Geotechnical Data Gap Analysis

Centre Block Project
Parliament Hill, Ottawa, ON

Prepared for:
Public Works and Government Services Canada
107 Sparks Street, Birks Building
Ottawa, ON K1P 5B5

Prepared by:
Stantec Consulting Ltd.
400-1331 Clyde Avenue
Ottawa, ON K2C 3G4

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Portions of the report not required for the solicitation have been removed.

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1.0 INTRODUCTION

It is understood that the PPB, a part of the PWGSC, is launching the Centre Block project as part of the planning, design and implementation of the projects in the Long Term Vision and Plan (LTVP). As part of the planning process for the Centre Block project, the intent of the proposed preliminary geotechnical investigation is to provide a basis for the development of concept stage options, to permit evaluation of geologic conditions on these options, and for each option to identify those areas for which there are not sufficiently detailed geotechnical data to permit the design to be developed for the next stage (design development stage).

This report comprises Phase 1 of the Centre Block planning process, and presents a desktop summary of the geotechnical data gathered from previous investigations, as well as gaps in the data which will require further investigation prior to the design phase. Suggestions for a geotechnical field investigation (Phase 2 of the Centre Block planning process) are provided.

Authorization to proceed was provided by Ms. Christine Oates of Public Works and Government Services Canada (PWGSC), under Contract No. EP764-150225/001/FE, on July 11th, 2014.

This report has been prepared specifically and solely for the Centre Block rehabilitation project which is described herein.

2.0 PROPOSED DEVELOPMENT

The subject site is the Centre Block, located on a promontory overlooking the Ottawa River between the West Block and the East Block on Parliament Hill. The Centre Block, built between 1916 and 1927 to replace the original Centre Block building destroyed by fire, is a symbol of Canada's highly regarded Parliamentary system. The Centre Block site and building in the Parliamentary Precinct is part of a designated National Historic Site and is also a Classified Federal Heritage Building. As such, it is the intention of the Government of Canada to maintain the Centre Block in perpetuity.

The Centre Block is founded on predominantly limestone bedrock with some veins of shale, with the majority of the foundations comprising poured unreinforced concrete walls bearing directly against bedrock.

It is understood that the design stage of the Centre Block project will include construction of the following:

- A new full basement level beneath the entire Centre Block (likely about 4 m high); this will require blasting rock and underpinning of existing foundations and possibly new foundations;
- Seismic upgrade (retrofit) of the Centre Block which has three distinct structural systems;
- New Centre Block Visitor Welcome Centre (immediately south of Centre Block, full length beneath the entire paved area in front of the Peace Tower) – excavation would be about 150 m by 40 m, extending 3 storeys below grade;

- New East Block Visitor Welcome Centre, north-northwest of the East Block Building, 3 storeys below grade;
- East Block Underground Services (EBUS) Building, 3 storeys below grade, north of East Block; and
- Tunnels and shafts to connect the West Block Visitor Welcome Centre to Centre Block Visitor Welcome Centre to East Block Visitor Welcome Centre – tunnels to be about 20 m below grade.

3.0 SCOPE OF WORK

The purpose of this report was to conduct a geotechnical desktop study of the available geotechnical data at the Centre Block. This includes the following:

- Review of existing geological information as it relates to the Centre Block project, and identify any gaps based on the project requirements;
- Conduct a review of the proposed works of the Centre Block project and identify the information that should be obtained based on the required geotechnical information;
- Prepare a report outlining the proposed preliminary investigation to acquire the required geotechnical information; and
- Identify potential environmental and archaeological impacts at the borehole locations and any required monitoring/testing program.

4.0 SITE TOPOGRAPHY

The Centre Block is located on the north side of Parliament Hill, located adjacent to the Ottawa River and Wellington Street in Ottawa, Ontario; the site is shown on the Key Plan, Drawing No. 1 in Appendix B.

The Centre Block is flanked to the east and west by the East Block and the West Block, respectively. Immediately to the south is a relatively flat landscaped area, which includes walkways and the Centennial Flame; further to the south is Wellington Street, approximately 3 to 4 m below the Centre Block elevation. To the northwest of Centre Block is the Centre Block Underground Services (CBUS), which is located up to 3 storeys underground. Immediately to the north of Centre Block is a relatively steep slope leading down to the Ottawa River (located approximately 40 m below Parliament Hill). A number of recreational paths are located at the top and bottom of the slope; in addition, the abandoned Lovers' Walk pathway encircles the area fronting the Centre Block approximately midway up the slope. Retaining structures associated with Lovers' Walk have been generally noted to be in poor condition, with evidence of path subsidence, loose blocks, etc. Ventilation tunnels, stairs, walls, terraced areas and buildings, generally in poor condition, are located throughout the slope. A staircase is present to the northwest of Centre Block; this staircase is in relatively good condition in comparison to the older structures.

Surveys of the grade show it to be sloped at roughly 2H:1V overall, with several sections steeper than 1H:1V (up to 50°). Some limestone outcrop cliffs are also present. The thin layer of talus and overburden covering the bedrock has undergone erosion and creep in the past, which is likely still occurring. Slope monitoring carried out by the NRC in 1985 showed that the total movement is relatively small, and that it is unlikely that mass block movements are occurring.

A number of statues and monuments surround the Centre Block.

5.0 BACKGROUND

Twenty two (22) geotechnical and/or subsurface reports and supporting documents were provided to Stantec by PWGSC, and are summarized below:

1. *Report by Stantec; Geotechnical Data Gap Analysis, Visitor Welcome Centre Phase 1, Parliament Hill, Ottawa ON, March 2013, Project No. 122410872;*
2. *Report by exp Services Inc.; Detailed Geotechnical Investigation Report, Visitor Welcome Centre Phase 1, Parliament Hill, Ottawa, ON, April 2014;*
3. *Report by Golder Associates; Parliament Hill Site Characterization Study, Ottawa, ON, June 2013, Project No. R.043542.001;*
4. *Report by Golder Associates; Geotechnical Investigation for Centre Block Ventilation Towers No. EP748-104383/001/FE, PWGSC Project No. R.010273.045, August 2010;*
5. *Report by Butts, Ross and Associates, Site Investigation Parliament Hill, June 1st, 1965;*
6. *Report by Wilf Ohlmann Geotechnical Services Ltd.; Borehole Investigation Report, Centre Block Parliament Hill, July 1985;*
7. *Report by Golder Associates; Centre Block Renovations, Phase 2A, Subsurface Geotechnical Investigation and Slope Reconnaissance Survey, April 1990;*
8. *Report by Fondex Ltd.;Foundation Investigation, Proposed Entrances, Speaker of the Senate, Parliament Buildings, Ottawa, Ontario, Nov 18, 1983;*
9. *Report by NRC Canada; Report A1-002613-02, 25 March 2013;*
10. *Report by NRC, Parliament Hill Slope Monitoring, October 1985;*
11. *Report by Surveyor, Nenniger and Chenevert, Subsurface Investigation, Service Tunnel, Centre Block Bypass, Dec 1, 1965;*
12. *Report by Golder Associates; Design Development, Renovations to Library of Parliament, October 1999;*
13. *Report by KIB Consultants + JV; Centre Block Ventilation Towers Rehabilitation, Concept Design Report, May 29, 2012;*
14. *Report by JD Paterson and Associate, Parliament Hill Parking Garage, October 2, 1967;*
15. *Report by Golder Associates; Subsurface Investigation, Proposed Television Studio, Parliament Hill, Ottawa, Ontario;*
16. *Figure showing Centre Block Basement Headroom;*
17. *Report by Golder VME; Test Blast Program for CBUS Facility, Ottawa, Ontario, May 1996;*
18. *Report by Golder VME; Results of Test Blast Program, CBUS Building Project, Ottawa, Ontario, December 1996;*

19. *Technical Paper by Carter, Pernica and M.V. van Bers; Response of Heritage Buildings to Excavation-Induced Vibrations;*
20. *Site Plan; Figure 1, Site Location Plan and Proposed Borehole Locations, April 2014, COE PWGSC;*
21. *Georeferenced CADD drawings of the proposed site; and*
22. *Report by Golder Associates Ltd.; As-Built Report, Centre Block Underground Services, Rock Excavation Aspects, Parliament Hill, Ottawa, Ontario, May 1998.*

Other project design documents discovered during the desktop study were also included in the background information.

6.0 SUMMARY OF SUBSURFACE CONDITIONS

The subsurface conditions referenced below were inferred from historical geotechnical reports provided to Stantec by PWGSC (as summarized in Section 5.0), as well as a recent geotechnical investigation carried out by Stantec which included boreholes advanced in support of the planned rehabilitation of the East Block. The location and ground surface elevation of relevant boreholes are shown on Drawing No.2 in Appendix B, with bedrock elevation and location of tunnels shown on Drawings No. 3 and 4, respectively. The location of all boreholes is approximate, and is based on historical data obtained from PWGSC. The historical borehole records are available in digital format from PWGSC.

In general, the stratigraphy consists of fill material underlain by shallow bedrock. Tunnels, both abandoned and in-use, are located throughout the Centre Block area.

6.1 OVERBURDEN

Surficial materials surrounding the Centre Block consist of asphalt pavement, concrete sidewalk, and landscaped grassed areas.

Extensive development on this site has resulted in the majority of the native overburden being replaced with fill. This fill is highly variable, and is typically less than 2 m thick. Native materials, where encountered, generally consist of glacial till (typically silty sand with gravel). Talus is present on the steep slopes to the north of Centre Block.

6.2 BEDROCK

Bedrock beneath the Centre Block area consists of limestone of the Verulam formation, underlain by limestone of the Bobcaygeon and Gull River formations. The depth to bedrock is variable, with deeper bedrock (up to 5.5 m below existing ground surface) noted to the north of Victoria Lookout (northwest of Centre Block), to the northeast of East Block and on the slope behind Centre Block (talus drifts), and shallower (generally less than 2 m) elsewhere. Deeper bedrock may be present near buried infrastructure and underground facilities. Bedrock elevation ranges from approximately 85 m to 88 m on most of the plateau, with a lower

elevation (roughly 79 m to 81 m) at the southeast corner of Centre Block. Bedrock drops sharply at the steep slope. Information on bedrock depths and elevations derives primarily from historical boreholes; as such, bedrock levels may have changed due to construction works.

The bedrock is of generally good quality. Typically, the upper 1 m to 2 m is weathered, although localized areas of deeper weathered bedrock exist (such as at the observed fault zone to the northwest of Centre Block, as described below). Bedrock may also be of poorer quality in the vicinity of any tunnels or service trenches, where blasting for rock excavation may have occurred. The rock has been noted as being near horizontally bedded (dipping to the south at approximately 5°), with shale interbedding and moderately to widely spaced joints (0.3 m to >1 m). Local weathering of the shale interbeds has resulted in undercutting in the vicinity of several limestone outcrops on the slope to the north of Centre Block. In general, RQD values for the rock are less than 50% for weathered bedrock, and in the 80% to 90% range for intact bedrock. RMR values for the Library of Parliament renovations were calculated by Golder to be in the vicinity of 68, with values of 40 for poorer quality rock areas (such as near the west Speaker's entrance, where a suspected fault may be present), while Q-values were calculated at 12.5 and 1.4 for good and poorer quality rock, respectively. Intact rock strengths are estimated to be 100 to 150 MPa on average, based on experience from other projects in this area.

Parliament Hill has been noted to contain several faults, including 5 near the West Block, and 1 along the Rideau Canal locks to the east of the East Block. Various minor faults were documented during the construction of the tunnels linking the East Block to the Chateau Laurier and to the NAC. Faulting was observed on the cliff face to the northeast of the Centre Block, and was documented in Golder report No. 801-2109, titled "Phase 1 Engineering, Geological Mapping and Geotechnical Considerations for Bedrock and Talus Slopes, Parliament Hill", and was included in documents relating to the renovation of the Centre Block (Golder, 1990). The presence of this fault has not been independently confirmed by Stantec.

6.3 GROUNDWATER

Groundwater levels in the vicinity of the Centre Block are based on historical measurements, and indicate the groundwater level to vary widely (less than 2 m to greater than 20 m below ground surface). In general, groundwater should be anticipated to be lower near buried infrastructure or near the cliff face. exp noted the potential for a perched water table to develop above the bedrock during heavy rains due to groundwater movement from south of Parliament Hill to the Ottawa River; this perched water table typically dissipates with time.

Due to their historical nature, the water levels given above should be considered only as approximate, and may not be an accurate representation of the current groundwater level. It should be noted that groundwater elevations are also expected to change based on time of year and in response to precipitation.

Updated groundwater levels should be taken in conjunction with Phase II and detailed design, as described in Section 7.8.

6.4 TUNNELS AND UNDERGROUND INFRASTRUCTURE

Portions of the report not required for the solicitation have been removed.

[redacted]

6.4.3 Abandoned Ventilation Ducts

A former ventilation tunnel (C1) runs west from the Centre Block and appears to exit on the cliff face near the former cat shelters. It is understood that the tunnel has been abandoned and is now filled with concrete. In 2002, J.D. Paterson advanced a borehole (BH1) through the tunnel roof. The tunnel crown was encountered at elevation 84.55 m (or 1.73 m below ground surface). The tunnel was constructed of cemented limestone, sandstone and brick blocks.

[redacted]

Another tunnel (C5) runs east from the Centre Block and appears to exit on the cliff face north of the East Block. It is understood that the tunnel has been abandoned and is now filled with unshrinkable fill and capped with a concrete wall.

[redacted]

[redacted]

6.4.6 East Block/Centre Block Tunnels

[redacted]

A pre-design report for the pedestrian tunnel (Burtts, Ross & Associates, 1965) indicates open-cut was most likely used in construction, and that the planned tunnel floor was at approximate elevation 263 feet (80.2 m).

A second pre-design report, presumably for the same tunnel (Fondex, 1989) indicates a tunnel base elevation of 81.99 m at Centre Block and 78.80 m at the East Block.

6.4.7 Centre Block Underground Services (CBUS)

The Centre Block Underground Services (CBUS) Building is located to the northwest of Centre Block, and extends three storeys below grade, with connections to Centre Block and various tunnels.

6.5 CENTRE BLOCK BASEMENT

A geotechnical investigation into the conditions at Centre Block basement was carried out by Wilf Ohlmann Geotechnical Services Ltd. in 1985. As part of this investigation, 13 boreholes were advanced through the basement slab (4 in lower floor locations, and the remainder in stepped up locations). The basement floor slab was found to be between 37 and 152 mm thick (average of 90 mm), while the overburden thickness beneath the slab varied between 490 mm and 830 mm for lower floor locations, and between 0 mm and 140 mm for stepped up locations. A borehole advanced near an interior column showed that the column is not supported by footings, but rather placed directly on the bedrock.

It is understood that portions of the Centre Block basement were excavated during construction of the CBUS; accordingly, conditions may have changed from the information given above.

The available headroom in the Centre Block basement varies from 1.0-1.5 m (primarily in the northwest corner and a portion near the south basement wall) to greater than 3.0 m (primarily in the southwest corner, and near the centre of the building.

7.0 DISCUSSION AND PRELIMINARY RECOMMENDATIONS

7.1 GENERAL

Based on discussions with PWGSC, it is understood that the Centre Block is to be rehabilitated. This work will include a seismic upgrade, subexcavation of the basement level, and construction of new Visitor's Welcome Centres (at both East Block and Centre Block).

The predominant geotechnical related features at this site include the following:

- Extensive development on this site has resulted in the majority of the native overburden being replaced with fill. This fill is highly variable.
- Native material (primarily silty sand with gravel till) was encountered discontinuously throughout the site.
- Bedrock at the site is relatively shallow, and generally consists of good to excellent quality limestone, with a weathered upper section.
- Although a large amount of geotechnical data is available at this site, much of it is historical; conditions may have changed since the original data was recorded due to construction activities.
- The site contains many utilities, both in-service and abandoned. Due to the relatively shallow bedrock, several utilities may have been installed in trenches or tunnels excavated into the rock. These service trenches may result in localized areas of deeper bedrock.
- The existing structures at the site, including the Centre Block, are sensitive to vibration and will require careful excavation sequencing and specialized rock excavation approaches.
- A steep slope is present to the north of the Centre Block; this slope has a history of creep.

7.2 FROST PENETRATION

The design frost penetration depth for the Ottawa area is 1.8 m. Foundations should extend to at least 1.8 m below ground surface or to bedrock (or equivalent insulation). The design frost penetration depth for foundations within 1.5 m of heated areas may be reduced to 1.5 m or to bedrock.

7.3 PRELIMINARY FOUNDATION RECOMMENDATIONS

New foundations for the proposed works, if required, are anticipated to be founded on spread footings on limestone bedrock.

7.3.1 Shallow Foundations

Spread footings should be placed on clean undisturbed sound bedrock which has been cleared of loose rock.

Table 7.1 provides preliminary Geotechnical Bearing Resistances for shallow foundations situated on bedrock.

Table 7.1: Geotechnical Bearing Resistance for Shallow Foundations

Foundation Type	Footing Width (m)	Geotechnical Resistance, ULS, (kPa)	Geotechnical Resistance, SLS, (kPa)
Strip Footing	0.6 to 2.0	3000	N/A
Square Footing	1.0 to 3.0	3000	N/A

The factored geotechnical bearing resistance at ultimate limit states (ULS) incorporates a resistance factor of 0.5. The settlement of foundations founded on bedrock is expected to be negligible and therefore, the geotechnical reaction at Serviceability Limit States (SLS) is not provided for footings on bedrock.

The design frost depth is 1.8 m; however, footings bearing on bedrock are not required to be founded below the frost penetration depth.

The base of all footing excavations should be inspected by a geotechnical engineer prior to placing concrete to confirm the design pressures and to ensure that there is no disturbance of the founding materials.

An inferred fault trend has been noted near the northwest corner of the Centre Block, which may extend beneath the structure. It is possible that a fault impacted area will be observed during inspection of the footing excavations. The requirement for special treatment, if any, would be assessed at the time of inspection. Treatment could include excavation of the fault breccia fragments and backfilling with mass concrete.

7.4 EXCAVATION AND BACKFILLING

7.4.1 Excavations in Soil

The fill present at the site should be considered a Type 3 soil in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects. Temporary excavations in the overburden may be supported or should be sloped at 1 horizontal to 1 vertical from the base of the excavation and as per the requirements of OHSA. Alternatively, soldier piles with lagging, a trench box, or other support methods will be required. Excavations should be inspected regularly for signs of instability and flattened as required. The excavation support system should be designed to resist loads from traffic and foundations from adjacent structures if applicable.

7.4.2 Groundwater

Historical groundwater readings show the groundwater level to vary between less than 2 m to greater than 20 m below ground surface; it has been noted that groundwater typically follows the bedrock profile and could be higher. The proposed Visitors' Welcome Centres, as well as associated tunnels and access shafts, are anticipated to be excavated three stories into bedrock, suggesting a high probability that groundwater will be encountered during construction.

The bedrock at Parliament Hill has been noted to be of generally low permeability due to the tight fractures; however, areas with poorer quality rock could produce larger quantities of inflow. In particular, care should be taken in areas of suspected faulting. Hydraulic conductivity of the bedrock was measured between 3x10-3 m/s and less than 1x10-5 m/s by Golder in their report regarding previous renovations to the Centre Block; exp found an average hydraulic conductivity of 1x10-5 m/s for fractured rock, 3.7x10-6 m/s to 2.14x10-7 m/s for the upper limestone unit, and 5.66x10-8 m/s to 1.26x10-7 m/s for the lower limestone unit.

The historical groundwater levels provided above and in Section 6.3 may not reflect current conditions, and can also be anticipated to fluctuate seasonally. Updated groundwater readings should be obtained as part of future work on this project (see Section 7.8). Should current groundwater levels, once known, suggest that water would be encountered within the depth of excavation, it is recommended a hydrogeological analysis be conducted to confirm the need for a Permit to Take Water (PTTW). At this time, the requirement for the contractor to submit a dewatering plan should also be assessed.

Any structures which are anticipated to be constructed beneath the water table, will need to be designed to be watertight or alternatively to be drained with an appropriate sump and drainage system. An undrained watertight design would need to consider uplift resistance. A drained design would need to consider the potential of contaminant impacted groundwater being directed from the site.

7.4.3 Excavations in Bedrock

Excavations in bedrock are anticipated for the proposed development, such as for the lowering of the Centre Block basement and the construction of tunnels and access shafts. The upper portion (approximately 0.5 m to 1.0 m) of the bedrock is weathered, and can likely be excavated using hoe-ramming. Deeper bedrock will require other methods, described below. Excavations in competent rock may be conducted with vertical walls up to a depth of 3 m, except in cases where the excavation is immediately adjacent an existing structure. For excavations deeper than 3 m in rock, rock mass stabilization will be required, as described in Section 7.4.4.

The Centre Block is considered to be of historical significance, and is constructed of rubble-filled masonry walls, which is expected to be sensitive to vibrations from blasting. Previous excavations for the CBUS and the Library of Parliament have recommended that no blasting occur within a defined distance from existing walls or foundations; this distance was dependent on the integrity of the nearby structure. Instead, hoe-ramming, hydraulic or chemical rock splitting, or line drilling should be used. For bedrock excavations in areas extremely close to existing structural elements (<3 m, such as in the Centre Block basement), a line-drilling program prior to excavation is recommended to define excavation limits.

Controlled blasting of rock may be an option away from structures, such as for potential access shafts or tunnels. Several test blast programs have been conducted around the vicinity of Parliament Hill. In the past, explosive weights of 0.5 kg to 2.6 kg have been used. It is expected that each blast would only last for 250 milliseconds and be limited to two or three small blasts per day during core business hours except for the changing of the guard between 10:30 to 11:30 am. Each blast would typically be covered with three layers of rubber blasting mats to reduce noise and prevent flying rock.

Due to the historical significance and heritage considerations associated with the Parliamentary Precinct, a detailed pre-construction survey should be performed prior to rock excavation taking place, including monitoring of any existing cracks on the interior and exterior of structures or tunnels. Previously, a limit of 12 mm/sec has been set as a limit of Peak Particle Velocity (PPV) for heritage buildings. For more modern structures, a PPV of 25 mm/sec has been suggested for safe use. The vibration limits provided in Table 7.2 were also provided for rehabilitation of similar structures (East Block, Visitor Welcome Centre) on Parliament Hill. These vibration limits are intended to prevent cracking and other structural problems, and do not address the needs of any vibration-sensitive equipment, if present. Should particularly vibration-sensitive equipment or facilities be present in the Centre Block area, it is recommended that a site-specific vibration analysis be carried out prior to rock excavation.

Table 7.2: Suggested Peak Vibration Limits at Nearby Structures/Services

Frequency Range (Hz)	< 10	10 to 30	> 30
Peak Particle Velocity (mm/s)	5	5 to 25(sliding scale)	25

7.4.4 Rock Mass Stabilization

Based on 3D modeling of the rock mass beneath the Library of Parliament, which is anticipated to be similar to that for the remainder of Centre Block, it was concluded that excavation-related vibration (including from mechanical excavation methods) had the potential to cause movement; so too could incorrect excavation sequencing. Horizontal stresses of no more than 0.5 MPA were found to cause movements, although this modelling result was found to be relatively conservative compared to what was noted in the field. Movement was more likely to occur along faults, bedding planes and joints, as opposed to stress-related movements.

The excavations for both the Library of Parliament and the CBUS required pre-support of the rock consisting of untensioned dowels to integrate the rock mass, as well as tensioned rock bolts to provide positive restraint to areas identified as potential wedge or block failures. It is anticipated that a similar approach will be required for the Centre Block.

The rock mass is anticipated to be more fractured in areas where historical tunnels are present. In these areas, additional support of the rock mass may be required, such as consolidation grouting or mesh reinforcement.

It is recommended that a detailed analysis of rock support requirements be performed in conjunction with the recommended additional field investigation; these are described in Section 7.8 of this report.

7.4.5 Tunneling

It is understood that tunneling may be considered for required access shafts or tunnels. If tunneling is to be undertaken, an analysis should be performed as part of the detailed investigation for this project. A description of the required parameters is provided in Section 7.8.

Due to the blasting restrictions at Parliament Hill, it is anticipated that any tunneling would be carried out using a mining approach using horizontal line drilling followed by the use of a hydraulic rock splitter within larger diameter predrilled horizontal holes.

7.4.6 Foundation Backfill

Foundation backfill should be placed and compacted in lifts and should consist of Structural Fill. Structural Fill should conform to the requirements of OPSS Granular A. It should be compacted in lifts no thicker than 300 mm to at least 100% Standard Proctor Maximum Dry Density (SPMDD). This material should be tested and approved by a Geotechnical Engineer prior to delivery to the site. Care should be taken immediately adjacent to walls to avoid over compaction of the soil which could result in damage to the walls.

Bedding for utilities should be placed in accordance with the pipe design requirements. It is recommended that a minimum of 150 mm to 200 mm of OPSS Granular A be placed below the pipe invert as bedding material. Granular pipe backfill placed above the invert should consist

of Granular A material. A minimum of 300 mm vertical and side cover should be provided. These materials should be compacted to at least 98% of SPMDD.

Backfill for service trenches in landscaped areas may consist of excavated material replaced and compacted in lifts. Where the service trenches extend below paved areas, the trench should be backfilled with subgrade fill material, meeting the requirements for OPSS Select Subgrade Material, from the top of the pipe cover to within 1.2 m of the proposed pavement surface, placed in lifts and compacted to at least 95% of SPMDD. The material used within the upper 1.2 m and below the subgrade line should be similar to that exposed in the trench walls to prevent differential frost heave, placed in lifts and compacted to at least 95% of SPMDD. Different abutting materials within this zone will require a 3H:1V frost taper in order to minimize the effects of differential frost heaving.

Excavations for manholes (if applicable) should be backfilled with compacted granular material. A 3H:1V frost taper should be built within the upper 1.2 m.

7.5 SEISMIC SITE CLASS AND LIQUEFACTION

As outlined in the 2010 National Building Code of Canada buildings and their foundations must be designed to resist a minimum earthquake force. The majority of the area beneath the Centre Block is underlain by relatively shallow bedrock. This site was analyzed using data obtained from the City of Ottawa seismic site classification map from combined geological/geophysical data, published by the Geological Survey of Canada and developed in conjunction with Carleton University. Figure 7.1 shows the most probable seismic site class for the soils underlying the Centre Block to be a Site Class A (“Hard Rock”) and a Site Class B (“Rock”).

The assignation of either a Site Class A or B to a site requires shear wave velocity measurements to a depth of 30 m below the founding elevations; in the absence of these measurements, the highest Site Class which can be assigned is Site Class C (“Very Dense Soil and Soft Rock”). In addition, a Site Class C must be assigned if there is more than 3 m of overburden between the founding elevation and the top of rock.

Four known shear wave velocity measurements have been carried out in the vicinity of Centre Block, as shown on Figure 6 in Appendix B, and summarized in Table 7.1.

Table 7.3: Summary of Shear Wave Velocity Tests

Type of Survey*	Location	Vs30 (m/s)	Foundation Depth (m)	Foundation Elevation (m)	Applicable Seismic Site Class	Study
MASW	Southwest of Centre Block	2060	Unknown	78.35	A	exp (2014)
		2120	Unknown	68.45	A	
MASW	West of East Block	1129.8	1.1 m	Unknown	B	Stantec (2014)
		2125.4	3.7 m	Unknown	A	
VSP	Northeast of Centre Block	1724	Unknown	87.2	A	Golder (2010)
		2205	Unknown	83.5	A	
VSP	West Block courtyard	2034	3 m	79.1	A	Golder (2010)
		2880	12 m	70.1	A	

* MASW = Multi-channel Analysis of Surface Waves
VSP = Vertical Seismic Profiling

The soils at this site are not considered liquefiable.

Figure 7.1: Seismic Site Class (from City of Ottawa seismic site classification map from combined geological/geophysical data, published by the Geological Survey of Canada)

7.6 SLOPE STABILITY

The area to the north of Centre Block is adjacent a steep slope which may be undergoing creep. Contour lines of the slope show it to have an overall slope of approximately 2H:1V; in

several locations, the slope is steeper than 1H:1V (up to 50°). Previous surveys of the slope indicate it to contain remnants of historic and current structures (tunnels, staircases, fences, retaining walls etc.).

It is recommended that a slope stability analysis be performed on this slope once details are known regarding construction equipment loads and placement.

7.7 PAVEMENTS

It is anticipated that a temporary roadway may be required for construction and emergency vehicles, should the existing roadway be blocked during construction. In addition, the existing pavement may be affected by the proposed works and may require pavement replacement.

When reinstating pavements affected by utility trench, it is common practice to match existing pavement thicknesses. Jacques Whitford advanced a number of boreholes through the asphalt to the southeast of the Centre Block, encountering between 30 mm and 180 mm of asphalt, occasionally laid directly over concrete; the asphalt thickness was typically greater than 100 mm.

The traffic levels for the existing roadway, as well as for any proposed temporary access road, are not known. Traffic has been assumed to consist of light traffic (primarily police cruisers, light delivery vehicles, and Parliament Shuttle Busses) in the case of the existing roadway; it is assumed the same vehicles will use a temporary pavement structure, in addition to construction and emergency vehicles.

The pavement structure presented in Table 7.6 should be used for pavement reinstatement and the temporary roadway.

Table 7.4: Recommended Pavement Design

Parameter	Pavement Reinstatement	Temporary Roadway
Asphalt Surface	50 mm SP 12.5	50 mm SP 12.5
Asphalt Binder	70 mm SP 19	70 mm SP 19
Base	150 mm OPSS Granular A	150 mm OPSS Granular A
Subbase	350 mm OPSS Granular B Type II	350 mm OPSS Granular B Type II

The following material types are recommended for this project:

- Asphalt performance grade PG 58-34.
- The Superpave mix designs should be in accordance with City of Ottawa S.P. No: F-3106 and should use a Traffic Category of A.
- The compaction of the asphalt layers should follow the City of Ottawa Special Provision No. 3106 and OPSS 310.
- All granular materials should be in accordance with the requirements of City of Ottawa Special Provision F-3147. Both the base and subbase layers should be compacted to 100% SPMDD.

- A tack coat is recommended between asphalt layers and along the edges of any cuts in asphalt.

Proper drainage of the pavement structure must be provided in order to ensure satisfactory performance. The subgrade and granular base/subbase should be graded to ensure positive drainage.

7.8 DATA GAP ANALYSIS

Portions of the report not required for the solicitation have been removed.

It is recommended that the issues summarized below be addressed in Phase 2 and detailed design of the Centre Block project.

7.8.1 Updated Borehole and Water Level Data

Borehole coverage surrounding and within the Centre Block is fairly detailed. However, much of this information is historical, and the accuracy of the information cannot be guaranteed, due to possible construction in the years since the original readings were carried out. PWGSC recommended that a series of boreholes be advanced around the building envelope to confirm current geotechnical conditions. Boreholes recommended consisted of the following:

- Three (3) sampled boreholes around the exterior of the Centre Block, to a depth of 24 m;
- One (1) sampled borehole at the exterior of the Centre Block, to a depth of 35 m;
- Ten (10) sampled boreholes at the interior of the Centre Block, to a depth of 24 m;
- Installation of five (5) monitoring wells in the boreholes.
- Vertical seismic profiling in the 35 m deep hole.

It is recommended that hydraulic conductivity testing be conducted in conjunction with the above field program. Should current groundwater levels, once known, suggest that water would be encountered within the depth of excavation, it is recommended a hydrogeological analysis be conducted to confirm the need for a Permit to Take Water (PTTW). At this time, the requirement for the contractor to submit a dewatering plan should also be assessed. A borehole survey using optical televiewers is also recommended in a minimum of five (5) boreholes, to depict the bedding, geology, fabric and measurable open fractures in the bedrock.

Suggested locations for the boreholes noted above are shown on Figure 7 in Appendix D.

7.8.2 Redundancy of Information

Exp borehole BH-1V is in the vicinity of proposed borehole BH-1 and exp borehole BH-7V is in the vicinity of proposed borehole BH-8. The exp boreholes include the following:

- 23 m deep boreholes into bedrock;
- Optical televiewer logging with stereo plot interpretations;
- Two packer permeability tests in borehole BH-1V and one on borehole BH-7V.

It is Stantec's opinion that the boreholes, BH-1 and BH-8 may be cancelled on the basis that there is information already available from exp boreholes, BH-1V and BH-7V.

The Geophysical Borehole Logging Data and the stereoplots from exp BH-1V and BH-7V are included in Appendix D.

7.8.3 Rock Parameters

Although rock data is present for most of the Parliament Hill area, much of it may not be in the specific area where planned infrastructure will be constructed. It is recommended that site-specific rock data be obtained in both the Phase 2 and detailed design phases of this project (once infrastructure locations are known), to aid in tunnel design and rock support requirements. Suggested parameters to aid in design include Total Core Recovery (TCR), Rock Quality Designation (RQD), Unconfined Compressive Strength, discontinuity data, Fracture Index, Rock Mass Rating (RMR), and Q-value.

[redacted]

[redacted]

7.8.5 Shear Wave Velocity Measurements

As stated in Section 6.6, a Seismic Site Response Class of A or B can only be assigned on the basis of site specific shear wave velocity measurements. To our knowledge, these measurements have not been carried out specifically for the Center Block. A Vertical Seismic Profile (or other method capable of measuring the shear wave velocity) is recommended at this site to support a Site Response Class designation of B or higher. Without site-specific shear wave velocity measurements, the highest Site Response Class which could be assigned to this site is Class C.

7.8.6 Slope Stability Analysis

The slope to the north of the Centre Block is fairly steep (2H:1V overall, and steeper than 1H:1V in areas). It is understood that slope stabilization work is currently occurring in areas of the slope. It is recommended that an up-to-date survey of the slope be conducted once this stabilization has been completed. In addition, a slope stability analysis of this area is recommended should construction equipment, scaffolding or stockpiled materials be placed in this area. The slope stability analysis will require knowledge of the loads associated with the specific equipment to be used at the site.

7.8.7 Chemical Parameters

It is recommended that samples of the soil be submitted for analysis of pH, water soluble sulphate and chloride concentrations, and resistivity. This testing will help to determine the potential for degradation of the concrete in the presence of soluble sulphates and the potential for corrosion of exposed steel used in foundations and buried infrastructure.

7.8.8 Review of Existing Information

It is recommended that the background information summarized in Section 5.0 be reviewed by the firm undertaking the detailed investigation. If warranted, the recommendations provided in this report should be upgraded based on the findings of the new investigation.

7.8.9 Additional Boreholes within Centre Block

The existing boreholes within the Centre Block basement suggest that there is up to 0.8 m of soil fill beneath the floor slab at the southeast corner of the building. It is recommended that additional boreholes be drilled in this area to determine if foundations in this area are also underlain by fill. This could consist of inclined boreholes extending from the top of the slab to below select footing locations.

8.0 CLOSURE

This report has been prepared for the sole benefit of Public Works and Government Services Canada and its agents, and may not be used by any third party without the express written consent of Stantec and the client. Any use which a third party makes of this report is the responsibility of such third party.

We trust the above meets your present requirements. Should you require any further information, please do not hesitate to contact us.

Yours very truly,

STANTEC CONSULTING LTD.

Laura Bostwick, M.Sc.(Eng)., P.Eng.

J.G.A. Raymond Haché, M.Sc., P.Eng.,
Principal and Central Canada Practice Lead
Geotechnical Engineering

APPENDIX A

Statement of General Conditions

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

APPENDIX B

Key Plan

Location of Existing Test Holes

Ground Surface Elevation

Bedrock Elevation

[redacted] and Underground Infrastructure (Portions of the map not required for the solicitation have been removed)

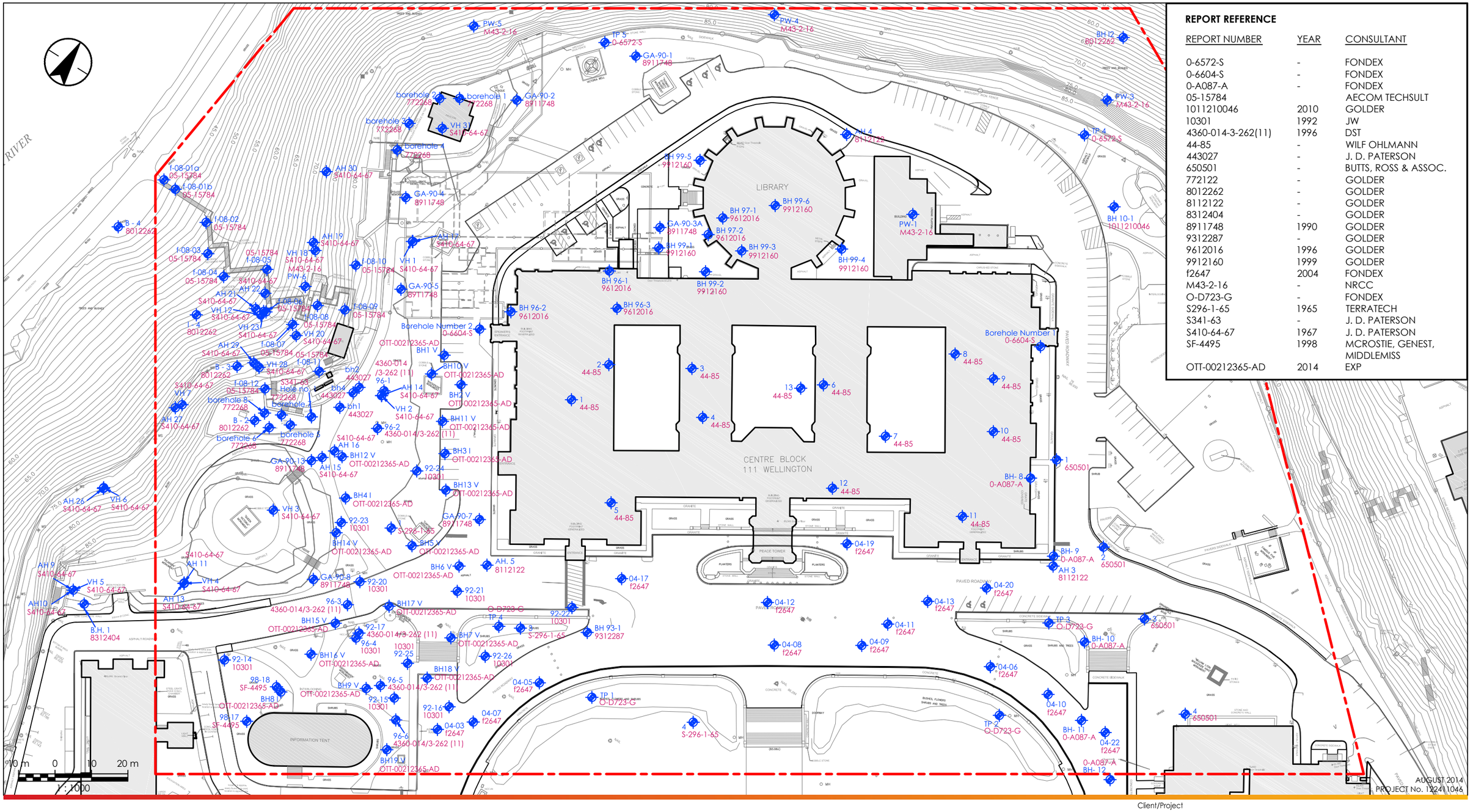
Seismic Testing Locations

Mapped Faults

SITE
N
Hull
GATINEAU
RIVIÈRE DES OUTAOUAIS
OTTAWA RIVER
QUEBEC ONTARIO
Lower Town
CITY OF OTTAWA
Centretown
Parliament Buildings
Wellington St
Rideau St
Laurier Av W
Laurier Bridge
Mackenzie King Bridge
Pont du Portage Bridge
Pont Interprovincial (Alexandra) Bridge
Sussex Dr
Queen Elizabeth Driveway
Colonel By Dr
Bank St
O'Connor St
Metcalfe St
Elgin St
Kent St
Bronson Av
Somerset St
Gladstone Av
Argyle
Rideau Centre
Confederation Sq
Confederation Park
Major's Hill Park
Dundonald Park
McNabb Park
St Luke's Park
Minto Park
Canal Rideau Canal
Ottawa Locks
Chateau Laurier
Fairmont Château Laurier
Centennial Flame
Peace Tower
Centre Block
West Block
East Block
Supreme Court of Canada/ Cour suprême du Canada
National Archives & National Library/ Archives nationales & Bibliothèque nationale
Currency Museum/ Musée de la monnaie
Canadian Museum of Civilization & Musée national de la Poste/ National Postal Museum
Musée canadien des civilisations/ Canadian Museum of Civilization
Canada Science and Technology Museum
Canada War Mus/ Mus can de la guerre
National Gallery/ Mus des beaux-arts
Royal Can Mint/ Monnaie royale can
Notre Dame Basilica
Peacekeeping Monument
Byward Market
ByWard Market
Rideau Centre
Ottawa City Hall
Ottawa Courthouse
Human Rights
Ottawa Art Gallery
National Arts Centre/ Centre national des arts
Lord Elgin Residence
Ontario Courthouse
Canada Science and Technology Museum
Canada Aviation and Space Museum
Canada Agriculture and Food Museum
Canada Postal Museum
Canada Museum of Nature/ Musée can de la nature
Victoria Memorial Museum Building
Canada Museum of Civilization
Canada Museum of History
Canada Museum of Nature
Canada Museum of Science and Technology
Canada Museum of Aviation and Space
Canada Museum of Agriculture and Food
Canada Museum of Postal
Canada Museum of War
Canada Museum of Canada
Canada Museum of Canada
Canada Museum of Canada

REPORT REFERENCE

REPORT NUMBER	YEAR	CONSULTANT
0-6572-S	-	FONDEX
0-6604-S	-	FONDEX
0-A087-A	-	FONDEX
05-15784		AECOM TECHSULT
1011210046	2010	GOLDER
10301	1992	JW
4360-014-3-262(11)	1996	DST
44-85	-	WILF OHLMANN
443027	-	J. D. PATERSON
650501	-	BUTTS, ROSS & ASSOC.
772122	-	GOLDER
8012262	-	GOLDER
8112122	-	GOLDER
8312404	-	GOLDER
8911748	1990	GOLDER
9312287	-	GOLDER
9612016	1996	GOLDER
9912160	1999	GOLDER
f2647	2004	FONDEX
M43-2-16	-	NRCC
O-D723-G	-	FONDEX
S296-1-65	1965	TERRATECH
S341-63	-	J. D. PATERSON
S410-64-67	1967	J. D. PATERSON
SF-4495	1998	MCROSTIE, GENEST, MIDDLEMISS
OTT-00212365-AD	2014	EXP



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400 - 1331 CLYDE AVENUE
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LEGEND

- AREA OF INTEREST
- 92-26 / 10301 — TEST HOLE NUMBER / REPORT REFERENCE (SEE SECTION 8.0)

NOTES

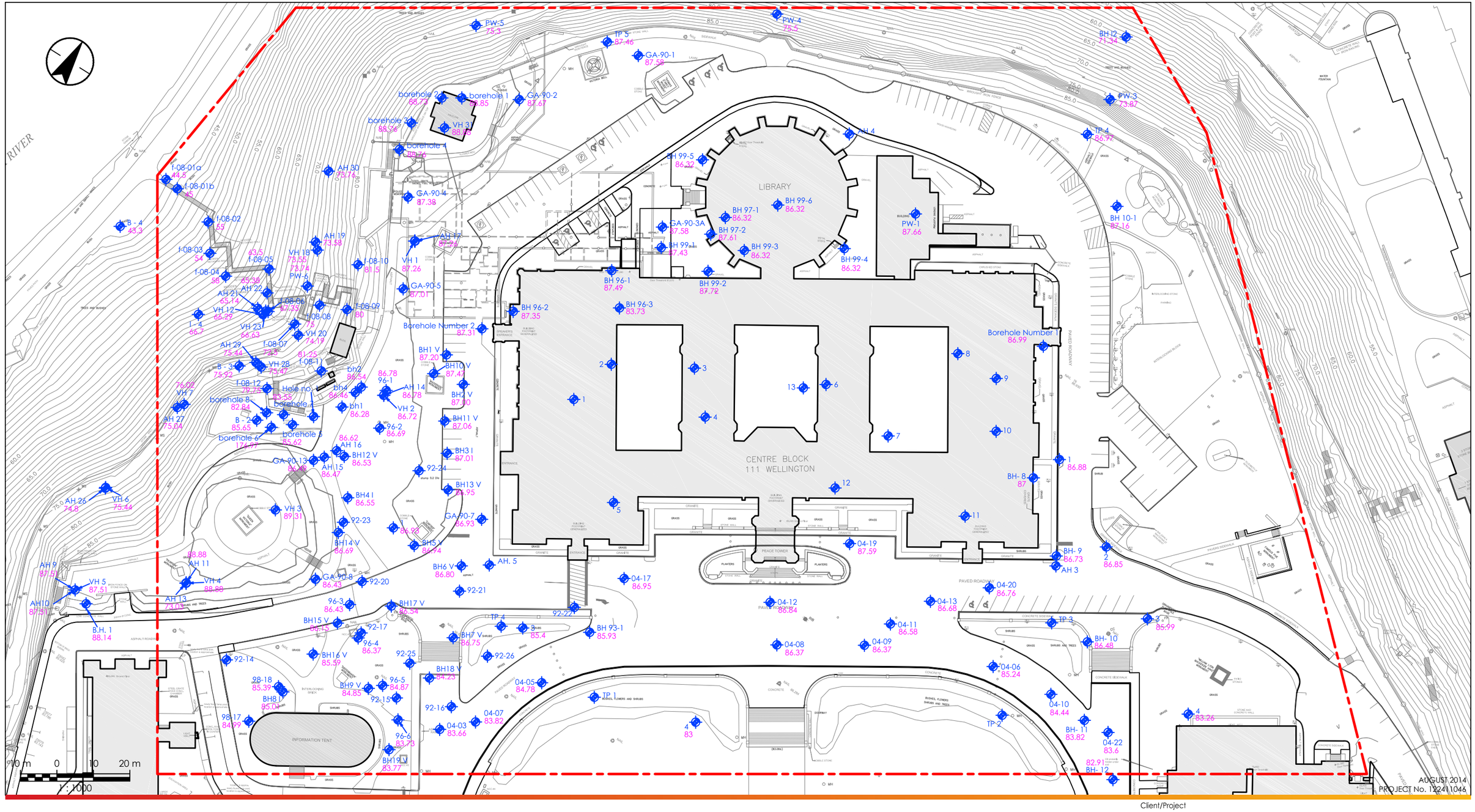
1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.

Client/Project
PWGSC
GEOTECHNICAL INVESTIGATION
CENTREBLOCK, 111 WELLINGTON ST., OTTAWA, ON

Drawing No.
2

Title
EXISTING TEST HOLE LOCATION PLAN

AUGUST 2014
PROJECT No. 122411046



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LEGEND

- AREA OF INTEREST
- 92-26 / 83.73 — TEST HOLE NUMBER / GROUND SURFACE ELEVATION

NOTES

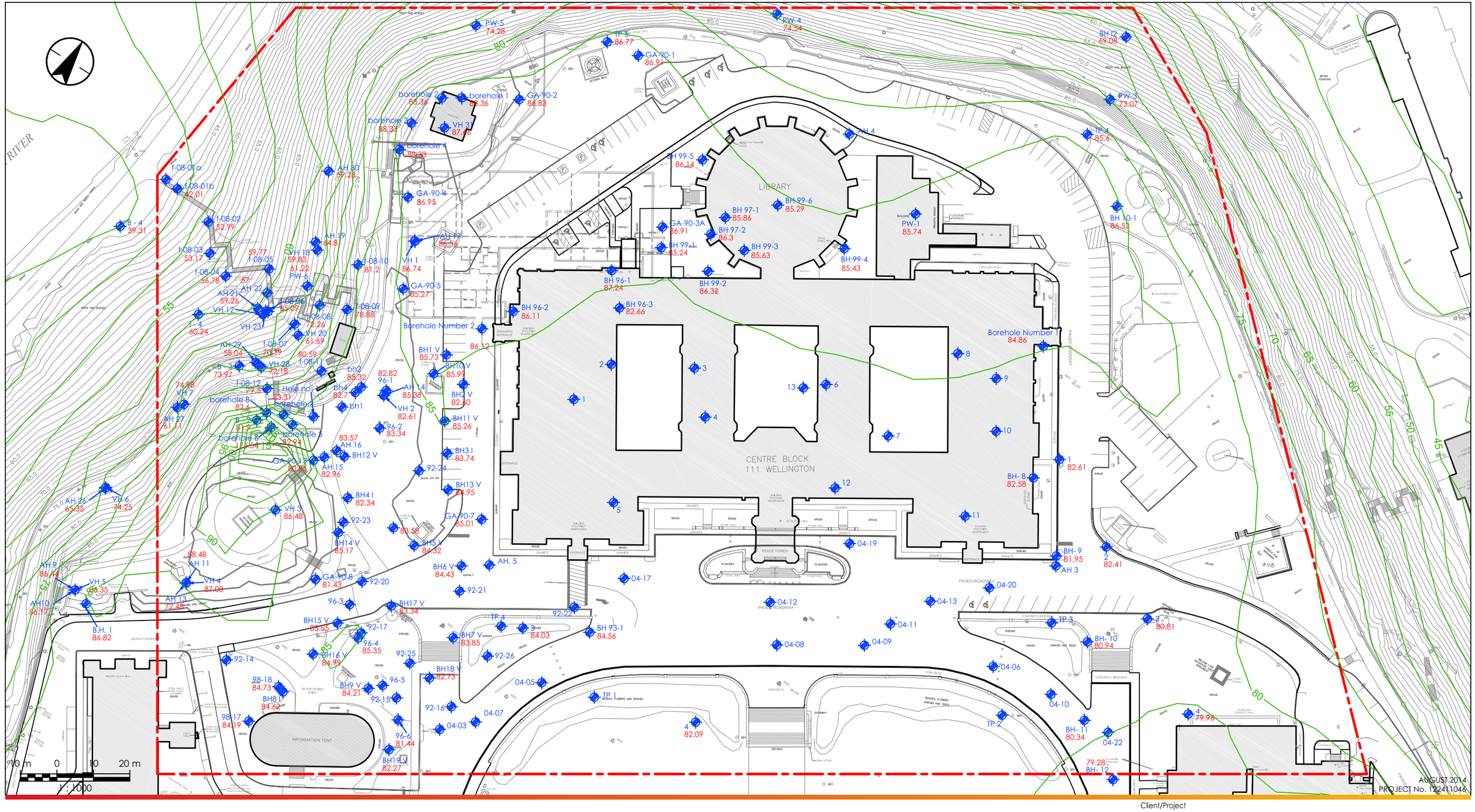
1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.

AUGUST 2014
PROJECT No. 122411046

Client/Project
PWGSC
GEOTECHNICAL INVESTIGATION
CENTREBLOCK, 111 WELLINGTON ST., OTTAWA, ON

Drawing No.
3

Title
GROUND SURFACE ELEVATION



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LEGEND

- AREA OF INTEREST
- 92-26 / 81.44 — TEST HOLE NUMBER / BEDROCK ELEVATION
- 84 — BEDROCK ELEVATION CONTOUR

NOTES

1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.

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PROJECT No. 122411046

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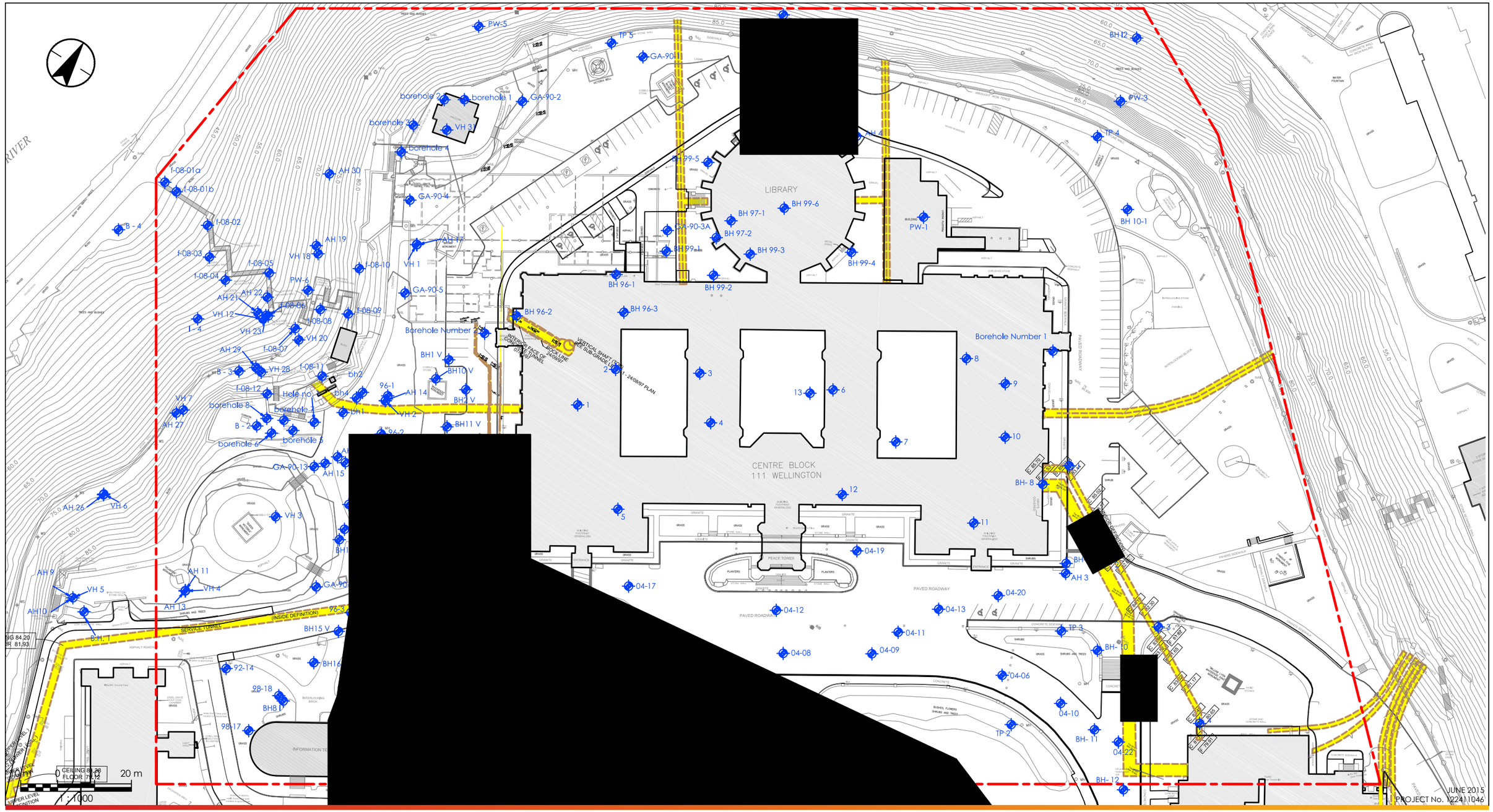
Drawing No.
4

Title
BEDROCK ELEVATION



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JUNE 2015
PROJECT No. 122411046

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LEGEND

- AREA OF INTEREST
- 92-26 TEST HOLE AND NUMBER
- TUNNEL

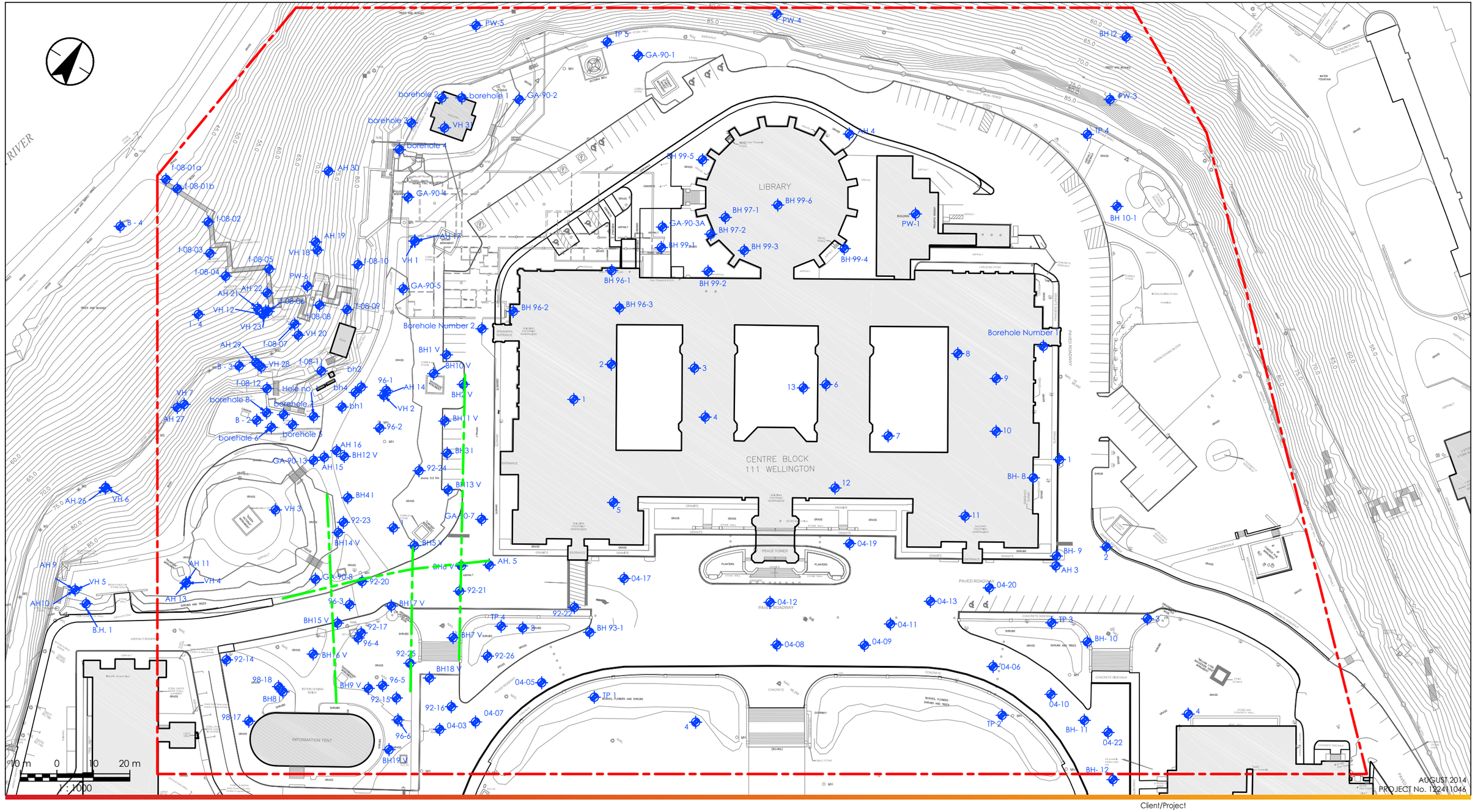
NOTES

1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.
3. BACKGROUND DATA INCLUDED IN STANTEC'S 2014 DATA GAP ANALYSIS REPORT.

