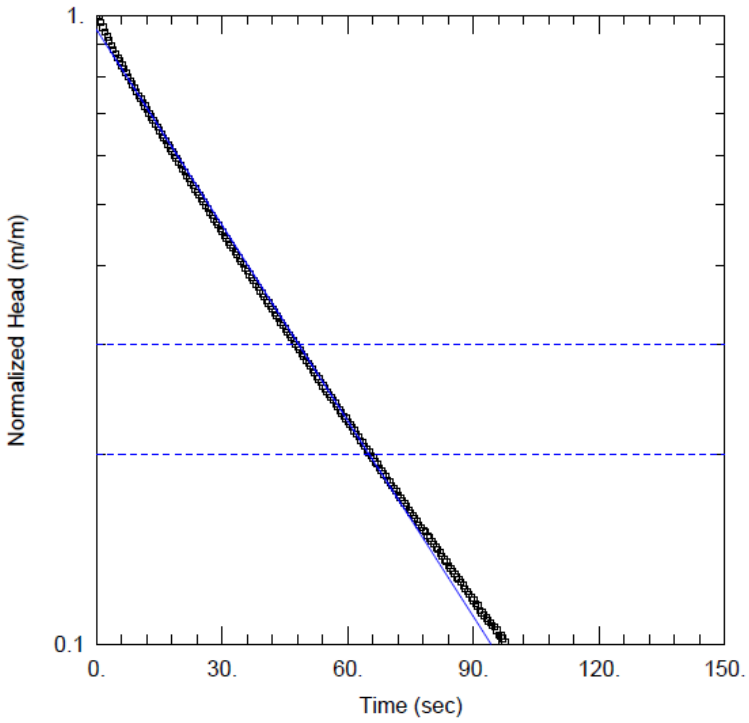
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-07B
Date of Test:	June 2, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	1.25 mbgs
Initial Displacement:	2.69 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	9.74 m to 11.26 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

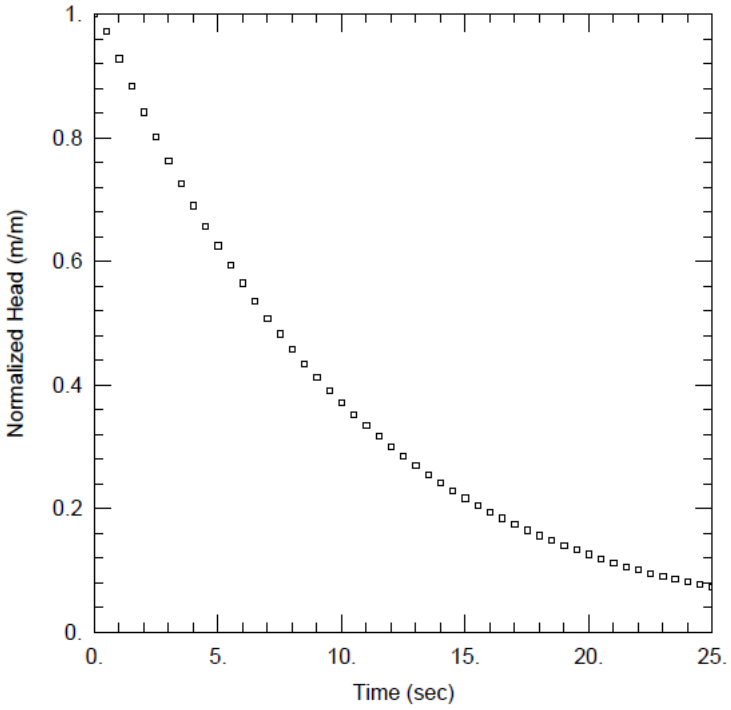
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-20
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-07B

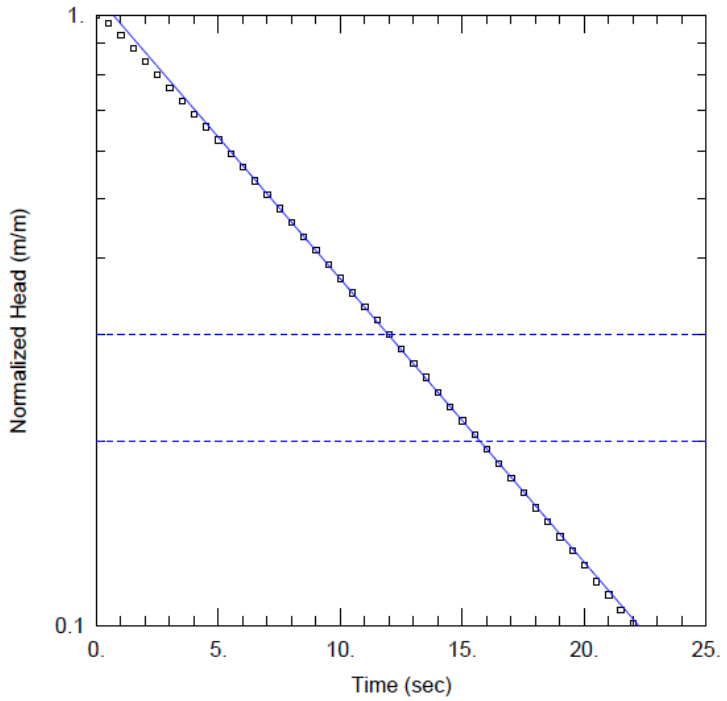
PROJECT No.	PHASE	Rev.	FIGURE
19129150	**2300**	**A**	**G-12**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-08A
Date of Test:	May 28, 2022
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	2.05 mbgs
Initial Displacement:	3.80 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	13.30 m to 14.82 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

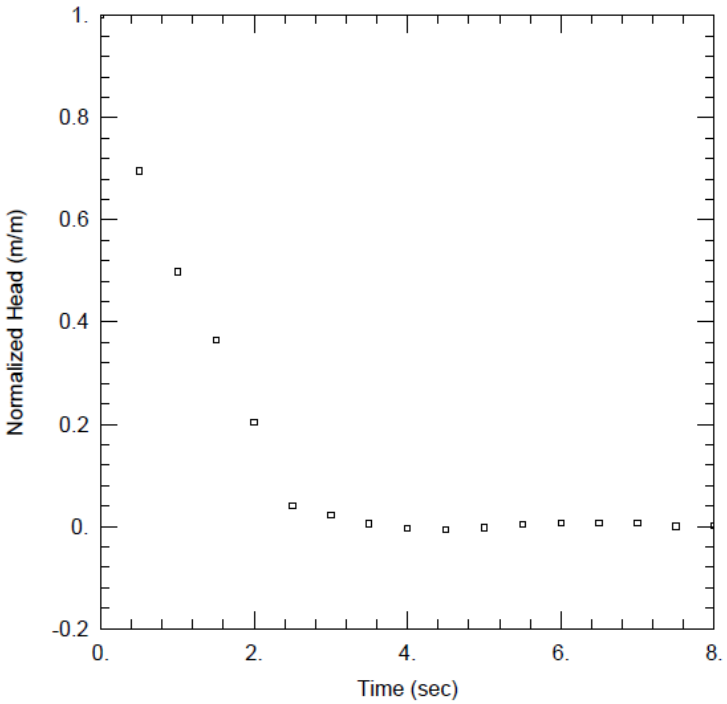
YYYY-MM-DD	2022-01-20
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-08A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-13

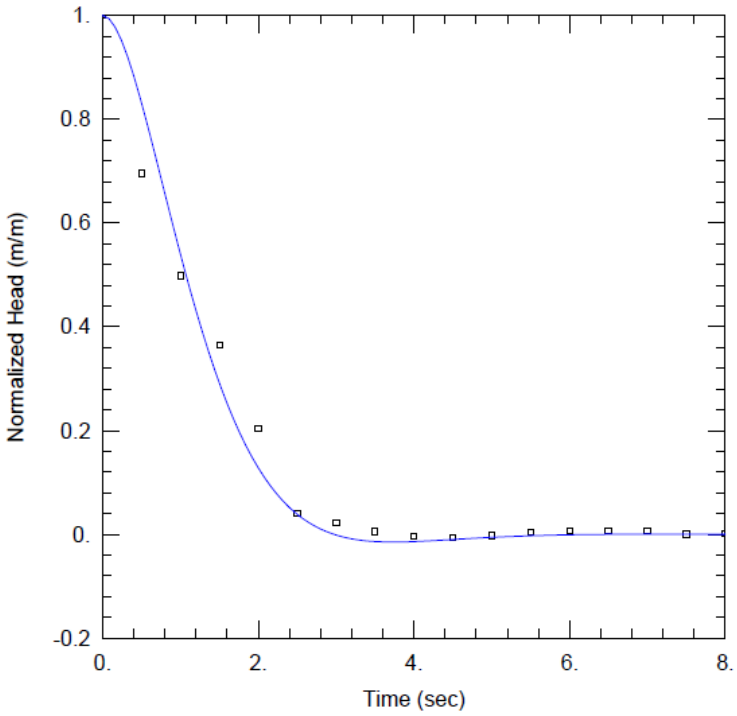
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-08B
Date of Test:	May 28, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	1.99 mbgs
Initial Displacement:	1.21 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	5.38 m to 6.90 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Solution Method:	Springer-Gelhar
Solution Type:	Inertial
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

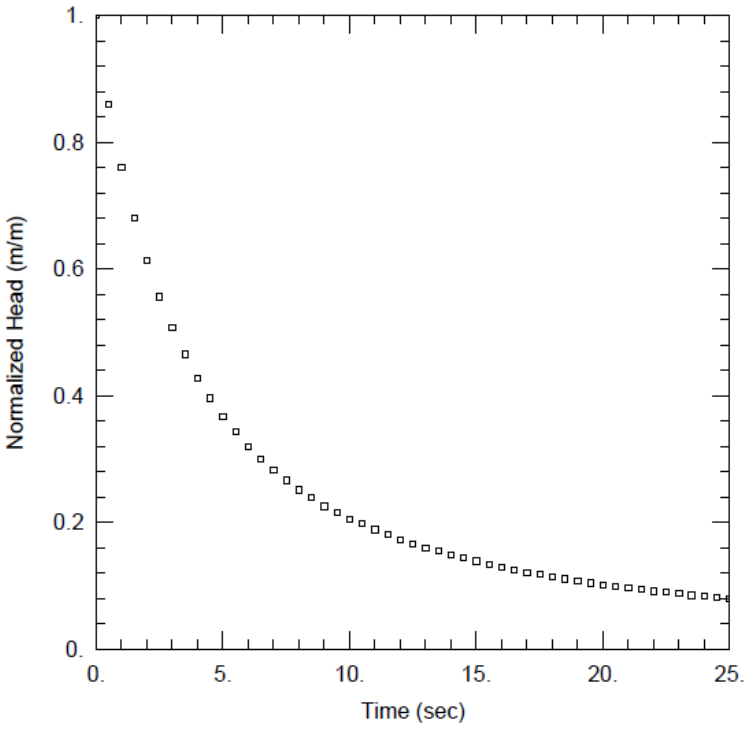
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-20
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-08B

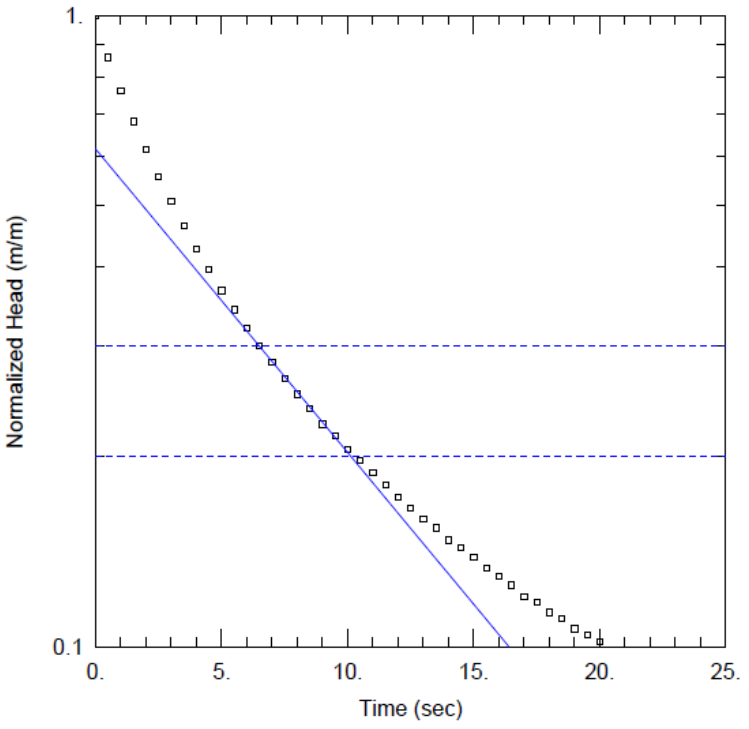
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-14

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-09
Date of Test:	June 4, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	3.37 mbgs
Initial Displacement:	1.14 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	6.85 m to 8.37 m
Geology:	Shaley Dolostone, Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

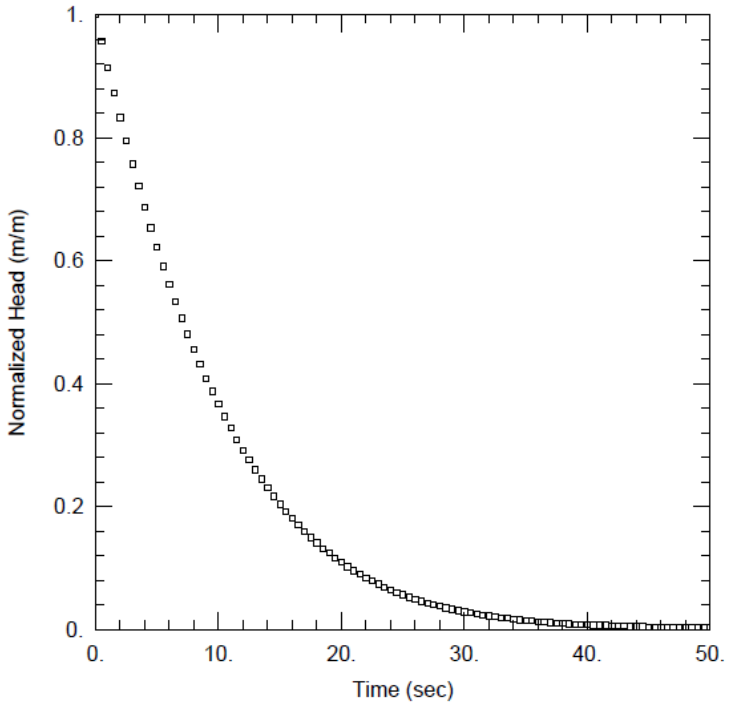
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-20
PREPARED	DB
DESIGN	DB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-09

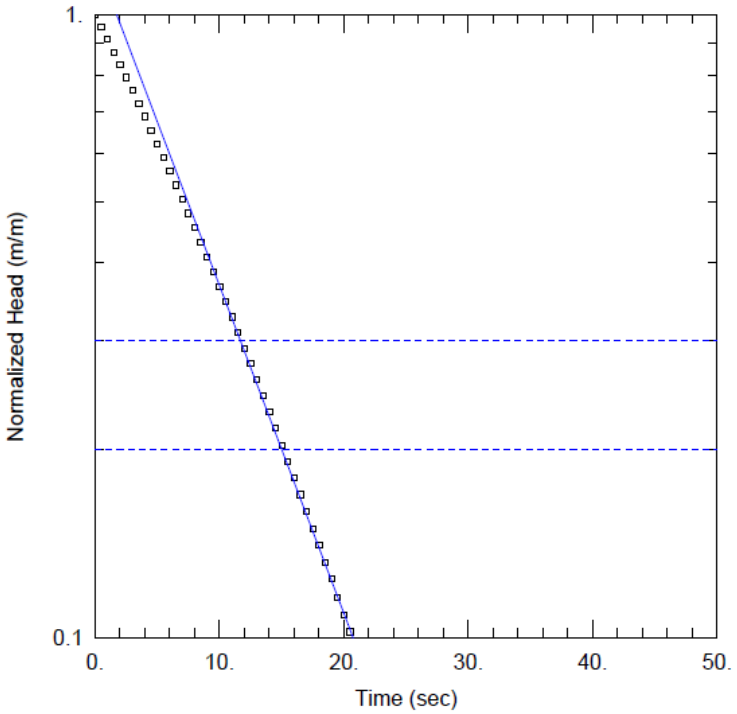
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-15

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-10A
Date of Test:	June 3, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	9.74 mbgs
Initial Displacement:	3.15 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	18.62 m to 20.14 m
Geology:	Shaley Dolostone, Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

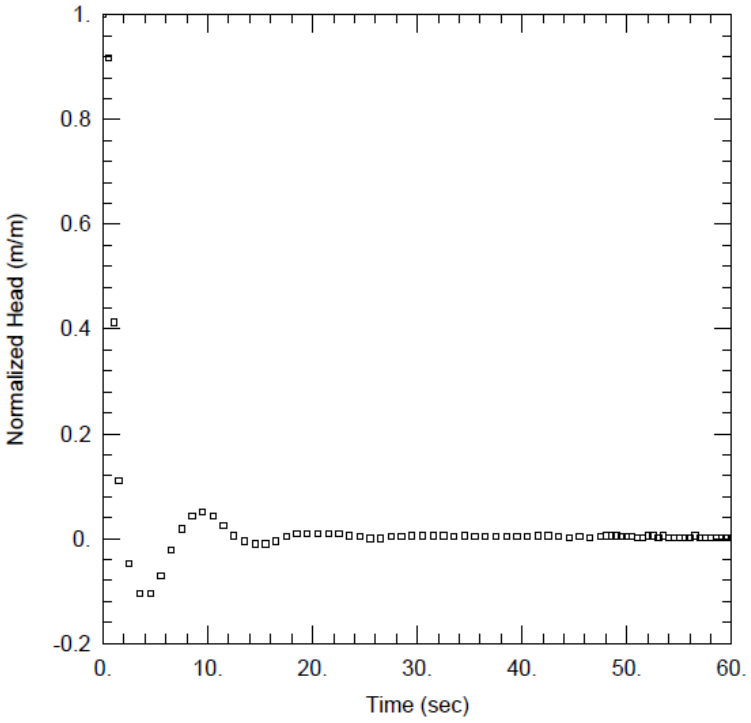
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-21
PREPARED	DB
DESIGN	DB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-10A

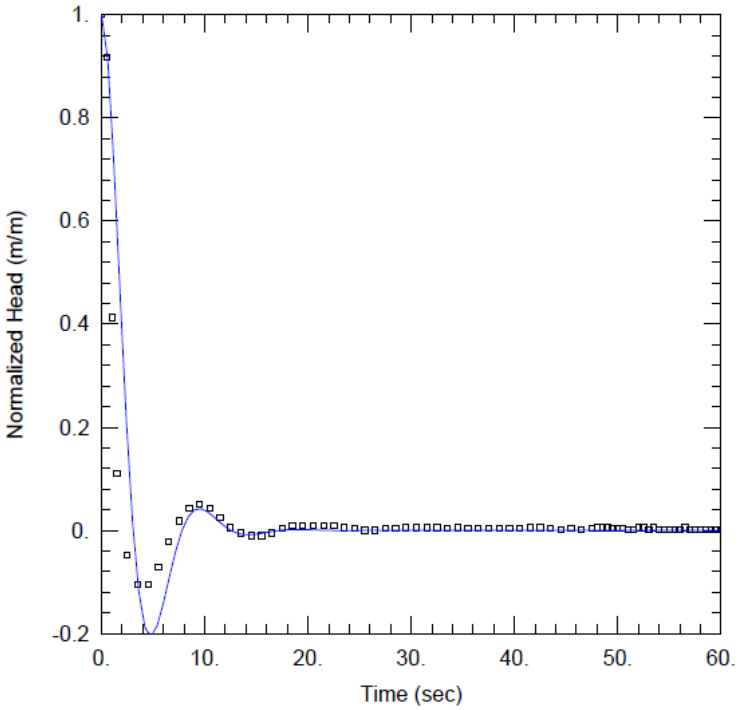
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-16

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-10B
Date of Test:	June 3, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	9.69 mbgs
Initial Displacement:	0.60 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	14.49 m to 16.01 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Springer-Gelhar
Solution Type:	Inertial
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT

CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-21
PREPARED	DB
DESIGN	DB
REVIEW	PGM
APPROVED	###

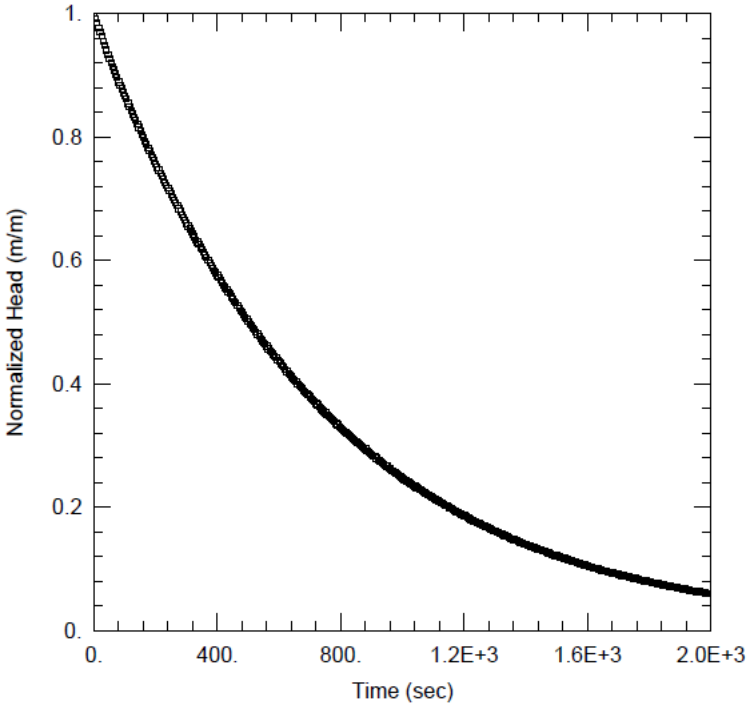
TITLE

SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-10B

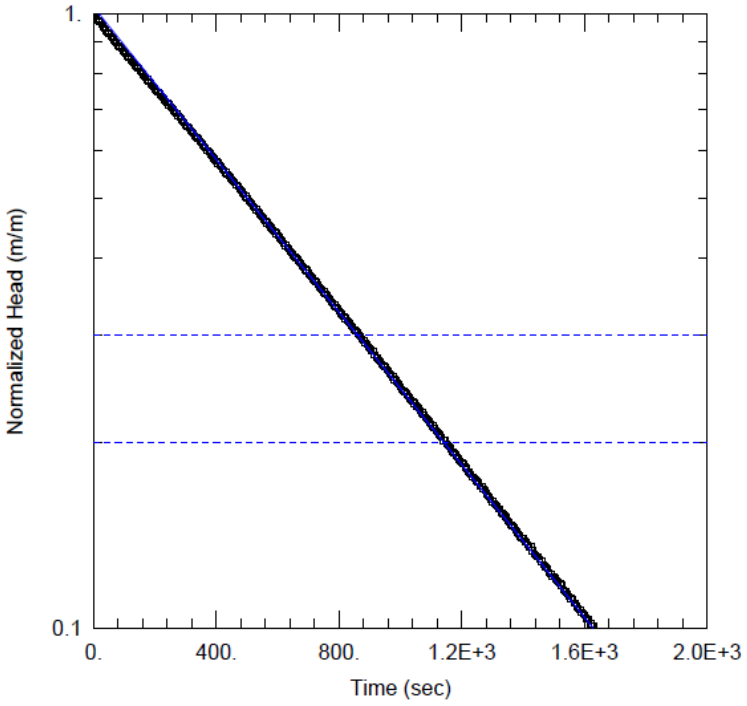
PROJECT No.	PHASE	Rev.	FIGURE
19129150	**2300**	**A**	**G-17**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-11A
Date of Test:	June 4, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	4.69 mbgs
Initial Displacement:	3.61 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	13.81 m to 15.33 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

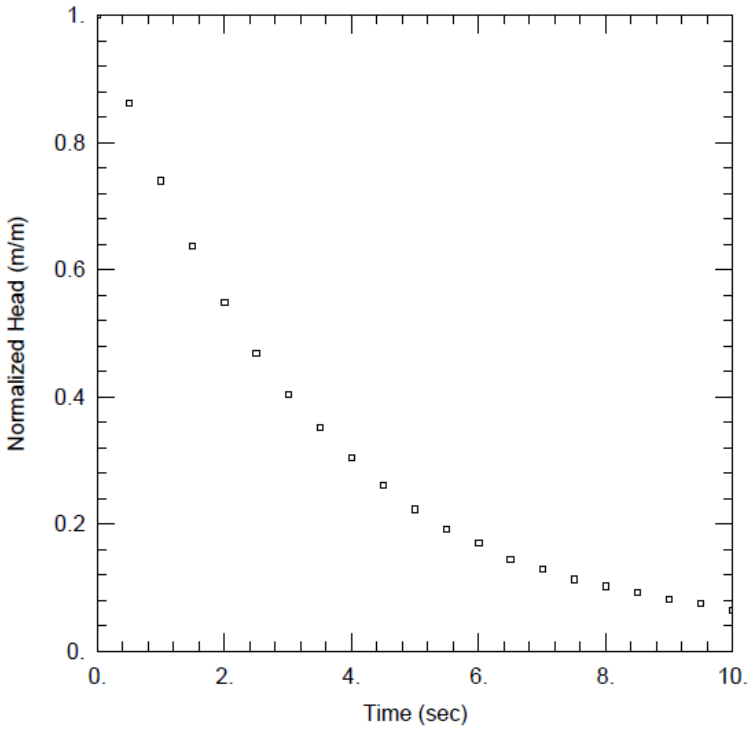
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-11A

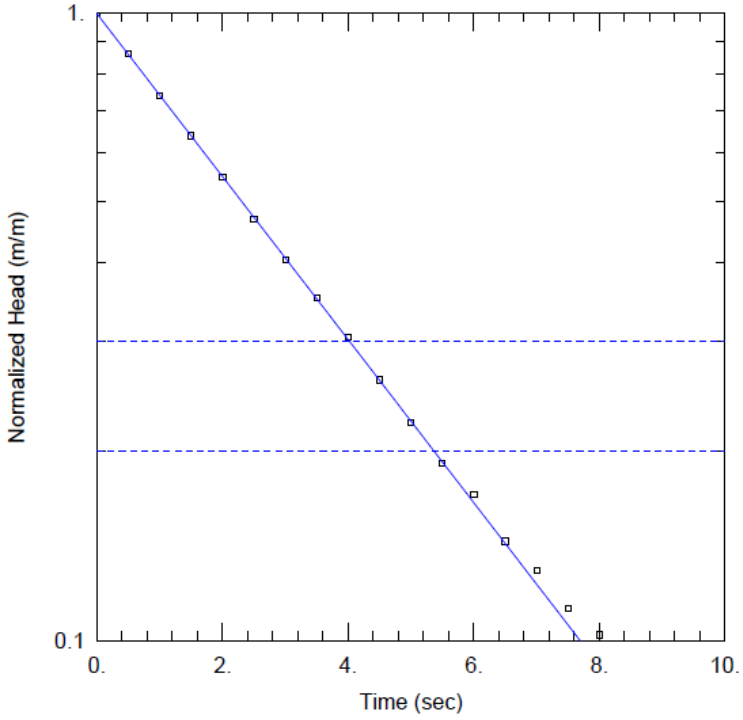
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-18

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-11B
Date of Test:	June 4, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	3.33 mbgs
Initial Displacement:	0.28 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	3.96 m to 5.48 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

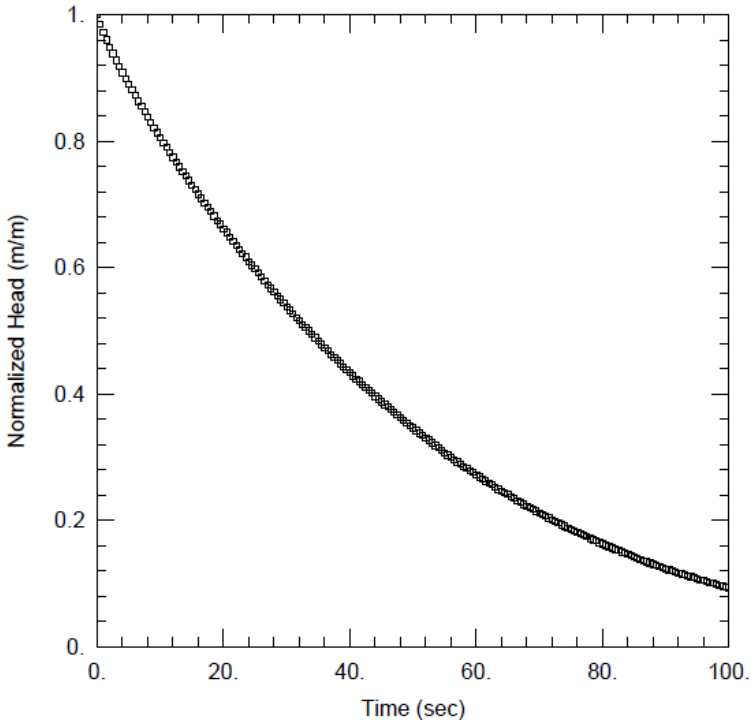
YYYY-MM-DD	2022-01-21
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-11B

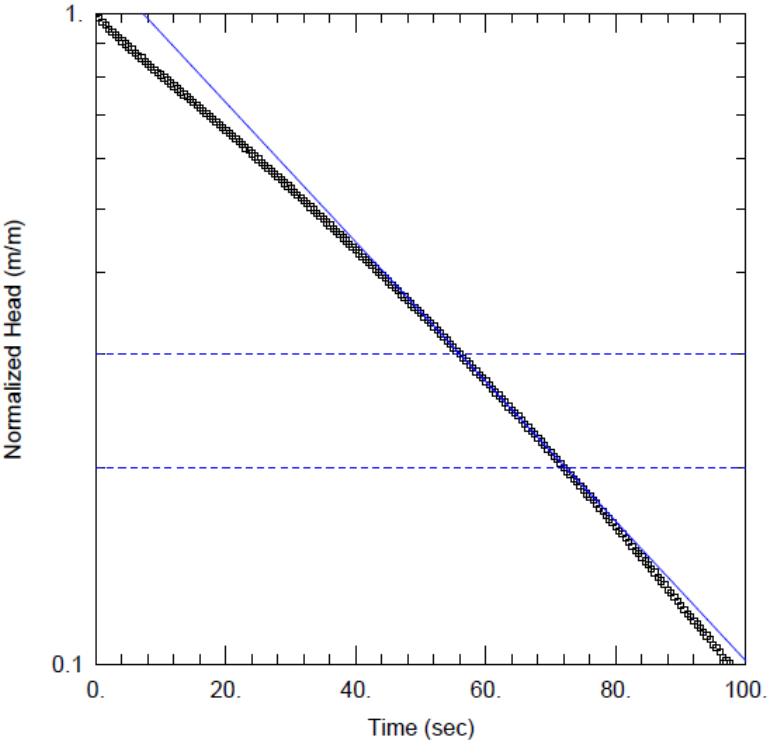
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-19

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-12A
Date of Test:	June 3, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	4.64 mbgs
Initial Displacement:	3.26 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	17.09 m to 18.62 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

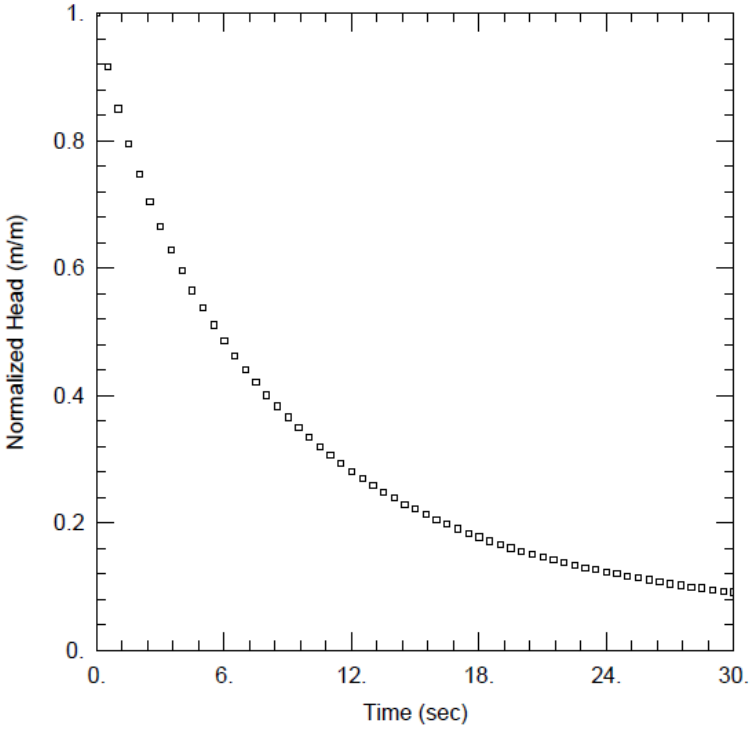
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-12A

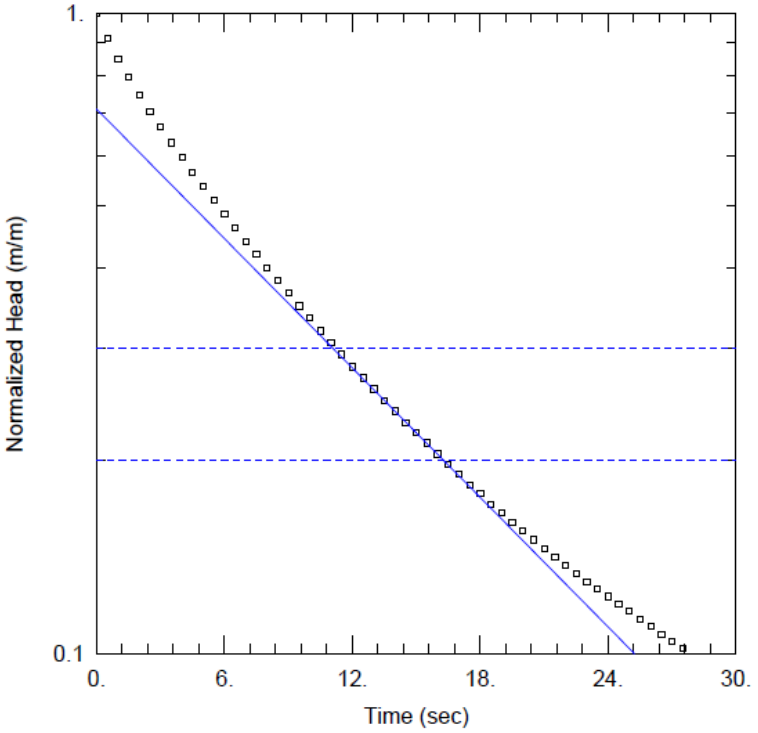
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-20

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-12B
Date of Test:	June 3, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	4.67 mbgs
Initial Displacement:	2.32 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	7.83 m to 9.35 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

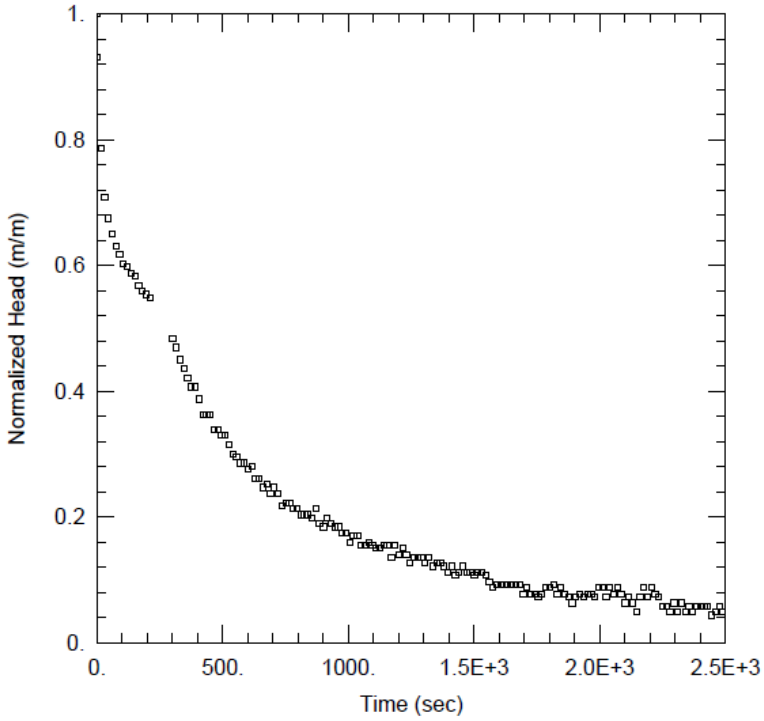
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-21
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-12B

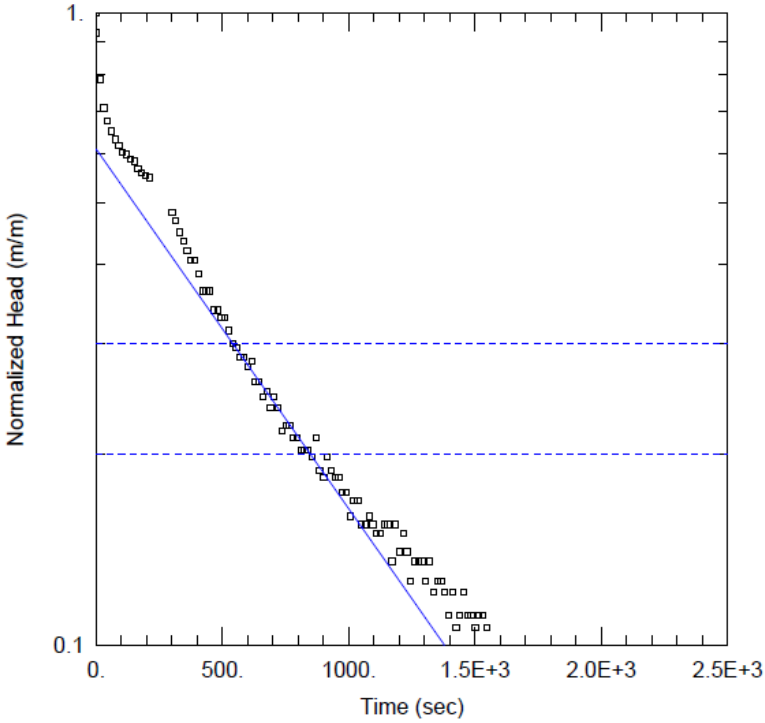
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-21

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-13A
Date of Test:	June 12, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	3.61 mbgs
Initial Displacement:	0.40 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	24.05 m to 25.57 m
Geology:	Shaley Dolostone, Cabot Head Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

6×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

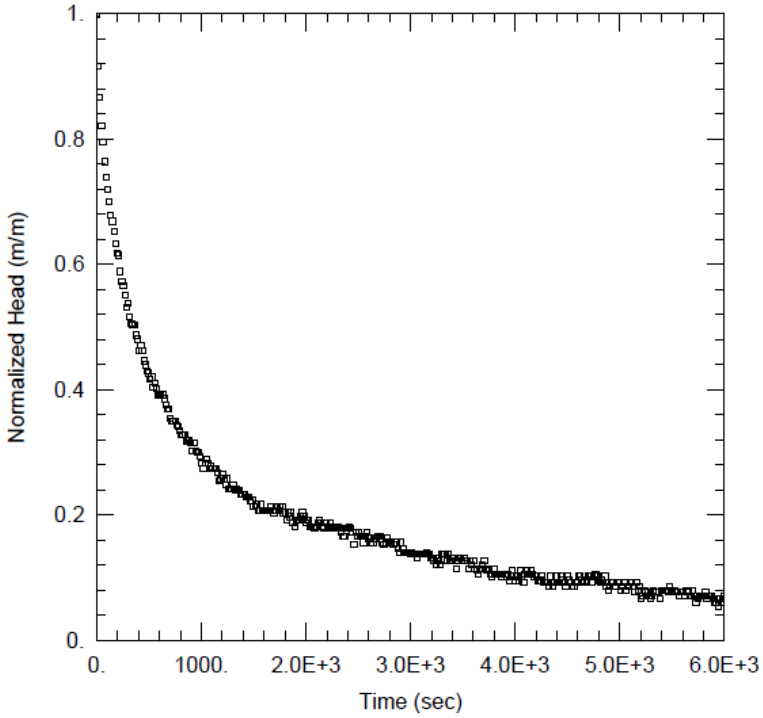
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-13A

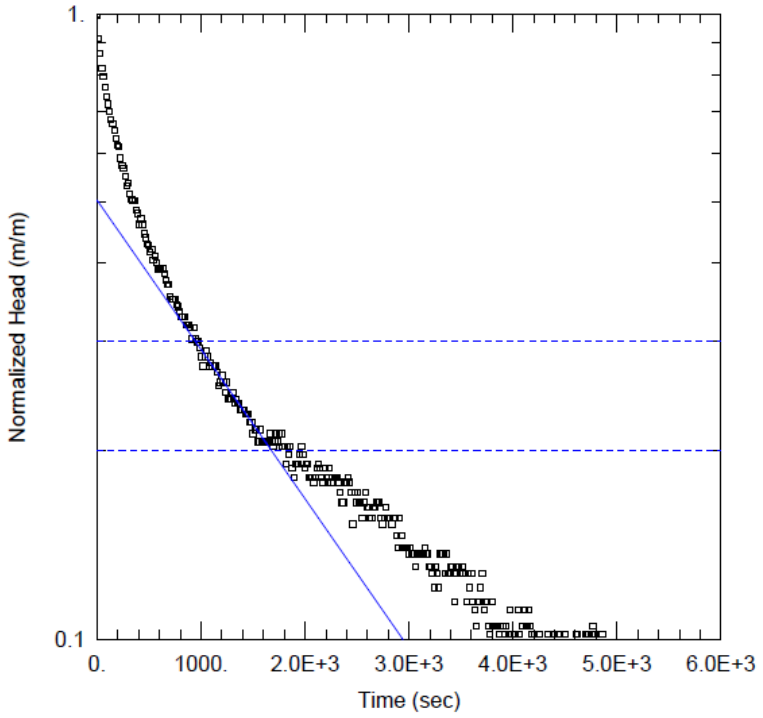
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-22

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-13B
Date of Test:	June 12, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	3.47 mbgs
Initial Displacement:	0.29 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	18.14 m to 19.66 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

1×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

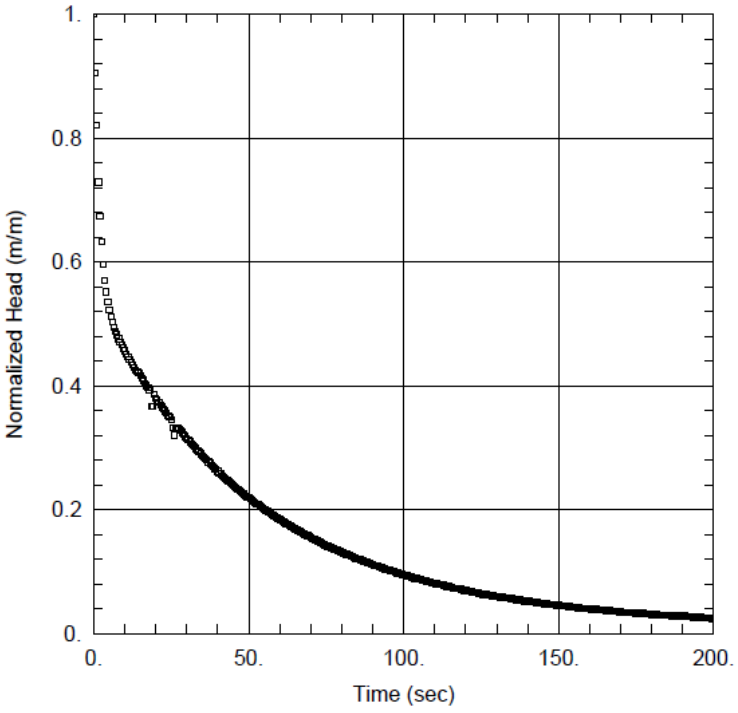
YYYY-MM-DD	2022-01-21
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-13B

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-23

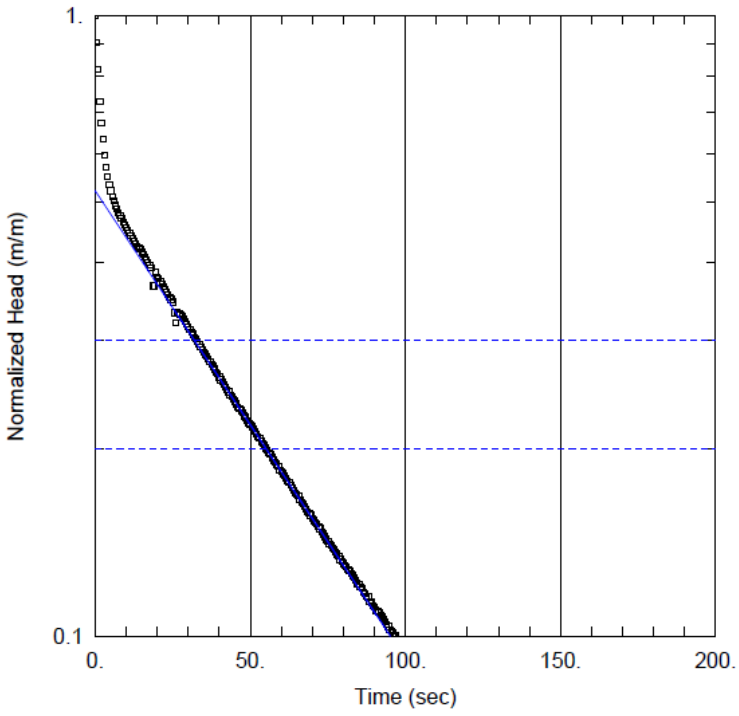
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-13C
Date of Test:	June 8, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.89 mbgs
Initial Displacement:	2.34 m
Casing Radius:	0.013 m
Borehole Radius:	0.083 m
Well Screen Interval:	3.08 m to 4.60 m
Geology:	Sand, some silt

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aiquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

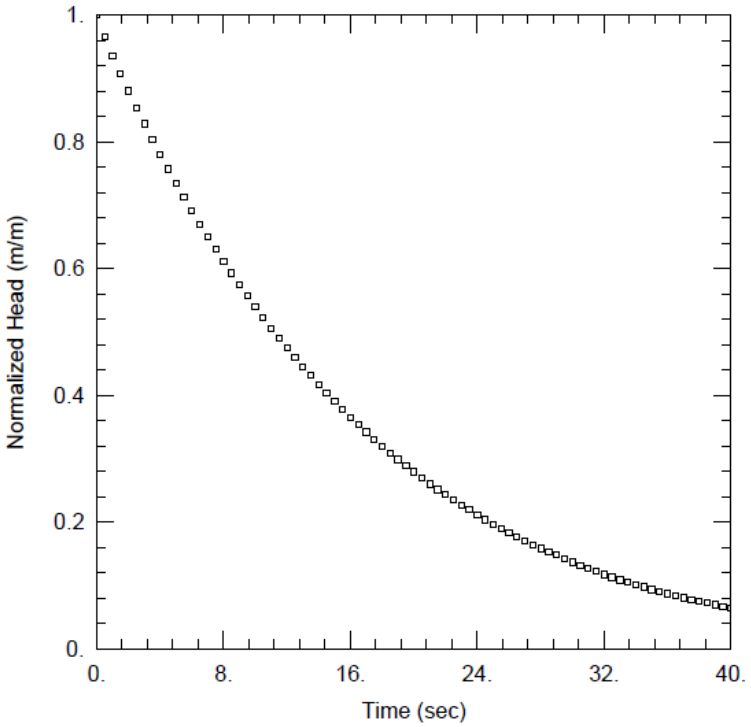
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-21
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-13C

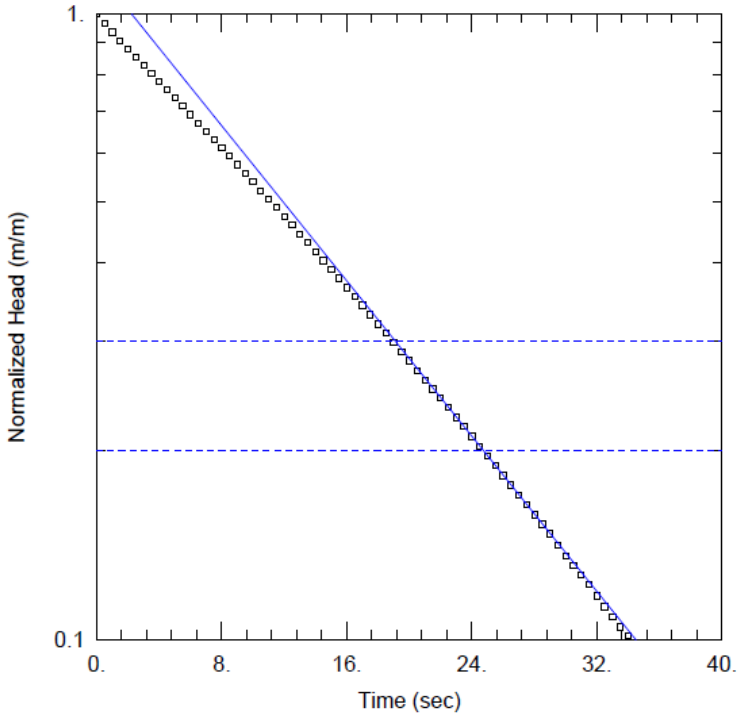
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-24

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-14A
Date of Test:	June 5, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	4.71 mbgs
Initial Displacement:	3.82 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	22.60 m to 24.12 m
Geology:	Shaley Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

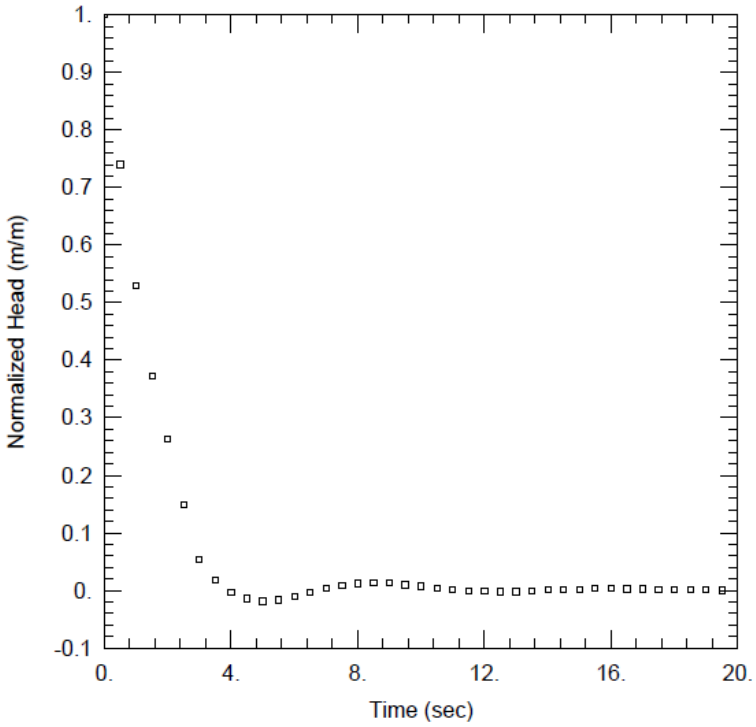
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-22
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-14A

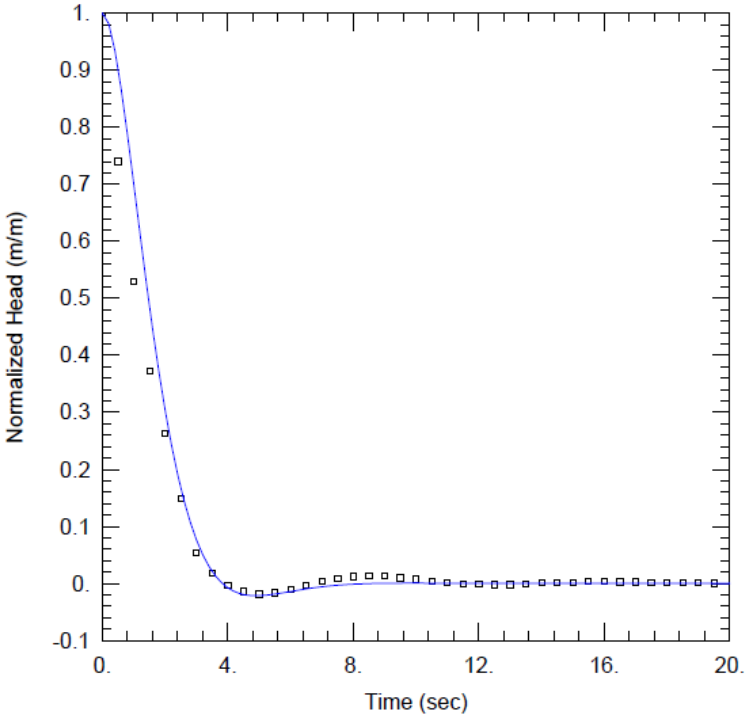
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-25

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-14B
Date of Test:	June 5, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	4.71 mbgs
Initial Displacement:	2.39 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	14.98 m to 16.50 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Springer-Gelhar
Solution Type:	Inertial
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
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PROJECT
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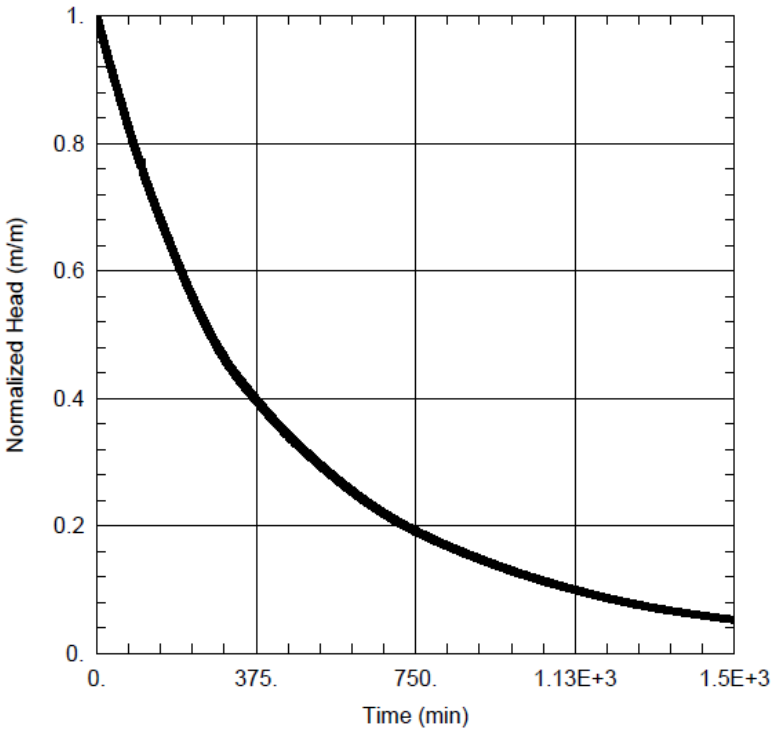
YYYY-MM-DD	2022-01-22
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-14B

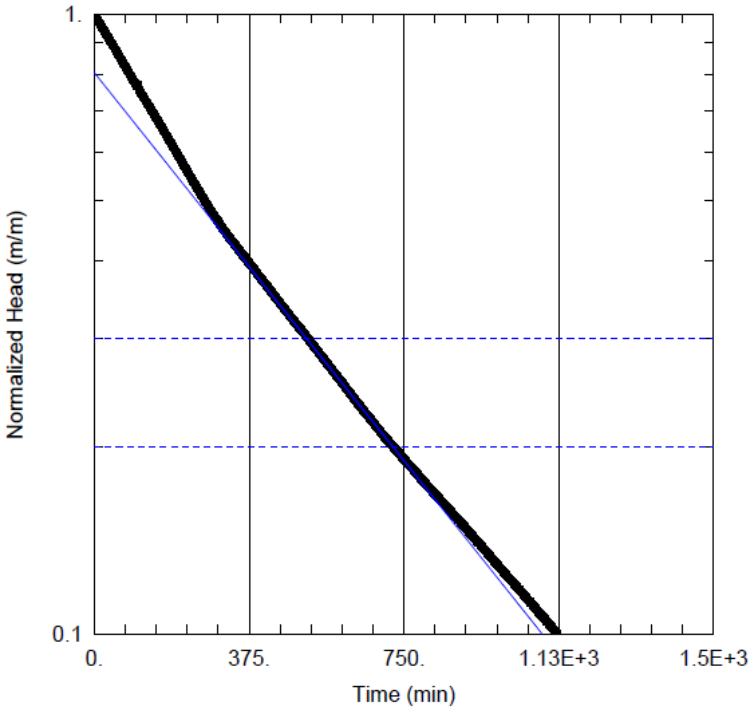
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-26

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-15A
Date of Test:	June 15, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	0.68 mbgs
Initial Displacement:	33.35 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	33.77 m to 35.29 m
Geology:	Shaley Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

7×10^{-9} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

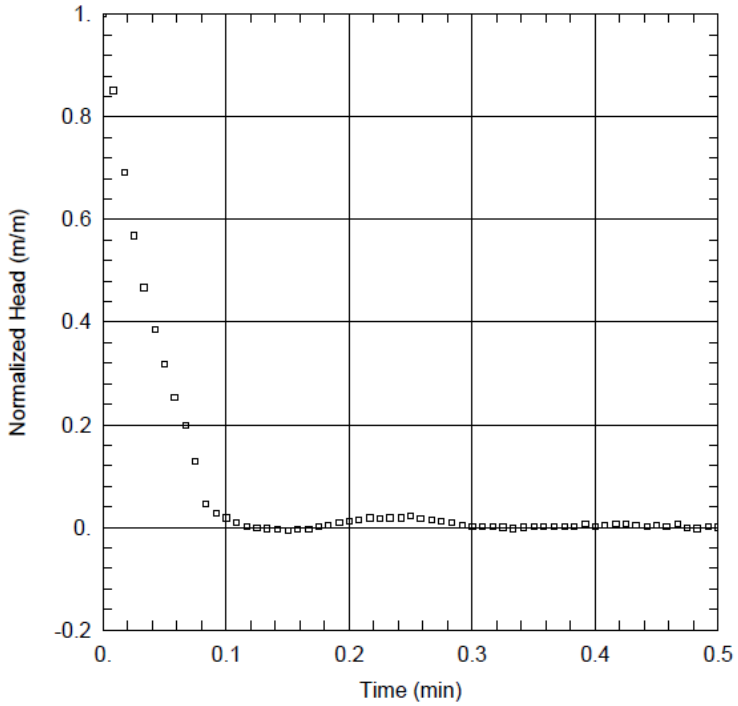
YYYY-MM-DD	2022-01-25
PREPARED	NU
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-15A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-27

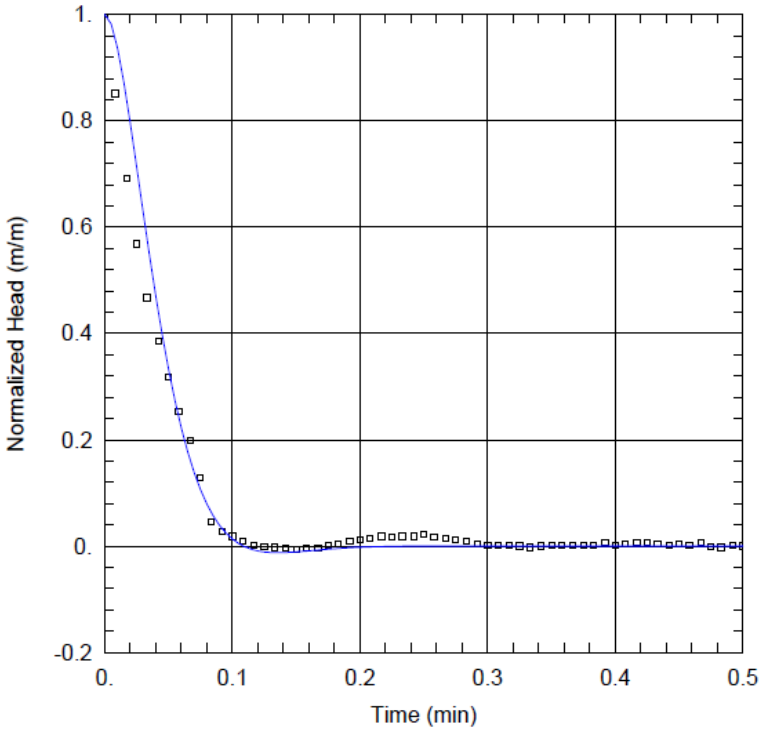
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-15B
Date of Test:	June 19, 2022
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	0.58 mbgs
Initial Displacement:	1.68 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	28.81 m to 30.33 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Solution Method:	Butler
Solution Type:	Inertial
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

9×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
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PROJECT
CALEDON PIT / QUARRY

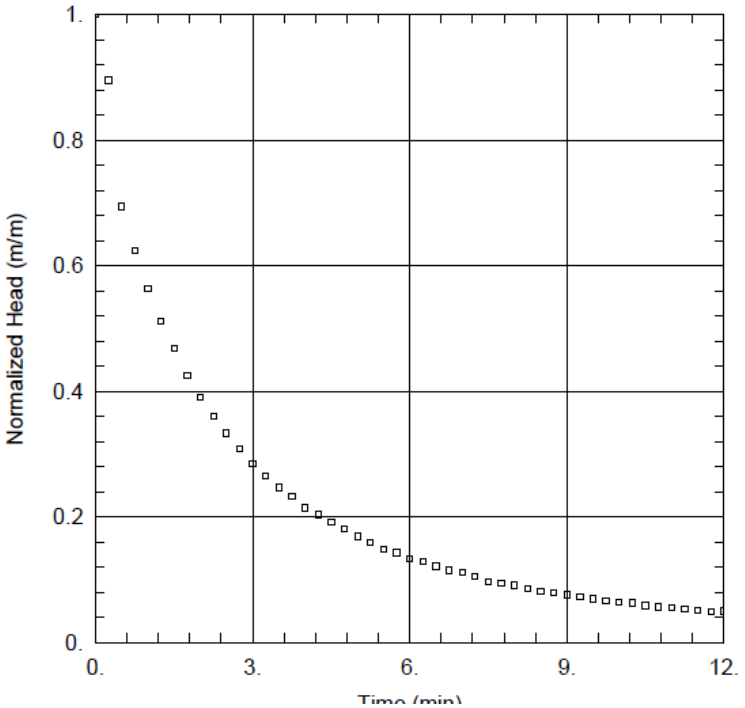
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-15B

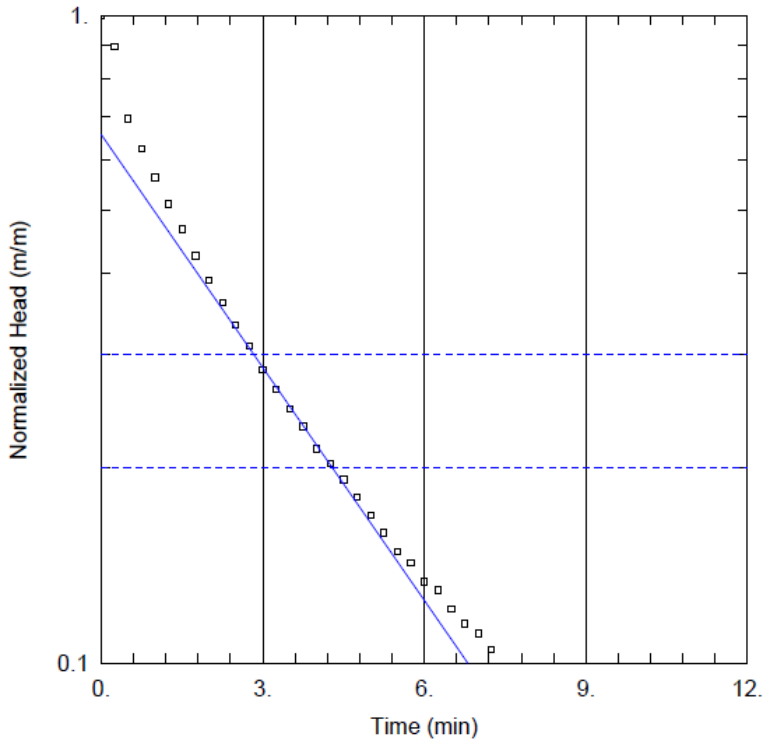
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-28

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-15C
Date of Test:	June 15, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.05 mbgs
Initial Displacement:	1.30 m
Casing Radius:	0.013 m
Borehole Radius:	0.083 m
Well Screen Interval:	2.74 m to 4.27 m
Geology:	Clayey Sand, Overburden



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

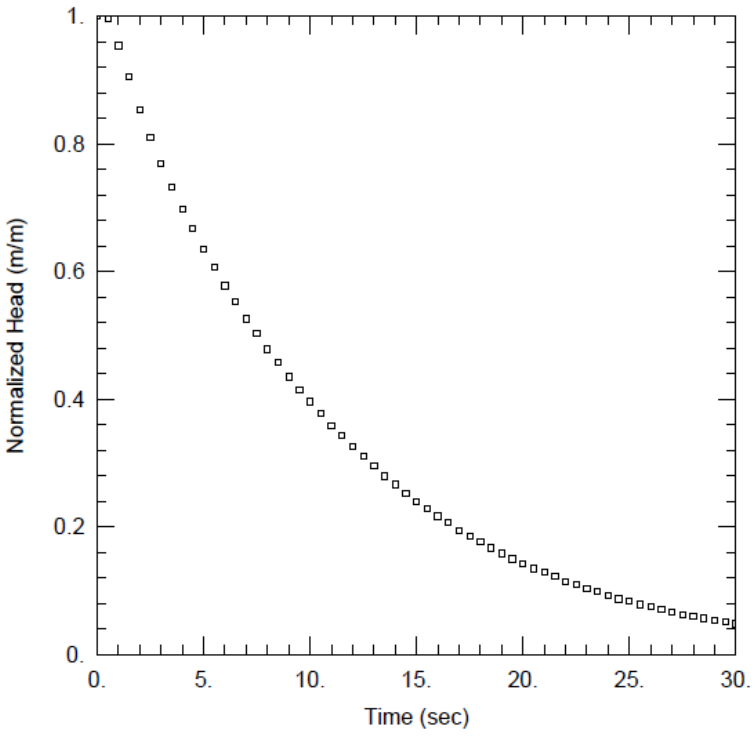
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-15C

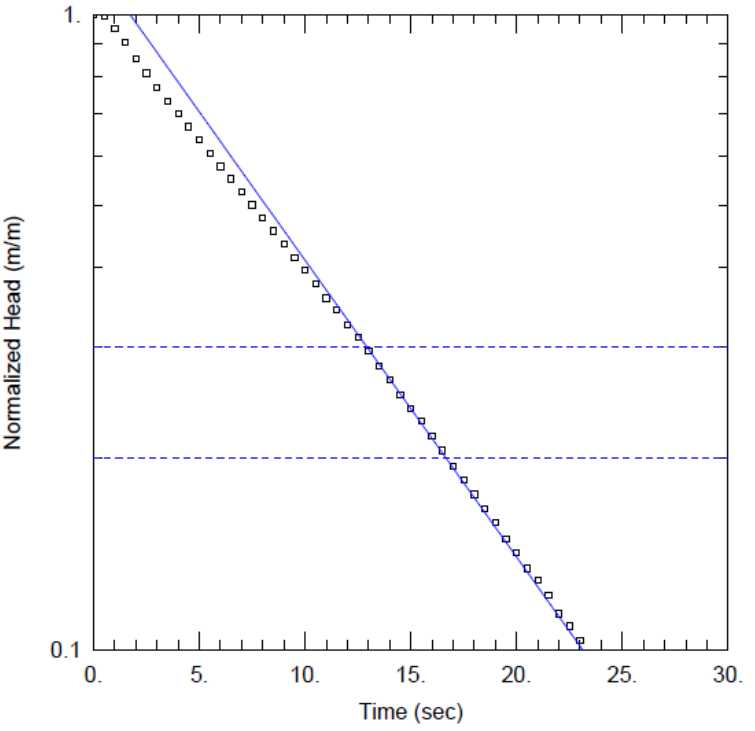
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-29

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-16A
Date of Test:	June 19, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	1.54 mbgs
Initial Displacement:	3.41 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	34.84 m to 36.36 m
Geology:	Shaley Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

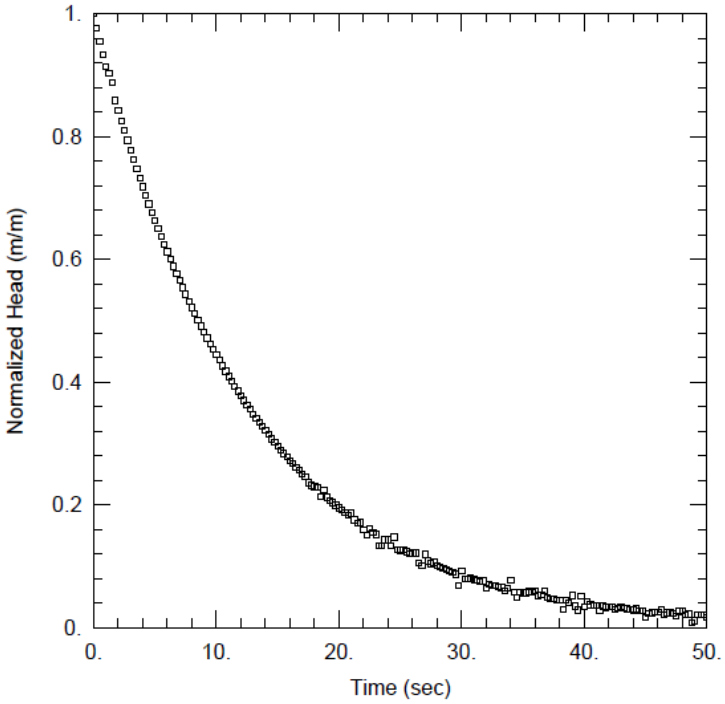
YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-16A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-30

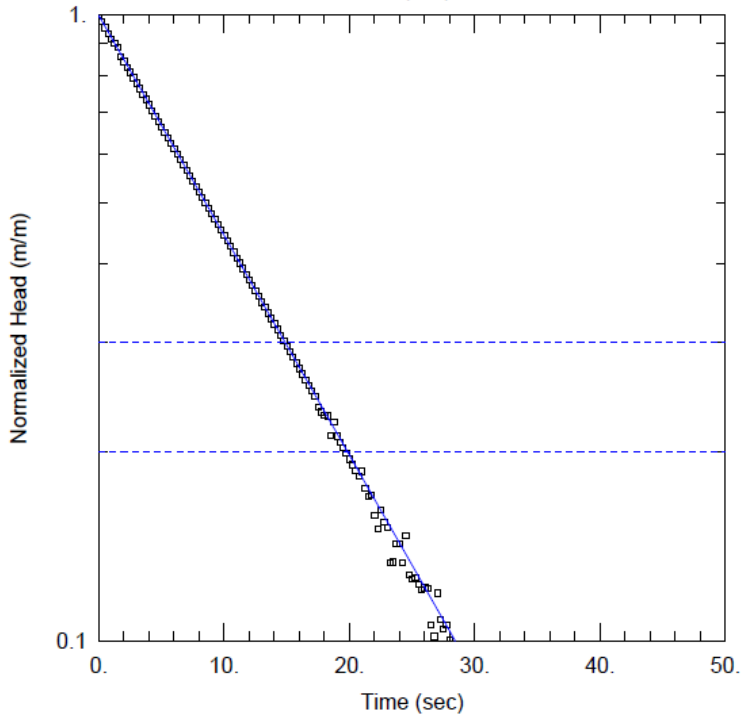
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-16B
Date of Test:	June 19, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.42 mbgs
Initial Displacement:	11.30 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	16.80 m to 18.33 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

1×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

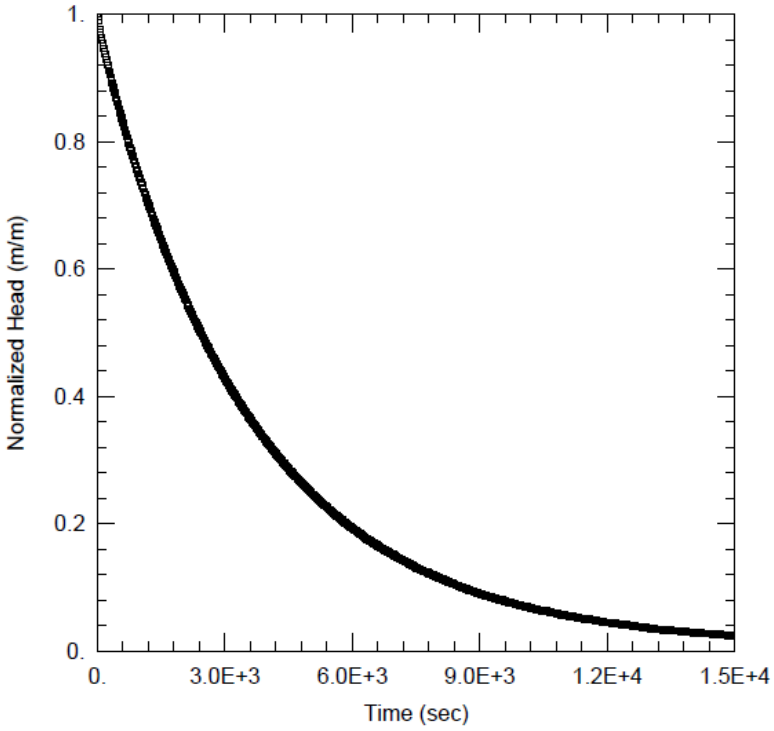
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-16B

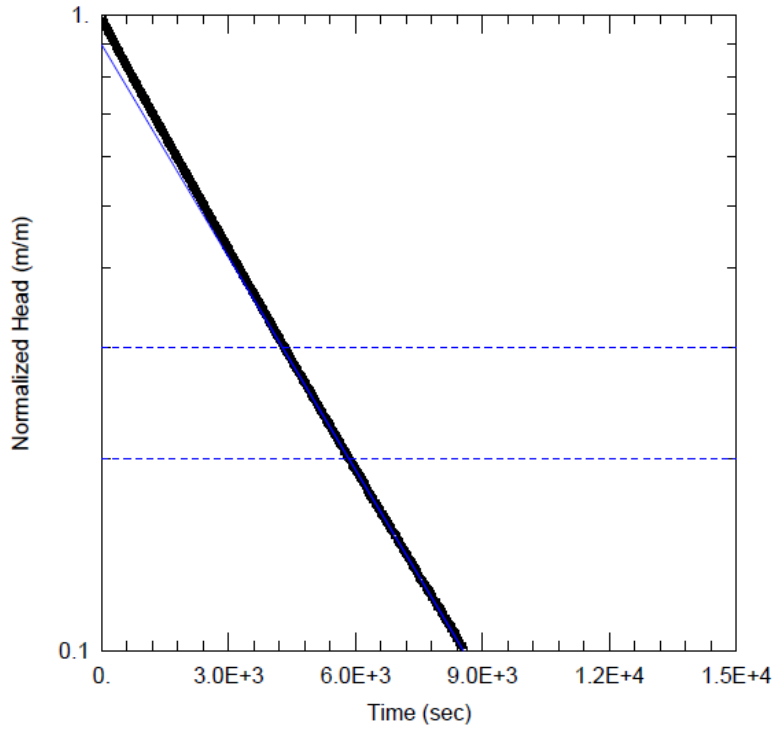
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-31

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-17A
Date of Test:	June 8, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	4.27 mbgs
Initial Displacement:	9.60 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	25.64 m to 27.16 m
Geology:	Shaley Dolostone



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

6×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

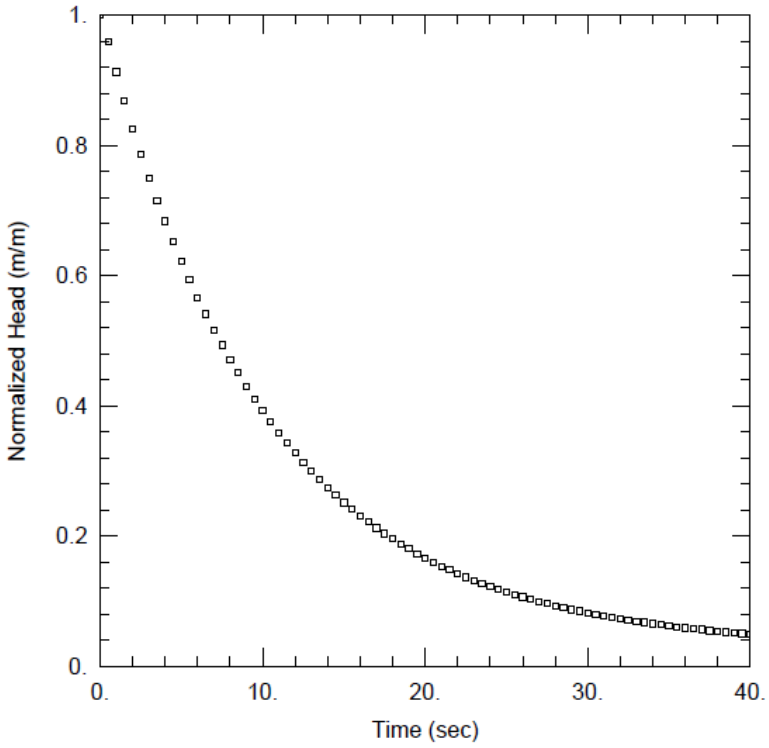
YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-17A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-32

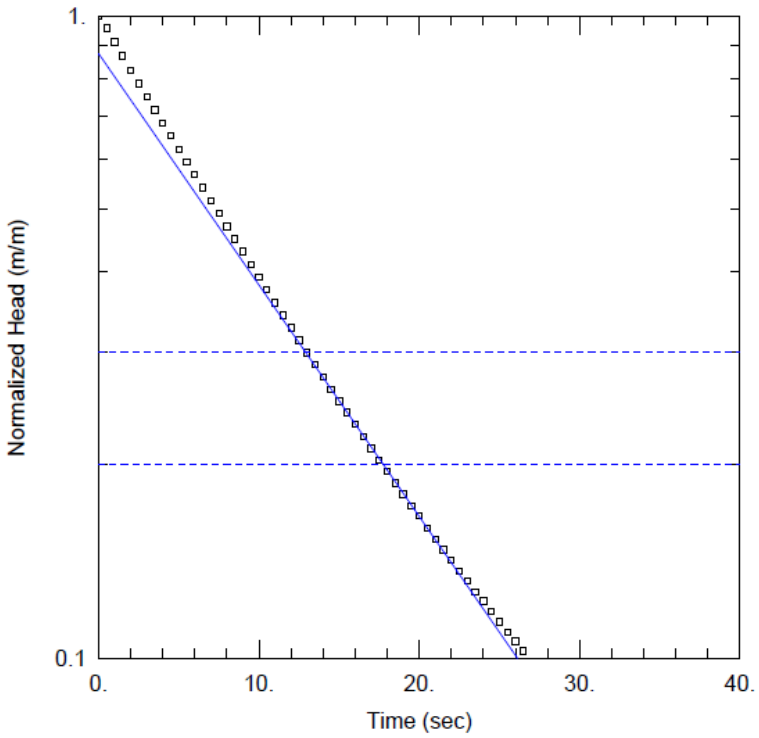
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-17B
Date of Test:	June 5, 2020
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	4.34 mbgs
Initial Displacement:	3.77 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	12.75 m to 14.27 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

CLIENT
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PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

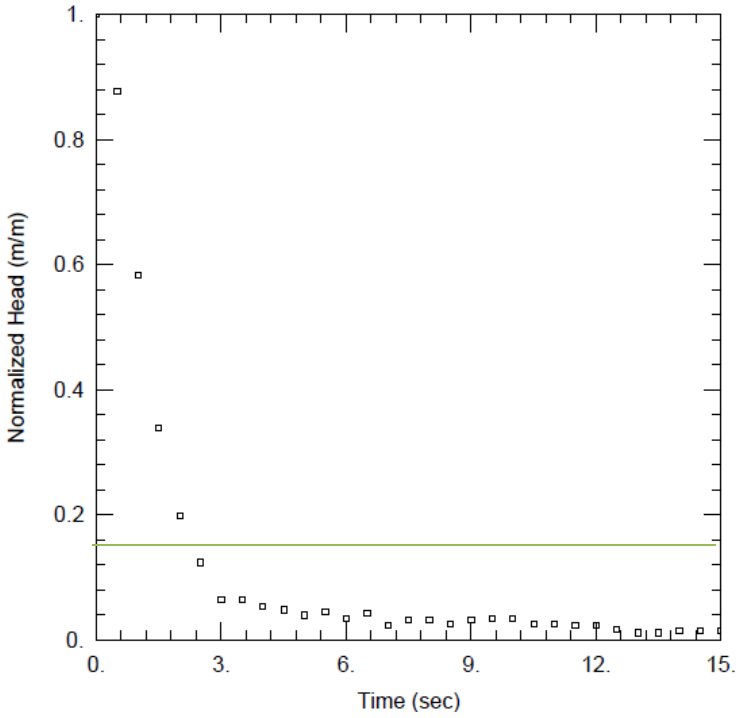
YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-17B

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-33

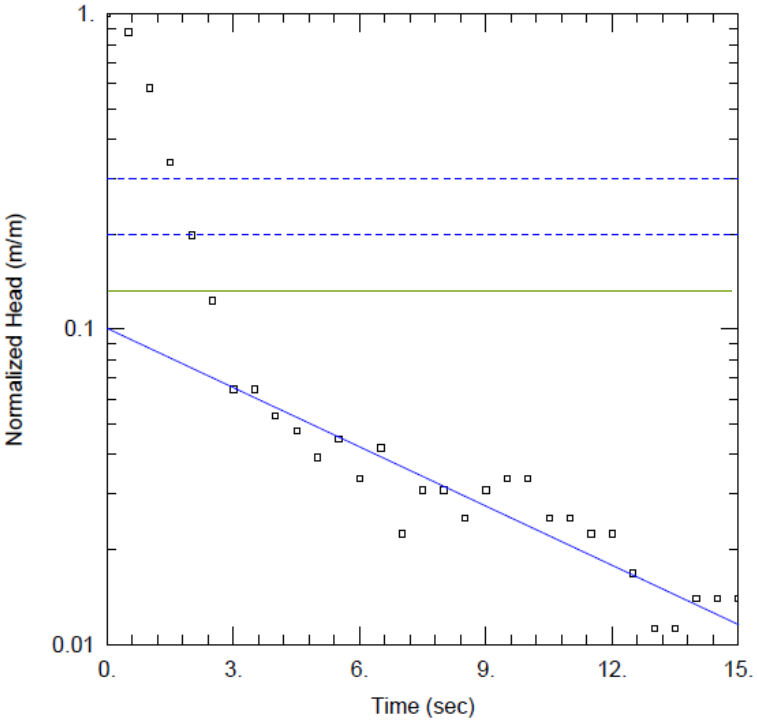
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-18
Date of Test:	June 19, 2020
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	12.07 mbgs
Initial Displacement:	0.36 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	12.42 m to 13.94 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Note: Fitted to later time data when water level was above the sand pack.

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

Top of Sand Pack Annotation Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

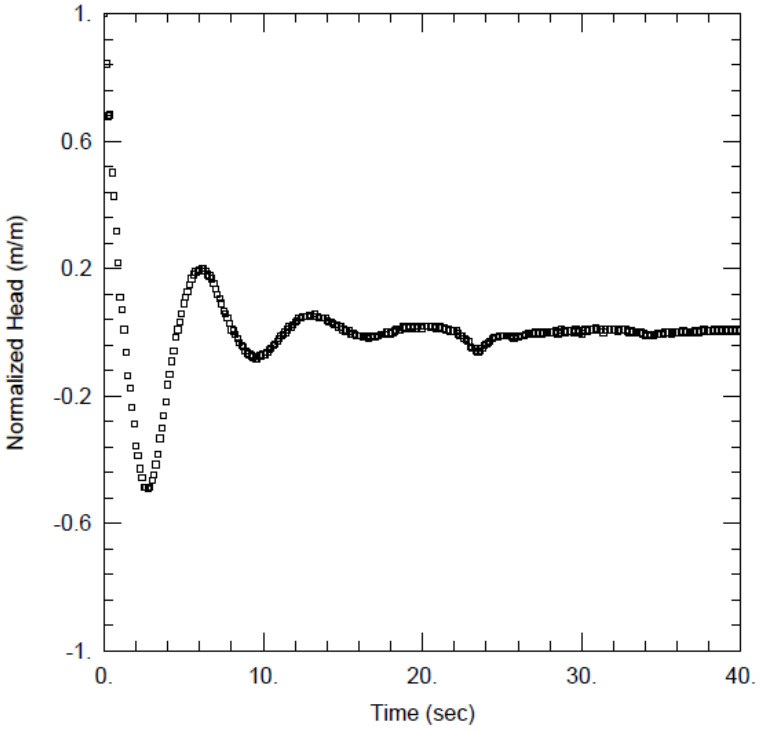
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-25
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-18

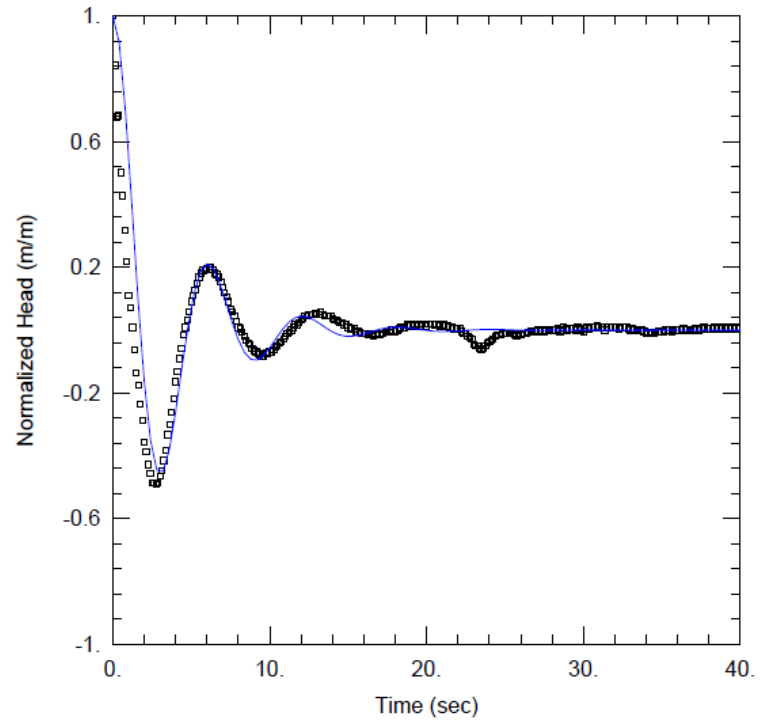
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-34

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-19A
Date of Test:	June 24, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	6.01 mbgs
Initial Displacement:	0.24 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	15.75 m to 17.27 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Springer-Gelhar
Solution Type:	Inertial
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

4×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

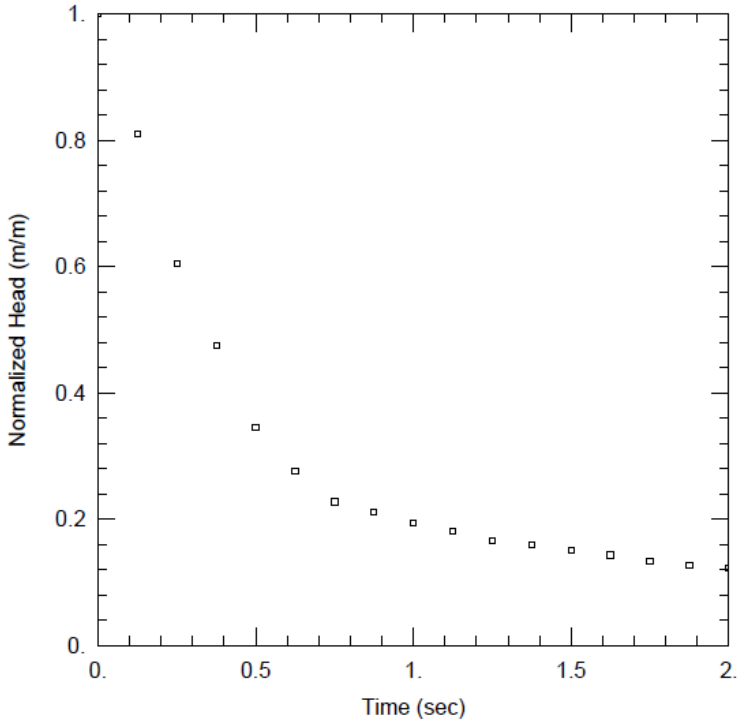
CONSULTANT
GOLDER
MEMBER OF WSP

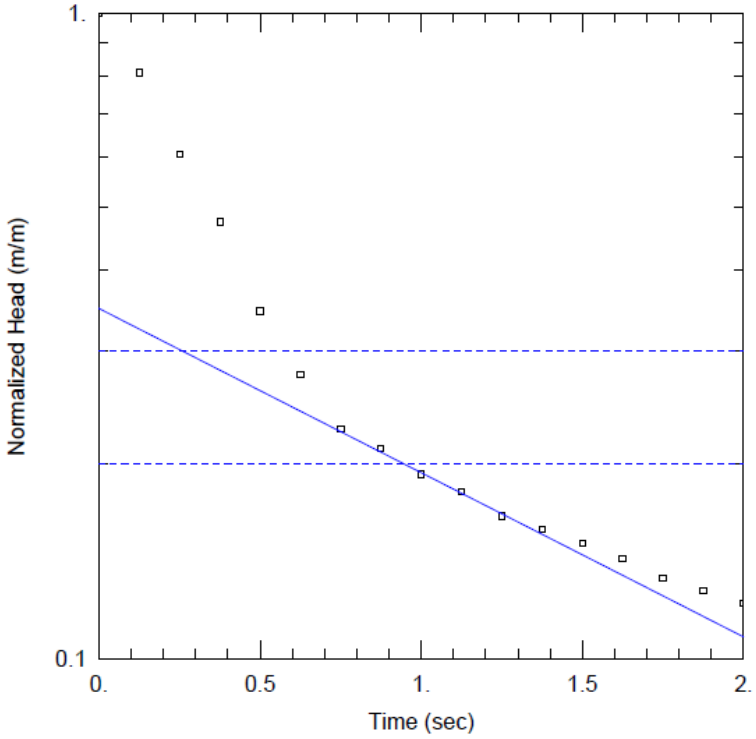
YYYY-MM-DD	2022-01-24
PREPARED	VRP
DESIGN	VRP
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-19A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-35

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A





TEST INFORMATION:

Test Well:	MW20-19B
Date of Test:	June 24, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	6.01 mbgs
Initial Displacement:	1.04 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	8.00 m to 9.52 m
Geology:	Dolostone, Gasport Fm

SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

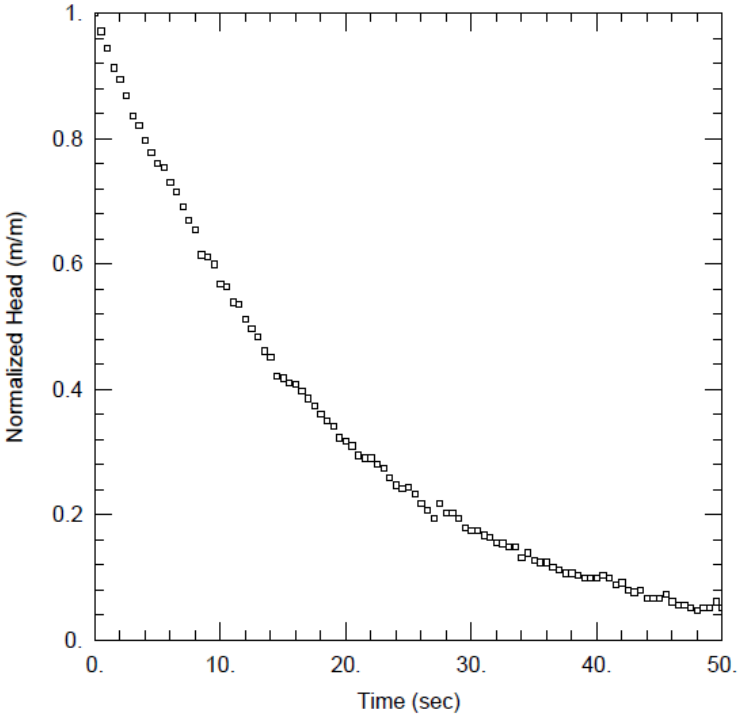
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
PREPARED	VRP
DESIGN	VRP
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-19B

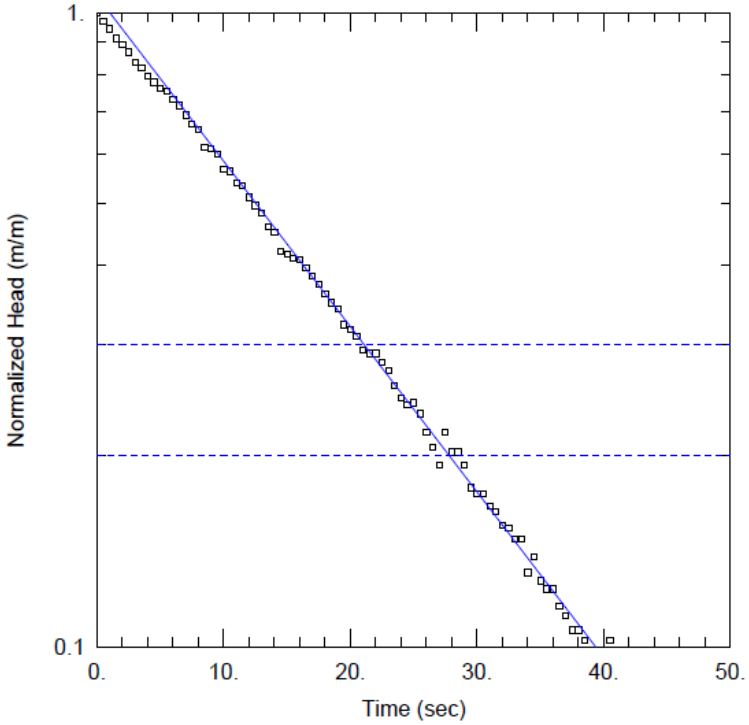
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-36

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-20A
Date of Test:	June 24, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	-0.99 mbgs
Initial Displacement:	0.53 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	25.33 m to 26.85 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

1×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

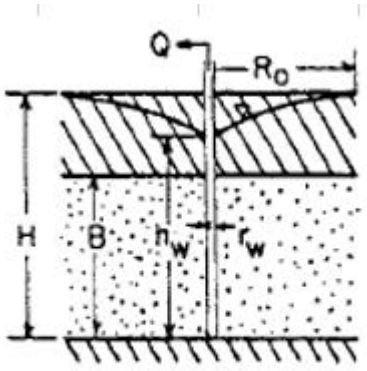
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-20A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-37

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



Radial flow, confined aquifer

$$Q_w = \frac{2\pi KB(H - h_w)}{\ln R_0 / r_w}$$

$$R_0 = 3000(H - h)\sqrt{K}$$

Where:

K = Hydraulic conductivity (m/s)

Q = Flow rate (2.2 L/min; 3.7 x 10^{-5} m^3/s)

B = Aquifer thickness, from base of screen (12.35 m)

H = Static groundwater level, from base of screen (16.37 m)

h = Dewatering height, above the base of screen (15.62 m)

r_w = Well Radius (0.013 m)

R_o = radius of influence (4.3 m).

TEST INFORMATION:

Test Well:	MW20-20B
Date of Test:	June 24, 2021
Test Type:	Rising Head Test
Test Method:	Constant Rate
Static Water Level:	-1.88 mbgs
Displacement:	0.75 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	12.97 to 14.49 m
Geology:	Dolostone, Gasport Formation

SOLUTION:

Solution Method:	Radial Flow (Powers, 2007)
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

4 x 10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

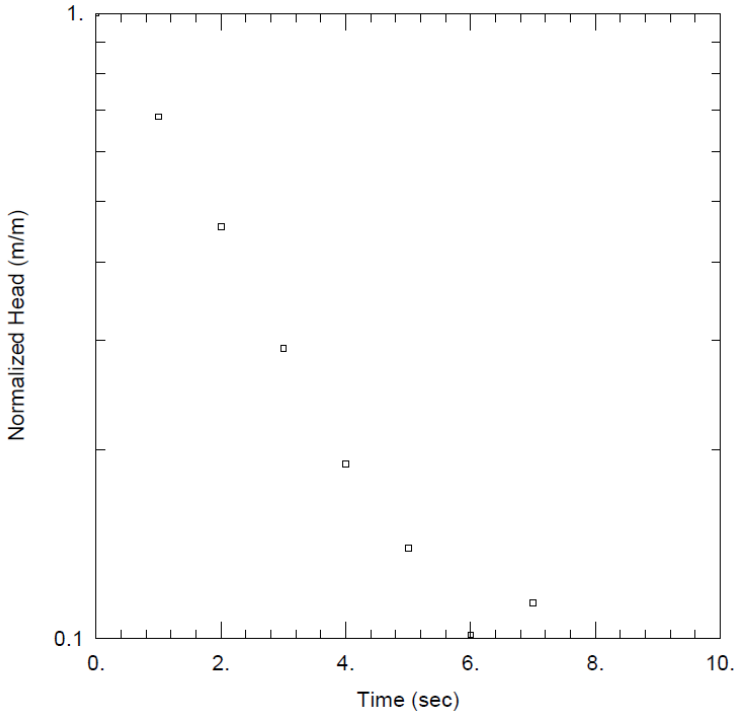
YYYY-MM-DD	2022-01-25
PREPARED	PGM
DESIGN	PGM
REVIEW	JLH
APPROVED	

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-20B

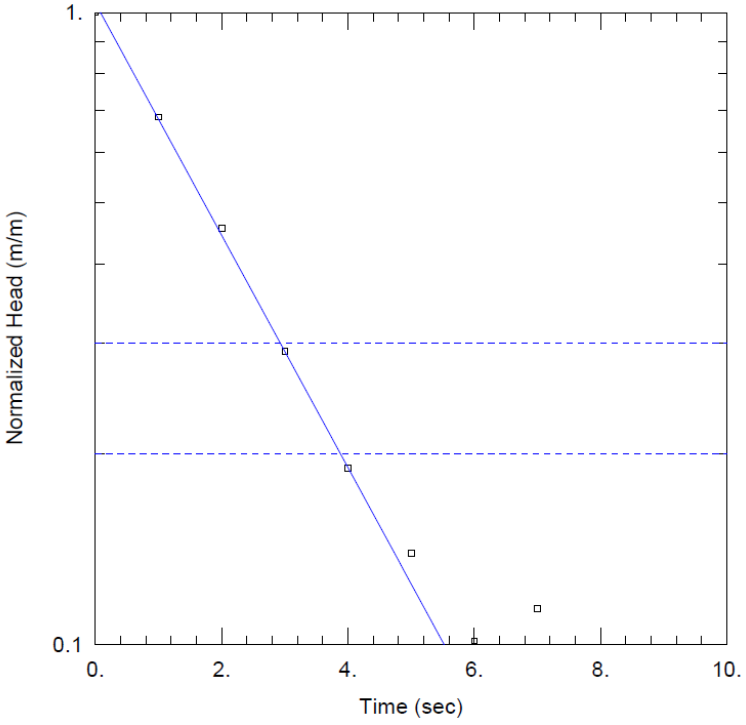
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-38

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-20C
Date of Test:	March 16, 2022
Test Type:	Rising Head Test
Test Method:	Bailer Rising Head Test
Static Water Level:	2.74 mbtoc
Initial Displacement:	0.08 m
Casing Radius:	0.013 m
Borehole Radius:	0.083 m
Well Screen Interval:	2.42 to 3.95 m
Geology:	Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

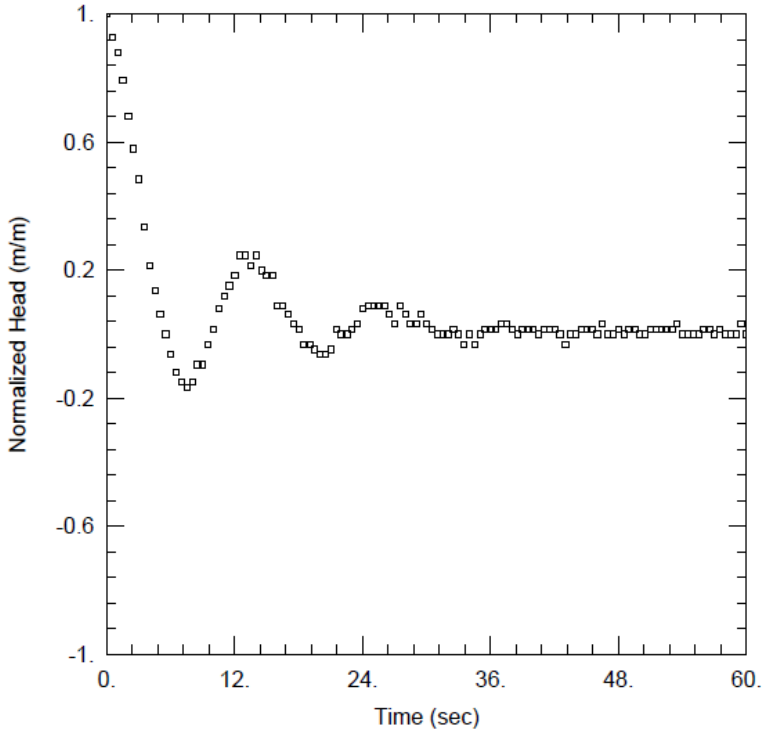
YYYY-MM-DD	2022-05-02
PREPARED	PGM
DESIGN	PGM
REVIEW	###
APPROVED	

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-20C

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-39

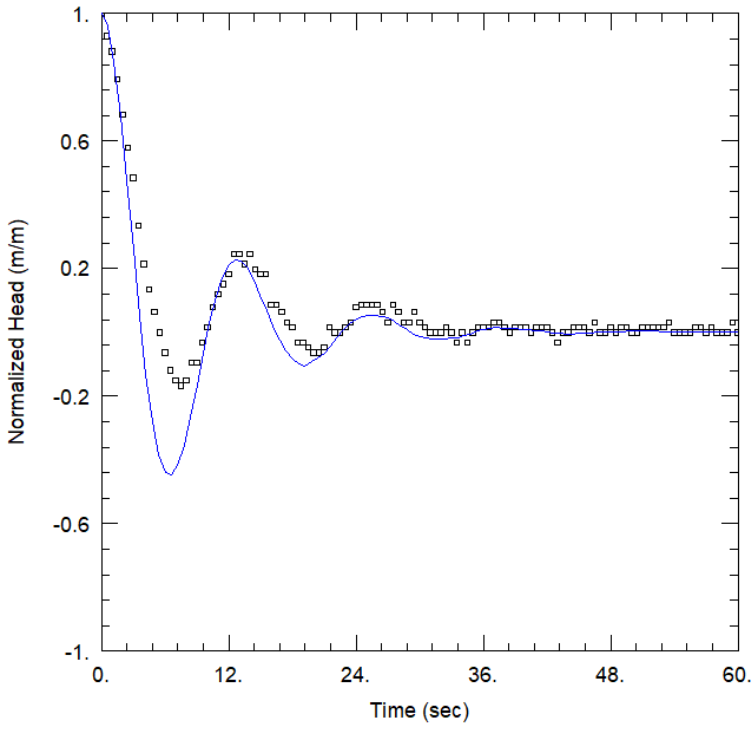
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-21A
Date of Test:	December 17, 2021
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	0.88 mbgs
Initial Displacement:	0.13 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	33.27 to 18.63 m
Geology:	Dolostone, Gasport Fm.

SOLUTION:



Solution Method:	Butler-Zhan
Solution Type:	Inertial
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

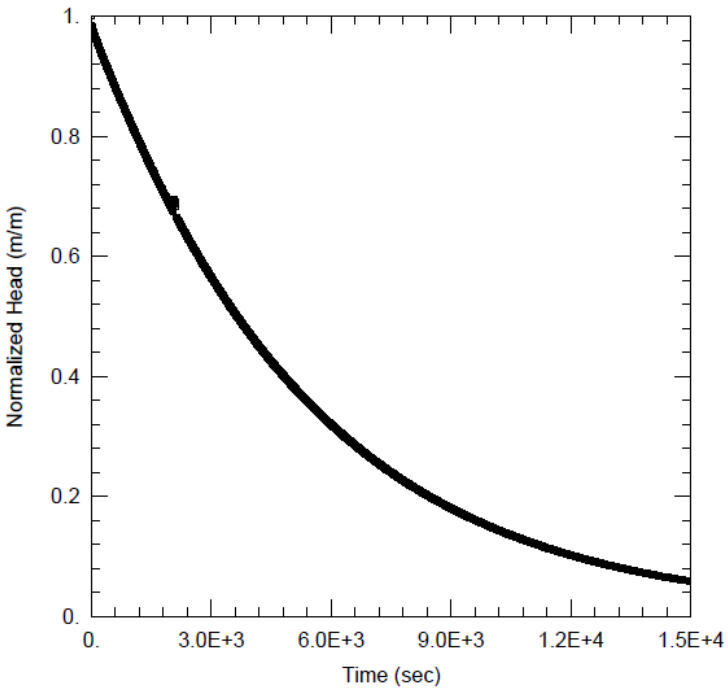
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-17
PREPARED	PGM
DESIGN	AIM
REVIEW	JLH
APPROVED	

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-21A

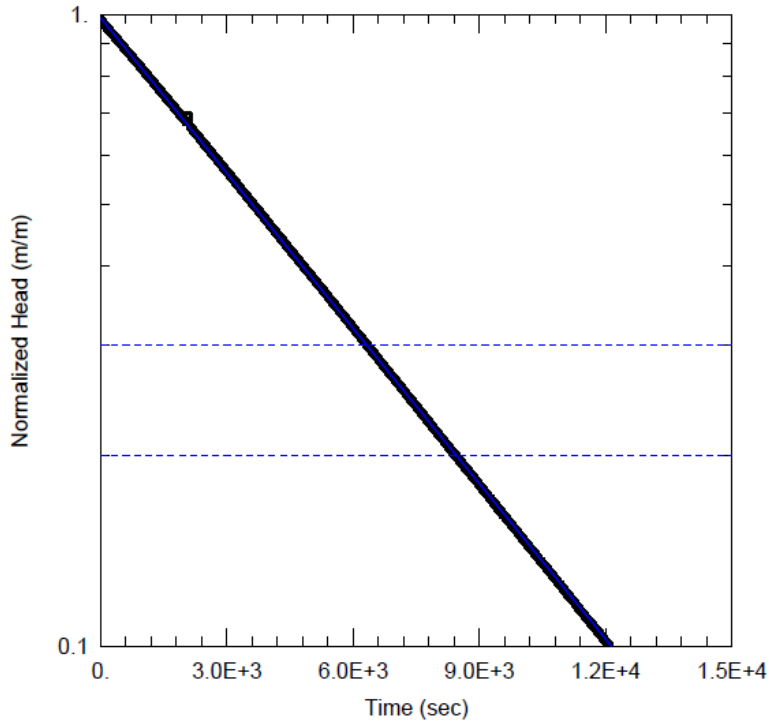
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-40

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-21B
Date of Test:	June 28, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.29 mbgs
Initial Displacement:	13.54 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	15.77 m to 17.29 m
Geology:	Dolostone, Gasport Fm.



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

6×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

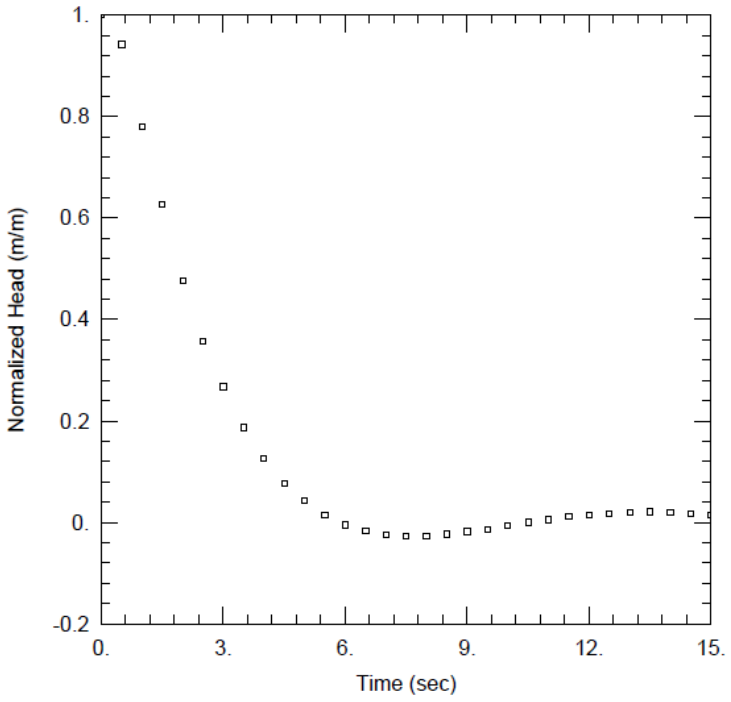
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-21B

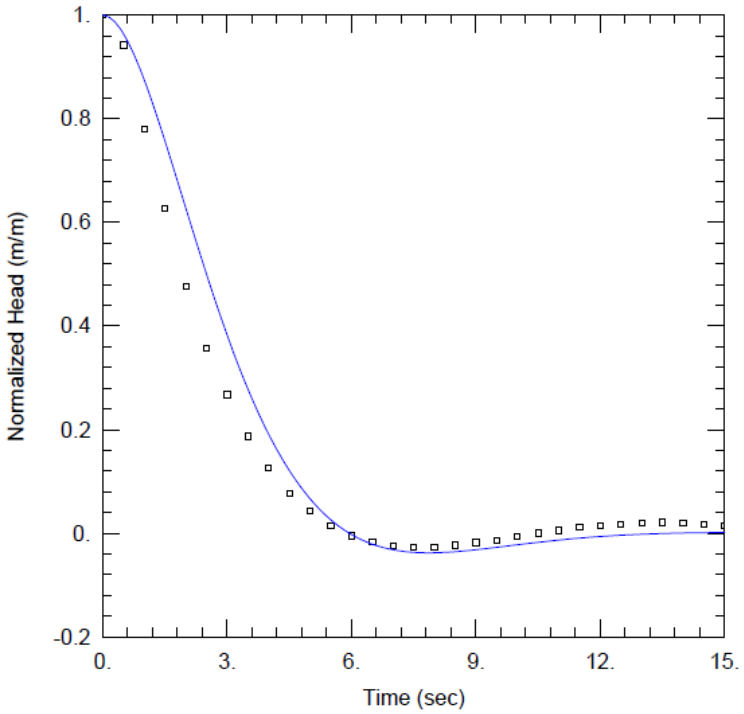
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-41

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-22A
Date of Test:	December 17, 2021
Test Type:	Rising Head Test
Test Method:	Pneumatic
Static Water Level:	-0.16 mbgs
Initial Displacement:	1.26 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	23.48 to 25.00 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Butler
Solution Type:	Inertial
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

9×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

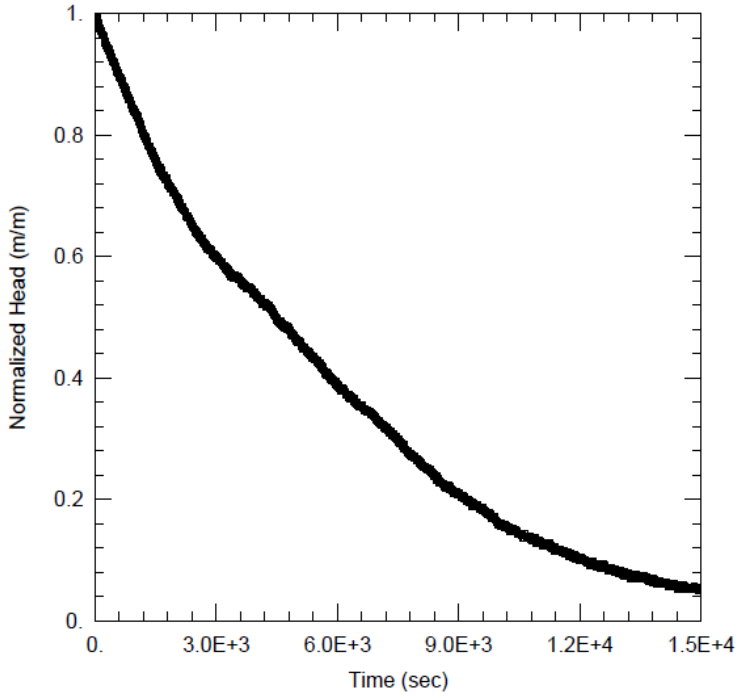
YYYY-MM-DD	2022-01-17
PREPARED	PGM
DESIGN	PGM
REVIEW	JLH
APPROVED	

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-22A

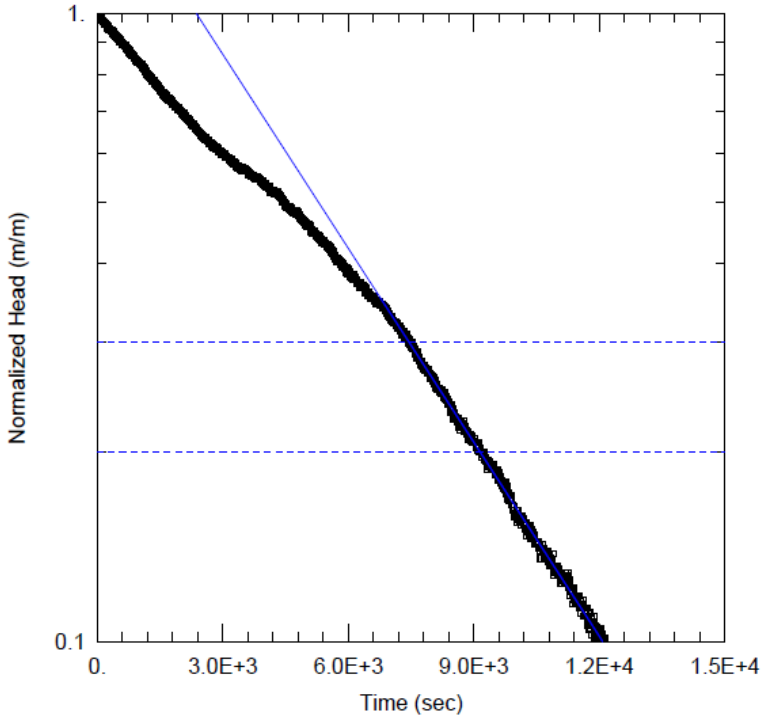
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-42

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A
1 in
0

TEST INFORMATION:



Test Well:	MW20-22B
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	6.34 mbgs
Initial Displacement:	0.83 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	6.89 m to 8.41 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

4×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

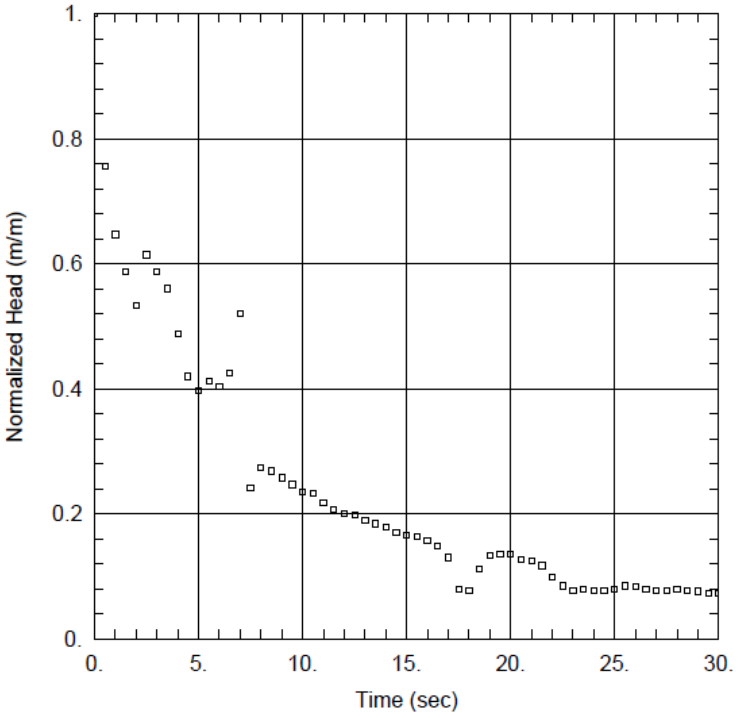
CONSULTANT
GOLDER
MEMBER OF WSP

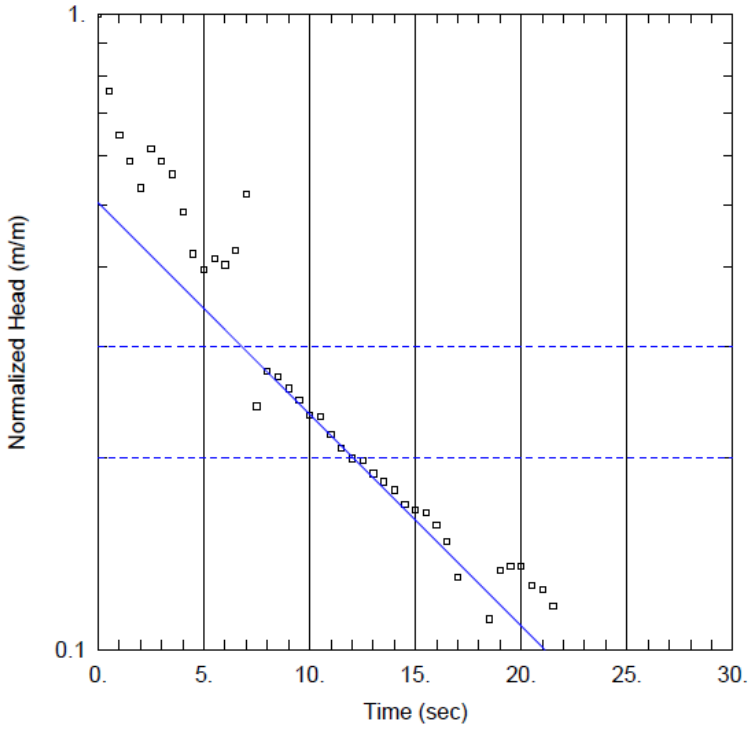
YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-22B

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-43

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A





TEST INFORMATION:

Test Well:	MW20-23A
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	3.66 mbgs
Initial Displacement:	0.56 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	22.59 m to 24.11 m
Geology:	Shaley Dolostone, Gasport Fm

SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

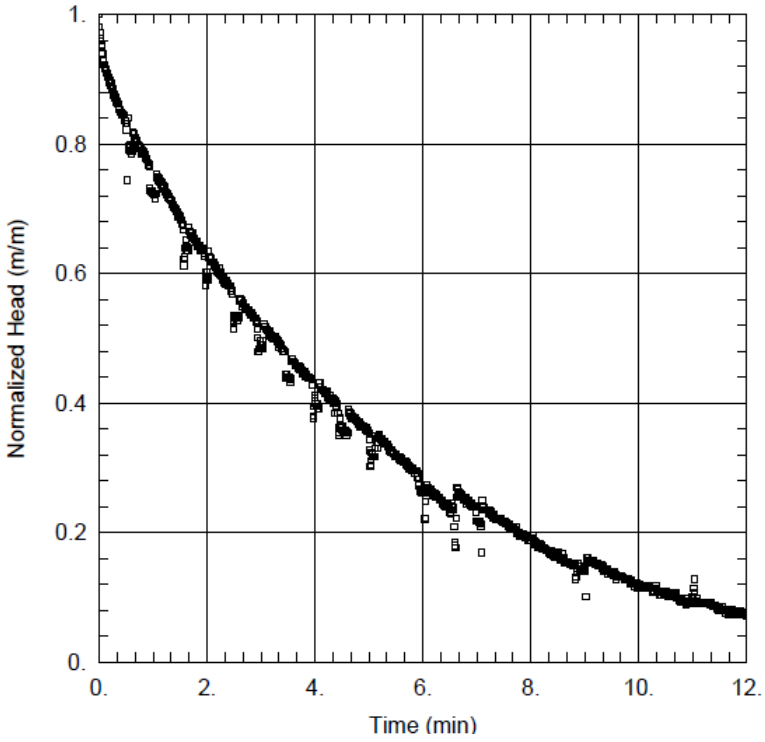
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-24
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-23A

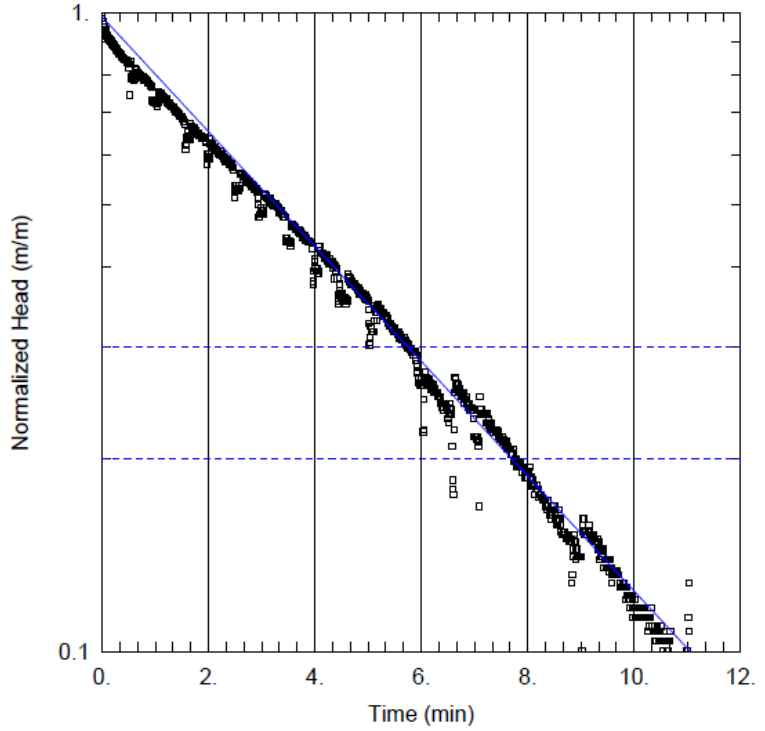
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-44

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-23B
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	3.72 mbgs
Initial Displacement:	0.54 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	14.68 m to 16.20 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

6×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

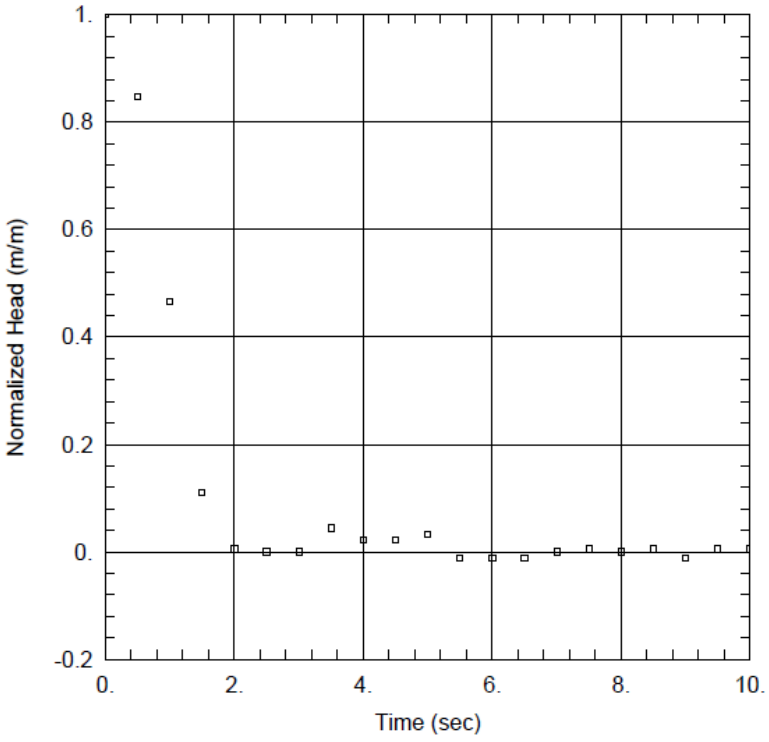
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-25
PREPARED	NU
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-23B

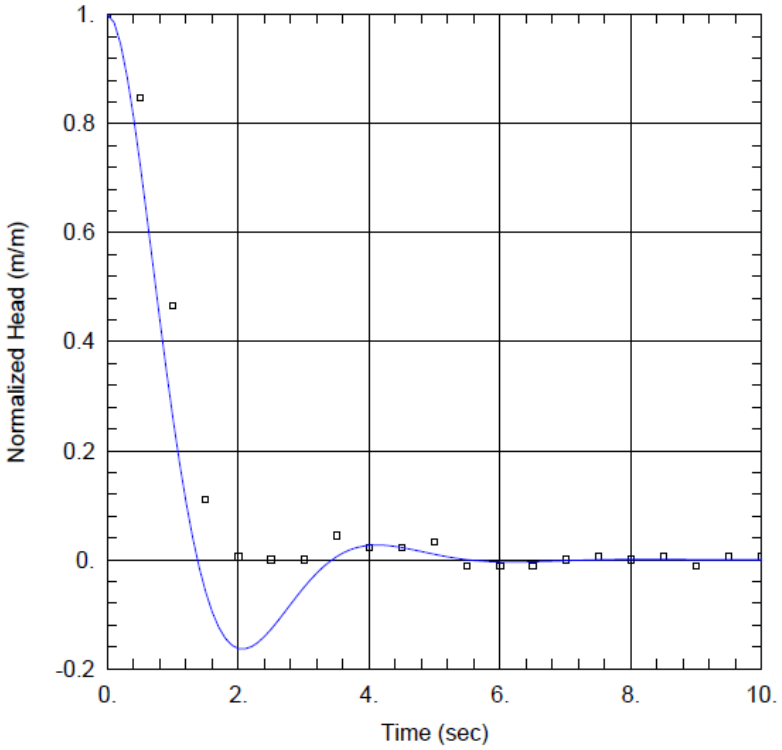
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-45

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-23C
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	3.62 mbgs
Initial Displacement:	0.18 m
Casing Radius:	0.013 m
Borehole Radius:	0.083 m
Well Screen Interval:	4.57 m to 6.09 m
Geology:	Silty Sand Till and Gravel, Overburden



SOLUTION:

Solution Method:	Springer-Gelhar
Solution Type:	Inertial
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

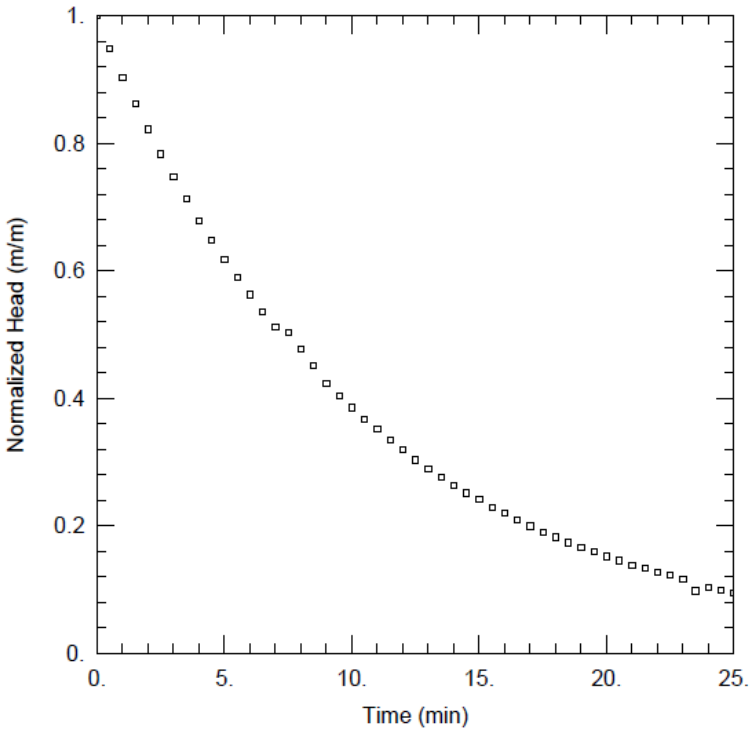
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	NU
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-23C

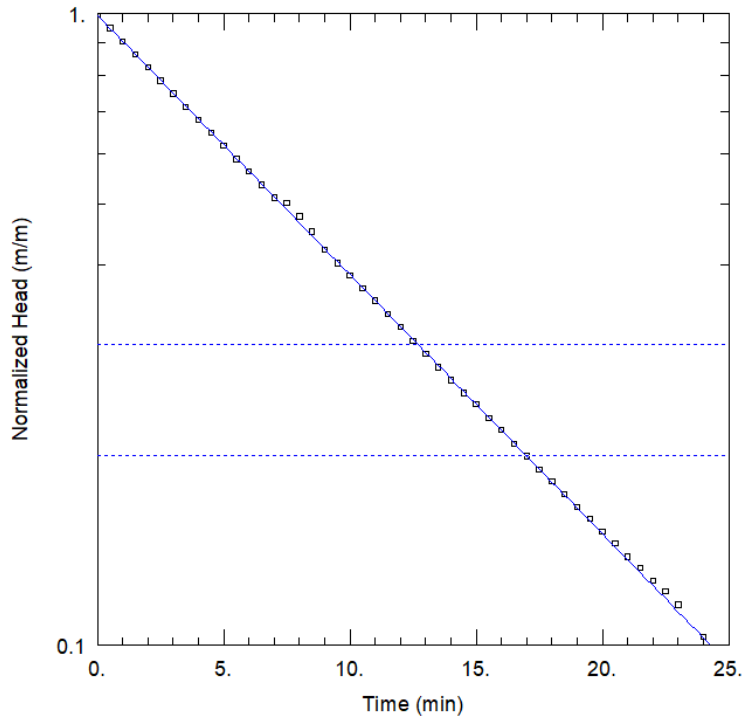
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-46

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-24A
Date of Test:	December 17, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	2.87 m
Initial Displacement:	5.09 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	33.81 to 35.33 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

4×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

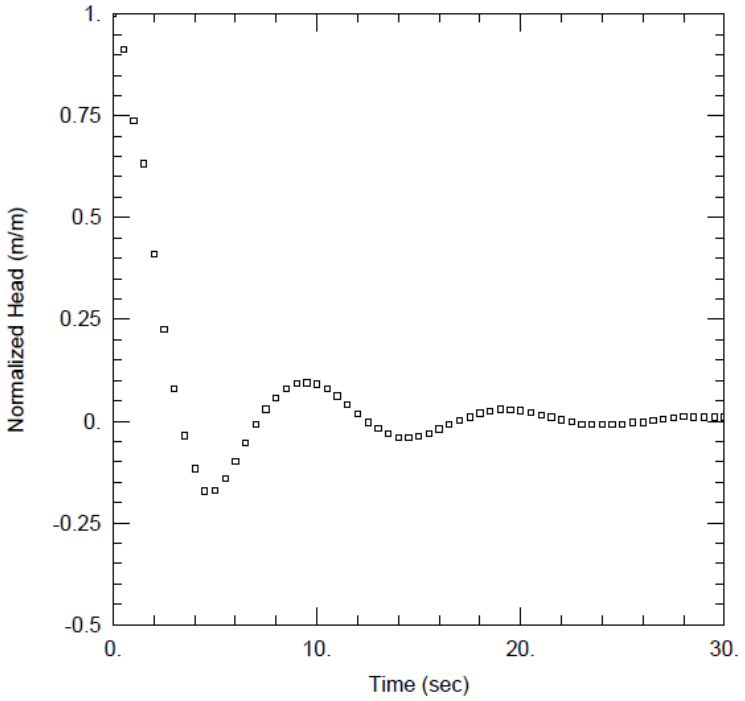
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-17
PREPARED	PGM
DESIGN	PGM
REVIEW	JLH
APPROVED	

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-24A

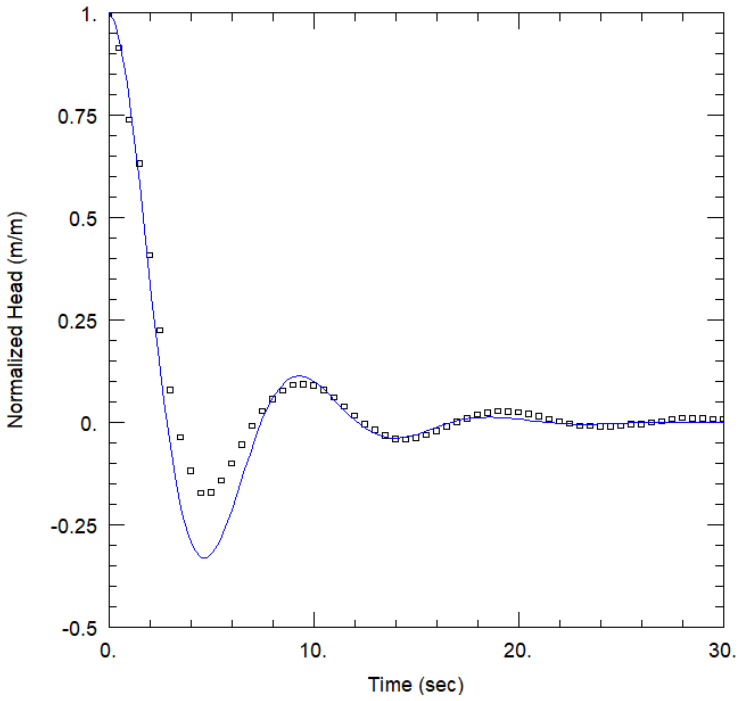
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-47

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-24B
Date of Test:	December 17, 2021
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	2.52 mbgs
Initial Displacement:	5.09 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	21.49 to 23.02 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Butler-Zhan
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

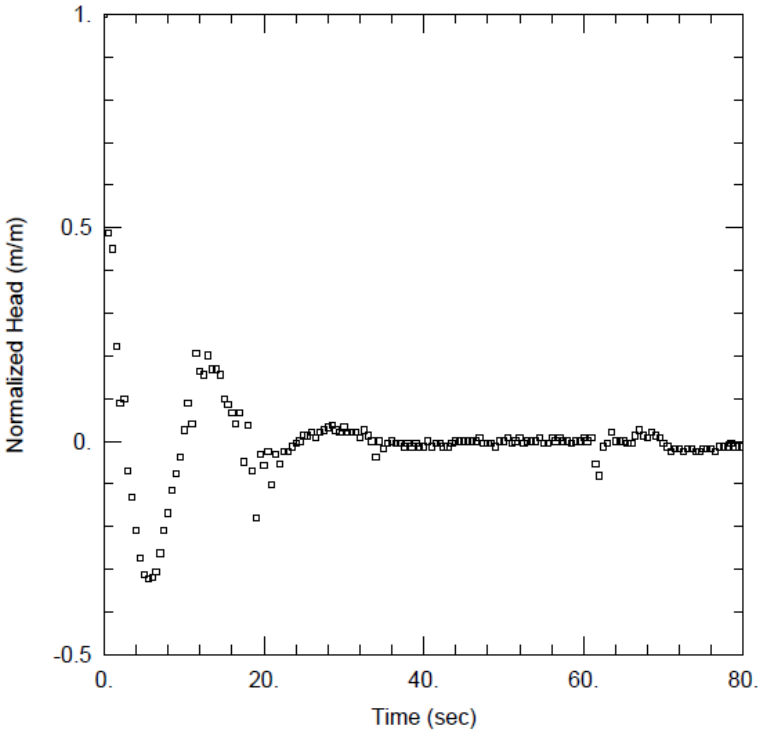
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-17
PREPARED	PGM
DESIGN	AIM
REVIEW	JLH
APPROVED	

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-24B

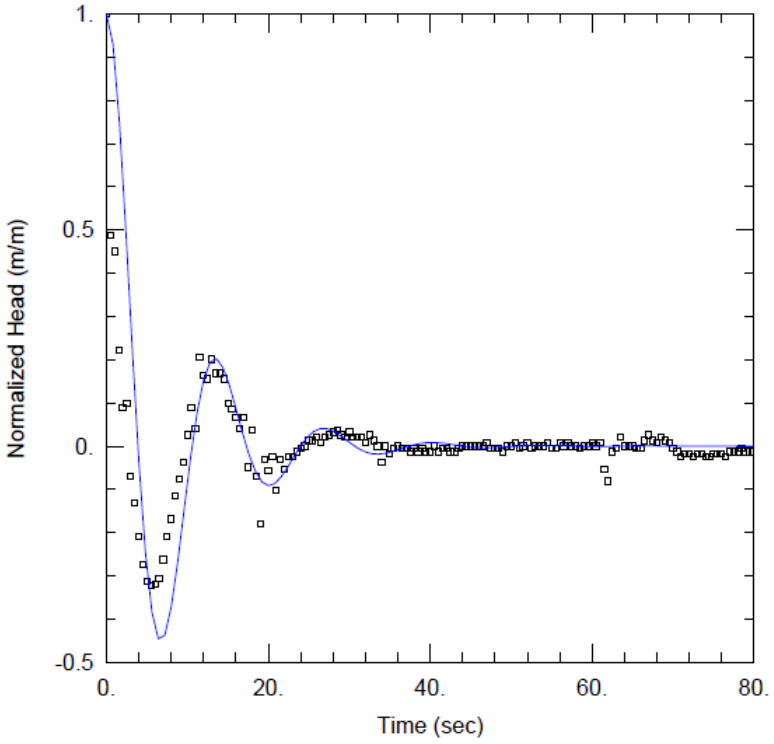
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-48

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-25A
Date of Test:	June 29, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	0.17 mbgs
Initial Displacement:	0.47 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	44.03 m to 45.55 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Inertial
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT

CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

CONSULTANT

GOLDER
MEMBER OF WSP

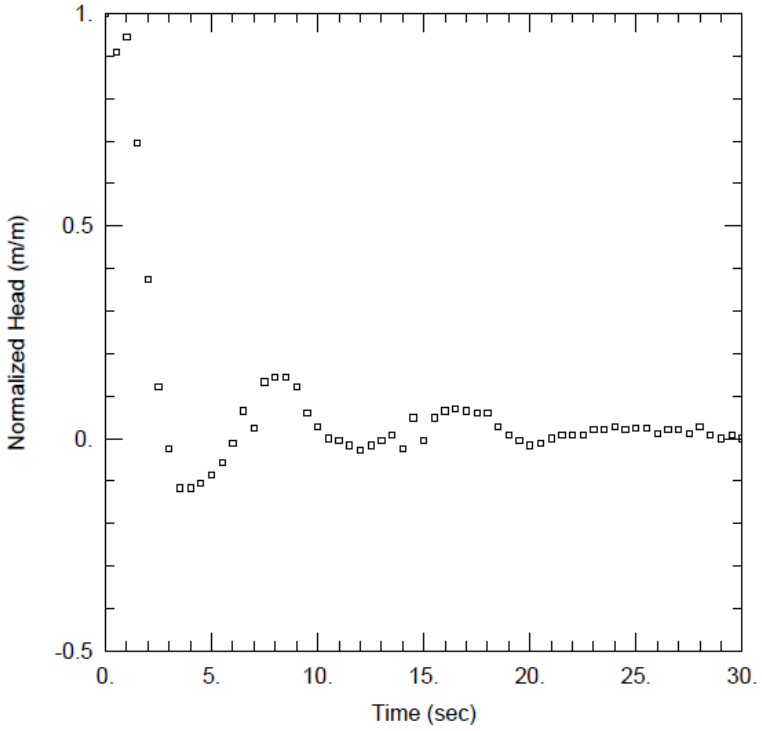
YYYY-MM-DD	2022-01-25
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE

SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-25A

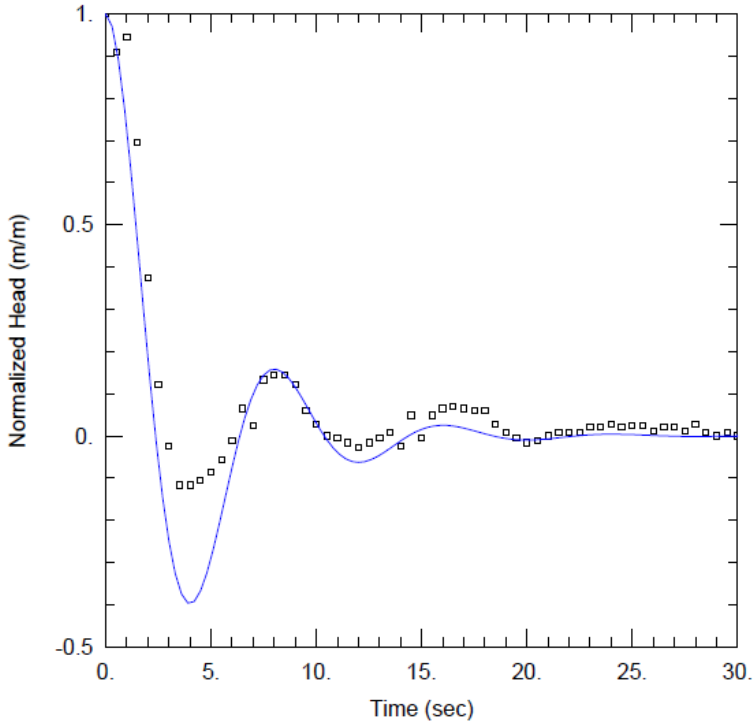
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-49

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-25B
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	0.89 mbgs
Initial Displacement:	0.25 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	16.84 m to 18.36 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Inertial
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

3×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

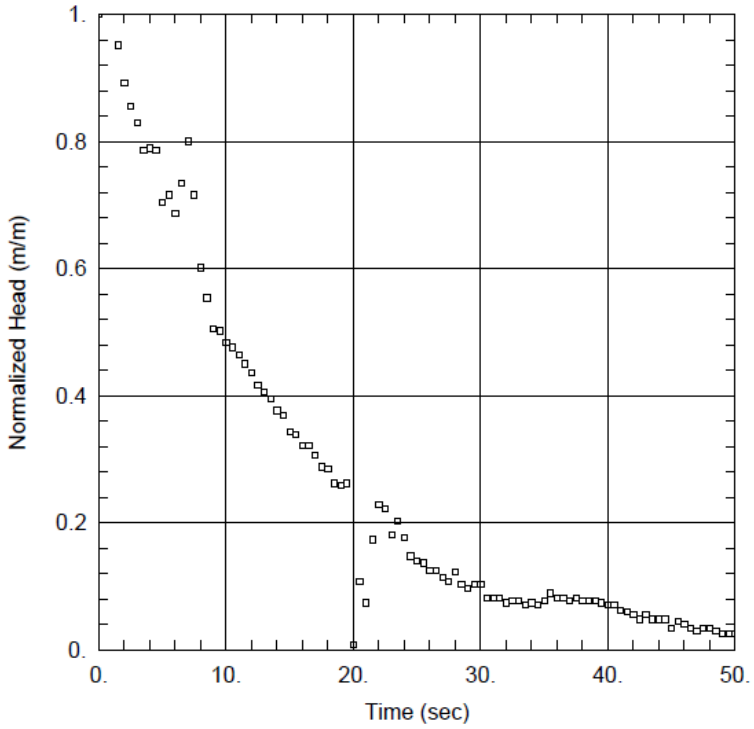
YYYY-MM-DD	2022-01-25
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-25B

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-50

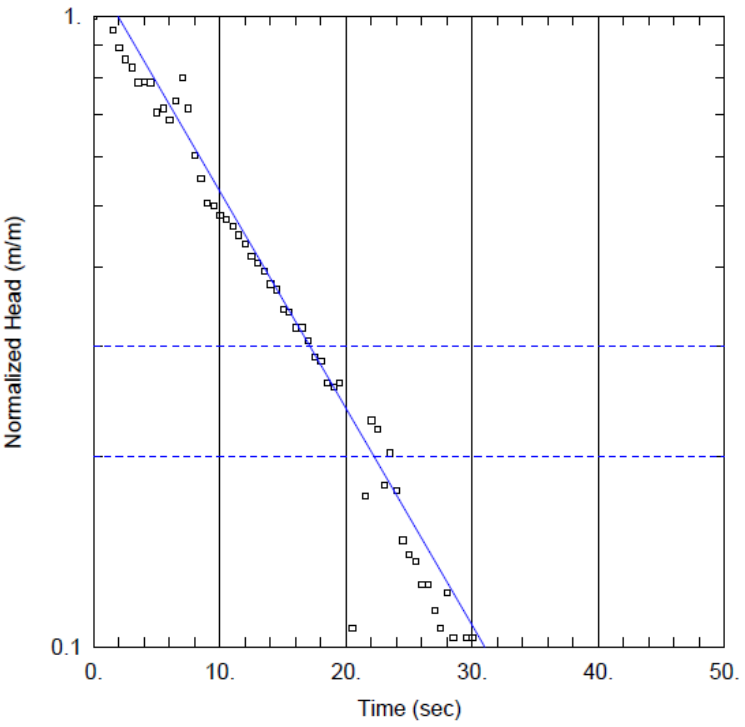
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-26A
Date of Test:	June 28, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	5.28 mbgs
Initial Displacement:	0.52 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	55.16 m to 56.68 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Water Level Measurement

Solution Match Line

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

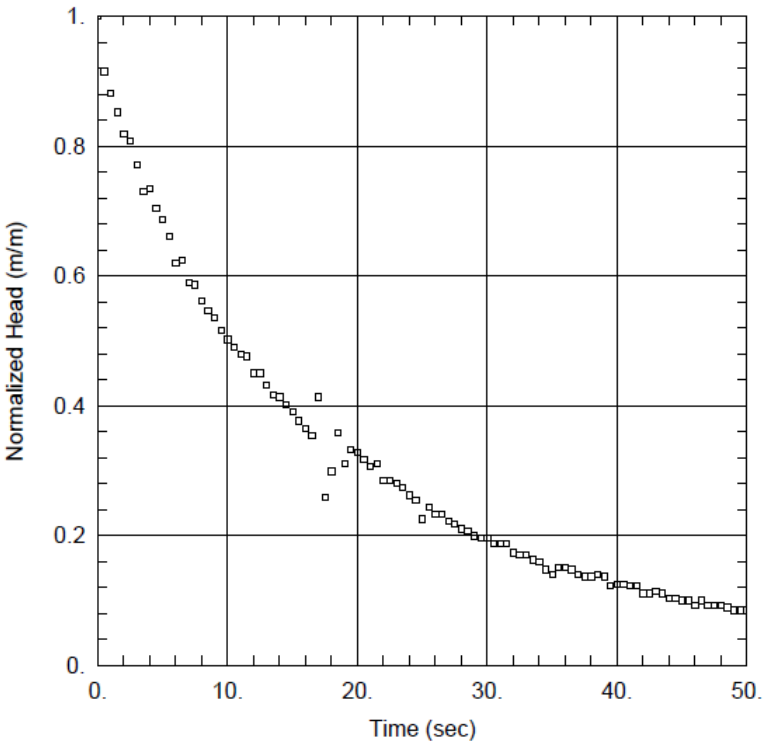
PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

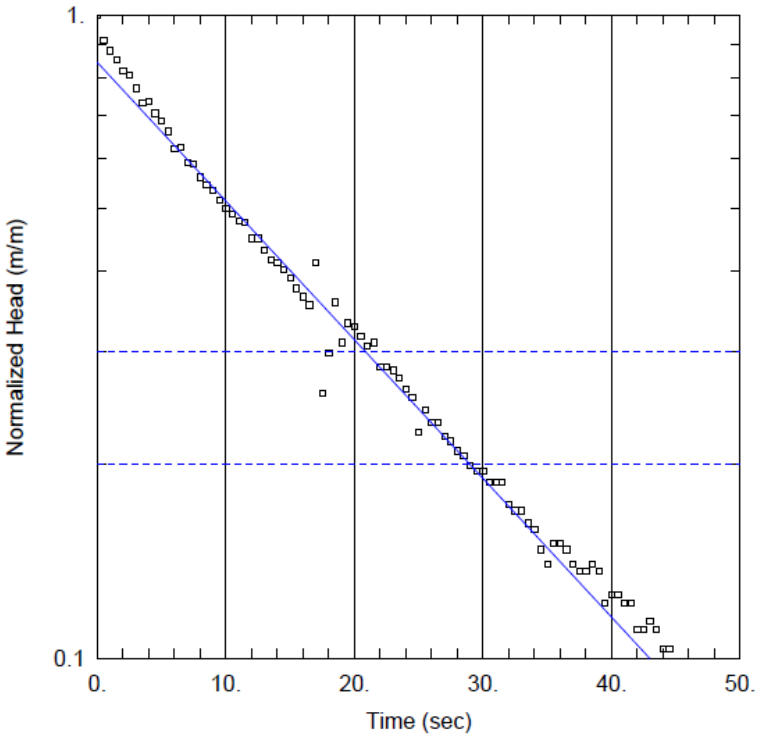
TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-26A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-51



TEST INFORMATION:

Test Well:	MW20-26B
Date of Test:	June 28, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	5.20 mbgs
Initial Displacement:	0.52 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	31.12 m to 32.64 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

1×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

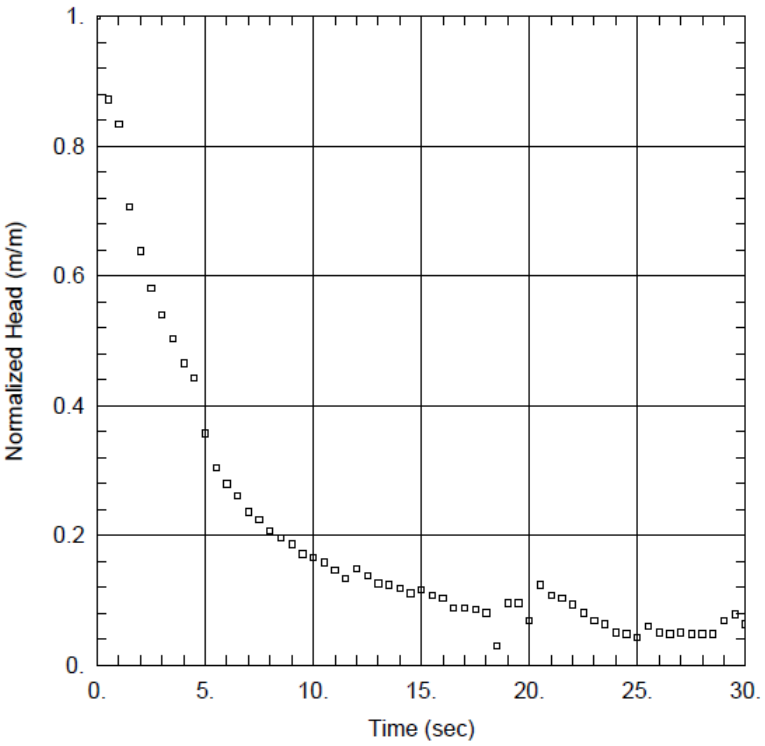
YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-26B

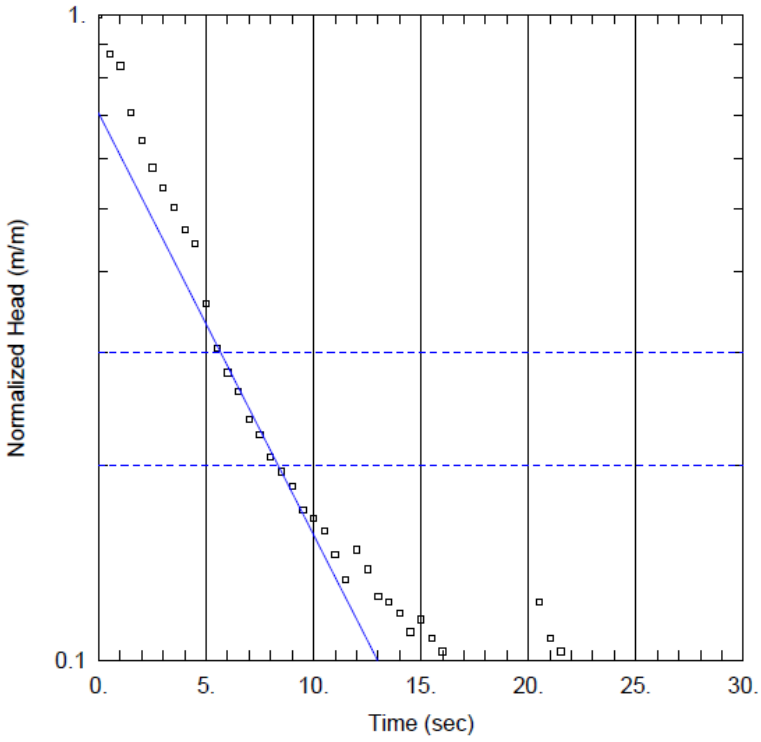
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-52

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-26C
Date of Test:	June 28, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	3.48 mbgs
Initial Displacement:	0.40 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	7.26 m to 8.78 m
Geology:	Silty Sand Till, Overburden



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

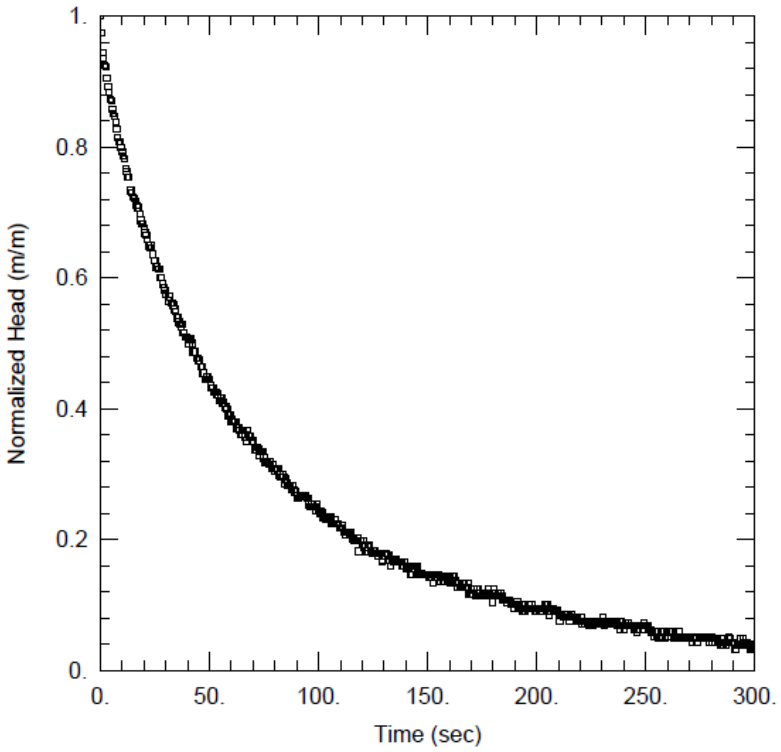
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-26C

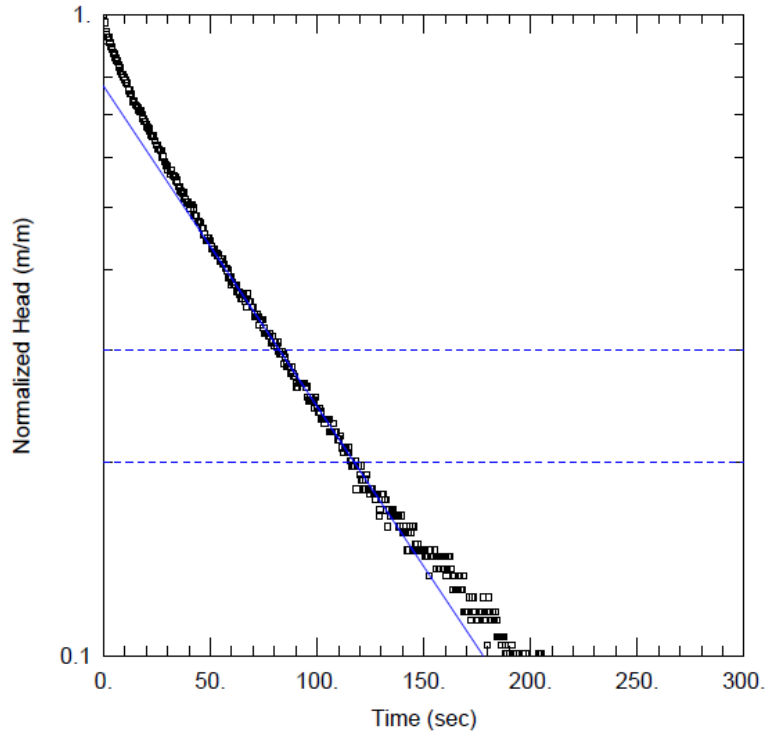
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-53

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-27A
Date of Test:	June 24, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	7.79 mbgs
Initial Displacement:	0.59 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	41.99 m to 43.51 m
Geology:	Dolostone, Goat Island Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

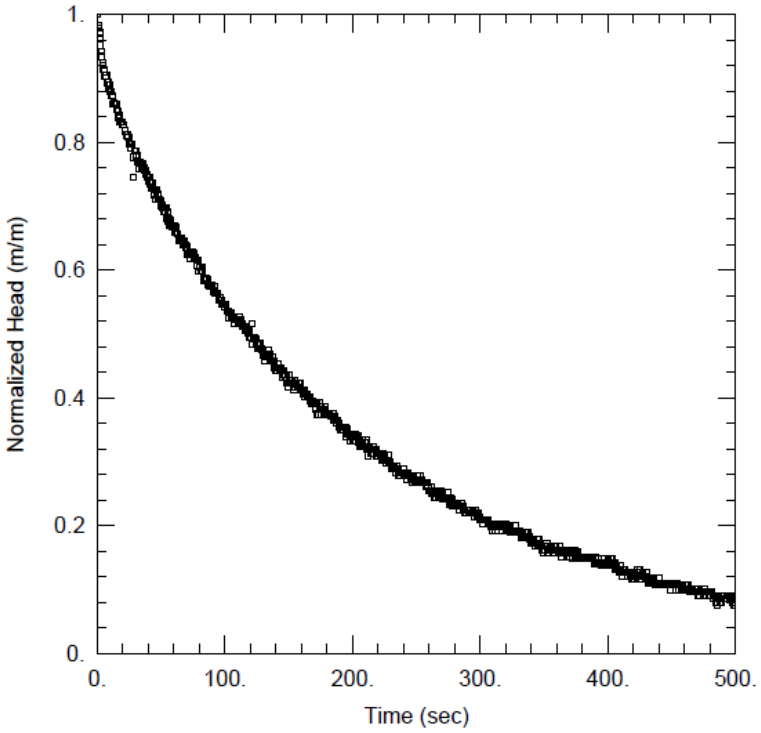
YYYY-MM-DD	2022-01-28
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-27A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-54

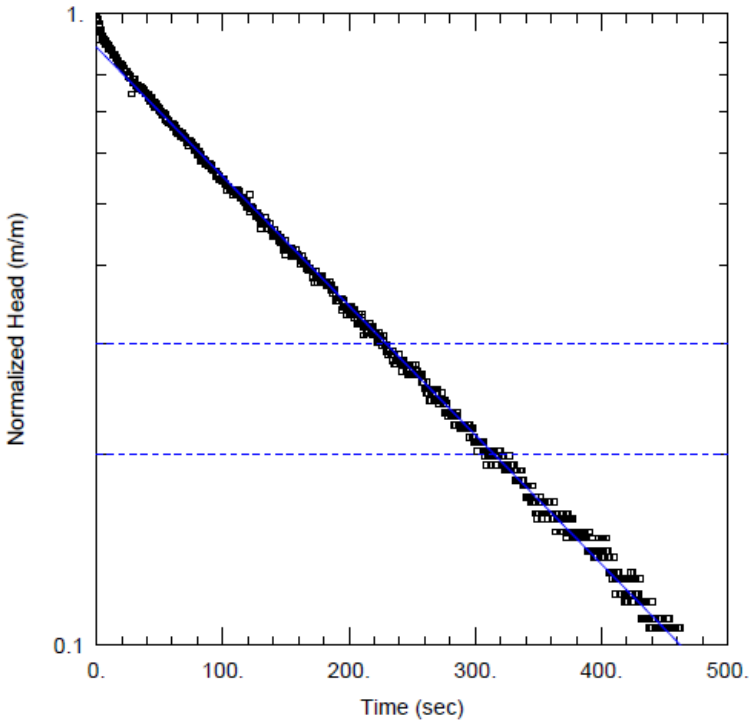
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW20-27B
Date of Test:	June 24, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	7.88 mbgs
Initial Displacement:	0.56 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	33.85 m to 35.37 m
Geology:	Dolostone, Goat Island Fm

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

9×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

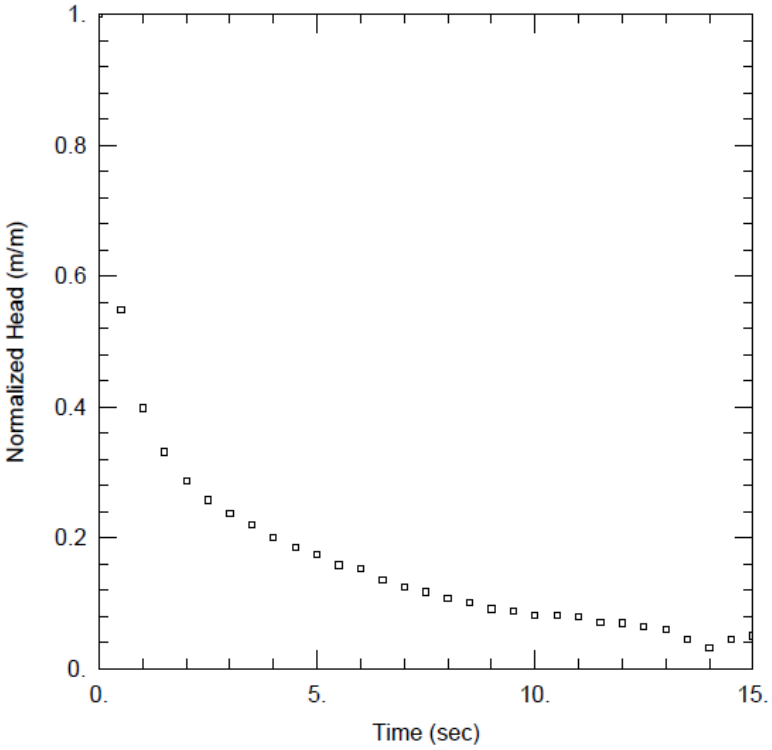
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW20-27B

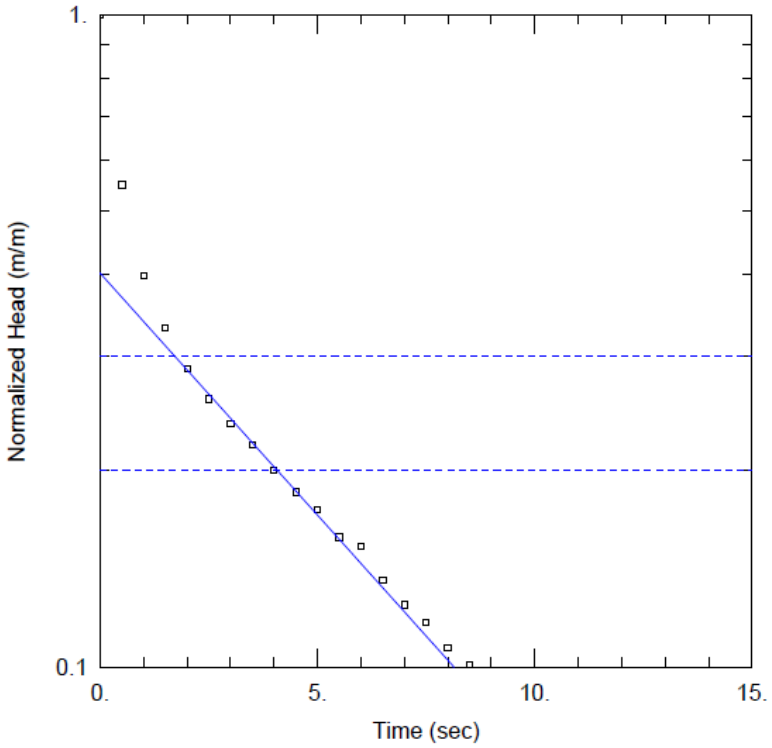
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-55

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-28A
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	1.31 mbgs
Initial Displacement:	0.80 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	24.07 m to 25.59 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

3×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

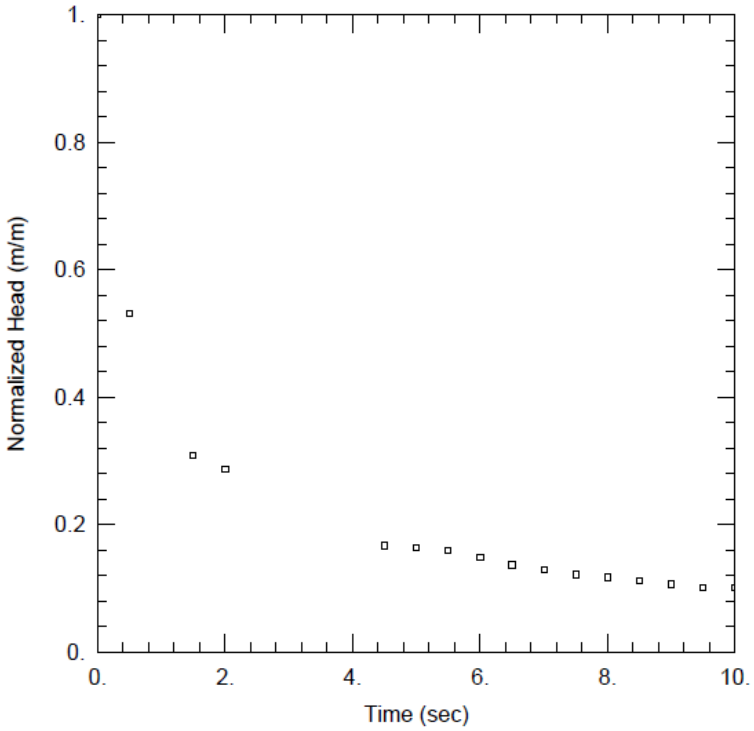
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-28A

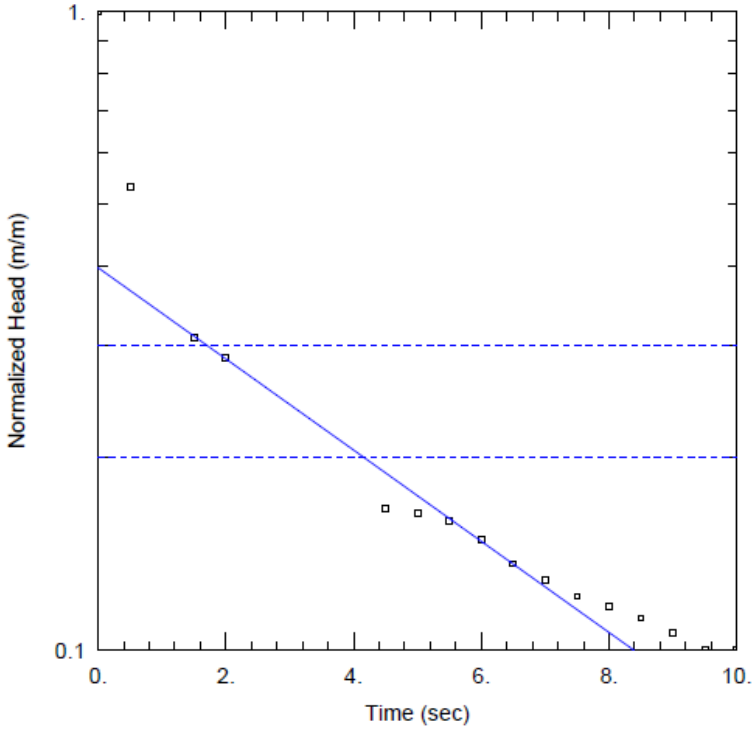
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-56

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW20-28B
Date of Test:	June 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	1.24 mbgs
Initial Displacement:	0.66 m
Casing Radius:	0.013 m
Borehole Radius:	0.048 m
Well Screen Interval:	16.51 m to 18.03 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

3×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

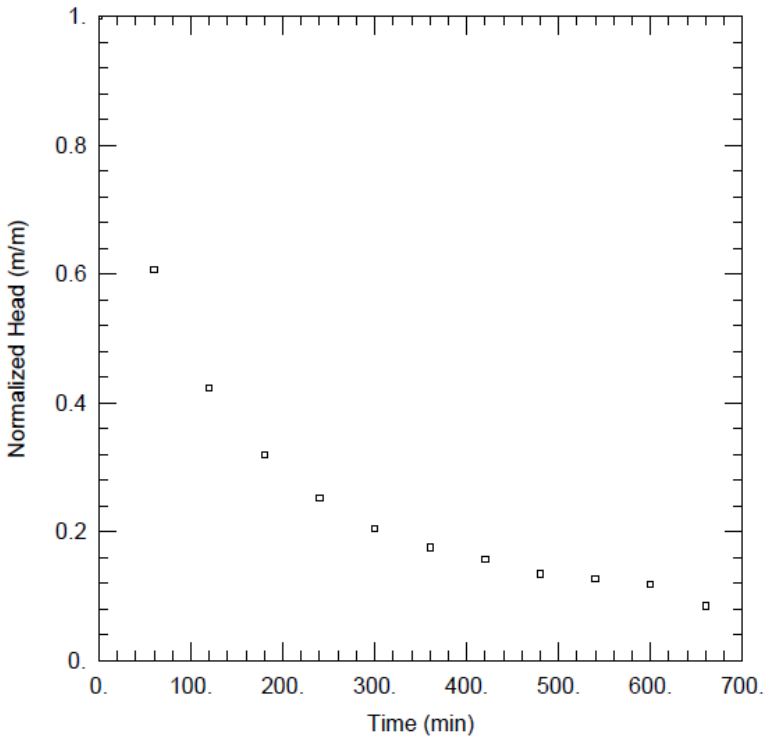
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW20-28B

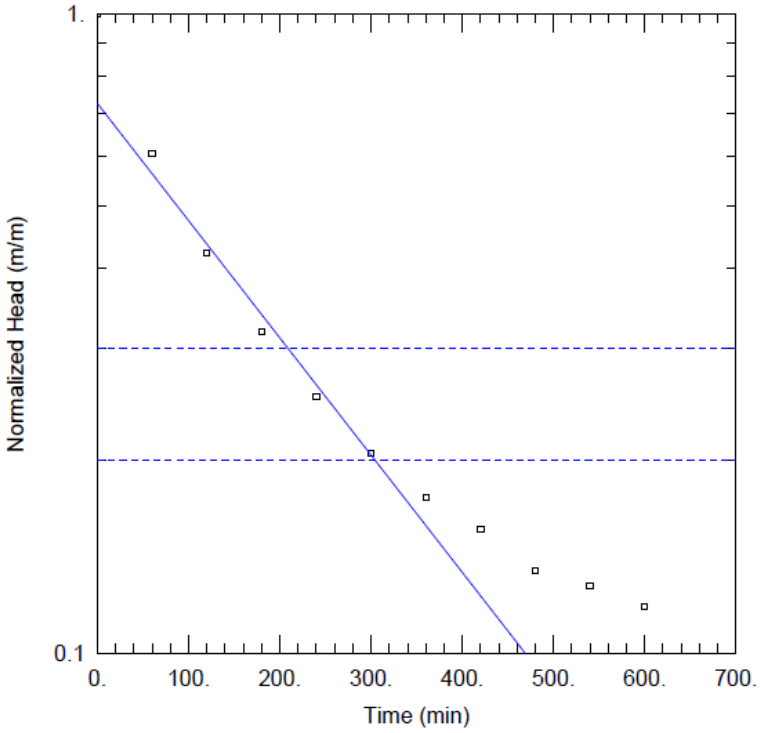
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-57

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	PW21-1
Date of Test:	September 14, 2021
Test Type:	Rising Head Test
Test Method:	Recovery following short duration pumping
Static Water Level:	2.97 mbgs
Initial Displacement:	0.92 m
Casing Radius:	0.069 m
Borehole Radius:	0.062 m
Open BH Interval:	12.19 m to 38.41 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

1×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

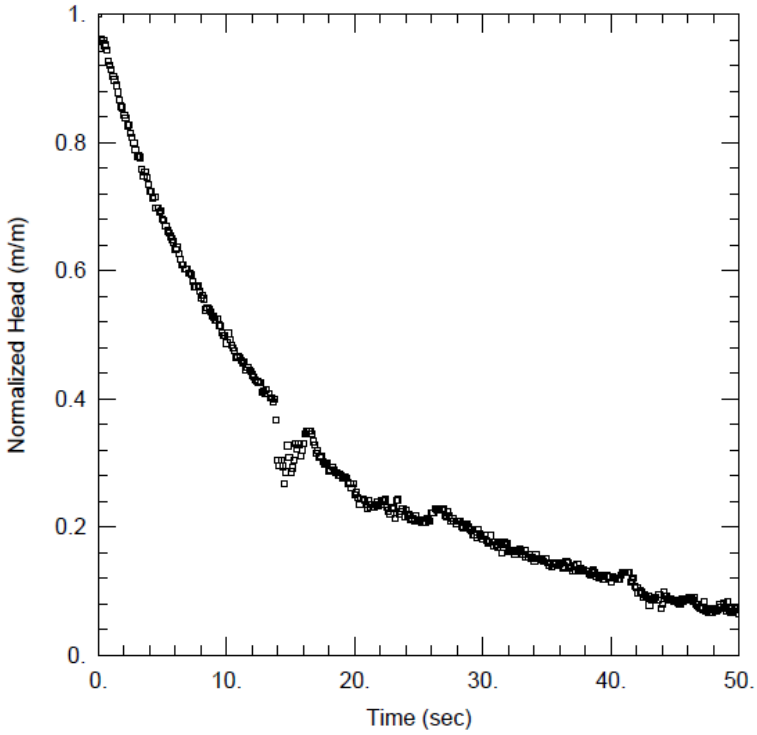
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL PW21-1

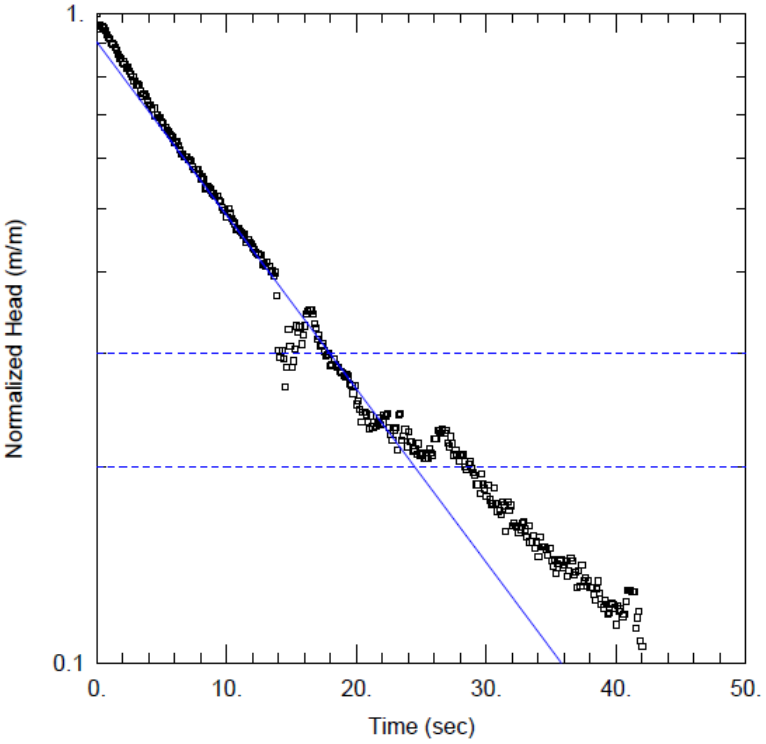
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-58

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-1-1
Date of Test:	August 25, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	3.20 mbgs
Initial Displacement:	0.14 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	11.60 m to 34.40 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

4×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

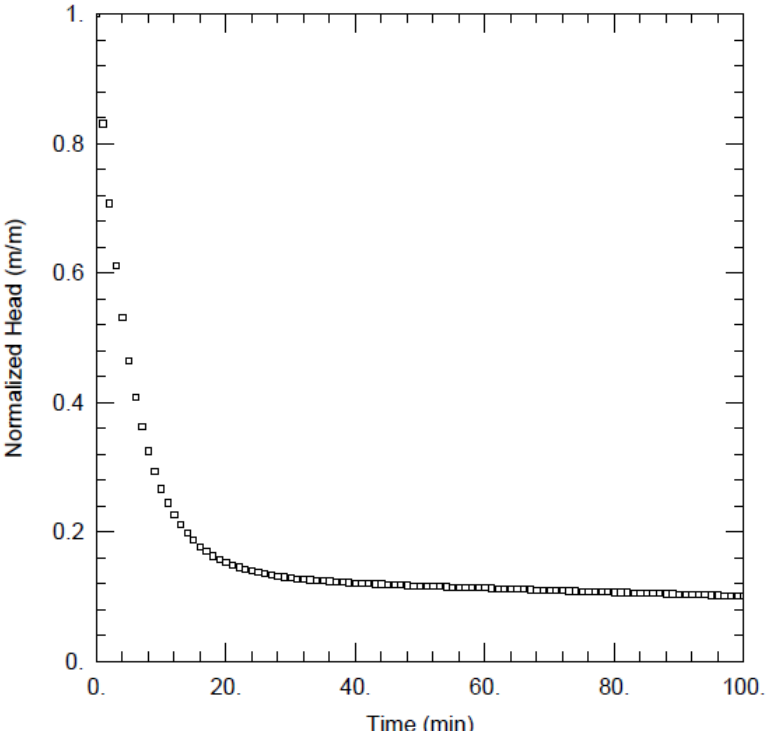
CONSULTANT
GOLDER
MEMBER OF WSP

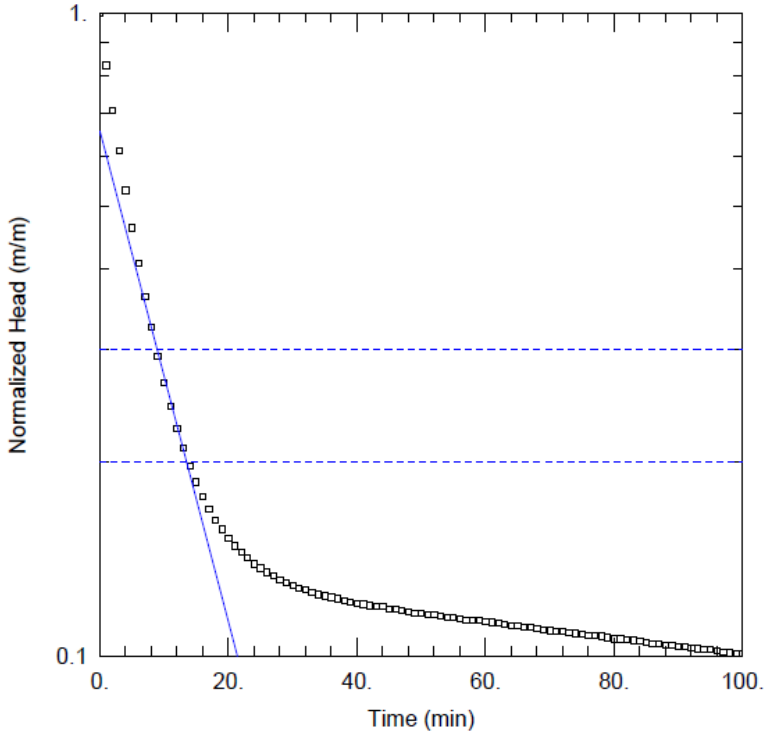
YYYY-MM-DD	2022-01-28
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-1-1

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-59

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A





TEST INFORMATION:

Test Well:	MW21-1-2
Date of Test:	August 26, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	7.65 mbgs
Initial Displacement:	4.45 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	13.40 m to 34.70 m
Geology:	Dolostone, Gasport Fm

SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

8×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

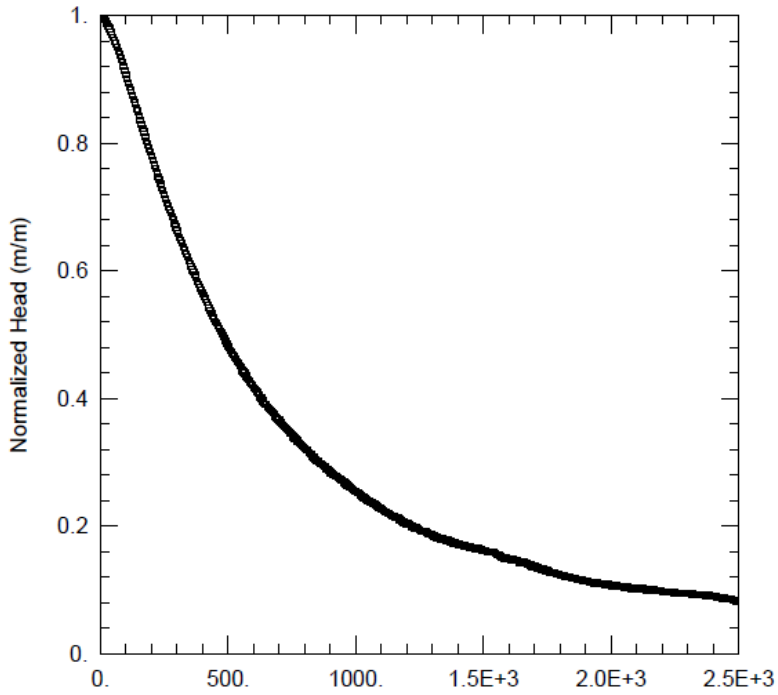
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-29
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-1-2

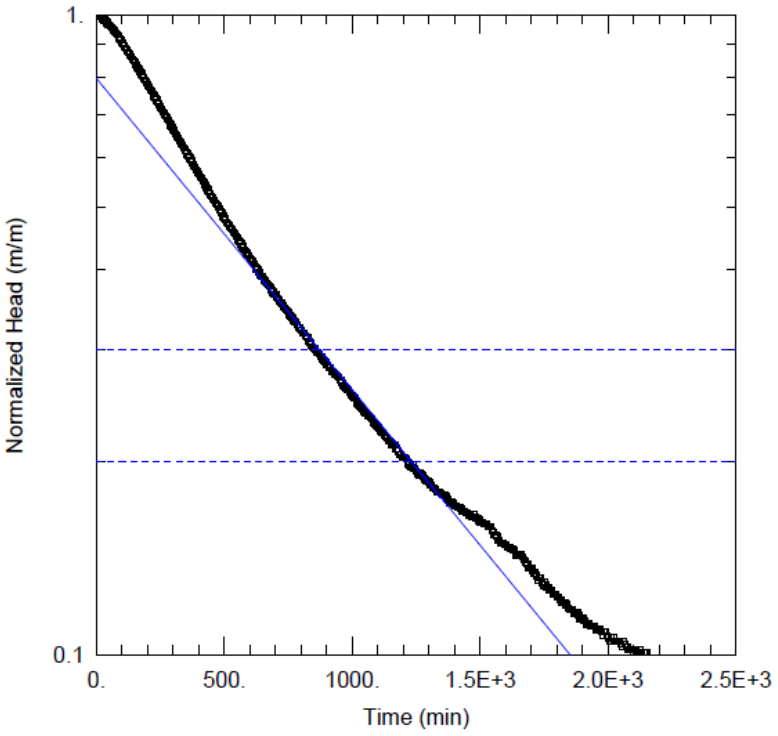
PROJECT No.	PHASE	Rev.	FIGURE
19129150	**2300**	**A**	**G-60**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-1-3
Date of Test:	September 24, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	6.52 mbgs
Initial Displacement:	2.85 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	9.10 m to 35.10 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

1×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

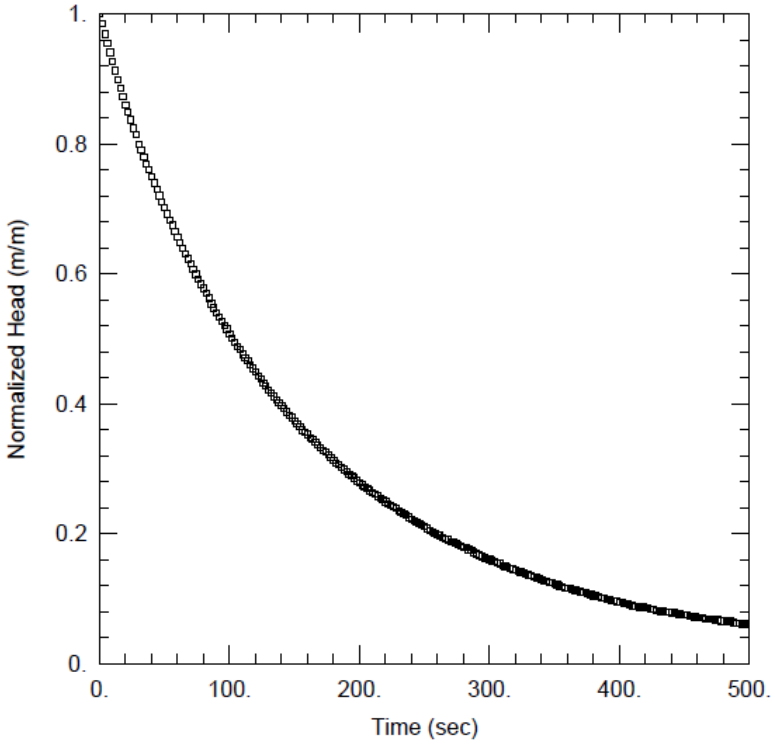
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-29
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-1-3

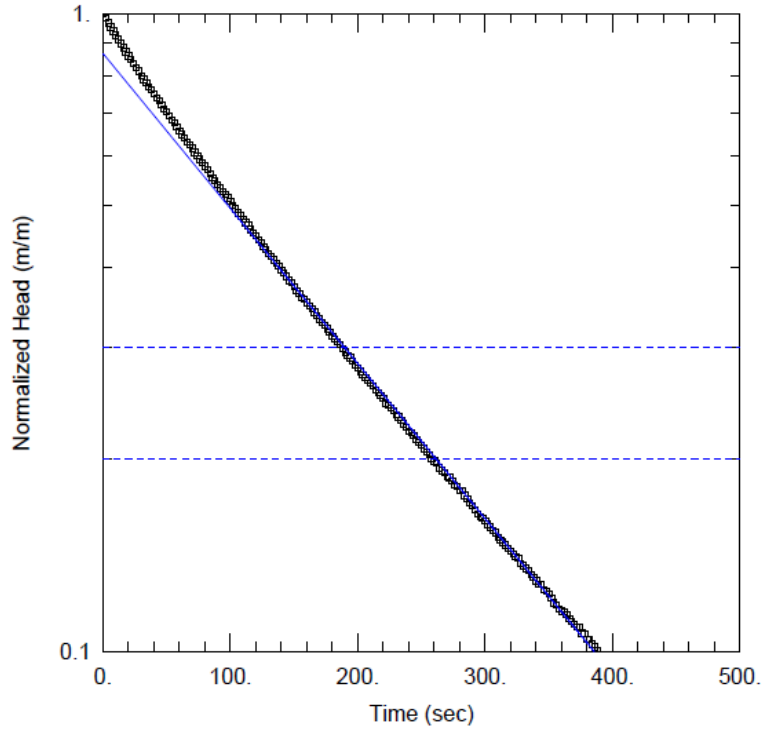
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-61

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-1-4
Date of Test:	September 29, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	4.78 mbgs
Initial Displacement:	2.61 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	13.10 m to 32.90 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

4×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

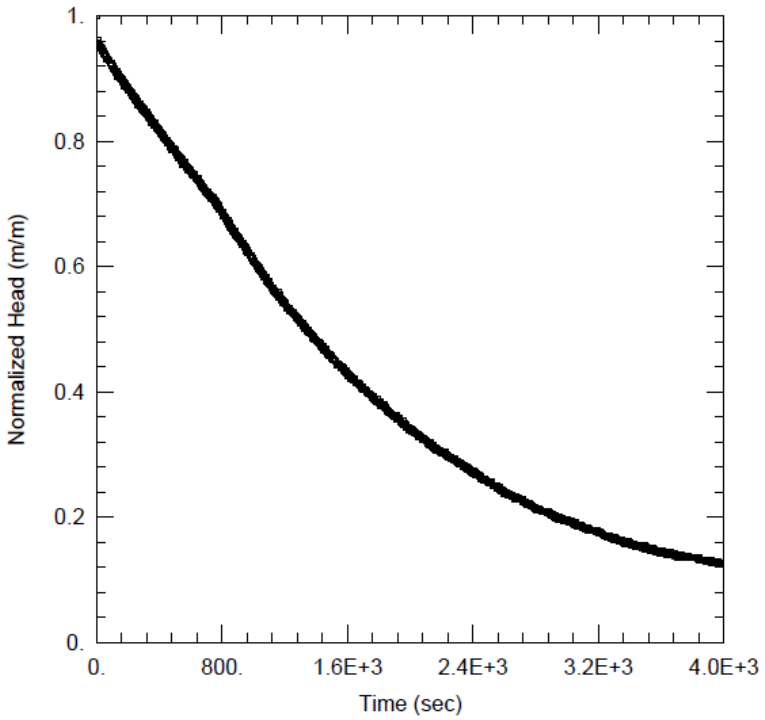
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-29
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-1-4

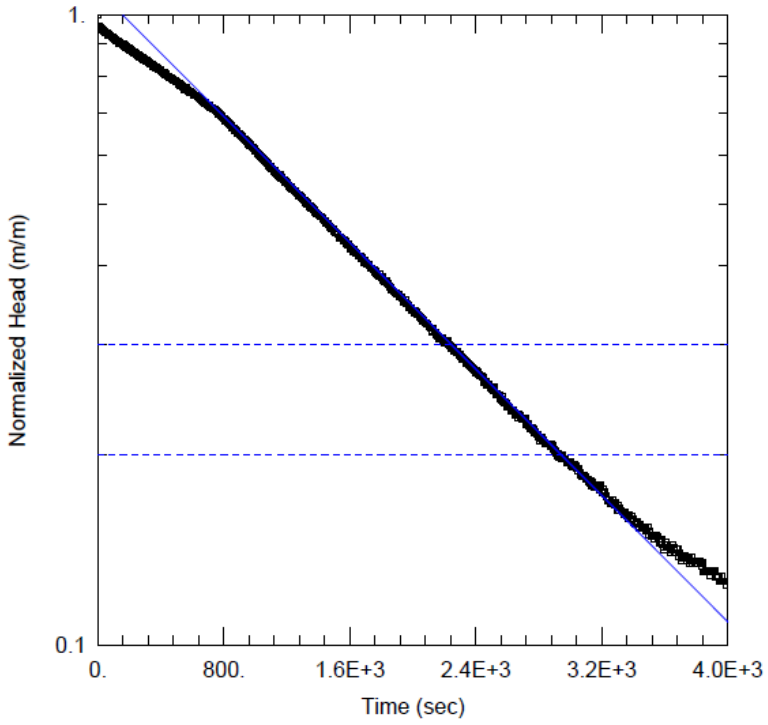
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-62

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	PW21-2
Date of Test:	September 29, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	5.52 mbgs
Initial Displacement:	1.06 m
Casing Radius:	0.069 m
Borehole Radius:	0.062 m
Open BH Interval:	12.19 m to 25.15 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

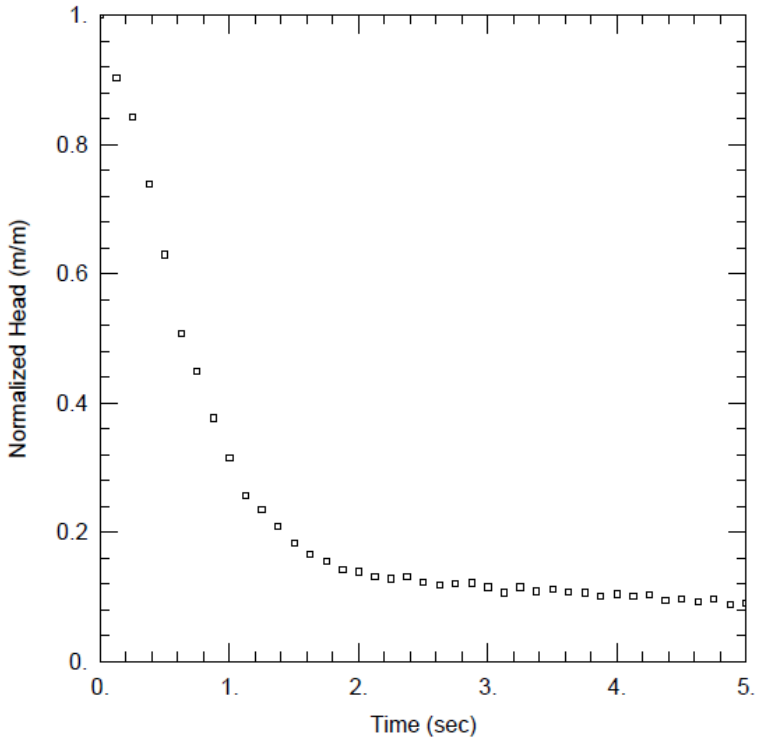
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL PW21-2

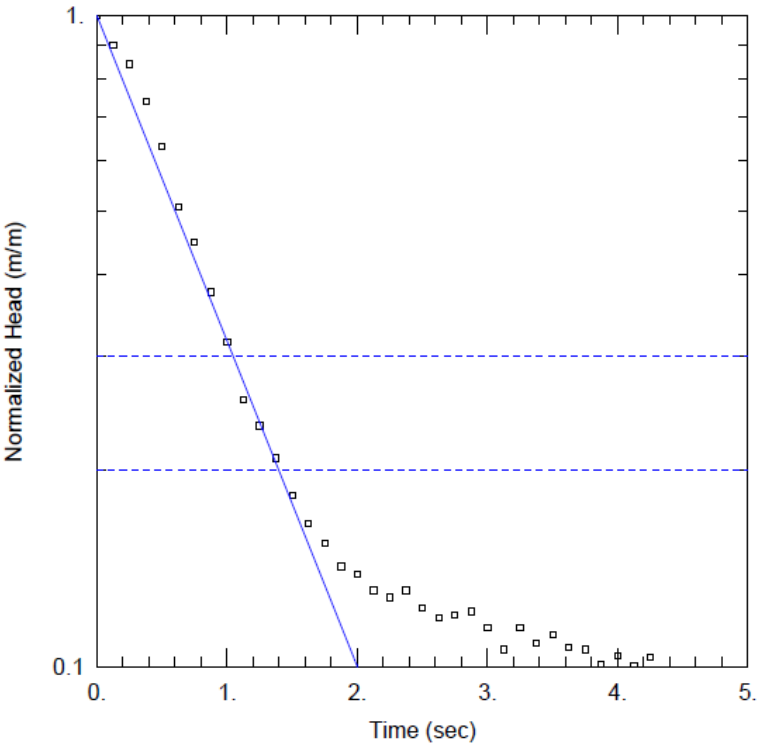
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-63

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-2-1
Date of Test:	August 27, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	6.20 mbgs
Initial Displacement:	0.21 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	6.70 m to 22.00 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

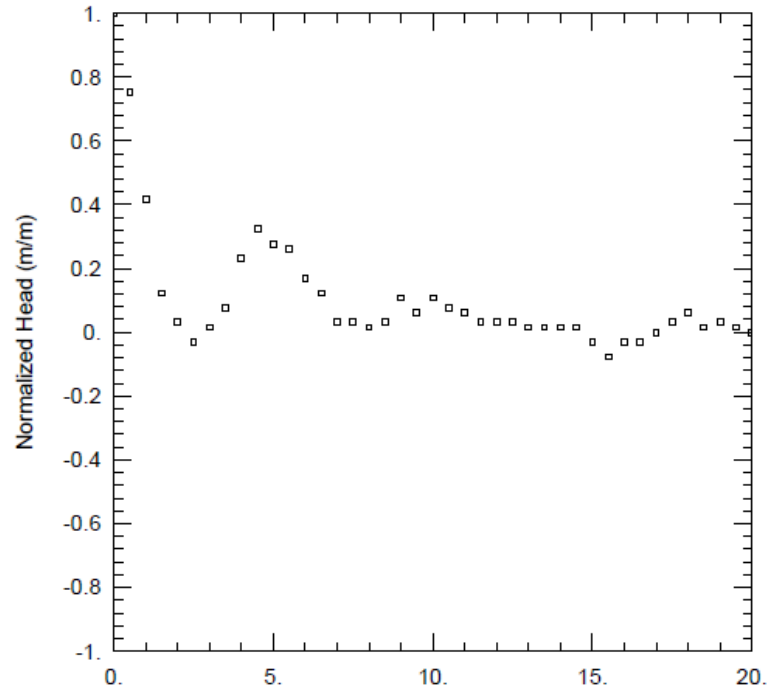
YYYY-MM-DD	2022-01-29
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-2-1

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-64

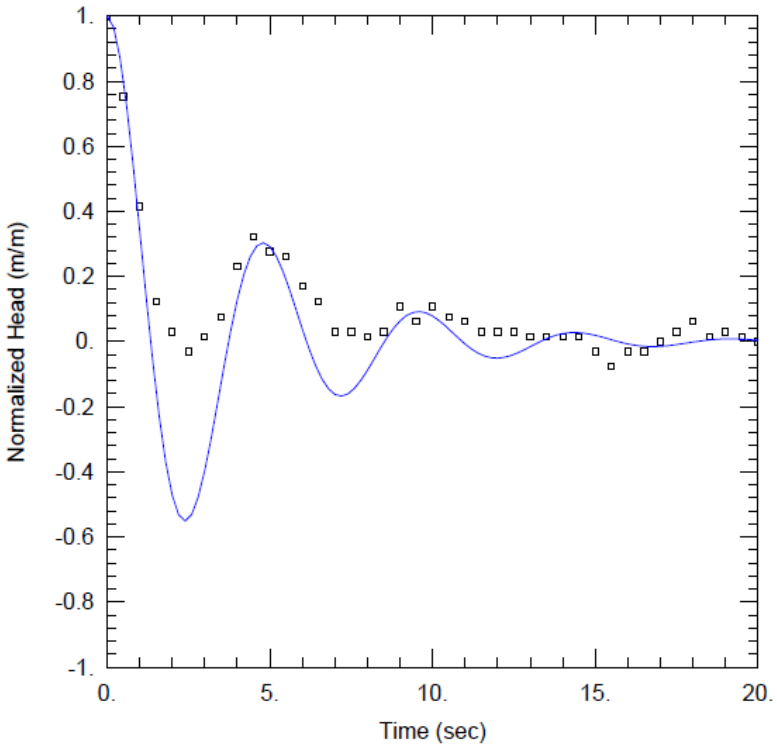
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW21-2-2
Date of Test:	December 9, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	5.12 mbgs
Initial Displacement:	0.07 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	7.00 m to 19.20 m
Geology:	Dolostone, Gasport Fm

SOLUTION:



Solution Method:	Butler
Solution Type:	Inertial
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

5×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

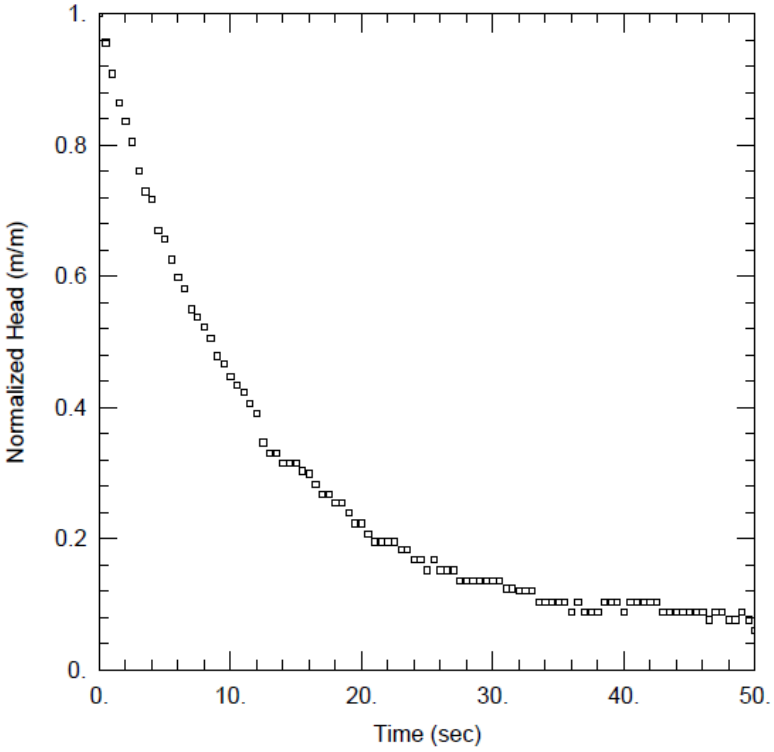
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-29
PREPARED	KB
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-2-2

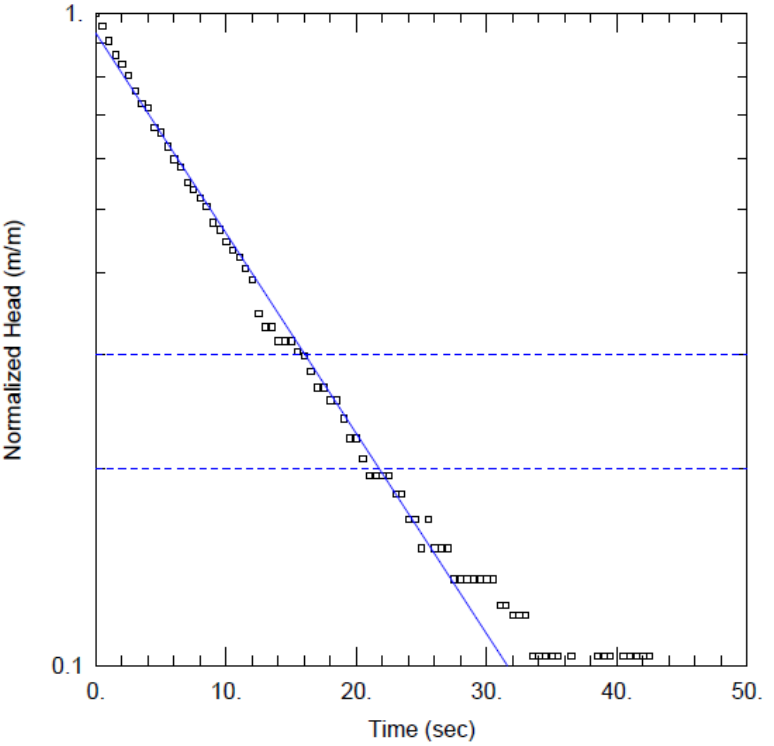
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-65

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-2-3
Date of Test:	August 31, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	3.33 mbgs
Initial Displacement:	0.48 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	6.10 to 18.30 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

4×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

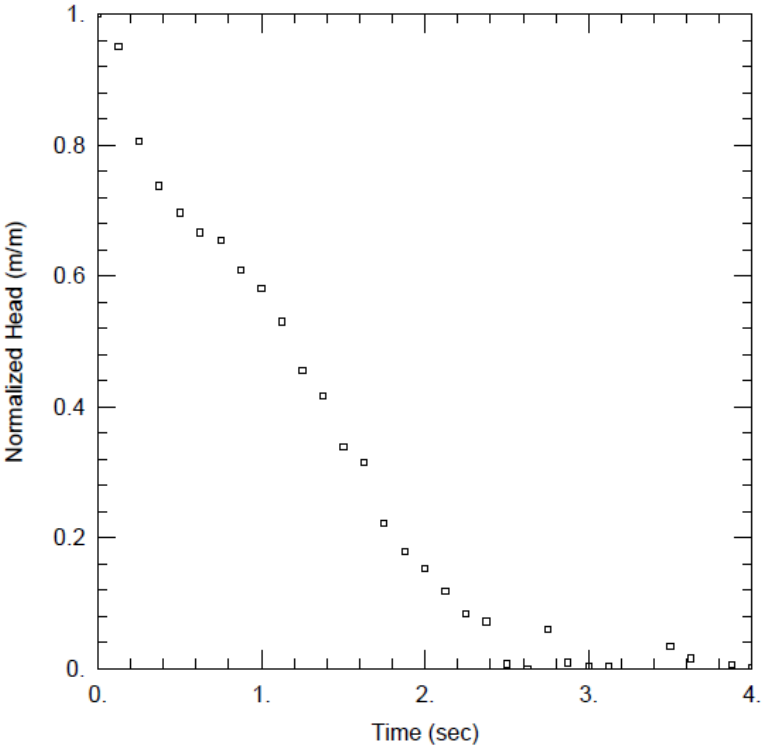
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-29
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-2-3

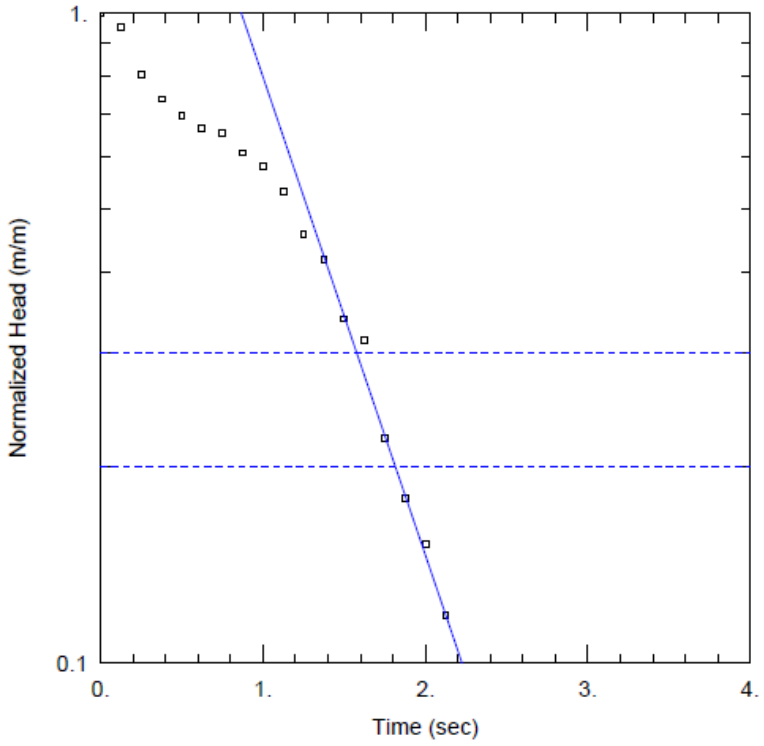
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-66

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-2-4
Date of Test:	August 27, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	6.66 mbgs
Initial Displacement:	0.10 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	6.40 m to 23.20 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

3×10^{-4} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

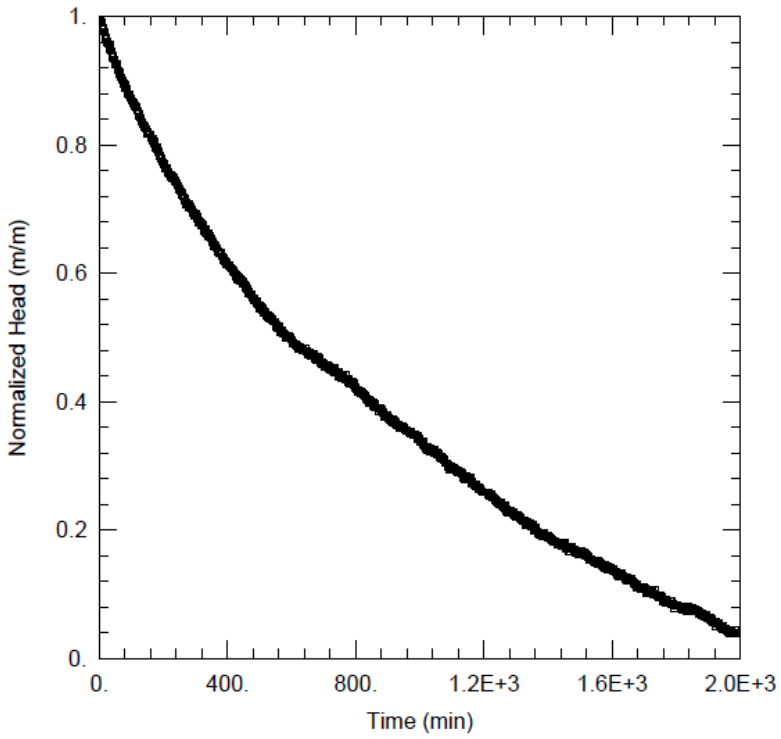
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-2-4

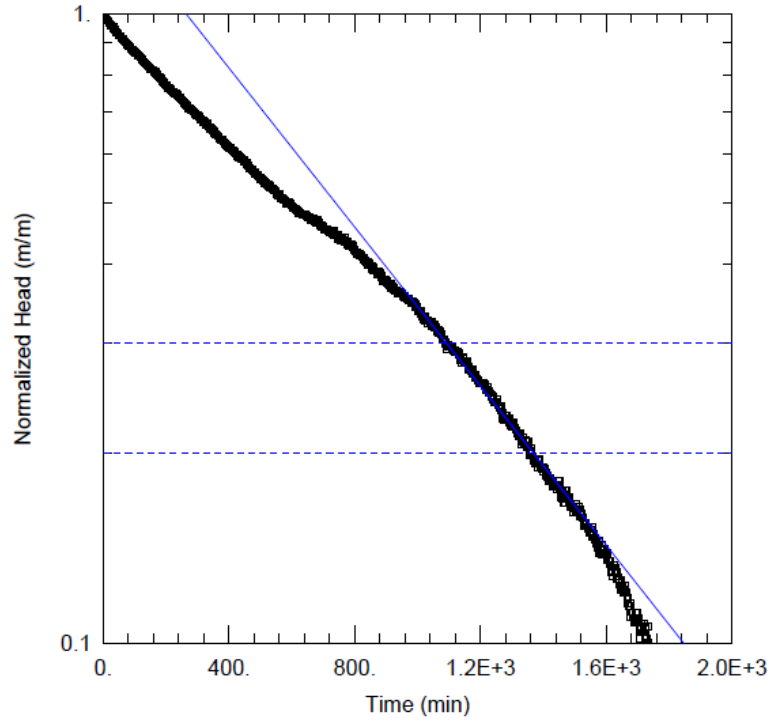
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-67

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	PW21-3
Date of Test:	September 23, 2021
Test Type:	Rising Head Test
Test Method:	Pump Down Recovery Rising Head Test
Static Water Level:	9.43 mbgs
Initial Displacement:	0.79 m
Casing Radius:	0.069 m
Borehole Radius:	0.062 m
Open BH Interval:	8.84 m to 21.34 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

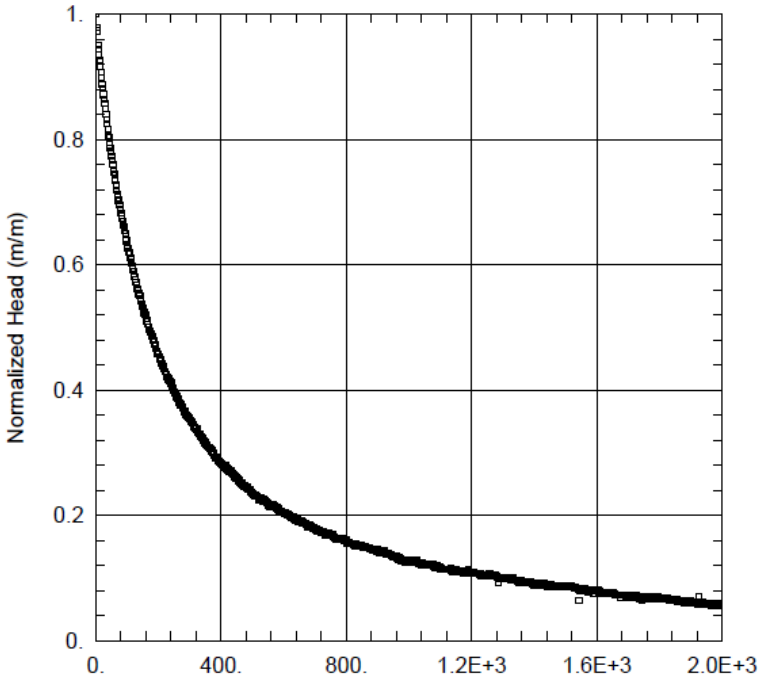
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL PW21-3

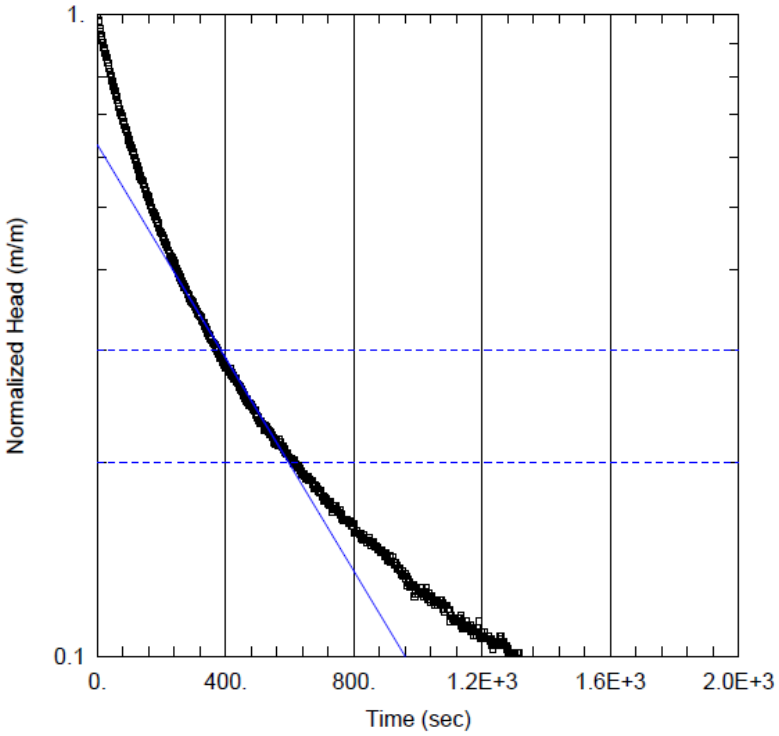
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-68

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-3-1
Date of Test:	September 21, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	6.83 mbgs
Initial Displacement:	1.04 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	5.80 m to 16.50 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

6×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

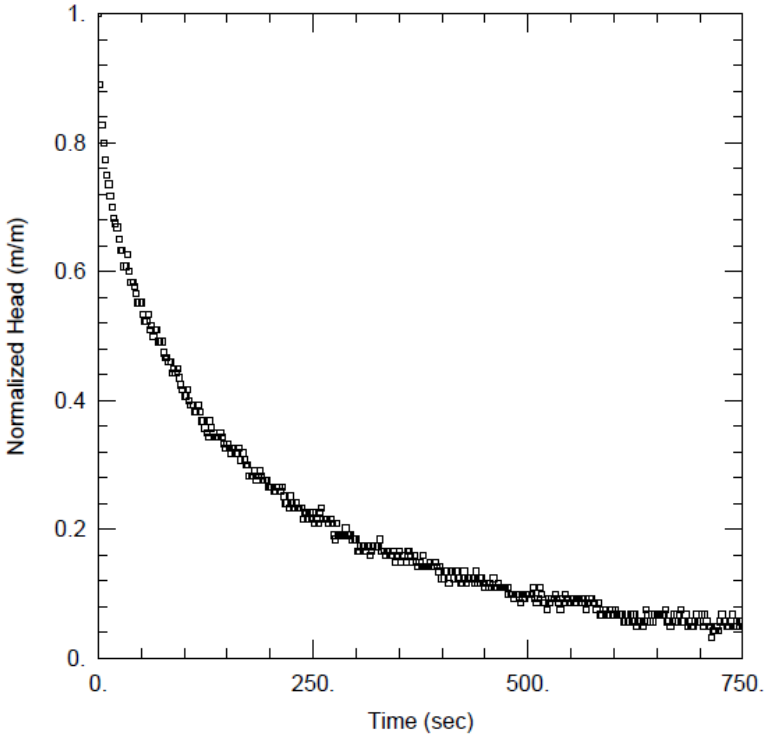
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	KB
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-3-1

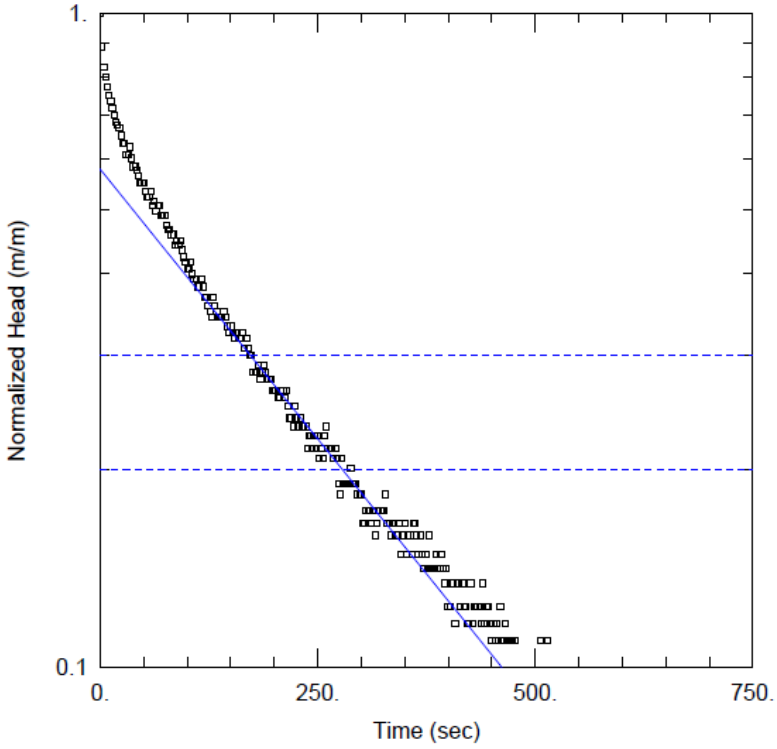
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-69

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-3-2
Date of Test:	September 23, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	8.32 mbgs
Initial Displacement:	0.17 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	4.90 m to 15.50 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

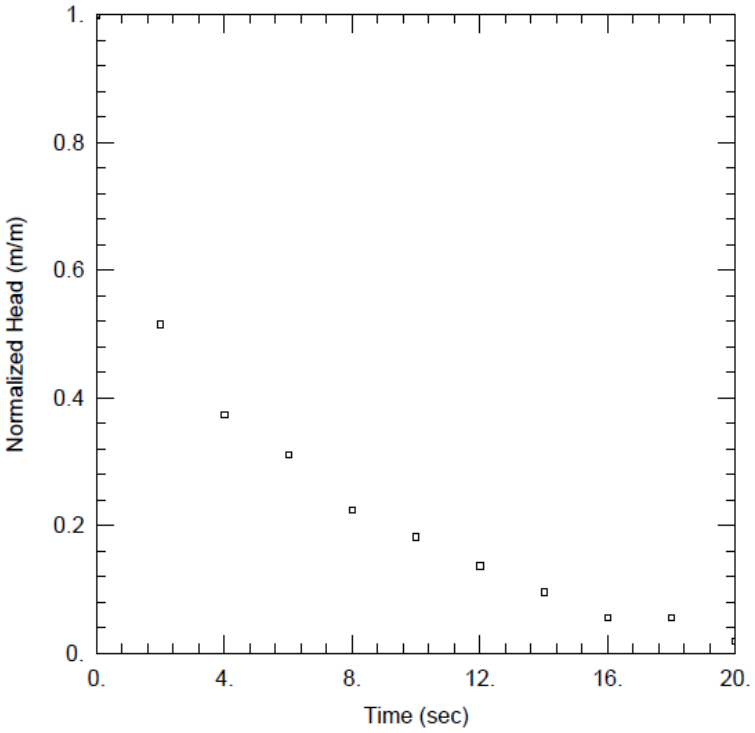
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-3-2

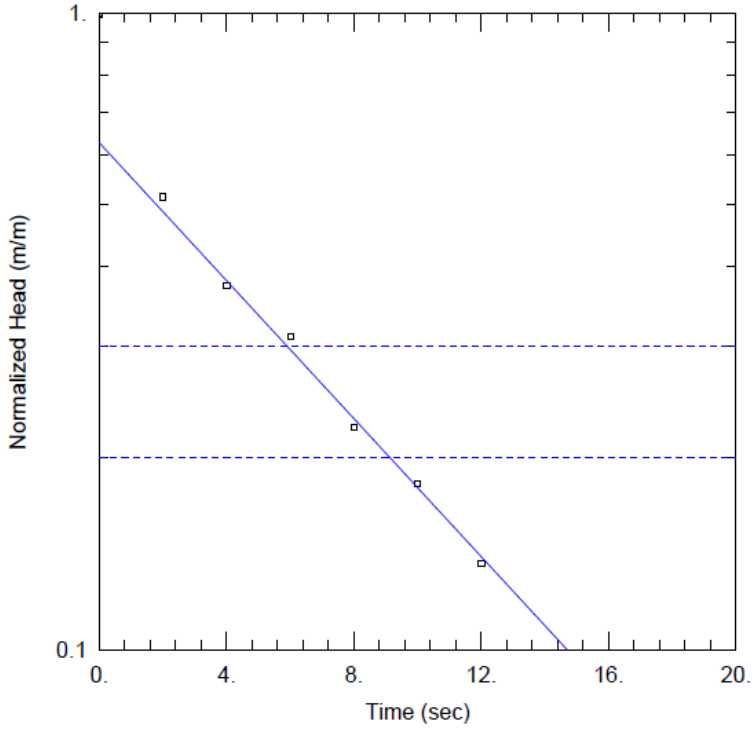
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-70

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-3-3
Date of Test:	September 29, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	12.46 mbgs
Initial Displacement:	0.13 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	9.10 m to 18.30 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

7×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

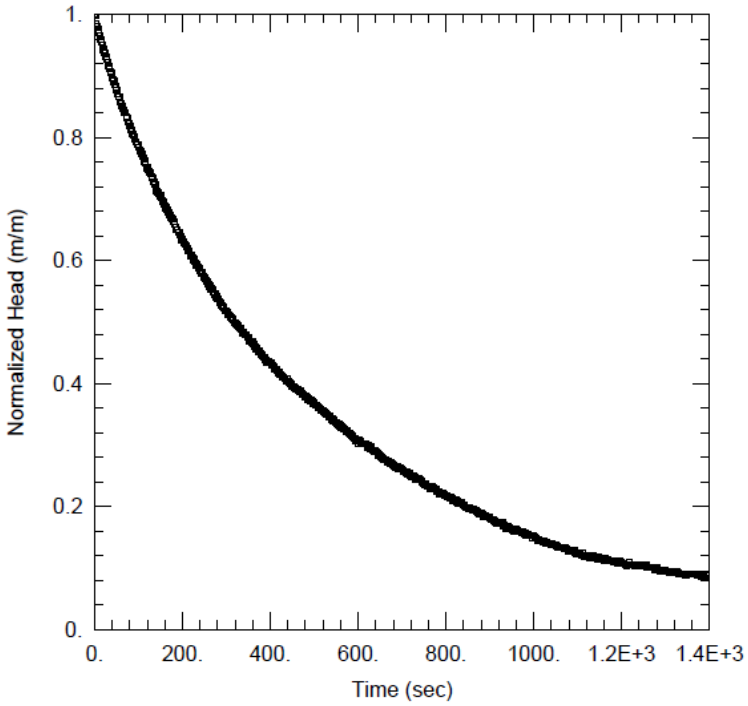
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-3-3

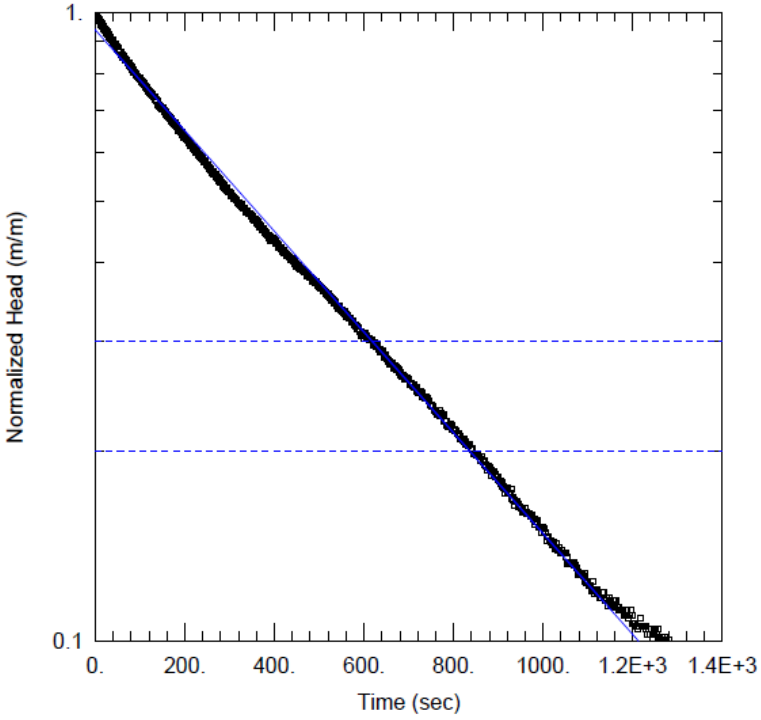
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-71

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-3-4
Date of Test:	September 23, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	6.05 mbgs
Initial Displacement:	0.95 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	5.20 m to 15.80 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

6×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

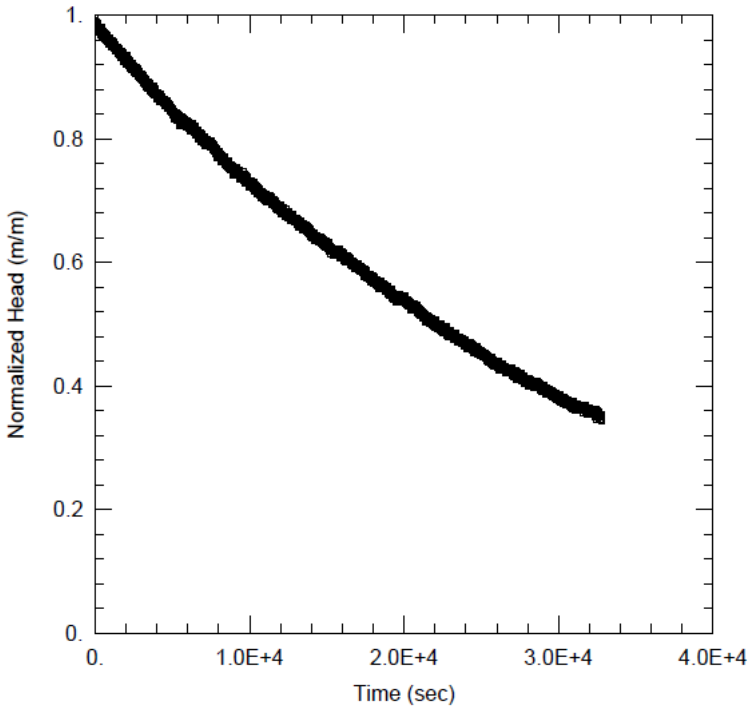
YYYY-MM-DD	2022-01-31
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-3-4

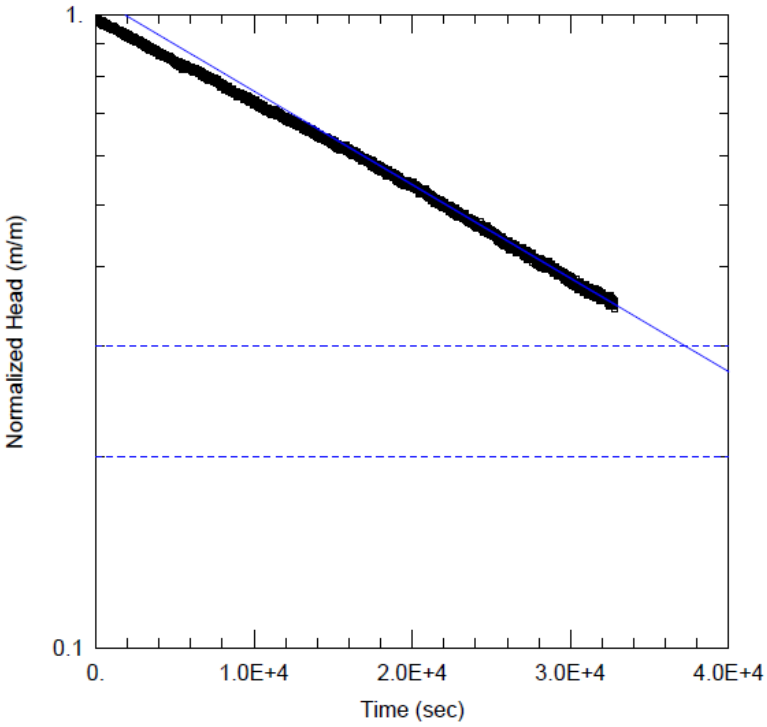
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-72

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	PW21-4
Date of Test:	September 1, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	12.82 mbgs
Initial Displacement:	0.70 m
Casing Radius:	0.069 m
Borehole Radius:	0.062 m
Open BH Interval:	9.25 m to 21.64 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

3×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

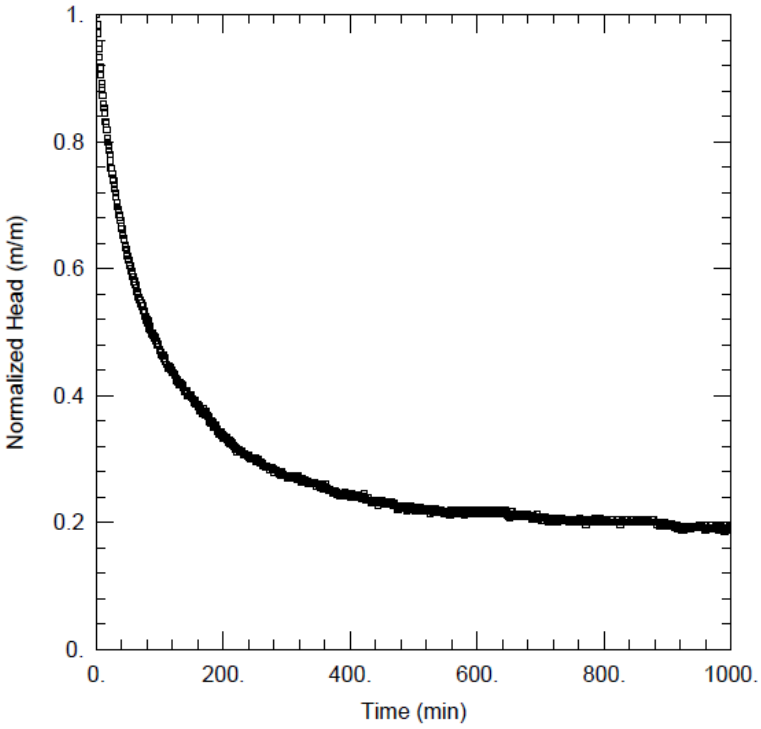
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL PW21-4

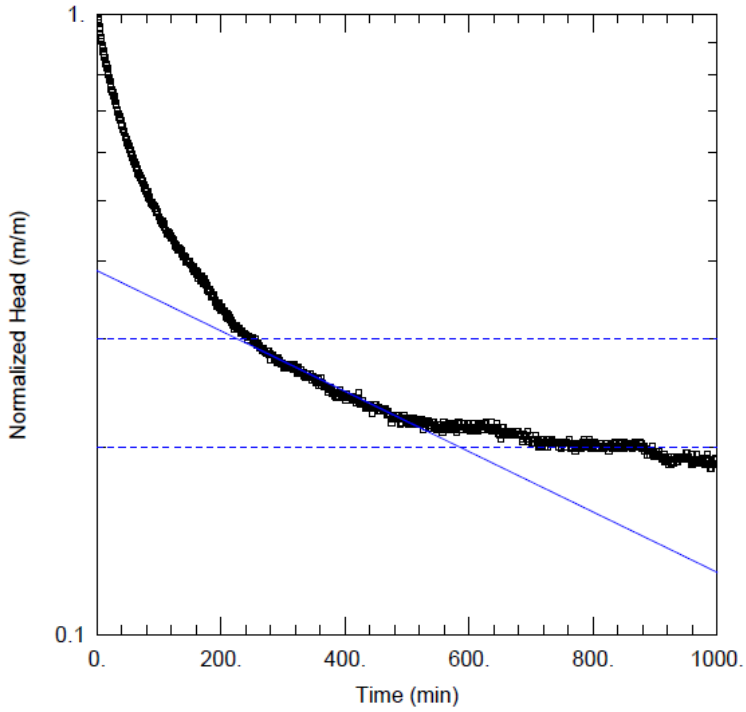
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-73

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	PW21-4A
Date of Test:	October 15, 2021
Test Type:	Rising Head Test
Test Method:	Development Recovery Rising Head Test
Static Water Level:	13.24 mbgs
Initial Displacement:	0.77 m
Casing Radius:	0.083 m
Borehole Radius:	0.076 m
Open BH Interval:	8.61 m to 21.64 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-8} m/s

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

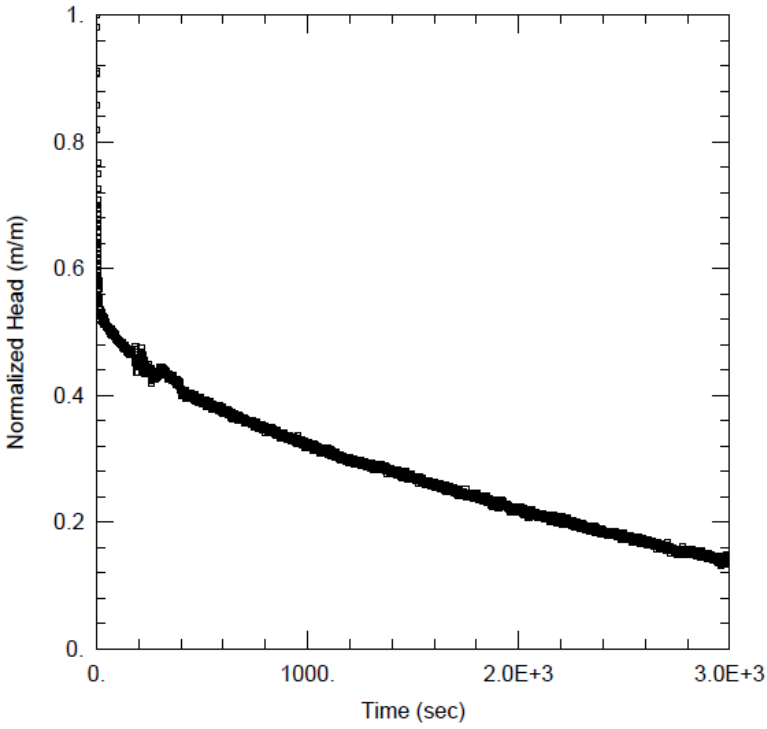
PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

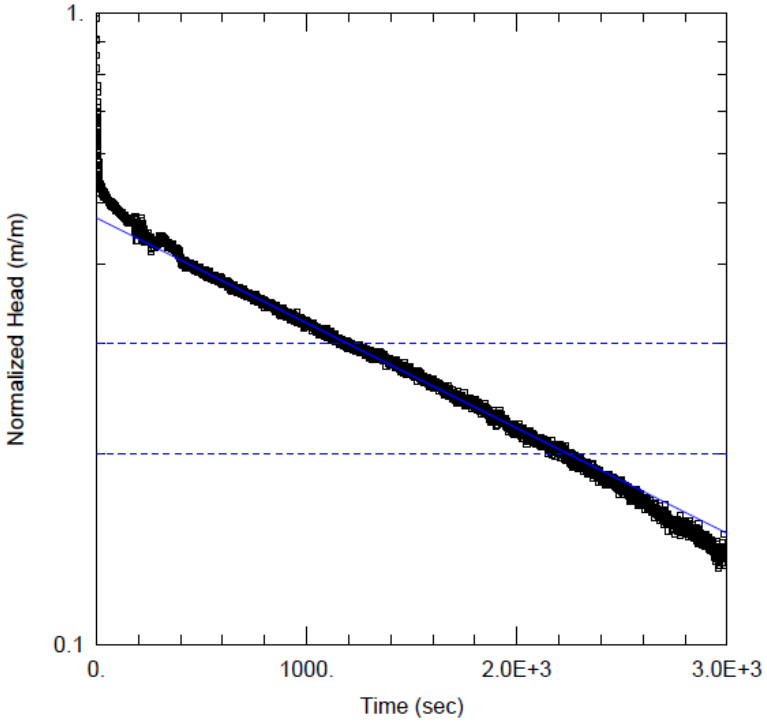
TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL PW21-4A

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-74



TEST INFORMATION:

Test Well:	MW21-4-1
Date of Test:	September 1, 2021
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	12.96 mbgs
Initial Displacement:	0.24 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	10.10 m to 17.70 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

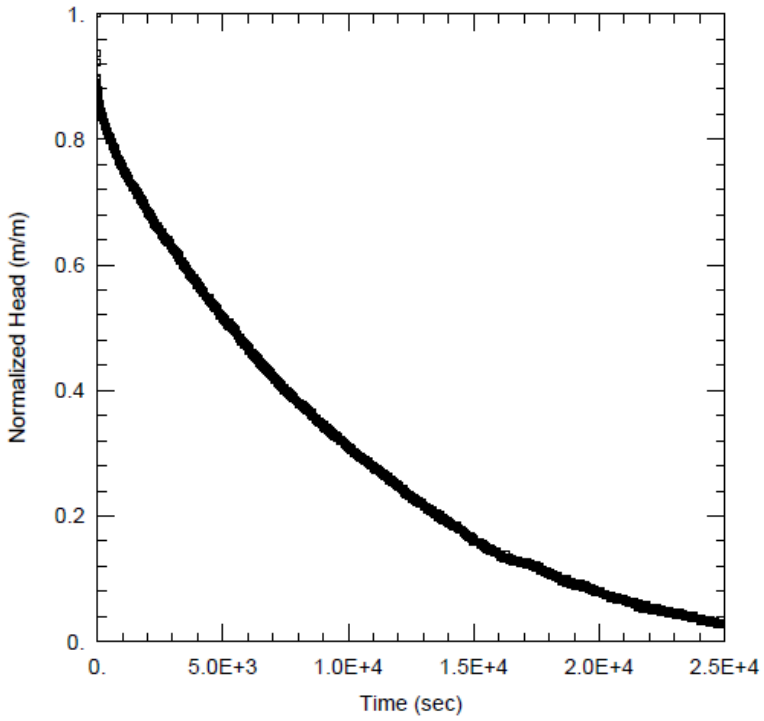
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-01
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-4-1

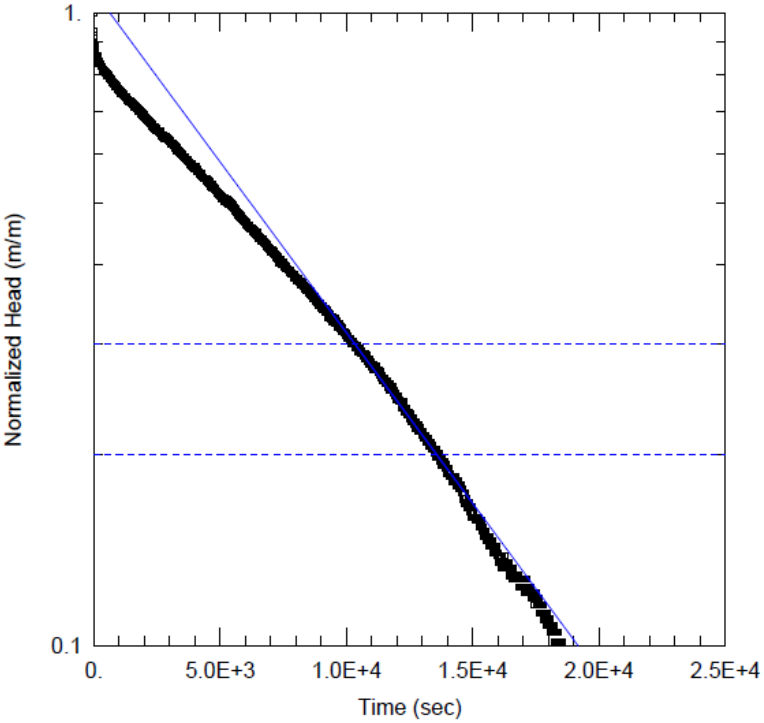
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-75

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-4-2
Date of Test:	September 1, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	13.52 mbgs
Initial Displacement:	1.16 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	11.00 m to 20.10 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

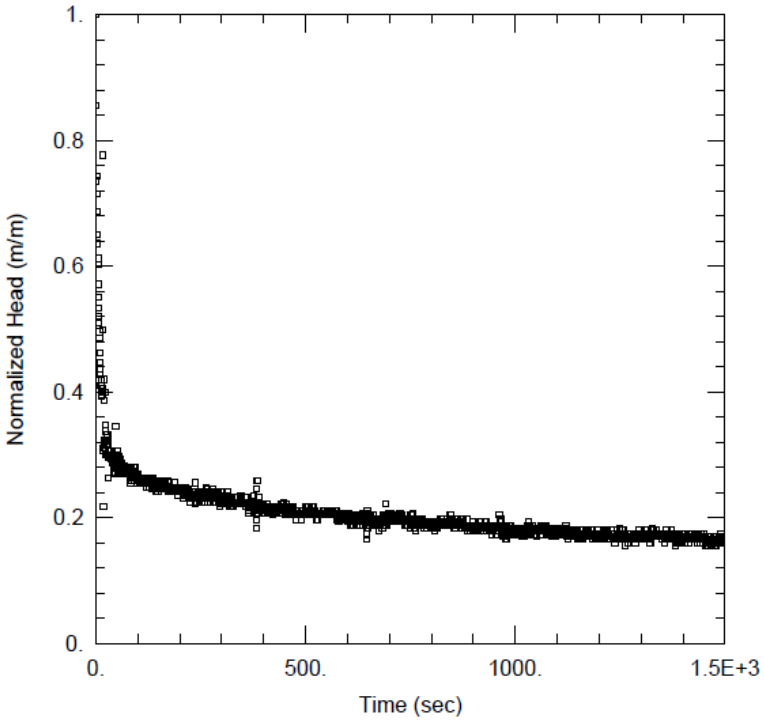
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-01
PREPARED	KB
DESIGN	KB
REVIEW	PGM
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW21-4-2

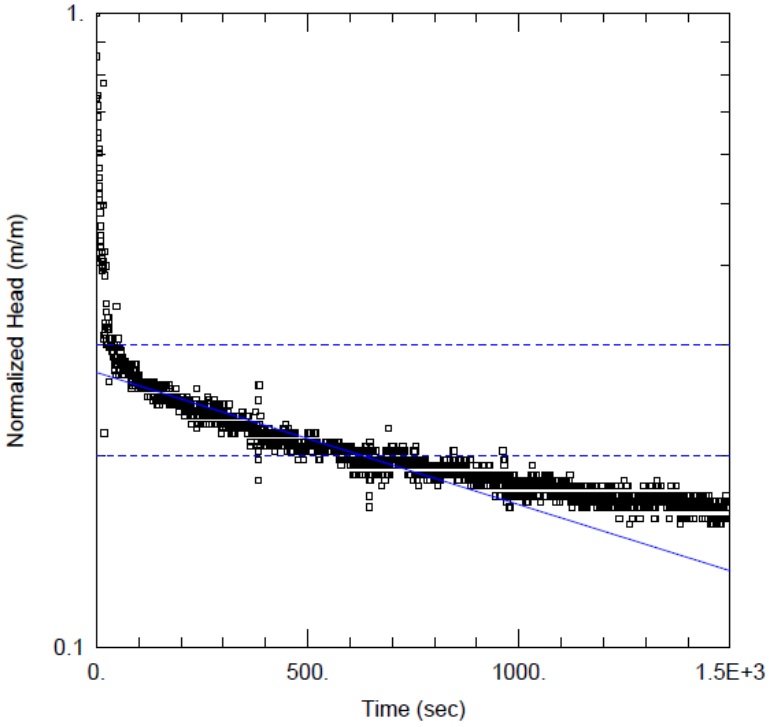
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-76

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW21-4-3
Date of Test:	December 9, 2021
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	11.61 mbgs
Initial Displacement:	0.27 m
Casing Radius:	0.025 m
Borehole Radius:	0.062 m
Well Screen Interval:	10.40 m to 19.50 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
PREPARED	AIM
DESIGN	AIM
REVIEW	PGM
APPROVED	###

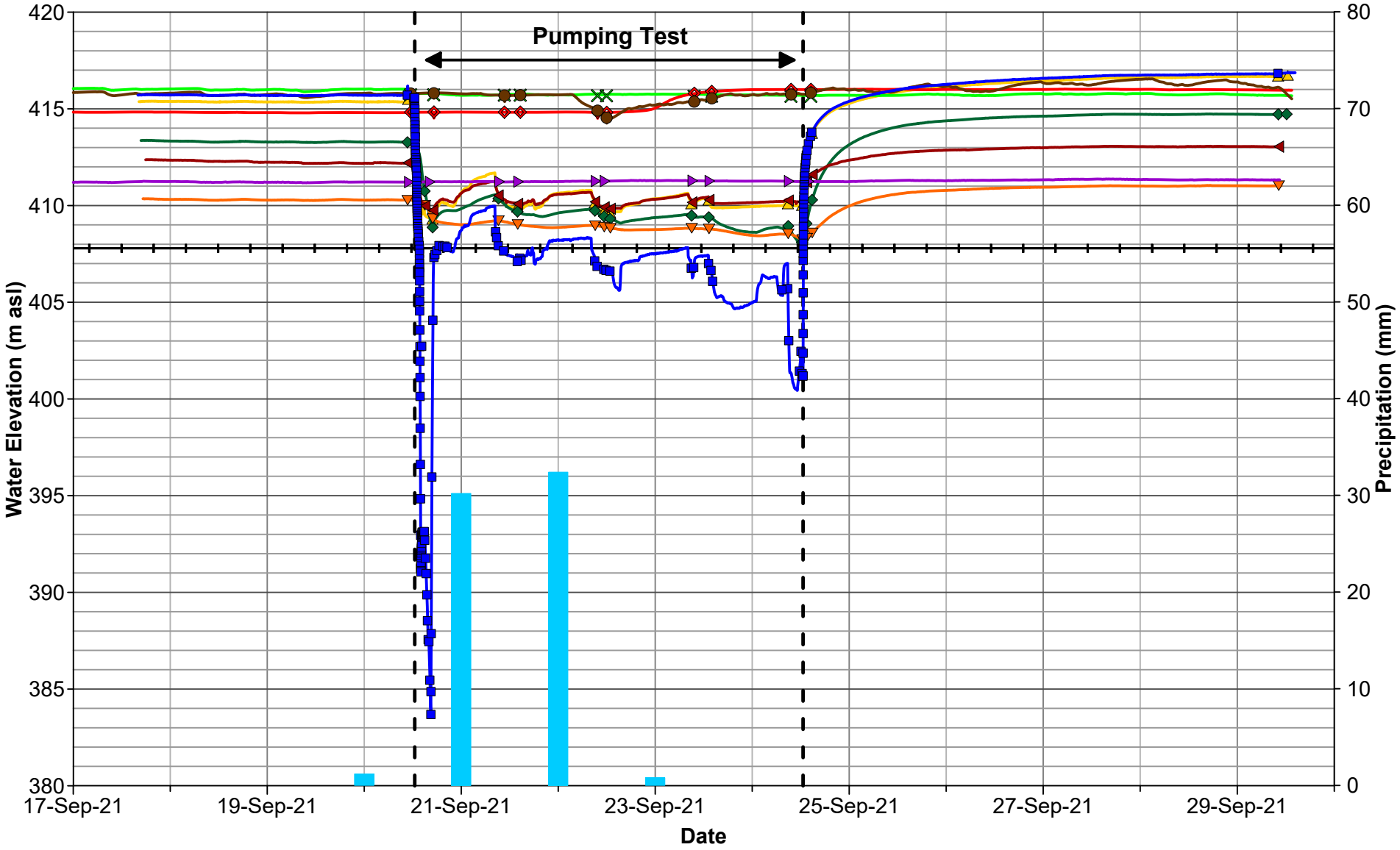
TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW21-4-3

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	G-77

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

APPENDIX H

Pumping Tests



PW21-1
MW21-1-1
MW21-1-2
MW21-1-3
MW21-1-4
BH2
MW20-15A
MW20-15B
MW20-15C
Precipitation (mm)
Bedrock Elevation

NOTE

Average pumping rate = 21.7 L/min
Top of rock as observed at PW21-1
Precipitation observed at Georgetown WWTP meteorological station (ID:6152695)

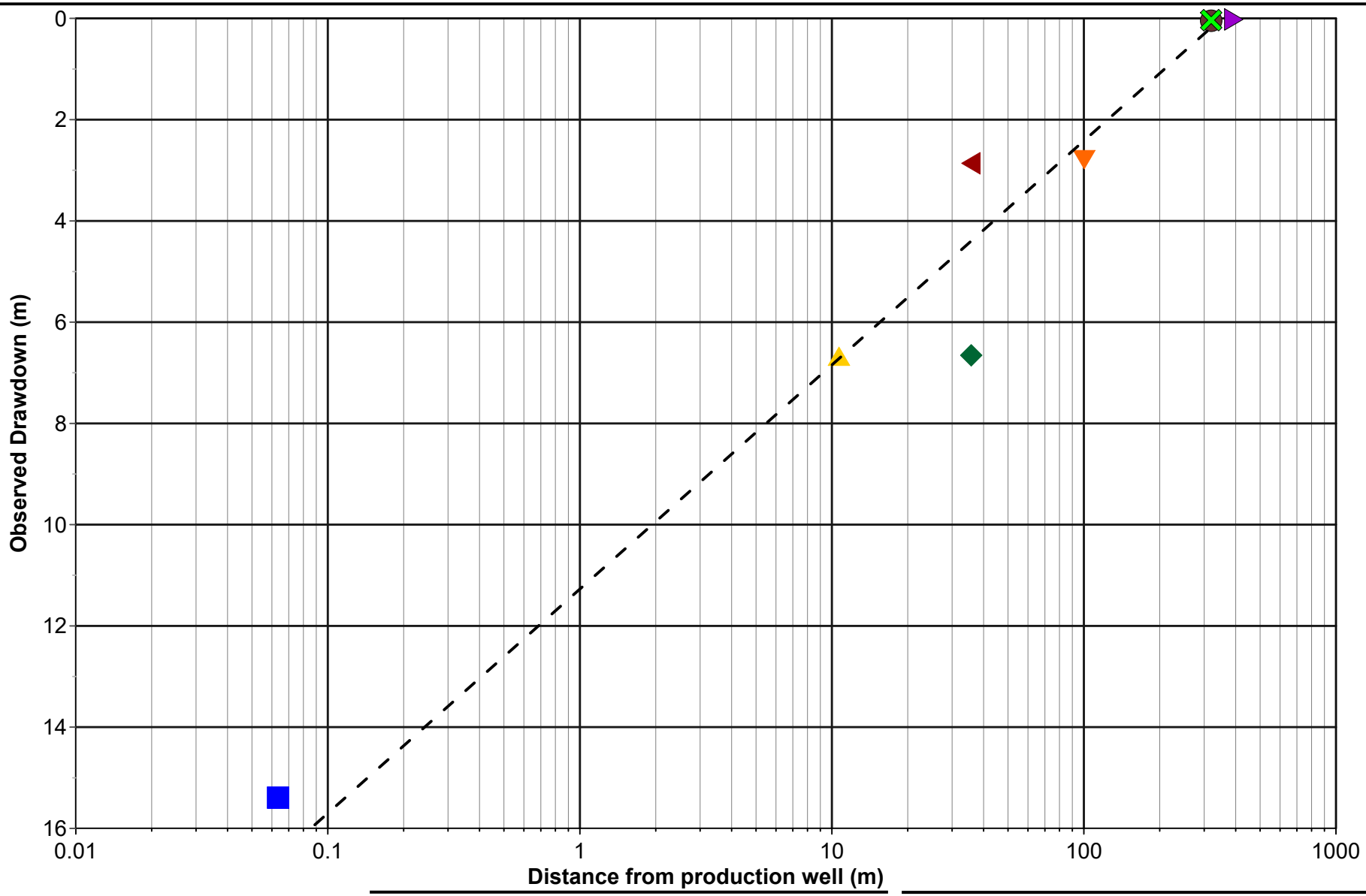
GOLDER
MEMBER OF WSP

DATE	March 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT CALEDON QUARRY

TITLE PW21-1 CONSTANT RATE TEST GROUNDWATER ELEVATION MONITORING

PROJECT NO.	REV	FIGURE
19129150	A	H-1



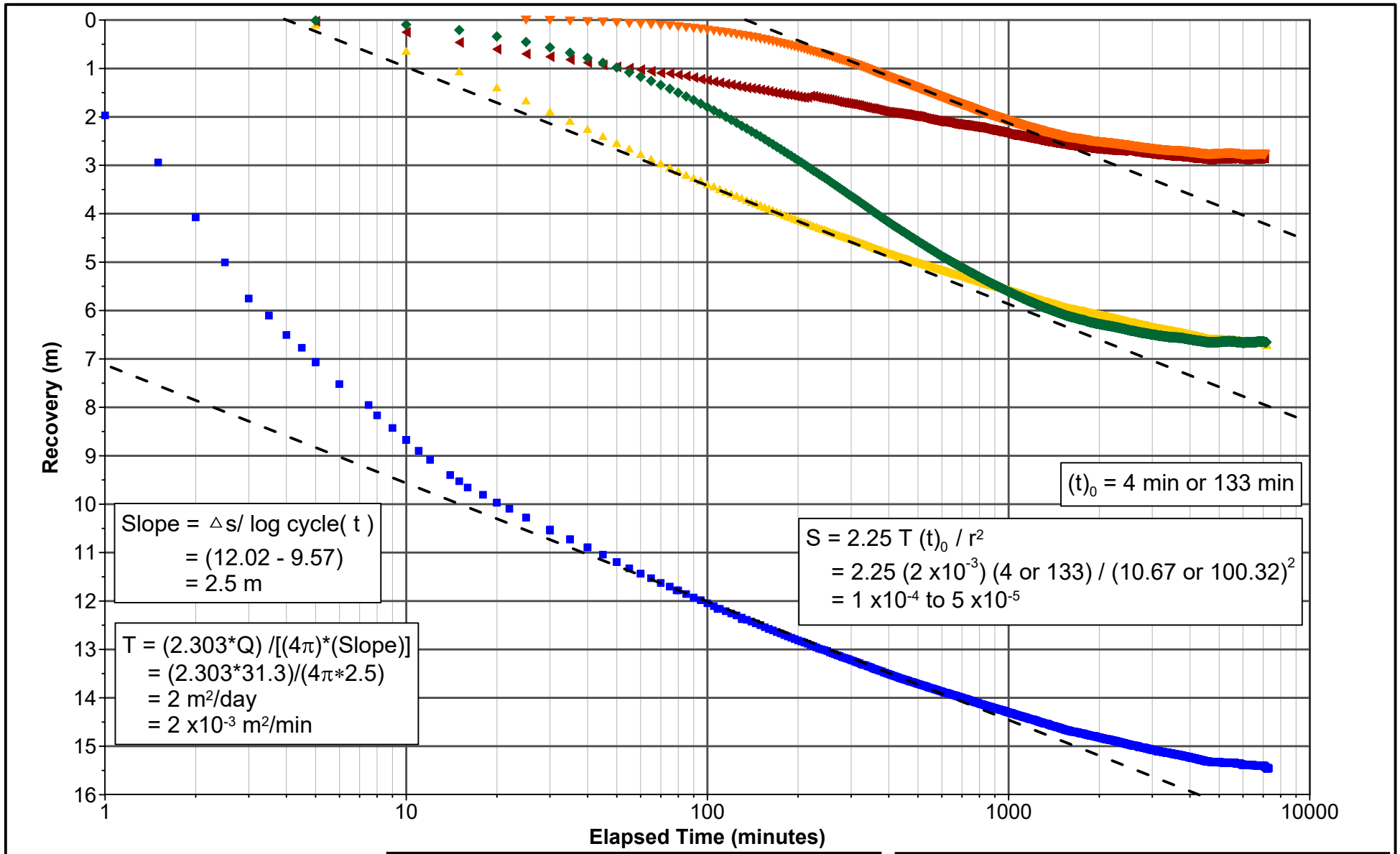
PROJECT **CBM CALEDON QUARRY**

TITLE **PW21-1 PUMPING TEST**
DRAWDOWN VERSUS DISTANCE

GOLDER
MEMBER OF WSP

DATE	December 2022
DESIGN	VRP
REVIEW	PGM
APPROVED	--

PROJECT NO.	REV	FIGURE
19129150	A	H-2



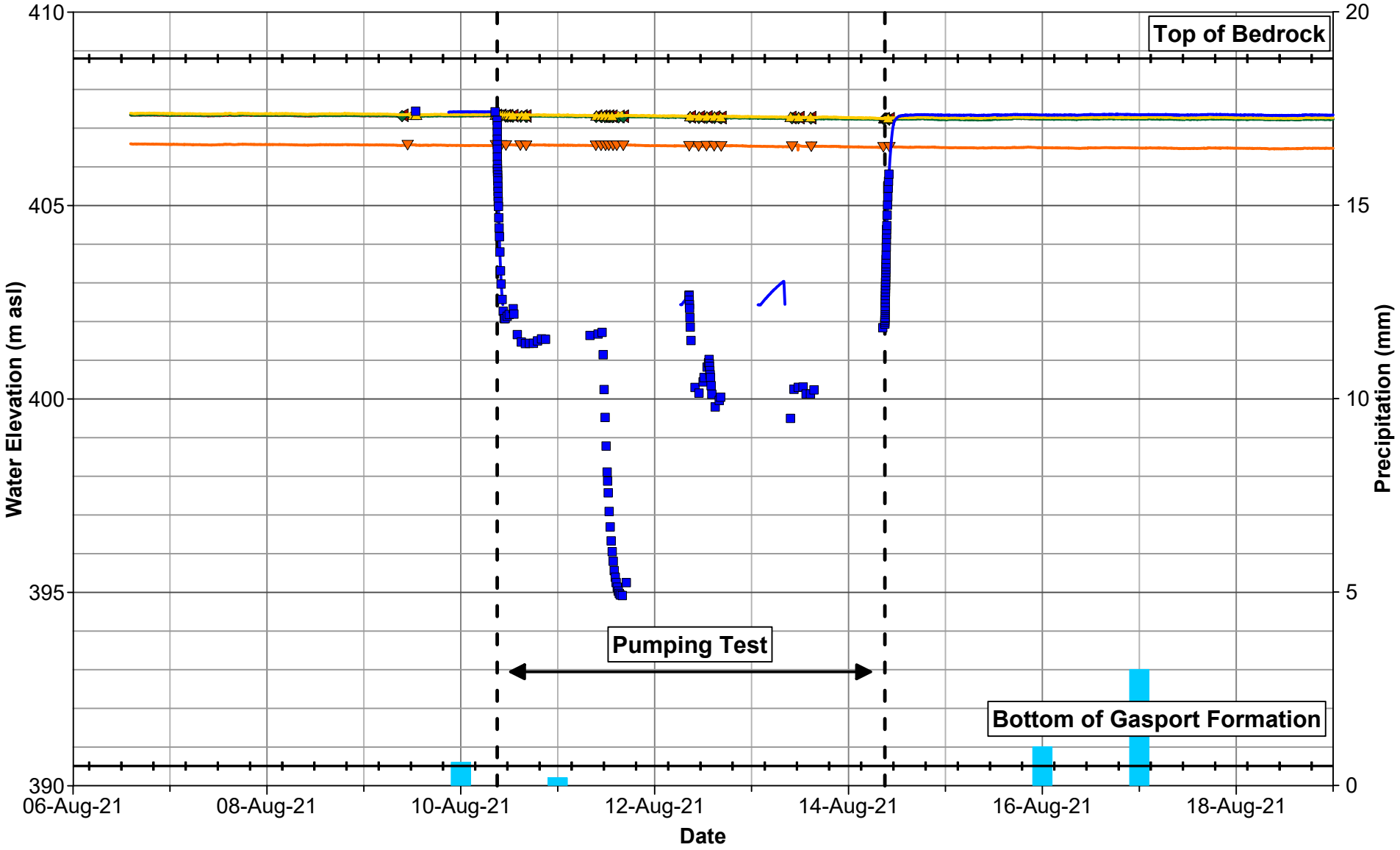
PROJECT **CALEDON QUARRY**

TITLE **PW21-1 CONSTANT RATE TEST RECOVERY VERSUS LOG TIME**

GOLDER
MEMBER OF WSP

DATE	March 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT NO.	REV	FIGURE
19129150	A	H-3



PW21-2
MW21-2-1
MW21-2-2
MW21-2-3
MW21-2-4
Precipitation (mm)
Bedrock Annotation

NOTE Average pumping rate = 2.2 L/min
Top of rock as observed at PW21-2
Precipitation observed at Georgetown WWTP meteorological station (ID:6152695)
PW21-2 transducer data discontinuous when elevation <402.4 masl

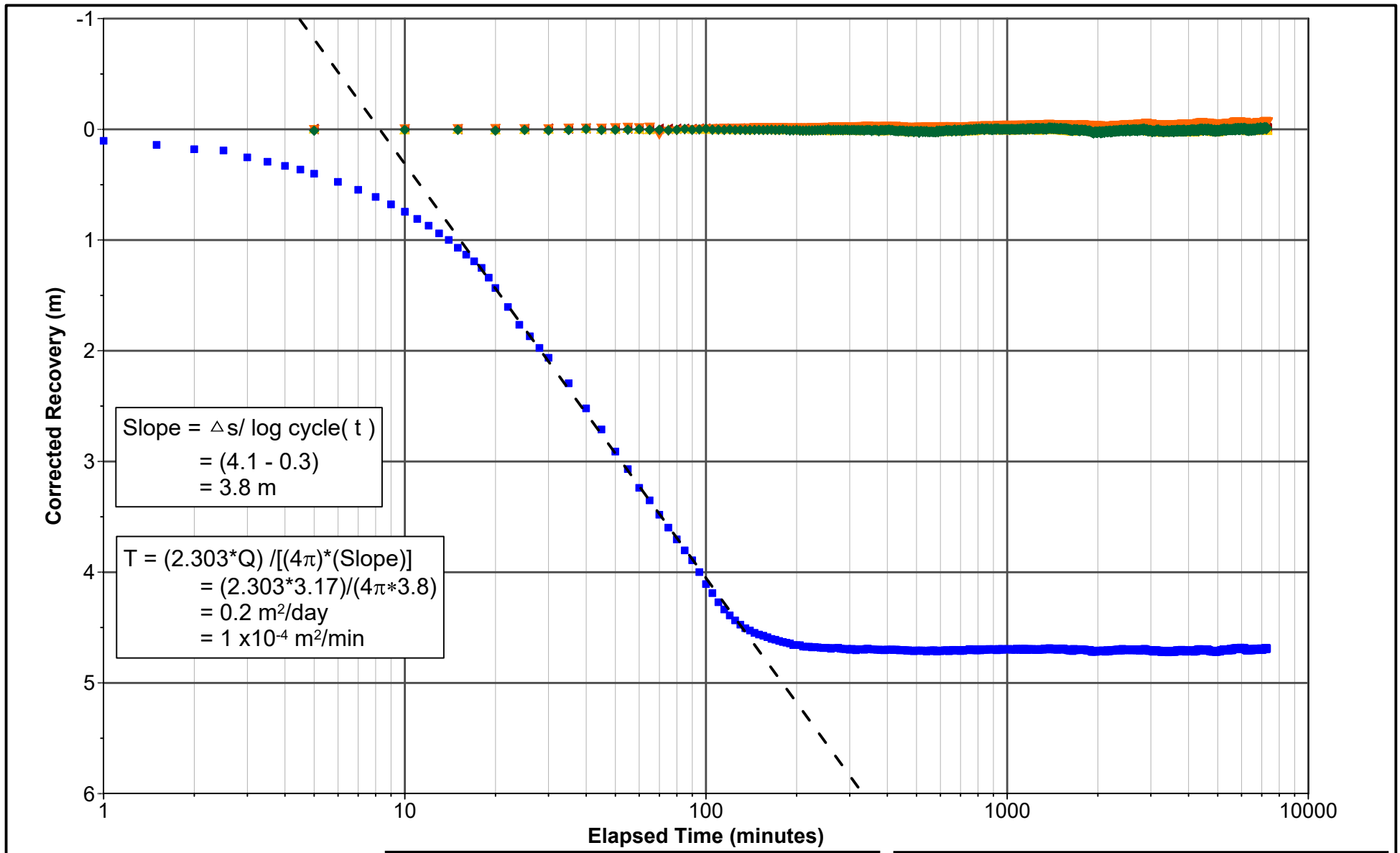
GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT CALEDON QUARRY

TITLE PW21-2 CONSTANT RATE TEST GROUNDWATER ELEVATION MONITORING

PROJECT NO.	REV	FIGURE
19129150	A	H-4



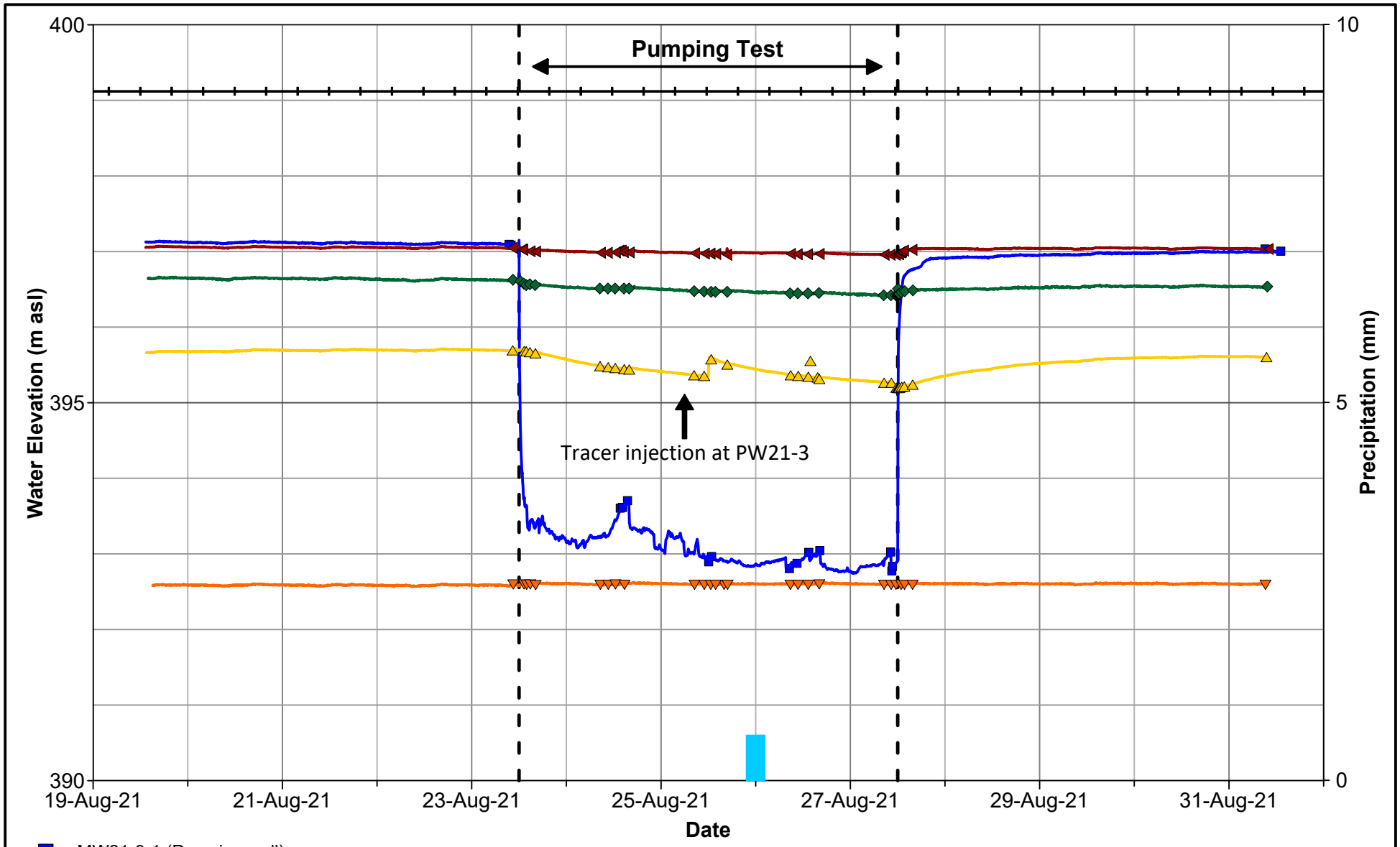
PROJECT **CALEDON QUARRY**

TITLE **PW21-2 CONSTANT RATE TEST**
CORRECTED RECOVERY VERSUS LOG TIME

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT NO.	REV	FIGURE
19129150	A	H-5



NOTE

Average pumping rate = 1.7 L/min
Top of rock as observed at MW21-3-1
Precipitation observed at Georgetown WWTP meteorological station (ID:6152695)

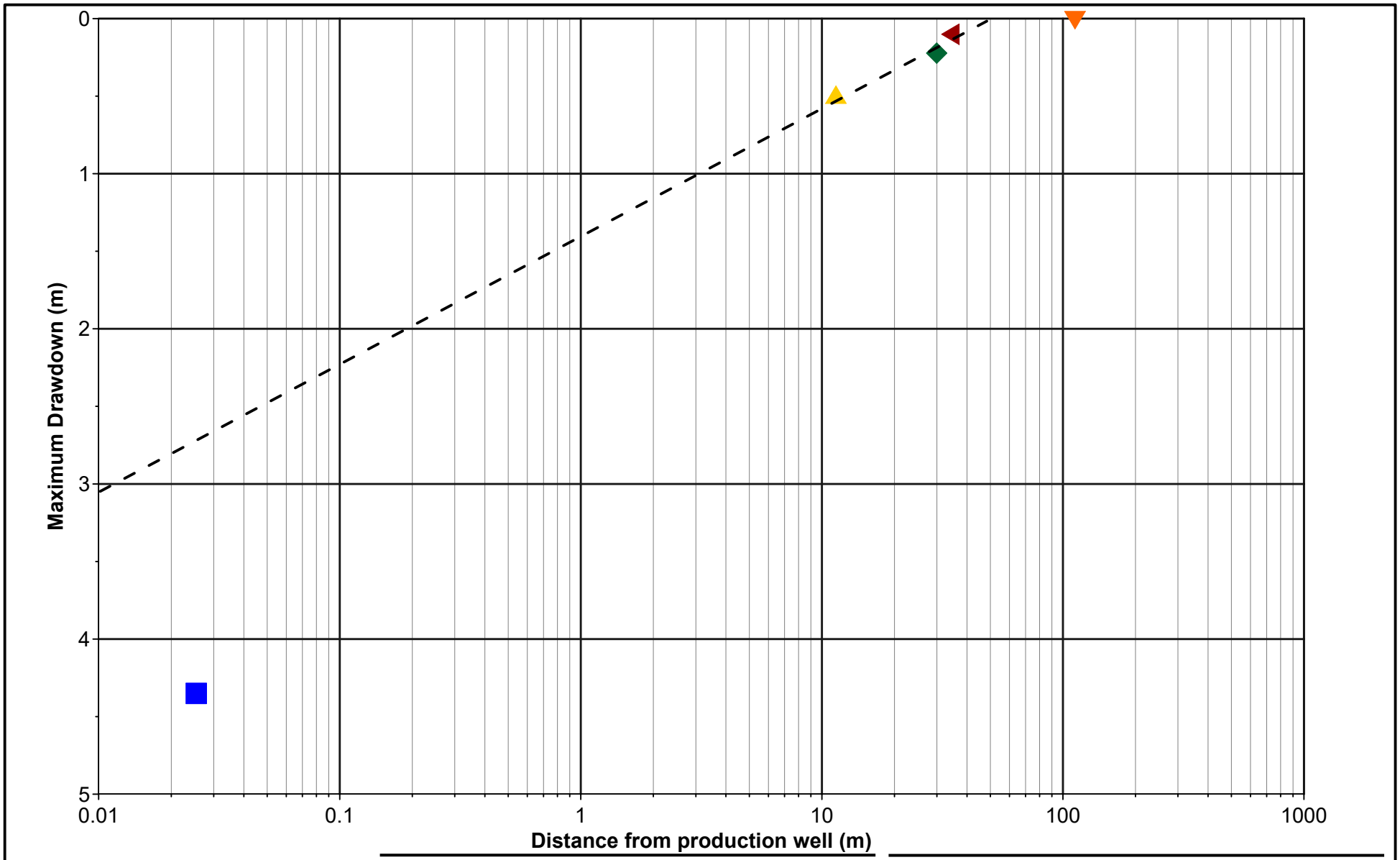
GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT CALEDON QUARRY

TITLE MW21-3-1 CONSTANT RATE TEST GROUNDWATER ELEVATION MONITORING

PROJECT NO.	REV	FIGURE
19129150	A	H-6



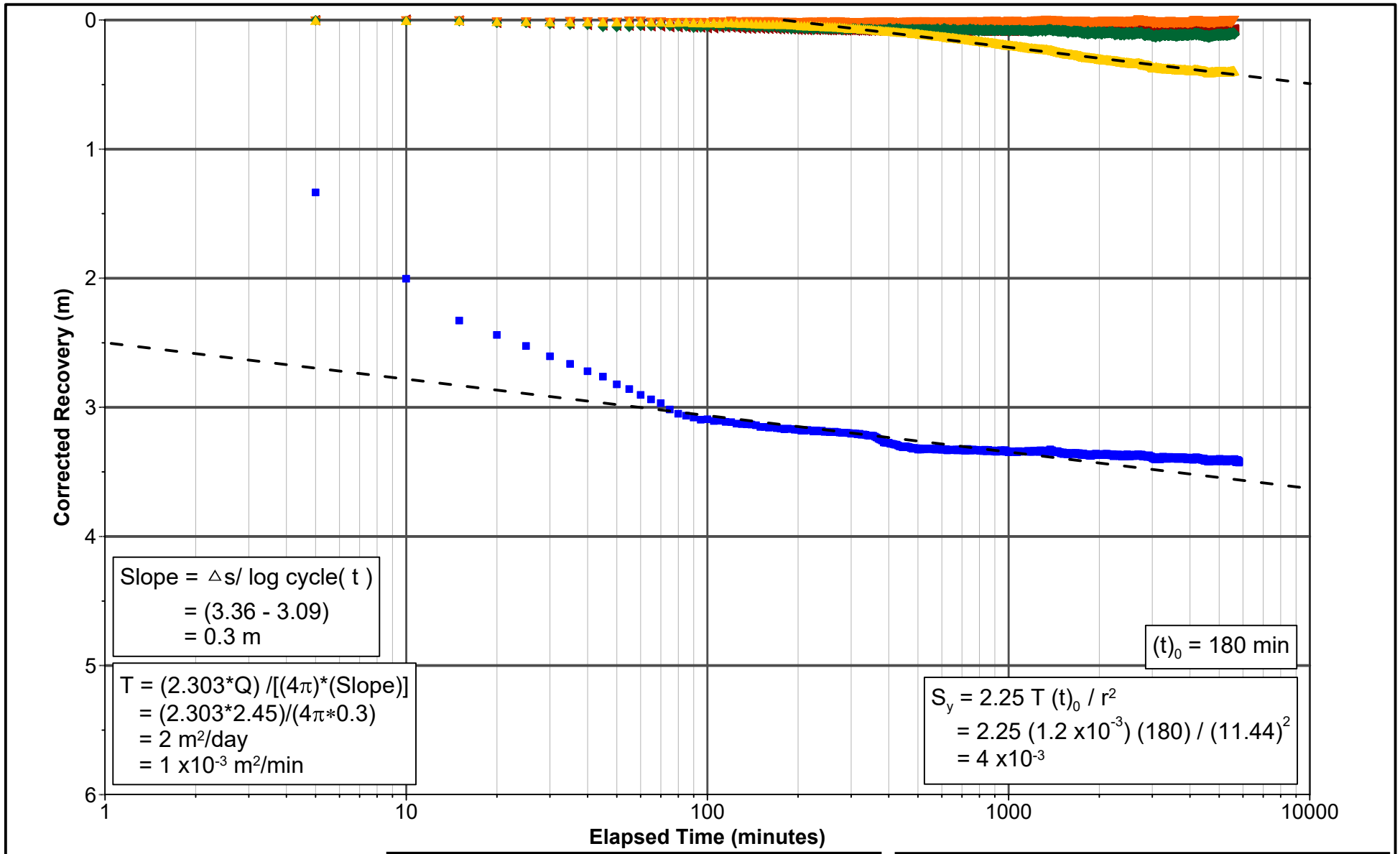
PROJECT **CALEDON QUARRY**

TITLE **MW21-3-1 CONSTANT RATE TEST DRAWDOWN VERSUS DISTANCE**

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT NO.	REV	FIGURE
19129150	A	H-7



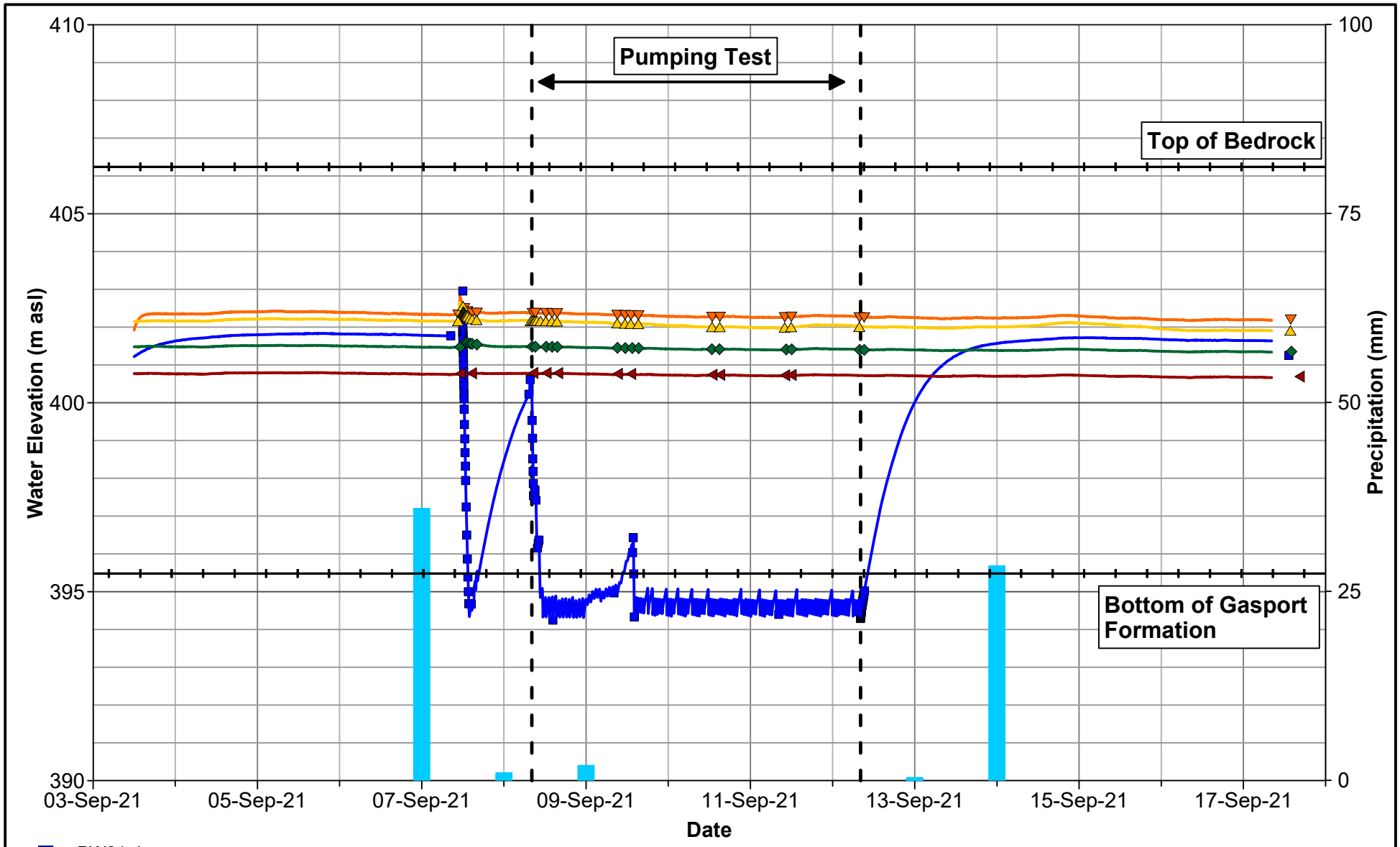
PROJECT **CALEDON QUARRY**

TITLE **MW21-3-1 CONSTANT RATE TEST**
CORRECTED RECOVERY VERSUS LOG TIME

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT NO.	REV	FIGURE
19129150	A	H-8



NOTE

Average pumping rate = 0.12 L/min
Top of rock as observed at PW21-4
Precipitation observed at Georgetown WWTP meteorological station (ID:6152695)

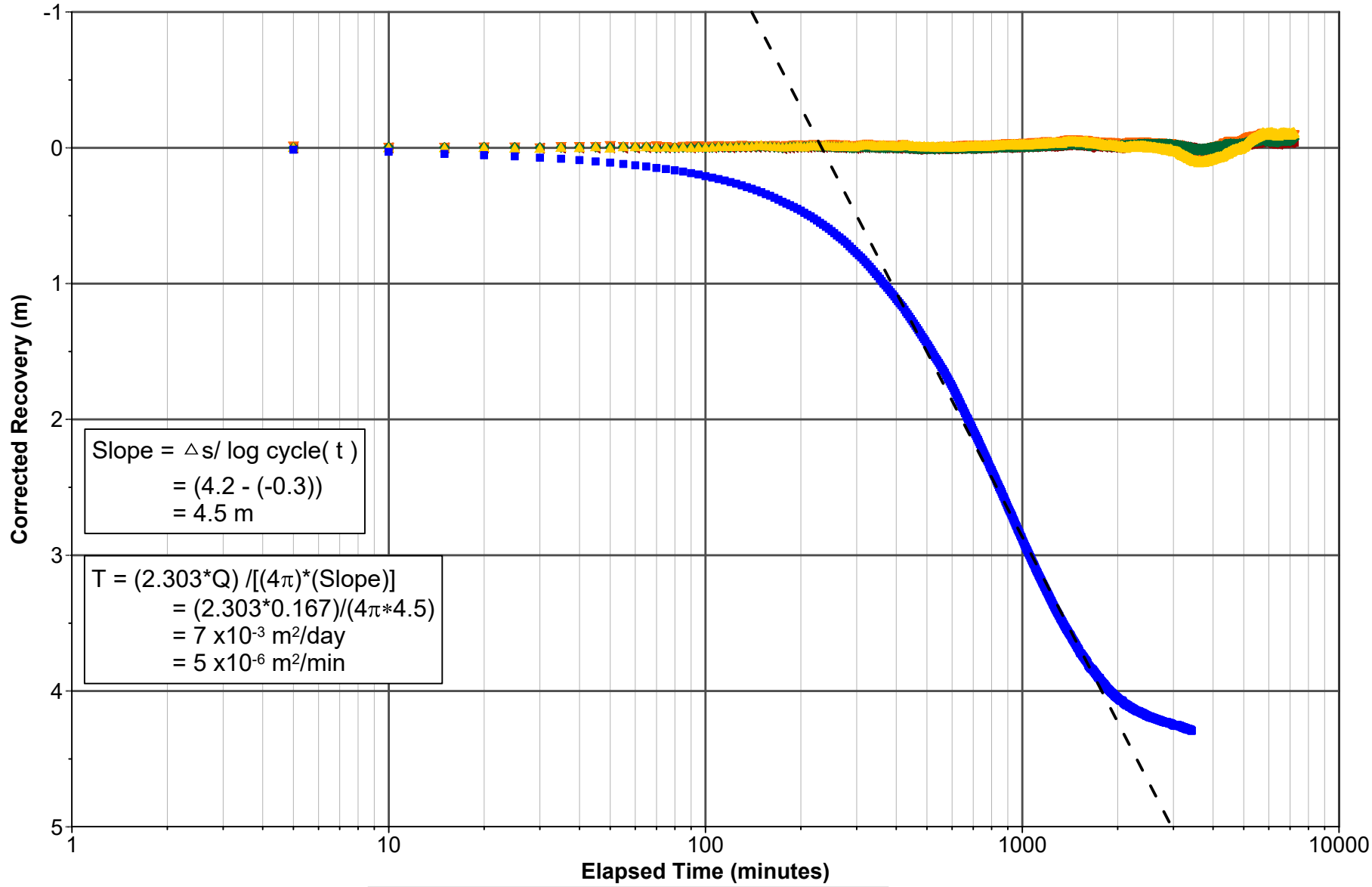
GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT CALEDON QUARRY

TITLE PW21-4 CONSTANT RATE TEST GROUNDWATER ELEVATION MONITORING

PROJECT NO.	REV	FIGURE
19129150	A	H-9



PROJECT **CALEDON QUARRY**

TITLE **PW21-4 CONSTANT RATE TEST**
CORRECTED RECOVERY VERSUS LOG TIME

GOLDER
MEMBER OF WSP

DATE	November 2022
DESIGN	VRP
REVIEW	PGM/GRP
APPROVED	--

PROJECT NO.	REV	FIGURE
19129150	A	H-10

APPENDIX I

Groundwater Quality

TABLE I-1
SUMMARY OF GROUNDWATER QUALITY RESULTS
CALEDON PIT / QUARRY

	Units	PWQO	ODWS				MECP	MW20-01 A	MW20-01B	MW20-02	MW20-03	MW20-04	MW20-05A	MW20-06A	MW20-06B	MW20-07A	MW20-07B	MW20-08A	MW20-08B	MW20-09	MW20-10A	MW20-10B
			MAC	IMAC	AO	OG	Table 2	22-Jun-21	22-Jun-21	22-Jun-21	22-Jun-21	22-Jun-21	22-Jun-21	22-Jun-21	22-Jun-21	21-Jun-21	21-Jun-21	21-Jun-21	21-Jun-21	23-Jun-21	24-Jul-21	24-Jul-21
Physical Tests (Water)																						
Anion Sum	me/L							11.0	8.68	7.55	7.21	8.34	7.09	8.04	6.89	7.85	9.08	9.16	13.1	6.84	8.43	8.14
Bicarb. Alkalinity (calc. as CaCO3)	mg/L							200	250	240	270	230	230	260	230	250	260	270	280	270	290	280
Calculated TDS	mg/L				500			690	460	410	380	460	380	440	370	410	500	490	720	360	460	450
Carb. Alkalinity (calc. as CaCO3)	mg/L							1.3	1.7	1.7	2.3	2.0	2.0	2.3	1.9	2.7	3.1	2.9	2.8	2.0	3.0	2.7
Cation Sum	me/L							11.7	8.24	7.40	7.18	8.38	6.94	8.20	6.82	7.75	9.08	9.23	13.2	6.73	8.45	8.41
Hardness (CaCO3)	mg/L					80-100		470	300	300	300	310	310	340	300	330	270	330	320	320	370	370
Ion Balance (% Difference)	%							2.81	2.62	1.00	0.190	0.210	1.11	1.02	0.520	0.610	0.00	0.400	0.690	0.850	0.0900	1.64
Langelier Index (@ 20C)	N/A							0.825	0.753	0.762	0.888	0.819	0.837	0.903	0.820	0.928	0.901	0.947	0.925	0.833	1.05	0.994
Langelier Index (@ 4C)	N/A							0.578	0.505	0.514	0.640	0.571	0.589	0.655	0.572	0.679	0.653	0.699	0.679	0.584	0.797	0.746
Saturation pH (@ 20C)	N/A							7.02	7.11	7.13	7.06	7.14	7.13	7.07	7.12	7.13	7.19	7.12	7.10	7.06	7.01	7.02
Saturation pH (@ 4C)	N/A							7.27	7.36	7.38	7.30	7.39	7.38	7.32	7.37	7.38	7.44	7.37	7.35	7.30	7.25	7.26
Inorganics																						
Total Ammonia-N	mg/L							0.90	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.28	0.10	<0.050	<0.050	0.081	<0.050
Unionized Ammonia	mg/L	20						<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	umho/cm							1000	840	730	680	810	680	760	670	740	870	900	1400	610	720	670
Dissolved Organic Carbon	mg/L				5			1.2	1.2	1.5	3.0	0.86	0.70	0.40	0.81	0.55	0.88	0.45	1.2	0.70	0.80	0.69
Orthophosphate (P)	mg/L							<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	pH	6.5-8.5				6.5-8.5		7.85	7.87	7.89	7.94	7.96	7.97	7.97	7.94	8.06	8.09	8.07	8.03	7.89	8.05	8.01
Dissolved Sulphate (SO4)	mg/L				500			310	24	33	22	20	39	26	16	40	20	22	17	16	22	18
Alkalinity (Total as CaCO3)[2]	mg/L					30-500		200	250	240	280	240	240	260	240	250	270	270	280	270	290	280
Dissolved Chloride (Cl-)	mg/L				250		790000	23	100	64	40	97	39	66	45	68	100	110	240	18	43	44
Nitrite (N)	mg/L		1.0					<0.010	<0.010	<0.010	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	<0.010
Nitrate (N)	mg/L		10.0					<0.10	3.87	3.85	1.85	6.24	6.28	6.44	8.03	0.73	5.20	3.65	4.31	7.61	13.0	13.1
Nitrate + Nitrite (N)	mg/L							<0.10	3.87	3.85	1.86	6.24	6.28	6.44	8.03	0.73	5.20	3.65	4.31	7.61	13.0	13.1
Metals[1]																						
Dissolved Aluminum (Al)	ug/L	75				100		**300**	17	<4.9	40	30	27	**230**	63	53	**92**	**120**	6.5	8.2	**150**	7.8
Dissolved Antimony (Sb)	ug/L	20		6			6	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Arsenic (As)	ug/L	100		10			25	9.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	7.9	<1.0	<1.0	<1.0	<1.0	1.4	<1.0
Dissolved Barium (Ba)	ug/L		1000				1000	15	42	55	75	41	110	30	19	56	34	41	31	19	46	25
Dissolved Beryllium (Be)	ug/L	1100					4	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Dissolved Boron (B)	ug/L	200		5000			5000	**680**	17	12	14	11	11	12	11	23	19	<10	<10	<10	11	10
Dissolved Cadmium (Cd)	ug/L	0.2	5				2.7	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Dissolved Calcium (Ca)	ug/L							150000	88000	87000	88000	88000	86000	94000	88000	81000	71000	82000	92000	88000	98000	99000
Dissolved Chromium (Cr)	ug/L	1[3]	50				50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	ug/L	1					3.8	0.56	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Copper (Cu)	ug/L	5			1000		87	<0.90	1.0	<0.90	<0.90	1.6	2.1	1.0	1.2	<0.90	2.8	**5.7**	1.6	1.1	1.2	<0.90
Dissolved Iron (Fe)	ug/L	300			300			**940**	<100	<100	<100	110	<100	**400**	<100	<100	<100	200	<100	<100	240	<100
Dissolved Lead (Pb)	ug/L	5	10				10	0.92	<0.50	<0.50	<0.50	0.63	<0.50	2.3	<0.50	<0.50	<0.50	1.1	<0.50	<0.50	1.2	<0.50
Dissolved Magnesium (Mg)	ug/L							22000	19000	20000	19000	21000	22000	27000	19000	30000	22000	30000	22000	25000	30000	29000
Dissolved Manganese (Mn)	ug/L				50			62	2.2	4.4	120	5.9	3.9	36	3.9	26	46	15	<2.0	<2.0	17	<2.0
Dissolved Molybdenum (Mo)	ug/L	40					70	1.6	<0.50	0.87	7.3	<0.50	<0.50	<0.50	<0.50	1.5	5.5	0.56	<0.50	<0.50	0.64	<0.50
Dissolved Nickel (Ni)	ug/L	25					100	2.2	<1.0	1.8	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	2.8	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Phosphorus (P)	ug/L	30						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Dissolved Potassium (K)	ug/L							11000	1300	1700	2100	1600	1500	2000	1200	2400	1500	880	920	1100	1200	1100
Dissolved Selenium (Se)	ug/L	100	50				10	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	ug/L							4200	2700	3100	4100	2900	2600	3500	2300	3900	3700	3900	2700	4300	4800	4700
Dissolved Silver (Ag)	ug/L	0.1					1.5	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Dissolved Sodium (Na)	ug/L				200000		490000	42000	52000	32000	26000	51000	17000	29000	20000	26000	83000	61000	160000	6400	25000	24000
Dissolved Strontium (Sr)	ug/L							5800	160	220	190	180	1400	320	100	2600	220	230	160	140	960	150
Dissolved Thallium (Tl)	ug/L	0.3					2	<0.050	<0.050	<0.050	<0.050	<0.050	0.065	<0.050	<0.050	0.056	0.079	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Titanium (Ti)	ug/L							7.7	<5.0	<5.0	7.3	<5.0	<5.0	11	<5.0	<5.0	<5.0	6.8	<5.0	<5.0	7.0	<5.0
Dissolved Uranium (U)	ug/L	5	20				20	0.23	0.33	0.57	0.77	0.22	0.23	0.25	0.13	0.53	1.2	0.88	0.21	0.14	0.98	0.14
Dissolved Vanadium (V)	ug/L	6					6.2	0.55	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Zinc (Zn)	ug/L	20			5000		1100	<5.0	<5.0	<5.0	<5.0	<5.0	5.5	10	<5.0	<5.0	9.5	9.3	<5.0	<5.0	<5.0	<5.0
BTEX & F1 Hydrocarbons																						
Benzene	ug/L	100	1				5		<0.20	<0.20	<0.20	<0.20			<0.20		<0.20		<0.20	<0.20		<0.20
Toluene	ug/L	1	60		24		24		<0.20	<0.20	<0.20	<0.20			<0.20		<0.20		<0.20	<0.20		<0.20
Ethylbenzene	ug/L	8	140		1.6		2.4		<0.20	<0.20	<0.20	<0.20			<0.20		<0.20		<0.20	<0.20		<0.20
o-Xylene	ug/L	40							<0.20	<0.20	<0.20	<0.20			<0.20		<0.20		<0.20	<0.20		<0.20
p+m-Xylene	ug/L	32[4]							<0.40	<0.40	<0.40	<0.40			<0.40		<0.40		<0.40	<0.40		<0.40
Total Xylenes	ug/L		90		20		300		<0.40	<0.40	<0.40	<0.40			<0.40		<0.40		<0.40	<0.40		<0.40
F1 (C6-C10)	ug/L								<25	<25	<25	<25			<25		<25		<25	<25		<25
F1 (C6-C10) - BTEX	ug/L						750		<25	<25	<25	<25			<25		<25		<25	<25		<25
F2-F4 Hydrocarbons																						
F2 (C10-C16 Hydrocarbons)	ug/L						150		<100	<100	<100	<100			<100		<100		<100	<100		<100
F3 (C16-C34 Hydrocarbons)	ug/L						500		<200	<200	<200	<200			<200		360		<200	<200		<200
F4 (C34-C50 Hydrocarbons)	ug/L						500		<200	<200	<200	<200			<200		<200		<200	<200		<200

Exceedance of PWQO Criteria	**620**
Exceedance of ODWS Criteria	310
Exceedance of MECP Table 2 Criteria	500

1) PWQO metals standards apply to unfiltered surface water samples. Included here for comparison to filtered groundwater samples.
2) Alkalinity should not be decreased by more than 25% of the natural concentration
3) 1 CrVI or 8.9 CrIII
4) 2-m and 30-p Xylenes

TABLE I-1
SUMMARY OF GROUNDWATER QUALITY RESULTS
CALEDON PIT / QUARRY

	Units	PWQO	ODWS				MECP	MW20-11A	MW20-11B	MW20-12A	MW20-12B	MW20-13A	MW20-13B	MW20-13C	MW20-14A	MW20-14B	MW20-15A	MW20-15B	MW20-15C	MW20-16A	MW20-16B	MW20-17A
			MAC	IMAC	AO	OG	Table 2	24-Jul-21	24-Jul-21	24-Jul-21	24-Jul-21	24-Jul-21	24-Jul-21	24-Jul-21	17-Feb-21	17-Feb-21	25-Jun-21	25-Jun-21	25-Jun-21	28-Jun-21	28-Jun-21	22-Jun-21
Physical Tests (Water)																						
Anion Sum	me/L							6.95	18.3	6.36	6.65	4.60	4.56	6.69	15.6	6.52	28.8	6.49	6.46	5.57	6.43	9.25
Bicarb. Alkalinity (calc. as CaCO3)	mg/L							250	380	260	260	190	190	280	200	240	190	210	290	200	240	210
Calculated TDS	mg/L				500			370	1000	340	350	240	240	340	980	340	1900	370	360	290	350	560
Carb. Alkalinity (calc. as CaCO3)	mg/L							4.7	3.6	2.9	2.9	2.7	3.6	5.0	2.3	3.2	1.2	2.0	2.7	3.2	5.2	2.4
Cation Sum	me/L							6.91	19.2	6.36	6.78	4.45	4.54	6.72	15.3	6.35	30.6	6.63	8.40	5.04	6.56	9.80
Hardness (CaCO3)	mg/L					80-100		230	430	300	300	200	200	320	630	300	1000	320	400	230	180	440
Ion Balance (% Difference)	%							0.290	2.27	0.0300	0.920	1.66	0.250	0.160	1.11	1.28	3.06	1.11	13.0	4.96	1.02	2.89
Langelier Index (@ 20C)	N/A							0.959	1.11	0.942	0.960	0.693	0.806	1.12	1.11	0.957	0.996	0.803	0.985	0.842	0.822	1.05
Langelier Index (@ 4C)	N/A							0.710	0.868	0.693	0.712	0.444	0.556	0.874	0.864	0.708	0.753	0.555	0.736	0.593	0.573	0.797
Saturation pH (@ 20C)	N/A							7.34	6.89	7.14	7.11	7.49	7.50	7.15	6.96	7.19	6.86	7.21	7.01	7.38	7.54	7.05
Saturation pH (@ 4C)	N/A							7.59	7.14	7.39	7.36	7.74	7.75	7.40	7.20	7.44	7.10	7.45	7.26	7.63	7.78	7.30
Inorganics																						
Total Ammonia-N	mg/L							0.081	<0.050	<0.050	<0.050	0.21	<0.050	0.11	1.2	<0.050	1.5	0.052	<0.050	0.063	0.23	0.19
Unionized Ammonia	mg/L	20						<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	umho/cm							670	1800	550	600	410	410	580	1300	600	2500	630	600	520	590	850
Dissolved Organic Carbon	mg/L				5			0.61	1.0	<0.40	0.68	<0.40	<0.40	1.3	0.52	0.65	1.7	0.46	0.52	0.66	2.5	1.9
Orthophosphate (P)	mg/L							<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	pH	6.5-8.5				6.5-8.5		8.30	8.01	8.08	8.07	8.18	8.30	8.27	8.07	8.14	7.85	8.01	7.99	8.22	8.36	8.09
Dissolved Sulphate (SO4)	mg/L				500			42	37	26	13	37	31	33	540	33	1200	110	25	58	29	230
Alkalinity (Total as CaCO3)[2]	mg/L					30-500		250	380	260	260	190	190	290	210	240	190	210	290	210	250	210
Dissolved Chloride (Cl-)	mg/L				250		790000	35	350	7.4	35	1.4	1.1	3.0	6.4	15	11	2.1	3.4	8.5	32	9.5
Nitrite (N)	mg/L		1.0					0.013	<0.010	<0.010	<0.010	<0.010	<0.010	0.133	0.027	<0.010	0.039	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate (N)	mg/L		10.0					0.18	2.73	4.91	2.45	<0.10	<0.10	1.76	0.21	7.35	0.31	<0.10	<0.10	<0.10	<0.10	<0.10
Nitrate + Nitrite (N)	mg/L							0.19	2.73	4.91	2.45	<0.10	<0.10	1.89	0.23	7.35	0.35	<0.10	<0.10	<0.10	<0.10	<0.10
Metals[1]																						
Dissolved Aluminum (Al)	ug/L	75				100		28	**520**	<4.9	6.1	12	5.9	7.7	18	5.8	**200**	<4.9	**600**	5.8	6.6	**80**
Dissolved Antimony (Sb)	ug/L	20		6			6	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.2	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Arsenic (As)	ug/L	100		10			25	5.9	<1.0	<1.0	<1.0	2.7	2.6	<1.0	3.0	<1.0	23	2.0	7.3	8.2	5.8	33
Dissolved Barium (Ba)	ug/L		1000				1000	96	61	52	30	43	57	37	30	38	24	19	170	42	73	31
Dissolved Beryllium (Be)	ug/L	1100					4	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Dissolved Boron (B)	ug/L	200		5000			5000	46	15	12	<10	67	56	27	**640**	<10	**720**	60	31	53	53	160
Dissolved Cadmium (Cd)	ug/L	0.2	5				2.7	<0.090	**0.25**	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Dissolved Calcium (Ca)	ug/L							49000	120000	74000	80000	43000	41000	66000	190000	72000	330000	81000	92000	53000	32000	130000
Dissolved Chromium (Cr)	ug/L	1[3]	50				50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	ug/L	1					3.8	0.63	**1.2**	<0.50	<0.50	<0.50	<0.50	0.89	<0.50	<0.50	0.60	<0.50	**1.4**	<0.50	<0.50	**1.1**
Dissolved Copper (Cu)	ug/L	5			1000		87	<0.90	**5.3**	<0.90	<0.90	2.1	<0.90	<0.90	**6.9**	1.5	1.3	<0.90	4.7	<0.90	<0.90	3.4
Dissolved Iron (Fe)	ug/L	300			300			<100	**590**	<100	<100	<100	110	<100	**380**	<100	210	<100	**1200**	110	<100	**900**
Dissolved Lead (Pb)	ug/L	5	10				10	<0.50	**5.2**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.1	<0.50	3.2	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	ug/L							26000	33000	28000	23000	22000	25000	38000	39000	30000	51000	27000	42000	23000	24000	30000
Dissolved Manganese (Mn)	ug/L				50			180	370	16	7.4	31	21	220	120	<2.0	54	16	130	11	21	61
Dissolved Molybdenum (Mo)	ug/L	40					70	15	<0.50	0.77	<0.50	2.8	2.5	15	3.0	0.55	**150**	2.2	1.4	4.6	35	8.1
Dissolved Nickel (Ni)	ug/L	25					100	4.3	4.2	<1.0	<1.0	<1.0	<1.0	1.6	2.9	<1.0	2.0	<1.0	2.1	<1.0	4.1	23
Dissolved Phosphorus (P)	ug/L	30						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	**130**	<100	<100	<100
Dissolved Potassium (K)	ug/L							1600	1300	3400	1600	2100	1700	1200	11000	740	12000	1600	1700	2100	1600	5300
Dissolved Selenium (Se)	ug/L	100	50				10	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.8	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	ug/L							4300	5200	4800	4000	6200	6400	3300	4200	3200	5500	6800	8500	5800	5200	4900
Dissolved Silver (Ag)	ug/L	0.1					1.5	<0.090	**0.19**	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Dissolved Sodium (Na)	ug/L				200000		490000	51000	240000	6200	19000	10000	9700	6100	54000	6500	220000	6500	5100	11000	67000	17000
Dissolved Strontium (Sr)	ug/L							1100	200	330	110	1700	960	250	5000	91	4700	1700	430	1000	210	3800
Dissolved Thallium (Tl)	ug/L	0.3					2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.052	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Titanium (Ti)	ug/L							<5.0	16	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	7.7	<5.0	18	<5.0	<5.0	<5.0
Dissolved Uranium (U)	ug/L	5	20				20	3.9	1.1	0.47	0.24	0.29	0.28	1.2	0.45	0.31	**21**	0.25	1.2	0.67	2.8	0.87
Dissolved Vanadium (V)	ug/L	6					6.2	0.77	0.87	<0.50	<0.50	<0.50	<0.50	0.55	<0.50	<0.50	0.78	<0.50	1.7	<0.50	<0.50	<0.50
Dissolved Zinc (Zn)	ug/L	20			5000		1100	<5.0	**29**	<5.0	<5.0	<5.0	<5.0	<5.0	5.9	<5.0	8.9	<5.0	13	<5.0	<5.0	8.6
BTEX & F1 Hydrocarbons																						
Benzene	ug/L	100	1				5		<0.20		<0.20		<0.20		<0.20	<0.20		<0.20			<0.20	
Toluene	ug/L	1	60		24		24		<0.20		<0.20		0.29		<0.20	0.23		<0.20			0.21	
Ethylbenzene	ug/L	8	140		1.6		2.4		<0.20		<0.20		<0.20		<0.20	<0.20		<0.20			<0.20	
o-Xylene	ug/L	40							<0.20		<0.20		<0.20		<0.20	<0.20		<0.20			<0.20	
p+m-Xylene	ug/L	32[4]							<0.40		<0.40		<0.40		<0.40	<0.40		<0.40			<0.40	
Total Xylenes	ug/L		90		20		300		<0.40		<0.40		<0.40		<0.40	<0.40		<0.40			<0.40	
F1 (C6-C10)	ug/L								<25		<25		<25		<25	<25		<25			86	
F1 (C6-C10) - BTEX	ug/L						750		<25		<25		<25		<25	<25		<25			86	
F2-F4 Hydrocarbons																						
F2 (C10-C16 Hydrocarbons)	ug/L						150		<100		<100		<100		<100	<100		<100			<100	
F3 (C16-C34 Hydrocarbons)	ug/L						500		<200		<200		<200		<200	<200		<200			<200	
F4 (C34-C50 Hydrocarbons)	ug/L						500		<200		<200		<200		<200	<200		<200			<200	

Exceedance of PWQO Criteria	**620**
Exceedance of ODWS Criteria	310
Exceedance of MECP Table 2 Criteria	500

1) PWQO metals standards apply to unfiltered surface water samples. Included here for comparison to filtered groundwater samples.
2) Alkalinity should not be decreased by more than 25% of the natural concentration
3) 1 CrVI or 8.9 CrIII
4) 2-m and 30-p Xylenes

TABLE I-1
SUMMARY OF GROUNDWATER QUALITY RESULTS
CALEDON PIT / QUARRY

	Units	PWQO	ODWS				MECP	MW20-17B	MW20-18	MW20-19A	MW20-19B	MW20-20A	MW20-20B	MW20-20C	MW20-21A	MW20-21B	MW20-22A	MW20-22B	MW20-23A	MW20-23B	MW20-23C	MW20-24A
			MAC	IMAC	AO	OG	Table 2	22-Jun-21	22-Jun-21	23-Jun-21	23-Jun-21	23-Jun-21	23-Jun-21	23-Jun-21	28-Jun-21	28-Jun-21	23-Jun-21	23-Jun-21	22-Jun-21	22-Jun-21	22-Jun-21	25-Jun-21
Physical Tests (Water)																						
Anion Sum	me/L							7.43	12.0	9.06	7.25	26.3	8.64	7.54	27.5	7.21	27.0	18.7	28.0	20.9	6.46	7.93
Bicarb. Alkalinity (calc. as CaCO3)	mg/L							240	260	240	260	180	200	310	200	290	200	220	190	210	240	270
Calculated TDS	mg/L				500			410	660	490	370	1700	500	380	1800	410	1700	1200	1900	1300	340	430
Carb. Alkalinity (calc. as CaCO3)	mg/L							2.1	2.2	2.1	2.4	<1.0	1.3	2.2	1.9	4.7	<1.0	1.9	1.4	1.1	2.5	2.0
Cation Sum	me/L							8.14	12.1	8.56	6.66	26.3	8.13	7.34	28.6	8.22	25.7	18.9	31.2	21.0	6.53	8.48
Hardness (CaCO3)	mg/L					80-100		340	390	420	310	1300	400	340	1400	350	1300	870	1500	990	280	350
Ion Balance (% Difference)	%							4.54	0.780	2.85	4.22	0.00	3.03	1.38	2.00	6.59	2.53	0.680	5.49	0.200	0.480	3.36
Langelier Index (@ 20C)	N/A							0.874	0.938	0.806	0.859	0.952	0.715	0.904	1.27	1.22	0.961	1.15	1.22	0.979	0.921	0.780
Langelier Index (@ 4C)	N/A							0.626	0.691	0.558	0.611	0.708	0.467	0.655	1.02	0.970	0.717	0.902	0.971	0.734	0.672	0.532
Saturation pH (@ 20C)	N/A							7.09	7.01	7.16	7.14	6.74	7.13	6.97	6.73	7.01	6.73	6.81	6.67	6.76	7.14	7.12
Saturation pH (@ 4C)	N/A							7.34	7.26	7.40	7.39	6.98	7.38	7.22	6.98	7.26	6.98	7.05	6.91	7.00	7.39	7.37
Inorganics																						
Total Ammonia-N	mg/L							<0.050	<0.050	<0.050	<0.050	0.22	<0.050	<0.050	0.085	0.61	0.070	0.15	0.23	0.20	<0.050	0.094
Unionized Ammonia	mg/L	20						<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	umho/cm							730	1300	780	640	2000	740	660	2100	640	2000	1500	2300	1700	630	770
Dissolved Organic Carbon	mg/L				5			0.67	1.6	1.1	0.62	<0.40	<0.40	4.6	0.92	5.5	1.2	0.85	0.68	0.69	1.6	2.4
Orthophosphate (P)	mg/L							<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	pH	6.5-8.5				6.5-8.5		7.97	7.95	7.96	8.00	7.69	7.85	7.88	8.00	8.23	7.69	7.95	7.88	7.74	8.06	7.90
Dissolved Sulphate (SO4)	mg/L				500			54	23	190	76	1100	220	15	1100	56	1100	650	1100	770	23	79
Alkalinity (Total as CaCO3)[2]	mg/L					30-500		250	260	250	260	180	200	310	200	300	200	230	190	210	240	270
Dissolved Chloride (Cl-)	mg/L				250		790000	47	210	7.1	18	4.2	4.5	35	15	3.1	7.2	24	13	23	39	31
Nitrite (N)	mg/L		1.0					<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010
Nitrate (N)	mg/L		10.0					0.74	3.04	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	0.25	<0.10	<0.10	1.39	<0.10
Nitrate + Nitrite (N)	mg/L							0.74	3.04	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	0.26	<0.10	<0.10	1.39	<0.10
Metals[1]																						
Dissolved Aluminum (Al)	ug/L	75				100		44	15	46	6.5	26	<4.9	**80**	7.4	**500**	9.4	9.7	**79**	64	<4.9	**79**
Dissolved Antimony (Sb)	ug/L	20		6			6	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.8	<0.50	<0.50	<0.50	<0.50
Dissolved Arsenic (As)	ug/L	100		10			25	3.8	<1.0	1.3	4.3	4.8	5.5	<1.0	14	9.3	2.8	11	5.5	10	<1.0	<1.0
Dissolved Barium (Ba)	ug/L		1000				1000	55	87	22	35	8.1	14	33	17	130	7.7	13	14	14	40	56
Dissolved Beryllium (Be)	ug/L	1100					4	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Dissolved Boron (B)	ug/L	200		5000			5000	26	14	35	12	54	13	16	110	47	71	54	130	48	10	31
Dissolved Cadmium (Cd)	ug/L	0.2	5				2.7	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	0.20	<0.090	<0.090	<0.090
Dissolved Calcium (Ca)	ug/L							92000	120000	83000	77000	430000	110000	95000	390000	91000	400000	260000	480000	320000	82000	79000
Dissolved Chromium (Cr)	ug/L	1[3]	50				50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	ug/L	1					3.8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52	<0.50	<0.50	<0.50
Dissolved Copper (Cu)	ug/L	5			1000		87	<0.90	**7.4**	<0.90	<0.90	<0.90	<0.90	2.0	<0.90	3.1	<0.90	1.0	3.5	2.6	3.2	**5.4**
Dissolved Iron (Fe)	ug/L	300			300			<100	<100	**310**	**380**	**620**	180	110	**810**	**1100**	**350**	<100	**340**	**1000**	<100	**640**
Dissolved Lead (Pb)	ug/L	5	10				10	1.4	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.1	<0.50	<0.50	0.85	<0.50	<0.50	0.72
Dissolved Magnesium (Mg)	ug/L							27000	23000	50000	29000	54000	30000	26000	94000	30000	62000	57000	71000	46000	19000	38000
Dissolved Manganese (Mn)	ug/L				50			35	16	7.0	48	41	6.7	6.0	21	41	39	34	62	47	<2.0	27
Dissolved Molybdenum (Mo)	ug/L	40					70	1.2	1.4	1.6	3.4	2.0	2.1	<0.50	4.0	5.1	2.9	24	5.4	7.1	0.61	20
Dissolved Nickel (Ni)	ug/L	25					100	1.9	3.3	<1.0	2.2	<1.0	<1.0	<1.0	<1.0	5.2	3.9	5.9	5.7	4.0	<1.0	1.7
Dissolved Phosphorus (P)	ug/L	30						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Dissolved Potassium (K)	ug/L							1400	1800	1700	730	1600	820	1100	3200	1100	2200	2000	3600	820	2600	1700
Dissolved Selenium (Se)	ug/L	100	50				10	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	ug/L							5300	3200	3900	2900	6700	7300	4700	6600	10000	5600	4700	6100	5700	2900	5200
Dissolved Silver (Ag)	ug/L	0.1					1.5	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	**0.11**	<0.090	<0.090	<0.090
Dissolved Sodium (Na)	ug/L				200000		490000	29000	100000	4400	8800	7100	3300	11000	33000	25000	14000	32000	29000	23000	19000	31000
Dissolved Strontium (Sr)	ug/L							750	200	1500	610	8600	2700	150	7100	1200	7200	4700	7900	5300	150	130
Dissolved Thallium (Tl)	ug/L	0.3					2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Titanium (Ti)	ug/L							<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	23	<5.0	<5.0	<5.0	8.8	<5.0	<5.0
Dissolved Uranium (U)	ug/L	5	20				20	0.61	0.82	0.12	0.13	0.17	<0.10	0.80	0.20	1.8	0.22	1.4	0.20	0.93	0.71	0.20
Dissolved Vanadium (V)	ug/L	6					6.2	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.2	<0.50	1.2	<0.50	<0.50	<0.50	<0.50
Dissolved Zinc (Zn)	ug/L	20			5000		1100	<5.0	8.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9.8	<5.0	<5.0	<5.0	<5.0	8.9	7.6
BTEX & F1 Hydrocarbons																						
Benzene	ug/L	100	1				5	<0.20	<0.20		<0.20		<0.20			<0.20		<0.20		<0.20		
Toluene	ug/L	1	60		24		24	<0.20	<0.20		<0.20		<0.20			<0.20		0.27		<0.20		
Ethylbenzene	ug/L	8	140		1.6		2.4	<0.20	<0.20		<0.20		<0.20			<0.20		<0.20		<0.20		
o-Xylene	ug/L	40						<0.20	<0.20		<0.20		<0.20			<0.20		<0.20		<0.20		
p+m-Xylene	ug/L	32[4]						<0.40	<0.40		<0.40		<0.40			<0.40		<0.40		<0.40		
Total Xylenes	ug/L		90		20		300	<0.40	<0.40		<0.40		<0.40			<0.40		<0.40		<0.40		
F1 (C6-C10)	ug/L							<25	<25		<25		<25			<25		<25		<25		
F1 (C6-C10) - BTEX	ug/L						750	<25	<25		<25		<25			<25		<25		<25		
F2-F4 Hydrocarbons																						
F2 (C10-C16 Hydrocarbons)	ug/L						150	<100	<100		<100		<100			<100		<100		<100		
F3 (C16-C34 Hydrocarbons)	ug/L						500	520	<200		1100		330			<200		<200		<200		
F4 (C34-C50 Hydrocarbons)	ug/L						500	420	<200		810		<200			<200		<200		<200		

Exceedance of PWQO Criteria	**620**
Exceedance of ODWS Criteria	310
Exceedance of MECP Table 2 Criteria	500

1) PWQO metals standards apply to unfiltered surface water samples. Included here for comparison to filtered groundwater samples.
2) Alkalinity should not be decreased by more than 25% of the natural concentration
3) 1 CrVI or 8.9 CrIII
4) 2-m and 30-p Xylenes

TABLE I-1
SUMMARY OF GROUNDWATER QUALITY RESULTS
CALEDON PIT / QUARRY

	Units	PWQO	ODWS				MECP	MW20-24B	MW20-25A	MW20-25B	MW20-26A	MW20-26B	MW20-26C	MW20-27A	MW20-27B	MW20-28A	MW20-28B	DUP1	DUP2	DUP3	DUP4	DUP5	DUP6
			MAC	IMAC	AO	OG	Table 2	25-Jun-21	25-Jun-21	25-Jun-21	24-Jun-21	24-Jun-21	24-Jun-21	24-Jun-21	24-Jun-21	24-Jun-21	24-Jun-21	22-Jun-21	23-Jun-21	24-Jun-21	24-Jun-21	24-Jun-21	25-Jun-21
Physical Tests (Water)																							
Anion Sum	me/L							11.5	29.8	15.5	22.9	11.2	18.7	22.8	8.56	4.78	4.78	7.46	6.82	4.74	6.65	11.2	15.8
Bicarb. Alkalinity (calc. as CaCO3)	mg/L							290	180	180	180	200	230	190	210	200	200	250	270	200	260	200	180
Calculated TDS	mg/L				500			620	2000	1000	1500	680	1000	1500	490	250	250	400	360	250	350	680	1000
Carb. Alkalinity (calc. as CaCO3)	mg/L							1.9	<1.0	1.1	1.4	2.2	1.3	1.8	2.6	3.4	3.1	2.1	1.9	3.2	2.9	2.1	1.0
Cation Sum	me/L							11.9	31.6	16.8	23.0	11.6	18.7	22.3	8.18	4.66	4.67	7.45	6.57	4.67	6.74	11.4	16.9
Hardness (CaCO3)	mg/L					80-100		500	1500	810	1100	540	840	1100	370	220	220	320	310	220	290	530	820
Ion Balance (% Difference)	%							1.67	3.01	3.97	0.160	1.84	0.110	1.09	2.27	1.31	1.20	0.0500	1.87	0.820	0.660	1.24	3.44
Langelier Index (@ 20C)	N/A							0.916	1.06	0.909	1.10	1.04	0.936	1.24	0.956	0.853	0.824	0.847	0.807	0.833	0.954	1.02	0.871
Langelier Index (@ 4C)	N/A							0.669	0.821	0.663	0.850	0.788	0.690	0.991	0.708	0.604	0.575	0.598	0.558	0.583	0.705	0.772	0.625
Saturation pH (@ 20C)	N/A							6.93	6.70	6.91	6.84	7.03	6.86	6.77	7.17	7.39	7.39	7.11	7.07	7.39	7.13	7.04	6.91
Saturation pH (@ 4C)	N/A							7.17	6.95	7.15	7.08	7.28	7.11	7.02	7.42	7.64	7.64	7.36	7.32	7.64	7.38	7.28	7.16
Inorganics																							
Total Ammonia-N	mg/L							<0.050	0.11	0.064	0.090	<0.050	<0.050	0.081	0.10	<0.050	0.051	<0.050	<0.050	0.053	<0.050	0.071	0.078
Unionized Ammonia	mg/L	20						<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Conductivity	umho/cm							1200	2400	1400	1900	1000	2000	1800	750	450	430	730	610	430	590	1000	1400
Dissolved Organic Carbon	mg/L				5			0.63	1.1	0.67	1.7	1.4	<0.40	0.68	0.66	<0.40	<0.40	0.68	0.65	<0.40	0.63	1.4	0.66
Orthophosphate (P)	mg/L							<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH	pH	6.5-8.5				6.5-8.5		7.84	7.77	7.82	7.93	8.07	7.80	8.01	8.13	8.25	8.21	7.96	7.88	8.22	8.08	8.05	7.78
Dissolved Sulphate (SO4)	mg/L				500			36	1300	570	920	340	24	910	200	29	29	53	16	29	13	340	580
Alkalinity (Total as CaCO3)[2]	mg/L					30-500		290	180	180	180	200	230	190	210	210	210	250	270	210	260	200	180
Dissolved Chloride (Cl-)	mg/L				250		790000	170	3.9	2.0	8.0	5.0	490	2.1	6.2	1.0	1.0	47	20	<1.0	36	4.2	1.5
Nitrite (N)	mg/L		1.0					<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate (N)	mg/L		10.0					0.98	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10	0.74	7.76	<0.10	2.42	<0.10	<0.10
Nitrate + Nitrite (N)	mg/L							0.98	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10	0.74	7.76	<0.10	2.42	<0.10	<0.10
Metals[1]																							
Dissolved Aluminum (Al)	ug/L	75				100		<4.9	<4.9	<4.9	14	7.6	6.9	<4.9	<4.9	20	5.8	32	7.1	7.8	<4.9	<4.9	<4.9
Dissolved Antimony (Sb)	ug/L	20		6			6	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Arsenic (As)	ug/L	100		10			25	<1.0	9.6	<1.0	8.7	2.9	<1.0	5.4	1.9	<1.0	<1.0	3.8	<1.0	<1.0	<1.0	2.9	<1.0
Dissolved Barium (Ba)	ug/L		1000				1000	120	10	6.6	12	20	110	18	26	12	11	52	19	10	29	21	6.9
Dissolved Beryllium (Be)	ug/L	1100					4	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Dissolved Boron (B)	ug/L	200		5000			5000	24	89	58	53	30	<10	42	24	23	22	25	<10	21	<10	32	47
Dissolved Cadmium (Cd)	ug/L	0.2	5				2.7	**0.29**	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Dissolved Calcium (Ca)	ug/L							130000	490000	240000	330000	150000	210000	360000	93000	49000	50000	87000	86000	50000	78000	150000	240000
Dissolved Chromium (Cr)	ug/L	1[3]	50				50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co)	ug/L	1					3.8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Copper (Cu)	ug/L	5			1000		87	2.1	<0.90	<0.90	<0.90	<0.90	1.0	<0.90	<0.90	<0.90	1.6	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90
Dissolved Iron (Fe)	ug/L	300			300			**460**	**460**	**330**	**590**	150	<100	**690**	**430**	<100	<100	<100	<100	<100	<100	150	**330**
Dissolved Lead (Pb)	ug/L	5	10				10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.0	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	ug/L							45000	77000	53000	70000	42000	74000	49000	33000	23000	23000	24000	24000	23000	24000	40000	53000
Dissolved Manganese (Mn)	ug/L				50			20	36	20	43	26	13	34	25	93	98	32	<2.0	100	7.2	26	21
Dissolved Molybdenum (Mo)	ug/L	40					70	1.7	8.7	9.0	8.6	8.1	0.55	3.0	11	2.4	1.9	1.2	<0.50	1.9	<0.50	8.1	8.8
Dissolved Nickel (Ni)	ug/L	25					100	2.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.9	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Phosphorus (P)	ug/L	30						<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Dissolved Potassium (K)	ug/L							1300	2700	1800	2300	1600	1100	1700	820	1300	1200	1300	1100	1200	1700	1500	1800
Dissolved Selenium (Se)	ug/L	100	50				10	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Silicon (Si)	ug/L							6600	5400	5400	5100	5600	6900	5500	5500	6300	6600	4900	4000	6700	3900	5500	5400
Dissolved Silver (Ag)	ug/L	0.1					1.5	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Dissolved Sodium (Na)	ug/L				200000		490000	41000	18000	11000	18000	17000	45000	10000	18000	5700	6000	25000	6200	6000	19000	17000	11000
Dissolved Strontium (Sr)	ug/L							170	8100	4400	5700	2400	320	9800	3000	460	420	740	140	420	110	2300	4600
Dissolved Thallium (Tl)	ug/L	0.3					2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Titanium (Ti)	ug/L							<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Uranium (U)	ug/L	5	20				20	0.70	<0.10	<0.10	0.27	0.86	0.52	0.47	1.6	0.38	0.44	0.58	0.14	0.43	0.23	0.87	<0.10
Dissolved Vanadium (V)	ug/L	6					6.2	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Zinc (Zn)	ug/L	20			5000		1100	**180**	<5.0	<5.0	14	<5.0	<5.0	<5.0	<5.0	5.4	11	<5.0	<5.0	8.1	<5.0	<5.0	<5.0
BTEX & F1 Hydrocarbons																							
Benzene	ug/L	100	1				5	<0.20		<0.20		<0.20			<0.20		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Toluene	ug/L	1	60		24		24	<0.20		<0.20		<0.20			<0.20		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Ethylbenzene	ug/L	8	140		1.6		2.4	<0.20		<0.20		<0.20			<0.20		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
o-Xylene	ug/L	40						<0.20		<0.20		<0.20			<0.20		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
p+m-Xylene	ug/L	32[4]						<0.40		<0.40		<0.40			<0.40		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Total Xylenes	ug/L		90		20		300	<0.40		<0.40		<0.40			<0.40		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
F1 (C6-C10)	ug/L							<25		<25		<25			<25		<25	<25	<25	<25	<25	<25	<25
F1 (C6-C10) - BTEX	ug/L						750	<25		<25		<25			<25		<25	<25	<25	<25	<25	<25	<25
F2-F4 Hydrocarbons																							
F2 (C10-C16 Hydrocarbons)	ug/L						150	<100		<100		<100			<100		<100	<100	<100	<100	<100	<100	<100
F3 (C16-C34 Hydrocarbons)	ug/L						500	<200		<200		<200			<200		<200	410	<200	<200	<200	<200	<200
F4 (C34-C50 Hydrocarbons)	ug/L						500	<200		<200		<200			<200		<200	300	<200	<200	<200	<200	<200

Exceedance of PWQO Criteria	**620**
Exceedance of ODWS Criteria	310
Exceedance of MECP Table 2 Criteria	500

1) PWQO metals standards apply to unfiltered surface water samples. Included here for comparison to filtered groundwater samples.
2) Alkalinity should not be decreased by more than 25% of the natural concentration
3) 1 CrVI or 8.9 CrIII
4) 2-m and 30-p Xylenes

Your Project #: 19129150
Your C.O.C. #: 813833-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/02/24
Report #: R6531316
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C145866
Received: 2021/02/19, 07:34

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	2	N/A	2021/02/22	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	2	N/A	2021/02/23	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2021/02/22	CAM SOP-00463	SM 23 4500-Cl E m
Chloride by Automated Colourimetry	1	N/A	2021/02/24	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	2	N/A	2021/02/22	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	2	N/A	2021/02/22	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	2	N/A	2021/02/22	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	2	2021/02/22	2021/02/23	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	2	N/A	2021/02/23	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2021/02/22	CAM SOP-00447	EPA 6020B m
Dissolved Metals by ICPMS	1	N/A	2021/02/23	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2021/02/23		
Ion Balance (% Difference)	1	N/A	2021/02/24		
Anion and Cation Sum	2	N/A	2021/02/23		
Total Ammonia-N	2	N/A	2021/02/22	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	2	N/A	2021/02/22	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	2	2021/02/20	2021/02/22	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2021/02/22	CAM SOP-00461	EPA 365.1 m
Orthophosphate	1	N/A	2021/02/23	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2021/02/23		Auto Calc
Sat. pH and Langelier Index (@ 20C)	1	N/A	2021/02/24		Auto Calc
Sat. pH and Langelier Index (@ 4C)	1	N/A	2021/02/23		Auto Calc
Sat. pH and Langelier Index (@ 4C)	1	N/A	2021/02/24		Auto Calc
Sulphate by Automated Colourimetry	1	N/A	2021/02/22	CAM SOP-00464	EPA 375.4 m
Sulphate by Automated Colourimetry	1	N/A	2021/02/24	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2021/02/23		Auto Calc
Total Dissolved Solids (TDS calc)	1	N/A	2021/02/24		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau

Your Project #: 19129150
Your C.O.C. #: 813833-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/02/24
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CERTIFICATE OF ANALYSIS

BV LABS JOB #: C145866
Received: 2021/02/19, 07:34

Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C145866
Report Date: 2021/02/24

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AL

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		OWT911			OWT912			OWT912		
Sampling Date		2021/02/17 11:00			2021/02/17 10:15			2021/02/17 10:15		
COC Number		813833-01-01			813833-01-01			813833-01-01		
	UNITS	MW20-14A	RDL	QC Batch	MW20-14B	RDL	QC Batch	MW20-14B Lab-Dup	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	15.6	N/A	7209514	6.52	N/A	7209514			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	200	1.0	7208473	240	1.0	7208473			
Calculated TDS	mg/L	980	1.0	7209509	340	1.0	7209509			
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.3	1.0	7208473	3.2	1.0	7208473			
Cation Sum	me/L	15.3	N/A	7209514	6.35	N/A	7209514			
Hardness (CaCO3)	mg/L	630	1.0	7208484	300	1.0	7208484			
Ion Balance (% Difference)	%	1.11	N/A	7209339	1.28	N/A	7209339			
Langelier Index (@ 20C)	N/A	1.11		7209510	0.957		7209510			
Langelier Index (@ 4C)	N/A	0.864		7209511	0.708		7209511			
Saturation pH (@ 20C)	N/A	6.96		7209510	7.19		7209510			
Saturation pH (@ 4C)	N/A	7.20		7209511	7.44		7209511			
Inorganics										
Total Ammonia-N	mg/L	1.2	0.050	7210859	<0.050	0.050	7210859			
Conductivity	umho/cm	1300	1.0	7210025	600	1.0	7210025			
Dissolved Organic Carbon	mg/L	0.52	0.40	7211055	0.65	0.40	7211055	0.65	0.40	7211055
Orthophosphate (P)	mg/L	<0.010	0.010	7210038	<0.010	0.010	7211780	<0.010	0.010	7211780
pH	pH	8.07		7210026	8.14		7210026			
Dissolved Sulphate (SO4)	mg/L	540	5.0	7210034	33	1.0	7211777	33	1.0	7211777
Alkalinity (Total as CaCO3)	mg/L	210	1.0	7210029	240	1.0	7210029			
Dissolved Chloride (Cl-)	mg/L	6.4	1.0	7210032	15	1.0	7211766	15	1.0	7211766
Nitrite (N)	mg/L	0.027	0.010	7210069	<0.010	0.010	7210049			
Nitrate (N)	mg/L	0.21	0.10	7210069	7.35	0.10	7210049			
Nitrate + Nitrite (N)	mg/L	0.23	0.10	7210069	7.35	0.10	7210049			
Metals										
Dissolved Aluminum (Al)	ug/L	18	4.9	7210321	5.8	4.9	7210328			
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7210321	<0.50	0.50	7210328			
Dissolved Arsenic (As)	ug/L	3.0	1.0	7210321	<1.0	1.0	7210328			
Dissolved Barium (Ba)	ug/L	30	2.0	7210321	38	2.0	7210328			
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7210321	<0.40	0.40	7210328			
Dissolved Boron (B)	ug/L	640	10	7210321	<10	10	7210328			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		OWT911			OWT912			OWT912		
Sampling Date		2021/02/17 11:00			2021/02/17 10:15			2021/02/17 10:15		
COC Number		813833-01-01			813833-01-01			813833-01-01		
	UNITS	MW20-14A	RDL	QC Batch	MW20-14B	RDL	QC Batch	MW20-14B Lab-Dup	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7210321	<0.090	0.090	7210328			
Dissolved Calcium (Ca)	ug/L	190000	200	7210321	72000	200	7210328			
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7210321	<5.0	5.0	7210328			
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7210321	<0.50	0.50	7210328			
Dissolved Copper (Cu)	ug/L	6.9	0.90	7210321	1.5	0.90	7210328			
Dissolved Iron (Fe)	ug/L	380	100	7210321	<100	100	7210328			
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7210321	<0.50	0.50	7210328			
Dissolved Magnesium (Mg)	ug/L	39000	50	7210321	30000	50	7210328			
Dissolved Manganese (Mn)	ug/L	120	2.0	7210321	<2.0	2.0	7210328			
Dissolved Molybdenum (Mo)	ug/L	3.0	0.50	7210321	0.55	0.50	7210328			
Dissolved Nickel (Ni)	ug/L	2.9	1.0	7210321	<1.0	1.0	7210328			
Dissolved Phosphorus (P)	ug/L	<100	100	7210321	<100	100	7210328			
Dissolved Potassium (K)	ug/L	11000	200	7210321	740	200	7210328			
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7210321	<2.0	2.0	7210328			
Dissolved Silicon (Si)	ug/L	4200	50	7210321	3200	50	7210328			
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7210321	<0.090	0.090	7210328			
Dissolved Sodium (Na)	ug/L	54000	100	7210321	6500	100	7210328			
Dissolved Strontium (Sr)	ug/L	5000	1.0	7210321	91	1.0	7210328			
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7210321	<0.050	0.050	7210328			
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7210321	<5.0	5.0	7210328			
Dissolved Uranium (U)	ug/L	0.45	0.10	7210321	0.31	0.10	7210328			
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7210321	<0.50	0.50	7210328			
Dissolved Zinc (Zn)	ug/L	5.9	5.0	7210321	<5.0	5.0	7210328			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		OWT911	OWT912		
Sampling Date		2021/02/17 11:00	2021/02/17 10:15		
COC Number		813833-01-01	813833-01-01		
	UNITS	MW20-14A	MW20-14B	RDL	QC Batch
BTEX & F1 Hydrocarbons					
Benzene	ug/L	<0.20	<0.20	0.20	7210596
Toluene	ug/L	<0.20	0.23	0.20	7210596
Ethylbenzene	ug/L	<0.20	<0.20	0.20	7210596
o-Xylene	ug/L	<0.20	<0.20	0.20	7210596
p+m-Xylene	ug/L	<0.40	<0.40	0.40	7210596
Total Xylenes	ug/L	<0.40	<0.40	0.40	7210596
F1 (C6-C10)	ug/L	<25	<25	25	7210596
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	7210596
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	7212293
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	200	7212293
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	7212293
Reached Baseline at C50	ug/L	Yes	Yes		7212293
Surrogate Recovery (%)					
1,4-Difluorobenzene	%	105	105		7210596
4-Bromofluorobenzene	%	90	93		7210596
D10-o-Xylene	%	98	103		7210596
D4-1,2-Dichloroethane	%	118	115		7210596
o-Terphenyl	%	97	99		7212293

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: C145866
Report Date: 2021/02/24

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AL

TEST SUMMARY

BV Labs ID: OWT911
Sample ID: MW20-14A
Matrix: Water

Collected: 2021/02/17
Shipped:
Received: 2021/02/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7210029	N/A	2021/02/22	Yogesh Patel
Carbonate, Bicarbonate and Hydroxide	CALC	7208473	N/A	2021/02/23	Automated Statchk
Chloride by Automated Colourimetry	KONE	7210032	N/A	2021/02/22	Deonarine Ramnarine
Conductivity	AT	7210025	N/A	2021/02/22	Yogesh Patel
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7211055	N/A	2021/02/22	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7210596	N/A	2021/02/22	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7212293	2021/02/22	2021/02/23	Prabhjot Gulati
Hardness (calculated as CaCO3)		7208484	N/A	2021/02/23	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7210321	N/A	2021/02/22	Arefa Dabhad
Ion Balance (% Difference)	CALC	7209339	N/A	2021/02/23	Automated Statchk
Anion and Cation Sum	CALC	7209514	N/A	2021/02/23	Automated Statchk
Total Ammonia-N	LACH/NH4	7210859	N/A	2021/02/22	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7210069	N/A	2021/02/22	Chandra Nandlal
pH	AT	7210026	2021/02/20	2021/02/22	Yogesh Patel
Orthophosphate	KONE	7210038	N/A	2021/02/22	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7209510	N/A	2021/02/23	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7209511	N/A	2021/02/23	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7210034	N/A	2021/02/22	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7209509	N/A	2021/02/23	Automated Statchk

BV Labs ID: OWT912
Sample ID: MW20-14B
Matrix: Water

Collected: 2021/02/17
Shipped:
Received: 2021/02/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7210029	N/A	2021/02/22	Yogesh Patel
Carbonate, Bicarbonate and Hydroxide	CALC	7208473	N/A	2021/02/23	Automated Statchk
Chloride by Automated Colourimetry	KONE	7211766	N/A	2021/02/24	Deonarine Ramnarine
Conductivity	AT	7210025	N/A	2021/02/22	Yogesh Patel
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7211055	N/A	2021/02/22	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7210596	N/A	2021/02/22	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7212293	2021/02/22	2021/02/23	Prabhjot Gulati
Hardness (calculated as CaCO3)		7208484	N/A	2021/02/23	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7210328	N/A	2021/02/23	Arefa Dabhad
Ion Balance (% Difference)	CALC	7209339	N/A	2021/02/24	Automated Statchk
Anion and Cation Sum	CALC	7209514	N/A	2021/02/23	Automated Statchk
Total Ammonia-N	LACH/NH4	7210859	N/A	2021/02/22	Alina Dobreanu
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7210049	N/A	2021/02/22	Chandra Nandlal
pH	AT	7210026	2021/02/20	2021/02/22	Yogesh Patel
Orthophosphate	KONE	7211780	N/A	2021/02/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7209510	N/A	2021/02/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7209511	N/A	2021/02/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7211777	N/A	2021/02/24	Deonarine Ramnarine
Total Dissolved Solids (TDS calc)	CALC	7209509	N/A	2021/02/24	Automated Statchk

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BV Labs Job #: C145866
Report Date: 2021/02/24

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AL

TEST SUMMARY

BV Labs ID: OWT912 Dup
Sample ID: MW20-14B
Matrix: Water

Collected: 2021/02/17
Shipped:
Received: 2021/02/19

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7211766	N/A	2021/02/24	Deonarine Ramnarine
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7211055	N/A	2021/02/22	Nimarta Singh
Orthophosphate	KONE	7211780	N/A	2021/02/23	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7211777	N/A	2021/02/24	Deonarine Ramnarine

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7210596	1,4-Difluorobenzene	2021/02/22	98	70 - 130	101	70 - 130	104	%		
7210596	4-Bromofluorobenzene	2021/02/22	101	70 - 130	102	70 - 130	94	%		
7210596	D10-o-Xylene	2021/02/22	96	70 - 130	122	70 - 130	102	%		
7210596	D4-1,2-Dichloroethane	2021/02/22	108	70 - 130	97	70 - 130	110	%		
7212293	o-Terphenyl	2021/02/22	100	60 - 130	100	60 - 130	99	%		
7210025	Conductivity	2021/02/22			101	85 - 115	<1.0	umho/cm	0.25	25
7210026	pH	2021/02/22			102	98 - 103			0.47	N/A
7210029	Alkalinity (Total as CaCO3)	2021/02/22			96	85 - 115	<1.0	mg/L	0.15	20
7210032	Dissolved Chloride (Cl-)	2021/02/22	103	80 - 120	102	80 - 120	<1.0	mg/L	NC	20
7210034	Dissolved Sulphate (SO4)	2021/02/22	121 (1)	75 - 125	107	80 - 120	<1.0	mg/L	0.84	20
7210038	Orthophosphate (P)	2021/02/22	110	75 - 125	100	80 - 120	<0.010	mg/L	NC	25
7210049	Nitrate (N)	2021/02/22	NC	80 - 120	99	80 - 120	<0.10	mg/L	2.8	20
7210049	Nitrite (N)	2021/02/22	NC	80 - 120	108	80 - 120	<0.010	mg/L		
7210069	Nitrate (N)	2021/02/22	99	80 - 120	100	80 - 120	<0.10	mg/L	5.4	20
7210069	Nitrite (N)	2021/02/22	100	80 - 120	107	80 - 120	<0.010	mg/L		
7210321	Dissolved Aluminum (Al)	2021/02/22	111	80 - 120	104	80 - 120	<4.9	ug/L		
7210321	Dissolved Antimony (Sb)	2021/02/22	113	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
7210321	Dissolved Arsenic (As)	2021/02/22	107	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7210321	Dissolved Barium (Ba)	2021/02/22	107	80 - 120	103	80 - 120	<2.0	ug/L	0.44	20
7210321	Dissolved Beryllium (Be)	2021/02/22	102	80 - 120	97	80 - 120	<0.40	ug/L	NC	20
7210321	Dissolved Boron (B)	2021/02/22	100	80 - 120	97	80 - 120	<10	ug/L	1.9	20
7210321	Dissolved Cadmium (Cd)	2021/02/22	107	80 - 120	100	80 - 120	<0.090	ug/L	NC	20
7210321	Dissolved Calcium (Ca)	2021/02/22	NC	80 - 120	100	80 - 120	<200	ug/L		
7210321	Dissolved Chromium (Cr)	2021/02/22	100	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
7210321	Dissolved Cobalt (Co)	2021/02/22	102	80 - 120	98	80 - 120	<0.50	ug/L	4.5	20
7210321	Dissolved Copper (Cu)	2021/02/22	102	80 - 120	96	80 - 120	<0.90	ug/L	3.0	20
7210321	Dissolved Iron (Fe)	2021/02/22	104	80 - 120	99	80 - 120	<100	ug/L		
7210321	Dissolved Lead (Pb)	2021/02/22	102	80 - 120	96	80 - 120	<0.50	ug/L	NC	20
7210321	Dissolved Magnesium (Mg)	2021/02/22	NC	80 - 120	101	80 - 120	<50	ug/L		
7210321	Dissolved Manganese (Mn)	2021/02/22	104	80 - 120	98	80 - 120	<2.0	ug/L		
7210321	Dissolved Molybdenum (Mo)	2021/02/22	109	80 - 120	98	80 - 120	<0.50	ug/L	5.1	20

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7210321	Dissolved Nickel (Ni)	2021/02/22	99	80 - 120	95	80 - 120	<1.0	ug/L	1.8	20
7210321	Dissolved Phosphorus (P)	2021/02/22	109	80 - 120	110	80 - 120	<100	ug/L		
7210321	Dissolved Potassium (K)	2021/02/22	109	80 - 120	102	80 - 120	<200	ug/L		
7210321	Dissolved Selenium (Se)	2021/02/22	107	80 - 120	103	80 - 120	<2.0	ug/L	NC	20
7210321	Dissolved Silicon (Si)	2021/02/22	106	80 - 120	100	80 - 120	<50	ug/L		
7210321	Dissolved Silver (Ag)	2021/02/22	102	80 - 120	94	80 - 120	<0.090	ug/L	NC	20
7210321	Dissolved Sodium (Na)	2021/02/22	NC	80 - 120	99	80 - 120	<100	ug/L	1.6	20
7210321	Dissolved Strontium (Sr)	2021/02/22	NC	80 - 120	98	80 - 120	<1.0	ug/L		
7210321	Dissolved Thallium (Tl)	2021/02/22	99	80 - 120	94	80 - 120	<0.050	ug/L	NC	20
7210321	Dissolved Titanium (Ti)	2021/02/22	107	80 - 120	98	80 - 120	<5.0	ug/L		
7210321	Dissolved Uranium (U)	2021/02/22	108	80 - 120	100	80 - 120	<0.10	ug/L	4.5	20
7210321	Dissolved Vanadium (V)	2021/02/22	105	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7210321	Dissolved Zinc (Zn)	2021/02/22	102	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7210328	Dissolved Aluminum (Al)	2021/02/23	108	80 - 120	101	80 - 120	<4.9	ug/L		
7210328	Dissolved Antimony (Sb)	2021/02/23	111	80 - 120	101	80 - 120	<0.50	ug/L	7.3	20
7210328	Dissolved Arsenic (As)	2021/02/23	106	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
7210328	Dissolved Barium (Ba)	2021/02/23	107	80 - 120	102	80 - 120	<2.0	ug/L	0.50	20
7210328	Dissolved Beryllium (Be)	2021/02/23	106	80 - 120	98	80 - 120	<0.40	ug/L	NC	20
7210328	Dissolved Boron (B)	2021/02/23	102	80 - 120	95	80 - 120	<10	ug/L	0.35	20
7210328	Dissolved Cadmium (Cd)	2021/02/23	105	80 - 120	99	80 - 120	<0.090	ug/L	NC	20
7210328	Dissolved Calcium (Ca)	2021/02/23	NC	80 - 120	100	80 - 120	<200	ug/L		
7210328	Dissolved Chromium (Cr)	2021/02/23	101	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
7210328	Dissolved Cobalt (Co)	2021/02/23	103	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7210328	Dissolved Copper (Cu)	2021/02/23	102	80 - 120	98	80 - 120	<0.90	ug/L	0.88	20
7210328	Dissolved Iron (Fe)	2021/02/23	104	80 - 120	97	80 - 120	<100	ug/L		
7210328	Dissolved Lead (Pb)	2021/02/23	104	80 - 120	96	80 - 120	<0.50	ug/L	NC	20
7210328	Dissolved Magnesium (Mg)	2021/02/23	NC	80 - 120	98	80 - 120	<50	ug/L		
7210328	Dissolved Manganese (Mn)	2021/02/23	103	80 - 120	96	80 - 120	<2.0	ug/L		
7210328	Dissolved Molybdenum (Mo)	2021/02/23	109	80 - 120	98	80 - 120	<0.50	ug/L	1.8	20
7210328	Dissolved Nickel (Ni)	2021/02/23	101	80 - 120	97	80 - 120	<1.0	ug/L	5.9	20
7210328	Dissolved Phosphorus (P)	2021/02/23	108	80 - 120	110	80 - 120	<100	ug/L		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7210328	Dissolved Potassium (K)	2021/02/23	107	80 - 120	101	80 - 120	<200	ug/L		
7210328	Dissolved Selenium (Se)	2021/02/23	107	80 - 120	101	80 - 120	<2.0	ug/L	1.7	20
7210328	Dissolved Silicon (Si)	2021/02/23	108	80 - 120	101	80 - 120	<50	ug/L		
7210328	Dissolved Silver (Ag)	2021/02/23	84	80 - 120	97	80 - 120	<0.090	ug/L	NC	20
7210328	Dissolved Sodium (Na)	2021/02/23	NC	80 - 120	97	80 - 120	<100	ug/L		
7210328	Dissolved Strontium (Sr)	2021/02/23	NC	80 - 120	97	80 - 120	<1.0	ug/L		
7210328	Dissolved Thallium (Tl)	2021/02/23	100	80 - 120	97	80 - 120	<0.050	ug/L	NC	20
7210328	Dissolved Titanium (Ti)	2021/02/23	105	80 - 120	97	80 - 120	<5.0	ug/L		
7210328	Dissolved Uranium (U)	2021/02/23	110	80 - 120	101	80 - 120	<0.10	ug/L	2.0	20
7210328	Dissolved Vanadium (V)	2021/02/23	105	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
7210328	Dissolved Zinc (Zn)	2021/02/23	100	80 - 120	97	80 - 120	<5.0	ug/L	0.33	20
7210596	Benzene	2021/02/22	101	50 - 140	105	50 - 140	<0.20	ug/L	NC	30
7210596	Ethylbenzene	2021/02/22	110	50 - 140	116	50 - 140	<0.20	ug/L	NC	30
7210596	F1 (C6-C10) - BTEX	2021/02/22					<25	ug/L	NC	30
7210596	F1 (C6-C10)	2021/02/22	91	60 - 140	102	60 - 140	<25	ug/L	NC	30
7210596	o-Xylene	2021/02/22	110	50 - 140	111	50 - 140	<0.20	ug/L	NC	30
7210596	p+m-Xylene	2021/02/22	110	50 - 140	116	50 - 140	<0.40	ug/L	NC	30
7210596	Toluene	2021/02/22	101	50 - 140	105	50 - 140	<0.20	ug/L	NC	30
7210596	Total Xylenes	2021/02/22					<0.40	ug/L	NC	30
7210859	Total Ammonia-N	2021/02/22	89	75 - 125	99	80 - 120	<0.050	mg/L	12	20
7211055	Dissolved Organic Carbon	2021/02/22	92	80 - 120	95	80 - 120	<0.40	mg/L	0.11	20
7211766	Dissolved Chloride (Cl-)	2021/02/24	106	80 - 120	102	80 - 120	<1.0	mg/L	0.084	20
7211777	Dissolved Sulphate (SO4)	2021/02/24	NC	75 - 125	100	80 - 120	<1.0	mg/L	0.45	20
7211780	Orthophosphate (P)	2021/02/23	103	75 - 125	102	80 - 120	<0.010	mg/L	NC	25
7212293	F2 (C10-C16 Hydrocarbons)	2021/02/23	103	60 - 130	105	60 - 130	<100	ug/L	NC	30
7212293	F3 (C16-C34 Hydrocarbons)	2021/02/23	107	60 - 130	110	60 - 130	<200	ug/L	NC	30

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7212293	F4 (C34-C50 Hydrocarbons)	2021/02/23	106	60 - 130	108	60 - 130	<200	ug/L	NC	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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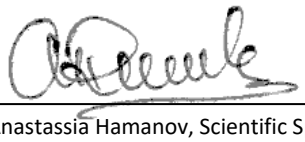
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Bureau Veritas Laboratories
109 & 110, 4023 Meadowbrook Drive, London, Ontario Canada N6L 1E7 Tel:(519) 652-9444 Toll-free:800-563-6266 Fax:(519) 652-8189 www.bvlabs.com

Page 1 of 1

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:	
Address:	210 Sheldon Drive	Address:		Project:	19129150
	Cambridge ON N1T 1A8			Project Name:	
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Site #:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Sampled By:	AL

Laboratory Use Only:

BV Labs Job #:	Bottle Order #:
	813833
COC #:	**Project Manager:**
C#813833-01-01	Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558. ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1		MW20-14A	21/2/17	11-	GW	X	X	X								8	
2		MW20-14B	21/2/17	10:15	GW	X	X	X								8	
3																	
4																	19-Feb-21 07:34
5																	Ema Gitej
6																	C145866
7																	NP4 ENV-511
8																	
9																	
10																	

REC'D IN WATERLOO

REC'D IN WATERLOO

NO ICE

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
[signature] / A. Linklater	21/02/17	17:50	[signature] TAMSIN DENISON	2021/02/19	07:34	
[signature] K. EASTON	21/02/18	18:15	[signature]	2021/02/19	15:41	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	1 / 1 / 1°C	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

0/0/0

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

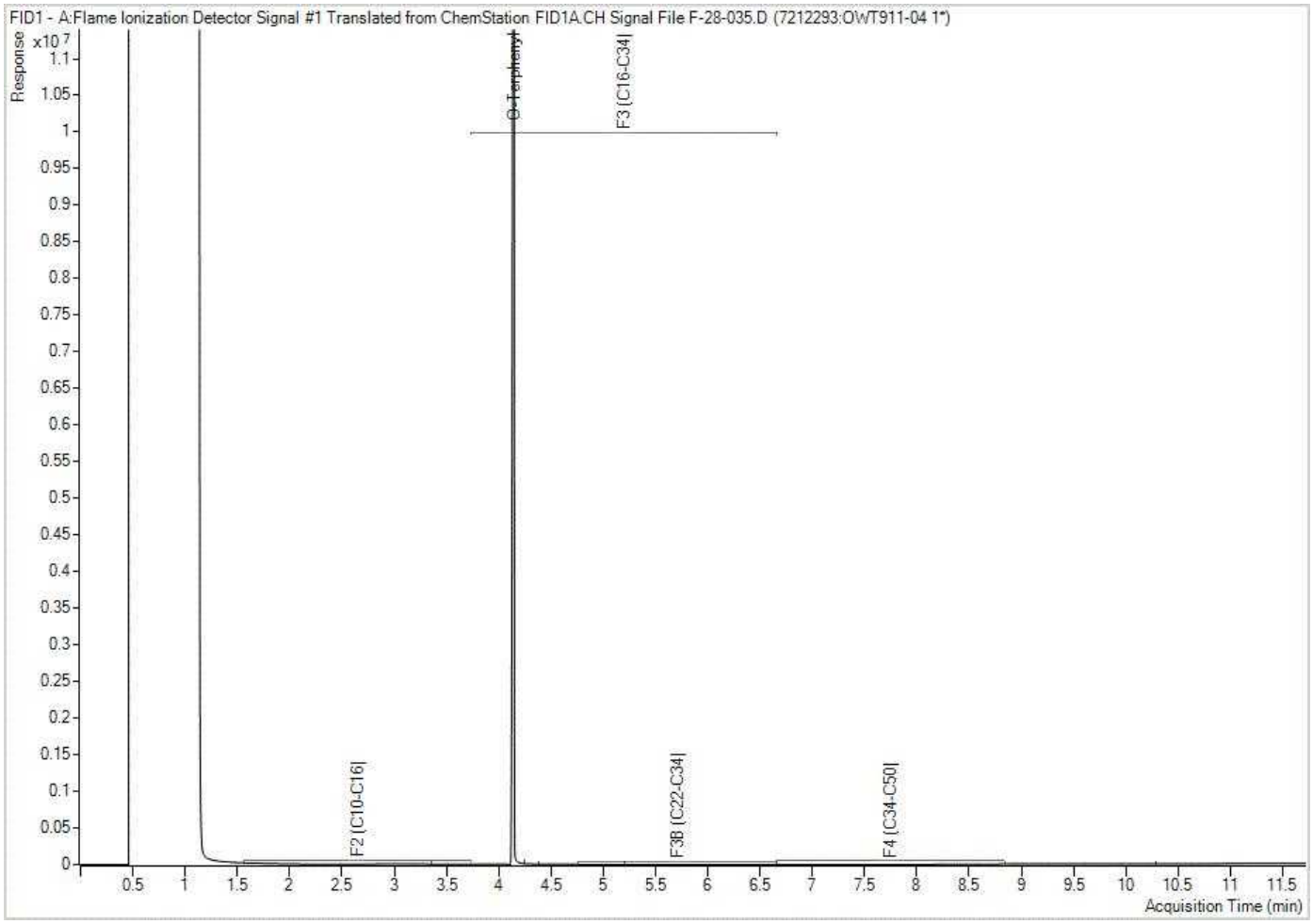
White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C145866
Report Date: 2021/02/24
BV Labs Sample: OWT911

Golder Associates Ltd
Client Project #: 19129150
Client ID: MW20-14A

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

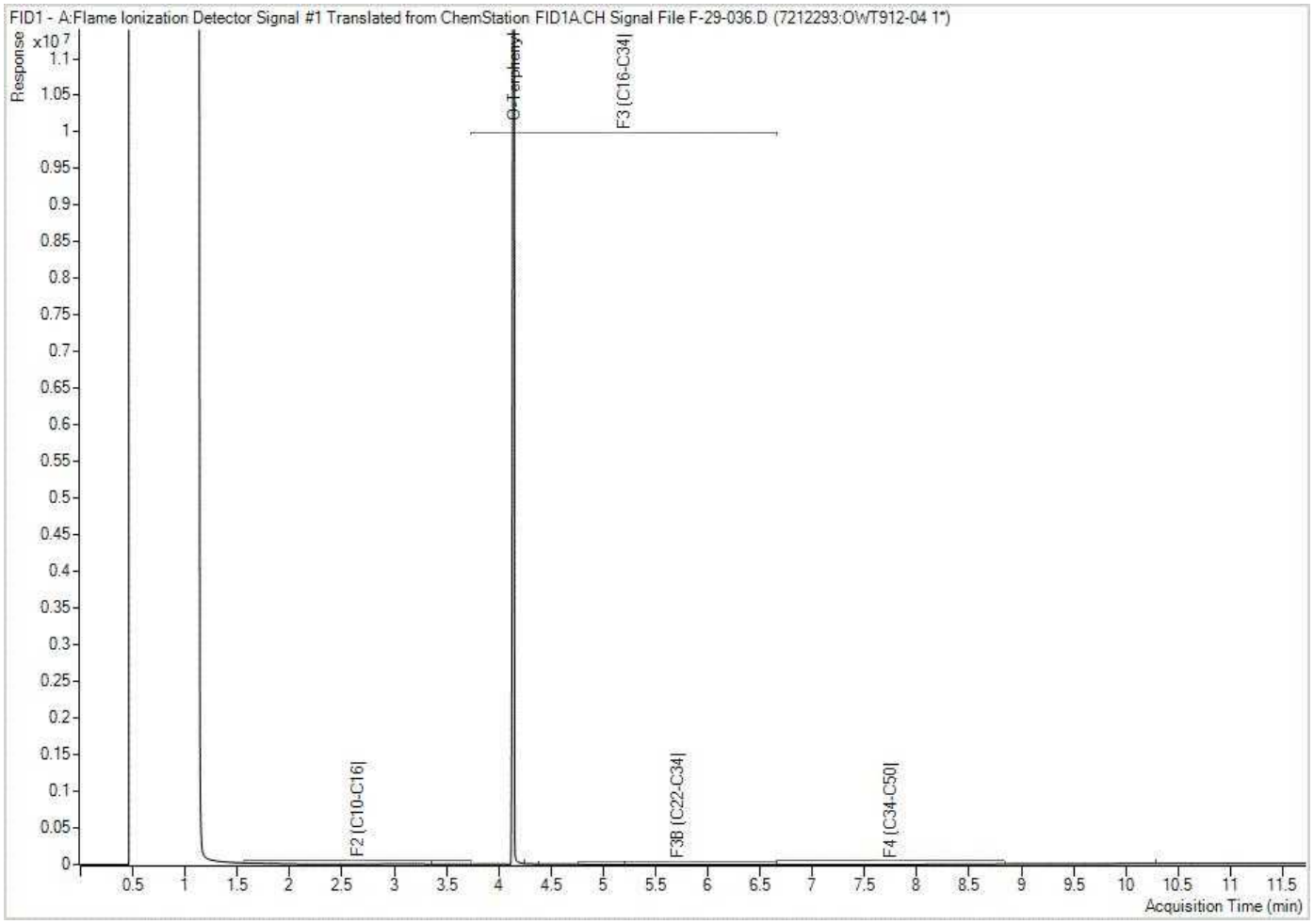


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C145866
Report Date: 2021/02/24
BV Labs Sample: OWT912

Golder Associates Ltd
Client Project #: 19129150
Client ID: MW20-14B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/06/29
Report #: R6697111
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H0819
Received: 2021/06/21, 18:30

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	3	N/A	2021/06/23	CAM SOP-00448	SM 23 2320 B m
Alkalinity	1	N/A	2021/06/24	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2021/06/24	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2021/06/23	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	3	N/A	2021/06/23	CAM SOP-00414	SM 23 2510 m
Conductivity	1	N/A	2021/06/24	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	3	N/A	2021/06/24	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/06/25	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	2	N/A	2021/06/25	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	2	2021/06/25	2021/06/27	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	4	N/A	2021/06/24	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	4	N/A	2021/06/24	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	4	N/A	2021/06/24		
Anion and Cation Sum	4	N/A	2021/06/24		
Total Ammonia-N	4	N/A	2021/06/28	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	4	N/A	2021/06/24	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	3	2021/06/22	2021/06/23	CAM SOP-00413	SM 4500H+ B m
pH	1	2021/06/22	2021/06/24	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	4	N/A	2021/06/23	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	4	N/A	2021/06/24		Auto Calc
Sat. pH and Langelier Index (@ 4C)	4	N/A	2021/06/24		Auto Calc
Sulphate by Automated Colourimetry	4	N/A	2021/06/24	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	4	N/A	2021/06/24		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/06/29
Report #: R6697111
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H0819
Received: 2021/06/21, 18:30

reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1H0819
Report Date: 2021/06/29

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PWX685			PWX685			PWX686		
Sampling Date		2021/06/21 15:30			2021/06/21 15:30			2021/06/21 15:30		
COC Number		831949-01-01			831949-01-01			831949-01-01		
	UNITS	MW20-08 A	RDL	QC Batch	MW20-08 A Lab-Dup	RDL	QC Batch	MW20-08 B	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	9.16	N/A	7421638				13.1	N/A	7421638
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	270	1.0	7421635				280	1.0	7421635
Calculated TDS	mg/L	490	1.0	7421642				720	1.0	7421642
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.9	1.0	7421635				2.8	1.0	7421635
Cation Sum	me/L	9.23	N/A	7421638				13.2	N/A	7421638
Hardness (CaCO3)	mg/L	330	1.0	7421636				320	1.0	7421636
Ion Balance (% Difference)	%	0.400	N/A	7421637				0.690	N/A	7421637
Langelier Index (@ 20C)	N/A	0.947		7421639				0.925		7421639
Langelier Index (@ 4C)	N/A	0.699		7421640				0.679		7421640
Saturation pH (@ 20C)	N/A	7.12		7421639				7.10		7421639
Saturation pH (@ 4C)	N/A	7.37		7421640				7.35		7421640
Inorganics										
Total Ammonia-N	mg/L	0.10	0.050	7430355				<0.050	0.050	7430355
Conductivity	umho/cm	900	1.0	7422524				1400	1.0	7422524
Dissolved Organic Carbon	mg/L	0.45	0.40	7427516				1.2	0.40	7428766
Orthophosphate (P)	mg/L	<0.010	0.010	7422545	<0.010	0.010	7422545	<0.010	0.010	7422545
pH	pH	8.07		7422527				8.03		7422527
Dissolved Sulphate (SO4)	mg/L	22	1.0	7422560	21	1.0	7422560	17	1.0	7422560
Alkalinity (Total as CaCO3)	mg/L	270	1.0	7422513				280	1.0	7422513
Dissolved Chloride (Cl-)	mg/L	110	1.0	7422556	110	1.0	7422556	240	3.0	7422556
Nitrite (N)	mg/L	<0.010	0.010	7423349				<0.010	0.010	7423349
Nitrate (N)	mg/L	3.65	0.10	7423349				4.31	0.10	7423349
Nitrate + Nitrite (N)	mg/L	3.65	0.10	7423349				4.31	0.10	7423349
Metals										
Dissolved Aluminum (Al)	ug/L	120	4.9	7423183				6.5	4.9	7423183
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7423183				<0.50	0.50	7423183
Dissolved Arsenic (As)	ug/L	<1.0	1.0	7423183				<1.0	1.0	7423183
Dissolved Barium (Ba)	ug/L	41	2.0	7423183				31	2.0	7423183
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7423183				<0.40	0.40	7423183

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PWX685			PWX685			PWX686		
Sampling Date		2021/06/21 15:30			2021/06/21 15:30			2021/06/21 15:30		
COC Number		831949-01-01			831949-01-01			831949-01-01		
	UNITS	MW20-08 A	RDL	QC Batch	MW20-08 A Lab-Dup	RDL	QC Batch	MW20-08 B	RDL	QC Batch
Dissolved Boron (B)	ug/L	<10	10	7423183				<10	10	7423183
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7423183				<0.090	0.090	7423183
Dissolved Calcium (Ca)	ug/L	82000	200	7423183				92000	200	7423183
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7423183				<5.0	5.0	7423183
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7423183				<0.50	0.50	7423183
Dissolved Copper (Cu)	ug/L	5.7	0.90	7423183				1.6	0.90	7423183
Dissolved Iron (Fe)	ug/L	200	100	7423183				<100	100	7423183
Dissolved Lead (Pb)	ug/L	1.1	0.50	7423183				<0.50	0.50	7423183
Dissolved Magnesium (Mg)	ug/L	30000	50	7423183				22000	50	7423183
Dissolved Manganese (Mn)	ug/L	15	2.0	7423183				<2.0	2.0	7423183
Dissolved Molybdenum (Mo)	ug/L	0.56	0.50	7423183				<0.50	0.50	7423183
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7423183				<1.0	1.0	7423183
Dissolved Phosphorus (P)	ug/L	<100	100	7423183				<100	100	7423183
Dissolved Potassium (K)	ug/L	880	200	7423183				920	200	7423183
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7423183				<2.0	2.0	7423183
Dissolved Silicon (Si)	ug/L	3900	50	7423183				2700	50	7423183
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7423183				<0.090	0.090	7423183
Dissolved Sodium (Na)	ug/L	61000	100	7423183				160000	100	7423183
Dissolved Strontium (Sr)	ug/L	230	1.0	7423183				160	1.0	7423183
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7423183				<0.050	0.050	7423183
Dissolved Titanium (Ti)	ug/L	6.8	5.0	7423183				<5.0	5.0	7423183
Dissolved Uranium (U)	ug/L	0.88	0.10	7423183				0.21	0.10	7423183
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7423183				<0.50	0.50	7423183
Dissolved Zinc (Zn)	ug/L	9.3	5.0	7423183				<5.0	5.0	7423183

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PWX686			PWX687	PWX688		
Sampling Date		2021/06/21 15:30			2021/06/21 16:45	2021/06/21 16:45		
COC Number		831949-01-01			831949-01-01	831949-01-01		
	UNITS	MW20-08 B Lab-Dup	RDL	QC Batch	MW20-07 A	MW20-07 B	RDL	QC Batch
Calculated Parameters								
Anion Sum	me/L				7.85	9.08	N/A	7421638
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				250	260	1.0	7421635
Calculated TDS	mg/L				410	500	1.0	7421642
Carb. Alkalinity (calc. as CaCO3)	mg/L				2.7	3.1	1.0	7421635
Cation Sum	me/L				7.75	9.08	N/A	7421638
Hardness (CaCO3)	mg/L				330	270	1.0	7421636
Ion Balance (% Difference)	%				0.610	0.00	N/A	7421637
Langelier Index (@ 20C)	N/A				0.928	0.901		7421639
Langelier Index (@ 4C)	N/A				0.679	0.653		7421640
Saturation pH (@ 20C)	N/A				7.13	7.19		7421639
Saturation pH (@ 4C)	N/A				7.38	7.44		7421640
Inorganics								
Total Ammonia-N	mg/L				<0.050	0.28	0.050	7430355
Conductivity	umho/cm				740	870	1.0	7422524
Dissolved Organic Carbon	mg/L	1.2	0.40	7428766	0.55	0.88	0.40	7427516
Orthophosphate (P)	mg/L				<0.010	<0.010	0.010	7422545
pH	pH				8.06	8.09		7422527
Dissolved Sulphate (SO4)	mg/L				40	20	1.0	7422560
Alkalinity (Total as CaCO3)	mg/L				250	270	1.0	7422513
Dissolved Chloride (Cl-)	mg/L				68	100	1.0	7422556
Nitrite (N)	mg/L				<0.010	<0.010	0.010	7423349
Nitrate (N)	mg/L				0.73	5.20	0.10	7423349
Nitrate + Nitrite (N)	mg/L				0.73	5.20	0.10	7423349
Metals								
Dissolved Aluminum (Al)	ug/L				53	92	4.9	7423183
Dissolved Antimony (Sb)	ug/L				<0.50	<0.50	0.50	7423183
Dissolved Arsenic (As)	ug/L				7.9	<1.0	1.0	7423183
Dissolved Barium (Ba)	ug/L				56	34	2.0	7423183
Dissolved Beryllium (Be)	ug/L				<0.40	<0.40	0.40	7423183

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PWX686			PWX687	PWX688		
Sampling Date		2021/06/21 15:30			2021/06/21 16:45	2021/06/21 16:45		
COC Number		831949-01-01			831949-01-01	831949-01-01		
	UNITS	MW20-08 B Lab-Dup	RDL	QC Batch	MW20-07 A	MW20-07 B	RDL	QC Batch
Dissolved Boron (B)	ug/L				23	19	10	7423183
Dissolved Cadmium (Cd)	ug/L				<0.090	<0.090	0.090	7423183
Dissolved Calcium (Ca)	ug/L				81000	71000	200	7423183
Dissolved Chromium (Cr)	ug/L				<5.0	<5.0	5.0	7423183
Dissolved Cobalt (Co)	ug/L				<0.50	<0.50	0.50	7423183
Dissolved Copper (Cu)	ug/L				<0.90	2.8	0.90	7423183
Dissolved Iron (Fe)	ug/L				<100	<100	100	7423183
Dissolved Lead (Pb)	ug/L				<0.50	<0.50	0.50	7423183
Dissolved Magnesium (Mg)	ug/L				30000	22000	50	7423183
Dissolved Manganese (Mn)	ug/L				26	46	2.0	7423183
Dissolved Molybdenum (Mo)	ug/L				1.5	5.5	0.50	7423183
Dissolved Nickel (Ni)	ug/L				<1.0	2.8	1.0	7423183
Dissolved Phosphorus (P)	ug/L				<100	<100	100	7423183
Dissolved Potassium (K)	ug/L				2400	1500	200	7423183
Dissolved Selenium (Se)	ug/L				<2.0	<2.0	2.0	7423183
Dissolved Silicon (Si)	ug/L				3900	3700	50	7423183
Dissolved Silver (Ag)	ug/L				<0.090	<0.090	0.090	7423183
Dissolved Sodium (Na)	ug/L				26000	83000	100	7423183
Dissolved Strontium (Sr)	ug/L				2600	220	1.0	7423183
Dissolved Thallium (Tl)	ug/L				0.056	0.079	0.050	7423183
Dissolved Titanium (Ti)	ug/L				<5.0	<5.0	5.0	7423183
Dissolved Uranium (U)	ug/L				0.53	1.2	0.10	7423183
Dissolved Vanadium (V)	ug/L				<0.50	<0.50	0.50	7423183
Dissolved Zinc (Zn)	ug/L				<5.0	9.5	5.0	7423183

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PWX686	PWX688		
Sampling Date		2021/06/21 15:30	2021/06/21 16:45		
COC Number		831949-01-01	831949-01-01		
	UNITS	MW20-08 B	MW20-07 B	RDL	QC Batch
BTEX & F1 Hydrocarbons					
Benzene	ug/L	<0.20	<0.20	0.20	7430651
Toluene	ug/L	<0.20	<0.20	0.20	7430651
Ethylbenzene	ug/L	<0.20	<0.20	0.20	7430651
o-Xylene	ug/L	<0.20	<0.20	0.20	7430651
p+m-Xylene	ug/L	<0.40	<0.40	0.40	7430651
Total Xylenes	ug/L	<0.40	<0.40	0.40	7430651
F1 (C6-C10)	ug/L	<25	<25	25	7430651
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	7430651
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	7430615
F3 (C16-C34 Hydrocarbons)	ug/L	<200	360	200	7430615
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	7430615
Reached Baseline at C50	ug/L	Yes	Yes		7430615
Surrogate Recovery (%)					
1,4-Difluorobenzene	%	99	100		7430651
4-Bromofluorobenzene	%	99	97		7430651
D10-o-Xylene	%	116	114		7430651
D4-1,2-Dichloroethane	%	112	111		7430651
o-Terphenyl	%	99	99		7430615

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PWX685
Sample ID: MW20-08 A
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/23	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Conductivity	AT	7422524	N/A	2021/06/23	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7427516	N/A	2021/06/24	Nimarta Singh
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal
pH	AT	7422527	2021/06/22	2021/06/23	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

BV Labs ID: PWX685 Dup
Sample ID: MW20-08 A
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan

BV Labs ID: PWX686
Sample ID: MW20-08 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Conductivity	AT	7422524	N/A	2021/06/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7428766	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7430651	N/A	2021/06/25	Lincoln Ramdahin
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7430615	2021/06/25	2021/06/27	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal

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TEST SUMMARY

BV Labs ID: PWX686
Sample ID: MW20-08 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH	AT	7422527	2021/06/22	2021/06/24	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

BV Labs ID: PWX686 Dup
Sample ID: MW20-08 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7428766	N/A	2021/06/25	Nimarta Singh

BV Labs ID: PWX687
Sample ID: MW20-07 A
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/23	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Conductivity	AT	7422524	N/A	2021/06/23	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7427516	N/A	2021/06/24	Nimarta Singh
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal
pH	AT	7422527	2021/06/22	2021/06/23	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

BV Labs ID: PWX688
Sample ID: MW20-07 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/23	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H0819
Report Date: 2021/06/29

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

TEST SUMMARY

BV Labs ID: PWX688
Sample ID: MW20-07 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7422524	N/A	2021/06/23	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7427516	N/A	2021/06/24	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7430651	N/A	2021/06/25	Lincoln Ramdahin
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7430615	2021/06/25	2021/06/27	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal
pH	AT	7422527	2021/06/22	2021/06/23	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.3°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7430615	o-Terphenyl	2021/06/27	98	60 - 130	101	60 - 130	99	%		
7430651	1,4-Difluorobenzene	2021/06/25	97	70 - 130	100	70 - 130	99	%		
7430651	4-Bromofluorobenzene	2021/06/25	103	70 - 130	102	70 - 130	99	%		
7430651	D10-o-Xylene	2021/06/25	94	70 - 130	106	70 - 130	114	%		
7430651	D4-1,2-Dichloroethane	2021/06/25	109	70 - 130	101	70 - 130	108	%		
7422513	Alkalinity (Total as CaCO3)	2021/06/23			99	85 - 115	<1.0	mg/L	0.56	20
7422524	Conductivity	2021/06/23			102	85 - 115	<1.0	umho/cm	0.24	25
7422527	pH	2021/06/23			102	98 - 103			1.2	N/A
7422545	Orthophosphate (P)	2021/06/23	106	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
7422556	Dissolved Chloride (Cl-)	2021/06/23	NC	80 - 120	102	80 - 120	<1.0	mg/L	4.3	20
7422560	Dissolved Sulphate (SO4)	2021/06/24	NC	75 - 125	102	80 - 120	<1.0	mg/L	1.6	20
7423183	Dissolved Aluminum (Al)	2021/06/24	105	80 - 120	101	80 - 120	<4.9	ug/L	4.6	20
7423183	Dissolved Antimony (Sb)	2021/06/24	108	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Arsenic (As)	2021/06/24	102	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7423183	Dissolved Barium (Ba)	2021/06/24	102	80 - 120	99	80 - 120	<2.0	ug/L	0.93	20
7423183	Dissolved Beryllium (Be)	2021/06/24	99	80 - 120	95	80 - 120	<0.40	ug/L	NC	20
7423183	Dissolved Boron (B)	2021/06/24	96	80 - 120	92	80 - 120	<10	ug/L	0.33	20
7423183	Dissolved Cadmium (Cd)	2021/06/24	106	80 - 120	101	80 - 120	<0.090	ug/L	NC	20
7423183	Dissolved Calcium (Ca)	2021/06/24	NC	80 - 120	98	80 - 120	<200	ug/L	1.1	20
7423183	Dissolved Chromium (Cr)	2021/06/24	98	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7423183	Dissolved Cobalt (Co)	2021/06/24	101	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Copper (Cu)	2021/06/24	102	80 - 120	99	80 - 120	<0.90	ug/L	4.1	20
7423183	Dissolved Iron (Fe)	2021/06/24	99	80 - 120	103	80 - 120	<100	ug/L	NC	20
7423183	Dissolved Lead (Pb)	2021/06/24	101	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Magnesium (Mg)	2021/06/24	96	80 - 120	99	80 - 120	<50	ug/L	2.6	20
7423183	Dissolved Manganese (Mn)	2021/06/24	100	80 - 120	100	80 - 120	<2.0	ug/L	2.9	20
7423183	Dissolved Molybdenum (Mo)	2021/06/24	105	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Nickel (Ni)	2021/06/24	97	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
7423183	Dissolved Phosphorus (P)	2021/06/24	104	80 - 120	104	80 - 120	<100	ug/L	NC	20
7423183	Dissolved Potassium (K)	2021/06/24	104	80 - 120	103	80 - 120	<200	ug/L	1.9	20
7423183	Dissolved Selenium (Se)	2021/06/24	104	80 - 120	103	80 - 120	<2.0	ug/L	NC	20

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7423183	Dissolved Silicon (Si)	2021/06/24	105	80 - 120	96	80 - 120	<50	ug/L	1.6	20
7423183	Dissolved Silver (Ag)	2021/06/24	99	80 - 120	97	80 - 120	<0.090	ug/L	NC	20
7423183	Dissolved Sodium (Na)	2021/06/24	NC	80 - 120	101	80 - 120	<100	ug/L	2.3	20
7423183	Dissolved Strontium (Sr)	2021/06/24	100	80 - 120	99	80 - 120	<1.0	ug/L	0.89	20
7423183	Dissolved Thallium (Tl)	2021/06/24	102	80 - 120	107	80 - 120	<0.050	ug/L	NC	20
7423183	Dissolved Titanium (Ti)	2021/06/24	105	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7423183	Dissolved Uranium (U)	2021/06/24	102	80 - 120	99	80 - 120	<0.10	ug/L	4.3	20
7423183	Dissolved Vanadium (V)	2021/06/24	101	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Zinc (Zn)	2021/06/24	100	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7423349	Nitrate (N)	2021/06/24	99	80 - 120	99	80 - 120	<0.10	mg/L	3.1	20
7423349	Nitrite (N)	2021/06/24	109	80 - 120	106	80 - 120	<0.010	mg/L	NC	20
7427516	Dissolved Organic Carbon	2021/06/24	95	80 - 120	96	80 - 120	<0.40	mg/L	0.29	20
7428766	Dissolved Organic Carbon	2021/06/25	98	80 - 120	102	80 - 120	<0.40	mg/L	0.57	20
7430355	Total Ammonia-N	2021/06/28	97	75 - 125	102	80 - 120	<0.050	mg/L	NC	20
7430615	F2 (C10-C16 Hydrocarbons)	2021/06/27	97	60 - 130	103	60 - 130	<100	ug/L	NC	30
7430615	F3 (C16-C34 Hydrocarbons)	2021/06/27	93	60 - 130	101	60 - 130	<200	ug/L	27	30
7430615	F4 (C34-C50 Hydrocarbons)	2021/06/27	92	60 - 130	99	60 - 130	<200	ug/L	NC	30
7430651	Benzene	2021/06/25	101	50 - 140	103	50 - 140	<0.20	ug/L	NC	30
7430651	Ethylbenzene	2021/06/25	104	50 - 140	112	50 - 140	<0.20	ug/L	NC	30
7430651	F1 (C6-C10) - BTEX	2021/06/25					<25	ug/L	NC	30
7430651	F1 (C6-C10)	2021/06/25	92	60 - 140	97	60 - 140	<25	ug/L	NC	30
7430651	o-Xylene	2021/06/25	103	50 - 140	107	50 - 140	<0.20	ug/L	NC	30
7430651	p+m-Xylene	2021/06/25	101	50 - 140	107	50 - 140	<0.40	ug/L	NC	30
7430651	Toluene	2021/06/25	97	50 - 140	101	50 - 140	<0.20	ug/L	NC	30

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7430651	Total Xylenes	2021/06/25					<0.40	ug/L	NC	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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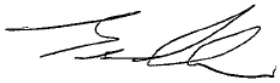
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvlabs.com

Page of

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:	Bottle Order #: 831949
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:			
Address:	210 Sheldon Drive. Cambridge ON N1T 1A8	Address:		Project:	19129150 (2300)	COC #: C#831949-01-01	Project Manager: Ema Gitej
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:			
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:			
				Sampled By:	UP + CS		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ☐ PWQO ☐ Reg 406 Table ☐ Other

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1	MW20-08A →		21-Jun-21	15:30	GW	Y	✓									4	
2	MW20-08B →		21-Jun-21	15:30	GW	Y	✓	✓								8	
3	MW20-07A →		21-Jun-21	16:45	GW	Y	✓									4	
4	MW20-07B →		21-Jun-21	16:45	GW	Y	✓	✓								8	
5																	
6																	
7																	
8																	
9																	
10																	

21-Jun-21 18:30
Ema Gitej
C1H0819

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	*RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Claire Steckle / C Steckle	21/06/21			21/06/21	18:30	

Laboratory Use Only					
Time Sensitive	Temperature (°C) on Recei	9/9/7	Custody Seal Present	Yes	No
			Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

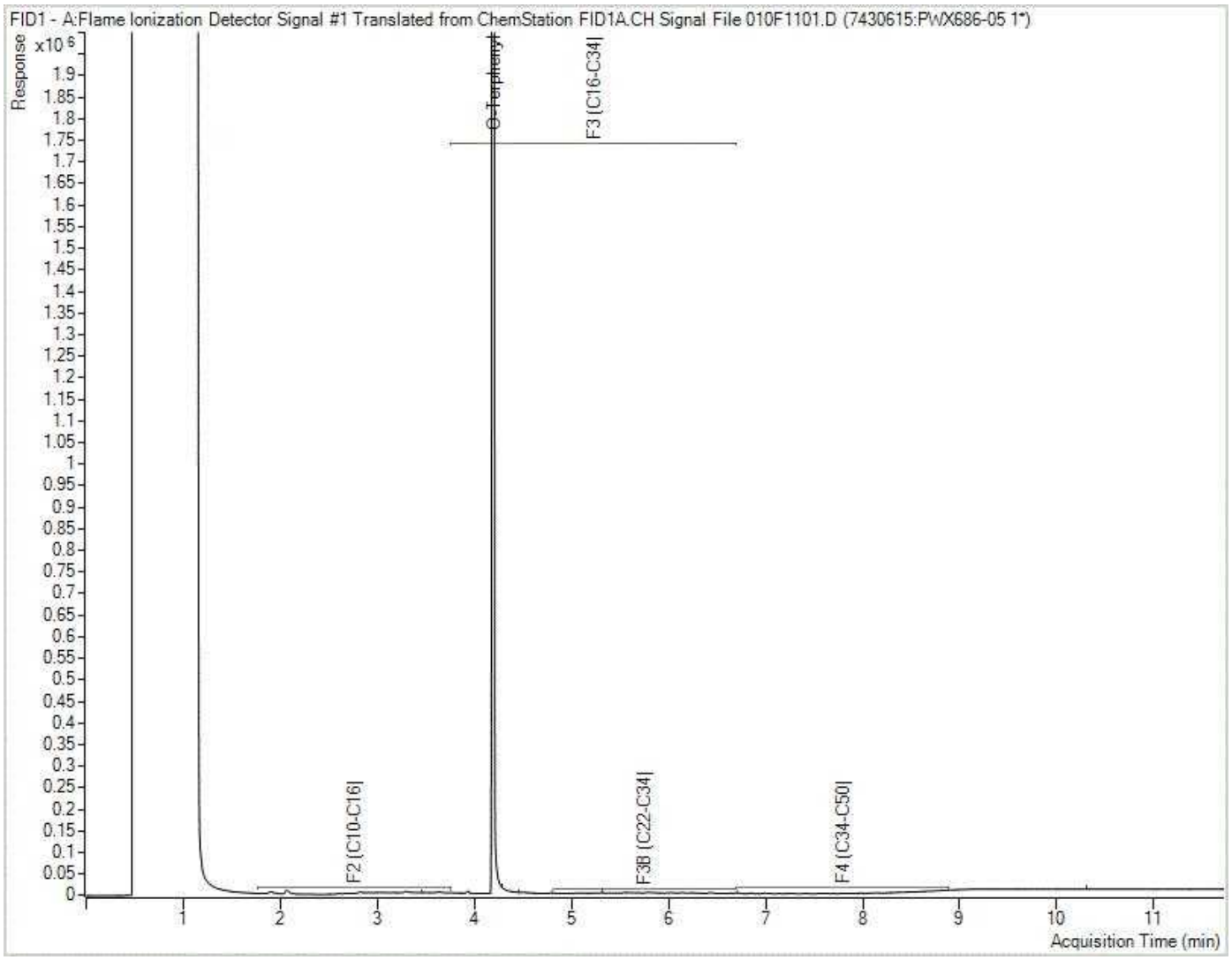
White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C1H0819
Report Date: 2021/06/29
BV Labs Sample: PWX686

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-08 B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

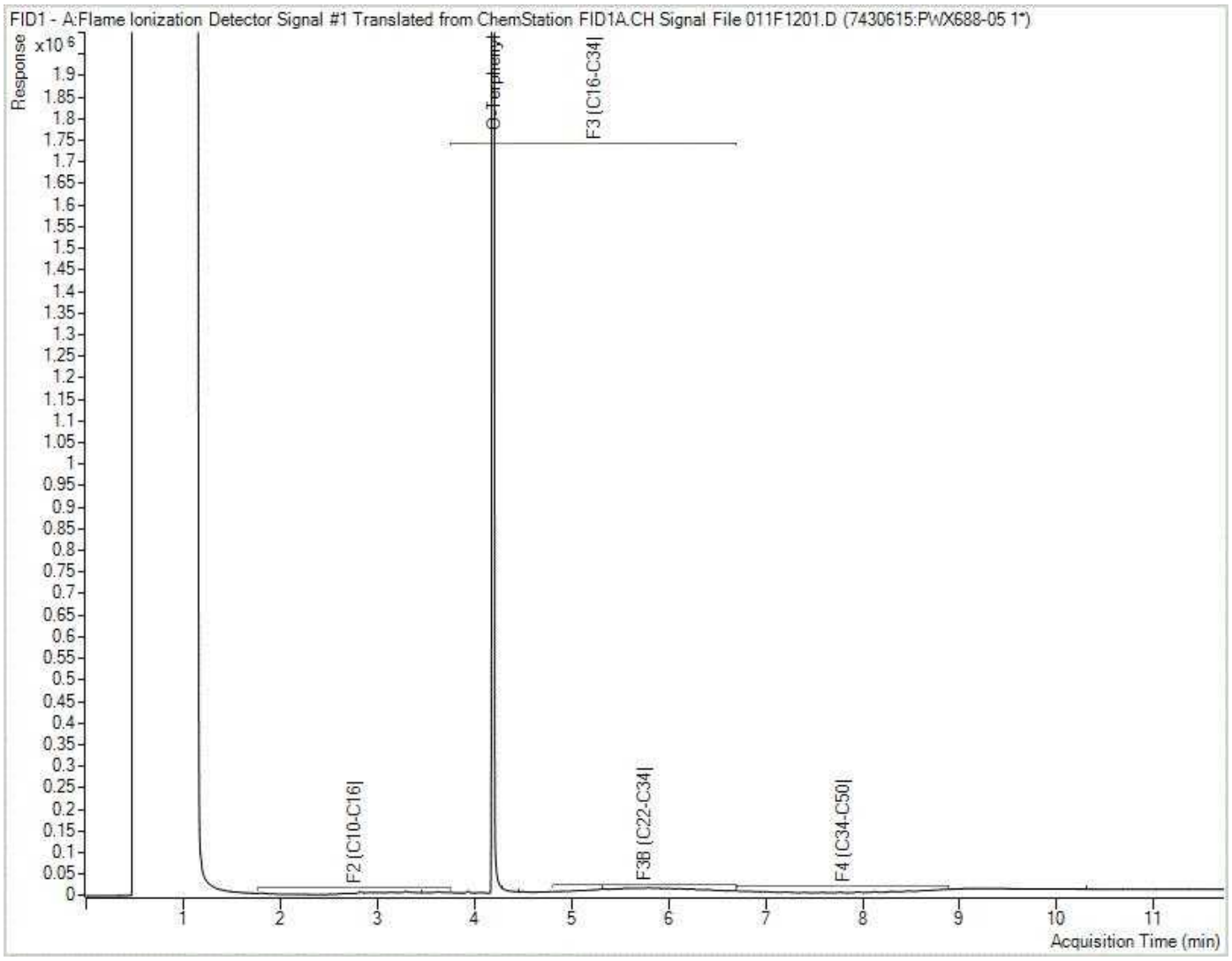


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H0819
Report Date: 2021/06/29
BV Labs Sample: PWX688

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-07 B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-01-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/27
Report #: R6738963
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1H0819
Received: 2021/06/21, 18:30

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	3	N/A	2021/06/23	CAM SOP-00448	SM 23 2320 B m
Alkalinity	1	N/A	2021/06/24	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2021/06/24	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2021/06/23	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	3	N/A	2021/06/23	CAM SOP-00414	SM 23 2510 m
Conductivity	1	N/A	2021/06/24	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	3	N/A	2021/06/24	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/06/25	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	2	N/A	2021/06/25	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	2	2021/06/25	2021/06/27	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	4	N/A	2021/06/24	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	4	N/A	2021/06/24	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	4	N/A	2021/06/24		
Anion and Cation Sum	4	N/A	2021/06/24		
Total Ammonia-N	4	N/A	2021/06/28	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	4	N/A	2021/06/24	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	3	2021/06/22	2021/06/23	CAM SOP-00413	SM 4500H+ B m
pH	1	2021/06/22	2021/06/24	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	4	N/A	2021/06/23	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	4	N/A	2021/06/24		Auto Calc
Sat. pH and Langelier Index (@ 4C)	4	N/A	2021/06/24		Auto Calc
Sulphate by Automated Colourimetry	4	N/A	2021/06/24	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	4	N/A	2021/06/24		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-01-01

Attention: Gregory Padusenko

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210 Sheldon Drive
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CANADA N1T 1A8

Report Date: 2021/07/27
Report #: R6738963
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1H0819
Received: 2021/06/21, 18:30

reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1H0819
Report Date: 2021/07/27

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID				PWX685			PWX685		
Sampling Date				2021/06/21 15:30			2021/06/21 15:30		
COC Number				831949-01-01			831949-01-01		
	UNITS	MAC	A/O	MW20-08 A	RDL	QC Batch	MW20-08 A Lab-Dup	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	-	-	9.16	N/A	7421638			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	270	1.0	7421635			
Calculated TDS	mg/L	-	500	490	1.0	7421642			
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.9	1.0	7421635			
Cation Sum	me/L	-	-	9.23	N/A	7421638			
Hardness (CaCO3)	mg/L	-	80:100	**330**	1.0	7421636			
Ion Balance (% Difference)	%	-	-	0.400	N/A	7421637			
Langelier Index (@ 20C)	N/A	-	-	0.947		7421639			
Langelier Index (@ 4C)	N/A	-	-	0.699		7421640			
Saturation pH (@ 20C)	N/A	-	-	7.12		7421639			
Saturation pH (@ 4C)	N/A	-	-	7.37		7421640			
Inorganics									
Total Ammonia-N	mg/L	-	-	0.10	0.050	7430355			
Conductivity	umho/cm	-	-	900	1.0	7422524			
Dissolved Organic Carbon	mg/L	-	5	0.45	0.40	7427516			
Orthophosphate (P)	mg/L	-	-	<0.010	0.010	7422545	<0.010	0.010	7422545
pH	pH	-	6.5:8.5	8.07		7422527			
Dissolved Sulphate (SO4)	mg/L	-	500	22	1.0	7422560	21	1.0	7422560
Alkalinity (Total as CaCO3)	mg/L	-	30:500	270	1.0	7422513			
Dissolved Chloride (Cl-)	mg/L	-	250	110	1.0	7422556	110	1.0	7422556
Nitrite (N)	mg/L	1	-	<0.010	0.010	7423349			
Nitrate (N)	mg/L	10	-	3.65	0.10	7423349			
Nitrate + Nitrite (N)	mg/L	10	-	3.65	0.10	7423349			
Metals									
Dissolved Aluminum (Al)	ug/L	-	100	**120**	4.9	7423183			
Dissolved Antimony (Sb)	ug/L	6	-	<0.50	0.50	7423183			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H0819
Report Date: 2021/07/27

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID				PWX685			PWX685		
Sampling Date				2021/06/21 15:30			2021/06/21 15:30		
COC Number				831949-01-01			831949-01-01		
	UNITS	MAC	A/O	MW20-08 A	RDL	QC Batch	MW20-08 A Lab-Dup	RDL	QC Batch
Dissolved Arsenic (As)	ug/L	10	-	<1.0	1.0	7423183			
Dissolved Barium (Ba)	ug/L	1000	-	41	2.0	7423183			
Dissolved Beryllium (Be)	ug/L	-	-	<0.40	0.40	7423183			
Dissolved Boron (B)	ug/L	5000	-	<10	10	7423183			
Dissolved Cadmium (Cd)	ug/L	5	-	<0.090	0.090	7423183			
Dissolved Calcium (Ca)	ug/L	-	-	82000	200	7423183			
Dissolved Chromium (Cr)	ug/L	50	-	<5.0	5.0	7423183			
Dissolved Cobalt (Co)	ug/L	-	-	<0.50	0.50	7423183			
Dissolved Copper (Cu)	ug/L	-	1000	5.7	0.90	7423183			
Dissolved Iron (Fe)	ug/L	-	300	200	100	7423183			
Dissolved Lead (Pb)	ug/L	10	-	1.1	0.50	7423183			
Dissolved Magnesium (Mg)	ug/L	-	-	30000	50	7423183			
Dissolved Manganese (Mn)	ug/L	-	50	15	2.0	7423183			
Dissolved Molybdenum (Mo)	ug/L	-	-	0.56	0.50	7423183			
Dissolved Nickel (Ni)	ug/L	-	-	<1.0	1.0	7423183			
Dissolved Phosphorus (P)	ug/L	-	-	<100	100	7423183			
Dissolved Potassium (K)	ug/L	-	-	880	200	7423183			
Dissolved Selenium (Se)	ug/L	50	-	<2.0	2.0	7423183			
Dissolved Silicon (Si)	ug/L	-	-	3900	50	7423183			
Dissolved Silver (Ag)	ug/L	-	-	<0.090	0.090	7423183			
Dissolved Sodium (Na)	ug/L	-	200000	61000	100	7423183			
Dissolved Strontium (Sr)	ug/L	-	-	230	1.0	7423183			
Dissolved Thallium (Tl)	ug/L	-	-	<0.050	0.050	7423183			
Dissolved Titanium (Ti)	ug/L	-	-	6.8	5.0	7423183			
Dissolved Uranium (U)	ug/L	20	-	0.88	0.10	7423183			
Dissolved Vanadium (V)	ug/L	-	-	<0.50	0.50	7423183			
Dissolved Zinc (Zn)	ug/L	-	5000	9.3	5.0	7423183			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
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MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H0819
Report Date: 2021/07/27

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID				PWX686			PWX686		
Sampling Date				2021/06/21 15:30			2021/06/21 15:30		
COC Number				831949-01-01			831949-01-01		
	UNITS	MAC	A/O	MW20-08 B	RDL	QC Batch	MW20-08 B Lab-Dup	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	-	-	13.1	N/A	7421638			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	280	1.0	7421635			
Calculated TDS	mg/L	-	500	**720**	1.0	7421642			
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.8	1.0	7421635			
Cation Sum	me/L	-	-	13.2	N/A	7421638			
Hardness (CaCO3)	mg/L	-	80:100	**320**	1.0	7421636			
Ion Balance (% Difference)	%	-	-	0.690	N/A	7421637			
Langelier Index (@ 20C)	N/A	-	-	0.925		7421639			
Langelier Index (@ 4C)	N/A	-	-	0.679		7421640			
Saturation pH (@ 20C)	N/A	-	-	7.10		7421639			
Saturation pH (@ 4C)	N/A	-	-	7.35		7421640			
Inorganics									
Total Ammonia-N	mg/L	-	-	<0.050	0.050	7430355			
Conductivity	umho/cm	-	-	1400	1.0	7422524			
Dissolved Organic Carbon	mg/L	-	5	1.2	0.40	7428766	1.2	0.40	7428766
Orthophosphate (P)	mg/L	-	-	<0.010	0.010	7422545			
pH	pH	-	6.5:8.5	8.03		7422527			
Dissolved Sulphate (SO4)	mg/L	-	500	17	1.0	7422560			
Alkalinity (Total as CaCO3)	mg/L	-	30:500	280	1.0	7422513			
Dissolved Chloride (Cl-)	mg/L	-	250	240	3.0	7422556			
Nitrite (N)	mg/L	1	-	<0.010	0.010	7423349			
Nitrate (N)	mg/L	10	-	4.31	0.10	7423349			
Nitrate + Nitrite (N)	mg/L	10	-	4.31	0.10	7423349			
Metals									
Dissolved Aluminum (Al)	ug/L	-	100	6.5	4.9	7423183			
Dissolved Antimony (Sb)	ug/L	6	-	<0.50	0.50	7423183			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
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MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID				PWX686			PWX686		
Sampling Date				2021/06/21 15:30			2021/06/21 15:30		
COC Number				831949-01-01			831949-01-01		
	UNITS	MAC	A/O	MW20-08 B	RDL	QC Batch	MW20-08 B Lab-Dup	RDL	QC Batch
Dissolved Arsenic (As)	ug/L	10	-	<1.0	1.0	7423183			
Dissolved Barium (Ba)	ug/L	1000	-	31	2.0	7423183			
Dissolved Beryllium (Be)	ug/L	-	-	<0.40	0.40	7423183			
Dissolved Boron (B)	ug/L	5000	-	<10	10	7423183			
Dissolved Cadmium (Cd)	ug/L	5	-	<0.090	0.090	7423183			
Dissolved Calcium (Ca)	ug/L	-	-	92000	200	7423183			
Dissolved Chromium (Cr)	ug/L	50	-	<5.0	5.0	7423183			
Dissolved Cobalt (Co)	ug/L	-	-	<0.50	0.50	7423183			
Dissolved Copper (Cu)	ug/L	-	1000	1.6	0.90	7423183			
Dissolved Iron (Fe)	ug/L	-	300	<100	100	7423183			
Dissolved Lead (Pb)	ug/L	10	-	<0.50	0.50	7423183			
Dissolved Magnesium (Mg)	ug/L	-	-	22000	50	7423183			
Dissolved Manganese (Mn)	ug/L	-	50	<2.0	2.0	7423183			
Dissolved Molybdenum (Mo)	ug/L	-	-	<0.50	0.50	7423183			
Dissolved Nickel (Ni)	ug/L	-	-	<1.0	1.0	7423183			
Dissolved Phosphorus (P)	ug/L	-	-	<100	100	7423183			
Dissolved Potassium (K)	ug/L	-	-	920	200	7423183			
Dissolved Selenium (Se)	ug/L	50	-	<2.0	2.0	7423183			
Dissolved Silicon (Si)	ug/L	-	-	2700	50	7423183			
Dissolved Silver (Ag)	ug/L	-	-	<0.090	0.090	7423183			
Dissolved Sodium (Na)	ug/L	-	200000	160000	100	7423183			
Dissolved Strontium (Sr)	ug/L	-	-	160	1.0	7423183			
Dissolved Thallium (Tl)	ug/L	-	-	<0.050	0.050	7423183			
Dissolved Titanium (Ti)	ug/L	-	-	<5.0	5.0	7423183			
Dissolved Uranium (U)	ug/L	20	-	0.21	0.10	7423183			
Dissolved Vanadium (V)	ug/L	-	-	<0.50	0.50	7423183			
Dissolved Zinc (Zn)	ug/L	-	5000	<5.0	5.0	7423183			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID				PWX687	PWX688		
Sampling Date				2021/06/21 16:45	2021/06/21 16:45		
COC Number				831949-01-01	831949-01-01		
	UNITS	MAC	A/O	MW20-07 A	MW20-07 B	RDL	QC Batch
Calculated Parameters							
Anion Sum	me/L	-	-	7.85	9.08	N/A	7421638
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	250	260	1.0	7421635
Calculated TDS	mg/L	-	500	410	500	1.0	7421642
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.7	3.1	1.0	7421635
Cation Sum	me/L	-	-	7.75	9.08	N/A	7421638
Hardness (CaCO3)	mg/L	-	80:100	**330**	**270**	1.0	7421636
Ion Balance (% Difference)	%	-	-	0.610	0.00	N/A	7421637
Langelier Index (@ 20C)	N/A	-	-	0.928	0.901		7421639
Langelier Index (@ 4C)	N/A	-	-	0.679	0.653		7421640
Saturation pH (@ 20C)	N/A	-	-	7.13	7.19		7421639
Saturation pH (@ 4C)	N/A	-	-	7.38	7.44		7421640
Inorganics							
Total Ammonia-N	mg/L	-	-	<0.050	0.28	0.050	7430355
Conductivity	umho/cm	-	-	740	870	1.0	7422524
Dissolved Organic Carbon	mg/L	-	5	0.55	0.88	0.40	7427516
Orthophosphate (P)	mg/L	-	-	<0.010	<0.010	0.010	7422545
pH	pH	-	6.5:8.5	8.06	8.09		7422527
Dissolved Sulphate (SO4)	mg/L	-	500	40	20	1.0	7422560
Alkalinity (Total as CaCO3)	mg/L	-	30:500	250	270	1.0	7422513
Dissolved Chloride (Cl-)	mg/L	-	250	68	100	1.0	7422556
Nitrite (N)	mg/L	1	-	<0.010	<0.010	0.010	7423349
Nitrate (N)	mg/L	10	-	0.73	5.20	0.10	7423349
Nitrate + Nitrite (N)	mg/L	10	-	0.73	5.20	0.10	7423349
Metals							
Dissolved Aluminum (Al)	ug/L	-	100	53	92	4.9	7423183
Dissolved Antimony (Sb)	ug/L	6	-	<0.50	<0.50	0.50	7423183
Dissolved Arsenic (As)	ug/L	10	-	7.9	<1.0	1.0	7423183

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
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N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID				PWX687	PWX688		
Sampling Date				2021/06/21 16:45	2021/06/21 16:45		
COC Number				831949-01-01	831949-01-01		
	UNITS	MAC	A/O	MW20-07 A	MW20-07 B	RDL	QC Batch
Dissolved Barium (Ba)	ug/L	1000	-	56	34	2.0	7423183
Dissolved Beryllium (Be)	ug/L	-	-	<0.40	<0.40	0.40	7423183
Dissolved Boron (B)	ug/L	5000	-	23	19	10	7423183
Dissolved Cadmium (Cd)	ug/L	5	-	<0.090	<0.090	0.090	7423183
Dissolved Calcium (Ca)	ug/L	-	-	81000	71000	200	7423183
Dissolved Chromium (Cr)	ug/L	50	-	<5.0	<5.0	5.0	7423183
Dissolved Cobalt (Co)	ug/L	-	-	<0.50	<0.50	0.50	7423183
Dissolved Copper (Cu)	ug/L	-	1000	<0.90	2.8	0.90	7423183
Dissolved Iron (Fe)	ug/L	-	300	<100	<100	100	7423183
Dissolved Lead (Pb)	ug/L	10	-	<0.50	<0.50	0.50	7423183
Dissolved Magnesium (Mg)	ug/L	-	-	30000	22000	50	7423183
Dissolved Manganese (Mn)	ug/L	-	50	26	46	2.0	7423183
Dissolved Molybdenum (Mo)	ug/L	-	-	1.5	5.5	0.50	7423183
Dissolved Nickel (Ni)	ug/L	-	-	<1.0	2.8	1.0	7423183
Dissolved Phosphorus (P)	ug/L	-	-	<100	<100	100	7423183
Dissolved Potassium (K)	ug/L	-	-	2400	1500	200	7423183
Dissolved Selenium (Se)	ug/L	50	-	<2.0	<2.0	2.0	7423183
Dissolved Silicon (Si)	ug/L	-	-	3900	3700	50	7423183
Dissolved Silver (Ag)	ug/L	-	-	<0.090	<0.090	0.090	7423183
Dissolved Sodium (Na)	ug/L	-	200000	26000	83000	100	7423183
Dissolved Strontium (Sr)	ug/L	-	-	2600	220	1.0	7423183
Dissolved Thallium (Tl)	ug/L	-	-	0.056	0.079	0.050	7423183
Dissolved Titanium (Ti)	ug/L	-	-	<5.0	<5.0	5.0	7423183
Dissolved Uranium (U)	ug/L	20	-	0.53	1.2	0.10	7423183
Dissolved Vanadium (V)	ug/L	-	-	<0.50	<0.50	0.50	7423183
Dissolved Zinc (Zn)	ug/L	-	5000	<5.0	9.5	5.0	7423183

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID				PWX686	PWX688		
Sampling Date				2021/06/21 15:30	2021/06/21 16:45		
COC Number				831949-01-01	831949-01-01		
	UNITS	MAC	A/O	MW20-08 B	MW20-07 B	RDL	QC Batch
BTEX & F1 Hydrocarbons							
Benzene	ug/L	1	-	<0.20	<0.20	0.20	7430651
Toluene	ug/L	60	24	<0.20	<0.20	0.20	7430651
Ethylbenzene	ug/L	140	1.6	<0.20	<0.20	0.20	7430651
o-Xylene	ug/L	-	-	<0.20	<0.20	0.20	7430651
p+m-Xylene	ug/L	-	-	<0.40	<0.40	0.40	7430651
Total Xylenes	ug/L	90	20	<0.40	<0.40	0.40	7430651
F1 (C6-C10)	ug/L	-	-	<25	<25	25	7430651
F1 (C6-C10) - BTEX	ug/L	-	-	<25	<25	25	7430651
F2-F4 Hydrocarbons							
F2 (C10-C16 Hydrocarbons)	ug/L	-	-	<100	<100	100	7430615
F3 (C16-C34 Hydrocarbons)	ug/L	-	-	<200	360	200	7430615
F4 (C34-C50 Hydrocarbons)	ug/L	-	-	<200	<200	200	7430615
Reached Baseline at C50	ug/L	-	-	Yes	Yes		7430615
Surrogate Recovery (%)							
1,4-Difluorobenzene	%	-	-	99	100		7430651
4-Bromofluorobenzene	%	-	-	99	97		7430651
D10-o-Xylene	%	-	-	116	114		7430651
D4-1,2-Dichloroethane	%	-	-	112	111		7430651
o-Terphenyl	%	-	-	99	99		7430615

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
MAC,A/O: Ontario Drinking Water Standards - Maximum Acceptable Concentration [MAC] & Table 4-Chemical/Physical Objectives [A/O] - Not Health Related, respectively
(Made under the Ontario Safe Drinking Water Act, 2002)

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PWX685
Sample ID: MW20-08 A
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/23	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Conductivity	AT	7422524	N/A	2021/06/23	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7427516	N/A	2021/06/24	Nimarta Singh
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal
pH	AT	7422527	2021/06/22	2021/06/23	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

BV Labs ID: PWX685 Dup
Sample ID: MW20-08 A
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan

BV Labs ID: PWX686
Sample ID: MW20-08 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/24	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Conductivity	AT	7422524	N/A	2021/06/24	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7428766	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7430651	N/A	2021/06/25	Lincoln Ramdahin
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7430615	2021/06/25	2021/06/27	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PWX686
Sample ID: MW20-08 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH	AT	7422527	2021/06/22	2021/06/24	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

BV Labs ID: PWX686 Dup
Sample ID: MW20-08 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7428766	N/A	2021/06/25	Nimarta Singh

BV Labs ID: PWX687
Sample ID: MW20-07 A
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/23	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu
Conductivity	AT	7422524	N/A	2021/06/23	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7427516	N/A	2021/06/24	Nimarta Singh
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal
pH	AT	7422527	2021/06/22	2021/06/23	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

BV Labs ID: PWX688
Sample ID: MW20-07 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7422513	N/A	2021/06/23	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7421635	N/A	2021/06/24	Automated Statchk
Chloride by Automated Colourimetry	KONE	7422556	N/A	2021/06/23	Alina Dobreanu

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H0819
Report Date: 2021/07/27

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

TEST SUMMARY

BV Labs ID: PWX688
Sample ID: MW20-07 B
Matrix: Water

Collected: 2021/06/21
Shipped:
Received: 2021/06/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7422524	N/A	2021/06/23	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7427516	N/A	2021/06/24	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7430651	N/A	2021/06/25	Lincoln Ramdahin
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7430615	2021/06/25	2021/06/27	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7421636	N/A	2021/06/24	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7423183	N/A	2021/06/24	Arefa Dabhad
Ion Balance (% Difference)	CALC	7421637	N/A	2021/06/24	Automated Statchk
Anion and Cation Sum	CALC	7421638	N/A	2021/06/24	Automated Statchk
Total Ammonia-N	LACH/NH4	7430355	N/A	2021/06/28	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7423349	N/A	2021/06/24	Chandra Nandlal
pH	AT	7422527	2021/06/22	2021/06/23	Surinder Rai
Orthophosphate	KONE	7422545	N/A	2021/06/23	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7421639	N/A	2021/06/24	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7421640	N/A	2021/06/24	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7422560	N/A	2021/06/24	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7421642	N/A	2021/06/24	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.3°C

Revised report (2021/07/27): Criteria is included as requested.

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7430615	o-Terphenyl	2021/06/27	98	60 - 130	101	60 - 130	99	%		
7430651	1,4-Difluorobenzene	2021/06/25	97	70 - 130	100	70 - 130	99	%		
7430651	4-Bromofluorobenzene	2021/06/25	103	70 - 130	102	70 - 130	99	%		
7430651	D10-o-Xylene	2021/06/25	94	70 - 130	106	70 - 130	114	%		
7430651	D4-1,2-Dichloroethane	2021/06/25	109	70 - 130	101	70 - 130	108	%		
7422513	Alkalinity (Total as CaCO3)	2021/06/23			99	85 - 115	<1.0	mg/L	0.56	20
7422524	Conductivity	2021/06/23			102	85 - 115	<1.0	umho/cm	0.24	25
7422527	pH	2021/06/23			102	98 - 103			1.2	N/A
7422545	Orthophosphate (P)	2021/06/23	106	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
7422556	Dissolved Chloride (Cl-)	2021/06/23	NC	80 - 120	102	80 - 120	<1.0	mg/L	4.3	20
7422560	Dissolved Sulphate (SO4)	2021/06/24	NC	75 - 125	102	80 - 120	<1.0	mg/L	1.6	20
7423183	Dissolved Aluminum (Al)	2021/06/24	105	80 - 120	101	80 - 120	<4.9	ug/L	4.6	20
7423183	Dissolved Antimony (Sb)	2021/06/24	108	80 - 120	102	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Arsenic (As)	2021/06/24	102	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7423183	Dissolved Barium (Ba)	2021/06/24	102	80 - 120	99	80 - 120	<2.0	ug/L	0.93	20
7423183	Dissolved Beryllium (Be)	2021/06/24	99	80 - 120	95	80 - 120	<0.40	ug/L	NC	20
7423183	Dissolved Boron (B)	2021/06/24	96	80 - 120	92	80 - 120	<10	ug/L	0.33	20
7423183	Dissolved Cadmium (Cd)	2021/06/24	106	80 - 120	101	80 - 120	<0.090	ug/L	NC	20
7423183	Dissolved Calcium (Ca)	2021/06/24	NC	80 - 120	98	80 - 120	<200	ug/L	1.1	20
7423183	Dissolved Chromium (Cr)	2021/06/24	98	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7423183	Dissolved Cobalt (Co)	2021/06/24	101	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Copper (Cu)	2021/06/24	102	80 - 120	99	80 - 120	<0.90	ug/L	4.1	20
7423183	Dissolved Iron (Fe)	2021/06/24	99	80 - 120	103	80 - 120	<100	ug/L	NC	20
7423183	Dissolved Lead (Pb)	2021/06/24	101	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Magnesium (Mg)	2021/06/24	96	80 - 120	99	80 - 120	<50	ug/L	2.6	20
7423183	Dissolved Manganese (Mn)	2021/06/24	100	80 - 120	100	80 - 120	<2.0	ug/L	2.9	20
7423183	Dissolved Molybdenum (Mo)	2021/06/24	105	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Nickel (Ni)	2021/06/24	97	80 - 120	99	80 - 120	<1.0	ug/L	NC	20
7423183	Dissolved Phosphorus (P)	2021/06/24	104	80 - 120	104	80 - 120	<100	ug/L	NC	20
7423183	Dissolved Potassium (K)	2021/06/24	104	80 - 120	103	80 - 120	<200	ug/L	1.9	20
7423183	Dissolved Selenium (Se)	2021/06/24	104	80 - 120	103	80 - 120	<2.0	ug/L	NC	20

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7423183	Dissolved Silicon (Si)	2021/06/24	105	80 - 120	96	80 - 120	<50	ug/L	1.6	20
7423183	Dissolved Silver (Ag)	2021/06/24	99	80 - 120	97	80 - 120	<0.090	ug/L	NC	20
7423183	Dissolved Sodium (Na)	2021/06/24	NC	80 - 120	101	80 - 120	<100	ug/L	2.3	20
7423183	Dissolved Strontium (Sr)	2021/06/24	100	80 - 120	99	80 - 120	<1.0	ug/L	0.89	20
7423183	Dissolved Thallium (Tl)	2021/06/24	102	80 - 120	107	80 - 120	<0.050	ug/L	NC	20
7423183	Dissolved Titanium (Ti)	2021/06/24	105	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7423183	Dissolved Uranium (U)	2021/06/24	102	80 - 120	99	80 - 120	<0.10	ug/L	4.3	20
7423183	Dissolved Vanadium (V)	2021/06/24	101	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7423183	Dissolved Zinc (Zn)	2021/06/24	100	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7423349	Nitrate (N)	2021/06/24	99	80 - 120	99	80 - 120	<0.10	mg/L	3.1	20
7423349	Nitrite (N)	2021/06/24	109	80 - 120	106	80 - 120	<0.010	mg/L	NC	20
7427516	Dissolved Organic Carbon	2021/06/24	95	80 - 120	96	80 - 120	<0.40	mg/L	0.29	20
7428766	Dissolved Organic Carbon	2021/06/25	98	80 - 120	102	80 - 120	<0.40	mg/L	0.57	20
7430355	Total Ammonia-N	2021/06/28	97	75 - 125	102	80 - 120	<0.050	mg/L	NC	20
7430615	F2 (C10-C16 Hydrocarbons)	2021/06/27	97	60 - 130	103	60 - 130	<100	ug/L	NC	30
7430615	F3 (C16-C34 Hydrocarbons)	2021/06/27	93	60 - 130	101	60 - 130	<200	ug/L	27	30
7430615	F4 (C34-C50 Hydrocarbons)	2021/06/27	92	60 - 130	99	60 - 130	<200	ug/L	NC	30
7430651	Benzene	2021/06/25	101	50 - 140	103	50 - 140	<0.20	ug/L	NC	30
7430651	Ethylbenzene	2021/06/25	104	50 - 140	112	50 - 140	<0.20	ug/L	NC	30
7430651	F1 (C6-C10) - BTEX	2021/06/25					<25	ug/L	NC	30
7430651	F1 (C6-C10)	2021/06/25	92	60 - 140	97	60 - 140	<25	ug/L	NC	30
7430651	o-Xylene	2021/06/25	103	50 - 140	107	50 - 140	<0.20	ug/L	NC	30
7430651	p+m-Xylene	2021/06/25	101	50 - 140	107	50 - 140	<0.40	ug/L	NC	30
7430651	Toluene	2021/06/25	97	50 - 140	101	50 - 140	<0.20	ug/L	NC	30

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7430651	Total Xylenes	2021/06/25					<0.40	ug/L	NC	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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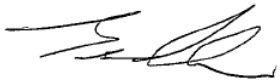
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Bureau Veritas Laboratories
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Page of

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:	Bottle Order #: 831949
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:			
Address:	210 Sheldon Drive. Cambridge ON N1T 1A8	Address:		Project:	19129150 (2300)	COC #: C#831949-01-01	Project Manager: Ema Gitej
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:			
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:			
				Sampled By:	UP + CS		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ☐ PWQO ☐ Reg 406 Table ☐ Other

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1	MW20-08A		21-Jun-21	15:30	GW	Y	J									4	
2	MW20-08B		21-Jun-21	15:30	GW	Y	J	J								8	
3	MW20-07A		21-Jun-21	16:45	GW	Y	J									4	
4	MW20-07B		21-Jun-21	16:45	GW	Y	J	J								8	
5																	
6																	
7																	
8																	
9																	
10																	

21-Jun-21 18:30
Ema Gitej
C1H0819

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	*RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Claire Steckle / C Steckle	21/06/21			21/06/21	18:30	

Laboratory Use Only					
Time Sensitive	Temperature (°C) on Recei	9/9/7	Custody Seal Present	Yes	No
			Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

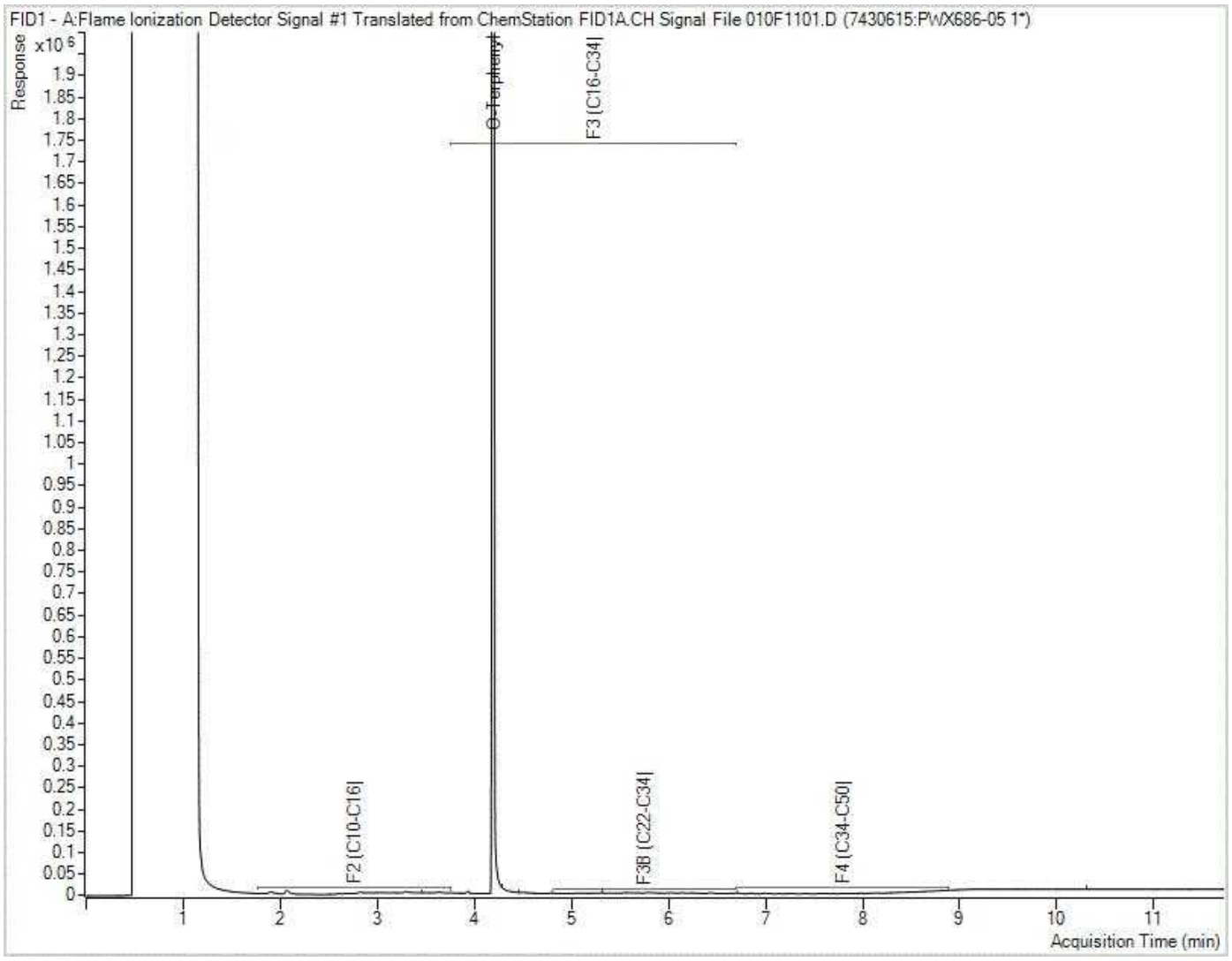
White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C1H0819
Report Date: 2021/07/27
BV Labs Sample: PWX686

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-08 B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

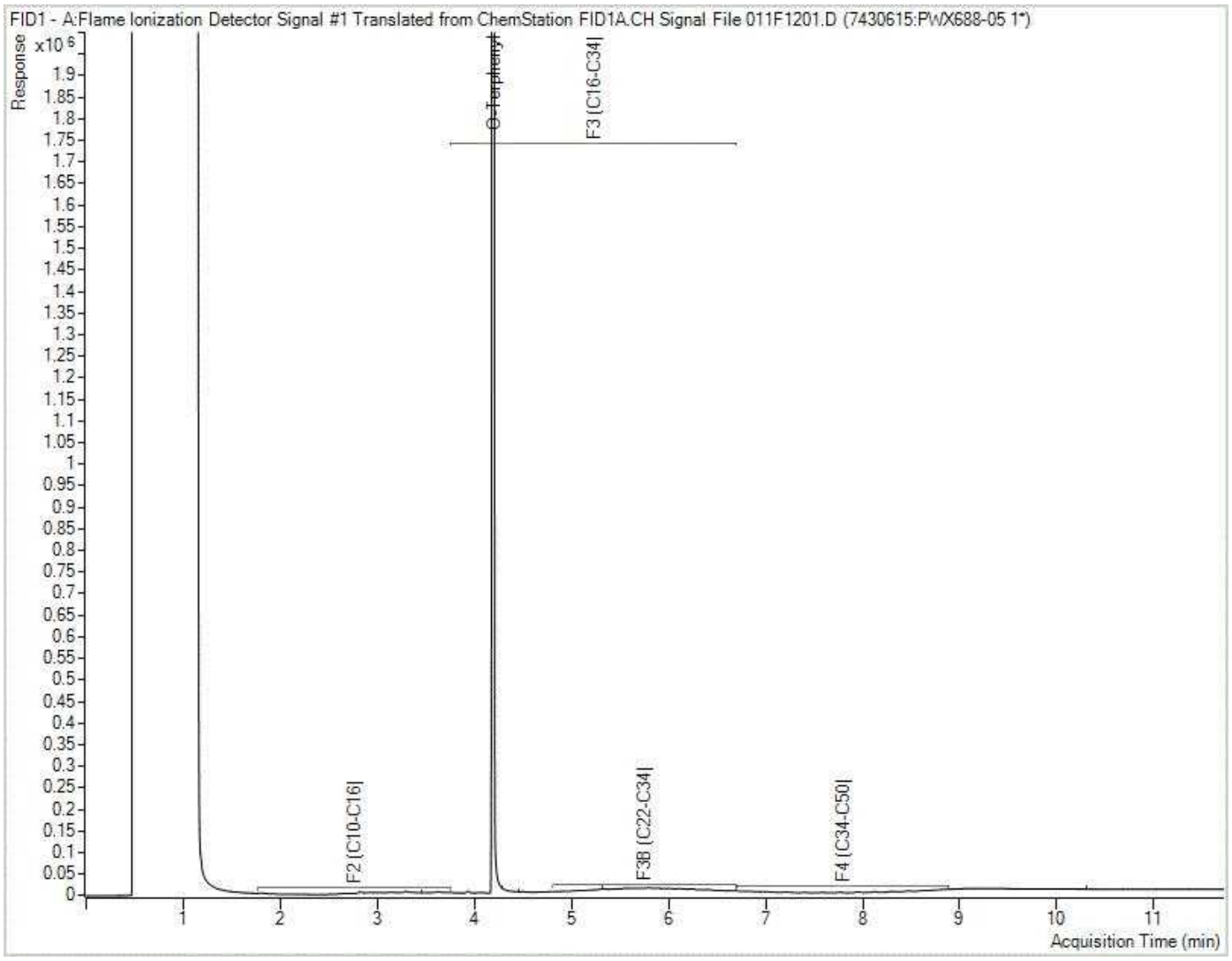


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H0819
Report Date: 2021/07/27
BV Labs Sample: PWX688

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-07 B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Exceedance Summary Table – ODWS (2002)

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
No Exceedances						

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

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Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-04-01, 831949-03-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/06/30
Report #: R6700304
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H2396
Received: 2021/06/22, 18:07

Sample Matrix: Water
Samples Received: 15

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	15	N/A	2021/06/29	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	3	N/A	2021/06/29	CAM SOP-00102	APHA 4500-CO2 D
Carbonate, Bicarbonate and Hydroxide	12	N/A	2021/06/30	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2021/06/28	CAM SOP-00463	SM 23 4500-Cl E m
Chloride by Automated Colourimetry	14	N/A	2021/06/29	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	15	N/A	2021/06/29	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	8	N/A	2021/06/25	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	5	N/A	2021/06/26	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/06/27	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/06/28	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	3	N/A	2021/06/27	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydro. CCME F1 & BTEX in Water	6	N/A	2021/06/28	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	9	2021/06/28	2021/06/28	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	15	N/A	2021/06/29	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	12	N/A	2021/06/28	CAM SOP-00447	EPA 6020B m
Dissolved Metals by ICPMS	3	N/A	2021/06/29	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	3	N/A	2021/06/29		
Ion Balance (% Difference)	12	N/A	2021/06/30		
Anion and Cation Sum	3	N/A	2021/06/29		
Anion and Cation Sum	12	N/A	2021/06/30		
Total Ammonia-N	15	N/A	2021/06/29	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	15	N/A	2021/06/29	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	2	2021/06/25	2021/06/29	CAM SOP-00413	SM 4500H+ B m
pH	1	2021/06/26	2021/06/29	CAM SOP-00413	SM 4500H+ B m
pH	12	2021/06/28	2021/06/29	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	2	N/A	2021/06/28	CAM SOP-00461	EPA 365.1 m
Orthophosphate	13	N/A	2021/06/30	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	3	N/A	2021/06/29		Auto Calc
Sat. pH and Langelier Index (@ 20C)	12	N/A	2021/06/30		Auto Calc
Sat. pH and Langelier Index (@ 4C)	3	N/A	2021/06/29		Auto Calc

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-04-01, 831949-03-01

Attention: Gregory Padusenko

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210 Sheldon Drive
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CANADA N1T 1A8

Report Date: 2021/06/30
Report #: R6700304
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H2396
Received: 2021/06/22, 18:07

Sample Matrix: Water
Samples Received: 15

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sat. pH and Langelier Index (@ 4C)	12	N/A	2021/06/30		Auto Calc
Sulphate by Automated Colourimetry	3	N/A	2021/06/28	CAM SOP-00464	EPA 375.4 m
Sulphate by Automated Colourimetry	12	N/A	2021/06/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	3	N/A	2021/06/29		Auto Calc
Total Dissolved Solids (TDS calc)	12	N/A	2021/06/30		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-04-01, 831949-03-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/06/30
Report #: R6700304
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H2396
Received: 2021/06/22, 18:07

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

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RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG071			PXG071			PXG072		
Sampling Date		2021/06/22 13:00			2021/06/22 13:00			2021/06/22 14:00		
COC Number		831949-04-01			831949-04-01			831949-04-01		
	UNITS	MW20-23A	RDL	QC Batch	MW20-23A Lab-Dup	RDL	QC Batch	MW20-23B	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	28.0	N/A	7424165				20.9	N/A	7424165
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	190	1.0	7424184				210	1.0	7424184
Calculated TDS	mg/L	1900	1.0	7424183				1300	1.0	7424183
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.4	1.0	7424184				1.1	1.0	7424184
Cation Sum	me/L	31.2	N/A	7424165				21.0	N/A	7424165
Hardness (CaCO3)	mg/L	1500	1.0	7424185				990	1.0	7424186
Ion Balance (% Difference)	%	5.49	N/A	7424164				0.200	N/A	7424164
Langelier Index (@ 20C)	N/A	1.22		7424177				0.979		7424177
Langelier Index (@ 4C)	N/A	0.971		7424178				0.734		7424178
Saturation pH (@ 20C)	N/A	6.67		7424177				6.76		7424177
Saturation pH (@ 4C)	N/A	6.91		7424178				7.00		7424178
Inorganics										
Total Ammonia-N	mg/L	0.23	0.050	7429602				0.20	0.050	7429602
Conductivity	umho/cm	2300	1.0	7431743	2300	1.0	7431743	1700	1.0	7433472
Dissolved Organic Carbon	mg/L	0.68	0.40	7431551				0.69	0.40	7430360
Orthophosphate (P)	mg/L	<0.010	0.010	7430971				<0.010	0.010	7434295
pH	pH	7.88		7431744	7.90		7431744	7.74		7433471
Dissolved Sulphate (SO4)	mg/L	1100	10	7430973				770	5.0	7434293
Alkalinity (Total as CaCO3)	mg/L	190	1.0	7431736	190	1.0	7431736	210	1.0	7433466
Dissolved Chloride (Cl-)	mg/L	13	1.0	7430955				23	1.0	7434287
Nitrite (N)	mg/L	<0.010	0.010	7431102				<0.010	0.010	7433476
Nitrate (N)	mg/L	<0.10	0.10	7431102				<0.10	0.10	7433476
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7431102				<0.10	0.10	7433476
Metals										
Dissolved Aluminum (Al)	ug/L	79	4.9	7429380				64	4.9	7429380
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7429380				<0.50	0.50	7429380
Dissolved Arsenic (As)	ug/L	5.5	1.0	7429380				10	1.0	7429380
Dissolved Barium (Ba)	ug/L	14	2.0	7429380				14	2.0	7429380
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7429380				<0.40	0.40	7429380
Dissolved Boron (B)	ug/L	130	10	7429380				48	10	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG071			PXG071			PXG072		
Sampling Date		2021/06/22 13:00			2021/06/22 13:00			2021/06/22 14:00		
COC Number		831949-04-01			831949-04-01			831949-04-01		
	UNITS	MW20-23A	RDL	QC Batch	MW20-23A Lab-Dup	RDL	QC Batch	MW20-23B	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	0.20	0.090	7429380				<0.090	0.090	7429380
Dissolved Calcium (Ca)	ug/L	480000	400	7429380				320000	400	7429380
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7429380				<5.0	5.0	7429380
Dissolved Cobalt (Co)	ug/L	0.52	0.50	7429380				<0.50	0.50	7429380
Dissolved Copper (Cu)	ug/L	3.5	0.90	7429380				2.6	0.90	7429380
Dissolved Iron (Fe)	ug/L	340	100	7429380				1000	100	7429380
Dissolved Lead (Pb)	ug/L	0.85	0.50	7429380				<0.50	0.50	7429380
Dissolved Magnesium (Mg)	ug/L	71000	50	7429380				46000	50	7429380
Dissolved Manganese (Mn)	ug/L	62	2.0	7429380				47	2.0	7429380
Dissolved Molybdenum (Mo)	ug/L	5.4	0.50	7429380				7.1	0.50	7429380
Dissolved Nickel (Ni)	ug/L	5.7	1.0	7429380				4.0	1.0	7429380
Dissolved Phosphorus (P)	ug/L	<100	100	7429380				<100	100	7429380
Dissolved Potassium (K)	ug/L	3600	200	7429380				820	200	7429380
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7429380				<2.0	2.0	7429380
Dissolved Silicon (Si)	ug/L	6100	50	7429380				5700	50	7429380
Dissolved Silver (Ag)	ug/L	0.11	0.090	7429380				<0.090	0.090	7429380
Dissolved Sodium (Na)	ug/L	29000	100	7429380				23000	100	7429380
Dissolved Strontium (Sr)	ug/L	7900	1.0	7429380				5300	1.0	7429380
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7429380				<0.050	0.050	7429380
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7429380				8.8	5.0	7429380
Dissolved Uranium (U)	ug/L	0.20	0.10	7429380				0.93	0.10	7429380
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7429380				<0.50	0.50	7429380
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7429380				<5.0	5.0	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H2396
Report Date: 2021/06/30

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG072			PXG073		PXG074		
Sampling Date		2021/06/22 14:00			2021/06/22 14:30		2021/06/22 17:00		
COC Number		831949-04-01			831949-04-01		831949-04-01		
	UNITS	MW20-23B Lab-Dup	RDL	QC Batch	MW20-23C	QC Batch	MW20-17A	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L				6.46	7424165	9.25	N/A	7424165
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				240	7424184	210	1.0	7424184
Calculated TDS	mg/L				340	7424183	560	1.0	7424183
Carb. Alkalinity (calc. as CaCO3)	mg/L				2.5	7424184	2.4	1.0	7424184
Cation Sum	me/L				6.53	7424165	9.80	N/A	7424165
Hardness (CaCO3)	mg/L				280	7424186	440	1.0	7424186
Ion Balance (% Difference)	%				0.480	7424164	2.89	N/A	7424164
Langelier Index (@ 20C)	N/A				0.921	7424177	1.05		7424177
Langelier Index (@ 4C)	N/A				0.672	7424178	0.797		7424178
Saturation pH (@ 20C)	N/A				7.14	7424177	7.05		7424177
Saturation pH (@ 4C)	N/A				7.39	7424178	7.30		7424178
Inorganics									
Total Ammonia-N	mg/L				<0.050	7429602	0.19	0.050	7429602
Conductivity	umho/cm	1700	1.0	7433472	630	7431056	850	1.0	7431056
Dissolved Organic Carbon	mg/L				1.6	7430572	1.9	0.40	7430360
Orthophosphate (P)	mg/L				<0.010	7431101	<0.010	0.010	7430971
pH	pH	7.71		7433471	8.06	7431065	8.09		7431065
Dissolved Sulphate (SO4)	mg/L				23	7431104	230	1.0	7430973
Alkalinity (Total as CaCO3)	mg/L	210	1.0	7433466	240	7431045	210	1.0	7431045
Dissolved Chloride (Cl-)	mg/L				39	7431020	9.5	1.0	7430955
Nitrite (N)	mg/L				<0.010	7431102	<0.010	0.010	7431102
Nitrate (N)	mg/L				1.39	7431102	<0.10	0.10	7431102
Nitrate + Nitrite (N)	mg/L				1.39	7431102	<0.10	0.10	7431102
Metals									
Dissolved Aluminum (Al)	ug/L				<4.9	7429380	80	4.9	7429380
Dissolved Antimony (Sb)	ug/L				<0.50	7429380	<0.50	0.50	7429380
Dissolved Arsenic (As)	ug/L				<1.0	7429380	33	1.0	7429380
Dissolved Barium (Ba)	ug/L				40	7429380	31	2.0	7429380
Dissolved Beryllium (Be)	ug/L				<0.40	7429380	<0.40	0.40	7429380
Dissolved Boron (B)	ug/L				10	7429380	160	10	7429380

RDL = Reportable Detection Limit
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Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG072			PXG073		PXG074		
Sampling Date		2021/06/22 14:00			2021/06/22 14:30		2021/06/22 17:00		
COC Number		831949-04-01			831949-04-01		831949-04-01		
	UNITS	MW20-23B Lab-Dup	RDL	QC Batch	MW20-23C	QC Batch	MW20-17A	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L				<0.090	7429380	<0.090	0.090	7429380
Dissolved Calcium (Ca)	ug/L				82000	7429380	130000	200	7429380
Dissolved Chromium (Cr)	ug/L				<5.0	7429380	<5.0	5.0	7429380
Dissolved Cobalt (Co)	ug/L				<0.50	7429380	1.1	0.50	7429380
Dissolved Copper (Cu)	ug/L				3.2	7429380	3.4	0.90	7429380
Dissolved Iron (Fe)	ug/L				<100	7429380	900	100	7429380
Dissolved Lead (Pb)	ug/L				<0.50	7429380	<0.50	0.50	7429380
Dissolved Magnesium (Mg)	ug/L				19000	7429380	30000	50	7429380
Dissolved Manganese (Mn)	ug/L				<2.0	7429380	61	2.0	7429380
Dissolved Molybdenum (Mo)	ug/L				0.61	7429380	8.1	0.50	7429380
Dissolved Nickel (Ni)	ug/L				<1.0	7429380	23	1.0	7429380
Dissolved Phosphorus (P)	ug/L				<100	7429380	<100	100	7429380
Dissolved Potassium (K)	ug/L				2600	7429380	5300	200	7429380
Dissolved Selenium (Se)	ug/L				<2.0	7429380	<2.0	2.0	7429380
Dissolved Silicon (Si)	ug/L				2900	7429380	4900	50	7429380
Dissolved Silver (Ag)	ug/L				<0.090	7429380	<0.090	0.090	7429380
Dissolved Sodium (Na)	ug/L				19000	7429380	17000	100	7429380
Dissolved Strontium (Sr)	ug/L				150	7429380	3800	1.0	7429380
Dissolved Thallium (Tl)	ug/L				<0.050	7429380	<0.050	0.050	7429380
Dissolved Titanium (Ti)	ug/L				<5.0	7429380	<5.0	5.0	7429380
Dissolved Uranium (U)	ug/L				0.71	7429380	0.87	0.10	7429380
Dissolved Vanadium (V)	ug/L				<0.50	7429380	<0.50	0.50	7429380
Dissolved Zinc (Zn)	ug/L				8.9	7429380	8.6	5.0	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H2396
Report Date: 2021/06/30

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG075	PXG076		PXG101			PXG102		
Sampling Date		2021/06/22 16:30	2021/06/22		2021/06/22 14:30			2021/06/22 14:45		
COC Number		831949-04-01	831949-04-01		831949-03-01			831949-03-01		
	UNITS	MW20-17B	DUP-1	RDL	MW20-01 A	RDL	QC Batch	MW20-01 B	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	7.43	7.46	N/A	11.0	N/A	7424165	8.68	N/A	7424165
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	240	250	1.0	200	1.0	7424184	250	1.0	7424184
Calculated TDS	mg/L	410	400	1.0	690	1.0	7424183	460	1.0	7424183
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.1	2.1	1.0	1.3	1.0	7424184	1.7	1.0	7424184
Cation Sum	me/L	8.14	7.45	N/A	11.7	N/A	7424165	8.24	N/A	7424165
Hardness (CaCO3)	mg/L	340	320	1.0	470	1.0	7424186	300	1.0	7424186
Ion Balance (% Difference)	%	4.54	0.0500	N/A	2.81	N/A	7424164	2.62	N/A	7424164
Langelier Index (@ 20C)	N/A	0.874	0.847		0.825		7424177	0.753		7424177
Langelier Index (@ 4C)	N/A	0.626	0.598		0.578		7424178	0.505		7424178
Saturation pH (@ 20C)	N/A	7.09	7.11		7.02		7424177	7.11		7424177
Saturation pH (@ 4C)	N/A	7.34	7.36		7.27		7424178	7.36		7424178
Inorganics										
Total Ammonia-N	mg/L	<0.050	<0.050	0.050	0.90	0.050	7429602	<0.050	0.050	7429602
Conductivity	umho/cm	730	730	1.0	1000	1.0	7433472	840	1.0	7433472
Dissolved Organic Carbon	mg/L	0.67	0.68	0.40	1.2	0.40	7430572	1.2	0.40	7430360
Orthophosphate (P)	mg/L	<0.010	<0.010	0.010	<0.010	0.010	7434295	<0.010	0.010	7434295
pH	pH	7.97	7.96		7.85		7433471	7.87		7433471
Dissolved Sulphate (SO4)	mg/L	54	53	1.0	310	2.0	7434293	24	1.0	7434293
Alkalinity (Total as CaCO3)	mg/L	250	250	1.0	200	1.0	7433466	250	1.0	7433466
Dissolved Chloride (Cl-)	mg/L	47	47	1.0	23	1.0	7434287	100	1.0	7434287
Nitrite (N)	mg/L	<0.010	<0.010	0.010	<0.010	0.010	7433476	<0.010	0.010	7433476
Nitrate (N)	mg/L	0.74	0.74	0.10	<0.10	0.10	7433476	3.87	0.10	7433476
Nitrate + Nitrite (N)	mg/L	0.74	0.74	0.10	<0.10	0.10	7433476	3.87	0.10	7433476
Metals										
Dissolved Aluminum (Al)	ug/L	44	32	4.9	300	4.9	7429380	17	4.9	7429380
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	0.50	<0.50	0.50	7429380	<0.50	0.50	7429380
Dissolved Arsenic (As)	ug/L	3.8	3.8	1.0	9.7	1.0	7429380	<1.0	1.0	7429380
Dissolved Barium (Ba)	ug/L	55	52	2.0	15	2.0	7429380	42	2.0	7429380
Dissolved Beryllium (Be)	ug/L	<0.40	<0.40	0.40	<0.40	0.40	7429380	<0.40	0.40	7429380
Dissolved Boron (B)	ug/L	26	25	10	680	10	7429380	17	10	7429380
Dissolved Cadmium (Cd)	ug/L	<0.090	<0.090	0.090	<0.090	0.090	7429380	<0.090	0.090	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG075	PXG076		PXG101			PXG102		
Sampling Date		2021/06/22 16:30	2021/06/22		2021/06/22 14:30			2021/06/22 14:45		
COC Number		831949-04-01	831949-04-01		831949-03-01			831949-03-01		
	UNITS	MW20-17B	DUP-1	RDL	MW20-01 A	RDL	QC Batch	MW20-01 B	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	92000	87000	200	150000	400	7429380	88000	200	7429380
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	5.0	<5.0	5.0	7429380	<5.0	5.0	7429380
Dissolved Cobalt (Co)	ug/L	<0.50	<0.50	0.50	0.56	0.50	7429380	<0.50	0.50	7429380
Dissolved Copper (Cu)	ug/L	<0.90	<0.90	0.90	<0.90	0.90	7429380	1.0	0.90	7429380
Dissolved Iron (Fe)	ug/L	<100	<100	100	940	100	7429380	<100	100	7429380
Dissolved Lead (Pb)	ug/L	1.4	1.0	0.50	0.92	0.50	7429380	<0.50	0.50	7429380
Dissolved Magnesium (Mg)	ug/L	27000	24000	50	22000	50	7429380	19000	50	7429380
Dissolved Manganese (Mn)	ug/L	35	32	2.0	62	2.0	7429380	2.2	2.0	7429380
Dissolved Molybdenum (Mo)	ug/L	1.2	1.2	0.50	1.6	0.50	7429380	<0.50	0.50	7429380
Dissolved Nickel (Ni)	ug/L	1.9	1.9	1.0	2.2	1.0	7429380	<1.0	1.0	7429380
Dissolved Phosphorus (P)	ug/L	<100	<100	100	<100	100	7429380	<100	100	7429380
Dissolved Potassium (K)	ug/L	1400	1300	200	11000	200	7429380	1300	200	7429380
Dissolved Selenium (Se)	ug/L	<2.0	<2.0	2.0	<2.0	2.0	7429380	<2.0	2.0	7429380
Dissolved Silicon (Si)	ug/L	5300	4900	50	4200	50	7429380	2700	50	7429380
Dissolved Silver (Ag)	ug/L	<0.090	<0.090	0.090	<0.090	0.090	7429380	<0.090	0.090	7429380
Dissolved Sodium (Na)	ug/L	29000	25000	100	42000	100	7429380	52000	100	7429380
Dissolved Strontium (Sr)	ug/L	750	740	1.0	5800	1.0	7429380	160	1.0	7429380
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	0.050	<0.050	0.050	7429380	<0.050	0.050	7429380
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	5.0	7.7	5.0	7429380	<5.0	5.0	7429380
Dissolved Uranium (U)	ug/L	0.61	0.58	0.10	0.23	0.10	7429380	0.33	0.10	7429380
Dissolved Vanadium (V)	ug/L	<0.50	<0.50	0.50	0.55	0.50	7429380	<0.50	0.50	7429380
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	5.0	<5.0	5.0	7429380	<5.0	5.0	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H2396
Report Date: 2021/06/30