Client/Project
PWGSC
GEOTECHNICAL INVESTIGATION
CENTREBLOCK, 111 WELLINGTON ST., OTTAWA, ON

Drawing No.
5

Title
[redacted] AND UNDERGROUND INFRUSTRUCTURE



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AUGUST 2014
PROJECT No. 122411046

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LEGEND

- AREA OF INTEREST
- 92-26 TEST HOLE AND NUMBER
- SEISMIC PROFILE LOCATION

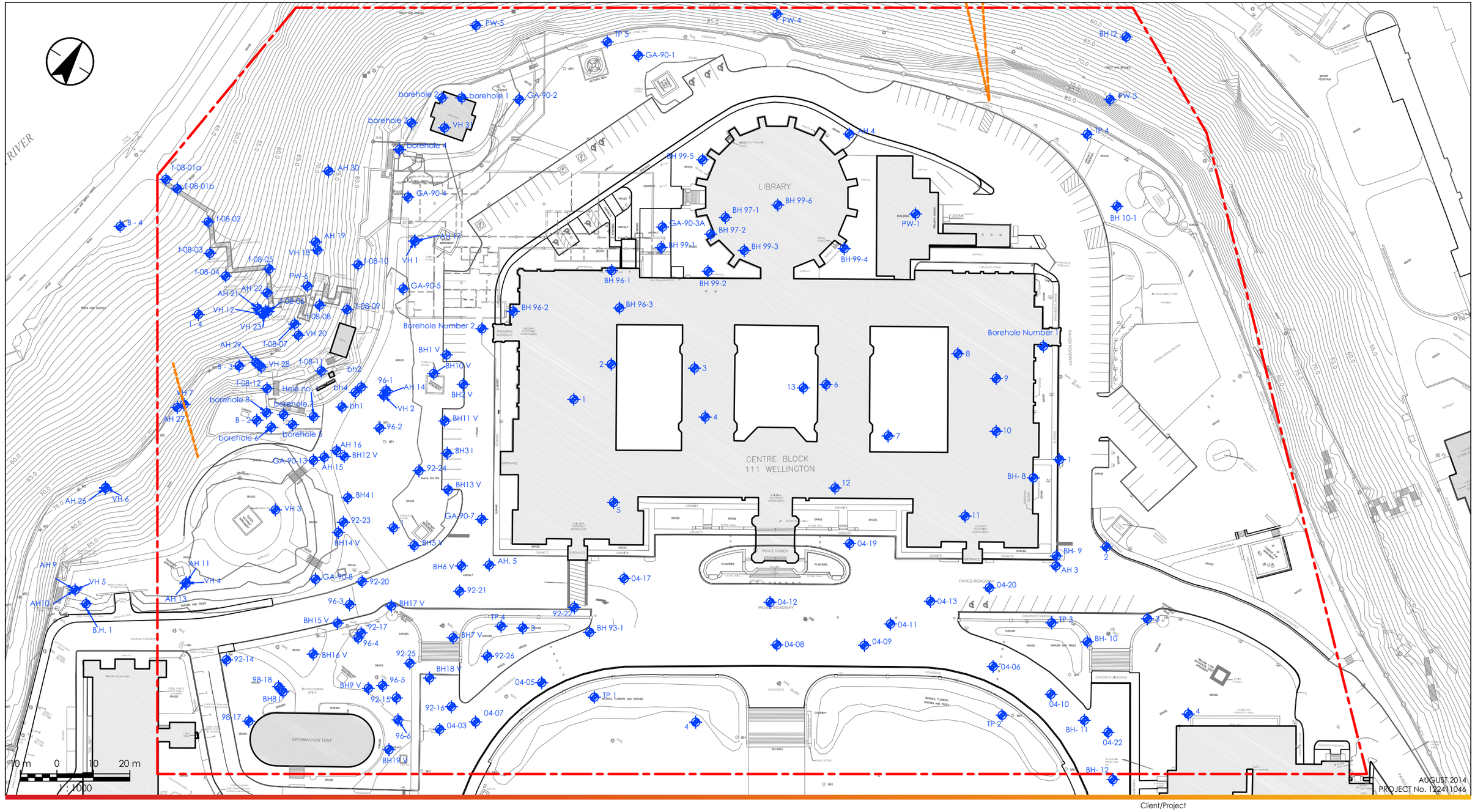
NOTES

1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.
3. SEISMIC PROFILE LOCATION FROM EXP REPORT OTT-00212365-AD, DATED APRIL 2014

Client/Project
PWGSC
GEOTECHNICAL INVESTIGATION
CENTREBLOCK, 111 WELLINGTON ST., OTTAWA, ON

Drawing No.
6

Title
SEISMIC TESTING LOCATIONS



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LEGEND

- AREA OF INTEREST
- 92-26 TEST HOLE AND NUMBER
- MAPPED FAULTS

NOTES

1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.
3. SEISMIC PROFILE LOCATION FROM EXP REPORT OTT-00212365-AD, DATED APRIL 2014

Client/Project
PWGSC
GEOTECHNICAL INVESTIGATION
CENTREBLOCK, 111 WELLINGTON ST., OTTAWA, ON

Drawing No.
7

Title
MAPPED FAULTS

AUGUST 2014
PROJECT No. 122411046

APPENDIX C

Historical Borehole Records

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-01A**

PAGE: 1 de 1

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **44.50**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031952.9
X: 367343.2

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **0.61**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: **76 mm** ROC:

DATE DÉBUT: **2009-09-23** DATE FIN: **2009-09-23**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL	STRATIGRA.	TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	SCHÉMA	NOTES
		44.50	Surface du terrain.												
		0.00 44.38	Remblai: Sable organique, brun foncé, humide.			A									
		0.12	Remblai: Sable graveleux, compact, gris-brun, sec.		CF-1	B		38	9-11-14-12	25					
		43.89 0.61	FIN DU FORAGE												

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-01B**

PAGE: 1 de 2

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **45.00**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: **5031950.5**
X: **367346.0**

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **4.99**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: **76 mm** ROC: **51 mm**

DATE DÉBUT: **2009-09-23** DATE FIN: **2009-09-23**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		45.00	Surface du terrain.												
		0.00	Remblai: Sable organique, brun.			A									
		44.82				B									
		0.18	Remblai: Sable et gravier avec un peu de cailloux, dense, brun, sec.		CF-1	C		41	8-21-16-6	37					
1															
2															
		42.01													
3		2.99	Roc: Calcaire avec bande de schiste argileux, qualité moyenne.												

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-01B**

PAGE: **2** de **2**

PROF. (m)	TUBAGE	ÉLÉV. (m) PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
4					CR-2			100		57					
5		40.01 4.99	FIN DU FORAGE												
6															
7															
8															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

RAPPORT DE FORAGE

AECOM

No.: 515784

PROJET: Caractérisation géotechnique

FORAGE No: F-08-02

PAGE: 1 de 1

CLIENT: Travaux publics et Services gouvernementaux Canada
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): 50.50

ÉLÉV. DU TUBE (m):

LOCALISATION: Escaliers de la Colline du Parlement
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031941.8
X: 367354.4

PROF. DU ROC (m):

FIRME: Advance Cutting and Coring Ltd.

PROF. MAX. (m): 3.22

ÉQUIPEMENT: Forage manuel

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: 76 mm ROC: 51 mm

DATE DÉBUT: 2009-09-17 DATE FIN: 2009-09-17

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL (COUPE STRATIGRAPHIQUE)	STRATIGRA.	TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm (ÉCHANTILLONS)	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	SCHÉMA (AMÉNAGEMENT)	NOTES
		50.50	Surface du terrain.												
		0.00	Sol naturel: Terre végétale.			A									
		50.46	Sable, brun, sec.			B									
		0.04	Sable et gravier avec un peu de cailloux, brun-gris, compact, sec.												
		50.40													
		0.10			CF-1	C		33	3-4-5-5	9					
1					CF-2			38	5-5-5-5	10					
					CF-3	A		21	7-5-4-7	9					
						B									
					CF-4			0	18-50 / 3,2cm	R					
2		48.49													
		2.01	Roc: Calcaire avec bandes de schiste, de qualité mauvaise.												
					CR-5			94		38					
3															
		47.28													
		3.22	FIN DU FORAGE												

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: Caractérisation géotechnique

FORAGE No: F-08-03

PAGE: 1 de 1

CLIENT: Travaux publics et Services gouvernementaux Canada
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): 54.00

ÉLÉV. DU TUBE (m):

LOCALISATION: Escaliers de la Colline du Parlement
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031933.6
X: 367355.2

PROF. DU ROC (m):

FIRME: Advance Cutting and Coring Ltd.

PROF. MAX. (m): 1.31

ÉQUIPEMENT: Forage manuel

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: 76 mm ROC: 51 mm

DATE DÉBUT: 2009-09-17 DATE FIN: 2009-09-17

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL	STRATIGRA.	TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	SCHÉMA	NOTES
		54.00	Surface du terrain.												
		0.00	Remblai: Sable avec traces de matière organique, brun foncé, sec.		CF-1			3	6-2-1-4	3					
		53.39													
		0.61	Sol naturel: Sable avec un peu à traces de gravier, brun, sec.		CF-2			43	13-50 / 7,6cm	R					
		53.17													
		0.83	Roc: Calcaire avec bandes de schiste de qualité très mauvaise.		CD-3			77		0					
1		52.69													
		1.31	FIN DU FORAGE												
2															
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-04**

PAGE: **1** de **1**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **58.00**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):

PROF. DU ROC (m):

Y: 5031927.3

FIRME: **Advance Cutting and Coring Ltd.**

X: 367359.5

PROF. MAX. (m): **2.69**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU

ÉLÉVATION DE L'EAU SOUTERRAINE (m)

DATE

CALIBRE SOL: **76 mm** ROC: **51 mm**

DATE DÉBUT: **2009-09-17** DATE FIN: **2009-09-17**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		58.00	Surface du terrain.												
		0.00	Terre végétale.			A									
		57.92 / 0.08	Sol naturel: Sable et gravier avec un peu de cailloux, compact, brun, sec.		CF-1	B		34	3-5-11-16	16					
					CF-2			0	50 / 3cm	R					
1		56.78 / 1.22	Roc: Calcaire avec bandes de schiste argileux, qualité très mauvaise.												
					CR-3			72		15					
2		55.31 / 2.69	FIN DU FORAGE												
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-05**

PAGE: **1** de **2**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **63.50**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031929.0
X: 367371.7

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **4.04**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: **76 mm** ROC: **51 mm**

DATE DÉBUT: **2009-09-17** DATE FIN: **2009-09-17**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		63.50	Surface du terrain.												
		0.00	Terre végétale.												
		63.40 / 0.10	Sol naturel: Sable graveleux avec un peu de cailloux, compact, brun foncé, sec.		CF-1			30	4-5-7-9	12					
1			Présence de blocs.		CF-2			33	6-5-5-6	10					
2															
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-05**

PAGE: **2** de **2**

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		59.77													
		3.73	Roc: Calcaire avec bandes de schiste argileux, qualité très mauvaise.		CR-3			32		23					
4		59.46													
		4.04	FIN DU FORAGE												
5															
6															
7															
8															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

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AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: Caractérisation géotechnique

FORAGE No: F-08-06

PAGE: 1 de 1

CLIENT: Travaux publics et Services gouvernementaux Canada
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): 67.35

ÉLÉV. DU TUBE (m):

LOCALISATION: Escaliers de la Colline du Parlement
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031920.0
X: 367371.3

PROF. DU ROC (m):

FIRME: Advance Cutting and Coring Ltd.

PROF. MAX. (m): 3.33

ÉQUIPEMENT: Forage manuel

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: 76 mm ROC: 51 mm

DATE DÉBUT: 2009-09-17 DATE FIN: 2009-09-17

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	DESCRIPTION DU SOL	STRATIGRA.	TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	SCHÉMA	NOTES
		67.35	Surface du terrain.												
		0.00 / 67.25	Sol naturel: Sable avec matière organique, brun foncé, sec.												
		0.10	Sable avec un peu de gravier et cailloux, compact, brun, sec.		CF-1			3	5-8-6-5	14					
1															
2		65.09													
		2.26	Roc: Calcaire avec bandes de schiste argileux, fracturé, qualité très mauvaise.		CR-2			53		0					
					CR-3			50		0					
3					CR-4			33		0					
		64.02													
		3.33	FIN DU FORAGE												

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

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RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-07**

PAGE: **1** de **2**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **72.50**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: **5031914.3**
X: **367378.8**

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **4.50**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: **76 mm** ROC: **51 mm**

DATE DÉBUT: **2009-09-17** DATE FIN: **2009-09-17**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		72.50	Surface du terrain.												
		0.00 / 72.40	Sol naturel: Sable et matière organique, brun foncé, sec.												
		0.10	Sable et gravier, brun, sec.												
1															
2		70.39													
		2.11	Roc: Calcaire avec bandes de schiste, qualité très mauvaise.		CR-1			2		0					
					CR-2			30		0					
					CR-3			38		0					
3					CR-4			29		0					

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-07**

PAGE: **2** de **2**

PROF. (m)	TUBAGE	ÉLÉV. (m) PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
4					CR-5			12		0					
		68.00													
		4.50	FIN DU FORAGE												
5															
6															
7															
8															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-08**

PAGE: **1** de **1**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **75.00**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031919.3
X: 367385.8

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **3.05**

ÉQUIPEMENT: **Forage manuel, forage incliné à 45°**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: ROC: **51 mm**

DATE DÉBUT: **2009-09-15** DATE FIN: **2009-09-15**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		75.00	Surface du béton.												
		0.00	Béton avec granulats (<5cm diam.), poreux (<5% de pores), couche de revêtement sur béton (3mm).		CR-1			92							
		74.39													
		0.61	Vide en dessous du béton (aucun matériaux) [air vicié]												
1															
2															
		72.41													
		2.59	Gavier concassé, présence de sacs de plastique déchiquetés.		CR-2			17							
		72.26													
		2.74	Roc calcaire altéré, présence de matériaux de remplissage composé de silt argileux, un peu de gravier, consolidé friable à non-consolidé.		CR-3			33							
3		71.95													
		3.05	FIN DU FORAGE												

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-09**

PAGE: 1 de 1

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **80.00**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031918.1
X: 367393.4

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **1.42**

ÉQUIPEMENT: **Forage manuel, forage incliné à 45°**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: ROC: **51 mm**

DATE DÉBUT: **2009-09-15** DATE FIN: **2009-09-15**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH.	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		80.00	Surface du béton.												
		0.00	Béton de masse sain, granulats <5cm diam.		CR-1			100							
		79.59													
		0.41	Béton altéré, poreux, intrusion de silt dans les fissures du béton.		CR-2			50							
1		78.88													
		1.12	Roc calcaire sain avec liminations schisteuses.		CR-3			100							
		78.58													
		1.42	FIN DU FORAGE												
2															
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-10**

PAGE: **1** de **1**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **81.50**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):

PROF. DU ROC (m):

Y: 5031930.3

FIRME: **Advance Cutting and Coring Ltd.**

X: 367395.7

PROF. MAX. (m): **0.68**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU

ÉLÉVATION DE L'EAU SOUTERRAINE (m)

DATE

CALIBRE SOL:

ROC: **51 mm**

DATE DÉBUT: **2009-09-15**

DATE FIN: **2009-09-15**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No	SOUS-ÉCH	ÉTAT	RÉCUPÉRATION %	No COUPS / 15 cm	N ou ROD %	OBS VISUELLE	OBS OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		81.50	Surface du terrain.												
		0.00	Terre végétale sablonneuse.												
		81.20													
		0.30	Roc calcaire altéré.												
		81.12	Roc calcaire sain.												
		0.38													
		80.82													
		0.68	FIN DU FORAGE												
1															
2															
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-11**

PAGE: **1** de **1**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **81.25**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031901.1
X: 367385.9

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **0.76**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: ROC: **51 mm**

DATE DÉBUT: **2009-09-15** DATE FIN: **2009-09-15**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE — DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS — TYPE No.	SOUS-ÉCH	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS. VISUELLE	OBS. OLFACTIVE	ANALYSE	AMÉNAGEMENT — SCHÉMA	NOTES
		81.25	Surface du terrain.												
		0.00	Terre végétale sablonneuse, trace de gravier (10%), présence de racines.												
		80.92 / 0.33	Bloc calcaire (<10cm diam.), sable, brun foncé.												
		80.59 / 0.66	Roc calcaire sain.												
		80.49 / 0.76	FIN DU FORAGE												
1															
2															
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

AECOM

RAPPORT DE FORAGE

No.: 515784

PROJET: **Caractérisation géotechnique**

FORAGE No: **F-08-12**

PAGE: **1** de **1**

CLIENT: **Travaux publics et Services gouvernementaux Canada**
Public Works and Government Services Canada

ÉLÉV. DU SOL (m): **79.75**

ÉLÉV. DU TUBE (m):

LOCALISATION: **Escaliers de la Colline du Parlement**
Parliament Hill Stairs, Ottawa, Ontario

COORD. (m):
Y: 5031896.2
X: 367371.5

PROF. DU ROC (m):

FIRME: **Advance Cutting and Coring Ltd.**

PROF. MAX. (m): **1.40**

ÉQUIPEMENT: **Forage manuel**

NIVEAU D'EAU
ÉLÉVATION DE L'EAU SOUTERRAINE (m) | DATE

CALIBRE SOL: ROC: **51 mm**

DATE DÉBUT: **2009-09-15** DATE FIN: **2009-09-15**

INDICES DE CONTAMINATION VISUEL ET OLFACTIF: 0 (inodore, léger, inexistant) ; 1 (faible, moyen, disséminé) ; 2 (persistant, imbibé, fort)

TYPE D'ÉCHANTILLONS: CF: cuillère fendue CR: carotte de roc M: manuel R: refus TA: tarière TM: tube à paroi mince

PROF. (m)	TUBAGE	ÉLÉV. (m) / PROF. (m)	COUPE STRATIGRAPHIQUE: DESCRIPTION DU SOL	STRATIGRA.	ÉCHANTILLONS: TYPE No.	SOUS-ÉCH	ÉTAT	RÉCUPÉRATION %	No. COUPS / 15 cm	N ou RQD %	OBS VISUELLE	OBS OLFACTIVE	ANALYSE	AMÉNAGEMENT: SCHÉMA	NOTES
		79.75	Surface du terrain.												
		0.00	Terre végétale, un peu de cailloux, brun foncé.		CF-1										
		79.50													
		0.25	Roc calcaire avec lamitations schisteuses, fracture à 0.94m avec remplissage de silt-argileux.		CR-2			93		2					
1															
		78.35													
		1.40	FIN DU FORAGE												
2															
3															

DÉCRIT PAR: G. Comeau, ing.jr

APPROUVÉ PAR: J.-F. Beaulieu, ing., Ph.D.

NIVEAUX D'EAU RELEVÉS PAR:

BUTTS, ROSS & ASSOCIATES LTD.
CONSULTING CIVIL ENGINEERS — OTTAWA, ONTARIO

BOREHOLE ANALYSIS
BOREHOLE NO. 1
DRILLING DATE May 3, 1965
TESTING DATE

CLIENT Dept. of Public Works
LOCATION Walking Tunnel
Centre to East Block

REMARKS

BOREHOLE ELEVATION 285.03

PENETRATION DATA	HAMMER	DROP
CASING		
CONE		
SAMPLER	140 lbs	30 in.

DEPTHS MEASURED FROM GROUND LEVEL

Depth	Blows/ft	Cone Penetration Blows/Foot	Description and Remarks	Sample Type No.	Sample Blows/ft	M.C.	L.L.	P.L.	P.I.	U.C.	Vane und.	Vane rem.	Vane sen.	U.W.	Water Table Date & Time
10"			Asphalt & concrete												
			Compact br F to C sand some silt	SS1	12										
4'			Boulders and sand	RC2											
6'3"			Compact br silty F to M sand	RC3											
				SS4	13										
9'6"			Very dense br F to M silty sand, some clay	SS5	62										
11'			Boulders with sand silt and clay as matrix	RC6											
14'			Cored 5'0" Recovered 4'11 1/2" 99.2% Recovery Limestone												
19'			Cored 10'4" Recovered 10'4" 100% Recovery Limestone												
29'4"															

Symbols

M.C. = Moisture content
L.L. = Liquid limit
P.L. = Plastic limit
P.I. = Plasticity index
U/C = Unconfined compressive strength tons sq/ft
U.W. = Unit weight
und. = Undisturbed shear strength Tons/sq ft
rem. = Remoulded "
sen. = Sensitivity - $\frac{\text{und}}{\text{rem}}$

br = brown
F = fine
M = medium
C = coarse

Plate No. 1

BUTTS, ROSS & ASSOCIATES LTD.
CONSULTING CIVIL ENGINEERS — OTTAWA, ONTARIO

BOREHOLE ANALYSIS
BOREHOLE NO. 2
DRILLING DATE May 4, 1965
TESTING DATE

CLIENT Dept. of Public Works
LOCATION Walking Tunnel
Centre to East Block

REMARKS

BOREHOLE ELEVATION 284.94

PENETRATION DATA	HAMMER	DROP
CASING		
CONE		
SAMPLER	140 lbs	30 in.

DEPTHS MEASURED FROM GROUND LEVEL

Depth	Blows/ft	Cone Penetration Blows/Foot	Description and Remarks	Sample Type No.	Sample Blows/ft	M.C.	L.L.	P.L.	P.I.	U.C.	Vane und.	Vane rem.	Vane sen.	U.W.		Water Table Date & Time
6"			Topsoil													
			Compact br silty													
			F to C sand, some	SS1	7											
4'			crushed stone													
			Limestone boulders	RC2												
6'10"			with silty sand													
				SS3	17											
			Compact to loose													
			gray gravely F to C	SS4	23											
			sand, some silt,	SS5	7											
			occ. brick pieces													
12'4"					15											
			Dense br F to M sand	SS6	32											
14'7"			some silt													
			Cored 5'0"													
			Recovered 4'3"													
			85.0% Recovery													
19'7"			Limestone													
			Cored 9'11"													
			Recovered 9'11"													
			100% Recovery													
			Limestone													
			Cored 2'4"													
29'6"			Recovered 2'4"													
			100% Recovery													
31'10"			Limestone													

Symbols

M.C = Moisture content
L.L. = Liquid limit
P.L. = Plastic limit
P.I. = Plasticity index
U/C = Unconfined compressive strength tons sq/ft
U.W = Unit weight
und = Undisturbed shear strength Tons/sq ft
rem = Remoulded " " "
sen = Sensitivity - $\frac{\text{und}}{\text{rem}}$

br = brown
occ = occasional
F = fine
M = medium
C = coarse

Plate No. 2

BUTTS, ROSS & ASSOCIATES LTD.
CONSULTING CIVIL ENGINEERS — OTTAWA, ONTARIO

BOREHOLE ANALYSIS
BOREHOLE NO. 3
DRILLING DATE May 5, 1965
TESTING DATE

CLIENT Dept. of Public Works
LOCATION Walking Tunnel
Centre to East Block

REMARKS

BOREHOLE ELEVATION 282.13

PENETRATION DATA	HAMMER	DROP
CASING		
CONE		
SAMPLER	140 lbs	30 in.

DEPTHS MEASURED FROM GROUND LEVEL

Depth	Blows/ft	Cone Penetration Blows/Foot	Description and Remarks	Sample Type No.	Sample Blows/ft	M.C.	L.L.	P.L.	P.I.	U/C	Vane und.	Vane rem.	Vane sen.	U.W.	Water Table Date & Time
			Asphalt and Concrete												
13'			Boulder	RC 1											
21'				RC2											
			Compact to loose	RC3											
			br silty(+)F to M	SS4	11										
			sand, some gravel	SS5	10										
				SS6	9										
11'6"			Compact br F to C	SS7	20										
			sand, some(+)gravel												
			some(-)silt	SS8	18										
15'4"															
17'			Dense br F to M sand												
			and(-)silt, some(+)												
			gravel, trace clay												
			Cored 5'3"												
			Recovered 5'0"												
22'3"			95.4% Recovery												
			Cored 5'0"												
			Recovered 4'9"												
			98.5% Recovery												
			Limestone												
27'3"															
			Cored 7'0"												
			Recovered 7'0"												
			100% Recovery												
34'3"			Limestone												

Symbols

M.C. = Moisture content
L.L. = Liquid limit
P.L. = Plastic limit
P.I. = Plasticity index
U/C = Unconfined compressive strength tons sq/ft
U.W. = Unit weight
und. = Undisturbed shear strength Tons/sq ft
rem. = Remoulded " " "
sen. = Sensitivity - $\frac{\text{und}}{\text{rem}}$

br = brown
F = fine
M = medium
C = coarse

Plate No. 3

BUTTS, ROSS & ASSOCIATES LTD.
CONSULTING CIVIL ENGINEERS — OTTAWA, ONTARIO

BOREHOLE ANALYSIS
BOREHOLE NO. 4
DRILLING DATE May 6 & 7/65
TESTING DATE

CLIENT Dept. of Public Works
LOCATION Walking Tunnel
Centre to East Block
REMARKS
BOREHOLE ELEVATION 273.15

PENETRATION DATA	HAMMER	DROP
CASING		
CONE		
SAMPLER	140 lbs	30 in.

DEPTHS MEASURED FROM GROUND LEVEL

Depth	Cone Penetration Blows/ft	Cone Penetration Blows/Foot	Description and Remarks	Sample Type No.	Sample Blows/ft	M.C.	L.L.	P.L.	P.I.	U.C.	Vane und.	Vane rem.	Vane sen.	U.W.	Water Table Date & Time
6"			Topsoil												
			Loose to compact gray F to C sand and(-)gravel some(-)silt	SS1	10										
5'8"					4										
					4										
			Loose to compact br M to F sand and(-)	SS2	6										
			gravel, trace(+)silt		12										
10'10"				SS3	11										
			Cored 3'8"												
			Recovered 3'8"												
			100% Recovery												
14'6"			Limestone												
			Cored 4'11"												
			Recovered 3'9"												
			76.3& Recovery												
19'5"			Limestone												
			Cored 5'1"												
			Recovered 5'1"												
			100% Recovery												
24'6"			Limestone												

Symbols

M.C. = Moisture content
L.L. = Liquid limit
P.L. = Plastic limit
P.I. = Plasticity index
U/C = Unconfined compressive strength tons sq/ft
U.W. = Unit weight
und. = Undisturbed shear strength Tons/sq ft
rem. = Remoulded " " "
sen. = Sensitivity - $\frac{\text{und}}{\text{rem}}$

br = brown
F = fine
M = medium
C = coarse

Plate No. 4

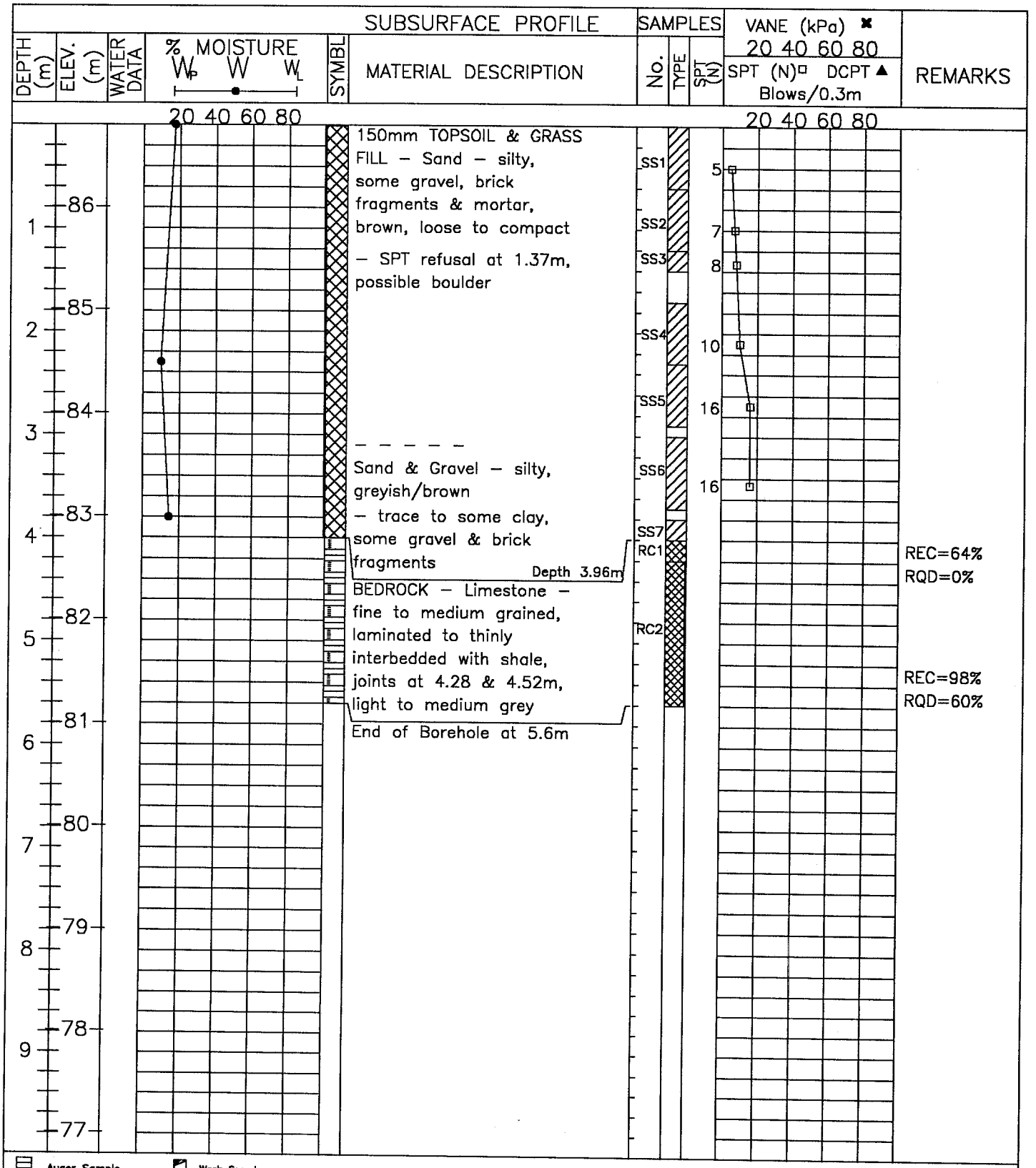
Consultant	Project	Borehole ID	Ground Surface Elevation (m)	Depth to Bedrock (m)	Bedrock Elevation (m)	Groundwater Elevation (m)
Dept. Public Works	2858	1	84.00	3.23	80.77	N/A
Dept. Public Works	2858	2	83.02	1.07	81.95	N/A
Dept. Public Works	2858	3	84.00	4.11	79.89	25.60
Dept. Public Works	2858	4	83.20	0.94	82.27	24.75
Dept. Public Works	2858	5	85.80	4.21	81.59	N/A
Dept. Public Works	2858	6	85.80	1.62	84.18	N/A

*From Golder (2013) GIS BH Location Plan

LOG OF BOREHOLE 96-1

ENCLOSURE No. 1

REF. No.: 329 J	
CLIENT: PUBLIC WORKS & GOVT. SERVICES CANADA	DRILLING DATA
PROJECT: HIGH VOLTAGE DUCT BANK, PARLIAMENT HILL	METHOD: HS AUGER
LOCATION: OTTAWA, ONTARIO	DIAMETER: 80mm id
SURFACE ELEVATION: 86.78 m	DATE: September 22nd, 1996



Auger Sample
Split Spoon
70mm Thin Wall Tube
Wash Sample
Rock Core

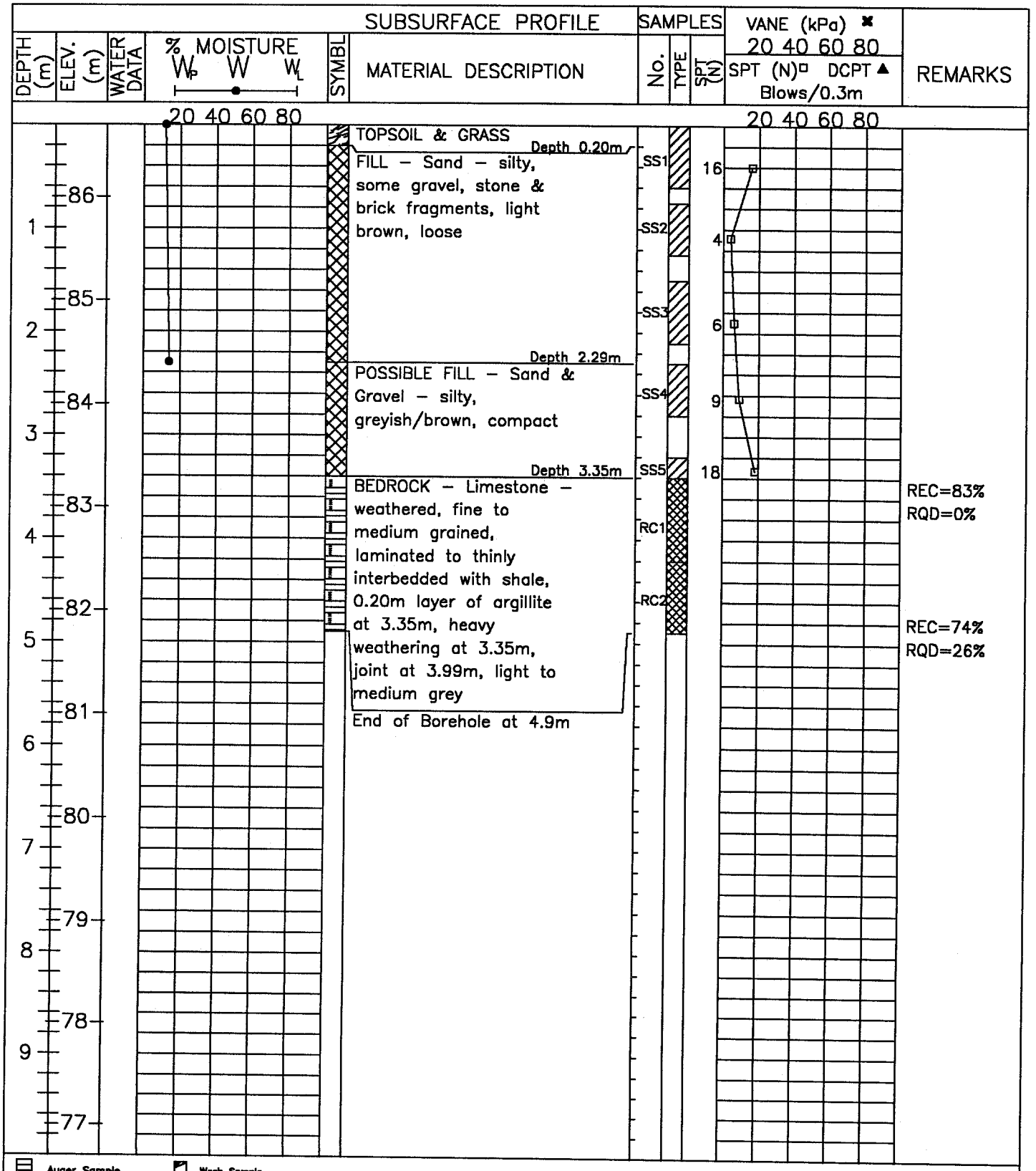
DST–AGI CONSULTING ENGINEERS INC.

Sheet 1 of 1 Hole No. 96-1

LOG OF BOREHOLE 96-2

ENCLOSURE No. 2

REF. No.: 329 J	
CLIENT: PUBLIC WORKS & GOVT. SERVICES CANADA	DRILLING DATA
PROJECT: HIGH VOLTAGE DUCT BANK, PARLIAMENT HILL	METHOD: HS AUGER
LOCATION: OTTAWA, ONTARIO	DIAMETER: 80mm id
SURFACE ELEVATION: 86.69 m	DATE: September 22nd, 1996



Auger Sample
Split Spoon
70mm Thin Wall Tube
Wash Sample
Rock Core

DST–AGI CONSULTING ENGINEERS INC.

Sheet 1 of 1 Hole No. 96–2

LOG OF BOREHOLE 96-3

ENCLOSURE No. 3

REF. No.: 329 J	
CLIENT: PUBLIC WORKS & GOVT. SERVICES CANADA	DRILLING DATA
PROJECT: HIGH VOLTAGE DUCT BANK, PARLIAMENT HILL	METHOD: HS AUGER
LOCATION: OTTAWA, ONTARIO	DIAMETER: 80mm id
SURFACE ELEVATION: 86.43 m	DATE: September 22nd, 1996

DEPTH (m)	ELEV. (m)	WATER DATA	% MOISTURE W_P W W_L 20 40 60 80	SYMBL	SUBSURFACE PROFILE: MATERIAL DESCRIPTION	SAMPLES: No.	TYPE	SPT (N)	VANE (kPa) ✖ 20 40 60 80 / SPT (N)□ DCPT ▲ Blows/0.3m 20 40 60 80	REMARKS
0	86		•		100mm ASPHALTIC CONCRETE	AS1				
					FILL – Gravel – sandy,	AS2				
					some silt, dark brown,	AS3				
					– – – – –	AS4				
1					– sand & gravel, some	AS5				
	85				brick fragments	AS6				
					Auger Refusal on Top of Steam Tunnel at 1.1m					
2	84									
3	83									
4	82									
5	81									
6	80									
7	79									
8	78									
9	77									

Auger Sample
Split Spoon
70mm Thin Wall Tube
Wash Sample
Rock Core

DST–AGI CONSULTING ENGINEERS INC.

LOG OF BOREHOLE 96-4

ENCLOSURE No. 4

REF. No.: 329 J	
CLIENT: PUBLIC WORKS & GOVT. SERVICES CANADA	DRILLING DATA
PROJECT: HIGH VOLTAGE DUCT BANK, PARLIAMENT HILL	METHOD: HS AUGER
LOCATION: OTTAWA, ONTARIO	DIAMETER: 80mm id
SURFACE ELEVATION: 86.37 m	DATE: September 22nd, 1996

DEPTH (m)	ELEV. (m)	WATER DATA	% MOISTURE W_P W W_L 20 40 60 80	SYMBL	MATERIAL DESCRIPTION	SAMPLES No.	SAMPLES TYPE	SAMPLES SPT (N)	VANE (kPa) ✖ 20 40 60 80 SPT (N)□ DCPT ▲ Blows/0.3m 20 40 60 80	REMARKS
0	86				100mm TOPSOIL & GRASS FILL – Sand – silty, some gravel, brick fragments, compact	SS1			20 □	
1	85				Depth 1.02m BEDROCK – Limestone – faintly weathered, fine to medium grained, laminated to thinly interbedded with shale, argillite layer at 1.9 to 2.2m, calcite seam at 1.1m iron stained, vertical joint at 1.5m, joints at 1.8 & 2.4m, clay gouge at 1.9 & 2.2m, med. grey.	RC1				REC=67% RQD=0%
2	84					RC2				REC=84% RQD=60%
3	83					RC3				REC=78% RQD=25%
4	82					RC4				REC=85% RQD=0%
5	81				End of Borehole at 2.5m					
6	80									
7	79									
8	78									
9	77									

Auger Sample
Split Spoon
70mm Thin Wall Tube
Wash Sample
Rock Core

DST–AGI CONSULTING ENGINEERS INC.

LOG OF BOREHOLE 96-5

ENCLOSURE No. 5

REF. No.: 329 J	
CLIENT: PUBLIC WORKS & GOVT. SERVICES CANADA	DRILLING DATA
PROJECT: HIGH VOLTAGE DUCT BANK, PARLIAMENT HILL	METHOD: HS AUGER
LOCATION: OTTAWA, ONTARIO	DIAMETER: 80mm id
SURFACE ELEVATION: 84.87 m	DATE: September 22nd, 1996

DEPTH (m)	ELEV. (m)	WATER DATA	% MOISTURE W_P W W_L 20 40 60 80	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	SAMPLES No.	SAMPLES TYPE	SAMPLES SPT (N)	VANE (kPa) ✖ 20 40 60 80 SPT (N)□ DCPT ▲ Blows/0.3m 20 40 60 80	REMARKS
0					150mm TOPSOIL & GRASS FILL – Sand & Gravel – some silt, stone fragments, loose to compact – boulder @ 1.1m	SS1		13		
1	84					SS2		10		
2	83					SS3		5		
3	82				End of Borehole at 2.3m Auger Refusal on Possible Pedestrian Tunnel	SS4		12		
4	81									
5	80									
6	79									
7	78									
8	77									
9	76									
	75									

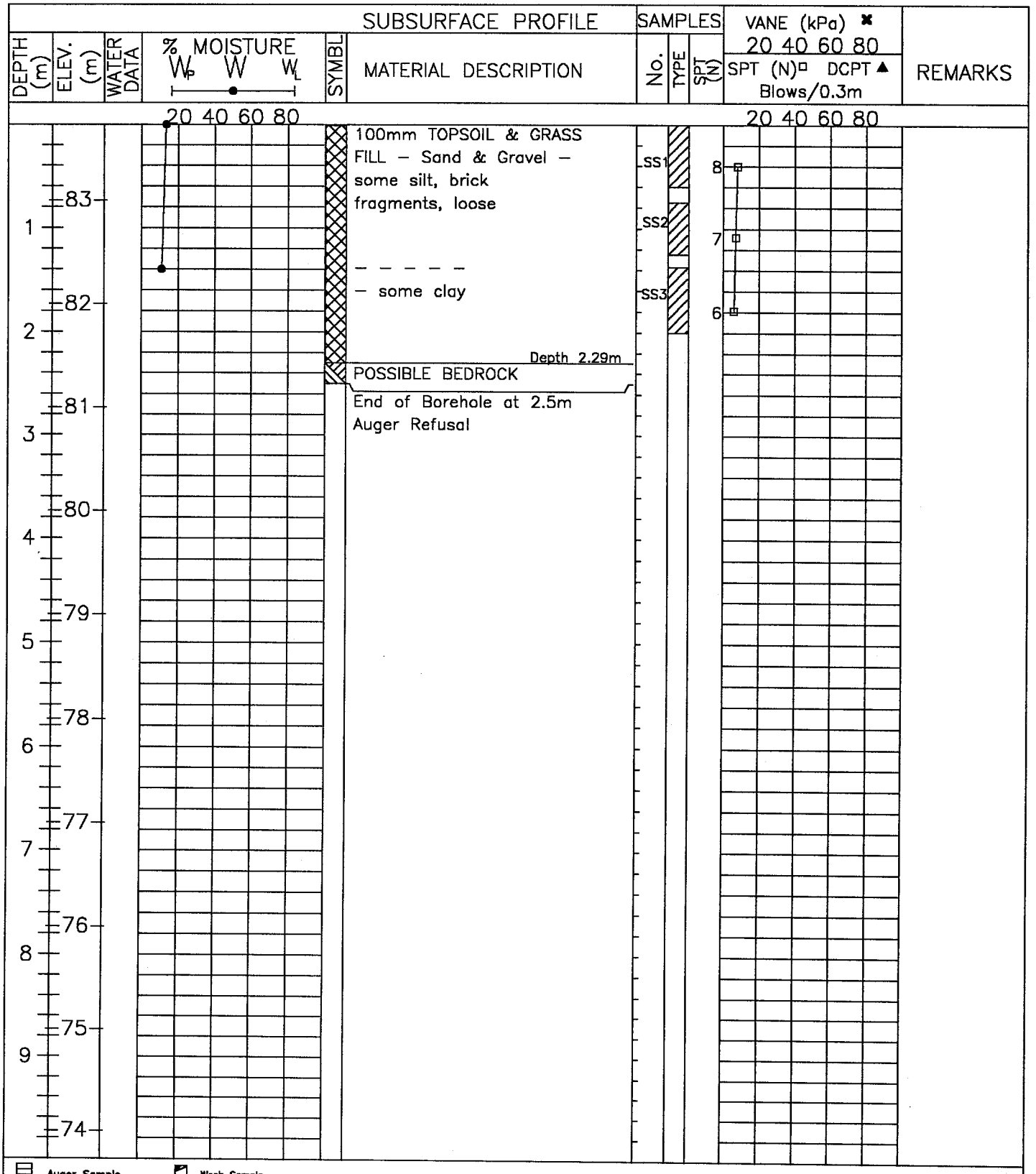
Auger Sample
Split Spoon
70mm Thin Wall Tube
Wash Sample
Rock Core

DST–AGI CONSULTING ENGINEERS INC.

LOG OF BOREHOLE 96-6

ENCLOSURE No. 6

REF. No.: 329 J	
CLIENT: PUBLIC WORKS & GOVT. SERVICES CANADA	DRILLING DATA
PROJECT: HIGH VOLTAGE DUCT BANK, PARLIAMENT HILL	METHOD: HS AUGER
LOCATION: OTTAWA, ONTARIO	DIAMETER: 80mm id
SURFACE ELEVATION: 83.73 m	DATE: September 22nd, 1996



Auger Sample
Split Spoon
70mm Thin Wall Tube
Wash Sample
Rock Core

DST–AGI CONSULTING ENGINEERS INC.