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG103		PXG104		PXG105	PXG106		
Sampling Date		2021/06/22 13:30		2021/06/22 12:30		2021/06/22 12:15	2021/06/22 11:00		
COC Number		831949-03-01		831949-03-01		831949-03-01	831949-03-01		
	UNITS	MW20-02	QC Batch	MW20-03	QC Batch	MW20-04	MW20-05A	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	7.55	7424165	7.21	7424165	8.34	7.09	N/A	7424165
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	240	7424184	270	7424184	230	230	1.0	7424184
Calculated TDS	mg/L	410	7424183	380	7424183	460	380	1.0	7424183
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.7	7424184	2.3	7424184	2.0	2.0	1.0	7424184
Cation Sum	me/L	7.40	7424165	7.18	7424165	8.38	6.94	N/A	7424165
Hardness (CaCO3)	mg/L	300	7424186	300	7424186	310	310	1.0	7424186
Ion Balance (% Difference)	%	1.00	7424164	0.190	7424164	0.210	1.11	N/A	7424164
Langelier Index (@ 20C)	N/A	0.762	7424177	0.888	7424177	0.819	0.837		7424177
Langelier Index (@ 4C)	N/A	0.514	7424178	0.640	7424178	0.571	0.589		7424178
Saturation pH (@ 20C)	N/A	7.13	7424177	7.06	7424177	7.14	7.13		7424177
Saturation pH (@ 4C)	N/A	7.38	7424178	7.30	7424178	7.39	7.38		7424178
Inorganics									
Total Ammonia-N	mg/L	<0.050	7429602	<0.050	7429602	<0.050	<0.050	0.050	7429602
Conductivity	umho/cm	730	7433472	680	7433472	810	680	1.0	7433472
Dissolved Organic Carbon	mg/L	1.5	7430360	3.0	7430572	0.86	0.70	0.40	7430360
Orthophosphate (P)	mg/L	<0.010	7434295	<0.010	7434295	<0.010	<0.010	0.010	7434295
pH	pH	7.89	7433471	7.94	7433471	7.96	7.97		7433471
Dissolved Sulphate (SO4)	mg/L	33	7434293	22	7434293	20	39	1.0	7434293
Alkalinity (Total as CaCO3)	mg/L	240	7433466	280	7433466	240	240	1.0	7433466
Dissolved Chloride (Cl-)	mg/L	64	7434287	40	7434287	97	39	1.0	7434287
Nitrite (N)	mg/L	<0.010	7433476	0.016	7433476	<0.010	<0.010	0.010	7433476
Nitrate (N)	mg/L	3.85	7433476	1.85	7433476	6.24	6.28	0.10	7433476
Nitrate + Nitrite (N)	mg/L	3.85	7433476	1.86	7433476	6.24	6.28	0.10	7433476
Metals									
Dissolved Aluminum (Al)	ug/L	<4.9	7429380	40	7429380	30	27	4.9	7429380
Dissolved Antimony (Sb)	ug/L	<0.50	7429380	<0.50	7429380	<0.50	<0.50	0.50	7429380
Dissolved Arsenic (As)	ug/L	<1.0	7429380	<1.0	7429380	<1.0	<1.0	1.0	7429380
Dissolved Barium (Ba)	ug/L	55	7429380	75	7429380	41	110	2.0	7429380
Dissolved Beryllium (Be)	ug/L	<0.40	7429380	<0.40	7429380	<0.40	<0.40	0.40	7429380
Dissolved Boron (B)	ug/L	12	7429380	14	7429380	11	11	10	7429380
Dissolved Cadmium (Cd)	ug/L	<0.090	7429380	<0.090	7429380	<0.090	<0.090	0.090	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG103		PXG104		PXG105	PXG106		
Sampling Date		2021/06/22 13:30		2021/06/22 12:30		2021/06/22 12:15	2021/06/22 11:00		
COC Number		831949-03-01		831949-03-01		831949-03-01	831949-03-01		
	UNITS	MW20-02	QC Batch	MW20-03	QC Batch	MW20-04	MW20-05A	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	87000	7429380	88000	7429380	88000	86000	200	7429380
Dissolved Chromium (Cr)	ug/L	<5.0	7429380	<5.0	7429380	<5.0	<5.0	5.0	7429380
Dissolved Cobalt (Co)	ug/L	<0.50	7429380	<0.50	7429380	<0.50	<0.50	0.50	7429380
Dissolved Copper (Cu)	ug/L	<0.90	7429380	<0.90	7429380	1.6	2.1	0.90	7429380
Dissolved Iron (Fe)	ug/L	<100	7429380	<100	7429380	110	<100	100	7429380
Dissolved Lead (Pb)	ug/L	<0.50	7429380	<0.50	7429380	0.63	<0.50	0.50	7429380
Dissolved Magnesium (Mg)	ug/L	20000	7429380	19000	7429380	21000	22000	50	7429380
Dissolved Manganese (Mn)	ug/L	4.4	7429380	120	7429380	5.9	3.9	2.0	7429380
Dissolved Molybdenum (Mo)	ug/L	0.87	7429380	7.3	7429380	<0.50	<0.50	0.50	7429380
Dissolved Nickel (Ni)	ug/L	1.8	7429380	1.5	7429380	<1.0	<1.0	1.0	7429380
Dissolved Phosphorus (P)	ug/L	<100	7429380	<100	7429380	<100	<100	100	7429380
Dissolved Potassium (K)	ug/L	1700	7429380	2100	7429380	1600	1500	200	7429380
Dissolved Selenium (Se)	ug/L	<2.0	7429380	<2.0	7429380	<2.0	<2.0	2.0	7429380
Dissolved Silicon (Si)	ug/L	3100	7429380	4100	7429380	2900	2600	50	7429380
Dissolved Silver (Ag)	ug/L	<0.090	7429380	<0.090	7429380	<0.090	<0.090	0.090	7429380
Dissolved Sodium (Na)	ug/L	32000	7429380	26000	7429380	51000	17000	100	7429380
Dissolved Strontium (Sr)	ug/L	220	7429380	190	7429380	180	1400	1.0	7429380
Dissolved Thallium (Tl)	ug/L	<0.050	7429380	<0.050	7429380	<0.050	0.065	0.050	7429380
Dissolved Titanium (Ti)	ug/L	<5.0	7429380	7.3	7429380	<5.0	<5.0	5.0	7429380
Dissolved Uranium (U)	ug/L	0.57	7429380	0.77	7429380	0.22	0.23	0.10	7429380
Dissolved Vanadium (V)	ug/L	<0.50	7429380	<0.50	7429380	<0.50	<0.50	0.50	7429380
Dissolved Zinc (Zn)	ug/L	<5.0	7429380	<5.0	7429380	<5.0	5.5	5.0	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG106			PXG107			PXG107		
Sampling Date		2021/06/22 11:00			2021/06/22 10:45			2021/06/22 10:45		
COC Number		831949-03-01			831949-03-01			831949-03-01		
	UNITS	MW20-05A Lab-Dup	RDL	QC Batch	MW20-06A	RDL	QC Batch	MW20-06A Lab-Dup	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L				8.04	N/A	7424165			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				260	1.0	7424184			
Calculated TDS	mg/L				440	1.0	7424183			
Carb. Alkalinity (calc. as CaCO3)	mg/L				2.3	1.0	7424184			
Cation Sum	me/L				8.20	N/A	7424165			
Hardness (CaCO3)	mg/L				340	1.0	7424186			
Ion Balance (% Difference)	%				1.02	N/A	7424164			
Langelier Index (@ 20C)	N/A				0.903		7424177			
Langelier Index (@ 4C)	N/A				0.655		7424178			
Saturation pH (@ 20C)	N/A				7.07		7424177			
Saturation pH (@ 4C)	N/A				7.32		7424178			
Inorganics										
Total Ammonia-N	mg/L				<0.050	0.050	7429602			
Conductivity	umho/cm				760	1.0	7433472			
Dissolved Organic Carbon	mg/L				0.40	0.40	7430572			
Orthophosphate (P)	mg/L	<0.010	0.010	7434295	<0.010	0.010	7434295			
pH	pH				7.97		7433471			
Dissolved Sulphate (SO4)	mg/L	39	1.0	7434293	26	1.0	7434293			
Alkalinity (Total as CaCO3)	mg/L				260	1.0	7433466			
Dissolved Chloride (Cl-)	mg/L	40	1.0	7434287	66	1.0	7434287			
Nitrite (N)	mg/L				<0.010	0.010	7433476	<0.010	0.010	7433476
Nitrate (N)	mg/L				6.44	0.10	7433476	6.44	0.10	7433476
Nitrate + Nitrite (N)	mg/L				6.44	0.10	7433476	6.44	0.10	7433476
Metals										
Dissolved Aluminum (Al)	ug/L				230	4.9	7429380	240	4.9	7429380
Dissolved Antimony (Sb)	ug/L				<0.50	0.50	7429380	<0.50	0.50	7429380
Dissolved Arsenic (As)	ug/L				<1.0	1.0	7429380	<1.0	1.0	7429380
Dissolved Barium (Ba)	ug/L				30	2.0	7429380	31	2.0	7429380
Dissolved Beryllium (Be)	ug/L				<0.40	0.40	7429380	<0.40	0.40	7429380
Dissolved Boron (B)	ug/L				12	10	7429380	11	10	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG106			PXG107			PXG107		
Sampling Date		2021/06/22 11:00			2021/06/22 10:45			2021/06/22 10:45		
COC Number		831949-03-01			831949-03-01			831949-03-01		
	UNITS	MW20-05A Lab-Dup	RDL	QC Batch	MW20-06A	RDL	QC Batch	MW20-06A Lab-Dup	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L				<0.090	0.090	7429380	<0.090	0.090	7429380
Dissolved Calcium (Ca)	ug/L				94000	200	7429380	90000	200	7429380
Dissolved Chromium (Cr)	ug/L				<5.0	5.0	7429380	<5.0	5.0	7429380
Dissolved Cobalt (Co)	ug/L				<0.50	0.50	7429380	<0.50	0.50	7429380
Dissolved Copper (Cu)	ug/L				1.0	0.90	7429380	0.94	0.90	7429380
Dissolved Iron (Fe)	ug/L				400	100	7429380	420	100	7429380
Dissolved Lead (Pb)	ug/L				2.3	0.50	7429380	2.3	0.50	7429380
Dissolved Magnesium (Mg)	ug/L				27000	50	7429380	27000	50	7429380
Dissolved Manganese (Mn)	ug/L				36	2.0	7429380	35	2.0	7429380
Dissolved Molybdenum (Mo)	ug/L				<0.50	0.50	7429380	<0.50	0.50	7429380
Dissolved Nickel (Ni)	ug/L				<1.0	1.0	7429380	<1.0	1.0	7429380
Dissolved Phosphorus (P)	ug/L				<100	100	7429380	<100	100	7429380
Dissolved Potassium (K)	ug/L				2000	200	7429380	2000	200	7429380
Dissolved Selenium (Se)	ug/L				<2.0	2.0	7429380	<2.0	2.0	7429380
Dissolved Silicon (Si)	ug/L				3500	50	7429380	3300	50	7429380
Dissolved Silver (Ag)	ug/L				<0.090	0.090	7429380	<0.090	0.090	7429380
Dissolved Sodium (Na)	ug/L				29000	100	7429380	28000	100	7429380
Dissolved Strontium (Sr)	ug/L				320	1.0	7429380	320	1.0	7429380
Dissolved Thallium (Tl)	ug/L				<0.050	0.050	7429380	<0.050	0.050	7429380
Dissolved Titanium (Ti)	ug/L				11	5.0	7429380	7.1	5.0	7429380
Dissolved Uranium (U)	ug/L				0.25	0.10	7429380	0.23	0.10	7429380
Dissolved Vanadium (V)	ug/L				<0.50	0.50	7429380	0.51	0.50	7429380
Dissolved Zinc (Zn)	ug/L				10	5.0	7429380	10	5.0	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG108		PXG109		
Sampling Date		2021/06/22 11:30		2021/06/22 15:00		
COC Number		831949-03-01		831949-03-01		
	UNITS	MW20-06 B	RDL	MW20-18	RDL	QC Batch
Calculated Parameters						
Anion Sum	me/L	6.89	N/A	12.0	N/A	7424165
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	230	1.0	260	1.0	7424184
Calculated TDS	mg/L	370	1.0	660	1.0	7424183
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.9	1.0	2.2	1.0	7424184
Cation Sum	me/L	6.82	N/A	12.1	N/A	7424165
Hardness (CaCO3)	mg/L	300	1.0	390	1.0	7424186
Ion Balance (% Difference)	%	0.520	N/A	0.780	N/A	7424164
Langelier Index (@ 20C)	N/A	0.820		0.938		7424177
Langelier Index (@ 4C)	N/A	0.572		0.691		7424178
Saturation pH (@ 20C)	N/A	7.12		7.01		7424177
Saturation pH (@ 4C)	N/A	7.37		7.26		7424178
Inorganics						
Total Ammonia-N	mg/L	<0.050	0.050	<0.050	0.050	7429602
Conductivity	umho/cm	670	1.0	1300	1.0	7433472
Dissolved Organic Carbon	mg/L	0.81	0.40	1.6	0.40	7430572
Orthophosphate (P)	mg/L	<0.010	0.010	<0.010	0.010	7434295
pH	pH	7.94		7.95		7433471
Dissolved Sulphate (SO4)	mg/L	16	1.0	23	1.0	7434293
Alkalinity (Total as CaCO3)	mg/L	240	1.0	260	1.0	7433466
Dissolved Chloride (Cl-)	mg/L	45	1.0	210	3.0	7434287
Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	7433476
Nitrate (N)	mg/L	8.03	0.10	3.04	0.10	7433476
Nitrate + Nitrite (N)	mg/L	8.03	0.10	3.04	0.10	7433476
Metals						
Dissolved Aluminum (Al)	ug/L	63	4.9	15	4.9	7429380
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	7429380
Dissolved Arsenic (As)	ug/L	<1.0	1.0	<1.0	1.0	7429380
Dissolved Barium (Ba)	ug/L	19	2.0	87	2.0	7429380
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	<0.40	0.40	7429380
Dissolved Boron (B)	ug/L	11	10	14	10	7429380
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	<0.090	0.090	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXG108		PXG109		
Sampling Date		2021/06/22 11:30		2021/06/22 15:00		
COC Number		831949-03-01		831949-03-01		
	UNITS	MW20-06 B	RDL	MW20-18	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	88000	200	120000	200	7429380
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	7429380
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	<0.50	0.50	7429380
Dissolved Copper (Cu)	ug/L	1.2	0.90	7.4	0.90	7429380
Dissolved Iron (Fe)	ug/L	<100	100	<100	100	7429380
Dissolved Lead (Pb)	ug/L	<0.50	0.50	<0.50	0.50	7429380
Dissolved Magnesium (Mg)	ug/L	19000	50	23000	50	7429380
Dissolved Manganese (Mn)	ug/L	3.9	2.0	16	2.0	7429380
Dissolved Molybdenum (Mo)	ug/L	<0.50	0.50	1.4	0.50	7429380
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	3.3	1.0	7429380
Dissolved Phosphorus (P)	ug/L	<100	100	<100	100	7429380
Dissolved Potassium (K)	ug/L	1200	200	1800	200	7429380
Dissolved Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	7429380
Dissolved Silicon (Si)	ug/L	2300	50	3200	50	7429380
Dissolved Silver (Ag)	ug/L	<0.090	0.090	<0.090	0.090	7429380
Dissolved Sodium (Na)	ug/L	20000	100	100000	100	7429380
Dissolved Strontium (Sr)	ug/L	100	1.0	200	1.0	7429380
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	7429380
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	<5.0	5.0	7429380
Dissolved Uranium (U)	ug/L	0.13	0.10	0.82	0.10	7429380
Dissolved Vanadium (V)	ug/L	<0.50	0.50	<0.50	0.50	7429380
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	8.0	5.0	7429380

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXG072	PXG075	PXG076	PXG102	PXG103	PXG104		
Sampling Date		2021/06/22 14:00	2021/06/22 16:30	2021/06/22	2021/06/22 14:45	2021/06/22 13:30	2021/06/22 12:30		
COC Number		831949-04-01	831949-04-01	831949-04-01	831949-03-01	831949-03-01	831949-03-01		
	UNITS	**MW20-23B**	**MW20-17B**	**DUP-1**	**MW20-01 B**	**MW20-02**	**MW20-03**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons									
Benzene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7432295
Toluene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7432295
Ethylbenzene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7432295
o-Xylene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7432295
p+m-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7432295
Total Xylenes	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7432295
F1 (C6-C10)	ug/L	<25	<25	<25	<25	<25	<25	25	7432295
F1 (C6-C10) - BTEX	ug/L	<25	<25	<25	<25	<25	<25	25	7432295
F2-F4 Hydrocarbons									
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	<100	<100	<100	<100	100	7432529
F3 (C16-C34 Hydrocarbons)	ug/L	<200	520	410	<200	<200	<200	200	7432529
F4 (C34-C50 Hydrocarbons)	ug/L	<200	420	300	<200	<200	<200	200	7432529
Reached Baseline at C50	ug/L	Yes	Yes	Yes	Yes	Yes	Yes		7432529
Surrogate Recovery (%)									
1,4-Difluorobenzene	%	102	103	103	103	103	101		7432295
4-Bromofluorobenzene	%	97	97	91	92	93	103		7432295
D10-o-Xylene	%	110	110	113	111	112	111		7432295
D4-1,2-Dichloroethane	%	108	111	112	109	112	110		7432295
o-Terphenyl	%	98	97	96	97	95	96		7432529

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXG105	PXG108	PXG109		
Sampling Date		2021/06/22 12:15	2021/06/22 11:30	2021/06/22 15:00		
COC Number		831949-03-01	831949-03-01	831949-03-01		
	UNITS	MW20-04	MW20-06 B	MW20-18	RDL	QC Batch
BTEX & F1 Hydrocarbons						
Benzene	ug/L	<0.20	<0.20	<0.20	0.20	7432295
Toluene	ug/L	<0.20	<0.20	<0.20	0.20	7432295
Ethylbenzene	ug/L	<0.20	<0.20	<0.20	0.20	7432295
o-Xylene	ug/L	<0.20	<0.20	<0.20	0.20	7432295
p+m-Xylene	ug/L	<0.40	<0.40	<0.40	0.40	7432295
Total Xylenes	ug/L	<0.40	<0.40	<0.40	0.40	7432295
F1 (C6-C10)	ug/L	<25	<25	<25	25	7432295
F1 (C6-C10) - BTEX	ug/L	<25	<25	<25	25	7432295
F2-F4 Hydrocarbons						
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	<100	100	7432529
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	<200	200	7432529
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	<200	200	7432529
Reached Baseline at C50	ug/L	Yes	Yes	Yes		7432529
Surrogate Recovery (%)						
1,4-Difluorobenzene	%	102	100	102		7432295
4-Bromofluorobenzene	%	102	88	99		7432295
D10-o-Xylene	%	111	112	113		7432295
D4-1,2-Dichloroethane	%	112	110	111		7432295
o-Terphenyl	%	97	95	97		7432529

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG071
Sample ID: MW20-23A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7431736	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7430955	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7431743	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7431551	N/A	2021/06/28	Nimarta Singh
Hardness (calculated as CaCO3)		7424185	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/29	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/29	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/29	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7431102	N/A	2021/06/29	Chandra Nandlal
pH	AT	7431744	2021/06/26	2021/06/29	Surinder Rai
Orthophosphate	KONE	7430971	N/A	2021/06/28	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/29	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/29	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7430973	N/A	2021/06/28	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/29	Automated Statchk

BV Labs ID: PXG071 Dup
Sample ID: MW20-23A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7431736	N/A	2021/06/29	Surinder Rai
Conductivity	AT	7431743	N/A	2021/06/29	Surinder Rai
pH	AT	7431744	2021/06/26	2021/06/29	Surinder Rai

BV Labs ID: PXG072
Sample ID: MW20-23B
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430360	N/A	2021/06/26	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/27	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG072
Sample ID: MW20-23B
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG072 Dup
Sample ID: MW20-23B
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai

BV Labs ID: PXG073
Sample ID: MW20-23C
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7431045	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7431020	N/A	2021/06/28	Alina Dobreanu
Conductivity	AT	7431056	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/29	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/29	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7431102	N/A	2021/06/29	Chandra Nandlal
pH	AT	7431065	2021/06/25	2021/06/29	Surinder Rai
Orthophosphate	KONE	7431101	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/29	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/29	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7431104	N/A	2021/06/28	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/29	Automated Statchk

BV Labs ID: PXG074
Sample ID: MW20-17A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7431045	N/A	2021/06/29	Surinder Rai

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG074
Sample ID: MW20-17A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	7430955	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7431056	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430360	N/A	2021/06/26	Nimarta Singh
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/29	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/29	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7431102	N/A	2021/06/29	Chandra Nandlal
pH	AT	7431065	2021/06/25	2021/06/29	Surinder Rai
Orthophosphate	KONE	7430971	N/A	2021/06/28	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/29	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/29	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7430973	N/A	2021/06/28	Avneet Kour Sudan
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/29	Automated Statchk

BV Labs ID: PXG075
Sample ID: MW20-17B
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/27	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/29	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG076
Sample ID: DUP-1
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/27	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG101
Sample ID: MW20-01 A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG102
Sample ID: MW20-01 B
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430360	N/A	2021/06/27	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/28	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG103
Sample ID: MW20-02
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430360	N/A	2021/06/26	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/28	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG104
Sample ID: MW20-03
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/28	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG105
Sample ID: MW20-04
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430360	N/A	2021/06/26	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/28	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/29	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG106
Sample ID: MW20-05A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430360	N/A	2021/06/26	Nimarta Singh
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG106 Dup
Sample ID: MW20-05A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu

BV Labs ID: PXG107
Sample ID: MW20-06A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXG107
Sample ID: MW20-06A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG107 Dup
Sample ID: MW20-06A
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal

BV Labs ID: PXG108
Sample ID: MW20-06 B
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/28	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

BV Labs ID: PXG109
Sample ID: MW20-18
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7433466	N/A	2021/06/29	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7424184	N/A	2021/06/30	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H2396
Report Date: 2021/06/30

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

TEST SUMMARY

BV Labs ID: PXG109
Sample ID: MW20-18
Matrix: Water

Collected: 2021/06/22
Shipped:
Received: 2021/06/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7434287	N/A	2021/06/29	Alina Dobreanu
Conductivity	AT	7433472	N/A	2021/06/29	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7430572	N/A	2021/06/25	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7432295	N/A	2021/06/28	Joe Paino
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7432529	2021/06/28	2021/06/28	Jeevaraj Jeevaratrnam
Hardness (calculated as CaCO3)		7424186	N/A	2021/06/29	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7429380	N/A	2021/06/28	Prempal Bhatti
Ion Balance (% Difference)	CALC	7424164	N/A	2021/06/30	Automated Statchk
Anion and Cation Sum	CALC	7424165	N/A	2021/06/30	Automated Statchk
Total Ammonia-N	LACH/NH4	7429602	N/A	2021/06/29	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7433476	N/A	2021/06/29	Chandra Nandlal
pH	AT	7433471	2021/06/28	2021/06/29	Surinder Rai
Orthophosphate	KONE	7434295	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7424177	N/A	2021/06/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7424178	N/A	2021/06/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7434293	N/A	2021/06/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7424183	N/A	2021/06/30	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	12.3°C
Package 2	15.3°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7432295	1,4-Difluorobenzene	2021/06/27	96	70 - 130	98	70 - 130	105	%		
7432295	4-Bromofluorobenzene	2021/06/27	109	70 - 130	111	70 - 130	92	%		
7432295	D10-o-Xylene	2021/06/27	99	70 - 130	96	70 - 130	112	%		
7432295	D4-1,2-Dichloroethane	2021/06/27	106	70 - 130	104	70 - 130	113	%		
7432529	o-Terphenyl	2021/06/28	97	60 - 130	98	60 - 130	96	%		
7429380	Dissolved Aluminum (Al)	2021/06/28	118	80 - 120	94	80 - 120	<4.9	ug/L	4.3	20
7429380	Dissolved Antimony (Sb)	2021/06/28	107	80 - 120	101	80 - 120	<0.50	ug/L	NC	20
7429380	Dissolved Arsenic (As)	2021/06/28	104	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7429380	Dissolved Barium (Ba)	2021/06/28	103	80 - 120	102	80 - 120	<2.0	ug/L	1.2	20
7429380	Dissolved Beryllium (Be)	2021/06/28	100	80 - 120	102	80 - 120	<0.40	ug/L	NC	20
7429380	Dissolved Boron (B)	2021/06/28	93	80 - 120	93	80 - 120	<10	ug/L	7.7	20
7429380	Dissolved Cadmium (Cd)	2021/06/28	103	80 - 120	99	80 - 120	<0.090	ug/L	NC	20
7429380	Dissolved Calcium (Ca)	2021/06/28	NC	80 - 120	98	80 - 120	<200	ug/L	3.8	20
7429380	Dissolved Chromium (Cr)	2021/06/28	97	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
7429380	Dissolved Cobalt (Co)	2021/06/28	101	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7429380	Dissolved Copper (Cu)	2021/06/28	98	80 - 120	96	80 - 120	<0.90	ug/L	7.2	20
7429380	Dissolved Iron (Fe)	2021/06/28	102	80 - 120	99	80 - 120	<100	ug/L	4.2	20
7429380	Dissolved Lead (Pb)	2021/06/28	97	80 - 120	97	80 - 120	<0.50	ug/L	0.58	20
7429380	Dissolved Magnesium (Mg)	2021/06/28	NC	80 - 120	98	80 - 120	<50	ug/L	0.19	20
7429380	Dissolved Manganese (Mn)	2021/06/28	100	80 - 120	98	80 - 120	<2.0	ug/L	2.0	20
7429380	Dissolved Molybdenum (Mo)	2021/06/28	103	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7429380	Dissolved Nickel (Ni)	2021/06/28	97	80 - 120	96	80 - 120	<1.0	ug/L	NC	20
7429380	Dissolved Phosphorus (P)	2021/06/28	96	80 - 120	105	80 - 120	<100	ug/L	NC	20
7429380	Dissolved Potassium (K)	2021/06/28	104	80 - 120	100	80 - 120	<200	ug/L	0.13	20
7429380	Dissolved Selenium (Se)	2021/06/28	105	80 - 120	99	80 - 120	<2.0	ug/L	NC	20
7429380	Dissolved Silicon (Si)	2021/06/28	106	80 - 120	97	80 - 120	<50	ug/L	6.7	20
7429380	Dissolved Silver (Ag)	2021/06/28	100	80 - 120	97	80 - 120	<0.090	ug/L	NC	20
7429380	Dissolved Sodium (Na)	2021/06/28	NC	80 - 120	95	80 - 120	<100	ug/L	1.0	20
7429380	Dissolved Strontium (Sr)	2021/06/28	100	80 - 120	97	80 - 120	<1.0	ug/L	0.32	20
7429380	Dissolved Thallium (Tl)	2021/06/28	100	80 - 120	100	80 - 120	<0.050	ug/L	NC	20
7429380	Dissolved Titanium (Ti)	2021/06/28	103	80 - 120	96	80 - 120	<5.0	ug/L	NC	20

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7429380	Dissolved Uranium (U)	2021/06/28	99	80 - 120	98	80 - 120	<0.10	ug/L	6.3	20
7429380	Dissolved Vanadium (V)	2021/06/28	98	80 - 120	94	80 - 120	<0.50	ug/L	2.0	20
7429380	Dissolved Zinc (Zn)	2021/06/28	98	80 - 120	96	80 - 120	<5.0	ug/L	3.4	20
7429602	Total Ammonia-N	2021/06/29	95	75 - 125	104	80 - 120	<0.050	mg/L	NC	20
7430360	Dissolved Organic Carbon	2021/06/26	95	80 - 120	98	80 - 120	<0.40	mg/L	5.2	20
7430572	Dissolved Organic Carbon	2021/06/25	95	80 - 120	95	80 - 120	<0.40	mg/L	0.014	20
7430955	Dissolved Chloride (Cl-)	2021/06/29	NC	80 - 120	103	80 - 120	<1.0	mg/L	1.1	20
7430971	Orthophosphate (P)	2021/06/28	115	75 - 125	102	80 - 120	<0.010	mg/L	NC	25
7430973	Dissolved Sulphate (SO4)	2021/06/28	NC	75 - 125	103	80 - 120	<1.0	mg/L	0.26	20
7431020	Dissolved Chloride (Cl-)	2021/06/28	NC	80 - 120	101	80 - 120	<1.0	mg/L	1.2	20
7431045	Alkalinity (Total as CaCO3)	2021/06/29			95	85 - 115	<1.0	mg/L	0.87	20
7431056	Conductivity	2021/06/29			102	85 - 115	<1.0	umho/cm	0.34	25
7431065	pH	2021/06/29			102	98 - 103			0.13	N/A
7431101	Orthophosphate (P)	2021/06/30	92	75 - 125	102	80 - 120	<0.010	mg/L	NC	25
7431102	Nitrate (N)	2021/06/29	106	80 - 120	105	80 - 120	<0.10	mg/L	7.7	20
7431102	Nitrite (N)	2021/06/29	105	80 - 120	104	80 - 120	<0.010	mg/L	NC	20
7431104	Dissolved Sulphate (SO4)	2021/06/28	NC	75 - 125	102	80 - 120	<1.0	mg/L	2.3	20
7431551	Dissolved Organic Carbon	2021/06/28	98	80 - 120	103	80 - 120	<0.40	mg/L	3.8	20
7431736	Alkalinity (Total as CaCO3)	2021/06/29			97	85 - 115	<1.0	mg/L	0.031	20
7431743	Conductivity	2021/06/29			101	85 - 115	<1.0	umho/cm	0.44	25
7431744	pH	2021/06/29			102	98 - 103			0.18	N/A
7432295	Benzene	2021/06/27	98	50 - 140	95	50 - 140	<0.20	ug/L	NC	30
7432295	Ethylbenzene	2021/06/27	101	50 - 140	98	50 - 140	<0.20	ug/L	NC	30
7432295	F1 (C6-C10) - BTEX	2021/06/27					<25	ug/L	NC	30
7432295	F1 (C6-C10)	2021/06/27	86	60 - 140	83	60 - 140	<25	ug/L	NC	30
7432295	o-Xylene	2021/06/27	100	50 - 140	98	50 - 140	<0.20	ug/L	NC	30
7432295	p+m-Xylene	2021/06/27	95	50 - 140	93	50 - 140	<0.40	ug/L	NC	30
7432295	Toluene	2021/06/27	91	50 - 140	87	50 - 140	<0.20	ug/L	NC	30
7432295	Total Xylenes	2021/06/27					<0.40	ug/L	NC	30
7432529	F2 (C10-C16 Hydrocarbons)	2021/06/28	101	60 - 130	100	60 - 130	<100	ug/L	NC	30
7432529	F3 (C16-C34 Hydrocarbons)	2021/06/28	100	60 - 130	100	60 - 130	<200	ug/L	NC	30

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7432529	F4 (C34-C50 Hydrocarbons)	2021/06/28	101	60 - 130	100	60 - 130	<200	ug/L	NC	30
7433466	Alkalinity (Total as CaCO3)	2021/06/29			98	85 - 115	<1.0	mg/L	1.4	20
7433471	pH	2021/06/29			102	98 - 103			0.39	N/A
7433472	Conductivity	2021/06/29			102	85 - 115	<1.0	umho/cm	0.17	25
7433476	Nitrate (N)	2021/06/29	104	80 - 120	104	80 - 120	<0.10	mg/L	0.050	20
7433476	Nitrite (N)	2021/06/29	105	80 - 120	104	80 - 120	<0.010	mg/L	NC	20
7434287	Dissolved Chloride (Cl-)	2021/06/29	NC	80 - 120	102	80 - 120	<1.0	mg/L	0.89	20
7434293	Dissolved Sulphate (SO4)	2021/06/29	NC	75 - 125	104	80 - 120	<1.0	mg/L	0.53	20
7434295	Orthophosphate (P)	2021/06/30	115	75 - 125	102	80 - 120	<0.010	mg/L	NC	25

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

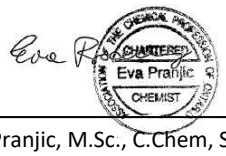
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvlabs.com

22-Jun-21 18:07
Ema Gitej
C1H2396
Bottle Order #: 831949

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:	
Address:	210 Sheldon Drive Cambridge ON N1T 1A8	Address:		Project:	19129150 (2300)
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:	
				Sampled By:	

COC #: C#831949-04-01
Project Manager: Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☐ Coarse
- ☐ Table 3 ☐ Agri/Other ☐ For RSC
- ☐ Table ___

Other Regulations
- ☐ CCME ☐ Sanitary Sewer Bylaw
- ☐ Reg 558 ☐ Storm Sewer Bylaw
- ☐ MISA Municipality ___
- ☐ PWQO ☐ Reg 406 Table ___
- ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O Reg 153 PHCs, BTEX/F1-F4	# of Bottles	Comments
1		MW20-23A	22-Jun-21	13:00	GW	✓	✓		4	
2		MW20-23B	22-Jun-21	14:00	GW	✓	✓	✓	8	
3		MW20-23C	22-Jun-21	14:30	GW	✓	✓		4	2 coolers
4		MW20-17A	22-Jun-21	17:00	GW	✓	✓		4	
5		MW20-17B	22-Jun-21	16:30	GW	✓	✓	✓	8	
6		DUP-1	22-Jun-21		GW	✓	✓	✓	8	
7										
8										
9										
10										

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
VTrapp	21/06/22	18:05	[illegible]	21/06/22	18:07	

Laboratory Use Only: ON ICE

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	15/12/10	Present		
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

18/4/14

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free 800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:			831949
Address:	210 Sheldon Drive Cambridge ON N1T 1A8	Address:		Project:	19129150 (2300)	COC #:	Project Manager:
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:		C#831949-03-01	Ema Gitej
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___	☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___	

Include Criteria on Certificate of Analysis (Y/N)? ___

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): (Metals / Hg / Cr VI)	ANALYSIS REQUESTED (PLEASE BE SPECIFIC): RCAp - Comprehensive	O.Reg 153 PHCs BTEX/F1-F4	# of Bottles	Comments
1		MW20-01 A	22-Jun-21	14:30	GW	✓	✓		4	
2		MW 20-01 B	22-Jun-21	14:45	GW	✓	✓	✓	8	
3		MW20-02	22-Jun-21	13:30	GW	✓	✓	✓	8	
4		MW20-03	22-Jun-21	12:30	GW	✓	✓	✓	8	
5		MW20-04	22-Jun-21	12:15	GW	✓	✓	✓	8	
6		MW20-05A	22-Jun-21	11:00	GW	✓	✓		4	
7		MW20-06A	22-Jun-21	10:45	GW	✓	✓		4	
8		MW20-06B	22-Jun-21	11:30	GW	✓	✓	✓	8	
9		MW20-18	22-Jun-21	15:00	GW	✓	✓	✓	8	
10										

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
VPtorp	~~22-Jun-21~~ 06/22	~~15:05~~ 13:05	see page 1			

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
		Present		
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

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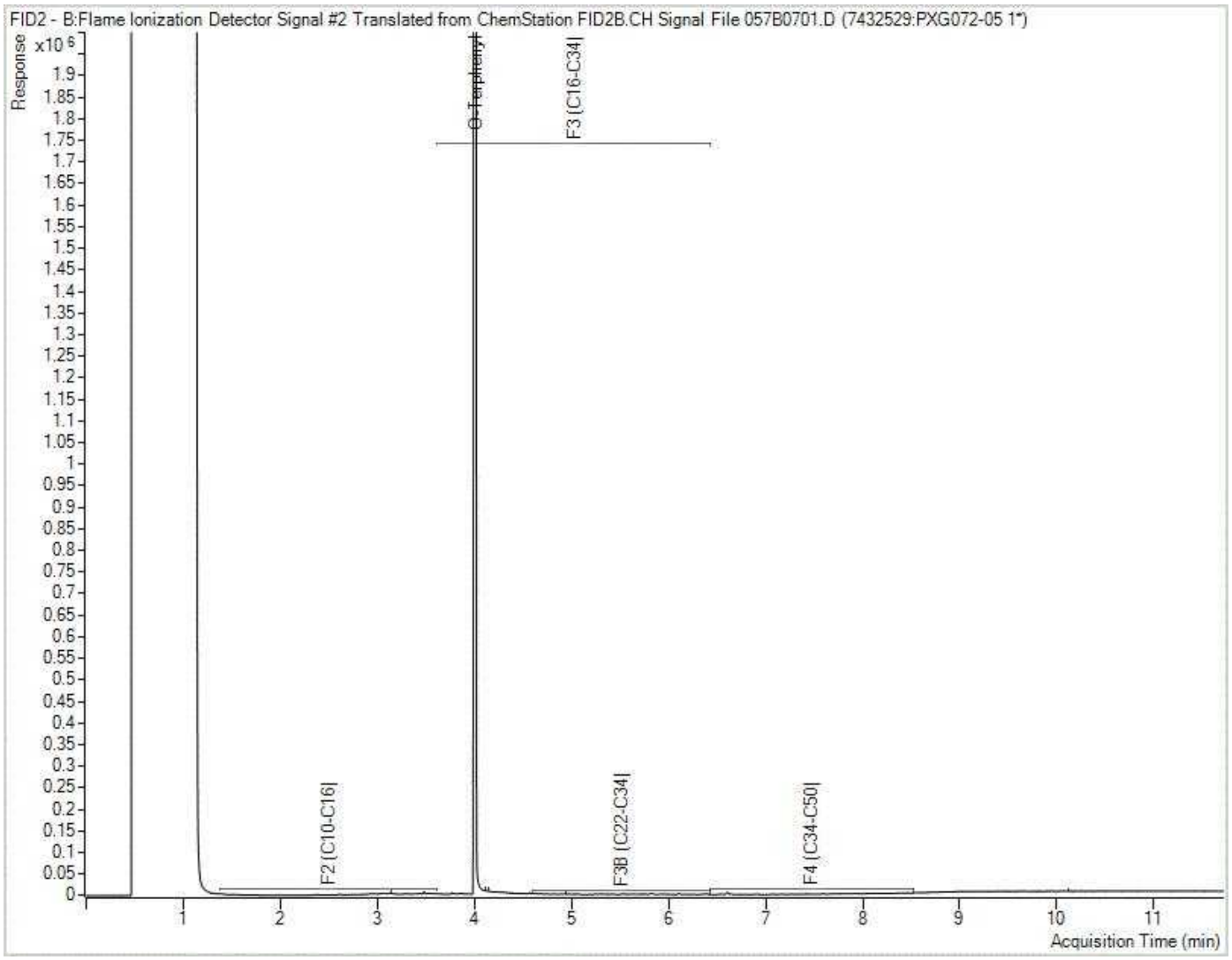
SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

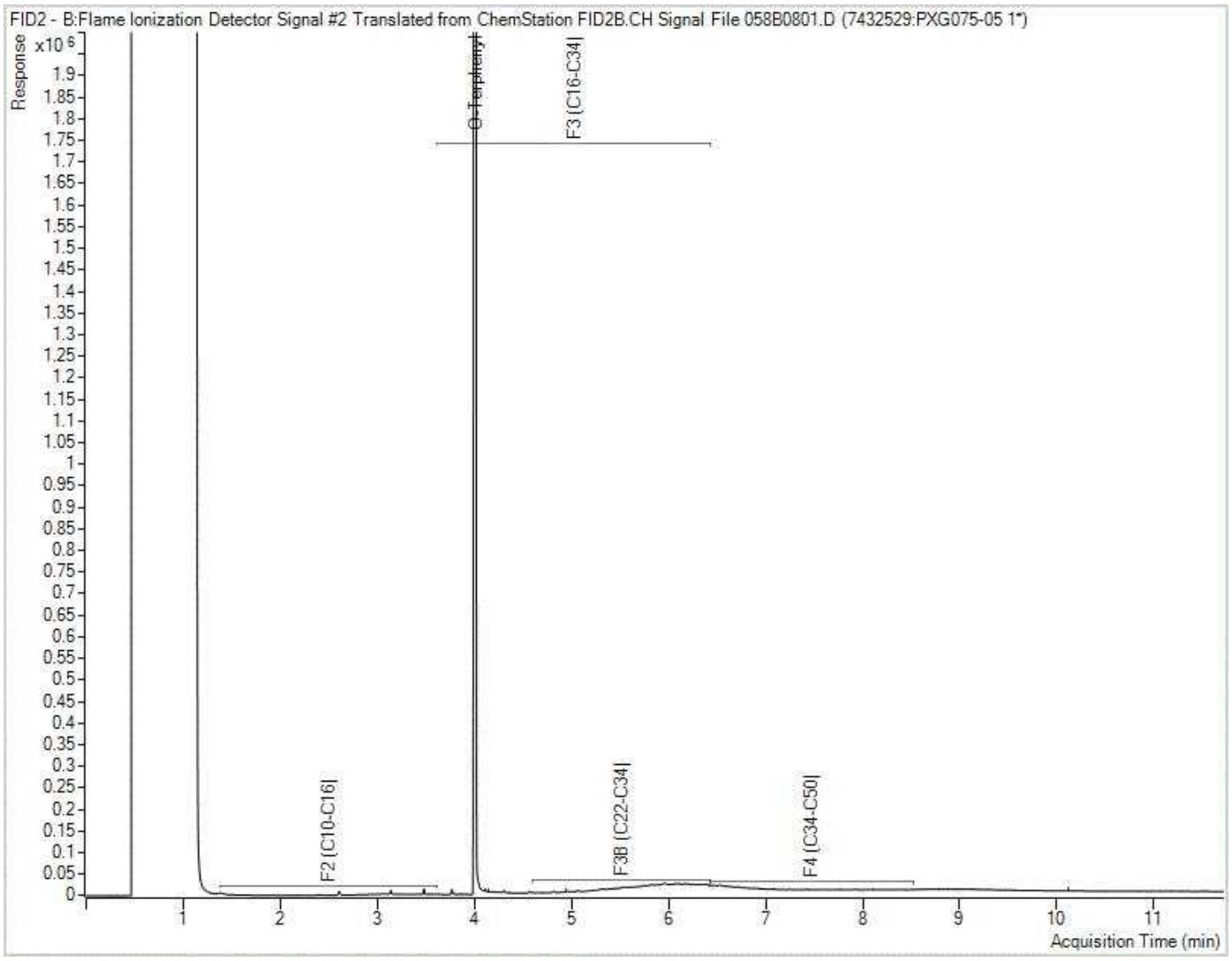


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG075

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-17B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

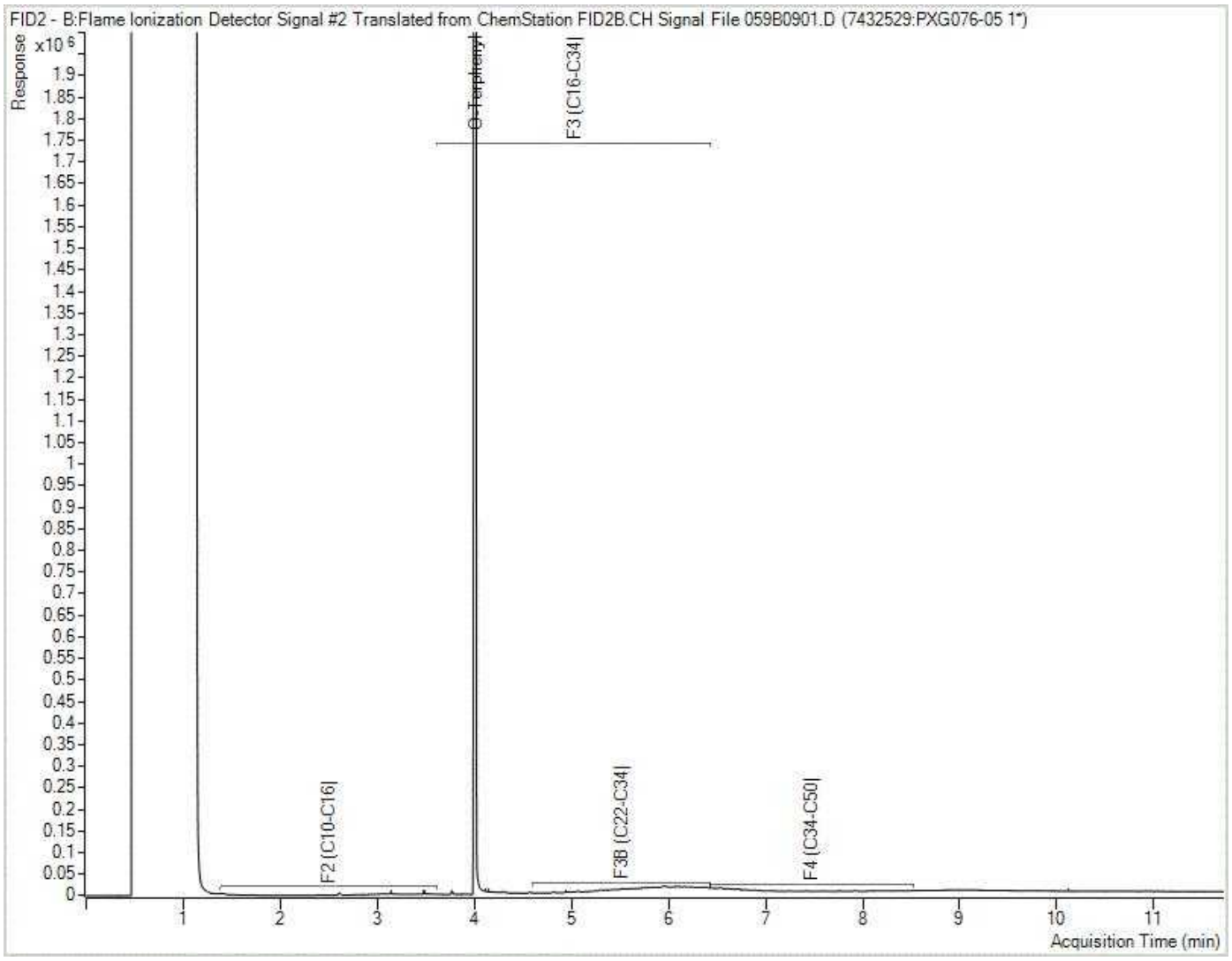


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG076

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP-1

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

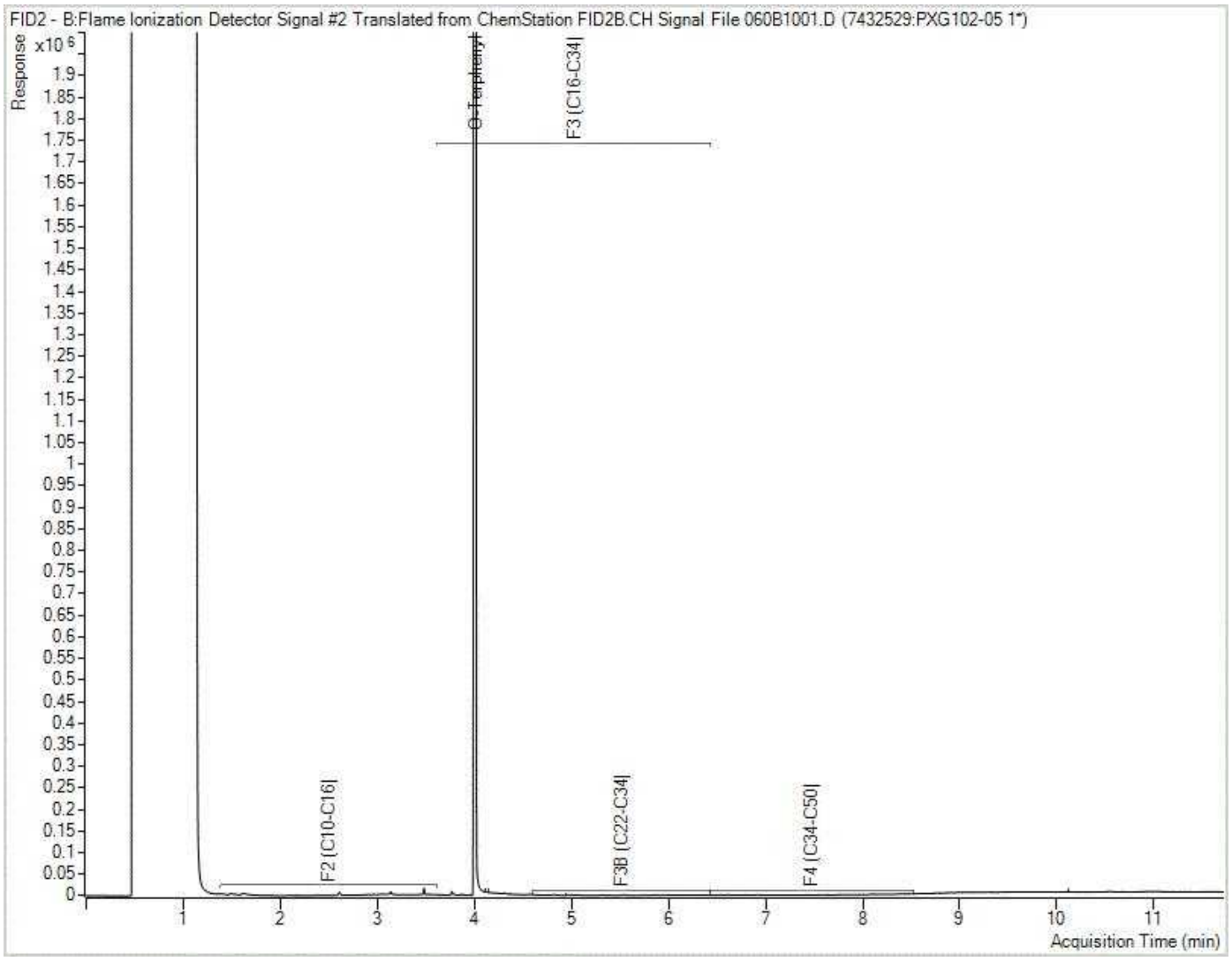


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG102

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-01 B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

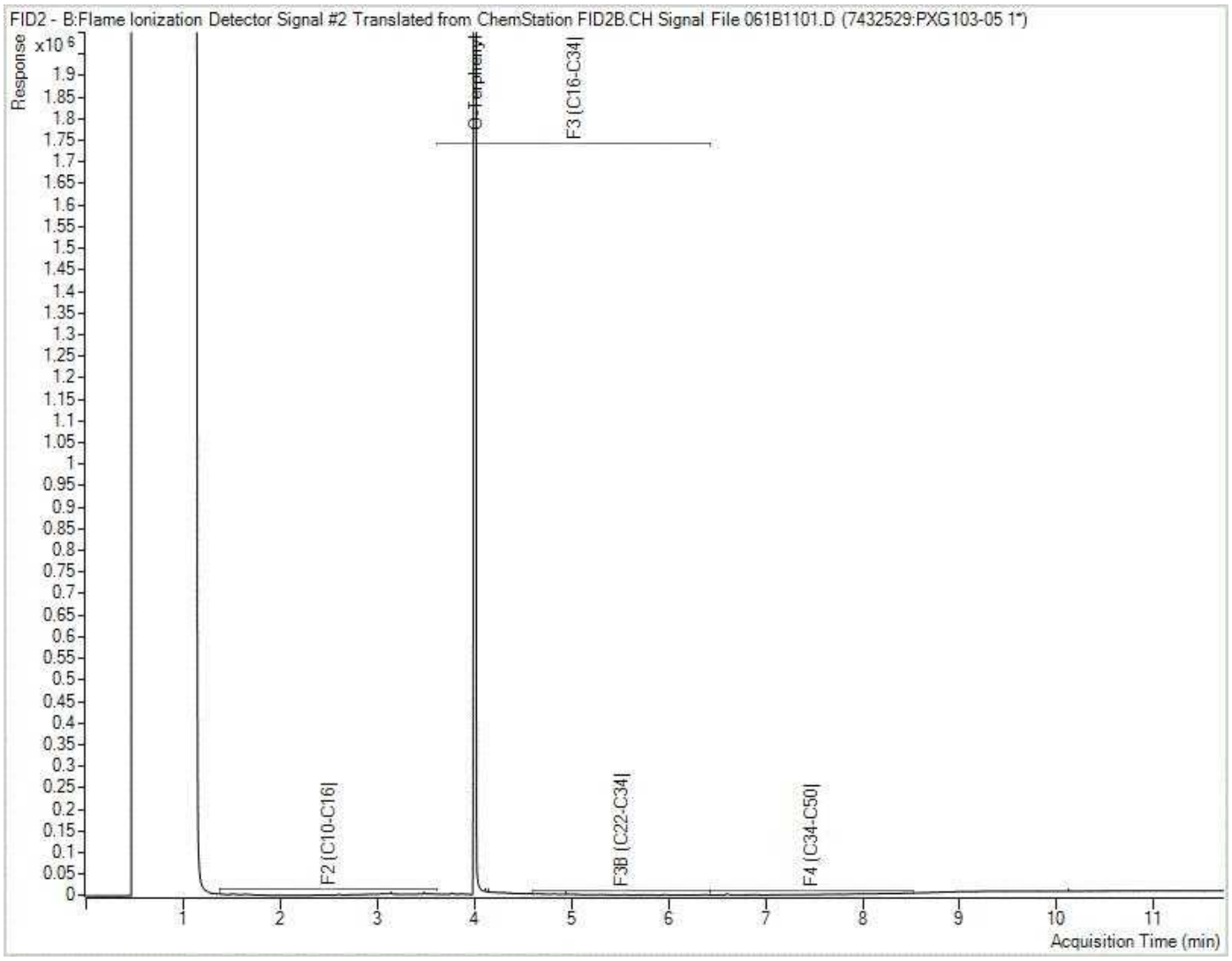


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG103

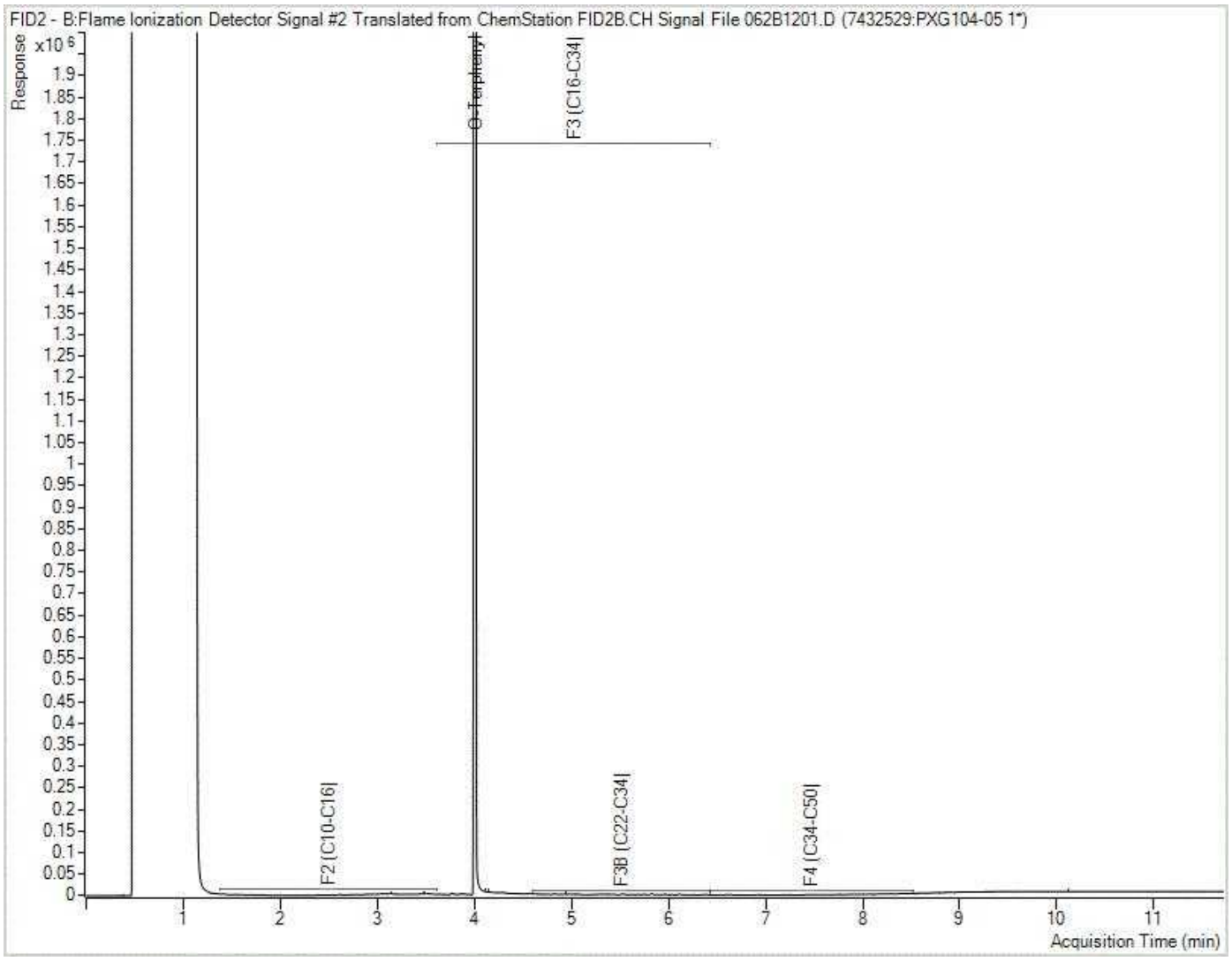
Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-02

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

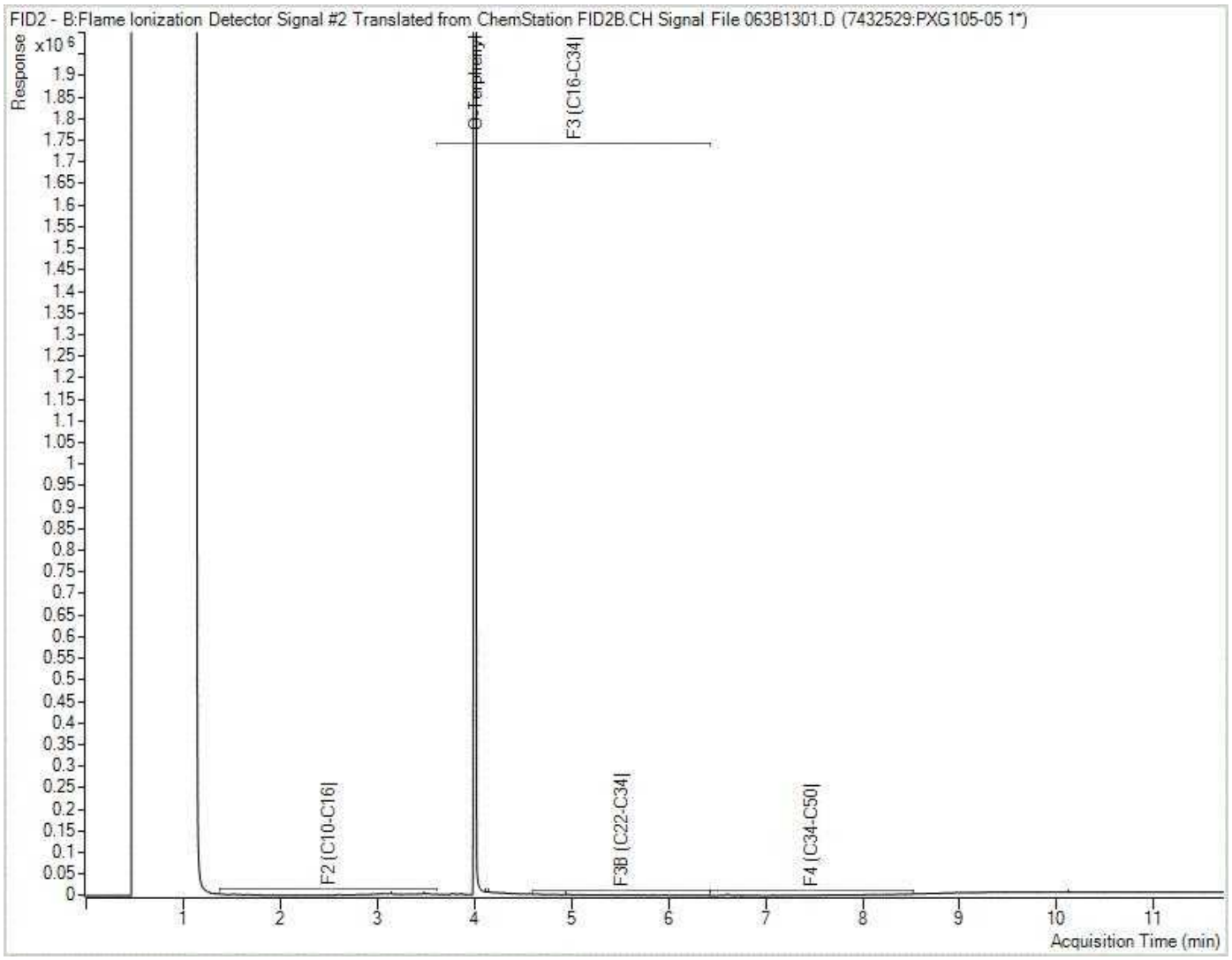


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG105

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-04

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

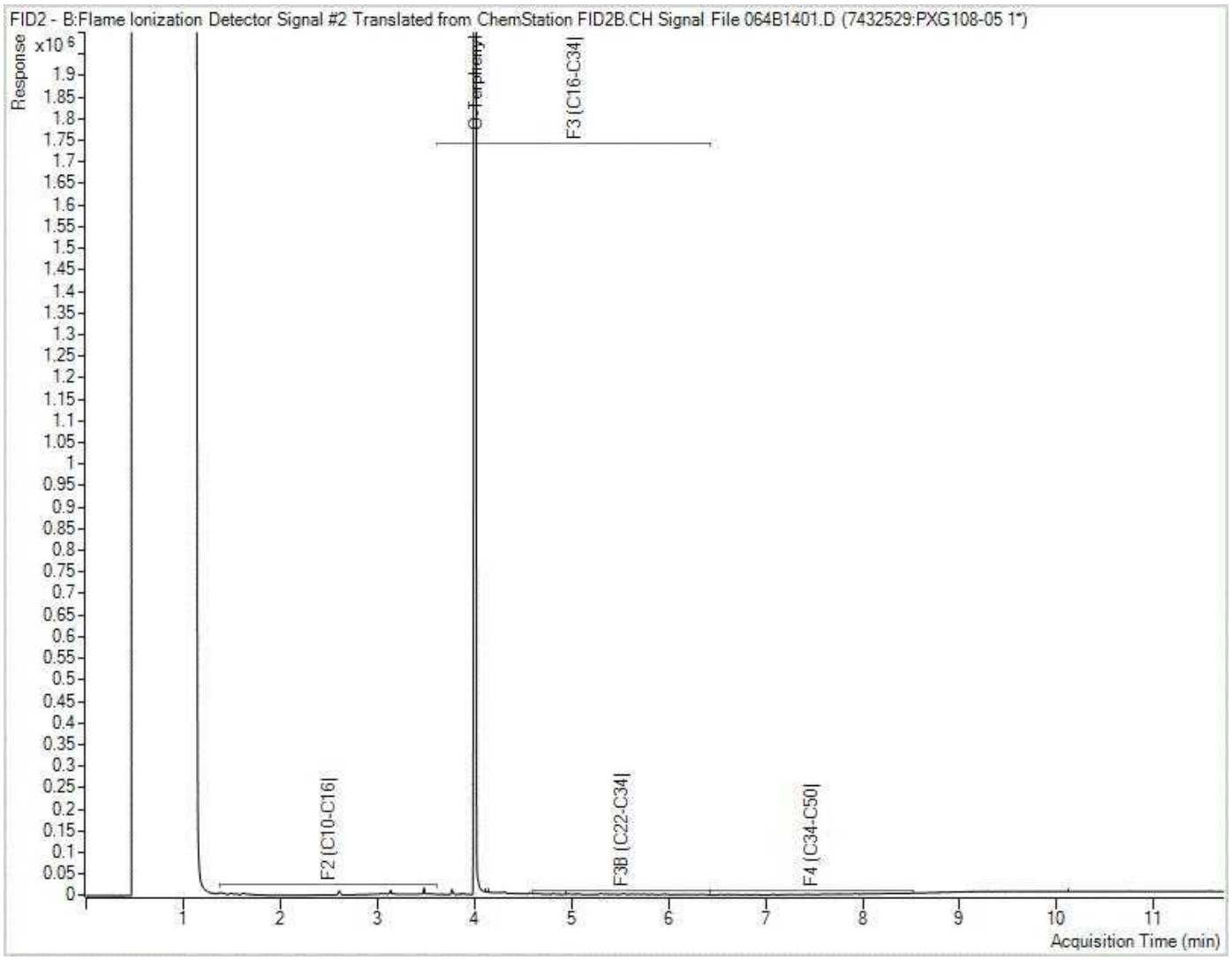


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG108

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-06 B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

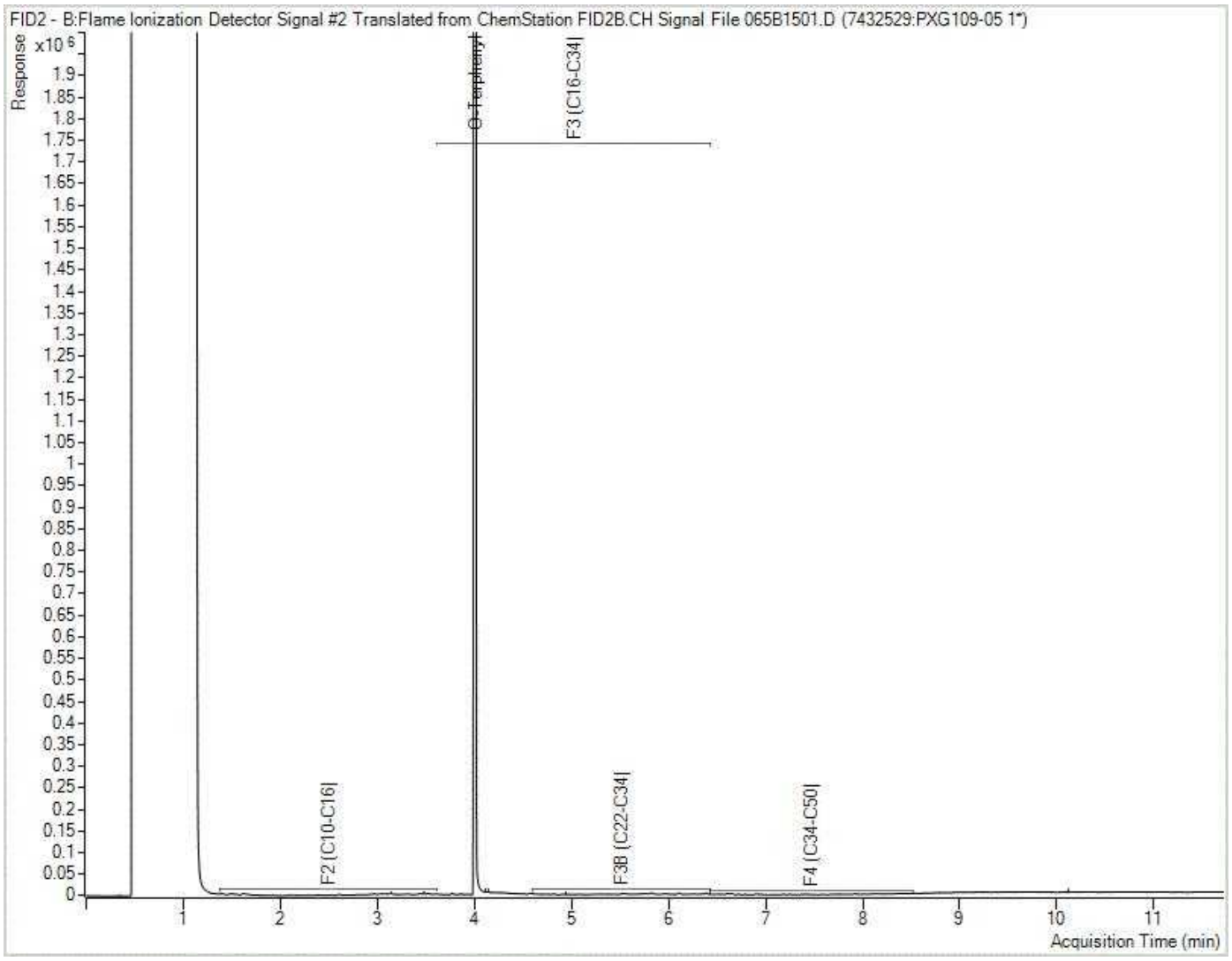


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H2396
Report Date: 2021/06/30
BV Labs Sample: PXG109

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-18

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-01-01, C#831949-02-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/02
Report #: R6702818
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H4635
Received: 2021/06/24, 08:00

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	9	N/A	2021/06/30	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	9	N/A	2021/06/30	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	9	N/A	2021/06/30	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	9	N/A	2021/06/30	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	9	N/A	2021/06/29	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	5	N/A	2021/06/29	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	4	2021/06/29	2021/06/30	CAM SOP-00316	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	1	2021/06/30	2021/06/30	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	9	N/A	2021/07/02	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	6	N/A	2021/06/30	CAM SOP-00447	EPA 6020B m
Dissolved Metals by ICPMS	3	N/A	2021/07/02	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	9	N/A	2021/07/02		
Anion and Cation Sum	9	N/A	2021/07/02		
Total Ammonia-N	9	N/A	2021/06/30	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	9	N/A	2021/06/30	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	1	2021/06/29	2021/06/30	CAM SOP-00413	SM 4500H+ B m
pH	8	2021/06/30	2021/06/30	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	9	N/A	2021/06/30	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	9	N/A	2021/07/02		Auto Calc
Sat. pH and Langelier Index (@ 4C)	9	N/A	2021/07/02		Auto Calc
Sulphate by Automated Colourimetry	9	N/A	2021/06/30	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	9	N/A	2021/07/02		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-01-01, C#831949-02-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/02
Report #: R6702818
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H4635
Received: 2021/06/24, 08:00

Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1H4635
Report Date: 2021/07/02

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS026			PXS026			PXS027		
Sampling Date		2021/06/23 15:30			2021/06/23 15:30			2021/06/23 15:45		
COC Number		C#831949-02-01			C#831949-02-01			C#831949-02-01		
	UNITS	MW20-19A	RDL	QC Batch	MW20-19A Lab-Dup	RDL	QC Batch	MW20-19B	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	9.06	N/A	7427593				7.25	N/A	7427593
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	240	1.0	7427591				260	1.0	7427591
Calculated TDS	mg/L	490	1.0	7426927				370	1.0	7426927
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.1	1.0	7427591				2.4	1.0	7427591
Cation Sum	me/L	8.56	N/A	7427593				6.66	N/A	7427593
Hardness (CaCO3)	mg/L	420	1.0	7429889				310	1.0	7429889
Ion Balance (% Difference)	%	2.85	N/A	7427592				4.22	N/A	7427592
Langelier Index (@ 20C)	N/A	0.806		7427594				0.859		7427594
Langelier Index (@ 4C)	N/A	0.558		7427596				0.611		7427596
Saturation pH (@ 20C)	N/A	7.16		7427594				7.14		7427594
Saturation pH (@ 4C)	N/A	7.40		7427596				7.39		7427596
Inorganics										
Total Ammonia-N	mg/L	<0.050	0.050	7436397				<0.050	0.050	7436397
Conductivity	umho/cm	780	1.0	7438035	770	1.0	7438035	640	1.0	7438035
Dissolved Organic Carbon	mg/L	1.1	0.40	7436754				0.62	0.40	7436754
Orthophosphate (P)	mg/L	<0.010	0.010	7437783	<0.010	0.010	7437783	<0.010	0.010	7437783
pH	pH	7.96		7438036	7.99		7438036	8.00		7438036
Dissolved Sulphate (SO4)	mg/L	190	1.0	7437782	190	1.0	7437782	76	1.0	7437782
Alkalinity (Total as CaCO3)	mg/L	250	1.0	7438032	240	1.0	7438032	260	1.0	7438032
Dissolved Chloride (Cl-)	mg/L	7.1	1.0	7437775	8.9	1.0	7437775	18	1.0	7437775
Nitrite (N)	mg/L	<0.010	0.010	7437964	<0.010	0.010	7437964	<0.010	0.010	7437964
Nitrate (N)	mg/L	<0.10	0.10	7437964	<0.10	0.10	7437964	<0.10	0.10	7437964
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7437964	<0.10	0.10	7437964	<0.10	0.10	7437964
Metals										
Dissolved Aluminum (Al)	ug/L	46	4.9	7435801				6.5	4.9	7435801
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7435801				<0.50	0.50	7435801
Dissolved Arsenic (As)	ug/L	1.3	1.0	7435801				4.3	1.0	7435801
Dissolved Barium (Ba)	ug/L	22	2.0	7435801				35	2.0	7435801
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7435801				<0.40	0.40	7435801
Dissolved Boron (B)	ug/L	35	10	7435801				12	10	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H4635
Report Date: 2021/07/02

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS026			PXS026			PXS027		
Sampling Date		2021/06/23 15:30			2021/06/23 15:30			2021/06/23 15:45		
COC Number		C#831949-02-01			C#831949-02-01			C#831949-02-01		
	UNITS	MW20-19A	RDL	QC Batch	MW20-19A Lab-Dup	RDL	QC Batch	MW20-19B	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7435801				<0.090	0.090	7435801
Dissolved Calcium (Ca)	ug/L	83000	200	7435801				77000	200	7435801
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7435801				<5.0	5.0	7435801
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7435801				<0.50	0.50	7435801
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7435801				<0.90	0.90	7435801
Dissolved Iron (Fe)	ug/L	310	100	7435801				380	100	7435801
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7435801				<0.50	0.50	7435801
Dissolved Magnesium (Mg)	ug/L	50000	50	7435801				29000	50	7435801
Dissolved Manganese (Mn)	ug/L	7.0	2.0	7435801				48	2.0	7435801
Dissolved Molybdenum (Mo)	ug/L	1.6	0.50	7435801				3.4	0.50	7435801
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7435801				2.2	1.0	7435801
Dissolved Phosphorus (P)	ug/L	<100	100	7435801				<100	100	7435801
Dissolved Potassium (K)	ug/L	1700	200	7435801				730	200	7435801
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7435801				<2.0	2.0	7435801
Dissolved Silicon (Si)	ug/L	3900	50	7435801				2900	50	7435801
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7435801				<0.090	0.090	7435801
Dissolved Sodium (Na)	ug/L	4400	100	7435801				8800	100	7435801
Dissolved Strontium (Sr)	ug/L	1500	1.0	7435801				610	1.0	7435801
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7435801				<0.050	0.050	7435801
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7435801				<5.0	5.0	7435801
Dissolved Uranium (U)	ug/L	0.12	0.10	7435801				0.13	0.10	7435801
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7435801				<0.50	0.50	7435801
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7435801				<5.0	5.0	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS028		PXS029		PXS030		
Sampling Date		2021/06/23		2021/06/23 16:10		2021/06/23 16:40		
COC Number		C#831949-02-01		C#831949-02-01		C#831949-02-01		
	UNITS	DUP2	RDL	MW20-20A	RDL	MW20-20B	RDL	QC Batch
Calculated Parameters								
Anion Sum	me/L	6.82	N/A	26.3	N/A	8.64	N/A	7427593
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	270	1.0	180	1.0	200	1.0	7427591
Calculated TDS	mg/L	360	1.0	1700	1.0	500	1.0	7426927
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.9	1.0	<1.0	1.0	1.3	1.0	7427591
Cation Sum	me/L	6.57	N/A	26.3	N/A	8.13	N/A	7427593
Hardness (CaCO3)	mg/L	310	1.0	1300	1.0	400	1.0	7429889
Ion Balance (% Difference)	%	1.87	N/A	0.00	N/A	3.03	N/A	7427592
Langelier Index (@ 20C)	N/A	0.807		0.952		0.715		7427594
Langelier Index (@ 4C)	N/A	0.558		0.708		0.467		7427596
Saturation pH (@ 20C)	N/A	7.07		6.74		7.13		7427594
Saturation pH (@ 4C)	N/A	7.32		6.98		7.38		7427596
Inorganics								
Total Ammonia-N	mg/L	<0.050	0.050	0.22	0.050	<0.050	0.050	7436397
Conductivity	umho/cm	610	1.0	2000	1.0	740	1.0	7438035
Dissolved Organic Carbon	mg/L	0.65	0.40	<0.40	0.40	<0.40	0.40	7436754
Orthophosphate (P)	mg/L	<0.010	0.010	<0.010	0.010	<0.010	0.010	7437783
pH	pH	7.88		7.69		7.85		7438036
Dissolved Sulphate (SO4)	mg/L	16	1.0	1100	5.0	220	1.0	7437782
Alkalinity (Total as CaCO3)	mg/L	270	1.0	180	1.0	200	1.0	7438032
Dissolved Chloride (Cl-)	mg/L	20	1.0	4.2	1.0	4.5	1.0	7437775
Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	<0.010	0.010	7437964
Nitrate (N)	mg/L	7.76	0.10	<0.10	0.10	<0.10	0.10	7437964
Nitrate + Nitrite (N)	mg/L	7.76	0.10	<0.10	0.10	<0.10	0.10	7437964
Metals								
Dissolved Aluminum (Al)	ug/L	7.1	4.9	26	4.9	<4.9	4.9	7435801
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	7435801
Dissolved Arsenic (As)	ug/L	<1.0	1.0	4.8	1.0	5.5	1.0	7435801
Dissolved Barium (Ba)	ug/L	19	2.0	8.1	2.0	14	2.0	7435801
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	<0.40	0.40	<0.40	0.40	7435801
Dissolved Boron (B)	ug/L	<10	10	54	10	13	10	7435801
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	<0.090	0.090	<0.090	0.090	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS028		PXS029		PXS030		
Sampling Date		2021/06/23		2021/06/23 16:10		2021/06/23 16:40		
COC Number		C#831949-02-01		C#831949-02-01		C#831949-02-01		
	UNITS	DUP2	RDL	MW20-20A	RDL	MW20-20B	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	86000	200	430000	400	110000	200	7435801
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	<5.0	5.0	7435801
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	7435801
Dissolved Copper (Cu)	ug/L	<0.90	0.90	<0.90	0.90	<0.90	0.90	7435801
Dissolved Iron (Fe)	ug/L	<100	100	620	100	180	100	7435801
Dissolved Lead (Pb)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	7435801
Dissolved Magnesium (Mg)	ug/L	24000	50	54000	50	30000	50	7435801
Dissolved Manganese (Mn)	ug/L	<2.0	2.0	41	2.0	6.7	2.0	7435801
Dissolved Molybdenum (Mo)	ug/L	<0.50	0.50	2.0	0.50	2.1	0.50	7435801
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	7435801
Dissolved Phosphorus (P)	ug/L	<100	100	<100	100	<100	100	7435801
Dissolved Potassium (K)	ug/L	1100	200	1600	200	820	200	7435801
Dissolved Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	<2.0	2.0	7435801
Dissolved Silicon (Si)	ug/L	4000	50	6700	50	7300	50	7435801
Dissolved Silver (Ag)	ug/L	<0.090	0.090	<0.090	0.090	<0.090	0.090	7435801
Dissolved Sodium (Na)	ug/L	6200	100	7100	100	3300	100	7435801
Dissolved Strontium (Sr)	ug/L	140	1.0	8600	1.0	2700	1.0	7435801
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	<0.050	0.050	7435801
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	<5.0	5.0	<5.0	5.0	7435801
Dissolved Uranium (U)	ug/L	0.14	0.10	0.17	0.10	<0.10	0.10	7435801
Dissolved Vanadium (V)	ug/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	7435801
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	<5.0	5.0	<5.0	5.0	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H4635
Report Date: 2021/07/02

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS031		PXS032			PXS033		
Sampling Date		2021/06/23 17:10		2021/06/23 09:30			2021/06/23 16:30		
COC Number		C#831949-02-01		C#831949-02-01			C#831949-02-01		
	UNITS	MW20-20C	QC Batch	MW20-09	RDL	QC Batch	MW20-22A	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	7.54	7427593	6.84	N/A	7427593	27.0	N/A	7427593
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	310	7434506	270	1.0	7434506	200	1.0	7434506
Calculated TDS	mg/L	380	7426927	360	1.0	7426927	1700	1.0	7426927
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.2	7434506	2.0	1.0	7434506	<1.0	1.0	7434506
Cation Sum	me/L	7.34	7427593	6.73	N/A	7427593	25.7	N/A	7427593
Hardness (CaCO3)	mg/L	340	7429889	320	1.0	7429889	1300	1.0	7429889
Ion Balance (% Difference)	%	1.38	7427592	0.850	N/A	7427592	2.53	N/A	7427592
Langelier Index (@ 20C)	N/A	0.904	7427594	0.833		7427594	0.961		7427594
Langelier Index (@ 4C)	N/A	0.655	7427596	0.584		7427596	0.717		7427596
Saturation pH (@ 20C)	N/A	6.97	7427594	7.06		7427594	6.73		7427594
Saturation pH (@ 4C)	N/A	7.22	7427596	7.30		7427596	6.98		7427596
Inorganics									
Total Ammonia-N	mg/L	<0.050	7436397	<0.050	0.050	7436397	0.070	0.050	7436397
Conductivity	umho/cm	660	7438035	610	1.0	7438035	2000	1.0	7438035
Dissolved Organic Carbon	mg/L	4.6	7436754	0.70	0.40	7436754	1.2	0.40	7436754
Orthophosphate (P)	mg/L	<0.010	7437783	<0.010	0.010	7436693	<0.010	0.010	7437783
pH	pH	7.88	7438036	7.89		7438036	7.69		7438036
Dissolved Sulphate (SO4)	mg/L	15	7437782	16	1.0	7436692	1100	5.0	7437782
Alkalinity (Total as CaCO3)	mg/L	310	7438032	270	1.0	7438032	200	1.0	7438032
Dissolved Chloride (Cl-)	mg/L	35	7437775	18	1.0	7436686	7.2	1.0	7437775
Nitrite (N)	mg/L	<0.010	7437964	<0.010	0.010	7437964	<0.010	0.010	7437964
Nitrate (N)	mg/L	0.13	7437964	7.61	0.10	7437964	<0.10	0.10	7437964
Nitrate + Nitrite (N)	mg/L	0.13	7437964	7.61	0.10	7437964	<0.10	0.10	7437964
Metals									
Dissolved Aluminum (Al)	ug/L	80	7437678	8.2	4.9	7435801	9.4	4.9	7435801
Dissolved Antimony (Sb)	ug/L	<0.50	7437678	<0.50	0.50	7435801	<0.50	0.50	7435801
Dissolved Arsenic (As)	ug/L	<1.0	7437678	<1.0	1.0	7435801	2.8	1.0	7435801
Dissolved Barium (Ba)	ug/L	33	7437678	19	2.0	7435801	7.7	2.0	7435801
Dissolved Beryllium (Be)	ug/L	<0.40	7437678	<0.40	0.40	7435801	<0.40	0.40	7435801
Dissolved Boron (B)	ug/L	16	7437678	<10	10	7435801	71	10	7435801
Dissolved Cadmium (Cd)	ug/L	<0.090	7437678	<0.090	0.090	7435801	<0.090	0.090	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS031		PXS032			PXS033		
Sampling Date		2021/06/23 17:10		2021/06/23 09:30			2021/06/23 16:30		
COC Number		C#831949-02-01		C#831949-02-01			C#831949-02-01		
	UNITS	MW20-20C	QC Batch	MW20-09	RDL	QC Batch	MW20-22A	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	95000	7437678	88000	200	7435801	400000	1000	7435801
Dissolved Chromium (Cr)	ug/L	<5.0	7437678	<5.0	5.0	7435801	<5.0	5.0	7435801
Dissolved Cobalt (Co)	ug/L	<0.50	7437678	<0.50	0.50	7435801	<0.50	0.50	7435801
Dissolved Copper (Cu)	ug/L	2.0	7437678	1.1	0.90	7435801	<0.90	0.90	7435801
Dissolved Iron (Fe)	ug/L	110	7437678	<100	100	7435801	350	100	7435801
Dissolved Lead (Pb)	ug/L	<0.50	7437678	<0.50	0.50	7435801	<0.50	0.50	7435801
Dissolved Magnesium (Mg)	ug/L	26000	7437678	25000	50	7435801	62000	50	7435801
Dissolved Manganese (Mn)	ug/L	6.0	7437678	<2.0	2.0	7435801	39	2.0	7435801
Dissolved Molybdenum (Mo)	ug/L	<0.50	7437678	<0.50	0.50	7435801	2.9	0.50	7435801
Dissolved Nickel (Ni)	ug/L	<1.0	7437678	<1.0	1.0	7435801	3.9	1.0	7435801
Dissolved Phosphorus (P)	ug/L	<100	7437678	<100	100	7435801	<100	100	7435801
Dissolved Potassium (K)	ug/L	1100	7437678	1100	200	7435801	2200	200	7435801
Dissolved Selenium (Se)	ug/L	<2.0	7437678	<2.0	2.0	7435801	<2.0	2.0	7435801
Dissolved Silicon (Si)	ug/L	4700	7437678	4300	50	7435801	5600	50	7435801
Dissolved Silver (Ag)	ug/L	<0.090	7437678	<0.090	0.090	7435801	<0.090	0.090	7435801
Dissolved Sodium (Na)	ug/L	11000	7437678	6400	100	7435801	14000	100	7435801
Dissolved Strontium (Sr)	ug/L	150	7437678	140	1.0	7435801	7200	1.0	7435801
Dissolved Thallium (Tl)	ug/L	<0.050	7437678	<0.050	0.050	7435801	<0.050	0.050	7435801
Dissolved Titanium (Ti)	ug/L	<5.0	7437678	<5.0	5.0	7435801	<5.0	5.0	7435801
Dissolved Uranium (U)	ug/L	0.80	7437678	0.14	0.10	7435801	0.22	0.10	7435801
Dissolved Vanadium (V)	ug/L	<0.50	7437678	<0.50	0.50	7435801	<0.50	0.50	7435801
Dissolved Zinc (Zn)	ug/L	<5.0	7437678	<5.0	5.0	7435801	<5.0	5.0	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS034		
Sampling Date		2021/06/23 18:30		
COC Number		C#831949-02-01		
	UNITS	MW20-22B	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	18.7	N/A	7427593
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	220	1.0	7434506
Calculated TDS	mg/L	1200	1.0	7426927
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.9	1.0	7434506
Cation Sum	me/L	18.9	N/A	7427593
Hardness (CaCO3)	mg/L	870	1.0	7429889
Ion Balance (% Difference)	%	0.680	N/A	7427592
Langelier Index (@ 20C)	N/A	1.15		7427594
Langelier Index (@ 4C)	N/A	0.902		7427596
Saturation pH (@ 20C)	N/A	6.81		7427594
Saturation pH (@ 4C)	N/A	7.05		7427596
Inorganics				
Total Ammonia-N	mg/L	0.15	0.050	7436397
Conductivity	umho/cm	1500	1.0	7438035
Dissolved Organic Carbon	mg/L	0.85	0.40	7436754
Orthophosphate (P)	mg/L	<0.010	0.010	7437783
pH	pH	7.95		7438036
Dissolved Sulphate (SO4)	mg/L	650	5.0	7437782
Alkalinity (Total as CaCO3)	mg/L	230	1.0	7438032
Dissolved Chloride (Cl-)	mg/L	24	1.0	7437775
Nitrite (N)	mg/L	0.010	0.010	7437964
Nitrate (N)	mg/L	0.25	0.10	7437964
Nitrate + Nitrite (N)	mg/L	0.26	0.10	7437964
Metals				
Dissolved Aluminum (Al)	ug/L	9.7	4.9	7435801
Dissolved Antimony (Sb)	ug/L	1.8	0.50	7435801
Dissolved Arsenic (As)	ug/L	11	1.0	7435801
Dissolved Barium (Ba)	ug/L	13	2.0	7435801
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7435801
Dissolved Boron (B)	ug/L	54	10	7435801
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXS034		
Sampling Date		2021/06/23 18:30		
COC Number		C#831949-02-01		
	UNITS	MW20-22B	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	260000	200	7435801
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7435801
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7435801
Dissolved Copper (Cu)	ug/L	1.0	0.90	7435801
Dissolved Iron (Fe)	ug/L	<100	100	7435801
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7435801
Dissolved Magnesium (Mg)	ug/L	57000	50	7435801
Dissolved Manganese (Mn)	ug/L	34	2.0	7435801
Dissolved Molybdenum (Mo)	ug/L	24	0.50	7435801
Dissolved Nickel (Ni)	ug/L	5.9	1.0	7435801
Dissolved Phosphorus (P)	ug/L	<100	100	7435801
Dissolved Potassium (K)	ug/L	2000	200	7435801
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7435801
Dissolved Silicon (Si)	ug/L	4700	50	7435801
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7435801
Dissolved Sodium (Na)	ug/L	32000	100	7435801
Dissolved Strontium (Sr)	ug/L	4700	1.0	7435801
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7435801
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7435801
Dissolved Uranium (U)	ug/L	1.4	0.10	7435801
Dissolved Vanadium (V)	ug/L	1.2	0.50	7435801
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7435801

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXS027	PXS028			PXS028		
Sampling Date		2021/06/23 15:45	2021/06/23			2021/06/23		
COC Number		C#831949-02-01	C#831949-02-01			C#831949-02-01		
	UNITS	MW20-19B	DUP2	RDL	QC Batch	DUP2 Lab-Dup	RDL	QC Batch
BTEX & F1 Hydrocarbons								
Benzene	ug/L	<0.20	<0.20	0.20	7435755			
Toluene	ug/L	<0.20	<0.20	0.20	7435755			
Ethylbenzene	ug/L	<0.20	<0.20	0.20	7435755			
o-Xylene	ug/L	<0.20	<0.20	0.20	7435755			
p+m-Xylene	ug/L	<0.40	<0.40	0.40	7435755			
Total Xylenes	ug/L	<0.40	<0.40	0.40	7435755			
F1 (C6-C10)	ug/L	<25	<25	25	7435755			
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	7435755			
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	7436245	<100	100	7436245
F3 (C16-C34 Hydrocarbons)	ug/L	1100	<200	200	7436245	<200	200	7436245
F4 (C34-C50 Hydrocarbons)	ug/L	810	<200	200	7436245	<200	200	7436245
Reached Baseline at C50	ug/L	Yes	Yes		7436245	Yes		7436245
Surrogate Recovery (%)								
1,4-Difluorobenzene	%	100	100		7435755			
4-Bromofluorobenzene	%	96	96		7435755			
D10-o-Xylene	%	98	97		7435755			
D4-1,2-Dichloroethane	%	107	107		7435755			
o-Terphenyl	%	93	97		7436245	97		7436245

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXS030			PXS030			PXS032		
Sampling Date		2021/06/23 16:40			2021/06/23 16:40			2021/06/23 09:30		
COC Number		C#831949-02-01			C#831949-02-01			C#831949-02-01		
	UNITS	MW20-20B	RDL	QC Batch	MW20-20B Lab-Dup	RDL	QC Batch	MW20-09	RDL	QC Batch
BTEX & F1 Hydrocarbons										
Benzene	ug/L	<0.20	0.20	7435755	<0.20	0.20	7435755	<0.20	0.20	7435755
Toluene	ug/L	<0.20	0.20	7435755	<0.20	0.20	7435755	<0.20	0.20	7435755
Ethylbenzene	ug/L	<0.20	0.20	7435755	<0.20	0.20	7435755	<0.20	0.20	7435755
o-Xylene	ug/L	<0.20	0.20	7435755	<0.20	0.20	7435755	<0.20	0.20	7435755
p+m-Xylene	ug/L	<0.40	0.40	7435755	<0.40	0.40	7435755	<0.40	0.40	7435755
Total Xylenes	ug/L	<0.40	0.40	7435755	<0.40	0.40	7435755	<0.40	0.40	7435755
F1 (C6-C10)	ug/L	<25	25	7435755	<25	25	7435755	<25	25	7435755
F1 (C6-C10) - BTEX	ug/L	<25	25	7435755	<25	25	7435755	<25	25	7435755
F2-F4 Hydrocarbons										
F2 (C10-C16 Hydrocarbons)	ug/L	<100	100	7436245				<100	100	7436245
F3 (C16-C34 Hydrocarbons)	ug/L	330	200	7436245				<200	200	7436245
F4 (C34-C50 Hydrocarbons)	ug/L	<200	200	7436245				<200	200	7436245
Reached Baseline at C50	ug/L	Yes		7436245				Yes		7436245
Surrogate Recovery (%)										
1,4-Difluorobenzene	%	99		7435755	101		7435755	99		7435755
4-Bromofluorobenzene	%	99		7435755	92		7435755	99		7435755
D10-o-Xylene	%	98		7435755	99		7435755	97		7435755
D4-1,2-Dichloroethane	%	106		7435755	108		7435755	103		7435755
o-Terphenyl	%	98		7436245				96		7436245

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXS034		
Sampling Date		2021/06/23 18:30		
COC Number		C#831949-02-01		
	UNITS	MW20-22B	RDL	QC Batch
BTEX & F1 Hydrocarbons				
Benzene	ug/L	<0.20	0.20	7435755
Toluene	ug/L	0.27	0.20	7435755
Ethylbenzene	ug/L	<0.20	0.20	7435755
o-Xylene	ug/L	<0.20	0.20	7435755
p+m-Xylene	ug/L	<0.40	0.40	7435755
Total Xylenes	ug/L	<0.40	0.40	7435755
F1 (C6-C10)	ug/L	<25	25	7435755
F1 (C6-C10) - BTEX	ug/L	<25	25	7435755
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/L	<100	100	7437559
F3 (C16-C34 Hydrocarbons)	ug/L	<200	200	7437559
F4 (C34-C50 Hydrocarbons)	ug/L	<200	200	7437559
Reached Baseline at C50	ug/L	Yes		7437559
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	100		7435755
4-Bromofluorobenzene	%	91		7435755
D10-o-Xylene	%	98		7435755
D4-1,2-Dichloroethane	%	104		7435755
o-Terphenyl	%	99		7437559

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXS026
Sample ID: MW20-19A
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7427591	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/06/30	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS026 Dup
Sample ID: MW20-19A
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu

BV Labs ID: PXS027
Sample ID: MW20-19B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7427591	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7435755	N/A	2021/06/29	Anca Ganea
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/06/30	Arefa Dabhad

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXS027
Sample ID: MW20-19B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS028
Sample ID: DUP2
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7427591	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7435755	N/A	2021/06/29	Anca Ganea
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/06/30	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS028 Dup
Sample ID: DUP2
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXS029
Sample ID: MW20-20A
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7427591	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/07/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS030
Sample ID: MW20-20B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7427591	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7435755	N/A	2021/06/29	Anca Ganea
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/06/30	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXS030 Dup
Sample ID: MW20-20B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7435755	N/A	2021/06/29	Anca Ganea

BV Labs ID: PXS031
Sample ID: MW20-20C
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7434506	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/07/02	Prempal Bhatti
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS032
Sample ID: MW20-09
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7434506	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7436686	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7435755	N/A	2021/06/29	Anca Ganea
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/06/30	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/29	2021/06/30	Surinder Rai
Orthophosphate	KONE	7436693	N/A	2021/06/30	Avneet Kour Sudan

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXS032
Sample ID: MW20-09
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7436692	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS033
Sample ID: MW20-22A
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7434506	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/07/02	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXS034
Sample ID: MW20-22B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438032	N/A	2021/06/30	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7434506	N/A	2021/06/30	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437775	N/A	2021/06/30	Alina Dobreanu
Conductivity	AT	7438035	N/A	2021/06/30	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7436754	N/A	2021/06/29	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7435755	N/A	2021/06/29	Anca Ganea
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7437559	2021/06/30	2021/06/30	(Kent) Maolin Li
Hardness (calculated as CaCO3)		7429889	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7435801	N/A	2021/06/30	Arefa Dabhad
Ion Balance (% Difference)	CALC	7427592	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7427593	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H4635
Report Date: 2021/07/02

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

TEST SUMMARY

BV Labs ID: PXS034
Sample ID: MW20-22B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437964	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438036	2021/06/30	2021/06/30	Surinder Rai
Orthophosphate	KONE	7437783	N/A	2021/06/30	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7427594	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7427596	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437782	N/A	2021/06/30	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7426927	N/A	2021/07/02	Automated Statchk

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H4635
Report Date: 2021/07/02

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7435755	1,4-Difluorobenzene	2021/06/30	98	70 - 130	99	70 - 130	100	%		
7435755	4-Bromofluorobenzene	2021/06/30	102	70 - 130	100	70 - 130	95	%		
7435755	D10-o-Xylene	2021/06/30	83	70 - 130	97	70 - 130	96	%		
7435755	D4-1,2-Dichloroethane	2021/06/30	101	70 - 130	99	70 - 130	101	%		
7436245	o-Terphenyl	2021/06/29	98	60 - 130	98	60 - 130	98	%		
7437559	o-Terphenyl	2021/06/30	97	60 - 130	99	60 - 130	96	%		
7435755	Benzene	2021/06/29	92	50 - 140	106	50 - 140	<0.20	ug/L	NC	30
7435755	Ethylbenzene	2021/06/29	100	50 - 140	115	50 - 140	<0.20	ug/L	NC	30
7435755	F1 (C6-C10) - BTEX	2021/06/29					<25	ug/L	NC	30
7435755	F1 (C6-C10)	2021/06/29	82	60 - 140	95	60 - 140	<25	ug/L	NC	30
7435755	o-Xylene	2021/06/29	98	50 - 140	112	50 - 140	<0.20	ug/L	NC	30
7435755	p+m-Xylene	2021/06/29	97	50 - 140	110	50 - 140	<0.40	ug/L	NC	30
7435755	Toluene	2021/06/29	88	50 - 140	101	50 - 140	<0.20	ug/L	NC	30
7435755	Total Xylenes	2021/06/29					<0.40	ug/L	NC	30
7435801	Dissolved Aluminum (Al)	2021/06/30	104	80 - 120	99	80 - 120	<4.9	ug/L	1.8	20
7435801	Dissolved Antimony (Sb)	2021/06/30	104	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
7435801	Dissolved Arsenic (As)	2021/06/30	100	80 - 120	98	80 - 120	<1.0	ug/L	13	20
7435801	Dissolved Barium (Ba)	2021/06/30	104	80 - 120	99	80 - 120	<2.0	ug/L	3.9	20
7435801	Dissolved Beryllium (Be)	2021/06/30	103	80 - 120	97	80 - 120	<0.40	ug/L	NC	20
7435801	Dissolved Boron (B)	2021/06/30	95	80 - 120	93	80 - 120	<10	ug/L	2.6	20
7435801	Dissolved Cadmium (Cd)	2021/06/30	99	80 - 120	97	80 - 120	<0.090	ug/L	NC	20
7435801	Dissolved Calcium (Ca)	2021/06/30	NC	80 - 120	100	80 - 120	<200	ug/L	1.0	20
7435801	Dissolved Chromium (Cr)	2021/06/30	95	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
7435801	Dissolved Cobalt (Co)	2021/06/30	97	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7435801	Dissolved Copper (Cu)	2021/06/30	99	80 - 120	95	80 - 120	<0.90	ug/L	4.4	20
7435801	Dissolved Iron (Fe)	2021/06/30	94	80 - 120	95	80 - 120	<100	ug/L	2.5	20
7435801	Dissolved Lead (Pb)	2021/06/30	95	80 - 120	94	80 - 120	<0.50	ug/L	NC	20
7435801	Dissolved Magnesium (Mg)	2021/06/30	97	80 - 120	97	80 - 120	<50	ug/L	1.3	20
7435801	Dissolved Manganese (Mn)	2021/06/30	97	80 - 120	96	80 - 120	<2.0	ug/L	0.82	20
7435801	Dissolved Molybdenum (Mo)	2021/06/30	101	80 - 120	94	80 - 120	<0.50	ug/L	0.23	20
7435801	Dissolved Nickel (Ni)	2021/06/30	93	80 - 120	95	80 - 120	<1.0	ug/L	0.95	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7435801	Dissolved Phosphorus (P)	2021/06/30	97	80 - 120	95	80 - 120	<100	ug/L	NC	20
7435801	Dissolved Potassium (K)	2021/06/30	104	80 - 120	98	80 - 120	<200	ug/L	1.3	20
7435801	Dissolved Selenium (Se)	2021/06/30	99	80 - 120	101	80 - 120	<2.0	ug/L	NC	20
7435801	Dissolved Silicon (Si)	2021/06/30	102	80 - 120	97	80 - 120	<50	ug/L	2.6	20
7435801	Dissolved Silver (Ag)	2021/06/30	94	80 - 120	94	80 - 120	<0.090	ug/L	NC	20
7435801	Dissolved Sodium (Na)	2021/06/30	NC	80 - 120	95	80 - 120	<100	ug/L	0.65	20
7435801	Dissolved Strontium (Sr)	2021/06/30	NC	80 - 120	94	80 - 120	<1.0	ug/L	0.72	20
7435801	Dissolved Thallium (Tl)	2021/06/30	98	80 - 120	98	80 - 120	<0.050	ug/L	NC	20
7435801	Dissolved Titanium (Ti)	2021/06/30	100	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
7435801	Dissolved Uranium (U)	2021/06/30	98	80 - 120	95	80 - 120	<0.10	ug/L	4.0	20
7435801	Dissolved Vanadium (V)	2021/06/30	98	80 - 120	95	80 - 120	<0.50	ug/L	15	20
7435801	Dissolved Zinc (Zn)	2021/06/30	93	80 - 120	94	80 - 120	<5.0	ug/L	NC	20
7436245	F2 (C10-C16 Hydrocarbons)	2021/06/30	90	60 - 130	99	60 - 130	<100	ug/L	NC	30
7436245	F3 (C16-C34 Hydrocarbons)	2021/06/30	88	60 - 130	103	60 - 130	<200	ug/L	NC	30
7436245	F4 (C34-C50 Hydrocarbons)	2021/06/30	93	60 - 130	106	60 - 130	<200	ug/L	NC	30
7436397	Total Ammonia-N	2021/06/30	100	75 - 125	104	80 - 120	<0.050	mg/L	20	20
7436686	Dissolved Chloride (Cl-)	2021/06/30	116	80 - 120	104	80 - 120	<1.0	mg/L	18	20
7436692	Dissolved Sulphate (SO4)	2021/06/30	174 (1)	75 - 125	105	80 - 120	<1.0	mg/L	NC	20
7436693	Orthophosphate (P)	2021/06/30	97	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
7436754	Dissolved Organic Carbon	2021/06/29	93	80 - 120	98	80 - 120	<0.40	mg/L	1.0	20
7437559	F2 (C10-C16 Hydrocarbons)	2021/06/30	104	60 - 130	111	60 - 130	<100	ug/L	NC	30
7437559	F3 (C16-C34 Hydrocarbons)	2021/06/30	114	60 - 130	115	60 - 130	<200	ug/L	NC	30
7437559	F4 (C34-C50 Hydrocarbons)	2021/06/30	112	60 - 130	118	60 - 130	<200	ug/L	NC	30
7437678	Dissolved Aluminum (Al)	2021/06/30	101	80 - 120	99	80 - 120	<4.9	ug/L	NC	20
7437678	Dissolved Antimony (Sb)	2021/06/30	105	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Arsenic (As)	2021/06/30	103	80 - 120	100	80 - 120	<1.0	ug/L	0.65	20
7437678	Dissolved Barium (Ba)	2021/06/30	102	80 - 120	100	80 - 120	<2.0	ug/L	3.8	20
7437678	Dissolved Beryllium (Be)	2021/06/30	103	80 - 120	96	80 - 120	<0.40	ug/L	NC	20
7437678	Dissolved Boron (B)	2021/06/30	97	80 - 120	88	80 - 120	<10	ug/L	4.1	20
7437678	Dissolved Cadmium (Cd)	2021/06/30	102	80 - 120	99	80 - 120	<0.090	ug/L	NC	20
7437678	Dissolved Calcium (Ca)	2021/06/30	NC	80 - 120	98	80 - 120	<200	ug/L	1.6	20

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7437678	Dissolved Chromium (Cr)	2021/06/30	100	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7437678	Dissolved Cobalt (Co)	2021/06/30	105	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Copper (Cu)	2021/06/30	101	80 - 120	105	80 - 120	<0.90	ug/L	NC	20
7437678	Dissolved Iron (Fe)	2021/06/30	102	80 - 120	99	80 - 120	<100	ug/L	0.31	20
7437678	Dissolved Lead (Pb)	2021/06/30	100	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Magnesium (Mg)	2021/06/30	NC	80 - 120	102	80 - 120	<50	ug/L	1.2	20
7437678	Dissolved Manganese (Mn)	2021/06/30	100	80 - 120	98	80 - 120	<2.0	ug/L	1.4	20
7437678	Dissolved Molybdenum (Mo)	2021/06/30	105	80 - 120	98	80 - 120	<0.50	ug/L	1.5	20
7437678	Dissolved Nickel (Ni)	2021/06/30	100	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7437678	Dissolved Phosphorus (P)	2021/06/30	102	80 - 120	103	80 - 120	<100	ug/L	NC	20
7437678	Dissolved Potassium (K)	2021/06/30	104	80 - 120	103	80 - 120	<200	ug/L	0.33	20
7437678	Dissolved Selenium (Se)	2021/06/30	106	80 - 120	102	80 - 120	<2.0	ug/L	NC	20
7437678	Dissolved Silicon (Si)	2021/06/30	98	80 - 120	97	80 - 120	<50	ug/L	1.0	20
7437678	Dissolved Silver (Ag)	2021/06/30	101	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7437678	Dissolved Sodium (Na)	2021/06/30	102	80 - 120	101	80 - 120	<100	ug/L	1.5	20
7437678	Dissolved Strontium (Sr)	2021/06/30	NC	80 - 120	97	80 - 120	<1.0	ug/L	2.9	20
7437678	Dissolved Thallium (Tl)	2021/06/30	106	80 - 120	102	80 - 120	<0.050	ug/L	NC	20
7437678	Dissolved Titanium (Ti)	2021/06/30	100	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
7437678	Dissolved Uranium (U)	2021/06/30	105	80 - 120	99	80 - 120	<0.10	ug/L	0.64	20
7437678	Dissolved Vanadium (V)	2021/06/30	100	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Zinc (Zn)	2021/06/30	99	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
7437775	Dissolved Chloride (Cl-)	2021/06/30	100	80 - 120	106	80 - 120	<1.0	mg/L	NC	20
7437782	Dissolved Sulphate (SO4)	2021/06/30	NC	75 - 125	104	80 - 120	<1.0	mg/L	0.82	20
7437783	Orthophosphate (P)	2021/06/30	97	75 - 125	102	80 - 120	<0.010	mg/L	NC	25
7437964	Nitrate (N)	2021/06/30	99	80 - 120	99	80 - 120	<0.10	mg/L	NC	20
7437964	Nitrite (N)	2021/06/30	106	80 - 120	105	80 - 120	<0.010	mg/L	NC	20
7438032	Alkalinity (Total as CaCO3)	2021/06/30			94	85 - 115	<1.0	mg/L	0.58	20
7438035	Conductivity	2021/06/30			102	85 - 115	<1.0	umho/cm	1.2	25

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7438036	pH	2021/06/30			102	98 - 103			0.38	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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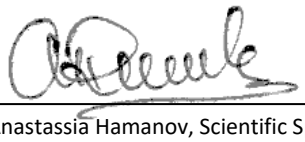
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Laboratories
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CHAIN OF CUSTODY RECORD

Page 1 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:	Bottle Order #: 831949
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:			
Address:	210 Sheldon Drive Cambridge ON N1T 1A8	Address:		Project:	19129150 (2300)	COC #: C#831949-02-01	Project Manager: Ema Gitej
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:			
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ☐ PWQO ☐ Reg 406 Table ☐ Other

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): (Metals) Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4	# of Bottles	Comments
1	MW20-19A		06/23/21	15:30	GW	X	X		4	
2	MW20-19B			15:45		X	X	X	8	
3	MW20-28A			12-		X	X		4	
4	MW20-28B			12:30		X	X	X	8	
5	DUP2			—		X	X	X	8	
6	MW20-20A		16/06/21			X	X		4	
7	MW20-20B		16/06/21			X	X	X	8	
8	MW20-20C		17/06/21			X	X		4	
9	MW20-09			9:30		X	X	X	8	
10	DUP3			—		X	X	X	8	

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

24-Jun-21 08:00
Ema Gitej
C1H4635
SYK ENV-796

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Diana Steckle / C Steckle	21/06/23			21/06/24	08:00	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	1 / 1 / 1 °C	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Page 2 of 2

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvlabs.com

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:	
Address:	210 Sheldon Drive	Address:		Project:	19129150 (2300)
	Cambridge ON N1T 1A8			Project Name:	
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Site #:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Sampled By:	

Laboratory Use Only:

BV Labs Job #:	Bottle Order #:
	831949
COC #:	Project Manager:
C#831949-05-01	Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1	MW20-22A		06/23/21	16:30	GW	X	X									4	
2	MW20-22B		06/23/21	18:30	GW	X	X	X								8	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
[signature] / C Steckle	21/06/23		see page 1			

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
		Present		
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

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** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

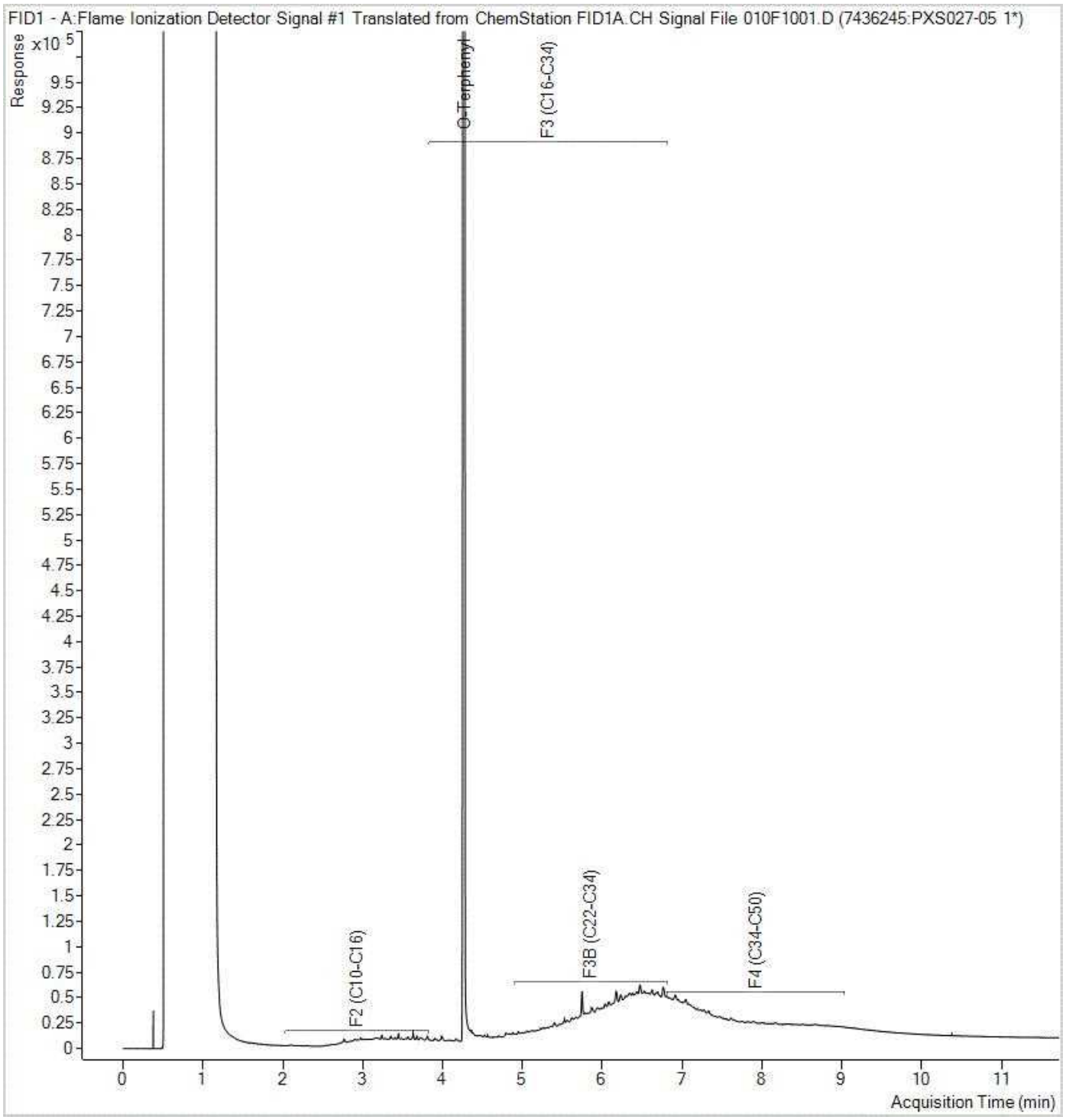
White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C1H4635
Report Date: 2021/07/02
BV Labs Sample: PXS027

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-19B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

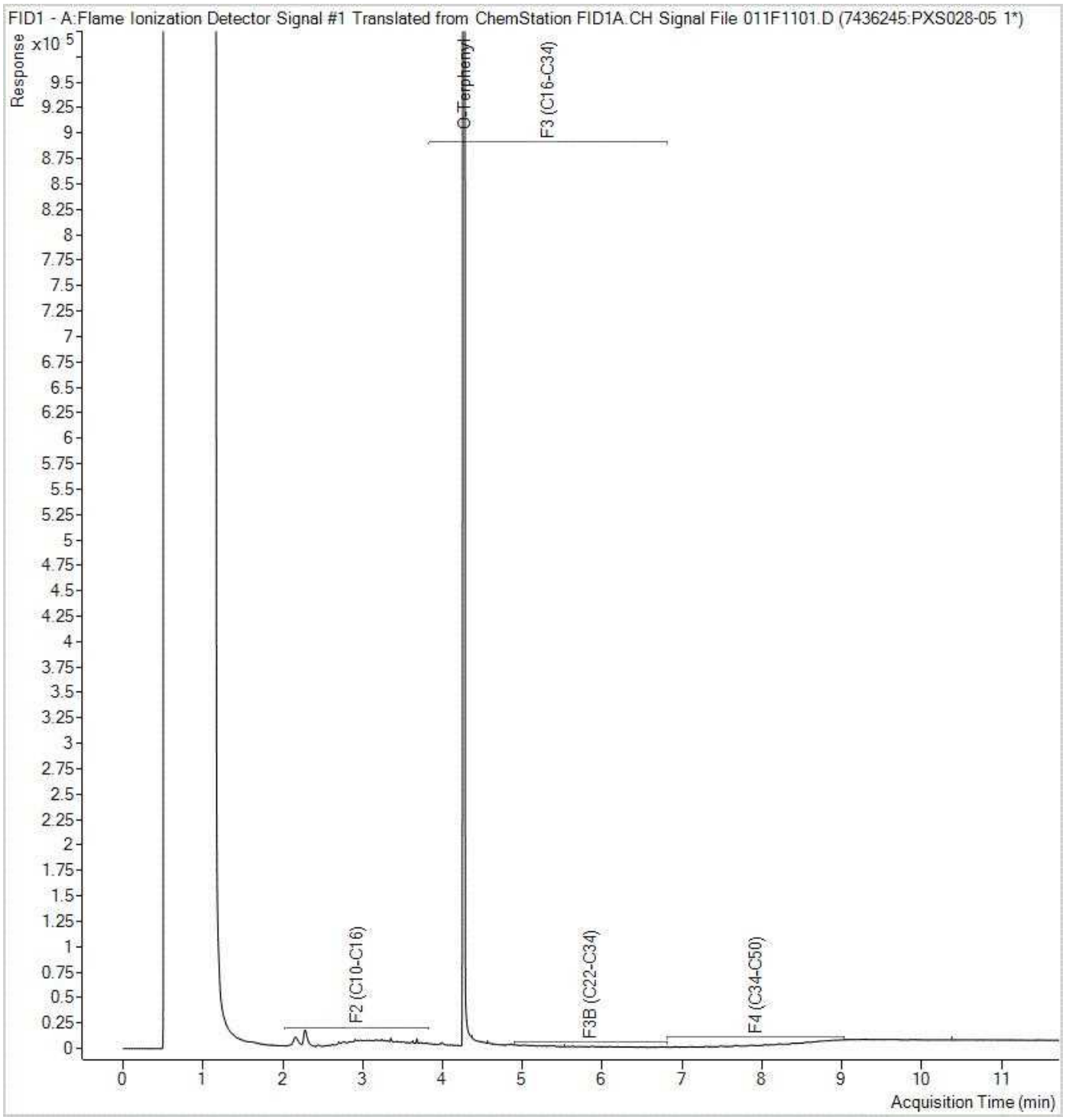


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H4635
Report Date: 2021/07/02
BV Labs Sample: PXS028

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP2

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

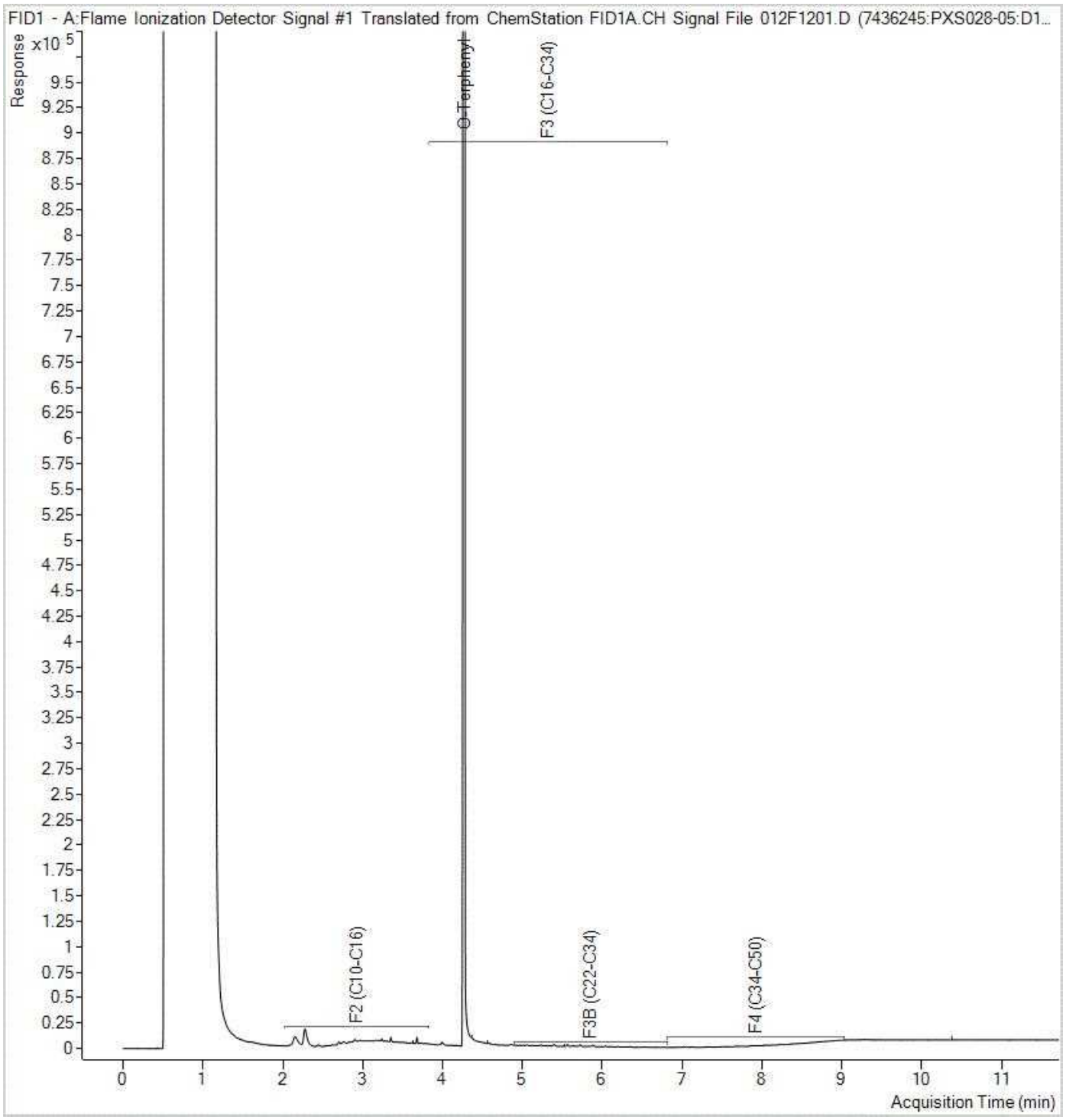


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H4635
Report Date: 2021/07/02
BV Labs Sample: PXS028 Lab-Dup

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP2

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

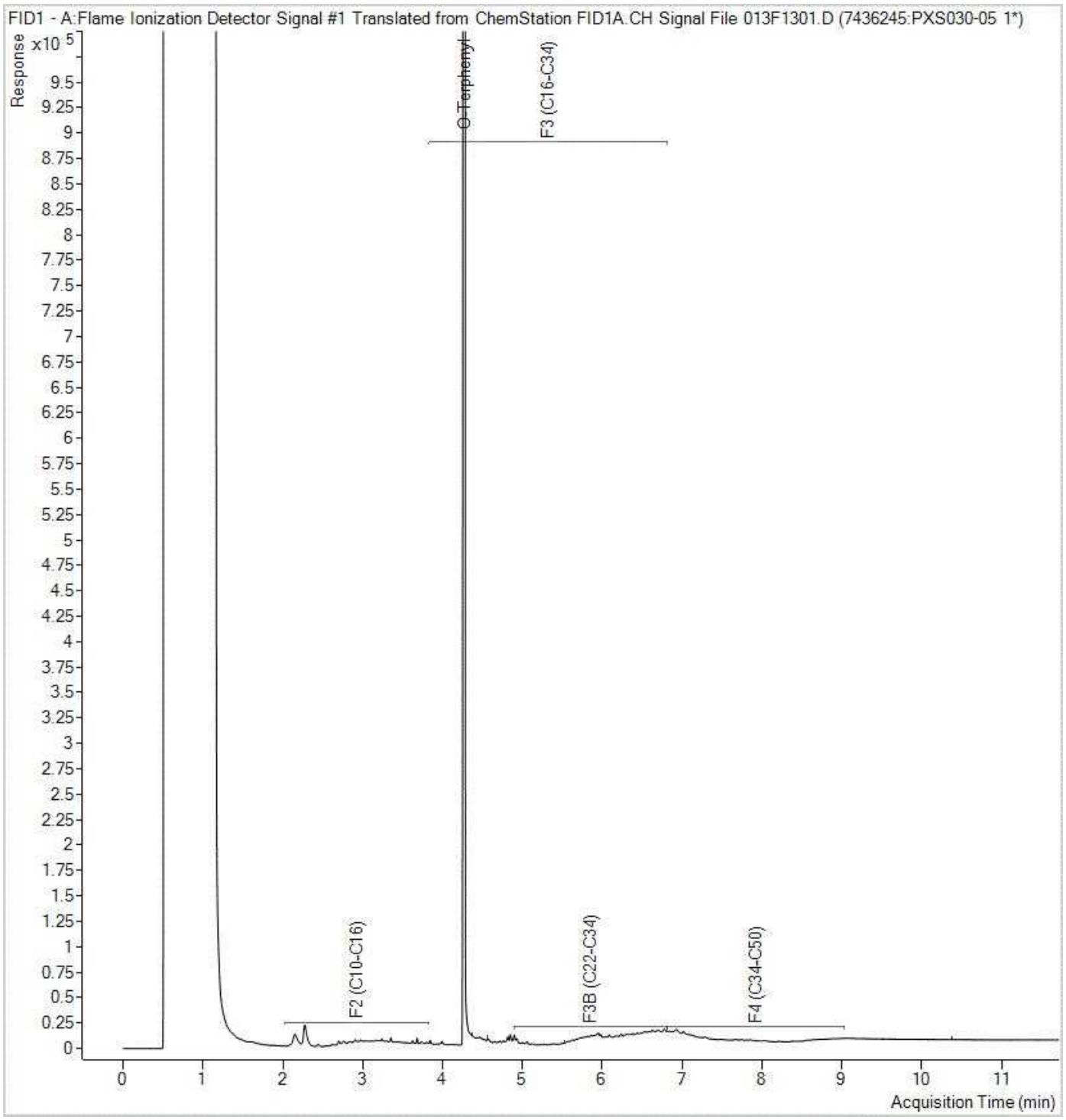


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H4635
Report Date: 2021/07/02
BV Labs Sample: PXS030

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-20B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

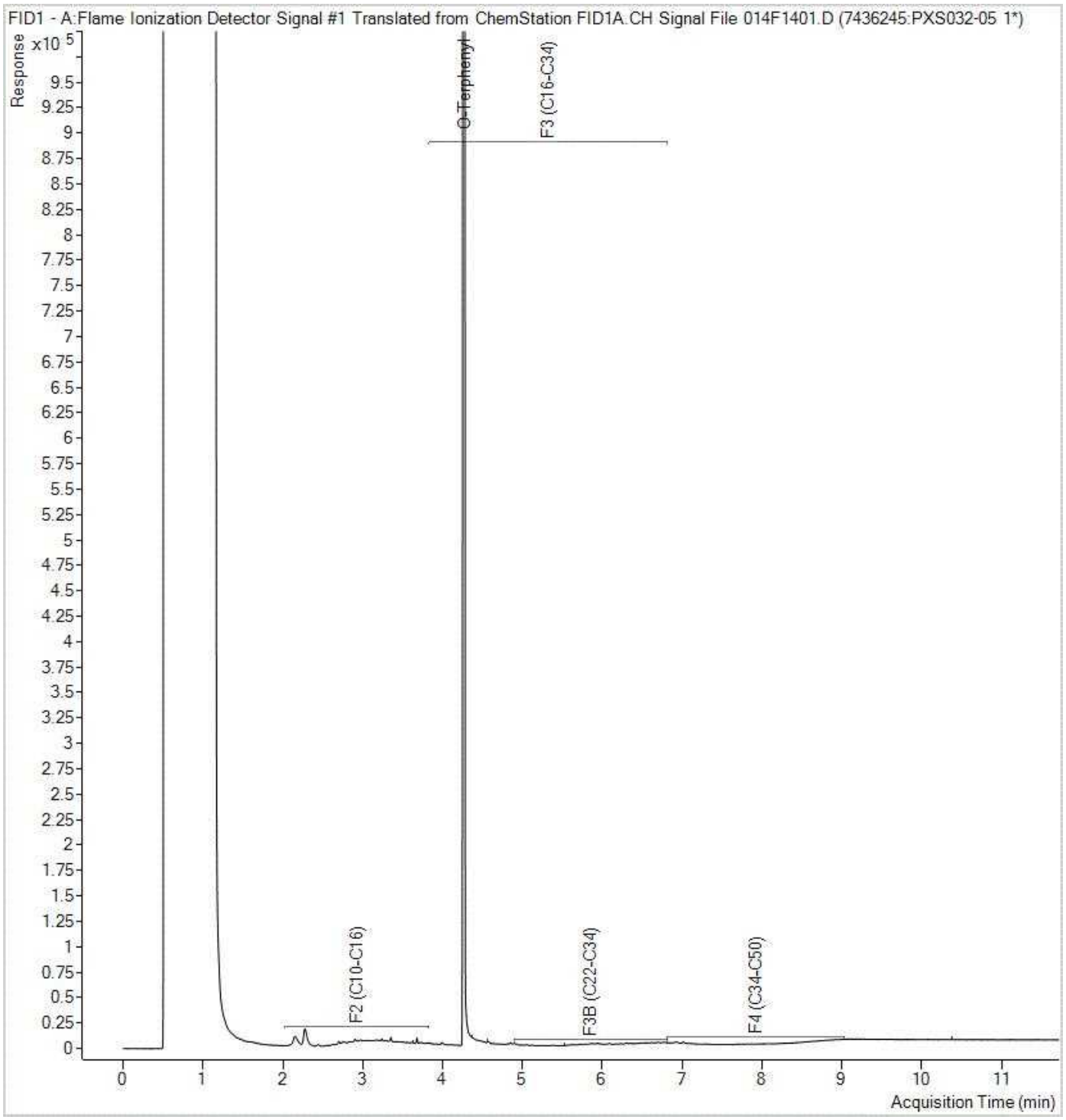


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H4635
Report Date: 2021/07/02
BV Labs Sample: PXS032

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-09

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

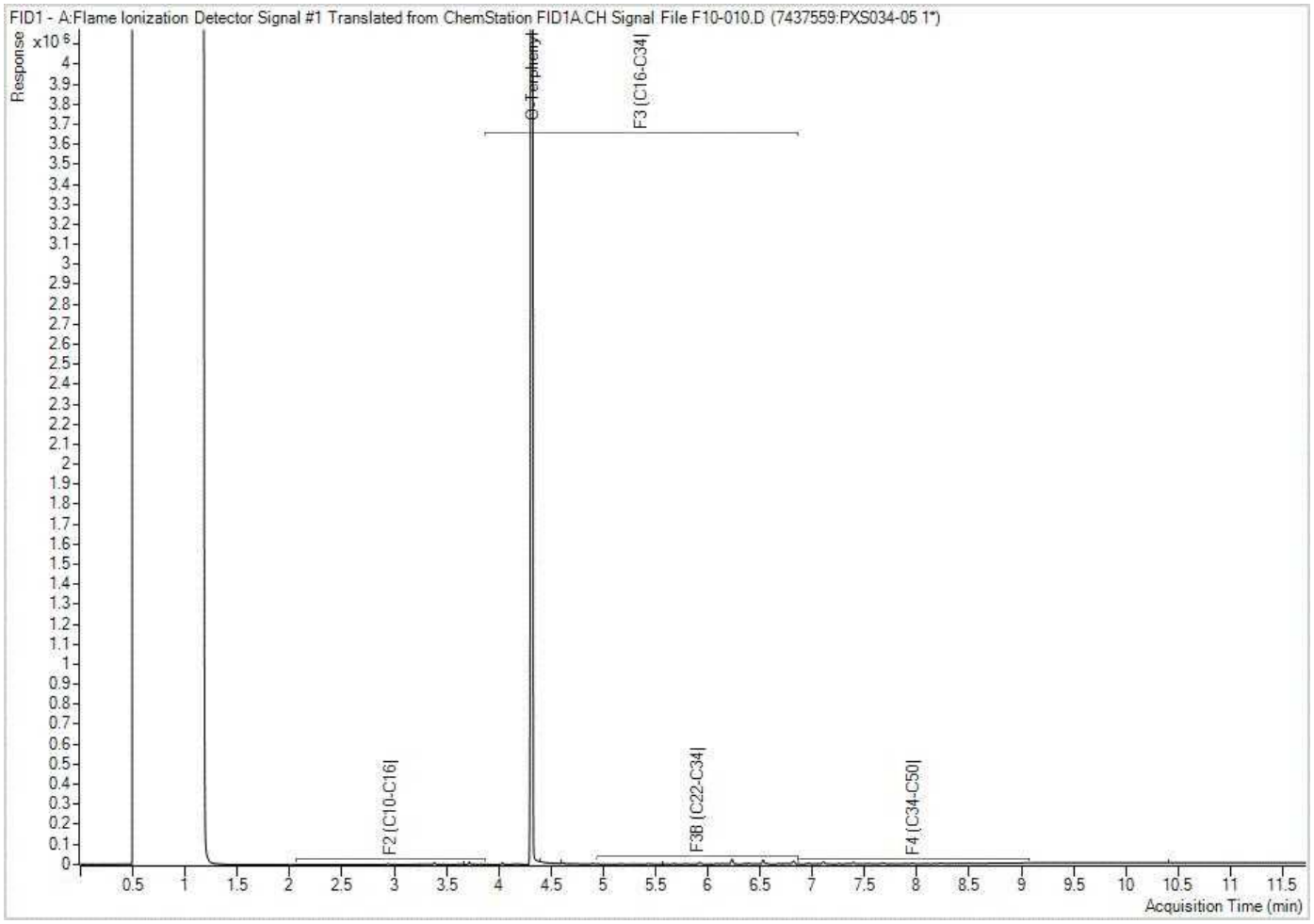


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H4635
Report Date: 2021/07/02
BV Labs Sample: PXS034

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-22B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-06-01, 831949-07-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/12
Report #: R6715096
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H5980
Received: 2021/06/25, 12:50

Sample Matrix: Water
Samples Received: 19

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	19	N/A	2021/07/01	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	19	N/A	2021/07/02	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	19	N/A	2021/07/02	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	19	N/A	2021/07/02	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	10	N/A	2021/06/30	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	9	N/A	2021/07/01	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	10	N/A	2021/06/30	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	10	2021/06/29	2021/06/30	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	19	N/A	2021/07/02	CAM SOP 00102/00408/00447	SM 2340 B
Lab Filtered Metals by ICPMS	1	2021/07/09	2021/07/12	CAM SOP-00447	EPA 6020B m
Dissolved Metals by ICPMS	18	N/A	2021/06/30	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	19	N/A	2021/07/02		
Anion and Cation Sum	19	N/A	2021/07/02		
Total Ammonia-N	7	N/A	2021/06/30	CAM SOP-00441	USGS I-2522-90 m
Total Ammonia-N	12	N/A	2021/07/02	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	17	N/A	2021/06/30	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (3)	2	N/A	2021/07/02	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	19	2021/06/30	2021/07/01	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	19	N/A	2021/07/05	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	19	N/A	2021/07/02		Auto Calc
Sat. pH and Langelier Index (@ 4C)	19	N/A	2021/07/02		Auto Calc
Sulphate by Automated Colourimetry	19	N/A	2021/07/02	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	19	N/A	2021/07/02		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-06-01, 831949-07-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/12
Report #: R6715096
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H5980
Received: 2021/06/25, 12:50

reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY679		PXY680			PXY680		
Sampling Date		2021/06/24 15:45		2021/06/24 16:30			2021/06/24 16:30		
COC Number		831949-06-01		831949-06-01			831949-06-01		
	UNITS	MW20-13A	QC Batch	MW20-13B	RDL	QC Batch	MW20-13B Lab-Dup	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	4.60	7433941	4.56	N/A	7433941			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	190	7433456	190	1.0	7433456			
Calculated TDS	mg/L	240	7433944	240	1.0	7433944			
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.7	7433456	3.6	1.0	7433456			
Cation Sum	me/L	4.45	7433941	4.54	N/A	7433941			
Hardness (CaCO3)	mg/L	200	7433195	200	1.0	7433195			
Ion Balance (% Difference)	%	1.66	7433940	0.250	N/A	7433940			
Langelier Index (@ 20C)	N/A	0.693	7433942	0.806		7433942			
Langelier Index (@ 4C)	N/A	0.444	7433943	0.556		7433943			
Saturation pH (@ 20C)	N/A	7.49	7433942	7.50		7433942			
Saturation pH (@ 4C)	N/A	7.74	7433943	7.75		7433943			
Inorganics									
Total Ammonia-N	mg/L	0.21	7436363	<0.050	0.050	7436363			
Conductivity	umho/cm	410	7438013	410	1.0	7438013			
Dissolved Organic Carbon	mg/L	<0.40	7438054	<0.40	0.40	7437920			
Orthophosphate (P)	mg/L	<0.010	7437991	<0.010	0.010	7437991			
pH	pH	8.18	7438016	8.30		7438016			
Dissolved Sulphate (SO4)	mg/L	37	7437990	31	1.0	7437990			
Alkalinity (Total as CaCO3)	mg/L	190	7438011	190	1.0	7438011			
Dissolved Chloride (Cl-)	mg/L	1.4	7437986	1.1	1.0	7437986			
Nitrite (N)	mg/L	<0.010	7437970	<0.010	0.010	7437970	<0.010	0.010	7437970
Nitrate (N)	mg/L	<0.10	7437970	<0.10	0.10	7437970	<0.10	0.10	7437970
Nitrate + Nitrite (N)	mg/L	<0.10	7437970	<0.10	0.10	7437970	<0.10	0.10	7437970
Metals									
Dissolved Aluminum (Al)	ug/L	12	7437678	5.9	4.9	7437678			
Dissolved Antimony (Sb)	ug/L	<0.50	7437678	<0.50	0.50	7437678			
Dissolved Arsenic (As)	ug/L	2.7	7437678	2.6	1.0	7437678			
Dissolved Barium (Ba)	ug/L	43	7437678	57	2.0	7437678			
Dissolved Beryllium (Be)	ug/L	<0.40	7437678	<0.40	0.40	7437678			
Dissolved Boron (B)	ug/L	67	7437678	56	10	7437678			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY679		PXY680			PXY680		
Sampling Date		2021/06/24 15:45		2021/06/24 16:30			2021/06/24 16:30		
COC Number		831949-06-01		831949-06-01			831949-06-01		
	UNITS	MW20-13A	QC Batch	MW20-13B	RDL	QC Batch	MW20-13B Lab-Dup	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	7437678	<0.090	0.090	7437678			
Dissolved Calcium (Ca)	ug/L	43000	7437678	41000	200	7437678			
Dissolved Chromium (Cr)	ug/L	<5.0	7437678	<5.0	5.0	7437678			
Dissolved Cobalt (Co)	ug/L	<0.50	7437678	<0.50	0.50	7437678			
Dissolved Copper (Cu)	ug/L	2.1	7437678	<0.90	0.90	7437678			
Dissolved Iron (Fe)	ug/L	<100	7437678	110	100	7437678			
Dissolved Lead (Pb)	ug/L	<0.50	7437678	<0.50	0.50	7437678			
Dissolved Magnesium (Mg)	ug/L	22000	7437678	25000	50	7437678			
Dissolved Manganese (Mn)	ug/L	31	7437678	21	2.0	7437678			
Dissolved Molybdenum (Mo)	ug/L	2.8	7437678	2.5	0.50	7437678			
Dissolved Nickel (Ni)	ug/L	<1.0	7437678	<1.0	1.0	7437678			
Dissolved Phosphorus (P)	ug/L	<100	7437678	<100	100	7437678			
Dissolved Potassium (K)	ug/L	2100	7437678	1700	200	7437678			
Dissolved Selenium (Se)	ug/L	<2.0	7437678	<2.0	2.0	7437678			
Dissolved Silicon (Si)	ug/L	6200	7437678	6400	50	7437678			
Dissolved Silver (Ag)	ug/L	<0.090	7437678	<0.090	0.090	7437678			
Dissolved Sodium (Na)	ug/L	10000	7437678	9700	100	7437678			
Dissolved Strontium (Sr)	ug/L	1700	7437678	960	1.0	7437678			
Dissolved Thallium (Tl)	ug/L	<0.050	7437678	<0.050	0.050	7437678			
Dissolved Titanium (Ti)	ug/L	<5.0	7437678	<5.0	5.0	7437678			
Dissolved Uranium (U)	ug/L	0.29	7437678	0.28	0.10	7437678			
Dissolved Vanadium (V)	ug/L	<0.50	7437678	<0.50	0.50	7437678			
Dissolved Zinc (Zn)	ug/L	<5.0	7437678	<5.0	5.0	7437678			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H5980
Report Date: 2021/07/12

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY681			PXY682		PXY683		
Sampling Date		2021/06/24 16:00			2021/06/24		2021/06/24 10:00		
COC Number		831949-06-01			831949-06-01		831949-06-01		
	UNITS	MW20-13C	RDL	QC Batch	DUP-4	QC Batch	MW20-10A	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	6.69	N/A	7433941	6.65	7433941	8.43	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	280	1.0	7433456	260	7433456	290	1.0	7433456
Calculated TDS	mg/L	340	1.0	7433944	350	7433944	460	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L	5.0	1.0	7433456	2.9	7433456	3.0	1.0	7433456
Cation Sum	me/L	6.72	N/A	7433941	6.74	7433941	8.45	N/A	7433941
Hardness (CaCO3)	mg/L	320	1.0	7433195	290	7433195	370	1.0	7433195
Ion Balance (% Difference)	%	0.160	N/A	7433940	0.660	7433940	0.0900	N/A	7433940
Langelier Index (@ 20C)	N/A	1.12		7433942	0.954	7433942	1.05		7433942
Langelier Index (@ 4C)	N/A	0.874		7433943	0.705	7433943	0.797		7433943
Saturation pH (@ 20C)	N/A	7.15		7433942	7.13	7433942	7.01		7433942
Saturation pH (@ 4C)	N/A	7.40		7433943	7.38	7433943	7.25		7433943
Inorganics									
Total Ammonia-N	mg/L	0.11	0.050	7436397	<0.050	7436397	0.081	0.050	7436397
Conductivity	umho/cm	580	1.0	7438013	590	7438013	720	1.0	7438013
Dissolved Organic Carbon	mg/L	1.3	0.40	7437920	0.63	7438054	0.80	0.40	7437920
Orthophosphate (P)	mg/L	<0.010	0.010	7437991	<0.010	7437991	<0.010	0.010	7437991
pH	pH	8.27		7438016	8.08	7438016	8.05		7438016
Dissolved Sulphate (SO4)	mg/L	33	1.0	7437990	13	7437990	22	1.0	7437990
Alkalinity (Total as CaCO3)	mg/L	290	1.0	7438011	260	7438011	290	1.0	7438011
Dissolved Chloride (Cl-)	mg/L	3.0	1.0	7437986	36	7437986	43	1.0	7437986
Nitrite (N)	mg/L	0.133	0.010	7437970	<0.010	7437970	0.013	0.010	7437970
Nitrate (N)	mg/L	1.76	0.10	7437970	2.42	7437970	13.0	0.10	7437970
Nitrate + Nitrite (N)	mg/L	1.89	0.10	7437970	2.42	7437970	13.0	0.10	7437970
Metals									
Dissolved Aluminum (Al)	ug/L				<4.9	7437678	150	4.9	7437678
Dissolved Antimony (Sb)	ug/L				<0.50	7437678	<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L				<1.0	7437678	1.4	1.0	7437678
Dissolved Barium (Ba)	ug/L				29	7437678	46	2.0	7437678
Dissolved Beryllium (Be)	ug/L				<0.40	7437678	<0.40	0.40	7437678
Dissolved Boron (B)	ug/L				<10	7437678	11	10	7437678
Dissolved Cadmium (Cd)	ug/L				<0.090	7437678	<0.090	0.090	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY681			PXY682		PXY683		
Sampling Date		2021/06/24 16:00			2021/06/24		2021/06/24 10:00		
COC Number		831949-06-01			831949-06-01		831949-06-01		
	UNITS	MW20-13C	RDL	QC Batch	DUP-4	QC Batch	MW20-10A	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L				78000	7437678	98000	200	7437678
Dissolved Chromium (Cr)	ug/L				<5.0	7437678	<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L				<0.50	7437678	<0.50	0.50	7437678
Dissolved Copper (Cu)	ug/L				<0.90	7437678	1.2	0.90	7437678
Dissolved Iron (Fe)	ug/L				<100	7437678	240	100	7437678
Dissolved Lead (Pb)	ug/L				<0.50	7437678	1.2	0.50	7437678
Dissolved Magnesium (Mg)	ug/L				24000	7437678	30000	50	7437678
Dissolved Manganese (Mn)	ug/L				7.2	7437678	17	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L				<0.50	7437678	0.64	0.50	7437678
Dissolved Nickel (Ni)	ug/L				<1.0	7437678	<1.0	1.0	7437678
Dissolved Phosphorus (P)	ug/L				<100	7437678	<100	100	7437678
Dissolved Potassium (K)	ug/L				1700	7437678	1200	200	7437678
Dissolved Selenium (Se)	ug/L				<2.0	7437678	<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L				3900	7437678	4800	50	7437678
Dissolved Silver (Ag)	ug/L				<0.090	7437678	<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L				19000	7437678	25000	100	7437678
Dissolved Strontium (Sr)	ug/L				110	7437678	960	1.0	7437678
Dissolved Thallium (Tl)	ug/L				<0.050	7437678	<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L				<5.0	7437678	7.0	5.0	7437678
Dissolved Uranium (U)	ug/L				0.23	7437678	0.98	0.10	7437678
Dissolved Vanadium (V)	ug/L				<0.50	7437678	<0.50	0.50	7437678
Dissolved Zinc (Zn)	ug/L				<5.0	7437678	<5.0	5.0	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY684			PXY684			PXY685		
Sampling Date		2021/06/24 10:30			2021/06/24 10:30			2021/06/24 12:45		
COC Number		831949-06-01			831949-06-01			831949-06-01		
	UNITS	MW20-10B	RDL	QC Batch	MW20-10B Lab-Dup	RDL	QC Batch	MW20-11A	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	8.14	N/A	7433941				6.95	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	280	1.0	7433456				250	1.0	7433456
Calculated TDS	mg/L	450	1.0	7433944				370	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.7	1.0	7433456				4.7	1.0	7433456
Cation Sum	me/L	8.41	N/A	7433941				6.91	N/A	7433941
Hardness (CaCO3)	mg/L	370	1.0	7433195				230	1.0	7433195
Ion Balance (% Difference)	%	1.64	N/A	7433940				0.290	N/A	7433940
Langelier Index (@ 20C)	N/A	0.994		7433942				0.959		7433942
Langelier Index (@ 4C)	N/A	0.746		7433943				0.710		7433943
Saturation pH (@ 20C)	N/A	7.02		7433942				7.34		7433942
Saturation pH (@ 4C)	N/A	7.26		7433943				7.59		7433943
Inorganics										
Total Ammonia-N	mg/L	<0.050	0.050	7436363				0.081	0.050	7436363
Conductivity	umho/cm	670	1.0	7438013	670	1.0	7438013	670	1.0	7438013
Dissolved Organic Carbon	mg/L	0.69	0.40	7437920				0.61	0.40	7438054
Orthophosphate (P)	mg/L	<0.010	0.010	7437991				<0.010	0.010	7437991
pH	pH	8.01		7438016	8.04		7438016	8.30		7438016
Dissolved Sulphate (SO4)	mg/L	18	1.0	7437990				42	1.0	7437990
Alkalinity (Total as CaCO3)	mg/L	280	1.0	7438011	290	1.0	7438011	250	1.0	7438011
Dissolved Chloride (Cl-)	mg/L	44	1.0	7437986				35	1.0	7437986
Nitrite (N)	mg/L	<0.010	0.010	7437970				0.013	0.010	7437970
Nitrate (N)	mg/L	13.1	0.10	7437970				0.18	0.10	7437970
Nitrate + Nitrite (N)	mg/L	13.1	0.10	7437970				0.19	0.10	7437970
Metals										
Dissolved Aluminum (Al)	ug/L	7.8	4.9	7437678				28	4.9	7437678
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7437678				<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L	<1.0	1.0	7437678				5.9	1.0	7437678
Dissolved Barium (Ba)	ug/L	25	2.0	7437678				96	2.0	7437678
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7437678				<0.40	0.40	7437678
Dissolved Boron (B)	ug/L	10	10	7437678				46	10	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY684			PXY684			PXY685		
Sampling Date		2021/06/24 10:30			2021/06/24 10:30			2021/06/24 12:45		
COC Number		831949-06-01			831949-06-01			831949-06-01		
	UNITS	MW20-10B	RDL	QC Batch	MW20-10B Lab-Dup	RDL	QC Batch	MW20-11A	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7437678				<0.090	0.090	7437678
Dissolved Calcium (Ca)	ug/L	99000	200	7437678				49000	200	7437678
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7437678				<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7437678				0.63	0.50	7437678
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7437678				<0.90	0.90	7437678
Dissolved Iron (Fe)	ug/L	<100	100	7437678				<100	100	7437678
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7437678				<0.50	0.50	7437678
Dissolved Magnesium (Mg)	ug/L	29000	50	7437678				26000	50	7437678
Dissolved Manganese (Mn)	ug/L	<2.0	2.0	7437678				180	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L	<0.50	0.50	7437678				15	0.50	7437678
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7437678				4.3	1.0	7437678
Dissolved Phosphorus (P)	ug/L	<100	100	7437678				<100	100	7437678
Dissolved Potassium (K)	ug/L	1100	200	7437678				1600	200	7437678
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7437678				<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L	4700	50	7437678				4300	50	7437678
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7437678				<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L	24000	100	7437678				51000	100	7437678
Dissolved Strontium (Sr)	ug/L	150	1.0	7437678				1100	1.0	7437678
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7437678				<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7437678				<5.0	5.0	7437678
Dissolved Uranium (U)	ug/L	0.14	0.10	7437678				3.9	0.10	7437678
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7437678				0.77	0.50	7437678
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7437678				<5.0	5.0	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY686			PXY687	PXY688	PXY888		
Sampling Date		2021/06/24 13:15			2021/06/24 15:45	2021/06/24 16:15	2021/06/23 12:00		
COC Number		831949-06-01			831949-06-01	831949-06-01	831949-07-01		
	UNITS	MW20-11B	RDL	QC Batch	MW20-12A	MW20-12B	MW20-28A	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	18.3	N/A	7433941	6.36	6.65	4.78	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	380	1.0	7433456	260	260	200	1.0	7433456
Calculated TDS	mg/L	1000	1.0	7433944	340	350	250	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.6	1.0	7433456	2.9	2.9	3.4	1.0	7433456
Cation Sum	me/L	19.2	N/A	7433941	6.36	6.78	4.66	N/A	7433941
Hardness (CaCO3)	mg/L	430	1.0	7433195	300	300	220	1.0	7433195
Ion Balance (% Difference)	%	2.27	N/A	7433940	0.0300	0.920	1.31	N/A	7433940
Langelier Index (@ 20C)	N/A	1.11		7433942	0.942	0.960	0.853		7433942
Langelier Index (@ 4C)	N/A	0.868		7433943	0.693	0.712	0.604		7433943
Saturation pH (@ 20C)	N/A	6.89		7433942	7.14	7.11	7.39		7433942
Saturation pH (@ 4C)	N/A	7.14		7433943	7.39	7.36	7.64		7433943
Inorganics									
Total Ammonia-N	mg/L	<0.050	0.050	7436397	<0.050	<0.050	<0.050	0.050	7436363
Conductivity	umho/cm	1800	1.0	7438013	550	600	450	1.0	7438013
Dissolved Organic Carbon	mg/L	1.0	0.40	7438054	<0.40	0.68	<0.40	0.40	7437920
Orthophosphate (P)	mg/L	<0.010	0.010	7437991	<0.010	<0.010	<0.010	0.010	7437991
pH	pH	8.01		7438016	8.08	8.07	8.25		7438016
Dissolved Sulphate (SO4)	mg/L	37	1.0	7437990	26	13	29	1.0	7437990
Alkalinity (Total as CaCO3)	mg/L	380	1.0	7438011	260	260	210	1.0	7438011
Dissolved Chloride (Cl-)	mg/L	350	5.0	7437986	7.4	35	1.0	1.0	7437986
Nitrite (N)	mg/L	<0.010	0.010	7437970	<0.010	<0.010	<0.010	0.010	7437970
Nitrate (N)	mg/L	2.73	0.10	7437970	4.91	2.45	<0.10	0.10	7437970
Nitrate + Nitrite (N)	mg/L	2.73	0.10	7437970	4.91	2.45	<0.10	0.10	7437970
Metals									
Dissolved Aluminum (Al)	ug/L	520	4.9	7437678	<4.9	6.1	20	4.9	7437678
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7437678	<0.50	<0.50	<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L	<1.0	1.0	7437678	<1.0	<1.0	<1.0	1.0	7437678
Dissolved Barium (Ba)	ug/L	61	2.0	7437678	52	30	12	2.0	7437678
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7437678	<0.40	<0.40	<0.40	0.40	7437678
Dissolved Boron (B)	ug/L	15	10	7437678	12	<10	23	10	7437678
Dissolved Cadmium (Cd)	ug/L	0.25	0.090	7437678	<0.090	<0.090	<0.090	0.090	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H5980
Report Date: 2021/07/12

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY686			PXY687	PXY688	PXY888		
Sampling Date		2021/06/24 13:15			2021/06/24 15:45	2021/06/24 16:15	2021/06/23 12:00		
COC Number		831949-06-01			831949-06-01	831949-06-01	831949-07-01		
	UNITS	MW20-11B	RDL	QC Batch	MW20-12A	MW20-12B	MW20-28A	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	120000	200	7437678	74000	80000	49000	200	7437678
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7437678	<5.0	<5.0	<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L	1.2	0.50	7437678	<0.50	<0.50	<0.50	0.50	7437678
Dissolved Copper (Cu)	ug/L	5.3	0.90	7437678	<0.90	<0.90	<0.90	0.90	7437678
Dissolved Iron (Fe)	ug/L	590	100	7437678	<100	<100	<100	100	7437678
Dissolved Lead (Pb)	ug/L	5.2	0.50	7437678	<0.50	<0.50	<0.50	0.50	7437678
Dissolved Magnesium (Mg)	ug/L	33000	50	7437678	28000	23000	23000	50	7437678
Dissolved Manganese (Mn)	ug/L	370	2.0	7437678	16	7.4	93	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L	<0.50	0.50	7437678	0.77	<0.50	2.4	0.50	7437678
Dissolved Nickel (Ni)	ug/L	4.2	1.0	7437678	<1.0	<1.0	<1.0	1.0	7437678
Dissolved Phosphorus (P)	ug/L	<100	100	7437678	<100	<100	<100	100	7437678
Dissolved Potassium (K)	ug/L	1300	200	7437678	3400	1600	1300	200	7437678
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7437678	<2.0	<2.0	<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L	5200	50	7437678	4800	4000	6300	50	7437678
Dissolved Silver (Ag)	ug/L	0.19	0.090	7437678	<0.090	<0.090	<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L	240000	100	7437678	6200	19000	5700	100	7437678
Dissolved Strontium (Sr)	ug/L	200	1.0	7437678	330	110	460	1.0	7437678
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7437678	<0.050	<0.050	<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L	16	5.0	7437678	<5.0	<5.0	<5.0	5.0	7437678
Dissolved Uranium (U)	ug/L	1.1	0.10	7437678	0.47	0.24	0.38	0.10	7437678
Dissolved Vanadium (V)	ug/L	0.87	0.50	7437678	<0.50	<0.50	<0.50	0.50	7437678
Dissolved Zinc (Zn)	ug/L	29	5.0	7437678	<5.0	<5.0	5.4	5.0	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H5980
Report Date: 2021/07/12

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY888			PXY889			PXY890		
Sampling Date		2021/06/23 12:00			2021/06/23 12:30			2021/06/24 10:30		
COC Number		831949-07-01			831949-07-01			831949-07-01		
	UNITS	MW20-28A Lab-Dup	RDL	QC Batch	MW20-28B	RDL	QC Batch	MW20-27A	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L				4.78	N/A	7433941	22.8	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				200	1.0	7433456	190	1.0	7433456
Calculated TDS	mg/L				250	1.0	7433944	1500	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L				3.1	1.0	7433456	1.8	1.0	7433456
Cation Sum	me/L				4.67	N/A	7433941	22.3	N/A	7433941
Hardness (CaCO3)	mg/L				220	1.0	7433195	1100	1.0	7433195
Ion Balance (% Difference)	%				1.20	N/A	7433940	1.09	N/A	7433940
Langelier Index (@ 20C)	N/A				0.824		7433942	1.24		7433942
Langelier Index (@ 4C)	N/A				0.575		7433943	0.991		7433943
Saturation pH (@ 20C)	N/A				7.39		7433942	6.77		7433942
Saturation pH (@ 4C)	N/A				7.64		7433943	7.02		7433943
Inorganics										
Total Ammonia-N	mg/L				0.051	0.050	7436363	0.081	0.050	7436397
Conductivity	umho/cm				430	1.0	7438013	1800	1.0	7438013
Dissolved Organic Carbon	mg/L	<0.40	0.40	7437920	<0.40	0.40	7438054	0.68	0.40	7438054
Orthophosphate (P)	mg/L				<0.010	0.010	7437991	<0.010	0.010	7437991
pH	pH				8.21		7438016	8.01		7438016
Dissolved Sulphate (SO4)	mg/L				29	1.0	7437990	910	5.0	7437990
Alkalinity (Total as CaCO3)	mg/L				210	1.0	7438011	190	1.0	7438011
Dissolved Chloride (Cl-)	mg/L				1.0	1.0	7437986	2.1	1.0	7437986
Nitrite (N)	mg/L				<0.010	0.010	7437970	<0.010	0.010	7437970
Nitrate (N)	mg/L				<0.10	0.10	7437970	<0.10	0.10	7437970
Nitrate + Nitrite (N)	mg/L				<0.10	0.10	7437970	<0.10	0.10	7437970
Metals										
Dissolved Aluminum (Al)	ug/L				5.8	4.9	7437678	<4.9	4.9	7437678
Dissolved Antimony (Sb)	ug/L				<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L				<1.0	1.0	7437678	5.4	1.0	7437678
Dissolved Barium (Ba)	ug/L				11	2.0	7437678	18	2.0	7437678
Dissolved Beryllium (Be)	ug/L				<0.40	0.40	7437678	<0.40	0.40	7437678
Dissolved Boron (B)	ug/L				22	10	7437678	42	10	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H5980
Report Date: 2021/07/12

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY888			PXY889			PXY890		
Sampling Date		2021/06/23 12:00			2021/06/23 12:30			2021/06/24 10:30		
COC Number		831949-07-01			831949-07-01			831949-07-01		
	UNITS	MW20-28A Lab-Dup	RDL	QC Batch	MW20-28B	RDL	QC Batch	MW20-27A	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L				<0.090	0.090	7437678	<0.090	0.090	7437678
Dissolved Calcium (Ca)	ug/L				50000	200	7437678	360000	400	7437678
Dissolved Chromium (Cr)	ug/L				<5.0	5.0	7437678	<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L				<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Copper (Cu)	ug/L				1.6	0.90	7437678	<0.90	0.90	7437678
Dissolved Iron (Fe)	ug/L				<100	100	7437678	690	100	7437678
Dissolved Lead (Pb)	ug/L				<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Magnesium (Mg)	ug/L				23000	50	7437678	49000	50	7437678
Dissolved Manganese (Mn)	ug/L				98	2.0	7437678	34	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L				1.9	0.50	7437678	3.0	0.50	7437678
Dissolved Nickel (Ni)	ug/L				<1.0	1.0	7437678	<1.0	1.0	7437678
Dissolved Phosphorus (P)	ug/L				<100	100	7437678	<100	100	7437678
Dissolved Potassium (K)	ug/L				1200	200	7437678	1700	200	7437678
Dissolved Selenium (Se)	ug/L				<2.0	2.0	7437678	<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L				6600	50	7437678	5500	50	7437678
Dissolved Silver (Ag)	ug/L				<0.090	0.090	7437678	<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L				6000	100	7437678	10000	100	7437678
Dissolved Strontium (Sr)	ug/L				420	1.0	7437678	9800	1.0	7437678
Dissolved Thallium (Tl)	ug/L				<0.050	0.050	7437678	<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L				<5.0	5.0	7437678	<5.0	5.0	7437678
Dissolved Uranium (U)	ug/L				0.44	0.10	7437678	0.47	0.10	7437678
Dissolved Vanadium (V)	ug/L				<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Zinc (Zn)	ug/L				11	5.0	7437678	<5.0	5.0	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY890			PXY891			PXY892		
Sampling Date		2021/06/24 10:30			2021/06/24 14:30			2021/06/24 17:00		
COC Number		831949-07-01			831949-07-01			831949-07-01		
	UNITS	MW20-27A Lab-Dup	RDL	QC Batch	MW20-27B	RDL	QC Batch	MW20-26A	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L				8.56	N/A	7433941	22.9	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				210	1.0	7433456	180	1.0	7433456
Calculated TDS	mg/L				490	1.0	7433944	1500	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L				2.6	1.0	7433456	1.4	1.0	7433456
Cation Sum	me/L				8.18	N/A	7433941	23.0	N/A	7433941
Hardness (CaCO3)	mg/L				370	1.0	7433195	1100	1.0	7433195
Ion Balance (% Difference)	%				2.27	N/A	7433940	0.160	N/A	7433940
Langelier Index (@ 20C)	N/A				0.956		7433942	1.10		7433942
Langelier Index (@ 4C)	N/A				0.708		7433943	0.850		7433943
Saturation pH (@ 20C)	N/A				7.17		7433942	6.84		7433942
Saturation pH (@ 4C)	N/A				7.42		7433943	7.08		7433943
Inorganics										
Total Ammonia-N	mg/L	0.066	0.050	7436397	0.10	0.050	7436363	0.090	0.050	7436363
Conductivity	umho/cm				750	1.0	7438013	1900	1.0	7438013
Dissolved Organic Carbon	mg/L				0.66	0.40	7437920	1.7	0.40	7438054
Orthophosphate (P)	mg/L	<0.010	0.010	7437991	<0.010	0.010	7437991	<0.010	0.010	7437991
pH	pH				8.13		7438016	7.93		7438016
Dissolved Sulphate (SO4)	mg/L	940	5.0	7437990	200	1.0	7437990	920	5.0	7437990
Alkalinity (Total as CaCO3)	mg/L				210	1.0	7438011	180	1.0	7438011
Dissolved Chloride (Cl-)	mg/L	1.9	1.0	7437986	6.2	1.0	7437986	8.0	1.0	7437986
Nitrite (N)	mg/L				<0.010	0.010	7437970	<0.010	0.010	7437970
Nitrate (N)	mg/L				<0.10	0.10	7437970	<0.10	0.10	7437970
Nitrate + Nitrite (N)	mg/L				<0.10	0.10	7437970	<0.10	0.10	7437970
Metals										
Dissolved Aluminum (Al)	ug/L	<4.9	4.9	7437678	<4.9	4.9	7437678	14	4.9	7437678
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L	5.4	1.0	7437678	1.9	1.0	7437678	8.7	1.0	7437678
Dissolved Barium (Ba)	ug/L	18	2.0	7437678	26	2.0	7437678	12	2.0	7437678
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7437678	<0.40	0.40	7437678	<0.40	0.40	7437678
Dissolved Boron (B)	ug/L	44	10	7437678	24	10	7437678	53	10	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY890			PXY891			PXY892		
Sampling Date		2021/06/24 10:30			2021/06/24 14:30			2021/06/24 17:00		
COC Number		831949-07-01			831949-07-01			831949-07-01		
	UNITS	MW20-27A Lab-Dup	RDL	QC Batch	MW20-27B	RDL	QC Batch	MW20-26A	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7437678	<0.090	0.090	7437678	<0.090	0.090	7437678
Dissolved Calcium (Ca)	ug/L	360000	1000	7437678	93000	200	7437678	330000	400	7437678
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7437678	<5.0	5.0	7437678	<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7437678	<0.90	0.90	7437678	<0.90	0.90	7437678
Dissolved Iron (Fe)	ug/L	690	100	7437678	430	100	7437678	590	100	7437678
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Magnesium (Mg)	ug/L	50000	50	7437678	33000	50	7437678	70000	50	7437678
Dissolved Manganese (Mn)	ug/L	34	2.0	7437678	25	2.0	7437678	43	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L	3.0	0.50	7437678	11	0.50	7437678	8.6	0.50	7437678
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7437678	<1.0	1.0	7437678	<1.0	1.0	7437678
Dissolved Phosphorus (P)	ug/L	<100	100	7437678	<100	100	7437678	<100	100	7437678
Dissolved Potassium (K)	ug/L	1700	200	7437678	820	200	7437678	2300	200	7437678
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7437678	<2.0	2.0	7437678	<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L	5500	50	7437678	5500	50	7437678	5100	50	7437678
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7437678	<0.090	0.090	7437678	<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L	10000	100	7437678	18000	100	7437678	18000	100	7437678
Dissolved Strontium (Sr)	ug/L	10000	1.0	7437678	3000	1.0	7437678	5700	1.0	7437678
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7437678	<0.050	0.050	7437678	<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7437678	<5.0	5.0	7437678	<5.0	5.0	7437678
Dissolved Uranium (U)	ug/L	0.47	0.10	7437678	1.6	0.10	7437678	0.27	0.10	7437678
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7437678	<5.0	5.0	7437678	14	5.0	7437678

RDL = Reportable Detection Limit
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Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY893			PXY894			PXY895		
Sampling Date		2021/06/24 18:30			2021/06/24 17:15			2021/06/23		
COC Number		831949-07-01			831949-07-01			831949-07-01		
	UNITS	MW20-26B	RDL	QC Batch	MW20-26C	RDL	QC Batch	DUP-3	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	11.2	N/A	7433941	18.7	N/A	7433941	4.74	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	200	1.0	7433456	230	1.0	7433456	200	1.0	7433456
Calculated TDS	mg/L	680	1.0	7433944	1000	1.0	7433944	250	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.2	1.0	7433456	1.3	1.0	7433456	3.2	1.0	7433456
Cation Sum	me/L	11.6	N/A	7433941	18.7	N/A	7433941	4.67	N/A	7433941
Hardness (CaCO3)	mg/L	540	1.0	7433195	840	1.0	7433195	220	1.0	7433195
Ion Balance (% Difference)	%	1.84	N/A	7433940	0.110	N/A	7433940	0.820	N/A	7433940
Langelier Index (@ 20C)	N/A	1.04		7433942	0.936		7433942	0.833		7433942
Langelier Index (@ 4C)	N/A	0.788		7433943	0.690		7433943	0.583		7433943
Saturation pH (@ 20C)	N/A	7.03		7433942	6.86		7433942	7.39		7433942
Saturation pH (@ 4C)	N/A	7.28		7433943	7.11		7433943	7.64		7433943
Inorganics										
Total Ammonia-N	mg/L	<0.050	0.050	7436363	<0.050	0.050	7436363	0.053	0.050	7436397
Conductivity	umho/cm	1000	1.0	7438013	2000	1.0	7438013	430	1.0	7438013
Dissolved Organic Carbon	mg/L	1.4	0.40	7437920	<0.40	0.40	7438054	<0.40	0.40	7437920
Orthophosphate (P)	mg/L	<0.010	0.010	7437991	<0.010	0.010	7437991	<0.010	0.010	7437991
pH	pH	8.07		7438016	7.80		7438016	8.22		7438016
Dissolved Sulphate (SO4)	mg/L	340	2.0	7437990	24	1.0	7437990	29	1.0	7437990
Alkalinity (Total as CaCO3)	mg/L	200	1.0	7438011	230	1.0	7438011	210	1.0	7438011
Dissolved Chloride (Cl-)	mg/L	5.0	1.0	7437986	490	6.0	7437986	<1.0	1.0	7437986
Nitrite (N)	mg/L	<0.010	0.010	7437970	<0.010	0.010	7437970	<0.010	0.010	7437970
Nitrate (N)	mg/L	<0.10	0.10	7437970	0.12	0.10	7437970	<0.10	0.10	7437970
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7437970	0.12	0.10	7437970	<0.10	0.10	7437970
Metals										
Dissolved Aluminum (Al)	ug/L	7.6	4.9	7437678	6.9	4.9	7437678	7.8	4.9	7437678
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L	2.9	1.0	7437678	<1.0	1.0	7437678	<1.0	1.0	7437678
Dissolved Barium (Ba)	ug/L	20	2.0	7437678	110	2.0	7437678	10	2.0	7437678
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7437678	<0.40	0.40	7437678	<0.40	0.40	7437678
Dissolved Boron (B)	ug/L	30	10	7437678	<10	10	7437678	21	10	7437678
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7437678	<0.090	0.090	7437678	<0.090	0.090	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY893			PXY894			PXY895		
Sampling Date		2021/06/24 18:30			2021/06/24 17:15			2021/06/23		
COC Number		831949-07-01			831949-07-01			831949-07-01		
	UNITS	MW20-26B	RDL	QC Batch	MW20-26C	RDL	QC Batch	DUP-3	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	150000	200	7437678	210000	200	7437678	50000	200	7437678
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7437678	<5.0	5.0	7437678	<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7437678	1.0	0.90	7437678	<0.90	0.90	7437678
Dissolved Iron (Fe)	ug/L	150	100	7437678	<100	100	7437678	<100	100	7437678
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Magnesium (Mg)	ug/L	42000	50	7437678	74000	50	7437678	23000	50	7437678
Dissolved Manganese (Mn)	ug/L	26	2.0	7437678	13	2.0	7437678	100	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L	8.1	0.50	7437678	0.55	0.50	7437678	1.9	0.50	7437678
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7437678	<1.0	1.0	7437678	<1.0	1.0	7437678
Dissolved Phosphorus (P)	ug/L	<100	100	7437678	<100	100	7437678	<100	100	7437678
Dissolved Potassium (K)	ug/L	1600	200	7437678	1100	200	7437678	1200	200	7437678
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7437678	<2.0	2.0	7437678	<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L	5600	50	7437678	6900	50	7437678	6700	50	7437678
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7437678	<0.090	0.090	7437678	<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L	17000	100	7437678	45000	100	7437678	6000	100	7437678
Dissolved Strontium (Sr)	ug/L	2400	1.0	7437678	320	1.0	7437678	420	1.0	7437678
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7437678	<0.050	0.050	7437678	<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7437678	<5.0	5.0	7437678	<5.0	5.0	7437678
Dissolved Uranium (U)	ug/L	0.86	0.10	7437678	0.52	0.10	7437678	0.43	0.10	7437678
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7437678	<0.50	0.50	7437678	<0.50	0.50	7437678
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7437678	<5.0	5.0	7437678	8.1	5.0	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY896		
Sampling Date		2021/06/24		
COC Number		831949-07-01		
	UNITS	DUP-5	RDL	QC Batch
Calculated Parameters				
Anion Sum	me/L	11.2	N/A	7433941
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	200	1.0	7433456
Calculated TDS	mg/L	680	1.0	7433944
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.1	1.0	7433456
Cation Sum	me/L	11.4	N/A	7433941
Hardness (CaCO3)	mg/L	530	1.0	7433195
Ion Balance (% Difference)	%	1.24	N/A	7433940
Langelier Index (@ 20C)	N/A	1.02		7433942
Langelier Index (@ 4C)	N/A	0.772		7433943
Saturation pH (@ 20C)	N/A	7.04		7433942
Saturation pH (@ 4C)	N/A	7.28		7433943
Inorganics				
Total Ammonia-N	mg/L	0.071	0.050	7436397
Conductivity	umho/cm	1000	1.0	7438013
Dissolved Organic Carbon	mg/L	1.4	0.40	7438054
Orthophosphate (P)	mg/L	<0.010	0.010	7437991
pH	pH	8.05		7438016
Dissolved Sulphate (SO4)	mg/L	340	2.0	7437990
Alkalinity (Total as CaCO3)	mg/L	200	1.0	7438011
Dissolved Chloride (Cl-)	mg/L	4.2	1.0	7437986
Nitrite (N)	mg/L	<0.010	0.010	7437970
Nitrate (N)	mg/L	<0.10	0.10	7437970
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7437970
Metals				
Dissolved Aluminum (Al)	ug/L	<4.9	4.9	7437678
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7437678
Dissolved Arsenic (As)	ug/L	2.9	1.0	7437678
Dissolved Barium (Ba)	ug/L	21	2.0	7437678
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7437678
Dissolved Boron (B)	ug/L	32	10	7437678
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PXY896		
Sampling Date		2021/06/24		
COC Number		831949-07-01		
	UNITS	DUP-5	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	150000	200	7437678
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7437678
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7437678
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7437678
Dissolved Iron (Fe)	ug/L	150	100	7437678
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7437678
Dissolved Magnesium (Mg)	ug/L	40000	50	7437678
Dissolved Manganese (Mn)	ug/L	26	2.0	7437678
Dissolved Molybdenum (Mo)	ug/L	8.1	0.50	7437678
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7437678
Dissolved Phosphorus (P)	ug/L	<100	100	7437678
Dissolved Potassium (K)	ug/L	1500	200	7437678
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7437678
Dissolved Silicon (Si)	ug/L	5500	50	7437678
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7437678
Dissolved Sodium (Na)	ug/L	17000	100	7437678
Dissolved Strontium (Sr)	ug/L	2300	1.0	7437678
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7437678
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7437678
Dissolved Uranium (U)	ug/L	0.87	0.10	7437678
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7437678
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7437678

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		PXY681		
Sampling Date		2021/06/24 16:00		
COC Number		831949-06-01		
	UNITS	MW20-13C	RDL	QC Batch
Metals				
Dissolved Aluminum (Al)	ug/L	7.7	4.9	7455024
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7455024
Dissolved Arsenic (As)	ug/L	<1.0	1.0	7455024
Dissolved Barium (Ba)	ug/L	37	2.0	7455024
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7455024
Dissolved Boron (B)	ug/L	27	10	7455024
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7455024
Dissolved Calcium (Ca)	ug/L	66000	200	7455024
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7455024
Dissolved Cobalt (Co)	ug/L	0.89	0.50	7455024
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7455024
Dissolved Iron (Fe)	ug/L	<100	100	7455024
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7455024
Dissolved Magnesium (Mg)	ug/L	38000	50	7455024
Dissolved Manganese (Mn)	ug/L	220	2.0	7455024
Dissolved Molybdenum (Mo)	ug/L	15	0.50	7455024
Dissolved Nickel (Ni)	ug/L	1.6	1.0	7455024
Dissolved Phosphorus (P)	ug/L	<100	100	7455024
Dissolved Potassium (K)	ug/L	1200	200	7455024
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7455024
Dissolved Silicon (Si)	ug/L	3300	50	7455024
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7455024
Dissolved Sodium (Na)	ug/L	6100	100	7455024
Dissolved Strontium (Sr)	ug/L	250	1.0	7455024
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7455024
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7455024
Dissolved Uranium (U)	ug/L	1.2	0.10	7455024
Dissolved Vanadium (V)	ug/L	0.55	0.50	7455024
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7455024

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXY680	PXY682	PXY684	PXY686	PXY688	PXY889		
Sampling Date		2021/06/24 16:30	2021/06/24	2021/06/24 10:30	2021/06/24 13:15	2021/06/24 16:15	2021/06/23 12:30		
COC Number		831949-06-01	831949-06-01	831949-06-01	831949-06-01	831949-06-01	831949-07-01		
	UNITS	MW20-13B	DUP-4	MW20-10B	MW20-11B	MW20-12B	MW20-28B	RDL	QC Batch
BTEX & F1 Hydrocarbons									
Benzene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7437379
Toluene	ug/L	0.29	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7437379
Ethylbenzene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7437379
o-Xylene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7437379
p+m-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7437379
Total Xylenes	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7437379
F1 (C6-C10)	ug/L	<25	<25	<25	<25	<25	<25	25	7437379
F1 (C6-C10) - BTEX	ug/L	<25	<25	<25	<25	<25	<25	25	7437379
F2-F4 Hydrocarbons									
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	<100	<100	<100	<100	100	7436245
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	<200	<200	<200	<200	200	7436245
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	<200	<200	<200	<200	200	7436245
Reached Baseline at C50	ug/L	Yes	Yes	Yes	Yes	Yes	Yes		7436245
Surrogate Recovery (%)									
1,4-Difluorobenzene	%	101	101	99	101	103	100		7437379
4-Bromofluorobenzene	%	86	93	90	88	86	97		7437379
D10-o-Xylene	%	111	114	112	111	112	110		7437379
D4-1,2-Dichloroethane	%	106	109	110	108	108	110		7437379
o-Terphenyl	%	96	97	96	96	97	95		7436245

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PXY891	PXY893	PXY895	PXY896		
Sampling Date		2021/06/24 14:30	2021/06/24 18:30	2021/06/23	2021/06/24		
COC Number		831949-07-01	831949-07-01	831949-07-01	831949-07-01		
	UNITS	MW20-27B	MW20-26B	DUP-3	DUP-5	RDL	QC Batch
BTEX & F1 Hydrocarbons							
Benzene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7437379
Toluene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7437379
Ethylbenzene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7437379
o-Xylene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7437379
p+m-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	7437379
Total Xylenes	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	7437379
F1 (C6-C10)	ug/L	<25	<25	<25	<25	25	7437379
F1 (C6-C10) - BTEX	ug/L	<25	<25	<25	<25	25	7437379
F2-F4 Hydrocarbons							
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	<100	<100	100	7436245
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	<200	<200	200	7436245
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	<200	<200	200	7436245
Reached Baseline at C50	ug/L	Yes	Yes	Yes	Yes		7436245
Surrogate Recovery (%)							
1,4-Difluorobenzene	%	100	101	100	101		7437379
4-Bromofluorobenzene	%	86	86	94	90		7437379
D10-o-Xylene	%	106	115	107	111		7437379
D4-1,2-Dichloroethane	%	111	107	106	108		7437379
o-Terphenyl	%	96	95	96	95		7436245

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY679
Sample ID: MW20-13A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY680
Sample ID: MW20-13B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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TEST SUMMARY

BV Labs ID: PXY680 Dup
Sample ID: MW20-13B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal

BV Labs ID: PXY681
Sample ID: MW20-13C
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	7455024	2021/07/09	2021/07/12	Nan Raykha
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY682
Sample ID: DUP-4
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY682
Sample ID: DUP-4
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY683
Sample ID: MW20-10A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY684
Sample ID: MW20-10B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY684
Sample ID: MW20-10B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY684 Dup
Sample ID: MW20-10B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai

BV Labs ID: PXY685
Sample ID: MW20-11A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY686
Sample ID: MW20-11B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY687
Sample ID: MW20-12A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY688
Sample ID: MW20-12B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY888
Sample ID: MW20-28A
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY888 Dup
Sample ID: MW20-28A
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh

BV Labs ID: PXY889
Sample ID: MW20-28B
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/07/02	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY890
Sample ID: MW20-27A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY890
Sample ID: MW20-27A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY890 Dup
Sample ID: MW20-27A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu

BV Labs ID: PXY891
Sample ID: MW20-27B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY892
Sample ID: MW20-26A
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY893
Sample ID: MW20-26B
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PXY894
Sample ID: MW20-26C
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436363	N/A	2021/07/02	Viorica Rotaru
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

BV Labs ID: PXY895
Sample ID: DUP-3
Matrix: Water

Collected: 2021/06/23
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7437920	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/06/30	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H5980
Report Date: 2021/07/12

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: VP

TEST SUMMARY

BV Labs ID: PXY896
Sample ID: DUP-5
Matrix: Water

Collected: 2021/06/24
Shipped:
Received: 2021/06/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7438011	N/A	2021/07/01	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7433456	N/A	2021/07/02	Automated Statchk
Chloride by Automated Colourimetry	KONE	7437986	N/A	2021/07/02	Alina Dobreanu
Conductivity	AT	7438013	N/A	2021/07/02	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7438054	N/A	2021/07/01	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7437379	N/A	2021/06/30	Haibin Wu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7436245	2021/06/29	2021/06/30	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7433195	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7437678	N/A	2021/06/30	Prempal Bhatti
Ion Balance (% Difference)	CALC	7433940	N/A	2021/07/02	Automated Statchk
Anion and Cation Sum	CALC	7433941	N/A	2021/07/02	Automated Statchk
Total Ammonia-N	LACH/NH4	7436397	N/A	2021/06/30	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7437970	N/A	2021/07/02	Chandra Nandlal
pH	AT	7438016	2021/06/30	2021/07/01	Surinder Rai
Orthophosphate	KONE	7437991	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7433942	N/A	2021/07/02	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7433943	N/A	2021/07/02	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7437990	N/A	2021/07/02	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7433944	N/A	2021/07/02	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	11.0°C
Package 2	9.7°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7436245	o-Terphenyl	2021/06/29	98	60 - 130	98	60 - 130	98	%		
7437379	1,4-Difluorobenzene	2021/06/30	94	70 - 130	96	70 - 130	100	%		
7437379	4-Bromofluorobenzene	2021/06/30	112	70 - 130	113	70 - 130	102	%		
7437379	D10-o-Xylene	2021/06/30	101	70 - 130	96	70 - 130	112	%		
7437379	D4-1,2-Dichloroethane	2021/06/30	99	70 - 130	95	70 - 130	104	%		
7436245	F2 (C10-C16 Hydrocarbons)	2021/06/30	90	60 - 130	99	60 - 130	<100	ug/L	NC	30
7436245	F3 (C16-C34 Hydrocarbons)	2021/06/30	88	60 - 130	103	60 - 130	<200	ug/L	NC	30
7436245	F4 (C34-C50 Hydrocarbons)	2021/06/30	93	60 - 130	106	60 - 130	<200	ug/L	NC	30
7436363	Total Ammonia-N	2021/07/02	97	75 - 125	101	80 - 120	<0.050	mg/L	3.4	20
7436397	Total Ammonia-N	2021/06/30	100	75 - 125	104	80 - 120	<0.050	mg/L	20	20
7437379	Benzene	2021/06/30	95	50 - 140	92	50 - 140	<0.20	ug/L	NC	30
7437379	Ethylbenzene	2021/06/30	100	50 - 140	98	50 - 140	<0.20	ug/L	NC	30
7437379	F1 (C6-C10) - BTEX	2021/06/30					<25	ug/L	NC	30
7437379	F1 (C6-C10)	2021/06/30	87	60 - 140	85	60 - 140	<25	ug/L	NC	30
7437379	o-Xylene	2021/06/30	99	50 - 140	97	50 - 140	<0.20	ug/L	NC	30
7437379	p+m-Xylene	2021/06/30	94	50 - 140	93	50 - 140	<0.40	ug/L	NC	30
7437379	Toluene	2021/06/30	90	50 - 140	88	50 - 140	<0.20	ug/L	NC	30
7437379	Total Xylenes	2021/06/30					<0.40	ug/L	NC	30
7437678	Dissolved Aluminum (Al)	2021/06/30	101	80 - 120	99	80 - 120	<4.9	ug/L	NC	20
7437678	Dissolved Antimony (Sb)	2021/06/30	105	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Arsenic (As)	2021/06/30	103	80 - 120	100	80 - 120	<1.0	ug/L	0.65	20
7437678	Dissolved Barium (Ba)	2021/06/30	102	80 - 120	100	80 - 120	<2.0	ug/L	3.8	20
7437678	Dissolved Beryllium (Be)	2021/06/30	103	80 - 120	96	80 - 120	<0.40	ug/L	NC	20
7437678	Dissolved Boron (B)	2021/06/30	97	80 - 120	88	80 - 120	<10	ug/L	4.1	20
7437678	Dissolved Cadmium (Cd)	2021/06/30	102	80 - 120	99	80 - 120	<0.090	ug/L	NC	20
7437678	Dissolved Calcium (Ca)	2021/06/30	NC	80 - 120	98	80 - 120	<200	ug/L	1.6	20
7437678	Dissolved Chromium (Cr)	2021/06/30	100	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7437678	Dissolved Cobalt (Co)	2021/06/30	105	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Copper (Cu)	2021/06/30	101	80 - 120	105	80 - 120	<0.90	ug/L	NC	20
7437678	Dissolved Iron (Fe)	2021/06/30	102	80 - 120	99	80 - 120	<100	ug/L	0.31	20
7437678	Dissolved Lead (Pb)	2021/06/30	100	80 - 120	98	80 - 120	<0.50	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7437678	Dissolved Magnesium (Mg)	2021/06/30	NC	80 - 120	102	80 - 120	<50	ug/L	1.2	20
7437678	Dissolved Manganese (Mn)	2021/06/30	100	80 - 120	98	80 - 120	<2.0	ug/L	1.4	20
7437678	Dissolved Molybdenum (Mo)	2021/06/30	105	80 - 120	98	80 - 120	<0.50	ug/L	1.5	20
7437678	Dissolved Nickel (Ni)	2021/06/30	100	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7437678	Dissolved Phosphorus (P)	2021/06/30	102	80 - 120	103	80 - 120	<100	ug/L	NC	20
7437678	Dissolved Potassium (K)	2021/06/30	104	80 - 120	103	80 - 120	<200	ug/L	0.33	20
7437678	Dissolved Selenium (Se)	2021/06/30	106	80 - 120	102	80 - 120	<2.0	ug/L	NC	20
7437678	Dissolved Silicon (Si)	2021/06/30	98	80 - 120	97	80 - 120	<50	ug/L	1.0	20
7437678	Dissolved Silver (Ag)	2021/06/30	101	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7437678	Dissolved Sodium (Na)	2021/06/30	102	80 - 120	101	80 - 120	<100	ug/L	1.5	20
7437678	Dissolved Strontium (Sr)	2021/06/30	NC	80 - 120	97	80 - 120	<1.0	ug/L	2.9	20
7437678	Dissolved Thallium (Tl)	2021/06/30	106	80 - 120	102	80 - 120	<0.050	ug/L	NC	20
7437678	Dissolved Titanium (Ti)	2021/06/30	100	80 - 120	96	80 - 120	<5.0	ug/L	NC	20
7437678	Dissolved Uranium (U)	2021/06/30	105	80 - 120	99	80 - 120	<0.10	ug/L	0.64	20
7437678	Dissolved Vanadium (V)	2021/06/30	100	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7437678	Dissolved Zinc (Zn)	2021/06/30	99	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
7437920	Dissolved Organic Carbon	2021/06/30	93	80 - 120	94	80 - 120	<0.40	mg/L	NC	20
7437970	Nitrate (N)	2021/06/30	94	80 - 120	97	80 - 120	<0.10	mg/L	NC	20
7437970	Nitrite (N)	2021/06/30	104	80 - 120	105	80 - 120	<0.010	mg/L	NC	20
7437986	Dissolved Chloride (Cl-)	2021/07/02	113	80 - 120	102	80 - 120	<1.0	mg/L	7.0	20
7437990	Dissolved Sulphate (SO4)	2021/07/02	NC	75 - 125	103	80 - 120	<1.0	mg/L	2.5	20
7437991	Orthophosphate (P)	2021/07/05	119	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
7438011	Alkalinity (Total as CaCO3)	2021/07/01			96	85 - 115	<1.0	mg/L	3.0	20
7438013	Conductivity	2021/07/02			99	85 - 115	<1.0	umho/cm	0	25
7438016	pH	2021/07/01			102	98 - 103			0.36	N/A
7438054	Dissolved Organic Carbon	2021/07/01	93	80 - 120	94	80 - 120	<0.40	mg/L	2.7	20
7455024	Dissolved Aluminum (Al)	2021/07/12	101	80 - 120	97	80 - 120	<4.9	ug/L	NC	20
7455024	Dissolved Antimony (Sb)	2021/07/12	109	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7455024	Dissolved Arsenic (As)	2021/07/12	106	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
7455024	Dissolved Barium (Ba)	2021/07/12	105	80 - 120	98	80 - 120	<2.0	ug/L	2.0	20
7455024	Dissolved Beryllium (Be)	2021/07/12	112	80 - 120	100	80 - 120	<0.40	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7455024	Dissolved Boron (B)	2021/07/12	105	80 - 120	93	80 - 120	<10	ug/L	2.8	20
7455024	Dissolved Cadmium (Cd)	2021/07/12	105	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7455024	Dissolved Calcium (Ca)	2021/07/12	NC	80 - 120	97	80 - 120	<200	ug/L	0.91	20
7455024	Dissolved Chromium (Cr)	2021/07/12	105	80 - 120	98	80 - 120	<5.0	ug/L	NC	20
7455024	Dissolved Cobalt (Co)	2021/07/12	104	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7455024	Dissolved Copper (Cu)	2021/07/12	105	80 - 120	101	80 - 120	1.2, RDL=0.90 (1)	ug/L	NC	20
7455024	Dissolved Iron (Fe)	2021/07/12	104	80 - 120	96	80 - 120	<100	ug/L	NC	20
7455024	Dissolved Lead (Pb)	2021/07/12	101	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
7455024	Dissolved Magnesium (Mg)	2021/07/12	98	80 - 120	99	80 - 120	<50	ug/L	1.5	20
7455024	Dissolved Manganese (Mn)	2021/07/12	104	80 - 120	97	80 - 120	<2.0	ug/L	NC	20
7455024	Dissolved Molybdenum (Mo)	2021/07/12	112	80 - 120	103	80 - 120	<0.50	ug/L	NC	20
7455024	Dissolved Nickel (Ni)	2021/07/12	101	80 - 120	97	80 - 120	<1.0	ug/L	NC	20
7455024	Dissolved Phosphorus (P)	2021/07/12	110	80 - 120	106	80 - 120	<100	ug/L	NC	20
7455024	Dissolved Potassium (K)	2021/07/12	103	80 - 120	98	80 - 120	<200	ug/L	4.8	20
7455024	Dissolved Selenium (Se)	2021/07/12	104	80 - 120	99	80 - 120	<2.0	ug/L	NC	20
7455024	Dissolved Silicon (Si)	2021/07/12	101	80 - 120	97	80 - 120	<50	ug/L	0.68	20
7455024	Dissolved Silver (Ag)	2021/07/12	106	80 - 120	100	80 - 120	<0.090	ug/L	NC	20
7455024	Dissolved Sodium (Na)	2021/07/12	102	80 - 120	98	80 - 120	<100	ug/L	0.96	20
7455024	Dissolved Strontium (Sr)	2021/07/12	106	80 - 120	96	80 - 120	<1.0	ug/L	2.9	20
7455024	Dissolved Thallium (Tl)	2021/07/12	103	80 - 120	99	80 - 120	<0.050	ug/L	NC	20
7455024	Dissolved Titanium (Ti)	2021/07/12	96	80 - 120	94	80 - 120	<5.0	ug/L	NC	20
7455024	Dissolved Uranium (U)	2021/07/12	98	80 - 120	94	80 - 120	<0.10	ug/L	5.1	20
7455024	Dissolved Vanadium (V)	2021/07/12	105	80 - 120	98	80 - 120	<0.50	ug/L	NC	20

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7455024	Dissolved Zinc (Zn)	2021/07/12	104	80 - 120	97	80 - 120	<5.0	ug/L	14	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Analyte was detected in the method blank at a level marginally above the detection limit. Sample results have not been blank corrected. Those results at or near the detection limit may be biased high..

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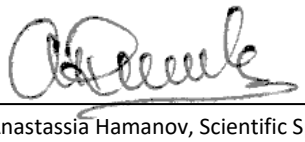
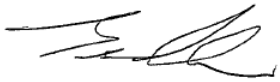
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist



Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Ema Gitej

C1H5980

ries
Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

2 coolers

CHAIN OF CUSTODY RECORD

Page 1 of 2

KTN ENV-1109

Company Name:	#21375 Golder Associates Ltd
Attention:	Accounts Payable
Address:	210 Sheldon Drive Cambridge ON N1T 1A8
Tel:	(519) 620-8182 Fax:
Email:	CanadaAccountsPayableInvoices@golder.com

REPORT TO:

Company Name:	
Attention:	Gregory Padusenko
Address:	
Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878
Email:	Gregory_Padusenko@golder.com

PROJECT INFORMATION:

Quotation #:	B80683
P.O. #:	
Project:	19129150 (2300)
Project Name:	
Site #:	
Sampled By:	

Laboratory Use Only:

BV Labs Job #:	Bottle Order #:
	831949
COC #:	**Project Manager:**
C#831949-06-01	Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
☐ Table 1 ☐ Res/Park ☐ Medium/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ For RSC
☐ Table ___

Other Regulations
☐ CCME ☐ Sanitary Sewer Bylaw
☐ Reg 558 ☐ Storm Sewer Bylaw
☐ MISA Municipality ___
☐ PWQO ☐ Reg 406 Table ___
☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1		MW20-13A	21/06/24	1545	GW	Y	X								8	4	
2		MW20-13B		1630			X	X								8	
3		MW20-13C		1600			X									4	
4		DUP-4		—	GW		X	X								8	
5		MW20-10A		1000			X									4	
6		MW20-10B		1030			X	X								8	
7		MW20-11A		1245			X									4	
8		MW20-11B		1315			X	X								8	
9		MW20-12A		1545			X									4	
10		MW20-12B		1615			X	X								8	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
JBOPP	21/06/24	20:40	RM/METHOD/ Rajan	2021-06-25	08:00	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	10/11/12 9/12/8	Present		
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

ON ICE

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

2 coolers

CHAIN OF CUSTODY RECORD

Page 2 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:	Bottle Order #: 831949
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:			
Address:	210 Sheldon Drive, Cambridge ON N1T 1A8	Address:		Project:	19129150 (2300)	COC #: C#831949-07-01	Project Manager: Ema Gitej
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Project Name:			
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Site #:			
				Sampled By:			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558. ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required: Please provide advance notice for rush projects

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(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1		MW20-28A	21/06/23	1200	GW	Y	X									4	
2		MW20-28B	21/06/23	1230			X	X								8	
3		MW20-27 A	21/06/24	1030			X									4	
4		MW20-27B	21/06/24	1430			X	X								8	
5		MW20-26 A	21/06/24	1700			X									4	
6		MW20-26 B	21/06/24	1830			X	X								8	
7		MW20-26C	21/06/24	1715			X									4	
8		DUP-3	21/06/23	–	GW		X	X								8	
9		DUP-5	21/06/24	–	GW	Y	X	X								8	
10																	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
V Propp [signature]	21/06/24	20:40	[signature]						Present		
									Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

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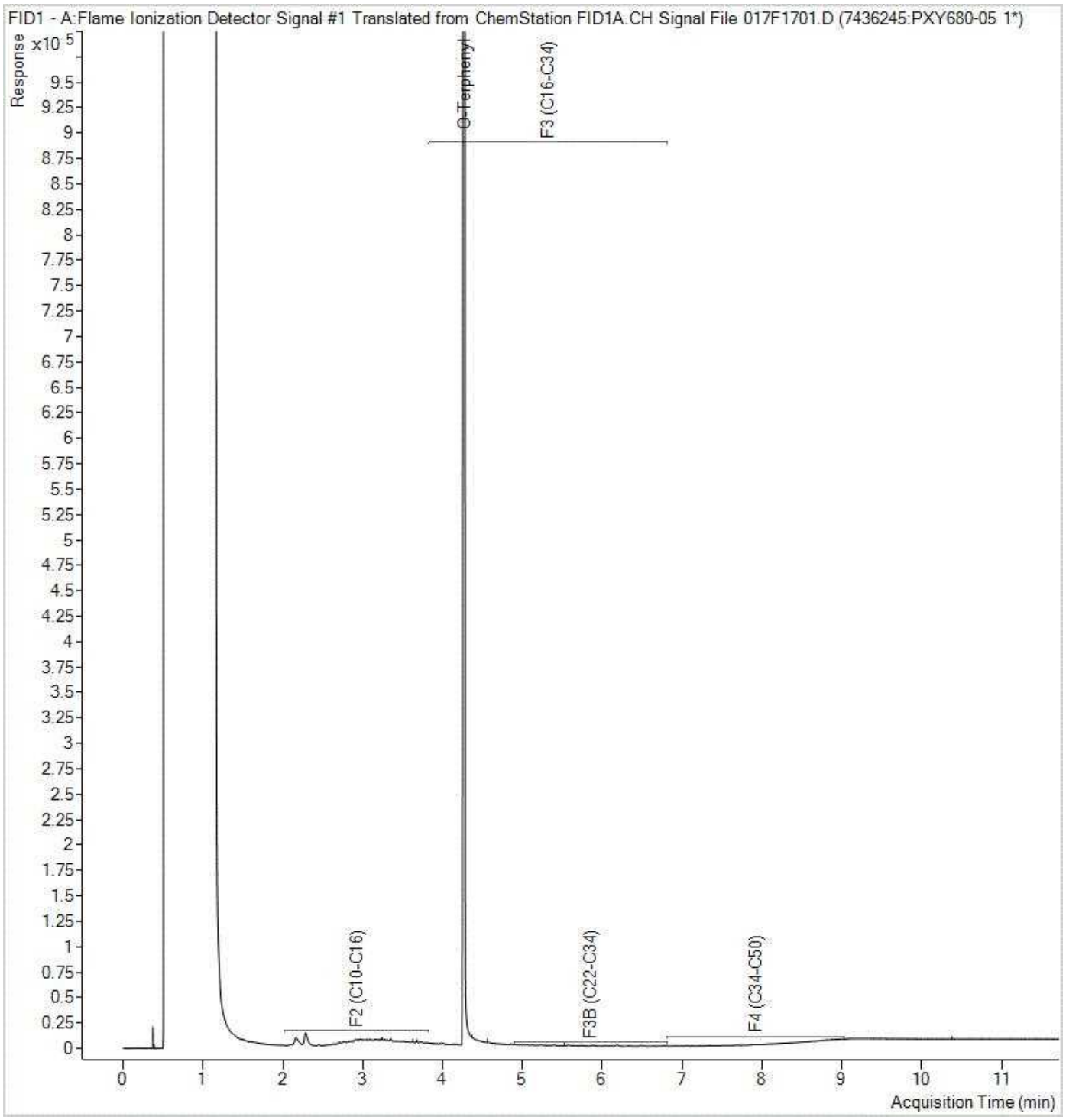
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

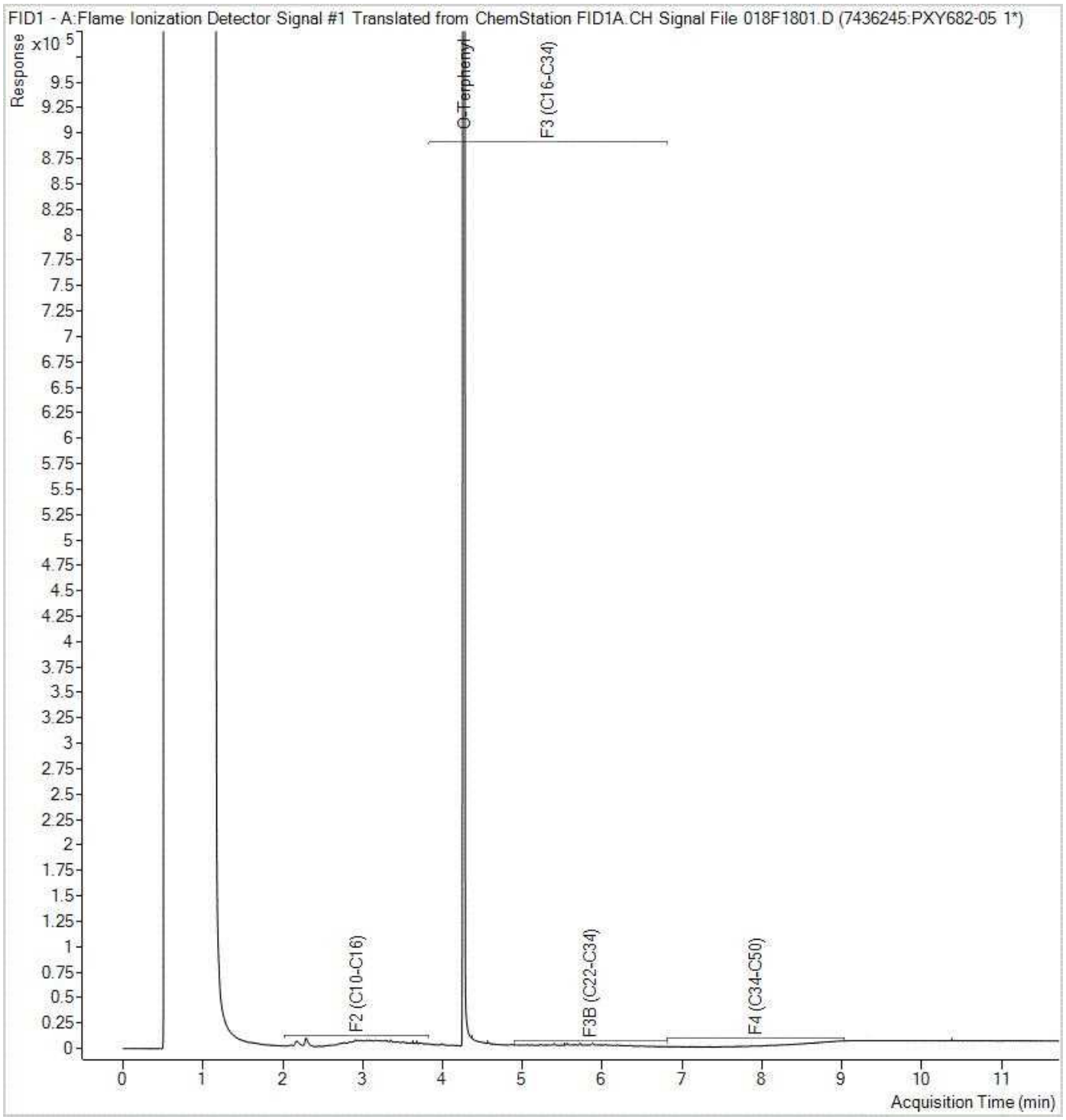


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY682

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP-4

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



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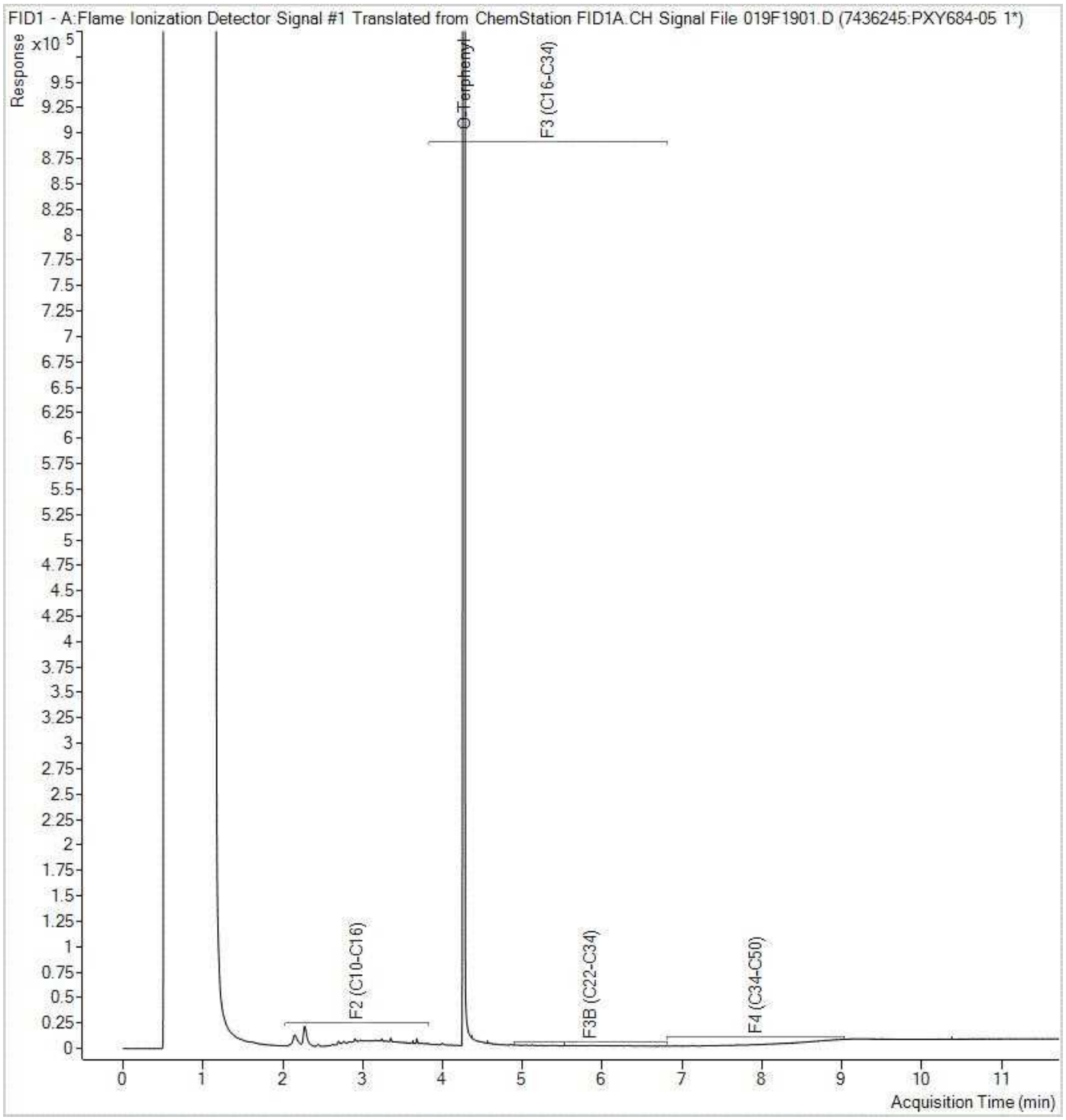
Petroleum Hydrocarbons F2-F4 in Water Chromatogram

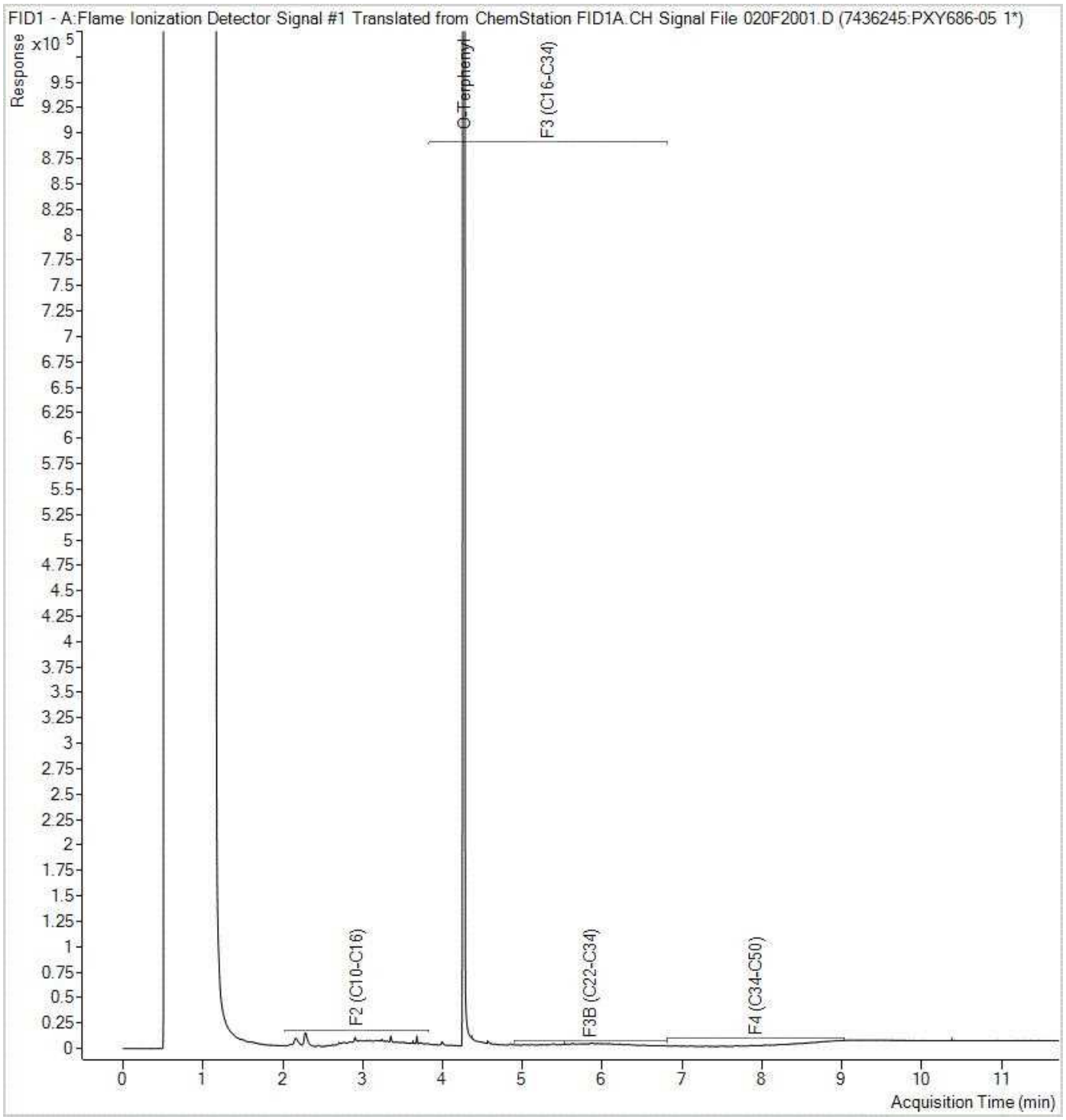


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY686

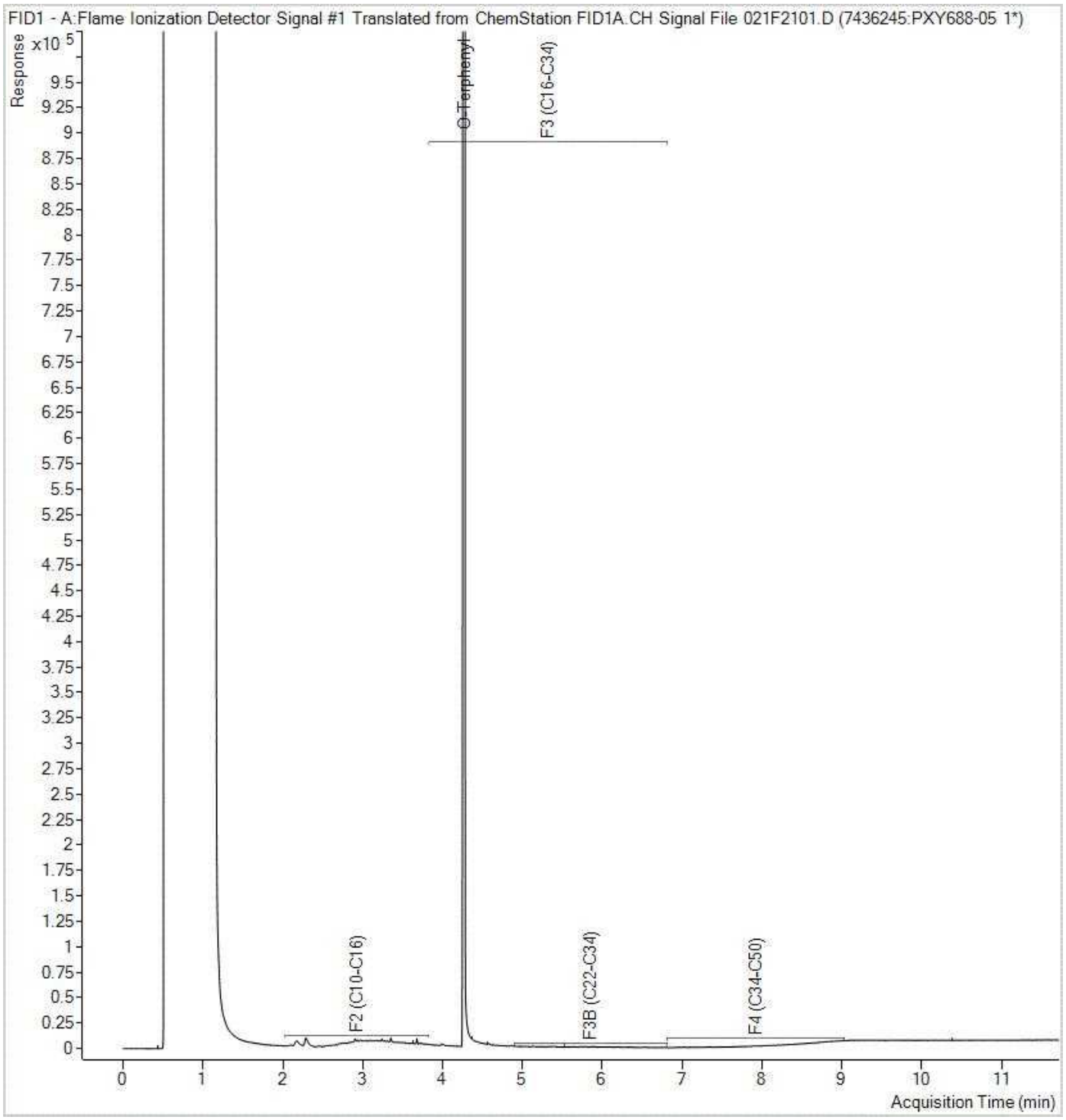
Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-11B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

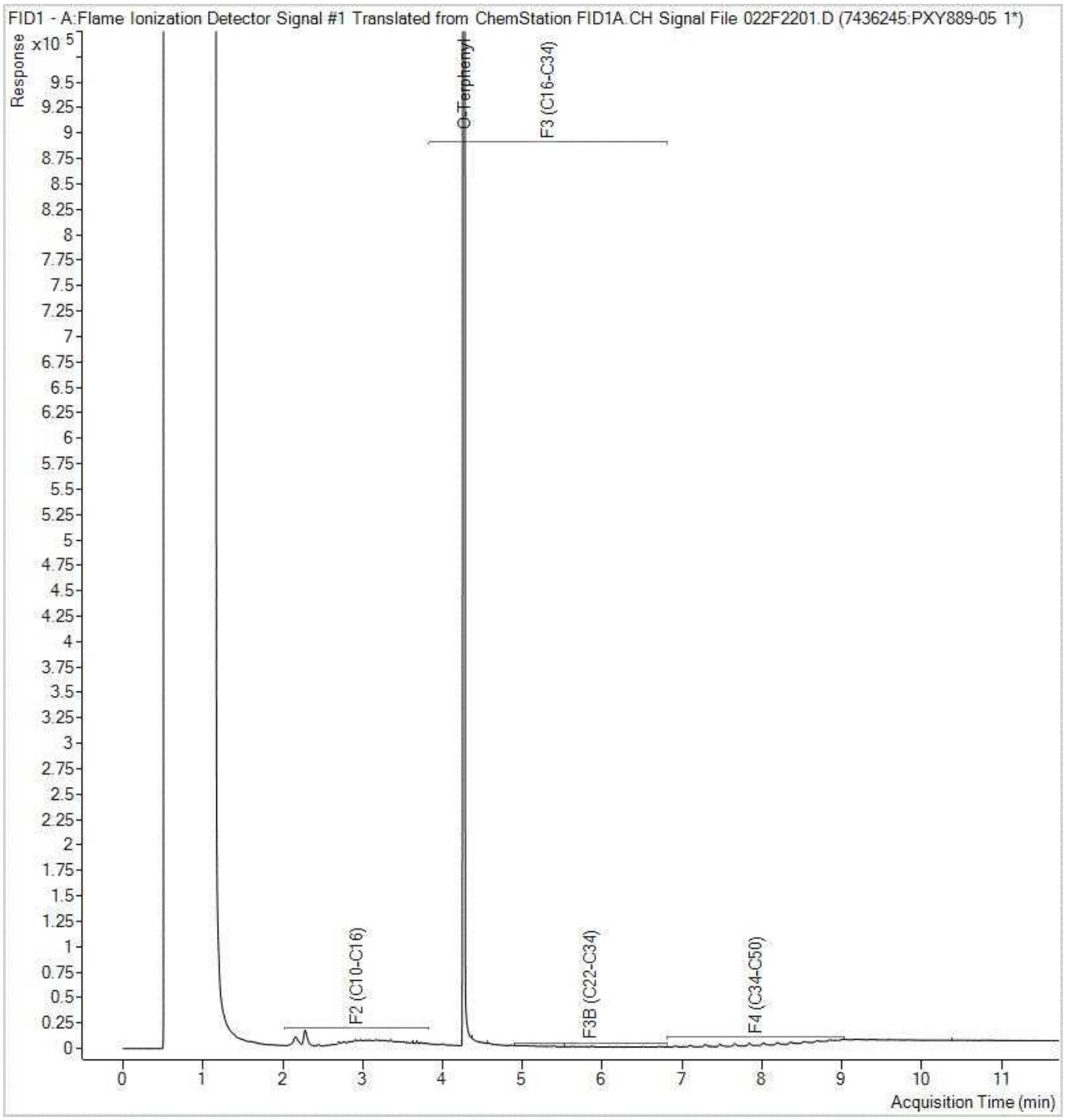


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY889

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-28B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

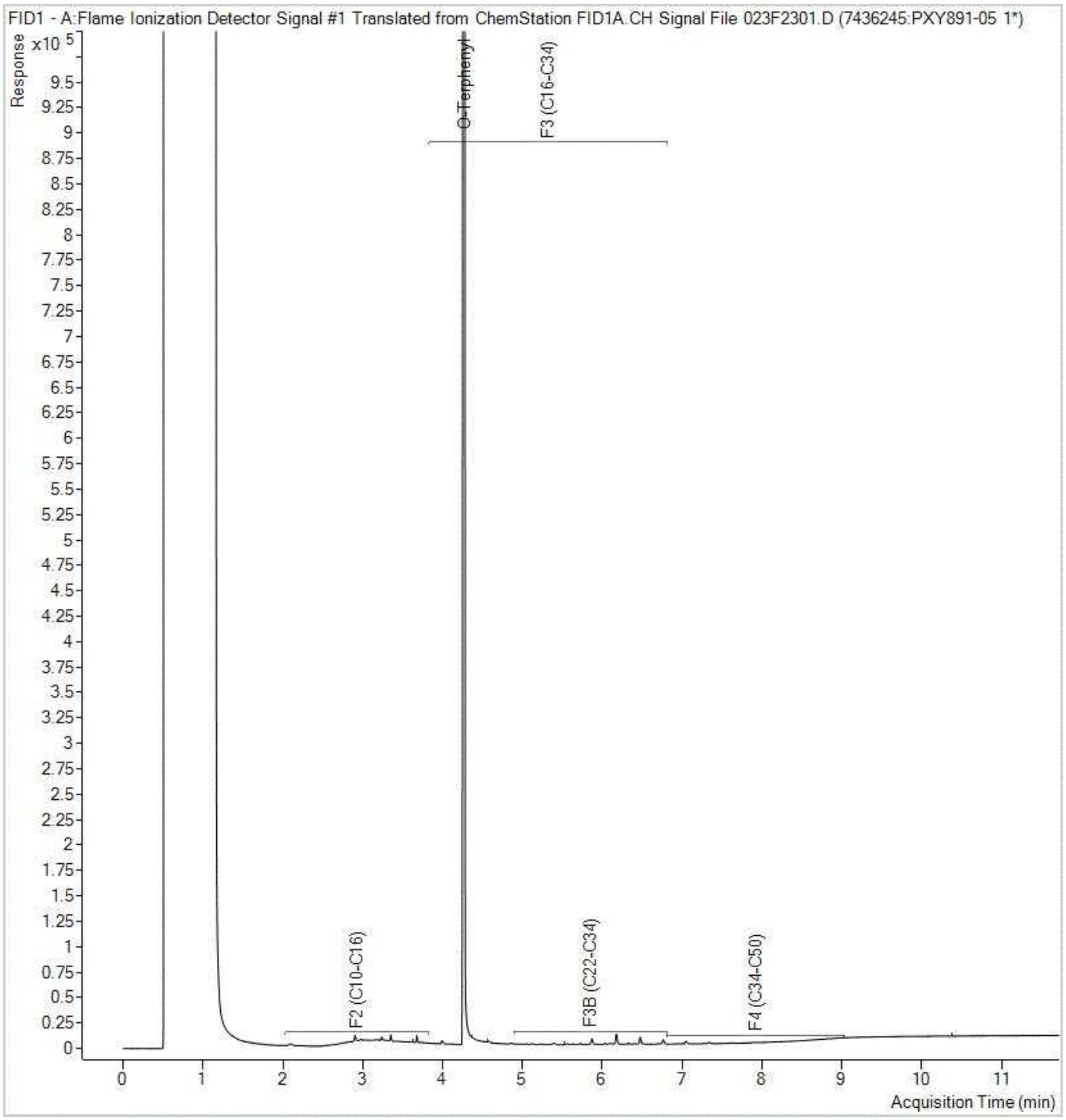


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY891

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-27B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

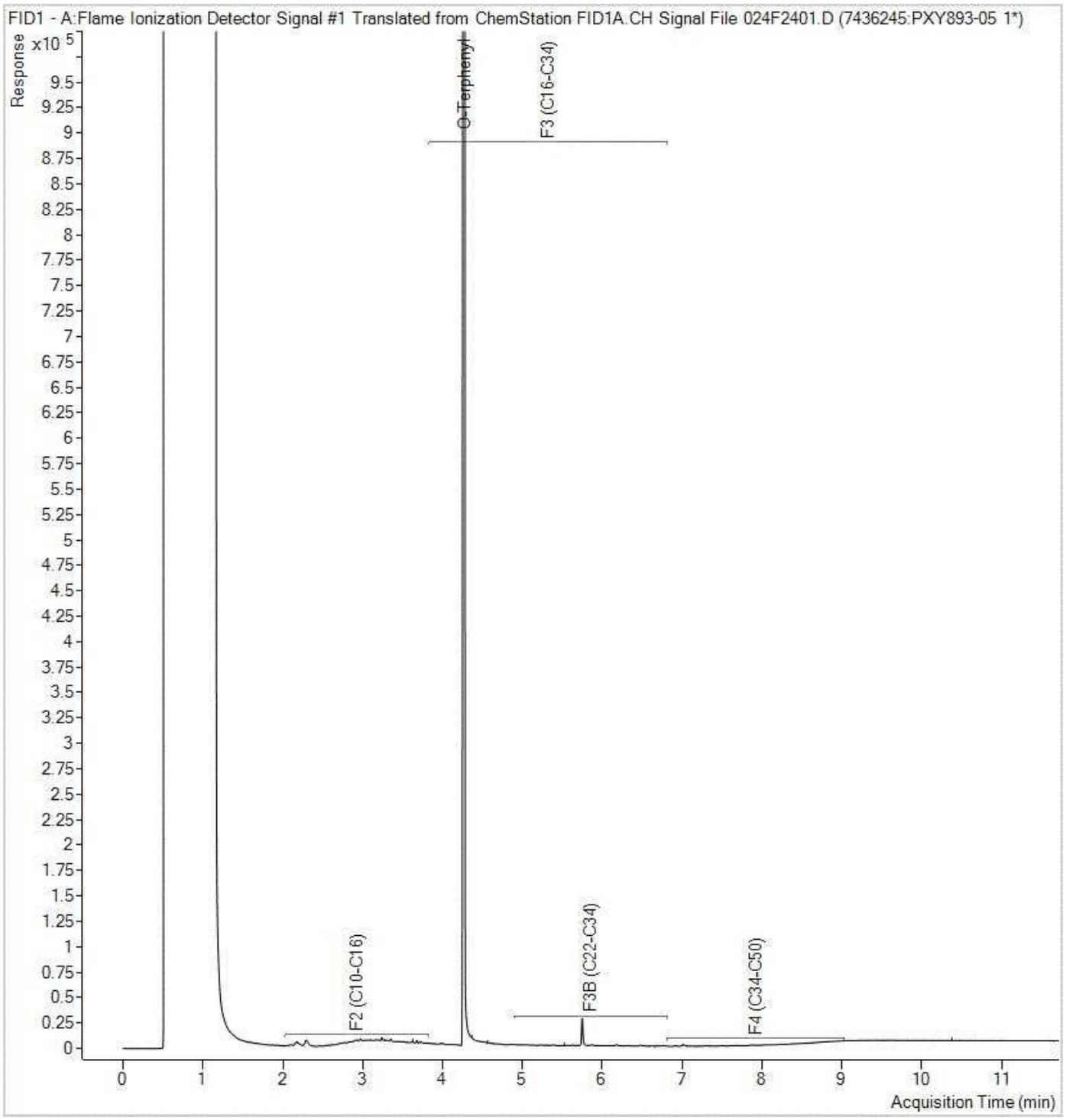


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY893

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-26B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

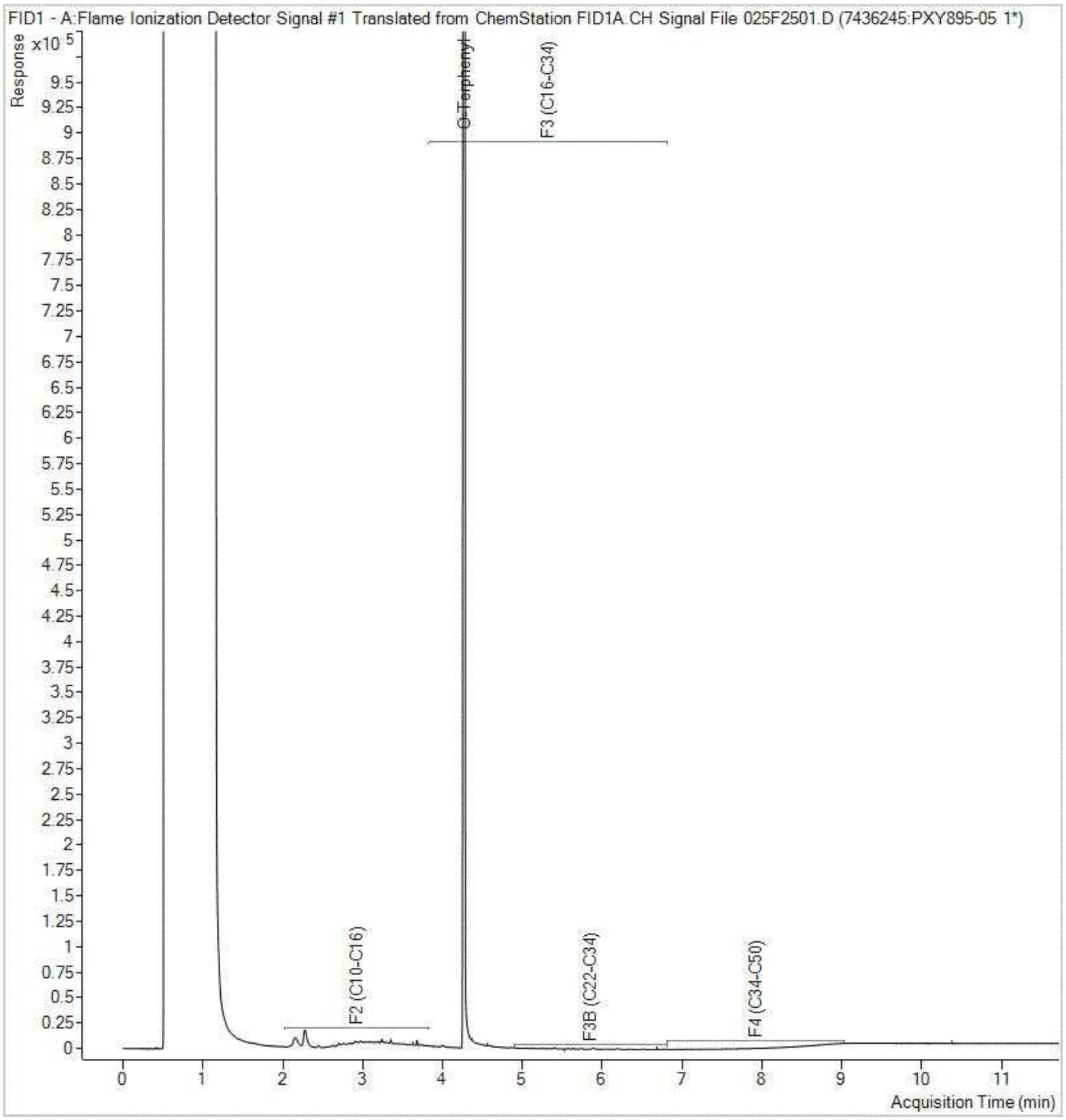


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY895

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP-3

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

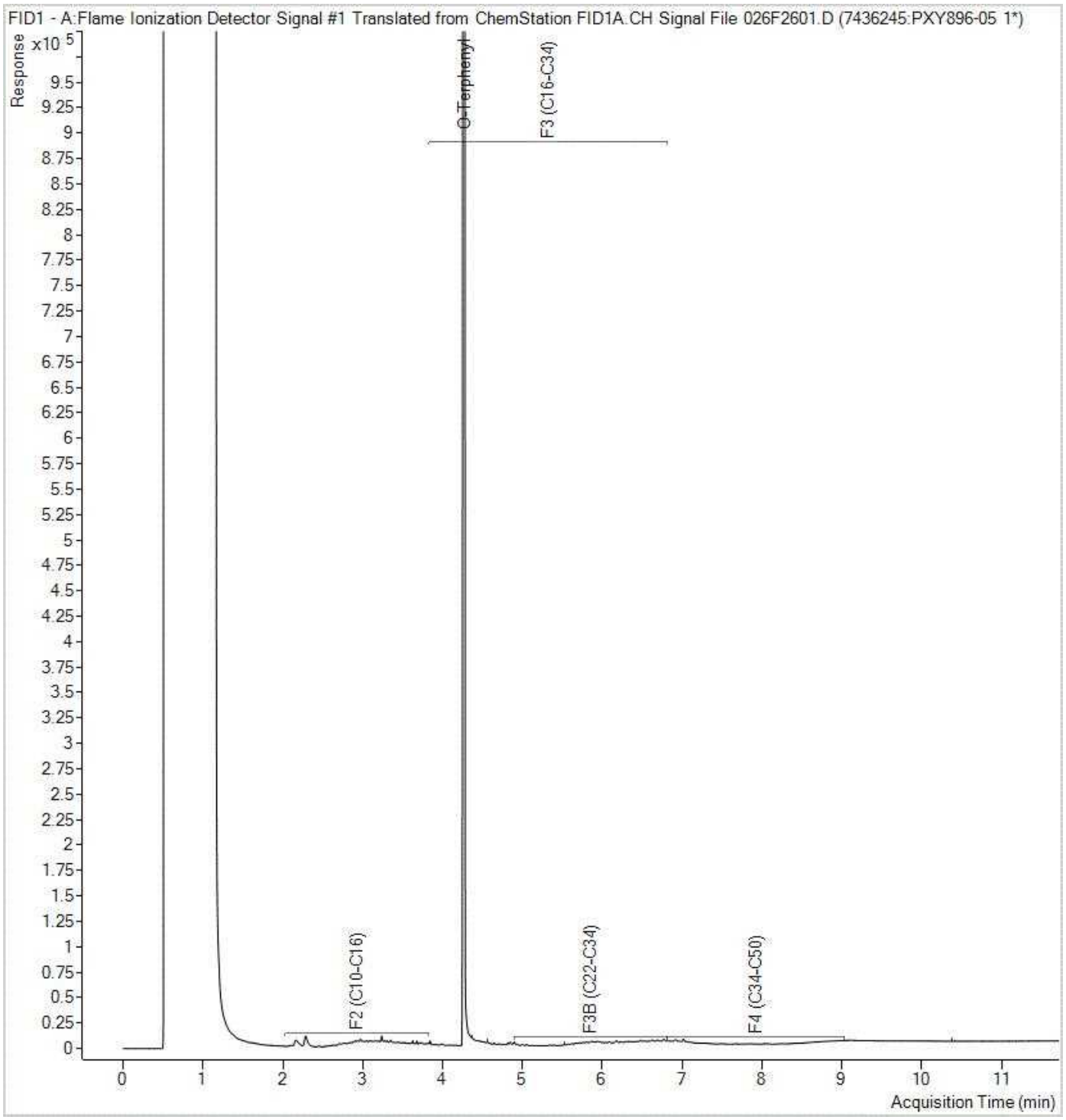


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H5980
Report Date: 2021/07/12
BV Labs Sample: PXY896

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP-5

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-08-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/08
Report #: R6709360
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H7092
Received: 2021/06/26, 10:13

Sample Matrix: Water
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	8	N/A	2021/07/05	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	8	N/A	2021/07/06	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	8	N/A	2021/07/05	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	8	N/A	2021/07/05	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/06/30	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	7	N/A	2021/07/02	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	4	N/A	2021/07/05	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	4	2021/07/02	2021/07/03	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	8	N/A	2021/07/02	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	8	N/A	2021/07/02	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	8	N/A	2021/07/06		
Anion and Cation Sum	8	N/A	2021/07/06		
Total Ammonia-N	8	N/A	2021/07/05	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	1	N/A	2021/07/02	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (3)	7	N/A	2021/07/05	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	8	2021/07/02	2021/07/05	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	8	N/A	2021/07/05	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	8	N/A	2021/07/06		Auto Calc
Sat. pH and Langelier Index (@ 4C)	8	N/A	2021/07/06		Auto Calc
Sulphate by Automated Colourimetry	8	N/A	2021/07/05	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	8	N/A	2021/07/06		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-08-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/08
Report #: R6709360
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1H7092
Received: 2021/06/26, 10:13

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1H7092
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF176			PYF177		PYF178		
Sampling Date		2021/06/25 13:30			2021/06/25 12:15		2021/06/25 13:15		
COC Number		831949-08-01			831949-08-01		831949-08-01		
	UNITS	MW20-15A	RDL	QC Batch	MW20-15B	QC Batch	MW20-15C	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	28.8	N/A	7437804	6.49	7437804	6.46	N/A	7437804
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	190	1.0	7437805	210	7437805	290	1.0	7437805
Calculated TDS	mg/L	1900	1.0	7437809	370	7437809	360	1.0	7437809
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.2	1.0	7437805	2.0	7437805	2.7	1.0	7437805
Cation Sum	me/L	30.6	N/A	7437804	6.63	7437804	8.40	N/A	7437804
Hardness (CaCO3)	mg/L	1000	1.0	7437803	320	7437803	400	1.0	7437803
Ion Balance (% Difference)	%	3.06	N/A	7437802	1.11	7437802	13.0	N/A	7437802
Langelier Index (@ 20C)	N/A	0.996		7437806	0.803	7437806	0.985		7437806
Langelier Index (@ 4C)	N/A	0.753		7437807	0.555	7437807	0.736		7437807
Saturation pH (@ 20C)	N/A	6.86		7437806	7.21	7437806	7.01		7437806
Saturation pH (@ 4C)	N/A	7.10		7437807	7.45	7437807	7.26		7437807
Inorganics									
Total Ammonia-N	mg/L	1.5	0.050	7441345	0.052	7441336	<0.050	0.050	7441345
Conductivity	umho/cm	2500	1.0	7442510	630	7442510	600	1.0	7442510
Dissolved Organic Carbon	mg/L	1.7	0.40	7441338	0.46	7441338	0.52	0.40	7439424
Orthophosphate (P)	mg/L	<0.010	0.010	7442183	<0.010	7442183	<0.010	0.010	7442183
pH	pH	7.85		7442511	8.01	7442511	7.99		7442511
Dissolved Sulphate (SO4)	mg/L	1200	10	7442181	110	7442181	25	1.0	7442181
Alkalinity (Total as CaCO3)	mg/L	190	1.0	7442502	210	7442502	290	1.0	7442502
Dissolved Chloride (Cl-)	mg/L	11	1.0	7442173	2.1	7442173	3.4	1.0	7442173
Nitrite (N)	mg/L	0.039	0.010	7442687	<0.010	7442216	<0.010	0.010	7442218
Nitrate (N)	mg/L	0.31	0.10	7442687	<0.10	7442216	<0.10	0.10	7442218
Nitrate + Nitrite (N)	mg/L	0.35	0.10	7442687	<0.10	7442216	<0.10	0.10	7442218
Metals									
Dissolved Aluminum (Al)	ug/L	200	4.9	7439514	<4.9	7439514	600	4.9	7439514
Dissolved Antimony (Sb)	ug/L	2.2	0.50	7439514	<0.50	7439514	<0.50	0.50	7439514
Dissolved Arsenic (As)	ug/L	23	1.0	7439514	2.0	7439514	7.3	1.0	7439514
Dissolved Barium (Ba)	ug/L	24	2.0	7439514	19	7439514	170	2.0	7439514
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7439514	<0.40	7439514	<0.40	0.40	7439514
Dissolved Boron (B)	ug/L	720	10	7439514	60	7439514	31	10	7439514
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7439514	<0.090	7439514	<0.090	0.090	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF176			PYF177		PYF178		
Sampling Date		2021/06/25 13:30			2021/06/25 12:15		2021/06/25 13:15		
COC Number		831949-08-01			831949-08-01		831949-08-01		
	UNITS	MW20-15A	RDL	QC Batch	MW20-15B	QC Batch	MW20-15C	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	330000	200	7439514	81000	7439514	92000	200	7439514
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7439514	<5.0	7439514	<5.0	5.0	7439514
Dissolved Cobalt (Co)	ug/L	0.60	0.50	7439514	<0.50	7439514	1.4	0.50	7439514
Dissolved Copper (Cu)	ug/L	1.3	0.90	7439514	<0.90	7439514	4.7	0.90	7439514
Dissolved Iron (Fe)	ug/L	210	100	7439514	<100	7439514	1200	100	7439514
Dissolved Lead (Pb)	ug/L	1.1	0.50	7439514	<0.50	7439514	3.2	0.50	7439514
Dissolved Magnesium (Mg)	ug/L	51000	50	7439514	27000	7439514	42000	50	7439514
Dissolved Manganese (Mn)	ug/L	54	2.0	7439514	16	7439514	130	2.0	7439514
Dissolved Molybdenum (Mo)	ug/L	150	0.50	7439514	2.2	7439514	1.4	0.50	7439514
Dissolved Nickel (Ni)	ug/L	2.0	1.0	7439514	<1.0	7439514	2.1	1.0	7439514
Dissolved Phosphorus (P)	ug/L	<100	100	7439514	<100	7439514	130	100	7439514
Dissolved Potassium (K)	ug/L	12000	200	7439514	1600	7439514	1700	200	7439514
Dissolved Selenium (Se)	ug/L	2.8	2.0	7439514	<2.0	7439514	<2.0	2.0	7439514
Dissolved Silicon (Si)	ug/L	5500	50	7439514	6800	7439514	8500	50	7439514
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7439514	<0.090	7439514	<0.090	0.090	7439514
Dissolved Sodium (Na)	ug/L	220000	100	7439514	6500	7439514	5100	100	7439514
Dissolved Strontium (Sr)	ug/L	4700	1.0	7439514	1700	7439514	430	1.0	7439514
Dissolved Thallium (Tl)	ug/L	0.052	0.050	7439514	<0.050	7439514	<0.050	0.050	7439514
Dissolved Titanium (Ti)	ug/L	7.7	5.0	7439514	<5.0	7439514	18	5.0	7439514
Dissolved Uranium (U)	ug/L	21	0.10	7439514	0.25	7439514	1.2	0.10	7439514
Dissolved Vanadium (V)	ug/L	0.78	0.50	7439514	<0.50	7439514	1.7	0.50	7439514
Dissolved Zinc (Zn)	ug/L	8.9	5.0	7439514	<5.0	7439514	13	5.0	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF179			PYF179			PYF180		
Sampling Date		2021/06/25 11:00			2021/06/25 11:00			2021/06/25 11:45		
COC Number		831949-08-01			831949-08-01			831949-08-01		
	UNITS	MW20-25A	RDL	QC Batch	MW20-25A Lab-Dup	RDL	QC Batch	MW20-25B	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	29.8	N/A	7437804				15.5	N/A	7437804
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	180	1.0	7437805				180	1.0	7437805
Calculated TDS	mg/L	2000	1.0	7437809				1000	1.0	7437809
Carb. Alkalinity (calc. as CaCO3)	mg/L	<1.0	1.0	7437805				1.1	1.0	7437805
Cation Sum	me/L	31.6	N/A	7437804				16.8	N/A	7437804
Hardness (CaCO3)	mg/L	1500	1.0	7437803				810	1.0	7437803
Ion Balance (% Difference)	%	3.01	N/A	7437802				3.97	N/A	7437802
Langelier Index (@ 20C)	N/A	1.06		7437806				0.909		7437806
Langelier Index (@ 4C)	N/A	0.821		7437807				0.663		7437807
Saturation pH (@ 20C)	N/A	6.70		7437806				6.91		7437806
Saturation pH (@ 4C)	N/A	6.95		7437807				7.15		7437807
Inorganics										
Total Ammonia-N	mg/L	0.11	0.050	7441336	0.10	0.050	7441336	0.064	0.050	7441345
Conductivity	umho/cm	2400	1.0	7442510				1400	1.0	7442510
Dissolved Organic Carbon	mg/L	1.1	0.40	7441338				0.67	0.40	7441338
Orthophosphate (P)	mg/L	<0.010	0.010	7442183				<0.010	0.010	7442183
pH	pH	7.77		7442511				7.82		7442511
Dissolved Sulphate (SO4)	mg/L	1300	10	7442181				570	5.0	7442181
Alkalinity (Total as CaCO3)	mg/L	180	1.0	7442502				180	1.0	7442502
Dissolved Chloride (Cl-)	mg/L	3.9	1.0	7442173				2.0	1.0	7442173
Nitrite (N)	mg/L	<0.010	0.010	7442218				<0.010	0.010	7442218
Nitrate (N)	mg/L	<0.10	0.10	7442218				<0.10	0.10	7442218
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7442218				<0.10	0.10	7442218
Metals										
Dissolved Aluminum (Al)	ug/L	<4.9	4.9	7439514				<4.9	4.9	7439514
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7439514				<0.50	0.50	7439514
Dissolved Arsenic (As)	ug/L	9.6	1.0	7439514				<1.0	1.0	7439514
Dissolved Barium (Ba)	ug/L	10	2.0	7439514				6.6	2.0	7439514
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7439514				<0.40	0.40	7439514
Dissolved Boron (B)	ug/L	89	10	7439514				58	10	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF179			PYF179			PYF180		
Sampling Date		2021/06/25 11:00			2021/06/25 11:00			2021/06/25 11:45		
COC Number		831949-08-01			831949-08-01			831949-08-01		
	UNITS	MW20-25A	RDL	QC Batch	MW20-25A Lab-Dup	RDL	QC Batch	MW20-25B	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7439514				<0.090	0.090	7439514
Dissolved Calcium (Ca)	ug/L	490000	400	7439514				240000	200	7439514
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7439514				<5.0	5.0	7439514
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7439514				<0.50	0.50	7439514
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7439514				<0.90	0.90	7439514
Dissolved Iron (Fe)	ug/L	460	100	7439514				330	100	7439514
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7439514				<0.50	0.50	7439514
Dissolved Magnesium (Mg)	ug/L	77000	50	7439514				53000	50	7439514
Dissolved Manganese (Mn)	ug/L	36	2.0	7439514				20	2.0	7439514
Dissolved Molybdenum (Mo)	ug/L	8.7	0.50	7439514				9.0	0.50	7439514
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7439514				<1.0	1.0	7439514
Dissolved Phosphorus (P)	ug/L	<100	100	7439514				<100	100	7439514
Dissolved Potassium (K)	ug/L	2700	200	7439514				1800	200	7439514
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7439514				<2.0	2.0	7439514
Dissolved Silicon (Si)	ug/L	5400	50	7439514				5400	50	7439514
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7439514				<0.090	0.090	7439514
Dissolved Sodium (Na)	ug/L	18000	100	7439514				11000	100	7439514
Dissolved Strontium (Sr)	ug/L	8100	1.0	7439514				4400	1.0	7439514
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7439514				<0.050	0.050	7439514
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7439514				<5.0	5.0	7439514
Dissolved Uranium (U)	ug/L	<0.10	0.10	7439514				<0.10	0.10	7439514
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7439514				<0.50	0.50	7439514
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7439514				<5.0	5.0	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H7092
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF180			PYF181		PYF182		
Sampling Date		2021/06/25 11:45			2021/06/25 13:45		2021/06/25 14:00		
COC Number		831949-08-01			831949-08-01		831949-08-01		
	UNITS	MW20-25B Lab-Dup	RDL	QC Batch	MW20-24A	RDL	MW20-24B	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L				7.93	N/A	11.5	N/A	7437804
Bicarb. Alkalinity (calc. as CaCO3)	mg/L				270	1.0	290	1.0	7437805
Calculated TDS	mg/L				430	1.0	620	1.0	7437809
Carb. Alkalinity (calc. as CaCO3)	mg/L				2.0	1.0	1.9	1.0	7437805
Cation Sum	me/L				8.48	N/A	11.9	N/A	7437804
Hardness (CaCO3)	mg/L				350	1.0	500	1.0	7437803
Ion Balance (% Difference)	%				3.36	N/A	1.67	N/A	7437802
Langelier Index (@ 20C)	N/A				0.780		0.916		7437806
Langelier Index (@ 4C)	N/A				0.532		0.669		7437807
Saturation pH (@ 20C)	N/A				7.12		6.93		7437806
Saturation pH (@ 4C)	N/A				7.37		7.17		7437807
Inorganics									
Total Ammonia-N	mg/L				0.094	0.050	<0.050	0.050	7441336
Conductivity	umho/cm				770	1.0	1200	1.0	7442510
Dissolved Organic Carbon	mg/L	0.71	0.40	7441338	2.4	0.40	0.63	0.40	7441338
Orthophosphate (P)	mg/L				<0.010	0.010	<0.010	0.010	7442183
pH	pH				7.90		7.84		7442511
Dissolved Sulphate (SO4)	mg/L				79	1.0	36	1.0	7442181
Alkalinity (Total as CaCO3)	mg/L				270	1.0	290	1.0	7442502
Dissolved Chloride (Cl-)	mg/L				31	1.0	170	2.0	7442173
Nitrite (N)	mg/L				<0.010	0.010	<0.010	0.010	7442218
Nitrate (N)	mg/L				<0.10	0.10	0.98	0.10	7442218
Nitrate + Nitrite (N)	mg/L				<0.10	0.10	0.98	0.10	7442218
Metals									
Dissolved Aluminum (Al)	ug/L				79	4.9	<4.9	4.9	7439514
Dissolved Antimony (Sb)	ug/L				<0.50	0.50	<0.50	0.50	7439514
Dissolved Arsenic (As)	ug/L				<1.0	1.0	<1.0	1.0	7439514
Dissolved Barium (Ba)	ug/L				56	2.0	120	2.0	7439514
Dissolved Beryllium (Be)	ug/L				<0.40	0.40	<0.40	0.40	7439514
Dissolved Boron (B)	ug/L				31	10	24	10	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF180			PYF181		PYF182		
Sampling Date		2021/06/25 11:45			2021/06/25 13:45		2021/06/25 14:00		
COC Number		831949-08-01			831949-08-01		831949-08-01		
	UNITS	MW20-25B Lab-Dup	RDL	QC Batch	MW20-24A	RDL	MW20-24B	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L				<0.090	0.090	0.29	0.090	7439514
Dissolved Calcium (Ca)	ug/L				79000	200	130000	200	7439514
Dissolved Chromium (Cr)	ug/L				<5.0	5.0	<5.0	5.0	7439514
Dissolved Cobalt (Co)	ug/L				<0.50	0.50	<0.50	0.50	7439514
Dissolved Copper (Cu)	ug/L				5.4	0.90	2.1	0.90	7439514
Dissolved Iron (Fe)	ug/L				640	100	460	100	7439514
Dissolved Lead (Pb)	ug/L				0.72	0.50	<0.50	0.50	7439514
Dissolved Magnesium (Mg)	ug/L				38000	50	45000	50	7439514
Dissolved Manganese (Mn)	ug/L				27	2.0	20	2.0	7439514
Dissolved Molybdenum (Mo)	ug/L				20	0.50	1.7	0.50	7439514
Dissolved Nickel (Ni)	ug/L				1.7	1.0	2.1	1.0	7439514
Dissolved Phosphorus (P)	ug/L				<100	100	<100	100	7439514
Dissolved Potassium (K)	ug/L				1700	200	1300	200	7439514
Dissolved Selenium (Se)	ug/L				<2.0	2.0	<2.0	2.0	7439514
Dissolved Silicon (Si)	ug/L				5200	50	6600	50	7439514
Dissolved Silver (Ag)	ug/L				<0.090	0.090	<0.090	0.090	7439514
Dissolved Sodium (Na)	ug/L				31000	100	41000	100	7439514
Dissolved Strontium (Sr)	ug/L				130	1.0	170	1.0	7439514
Dissolved Thallium (Tl)	ug/L				<0.050	0.050	<0.050	0.050	7439514
Dissolved Titanium (Ti)	ug/L				<5.0	5.0	<5.0	5.0	7439514
Dissolved Uranium (U)	ug/L				0.20	0.10	0.70	0.10	7439514
Dissolved Vanadium (V)	ug/L				<0.50	0.50	<0.50	0.50	7439514
Dissolved Zinc (Zn)	ug/L				7.6	5.0	180	5.0	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF183			PYF183		
Sampling Date		2021/06/25			2021/06/25		
COC Number		831949-08-01			831949-08-01		
	UNITS	DUP-6	RDL	QC Batch	DUP-6 Lab-Dup	RDL	QC Batch
Calculated Parameters							
Anion Sum	me/L	15.8	N/A	7437804			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	180	1.0	7437805			
Calculated TDS	mg/L	1000	1.0	7437809			
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.0	1.0	7437805			
Cation Sum	me/L	16.9	N/A	7437804			
Hardness (CaCO3)	mg/L	820	1.0	7437803			
Ion Balance (% Difference)	%	3.44	N/A	7437802			
Langelier Index (@ 20C)	N/A	0.871		7437806			
Langelier Index (@ 4C)	N/A	0.625		7437807			
Saturation pH (@ 20C)	N/A	6.91		7437806			
Saturation pH (@ 4C)	N/A	7.16		7437807			
Inorganics							
Total Ammonia-N	mg/L	0.078	0.050	7441345			
Conductivity	umho/cm	1400	1.0	7442510			
Dissolved Organic Carbon	mg/L	0.66	0.40	7441338			
Orthophosphate (P)	mg/L	<0.010	0.010	7442183	<0.010	0.010	7442183
pH	pH	7.78		7442511			
Dissolved Sulphate (SO4)	mg/L	580	5.0	7442181	590	5.0	7442181
Alkalinity (Total as CaCO3)	mg/L	180	1.0	7442502			
Dissolved Chloride (Cl-)	mg/L	1.5	1.0	7442173	2.1	1.0	7442173
Nitrite (N)	mg/L	<0.010	0.010	7442218			
Nitrate (N)	mg/L	<0.10	0.10	7442218			
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7442218			
Metals							
Dissolved Aluminum (Al)	ug/L	<4.9	4.9	7439514	<4.9	4.9	7439514
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7439514	<0.50	0.50	7439514
Dissolved Arsenic (As)	ug/L	<1.0	1.0	7439514	<1.0	1.0	7439514
Dissolved Barium (Ba)	ug/L	6.9	2.0	7439514	6.6	2.0	7439514
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7439514	<0.40	0.40	7439514
Dissolved Boron (B)	ug/L	47	10	7439514	48	10	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYF183			PYF183		
Sampling Date		2021/06/25			2021/06/25		
COC Number		831949-08-01			831949-08-01		
	UNITS	DUP-6	RDL	QC Batch	DUP-6 Lab-Dup	RDL	QC Batch
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7439514	<0.090	0.090	7439514
Dissolved Calcium (Ca)	ug/L	240000	200	7439514	240000	200	7439514
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7439514	<5.0	5.0	7439514
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7439514	<0.50	0.50	7439514
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7439514	<0.90	0.90	7439514
Dissolved Iron (Fe)	ug/L	330	100	7439514	330	100	7439514
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7439514	<0.50	0.50	7439514
Dissolved Magnesium (Mg)	ug/L	53000	50	7439514	52000	50	7439514
Dissolved Manganese (Mn)	ug/L	21	2.0	7439514	20	2.0	7439514
Dissolved Molybdenum (Mo)	ug/L	8.8	0.50	7439514	8.8	0.50	7439514
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7439514	<1.0	1.0	7439514
Dissolved Phosphorus (P)	ug/L	<100	100	7439514	<100	100	7439514
Dissolved Potassium (K)	ug/L	1800	200	7439514	1800	200	7439514
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7439514	<2.0	2.0	7439514
Dissolved Silicon (Si)	ug/L	5400	50	7439514	5400	50	7439514
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7439514	<0.090	0.090	7439514
Dissolved Sodium (Na)	ug/L	11000	100	7439514	11000	100	7439514
Dissolved Strontium (Sr)	ug/L	4600	1.0	7439514	4500	1.0	7439514
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7439514	<0.050	0.050	7439514
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7439514	<5.0	5.0	7439514
Dissolved Uranium (U)	ug/L	<0.10	0.10	7439514	<0.10	0.10	7439514
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7439514	<0.50	0.50	7439514
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7439514	<5.0	5.0	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PYF177	PYF180	PYF182	PYF183			PYF183		
Sampling Date		2021/06/25 12:15	2021/06/25 11:45	2021/06/25 14:00	2021/06/25			2021/06/25		
COC Number		831949-08-01	831949-08-01	831949-08-01	831949-08-01			831949-08-01		
	UNITS	MW20-15B	MW20-25B	MW20-24B	DUP-6	RDL	QC Batch	DUP-6 Lab-Dup	RDL	QC Batch
BTEX & F1 Hydrocarbons										
Benzene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7443249			
Toluene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7443249			
Ethylbenzene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7443249			
o-Xylene	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	7443249			
p+m-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	7443249			
Total Xylenes	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	7443249			
F1 (C6-C10)	ug/L	<25	<25	<25	<25	25	7443249			
F1 (C6-C10) - BTEX	ug/L	<25	<25	<25	<25	25	7443249			
F2-F4 Hydrocarbons										
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	<100	<100	100	7441556	<100	100	7441556
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	<200	<200	200	7441556	<200	200	7441556
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	<200	<200	200	7441556	<200	200	7441556
Reached Baseline at C50	ug/L	Yes	Yes	Yes	Yes		7441556	Yes		7441556
Surrogate Recovery (%)										
1,4-Difluorobenzene	%	99	98	99	97		7443249			
4-Bromofluorobenzene	%	89	90	90	89		7443249			
D10-o-Xylene	%	100	99	99	97		7443249			
D4-1,2-Dichloroethane	%	97	93	95	97		7443249			
o-Terphenyl	%	95	94	94	93		7441556	94		7441556

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H7092
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

TEST SUMMARY

BV Labs ID: PYF176
Sample ID: MW20-15A
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442687	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYF177
Sample ID: MW20-15B
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7443249	N/A	2021/07/05	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441556	2021/07/02	2021/07/03	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441336	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442216	N/A	2021/07/02	Chandra Nandlal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H7092
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

TEST SUMMARY

BV Labs ID: PYF178
Sample ID: MW20-15C
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7439424	N/A	2021/06/30	Nimarta Singh
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYF179
Sample ID: MW20-25A
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441336	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PYF179 Dup
Sample ID: MW20-25A
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Ammonia-N	LACH/NH4	7441336	N/A	2021/07/05	Amanpreet Sappal

BV Labs ID: PYF180
Sample ID: MW20-25B
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7443249	N/A	2021/07/05	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441556	2021/07/02	2021/07/03	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYF180 Dup
Sample ID: MW20-25B
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh

BV Labs ID: PYF181
Sample ID: MW20-24A
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk

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TEST SUMMARY

BV Labs ID: PYF181
Sample ID: MW20-24A
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441336	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYF182
Sample ID: MW20-24B
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7443249	N/A	2021/07/05	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441556	2021/07/02	2021/07/03	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441336	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYF183
Sample ID: DUP-6
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7442502	N/A	2021/07/05	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1H7092
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: CS

TEST SUMMARY

BV Labs ID: PYF183
Sample ID: DUP-6
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7442510	N/A	2021/07/05	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7443249	N/A	2021/07/05	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441556	2021/07/02	2021/07/03	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7442511	2021/07/02	2021/07/05	Surinder Rai
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYF183 Dup
Sample ID: DUP-6
Matrix: Water

Collected: 2021/06/25
Shipped:
Received: 2021/06/26

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7442173	N/A	2021/07/05	Alina Dobreanu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441556	2021/07/02	2021/07/03	Ravinder Gaidhu
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Orthophosphate	KONE	7442183	N/A	2021/07/05	Avneet Kour Sudan
Sulphate by Automated Colourimetry	KONE	7442181	N/A	2021/07/05	Alina Dobreanu

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.7°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7441556	o-Terphenyl	2021/07/03	95	60 - 130	96	60 - 130	94	%		
7443249	1,4-Difluorobenzene	2021/07/05	95	70 - 130	98	70 - 130	98	%		
7443249	4-Bromofluorobenzene	2021/07/05	91	70 - 130	93	70 - 130	89	%		
7443249	D10-o-Xylene	2021/07/05	88	70 - 130	95	70 - 130	100	%		
7443249	D4-1,2-Dichloroethane	2021/07/05	93	70 - 130	90	70 - 130	95	%		
7439424	Dissolved Organic Carbon	2021/06/30	95	80 - 120	98	80 - 120	<0.40	mg/L	0.99	20
7439514	Dissolved Aluminum (Al)	2021/07/02	101	80 - 120	101	80 - 120	<4.9	ug/L	NC	20
7439514	Dissolved Antimony (Sb)	2021/07/02	104	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Arsenic (As)	2021/07/02	103	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7439514	Dissolved Barium (Ba)	2021/07/02	102	80 - 120	98	80 - 120	<2.0	ug/L	3.5	20
7439514	Dissolved Beryllium (Be)	2021/07/02	103	80 - 120	100	80 - 120	<0.40	ug/L	NC	20
7439514	Dissolved Boron (B)	2021/07/02	98	80 - 120	96	80 - 120	<10	ug/L	2.1	20
7439514	Dissolved Cadmium (Cd)	2021/07/02	101	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7439514	Dissolved Calcium (Ca)	2021/07/02	NC	80 - 120	100	80 - 120	<200	ug/L	0.63	20
7439514	Dissolved Chromium (Cr)	2021/07/02	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7439514	Dissolved Cobalt (Co)	2021/07/02	103	80 - 120	105	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Copper (Cu)	2021/07/02	106	80 - 120	103	80 - 120	<0.90	ug/L	NC	20
7439514	Dissolved Iron (Fe)	2021/07/02	101	80 - 120	100	80 - 120	<100	ug/L	2.1	20
7439514	Dissolved Lead (Pb)	2021/07/02	102	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Magnesium (Mg)	2021/07/02	NC	80 - 120	102	80 - 120	<50	ug/L	2.1	20
7439514	Dissolved Manganese (Mn)	2021/07/02	97	80 - 120	96	80 - 120	<2.0	ug/L	2.6	20
7439514	Dissolved Molybdenum (Mo)	2021/07/02	106	80 - 120	99	80 - 120	<0.50	ug/L	0.43	20
7439514	Dissolved Nickel (Ni)	2021/07/02	98	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
7439514	Dissolved Phosphorus (P)	2021/07/02	102	80 - 120	101	80 - 120	<100	ug/L	NC	20
7439514	Dissolved Potassium (K)	2021/07/02	102	80 - 120	100	80 - 120	<200	ug/L	0.43	20
7439514	Dissolved Selenium (Se)	2021/07/02	103	80 - 120	102	80 - 120	<2.0	ug/L	NC	20
7439514	Dissolved Silicon (Si)	2021/07/02	100	80 - 120	97	80 - 120	<50	ug/L	0.98	20
7439514	Dissolved Silver (Ag)	2021/07/02	100	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7439514	Dissolved Sodium (Na)	2021/07/02	104	80 - 120	102	80 - 120	<100	ug/L	1.7	20
7439514	Dissolved Strontium (Sr)	2021/07/02	NC	80 - 120	90	80 - 120	<1.0	ug/L	2.2	20
7439514	Dissolved Thallium (Tl)	2021/07/02	107	80 - 120	102	80 - 120	<0.050	ug/L	NC	20

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7439514	Dissolved Titanium (Ti)	2021/07/02	96	80 - 120	94	80 - 120	<5.0	ug/L	NC	20
7439514	Dissolved Uranium (U)	2021/07/02	101	80 - 120	97	80 - 120	<0.10	ug/L	NC	20
7439514	Dissolved Vanadium (V)	2021/07/02	101	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Zinc (Zn)	2021/07/02	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7441336	Total Ammonia-N	2021/07/05	96	75 - 125	101	80 - 120	<0.050	mg/L	6.3	20
7441338	Dissolved Organic Carbon	2021/07/02	94	80 - 120	92	80 - 120	<0.40	mg/L	5.9	20
7441345	Total Ammonia-N	2021/07/05	96	75 - 125	99	80 - 120	<0.050	mg/L	NC	20
7441556	F2 (C10-C16 Hydrocarbons)	2021/07/03	107	60 - 130	108	60 - 130	<100	ug/L	NC	30
7441556	F3 (C16-C34 Hydrocarbons)	2021/07/03	108	60 - 130	110	60 - 130	<200	ug/L	NC	30
7441556	F4 (C34-C50 Hydrocarbons)	2021/07/03	110	60 - 130	110	60 - 130	<200	ug/L	NC	30
7442173	Dissolved Chloride (Cl-)	2021/07/05	116	80 - 120	104	80 - 120	<1.0	mg/L	NC	20
7442181	Dissolved Sulphate (SO4)	2021/07/05	NC	75 - 125	102	80 - 120	<1.0	mg/L	1.2	20
7442183	Orthophosphate (P)	2021/07/05	105	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
7442216	Nitrate (N)	2021/07/02	94	80 - 120	99	80 - 120	<0.10	mg/L	2.8	20
7442216	Nitrite (N)	2021/07/02	103	80 - 120	108	80 - 120	<0.010	mg/L	NC	20
7442218	Nitrate (N)	2021/07/05	87	80 - 120	99	80 - 120	<0.10	mg/L	0.50	20
7442218	Nitrite (N)	2021/07/05	100	80 - 120	103	80 - 120	<0.010	mg/L	11	20
7442502	Alkalinity (Total as CaCO3)	2021/07/06			97	85 - 115	<1.0	mg/L	0.34	20
7442510	Conductivity	2021/07/05			103	85 - 115	<1.0	umho/cm	0.14	25
7442511	pH	2021/07/05			102	98 - 103			0.21	N/A
7442687	Nitrate (N)	2021/07/05	96	80 - 120	98	80 - 120	<0.10	mg/L	0.38	20
7442687	Nitrite (N)	2021/07/05	103	80 - 120	104	80 - 120	<0.010	mg/L	5.3	20
7443249	Benzene	2021/07/05	94	50 - 140	99	50 - 140	<0.20	ug/L	NC	30
7443249	Ethylbenzene	2021/07/05	103	50 - 140	110	50 - 140	<0.20	ug/L	NC	30
7443249	F1 (C6-C10) - BTEX	2021/07/05					<25	ug/L	NC	30
7443249	F1 (C6-C10)	2021/07/05	84	60 - 140	89	60 - 140	<25	ug/L	NC	30
7443249	o-Xylene	2021/07/05	100	50 - 140	107	50 - 140	<0.20	ug/L	NC	30
7443249	p+m-Xylene	2021/07/05	111	50 - 140	122	50 - 140	<0.40	ug/L	NC	30
7443249	Toluene	2021/07/05	98	50 - 140	105	50 - 140	<0.20	ug/L	NC	30

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7443249	Total Xylenes	2021/07/05					<0.40	ug/L	NC	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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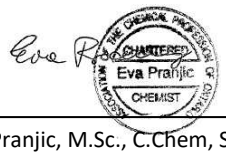
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

Page of

26-Jun-21 10:13
Ema Gitej
C1H7092
URE ENV 1359

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:	
Address:	210 Sheldon Drive	Address:		Project:	19129150 (2300)
	Cambridge ON N1T 1A8			Project Name:	
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Site #:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Sampled By:	CS + VP

ly:
Bottle Order #: 831949
COC #: C#831949-08-01
Project Manager: Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O.Reg 153 PHCs, BTEX/F1-F4								# of Bottles	Comments
1		MW20-15A	June 25 2021	13:30	GW	Y	✓	~~✓~~								4	
2		MW20-15B	↓	12:15	↓	Y	✓	✓								8	
3		MW20-15C	↓	13:15	↓	Y	✓									4	
4		MW20-25A	↓	1100	↓	Y	✓									4	
5		MW20-25B	↓	1145	↓	Y	✓	✓								8	
6		MW20-24A*	↓	1345	↓	Y	✓		*Field filtered, not preserved, lab to preserve							4	
7		MW20-24B	↓	1400	↓	Y	✓	✓								8	
8		DUP-6	↓	—	↓	Y	✓	✓								8	
9																	
10																	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
Claire Steckle / C Steckle	21/06/25	1630	[signature]	021/06/25	1659			14/17/16	Present		✓
									Intact		✓

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

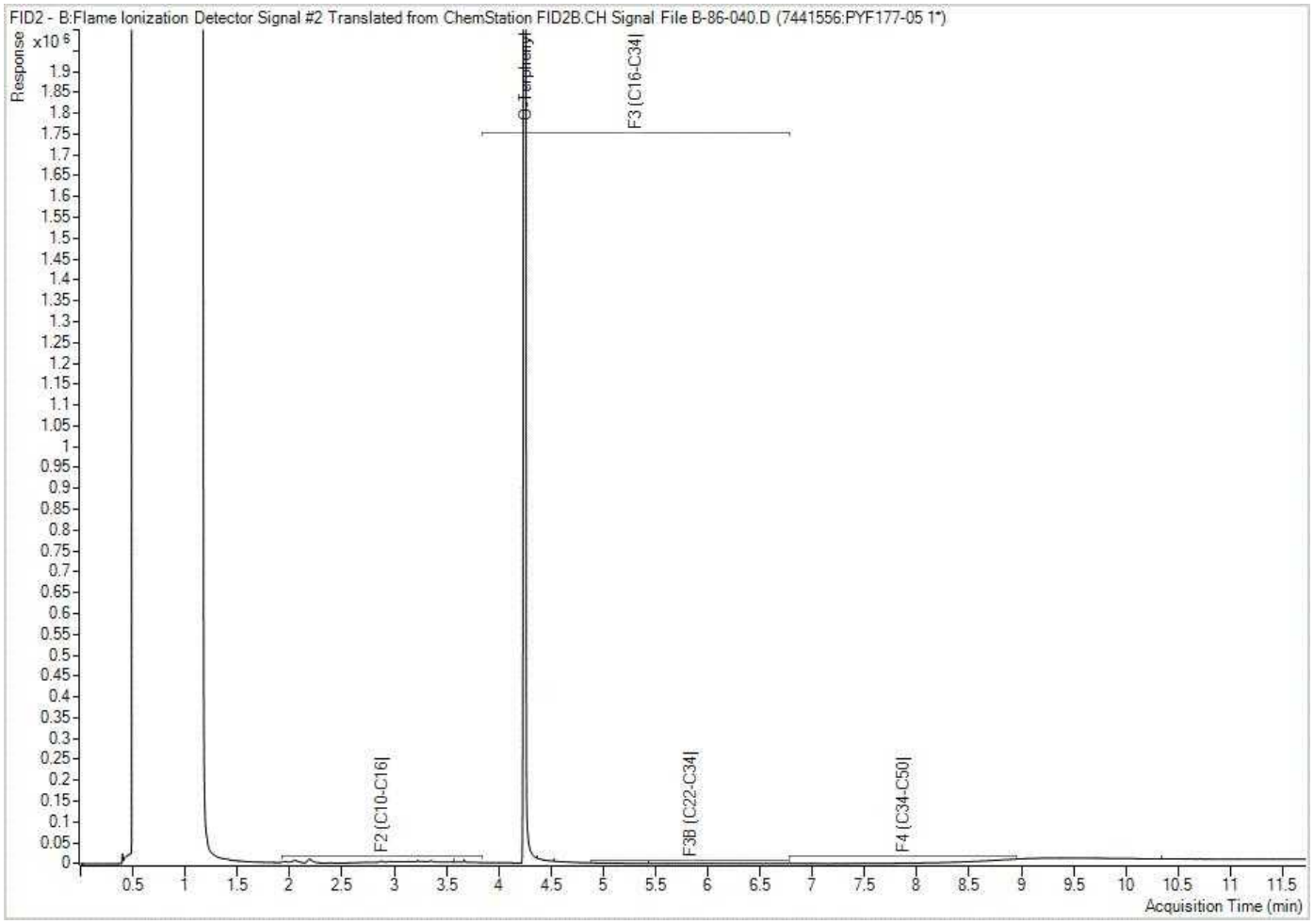
White: BV Labs Yellow: Client
UV Ice

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C1H7092
Report Date: 2021/07/08
BV Labs Sample: PYF177

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-15B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

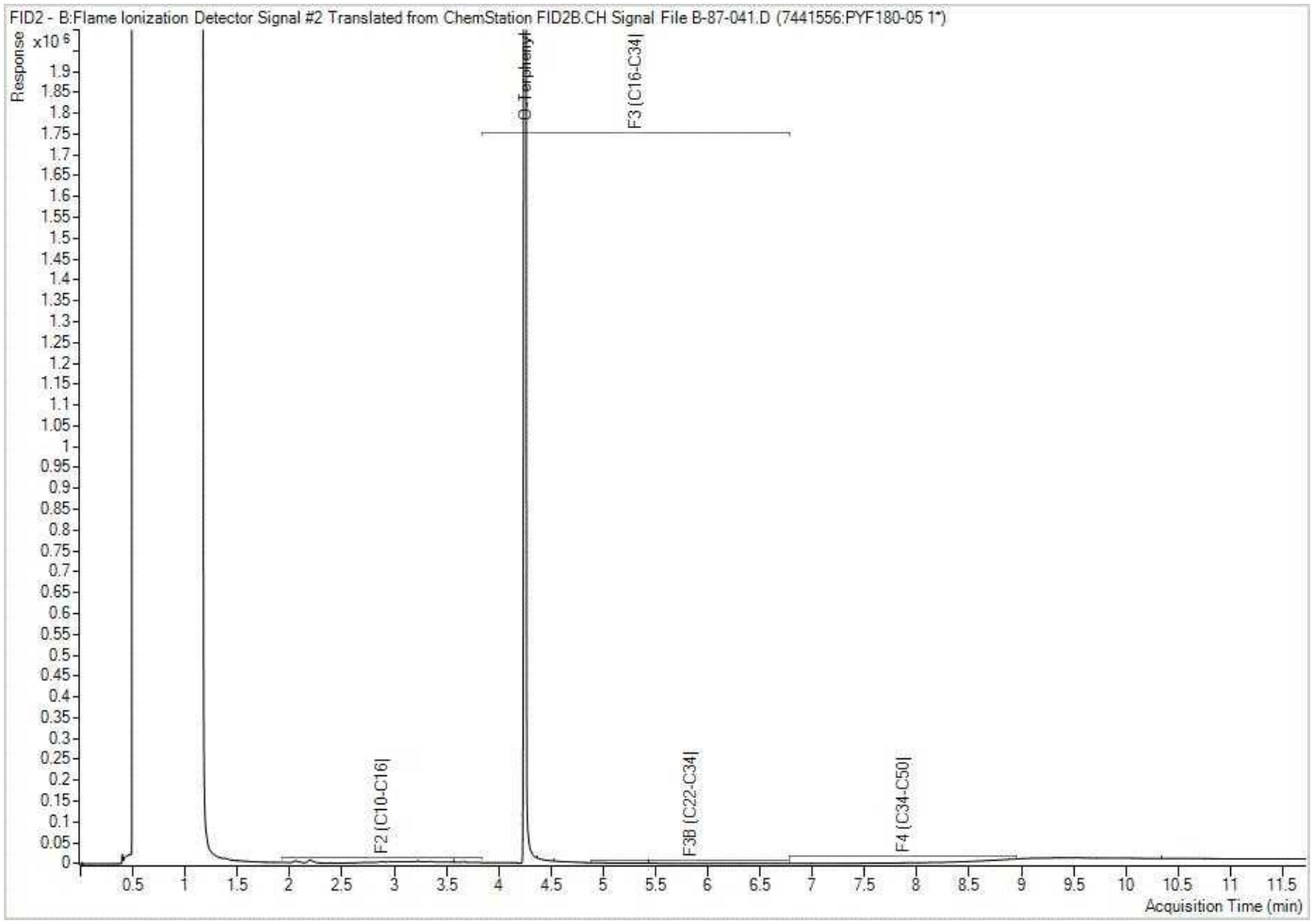


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7092
Report Date: 2021/07/08
BV Labs Sample: PYF180

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-25B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

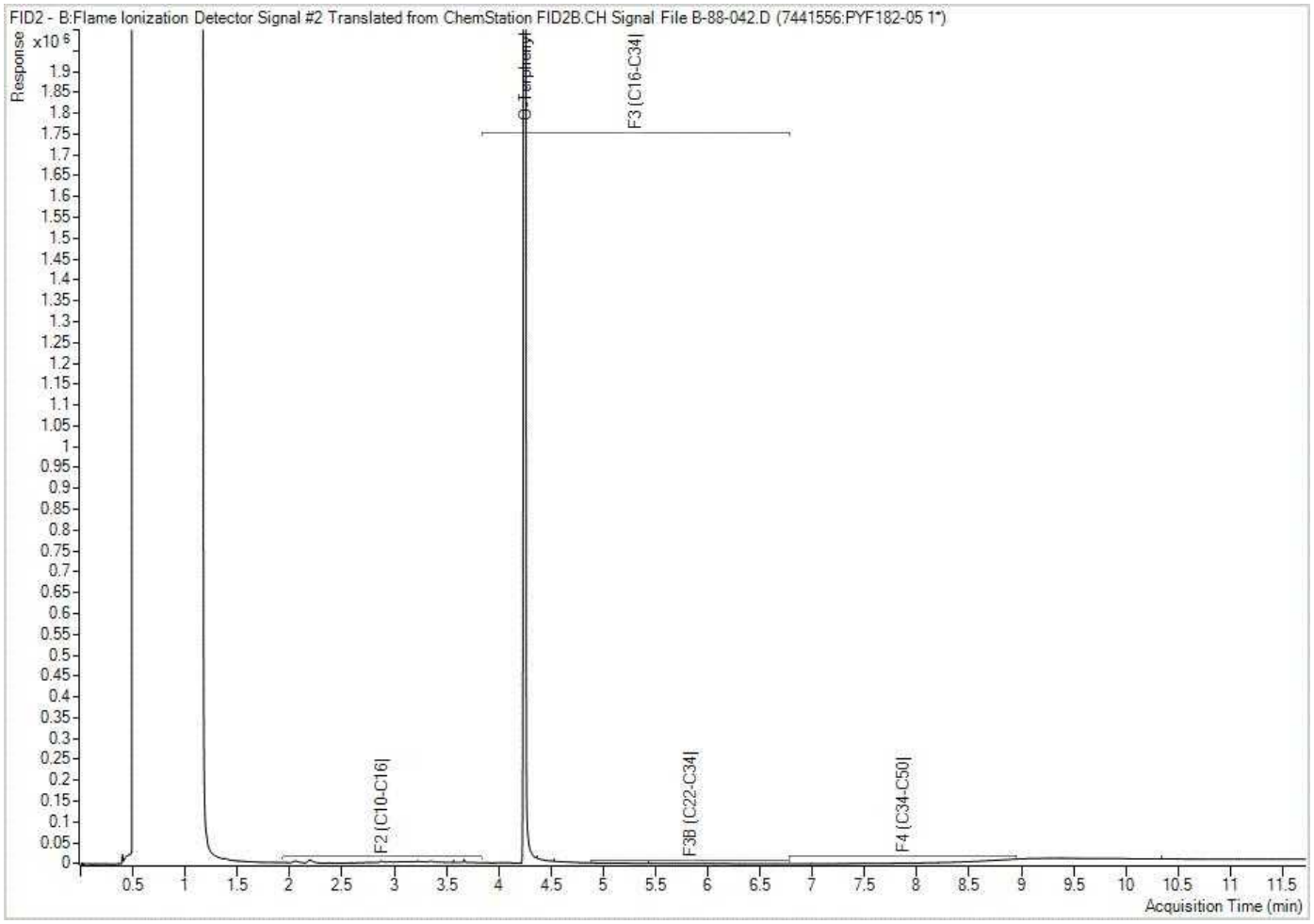


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7092
Report Date: 2021/07/08
BV Labs Sample: PYF182

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-24B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

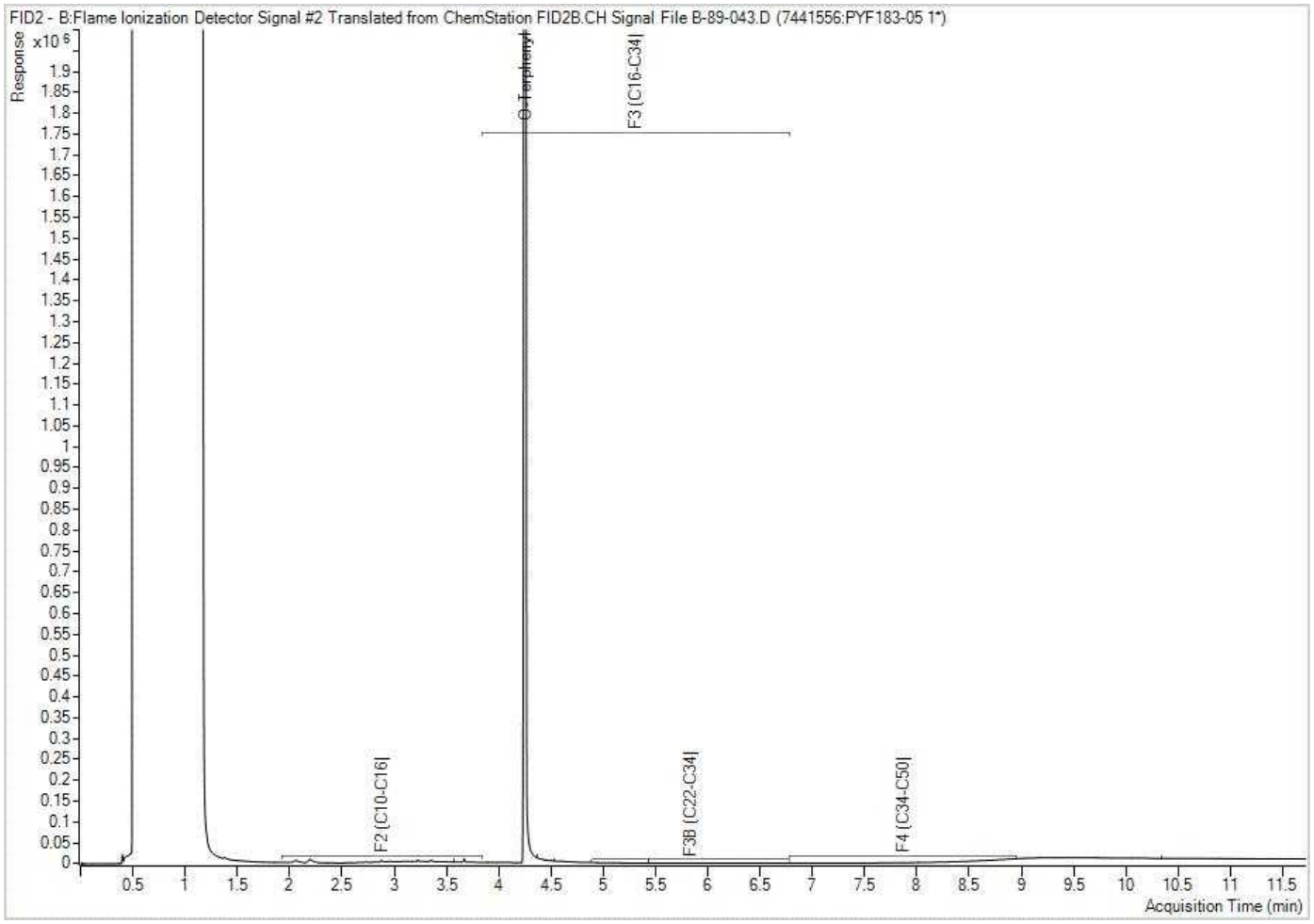


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7092
Report Date: 2021/07/08
BV Labs Sample: PYF183

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP-6

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

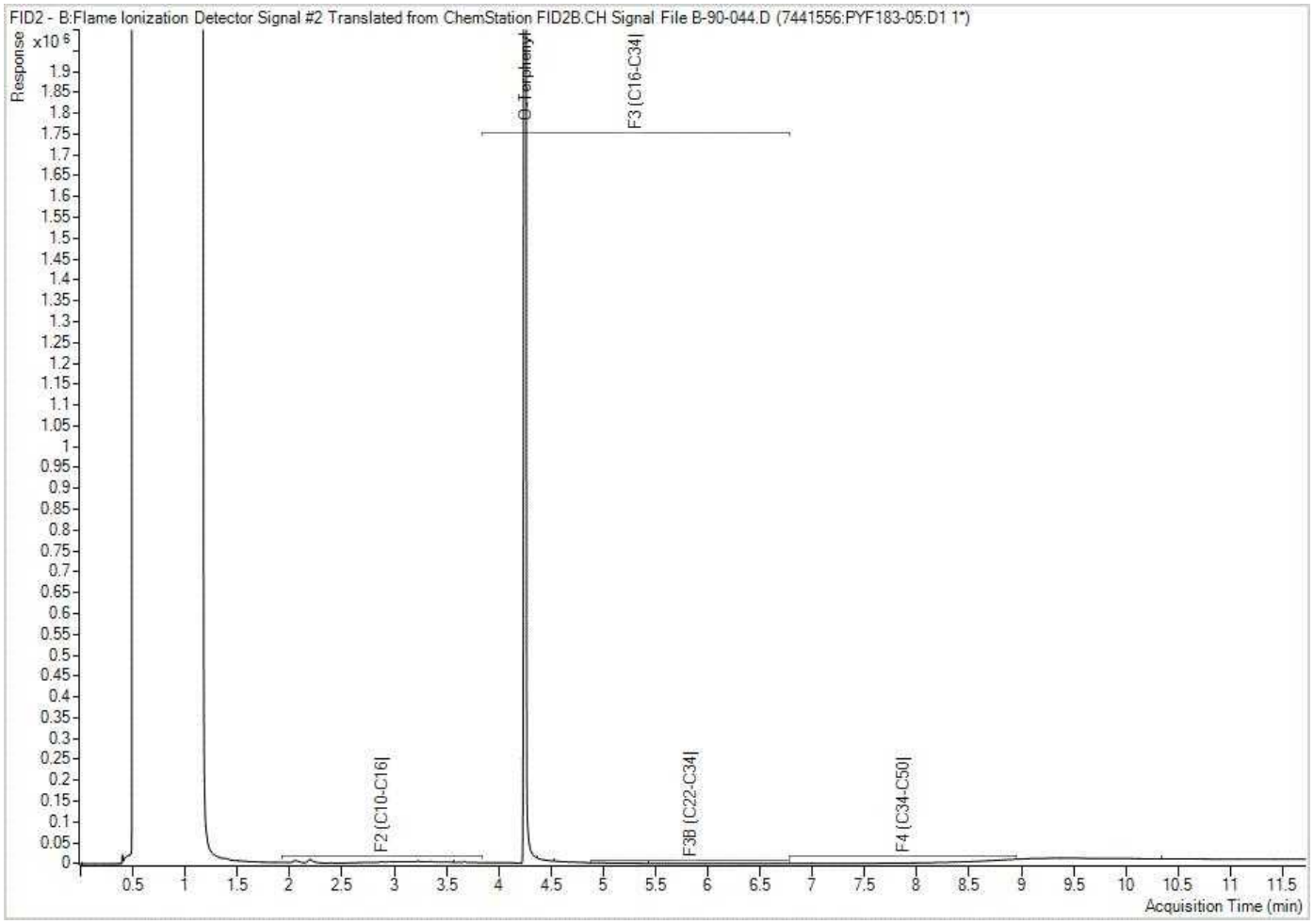


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1H7092
Report Date: 2021/07/08
BV Labs Sample: PYF183 Lab-Dup

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: DUP-6

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-09-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/08
Report #: R6709541
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1I0177
Received: 2021/06/28, 16:35

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	4	N/A	2021/07/06	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2021/07/06	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2021/07/05	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	4	N/A	2021/07/06	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2021/06/30	CAM SOP-00446	SM 23 5310 B m
Dissolved Organic Carbon (DOC) (1)	3	N/A	2021/07/02	CAM SOP-00446	SM 23 5310 B m
Petroleum Hydro. CCME F1 & BTEX in Water	2	N/A	2021/07/05	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (2)	2	2021/07/02	2021/07/03	CAM SOP-00316	CCME PHC-CWS m
Hardness (calculated as CaCO3)	3	N/A	2021/07/02	CAM SOP 00102/00408/00447	SM 2340 B
Hardness (calculated as CaCO3)	1	N/A	2021/07/05	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	4	N/A	2021/07/02	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	4	N/A	2021/07/06		
Anion and Cation Sum	4	N/A	2021/07/06		
Total Ammonia-N	4	N/A	2021/07/05	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (3)	4	N/A	2021/07/05	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	4	2021/07/02	2021/07/06	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	4	N/A	2021/07/05	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	4	N/A	2021/07/06		Auto Calc
Sat. pH and Langelier Index (@ 4C)	4	N/A	2021/07/06		Auto Calc
Sulphate by Automated Colourimetry	4	N/A	2021/07/05	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	4	N/A	2021/07/06		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement

Your Project #: 19129150 (2300)
Your C.O.C. #: 831949-09-01

Attention: Gregory Padusenko

Golder Associates Ltd
210 Sheldon Drive
Cambridge, ON
CANADA N1T 1A8

Report Date: 2021/07/08
Report #: R6709541
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1I0177
Received: 2021/06/28, 16:35

Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1I0177
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: AK

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYW902			PYW902			PYW903		
Sampling Date		2021/06/28			2021/06/28			2021/06/28		
COC Number		831949-09-01			831949-09-01			831949-09-01		
	UNITS	MW20-16A	RDL	QC Batch	MW20-16A Lab-Dup	RDL	QC Batch	MW20-16B	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	5.57	N/A	7437804				6.43	N/A	7437804
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	200	1.0	7437805				240	1.0	7437805
Calculated TDS	mg/L	290	1.0	7437809				350	1.0	7437809
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.2	1.0	7437805				5.2	1.0	7437805
Cation Sum	me/L	5.04	N/A	7437804				6.56	N/A	7437804
Hardness (CaCO3)	mg/L	230	1.0	7437803				180	1.0	7437803
Ion Balance (% Difference)	%	4.96	N/A	7437802				1.02	N/A	7437802
Langelier Index (@ 20C)	N/A	0.842		7437806				0.822		7437806
Langelier Index (@ 4C)	N/A	0.593		7437807				0.573		7437807
Saturation pH (@ 20C)	N/A	7.38		7437806				7.54		7437806
Saturation pH (@ 4C)	N/A	7.63		7437807				7.78		7437807
Inorganics										
Total Ammonia-N	mg/L	0.063	0.050	7441345				0.23	0.050	7441345
Conductivity	umho/cm	520	1.0	7441777				590	1.0	7441777
Dissolved Organic Carbon	mg/L	0.66	0.40	7441338				2.5	0.40	7439424
Orthophosphate (P)	mg/L	<0.010	0.010	7441833				<0.010	0.010	7441833
pH	pH	8.22		7441778				8.36		7441778
Dissolved Sulphate (SO4)	mg/L	58	1.0	7441832				29	1.0	7441832
Alkalinity (Total as CaCO3)	mg/L	210	1.0	7441747				250	1.0	7441747
Dissolved Chloride (Cl-)	mg/L	8.5	1.0	7441814				32	1.0	7441814
Nitrite (N)	mg/L	<0.010	0.010	7442218				<0.010	0.010	7442481
Nitrate (N)	mg/L	<0.10	0.10	7442218				<0.10	0.10	7442481
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7442218				<0.10	0.10	7442481
Metals										
Dissolved Aluminum (Al)	ug/L	5.8	4.9	7439414	5.6	4.9	7439414	6.6	4.9	7439514
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	7439414	<0.50	0.50	7439414	<0.50	0.50	7439514
Dissolved Arsenic (As)	ug/L	8.2	1.0	7439414	8.1	1.0	7439414	5.8	1.0	7439514
Dissolved Barium (Ba)	ug/L	42	2.0	7439414	42	2.0	7439414	73	2.0	7439514
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	7439414	<0.40	0.40	7439414	<0.40	0.40	7439514
Dissolved Boron (B)	ug/L	53	10	7439414	53	10	7439414	53	10	7439514
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	7439414	<0.090	0.090	7439414	<0.090	0.090	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYW902			PYW902			PYW903		
Sampling Date		2021/06/28			2021/06/28			2021/06/28		
COC Number		831949-09-01			831949-09-01			831949-09-01		
	UNITS	MW20-16A	RDL	QC Batch	MW20-16A Lab-Dup	RDL	QC Batch	MW20-16B	RDL	QC Batch
Dissolved Calcium (Ca)	ug/L	53000	200	7439414	53000	200	7439414	32000	200	7439514
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	7439414	<5.0	5.0	7439414	<5.0	5.0	7439514
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	7439414	<0.50	0.50	7439414	<0.50	0.50	7439514
Dissolved Copper (Cu)	ug/L	<0.90	0.90	7439414	<0.90	0.90	7439414	<0.90	0.90	7439514
Dissolved Iron (Fe)	ug/L	110	100	7439414	110	100	7439414	<100	100	7439514
Dissolved Lead (Pb)	ug/L	<0.50	0.50	7439414	<0.50	0.50	7439414	<0.50	0.50	7439514
Dissolved Magnesium (Mg)	ug/L	23000	50	7439414	23000	50	7439414	24000	50	7439514
Dissolved Manganese (Mn)	ug/L	11	2.0	7439414	10	2.0	7439414	21	2.0	7439514
Dissolved Molybdenum (Mo)	ug/L	4.6	0.50	7439414	4.5	0.50	7439414	35	0.50	7439514
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	7439414	<1.0	1.0	7439414	4.1	1.0	7439514
Dissolved Phosphorus (P)	ug/L	<100	100	7439414	<100	100	7439414	<100	100	7439514
Dissolved Potassium (K)	ug/L	2100	200	7439414	2100	200	7439414	1600	200	7439514
Dissolved Selenium (Se)	ug/L	<2.0	2.0	7439414	<2.0	2.0	7439414	<2.0	2.0	7439514
Dissolved Silicon (Si)	ug/L	5800	50	7439414	5800	50	7439414	5200	50	7439514
Dissolved Silver (Ag)	ug/L	<0.090	0.090	7439414	<0.090	0.090	7439414	<0.090	0.090	7439514
Dissolved Sodium (Na)	ug/L	11000	100	7439414	11000	100	7439414	67000	100	7439514
Dissolved Strontium (Sr)	ug/L	1000	1.0	7439414	1000	1.0	7439414	210	1.0	7439514
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	7439414	<0.050	0.050	7439414	<0.050	0.050	7439514
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	7439414	<5.0	5.0	7439414	<5.0	5.0	7439514
Dissolved Uranium (U)	ug/L	0.67	0.10	7439414	0.66	0.10	7439414	2.8	0.10	7439514
Dissolved Vanadium (V)	ug/L	<0.50	0.50	7439414	<0.50	0.50	7439414	<0.50	0.50	7439514
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	7439414	<5.0	5.0	7439414	<5.0	5.0	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1I0177
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: AK

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYW904		PYW905		
Sampling Date		2021/06/28		2021/06/28		
COC Number		831949-09-01		831949-09-01		
	UNITS	MW20-21A	RDL	MW20-21B	RDL	QC Batch
Calculated Parameters						
Anion Sum	me/L	27.5	N/A	7.21	N/A	7437804
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	200	1.0	290	1.0	7437805
Calculated TDS	mg/L	1800	1.0	410	1.0	7437809
Carb. Alkalinity (calc. as CaCO3)	mg/L	1.9	1.0	4.7	1.0	7437805
Cation Sum	me/L	28.6	N/A	8.22	N/A	7437804
Hardness (CaCO3)	mg/L	1400	1.0	350	1.0	7437803
Ion Balance (% Difference)	%	2.00	N/A	6.59	N/A	7437802
Langelier Index (@ 20C)	N/A	1.27		1.22		7437806
Langelier Index (@ 4C)	N/A	1.02		0.970		7437807
Saturation pH (@ 20C)	N/A	6.73		7.01		7437806
Saturation pH (@ 4C)	N/A	6.98		7.26		7437807
Inorganics						
Total Ammonia-N	mg/L	0.085	0.050	0.61	0.050	7441345
Conductivity	umho/cm	2100	1.0	640	1.0	7441777
Dissolved Organic Carbon	mg/L	0.92	0.40	5.5	0.40	7441338
Orthophosphate (P)	mg/L	<0.010	0.010	<0.010	0.010	7441833
pH	pH	8.00		8.23		7441778
Dissolved Sulphate (SO4)	mg/L	1100	10	56	1.0	7441832
Alkalinity (Total as CaCO3)	mg/L	200	1.0	300	1.0	7441747
Dissolved Chloride (Cl-)	mg/L	15	1.0	3.1	1.0	7441814
Nitrite (N)	mg/L	<0.010	0.010	<0.010	0.010	7442481
Nitrate (N)	mg/L	<0.10	0.10	<0.10	0.10	7442481
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	<0.10	0.10	7442481
Metals						
Dissolved Aluminum (Al)	ug/L	7.4	4.9	500	4.9	7439514
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	<0.50	0.50	7439514
Dissolved Arsenic (As)	ug/L	14	1.0	9.3	1.0	7439514
Dissolved Barium (Ba)	ug/L	17	2.0	130	2.0	7439514
Dissolved Beryllium (Be)	ug/L	<0.40	0.40	<0.40	0.40	7439514
Dissolved Boron (B)	ug/L	110	10	47	10	7439514
Dissolved Cadmium (Cd)	ug/L	<0.090	0.090	<0.090	0.090	7439514
Dissolved Calcium (Ca)	ug/L	390000	400	91000	200	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

RCAP - COMPREHENSIVE (WATER)

BV Labs ID		PYW904		PYW905		
Sampling Date		2021/06/28		2021/06/28		
COC Number		831949-09-01		831949-09-01		
	UNITS	MW20-21A	RDL	MW20-21B	RDL	QC Batch
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	<5.0	5.0	7439514
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	<0.50	0.50	7439514
Dissolved Copper (Cu)	ug/L	<0.90	0.90	3.1	0.90	7439514
Dissolved Iron (Fe)	ug/L	810	100	1100	100	7439514
Dissolved Lead (Pb)	ug/L	<0.50	0.50	2.1	0.50	7439514
Dissolved Magnesium (Mg)	ug/L	94000	50	30000	50	7439514
Dissolved Manganese (Mn)	ug/L	21	2.0	41	2.0	7439514
Dissolved Molybdenum (Mo)	ug/L	4.0	0.50	5.1	0.50	7439514
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	5.2	1.0	7439514
Dissolved Phosphorus (P)	ug/L	<100	100	<100	100	7439514
Dissolved Potassium (K)	ug/L	3200	200	1100	200	7439514
Dissolved Selenium (Se)	ug/L	<2.0	2.0	<2.0	2.0	7439514
Dissolved Silicon (Si)	ug/L	6600	50	10000	50	7439514
Dissolved Silver (Ag)	ug/L	<0.090	0.090	<0.090	0.090	7439514
Dissolved Sodium (Na)	ug/L	33000	100	25000	100	7439514
Dissolved Strontium (Sr)	ug/L	7100	1.0	1200	1.0	7439514
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	<0.050	0.050	7439514
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	23	5.0	7439514
Dissolved Uranium (U)	ug/L	0.20	0.10	1.8	0.10	7439514
Dissolved Vanadium (V)	ug/L	<0.50	0.50	1.2	0.50	7439514
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	9.8	5.0	7439514

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		PYW903	PYW905		
Sampling Date		2021/06/28	2021/06/28		
COC Number		831949-09-01	831949-09-01		
	UNITS	MW20-16B	MW20-21B	RDL	QC Batch
BTEX & F1 Hydrocarbons					
Benzene	ug/L	<0.20	<0.20	0.20	7443249
Toluene	ug/L	0.21	<0.20	0.20	7443249
Ethylbenzene	ug/L	<0.20	<0.20	0.20	7443249
o-Xylene	ug/L	<0.20	<0.20	0.20	7443249
p+m-Xylene	ug/L	<0.40	<0.40	0.40	7443249
Total Xylenes	ug/L	<0.40	<0.40	0.40	7443249
F1 (C6-C10)	ug/L	86	<25	25	7443249
F1 (C6-C10) - BTEX	ug/L	86	<25	25	7443249
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	7441624
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	200	7441624
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	7441624
Reached Baseline at C50	ug/L	Yes	Yes		7441624
Surrogate Recovery (%)					
1,4-Difluorobenzene	%	97	98		7443249
4-Bromofluorobenzene	%	92	89		7443249
D10-o-Xylene	%	97	98		7443249
D4-1,2-Dichloroethane	%	98	97		7443249
o-Terphenyl	%	93	94		7441624

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PYW902
Sample ID: MW20-16A
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7441747	N/A	2021/07/06	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7441814	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7441777	N/A	2021/07/06	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/05	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439414	N/A	2021/07/02	Nan Raykha
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442218	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7441778	2021/07/02	2021/07/06	Surinder Rai
Orthophosphate	KONE	7441833	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7441832	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYW902 Dup
Sample ID: MW20-16A
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Metals by ICPMS	ICP/MS	7439414	N/A	2021/07/02	Nan Raykha

BV Labs ID: PYW903
Sample ID: MW20-16B
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7441747	N/A	2021/07/06	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7441814	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7441777	N/A	2021/07/06	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7439424	N/A	2021/06/30	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7443249	N/A	2021/07/05	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441624	2021/07/02	2021/07/03	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442481	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7441778	2021/07/02	2021/07/06	Surinder Rai
Orthophosphate	KONE	7441833	N/A	2021/07/05	Avneet Kour Sudan

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PYW903
Sample ID: MW20-16B
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7441832	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYW904
Sample ID: MW20-21A
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7441747	N/A	2021/07/06	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7441814	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7441777	N/A	2021/07/06	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442481	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7441778	2021/07/02	2021/07/06	Surinder Rai
Orthophosphate	KONE	7441833	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7441832	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

BV Labs ID: PYW905
Sample ID: MW20-21B
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7441747	N/A	2021/07/06	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	7437805	N/A	2021/07/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	7441814	N/A	2021/07/05	Alina Dobreanu
Conductivity	AT	7441777	N/A	2021/07/06	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	7441338	N/A	2021/07/02	Nimarta Singh
Petroleum Hydro. CCME F1 & BTEX in Water	HSGC/MSFD	7443249	N/A	2021/07/05	Domnica Andronescu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	7441624	2021/07/02	2021/07/03	Ravinder Gaidhu
Hardness (calculated as CaCO3)		7437803	N/A	2021/07/02	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	7439514	N/A	2021/07/02	Daniel Teclu
Ion Balance (% Difference)	CALC	7437802	N/A	2021/07/06	Automated Statchk
Anion and Cation Sum	CALC	7437804	N/A	2021/07/06	Automated Statchk
Total Ammonia-N	LACH/NH4	7441345	N/A	2021/07/05	Amanpreet Sappal

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1I0177
Report Date: 2021/07/08

Golder Associates Ltd
Client Project #: 19129150 (2300)
Sampler Initials: AK

TEST SUMMARY

BV Labs ID: PYW905
Sample ID: MW20-21B
Matrix: Water

Collected: 2021/06/28
Shipped:
Received: 2021/06/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7442481	N/A	2021/07/05	Amanpreet Sappal
pH	AT	7441778	2021/07/02	2021/07/06	Surinder Rai
Orthophosphate	KONE	7441833	N/A	2021/07/05	Avneet Kour Sudan
Sat. pH and Langelier Index (@ 20C)	CALC	7437806	N/A	2021/07/06	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	7437807	N/A	2021/07/06	Automated Statchk
Sulphate by Automated Colourimetry	KONE	7441832	N/A	2021/07/05	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	7437809	N/A	2021/07/06	Automated Statchk

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	15.0°C

Sample PYW903 [MW20-16B] : F1 BTEX analysis:The contamination in the F1 range is mainly due to a single peak , not a typical petroleum product.

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7441624	o-Terphenyl	2021/07/02	99	60 - 130	98	60 - 130	95	%		
7443249	1,4-Difluorobenzene	2021/07/05	95	70 - 130	98	70 - 130	98	%		
7443249	4-Bromofluorobenzene	2021/07/05	91	70 - 130	93	70 - 130	89	%		
7443249	D10-o-Xylene	2021/07/05	88	70 - 130	95	70 - 130	100	%		
7443249	D4-1,2-Dichloroethane	2021/07/05	93	70 - 130	90	70 - 130	95	%		
7439414	Dissolved Aluminum (Al)	2021/07/02	93	80 - 120	101	80 - 120	<4.9	ug/L	3.5	20
7439414	Dissolved Antimony (Sb)	2021/07/02	108	80 - 120	100	80 - 120	<0.50	ug/L	NC	20
7439414	Dissolved Arsenic (As)	2021/07/02	103	80 - 120	98	80 - 120	<1.0	ug/L	0.20	20
7439414	Dissolved Barium (Ba)	2021/07/02	102	80 - 120	101	80 - 120	<2.0	ug/L	0.49	20
7439414	Dissolved Beryllium (Be)	2021/07/02	110	80 - 120	102	80 - 120	<0.40	ug/L	NC	20
7439414	Dissolved Boron (B)	2021/07/02	108	80 - 120	100	80 - 120	<10	ug/L	0.65	20
7439414	Dissolved Cadmium (Cd)	2021/07/02	103	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7439414	Dissolved Calcium (Ca)	2021/07/02	NC	80 - 120	91	80 - 120	<200	ug/L	0.39	20
7439414	Dissolved Chromium (Cr)	2021/07/02	100	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7439414	Dissolved Cobalt (Co)	2021/07/02	98	80 - 120	96	80 - 120	<0.50	ug/L	NC	20
7439414	Dissolved Copper (Cu)	2021/07/02	102	80 - 120	97	80 - 120	<0.90	ug/L	NC	20
7439414	Dissolved Iron (Fe)	2021/07/02	98	80 - 120	95	80 - 120	<100	ug/L	0.35	20
7439414	Dissolved Lead (Pb)	2021/07/02	103	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7439414	Dissolved Magnesium (Mg)	2021/07/02	93	80 - 120	92	80 - 120	<50	ug/L	0.98	20
7439414	Dissolved Manganese (Mn)	2021/07/02	99	80 - 120	96	80 - 120	<2.0	ug/L	2.6	20
7439414	Dissolved Molybdenum (Mo)	2021/07/02	107	80 - 120	101	80 - 120	<0.50	ug/L	1.4	20
7439414	Dissolved Nickel (Ni)	2021/07/02	96	80 - 120	94	80 - 120	<1.0	ug/L	NC	20
7439414	Dissolved Phosphorus (P)	2021/07/02	102	80 - 120	110	80 - 120	<100	ug/L	NC	20
7439414	Dissolved Potassium (K)	2021/07/02	99	80 - 120	97	80 - 120	<200	ug/L	1.0	20
7439414	Dissolved Selenium (Se)	2021/07/02	98	80 - 120	94	80 - 120	<2.0	ug/L	NC	20
7439414	Dissolved Silicon (Si)	2021/07/02	91	80 - 120	91	80 - 120	<50	ug/L	0.20	20
7439414	Dissolved Silver (Ag)	2021/07/02	98	80 - 120	96	80 - 120	<0.090	ug/L	NC	20
7439414	Dissolved Sodium (Na)	2021/07/02	96	80 - 120	92	80 - 120	<100	ug/L	2.3	20
7439414	Dissolved Strontium (Sr)	2021/07/02	NC	80 - 120	98	80 - 120	<1.0	ug/L	0.37	20
7439414	Dissolved Thallium (Tl)	2021/07/02	104	80 - 120	98	80 - 120	<0.050	ug/L	NC	20
7439414	Dissolved Titanium (Ti)	2021/07/02	91	80 - 120	90	80 - 120	<5.0	ug/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7439414	Dissolved Uranium (U)	2021/07/02	104	80 - 120	96	80 - 120	<0.10	ug/L	0.30	20
7439414	Dissolved Vanadium (V)	2021/07/02	99	80 - 120	95	80 - 120	<0.50	ug/L	NC	20
7439414	Dissolved Zinc (Zn)	2021/07/02	99	80 - 120	95	80 - 120	<5.0	ug/L	NC	20
7439424	Dissolved Organic Carbon	2021/06/30	95	80 - 120	98	80 - 120	<0.40	mg/L	0.99	20
7439514	Dissolved Aluminum (Al)	2021/07/02	101	80 - 120	101	80 - 120	<4.9	ug/L	NC	20
7439514	Dissolved Antimony (Sb)	2021/07/02	104	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Arsenic (As)	2021/07/02	103	80 - 120	100	80 - 120	<1.0	ug/L	NC	20
7439514	Dissolved Barium (Ba)	2021/07/02	102	80 - 120	98	80 - 120	<2.0	ug/L	3.5	20
7439514	Dissolved Beryllium (Be)	2021/07/02	103	80 - 120	100	80 - 120	<0.40	ug/L	NC	20
7439514	Dissolved Boron (B)	2021/07/02	98	80 - 120	96	80 - 120	<10	ug/L	2.1	20
7439514	Dissolved Cadmium (Cd)	2021/07/02	101	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7439514	Dissolved Calcium (Ca)	2021/07/02	NC	80 - 120	100	80 - 120	<200	ug/L	0.63	20
7439514	Dissolved Chromium (Cr)	2021/07/02	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7439514	Dissolved Cobalt (Co)	2021/07/02	103	80 - 120	105	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Copper (Cu)	2021/07/02	106	80 - 120	103	80 - 120	<0.90	ug/L	NC	20
7439514	Dissolved Iron (Fe)	2021/07/02	101	80 - 120	100	80 - 120	<100	ug/L	2.1	20
7439514	Dissolved Lead (Pb)	2021/07/02	102	80 - 120	99	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Magnesium (Mg)	2021/07/02	NC	80 - 120	102	80 - 120	<50	ug/L	2.1	20
7439514	Dissolved Manganese (Mn)	2021/07/02	97	80 - 120	96	80 - 120	<2.0	ug/L	2.6	20
7439514	Dissolved Molybdenum (Mo)	2021/07/02	106	80 - 120	99	80 - 120	<0.50	ug/L	0.43	20
7439514	Dissolved Nickel (Ni)	2021/07/02	98	80 - 120	98	80 - 120	<1.0	ug/L	NC	20
7439514	Dissolved Phosphorus (P)	2021/07/02	102	80 - 120	101	80 - 120	<100	ug/L	NC	20
7439514	Dissolved Potassium (K)	2021/07/02	102	80 - 120	100	80 - 120	<200	ug/L	0.43	20
7439514	Dissolved Selenium (Se)	2021/07/02	103	80 - 120	102	80 - 120	<2.0	ug/L	NC	20
7439514	Dissolved Silicon (Si)	2021/07/02	100	80 - 120	97	80 - 120	<50	ug/L	0.98	20
7439514	Dissolved Silver (Ag)	2021/07/02	100	80 - 120	98	80 - 120	<0.090	ug/L	NC	20
7439514	Dissolved Sodium (Na)	2021/07/02	104	80 - 120	102	80 - 120	<100	ug/L	1.7	20
7439514	Dissolved Strontium (Sr)	2021/07/02	NC	80 - 120	90	80 - 120	<1.0	ug/L	2.2	20
7439514	Dissolved Thallium (Tl)	2021/07/02	107	80 - 120	102	80 - 120	<0.050	ug/L	NC	20
7439514	Dissolved Titanium (Ti)	2021/07/02	96	80 - 120	94	80 - 120	<5.0	ug/L	NC	20
7439514	Dissolved Uranium (U)	2021/07/02	101	80 - 120	97	80 - 120	<0.10	ug/L	NC	20

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7439514	Dissolved Vanadium (V)	2021/07/02	101	80 - 120	98	80 - 120	<0.50	ug/L	NC	20
7439514	Dissolved Zinc (Zn)	2021/07/02	98	80 - 120	97	80 - 120	<5.0	ug/L	NC	20
7441338	Dissolved Organic Carbon	2021/07/02	94	80 - 120	92	80 - 120	<0.40	mg/L	5.9	20
7441345	Total Ammonia-N	2021/07/05	96	75 - 125	99	80 - 120	<0.050	mg/L	NC	20
7441624	F2 (C10-C16 Hydrocarbons)	2021/07/03	NC	60 - 130	111	60 - 130	<100	ug/L	12	30
7441624	F3 (C16-C34 Hydrocarbons)	2021/07/03	100	60 - 130	113	60 - 130	<200	ug/L	NC	30
7441624	F4 (C34-C50 Hydrocarbons)	2021/07/03	104	60 - 130	112	60 - 130	<200	ug/L	NC	30
7441747	Alkalinity (Total as CaCO3)	2021/07/06			95	85 - 115	<1.0	mg/L	1.2	20
7441777	Conductivity	2021/07/06			99	85 - 115	<1.0	umho/cm	0.38	25
7441778	pH	2021/07/06			101	98 - 103			0.42	N/A
7441814	Dissolved Chloride (Cl-)	2021/07/05	112	80 - 120	104	80 - 120	<1.0	mg/L	1.9	20
7441832	Dissolved Sulphate (SO4)	2021/07/05	NC	75 - 125	102	80 - 120	<1.0	mg/L	0.30	20
7441833	Orthophosphate (P)	2021/07/05	113	75 - 125	99	80 - 120	<0.010	mg/L	NC	25
7442218	Nitrate (N)	2021/07/05	87	80 - 120	99	80 - 120	<0.10	mg/L	0.50	20
7442218	Nitrite (N)	2021/07/05	100	80 - 120	103	80 - 120	<0.010	mg/L	11	20
7442481	Nitrate (N)	2021/07/05	97	80 - 120	100	80 - 120	<0.10	mg/L	NC	20
7442481	Nitrite (N)	2021/07/05	102	80 - 120	103	80 - 120	<0.010	mg/L	NC	20
7443249	Benzene	2021/07/05	94	50 - 140	99	50 - 140	<0.20	ug/L	NC	30
7443249	Ethylbenzene	2021/07/05	103	50 - 140	110	50 - 140	<0.20	ug/L	NC	30
7443249	F1 (C6-C10) - BTEX	2021/07/05					<25	ug/L	NC	30
7443249	F1 (C6-C10)	2021/07/05	84	60 - 140	89	60 - 140	<25	ug/L	NC	30
7443249	o-Xylene	2021/07/05	100	50 - 140	107	50 - 140	<0.20	ug/L	NC	30
7443249	p+m-Xylene	2021/07/05	111	50 - 140	122	50 - 140	<0.40	ug/L	NC	30
7443249	Toluene	2021/07/05	98	50 - 140	105	50 - 140	<0.20	ug/L	NC	30

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7443249	Total Xylenes	2021/07/05					<0.40	ug/L	NC	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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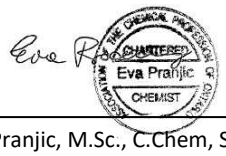
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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28-Jun-21 16:35
Ema Gitej
C1I0177
KSE ENV 1320

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#21375 Golder Associates Ltd	Company Name:		Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Gregory Padusenko	P.O. #:	
Address:	210 Sheldon Drive	Address:		Project:	19129150 (2300)
	Cambridge ON N1T 1A8			Project Name:	
Tel:	(519) 620-8182 Fax:	Tel:	(519) 620-8182 Ext: 6509 Fax: (519) 620-9878	Site #:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Gregory_Padusenko@golder.com	Sampled By:	

Only:
Bottle Order #: 831949
Project Manager: Ema Gitej
C#831949-09-01

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	RCAp - Comprehensive	O Reg 153 PHCs, BTEX/F1-F4	# of Bottles	Comments
1		MW20-16A	06/28/21	GW	12-	X	X		4	
2		MW20-16B	↓	↓	12:30	X	X	X	8	
3		MW20-21A	↓	↓	9-	X	X		4	
4		MW20-21B	↓	↓	9:30	X	X	X	8	
5										
6										
7										
8										
9										
10										

REC'D IN WATERLOO

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
[signature] A. Link Late	21/06/28		JASPREE TEAUR [signature]	2021/06/28	16:35	
			WISIPREETHA SAHANTHE	21/06/29	12:30	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	19° / 12° / 14°	Present		
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

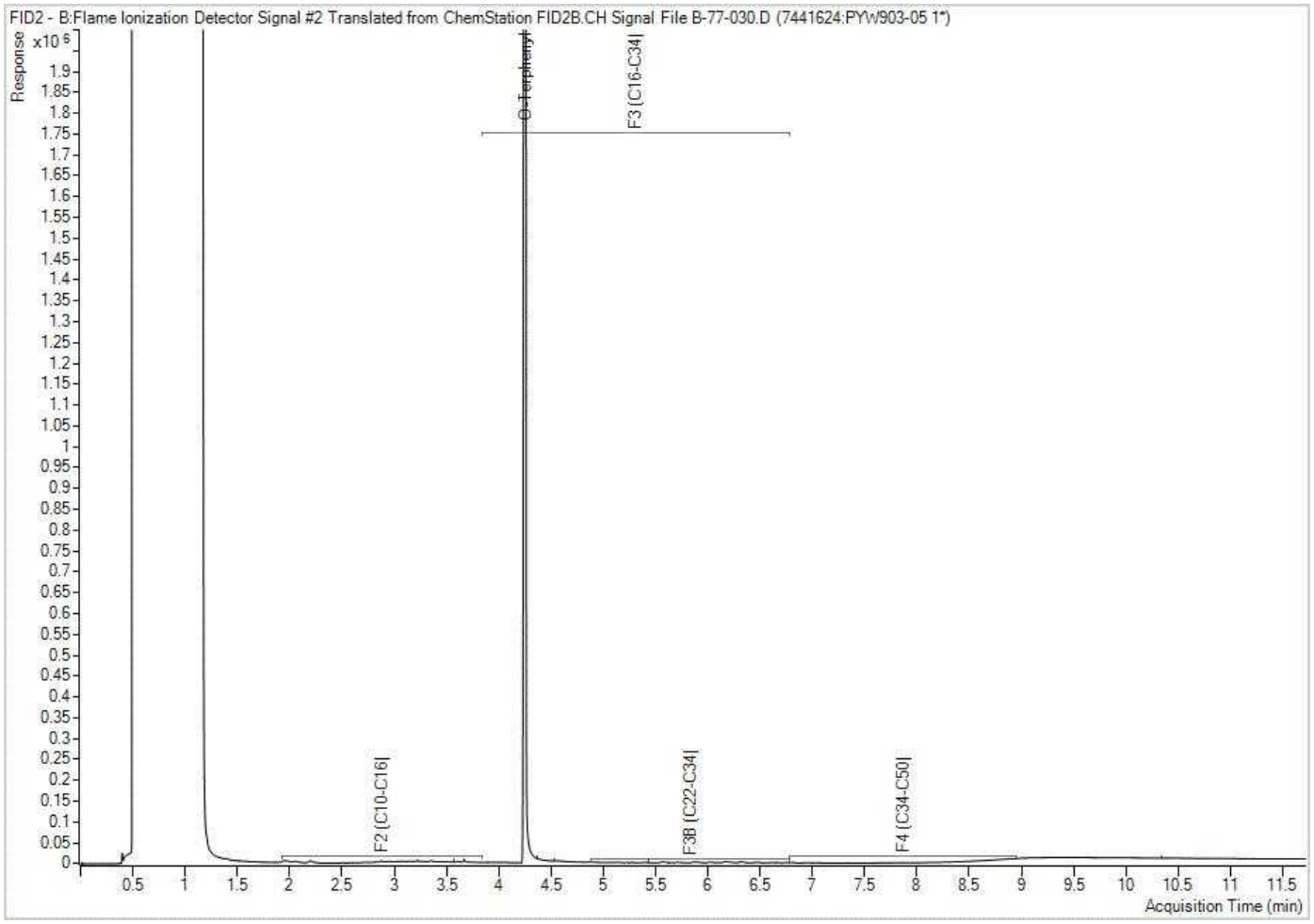
Bureau Veritas Canada (2019) Inc.

6/7/3 ON ICE

BV Labs Job #: C1I0177
Report Date: 2021/07/08
BV Labs Sample: PYW903

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-16B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

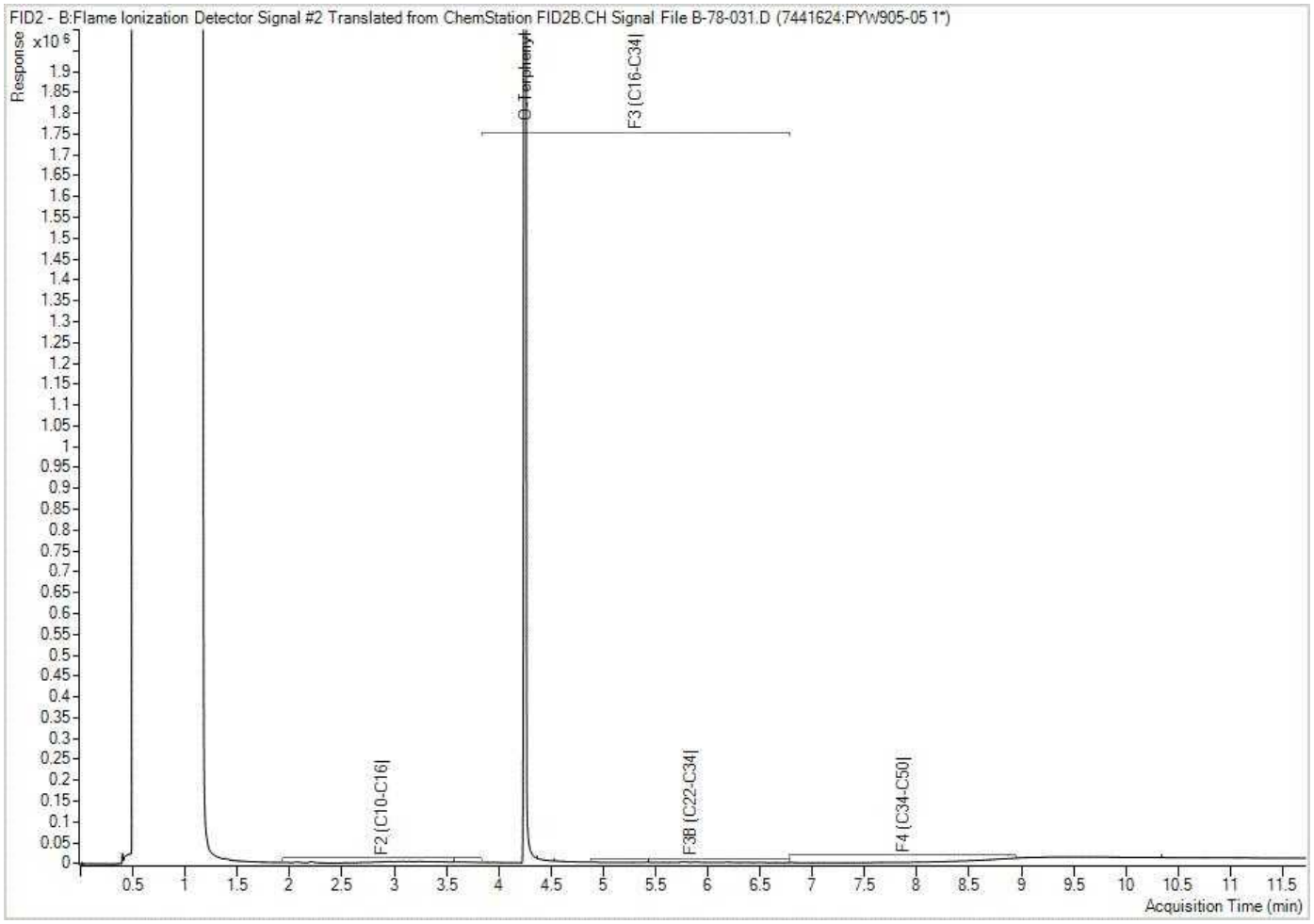


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

BV Labs Job #: C1I0177
Report Date: 2021/07/08
BV Labs Sample: PYW905

Golder Associates Ltd
Client Project #: 19129150 (2300)
Client ID: MW20-21B

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

APPENDIX J

Northwest Area Investigations

APPENDIX J

Northwest Investigation Borehole Logs

PROJECT: 19129150

RECORD OF DRILLHOLE: MW22-01 (CAL)

SHEET 1 OF 1

LOCATION: N 4853808.0 ;E 576781.7

DRILLING DATE: August 9, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		421.40																		
0		(SM) SILTY SAND LOAM; dark brown, no odors, no straining, non-cohesive, moist (TOPSOIL)		0.00 420.79 0.61																		
		(SM) SILTY SAND, with trace clay; brown, no odors, no staining, non-cohesive, moist		419.57 1.83																		
2		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, cohesive, w<PL																				Bentonite August 26, 2022
4				415.92																		Sand
6		(SM) SILTY SAND; brown, no odors, no staining, non-cohesive, moist		5.49 415.00																		Screen
		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, cohesive, w<PL		6.40																		
8				413.33																		Sand
		BOTTOM OF HOLE		8.08																		
10																						
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: VP
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW22-02 (CAL) - OFFSET

SHEET 1 OF 1

LOCATION: N 4853793.8 ;E 576478.0

DRILLING DATE: August 8, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		420.00																		
0		(ML/SP) SILT and SAND LOAM; brown, no odors, no staining, cohesive, w<PL (TOPSOIL)		0.00																		
				0.30																		
2		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, cohesive, w<PL																				Bentonite August 26, 2022
				416.64																		
4		(SM/GP) SILTY SAND and GRAVEL TILL; brown, no odors, no staining, non-cohesive, moist		3.35																		Sand; Screen
				414.51																		
6		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, cohesive, w<PL		5.49																		Sand; Bentonite
8				411.31																		
		BOTTOM OF HOLE		8.69																		
10																						
12																						
14																						
16																						
18																						
20																						
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: VP

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW22-02 (CAL)

SHEET 1 OF 2

LOCATION: N 4853794.9 ;E 576481.0

DRILLING DATE: August 2-3, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		419.81																		
0		(ML/SP) SILT and SAND LOAM; brown, no odors, no staining, cohesive, w<PL (TOPSOIL)		0.00																		
				0.46																		
2		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, cohesive, w<PL																				August 26, 2022 (B) August 26, 2022 (A)
				416.45																		
4		(SM/GP) SILTY SAND and GRAVEL TILL; brown, no odors, no staining, non-cohesive, moist		3.35																		
				414.32																		
6		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, cohesive, w<PL		5.49																		Bentonite
8				411.27																		
		(CH) SILTY CLAY TILL, some sand and gravel; brown, no odors, no staining, cohesive, W < PL		8.53																		
10				409.14																		
		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, non-cohesive, wet		10.67																		
12				407.31																		Sand
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		12.50																		Screen
14																						
16																						Sand
18																						
20																						
22																						Bentonite
24																						
26																						
28																						
30		*CONTINUED NEXT PAGE*																				

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: VP
CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW22-02 (CAL)

SHEET 2 OF 2

LOCATION: N 4853794.9 ;E 576481.0

DRILLING DATE: August 2-3, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		--- CONTINUED FROM PREVIOUS PAGE ---																				
30		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)																				
32																						Bentonite
34																						Sand
36																						Screen Sand
				382.62																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		37.19																		
38				381.71																		Bentonite
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		38.10																		
				380.18																		
40		BOTTOM OF HOLE		39.62																		
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE

1 : 150

GOLDER
MEMBER OF WSP

LOGGED: VP

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: MW22-03 (CAL)

SHEET 1 OF 1

LOCATION: N 4854077.5 ;E 576200.6

DRILLING DATE: August 8-9, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		421.87																		
0		(ML) SILT, some sand and trace clay; dark brown, no odors, no staining, cohesive, w<PL (TOPSOIL)		0.00																		
				0.46																		
		(ML/SP) SILT and SAND, trace clay; brown, no odors, no staining, cohesive, w<PL		420.80 1.07																		
2		(SM/GP) SILTY SAND and GRAVEL TILL; brown, no odors, no staining, non-cohesive, moist																				August 26, 2022 (A) Bentonite August 26, 2022 (B)
4																						Sand
																						Screen
6				415.31																		Sand
		(CH) SILTY CLAY TILL, some sand and gravel; brown, no odors, no staining, cohesive, W < PL		6.55																		
8				413.33																		
		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, non-cohesive, moist		8.53																		Bentonite
10																						
12																						Sand
14																						Screen
16																						Sand
18																						Bentonite
				402.82																		
20		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		19.05 401.45																		
		BOTTOM OF HOLE		20.42																		
22																						
24																						
26																						
28																						
30																						

DEPTH SCALE

1 : 150

GOLDER MEMBER OF WSP

LOGGED: VP

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW22-01 (CAL)

SHEET 1 OF 2

LOCATION: N 4853535.3 ;E 576573.8

DRILLING DATE: August 9-10, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		416.75																		
		(SM) SILTY SAND LOAM; dark brown, no odors, no straining, non-cohesive, moist (TOPSOIL)		0.00																		
				0.46																		
		(SM) SILTY SAND TILL, with some gravel; brown, no odors, no staining, non-cohesive, moist		415.53 1.22																		
		(CH) SILTY CLAY TILL, some sand and gravel; brown, no odors, no staining, cohesive, W < PL																				
				406.38																		
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)		10.36																		
		CONTINUED NEXT PAGE																				

August 26, 2022

Bentonite

Sand

Screen

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: VP

CHECKED: GRP

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PROJECT: 19129150

RECORD OF DRILLHOLE: PW22-01 (CAL)

SHEET 2 OF 2

LOCATION: N 4853535.3 ;E 576573.8

DRILLING DATE: August 9-10, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: Sonic

DRILLING CONTRACTOR: Choice Sonic Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU - Curved; UN - Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE min/(m)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		*--- CONTINUED FROM PREVIOUS PAGE ---*																				
		DOLOSTONE, highly weathered to fresh, bedded dolostone, grey (GASPORT FORMATION)																				
32																						Screen
				383.83																		
		SHALEY DOLOSTONE, bedded, shaley dolostone, slate grey/brown		32.92																		
34				382.61																		
		SHALE; bedded shale, blue green (CABOT HEAD FORMATION)		34.14																		
36																						Sand
38				377.12																		
		BOTTOM OF HOLE		39.62																		
40																						
42																						
44																						
46																						
48																						
50																						
52																						
54																						
56																						
58																						
60																						

DEPTH SCALE
1 : 150

GOLDER
MEMBER OF WSP

LOGGED: VP
CHECKED: GRP

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APPENDIX J

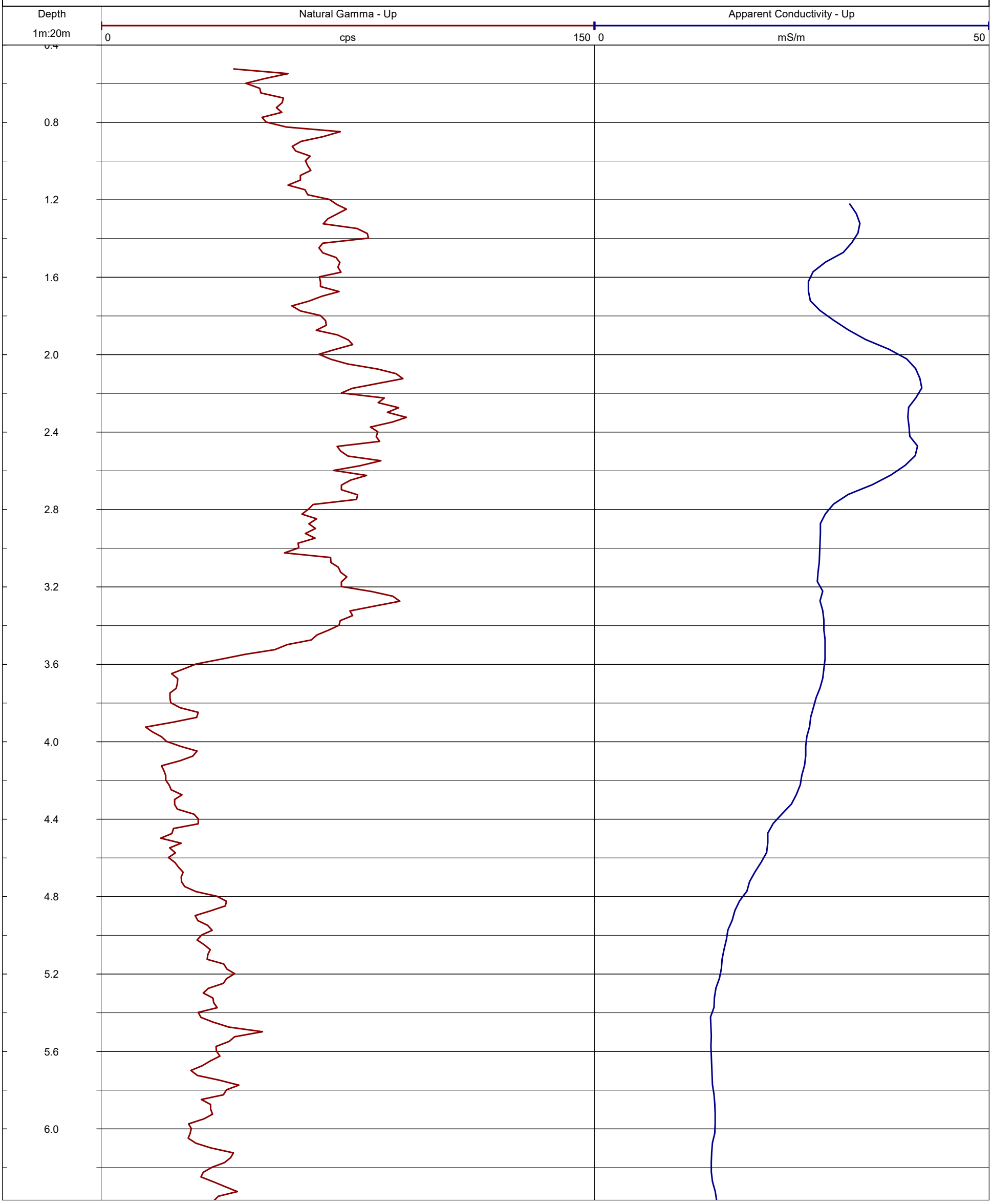
Northwest Investigation - Geophysical Borehole Logs

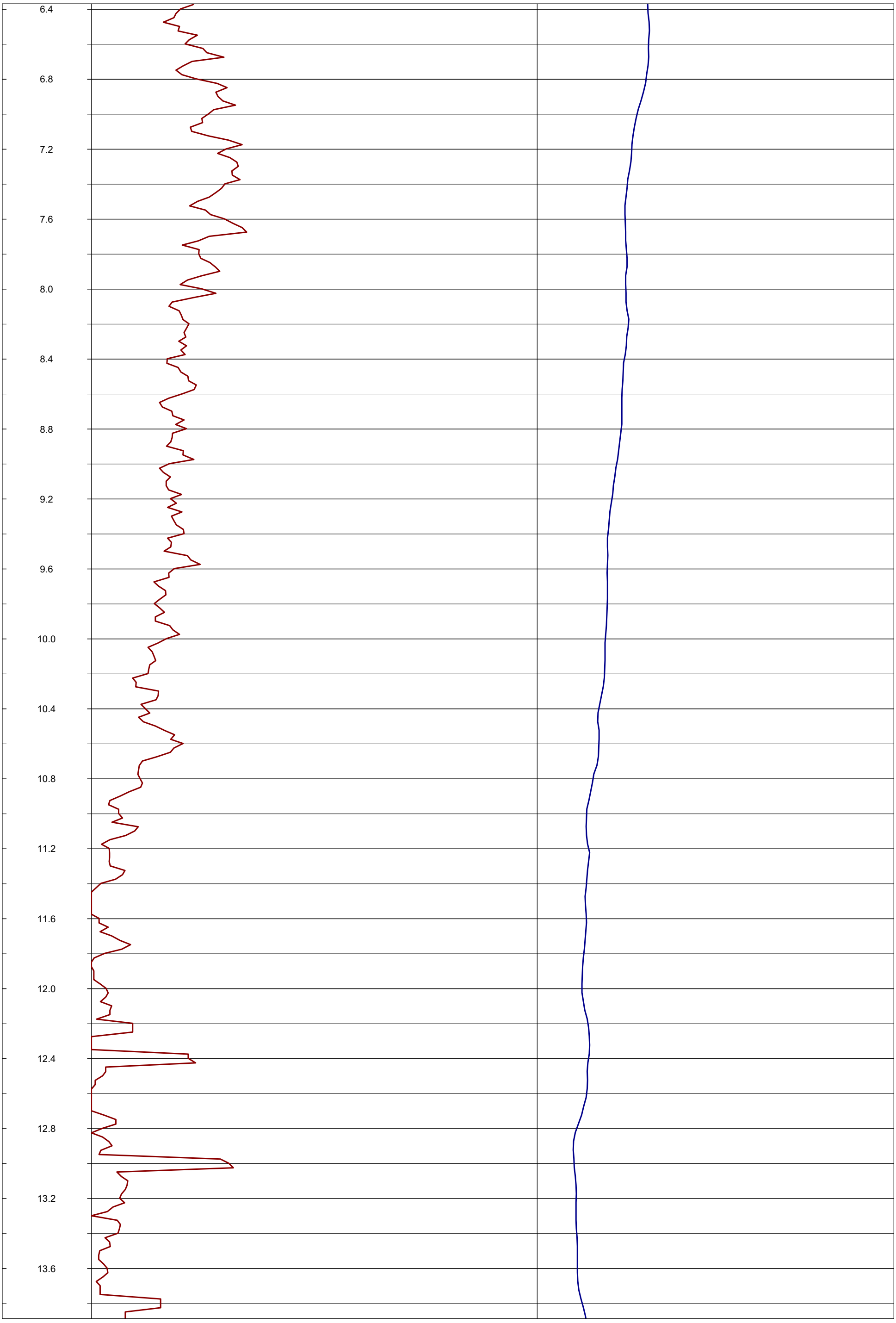
GOLDER
MEMBER OF WSP

Geophysical Record of Borehole: PW22-01 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: September 2022

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	1.22 m bgs	**Location:**	Caledon, Ontario
Easting:		**Drilled Depth:**	34.14 m bgs	**Water Level:**	1.54 m bgs	**Log Date:**	Sept-9-2022
Northing:		**Borehole Diameter:**	124 mm	**Borehole Inclination:**	0 degs		
Elevation:		**Casing Diameter:**	152 mm	**Casing Stickup:**	0.97 m ags	**Logged By:**	EP

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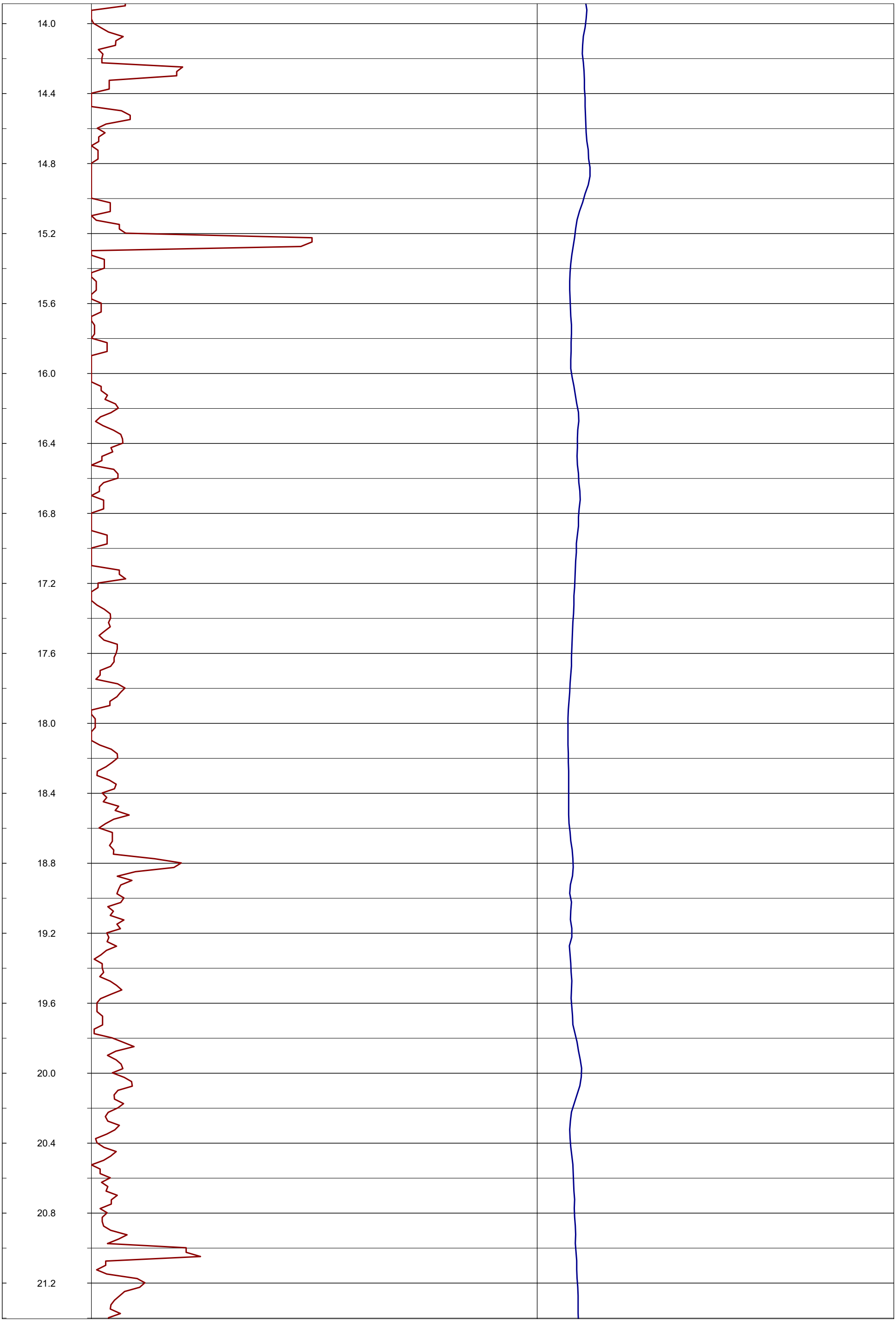
13.2
13.6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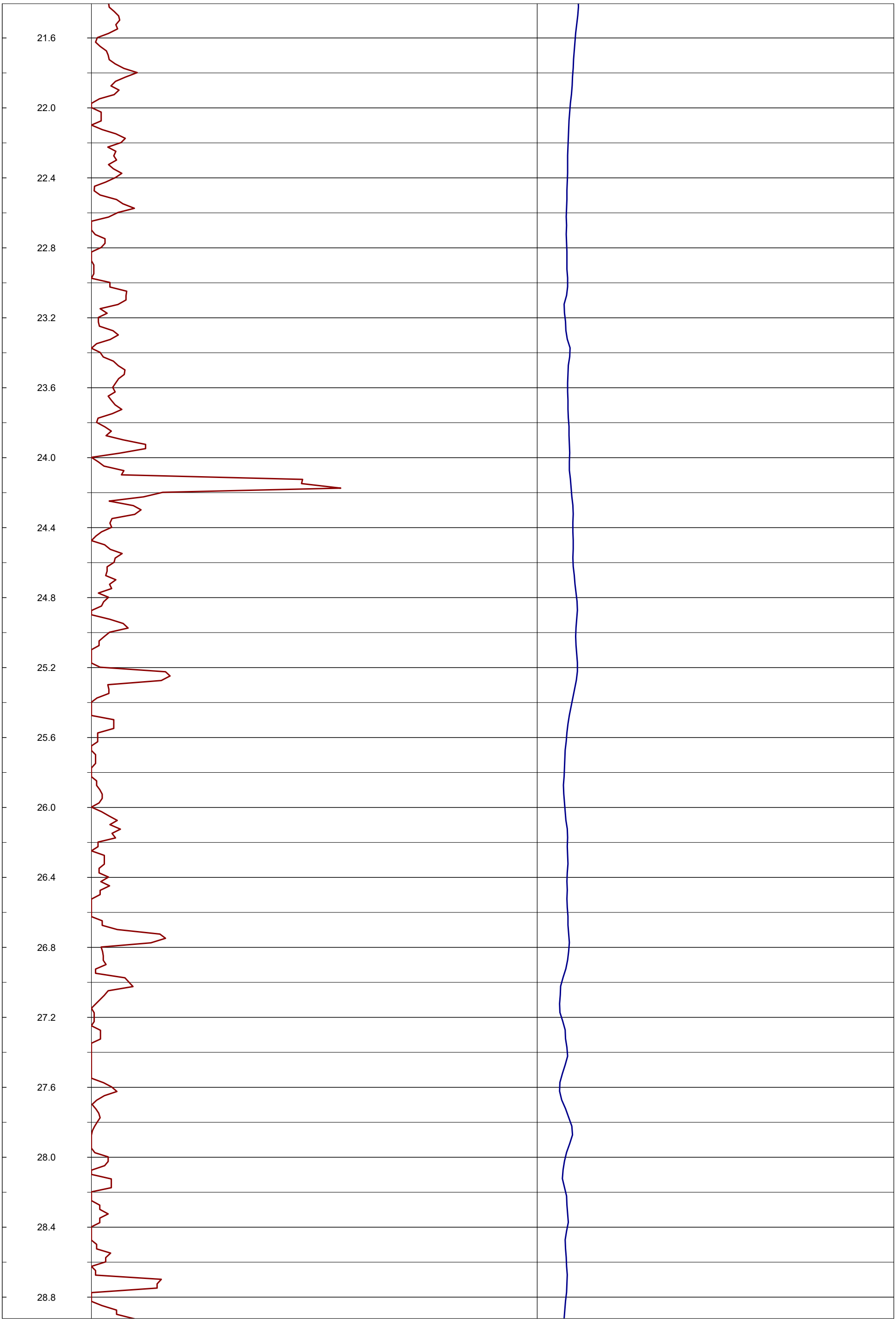
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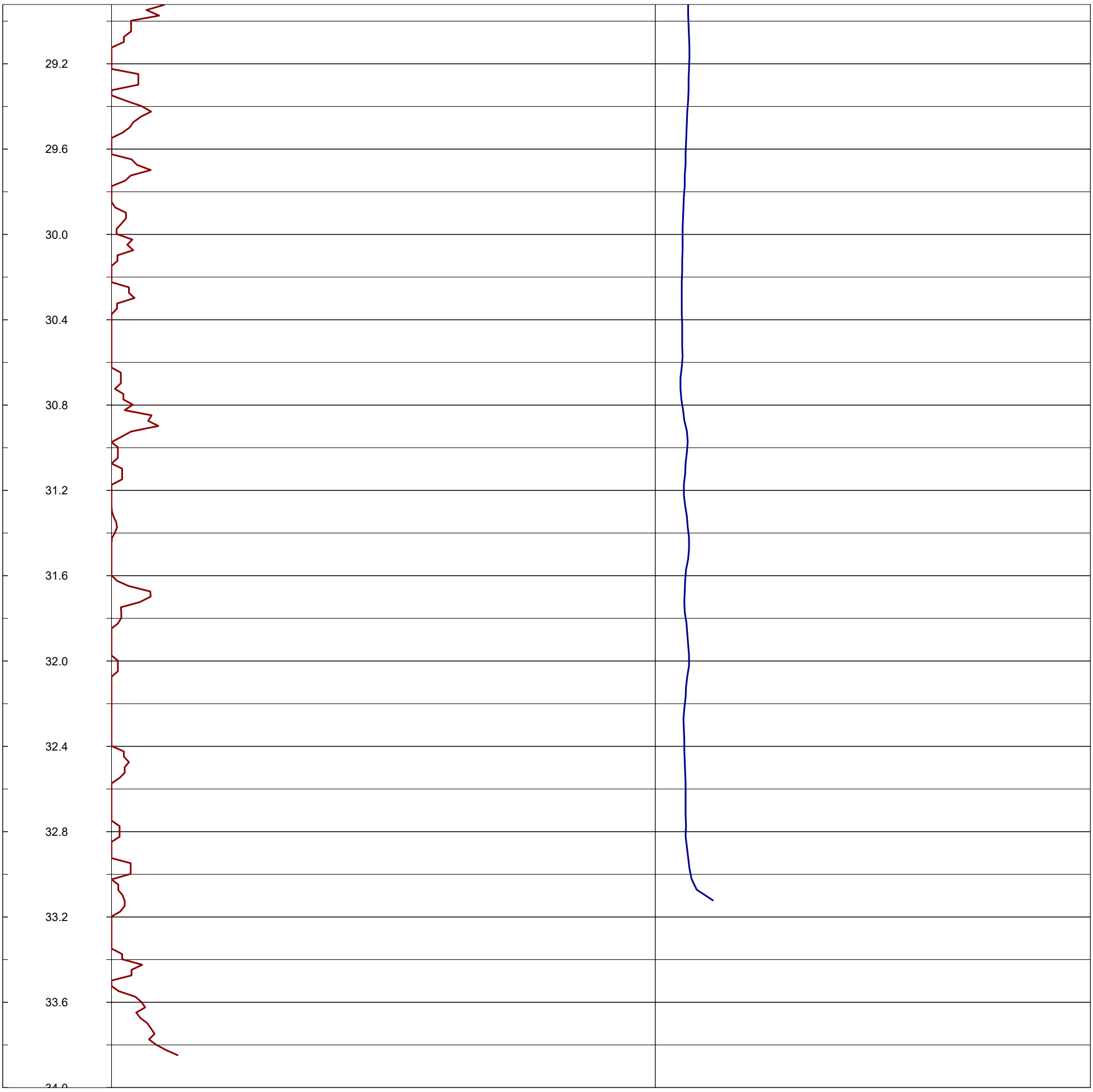
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33.6

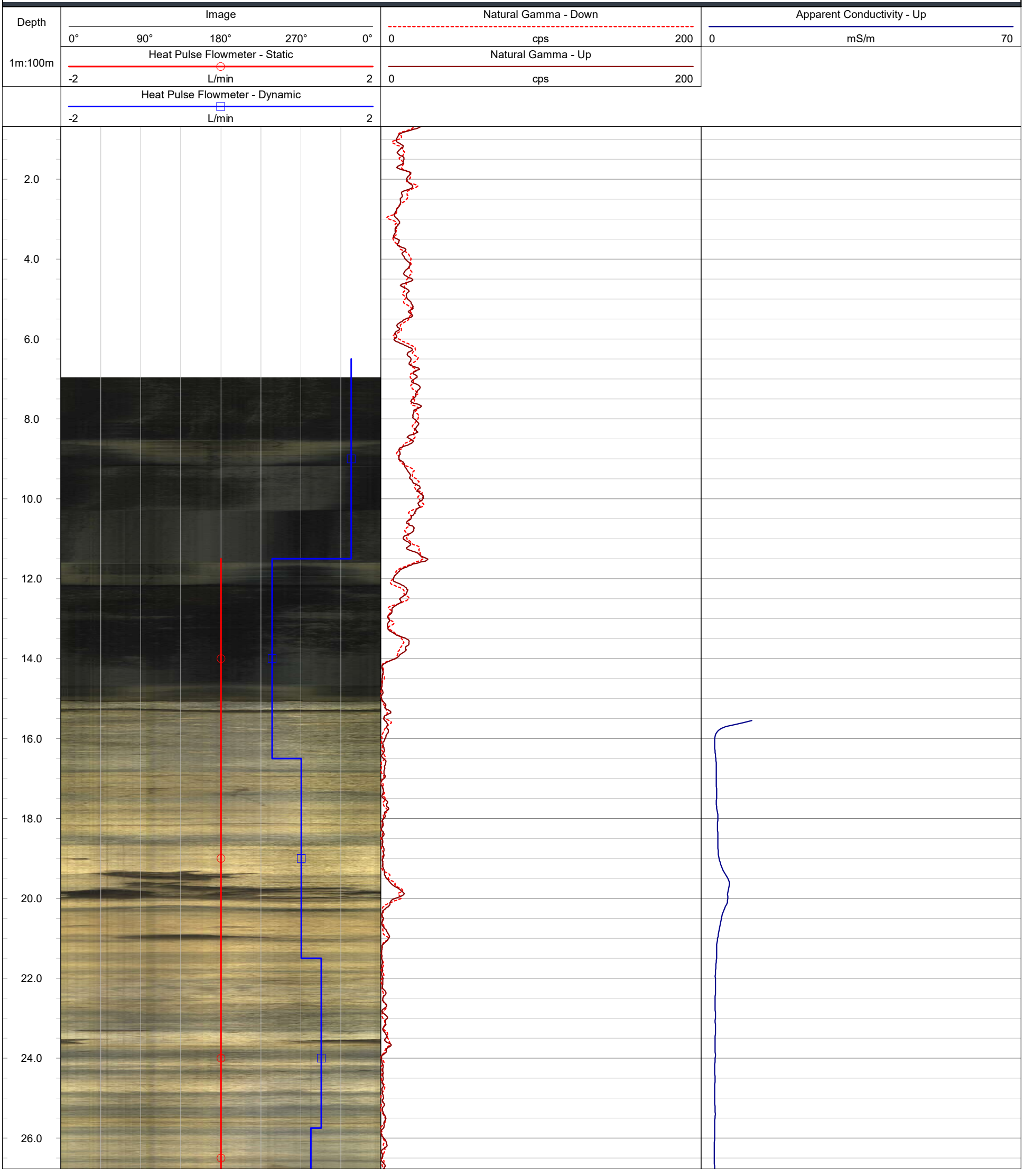
GOLDER
MEMBER OF WSP

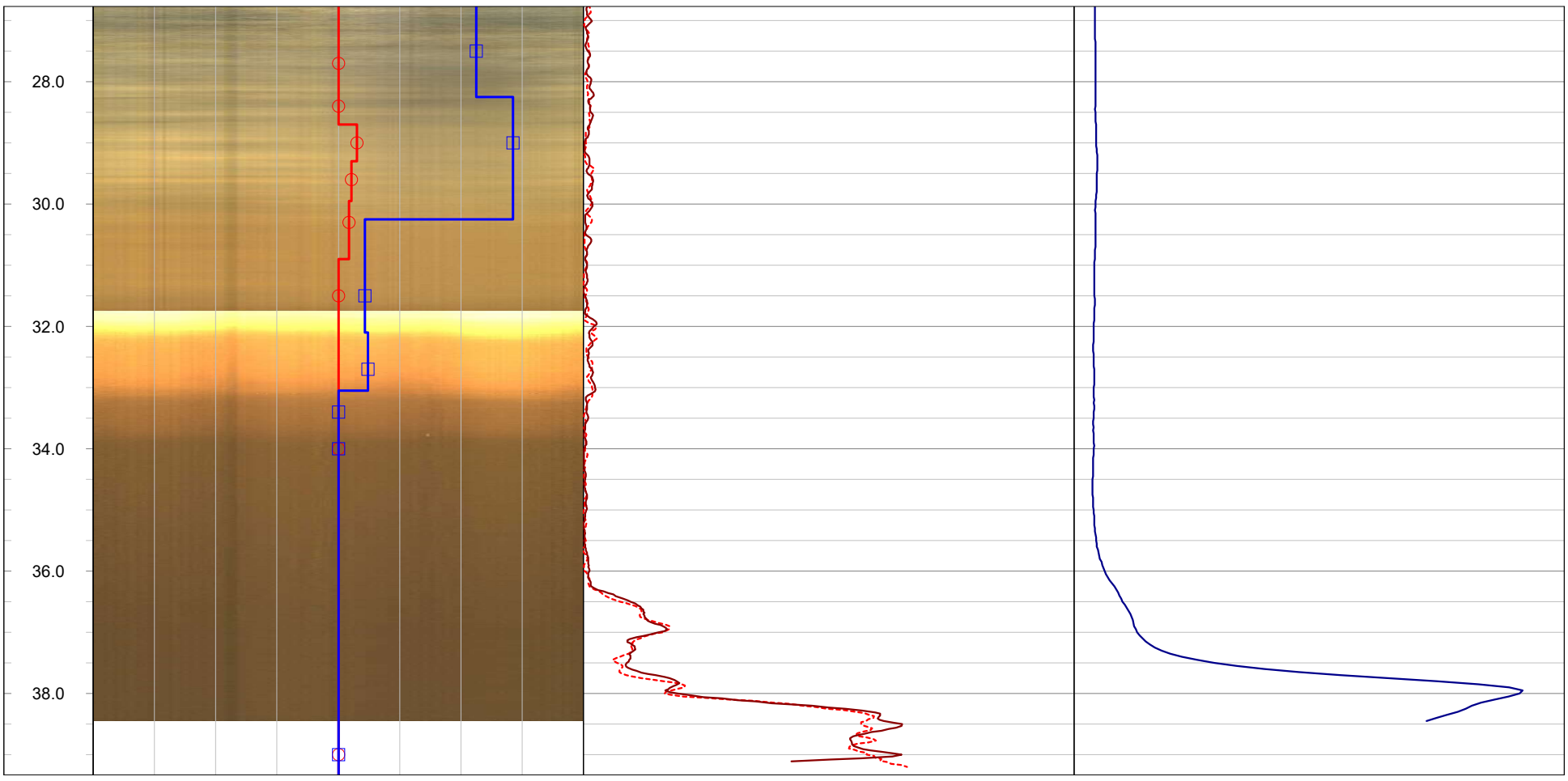
Geophysical Record of Borehole: MW22-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: August 2022

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	14.85 m bgs	**Location:**	Caledon, Ontario
Easting:		**Drilled Depth:**	39.27 m bgs	**Water Level:**	0.67 m bgs	**Log Date:**	Aug-05-2022
Northing:		**Borehole Diameter:**	124 mm	**Borehole Inclination:**	0 degs		
Elevation:		**Casing Diameter:**	152 mm	**Casing Stickup:**	0.33 m ags	**Logged By:**	PL

Notes: OBI Image opaque >39 m bgs

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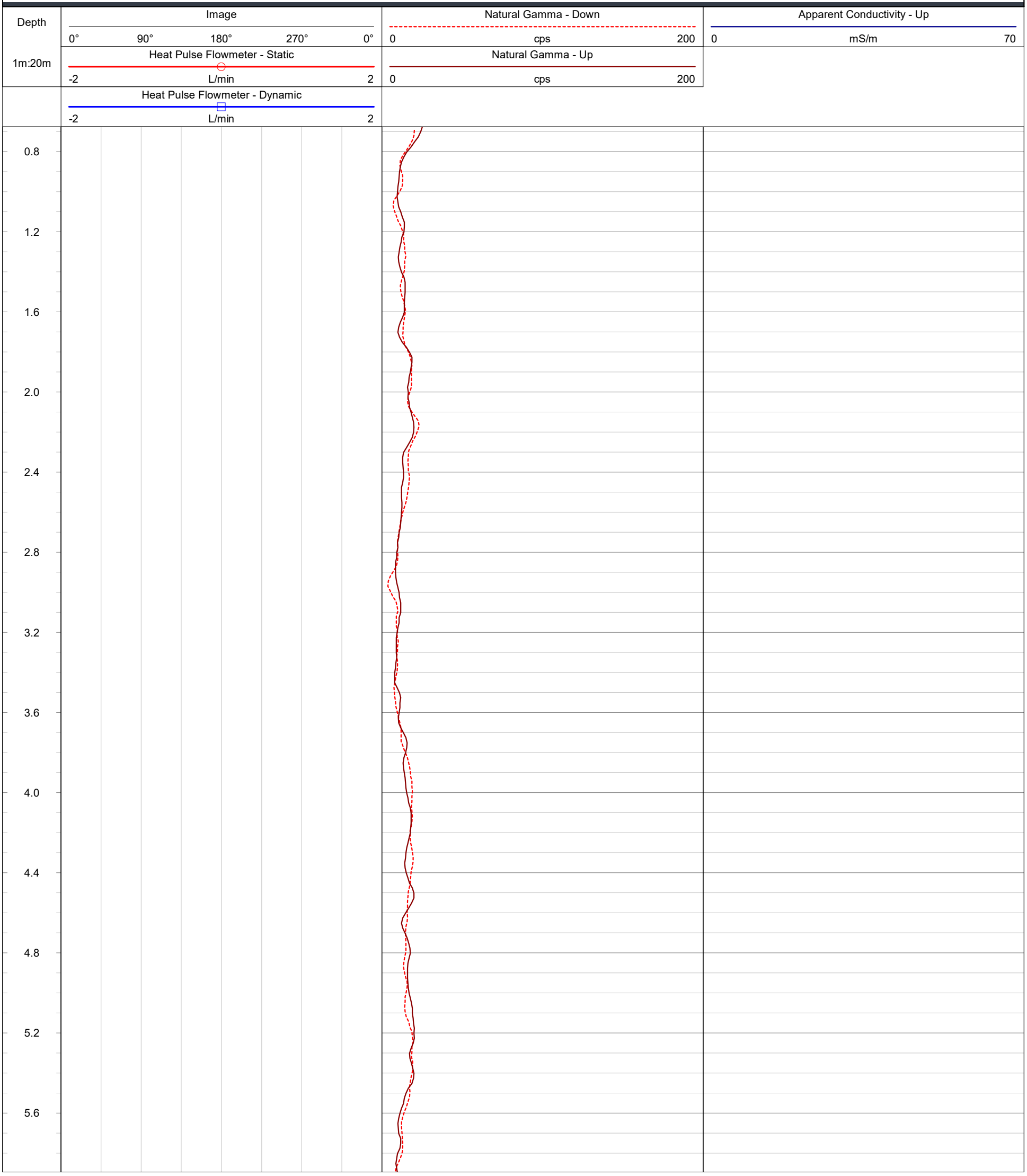
GOLDER
MEMBER OF WSP

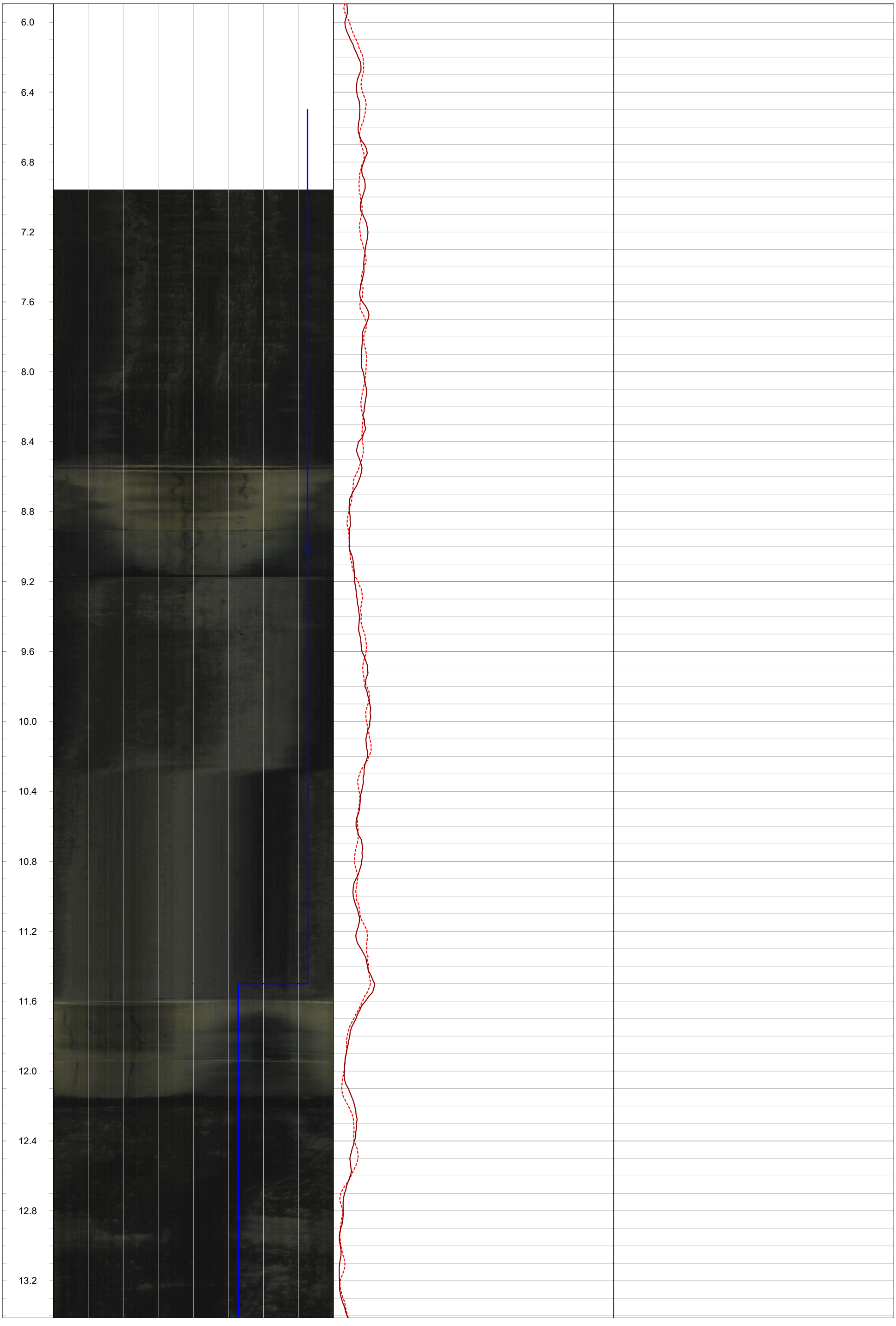
Geophysical Record of Borehole: MW22-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: August 2022

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	14.85 m bgs	**Location:**	Caledon, Ontario
Easting:		**Drilled Depth:**	39.27 m bgs	**Water Level:**	0.67 m bgs	**Log Date:**	Aug-05-2022
Northing:		**Borehole Diameter:**	124 mm	**Borehole Inclination:**	0 degs		
Elevation:		**Casing Diameter:**	152 mm	**Casing Stickup:**	0.33 m ags	**Logged By:**	PL

Notes: OBI Image opaque >39 m bgs

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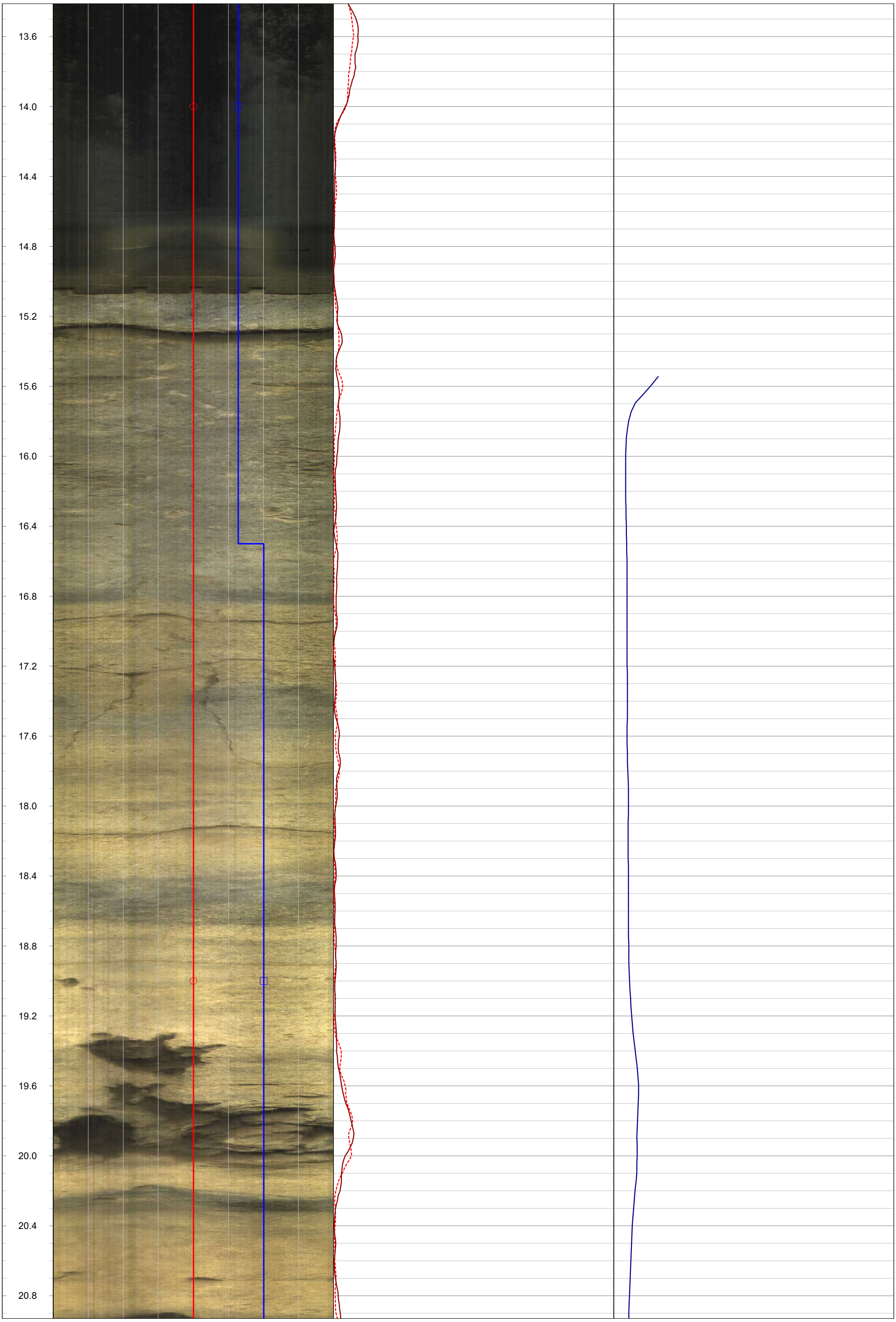
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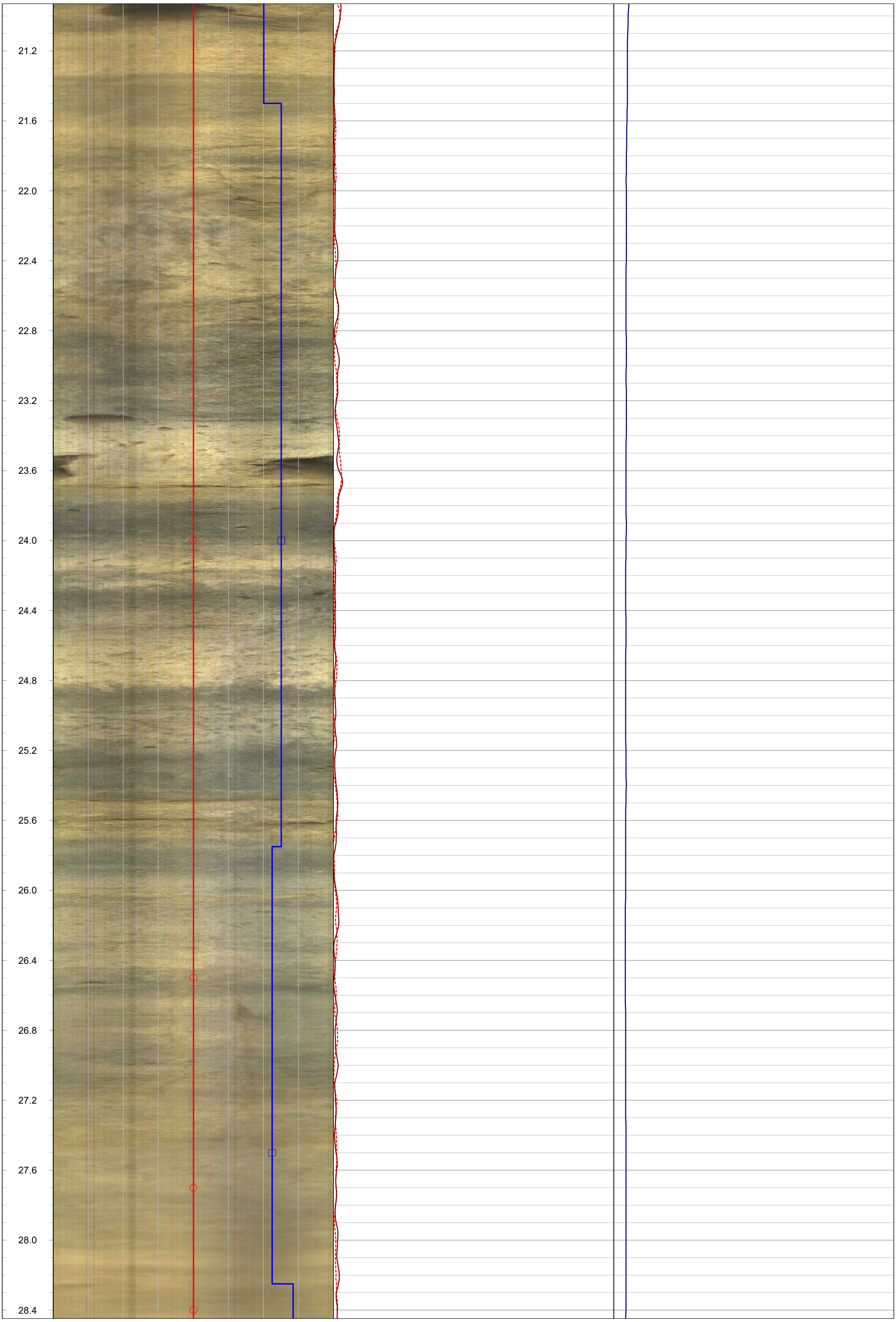
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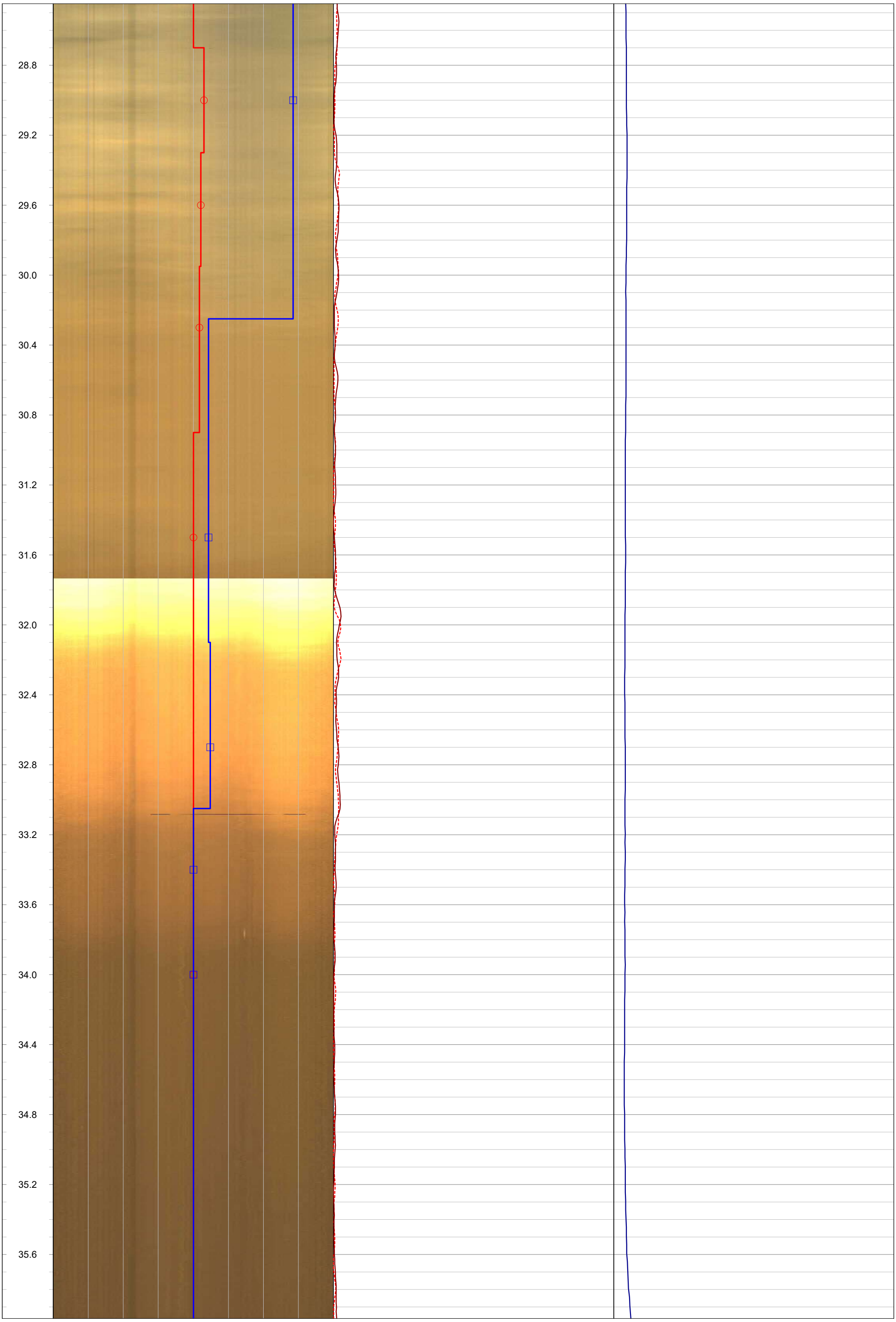
28.4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34.4
34.8
35.2
35.6


36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2

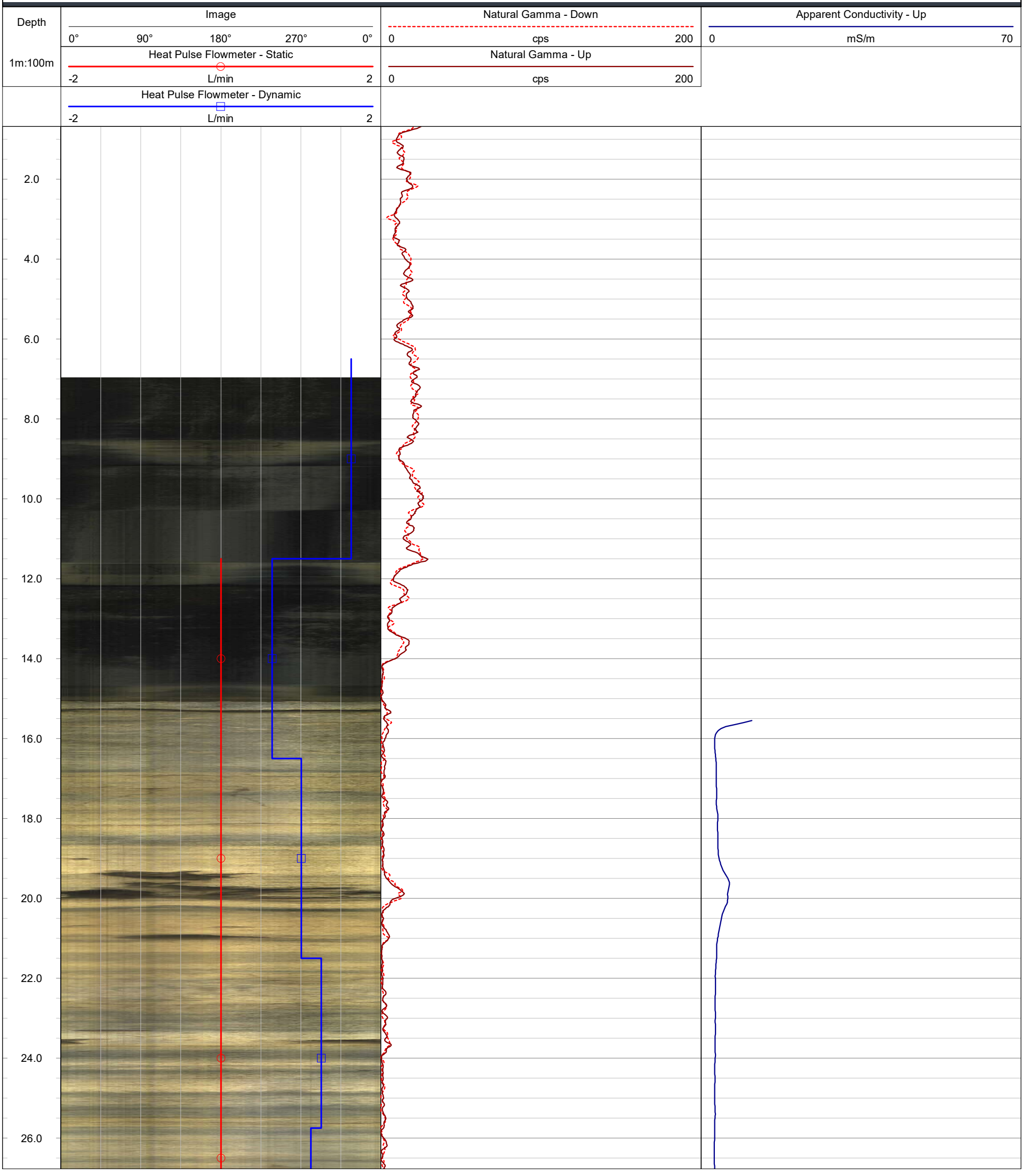
GOLDER
MEMBER OF WSP

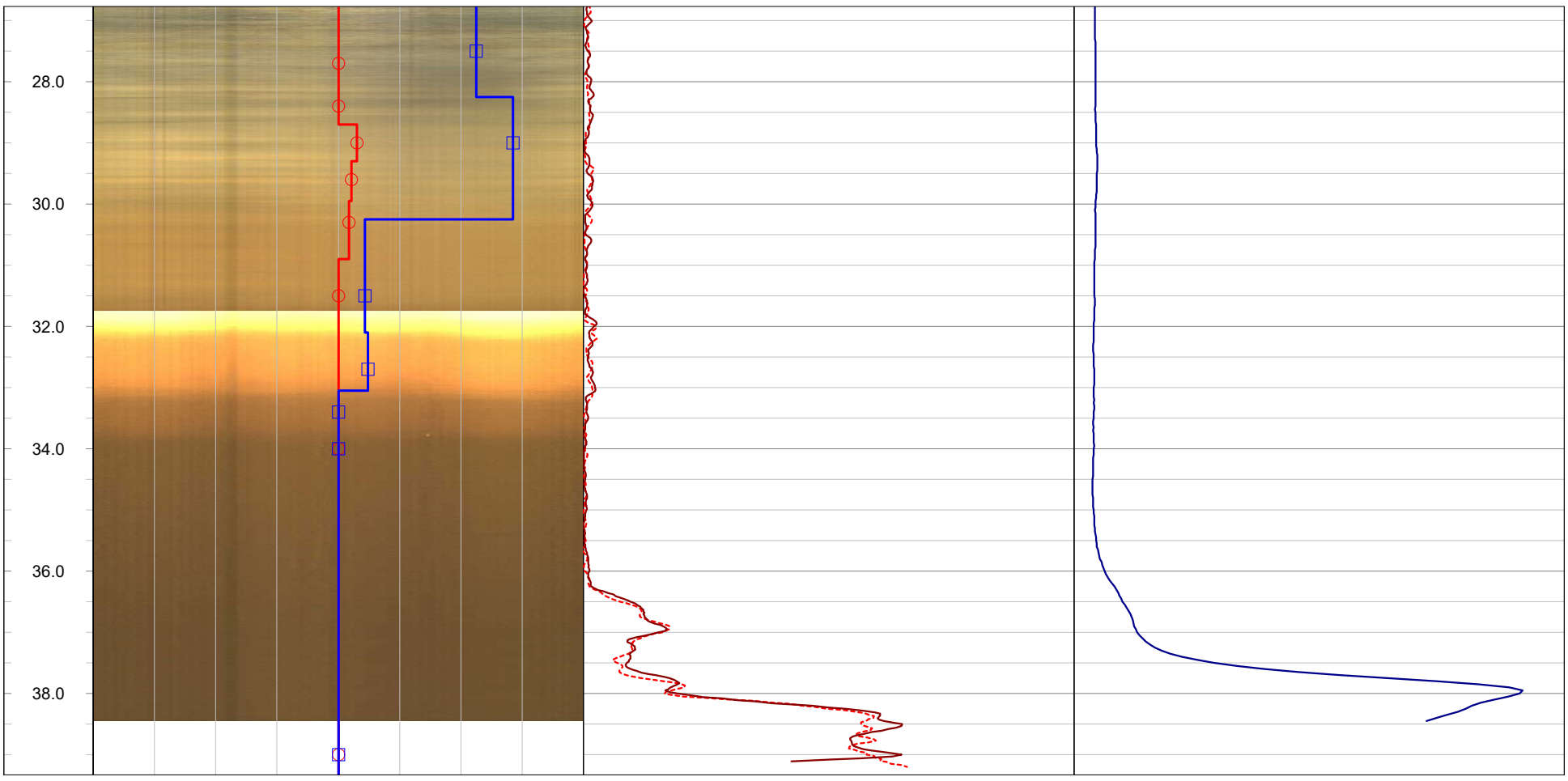
Geophysical Record of Borehole: MW22-02 (CAL)

Log Title: Geophysical Log
Project Number: 19129150
Client: St. Marys Cement Inc. (Canada)
Date: August 2022

Datum:	NAD83, UTM Zone 17N	**Depth Reference:**	"0" at Ground	**Casing Depth:**	14.85 m bgs	**Location:**	Caledon, Ontario
Easting:		**Drilled Depth:**	39.27 m bgs	**Water Level:**	0.67 m bgs	**Log Date:**	Aug-05-2022
Northing:		**Borehole Diameter:**	124 mm	**Borehole Inclination:**	0 degs		
Elevation:		**Casing Diameter:**	152 mm	**Casing Stickup:**	0.33 m ags	**Logged By:**	PL

Notes: OBI Image opaque >39 m bgs




28.0
30.0
32.0
34.0
36.0
38.0

APPENDIX J

Northwest Investigation - Soil Core Soil Sample Results

SUMMARY OF WATER CONTENT DETERMINATIONS

ASTM D 2216-10

PROJECT NUMBER	19129150 (7900)
PROJECT NAME	
DATE TESTED	September 20, 2022

Borehole No.	Sample No.	Water Content (%)	Atterberg Limits LL, PL, PI
SC 22-01	1	35.5%	
SC 22-01	2	15.5%	
SC 22-01	3	5.8%	
SC 22-02	1	24.6%	
SC 22-02	2	16.5%	
SC 22-03	1	43.3%	
SC 22-03	2	15.1%	
SC 22-04	1	56.4%	
SC 22-04	2	22.4%	
SC 22-05	1	19.0%	
SC 22-05	2	10.6%	
SC 22-06	2	20.7%	
SC 22-07	2	32.3%	
SC 22-07	3	30.5%	
SC 22-07	4	14.1%	
SC 22-08	1	23.5%	
SC 22-08	2	15.8%	
SC 22-09	1	21.6%	
SC 22-09	2	10.3%	

SUMMARY OF WATER CONTENT DETERMINATIONS

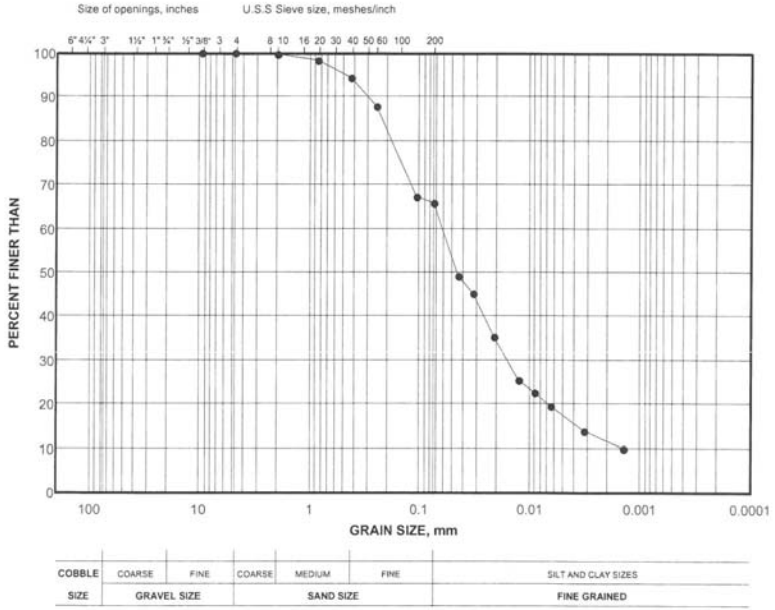
ASTM D 2216-10

PROJECT NUMBER	19129150 (7900)
PROJECT NAME	
DATE TESTED	September 20, 2022

Borehole No.	Sample No.	Water Content (%)	Atterberg Limits LL, PL, PI
SC 22-10	1	29.1%	
SC 22-10	2	11.9%	

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-01	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 286.74(g)
Weight measured for back sieving = 50.26(g)
Weight of Sample for Hydrometer = 50.26(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	0.38	0.13	4.75	99.9
2.00mm	1.07	0.24	2.00	99.6
PAN	284.88	99.63	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.69	1.37	0.85	98.3
425µm	2.62	3.83	0.43	94.4
250µm	5.99	6.68	0.25	87.8
106µm	16.38	20.60	0.11	67.2
75µm	17.11	1.45	0.08	65.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-21	10:11:00 AM
Finished :	2022-09-22	8:30:00 AM

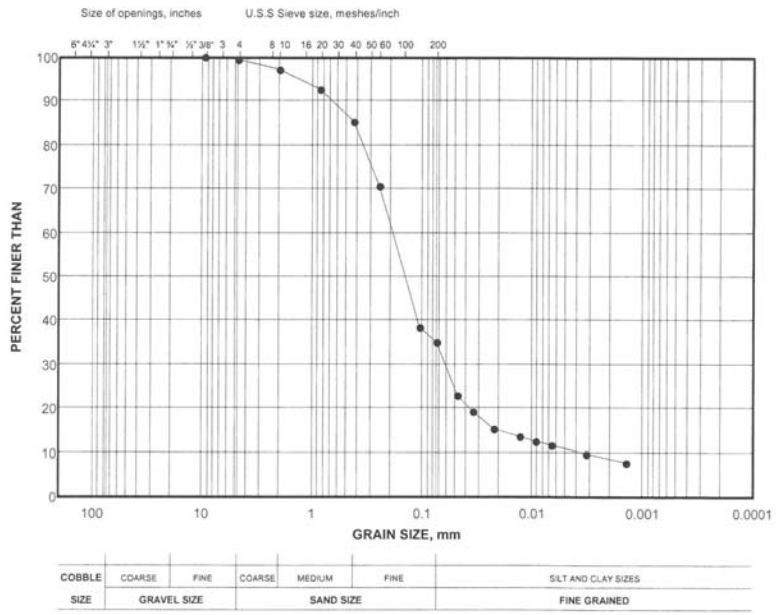
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	30.00	5.0	23.7	25.00	0.0450	49.1	True
2.00	28.00	5.0	23.7	23.00	0.0323	45.1	True
5.00	23.00	5.0	23.7	18.00	0.0211	35.3	True
15.00	18.00	5.0	23.5	13.00	0.0126	25.5	True
30.00	16.50	5.0	23.5	11.50	0.0090	22.6	True
60.00	15.00	5.0	23.6	10.00	0.0064	19.6	True
250.00	12.00	5.0	23.6	7.00	0.0032	13.7	True
1339.00	10.00	5.0	21.9	5.00	0.0014	9.8	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-01	Testing Date	2022-09-22 12:16:12 PM
Sample Number	1	Tested By	Sieve - SI, Hydrometer - KM
Checked By	_____	LabID	22-2006

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-01	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 360.01(g)
Weight measured for back sieving = 50.26(g)
Weight of Sample for Hydrometer = 50.26(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	2.32	0.64	4.75	99.4
2.00mm	9.77	2.07	2.00	97.3
PAN	349.07	97.29	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	2.44	4.72	0.85	92.6
425µm	6.16	7.20	0.43	85.4
250µm	13.72	14.63	0.25	70.7
106µm	30.48	32.44	0.11	38.3
75µm	32.19	3.31	0.08	35.0

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	11:23:00 AM
Finished :	2022-09-21	9:33:00 AM

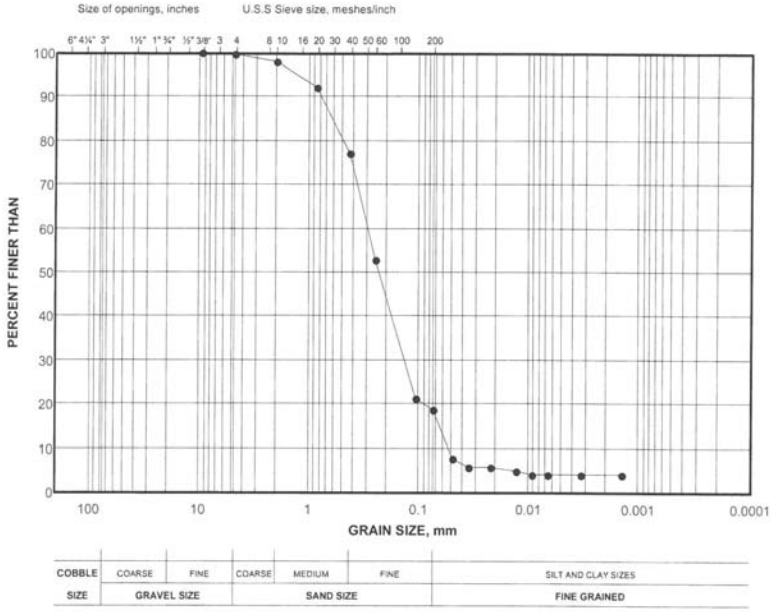
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	17.00	5.0	24.2	12.00	0.0486	23.0	True
2.00	15.00	5.0	24.2	10.00	0.0348	19.2	True
5.00	13.00	5.0	24.2	8.00	0.0222	15.3	True
15.00	12.00	5.0	24.0	7.00	0.0129	13.4	True
30.00	11.50	5.0	23.9	6.50	0.0092	12.5	True
60.00	11.00	5.0	23.5	6.00	0.0066	11.5	True
250.00	10.00	5.0	23.2	5.00	0.0032	9.6	True
1330.00	9.00	5.0	22.3	4.00	0.0014	7.7	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-01	Testing Date	2022-09-22 8:47:23 AM
Sample Number	2	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2007

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-01	3	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 455.09(g)
Weight measured for back sieving = 50.24(g)
Weight of Sample for Hydrometer = 50.24(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	1.25	0.27	4.75	99.7
2.00mm	9.81	1.88	2.00	97.9
PAN	444.39	97.85	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	2.89	5.63	0.85	92.2
425µm	10.69	15.19	0.43	77.0
250µm	23.07	24.11	0.25	52.9
106µm	39.33	31.67	0.11	21.3
75µm	40.65	2.57	0.08	18.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-21	10:01:00 AM
Finished :	2022-09-22	8:27:00 AM

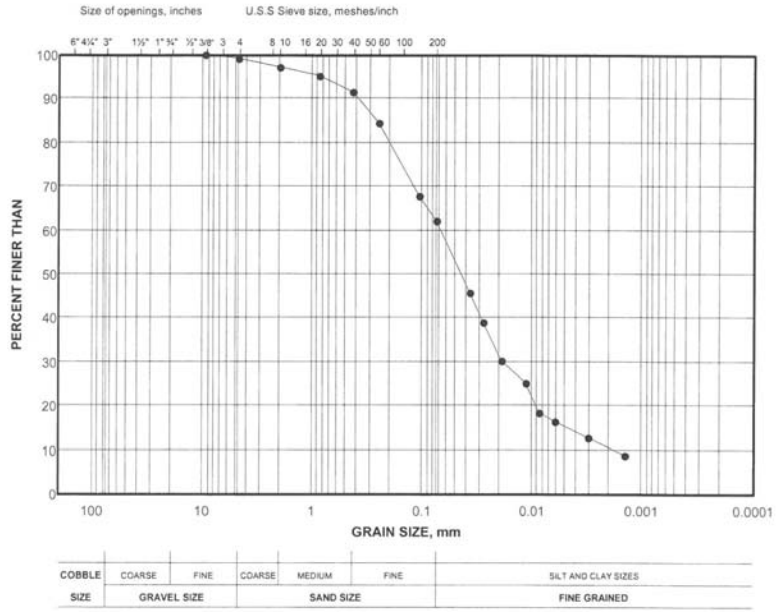
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	9.00	5.0	25.9	4.00	0.0497	7.7	True
2.00	8.00	5.0	25.9	3.00	0.0353	5.8	True
5.00	8.00	5.0	25.9	3.00	0.0224	5.8	True
15.00	7.50	5.0	25.5	2.50	0.0130	4.8	True
30.00	7.00	5.0	25.0	2.00	0.0093	3.9	True
60.00	7.00	5.0	24.8	2.00	0.0066	3.9	True
250.00	7.00	5.0	23.8	2.00	0.0033	3.9	True
1346.00	7.00	5.0	21.7	2.00	0.0014	3.9	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-01	Testing Date	2022-09-22 12:19:41 PM
Sample Number	3	Tested By	Sieve - SI, Hydrometer - KM
Checked By		LabID	22-2008

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-02	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 277.93(g)
Weight measured for back sieving = 98.96(g)
Weight of Sample for Hydrometer = 98.96(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	2.25	0.81	4.75	99.2
2.00mm	8.01	2.07	2.00	97.1
PAN	268.07	97.12	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	2.03	1.99	0.85	95.1
425µm	5.83	3.73	0.43	91.4
250µm	12.78	6.82	0.25	84.6
106µm	29.77	16.67	0.11	67.9
75µm	35.70	5.82	0.08	62.1

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-19	9:35:00 AM
Finished :	2022-09-20	8:33:00 AM

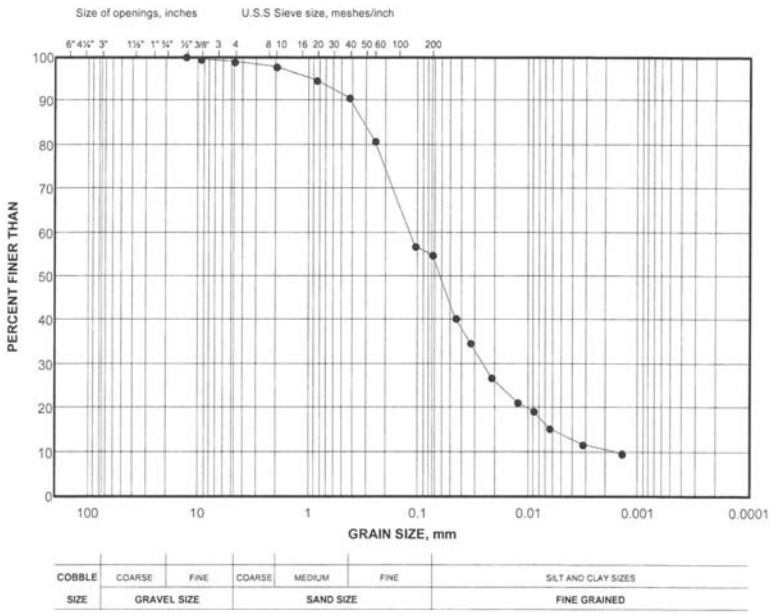
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	52.00	5.0	24.9	47.00	0.0369	45.7	True
2.00	45.00	5.0	24.9	40.00	0.0279	38.9	True
5.00	36.00	5.0	24.9	31.00	0.0190	30.1	True
15.00	31.00	5.0	24.7	26.00	0.0114	25.3	True
30.00	24.00	5.0	24.4	19.00	0.0085	18.5	True
60.00	22.00	5.0	24.2	17.00	0.0061	16.5	True
250.00	18.00	5.0	23.8	13.00	0.0031	12.6	True
1378.00	14.00	5.0	22.6	9.00	0.0014	8.7	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-02	Testing Date	2022-09-21 8:00:32 AM
Sample Number	1	Tested By	Sieve - ES, Hydrometer - KM
Checked By	_____	LabID	22-2009

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-02	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 346.23(g)
Weight measured for back sieving = 50.27(g)
Weight of Sample for Hydrometer = 50.27(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	2.12	0.61	9.50	99.4
4.75mm	3.72	0.46	4.75	98.9
2.00mm	7.86	1.20	2.00	97.7
PAN	337.81	97.73	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	1.55	3.01	0.85	94.7
425µm	3.63	4.04	0.43	90.7
250µm	8.68	9.82	0.25	80.9
106µm	21.12	24.18	0.11	56.7
75µm	22.06	1.83	0.08	54.9

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	10:09:00 AM
Finished :	2022-09-21	9:05:00 AM

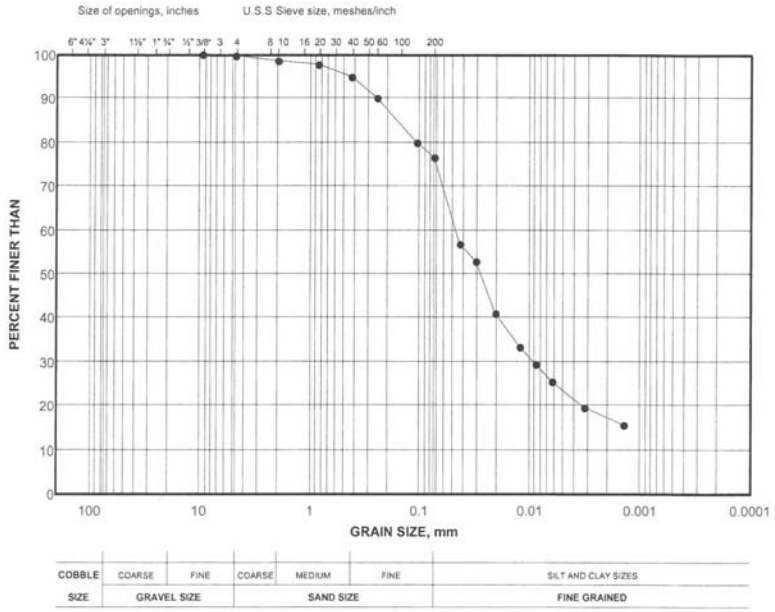
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	26.00	5.0	24.2	21.00	0.0460	40.4	True
2.00	23.00	5.0	24.2	18.00	0.0331	34.6	True
5.00	19.00	5.0	24.2	14.00	0.0215	26.9	True
15.00	16.00	5.0	24.0	11.00	0.0127	21.2	True
30.00	15.00	5.0	23.8	10.00	0.0090	19.2	True
60.00	13.00	5.0	23.7	8.00	0.0065	15.4	True
250.00	11.00	5.0	23.2	6.00	0.0032	11.5	True
1440.00	10.00	5.0	22.3	5.00	0.0014	9.6	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-02	Testing Date	2022-09-22 8:50:41 AM
Sample Number	2	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2010

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-03	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 290.11(g)
Weight measured for back sieving = 49.95(g)
Weight of Sample for Hydrometer = 49.95(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	0.90	0.31	4.75	99.7
2.00mm	4.13	1.11	2.00	98.6
PAN	284.99	98.58	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.52	1.03	0.85	97.6
425µm	1.86	2.64	0.43	94.9
250µm	4.33	4.87	0.25	90.0
106µm	9.46	10.12	0.11	79.9
75µm	11.18	3.39	0.08	76.5

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-15	9:30:00 AM
Finished :	2022-09-16	7:21:00 AM

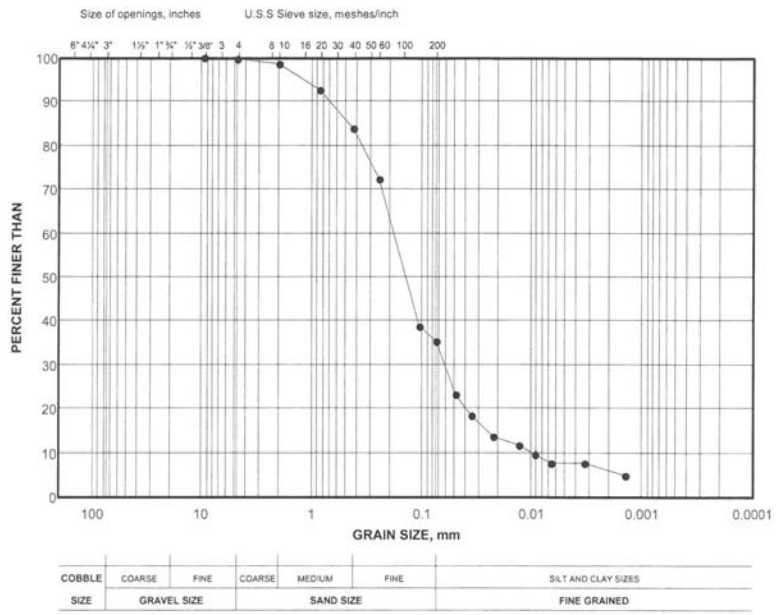
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	34.00	5.0	24.1	29.00	0.0435	56.7	True
2.00	32.00	5.0	24.1	27.00	0.0312	52.8	True
5.00	26.00	5.0	24.1	21.00	0.0206	41.0	True
15.00	22.00	5.0	23.8	17.00	0.0122	33.2	True
30.00	20.00	5.0	23.6	15.00	0.0088	29.3	True
60.00	18.00	5.0	23.4	13.00	0.0063	25.4	True
250.00	15.00	5.0	22.7	10.00	0.0032	19.5	True
1311.00	13.00	5.0	22.5	8.00	0.0014	15.6	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-03	Testing Date	2022-09-21 8:28:56 AM
Sample Number	1	Tested By	Sieve - ES, Hydrometer - KM
Checked By	_____	LabID	22-2011

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-03	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 402.83(g)
Weight measured for back sieving = 50.66(g)
Weight of Sample for Hydrometer = 50.66(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	1.62	0.40	4.75	99.6
2.00mm	5.82	1.04	2.00	98.6
PAN	396.27	98.56	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	3.09	6.01	0.85	92.6
425µm	7.57	8.72	0.43	83.8
250µm	13.56	11.65	0.25	72.2
106µm	30.75	33.44	0.11	38.7
75µm	32.52	3.44	0.08	35.3

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	10:37:00 AM
Finished :	2022-09-21	9:19:00 AM

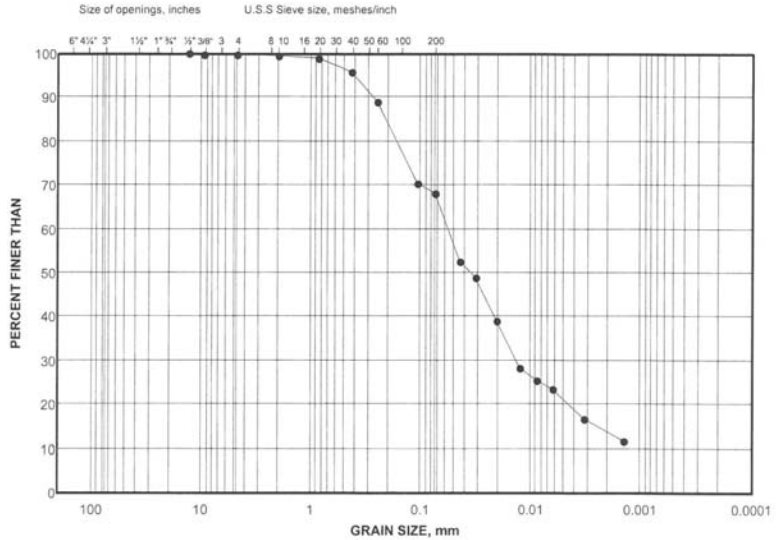
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	17.00	5.0	24.1	12.00	0.0487	23.1	True
2.00	14.50	5.0	24.1	9.50	0.0349	18.3	True
5.00	12.00	5.0	24.1	7.00	0.0224	13.5	True
15.00	11.00	5.0	24.0	6.00	0.0130	11.6	True
30.00	10.00	5.0	23.9	5.00	0.0093	9.6	True
60.00	9.00	5.0	23.7	4.00	0.0066	7.7	True
250.00	9.00	5.0	23.2	4.00	0.0033	7.7	True
1362.00	7.50	5.0	22.2	2.50	0.0014	4.8	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-03	Testing Date	2022-09-22 8:55:01 AM
Sample Number	2	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2012

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-04	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 323(g)
Weight measured for back sieving = 50.53(g)
Weight of Sample for Hydrometer = 50.53(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.80	0.25	9.50	99.8
4.75mm	0.80	0.00	4.75	99.8
2.00mm	1.71	0.28	2.00	99.5
PAN	320.07	99.47	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.36	0.71	0.85	98.8
425µm	1.94	3.11	0.43	95.7
250µm	5.35	6.71	0.25	88.9
106µm	14.80	18.60	0.11	70.3
75µm	16.00	2.36	0.08	68.0

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	10:20:00 AM
Finished :	2022-09-21	9:11:00 AM

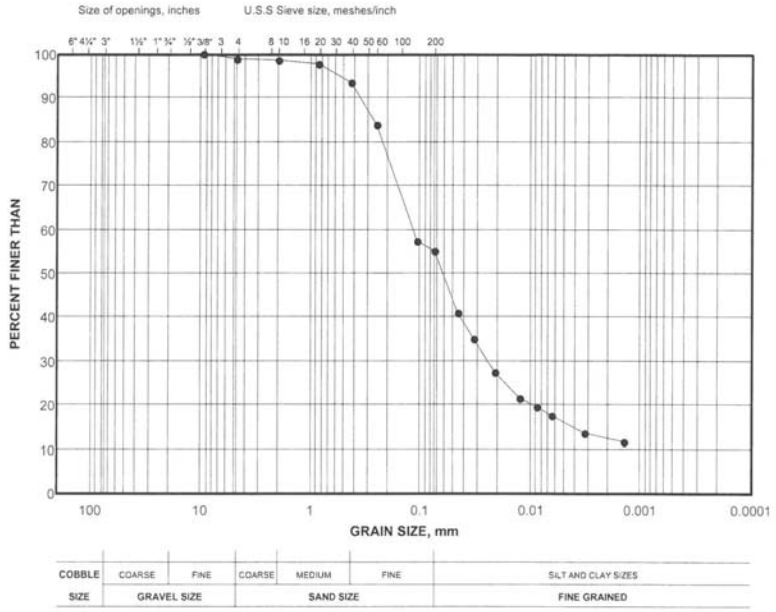
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	32.00	5.0	23.7	27.00	0.0444	52.6	True
2.00	30.00	5.0	23.7	25.00	0.0318	48.7	True
5.00	25.00	5.0	23.7	20.00	0.0208	39.0	True
15.00	19.50	5.0	23.6	14.50	0.0125	28.3	True
30.00	18.00	5.0	23.6	13.00	0.0089	25.3	True
60.00	17.00	5.0	23.5	12.00	0.0063	23.4	True
250.00	13.50	5.0	23.1	8.50	0.0032	16.6	True
1371.00	11.00	5.0	23.3	6.00	0.0014	11.7	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-04	Testing Date	2022-09-22 8:58:46 AM
Sample Number	1	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2013

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-04	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 369.77(g)
Weight measured for back sieving = 50.1(g)
Weight of Sample for Hydrometer = 50.1(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	4.04	1.09	4.75	98.9
2.00mm	5.07	0.28	2.00	98.6
PAN	363.92	98.63	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.54	1.06	0.85	97.6
425µm	2.55	3.96	0.43	93.6
250µm	7.54	9.82	0.25	83.8
106µm	21.01	26.52	0.11	57.3
75µm	22.10	2.15	0.08	55.1

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	10:50:00 AM
Finished :	2022-09-21	9:20:00 AM

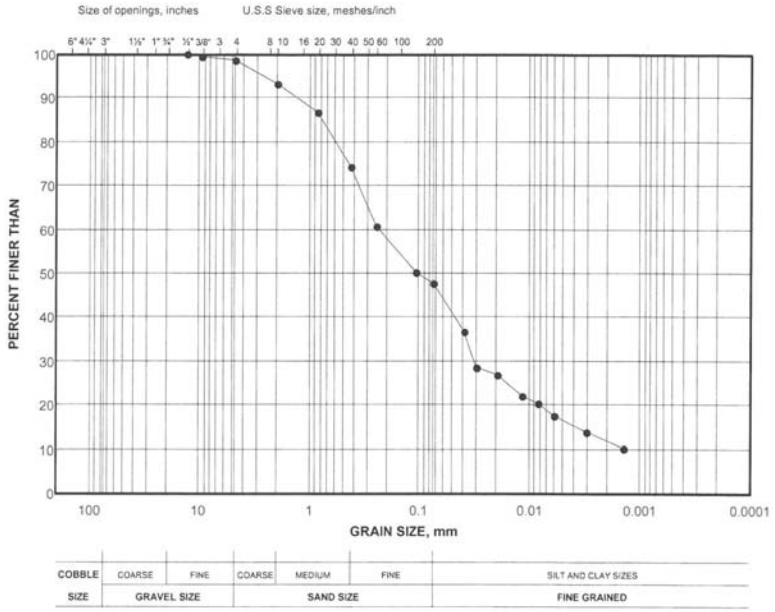
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	26.00	5.0	25.1	21.00	0.0454	40.9	True
2.00	23.00	5.0	25.1	18.00	0.0327	35.1	True
5.00	19.00	5.0	25.1	14.00	0.0212	27.3	True
15.00	16.00	5.0	24.7	11.00	0.0125	21.4	True
30.00	15.00	5.0	24.5	10.00	0.0089	19.5	True
60.00	14.00	5.0	24.1	9.00	0.0064	17.5	True
250.00	12.00	5.0	23.3	7.00	0.0032	13.6	True
1350.00	11.00	5.0	22.3	6.00	0.0014	11.7	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-04	Testing Date	2022-09-22 9:02:24 AM
Sample Number	2	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2014

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-05	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 296.78(g)
Weight measured for back sieving = 100.12(g)
Weight of Sample for Hydrometer = 100.12(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	2.13	0.72	9.50	99.3
4.75mm	4.27	0.72	4.75	98.6
2.00mm	20.16	5.35	2.00	93.2
PAN	275.89	93.21	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	6.96	6.48	0.85	86.7
425µm	20.24	12.36	0.43	74.4
250µm	34.91	13.66	0.25	60.7
106µm	46.12	10.44	0.11	50.3
75µm	48.87	2.56	0.08	47.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-15	10:46:00 AM
Finished :	2022-09-16	7:28:00 AM

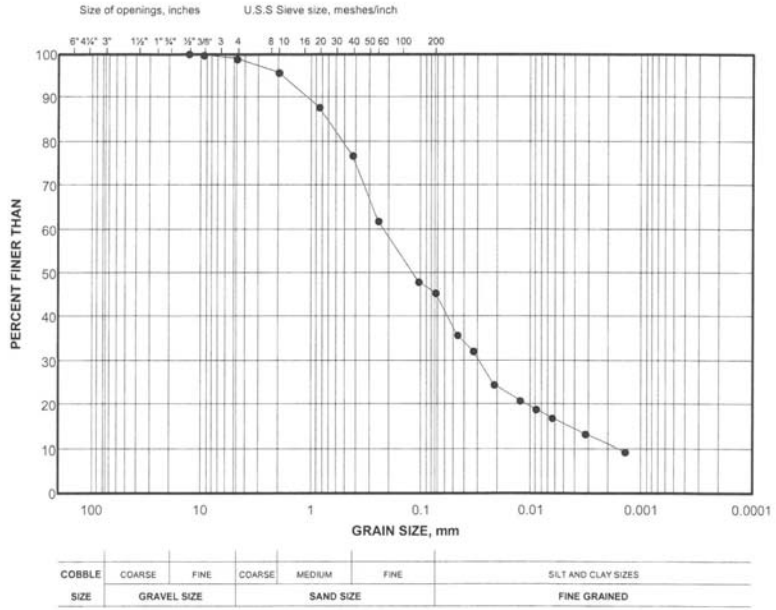
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	45.00	5.0	24.7	40.00	0.0395	36.9	True
2.00	36.00	5.0	24.7	31.00	0.0301	28.6	True
5.00	34.00	5.0	24.7	29.00	0.0193	26.7	True
15.00	29.00	5.0	24.3	24.00	0.0116	22.1	True
30.00	27.00	5.0	24.2	22.00	0.0083	20.3	True
60.00	24.00	5.0	23.8	19.00	0.0060	17.5	True
250.00	20.00	5.0	22.8	15.00	0.0031	13.8	True
1242.00	16.00	5.0	22.5	11.00	0.0014	10.1	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-05	Testing Date	2022-09-21 8:48:30 AM
Sample Number	1	Tested By	Sieve - ES, Hydrometer - KM
Checked By	_____	LabID	22-2015

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-05	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 353.21(g)
Weight measured for back sieving = 50.28(g)
Weight of Sample for Hydrometer = 50.28(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.70	0.20	9.50	99.8
4.75mm	3.95	0.92	4.75	98.9
2.00mm	14.56	3.00	2.00	95.9
PAN	338.05	95.88	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	4.23	8.07	0.85	87.8
425µm	10.00	11.00	0.43	76.8
250µm	17.82	14.91	0.25	61.9
106µm	25.16	14.00	0.11	47.9
75µm	26.42	2.40	0.08	45.5

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	9:57:00 AM
Finished :	2022-09-21	8:50:00 AM

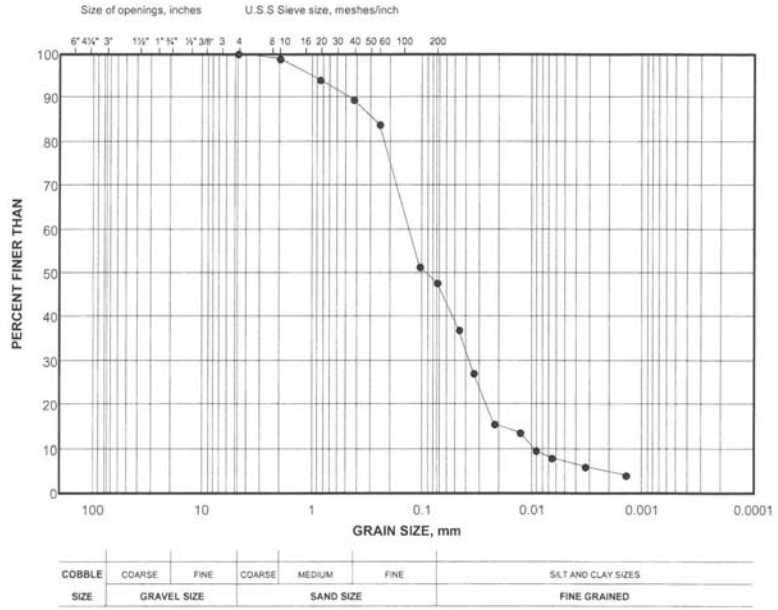
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	24.00	5.0	24.2	19.00	0.0466	35.9	True
2.00	22.00	5.0	24.2	17.00	0.0333	32.1	True
5.00	18.00	5.0	24.2	13.00	0.0216	24.6	True
15.00	16.00	5.0	24.0	11.00	0.0127	20.8	True
30.00	15.00	5.0	23.9	10.00	0.0090	18.9	True
60.00	14.00	5.0	23.7	9.00	0.0064	17.0	True
250.00	12.00	5.0	23.2	7.00	0.0032	13.2	True
1373.00	10.00	5.0	22.3	5.00	0.0014	9.4	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-05	Testing Date	2022-09-22 9:05:36 AM
Sample Number	2	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2016

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-06	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 443.64(g)
Weight measured for back sieving = 50.31(g)
Weight of Sample for Hydrometer = 50.31(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	0.00	0.00	4.75	100.0
2.00mm	5.21	1.17	2.00	98.8
PAN	437.75	98.83	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	2.44	4.79	0.85	94.0
425µm	4.68	4.40	0.43	89.6
250µm	7.64	5.81	0.25	83.8
106µm	24.10	32.33	0.11	51.5
75µm	26.04	3.81	0.08	47.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	11:01:00 AM
Finished :	2022-09-21	9:29:00 AM

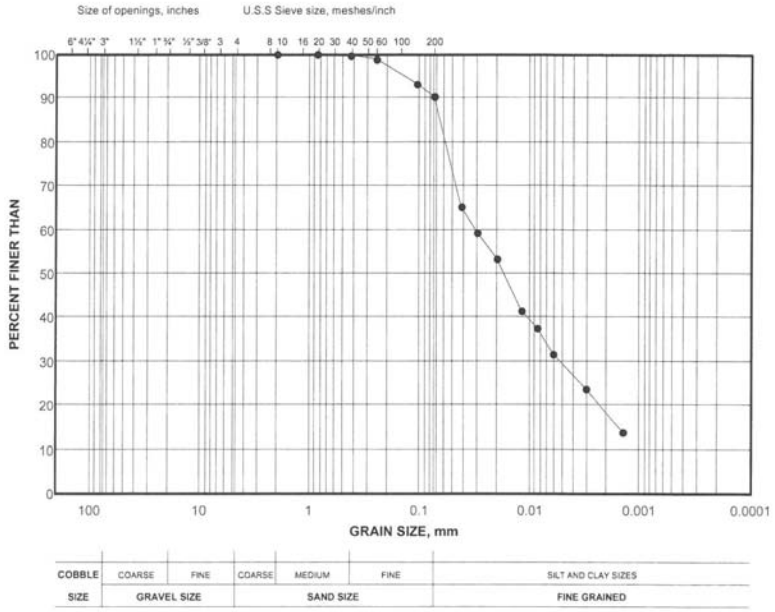
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	24.00	5.0	24.1	19.00	0.0466	36.9	True
2.00	19.00	5.0	24.1	14.00	0.0340	27.2	True
5.00	13.00	5.0	24.1	8.00	0.0223	15.6	True
15.00	12.00	5.0	23.9	7.00	0.0130	13.6	True
30.00	10.00	5.0	23.7	5.00	0.0093	9.7	True
60.00	9.00	5.0	23.6	4.00	0.0066	7.8	True
250.00	8.00	5.0	23.7	3.00	0.0033	5.8	True
1440.00	7.00	5.0	22.3	2.00	0.0014	3.9	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-06	Testing Date	2022-09-22 9:08:49 AM
Sample Number	2	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2017

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-07	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 361.84(g)
Weight measured for back sieving = 50.16(g)
Weight of Sample for Hydrometer = 50.16(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	0.00	0.00	4.75	100.0
2.00mm	0.14	0.04	2.00	100.0
PAN	361.06	99.96	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.05	0.10	0.85	99.9
425µm	0.17	0.24	0.43	99.6
250µm	0.50	0.66	0.25	99.0
106µm	3.37	5.72	0.11	93.2
75µm	4.79	2.83	0.08	90.4

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-15	10:38:00 AM
Finished :	2022-09-16	7:27:00 AM

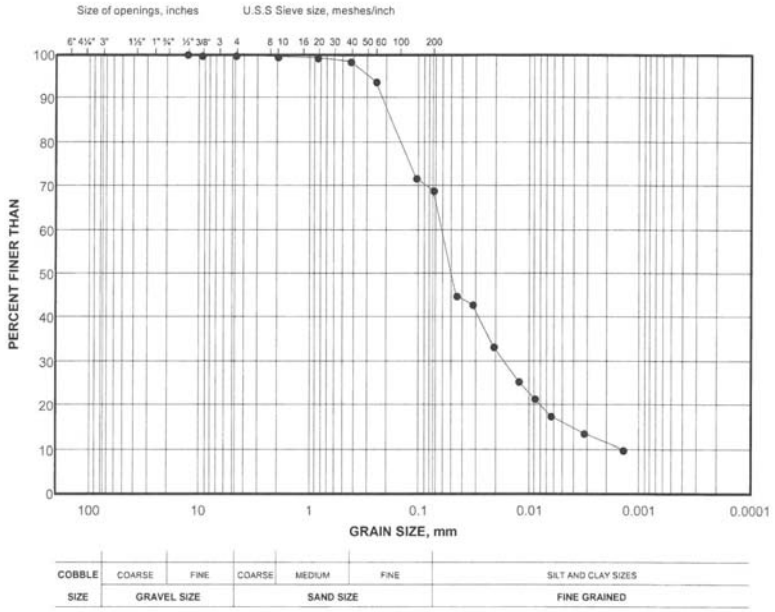
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	38.00	5.0	24.1	33.00	0.0422	65.1	True
2.00	35.00	5.0	24.1	30.00	0.0306	59.2	True
5.00	32.00	5.0	24.1	27.00	0.0198	53.3	True
15.00	26.00	5.0	23.9	21.00	0.0119	41.5	True
30.00	24.00	5.0	23.8	19.00	0.0085	37.5	True
60.00	21.00	5.0	23.3	16.00	0.0062	31.6	True
250.00	17.00	5.0	22.6	12.00	0.0031	23.7	True
1249.00	12.00	5.0	22.5	7.00	0.0014	13.8	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-07	Testing Date	2022-09-21 8:52:01 AM
Sample Number	2	Tested By	Sieve - ES, Hydrometer - KM
Checked By	_____	LabID	22-2018

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-07	3	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 455.69(g)
Weight measured for back sieving = 50.32(g)
Weight of Sample for Hydrometer = 50.32(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	1.25	0.27	9.50	99.7
4.75mm	1.51	0.06	4.75	99.7
2.00mm	2.11	0.13	2.00	99.5
PAN	451.48	99.54	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.15	0.30	0.85	99.2
425µm	0.60	0.89	0.43	98.4
250µm	2.91	4.57	0.25	93.8
106µm	14.00	21.94	0.11	71.8
75µm	15.53	3.03	0.08	68.8

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-20	11:13:00 AM
Finished :	2022-09-21	9:30:00 AM

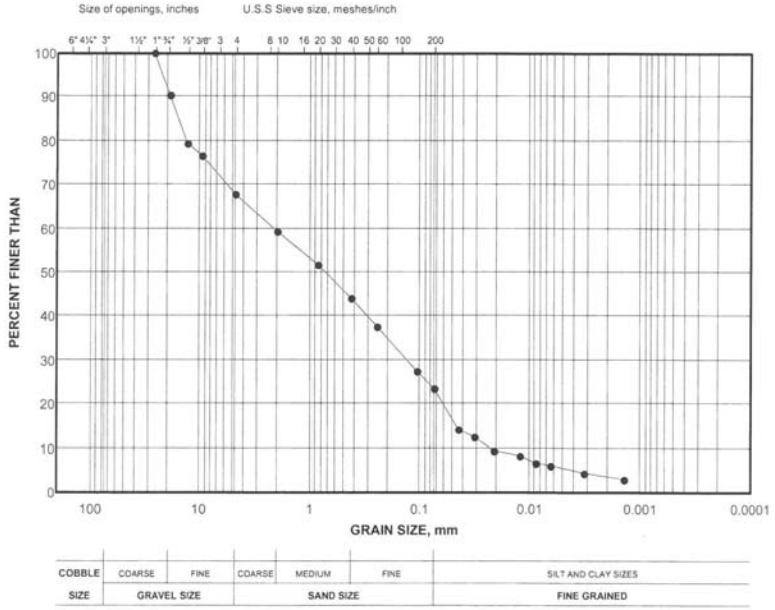
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	28.00	5.0	23.9	23.00	0.0455	45.0	True
2.00	27.00	5.0	23.9	22.00	0.0324	43.1	True
5.00	22.00	5.0	23.9	17.00	0.0212	33.3	True
15.00	18.00	5.0	23.7	13.00	0.0126	25.5	True
30.00	16.00	5.0	23.6	11.00	0.0090	21.5	True
60.00	14.00	5.0	23.4	9.00	0.0065	17.6	True
250.00	12.00	5.0	23.2	7.00	0.0032	13.7	True
1337.00	10.00	5.0	22.4	5.00	0.0014	9.8	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-07	Testing Date	2022-09-22 9:12:44 AM
Sample Number	3	Tested By	Sieve - KM, Hydrometer - KM
Checked By	_____	LabID	22-2019

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-07	4	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 414.49(g)
Weight measured for back sieving = 99.89(g)
Weight of Sample for Hydrometer = 99.89(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	39.34	9.49	19.00	90.5
13.2mm	85.98	11.25	13.20	79.3
9.5mm	97.21	2.71	9.50	76.6
4.75mm	133.16	8.67	4.75	67.9
2.00mm	168.37	8.49	2.00	59.4
PAN	246.10	59.39	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	12.79	7.60	0.85	51.8
425µm	25.50	7.56	0.43	44.2
250µm	36.53	6.56	0.25	37.7
106µm	53.74	10.23	0.11	27.4
75µm	60.43	3.98	0.08	23.5

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-15	9:52:00 AM
Finished :	2022-09-16	7:24:00 AM

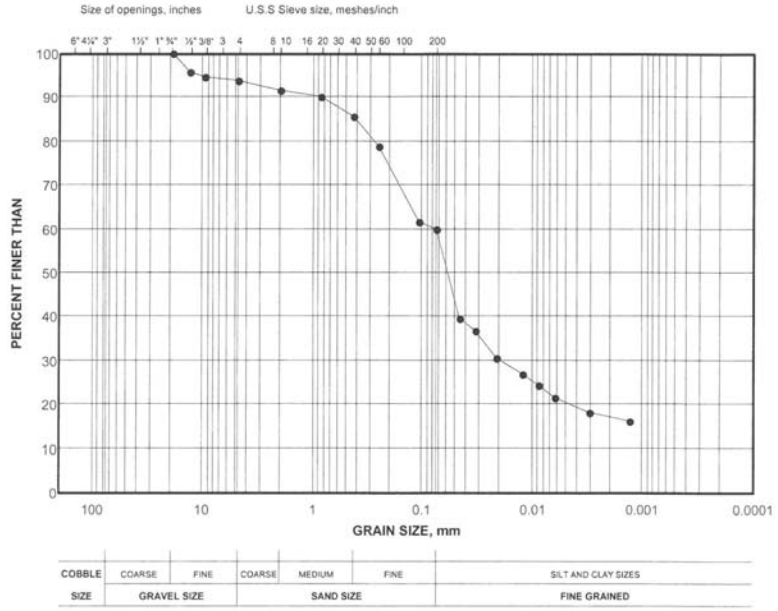
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	29.00	5.0	25.0	24.00	0.0446	14.1	True
2.00	26.00	5.0	25.0	21.00	0.0322	12.4	True
5.00	21.00	5.0	25.0	16.00	0.0210	9.4	True
15.00	19.00	5.0	24.6	14.00	0.0123	8.2	True
30.00	16.00	5.0	24.2	11.00	0.0089	6.5	True
60.00	15.00	5.0	23.9	10.00	0.0064	5.9	True
250.00	12.00	5.0	22.8	7.00	0.0032	4.1	True
1292.00	10.00	5.0	22.5	5.00	0.0014	2.9	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-07	Testing Date	2022-09-21 8:55:18 AM
Sample Number	4	Tested By	Sieve - ES, Hydrometer - KM
Checked By	_____	LabID	22-2020

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-08	1	

Project Number: 19129150 (7900)

Checked By:

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 320.45(g)
Weight measured for back sieving = 50.38(g)
Weight of Sample for Hydrometer = 50.38(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	13.64	4.26	13.20	95.7
9.5mm	16.89	1.01	9.50	94.7
4.75mm	19.79	0.90	4.75	93.8
2.00mm	27.37	2.37	2.00	91.5
PAN	292.77	91.46	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.68	1.23	0.85	90.2
425µm	3.25	4.67	0.43	85.6
250µm	6.98	6.77	0.25	78.8
106µm	16.39	17.08	0.11	61.7
75µm	17.39	1.82	0.08	59.9

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-21	10:56:00 AM
Finished :	2022-09-22	8:36:00 AM

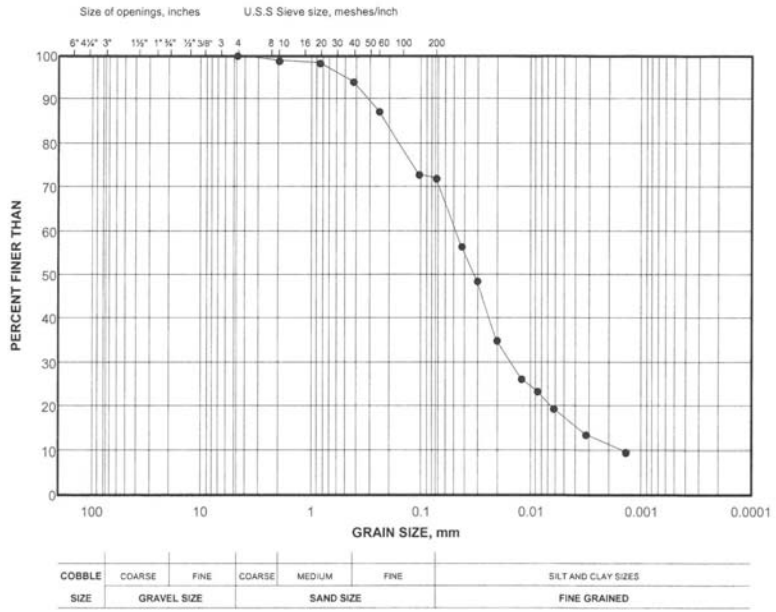
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	27.00	5.0	24.4	22.00	0.0455	39.6	True
2.00	25.50	5.0	24.4	20.50	0.0325	36.9	True
5.00	22.00	5.0	24.4	17.00	0.0210	30.6	True
15.00	20.00	5.0	24.2	15.00	0.0123	27.0	True
30.00	18.50	5.0	24.2	13.50	0.0088	24.3	True
60.00	17.00	5.0	23.9	12.00	0.0063	21.6	True
250.00	15.00	5.0	23.8	10.00	0.0031	18.0	True
1440.00	14.00	5.0	21.8	9.00	0.0013	16.2	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-08	Testing Date	2022-09-22 12:22:49 PM
Sample Number	1	Tested By	Sieve - SI, Hydrometer - KM
Checked By		LabID	22-2021

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-08	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 281.35(g)
Weight measured for back sieving = 50.22(g)
Weight of Sample for Hydrometer = 50.22(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	0.00	0.00	4.75	100.0
2.00mm	3.26	1.16	2.00	98.8
PAN	276.89	98.84	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.32	0.63	0.85	98.2
425µm	2.36	4.02	0.43	94.2
250µm	5.80	6.77	0.25	87.4
106µm	13.11	14.39	0.11	73.0
75µm	13.67	1.10	0.08	71.9

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-21	10:45:00 AM
Finished :	2022-09-22	8:35:00 AM

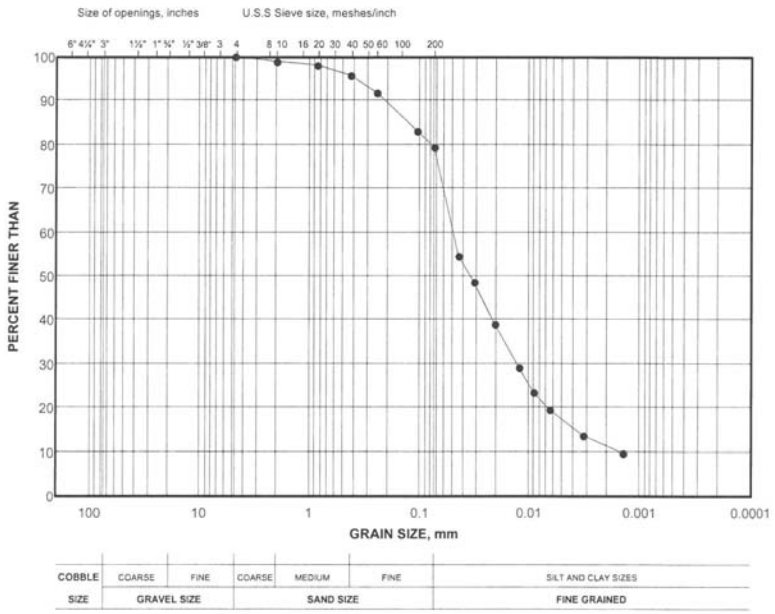
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	34.00	5.0	24.7	29.00	0.0432	56.5	True
2.00	30.00	5.0	24.7	25.00	0.0314	48.7	True
5.00	23.00	5.0	24.7	18.00	0.0208	35.1	True
15.00	18.50	5.0	24.7	13.50	0.0124	26.3	True
30.00	17.00	5.0	24.6	12.00	0.0088	23.4	True
60.00	15.00	5.0	24.3	10.00	0.0063	19.5	True
250.00	12.00	5.0	23.8	7.00	0.0032	13.6	True
1310.00	10.00	5.0	21.9	5.00	0.0014	9.7	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-08	Testing Date	2022-09-22 12:28:38 PM
Sample Number	2	Tested By	Sieve - SI, Hydrometer - KM
Checked By		LabID	22-2022

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-09	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 280.77(g)
Weight measured for back sieving = 50.33(g)
Weight of Sample for Hydrometer = 50.33(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	0.00	0.00	4.75	100.0
2.00mm	3.01	1.07	2.00	98.9
PAN	277.43	98.93	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.50	0.98	0.85	98.0
425µm	1.66	2.28	0.43	95.7
250µm	3.68	3.97	0.25	91.7
106µm	8.05	8.59	0.11	83.1
75µm	9.95	3.73	0.08	79.4

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-15	10:04:00 AM
Finished :	2022-09-16	7:25:00 AM

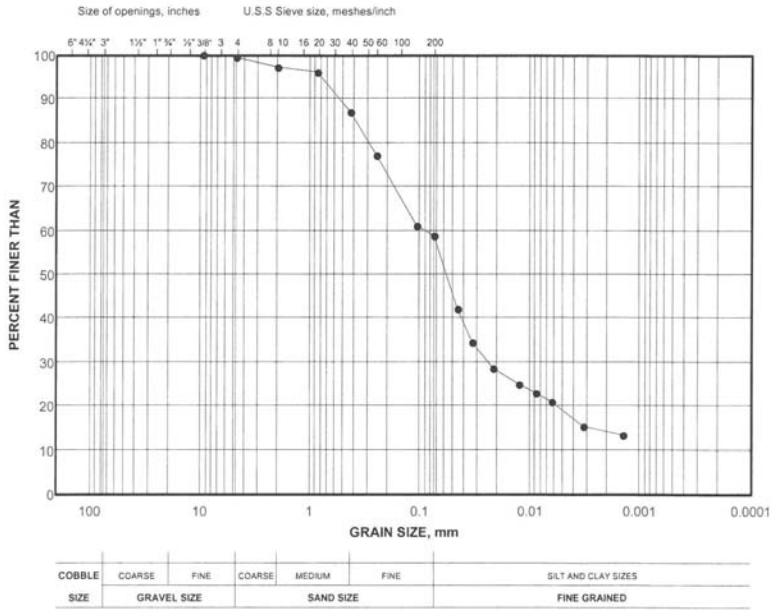
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	33.00	5.0	23.8	28.00	0.0440	54.5	True
2.00	30.00	5.0	23.8	25.00	0.0318	48.6	True
5.00	25.00	5.0	23.8	20.00	0.0208	38.9	True
15.00	20.00	5.0	23.6	15.00	0.0124	29.2	True
30.00	17.00	5.0	23.4	12.00	0.0090	23.3	True
60.00	15.00	5.0	23.3	10.00	0.0064	19.5	True
250.00	12.00	5.0	22.6	7.00	0.0032	13.6	True
1440.00	10.00	5.0	22.5	5.00	0.0014	9.7	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-09	Testing Date	2022-09-21 8:58:59 AM
Sample Number	1	Tested By	Sieve - ES, Hydrometer - KM
Checked By		LabID	22-2023

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	SC 22-09	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 405.06(g)
Weight measured for back sieving = 50.4(g)
Weight of Sample for Hydrometer = 50.4(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	2.94	0.73	4.75	99.3
2.00mm	11.61	2.14	2.00	97.1
PAN	392.87	97.13	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.54	1.04	0.85	96.1
425µm	5.23	9.04	0.43	87.1
250µm	10.44	10.04	0.25	77.0
106µm	18.74	16.00	0.11	61.0
75µm	19.91	2.25	0.08	58.8

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-21	10:33:00 AM
Finished :	2022-09-22	8:34:00 AM

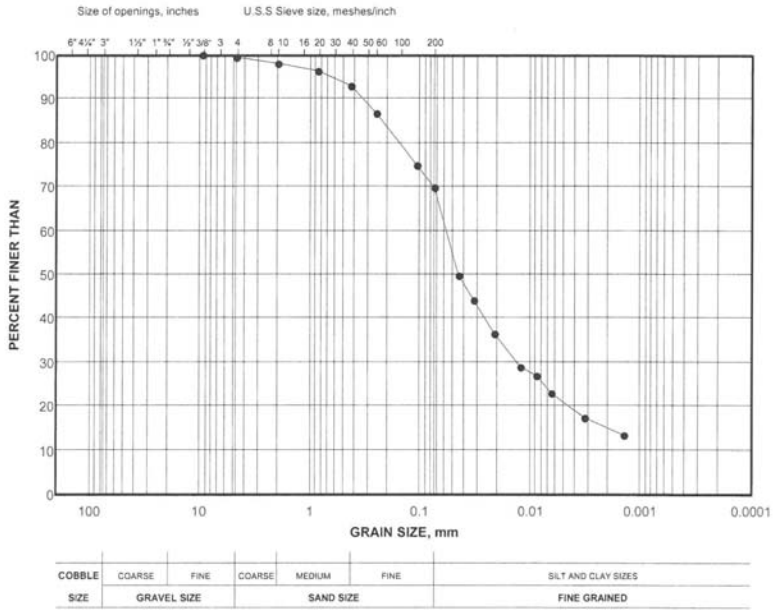
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	27.00	5.0	24.1	22.00	0.0457	42.0	True
2.00	23.00	5.0	24.1	18.00	0.0332	34.3	True
5.00	20.00	5.0	24.1	15.00	0.0214	28.6	True
15.00	18.00	5.0	24.0	13.00	0.0125	24.8	True
30.00	17.00	5.0	24.0	12.00	0.0089	22.9	True
60.00	16.00	5.0	24.0	11.00	0.0063	21.0	True
250.00	13.00	5.0	23.7	8.00	0.0032	15.3	True
1321.00	12.00	5.0	21.9	7.00	0.0014	13.4	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-09	Testing Date	2022-09-22 12:32:52 PM
Sample Number	2	Tested By	Sieve - SI, Hydrometer - KM
Checked By	_____	LabID	22-2024

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-10	1	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 280.03(g)
Weight measured for back sieving = 50.59(g)
Weight of Sample for Hydrometer = 50.59(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	1.61	0.57	4.75	99.4
2.00mm	5.96	1.55	2.00	97.9
PAN	273.78	97.88	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	0.78	1.51	0.85	96.4
425µm	2.63	3.58	0.43	92.8
250µm	5.79	6.11	0.25	86.7
106µm	11.91	11.84	0.11	74.8
75µm	14.59	5.19	0.08	69.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-15	9:40:00 AM
Finished :	2022-09-16	7:22:00 AM

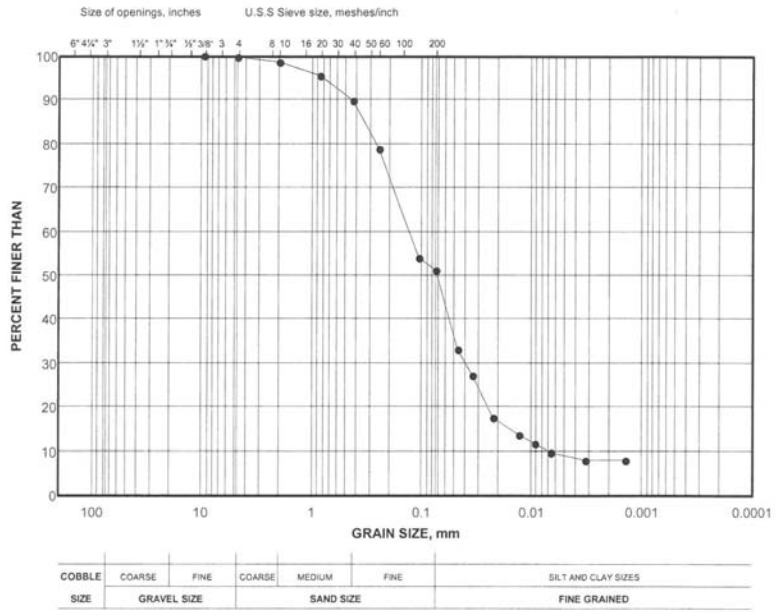
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	31.00	5.0	23.7	26.00	0.0447	49.8	True
2.00	28.00	5.0	23.7	23.00	0.0323	44.1	True
5.00	24.00	5.0	23.7	19.00	0.0210	36.4	True
15.00	20.00	5.0	23.5	15.00	0.0124	28.7	True
30.00	19.00	5.0	23.3	14.00	0.0089	26.8	True
60.00	17.00	5.0	23.1	12.00	0.0064	23.0	True
250.00	14.00	5.0	22.6	9.00	0.0032	17.2	True
1302.00	12.00	5.0	22.5	7.00	0.0014	13.4	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-10	Testing Date	2022-09-21 9:02:22 AM
Sample Number	1	Tested By	Sieve - ES, Hydrometer - KM
Checked By	_____	LabID	22-2025

Golder Associates

GRAIN SIZE DISTRIBUTION
MTO LS-702

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
•	SC 22-10	2	

Project Number: 19129150 (7900)

Checked By: _____

Golder Associates

Date: 23-Sep-22

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 459.94(g)
Weight measured for back sieving = 50.18(g)
Weight of Sample for Hydrometer = 50.18(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
150mm	0.00	0.00	150.00	100.0
125mm	0.00	0.00	125.00	100.0
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	1.05	0.23	4.75	99.8
2.00mm	6.72	1.23	2.00	98.5
PAN	452.63	98.54	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	1.54	3.02	0.85	95.5
425µm	4.40	5.62	0.43	89.9
250µm	10.03	11.06	0.25	78.8
106µm	22.74	24.96	0.11	53.9
75µm	24.10	2.67	0.08	51.2

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	2022-09-21	10:21:00 AM
Finished :	2022-09-22	8:32:00 AM

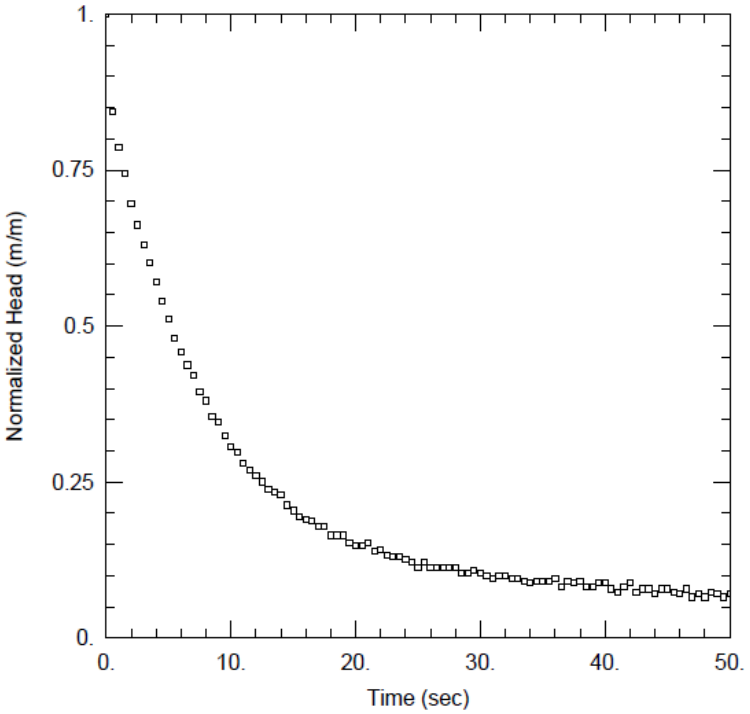
Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	22.00	5.0	23.9	17.00	0.0473	33.0	True
2.00	19.00	5.0	23.9	14.00	0.0341	27.2	True
5.00	14.00	5.0	23.9	9.00	0.0222	17.5	True
15.00	12.00	5.0	23.7	7.00	0.0130	13.6	True
30.00	11.00	5.0	23.7	6.00	0.0092	11.7	True
60.00	10.00	5.0	23.8	5.00	0.0066	9.7	True
250.00	9.00	5.0	23.6	4.00	0.0032	7.8	True
1331.00	9.00	5.0	21.8	4.00	0.0014	7.8	True

Project Number	19129150 (7900)	Depth	
Project Task	1000	Units	Metric
Borehole Number	SC 22-10	Testing Date	2022-09-22 12:36:13 PM
Sample Number	2	Tested By	Sieve - SI, Hydrometer - KM
Checked By	_____	LabID	22-2026

Golder Associates

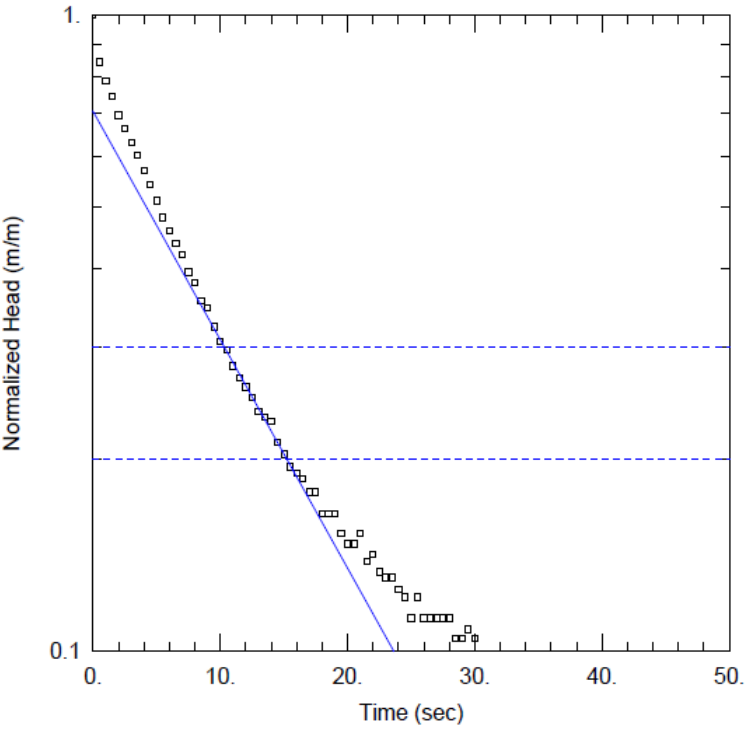
APPENDIX J

Northwest Investigation - Single Well Response Test Results



TEST INFORMATION:

Test Well:	PW22-01
Date of Test:	September 14, 2022
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	0.62 mbgs
Initial Displacement:	1.12 m
Casing Radius:	0.051 m
Borehole Radius:	0.084 m
Well Screen Interval:	10.36 m to 39.62 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT
CALEDON PIT / QUARRY

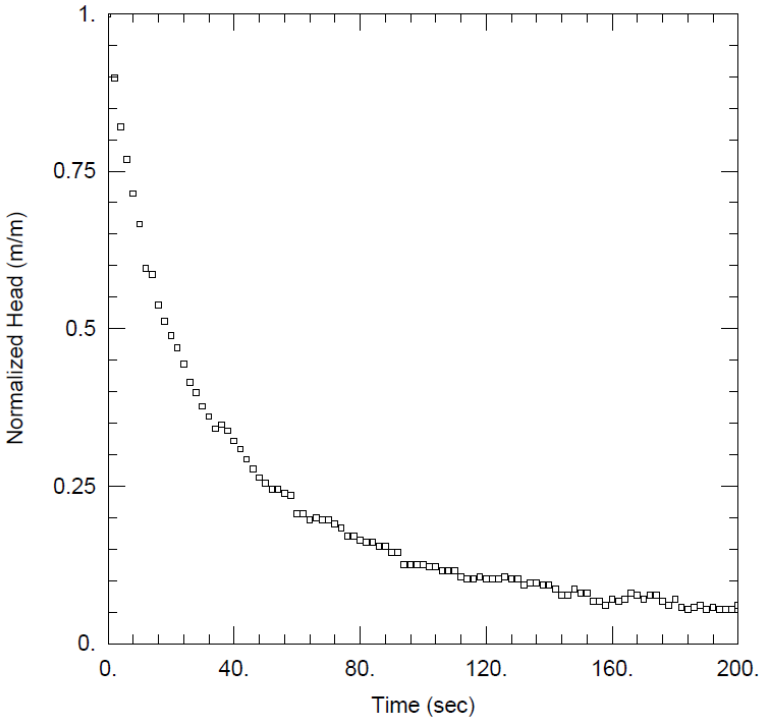
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL PW22-01

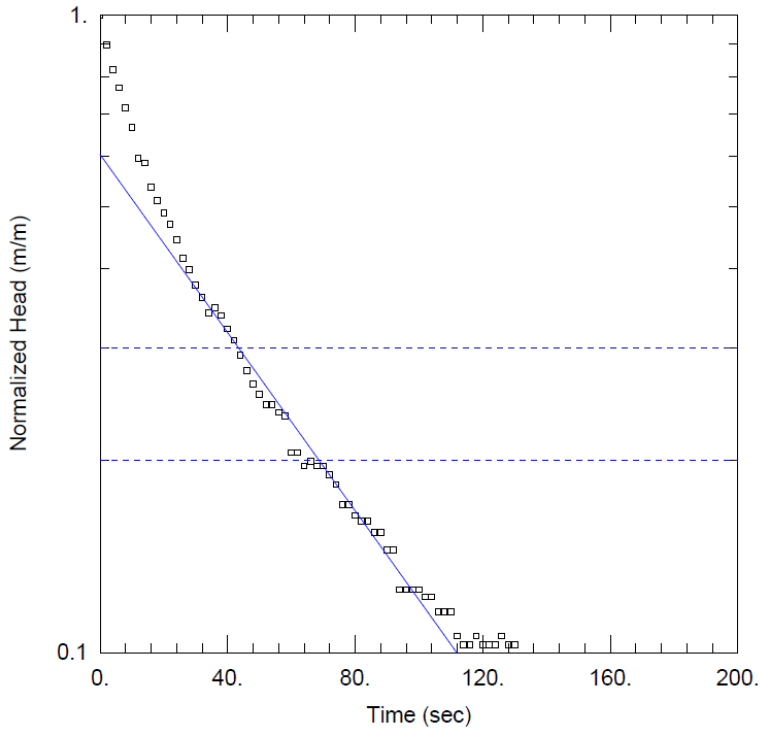
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-01

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW22-01
Date of Test:	August 15, 2022
Test Type:	Rising Head Test
Test Method:	Physical Slug Rising Head Test
Static Water Level:	2.35 mbgs
Initial Displacement:	0.31 m
Casing Radius:	0.025 m
Borehole Radius:	0.079 m
Well Screen Interval:	4.11 m to 7.16 m
Geology:	Silty Sand



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

5×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

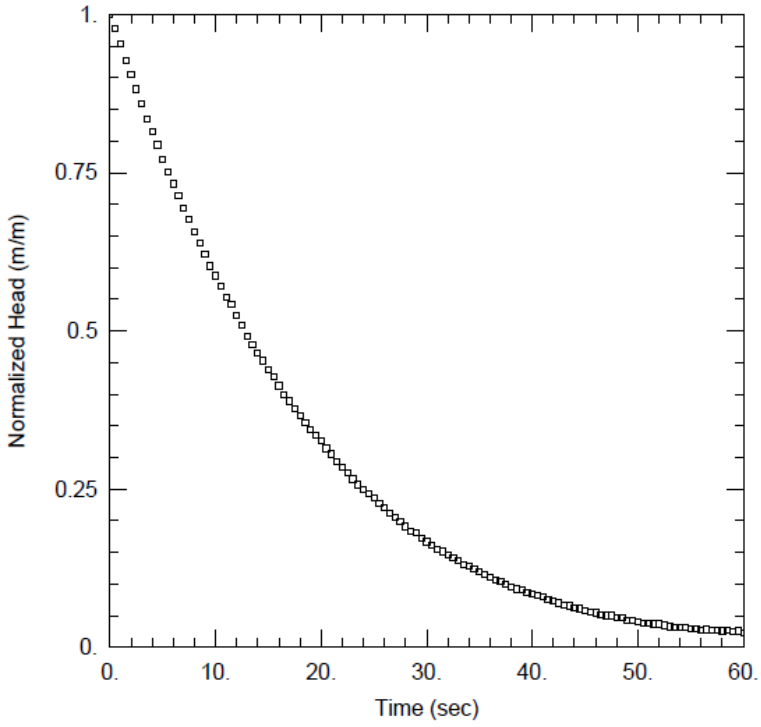
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW22-01

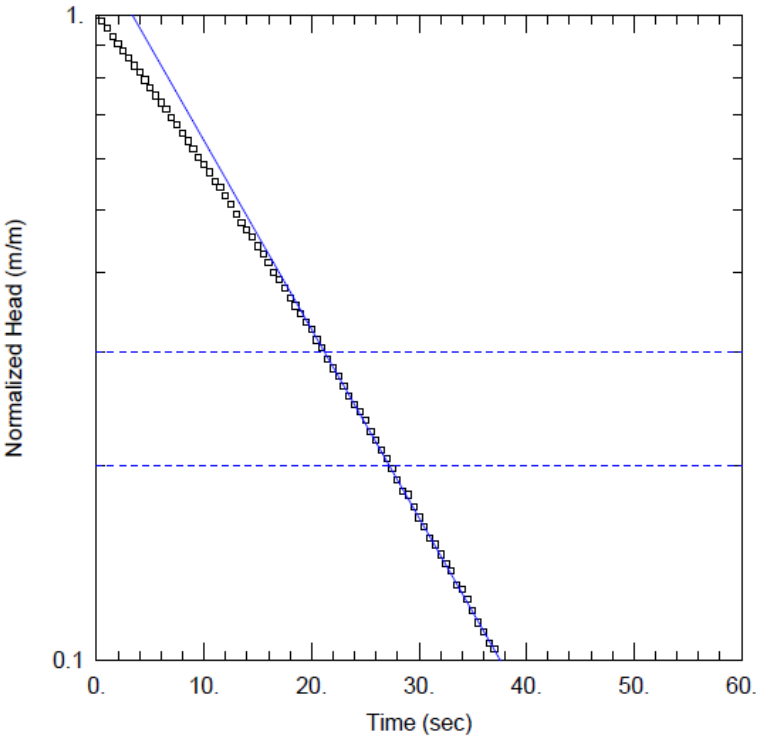
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-02

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW22-02A
Date of Test:	September 14, 2022
Test Type:	Rising Head Test
Test Method:	Pneumatic Rising Head Test
Static Water Level:	1.56 mbgs
Initial Displacement:	3.65 m
Casing Radius:	0.013 m
Borehole Radius:	0.054 m
Well Screen Interval:	34.75 m to 36.27 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-5} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

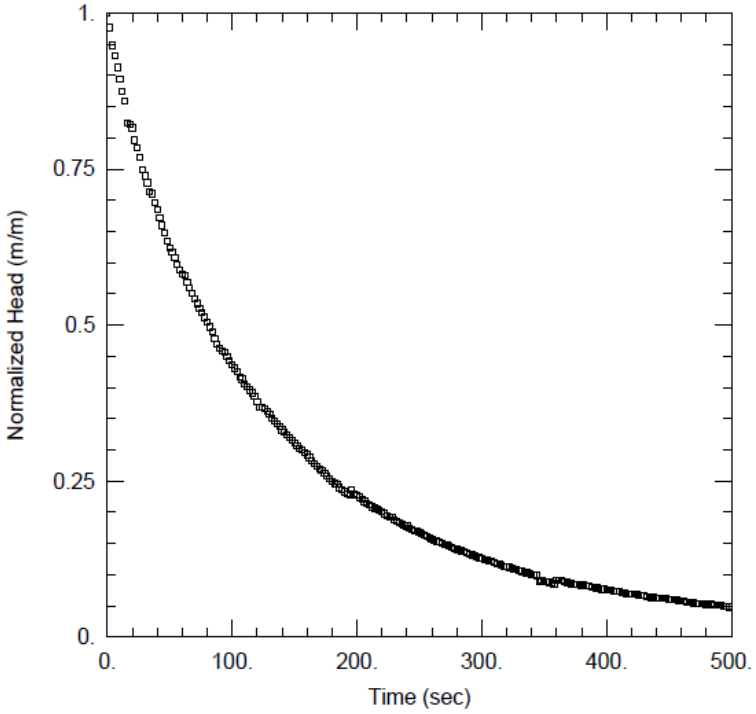
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW22-02A