Sheet 1 of 1 Hole No. 96–6

Log of Borehole 1V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'November 30 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 75 mm	87.2	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		FILL Crusher-run to sand and gravel, moist, brown.	87.1					
		FILL Sand and gravel, some brick pieces, boulder, moist, brown (compact)	86.5	1	28			
		Auger Refusal at 1.5 m For bedrock information see subsequent pages	85.7					

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Dec. 1, 2013	6.7	
Dec. 2, 2013	5.8	
Dec. 4, 2013	8.6	
Mar. 10, 2014	20.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 1V

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**90**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**0**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367329.1** Y: **5031957.1** Z: **85.73**

Site number:

Localisation Plan:

Drilling start Date: **2013-11-30**

Borehole Depth: **23.19**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		85,73				8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
		1.47	Grey argillaceous nodular, fine-to-medium grained limestone. Fine shale lamineous. First 3 runs weathered on joint surfaces small broken zone between 2,9 and 3,0 m.				55	98	R3	2	1.5	5	8.3	
3	10						77	96	R4	3	1.5	6	6.4	
4														
5	15						86	100	R3	3	2	2	28.7	$1.44x10^{-7}$
6	20		Broken zone between 5,35 and 5,59 m on a sub-vertical weathered joint (yellow fine mineral present on surfaces).				100	100	R3	2	1.5	1	75.0	
7														
8	25						98	100	R3	2	1.5	1	73.5	
9	30						95	100	R3	3	1.5	1	47.5	
10														
11	35		From 11.50 m, more regular shale beds are present.				84	100	R3	2	1.5	1	63.0	
12	40						97	100	R3	2	1.5	1	72.8	
13														

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 1V

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
						8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
15	50	70.23					90	100	R4	2	1.5	1	67.5	
		15.50	Thinly to medium (20 at 60 cm thick) bedded fine-to-medium grained limestone, interbedded with shale seams (< 5 cm). Traces of fossils.				100	100	R3	3	1.5	1	50.0	
16	55						99	100	R3	2	1.5	1	74.3	
17														
18	60						97	98	R3	2	1.5	1	72.8	
19														
20	65						91	100	R3	2	1.5	1	68.3	$1.26x10^{-7}$
21														
22	70						93	100	R3	3	1.5	1	46.5	
23	75						100	100	R5	2	1.5	1	75.0	
		62.54												
		23.19	End of borehole at 23,2 m depth.											
24	80													
25														
26	85													
27														
28	90													
29	95													
30														
31	100													

Log of Borehole 2V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Date Drilled: 'December 2, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Figure No. 8

Page. 1 of 1

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth
		ASPHALTIC CONCRETE 75 mm	87 / 86.9	0
		FILL Crusher-run limestone/sand and gravel, grey, moist (compact)	86.3	
		FILL Silty fine sand with some gravel, light brown to grey, moist (compact to loose)		1
				2
			84.3	
		SAND AND GRAVEL Sandy silt seams/layers, brown, moist (loose)		3
			82.7	4
		WEATHERED BEDROCK	82.6	
		Refusal to Augers @ 4.4 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60
SAMPLES
Natural Unit Wt. kN/m³

30 25 38 8 8

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 3I

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Date Drilled: 'December 9 & 13, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Figure No. 9

Page. 1 of 1

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength (kPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 90 mm	87.01 86.9	0				
		FILL Crusher-run limestone/sand and gravel, grey, moist (compact)	86.3					
		FILL Silty sand and gravel, some bricks, boulder, moist, brown to grey brown (compact to very loose)		1	12			
				2	8 2			
			83.7	3	2			
		Auger Refusal at 3.5 m For bedrock information see subsequent pages			95			

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Mar. 10, 2014	21.3	
Mar. 10, 2014	20.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 3I

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**70**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**204**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**V. Boivin**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367338.6** Y: **5031934.4** Z: **87.01**

Site number:

Localisation Plan:

Drilling start Date: **2013-12-09**

Borehole Depth: **29.73**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		83,74				8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
		3.48	Grey argillaceous nodular fine-to-medium grained limestone. Fine shale laminae. Traces of fossils.				24	100	R4	3	1.5	3	4.0	
4							0	90	R4	3	1.5	3	0.0	
	15													
5							13	75	R4	3	1.5	3	2.2	
6	20						94	100	R4	3	1.5	2	23.5	
7														$3.91x10^{-6}$
	25						95	100	R4	2	1.5	3	23.8	
8														$1.58x10^{-7}$
9	30						94	100	R4	2	1.5	3	23.5	
10														
	35						94	100	R4	2	1.5	3	28.2	
11														
12	40		Calcite veined breccia between 12.33 m and 12.5 m. More regular thick shale beds are present from 12.5 m.				78	100	R4	3	1.5	5	7.8	
13														
	45						100	100	R4	2	1	3	16.7	
14														
15	50						88	100	R4	3	3	5	17.6	

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 3I

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		71.27												
17	55	16.75	Thinly to medium bedded fine-to-medium grained limestone (20-60 cm beds), interbedded with shale beds (1-12 cm thick). Traces of fossils. Broken zone from 17.80 to 17.88 m and from 23.77 to 23.90 m.				83	97	R4	2	1.5	3	20.8	
18	60						88	100	R4	2	1	3	14.7	
19														
20	65						91	100	R4	2	1	3	15.2	
21														
22	70						83	97	R4	2	1	3	13.8	
23	75						85	95	R4	2	1	3	14.2	
24														
25	80						77	97	R4	2	1	1	38.5	
26	85						100	100	R4	2	1	1	50.0	
27														
28	90						97	97	R4	2	1	1	48.5	
29	95						92	100	R4	2	1	3	15.3	
		59.07												
30		29.73	End of borehole at 29.7 m depth.											
	100													
31														
32	105													
33														

FRACTURES per 0.25m: 8 6 4 2

RQD (%): 25 50 75

Q INDEX (Barton): 0.1 1.0 10.0 100.0

HYDRAULIC CONDUCTIVITY k (m/s): $1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 4I

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 10

Page. 1 of 1

Date Drilled: 'November 21 & 22, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL 200 mm	86.55	0	11			
		FILL	86.4					
		Fine to medium sand, trace clay, occasional gravel, brown, moist (loose to dense)		1	11			
				2	7			
				3	35			
					43			
			83.3	4				
		Auger Refusal at 4.2 m For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled and grouted upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Nov. 21, 2013	7.0	
Nov. 25, 2013	8.9	
Dec. 4, 2013	8.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 4I

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa (Ontario)**		
Drilling contractor:	**Marathon**	Dip:	**50**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**239**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

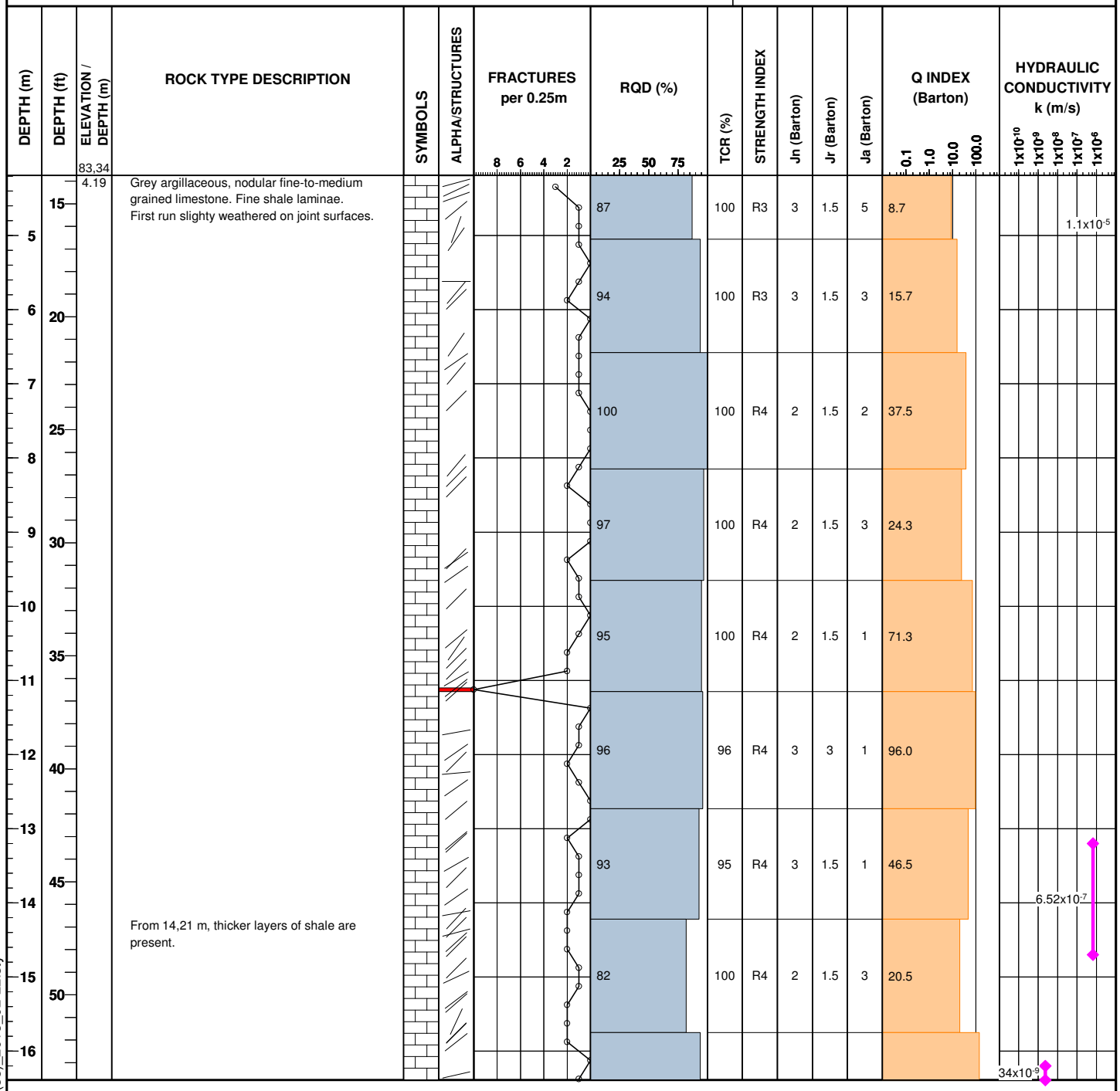
Coordinates (MTM Zone 9) X: **367326.9** Y: **5031909.7** Z: **86.55**

Site number:

Localisation Plan:

Drilling start Date: **2013-11-22**

Borehole Depth: **31.01**



Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 4I

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		73.83				8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
17	55	16.60	From 16,62 m, thinly to medium bedded, fine-to-medium grained limestone interbedded with shale layers.				94	100	R4	2	3	1	141.0	$34x10^{-9}$
18	60		Weathered shale bed at 18,11 to 18,22 depth.				59	97	R4	2	1.5	5	8.8	
19	65						82	100	R4	2	1.5	1	61.5	
20														
21	70		Small broken zone at 20,81 - 20,92 m depth and 21,64 to 21,72 m depth.				63	95	R4	2	1.5	5	9.4	
22							82	99	R4	2	1.5	1	61.5	
23	75						96	99	R4	2	1.5	1	72.0	
24	80													
25							79	98	R4	3	1.5	1	39.5	
26	85													
27							80	100	R4	3	3	3	26.7	$5.66x10^{-8}$
28	90													
29							88	100	R4	3	1.5	1	44.0	
30	95													
31	100	62.79					100	100	R4	2	1.5	1	75.0	
		31.01	End of borehole at 31,0 m depth.											
32	105													
33														

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 5V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 11

Page. 1 of 1

Date Drilled: 'December 2 to 4, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			86.94	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		TOPSOIL 200 mm	86.7					
		FILL Silty sand to sandy silt, some gravel, occasional roots, brown, to reddish brown, moist (loose to compact)			5			
				1	10			
					13			
				2				
			84.3		51/200mm			
		Auger Refusal at 2.6 m For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Dec. 4, 2013	7.7	
Dec. 5, 2013	8.6	
Dec. 6, 2013	9.3	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 5V

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**90**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**0**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367349.1** Y: **5031908.1** Z: **86.94**

Site number:

Localisation Plan:

Drilling start Date: **2013-12-02**

Borehole Depth: **23.53**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		84,32									
		2.62	Bedrock : Grey argillaceous nodular fine-to-medium grained limestone. Fine shale laminae. Broken cores between 2,62 and 2,68 m, and between 2,84 and 3,02 m. Good to excellent rock quality from 3,02 m. Weathering limited to joint surfaces only, particularly in the first two runs.	32	90	R4	3	1.5	4	4.0	
3	10			91	94	R4	3	1.5	4	11.4	
4											
	15			86	100	R3	3	1.5	1	43.0	$2.14x10^{-7}$
5											
6	20			99	100	R3	3	1.5	1	49.5	$1.82x10^{-7}$
7											
	25			100	100	R3	2	1.5	1	75.0	
8											
9	30			100	100	R3	2	1.5	1	75.0	
10											
	35			100	100	R3	2	1.5	1	75.0	
11											
12	40		From 12.19 m, thicker shale beds and less nodules.	97	100	R3	2	1	3	16.2	
13	45			85	100	R3	3	1.5	3	14.2	
14											

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 5V

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)
16		70.45								
	55	16.49	Thinly to medium bedded, fine-to-medium grained limestone, interbedded with shale seams.	95	100	R4	2	1.5	10	7.1
17				95	100	R4	3	1.5	1	47.5
18	60			88	100	R3	2	1.5	3	22.0
19										
20	65			89	100	R3	2	1	5	8.9
21										
	70			96	100	R3	2	1.5	4	18.0
22										
23	75			87	100	R3	2	1.5	3	21.8
		63.41								
		23.53	End of borehole at 23,5 m depth.							
24										
	80									
25										
26	85									
27										
	90									
28										
29	95									
30										
	100									
31										
32	105									

SYMBOLS

ALPHA/STRUCTURES

FRACTURES per 0.25m (8 6 4 2)

RQD (%) (25 50 75)

Q INDEX (Barton) (0.1 1.0 10.0 100.0)

HYDRAULIC CONDUCTIVITY k (m/s) ($1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$)

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 6V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Date Drilled: 'December 4 & 5, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Figure No. 12

Page. 1 of 1

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○—|
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			86.8	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		ASPHALTIC CONCRETE 100mm	86.7					
		FILL Crusher-run limestone/sand and gravel pit-run, grey/brown, moist	86.1					
		FILL Sand and gravel, grey, moist (compact)		1	15			
				2	8			
			84.4		50/25 mm			
		Auger Refusal at 2.4 m For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Dec. 5, 2013	10.2	
Dec. 6, 2013	7.2	
Mar. 10, 2014	20.3	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 6V

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**90**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**0**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367363.2** Y: **5031907.3** Z: **86.82**

Site number:

Localisation Plan:

Drilling start Date: **2013-12-02**

Borehole Depth: **23.39**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		84,43										
		2.39	Bedrock : Grey argillaceous nodular fine-to-medium grained limestone. Fine shale laminae. Broken cores between 2,39 and 2,47 m and between 3,02 and 3,13 m. Weathering limited to joint surfaces in the first two runs. Good to excellent rock quality from 2,95 m.		48	100	R4	2	1.5	3	12.0	
3	10				100	100	R4	3	1.5	3	16.7	
4												
	15		Calcite veins intersect borehole between 4,75 and 5,75 m and between 7,75 and 8,25 m.		100	100	R4	3	1.5	1	50.0	$1.44x10^{-7}$
5												
6	20				97	100	R4	3	1.5	1	48.5	$9.3x10^{-8}$
7												
	25				100	100	R4	3	1.5	5	10.0	
8												
9	30				91	100	R4	3	1.5	1	45.5	
10												
	35				100	100	R4	2	1.5	1	75.0	$1.38x10^{-7}$
11												
12	40		From 12.2 m, thicker shale laminae.		97	100	R4	1	1.5	3	48.5	$1.07x10^{-7}$
13												
	45				95	100	R4	2	1.5	1	71.3	$1.15x10^{-7}$
14												

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 6V

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
						8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
16	50	70.43												$1.15x10^{-7}$
		16.39	Thinly to medium bedded, fine-to-medium grained limestone, interbedded with shale seams. Fair to excellent rock quality.				88	100	R4	3	1.5	1	44.0	
17	55						67	100	R4	2	1.5	1	50.3	
18	60						93	100	R4	2	1.5	4	17.4	
19														
20	65						78	100	R4	2	1.5	1	58.5	
21														
22	70						96	100	R4	2	1.5	2	36.0	
23	75	63.43					91	100	R4	2	1.5	1	68.3	
		23.39	End of borehole at 23,4 m depth.											
24														
25	80													
26														
27	85													
28														
29	90													
30														
31	95													
32	100													
	105													

Log of Borehole 7V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 13

Page. 1 of 1

Date Drilled: 'November 18 to 20, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
			86.75	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		CONCRETE 200 mm	86.6					
		FILL Crusher-run limestone to sand and gravel, some bricks pieces, occasional boulders and rock fragments, brown, moist to very moist (loose to compact)		1	7			
				2	11	×		
			83.9					
		Auger Refusal at 2.9 m For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Nov. 20, 2013	3.8	
Nov. 25, 2013	5.7	
Dec. 6, 2013	5.5	
Mar. 10, 2014	12.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

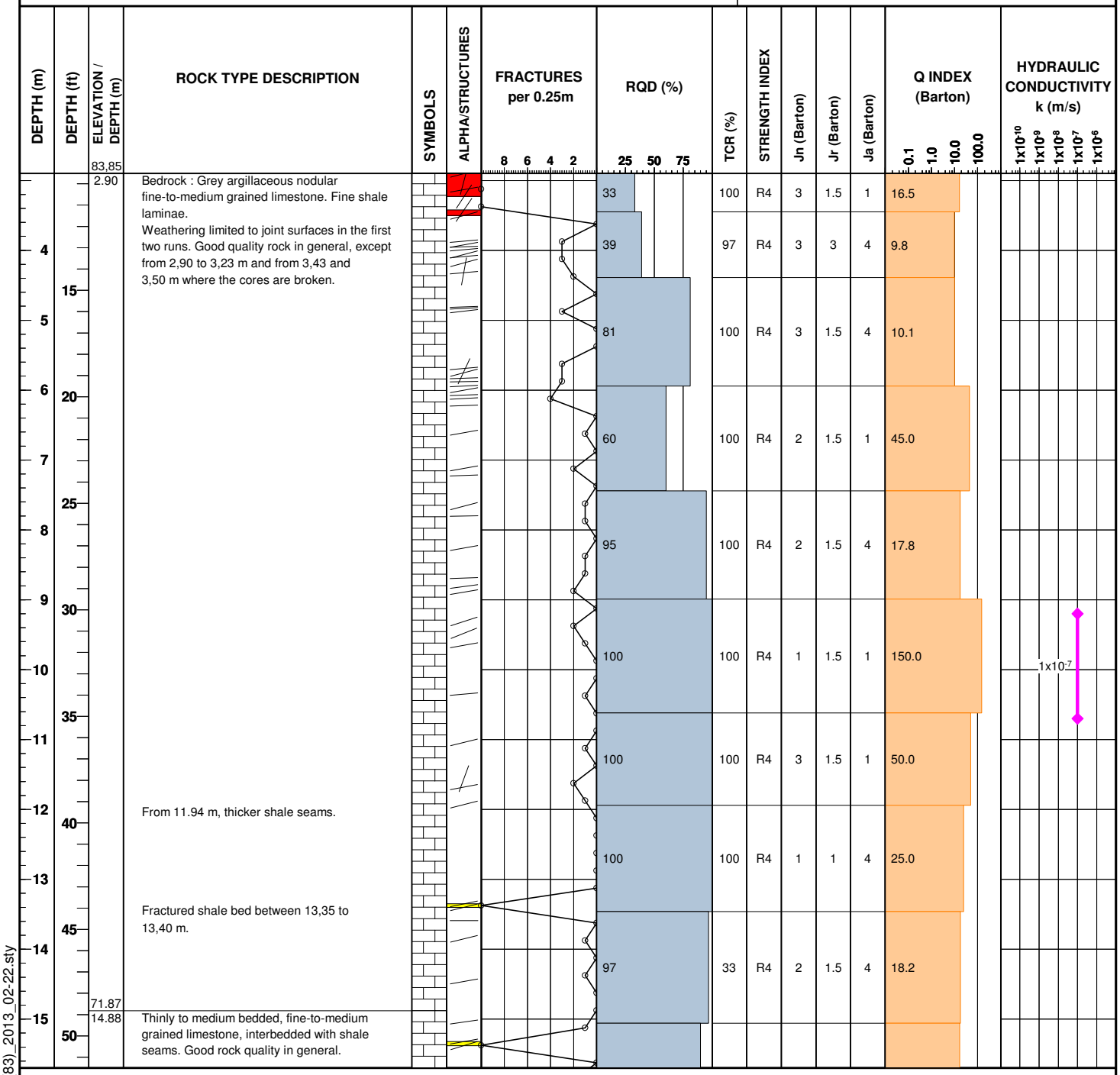
LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 7V

Project:	**Proposed Visitor Welcome Centre - Phase I**			Coordinates (MTM Zone 9)	X: **367371.6**
					Y: **5031891.3**
Client:	**Public Works and Government Services Canada**				Z: **86.75**
				Site number:	
Location:	**Parliament Hill, Ottawa, Ontario**			Localisation Plan:	
Drilling contractor:	**Marathon**	Dip:	**90**	Drilling start Date:	**2013-11-18**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**0**	Borehole Depth:	**23.22**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ-3**		
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**		



Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 7V

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
						8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
16			Fractured shale beds from 15,32 to 15,38 m, 17,25 to 17,40 m and 20,15 to 20,26 m.				90	100	R4	2	1.5	4	16.9	
17	55						90	100	R4	2	1.5	3	22.5	
18	60						83	100	R4	3	1.5	4	10.4	
19														
20	65						84	100	R4	2	1.5	1	63.0	
21	70													
22							90	100	R4	3	1.5	4	11.3	
23	75	63.53					100	100	R4	1	1	3	33.3	
		23.22	End of borehole at 23,2 m depth.											
24														
25	80													
26	85													
27														
28	90													
29	95													
30														
31	100													
32	105													
33														

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 8I

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 14

Page. 1 of 1

Date Drilled: 'November 11 to 13, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth 0	Standard Penetration Test N Value 20 40 60 80 / Shear Strength kPa 50 100 150 200	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 100 mm	85.01					
		FILL	84.9					
		Sand and gravel, some brick pieces, boulder, moist, brown (compact)	84.6					
		Auger Refusal at 0.43 m						
		For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Nov. 13, 2013	7.6	
Nov. 25, 2013	6.0	
Dec. 5, 2013	6.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 8I

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**65**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**37**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367339.6** Y: **5031853.9** Z: **85.01**

Site number:

Localisation Plan:

Drilling start Date: **2013-11-11**

Borehole Depth: **29.13**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		84,62		8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
		0.43	Bedrock : Grey argillaceous nodular, fine grained limestone. Fine shale laminae. First three runs weathered on joints surface. Broken zones from 0,43 to 0,65 m and 1,33 to 1,52 m.		20	71	R4	2	3	1	30.0	
1	5				67	86	R4	2	3	1	100.5	
2					47	92	R4	3	3	5	9.4	
3	10				81	99	R4	3	3	3	27.0	
4					92	100	R4	2	1	4	11.5	
5	15											
6	20				99	100	R4	2	3	1	148.5	$1.53x10^{-7}$
7												
8	25				100	100	R4	1	1.5	1	150.0	
9	30				99	100	R4	2	1.5	1	74.3	
10												
11	35				97	97	R4	2	1.5	1	72.8	
12	40		From 12.18 m, thicker shale beds start to appear.		93	100	R4	2	1.5	3	23.3	

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 8I

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
14	45			93	100	R4	3	1.5	1	46.5	
15	50		Weathered shale beds at 15,45 to 15,46 m and 15,78 to 15,80 m depths.	83	100	R4	2	3	4	31.1	
16		69.87									
17	55	16.70	Thinly to medium bedded, fine grained limestone, interbedded with shale layers.	100	100	R4	2	3	1	150.0	2.91×10^{-7}
18	60			92	100	R4	2	1.5	4	17.3	
19											
20	65			74	100	R4	2	1	4	9.3	6.98×10^{-8}
21			Weathered shale beds at : 20,62 to 20,63 m, 22,79 to 22,82 m, 24,80 to 24,83 m, 25,87 to 25,91 m and 25,97 to 25,99 m.								
22	70			98	100	R4	2	1.5	4	18.4	
23	75			82	100	R4	2	1.5	4	15.4	6.56×10^{-8}
24											
25	80			88	99	R4	2	1.5	1	66.0	
26	85			69	100	R4	3	3	1	69.0	
27											
28	90			95	100	R4	2	3	3	47.5	
29	95	58.61		85	100	R4	2	1.5	1	63.8	
30		29.13	End of borehole at 29,1 m depth.								

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 9V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 15

Page. 1 of 1

Date Drilled: 'November 7 & 8, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth 0	Standard Penetration Test N Value 20 40 60 80 / Shear Strength kPa 50 100 150 200	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 75 mm	84.85					
		FILL	84.8					
		Crusher-run to sand and gravel, dark grey (compact)	84.2					
		Auger Refusal at 0.62 m						
		For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Nov. 8, 2013	3.3	
Nov. 28, 2013	5.7	
Dec. 5, 2013	6.1	
Mar. 10, 2014	14.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 9V

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**90**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**0**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367358.9** Y: **5031868.5** Z: **84.85**

Site number:

Localisation Plan:

Drilling start Date: **2013-11-06**

Borehole Depth: **22.10**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)
		84,21		8 6 4 2	25 50 75						0.1 1.0 10.0 100.0
		0.64	Bedrock : Lost core to 0,79 m. Grey argillaceous nodular, fine grained limestone. Fine shale laminae. Joint surfaces weathered from 0,64 to 3,40 m. Many broken zones in the first three runs.		64	73	R3	2	1.5	2	24.0
1	5				57	100	R4	3	3	2	38.0
2					45	95	R4	2	1.5	4	8.4
3	10				88	100	R3	2	1.5	2	33.0
4											
	15										
5			Sub-vertical calcite veinlet fractured and oxydized between 4,70 m and 4,95 m.		98	100	R3	3	1.5	1	49.0
6	20				95	95	R4	2	1	1	47.5
7			From 7.30 m, thicker shale beds, and more regular beds of limestone.								
	25				91	91	R4	2	1.5	1	68.3
8			One piece of core missing (between 8,58 and 8,71 m).								
9	30				94	97	R4	2	1.5	1	70.5
10											
	35				84	100	R4	3	3	1	84.0
11			Sub-vertical fractured veinlet present between 10,60 and 11,04 m of depth.								
12	40		Weathered shale beds at 11,80 to 11,83 m and 12,15 to 12,19 m.		87	100	R4	2	1.5	5	13.1

HYDRAULIC CONDUCTIVITY k (m/s): $1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$

$3.07x10^{-6}$

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 9V

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)
		71.35								
	45	13.50	Thinly to medium bedded fine grained limestone (20 cm beds), interbedded with shale beds (3-4 cm thick). Crushed rock / weathered shale infill on a structure at 14,16 to 14,19 m.	83	99	R4	3	1.5	5	8.3
14										
	50			92	100	R4	2	2	4	23.0
15										
16										
	55			83	97	R4	3	1	3	9.2
17										
18										
	60			91	100	R4	2	1.5	5	13.7
19			Weathered shale bed between 19,11 and 19,21 m.							
	65			100	100	R4	2	1	3	16.7
20										
21										
	70			94	94	R4	1	1.5	3	47.0
		62.75								
22		22.10	End of borehole at 22,10 m depth.							
	75									
23										
24										
	80									
25										
26										
	85									
27										
28										
	90									
29										
	95									
30										

SYMBOLS

ALPHA/STRUCTURES

FRACTURES per 0.25m (8 6 4 2)

RQD (%) (25 50 75)

Q INDEX (Barton) (0.1 1.0 10.0 100.0)

HYDRAULIC CONDUCTIVITY k (m/s) ($1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$)

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 10V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 16

Page. 1 of 1

Date Drilled: 'November 24 to 26, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL 100 mm	87.41	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		FILL Sand and gravel, some brick pieces, boulders, occasional roots, moist, brown (compact)	87.3		○	×		
				1	○			
			86.0					
		Auger Refusal at 1.4 m For bedrock information see subsequent pages						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 50 mm Monitoring Well was installed upon completion of drilling.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Nov. 27, 2013	8.1	
Dec. 3, 2013	8.0	
Dec. 4, 2013	8.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

BOREHOLE REPORT

Project : **OTT-00212365-A0**

BOREHOLE N° 10V

Project:	**Proposed Visitor Welcome Centre - Phase I**		
Client:	**Public Works and Government Services Canada**		
Location:	**Parliament Hill, Ottawa, Ontario**		
Drilling contractor:	**Marathon**	Dip:	**90**
Borehole Type:	**Cased Hole**	Azimuth (Mag. North):	**0**
Borehole Diameter:	**HW**	Core Barel Diameter:	**HQ3**
Compiled:	**G. Lapointe**	Verified:	**V. Boivin**

Coordinates (MTM Zone 9) X: **367328.9** Y: **5031951.0** Z: **87.41**

Site number:

Localisation Plan:

Drilling start Date: **2013-11-25**

Borehole Depth: **24.23**

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
		85,99		8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
		1.42	Bedrock : Grey argillaceous, nodular, fine-to-medium grained limestone. Traces of fossils. Fine shale partings.									
2			Lost / broken core between 1,42 and 1,87 m depth. Structure surfaces oxydized in the first run.		64	100	R3	2	3	1	96.0	
3	10				100	100	R3	2	3	1	150.0	
4					88	100	R4	2	2	3	29.3	
	15											
5					91	100	R4	3	3	1	91.0	
6	20				92	100	R4	2	3	1	138.0	
7					100	100	R4	2	1.5	1	75.0	
	25											
8					100	100	R4	2	3	1	150.0	
9	30				89	100	R4	2	3	1	133.5	
10												
	35		From 10,5 m : Thicker and more regular dark argillaceous beds appear.									
11					89	100	R4	2	1.5	1	66.8	$8.69x10^{-8}$
12	40											
13					100	100	R4	0.5	4	0.75	1066.7	

Comments:

The Q indices were computed assuming a value of 1 for the Jw/SRF coefficient.

Structure Legend:

- Broken core / Fractured zone
- Drilling water lost
- Weathered argillaceous/silt bed
- Lost core

Report created: 2014-04-08

Log_Forage_ROC_(83)_2013_02-22.sty

BOREHOLE REPORT

BOREHOLE N° 10V

DEPTH (m)	DEPTH (ft)	ELEVATION / DEPTH (m)	ROCK TYPE DESCRIPTION	SYMBOLS	ALPHA/STRUCTURES	FRACTURES per 0.25m	RQD (%)	TCR (%)	STRENGTH INDEX	Jn (Barton)	Jr (Barton)	Ja (Barton)	Q INDEX (Barton)	HYDRAULIC CONDUCTIVITY k (m/s)
						8 6 4 2	25 50 75						0.1 1.0 10.0 100.0	$1x10^{-10}$ $1x10^{-9}$ $1x10^{-8}$ $1x10^{-7}$ $1x10^{-6}$
15	50		Weathered shale bed between 14,66 and 14,75 m depth.				84	100	R4	2	1.5	4	15.8	
16		70.91												
		16.50	Thinly to medium bedded, fine grained grey crystalline limestone, interbedded with shale seams. Fossileferous, occasional nodular structures.				100	100	R4	2	1.5	1	75.0	
17	55						90	100	R4	2	1.5	10	6.8	
18	60						96	100	R4	2	1.5	1	72.0	
19														
20	65						68	100	R4	2	1	4	8.5	
21														
22	70						97	100	R4	2	1.5	4	18.2	$5.8x10^{-8}$
23	75		Weathered shale bed between 22,37 and 22,42 m.				100	100	R4	2	1.5	1	75.0	
24		63.18												
	80	24.23	End of borehole at 24,2 m depth.											
25														
26	85													
27														
	90													
28														
29	95													
30														
	100													
31														

Log_Forage_ROC_(83)_2013_02-22.sty

Log of Borehole 11V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 17

Page. 1 of 1

Date Drilled: 'December 18, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth
			87.06	0
		ASPHALTIC CONCRETE 100 mm	87.0	
		FILL Crusher-run limestone, grey, moist	86.3	
		FILL Sand and gravel, some cobbles and boulders, grey brown (compact)	85.7	1
		CLAYEY SILT TILL Fine to coarse gravel, brown, moist (dense)	85.3	
		Refusal to Augers @ 1.8 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
N = 31 at 0.8 m; N = 55 at 1.5 m

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 12V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 18

Page. 1 of 1

Date Drilled: 'November 23, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL 250 mm	86.53	0				
			86.3					
		FILL Silty sand with some gravel to sandy gravel, some clayey silt partings, brown, moist (compact to very loose)		1	12			
					18			
				2	6			
					6			
				3	6			
					3			
				4	14			
			80.9					
		FILL Sandy silt with coarse gravel, reddish brown, very moist (loose)		5				
					5			
			79.8	6				
		Terminated @ 6.7 m Depth						

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 13V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 19

Page. 1 of 1

Date Drilled: 'November 23, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 50 mm	86.95	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		FILL Crusher-run limestone to sand and gravel, grey, slightly moist	86.9					
		SILTY SAND TILL Some rock fragments, brown, moist (loose to dense)	86.3	1	7			
					88/180mm			
		Refusal to Augers @ 2.0 m Depth	85.0	2				

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 14V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 20

Page. 1 of 1

Date Drilled: 'November 23, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 50 mm **FILL** Crusher-run limestone underlain by fine to medium sand with some gravel, brown, moist to very moist (compact)	86.69	0	20 40 60 80 Shear Strength kPa 50 100 150 200	250 500 750 Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60		
				1	11 50/25mm			
		Refusal to Augers @ 1.5 m Depth	85.2					

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 15V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 21

Page. 1 of 1

Date Drilled: 'November 15, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth 0	Standard Penetration Test N Value 20 40 60 80 / Shear Strength kPa 50 100 150 200	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 75 mm	86.15					
		FILL Sand and gravel with cobbles, limestone fragments, grey brown, moist	85.7			×		
		WEATHERED BEDROCK	85.6					
		Refusal to Augers @ 0.6 m Depth						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 16V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Date Drilled: 'December 18, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Figure No. 22

Page. 1 of 1

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth 0	Standard Penetration Test N Value 20 40 60 80 / Shear Strength kPa 50 100 150 200	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		FILL Crusher-run limestone underlain by sand and gravel with cobbles, grey brown, moist	85.59			×		
			85.0					
		Refusal to Augers @ 0.6 m Depth						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 17V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 23

Page. 1 of 1

Date Drilled: 'December 18, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◨
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		CONCRETE 130 mm	86.54	0				
		FILL Crusher-run limestone underlain by sand and gravel, trace silt, grey, moist	86.4					
		SILTY SAND TILL Fine to medium gravel, oxidized silt partings, yellowish brown, moist to very moist (loose to very dense)	85.3	1	14			
				2	9			
					80			
			83.5	3	50/125mm			
		WEATHERED BEDROCK	83.3					
		Refusal to Augers @ 3.2 m Depth						

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 18V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 24

Page. 1 of 1

Date Drilled: 'December 18, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		ASPHALTIC CONCRETE 100 mm	84.23	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		FILL Silty sand and gravel, some limestone fragments, brown, moist	84.1					
			83.1	1	75/230mm			
		WEATHERED BEDROCK	82.7					
		Refusal to Augers @ 1.5 m Depth						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

Log of Borehole 19V

Project No: OTT-000212365-A0

Project: Geotechnical Investigation - Proposed Visitor Welcome Centre - Phase I

Location: Parliament Hill, City of Ottawa, Ontario

Figure No. 25

Page. 1 of 1

Date Drilled: 'November 15, 2013

Drill Type: CME-75 (Track Mount)

Datum: Geodetic

Logged by: AN Checked by: SKA

Split Spoon Sample ☒
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Crusher-run limestone underlain by silty sand and gravel, some bricks, boulders, moist, brown (compact)	83.77	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		WEATHERED BEDROCK	82.8	1	30			
		Refusal to Augers @ 1.5 m Depth	82.3					

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled upon completion
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-000212365-A0

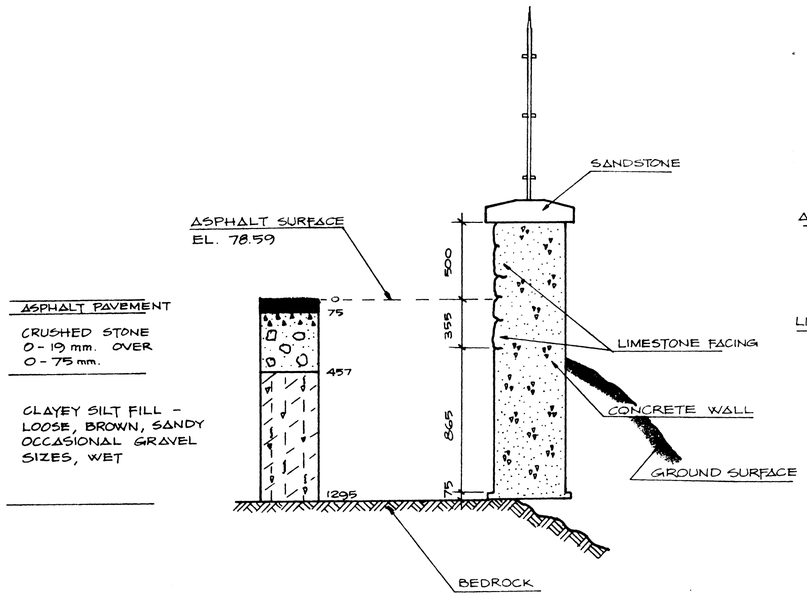
WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE GINT_LOGS OF BOREHOLES_NEW.GPJ TROW OTTAWA.GDT 2/4/14

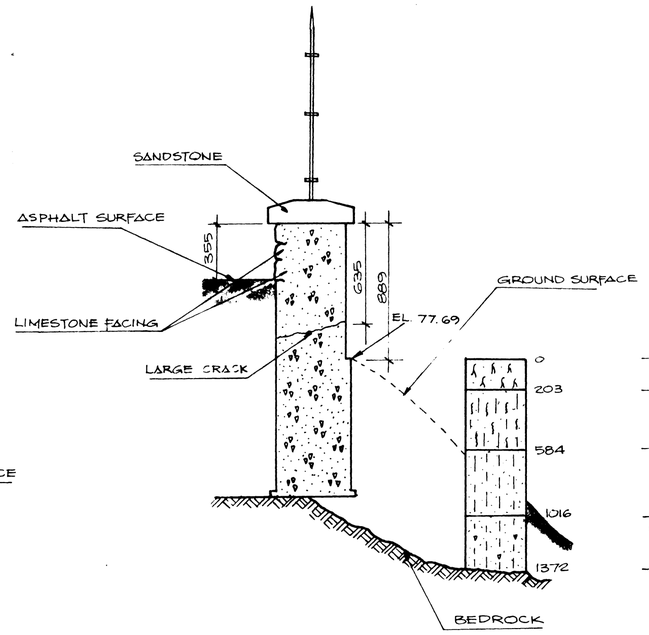


ASPHALT PAVEMENT

CRUSHED STONE 0 - 19 mm. OVER 0 - 75 mm.

CLAYEY SILT FILL - LOOSE, BROWN, SANDY OCCASIONAL GRAVEL SIZES, WET

TP - 1



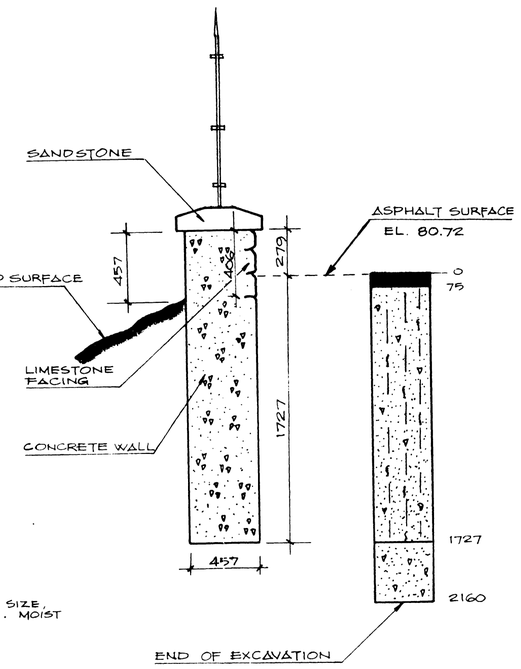
TOPSOIL

SILT, SAND WITH ORGANIC MATTER

SANDY SILT WITH ORGANIC MATTER

CLAYEY SILT, SANDY - COMPACT, BROWN. OCCASIONAL GRAVEL SIZE, SLIGHTLY COHESIVE. MOIST

TP - 2

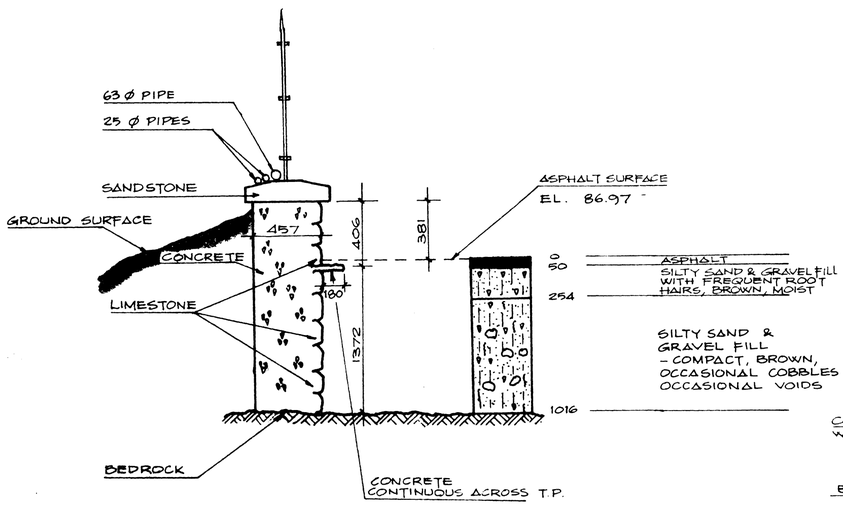


ASPHALT

SILTY SAND FILL - COMPACT, BROWN, DIRTY, OCCASIONAL GRAVEL SIZES & BRICK PIECES, MOIST

SAND FILL COMPACT, BROWN, CLEAN, OCCASIONAL GRAVEL SIZES, MOIST.

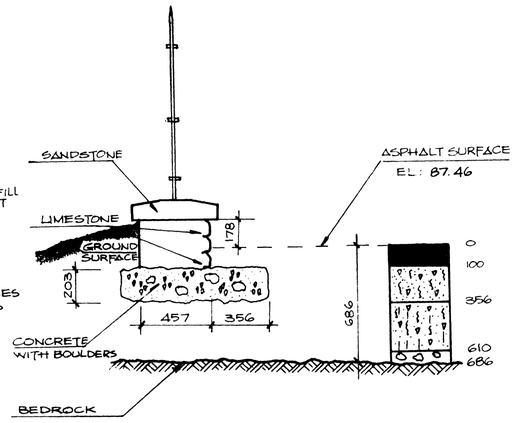
TP - 3



ASPHALT
SILTY SAND & GRAVEL FILL WITH FREQUENT ROOT HAIRS, BROWN, MOIST

SILTY SAND & GRAVEL FILL - COMPACT, BROWN, OCCASIONAL COBBLES OCCASIONAL VOIDS

TP - 4



50 mm ASPHALTIC CONC.
50 mm CRUSHED STONE. DENSE, GREY, MOIST
FILL 0-19mm CRUSHED SAND & GRAVEL COMPACT, BROWN, DIRTY, FREQUENT ROOTS, VERY MOIST
BECOMING 0-50 mm AS ABOVE

SILTY SAND & GRAVEL FILL
ORGANIC MATTER

COBBLE AND ROCK PIECES WITH SAND

TP - 5

PARLIAMENT FENCING & RETAINING WALLS
SKETCH OF TEST PIT DATA.
OTTAWA, ONTARIO.

DRAWN BY: BC & GV CHECKED BY: HRK	DRAWING No. 0-6572-5-2
FONDEX LTD.	SCALE 1:25 DATE: DECEMBER 1983

0-6604-S

FONDEX LTD.
FOUNDATION ENGINEERS

BOREHOLE NUMBER 1

PROJECT PROPOSED ENTRANCES - SPEAKER OF SENATE

LOCATION CENTRE BLOCK, PARLIAMENT BUILDINGS, OTTAWA

DATUM _____ BOREHOLE TYPE PORTABLE ELECTRIC

DRILLING DATE Nov. 1/83

REPORT DATE Nov. 18/83

DRAWN BY HRK

GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80 SHEAR STRENGTH FIELD VANE SHEAR * LAB VANE SHEAR X	CONSISTENCY: NATURAL MOISTURE CONTENT (W) LIQUID LIMIT (W) PLASTIC LIMIT (Wp) %
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	% RECOVERY		
86.99								
0. 86.79	TOPSOIL							
0.20	SAND & GRAVEL FILL - compact, brown, dirty at upper levels, frequent cobbles by 1.0 m depth, becoming clean sand and gravel by 1.5 m, moist.	F.	1	SS	28			
0.5		F.						
1.		F.	2	RC				
		F.	3	RC				
1.5		F.	4	SS	7			
2. 84.86		F.						
2.13	LIMESTONE BEDROCK - Ottawa Formation - moderately fractured - fair quality		5	RC		85 RQD 65		
2.5 84.19								
2.80	END OF BOREHOLE							

0-6604-S

FONDEX LTD.
FOUNDATION ENGINEERS

BOREHOLE NUMBER 2

PROJECT PROPOSED ENTRANCES - SPEAKER OF ~~SENATE~~ HOUSE OF COMMONS

LOCATION CENTRE BLOCK, PARLIAMENT BUILDINGS, OTTAWA

DATUM _____ BOREHOLE TYPE PORTABLE ELECTRIC

DRILLING DATE Nov. 2/83

REPORT DATE Nov. 18/83

DRAWN BY HRK

GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80	CONSISTENCY: NATURAL MOISTURE CONTENT (W) LIQUID LIMIT (W) PLASTIC LIMIT (Wp) %
Elev. / Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	RECOVERY %	SHEAR STRENGTH FIELD VANE SHEAR * LAB VANE SHEAR X	
87.31 / 0.	TOPSOIL							
87.11 / 0.20	SAND & GRAVEL FILL - loose, brown, dirty and silty at upper levels, moist.		1	SS	12			
0.5			2	SS	6			
86.12 / 1.								
1.19	LIMESTONE BEDROCK - Ottawa Formation		3	RC		100 RQD 75		
1.5	- moderately fractured - good quality		4	RC		100		
			5	RC		100		
2.			6	RC		100		
84.64 / 2.5								
84.33 / 2.67	END OF BOREHOLE							

O-A-087-A

FONDEX

BOREHOLE NUMBER BH-8

PROJECT Geotechnical Investigation - East Block Tunnel

DRILLING DATE 89-07-14

LOCATION Parliament Hill, Ottawa

REPORT DATE 89-07

DATUM Geodetic BOREHOLE TYPE Electric Winki

DRAWN BY MTW

GEOLOGIC PROFILE		SAMPLES						DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80 / SHEAR STRENGTH kPa: FIELD VANE SHEAR •, LAB VANE SHEAR X	CONSISTENCY: NATURAL MOISTURE CONTENT (W), LIQUID LIMIT (W), PLASTIC LIMIT (Wp) % 20 40 60 80
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	% RECOVERY			
87.00									
0.00	Grass and Topsoil over Fill: fine sand, some gravel, trace of clay, brick, and mortar, loose, brown, moist		1	SS	5				
85.78			2	SS	3				
1.22	Fill: mixture of fine sand, gravel, silt, and boulders with brick and mortar fragments, compact, brown, moist		3	SS	15				
85.00									
2.00									
84.41									
2.59	Fine Sand (Fill): with some clay and gravel, trace of brick, loose to very dense, brown, wet		4	SS	2				
84.00									
3.00			5	SS	40				
83.19									
3.81	Till: silty sand, trace gravel, compact, olive grey, moist		6	SS	26				G.W.L. July 31/89
82.58									
4.42	Limestone Bedrock: with horizontal shale seams, some fracturing of core along seams		7	RC		88	RQD=77%		
82.00									
5.00			8	RC		97	RQD = 57%		
81.00									
6.00									
80.68									
6.32	END OF BOREHOLE								

Notes:
1. Piezometer installed
2. Water Level Records

Time	Water Level
89-07-16	4.1m
89-07-17	5.0m
89-07-21	4.1m
89-07-27	4.1m
89-07-31	4.1m

O-A-087 -A

FONDEX

BOREHOLE NUMBER BH-9

PROJECT Geotechnical Investigation - East Block Tunnel

LOCATION Parliament Hill, Ottawa

DATUM Geodetic BOREHOLE TYPE Electric Winki

DRILLING DATE 89-07-17

REPORT DATE 89-07

DRAWN BY MTW

GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80 / SHEAR STRENGTH kPa (FIELD VANE SHEAR *, LAB VANE SHEAR X)	CONSISTENCY: NATURAL MOISTURE CONTENT (W), LIQUID LIMIT (W), PLASTIC LIMIT (Wp) % 20 40 60 80
Elev. / Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	% RECOVERY		
86.73								
0.00	115mm asphalt over 165mm concrete over Sand and Gravel Fill: loose to compact, some brick, trace clay, damp		1	SS	18			
85.73								
1.00			2	SS	7			
84.73			3	SS	7			
2.00			4	SS	23			
83.73			5	SS	4			
3.00			6	SS	12			
82.77								
3.96	Silty Sand Fill: trace gravel, clay, and brick, compact, brown moist		7	SS	10			GWL July 31/89
81.95			8	SS	16			
4.78	Limestone Bedrock: with horizontal shale seams. vertical fracture from 5.64 to 6.27m		9	RC		100	RQD = 26%	
			10	RC		100	RQD = 56%	
80.73			11	RC		100	RQD = 0%	
6.00			12	RC		86	RQD = 0%	
80.23								
6.50	END OF BOREHOLE							

Notes:

1. Piezometer installed
2. Water Level Records

Time	Water Level
89-07-27	4.6m
89-07-31	4.5m

O-A-087-A

FONDEX

BOREHOLE NUMBER BH-10

PROJECT Geotechnial Investigation - East Block Tunnel

DRILLING DATE 89-07-12

LOCATION Parliament Hill, Ottawa

REPORT DATE 89-07

DATUM Geodetic BOREHOLE TYPE Electric Winki

DRAWN BY MTW

GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80 / SHEAR STRENGTH kPa FIELD VANE SHEAR • LAB VANE SHEAR X	CONSISTENCY: NATURAL MOISTURE CONTENT (W) LIQUID LIMIT (W) PLASTIC LIMIT (Wp) % 20 40 60 80
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	% RECOVERY		
86.48								
0.00	150mm concrete over Fill: drilling through wood and soil to 2.51 m depth							
85.48								
1.00								
84.48								
2.00	-Fill: fine sand with some gravel and clay, trace brick and mortar loose to compact, brown, moist		1	SS	6			
83.48								
3.00	-greenish-brown, moist		2	SS	10			
82.67								
3.81	Fine to Medium Sand (Fill): with trace silt, gravel, loose to compact brown, moist		3	SS	7			
			4	SS	10			
81.94	-difficult drilling							
5.00	trough 75mm of metal							
80.94								
5.54	Limestone Bedrock: with some fracturing along horizontal shale seams		5	RC	93		RQD = 36%	
80.48								
6.00			6	RC	96		RQD = 38%	
79.42								
7.06	END OF BOREHOLE							

GWL July 17/89

Notes:

1. Piezometer installed
2. Highly permeable zones at 0.20m (in fill) and 5.56m (in bedrock)
3. Water Level Records:

Time	Water Level
89-07-17	6.1m
89-07-31	6.1m

FONDEX

O-A-087 -A

BOREHOLE NUMBER BH-11

PROJECT Geotechnical Investigation - East Block Tunnel

DRILLING DATE 89-07-12

LOCATION Parliament Hill, Ottawa

REPORT DATE 89-07

DATUM Geodetic BOREHOLE TYPE Electric Winki

DRAWN BY MTW

Elev. / Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	% RECOVERY	DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80 / SHEAR STRENGTH kPa: FIELD VANE SHEAR *, LAB VANE SHEAR X	CONSISTENCY: NATURAL MOISTURE CONTENT (W), LIQUID LIMIT (W), PLASTIC LIMIT (Wp) % 20 40 60 80
83.82								
0.00 82.82	125mm asphalt and 50 mm concrete over Fill: fine sand, some gravel trace silt and brick, compact, brown, moist	F A	1	SS	10			
1.00 81.82	Fine Sand: some gravel trace silt, cohesive, compact, brown, moist (Fill)	A F A	2	SS	12			
		A F	3	SS	13			
2.00 81.53		A A						
2.29 80.82	Fine Sand (Fill): some gravel, trace silt, loose to compact, brown, moist	F A	4	SS	9			
3.00 80.34	cored through 250 mm gabbro boulder from 2.90 to 3.15 m	F A	5	SS	4			
3.48 79.98			6	RC		64	RQD = 36%	
3.84 78.82	Limestone Bedrock with horizontal seams		7	RC		99	RQD = 68%	
5.00 78.23								▽ GWL July 27/89
5.59	END OF BOREHOLE							

Notes:

1. Piezometer installed
2. probable step in Bedrock from 3.48 to 3.84 m
3. Probable void between 3.30 & 3.45 m
4. Water Level Records

Time	Water Level
89-07-17	5.4m
89-07-21	5.5m
89-07-27	5.5m
89-07-31	5.5m

O-A-087-A

FONDEX

BOREHOLE NUMBER BH-12

PROJECT Geotechnical Investigation - East Block Tunnel
LOCATION Parliament Hill, Ottawa
DATUM Geodetic BOREHOLE TYPE Electric Winki

DRILLING DATE 89-07-14
REPORT DATE 89-07
DRAWN BY MTW

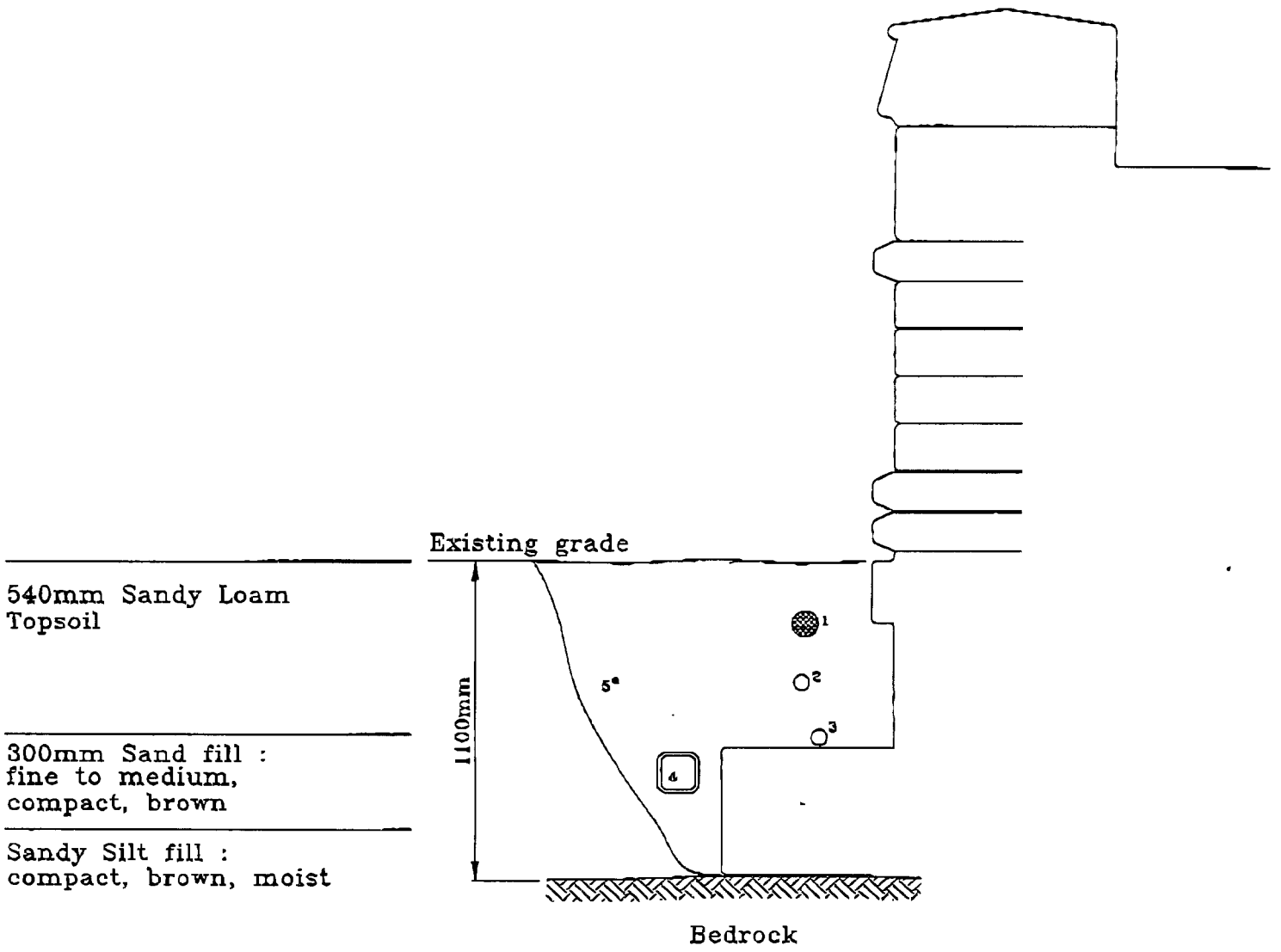
GEOLOGIC PROFILE		SAMPLES					DYNAMIC PENETRATION RESISTANCE BLOWS 0 20 40 60 80 / SHEAR STRENGTH kPa: FIELD VANE SHEAR *, LAB VANE SHEAR X	CONSISTENCY: NATURAL MOISTURE CONTENT (W), LIQUID LIMIT (W), PLASTIC LIMIT (Wp) — % 20 40 60 80
Elev. Depth	DESCRIPTION	STRATIGRAPHY	NUMBER	TYPE	BLOWS (N)	% RECOVERY		
82.91								
0.00	125mm asphalt, 50mm concrete & 100mm crushed stone over Fine Sand: trace gravel, cohesive, compact, dark brown,		1	SS	5			
82.02	moist							
0.89	Gravel with some sand compact, brown, moist		2	SS	20			
80.19								
2.00				SS	10			
80.24								
2.67	Fine Sand: trace silt, some voids, loose,		3	SS	3			
79.91								
3.00	brown, wet		4	SS	4			
79.28								
3.63	Limestone Bedrock: with horizontal shale seams, 50mm thick solution cavity		5	RC		97	RQD = 63%	
78.91								
4.00								
77.91								
5.00								
77.55								
5.36	END OF BOREHOLE							

Notes:
1. Piezometer installed
2. Probable step in bedrock from 3.63 to 4.27m depth
3. Water Level Records

Time	Water Level
89-07-17	dry @ 5.4m
89-07-21	dry @ 5.2m
89-07-27	dry @ 5.2m

TP-1

Lower Wall - West Side

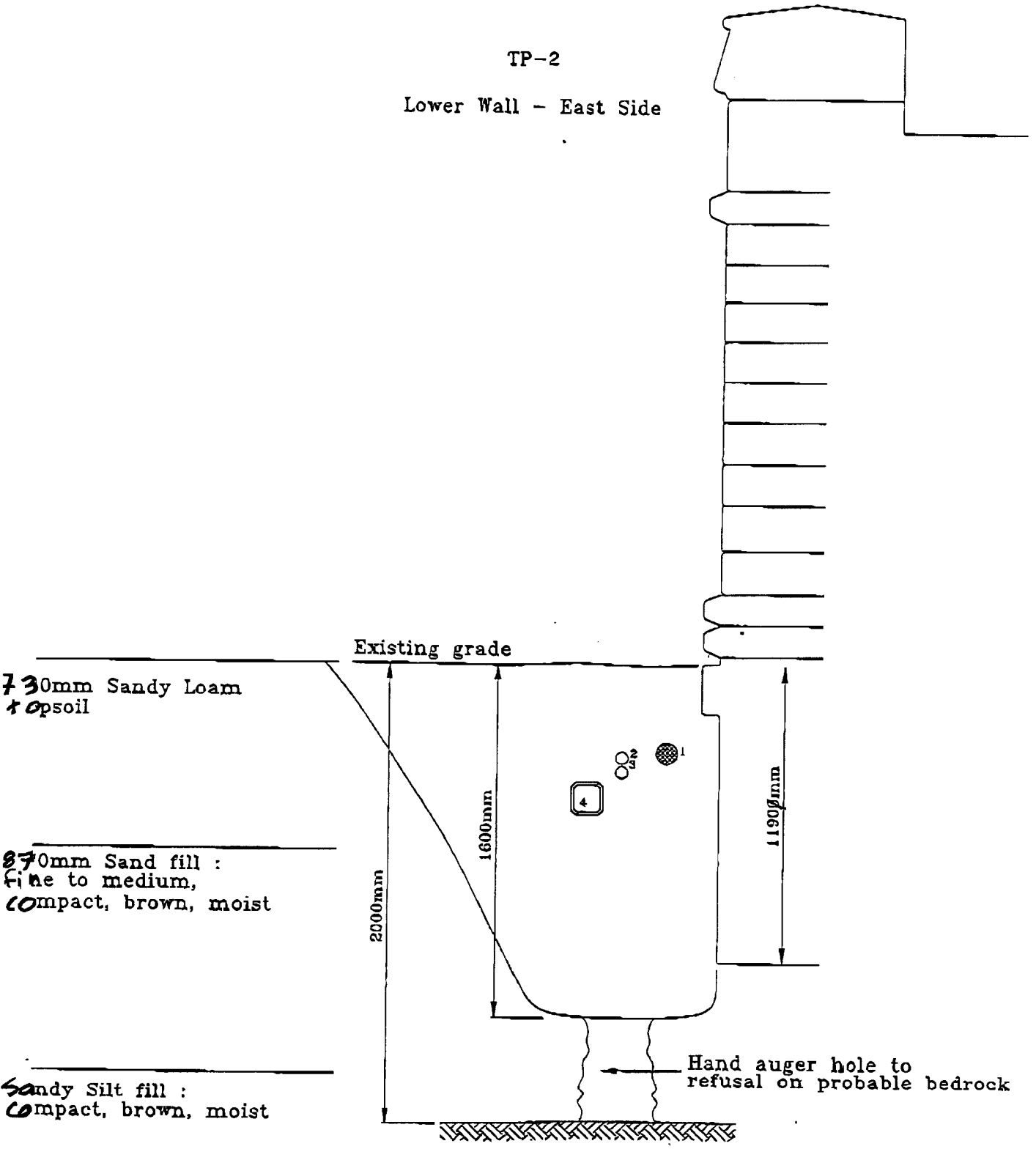


1. Bundle of 30 loose, small diameter wires.
2. Black PVC pipe 30mm ø.
3. Bundle of 4 loose, small diameter wires.
4. Clay tile duct 125 x 125mm.
5. Single small diameter wire