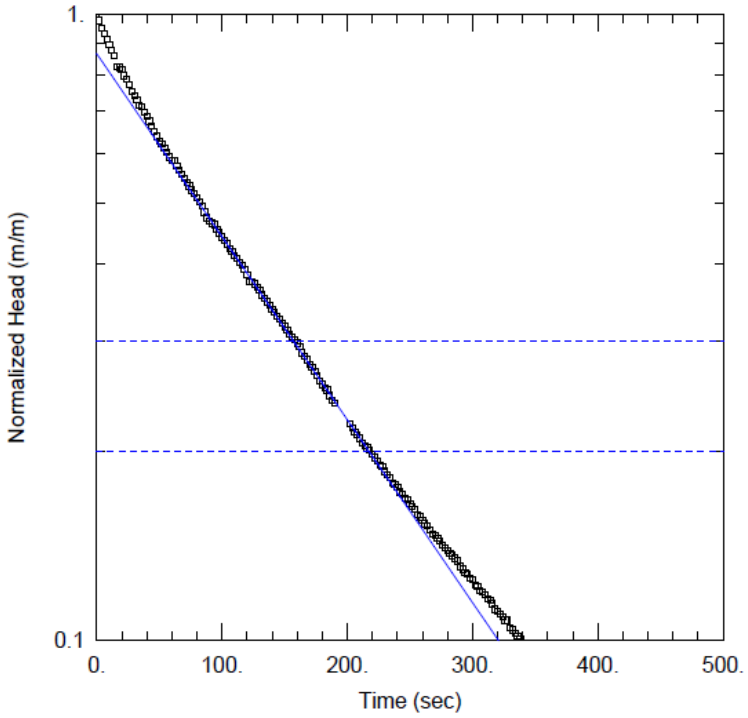
PROJECT No.	PHASE	Rev.	FIGURE
19129150	**2300**	**A**	**J-03**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW22-02B
Date of Test:	September 6, 2022
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.29 mbgs
Initial Displacement:	2.20 m
Casing Radius:	0.013 m
Borehole Radius:	0.054 m
Well Screen Interval:	12.80 m to 15.85 m
Geology:	Dolostone, Gasport Fm



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

8×10^{-6} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

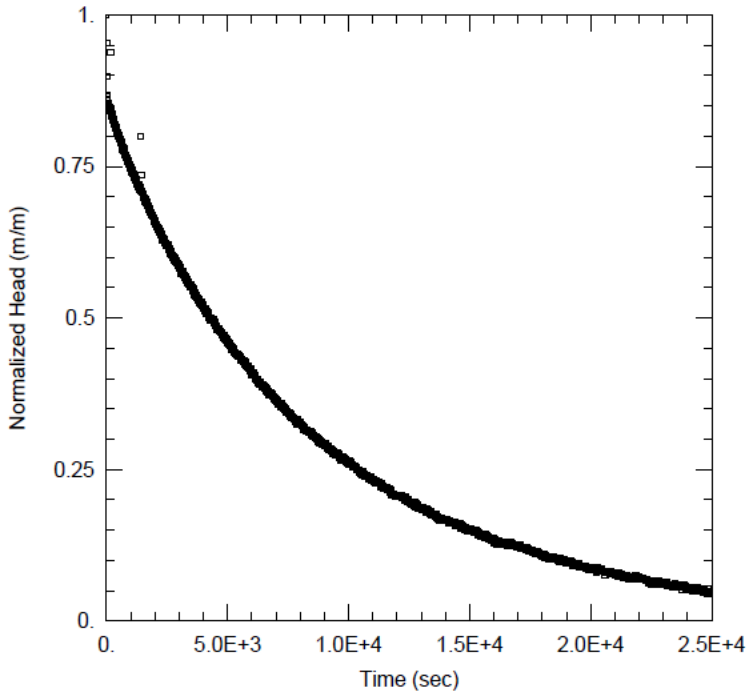
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW22-02B

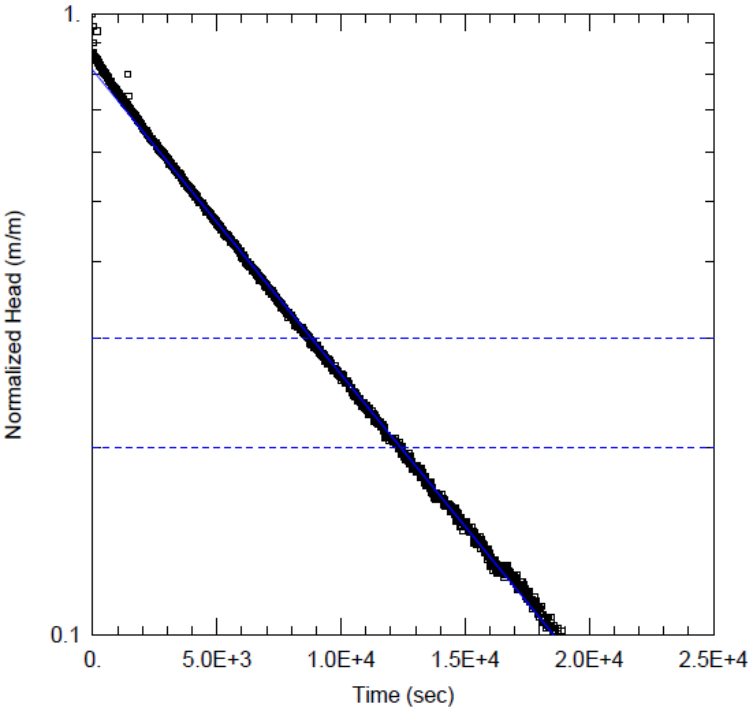
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-04

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW22-02C
Date of Test:	September 6, 2022
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.64 mbgs
Initial Displacement:	0.94 m
Casing Radius:	0.025 m
Borehole Radius:	0.079 m
Well Screen Interval:	3.96 m to 5.49 m
Geology:	Silty Sand and Gravel Till



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

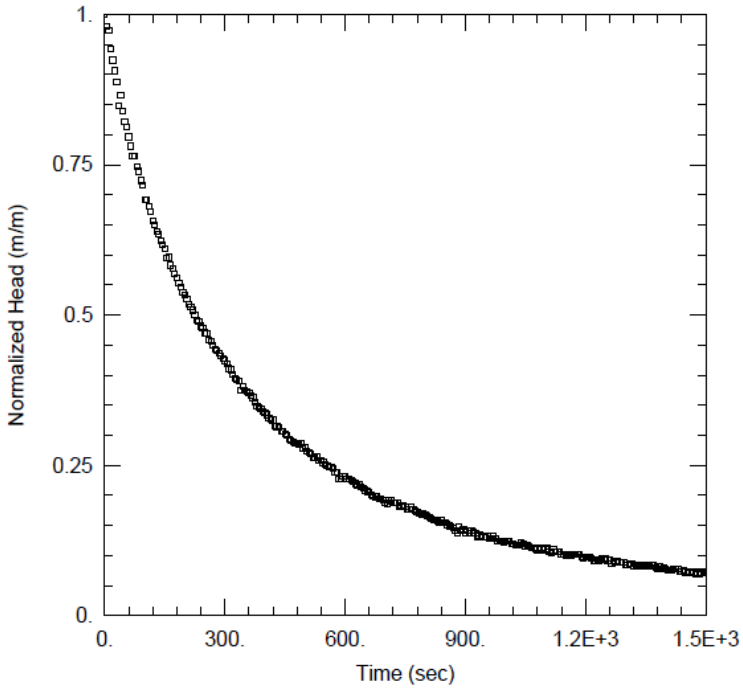
PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW22-02C

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-05

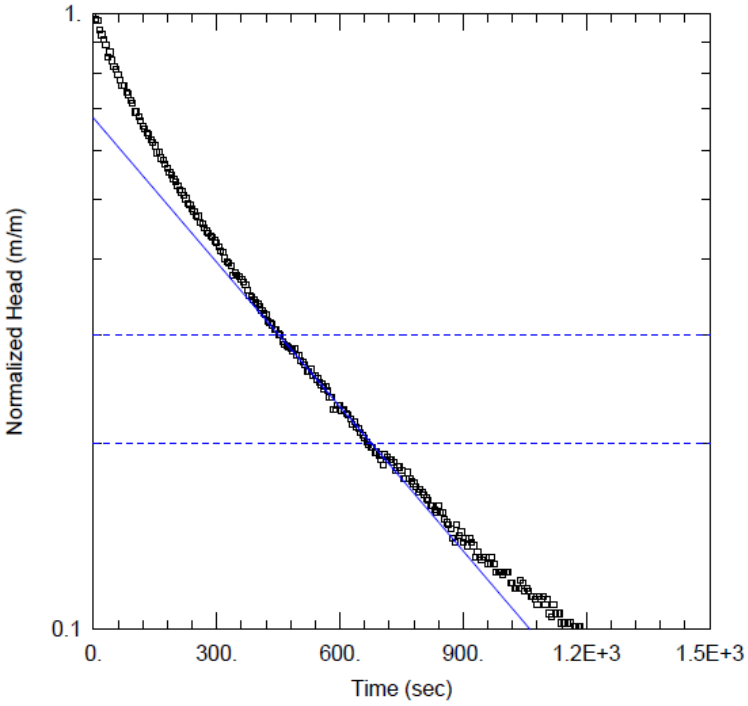
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

TEST INFORMATION:



Test Well:	MW22-03A
Date of Test:	September 6, 2022
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	0.92 mbgs
Initial Displacement:	2.68 m
Casing Radius:	0.013 m
Borehole Radius:	0.079 m
Well Screen Interval:	12.80 m to 15.85 m
Geology:	Silty Sand Till

SOLUTION:



Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

2×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

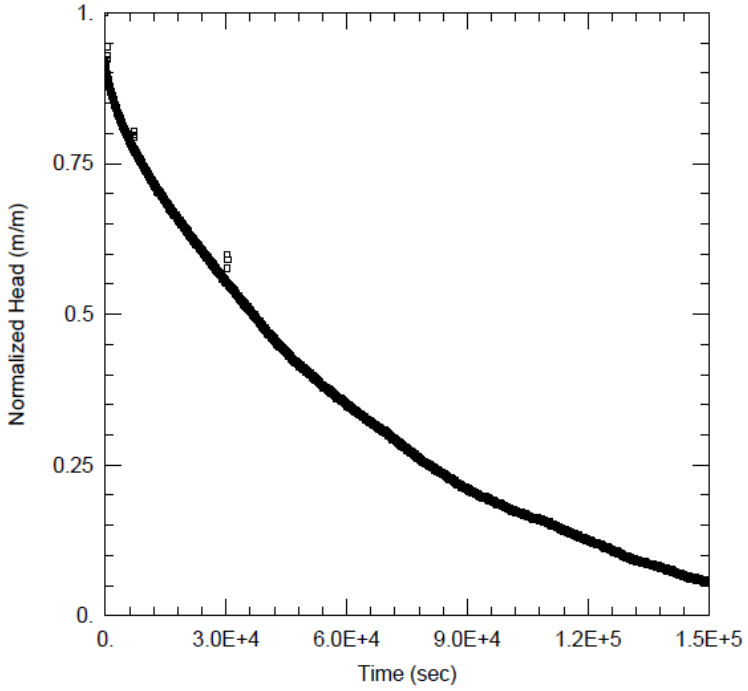
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS
MONITORING WELL MW22-03A

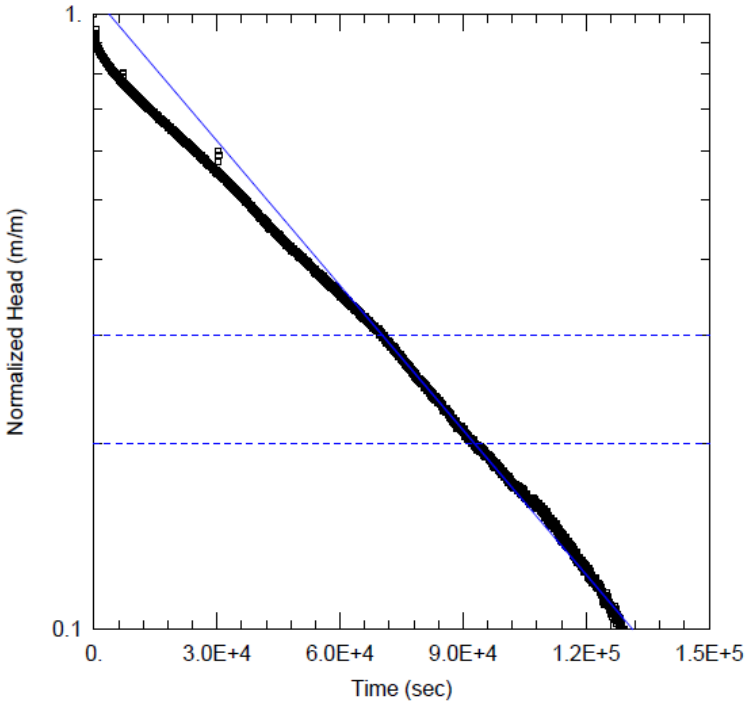
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-06

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MW22-03B
Date of Test:	September 6 to 8, 2022
Test Type:	Rising Head Test
Test Method:	Waterra Purge Rising Head Test
Static Water Level:	1.73 mbgs
Initial Displacement:	1.59 m
Casing Radius:	0.013 m
Borehole Radius:	0.079 m
Well Screen Interval:	4.57 m to 6.10 m
Geology:	Silty Sand and Gravel Till



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Confined

Hydraulic Conductivity (K) =

3×10^{-9} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
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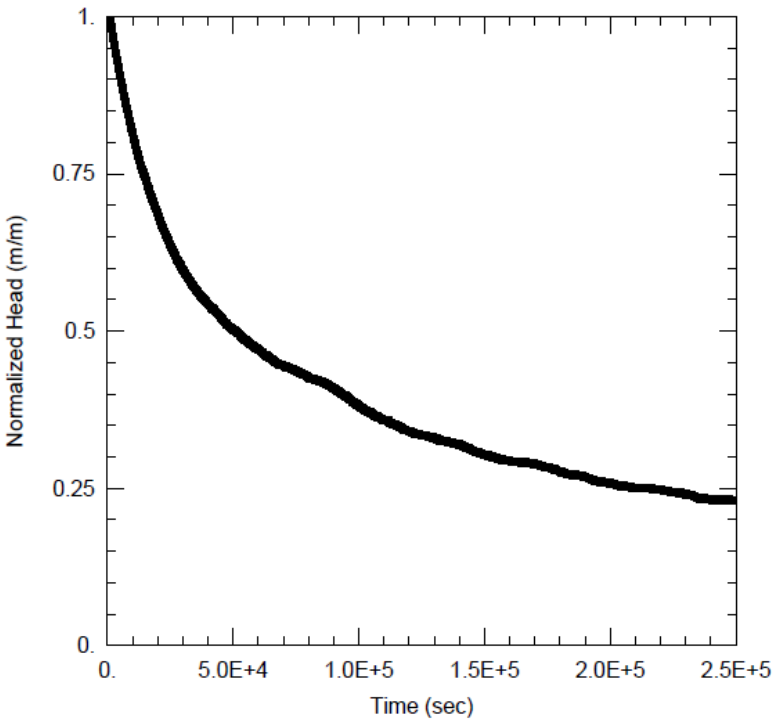
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MW22-03B

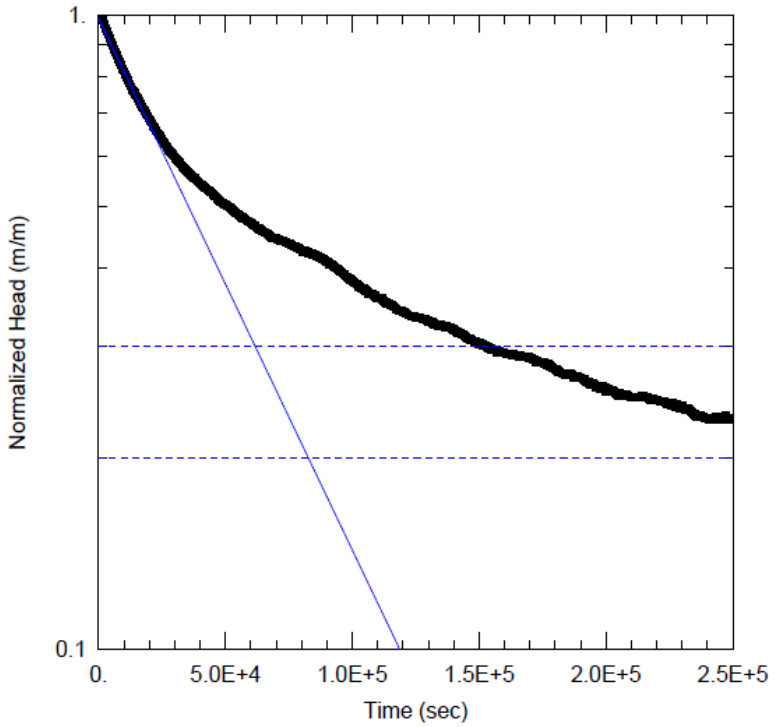
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-07

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MP17
Date of Test:	August 12 to 15, 2022
Test Type:	Falling Head Test
Test Method:	Pour In Falling Head Test
Static Water Level:	0.80 mbgs
Initial Displacement:	1.74 m
Casing Radius:	0.010 m
Borehole Radius:	0.013 m
Well Screen Interval:	0.90 m to 1.10 m
Geology:	Silty Sand Till



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-8} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

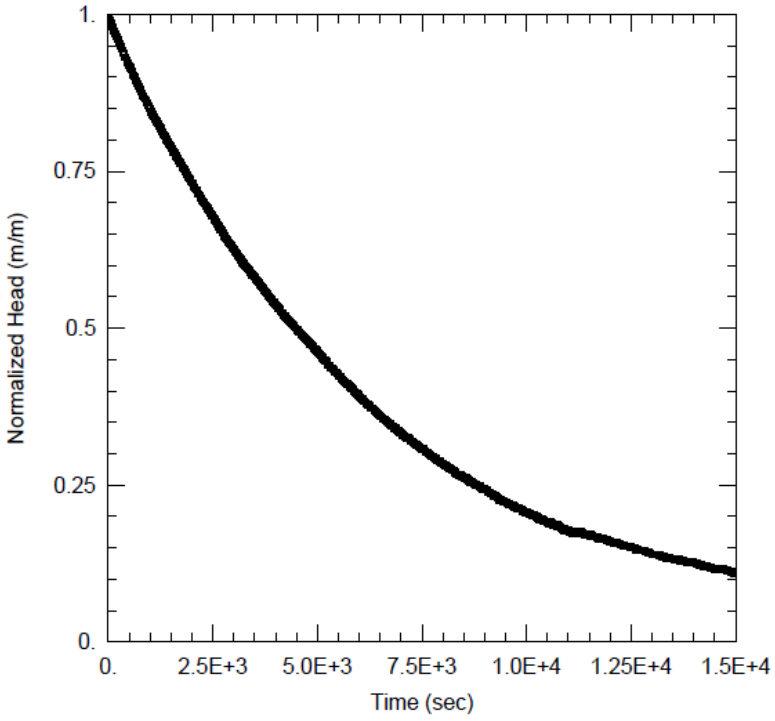
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MP17

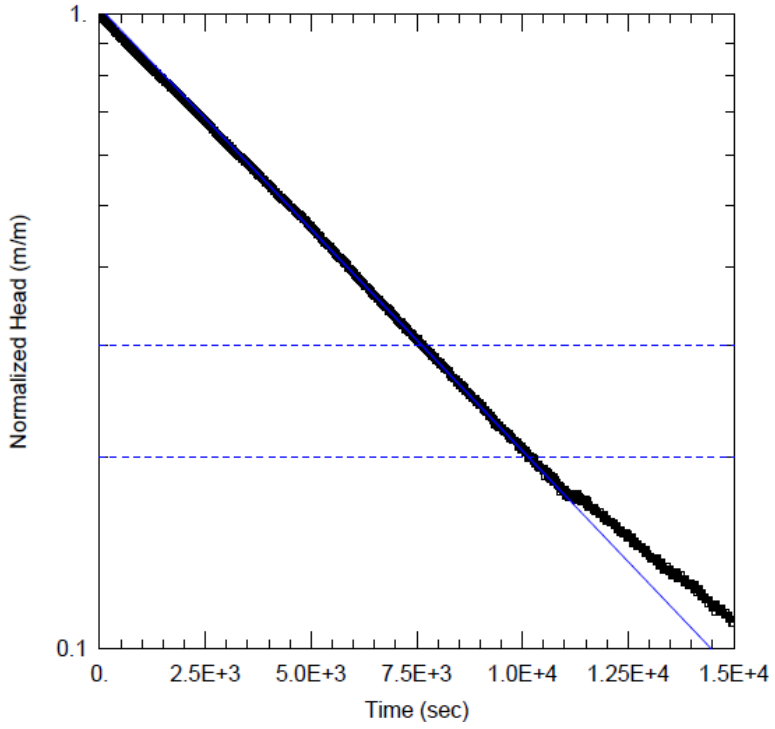
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-08

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MP18
Date of Test:	August 12, 2022
Test Type:	Falling Head Test
Test Method:	Pour In Falling Head Test
Static Water Level:	0.55 mbgs
Initial Displacement:	1.10 m
Casing Radius:	0.010 m
Borehole Radius:	0.013 m
Well Screen Interval:	1.35 m to 1.55 m
Geology:	-



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

1×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

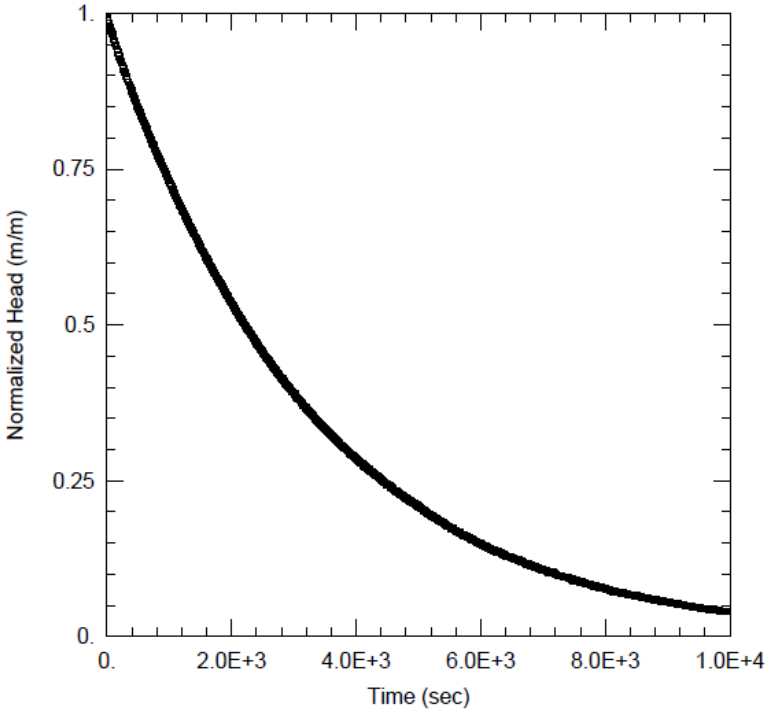
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MP18

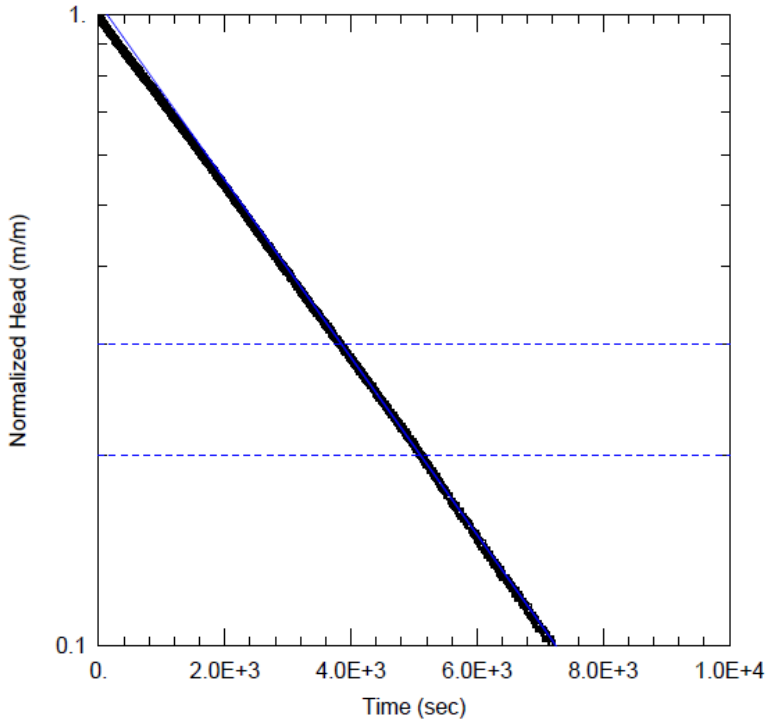
PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-09

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



TEST INFORMATION:

Test Well:	MP19
Date of Test:	August 12, 2022
Test Type:	Falling Head Test
Test Method:	Pour In Falling Head Test
Static Water Level:	0.62 mbgs
Initial Displacement:	1.50 m
Casing Radius:	0.010 m
Borehole Radius:	0.013 m
Well Screen Interval:	1.01 m to 1.21 m
Geology:	-



SOLUTION:

Solution Method:	Bouwer-Rice
Solution Type:	Zero Storage
Aquifer Model:	Unconfined

Hydraulic Conductivity (K) =

2×10^{-7} m/s

Water Level Measurement

Solution Match Line

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

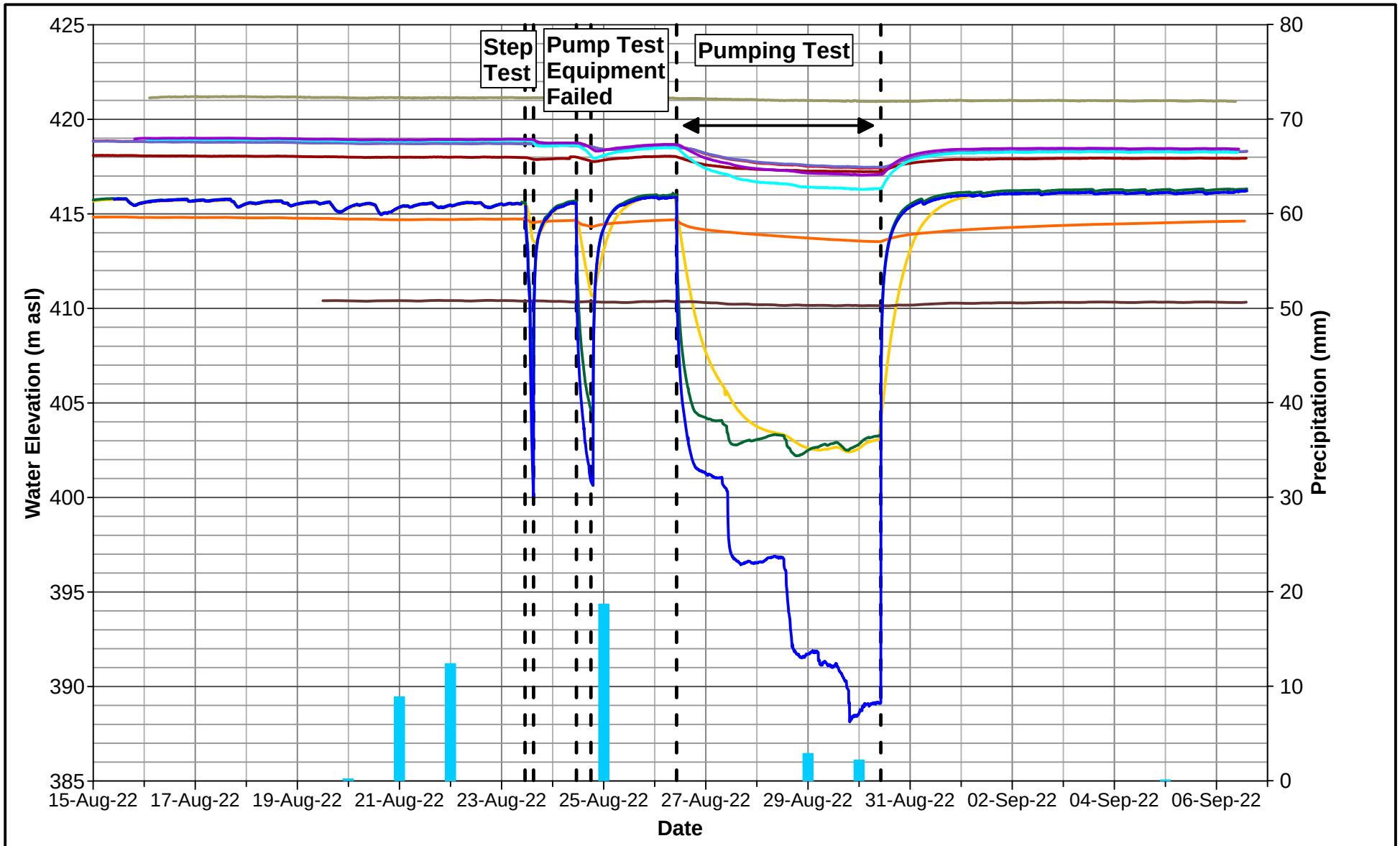
YYYY-MM-DD	2022-10-12
PREPARED	PGM
DESIGN	PGM
REVIEW	GWS
APPROVED	###

PROJECT
CALEDON PIT / QUARRY

TITLE
SINGLE WELL RESPONSE TEST ANALYSIS MONITORING WELL MP19

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	J-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A



PW22-01 MW20-15A MW20-16A MW22-02A MW22-03A
PW21-1 MW20-15B MW20-16B MW22-02B Precipitation (mm)
MW21-1-3 MW20-15C

Notes:
1) Average pumping rate = 80.4 L/min
2) Precipitation data from Met Station ID 6157000

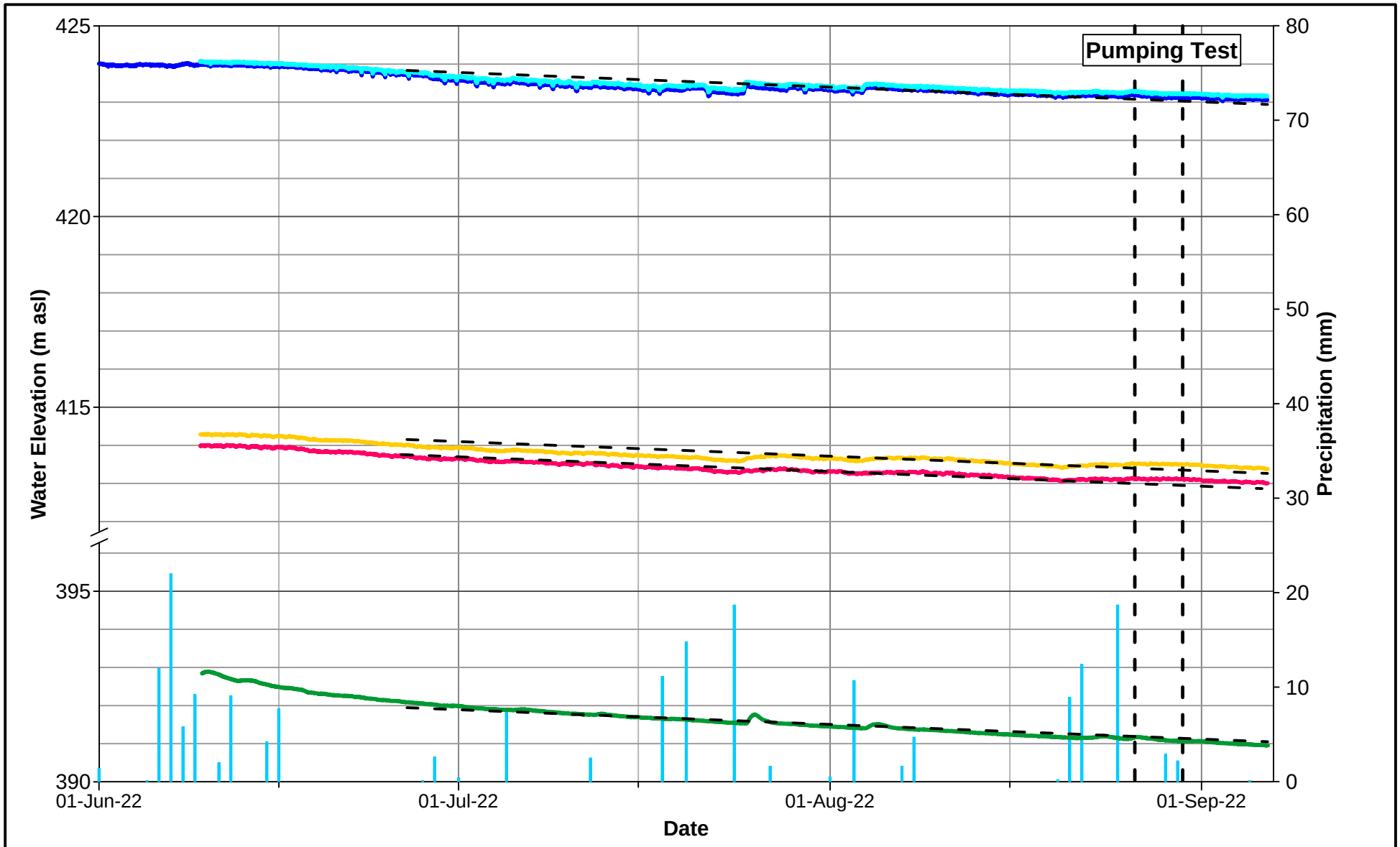
GOLDER
MEMBER OF WSP

DATE	October 2022
DESIGN	PGM
REVIEW	GWS
APPROVED	GWS

PROJECT: CBM CALEDON QUARRY

TITLE: PW22-01 PUMPING TEST GROUNDWATER ELEVATION

PROJECT NO.	REV	FIGURE
19129150	A	J-11



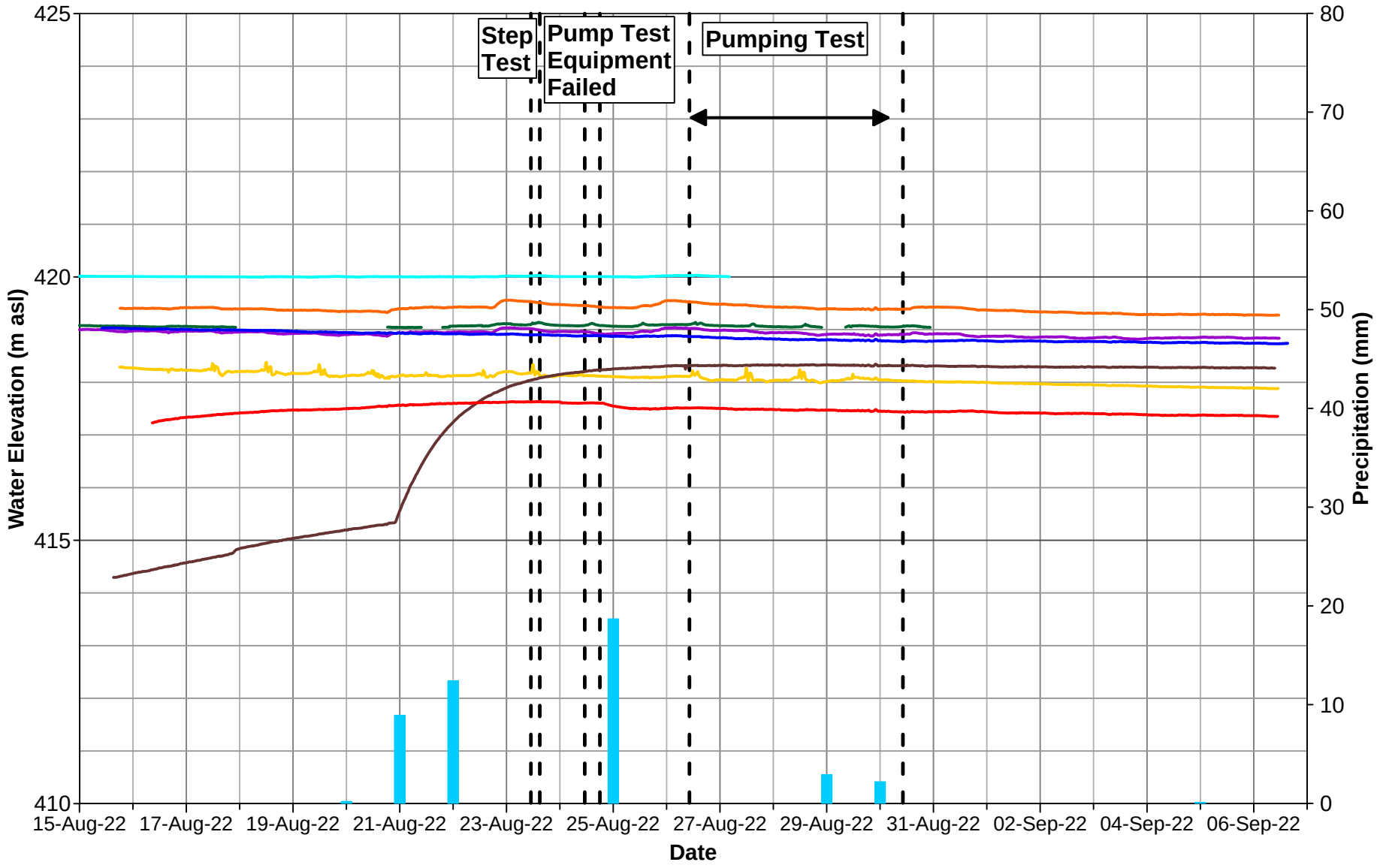
GOLDER
MEMBER OF WSP

DATE	October 2022
DESIGN	PGM/ VRP
REVIEW	GWS
APPROVED	GWS

PROJECT: **CBM CALEDON QUARRY**

TITLE: **PW22-01 PUMPING TEST BEDROCK AQUIFER BACKGROUND GROUNDWATER ELEVATION**

PROJECT NO.	REV	FIGURE
19129150	A	J-12



Notes:
1) Average pumping rate = 80.4 L/min
2) Precipitation data from Met Station ID 6157000

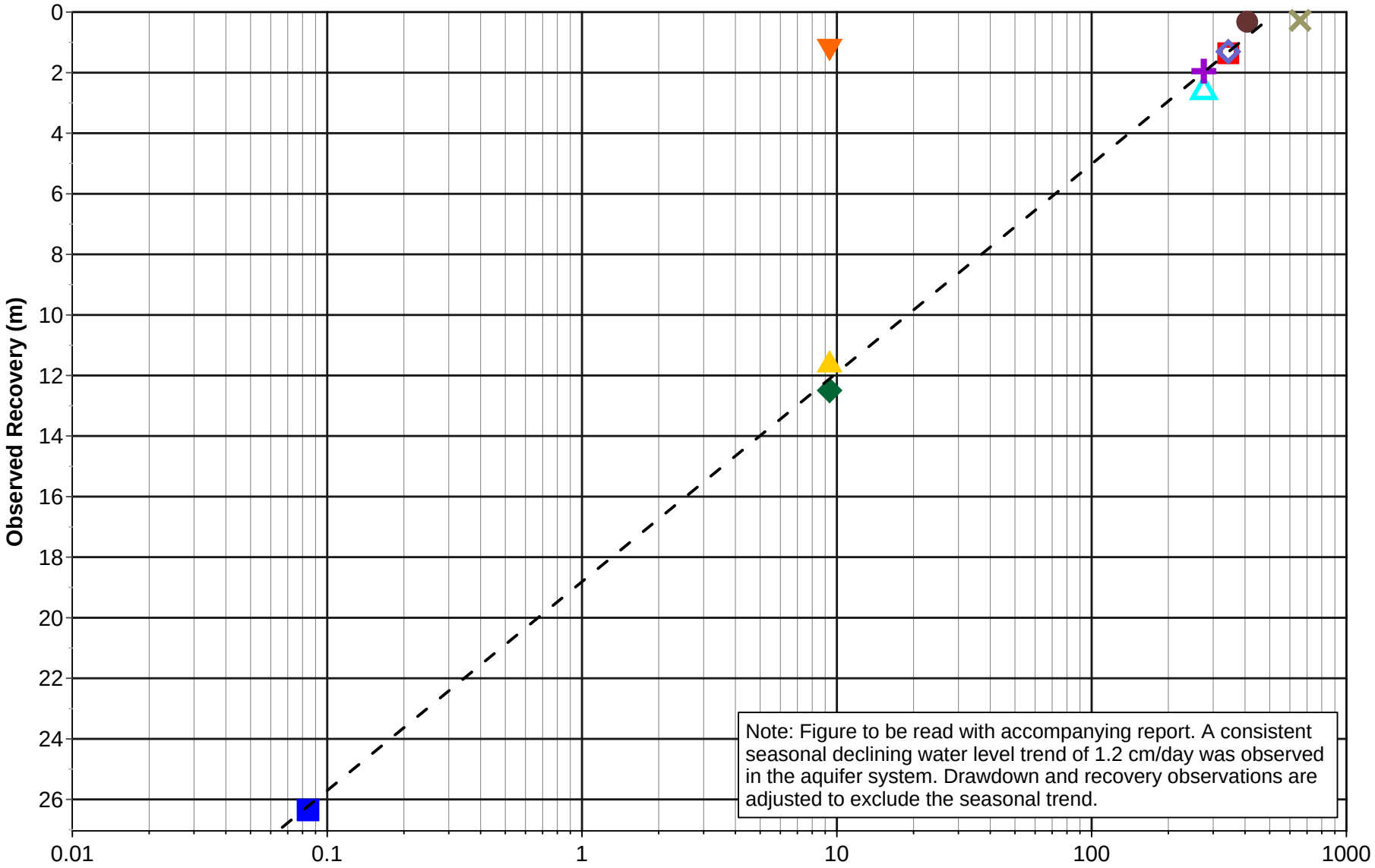
GOLDER
MEMBER OF WSP

DATE	October 2022
DESIGN	PGM/ VRP
REVIEW	GWS
APPROVED	GWS

PROJECT: **CBM CALEDON QUARRY**

TITLE: **PW22-01 PUMPING TEST OVERBURDEN GROUNDWATER AND SURFACE WATER ELEVATION**

PROJECT NO.	REV	FIGURE
19129150	A	J-13



GOLDER
MEMBER OF WSP

DATE	October 2022
DESIGN	PGM
REVIEW	GWS
APPROVED	GWS

PROJECT **CBM CALEDON QUARRY**

TITLE
PW22-01 PUMPING TEST
DISTANCE VERSUS RECOVERY

PROJECT NO.	REV	FIGURE
19129150	A	J-14



LEGEND

- MONITORING WELL
- MONITORING WELL (PUMPING TEST)
- TEST WELL
- DISCHARGE LOCATION
- HISTORICAL MONITORING WELL
- SOIL CORE LOCATIONS
- SURFACE WATER LOCATIONS
- GASPORT FORMATION FINAL DRAWDOWN CONTOUR
- INFERRED GASPORT FORMATION FINAL DRAWDOWN CONTOURS
- ROAD
- WATERCOURSE
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- NORTHWEST WETLAND
- LICENCE BOUNDARY
- LIMIT OF EXTRACTION

0 100 200 300

1:5,000 METRES

NOTE(S)

1. FIGURE TO BE READ WITH ACCOMPANYING REPORT. A CONSISTENT SEASONAL DECLINING WATER LEVEL TREND OF 1.2 CM/DAY WAS OBSERVED IN THE AQUIFER SYSTEM. DRAWDOWN AND RECOVERY OBSERVATIONS ARE ADJUSTED TO EXCLUDE THE SEASONAL TREND.

REFERENCE(S)

1. BASE DATA MNRF LIO OBTAINED 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENCE AND LIMIT OF EXTRACTION PROVIDED BY MHBC APRIL 2023.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA).

PROJECT
CALEDON PIT / QUARRY

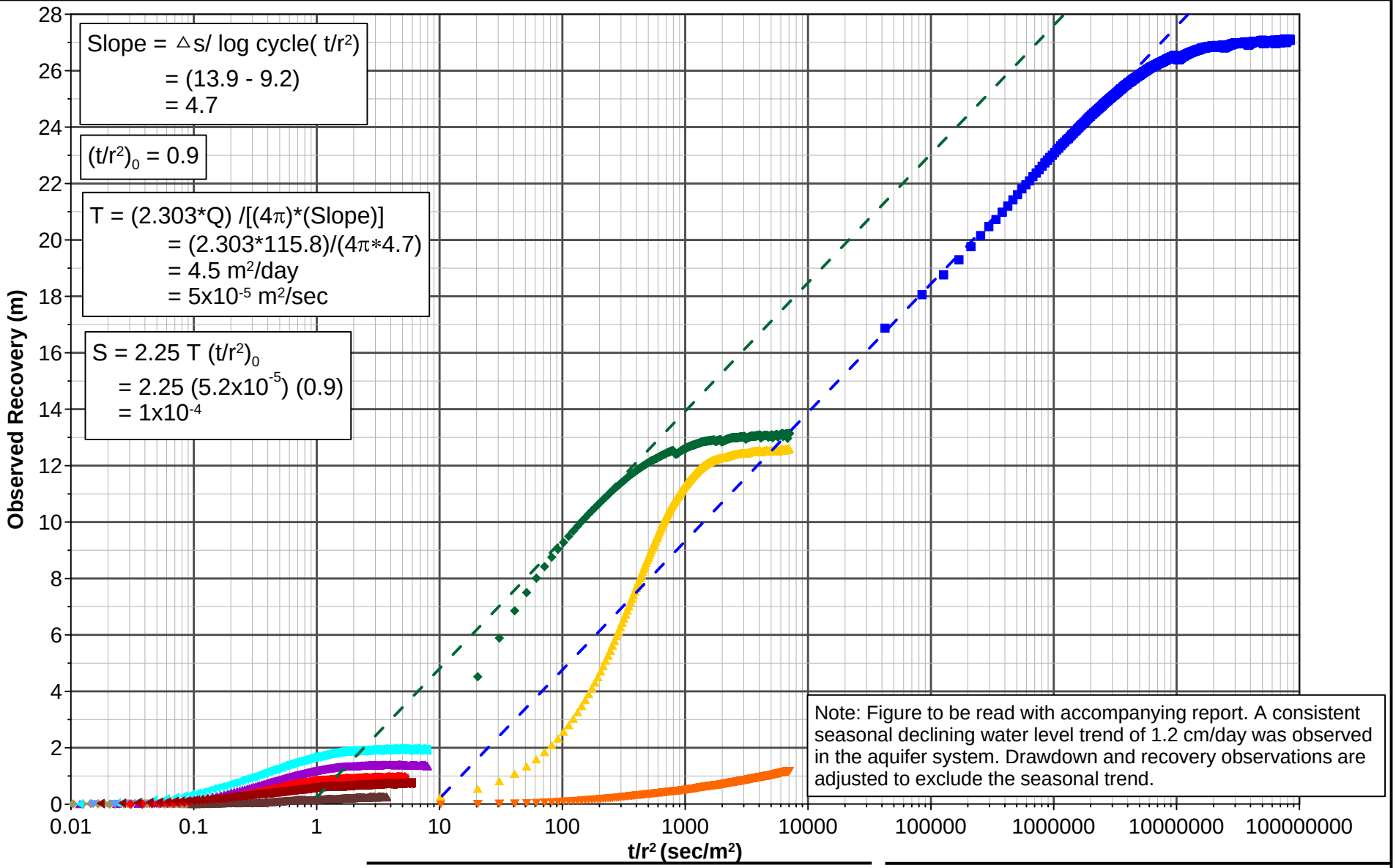
TITLE
OBSERVED DRAWDOWN IN THE GASPORT

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-04-27
DESIGNED	CGE
PREPARED	SO
REVIEWED	PM
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0006	0.0	J-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



GOLDER
MEMBER OF WSP

DATE	October 2022
DESIGN	PGM
REVIEW	GWS
APPROVED	GWS

PROJECT **CBM CALEDON QUARRY**

TITLE **PW22-01 PUMPING TEST**
t/r² VERSUS RECOVERY

PROJECT NO.	REV	FIGURE
19129150	A	J-16

APPENDIX K

Karst Assessment

Report on potential karst issues at the proposed Caledon Quarry
Stephen R.H. Worthington, Ph.D., P.Geo.

1. Introduction

Karst is a geomorphological term that refers to a landscape that exhibits solutional erosion of outcropping bedrock and associated hydrological features such as sinking streams and springs. It is common on limestone and dolostone, which are moderately soluble, as well as on the more highly-soluble halite and gypsum rocks. All four rocks occur in Ontario, with limestone and dolostone often forming prominent escarpments such as the Niagara Escarpment, and halite and gypsum being so soluble that they have been completely dissolved away at the surface. Limestone and dolostone are collectively referred to as carbonate rocks. Dissolution of the bedrock enhances the hydraulic conductivity of carbonate rocks so that in some areas the hydraulic conductivity is high enough that carbonate aquifers are able to transmit the entire water surplus (i.e. precipitation minus evapotranspiration). In these situations there is an absence of surface streams. Where lower-hydraulic conductivity rocks or sediments are adjacent to limestone or dolostone, then streams that flow off the lower-hydraulic conductivity rock and onto the higher-hydraulic conductivity carbonate rocks may lose all their flow into the bedrock. Such streams are referred to as sinking streams. These streams often have low solute concentrations and substantial dissolution occurs when they flow onto carbonate bedrock, enlarging fractures to form conduits and sometimes caves. Many hundreds of sinking streams are known in southern Ontario, of which some dozens have known caves associated with them.

The solution of limestone and dolostone varies with the carbon dioxide concentration. In areas of bare rock, dissolved carbon dioxide in recharge water equilibrates with the 415 ppm concentration in the atmosphere, and the solubility limit is <50 mg/L. Where there are thick soils and a vegetation cover then plants and microorganisms can raise the soil water carbon dioxide to >1%, resulting in greater dissolution and solute concentrations are often >300 mg/L. Caves are more likely to be formed in limestone than in dolostone because the dissolution rate is about twenty times higher.

There are a range of definitions of the term "karst aquifer". There are five common ones (Worthington et al., 2017). The defining characteristic of the five definitions are that a karst aquifer is characterized by:

a) the presence of caves
b) a karstic landscape, or "karst terrain" on the surface
c) the presence of turbulent flow in conduits
d) the presence of hydraulic conductivities >10^{-6} m/s
e) the presence of solutionally-enlarged fractures.

The use of different definitions can result on conflicting views on whether specific areas have karst aquifers. If any of the first three definitions is used than a majority of southern Ontario carbonate aquifers would not be classified as karstic. If the either of the last two definitions is used than a majority of southern Ontario carbonate aquifers would be classified as karstic. However, it is not the definition

that is important in evaluating an aquifer but rather how karst processes may have affected the functioning of the aquifer.

There are two major karst considerations associated with development on karst areas. The first is the extent of preferential flow paths, especially those associated with recharge at sinking streams. These result in faster groundwater velocities and less predictable flow directions than in lithologies that are less soluble, such as shale or sand. This is particularly the case where there are substantial (e.g. >10 L/s) sinking streams or springs.

A second karst consideration is that dissolution of the bedrock may result in an uneven bedrock surface and the possibility of collapse of voids created by dissolution. This creates a potential hazard for building structures in karst areas. However, this risk applies to built structures and so is not relevant to this quarry application.

2. Investigation of closed depressions and surface flow

A site visit was carried out on April 23, 2020 to assess possible karst features. The timing was chosen because it was before the onset of seasonal growth of surface vegetation that might obscure karst features and because high water levels in both the groundwater and surface water features in April enable seasonally active flows to be assessed. The main focus of the investigation was to visit closed depressions, 15 of which had been identified within the project area from topographic mapping with a 1 m contour interval (Figure 1). Overburden thickness varies from <5 m over much of the centre of the project area to >10 m in the northern part of the site and to >20 m in the southern part of the site. Sediments vary from gravel and sand in the southern part of the site to sandy silt till to the north.

One closed depression (Figure 2 and location 2 on Figure 1) had standing water when visited on April 23, 2020. Several more depressions are also shallow, have gentle slopes, and lie within arable fields (e.g. Figures 3, 4, 5, and 7). The small depression show in Figure 6 has somewhat steeper sides. The origin of all of the depressions appears to have been from the uneven deposition of the glacial and fluvioglacial sediments. No evidence of concentrated surface flow into any of the depressions was found. This is not surprising, given the coarse-grained nature and thus high hydraulic conductivity of the overburden sediments. One depression (Figure 5) has field stones in the center of the depression. However, the lack of vegetation in this area does suggest that the depression does flood at times. This inference was supported by checking the 17 historical images available in Google Earth. Consequently, it is concluded that none of the depressions in the project area deliver concentrated recharge into the subsurface and thus do not perform a karstic function.

An important consideration in a karst assessment is whether there are substantial sinking (or losing) streams. In the Caledon investigation, there is a wetland (the Northwest Wetland) at an elevation of 420-421 m, which is >30 m higher than the Credit River some 2 km to the east. Accordingly, it was thought likely that groundwater flow would predominantly be to the east in the northern part of the site, and it was possible that there might be a sinking stream at the eastern end of the wetland. This part

of the wetland was visited on April 23, 2020, and it was found that flow in the wetland was towards the creek to the west, and no evidence of any sinking stream was found. Subsequent investigations showed that the water-table contours are smooth and that the hydraulic conductivity in this area is fairly low (Gasport zone GP6: Kh= 1E-7 m/s). These are both indications that there is an absence of the preferential flow that would be expected if there were a sinking stream in the wetland.

3. Investigations during pumping tests

3.1 Tracer tests

Four four-day pumping tests were carried out in the project area in August and September 2021. It was planned to carry out tracer tests from nearby monitoring wells to each pumping well if drawdowns in the wells indicated that the tracer test would probably succeed. In the event, tracer injections were made during three of the four pumping tests. It was decided to not perform a tracer test at the PW21-4 cluster due to the small response at the monitoring wells during the first day of the pumping test. Sodium fluorescein (uranine) was chosen as the tracer due to its high detectability and low toxicity. The mass injected was calculated from equations developed by Worthington and Smart (2016).

3.1.1. Pumping test at PW21-1 cluster

A four-day pumping test took place at PW-21-1, starting on September 20, 2021 at 12:00. A mass of 0.76 g of sodium fluorescein was injected into MW21-1-1 at 14:27, following which 80 litres of water was siphoned into the well over the following 20 minutes to ensure that the tracer was flushed out of the well and into the aquifer. Initial manual sampling at the pumping well took place at one minute intervals, reducing to 5 minute intervals after 30 minutes, and ten minutes intervals after two hours. Manual sampled was discontinued at 17:50, when an Isco model 3700 24-bottle water sampler started to collect samples at 40 minute intervals was installed at the pumping well. The following day the Isco was reprogrammed to collect samples every three hours for the last three days of the pumping test.

Dye concentrations were measured on site with a Turner Designs Picofluor filter fluorometer, and following the end of the test all samples were measured under lab conditions. Tracer test results are shown in Figure 8a. The dye arrived at the pumping well after 1.25 hours, reached a peak after 8.7 hours, and thereafter followed an approximately exponential recession.

3.1.2. Pumping test at PW21-2 cluster

A four-day pumping test at PW-21-2 started on August 10, 2021, but small drawdowns at monitoring wells resulted in a delay in dye injection until 14:22 on August 11. A mass of 0.26 g of sodium fluorescein was injected in MW21-2-1, following which 60 litres of water was injected over the following 85 minutes to flush the dye into the aquifer. Initial sampling took place at about 5 minute intervals, with the Isco collecting samples at 40 minute intervals over the first night and then at 2 hour intervals over the last two days of the test.

The main dye breakthrough curve started after 4.1 hours, reaching a peak after 15.8 hours, followed by an exponential decline in dye concentration (Figure 8b). There were also two sharp and short-lived

earlier peaks, with the first starting 0.88 hours after tracer injection. It is thought that these are associated with the flushing of the dye into the aquifer. The flushing consisted of three slugs, each of 20 litres, which would have raised the water table in PW-21-2 and may have activated a preferential flow path for a short period that could have carried a small fraction of the dye to the pumping well.

3.1.3. Pumping test at PW21-3 cluster

A tracer test was also carried out at the PW3 well cluster, where MW21-3-1 served as the as the pumping well. Injection of 0.922 g of sodium fluorescein into PW21-3 took place at 12:00 on August 25. Sampling protocols were similar to the other tracer tests, with 98 samples being collected, but no dye was detected in the pumping well. At the end of the test, a sampling at the injection well gave a dye concentration of 6925 ppb, giving a mass of 0.794 g of sodium fluorescein still in the well. Thus some 86% of the dye injected had not moved out of the injection well, indicating the very low hydraulic conductivity of this well.

3.2 Electrical conductivity profiling

A series of electrical conductivity (EC) profiles were measured at the PW21-1, PW21-2, and PW21-3 clusters, using a Heron Instruments conductivity meter. Profiles were measured at the monitoring wells before the pumping tests started and thereafter during the tracer tests. A total of 41 profiles were measured at 11 wells (Figure 9, 10, and 11). Measurements were usually made at 1 m intervals, with closer-spaced measurements being made where there were substantial changes in EC values.

Results show a number of distinctive characteristics which are typical of bedrock aquifers dominated by fracture flow. Notable characteristics include:

a) the combination of minimal changes over most of the profiles due to vertical flow with the well between horizontal bedding plane fractures with different heads.

b) substantial changes over narrow intervals due to substantial fracture flow and varying fractures flow EC.

c) a substantial decrease in the EC in the top 2 m of MW21-1-1 on September 21, 2021. This followed heavy overnight rain.

d) contrasts at the bottom of MW21-1-2, MW21-1-3, MW21-2-1, MW21-2-2, MW21-2-4, PW21-3

4. Correlation with other site investigations

4.1 Proportions of surface flow and groundwater flow in the study area

Long-term measurements of flow in the Credit River are made to the east of the site. The average flow for the period 1915 to 2020 was 1.79 m^3/s. The average discharge per unit area is known as the specific discharge. For the 209 km^2 catchment area of the Credit River, the specific discharge is 8.6 $L/s/km^2$. This is shown in Figure 12, along with specific discharges for 16 much smaller catchments gauged by Golder Associates. Most of these have values <8.6 $L/s/km^2$, and are shown with a pink background. Low values represent recharge from the surface to groundwater, and this reflects the high hydraulic conductivity of both the sediments and the bedrock in the area. Higher values than the specific discharge in the Credit River are shown with a blue background, and represent groundwater discharge areas. Two are to the

east of the site and represent low-elevation groundwater discharge. The third site is two kilometres to the west of the site, and also represents an area where the groundwater catchment is larger than the surface water catchment.

4.2 Preferential flow in the bedrock aquifer

Carbonate aquifers sometimes have large conduits in which flow is turbulent rather than laminar. The high hydraulic conductivity in such conduits often results in there being troughs in the water table, with convergent flow to the troughs. Turbulent flow in a conduit results in much larger seasonal changes in water levels than if flow were laminar. This is because the water level change is proportional to the square root of the hydraulic gradient if flow is turbulent, but is proportional to the gradient if flow is laminar (Worthington and Soley, 2017).

There is a trough in the water table on the western site of the site, and it defined by five well along or close to Mississauga Road, MW 20-01, MW20-15, MW20-17, MW20-18, and MW20-27. Groundwater levels in the bedrock at times of high levels in April 2021 and low levels in September 2021 are shown in Figure 13. The difference in water levels at these two times at the five wells are 1.52 m, 0.90 m, 0.65 m, 2.21 m, and 0.80 m, respectively. These values are not consistently much greater than elsewhere on the site, and so it is concluded that there is no conduit with turbulent flow in this area.

4.3 Fracture apertures from tracer tests and packer tests

The results from the tracer tests and packer tests can be correlated by calculating fracture apertures. The first method is to use the cubic law (Domenico and Schwartz, 1998, p. 50):

$$Q = \rho g b^3 w i / 12\mu \quad (1)$$

where Q is discharge, Δ is the density of water, g is gravitational acceleration, b is fracture aperture, w is fracture width, and $\therefore$ is dynamic viscosity. This equation can be combined with the continuity equation $Q = vA$, where v is groundwater velocity in the fracture and A is fracture cross-sectional area (= wb), to give

$$b = (12v\mu / \rho g i)^{1/2} \quad (2)$$

Calculated fracture apertures from the two tracer tests are shown in Table 1.

Table 1 Calculated fracture apertures from tracer tests

Injection well	Recovery well	Traced distance (m)	Elapsed time to tracer peak (hours)	Groundwater velocity (m/d)	Hydraulic gradient	Fracture aperture (mm)
MW21-1-1	PW21-1	10.7	8.7	29.5	0.54	0.032
MW21-2-1	PW21-2	11.3	15.8	17.2	0.62	0.023

The second method is to use transmissivity (*T*) measurements from the packer tests (Novakowski et al., 2016), using the cubic law

$$T = \rho g b^3 / 12 \text{:} \quad (3)$$

Equation 3 was applied to the 81 packer tests in 44 wells carried out at the site in the Gasport Formation. Results are shown in Figure 14. In both cases, most calculated fracture apertures are between 0.1 mm and 1 mm, with a minority up to several millimetres in diameter.

4.4 Groundwater modelling

Groundwater models provide a useful tool for understanding aquifer behaviour because they synthesize available data to provide a coherent explanation of groundwater flow and transport. This is particularly the case in carbonate aquifers due to dissolution preferentially enlarging some fractures. If wells encounter solutionally-enlarged fractures then they can have high hydraulic conductivities. Conversely, if a well does not encounter any solutionally-enlarged fractures then it can have very low hydraulic conductivity. Regional groundwater models are calibrated principally on the water levels in wells and the flow through the aquifers, and give estimates of hydraulic conductivity over much broader areas than individual well tests. However, measurements at a local scale using pumping tests, packer tests, and single well response (slug) tests are a useful complement for understanding the detailed local permeability variation in the aquifer.

Hydraulic conductivity in carbonates in highest where there is the most dissolution. The most obvious place where dissolution takes place is in the uppermost bedrock, where infiltration from rainwater has low solute concentrations and consequently there is substantial dissolution. Consequently a high-hydraulic conductivity zone develops here, which is referred to as the weathered zone or epikarst. This is present in the Caledon model, where its horizontal hydraulic conductivity (Kh) varies from 5E-6 to 1E-3 m/s.

Deeper in the bedrock, the major factor determining hydraulic conductivity is the specific discharge (i.e. the flow per unit of cross-sectional area). In an aquifer such as at Caledon there is an increase in flow in

a downgradient direction as a result of there being more recharge to the aquifer than discharge from the aquifer to creeks, except at the downgradient termination of the Gasport where it discharges to the Credit River. Such a flow pattern in a sand would result in increasing hydraulic gradients, giving a convex water table. However, in limestone and dolostone the increase in flow results in an increase in hydraulic conductivity, so the convexity of the water table is less than in a sand and may be flat or concave, especially for long flow paths (>10 km). This is well established and widespread (Worthington, 2009; Worthington and Foley, 2021). In the Caledon model this is seen in higher hydraulic conductivity (1E-5 m/s) in the downgradient GP4 and GP5 than further upgradient (e.g. 1E-7 m/s in GP2). However this is not ubiquitous; the downgradient GP6 has low K (1E-7 m/s).

The third dissolution effect seen at the site is a groundwater trough identified in particular at three wells along Mississauga Road - MW20-01, MW20-17, and MW20-18. Flowlines converge on groundwater troughs and this increases the specific discharge and hence there is more dissolution and the hydraulic conductivity increases. This trough has the highest Kh values at the site in both the Gasport (GP4: 1E-5 m/s) and in the overlying weathered zone (WB4: 1E-3 m/s).

The above explanation broadly accounts for the variation in hydraulic conductivity across the site. It shows that the calibration of the groundwater model on flow and water level data provides an excellent way to determine regional hydraulic conductivity.

5. Conclusions

The karst investigation found that dolostone aquifer on the study area is a typical of such aquifers where there is fairly thin overburden, which allows substantial recharge to enter the bedrock. Such distributed recharge results in pervasive dissolution of fractures, with most enlarged fractures having apertures of 0.1 mm - 3 mm. This results in the aquifer having a predictable to response to large-scale stresses such as quarry development.

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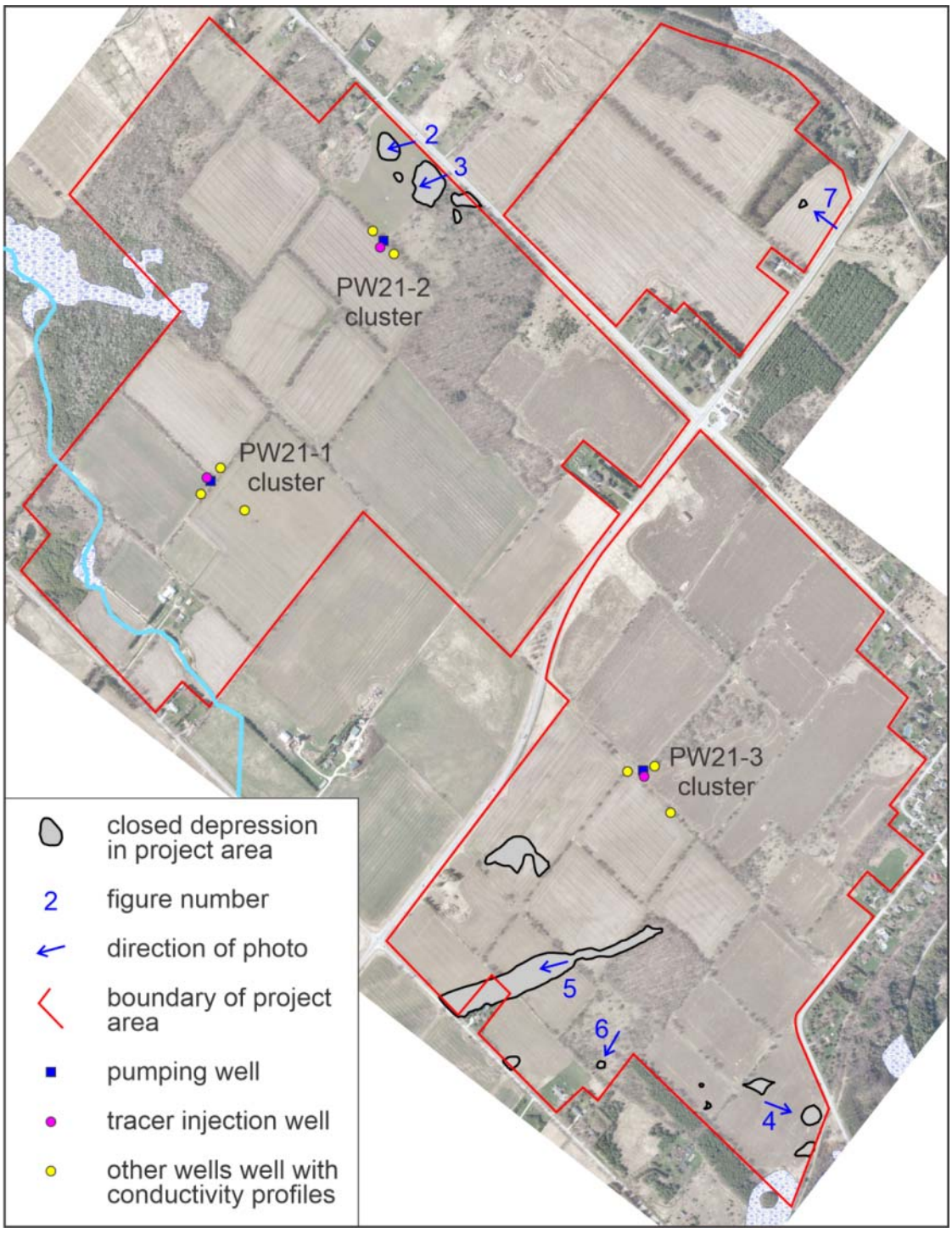


Figure 1. Orthophotography of the project area, showing locations of tracer tests, electrical conductivity profiles, and closed depressions identified from 1 m contour interval mapping. Numbers 2 to 7 refer to the photos shown in Figures 2 to 7, respectively.



Figure 2. Looking west from Main Street (Regional Road 136) across a closed depression with ponded surface water on April 23, 2020 (location 2 on Figure 1).



Figure 3. Looking west from Main Street (Regional Road 136) across a closed depression (with darker vegetation) on April 23, 2020 (location 3 on Figure 1).



Figure 4. Looking southeast towards a closed depression on April 23, 2020. (location 4 on Figure 1).



Figure 5. Looking west to a closed depression filled with field stones(location 5 on Figure 1).



Figure 6. Looking southwest to a closed depression with willow saplings, just behind the pine tree (location 6 on Figure 1).



Figure 7. Looking northwest from Charleston Sideroad (Regional Road 24) (location 7 on Figure 1).

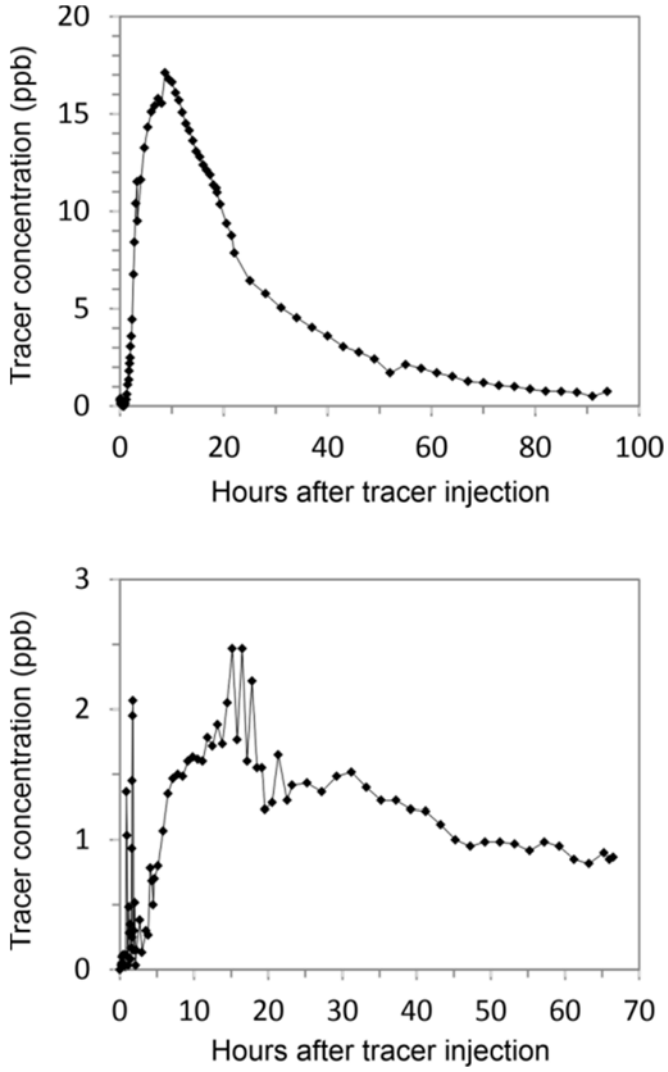


Figure 8. Tracer test results:

(top) From MW1-1 to PW21-1, starting on September 20, 2021.

(bottom) From MW2-1 to PW21-2, starting on August 11, 2021.

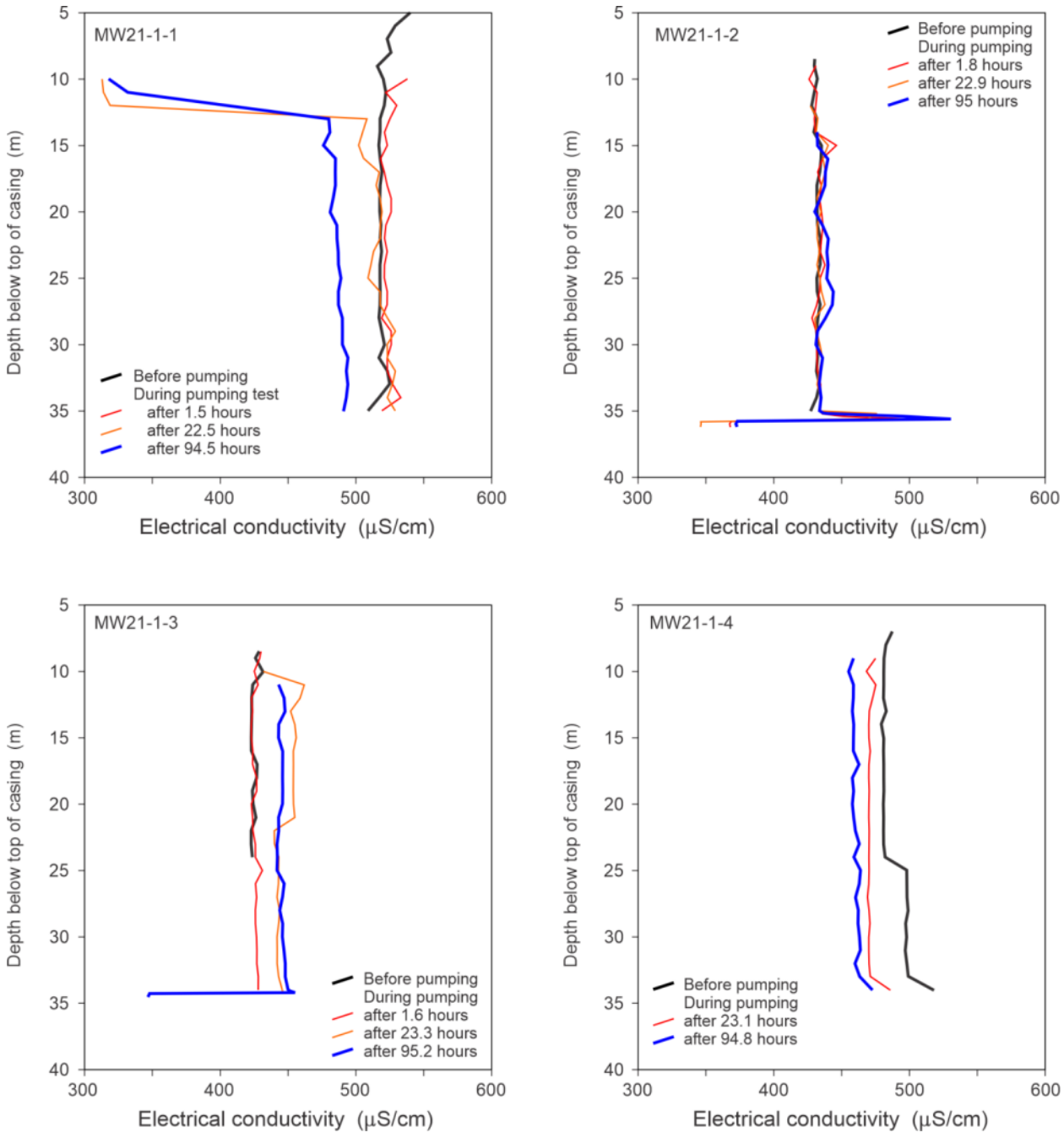


Figure 9. Electrical conductivity profiles at the PW21-1 cluster during the pumping test

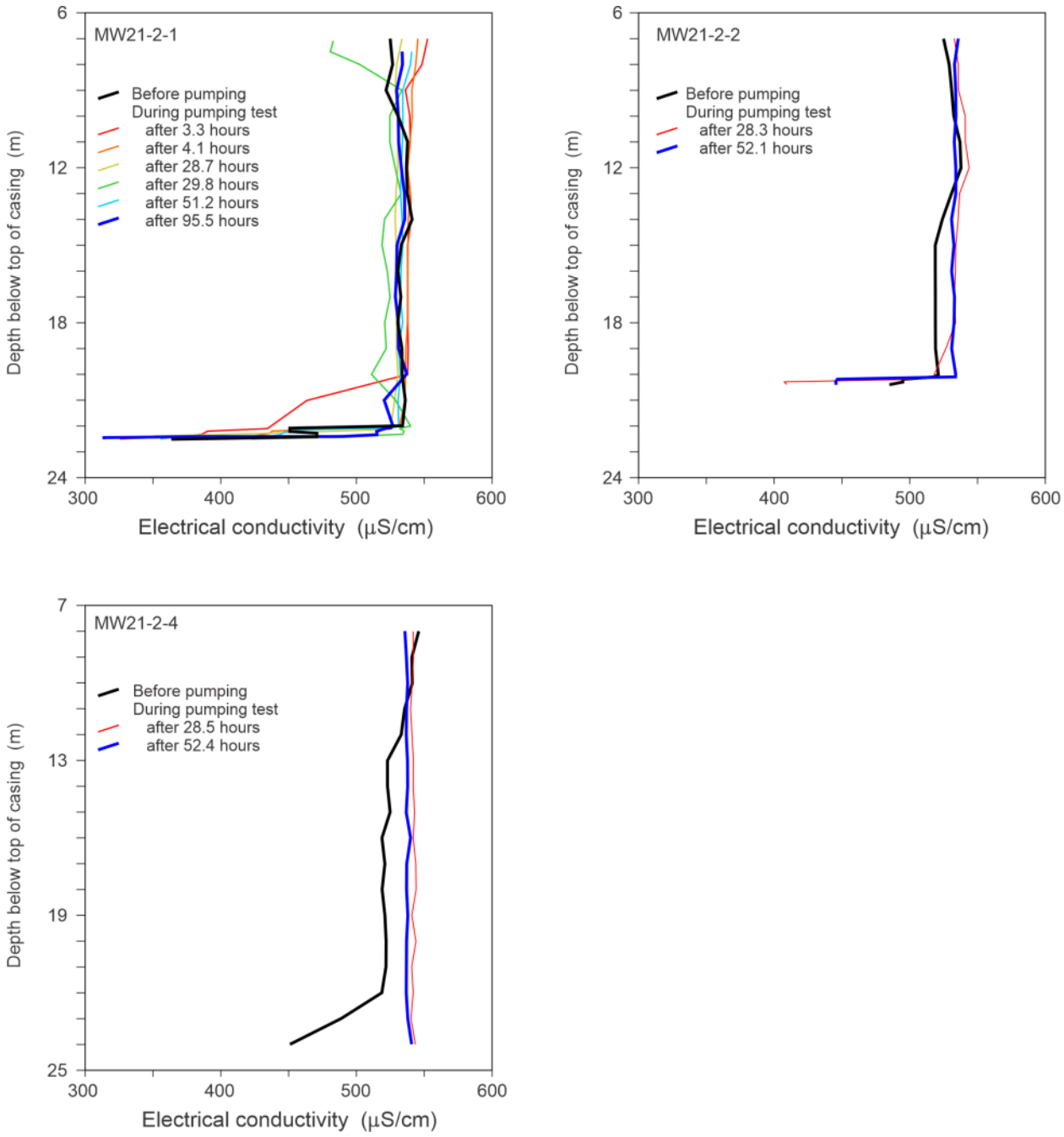


Figure 10. Electrical conductivity profiles at the PW21-2 cluster during the pumping test

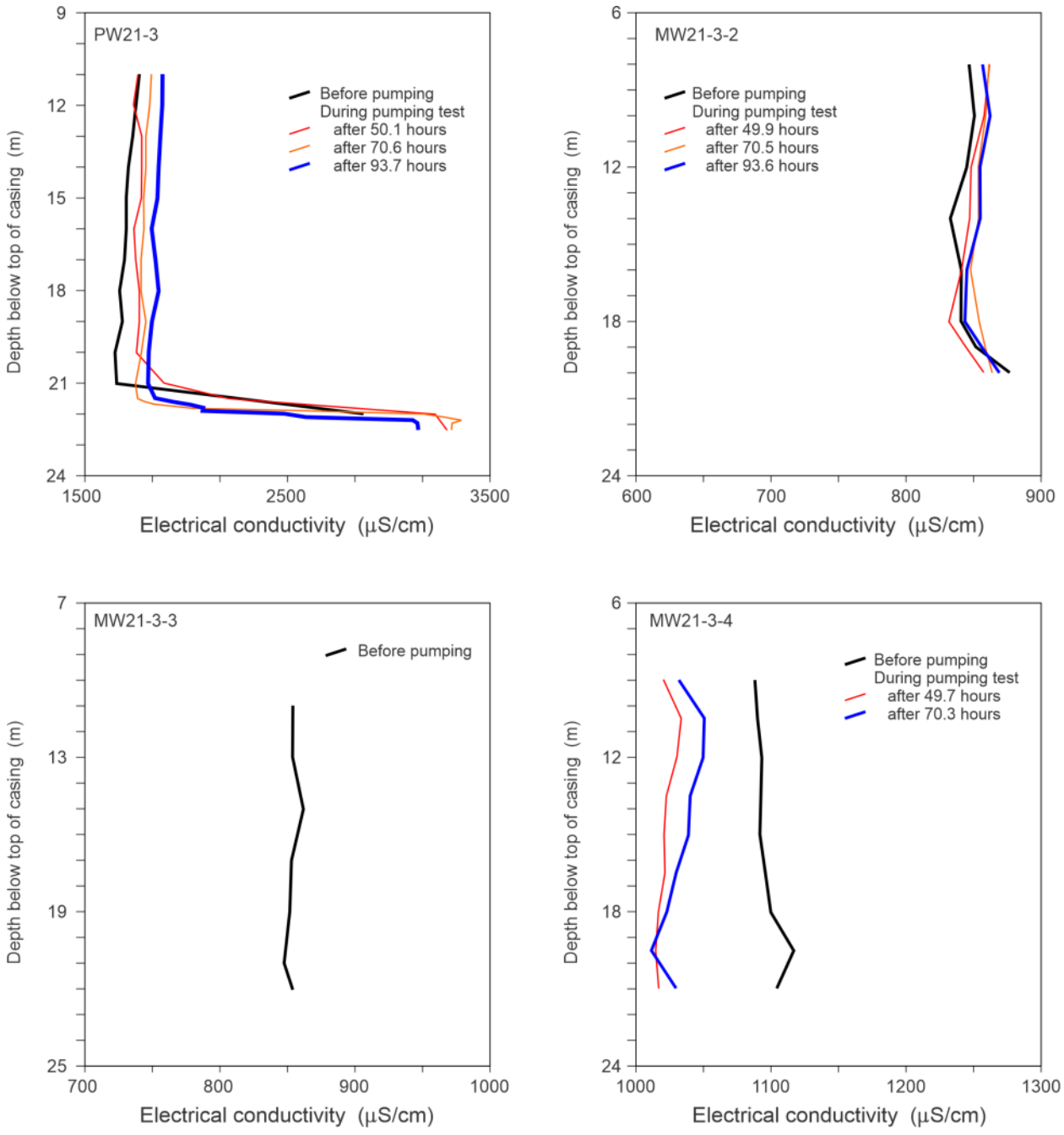


Figure 11. Electrical conductivity profiles at the PW21-3 cluster during the pumping test

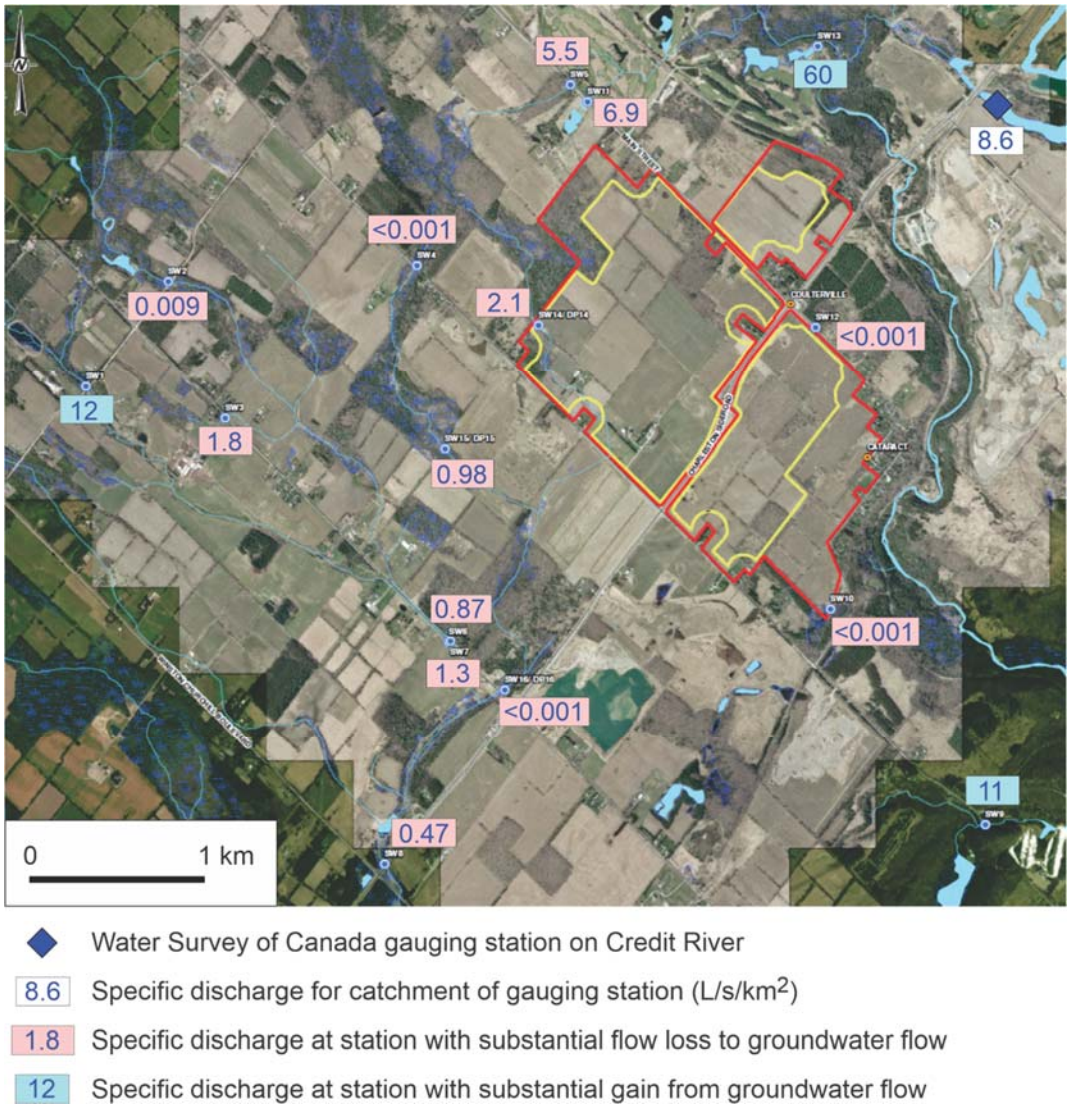


Figure 12. Specific discharge at stream gauging stations in the study area, showing values calculated for the 16 stations monitored by Golder Associates plus the Water Survey of Canada station on the Credit River.

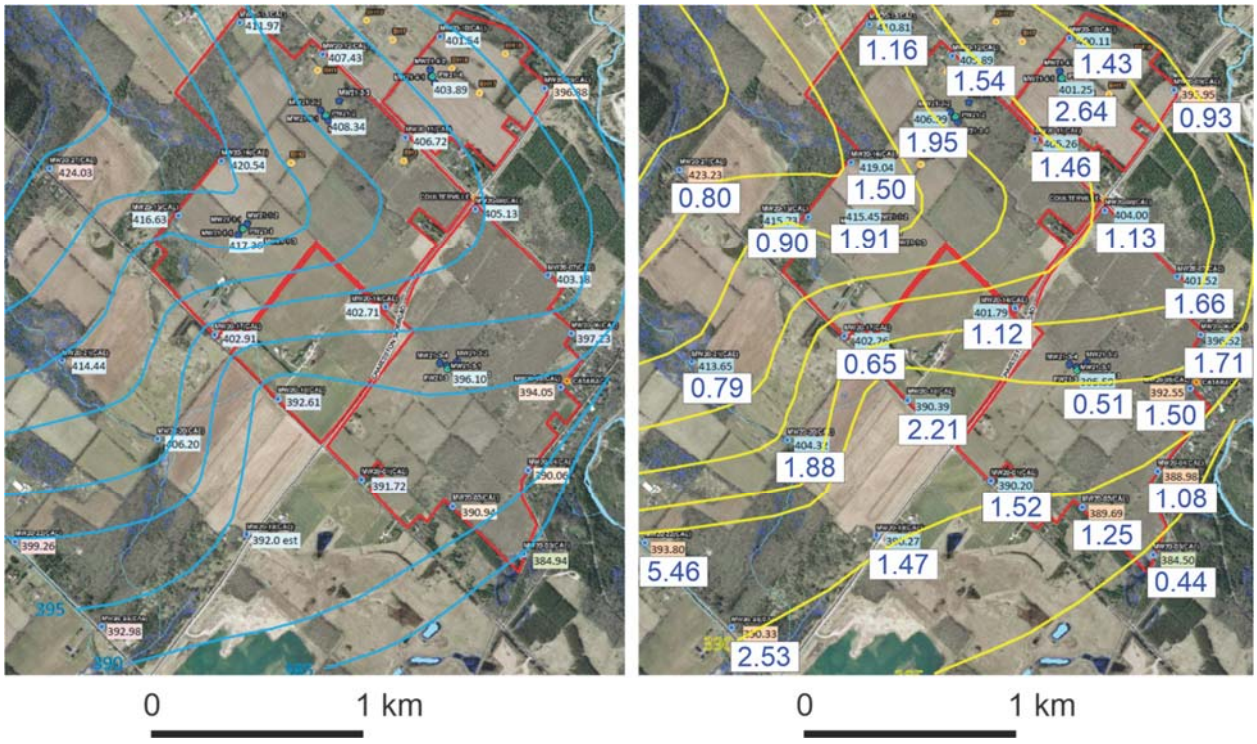


Figure 13. Inferred bedrock groundwater levels in April 2021 (left) and September 2021 (right). The differences in water levels between the two values are shown in blue on the right-hand figure.

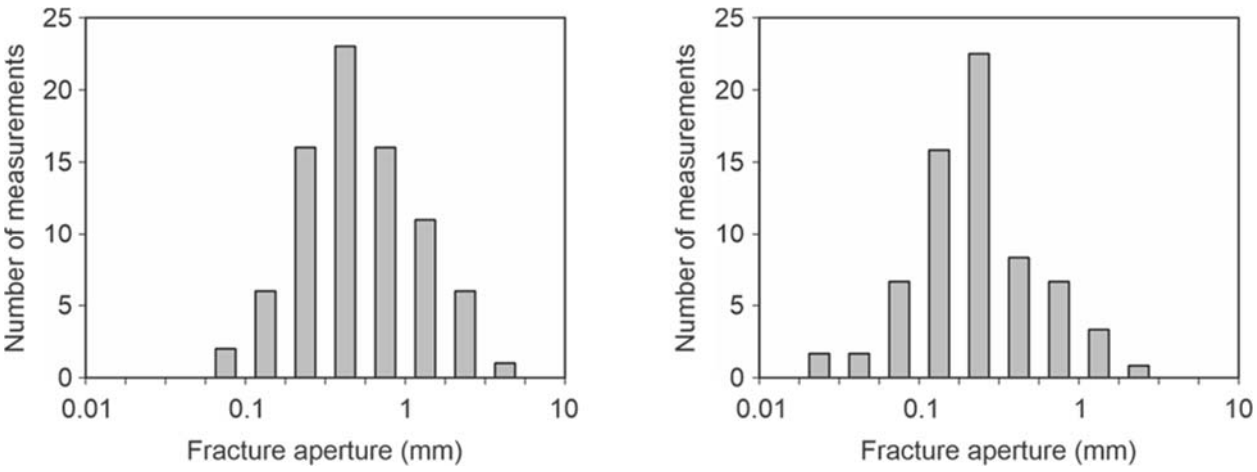


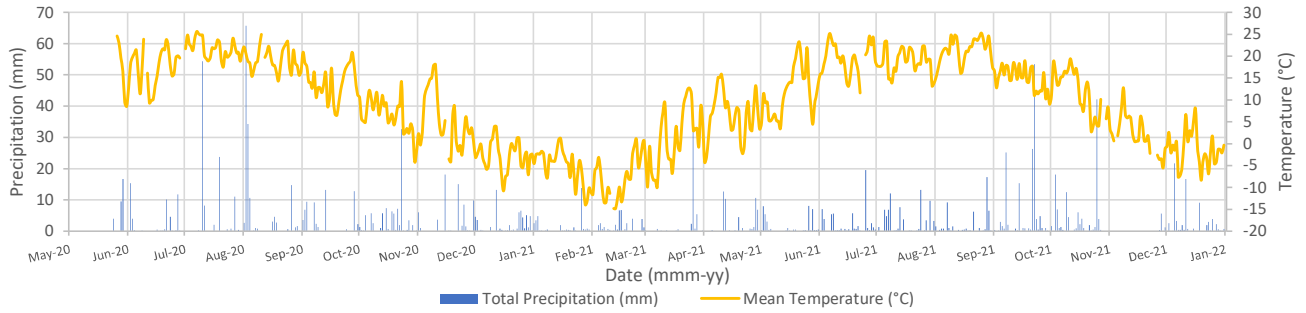
Figure 14. Calculated fracture apertures derived from packer testing using the cubic law, based on the assumption that all flow is through a single constant-aperture fracture per packer test intervals (left), and through ten fractures with identical apertures (right).

APPENDIX L

Surface Water Levels and Flows

Water Levels & Flow at SW1 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L1

A



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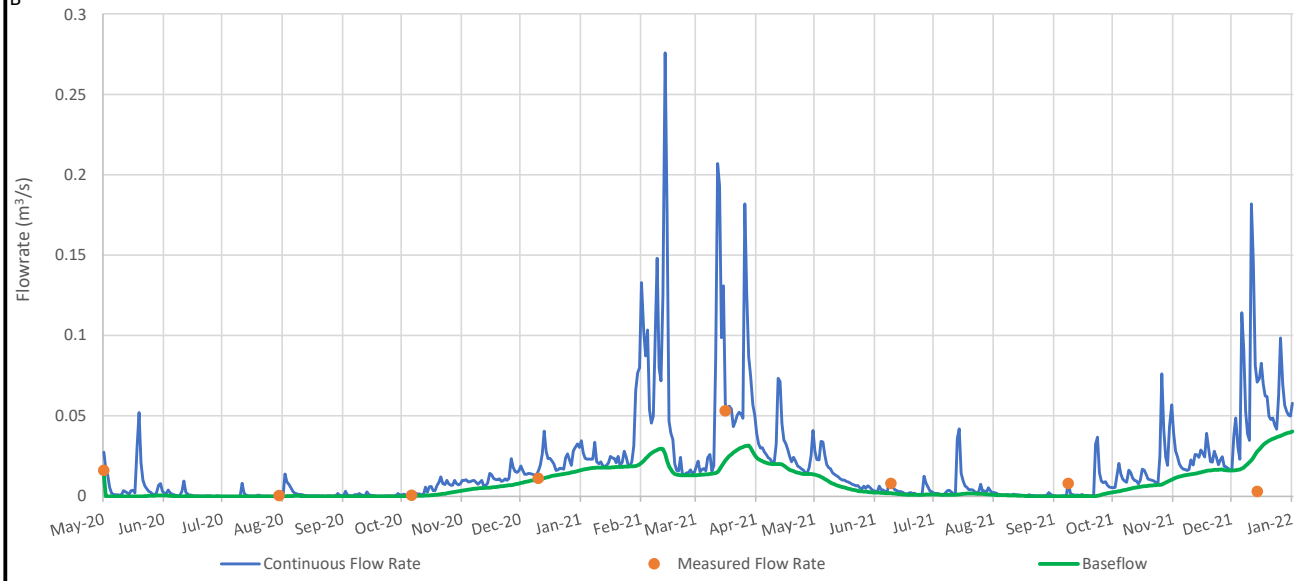

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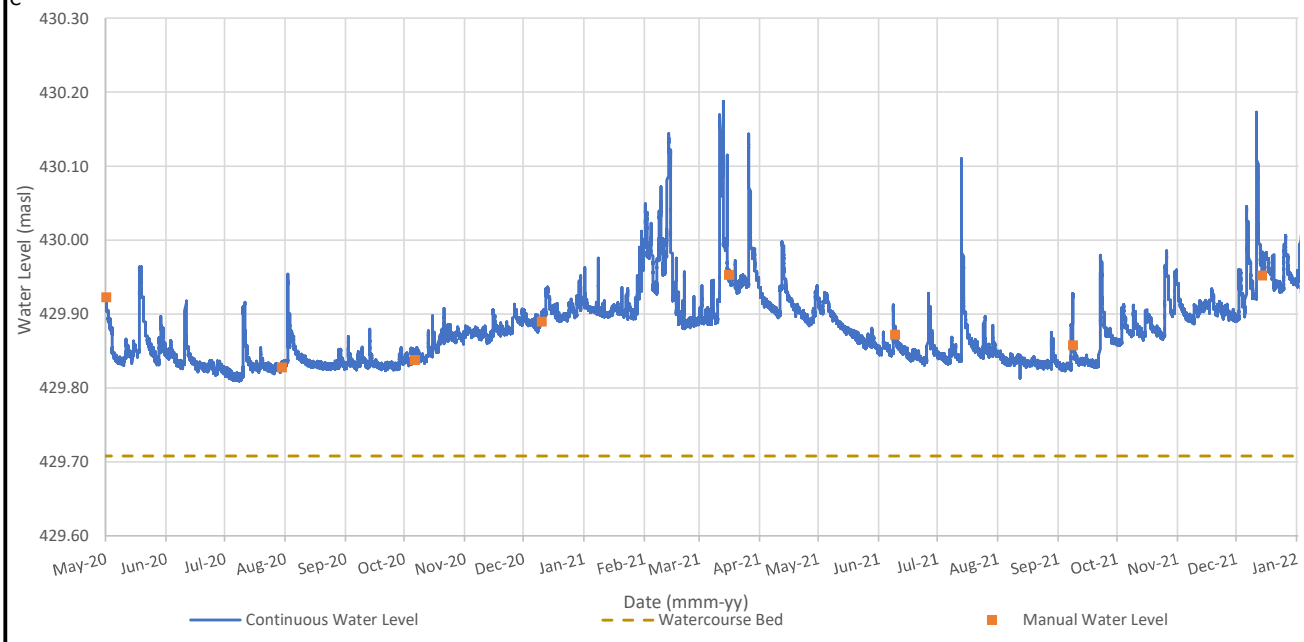


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

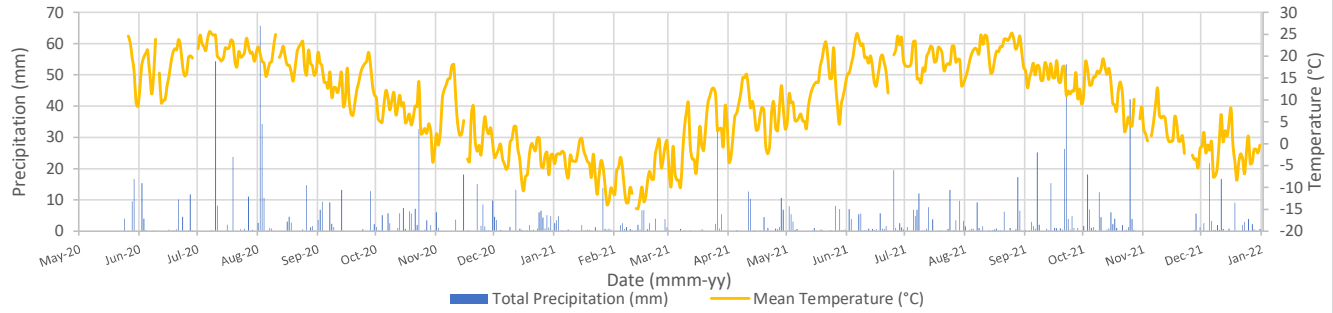
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW2 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L2

A



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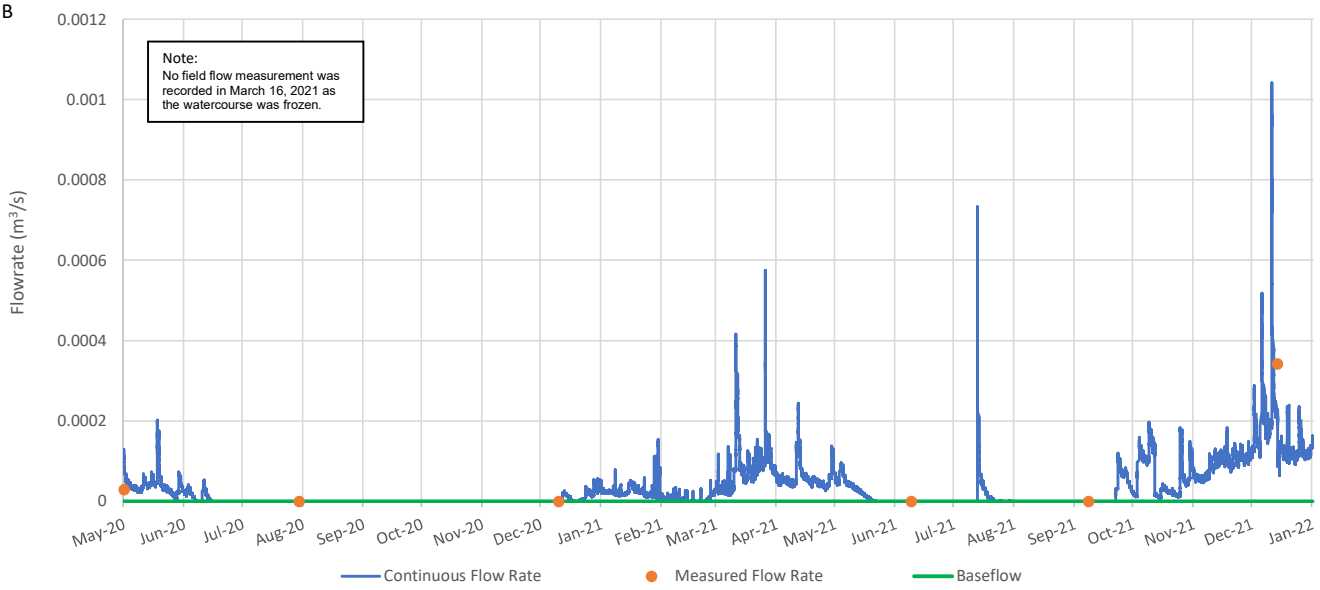

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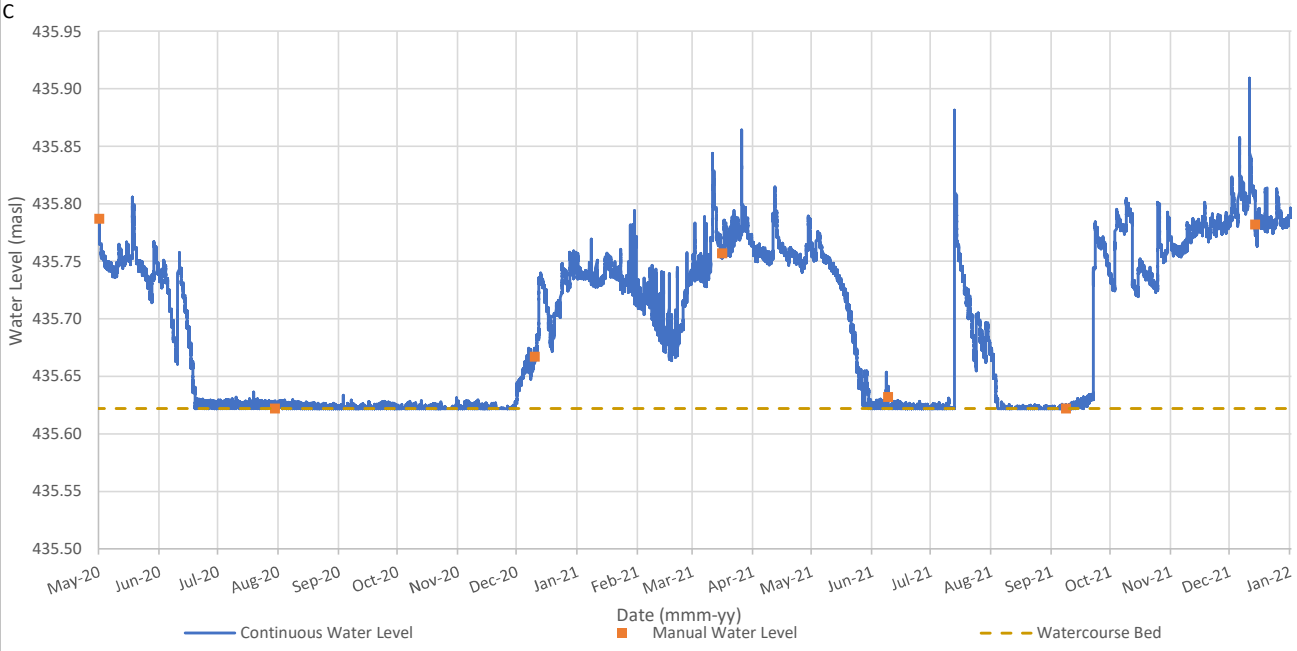


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow rate** **C. Water Level**

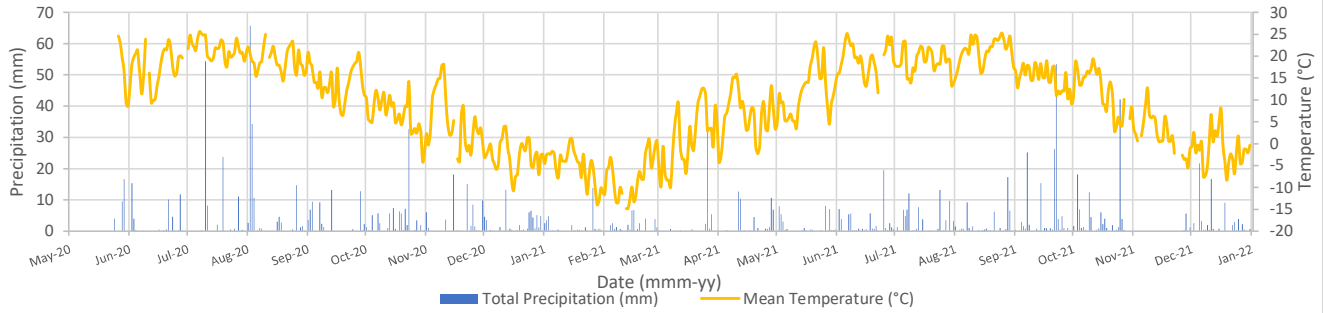
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW3 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L3

A



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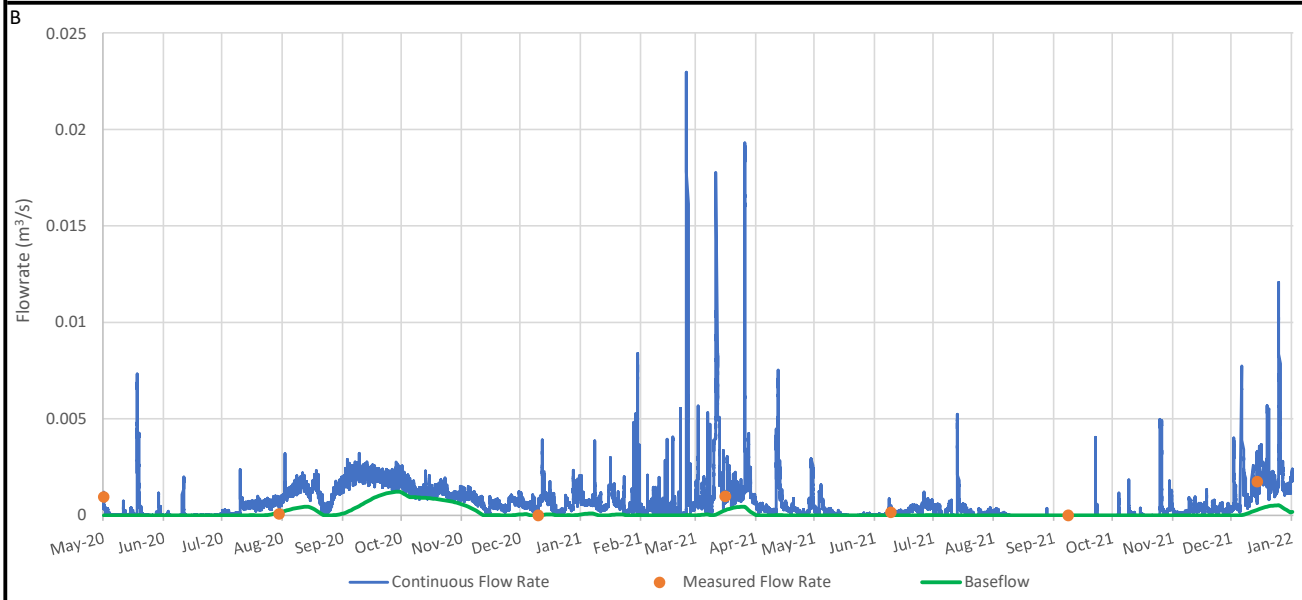

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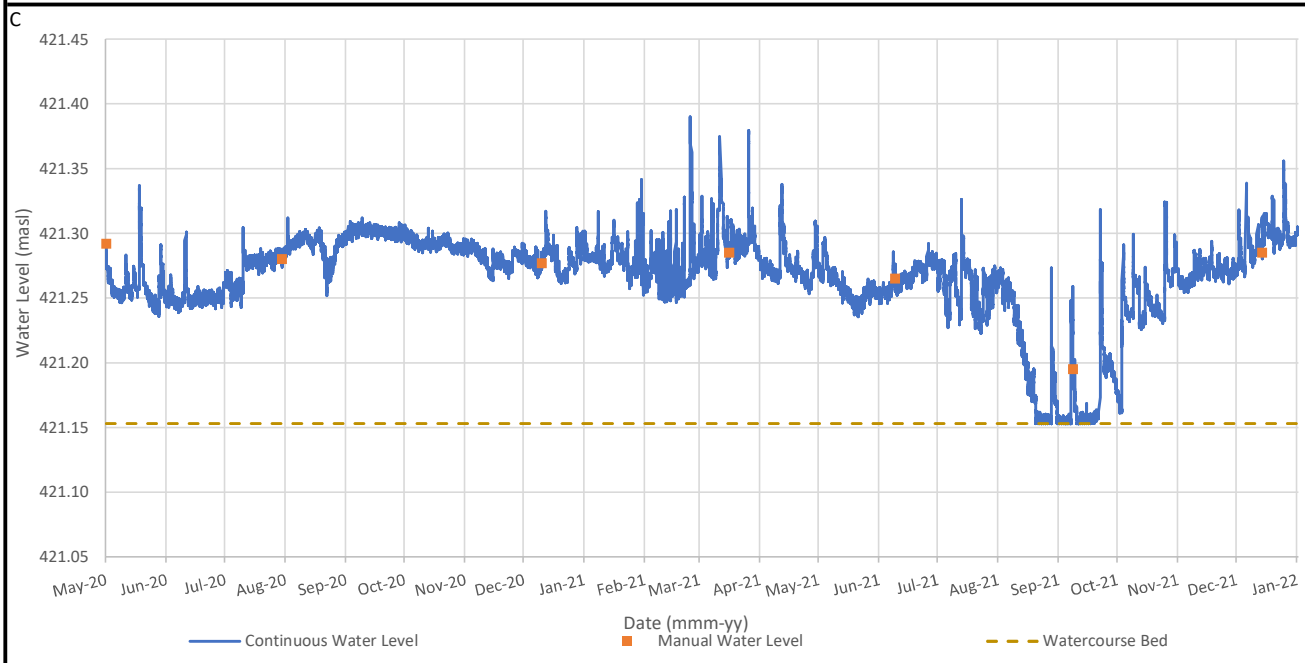


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

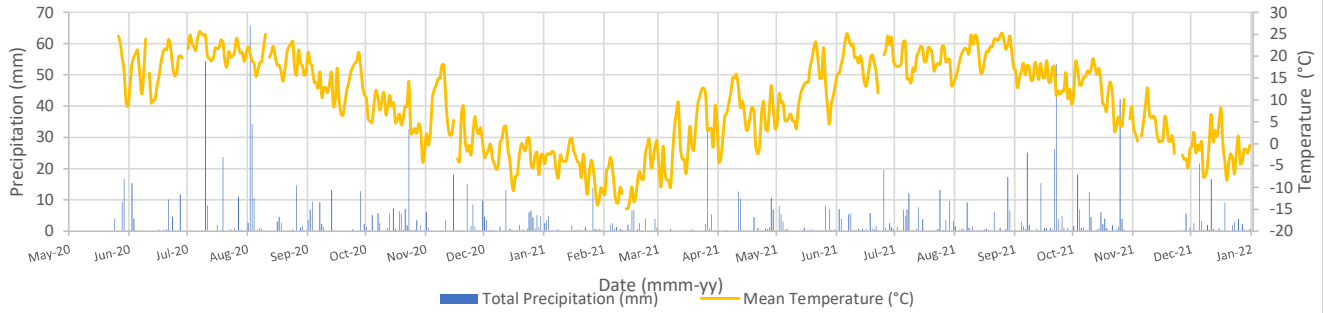
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW4 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L4

A



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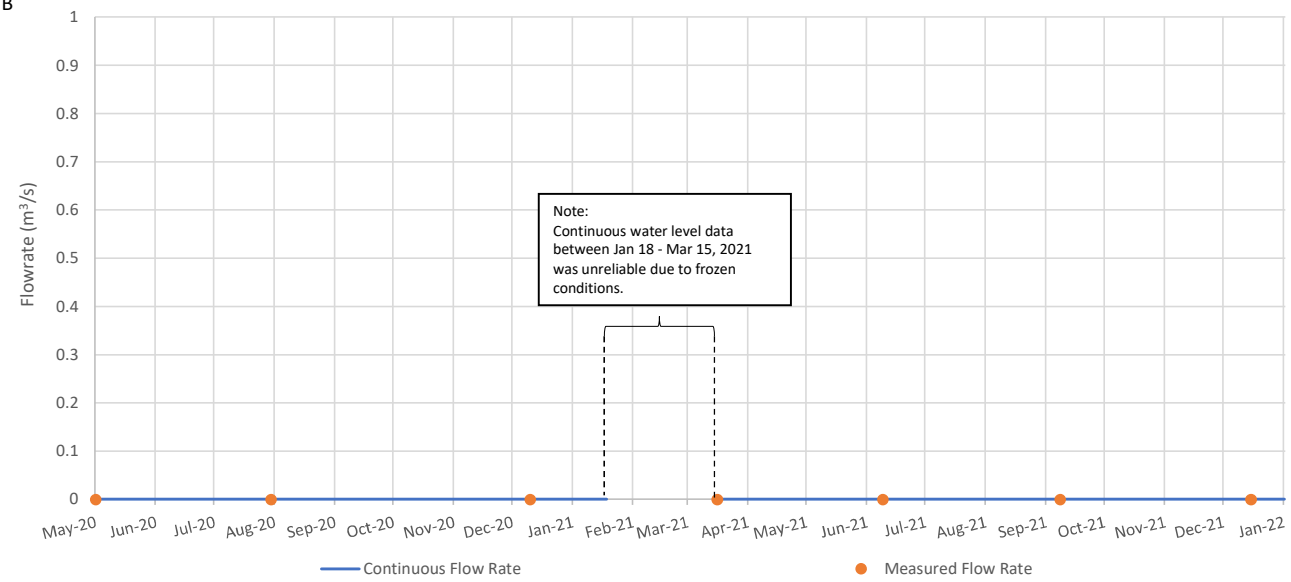

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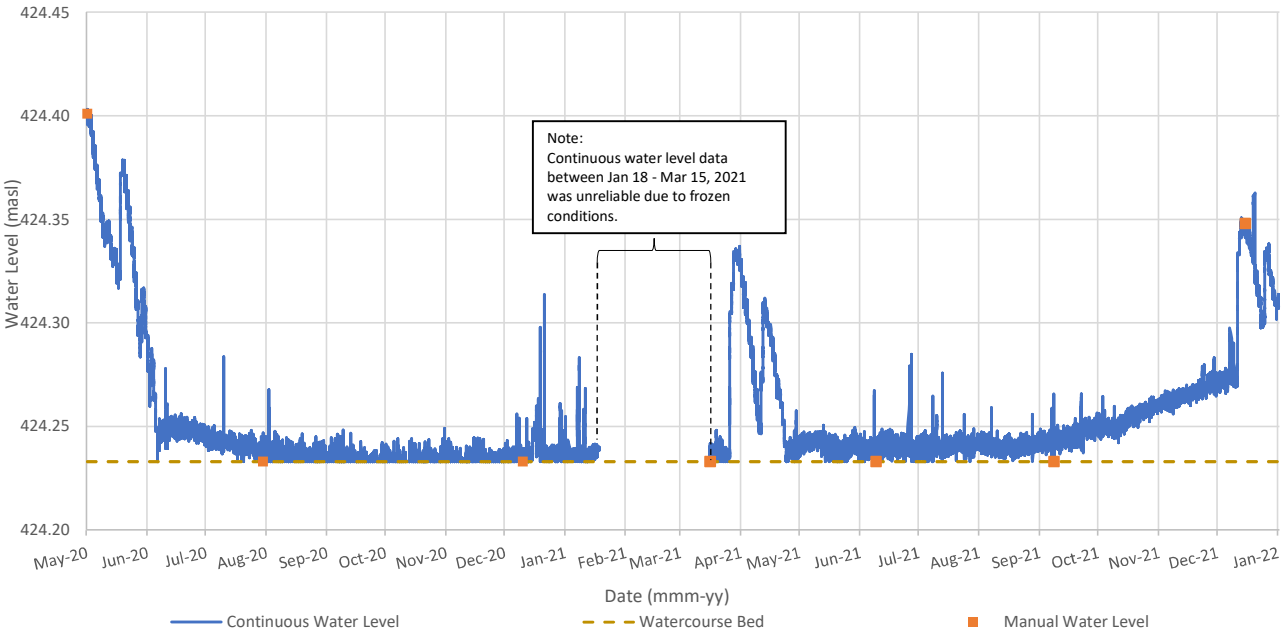


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

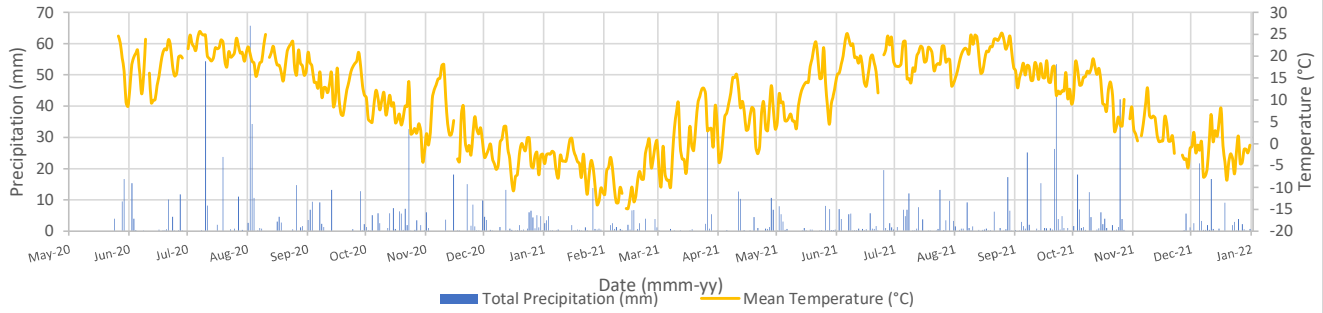
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW5 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L5

A



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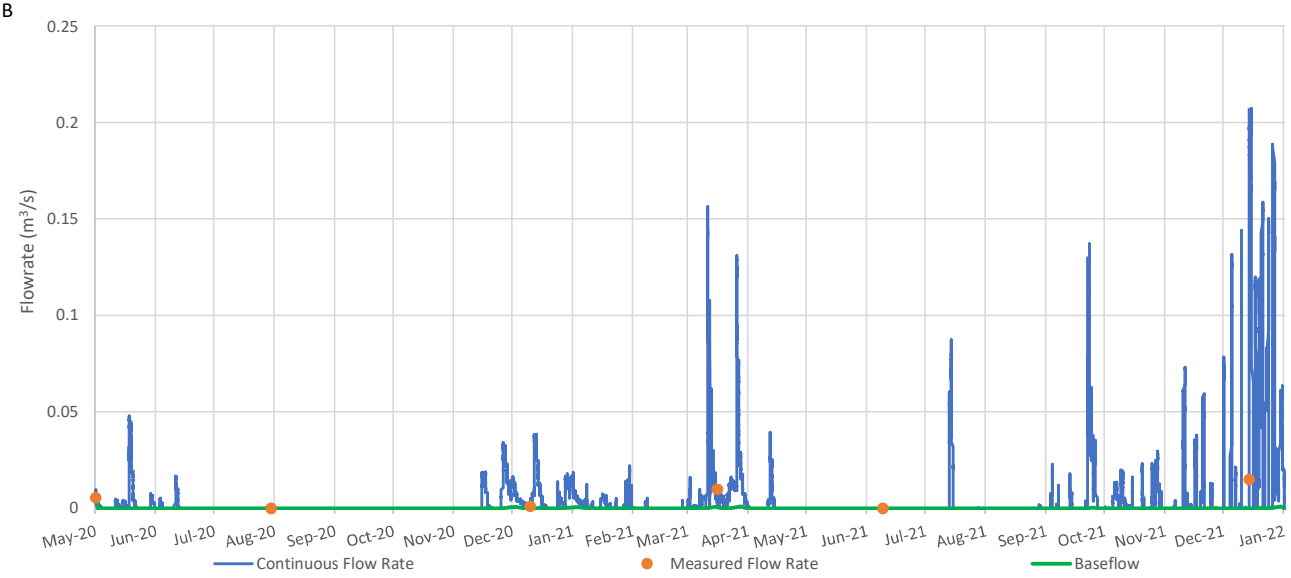

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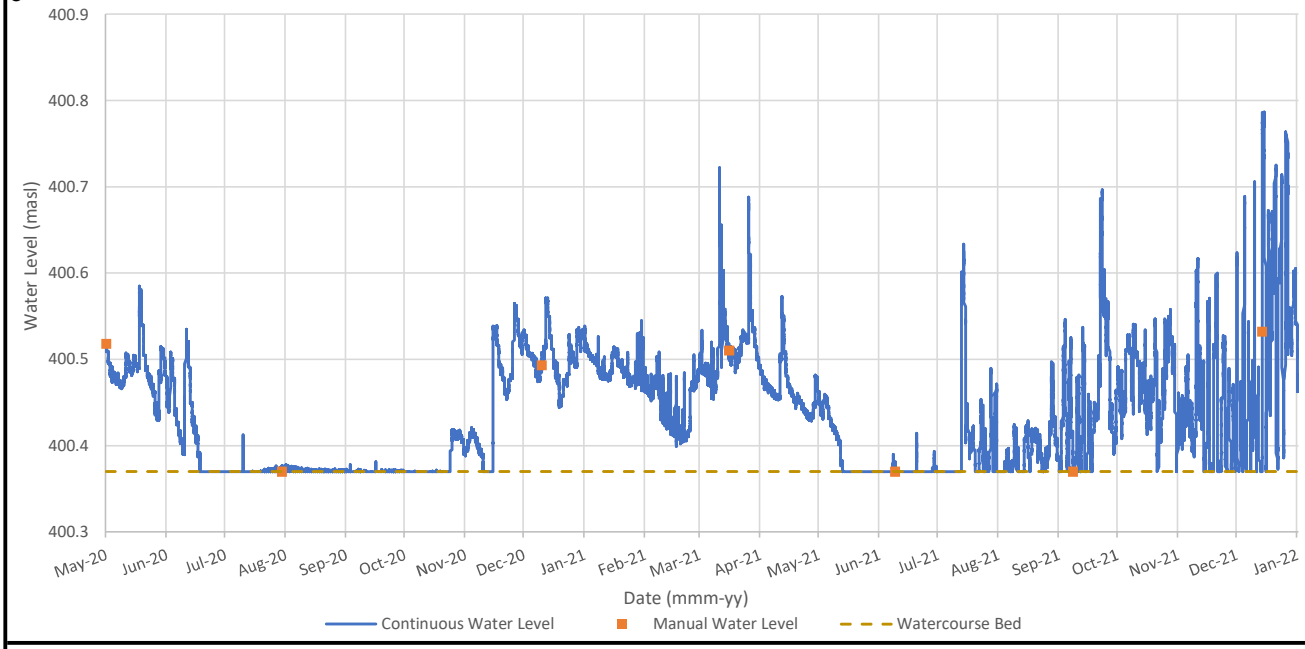


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

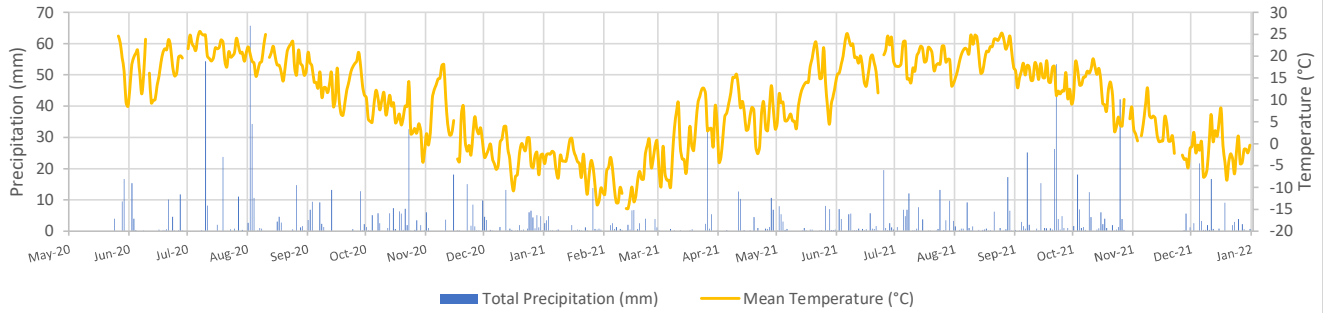
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW6 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L6

A



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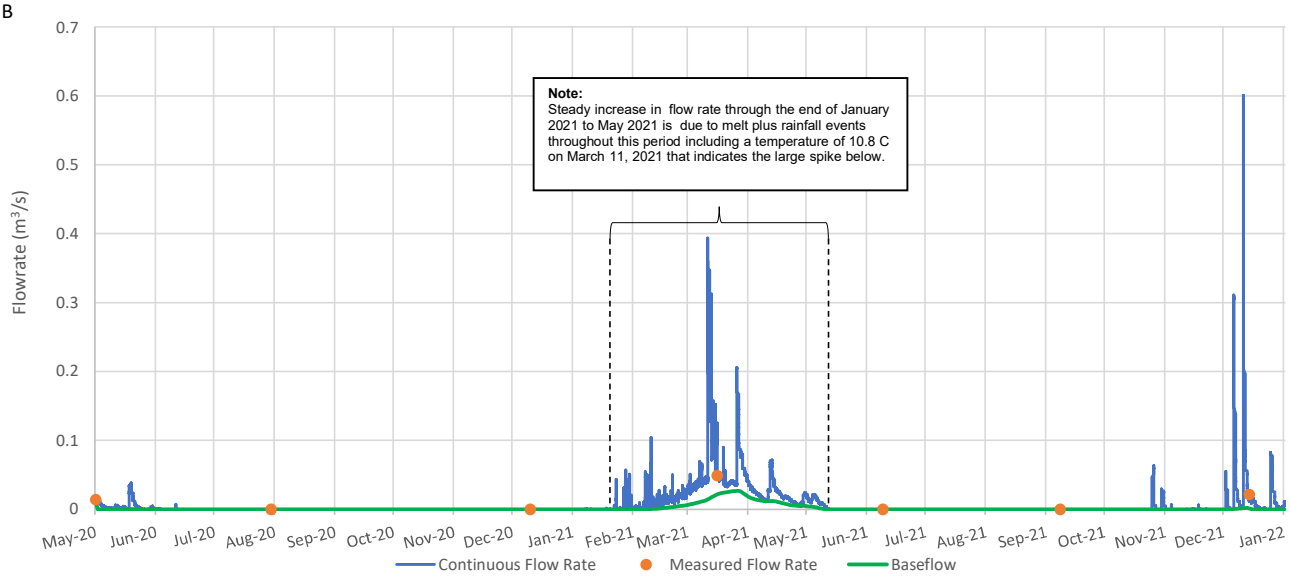

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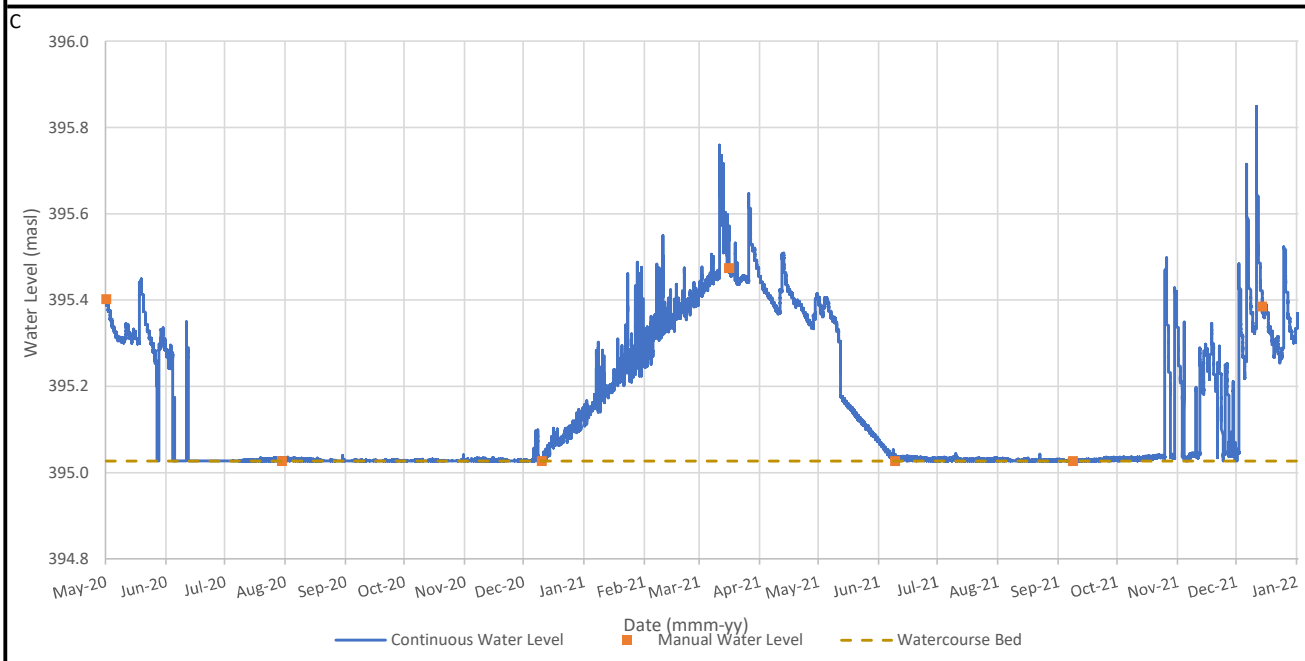


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

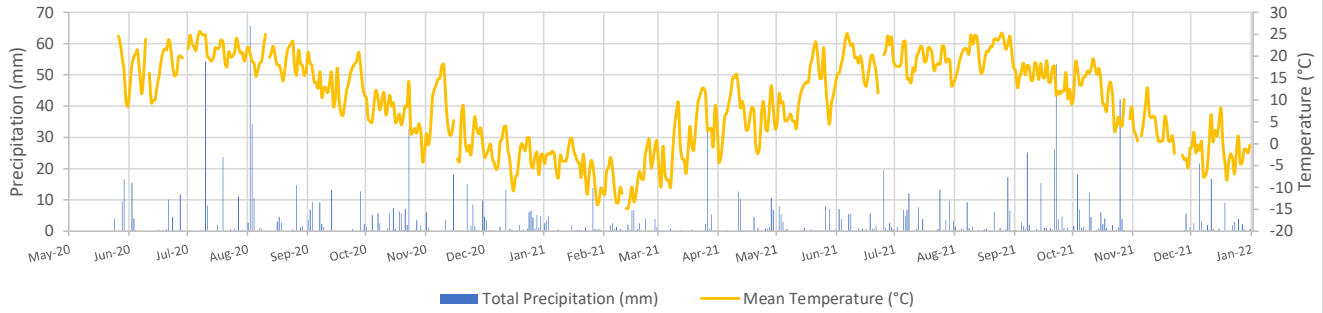
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW7 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L7

A



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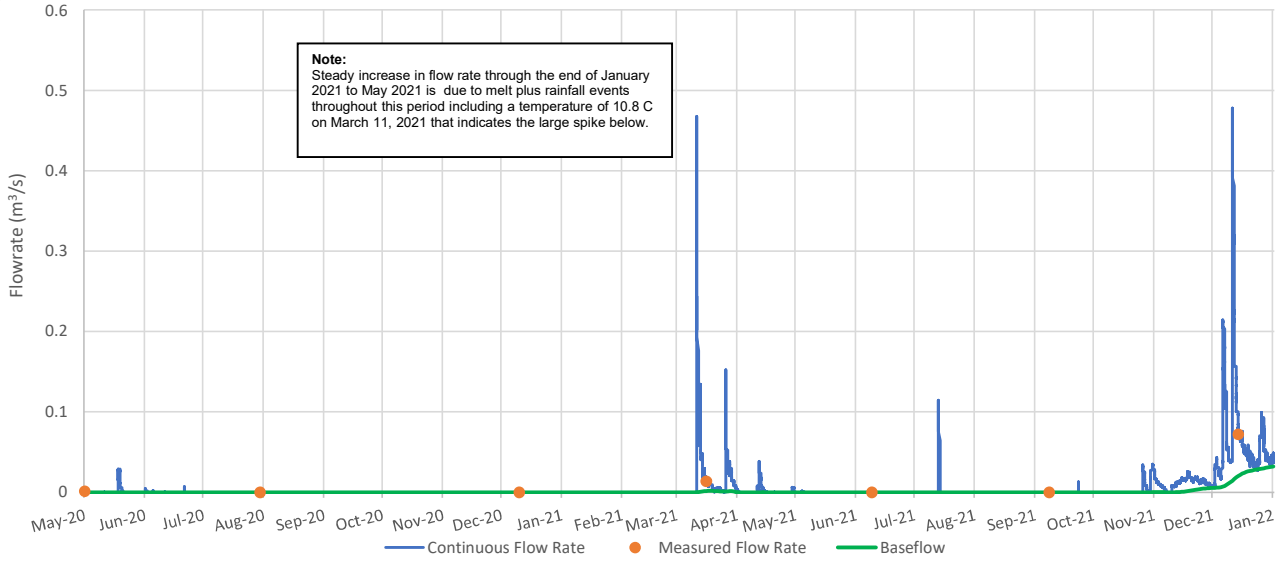
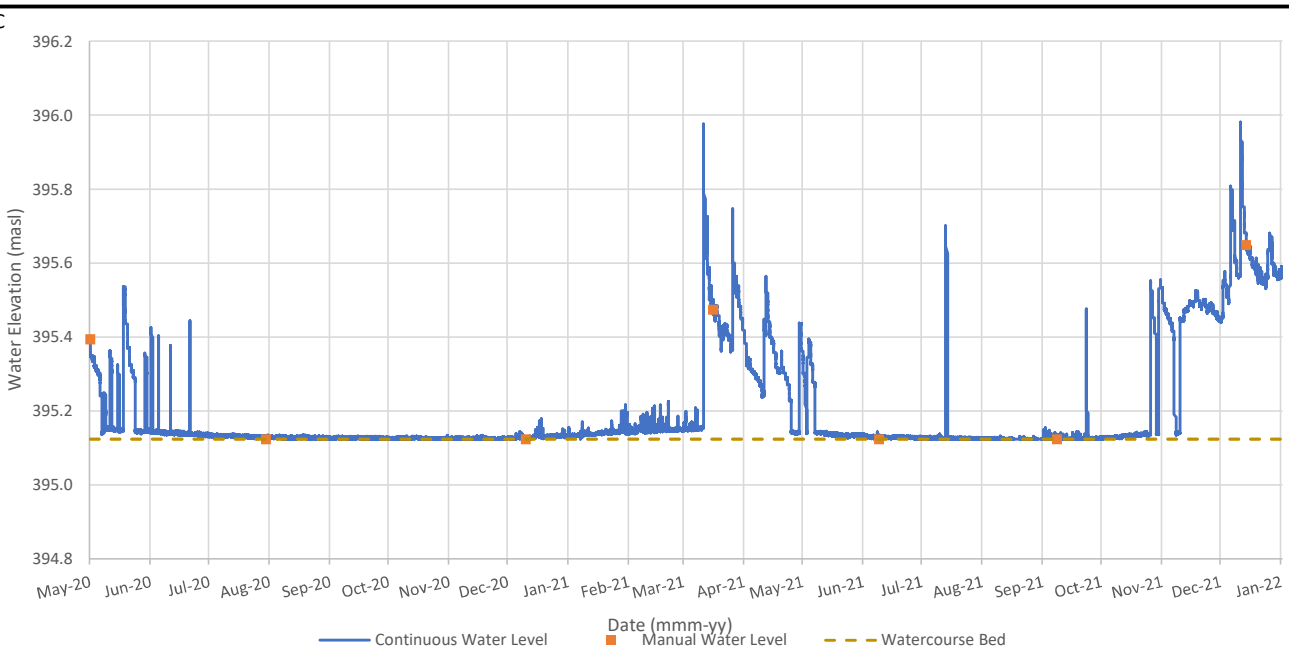


C



A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

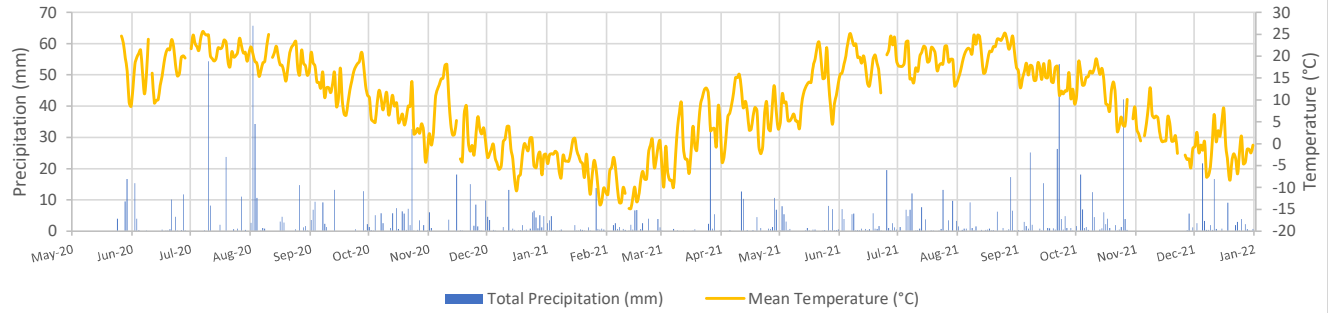
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW8 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L8

A



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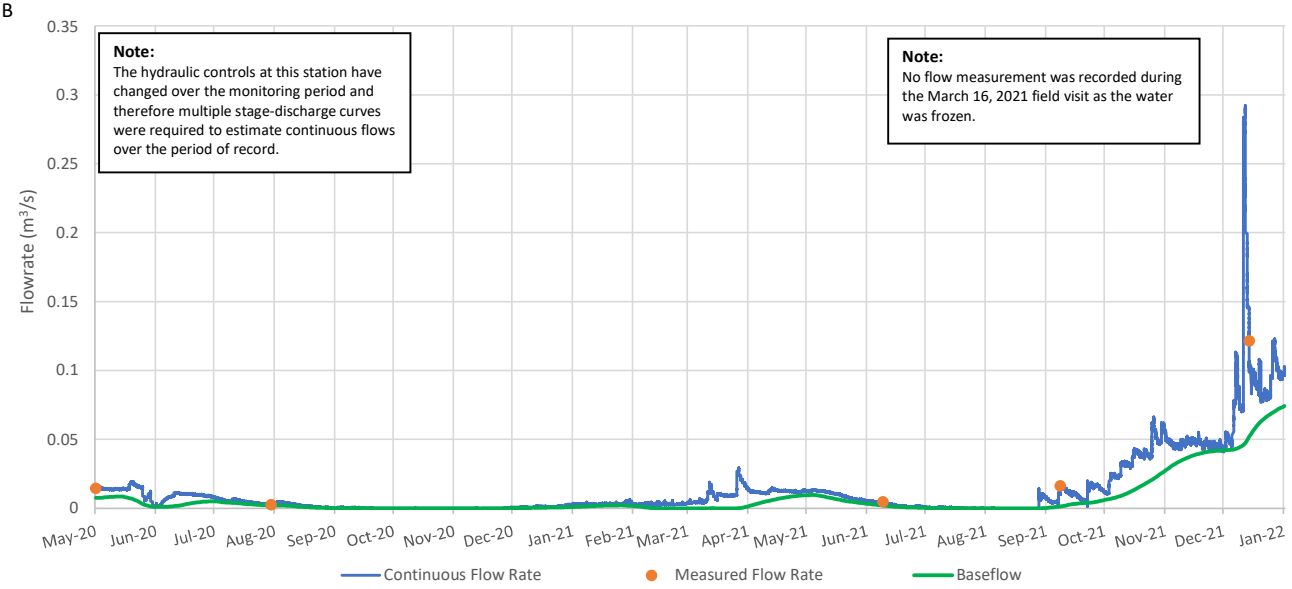

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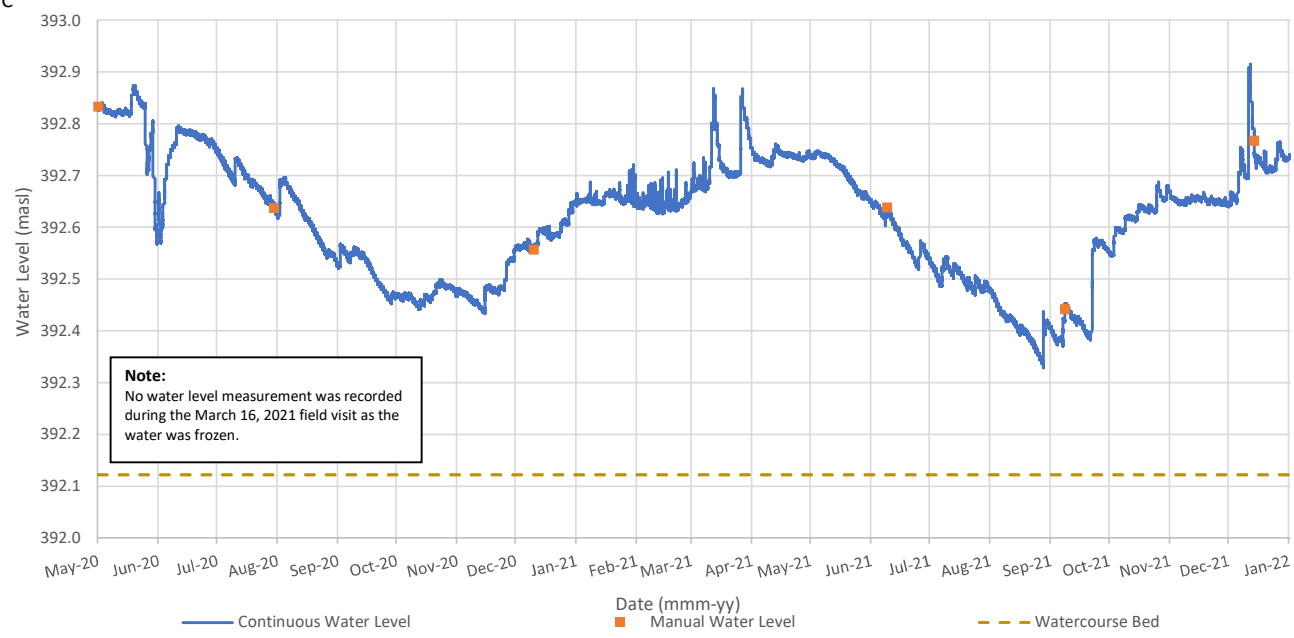


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

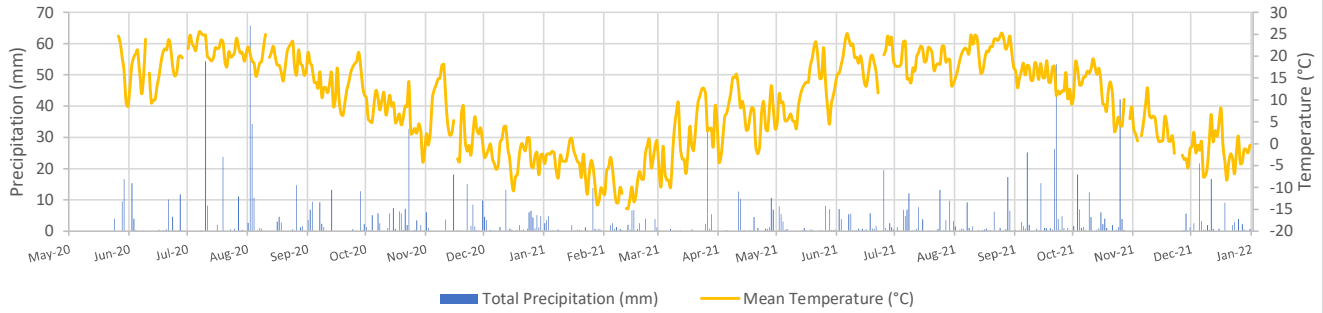
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW9 Adjacent to Caledon Quarry (2020 - 2021) | FIGURE L9

A



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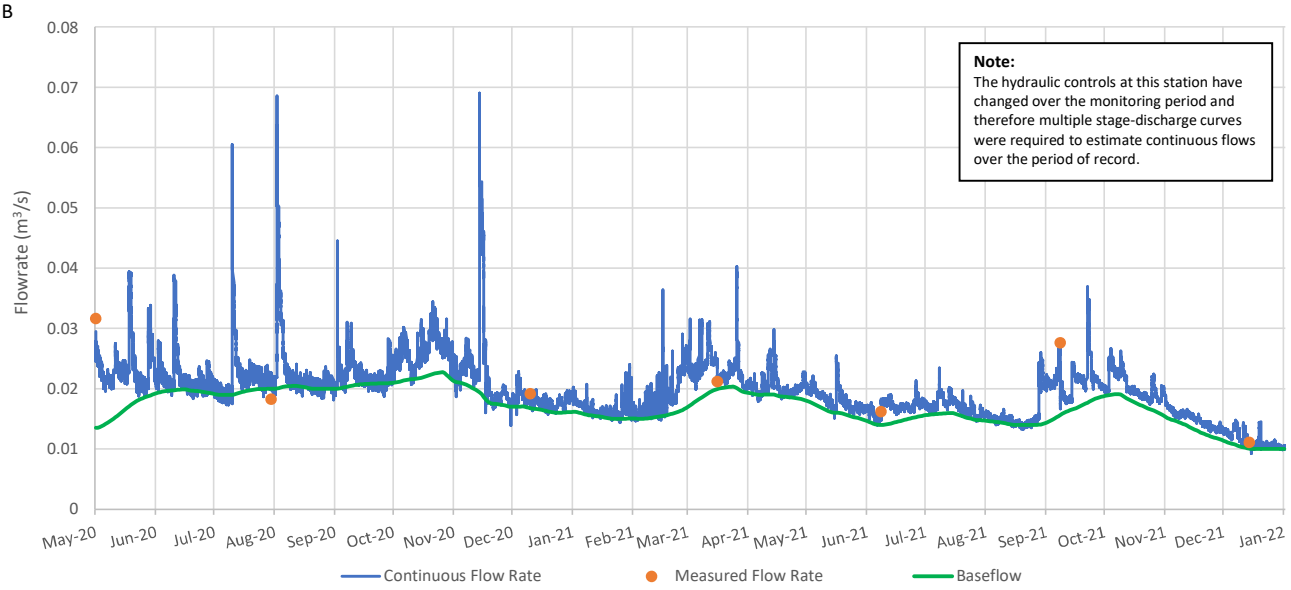

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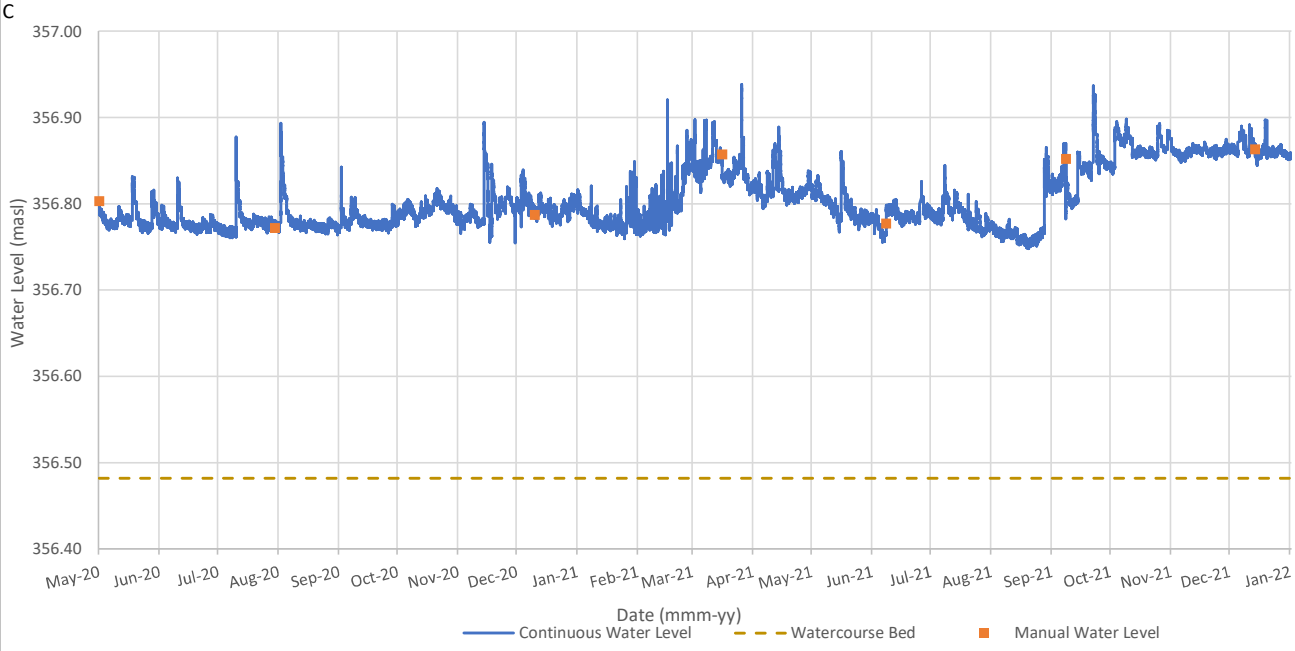


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow rate** **C. Water Level**

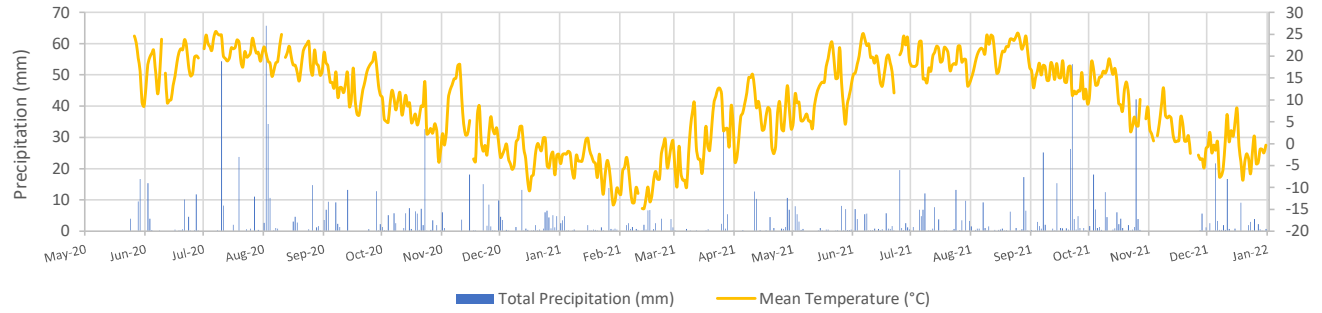
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW10 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L10

A



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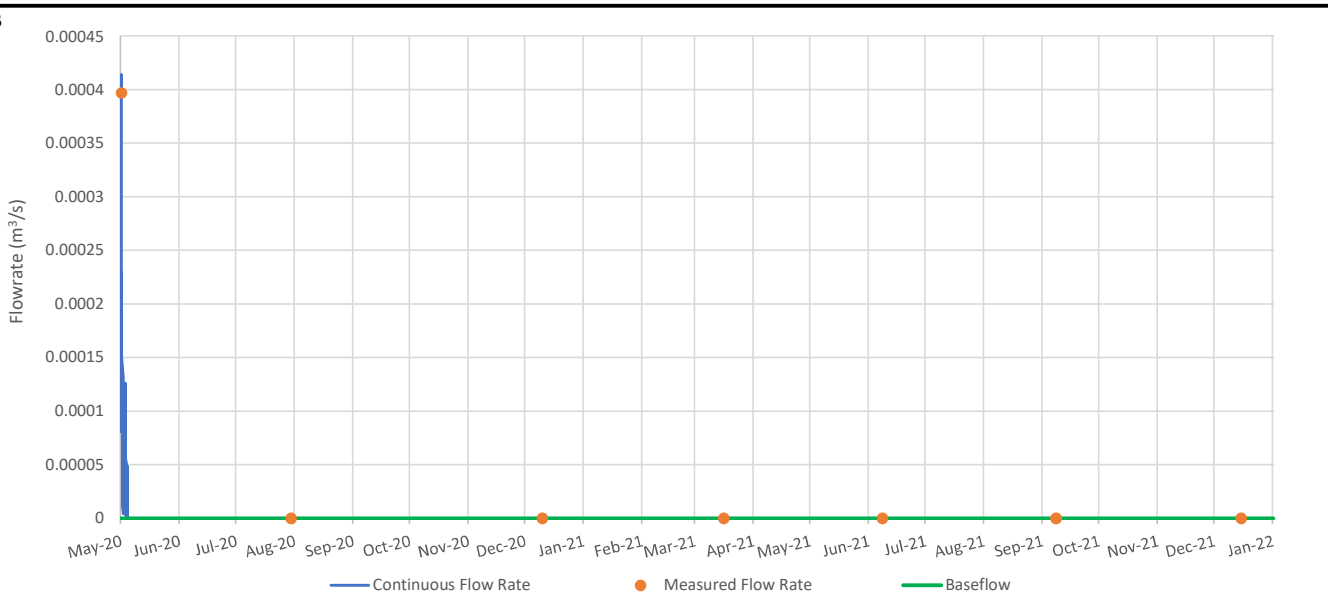

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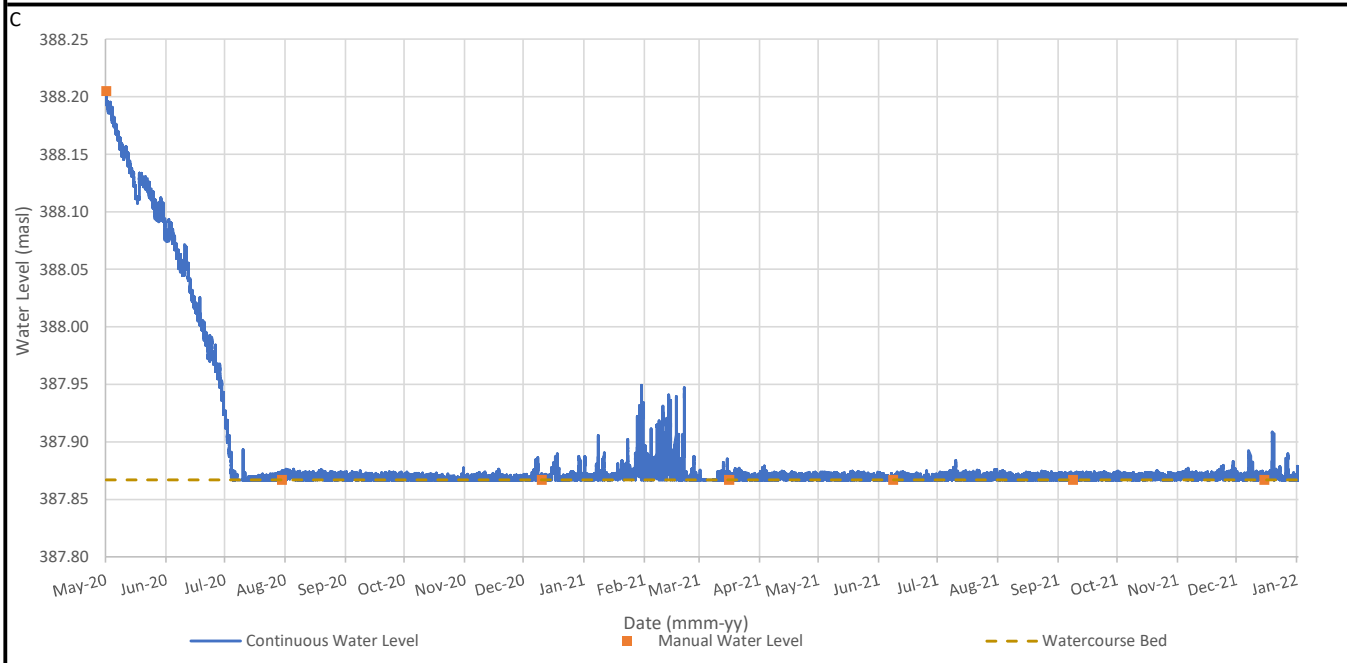


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow rate** **C. Water Level**

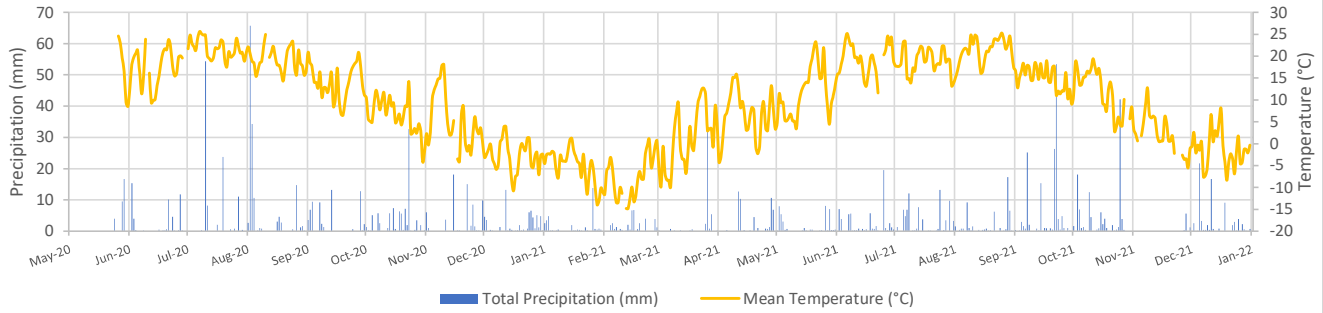
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW11 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L11

A



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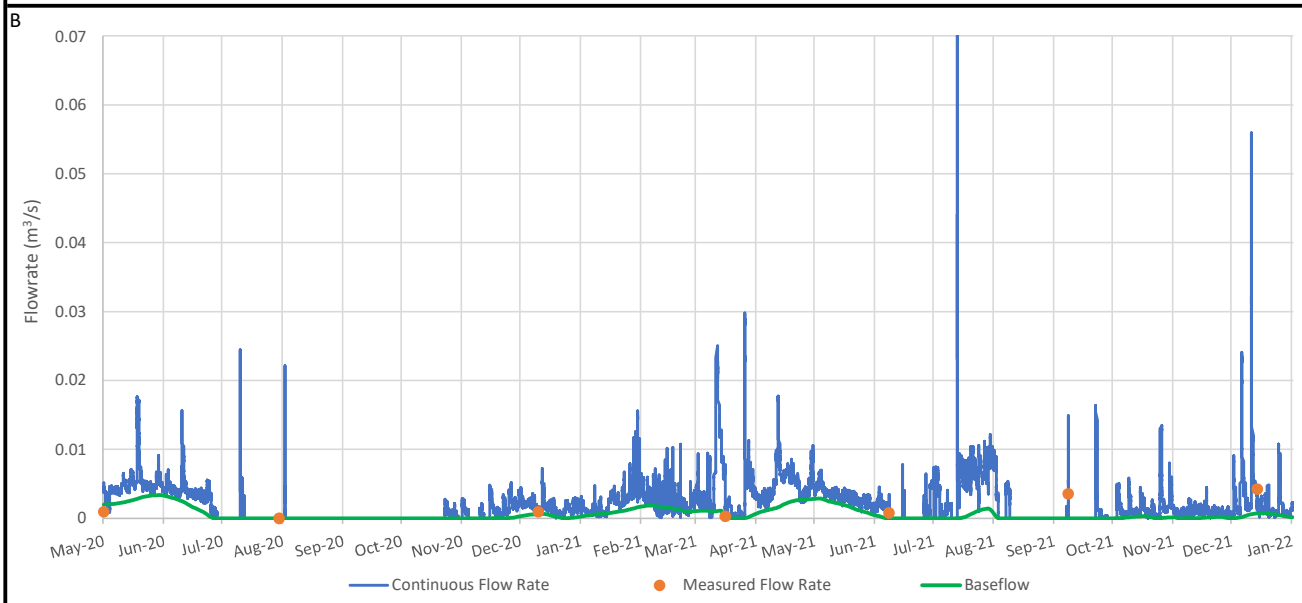

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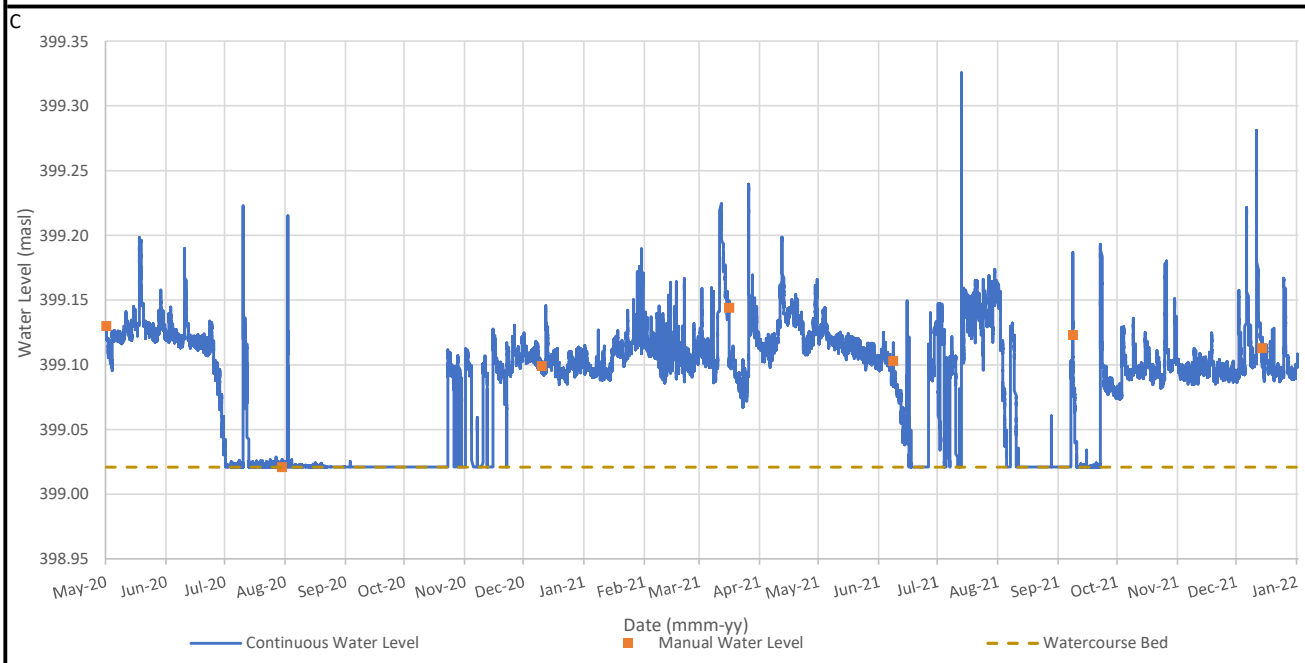


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow rate** **C. Water Level**

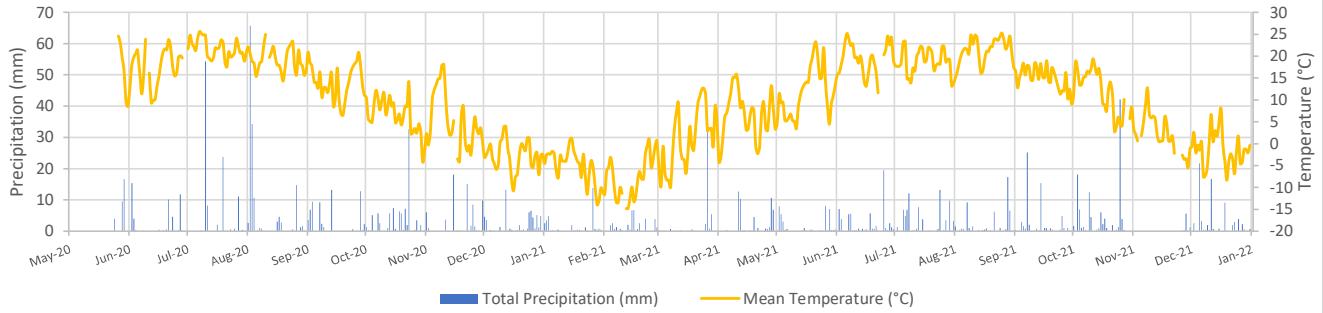
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW12 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L12

A



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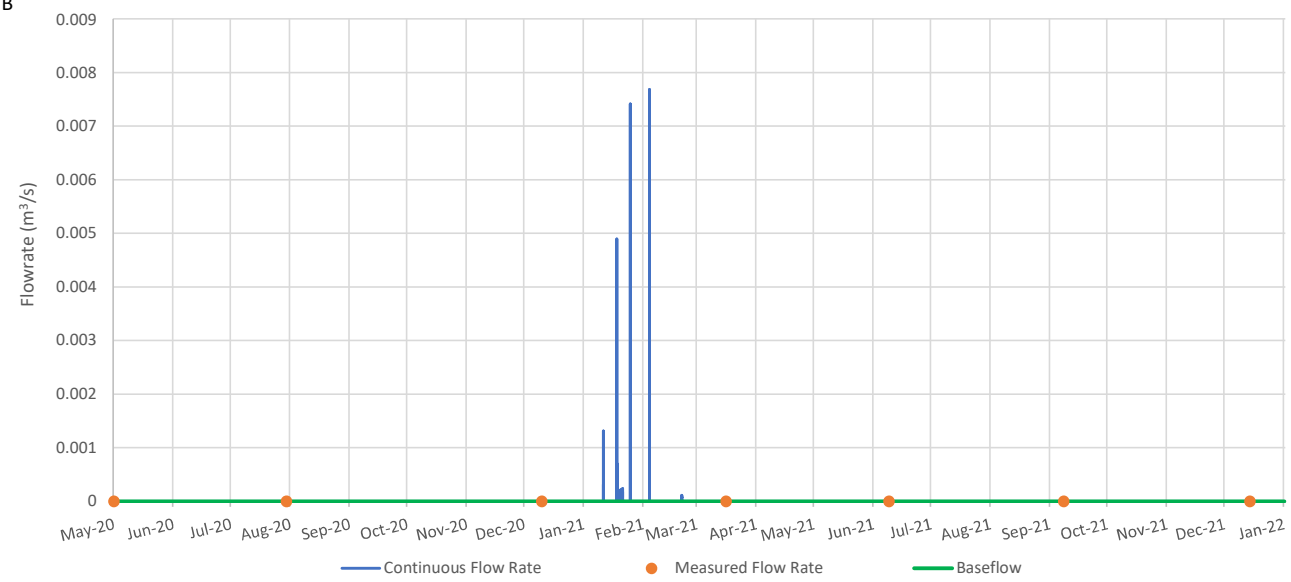

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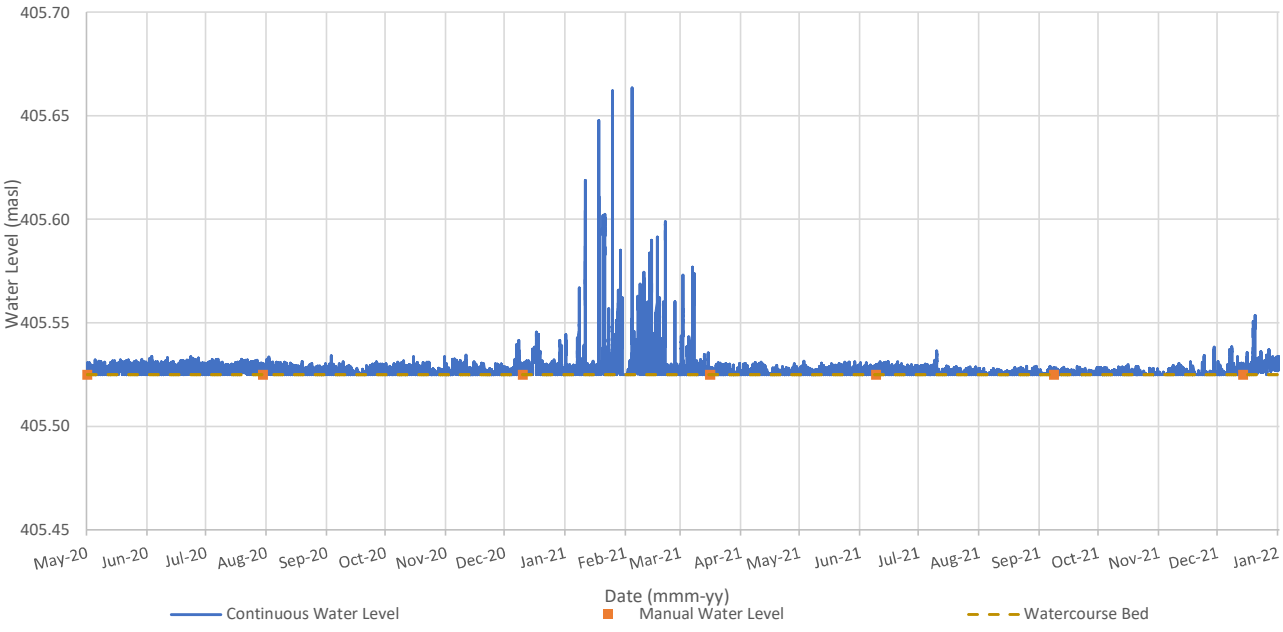


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

PROJECT: 19129150
DATE: December 2022

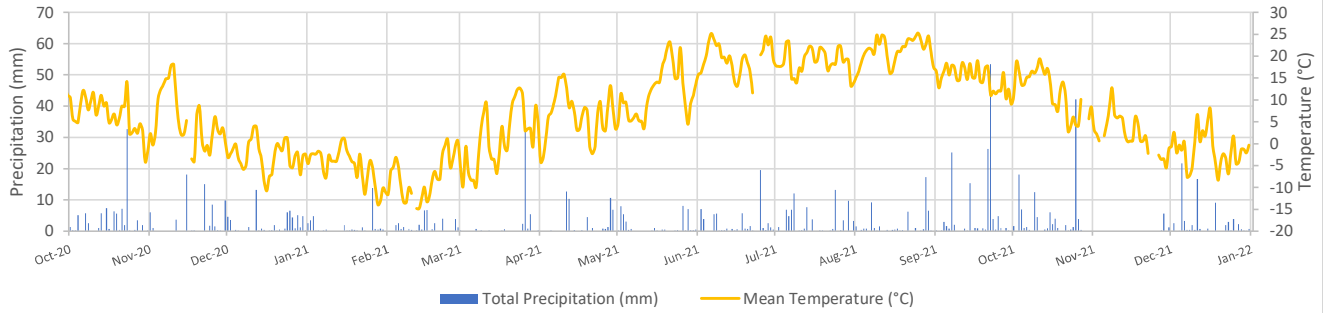
GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW13 Adjacent to VCNA Caledon Quarry (2020 - 2021)

FIGURE L13

A



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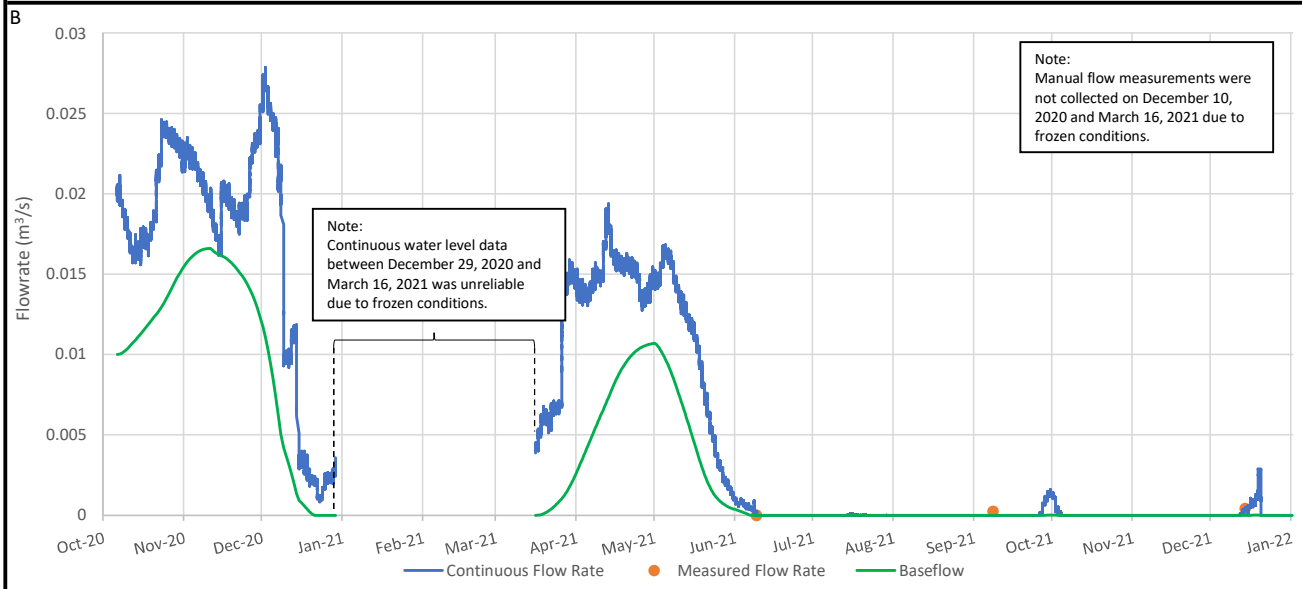

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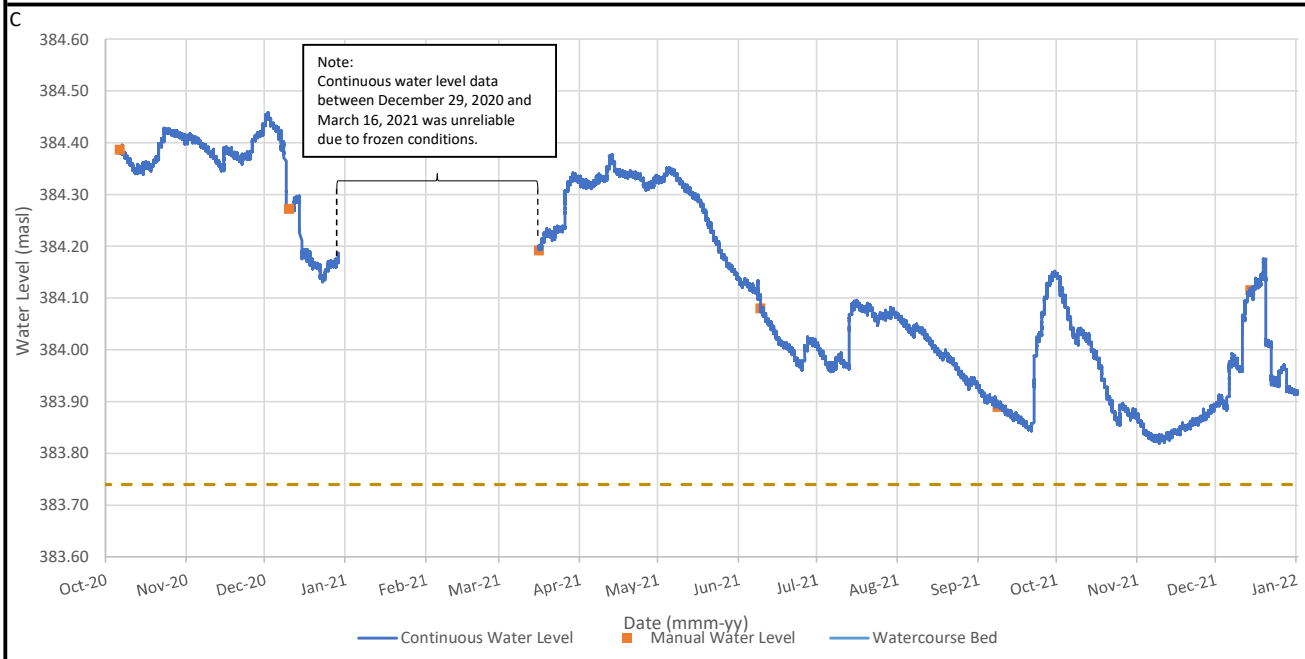


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

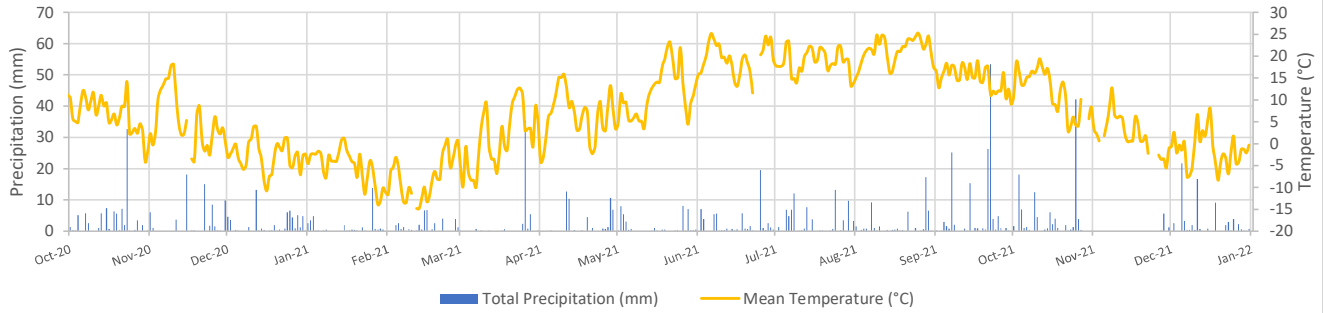
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW14/MP14 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L14

A



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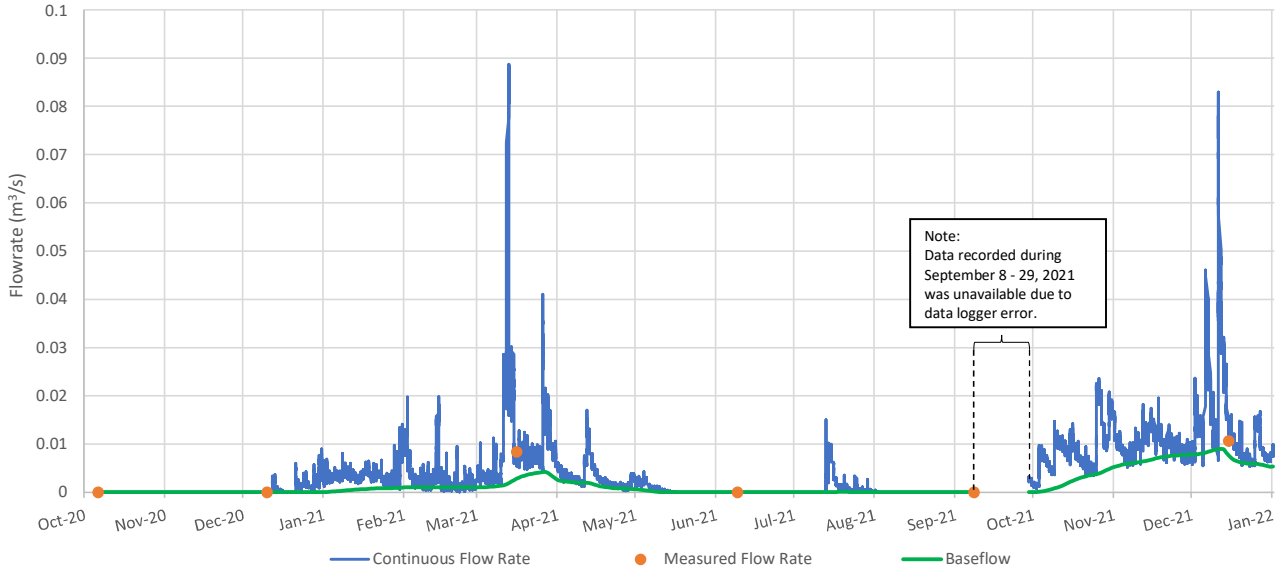
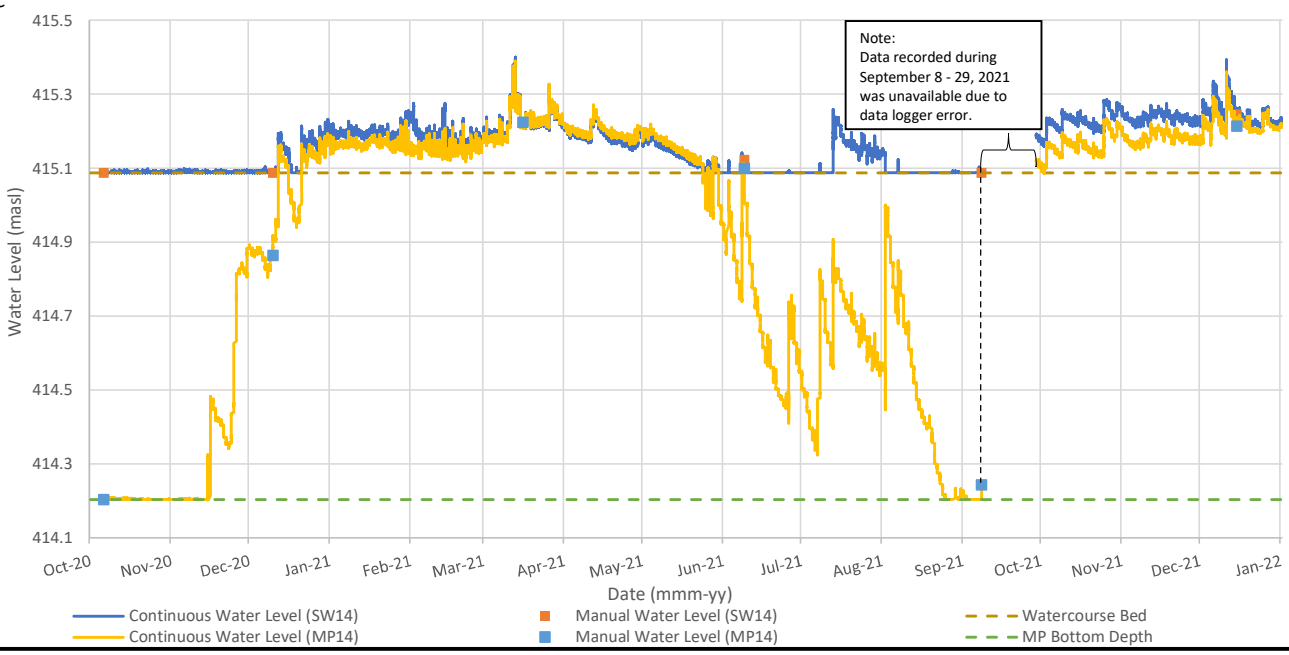


C



A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

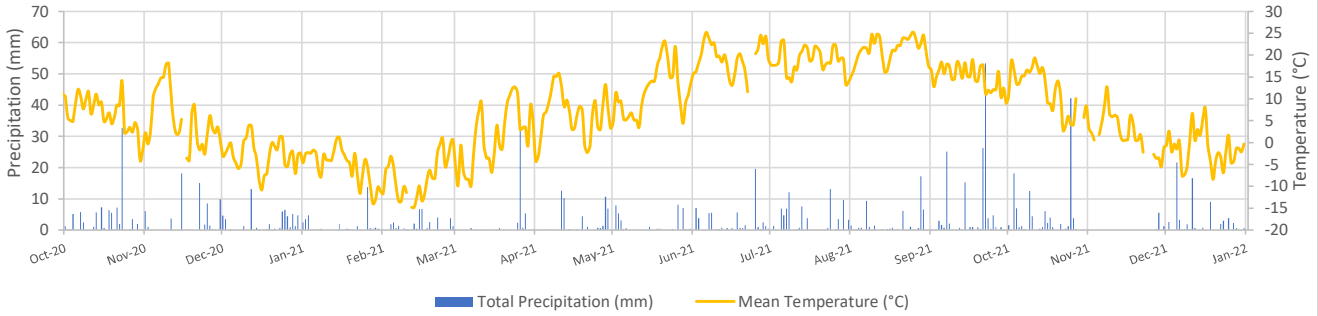
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW15/MP15 Adjacent to VCNA Caledon Quarry (2020 - 2021) | Figure L15

A



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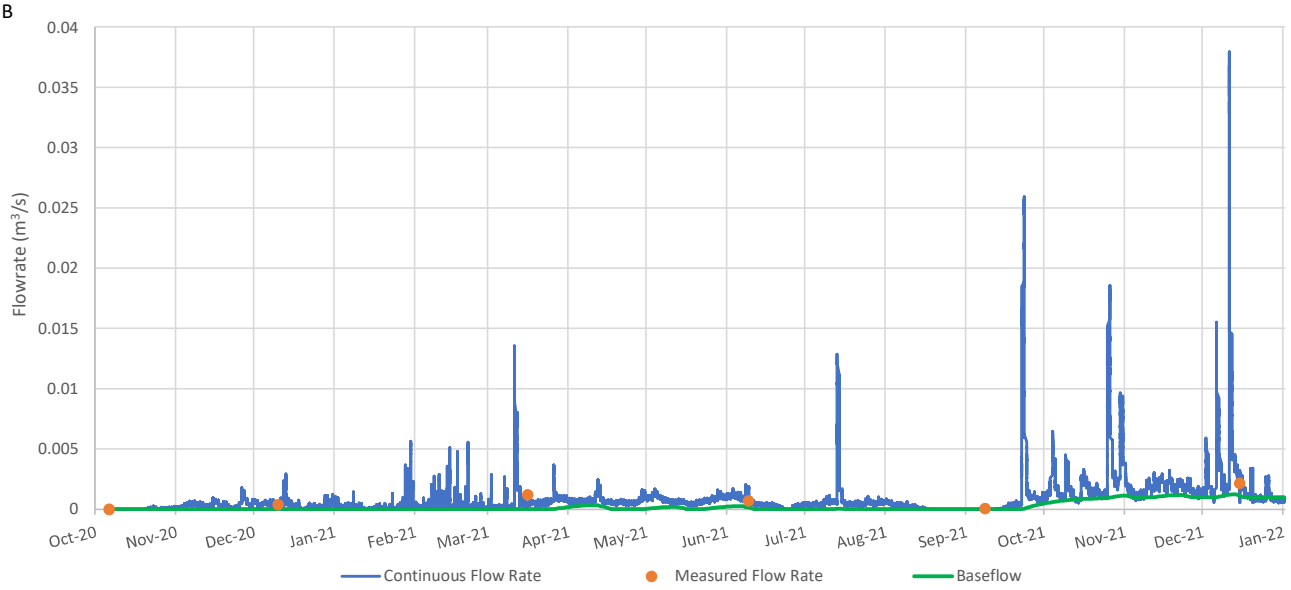

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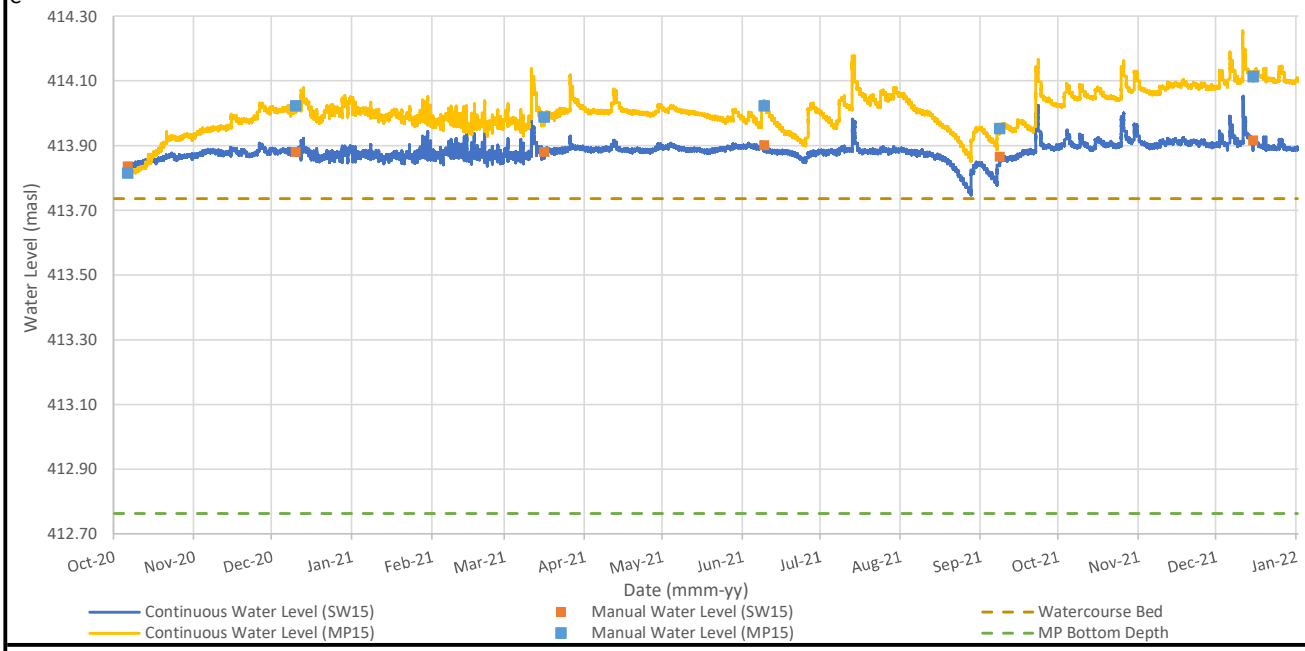


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

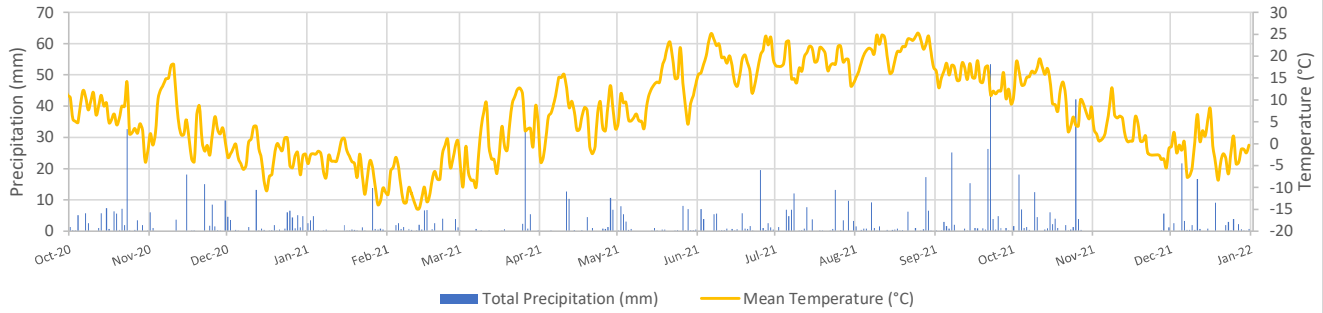
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels & Flow at SW16/MP16 Adjacent to VCNA Caledon Quarry (2020 - 2021) | FIGURE L16

A



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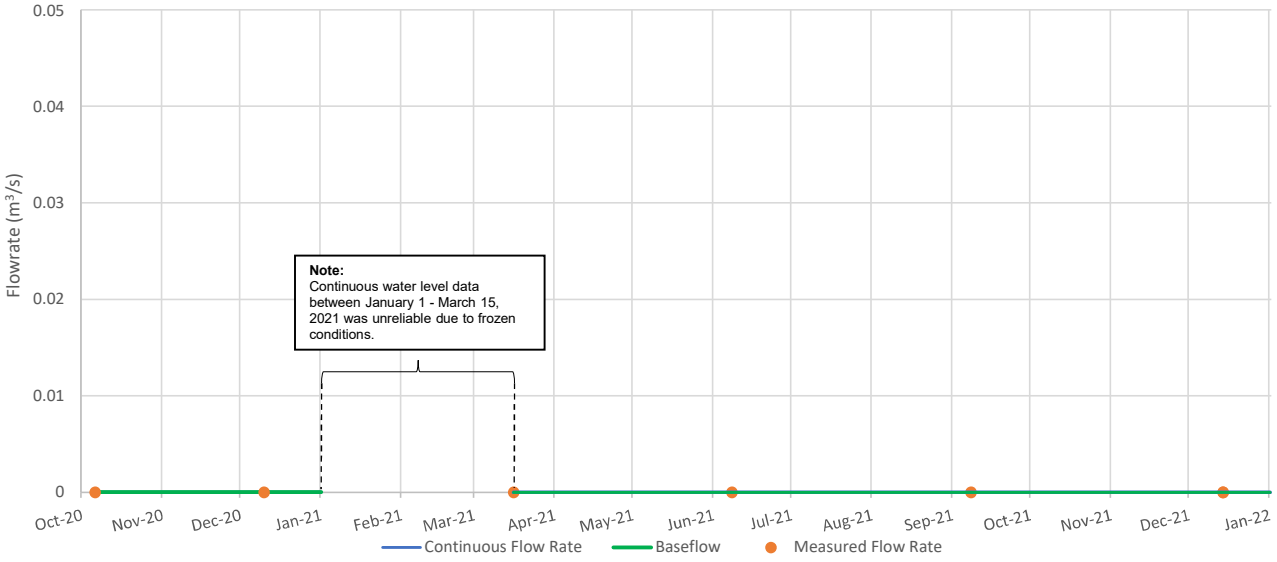
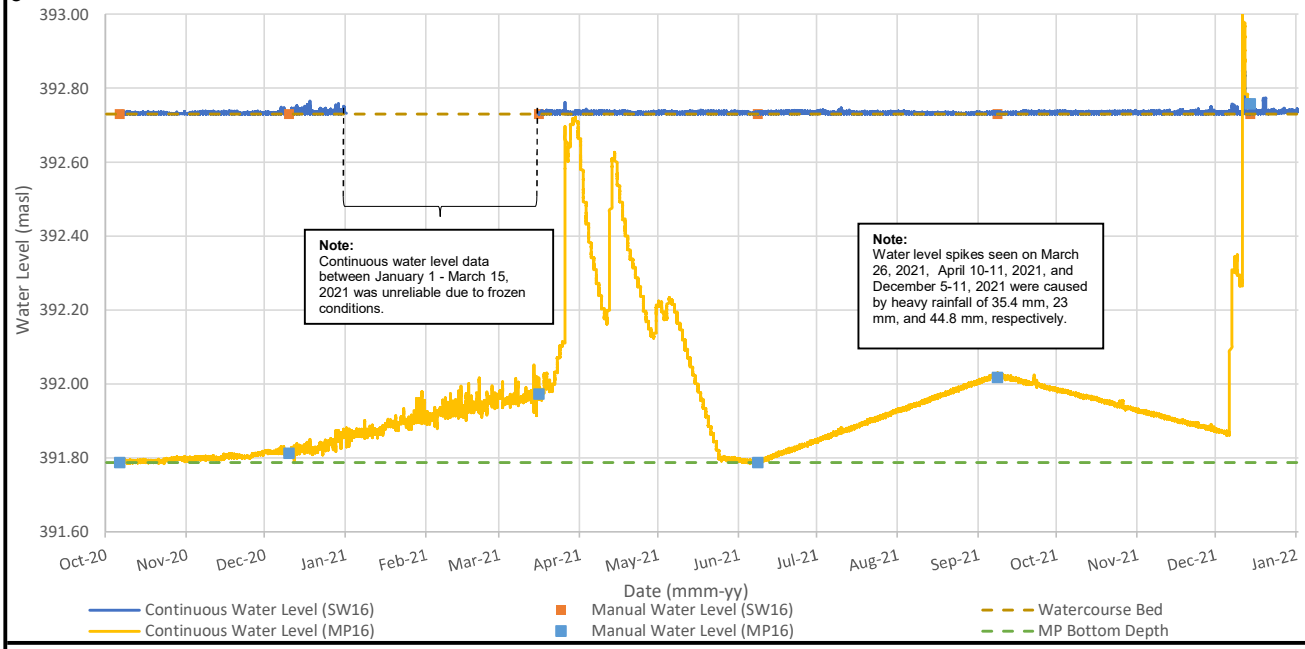


C



A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Flow Rate** **C. Water Level**

PROJECT: 19129150
DATE: December 2022

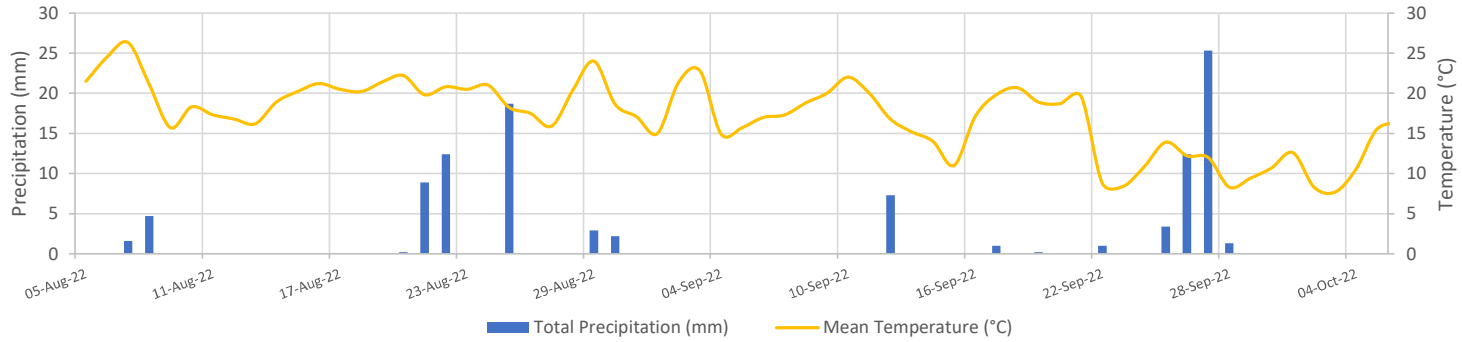
GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels at SW17/MP17 Adjacent to VCNA Caledon Quarry in the Northwest Wetland (2022)

FIGURE L17

A



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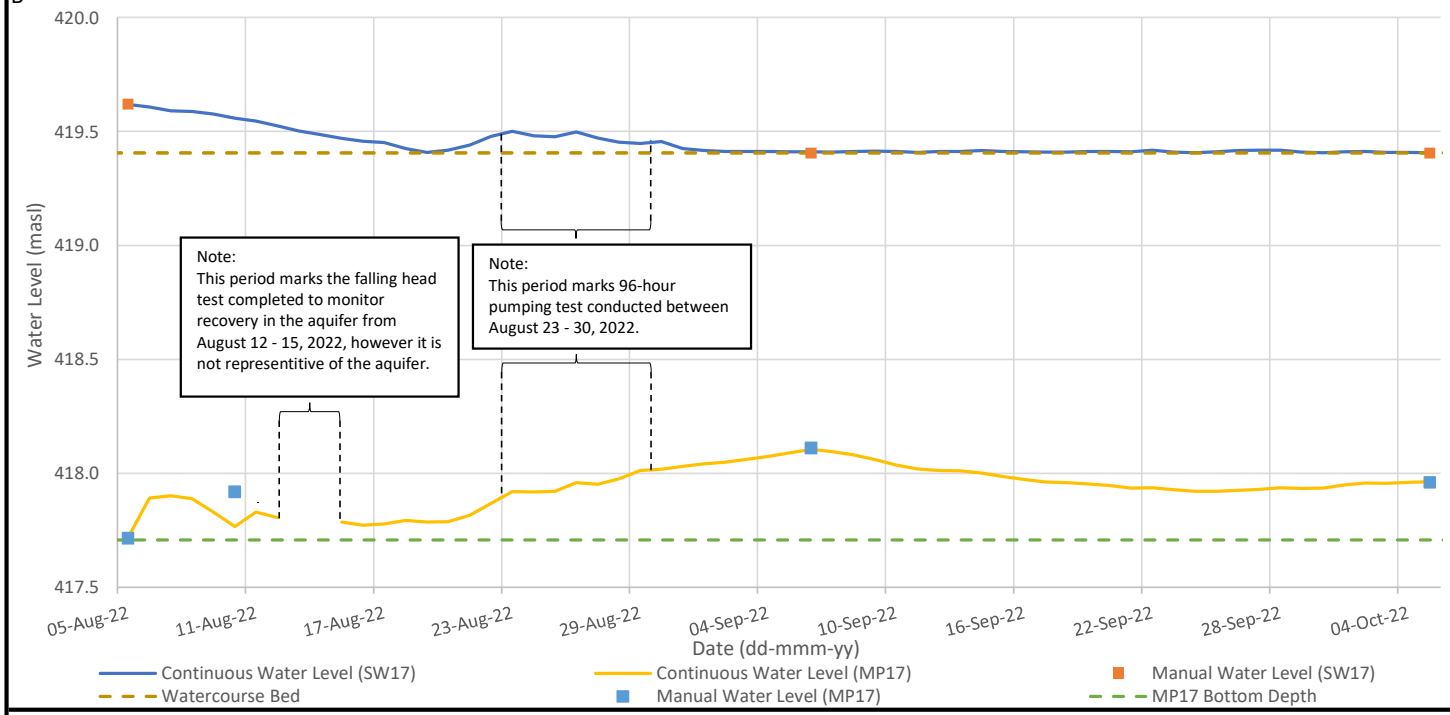


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Water Level**

PROJECT: 19129150

DATE: December 2022

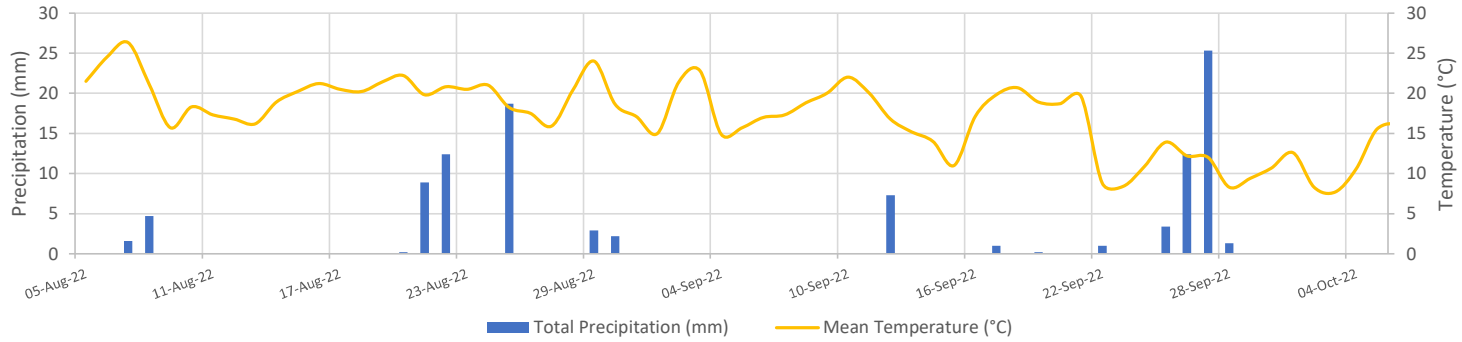
GOLDER
MEMBER OF WSP

DRAWN: MR

CHECK: CDV

Water Levels at SW18/MP18 Adjacent to VCNA Caledon Quarry in the Northwest Wetland (2022) | FIGURE L18

A



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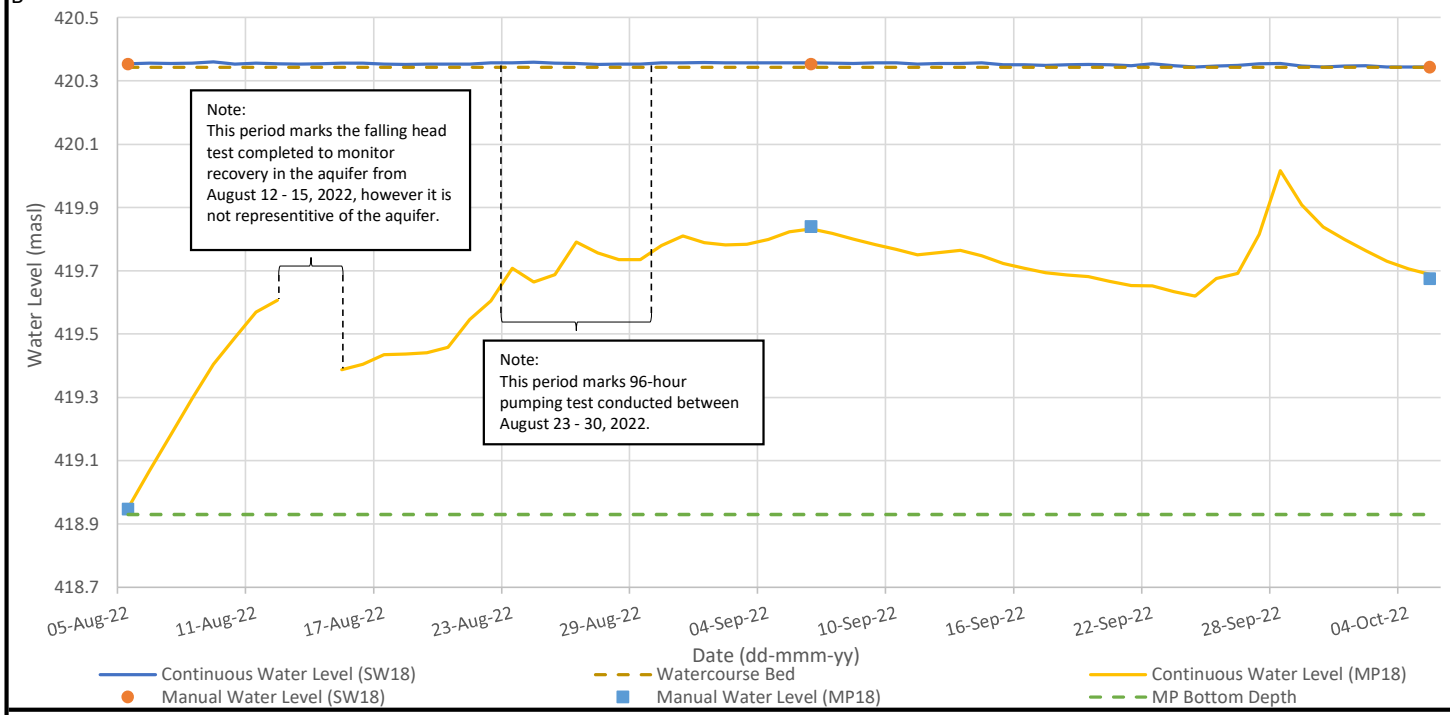


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Water Level**

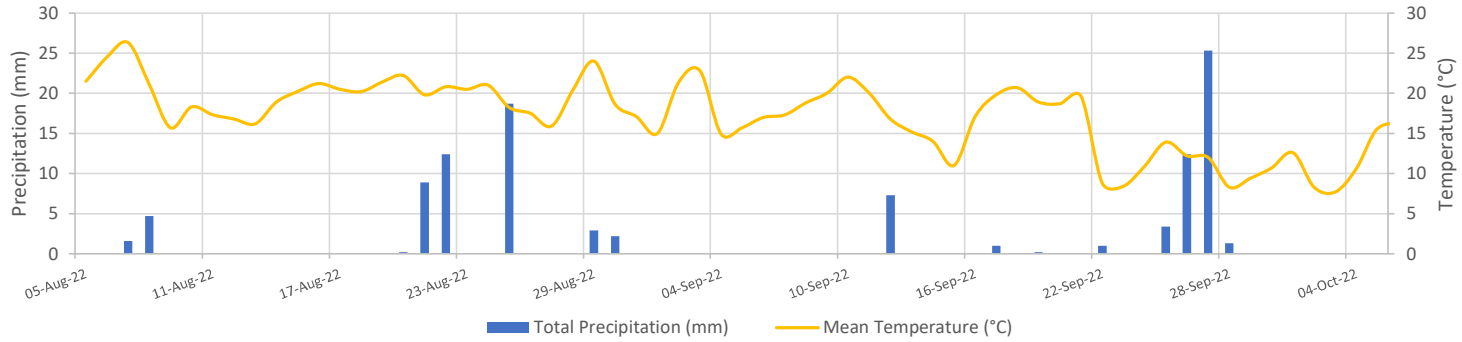
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels at SW19/MP19 Adjacent to VCNA Caledon Quarry in the Northwest Wetland (2022) | FIGURE L19

A



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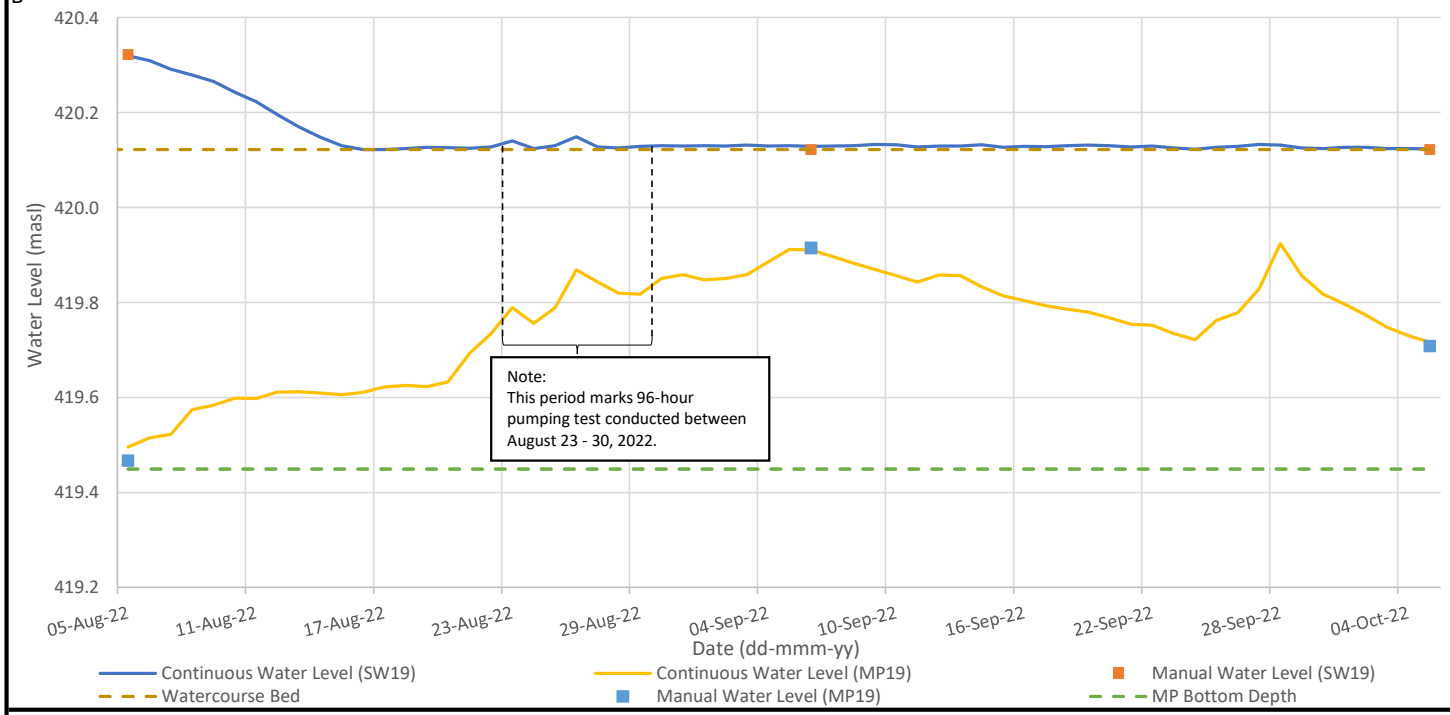


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Water Level**

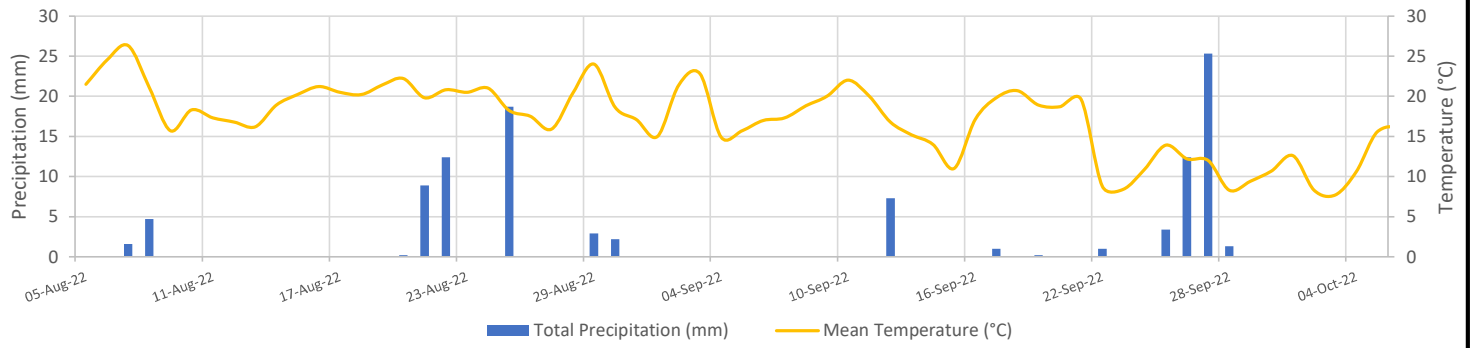
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Levels at SW20/MP20 Adjacent to VCNA Caledon Quarry in the Northwest Wetland (2022)	FIGURE L20

A



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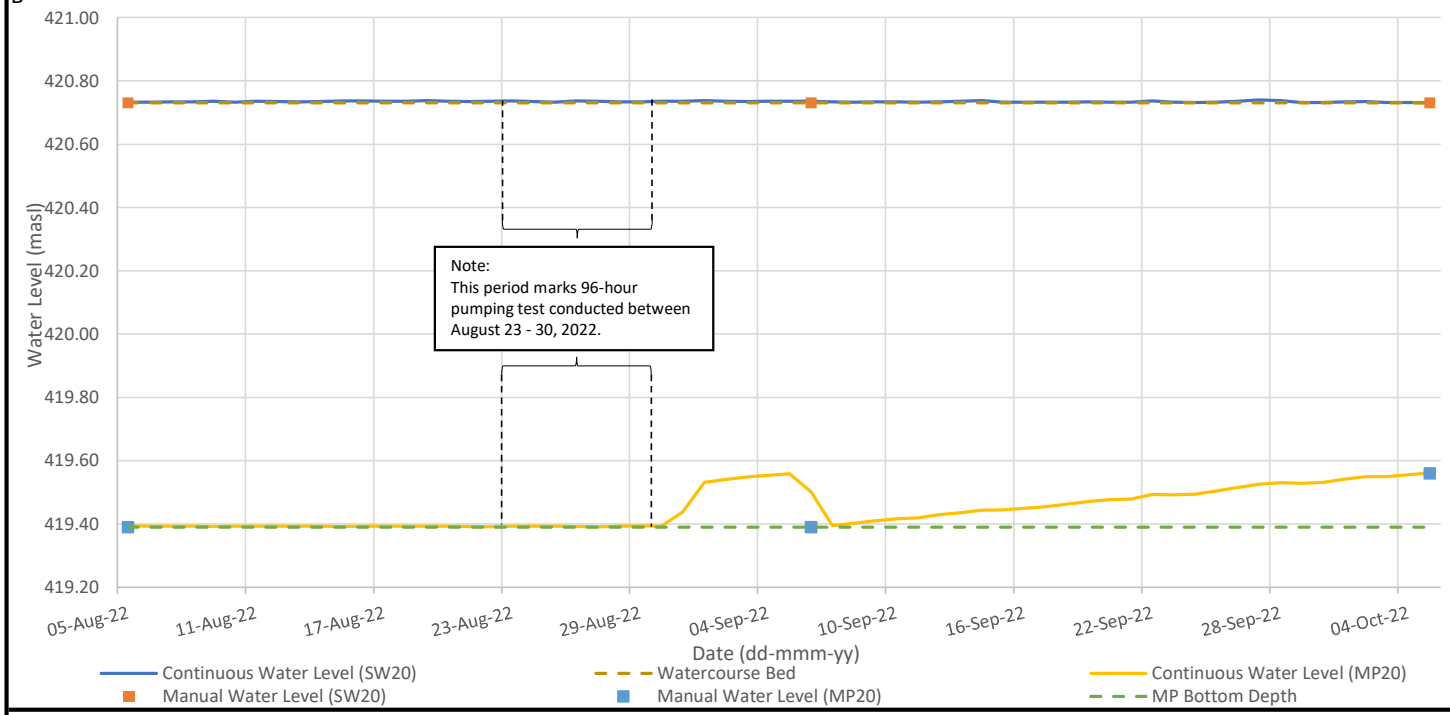


A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Water Level**

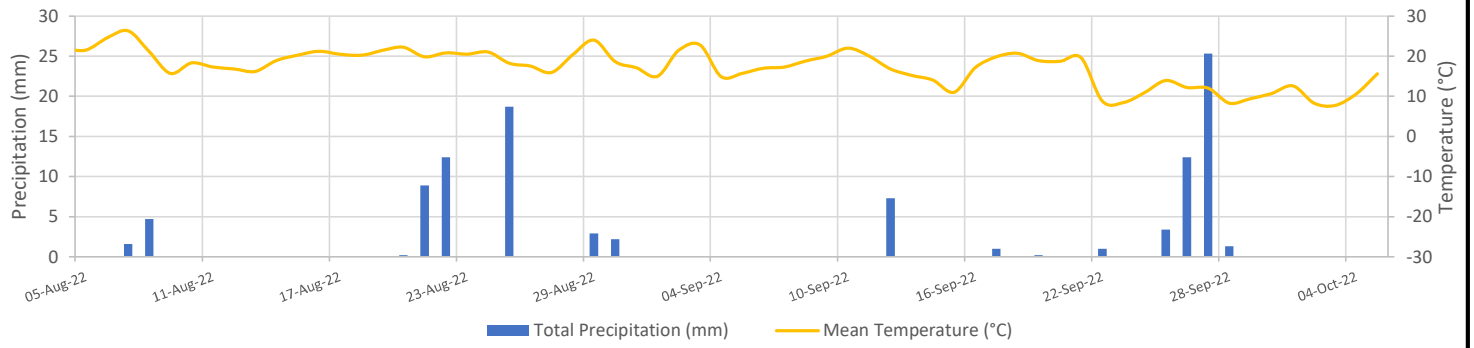
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

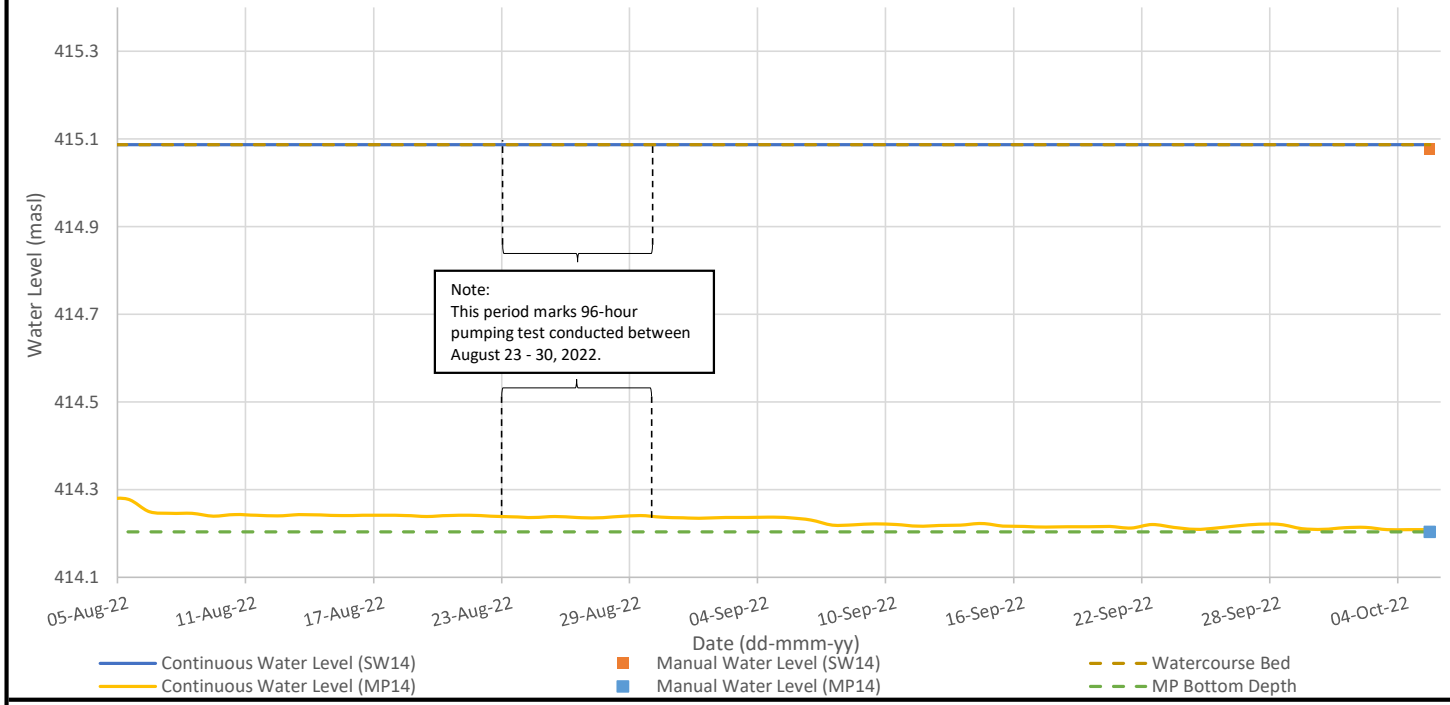
DRAWN: MR
CHECK: CDV

Water Levels at SW14/MP14 Adjacent to VCNA Caledon Quarry in the Northwest Wetland (2022) | FIGURE L21