Scale : 1 : 20

TP-2

Lower Wall - East Side

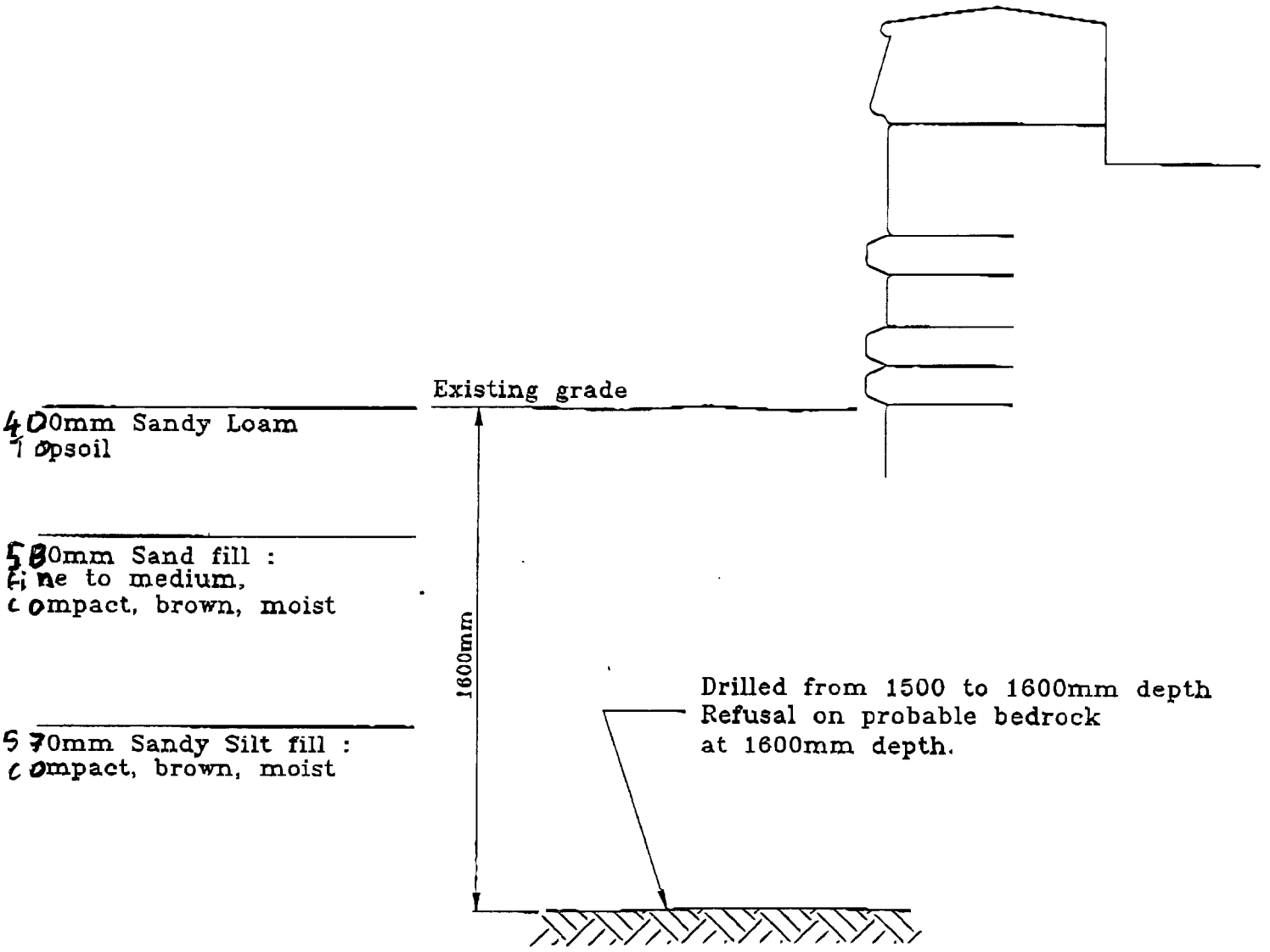


1. Bundle of 19 loose, small diameter wires.
2. Black PVC pipe 30mm ø.
3. Bundle of 2 loose, 125mm ø diameter wires.
4. Clay tile duct 125 x 125mm.

e : 1 : 20

TP-3

Upper Wall – East Side
(Abandoned due to construction activity)

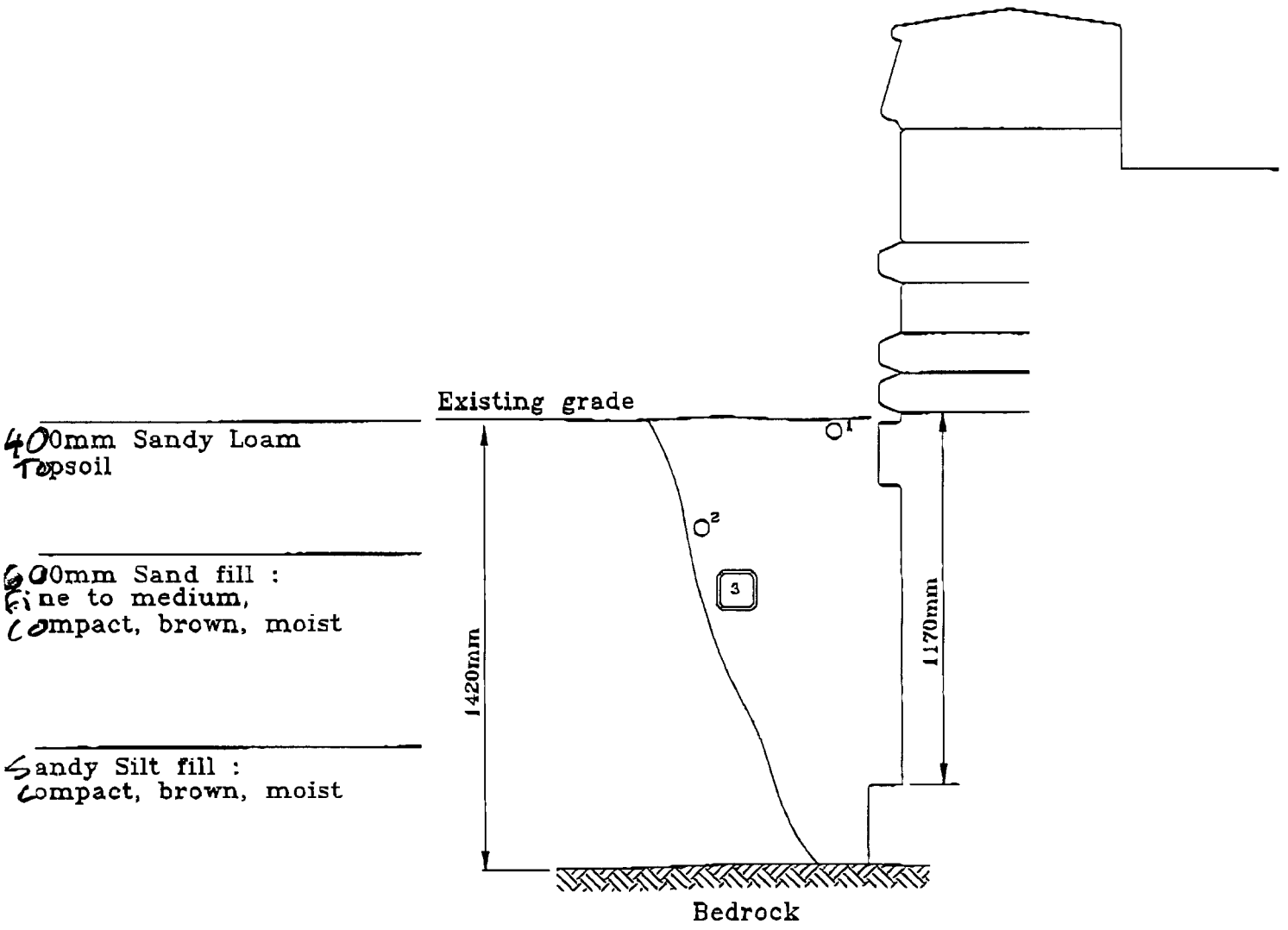


Testpit abandoned before side of wall
below grade was cleaned for inspection.
Bottom of wall was not determined.

e : 1 : 20

TP-4

Upper Wall - West Side



1. Black PVC pipe 30mm ø.
2. 50mm ø grey ABS pipe
3. Clay tile duct 125 x 125mm.

le : 1 : 20

Consultant	Project	Borehole ID	Ground Surface Elevation (m)
FONDEX LTD	f2647	04-01	81.66
FONDEX LTD	f2647	04-02	82.32
FONDEX LTD	f2647	04-03	83.66
FONDEX LTD	f2647	04-04	81.95
FONDEX LTD	f2647	04-05	84.78
FONDEX LTD	f2647	04-06	85.24
FONDEX LTD	f2647	04-07	83.82
FONDEX LTD	f2647	04-08	86.37
FONDEX LTD	f2647	04-09	86.37
FONDEX LTD	f2647	04-10	84.44
FONDEX LTD	f2647	04-11	86.58
FONDEX LTD	f2647	04-12	86.84
FONDEX LTD	f2647	04-13	86.68
FONDEX LTD	f2647	04-14	85.31
FONDEX LTD	f2647	04-15	85.51
FONDEX LTD	f2647	04-16	85.74
FONDEX LTD	f2647	04-17	86.95
FONDEX LTD	f2647	04-18	87.15
FONDEX LTD	f2647	04-19	87.59
FONDEX LTD	f2647	04-20	86.76
FONDEX LTD	f2647	04-21	86.45
FONDEX LTD	f2647	04-22	83.6
FONDEX LTD	f2647	04-23	81.75
FONDEX LTD	f2647	04-24	82.55
FONDEX LTD	f2647	04-25	82.71
FONDEX LTD	f2647	04-26	82.06

*From Golder (2013) GIS BH Location Plan

Form G A -0-1

Project No. 762034

RECORD OF BOREHOLE 10

LOCATION See Figure 1 BORING DATE MARCH 29, 1976 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 140 LB., [illegible] PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

BORING METHOD	SOIL PROFILE: ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS/FT	ELEVATION SCALE
	155.5 / 0.0	GROUND SURFACE					155
	154.0 / 1.5	DARK BROWN ORGANIC TOPSOIL					
8" DIAM. (HOLLOW STEM) POWER AUGER 6" DIAM. (UNCASED)		LOOSE BROWN SILTY SAND, TRACE GRAVEL, OCCASIONAL COBBLE (FILL)		1	2" DO	8	
				2	"	8	150
				3	"	10	
	144.5 / 11.0	END OF SAMPLING		4	"	3	145
	124.5 / 31.0	END OF HOLE REFUSAL TO AUGERING, POSSIBLY BEDROCK					140
							135
							130
							125
							120

DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (20 40 60 80)

SHEAR STRENGTH Cu, LB / SQ FT. (NAT V. ○ REM V. ●)

COEFFICIENT OF PERMEABILITY, K, CM/SEC (10⁻⁵ 10⁻⁴ 10⁻³ 10⁻²)

WATER CONTENT, PCF (20 40 60 80)

○ 9

○ 10

MH

FREE WATER ELEVATIONS AND DATES WHEN MEASURED

15 Percent axial strain at failure

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DN
BG

Form G.A.-D-1

Project No. 762034

RECORD OF BOREHOLE 11

LOCATION See Figure 1 BORING DATE MARCH 29, 1976 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 140 LB., FROM 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., FROM 30 IN.

BORING METHOD	ELEV'N / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FT	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (20 40 60)	SHEAR STRENGTH c_u, LB./SQ.FT. NAT. V. + PEAK V. + REMV. ○	COEFFICIENT OF PERMEABILITY, k_v, CM/SEC (1x10 1x10 1x10 1x10)	WATER CONTENT, PERCENT w_p (20 40 60 80) w_l	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	154.5±	GROUND SURFACE					155						
POWER AUGER 8" DIAM. (HOLLOW STEM)	0.0	GREY CRUSHED STONE, 2" DIAM. (FILL)											
	151.5 / 3.0	LOOSE BROWN TO GREY DEPTH SILTY SAND, GRAVEL AND CLAYEY SILT, TRACE ORGANIC MATERIAL, OCCASIONAL COBBLE (FILL)		1	2" D.O.	39	150			○			
				2	"	6	145			○		MH	
				3	"	17	140						
				4	"	18							
	133.0			5	"	9	135						
	21.5 / 130.5	LOOSE GREY SILTY SAND, TRACE GRAVEL (ALLUVIUM)		6	"	5 / 8							
	24.0	END OF HOLE					130						

ε = 10.0-3 Percent av. of strain at failure

VERTICAL SCALE 1 IN. TO 5 FT

Golder Associates

DRAWN DN

CHECKED BG

772268

RECORD OF BOREHOLES 1 & 2

LOCATION See Figure 2 BORING DATE DEC. 12 & 13, 1977 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.	ELEVATION SCALE
	291.5	GROUND SURFACE					
ROTARY DRILLING, BX CASING	0.2 / 289.9	ASPHALT; SAND AND GRAVEL (FILL)					
	1.6	FRACTURED GREY LIMESTONE BEDROCK, SOME WEATHERED SEAMS, RUST COLORED JOINTS AND BEDDING PLANES		1 2 3	BX RC " "	1 1 1	290 285
	279.5						
ROTARY DRILLING, BX CORE	12.0	FAIRLY SOUND GREY LIMESTONE BEDROCK, SOME WAVY BANDS OF DARK GREY SHALY LIMESTONE (OTTAWA FORMATION)		4 5	" "	1 1	280 275
	273.8						
	17.7	END OF HOLE					
	291.1	GROUND SURFACE					
ROTARY DRILLING, BX CASING	0.2 / 290.9	ASPHALT; SAND AND GRAVEL (FILL)					
	1.2	FRACTURED GREY LIMESTONE BEDROCK, SOME WEATHERED SEAMS		1 2 3	BX RC " "		290 285
	285.0						
ROTARY DRILLING, BX CORE	6.1	FAIRLY SOUND GREY LIMESTONE BEDROCK, SOME WAVY BANDS OF DARK GREY SHALY LIMESTONE (OTTAWA FORMATION)		4 5 6	" " "		280 275
	272.8						
	18.3	END OF HOLE					

DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (20 40 60 80)

SHEAR STRENGTH Cu., LB./SQ.FT. NAT. V.- + Q.-● REM.V.- ● U.-○

COEFFICIENT OF PERMEABILITY, k, CM./SEC. (1x10 1x10 1x10 1x10)

WATER CONTENT, PERCENT (WP — W — WL)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

BH. 1

	R.Q.D. (%)	CORE RECOVERY (%)
	42	0
	73	33
	39	0
	22	
	97	38

BH. 2

	R.Q.D. (%)	CORE RECOVERY (%)
	25	
	33	
	88	
	96	0
	69	
	98	

Percent axial strain at failure

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DRAWN D.N.

CHECKED F.J.H.

RECORD OF BOREHOLES 3 & 4

LOCATION See Figure 2 BORING DATE DEC. 14, 1977 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

BORING METHOD	SOIL PROFILE: ELEV'N. / DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.	ELEVATION SCALE
	291.2 / 0	GROUND SURFACE					290
ROTARY DRILLING, BX CASING	0.2 / 289.8	ASPHALT; SAND AND GRAVEL (FILL)					
	1.4 / 288.5	WEATHERED LIMESTONE BEDROCK		1	BX RC	—	
BX CORE	2.7	FAIRLY SOUND GREY LIMESTONE BEDROCK (OTTAWA FORMATION)		2	"	—	285
	281.6 / 9.6	END OF HOLE					280

BH. 3

72 90 0

R.Q.D. (%)
CORE RECOVERY (%)

BORING METHOD	SOIL PROFILE: ELEV'N. / DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.	ELEVATION SCALE
	291.2 / 0	GROUND SURFACE					290
ROTARY DRILLING, BX CASING	0.2 / 289.9	ASPHALT; SAND AND GRAVEL (FILL)					
	1.3	FRACTURED GREY LIMESTONE BEDROCK		1	BX RC	—	
	286.9 / 4.3			2	"	—	285
BX CORE		FAIRLY SOUND GREY LIMESTONE BEDROCK (OTTAWA FORMATION)		3	"	—	
	279.3 / 11.9	END OF HOLE					280
							275

BH. 4

50 67 94 0

R.Q.D. (%)
CORE RECOVERY (%)

DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (20 40 60 80)
SHEAR STRENGTH Cu., LB./SQ.FT. NAT. V. - + Q. - ● REM.V. - ⊕ U. - ○
COEFFICIENT OF PERMEABILITY, k, CM./SEC. (1x10 1x10 1x10 1x10)
WATER CONTENT, PERCENT (Wp W Wl)
ADDITIONAL LAB. TESTING
PIEZOMETER OR STANDPIPE INSTALLATION

15 / 10 Percent axial strain at failure

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DRAWN D.N.
CHECKED F.J.B.

RECORD OF BOREHOLES 5 & 6

LOCATION See Figure 3 BORING DATE DEC. 12 & 13, 1977 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

B.H. 5

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS/FT.	ELEVATION SCALE
	280.9	GROUND SURFACE					
ROTARY DRILLING, BX CASING	0.1 / 279.6 / 1.3	ASPHALT. SAND AND GRAVEL (FILL)					
		LOOSE BROWN SILTY SAND, SOME GRAVEL, BRICK AND CINDERS (RUBBLE FILL)		1	BX R.C.	3	280
				2	"	50	
				3	"	58	275
	272.1						
ROTARY DRILLING, BX CORE	8.8	FAIRLY SOUND GREY LIMESTONE BEDROCK (OTTAWA FORMATION)		4	"	82	
				5	"	100	270
	265.3						
	15.4	END OF HOLE					265

DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (20, 40, 60, 80)

SHEAR STRENGTH Cu., LB./SQ. FT. NAT. V. - + Q. - ● REM.V. - ⊕ U. - ○

COEFFICIENT OF PERMEABILITY, k, CM./SEC. (1x10, 1x10, 1x10, 1x10)

WATER CONTENT, PERCENT Wp W Wl

R.Q.D. (%) 3 50 58 82 100

CORE RECOVERY (%) 0 0 33

B.H. 6

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS/FT.	ELEVATION SCALE
	280.6	GROUND SURFACE					
ROTARY DRILLING, BX CASING	0.3 / 279.4 / 1.2	ASPHALT. SAND AND GRAVEL (FILL)					
		LOOSE BROWN SANDY SILT, SOME GRAVEL AND BRICKS (RUBBLE FILL)		1	2" O.D.	7	280
	275.9 / 4.7	FRACTURED BEDROCK		2	"	4/1"	
ROTARY DRILLING, BX CORE	5.3	FAIRLY SOUND GREY LIMESTONE BEDROCK, SOME WAVY BANDS OF DARK GREY SHALY LIMESTONE (OTTAWA FORMATION)		3	BX R.C.	1	
				4	"	1	275
	265.4						
	15.2	END OF HOLE		5	"	1	270
							265
							260

R.Q.D. (%) 75 93

CORE RECOVERY (%) 0 49 55

15 - 0/10 - 5 Percent axial strain at failure

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DRAWN ...D.N.....

CHECKED ...F.K.H.....

RECORD OF BOREHOLES 7 & 8

LOCATION See Figure 3 BORING DATE DEC. 14, 1977 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 140 LB., DROP 30 IN. PENETRATION TEST HAMMER WEIGHT 140 LB., DROP 30 IN.

BORING METHOD	ELEV'N. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS/FT. (20 40 60 80) / SHEAR STRENGTH Cu., LB./SQ.FT. NAT. V. - + Q. - ● REM.V. - ● U. - ○	COEFFICIENT OF PERMEABILITY, k, CM./SEC. (1x10 1x10 1x10 1x10) / WATER CONTENT, PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
								BH 7			
	274.1	GROUND SURFACE					275				
ROTARY DRILLING, BX CASING, BX CORE	273.3	CONCRETE		1	BX R.C.	1		130			
	0.8	FRACTURED GREY LIMESTONE BEDROCK		2	"	1		4 — 0			
	269.6			3	"	1	270	31 — 15			
	4.5	FAIRLY SOUND GREY LIMESTONE BEDROCK		4	"	1		98 — 36			
	263.9						265	R.Q.D. (%) / CORE RECOVERY (%)			
	10.2	END OF HOLE					260				
								BH 8			
							275				
	271.8	GROUND SURFACE									
ROTARY DRILLING, BX CASING, BX CORE	271.8	CONCRETE		1	BX R.C.	1		75 — 0			
	0.8	FRACTURED GREY LIMESTONE BEDROCK		2	"	1	270	67			
	268.8			3	"	1		94 — 36			
	3.0	FAIRLY SOUND GREY LIMESTONE BEDROCK					265	R.Q.D. (%) / CORE RECOVERY (%)			
	262.5										
	9.3	END OF HOLE					260				

15 - 0 / 10 - 5 Percent axial strain at failure

VERTICAL SCALE 1 IN. TO 5 FT.

Golder Associates

DRAWN DN

CHECKED EJH

RECORD OF BOREHOLE I-1

SHEET 1 OF 1

LOCATION SEE FIGURE — BORING DATE DEC. 15, 1980 - JAN. 9, 1980 — DATUM GEODETIC

INCLINATION 90° (VERTICAL) — SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76 m

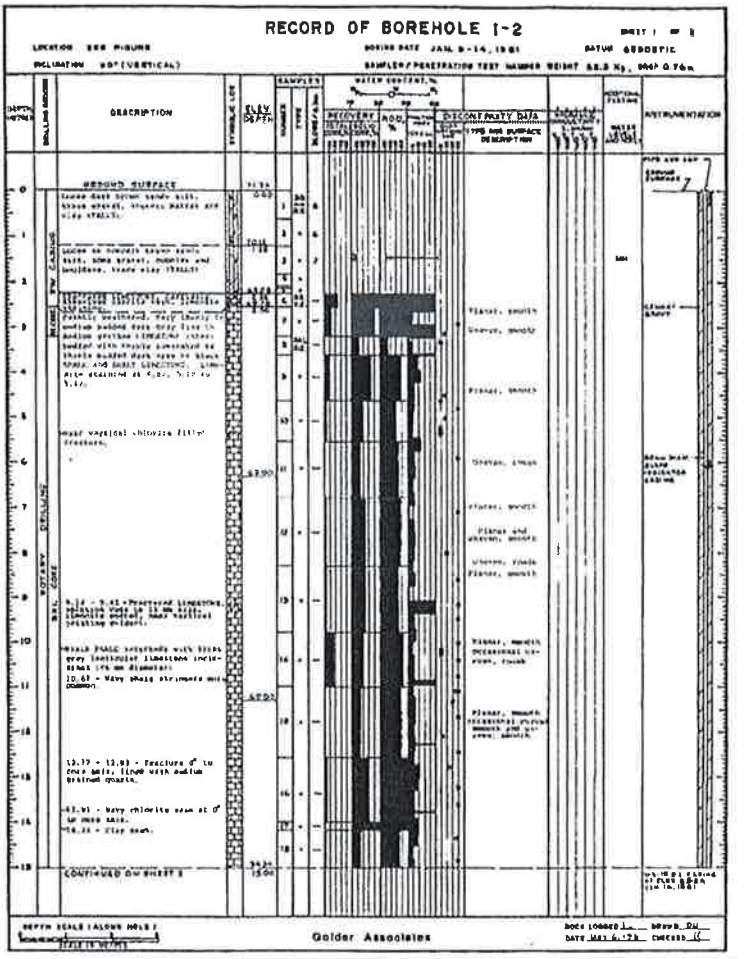
DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	WATER CONTENT, % (Wp — W — Wl)	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACTURE INDEX PER 0.3m	DISCONTINUITY DATA: DIPS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY	ADDITIONAL TESTING: WATER LEVELS AND NOTES	INSTRUMENTATION
0		GROUND SURFACE		69.49													PIPE AND CAP; GROUND SURFACE
0	BW CASING	Loose to compact dark brown sandy silt, some gravel and cobbles, trace organic matter (TALUS).		0.00	1	SS	4									MH	
1					2	"	11										
1					3	"	24									MH	
2		Loose to dense brown sandy silt, some gravel trace clay, occasional boulder (TALUS).		67.66 1.83	4	"	5									MH	
2					5	"	8										
3				65.83	6	"	32									MH	CEMENT GROUT
4	BX CORE	Slightly weathered to fresh, very thinly bedded to medium bedded dark grey fine to medium grained LIMESTONE interbedded with laminated to thinly bedded dark grey to black SHALE and SHALY LIMESTONE and wavy shale stringers, occasional fossil.		3.60	7	BX R.C.											
4				65.00	8	"								Planar, rough			
5					9	"								Rough			
6					10	"								Planar, rough and smooth			50mm DIAM. SLOPE INDICATOR CASING
7	ROTARY DRILLING				11	BXL R.C.								Planar and uneven, smooth			
7					12	"											
8	BXL CORE	Driller noted possible soft layer or void. Iron stained near vertical joint. Scattered solution spots, limonite rimmed.			13	"								Planar and uneven, smooth; Uneven, rough			
9				60.00	14	"								Planar and uneven, smooth; Uneven, rough			
10		Occasional medium grained quartz grains. Ovoid elongated lenticular markings up to 15 mm long, light grey crystalline calcite.			15	"								Planar and uneven, smooth; Uneven, rough			
11		Shaly interbeds becoming thicker and more common.															
12					16	"								Planar, smooth			
13		Several shale interbeds containing lenticular shapes. Limonite staining at limestone shale contact.															
14		3 mm sedimentary fault in fine grained sediment			17	"											
		END OF HOLE		55.13 14.36													W.L. IN CASING AT ELEV. 65.38 JAN 9, 1981

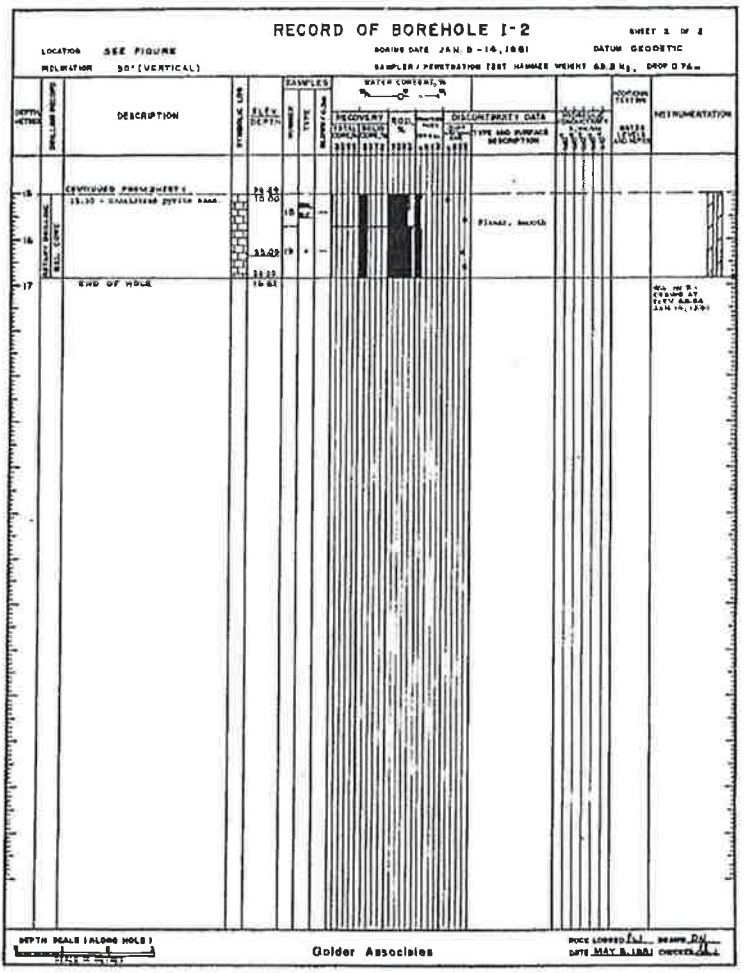
DEPTH SCALE (ALONG HOLE) — SCALE IN METRES

Golder Associates

ROCK LOGGED JW — DRAWN DN

DATE MAY 6, 1981 — CHECKED


RECORD OF BOREHOLE 1-2
SHEET 1 OF 2
LOCATION SEE FIGURE
BORING DATE JAN. 8-14, 1981
DATUM GEODETIC
INCLINATION 90° (VERTICAL)
SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg, DROP 0.76m
DEPTH METRES
DRILLING RECORD
DESCRIPTION
STRATIGRAPHIC LOG
ELEV. DEPTH
SAMPLES
NUMBER
TYPE
BLOWS/0.3m
WATER CONTENT, %
RECOVERY
ROD
DISCONTINUITY DATA
TYPE AND SURFACE DESCRIPTION
WEATHERING
FRACTURE INDEX
BEDDING
TESTING
WATER LEVELS
INSTRUMENTATION
GROUND SURFACE
CASING
ROTARY DRILLING
REC. CORE
CONTINUED ON SHEET 2
DEPTH SCALE (ALONG HOLE)
Golder Associates
DATE MAY 6, '81
CHECKED


RECORD OF BOREHOLE 1-2
SHEET 2 OF 2
LOCATION SEE FIGURE
BORING DATE JAN. 8-14, 1981
DATUM GEODETIC
INCLINATION 90° (VERTICAL)
SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg, DROP 0.76m
DEPTH METRES
DRILLING RECORD
DESCRIPTION
STRATIGRAPHIC LOG
ELEV. DEPTH
SAMPLES
NUMBER
TYPE
BLOWS/0.3m
WATER CONTENT, %
RECOVERY
ROD
DISCONTINUITY DATA
TYPE AND SURFACE DESCRIPTION
WEATHERING
FRACTURE INDEX
BEDDING
TESTING
WATER LEVELS
INSTRUMENTATION
ROTARY DRILLING
REC. CORE
CONTINUED FROM SHEET 1
END OF HOLE
DEPTH SCALE (ALONG HOLE)
Golder Associates
DATE MAY 8, 1981

RECORD OF BOREHOLE 1-3

SHEET 1 OF 2

LOCATION SEE FIGURE
INCLINATION 90° (VERTICAL)
BORING DATE APRIL 3-14, 1981
DATUM GEODETIC
SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76 m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	WATER CONTENT, % w_P / w / w_L	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	DISCONTINUITY DATA FRACTURE INDEX	DISCONTINUITY DATA DIP	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY	ADDITIONAL TESTING WATER LEVELS AND NOTES	INSTRUMENTATION
0	610 mm CASING	GROUND SURFACE		72.05													PIPE AND CAP GROUND SURFACE
		Very loose dark brown sandy silt, trace gravel, organic matter, brick mortar (FILL)		0.00 71.16 0.90	1	SS	1										
1		Very loose to compact brown sandy silt, some gravel, trace clay and organic matter, rootmat (TILL)			2	SS	8										
					3	SS	2										
2				70.00	4	SS	6										CEMENT GROUT
					5	SS	22										
3				68.72	6	SS	100/										
	NQ CORE DRILLING	Faintly weathered to fresh very thinly to medium bedded dark grey fine to medium grained LIMESTONE interbedded with thinly laminated to thinly bedded dark grey to black SHALE and SHALY LIMESTONE. 3.51-3.72 - Solution weathered, calcite coated vertical fracture, silty sand or clay on fractures between 3.96 and 4.45.		3.32	7	RC	1										
4					8		1							Planar, smooth, occasional uneven smooth, scattered, coarse			
					9		1										
5					10		1										
		6.28-6.37 - Vertical calcite filled fracture, small limonite stained voids.			11		1							Planar, smooth			
6					12		1							Uneven, rough			
		NO NQ CORE - crushed rock containing clay. Many white patches and laminations more common below 7.04.		63.00	13		1										
7		7.47-8.21 - Limonite stained.															
		Fractured zone with silt on parting.			14		1							Planar, smooth, occasional uneven smooth			
8																	
														Scattered, coarse			
9		Limonite stained.															
		1/4 cm diameter light grey lenticular limestone separated by very thin shale laminae. 25 to 75 % zones become more common with depth.			15		1										
10		Silt on fracture.															
		Limonite stained vertical fracture															
11		10.85-11.01 - Vertical flow structures in shale, soft sediment deformation.			16		1										
		Limonite stained.		60.00													
12		12.19-12.68 - Shale laminations thicker and more numerous			17		1										
13					18		1										
14																	
					19		1										
15		CONTINUED ON SHEET 2		57.05 15.00													

DEPTH SCALE (ALONG HOLE)
SCALE IN METRES

Golder Associates

ROCK LOGGED NL DRAWN DW
DATE MAY 5, 1981 CHECKED NL

RECORD OF BOREHOLE 1-3

SHEET 2 OF 2

LOCATION SEE FIGURE
INCLINATION 90° (VERTICAL)
BORING DATE APRIL 3-14, 1981
DATUM GEODETIC
SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76 m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	WATER CONTENT, % w_P / w / w_L	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	DISCONTINUITY DATA FRACTURE INDEX	DISCONTINUITY DATA DIP	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY	ADDITIONAL TESTING WATER LEVELS AND NOTES	INSTRUMENTATION
15		CONTINUED FROM SHEET 1		57.05 15.00													
	NQ CORE DRILLING				20	RC	1							Planar, smooth, occasional wavy and curved, smooth			
16																	
17		17.07-17.37 - Limestone fracture 10° to core axis, several long narrow limonite stained voids on horizontal fractures.		39.00	21		1										
18					22		1										
19					23		1										
20		END OF HOLE		37.02 20.03													
21																	

DEPTH SCALE (ALONG HOLE)
SCALE IN METRES

Golder Associates

ROCK LOGGED NL DRAWN DW
DATE MAY 8, 1981 CHECKED NL

RECORD OF BOREHOLE I-4

SHEET 1 OF 1

LOCATION SEE FIGURE

BORING DATE APRIL 3-10, 1981

DATUM GEODETIC

INCLINATION 90° (VERTICAL)

SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / 0.3m	WATER CONTENT, % (W_P — W — W_L)	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE, %	R.Q.D. %	FRACTURE INDEX PER 0.3m	DISCONTINUITY DATA: DIP° w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	ADDITIONAL TESTING: WATER LEVELS AND NOTES	INSTRUMENTATION
		GROUND SURFACE		66.70													PIPE AND CAP GROUND SURFACE
0		Very loose dark brown sandy silt, trace gravel, glass (FILL)		0.00	1	SS	8										
				66.18		50 mm O.D.											
		Very loose brown silty sand, trace gravel (TALUS)		0.52	2	"	2										
1				65.63													
		Very loose to very dense brown sandy silt, some gravel, cobbles and boulders, trace clay and organic matter (TALUS)		1.07	3	"	15										
				65.00	4	"	6									MH	
2					5	"	3										
					6	"	8	NON PLASTIC									CEMENT GROUT
3					7	"	94										
4					8	"	21										
																MH	
5					9	"	70										
					10	BXL B.C.											
6				60.24	11	"											
		Faintly weathered very thinly to medium bedded dark grey fine to medium grained LIMESTONE interbedded with thinly laminated to thinly bedded dark grey to black SHALE and SHALY LIMESTONE.		6.46	12	"											50mm DIAM. SLOPE INDICATOR CASING
7		7.41 - Very fine grained secondary calcite on horizontal fracture.			13	"											
		7.62 - Flame structure: sedimentary deformation. Horizontal and near horizontal fractures exist along shale laminae or stringers which are more common below 9.45.			14	"											
8					15	"											
9																	
10		50 mm sand seam.			16	"											
		Coarse recrystallized calcite and small fossil on mechanical break.															
		Limonite stain.												Planar, smooth, occasional uneven, rough			
11				55.00													
					17	"											
12		Flame structure, fossils.												Planar and uneven, smooth			
		12.71-14.02 - Pyrite crystals common in shale, sedimentary structures. Limestone fragmentation is common, shale laminae deformed around fragments.															
13					18	"											
14																	W.L. IN B.I. CASING AT ELEV. 60.60 APRIL 10, 1981
15					19	"											
				50.88													
16		END OF HOLE		15.82													

ROTARY DRILLING — BXL CORE — BW CASING

DEPTH SCALE (ALONG HOLE)

0 1 2 3

SCALE IN METRES

Golder Associates

ROCK LOGGED PWJ DRAWN DN

DATE MAY 8, 1981 CHECKED PWJ

8012262

RECORD OF BOREHOLE B-1

SHEET 1 OF 1

LOCATION SEE FIGURE

BORING DATE APRIL 30, 1981

DATUM GEODETIC

INCLINATION 90° (VERTICAL)

SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76 m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / 0.3 m	WATER CONTENT, % (Wp, W, Wl; 10 20 30 40)	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACTURE INDEX PER 0.3 m	DISCONTINUITY DATA: DIP WRT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY, K, cm/sec	ADDITIONAL TESTING: WATER LEVELS AND NOTES	INSTRUMENTATION
0	ROTARY DRILLING; BW CASING	GROUND SURFACE		43.53													PIPE AND CAP; GROUND SURFACE; SURFACE SEAL
		Compact brown sandy silt, some gravel, trace brick and clay (FILL).		0.00	1	SS	10										
1					2	SS	13									MH	
		Very dense brown silty sand and gravel, trace asphalt (FILL).		1.22	3	SS	65									MH	PLASTIC TUBING
2				41.40													
		Loose to compact brown fine to coarse gravel, trace to some sandy silt (TALUS).		2.13	4	SS	4										GRANULAR BACKFILL
3					5	SS	22										
				40.00													
4	BXL CORE			39.85	6	SS	6										
		Faintly weathered very thinly to thinly bedded dark grey fine to medium grained LIMESTONE interbedded with thinly laminated to laminated dark grey to black shale. Fractures exist along SHALE laminae. 4.27 - Limonite stains.		4.18	7	BXL R.C.	—							Planar, smooth some uneven			
5					8	"	—							Uneven, rough			STANDPIPE
				37.62										Planar, smooth			
6		END OF HOLE		5.91													W.L. IN STANDPIPE AT ELEV. 42.16 JUNE 8, 1981

DEPTH SCALE (ALONG HOLE)

0 1 2 3

SCALE IN METRES

Golder Associates

ROCK LOGGED [illegible] DRAWN DN

DATE MAY 6, 1981 CHECKED [illegible]

RECORD OF BOREHOLE B-2

SHEET 1 OF 1

LOCATION SEE FIGURE

BORING DATE APRIL 20 & 21, 1981

DATUM GEODETIC

INCLINATION 90° (VERTICAL)

SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76 m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / 0.3 m	WATER CONTENT, % (Wp, W, Wl)	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE, %	R.Q.D. %	FRACTURE INDEX PER 0.3 m	DISCONTINUITY DATA: DIP°	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	ADDITIONAL TESTING: WATER LEVELS AND NOTES	INSTRUMENTATION
0		Asphalt GROUND SURFACE		85.65													PIPE AND CAP GROUND SURFACE
		Crushed stone		0.02													SURFACE SEAL
		Loose brown fine to coarse sand, trace gravel (FILL)		0.24 85.00	1	SS	7										
1																	PLASTIC TUBING
					2	SS	6									MH	
2					3	SS	6										
3					4	SS	7									M	GRANULAR BACKFILL
		Grey crushed stone (FILL)		82.18 3.47													
		Faintly to slightly weathered, thinly to medium bedded dark grey fine to medium grained LIMESTONE interbedded with thinly laminated to thinly bedded dark grey to black SHALE and SHALY LIMESTONE.		81.90 3.75	5	BXL R.C.	>100							Uneven, smooth and rough			BENTONITE SEAL
4																	
					7									Planar, wavy and uneven, smooth			
5		3.75-3.96 - Fractured. 4.57 - Vertical seam, limonite stained.												Uneven, rough			
		5.27-5.49 - Vertical seam, limonite stained, some calcite.		80.00	8												GRANULAR BACKFILL
6		5.49-6.71 - Limonite stained fractures.												Planar, smooth			
					9									Scattered, uneven, rough			
7		6.71-8.23 - Shale laminae.															
					10												STANDPIPE
8				77.27													
		END OF HOLE		8.38													W.L. IN STANDPIPE AT ELEV. 84.38 JUNE 8, 1981
9																	

ROTARY DRILLING — BW CASING — BXL CORE

DEPTH SCALE (ALONG HOLE)

0 1 2 3

SCALE IN METRES

Golder Associates

ROCK LOGGED PW DRAWN DN

DATE MAY 6, 1981 CHECKED AW

RECORD OF BOREHOLE B-3

SHEET 1 OF 1

LOCATION SEE FIGURE

BORING DATE APRIL 13-16, 1981

DATUM GEODETIC

INCLINATION 90° (VERTICAL)

SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / 0.3m	WATER CONTENT, % (W_P, W, W_l)	RECOVERY: TOTAL CORE, %	RECOVERY: SOLID CORE, %	R.Q.D., %	FRACTURE INDEX PER 0.3m	DISCONTINUITY DATA: DIP (WITH CORE AXIS)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY, K, cm/sec	ADDITIONAL TESTING: WATER LEVELS AND NOTES	INSTRUMENTATION
0	ROTARY DRILLING; BW CASING; BXL CORE	GROUND SURFACE		75.92													PIPE AND CAP; GROUND SURFACE
		Very loose dark brown sandy silt, trace gravel, brick and organic matter (FILL)		0.00 / 75.46	1	SS & D.O.	4										SURFACE SEAL
1		Very loose to compact brown sandy silt some gravel, trace to some clay, occasional boulder (TALUS)		0.46 / 75.00	2	"	16										
					3	"	100										PIEZOMETER 'B'
2		Faintly to slightly weathered very thinly to medium bedded dark grey fine to medium grained LIMESTONE interbedded with thinly laminated to very thinly bedded dark grey to black SHALE and SHALY LIMESTONE.		75.97 / 1.95	4	BXL N.C.	1										BENTONITE SEAL
					5	"	1										
					6	"	1							Uneven, rough			
3		1.95-2.68 - Fractured.			7	"	1							Planar and uneven, smooth			PLASTIC TUBING
		1.98 - Limonite stained zone.															
4		2.16, 2.38, 2.65, 3.41 - mid seams															
		2.50-2.56 - Vertical fracture, limonite and mud filled.			8	"	—							Planar and uneven, smooth			
5		4.27-5.49 - Limonite on most fractures.															GRANULAR BACKFILL
		50 mm sand seam.															
6				70.00	9	"	1										
				69.18													PIEZOMETER 'A'
7		END OF HOLE		6.74													

W.L. IN PIEZOMETER 'A' AT ELEV. 72.48
PIEZOMETER 'B' AT ELEV. 74.43
JUNE 5, 1981

DEPTH SCALE (ALONG HOLE)
0 1 2 3
SCALE IN METRES

Golder Associates

ROCK LOGGED PWJ DRAWN DN
DATE MAY 6, 1981 CHECKED

RECORD OF BOREHOLE B-4

SHEET 1 OF 1

LOCATION SEE FIGURE

BORING DATE APRIL 29, 1981

DATUM GEODETIC

INCLINATION 90° (VERTICAL)

SAMPLER / PENETRATION TEST HAMMER WEIGHT 63.5 Kg., DROP 0.76m

DEPTH METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / 0.3m	WATER CONTENT, % (W_P — W — W_L)	RECOVERY: TOTAL CORE, %	RECOVERY: SOLID CORE, %	R.Q.D., %	FRACTURE INDEX PER 0.3m	DISCONTINUITY DATA: DIP° TO CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY, k, cm/sec	ADDITIONAL TESTING: WATER LEVELS AND NOTES	INSTRUMENTATION
0		GROUND SURFACE		43.30													PIPE AND CAP; GROUND SURFACE
0	ROTARY DRILLING — BW CASING	Compact brown sandy silt, some gravel and wood, trace mortar (FILL).		0.00	1	50 mm O.D.	13										SURFACE SEAL
1					2	"	79										PLASTIC TUBING
2					3	"	14										
3		Loose dark brown sandy silt, some gravel, cobbles and boulders, trace clay (TALUS).		40.56 2.74	4	"	9									MH	GRANULAR BACKFILL
4	ROTARY DRILLING — BXL CORE	Fresh to faintly weathered thinly to medium bedded dark grey fine grained fossiliferous LIMESTONE, occasional black SHALE laminae.		40.00 39.31 3.99	5	BXL N.C.	—							Planar and uneven, smooth; scattered, uneven, rough			
4		3.99-4.27 - Slightly weathered; some clay and limonite staining on fractures.			6	"	—										
5		4.42-4.57 - Vertical unweathered fracture.												Planar, curved and uneven, smooth			
5		5.33 - Mud on fracture.			7	"	—										
6				36.66													STANDPIPE
6		END OF HOLE		6.64													W.L. IN STANDPIPE AT ELEV 42.11 JUNE 8, 1981
7																	

DEPTH SCALE (ALONG HOLE)

0 1 2 3

SCALE IN METRES

Golder Associates

ROCK LOGGED YU DRAWN DN

DATE MAY 6, 1981 CHECKED

RECORD OF AUGERHOLES 1, 2 and 3

LOCATION See Figure 2 BORING DATE JUNE 2, 1981 DATUM ----

SAMPLER HAMMER WEIGHT ---- DROP ---- PENETRATION TEST HAMMER WEIGHT ---- DROP ----

BORING METHOD	SOIL PROFILE: ELEV'N DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/—	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS/— / SHEAR STRENGTH Cu. NAT V.+ REM V.● 0.-0 U.-O	COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 / WATER CONTENT, PERCENT Wp W Wl	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	0.12	ASPHALT WEATHERED CONCRETE						AH.	1		
	0.90	SAND AND GRAVEL (FILL)									
	1.20	MEDIUM TO FINE SAND (FILL) TOPSOIL SAND AND GRAVEL (GLACIAL TILL)									
	0.30	ASPHALT CONCRETE		1				AH.	2		
	0.76	MODERATELY WEATHERED LIMESTONE END OF HOLE REFUSAL TO AUGER ADVANCEMENT (PROBABLY BEDROCK)									
	0.00	ROAD SURFACE ASPHALT						AH.	3		
	0.10	CONCRETE									
	0.30	DARK BROWN SILTY SAND AND GRAVEL, (FILL)		1							
		END OF HOLE									

● Percent axial strain at failure

VERTICAL SCALE 1: 25

Golder Associates

DRAWN MLV & DN

CHECKED GMM

RECORD OF AUGERHOLES 4, 5 and 6

LOCATION See Figure | BORING DATE JUNE 2, 1986 | DATUM —

SAMPLER HAMMER WEIGHT — DROP — | PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	SOIL PROFILE: ELEV'N / DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/—	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE, BLOWS/—	SHEAR STRENGTH Cu, NAT V · + REMV · ⊕	COEFFICIENT OF PERMEABILITY, k, CM/SEC (1x10 1x10 1x10 1x10)	WATER CONTENT, PERCENT	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
												AH.	4
		ASPHALT											
		SILTY SAND & GRAVEL (FILL)											
		BROWN TO GREY SILTY SAND, (FILL)											
		ASPHALT CONCRETE										AH.	5
		SAND GRAVEL (FILL)											
		ASPHALT										AH.	6
		SILTY SAND (FILL)											
		SILTY SAND (FILL)											

15 ± 3 Percent axial strain at failure

VERTICAL SCALE 1 : 25

Golder Associates

DRAWN M.M.L.N.

CHECKED MR

RECORD OF DRILLHOLE 90-1

SHEET 1 of 2

LOCATION See figure 2

INCLINATION -60 AZIMUTH 338

DRILLING DATE Jan. 26&29,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2695

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/min)	% RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		87.68													
		Medium brown SILTY SAND, trace gravel.		0.00													
		BEDROCK SURFACE		87.00													
				0.67	1	0.08								BC			
1	NXL RC				2	0.06	0-100%	100%						B,R,UE			
	NXL													BC			
					3	0.16		0%						BC			
2	NXL RC				4	0.05		0%						B, SM, UE			
														B,R,UE,Fe-stain			
3					5	0.13		0%						B,R,UE			
	NXL RC	Faintly weathered to weathered, light to medium grey, fine grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE interbedded with argillaceous layers. Void in core from 4.27-4.48m. (UNIT B1)												B,R,UE,Fe-stain			
4	JAN. 28													B,R,UE,Fe-stain			
					6	0.09		0%						B,R,UE,Fe-stain			
	NXL RC													J,R,UE,Fe-stain			
5														B,R,UE,Fe-stain			
														B,R,UE,Fe-stain			
														B,R,UE			
6														B,R,UE			
	NXL RC				7	0.12		0%						B,R,UE			
														B,R,UE,Fe-stain			
7														B,R,UE			
														B,R,UE,Fe-stain			
														B,R,UE			
8	NXL RC				8	0.13		0%						B,R,UE			
				79.87										B,R,UE			
9				8.90										B,R,UE			
	NXL RC	FOR DETAILED DESCRIPTION, SEE SHEET 2.			9	0.11		0%						Carbonate VN			
10	JAN. 29			78.92										B,R,UE			
		CONTINUED ON SHEET 2		10.00													

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 26&29,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-1

SHEET 2 of 2

LOCATION See figure 2

INCLINATION -60 AZIMUTH 338

DRILLING DATE Jan. 26&29,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	FLUSH	% RETURN COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10		CONTINUED FROM SHEET 1		78.92													
	NXL			10.00	9	0.11	0%							B,R,UE			
														B,R,UE			
11	NXL RC	Fresh to faintly weathered, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, crystalline massive, nodular LIMESTONE interbedded with argillaceous layers. (UNIT B2)			10	0.10	0%							B,R,UE			
														B,R,UE			
														B,R,UE,mud			
														B,R,UE			
12	NXL RC				11	0.09	0%							B,R,UE			
														B,R,UE			
				76.62										B,R,UE,mud			
		END OF HOLE		12.65													
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 26&29,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-2

SHEET 1 of 2

LOCATION See figure 2

INCLINATION -45 AZIMUTH 328

DRILLING DATE Jan. 24-25,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN F-FAULT J-JOINT P-POLISHED SS-SLICKENSIDED SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / FLUSH / COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		87.67												
		Medium brown SILTY SAND, some gravel.		0.00												
		BEDROCK SURFACE		87.08	1	50	22/ DC, 15									
1	JAN. 24 NXL RC			0.84	2	0.06	100%						BC,Fe-stain			
	NXL RC				3	0.11	100%						BC,Fe-stain			
	NXL RC				4	0.08	100%						BC,Fe-stain			
2	NXL RC											•	J,R,UE,Fe-stain			
	NXL RC				5	0.11	100%					•	J,R,UE,Fe-stain			
	NXL RC											•	B,R,UE,Fe-stain			
3	NXL RC				6	0.07	100%						BC,Fe-stain			
	NXL RC	Faintly weathered to weathered, light to medium grey, fine to medium grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B1) Two 5mm argillaceous layers overlying a non-mottled limestone layer at 5.15m depth.										•	B,R,UE,Fe-stain			
												•	B,R,UE,Fe-stain Carbonate VN			
4	NXL RC				7	0.12	0%					•	B,R,UE,Fe-stain			
	NXL RC											•	J,R,UE,Fe-stain			
	NXL RC											•	B,R,PL,Fe-stain			
5	NXL RC				8	0.11	0%					•	B,R,PL,Fe-stain			
	NXL RC											•	J,R,UE,Fe-stain			
	NXL RC											•	B,R,UE,Fe-stain			
6	NXL RC											•	B,SM,UE			
	NXL RC				9	0.19	0%					•	B,R,UE			
7	NXL RC											•	B,R,UE			
	NXL RC											•	B,R,UE			
	NXL RC											•	J,R,UE,Fe-stain			
8	NXL RC											•	B,R,UE			
	NXL RC				10	0.15	0%					•	B,R,UE			
9	NXL RC											•	B,R,UE			
	JAN. 25 NXL RC															
10				80.60	11							•	B,R,UE			
		CONTINUED ON SHEET 2		10.00												

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 24-25,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-2

SHEET 2 of 2

LOCATION See figure 2

INCLINATION -45 AZIMUTH 328

DRILLING DATE Jan. 24-25,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2586

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN (COLOUR) FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10		CONTINUED FROM SHEET 2		80.60												
				80.49												
	NXL RC			10.16	11	0.09	0%					•	B,R,UE			
11												•	B,R,UE			
												•	J,R,UE,Fe-stain			
		Fresh to faintly weathered, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic nodular, crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B2)														
12												•	B,R,UE,Fe-stain			
												•	B,R,UE			
	NXL RC				12	0.09	0%					•	B,R,UE			
13												•	B,R,UE			
												•	B,R,UE			
												•	B,R,UE			
14												•	B,R,PL			
												•	B,R,PL			
15	JAN. 25 NXL RC				13	0.08	0%					•	B,R,UE			
				78.68												
		END OF HOLE		15.54												
16																
17																
18																
19																
20																

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 24-25,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-3A

SHEET 1 of 1

LOCATION See figure 2

INCLINATION -90 AZIMUTH

DRILLING DATE Jan. 16,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP W.R.T. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		87.56												
	NW Casing	CONCRETE		0.00	1											Asphalt Seal
		BEDROCK SURFACE		86.89												Bentonite Seal
1	NXL			0.67	2	0.09	100%						mech. break			
	NXL				3	0.11	0-50%						BC			Granular Filter
2					4	0.09	100%						BC			
	NXL RC	Faintly weathered, light to medium grey, fine to medium grained, medium bedded, stylolitic, mottled crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B1) Two 3mm argillaceous layers overlying a non-mottled limestone layer at 4.68m.			5	0.07	100%						B,R,UE			
3													B,R,UE			
													B,R,UE			
													B,R,UE			
													B,R,UE			
4	NXL RC				6	0.09	100%						B,R,UE, Fe-stain			
													B,R,UE			
													B,R,UE			
													B,R,UE			
5													B,R,UE			
													B,R,UE			
	NXL RC				7	0.11	100%						B,R,UE Carbonate VN			
6	JAN. 16												B,R,UE			
				81.08									B,R,UE			
		END OF HOLE		6.48												
7																
8																
9																
10																

WATER LEVEL IN STANDPIPE AT ELEV. 85.76m ON FEB. 6/90.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 16,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-4

SHEET 1 of 2

LOCATION See figure 2

INCLINATION -60 AZIMUTH 244

DRILLING DATE Jan. 23-24,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.4M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		87.38												
		Medium brown SILTY SAND, trace gravel and brick.		0.00												Granular Backfill
		BEDROCK SURFACE		87.01												Bentonite Seal
	NXL			0.43	1	0.09	100%									Caved
1	NXL				2	0.12	100%					•	B,R,UE,Fe-stain			
												•	B,R,UE,Fe-stain			
												•	B,R,UE			
2	NXL RC				3	0.17	100%					•	B,R,UE,Fe-stain			
												•	B,R,UE,Fe-stain			
												•	B,R,UE,Fe-stain			
3												•	B,R,UE			
												•	B,R,UE,Fe-stain			
		Faintly weathered to weathered, light to medium grey, fine grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE. (UNIT B1) 6mm argillaceous layer over non-mottled limestone at 5.12m depth.										•	B,R,UE,Fe-stain			
	NXL RC				4	0.14	100%					•	B,R,UE,Fe-stain			
4												•	B,R,UE			Bentonite Seal
												•	B,R,UE			
												•	B,R,UE			
5												•	B,R,UE			
												•	B,R,UE			
												•	B,R,UE			
6												•	B,R,UE,mud			
												•	B,R,UE			Granular Filter
	NXL RC				5	0.10	75%									
7												•	B,R,UE			
												•	B,R,UE			
												•	B,R,UE			
8												•	B,R,UE			
												•	B,R,UE,mud Carbonate VN			
				80.12								•	J,R,UE,Fe-stain			
				8.38												
9	NXL RC	FOR DETAILED DESCRIPTION, SEE SHEET 2.			6	0.14	75%					•	B,R,UE			
												•	B,R,UE			
10	JAN. 23			78.72								•	B,R,UE			
		CONTINUED ON SHEET 2		10.00												

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 23-24,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-4

SHEET 2 of 2

LOCATION See figure 2

INCLINATION -60 AZIMUTH 244

DRILLING DATE Jan. 23-24,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2696

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN | F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED | SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR | FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10	JAN. 23 NXL RC	CONTINUED FROM SHEET 2		78.72												
				10.00	6	0.14	75%					90	B,R,UE			Granular filter
												90	B,R,UE			
11		Fresh to faintly weathered, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, nodular, crystalline LIMESTONE. Nodules vary from 1.5 to 25mm in diameter. (UNIT B2)			7	0.11	75%					90	B,R,UE			
												90	B,R,UE			
12	NXL RC											90	B,R,UE			
												90	B,R,UE			
					8	0.14	75%					90	B,R,UE			
13												70	J,R,UE			
												90	B,R,UE			
												90	B,SM,PL			
14												90	B,R,PL			
												90	B,R,UE			
												90	B,R,UE			
												90	B,R,UE			
15	JAN. 24 NXL RC				9	0.13	75%					90	B,R,UE			
												90	B,R,UE,mud			
		END OF HOLE		73.78 15.70												WATER LEVEL IN STANDPIPE AT ELEV. 76.61m ON FEB. 6/90.
16																
17																
18																
19																
20																

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 23-24,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-5

SHEET 1 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 178

DRILLING DATE Jan. 8-12,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2695

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN
F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED
SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR
FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN FLUSH	COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP W.R.T. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		87.01													
				0.00													Backfill
		Grey brown SILTY SAND, some gravel, trace wood and brick.				50 DO	-										Bentonite Seal
1																	
		BEDROCK SURFACE		86.01	2	50 DO	23/15										Granular Filter
2	NXL RC			1.74	3	0.08	0-100%							J,R,UE,Fe-stain			
														BC,Fe-stain			
														BC,Fe-stain			
3														BC,Fe-stain			
		Faintly weathered, light to medium grey, fine grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B1) 20mm argillaceous layer overlying a non-mottled limestone layer at 6.86m.			4	0.18	0%							B,R,UE			
														B,R,UE			
4														B,R,UE			
														J,R,UE,Fe-stain			
5														J,R,UE,Fe-stain			
					5	0.14	0%							B,R,UE			
6	NXL RC													B,R,UE Carbonate VN			
														BC			
7														B,R,UE Carbonate VN			
	JAN. 8				8	0.09	0%							J,R,UE			
	NXL RC													B,R,UE			
8														J,R,UE,Ca-stain			
														B,R,UE Carbonate VN			
9	JAN. 9 NXL RC				7	0.09	0%							B,R,UE			
														B,R,UE			
														J,R,UE,Fe-stain			
10				81.27										B,R,UE			
		CONTINUED ON SHEET 2		10.00													

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 8-12,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-5

SHEET 2 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 178

DRILLING DATE Jan. 8-12,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

PROJECT 891-2595

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	FLUSH % RETURN COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10		CONTINUED FROM SHEET 1		81.27												
				10.00	7								B,R,UE			A B Granular Filter
													B,R,UE Carbonate VN			
11	NXL RC				8	0.08	0%						B,R,UE			
12													Carbonate VN			
													B,R,UE			
		FOR DETAILED DESCRIPTION, SEE SHEET 2.														
13													B,R,UE			
													B,R,UE			
													B,R,UE			
14													Carbonate VN			
													B,R,UE			
	NXL RC				9	0.07	0%						B,R,UE Carbonate VN			
15																
													B,R,UE			
													Carbonate VN B,R,UE,Ca-stain			
16													B,R,UE			
													B,R,UE			
				77.40									B,R,UE			
17		Fresh, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, crystalline, massive, nodular LIMESTONE interbedded with argillaceous layers. Nodules vary from 1.5 to 25mm in diameter. (UNIT B2)		16.76									B,R,UE			
					10	0.08	0%						B,R,UE Carbonate VN			
18	JAN. 9												B,R,UE			
	NXL RC												Carbonate VN			
													B,R,UE			
					11	0.08	0%						B,R,UE,Fe-stain			
19													B,R,UE,Fe-stain			
													B,R,UE			
	JAN. 10 NXL RC				12	0.08	0%						B,R,UE			
20				76.64									B,R,UE			
		CONTINUED ON SHEET 3		20.00												

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 8-12,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-5

SHEET 3 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 178

DRILLING DATE Jan. 8-12,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2695

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN
F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED
SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR
FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	FLUSH % RETURN / COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
20		CONTINUED FROM SHEET 3		76.54												B
				20.00	12											Granular Filter
													B,R,UE			
													J,R,UE,Ca-stain			
21													B,R,UE			
	NXL RC				13	0.08	0%						B,R,UE			
22													B,R,UE			
													B,R,UE			
	JAN. 10	FOR DETAILED DESCRIPTION, SEE SHEET 2.											B,R,UE			
23													B,R,UE			
													B,SM,PL			
	NXL RC				14	0.07	0%						B,R,PL			
24													B,R,UE			
													B,R,UE,mud			
													BC			
25													BC			
				72.66												
				25.21									J,R,UE,Ca-stain			
		Fresh, medium grey, fine to medium grained, thinly to medium bedded, stylolitic, nodular LIMESTONE. (UNIT C1)											B,R,UE			
26	NXL RC				15	0.07	0%									
													B,R,UE			
													B,R,UE			
27													J,R,UE,Ca-stain			
				71.28									B,R,UE			
				27.43									BC			
		Fresh, dark grey to black, fine grained, laminated to thinly bedded LIMESTONE interbedded with fissile, friable, black SHALE. (UNIT C1A)														
28	JAN. 11 NXL RC				16	0.05	0%						B,R,UE			
													B,R,UE			
				70.54												
		Fresh, light to medium grey, medium grained, medium bedded, crystalline, fossiliferous LIMESTONE. (UNIT C2)		28.71									B,SM,PL			
29				70.33												
	NXL RC			29.08	17	0.07	0%						B,R,UE			Bentonite Seal
	JAN. 12	FOR DETAILED DESCRIPTION, SEE SHEET 5.											B,SM,PL			
													B,SM,PL			
30				69.80	18											
		CONTINUED ON SHEET 4		30.00												

DEPTH SCALE

1 : 50

LOGGED LQ,SPM

DATE Jan. 8-12,1990

CHECKED MvB

Golder Associates

RECORD OF DRILLHOLE 90-5

SHEET 4 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 178

DRILLING DATE Jan. 8-12,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / FLUSH / COLOUR	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k_x cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES: WATER LEVELS / INSTRUMENTATION
30		CONTINUED FROM SHEET 3		29.80												B
				30.00									B,SM,PL			Bentonite Seal
31	NXL RC				18	0.15	0%						B,R,UE			
		Fresh, light to medium grey, fine to medium grained, thinly to medium bedded, stylolitic, interbedded, massive, laminar LIMESTONE. (UNIT C3)											B,R,PL Carbonate VN			Granular Filter
32	NXL RC				19	0.07	0%						B,R,PL B,R,UE B,R,UE B,R,PL			
33	NXL RC				20	0.07	0%						B,R,UE B,R,UE B,R,PL			
34	JAN. 12			67.46									B,R,UE			
		END OF HOLE		34.09												STANDPIPE A WAS DRY ON FEB. 6/90. WATER LEVEL IN STANDPIPE B AT ELEV. 74.67m ON FEB. 6/90.
35																
36																
37																
38																
39																
40																

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 8-12,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-7

SHEET 1 of 3

LOCATION See figure 2

INCLINATION -90 AZIMUTH

DRILLING DATE Jan. 18-19,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	ELEV. / DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR / FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE	86.93												
0			0.00												Asphalt Seal
		Medium brown SILTY SAND, trace gravel.													Granular Filter
1				1	60	DO 24									
				2	60	DO 7									
		BEDROCK SURFACE	85.01												
2	NXL RC		1.92									B,R,UE,Fe-stain			
				3	0.10	0%						B,R,UE,Fe-stain			
3												BC			
	NXL RC	Faintly weathered, light to medium grey, medium grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B1)		4	0.10	0%						BC			
	NXL	25mm argillaceous layer overlying a non-mottled limestone layer at 5.33m.		5	0.06	0%						BC, Fe-Ca-stain			
4	NXL RC											BC, Fe-Ca-stain			
				6	0.08	0%						BC			
												B,R,UE,Fe-stain			
5												B,R,UE,Fe-stain			
												B,R,UE			
												B,R,UE			
	NXL RC			7	0.12	0%						B,R,UE			
6												B,R,UE			
												B,R,UE			
												B,R,UE			
7												B,R,UE			
												B,R,UE, Fe-stain			
												B,R,UE			
8												B,R,UE			
				8	0.13	0%						B,R,UE			
												B,R,UE			
9												B,R,UE			
												B,R,UE			
												B,R,UE			
10	JAN. 18		76.93									B,R,UE			
		CONTINUED ON SHEET 2	10.00												

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED SL-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 18-19,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-7

SHEET 2 of 3

LOCATION See figure 2

INCLINATION -90 AZIMUTH

DRILLING DATE Jan. 18-19,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2696

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3M	DISCONTINUITY DATA DIP W.R.T. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10		CONTINUED FROM SHEET 1		76.93												
	NXL RC	FOR DETAILED DESCRIPTION, SEE SHEET 1.		10.00	8	0.13	0%						B,R,UE			Granular Filter
				75.99									B,R,UE			
11				10.94									B,R,UE			
													B,R,UE			
													B,R,UE			
													B,R,UE			
12	NXL RC				9	0.16	0%						B,R,UE			
													B,R,PL			
		Fresh, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, crystalline, massive, nodular LIMESTONE interbedded with argillaceous layers. (UNIT B2) Nodules vary from 1.5 to 25mm in diameter.														
13	JAN. 18												B,R,UE			
													B,R,UE			
													B,R,UE			
14					10	0.14	0%						B,R,PL			
													B,R,UE			
	NXL RC												B,R,UE			
													B,R,UE			
15													B,R,UE			
													B,R,UE			
													B,R,UE			
													B,R,PL			
16		Fresh, medium grey, fine to medium grained, thinly to medium bedded, argillaceous, nodular LIMESTONE. (UNIT C1)		70.99									B,R,PL			
				15.94												
				70.44									B,R,UE			
		Fresh, dark grey to black, fine grained, laminated to thinly bedded LIMESTONE interbedded with fissile, friable black SHALE. (UNIT C1A)		16.49	11	0.10	0%						B,R,UE			
17				69.77									B,R,UE			
				17.16									B,R,UE			
		Fresh, light to medium grey, medium grained, medium bedded, crystalline, fossiliferous LIMESTONE. (UNIT C2)											B,R,UE			
				68.86									B,R,UE			
18				18.07									B,R,PL			
	NXL RC												B,R,UE			
		Fresh, light to medium grey, fine to medium grained, thinly to medium bedded, stylolitic, massive, laminar LIMESTONE, interbedded with thin shale partings. (UNIT C3)											B,R,UE			
19					12	0.12	0%						B,R,UE			
													B,R,UE			
	JAN. 19												B,R,UE			
				66.93									B,R,UE			Bentonite Seal
20		CONTINUED ON SHEET 3		20.00												

DEPTH SCALE 1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 18-19,1990

CHECKED MvB

RECORD OF DRILLHOLE 90-7

SHEET 3 of 3

LOCATION See figure 2

INCLINATION -90 AZIMUTH

DRILLING DATE Jan. 18-19,1990

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2695

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
20		CONTINUED FROM SHEET 2		66.93												
				20.00												Bentonite Seal
	NXL RC				12	0.12	0%						B,R,UE			
21													B,R,UE			
													B,R,UE			
													B,R,UE			
		FOR DETAILED DESCRIPTION, SEE SHEET 2.											B,R,UE Carbonate VN			
22													B,R,UE			
													B,R,UE Carbonate VN			Granular Filter
	NXL RC				13	0.10	0%						B,R,PL			
23																
													B,R,UE			
													B,R,UE			
24				62.70									B,R,UE			
				24.23									B,R,PL			
													B,R,PL			
25													B,R,PL			
													B,SM,PL			
		Fresh,medium grey,fine grained,medium to thickly bedded,massive LIMESTONE interbedded with dark grey to black SHALE layers. (UNIT C4)											B,SM,PL			
	NXL RC				14	0.11	0%						B,SM,PL			
26													B,SM,PL			
													B,SM,PL,pebble			
27	JAN. 19												B,SM,PL			
				59.37									B,R,UE			
		END OF HOLE		27.56												WATER LEVEL IN STANDPIPE AT ELEV. 67.47m ON FEB. 6/90.
28																
29																
30																

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan. 18-19,1990

CHECKED MvB

RECORD OF BOREHOLE 90-8

SHEET 1 of 4

LOCATION See figure 2

BORING DATE Dec.20-Jan.5/90

DATUM Geodetic

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 891-2595

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH Cu, kPa (nat.V.- + Q.- ● rem.V.- ⊕ U.- O)	HYDRAULIC CONDUCTIVITY, k, CM/SEC / WATER CONTENT, PERCENT (Wp, W, Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		86.43							Asphalt
				0.00	1	AS	-				Sand
1					2	50 DO	22				Concrete
											Granular Filter
2	ROTARY DRILLING				3	50 DO	15				
		Medium brown SAND, trace to some silt, trace gravel.									
3					4	50 DO	15				
4					5	50 DO	14				
					6	50 DO	-				
5		BEDROCK SURFACE		82.74							
				5.00							
		BOREHOLE CONTINUED. FOR ROCK INFORMATION, SEE SHEET 2.									
6											
7											
8											
9											
10											

0 15 10 5 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ

CHECKED MvB

RECORD OF DRILLHOLE 90-8

SHEET 2 of 4

LOCATION See figure 2

INCLINATION -47.5 AZIMUTH 242

DRILLING DATE Dec.20-Jan.5/90

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2595

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	FLUSH % RETURN COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP W.R.T. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0								40 20	40 20	80 40 20	5 10 15 20	0 30 60 90		10^{-3} 10^{-5} 10^{-7} 10^{-9}		
1																
2		CONTINUED FROM SHEET 1														
3																
4																
5		BEDROCK SURFACE		82.74												
	DEC. 20 NXL			5.00	7											
					8	0.07	100%						BC,Fe-stain			Granular filter
					9		0%						BC,Fe-stain			
					10	0.02							BC,Fe-stain			
6	DEC. 21 NXL RC				11	0.04	60-100%						BC,Fe-stain			
	NXL RC	Faintly weathered, light to medium grey, fine grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B1)			12	0.03	0-50%					•	B,R,UE			
7					13	0.10	0%					•	J,R,UE			
	NXL RC											•	J,R,UE			
												•	J,R,UE			
												•	B,R,UE			
8												•	Carbonate VN			
												•	B,R,UE			
												•	B,R,UE,Fe-Ca			
					14	0.10	0%					•	B,R,UE			
9												•	J,R,UE			
	NXL RC															
	JAN. 2				15	0.11	0%					•	B,R,UE			
		FOR DETAILED DESCRIPTION, SEE SHEET 3		79.33 9.83								•	B,R,UE			
10		CONTINUED ON SHEET 3		79.06 10.00												

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Dec.20-Jan.5/90

CHECKED MvB

RECORD OF DRILLHOLE 90-8

SHEET 3 of 4

LOCATION See figure 2

INCLINATION -47.5 AZIMUTH 242

DRILLING DATE Dec.20-Jan.5/90

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2686

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN FLUSH	COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.5M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10	JAN. 2 NXL RC	CONTINUED FROM SHEET 2		79.08													
				10.00	15	0.11	0%							B,R,UE			Granular Filter
11					16	0.10	0%							B,R,UE B,R,UE B,R,UE			
12	NXL RC													B,R,UE B,R,UE			Bentonite Seal
13					17	0.31	0%							B,R,UE			
14	NXL RC	Fresh to faintly weathered, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, nodular, crystalline LIMESTONE interbedded with argillaceous layers. Nodular vary from 1.5 to 25mm in diameter. (UNIT B2												B,R,UE B,R,UE B,R,PL			
15					18	0.11	0%							B,R,UE B,R,UE B,R,UE B,R,UE			
16														B,R,UE B,R,UE			
17	JAN. 3 NXL RC				19	0.07	0%							BC, Fe-Ca-stain J,R,UE, Fe-Ca-st			
18	NXL RC				20	0.05	0%							B,R,UE Carbonate VN BC BC			Granular Filter
19	JAN. 5 NXL RC				21	0.07	0%							B,R,UE,mud B,R,UE B,R,PL B,R,UE			
20		CONTINUED ON SHEET 4		71.68 20.00										B,R,UE			

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Dec.20-Jan.5/90

CHECKED MvB

RECORD OF DRILLHOLE 90-8

SHEET 4 of 4

LOCATION See figure 2

INCLINATION -47.5 AZIMUTH 242

DRILLING DATE Dec.20-Jan.5/90

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP W.R.A. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
20		CONTINUED FROM SHEET 3		71.68												
	JAN. 5 NXL RC	FOR DETAILED DESCRIPTION, SEE SHEET 3.		20.00	21	0.07	0%					•	B,R,UE			Granular Filter
21				70.91									BC			
		END OF HOLE		21.05												WATER LEVEL IN STANDPIPE AT ELEV. 80.63m ON FEB. 2/90.
22																
23																
24																
25																
26																
27																
28																
29																
30																

PROJECT 891-2695

DEPTH SCALE
1 : 50

Golder Associates

LOGGED LQ,SPM
DATE Dec.20-Jan.5/90
CHECKED MvB

RECORD OF BOREHOLE 90-13

SHEET 1 of 4

LOCATION See figure 2

BORING DATE Jan.30-Feb.1/90

DATUM Geodetic

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

PROJECT 891-2595

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3M	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat.V.- + Q.- ●, rem.V.- ⊕ U.- ○)	HYDRAULIC CONDUCTIVITY, k, CM/SEC; WATER CONTENT, PERCENT (Wp, W, Wl; 20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		88.49							
	ROTARY DRILLING			0.00							Asphalt Seal, Granular Filter
1											Bentonite Seal
2		Medium brown SILTY SAND, some gravel, occasional cobble.									Caved Material
3					1	50 DO	13				
4					2	50 DO	80				
					3	50 DO	12				
5					4	50 DO	15				
				83.26							
6		Grey brown SANDY SILT, some gravel, trace clay, occasional cobbles and boulders.		5.84	5	50 DO	22				
		BEDROCK SURFACE		82.82							
		BOREHOLE CONTINUED. FOR ROCK INFORMATION, SEE SHEET 2.		6.40							
7											
8											
9											
10											

0 / 15 / 10 PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 : 60

Golder Associates

LOGGED LQ

CHECKED MvB

RECORD OF DRILLHOLE 90-13

SHEET 2 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 010

DRILLING DATE Jan.30-Feb.1/90

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

PROJECT 891-2595

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN	FLUSH COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP W.R.T. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0									80 60 40 20	80 60 40 20	80 60 40 20	5 10 15 20	0 30 60 90		10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9} 10^{-10}		
1																	
2																	
3		CONTINUED FROM SHEET 1															
4																	
5																	
6		BEDROCK SURFACE		82.82													
	JAN. 30 NXL RC	Faintly weathered to weathered, light to medium grey, fine grained, medium bedded, stylolitic, mottled, crystalline LIMESTONE interbedded with argillaceous layers. (UNIT B1) 8mm argillaceous layer overlying a non-mottled limestone layer at 9.75m.		6.40	6	0.11	0-100%							Carbonate VN			Caved Material
7	NXL RC				7	0.16	0-50%							BC, Fe-stain Carbonate VN			
														J, R, UE, Fe-Ca			
														VOID, Fe-stain			
														VOID, Fe-stain			
8	NXL RC				8	0.10	0%							VOID, Fe-stain			
														VOID, Fe-stain			
														VOID, Fe-stain			
9	JAN. 31 NXL RC				9	0.13	100%							BC, Fe-stain			
														B, R, UE, Fe-stain Carbonate VN			
10				80.75	10									B, R, UE, Fe-stain			
		CONTINUED ON SHEET 3		10.00													

DEPTH SCALE

1 : 60

Golder Associates

LOGGED LQ,SPM

DATE Jan.30-Feb.1/90

CHECKED MvB

RECORD OF DRILLHOLE 90-13

SHEET 3 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 010

DRILLING DATE Jan.30-Feb.1/90

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 881-2696

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED
CL-CLEAVAGE J-JOINT R -ROUGH UE-UNEVEN
SH-SHEAR P-POLISHED ST-STEPPED W -WAVY
VN-VEIN S-SLICKENSIDED PL-PLANAR C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN / COLOUR FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.6M	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
10		CONTINUED FROM SHEET 2		80.75												
				10.00									J,R,UE			Caved Material
													J,R,UE			
11	NXL RC	FOR DETAILED DESCRIPTION, SEE SHEET 2.			10	0.13	50%						B,R,UE,Fe-stain			
													BC			
12	NXL RC				11	0.08	50%						J,R,UE,Ca-Fe			
													B,R,UE			
13				78.87												
				13.29									B,R,UE			
14	NXL RC				12	0.12	50%						B,R,UE			
													B,R,UE			
													J,R,UE,mud			
15													B,R,UE,Ca-stain			
16	NXL RC	Fresh, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, crystalline, massive, nodular LIMESTONE interbedded with argillaceous layers. (UNIT B2)			13	0.09	50%						J,R,UE,Ca-stain			
													B,R,UE			
17													B,R,PL			
													B,R,UE			
													B,R,UE			
18	NXL RC				14	0.15	50%						B,R,UE			
													B,R,UE			
19													B,R,UE,mud			
													B,R,PL			
	NXL RC				15	0.10	50%						B,R,UE			
20				75.02									B,R,UE			Bentonite Seal
		CONTINUED ON SHEET 4		20.00												

JAN. 31

FEB. 1

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan.30-Feb.1/90

CHECKED MvB

RECORD OF DRILLHOLE 90-13

SHEET 4 of 4

LOCATION See figure 2

INCLINATION -35 AZIMUTH 010

DRILLING DATE Jan.30-Feb.1/90

DRILL RIG Rotary Diamond

DRILLING CONTRACTOR Marathon Drilling Co Ltd

DATUM Geodetic

PROJECT 891-2696

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN

F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED

SM-SMOOTH R -ROUGH ST-STEPPED PL-PLANAR

FL-FLEXURED UE-UNEVEN W -WAVY C -CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	RUN No.	PENETRATION RATE (M/MIN)	% RETURN FLUSH COLOUR	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.5M	DISCONTINUITY DATA DIP W.R.T. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
20		CONTINUED FROM SHEET 3		75.02												
	NXL RC			20.00	15	0.10	50%					0 0 0 0	B,R,UE			Bentonite Seal
												0 0 0 0	Carbonate VN J,R,UE,Ca-stain			
21																
												0 0 0 0	Carbonate VN			
												0 0 0 0	B,R,UE			
	NXL RC	Fresh, light to medium grey, fine to medium grained, thin to medium bedded, stylolitic, crystalline, massive, nodular LIMESTONE interbedded with argillaceous layers. (UNIT B2)			16	0.08	60%					0 0 0 0	B,R,UE			Granular Filter
22												0 0 0 0	B,R,PL			
												0 0 0 0	B,R,UE			
												0 0 0 0	B,R,UE			
23												0 0 0 0	B,R,UE			
	NXL RC				17	0.06	60%					0 0 0 0	B,R,UE			
												0 0 0 0	B,R,UE			
24	FEB. 1			72.58								0 0 0 0	B,R,UE,mud			
		END OF HOLE		24.25												WATER LEVEL IN STANDPIPE AT ELEV. 74.20m ON FEB. 6/90.
25																
26																
27																
28																
29																
30																

DEPTH SCALE

1 : 50

Golder Associates

LOGGED LQ,SPM

DATE Jan.30-Feb.1/90

CHECKED MvB

PROJECT: 911-2400

RECORD OF BOREHOLE 1

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov 26 1991

DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. + ○●, rem V. ⊞ U-○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT (Wp, W, WL)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		42.44							
		Topsoil (FILL)		0.07							
1		Loose to compact dark brown to grey, silty sand and gravel, occasional cobbles, some concrete, glass, and cinders (FILL)			1	SS	5				
2					2	SS	4				
3					3	SS	10				
					4	SS	9				
				38.78							
4				3.66							
5		Loose grey to grey green, silty fine to medium sand, occasional silt layer, trace wood (ALLUVIUM)			5	SS	8				
					6	SS	7			MH	W.L in open hole at elev. 41.65m upon completion of drilling
				36.85							
6				5.59	7	SS	1				
7	Rotary Drilling NQ Core	Slightly to moderately weathered fractured grey LIMESTONE BEDROCK (OTTAWA FORMATION)			8	RC	-	T.C.R. = 43% S.C.R. = 22% R.Q.D. = 17%			
				35.35							
				7.09	9	RC	-	T.C.R. = 100% S.C.R. = 100% R.Q.D. = 100%			
8		Fresh to faintly weathered grey LIMESTONE BEDROCK, occasional shale seams (OTTAWA FORMATION)									
9					10	RC	-	T.C.R. = 100% S.C.R. = 83% R.Q.D. = 72%			
				33.36							
		End of Hole		9.08							
10											

0 / 15 / 10 PERCENT AXIAL STRAIN AT FAILURE

DATA INPUT: Dale 10, Steve

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: V.C.H

CHECKED: VCH

PROJECT: 911-2405

RECORD OF BOREHOLE 2

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov 27, 1991

DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5KG; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. + ; rem V. ●; U ■; ○)	HYDRAULIC CONDUCTIVITY, k, cm/s	WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		42.46								
		Topsoil (FILL)		0.07								
1		Loose dark brown to grey sand and gravel, occasional cobbles (FILL)			1	SS	1					
				40.94								
				1.52	2	SS	3					
2		Grey to grey brown clayey silt to silty clay, some sand and gravel, slight organic odour, trace rootlets (FILL)			3	SS	PH				WH	
				39.41								
				3.05	4	SS	1					
3		Very loose brown sandy silt, some clay, trace gravel (FILL)		38.65								
				3.81	5	SS	PH					
					6	SS	1					W.L. in open hole at elev. 41.85m upon completion of drilling
5		Very loose to loose grey SILTY SAND, some gravel, trace to some clay			7	SS	4					
					8	SS	2					
6												
				35.58								
7	Rotary Drilling NQ Core	Fresh to faintly weathered grey LIMESTONE BEDROCK, occasional shale seam (OTTAWA FORMATION)		6.88	9	RC	4	T.C.R. = 92% S.C.R. = 79% R.Q.D. = 32%				
8					10	RC	1	T.C.R. = 90% S.C.R. = 76% R.Q.D. = 54%				
				33.55								
9		End of Hole		8.91								
10												

DATA INPUT: Bob Mc Drew

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: V.C.H

CHECKED: VCH

PROJECT: 911-2405

RECORD OF BOREHOLE 3

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov 27, 1991

DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, nat U. ●, rem U. ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		42.43							
		Topsoil (FILL)		0.00							
		Brown silty sand and limestone rubble (FILL)		0.12							
				41.82							
				0.61	1	SS	5				
1					2	SS	1				
2					3	SS	6				
3	Power Auger 300mm Diam. (Hollow Stem)	Very loose to loose dark brown to grey silty sand, some gravel, trace clay, brick, glass and organic matter (FILL)			4	SS	2				
4					5	SS	3				
5					6	SS	3				W.L. in open hole at elev. 41.65m upon completion of drilling
6					7	SS	4				
				36.03	8	SS	7				
		Loose grey SILTY SAND, occasional silty clay seam		6.40							
				35.57							
7		Grey sandy silt (GLACIAL TILL)		6.86							
				6.98							
		Moderately weathered fractured grey LIMESTONE BEDROCK (OTTAWA FORMATION)			9	NQ	1	T.C.R. = 100% S.C.R. = 70% R.Q.D. = 0%			
					10	NQ	1	T.C.R. = 100% S.C.R. = 0% R.Q.D. = 0%			
8	Rotary Drilling NQ Core			34.35							
				8.08							
		Fresh to faintly weathered grey LIMESTONE BEDROCK, occasional shale seam (OTTAWA FORMATION)			11	NQ	1	T.C.R. = 100% S.C.R. = 64% R.Q.D. = 64%			
9				33.29							
		End of Hole		9.14							
10											

15 ÷ 5 PERCENT AXIAL STRAIN AT FAILURE

DATA INPUT: Dick 10, Steve

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: V.C.H

CHECKED: VCH

RECORD OF BOREHOLE 4

PROJECT: 913.7405 | SHEET 1 OF 1

LOCATION: See Figure 2 | BORING DATE: Nov 29, 1991 | DATUM: Geodetic

SAMPLER HAMMER 63.5kg; dROP, 760mm | PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: SHEAR STRENGTH Cu, kPa (rem.V- +, rem.V-⊕, Q-●, U-○)	HYDRAULIC CONDUCTIVITY, K, cm/s	WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam (Hollow Stem)	Ground Surface		42.45								
		Topsoil (FILL)		0.00								
1		Very loose to compact brown to grey silty sand and gravel, trace organic matter and brick (FILL)		0.12	1	SS	13					▽
2					2	SS	8					
3					3	SS	7					
4					4	SS	8					
5					5	SS	11					
					6	SS	4					
6				36.81	7	SS	3					
		Very loose to loose grey silty fine sand, some wood chips (ALLUVIUM)		5.64								
7				36.05	8	SS	1					
		Loose grey silty sand, trace gravel (GLACIAL TILL)		6.40								
	Rotary Drilling NQ Core			35.81								
		Slightly weathered fractured grey LIMESTONE BEDROCK, occasional shale seams (OTTAWA FORMATION)		6.64	9	RC	24/5	T.C.R. = 100% S.C.R. = 54% R.Q.D. = 28%				
					10	RC	NO RECOVERY	T.C.R. = 84% S.C.R. = 31% R.Q.D. = 0%				
8				34.65								
		End of Hole		7.80								
9												
10												

W.L. in open hole at elev. 41.65m upon completion of drilling

15-45 PERCENT AXIAL STRAIN AT FAILURE

DATa INPUT: Dirk Ie, Steven

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: V.C.H

CHECKED: VCH

PROJECT: 911-240

RECORD OF BOREHOLE 5

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov 29, 1991

DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa	HYDRAULIC CONDUCTIVITY, K, cm/s; WATER CONTENT, PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		42.45							
		Brown sand and gravel (FILL)		0.00							
				0.15							
1		Grey cobbles and boulders, some sand and gravel infilling (ROCK FILL)									
				40.93							
2	Power Auger; 203mm Diam (Hollow Stem)			1.52	1	SS	8				
		Very loose to loose dark grey silty sand and gravel, some cobbles and boulders, trace wood (FILL)			2	SS	5				
3					3	SS	4				
					4	NQ RC	1				
4					5	SS	1				
				37.66							
				4.79							W.L. in open hole at elev. 41.65m upon completion of drilling
5	Rotary Drilling; NQ Core	Fresh to faintly weathered grey LIMESTONE BEDROCK, occasional black shale interbed (OTTAWA FORMATION)			6	NQ RC	1	T.C.R. = 100% S.C.R. = 98% R.Q.D. = 87%			
6											
					7	NQ RC	1	T.C.R. = 100% S.C.R. = 97% R.Q.D. = 80%			
7				34.74							
		End of Hole		7.71							
8											
9											
10											

DATA INPUT: Dick to Slaver

B PERCENT AXIAL STRAIN AT FAILURE

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: V.C.H

CHECKED: VCH

PROJECT: 911-2405

RECORD OF BOREHOLE 6

SHEET 1 OF 1

LOCATION: See Figure 2

BORING DATE: Nov 28, 1991

DATUM: Geodetic

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (rmV ×, + ; rmV ●, ○ ; U ●, U ○)	HYDRAULIC CONDUCTIVITY, K, cm/s; WATER CONTENT, PERCENT (Wp, W, WI)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger 200mm Diam. (Hollow Stem)	Ground Surface		42.45							
		Brown sand and gravel (FILL)		42.30 / 0.15							
1		Grey cobbles and boulders with brown sand and gravel infilling (ROCK FILL)			1	SS	1				
				40.93 / 1.52	2	SS	13				
2		Very loose to compact grey sand to silty sand and gravel, some cobbles, trace ashes and glass (FILL)			3	SS	4				
3					4	SS	1				
					5	SS	1				
				37.88 / 4.57							
5	Power Auger NQ Core	Fresh to faintly weathered grey LIMESTONE BEDROCK, occasional black shale interbed (OTTAWA FORMATION)			6	RC	1	T.C.R. = 100% S.C.R. = 92% R.Q.D. = 44%			
					7	RC	1	T.C.R. = 100% S.C.R. = 99% R.Q.D. = 86%			
				36.23 / 6.22							
		End of Hole									

W.L. in open hole at elev. 41.65m upon completion of drilling

DATA INPUT: CHK 10, SHEET

DEPTH SCALE

1 to 50

Golder Associates

LOGGED: V.C.H

CHECKED: VCH

PROJECT: 931-2287

LOCATION: See Plan

SAMPLER HAMMER, 63.5kg; DROP, 760mm

RECORD OF BOREHOLE 93-1

BORING DATE: Aug. 25, 1993

SHEET 1 OF 1

DATUM: Geodetic

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat.V - +, rem.V - ⊕, Q - ●, U - O)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT, PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		85.93							
		Brown sandy silt, trace concrete and cobbles (FILL)		0.00 85.20							
1	NW Casing	Dark brown sandy silt, some gravel and clay (TILL)		0.73 84.56							
		Moderately to slightly weathered, thin to medium bedded, light to medium grey, fine grained, NODULAR LIMESTONE (Ottawa Formation)		1.37	1	NQ RC					
2				83.37 2.56	2	NQ RC		T.C.R. 95% S.C.R. 78% R.Q.D. 48%			
3					3	NQ RC		T.C.R. 100% S.C.R. 87% R.Q.D. 53%			
4											
5					4	NQ RC		T.C.R. 100% S.C.R. 77% R.Q.D. 55%			
6	Rotary Drill NQ Core	Slightly to faintly weathered, thin to medium bedded, light to medium grey, fine grained, NODULAR LIMESTONE (Ottawa Formation). Mud seams at 4.82 to 5.00 metres, occasional near vertical calcite infilled fractures, occasional thin black shale seams at 60 degress to core axis.			5	NQ RC		T.C.R. 100% S.C.R. 25% R.Q.D. 13%			
7											
8					6	NQ RC		T.C.R. 100% S.C.R. 84% R.Q.D. 81%			
9											
10					7	NQ RC		T.C.R. 100% S.C.R. 97% R.Q.D. 87%			
11					8	NQ RC		T.C.R. 100% S.C.R. 90% R.Q.D. 66%			
12											
13					9	NQ RC		T.C.R. 100% S.C.R. 84% R.Q.D. 61%			
				72.06							
14		End of Hole		13.67							
15											
16											
17											
18											
19											
20											

Bentonite Seal

Granular Filter

Standpipe

W.L in Standpipe at Elev.82.55m Sept.7, 1993

DATA INPUT: S. Leighton, Disk 15

DEPTH SCALE

1 to 100

Golder Associates

LOGGED: T.J.N

CHECKED:

PROJECT: 961-2016

LOCATION: See Plan

INCLINATION: AZIMUTH:

RECORD OF DRILLHOLE: 96-1

SHEET 1 OF 1

DRILLING DATE: Aug. 19, 1996

DATUM: Geodetic

DRILL RIG: Portable Drill

DRILLING CONTRACTOR: OLHMAN GEOTECHNICAL SERVICES

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

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	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0	BW Casing	Asphalt Surface ASPHALTIC CONCRETE CONCRETE Fresh to slightly weathered fine grained grey LIMESTONE, prominent near vertical fracture present.		87.49 0.00 0.12 0.25	1		0										
1					2		0										
					3		0										
					4		0							BP,R,UE,Fe Stained BP,R,Fe Stained			
2				86.27 1.22	5		0							BP,R, Stained BP,UE			
					6									B,UE, Slight Stain B,UE, Slight Stain B,UE, Stained B,SM, Stained R, P			
3					7		0							R,J, Stained R,J, Stained B,R, Fe Stained B,R, Fe Stained B,R, Fe Stained B,UE, Fe Stained			
4														J,UE, Stained B,UE, Stained B,SM B,UE, Stained			
5	AW Core	Fresh to faintly weathered fine grained grey LIMESTONE; nodules and stylolites present; fractures commonly coincident with bedding planes. Slightly open vertical fracture extends to 2.4m depth. Some 45° coated joints at 1.86m, 2.75m and 3.1m. Joints at 1.86m and 3.1m are weathered and slightly open.			8		0							B,SM B,UE B,UE, Stained B,UE B,SM, Stained B,SM, Stained B,UE			
6														B,UE B,UE, Stained B,UE, Stained			
					9		0							B,UE B,UE B,UE B,UE, Stained			
7														B,UE, Stained B,UE, Stained B,UE, Stained B,UE, Stained			
					10		0							B,UE, Stained B,UE, Stained B UE Stained B,UE, Stained B,UE, Stained B,UE, Stained			
8														B,UE, Stained B,UE, Stained B,UE, Stained			
					11		0							B,UE, Stained B,UE, Stained			
9	Rotary Drill			77.53													
10		End of Hole		9.96										B,UE, Stained			
11																	
12																	

DEPTH SCALE:
1 to 60

Golder Associates

LOGGED: P.A.H
DATE: MARCH 25/97
CHECKED: GSW/TGC

C:96-1-016 DRF

DATA INPUT C:96-1-016 DRF/S.L

ROCKMV5

PROJECT: 961-2016

LOCATION: See Plan

INCLINATION: AZIMUTH:

RECORD OF DRILLHOLE: 96-2

DRILLING DATE: Aug. 20, 1996

DRILL RIG: Portable Drill

DRILLING CONTRACTOR: OLHMAN GEOTECHNICAL SERVICES

SHEET 1 OF 1

DATUM: Geodetic

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH / % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX per m	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		Ground Surface		87.35												
0	BW Casing	Loose brown silty sand, some gravel, trace organics, brick (FILL)		0.00	1											
1				86.11	2											
		Fresh to faintly weathered fine grained grey LIMESTONE, prominent near vertical fractures present		1.24	3		0						B,R, Stained			
					4		0						Near Vert. Frac. B,UE, Stained			
2													J,UE, Stained			
				85.06 2.29	5		0						J,UE, Stained B,UE, Stained			
3					6		0									
4					7		0									
5	AW Core	Fresh to faintly weathered fine grained grey LIMESTONE, nodules and stylolites present; fractures commonly coincident with bedding. Some prominent vertical fracturing at 2.1m depth.			8		0									
6					9		0						B,UE, Stained J,UE, Stained B,UE, Stained B,UE, Stained			
7													B,UE, Stained			
8					10		0									
9	Rotary Drill				11		0						B,UE, Stained B,UE, Stained			
				77.67												
		End of Hole		9.68									B,UE, Stained			
10																
11																
12																

DEPTH SCALE:

1 to 60

Golder Associates

LOGGED: P.A.H

DATE: MARCH 25/97

CHECKED: GSW/TGC

C:\96-2-016.DRF

DATA INPUT c:\96-2-016.DRF/S L

ROCKMVS

PROJECT: 861-2016

RECORD OF DRILLHOLE: 96-3

SHEET 1 OF 1

LOCATION: See Plan

DRILLING DATE: Aug. 21,22, 1996

DATUM: Geodetic

INCLINATION: AZIMUTH:

DRILL RIG: Portable Drill

DRILLING CONTRACTOR: OLHMAN GEOTECHNICAL SERVICES

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH	CORE LOSS % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3 m RUN	DISCONTINUITY DATA (OF WELL CORE AXIS)	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		Basement Floor		83.73													
		CONCRETE		83.61 0.00													
	BW Casing	Loose rubble, mortar, brick, gravel, cinders (FILL)		0.12	1									R			
					2												
1				82.66										BP,R			
				1.07	3		0							BP,UE			
														BP, Slight Staining			
														BP,UE			
2														BP,UE			
					4		0							BP,UE			
														BP,UE			
														BP,UE W			
														BP,UE			
														BP,UE			
3		Fresh to faintly weathered fine grained grey LIMESTONE, nodules and stylolites present; fracturing commonly coincident with bedding. Prominent vertical joints at 1.37m and 2.13m.												Core Break Shale Parting			
														BP,UE			
					5		0							BP,UE			
														BP,UE			
														BP,R,UE Some Stain			
4														BP,R,UE Some Stain			
														Shale Parting			
					6		0							BP			
														BP,UE Some Stain			
														BP,UE Some Stain			
5														BP,UE			
														BP,S			
														Core Break			
					7		0							BP,UE, Stylolite			
														UE			
	Rotary Drill													UE,S, Calcite			
6				77.41													
		End of Hole		6.32										UE,W			
7																	
8																	
9																	
10																	
11																	
12																	

DEPTH SCALE
1 to 60

Golder Associates

LOGGED: P.A.H
DATE: MARCH 25/97
CHECKED: GSW/TGC

C 96-3-016 DRF
DATA INPUT: C 96-3-016 DRF/S L
ROCKMAN5

PROJECT: 961-2016D

RECORD OF DRILLHOLE: 97-1

SHEET 1 OF 1

LOCATION: See Plan

DRILLING DATE: Jan. 31, 1997

DATUM: Geodetic

INCLINATION: AZIMUTH:

DRILL RIG: Portable Drill

DRILLING CONTRACTOR: OHLMAN GEOTECHNICAL SERVICES

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT INDEX PER	DISCONTINUITY DATA DIP w/r CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0	BW Casing	Top of Loading Dock		86.32												
		CONCRETE		0.00												
		Red BRICK		0.15												
		Brown fine sand (FILL)		0.24 / 85.86												
		Fresh to slightly weathered fine grained grey LIMESTONE, prominent fractures present with some staining on fracture surfaces.		0.46	1		0						B, UE, Stained			
					2		0						B, UE, Stained			
1					3		0						J, UE, Fe Stained J, UE, Fe Stained B, UE, Fe Stained			
				85.10 / 1.22									B, UE, Fe Stained			
		Fresh to faintly weathered fine grained grey LIMESTONE, occasional horizontal fracture			4		0						B, UE			
2	AW Casing Core				5		0						B, UE J, UE			
					6		0						B, UE			
				83.73 / 2.59									B, UE B, UE Stained J, SM, Fe Stained B, UE Stained J, UE Heavy Fe Stain B, UE, Fe Stained B, SM, Fe Stained			
3		Fresh to faintly weathered fine grained grey LIMESTONE, prominent vertical to near vertical fractures between 2.74 and 3.26m and between 4.45 and 4.58m, heavy iron staining along thin fracture surfaces.			7		0						J, SM, Fe Stained			
					8		0						B, UE, Stained B, SM			
					9		0						B, SM, Fe Stained B, SM, Fe Stained B, SM, Fe Stained B, SM			
4	Rotary Drill				10		0						B, SM Fe Stained B, UE Fe Stained B, SM, Stained			
				81.75									B, UE Stained			
		End of Hole		4.57									J, SM, Fe Stained			
5													2.87-3.26m - Major near Vertical joint 4.45-4.57 - Heavy Fe Staining			
6																
7																
8																
9																
10																

DEPTH SCALE
1 to 50

Golder Associates

LOGGED: D.J.S
DATE: MARCH 25/97
CHECKED: GSW/TGC

DATA INPUT: O 97-1-016 dri
ROCKMS
O 97-1-016 DRF

PROJECT: 961-2016D

RECORD OF DRILLHOLE: 97-2

SHEET 1 OF 1

LOCATION: See Plan

DRILLING DATE: Jan. 31, 1997

DATUM: Geodetic

INCLINATION: AZIMUTH:

DRILL RIG: Portable Drill

DRILLING CONTRACTOR: OHLMAN GEOTECHNICAL SERVICES

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV / DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH / % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	RQD %	FRACT. INDEX PER	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
0		Top of Loading Dock		87.81											
		CONCRETE		0.00 / 0.18											
		Grey crushed stone (FILL)		87.24 / 0.37											
	BW Casing	Loose brown sandy silt, some gravel and clay, occasional cobble (FILL)		86.30	1										
1				1.31	2		0					B, UE			
					3		0					B, UE, Fe Stained B, UE B, UE B, UE B, UE, Stained			
2					4		0					B, UE, Fe Stained B, UE, Stained B, UE, Stained B, UE, Fe Stained B, SM, Fe Stained			
3	AW Casing Core	Fresh to faintly weathered fine grained grey LIMESTONE, horizontal bedding plane fractures common; some staining along fracture surfaces.										B, UE B, UE B, UE, Stained B, SM, Stained			
												B, UE, Stained B, UE, Stained			
4												B, UE, Stained B, SM			
					5		0					B, UE, Stained B, UE, Stained B, SM, Stained B, SM B, SM, Stained B, SM			
5												B, SM B, SM B, SM B, SM B, SM B, SM			
					6		0					B, UE, Stained B, SM, Stained			
6	Rotary Drill			81.45											
		End of Hole		6.16											
7															
8															
9															
10															

NOTES
WATER LEVELS
INSTRUMENTATION

Cement Seal
Granular Filter
Bentonite Seal
Granular Filter
Standpipe

W.L in Standpipe at Elev. 85.86m Feb. 3, 1997

DEPTH SCALE:
1 to 50

Golder Associates

LOGGED: D.J.S
DATE: MARCH 25/97
CHECKED: GSW/TGC

DATA INPUT: O.97-2-016.dat
ROCKMVS
O 97-2-016 DRF

PROJECT: 991-2160

RECORD OF BOREHOLE: 99-1

SHEET 1 OF 4

LOCATION: See Site Plan

BORING DATE: August 21&22, 1999

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface		87.43							
		CONCRETE.		0.00							
				87.30							
		Grey crushed stone, (FILL)		0.15							
1	Rotary Drill / NW Casing										
				86.37							
		Probably brown sand, (FILL)		1.22							
2											
3											
4											
5											

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

BOREHOLE 991-2160.GPJ GLDR_CAN.GDT 29/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-1

SHEET 2 OF 4

LOCATION: See Site Plan

DRILLING DATE: August 21&22, 1999

DATUM: Geodetic

INCLINATION: -60° AZIMUTH: N 148°E

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (min./m)	CORE LOSS % RETURN FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				85.53												
		Fresh to faintly weathered fine grained grey LIMESTONE,occasional fracture, stylolites common		2.19	1								BC from 2.19m - 2.47m			
					2								FR, R some staining along FR surface B, UE B, UE some staining B, UE some staining B, UE B, UE some staining B, UE some staining			
3		Fresh to slightly weathered fine grained grey LIMESTONE,occasional fracture, commonly coincident with shaly partings, occasional nodules, stylolites common. Fracture from 11.83m to 11.92m characterized by secondary calcite deposition and iron staining.		84.79 3.03												
					3								B, UE B, UE B, UE/R	NO TAKE		
4													BR			
	NQ Core				4								FR, R FR, UE some staining B, UE FR, R B, UE B, UE B, 6M Coincident with shaly parting	NO TAKE		
5																
6					5								B, 6M Coincident with shaly parting B, UE B, UE B, UE	NO TAKE		
7													B, UE B, UE B, UE			
		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 29/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-1

SHEET 3 OF 4

LOCATION: See Site Plan

DRILLING DATE: August 21&22, 1999

DATUM: Geodetic

INCLINATION: -60° AZIMUTH: N 148°E

DRILL RIG:

DRILLING CONTRACTOR:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No	PENETRATION RATE (m/min)	CORE DIA. & RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION

FR-FRACTURE; CL-CLEAVAGE; SH-SHEAR; VN-VEIN; F-FAULT; J-JOINT; P-POLISHED; S-SLICKENSIDED; SM-SMOOTH; R-ROUGH; ST-STEPPED; PL-PLANAR; FL-FLEXURED; UE-UNEVEN; W-WAVY; C-CURVED; BC-BROKEN CORE; MB-MECH. BREAK; B-BEDDING

Fresh to slightly weathered fine grained grey LIMESTONE,occasional fracture, commonly coincident with shaly partings, occasional nodules, stylolites common. Fracture from 11.83m to 11.92m characterized by secondary calcite deposition and iron staining. *(continued)*

NO Core

5 6 7 8 9

B, UE
B, UE
B, UE
FR, UE, staining (coal/siliceous (coral)
B, UE
B, SM Coincident with shaly parting
B, UE
B, SM
B, UE
FR UE
B, UE
B, UE
FR UE
B, UE
B, UE
B, R Secondary calcite deposition on fracture surface; some Fe staining present
FR UE
B, UE
B, UE
B, UE
B, SM
B, SM
B, UE
B, UE
B, UE
B, UE
B, UE
FR UE to SM Approx. 5mm of secondary calcite deposition along fracture surface with significant Fe staining
FR UE to SM
B UE to SM

NO TAKE

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-1

SHEET 4 OF 4

LOCATION: See Site Plan

DRILLING DATE: August 21&22, 1999

DATUM: Geodetic

INCLINATION: -60° AZIMUTH: N 148°E

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
13	NQ Core	Fresh to slighly weathered fine grained grey LIMESTONE,occasional fracture, commonly coincident with shaly partings, occasional nodules, stylolites common. Fracture from 11.83m to 11.92m characterized by secondary calcite deposition and iron staining. *(continued)*		75.93	9			100	100	100	0	0	FR UE to SM	NO TAKE		
												0	FR UE to SM			
					10			100	100	100	0	0	B, SM Coincident with 3-4cm shaly parting			
												0	B, SM Secondary calcite deposition			
												0	B, SM Hairline fracture perpendicular to primary fracture			
												0	B, VE (<1mm thick)			
												0	B, VE			
		END OF BOREHOLE		13.02												
14																
15																
16																
17																

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 2/9/99

PROJECT: 991-2160

RECORD OF BOREHOLE: 99-2

SHEET 1 OF 4

LOCATION: See Site Plan

BORING DATE: August 28,29, 1999

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp — W — Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Rotary Drill, NW Casing	Ground Surface		87.72							
		TOPSOIL		0.00 / 87.60							
		Brown sandy silt, some gravel, trace red brick (FILL)		0.12							
1											
2											
3											
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

BOREHOLE 991-2160.GPJ GLDR.CAN.GDT 2/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-2

SHEET 2 OF 4

LOCATION: See Site Plan

DRILLING DATE: August 28,29, 1999

DATUM: Geodetic

INCLINATION: -60° AZIMUTH: N 13°E

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE CL-CLEAVAGE SH-SHEAR VN-VEIN | F-FAULT J-JOINT P-POLISHED S-SLICKENSIDED | SM-SMOOTH R-ROUGH ST-STEPPED PL-PLANAR | FL-FLEXURED UE UNEVEN W-WAVY C-CURVED | BC-BROKEN CORE MB-MECH BREAK B-BEDDING

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 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				88.51													
		Fresh to moderatly weathered fine grained grey **LIMESTONE** fractured with staining and soil material along fracture surfaces; stylolites common; some secondary calcite calcification.		1.40	1									B, UE some staining FR, UE some staining			
2	NQ Core													B, UE some staining FR, UE soil material along fracture surface FR, UE soil material along fracture surface FR, UE B, R			
					2									broken core-some material along fracture surfaces, some iron staining FR, UE vertical fracture along core length some staining FR, UE			
3														UE B, UE iron staining B, UE iron staining with soil material along fracture surface FR, UE some iron staining FR, UE FR, UE			
					3										NO TAKE		
														FR, UE-SM near vertical fracture, some staining B, UE B, SM coincident with shale parting some staining B, UE FR, UE to SM vertical to near vertical fracture with soil material along fracture surface; some staining and secondary clacite deposition B, UE FR, UE B, UE B, UE-SM FR, UE-SM vertical to near vertical fracture with soil material along fracture surface, some staining B, UE FR, UE FR, UE B, UE			
4					4												
														B, SM some staining B, SM shale parting B, SM shale partings, staining B, UE staining B, UE			
5														FR, UE FR, SM			
														B, UE			
														B, UE-SM			
					5									FR/B UE-SM horizontal fracture pair; secondary calcite deposition and staining along 30 degree fracture B, UE B, UE B, UE B, UE B, UE B, SM coincident with shale partings B, SM B, SM	NO TAKE		
6				82.15													
		CONTINUED NEXT PAGE															

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

DEPTH SCALE 1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-2

SHEET 3 OF 4

LOCATION: See Site Plan

DRILLING DATE: August 28,29, 1999

DATUM: Geodetic

INCLINATION: -60° AZIMUTH: N 13°E

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE; CL-CLEAVAGE; SH-SHEAR; VN-VEIN; F-FAULT; J-JOINT; P-POLISHED; S-SLICKENSIDED; SM-SMOOTH; R-ROUGH; ST-STEPPED; PL-PLANAR; FL-FLEXURED; UE-UNEVEN; W-WAVY; C-CURVED; BC-BROKEN CORE; MB-MECH. BREAK; B-BEDDING