A



B



A. Total Daily Precipitation and Mean Daily Temperature (Mono Centre, ON, EC Climate ID#6157000) **B. Water Level**

PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

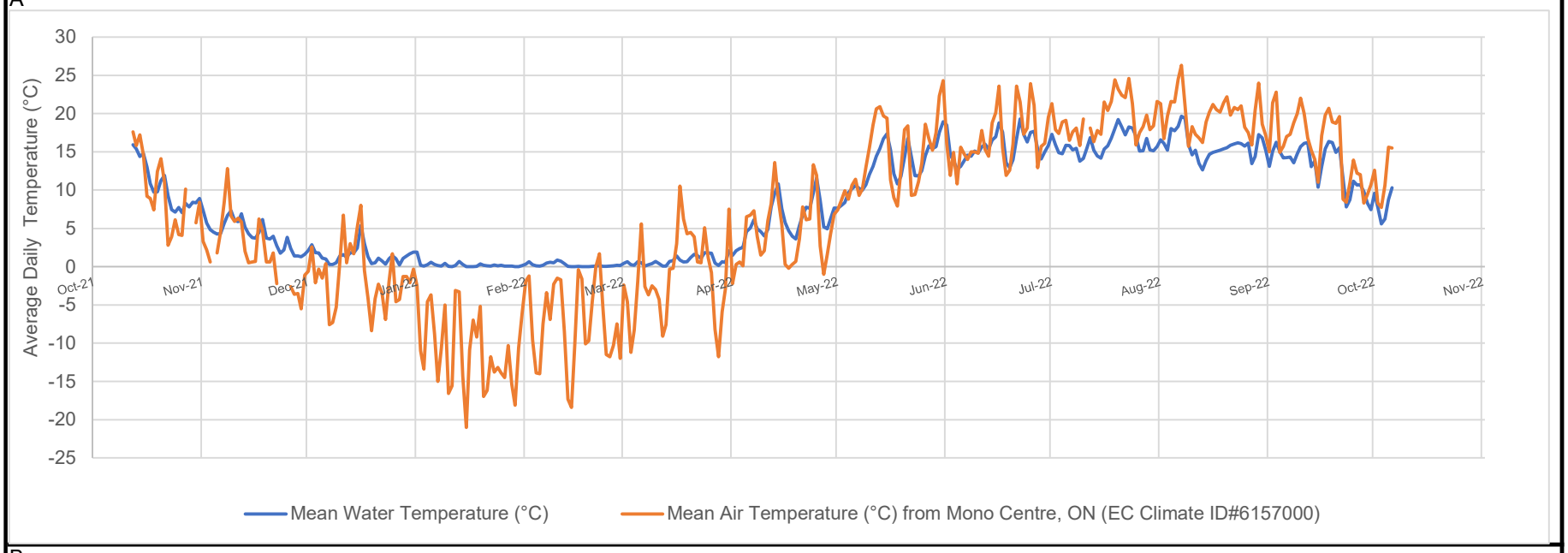
DRAWN: MR
CHECK: CDV

APPENDIX M

Surface Water Temperature

Water Temperatures at Surface Water Stations SW1 - SW4 Adjacent to VCNA License Caledon Quarry (2021 - 2022)	FIGURE M1

A



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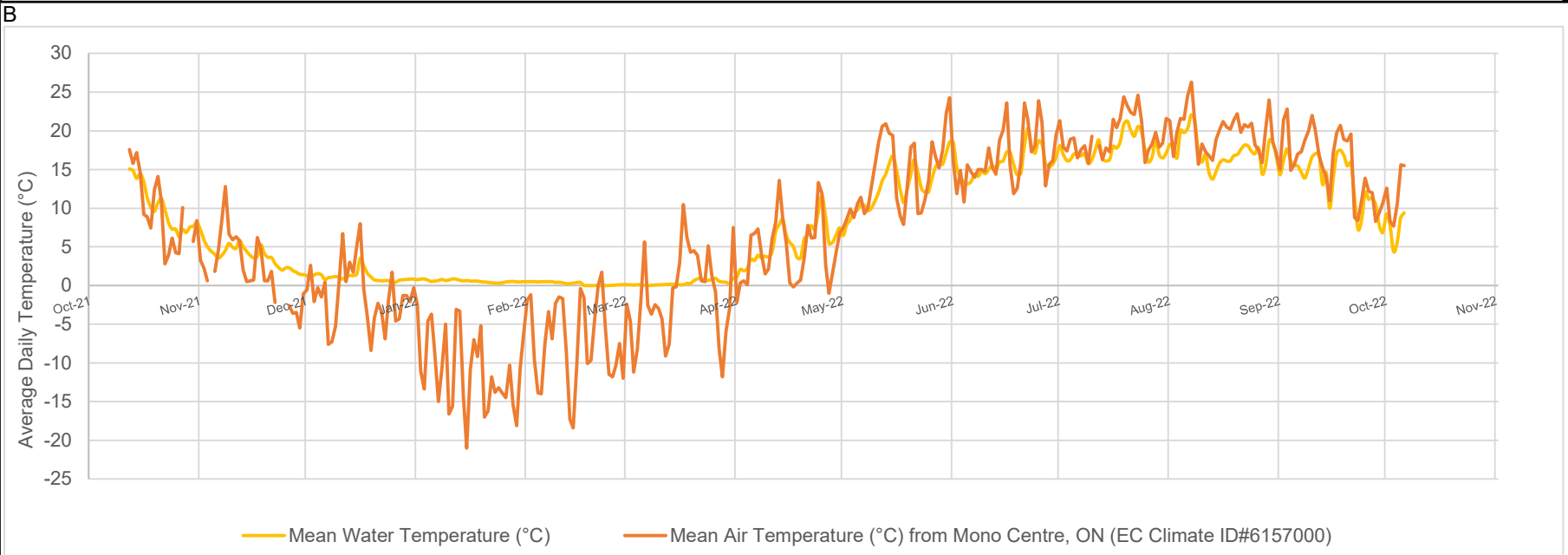

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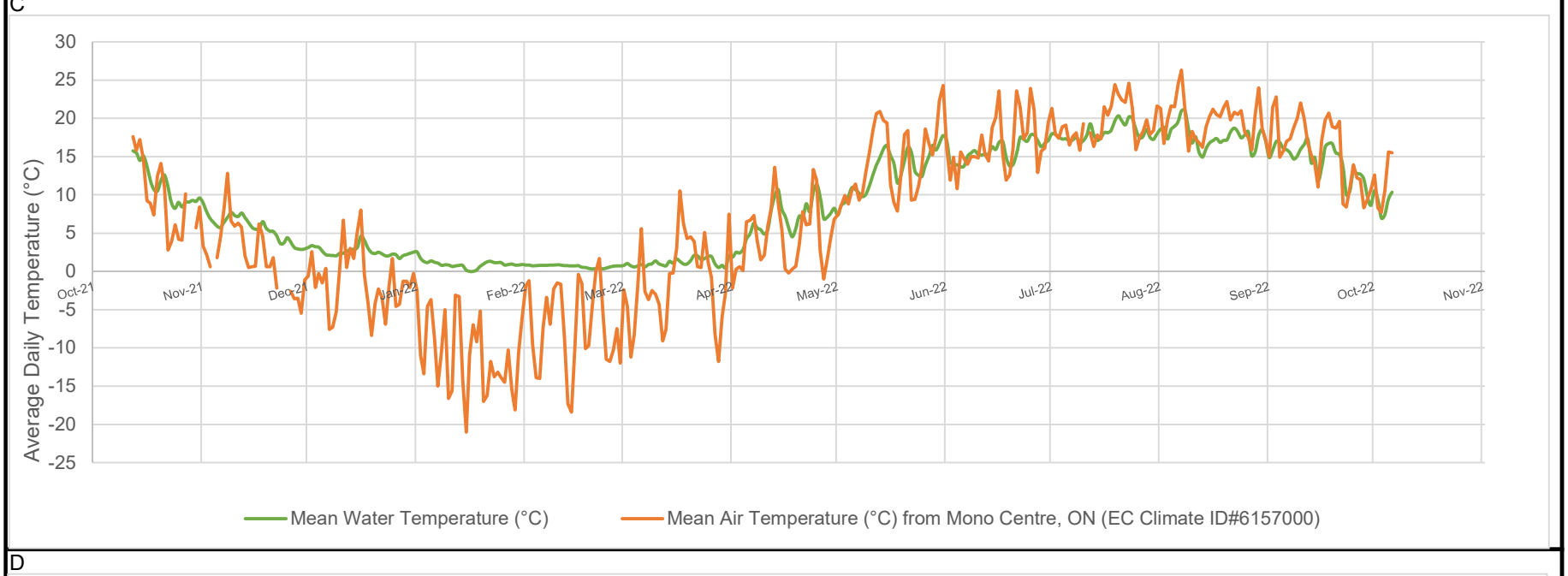

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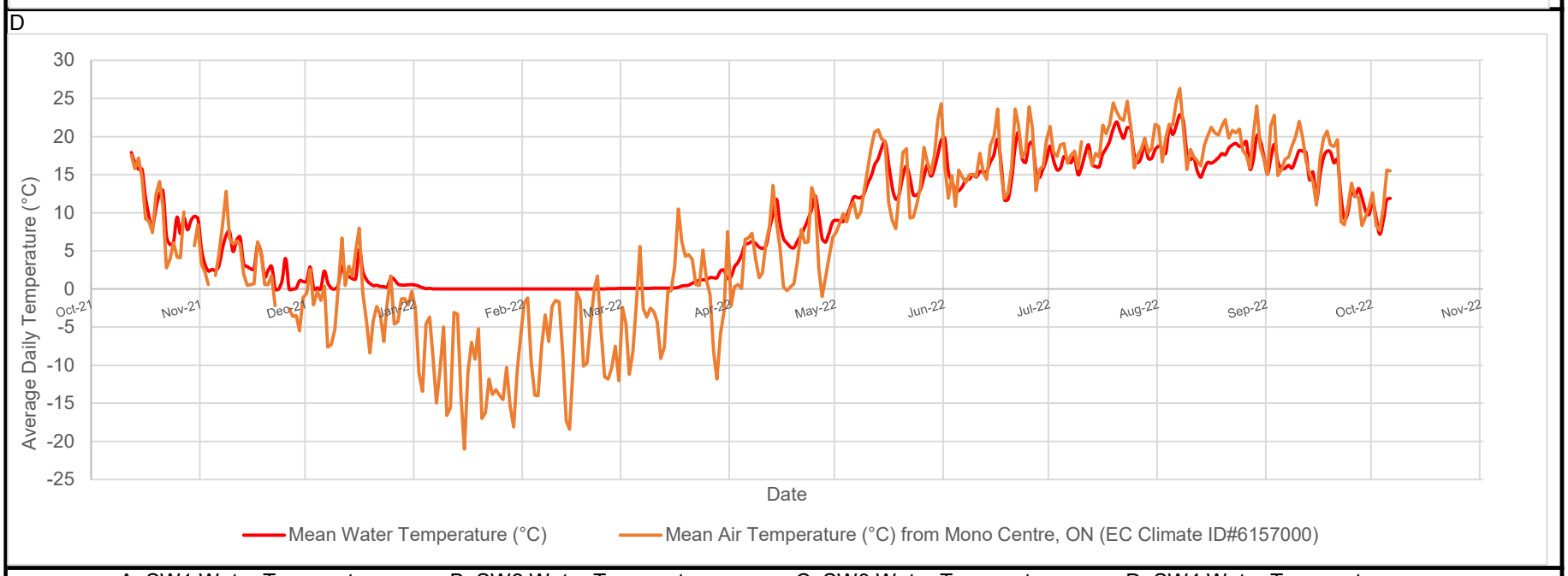


A. SW1 Water Temperature	B. SW2 Water Temperature	C. SW3 Water Temperature	D. SW4 Water Temperature

PROJECT: 19129150
DATE: December 2022

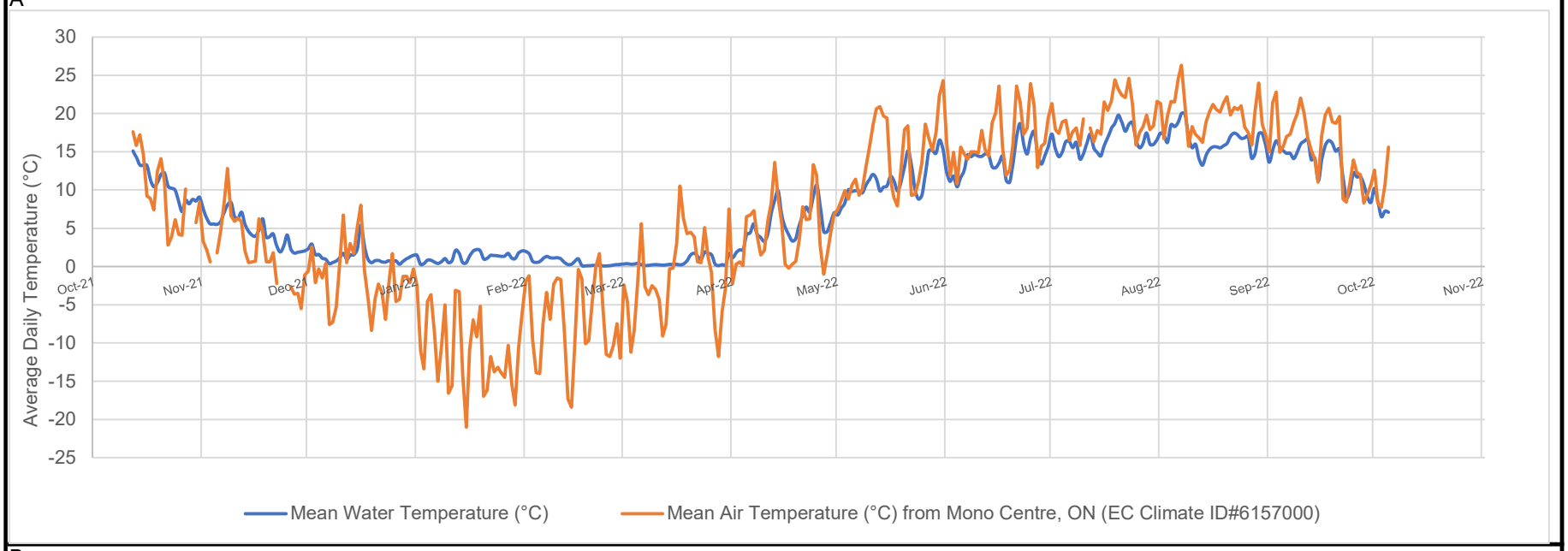
GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

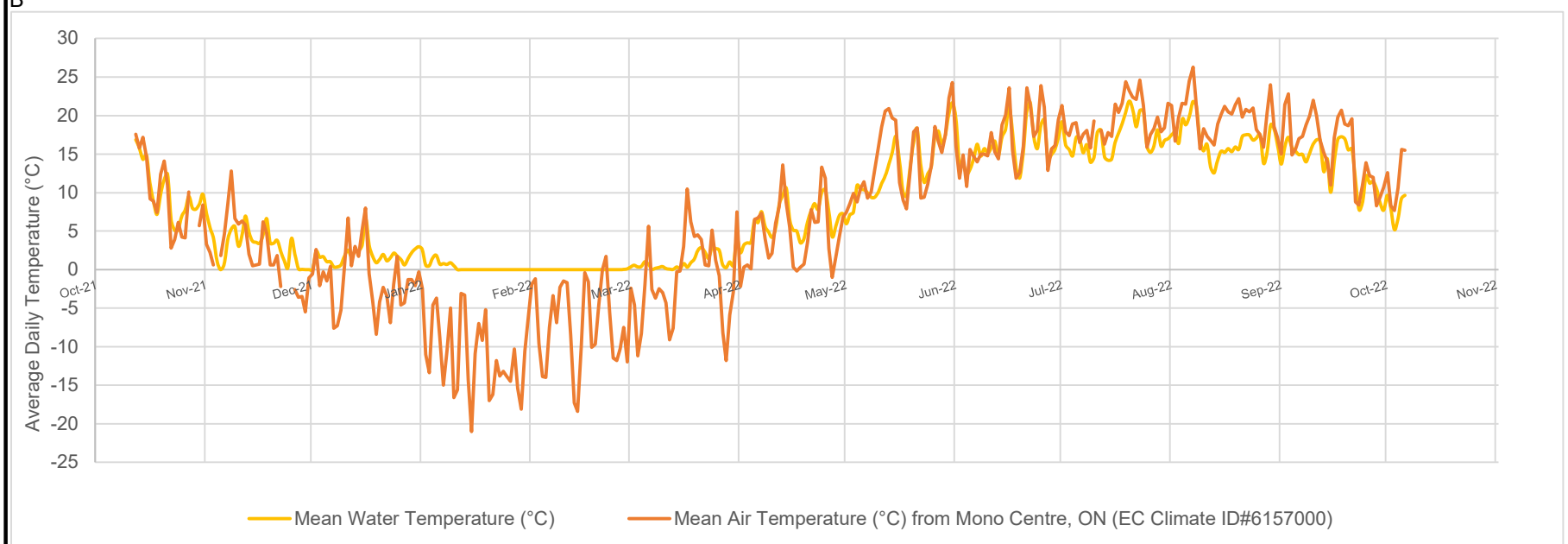
Water Temperatures at Surface Water Stations SW5 - SW8 Adjacent to VCNA License Caledon Quarry (2021 - 2022)

FIGURE M2

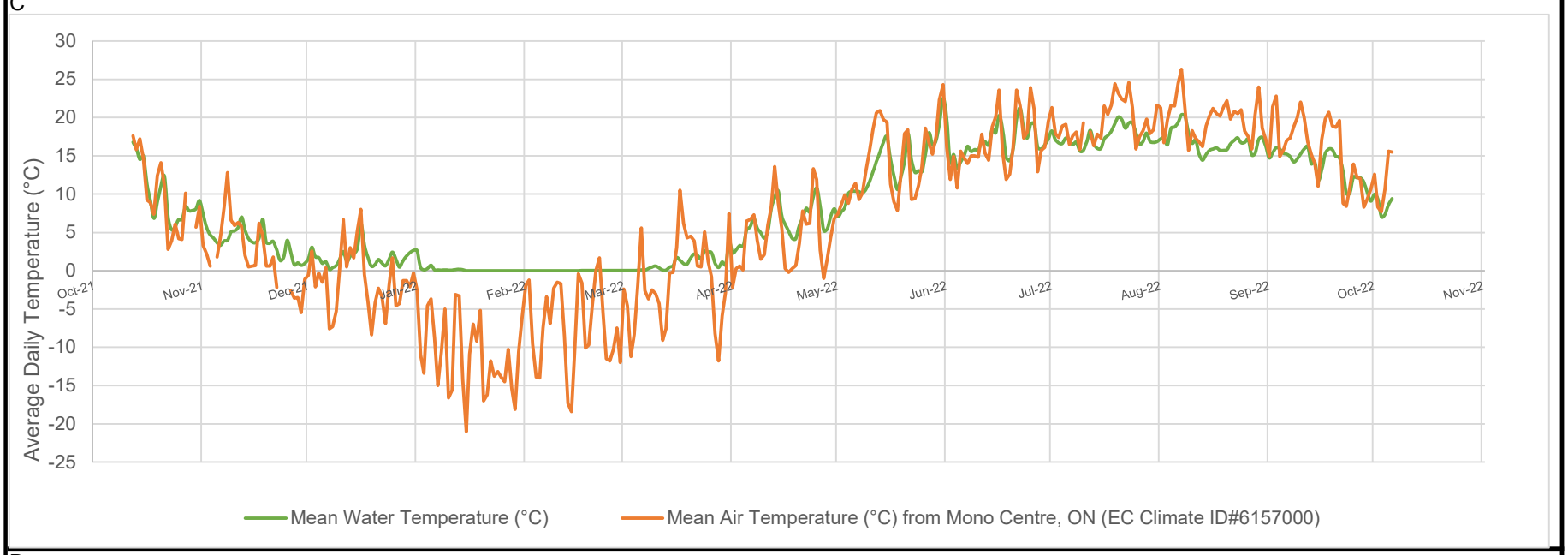
A



B



C



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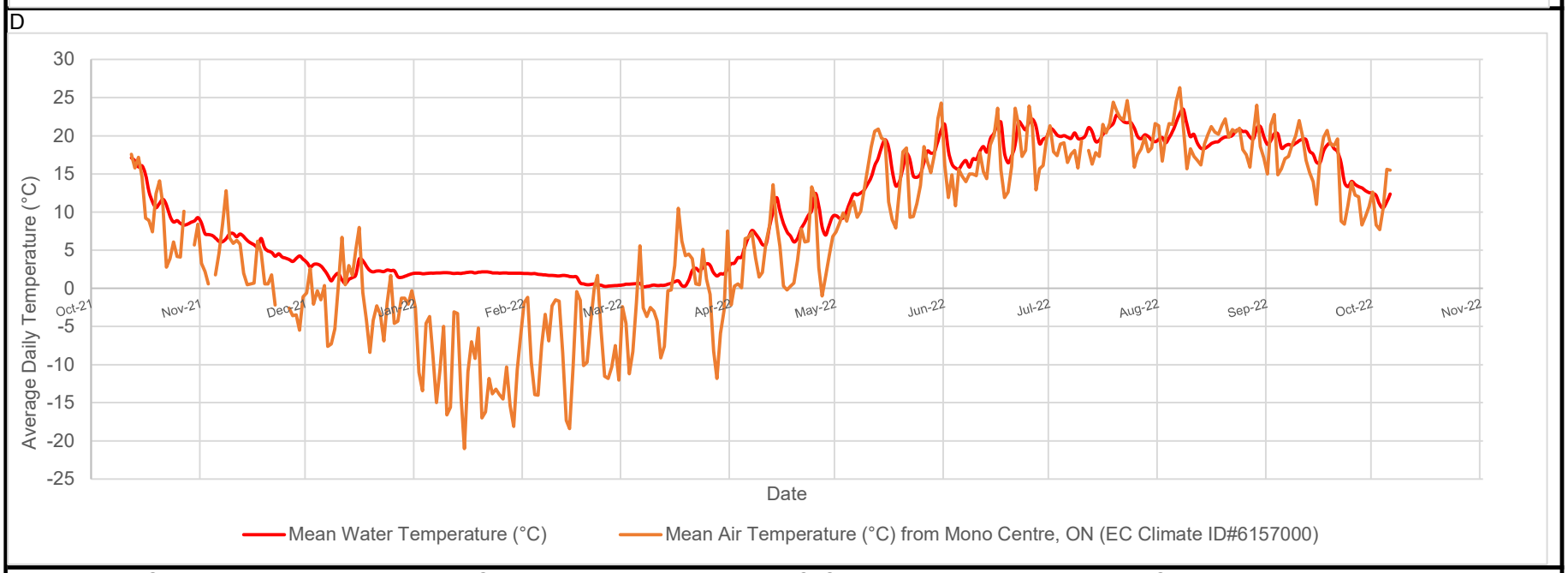


A. SW5 Water Temperature B. SW6 Water Temperature C. SW7 Water Temperature D. SW8 Water Temperature

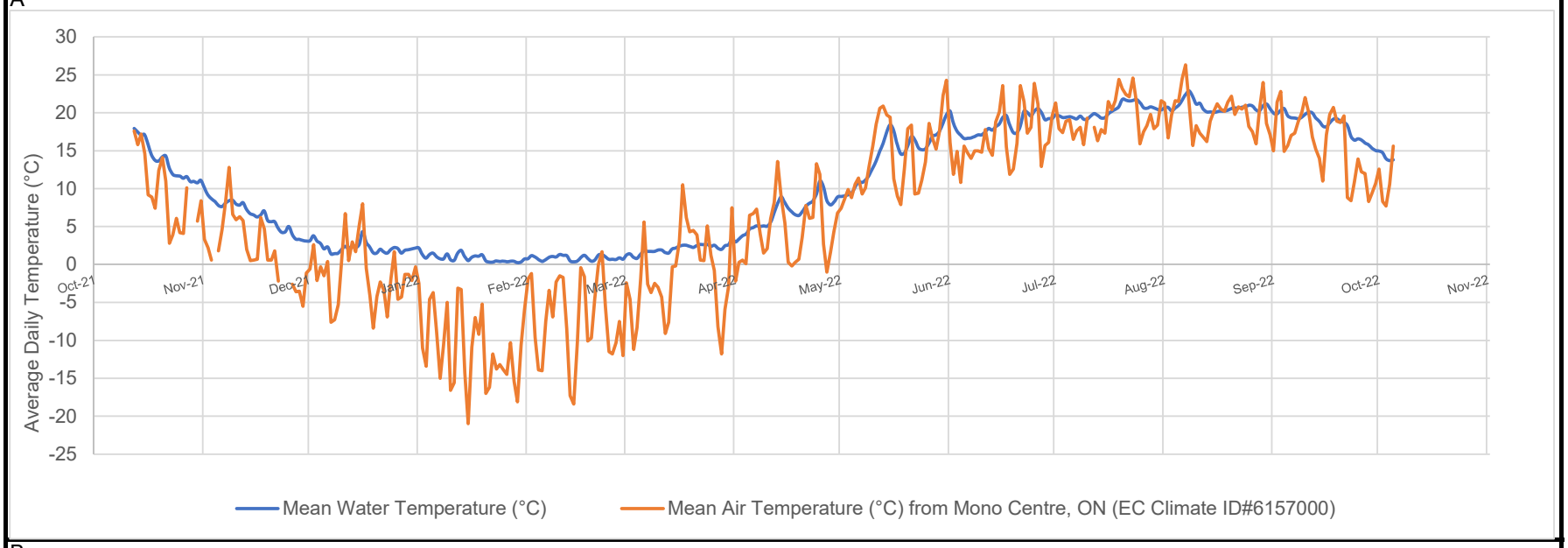
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

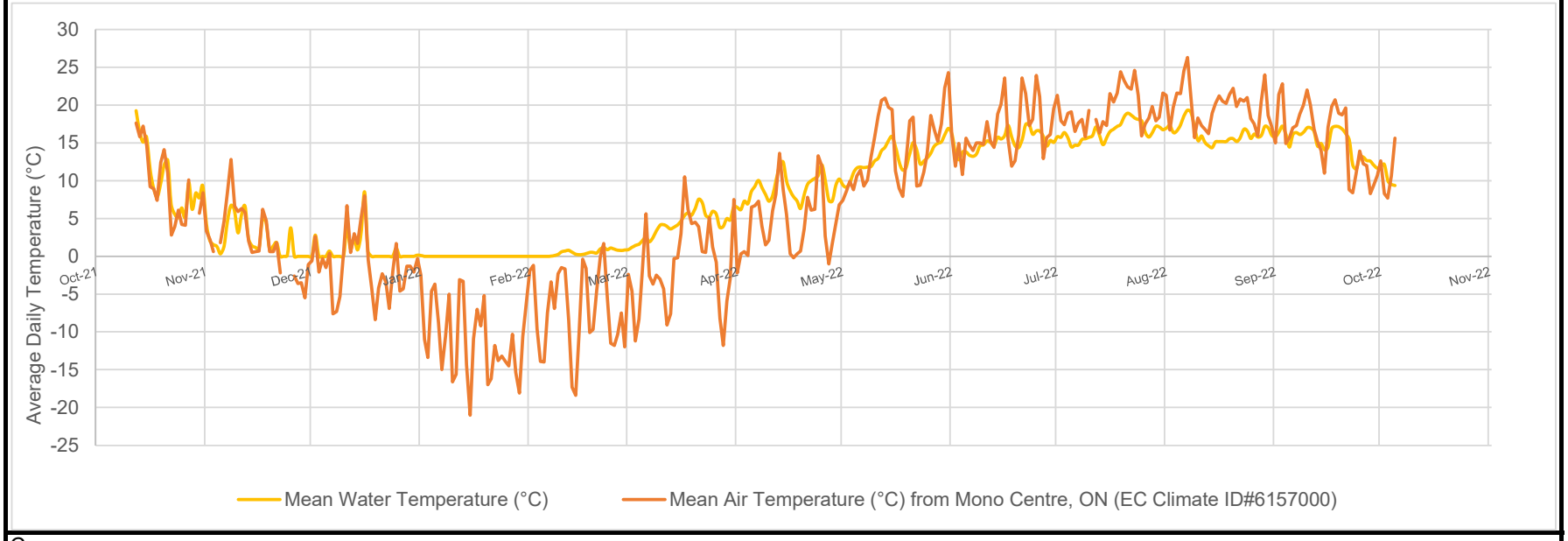
DRAWN: MR
CHECK: CDV

Water Temperatures at Surface Water Stations SW9 - SW12 Adjacent to VCNA License Caledon Quarry (2021 - 2022)	FIGURE M3

A



B



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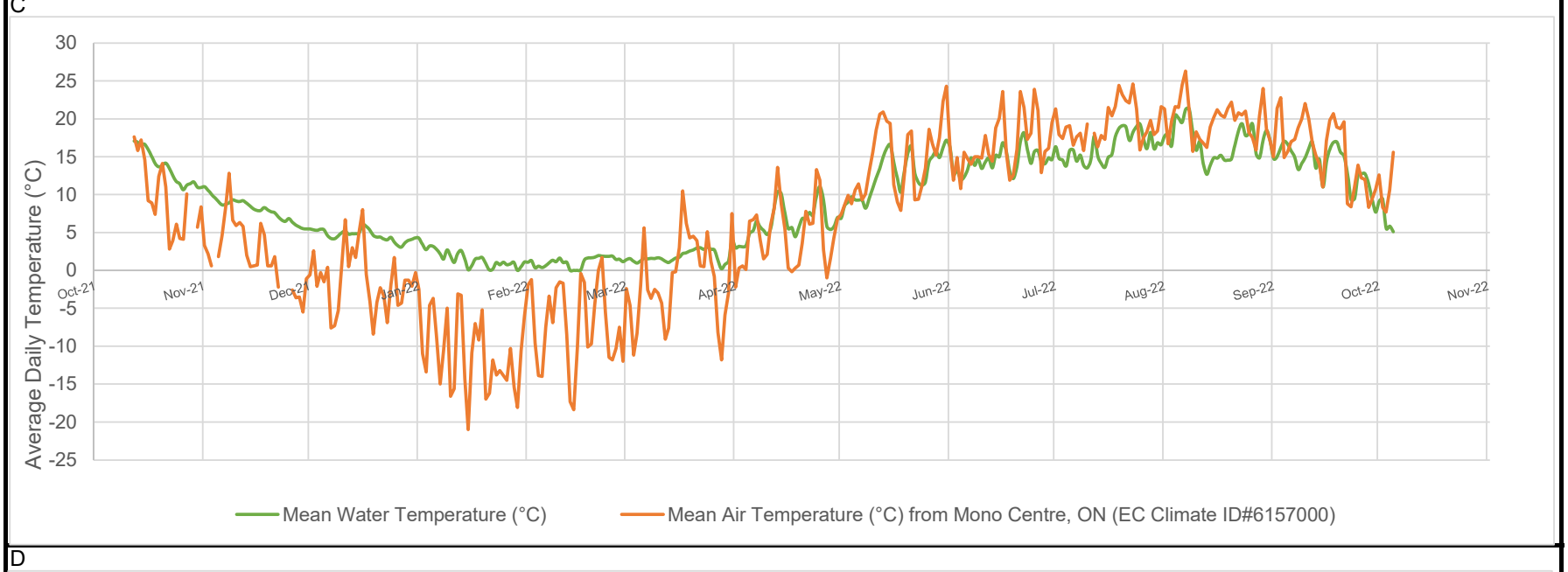

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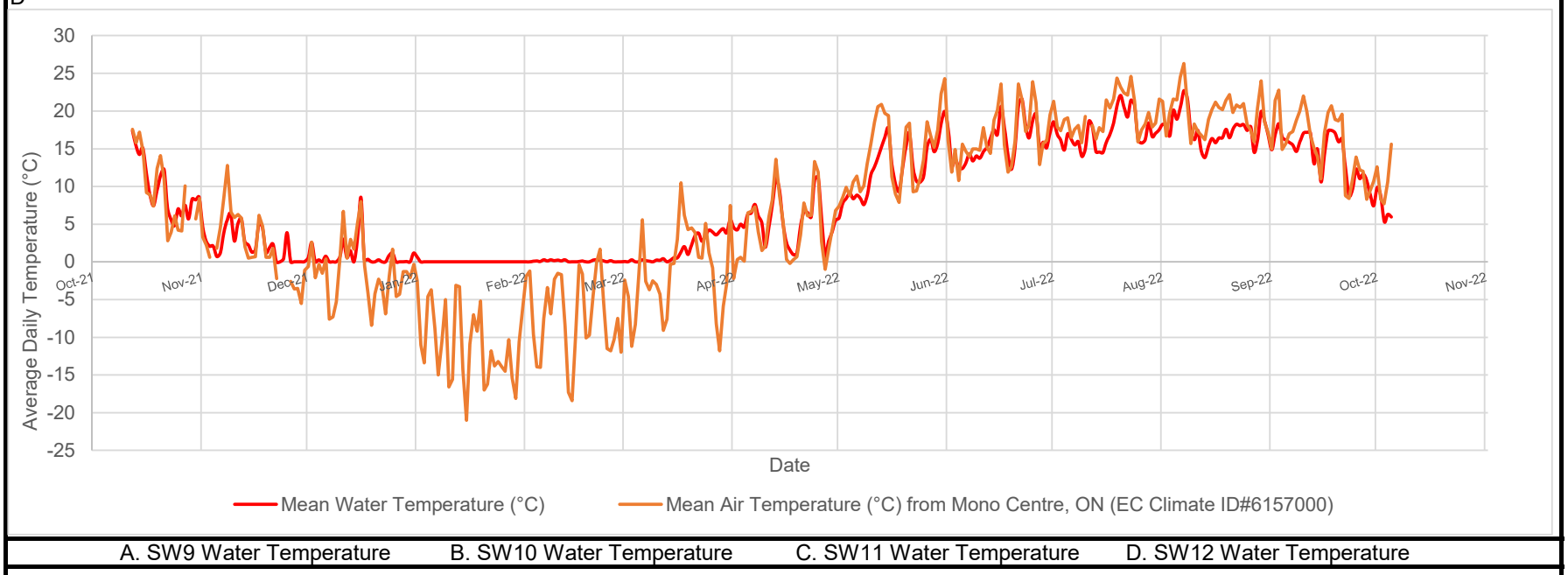


A. SW9 Water Temperature	B. SW10 Water Temperature	C. SW11 Water Temperature	D. SW12 Water Temperature

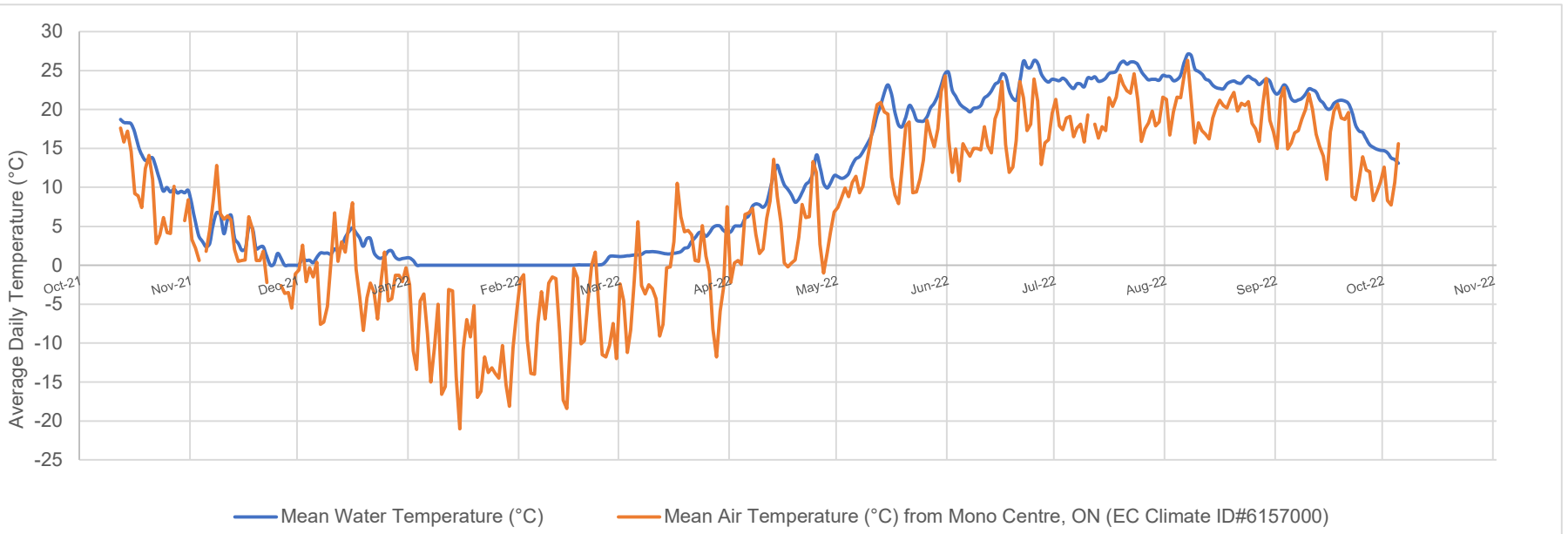
PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

Water Temperatures at Surface Water Stations SW13 - SW16 Adjacent to VCNA License Caledon Quarry (2021 - 2022)	FIGURE M4

A



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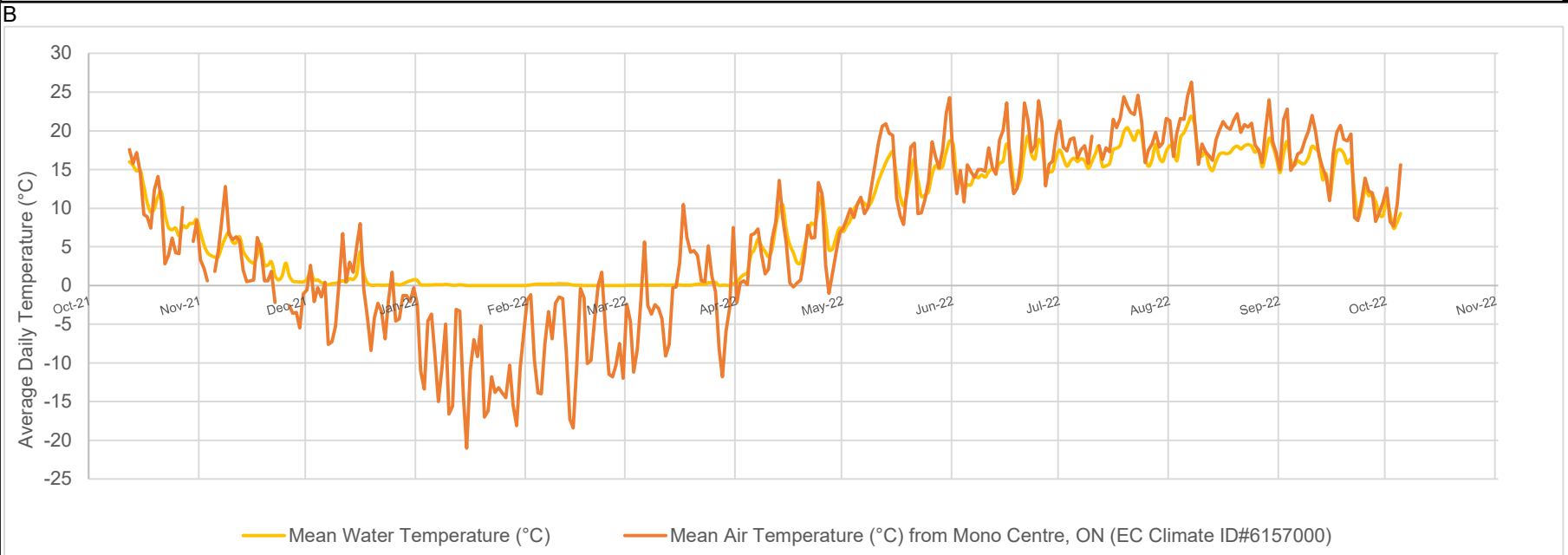
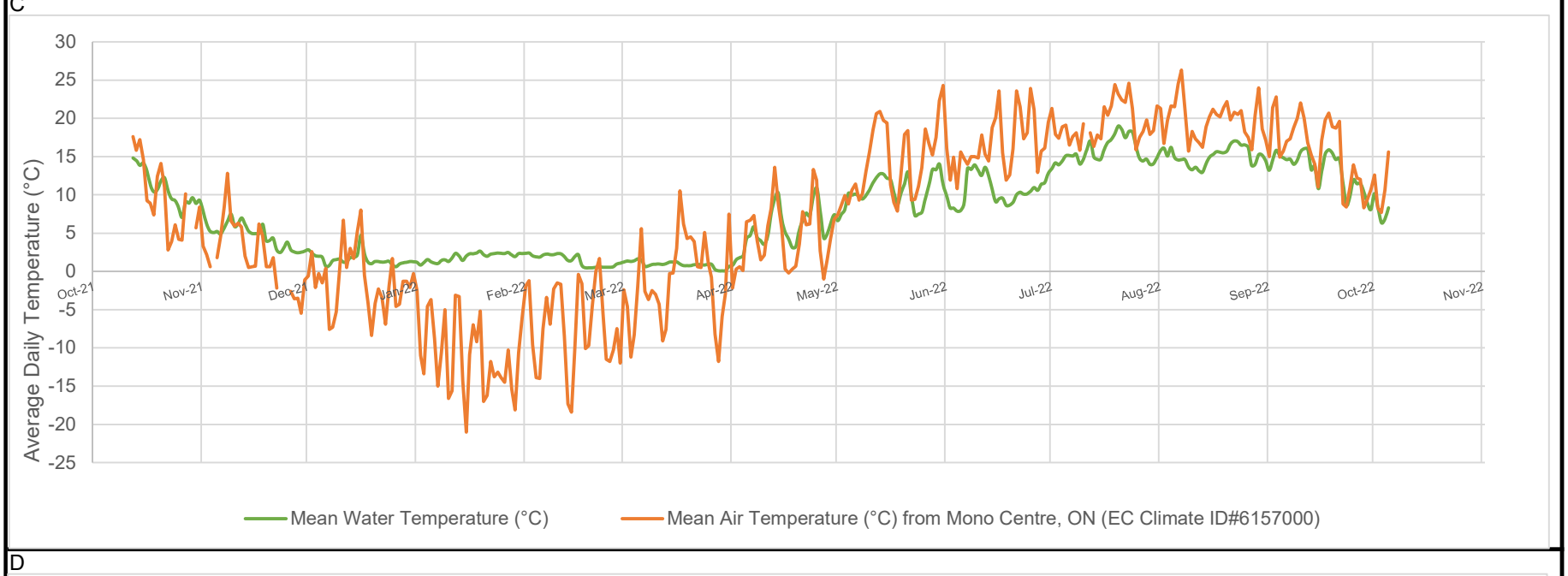
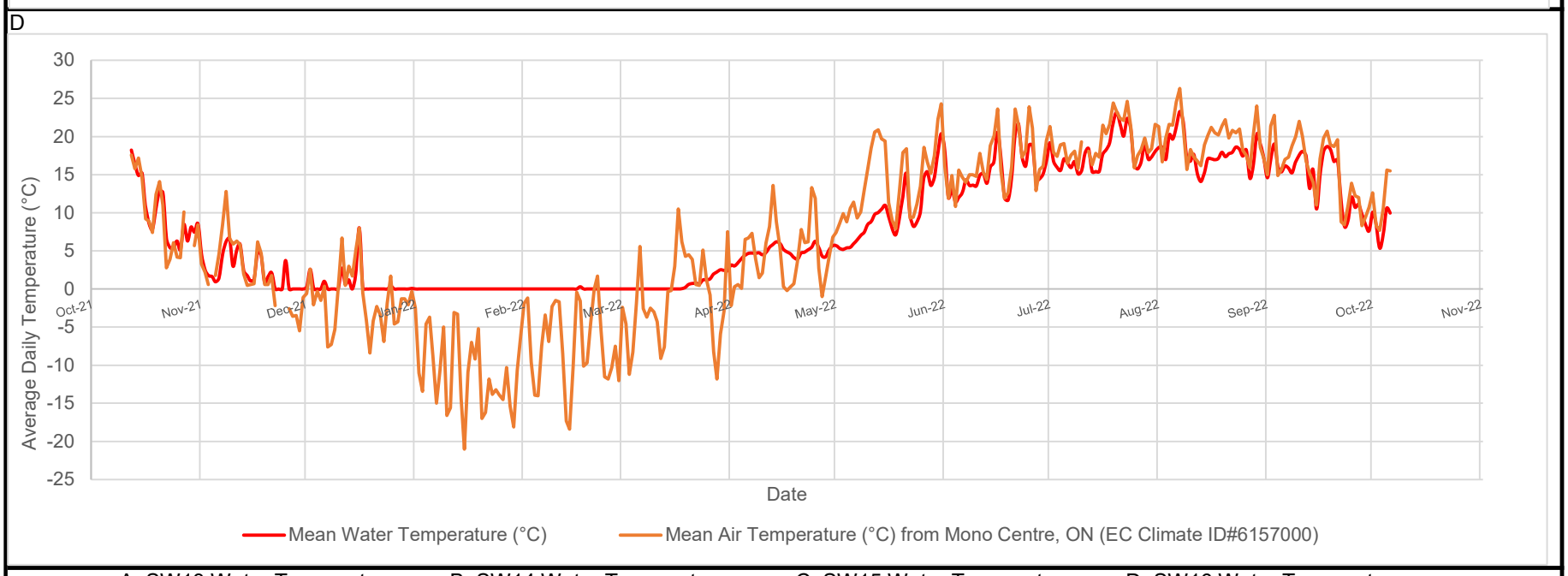


C



D



A. SW13 Water Temperature B. SW14 Water Temperature C. SW15 Water Temperature D. SW16 Water Temperature

PROJECT: 19129150
DATE: December 2022

GOLDER
MEMBER OF WSP

DRAWN: MR
CHECK: CDV

APPENDIX N

Surface Water Quality

Table N-1

CBM Caledon Quarry Water Quality Results

Sampling Date			June 8, 2021					September 8, 2021				December 14, 2021				March 24, 2022				
Calculated Parameters	**UNITS**	**PWQO**	**SW8**	**SW9**	**SW10**	**SW11**	**SW13**	**SW8**	**SW9**	**SW11**	**SW13**	**SW8**	**SW9**	**SW11**	**SW13**	**SW8**	**SW9**	**SW10**	**SW11**	**SW13**
Hardness (CaCO3)	mg/L	-	250.00	260.00	250.00	170.00	150.00	190.00	250.00	130.00	220.00	240	270	230	170	220	230	280	230	210
Field Measurements																				
Field Temperature	Celsius	-	25.2	23.6	26.9	22.6	25.1	18.6	21.8	20.5	15.1	1.2	1.9	2.4	1.5	4.3	2.6	5.2	3.0	3.0
Field Measured pH	-	6.5 - 8.5	7.8	8.4	8.1	7.5	8.3	8.1	8.7	8.3	8.3	7.9	8.7	8.4	8.7	8.0	7.8	7.9	7.9	7.8
Field Measured Conductivity	uS/cm	-	812	615	595	407	411	1817	606	305	759	547	615	494	424	627	507	626	465	450
Field Measured Dissolved Oxygen	mg/L	-	7.31	8.33	9.85	4.21	9.62	8.00	8.52	6.25	6.95	10.63	12.30	11.81	14.41	10.12	9.47	10.80	11.06	11.58
Field Measured Turbidity	NTU	-	2.3	6.0	1.2	1.5	1.2	11.1	25.5	7.6	17.3	1.2	3.7	3.4	4.5	0.0	0.8	0.0	5.5	0.3
Inorganics																				
Total Ammonia-N	mg/L	-	<0.050	0.06	<0.050	0.21	<0.050	0.07	<0.050	<0.050	<0.050	<0.050	0.39	0.35	0.13	<0.050	0.099	<0.050	1.2	0.087
Total Phosphorus	mg/L	0.03	0.081	0.028	0.027	0.180	0.027	0.064	0.020	0.120	0.025	0.024	0.016	0.220	0.007	0.014	0.020	0.008	0.37	0.009
Alkalinity (Total as CaCO3)	mg/L	-	240.00	230.00	180.00	160.00	140.00	170.00	210.00	120.00	180.00	200	230	220	150	200	200	240	210	190
Dissolved Chloride (Cl-)	mg/L	-	130.00	44.00	45.00	23.00	39.00	420.00	44.00	21.00	110.00	29	40	19	34	36	30	42	37	31
Nitrite (N)	mg/L	-	<0.010	0.01	<0.010	0.02	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	0.022	0.021	<0.010	<0.010	<0.010	<0.010	0.059	<0.010
Nitrate (N)	mg/L	-	<0.10	0.72	<0.10	<0.10	<0.10	<0.10	0.50	<0.10	0.63	1.7	0.63	0.36	0.10	1.26	1.00	1.08	1.14	0.26
Nitrate + Nitrite (N)	mg/L	-	<0.10	0.74	<0.10	<0.10	<0.10	<0.10	0.50	<0.10	0.63	1.71	0.66	0.38	0.10	1.26	1.00	1.08	1.20	0.26
Total Kjeldahl Nitrogen (TKN)	mg/L	-	0.54	0.17	0.46	0.88	0.43	0.50	0.27	0.55	0.24	0.37	0.58	1	0.48	0.20	0.30	0.12	1.6	0.27
Total Suspended Solids	mg/L	-	4.00	13.00	2.00	7.00	4.00	13.00	9.00	14.00	11.00	1	7	8	4	<1	18	<1	5	2
Petroleum Hydrocarbons																				
Total Oil & Grease	mg/L	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.60	0.80	0.70	0.70
Total Metals																				
Aluminum (Al)	ug/L	-	12	21	7	31	7	180	20	32	30	17	24	30	4.9	23	13	7.0	27	18
Antimony (Sb)	ug/L	20	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic (As)	ug/L	100	<1.0	<1.0	<1.0	1	<1.0	<1.0	<1.0	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Barium (Ba)	ug/L	-	16	140	76	19	27	46	130	12	47	16	130	19	28	16	97	63	19	28
Beryllium (Be)	ug/L	11	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Bismuth (Bi)	ug/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Boron (B)	ug/L	200	12	27	24	25	10	12	29	22	32	<10	24	16	<10	<10	16	<10	10	<10
Cadmium (Cd)	ug/L	0.2	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Calcium (Ca)	ug/L	-	68000	72000	74000	42000	37000	56000	63000	25000	62000	60000	69000	66000	43000	62000	59000	77000	66000	58000
Chromium (Cr)	ug/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cobalt (Co)	ug/L	0.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Copper (Cu)	ug/L	5	<0.90	<0.90	<0.90	<0.90	2	3	<0.90	<0.90	1	<0.90	<0.90	1.1	<0.90	<0.90	<0.90	1.8	1.4	<0.90
Iron (Fe)	ug/L	300	1200	<100	<100	730	210	610	<100	170	<100	<100	<100	280	110	<100	<100	<100	290	130
Lead (Pb)	ug/L	5	<0.50	<0.50	<0.50	<0.50	<0.50	1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Lithium (Li)	ug/L	-	<5.0	8	<5.0	<5.0	<5.0	<5.0	9	<5.0	<5.0	<5.0	6.6	<5.0	<5.0	<5.0	5.3	<5.0	<5.0	<5.0
Magnesium (Mg)	ug/L	-	22000	24000	17000	17000	17000	13000	24000	16000	17000	16000	22000	15000	12000	16000	16000	16000	13000	12000
Manganese (Mn)	ug/L	-	110	13	20	420	31	130	8	23	58	3.4	13	65	11	4.6	13	3.9	130	41
Molybdenum (Mo)	ug/L	40	<0.50	<0.50	<0.50	<0.50	<0.50	1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.59	<0.50	<0.50	<0.50
Nickel (Ni)	ug/L	25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)	ug/L	-	690	1500	770	9000	1400	1200	1600	9000	2700	2600	1400	12000	1400	1800	1100	1200	6400	1200
Selenium (Se)	ug/L	100	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Silicon (Si)	ug/L	-	2100	3400	7700	890	680	2500	3500	640	2900	3700	5500	1800	2800	2000	3800	3300	2500	2100
Silver (Ag)	ug/L	0.1	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
Sodium (Na)	ug/L	-	73000	24000	22000	7800	23000	280000	25000	6100	60000	12000	20000	4700	18000	18000	16000	24000	17000	16000
Strontium (Sr)	ug/L	-	180	240	140	94	120	180	240	81	140	110	230	120	110	110	180	130	100	100
Tellurium (Te)	ug/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Thallium (Tl)	ug/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	ug/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Titanium (Ti)	ug/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	7	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Tungsten (W)	ug/L	30	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Uranium (U)	ug/L	5	0	1	0	0	0	0.2	0	<0.10	0	0.65	0.38	0.28	0.2	0.54	0.59	0.19	0.26	0.18
Vanadium (V)	ug/L	6	<0.50	<0.50	1	1	<0.50	1	<0.50	1	1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc (Zn)	ug/L	30	<5.0	<5.0	<5.0	<5.0	<5.0	8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.6	<5.0
Zirconium (Zr)	ug/L	4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Note(s):

(1) Shaded (grey) results indicate an exceedance of Ontario Provincial Water Quality Objectives (PWQO).

Entered by: MR
Checked by: CDV

APPENDIX O

Surface Water Lab Certificates

Your Project #: 19129150
Your C.O.C. #: 830687-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/06/15
Report #: R6676766
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F8070
Received: 2021/06/09, 07:59

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	5	N/A	2021/06/11	CAM SOP-00448	SM 23 2320 B m
Chloride by Automated Colourimetry	5	N/A	2021/06/11	CAM SOP-00463	SM 23 4500-Cl E m
Hardness (calculated as CaCO3)	5	N/A	2021/06/14	CAM SOP 00102/00408/00447	SM 2340 B
Total Metals Analysis by ICPMS	5	N/A	2021/06/14	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	5	N/A	2021/06/11	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (1)	3	N/A	2021/06/11	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (1)	2	N/A	2021/06/14	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Total Oil and Grease	5	2021/06/13	2021/06/13	CAM SOP-00326	EPA1664B m,SM5520B m
Total Kjeldahl Nitrogen in Water	5	2021/06/10	2021/06/11	CAM SOP-00938	OMOE E3516 m
Total Phosphorus (Colourimetric)	3	2021/06/10	2021/06/11	CAM SOP-00407	SM 23 4500 P B H m
Total Phosphorus (Colourimetric)	2	2021/06/10	2021/06/14	CAM SOP-00407	SM 23 4500 P B H m
Low Level Total Suspended Solids	2	2021/06/11	2021/06/14	CAM SOP-00428	SM 23 2540D m
Low Level Total Suspended Solids	3	2021/06/12	2021/06/14	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope

Your Project #: 19129150
Your C.O.C. #: 830687-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/06/15
Report #: R6676766
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F8070
Received: 2021/06/09, 07:59

dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1F8070
Report Date: 2021/06/15

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

RESULTS OF ANALYSES OF WATER

BV Labs ID		PUG858		PUG859			PUG859		
Sampling Date		2021/06/08 14:00		2021/06/08 15:00			2021/06/08 15:00		
COC Number		830687-01-01		830687-01-01			830687-01-01		
	UNITS	SW8	QC Batch	SW9	RDL	QC Batch	SW9 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Hardness (CaCO3)	mg/L	250	7398104	260	1.0	7398104			
Inorganics									
Total Ammonia-N	mg/L	<0.050	7400379	0.055	0.050	7401360	<0.050	0.050	7401360
Total Kjeldahl Nitrogen (TKN)	mg/L	0.54	7401057	0.17	0.10	7401057			
Total Phosphorus	mg/L	0.081	7400351	0.028	0.004	7400351			
Total Suspended Solids	mg/L	4	7404824	13	1	7400752			
Alkalinity (Total as CaCO3)	mg/L	240	7401873	230	1.0	7401873			
Dissolved Chloride (Cl-)	mg/L	130	7401927	44	1.0	7401927			
Nitrite (N)	mg/L	<0.010	7401889	0.014	0.010	7401903			
Nitrate (N)	mg/L	<0.10	7401889	0.72	0.10	7401903			
Nitrate + Nitrite (N)	mg/L	<0.10	7401889	0.74	0.10	7401903			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	<0.50	7405212	<0.50	0.50	7405212			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1F8070
Report Date: 2021/06/15

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

RESULTS OF ANALYSES OF WATER

BV Labs ID		PUG860			PUG861			PUG862		
Sampling Date		2021/06/08 15:45			2021/06/08 12:15			2021/06/08 11:00		
COC Number		830687-01-01			830687-01-01			830687-01-01		
	UNITS	SW10	RDL	QC Batch	SW11	RDL	QC Batch	SW13	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	250	1.0	7398104	170	1.0	7398104	150	1.0	7398104
Inorganics										
Total Ammonia-N	mg/L	<0.050	0.050	7400379	0.21	0.050	7400379	<0.050	0.050	7400379
Total Kjeldahl Nitrogen (TKN)	mg/L	0.46	0.10	7401057	0.88	0.10	7401057	0.43	0.10	7401057
Total Phosphorus	mg/L	0.027	0.004	7400351	0.18	0.02	7400351	0.027	0.004	7400351
Total Suspended Solids	mg/L	2	1	7400752	7	1	7404824	4	1	7404824
Alkalinity (Total as CaCO3)	mg/L	180	1.0	7401873	160	1.0	7401873	140	1.0	7401873
Dissolved Chloride (Cl-)	mg/L	45	1.0	7401927	23	1.0	7401927	39	1.0	7401927
Nitrite (N)	mg/L	<0.010	0.010	7401889	0.022	0.010	7401889	<0.010	0.010	7401903
Nitrate (N)	mg/L	<0.10	0.10	7401889	<0.10	0.10	7401889	<0.10	0.10	7401903
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7401889	<0.10	0.10	7401889	<0.10	0.10	7401903
Petroleum Hydrocarbons										
Total Oil & Grease	mg/L	<0.50	0.50	7405212	<0.50	0.50	7405212	<0.50	0.50	7405212

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs ID		PUG862		
Sampling Date		2021/06/08 11:00		
COC Number		830687-01-01		
	UNITS	SW13 Lab-Dup	RDL	QC Batch
Inorganics				
Total Phosphorus	mg/L	0.026	0.004	7400351
Dissolved Chloride (Cl-)	mg/L	40	1.0	7401927

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		PUG858	PUG859	PUG860	PUG861	PUG862		
Sampling Date		2021/06/08 14:00	2021/06/08 15:00	2021/06/08 15:45	2021/06/08 12:15	2021/06/08 11:00		
COC Number		830687-01-01	830687-01-01	830687-01-01	830687-01-01	830687-01-01		
	UNITS	SW8	SW9	SW10	SW11	SW13	RDL	QC Batch
Metals								
Total Aluminum (Al)	ug/L	12	21	6.7	31	6.5	4.9	7405528
Total Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7405528
Total Arsenic (As)	ug/L	<1.0	<1.0	<1.0	1.4	<1.0	1.0	7405528
Total Barium (Ba)	ug/L	16	140	76	19	27	2.0	7405528
Total Beryllium (Be)	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7405528
Total Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7405528
Total Boron (B)	ug/L	12	27	24	25	10	10	7405528
Total Cadmium (Cd)	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	7405528
Total Calcium (Ca)	ug/L	68000	72000	74000	42000	37000	200	7405528
Total Chromium (Cr)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7405528
Total Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7405528
Total Copper (Cu)	ug/L	<0.90	<0.90	<0.90	<0.90	1.5	0.90	7405528
Total Iron (Fe)	ug/L	1200	<100	<100	730	210	100	7405528
Total Lead (Pb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7405528
Total Lithium (Li)	ug/L	<5.0	7.8	<5.0	<5.0	<5.0	5.0	7405528
Total Magnesium (Mg)	ug/L	22000	24000	17000	17000	17000	50	7405528
Total Manganese (Mn)	ug/L	110	13	20	420	31	2.0	7405528
Total Molybdenum (Mo)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7405528
Total Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7405528
Total Potassium (K)	ug/L	690	1500	770	9000	1400	200	7405528
Total Selenium (Se)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7405528
Total Silicon (Si)	ug/L	2100	3400	7700	890	680	50	7405528
Total Silver (Ag)	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	7405528
Total Sodium (Na)	ug/L	73000	24000	22000	7800	23000	100	7405528
Total Strontium (Sr)	ug/L	180	240	140	94	120	1.0	7405528
Total Tellurium (Te)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7405528
Total Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7405528
Total Tin (Sn)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7405528
Total Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7405528
Total Tungsten (W)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7405528
Total Uranium (U)	ug/L	0.12	0.50	0.22	0.20	0.21	0.10	7405528

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1F8070
Report Date: 2021/06/15

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		PUG858	PUG859	PUG860	PUG861	PUG862		
Sampling Date		2021/06/08 14:00	2021/06/08 15:00	2021/06/08 15:45	2021/06/08 12:15	2021/06/08 11:00		
COC Number		830687-01-01	830687-01-01	830687-01-01	830687-01-01	830687-01-01		
	UNITS	SW8	SW9	SW10	SW11	SW13	RDL	QC Batch
Total Vanadium (V)	ug/L	<0.50	<0.50	0.54	0.57	<0.50	0.50	7405528
Total Zinc (Zn)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7405528
Total Zirconium (Zr)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7405528

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PUG858
Sample ID: SW8
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7401873	N/A	2021/06/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7401927	N/A	2021/06/11	Alina Dobreanu
Hardness (calculated as CaCO3)		7398104	N/A	2021/06/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7405528	N/A	2021/06/14	Prempal Bhatti
Total Ammonia-N	LACH/NH4	7400379	N/A	2021/06/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7401889	N/A	2021/06/11	Chandra Nandlal
Total Oil and Grease	BAL	7405212	2021/06/13	2021/06/13	Mitul Patel
Total Kjeldahl Nitrogen in Water	SKAL	7401057	2021/06/10	2021/06/11	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7400351	2021/06/10	2021/06/14	Shivani Shivani
Low Level Total Suspended Solids	BAL	7404824	2021/06/12	2021/06/14	Sandeep Kaur

BV Labs ID: PUG859
Sample ID: SW9
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7401873	N/A	2021/06/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7401927	N/A	2021/06/11	Alina Dobreanu
Hardness (calculated as CaCO3)		7398104	N/A	2021/06/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7405528	N/A	2021/06/14	Prempal Bhatti
Total Ammonia-N	LACH/NH4	7401360	N/A	2021/06/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7401903	N/A	2021/06/14	Chandra Nandlal
Total Oil and Grease	BAL	7405212	2021/06/13	2021/06/13	Mitul Patel
Total Kjeldahl Nitrogen in Water	SKAL	7401057	2021/06/10	2021/06/11	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7400351	2021/06/10	2021/06/11	Shivani Shivani
Low Level Total Suspended Solids	BAL	7400752	2021/06/11	2021/06/14	Sandeep Kaur

BV Labs ID: PUG859 Dup
Sample ID: SW9
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Ammonia-N	LACH/NH4	7401360	N/A	2021/06/11	Amanpreet Sappal

BV Labs ID: PUG860
Sample ID: SW10
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7401873	N/A	2021/06/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7401927	N/A	2021/06/11	Alina Dobreanu
Hardness (calculated as CaCO3)		7398104	N/A	2021/06/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7405528	N/A	2021/06/14	Prempal Bhatti
Total Ammonia-N	LACH/NH4	7400379	N/A	2021/06/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7401889	N/A	2021/06/11	Chandra Nandlal

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: PUG860
Sample ID: SW10
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Oil and Grease	BAL	7405212	2021/06/13	2021/06/13	Mitul Patel
Total Kjeldahl Nitrogen in Water	SKAL	7401057	2021/06/10	2021/06/11	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7400351	2021/06/10	2021/06/11	Shivani Shivani
Low Level Total Suspended Solids	BAL	7400752	2021/06/11	2021/06/14	Sandeep Kaur

BV Labs ID: PUG861
Sample ID: SW11
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7401873	N/A	2021/06/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7401927	N/A	2021/06/11	Alina Dobreanu
Hardness (calculated as CaCO3)		7398104	N/A	2021/06/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7405528	N/A	2021/06/14	Prempal Bhatti
Total Ammonia-N	LACH/NH4	7400379	N/A	2021/06/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7401889	N/A	2021/06/11	Chandra Nandlal
Total Oil and Grease	BAL	7405212	2021/06/13	2021/06/13	Mitul Patel
Total Kjeldahl Nitrogen in Water	SKAL	7401057	2021/06/10	2021/06/11	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7400351	2021/06/10	2021/06/14	Shivani Shivani
Low Level Total Suspended Solids	BAL	7404824	2021/06/12	2021/06/14	Sandeep Kaur

BV Labs ID: PUG862
Sample ID: SW13
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7401873	N/A	2021/06/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7401927	N/A	2021/06/11	Alina Dobreanu
Hardness (calculated as CaCO3)		7398104	N/A	2021/06/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7405528	N/A	2021/06/14	Prempal Bhatti
Total Ammonia-N	LACH/NH4	7400379	N/A	2021/06/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7401903	N/A	2021/06/14	Chandra Nandlal
Total Oil and Grease	BAL	7405212	2021/06/13	2021/06/13	Mitul Patel
Total Kjeldahl Nitrogen in Water	SKAL	7401057	2021/06/10	2021/06/11	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7400351	2021/06/10	2021/06/11	Shivani Shivani
Low Level Total Suspended Solids	BAL	7404824	2021/06/12	2021/06/14	Sandeep Kaur

BV Labs ID: PUG862 Dup
Sample ID: SW13
Matrix: Water

Collected: 2021/06/08
Shipped:
Received: 2021/06/09

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7401927	N/A	2021/06/11	Alina Dobreanu
Total Phosphorus (Colourimetric)	LACH/P	7400351	2021/06/10	2021/06/11	Shivani Shivani

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1F8070
Report Date: 2021/06/15

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	-0.3°C
Package 2	0.7°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1F8070
Report Date: 2021/06/15

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7400351	Total Phosphorus	2021/06/11	102	80 - 120	101	80 - 120	<0.004	mg/L	0.38	20	96	80 - 120
7400379	Total Ammonia-N	2021/06/11	86	75 - 125	103	80 - 120	<0.050	mg/L	0.48	20		
7400752	Total Suspended Solids	2021/06/14					<1	mg/L	3.6	25	98	85 - 115
7401057	Total Kjeldahl Nitrogen (TKN)	2021/06/11	NC	80 - 120	95	80 - 120	<0.10	mg/L	1.1	20	94	80 - 120
7401360	Total Ammonia-N	2021/06/11	97	75 - 125	100	80 - 120	<0.050	mg/L	10	20		
7401873	Alkalinity (Total as CaCO3)	2021/06/11			96	85 - 115	<1.0	mg/L	1.0	20		
7401889	Nitrate (N)	2021/06/11	97	80 - 120	97	80 - 120	<0.10	mg/L	0.76	20		
7401889	Nitrite (N)	2021/06/11	100	80 - 120	101	80 - 120	<0.010	mg/L	NC	20		
7401903	Nitrate (N)	2021/06/14	99	80 - 120	100	80 - 120	<0.10	mg/L	NC	20		
7401903	Nitrite (N)	2021/06/14	105	80 - 120	106	80 - 120	<0.010	mg/L	NC	20		
7401927	Dissolved Chloride (Cl-)	2021/06/11	NC	80 - 120	105	80 - 120	<1.0	mg/L	1.2	20		
7404824	Total Suspended Solids	2021/06/14					<1	mg/L	6.1	25	96	85 - 115
7405212	Total Oil & Grease	2021/06/13			98	85 - 115	<0.50	mg/L	1.0	25		
7405528	Total Aluminum (Al)	2021/06/14	NC	80 - 120	95	80 - 120	<4.9	ug/L	3.5	20		
7405528	Total Antimony (Sb)	2021/06/14	101	80 - 120	99	80 - 120	<0.50	ug/L				
7405528	Total Arsenic (As)	2021/06/14	98	80 - 120	98	80 - 120	<1.0	ug/L				
7405528	Total Barium (Ba)	2021/06/14	95	80 - 120	96	80 - 120	<2.0	ug/L				
7405528	Total Beryllium (Be)	2021/06/14	99	80 - 120	95	80 - 120	<0.40	ug/L				
7405528	Total Bismuth (Bi)	2021/06/14	103	80 - 120	99	80 - 120	<1.0	ug/L				
7405528	Total Boron (B)	2021/06/14	95	80 - 120	92	80 - 120	<10	ug/L				
7405528	Total Cadmium (Cd)	2021/06/14	99	80 - 120	99	80 - 120	<0.090	ug/L	7.2	20		
7405528	Total Calcium (Ca)	2021/06/14	NC	80 - 120	98	80 - 120	<200	ug/L				
7405528	Total Chromium (Cr)	2021/06/14	93	80 - 120	92	80 - 120	<5.0	ug/L	2.6	20		
7405528	Total Cobalt (Co)	2021/06/14	101	80 - 120	98	80 - 120	<0.50	ug/L				
7405528	Total Copper (Cu)	2021/06/14	100	80 - 120	99	80 - 120	<0.90	ug/L	3.2	20		
7405528	Total Iron (Fe)	2021/06/14	96	80 - 120	96	80 - 120	<100	ug/L	0.68	20		
7405528	Total Lead (Pb)	2021/06/14	102	80 - 120	99	80 - 120	<0.50	ug/L	9.6	20		
7405528	Total Lithium (Li)	2021/06/14	102	80 - 120	96	80 - 120	<5.0	ug/L				
7405528	Total Magnesium (Mg)	2021/06/14	95	80 - 120	98	80 - 120	<50	ug/L				
7405528	Total Manganese (Mn)	2021/06/14	95	80 - 120	95	80 - 120	<2.0	ug/L				
7405528	Total Molybdenum (Mo)	2021/06/14	98	80 - 120	96	80 - 120	<0.50	ug/L				

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7405528	Total Nickel (Ni)	2021/06/14	96	80 - 120	96	80 - 120	<1.0	ug/L	8.2	20		
7405528	Total Potassium (K)	2021/06/14	92	80 - 120	96	80 - 120	<200	ug/L				
7405528	Total Selenium (Se)	2021/06/14	90	80 - 120	102	80 - 120	<2.0	ug/L				
7405528	Total Silicon (Si)	2021/06/14	97	80 - 120	96	80 - 120	<50	ug/L				
7405528	Total Silver (Ag)	2021/06/14	98	80 - 120	99	80 - 120	<0.090	ug/L				
7405528	Total Sodium (Na)	2021/06/14	NC	80 - 120	97	80 - 120	<100	ug/L				
7405528	Total Strontium (Sr)	2021/06/14	93	80 - 120	94	80 - 120	<1.0	ug/L				
7405528	Total Tellurium (Te)	2021/06/14	95	80 - 120	99	80 - 120	<1.0	ug/L				
7405528	Total Thallium (Tl)	2021/06/14	102	80 - 120	101	80 - 120	<0.050	ug/L				
7405528	Total Tin (Sn)	2021/06/14	98	80 - 120	98	80 - 120	<1.0	ug/L				
7405528	Total Titanium (Ti)	2021/06/14	93	80 - 120	96	80 - 120	<5.0	ug/L				
7405528	Total Tungsten (W)	2021/06/14	104	80 - 120	101	80 - 120	<1.0	ug/L				
7405528	Total Uranium (U)	2021/06/14	104	80 - 120	99	80 - 120	<0.10	ug/L				
7405528	Total Vanadium (V)	2021/06/14	95	80 - 120	93	80 - 120	<0.50	ug/L				
7405528	Total Zinc (Zn)	2021/06/14	100	80 - 120	102	80 - 120	<5.0	ug/L	0.83	20		
7405528	Total Zirconium (Zr)	2021/06/14	65 (1)	80 - 120	96	80 - 120	<1.0	ug/L				

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

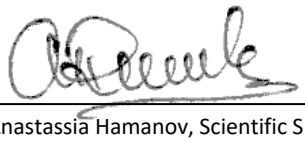
(1) Matrix spike exceedes aceptance limits, probable matrix interference

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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CHAIN OF CUSTODY RECORD

Page | of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	B80683	BV Labs Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Craig De Vito	P.O. #:			830687
Address:	6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address:		Project:	19129150	COC #:	Project Manager:
Tel:	(905) 567-4444 Fax: (905) 567-6561	Tel:	(905) 567-6100 Ext: 1507 Fax:	Project Name:		C#830687-01-01	Ema Gitej
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Craig_DeVito@golder.com	Site #:			
				Sampled By:	B. LINGELBACH		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine; ☐ Table 2 ☐ Ind/Comm ☐ Coarse; ☐ Table 3 ☐ Agri/Other ☐ For RSC; ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw; ☐ Reg 558 ☐ Storm Sewer Bylaw; ☐ MISA Municipality ___; ☐ PWQO ☐ Reg 406 Table ___; ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? N

Field Filtered (please circle): Metals / Hg / Cr VI

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Total Metals Analysis by ICPMS	Chloride, Nitrate & Nitrite	Total Ammonia-N, TKN, Total P	Alkalinity, Hardness	Low Level Total Suspended Solids	Total Oil and Grease	# of Bottles	Comments
1		SW 8	2021-06-08	14:00	SW	Y	Y	Y	Y	Y	Y	6	
2		SW 9	"	15:00	SW	Y	Y	Y	Y	Y	Y	6	
3		SW 10	"	15:45	SW	Y	Y	Y	Y	Y	Y	6	
4		SW 11	"	12:15	SW	Y	Y	Y	Y	Y	Y	6	
5		SW 13	"	11:00	SW	Y	Y	Y	Y	Y	Y	6	
6													
7													
8													
9													
10													

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: Y
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ *(call lab for #)*

09-Jun-21 07:59
Ema Gitej
C1F8070
AE2 ENV-1324

REC'D IN WATERLOO

Ice Melted

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only: Time Sensitive	Temperature (°C) on Recei	Custody Seal Present	Yes	No
K. EASTON	21/06/08	17:20	JASPREET KAUR	2021/06/09	7:59			-1.1 0.1 0.1	Intact	Y	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

KAVITHASELVAN 2021/06/09 16:02 BV # B213 1/1/2

Your Project #: 19129150
Your C.O.C. #: 845006-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/09/14
Report #: R6810615
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1P7686
Received: 2021/09/08, 16:40

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	2	N/A	2021/09/11	CAM SOP-00448	SM 23 2320 B m
Alkalinity	2	N/A	2021/09/14	CAM SOP-00448	SM 23 2320 B m
Chloride by Automated Colourimetry	4	N/A	2021/09/13	CAM SOP-00463	SM 23 4500-Cl E m
Hardness (calculated as CaCO3)	4	N/A	2021/09/14	CAM SOP 00102/00408/00447	SM 2340 B
Total Metals Analysis by ICPMS	4	N/A	2021/09/10	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	4	N/A	2021/09/11	CAM SOP-00441	USGS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (1)	4	N/A	2021/09/10	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Total Oil and Grease	4	2021/09/11	2021/09/11	CAM SOP-00326	EPA1664B m,SM5520B m
Total Kjeldahl Nitrogen in Water	1	2021/09/10	2021/09/13	CAM SOP-00938	OMOE E3516 m
Total Kjeldahl Nitrogen in Water	3	2021/09/09	2021/09/13	CAM SOP-00938	OMOE E3516 m
Total Phosphorus (Colourimetric)	1	2021/09/10	2021/09/10	CAM SOP-00407	SM 23 4500 P B H m
Total Phosphorus (Colourimetric)	1	2021/09/10	2021/09/13	CAM SOP-00407	SM 23 4500 P B H m
Total Phosphorus (Colourimetric)	2	2021/09/10	2021/09/14	CAM SOP-00407	SM 23 4500 P B H m
Low Level Total Suspended Solids	4	2021/09/10	2021/09/13	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Your Project #: 19129150
Your C.O.C. #: 845006-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/09/14
Report #: R6810615
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1P7686
Received: 2021/09/08, 16:40

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1P7686
Report Date: 2021/09/14

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AK

RESULTS OF ANALYSES OF WATER

BV Labs ID		QPC693			QPC693			QPC694		
Sampling Date		2021/09/08 08:45			2021/09/08 08:45			2021/09/08 10:00		
COC Number		845006-01-01			845006-01-01			845006-01-01		
	UNITS	SW 13	RDL	QC Batch	SW 13 Lab-Dup	RDL	QC Batch	SW 11	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	220	1.0	7564190				130	1.0	7564190
Inorganics										
Total Ammonia-N	mg/L	<0.050	0.050	7571013				<0.050	0.050	7571013
Total Kjeldahl Nitrogen (TKN)	mg/L	0.24	0.10	7567963				0.55	0.10	7567963
Total Phosphorus	mg/L	0.025	0.004	7570124	0.027	0.004	7570124	0.12	0.02	7570124
Total Suspended Solids	mg/L	11	1	7568700				14	1	7568700
Alkalinity (Total as CaCO3)	mg/L	180	1.0	7569431				120	1.0	7569431
Dissolved Chloride (Cl-)	mg/L	110	1.0	7569572	100	1.0	7569572	21	1.0	7569572
Nitrite (N)	mg/L	<0.010	0.010	7569473				<0.010	0.010	7569473
Nitrate (N)	mg/L	0.63	0.10	7569473				<0.10	0.10	7569473
Nitrate + Nitrite (N)	mg/L	0.63	0.10	7569473				<0.10	0.10	7569473
Petroleum Hydrocarbons										
Total Oil & Grease	mg/L	<0.50	0.50	7572204				<0.50	0.50	7572204

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1P7686
Report Date: 2021/09/14

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AK

RESULTS OF ANALYSES OF WATER

BV Labs ID		QPC695			QPC696			QPC696		
Sampling Date		2021/09/08 13:45			2021/09/08 15:00			2021/09/08 15:00		
COC Number		845006-01-01			845006-01-01			845006-01-01		
	UNITS	SW 8	RDL	QC Batch	SW 9	RDL	QC Batch	SW 9 Lab-Dup	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	190	1.0	7564190	250	1.0	7564190			
Inorganics										
Total Ammonia-N	mg/L	0.066	0.050	7571013	<0.050	0.050	7571013			
Total Kjeldahl Nitrogen (TKN)	mg/L	0.50	0.10	7570411	0.27	0.10	7567963			
Total Phosphorus	mg/L	0.064	0.004	7570124	0.020	0.004	7569427	0.019	0.004	7569427
Total Suspended Solids	mg/L	13	1	7568700	9	1	7568700			
Alkalinity (Total as CaCO3)	mg/L	170	1.0	7571045	210	1.0	7571045			
Dissolved Chloride (Cl-)	mg/L	420	5.0	7569572	44	1.0	7569572			
Nitrite (N)	mg/L	<0.010	0.010	7569473	<0.010	0.010	7569473	<0.010	0.010	7569473
Nitrate (N)	mg/L	<0.10	0.10	7569473	0.50	0.10	7569473	0.50	0.10	7569473
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	7569473	0.50	0.10	7569473	0.50	0.10	7569473
Petroleum Hydrocarbons										
Total Oil & Grease	mg/L	<0.50	0.50	7572204	<0.50	0.50	7572204			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		QPC693	QPC694	QPC695	QPC696		
Sampling Date		2021/09/08 08:45	2021/09/08 10:00	2021/09/08 13:45	2021/09/08 15:00		
COC Number		845006-01-01	845006-01-01	845006-01-01	845006-01-01		
	UNITS	SW 13	SW 11	SW 8	SW 9	RDL	QC Batch
Metals							
Total Aluminum (Al)	ug/L	30	32	180	20	4.9	7569728
Total Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	7569728
Total Arsenic (As)	ug/L	<1.0	1.2	<1.0	<1.0	1.0	7569728
Total Barium (Ba)	ug/L	47	12	46	130	2.0	7569728
Total Beryllium (Be)	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	7569728
Total Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	7569728
Total Boron (B)	ug/L	32	22	12	29	10	7569728
Total Cadmium (Cd)	ug/L	<0.090	<0.090	<0.090	<0.090	0.090	7569728
Total Calcium (Ca)	ug/L	62000	25000	56000	63000	200	7569728
Total Chromium (Cr)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	7569728
Total Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	7569728
Total Copper (Cu)	ug/L	1.3	<0.90	3.1	<0.90	0.90	7569728
Total Iron (Fe)	ug/L	<100	170	610	<100	100	7569728
Total Lead (Pb)	ug/L	<0.50	<0.50	0.61	<0.50	0.50	7569728
Total Lithium (Li)	ug/L	<5.0	<5.0	<5.0	8.9	5.0	7569728
Total Magnesium (Mg)	ug/L	17000	16000	13000	24000	50	7569728
Total Manganese (Mn)	ug/L	58	23	130	7.6	2.0	7569728
Total Molybdenum (Mo)	ug/L	<0.50	<0.50	0.90	<0.50	0.50	7569728
Total Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	7569728
Total Potassium (K)	ug/L	2700	9000	1200	1600	200	7569728
Total Selenium (Se)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	7569728
Total Silicon (Si)	ug/L	2900	640	2500	3500	50	7569728
Total Silver (Ag)	ug/L	<0.090	<0.090	<0.090	<0.090	0.090	7569728
Total Sodium (Na)	ug/L	60000	6100	280000	25000	100	7569728
Total Strontium (Sr)	ug/L	140	81	180	240	1.0	7569728
Total Tellurium (Te)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	7569728
Total Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	7569728
Total Tin (Sn)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	7569728
Total Titanium (Ti)	ug/L	<5.0	<5.0	7.2	<5.0	5.0	7569728
Total Tungsten (W)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	7569728
Total Uranium (U)	ug/L	0.27	<0.10	0.17	0.41	0.10	7569728

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		QPC693	QPC694	QPC695	QPC696		
Sampling Date		2021/09/08 08:45	2021/09/08 10:00	2021/09/08 13:45	2021/09/08 15:00		
COC Number		845006-01-01	845006-01-01	845006-01-01	845006-01-01		
	UNITS	SW 13	SW 11	SW 8	SW 9	RDL	QC Batch
Total Vanadium (V)	ug/L	0.51	0.61	0.89	<0.50	0.50	7569728
Total Zinc (Zn)	ug/L	<5.0	<5.0	7.6	<5.0	5.0	7569728
Total Zirconium (Zr)	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	7569728

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

BV Labs ID: QPC693
Sample ID: SW 13
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7569431	N/A	2021/09/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7569572	N/A	2021/09/13	Alina Dobreanu
Hardness (calculated as CaCO3)		7564190	N/A	2021/09/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7569728	N/A	2021/09/10	Nan Raykha
Total Ammonia-N	LACH/NH4	7571013	N/A	2021/09/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7569473	N/A	2021/09/10	Chandra Nandlal
Total Oil and Grease	BAL	7572204	2021/09/11	2021/09/11	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7567963	2021/09/09	2021/09/13	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7570124	2021/09/10	2021/09/13	Shivani Shivani
Low Level Total Suspended Solids	BAL	7568700	2021/09/10	2021/09/13	Shaneil Hall

BV Labs ID: QPC693 Dup
Sample ID: SW 13
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7569572	N/A	2021/09/13	Alina Dobreanu
Total Phosphorus (Colourimetric)	LACH/P	7570124	2021/09/10	2021/09/13	Shivani Shivani

BV Labs ID: QPC694
Sample ID: SW 11
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7569431	N/A	2021/09/11	Surinder Rai
Chloride by Automated Colourimetry	KONE	7569572	N/A	2021/09/13	Alina Dobreanu
Hardness (calculated as CaCO3)		7564190	N/A	2021/09/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7569728	N/A	2021/09/10	Nan Raykha
Total Ammonia-N	LACH/NH4	7571013	N/A	2021/09/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7569473	N/A	2021/09/10	Chandra Nandlal
Total Oil and Grease	BAL	7572204	2021/09/11	2021/09/11	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7567963	2021/09/09	2021/09/13	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7570124	2021/09/10	2021/09/14	Shivani Shivani
Low Level Total Suspended Solids	BAL	7568700	2021/09/10	2021/09/13	Shaneil Hall

BV Labs ID: QPC695
Sample ID: SW 8
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7571045	N/A	2021/09/14	Surinder Rai
Chloride by Automated Colourimetry	KONE	7569572	N/A	2021/09/13	Alina Dobreanu
Hardness (calculated as CaCO3)		7564190	N/A	2021/09/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7569728	N/A	2021/09/10	Nan Raykha
Total Ammonia-N	LACH/NH4	7571013	N/A	2021/09/11	Amanpreet Sappal

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1P7686
Report Date: 2021/09/14

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AK

TEST SUMMARY

BV Labs ID: QPC695
Sample ID: SW 8
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7569473	N/A	2021/09/10	Chandra Nandlal
Total Oil and Grease	BAL	7572204	2021/09/11	2021/09/11	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7570411	2021/09/10	2021/09/13	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7570124	2021/09/10	2021/09/14	Shivani Shivani
Low Level Total Suspended Solids	BAL	7568700	2021/09/10	2021/09/13	Shaneil Hall

BV Labs ID: QPC696
Sample ID: SW 9
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7571045	N/A	2021/09/14	Surinder Rai
Chloride by Automated Colourimetry	KONE	7569572	N/A	2021/09/13	Alina Dobreanu
Hardness (calculated as CaCO3)		7564190	N/A	2021/09/14	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7569728	N/A	2021/09/10	Nan Raykha
Total Ammonia-N	LACH/NH4	7571013	N/A	2021/09/11	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7569473	N/A	2021/09/10	Chandra Nandlal
Total Oil and Grease	BAL	7572204	2021/09/11	2021/09/11	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7567963	2021/09/09	2021/09/13	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7569427	2021/09/10	2021/09/10	Shivani Shivani
Low Level Total Suspended Solids	BAL	7568700	2021/09/10	2021/09/13	Shaneil Hall

BV Labs ID: QPC696 Dup
Sample ID: SW 9
Matrix: Water

Collected: 2021/09/08
Shipped:
Received: 2021/09/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	7569473	N/A	2021/09/10	Chandra Nandlal
Total Phosphorus (Colourimetric)	LACH/P	7569427	2021/09/10	2021/09/10	Shivani Shivani

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.0°C

Results relate only to the items tested.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1P7686
Report Date: 2021/09/14

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AK

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7567963	Total Kjeldahl Nitrogen (TKN)	2021/09/13	102	80 - 120	105	80 - 120	<0.10	mg/L	NC (1)	20	102	80 - 120
7568700	Total Suspended Solids	2021/09/13					<1	mg/L	8.3	25	95	85 - 115
7569427	Total Phosphorus	2021/09/10	110	80 - 120	99	80 - 120	<0.004	mg/L	1.0	20	104	80 - 120
7569431	Alkalinity (Total as CaCO3)	2021/09/11			96	85 - 115	<1.0	mg/L	0.49	20		
7569473	Nitrate (N)	2021/09/10	99	80 - 120	100	80 - 120	<0.10	mg/L	0.30	20		
7569473	Nitrite (N)	2021/09/10	104	80 - 120	104	80 - 120	<0.010	mg/L	NC	20		
7569572	Dissolved Chloride (Cl-)	2021/09/13	NC	80 - 120	103	80 - 120	<1.0	mg/L	1.2	20		
7569728	Total Aluminum (Al)	2021/09/10	95	80 - 120	95	80 - 120	<4.9	ug/L	NC	20		
7569728	Total Antimony (Sb)	2021/09/10	105	80 - 120	104	80 - 120	<0.50	ug/L	NC	20		
7569728	Total Arsenic (As)	2021/09/10	96	80 - 120	97	80 - 120	<1.0	ug/L	NC	20		
7569728	Total Barium (Ba)	2021/09/10	92	80 - 120	93	80 - 120	<2.0	ug/L	3.4	20		
7569728	Total Beryllium (Be)	2021/09/10	94	80 - 120	92	80 - 120	<0.40	ug/L	NC	20		
7569728	Total Bismuth (Bi)	2021/09/10	95	80 - 120	91	80 - 120	<1.0	ug/L				
7569728	Total Boron (B)	2021/09/10	91	80 - 120	89	80 - 120	<10	ug/L	NC	20		
7569728	Total Cadmium (Cd)	2021/09/10	97	80 - 120	98	80 - 120	<0.090	ug/L	NC	20		
7569728	Total Calcium (Ca)	2021/09/10	NC	80 - 120	94	80 - 120	<200	ug/L	0.44	20		
7569728	Total Chromium (Cr)	2021/09/10	90	80 - 120	90	80 - 120	<5.0	ug/L	NC	20		
7569728	Total Cobalt (Co)	2021/09/10	97	80 - 120	96	80 - 120	<0.50	ug/L	NC	20		
7569728	Total Copper (Cu)	2021/09/10	90	80 - 120	91	80 - 120	<0.90	ug/L	NC	20		
7569728	Total Iron (Fe)	2021/09/10	94	80 - 120	94	80 - 120	<100	ug/L	NC	20		
7569728	Total Lead (Pb)	2021/09/10	91	80 - 120	93	80 - 120	<0.50	ug/L	NC	20		
7569728	Total Lithium (Li)	2021/09/10	105	80 - 120	97	80 - 120	<5.0	ug/L				
7569728	Total Magnesium (Mg)	2021/09/10	NC	80 - 120	92	80 - 120	<50	ug/L	1.8	20		
7569728	Total Manganese (Mn)	2021/09/10	92	80 - 120	93	80 - 120	<2.0	ug/L	NC	20		
7569728	Total Molybdenum (Mo)	2021/09/10	94	80 - 120	95	80 - 120	<0.50	ug/L	NC	20		
7569728	Total Nickel (Ni)	2021/09/10	92	80 - 120	94	80 - 120	<1.0	ug/L	NC	20		
7569728	Total Potassium (K)	2021/09/10	95	80 - 120	92	80 - 120	<200	ug/L	1.1	20		
7569728	Total Selenium (Se)	2021/09/10	99	80 - 120	100	80 - 120	<2.0	ug/L	NC	20		
7569728	Total Silicon (Si)	2021/09/10	92	80 - 120	92	80 - 120	<50	ug/L	1.1	20		
7569728	Total Silver (Ag)	2021/09/10	95	80 - 120	95	80 - 120	<0.090	ug/L	NC	20		
7569728	Total Sodium (Na)	2021/09/10	92	80 - 120	95	80 - 120	<100	ug/L	2.7	20		

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7569728	Total Strontium (Sr)	2021/09/10	91	80 - 120	93	80 - 120	<1.0	ug/L	0.22	20		
7569728	Total Tellurium (Te)	2021/09/10	94	80 - 120	93	80 - 120	<1.0	ug/L				
7569728	Total Thallium (Tl)	2021/09/10	91	80 - 120	94	80 - 120	<0.050	ug/L	NC	20		
7569728	Total Tin (Sn)	2021/09/10	97	80 - 120	97	80 - 120	<1.0	ug/L				
7569728	Total Titanium (Ti)	2021/09/10	91	80 - 120	91	80 - 120	<5.0	ug/L	NC	20		
7569728	Total Tungsten (W)	2021/09/10	98	80 - 120	97	80 - 120	<1.0	ug/L				
7569728	Total Uranium (U)	2021/09/10	91	80 - 120	94	80 - 120	<0.10	ug/L				
7569728	Total Vanadium (V)	2021/09/10	90	80 - 120	90	80 - 120	<0.50	ug/L	NC	20		
7569728	Total Zinc (Zn)	2021/09/10	95	80 - 120	97	80 - 120	<5.0	ug/L	3.8	20		
7569728	Total Zirconium (Zr)	2021/09/10	98	80 - 120	99	80 - 120	<1.0	ug/L				
7570124	Total Phosphorus	2021/09/13	112	80 - 120	100	80 - 120	<0.004	mg/L	8.8	20	99	80 - 120
7570411	Total Kjeldahl Nitrogen (TKN)	2021/09/13	104	80 - 120	105	80 - 120	<0.10	mg/L	5.9	20	101	80 - 120
7571013	Total Ammonia-N	2021/09/11	98	75 - 125	102	80 - 120	<0.050	mg/L	9.5	20		
7571045	Alkalinity (Total as CaCO3)	2021/09/14			97	85 - 115	<1.0	mg/L	1.5	20		
7572204	Total Oil & Grease	2021/09/11			98	85 - 115	<0.50	mg/L	1.5	25		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Due to a high concentration of NOx, the sample required dilution. The detection limit was adjusted accordingly.

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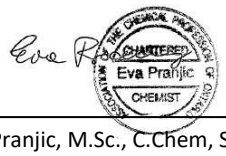
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C1P7686
Report Date: 2021/09/14

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: AK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

08-Sep-21 16:40

Ema Gitej

C1P7686

RJM ENV-907

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	B80683
Attention:	Accounts Payable	Attention:	Craig De Vito	P.O. #:	
Address:	6925 Century Ave Suite 100	Address:		Project:	19129150
	Mississauga ON L5N 7K2			Project Name:	
Tel:	(905) 567-4444 Fax: (905) 567-6561	Tel:	(905) 567-6100 Ext: 1507 Fax:	Site #:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Craig_DeVito@golder.com	Sampled By:	AK/MH

...se Only:

Bottle Order #: 845006

COC #: C#845006-01-01

Project Manager: Ema Gitej

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558. ☐ Storm Sewer Bylaw ☐ MISA Municipality ___ ☐ PWQO ☐ Reg 406 Table ___ ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Total Metals Analysis by ICPMS	Chloride, Nitrate & Nitrite	Total Ammonia-N, TKN, Total P	Alkalinity, Hardness	Low Level Total Suspended Solids	Total Oil and Grease					# of Bottles	pH	Comments Temp °C
1		SW 13	21/09/08	8:45	SW	No	✓	✓	✓	✓	✓	✓					6	8.27	15.05
2		SW 11	↓	10:00	↓	↓	✓	✓	✓	✓	✓	✓					6	8.34	20.46
3		SW 8	↓	13:45	↓	↓	✓	✓	✓	✓	✓	✓					6	8.12	18.63
4		SW 9	↓	15:00	↓	↓	✓	✓	✓	✓	✓	✓					6	8.65	21.75
5																			
6																			
7																			
8																			
9																			
10																			

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Adam Kennedy	21/09/08	16:40	[signature]	21/09/08	16:40	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	19/10/10	Present	✓	
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

ONTR

Bureau Veritas Canada (2019) Inc.

Your Project #: 19129150
Your C.O.C. #: 844029-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/12/23
Report #: R6936963
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1Z1795
Received: 2021/12/15, 09:16

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	5	N/A	2021/12/17	CAM SOP-00448	SM 23 2320 B m
Chloride by Automated Colourimetry	5	N/A	2021/12/17	CAM SOP-00463	SM 23 4500-Cl E m
Hardness (calculated as CaCO3)	5	N/A	2021/12/22	CAM SOP 00102/00408/00447	SM 2340 B
Total Metals Analysis by ICPMS	5	N/A	2021/12/21	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	4	N/A	2021/12/20	CAM SOP-00441	USGS I-2522-90 m
Total Ammonia-N	1	N/A	2021/12/21	CAM SOP-00441	USGS I-2522-90 m
Nitrate & Nitrite as Nitrogen in Water (1)	5	N/A	2021/12/20	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Total Oil and Grease	5	2021/12/17	2021/12/17	CAM SOP-00326	EPA1664B m,SM5520B m
Total Kjeldahl Nitrogen in Water	5	2021/12/17	2021/12/20	CAM SOP-00938	OMOE E3516 m
Total Phosphorus (Colourimetric)	5	2021/12/17	2021/12/19	CAM SOP-00407	SM 23 4500 P B H m
Low Level Total Suspended Solids	5	2021/12/18	2021/12/20	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Your Project #: 19129150
Your C.O.C. #: 844029-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2021/12/23
Report #: R6936963
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1Z1795
Received: 2021/12/15, 09:16

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829

==========

This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Job #: C1Z1795
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		RJF526			RJF526			RJF527		
Sampling Date		2021/12/14 15:45			2021/12/14 15:45			2021/12/14		
COC Number		844029-01-01			844029-01-01			844029-01-01		
	UNITS	SW8	RDL	QC Batch	SW8 Lab-Dup	RDL	QC Batch	DUP	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	240	1.0	7727723				240	1.0	7727723
Inorganics										
Total Ammonia-N	mg/L	<0.050	0.050	7736126				<0.050	0.050	7736126
Total Kjeldahl Nitrogen (TKN)	mg/L	0.37	0.10	7735168				0.40	0.10	7735168
Total Phosphorus	mg/L	0.024	0.004	7735497				0.025	0.004	7735497
Total Suspended Solids	mg/L	1	1	7736524				2	1	7736524
Alkalinity (Total as CaCO3)	mg/L	200	1.0	7732729	200	1.0	7732729	210	1.0	7732729
Dissolved Chloride (Cl-)	mg/L	29	1.0	7733859				29	1.0	7733859
Nitrite (N)	mg/L	0.012	0.010	7732590				0.012	0.010	7733819
Nitrate (N)	mg/L	1.70	0.10	7732590				1.69	0.10	7733819
Nitrate + Nitrite (N)	mg/L	1.71	0.10	7732590				1.71	0.10	7733819
Petroleum Hydrocarbons										
Total Oil & Grease	mg/L	<0.50	0.50	7736936				<0.50	0.50	7736936

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C1Z1795
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		RJF528			RJF528			RJF529		
Sampling Date		2021/12/14 11:30			2021/12/14 11:30			2021/12/14 10:40		
COC Number		844029-01-01			844029-01-01			844029-01-01		
	UNITS	SW9	RDL	QC Batch	SW9 Lab-Dup	RDL	QC Batch	SW11	RDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	270	1.0	7727723				230	1.0	7727723
Inorganics										
Total Ammonia-N	mg/L	0.39	0.050	7736146	0.37	0.050	7736146	0.35	0.050	7736126
Total Kjeldahl Nitrogen (TKN)	mg/L	0.58	0.10	7735168	0.59	0.10	7735168	1.0	0.10	7735168
Total Phosphorus	mg/L	0.016	0.004	7735497				0.22	0.02	7735497
Total Suspended Solids	mg/L	7	1	7736524				8	1	7736524
Alkalinity (Total as CaCO3)	mg/L	230	1.0	7732729				220	1.0	7732729
Dissolved Chloride (Cl-)	mg/L	40	1.0	7733859	40	1.0	7733859	19	1.0	7733859
Nitrite (N)	mg/L	0.022	0.010	7732590				0.021	0.010	7732590
Nitrate (N)	mg/L	0.63	0.10	7732590				0.36	0.10	7732590
Nitrate + Nitrite (N)	mg/L	0.66	0.10	7732590				0.38	0.10	7732590
Petroleum Hydrocarbons										
Total Oil & Grease	mg/L	<0.50	0.50	7736936				<0.50	0.50	7736936

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Bureau Veritas Job #: C1Z1795
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		RJF530		
Sampling Date		2021/12/14 09:20		
COC Number		844029-01-01		
	UNITS	SW13	RDL	QC Batch
Calculated Parameters				
Hardness (CaCO3)	mg/L	170	1.0	7727723
Inorganics				
Total Ammonia-N	mg/L	0.13	0.050	7736126
Total Kjeldahl Nitrogen (TKN)	mg/L	0.48	0.10	7735168
Total Phosphorus	mg/L	0.007	0.004	7735497
Total Suspended Solids	mg/L	4	1	7736524
Alkalinity (Total as CaCO3)	mg/L	150	1.0	7732729
Dissolved Chloride (Cl-)	mg/L	34	1.0	7733859
Nitrite (N)	mg/L	<0.010	0.010	7732590
Nitrate (N)	mg/L	0.10	0.10	7732590
Nitrate + Nitrite (N)	mg/L	0.10	0.10	7732590
Petroleum Hydrocarbons				
Total Oil & Grease	mg/L	<0.50	0.50	7736936

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Bureau Veritas Job #: C1Z1795
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID		RJF526	RJF527	RJF528	RJF529	RJF530	RJF530		
Sampling Date		2021/12/14 15:45	2021/12/14	2021/12/14 11:30	2021/12/14 10:40	2021/12/14 09:20	2021/12/14 09:20		
COC Number		844029-01-01	844029-01-01	844029-01-01	844029-01-01	844029-01-01	844029-01-01		
	UNITS	SW8	DUP	SW9	SW11	SW13	SW13 Lab-Dup	RDL	QC Batch
Metals									
Total Aluminum (Al)	ug/L	17	14	24	30	7.8	7.1	4.9	7742166
Total Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7742166
Total Arsenic (As)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166
Total Barium (Ba)	ug/L	16	16	130	19	28	29	2.0	7742166
Total Beryllium (Be)	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7742166
Total Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166
Total Boron (B)	ug/L	<10	<10	24	16	<10	<10	10	7742166
Total Cadmium (Cd)	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	7742166
Total Calcium (Ca)	ug/L	60000	61000	69000	66000	43000	43000	200	7742166
Total Chromium (Cr)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7742166
Total Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7742166
Total Copper (Cu)	ug/L	<0.90	<0.90	<0.90	1.1	<0.90	<0.90	0.90	7742166
Total Iron (Fe)	ug/L	<100	<100	<100	280	110	110	100	7742166
Total Lead (Pb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7742166
Total Lithium (Li)	ug/L	<5.0	<5.0	6.6	<5.0	<5.0	<5.0	5.0	7742166
Total Magnesium (Mg)	ug/L	16000	16000	22000	15000	12000	12000	50	7742166
Total Manganese (Mn)	ug/L	3.4	3.3	13	65	11	11	2.0	7742166
Total Molybdenum (Mo)	ug/L	<0.50	0.51	<0.50	<0.50	<0.50	<0.50	0.50	7742166
Total Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166
Total Potassium (K)	ug/L	2600	2600	1400	12000	1400	1400	200	7742166
Total Selenium (Se)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7742166
Total Silicon (Si)	ug/L	3700	3700	5500	1800	2800	2800	50	7742166
Total Silver (Ag)	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	7742166
Total Sodium (Na)	ug/L	12000	12000	20000	4700	18000	18000	100	7742166
Total Strontium (Sr)	ug/L	110	110	230	120	110	110	1.0	7742166
Total Tellurium (Te)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166
Total Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7742166
Total Tin (Sn)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166
Total Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7742166
Total Tungsten (W)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166
Total Uranium (U)	ug/L	0.65	0.70	0.38	0.28	0.20	0.20	0.10	7742166

RDL = Reportable Detection Limit
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Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID		RJF526	RJF527	RJF528	RJF529	RJF530	RJF530		
Sampling Date		2021/12/14 15:45	2021/12/14	2021/12/14 11:30	2021/12/14 10:40	2021/12/14 09:20	2021/12/14 09:20		
COC Number		844029-01-01	844029-01-01	844029-01-01	844029-01-01	844029-01-01	844029-01-01		
	UNITS	**SW8**	**DUP**	**SW9**	**SW11**	**SW13**	**SW13 Lab-Dup**	**RDL**	**QC Batch**
Total Vanadium (V)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7742166
Total Zinc (Zn)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7742166
Total Zirconium (Zr)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7742166

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

Bureau Veritas ID: RJF526
Sample ID: SW8
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7732729	N/A	2021/12/17	Surinder Rai
Chloride by Automated Colourimetry	KONE	7733859	N/A	2021/12/17	Alina Dobreanu
Hardness (calculated as CaCO3)		7727723	N/A	2021/12/22	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7742166	N/A	2021/12/21	Daniel Teclu
Total Ammonia-N	LACH/NH4	7736126	N/A	2021/12/20	Amanpreet Sappal
Nitrate & Nitrite as Nitrogen in Water	LACH	7732590	N/A	2021/12/20	Chandra Nandlal
Total Oil and Grease	BAL	7736936	2021/12/17	2021/12/17	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7735168	2021/12/17	2021/12/20	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7735497	2021/12/17	2021/12/19	Shivani Shivani
Low Level Total Suspended Solids	BAL	7736524	2021/12/18	2021/12/20	Shivani Desai

Bureau Veritas ID: RJF526 Dup
Sample ID: SW8
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7732729	N/A	2021/12/17	Surinder Rai

Bureau Veritas ID: RJF527
Sample ID: DUP
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7732729	N/A	2021/12/17	Surinder Rai
Chloride by Automated Colourimetry	KONE	7733859	N/A	2021/12/17	Alina Dobreanu
Hardness (calculated as CaCO3)		7727723	N/A	2021/12/22	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7742166	N/A	2021/12/21	Daniel Teclu
Total Ammonia-N	LACH/NH4	7736126	N/A	2021/12/20	Amanpreet Sappal
Nitrate & Nitrite as Nitrogen in Water	LACH	7733819	N/A	2021/12/20	Chandra Nandlal
Total Oil and Grease	BAL	7736936	2021/12/17	2021/12/17	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7735168	2021/12/17	2021/12/20	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7735497	2021/12/17	2021/12/19	Shivani Shivani
Low Level Total Suspended Solids	BAL	7736524	2021/12/18	2021/12/20	Shivani Desai

Bureau Veritas ID: RJF528
Sample ID: SW9
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7732729	N/A	2021/12/17	Surinder Rai
Chloride by Automated Colourimetry	KONE	7733859	N/A	2021/12/17	Alina Dobreanu
Hardness (calculated as CaCO3)		7727723	N/A	2021/12/22	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7742166	N/A	2021/12/21	Daniel Teclu
Total Ammonia-N	LACH/NH4	7736146	N/A	2021/12/21	Amanpreet Sappal
Nitrate & Nitrite as Nitrogen in Water	LACH	7732590	N/A	2021/12/20	Chandra Nandlal

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TEST SUMMARY

Bureau Veritas ID: RJF528
Sample ID: SW9
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Oil and Grease	BAL	7736936	2021/12/17	2021/12/17	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7735168	2021/12/17	2021/12/20	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7735497	2021/12/17	2021/12/19	Shivani Shivani
Low Level Total Suspended Solids	BAL	7736524	2021/12/18	2021/12/20	Shivani Desai

Bureau Veritas ID: RJF528 Dup
Sample ID: SW9
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7733859	N/A	2021/12/17	Alina Dobreanu
Total Ammonia-N	LACH/NH4	7736146	N/A	2021/12/21	Amanpreet Sappal
Total Kjeldahl Nitrogen in Water	SKAL	7735168	2021/12/17	2021/12/20	Rajni Tyagi

Bureau Veritas ID: RJF529
Sample ID: SW11
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7732729	N/A	2021/12/17	Surinder Rai
Chloride by Automated Colourimetry	KONE	7733859	N/A	2021/12/17	Alina Dobreanu
Hardness (calculated as CaCO3)		7727723	N/A	2021/12/22	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7742166	N/A	2021/12/21	Daniel Teclu
Total Ammonia-N	LACH/NH4	7736126	N/A	2021/12/20	Amanpreet Sappal
Nitrate & Nitrite as Nitrogen in Water	LACH	7732590	N/A	2021/12/20	Chandra Nandlal
Total Oil and Grease	BAL	7736936	2021/12/17	2021/12/17	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7735168	2021/12/17	2021/12/20	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7735497	2021/12/17	2021/12/19	Shivani Shivani
Low Level Total Suspended Solids	BAL	7736524	2021/12/18	2021/12/20	Shivani Desai

Bureau Veritas ID: RJF530
Sample ID: SW13
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7732729	N/A	2021/12/17	Surinder Rai
Chloride by Automated Colourimetry	KONE	7733859	N/A	2021/12/17	Alina Dobreanu
Hardness (calculated as CaCO3)		7727723	N/A	2021/12/22	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7742166	N/A	2021/12/21	Daniel Teclu
Total Ammonia-N	LACH/NH4	7736126	N/A	2021/12/20	Amanpreet Sappal
Nitrate & Nitrite as Nitrogen in Water	LACH	7732590	N/A	2021/12/20	Chandra Nandlal
Total Oil and Grease	BAL	7736936	2021/12/17	2021/12/17	Saumya Modh
Total Kjeldahl Nitrogen in Water	SKAL	7735168	2021/12/17	2021/12/20	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7735497	2021/12/17	2021/12/19	Shivani Shivani
Low Level Total Suspended Solids	BAL	7736524	2021/12/18	2021/12/20	Shivani Desai

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Bureau Veritas Job #: C1Z1795
Report Date: 2021/12/23

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

TEST SUMMARY

Bureau Veritas ID: RJF530 Dup
Sample ID: SW13
Matrix: Water

Collected: 2021/12/14
Shipped:
Received: 2021/12/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Metals Analysis by ICPMS	ICP/MS	7742166	N/A	2021/12/21	Daniel Teclu

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C

Results relate only to the items tested.

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Bureau Veritas Job #: C1Z1795
Report Date: 2021/12/23

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BL

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7732590	Nitrate (N)	2021/12/20	NC	80 - 120	104	80 - 120	<0.10	mg/L	0.25	20		
7732590	Nitrite (N)	2021/12/20	105	80 - 120	106	80 - 120	<0.010	mg/L	9.6	20		
7732729	Alkalinity (Total as CaCO3)	2021/12/17			97	85 - 115	<1.0	mg/L	0.10	20		
7733819	Nitrate (N)	2021/12/20	106	80 - 120	104	80 - 120	<0.10	mg/L	1.8	20		
7733819	Nitrite (N)	2021/12/20	106	80 - 120	107	80 - 120	<0.010	mg/L				
7733859	Dissolved Chloride (Cl-)	2021/12/17	NC	80 - 120	104	80 - 120	<1.0	mg/L	0.091	20		
7735168	Total Kjeldahl Nitrogen (TKN)	2021/12/20	102	80 - 120	105	80 - 120	<0.10	mg/L	1.7	20	101	80 - 120
7735497	Total Phosphorus	2021/12/19	104	80 - 120	103	80 - 120	<0.004	mg/L	3.9	20	102	80 - 120
7736126	Total Ammonia-N	2021/12/20	98	75 - 125	103	80 - 120	<0.050	mg/L	NC	20		
7736146	Total Ammonia-N	2021/12/21	98	75 - 125	101	80 - 120	<0.050	mg/L	4.0	20		
7736524	Total Suspended Solids	2021/12/20					<1	mg/L	19	25	95	85 - 115
7736936	Total Oil & Grease	2021/12/17			99	85 - 115	<0.50	mg/L	1.0	25		
7742166	Total Aluminum (Al)	2021/12/21	98	80 - 120	99	80 - 120	<4.9	ug/L	8.7	20		
7742166	Total Antimony (Sb)	2021/12/21	101	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
7742166	Total Arsenic (As)	2021/12/21	97	80 - 120	98	80 - 120	<1.0	ug/L	NC	20		
7742166	Total Barium (Ba)	2021/12/21	94	80 - 120	97	80 - 120	<2.0	ug/L	4.6	20		
7742166	Total Beryllium (Be)	2021/12/21	96	80 - 120	96	80 - 120	<0.40	ug/L	NC	20		
7742166	Total Bismuth (Bi)	2021/12/21	88	80 - 120	92	80 - 120	<1.0	ug/L	NC	20		
7742166	Total Boron (B)	2021/12/21	100	80 - 120	99	80 - 120	<10	ug/L	NC	20		
7742166	Total Cadmium (Cd)	2021/12/21	98	80 - 120	94	80 - 120	<0.090	ug/L	NC	20		
7742166	Total Calcium (Ca)	2021/12/21	NC	80 - 120	96	80 - 120	<200	ug/L	0.085	20		
7742166	Total Chromium (Cr)	2021/12/21	94	80 - 120	94	80 - 120	<5.0	ug/L	NC	20		
7742166	Total Cobalt (Co)	2021/12/21	94	80 - 120	95	80 - 120	<0.50	ug/L	NC	20		
7742166	Total Copper (Cu)	2021/12/21	97	80 - 120	95	80 - 120	<0.90	ug/L	NC	20		
7742166	Total Iron (Fe)	2021/12/21	92	80 - 120	94	80 - 120	<100	ug/L	2.2	20		
7742166	Total Lead (Pb)	2021/12/21	89	80 - 120	93	80 - 120	<0.50	ug/L	NC	20		
7742166	Total Lithium (Li)	2021/12/21	94	80 - 120	96	80 - 120	<5.0	ug/L	NC	20		
7742166	Total Magnesium (Mg)	2021/12/21	92	80 - 120	96	80 - 120	<50	ug/L	0.38	20		
7742166	Total Manganese (Mn)	2021/12/21	96	80 - 120	97	80 - 120	<2.0	ug/L	2.9	20		
7742166	Total Molybdenum (Mo)	2021/12/21	99	80 - 120	96	80 - 120	<0.50	ug/L	NC	20		
7742166	Total Nickel (Ni)	2021/12/21	95	80 - 120	95	80 - 120	<1.0	ug/L	NC	20		

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7742166	Total Potassium (K)	2021/12/21	97	80 - 120	97	80 - 120	<200	ug/L	1.2	20		
7742166	Total Selenium (Se)	2021/12/21	100	80 - 120	99	80 - 120	<2.0	ug/L	NC	20		
7742166	Total Silicon (Si)	2021/12/21	99	80 - 120	99	80 - 120	<50	ug/L	0.52	20		
7742166	Total Silver (Ag)	2021/12/21	98	80 - 120	96	80 - 120	<0.090	ug/L	NC	20		
7742166	Total Sodium (Na)	2021/12/21	93	80 - 120	96	80 - 120	<100	ug/L	0.093	20		
7742166	Total Strontium (Sr)	2021/12/21	94	80 - 120	95	80 - 120	<1.0	ug/L	0.45	20		
7742166	Total Tellurium (Te)	2021/12/21	102	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
7742166	Total Thallium (Tl)	2021/12/21	90	80 - 120	94	80 - 120	<0.050	ug/L	NC	20		
7742166	Total Tin (Sn)	2021/12/21	99	80 - 120	95	80 - 120	<1.0	ug/L	NC	20		
7742166	Total Titanium (Ti)	2021/12/21	93	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
7742166	Total Tungsten (W)	2021/12/21	94	80 - 120	95	80 - 120	<1.0	ug/L	NC	20		
7742166	Total Uranium (U)	2021/12/21	92	80 - 120	93	80 - 120	<0.10	ug/L	1.5	20		
7742166	Total Vanadium (V)	2021/12/21	96	80 - 120	95	80 - 120	<0.50	ug/L	NC	20		
7742166	Total Zinc (Zn)	2021/12/21	95	80 - 120	97	80 - 120	<5.0	ug/L	NC	20		
7742166	Total Zirconium (Zr)	2021/12/21	99	80 - 120	96	80 - 120	<1.0	ug/L	NC	20		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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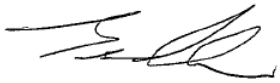
Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Your Project #: 19129150
Your C.O.C. #: 868520-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2022/03/31
Report #: R7067378
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C279893
Received: 2022/03/25, 08:35

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	5	N/A	2022/03/28	CAM SOP-00448	SM 23 2320 B m
Chloride by Automated Colourimetry	5	N/A	2022/03/28	CAM SOP-00463	SM 23 4500-Cl E m
Hardness (calculated as CaCO3)	3	N/A	2022/03/29	CAM SOP 00102/00408/00447	SM 2340 B
Hardness (calculated as CaCO3)	2	N/A	2022/03/30	CAM SOP 00102/00408/00447	SM 2340 B
Total Metals Analysis by ICPMS	5	N/A	2022/03/30	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	5	N/A	2022/03/30	CAM SOP-00441	USGS I-2522-90 m
Nitrate & Nitrite as Nitrogen in Water (1)	2	N/A	2022/03/27	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Nitrate & Nitrite as Nitrogen in Water (1)	3	N/A	2022/03/29	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Total Oil and Grease	5	2022/03/29	2022/03/29	CAM SOP-00326	EPA1664B m,SM5520B m
Total Kjeldahl Nitrogen in Water	5	2022/03/29	2022/03/30	CAM SOP-00938	OMOE E3516 m
Total Phosphorus (Colourimetric)	5	2022/03/29	2022/03/29	CAM SOP-00407	SM 23 4500 P B H m
Low Level Total Suspended Solids	5	2022/03/28	2022/03/29	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope

Your Project #: 19129150
Your C.O.C. #: 868520-01-01

Attention: Craig De Vito

Golder Associates Ltd
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2022/03/31
Report #: R7067378
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C279893
Received: 2022/03/25, 08:35

dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ankita Bhalla, Project Manager
Email: Ankita.Bhalla@bureauveritas.com
Phone# (905) 817-5700
==========
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For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		SES283		SES284			SES284		
Sampling Date		2022/03/24 17:30		2022/03/24 11:30			2022/03/24 11:30		
COC Number		868520-01-01		868520-01-01			868520-01-01		
	UNITS	SW8	QC Batch	SW10	RDL	QC Batch	SW10 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Hardness (CaCO3)	mg/L	220	7903799	280	1.0	7903799			
Inorganics									
Total Ammonia-N	mg/L	<0.050	7909691	<0.050	0.050	7910207			
Total Kjeldahl Nitrogen (TKN)	mg/L	0.20	7909303	0.12	0.10	7909303	<0.10	0.10	7909303
Total Phosphorus	mg/L	0.014	7909659	0.008	0.004	7909659			
Total Suspended Solids	mg/L	<1	7905830	<1	1	7905830	1	1	7905830
Alkalinity (Total as CaCO3)	mg/L	200	7905833	240	1.0	7905833			
Dissolved Chloride (Cl-)	mg/L	36	7905356	42	1.0	7905356			
Nitrite (N)	mg/L	<0.010	7905642	<0.010	0.010	7905733			
Nitrate (N)	mg/L	1.26	7905642	1.08	0.10	7905733			
Nitrate + Nitrite (N)	mg/L	1.26	7905642	1.08	0.10	7905733			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	<0.50	7908938	0.80	0.50	7908938			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C279893
Report Date: 2022/03/31

Golder Associates Ltd
Client Project #: 19129150
Sampler Initials: BC

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		SES285			SES286	SES287		
Sampling Date		2022/03/24 09:30			2022/03/24 12:00	2022/03/24 09:00		
COC Number		868520-01-01			868520-01-01	868520-01-01		
	UNITS	SW11	RDL	QC Batch	SW9	SW13	RDL	QC Batch
Calculated Parameters								
Hardness (CaCO3)	mg/L	230	1.0	7903799	230	210	1.0	7903799
Inorganics								
Total Ammonia-N	mg/L	1.2	0.050	7910207	0.099	0.087	0.050	7910207
Total Kjeldahl Nitrogen (TKN)	mg/L	1.6	0.10	7909303	0.30	0.27	0.10	7909303
Total Phosphorus	mg/L	0.37	0.02	7909659	0.020	0.009	0.004	7909659
Total Suspended Solids	mg/L	5	1	7905830	18	2	1	7905830
Alkalinity (Total as CaCO3)	mg/L	210	1.0	7905833	200	190	1.0	7905833
Dissolved Chloride (Cl-)	mg/L	37	1.0	7905356	30	31	1.0	7905356
Nitrite (N)	mg/L	0.059	0.010	7905733	<0.010	<0.010	0.010	7905642
Nitrate (N)	mg/L	1.14	0.10	7905733	1.00	0.26	0.10	7905642
Nitrate + Nitrite (N)	mg/L	1.20	0.10	7905733	1.00	0.26	0.10	7905642
Petroleum Hydrocarbons								
Total Oil & Grease	mg/L	0.70	0.50	7908938	0.60	0.70	0.50	7908938

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID		SES283	SES284	SES285	SES286	SES287		
Sampling Date		2022/03/24 17:30	2022/03/24 11:30	2022/03/24 09:30	2022/03/24 12:00	2022/03/24 09:00		
COC Number		868520-01-01	868520-01-01	868520-01-01	868520-01-01	868520-01-01		
	UNITS	SW8	SW10	SW11	SW9	SW13	RDL	QC Batch
Metals								
Total Aluminum (Al)	ug/L	23	7.0	27	13	18	4.9	7911690
Total Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7911690
Total Arsenic (As)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690
Total Barium (Ba)	ug/L	16	63	19	97	28	2.0	7911690
Total Beryllium (Be)	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	7911690
Total Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690
Total Boron (B)	ug/L	<10	<10	10	16	<10	10	7911690
Total Cadmium (Cd)	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	7911690
Total Calcium (Ca)	ug/L	62000	77000	66000	59000	58000	200	7911690
Total Chromium (Cr)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7911690
Total Cobalt (Co)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7911690
Total Copper (Cu)	ug/L	<0.90	1.8	1.4	<0.90	<0.90	0.90	7911690
Total Iron (Fe)	ug/L	<100	<100	290	<100	130	100	7911690
Total Lead (Pb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7911690
Total Lithium (Li)	ug/L	<5.0	<5.0	<5.0	5.3	<5.0	5.0	7911690
Total Magnesium (Mg)	ug/L	16000	16000	13000	16000	12000	50	7911690
Total Manganese (Mn)	ug/L	4.6	3.9	130	13	41	2.0	7911690
Total Molybdenum (Mo)	ug/L	<0.50	<0.50	<0.50	0.59	<0.50	0.50	7911690
Total Nickel (Ni)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690
Total Potassium (K)	ug/L	1800	1200	6400	1100	1200	200	7911690
Total Selenium (Se)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7911690
Total Silicon (Si)	ug/L	2000	3300	2500	3800	2100	50	7911690
Total Silver (Ag)	ug/L	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	7911690
Total Sodium (Na)	ug/L	18000	24000	17000	16000	16000	100	7911690
Total Strontium (Sr)	ug/L	110	130	100	180	100	1.0	7911690
Total Tellurium (Te)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690
Total Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7911690
Total Tin (Sn)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690
Total Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	7911690
Total Tungsten (W)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690
Total Uranium (U)	ug/L	0.54	0.19	0.26	0.59	0.18	0.10	7911690

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID		SES283	SES284	SES285	SES286	SES287		
Sampling Date		2022/03/24 17:30	2022/03/24 11:30	2022/03/24 09:30	2022/03/24 12:00	2022/03/24 09:00		
COC Number		868520-01-01	868520-01-01	868520-01-01	868520-01-01	868520-01-01		
	UNITS	**SW8**	**SW10**	**SW11**	**SW9**	**SW13**	**RDL**	**QC Batch**
Total Vanadium (V)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7911690
Total Zinc (Zn)	ug/L	<5.0	<5.0	6.6	<5.0	<5.0	5.0	7911690
Total Zirconium (Zr)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7911690

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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TEST SUMMARY

Bureau Veritas ID: SES283 **Collected:** 2022/03/24
Sample ID: SW8 **Shipped:**
Matrix: Water **Received:** 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7905833	N/A	2022/03/28	Surinder Rai
Chloride by Automated Colourimetry	KONE	7905356	N/A	2022/03/28	Alina Dobreanu
Hardness (calculated as CaCO3)		7903799	N/A	2022/03/29	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7911690	N/A	2022/03/30	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7909691	N/A	2022/03/30	Raiq Kashif
Nitrate & Nitrite as Nitrogen in Water	LACH	7905642	N/A	2022/03/29	Samuel Law
Total Oil and Grease	BAL	7908938	2022/03/29	2022/03/29	Jay Bhadresh Doshi
Total Kjeldahl Nitrogen in Water	SKAL	7909303	2022/03/29	2022/03/30	Massarat Jan
Total Phosphorus (Colourimetric)	LACH/P	7909659	2022/03/29	2022/03/29	Nimarta Singh
Low Level Total Suspended Solids	BAL	7905830	2022/03/28	2022/03/29	Shaneil Hall

Bureau Veritas ID: SES284 **Collected:** 2022/03/24
Sample ID: SW10 **Shipped:**
Matrix: Water **Received:** 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7905833	N/A	2022/03/28	Surinder Rai
Chloride by Automated Colourimetry	KONE	7905356	N/A	2022/03/28	Alina Dobreanu
Hardness (calculated as CaCO3)		7903799	N/A	2022/03/29	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7911690	N/A	2022/03/30	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7910207	N/A	2022/03/30	Raiq Kashif
Nitrate & Nitrite as Nitrogen in Water	LACH	7905733	N/A	2022/03/27	Raiq Kashif
Total Oil and Grease	BAL	7908938	2022/03/29	2022/03/29	Jay Bhadresh Doshi
Total Kjeldahl Nitrogen in Water	SKAL	7909303	2022/03/29	2022/03/30	Massarat Jan
Total Phosphorus (Colourimetric)	LACH/P	7909659	2022/03/29	2022/03/29	Nimarta Singh
Low Level Total Suspended Solids	BAL	7905830	2022/03/28	2022/03/29	Shaneil Hall

Bureau Veritas ID: SES284 Dup **Collected:** 2022/03/24
Sample ID: SW10 **Shipped:**
Matrix: Water **Received:** 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Kjeldahl Nitrogen in Water	SKAL	7909303	2022/03/29	2022/03/30	Massarat Jan
Low Level Total Suspended Solids	BAL	7905830	2022/03/28	2022/03/29	Shaneil Hall

Bureau Veritas ID: SES285 **Collected:** 2022/03/24
Sample ID: SW11 **Shipped:**
Matrix: Water **Received:** 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7905833	N/A	2022/03/28	Surinder Rai
Chloride by Automated Colourimetry	KONE	7905356	N/A	2022/03/28	Alina Dobreanu
Hardness (calculated as CaCO3)		7903799	N/A	2022/03/30	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7911690	N/A	2022/03/30	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7910207	N/A	2022/03/30	Raiq Kashif

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

TEST SUMMARY

Bureau Veritas ID: SES285
Sample ID: SW11
Matrix: Water

Collected: 2022/03/24
Shipped:
Received: 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Nitrate & Nitrite as Nitrogen in Water	LACH	7905733	N/A	2022/03/27	Raiq Kashif
Total Oil and Grease	BAL	7908938	2022/03/29	2022/03/29	Jay Bhadresh Doshi
Total Kjeldahl Nitrogen in Water	SKAL	7909303	2022/03/29	2022/03/30	Massarat Jan
Total Phosphorus (Colourimetric)	LACH/P	7909659	2022/03/29	2022/03/29	Nimarta Singh
Low Level Total Suspended Solids	BAL	7905830	2022/03/28	2022/03/29	Shaneil Hall

Bureau Veritas ID: SES286
Sample ID: SW9
Matrix: Water

Collected: 2022/03/24
Shipped:
Received: 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7905833	N/A	2022/03/28	Surinder Rai
Chloride by Automated Colourimetry	KONE	7905356	N/A	2022/03/28	Alina Dobreanu
Hardness (calculated as CaCO3)		7903799	N/A	2022/03/30	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7911690	N/A	2022/03/30	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7910207	N/A	2022/03/30	Raiq Kashif
Nitrate & Nitrite as Nitrogen in Water	LACH	7905642	N/A	2022/03/29	Samuel Law
Total Oil and Grease	BAL	7908938	2022/03/29	2022/03/29	Jay Bhadresh Doshi
Total Kjeldahl Nitrogen in Water	SKAL	7909303	2022/03/29	2022/03/30	Massarat Jan
Total Phosphorus (Colourimetric)	LACH/P	7909659	2022/03/29	2022/03/29	Nimarta Singh
Low Level Total Suspended Solids	BAL	7905830	2022/03/28	2022/03/29	Shaneil Hall

Bureau Veritas ID: SES287
Sample ID: SW13
Matrix: Water

Collected: 2022/03/24
Shipped:
Received: 2022/03/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	7905833	N/A	2022/03/28	Surinder Rai
Chloride by Automated Colourimetry	KONE	7905356	N/A	2022/03/28	Alina Dobreanu
Hardness (calculated as CaCO3)		7903799	N/A	2022/03/29	Automated Statchk
Total Metals Analysis by ICPMS	ICP/MS	7911690	N/A	2022/03/30	Azita Fazaeli
Total Ammonia-N	LACH/NH4	7910207	N/A	2022/03/30	Raiq Kashif
Nitrate & Nitrite as Nitrogen in Water	LACH	7905642	N/A	2022/03/29	Samuel Law
Total Oil and Grease	BAL	7908938	2022/03/29	2022/03/29	Jay Bhadresh Doshi
Total Kjeldahl Nitrogen in Water	SKAL	7909303	2022/03/29	2022/03/30	Massarat Jan
Total Phosphorus (Colourimetric)	LACH/P	7909659	2022/03/29	2022/03/29	Nimarta Singh
Low Level Total Suspended Solids	BAL	7905830	2022/03/28	2022/03/29	Shaneil Hall

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Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.3°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7905356	Dissolved Chloride (Cl-)	2022/03/28	NC	80 - 120	106	80 - 120	<1.0	mg/L	0.17	20		
7905642	Nitrate (N)	2022/03/29	100	80 - 120	102	80 - 120	<0.10	mg/L	0.043	20		
7905642	Nitrite (N)	2022/03/29	107	80 - 120	107	80 - 120	<0.010	mg/L	NC	20		
7905733	Nitrate (N)	2022/03/27	103	80 - 120	104	80 - 120	<0.10	mg/L	NC	20		
7905733	Nitrite (N)	2022/03/27	105	80 - 120	105	80 - 120	<0.010	mg/L	NC	20		
7905830	Total Suspended Solids	2022/03/29					<1	mg/L	0	25	97	85 - 115
7905833	Alkalinity (Total as CaCO3)	2022/03/28			96	85 - 115	<1.0	mg/L	1.4	20		
7908938	Total Oil & Grease	2022/03/29			98	85 - 115	<0.50	mg/L	0.26	25		
7909303	Total Kjeldahl Nitrogen (TKN)	2022/03/30	105	80 - 120	102	80 - 120	<0.10	mg/L	19	20	94	80 - 120
7909659	Total Phosphorus	2022/03/29	105	80 - 120	108	80 - 120	<0.004	mg/L	NC	20	110	80 - 120
7909691	Total Ammonia-N	2022/03/30	50 (1)	75 - 125	99	80 - 120	<0.050	mg/L	NC	20		
7910207	Total Ammonia-N	2022/03/30	47 (1)	75 - 125	100	80 - 120	<0.050	mg/L	1.7	20		
7911690	Total Aluminum (Al)	2022/03/30	99	80 - 120	98	80 - 120	<4.9	ug/L				
7911690	Total Antimony (Sb)	2022/03/30	102	80 - 120	98	80 - 120	<0.50	ug/L				
7911690	Total Arsenic (As)	2022/03/30	99	80 - 120	96	80 - 120	<1.0	ug/L				
7911690	Total Barium (Ba)	2022/03/30	98	80 - 120	95	80 - 120	<2.0	ug/L				
7911690	Total Beryllium (Be)	2022/03/30	96	80 - 120	95	80 - 120	<0.40	ug/L				
7911690	Total Bismuth (Bi)	2022/03/30	94	80 - 120	94	80 - 120	<1.0	ug/L				
7911690	Total Boron (B)	2022/03/30	94	80 - 120	91	80 - 120	<10	ug/L	NC	20		
7911690	Total Cadmium (Cd)	2022/03/30	99	80 - 120	97	80 - 120	<0.090	ug/L				
7911690	Total Calcium (Ca)	2022/03/30	NC	80 - 120	95	80 - 120	<200	ug/L	0.82	20		
7911690	Total Chromium (Cr)	2022/03/30	97	80 - 120	94	80 - 120	<5.0	ug/L				
7911690	Total Cobalt (Co)	2022/03/30	102	80 - 120	97	80 - 120	<0.50	ug/L				
7911690	Total Copper (Cu)	2022/03/30	96	80 - 120	92	80 - 120	<0.90	ug/L				
7911690	Total Iron (Fe)	2022/03/30	99	80 - 120	95	80 - 120	<100	ug/L	NC	20		
7911690	Total Lead (Pb)	2022/03/30	97	80 - 120	95	80 - 120	<0.50	ug/L				
7911690	Total Lithium (Li)	2022/03/30	96	80 - 120	94	80 - 120	<5.0	ug/L				
7911690	Total Magnesium (Mg)	2022/03/30	98	80 - 120	97	80 - 120	<50	ug/L	1.3	20		
7911690	Total Manganese (Mn)	2022/03/30	99	80 - 120	96	80 - 120	<2.0	ug/L				
7911690	Total Molybdenum (Mo)	2022/03/30	99	80 - 120	94	80 - 120	<0.50	ug/L				
7911690	Total Nickel (Ni)	2022/03/30	98	80 - 120	96	80 - 120	<1.0	ug/L				

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7911690	Total Potassium (K)	2022/03/30	99	80 - 120	97	80 - 120	<200	ug/L	1.4	20		
7911690	Total Selenium (Se)	2022/03/30	102	80 - 120	101	80 - 120	<2.0	ug/L				
7911690	Total Silicon (Si)	2022/03/30	98	80 - 120	96	80 - 120	<50	ug/L				
7911690	Total Silver (Ag)	2022/03/30	95	80 - 120	93	80 - 120	<0.090	ug/L				
7911690	Total Sodium (Na)	2022/03/30	NC	80 - 120	95	80 - 120	<100	ug/L	1.5	20		
7911690	Total Strontium (Sr)	2022/03/30	96	80 - 120	93	80 - 120	<1.0	ug/L				
7911690	Total Tellurium (Te)	2022/03/30	99	80 - 120	96	80 - 120	<1.0	ug/L				
7911690	Total Thallium (Tl)	2022/03/30	103	80 - 120	98	80 - 120	<0.050	ug/L				
7911690	Total Tin (Sn)	2022/03/30	101	80 - 120	96	80 - 120	<1.0	ug/L				
7911690	Total Titanium (Ti)	2022/03/30	94	80 - 120	93	80 - 120	<5.0	ug/L				
7911690	Total Tungsten (W)	2022/03/30	102	80 - 120	98	80 - 120	<1.0	ug/L				
7911690	Total Uranium (U)	2022/03/30	95	80 - 120	92	80 - 120	<0.10	ug/L				
7911690	Total Vanadium (V)	2022/03/30	97	80 - 120	94	80 - 120	<0.50	ug/L				
7911690	Total Zinc (Zn)	2022/03/30	101	80 - 120	100	80 - 120	<5.0	ug/L	0.42	20		
7911690	Total Zirconium (Zr)	2022/03/30	103	80 - 120	97	80 - 120	<1.0	ug/L				

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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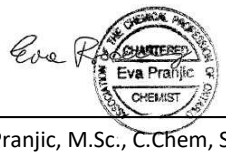
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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109 & 110, 4023 Meadowbrook Drive, London, Ontario Canada N6L 1E7 Tel:(519) 652-9444 Toll-free:800-563-6266 Fax:(519) 652-8189 www.bvna.com

Page of

25-Mar-22 08:35
Ankita Bhalla
C279893
KTN ENV-1171
C#868520-01-01

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	C20239
Attention:	Accounts Payable	Attention:	Craig De Vito	P.O. #:	
Address:	6925 Century Ave Suite 100	Address:		Project:	19129150
	Mississauga ON L5N 7K2			Project Name:	
Tel:	(905) 567-4444 Fax: (905) 567-6561	Tel:	(905) 567-6100 Ext: 1507 Fax:	Site #:	
Email:	CanadaAccountsPayableInvoices@golder.com	Email:	Craig_DeVito@golder.com	Sampled By:	

Bottle Order #: 868520
Project Manager: Ankita Bhalla

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ___ ☐ Res/Park ☐ Ind/Comm ☐ Agri/Other ☐ Medium/Fine ☐ Coarse ☐ For RSC

Other Regulations: ☐ CCME ☐ Reg 558 ☐ MISA ☐ PWQO ☐ Other ☐ Sanitary Sewer Bylaw ☐ Storm Sewer Bylaw Municipality ___ ☐ Reg 406 Table ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Total Metals Analysis by ICPMS	Chloride, Nitrate & Nitrite	Total Ammonia-N, TKN, Total P	Alkalinity, Hardness	Low Level Total Suspended Solids	Total Oil and Grease					# of Bottles	Comments
1		SW 8	Mar 24 2022	1730	SW		X	X	X	X	X	X					6	
2		SW 10		1130													6	
3		SW 11		930													6	
4		SW 9		1200													6	
5		SW 13		900													6	
6																		
7																		
8																		
9																		
10																		

REC'D IN WATERLOO

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Brian Lingelbach	22 03 24	20:20	Sarah Webster	2022/03/25	0835	
			Sh Ray Mascary	2022/03/25	1546	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	1/4/2.	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS.
* IT IS THE RESPO[illegible]Y OF THE [illegible]E RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTO[illegible]CORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** SAMPLE O[illegible], HOLD TIME AND PACKAGE INFORMATION CAN BE V[illegible]ED AT [illegible]COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

White: Bureau Veritas Yellow: Client
on ice.

Bureau Veritas Canada (2019) Inc.

1/0/3, 2/0/0 BV- [illegible]

APPENDIX P

Water Balance Calculations

Table P-1
Land Use Designations and Infiltration Factors

Existing Conditions

Type	WHC	Type of Land Use	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Forested Swamp	250 mm	Wetland / Mature Forest	Silt Loam / Organics	0.00	0.00	0.00	0.00
Local Pond	Precip-Lake Evap.	Open Aquatic	Silt Loam / Organics	0.00	0.00	0.00	0.00
Marsh / Wet Meadow	Precip. - Lake Evap.	Wetland	Silt Loam / Organics	0.00	0.00	0.00	0.00
Forested Area	300 mm	Mature Forest	Fine Sandy Loam	0.10	0.40	0.20	0.70
Pervious Built-Up Area	75 mm	Urban Lawns	Fine Sandy Loam	0.20	0.40	0.10	0.70
Impervious Built up Areas	3 mm	Roadway	n/a	n/a	0.00	0.00	0.00
Moderately Rooted Agricultural Land / Meadow	150 mm	Tilled / Pasture & Shrubs	Fine Sandy Loam	0.15	0.40	0.10	0.65

Operational Conditions (Phases 1 - 7)

Type	WHC	Type of Land Use	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Forested Swamp	250 mm	Wetland / Mature Forest	Silt Loam / Organics	0.00	0.00	0.00	0.00
Local Pond	Precip-Lake Evap.	Open Aquatic	Silt Loam / Organics	0.00	0.00	0.00	0.00
Marsh / Wet Meadow	Precip. - Lake Evap.	Wetland	Silt Loam / Organics	0.00	0.00	0.00	0.00
Forested Area	300 mm	Mature Forest	Fine Sandy Loam	0.10	0.40	0.20	0.70
Impervious Built up Areas	90% Precip	Roadway / Buildings	n/a	n/a	0.00	0.00	0.00
Moderately Rooted Agricultural Land / Meadow	150 mm	Tilled / Pasture & Shrubs	Fine Sandy Loam	0.15	0.40	0.10	0.65
Till / Rehab Area	100 mm	Tilled	Fine Sandy Loam	0.20	0.40	0.10	0.70
Quarry Sump	Precip. - Lake Evap.	Ponded Area	n/a	0.00	0.00	0.00	0.00
Quarry Extraction Area	10 mm	Quarry (Dewatered)	Bedrock	0.00	0.00	0.00	0.00

Rehabilitated Conditions

Type	WHC	Type of Land Use	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Forested Swamp	250 mm	Wetland / Mature Forest	Silt Loam / Organics	0.00	0.00	0.00	0.00
Marsh / Wet Meadow / Wetland	Precip. - Lake Evap.	Wetland	Silt Loam / Organics	0.00	0.00	0.00	0.00
Forested Area	300 mm	Mature Forest	Fine Sandy Loam	0.10	0.40	0.20	0.70
Post-Agricultural land / Meadow / Grassland / Island	150 mm	Pastures and Shrubs	Fine Sandy Loam	0.15	0.40	0.10	0.65
Lake / Local Pond	Precip.- Lake Evap	Open Aquatic	n/a	0.00	0.00	0.00	0.00

Note:
WHC - Water Holding Capacity
The infiltration factor is estimated by summing a factor for topography, soils and cover (MOE Stormwater Management Planning and Design Manual, 2003-Table 3.1)

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9940	578	6400	319	3530	0	0	319	3530
Wet Meadow	8,244	898	7,400	664	5,470	382	3150	0	0	382	3150
Impervious Built-Up Areas	120	898	110	444	50	452	55	0	0	452	50
Pervious Built-Up Areas	21,106	898	18,950	514	10,850	382	8065	267	5645	115	2420
Forested Area	229,498	898	206,090	578	132,650	319	73210	223	51245	96	21965
Moderately Rooted Agricultural Land / Meadow	2,349,774	898	2,110,100	556	1,306,470	342	803620	222	522355	120	281270
TOTAL	**2,619,807**	**898**	**2,352,590**	**558**	**1,461,890**	**340**	**891,630**	**221**	**579,245**	**119**	**312,385**

Operational Condition (Phase 1) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,940	514	5,690	382	4,225	0	0	382	4,225
Wet Meadow	8,244	898	7,400	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	55	0	0	452	50
Pervious Built-Up Areas	17,934	898	16,100	556	9,970	347	6,225	243	4,360	104	1,865
Forested Area	178,785	898	160,550	578	103,340	319	57,030	223	39,920	96	17,110
Moderately Rooted Agricultural Land / Meadow	1,778,535	898	1,597,120	556	988,870	342	608,260	222	395,370	120	212,890
Till / Rehab Area	186,269	898	167,270	532	99,100	365	67,990	256	47,590	110	20,400
Quarry Sump	27,900	898	25,050	664	18,530	234	6,525	0	0	234	6,530
Quarry Extraction Area	410,956	898	369,040	453	186,160	446	183,285	0	0	446	183,290
TOTAL	**2,619,807**	**898**	**2,352,580**	**541**	**1,417,180**	**357**	**935,525**	**186**	**487,240**	**171**	**448,290**

Operational Condition (Phases 2A & 2B) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,940	514	5,690	382	4,225	0	0	382	4,225
Wet Meadow	8,244	898	7,400	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	50	0	0	452	55
Pervious Built-Up Areas	16,822	898	15,110	514	8,650	382	6,430	267	4,500	115	1,930
Forested Area	161,010	898	144,590	578	93,060	319	51,360	223	35,950	96	15,410
Moderately Rooted Agricultural Land / Meadow	1,578,321	898	1,417,330	556	877,550	342	539,790	222	350,860	120	188,925
Till / Rehab Area	337,364	898	302,950	532	179,480	365	123,140	256	86,200	110	36,940
Quarry Sump	27,900	898	25,050	664	18,530	234	6,530	0	0	234	6,525
Quarry Extraction Area	478,961	898	430,110	453	216,970	446	213,620	0	0	446	213,620
TOTAL	**2,619,807**	**898**	**2,352,590**	**536**	**1,405,450**	**362**	**947,075**	**182**	**477,510**	**179**	**469,560**

Operational Condition (Phase 3) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,940	514	5,690	382	4,225	0	0	382	4,230
Wet Meadow	8,244	898	7,400	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	50	0	0	452	50
Pervious Built-Up Areas	15,901	898	14,280	514	8,170	382	6,075	267	4,250	115	1,820
Forested Area	146,280	898	131,360	578	84,550	319	46,665	223	32,660	96	14,000
Moderately Rooted Agricultural Land / Meadow	1,412,398	898	1,268,330	556	785,290	342	483,040	222	313,980	120	169,060
Till / Rehab Area	436,300	898	391,800	532	232,110	365	159,250	256	111,470	110	47,770
Quarry Sump	27,900	898	25,050	664	18,530	234	6,530	0	0	234	6,530
Quarry Extraction Area	561,600	898	504,320	453	254,400	446	250,470	0	0	446	250,470
TOTAL	**2,619,807**	**898**	**2,352,590**	**532**	**1,394,260**	**366**	**958,235**	**176**	**462,360**	**189**	**495,860**

Operational Condition (Phase 4) - Estimated Average Annual Water Balance										
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,940	514	5,690	382	4,230	0	0	382	4,230
Wet Meadow	8,244	898	7,400	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	50	0	0	452	50
Pervious Built-Up Areas	14,892	898	13,370	514	7,650	382	5,690	267	3,980	115	1,710
Forested Area	130,160	898	116,880	578	75,230	319	41,520	223	29,060	96	12,455
Moderately Rooted Agricultural Land / Meadow	1,230,826	898	1,105,280	556	684,340	342	420,940	222	273,610	120	147,330
Till / Rehab Area	490,700	898	440,650	532	261,050	365	179,105	256	125,370	110	53,730
Quarry Sump	27,900	898	25,050	664	18,530	234	6,530	0	0	234	6,525
Quarry Extraction Area	705,900	898	633,900	453	319,770	446	314,830	0	0	446	314,830
TOTAL	**2,619,807**	**898**	**2,352,580**	**526**	**1,377,780**	**372**	**974,825**	**165**	**432,020**	**207**	**542,790**

Operational Condition (Phase 5) - Estimated Average Annual Water Balance										
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,940	514	5,690	382	4,230	0	0	382	4,230
Wet Meadow	8,244	898	7,400	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	55	0	0	452	55
Pervious Built-Up Areas	13,251	898	11,900	514	6,810	382	5,060	267	3,545	115	1,520
Forested Area	103,932	898	93,330	578	60,070	319	33,155	223	23,210	96	9,945
Moderately Rooted Agricultural Land / Meadow	935,394	898	839,980	556	520,080	342	319,905	222	207,940	120	111,965
Till / Rehab Area	558,675	898	501,690	532	297,220	365	203,915	256	142,740	110	61,175
Quarry Sump	27,900	898	25,050	664	18,530	234	6,525	0	0	234	6,525
Quarry Extraction Area	961,225	898	863,180	453	435,430	446	428,705	0	0	446	428,705
TOTAL	**2,619,807**	**898**	**2,352,580**	**515**	**1,349,350**	**383**	**1,003,480**	**144**	**377,435**	**239**	**626,050**

Operational Condition (Phase 6) - Estimated Average Annual Water Balance										
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,940	514	5,690	382	4,230	0	0	382	4,230
Wet Meadow	8,244	898	7,400	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	50	0	0	452	50
Pervious Built-Up Areas	12,028	898	10,800	514	6,180	382	4,595	267	3,220	115	1,380
Forested Area	84,377	898	75,770	578	48,770	319	26,920	223	18,840	96	8,075
Moderately Rooted Agricultural Land / Meadow	715,123	898	642,180	556	397,610	342	244,570	222	158,970	120	85,600
Till / Rehab Area	621,189	898	557,830	532	330,470	365	226,730	256	158,710	110	68,020
Quarry Sump	32,650	898	29,320	664	21,680	234	7,640	0	0	234	7,640
Quarry Extraction Area	1,135,011	898	1,019,240	453	514,160	446	506,210	0	0	446	506,215
TOTAL	**2,619,807**	**898**	**2,352,590**	**508**	**1,330,080**	**390**	**1,022,875**	**130**	**339,740**	**261**	**683,140**

Operational Condition (Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9,935	514	5,690	382	4,230	0	0	382	4,230
Wet Meadow	8,244	898	7,405	664	5,470	234	1,930	0	0	234	1,930
Impervious Built-Up Areas	120	898	110	444	50	452	50	0	0	452	50
Pervious Built-Up Areas	10,923	898	9,810	514	5,610	382	4,170	267	2,920	115	1,250
Forested Area	66,704	898	59,900	578	38,550	319	21,280	223	14,895	96	6,385
Moderately Rooted Agricultural Land / Meadow	516,052	898	463,415	556	286,920	342	176,490	222	114,720	120	61,770
Till / Rehab Area	581,995	898	522,630	532	309,620	365	212,430	256	148,700	110	63,730
Quarry Sump	32,650	898	29,320	664	21,680	234	7,640	0	0	234	7,640
Quarry Extraction Area	1,392,055	898	1,250,065	453	630,600	446	620,855	0	0	446	620,855
TOTAL	**2,619,807**	**898**	**2,352,590**	**498**	**1,304,190**	**400**	**1,049,075**	**107**	**281,235**	**293**	**767,840**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	11,065	898	9940	574	6350	321	3550	0	0	321	3550
Wet Meadow / Wetland	56,244	898	50,510	664	37350	234	13160	0	0	234	13160
Forested Area	540,353	898	485,240	453	244780	446	241000	312	168700	134	72300
Post-Agricultural land / Meadow / Grasslan	429,145	898	385,370	578	248050	319	136895	207	88980	112	47915
Lake	1,583,000	898	1,421,530	664	1051210	234	370320	234	370320	0	0
TOTAL	**2,619,807**	**898**	**2,352,590**	**606**	**1,587,740**	**292**	**764,925**	**240**	**628,000**	**52**	**136,925**

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	1,278,334	898	1147940	574	733760	321	410345	0	0.0	321	410345
Wet Meadow	476,174	898	427,600	664	316,210	234	111,390	0	0	234	111,395
Impervious Built-Up Areas	420,044	898	377,200	444	186,500	452	189,860	0	0	452	189,860
Pervious Built-Up Areas	741,375	898	665,750	90	66,580	382	283,205	267	198,240	115	84,960
Forested Area	3,436,450	898	3,085,930	578	1,986,270	319	1,096,230	223	767,360	96	328,870
Moderately Rooted Agricultural Land / Meadow	11,044,239	898	9,917,730	556	6,140,600	342	3,777,130	222	2,455,135	120	1,321,995
TOTAL	**17,396,615**	**898**	**15,622,150**	**542**	**9,429,920**	**337**	**5,868,160**	**197**	**3,420,735**	**141**	**2,447,425**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	1,278,334	898	1,147,940	574	733,760	321	410,345	0	0	321	410,345
Wet Meadow	476,174	898	427,600	664	316,210	234	111,395	0	0	234	111,395
Impervious Built-Up Areas	397,295	898	356,770	444	176,400	452	179,575	0	0	452	179,575
Pervious Built-Up Areas	732,473	898	657,760	514	376,490	382	279,805	267	195,865	115	83,940
Forested Area	3,344,279	898	3,003,160	578	1,932,990	319	1,066,825	223	746,775	96	320,050
Moderately Rooted Agricultural Land / Meadow	9,480,140	898	8,513,170	556	5,270,960	342	3,242,210	222	2,107,435	120	1,134,770
TOTAL	**15,708,695**	**898**	**14,106,400**	**561**	**8,806,810**	**337**	**5,290,155**	**194**	**3,050,075**	**143**	**2,240,075**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	1,278,334	898	1147940	574	733760	321	410345	0	0	321	410345
Wet Meadow	476,174	898	427,600	664	316210	234	111395	0	0	234	111390
Impervious Built-Up Areas	397,295	898	356,770	444	176400	452	179575	0	0	452	179580
Pervious Built-Up Areas	732,473	898	657,760	514	376490	382	279805	267	195865	115	83940
Forested Area	3,344,279	898	3,003,160	578	1932990	319	1066825	223	746775	96	320050
Post-Agricultural Land / Meadow / Grassland	9,480,140	898	8,513,170	556	5270960	342	3242210	222	2107435	120	1134770
TOTAL	**15,708,695**	**898**	**14,106,400**	**549**	**8,806,810**	**325**	**5,290,155**	**194**	**3,050,075**	**131**	**2,240,075**

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Marsh	19,474	898	17490	664	12930	234	4555	0	0.0	233.935	4560
Impervious Built-Up Areas	11,931	898	10,710	444	5,300	452	5,395	0	0	452	5,390
Pervious Built-Up Areas	16,805	898	15,090	514	8,640	382	6,420	248	4,175	134	2,245
Forested Area	47,247	898	42,430	578	27,310	319	15,070	223	10,550	96	4,520
Moderately Rooted Agricultural Land / Meadow	168,513	898	151,320	556	93,690	342	57,630	222	37,460	120	20,170
TOTAL	**263,969**	**898**	**237,040**	**560**	**147,870**	**337**	**89,070**	**198**	**52,185**	**140**	**36,885**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Marsh	19,474	898	17,490	664	12,930	234	4,560	0	0	234	4,560
Impervious Built-Up Areas	113,283	898	101,730	444	50,300	452	51,205	0	0	452	51,205
Pervious Built-Up Areas	20,425	898	18,340	514	10,500	382	7,800	267	5,460	115	2,340
Forested Area	55,211	898	49,580	578	31,910	319	17,610	223	12,330	96	5,280
Moderately Rooted Agricultural Land / Meadow	302,992	898	272,090	556	168,460	342	103,620	222	67,355	120	36,270
TOTAL	**511,385**	**898**	**459,230**	**536**	**274,100**	**361**	**184,795**	**166**	**85,145**	**195**	**99,655**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Marsh	19,474	898	17490	664	12930	234	4560	0	0	234	4560
Impervious Built-Up Areas	113,283	898	101,730	453	51320	446	50525	0	0	446	50525
Pervious Built-Up Areas	20,425	898	18,340	514	10500	382	7800	248	5070	134	2730
Forested Area	55,211	898	49,580	578	31910	319	17610	223	12330	96	5280
Post-Agricultural Land / Meadow	302,992	898	272,090	556	168460	342	103620	222	67355	120	36270
TOTAL	**511,385**	**898**	**459,230**	**538**	**275,120**	**360**	**184,115**	**166**	**84,755**	**194**	**99,365**

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Local Pond	7,775	898	6980	664	5160	234	1820	0	0.0	233.935	1820
Impervious Built-Up Areas	560	898	500	444	250	452	255	0	0	452	250
Pervious Built-Up Areas	736	898	660	514	380	382	280	267	200	115	85
Forested Area	49,373	898	44,340	578	28,540	319	15,750	223	11,025	96	4,725
Moderately Rooted Agricultural Land / Mea	225,235	898	202,260	556	125,230	342	77,030	222	50,070	120	26,960.0
TOTAL	**283,679**	**898**	**254,740**	**562**	**159,560**	**335**	**95,135**	**216**	**61,295**	**119**	**33,840**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Local Pond	7,775	898	6,980	664	5,160	234	1,820	0	0	234	1,820
Impervious Built-Up Areas	886	898	800	444	390	452	400	0	0	452	400
Pervious Built-Up Areas	736	898	660	514	380	382	280	267	200	115	85
Forested Area	49,373	898	44,340	578	28,540	319	15,750	223	11,020	96	4,725
Moderately Rooted Agricultural Land / Meadow	224,583	898	201,680	556	124,870	342	76,805	222	49,920	120	26,885
TOTAL	**283,353**	**898**	**254,460**	**562**	**159,340**	**335**	**95,055**	**216**	**61,140**	**120**	**33,915**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Local Pond	7,775	898	6,980	664	5160	234	1820	0	0	234	1820
Impervious Built-Up Areas	886	898	800	444	390	452	400	0	0	452	400
Pervious Built-Up Areas	736	898	660	514	380	382	280	267	200	115	85
Forested Area	49,373	898	44,340	578	28540	319	15750	223	11020	96	4725
Post-Agricultural Land / Meadow	224,583	898	201,680	556	124870	342	76805	222	49920	120	26885
TOTAL	**283,353**	**898**	**254,460**	**562**	**159,340**	**335**	**95,055**	**216**	**61,140**	**120**	**33,915**

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Impervious Built-Up Areas	6,462	898	5,800	444	2,870	452	2,920	0	0	452	2,920
Moderately Rooted Agricultural Land / Meadow	57,134	898	51,310	556	31,770	342	19,540	222	12,700	120	6,840
TOTAL	**63,596**	**898**	**57,110**	**545**	**34,640**	**353**	**22,460**	**200**	**12,700**	**153**	**9,760**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Impervious Built-Up Areas	6,462	898	5,800	444	2,870	452	2,920	0	0	452	2,920
Moderately Rooted Agricultural Land / Meadow	19,515	898	17,520	556	10,850	342	6,675	222	4,340	120	2,335
TOTAL	**25,977**	**898**	**23,320**	**528**	**13,720**	**369**	**9,595**	**167**	**4,340**	**202**	**5,255**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Impervious Built-Up Areas	6,462	898	5,800	444	2870	452	2920	0	0	452	2920
Post-Agricultural Land / Meadow	19,515	898	17,520	556	10850	342	6675	222	4340	120	2335
TOTAL	**25,977**	**898**	**23,320**	**528**	**13,720**	**369**	**9,595**	**167**	**4,340**	**202**	**5,255**

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	397,020	898	356520	574	227890	321	127440	0	0.0	321	127445
Marsh	16,352	898	14,680	664	10,860	234	3,830	0	0	234	3,825
Local Pond	1,281	898	1,150	664	850	234	300	0	0	234	300
Impervious Built-Up Areas	4,080	898	3,660	444	1,810	452	1,840	0	0	452	1,845
Pervious Built-Up Areas	16,745	898	15,040	514	8,610	382	6,400	267	4,480	115	1,920
Forested Area	556,118	898	499,390	578	321,440	319	177,400	223	124,180	96	53,220
Moderately Rooted Agricultural Land / Meadow	420,517	898	377,620	556	233,810	342	143,820	222	93,480	120	50,335
TOTAL	**1,412,112**	**898**	**1,268,060**	**570**	**805,270**	**326**	**461,030**	**157**	**222,140**	**169**	**238,890**

Operational Condition (Phase 2A) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	397,020	898	356,520	574	227,890	321	127,445	0	0	321	127,445
Marsh	16,352	898	14,680	664	10,860	234	3,825	0	0	234	3,825
Local Pond	1,281	898	1,150	664	850	234	300	0	0	234	300
Impervious Built-Up Areas	4,458	898	4,000	444	1,980	452	2,015	0	0	452	2,015
Pervious Built-Up Areas	16,745	898	15,040	514	8,610	382	6,395	267	4,480	115	1,920
Forested Area	556,118	898	499,390	578	321,440	319	177,400	223	124,180	96	53,220
Moderately Rooted Agricultural Land / Meadow	402,935	898	361,840	556	224,030	342	137,805	222	89,570	120	48,230
TOTAL	**1,394,909**	**898**	**1,252,620**	**570**	**795,660**	**326**	**455,185**	**156**	**218,230**	**170**	**236,955**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	397,020	898	356520	574	227890	321	127445	0	0	321	127445
Marsh	16,352	898	14,680	664	10860	234	3825	0	0	234	3825
Local Pond	1,281	898	1,150	664	850	234	300	0	0	234	300
Impervious Built-Up Areas	4,458	898	4,000	444	1980	452	2015	0	0	452	2015
Pervious Built-Up Areas	16,745	898	15,040	514	8610	382	6395	267	4480	115	1920
Forested Area	556,118	898	499,390	578	321440	319	177400	223	124180	96	53220
Post-Agricultural Land / Meadow	402,935	898	361,840	556	224030	342	137805	222	89570	120	48230
TOTAL	**1,394,909**	**898**	**1,252,620**	**570**	**795,660**	**326**	**455,185**	**156**	**218,230**	**170**	**236,955**

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	612,941	898	550420	574	351830	321	196750	0	0.0	321	196755
Wet Meadow	84,057	898	75,480	664	55,820	234	19,665	0	0	234	19,665
Impervious Built-Up Areas	149,595	898	134,340	444	66,420	452	67,620	0	0	452	67,615
Pervious Built-Up Areas	123,867	898	111,230	90	11,120	382	47,315	267	33,120	115	14,195
Forested Area	1,223,295	898	1,098,520	578	707,060	319	390,230	223	273,160	96	117,070
Moderately Rooted Agricultural Land / Meadow	3,743,097	898	3,361,300	556	2,081,160	342	1,280,140	222	832,090	120	448,050
TOTAL	**5,936,853**	**898**	**5,331,290**	**551**	**3,273,410**	**337**	**2,001,720**	**192**	**1,138,370**	**145**	**863,350**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	612,941	898	550,420	574	351,830	321	196,755	0	0	321	196,755
Wet Meadow	84,057	898	75,480	664	55,820	234	19,665	0	0	234	19,665
Impervious Built-Up Areas	126,846	898	113,910	444	56,320	452	57,335	0	0	452	57,335
Pervious Built-Up Areas	114,956	898	103,230	514	59,090	382	43,915	267	30,740	115	13,175
Forested Area	1,131,124	898	1,015,750	578	653,790	319	360,830	223	252,580	96	108,250
Moderately Rooted Agricultural Land / Meadow	2,178,998	898	1,956,740	556	1,211,520	342	745,220	222	484,390	120	260,825
TOTAL	**4,248,922**	**898**	**3,815,530**	**562**	**2,388,370**	**335**	**1,423,720**	**181**	**767,710**	**154**	**656,005**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Swamp	612,941	898	550420	574	351830	321	196755	0	0	321	196755
Wet Meadow	84,057	898	75,480	664	55820	234	19665	0	0	234	19665
Impervious Built-Up Areas	126,846	898	113,910	444	56320	452	57335	0	0	452	57335
Pervious Built-Up Areas	114,956	898	103,230	514	59090	382	43915	267	30740	115	13175
Forested Area	1,131,124	898	1,015,750	578	653790	319	360830	223	252580	96	108250
Post-Agricultural Land / Meadow	2,178,998	898	1,956,740	556	1211520	342	745220	222	484390	120	260825
TOTAL	**4,248,922**	**898**	**3,815,530**	**549**	**2,388,370**	**322**	**1,423,720**	**181**	**767,710**	**141**	**656,005**

Table P-9
Summary of Results - South Area Internally Draining Catchment Water Balance

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Moderately Rooted Agricultural Land	115,593	898	103,800	556	64,270	342	39,530	222	25,695	120	13,835.0
TOTAL	**115,593**	**898**	**103,800**	**556**	**64,270**	**342**	**39,530**	**222**	**25,695**	**120**	**13,835**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Moderately Rooted Agricultural Land	31,694	898	28,460	556	17,620	342	10,840	222	7,045	120	3,795
TOTAL	**31,694**	**898**	**28,460**	**556**	**17,620**	**342**	**10,840**	**222**	**7,045**	**120**	**3,795**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Post-Agricultural Land / Grassland	15,847	898	14,230	556	8810	342	5420	222	3525	120	1895
Forested Area	15,847	898	14,230	578	9160	319	5055	239	3790	80	1265
TOTAL	**31,694**	**898**	**28,460**	**567**	**17,970**	**331**	**10,475**	**231**	**7,315**	**100**	**3,160**

Entered by: NP
Checked by: CDV

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Pervious Built-Up Areas	11,538	898	10,360	514	5,930	382	4,405	267	3,085	115	1,320
Forested Area	84,754	898	76,110	578	48,990	319	27,035	223	18,925	96	8,110
Moderately Rooted Agricultural Land / Meadow	368,884	898	331,260	556	205,100	342	126,160	222	82,005	120	44,155
TOTAL	**465,175**	**898**	**417,730**	**559**	**260,020**	**339**	**157,600**	**224**	**104,015**	**115**	**53,585**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Pervious Built-Up Areas	2,068	898	1,860	514	1,060	382	790	267	550	115	240
Forested Area	8,589	898	7,710	578	4,960	319	2,740	223	1,920	96	820
Moderately Rooted Agricultural Land / Meadow	53,542	898	48,080	556	29,770	342	18,310	222	11,900	120	6,410
TOTAL	**64,199**	**898**	**57,650**	**558**	**35,790**	**340**	**21,840**	**224**	**14,370**	**116**	**7,470**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Area	42,799	898	38,430	578	24740	319	13650	223	9560	96	4095
Grassland	21,400	898	19,220	556	11900	342	7320	222	4755	120	2560
TOTAL	**64,199**	**898**	**57,650**	**571**	**36,640**	**327**	**20,970**	**223**	**14,315**	**104**	**6,655**

Table P-11
Summary of Results - North Area Internally Draining Catchment Water Balance

Existing Condition - Estimated Annual Average Water Balance											
Land Use	Area	Precipitation		ET		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Pervious Built-Up Areas	1,232	898	1,110	514	630	382	470	267	330	115	140
Forested Area	21,698	898	19,480	578	12,540	319	6,920	223	4,845	96	2,075
Moderately Rooted Agricultural Land / Meadow	279,479	898	250,970	556	155,390	342	95,580	222	62,130	120	33,450
TOTAL	**302,408**	**898**	**271,560**	**557**	**168,560**	**341**	**102,970**	**223**	**67,305**	**118**	**35,665**

Operational Condition (At the End of Phase 7) - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Pervious Built-Up Areas	1,232	898	1,110	514	630	382	470	267	330	115	140
Forested Area	19,040	898	17,100	578	11,010	319	6,070	223	4,250	96	1,820
Moderately Rooted Agricultural Land / Meadow	121,926	898	109,490	556	67,790	342	41,700	222	27,105	120	14,595
TOTAL	**142,198**	**898**	**127,700**	**559**	**79,430**	**339**	**48,240**	**223**	**31,685**	**116**	**16,555**

Rehabilitated - Estimated Average Annual Water Balance											
Land use	Area	Precipitation		Evapotranspiration		Surplus		Infiltration		Runoff	
	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Forested Area	41,198	898	37,000	578	23810	319	13140	223	9200	96	3940
Post-Agricultural Land / Meadow / Grassland	101,000	898	90,700	556	56160	342	34540	222	22450	120	12090
TOTAL	**142,198**	**898**	**127,700**	**562**	**79,970**	**335**	**47,680**	**223**	**31,650**	**113**	**16,030**

Entered by: NP
Checked by: CDV

Summary of Changes to Water Balance Results Based on Operational Phases 1- 7

SW Station / Internally Draining Catchments	Parameters	Operational Phases													
		Phase 1		Phase 2A & 2B		Phase 3		Phase 4		Phase 5		Phase 6		Phase 7	
		(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
Site-Wide	Total Site Area (m^2)	2,619,807		2,619,807		2,619,807		2,619,807		2,619,807		2,619,807		2,619,807	
	Precipitation	898	2,352,580	898	2,352,590	898	2,352,590	898	2,352,580	898	2,352,580	898	2,352,590	898	2,352,590
	Evapotranspiration	541	1,417,180	536	1,405,450	532	1,394,260	526	1,377,780	515	1,349,350	508	1,330,080	498	1,304,190
	Surplus	357	935,525	362	947,075	366	958,235	372	974,825	383	1,003,480	390	1,022,875	400	1,049,075
	Infiltration	186	487,240	182	477,510	176	462,360	165	432,020	144	377,435	130	339,740	107	281,235
	Runoff	171	448,290	179	469,560	189	495,860	207	542,790	239	626,050	261	683,140	293	767,840
SW8	Catchment Area Under Operational Phase (m^2)	16,541,534		16,541,160		-		-		16,461,075		16,056,240		15,708,695	
	Precipitation	898	14,854,298	898	14,853,962	-	-	-	-	898	14,782,045	898	14,418,503	898	14,106,408
	Evapotranspiration	560	9,269,433	560	9,269,225	-	-	-	-	560	9,224,740	561	8,999,866	561	8,806,815
	Surplus	337	5,575,349	337	5,575,221	-	-	-	-	337	5,547,797	337	5,409,166	337	5,290,154
	Infiltration	195	3,232,965	195	3,232,882	-	-	-	-	195	3,215,296	195	3,126,396	194	3,050,076
	Runoff	142	2,342,385	142	2,342,339	-	-	-	-	142	2,332,501	142	2,282,771	143	2,240,078
SW10	Catchment Area Under Operational Phase (m^2)	-		-		-		-		-		-		511,385	
	Precipitation	-	-	-	-	-	-	-	-	-	-	-	-	898	459,230
	Evapotranspiration	-	-	-	-	-	-	-	-	-	-	-	-	536	274,100
	Surplus	-	-	-	-	-	-	-	-	-	-	-	-	361	184,795
	Infiltration	-	-	-	-	-	-	-	-	-	-	-	-	166	85,145
	Runoff	-	-	-	-	-	-	-	-	-	-	-	-	195	99,655
SW11	Catchment Area Under Operational Phase (m^2)	-		283,353		-		-		-		-		-	
	Precipitation	-	-	898	254,460	-	-	-	-	-	-	-	-	-	-
	Evapotranspiration	-	-	562	159,340	-	-	-	-	-	-	-	-	-	-
	Surplus	-	-	335	95,055	-	-	-	-	-	-	-	-	-	-
	Infiltration	-	-	216	61,140	-	-	-	-	-	-	-	-	-	-
	Runoff	-	-	120	33,915	-	-	-	-	-	-	-	-	-	-
SW12	Catchment Area Under Operational Phase (m^2)	-		-		-		-		25,977		-		-	
	Precipitation	-	-	-	-	-	-	-	-	898	23,320	-	-	-	-
	Evapotranspiration	-	-	-	-	-	-	-	-	528	13,720	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	369	9,595	-	-	-	-
	Infiltration	-	-	-	-	-	-	-	-	167	4,340	-	-	-	-
	Runoff	-	-	-	-	-	-	-	-	202	5,255	-	-	-	-
SW14	Catchment Area Under Operational Phase (m^2)	1,397,307		1,394,909		-		-		-		-		-	
	Precipitation	898	1,254,781	898	1,252,620	-	-	-	-	-	-	-	-	-	-
	Evapotranspiration	570	797,055	570	795,660	-	-	-	-	-	-	-	-	-	-
	Surplus	326	455,938	326	455,185	-	-	-	-	-	-	-	-	-	-
	Infiltration	157	218,900	156	218,230	-	-	-	-	-	-	-	-	-	-
	Runoff	170	237,038	170	236,955	-	-	-	-	-	-	-	-	-	-
SW16	Catchment Area Under Operational Phase (m^2)	5,081,772		5,079,050		-		-		5,001,313		4,596,478		4,248,922	
	Precipitation	898	4,563,431	898	4,560,987	-	-	-	-	898	4,491,179	898	4,127,637	898	3,815,532
	Evapotranspiration	561	2,850,990	561	2,849,478	-	-	-	-	561	2,806,298	562	2,581,424	562	2,388,367
	Surplus	336	1,708,911	336	1,707,978	-	-	-	-	336	1,681,358	336	1,542,727	335	1,423,711
	Infiltration	187	950,601	187	950,004	-	-	-	-	187	932,933	63	288,048	181	767,710
	Runoff	149	758,309	149	757,975	-	-	-	-	150	748,425	273	1,254,680	154	656,001
South Area	Catchment Area Under Operational Phase (m^2)	-		-		-		-		31,694		-		-	
	Precipitation	-	-	-	-	-	-	-	-	898	28,460	-	-	-	-
	Evapotranspiration	-	-	-	-	-	-	-	-	556	17,620	-	-	-	-
	Surplus	-	-	-	-	-	-	-	-	342	10,840	-	-	-	-
	Infiltration	-	-	-	-	-	-	-	-	222	7,045	-	-	-	-
	Runoff	-	-	-	-	-	-	-	-	120	3,795	-	-	-	-
Main Area	Catchment Area Under Operational Phase (m^2)	64,199		-		-		-		-		-		-	
	Precipitation	898	57,650	-	-	-	-	-	-	-	-	-	-	-	-
	Evapotranspiration	558	35,790	-	-	-	-	-	-	-	-	-	-	-	-
	Surplus	340	21,840	-	-	-	-	-	-	-	-	-	-	-	-
	Infiltration	224	14,370	-	-	-	-	-	-	-	-	-	-	-	-
	Runoff	116	7,470	-	-	-	-	-	-	-	-	-	-	-	-
North Area	Catchment Area Under Operational Phase (m^2)	142,198		-		-		-		-		-		-	
	Precipitation	898	127,700	-	-	-	-	-	-	-	-	-	-	-	-
	Evapotranspiration	559	79,430	-	-	-	-	-	-	-	-	-	-	-	-
	Surplus	339	48,240	-	-	-	-	-	-	-	-	-	-	-	-
	Infiltration	223	31,685	-	-	-	-	-	-	-	-	-	-	-	-
	Runoff	116	16,555	-	-	-	-	-	-	-	-	-	-	-	-

Note:
"-" represents no changes in the surface water station / internally draining catchment water balance estimates or catchment area under that particular phase to either the existing condition or the previous phase.

APPENDIX Q

Numerical Modelling

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APPENDIX Q

Integrated Groundwater - Surface Water Modelling

Proposed Caledon Pit / Quarry

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December 2022 (Revised July 2023)

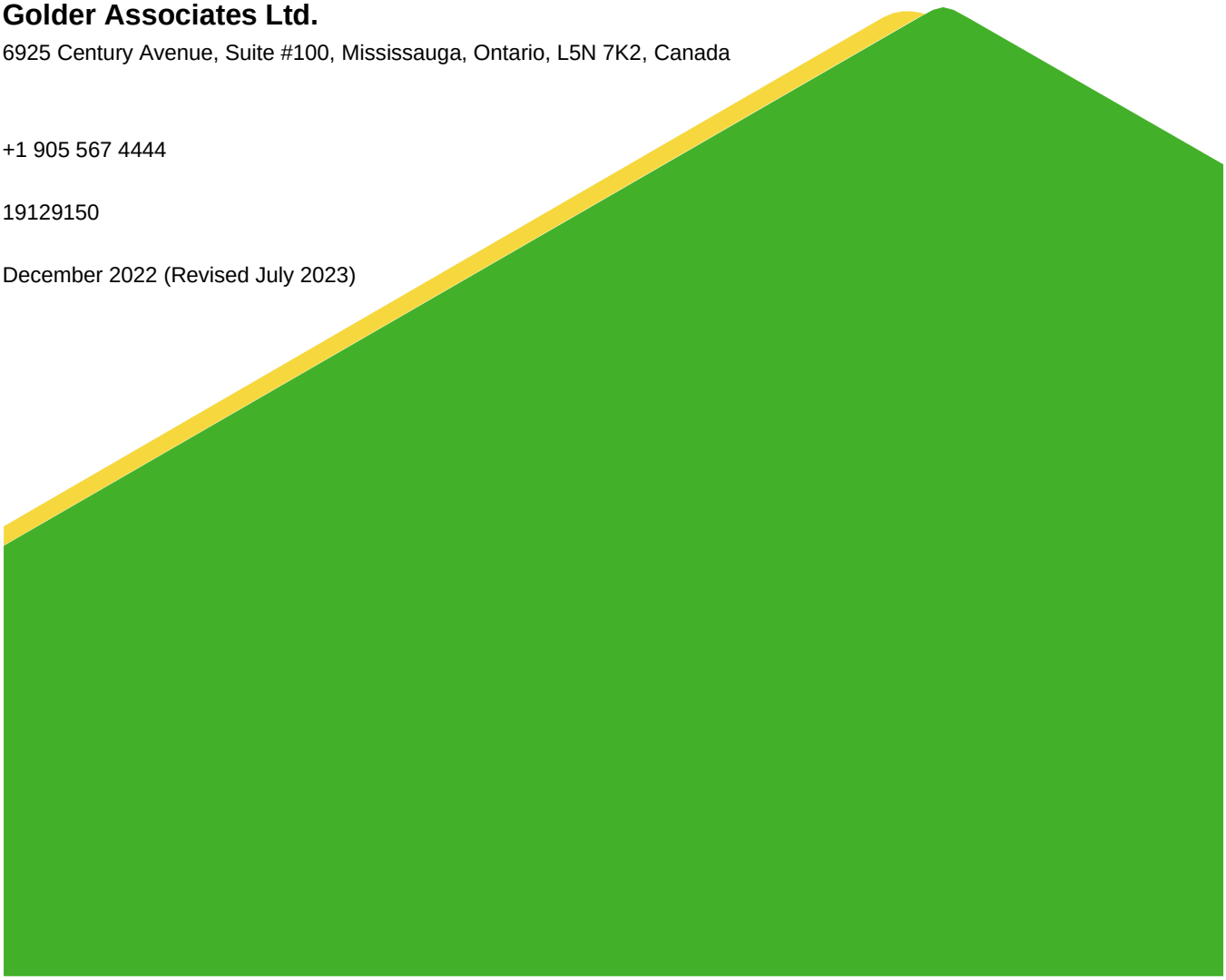

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Figure 8A: Phase 1 Simulated Head

Figure 8B: Phase 2 Simulated Head

Figure 8C: Phase 3 Simulated Head

Figure 8D: Phase 4 Simulated Head

Figure 8E: Phase 5 Simulated Head

Figure 8F: Phase 6 Simulated Head

Figure 8G: Phase 7 Simulated Head

Figure 8H: Rehabilitation Simulated Head

Figure 9A: Phase 1 Simulated Drawdown

Figure 9B: Phase 2 Simulated Drawdown

Figure 9C: Phase 3 Simulated Drawdown

Figure 9D: Phase 4 Simulated Drawdown

Figure 9E: Phase 5 Simulated Drawdown

Figure 9F: Phase 6 Simulated Drawdown

Figure 9G: Phase 7 Simulated Drawdown

Figure 9H: Rehabilitation Simulated Drawdown

Figure 10: Simulated Change in Surface Water Flow at Monitoring Stations

1.0 INTRODUCTION

CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada), is applying to the Ministry of Natural Resources and Forestry (MNRF) for a Class A License (Pit and Quarry Below Water) and to the Town of Caledon for an Official Plan Amendment and Zoning By-law Amendment to permit a mineral aggregate operation for the proposed CBM Caledon Pit / Quarry.

CBM controls approximately 323 hectares of land located at the northwest, northeast and southwest intersection of Regional Road 24 (Charleston Sideroad) and Regional Road 136 (Main Street). Of these lands, approximately 261 hectares are proposed to be licensed under the Aggregate Resources Act and designated / zoned under the Planning Act to permit the proposed CBM Caledon Pit / Quarry. The lands proposed to be licensed under the Aggregate Resources Act are referred to herein as the “Subject Site” (or “Site”) and are legally described as Part of Lots 15-18, Concession 4 WSCR and Part of Lot 16, Concession 3 WSCR (former Geographic Township of Caledon). The area located to the northwest of the intersection of Regional Road 24 and 136 is referred to as the “Main Area”. The area to the northeast of the intersection of Regional Road 24 and 136 is referred to as the “North Area”, and the area located to the southwest of the intersection of Regional Road 24 and 136 is referred to as the “South Area” (Figure 1).

The objective of this report is to document the development of (and results from) an integrated groundwater-surface water model used to assess the potential changes in hydrogeological conditions associated with the proposed Project. This includes estimates of the extent of drawdown during the various stages of development and rehabilitation stage, including the implementation of a proposed mitigation system, and groundwater inflow estimates to the proposed pit / quarry during operations.

2.0 MODEL CONSTRUCTION AND CALIBRATION

2.1 Approach

The objective of the hydrogeological modelling assessment is to provide estimates of the potential impact of the proposed Caledon Pit / Quarry on local and regional groundwater and surface water conditions. This includes potential changes in groundwater elevations and flow rates in nearby surface features relative to background conditions. Given the emphasis on both groundwater and surface water impacts, a coupled surface water/groundwater (SW/GW) modelling approach was applied. This entailed the construction of a 3D numerical model of the pit / quarry and surrounding regional groundwater flow system, with the addition of a 2D grid that represented the surface flow domain (which is coincident with the top of the 3D model domain).

The 3D model was constructed based on the Conceptual Site Model (CSM) presented in Section 5.10 of the Water Report (Golder 2022) and was calibrated to observed groundwater elevations and surface water flows under steady state conditions. The model was also calibrated transiently to a four-day pumping test that took place as part of the Northwest Investigation (summarized in Section 5.8 of Golder 2022). This calibrated numerical flow model was then used as the basis for forecast simulations of the proposed pit / quarry development.

2.2 Code Selection

HydroGeoSphere (HGS), a finite element modelling package developed jointly by the University of Waterloo, Laval University, and Aquanty (Aquanty 2015), was used as the numerical simulation tool for the assessment. In addition to its basis as a fully-integrated, groundwater / surface water code, HGS was selected for this project given its capabilities to efficiently discretize local features around the Site and Study Area, within a larger footprint around the Site in order to calibrate to water elevations and water balances within the surrounding region.

HGS uses a globally-implicit approach to simultaneously solve the 2D diffusion-wave equation (surface flow domain) and the 3D form of Richards' equation (i.e., variably-saturated flow) in the subsurface domain. The HGS platform uses a Newton iteration to handle nonlinearities in the governing flow equations, a robust and efficient iterative sparse matrix solver, which has been parallelized to utilize high performance computing facilities for addressing large-scale problems.

HGS revision 2270 (build date June 3, 2021) was used to complete the simulations presented in this report. Assumptions and limitations of the numerical integrated groundwater- surface water model are as follows:

- In the HGS model, the groundwater flow system is represented by an 'equivalent porous medium' (EPM). Under this assumption, the rate of groundwater flow occurs as a function of hydraulic gradient, hydraulic conductivity, and the porosity of the aquifer (governed by Darcy's Law and the 3D form of the Richards' equations for variably saturated flow). While groundwater flow in sedimentary rock can be influenced by fracture networks within the rock mass, an EPM approach is commonly used to represent these flow systems. This EPM representation is considered reasonable for this study, as the scale of the groundwater head and flow observations (and forecasts) are much greater than the size of individual fractures.
- Surface flow is assumed to be governed by the 2D diffusion-wave equations (Aquanty 2015).

2.3 Model Domain and Boundary Conditions

The model domain is shown on Figure 1, and encompasses three sub-watersheds (No.15, No.17, No.18) within the larger Credit Valley watershed (CVC 2021). The 3D model is discretized into a triangular prismatic mesh with horizontal nodal spacing of approximately 2 m along the west and south property boundary transitioning to 50 m in the area of the Site, and within a 1 km buffer area around the Site, to provide greater resolution in the simulation of hydraulic heads near the proposed quarry. This spacing transitions to a maximum nodal spacing of ~500 m beyond the proposed pit / quarry footprint, with some additional refinement around the Credit River valley (maximum nodal spacing of 200 m). A total of 66,629 elements are specified per model layer, for a total of 1,732,354 elements across the full 26 layers of the model domain. A summary of the model mesh is shown on Figure 2. The vertical discretization of the model is further described below.

The boundary conditions for the steady state calibration model are comprised of an average annual net surplus of 364 mm/yr applied to the surface flow domain (i.e., the upper surface of the model), and critical depth nodes around the perimeter of the surface flow domain (Figure 2). A critical depth boundary condition allows water to flow freely from the surface flow domain if surface water ponding occurs. In the subsurface domain, all side boundaries are interpreted as locations of groundwater flow divides and therefore defined as a “no-flow” boundary condition. The base of the model (250 masl within the Queenston Formation) is also assigned as a no-flow boundary.

For the transient model calibration, an additional boundary condition was added to reflect pumping from Well PW22-01. The boundary condition applies a constant rate of 80.4 L/min through the four-day test period, with extraction of groundwater by pumping applied across the full thickness of the Gasport Formation.

2.4 Hydrostratigraphy and Parameterization

The generalized hydrostratigraphy for the Study Area is described in the CSM presented in Section 5.10 of the Water Report (Golder 2022). To represent hydrostratigraphy within the HGS model, a total of 26 numerical layers are used. Whereas this is greater than the number of hydrostratigraphic units present in the model domain, the additional number of layers were adopted to allow for increased resolution of vertical hydraulic heads within the model domain, as well as to capture vertical variability in overburden and bedrock stratigraphy.

The distribution of hydrostratigraphic units within these layers and the hydraulic conductivity values applied to each unit are shown on Figure 3. The initial horizontal hydraulic conductivity assigned to these units was based on the range of values estimated from Site hydraulic conductivity testing (Golder 2022) as well as estimates used in Tier 2 (AquaResource, 2009) and Tier 3 (AquaResource, 2011) groundwater modelling studies previously conducted in the area. The values were later adjusted during the calibration process to match observed groundwater elevations and stream flows within the Site and Study Area. The hydrostratigraphic units, from the ground surface down, are summarized as follows:

- **Overburden**: Model Layers 1 to 11 represent the overburden geology within the model, which is defined collectively by the total thickness from ground surface to the top of bedrock. Within this sequence, there are three hydrostratigraphic units incorporated: Upper Sand, Till, and Lower Sand (Golder 2022). The upper sand unit exists where sand is observed at ground surface, and where the entirety of the overburden sequence is described as sand. The till unit exists either where there is till at surface, or where there is till underlying the upper sand unit. The lower sand exists where there is sand beneath till, and above the bedrock. These units were delineated using Site borehole data, the Ministry of Environment and Climate Change (MECP) Water Well Record (WWR) database borehole information (MECP 2020), borehole data

obtained from several studies conducted for Armbro-Pinchin and James Dick quarry sites located to the southwest of the Site (CRA 1990, CRA 1994, Harden 2016) and regional surficial geology mapping (OGS 2010). Model layer 1 has a fixed thickness of 1 m, and the thickness of model layers 2 to 11 represent the total overburden thickness remaining divided evenly into 10 layers with a minimum total thickness of 3 m (minimum layer thickness of 0.3 m).

- **Valley Skin**: The valley skin unit is defined in the model as a local unit within Layers 1 to 12 along the Credit River valley to the east and south of the Site. This area was conceptualized and defined during the model calibration process to improve the match to observed groundwater elevations in this specific area.
- **Weathered Bedrock**: A uniform 3 m thick weathered bedrock layer is assigned along the top of the bedrock surface in the model and is located primarily in Layer 12. In the Site area, the weathered bedrock is divided into seven sub-zones (shown on Figure 3). The zones are delineated based on groundwater levels and flow patterns observed in the Site monitoring wells and are coincident with the sub-zones defined in the underlying Gasport Formation. Hydraulic conductivity values were informed by field observations and refined through the model calibration process. They generally reflect the same pattern observed in the underlying Gasport Formation (described below), yielding lower hydraulic conductivity values in the sub-zones north of the Site, and higher hydraulic conductivity values south of the Site.
- **Guelph Formation:** Model Layer 13 represents the Guelph Formation, which is present on the westernmost edge of the model domain and is not present in the area of the Site. This unit is defined within the model domain by the surface / thickness in the OGS Leapfrog Files for the 3D Bedrock Geology Model of Southern Ontario (Carter et al. 2019). The thickness of Layer 13 varies from a minimum thickness of 1 m to 21 m thick as the westernmost edge of the model domain.
- **Eramosa Formation:** Model Layer 14 represents the Eramosa Formation, which is present on the western side of the model domain, pinching out approximately 2.5 km west of the Site (MW20-26 location). The thickness of Layer 14 varies from a minimum thickness of 1 m to 21 m thick to the west of the model domain.
- **Goat Island Formation:** Model Layer 15 represents the Goat Island Formation, which is present on the west side of the model domain, pinching out approximately 500 m west of the Site. The thickness of Layer 15 varies from a minimum thickness of 1 m to 41 m thick.
- **Gasport Formation:** Model Layers 16 to 21 represent the Gasport Formation, which is defined collectively by the total thickness of the Gasport Formation and has been subdivided into 6 vertical layers. The thickness of this layer package ranges from a total minimum thickness of 1 m (0.17 m per numerical layer) to 51 m (8.6 m per numerical layer). In the Site area, the Gasport Formation is divided into seven sub-zones that are coincident with the sub-zones defined in the weathered bedrock layer (shown on Figure 3). The zones are delineated based on groundwater levels and flow patterns observed in the Site monitoring wells. Monitoring data shows a greater horizontal hydraulic gradient across the north area of the Site, while the water levels south of the Site have a lower horizontal hydraulic gradient. The hydraulic conductivity of each sub-zone was determined through the model calibration process, where the Gasport sub-zones north of the Site have lower hydraulic conductivity values than the sub-zones south of the Site. This is consistent with measured hydraulic conductivity.

- **Shaley Dolostone Unit:** Model Layer 22 represents the shaley dolostone unit that underlies the Gasport Formation. The thickness of this layer is defined by Site borehole data in the area of the Site and is assigned a fixed thickness of 2 m (average thickness measured in Site borehole data) outside of 1 km of the Site. Layer 22 ranges in thickness from a minimum thickness of 1 m to 4 m thick.
- **Cabot Head Formation:** Model Layer 23 represents the Cabot Head Shale Formation. The thickness of Layer 23 varies from a minimum thickness of 1 m to 20 m thick.
- **Whirlpool Formation:** Model Layer 24 represents the Whirlpool Formation. The thickness of Layer 24 varies from a minimum thickness of 1 m to 8 m thick.
- **Manitoulin Formation:** Model Layer 25 represents the Manitoulin Formation. The thickness of Layer 25 varies from a minimum thickness of 1 m to 5 m thick.
- **Queenston Formation:** Model Layer 26 represents the Queenston Formation. The thickness of this layer varies from 20 m to 120 m, with the base of the unit representing the base of the model domain at 250 masl.

All bedrock unit model layers (from the bedrock surface down) have a minimum thickness of 1 m. Where this minimum thickness exists (i.e., the unit is discontinuous and been ‘pinched out’) the hydraulic properties of the underlying unit are assigned to the ‘pinched out” layer in that area.

2.5 Model Calibration

2.5.1 Calibration Approach

The approach adopted to calibrate an integrated surface water - groundwater model is somewhat different than that for conventional groundwater models because of the addition of the 2D surface flow domain at the ground surface. Here, water surplus (the difference between precipitation and evapotranspiration / sublimation) is the only input of water to the system, and one of the main calibration considerations (in addition to groundwater elevations) becomes the distribution of surface and groundwater flows observed throughout the system. The model calibration process for this assessment involved the refinement of horizontal and vertical hydraulic conductivity, and storage parameters of the various geologic units until the simulated hydraulic head distribution and surface water flows compared reasonably well with the measured (observed) conditions. The first step in the calibration process was to calibrate the model to average, long-term hydraulic heads observed at Site monitors, water level information obtained from consultant reports (CRA 1990, 1994, 2012), water wells in the MECP WWR database, and long-term average flow rates at surface water monitoring stations for the current condition. This steady state calibrated model formed the initial condition for the transient pumping test calibration, where hydraulic conductivity and storage parameters were further refined to capture the transient response observed at peripheral monitoring wells the during the pumping test.

The following calibration measures were used in the assessment:

- Average groundwater levels at 88 groundwater monitoring well locations across the Site area, over the period of record for each location. The monitoring locations include 24 sets of nested monitoring wells. Average head differences between each nested pair of monitoring wells are also considered as part of the calibration process.
- Average streamflow measurements in 16 surface water monitoring stations in the Site area, over the period of record for each location.

- Average groundwater levels at 40 monitoring well locations at the Armbro-Pinchin site over the period of record for each location as outlined in CRA (1990 and 1994). These monitoring well locations are within 1 km of the Site and were therefore considered in the Site calibration data set.
- Average groundwater levels at 39 monitoring well locations at the James Dick Pit over the period of record for each location as outlined in Harden (2016). These monitoring well locations are located ~2 km or more from the Site and were therefore considered in the regional calibration data set.
- Groundwater level measurements from 1857 water well records in the MECP WWR database, located within the model domain (MECP 2020).
- Transient water level drawdown responses at 8 monitoring well locations (5 of which are nested monitoring wells, amounting to 16 monitoring points in total) during a four-day pumping test conducted as part of the Northwest Investigation (described in Section 5.8.6 of Golder 2022).

2.5.2 Calibration Assessment

The simulated calibrated model results are shown on Figures 4 through 6, and in Table 1 (next page). A review of the results is as follows:

- Plan view maps of the simulated hydraulic head distribution and groundwater flow direction in the overburden, Gasport Formation, and Manitoulin/ Whirlpool Formation (Figure 4) are, in general, consistent with the conceptual understanding of the groundwater flow system in the Credit River Watershed. West of the Niagara escarpment, shallow groundwater flow follows topographic relief, and generally flows from northwest to southeast, towards the escarpment. Closer to the Niagara escarpment, the water table declines significantly, following the ground surface topography. The simulated hydraulic head distribution and groundwater flow direction in the Gasport Formation is consistent with observed data at the Site (Figures 5-2 to 5-6 of Golder 2022).
- A scatter plot of the regional simulated hydraulic head versus the average head for the target observation points (both MECP WWR measurements, additional water level information from consultant reports (CRA 1990, 1994, 2012 and Harden 2016) and Site monitoring wells, 2024 total water levels) shows the simulated points generally close to the 45-degree line and in reasonable agreement with the observed values (Figure 4). Regionally, the mean residual is calculated to be 3.2 m, while the normalized root mean square (RMS) error is 3.8%. Looking at the Site data only (128 total average water level measurements), the mean residual is calculated to be 0.03 m, while the normalized root mean square (RMS) error is 3.8%.
- A plot of the observed and simulated head differences at nested monitoring locations (Figure 4) generally shows good agreement between the two datasets, with more upward gradients to the west of the Site transitioning to neutral / slight downward gradients to the east, and downward gradient to the north. The observed head difference values used for comparison represent the averages over the period of record, though it is recognized that there could be variability in the magnitude (and direction) of the gradient throughout the year.
- A plot of the unit yield for each surface water station (i.e., the simulated and observed flows divided by the surface water monitoring station catchment area) is shown on Figure 5. These unit yield values, when compared to the normalized applied surplus can be used to infer whether the catchment is exhibiting ‘gaining’ or ‘losing’ behaviour. When the observed unit yield value for a given catchment is less than the surplus, that indicates that the catchment is ‘losing’ water (i.e., some of the net surplus water entering the

catchment is being lost to deeper groundwater flowing toward the escarpment valley/Credit River rather than discharging locally and flowing through the surface water feature at the monitoring location), while the inverse is considered to be 'gaining'. The plot shows that the model results are consistent with the conceptual behaviour in the Site area (Figure 5). Comparing the observed unit yield values to the applied surplus shows that the catchment areas for almost all the surface water stations exhibit a 'losing' behaviour. When comparing the simulated unit yield values to the applied surplus, although they are higher in general than the observed unit yield values, they show a similar 'losing' behaviour, where the model applied surplus is being lost to deeper groundwater flow and being measured at model locations closer to the Credit River valley (for example, the relatively high simulated unit yield at SW9 and SW13).

- The results of the transient pumping test calibration are presented on Figure 6. In general, the simulated drawdown at the pumping well (PW22-01) and nearby monitoring wells (MW20-15 at 11 m away and MW22-02 at 281 m away) is slightly underpredicted, while the drawdown at monitoring wells farther away from the pumping well (PW21-1 at 321 m away and MW21-1-3 at 408 m away) is well represented by the simulation. The focus of the transient calibration for the purpose of this assessment was primarily on the more distant monitoring wells, recognizing the objective of the forecast simulations is to estimate drawdown away from the proposed pit / quarry development. The lesser match to observed water levels at the wells in close proximity to the pumping well likely reflects local scale variability in the hydraulic properties of the bedrock aquifer at this particular location.

Table 1: Comparison of Steady State Simulated and Average Measured Groundwater Elevation at Site Well Locations

Well ID	Average Measured Water Level (masl)[1]	Simulated Water Level (masl)	Residual (m)[2]
JHL_BH1	405.9	406.3	0.4
JHL_BH16	400.7	399.2	-1.6
JHL_BH17	400.8	398.9	-1.9
JHL_BH18	396.7	394.7	-2.0
JHL_BH19	402.1	401.3	-0.8
JHL_BH2	411.3	409.2	-2.0
JHL_BH3	405.1	404.5	-0.7
JHL_BH7	402.7	401.9	-0.8
MW20-01A	391.0	394.3	3.3
MW20-01B	390.9	394.3	3.5
MW20-02	390.2	390.3	0.1
MW20-03	384.9	385.5	0.6
MW20-04	389.4	387.3	-2.1
MW20-05A	393.2	395.4	2.1
MW20-06A	396.8	397.8	1.0
MW20-06B	397.0	397.8	0.8
MW20-07A	402.3	399.6	-2.7
MW20-07B	402.4	399.6	-2.8
MW20-08A	404.4	401.7	-2.7
MW20-08B	404.4	401.8	-2.6
MW20-09	396.3	392.5	-3.8
MW20-10A	400.6	397.3	-3.3
MW20-10B	400.6	397.4	-3.2
MW20-11A	405.7	404.4	-1.2
MW20-11B	405.7	404.9	-0.7
MW20-12A	406.5	405.7	-0.8
MW20-12B	406.5	405.8	-0.7
MW20-13A	411.1	408.3	-2.9
MW20-13B	411.2	408.3	-2.9
MW20-13C	412.8	410.3	-2.5
MW20-14A	402.1	402.1	0.1

Well ID	Average Measured Water Level (masl)[1]	Simulated Water Level (masl)	Residual (m)[2]
MW20-14B	402.1	402.1	0.1
MW20-15A	415.8	416.1	0.3
MW20-15B	415.7	416.6	0.9
MW20-15C	415.5	417.0	1.5
MW20-16A	419.6	414.7	-4.9
MW20-16B	419.6	414.7	-4.8
MW20-17A	402.7	405.5	2.8
MW20-17B	402.5	405.2	2.8
MW20-18	391.6	397.9	6.3
MW20-19A	390.7	395.0	4.3
MW20-19B	390.7	395.0	4.3
MW20-20A	405.4	402.7	-2.7
MW20-20B	405.5	402.9	-2.6
MW20-20C	401.4	402.9	1.6
MW20-21A	413.9	415.4	1.5
MW20-21B	414.2	415.5	1.4
MW20-22A	396.4	400.0	3.6
MW20-22B	395.3	399.6	4.3
MW20-23A	391.8	395.4	3.6
MW20-23B	391.6	395.4	3.8
MW20-23C	391.5	395.3	3.9
MW20-24A	433.7	433.6	-0.1
MW20-24B	434.1	434.5	0.3
MW20-25A	419.9	420.0	0.2
MW20-25B	419.2	419.5	0.3
MW20-26A	433.7	433.5	-0.2
MW20-26B	433.9	433.5	-0.4
MW20-26C	436.1	434.1	-2.1
MW20-27A	423.7	421.2	-2.6
MW20-27B	423.7	421.2	-2.4
MW20-28A	418.4	415.1	-3.3
MW20-28B	418.5	415.1	-3.4
MW22-01	418.8	418.5	-0.3

Well ID	Average Measured Water Level (masl)[1]	Simulated Water Level (masl)	Residual (m)[2]
MW22-02A	418.4	418.7	0.3
MW22-02B	418.6	419.0	0.4
MW22-02C	418.3	419.0	0.7
MW22-03A	420.6	420.5	-0.1
MW22-03B	419.8	420.6	0.8
OVG-MW10-20	388.5	393.4	4.8
OVG-MW11-20	392.1	392.8	0.8
OVG-MW12-20	393.9	393.2	-0.7
OVG-MW13-20	394.7	392.7	-2.0
OVG-MW16-20	392.4	392.0	-0.5
OVG-MW18-20	389.6	390.2	0.7
OVG-MW19-20	391.1	391.3	0.2
OVG-MW24-20	400.3	396.5	-3.7
OVG-MW25-20	397.4	396.5	-0.9
OVG-MW5-20	387.1	388.3	1.2
OVG-MW6-20	392.7	387.9	-4.8
OVG-MW7-20	387.0	388.0	1.1
OVG-MW8-20	386.5	387.2	0.7
OVG-MW9-20	388.8	393.7	4.8
PW21-1	416.8	412.2	-4.5
PW21-2	407.8	407.2	-0.6
PW21-3	395.9	399.3	3.4
PW21-4	402.7	402.2	-0.5
PW22-01	416.2	416.6	0.4
OW10B-90	388.3	387.7	-0.6
OW11B-90	388.7	389.3	0.6
OW12-90	392.1	393.9	1.8
OW13-90	390.3	391.9	1.6
OW14-90	389.1	389.1	0.0
OW15-90	388.4	386.9	-1.5
OW16-90	387.7	388.3	0.6
OW17-90	392.6	394.6	2.0
OW18-90	388.2	389.5	1.3

Well ID	Average Measured Water Level (masl)[1]	Simulated Water Level (masl)	Residual (m)[2]
OW19-94	389.2	390.9	1.6
OW20-94	387.8	387.9	0.0
OW21-94	388.4	389.4	1.1
OW22-94	387.1	386.4	-0.7
OW23-94	385.1	385.5	0.5
OW3B-90	391.5	393.0	1.5
P-1	379.9	379.1	-0.9
P-10	382.6	381.6	-1.0
P-12	378.8	380.3	1.4
P-2	386.5	386.7	0.3
P-3	384.5	384.8	0.4
P-4	385.3	385.7	0.4
P-6	385.7	385.4	-0.3
P-7	385.7	383.2	-2.5
P-8	383.1	383.9	0.9
P-9	386.7	385.8	-0.9
POND1	388.5	389.3	0.8
POND2	388.6	389.1	0.5
POND3	389.0	389.3	0.4
POND4	388.3	388.0	-0.3
TH10-89	388.2	386.1	-2.2
TH11-89	388.6	388.6	-0.1
TH1-89	388.8	388.4	-0.4
TH2-89	391.1	392.5	1.4
TH3-89	391.5	393.0	1.5
TH4-89	391.5	390.7	-0.8
TH5-89	387.7	387.8	0.1
TH6-89	389.0	390.4	1.4
TH7-89	388.2	391.9	3.7
TH8-89	388.1	389.8	1.7
TH9-89	389.6	390.9	1.3

1. Average measured water level represents the average water level over the period of record for each location.

2. Residual is calculated by subtracting the measured water level from the simulated water level.

3.0 FORECAST SIMULATIONS

3.1 Approach

The approach to the forecast simulations was to utilize the calibrated model to assess the potential impacts of proposed pit / quarry development on groundwater levels and surface water flows. A total of eight model forecast simulations were completed, each representing a different phase of quarry development (including the final Rehabilitation phase) as shown in Figure 7.

Initial simulations indicated that pit / quarry dewatering during later the stages of operations (Phases 4 to 7) may result in a decline in groundwater levels in the water table aquifer that would extend southward and to the southwest of the licence area. If so, these forecast changes in groundwater levels could potentially impact natural features, groundwater users, and influence groundwater levels beneath active aggregate operations that were licensed to extract sand and gravel above the water table. To mitigate the potential impact of these forecast changes in groundwater levels during the operational phases of the proposed CBM Caledon Pit / Quarry, groundwater mitigation measures were developed by Golder and implemented in the modelling simulations for Operational Phase 3 to 7. The groundwater mitigation measures developed are described in Appendix R, and further discussed in Section 9 of Golder 2022. The mitigation measures consist of six infiltration trench zones along a 1,900 m alignment along the west side of the Main Area and the west and south side of the South Area, in the setback area between the licence limit and the limit of extraction. Additionally, a slurry wall would be installed in the overburden between the infiltration trenches and the extraction limit, in order to minimize the flow of water back into the pit / quarry. The weathered upper bedrock zone along the proposed slurry wall alignment was also assumed to be grouted in the simulation. Each phase of quarry development and its associated mitigation system is shown on Figure 7.

The forecast simulations representing the seven phases of quarry development, and the final rehabilitation scenario are completed under steady state conditions. Steady state simulations were completed to provide a conservative estimate of the extent of drawdown for each operational phase of quarry development. Groundwater elevations, water level drawdown relative to current conditions, reduction in surface water flows at surface water monitoring stations, and quarry inflows were tracked through each model simulation. In addition, a sensitivity analysis was done by increasing and decreasing the hydraulic conductivity of the slurry wall / grouting alignment to simulate the potential range of quarry inflow that may occur at each development phase.

3.2 Model Parameterization for Forecast Simulations

To complete the forecast simulations, several assumptions are made to approximate the proposed development phases of the CBM Caledon pit / quarry. These are outlined below:

- The soil/rock material (i.e., overburden and underlying aggregate) removed during each phase of extraction is simulated as a relatively high hydraulic conductivity zone (a value of 1 m/s).
- Progressive rehabilitation, or the placement of till material against the pit / quarry walls during each phase of development is simulated as a separate hydraulic conductivity zone with a value of $1x10^{-6}$ m/s for Phases 1 to 7.
- For each phase of pit / quarry development (i.e., Phases 1 to 7), a head-constrained specified flux was assigned at a single node to act as a sump at the base of the quarry (i.e., water is removed the model at a rate that facilitates maintaining the quarry water level at a specified elevation). Sump locations for the Main, North, and South areas during each phase are shown on Figure 7. Water removed from the sump was re-

introduced to the surface flow domain at the Credit River directly to the east of the North Area to simulate off-Site discharge.

- The numerical simulations for Operational Phases 3 to 7 presented in the subsections below include the implementation of the following groundwater mitigation system elements:
  - Phase 3 – Implementation of the slurry wall / grouting of the weathered bedrock zone on the west side of the Main Area prior to the start of Phase 3 extraction.
  - Phases 4 and 5 – Implementation of the infiltration trench system (Trench Zones 1 and 2) on the west side of the Main Area prior to the start of Phase 4 and 5 extraction.
  - Phase 6 and 7 – Implementation of the second slurry wall / grouting of the weathered bedrock zone and the second phase of the infiltration trench system (Trench Zones 4 to 6) prior to the start of Phase 6 and 7 extraction.
- The numerical simulation for the post-Rehabilitation scenario includes the removal of the slurry wall in the overburden in the southwest corner of the South Area (adjacent to Trench Zones 4 and 5), to reinstate hydraulic connection between the South Area and the lands to the south and southwest of the Site.
- The proposed slurry walls through the overburden (model layers 1-11) and grouting of the upper bedrock (model layer 12) at the base of the slurry wall alignments was simulated as a low hydraulic conductivity zone (a value of $1x10^{-7}$ m/s). The six infiltration trench zones were simulated as constant head boundaries. The head values assigned to each of these infiltration trench zones (see Table 2 below) were assigned based on the average calibrated model head along the trench alignment.
- For the rehabilitation phase, the Main Pond and North Pond elevations are controlled at 400 masl and 399 masl respectively by using a head-constrained specified flux at a single node within the pond areas. Water removed from the ponds is re-introduced to the surface flow domain at the Credit River to the east of the North Area to simulate off-Site discharge.

A summary of the modelled mitigation system configurations implemented for each of the eight forecast simulations is presented in Table 2.

Table 2: Simulated Mitigation System at Each Phase of Quarry Development

Phase	Operational Year	Slurry Wall / Grout Zone	Infiltration Trench Zone / Constant Head (masl)
End of Phase 1	End of Year 8	N/A	N/A
End of Phase 2	End of Year 13	N/A	N/A
End of Phase 3	End of Year 17	West side of Main Area	N/A
End of Phase 4	End of Year 22	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5
End of Phase 5	End of Year 26	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5
End of Phase 6	End of Year 32	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5

Phase	Operational Year	Slurry Wall / Grout Zone	Infiltration Trench Zone / Constant Head (masl)
		West and south side of South Area	Trench Zone 3: 395.5 Trench Zone 4: 393.0 Trench Zone 5: 392.0 Trench Zone 6: 394.0
End of Phase 7	End of Year 38	West side of Main Area West and south side of South Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5 Trench Zone 3: 395.5 Trench Zone 4: 393.0 Trench Zone 5: 392.0 Trench Zone 6: 394.0
Post-Rehabilitation	Year 39+	Slurry wall removed along Trench Zones 4 and 5	N/A

3.3 Results

3.3.1 Simulated Head and Drawdown

The simulated hydraulic head, drawdown of the water table, and head change within the Gasport Formation, and the Whirlpool / Manitoulin Formations for Phases 1 to 7 and the Rehabilitation phase are shown on Figure 8A-H, and Figure 9A-H respectively.

The general simulated groundwater flow direction across the Site in each unit remained consistent with the current condition; groundwater flow is southeast across the Site toward the Credit River and bedrock valley.

The simulated water table drawdown is consistent with the head change in the Gasport Formation south and southwest of the Site. During operation, the extent of drawdown in this area is the largest during Phase 3, prior to the implementation of the infiltration trench mitigation system in the Main Area, and Phase 5, prior to the implementation of the mitigation system in the South Area.

To the northwest, and north of the Site, where fine grained material is present, the water table drawdown is less than the head change in the Gasport Formation. The finer grained, lower hydraulic conductivity materials provide a significant degree of hydraulic isolation between the shallow overburden and the underlying Gasport Formation layers, where dewatering mainly occurs during operations. The progressive rehabilitation of the pit / quarry walls during operation provides further hydraulic isolation between the pit / quarry operation and the surrounding environment, helping to minimize drawdown and dewatering requirements.

There is also drawdown observed in the Whirlpool / Manitoulin Formations, but is relatively small in magnitude relative to the available drawdown in this aquifer, given its depth and typical static water level. The drawdown beyond the Site is predicted to reach a maximum of approximately 3 m, which represents a fraction of the available water column in wells screened in that aquifer, as discussed in Section 9.3.1 of Golder (2022). Upon rehabilitation, the residual change in groundwater heads within all aquifer units is small typically less than +/- 1 m. Further discussion of the potential impact to aquifers during pit / quarry operations and upon rehabilitation is found in Section 9.2 of Golder (2022).

3.3.2 Surface Flow

A summary of the simulated changes in surface water flow at the 16 surface water monitoring stations for Operational Phases 1 to 7 and post-Rehabilitation is shown on Figure 10. Surface water stations SW1 to SW4, SW6 to SW10, SW13, and SW16 generally experience simulated reduction in flows of less than 10% of the current conditions. Station SW11 experiences a reduction of 15% during Phase 2, but recovers during the subsequent phases showing a reduction of 6-7% in Phases 3 to 7. Similarly, SW15 experienced a 14% reduction in Phase 4, but shows a reduction of 8-9% in subsequent phases.

Station SW14 experiences a reduction in simulated flow of up a 16% (during Phases 3 and 4), and 12-14% during Phases 5 to 7. The largest percentage of simulated reduction in flows occurs at SW5; ranging from 14% to 23% throughout the quarry development; this reduction represents a maximum simulated change of 0.6 L/s. Further discussion of these predicted changes in flow based on HGS model simulations and the potential impact to surface water is provided in Section 9.1 of Golder (2022).

3.3.3 Quarry Inflows

The steady state simulated groundwater inflow during Operational Phases 1 to 7 for each area (Main, North, South) is summarized in Table 3.

Table 3: Simulated Quarry Inflow at Each Phase of Development

Phase	Main Area Simulated Inflow (L/s)	North Area Simulated Inflow (L/s)	South Area Simulated Inflow (L/s)	Total Inflow (L/s)
1	14.3	0.0	0.0	14.3
2	18.0	2.8	0.0	20.8
3	17.4	2.9	0.0	20.3
4	25.3	2.9	0.0	28.2
5	70.8	2.9	0.0	73.7
6	81.3	2.9	7.7	91.9
7	53.6	2.5	77.5	133.6

1.The inflows include the surplus applied to the pit area.

Overall, the total simulated inflow to all areas of the pit / quarry during operations ranges from 14.3 L/s to 133.7 L/s. The majority of the simulated inflow is in the Main Area of the pit / quarry, with inflows up to 81.3 L/s during Phase 6 of the operation. During Phase 7 of operation, the majority of the simulated inflow is in the South Area, with an inflow of 77.5 L/s.

Upon rehabilitation, the maximum water level in the Main Pond will be controlled by an outflow to the North Pond at an approximate elevation of 400 masl, and the maximum water level in the North Pond will be controlled by an outflow and pipe to the Osprey Valley Golf Course irrigation system at an approximate elevation of 399 masl. The simulated elevation of the South Pond is estimated to be 393.5 masl and will be internally contained, with no surface outflow. The simulated steady state outflow from the Main and North Ponds to the golf course irrigation system is estimated to be approximately 12 L/s.

A sensitivity analysis was done by increasing and decreasing the hydraulic conductivity of the slurry wall / grouting alignment to simulate the potential increase and decrease in quarry inflows at each development phase. The results are summarized in Table 4:

Table 4: Simulated Change in Quarry Inflow at Each Phase of Development

Phase	K wall: 1E-06 m/s, % change				K wall: 1E-08 m/s, % change			
	Main Area	South Area	North Area	Total Inflow	Main Area	South Area	North Area	Total Inflow
3	0%		0%	0%	0%		0%	0%
4	0%		0%	0%	0%		0%	0%
5	8%		0%	8%	-2%		0%	-1%
6	9%	0%	0%	8%	-1%	0%	0%	-1%
7	8%	6%	0%	7%	-1%	-1%	0%	-2%

1.The inflows include the surplus applied to the pit area.

The simulated pit / quarry inflow is more sensitive to an increase in the hydraulic conductivity of the slurry wall / weathered zone grouting to $1x10^{-6}$ m/s, with the increase in total quarry inflow ranging from 8 to 9% when the hydraulic conductivity is increased by an order of magnitude. The largest predicted increase (9%) occurs in the inflow to the Main Area during Operational Phase 6. The reduction of predicted water inflow when the hydraulic conductivity of the slurry wall / weathered zone grouting is reduced to $1x10^{-8}$ m/s is relatively small, ranging from 1 to 2% when the hydraulic conductivity is decreased by an order of magnitude. The water table drawdown is not affected by the increase and decreasing the hydraulic conductivity of the slurry wall / grouting alignment.

4.0 REFERENCES

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Signature Page

We trust that this report meets your current requirements. Please contact the undersigned should you have any questions.

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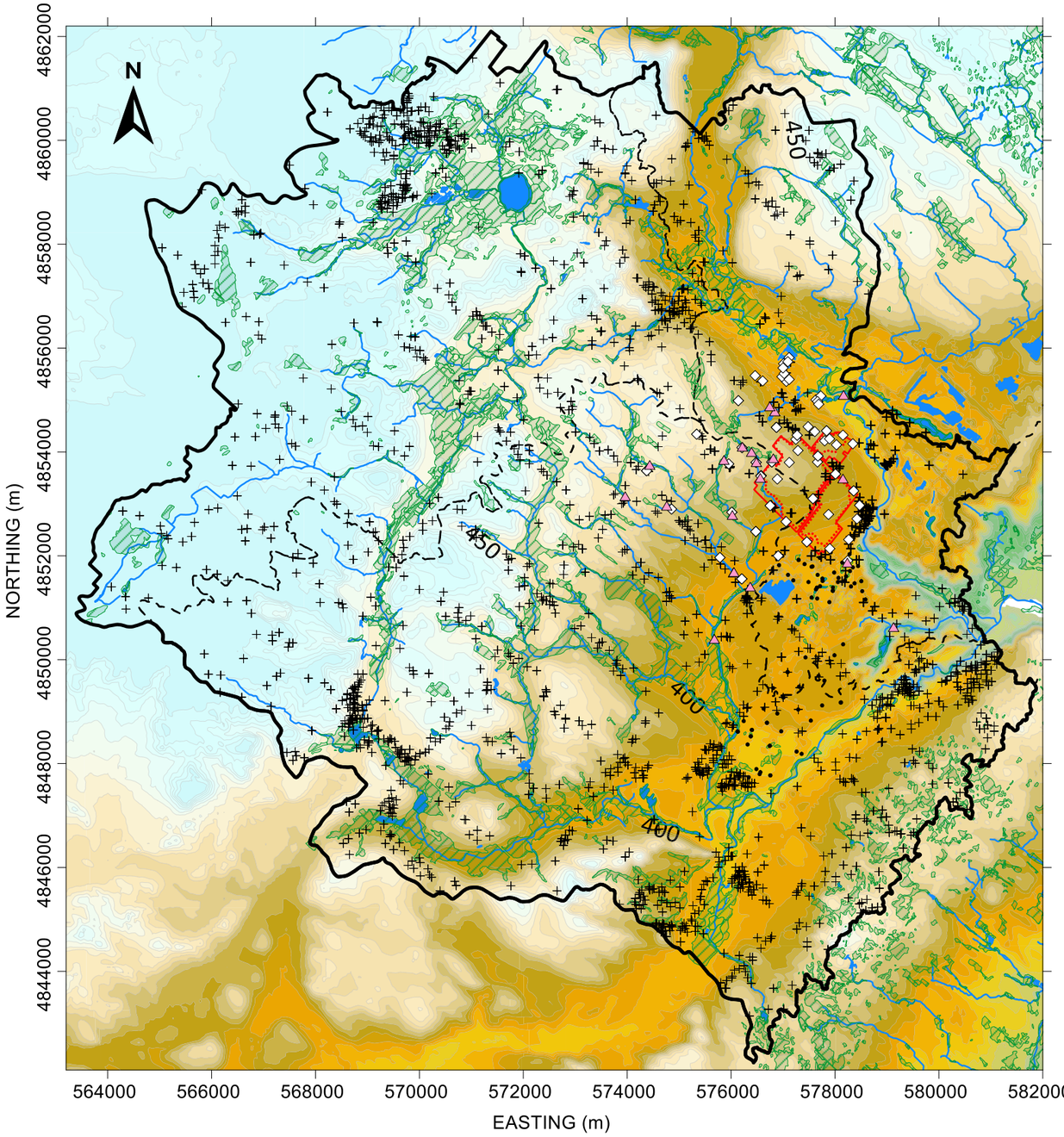
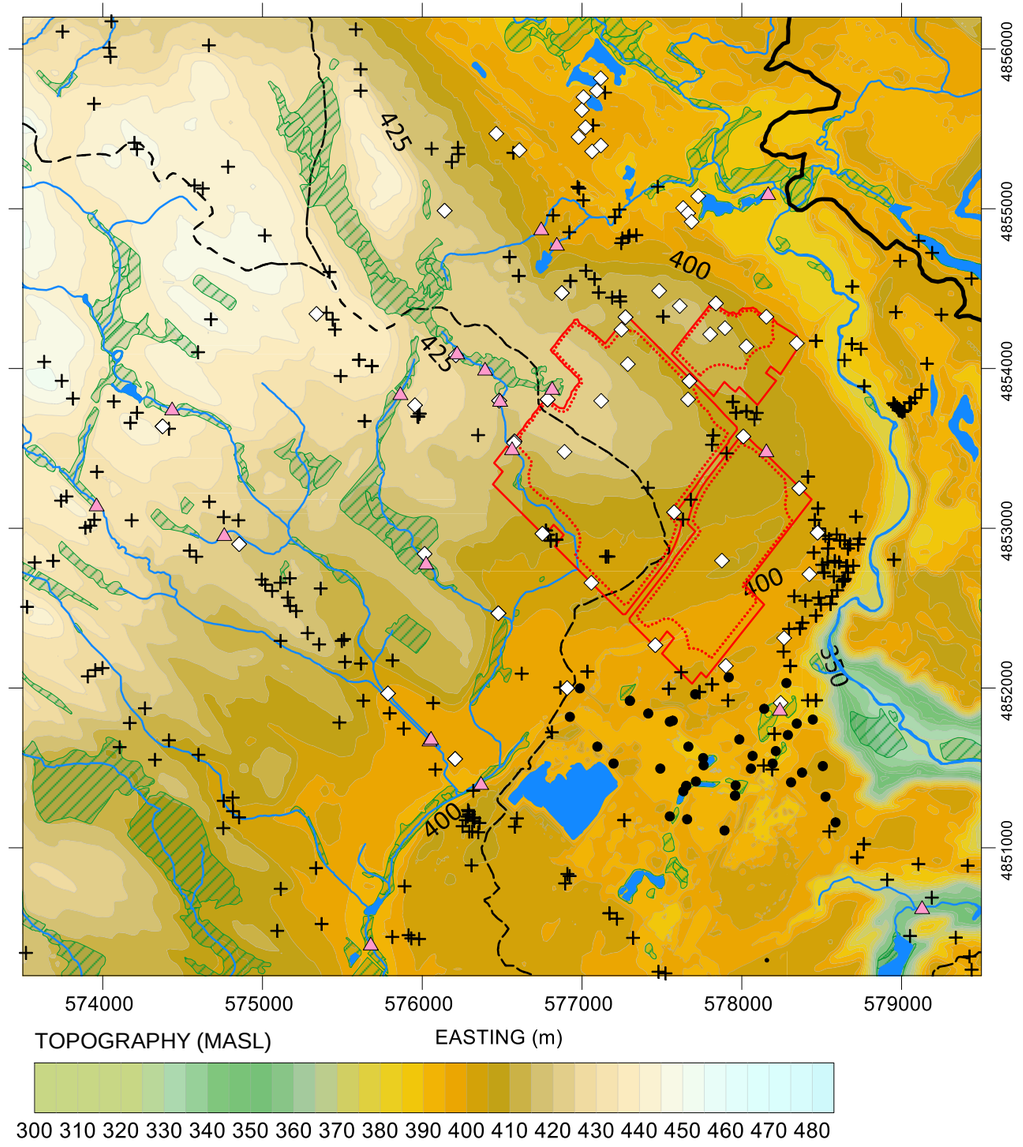
FIGURES





TOPOGRAPHY (MASL)

300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480

LEGEND

- LAKES
- RIVERS/ STREAMS
- WETLAND
- MODEL DOMAIN
- CVC SUBWATERSHED
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENT
- MECP WWR WELL LOCATION
- SITE GROUNDWATER MONITORING LOCATION
- SITE SURFACE WATER MONITORING LOCATION
- ADDITIONAL GROUNDWATER MONITORING LOCATION[6]

NOTES

1. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
2. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
3. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
4. Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2020).
5. Quarry license and modelled limit of extraction provided by MHBC (May, 2023)
6. Additional groundwater monitoring points from CRA (2012) and Harden (2016) reports

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REVIEW	SD
APPROVED	GS

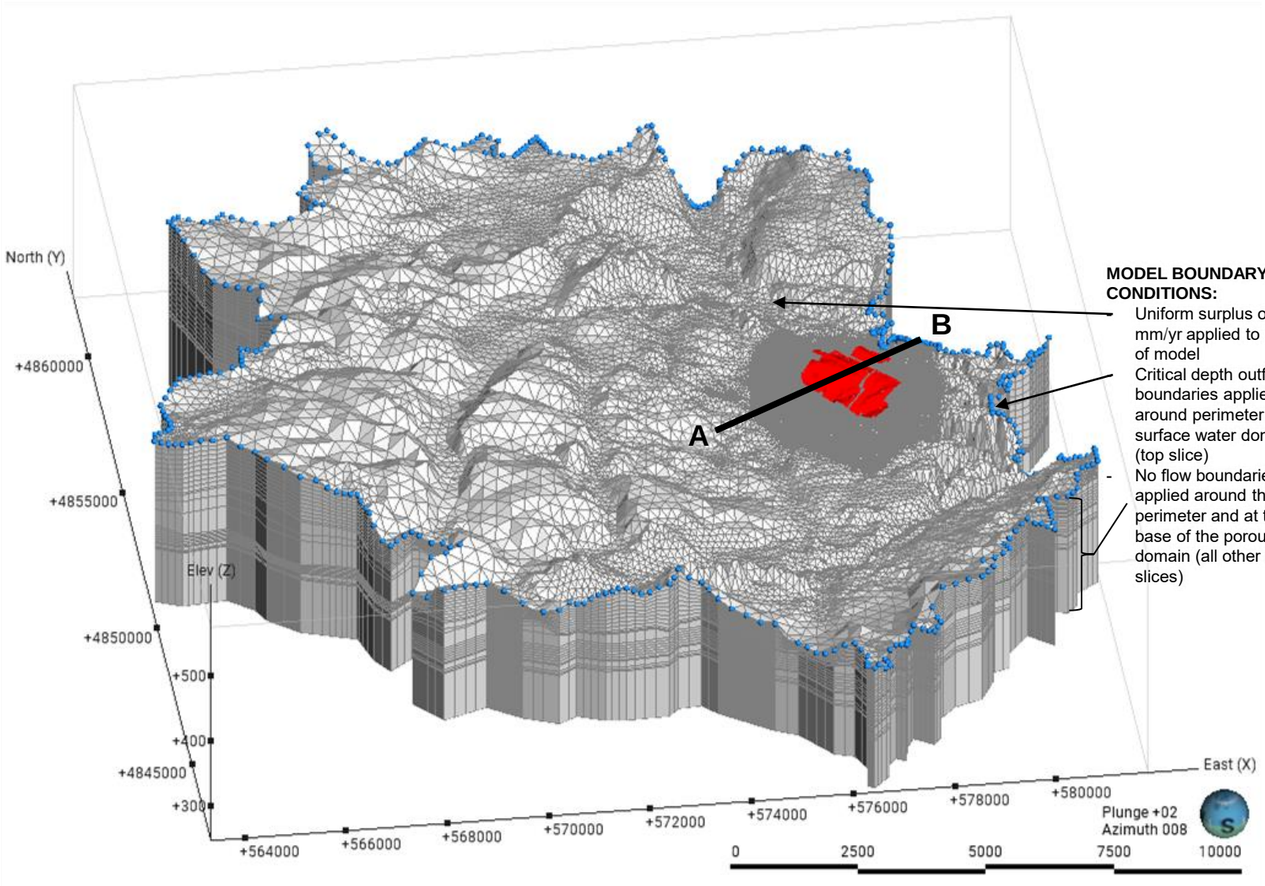
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
STUDY AREA AND MODEL DOMAIN

PROJECT No. 19129150 | Rev. 0 | FIGURE 1

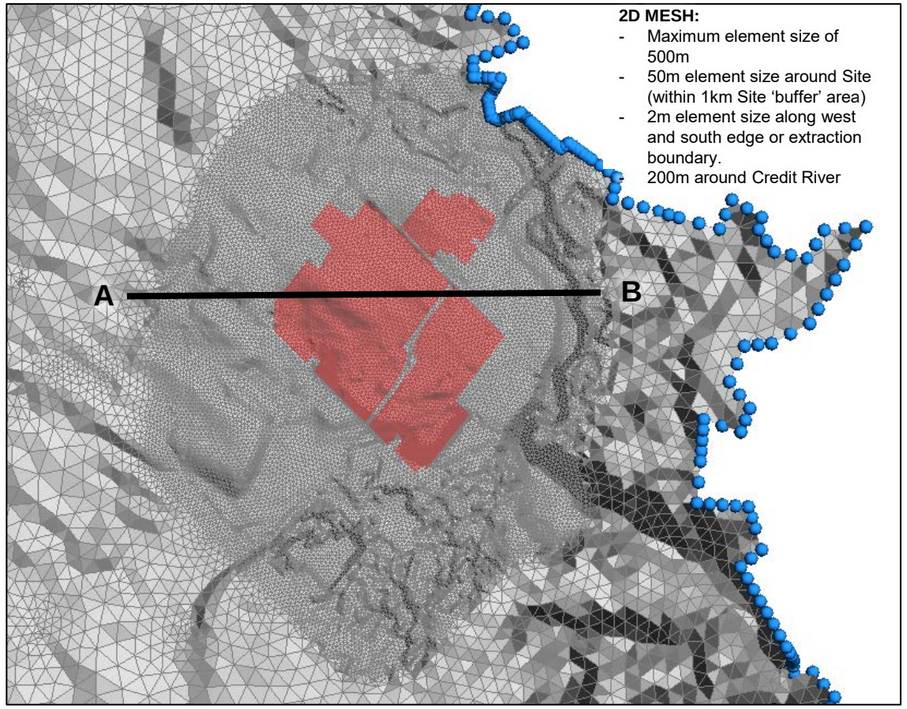
1. 3D PERSPECTIVE VIEW OF MODEL MESH (LOOKING NORTH)

OVERALL MODEL MESH:
- 26 vertical layers (27 slices)
- 906,471 mesh nodes (33,573 nodes per slice)
- 1,732,354 mesh elements (66,629 elements per layer)



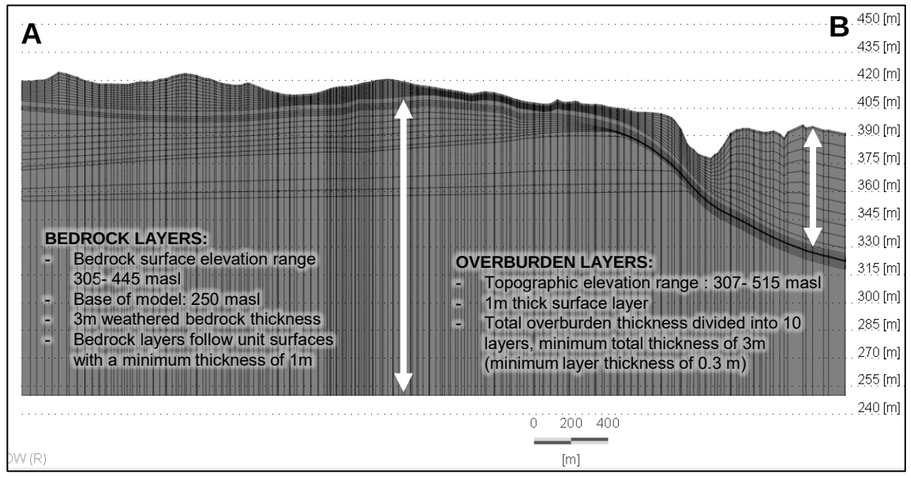
MODEL BOUNDARY CONDITIONS:
- Uniform surplus of 364 mm/yr applied to surface of model
- Critical depth outflow boundaries applied around perimeter of surface water domain (top slice)
- No flow boundaries applied around the perimeter and at the base of the porous media domain (all other model slices)

2. PLAN VIEW OF MODEL MESH IN SITE AREA



2D MESH:
- Maximum element size of 500m
- 50m element size around Site (within 1km Site 'buffer' area)
- 2m element size along west and south edge or extraction boundary.
- 200m around Credit River

3. CROSS SECTION VIEW OF MODEL MESH IN SITE AREA



BEDROCK LAYERS:
- Bedrock surface elevation range 305- 445 masl
- Base of model: 250 masl
- 3m weathered bedrock thickness
- Bedrock layers follow unit surfaces with a minimum thickness of 1m

OVERBURDEN LAYERS:
- Topographic elevation range : 307- 515 masl
- 1m thick surface layer
- Total overburden thickness divided into 10 layers, minimum total thickness of 3m (minimum layer thickness of 0.3 m)

LEGEND

LICENSE LIMIT

CRITICAL DEPTH MODEL BOUNDARY

Hydrostratigraphic Unit		Primary Model Layer
Overburden	Surficial Sediment	1
	Till	2-11
	Upper Sand	2-11
	Lower Sand	2-11
	Valley Skin	1-12 (in river valley)

Hydrostratigraphic Unit		Primary Model Layer
Bedrock	Weathered Bedrock	1-12 (primarily 12)
	Guelph Formation	13
	Eramosa Formation	14
	Goat Island Formation	15
	Gasport Formation	16- 21
	Shaley Dolostone Unit	22
	Cabot Head Formation	23
	Manitoulin Formation	24
	Whirlpool Formation	25
	Queenston Formation	26

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CALEDON PIT AND QUARRY NUMERICAL MODELLING

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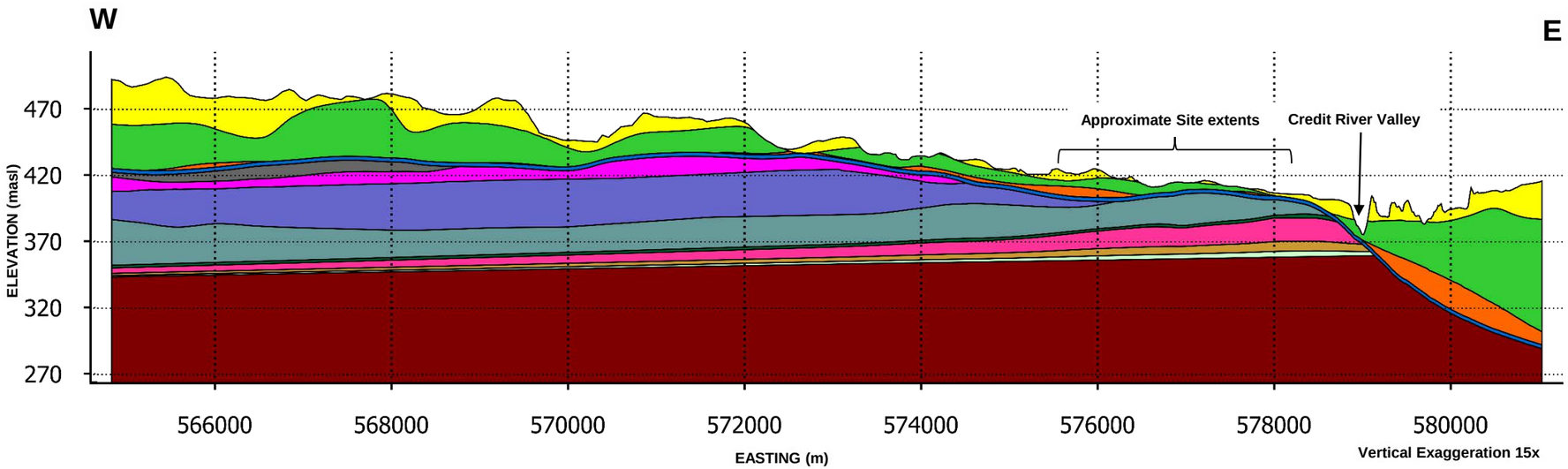
DESIGN	HW
REVIEW	SD
APPROVED	GS

TITLE
MODEL MESH AND BOUNDARY CONDITIONS

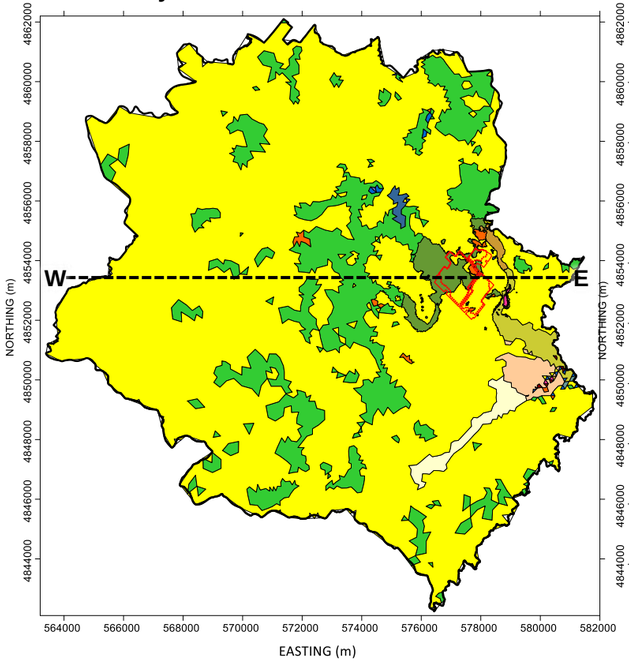
PROJECT No. 19129150 | Rev. 0 | FIGURE 2

CROSS SECTION: GENERAL MODEL HYDROSTRATIGRAPHY

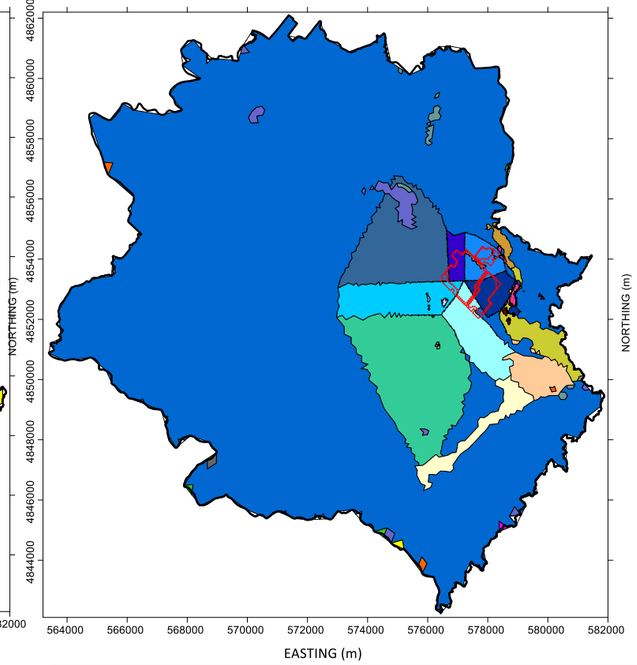


PLAN VIEW: MODEL UNIT SUB-ZONES WITHIN PARENT UNITS

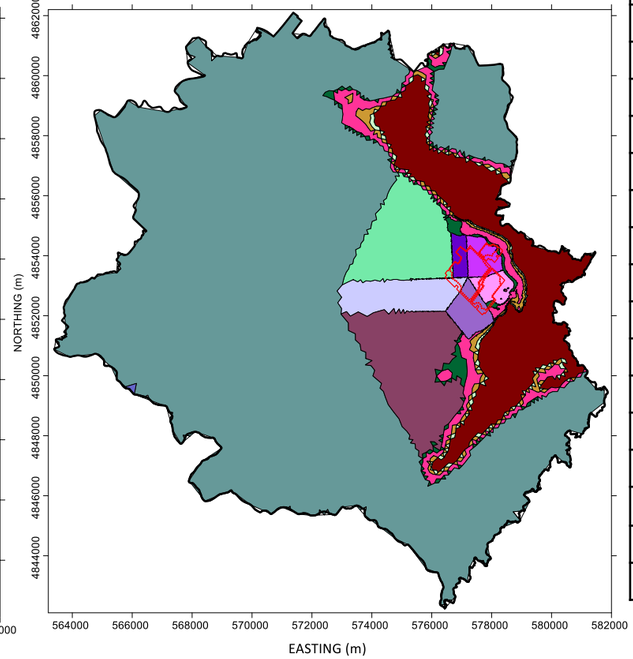
1. Model Layer 1: Overburden Sub-Zones



2. Model Layer 12: Weathered Bedrock Sub-Zones



3. Model Layer 16: Gasport Formation Sub-Zones



Unit	Kh (m/s)	Kv (m/s)	Porosity	Specific Storage (1/m)
Regional Till	1.E-06	1.E-06	0.3	1.E-04
Local Till	1.E-08	5.E-09	0.3	1.E-04
Upper Sand	1.E-04	1.E-04	0.3	1.E-04
Lower Sand	1.E-04	1.E-04	0.3	1.E-04
Till (Valley Skin) Zone 1	4.E-06	4.E-06	0.3	1.E-04
Till (Valley Skin) Zone 2	1.E-06	1.E-06	0.3	1.E-04
Till (Valley Skin) Zone 3	5.E-06	5.E-06	0.3	1.E-04
Till (Valley Skin) Zone 4	2.E-04	2.E-04	0.3	1.E-04
Weathered Bedrock (Regional)	2.E-04	5.E-06	0.01	5.E-06
Weathered Bedrock Zone 1	5.E-06	5.E-07	0.01	5.E-06
Weathered Bedrock Zone 2	4.E-06	4.E-06	0.01	5.E-06
Weathered Bedrock Zone 3	4.E-06	4.E-06	0.01	5.E-06
Weathered Bedrock Zone 4	1.E-03	1.E-03	0.01	5.E-06
Weathered Bedrock Zone 5	5.E-05	5.E-06	0.01	5.E-06
Weathered Bedrock Zone 6	5.E-04	5.E-04	0.01	5.E-06
Weathered Bedrock Zone 7	5.E-06	5.E-07	0.01	5.E-06
Guelph Formation	5.E-05	5.E-06	0.01	5.E-06
Eramosa Formation	9.E-08	9.E-09	0.01	5.E-06
Goat Island Formation	1.E-06	1.E-07	0.01	5.E-06
Gasport Formation Regional	1.E-06	1.E-07	0.01	5.E-06
Gasport Formation Zone 1	5.E-06	5.E-07	0.01	5.E-06
Gasport Formation Zone 2	5.E-07	5.E-08	0.01	5.E-06
Gasport Formation Zone 3	1.E-06	1.E-07	0.01	5.E-06
Gasport Formation Zone 4	1.E-05	1.E-06	0.01	5.E-06
Gasport Formation Zone 5	1.E-05	1.E-06	0.01	5.E-06
Gasport Formation Zone 6	1.E-07	1.E-08	0.01	5.E-06
Gasport Formation Zone 7	5.E-06	5.E-07	0.01	5.E-06
Shaley Dolostone Unit	1.E-07	2.E-09	0.01	5.E-06
Cabot Head Formation	1.E-08	1.E-09	0.01	5.E-06
Manitoulin Formation	1.E-05	1.E-06	0.01	5.E-06
Whirlpool Formation	1.E-06	1.E-07	0.01	5.E-06
Queenston Formation	1.E-08	1.E-09	0.01	5.E-06

LEGEND

- LICENSE LIMIT
- MODELLED EXTRACTION EXTENT
- MODEL DOMAIN

NOTES

1. Quarry license and modelled limit of extraction provided by MHBC (May, 2023)
2. Only parent units are shown in cross section view (not sub-zones)
3. Figure 1 shows the sub-zones within the modelled overburden layers, which are assigned form model layer 1-11. Layer 1 is shown as an example of the hydraulic conductivity distribution.
4. Figure 2 shows the weathered bedrock unit sub-zones, which are assigned primarily to model layer 12
5. Figure 3 shows the Gasport Formation sub-zones, which are assigned to model layers 16-21.

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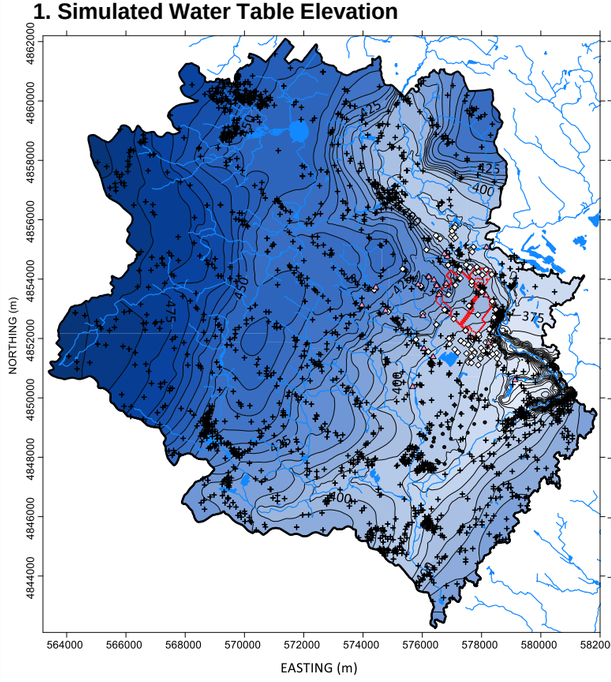
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
MODEL PARAMETERIZATION

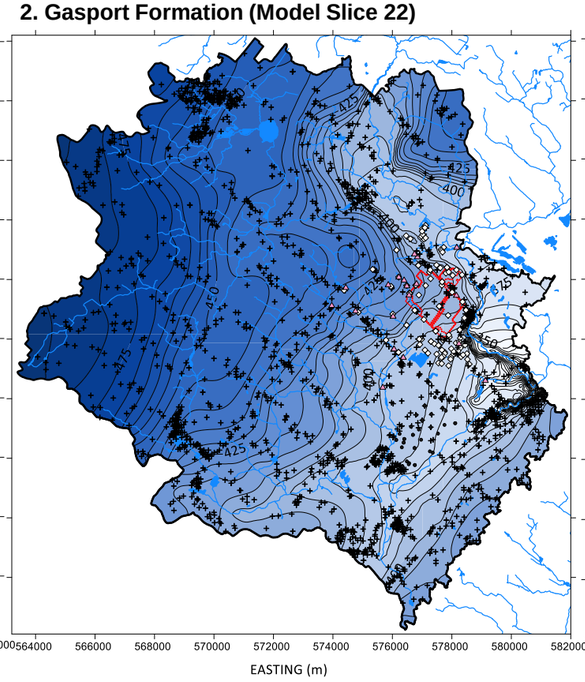
PROJECT No. 19129150 | Rev. 0 | FIGURE 3

SIMULATED HYDAULIC HEAD: REGIONAL (masl)

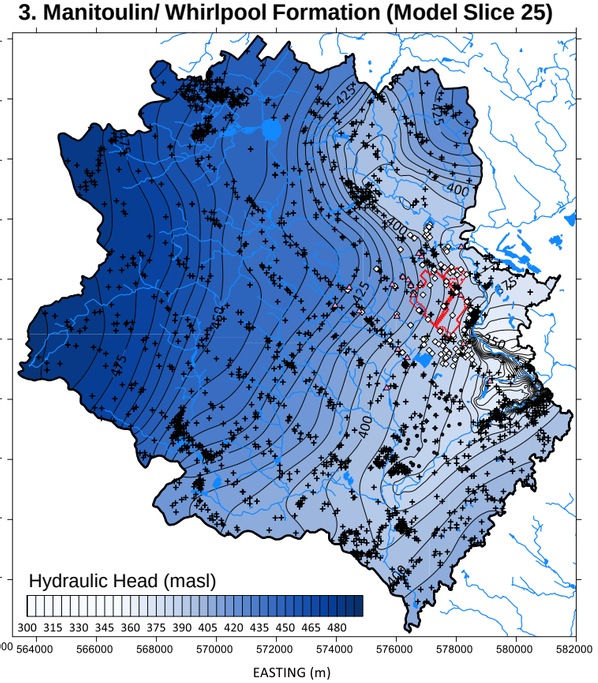
1. Simulated Water Table Elevation

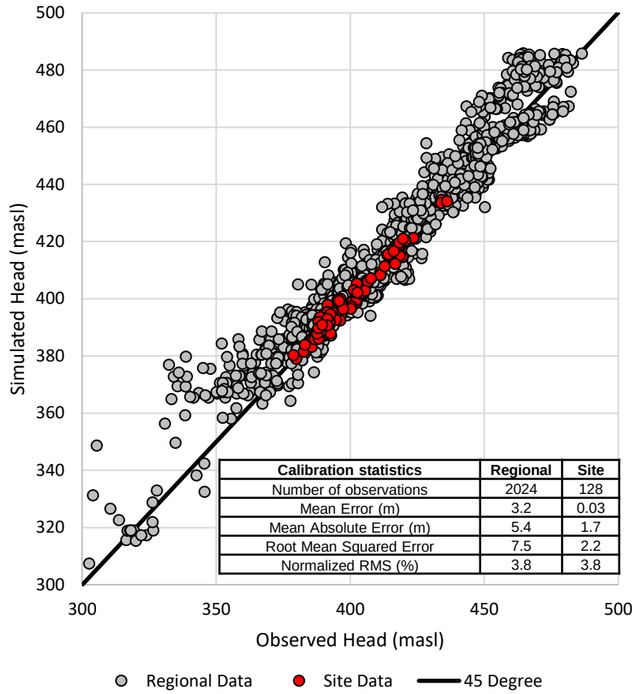


2. Gasport Formation (Model Slice 22)



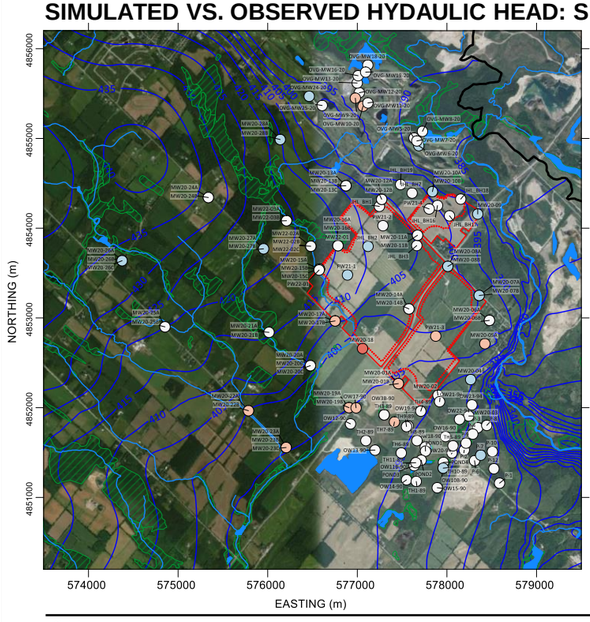
3. Manitoulin/ Whirlpool Formation (Model Slice 25)





Calibration statistics	Regional	Site
Number of observations	2024	128
Mean Error (m)	3.2	0.03
Mean Absolute Error (m)	5.4	1.7
Root Mean Squared Error	7.5	2.2
Normalized RMS (%)	3.8	3.8

SIMULATED VS. OBSERVED HYDRAULIC HEAD: SITE

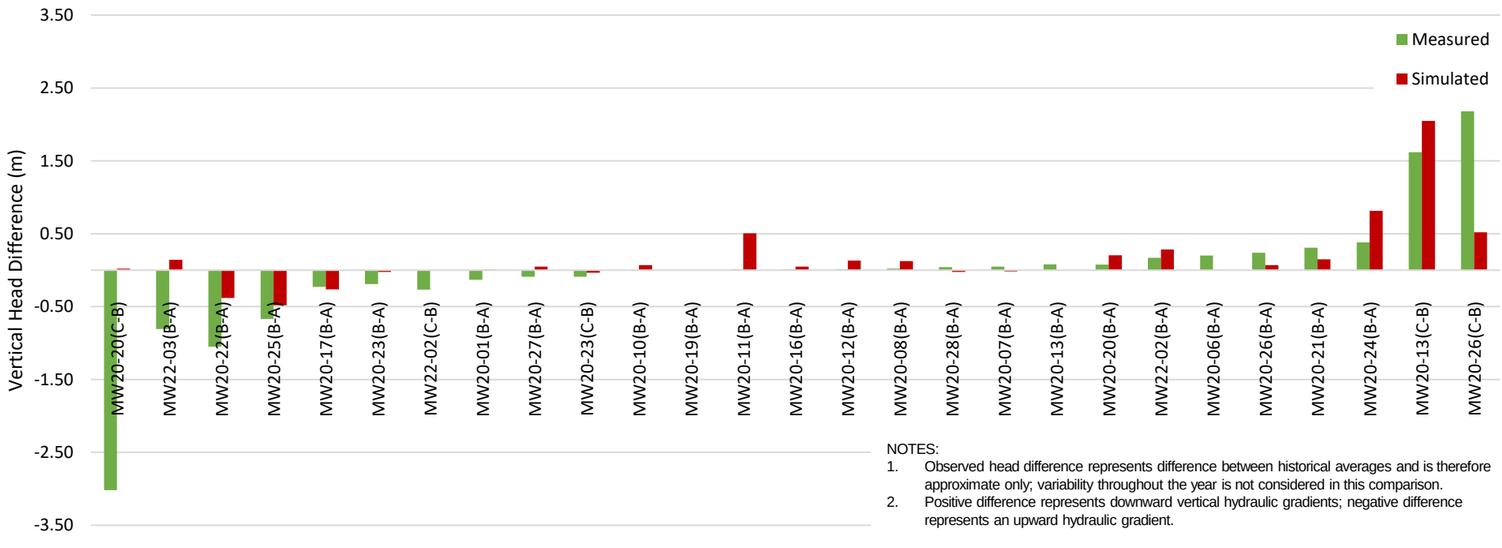


Residual: Simulated- Observed Hydraulic Head (m)

- -15 to -10
- -10 to -5
- -5 to -2
- -2 to 2
- 2 to 5
- 5 to 10
- 10 to 15

Simulated hydraulic head Gasport Fm (slice 22)

SIMULATED VS. OBSERVED HYDRAULIC HEAD DIFFERENCE IN NESTED MONITORING WELLS



NOTES:
1. Observed head difference represents difference between historical averages and is therefore approximate only; variability throughout the year is not considered in this comparison.
2. Positive difference represents downward vertical hydraulic gradients; negative difference represents an upward hydraulic gradient.

LEGEND
- LAKES
- RIVERS/ STREAMS
- WETLAND
- MODEL DOMAIN
- CVC SUBWATERSHED
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- MECP WWR WELL LOCATION
- SITE GROUNDWATER MONITORING LOCATION
- SITE SURFACE WATER MONITORING LOCATION
- ADDITIONAL GROUNDWATER MONITORING LOCATION[6]

NOTES
3. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
4. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
5. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
6. Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2020).
7. Quarry license and modelled limit of extraction provided by MHBC (May, 2023)
8. Additional groundwater monitoring points from CRA (2012) and Harden (2016) reports

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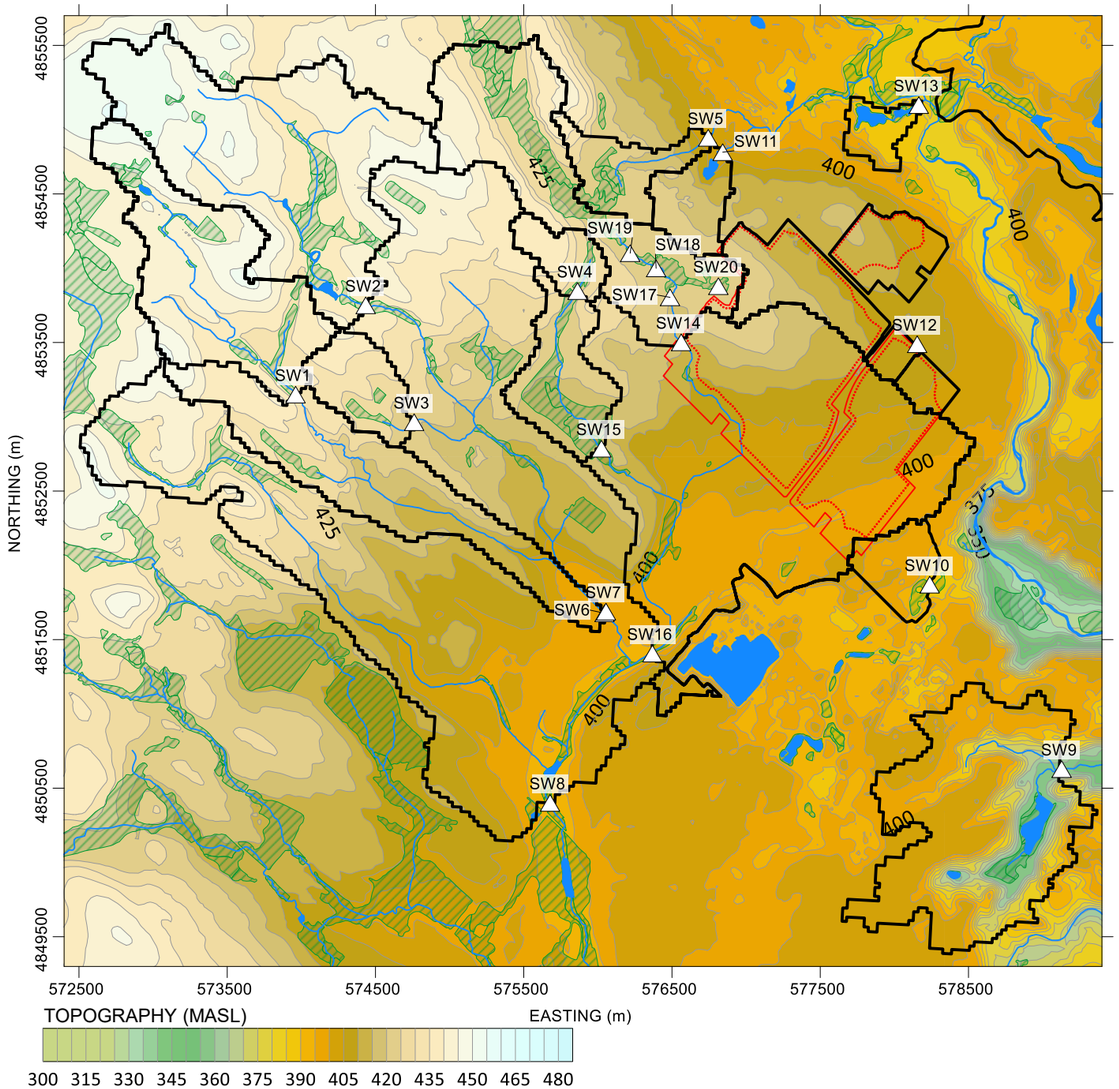
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

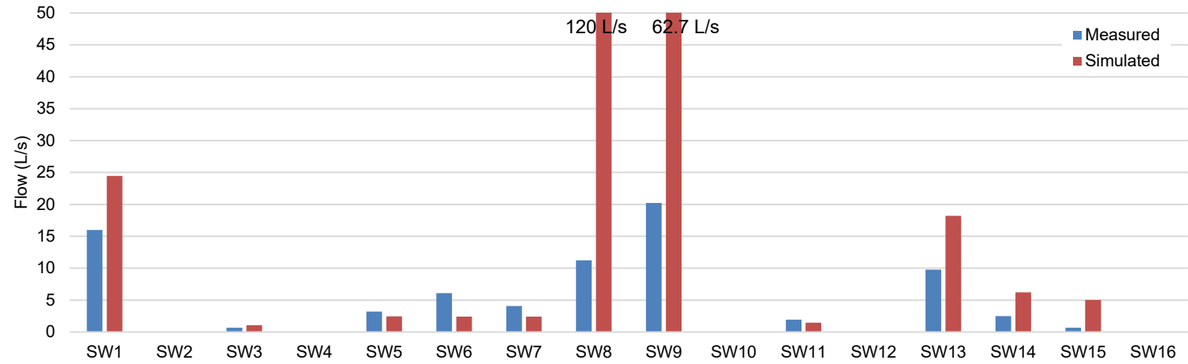
TITLE
CURRENT CONDITIONS SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 4

SURFACE WATER MONITORING STATIONS AND CATCHMENT AREAS



AVERAGE MEASURED AND SIMULATED FLOW (L/s)



AVERAGE MEASURED AND SIMULATED UNIT YIELD (L/s/km²)



Stations	Catchment Area (km²)	Flow (L/s)		Unit Yield (L/s/km²)		
		Average Measured	Model Simulated	Average Measured	Model Simulated	Surplus
SW1	1.32	16.00	24.45	12.12	18.52	11.54
SW2	2.21	0.03	0.00	0.01	0.00	11.54
SW3	0.35	0.68	1.06	1.98	3.07	11.54
SW4	0.22	0.00	0.02	0.00	0.09	11.54
SW5	0.35	3.20	2.46	9.20	7.07	11.54
SW6/7	7.73	10.17	2.41	1.32	0.31	11.54
SW8	17.40	11.25	119.98	0.65	6.90	11.54
SW9	1.81	20.23	62.71	11.19	34.68	11.54
SW10	0.26	0.00	0.00	0.00	0.00	11.54
SW11	0.28	1.94	1.45	6.83	5.11	11.54
SW12	0.06	0.00	0.00	0.02	0.00	11.54
SW13	0.16	9.79	18.23	60.44	112.51	11.54
SW14	1.41	2.50	6.20	1.77	4.39	11.54
SW15	0.73	0.65	5.03	0.89	6.86	11.54
SW16	5.94	0.00	0.00	0.00	0.00	11.54

NOTES:
1. Average measured surface water flows represent the average over the period of record for each station (approximately May 2020 to December 2021). There may be considerable variability in flows as a results of short-term climate events, which is shown in the hydrograph figures in the main report.
2. Several surface water stations have an average flow of 0.00 L/s (SW4, SW10, SW12, and SW16).
3. The 'unit yield' for both average measured and simulated surface water flow represents the average measured flow and model simulated flow for each surface water monitoring station divided by the catchment area.
4. The 'unit yield' surplus value represents the surplus value of 364 mm/yr applied to the top surface of the model (surface water domain), normalized by area.

LEGEND
- LAKES
- RIVERS/ STREAMS
- WETLAND
- CATCHMENT AREA
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- SURFACE WATER MONITORING STATION

ADDITIONAL MAP NOTES
5. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
6. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
7. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
8. Quarry license and modelled limit of extraction provided by MHBC (May, 2023)

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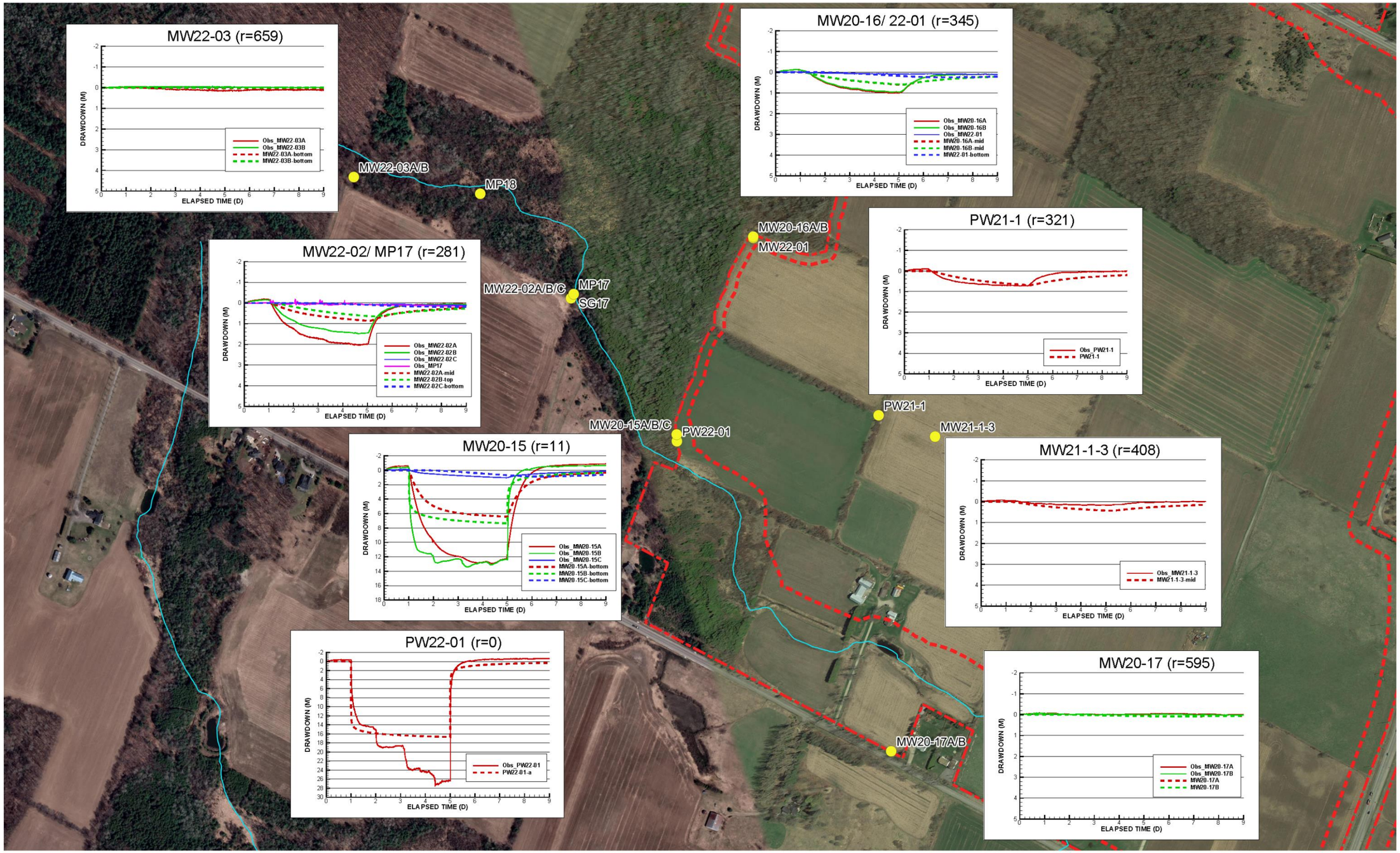
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
CURRENT CONDITIONS SIMULATED SURFACE WATER FLOW

PROJECT No. 19129150 | Rev. 0 | FIGURE 5



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- MONITORING WELL LOCATION

r DISTANCE FROM PUMPING WELL

ADDITIONAL MAP NOTES

1. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
2. Quarry license and modelled limit of extraction provided by MHBC (May, 2023)
3. The pumping test was conducted over a 4-day period from August 26, 2022, to August 30, 2022 at an average rate of 80.4 L/min, with monitoring continuing from August 23, 2022, to September 7, 2022.
4. Additional details on the pumping test methodology and interpretation are described in section 5.8.6 of the main report.
5. Gasport aquifer transmissivity is estimated to be 4.5 m2/day, and with an aquifer thickness of 23.8m the hydraulic conductivity is 2E-06 m/s.

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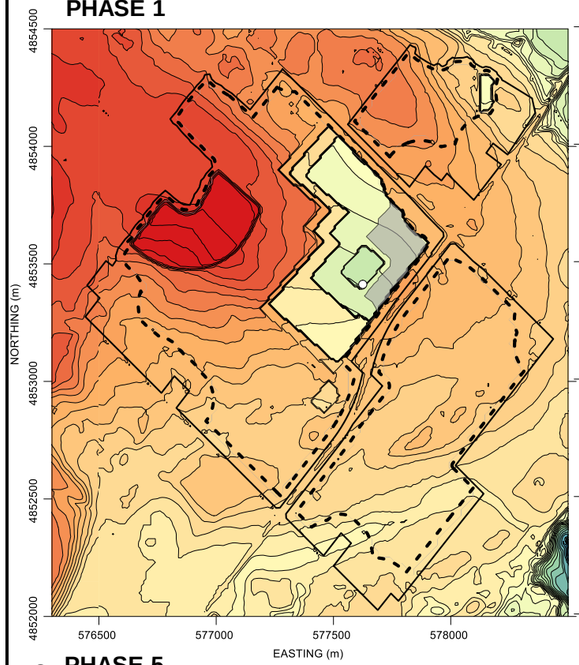
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
TRANSIENT CALIBRATION: NORTHWEST PUMPING TEST

PROJECT No.	Rev.	FIGURE
19129150	0	6

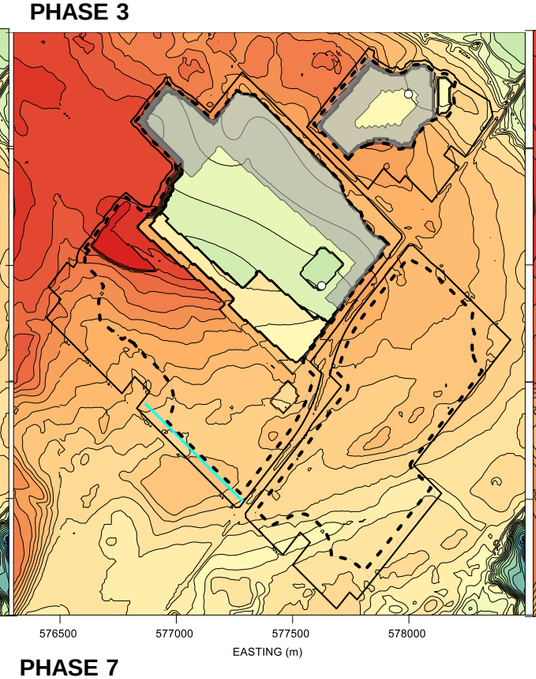
PHASE 1



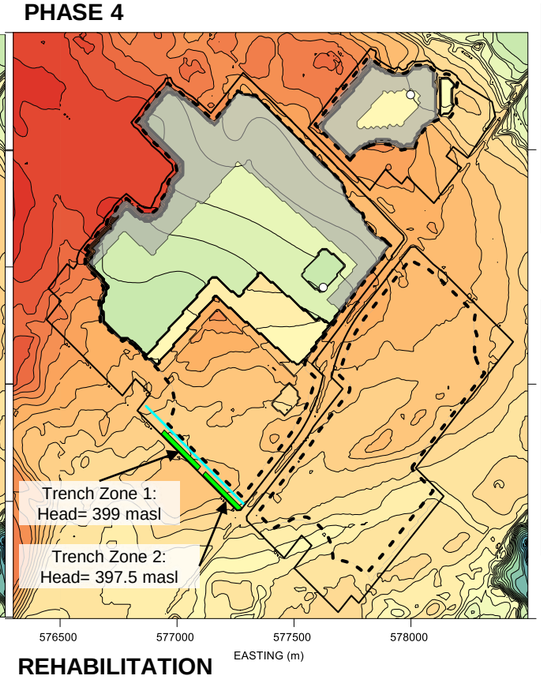
PHASE 2



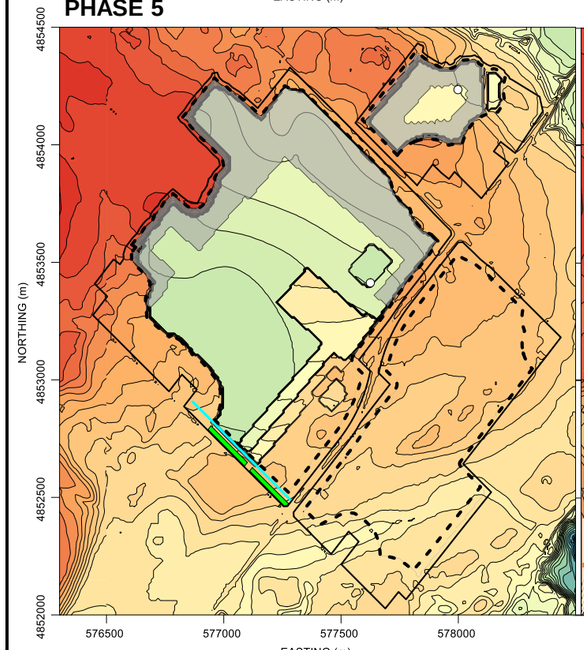
PHASE 3



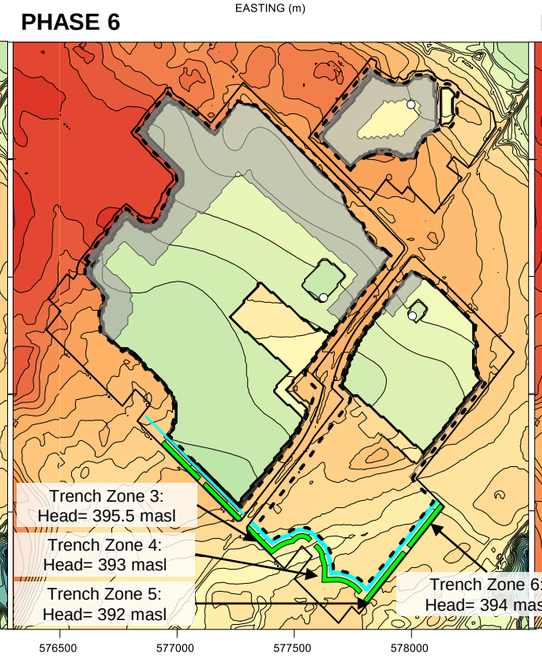
PHASE 4



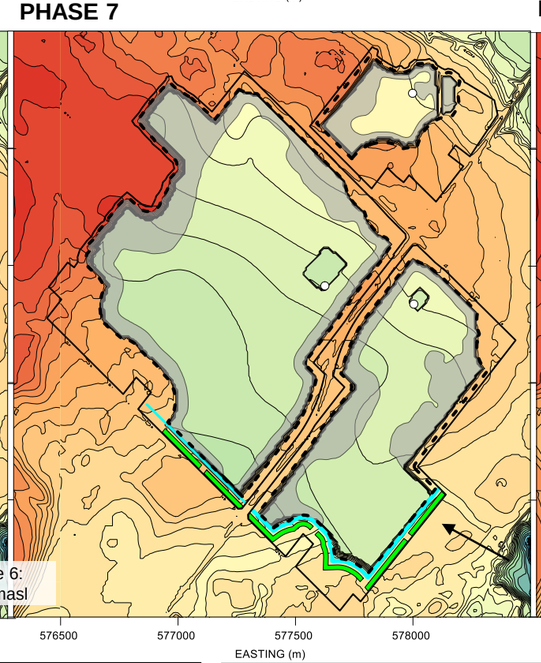
PHASE 5



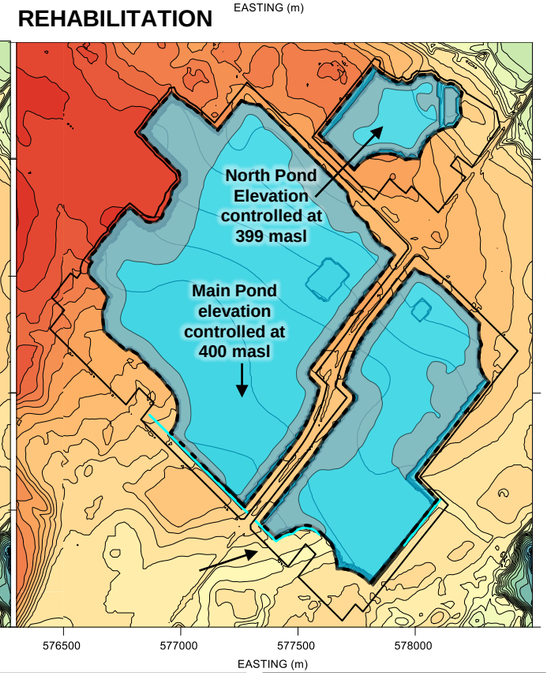
PHASE 6



PHASE 7



REHABILITATION



TIMELINE OF QUARRY DEVELOPMENT

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

QUARRY SUMP ELEVATIONS

Phase of Operation	Main Area	North Area	South Area
1	384.63	-	-
2	384.63	393.79	-
3	384.63	393.79	-
4	384.63	393.79	-
5	384.63	393.79	-
6	384.63	393.79	387.67
7	384.63	393.79	387.67

NOTES ON MODEL SETUP:

1. Quarry area is simulated as a high hydraulic conductivity zone (K= 1m/s)
2. Till backfill has an assumed value of 1E-6 m/s. There is no till backfill placed along trench zones 4 and 5 in the South Quarry, and along an 80m length adjacent to trench zone 2 in Phase 7 and the rehabilitation phase (as shown right).
3. Infiltration trench zones are simulated as constant head boundaries.
4. Slurry wall and grout alignment is modelled as a hydraulic conductivity zone with K= 1E-7m/s. Slurry wall is removed along trench zones 4 and 5 during the rehabilitation phase.
5. Sump locations are set in the South Quarry, Main Quarry, and North Quarry as they are developed. These sump nodes discharge to the Credit River directly to the east of the North Quarry, as shown in Figure 7-4 (potential discharge location) of the main report.

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- QUARRY SUMP LOCATION
- TILL BACKFILL MATERIAL
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH
- ELEVATION (masl)

360 364 368 372 376 380 384 388 392 396 400 404 408 412 416 420 424

ADDITIONAL MAP NOTES

4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
6. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
7. Quarry license and ultimate modelled limit of extraction provided by MHBC (May, 2023)

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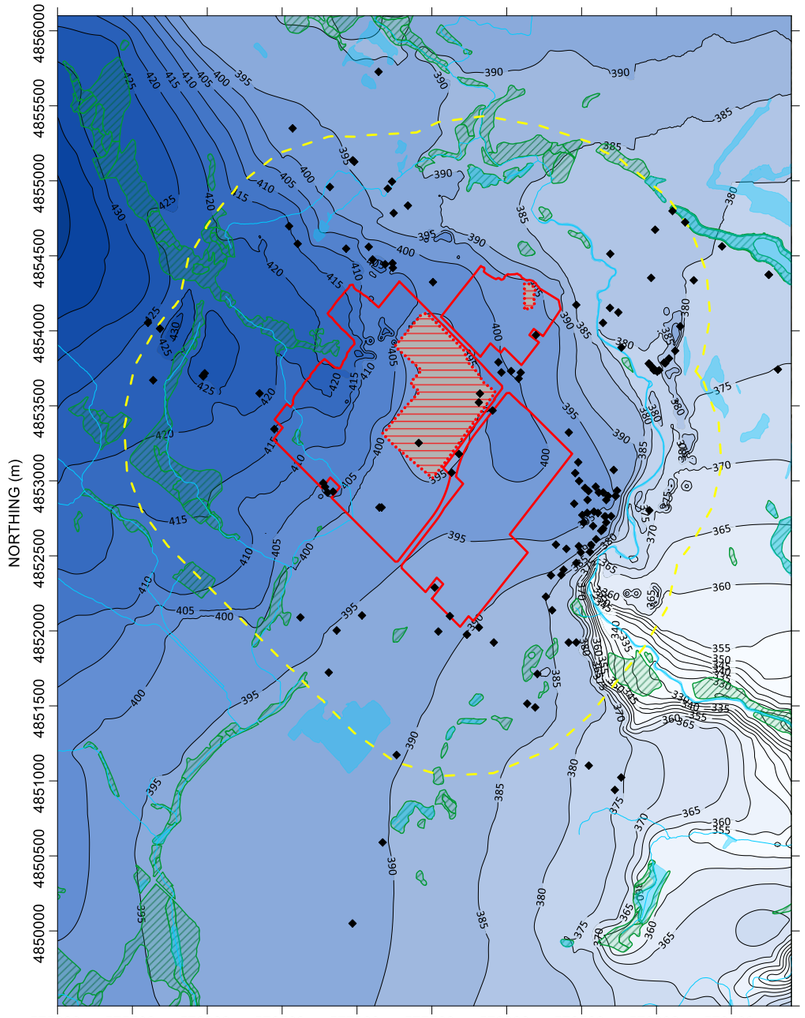
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

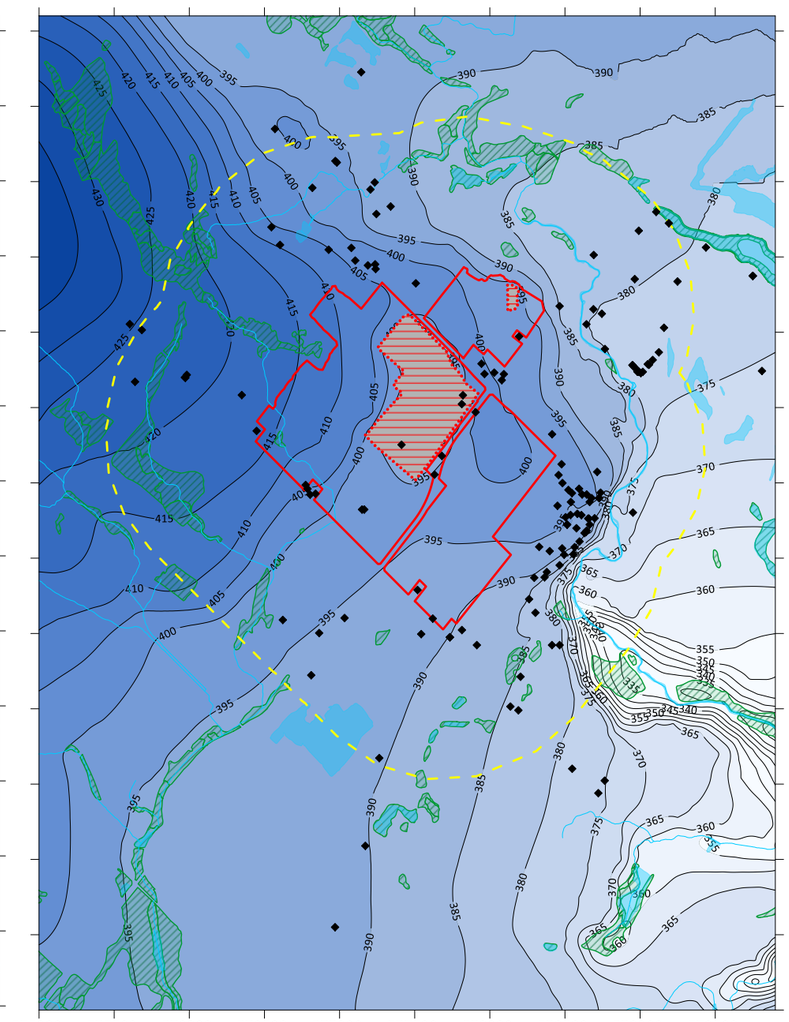
TITLE
MODELLED QUARRY DEVELOPMENT PHASES AND MITIGATION

PROJECT No. 19129150 | Rev. 0 | FIGURE 7

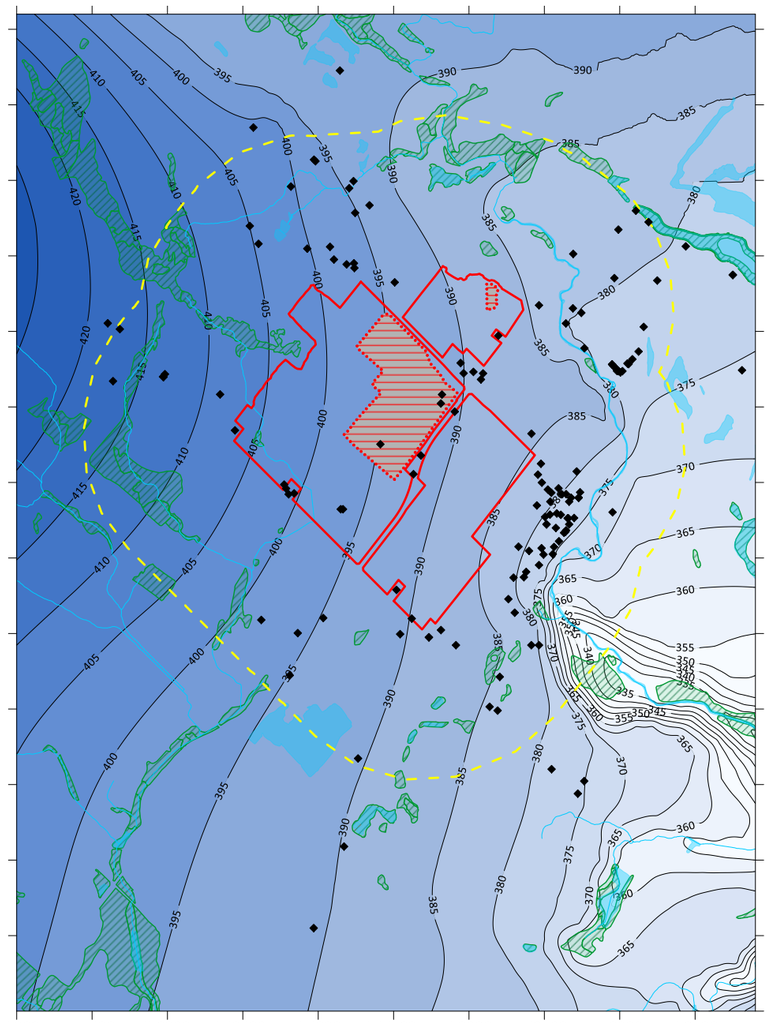
1. SIMULATED WATER TABLE ELEVATION (masl)



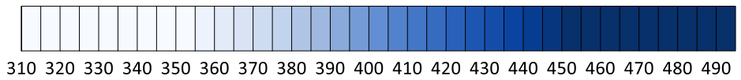
2. SIMULATED GASPORT FORMATION HEAD (masl)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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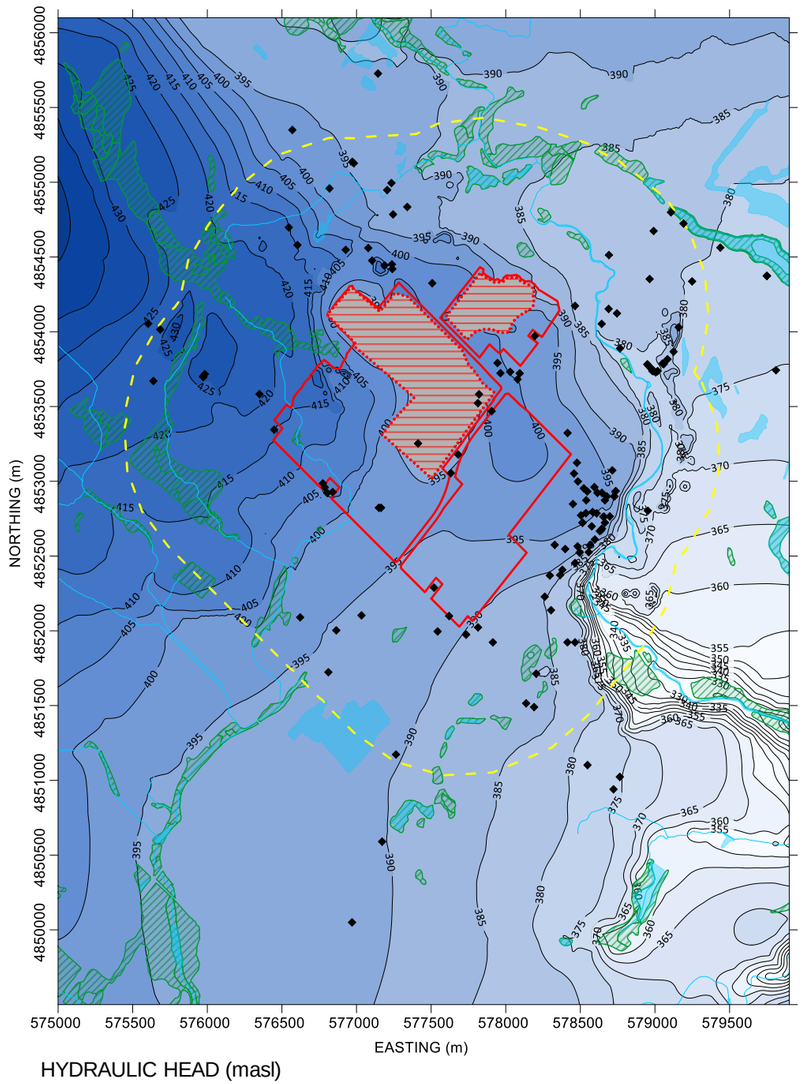
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

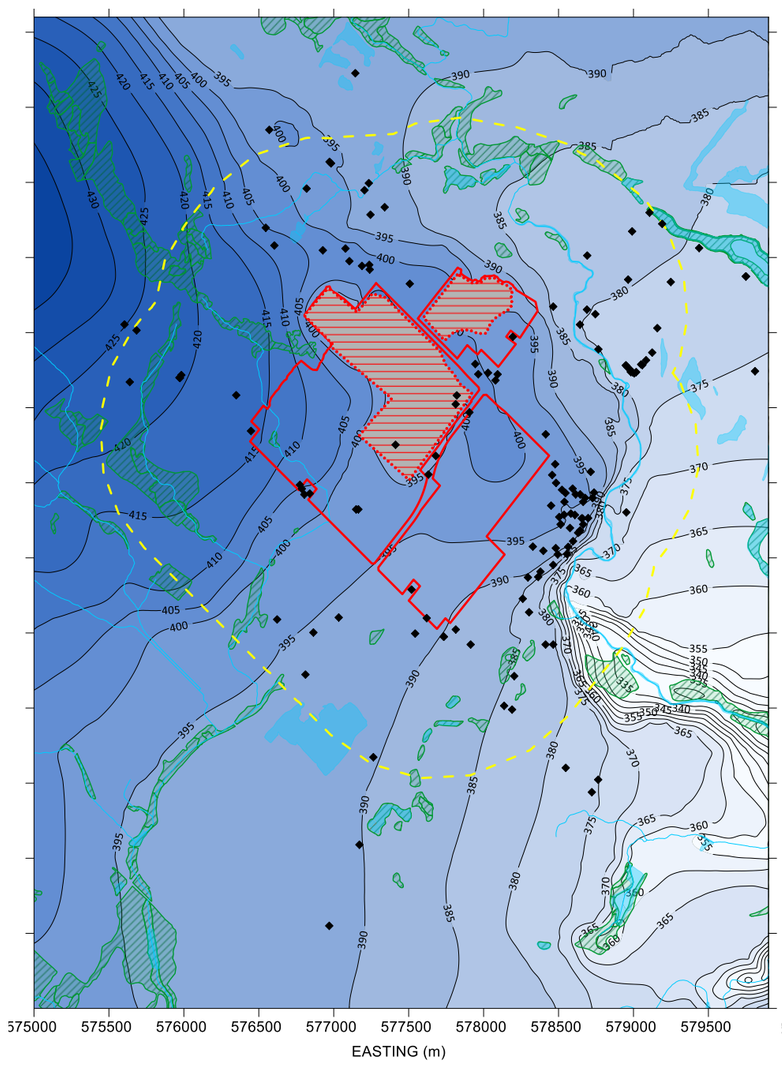
TITLE
PHASE 1 SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8A

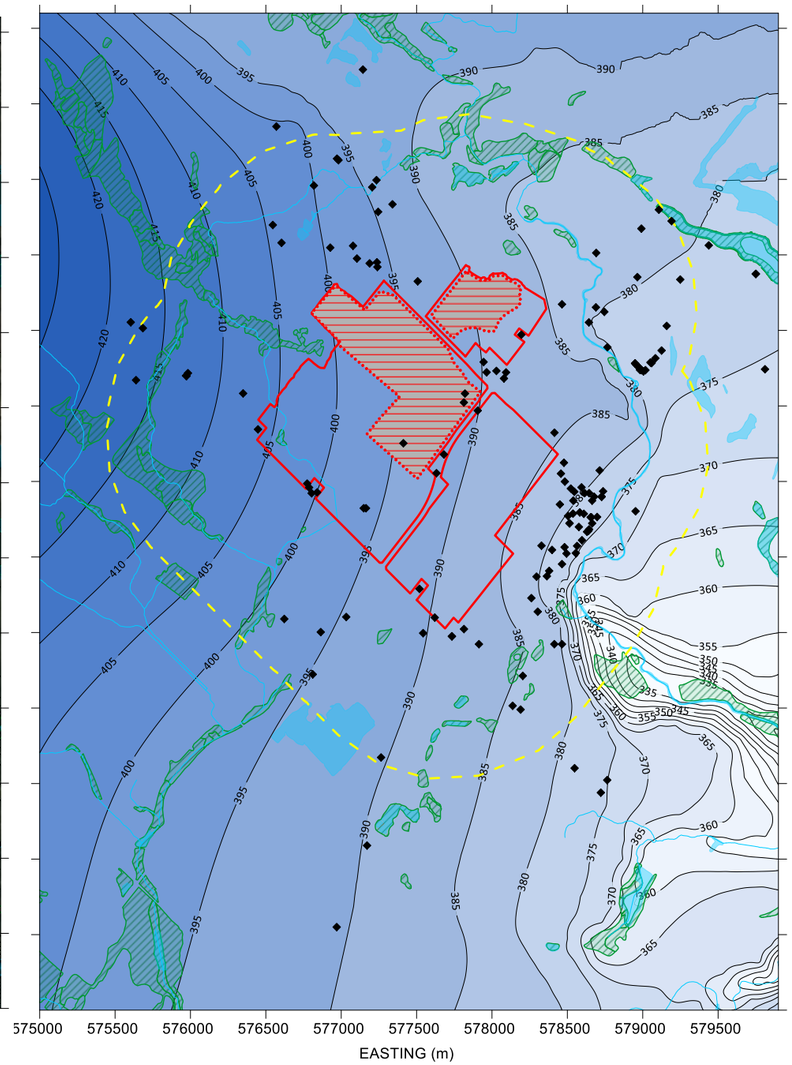
1. SIMULATED WATER TABLE ELEVATION (masl)



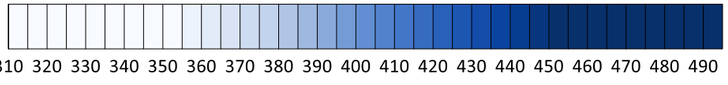
2. SIMULATED GASPORT FORMATION HEAD (masl)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

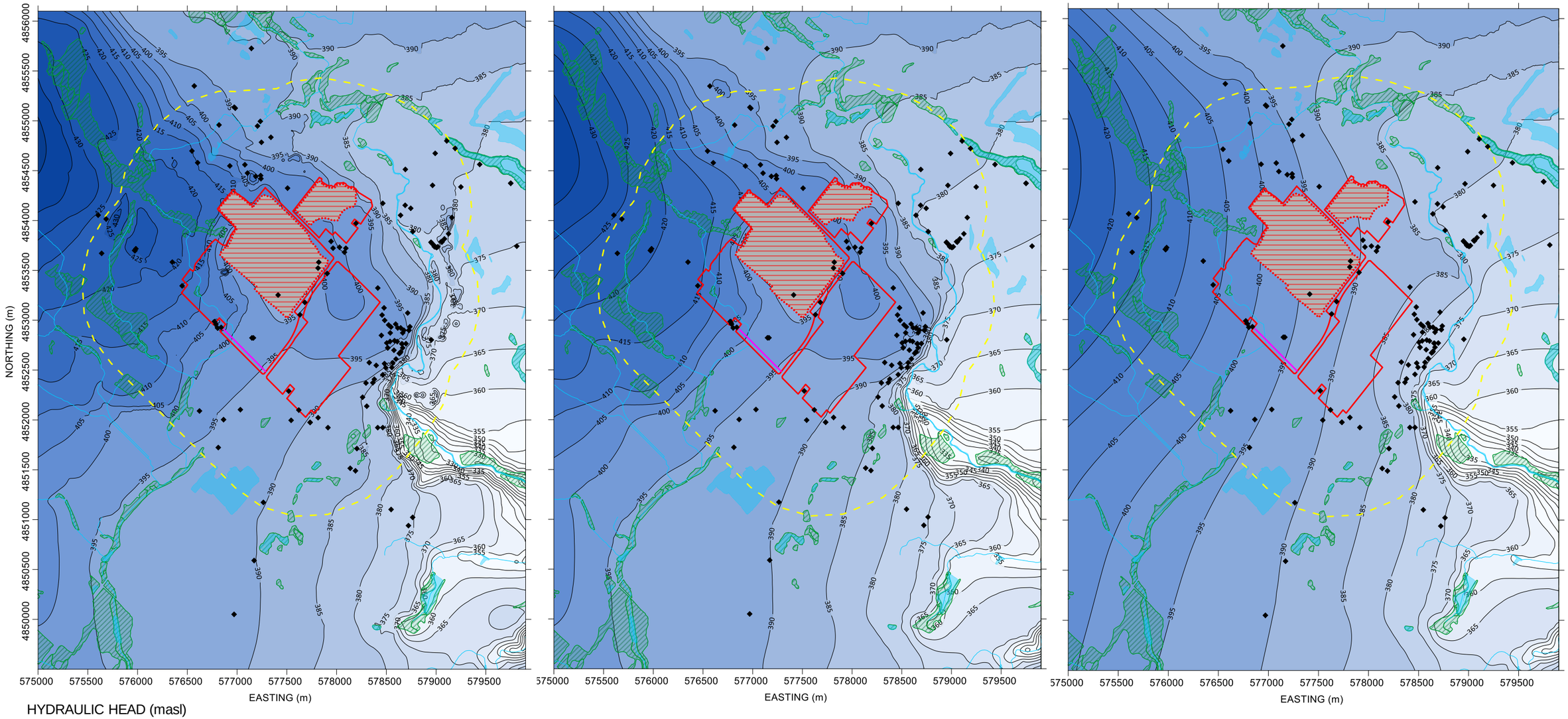
TITLE
PHASE 2 SIMULATED HYDRAULIC HEAD

PROJECT No.	Rev.	FIGURE
19129150	0	8B

1. SIMULATED WATER TABLE ELEVATION (masl)

2. SIMULATED GASPORT FORMATION HEAD (masl)

3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
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5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

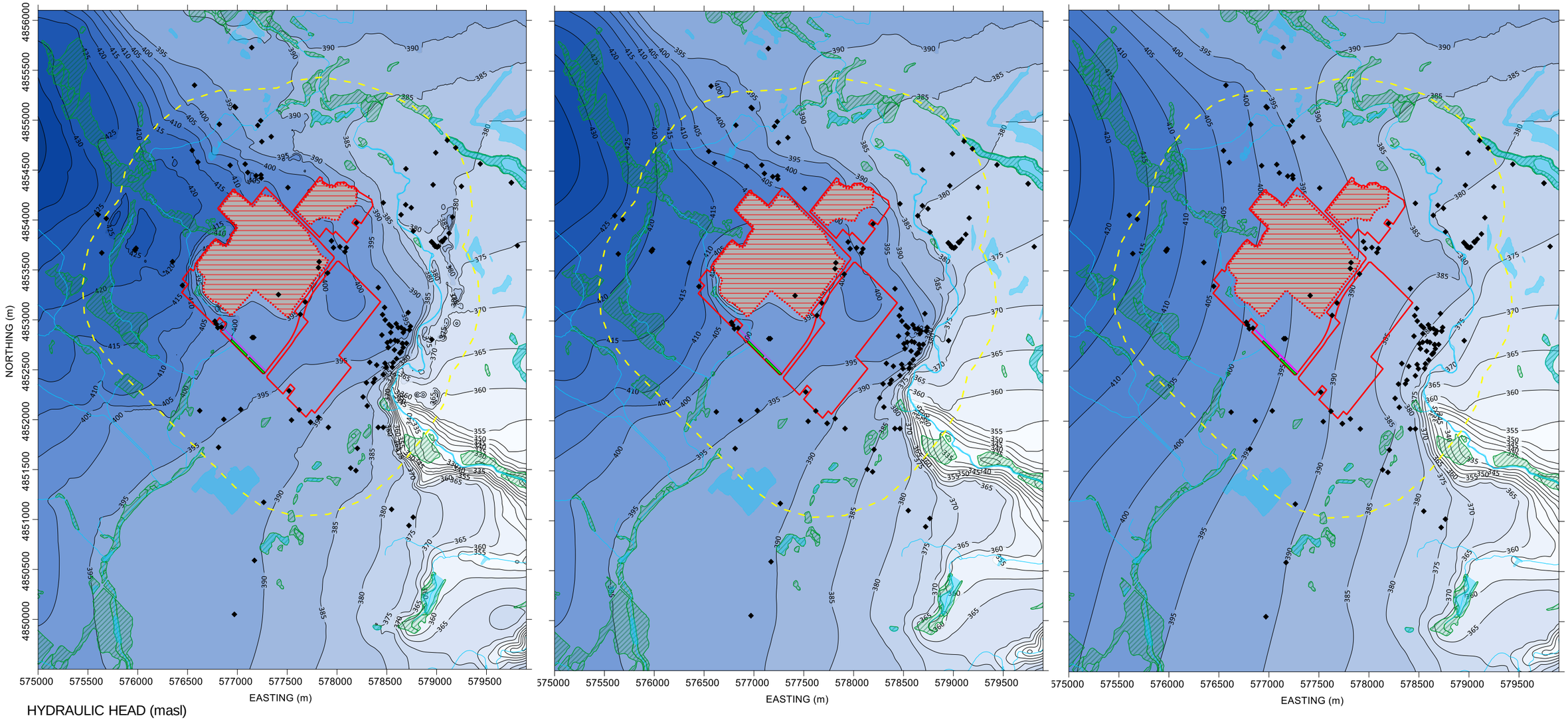
TITLE
PHASE 3 SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8C

1. SIMULATED WATER TABLE ELEVATION (masl)

2. SIMULATED GASPORT FORMATION HEAD (masl)

3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
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5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

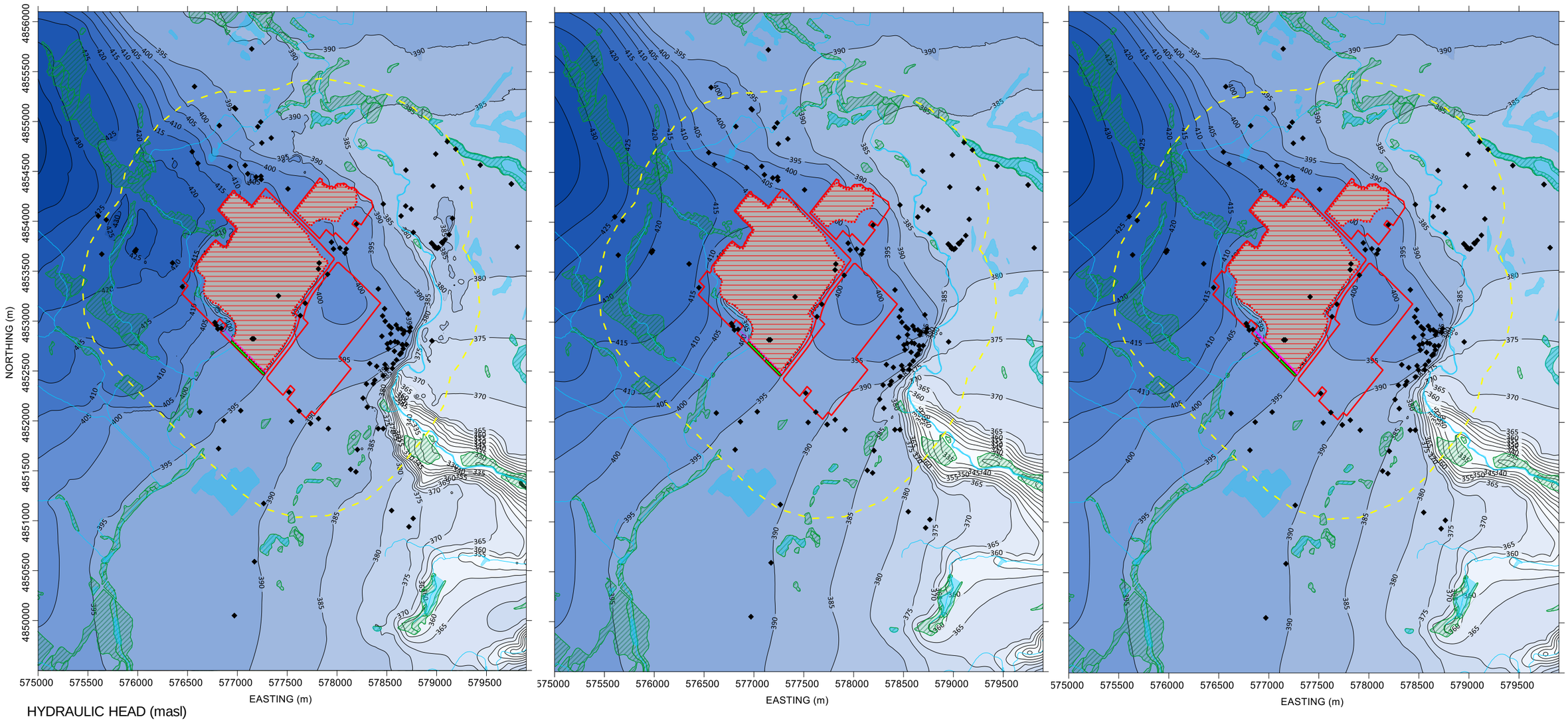
TITLE
PHASE 4 SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8D

1. SIMULATED WATER TABLE ELEVATION (masl)

2. SIMULATED GASPORT FORMATION HEAD (masl)

3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

CLIENT
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DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

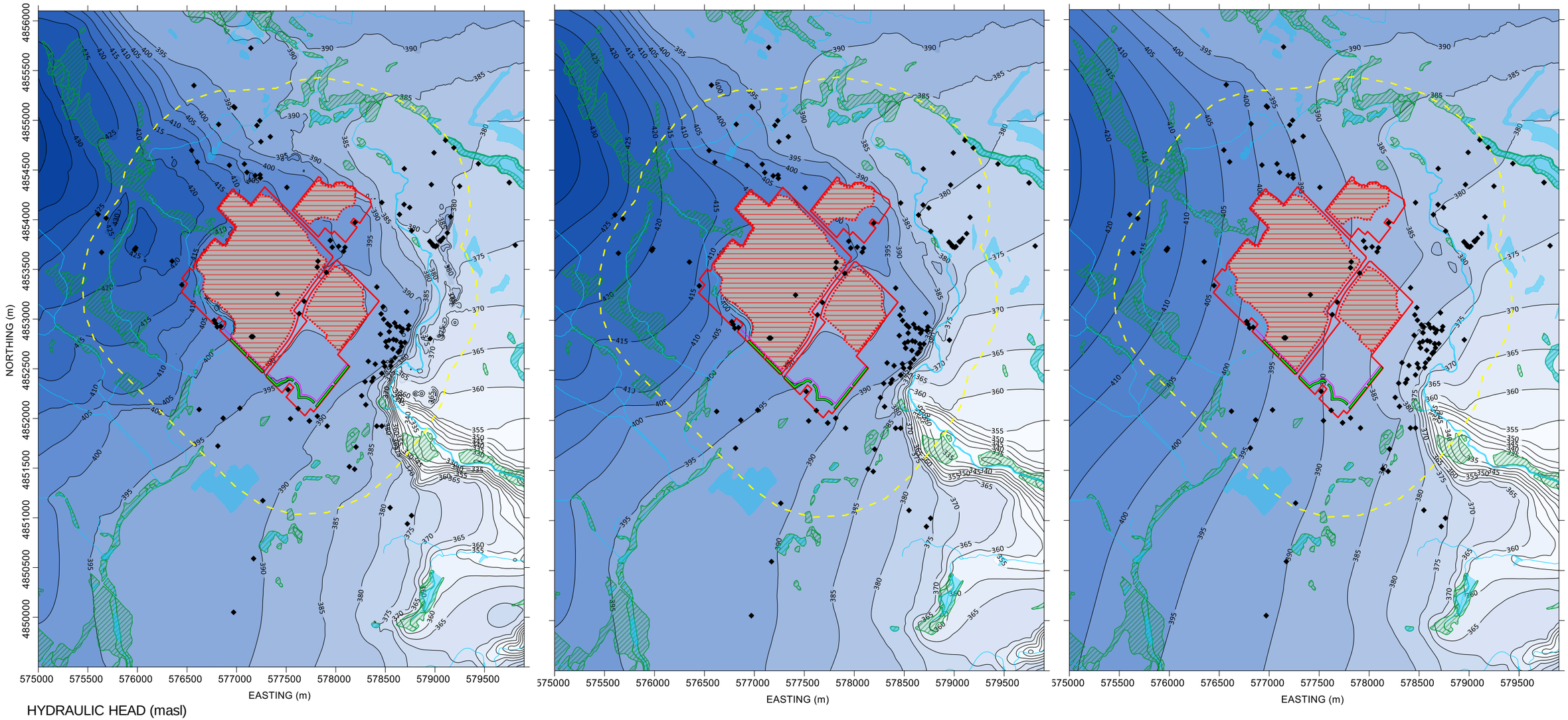
TITLE
PHASE 5 SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8E

1. SIMULATED WATER TABLE ELEVATION (masl)

2. SIMULATED GASPORT FORMATION HEAD (masl)

3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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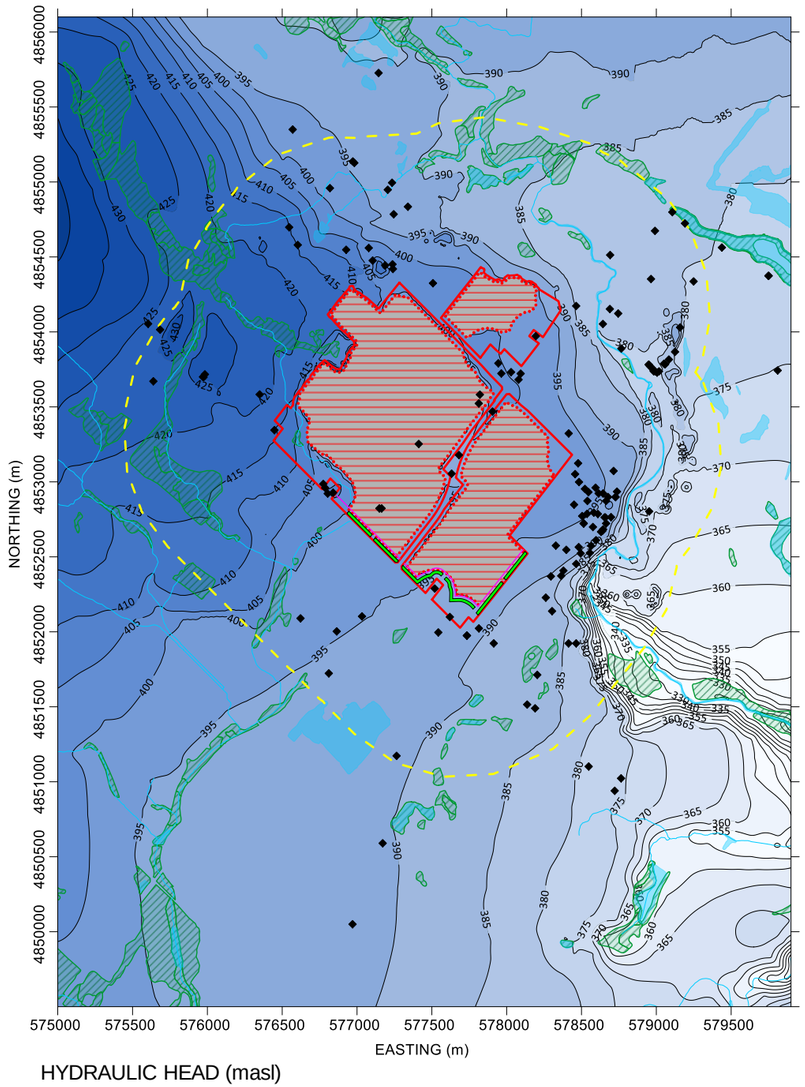
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

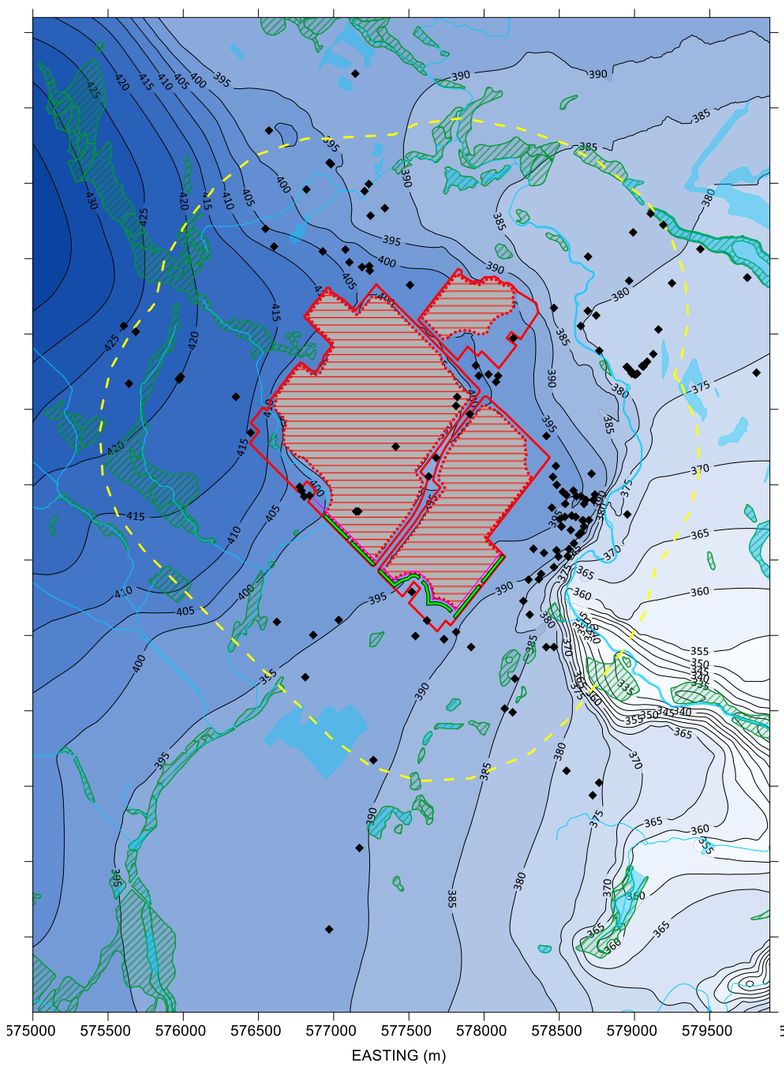
TITLE
PHASE 6 SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8F

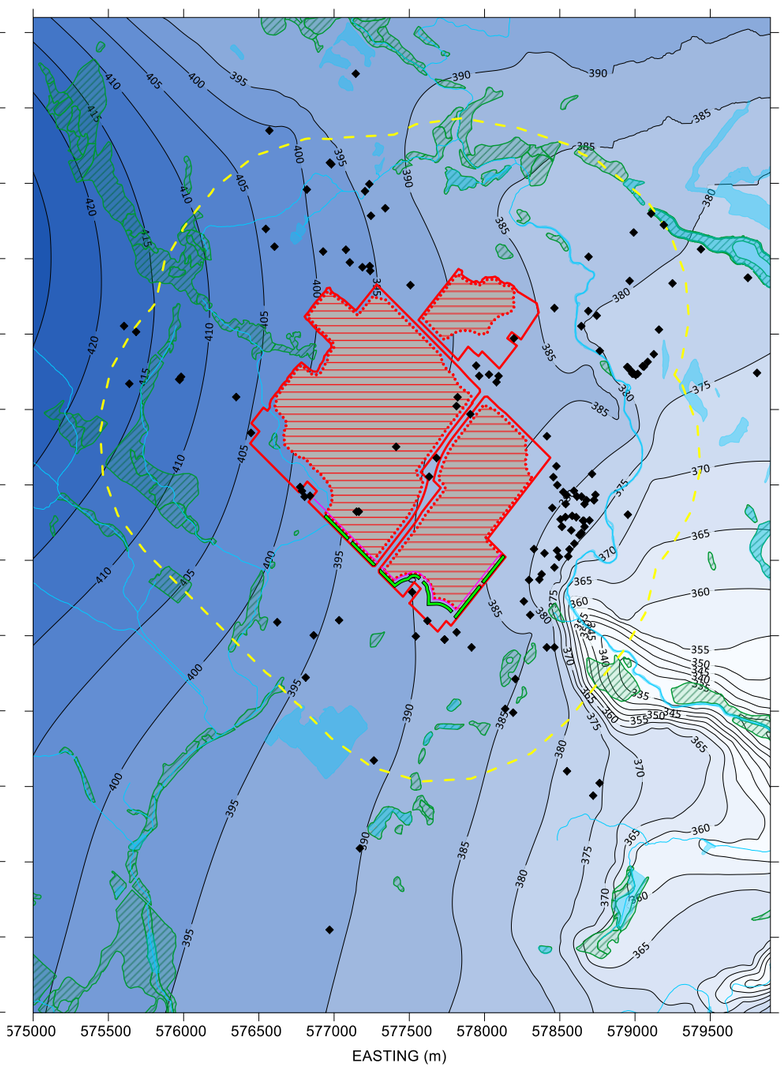
1. SIMULATED WATER TABLE ELEVATION (masl)



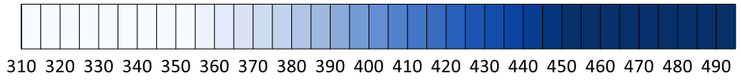
2. SIMULATED GASPORT FORMATION HEAD (masl)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
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5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

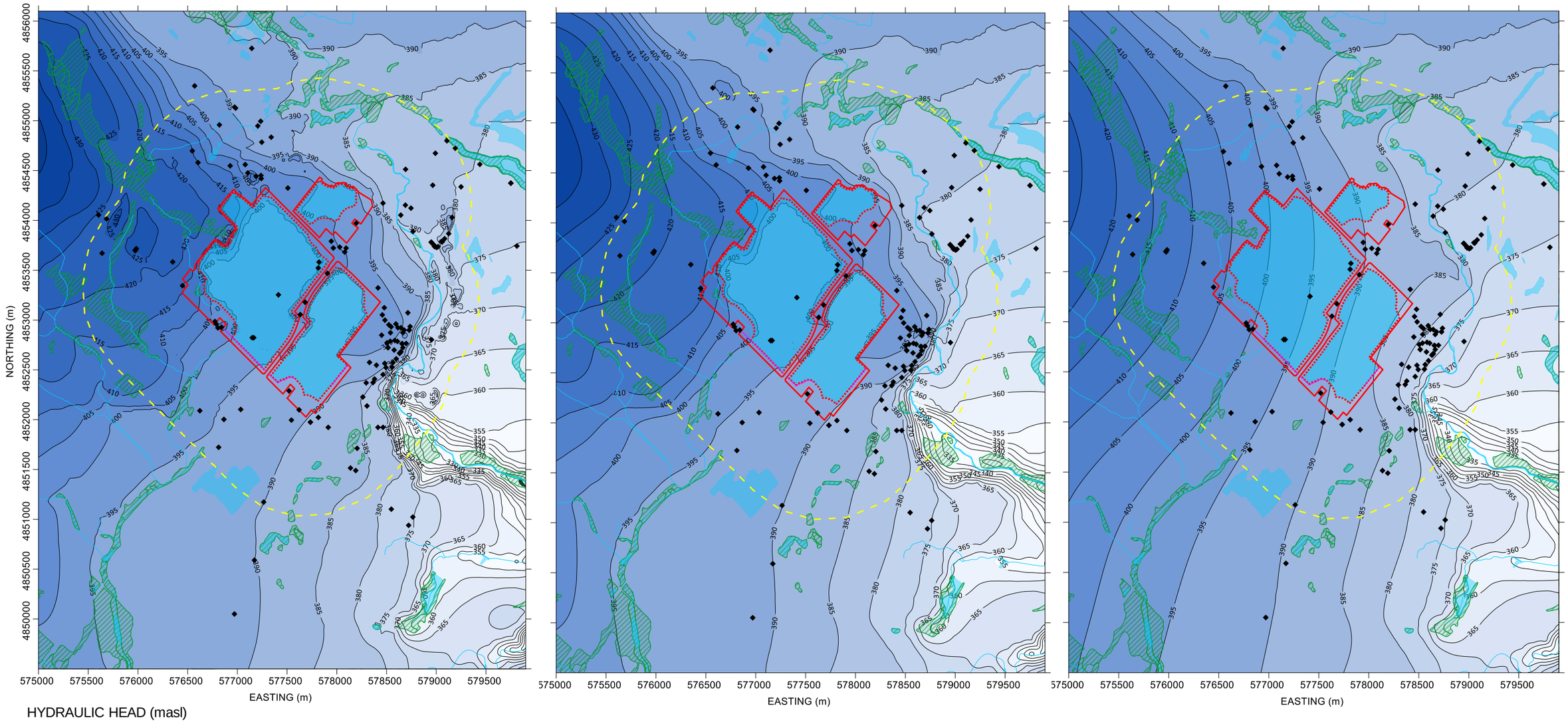
TITLE
PHASE 7 SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8G

1. SIMULATED WATER TABLE ELEVATION (masl)

2. SIMULATED GASPORT FORMATION HEAD (masl)

3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION HEAD (masl)



HYDRAULIC HEAD (masl)

310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic head is shown at a contour interval of 5m
2. Gasport formation head extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation head extracted from model slice 25
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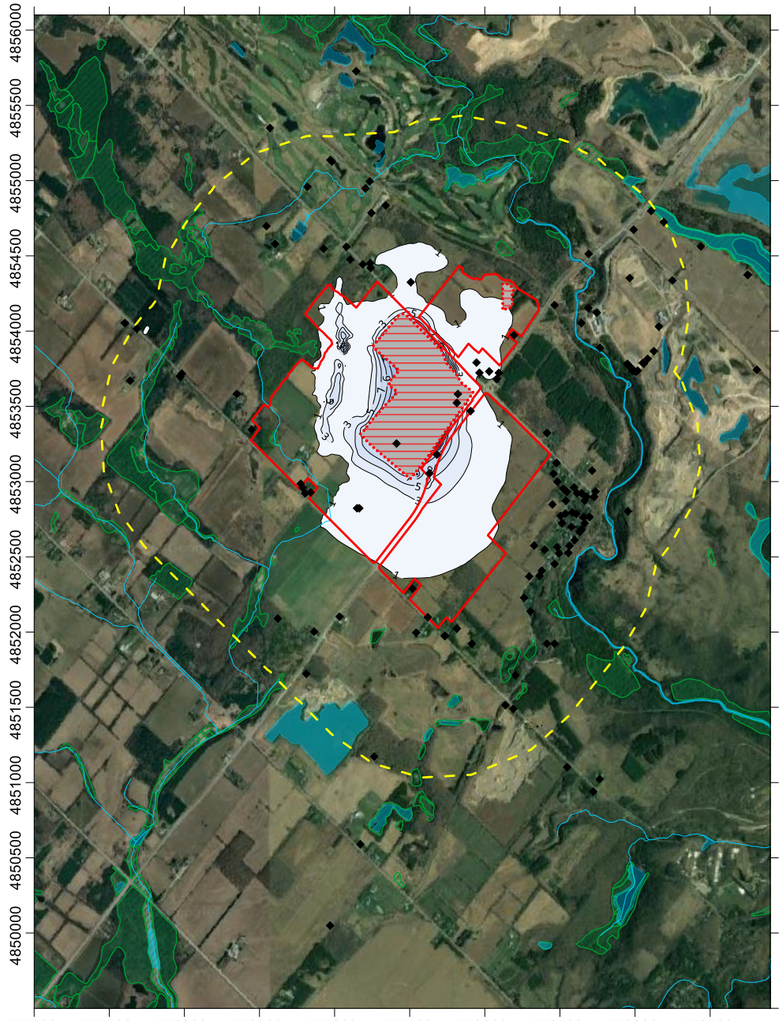
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

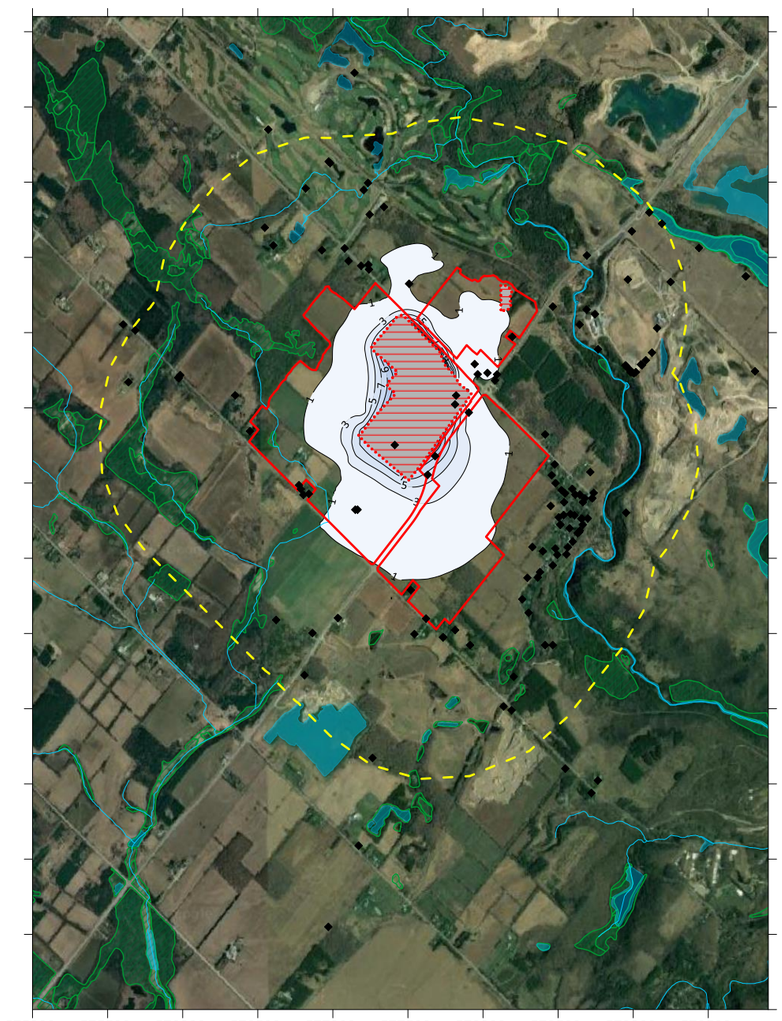
TITLE
REHABILITATION SIMULATED HYDRAULIC HEAD

PROJECT No. 19129150 | Rev. 0 | FIGURE 8H

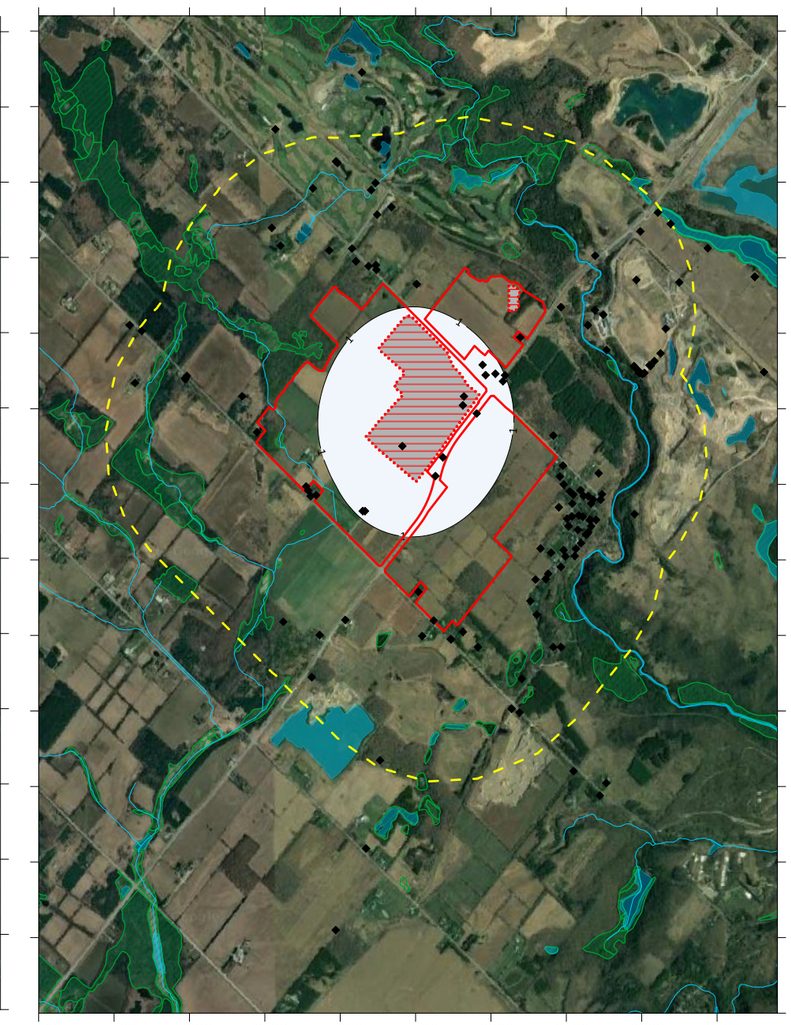
1. SIMULATED WATER TABLE DRAWDOWN (m)



2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
2. Gasport formation drawdown extracted from model slice 22 (base of Gasport)
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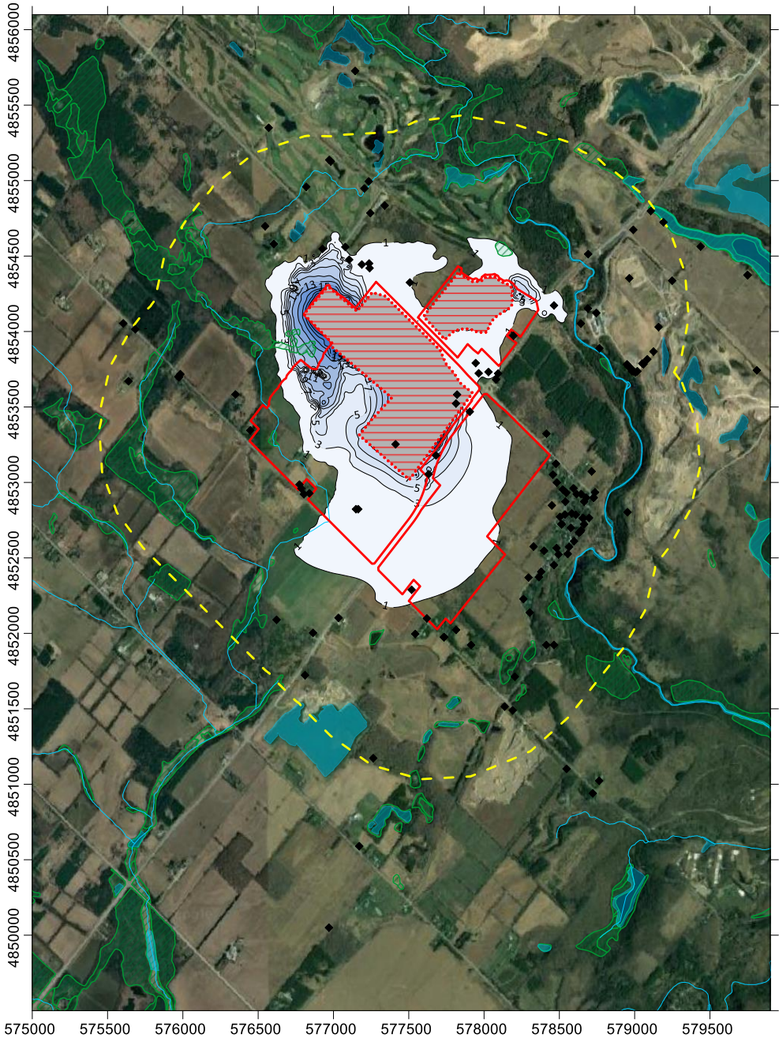
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

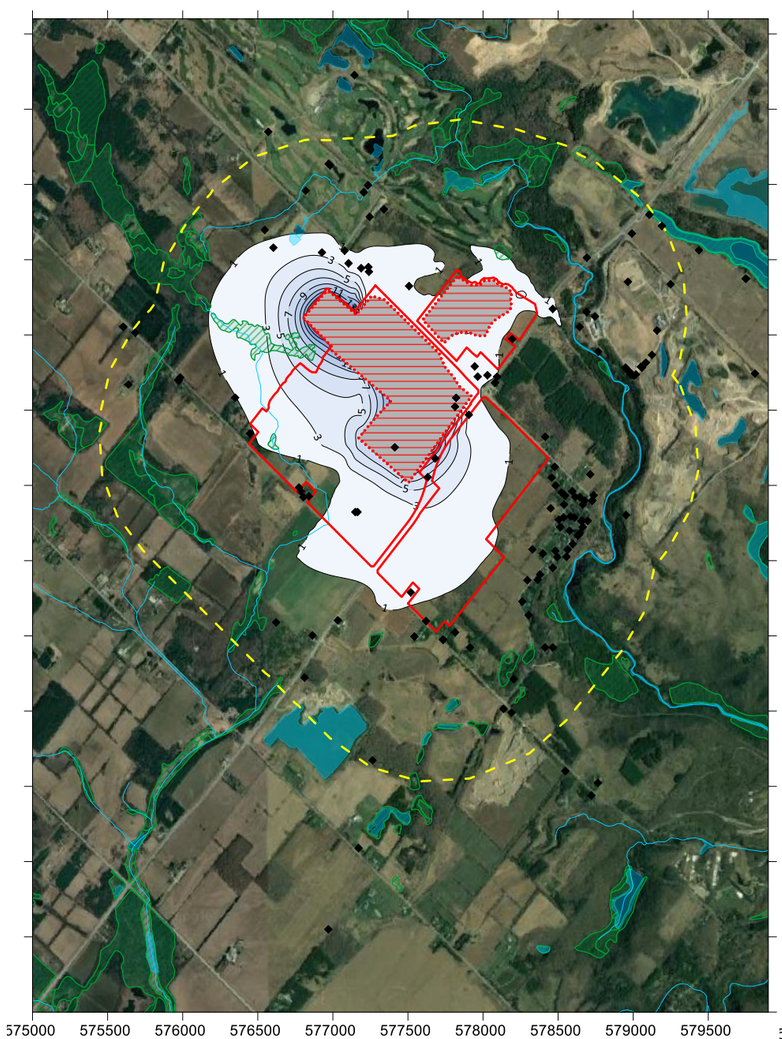
TITLE
PHASE 1 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9A

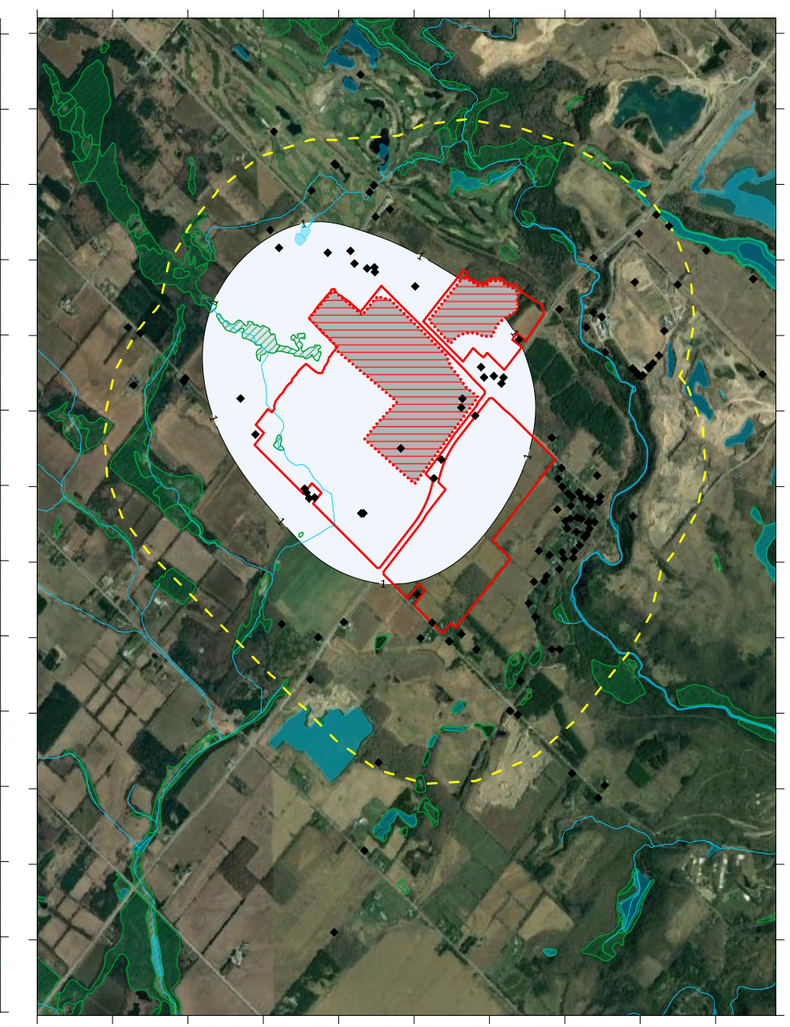
1. SIMULATED WATER TABLE DRAWDOWN (m)



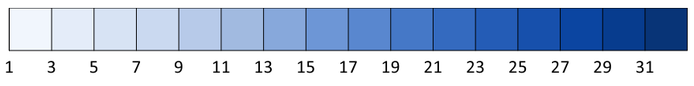
2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
2. Gasport formation drawdown extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation drawdown extracted from model slice 25
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5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

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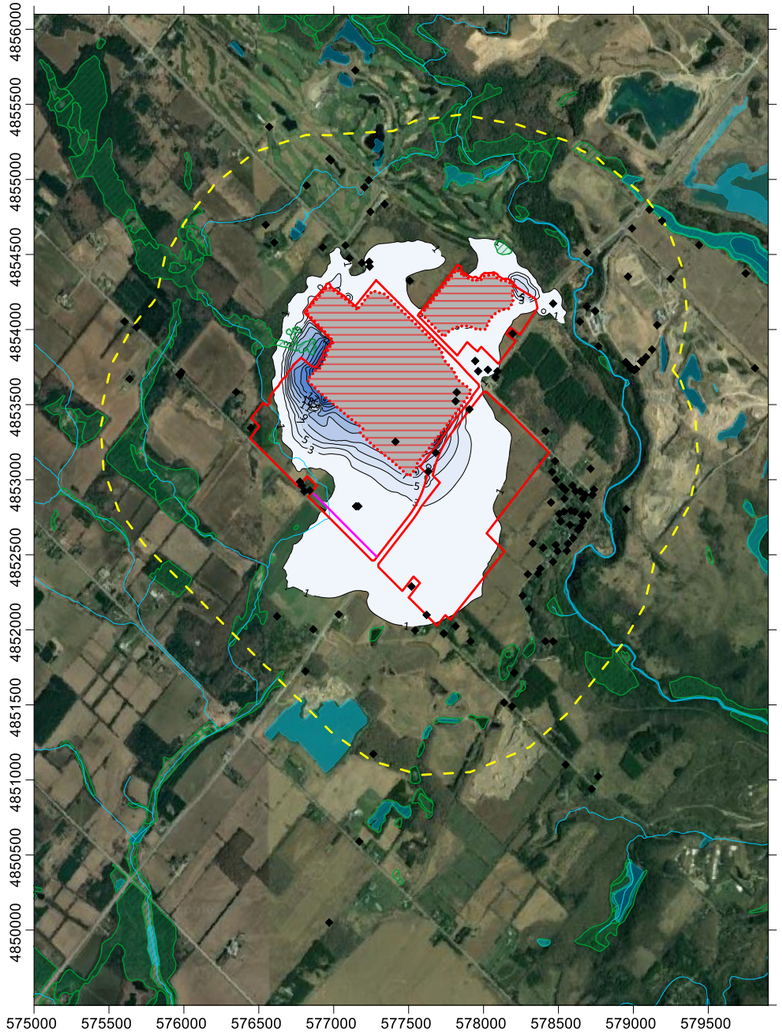
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
PHASE 2 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9B

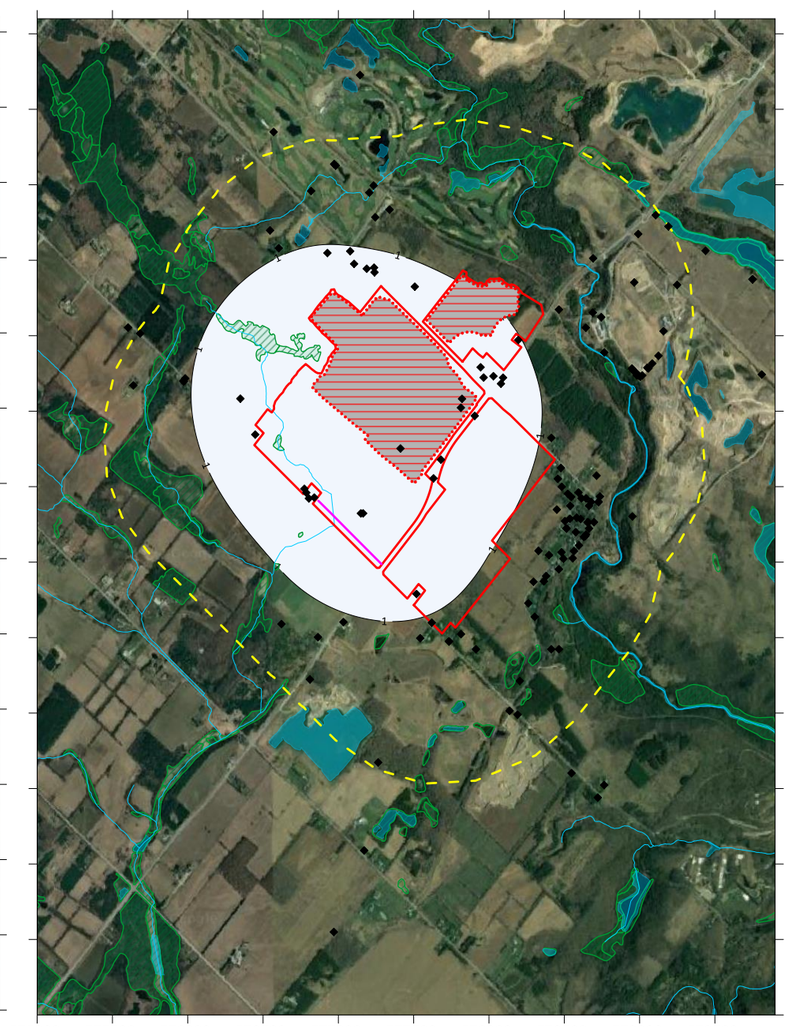
1. SIMULATED WATER TABLE DRAWDOWN (m)



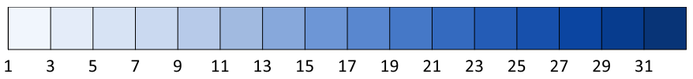
2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
2. Gasport formation drawdown extracted from model slice 22 (base of Gasport)
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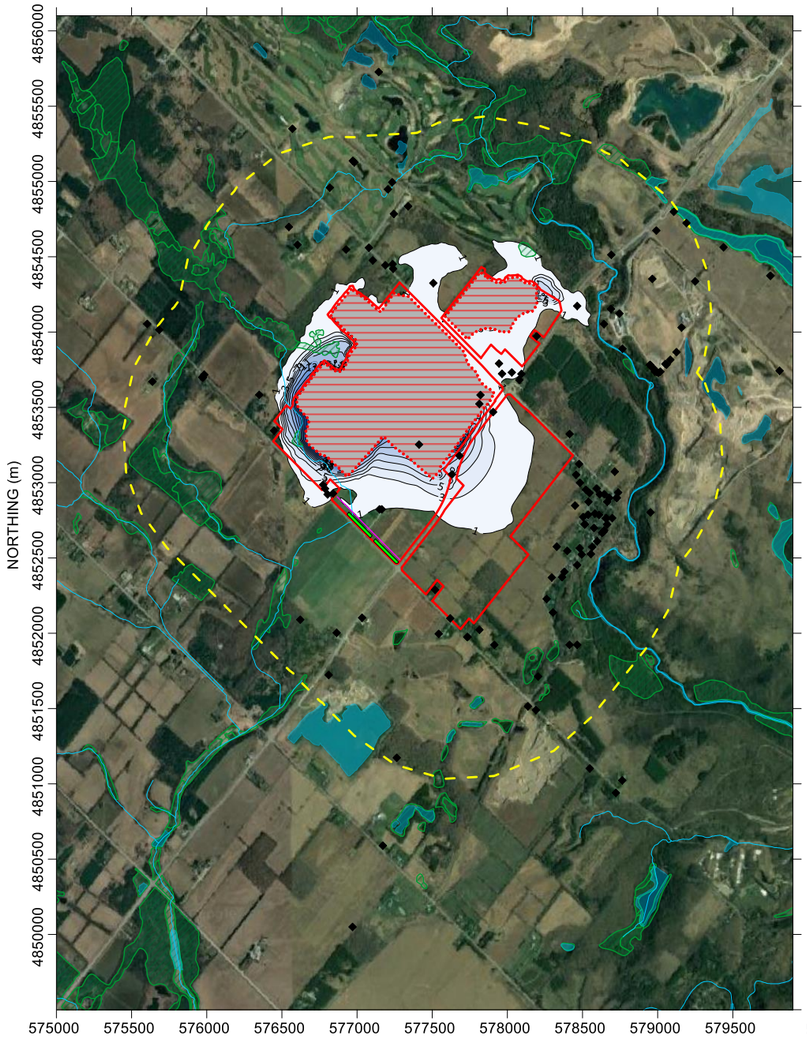
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
PHASE 3 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9C

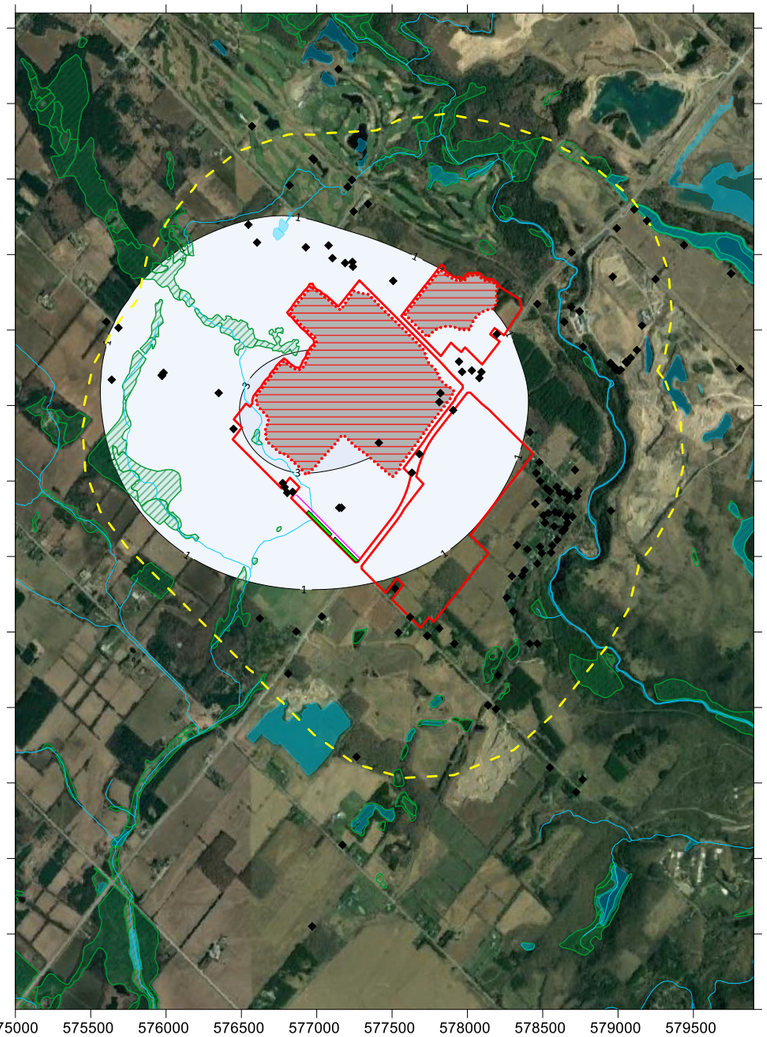
1. SIMULATED WATER TABLE DRAWDOWN (m)



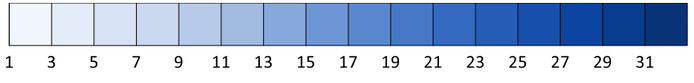
2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
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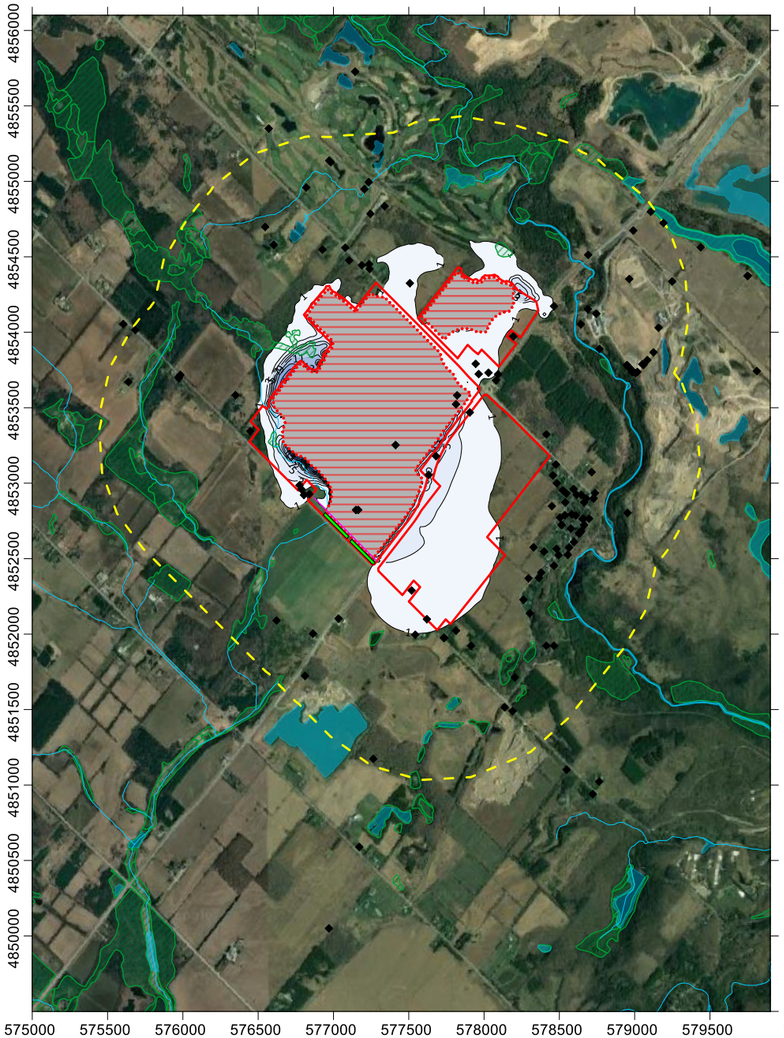
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
PHASE 4 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9D

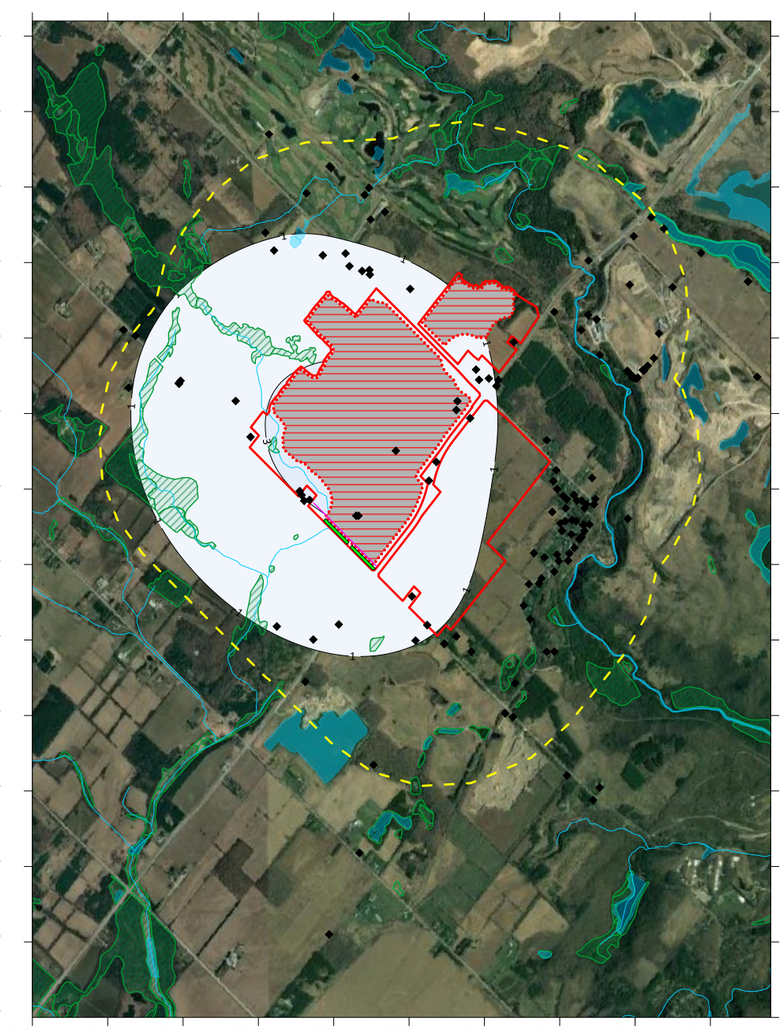
1. SIMULATED WATER TABLE DRAWDOWN (m)



2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)

1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31

LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
2. Gasport formation drawdown extracted from model slice 22 (base of Gasport)
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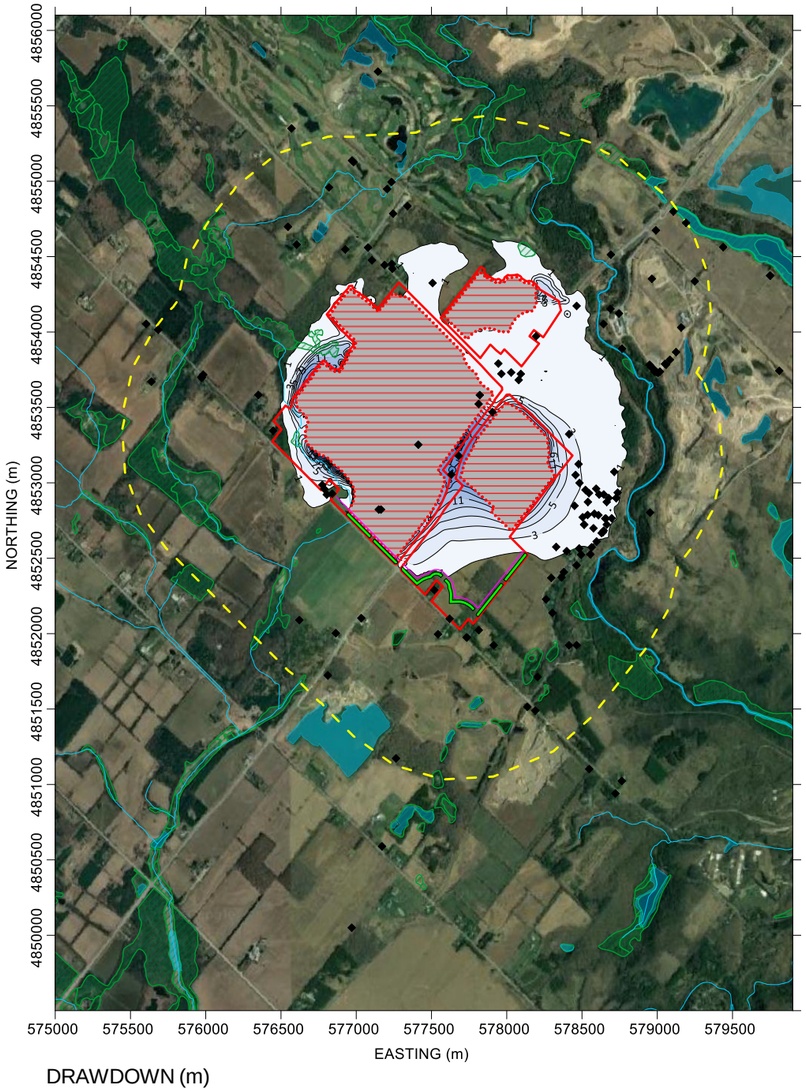
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
PHASE 5 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9E

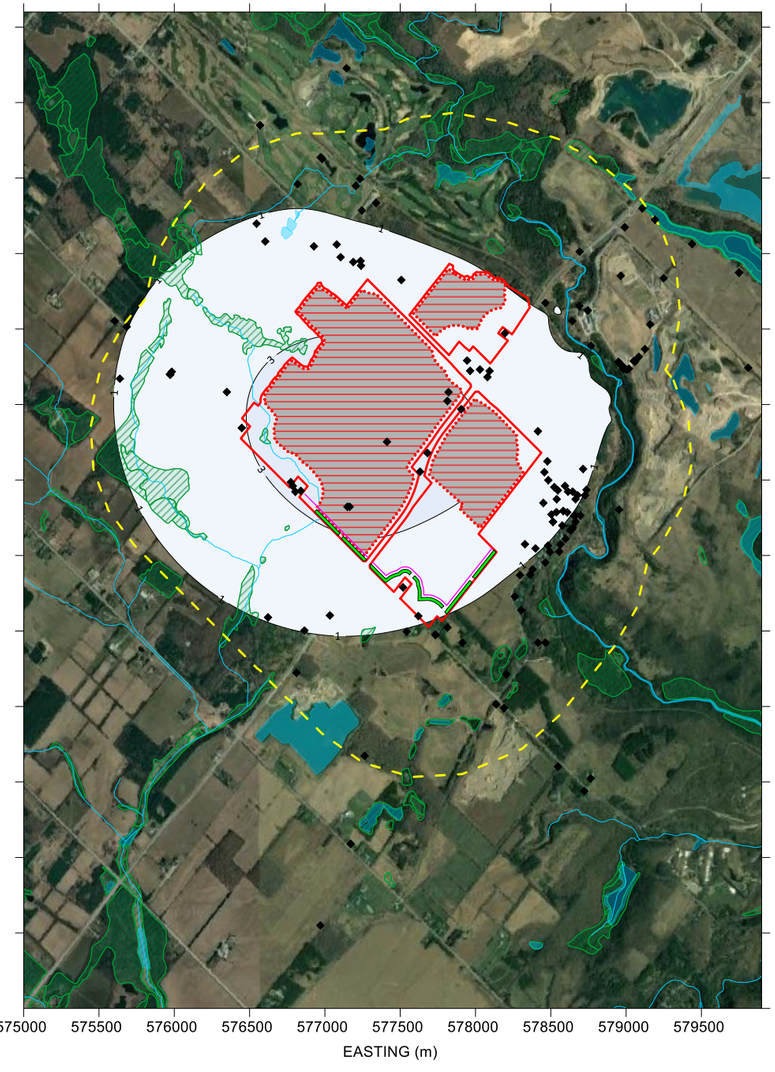
1. SIMULATED WATER TABLE DRAWDOWN (m)



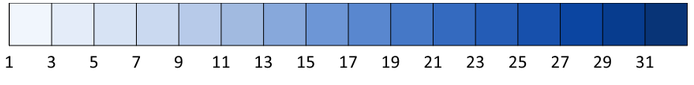
2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
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NOTES

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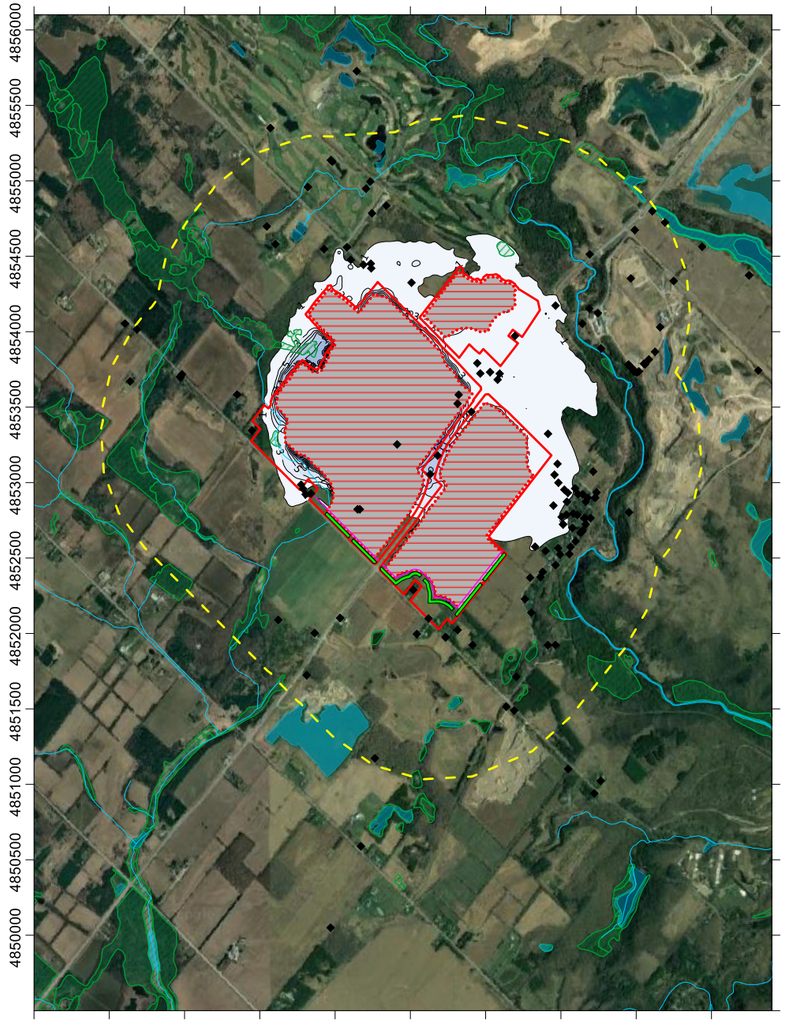
PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
PHASE 6 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9F

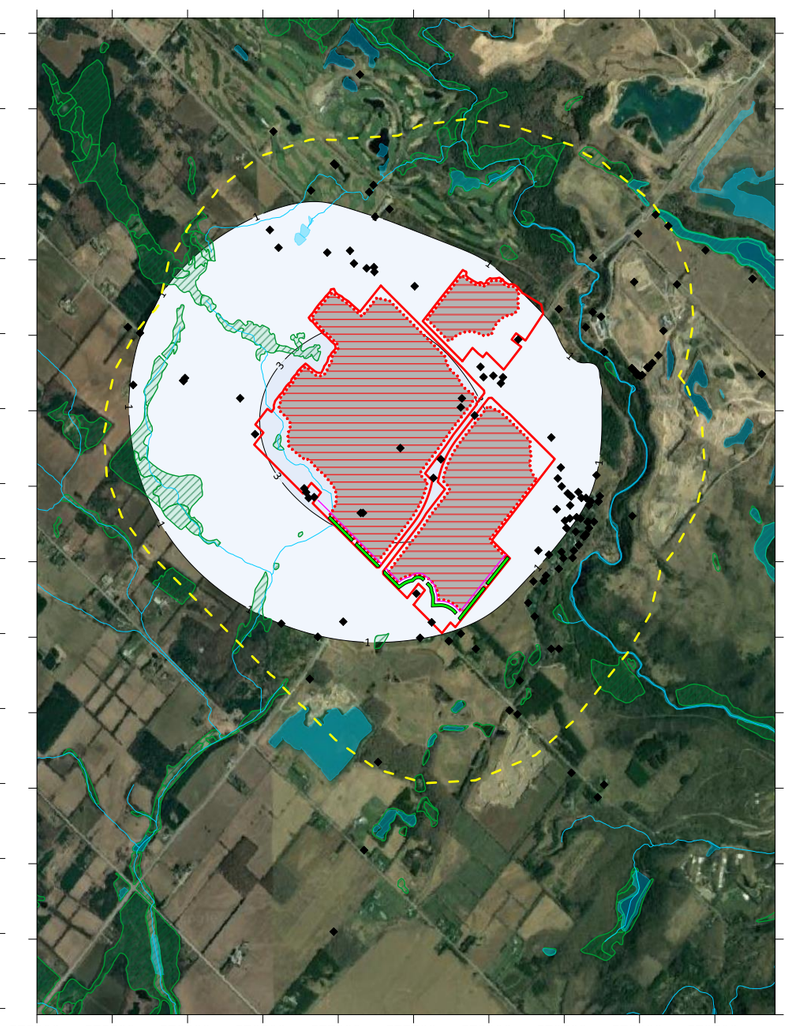
1. SIMULATED WATER TABLE DRAWDOWN (m)



2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
2	9 to 13
3	14 to 17
4	18 to 22
5	23 to 26
6	27 to 32
7	33 to 38

NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
2. Gasport formation drawdown extracted from model slice 22 (base of Gasport)
3. Manitoulin/ Whirlpool formation drawdown extracted from model slice 25
4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Private wells shown are from the Ministry of Environment Conservation and Parks (MECP) Water Well Information System Database (MECP, 2021).

CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

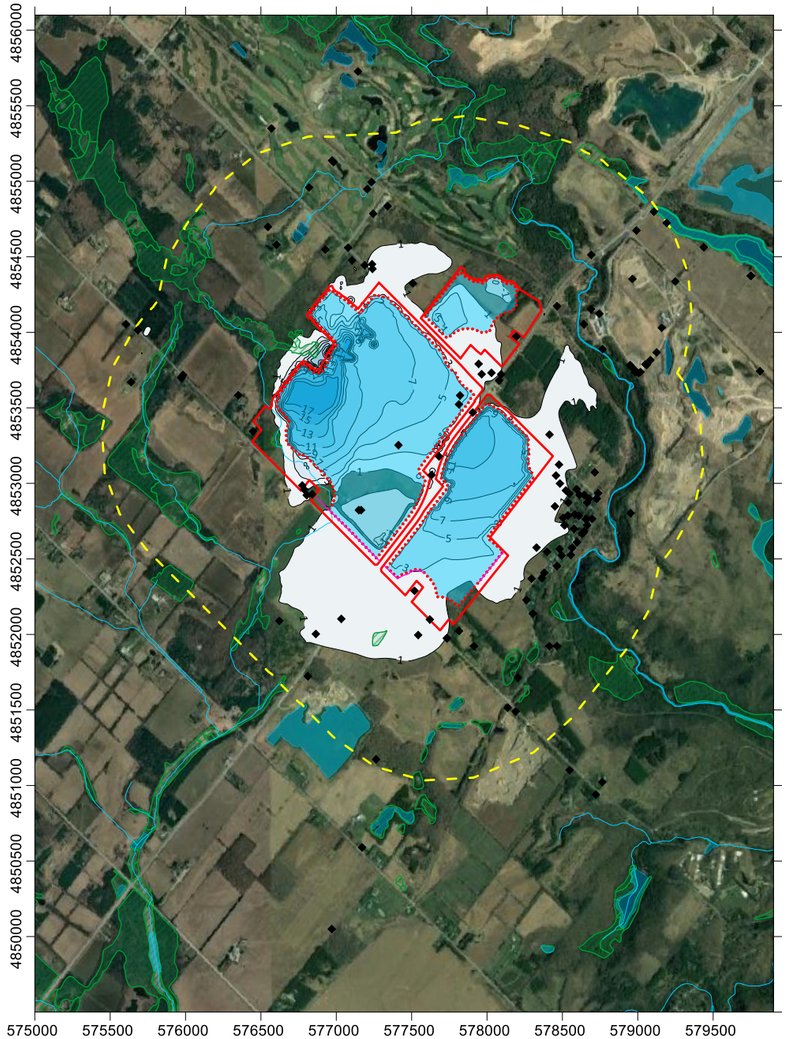
YYYY-MM-DD	2023-07-20
PREPARED	HW
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
PHASE 7 SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9G

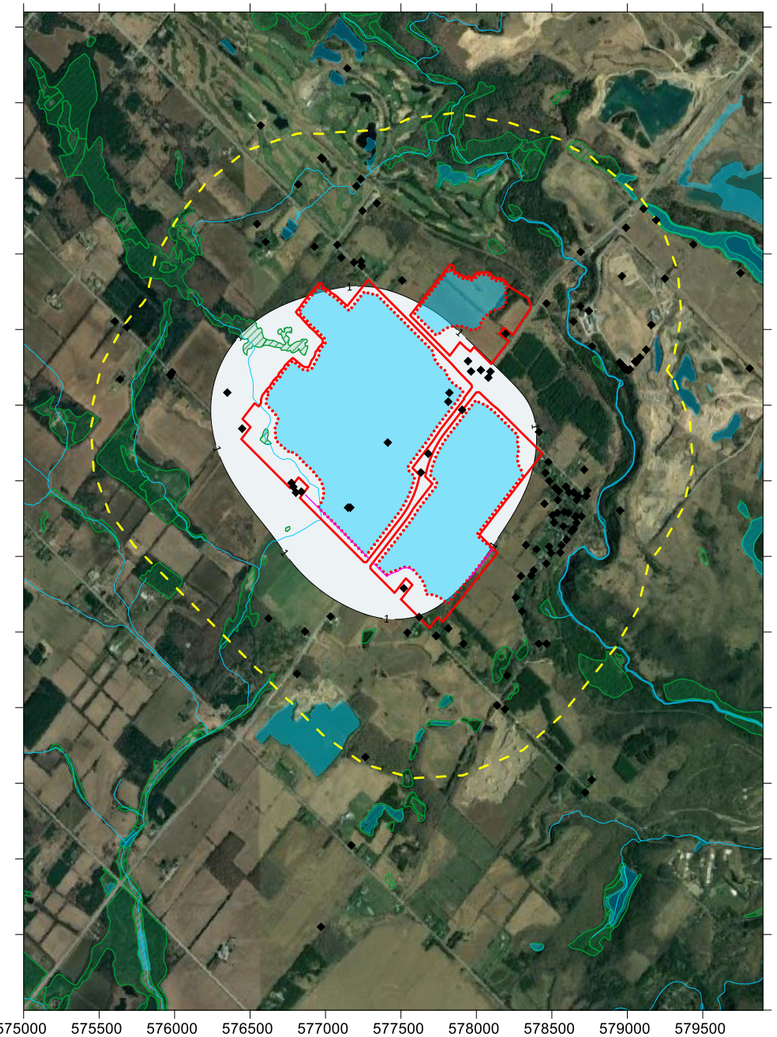
1. SIMULATED WATER TABLE DRAWDOWN (m)



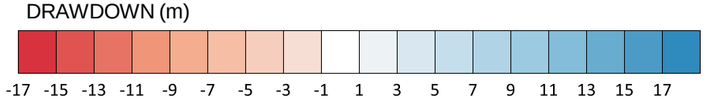
2. SIMULATED GASPORT FORMATION DRAWDOWN (m)



3. SIMULATED MANITOULIN/ WHIRLPOOL FORMATION DRAWDOWN (m)



DRAWDOWN (m)



LEGEND

- LAKES
- RIVERS/ STREAMS
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- WETLAND
- 1KM BUFFER AROUND PROPERTY
- MECP PRIVATE WELL LOCATION
- SLURRY WALL/ GROUT ALIGNMENT
- INFILTRATION TRENCH

Phase of Operation	Years
1	1 to 8
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NOTES

1. Simulated hydraulic drawdown is shown at a contour interval of 2m
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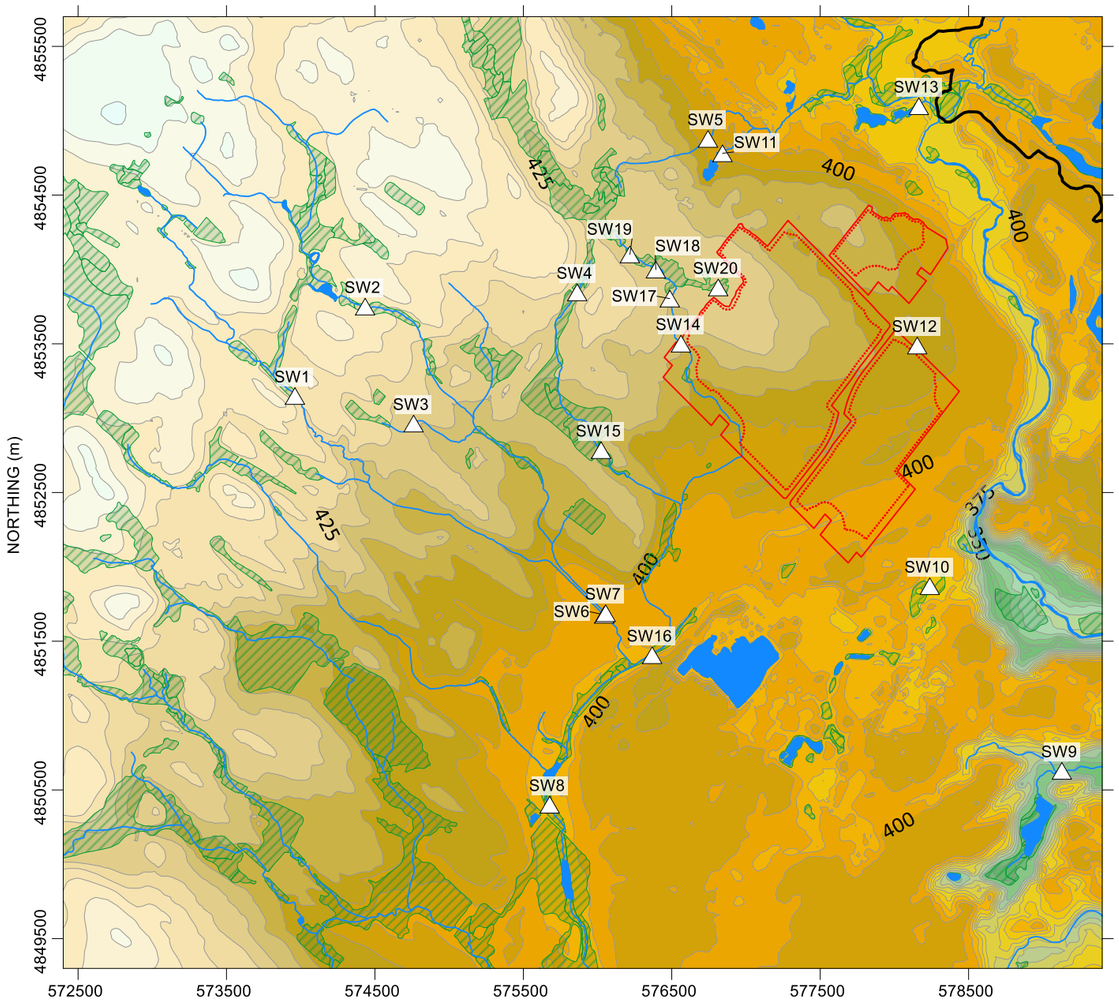
DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY NUMERICAL MODELLING

TITLE
REHABILITATION SIMULATED DRAWDOWN

PROJECT No. 19129150 | Rev. 0 | FIGURE 9H

SURFACE WATER MONITORING STATIONS



CURRENT CONDITIONS TOPOGRAPHY (MASL)

300 315 330 345 360 375 390 405 420 435 450 465 480

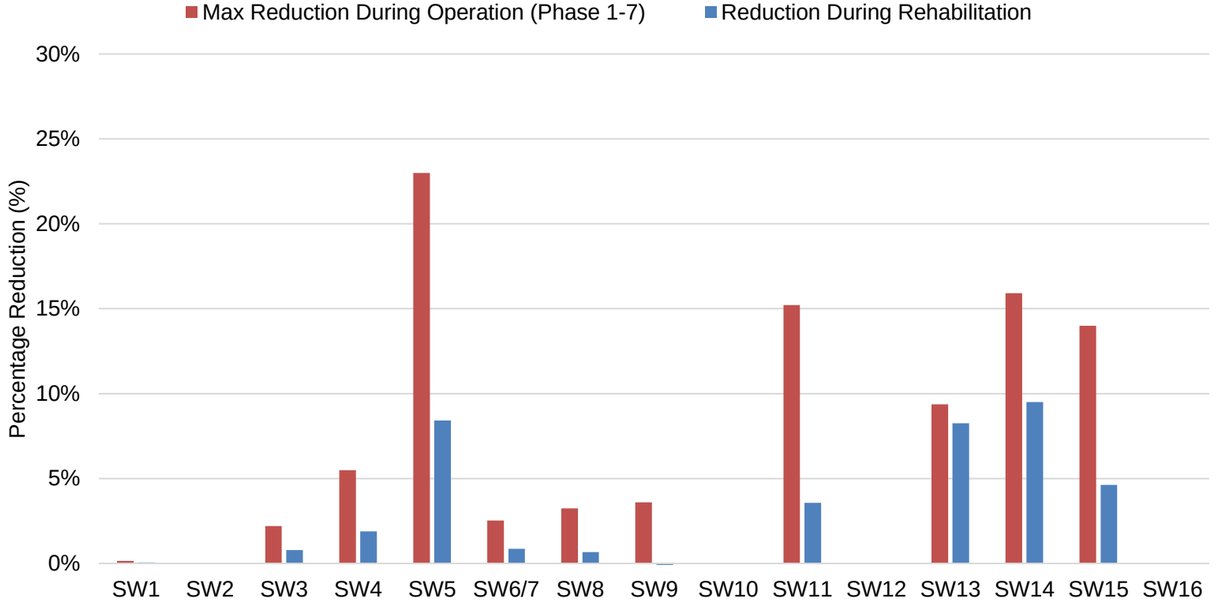
NOTES:

1. Simulated surface water flows for phases 1-7 and rehabilitation represent long term average (steady state) values
2. Several surface water stations have a current conditions simulated flow of 0.00 L/s (SW2, SW10, SW12 and SW16), and continue to have a simulated flow of 0.00 L/s throughout quarry operation and rehabilitation

SIMULATED REDUCTION IN SURFACE WATER FLOW THROUGH VARIOUS QUARRY PHASES AND AT REHABILITATION

Station	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Rehab
SW1	0%	0%	0%	0%	0%	0%	0%	0%
SW2	0%	0%	0%	0%	0%	0%	0%	0%
SW3	0%	-1%	-1%	-2%	-2%	-2%	-1%	-1%
SW4	0%	-2%	-2%	-5%	-4%	-4%	-3%	-2%
SW5	-2%	-18%	-12%	-23%	-16%	-16%	-14%	-8%
SW6/7	0%	-1%	-1%	-3%	-2%	-2%	-1%	-1%
SW8	-2%	-3%	-3%	-2%	-3%	-1%	-1%	-1%
SW9	-2%	-3%	-3%	0%	-4%	1%	0%	0%
SW10	0%	0%	0%	0%	0%	0%	0%	0%
SW11	-1%	-15%	-6%	-7%	-6%	-6%	-6%	-4%
SW12	0%	0%	0%	0%	0%	0%	0%	0%
SW13	-6%	-9%	-8%	-7%	-7%	-7%	-9%	-8%
SW14	-1%	-8%	-16%	-16%	-14%	-14%	-12%	-10%
SW15	-1%	-5%	-5%	-14%	-9%	-9%	-8%	-5%
SW16	0%	0%	0%	0%	0%	0%	0%	0%

SIMULATED PERCENT REDUCTION IN SURFACE WATER FLOW: MAXIMUM DURING OPERATION, AND REHABILITION PHASES



LEGEND

- LAKES
- RIVERS/ STREAMS
- WETLAND
- LICENSE LIMIT
- MODELLED EXTRACTION EXTENTS
- SURFACE WATER MONITORING STATION

ADDITIONAL MAP NOTES

4. Source of spatial mapping of watercourses, waterbodies, and wetlands: Land Information Ontario (MNRF, 2018)
5. Source of Regional Topography dataset Ontario Ministry of Natural Resources and Forestry (MNRF) Southwestern Ontario Orthophotography (SWOOP) 2019
6. Source of Site Topography dataset provided by Firstbase Solutions (Spring 2021)
7. Quarry license and modelled limit of extraction provided by MHBC (May, 2023)

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DESIGN	HW
REVIEW	SD
APPROVED	GS

PROJECT
CALEDON PIT AND QUARRY

TITLE
SIMULATED CHANGE IN SURFACE WATER FLOW AT MONITORING STATIONS

PROJECT No. 19129150 | Rev. 0 | FIGURE 10



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APPENDIX R

Water Management and Discharge Plan

TECHNICAL MEMORANDUM

DATE July 24, 2023 **Project No.** 19129150

TO David Hanratty, Mike Lebreton
CBM

CC Heather Melcher

FROM George Schneider, Craig DeVito, Hayley Wallace **EMAIL george.schneider@wsp.com**

WATER MANAGEMENT AND DISCHARGE PLAN - CBM CALEDON PIT / QUARRY

This memorandum provides an overview of the proposed water management and discharge plan for the CBM Caledon Pit / Quarry project.

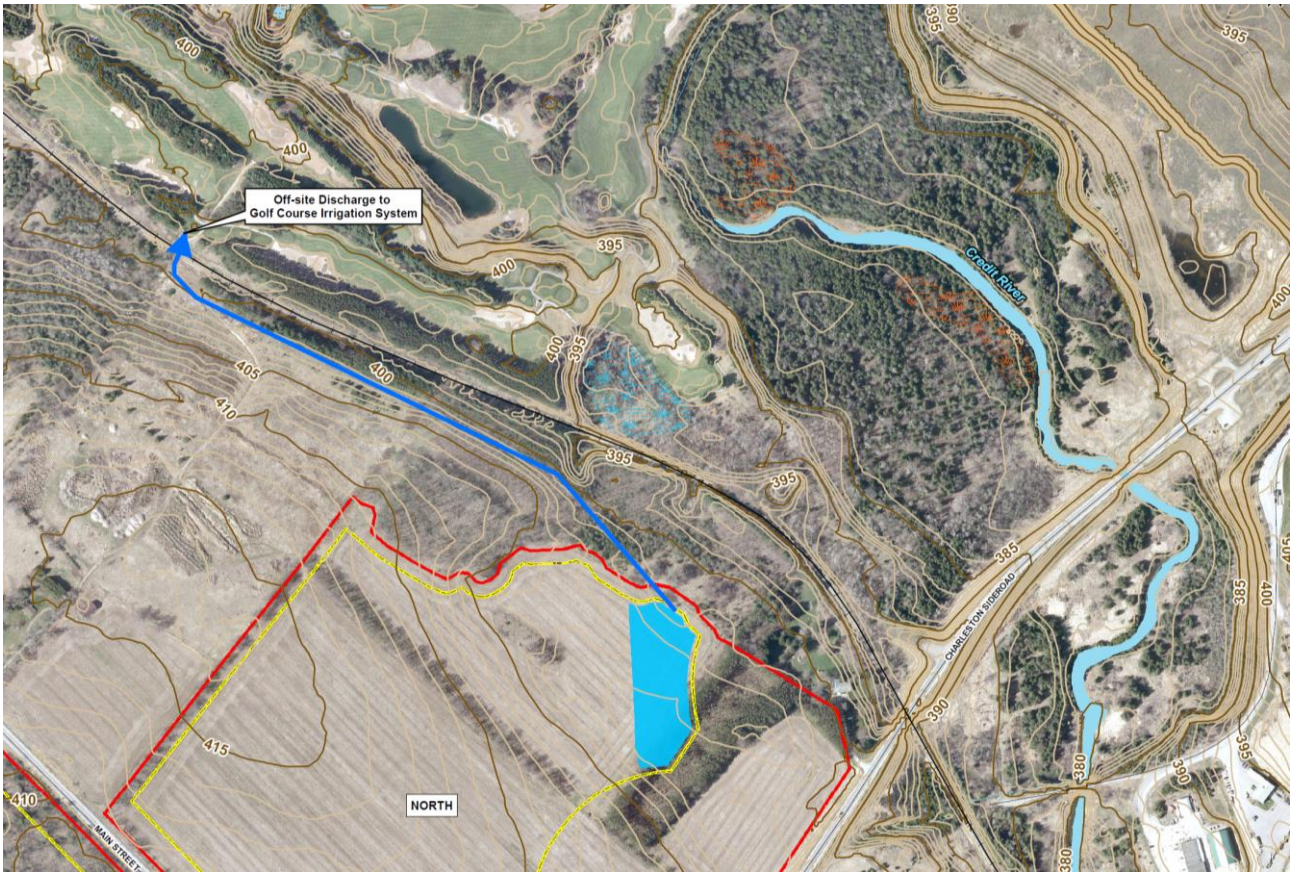

Figure 1: Proposed Water Discharge Location to the Osprey Valley Golf Course

Golder Associates Ltd.
6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada T: +1 905 567 4444 F: +1 905 567 6561

OFF-SITE DISCHARGE

A single point of discharge has been identified for water collected from the combined land assemblages of the proposed Caledon Pit / Quarry to the Osprey Valley Golf Course irrigation system infrastructure (Figure 1), where water will be used for irrigation when needed, with excess water stored in the existing pond system which ultimately discharges to the Credit River.

PROPOSED GROUNDWATER MITIGATION SYSTEM

A groundwater mitigation system has been proposed for Phases 3 to 7 of pit / quarry operation, and a portion of the water collected during those phases of operations is expected to be directed to the infiltration trenches that form part of the mitigation system to mitigate impacts of pit / quarry dewatering (Figure 2). The mitigation measures consist of the installation and operation of six infiltration trench zones along a 1,900 m alignment along the west side of the Main Area and the west and south side of the South Area, in the setback area between the licence limit and the limit of extraction.

Water collected in the pit / quarry from dewatering will be reintroduced into the groundwater system through these infiltration trench zones to maintain the groundwater levels west and south of the licence area to levels within their current typical range. Additionally, a slurry wall will be installed in the overburden between the infiltration trenches and the extraction limit, in order to minimize the flow of groundwater back into the pit / quarry from the injection trench. The weathered upper bedrock zone along the proposed slurry wall alignment may be grouted to reduce the permeability of this zone and further reduce the inflow of groundwater into the pit / quarry and help sustain existing groundwater levels outside of the licence area.

If required, the proposed groundwater mitigation system would be implemented in the following stages of pit / quarry operation:

- Phase 3 – Implementation of the slurry wall / grouting of the weathered bedrock zone on the west side of the Main Area prior to the start of Phase 3 extraction.
- Phases 4 and 5 – Implementation of the infiltration trench system (Trench Zones 1 and 2) on the west side of the Main Area prior to the start of Phase 4 and 5 extraction.
- Phase 6 and 7 – Implementation of the second slurry wall / grouting of the weathered bedrock zone and the second phase of the infiltration trench system (Trench Zones 4 to 6) prior to the start of Phase 6 and 7 extraction.

The post-Rehabilitation scenario includes the removal of the slurry wall in the overburden in the southwest corner of the South Area (adjacent to Trench Zones 4 and 5) to reinstate hydraulic connection between the South Area and the lands to the south and southwest of the Site.

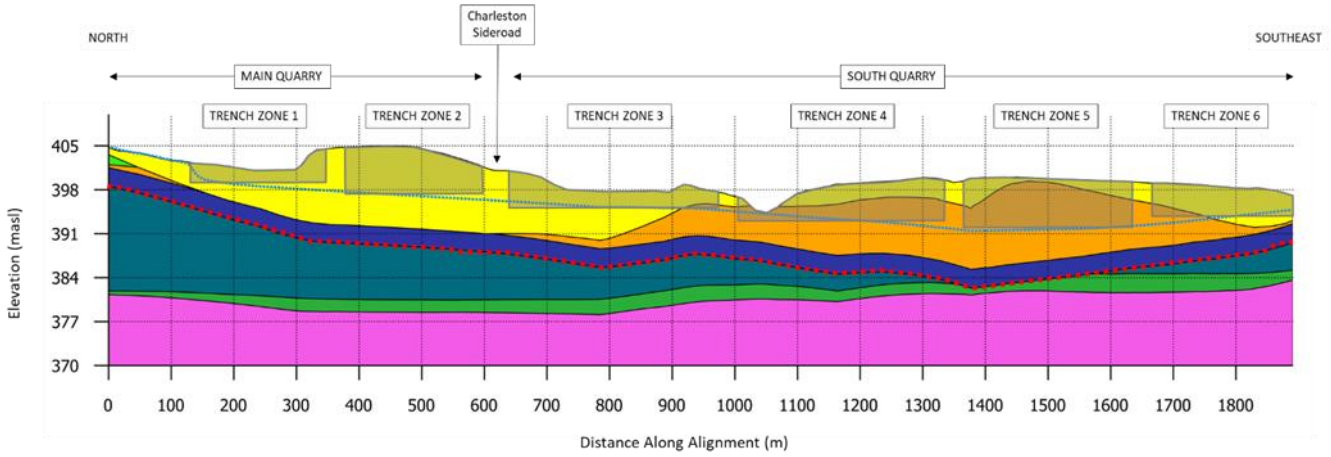

Figure 2: Proposed Groundwater Mitigation System, consisting of six Infiltration Trench zones and two Slurry Wall / Grout zones

WATER INFLOW PREDICTIONS AND WATER MANAGEMENT STRATEGY

Water balance calculations were performed for the pit / quarry areas, at one-year increments, for each year of operation as proposed in the Caledon Pit / Quarry Mining Plan (Mining Plan) dated 12 December 2022, in order to help predict water inflows to the quarry and inform a water management strategy.

The calculations estimated how much water will be generated by pit / quarry operations each year and evaluated options to best manage the water. The calculation was generally performed as follows, with the calculations and results presented in Tables 1 and 2.

- The net annual water surplus was calculated for each of the pit / quarry areas, year by year, for each operational year, based on plan view “snapshots” presented in the Mining Plan.
- These annual snapshots were used to calculate the spatial size of vegetated, till, rock and open water areas, and along with water surplus factors unique to each of the land surface types, a net annual water surplus was calculated for each quarry parcel. It was assumed that the surplus water from exposed till, exposed rock and ponded water areas was captured within the quarry, while surplus water from the undisturbed vegetated areas was not.
- Groundwater seepage was inferred by subtracting the annual water surplus from the total water inflow predicted by the HydroGeoSphere (HGS) simulations at key time steps during pit / quarry operations.
- The annual water surplus from each area including the estimated seepage contributions were summed to estimate the total water generated by quarry operation each year.
- A portion of the pit / quarry water generated each year will be used for aggregate washing, and while washing is largely non-consumptive, we assumed that 0.05 m^3 of water would be lost for every tonne of aggregate washed.

- The net water surplus for each year was then allocated to storage, use in the proposed groundwater mitigation system or discharged to the Osprey Valley Golf Course irrigation pond system, depending on the operational needs for that year. Key water management milestones are highlighted in the table below.

Table 1
Water Generation Estimate - Caledon Quarry

Year	Main Quarry						HGS Inflow Prediction			
	Total area	Veg area	Open Rock area	Till / Rehab area	Pond area	Site Surplus Inflow	Total Model Inflow	Total Model Inflow	GW Seepage (by HGS)	Annual Water Generated
	mm/yr	342	446	365	234					
	m2	m2	m2	m2	m2	m3/yr	m3/d	m3/yr	m3/yr	m3
0	1,245,747	1,245,747	0	0	0	0	0	0	0	0
1	1,245,747	1,130,547	70,475	44,725	0	47,756	154	56,357	34,905	82,661
2	1,245,747	1,130,547	70,475	44,725	0	47,756	309	112,715	69,809	117,566
3	1,245,747	1,093,797	105,825	46,125	0	64,034	463	169,072	104,714	168,747
4	1,245,747	1,047,647	141,025	57,075	0	83,730	618	225,430	139,618	223,348
5	1,245,747	1,026,847	158,625	60,275	0	92,747	772	281,787	174,523	267,270
6	1,245,747	966,372	214,450	64,925	0	119,342	926	338,144	209,428	328,770
7	1,245,747	907,172	256,950	81,625	0	144,393	1,081	394,502	244,332	388,725
8	1,245,747	835,072	298,950	92,725	19,000	171,622	1,235	450,859	279,237	450,859
9	1,245,747	776,672	317,500	132,575	19,000	194,441	1,300	474,356	282,877	477,318
10	1,245,747	769,972	318,900	137,875	19,000	197,000	1,364	497,852	286,518	483,517
11	1,245,747	708,797	378,500	139,450	19,000	224,156	1,428	521,349	290,158	514,314
12	1,245,747	626,447	395,975	204,325	19,000	255,629	1,493	544,846	293,798	549,428
13	1,245,747	589,572	418,382	218,792	19,000	270,904	1,557	568,342	297,439	568,342
14	1,245,747	550,872	427,161	248,714	19,000	285,740	1,544	563,588	276,511	562,251
15	1,245,747	514,122	445,796	266,829	19,000	300,664	1,531	558,834	255,583	556,247
16	1,245,747	476,072	459,375	291,300	19,000	315,652	1,518	554,079	234,656	550,308
17	1,245,747	426,072	480,300	320,375	19,000	335,597	1,505	549,325	213,728	549,325
18	1,245,747	369,297	509,800	347,650	19,000	358,709	1,642	599,184	245,259	603,968
19	1,245,747	323,772	536,660	366,315	19,000	377,501	1,778	649,043	276,790	654,291
20	1,245,747	276,697	573,262	376,788	19,000	397,648	1,915	698,902	308,320	705,969
21	1,245,747	248,497	606,117	372,133	19,000	410,603	2,051	748,761	339,851	750,454
22	1,245,747	208,397	630,800	387,550	19,000	427,239	2,188	798,620	371,381	798,620
23	1,245,747	170,597	654,100	402,050	19,000	442,923	3,170	1,157,055	712,279	1,155,202
24	1,245,747	94,447	705,313	426,987	19,000	474,866	4,152	1,515,491	1,053,177	1,528,042
25	1,245,747	74,147	718,620	433,980	19,000	483,353	5,134	1,873,926	1,394,074	1,877,427
26	1,245,747	41,622	745,352	439,773	19,000	497,390	6,116	2,232,362	1,734,972	2,232,362
27	1,245,747	3,722	775,925	447,100	19,000	513,700	6,267	2,287,534	1,786,761	2,300,461
28	1,245,747	0	799,950	426,797	19,000	517,005	6,418	2,342,706	1,838,549	2,355,554
29	1,245,747	0	811,650	415,097	19,000	517,952	6,570	2,397,878	1,890,338	2,408,290
30	1,245,747	0	808,419	418,328	19,000	517,691	6,721	2,453,051	1,942,127	2,459,817
31	1,245,747	0	808,419	418,328	19,000	517,691	6,872	2,508,223	1,993,916	2,511,606
32	1,245,747	0	808,419	418,328	19,000	517,691	7,023	2,563,395	2,045,704	2,563,395
33	1,245,747	0	808,419	418,328	19,000	517,691	6,624	2,417,825	1,900,061	2,417,752
34	1,245,747	0	808,419	418,328	19,000	517,691	6,225	2,272,254	1,754,418	2,272,109
35	1,245,747	0	808,419	418,328	19,000	517,691	5,827	2,126,684	1,608,775	2,126,466
36	1,245,747	0	808,419	418,328	19,000	517,691	5,428	1,981,114	1,463,132	1,980,822
37	1,245,747	0	813,819	412,928	19,000	518,128	5,029	1,835,544	1,317,489	1,835,617
38	1,245,747	0	813,819	412,928	19,000	518,128	4,630	1,689,973	1,171,845	1,689,973

Table 1
Water Generation Estimate - Caledon Quarry

Year	North Quarry - Scenario 1 - No Flooding Immediately Post-Rehab						HGS Inflow Prediction			
	Total area	Veg area	Rock area	Till area	Pond area	Site Surplus	Total Model Inflow	Total Model Inflow	GW Seepage (by HGS)	Annual Water Generated
	m/yr	342	446	365	234					
	m2	m2	m2	m2	m2	m3	m3/d	m3/yr	m3/yr	m3
0	149,350	149,350	0	0	0	0	0	0	0	0
1	149,350	135,650	0	4,800	8,900	3,835				
2	149,350	135,650	0	4,800	8,900	3,835				
3	149,350	135,650	0	4,800	8,900	3,835				
4	149,350	135,650	0	4,800	8,900	3,835				
5	149,350	135,650	0	4,800	8,900	3,835				
6	149,350	135,650	0	4,800	8,900	3,835				
7	149,350	135,650	0	4,800	8,900	3,835				
8	149,350	135,650	0	4,800	8,900	3,835	0	0	0	3,835
9	149,350	77,950	50,025	12,475	8,900	28,947	49	17,721	6,212	35,159
10	149,350	0	92,056	48,394	8,900	60,803	97	35,441	12,424	73,228
11	149,350	0	56,369	84,081	8,900	57,913	146	53,162	18,637	76,549
12	149,350	0	51,800	88,650	8,900	57,543	194	70,883	24,849	82,391
13	149,350	0	51,800	88,650	8,900	57,543	243	88,604	31,061	88,604
14	149,350	0	51,800	88,650	8,900	57,543	245	89,356	31,814	89,356
15	149,350	0	51,800	88,650	8,900	57,543	247	90,109	32,567	90,109
16	149,350	0	51,800	88,650	8,900	57,543	249	90,862	33,319	90,862
17	149,350	0	51,800	88,650	8,900	57,543	251	91,615	34,072	91,615
18	149,350	0	51,800	88,650	8,900	57,543	251	91,593	34,050	91,593
19	149,350	0	51,800	88,650	8,900	57,543	251	91,571	34,029	91,571
20	149,350	0	51,800	88,650	8,900	57,543	251	91,549	34,007	91,549
21	149,350	0	51,800	88,650	8,900	57,543	251	91,527	33,985	91,527
22	149,350	0	51,800	88,650	8,900	57,543	251	91,506	33,963	91,506
23	149,350	0	51,800	88,650	8,900	57,543	251	91,516	33,974	91,516
24	149,350	0	51,800	88,650	8,900	57,543	251	91,527	33,984	91,527
25	149,350	0	51,800	88,650	8,900	57,543	251	91,538	33,995	91,538
26	149,350	0	51,800	88,650	8,900	57,543	251	91,548	34,006	91,548
27	149,350	0	51,800	88,650	8,900	57,543	251	91,497	33,955	91,497
28	149,350	0	51,800	88,650	8,900	57,543	251	91,446	33,903	91,446
29	149,350	0	51,800	88,650	8,900	57,543	250	91,395	33,852	91,395
30	149,350	0	51,800	88,650	8,900	57,543	250	91,344	33,801	91,344
31	149,350	0	51,800	88,650	8,900	57,543	250	91,293	33,750	91,293
32	149,350	0	51,800	88,650	8,900	57,543	250	91,242	33,699	91,242
33	149,350	0	51,800	88,650	8,900	57,543	244	89,041	31,498	89,041
34	149,350	0	51,800	88,650	8,900	57,543	238	86,839	29,297	86,839
35	149,350	0	51,800	88,650	8,900	57,543	232	84,638	27,095	84,638
36	149,350	0	51,800	88,650	8,900	57,543	226	82,437	24,894	82,437
37	149,350	0	51,800	88,650	8,900	57,543	220	80,235	22,693	80,235
38	149,350	0	51,800	88,650	8,900	57,543	214	78,034	20,492	78,034

Table 1
Water Generation Estimate - Caledon Quarry

Year	North Quarry - Scenario 2 - Flooding Immediately Post-Rehab						HGS Inflow Prediction			
	Total area	Veg area	Rock area	Till area	Pond area	Site Surplus	Total Model Inflow	Total Model Inflow	GW Seepage (by HGS)	Annual Water Generated
	m/yr	342	446	365	234					
	m2	m2	m2	m2	m2	m3	m3/d	m3/yr	m3/yr	m3
0	149,350	149,350	0	0	0	0				
1	149,350	135,650	0	4,800	8,900	3,835				
2	149,350	135,650	0	4,800	8,900	3,835				
3	149,350	135,650	0	4,800	8,900	3,835				
4	149,350	135,650	0	4,800	8,900	3,835				
5	149,350	135,650	0	4,800	8,900	3,835				
6	149,350	135,650	0	4,800	8,900	3,835				
7	149,350	135,650	0	4,800	8,900	3,835				
8	149,350	135,650	0	4,800	8,900	3,835	0	0	0	3,835
9	149,350	77,950	50,025	12,475	8,900	28,947	49	17,721	6,212	35,159
10	149,350	0	92,056	48,394	8,900	60,803	97	35,441	12,424	73,228
11	149,350	0	56,369	84,081	8,900	57,913	146	53,162	18,637	76,549
12	149,350	0	51,800	88,650	8,900	57,543	194	70,883	24,849	82,391
13	131,175	0	51,800	88,650	8,900	57,543	243	88,604	31,061	88,604
14	131,175	0	0	0	131,175	30,695				30,695
15	131,175	0	0	0	131,175	30,695				30,695
16	131,175	0	0	0	131,175	30,695				30,695
17	131,175	0	0	0	131,175	30,695				30,695
18	131,175	0	0	0	131,175	30,695				30,695
19	131,175	0	0	0	131,175	30,695				30,695
20	131,175	0	0	0	131,175	30,695				30,695
21	131,175	0	0	0	131,175	30,695				30,695
22	131,175	0	0	0	131,175	30,695				30,695
23	131,175	0	0	0	131,175	30,695				30,695
24	131,175	0	0	0	131,175	30,695				30,695
25	131,175	0	0	0	131,175	30,695				30,695
26	131,175	0	0	0	131,175	30,695				30,695
27	131,175	0	0	0	131,175	30,695				30,695
28	131,175	0	0	0	131,175	30,695				30,695
29	131,175	0	0	0	131,175	30,695				30,695
30	131,175	0	0	0	131,175	30,695				30,695
31	131,175	0	0	0	131,175	30,695				30,695
32	131,175	0	0	0	131,175	30,695				30,695
33	131,175	0	0	0	131,175	30,695				30,695
34	131,175	0	0	0	131,175	30,695				30,695
35	131,175	0	0	0	131,175	30,695				30,695
36	131,175	0	0	0	131,175	30,695				30,695
37	131,175	0	0	0	131,175	30,695				30,695
38	131,175	0	0	0	131,175	30,695				30,695

Table 1
Water Generation Estimate - Caledon Quarry

Year	South Quarry						HGS Inflow Prediction			
	Total area	Veg area	Open Rock area	Till / Rehab area	Pond area	Site Surplus	Total Model Inflow	Total Model Inflow	GW Seepage (by HGS)	Annual Water Generated
	m/yr	342	446	365	234					
	m2	m2	m2	m2	m2	m3	m3/d	m3/yr	m3/yr	m3
0	581,534	581,534	0	0	0	0				
1	581,534	581,534	0	0	0	0				
2	581,534	581,534	0	0	0	0				
3	581,534	581,534	0	0	0	0				
4	581,534	581,534	0	0	0	0				
5	581,534	581,534	0	0	0	0				
6	581,534	581,534	0	0	0	0				
7	581,534	581,534	0	0	0	0				
8	581,534	581,534	0	0	0	0				
9	581,534	581,534	0	0	0	0				
10	581,534	581,534	0	0	0	0				
11	581,534	581,534	0	0	0	0				
12	581,534	581,534	0	0	0	0				
13	581,534	581,534	0	0	0	0				
14	581,534	581,534	0	0	0	0				
15	581,534	581,534	0	0	0	0				
16	581,534	581,534	0	0	0	0				
17	581,534	581,534	0	0	0	0				
18	581,534	581,534	0	0	0	0				
19	581,534	581,534	0	0	0	0				
20	581,534	581,534	0	0	0	0				
21	581,534	581,534	0	0	0	0				
22	581,534	581,534	0	0	0	0				
23	581,534	581,534	0	0	0	0				
24	581,534	581,534	0	0	0	0				
25	581,534	581,534	0	0	0	0				
26	581,534	581,534	0	0	0	0	0	0	0	0
27	581,534	517,109	43,075	21,350	0	27,004	111	40,348	17,706	44,710
28	581,534	461,384	89,525	30,625	0	51,106	221	80,696	35,411	86,517
29	581,534	437,809	97,775	45,950	0	60,379	332	121,043	53,117	113,496
30	581,534	376,734	130,380	69,670	4,750	84,691	442	161,391	70,822	155,513
31	581,534	314,784	166,025	95,975	4,750	110,190	553	201,739	88,528	198,717
32	581,534	259,984	235,925	80,875	4,750	135,853	663	242,087	106,233	242,087
33	581,534	196,759	274,792	105,233	4,750	162,079	1,669	609,205	453,614	615,693
34	581,534	110,609	364,850	101,325	4,750	200,818	2,675	976,323	800,994	1,001,812
35	581,534	33,584	449,400	93,800	4,750	235,781	3,681	1,343,441	1,148,375	1,384,155
36	581,534	0	524,944	51,840	4,750	254,158	4,686	1,710,559	1,495,755	1,749,913
37	581,534	0	526,550	50,234	4,750	254,288	5,692	2,077,677	1,843,135	2,097,423
38	581,534	0	526,435	50,349	4,750	254,279	6,698	2,444,795	2,190,516	2,444,795

Table 2
Water Consumption and Discharge Scenarios - Caledon Quarry

Year	Scenario 1	Water Consumed		Water Stored					Water Injected to Trench							Water Discharged			
	Annual Water Generated	Agg Prod-uction	Water for Agg Washing	Main Sump Storage	Wash Plant Storage	North Sump Storage	North Quarry Allowed to Fill	South Sump Storage	Trench Zone 1	Trench Zone 2	Trench Zone 3	Trench Zone 4	Trench Zone 5	Trench Zone 6	Total Trench Injection	Water to be Discharged	Off Site Discharge to Credit River	Mitigation Discharge from Main Quarry	Mitigation Discharge from South Quarry
			0.05																
	m3	T	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3		m3	m3	m3	m3
0	0	0	0	0	0	0	0	0							0	0	0	0	0
1	82,661	250,000	12,500	1,000	20,000	40,000	0	0							0	9,161	9,161	0	0
2	117,566	500,000	25,000	0	0	0	0	0							0	92,566	92,566	0	0
3	168,747	750,000	37,500	0	0	0	0	0							0	131,247	131,247	0	0
4	223,348	1,000,000	50,000	0	0	0	0	0							0	173,348	173,348	0	0
5	267,270	1,500,000	75,000	0	0	0	0	0							0	192,270	192,270	0	0
6	328,770	2,000,000	100,000	0	0	0	0	0							0	228,770	228,770	0	0
7	388,725	2,500,000	125,000	0	0	0	0	0							0	263,725	263,725	0	0
8	454,694	2,500,000	125,000	0	150,000	0	0	0							0	179,694	179,694	0	0
9	512,477	2,500,000	125,000	0	0	0	0	0							0	387,477	387,477	0	0
10	556,745	2,500,000	125,000	0	0	0	0	0							0	431,745	431,745	0	0
11	590,863	2,500,000	125,000	0	0	1,000	0	0							0	464,863	464,863	0	0
12	631,819	2,500,000	125,000	0	0	0	0	0							0	506,819	506,819	0	0
13	656,946	2,500,000	125,000	0	0	0	0	0							0	531,946	531,946	0	0
14	651,608	2,500,000	125,000	0	0	0	0	0							0	526,608	526,608	0	0
15	646,356	2,500,000	125,000	0	0	0	0	0							0	521,356	521,356	0	0
16	641,170	2,500,000	125,000	0	0	0	0	0							0	516,170	516,170	0	0
17	640,940	2,500,000	125,000	0	0	0	0	0	0	0					0	515,940	515,940	0	0
18	695,561	2,500,000	125,000	0	0	0	0	0	59,349	36,850					96,199	570,561	474,362	96,199	0
19	745,862	2,500,000	125,000	0	0	0	0	0	118,698	73,701					192,399	620,862	428,463	192,399	0
20	797,518	2,500,000	125,000	0	0	0	0	0	178,047	110,551					288,598	672,518	383,920	288,598	0
21	841,981	2,500,000	125,000	0	0	0	0	0	237,396	147,402					384,798	716,981	332,183	384,798	0
22	890,126	2,500,000	125,000	0	0	0	0	0	296,745	184,252					480,997	765,126	284,129	480,997	0
23	1,246,718	2,500,000	125,000	0	0	0	0	0	387,058	384,145					771,203	1,121,718	350,515	771,203	0
24	1,619,569	2,500,000	125,000	0	0	0	0	0	477,372	584,037					1,061,409	1,494,569	433,160	1,061,409	0
25	1,968,965	2,500,000	125,000	0	0	0	0	0	567,685	783,930					1,351,615	1,843,965	492,350	1,351,615	0
26	2,323,910	2,500,000	125,000	0	0	0	0	0	657,999	983,823	0	0	0	0	1,641,821	2,198,910	557,089	1,641,821	0
27	2,436,668	2,500,000	125,000	0	0	0	0	1,000	651,839	964,416	126,310	0	25,056	20,115	1,787,735	2,310,668	522,933	1,616,254	171,480
28	2,533,517	2,500,000	125,000	0	0	0	0	0	645,678	945,009	252,619	0	50,111	40,230	1,933,648	2,408,517	474,869	1,590,687	342,961
29	2,613,182	2,500,000	125,000	0	0	0	0	0	639,518	925,602	378,929	0	75,167	60,346	2,079,561	2,488,182	408,620	1,565,120	514,441
30	2,706,674	2,500,000	125,000	0	0	0	0	20,000	633,358	906,195	505,238	0	100,222	80,461	2,225,475	2,561,674	336,199	1,539,553	685,922
31	2,801,616	2,500,000	125,000	0	0	0	0	0	627,198	886,788	631,548	0	125,278	100,576	2,371,388	2,676,616	305,228	1,513,986	857,402
32	2,896,724	2,500,000	125,000	0	0	0	0	0	621,037	867,382	757,858	0	150,334	120,691	2,517,302	2,771,724	254,422	1,488,419	1,028,883
33	3,122,485	2,500,000	125,000	0	0	0	0	0	586,513	829,605	750,153	227,281	194,364	132,852	2,720,768	2,997,485	276,717	1,416,117	1,304,651
34	3,360,760	2,500,000	125,000	0	0	0	0	0	551,988	791,828	742,449	454,562	238,394	145,013	2,924,235	3,235,760	311,526	1,343,816	1,580,419
35	3,595,259	2,500,000	125,000	0	0	0	0	0	517,463	754,051	734,745	681,843	282,425	157,175	3,127,701	3,470,259	342,558	1,271,514	1,856,187
36	3,813,172	2,500,000	125,000	0	0	0	0	0	482,939	716,274	727,040	909,124	326,455	169,336	3,331,168	3,688,172	357,005	1,199,212	2,131,955
37	4,013,275	2,500,000	125,000	0	0	0	0	0	448,414	678,497	719,336	1,136,406	370,485	181,497	3,534,634	3,888,275	353,641	1,126,911	2,407,723
38	4,212,802	500,000	25,000	0	0	0	0	0	413,889	640,720	711,631	1,363,687	414,515	193,658	3,738,101	4,187,802	449,702	1,054,609	2,683,491

Max annual discharge to the Golf Course Irrigation Ponds: 557,089 m3
Avg discharge flow rate to the Golf Course Irrigation Ponds (max year): 17.7 L/s

Table 2
Water Consumption and Discharge Scenarios - Caledon Quarry

Year	Scenario 2	Water Consumed		Water Stored					Water Injected to Trench							Water Discharged			
	Annual Water Generated	Agg Prod-uction	Water for Agg Washing	Main Sump Storage	Wash Plant Storage	North Sump Storage	North Quarry Allowed to Fill	South Sump Storage	Trench Zone 1	Trench Zone 2	Trench Zone 3	Trench Zone 4	Trench Zone 5	Trench Zone 6	Total Trench Injection	Water to be Discharged	Off Site Discharge to Credit River	Mitigation Discharge from Main Quarry	Mitigation Discharge from South Quarry
			0.05																
	m3	T	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3	m3		m3	m3	m3	m3
0	0	0	0	0	0	0	0	0							0	0	0	0	0
1	82,661	250,000	12,500	1,000	20,000	40,000	0	0							0	9,161	9,161	0	0
2	117,566	500,000	25,000	0	0	0	0	0							0	92,566	92,566	0	0
3	168,747	750,000	37,500	0	0	0	0	0							0	131,247	131,247	0	0
4	223,348	1,000,000	50,000	0	0	0	0	0							0	173,348	173,348	0	0
5	267,270	1,500,000	75,000	0	0	0	0	0							0	192,270	192,270	0	0
6	328,770	2,000,000	100,000	0	0	0	0	0							0	228,770	228,770	0	0
7	388,725	2,500,000	125,000	0	0	0	0	0							0	263,725	263,725	0	0
8	454,694	2,500,000	125,000	0	150,000	0	0	0							0	179,694	179,694	0	0
9	512,477	2,500,000	125,000	0	0	0	0	0							0	387,477	387,477	0	0
10	556,745	2,500,000	125,000	0	0	0	0	0							0	431,745	431,745	0	0
11	590,863	2,500,000	125,000	0	0	1,000	0	0							0	464,863	464,863	0	0
12	631,819	2,500,000	125,000	0	0	0	0	0							0	506,819	506,819	0	0
13	656,946	2,500,000	125,000	0	0	0	376,000	0							0	155,946	155,946	0	0
14	592,946	2,500,000	125,000	0	0	0	0	0							0	467,946	467,946	0	0
15	586,942	2,500,000	125,000	0	0	0	0	0							0	461,942	461,942	0	0
16	581,003	2,500,000	125,000	0	0	0	0	0							0	456,003	456,003	0	0
17	580,020	2,500,000	125,000	0	0	0	0	0	0	0					0	455,020	455,020	0	0
18	634,663	2,500,000	125,000	0	0	0	0	0	59,349	36,850					96,199	509,663	413,464	96,199	0
19	684,986	2,500,000	125,000	0	0	0	0	0	118,698	73,701					192,399	559,986	367,587	192,399	0
20	736,664	2,500,000	125,000	0	0	0	0	0	178,047	110,551					288,598	611,664	323,065	288,598	0
21	781,149	2,500,000	125,000	0	0	0	0	0	237,396	147,402					384,798	656,149	271,351	384,798	0
22	829,315	2,500,000	125,000	0	0	0	0	0	296,745	184,252					480,997	704,315	223,318	480,997	0
23	1,185,897	2,500,000	125,000	0	0	0	0	0	387,058	384,145					771,203	1,060,897	289,694	771,203	0
24	1,558,737	2,500,000	125,000	0	0	0	0	0	477,372	584,037					1,061,409	1,433,737	372,328	1,061,409	0
25	1,908,122	2,500,000	125,000	0	0	0	0	0	567,685	783,930					1,351,615	1,783,122	431,507	1,351,615	0
26	2,263,057	2,500,000	125,000	0	0	0	0	0	657,999	983,823	0	0	0	0	1,641,821	2,138,057	496,236	1,641,821	0
27	2,375,865	2,500,000	125,000	0	0	0	0	1,000	651,839	964,416	126,310	0	25,056	20,115	1,787,735	2,249,865	462,131	1,616,254	171,480
28	2,472,766	2,500,000	125,000	0	0	0	0	0	645,678	945,009	252,619	0	50,111	40,230	1,933,648	2,347,766	414,118	1,590,687	342,961
29	2,552,481	2,500,000	125,000	0	0	0	0	0	639,518	925,602	378,929	0	75,167	60,346	2,079,561	2,427,481	347,920	1,565,120	514,441
30	2,646,025	2,500,000	125,000	0	0	0	0	20,000	633,358	906,195	505,238	0	100,222	80,461	2,225,475	2,501,025	275,550	1,539,553	685,922
31	2,741,019	2,500,000	125,000	0	0	0	0	0	627,198	886,788	631,548	0	125,278	100,576	2,371,388	2,616,019	244,630	1,513,986	857,402
32	2,836,177	2,500,000	125,000	0	0	0	0	0	621,037	867,382	757,858	0	150,334	120,691	2,517,302	2,711,177	193,875	1,488,419	1,028,883
33	3,064,139	2,500,000	125,000	0	0	0	0	0	586,513	829,605	750,153	227,281	194,364	132,852	2,720,768	2,939,139	218,371	1,416,117	1,304,651
34	3,304,616	2,500,000	125,000	0	0	0	0	0	551,988	791,828	742,449	454,562	238,394	145,013	2,924,235	3,179,616	255,381	1,343,816	1,580,419
35	3,541,316	2,500,000	125,000	0	0	0	0	0	517,463	754,051	734,745	681,843	282,425	157,175	3,127,701	3,416,316	288,615	1,271,514	1,856,187
36	3,761,430	2,500,000	125,000	0	0	0	0	0	482,939	716,274	727,040	909,124	326,455	169,336	3,331,168	3,636,430	305,263	1,199,212	2,131,955
37	3,963,735	2,500,000	125,000	0	0	0	0	0	448,414	678,497	719,336	1,136,406	370,485	181,497	3,534,634	3,838,735	304,101	1,126,911	2,407,723
38	4,165,463	500,000	25,000	0	0	0	0	0	413,889	640,720	711,631	1,363,687	414,515	193,658	3,738,101	4,140,463	402,362	1,054,609	2,683,491

Max annual discharge to the Golf Course Irrigation Ponds: 506,819 m3
Avg discharge flow rate to the Golf Course Irrigation Ponds (max year): 16.1 L/s

Water Management Milestones - Caledon Pit / Quarry

Year	Milestone / Operational Note
1	Establish Main Area sump with 1,000 m^3 storage in low point. Establish 0.5 Ha temporary wash pond with 20,000 m^3 storage. Establish 0.89 Ha settling pond in North Area with 40,000 m^3 storage.
8	Establish permanent 1.9 Ha wash ponds in the Main Area with 150,000 m^3 storage. May decommission temporary wash pond.
10	Establish North Area sump with 1,000 m^3 storage in low point.
13	North Area extraction complete. Assume CBM will continue to dewater it, but CBM could possibly use it for additional water storage capacity, if needed. There is in excess of 300,000 m^3 of additional water storage capacity in the North Area.
17	**Initiate discharge to groundwater infiltration Trench Zones 1 and 2 in the Main Area.** Additional water storage to operate the infiltration trench system, if needed, could be accommodated in the Main Area or the North Area (preferred). Storage of this water is not formally accounted, but there is sufficient water generated to supply the mitigation system.
26	Establish South Area sump with 1,000 m^3 storage in low point. Establish 0.47 Ha sump in South Area with 20,000 m^3 storage. **Initiate discharge to groundwater infiltration Trench Zones 3 to 6 in the South Area.**
38	Last year of scheduled dewatering / water discharge. Discharge of water will cease once the Site has been rehabilitated and the excavated and rehabbed areas are allowed to naturally flood.

QUARRY SUMP(S)

Figure 3 below shows elevation contours for the base of the Gasport Formation, which is the lower limit of extraction and approximately represents the pit / quarry floor surface. As extraction proceeds, it is assumed that at any given time the pit / quarry sump(s) will be located proximal to the low point of the excavation floor.

TRANSFER OF WATER BETWEEN QUARRY PARCELS

During operational phases, it will be necessary to transfer excess pit / quarry water from the South and Main Areas to the North Area, in order to store and convey excess quarry water to the golf course irrigation system at the proposed point of discharge. This will require pumping, and piping would need to be constructed to cross the roadways, either by cut and fill, or directional drilling.

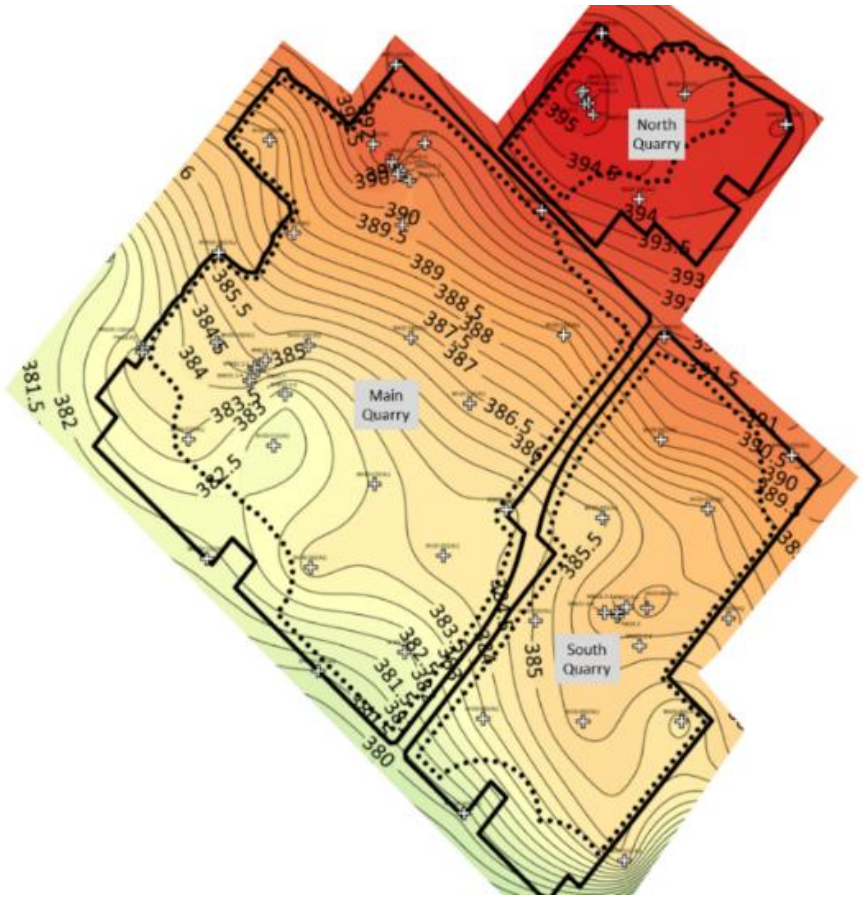

Figure 3: Elevation of the Base of the Gasport Formation (masl)

QUARRY WATER DISCHARGE AND FLOWS

With reference to Table 2, discharges of surplus water to the Osprey Valley Golf Course irrigation system are anticipated to begin during Operational Year 1 with an annual discharge of approximately 10,000 m^3 that year. The rate of discharge is expected to increase annually to a maximum of approximately 560,000 m^3 / year in operational Year 26, and then stabilize and decline in future years. The highest annual average water discharge (Year 26) is expected to be approximately 18 L/s.

It should be noted that additional HGS water model simulations indicated the groundwater mitigation system could be used to re-infiltrate additional groundwater, in the range of 200,000 to 400,000 m^3 / year, without adversely affecting groundwater levels. As such there is an option to re-infiltrate additional groundwater if needed to manage surplus water and reduce the quantity of water discharged to the Osprey Valley Golf Course irrigation pond system.

Because no water will be discharged from the proposed pit / quarry directly to the Credit River, there are no significant changes expected to flows or thermal characteristics of the Credit River.

FINAL POND WATER LEVELS

Upon rehabilitation, the maximum water level in the Main Pond will be controlled by an outflow to the North Pond at an approximate elevation of 400 masl, and the maximum water level in the North Pond will be controlled by an outflow to the Osprey Valley Golf Course irrigation system at an approximate elevation of 399 masl. The simulated post-rehabilitation water level in the South Pond is predicted to be 393.5 masl and will be internally contained, with no outflow. The simulated steady state outflow from the Main and North Ponds to the golf course irrigation system is estimated to be approximately 12.1 L/s.

Table 3: Final Pond Capacities and Water Levels Post-Rehabilitation

Parameter	Units	Main	South	North (Scenario 1)
Base of Gasport (range)	masl	381 - 392.5	383.5 - 390.5	394 - 395
Base of Gasport (average)	masl	386	386	394.5
Pit Shell Area	m2	1,245,747	581,534	149,350
Current High Water Table (range)	masl	406 - 420	392 - 405	398 - 406
Final Pond Water Level	**masl**	**400**	**393.5**	**399**
Pond Capacity Post-Rehab	m3	13,599,000	3,055,000	376,000
Average post-rehab inflow rate (50% of initial post-rehab inflow rate)	m3/yr	844,987	1,222,397	39,017
Time required to fill ponds (average inflow rate)	yr	16.1	2.5	9.6

Notes
1. Main Pond overflow would be directed via a culvert to the North Pond - invert at ~400 masl.
2. North Pond overflow would be directed via main outlet to the Osprey Valley Golf Course Irrigation System - invert at ~399 masl.
3. South Pond does not have an outlet.

With reference to Table 4, it is anticipated that it will require approximately 16.1, 9.6 and 2.5 years for the ponds in the Main, North and South Areas to reach their final water levels, assuming that 50% of the steady state inflow rate for the final operational year is maintained, on average, as the ponds fill post-rehabilitation.

SUMMARY

In summary, we note the following key points with respect to water management at the proposed Caledon Pit / Quarry:

- The Operational Plan for the pit / quarry has been revised to construct a 40,000 m^3 settling pond / holding pond for managing discharge water in the North Area during Year 1, in order provide “immediate” water storage capacity.

- Based on water inflow predictions and mitigation water needs from numerical simulations during operations, enough water will be generated during Years 17 to 38 of operation to supply the water needed for the proposed groundwater mitigation system.
- Additional water storage to operate the groundwater mitigation system, if needed, could be accommodated in the Main Area or the North Area (preferred). If needed, the North Area could be used to store additional water, as there is in excess of 300,000 m^3 of capacity in that area once extraction has been completed at the end of Operational Year 14.
- The maximum annual average rate of discharge throughout pit / quarry operations is approximately 560,000 m^3 / year in Operational Year 26. The peak average annual water discharge rate (in Year 26) is expected to be approximately 18 L/s.
- There is an option to re-infiltrate an additional 200,000 to 400,000 m^3 / year of groundwater if needed to manage surplus water, and reduce the quantity of water discharged to the Osprey Valley Golf Course irrigation pond system.
- Because no water will be discharged from the proposed pit / quarry directly to the Credit River, there are no significant changes expected to flows or thermal characteristics of the Credit River.

CLOSURE

We trust that this memorandum meets your current needs. If you have any questions or require clarification, please contact WSP at your earliest convenience.

HW/CDV/GWS/mp

https://golderassociates.sharepoint.com/sites/114392/project files/6 deliverables/ph 2300-hydrogeology/300e revised water report july 2023/appendices/appr-water management plan/19129150 wmp 24jul2023 r2.docm

APPENDIX S

Groundwater Mitigation System Description

Impact Assessment Methodology for Well Users

Water Well Complaint Response Plan

APPENDIX S1

Groundwater Mitigation System Description

Proposed Caledon Pit / Quarry

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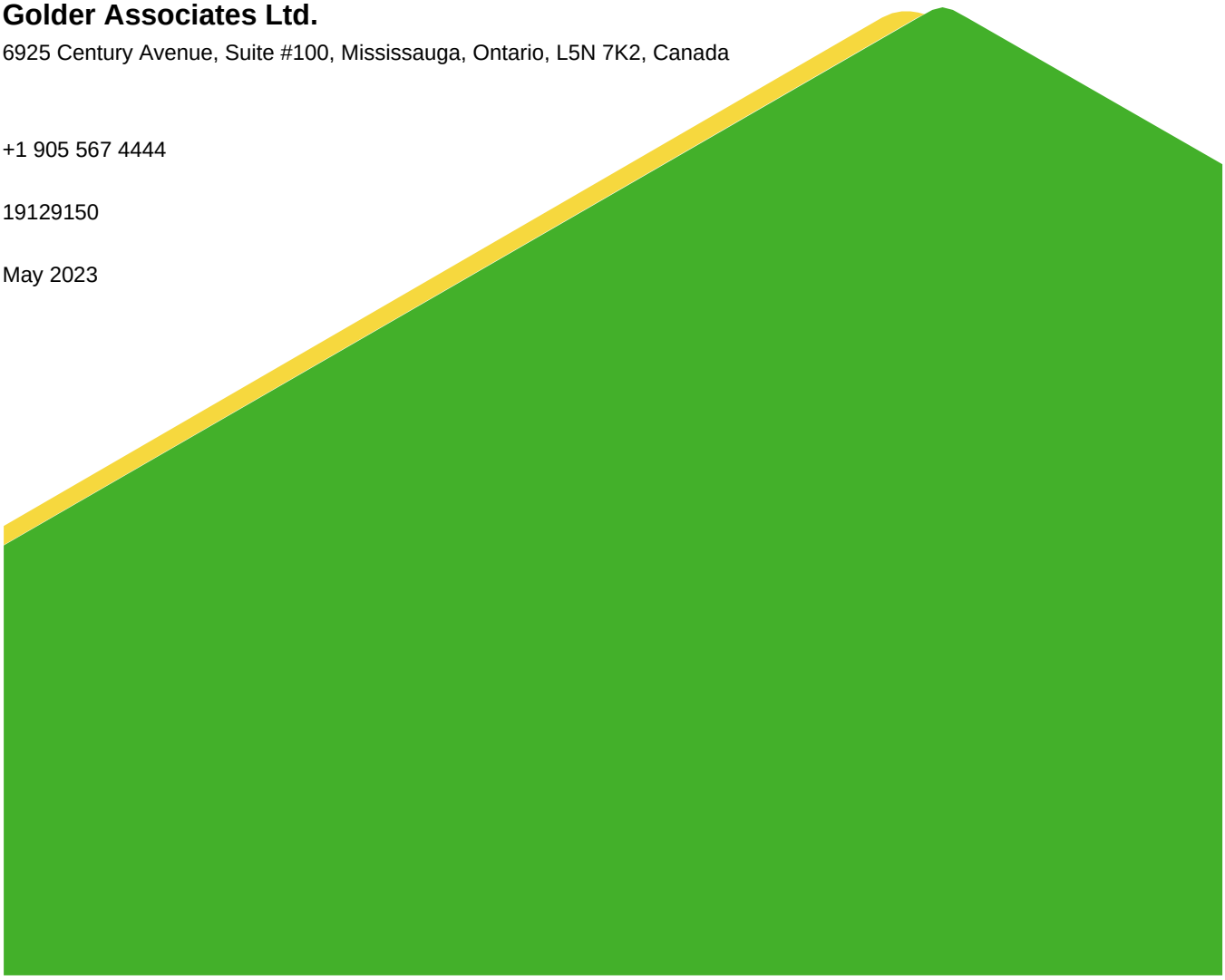
19129150

May 2023



Distribution List

1 e-copy: CBM Aggregates, a division of St. Marys Cement Inc. (Canada)

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1.0 INTRODUCTION

CBM Aggregates (CBM), a division of St. Marys Cement Inc. (Canada), is applying to the Ministry of Natural Resources and Forestry (MNRF) for a Class A License (Pit and Quarry Below Water) and to the Town of Caledon for an Official Plan Amendment and Zoning By-law Amendment to permit a mineral aggregate operation for the proposed CBM Caledon Pit / Quarry.

CBM controls approximately 323 hectares of land located at the northwest, northeast and southwest intersection of Regional Road 24 (Charleston Sideroad) and Regional Road 136 (Main Street). Of these lands, approximately 262 hectares are proposed to be licenced under the Aggregate Resources Act and designated / zoned under the Planning Act to permit the proposed CBM Caledon Pit / Quarry. The lands proposed to be licenced under the Aggregate Resources Act are referred to herein as the “Subject Site” (or “Site”) and are legally described as Part of Lots 15-18, Concession 4 WSCR and Part of Lot 16, Concession 3 WSCR (former Geographic Township of Caledon). The area located to the northwest of the intersection of Regional Road 24 and 136 is referred to as the “Main Area”. The area to the northeast of the intersection of Regional Road 24 and 136 is referred to as the “North Area”, and the area located to the southwest of the intersection of Regional Road 24 and 136 is referred to as the “South Area” (Figure 1).

Initial review of the HGS groundwater-surface water model simulations undertaken as part of the Water Report (Golder 2022) indicated that pit / quarry dewatering during later the stages of operations (Phases 4 to 7) would likely result in a decline in groundwater levels in the water table aquifer that would extend southward and to the southwest of the licence area. If so, these predicted changes in groundwater levels could potentially effect natural features, groundwater users, and influence groundwater levels beneath existing aggregate pit #6525 (Lafarge Pit #3) that is currently licenced to extract sand and gravel above the water table.

In order to mitigate the potential effects of these predicted changes in groundwater levels during the operational phases of the proposed CBM Caledon Pit / Quarry, groundwater mitigation measures were developed by Golder and then implemented in the HydroGeoSphere (HGS) modelling simulations for Operational Phase 3 to 7, to assess their effectiveness, as described in the Water Report (Golder 2022).

This appendix report to the Water Report provides a description of the groundwater mitigation system proposed for the Caledon Pit / Quarry based on these simulations, including the conceptual design and proposed implementation phasing of the system.

2.0 SYSTEM DESCRIPTION

2.1 General Configuration

The proposed mitigation system generally consists of a groundwater infiltration trench and slurry wall / grout zone, as shown conceptually on Figure 2, which will be implemented within a 50 m wide zone of the pit / quarry setback, where it is required to sustain groundwater levels during operations.

- The infiltration trench would be constructed within the setback, parallel and a minimum of 3 m from the licence limit. The trench will be excavated down through the sand and gravel overburden to the current water table using 1:1 sloping. Based on current groundwater levels along the proposed trench alignment, the trench would have a maximum depth of 8.5 m, and a typical minimum width at the base of 3 m, making the trench alignment up to 20 m wide at surface.

- A perforated horizontal infiltration pipe would be placed at the base of the trench, and the trench would then be backfilled with coarse granular material, covered with a non-woven geotextile and capped with a topsoil layer at surface. The perforated infiltration pipe would be sized / specified based on infiltration rate requirements. Several air release vent pipes to surface will also be installed along the horizontal infiltration pipe to allow any entrapped air in the granular material to escape and avoid a potential air pressure buildup in the system and help ensure that water flows freely into the infiltration pipe from the trench vault.
- Water collected during pit / quarry operations would be stored and used to supply water to the infiltration trench via an infiltration vault, as may be needed to help maintain groundwater levels in the areas of potential concern at their current typical range during pit / quarry operations.
- An infiltration vault (Figure 3) would consist of prefabricated concrete “box culvert” segments, placed vertically on a concrete slab at the base of the trench, and extending to ground surface. The vault would be sized based on water infiltration requirements. The infiltration vault would be supplied with water via piping from the pit / quarry, which would be installed below the frost line for year-round operation, if required.
- A hydraulic barrier will also be constructed in the setback area, through the sand and gravel overburden and into the upper weather zone of the bedrock, between the infiltration trench alignment and the extraction limit, approximately 10 m from the extraction limit. The hydraulic barrier will consist of two components: grouting the weathered zone in the upper bedrock, followed by constructing a slurry wall through the overburden on the same alignment.
- The target hydraulic conductivity (k) of the hydraulic barrier created by the slurry wall and grout zone within the overburden and weathered bedrock is $1x10^{-7}$ m/s, and this k value was use in the HGS numerical simulations to represent these zones in the scenarios with the mitigation system in place.
- Grouting of the more permeable upper weathered bedrock zone would be performed, typically by means of pressurized injection grouting, where is it required to help create a hydraulic barrier. The slurry wall would extend from ground surface down to the top of bedrock, and would typically be constructed using “one-pass” trenching technology. Given its proposed location within the setback, this hydraulic barrier would be constructed prior to the installation of the berm in that part of the setback area.
- Lastly, monitoring well nests (seven in total) would be constructed at key locations in the setback along the proposed mitigation system between the infiltration trench and the licence limit. Each well nest would consist of a deep piezometer in the Gasport Formation and a shallow piezometer in the overburden. These monitoring well nests would be used initially to establish baseline groundwater levels along the mitigation system, and later to provide “feedback” on groundwater levels, both to “inform” the injection rate needed to sustain groundwater levels and to monitor the performance of the mitigation system.
- When operational, the mitigation system would be used to maintain groundwater levels within their current typical ranges, as illustrated on Figure 3 (proximal to the trench vault) and Figure 4 (along other parts of the trench).

2.2 Mitigation System Zones

To mitigate the potential decline in groundwater levels during later the stages of operations (Phases 4 to 7) due to dewatering, the proposed mitigation system would consist of six infiltration trench zones and two slurry wall / grout zones constructed along a 1,900 m alignment, as shown on Figure 5, and summarized in Table 1.

- North of Charleston Sideroad in the Main Area, two trench zones (Zones 1 and 2) and a 600 m long slurry wall / grout zone are proposed. See the plan view detail on Figure 6.
- South of Charleston Sideroad in the South Area, four trench zones (Zones 3 to 6) and a 1,250 m long slurry wall / grout zone are proposed. See the plan view detail on Figure 7.
- The six individual trench zones would range in length from ~220 to ~335 m and are typically separated from one another by a "gap" of 30 m, except Trenches 2 and 3, which are separated by a gap of ~43 m as they straddle Charleston Sideroad.
- Each trench zone would be assigned a "target" water level to be maintained during mitigation. For the purposes of the conceptual design and testing the feasibility of this mitigation, the steady state current condition water table from the calibrated HGS model was assumed to be the "target" water level in numerical simulations.

Table 1: Proposed Groundwater Mitigation Zones

Mitigation		Start (m)	End (m)	Length (m)	Target Trench Water Level (masl)
Main Area	Slurry Wall	0.0	128.6	N/A	N/A
	Trench Zone 1 / Slurry Wall	128.6	348.7	220.1	399.0
	Trench Zone 2 / Slurry Wall	378.7	596.7	218.0	397.5
South Area	Trench Zone 3 / Slurry Wall	640.1	974.8	334.7	395.5
	Trench Zone 4 / Slurry Wall	1004.8	1334.9	330.2	393.0
	Trench Zone 5 / Slurry Wall	1365.8	1634.5	268.7	392.0
	Trench Zone 6 / Slurry Wall	1664.5	1890.5	226.0	394.0

- With reference to Figure 5 and Table 1, the "average" current condition groundwater table assigned to each trench segment in the HGS model simulation varied along the alignment, from 399.0 masl at the north end in Trench Zone 1 in the Main Area, to as low as 393.0, 392.0 and 394.0 masl at the southernmost trench Zones 4, 5 and 6 in the South Area.
- When the system is eventually implemented, the actual target water level for each trench zone will be determined from baseline water level monitoring data at the monitoring wells nest or nests corresponding to that zone. To replicate variations observed in baseline groundwater levels, the target water levels will account for seasonal variability and climate variability, as much as possible.
- The variable target water levels will be determined from baseline monitoring at the infiltration trench monitoring well nests, acquired for a minimum period of 2 years prior to the start of below water table extraction. Based on the water level variability observed at existing site monitoring wells MW20-01, MW20-02 and MW20-18 for the 2021 period, it is expected that target water levels for the proposed infiltration trench system will vary seasonally by 1.5 to 2 m. It is expected that it will also be necessary to periodically

adjust the range of target levels to account for longer term changes in groundwater levels due to climate trends.

2.3 Phasing of Implementation

Based on numerical simulations for Operational Phases 3 to 7 as described in Section 8 and Appendix Q of the Water Report (Golder 2022), the groundwater mitigation system elements would be implemented in the following operational sequence.

- Phase 3 – Implementation of the slurry wall / grouting of the weathered bedrock zone on the west side of the Main Area prior to the start of Phase 3 extraction (Figure 6).
- Phases 4 and 5 – Implementation of the infiltration trench system (Trench Zones 1 and 2) on the west side of the Main Area prior to the start of Phase 4 and 5 extraction (Figure 6).
- Phase 6 and 7 – Implementation of the second slurry wall / grouting of the weathered bedrock zone and the second phase of the infiltration trench system (Trench Zones 4 to 6) prior to the start of Phase 6 and 7 extraction (Figure 7).

The post-Rehabilitation scenario includes the removal of the slurry wall in the overburden in the southwest corner of the South Area (adjacent to Trench Zones 4 and 5), to reinstate hydraulic connection between the South Area and the lands to the south and southwest of the Site. The other slurry walls would remain in place. The infiltration trenches would also remain in place, the trench vaults could remain in place or be removed, and the piping that supplies water to the trench vaults would be removed.

A summary of the mitigation system elements that were simulated and are proposed to be implemented during pit / quarry operations is presented in Table 2.

Table 2: Implementation Sequence of Groundwater Mitigation System Elements

Phase	Operational Year	Slurry Wall / Grout Zone	Infiltration Trench Zone / Constant Head (masl)
Phase 1	1 to 8	N/A	N/A
Phase 2	9 to 13	N/A	N/A
Phase 3	14 to 17	West side of Main Area	N/A
Phase 4	18 to 22	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5
Phase 5	23 to 26	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5
Phase 6	27 to 32	West side of Main Area West and south side of South Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5 Trench Zone 3: 395.5 Trench Zone 4: 393.0 Trench Zone 5: 392.0 Trench Zone 6: 394.0
Phase 7	33 to 38	West side of Main Area	Trench Zone 1: 399.0 Trench Zone 2: 397.5

Phase	Operational Year	Slurry Wall / Grout Zone	Infiltration Trench Zone / Constant Head (masl)
		West and south side of South Area	Trench Zone 3: 395.5 Trench Zone 4: 393.0 Trench Zone 5: 392.0 Trench Zone 6: 394.0
Post-Rehabilitation	Year 39+	Slurry wall removed along Trench Zones 4 and 5	N/A

2.4 Estimated Pit / Quarry Inflows and Trench Infiltration Rates

Numerical simulations in HGS for each phase of pit / quarry operations, without and with the proposed groundwater mitigation system in place, were used to estimate the inflows, initially with no mitigation (inflows presented in Table 3) as well as with the proposed mitigation system elements in place (inflows presented in Table 4), in accordance with the implementation sequence noted above (Table 2). The estimated inflows by phase, without and then with mitigation, are also shown graphically on Figure 8.

Table 3: Estimated Pit / Quarry Inflows (No Mitigation)

Phase	Period (years)	Forecast Year	Pit / Quarry Inflow – No Mitigation (m3/day)			
			Main Area	North Area	South Area	Total Inflow
1	1 to 8	8	1240	0	0	1240
2	9 to 13	13	1555	243	0	1798
3	14 to 17	17	1513	252	0	1765
4	18 to 22	22	2156	251	0	2407
5	23 to 26	26	3951	251	0	4201
6	27 to 32	32	3593	250	623	4466
7	33 to 38	38	2458	214	1024	3696

Table 4: Estimated Pit / Quarry Inflows (With Mitigation)

Phase	Period (years)	Forecast Year	Pit / Quarry Inflow – With Mitigation Trench (m3/day)				
			Main Area	North Area	South Area	Total Inflow	Additional Inflow
1	1 to 8	8	1235	0	0	1235	0
2	9 to 13	13	1557	243	0	1800	2
3	14 to 17	17	1505	251	0	1756	-9
4	18 to 22	22	2188	251	0	2439	31

Phase	Period (years)	Forecast Year	Pit / Quarry Inflow – With Mitigation Trench (m3/day)				
			Main Area	North Area	South Area	Total Inflow	Additional Inflow
5	23 to 26	26	6116	251	0	6367	2166
6	27 to 32	32	7023	250	663	7936	3470
7	33 to 38	38	4630	214	6698	11542	7846

The HGS model simulations were also used to estimate the quantity of water required to maintain the groundwater tables at the target trench water levels, as summarized in Table 5, and shown graphically on Figure 8. The simulations demonstrate that the volume of water required for the implementation of the groundwater mitigation system is less than the corresponding quarry inflows, indicating that there will be sufficient water available from operation to operate the system throughout all phases of the pit / quarry.

Hydraulic conductivity estimates from field observations and HGS numerical simulations demonstrate that the sand and gravel comprising the overburden along the trench alignments are sufficiently permeable ($k = 1x10^{-4}$ m/s) to receive the proposed groundwater inflow rates, given the size of the contact area within the trench that is available for infiltration.

Table 5: Estimated Recharge Required to Infiltration Trench

Phase	Period (years)	Forecast Year	Recharge Required to Infiltration Trench (m3/day)						
			Trench Zone 1	Trench Zone 2	Trench Zone 3	Trench Zone 4	Trench Zone 5	Trench Zone 6	Total Trench Recharge
1	1 to 8	8	0	0	0	0	0	0	0
2	9 to 13	13	0	0	0	0	0	0	0
3	14 to 17	17	0	0	0	0	0	0	0
4	18 to 22	22	813	505	0	0	0	0	1318
5	23 to 26	26	1803	2695	0	0	0	0	4498
6	27 to 32	32	1701	2376	2076	0	412	331	6897
7	33 to 38	38	1134	1755	1950	3736	1136	531	10241
Max. trench pumping rate (m3/day):			1803	2695	2076	3736	1136	531	10241
Max. trench pumping rate (igpm):			276	412	318	571	174	81	1567

Based on the recharge required for each infiltration trench, as noted in Table 5, a preliminary estimate of the infiltration vault capacity required to supply the infiltration trench system has been made and is summarized in Table 6, with key assumptions noted.

Table 6: Preliminary Infiltration Vault Capacity and Estimated Vault Retention Time

Trench Zone	# Vaults	Vault Height (m)	Vault Capacity (m3)	Total Max Inflow per Trench Zone (m3/min)	Max Inflow per Vault (m3/min)	Retention Time (50% full) (min)
1	2	3.0	35.7	1.25	0.63	28.5
2	2	7.0	83.2	1.87	0.94	44.5
3	2	3.0	35.7	1.44	0.72	24.7
4	1	6.0	71.3	2.59	2.59	13.7
5	1	8.0	95.1	0.79	0.79	60.3
6	1	5.0	59.5	0.37	0.37	80.7

Notes:
1. Assumes the infiltration vaults are constructed using 2.44 x 4.88 m (8 x 16 ft) rectangular concrete box culverts.
2. Vault height is assumed to be approximately equal to the trench depth below ground surface.
3. Two vaults would be utilized for trench zones 1, 2 and 3, based on vault height and estimated rate of infiltration.

The “retention time” shown in Table 6 is calculated as the time required to fill 50% of the infiltration vault at the maximum required infiltration rate, and is intended to be “indicative” of the vault’s approximate retention capacity at the maximum flow rate. The estimated retention times for the vaults at maximum infiltration rates range from ~14 to ~80 minutes, which suggest that vaults of these sizes would be sufficient, as they would provide storage capacity in the event that pumping was briefly interrupted, and they are large enough to minimize turbulence, which will help ensure that the hydraulic head of the water in the vault will be effectively transmitted in the infiltration pipes.

A sensitivity analysis was done on predicted pit / quarry inflows by varying the hydraulic conductivity of the proposed hydraulic barrier to assess the variability of pit / quarry inflows for each of the operational phases. The results are summarized in Table 7.

Table 7: Sensitivity of Pit / Quarry Inflow to Hydraulic Conductivity

Phase	K wall: $1x10^{-6}$ m/s, % change				K wall: $1x10^{-8}$ m/s, % change			
	Main Area	South Area	North Area	Total Inflow	Main Area	South Area	North Area	Total Inflow
3	0%		0%	0%	0%		0%	0%
4	0%		0%	0%	0%		0%	0%
5	8%		0%	8%	-2%		0%	-1%
6	9%	0%	0%	8%	-1%	0%	0%	-1%
7	8%	6%	0%	7%	-1%	-1%	0%	-2%

Notes:
1. The inflows include the surplus applied to the pit / quarry area.

The simulated pit / quarry inflow is more sensitive to an increase in the hydraulic conductivity of the slurry wall / weathered zone grouting to $1x10^{-6}$ m/s, with the increase in total quarry inflow ranging from 7 to 8% when the hydraulic conductivity is increased by an order of magnitude. The reduction of predicted water inflow when the hydraulic conductivity of the slurry wall / weathered zone grouting is reduced to $1x10^{-8}$ m/s is relatively small, ranging from 1 to 2% when the hydraulic conductivity is decreased by an order of magnitude.

2.5 Water Quality

Water collected from the pit / quarry operations and used to supply the infiltration system will first be clarified by settling in a sump or settling pond, to minimize plugging of the filtration trench system with fines. As described in Section 5 and Appendix I of the Water Report (Golder 2022) groundwater quality at the Site is generally good and within the typical range expected for groundwater in this hydrogeologic setting for the parameters tested.

The proposed pit / quarry is not expected to impact existing water quality, as aggregate operations will follow all applicable environmental standards and employ current industry best practices. This includes strict protocols for the handling of fuel on site, on-site storage and servicing of machinery, and the use and storage of hazardous substances.

Pit / quarry water that will be used to maintain groundwater levels via the infiltration trench system will be operated in accordance with the PTTW and ECA Permit requirements (see Section 3.2) and as such, operation of this mitigation system is not expected to impact groundwater quality relative to current baseline groundwater conditions.

3.0 DETAILED DESIGN, PERMITTING, CONSTRUCTION AND OPERATION

3.1 Detailed Design

This appendix report provides a conceptual design for the proposed groundwater mitigation system at the Caledon Pit / Quarry. While this report provides “a proof of concept” for the purposes of supporting this ARA licence application, a detailed design will be required in future to support the permitting and construction of the proposed groundwater mitigation system.

The detailed design would likely require additional hydrogeological and geotechnical characterization of the proposed infiltration trench and slurry wall / grout zone alignment within the Main Area and South Area lands. The detailed design would also recommend preferred construction techniques as well as provide a “life-cycle” cost estimate for construction, operation and decommissioning of the mitigation system.

3.2 Permitting

Prior to implementation of the proposed groundwater mitigation system, CBM would be required to obtain and operate in accordance with a Permit To Take Water and Industrial Sewage Works (ISW) Environmental Compliance Approval (ECA) under the Ontario Water Resources Act to permit the water management activities needed to operate this system.

The PTTW and ECA Permit would be a part of the overall approvals required to operate the pit / quarry, which would include:

- Pumping, collection, storage and discharge of pit / quarry water;
- Operation of the groundwater mitigation system (i.e., infiltration trench system); and
- Construction and operation of an aggregate wash plant.

Regarding the operation of the proposed groundwater mitigation system, the PTTW and ECA Permit would typically need to specifically include and/or address the following key elements:

- A description of the groundwater mitigation system, including a functional (process flow) diagram of the system;
- Target groundwater levels (see Note 1 below);
- Water handling requirements (i.e., water collection, temporary storage, settling, filtration, pumping and re-infiltration);
- Water level and water quality monitoring requirements;
- System operation and maintenance requirements; and
- Reporting requirements.

Note1: The target water level for each trench zone will be determined from baseline water level monitoring data at the monitoring wells nest or nests corresponding to that zone, and will account for seasonal variability and climate variability, as much as possible.

3.3 Construction and Operation

Construction of the various elements of the proposed groundwater mitigation system would be integrated into the overall planned schedule for pit / quarry operations, generally as follows:

- Phase 3 – Implementation of the slurry wall / grouting of the weathered bedrock zone on the west side of the Main Area prior to the start of Phase 3 extraction.
- Phases 4 and 5 – Implementation of the infiltration trench system (Trench Zones 1 and 2) on the west side of the Main Area, including pilot-scale testing, prior to the start of Phase 4 and 5 extraction. This stage of implementation would include pilot test of the system prior to its full implementation
- Phase 6 and 7 – Implementation of the second slurry wall / grouting of the weathered bedrock zone and the second phase of the infiltration trench system (Trench Zones 4 to 6), including pilot-scale testing, prior to the start of Phase 6 and 7 extraction.

The construction of the proposed mitigation system would be carried out concurrently with other operation activities in a manner that would not adversely impact the overall operational schedule.

Additionally, the proposed monitoring well nests (MW-IT-01A/B to MW-IT-07A/B, Figures 6 and 7) along the mitigation system alignment should be installed in the near future, to facilitate the collection of baseline groundwater level data for a minimum period of 2 years prior to the start of below water table extraction.

Signature Page

We trust that this appendix report meets your current requirements. Please contact the undersigned should you have any questions.

Golder Associates Ltd.