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH	R.Q.D. % RECOVERY	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		Fresh to moderately weathered fine grained grey LIMESTONE occasional fracture commonly coincident with shaly partings; occasional nodules. *(continued)*		8.40	5									B, SM FR, UE B, UE-SM coincident with shaly partings, some staining B, UE B, UE	NO TAKE		
7	NQ Core				6									FR, VE B, UE B, UE-SM B, UE-SM B, UE	NO TAKE		
8														B, UE B, UE B, UE FR, UE FR, UE			
9					7									FR, UE B, UE-SM FR, UE FR, UE-SM	NO TAKE		
10														B, UE B, UE FR, SM near vertical mechanical fractures B, UE coincident with shaly partings			
11					8									B, UE coincident with shaly partings B, UE-SM FR, UE FR, UE FR, UE	NO TAKE		
		CONTINUED NEXT PAGE															

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 26/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-2

SHEET 4 OF 4

LOCATION: See Site Plan

DRILLING DATE: August 28,29, 1999

DATUM: Geodetic

INCLINATION: -60° AZIMUTH: N 13°E

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (min./0)	FLUSH / % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
12	NQ Core	Fresh to moderately weathered fine grained grey LIMESTONE occasional fracture commonly coincident with shaly partings; occasional nodules. *(continued)*			9								FR, UE B, UE B, UE B, UE coincident with shaly partings B, UE B, UE B, UE FR, UE B, UE B, UE	NO TAKE		
				76.58												
		END OF BOREHOLE		12.66												
13																
14																
15																
16																

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 29/9/99

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: D.J.S./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF BOREHOLE: 99-3

SHEET 1 OF 3

LOCATION: See Site Plan

BORING DATE: August 28&29, 1999

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-4} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Floor Surface		88.32							
	Rotary Drill / BW Casing	CONCRETE.		0.00							
				88.14							
		Brown fine sand. (FILL)		0.18							
1											
2											
3											
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

BOREHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-3

SHEET 2 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 28&29, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				85.53													
		Fresh to faintly weathered fine grained grey LIMESTONE, occasional fractured commonly coincidant with shale partings; nodular; some secondary mineralization and staining.		0.69													W.L. @ 0.73m depth Sept.2/99
1	BQ Core				1									B, UE staining B, UE staining B, UE staining			
														B, UE B, UE			
					2									B, UE staining B, UE staining			
														FR, SM mechanical break			
2														B, SM			
														B, VE-SM some stains			
					3									B, SM			
														B, UE-SM B, UE-SM			
3														B, UE			
														B, UE			
														B-UE-SM coincident with shaly partings			
					4									B, SM coincident with shaly partings B, SM coincident with shaly partings B, SM coincident with shaly partings B VE-SM coincident with shaley partings B, VE-SM B-SM coincident with shaly partings			
4														FR, UC B, SM B, SM			
														B, SM note: 4.83m to 4.98mm near vertical fracture through core but not open			
														B, SM B, SM			
5														B, UE B, SM B, SM			
					5									B, SM B, SM			
														B, UE B, SM			
		CONTINUED NEXT PAGE															

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-3

SHEET 3 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 28&29, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: --

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
6	BQ Core	Fresh to faintly weathered fine grained grey LIMESTONE, occasional fractured commonly coincident with shale partings; nodular; some secondary mineralization and staining. *(continued)*			5								B, UE B, UE B, SM B, SM B, SM B, UE FR, UE B, VE-SM B, UE B, SM B, SM FR-VE B, VE			
7					6								B, VE V, VE-M F, SM mechanical break B, VE-SM B, VE note: 7.41m to 7.92m healed non vertical fracture infilled with secondary mineralization. (calcite and metallic minerals) B, UE B, UE B, SM B, SM B, UE			
8					7								B, VE-SM B, UE B, UE B, VE-SM B, UE B, UE B, SM B, SM B, UE B, UE-SM			
9		END OF BOREHOLE		77.25 9.07												
10																

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 26/3/99

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF BOREHOLE: 99-4

SHEET 1 OF 3

LOCATION: See Site Plan

BORING DATE: August 26&27, 1999

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-2} 10^{-3} 10^{-4} 10^{-5})	WATER CONTENT PERCENT Wp — W — Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Rotary Drill, BW Casing	Floor Surface		88.32									
		CONCRETE.		88.22									
		CLAY TILE.		0.10									
				88.07									
		Fine brown sand. (FILL)		0.25									
1													
2													
3													
4													
5													

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

BOREHOLE 991-2160.GPJ GLDR_CAN.GDT 25/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-4

SHEET 2 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 25&27, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED BT-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No	PENETRATION RATE (min/ft)	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				85.43												
1	BQ Core	Fresh to faintly weathered fine grained grey LIMESTONE, occasional fracture commonly coincident with shaly partings; nodular stylolites, some secondary calcite mineralization and staining.		0.89	1								B, UE B, UE B, UE B, UE			
					2								FR, UE mechanical fracture B, UE			
2					3								B, UE B, UE B, UE B, UE FR, SM FR, SM B, UE B, UE-SM B, SM FR, UE B, UE-SM B, UE			
3					4								B, UE mechanical fracture B, UE B, UE B, UE FR, UE mechanical fracture B, SM B, SM B, SM B, SM B, SM			W.L. @ 3.42m depth Sept.2/99
					5								B, SM B, UE B B, UE-SM B, UE B, UE B, UE B, UE-SM B, UE-SM B, UE B, SM B, SM B, SM clay parting B, SM			
4					6								B, UE-SM B, UE B, SM B, SM B, SM B, UE B, UE B, UE B, UE B, UE B, UE B, UE SM			
5		CONTINUED NEXT PAGE														

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 26/9/99

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 991-2150

RECORD OF DRILLHOLE: 99-4

SHEET 3 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 26&27, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE, CL-CLEAVAGE, SH-SHEAR, VN-VEIN, F-FAULT, J-JOINT, P-POLISHED, S-SLICKENSIDED, SM-SMOOTH, R-ROUGH, ST-STEPPED, PL-PLANAR, FL-FLEXURED, UE-UNEVEN, W-WAVY, C-CURVED, BC-BROKEN CORE, MB-MECH. BREAK, B-BEDDING

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 %	ROD %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA Diff w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
6	BQ Core	Fresh to faintly weathered fine grained grey LIMESTONE, occasional fracture commonly coincident with shaly partings; nodular stylolites, some secondary calcite mineralization and staining. *(continued)*			6									B, VE B, SM B, BE-SM B, UE B, UE B, SM B, UE-SM B, UE-SM			
7					7									B, SM B, UE B, SM B, UE B, UE B, UE B, UE B, SM B, UE B, SM			
				78.42									50	B, UE FR near vertical fracture with secondary calcite mineralization, some staining.			
8		END OF BOREHOLE		7.90													
9																	
10																	

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF BOREHOLE: 99-5

SHEET 1 OF 3

LOCATION: See Site Plan

BORING DATE: August 25&26, 1999

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-5} 10^{-6} 10^{-7})	WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Rotary Drill, No Casing	Floor Surface		88.32									
		CONCRETE.		0.00									
1													
2													
3													
4													
5													

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

BOREHOLE 991-2160.GPJ GLDR_CAN.GDT 29/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-5

SHEET 2 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 25&26, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	CORE RETURN %	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				86.14													
	BQ Core	Fresh to faintly weathered fine grained grey LIMESTONE, fractures commonly coincident with shaly partings and stylolites, nodular, occasional staining.		0.18	1									B, UE			
					2									B, UE B, UE B, UE B, UE B, UE			
					3									B, UE FR, UE FR, UE			
1					4									B, UE B, UE B, UE B, UE			
					5									B, SM B, UE B, UE			
					6									FR, UE FR, UE FR, UE FR, SM			
2					7									B, SM B, SM B, SM B, SM B, SM B, SM B, UE B, UE B, UE B, UE			
					8									FR, S-SM with staining B, SM FR, SM mechanical fracture B, SM B, UE			
3					9									B, UE-SM B, UE-SM B, UE-SM mechanical fracture B, UE-SM FR, SM B, SM B, SM B, SM B, SM B, SM FR, UE B, SM B, SM B, SM B, SM B, SM B, SM			
4					10									B, SM B, UE			
5		CONTINUED NEXT PAGE															

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 2/9/99

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-5

SHEET 3 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 25&26, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE | F-FAULT | SM-SMOOTH | FL-FLEXURED | BC-BROKEN CORE
CL-CLEAVAGE | J-JOINT | R-ROUGH | UE-UNEVEN | NB-MECH. BREAK
SH-SHEAR | P-POLISHED | ST-STEPPED | W-WAVY | B-BEDDING
VN-VEIN | S-SLICKENSIDED | PL-PLANAR | C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
5	BQ Core	Fresh to faintly weathered fine grained grey LIMESTONE, fractures commonly coincident with shaly partings and stylolites, nodular, occasional staining. *(continued)*			10								B, UE B, SM B, SM B, SM B, SM mechanical break B, UE B, SM B, SM B, SM B, SM B, UE			
6													B, UE B, SM B, SM B, UE B, SM B, SM B, UE			
7					11								B, UE B, UE B, UE B, UE B, UE B, UE B, UE B, UE B, SM B, SM B, SM B, SM B, SM B, SM B, UE B, UE B, UE			
8		END OF BOREHOLE		78.42 7.90												
9																
10																

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

PROJECT: 991-2160

RECORD OF BOREHOLE: 99-6

SHEET 1 OF 3

LOCATION: See Site Plan

BORING DATE: August 23&24, 1999

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Rotary Drill, No Casing	Floor Surface		86.32							
		CONCRETE.		0.00 / 86.20							
		VOID duct work and piping.		0.12							
				85.48							
		CONCRETE.		0.84							
1											
2											
3											
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

BOREHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-6

SHEET 2 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 23&24, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (mm/s)	FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: Diff w.r.t CORE Axis	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
				85.28												
		Fresh to slightly weathered fine granular grey LIMESTONE, fractured with secondary calcite mineralization and staining common.		1.03	2											
					3											
					4											
				84.42	5											
2		Fresh to faintly weathered fine grained grey LIMESTONE fractures commonly coincedent with shaly partings/stylolites nodular, some staining.		1.99	6								B, SM			W.L. @ 1.33m depth Sept.2/99
													B, UE			
					7								B, UE			
													B, UE some staining			
													B, UE			
					8								B, UE SM			
													B, UE			
													B, SM			
													B, UE			
3													B, UE some staining			
													B, UE some staining			
					9								B, UE some staining			
													B, UE-SM			
													B, UE			
													B, UE-SM			
					10											
4													B, SM			
													B, SM			
													B, SM			
													F, UE			
													B, UE			
													F, UE			
													F, UE			
													B, SM			
													D, SM some staining			
													B, SM staining			
					11								B, UE			
													B, SM			
													B, UE staining			
5													B, UE staining			
													B, UE mechanical fracture			
													B, SM			
													F, UE			
													B, SM			
													B, SM			
					12								B, SM			
													B, UE			
													B, UE			
													B, UE SM			
													B, UE			
6													B, SM			
		CONTINUED NEXT PAGE														

BQ Core

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 28/9/99

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 991-2160

RECORD OF DRILLHOLE: 99-6

SHEET 3 OF 3

LOCATION: See Site Plan

DRILLING DATE: August 23&24, 1999

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG:

DRILLING CONTRACTOR:

FR-FRACTURE, CL-CLEAVAGE, SH-SHEAR, VN-VEIN, F-FAULT, J-JOINT, P-POLISHED, S-SLICKENSIDED, SM-SMOOTH, R-ROUGH, ST-STEPPED, PL-PLANAR, FL-FLEXURED, UE-UNEVEN, W-WAVY, C-CURVED, BC-BROKEN CORE, MB-MECH. BREAK, B-BEDDING

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH / % RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
7	BQ Core	Fresh to faintly weathered fine grained grey LIMESTONE fractures commonly coincedent with shaly partings/stylolites nodular, some staining. *(continued)*			12								B, UE B, UE B, UE B, UE B, UE F, UE staining B, UE B, UE-SM B, UE-SM B, UE			
					13								B, UE B, UE-SM B, UE-SM B, UE B, UE-SM staining B, UE B, UE B, SM B, UE-SM B, UE-SM			
				78.78												
		END OF BOREHOLE		7.54												
8																
9																
10																
11																

DRILLHOLE 991-2160.GPJ GLDR_CAN.GDT 2/8/99

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: H.E.C./K.A.M.

CHECKED: .....

PROJECT: 10-1121-0046

RECORD OF DRILLHOLE: 10-1

SHEET 1 OF 3

LOCATION: N 5032089.931, E 367462.446 (See Site Plan)

DRILLING DATE: July 2-3, 2010

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Maratlion Drilling

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 0.3	DISCONTINUITY DATA: DIP WITH CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K (cm/sec)	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		GROUND SURFACE		A7.16												
0	P.A. (HSA)	Brown poorly graded sand, with silt and gravel (FILL)		0.00	1											
		- SPT 'N' value of 14 blows per 300mm for SA 1		M.52												
1	Rotary Drill HQ Core	Fresh thinly to medium bedded grey LIMESTONE BEDROCK, with thin shale interbedding		0.64	C1		100						B,UE,R B,UE,R B,UE,R			
													B,UE,R B,UE,R			
2					C2		100						B,C,R B,UE,R B,PL,R			
3					C3		100						B,UE,R B,UE,R			
4													B,UE,R B,C,R			
5					C4		100						R,C,R			
6					C5		100						B,UE,R B,PL,R B,UE,R B,C,SM			
7													B,PL,SM ST,R B,PL,R			VSP Installation (63.5mm Dia. PVC Pipe)
8					C6		100						B,PL,R B,UE,R,FE			
9					C7		100						B,UE,R B,UE,R B,UE,R			
10													B,UE,R			
11					C8		100						B,UE,R B,C,R			
12					C9		100						B,PL,SM B,PL,R			
13													B,PL,SM B			
14					C10		100									
15		CONTINUED NEXT PAGE														

DEPTH SCALE

1 : 75

LOGGED: J.C.

CHECKED: B.D.G.

Golder Associates

MIS-RCK 001 10-1121-0046.GPJ GAL-MISS.GDT 2/9/11 JN

PROJECT: 10-1121-0046

RECORD OF DRILLHOLE: 10-1

SHEET 2 OF 3

LOCATION: N 5032089.931, E 367462.446 (See Site Plan)

DRILLING DATE: July 2-3, 2010

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Marathon Drilling

FRFX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UN-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV / DEPTH (m)	RUN No	PENETRATION RATE (min/m)	FLUSH % CORE RETURN	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA: DIP to CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		— CONTINUED FROM PREVIOUS PAGE —														
15		Fresh thinly to medium bedded grey LIMESTONE BEDROCK, with thin shale interbedding														
16					C11		100						D,C,R			
17					C12		100						B,C,R B,PL,SM B,PL,SM			
18					C13		100						D,PL,R B,C,R B,PL,R			
19													J,UE,R,VE B,UE,R J,UE,R			
20					C14		110						B,C,SM B,UE,R B,UE,R B,UE,R B,C,R			
21					C15		110						B,C,SM B,PL,SM J,UE,R B,UE,R			
22	Rotary Drill															VSP Installation (63.5mm Dia. PVC Pipe)
23	HQ Core				C16		100						B,UE,SM			
24					C17		120						FR,BC,FE B,PL,R B,C,R			
25													B,C,R B,C,SM			
26					C18		100									
27					C19		100						D,PL,SM			
28													B,PL,SM			
29					C20		100						D,PL,SM			
30		CONTINUED NEXT PAGE														

DEPTH SCALE
1 : 75

LOGGED: J.C.
CHECKED: B.D.G.

Golder Associates

PROJECT: 10-1121-0046

RECORD OF DRILLHOLE: 10-1

LOCATION: N 5032089.931, E 367462.446 (See Site Plan)

INCLINATION: -90° AZIMUTH: —

DRILLING DATE: July 2-3, 2010

DRILL RIG: CME 75

DRILLING CONTRACTOR: Marathon Drilling

DATUM: Geodetic

FRFX-FRACTURE F-FAULT; CL-CLEAVAGE; J-JOINT; SH-SHEAR; P-POLISHED; VN-VEIN; S-SLICKENSIDED; SM-SMOOTH; R-ROUGH; ST-STEPPED; PL-PLANAR; FL-FLEXURED; UE-UNEVEN; W-WAVY; C-CURVED; BC-BROKEN CORE; MB-MECH BREAK; B-BEDDING

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH % CIRC. RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	RQD %	FRACT INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K_{sat} cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
30		-- CONTINUED FROM PREVIOUS PAGE --														
		Fresh thinly to medium bedded grey LIMESTONE BEDROCK, with thin shale interbedding			C20								JUR,R			
31					C21		100									
32					C22		100									
33	Rotary Drill															
34	HQ Core				C23		100						B,PL,R			VSP Installation (63.5mm Dia. PVC Pipe)
35																
36					C24		100						B,PL,R			
37					C25		100									
		End of Drillhole		38.66												
38		Note: Borehole and VSP casing grouted and abandoned on July 16, 2010.		37.50												
39																W.L. in open borehole at 18.30m depth below ground surface on July 3, 2010
40																
41																
42																
43																
44																
45																

MIS-ROK 001 10-1121-0046.GPJ GAL-MISS.GDT 2/9/11 JM

DEPTH SCALE
1 : 75

Golder Associates

LOGGED: J.C.

CHECKED: B.D.G.

TABLE 1

Probe Hole	Overburden Type	Depth Drilled	Refusal
92-10	70 mm asphalt, over 100 mm concrete, over brown sand fill.	0.5	Inferred Bedrock
92-13	125 mm asphalt, over 110 mm concrete, over brown sand fill.	1.0	Inferred Bedrock
92-16	100 mm asphalt, over 100 mm concrete, over > 200 mm of sand fill.	0.4	Not encountered due to drilling difficulties.
92-20	150 mm asphalt, over 100 mm concrete, over light brown sand fill.	1.8	_____
92-21	100 mm asphalt, over 50 mm concrete, over brown sand fill.	1.8	_____
92-22	80 mm asphalt, over 80 mm concrete, over brown sand fill.	1.8	_____

We trust the above information meets with your present requirements. Should further consultation be necessary please feel free to contact us.

We thank you for the opportunity to be of service to you.

Yours very truly,

JACQUES, WHITFORD LIMITED

J.G.A. Raymond Haché, M.Sc., P.Eng.

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TABLE 1 CONTINUED

Probe Holes	Overburden Type	Depth Drilled	Refusal
92-11	Loose, brown sand, some silt and gravel, trace bricks: FILL	0.9	Inferred Bedrock
92-12	Loose, brown sand and gravel, some silt: FILL	1.5	Inferred Boulders
92-13	No sample recovered: pavement over concrete	0.16	Inferred Concrete
92-14	Loose, brown sand, some silt and gravel: FILL	1.4	Inferred Bedrock
92-15	Loose, silty sand, trace gravel: FILL	1.8	------
92-16	No sample recovered: pavement over concrete	0.25	Inferred Concrete
92-17	Loose, dark brown sand, some silt, trace gravel: FILL	0.6	Inferred Concrete
92-18	No sample recovered: pavement over concrete	0.18	Inferred Concrete
92-19	180 mm of pavement overlying compact, brown sand, trace gravel: FILL	1.2	Inferred Concrete
92-20	No sample recovered: pavement over concrete	0.16	Inferred Concrete
92-21	No sample recovered: pavement over concrete	0.09	Inferred Concrete
92-22	No sample recovered: pavement over concrete	0.15	Inferred Concrete
92-23	30 mm of pavement overlying loose, brown sand, some silt, trace gravel: FILL	1.8	------
92-24	Loose, brown sand, some silt, trace gravel: FILL	1.8	------
92-25	Loose, dark brown sand, trace gravel: FILL	1.8	------
92-26	Loose, dark brown sand, some silt, trace gravel: FILL	0.75	Inferred Concrete

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1479 Laperriere Ave.
Ottawa 3, Ontario.

LOG OF DIAMOND DRILL HOLES

Date Dec., 1964.

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
V.H.1	286.3	284.6	1.7	0.9	Overburden
	284.6	253.0	31.6	29.4	Type 1A
	253.0	243.7	9.3	9.3	Type 1A with two 4" bands of Type 2
	243.7	235.0	8.7	8.7	Interbanded Types 1A, 2 & 3
V.H.2	284.5	271.0	13.5	0	Overburden
	271.0	253.9	17.1	17.3	Type 1A
	253.9	243.4	10.5	10.3	80% Type 1A interbanded with shale & Types 2 & 3
	243.4	233.0	10.4	10.3	50% Type 1A interbanded with shale & Types 1B & 3
	233.0	222.4	10.6	10.3	Interbanded shale & Types 1, 2, 3 & 4
V.H.3	293.0	283.7	9.3	0	Overburden
	283.7	250.3	33.4	31.0	Type 1A
	250.3	241.3	9.0	8.8	Type 1A & Minor Type 1
	241.3	235.6	5.7	5.3	Interbanded 50% Type 1A & 50% Type 1
	235.6	227.2	8.4	7.8	Type 1 with 13% Type 1B & 16% Type 1A

JOHN D. PATERSON & ASSOCIATES LTD.
CONSULTING ENGINEERS
1479 Laperriere Ave.
Ottawa 3, Ontario.

Dec., 1964.

LOG OF DIAMOND DRILL HOLES

Date Jan., 1965.

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
V.H.4	291.6	285.7	5.9	0	Overburden
	285.7	275.6	10.1	9.6	Type 1A with minor Type 2
	275.6	271.0	4.6	4.6	Type 1A with bands of Type 2 & 1B
	271.0	263.2	7.8	7.6	Type 1A with minor Type 2 & shale
	263.2	252.7	10.5	10.3	Type 1A with minor Type 2 & 1B
	252.7	242.1	10.6	10.2	Interbanded shale, Types 4, 1B & 1A
	242.1	231.5	10.6	9.2	Type 1A with Types 2, 1B, 1 & 3
	231.5	220.7	10.8	10.4	Type 4 with some shale & Type 3
V.H.5	287.1	283.3	3.8	0	Overburden
	283.3	272.3	11.0	3.9	Type 1A with voids and/or overburden
	272.3	255.7	16.6	15.2	Type 1A
	255.7	246.0	9.7	9.0	Interbanded Type 1A, 1B, 4 & some shale
	246.0	237.4	8.6	8.1	Type 1A some Type 4
	237.4	230.8	6.6	5.7	1' Type 1A remainder Type 4
	230.8	225.3	5.5	5.2	Interbanded Type 4 & shale, minor Type 1A

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LOG OF DIAMOND DRILL HOLES

Date Jan., 1965.

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
V.H.6	247.5	243.6	3.9	0	Overburden
	243.6	240.7	2.9	2.7	Type 1A
	240.7	239.3	1.4	1.3	Type 2
	239.3	237.6	1.7	1.6	Type 3 with shale seams
	237.6	234.3	3.4	3.1	Types 1A and 4
	234.3	231.3	3.0	2.8	Type 4 with shale
V.H.7	249.4	246.0	3.4	0.8	Overburdern
	246.0	240.8	5.2	4.4	Type 1A
	240.8	237.4	3.4	3.2	Type 4, some 1A
	237.4	235.8	1.6	1.6	Interbanded shale, Types 2 & 4
	235.8	234.4	1.4	1.4	Type 3A to Type 1A at bottom
	234.4	232.7	1.7	1.7	Interbanded shale & Type 4
	232.7	231.6	1.1	0.9	Type 4 & Type 1A
	231.6	229.2	2.4	2.1	Type 4 & odd shale seam
	229.2	225.8	3.4	3.5	Type 4
V.H.8	211.0	192.2	18.8	0	Overburden
	192.2	185.9	6.3	5.8	Type 4 & an odd shale seam
	185.9	184.8	1.1	0.4	Type 4

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LOG OF DIAMOND DRILL HOLES

Date Jan. & Feb./65.

CLIENT J. L. Richards & Associates Limited,

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
	Corrected To Vertical		On The Angle 45°		
AH 9	287.1	283.6	4.9		Overburden
	283.6	238.7	63.1	50.0	Type 1A with minor Type 1 at El. 276 & El. 252
	238.7	235.0	5.4	4.8	Type 1A & Type 1
	235.0	231.3	5.2	3.9	Type 1A & Type 3A
	231.3	221.9	13.4		Overburden
	Corrected To Vertical		On The Angle 59.5°		
AH 10	287.1	282.7	5.1	0	Overburden
	282.7	249.2	38.9	36.0	Type 1A
	249.2	244.5	5.5	3.5	Type 1A & 4
	244.5	231.2	15.5	15.3	Type 1A interbanded with thick shale bands
	231.2	226.6	5.3	5.2	Type 1A, 1, 3 & 4
	226.6	225.1	1.8	1.8	Type 1A & 3
	225.1	220.7	5.1	5.0	Type 3, 3A, and 4
	220.7	216.0	5.4	5.3	Type 3A with a 5" band of shale
	216.0	211.5	5.3	5.3	Type 3A & 4
	211.5	172.1	45.9	43.7	Type 3A with 1½", 3" & 5" bands of shale

JOHN D. PATERSON & ASSOCIATES LTD.
CONSULTING ENGINEERS
1479 Laperriere Ave.
Ottawa 3, Ontario.

Feb., 1965.

LOG OF DIAMOND DRILL HOLES

Date Nov., 1966.

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
	Corrected To Vertical		on the Angle 35°		
AH 11	291.6	290.3	2.3	0	Overburden
	290.3	289.3	1.8	1.2	Type 1
	289.3	277.0	21.3	18.2	Type 1A
	277.0	274.3	4.6	4.4	Type 1A & 1
	274.3	268.0	11.0	10.3	Type 1A & 1B
	268.0	264.0	6.9	5.5	Type 1A with 4" shale band
	264.0	234.7	51.3	51.0	Type 1 with interbanded 1A, 1B, 3 & 4
	234.7	228.3	11.1	10.6	Type 3 & Type 1A interbanded with shale
	228.3	221.9	11.3	10.4	Type 1 & Type 3 interbanded with shale
VH 12	217.5	192.5	25.0	0	Overburden (Forced to abandon hole)
	Corrected To Vertical		on the Angle 37.5°		
AH 13	291.6	289.9	0	2.8	Overburden
	289.9	275.2	24.1	19.4	Type 1A
	275.2	269.1	10.1	8.3	Type 1A interbanded with Type 4
	269.1	253.1	26.5	23.2	Type 1A
	253.1	251.1	3.3	3.0	Type 1
	251.1	249.4	2.8	2.5	Type 3
	249.4	239.6	16.2	13.6	Type 1A

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LOG OF DIAMOND DRILL HOLES

Date Nov. & Dec./66

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
	Corrected To Vertical		On The Angle 37.5°		
AH 13	239.6	237.8	2.9	2.8	Banded Type 1B, Type 1, shale & Type 1B
	237.8	235.0	4.7	4.1	Type 1A
	235.0	231.3	6.0	4.9	Type 1
	231.3	230.0	2.2	1.6	Type 3
	230.0	225.5	7.3	6.7	Type 1 with some shale in seams
	225.5	215.5	16.3	13.2	Type 1 with minor Type 1A
	Corrected To Vertical		on the Angle 26.5°		
AH 14	284.7	280.1	10.3		Overburden
	280.1	271.4	20.7	15.8	Type 1A
	271.4	270.8	1.3	1.3	Type 3 with shale bands up to 1" thick
	270.8	266.7	9.2	88.3	Type 1A
	266.7	265.4	2.9	2.9	Interbanded Types 3, 1 & 1A
	265.4	243.2	49.6	44.1	Type 1A with some Type 1
	243.2	230.5	28.6	22.6	Type 1A with interbanded Types 1 and 3
	230.5	215.3	35.8	27.1	Type 1 with minor Type 3
	Corrected To Vertical		on the Angle 30°		
AH 15	283.7	272.2	23.0	23.0	Overburden
	272.2	246.4	51.5	42.3	Type 1A with minor amounts of Type 1
	246.4	237.0	18.7	15.1	Interbanded Types 3, 1A, 1, 1B

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LOG OF DIAMOND DRILL HOLES

Date Dec., 1966.

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
	Corrected To Vertical		on the Angle 30°		
AH 16	284.2	274.2	20.0		Overburden
	274.2	254.1	39.9	36.1	Type 1A with minor Type 1
	254.1	250.8	6.7	6.3	Type 3
	250.8	242.3	23.8	22.9	Interbanded Types 1A & 1
	242.3	238.0	8.6	7.9	Interbanded shale & Types 1B, 1A & 1
	Corrected To Vertical		on the Angle 35°		
AH 17	286.3	284.0	4.0		Overburden
	284.0	244.0	69.9	58.2	Type 1A
	244.0	236.7	12.7	9.4	Interbanded Types 1A & 3
	236.7	235.0	3.1	2.3	Type 1A
	235.0	231.2	6.7		Overburden
VH 18	241.3	196.3	45.0		Overburden
	196.3	180.1	16.3	15.0	Type 3 with minor amounts of Type 1A

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1479 Laperriere Ave.
Ottawa 3, Ontario.

Dec., 1966.

LOG OF DIAMOND DRILL HOLES

Date Jan., 1967.

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
	Corrected To Vertical		On The Angle 40°		
AH 19	241.4	212.6	45.0		Overburden
	212.6	203.1	14.8	3.5	Type 1
	203.1	201.3	2.8	1.8	Type 1A with some Type 1B
	201.3	190.4	17.0	14.4	Type 3 with minor Type 1A
VH 20	243.4	202.4	41.0		Overburden
	202.4	190.7	11.7	7.8	Type 1 with an odd shale seam
	190.7	188.4	2.3	2.3	Type 3 with minor shale & some Type 1
	188.4	184.0	4.4	4.4	Type 3
	Corrected To Vertical		On The Angle 60°		
AH 21	213.7	194.4	22.3		Overburden
	194.4	191.9	2.8	2.0	Type 1A with 0.5' of Type 1
	191.9	179.3	14.5	12.7	Type 3 with Type 1A El. 189 - 187
	Corrected To Vertical		On The Angle 30°		
AH 22	214.5	187.0	54.9		Overburden
	187.0	183.5	7.2	5.2	Type 1
	183.5	180.3	6.1	5.9	Type 1 & Type 1A interbanded 1" shale layer
	180.3	177.5	5.7	5.0	Type 1A with some Type 1

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LOG OF DIAMOND DRILL HOLES

Date Mar.14-29/67

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
	Corrected To Vertical		On the Angle 50°		
AH 25	247.2	196.3	66.3	-	Overburden
	196.3	185.0	13.9	13.4	50% Type 1A interbanded with Type 1 and minor Type 4. 1-inch shale seams at el. 193 and el. 190
	Corrected To Vertical		On the Angle 55.5°		
AH 26	245.4	214.4	37.7	-	Overburden
	214.4	209.4	6.1	5.3	45% Type 1A interbanded with 55% Type 1
	209.4	205.0	5.3	4.8	0-0.4 Shale 0.4-0.8 Type 1
					0.8-1.0 Shale 1.0-4.8 Interbanded Types 1A, 1, 3 & 4
	Corrected To Vertical		On the Angle 67.5°		
AH 27	246.2	200.5	49.5	-	Overburden
	200.5	195.1	5.8	5.3	0-0.3 Type 1A 0.3-0.5 Shale
					0.5-1.1 Type 1A 1.1-1.3 Shale
					1.3-5.3 Interbanded Types 1 and 1A
	195.1	189.8	5.7	5.33	Type 3 (similar to Type 1A)

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Ottawa 3, Ontario.

Mar.31, 1967.
Date Apr.13, 1967.

LOG OF DIAMOND DRILL HOLES

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
VH 28	247.6	236.8	10.8	-	Overburden
	236.8	225.9	10.9	9.4	Type 1 with 1"shale seam at el. 230
	225.9	221.1	4.8	3.3	Interbanded Types 1, 4 & 1A with a thin shale seam at el. 226
	221.1	216.7	4.4	4.5	50% Type 1 interbanded with 50% Type 1A
	Corrected To Vertical		On the Angle 44.5°		
AH 29	247.5	190.4	81	-	Overburden
	190.4	184.0	9.2	8.2	65% Type 1A interbanded with Type 1 with shale seams at el. 187.5 & El. 186
	Corrected to Vertical		On the Angle 63°		
AH 30	242.0	194.5	53.3	-	Overburden
	194.5	188.3	7.0	4.6	Type 1A weathered & severely broken
	188.3	183.4	5.5	4.6	0-2.5 Type 1A 2.5-4.6 Type 4
	183.4	180.0	3.9	3.4	Type 1A interbanded with Type 4
VH 31	291.6	287.1	4.5	-	0-4.0 Overburden 4.0-4.5 Weathered limestone
	287.1	281.7	5.4	5.0	Type 1A
	281.7	275.3	6.4	5.3	Type 1A interbanded with Type 4
	275.3	270.4	4.9	4.8	" " " " " "

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LOG OF DIAMOND DRILL HOLES

Date Apr.14-19/67

CLIENT J. L. Richards & Associates Limited

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ontario.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
VH 32	226.3	208.3	18	-	Overburden (Miscellaneous Fill)
	208.3	166.3	42	-	Overburden (Glacial Till)
	166.3	161.3	5	-	Boulders
	161.3	159.3	2	1.9	Type 1
	159.3	153.7	5.6	5.3	Interbanded Types 3 and 1A
	153.7	148.0	5.7	5.0	Interbanded Types 3 and 1A with some Type 1
VH 33	212.5	197.5	15	-	Miscellaneous granular fill
	197.5	183.5	15	-	Miscellaneous granular fill including construction materials
	182.5	178.6	3.9	-	Boulders
	178.6	171.0	7.6	7.0	Type 1A
	171.0	165.5	5.5	5.5	75% Type 1A interbedded with Type 4
					Total 562.8 feet

Ottawa 3, Ontario.

LOG OF DIAMOND DRILL HOLES

Date Jan.17 & 20/67

Sheet No. 1 of 1

CLIENT J. L. Richards and Associates Ltd.

JOB Parliament Hill Parking Facility

LOCATION Parliament Hill, Ottawa.

Hole No.	From El.	To El.	Feet Drilled	Feet Recovered	Description
VH23	218.6	216.6	2		Miscellaneous granular fill, including rubble, stones, clay & a few roots.
	216.6	207.6	9		Very loose to loose, saturated, brown sandy/gravelly glacial till with traces of roots to 7'.
	207.6	198.6	9		Medium dense brown gravelly/sandy glacial till.
	198.6	196.1	2.5		Medium dense gravelly till (possibly talus) mixed with marl.
	196.1	-			Refusal.
					NOTE: Samples of the various soils recovered by split spoon sampler.

JOHN D. PATERSON & ASSOCIATES LTD.

Consulting Engineers & Geologists

1479 Laperriere Ave. Ottawa 3, Canada

SOIL PROFILE AND TEST DATA

Parliament Hill Parking Facility

Parliament Hill, Ottawa

Datum B.M. El. 252.54 Top & end of concrete wall on Lovers' Walk - east of Refrigeration Plant.

Remarks Test Boring Hole.

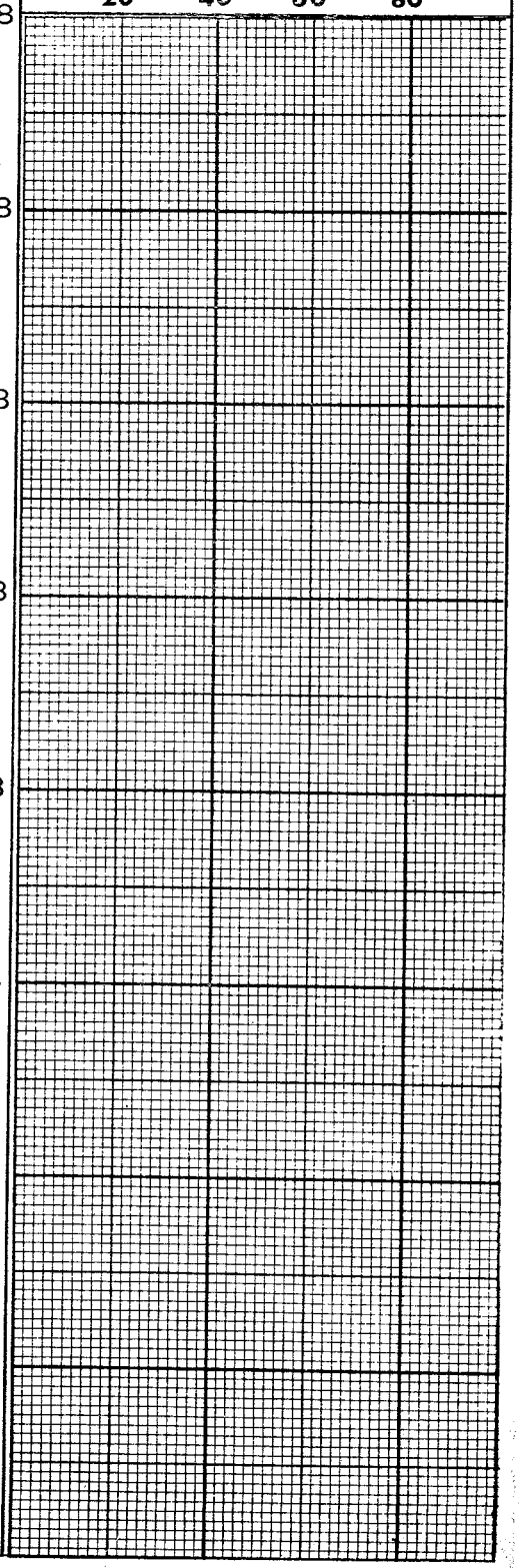
Borings By J.B. Dufresne & Co. Ltd. **Date** Mar. 10 & 13, 1967.

Sheet No 1 of 4

Hole No VH 24

SOIL DESCRIPTION	SAMPLE Type	SAMPLE No.	q_u TONS psf	N	DEPTH FEET	ELEV
Ground Surface					0	214.8
Miscellaneous Fill (Sand with some gravel. Includes some fragments of building materials, bricks, etc.)	SS	1		11	3	
					6	208.8
	SS	2		9	9	
					12	202.8
17					15	
	SS	3		8	18	196.8
Miscellaneous Fill. (Gravel with boulders)	SS	4		8 For 3"	21	
					24	190.8
30.0					27	
Bedrock					30	184.8
Type 1A interbanded with 18% Type 3.	Core 90% Recovery				33	
					36	178.8
42.1					39	
					42	172.8
					45	169.8

Penetration Resistance Blows/Ft.
o—o 2 Inch Diameter Cone
⊢o⊣ MOISTURE CONTENT IN %
20 40 60 80



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1479 Laperriere Ave.
Ottawa Canada

SOIL PROFILE AND LABORATORY TESTS

LOCATION: Parliament Hill Parking Facility Ottawa

Elevation (Zero Depth): Top of hydrant No. 24 El. 288.74

Remarks: Test boring hole of overburden only

Sheet No: 1 of 1

Hole No: VH 23

Borings By: J.B. Dufresne & Co. Date: Jan. 17 & 20/67

Blows per Foot	Soil Description	Sample Type	Sample No	Qu Tons/sq.ft.	N	Depth in Feet	Elev.	Moisture Content Per Cent. 30 40 50 60 70
	Ground Surface					0	218.6	
	Miscellaneous granular fill, including rubble, stones & clay. A few roots. 2					2		
	Very loose to loose, saturated, brown sandy/gravelly glacial till with traces of roots to 7'.	SS	1		4	4	214.6	
		SS	2		2	6		
		SS	3		7	8	210.6	
		SS	4		9	10		
	11	SS	5		11	12	206.6	
	Medium dense brown gravelly/sandy glacial till.					14		
		SS	6	boulder		16	202.6	
		SS	7		16	18		
	20					20	198.6	
	Medium dense gravelly till (possibly talus) mixed with marl.	SS	8		25	22		
	22.5	SS	9		28			
	Refusal.					24	194.6	

JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
North Perimeter Wall, Parliament Hill
Ottawa, Ontario

DATUM Approximate Geodetic

FILE NO. G8707

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger DATE 18 OCT 02

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.28
Asphaltic concrete 0.05							
FILL: Brown silty fine sand and gravel, some organic matter, occasional cobbles and boulders		SS	1		10	1	85.28
1.73		SS	2		50+		
TUNNEL ROOF: Cemented limestone, sandstone and brick blocks		RC	1			2	84.28
2.21		RC	2				
End of Borehole							
(BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

PIEZOMETER CONSTRUCTION

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

Geotechnical Investigation
North Perimeter Wall, Parliament Hill
Ottawa, Ontario

DATUM Approximate Geodetic
FILE NO. G870
REMARKS
HOLE NO. BH 2
BORINGS BY CME 55 Power Auger DATE 18 OCT 02

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	86.54		
Asphaltic concrete 0.05									
FILL: Brown silty sand and gravel, occasional cobbles and boulders		SS	3		50+	1	85.54		
1.22									
End of Borehole									
Practical refusal to augering @ 1.22m depth									
(BH dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
North Perimeter Wall, Parliament Hill
Ottawa, Ontario

DATUM Approximate Geodetic

FILE NO. G8707

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger DATE 18 OCT 02

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	85.82
Asphaltic concrete 0.08							
FILL: Brown silty fine to medium sand, some gravel, occasional cobbles and boulders		SS	4		4	1	84.82
		SS	5		12	2	83.82
2.74		SS	6	42	25		
Compact, brown SILTY **SAND/SANDY SILT**, some gravel, occasional cobbles and boulders		SS	7		66+	3	82.82
3.76							
End of Borehole							
Practical refusal to augering @ 3.76m depth							
(BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

PIEZOMETER CONSTRUCTION

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

Geotechnical Investigation
North Perimeter Wall, Parliament Hill
Ottawa, Ontario

DATUM Approximate Geodetic
FILE NO. G87(
REMARKS
HOLE NO. BH 4
BORINGS BY CME 55 Power Auger
DATE 18 OCT 02

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.46
Asphaltic concrete 0.08							
FILL: Brown silty fine sand with gravel, occasional cobbles and boulders		SS	8		9	1	85.46
		SS	9		18	2	84.46
		SS	10		16	3	83.46
3.76							
End of Borehole							
Practical refusal to augering @ 3.76m depth							
(BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

PIEZOMETER CONSTRUCTION

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2, & 3 BOREHOLE NO. 0-16 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 20, 1980 DATE OF WL READING April 1980 DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY %	N VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp W Wl
	47.0	Ground Level									DYNAMIL PENETRATION TEST BLOWS PER FOOT....K..... 0 20 40 60 80
0		Asphalt concrete 0.15 m				AS	1	-	-		
		Compact to very loose to loose silty sand, sandy silt, and clayey silt fill with gravel, cobbles some cinders. Possible boulders				2" DO	2	60	11		
2						2" DO	3	30	13		
4						2" DO	4	25	3		
6						2" DO	5	50	7	G_s = 2.6 S	
8						2" DO	6	80	6	G_s = 2.8 S	
						2" DO	7	100	29		
10	9.3 / 37.7	Compact grey sandy silt and gravel till				2" DO	8		11	G_s = 2.8 S	
12	11.5 / 35.5	Grey horizontally bedded limestone bedrock several shaley zones				NX RC	9	100	-		
14	13.5 / 33.5	End of borehole									

WL EL. 42.2 April 21, 1980

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO. 0-26 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 20, 1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N. VALUE		WATER CONTENT & ATTERBERG LIMITS. WP W WL
0	47.0	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT. ..K 0 20 40 60 80
		Grey and brown silty sand and gravel fill with wood and brick fragments.									
2											
4											
6											
8	38.0										
	9.0	End of borehole Auger Refusal Probably bedrock									
10											

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada- Reconstruction of Ottawa locks No. 1,2,&3

BOREHOLE NO. 0-36 W

LOCATION Rideau Canal, Ottawa

CASING Auger

DATE OF BORING March 17,1980 DATE OF WL READING

DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp — W — WL
0	47.0	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT ...K 0 20 40 60 80
		Dense dark grey and brown silty sand and gravel fill with wood and brick fragments.				AS	1	-	-		
2						2" DO	2	50	41		
						2" DO	3	80	52		
	43.6					NX RC	4	20	-		
4	3.4	Grey horizontally bedded fractured lime stone bedrock 10-75mm mudseams throughout.				NX RC	5	40	-		
	40.9										
6	6.1	Void				NX RC	6	10	-		
8	38.6	Probably sewer tunnel									
	8.4	End of borehole									
10											

CANADA BEDFORD PARK FORM

OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,& 3 BOREHOLE NO. 0-46 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 17,1980 DATE OF WL READING April 1980 DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY %	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp — W — WL
0	47.8	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
		Loose dark grey silty sand, silty clay, wood brick, and gravel fill.				AS 2"	1	-	-		
2	44.7					DO	2	67	9	S	
	3.1	Grey horizontally bedded shaley lime-				NX RC	3	73	-		
4	42.7	stone bedrock, fractured in top meter.				NX RC	4	96	-		
	5.1	End of borehole									
6											

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,& 3
LOCATION Rideau Canal, Ottawa
BOREHOLE NO. 20-16 W
CASING Auger
DATE OF BORING March 14,1980 DATE OF WL READING April 1980 DATUM Geodetic

DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	SAMPLES: CONDITION	TYPE	NUMBER	RECOVERY	N VALUE	LABORATORY TESTS PERFORMED
0	47.2	Ground Level								
		Topsoil & roots 0.25m				AS	1	–	–	
		Loose grey and brown silty clayey sand and silty sand fill, some gravel. Possible boulders			2" DO	2	17		4	
4				▼	2" DO	3	33		10	
					2" DO	4	13		10	
6					2" DO	5	100		1	
					2" DO	6	75		7	γ_d = 22.2 kN/m³ S
8	38.7									
	8.5	Compact grey sandy silt till with boulders.								
10	36.0				2" DO	7	75		29	
	11.2	End of borehole Auger Refusal Probably bedrock								
12										

LAB TEST RESULTS

WATER CONTENT & ATTERBERG LIMITS. WP W WL

DYNAMIC PENETRATION TEST BLOWS PER FOOT....K .....
0 20 40 60 80

OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3

BOREHOLE NO. 20-26 W

LOCATION Rideau Canal, Ottawa

CASING Auger

DATE OF BORING March 20, 1980 DATE OF WL READING

DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N VALUE		WATER CONTENT & ATTERBERG LIMITS. WP — W — WL
0	47.0	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
0		Grey and brown silty sand and gravel fill with brick and limestone fragments mica flakes encountered between 3 and 4 m. depth.									
2											
4	42.0										
	5.0	Grey silty sand and gravel till.									
6											
	39.2										
8	7.8	End of borehole Auger Refusal Probably bedrock									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO. 20-36 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 18, 1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N VALUE		WATER CONTENT & ATTERBERG LIMITS. WP — W — WL
0	47.5	Ground Level						%			DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
		Asphalt concrete 0.15m									
		Gravel fill 0.4 m				AS	1	-	-		
		Compact brown silty sand and gravel, grey clayey silt and gravel				2" DO	2	50	13		
2	45.1 2.4	fill									
		Compact grey silty clayey sand till				2" DO	3	63	10		
4	42.0 5.5	Grey horizontally bedded limestone bedrock, shaley zones 1" mud-seams in upper 1 m				NX RC	4	89	-		
6	40.0 7.5	End of borehole									
8											

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa Locks No. 1,2,&3 BOREHOLE NO. 40-16 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 21, 1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N. VALUE		WATER CONTENT & ATTERBERG LIMITS. WP W WL
0	47.5	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT. N. 0 20 40 60 80
		Grey and brown silty sand and gravel fill several clay lumps, Possible boulders									
10	38.5 9.0	Grey silty sand and gravel till possible boulders									
	36.5 11.0	End of borehole Auger Refusal Probably bedrock									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada- Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO 40-26 W

LOCATION ~~Rideau Canal, Ottawa~~ CASING Auger

DATE OF BORING ~~March 19, 1980~~ DATE OF WL READING DATUM Geodetic

DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	SAMPLES: CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE	LABORATORY TESTS PERFORMED	LAB TEST RESULTS
	47.5	Ground Level									WATER CONTENT & ATTERBERG LIMITS. Wp W WL
0		Topsoil & roots 0.2 m Dark grey silty sand and gravel fill, some brick fragments.									DYNAMIC PENETRATION TEST BLOWS PER FOOT...N..... 0 20 40 60 80
2											
4											
6	41.0										
	6.5	Grey silty sand and gravel till									
	40.0										
8	7.5	End of borehole Auger Refusal Probably bedrock									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3

BOREHOLE NO. 40-36 W

LOCATION Rideau Canal, Ottawa

CASING Auger

DATE OF BORING ~~March 18, 1980~~ DATE OF WL READING

DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp — W — WL
0	48.0	Ground Level						%			DYNAMIC PENETRATION TEST BLOWS PER FOOT....K..... 0 20 40 60 80
	0.1	Asphalt concrete									
2		Compact grey silty sand and gravel till with wood, brick and boulders				AS	1	-	-		
						2" OD	2	00	18		
	44.5					AS	3	-	-		
4	3.5	Fractured, grey horizontally bedded limestone bedrock several 1" to 2" mudseams in upper 1 m.				NX RC	4	70	-		
	42.5										
6	5.5	End of borehole									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. 80-312

CLIENT Parks Canada- Reconstruction of Ottawa locks No. 1,2, &3 BOREHOLE NO. 80-26 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 19, 1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N VALUE		WATER CONTENT & ATTERBERG LIMITS. WP — W — WL
	49.0	Ground Level						%			DYNAMIC PENETRATION TEST BLOWS PER FOOT....N..... 0 20 40 60 80
0		Topsoil & roots 0.2 m.									
		Compact grey silty sand and sandy silt fill with cobbles and/or boulders				AS	1	-	-		
2						2" DO	2	25	10		
						2" DO	3	33	22		
	45.0										
4	4.0	Fractured shaley limestone probably boulders.				NX RC	4	17	-		
	42.8										
6	6.2	End of borehole									
8											

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO. 60-36 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING ~~March 20, 1980~~ DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. WP — W — WL
0	50.0	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
2		Grey silty sand and gravel fill with brick, wood, and lime-stone fragments.									
4	44.5										
6	5.5	End of borehole Auger Refusal Probably bedrock									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO. 80-26 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 21,1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. WP W WL
0	52.0	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
2		Grey and brown silty sand and gravel fill.									
4	48.0 5.0	Grey silty sand and gravel till possible boulders.									
6	44.5										
8	7.5	End of borehole Auger Refusal Probably boulders									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1.2.&3 BOREHOLE NO. 80-36 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 25, 1980 DATE OF WL READING April 1980 DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp — W — Wl.
0	52.3	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT ... R ... 0 20 40 60 80
		Asphalt concrete 0.15 m				AS	1	-	-		
2		Compact brown and grey silty sand and gravel fill				2" OD	2	25	17		
	49.2										
4	3.1	Dense grey silty and gravel till with boulders and cobbles				2" OD	3	50	36	S	
						2" OD	4	75	39	S	
6						NX RC	5	12	-		
8											
	43.1										
10	9.2	Grey horizontally bedded limestone bedrock, fractured in 10 m.				NX RC	6	87	-		
	41.1										
12	11.2	End of borehole									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO. 100- 36 W

LOCATION Rideau Canal, Ottawa CASING Auger

DATE OF BORING March 24, 1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE				SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N. VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp W WL
	55.5	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
0		Grey and brown silty sand and gravel fill.									
	54.0										
	1.5										
2	53.5	Void									
	4.5	Grey and brown silty sand and gravel till.									
4	51.0										
	4.5	End of borehole Auger Refusal Probably boulders									
6											

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada- Reconstrcution of Ottawa locks No. 1,2,&3 BOREHOLE NO. 100-46W

LOCATION Rideau Canal, Ottawa CASING AX

DATE OF BORING April 18,1980 DATE OF WL READING DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. WP W WL
0	59.0	Ground level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K..... 0 20 40 60 80
		Dark grey silty top-soil fill with lime-stone and brick frag-ments, root inclusions, cobbles, possible boulders.				1.5" DO	1	2"	-		
2						1.5" DO	2	1"	-		
	55.8										
	3.2	Grey horizontally bedded limestone bedrock, fractured in top meter.				EX RC	3	70			
4	54.0										
	5.0	End of borehole									
6											

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada

LOCATION Rideau Canal, Ottawa

BOREHOLE NO. 100-56W

CASING AX

DATE OF BORING April 18, 1980 DATE OF WL READING

DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N. VALUE		WATER CONTENT & ATTERBERG LIMITS. Wp W Wl.
								%			DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
0	69.1	Ground level									
		Dark grey silty top-soil fill with lime-stone and brick frag-ments, several cob-bles, possible boul-ders				L.S DO	1	33	-		
2						L.S DO	2	80	-		
	65.2										
4	3.9	Grey horizontally bed-ded limestone bedrock several shaley zones.				EX	3	50	-		
						EX RC	4	90	-		
	63.1										
6	6.0	End of borehole									

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OFFICE BOREHOLE RECORD

APPENDIX

CLIENT Parks Canada- Reconstruction of Ottawa locks No. 1,2,&3
LOCATION Rideau Canal, Ottawa
DATE OF BORING April 22,1980 DATE OF WL READING

PROJECT NO. S-80-312
BOREHOLE NO. 120-46 W
CASING EX
DATUM Geodetic

SOIL PROFILE					SAMPLES					LABORATORY TESTS PERFORMED	LAB TEST RESULTS
DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE		WATER CONTENT & ATTERBERG LIMITS. WP W WL
0	59.5	Ground Level									DYNAMIC PENETRATION TEST BLOWS PER FOOT....K 0 20 40 60 80
		Dark grey silty top-soil fill with lime-stone and brick frag-				15" DO	1	50	-		
2	57.9 1.6	ments root inclu-sions, cobbles				EX RC	2	67			
	56.5 3.0	Grey horizontally bedded limestone bedrock									
4		End of borehole									

OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 BOREHOLE NO. 120-56 W

LOCATION Rideau Canal, Ottawa CASING AX

DATE OF BORING April 21, 1980 DATE OF WL READING DATUM ~~Geodetic~~

DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	SAMPLES: CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE	LABORATORY TESTS PERFORMED	LAB TEST RESULTS: WATER CONTENT & ATTERBERG LIMITS. WP W WL
	67.9	Ground Level						%			DYNAMIC PENETRATION TEST BLOWS PER FOOT... 0 20 40 60 80
0		Dark grey silty top-soil fill with lime-stone fragments, possible boulders				15" DO	1	40	-		
2	65.2										
	2.7	Grey horizontally bed-ded limestone bedrock				EX RC	2	55	-		
4	63.9										
	4.0	End of borehole									

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OFFICE BOREHOLE RECORD

APPENDIX

PROJECT NO. S-80-312

CLIENT Parks Canada - Reconstruction of Ottawa locks No. 1,2,&3 — BOREHOLE NO. 140-56 W

LOCATION Rideau Canal, Ottawa — CASING AX

DATE OF BORING April 21, 1980 — DATE OF WL READING — DATUM Geodetic

DEPTH	ELEVATION / DEPTH	SOIL DESCRIPTION	STRAT. PLOT	WATER CONDITIONS	SAMPLES: CONDITION	TYPE	NUMBER	RECOVERY	N-VALUE	LABORATORY TESTS PERFORMED	LAB TEST RESULTS: WATER CONTENT & ATTERBERG LIMITS (WP, W, WL)
								%			DYNAMIC PENETRATION TEST BLOWS PER FOOT ... 0 20 40 60 80
0	70.8	Ground Level									
		Dark grey silty top-soil fill with roots, limestone, and brick fragments, some cobbles. Possible boulders				1.5" DO	1	25	-		
2						1.5" DO	2	39	-		
						1.5" DO	3	50	-		
	66.9										
4	3.9	Horizontally bedded grey limestone bedrock 1 cm mudseam @ 4.4 m fractured				RX RC	4	75	-		
	65.0					EX RC	5	35	-		
	5.8	End of borehole									

CANADA BLUE PRINT CO. LTD. FORM - 103

McROSTIE SETO GENEST

& ASSOCIATES LTD. & ASSOCIÉS LTÉE

CONSULTING ENGINEERS – INGÉNIEURS CONSEILS

OTTAWA CANADA

SOIL PROFILE & TEST SUMMARIES

PROFIL SOUTERRAIN ET RÉSUMÉ DES ESSAIS

CONFEDERATION SQUARE
EAST BANK COLLECTOR SEWER

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 146·3' DATE JULY 11, 1968
NIVEAU DU SOL (PROFONDEUR ZERO)

NOTES

HOLE FORAGE No. 201

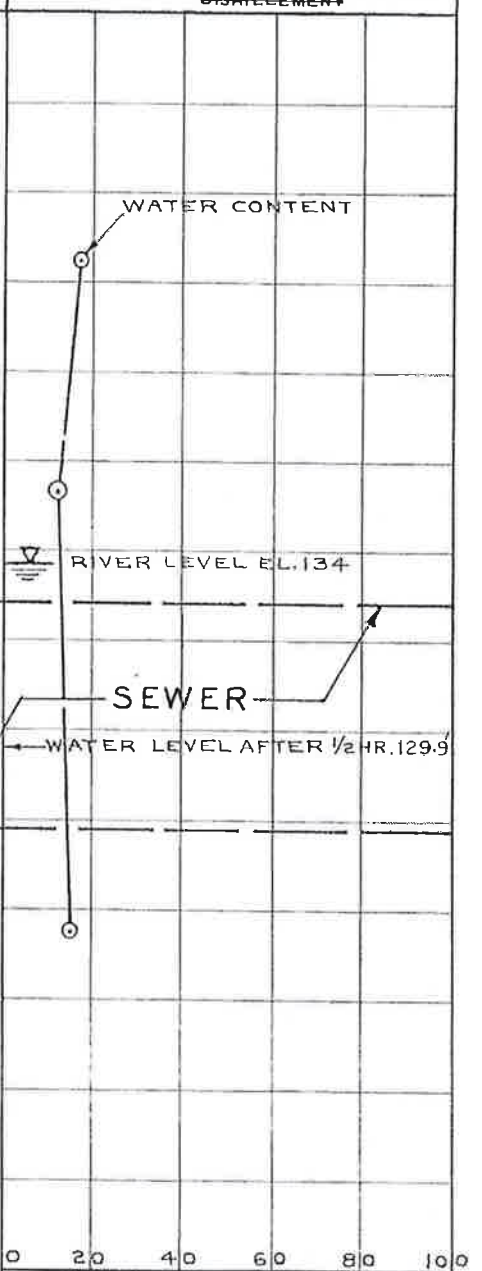
Compressive Strength K.S.F. Résistance à la Compression K/Pd.2	Small Scale Penetrometer K.S.F. Petit Pénétromètre K/Pd.2	Essai-Standard Penetration Blows/ft. Coups/pd	Sample No. Echantillon	DESCRIPTION OF SOIL DU SOL	Depth in Feet Profondeur-Pied	Elevation Niveau
				Ground Surface – Niveau du Sol	0'	146·3'
		24	201-1			
					10'	136·3'
		20	201-2	FILL - BROKEN ROCK WITH SOME SAND & A LITTLE CLAY		
		21	201-3			
		15	201-4		20'	126·3'
				BOTTOM OF HOLE	25'	121·3'

~~PROBING OR VANE TEST~~ ~~SONDAGE OU ESSAI AU MOULINET~~

MARTEAU----HAMMER
CHUTE LIBRE---DROP

NO CASING SANS TUBAGE
BARRE-----DIA. ROD

~~BLOWS/FOOT OR SHEAR STRENGTH K.S.F.~~ ~~COUPS/PIED OU RÉSISTANCE AU CISAILLEMENT K/PD.2~~



WATER CONTENT
%TENEUR EN EAU
NATURAL NATURELLE ⊙
LIQUID LIMIT LIMITE DE LIQUIDITÉ □
PLASTIC LIMIT LIMITE DE PLASTICITÉ △

PLATE PLAQUE No. 2

R = REMOULDED-REMANIE
CR = CORE RECOVERY CAROTTE RECUPEREE

WEST BLOCK RENOVATIONS, PARLIAMENT HILL	B.M.(ELEV 82.78m)geodetic: Top of	BOREHOLE NO: 98-17
	manhole cover at courtyard entrance	PROJECT NO: E-7649A
START DATE: 98/08/10	supplied by PWGSC.	ELEVATION: 84.99 m

SAMPLE TYPE: REMOULDED-AUGER | SHELBY TUBE | SPLIT-SPOON | NW-CASING | NO RECOVERY | NQ CORE

DEPTH(m)	COMMENTS..SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	ROD %	SOIL / ROCK DESCRIPTION	ELEVATION(m)
0.0	12 20/7cm split barrel refusal- power auger refusal-		1			TOPSOIL FILL 84.69 sand with pieces of broken rock, traces of topsoil and brick 84.19 LIMESTONE ---see Core Descriptions C.R.=100%	
1.0				100	82		84.0
2.0						Bottom of hole 83.13	83.0
3.0							82.0
4.0							81.0
5.0							80.0
6.0							79.0
7.0							78.0
8.0							77.0

VANE Cu (kPa) 80 160 240 320
VANE Cu REMOULDED (kPa) 80 160 240 320
PLASTIC M.C. LIQUID
20 40 60 80

McROSTIE GENEST ST-LOUIS
Ottawa, Canada

LOGGED BY: JML
REVIEWED BY: E.S.
Fig. No: 17

COMPLETION DEPTH: 1.86 m
COMPLETE: 98/08/10

98/08/25 10:32AM (NQ-ROD)

WEST BLOCK RENOVATIONS, PARLIAMENT HILL	B.M.(ELEV 82.78m)geodetic: Top of	BOREHOLE NO: 98-18
	manhole cover at courtyard entrance	PROJECT NO: E-7649A
START DATE: 98/08/10	supplied by PWGSC.	ELEVATION: 85.39 m

SAMPLE TYPE ■ REMOULDED-AUGER ⁄ SHELBY TUBE ☒ SPLIT-SPOON ▤ NW-CASING ▯ NO RECOVERY ▮ NQ CORE

DEPTH(m)	COMMENTS..SPT (N)	SAMPLE TYPE	SAMPLE NO	% CORE RECOVERY	RQD %	SOIL / ROCK DESCRIPTION	ELEVATION(m)
0.0						TOPSOIL	
	14	☒	1			FILL 85.09	85.0
	split barrel refusal					sand with some pieces of broken rock	
	power auger refusal-					traces of brick and topsoil	
1.0				100	100	LIMESTONE 84.73	
						--see Core Descriptions	
						C.R.=100%	
						84.06	84.0
						LIMESTONE	
2.0				97	58	--see Core Descriptions	
						C.R.=97%	
							83.0
3.0						82.56	
	3cm drop-					LIMESTONE	
	50% water lost			91	72	--see Core Descriptions	82.0
						C.R.=91%	
4.0							
						81.06	81.0
	25% water returning-					LIMESTONE	
5.0	all water lost			100	11	--see Core Descriptions	
						C.R.=100%	80.0
6.0				100	84	LIMESTONE 79.56	
						--see Core Descriptions	
						C.R.=100%	
						Bottom of hole 79.18	79.0
7.0							78.0
8.0							

VANE Cu (kPa) ■ 80 160 240 320
▲ VANE Cu REMOULDED (kPa) ▲ 80 160 240 320
PLASTIC M.C. LIQUID
20 40 60 80

McROSTIE GENEST ST-LOUIS	LOGGED BY: JML	COMPLETION DEPTH: 6.21 m
Ottawa, Canada	REVIEWED BY: E.S.	COMPLETE: 98/08/10
	Fig. No: 18	Page 1 of 1

98/08/25 10:32AM (NQ-ROD)

TABLE I: BOREHOLE INFORMATION

Borehole No.	PW-1	PW-2	PW-3	PW-4	PW-5	PW-6
Date of installation						
April 1984	09-13	23-25	16-19		26-	
May 1984	16-18			10-15	2	3-9
Ground surface elevation m	87.66	72.63	73.87	75.50	75.30	73.74
Elevation of top of inclinometer casing m	88.66	73.24	74.21	75.96	76.02	73.96
Thickness of overburden m	1.92	1.93	0.80	0.96	1.02	12.52
Elevation of borehole bottom m	27.08	32.48	33.64	35.28	22.98	35.41
Total length of borehole m	60.58	40.15	40.23	40.22	52.32	38.33
Orientation of A+ direction	N25°W	N27°E	N21°E	N15°E	N43°W	N108°W

TABLE II: INITIAL BOREHOLE DEVIATION FROM THE VERTICAL, mm

Borehole No.	PW-1	PW-2	PW-3	PW-4	PW-5	PW-6
Max. deviation in A direction, b	-309.0	-301.9	230.1	317.3	-191.6	817.6
Max. deviation in B direction, c	-125.0	-319.20	-174.9	369.3	715.0	523.6
Max. resultant deviation, d	333.3	439.4	289.0	486.9	740.2	970.9
Max. inclination, in degrees, e	0.31	0.63	0.41	0.69	0.81	1.45

$d^2 = \sqrt{b^2 + c^2}$; $e = \sin^{-1}$ [d/length of borehole]

TABLE III: ESTIMATED ACCURACY OF MEASURED HORIZONTAL MOVEMENTS

Borehole No.	Accuracy, mm
PW-1	±1.6
PW-2	±2.1
PW-3	±1.4
PW-4	±2.3
PW-5	±3.5
PW-6	±4.6

Stantec

BOREHOLE RECORD

BH 14-9

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH 14-9

LOCATION East Block, Parliament Hill, Ottawa, ON — PROJECT No. 122410970

DATES: BORING February 18, 2014 — WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**84.66**							
	84.4	250 mm TOPSOIL						
		FILL: dark brown to brown silty sand with gravel			BS	1	-	-
1					BS	2	-	-
		- moist below 1.5 m						
2					BS	3	-	-
3								
	80.7							
4		End of Borehole						
		Auger Refusal on Inferred Bedrock						
5								
6								
7								
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa App'd

△ Pocket Penetrometer Test, kPa Date

STN13-STAN-GEO 122410970 - PARLIAMENT HILL EAST BLOCK REHABILITATION.GPJ SMART.GDT 7/21/14

Stantec

BOREHOLE RECORD

BH 14-10

CLIENT Public Works and Government Services Canada — BOREHOLE No. BH 14-10

LOCATION East Block, Parliament Hill, Ottawa, ON — PROJECT No. 122410970

DATES: BORING February 22, 2014 — WATER LEVEL — DATUM Geodetic

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**84.66**							
	84.6	100 mm ASPHALT						
		FILL: loose to compact brown poorly graded sand			BS	1	-	-
1					SS	2	460	11
	83.3	FILL: loose greyish brown silty sand with some gravel			SS	3	380	7
2	82.6	FILL: very loose golden brown poorly graded sand			SS	4	460	4
3					SS	5	280	0
	80.9	Limestone BEDROCK (Verulam Formation) - fair to good rock quality - light grey colour - fresh/ unweathered - very close to moderate joint spacing (Refer to Field Bedrock Core Log)			NQ	6	99%	67%
4								
5					NQ	7	100%	64%
6								
7					NQ	8	100%	88%
8					NQ	9	100%	89%
	76.3	End of Borehole						
9								
10								

UNDRAINED SHEAR STRENGTH - kPa
50 100 150 200
WATER CONTENT & ATTERBERG LIMITS W_P W W_L
DYNAMIC PENETRATION TEST, BLOWS/0.3m
STANDARD PENETRATION TEST, BLOWS/0.3m
10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd _____
Date _____

STN13-STAN-GEO 122410970 - PARLIAMENT HILL EAST BLOCK REHABILITATION.GPJ SMART.GDT 7/21/14

TT FORM 1812

Terratech LTD
Montreal Que

SHEET 1 OF 2

OFFICE RECORD OF EXPLORATION

PROJECT Service Tunnel, Centre Block By-Pass, Ottawa (S-296-65)
LOCATION Parliament Hill, Ottawa, Ont.
ELEVATION DATUM Geodetic CASING SIZE BX
SAMPLER HAMMER WEIGHT _____ LBS DROP _____ INCHES

HOLE Nº 01
HOLE DATE 12-14/10/65
REPORT DATE Dec. 1965
COMPILED BY J.S.
CHECKED BY P.L.

TESTS
WL : WATER LEVEL
N : STANDARD PENETRATION VALUE (BLOWS / FOOT)
K : PERMEABILITY (CM/SEC)
V : IN-SITU VANE TEST (LBS/SQ. FT.)

SAMPLE TYPES
AS : AUGER SAMPLE
SS : SPLIT SPOON
ST : SHELBY TUBE, DIAM _____ IN.
WS : WASHED SAMPLE
RC : ROCK CORE BX SIZE

SAMPLE CONDITIONS
DISTURBED
GOOD
LOST
DRILL CORE SAMPLE

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION	STRAT.	GROUND WATER	SAMPLES COND.	SAMPLES Nº & TYPE	SAMPLES REC. (%)	TESTS
0	285.2	Ground surface						
	86.93	6 inches of organic topsoil over a silty sand with gravel, cobbles and boulders below 5.3 feet.				1 RC	39	
10	274.2							
	83.58	Limestone bedrock. Grey nodular limestone. Nodules are coated with thin shale beds 1/8 to 1/4 inch in thickness. Well cemented.				2 RC	100	
15						3 RC	93	
20						4 RC	100	
25						5 RC		
30						6 RC	100	
						7 RC	100	
35						8 RC	93	

NOTES

No wash water return after 14 feet.

Water level below 34 feet on October 27, 1965.

FORM 64.2

Terraterk LTD
Montreal Que

SHEET 2 OF 2

OFFICE RECORD OF EXPLORATION

PROJECT Service Tunnel, Centre Block By-Pass, Ottawa (S-296-65)
LOCATION Parliament Hill, Ottawa, Ontario.
ELEVATION DATUM Geodetic CASING SIZE BX
SAMPLER HAMMER WEIGHT ____ LBS DROP ____ INCHES

HOLE Nº 01
HOLE DATE 12-14/10/65
REPORT DATE Dec. 1965
COMPILED BY J.S.
CHECKED BY P.L.

TESTS

WL : WATER LEVEL
N : STANDARD PENETRATION VALUE (BLOWS / FOOT)
K : PERMEABILITY (CM / SEC)
V : IN-SITU VANE TEST (LBS / SQ. FT.)

SAMPLE TYPES

AS : AUGER SAMPLE
SS : SPLIT SPOON
ST : SHELBY TUBE, DIAM ____ IN.
WS : WASHED SAMPLE
RC : ROCK CORE BX SIZE

SAMPLE CONDITIONS

DISTURBED
GOOD
LOST
DRILL CORE SAMPLE

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION	STRAT.	GROUND WATER	SAMPLES COND.	SAMPLES Nº & TYPE	SAMPLES REC. (%)	TESTS
35								
40						9 RC	91	
45						10 RC	100	
50						11 RC	89	
55						12 RC	96	
	227.2					13 RC	80	
60		Transition zone. Nodular structure is decreasing. Poorly cemented.				14 RC	93	
	222.2							
65		Crystallized limestone with a few beds of shale $\frac{1}{4}$ to 2 inches in thickness.				15 RC	84	
						16 RC	96	
70	215.1	End of borehole						

NOTES

56.5 to 57.5 ft. - vertical joint.

63.0 ft. - Joint with 70 degree dip

67.5 to 68.1 ft. - Vertical joint.

TT FORM No. 2

Terratech LTD
Montreal Que

SHEET 1 OF 2

OFFICE RECORD OF EXPLORATION

PROJECT Service Tunnel, Centre Block By-Pass, Ottawa (S-296-65)
LOCATION Parliament Hill, Ottawa, Ontario.
ELEVATION DATUM Geodetic CASING SIZE BX
SAMPLER HAMMER WEIGHT _____ LBS DROP _____ INCHES

HOLE No 03
HOLE DATE 14,15/10/65
REPORT DATE Dec. 1965.
COMPILED BY J.S.
CHECKED BY P.L.

TESTS
WL : WATER LEVEL
N : STANDARD PENETRATION VALUE (BLOWS / FOOT)
K : PERMEABILITY (CM/SEC)
V : IN-SITU VANE TEST (LBS/SQ. FT.)

SAMPLE TYPES
AS : AUGER SAMPLE
SS : SPLIT SPOON
ST : SHELBY TUBE, DIAM _____ IN.
WS : WASHED SAMPLE
RC : ROCK CORE BX SIZE

SAMPLE CONDITIONS
DISTURBED
GOOD
LOST
DRILL CORE SAMPLE

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION	STRAT.	GROUND WATER	SAMPLES COND.	SAMPLES No & TYPE	SAMPLES REC. (%)	TESTS
0	280.2	Ground surface						
	85.40	6 inches of organic soil over silty sand with a few cobbles.						
5	275.7							
	84.03	Limestone bedrock. Grey nodular limestone. Nodules are coated with thin shale beds. Well cemented. (Stylolitic structure from 27 to 29 feet and slightly crystallized from 29 to 31 feet).		WL		1 RC	78	
						2 RC	99	
10						3 RC	95	
15						4 RC	97	
20						5 RC	88	
25						6 RC	97	
						7 RC	90	
30						8 RC	100	
						9 RC	90	
35								

NOTES

No wash water return after = 7 feet.

Water level at 7.7 feet on October 27, 1965.

17.0 to 18.0 ft. - Vertical Joint.

20.0 ft. - Slightly weathered joint plane with 85 degree dip.

FORM NO. 2

Terratech Ltd
Montreal Que

SHEET 2 OF 2

OFFICE RECORD OF EXPLORATION

PROJECT Service Tunnel, Centre Block By-Pass, Ottawa (S-296-65)
LOCATION Parliament Hill, Ottawa, Ontario.
ELEVATION DATUM Geodetic CASING SIZE BX
SAMPLER HAMMER WEIGHT ____ LBS DROP ____ INCHES

HOLE Nº 03
HOLE DATE 14-15/10/65
REPORT DATE Dec. 1965
COMPILED BY J.S.
CHECKED BY P.L.

TESTS
WL : WATER LEVEL
N : STANDARD PENETRATION VALUE (BLOWS / FOOT)
K : PERMEABILITY (CM/SEC)
V : IN-SITU VANE TEST (LBS/SQ. FT.).

SAMPLE TYPES
AS : AUGER SAMPLE
SS : SPLIT SPOON
ST : SHELBY TUBE, DIAM. ____ IN.
WS : WASHED SAMPLE
RC : ROCK CORE BX SIZE

SAMPLE CONDITIONS
DISTURBED
GOOD
LOST
DRILL CORE SAMPLE

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION	STRAT.	GROUND WATER	SAMPLES COND.	SAMPLES Nº & TYPE	SAMPLES REC. (%)	TESTS
35								
40	240.2					10 RC	95	
		Transition zone. Nodular structure disappears and a few beds of shale are present. Shale beds $\frac{1}{4}$ to $\frac{1}{2}$ inch thick. Poorly cemented.				11 RC	98	
45								
						12 RC	84	
50	230.2							
		Massive limestone. Contains a few shale beds ranging from 1/8 inch in thickness at 50 feet and gradually increasing in thickness to 2 inches at the end of the borehole.				13 RC	95	
55								
						14 RC	100	
60								
						15 RC	97	
65	215.4							
		End of borehole.						
70								

NOTE

39.0 to 40.0 ft. - vertical joint.

Terraterk LTD
Montreal Que

SHEET 1 OF 2

OFFICE RECORD OF EXPLORATION

PROJECT Service Tunnel, Centre Block By-Pass, Ottawa (S-296-65)
LOCATION Parliament Hill, Ottawa, Ontario
ELEVATION DATUM _____ CASING SIZE BX
SAMPLER HAMMER WEIGHT _____ LBS DROP _____ INCHES

HOLE Nº 04
HOLE DATE 18, 19/10/65
REPORT DATE Dec. 1965
COMPILED BY J.S.
CHECKED BY P.L

TESTS

WL : WATER LEVEL
N : STANDARD PENETRATION VALUE (BLOWS/FOOT)
K : PERMEABILITY (CM/SEC)
V : IN-SITU VANE TEST (LBS/SQ.FT.)

SAMPLE TYPES

AS : AUGER SAMPLE
SS : SPLIT SPOON
ST : SHELBY TUBE, DIAM ___ IN.
WS : WASHED SAMPLE
RC : ROCK CORE BX SIZE

SAMPLE CONDITIONS

DISTURBED
GOOD
LOST
DRILL CORE SAMPLE

PROFILE				SAMPLES			TESTS	NOTES
DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION	STRAT.	GROUND WATER COND.	Nº & TYPE	REC. (%)		
0	272.3	Ground surface						
	83.0	Thin organic layer over silty sand.						No wash water return after 4.8 feet.
	269.3							
	82.08	Fine grained grey nodular limestone bedrock. The nodules are thinly coated with shale. Well cemented.						Water level at 4.8 feet on October 17, 1965, and 6.8 ft. on October 27, 1965.
5				WL	1 RC	100		9.3 to 10.4 feet - Vertical joint, tight.
					2 RC	98		
10					3 RC	99		
15					4 RC	95		
20					5 RC	100		
25					6 RC	100		
30					7 RC	93		
35					8 RC	100		

FORM No. 2

Terrateck LTD
Montreal Que

SHEET 2 OF 2

OFFICE RECORD OF EXPLORATION

PROJECT Service Tunnel, Centre Block By-Pass, Ottawa (S-296-65)
LOCATION Parliament Hill, Ottawa, Ontario
ELEVATION DATUM Geodetic CASING SIZE BX
SAMPLER HAMMER WEIGHT _____ LBS DROP _____ INCHES

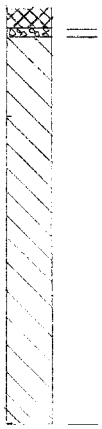
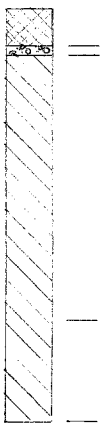
HOLE No 04
HOLE DATE 18, 19/10/65
REPORT DATE Dec. 1965
COMPILED BY J.S.
CHECKED BY P.L.

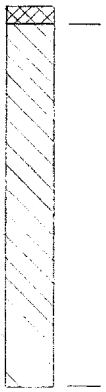
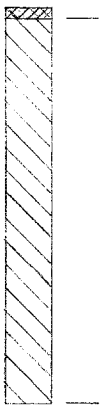
TESTS
WL : WATER LEVEL
N : STANDARD PENETRATION VALUE (BLOWS / FOOT)
K : PERMEABILITY (CM/SEC)
V : IN-SITU VANE TEST (LBS/SQ. FT.)

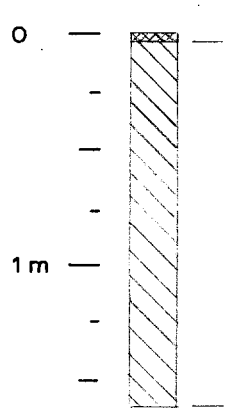
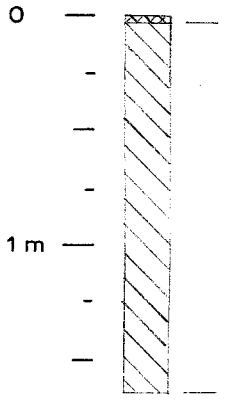
SAMPLE TYPES
AS : AUGER SAMPLE
SS : SPLIT SPOON
ST : SHELBY TUBE, DIAM _____ IN.
WS : WASHED SAMPLE
RC : ROCK CORE BX SIZE

SAMPLE CONDITIONS
DISTURBED
GOOD
LOST
DRILL CORE SAMPLE

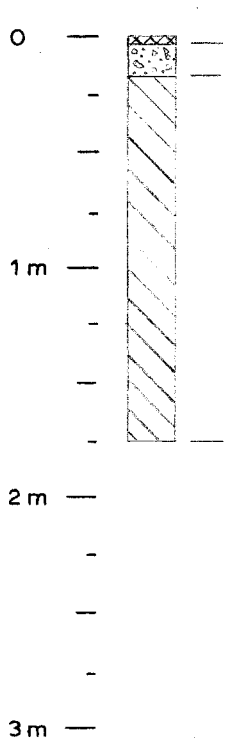
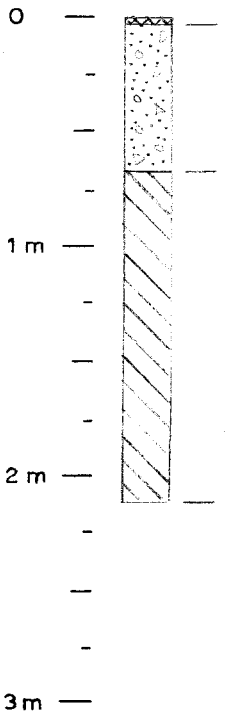
PROFILE				GROUND WATER	SAMPLES			TESTS
DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION	STRAT.		COND.	No & TYPE	REC. (%)	
35	236.9							
		Transition zone. Nodular structure is disappearing and shale beds $\frac{1}{4}$ to 5 inches in thickness are present. The thicker shale beds contain some limestone lenses. Poorly cemented.				9 RC	100	
40						10 RC	98	
45	226.9							
		Limestone, slightly argillaceous and containing beds of shale from $\frac{1}{4}$ to 3 inches in thickness. The shale layers are sometimes not too distinct and increase in thickness with depth. The limestone is slightly crystallized below 58 feet.				11 RC	96	
50						12 RC	97	
55						13 RC	97	
60						14 RC	95	
	208.5	End of borehole.						
65								
70								

B.H. No. 1	DESCRIPTION	CORE RECOVERY
0 m 	Concrete 0 to 76mm Cinders, gravel and sand from 76mm to 115mm. Limestone bedrock	0.115m to 1.790m Cored 1.675m Recovered 1.665m 99% recovery. R.Q.D. = 83%
1 m 2 m 3 m		
B.H. No. 2		
0 m 	Concrete 0 to 152mm Sand, gravel, ashes, cinders and wood from 152mm to 215 mm Limestone bedrock Lost wash water at 0.79m	0.215m to 1.34m Cored 1.125m Recovered 1.09m 96% recovery. R.Q.D. = 47%
1 m		
	Limestone bedrock Vertical seam from 1.30m to 1.46m.	1.34m to 1.80m Cored 0.46m Recovered 0.46m 100 % recovery. R.Q.D. = 61 %
2 m 3 m		

B.H. No. 3	DESCRIPTION	CORE RECOVERY
0 1 m 2 m 3 m	 Concrete from 0 to 95mm Limestone bedrock No loss of wash water	0.095m to 1.66m Cored 1.565m Recovered 1.565m 100 % recovery. R.Q.D. = 25 %
B.H. No. 4		
0 1 m 2 m 3 m	 Concrete from 0 to 75mm Limestone bedrock No loss of wash water	0.075m to 1.775m Cored 1.7m Recovered 1.695m 99.7 % recovery R.Q.D. = 57 %

B.H. No. 5	DESCRIPTION	CORE RECOVERY
	Concrete from 0 to 50mm Limestone bedrock Lost some wash water at .18m 10mm void from 1.33m to 1.34mm, also lost all lost all wash water.	.050m to 1.65m Cored 1.60m Recovered 1.57m 98 % recovery R.Q.D. = 53 %
B.H. No. 6		
	Concrete from 0 to 65mm Limestone bedrock Vertical seam from 1.05m to 1.14m. Lost wash water at .76m	.065m to 1.65m Cored 1.585m Recovered 1.56m 98 % recovery R.Q.D. = 43 %

B.H. No. 7	DESCRIPTION	CORE RECOVERY
0	Concrete from 0 to 130mm	
	Loose to compact sand, gravel, ashes and cinders.	
	N- values 9,11	
	Ground water table at .60m	
1 m		0.71m to 2.25m
		Cored 1.54m
		Recovered 1.54m
		100 % recovery
	Limestone bedrock	R.Q.D. = 41 %
	Lost most of wash water at 1.12m	
2 m		
3 m		
B.H. No. 8		
0	Concrete from 0 to 100mm	
	Sand, gravel, ashes and cinders	
		.13m to 1.71m
		Cored 1.58m
		Recovered 1.53m
		97 % recovery
1 m	Limestone bedrock	R.Q.D. = 35 %
	Lost wash water at .80m	
	Vertical seam from 1.25m to 1.33m	
2 m		
3 m		

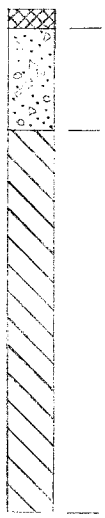
B.H. No. 9	DESCRIPTION	CORE RECOVERY
	Concrete from 0 to 64mm Sand, gravel, ashes and cinders Limestone bedrock 6mm void from .633m to .639m Lost all wash water in void.	0.165m to 1.74m Cored 1.575m Recovered 1.544m 98 % recovery R.Q.D. = 61 %
B.H. No. 10		
	Concrete from 0 to 37mm 37mm of ashes, cinders, sand and gravel 203 mm of sand then mostly broken stone pieces to bedrock. N-values 4,22 Ground water level at .51m Limestone bedrock Lost wash water at .81m	0.67m to 2.13m Cored 1.46m Recovered 1.45m 99 % recovery R.Q.D. = 31 %

B.H. No. 11	DESCRIPTION	CORE RECOVERY
0	Concrete from 0 to 140mm	
	Sand, gravel, ashes, and cinders to 30m.	
	Broken pieces of stone	
	N-values 5, 14, 12	
1 m	Ground water level at .71m	
		0.97m to 2.51m
		Cored 1.54m
	Limestone bedrock	Recovered 1.54m
		100 % recovery
	Lost wash water at 1.52m.	R.Q.D. = 67 %
2 m		
3 m		
B.H. No. 12		
0	Concrete from 0 to 100mm	
	Boulder	
		0.24m to 1.88m
	Limestone bedrock	Cored 1.64m
1 m		Recovered 1.61m
	Vertical seam from .93m to 1.25m	98 % recovery
		R.Q.D. = 67 %
2 m		
3 m		

B.H. No. 13

DESCRIPTION

CORE RECOVERY



Concrete from 0 to 100mm

Sand, gravel, pieces of wood and ashes.
N-value 4

Limestone bedrock

Lost wash water at 1.30m

.59m to 2.16m
Cored 1.57m
Recovered 1.51m
96 % recovery
R.Q.D. = 62 %

B.H. No.

APPENDIX D

Geophysical Borehole Logging (exp BH-1V and BH-7V)

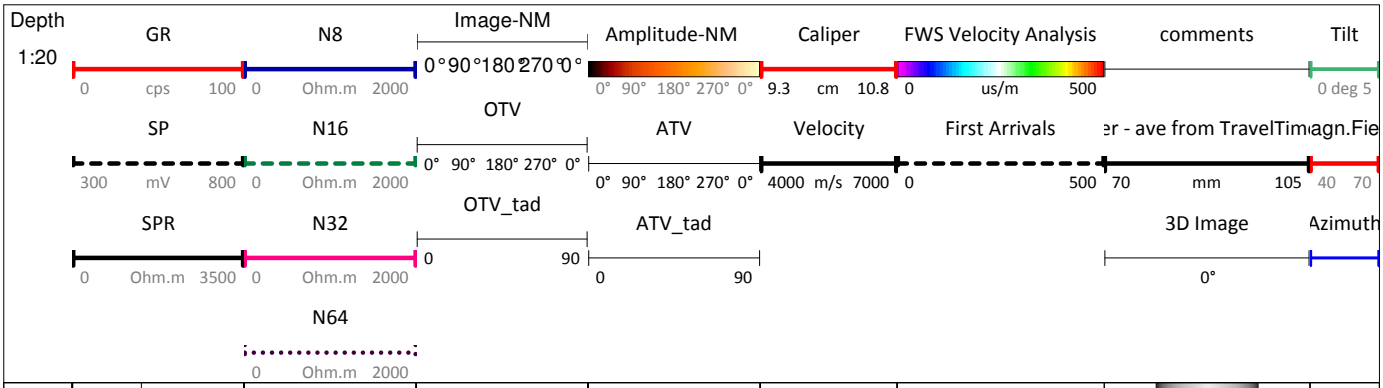
Stereographic Projection Televiewer Data (exp)

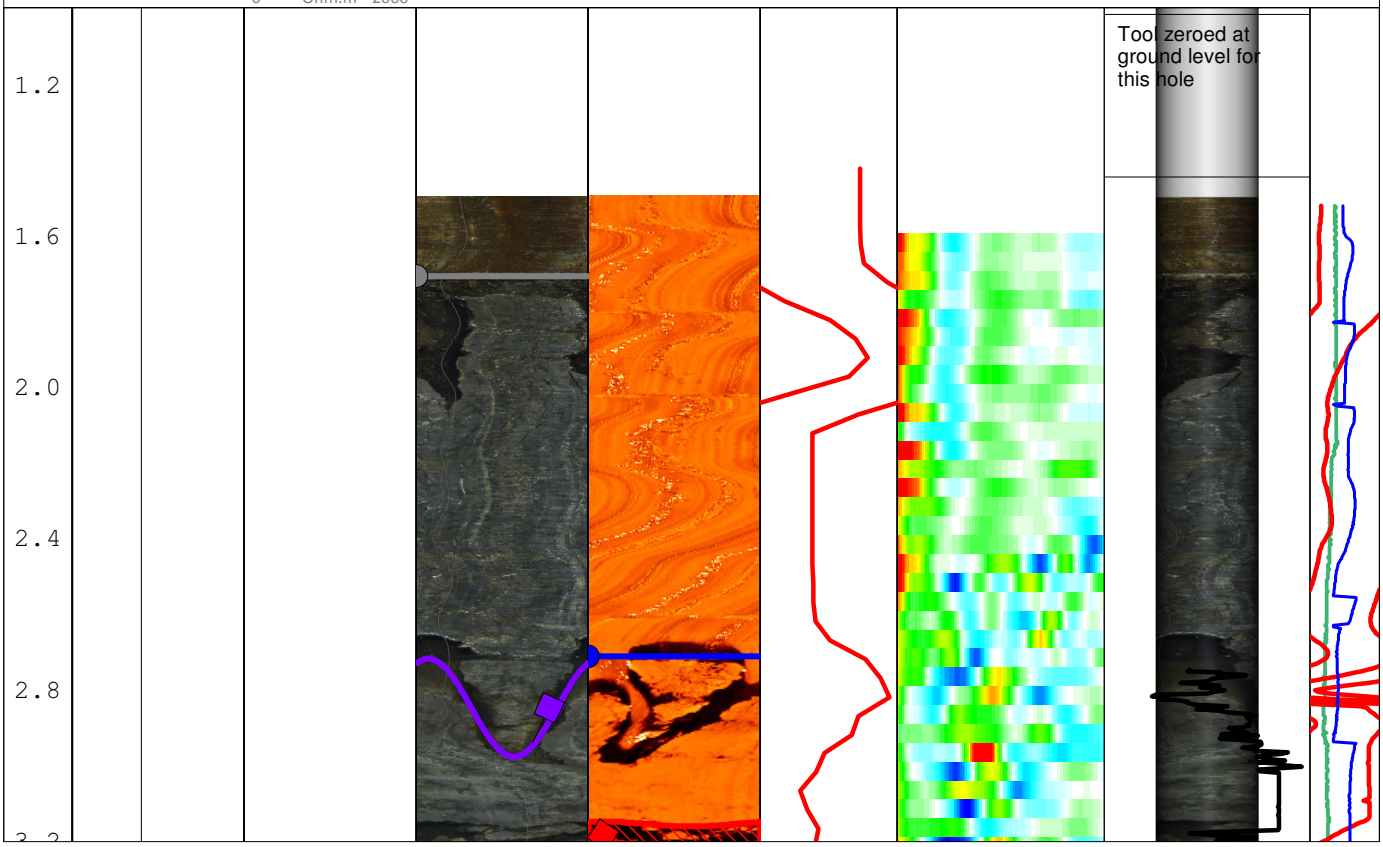
GEOPHYSICS GPR INTERNATIONAL INC.

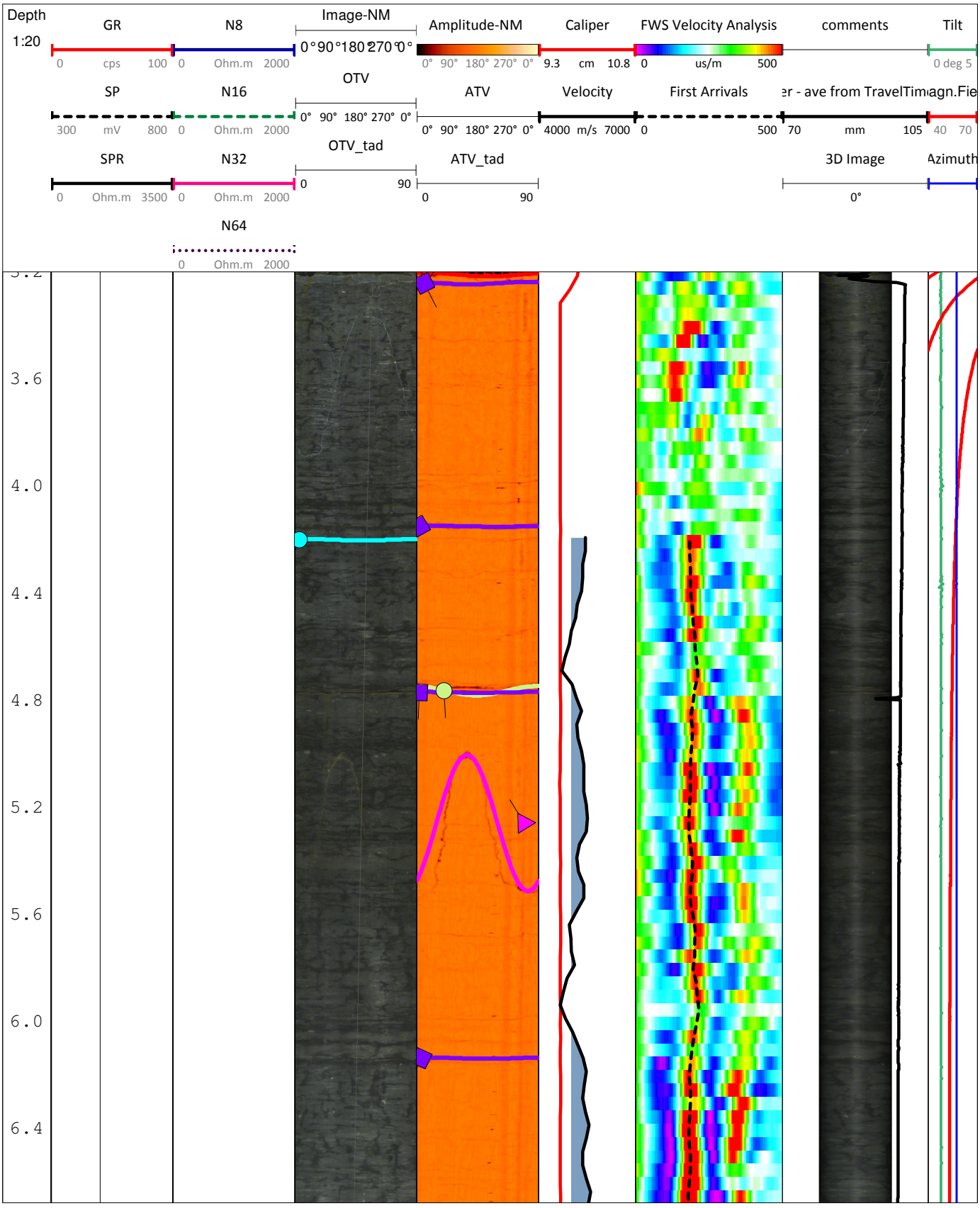
COMPANY :	VISITORS WELCOME CENTRE PHASE 1
LOCATION :	Parliament Hill, Ottawa, Ontario

Well	BH1V		
Date	December 5 2013	BH Fluid	
Casing	3 3/4" inside diameter		
File Name	BH1V.wcl		
Depth Driller			
Depth Logger	23 m		
Logged by	C. Coatsworth		
Witnessed by			

NOTES:
Tool zeroed at ground level.
Casing is 0.117m below ground.
Water is 2.78 m below ground level.



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GR
0 cps 100
N8
0 Ohm.m 2000
Image-NM
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Caliper
9.3 cm 10.8
FWS Velocity Analysis
0 us/m 500
comments
Tilt
0 deg 5
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
ATV
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 500
70 mm 105
40 70
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV_tad
0 90
3D Image
0°
Azimuth
N64
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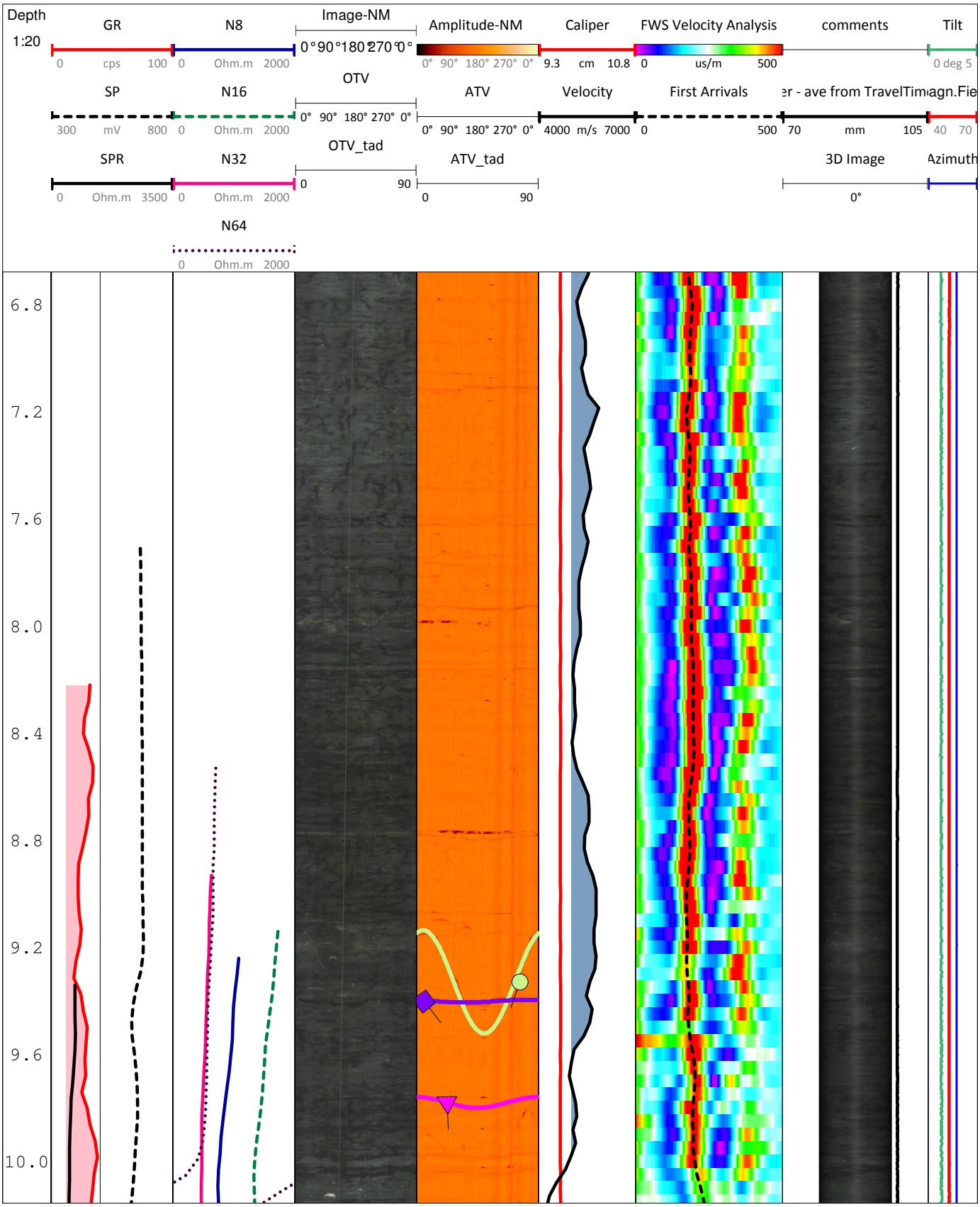
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4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0 Ohm.m 2000
Image-NM
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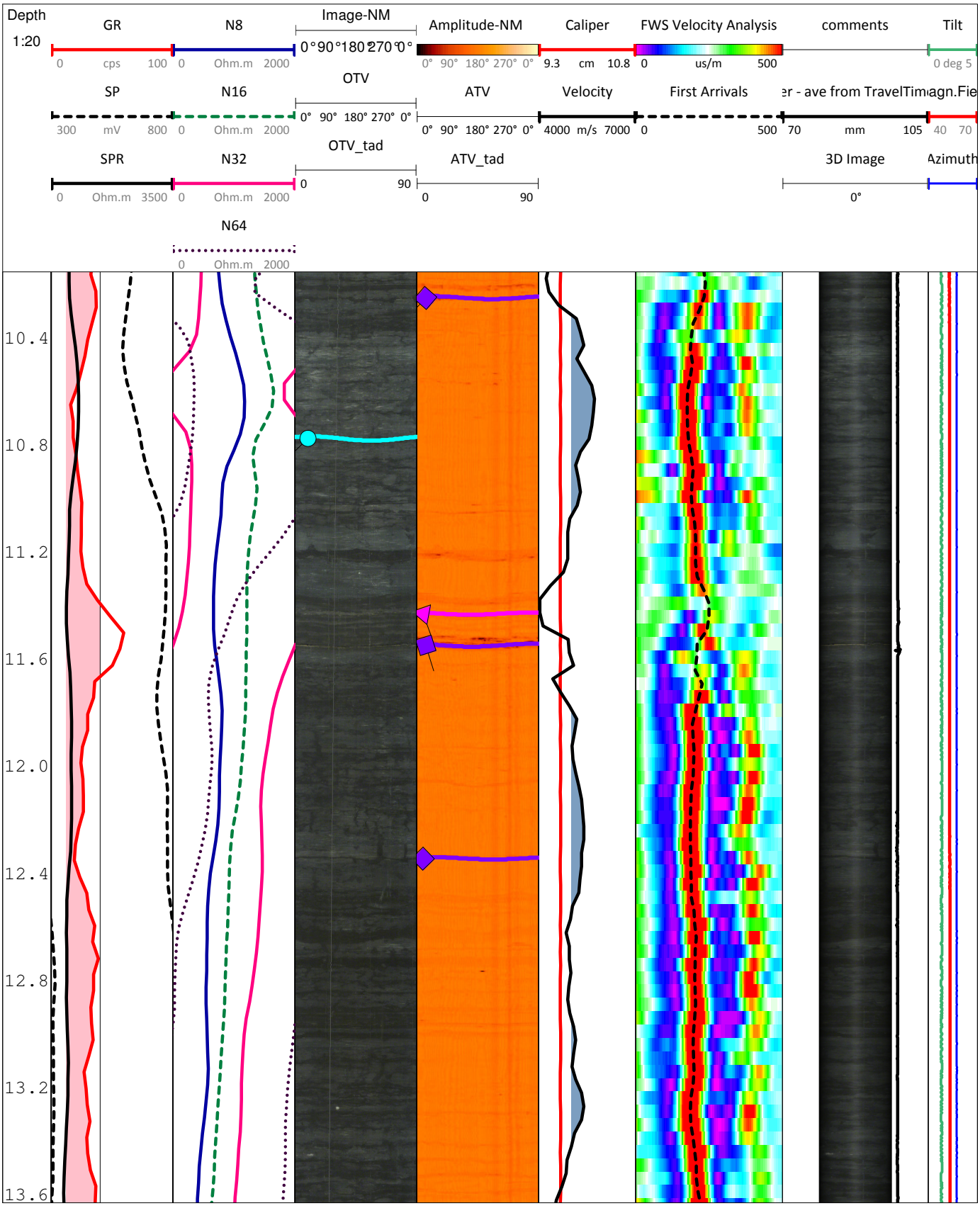
Amplitude-NM
0° 90° 180° 270° 0°
Caliper
9.3 cm 10.8
FWS Velocity Analysis
0 us/m 500
comments
Tilt
0 deg 5
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
ATV
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 500
70 mm 105
40 70
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV_tad
0 90
3D Image
0°
Azimuth
N64
0 Ohm.m 2000
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0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GR
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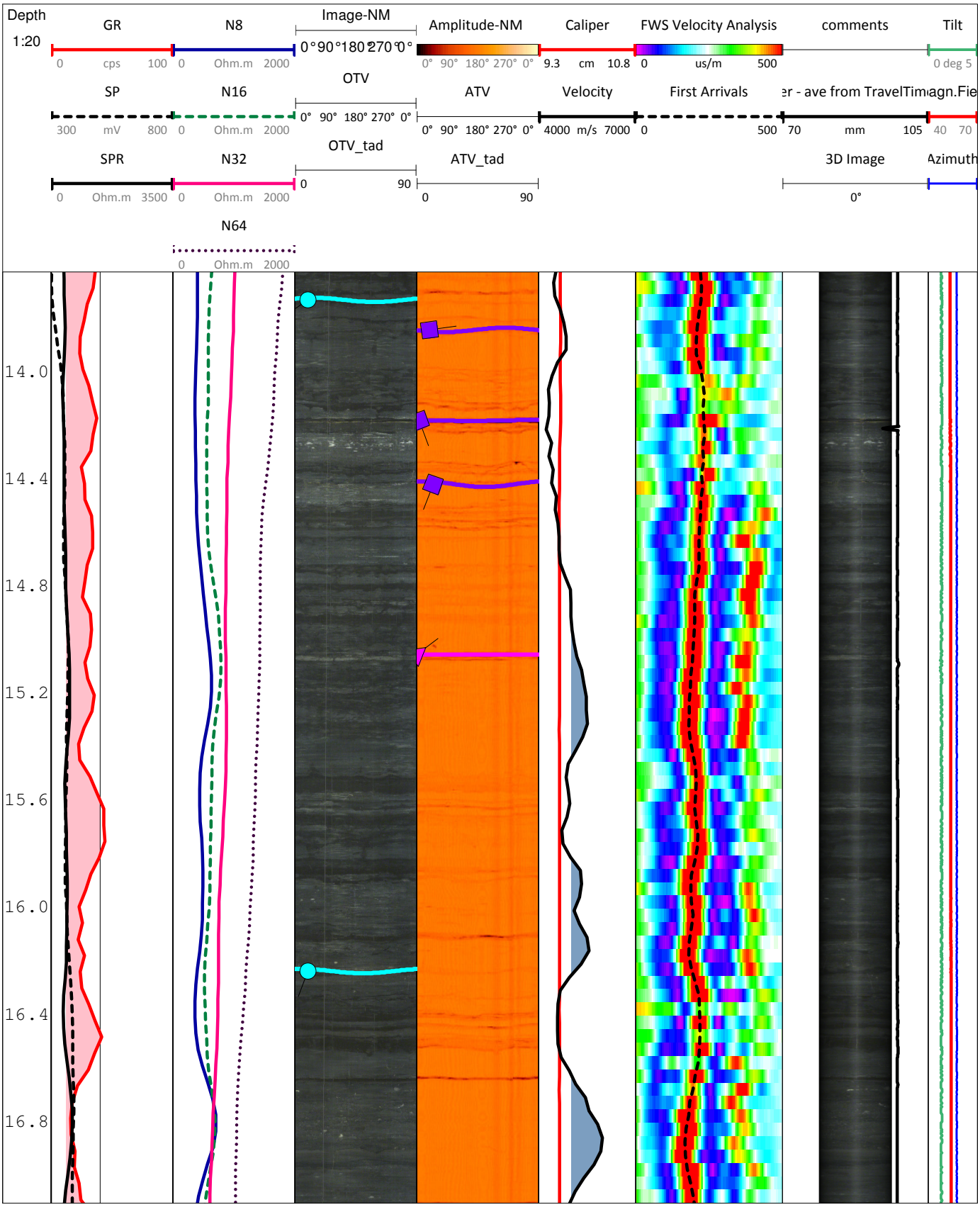
N8
0 Ohm.m 2000
Image-NM
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Caliper
9.3 cm 10.8
FWS Velocity Analysis
0 us/m 500
comments
Tilt
0 deg 5
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
ATV
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 500
70 mm 105
40 70
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV_tad
0 90
3D Image
0°
Azimuth
N64
0 Ohm.m 2000
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2
13.6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N8
0 Ohm.m 2000
Image-NM
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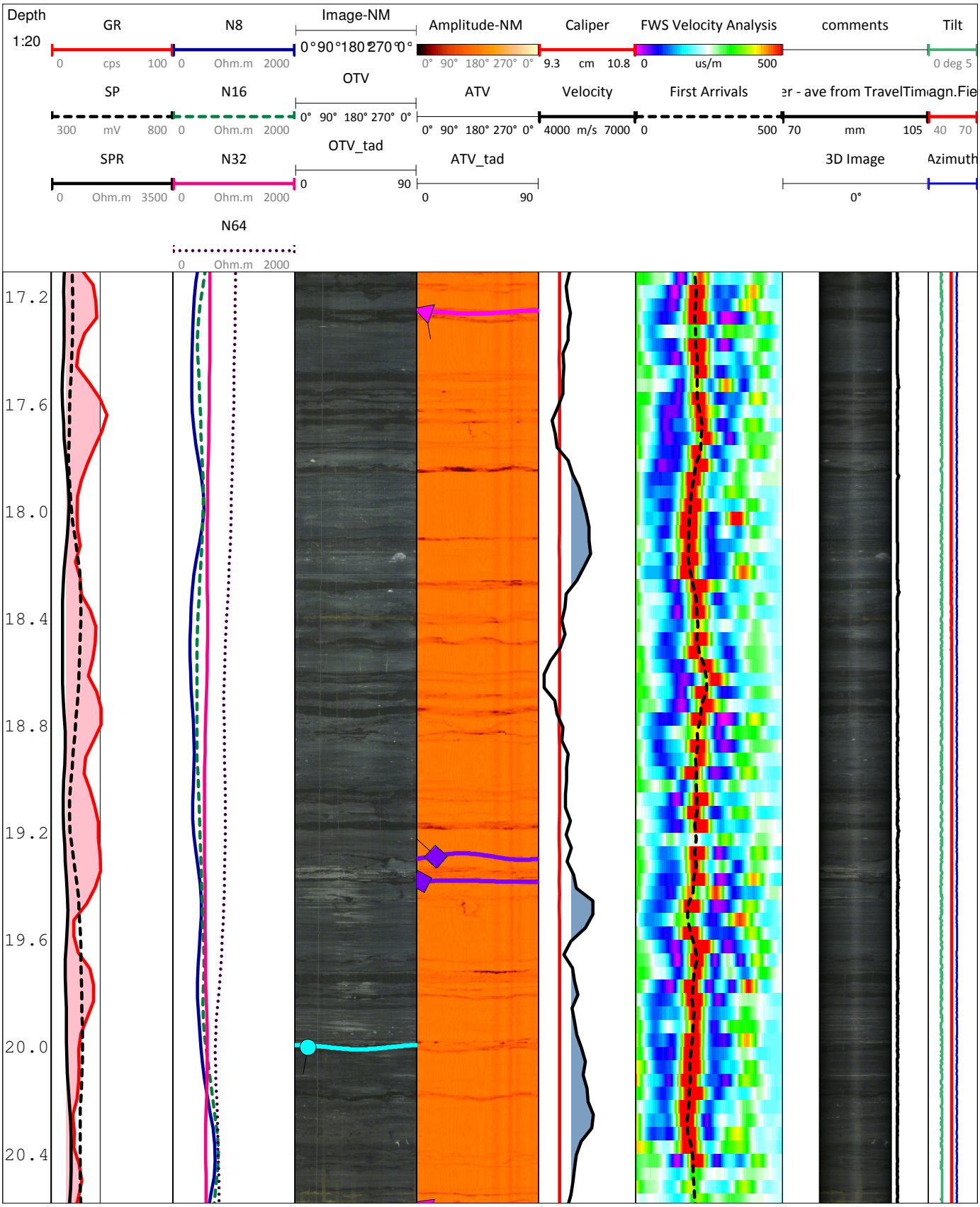
Amplitude-NM
0° 90° 180° 270° 0°
Caliper
9.3 cm 10.8
FWS Velocity Analysis
0 us/m 500
comments
Tilt
0 deg 5
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
ATV
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 500
70 mm 105
40 70
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV_tad
0 90
3D Image
0°
Azimuth
N64
0 Ohm.m 2000
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8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N8
0 Ohm.m 2000
Image-NM
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Caliper
9.3 cm 10.8
FWS Velocity Analysis
0 us/m 500
comments
Tilt
0 deg 5
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
ATV
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 500
er - ave from TravelTim
agn.Fie
70 mm 105
40 70
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV_tad
0 90
3D Image
0°
Azimuth
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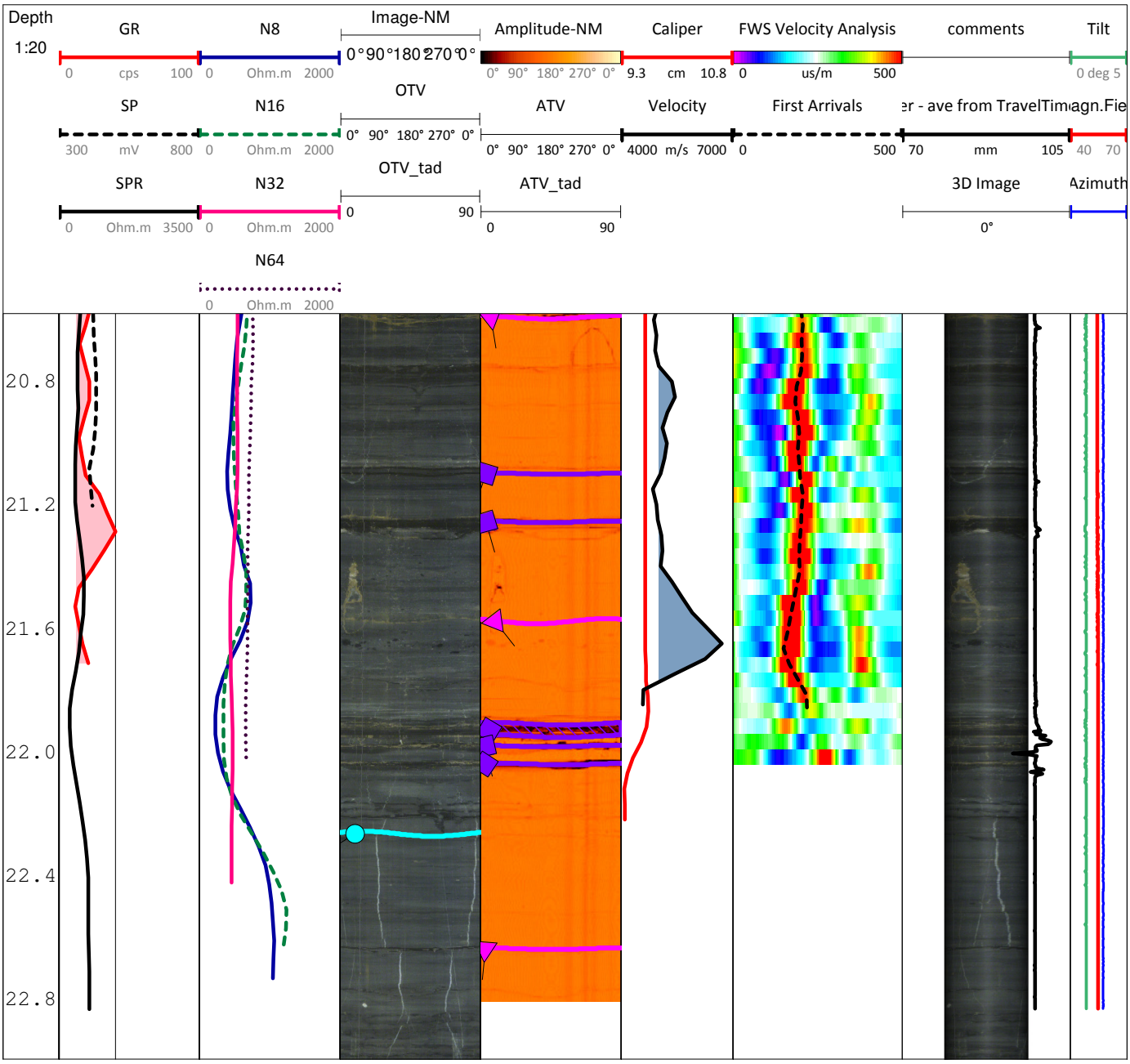
0 Ohm.m 2000
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4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FWS Velocity Analysis
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comments
Tilt
0 deg 5
SP
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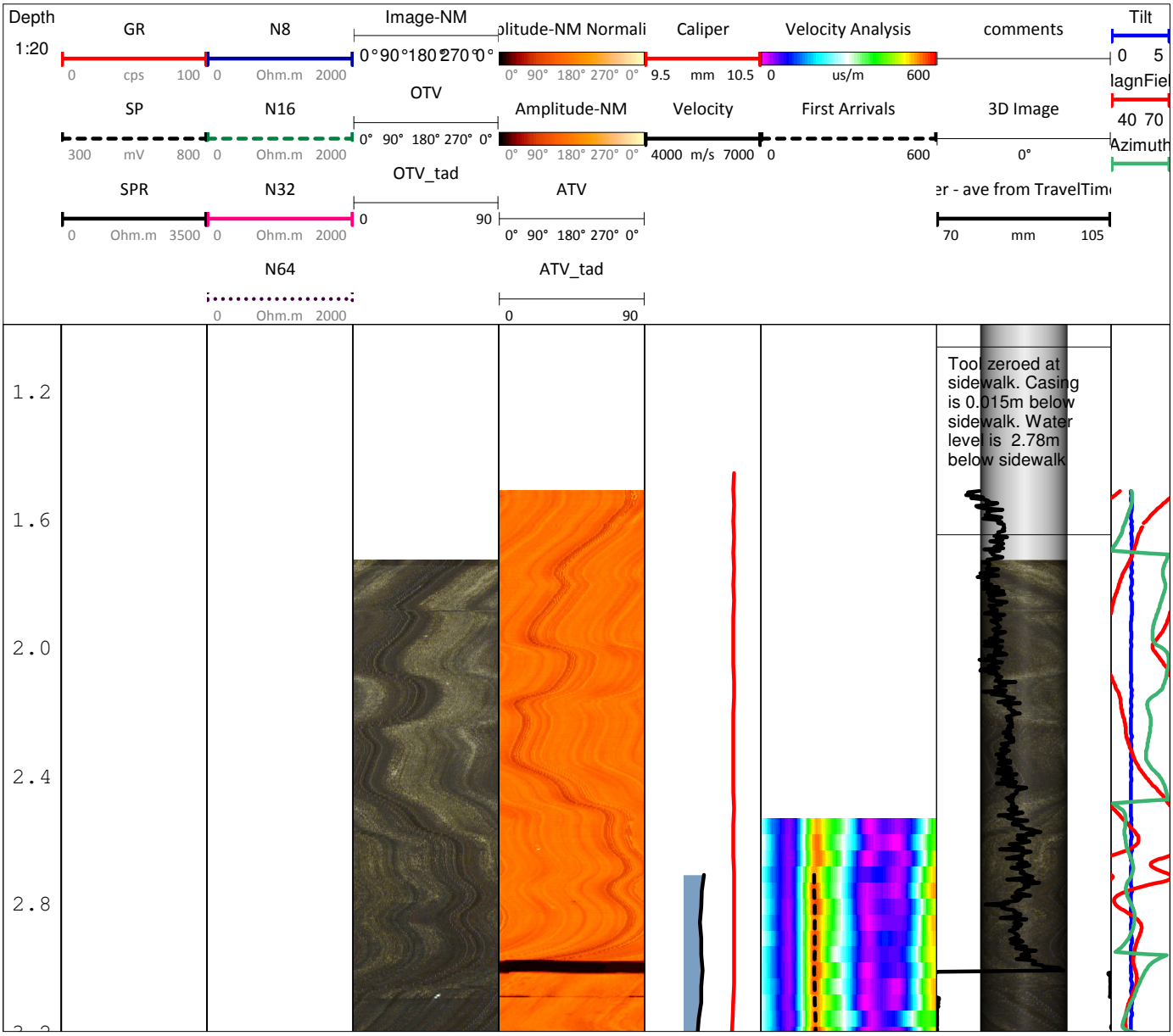
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
ATV
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 500
70 mm 105
40 70
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV_tad
0 90
3D Image
0°
Azimuth
N64
0 Ohm.m 2000
20.8
21.2
21.6
22.0
22.4
22.8