George Schneider M.Sc., P.Geo.
Senior Geoscientist

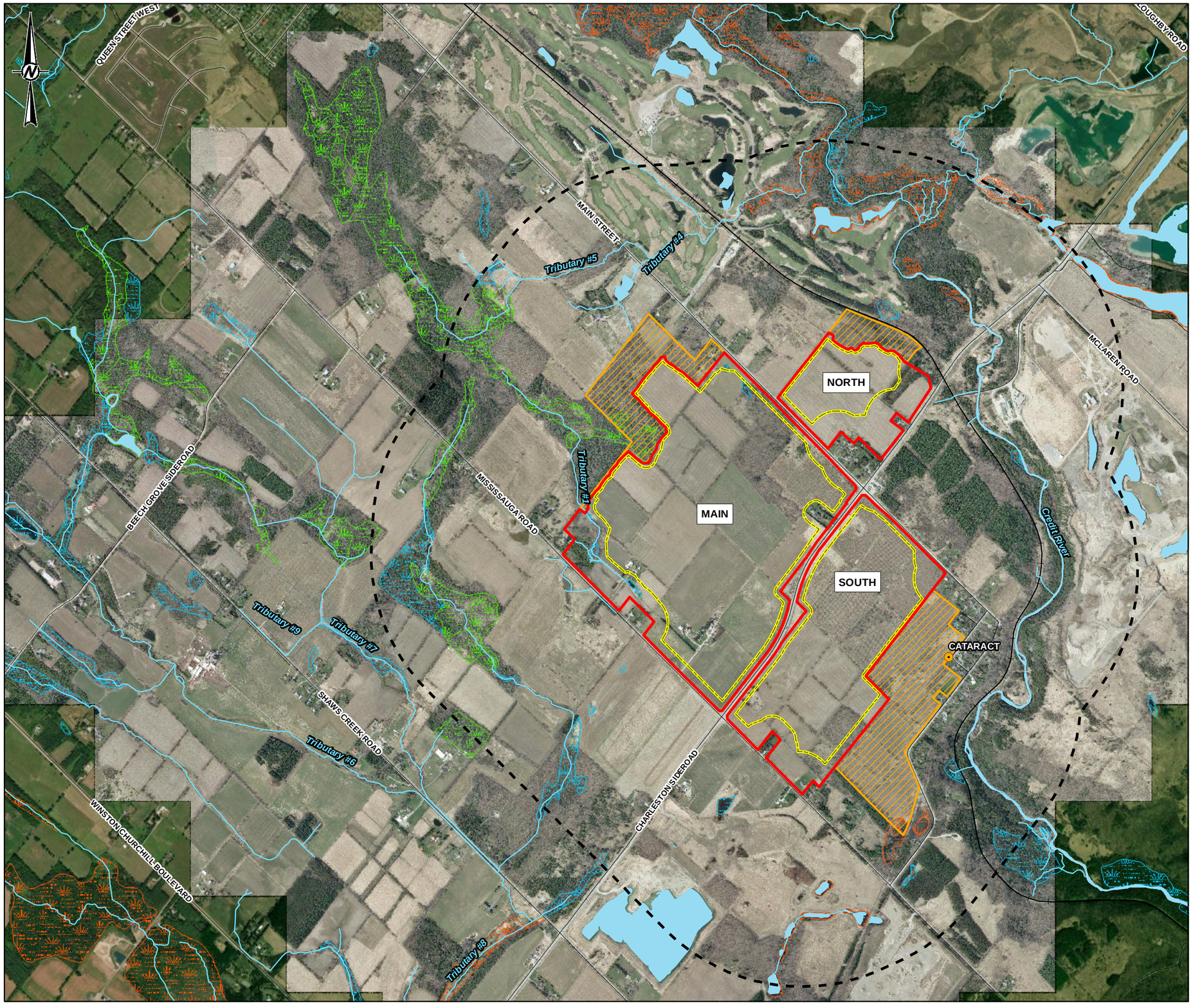
Craig DeVito, P.Eng.
Senior Water Resources Engineer

Frank Barone, Ph.D., P.Eng.
Senior Geo-environmental Engineer

HW/GWSCVD/FSB/

https://golderassociates.sharepoint.com/sites/114392/project files/5 technical work/ph 2300-hydrogeology/36 mitigation work/07 mitigation tm/19129250 apps mitigation system tm 31may2023.docm

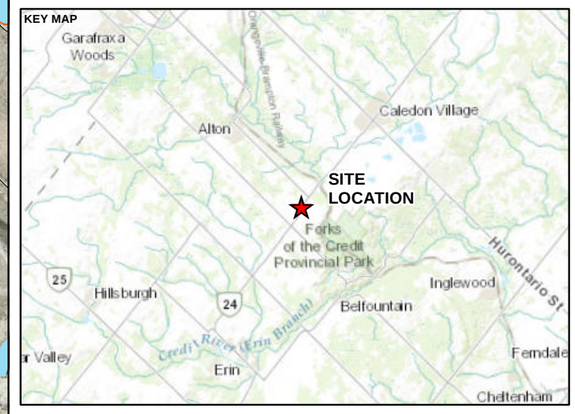
FIGURES



LEGEND

- TOWN/VILLAGE
- ROAD
- RAILWAY
- WATERCOURSE
- WATERBODY
- UNEVALUATED WETLAND
- OTHER EVALUATED WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- 1 km LICENCE BOUNDARY BUFFER
- LIMIT OF EXTRACTION
- LICENCE BOUNDARY
- ADDITIONAL LANDS OWNED / CONTROLLED BY CBM

KEY MAP



0 500 1,000

1:20,000 METRES

REFERENCE(S)

1. BASEDATA MNRF LIO OBTAINED APRIL 2020
2. WATERCOURSES OBTAINED FROM CREDIT VALLEY CONSERVATION AUTHORITY OPEN DATA PORTAL, NOVEMBER 2022 IN COMBINATION WITH SITE WATERCOURSE SURVEY PROVIDED BY FIRST BASE SOLUTIONS NOVEMBER 2021.
3. IMAGERY FIRSTBASE SOLUTIONS SPRING 2019 (15CM RESOLUTION) AND SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
4. LICENCE AND LIMIT OF EXTRACTION PROVIDED BY MHBC JUNE 2023
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

CBM AGGREGATES, A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

PROJECT

CALEDON PIT / QUARRY

TITLE

STUDY AREA

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2023-07-18
DESIGNED	SO
PREPARED	SO
REVIEWED	GWS
APPROVED	HM

PROJECT NO.	CONTROL	REV.	FIGURE
19129150	0036	0.0	1

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0 25mm

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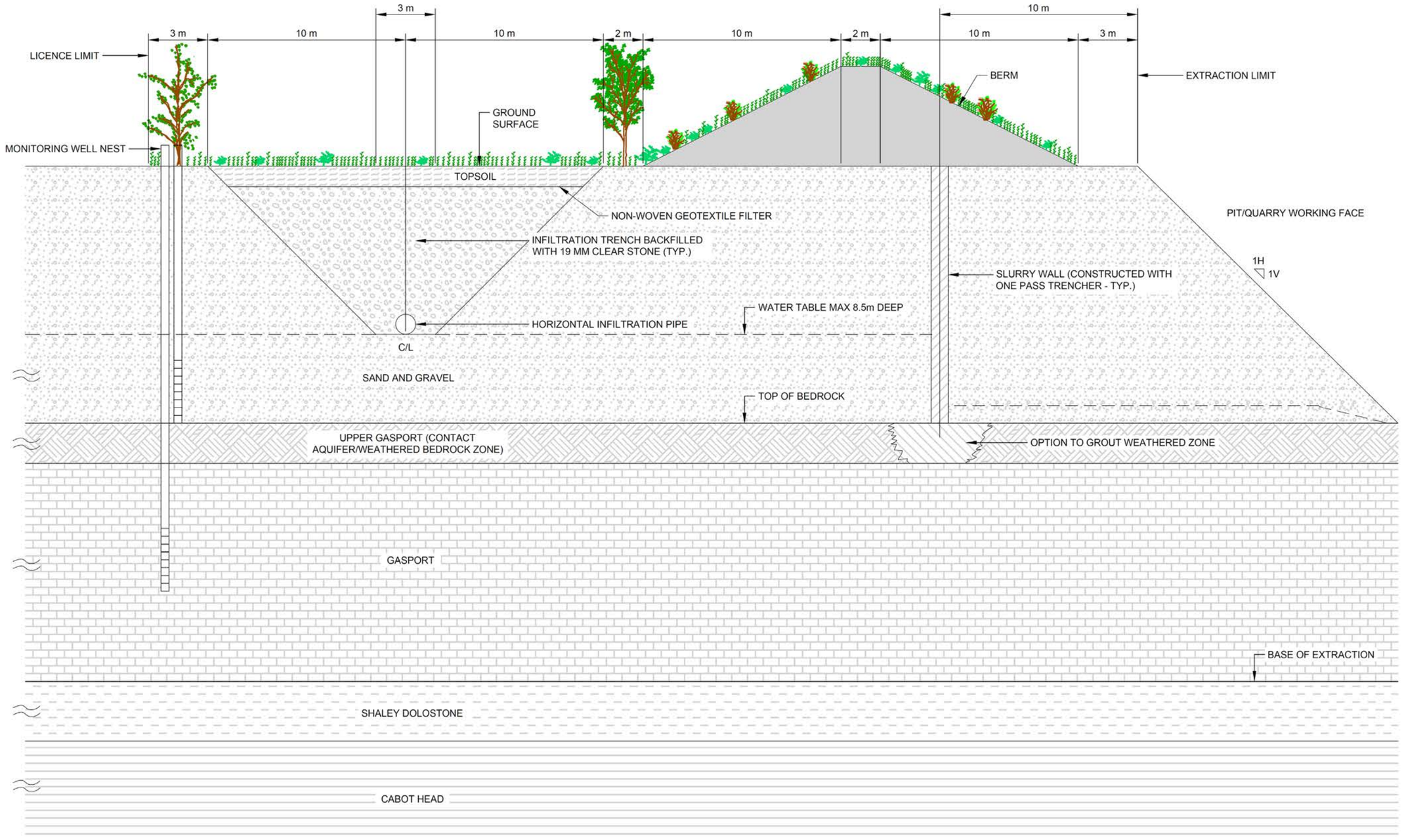

NOTES

1. Max trench width 20 m - depth will vary depending on the depth to water.
2. Infiltration piping will be sized to meet required infiltration rate.
3. Infiltration rate will vary to maintain groundwater table within required range.
4. Groundwater level to be monitored at well installed between trench and licence limit.
5. Minimum setback of 50 m needed.
6. Construct slurry wall/grout 10 m from extraction limit.
7. Construct infiltration trench c/l 13 m from licence limit.
8. Construct berm in setback.
9. Main Quarry - slurry wall and infiltration trench to be constructed at the start of extraction phase 4.
10. South Quarry - Slurry wall and infiltration trench to be constructed at the start of extraction phase 6.

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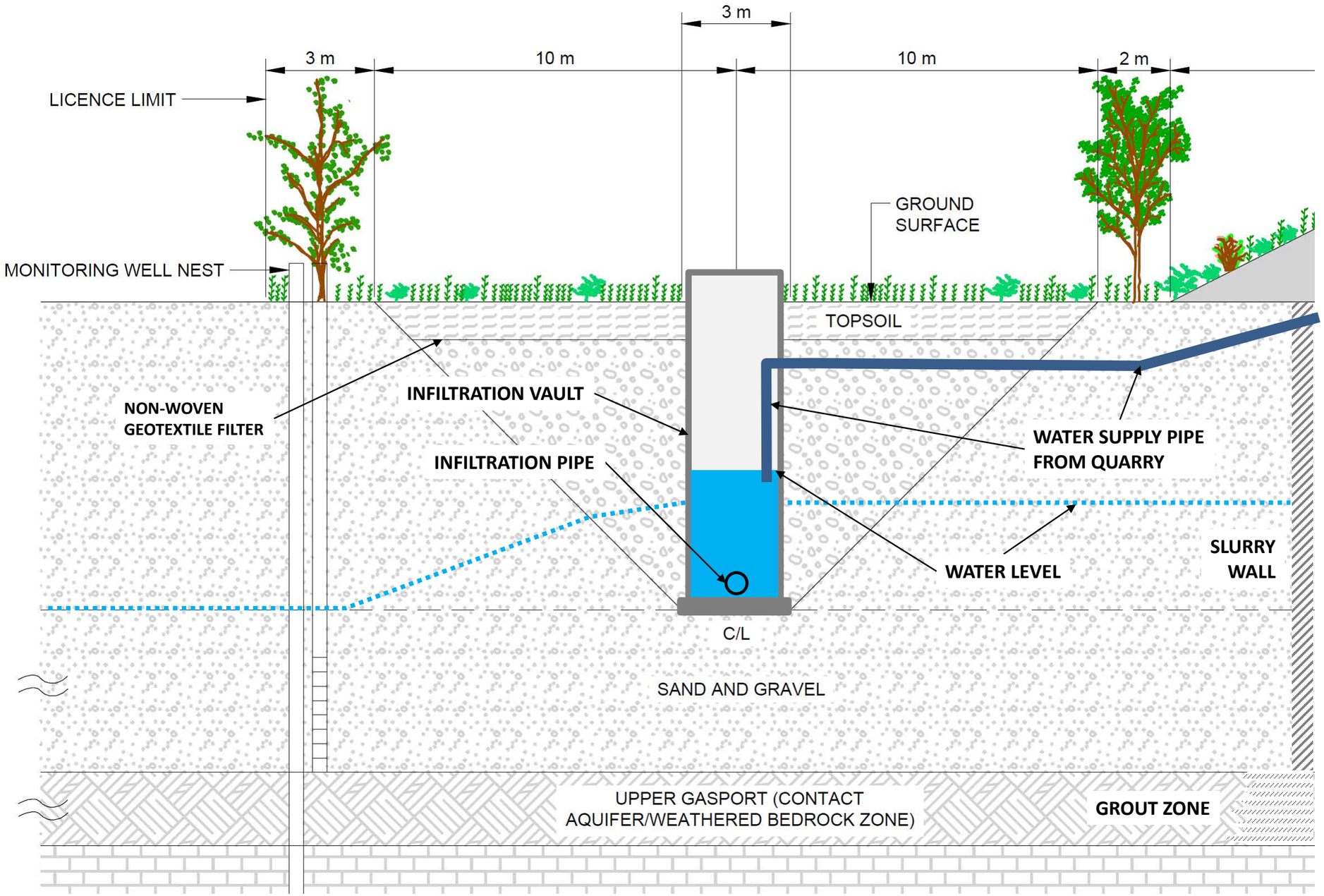
DESIGN	GWS
REVIEW	FB
APPROVED	GWS

PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
CONCEPTUAL CROSS-SECTION SHOWING GENERAL CONFIGURATION OF PROPOSED GROUNDWATER INFILTRATION TRENCH AND SLURRY WALL

PROJECT No. 19129150 | Rev. A | FIG. 2



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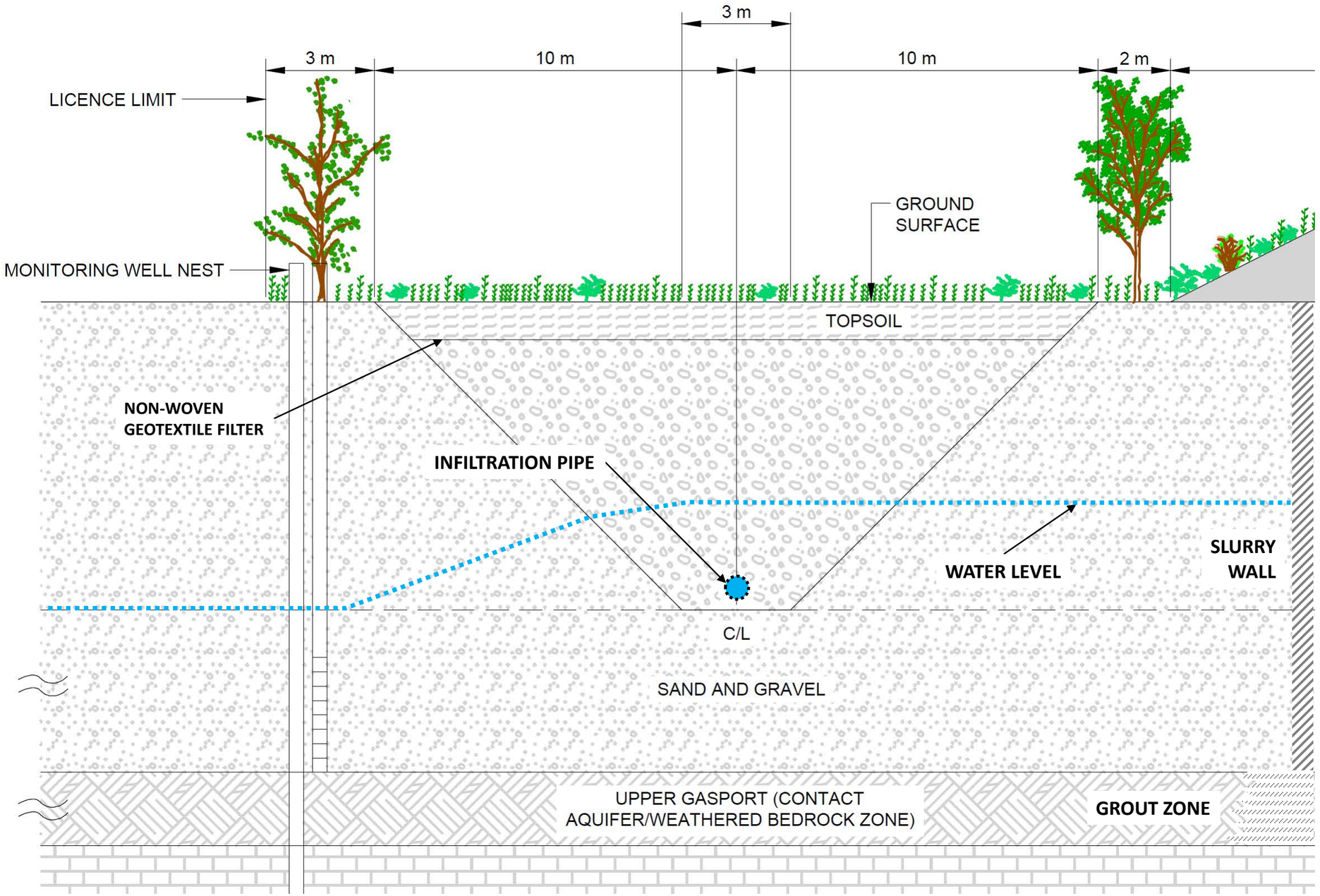
PREPARED	DD
DESIGN	GWS
REVIEW	FB
APPROVED	GWS

PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
CROSS-SECTION SHOWING PROPOSED INFILTRATION VAULT DETAIL

PROJECT No. 19129150 | Rev. A | FIG. 3



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PROJECT
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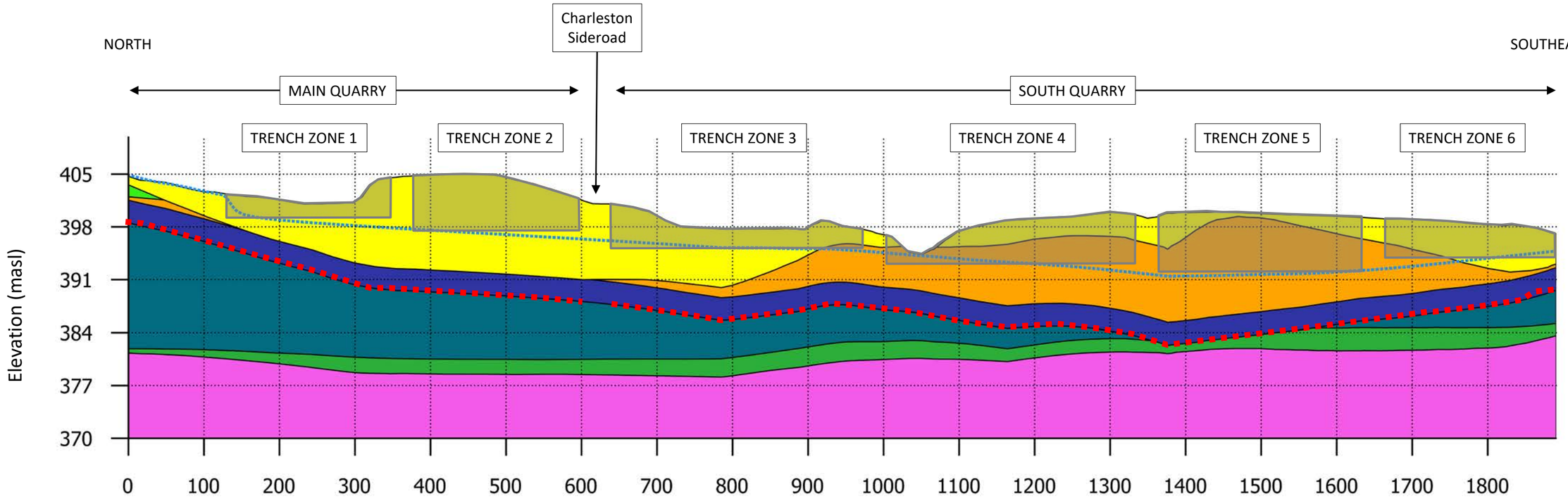
Water Resources Report

TITLE
CROSS-SECTION SHOWING PROPOSED INFILTRATION TRENCH DETAIL

PROJECT No. 19129150 | Rev. A | FIG. 4

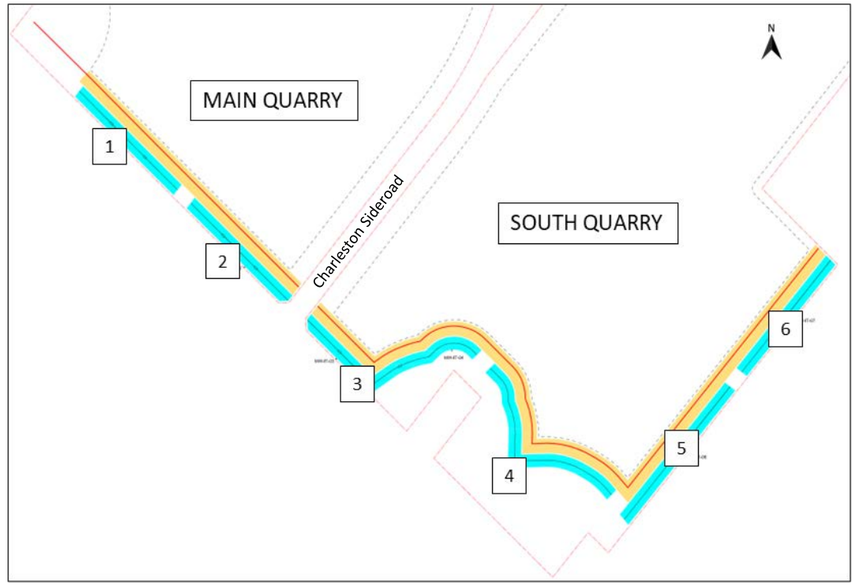


TRENCH AND SLURRY WALL CHAINAGES

	Start (m)	End (m)	Trench Length (m)	Target WL (masl)
Slurry wall only	0.0	128.6	N/A	N/A
Trench Zone 1	128.6	348.7	220.1	399.0
Trench Zone 2	378.7	596.7	218.0	397.5
Trench Zone 3	640.1	974.8	334.7	395.5
Trench Zone 4	1004.8	1334.9	330.2	393.0
Trench Zone 5	1365.8	1634.5	268.7	392.0
Trench Zone 6	1664.5	1890.5	226.0	394.0

LEGEND

- Upper Sand
- Till
- Lower Sand/ Channel Sediment
- Weathered Bedrock
- Gasport Formation (Dolostone)
- Fossil Hill Formation (Shaley Dolostone)
- Cabot Head Formation (Shale)
- Water Table (approx.)
- Base of Slurry Wall / Grout Zone
- Infiltration Trench Zone



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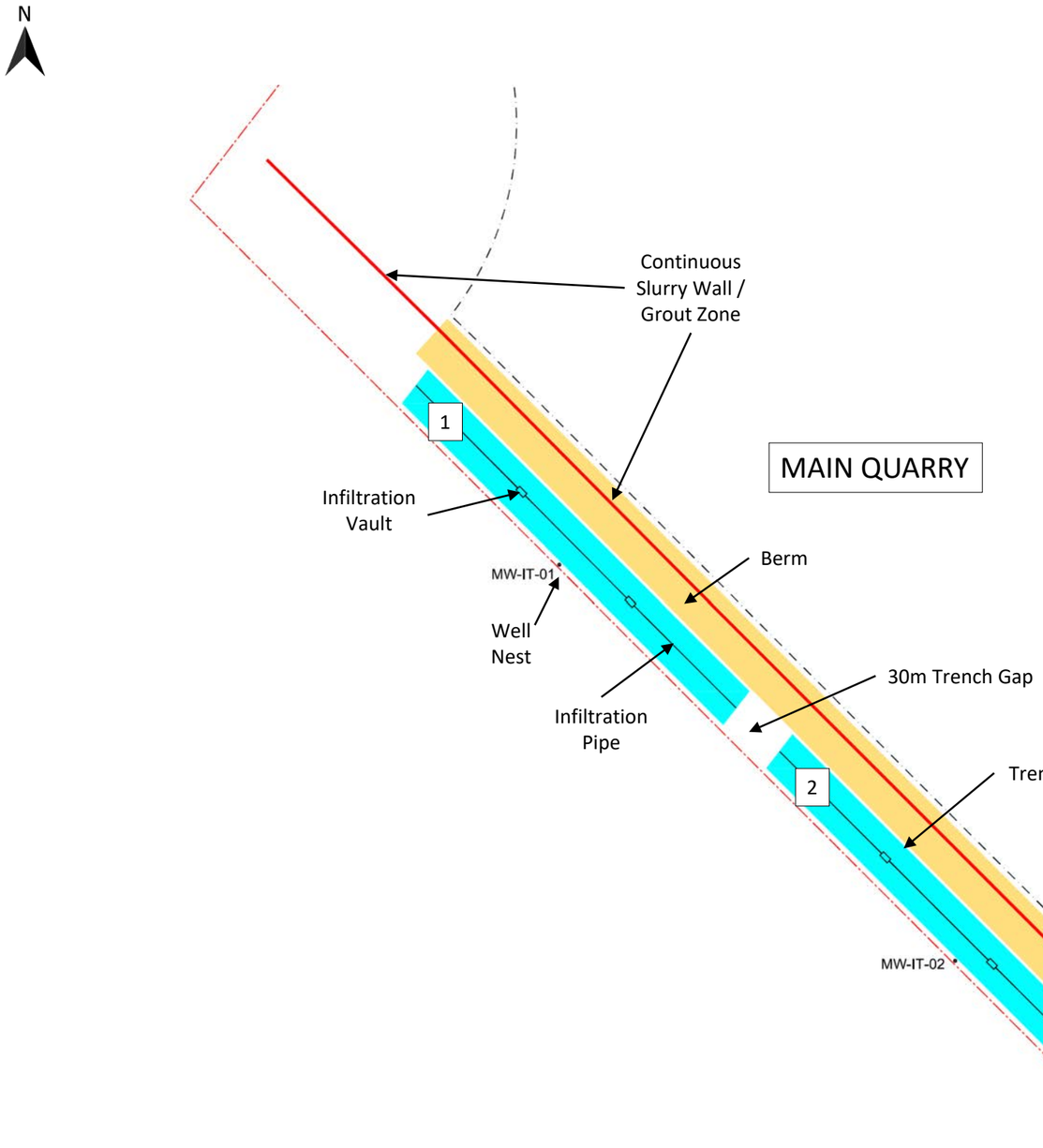
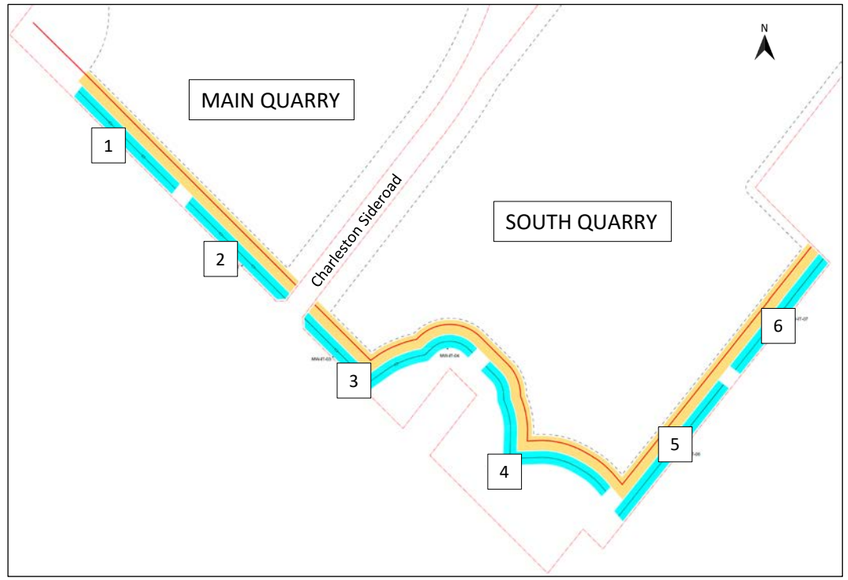
PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
HYDROSTRATIGRAPHIC CROSS-SECTION ALONG PROPOSED INFILTRATION TRENCH / SLURRY WALL ALIGNMENT

PROJECT No. 19129150 | Rev. A | FIG. 5





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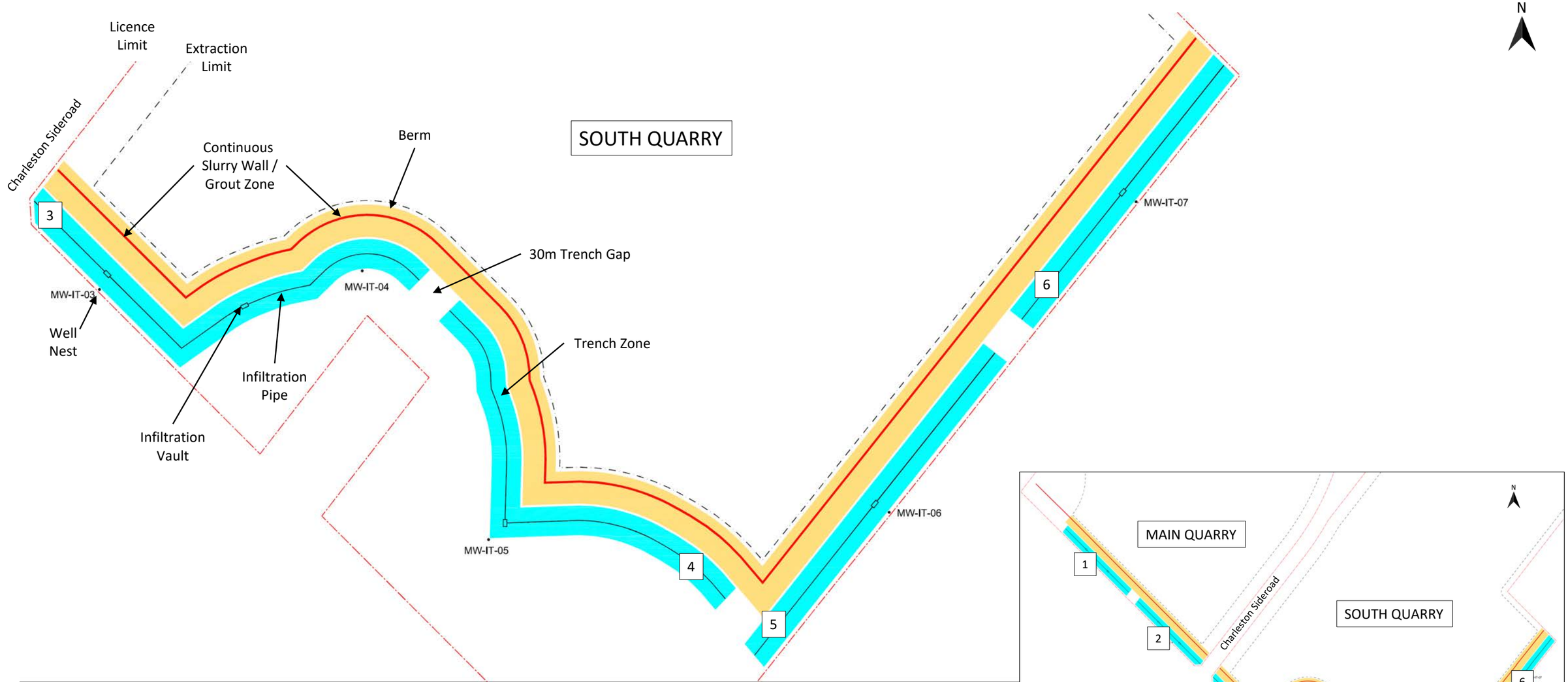
PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
PLAN VIEW OF PROPOSED INFILTRATION TRENCH / SLURRY WALL ZONES 1 AND 2 - MAIN QUARRY

PROJECT No. 19129150 | Rev. A | FIG. 6



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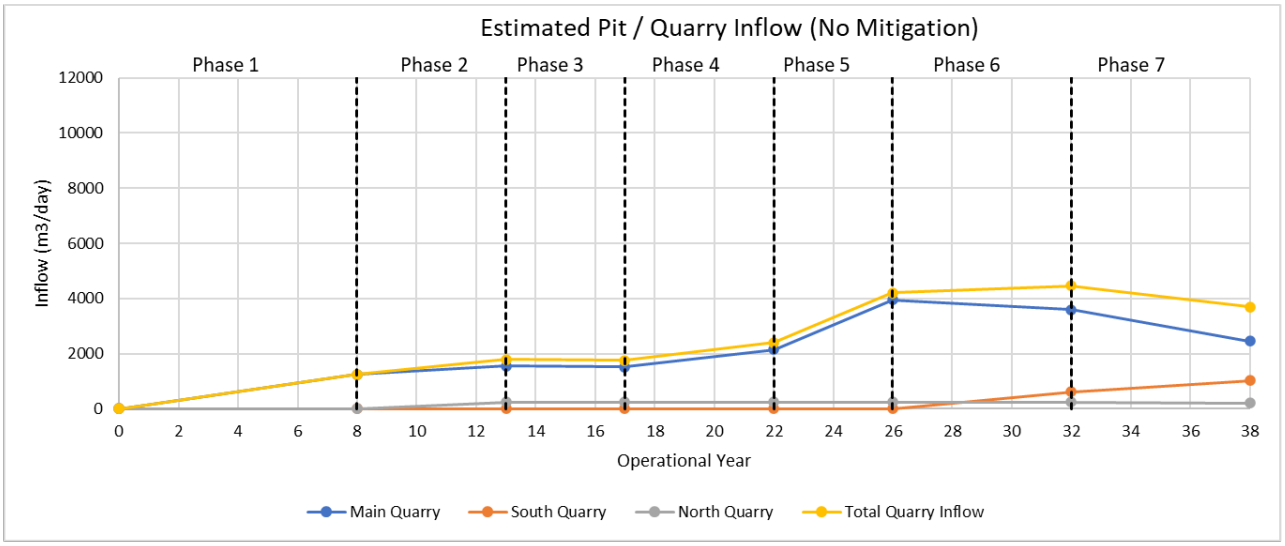
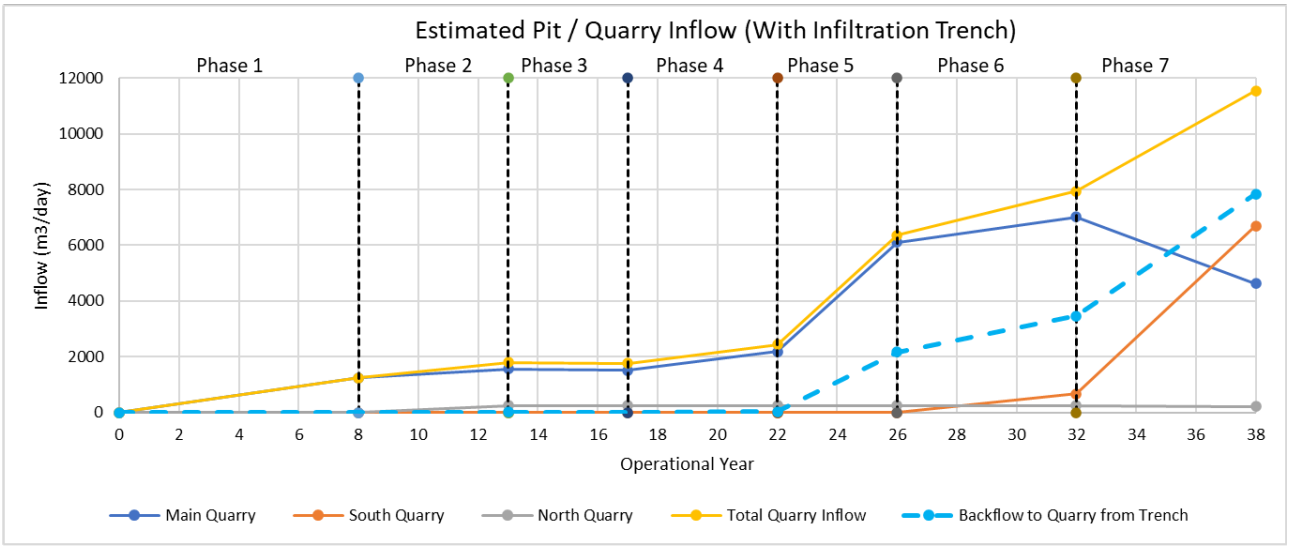
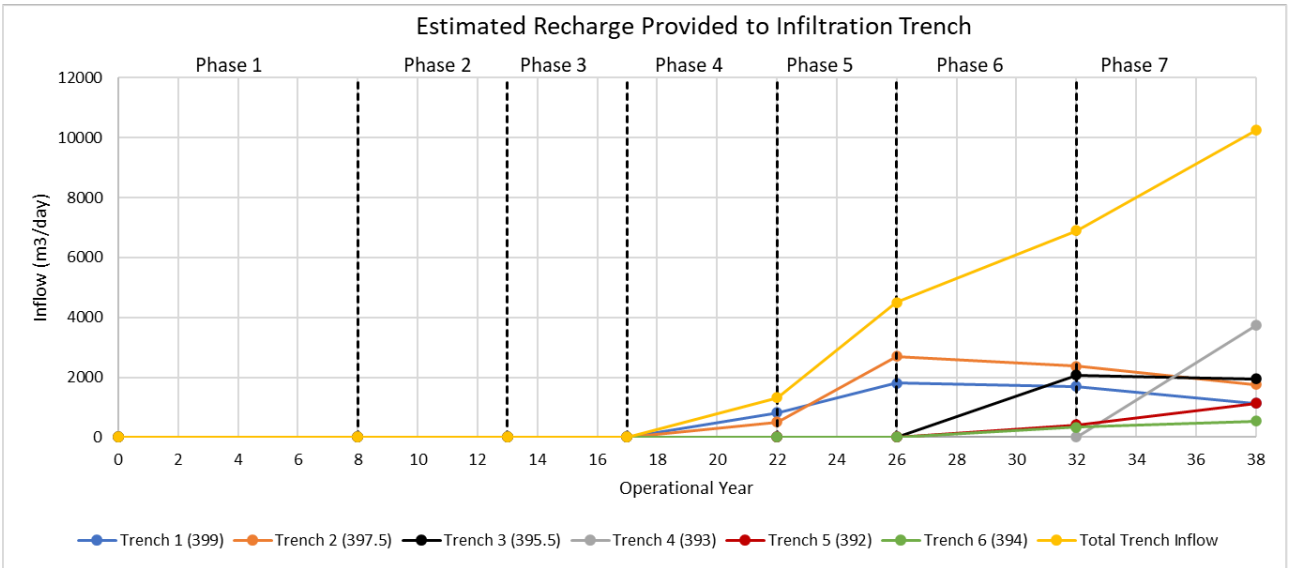
PROJECT
Caledon Pit / Quarry
Water Resources Report

TITLE
PLAN VIEW OF PROPOSED INFILTRATION TRENCH / SLURRY WALL ZONES 3, 4, 5 AND 6 - SOUTH QUARRY

PROJECT No. 19129150 | Rev. A | FIG. 7







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PROJECT
Caledon Pit / Quarry
Water Resources Report

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PREPARED	HW
DESIGN	HW
REVIEW	GWS
APPROVED	GWS

TITLE
ESTIMATED PIT / QUARRY INFLOWS AND INFILTRATION RATES FOR PROPOSED MITIGATION SYSTEM

PROJECT No.
19129150

Rev.
A

FIG.
8

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE December 5, 2022 **Project No.** 19129150

TO File
Golder

CC George Schneider

FROM Paul Menkveld **EMAIL paul.menkveld@wsp.com**

METHODOLOGY FOR ASSESSING THE POTENTIAL IMPACTS TO WATER WELL USERS – CBM CALEDON PIT / QUARRY

A conservative methodology was applied to assess which water supply wells could potentially be impacted by the proposed Caledon pit / quarry operations. The process is described as follows:

1) Calculate Initial Water Column = Modelled Static Water Level – Well Depth. Modelled static water levels are based on current steady state conditions, prior to any extraction simulation.

2) Establish Maximum Drawdown at each location: Maximum drawdown was established using the HGS predictive model. Since some water supply wells were fully penetrating (screened across multiple aquifer units), the actual amount of drawdown observed at these locations will be a function of the drawdown in all screened aquifers weighted by the transmissivity of those aquifers. A conservative simplifying approach was adopted to represent the drawdown at water supply wells. For each water supply well screen three groundwater level observation points (top, middle, and bottom of the screened interval) were extracted from the HGS model predictions, and the maximum drawdown observed at any of the points was taken to be the (worst case) drawdown at that water supply well. Table S-1 includes the maximum drawdown predicted at each well and the phase of extraction in which it occurred. This conservative scenario was evaluated for purposes of impact assessment.

3) Calculate Minimum Water Column = Initial Water Column – Maximum Drawdown.

4) Calculate Percent Remaining Water Column = Minimum Water Column / Initial Water Column x 100%

5) Apply Criteria 1: <90% Remaining Water Column. If greater than 90% of the initial water column remains available at that location, it is unlikely that the small reduction in water column adversely affects the water supply. If less than 90% of the water column remains available it is considered possible that the water well could be impacted, and Criteria 2 is applied.

6) Apply Criteria 2: <10m Minimum Water Column. If a minimum of >10m of water column is available, it is considered likely that it is sufficient for the water supply needs of the user. If the minimum water column is less than 10m then the water well is considered to be potentially impacted. Wells not identified by these

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criteria are considered to have negligible impacts. Despite the classification of the wells as having negligible impacts, well complaints protocol will be in place to address the possibility of unforeseen impacts.

7) Within the category of potentially impacted water supply wells, wells will be considered in detail and classified by the likelihood and intensity of predicted impacts on the water well as a water supply, into subcategories of potential impact: low, moderate, and significant.

Attachments: Table S-1

PGM/

https://golderassociates.sharepoint.com/sites/114392/project files/5 technical work/ph 2300-hydrogeology/30 impact assessment/06_water well impact assessment/methodology/19129150 caledon water well impact methodology 05dec2022.docx

Table S-1 - Water Well Impact Assessment (<1 km from Study Site)
Caledon Pit / Quarry

Well ID	Easting	Northing	Elevation (masl)	Distance from Pit / Quarry (m)	Well Depth (m)	Modelled Static Water Level (m)	Aquifer Description	Well Purpose	Well Use	Initial Water Column Available (m)	Phase 1 Max Drawdown (m)	Phase 2 Max Drawdown (m)	Phase 3 Max Drawdown (m)	Phase 4 Max Drawdown (m)	Phase 5 Max Drawdown (m)	Phase 6 Max Drawdown (m)	Phase 7 Max Drawdown (m)	Rehab Max Drawdown (m)	Maximum Drawdown (any phase) (m)	Phase of Max Drawdown	Minimum Water Column Available (m)	Min Remaining Water Column	Remaining Water Column Rehab	Criteria 1 - Remaining in Water Column	Criteria 2 - Minimum Water Column	Potential for Impact
4905228	578414	4853323	404.47	141	8.50	6.09	Bedrock (Gasport)	Water Supply	Domestic	2.41	0.54	0.51	0.54	0.53	0.49	3.44	2.58	1.87	3.44	6	0.00	0%	22%	<90%	<10m	Significant
4900879	578093	4853722	409.71	213	13.70	9.53	Bedrock (Gasport)	Water Supply	Domestic	4.17	0.77	0.67	0.70	0.71	0.71	0.94	1.21	0.82	1.21	7	2.96	71%	80%	<90%	<10m	Significant
4900878	578079	4853682	410.00	171	15.20	9.27	Bedrock (Gasport)	Water Supply	Domestic	5.93	0.91	0.78	0.81	0.83	0.83	1.12	1.48	0.98	1.48	7	4.45	75%	83%	<90%	<10m	Significant
4900947	578483	4852999	401.04	175	12.80	3.14	Bedrock (Gasport)	Water Supply	Domestic	9.66	0.46	0.40	0.47	0.44	0.43	3.26	2.23	1.54	3.26	6	6.40	66%	84%	<90%	<10m	Significant
4903132	578644	4852923	399.80	352	10.10	4.03	Bedrock (Gasport)	Water Supply	Domestic	6.07	0.23	0.17	0.24	0.23	0.22	1.65	1.27	0.91	1.65	6	4.41	73%	85%	<90%	<10m	Moderate
4900946	578303	4852138	395.31	417	15.80	10.04	Overburden	Water Supply	Domestic	5.76	0.43	0.28	0.60	0.04	0.72	-0.24	-0.12	-0.04	0.72	5	5.04	87%	101%	<90%	<10m	Moderate
4908162	577620	4852099	399.99	157	15.20	7.78	Bedrock (Gasport)	Water Supply	Domestic	7.42	0.75	0.63	1.08	-0.04	1.36	-0.25	0.00	-0.12	1.36	5	6.06	82%	102%	<90%	<10m	Low
4905272	578514	4852723	400.08	356	13.70	4.54	Bedrock (Gasport and Lower)	Water Supply	Domestic	9.16	0.32	0.24	0.34	0.30	0.32	2.21	1.78	1.32	2.21	6	6.95	76%	86%	<90%	<10m	Low
4905365	578514	4852723	400.08	356	29.90	20.64	Bedrock (Gasport and Lower)	Water Supply	Domestic	9.26	0.40	0.21	0.52	0.50	0.68	2.15	1.74	1.27	2.15	6	7.11	77%	86%	<90%	<10m	Low
4907244	577734	4851975	402.01	222	20.10	11.46	Bedrock (Gasport)	Water Supply	Domestic	8.64	0.65	0.51	0.93	-0.02	1.13	-0.35	-0.12	-0.17	1.13	5	7.51	87%	102%	<90%	<10m	Low
4903810	578539	4852873	399.90	284	13.10	3.01	Bedrock (Gasport and Lower)	Water Supply	Domestic	10.09	0.36	0.29	0.38	0.35	0.36	2.43	1.74	1.24	2.43	6	7.66	76%	88%	<90%	<10m	Low
4907589	578457	4853052	401.91	142	15.20	3.68	Bedrock (Gasport and Lower)	Water Supply	Domestic	11.52	0.48	0.43	0.50	0.48	0.47	3.61	2.44	1.65	3.61	6	7.91	69%	86%	<90%	<10m	Low
4903189	578664	4852723	399.93	475	15.20	5.38	Bedrock (Gasport and Lower)	Water Supply	Domestic	9.82	0.25	0.18	0.26	0.24	0.24	1.44	1.11	0.82	1.44	6	8.39	85%	92%	<90%	<10m	Low
4900948	578450	4852848	399.92	229	13.70	2.50	Bedrock (Gasport and Lower)	Water Supply	Domestic	11.20	0.42	0.35	0.44	0.41	0.42	2.80	1.95	1.40	2.80	6	8.40	75%	87%	<90%	<10m	Low
4906635	577507	4854325	415.01	186	21.60	10.55	Bedrock (Gasport)	Water Supply	Domestic	11.05	0.81	0.90	0.84	0.76	0.76	0.78	1.28	1.00	1.28	7	9.77	88%	91%	<90%	<10m	Low
4907201	575983	4853717	430.11	641	21.30	9.13	Overburden	Water Supply	Domestic	12.17	0.07	0.62	0.62	1.62	1.05	1.06	0.89	0.55	1.62	4	10.55	87%	95%	<90%	>10m	Negligible
4900945	578477	4853124	402.48	180	18.30	4.28	Bedrock (Gasport and Lower)	Water Supply	Domestic	14.02	0.42	0.37	0.43	0.42	0.40	3.16	2.20	1.53	3.16	6	10.86	77%	89%	<90%	>10m	Negligible
4904102	576927	4854548	414.92	266	23.20	9.55	Bedrock (Gasport)	Water Supply	Domestic	13.65	0.14	2.50	0.48	0.29	0.21	0.21	0.39	0.20	2.50	2	11.15	82%	99%	<90%	>10m	Negligible
4906023	577964	4853723	408.53	131	19.50	6.53	Bedrock (Gasport and Lower)	Water Supply	Domestic	12.97	1.19	1.04	1.07	1.10	1.12	1.31	1.64	1.18	1.64	7	11.32	87%	91%	<90%	>10m	Negligible
4908005	578546	4852932	399.99	259	21.00	4.07	Bedrock (Gasport and Lower)	Water Supply	Domestic	16.93	0.36	0.28	0.37	0.35	0.36	2.34	1.79	1.29	2.34	6	14.59	86%	92%	<90%	>10m	Negligible
7139063	577237	4854451	415.24	201	29.60	11.73	Bedrock (Gasport and Lower)	Water Supply	Domestic	17.87	0.65	2.06	1.21	0.70	0.69	0.72	1.66	1.18	2.06	2	15.81	88%	93%	<90%	>10m	Negligible
4907018	578029	4853732	409.42	183	30.20	9.52	Bedrock (Gasport and Lower)	Water Supply	Domestic	20.68	1.29	1.15	1.38	1.52	1.70	2.31	2.53	1.29	2.53	7	18.14	88%	94%	<90%	>10m	Negligible
4906521	576787	4852960	406.29	166	22.90	1.15	Bedrock (Gasport)	Water Supply	Domestic	21.75	0.14	0.24	0.49	2.45	2.63	2.63	2.13	1.29	2.63	5	19.12	88%	94%	<90%	>10m	Negligible
C	576448	4853345	416.27	218	53.46	-1.18	Bedrock (Gasport and Lower)	Water Supply	Domestic	54.64	0.60	1.15	1.54	5.85	3.15	3.15	2.87	1.68	5.85	4	48.79	89%	97%	<90%	>10m	Negligible
4905439	578459	4851827	391.72	637	12.80	2.66	Overburden	Water Supply	Commercial	10.14	0.33	0.17	0.48	0.01	0.57	-0.18	-0.03	-0.02	0.57	5	9.57	94%	100%	>90%	-	Negligible
4904297	578630	4852667	400.40	482	32.00	23.76	Bedrock (Below Gasport)	Water Supply	Domestic	8.24	0.29	-0.82	0.37	0.35	0.47	0.86	0.86	0.39	0.86	6	7.38	90%	95%	>90%	-	Negligible
4900950	576546	4854698	416.68	586	5.30	2.30	Overburden	Water Supply	Domestic	3.00	0.01	0.10	0.04	0.06	0.04	0.05	0.04	0.02	0.10	2	2.90	97%	99%	>90%	-	Negligible
4908905	579059	4853784	393.40	922	13.70	9.79	Overburden	Water Supply	Industrial	3.91	0.00	-0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6	3.91	100%	100%	>90%	-	Negligible
7241044	579051	4853788	393.64	917	16.80	11.30	Overburden	Other Status	Purge well	5.50	0.00	-0.11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	6	5.49	100%	100%	>90%	-	Negligible
4904054	578494	4852523	400.33	400	16.80	10.06	Bedrock (Gasport and Lower)	Water Supply	Domestic	6.74	0.13	0.09	0.14	0.12	0.15	0.62	0.46	0.32	0.62	6	6.12	91%	95%	>90%	-	Negligible
4908541	578745	4854123	389.83	551	15.50	8.47	Overburden	Water Supply	Other	7.03	0.01	-0.41	0.01	0.01	0.01	0.01	0.01	0.01	0.01	6	7.02	100%	100%	>90%	-	Negligible
4903950	578514	4851832	389.99	677	14.30	-0.25	Overburden	Water Supply	Commercial	14.55	0.24	0.13	0.35	0.01	0.42	-0.13	0.00	0.00	0.42	5	14.13	97%	100%	>90%	-	Negligible
4901027	576811	4851723	397.74	887	12.20	4.06	Bedrock (Gasport)	Water Supply	Domestic	8.14	0.34	0.26	0.56	-0.03	0.44	0.01	0.00	0.00	0.56	3	7.58	93%	100%	>90%	-	Negligible
4907246	577734	4851975	402.01	222	24.70	11.45	Bedrock (Gasport and Lower)	Water Supply	Domestic	13.25	0.65	0.51	0.93	-0.02	1.13	-0.35	-0.12	-0.17	1.13	5	12.11	91%	101%	>90%	-	Negligible
4900941	578697	4852765	399.57	475	36.60	22.53	Bedrock (Below Gasport)	Water Supply	Domestic	14.07	0.30	0.09	0.37	0.36	0.48	1.41	1.11	0.81	1.41	6	12.66	90%	94%	>90%	-	Negligible
4903630	578379	4852408	399.01	316	24.40	10.70	Bedrock (Gasport and Lower)	Water Supply	Domestic	13.70	0.37	0.13	0.50	0.38	0.67	0.85	0.93	0.38	0.93	7	12.77	93%	97%	>90%	-	Negligible
4905093	578364	4852373	397.48	320	24.70	10.61	Bedrock (Gasport and Lower)	Water Supply	Domestic	14.09	0.67	0.59	0.75	0.46	0.81	0.79	0.88	0.87	0.88	7	13.21	94%	94%	>90%	-	Negligible
4903338	576864	4852003	397.17	651	16.20	1.90	Bedrock (Gasport)	Water Supply	Domestic	14.30	0.53	0.48	0.83	-0.06	0.56	0.05	0.01	-0.01	0.83	3	13.47	94%	100%	>90%	-	Negligible
4906547	577543	4851996	400.04	281	22.60	7.97	Bedrock (Gasport)	Water Supply	Domestic	14.63	0.68	0.56	0.98	-0.05	1.17	-0.16	-0.01	-0.07	1.17	5	13.46	92%	100%	>90%	-	Negligible
4903169	578964	4854353	397.65	768	30.80	17.25	Bedrock (Gasport and Lower)	Water Supply	Commerical	13.55	0.02	-1.36	0.02	0.02	0.02	0.03	0.03	0.02	0.03	6	13.52	100%	100%	>90%	-	Negligible
4906026	577814	4852023	398.72	162	23.50	8.51	Bedrock (Gasport and Lower)	Water Supply	Domestic	14.99	0.65	0.51	0.93	0.09	1.17	-0.18	0.08	-0.12	1.17	5	13.82	92%	101%	>90%	-	Negligible
4907069	575970	4853700	430.25	650	25.90	9.27	Overburden	Water Supply	Domestic	16.63	0.07	0.62	0.62	1.62	1.05	1.06	0.89	0.55	1.62	4	15.01	90%	97%	>90%	-	Negligible
4904178	578464	4852453	398.55	381	29.90	14.16	Bedrock (Gasport and Lower)	Water Supply	Domestic	15.74	0.28	0.02	0.37	0.29	0.48	0.70	0.72	0.33	0.72	7	15.02	95%	98%	>90%	-	Negligible
4907199	575974	4853698	430.08	646	25.90	9.09	Overburden	Water Supply	Domestic	16.81	0.07	0.62	0.62	1.62	1.05	1.06	0.89	0.55	1.62	4	15.19	90%	97%	>90%	-	Negligible
4900882	576819	4854959	400.46	689	17.70	2.25	Overburden	Water Supply	Domestic	15.45	0.02	0.21	0.11	0.16	0.12	0.12	0.12	0.08	0.21	2	15.24	99%	100%	>90%	-	Negligible
4908100	577078	4854560	412.89	300	27.40	11.04	Bedrock (Gasport and Lower)	Water Supply	Domestic	16.36	0.09	0.91	0.27	0.16	0.15	0.16	0.28	0.18	0.91	2	15.45	94%	99%	>90%	-	Negligible
4901026	577033	4852103	398.00	460	19.80	2.88	Bedrock (Gasport)	Water Supply	Domestic / Livestock	16.92	0.60	0.55	0.94	-0.09	0.66	0.05	0.01	-0.02	0.94	3	15.98	94%	100%	>90%	-	Negligible
4904175	578564	4852573	399.87	470	27.70	10.64	Bedrock (Gasport and Lower)	Water Supply	Domestic	17.06	0.28	0.17	0.36	0.32	0.47	0.99	0.82	0.54	0.99	6	16.07	94%	97%	>90%	-	Negligible
4903844	578714	4853073	400.10	400	27.40	7.69	Bedrock (Gasport and Lower)	Water Supply	Industrial	19.71	0.41	0.01	0.50	0.51	0.61	1.24	1.17	0.68	1.24	6	18.47	94%	97%	>90%	-	Negligible
4907628	576570	4855350	401.43	1135	24.40	4.93	Bedrock (Gasport and Lower)	Water Supply	Public	19.47	0.11	0.32	0.27	0.36	0.34	0.36	0.40	0.17	0.40	7	19.07	98%	99%	>90%	-	Negligible
4904052	578644	4852683	400.47	484	29.90	9.27	Bedrock (Gasport and Lower)	Water Supply	Domestic	20.63	0.34	0.25	0.36	0.34	0.46	1.44	1.16	0.91	1.44	6	19.19	93%	96%	>90%	-	Negligible
4908895	578556	4852526	397.51	461	42.10	21.75	Bedrock (Gasport and Lower)	Water Supply	Domestic	20.35	0.25	0.01	0.32	0.28	0.41	0.75	0.72	0.35	0.75	6	19.59	96%	98%	>90%	-	Negligible
4906637	576804	4852922	405.95	176	22.90	1.50	Bedrock (Gasport)	Water Supply	Domestic	21.40	0.12	0.19	0.37	1.48	1.72	1.71	1.38	0.79	1.72	5	19.69	92%	96%	>90%	-	Negligible
4907712	578481	4852565	401.11	387	44.20	22.75	Bedrock (Gasport and Lower)	Water Supply	Domestic	21.45	0.36	0.01	0.46	0.41	0.61	1.00	1.02	0.45	1.02	7	20.43	95%	98%	>90%	-	Negligible
4903186	578664	4852873	398.51	390	41.50	19.88	Bedrock (Below Gasport)	Water Supply	Domestic	21.62	0.35	-1.27	0.44	0.44	0.56	1.05	1.04	0.49	1.05	6	20.57	95%	98%	>90%	-	Negligible
4904252	578537	4852787	400.22	335	43.30	20.32	Bedrock (Gasport and Lower)	Water Supply	Domestic	22.98	0.42	0.22	0.54	0.52	0.70	2.28	1.73	1.21	2.28	6	20.70	90%	95%	>90%	-	Negligible
4907938	578582	4852795	400.11	366	43.60	20.88	Bedrock (Gasport and Lower)	Water Supply	Domestic	22.72	0.39	0.18	0.49	0.48	0.64	1.89	1.45	1.06	1.89	6	20.83	92%	95%	>90%	-	Negligible
4907314	578727	4852899	399.99	438	29.00	6.29	Bedrock (Gasport and Lower)	Water Supply	Domestic	22.71	0.33	0.11	0.42	0.42	0.53	1.34	1.00	0.71	1.34	6	21.37	94%	97%	>90%	-	Negligible
4900943	578639	4852673	400.45	486	34.10	11.34	Bedrock (Gasport and Lower)	Water Supply	Domestic	22.76	0.37	0.27	0.38	0.35	0.42	1.24	1.04	0.83	1.24	6	21.52	95%	96%	>90%	-	Negligible
4905577	578614	4852923	399.49	324	43.00	19.06	Bedrock (Gasport and Lower)	Water Supply	Domestic	23.94	0.42	0.22	0.53	0.54	0.68	1.95	1.48	1.07	1.95	6	21.98	92%	96%	>90%	-	Negligible
4906777	576622	4852090	398.39	760	25.30	1.84	Bedrock (Gasport and Lower)	Water Supply	Domestic	23.46	0.51	0.49	0.80	0.03	0.53	0.17	0.12	0.03	0.80	3	22.65	97%	100%	>90%	-	Negligible
4907364	578609	4852786	399.89	393	31.10	6.67	Bedrock (Gasport and Lower)	Water Supply	Domestic	24.43	0.36	0.20	0.46	0.45	0.60	1.65	1.29	0.96	1.65	6	22.78	93%	96%	>90%	-	Negligible
4907315	578504	4852772	400.15	318	30.50	4.87	Bedrock (Below Gasport)	Water Supply	Domestic	25.63	0.43	0.26	0.55	0.53	0.72	2.38	1.85	1.30	2.38	6	23.25	91%	95%	>90%	-	Negligible
4907794	577104	4854476	411.45	239	33.50	7.74	Bedrock (Gasport and Lower)	Water Supply	Domestic	25.76	0.59	2.04	1.20	1.38	1.41	1.54	1.86	0.76	2.04	2	23.72	92%	97%	>90%	-	Negligible
4909251	578594	4852961	400.00	292	44.80	18.96	Bedrock (Gasport and Lower)	Water Supply	Domestic	25.84	0.45	0.25	0.57	0.57	0.73	1.97	1.63	1.19	1.97	6	23.87	92%	95%	>90%	-	Negligible
4903532	578654	4852763	399.05	442	32.90	7.30	Bedrock (Gasport and Lower)	Water Supply	Domestic	25.60	0.30	0.18	0.38	0.37	0.49	1.49	1.15	0.85	1.49	6	24.11	94%	97%	>90%	-	Negligible
4905163	577264	4851173	396.57	1148	31.40	5.86	Overburden	Water Supply	Domestic	25.54	0.33	0.19	0.54	-0.03	0.54	-0.05	-0.01	-0.01	0.54	3	25.00	98%	100%	>90%	-	Negligible
4908197	578677	4852899	399.94	392	47.20	20.80	Bedrock (Gasport and Lower)	Water Supply	Domestic	26.40	0.37	0.14	0.46	0.46	0.58	1.37	1.10	0.80	1.37	6	25.02	95%	97%	>90%	-	Negligible
4909536	578523	4852953	400.08	228	45.70	18.13	Bedrock (Below Gasport)	Recharge Well	Cooling / AC	27.57	0.50	0.27	0.63	0.64	0.82	2.55	1.84	1.32	2.55	6	25.03	91%	95%	>90%	-	Negligible
4907456	578727	4852899	399.99	438	48.80	21.63	Bedrock (Gasport and Lower)	Water Supply	Domestic	27.17	0.33	0.11	0.42	0.42	0.53	1.34	1.00	0.71	1.34	6	25.82	95%	97%	>90%	-	Negligible
4906974	578659	4852763	398.98	446	34.70	7.22	Bedrock (Gasport and Lower)	Water Supply	Domestic	27.48	0.30	0.18	0.38	0.37	0.49	1.49	1.15	0.85	1.49	6	25.99	95%	97%	>90%	-	Negligible
4900942	578261	4852228	396.31	328	38.70	11.44	Bedrock (Gasport and Lower)	Water Supply	Domestic	27.26	0.47	0.31	0.66	0.33	0.79	0.59	0.75	0.25	0.79	5	26.47	97%	99%	>90%	-	Negligible
4909122	578766	4853889	381.15	640	29.00	1.61	Bedrock (Below Gasport)	Water Supply	Municipal	27.39	0.11	-2.31	0.12	0.12	0.12	0.21	0.20	0.16	0.21	6	27.18	99%	99%	>90%	-	Negligible
4900944	578328	4852575	400.04	235	36.60	6.55	Bedrock (Gasport and Lower)	Water Supply	Domestic	30.05	0.57	0.46	0.66	0.59	0.91	1.96	1.70	1.32	1.96	6	28.09	93%	96%	>90%	-	Negligible
4907787	578576	4852699	400.02	420	36.60	6.54	Bedrock (Gasport and Lower)	Water Supply	Domestic	30.06	0.34	0.19	0.44	0.42	0.57	1.68	1.34	0.99	1.68	6	28.38	94%	97%	>90%	-	Negligible
A	578195	4853972	405.87	169	37.94	7.56	Bedrock (Gasport and Lower)	Water Supply	Domestic	30.37	0.74	0.77	1.02	1.10	1.19	1.57	1.69	0.77	1.69	7	28.68	94%	97%	>90%	-	Negligible
4907362	578398	4852547	400.21	303	38.40	8.12	Bedrock (Gasport and Lower)	Water Supply	Domestic	30.28	0.40	0.31	0.53	0.46	0.72	1.09	1.15	0.74	1.15	7	29.14	96%	98%	>90%	-	Negligible
4907145	577944	4853791	408.86	163	50.30	17.50	Bedrock (Gasport and Lower)	Water Supply	Domestic	32.80	1.13	1.19	1.50	1.68	1.86	2.40	2.69	1.07	2.69	7	30.11	92%	97%	>90%	-	Negligible
4902982	578204	4851713	393.20	616	39.30	8.06	Overburden	Water Supply	Domestic	31.24	0.42	0.24	0.61	0.00	0.70	-0.22	-0.09	-0.08	0.70	5	30.54	98%	100%	>90%	-	Negligible

Table S-1 - Water Well Impact Assessment (<1 km from Study Site)
Caledon Pit / Quarry

Well ID	Easting	Northing	Elevation (masl)	Distance from Pit / Quarry (m)	Well Depth (m)	Modelled Static Water Level (m)	Aquifer Description	Well Purpose	Well Use	Initial Water Column Available (m)	Phase 1 Max Drawdown (m)	Phase 2 Max Drawdown (m)	Phase 3 Max Drawdown (m)	Phase 4 Max Drawdown (m)	Phase 5 Max Drawdown (m)	Phase 6 Max Drawdown (m)	Phase 7 Max Drawdown (m)	Rehab Max Drawdown (m)	Maximum Drawdown (any phase) (m)	Phase of Max Drawdown	Minimum Water Column Available (m)	Min Remaining Water Column	Remaining Water Column Rehab	Criteria 1 - Remaining in Water Column	Criteria 2 - Minimum Water Column	Potential for Impact
7145140	578190	4851490	391.09	793	39.30	6.98	Overburden	Water Supply	Domestic	32.32	0.38	0.18	0.55	-0.01	0.62	-0.18	-0.07	-0.07	0.62	5	31.71	98%	100%	>90%	-	Negligible
4909671	578737	4852935	400.04	437	41.80	8.97	Bedrock (Gasport and Lower)	Water Supply	Domestic	32.83	0.33	0.08	0.41	0.41	0.51	1.05	0.96	0.60	1.05	6	31.79	97%	98%	>90%	-	Negligible
B	577519	4852289	395.45	129	35.65	1.46	Bedrock (Gasport and Lower)	Water Supply	Domestic	34.19	0.94	0.85	1.33	0.87	1.84	1.67	2.00	0.51	2.00	7	32.20	94%	99%	>90%	-	Negligible
4905870	578464	4854173	387.90	266	36.60	2.99	Bedrock (Below Gasport)	Water Supply	Domestic	33.61	0.61	1.02	1.11	1.13	1.14	1.21	0.96	0.61	1.21	6	32.40	96%	98%	>90%	-	Negligible
7218147	578597	4852611	400.00	490	60.40	24.40	Bedrock (Gasport and Lower)	Water Supply	Domestic	36.00	0.25	0.01	0.32	0.30	0.41	0.75	0.74	0.35	0.75	6	35.25	98%	99%	>90%	-	Negligible
4908976	578295	4852370	398.40	266	54.30	17.23	Bedrock (Gasport and Lower)	Water Supply	Domestic	37.07	0.43	0.16	0.58	0.43	0.80	0.90	1.04	0.38	1.04	7	36.03	97%	99%	>90%	-	Negligible
4903765	576349	4853583	421.50	259	42.70	2.23	Bedrock (Gasport and Lower)	Water Supply	Domestic / Livestock	40.47	0.15	0.96	1.19	3.56	2.27	2.27	1.89	1.17	3.56	4	36.91	91%	97%	>90%	-	Negligible
4906636	575684	4854015	436.19	1024	50.30	12.10	Bedrock (Gasport)	Water Supply	Domestic	38.20	0.05	0.48	0.44	1.05	0.70	0.70	0.59	0.36	1.05	4	37.15	97%	99%	>90%	-	Negligible
4907630	577245	4854785	400.03	534	42.70	4.30	Bedrock (Below Gasport)	Water Supply	Commerical	38.40	0.36	0.78	0.69	0.79	0.80	0.87	1.06	0.46	1.06	7	37.34	97%	99%	>90%	-	Negligible
4909948	575639	4853671	427.47	974	50.90	4.88	Bedrock (Gasport and Lower)	Water Supply	Domestic	46.02	0.05	0.34	0.33	0.83	0.56	0.56	0.49	0.28	0.83	4	45.19	98%	99%	>90%	-	Negligible
4900880	578643	4854053	383.99	464	50.90	2.94	Overburden	Water Supply	Domestic	47.96	0.20	-0.69	0.29	0.30	0.30	0.34	0.30	0.21	0.34	6	47.62	99%	100%	>90%	-	Negligible
4909177	577144	4855727	396.20	1454	53.34	5.24	Bedrock (Gasport and Lower)	Water Supply	Commercial	48.10	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	2	48.09	100%	100%	>90%	-	Negligible
4907147	576840	4852928	405.77	145	55.20	1.61	Bedrock (Gasport and Lower)	Water Supply	Domestic	53.59	0.86	1.15	1.66	2.50	3.26	3.44	3.48	1.05	3.48	7	50.11	94%	98%	>90%	-	Negligible
7193044	576604	4854580	417.19	463	60.40	8.31	Bedrock (Gasport and Lower)	Water Supply	Domestic / Livestock	52.09	0.39	1.56	0.95	1.22	1.19	1.27	1.43	0.59	1.56	2	50.53	97%	99%	>90%	-	Negligible
4907363	576774	4852986	406.75	152	61.00	4.38	Bedrock (Gasport and Lower)	Water Supply	Domestic	56.62	0.82	1.16	1.67	2.69	3.27	3.44	3.47	1.12	3.47	7	53.15	94%	98%	>90%	-	Negligible
4907629	577340	4854835	399.80	590	67.10	6.00	Bedrock (Below Gasport)	Water Supply	Commerical	61.10	0.29	0.60	0.53	0.58	0.60	0.65	0.80	0.37	0.80	7	60.29	99%	99%	>90%	-	Negligible
4903324	578689	4854153	387.20	492	69.80	6.46	Bedrock (Below Gasport)	Water Supply	Commerical	63.34	0.09	-1.22	0.14	0.14	0.14	0.16	0.14	0.10	0.16	6	63.17	100%	100%	>90%	-	Negligible
4905497	577914	4851923	398.04	282	82.60	9.88	Bedrock (Below Gasport)	Water Supply	Domestic	72.72	0.56	0.40	0.81	0.32	1.09	0.50	0.73	0.16	1.09	5	71.63	99%	100%	>90%	-	Negligible
4900845	579191	4854724	395.27	1085	11.00	12.33	Overburden	Water Supply	Domestic	0.00	0.00	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6	0.00	Screened above modelled groundwater level				Negligible
4900876	578952	4852803	402.29	683	13.10	15.97	Overburden	Water Supply	Domestic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	0.00	Screened above modelled groundwater level				Negligible

TECHNICAL MEMORANDUM

DATE December 9, 2022 **Project No.** 19129150

TO David Hanratty
CBM Aggregates (CBM), a Division of St. Marys Cement Inc. (Canada)

CC Mike Lebreton (CBM)

FROM Greg Padusenko, George Schneider (WSP Golder) **EMAIL gregory.padusenko@wsp.com**

CALEDON PIT / QUARRY – WATER WELL COMPLAINT RESPONSE PLAN

This water well complaint response plan is intended to help ensure CBM can promptly respond to and remedy, if necessary, potential water supply impacts to any neighbouring private water well user (referred to herein as "resident") should their water supply be affected by the future proposed Caledon Pit / Quarry aggregate operation. As indicated in the Water Report (Golder, 2022), there is a potential for adverse effects to a small number of neighbouring private wells as a result of the proposed aggregate operations.

It should be noted that a water monitoring program (Section 9 of the Water Report; Golder, 2022) shall be implemented throughout the operation of the pit / quarry. The data collected through the monitoring program will allow the aggregate operator to identify the potential for impacts to neighbouring private water wells before they occur. This will provide the aggregate operator with relevant information to proactively address potential interference with neighbouring water supplies before impacts occur. Furthermore, an additional private well survey shall be conducted prior to the start of aggregate operations at the Site, to help establish water use, well construction details and the available drawdown within each neighbouring private well.

Well complaints in the neighbouring area shall be evaluated on a case by case basis and the appropriate actions shall be undertaken to address the issue, as is the current practice by CBM at all its pits and quarries. Although the potential impacts on wells related to the proposed pit / quarry development is generally expected to be minimal, CBM shall respond to well complaints in accordance with the procedures proposed herein. The process is described below.

Water Well Interference Process

If a water well complaint is received by CBM for a private well located within the estimated zone of influence (within 1,000 m) the following actions shall be taken:

- A representative from CBM shall meet with the resident and discuss the complaint. If warranted, CBM shall contact a local well contractor, and the resident shall be immediately supplied a temporary water source if the issue cannot be easily determined and rectified (see steps below).
- If the issue raised by the resident is related to a loss of water supply, CBM shall have a consultant / well contractor determine the likely causes of the loss of water supply, which can result from a number of factors, including pump failure, extended overuse of the well or lowering of the water level in the well from potential

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aggregate operations interference. This assessment process would be carried out at the expense of the aggregate operator and the results of the assessment shall be provided to the resident.

- The consultant / well contractor will be able to readily determine if pump failure is the problem and, should the resident choose to have the pump repaired or replaced at their expense, the well contractor would correct the situation for the resident. If well capacity in relation to the demand being placed on the well by the resident (i.e., extended overuse) is determined to be the issue by the consultant / well contractor, recommendations shall be provided to the resident for their consideration, implementation of which would be at their expense.
- If, however, well interference is determined to potentially have been caused by CBM aggregate extraction and dewatering activities, then water well supply mitigation shall be reviewed with the resident and the best course of action to restore an equivalent water supply to the resident shall be implemented at CBM's expense. For instance, if the water level in the well is lowered to a point where it has interfered with pumping, then potential solutions shall be evaluated including adjusting the pump pressure and / or lowering the pump level in the well.
- In the event that the well is incapable of providing an adequate supply of water (i.e., the water level is too low in comparison to the depth of the well), or the repair to the pumping system will be more than a day, the consultant / well contractor shall continue to supply a potable water source to the resident (until restoration of the well is complete). These actions would be carried out at the expense of CBM. In rare cases where the water level in the well has been lowered significantly, the well may have to be deepened, widened or relocated (also CBM's expense).

In summary, should mitigation options be required as a result of CBM's extraction and dewatering activities negatively affecting neighbouring water well levels, these options could potentially include the following measures:

1) lowering of the pump to take advantage of existing storage within the well;
2) deepening of the well to increase the available water column;
3) widening of the well to increase the available storage of water;
4) relocation of the well to another area on the property;
5) installing a cistern for additional storage that can be filled with water from the existing well on a low yield setting; and/or
6) the installation of multiple wells that would collectively deliver the required water supply to the resident.

The requirement for any of these mitigation measures would be determined based on the results of the groundwater monitoring program and the assessment of the specific private water supply well in question. It would also take into account the recommendation of the consultant and/or well contractor that were involved in the assessment.

Contact Information

The public would be provided with contact information for CBM employees in the following positions at the start of operations:

1) Land & Resource Manager
2) Area Manager
3) Plant Manager

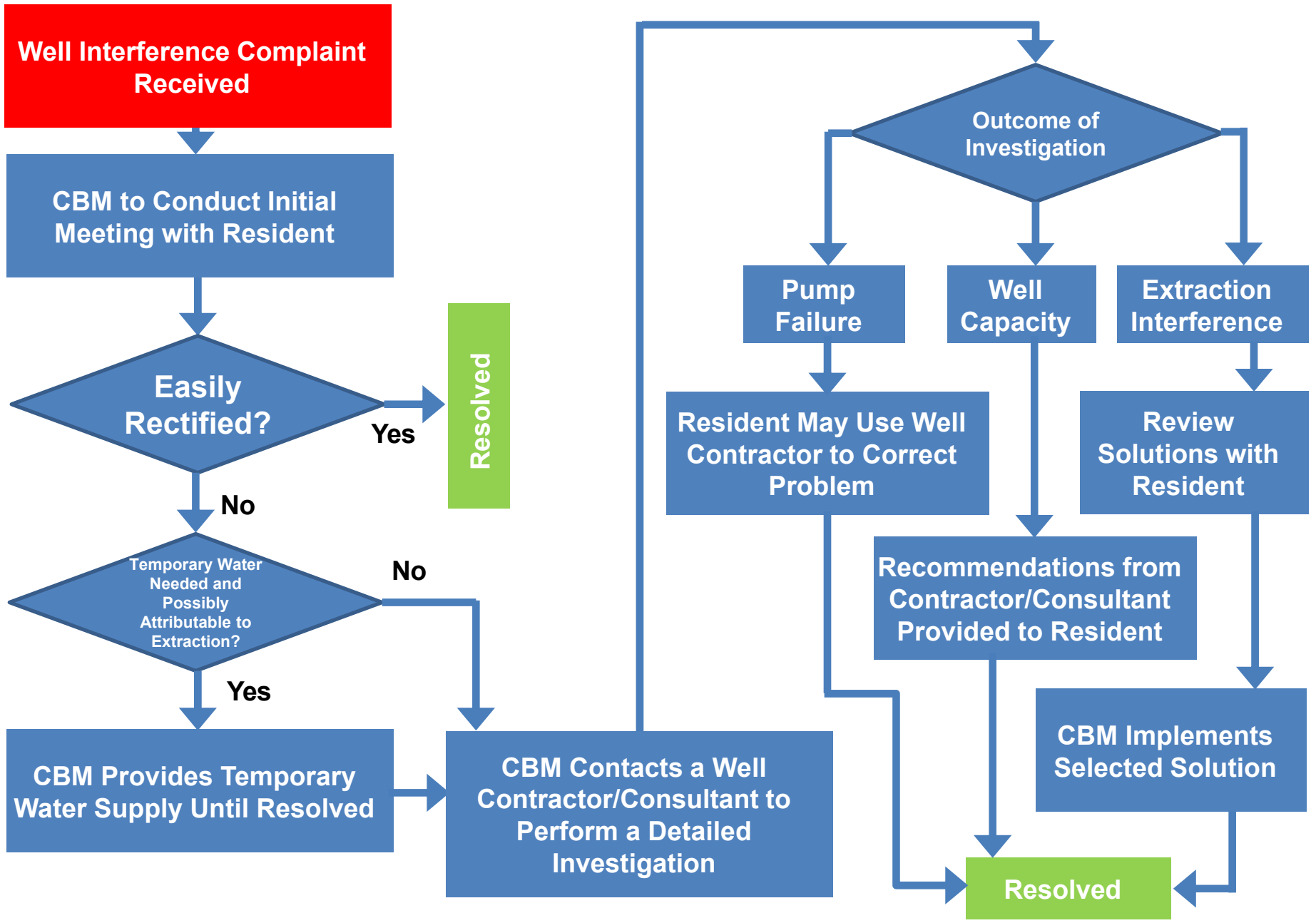
Contact information, including cell phone number and email address, would be provided for each person filling these positions at the start of operations and would be updated, as needed, during the duration of the operation.

Attachments: Well Interference Complaint Response Flow Chart

https://golderassociates.sharepoint.com/sites/114392/project files/5 technical work/ph 2300-hydrogeology/30 impact assessment/07 well complaint protocol/19129150 cbm well complaint response plan 09dec2022.docx

ATTACHMENT

Well Interference Complaint Response Flow Chart



CLIENT
CBM AGGREGATES (CBM), A DIVISION OF ST. MARYS CEMENT INC. (CANADA)

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-12-06
PREPARED	PGM
DESIGN	PGM
REVIEW	GRP
APPROVED	GWS

PROJECT
Caledon Pit and Quarry

TITLE
Well Interference Complaint Response Flow Chart

PROJECT No.	PHASE	Rev.	FIGURE
19129150	2300	A	R-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

APPENDIX T

Project Team CVs

Education

MSc. Earth Sciences, University of Waterloo, 1995

BSc. Honours Earth Sciences, Physics Minor, University of Waterloo, 1987

Areas of Experience

Large Project Management

Aggregates

Water Resources and Protection

Nuclear Waste Management

Mine Site and Tailings Investigations

Explosives Site Assessment

Contaminated Site Assessment

Geothermal Energy

Waste Management

Engineering Geophysics

Archaeology

Applied Geophysics Research

George Schneider, MSc., P.Geo.

PROFESSIONAL SUMMARY

George Schneider is a Senior Geoscientist and Principal with Golder's Greater Toronto Area (GTA) Operations and has over 30 years of professional experience. George received his B.Sc. (1987) and M.Sc. (1995) in Earth Sciences from the University of Waterloo. From 1987 to 1995, he was a researcher in the Geophysics Laboratory at the Centre for Groundwater Research at the University of Waterloo and has co-authored more than 25 technical publications. George joined Golder in 1995; he became an Associate in 2002 and a Principal in 2006. George is a Professional Geoscientist registered in the Province of Ontario.

EMPLOYMENT HISTORY

Principal / Senior Geoscientist, Golder Associates (2013 to Present)

Cambridge, Ontario

Project Manager / Director responsible for multi-disciplinary projects including: nuclear waste management, explosives site remediation, mine site rehabilitation, aggregate resource studies, and groundwater supply and source water protection studies. George has been with Golder for 23 years, he is currently a leader of the Canadian Nuclear Services Group, responsible for project management, business development and client relations.

George is currently serving as a member of the Lake Erie Source Protection Committee (LESWPC) and the Waterloo-Wellington-Brant Regional Committee of the Ontario Stone Sand and Gravel Association (OSSGA).

Principal / Division Manager, Golder Associates (2006 to 2013)

Mississauga, Cambridge and Whitby, Ontario

Project director responsible for a range of multi-disciplinary projects including: environmental investigations at explosive contaminated sites and mine sites, aggregate resource studies, groundwater supply and management studies and nuclear waste management. Managed the Environmental Services Division in the GTA including: Geosciences, Geophysics, Site Characterization and Restoration, Environmental Due Diligence, Hydrogeology and Waste Management and Field Technician Groups.

Associate / Senior Project Manager, Golder Associates (2002 to 2005)

Mississauga, Ontario

Senior geoscientist responsible for the management of a diverse range of projects including: environmental investigations at explosive contaminated sites, aggregate resource studies, hydrogeological studies and geophysical investigations in support of hydrogeological studies, environmental site

assessments, mine site developments, aggregate resource studies and geotechnical investigations.

Intermediate, then Senior Geoscientist, Golder Associates (1995 to 2002)

Waterloo, then Mississauga, Ontario

Responsible for project management, performing geophysical, geological and hydrogeological field investigations, numerical data analysis, data assessment, and reporting for: aggregate resource studies, groundwater resource studies, permits to take water, assessment of contaminated sites, geotechnical investigations and hydrogeologic characterization of mine tailings disposal and open pit mine sites.

Collected, processed and interpreted data for a variety of land and marine geophysical techniques including: time and frequency domain electromagnetics, magnetics, gravity, ground penetrating radar (GPR), seismic reflection and refraction, acoustic tomography, pulse velocity testing of man-made structures, cross-hole seismic testing, leak detection, vertical seismic profiling (VSP), electrical resistivity imaging (ERI), borehole camera logging and geophysical well logging including: natural gamma, gamma-gamma, neutron, temperature, deviation, inductive conductivity, magnetic, caliper, resistivity, heat-pulse flowmeter and optical televiewer.

Geophysicist, Waterloo Centre for Groundwater Research (1987 to 1995)

University of Waterloo, Waterloo, Ontario

Conducted geophysical field investigations and drilling programmes under the direction of Dr. J.P. Greenhouse and Dr. P.F. Karrow in the Waterloo Region related to the quaternary geology and the assessment of water resources in the Region including: seismic surveys, borehole geophysical surveys and two Rotasonic drilling programmes. Compiled three editions of a catalogue of geophysical logs for the Waterloo Region from 1988 to 1993. Co-authored more than 20 research papers, reports and posters, including 13 publications on the quaternary geology and/or water resources of the Waterloo Region.

Designed and constructed borehole and resistivity geophysical instruments, digital data acquisitions systems and developed innovative computer software for geophysical and hydrogeological applications. Carried out surface, borehole and laboratory geophysical investigations in support of more than 85 groundwater-related research projects including: geophysical investigations of DNAPL/LNAPL contamination, delineation of aquifers, groundwater contaminant plumes and karst features.

Other duties included: teaching assistance for University of Waterloo Earth Sciences and Geophysics courses and organization of technical conferences, short courses and field demonstrations.

RELEVANT EXPERIENCE

Project Experience – Large Project Management (>$1M)

Phase 2 Initial Drilling and Testing, Ignace - NWMO (2017- 2020)
Ignace, Ontario

Project manager and senior geoscientist responsible for the Phase 2 Initial Borehole Drilling and Testing in the Ignace Area. Main point of contact to NWMO responsible for project management, HSSE, QA/QC, schedule tracking, budget and earned value tracking, change management, and subcontractors. Managed daily activities on the project including planning and coordination of multiple work packages, including site infrastructure setup, drilling, core logging, core sampling, downhole geophysics, hydraulic testing, and the installation of Westbay monitoring systems.

Phase 1 and Phase 2 Geoscientific and Environmental Studies - NWMO (2009-2017)
Canada

Project manager responsible for geoscientific, geophysical and environmental studies conducted by Golder for NWMO including reports on: assessment of geophysical methods for site characterization, Initial Screenings, Phase 1 Geoscientific Assessments, Phase 1 Reports on Environment and Safety, and Phase 2 OGGF and Detailed Mapping. Specific experience at Ignace and other communities in northern Ontario and Saskatchewan.

IUS Project – Region of Waterloo (2005-2014)
Waterloo Region, Ontario

The hydrogeological assessment and permitting of existing and potential new Municipal supply Wells for the Region of Waterloo's Integrated Urban Supply System. Project manager, responsible for technical tasks, invoicing, budgeting, tendering and contract administration, presentations, interim and final reporting. Performed a technical role in the water supply development and expansion tasks carried out at the Chicopee, Breslau, Fountain Street, Lancaster, Seagrams and Waterloo North study areas.

Coldstream Mine Site - EWL Management Ltd. (2003-2015)
Kashabowie, Ontario

Project Manager and senior geoscientist responsible for environmental investigations and remediation at this former mine site. Work has included surface water, groundwater and ecological studies, assessment of above water and below water tailings management areas, ecological and human health risk assessment, tailings relocation, spillway and watercourse improvements, predictive modelling, public consultation, and negotiations with regulatory agencies.

CIL Explosives Site – Akzo Nobel Coatings Ltd. (1998-2019)
Parry Sound, Ontario

Project Manager and senior geoscientist responsible for environmental investigations and remediation at this former mine site. Work has included surface water, groundwater and ecological studies, assessment of above water and below water tailings management areas, ecological and human health risk assessment, tailings relocation, spillway and watercourse improvements, predictive modelling, public consultation, and negotiations with regulatory agencies.

McMasterville Site – Akzo Nobel Coatings Ltd. (1999-2016)
McMasterville, Quebec

Project manager for the assessment and remediation of this former explosives and fertilizer manufacturing site, which operated from the 1890 to 1999 and manufactured a wide range of products including TNT, nitroglycerine, PETN, slurries, and fertilizers. Work has included: geophysical investigations, remote control drilling for explosives contaminants, Phase I ESA, Phase II ESA, risk assessment, ecological assessment, diversion and repatriation of a creek, construction of an onsite landfill and risk-managed area, and ongoing surface water and groundwater monitoring.

Project Experience – Aggregates

Aggregate Licence Investigations (2019-present) Caledon, Ontario	Project Director and Senior Technical Reviewer for resource and hydrogeological technical studies at the Caledon properties for CBM Aggregates for a future below water table quarry licence application near Caledon, Ontario.
Aggregate Licence Investigations (2018-present) Peterborough, Ontario	Project Director and Senior Technical Reviewer for hydrogeological, natural environment and cultural heritage technical studies at the Blezard property for CBM Aggregates near Peterborough, Ontario.
Resource Evaluation – CBM (2018) Ayr, Ontario	Project Manager and Senior Technical Reviewer for an aggregate resource assessment at the Bromberg Pit for CBM Aggregates near Ayr Ontario.
Resource and Hydrogeological Investigation – CBM (2018) Dorchester, Ontario	Project Director and Senior Technical Reviewer for aggregate resource and hydrogeological studies at the Dorchester Pit for CBM Aggregates to support a Site Plan Amendment.
Resource and Hydrogeological Investigation – CBM (2018) Thamesford, Ontario	Project Director and Senior Technical Reviewer for aggregate resource and hydrogeological studies at the Thamesford Pit for CBM Aggregates to support a Site Plan Amendment.
Aggregate Licence Investigations – CBM (2018-present) Puslinch, Ontario	Project Director and Senior Technical Reviewer for hydrogeological, natural environment and cultural heritage studies at the Lake property for CBM Aggregates in Puslinch, Ontario.
Resource and Hydrogeological Investigation – CBM (2017) Puslinch, Ontario	Project Director and Senior Technical Reviewer for aggregate resource and hydrogeological studies at the Lanci Pit for CBM Aggregates to support a Site Plan Amendment.
Resource Evaluation – CBM (2017) North Dumfries, Ontario	Project Manager and Senior Technical Reviewer for an aggregate resource assessment at the Dabrowski Pit for CBM Aggregates.
Resource Evaluation – CBM (2017) Puslinch, Ontario	Project Manager and Senior Technical Reviewer for an aggregate resource assessment at the McNally Pit in support the expropriation of land for highway development at the McNally Pit for CBM Aggregates.
Resource and Hydrogeological Investigation – CBM (2016) North Dumfries, Ontario	Project Director and Senior Technical Reviewer for an aggregate resource evaluation and Level 1&2 Hydrogeological Assessment at the Dance Pit for CBM Aggregates in North Dumfries, Ontario.
Imported Fill Investigation – CBM (2016) Limehouse, Ontario	Project Manager for a soil sampling investigation to confirm imported soil quality at the CBM Pit near Limehouse, Ontario.
Resource Evaluation – CBM (2016) Orangeville, Ontario	Project Director and Senior Technical Reviewer for an aggregate resource evaluation at the Gray Pit for CBM Aggregates near Orangeville, Ontario.

Resource and Hydrogeological Investigation – CBM (2016) North Dumfries, Ontario	Project Director and Senior Technical Reviewer for an aggregate resource evaluation and Level 1&2 Hydrogeological Assessment at the Dance Pit for CBM Aggregates in North Dumfries, Ontario.
Aggregate Investigations - MTO Northeast (2015) North Bay, Ontario	Project Manager for aggregate investigations on numerous Crown land sites for MTO Northeast. Work included resource assessments, Level 1 / 2 Hydrogeological, Natural Heritage and Cultural Heritage Assessments, in support of Pit and Quarry Permits.
Resource Evaluation and Expert Testimony- Ministry of Transportation Ontario (2013-2014) Ontario	Provided specialized forensic engineering / geological advice and services related to aggregate resources on a property in northern Ontario. Work included resource modelling and resource valuation for a variety of potential land development scenarios.
Resource Evaluation Arriscraft International (2011) Ontario	Conducted a geological testing program and completed a resource evaluation of the Hill Top Pit Property in Kitchener, Ontario. Resource evaluation results were used in the appraisal of the property for the purposes of acquisition.
Aggregate Properties Valuation – Confidential (2011) Ontario, Alberta	Conducted valuation studies of more than a dozen aggregate properties in Ontario and Alberta to estimate the net present value of these properties for the purposes of financing.
Aggregate Source Investigations – MTO (2010-2011) Northeastern Ontario	Project Director and senior technical reviewer for the geological and hydrogeological components of the 2010 Northeastern Region Aggregate Source Investigation (MTO Assignment NO. 5010-E-0003) which included assessment and permitting studies for 23 sites across Ontario.
Resource Evaluation, Weeks Pit and Quarry – Altus Group (2010-2011) Parry Sound, Ontario	Senior technical review for an investigation to estimate the total aggregate resources available at the Weeks Pit and quarry property, in order to assist in the valuation of the property to settle an expropriation dispute with the owner and the MTO.
Feasibility Assessment – Lafarge (2010) Harvey Township, Ontario	Senior technical review for an investigation to assess the feasibility for the development of a limestone quarry on the Buckhorn Property in support of the renewal of a mining lease for the property.
Soil Borrow Search - IBI Group (2009-2010) Niagara, Ontario	Senior technical reviewer for a soil borrow search in the Niagara Region for the MTO, in support of new construction activities on Highway 406.
Geophysical Investigation – Confidential (2007) Ontario	Project manager and senior technical advisor for a geophysical and test pitting investigation at a confidential quarry site in Ontario to assess the potential presence of buried waste, as part of a legal claim.
Preliminary Resource Evaluation – SCAW (2004) Caledon, Ontario	Directed junior staff in a preliminary assessment of the potential for aggregate resources to be present on a property in Caledon, Ontario on behalf of the property owner.

Borehole Geophysical Logging – Confidential (2004)
Brechin, Ontario

Acquired gamma and conductivity borehole geophysical logs at a property near Brechin, Ontario for a confidential client.

Acton Quarry Escarpment Seep Investigation - Dufferin Aggregates (2003)
Acton, Ontario

Led a multidisciplinary project team in an investigation to assess hydrogeologic conditions at Phase 2 of the Acton Quarry and develop conceptual designs for short term and long term hydrogeologic mitigation systems to maintain seep flow in the Guelph-Amabel Formation along the Niagara Escarpment, immediately adjacent to advancing quarry workings.

Resource Evaluation – Dufferin Aggregates (2003)
Ontario

Led a project team to carry out a resource evaluation of the Mosport West Pit property for Dufferin Aggregates. The project involved the integration of high quality coring methods, gradation testing of core samples and ERI (electrical resistivity imaging) geophysical surveying to develop realistic 3D subsurface geologic models for these properties, from which available resources were then estimated and areas of preferred extraction were identified. Duties included: planning, ERI field QA/QC, ERI interpretation, correlation of geophysical and gradation data to establish empirical relationships between ERI response and resource quality and reporting.

ERI Investigation – Nelson Aggregates (2003)
Burlington, Ontario

Directed junior staff in an ERI geophysical investigation to map overburden thickness and assess the underlying rock for karst potential as part of a Level 2 Hydrogeological Assessment under the Aggregate Resources Act, for the planned expansion of the Nelson Quarry in Burlington, Ontario.

Aggregate Resource Evaluation – Confidential (2003)
Sudbury, Ontario

Carried out an evaluation of the potential aggregate resources present on properties in Dill Township near Sudbury, Ontario in support of the appraisal of the properties, which were to be expropriated from the owner by the MTO for the construction of an interchange and highway realignment.

Overburden Investigation – Dufferin Aggregates (2002)
Milton, Ontario

Conducted an ERI (electrical resistivity imaging) and test pitting investigation to develop a 3D model of overburden thickness and the top of bedrock to assist in planning overburden stripping requirements for Dufferin Aggregates in the Western Extension of the Milton North Quarry. Responsible for all aspects of planning, acquisition, processing, interpretation and reporting, as well as client liaison.

Gravel Pit Evaluation - Township of Perth East (2002)
Shakespeare, Ontario

Conducted an investigation to complete a resource evaluation, assess the net present value and make recommendations for optimization to the Perth East Gravel Pit near Shakespeare, Ontario. The Project Team consisted of Golder Associates Ltd., Beck and Associates GeoConsultants Inc. and MHBC Planning Ltd.

Aggregate Properties Valuation – Confidential (2002)
Ontario

Led a multidisciplinary project team which conducted valuations studies of four large aggregate properties in Ontario to estimate the net present value of these properties for the purposes of obtaining bank financing. The Project Team consisted of Golder Associates Ltd., Beck and Associates GeoConsultants Inc. and MHBC Planning Ltd.

Acton Quarry Resource Evaluation – Dufferin Aggregates (2002)
Acton, Ontario

Conducted a resource evaluation and estimated overburden stripping requirements for Phase 3 of the Acton Quarry, which involved ERI geophysical surveying, test pitting and drilling. Responsible for all aspects of

planning, acquisition, processing, interpretation and reporting, as well as client liaison.

Overburden Investigation – Dufferin Aggregates (2001)
Milton, Ontario

Conducted a GPR and test pitting investigation to develop a 3D model of overburden thickness and the top of bedrock to assist in planning overburden stripping requirements for Dufferin Aggregates in the Milton North Quarry. Responsible for all aspects of planning, acquisition, processing, interpretation and reporting, as well as client liaison.

Quarry Resource Assessment – Dufferin Aggregates (2001)
Ontario

Acquired, processed, interpreted and reported gamma and conductivity geophysical log surveys in test boreholes at the Ogden Point Limestone Quarry to identify the stratigraphy within a Regional context and infer the suitability of strata within the quarry for use in the manufacture of cement products, based on experience elsewhere in Ontario.

Resource Evaluations – Dufferin Aggregates (1998-1999)
Ontario

Helped conduct sand and gravel resource evaluations as part of a multidisciplinary project team for Dufferin Aggregates at sand and gravel properties in Ontario including Mosport Pit 1 and 2, Bethany, TRT, Mill Creek, Paris and Naylor properties. The projects involved the integration of high quality coring methods, gradation testing of core samples and ERI (electrical resistivity imaging) geophysical surveying to develop realistic 3D subsurface geologic models for these properties, from which available resources were then estimated and areas of preferred extraction were identified. Duties included: ERI modelling and interpretation, 3D geological modelling, correlation of geophysical and gradation data to establish empirical relationships between ERI response and resource quality, volume and tonnage estimates and reporting.

Project Experience – Water Resources and Protection

Hydrogeological Assessment – Cambridge Zone 3 Class EA – Region of Waterloo (2016-2019) Cambridge, Ontario	As a subcontractor to GM BluePlan, completed a hydrogeological assessment for the Region of Waterloo of the Cambridge Zone 3 Well Field, as part of a class EA, to examine options to increase the sustainable water supply capacity of the well field. Project Director and Senior Technical Reviewer.
Hydrogeological Assessment – Harrington McAvan (2015 – 2019) Puslinch, Ontario	Carried out a hydrogeological and geotechnical assessment to support the re-zoning and future redevelopment of a property near Puslinch, Ontario for Farhi Holdings, including a preliminary assessment of potential water resources and septic capacity. Project Manager and Senior Technical Reviewer.
Municipal Well Construction and Testing (2015-2019) Waterloo Region, Ontario	Project manager, contract administrator and senior technical reviewer for the construction and testing of new municipal supply wells in 2015 at K21, K4A and W6A/B and in 2016 at NH3 and Maryhill. Designed, constructed and permitted new supply wells at each of these sites in order to replace older wells with performance problems, provide system redundancy and help ensure the well fields can deliver their full permitted capacity.
Hydrogeological Assessment of Production Wells K23 and K24 (2014-2018) Waterloo Region, Ontario	Senior technical reviewer for the hydrogeological assessment of wells K23 and K24, initiated in 2014 to better understand increasing nitrate concentrations in the wells due to nearby anthropogenic sources, primarily septic systems and agricultural fertilizers. The investigation is developing an improved understanding of the hydrogeology, aquifer vulnerability and water quality in areas around the supply wells and the interrelationships between the wells and potential contaminant sources.
Hydrogeologic Data Analysis Software System Update (2014-present) Waterloo Region, Ontario	Project manager and senior technical reviewer for the selection and implementation of a new hydrogeologic data analysis (HDA) system for the Region. The project involved a detailed assessment of the Region's current and future data needs, the procurement and evaluation of potential commercial software solutions, and the implementation of the new software database and tools.
Hydrogeologic and Source Water Protection Services (2013-2018) Centre Wellington, Ontario	Senior technical reviewer for hydrogeologic and source water protection services provided on an as-needed basis to the Township of Centre Wellington. The work includes on-going investigations and monitoring related to source water "Issues", as well as the evaluation of the hydrogeological aspects of infrastructure and development projects on behalf of the Township.
Hydrogeologic Services - Cambridge Aggregates (2008-present) North Dumfries and Brant, Ontario	Senior technical reviewer for various projects for Cambridge Aggregates related to the development of large volume groundwater supply wells and Permits to Take Water for aggregate washing, and hydrogeological assessments in support of new licence applications and licence expansions under the Aggregate Resources Act.
Water Supply Class EA – Region of Waterloo (2010-2012) West Montrose, Ontario, Canada	Senior technical reviewer for the hydrogeological component of a Water Supply Class Environmental Assessment for West Montrose. The hydrogeological component involved the exploration for an additional water supply within West Montrose. Through a field program involving drilling, hydraulic testing and water quality sampling a potential groundwater supply source was identified and carried forward as part of the assessment.

TICS Project – Region of Waterloo (2009-2012) Waterloo Region, Ontario	Project manager for the Threats Inventory and Circumstances Survey (TICS) project for the Region of Waterloo. The project involved conducting Canada's largest drinking water census across the Waterloo Region and the evaluation of potential threats to drinking water sources in the Waterloo Region for each well field and surface water intake source.
Waterloo North Water Supply Class EA – Region of Waterloo (2008-2012) Waterloo Region, Ontario	Senior technical advisor to the class EA project carried out for the Region of Waterloo with AECOM to develop additional groundwater supply wells in North Waterloo and Erbsville. The project involved the drilling of a new test supply well and a long term pumping test of three new supply wells, along with an extensive groundwater monitoring program.
New Wells Project – Region of Waterloo (2008-2009) Waterloo Region, Ontario	Senior technical advisor to the project to install over 40 new monitoring wells nests throughout the Waterloo Region. Focus was on senior technical review and the interpretation of overburden and bedrock stratigraphy based on core logs, core photographs and samples, grain size analysis and geophysical logs, using nomenclature recently developed by the Ontario Geologic Survey (OGS).
Land Use Designations for Source Water Protection – Brookfield Homes (2007) Paris, Ontario	Manager and senior technical review on a project to evaluate potential changes in land use designation within WHPAs and the associated change in risk to groundwater to well fields, that have high aquifer vulnerability ratings for a proposed development in Paris, Ontario.
Geophysical Investigation, Middleton Wellfield – Stantec (2005) Cambridge, Ontario	Manager and senior technical reviewer on a project to use geophysical methods to map the top of bedrock and identify buried infrastructure around the Middleton Wellfield, in order to identify potential contaminant pathways to the shallow bedrock aquifer system.
IUS Project – Region of Waterloo (2005-present) Waterloo Region, Ontario	The hydrogeological assessment and permitting of existing and potential new Municipal supply Wells for the Region of Waterloo's Integrated Urban Supply System. Assistant project manager, responsible for technical tasks, invoicing, budgeting, tendering and contract administration, presentations, interim and final reporting. Performed a technical role in the water supply development and expansion tasks carried out at the Chicopee, Breslau, Fountain Street, Lancaster, Seagrams and Waterloo North study areas.
Permit to Take Water – Lafarge (2002) Guelph, Ontario	Completed a hydrogeologic study to support a permit to take water (PTTW) application for Lafarge Canada at the Guelph Asphalt and Ready Mix Concrete Plant in Guelph, Ontario.
Permit to Take Water – Lafarge (2002) New Lowell, Ontario	Completed a hydrogeologic study to support a permit to take water (PTTW) application for Lafarge Canada at the Home Pit in New Lowell, Ontario.
Permit to Take Water – Heritage Golf Club (2002) Barrie, Ontario	Completed a hydrogeologic study to support a permit to take water (PTTW) application for Heritage Golf Club near Barrie, Ontario. The work included the supervision and analysis of a 24 hour pumping test.
Geophysical Logging Investigation – Golder (1994) Cambridge, Ontario	Acquired, processed, interpreted and reported on gamma and neutron geophysical logs in a test supply well in Cambridge East, Ontario as part of a water supply development programme for Golder Associates.

Groundwater Study - Victoria County (2000) Oak Ridges Moraine, Ontario	Acquired gamma and conductivity geophysical logs in deep boreholes in the Oak Ridges Moraine as part of the Groundwater Study for Victoria County.
Oxford County Groundwater Study – Oxford County (2000) Stratford, Ontario	Acquired gamma, conductivity, heat pulse flowmeter and optical televiewer geophysical logs in Municipal Supply wells in the Town of Stratford, Ontario, as part of the Oxford County Groundwater Study.
Permit to Take Water – Lafarge (2001) New Dundee, Ontario	Completed a hydrogeologic study to support a permit to take water (PTTW) application for Lafarge Canada at Warren Bitulithic's Seibert Pit in New Dundee, Ontario.
Rotasonic Drilling Programme – Waterloo Region University of Waterloo (1990-1991) Waterloo, Ontario	Under the direction of Dr. P.F. Karrow, carried out all aspects of two drilling programmes in 1990 and 1991 including: siting, permitting, utility clearances, drill supervision, well development, geophysical logging, vertical seismic profiling and reporting.
Borehole Geophysical Logging and Well Log Catalogue for the Waterloo Region University of Waterloo (1987-1993) Waterloo, Ontario	Under the direction of Dr. J.P. Greenhouse, acquired the first digital geophysical logs in the Waterloo Region including: gamma, density, neutron, resistivity, conductivity and caliper log data. Collected and digitized historic logs, as well as digital logs from local consultants. Compiled these logs into a Catalogue in Viewlog format. This log catalogue formed the basis of the current understanding of the quaternary geology and overburden aquifer system in the Waterloo Region.
Seismic Reflection and VSP Studies – Waterloo Region - University of Waterloo (1987-1995) Waterloo, Ontario	Under the direction of Dr. J.P. Greenhouse, carried out pioneering investigative work to optimise high resolution shallow seismic reflection and vertical seismic profiling geophysical methods for the characterisation of geology and aquifers in the Waterloo Region. This work culminated in the development of a controlled vibratory source for high resolution seismic surveys.

Professional Affiliations

Practising Member, Association of Professional Geoscientists of Ontario

Active Member, Society of Exploration Geophysicists

Member, Canadian Nuclear Society

Publications

Monier-Williams, M.E., Davis, R.K., Paillet, F.L., Turpening, R.M., Sol, S.J.Y. and Schneider, G.W. 2009. Review of Borehole Based Geophysical Site Evaluation Tools and Techniques. NWMO Technical Report TR-2009-25, 174 p.

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Schneider, G.W., and Greenhouse, J.P., 1988a. Geophysical well logs for the Waterloo Region and surrounding areas: A catalogue. Report of the Geophysics Lab, Department of Earth Sciences, University of Waterloo, 110 p.

Nobes, D.C., Schneider, G.W., and Hodgson, S., 1987. Discussion on: "Effects of porosity and clay content on wave velocities in sandstones". Geophysics, Vol. 52 pp. 1439.

Education

BSc Engineering (Co-op), University of Guelph, Guelph, Ontario, 2007

Languages

English – Fluent

Golder Associates Ltd. – Mississauga

Employment History

Golder Associates Ltd. – Mississauga, Ontario
Water Resources Specialist (2007 to Present)

Responsible for conducting water quantity and water quality investigation programs that include hydraulic and hydrologic modelling, analysis of riverine and lacustrine environments, the design, execution and management of meteorological, hydrological and water quality field programs and development of water balance and water quality modelling analyses. Currently working on various surface mine and mine rehabilitation investigations of hydrology and water quality. Completes water resources projects from desktop reviews to design, construction monitoring and erosion and sediment control inspection.

Golder Associates Ltd. – Mississauga, Ontario
Water Resources (Co-Op) (May 2006 to December 2006)

University of Guelph, Environmental Biology – Guelph, Ontario
Co-Op Student (May 2005 to August 2005)

Ontario Clean Water Agency – Toronto, Ontario
Water Resources (Co-Op) (January 2005 to April 2005)

Hydromantis Inc., Consulting Engineers – Toronto, Ontario
Co-Op Student (June 2004 to September 2004)

PROJECT EXPERIENCE – WATER SUPPLY FORECASTING

City of Iqaluit , Nunavut, Canada

Developed a water balance model (using GoldSim) to quantify water deficit risks under future population growth and climate change scenarios. Analytical output and recommendations were subsequently provided in order to assist the City in water license application process for a supplementary source and provide a risk matrix of long-term probabilistic water supply deficits. (2012 to 2013)

City of Rankin Inlet Rankin Inlet, Nunavut, Canada

Water supply deficits were evaluated using a water balance model (using GoldSim) under future growth and climate change scenarios. The model evaluated water taking from the supply reservoir and an adjacent river while maintain use for aquatic live and social activities. (2015)

PROJECT EXPERIENCE – CHANNEL / CROSSING DESIGN

County of Northhumberland Cobourg, Canada

Ongoing support regarding a channel remediation design/assessment for the County of Northhumberland on a reach of Brookside Creek located downstream of the closed Eagleson Landfill to reroute unaffected surface water flows away from a zone of leachate influenced groundwater – conducted field studies, fluvial geomorphic and hydraulic analyses, preparation of conceptual/detailed design plans, liaison with contractor and reporting. (2009 to 2015)

Region of Durham Whitby, Canada	Completed a hydraulic analysis and fluvial geomorphic assessment at East Corbett Creek and tributary of East Corbett Creek. The analyses were conducted in support of a proposed extension of Consumers Drive that includes culvert crossings at the two watercourses – conducted field investigations, fluvial geomorphic analyses, hydraulic modelling, environmental permitting and reporting. (2014 to 2016)
Confidential Client Timmins, Canada	Ongoing support of a natural channel diversion design/assessment for a proposed pit mine. The channel design incorporates fluvial geomorphic processes to accommodate fish passage and habitat. Hydraulic modelling was conducted to limit erosion and maintain stability of the channel banks and crossings. (2015)
Canadian National Railway Southern Ontario, Canada	Many rail crossings were evaluated at locations of aging bridges, collapsed culverts and areas of flooding. Sites were visited and surveyed to confirm conditions and provide detailed data for desktop analysis. Hydraulic analyses were completed for each site to evaluate existing infrastructure. New crossing designs were evaluated based on MTO and CN guidelines and developed to conceptual and final designs. (2016 to 2020)
Trans Canada Pipelines Channel Rehabilitation Dryden, Ontario, Canada	Designed a stream channel rehabilitation to remediate TransCanada Line 100-1 exposure caused by erosion and beaver activity near Dryden, Ontario. The project progressed from conceptual design through to construction monitoring. The final design was focused on improving channel stability over the pipelines to reduce meander and erosion. (2017)
Trans Canada Pipelines Channel Rehabilitation Barrie, Ontario, Canada	Developed the design and supported construction of channel rehabilitation works at a tributary of Bear Creek that is crossed by TransCanada pipelines Line 100-1 and Line 100-2 near Barrie, Ontario. The goal of the rehabilitation is to improve long term channel stability at the watercourse crossing. The work includes the completion of field studies and hydraulic modelling, development of conceptual designs, and the preparation of environmental permitting. (2016 to 2017)

PROJECT EXPERIENCE – EROSION AND SEDIMENT CONTROL

Prodigy Gold Inc. Wawa, Ontario, Canada	Completed Erosion and Sediment Control Plans for a variety of earth work projects at the Magino Mine Project. These plans for stream diversions, embankments and shorelines were completed as part of a LRIA permitting package. (2021 to 2022)
Prodigy Gold Inc. Wawa, Ontario, Canada	Managed the monitoring and inspection of erosion and sediment control measures site-wide that included various earth work projects. The continuous monitoring was responsible for identifying erosion and sedimentation issues and recommend corrective actions. (2021)

PROJECT EXPERIENCE – ENVIRONMENTAL COMPLIANCE APPROVALS, WATER DISCHARGES

Canadian National Railway Algonquin Park, Ontario, Canada	Completed an Environmental Compliance Approval for Industrial Sewage Works for a temporary water treatment facility which was designed to treat contaminated water and sediments from a historic train derailment. The facility discharged to a nearby lake within the Park. (2015 to 2017)
Essroc Aggregates Cambridge, Ontario, Canada	Managed and completed an Environmental Compliance Approval for Industrial Sewage Works for an aggregate pit and wash plant in Cambridge, Ontario. The application included supporting documentation of the wash ponds which only discharged to the environment through the groundwater. (2016 to 2017)
Fish and Bird Emporium Innisfil, Ontario, Canada	Lead a team that completed an Environmental Compliance Approval for Industrial Sewage Works for a tropic fish warehouse and distribution centre. The application included multiple water filtration facilities designed to reduce the effluent contaminant concentrations without impacting the health of the fish at the site. (2016)
Lafarge Canada Inc. – Soares Dundas, Ontario, Canada	Carried out field investigations, water budget analysis and coordinated various project tasks related to the proposed Lafarge Soares License Application. (2007 to 2009)
Amherst Quarries Ltd. Windsor, Ontario, Canada	Performed reconnaissance of the local watersheds and hydrologic features of the quarry sumps. Carrying out quarterly volumetric flow monitoring and water quality sampling. Local drainage channels were evaluated using computer models including HEC-RAS. Developed a water balance to model drainage from the site and the adjacent Canard River. (2008)
O'Shanter Development Company – Arbour Farms Dufferin, Ontario, Canada	Conducting annual dry weather volumetric flow monitoring and groundwater well monitoring related to the Arbour Farms assessment of the proposed quarry. (2007 to 2021)
Brampton Brick – Norval Norval, Ontario, Canada	Performed field investigations and coordinated various project tasks related to the proposed Brampton Brick Norval quarry development. (2007 to 2008)
Lafarge Canada Inc. West Paris, Ontario, Canada	Completed baseline monitoring, including flow and water level monitoring, water quality monitoring. Supported license applications for extension properties and Permit to Take Water applications and continued site plan monitoring. (2016 to 2022)
Lafarge Canada Inc. Wellington, Ontario, Canada	Conducted baseline investigations of site drainage, local watercourses, including the Speed River. Potential impact on the water resources as a result of below water extraction was evaluated to support Permit to Take Water Applications and Environmental Compliance Approvals. (2015-2022)
Lafarge Canada Inc. Woodstock, Ontario, Canada	Completed water quality, water level and flow monitoring at local water features. Developed potential effects assessment of quarry extraction and drain realignments in support of a Major Site Plan Amendment. (2015-2022)

Nelson Aggregate Company Burlington, Ontario, Canada	Carried out volumetric flow monitoring throughout neighbouring watersheds for the proposed Lafarge Nelson License Application. Performed wetland mapping on the proposed quarry site. (2006 to 2007)
CBM Aggregates Various Sites in Southern Ontario	Various aggregate properties have been monitored and evaluated for aggregate license applications. this monitoring included water level monitoring, stream flow monitoring, groundwater piezometer monitoring and meteorological monitoring. Detailed site water balances as well as site and water course characterization have been evaluate and reported as part of the multidisciplinary applications. (2007 to 2022)

PROJECT EXPERIENCE – SITE REHABILITATION

Client Confidential Bancroft, Ontario, Canada	Completed surface water investigations at a decommissioned mine site (uranium) near Bancroft, Ontario, including meteorology, flow and water quality monitoring. Developed a detailed water balance to evaluate the site drainage and adjacent stream networks. Characterized and reported the surface water networks and their impacts. (2010 to 2022)
Client Confidential Near Kenora, Ontario, Canada	Completed surface water investigations at a former mine (nickel) near Kenora, Ontario, including meteorology, flow monitoring, water column profiling and water quality sampling. Flow regimes were characterized and modelled to evaluate impacts of adverse water quality on downstream environments. (2009 to 2018)
Niagara Peninsula Conservation Authority Welland, Ontario, Canada	Completed stream sediment investigations on Lyon's Creek, downstream of the Welland Canal, including a stream survey, sediment sampling, loading, scour and re-suspension analysis. Reported investigation results as part of the Niagara River remedial options. (2009 to 2010)
Lafarge Canada Inc. Bath, Ontario, Canada	Reporting annually on volumetric flow monitoring and water quality data collected monthly on and adjacent to the Lafarge Bath cement kiln dust landfill and rehabilitation. Engineering drainage features on site was also completed. (2006 to 2008)
Canadian Gypsum Company Ltd. Haggersville, Ontario, Canada	Performing volumetric flow monitoring, water quality and continuous water level monitoring on Boston Creek adjacent to the mine site. Annual reporting was also conducted until rehabilitation completion. (2006 to 2015)

PROJECT EXPERIENCE – THREATS ASSESSMENT

Hanson Brick Ltd. – Tremaine Bronte Creek Burlington, Ontario, Canada	Evaluated the risks of a potential drinking water intake on Bronte Creek. Risks in the watershed were evaluated and analysed using plume dispersion algorithms to estimate contaminate impacts on the potential intake. Evaluation was completed using computer models including HEC-RAS. (2008)

Teck Resources Elk Valley, British Columbia, Canada	Conducted water quality modelling to support mine site investigations for a mining project in British Columbia. Water quality parameters were modelled throughout the watersheds from natural sources, mining and metal processing activities as well as their reactions within the watershed. Modelling efforts were used to evaluate treatment options and water handling / management. (2013 to 2015)

PROJECT EXPERIENCE – URBAN WATER MANAGEMENT

Metrolinx Toronto, Ontario, Canada	Project manager for the program which included stormwater sampling of a Metrolinx rail yard. The sample results were compared to the municipal stormwater sewer quality limits and reported at the season. (2017 to 2018)
Toronto Transit Commission Vaughan, Ontario, Canada	Task Manager of the stormwater monitoring and reporting as part of the ECA requirements at the 407 subways station. The monitoring involved storm event water quality monitoring to evaluate Stormwater Management Pond performance, erosion and sediment control inspections, annual reporting and recommendations for performance improvements. (2018 to 2019)
Town of Oakville Oakville, Ontario, Canada	Project manager for the program which included dry weather outfall sampling and wet weather storm sewer sampling. Results were analysed to develop water quality trends in order to estimate contaminate sources and evaluate the effectiveness of Best Management Practices and Stormwater Management Plans (Town of Oakville). (2008 to 2012)
City of Barrie Barrie, Ontario, Canada	Performing volumetric flow monitoring under flash flooding or melting conditions in areas of low permeability in the City of Barrie. (2008)
Black and McDonald Ltd. – Castrol Toronto, Ontario, Canada	Conducted reconnaissance and water quality sampling regarding the Castrol Oil storm water discharge to the city storm sewer. Testing performance of the on-site water treatment equipment and evaluating replacements. (2007)

PROJECT EXPERIENCE – MINING OPERATIONS AND EXPLORATION

Adrianna Resources Lac Otelnuk, Quebec, Canada	Conducted transducer installations and collected cross sectional geometry information at surface water points of interest influencing site drainage and watersheds adjacent to Lac Otelnuk. (2010)
Xstrata, Copper Las Bambas, Peru	Conducted transducer installations at surface water points of interests influencing the site drainage and watersheds located on and adjacent to site Las Bambas. (2008)
Xstrata, Copper Antapaccay, Peru	Conducted transducer installations at surface water points of interests influencing the site drainage and watersheds located on and adjacent to site Antapaccay. (2008)

Xstrata, Nickel Loma Miranda, Dominican Republic	Managed and carried out quarterly field campaigns for Loma Miranda and Energy Conversion Project, which involved installation and monitoring of river hydrology, water quality sampling and rain data collection. Quarterly reporting was conducted, summarizing campaigns. (2007 to 2010)

PROJECT EXPERIENCE – PIPELINE WORK

Trans Canada Pipelines New Gas Line Vaughan, Ontario, Canada	Managed and supported continuous instream turbidity monitoring of many watercourse crossings as part of the Vaughan Mainline pipeline construction and Gravenhurst pipe replacement. This program included site reconnaissance, equipment installation, intensive 24-hour monitoring and troubleshooting, daily and final reporting. (2017 to 2018)
Trans Canada Pipelines New Gas Line South Eastern, Ontario, Canada	Completed watercourse baseline investigations for Eastern Mainline Expansion in Ontario (260 km long new gas pipeline spanning central and eastern Ontario). Responsible for field data collection of baseline conditions at major watercourse crossings and evaluating the hydrotechnical characteristics of each potential crossing. (2015 to 2016)
Trans Canada Pipelines Gas Line Construction Brampton, Ontario, Canada	Designed drainage improvements at a gas pipeline valve station to control flooding in the area to allow maintenance staff to work safely. The work involved conservation authority permitting and negotiation with landowners and other stakeholders. (2018-2020)

PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSTMENT AND PERMITTING

Walker Environmental Group Inc. Ingersol, Ontario, Canada	Completed baseline evaluation and impact assessment for the proposed landfill in the Town of Ingersol. This included the flow and water quality monitoring of the Thames River and local tributaries. Desktop analysis of the potential impacts utilized hydrologic models, climate change predictions, water quality models and stormwater design. (2018-2019)
Marten Falls First Nation Marten Falls, Ontario, Canada	Drafted existing surface water conditions report and impact assessment to support the proposed all season road from Marten Falls to Nakina Ontario. This work involved watercourse crossing surveys utilizing helicopter transportation. The field studies visited a subset of the crossings to evaluate the impacts of the road alignment. (2019-2020)
NextBridge Northern Ontario, Canada	Completed water quality and hydrotechnical analysis to support the NextBridge Infrastructure East-West Tie Transmission Line Project in Northern Ontario (430 km long new transmission line). Conducted baseline studies, effects evaluations, permitting support through hydrotechnical analysis and preliminary design criteria. (2018)
Hydro One Northern Ontario, Canada	Completing baseline evaluation and impact assessment for the proposed power transmission corridor from Thunder Bay to Dryden. This work involved watercourse crossing surveys in remote areas of a subset of the crossings to evaluate impacts of the proposed transmission line corridor. (2019-2022)

Cambridge

Kevin M. MacKenzie M.Sc. (Eng.) P.Eng. Water Resources Engineer

Mr. MacKenzie joined Golder Associates in 1997. Principal responsibilities include hydrologic and hydraulic modelling, design of hydraulic structures and erosion control measures and providing technical water resources support for a wide variety of environmental studies. Project experience includes unsteady hydraulic modelling of mixed sub and supercritical flood waves, prediction of flood flows from extreme design storms, flow monitoring and rating curve development, regional hydrological analyses, water budgets and balances, water management planning and consideration of fluvial geomorphology and ecological principles in design. Water resources work has been completed for clients in the Power Generation, Power Transmission, Aggregate and Mining Sectors as well as Regional Government Agencies and Environment Canada. Prior to joining Golder Associates, Mr. MacKenzie was involved in water resources research for four years, as part of his graduate studies, then as a research associate at the University of Guelph. Mr. MacKenzie has an excellent understanding of a wide variety of hydrology, hydraulics, soil erosion and fluvial geomorphology disciplines.

Education

PhD Candidate Water Resource Engineering, University of Guelph, Guelph, In Progress

M.Sc. (Eng.) Water Resource Engineering, University of Guelph, Guelph, 1995

B.Sc. (Eng.) Water Resource Engineering, Minor: Environmental Engineering, University of Guelph, Guelph, 1993

Languages

English – Fluent

Employment History

Golder Associates Ltd. – Cambridge, Ontario

Water Resources Engineer, Principal (1997 to Present)

Responsible for management of water resources assessments including hydrology, hydraulics, upland and in stream erosion, water quality and water management for a wide variety of government, power generation, industrial, mining and aggregate producing clients. Being part of a comprehensive client service team for aggregate producers in Ontario has facilitated an excellent understanding of the aggregate business and how water management affects their operations. Water resources assessments have been completed in support of Environmental Assessments (EA) and Permitting and Approvals under Federal, provincial and international regulations. Peer reviewer for two Ontario Source Water Protection projects and water resources sections of a new international airport in Quito, Ecuador. Responsible for managing and implementing field data collection studies, including stream flow monitoring, water budget assessments, meteorology and water quality. Other abilities include assessments of upland soil erosion, natural channel design and fluvial geomorphology.

University of Guelph – Guelph, Ontario

Hydrologist (1996 to 1996)

Responsible for collection and analysis of four large databases of rural hydrology parameters in Southern Ontario. Frequency distributions were found for event, daily and yearly runoff coefficients and detailed daily water budgets were synthesised for the duration of each record. Estimated evapo-transpiration in the absence of meteorological data required for the Penman equation.

PROJECT EXPERIENCE – HYDROLOGY/HYDRAULICS

Moira River Flood Mitigation Alternatives Assessment
Foxboro, Ontario

Reviewed and updated floodplain mapping for the Foxboro area, identified several alternative flood mitigation alternatives ranging from floodways and hydraulic controls to lot level flood proofing. Alternatives were assessed and compared based on triple bottom line scores. Triple bottom line analysis considered detailed economic analysis using regions specific flood damage curves developed by Golder's project partner.

Garson Mine Water Management and Inundation Study
Sudbury, Ontario

Senior review and technical advice for flood inundation study downstream of the Vale Garson Mine near Sudbury Ontario. The study included an options assessment, development of improved water management operating practices and conceptual design of reservoir retrofits.

International Falls Dam Rule Curve Cultural Study
Rainy River, Ontario

The effects of a recently updated operating rule curve at the International Falls Dam on water levels in Rainy River and the potential for changed water levels to affect locations of cultural significance are being investigated on behalf of the International Joint Commission on the Great Lakes.

Credit River Floodline Mapping
Mississauga, Ontario

Golder completed the most recent comprehensive update of the flood risk investigation and floodline mapping for the Credit River between Old Derry Road and Lake Ontario. This reach alternately flows through an entrenched bedrock valley and remnant beach plains adjacent to Lake Ontario in the most urbanised part of Mississauga. Mr. MacKenzie served as project staff on this project.

Water Quality Forecasting and Infrastructure
Annapolis Basin, Nova Scotia

Golder was part of a project team working with the Atlantic Innovation Fund / Applied Geomatics Research Group to develop a complex water quality forecasting tool for use by the shell fishing industry in the Digby Gut area. Real time weather forecasts were used to drive real time hydrology and database scenario models of runoff, water quality (bacteriological) and Bay of Fundy tidal fluctuations and their effects on contaminant movement in the Digby Gut. Hydrodynamic modelling was used to estimate contaminant movement and exposure of shell fishing areas to contamination. This information was packaged for use by shell fishers in order to minimize harvests of contaminated shellfish, thereby protecting the resource and minimizing post-harvest dupurification costs. Mr. MacKenzie was the hydrology and hydrometry technical lead for Golder on this project.

Brookfield Homes – Channel Rehabilitation
Brantford, Ontario

Assisted a channel rehabilitation/stabilization assessment and associated 'field fit' design for Brookfield at a tributary of Fairchild Creek to address debris removal and channel instability - responsible for field investigations and construction supervision/inspections.

River Diversion Design
Northern Ontario

Technical advisor for baseline channel hydraulics and fluvial geomorphic studies in support of a major mine development project in Northern Ontario to characterize baseline conditions at several stream channels, as well as to advance a conceptual design for a proposed diversion channel.

Borer's Creek Modelling and Restoration Design
Dundas, Ontario

HEC-RAS modelling and assessment of a failing reach of Borer's Creek that threatened to expose a high-pressure natural gas pipeline. Design of remedial measures for failing banks and restoration of the affected reach. Coordinated regulatory approvals. The project was successfully implemented before the spring freshet and significantly reduced the risk of damage to the pipeline.

Voisey's Bay Nickel Mine
Voisey's Bay, Labrador

A theoretical tailings dam breach was investigated using DAMBREAK to quantify potential impacts on an environmentally sensitive creek. Flood passage downstream of the breach was complicated by several small ponds and alternating sub and supercritical river reaches. Proposed mining operations at the Voisey's Bay nickel deposit require extensive management of surface waters. Five small dams were considered to safely convey clean water around the proposed tailings facility and to contain and treat tailings water. Modelling and design of the reservoirs and outflow structures was completed using GAWSER.

Plains Midstream – Dechlorination and Approval
Sarnia, Ontario

Technical advisor for the design and permitting of a dechlorination system for the Plains Midstream fractionation plant in Sarnia, Ontario. The system is being designed to reduce the free chlorine concentration in the wastewater discharge. Golder is also preparing the ECA (Industrial Sewage Works) amendment package for the facility, to include additional Limited Operational Flexibility (LOF) for the facility for the additional of the dechlorination system, and future sewage work modifications. LOF for the facility will grant future modifications to the works through the appropriate MOE reporting progress, if a professional engineer can demonstrate the modifications will not alter the process discharge quantity and quality limits established for the facility.

Channel Restoration Design
Algonquin Park, Ontario

Technical advisor for the hydraulic design of a stream re-alignment with associated grade controls at an historic train derailment site. Contaminated materials will be removed from the stream bed and banks and adjacent railway embankment. Removal of the contaminated materials will result in a net loss of stream substrate and a change to the fluvial geomorphology of the reach. Grade and stream bank controls were designed to minimize the risks of mobilizing residual contaminants and of significant channel migration.

Omya – Stormwater Management Design and Approvals
Perth, Ontario

A review of existing stormwater management infrastructure was completed for an industrial mineral processing site near Perth Ontario. As a result of incremental development of the site, parts of the stormwater management infrastructure were found to be inadequate. Additional stormwater management works were conceptualized and submitted to MOE for approval. Following approval, Golder provided liaison with the local Conservation Authority, completed basic design drawings suitable for design-build and applied for permitting under the Conservation Authorities Act.

OSSGA Carden Plain Cumulative Impact Assessment
Carden, Ontario

Due to the increased level of aggregate extraction activity in the Carden Plain area, the Ontario Ministry of the Environment (MOE) requested a multidisciplinary study and impact assessment to evaluate the potential cumulative impacts of quarry dewatering at multiple sites on groundwater, surface water and ecological receptors. Golder was retained by the Ontario Stone, Sand & Gravel Association to complete the required study. The project included extensive interaction with the MOE and the Ministry of Natural Resources (MNR). The objectives of the study were to screen out areas where cumulative impacts are unlikely, identify areas where cumulative impacts are likely, and to provide a preliminary assessment of the potential magnitude of predicted cumulative impacts. For the purpose of this study, a cumulative impact was defined as the additive effect of multiple quarry dewatering operations on groundwater, surface water and/or natural environment features. Golder was responsible for all aspects of this project including the development of the final field programs in consultation with personnel from the MOE. Mr. MacKenzie was the surface water lead for the project and participated in the public consultation aspects of the project.

Technical Reviewer Contaminated Site Channel Design
Mississauga, Ontario

Golder was retained to review an options analysis and remedial channel design for a PCB contaminated channel in Mississauga. The remedial design included removal of the most contaminated material and design of a hardened channel lining to secure residual contaminants in-situ. Mr. MacKenzie reviewed the hydraulic channel analysis and design and provided a technical review report for consideration by the municipality and the channel designer.

Contaminated Site Channel Stability Analysis
Welland, Ontario

Golder recently completed Phase IV of an assessment of 12 sites in the Niagara River Area of Concern that were identified in the RAP Stage 1 Update as requiring further assessment. The Phase IV study is a detailed assessment of remedial alternatives for the site including passive and intervention options. In support of the passive treatment options, Golder completed a detailed investigation of the complicated stream and wetland hydraulics of one of the sites on Lyon's Creek. In the intervening years since the historic contamination, the site had developed into a wetland, which provided habitat for threatened plant and animal species. The hydraulic conditions were evaluated using one- and two-dimensional hydraulic models (HEC-RAS and RIVER-2D) to identify areas that are at risk for re-suspension of contaminated sediments and areas that are likely to accumulate new un-contaminated sediment with time. The results supported the passive treatment alternative. Mr. MacKenzie led the hydraulic investigation component of the Lyon's Creek study.

Confidential Mine Site Closure
Eastern Ontario

Technical advisor for comprehensive surface water investigations in support of a risk assessment at two former uranium mines near Bancroft, Ontario. The studies included meteorology and flow monitoring, water column profiling with a particular focus on lake stratification and turnover, and water quality sampling.

Confidential Mine Site Closure
Northern Ontario

Technical advisor for surface water investigations, including streamflow studies, lake column profiling and water quality sampling, at a former nickel mine near Kenora, Ontario.

OPG Atikokan – Environmental Compliance Approval
Northern Ontario

Technical advisor for the Environmental Compliance Approval ('ECA') Sewage (including Stormwater) amendment application for the Atikokan GS Biomass Conversion project. The study included a review of existing sewage works and associated ECA and MISA conditions. Implications from the proposed site changes to the sewage works, consisting of process streams (Furnace Ash Treatment Plant, Condenser Cooling Water), sanitary sewage system/lagoons and the coal pile runoff pond, along with their associated ECA conditions.

Confidential Manufacturing Client
Norval, Ontario

Baseline characterisation and impact assessment modelling of a proposed shale quarry in order to quantify and where necessary mitigate potential flow, water quality and thermal effects of the quarry on nearby watercourse and wetlands. Included conceptual design of mitigation measures and preparation of application materials for re-zoning and license under the Ontario Aggregate Resources Act.

Big Bay Point Water Balance
Barrie, Ontario

Monthly and annual water budgets were prepared using the Thornthwaite Water Budget method. This water budget assessment was performed to determine the rate of marina water pumping required from the proposed development area at Big Bay Point, to the golf course and Environmental Protection Area in support of detailed design of stormwater management facilities to meet post-development peak flow targets. Mr. MacKenzie provided technical advice and senior review for this project.

Baseline Hydrology Study for Proposed Mine
Ring of Fire, Northern Ontario

Technical advisor for baseline hydrology studies and effects evaluations in support of a major mine development project in Northern Ontario. Assessments were prepared as part of a multi-disciplinary Environmental Impact Statement (EIS) and Environmental Assessment (EA) under the Canadian Environmental Assessment Act (CEAA).

Quarry License Expansion
Flamborough, Ontario

A level II hydrogeology study was completed in support of a rock quarry license expansion application. The surface water component of the study included establishment of eight continuous stream flow gauges and associated baseflow separation analysis. The baseflow separations were used to estimate mean annual recharge to groundwater. This information was provided to Golder hydrogeologists for use in estimating boundary conditions for the FEFLOW groundwater model. In addition, monthly and annual surface water balances were modelled using the Thornthwaite Water Budget method coupled to a GIS procedure. The fraction of surplus water that infiltrates was estimated using GIS and the method outlined in MOE 2003. The infiltration estimates were initially assumed to equal recharge. The resulting modelled groundwater levels were reviewed to identify areas of upward gradient or minimal downward gradient. This information was used in subsequent iterations to adjust the recharge estimates.

Quarry License Expansion
Northern Ontario

A level II hydrogeology study is underway in support of a rock quarry license expansion application. Surface water features in the area are characterized by shallow intermittent streams flowing on top of bedrock above a small escarpment running through the site. Below the escarpment, there is a line of small watercourses connecting a series of small lakes. The surface water study includes monitoring of several of the small intermittent watercourses and the outlet of two of the small lakes. Surface hydrological. The results of this analysis will form input to the groundwater modelling discipline. Recharge will initially be assumed to equal infiltration in the groundwater model; however, we expect this will cause mounding in parts of the model. Further iterations will be used to calibrate the recharge estimates subject to a mass balance at the surface.

Aggregate Site Water Use Study
Southern Ontario

Participated in a “typical water use” study for the aggregate industry. The study was initiated by the Aggregate Producers Association of Ontario (now the Ontario Stone Sand and Gravel Association) in preparation for planned changes, by the MOE, to the Permit to Take Water application process. Changes to the process were anticipated to include charges for water taking or use. The MOE was simultaneously working on new Source Water Protection legislation. As a result, the APAO felt it would be prudent to quantify actual water use versus maximum permitted water taking rate and to illustrate typical water use at aggregate sites.

Aggregate Site Permitting and Approvals
Southern Ontario

Application packages including MNRF and MECP applications and supporting studies and reports have been prepared for numerous aggregate sites across Southern Ontario. Applications have been completed for aggregate pit and quarry licenses under the Aggregate Resources Act, Permits to Take Water (PTTW) to allow quarry dewatering and for Environmental Compliance Approvals (ECA) under Section 53 of the Ontario Water Resources Act to allow offsite discharge of quarry and storm water.

Simcoe County Groundwater Studies
Simcoe County, Ontario

A base flow survey was conducted to quantify groundwater discharge in a series of watershed in Simcoe County. The project was conducted in two phases, one for North Simcoe and one for South Simcoe. Water budget and average annual infiltration calculations were completed in support of groundwater modelling. Surface-groundwater interactions were estimated throughout the region to provide a water balance.

Hydrology Studies for Quarry Developments
Ottawa Region, Ontario

A series of water resources investigations were completed for aggregate producing clients in the Ottawa area. The studies were completed in support of Certificate of Approval applications made under Section 53 of the Water Resources Act. Each study included a water balance analysis for the quarry and an estimate of future quarry discharge rates. These data were used to estimate the effects of quarry development on downstream water resources.

Water Supply Studies
Sudbury, Ontario

Two municipal water supplies were investigated as Groundwater Under Direct Influence of surface water (GUDI). Surficial water resources were investigated, and a water balance was prepared in support of groundwater modelling studies.

Hydrological Effects Assessment Hagersville, Ontario	A long-term field monitoring programme was designed and implemented to track changes in flow regime resulting from closure of an underground Gypsum mine. Part of the mine was closed and allowed to flood. Three flow monitoring stations were established in Boston Creek, which flows over the mine. The stations were selected to represent background conditions upstream of the mines influence, conditions above the mine and downstream of the mine influence. Data loggers and transducers were installed to continuously (hourly) record water levels and flows in the creek.
GORO Nickel Mine New Caledonia	The GORO Nickel mine is located in an area of extreme precipitation. Hydrological and preliminary erosion assessments were completed in support of mine development planning and design. These data were used, by the multi-disciplinary project team, to design tailing basin capacities, diversion ditches and dams.
Round Lake Water Level Control Study Engelhart, Ontario	Flow exiting Round Lake flows down several kilometres of a very mild sloped reach of the Blanche River before cascading down a set of rapids at a rock outcrop. The rock outcrop was historically blasted to facilitate log driving practices. This modification has caused large fluctuations in water levels in Round Lake and the Blanche River. A hydrological and hydraulic study of the river and lake were completed and a fish-friendly rock-fill weir was designed to stabilise water levels.
Bruce Nuclear Generating Station Bruce County, Ontario	Participated in background water quality assessments in the surrounding environment. This work included water quality sampling in Baie du D'Or and Lake Huron. The data were used to assess potential effects of the generating station on the quality of surrounding water resources.
Pickering-A Nuclear Generating Station Pickering, Ontario	A multi-disciplinary environmental assessment was completed for the re-start of four CANDU reactors at the Pickering A generating station. A comprehensive review of existing water quantity and quality data was completed. Potential effects, of operating the station, on surrounding water resources were identified and evaluated.
Falconbridge Smelter Area Closure Falconbridge, Ontario	Performing a detailed analysis of water quantity and quality to address potential long-term impacts of the closure on the watersheds of Coniston and Emery Creeks. A daily water budget and reservoir routing model was implemented on a spreadsheet to investigate the efficiency of a variety of different closure scenarios. Also involved in hydrometry, automated water level monitoring, water quality sampling, hydrologic modelling.
Fire Water Intake Blind River, Ontario	Alternative designs for a fire water intake structure modification were assessed to minimise maintenance and sediment deposition and increase safety. Two-dimensional finite element flow modelling of the intake environment and one dimensional, coupled, unsteady, sediment and hydraulic modelling of the river reach was completed. Modelling results indicated that relocating the intake structure would reduce the risk of failure resulting from sediment accumulation.
Asacha Gold Mine Russia	The Asacha gold mine lies close to the divide between a pristine watershed and a partially developed watershed. Hydrologically modelled areas potentially affected by mining operations to aid in developing a safe and detailed water management plan.

PROJECT EXPERIENCE – LINEAR INFRASTRUCTURE

Trans Canada Pipelines Vaughan Mainline Expansion
Vaughan, Ontario

Senior technical advisor for baseline hydrology studies, effects assessments and permitting, in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) filing process and construction planning and design for a ~12 km pipeline expansion in the Greater Toronto Area.

Trans Canada Pipelines Eastern Mainline Expansion
Vaughan, Ontario

Senior technical advisor for baseline hydrology studies, effects assessments and permitting in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) filing for the Eastern Mainline Expansion in Ontario (~260 km long gas pipeline through central and eastern Ontario).

Trans Canada Pipelines Parkway West Connection
Vaughan, Ontario

Senior technical advisor for baseline hydrology studies, effects assessments and permitting, in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) filing process for a local service connection in the Greater Toronto Area.

Trans Canada Pipelines Kings North Connection
Ontario

Surface water discipline lead for the Kings North Connection Project, including baseline hydrology studies and effects assessments in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) process. Scour assessments, sag-bend setback recommendations and permitting were also completed to support construction activities.

Pipeline Corridor Investigations
Timmins, Ontario

A pipeline was proposed to slurry tailing from the Kidd Metallurgical Site to the Kidd Mine, approximately 35 km away. The tailings are to be used for paste back-filling of depleted areas of the underground mine. An environmental review of water resources along the proposed pipeline corridor was completed. Larger watercourse crossings were mapped, and directional drilling was proposed to mitigate environmental effects.

Trans Canada Pipelines Borer's Creek Modelling and Restoration Design
Dundas, Ontario

HEC-RAS modelling and assessment of a failing reach of Borer's Creek that threatened to expose a high pressure natural gas pipeline. Design of remedial measures for failing banks and restoration of the affected reach. Coordinated regulatory approvals. The project was successfully implemented before the spring freshet and significantly reduced the risk of damage to the pipeline.

PROJECT EXPERIENCE – CLIMATE CHANGE

Goldcorp Sudbury Integrated Nickel Operations – East End Water Management
Sudbury, Ontario

Senior review and technical advisor for an assessment of potential climate change effects and vulnerabilities on a multi-site water management system including eight reservoirs, flooded underground mine works, an active smelter complex, a water treatment plant and associated dams and infrastructure. A Goldsim model of the water management system was constructed and validated. Ensemble Global Circulation Model (GCM) results, from approximately ninety model runs, were obtained for the 2050 horizon. Monte Carlo simulations were used to simulate daily weather patterns constrained by the GCM results and the same daily weather patterns were used to model a potential future range of water management scenarios using the Goldsim water management model.

Goldcorp Sudbury Integrated Nickel Operations – East End Infrastructure Assessment
Sudbury, Ontario

Evaluated climate change risks to several small flow conveyance structures including culverts, pipes and flow measurement structures. Peak flows from small sub-catchments are typically sensitive to short duration intense precipitation events. A trend analysis and curve fitting exercise was completed on observed maximum annual events, over recent site history, for a range of event durations ranging up to 24 hours. The trend analysis was used to estimate potential changes to Intensity-Duration-Frequency statistics at the 2050 horizon. This information was used to assess the capacity of existing flow conveyance infrastructure in small sub-catchments.

Meteorological Service of Canada – Environment Canada
Ottawa and across Canada

Participated on a national research team studying the effects of climate change on hydrological variables. Contribution to the study was to complete a regionalization study based on measured hydrologic variables from the Reference Hydrometric Basin Network (RHBN) including mean annual flow, lowest annual daily flow and peak annual daily flow. The data series were grouped according to their similarity using a cluster analysis routine. The homogeneous hydrologic regions identified by this method were compared to hydrologic regions identified in previous studies using meteorological and physiographic variables. Cluster analysis results consistently identified three homogeneous regions in the British Columbia mountains as well as several regions in Ontario, the Maritimes and along the St. Lawrence. The study demonstrated a significant lack of RHBN coverage in the northern part of the Prairie Provinces and the North West Territories, such that homogenous regions, if they exist in these areas, could not be identified by cluster analysis.

Infrastructure Ontario (Ontario Realty Corp.) – Infrastructure Climate Risk Assessment
Ontario

Completed the water resources and drainage components of a climate risk assessment on three typical buildings owned by Infrastructure Ontario. Risk was assessed using guidance provided in Engineers Canada's PIEVC protocol. Co-led focus group workshops with building operators and subject matter experts to assess potential future risk.

Iqaluit Water Supply
Nunavut

Senior technical reviewer for a climate risk investigation of the Town of Iqaluit's water supply. A Goldsim model was developed for the lake-based water supply. Various scenarios were investigated to assess the vulnerability of the supply to climate change.

BHP Billiton
Elliot Lake, Ontario

Technical advisor for applying climate change projections to extreme precipitation events used to assess potential climate change implications for tailings storage facilities and water management ponds. This work was completed as a part of the Dam Safety Surveillance and Management program at BHP Billiton's closed Canadian and U.S. sites.

PROJECT EXPERIENCE – SOURCE WATER PROTECTION

Ontario Clean Water Agency
Lake Ontario, Canada

Hydrology and river boundary conditions lead for the Ontario Clean Water Agency (OCWA) Lake Ontario Decision Support System (DSS). OCWA, in partnership with GTA municipalities, is developing a DSS for managing Lake Ontario based drinking water intakes. Golder teamed with DHI to develop a hydrodynamic, thermodynamic and water quality model to integrate into a web-based forecasting platform for Lake Ontario. The system is expected to go live in 2021 to provide municipalities with the advance information to anticipate and mitigate the effects of accidental spills on water supply infrastructure.

Source Water Protection: Midland and Penetanguishene Tier 3
Midland, Ontario

Surface water lead for the Midland and Penetanguishene Tier 3 water budget and water quantity risk level assessment. This study involved implementation of a combined surface and groundwater model using MIKE-SHE. The modelled recharge distribution was applied to a groundwater model developed by Golder using FEFLOW in order to further refine drawdown effects in close proximity to wells and surface water features. The study area included the whole of the Midland Peninsula and areas of provincially significant wetlands in close proximity to municipal wells with GUDI designation. Groundwater and surface water interactions, both recharge and discharge areas were significant in spatial scale and an important part of this project.

Source Water Protection: Peer Reviewer York Region Tier 3
York Region, Ontario

Peer reviewer for the surface water components of the ongoing York Region Tier 3 water budget and water quantity risk level assessment for the area between and surrounding Aurora and Stouffville. The project team is proposing to use GSFLOW to model both the surface and groundwater systems. GSFLOW is an integrated surface and groundwater hydrology model developed by the US Geological Survey, based on MODFLOW and PRMS components. The study area is complex as it includes the southern flank of the Oak Ridges Moraine and straddles the divide between Lake Ontario and Lake Simcoe. Stouffville is in the headwaters of the Rouge River watershed.

Source Water Protection: Peer Reviewer Halton Hills Tier 3
Halton, Ontario

Peer reviewer for the surface water components of the ongoing Halton Region Tier 3 water budget and water quantity risk level assessment for the Georgetown and Acton areas. The project team used MIKE-SHE to model surface and groundwater hydrology and applied the modelled recharge distribution to FEFLOW to provide further discretization around key areas of interest including wells and surface water features. The study area is complex as it includes the Niagara Escarpment, the Acton re-entrant valley and several buried bedrock valleys which are believed to play and important role in delivering groundwater to the area. The study area also straddles the divide between the Grand River and Credit River watersheds.

Source Water Protection: Peer Reviewer Orangeville Tier 3
Orangeville, Ontario

Peer reviewer for the surface water components of the ongoing Orangeville, Mono and Amaranth Pilot Tier 3 water budget and water quantity risk level assessment. The project team is using HSPF and MODFLOW to model surface and groundwater hydrology respectively. The study area is complex as it includes the Niagara Escarpment and the Oak Ridges Moraine. The study area also straddles the divides between the Grand River, Credit River and Nottawasaga River watersheds.

Source Water Protection: Peer Reviewer CTC Tier 1 and Tier 2
Southern Ontario

Peer reviewer for the surface water components of the Tier 1 and Tier 2 water quantity stress assessments for the CTC Source Protection Region, which includes the Credit River (CVC), Toronto Region (TRCA) and Central Lake Ontario (CLOCA) watersheds. Data availability and modelling approaches used by the different conservation authorities and their consultants varied across the CTC region.

Source Water Protection: Lower Speed River (Guelph) Tier 3
Guelph, Ontario

Golder Associates teamed with AquaResource to complete a Tier 3 water budget and water quantity risk level assessment for the Lower Speed River watershed. The study area includes the City of Guelph, part of Cambridge and contributing drainage and recharge areas located north and east of Guelph. An extensive baseflow survey was conducted across the study. Baseflow was measured at thirty-two locations during the spring, summer and autumn of 2008. This information was used to estimate varying groundwater discharge and recharge rates to support definition of boundary conditions for the groundwater model.

Source Water Protection: Nickel District CA Valley East Tier 3
Sudbury, Ontario

Senior technical advisor for the Valley East Tier 2 and Tier 3 water quantity stress assessment. The City of Sudbury draws drinking water from several wells located in the Valley East area. Worked with project team to identify a modelling approach that would make the best use of, sometimes limited, existing data. The Tier 2 results led to the initiation of the Tier 3 Local Area Water Budget for the groundwater supply in Valley East.

Source Water Protection: Ramsay Lake Tier 1 and Tier 2
Sudbury, Ontario

Senior technical advisor for the Ramsay Lake Tier 3 water budget and water quantity risk level assessment. The City of Sudbury draws water directly from Ramsay Lake for part of its drinking water supply. Ramsay Lake and its contributing drainage areas are being modelled using HEC-HMS (Hydraulic Engineering Corps - Hydrological Modelling System). Based on existing information, it appears that the hydrology of Ramsay Lake is dominated by surface water inputs and as such, there is no plan to include groundwater modelling at this time. HEC-HMS will be used to complete the risk level assessments. Additional field data collection has been initiated to fill existing data gaps regarding key inflows to the lake and the outflow adjacent to Science North.

Source Water Protection: Bronte Creek
Halton, Ontario

Golder Associates were commissioned to undertake a Threats Assessment of a potential intake at Bronte Creek. Mr. MacKenzie directed the project for Golder. The intake, intended to deliver surface water to a small water treatment plant, was identified as one potential alternative for providing a drinking water supply to nearby residential properties possibly affected through the construction of an adjacent quarry. The Threats Assessment identified eleven water quality issues at the potential intake location, attributing causes to a number of likely contaminant sources throughout the watershed. In accordance with MOE Draft Guidance Modules, the work undertaken as part of this assessment included stakeholder liaison, hydraulic modelling, IPZ delineation, vulnerability analysis, the compilation of issues and threats inventories and a description of data knowledge gaps. Should surface water abstraction from Bronte Creek be identified as the preferred alternative for providing long-term drinking water supply, this Threats Assessment report will provide the basis for the Tier 2 assessment.

Source Water Protection: Timmins IPZ Study
Timmins, Ontario

An Intake Protection Zone (IPZ) and the vulnerability scores for the City of Timmins drinking water treatment plant on the Mattagami River were assessed. The delineation of the IPZ included the consideration of river flow conditions, influences of dam operation, location of significant potential upstream sources of contamination, local transportation routes, storm sewer drainage patterns and the behaviour of spills in the river. The project also included the collection of site-specific data through a field program. The field program used non-conventional methods to measure travel time due to restrictions on the use of dye tracers in the river because of the presence of private drinking water intakes. The field program collected detailed velocity data that was used to estimate dispersion and to calibrate a HEC-RAS model that was used to predict the travel time under various flow conditions,

PROJECT EXPERIENCE – WASTE MANAGEMENT

Barrie Landfill Reclamation
Barrie, Ontario

Technical advisor for stormwater management modelling and conceptual stormwater infrastructure design. The project included a significant removal and replacement of historic municipal waste. Daily and permanent cover design required new stormwater management strategies and facility design. Interacted with groundwater modellers to develop representative and conservative boundary conditions for modelling.

Nexcycle
Southern Ontario

Technical advisor in support of the ECA (Sewage) application package for a glass recycling facility. The project included conceptual design of Best Management Practices and source controls to improve stormwater quality.

Eagleson Landfill Brookside Creek Channel Design
Northumberland, Ontario

Ongoing support regarding a channel remediation design/assessment for the County of Northumberland on a reach of Brookside Creek located downstream of the closed Eagleson Landfill to reroute unaffected surface water flows away from a zone of leachate influenced groundwater.

Edgewood Landfill Monitoring
Flamborough, Ontario

Designed and implemented a flow and water quality monitoring programme to assess potential historic effects of watercourses surrounding the closed Edgewood Landfill site in Flamborough Ontario. This work was completed as part of an inventory and assessment of historic landfill operations in the City of Hamilton.

Bath CKD Landfill Design and Monitoring
Kingston, Ontario

Monitored existing water quality and flows associated with an existing Cement Kiln Dust landfill. Designed stormwater control measures for design of a new landfill cover for the existing landfill as well as four new cells to increase the capacity of the landfill.

Brow Landfill Storm-water Management Plan
Flamborough, Ontario

Developed a storm-water management plan to address drainage requirements for the site and mitigation measures required to control potential impacts as part of the closure process. Designed drainage channels, a stormwater management pond, hydraulic flow control structures and a drop structure to safely convey stormwater over the edge of the Niagara Escarpment into a purpose designed plunge pool.

Adams Mine Landfill
Kirkland Lake, Ontario

Completed a baseline hydrology assessment including flow and water quality monitoring as part of an investigation into the feasibility of a proposed land-filling operation at Adams Mine. Monitoring included flow measurements from boats in medium to large rivers.

SUPPLEMENTAL SKILLS

Soil Erosion
Upland inter-rill soil erosion by rainfall impact; Upland soil erosion by concentrated flow in rills and gullies; In stream, bed and bank erosion and transport.

Hydrology
Stream-flow monitoring and hydrometry; Hydrologic modelling and calibration for event and continuous simulations; Potential and actual evapo-transpiration estimates; Single station frequency analysis; and Water balance calculations.

Hydraulics
Sediment transport hydraulics; Velocity profiling; Flood-wave routing in complex channels; Channel erosion potential analysis, including tractive force indices; and Hydraulic design of water management structures.

Fluvial Geomorphology
Initiation of sediment movement; Constructed bed-form frequency and channel stability issues; Channel plan-form and section morphology; Impacts of sediment transport on channel morphology and Stream form classification using the Rosgen Classification Scheme.

PROFESSIONAL AFFILIATIONS

Professional Engineers Ontario

Engineers Nova Scotia

PUBLICATIONS

MacKenzie, K.M., Singh, K., Binns, A.D., Whiteley, H.R. and Gharabaghi, B., 2022. Effects of urbanization on stream flow, sediment, and phosphorous regime. *Journal of Hydrology*, *612*, p.128283.

MacKenzie, K.M., Gharabaghi, B., Binns, A.D. and Whiteley, H.R., 2022. Early detection model for the urban stream syndrome using specific stream power and regime theory. *Journal of Hydrology*, *604*, p.127167.

Rose, G. T and MacKenzie, K. M. (2013). Water Quality Forecasting and Infrastructure Optimization System. Meeting #68 of the Atlantic Coastal Zone Information Steering Committee (ACZISC). Bedford Institute of Oceanography, Halifax, Nova Scotia, January 16-17, 2013.

S. I. Ahmed, K. MacKenzie, B. Gharabaghi, R.P. Rudra, W.T. Dickinson. (2011). Within-storm rainfall distribution effect on soil erosion rate. ISELE Paper Number 11000. International Symposium on Erosion and Landscape Evolution. Anchorage, Alaska September 18-21, 2011.

Bell, J., K. MacKenzie and J. Southwood. (2011). Down Under Up North - Could an Australian water- sensitive urban design project work in the Canadian context? Water Canada July/August 2011.

DeVito, C. and MacKenzie K. (2011). Critical Shear Velocity Estimates Improved with In-Situ Flume. 20th Canadian Hydrotechnical Conference, Ottawa Ontario June 14th to 17th 2011.

Davidson C. and MacKenzie K. (2011). Golder Daily Climate Record Generator. 20th Canadian Hydrotechnical Conference, Ottawa Ontario June 14th to 17th 2011.

MacKenzie, Kevin. (2009). Industrial Wastewater Approvals. Canadian Environmental Compliance Conference and Trade Show (CANECT). Metro Toronto Convention Centre, April 2009.

MacKenzie, Kevin. (2007). Industrial Wastewater Approvals. Canadian Environmental Compliance Conference and Trade Show (CANECT). Metro Toronto Convention Centre, April 2007.

Mackenzie, K.M., R.P. Rudra and W.T. Dickinson. (1996). Modelling the inter-rill detachment process: Some considerations for improving model results. ASAE Paper No. NABEC96-94, Amer. Soc. Agr. Engr., St. Joseph, MI.

MacKenzie, K.M., R.P. Rudra and W.T. Dickinson. (1995). The effect of temporal distribution of rainfall on inter-rill detachment. ASAE Paper No. 95-2378, Amer Soc. Agr. Engr., St. Joseph, MI.

Education

B.A.Sc Geological Engineering (Water Resources Option) University of Waterloo, Waterloo, Ontario, 1997

M.Sc. Earth Sciences (Hydrogeology), University of Waterloo, Waterloo Ontario, 2001

Certifications

Registered Professional Geoscientist, Association of Professional Geoscientists Ontario (PGO)

Registered Professional Engineer, Association of Professional Engineers Ontario (PEO)

Golder Associates Ltd. – Cambridge

Project Manager / Hydrogeologist

Greg is a Project Manager/Hydrogeologist within Golder's Cambridge office with over 20 years of experience in groundwater resource consulting. He is a graduate of the M.Sc. program in hydrogeology at the University of Waterloo where he studied groundwater contamination from agricultural activities near a municipal well field in Southern Ontario. Greg has technical experience in assessment of aquifer and well yields, groundwater exploration, development and protection, groundwater/surface water interactions, source water protection, groundwater under the direct influence of surface water investigations, groundwater monitoring, borehole geophysics interpretation, groundwater modelling, well installations, well maintenance and decommissioning and aggregate resource investigations. He is typically responsible for hydrogeologic analysis, interpretation and assessment, field supervision, report preparation and project management. Greg has been a project hydrogeologist and project manager for several large and challenging aggregate resource development projects in Ontario.

Employment History

Golder Associates Ltd. – Cambridge, Ontario

Hydrogeologist (2009 to Present)

Hydrogeologist and project manager responsible for the implementation and management of hydrogeological projects that encompass groundwater supply, development and protection. Greg has technical experience in assessment of aquifer and well yields, groundwater exploration, development and protection, groundwater/surface water interactions, source water protection, groundwater under the direct influence of surface water investigations, groundwater monitoring, borehole geophysics interpretation, well installations, well maintenance and decommissioning, and aggregate resource investigations.

Lotowater Technical Services Inc. – Paris, Ontario

Hydrogeologist (2000 to 2009)

Project hydrogeologist and project manager responsible for hydrogeologic assessments, water supply, development and protection projects, groundwater under the direct influence of surface water investigations and source water protection studies. Responsibilities included hydrogeologic analysis, interpretation and assessment, field supervision, report preparation, development and coordination of field investigation and/or monitoring programs and liaison with regulatory agencies. These projects typically included both a field investigation/testing component and a desk-top assessment/analysis. Projects included the exploration and development of groundwater supplies for various uses, assessing the associated impacts and developing water resources protection strategies. Several large and challenging groundwater resource and development projects have been undertaken in southern Ontario.

Research Experience – Woodstock, Ontario
M.Sc. Thesis (1997 to 2001)

Research on groundwater contamination from agricultural land use activities. The study investigated the increasing nitrate concentrations at a municipal well field located in an urban/rural area. The investigation included a hydrogeological investigation to assess the impacts of agricultural activities at the regional scale on nitrate quality in an urban/rural well field and to evaluate potential strategies to minimize the impacts within a reasonable time period. The research included the installation and monitoring of numerous monitoring wells, a large-scale aquifer test and numerical modelling of the aquifer system. The results were used to aide in protecting the municipal aquifer.

PROJECT EXPERIENCE – AGGREGATE RESOURCES

CBM Aggregates North Dumfries Township, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment to support a future licence application for the Cambridge Pit Expansion. The application is for aggregate extraction below the water table and the study includes a Level 1/2 Water Report. The study also included a drilling and testing program to evaluate the resource.
CBM Aggregates North Dumfries Township, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment to support a future licence application for the David Pite Expansion. The application is for aggregate extraction below the water table and the study includes a Level 1/2 Water Report. The study also included a drilling and testing program to evaluate the resource.
CBM Aggregates Caledon, Ontario, Canada	Senior Reviewer and Field Program Lead for an integrated impact assessment to support a future licence application for the Caledon Pit / Quarry. The proposed licence is intended to permit the extraction of aggregate and rock from below the water table.
CBM Aggregates Dorchester, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment supporting a major Site Plan amendment at the Dorchester Pit. The proposed amendment is intended to permit the extraction of additional available aggregate resources from below the water table at the existing pit.
CBM Aggregates Sunderland, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment to support a future licence application for the Sunderland South Pit Expansion. The application is for aggregate extraction below the water table and the study includes a Level 1/2 Water Report. The study also included a drilling and testing program to evaluate the resource.
CBM Aggregates Peterborough County, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment to support a future licence application for the Godfrey Pit Expansion. The application is for aggregate extraction above and below the water table and the study includes a Level 1/2 Water Report. The study also included a drilling and testing program to evaluate the resource.
Lafarge Canada Glen Morris, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment to support a future licence application for the Glen Morris Pit. The application is for aggregate extraction above and below the water table and the study includes a Level 1/2 Water Report. The study also included a drilling and testing program to evaluate the resource.

CBM Aggregates North Dumfries Township, Ontario, Canada	Lead Hydrogeologist for an integrated impact assessment to support a future licence application for the Dance Pit Extension to an existing licence. The application is for aggregate extraction above the water table and the study includes a Maximum Predicted Water Table Assessment.
Cambridge Aggregates Ayr, Ontario, Canada	Lead Hydrogeologist for a Level 1/2 Hydrogeological Assessment in support of a licence application for the Ayr Pit. Work was conducted in a sensitive area and included the preparation of trigger levels and a contingency plan. Aggregate extraction is above the water table.
Cambridge Aggregates North Dumfries Township, Ontario, Canada	Lead Hydrogeologist for a Level 1/2 Hydrogeological Assessment in support of a licence application to expand the North Dumfries Pit. Aggregate extraction is above the water table. Work also included testing a supply well to provide water for aggregate washing along with the associated permitting.
Preston Sand and Gravel North Dumfries Township, Ontario, Canada	Lead Hydrogeologist for a Level 1/2 Hydrogeological Assessment in support of a licence application for the Henning Pit. Aggregate extraction is above the water table.

TRAINING

Aquifer Mapping/Wellhead Delineation Workshop, 2001

Source Water Protection Best Management Practices and Other Measures for Protecting Drinking Water Supplies, 2003

Borehole Geophysics Short Course, 2007

Critical Thinking in Aquifer Test Interpretation, 2011

Interpreting Aquifer Tests in Fractured Rock, 2012

PUBLICATIONS

Padusenko, G. 1997. Undergrad Thesis (B.A.Sc.): The Influence of Scale on Hydraulic Conductivity Measurements.

Padusenko, G. 2001. Masters Thesis (M.Sc.): Regional Hydrogeologic Evaluation of a Complex Glacial Aquifer System in an Agricultural Landscape: Implications for Nitrate Distribution.

Padusenko, G. 2003. Presentation: A Comparison of Particle Count Data to On Line Turbidity From a Pumping Well. OWWA Conference.

Lotimer, T. and Padusenko, G. 2008. Presentation: Constructed Preferential Pathways: Where Did My Well Go? OWWA Conference.

Chapman et. al., 2015. Paper: Hybrid Multilevel System for Monitoring Groundwater Flow and Agricultural Impacts in Fractured Sedimentary Bedrock. National Groundwater Association – Groundwater Monitoring and Remediation.

St. Catharines

Senior Hydrogeologist and Principal

As a Senior Hydrogeologist with Golder, Dr. McFarland has more than 30 years of professional experience and a broad background in conducting, managing and directing aggregate waste management, mining, power, oil and gas, and ground management and protection projects. He served as the project director for work programs for proposed mines, aggregate operations and industrial facilities.

He has a broad background in licensing and permitting of pits and quarries. This includes the licensing for the expansion of the Lafarge Dundas Quarry, the expansion of the Lafarge Woodstock Quarry, the expansion of the Nelson Aggregate Quarry, the RW Tomlinson license application, the St. Mary's cement Bonis Quarry, the ongoing expansion of the Port Colborne Quarry, and the Lafarge Goodwood Pit and other sites. He is also involved in numerous PPTW applications for pits and quarries. In addition, he has extensive experience in site selection studies and resource evaluations for aggregate sites.

Sean acted as the Project Director and Senior Hydrogeologist for the 2014 and 2015 annual landfill monitoring reports for the Vale Port Colborne site and for 8 landfill monitoring programs in Niagara Region. He was the Project Manager and Senior Hydrogeologist for the extensive Adams Mine landfill project, which involved the successful permitting of a 20 million tonne hydraulic containment engineered landfill facility, within a 200 m deep former open pit mine, following hydrogeological investigations collected over an 8-year period that involved extensive monitoring well installation, electronic instrumentation and testing, pump test analyses and groundwater flow modelling. He has also been an expert witness for hydrogeology at Environmental Assessment (EA) and Ontario Municipal board (OMB) hearings and has been involved in extensive contaminated site investigations including legal disputes.

Additional project experience includes hydrogeological assessments for the low level radioactive (LLRWM) facility concepts of waste management for the Canadian federal government Siting Task Force Secretariat (STFS) in limestone bedrock beneath the Great Lakes, and fractured and faulted Precambrian granitic gneiss at the Chalk River Nuclear Reactor site in northern Ontario, Canada. Further project experience in fractured rock includes the proposed Steetley Landfill, in limestone bedrock of the Niagara escarpment, including an extensive EA level hydrogeological investigation, over a 5-year period, and the existing Brow Landfill including an EPA level investigation, a long-term monitoring program and remediation.

Education

PhD Osgoode Hall Law School, York University, 2013

LLM Osgoode Hall Law School, York University, 2005

MBA Centre for Innovative Management, Athabasca University, 2001

M.Sc. Earth Sciences, Brock University, 1997

B.Sc. Geological Sciences (Honours), University of Toronto, 1985

Certifications

Professional Geoscientist, P.Geo., Ontario

Certified Professional Accountant, CPA, Ontario

Certified Management Consultant, CMC

Project Management Professional, PMP

Languages

English – Fluent

Employment History

Golder Associates Ltd. – Mississauga, Ontario

Senior Geoscientist and Principal (1987 to Present)

Hydrogeologist then Senior Hydrogeologist (1987-present)
Managing Principal, Vice President, Canada (2005-2014)
Associate - 1997 appointment
Principal - 2003 appointment
Geologist and Hydrogeologist (1985 to 1987)

Characterization of proposed and existing metal and industrial mineral facilities and impact assessments for industrial facilities.

Regina Associates Ltd. – Kingston, Ontario
Geoscientist (1983 to 1987)

Characterization of proposed and existing metal and industrial mineral facilities in Ontario, Nova Scotia, Newfoundland, British Columbia and the Northwest Territories; and hydrogeological impact assessments for industrial facilities.

SELECTED PROJECT EXPERIENCE – AGGREGATE INDUSTRY

Aggregate Resource Evaluation Regional Municipality of Peel, ON	Project Manager and geologist for evaluation of sand and gravel and bedrock resources in the Regional Municipality of Peel, Ontario for the provincial Ministry of Municipal Affairs and Housing (MMAH). The project was carried out as part of the development of the official plan for the Region.
Region of Peel Regional Municipality of Peel, ON	Technical advisor for ARIP (Aggregate Resource Inventory Paper) report for the Regional Municipality of Peel. The project involves and evaluation of shale and gravel, limestone and shale resources in the Region and was submitted to the Ontario Geological Survey for publication as a government document ARIP Paper.
Navan Quarry Navan, ON	Project Manager and geologist for evaluation of sand and gravel and bedrock resources in the Regional Municipality of Peel, Ontario for the provincial Ministry of Municipal Affairs and Housing (MMAH). The project was carried out as part of the development of the official plan for the Region.
Brockville Quarry Brockville, ON	Project Manager and hydrogeologist for hydrogeological evaluation of the Permanent Lafarge Brockville Quarry. The results of the evaluation were used to negotiate the liability of the quarry to alleged water well interference associated with quarry expansion with the Ontario Ministry of the Environment.
Dufferin Aggregates ON	Project Director and senior hydrogeologist for numerous aggregate projects at quarries and sand and gravel pits within Ontario including resource evaluations, hydrogeological investigations and environmental assessments.
Due Diligence Studies Southern Ontario	Project Manager and senior hydrogeologist for due diligence studies as part of the potential purchase of aggregate companies and operating pits and quarries in Ontario.
Site Selection Studies Southern Ontario	Project Director for site selection studies for development of quarries and sand and gravel operations in Ontario.
Lafarge - North Quarry Flamborough, ON	Project Director for hydrogeological program at the Lafarge (formerly Redland) Quarry Operations in Flamborough, Ontario, to meet the regulatory requirements of the Ontario Ministry of the Environment.
Proposed Halminen Quarry Buckhorn, ON	Project Manager for a private application for a license for a proposed limestone quarry near Buckhorn, Ontario. The project involved management of multi-disciplinary project team public meetings, and application for a Class A licence under the Aggregate Resources Act.
Votorantim Cimentos Bowmanville, ON	Project Director for the development of a limestone/dolostone mine under Lake Ontario. The work programs involve drilling and testing of a 275m deep borehole under the lake, development of an underground mine plan, preparation of an EA document for regulatory approvals and public participation programs.

Milton Limestone Quarry Peer Review Milton, ON	Project Director for the peer review of the hydrogeological and adaptive management plan report for the proposed Dufferin Aggregates Milton Quarry expansion. The work program involved meetings with the hydrogeological consultant and legal counsel and attendance at Ontario Municipal Board hearings.
SAROS Study Greater Golder Horseshoe, ON	Evaluation of supply and demand of aggregate resources in the Greater Golden Horseshoe for the MMNR (Ministry of Natural Resources and Forestry). The project includes resource estimates for 25 quarries and 120 pits and unlicensed sand and gravel resources in the study area.
Nelson Quarry Expansion Burlington, ON	Project Director for the proposed Nelson Quarry extension including extensive borehole drilling and monitoring well installations, water quality sampling, a surface water program, groundwater flow modeling, impact assessments, preparation of an Adaptive Management Plan (AMP), reporting and acting as an expert witness at an Ontario Municipal Board hearing.
Lafarge South Quarry Expansion Dundas, ON	Project Director for a hydrogeological and hydrological work programs in support of a license application for the expansion of the Lafarge South Quarry near Dundas, Ontario (ongoing). The work program involves borehole drilling and monitoring well installations, geophysical borehole logging, water quality sampling and analyses, hydrological analyses of streams and wetlands, a karst assessment, a water well survey, geological and hydrogeological interpretation, groundwater flow modeling, agency interaction and attendance at public meetings.
Lafarge Fonthill Pit PTTW Renewal Fonthill, ON	Project Director for a hydrogeological work program in support of a Permit to Take Water (PTTW) application for the Lafarge, The work program included interpretation of pumping wells records, evaluation of drawdown in water wells related to pumping, water quality analyses and preparation and submission of a report in support of the permit application.
Lafarge North Quarry Expansion Dundas, ON	Project Director for a hydrogeological work program conducted in support of a license application for the expansion of the Lafarge North Quarry. The work program involved borehole drilling and monitoring well installations, pumping tests, groundwater flow modelling, a water well survey, an impact assessment of potential effects on water wells and an adjacent provincially significant wetland, agency interaction and preparation of a report submitted in support of the license application. The application was approved with an Ontario Municipal Board hearing.
Lafarge PTTW Monitoring Programs ON	Project Director for hydrogeological monitoring programs for a portfolio of more than 50 pits and quarries in Ontario. The programs involved water level and water quality monitoring, evaluation of pumping records, effects assessments and preparation and submission of monitoring reports for compliance with the permits.

RW Tomlinson Quarry License Application
Brechin, ON

Project Co-director for the hydrogeological work program for a hydrogeological work program performed in support of a license application for a dolostone quarry in the Carden Plain. The work program involved borehole drilling and monitoring well installation, geophysical borehole logging, packer testing, well response testing, pump testing, water quality sampling, groundwater flow monitoring, an impact assessment including potential effects on surrounding water wells and an adjacent wetland, development of a monitoring program preparation of a report in support of the application and agency interaction.

Proposed Lafarge Glen Morris Pit
ON

Project Director and senior hydrogeologist for the hydrogeological work program in support of a license application for the proposed Glen Morris Pit. The work program included borehole drilling, monitoring well installations, groundwater level monitoring and the provision of data and preparation of a hydrogeological report.

Lafarge Wellington Quarry PTTW and ECA Renewal
ON

Project Director and senior hydrogeologist for the Lafarge Wellington Quarry Renewal. The field program involved borehole drilling, packer testing, monitoring well installations, groundwater level monitoring, a field pumping test, development of a water budget and groundwater quality sampling. A hydrogeological impact assessment was developed to assess the potential impacts of quarry groundwater level drawdown related to quarry dewatering activities on surrounding private water wells and municipal wells. The work program included the modification of the regional source water protection to incorporate site data to assess the potential affects on the Guelph municipal wells.

Lafarge Regan Resource Drilling
ON

Project Manager and senior geoscientist for resource drilling at the Lafarge Regan site using some drilling techniques. The results of the work program were provided to Lafarge for their resource assessment.

Lafarge Hagersville Quarry
Hagersville, ON

Senior Hydrogeologist for the assessment of quarry dewatering and pumping for the Lafarge Hagersville Quarry as part of the PTTW monitoring program.

Arbour Farms License Application
ON

Senior Hydrogeologist for the Arbour Farms license application for a pit below water. The work program included borehole drilling, installation of monitoring wells, groundwater level monitoring and assessment of potential affects on an adjacent water course. Three-dimensional groundwater flow and heat transport modeling was completed to assess the potential thermal impacts on the surrounding surface water courses.

Rankin Construction Port Colborne Quarry Extension
Port Colborne, ON

Project Director for a multi-disciplinary work program for a license application for an extension of the Port Colborne Quarry. The work program involved hydrogeological, hydrological, blasting, noise, air, natural environment, planning, agricultural and archaeological studies and a resource estimate. Senior Hydrogeologist for the hydrogeological work program that involved borehole drilling, monitoring well installations, groundwater quality sampling and analysis, an impact assessment and a monitoring and response program for potential impacts on surrounding water wells.

Lafarge Goodwood Pit Extension Goodwood, ON	Project Director and senior hydrogeologist for a license application for the Lafarge Goodwood Pit extension, for a Category 1 Class EA pit below water. The objective of the work program was to characterize the existing hydrogeological and hydrological conditions in the vicinity of the site, including the depth and elevation of the water table and assess potential affects of the operational and rehabilitation scenarios. The work program involved borehole drilling, monitoring well installations, groundwater level monitoring, development of a water budget and a hydrogeological impact assessment.
Lafarge Woodstock Quarry Expansion Woodstock, ON	Project Director and senior hydrogeologist for the hydrogeological investigation of the Woodstock quarry for support of a license amendment. The field program involved borehole drilling, packer testing, monitoring well installations, groundwater quality sampling and analysis, a field water well survey and development of a water budget. An impact assessment was conducted to assess the potential affect of quarry related groundwater level drawdown on surrounding water wells and surface water courses.
CRH Resource Evaluation and Due Diligence ON	Project Manager and senior geoscientist for a resource evaluation of a property near Orangeville, Ontario for potential acquisition for quarry development. The work program included borehole drilling, geological logging of the rock core, monitoring well installations to determine the depth of the water table, aggregate quality testing and reporting.
Limestone and Sandstone Resource Evaluation and Due Diligence Regional Municipality of Peel, ON	Project Director and senior hydrogeologist for a resource evaluation for a property developer for potential acquisition of an existing quarry near Mississauga. The work program involved borehole drilling, core logging, aggregate quality testing and reporting.
Stouffville Resource Drilling Stouffville, ON	Project Manager and senior hydrogeologist for the resource drilling at Lafarge Stouffville Quarry. The drilling was conducted using a sonic drill rig with continuous core sampling. The results were provided to the Lafarge geologist for the resource assessment.
Lakeridge Resource Drilling ON	Project Manager and senior geoscientist for the resource drilling at the Lafarge Lakeridge site. The drilling was conducted using sonic coring and the results provided to the Lafarge geologist for development of a resource assessment.
Votorantim Thomas Quarry License Application ON	Senior hydrogeologist for the hydrogeological component of the Votorantim Thomas Quarry Extension license application. The work program involved borehole drilling, packer testing, geophysical borehole logging monitoring well installations and groundwater quality sampling and analysis. Three-dimensional groundwater flow monitoring was conducted to assessment the potential hydrogeological impacts of the quarry.
Lafarge Pinkney Pit #3 ON	Senior Hydrogeologist for the hydrogeological work program for the Lafarge Pinkney Pit #3 license application. The work program involved borehole drilling, monitoring well installations and a hydrogeological impact assessment.

Lafarge Mosport Resource Drilling
ON

Project Manager and senior geoscientist for the sonic borehole drilling at the Lafarge Mosport Pit. The results of the resource drilling were provided to the Lafarge geologist as part of the site resource assessment.

Lafarge Goodwood Resource Drilling
ON

Project Manager and senior geoscientist for sonic borehole drilling of the resource near the Lafarge Goodwood Pit. The results of the drilling were provided to the Lafarge geologist for a resource assessment.

APAO (Aggregate Producers Association of Ontario) Water Consumption Study
ON

Project Director for a study for the APAO to determine the consumption of water associated with pits and quarries.

Lafarge Sunningdale Pit Monitoring Program
ON

Senior Hydrogeologist for the Lafarge Sunningdale Pit Monitoring Program. The work program includes hydrogeological monitoring, an assessment of potential impacts and preparation of an annual monitoring report.

Votorantim Resource Assessment
ON

Project Manager and senior geoscientist for a resource assessment at a Votorantim Quarry in central Ontario. The work program involved borehole drilling and borehole geophysics were used to identify and correlate the geological formations and members at the site.

Cox Construction Monitoring Well Network
Wellington County, ON

Project Manager and senior hydrogeologist for borehole drilling and monitoring well installations at a property in Wellington County to provide baseline date for potential future licensing as a quarry. The wells were installed in the thick sequence of Amabel Formation at this locates. Groundwater level monitoring was performed to determine the depth to water table.

Cox Construction Resource Evaluation and Due Diligence
ON

Project Director for a drilling program to evaluate to the limestone resource for potential acquisition of a property for development. The work program involved borehole drilling, geological logging of the rock core, monitoring well installations, aggregate quality testing and reporting.

SELECTED PROJECT EXPERIENCE – WASTE MANAGEMENT

Adams Mine
Kirkland Lake, ON

Project Hydrogeologist and Project Manager for the hydrogeological assessment of the Adams Mine near Kirkland Lake, Ontario over a five-year period as part of the proposed development of 20 million tonne engineered landfill facility for solid non-hazardous waste. The facility will receive waste from the Greater Toronto Area (GTA) via a rail line system. The landfill facility incorporates a hydraulic containment design, which prevents outward migration of contaminants from the landfill, which reduces environmental impacts and long-term operating costs. Provided expert witness testimony in an environmental assessment (EA) hearing.

Brow Landfill Dundas, ON	Project Hydrogeologist then Project Manager for hydrogeological assessment for landfill expansion of the existing Redland Quarries Inc. (formerly Steetley Quarry Products Ltd.) solid industrial waste Brow Landfill in Flamborough, Ontario. Subsequent work included ongoing groundwater and surface water quality monitoring and preparation monitoring reports submitted to the MOE, followed by development of a closure plan and an ongoing compliance monitoring program.
South Quarry Landfill Flamborough, ON	Project Hydrogeologist for hydrogeological assessment of the proposed Redland Quarries Inc. (formerly Steetley Quarry Products Ltd.) South Quarry in Flamborough, Ontario for the proposed development of an engineered landfill facility. Participated in environmental assessment (EA) hearings and assisted with the preparation of final arguments with legal counsel.
Siting Task Force Secretariat Chalk River, ON	Project Hydrogeologist, then Project Manager for geological and hydrogeological characterizations of the Chalk River Nuclear laboratories property, near Chalk River, Ontario for siting of a proposed facility for the disposal of low-level nuclear waste for the federal Siting Task Force Secretariat (STFS).
Siting Task Force Secretariat Port Hope, ON	Project Hydrogeologist then Project Manager for geological and hydrogeological characterization of the Lakeshore site in Port Hope, Ontario, for the federal Siting Task Force Secretariat (STFS). The work was carried out as part of the feasibility level I study for dispose of low-level waste in engineered caverns beneath Lake Ontario and the Cameco Uranium fuel processing facility in Port Hope.
Interim Waste Authority Regional Municipality of Peel, ON	Project Hydrogeologist for geological and hydrogeological characterization comparative evaluation of five short-listed sites for siting of an engineered landfill facility as part of the provincial Interim Waste Authority (IWA) landfill site selection process for the Region of Peel.
Guelph-Wellington County WMMP Wellington County, ON	Project Hydrogeologist for geological and hydrogeological characterization of five candidate sites and identification of a preferred site in Wellington County for siting of an engineered municipal landfill facility, as part of the joint City of Guelph - County of Wellington Waste Management Master Plan (WMMP).
Model City Landfill Lewiston, NY	Project Hydrogeologist for hydrogeological investigation of the Model City hazardous waste landfill, near Lewiston, New York, carried out as part of landfill expansion.
Welland-Wainfleet WWMP Townships of Welland and Wainfleet, ON	Project Hydrogeologist for the identification of preferred sites for development of a municipal landfill facility, as part of the Welland-Wainfleet Waste Management Master Plan (WMMP).
Brock South Landfill Pickering, ON	Project Hydrogeologist for assessment of the proposed Brock South Landfill near Pickering, Ontario, to assess the suitability of the site for development of an engineered municipal landfill facility for Metropolitan Toronto.
Redland Queenston Quarry Queenston, ON	Project Hydrogeologist for hydrogeological assessment of the Redland Quarries Inc., Queenston Quarry to determine the suitability of the site for disposal of waste rock saline shale, from the construction of the proposed diversion tunnels of the Sir Adam Beck III hydroelectric generating facility in Niagara Falls, Ontario.

Fly Ash Disposal Facility ON	Project Hydrogeologist for hydrogeological investigations at four quarries located near Hagersville, Cayuga, Smithville and Milton to determine their suitability for development an engineered landfill for disposal of fly ash from the Ontario Hydro Lakeview Power Generating Station.
Mohawk Street Landfill Brantford, ON	Project Hydrogeologist for assessment of groundwater and surface water quality impacts at the municipal Mohawk Street Landfill in Brantford, Ontario.
Vale Industrial Landfill Port Colborne, ON	Project director for the preparation of an annual report for the groundwater monitoring program for an industrial waste landfill at a former nickel refinery. The work program included interpretation of groundwater flow directions and water quality trends, evaluation of the extent of the leachate plume, and an impact assessment.
Vale Industrial Refinery Landfill Monitoring Port Colborne, ON	Project Director and senior hydrogeologist for an evaluation of the effectiveness of the purge well system at a former nickel refinery and the development of mitigation and rehabilitation measures for well clogging. The work program involved step drawdown pumping tests, longer term pumping tests, hydraulic analysis of pumping test data, assessment of the decline of well efficiency due to scaling and bio fouling and the development of a work program for well rehabilitation and maintenance including acidification.
Municipal Landfill Annual Monitoring Programs Niagara Region, ON	Project Director for the annual monitoring program for 8 landfills in bedrock and escarpment settings in Niagara Region. The work program involves field water quality sampling, groundwater level monitoring, and provision of progress and annual reports.
Proposed Walker Ingersoll Landfill ON	Senior Hydrogeologist for the hydrogeological investigation for the proposed Walker Landfill near Ingersoll, Ontario. The field program involved borehole drilling, monitoring well installations, packer testing, geophysical borehole logging, downhole flow profiling, groundwater quality sampling and analysis, a karst study and a water well survey. Three-dimensional groundwater flow modeling was conducted to assess the potential impacts of the landfill.

SELECTED PROJECT EXPERIENCE – SHALE INDUSTRY

Canada Brick Mississauga, ON	Specialist for assessment of geological controls upon shale quality at the Canada Brick Britannia Road quarry site. The work was carried out in conjunction with quality control estimate of shale reservoir on the property.
Canada Brick Halton Region, ON	Project Manager for a hydrogeological work program in support on an application for a license for the Hanson Brick Tremaine Quarry in Halton Region, Ontario.
Brampton Brick Limited Halton and Peel Region, ON	Project Director for a hydrogeological and surface water program in support of a license application for a proposed shale quarry for a brick manufacturer. The work programs involved borehole drilling and monitoring well installations, surface water flow monitoring, water quality sampling, groundwater flow modelling and preparation of an Adaptive Management Plan (AMP).

Hanson Brick Limited
Halton Region, ON

Project Director for the assessment of the potential gas migration from a landfill to an adjacent brick manufacturing facility containing a brick kiln. The program identified potential risks and a monitoring and response program.

SELECTED PROJECT EXPERIENCE – MINING

Stanleigh Mine
Elliot Lake, ON

Project Hydrogeologist for assessment of the Rio Algom Stanleigh Mine near Elliot Lake, Ontario. The project included development of a three-dimensional flow model of a low-level radioactive waste tailings facility in Precambrian bedrock of the Canadian Shield. The model was used to develop estimates of seepage rates from the facility and was submitted to the Atomic Energy Control Board (AECB) as part of the regulatory approvals process.

Voisey's Bay Mine
Labrador

Technical specialist for hydrogeological modelling at the Voisey's Bay Mine site involving development of three-dimensional groundwater flow models of a proposed tailings basin, mine waste rock disposal facility, and an open pit mine at the Voisey's Bay Mine Site in Labrador. The modelling was carried out for the Voisey's Bay Nickel Company (VBNC) as part of the hydrogeological assessment of the mine. The work was subject to regulatory review and presented as evidence at an environmental assessment hearing.

Baley Gold Mine
Baley, Russia

Project Hydrogeologist for an Environmental Impact Assessment (EIA) as part of a feasibility study for mine expansion. The hydrogeological component included evaluation of potential for water quality impacts for an open pit mine and tailings basin, reduction of flow in stream and interference with the municipal water well supply.

Asacha Gold Mine
Kamchatka, Russia

Project Hydrogeologist of the proposed Asacha Gold Mine in northeastern Russia. The assessment focused upon chemical water quality and streamflow impacts associated dewatering of an underground mine and construction of a tailings basin. The results of the assessment formed part of the mine feasibility study.

Timmins Mine Water Study
Timmins, ON

Project Hydrogeologist for assessment of flooding of an extensive array of underground mine working beneath the City of Timmins. The assessment included evaluation of the potential impacts arising from the discharge of water from the flooded mine workings at surface within the city.

Cigar Lake Mine
Saskatchewan

Project Hydrogeologist for assessment of potential groundwater inflows into proposed shaft in northern Saskatchewan for the Cigar Lake Mining Corporation (CLMC). The results of the assessment were used as the basis for the engineering design at the shaft.

Denison Mines
Elliot Lake, ON

Project Hydrogeologist for an assessment of low-level nuclear waste tailings basin at the Denison Mines near Elliot Lake, Ontario. The hydrogeology study included assessment of seepage of uranium-impacted groundwater from the basin.

MaCassa Mines
Kirkland Lake, ON

Project Hydrogeologist for hydrogeological assessment at the Lac Minerals MaCassa Mine tailing basins in Precambrian bedrock near Kirkland Lake, Ontario. The work was carried out to evaluate the potential impacts during operation and following decommissioning of the facility.

SELECTED PROJECT EXPERIENCE – CONTAMINATED INDUSTRIAL SITES

ICI
Nobel, ON

Hydrogeological assessment of groundwater and surface water quality at the former ICI explosives and war productions plant near Parry Sound, Ontario for ICI Canada. The program included assessment of groundwater and surface water quality impacts and removal of buried underground fuel storage tanks. The results of the investigations were submitted to the Ontario Ministry of the Environment as part of the site decommissioning.

Ford Motor Company
North York, ON

Dewatering of a groundwater collection gallery and discharge of the contaminated (chlorinated solvent) wastewater to the municipal sewer system (under special conditions), at the Ford Motor Company Plant in North York, Ontario.

Shell Oil
North York, ON

Dewatering of a groundwater collection gallery and discharge of the contaminated (chlorinated solvent) wastewater to the municipal sewer system (under special conditions), at the Ford Motor Company Plant in North York, Ontario.

Beaver Lumber
Cole Harbour, NS

Excavation of underground storage tank (fuel oil) at the Beaver Lumber store at Cole Harbour, Nova Scotia. The results of the investigation favoured Beaver Lumber, by indicating that damage to the store was due to lack of delivery of the fuel supplier rather than leakage from the site fuel storage tank.

ICI Surfactants
Oakville, ON

Hydrogeological impact assessment of cadmium concentrations in groundwater at the ICI Surfactants (formerly Atkemix) site in Oakville, Ontario. The results of the monitoring were submitted to the Ministry of Environment and Energy for regulatory purposes.

Bata Footwear
Batawa, ON

Participation in the hydrogeological investigation of chlorinated solvent contamination of a bedrock limestone aquifer at the Bata Footwear plant site in Batawa, Ontario. The results of the hydrogeological impact assessment were submitted to the Ministry of Environment and Energy and used during subsequent legal proceedings to determine financial liability of Bata Footwear for the groundwater contamination.

Niagara Recycling Centre
Niagara Falls, ON

Project Director and senior hydrogeologist for the annual operational and monitoring programs for a hydrogeological work program involving groundwater contaminated with chlorinated solvents at the Niagara Recycling Centre related to prior industrial land use. The work program involved operation of the groundwater injection remediation system, assessment of subsurface contamination and preparation of annual monitoring reports.

Rankin Construction Fill Management Plan
Port Colborne, ON

Project Director and senior geoscientist for the development of a fill management plan for Pit 1 at the Rankin Construction Port Colborne Quarry. The program included a plan to take excess fill from the area to fill Pit 1. This included a sampling and reporting program to meet MECP requirements.

SELECTED PROJECT EXPERIENCE – OIL & GAS

Assessment of Natural Gas Storage Potential
Lake Erie, ON

Project Manager for an assessment of the potential for natural gas storage on Crown Lands beneath Lake Erie. The study involved the assessment of natural gas reservoirs to evaluate their suitability for use as gas storage facilities. Estimated available storage volumes were provided for each of the reservoirs.

Assessment of Natural Gas Storage Potential
Southwestern Ontario

Project Manager for an evaluation of the hydrocarbon resources in Southwestern Ontario for the Petroleum Resources Centre of the Ministry of Natural Resources. The study included the interpretation and mapping of pool boundaries for major pools, calculations of in place and recoverable reserves, tabulation of reservoir characteristics, and estimation of potential hydrocarbon resources in the Ordovician strata of southern Ontario.

SELECTED PROJECT EXPERIENCE – MUNICIPAL GROUNDWATER STUDIES

Groundwater Study for the County of Victoria
ON

Project Director and senior hydrogeologist for a large-scale groundwater study for the County of Victoria with funding from the Provincial Water Protection Plan (PWPP). The work program involved a groundwater resource assessment, evaluation of existing groundwater usage, contamination assessment, development of management options and protection strategies, and an economic evaluation.

Groundwater Study for the City of Stratford
ON

Project Director and senior hydrogeologist for a Groundwater Study for the City of Stratford involving an assessment of groundwater resources, source of contamination, pump testing of deep wells in limestone bedrock, and development of groundwater management options and protection strategies.

Simcoe and South Simcoe Groundwater Studies
ON

Provided specialist hydrogeological services for both the North Simcoe Groundwater Study and South Simcoe Groundwater Study. The work program involved a characterization of the hydrogeology of the study areas and numerical groundwater modelling of Well Head Protection Areas for municipal wells (WHPAs).

SELECTED PROJECT EXPERIENCE – KARST

Nelson Quarry Extension
ON

Project Director and Senior Hydrogeologist for karst assessment of the proposed Nelson Quarry extension that involved mapping of the Amabel Formation along the exposed cliff faces of the Mount Nemo outlier, identification of karstic springs in the Medad Valley and associated water courses, mapping of karst features along more than 1 km of exposed quarry faces. Examination of surface karst features including sinkholes and internal drainage were mapped in the area of the quarry. An ERI (Electrical Resistivity Imaging) survey was conducted over a linear distance to identify potential anomalies that could represent karstic features. Boreholes were drilled into the karstic features to evaluate karstic conditions. The boreholes were video logged along the length of the hole to evaluate karstic features such as solution enlarged fractures and voids. The flow in the boreholes were pumped and logged during an impeller flow meter to assess inflow into boreholes from potential karstic features. An array of 8 wells and a pumping well were drilled to conduct a tracer test using fluorescein dye. The dye was injected into the wells and the travel time and dye concentrations were recorded to evaluate karstic flow paths and velocities. The results were incorporated in a report submitted as part of the regulatory approvals process and presented and defended at an Ontario Municipal Board hearing.

Proposed Redland Quarries Landfill
ON

Project Hydrogeologist for a karst study as part of a geological and hydrogeological evaluations of a proposed hydraulic containment engineered landfill facility in a quarry near Dundas, Ontario. The karst study involved examination and evaluation of karstic features in the vicinity of the quarry including solution-enhanced weathering and extensive network of surficial dolostone plain, and examination of epi-karst on more than 1 km of quarry faces including solution enlarged and materialized vertical joints. The results of groundwater level monitoring results were evaluated for patterns indicative of presence of karst including rapid rises in groundwater levels (‘spiking’). Pump tests were analysed to evaluate the drawdown and recovery responses characteristic of karst.

Proposed Dundas Quarry Extension
ON

Project Director and Senior Hydrogeologist for a karst assessment as part of a hydrogeological work program for the approval of an application for a large dolostone quarry near Dundas, Ontario. The work program involved an ERI surface geophysical survey along more than 500 m of line to test for potential karstic anomalies. Boreholes were drilled in the areas of identified anomalies to evaluate the potential presence of karst. The faces of the quarries were also examined for layers of karstic groundwater inflow. The results of the karst study have been peer reviewed and are currently being used in support of the license application for quarry expansion.

Karst Remediation
Hamilton, ON

Senior Hydrogeologist for a karst assessment of a remediated industry site in the area of the Eramosa Karst Conservation Area in Hamilton, Ontario. The work program involved a review of literature on karst in the area. An inspection of the karstic features includes sinkholes, internal drainage and inferred subsurface karstic flow pathways was undertaken in areas around the site. A report in support of a property transaction was provided to regulatory authorities and agencies.

Brow Landfill Monitoring Program
ON

Project Hydrogeologist for an assessment of leachate seepage from an industrial solid waste landfill along karstic flow pathways including epi-karst, solution weathered vertical joints and horizontal fracture networks. The assessment involved monitoring of the flow rates from leachate springs and water quality of springs.

Hydrocarbon Reserve Evaluation
Southwestern Ontario

Project Director and Senior Geologist/Hydrogeologist for the estimation of hydrocarbon reserves in Southern Ontario for the Petroleum Resource Centre of Ontario Ministry of Natural Resources. The work program involved extensive analysis of karstic reservoirs formed and dolomitization from solution weathering and collapse along vertical joints and horizontal sub horizontal fracture networks. Prepared a report summarizing the study and provided to the MNR as a commercial publication.

SELECTED PROJECT EXPERIENCE – LAND DEVELOPMENT AND INFRASTRUCTURE

Peer Review, Town of Caledon
Caledon, ON

Peer review of the hydrogeological work program for a proposed residential development in Palgrave for the Town of Caledon planning department. The work program involved review of hydrogeological reports, discussions with the Town and preparation of a peer review reports with recommendations.

Peer Review, Town of Caledon
Caledon, ON

Peer review of the hydrogeological and geotechnical work program for a proposed residential development in Beaverhall for the Town of Caledon planning department. The work program involved review of hydrogeological reports, discussions with the Town and preparation of a peer review reports with recommendations.

Niacon Construction
Niagara-on-the-Lake, ON

Hydrogeological assessment of the potential impacts associated with the development of an infrastructure for a zipline facility along the Niagara river at Thompsons Point. The work program involved an evaluation of the potential for reduction of groundwater seepage along the Niagara Gorge and related environmental effects. A report was prepared that was submitted to agencies as part of the regulatory approvals process.

Time Developments
Niagara Falls, ON

Senior hydrogeologist for the hydrogeological assessment of the existing conditions and potential impacts associated with the development of a condominium adjacent to the Niagara River in Niagara Falls. The work program involved borehole drilling, monitoring wells installation, groundwater level monitoring and assessment of groundwater levels and flow directions. The results of the work program were incorporated into a geotechnical and hydrogeological report.

Time Developments
Niagara Falls, ON

Phase 1 and Phase 2 Environmental Site Assessments (ESA) for regulatory approval for condominium development on River Road in Niagara Falls, Ontario. The work program involved test pitting and surface sampling as well as collection and analysis of soil and water samples and evaluation of potential soil and water contamination.

AECOM Oakville, ON	Hydrogeological assessment of the excavation and construction of a water pumping station in till and bedrock adjacent to a surface water course. The work program involved borehole drilling, monitoring well installations, hydraulic conductivity testing and a hydrogeological assessment of impacts on surrounding private wells associated with construction dewatering.
Geranium Homes Woodview Development ON	Hydrogeological assessment in support of approval for a proposed residential development involving borehole drilling, monitoring well installations, hydraulic conductivity testing, groundwater level monitoring, determination of groundwater levels and flow directions and a hydrogeological impact assessment involving a water balance to evaluate reduction in infiltration and potential interference with surrounding water wells and effects on an adjacent provincially significant wetland. Participated in meetings with the TRCA as part of the approvals process. A report was prepared in support of the approvals process.
Geranium Homes Altona Development ON	Hydrogeological assessment in support of approval for a proposed residential development. The work program involved borehole drilling, monitoring well installations, groundwater level monitoring, development of a water balance and a hydrogeological impact assessment. A report was prepared in support of the application.

Golder Associates Ltd. – Canada

Education

B.Sc. Civil Engineering, University of Waterloo, Ontario, 1988

M.A.Sc. Civil Engineering, University of Waterloo, Ontario, 1990

Mr. Scott Donald, M.A. Sc., P.Eng. (Mining)

Mr. Donald is a Principal and Senior Hydrogeologist with Golder Associates, and a specialist in numerical, analytical and statistical analysis of hydrogeological processes. He has over 30 years of experience applying numerical and analytical techniques to the solution of groundwater flow and solute transport problems over a wide range of projects. Over much of this time these skills have been primarily applied to the mining industry where he has directed or played a leading role in assessing potential hydrologic and hydrogeologic impacts and issues related to the development of new mines or in the mine closure process. This includes issues related to mine water balance, dewatering, aquifer depressurization, and modelling of seepage / solute transport from waste rock piles and tailings facilities. Mr. Donald's project experience includes conceptual hydrogeological model development and groundwater modelling simulations to address mine operation and closure issues for: oilsands operations in Northern Alberta (e.g., Syncrude's Base Mine and Aurora North operation; CNRL Horizon and the Fort Hills project; Teck's proposed Frontier Project, etc.); uranium mine operations/closure studies in Northern Ontario (Denison and Stanrock Mine) and Northern Saskatchewan (Key Lake, Rabbit Lake, Cigar Lake and McArthur River); tailings design/seepage optimization studies in South America (Newmont's proposed Conga Project in Peru, the Pachon project in Argentina, the Gramalote and Quebradona Projects in Columbia; and the Penasquito Project in Mexico). Mr. Donald was also responsible for the development a 3D finite element groundwater model (HydroGeoSphere) for the Brukunga Mine Rehabilitation Program near Adelaide, Australia to evaluate the long-term sustainability of a co-disposed tailings and waste rock facility. For many of the above projects, Mr. Donald has represented the hydrogeological and/or groundwater modelling component of the work at public hearings and/or through expert review panels as part of the formal review process.

PROJECT EXPERIENCE – CONCEPTUAL HYDROGEOLOGICAL MODEL DEVELOPMENT & GROUNDWATER MODELLING

Fort Hills Oil Sand Project EIA
Fort McMurray, Alberta, Canada

Responsible for the technical direction and review of groundwater modelling work completed in support of the Fort Hills Oil Sands Project EIA and associated engineering studies. The work involved an assessment of the impacts of mine development including: dewatering of surficial aquifers; depressurization and re-injection of basal water sands water; management of seepage from an out-of-pit tailings area and the change in groundwater/surface water interactions. Represented the hydrogeological component of the EIA through the public hearing process in Fort McMurray.

Teck Frontier Project EIA
Alberta, Canada

Task leader for the hydrogeological component of the Application. Work involved the development of baseline conditions, construction and calibration of a groundwater flow model and the completion of predictive simulations to support the impact assessment. Estimates of basal aquifer depressurization, overburden dewatering and seepage from tailings storage areas were developed from these calculations. A key component was to establish a sustainable closure landscape recognizing long term seepage from the external tailings disposal areas.

Rabbit Lake In-Pit Tailings Management Facility
Rabbit Lake Mine, Saskatchewan, Canada

Project Manager for completion of a detailed performance assessment of the Rabbit Lake In-Pit Tailings Management Facility. Work included the completion of detailed 3-D groundwater flow and solute transport modelling, and site-wide mass loading estimates derived from the disposal of Cigar Lake Ore Type tailings at the Rabbit Lake site. Source areas considered include waste rock piles and uranium tailings. Environmental fate and transport of metals and radionuclides in both porous media and fractured rock environments were simulated. This work subject to both provincial and federal regulatory review.

Gaertner Pit Waste Rock Disposal Scheme
Key Lake, Saskatchewan, Canada

Team leader for the preparation of decommissioning plans for waste rock at Cameco's Key Lake Mine. Work included mass balance modelling for nickel-rich waste rock deposited in the mined-out Gaertner Pit, as well as relatively clean waste rock above-grade around the perimeter of the pit. Pump and treat time frames and mass loading estimates to the treatment plant were estimated.

Deilmann In-Pit TMF
Key Lake, Saskatchewan, Canada

Project Manager for the completion of detailed groundwater flow and solute transport modelling, supporting Cameco's EIS for the placement of uranium mine tailings in the mined-out Deilmann Pit at Key Lake. Regional and local scale 3-D flow models were developed using MODFLOW to gain a better understanding of the regional groundwater flow system and the detailed distribution of flow in and adjacent to an underground tailings facility. Detailed 2D and 3D flow and solute transport models of the proposed in-pit tailings management facility were then constructed and used to evaluate design cases which included direct placement of tailings in the host sandstone bedrock, placement of tailings within a full pervious surround of coarse rock and filter sand and the placement of tailings within the host rock with a side and bottom drain configuration only.

Cigar Lake Project
Saskatchewan, Canada

Detailed numerical modelling was conducted in support of an EIS submission for the Cigar Lake mine. Both regional and local scale 3-D models were constructed using MODFLOW to gain a better understanding of regional groundwater flow systems and the local groundwater regime in the vicinity of the proposed underground tailings basins. The numerical models were used to predict inflows to the underground facilities during construction and operational phases and to identify potential receptors downgradient of the facilities. Solute mass loadings from the tailings facilities to the identified receptors were estimated using a combination of particle tracking techniques and POLLUTE, an analytical model which established the solute mass fluxes at the interface between the tailings and the host sandstone bedrock. Sensitivity analyses were performed to establish the impact of a low permeability sand-bentonite cap placed on top of the tailings at closure.

Mildred Lake Closure Plan
Fort McMurray, Alberta, Canada

Project Manager for completion of a hydrogeological assessment of Syncrude's proposed Closure Plan for the Mildred Lake facility. Work involved the development of 3-D groundwater flow and solute transport models for the proposed closure landscape including both above grade and in-pit tailings disposal systems, and coke storage areas.

OPTI Long Lake Project EIA
Fort McMurray, Alberta, Canada

Responsible for the technical direction and review of groundwater modelling work completed in support of the Long Lake Project EIA and associated engineering studies. The work involved an assessment of water supply for the SADG operations and the potential environmental impacts associated with groundwater withdrawals and the injection of waste water in the basal water sands.

Falconbridge Smelter Area Closure Plan
Falconbridge, Ontario, Canada

Hydrogeological team leader for a large multi-disciplinary study to develop closure plans for Falconbridge's smelter operations in Falconbridge, Ontario. Development of an effective closure plan required the successful integration of geochemical, hydrogeological, water treatment and surface water issues. 3-D numerical groundwater flow modelling was used to identify the direction of solute migration in groundwater from tailings source areas and to evaluate alternative pump and treat remediation schemes.

Brukunga Mine Closure Plan
Australia

Responsible for the development of an integrated groundwater – surface water numerical model (HydroGeoSphere) to support evaluation of alternative closure strategies for disposal of co-mixed ARD mine rock and tailings. Key to the development of the closure plan was maintaining saturated of the co-disposed material under future climate variability.

Denison and Stanrock Mine Closure Plans
Elliot Lake, Ontario, Canada

Responsible for the completion of detailed 3-D groundwater flow modelling (MODFLOW) at the Denison and Stanrock Mines. Flow modelling was used in the mine closure development process to estimate seepage rates in the project area for several alternative mine closure plans.

Agrium Phosphate Mine
Kapuskasing, Ontario, Canada

Constructed a 3-D groundwater flow model for a proposed phosphate mine in Kapuskasing, Ontario. A parametric analysis (with respect to aquifer storage and hydraulic conductivity) was completed to evaluate pre-dewatering requirements and provide input to the overall mine water budget.

Mildred Lake G-Pit Area
Fort McMurray, Alberta, Canada

Project Manager responsible for the development of a dewatering design for Syncrude's G-Pit borrow area. Work included the geological interpretation of channel deposits and the potential impact of dewatering on a large aboveground tailings impoundment.

Cigar Lake Mine Inflows
Cigar Lake, Saskatchewan, Canada

Constructed a simplified 3-D groundwater flow model to complete a parametric analyses of potential maximum groundwater inflows to the underground mine workings. These scoping level calculations were completed to provide a preliminary indication of potential water treatment requirements.

Mildred Lake T-Pit Area
Fort McMurray, Alberta, Canada

Responsible for the direction of a detailed technical assessment of the T-Pit aggregate borrow area at Syncrude Canada's Mildred Lake Operations. A deep sand and gravel paleochannel above the McMurray Formation oilsands was mapped and a 3-D numerical model constructed, in order to optimize the design of the dewatering system required. Design optimization required consideration of time frames for dewatering, and location of the dewatering wells.

Aurora East Mine Overburden Aquifer Test Analysis Fort McMurray, Alberta, Canada	Project Manager for the analysis of a long-term aquifer test (trench dewatering) in a surficial sand and gravel deposit. A 2-D numerical model was constructed and calibrated to monitoring results at over 6 monitoring well locations. The calibrated numerical model was used to estimate aquifer parameters and subsequently to evaluate alternative dewatering schemes for the entire deposit. Alternative dewatering layouts were provided that allowed for effective dewatering of the aquifer for different time frames under consideration by Syncrude.
Potash Corporation of Saskatchwan, Closure Plans Saskatchewan, Canada	Task leader for the completion of regional and local scale numerical groundwater flow models at five potash mines in Saskatchewan: Rocanville, Allan, Cory, Patience Lake and Lanigan Mine. Numerical modelling was completed to provide an understanding of regional and local scale groundwater flow conditions and to support the development of closure plans for each mine. Density dependent flow modelling was completed at a local scale in order to estimate the impact of the brine ponds present on surface at each location.
Conga Project Cajamarca, Peru	Responsible for the direction of the conceptual hydrogeological model and subsequent numerical modelling to help optimize the design of the tailings management facilty. Design optimization required consideration of extent and nature of liner design requirements, detailed characterization of the saprolitic soils and underlying limestone terrain, and evaluation of the downstream seepage collection systems. The modelling assessment considered solute transport from the tailings facility using a combination of FEFLOW and GoldSim.
Pachon Project Tailings Design Argentina	Together with the Project Engineering Geologist, responsible for the development of the regional conceptual hydrogeological model and numerical FEFLOW groundwater model to assess risks associated with seepage from the tailings facility. The majority of the proposed facility is underlain by intrusive bedrock, though upstream portions required characterization of karstic topography and its interaction with alluvial deposits in the valley bottom.
AngloGoldAshanti Gramalote Mine Project Colombia	Responsible for the technical direction of the hydrogeological team developing the site wide conceptual model, and the regional scale numerical modelling. Design input included: groundwater inflows to the two open pits; seepage from the waste rock piles; and seepage control measures for the tailings facility. Detailed characterization of springs and seeps served to constrain the water balance estimates and support the modelling assumptions; while extensive sensitivity analyses helped frame the potential range of seepages to consider in the design of the facilities.
Newmont Penasquito Project Mexico	Responsible for the technical direction of the hydrogeological team developing the conceptual hydrogeological model for the tailings facility at the Penasquito Mine, including scoping and execution of the field characterization program and subsequent development and application of a 3D numerical groundwater flow model (using HydroGeoSphere). Program objectives were to provide design input related to TMF engineering, including stability analyses and seepage management.

PROFESSIONAL AFFILIATIONS

Registered Professional Engineer, Ontario

Golder Associates Ltd. – Canada

Education

M.E.Sc. Environmental Engineering, University of Western Ontario, Ontario, 2018

B.E.Sc. Civil-Environmental Engineering, University of Western Ontario, Ontario, 2016

Professional Affiliations

Registered Professional Engineer, Ontario

Geo-Environmental Engineer

Hayley is a geo-environmental engineer with Golder Associates. Her experience is in the fields of water resources and hydrogeology, specializing in numerical modelling. Her project experience is in conceptual and numerical groundwater and groundwater-surface water flow model development for hydrogeologic investigations. She has provided technical support for projects utilizing FEFLOW, MODFLOW, Groundwater Vistas, HydroGeoSphere, GoldSim, Surfer, and QGIS. Hayley also has experience with application of field techniques for groundwater monitoring and sampling, and aquifer test analysis related to water supply permitting.

PROJECT EXPERIENCE – NUMERICAL GROUNDWATER MODELLING

Hydrologic Modelling of the Osprey Quarry
Ontario, Canada

Involved in conceptual and numerical model development for a transient groundwater- surface water model developed using the HydroGeoSphere (HGS) code, for the Osprey Quarry site in Ontario. This work included site characterization, transient calibration to 10 years of site surface water and groundwater monitoring data, and forecast simulations of quarry development under several climate scenarios. The model was used estimate the potential impacts of future quarry development on surrounding groundwater and surface water features, as part of the quarry's Adaptive Management Plan (AMP).

Cameco Key Lake Leapfrog Model Development
Saskatchewan, Canada

Involved in updated the conceptual site model using historic and recent drilling data and constructing a 3D Leapfrog model for the Key Lake Mill Terrace Groundwater Model domain. This involved review of site information, data processing to create geologic unit surfaces, and use of the Leapfrog model to refine and populate the 3D HydroGeoSphere (HGS) model. The results of this study were used to evaluate water management options.

Cameco Rabbit Lake Tailings GoldSim Modelling
Saskatchewan, Canada

Involved in simulating solute mass loading from source areas to various downgradient receptors using the Rabbit Lake GoldSim model. The work involved utilizing flow rates derived from groundwater flow modelling as inputs to the GoldSim model and simulating seven different model scenarios with variable source concentrations and volumes. The results of this component of the study assisted in the process of evaluating potential long term impacts and management practices.

City of Barrie Risk Municipal Water Supply Risk Assessment Modelling
Ontario, Canada

Involved in reviewing and updating groundwater model files for two existing groundwater models covering the City of Barrie (MODFLOW and FEFLOW) to reflect several potential future pumping scenarios for the municipal water supply system. This involved assessment of simulated potential changes to groundwater flow patterns and pressures in the municipal aquifer. The results of this study will be used as part of a groundwater drinking water system contingency plan for the City of Barrie.

Quaternary Groundwater Seepage Modelling of the Horizon Oil Sands Mine
Alberta, Canada

Involved in building, calibrating, and modelling long-term post-closure groundwater heads and flows within the mine closure landscape, using an FEFLOW model. This work involved modelling long term groundwater seepage rates and flow directions from the mine structures to potentially sensitive receptors for several climate scenarios. The results of the study are used in conjunction with results of water quality modelling as part of the reclamation planning submitted to the Alberta Energy Regulator (AER).

Simulating Large Scale Dewatering of Hardy Mine Pit Lake
Ontario, Canada

Involved in building, calibrating, and modelling the large-scale dewatering of a mine pit lake, using a FEFLOW model. This work involved characterization of the conceptual geology and building a geologic model using Leapfrog Works. Model simulations of several largescale dewatering options were conducted, including assessment of dewatering rates and potential impact of the water taking. The results of the study will be used in conjunction with construction cost estimates, in an options analysis process.

PUBLICATIONS

Journal Articles

Wallace, H., Wexler, E.J., Malott, S., Robinson, C.E. (2021). Evaluating lacustrine groundwater discharge to a large glacial lake using regional scale radon-222 surveys and groundwater modelling. *Hydrologic Processes.* https://doi.org/10.1002/hyp.14165

Wallace, H., Ji, T., & Robinson, C. E. (2020). Hydrogeological controls on heterogeneous groundwater discharge to a large glacial lake. *Journal of Great Lakes Research*, *46*(3), 476-485.

Other

Wallace, H. and Robinson, C.E. (2020). Assessment of nearshore groundwater discharge to Lake Simcoe, Ontario and identification of regional hydrogeological controls. In Russell, H.A.J. and Kjarsgaard, B.A. Eds. Southern Ontario groundwater project 2014-2019 summary report. Geological Survey of Canada, Open File 8536. https://doi.org/10.4095/321105

Golder Associates Ltd. – Cambridge

Education

Master of Science (Water), Earth Science, University of Waterloo, Waterloo, 2019

Bachelor of Applied Science Geological Engineering (Water Resources Option, Honours), University of Waterloo, Waterloo, 2014

Paul Menkveld, M.Sc., EIT, Environmental Scientist

Mr. Menkveld is an Environmental Scientist and Engineer in Training in the Geoscience Group at WSP Golder's Cambridge office, with more than 7 years experience in engineering consulting and hydrogeology. He is a graduate of the Geological Engineering (B.A.Sc.) and Master of Science (M.Sc.) programs at the University of Waterloo.

During Mr. Menkveld's 6 years at WSP Golder, he has built meaningful experience in hydrogeologic investigations, aggregate licencing, water supply investigations, and project management. He is a skilled hydraulic and aquifer test analyst and has extensive field experience to support lithological and hydrogeological characterization.

Employment History

WSP Golder – Cambridge, Ontario

Environmental Scientist (2016 to Present)

Responsible for the coordination, implementation, analysis, and reporting of hydrogeology projects for a range of applications including: aggregate operations, construction dewatering, municipal water supply, environmental assessments, and land development. Developed project management skills to collect comprehensive environmental data on interdisciplinary teams for permit applications, amendments, and compliance monitoring. Mr. Menkveld has consistently managed projects with attention to detail to implement best practices and meet client expectations.

Mr. Menkveld has coordinated, supervised, and conducted field work including: borehole drilling, soil sampling (including brown field sampling), monitoring well installations, aquifer testing, groundwater sampling, and surface water sampling

University of Waterloo, Earth and Environmental Science Department – Waterloo, Ontario

Researcher (M.Sc. and follow up) (2014 to 2019)

Award winning researcher and conference speaker on the topics of recharge and physical hydrogeology. Mr. Menkveld managed a research project with a significant budget, team, and external partners. During the research program Mr. Menkveld designed field and lab experiments to gather detailed datasets to observe complex recharge processes and their impact on shallow aquifers and well vulnerability. Following the completion of his M.Sc., Mr. Menkveld has continued to support the research group and its initiatives.

WSP Golder – Mississauga, Ontario

Hydrogeological Engineering Intern (2013)

Collaborated in the preparation, execution, and post-processing of numerical models including MODFLOW and FEFLOW to solve physical flow and contaminant transport analyses. Mr. Menkveld built site scale hydrostratigraphic

models, performed a variety of hydrogeological analyses including slug, rising head, and pump tests. He also used VBA and C++ code to analyze data sets, process data files, and prepare figures efficiently.

WSP Global Inc. (formerly GENIVAR and Jagger Hims Ltd.) – St. Catharine's, Ontario

Environmental Engineering Intern (2012)

Performed data analysis, figure preparation, and technical report writing to support landfill monitoring, aggregate extraction, environmental assessments, and groundwater monitoring. Mr. Menkveld conducted a wide variety of field work including ground water monitoring and sampling, supervising drilling and logging in overburden and bed rock, stream gauging, and surface water sampling.

GeoSolv Design/Build Inc. – Aurora, Ontario

Engineering Intern (2012)

Supervised large construction sites during the geotechnical soil improvement stage and coordinated projects with contractors, clients, drillers, and suppliers to maximize project efficiency. Mr. Menkveld supervised the successful application of specialized geotechnical techniques including helical screw piles and rammed aggregate piers.

BMRoss and Associated Ltd. – Goderich, Ontario

Undergraduate Engineer (2010)

Responsible for performing site inspections of infrastructure projects, and CAD drafting of projects such as bridges and water treatment plants.

PROJECT EXPERIENCE – HYDROGEOLOGY

Aggregate Extraction Site Baseline Monitoring Brantford, Ontario, Canada	Project manager of a multi-year baseline surface water and groundwater data collection, permit to take water application, and revision of threshold triggers for extraction. Monitoring was conducted to characterize the groundwater flow system and surface water features on the site to support dynamic management of operations and mitigate environmental impacts.
Cameco Port Hope Aquifer Vulnerability Mapping Ontario, Canada	Developed a site conceptual model, scored aquifer vulnerability of surface contamination, and mapped vulnerability to support regulatory requirements for the protection of groundwater resources at nuclear facilities.
Metrolinx Subway Design and Permitting Ontario, Canada	Supported the hydrogeology and dewatering scope of the project, which included development, single well response testing, groundwater, and headspace sampling, to support design and dewatering calculations.
Niagara Region Closed Landfill Improvements Ontario, Canada	Project's scope included investigative drilling to characterize leachate, observe groundwater conditions, and the use of sheet piles to protect surface water receptors. Supervised field work, including responding to encountered leachate gas and artesian groundwater conditions.
Niagara Region Closed Landfill Monitoring Ontario, Canada	Performed groundwater and surface water monitoring and sampling at various closed landfills in the Niagara Region.
NWMO Ignace Phase 2 Geoscientific Preliminary Field Investigations Ontario, Canada	Supervised drilling operations and fluid management of a deep borehole for preliminary deep geologic repository studies for the Nuclear Waste Management Organization. Responsibilities included managing fluid quantities, specifics of drill operation, preparation of tracer tagged drill water, preliminary borehole geophysics, and site supervision.
NWMO Bruce Power Deep Geologic Repository Baseline Monitoring Ontario, Canada	Performed monitoring, sampling, maintenance, and troubleshooting of Westbay systems to complete baseline hydrogeologic monitoring, for the Nuclear Waste Management Organization.
Agnico Eagle Mining, Meliadine Nunavut, Canada	Responsible for core logging, fluid management, preparation of drill fluid with a tracer, packer testing, and project coordination at a remote helicopter access location.
Cambridge Zone 3 Monitoring Well Construction Ontario, Canada	Supervised the drilling, construction, hydraulic testing, and sampling of three bed rock monitoring well nests, including karst features.
Maryhill Supply Well Drilling Ontario, Canada	Supervised drilling, including wireline PQ coring and tricone mud rotary methods, of a municipal supply wells. Prepared borehole logs and supervised hydraulic testing the well.

Colour Paradise Greenhouses Research Site, Manheim, Ontario, Canada

Conducted an extensive field program to assess the vulnerability of a shallow screened well to transient surface water features. During the course of this research program the field work included: well installation, time domain reflectometry, stream gauging, meteorology station deployment, geophysical soil moisture measurements, optical surface water tracking, groundwater sampling, resistivity measurements, and Guelph Permeameter operation. Lab work included, sieve analysis, permeameter, moisture content analysis, and the construction of a high accuracy Buchner Funnel apparatus.

Technical Advisory Group for Chemtura, Elmira, Ontario Ontario, Canada

Participated in the public review of technical proposals for the remediation of a highly contaminated aquifer, as a member of the Technical Advisory Group, Chemtura Public Advisory Committee. Mr. Menkveld contributed to meetings including government, consultants, industry, and the public stakeholders during a challenging political process.

TRAINING

NSERC Short Course in Reactive Transport Modelling
University of Waterloo, February 2015

PUBLICATIONS

Thesis

Menkveld, Paul G. and Rudolph, David, L., 2019. *A field study of event based, seasonally affected, depression focused recharge in glaciated terrain*, University of Waterloo, Department of Earth and Environmental Sciences, 2019 March. Waterloo, Canada.

Articles

Wiebe, Andrew J.; Menkveld, Paul G.; Hillier, Cailin E.; Mesec, Emilie; Rudolph, David L., 2019. *Meteorological and hydrological data from the Alder Creek watershed*, Grand River basin, Ontario. Federated Research Data Repository, https://doi.org/10.20383/101.0178.

Wiebe, Andrew , Paul Menkveld, Ehsan Pasha, Jacqueline Brook, Mike Christie and David Rudolph. Impacts of Event-based Recharge on the Vulnerability of Public Supply. Sustainability, 13(14) (2021), 7695.

Education

Bachelor of Applied Science Civil Engineering, Queen's University, Kingston, Ontario, 2020

Languages

English – Fluent

Golder Associates Ltd. – Mississauga

Junior Water Resources Engineer-in-Training (E.I.T)

Maxwell Robinson is a Junior Water Resources Engineer-in-Training (E.I.T) with consulting experience in a wide range of water quality, hydrotechnical and fluvial geomorphic related investigations. Project experience includes supporting environmental compliance approval applications, water balance studies, hydrologic and hydraulic modelling, meteorological data analysis, and fluvial geomorphic assessments. He has also assisted in water quality sampling and monitoring stream flows during field campaigns.

Employment History

Golder Associates Ltd. – Mississauga, Ontario

Junior Water Resources Engineer- in-Training (E.I.T) (October 2020 to Present)

Responsible for conducting water quantity and water quality investigation programs that include hydraulic and hydrologic modelling, analysis of watersheds, and the development of water balance and water quality modelling analyses. Currently working on various environmental compliance approval applications and permit To take water applications. Completes water resources projects from desktop reviews to design as well as participating in field programs.

SCS Consulting Group Ltd. – Markham, ON

Cost Sharing Engineering Assistant (May 2019 to August 2019)

PROJECT EXPERIENCE – MUNICIPAL ENGINEERING

Client Confidential
Near Whitby, Ontario, Canada

Carried out a hydrologic budget assessment and reporting as part of the hydrogeological assessment for a proposed development of detached houses, townhouses, underground parking, a SWM pond, and a park. Analysed possible low impact development features including infiltration trenches and downspout disconnection.

Shining Hill Estates Collection Inc.
Aurora, Ontario, Canada

Carried out a hydrologic budget assessment and reporting as part of the hydrogeological assessment for a proposed development of detached houses, townhouses, school, and a park. Analysed possible low impact development features including rear-yard infiltration trenches, bioretention cells and downspout disconnection. Completed additional impact water budget analyses for the surrounding wetlands and watercourses.

PROJECT EXPERIENCE – HYDROLOGY

CBM Aggregates
Various Sites in Southern Ontario

Various aggregate properties have been monitored and evaluated for aggregate license applications. This monitoring included water level monitoring, stream flow monitoring, groundwater piezometer monitoring and meteorological monitoring. Detailed site water balances as well as site and water course characterization have been evaluate and reported as part of the multidisciplinary applications.

PROJECT EXPERIENCE – ENVIRONMENTAL ASSESSMENT AND PERMITTING

Marten Falls Community Access Road
Ontario, Canada

Provided desktop analysis assistance to the fluvial geomorphic studies of the watercourse crossings in support of the surface water conditions report and impact assessment to support the proposed all season road from Marten Falls to Nakina Ontario.

PROJECT EXPERIENCE – STREAM EROSION AND SCOUR ANALYSIS

Roc-Terra Soil Management Inc.
Stoufville, Ontario, Canada

Provided assistance to complete flood and erosion study of Willowgrove Creek in support of the fill management plan proposed for the adjacent extraction pit. Also assisted in design of stormwater channel to downstream receiving watercourse.

HDR Corporation - City of Brampton
Brampton, Ontario, Canada

Assisted in the Brampton Light Rail Transit (LRT) Environment Approval by providing fluvial geomorphology support for the proposed surface and subsurface options for an LRT line crossing over/under Etobicoke Creek. Conducted rapid geomorphic assessment of the creek, estimated scour depths and hazard limits, and assisted in conceptual design of several mitigation and erosion protection options.

Cooksville Creek Sanitary Sewer Crossing
Mississauga, Ontario, Canada

Provided assistance through fluvial geomorphology studies in support of a sanitary sewer connection in Mississauga. Conducted rapid geomorphic assessment of the creek, estimated scour depths and hazard limits, and assisted in conceptual design of several mitigation and erosion protection options.

PROJECT EXPERIENCE – ENVIRONMENT COMPLIANCE APPROVALS, WATER DISCHARGES

Linde Canada Inc.
Mooretown, Ontario, Canada

Assisted in preparing an Industrial Sewage Works (ISW) Environmental Compliance Approval (ECA) application.

West Carleton Sand & Gravel Inc. - Burntlands Quarry
Ramsay, Ontario, Canada

Assisted in preparing a Quarry Water Management (QWM) report in support of an Industrial Sewage Works (ISW) Environmental Compliance Approval (ECA) application and discharge capacity model for the receiving watercourse.

Lafarge Canada Inc. - Osgoode Quarry
Greely, Ontario, Canada

Assisted in preparing an Industrial Sewage Works Environmental Compliance Approval (ECA) application and discharge capacity model for the effluent receiver.

Lafarge Canada Inc. - Dundas Quarry
Dundas, Ontario, Canada

Assisted in preparing an Industrial Sewage Works Environmental Compliance Approval (ECA) Amendment application and settling analysis model of the quarry water management system based on quarry operating expansions. Also helped complete detailed design of pre-treatment SWM pond for the expansion area.

Lafarge Canada Inc. - Brechin Quarry Brechin, Ontario, Canada	Assisted in preparing an Industrial Sewage Works Environmental Compliance Approval (ECA) Amendment application and settling analysis model of the quarry water management system based on proposed flow rates.

TRAINING

Utility Vehicle Training Course
S.M.A.R.T. Adventure Programs, May 19, 2022

ATV Training Course
S.M.A.R.T. Adventure Programs, May 19, 2022

Standard First Aid with CPR/AED Level C
Heaven Can Wait - Emergency First Aid Training, June 4, 2022

Surface Miner Common Core Training
2021



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