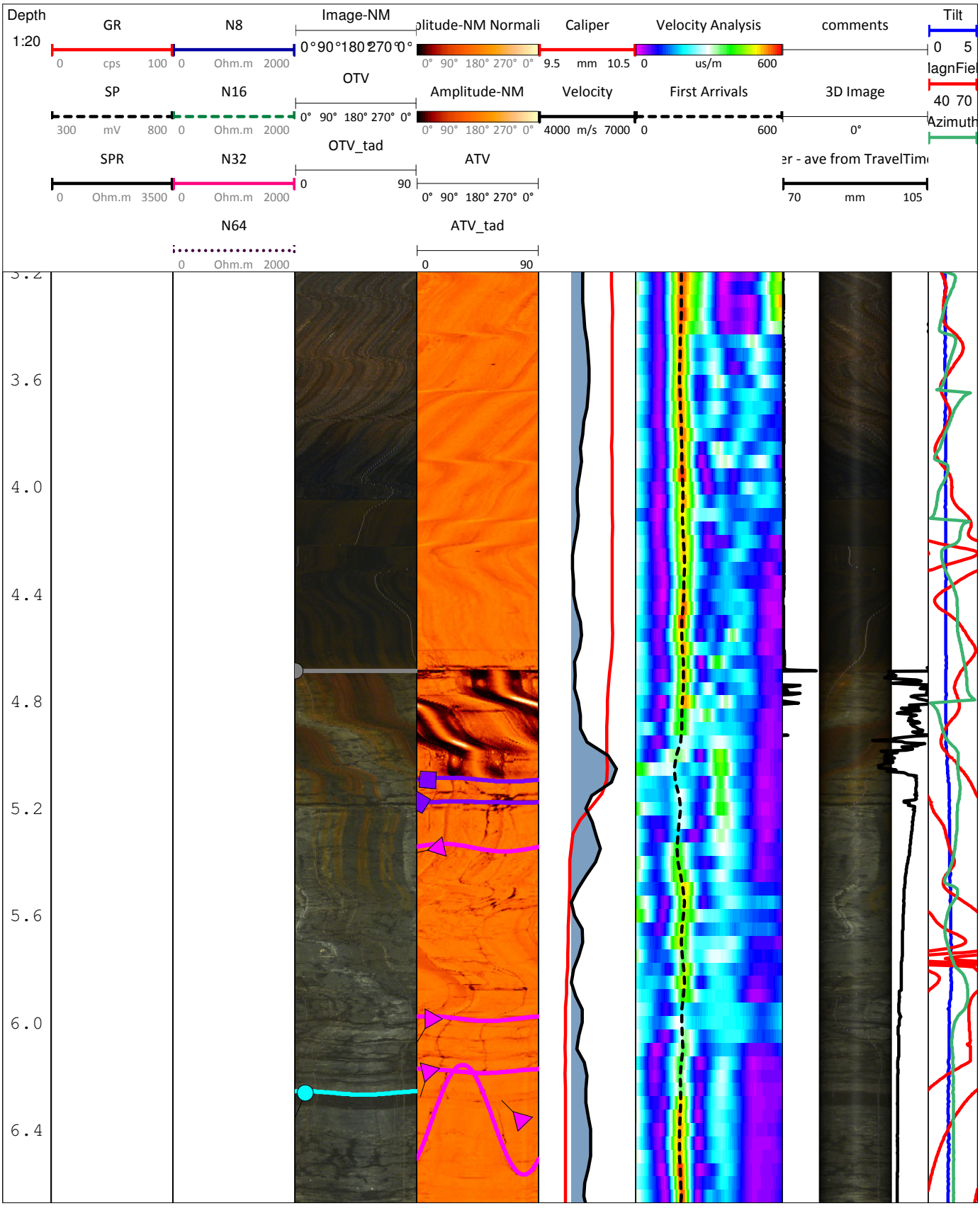
GEOPHYSICS GPR INTERNATIONAL INC.

COMPANY :	VISITORS WELCOME CENTRE PHASE 1
LOCATION :	Parliament Hill, Ottawa, Ontario

Well	BH7V		
Date	December 6 2013	BH Fluid	
Casing	3 3/4" inside diameter		
File Name	BH7V.wcl		
Depth Driller			
Depth Logger	23 m		
Logged by	C. Coatsworth		
Witnessed by			

NOTES:
Tool zeroed at sidewalk.
Casing is 0.015m below sidewalk.
Water is 2.78 m below sidewalk.

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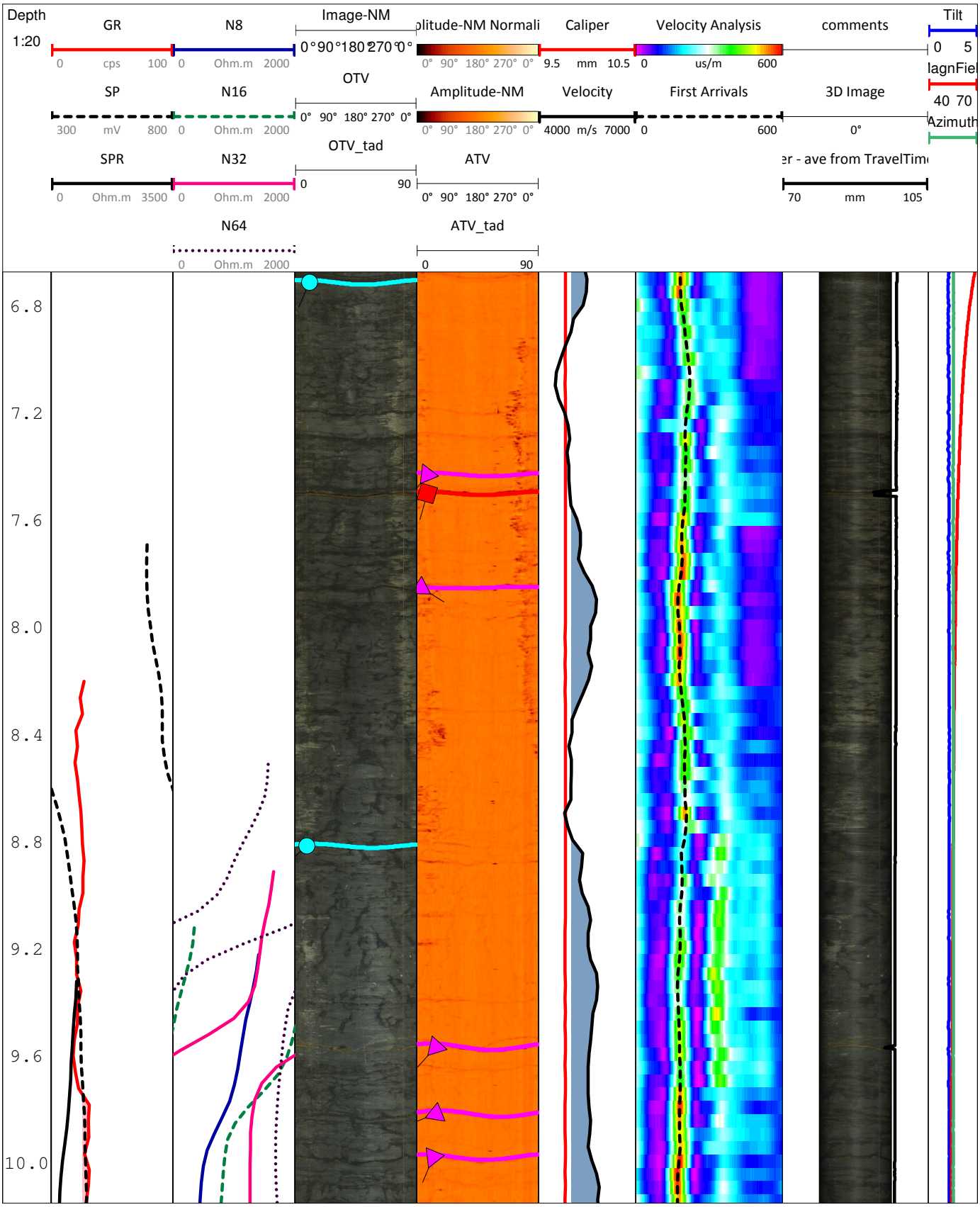
litude-NM Normali
0° 90° 180° 270° 0°
Caliper
9.5 mm 10.5
Velocity Analysis
0 us/m 600
comments
Tilt
0 5
lagnFiel
40 70
Azimuth
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 600
3D Image
0°
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV
0° 90° 180° 270° 0°
er - ave from TravelTim
70 mm 105
N64
0 Ohm.m 2000
ATV_tad
0 90
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4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Caliper
9.5 mm 10.5
Velocity Analysis
0 us/m 600
comments
Tilt
0 5
lagnFiel
40 70
Azimuth
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 600
3D Image
0°
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV
0° 90° 180° 270° 0°
er - ave from TravelTim
70 mm 105
N64
0 Ohm.m 2000
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0 90
6.8
7.2
7.6
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8.4
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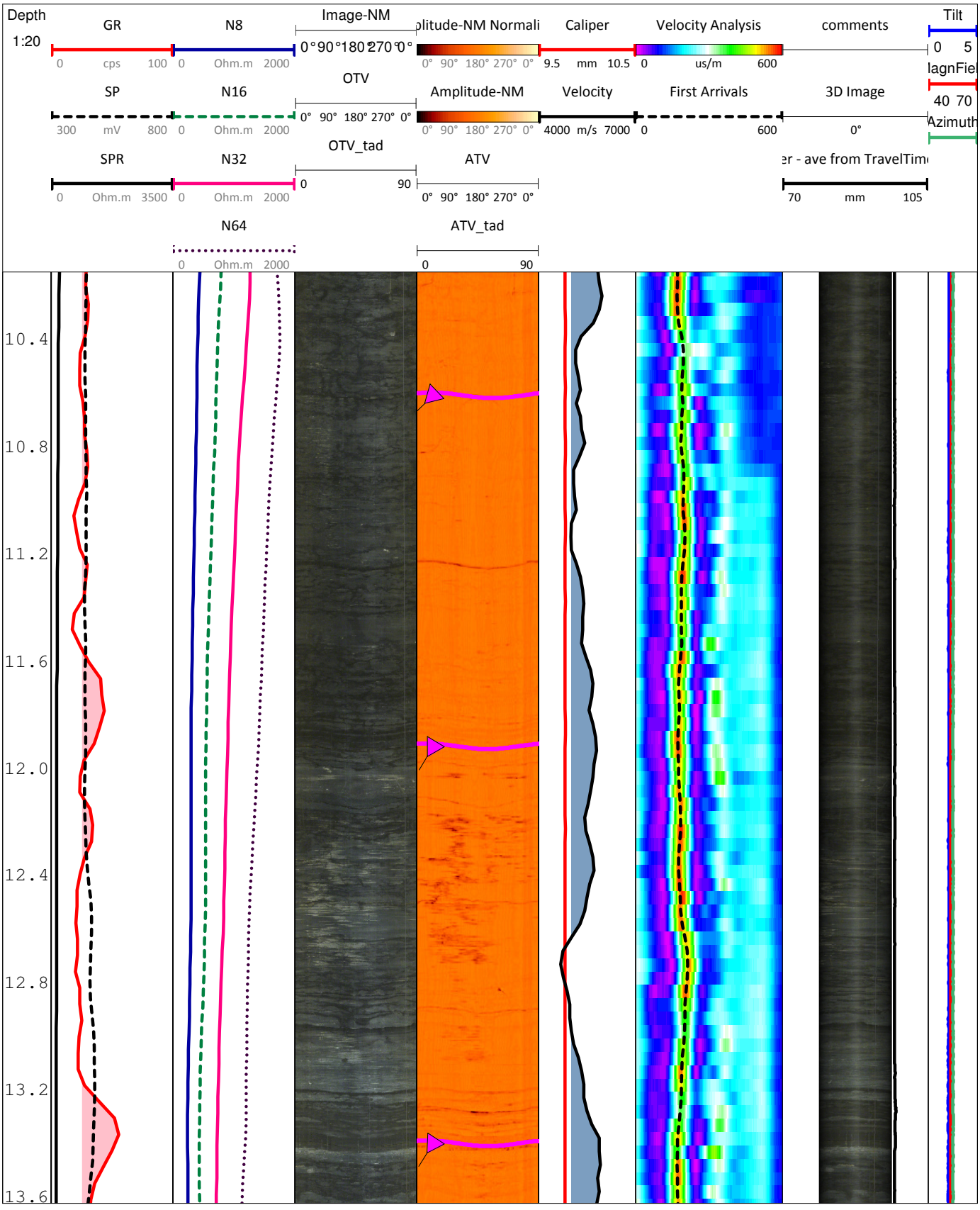
10.0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Caliper
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Velocity Analysis
0 us/m 600
comments
Tilt
0 5
lagnFiel
40 70
Azimuth
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OTV
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0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 600
3D Image
0°
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV
0° 90° 180° 270° 0°
er - ave from TravelTim
70 mm 105
N64
0 Ohm.m 2000
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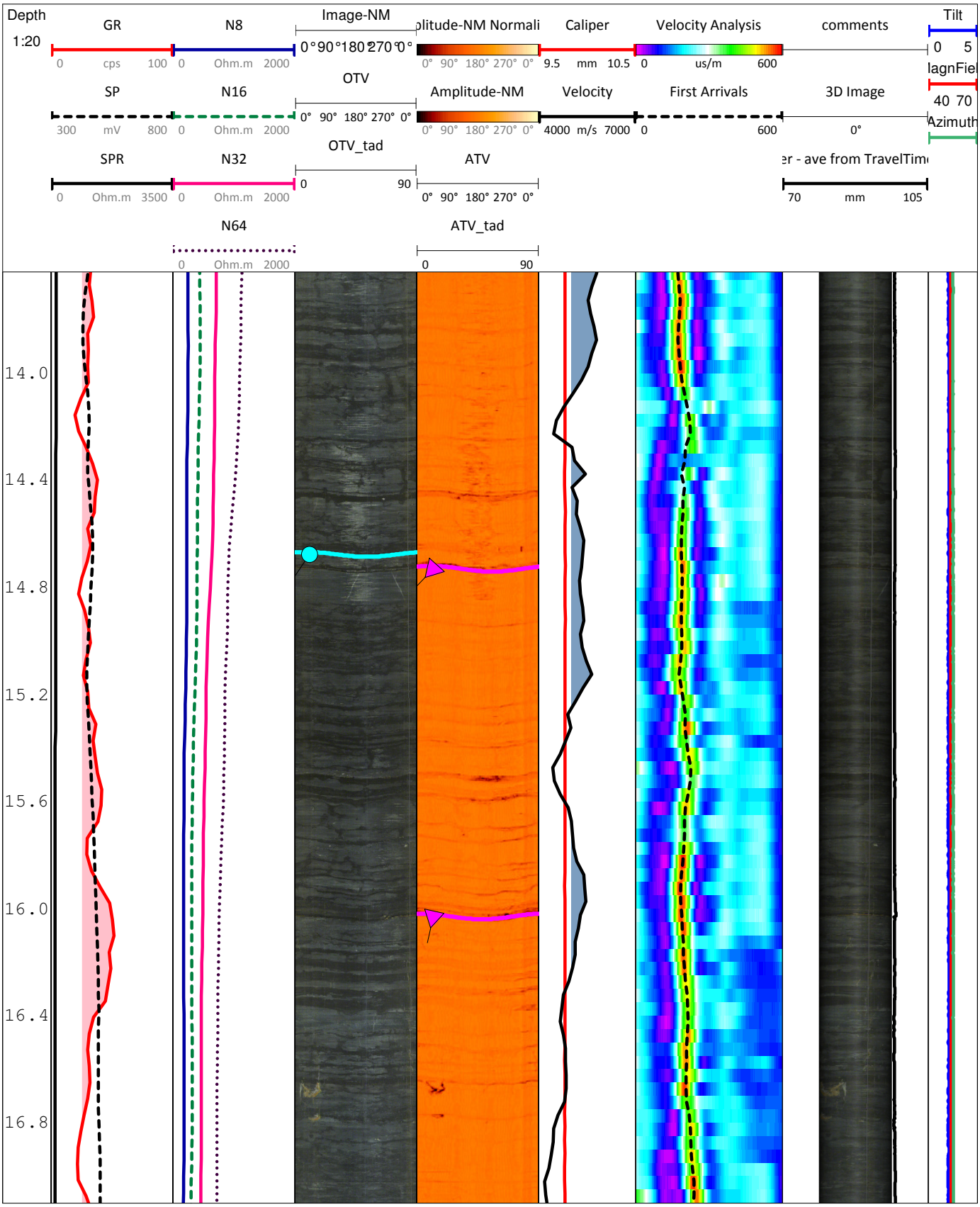
13.2
13.6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Caliper
9.5 mm 10.5
Velocity Analysis
0 us/m 600
comments
Tilt
0 5
lagnFiel
40 70
Azimuth
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 600
3D Image
0°
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV
0° 90° 180° 270° 0°
er - ave from TravelTim
70 mm 105
N64
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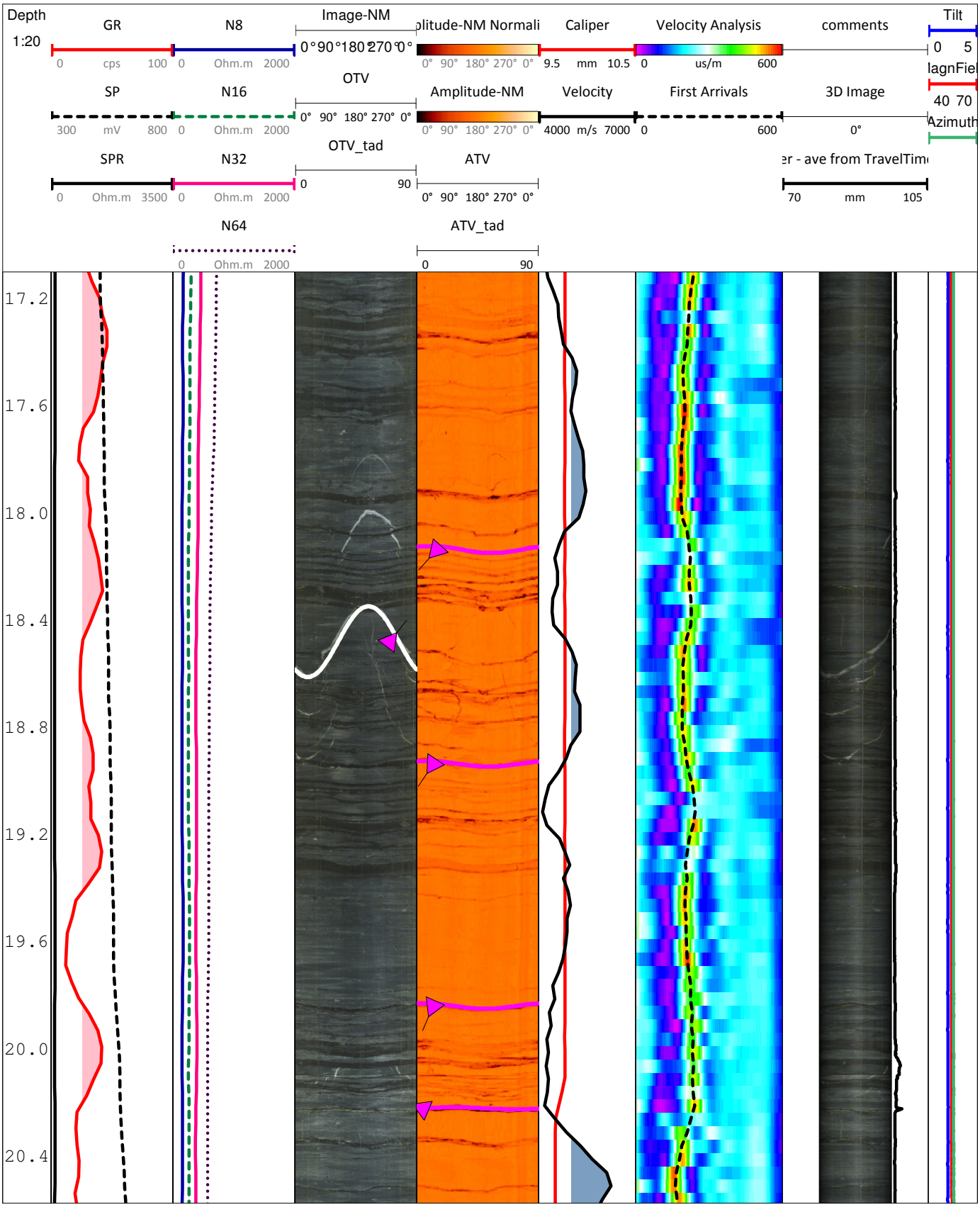
16.8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Caliper
9.5 mm 10.5
Velocity Analysis
0 us/m 600
comments
Tilt
0 5
lagnFiel
40 70
Azimuth
SP
300 mV 800
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0 Ohm.m 2000
OTV
0° 90° 180° 270° 0°
Amplitude-NM
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 600
3D Image
0°
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
0 90
ATV
0° 90° 180° 270° 0°
er - ave from TravelTim
70 mm 105
N64
0 Ohm.m 2000
ATV_tad
0 90
17.2
17.6
18.0
18.4
18.8
19.2
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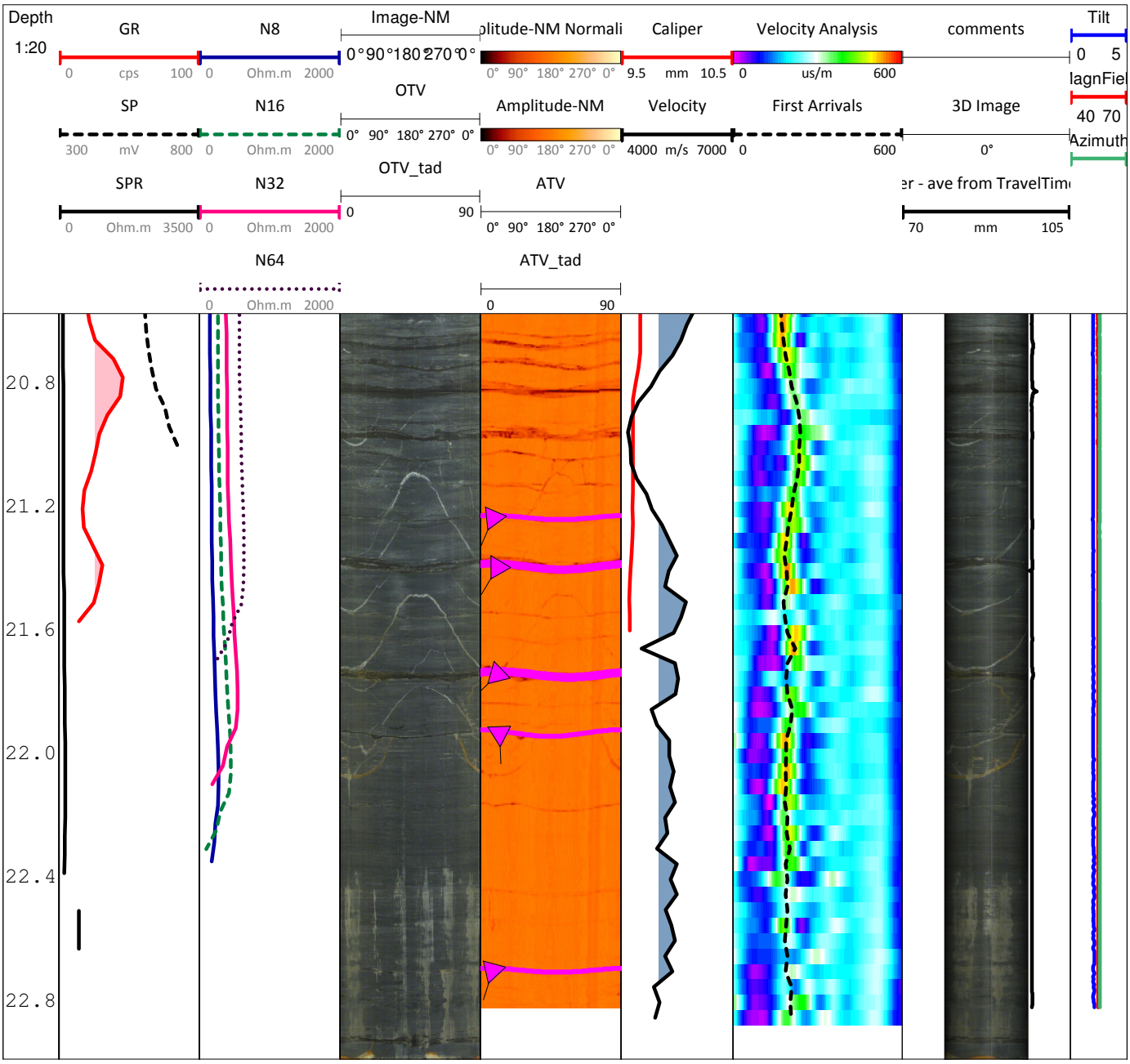
20.0
20.4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Caliper
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Velocity Analysis
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comments
Tilt
0 5
lagnFiel
40 70
Azimuth
SP
300 mV 800
N16
0 Ohm.m 2000
OTV
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Amplitude-NM
0° 90° 180° 270° 0°
Velocity
4000 m/s 7000
First Arrivals
0 600
3D Image
0°
SPR
0 Ohm.m 3500
N32
0 Ohm.m 2000
OTV_tad
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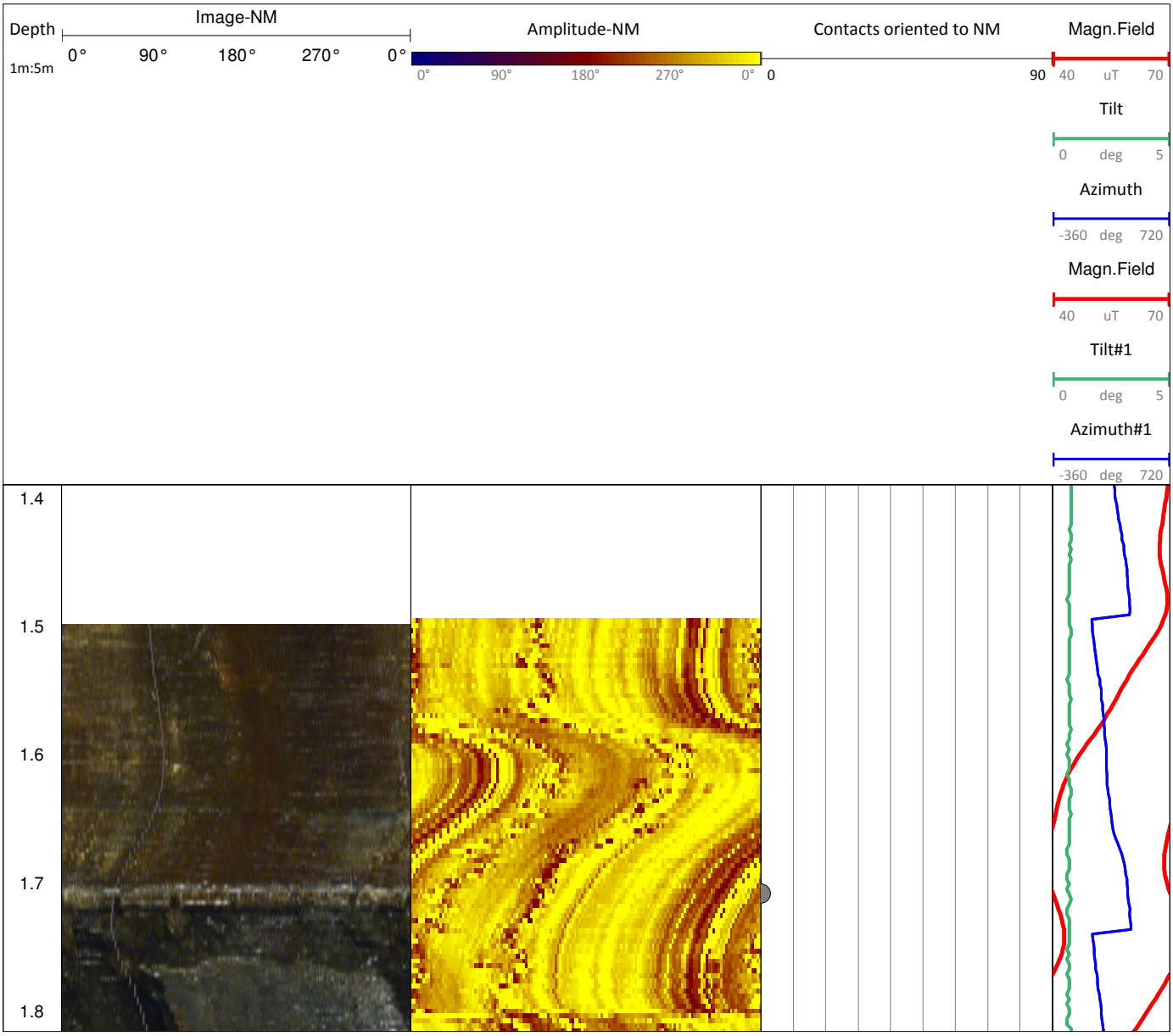
ATV
0° 90° 180° 270° 0°
er - ave from TravelTim
70 mm 105
N64
0 Ohm.m 2000
ATV_tad
0 90
20.8
21.2
21.6
22.0
22.4
22.8

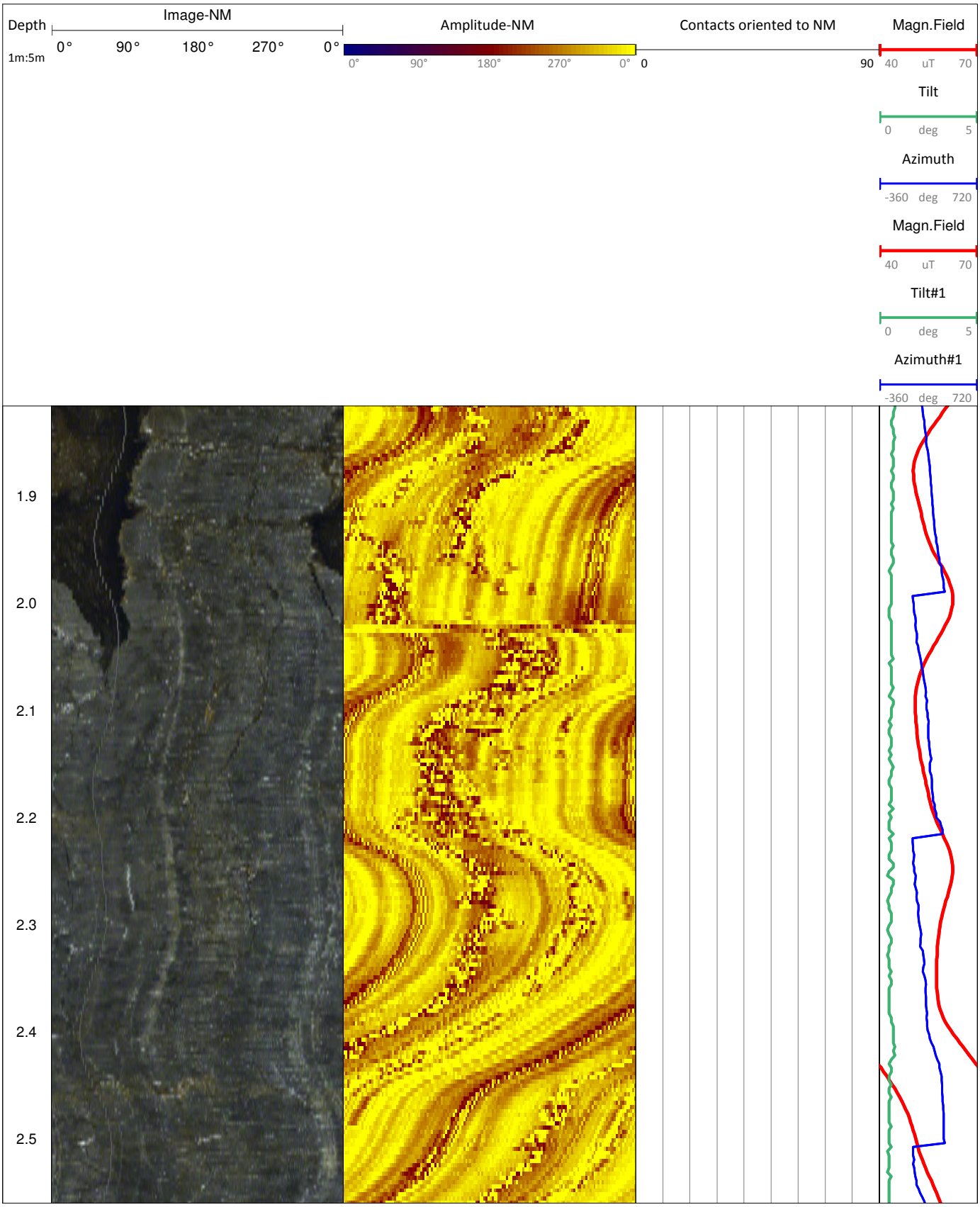
GEOPHYSICS GPR INTERNATIONAL INC.

COMPANY :	VISITORS WELCOME CENTRE PHASE 1
LOCATION :	Parliament Hill, Ottawa, Ontario

Well	BH1V		
Date	December 5 2013	BH Fluid	
Casing	3 3/4" inside diameter		
File Name	BH1V.wcl		
Depth Driller			
Depth Logger	23 m		
Logged by	C. Coatsworth		
Witnessed by			

NOTES:
Tool zeroed at ground level.
Casing is 0.117m below ground.
Water is 2.78 m below ground level.

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180°
270°
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Contacts oriented to NM
0
90
Magn.Field
40
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Tilt
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deg
5
Azimuth
-360
deg
720
Magn.Field
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uT
70
Tilt#1
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deg
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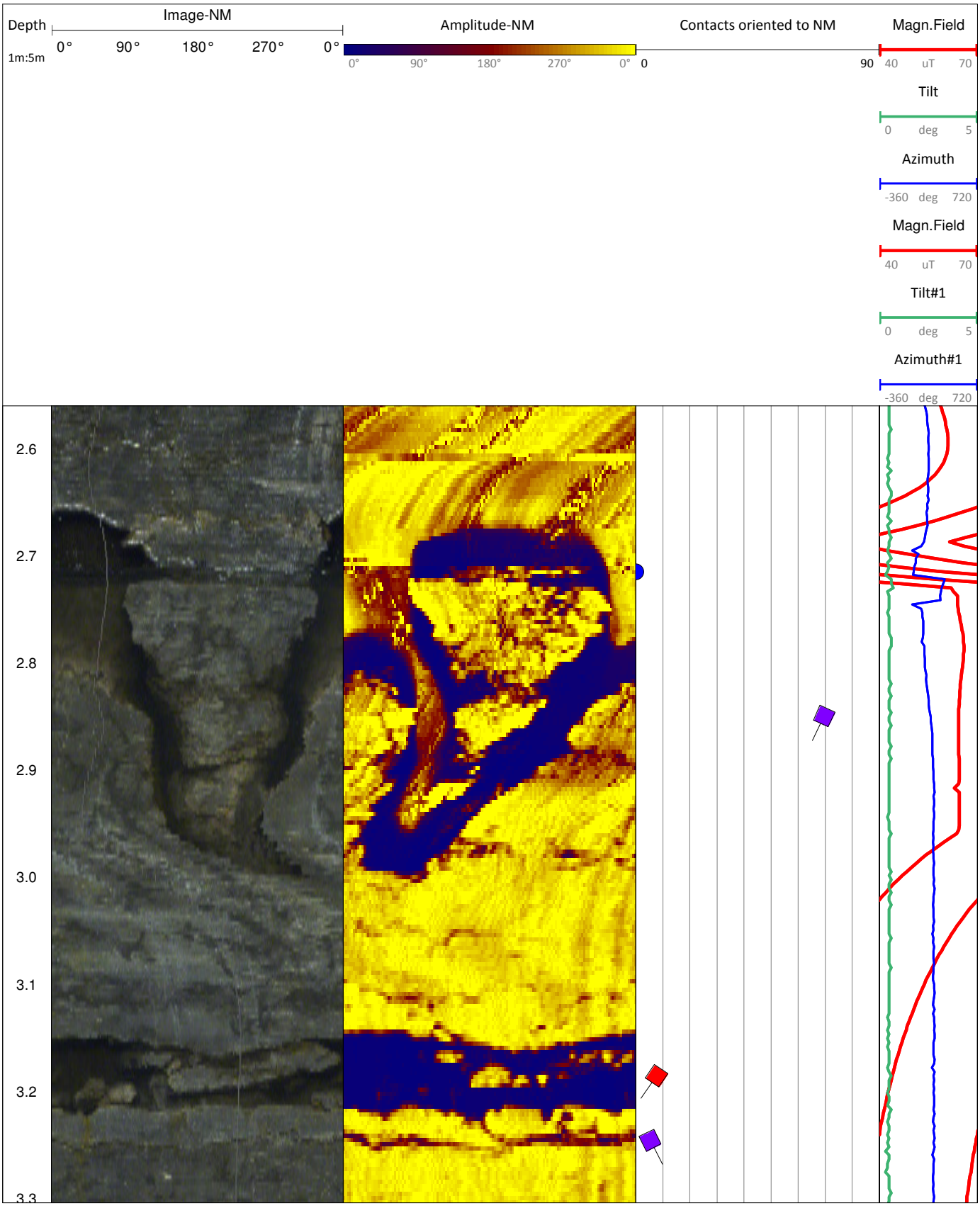
2.4
2.5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Contacts oriented to NM
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Magn.Field
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Magn.Field
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2.9
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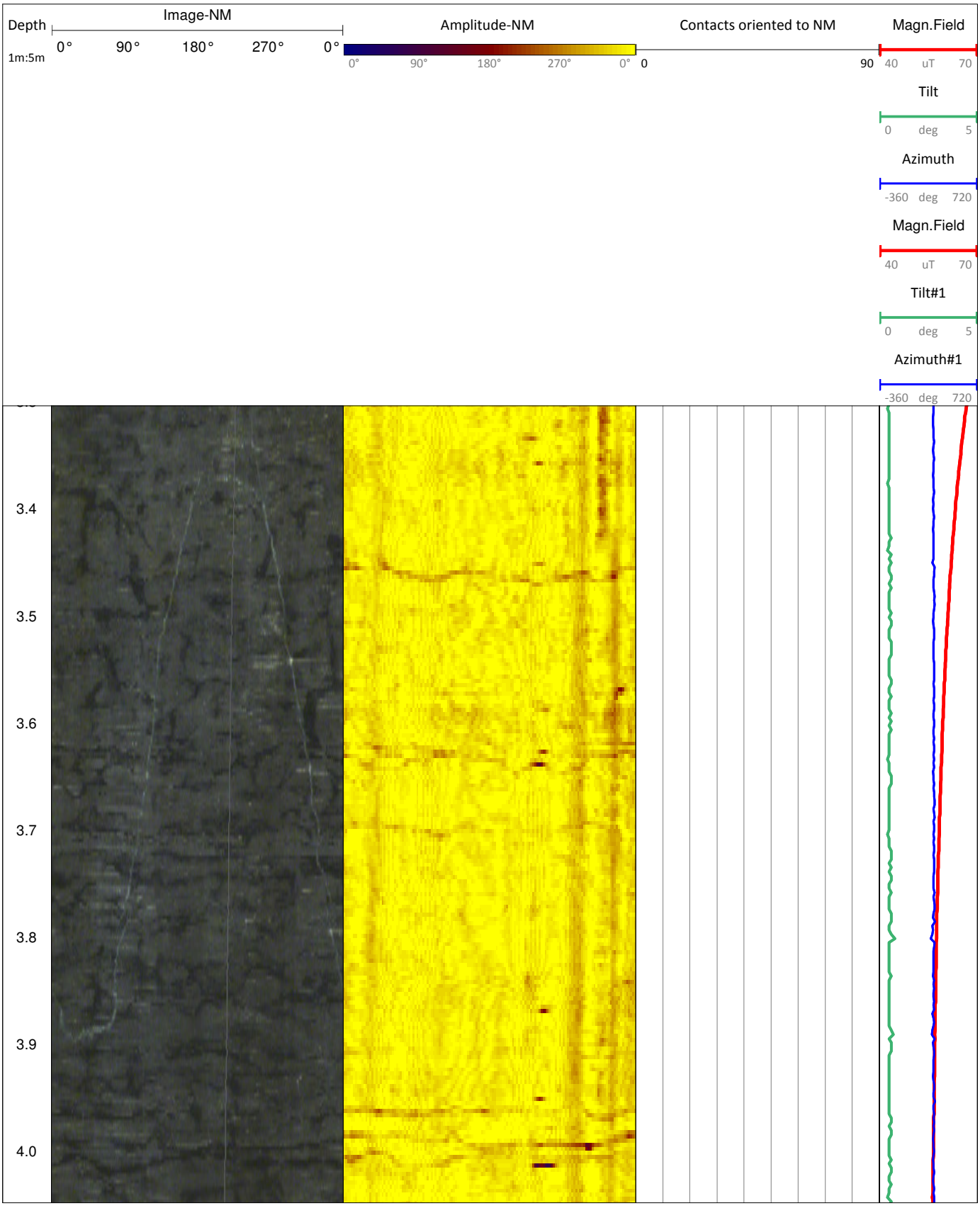
3.3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Contacts oriented to NM
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Magn.Field
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Tilt#1
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3.4
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3.7
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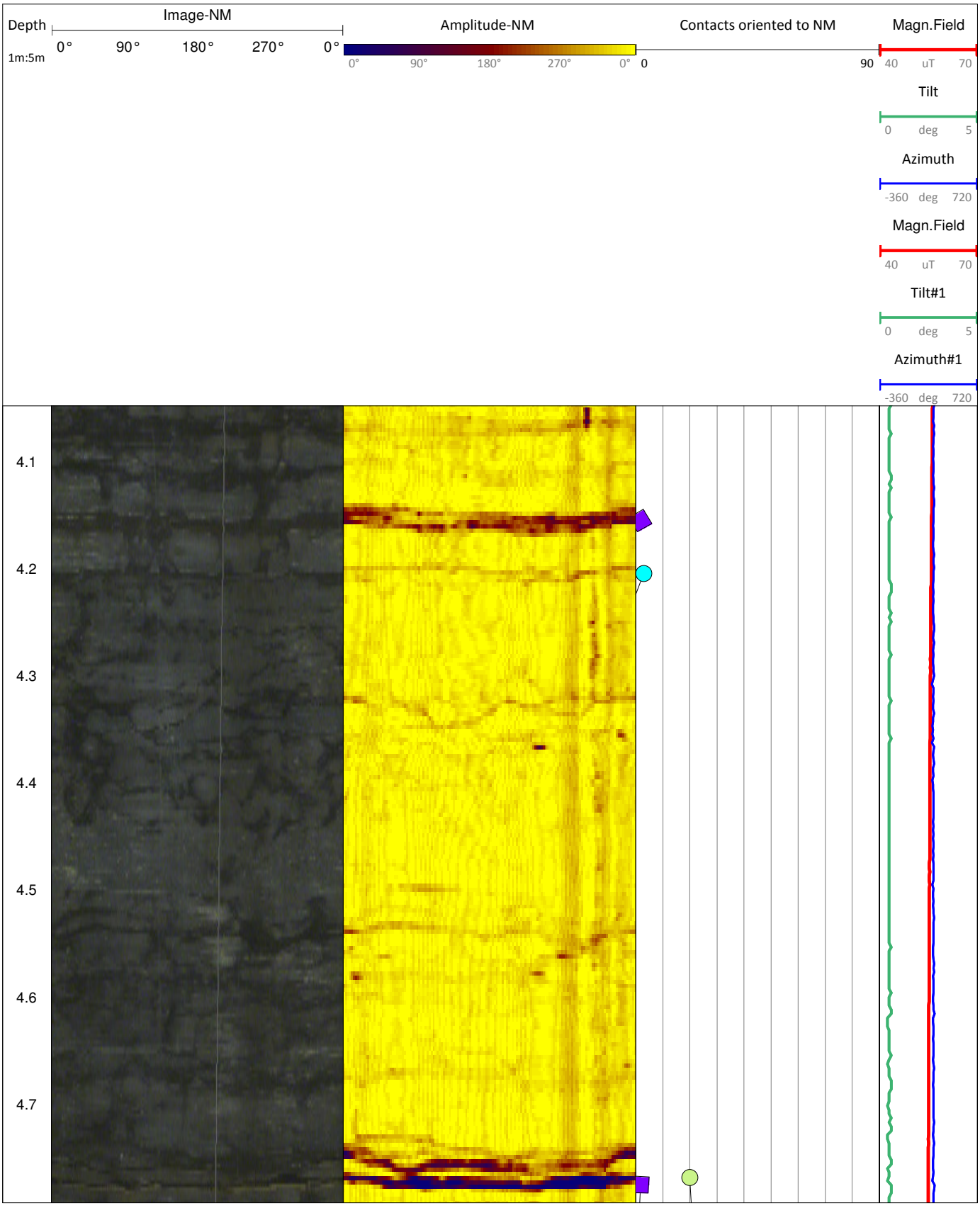
3.9
4.0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Contacts oriented to NM
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Magn.Field
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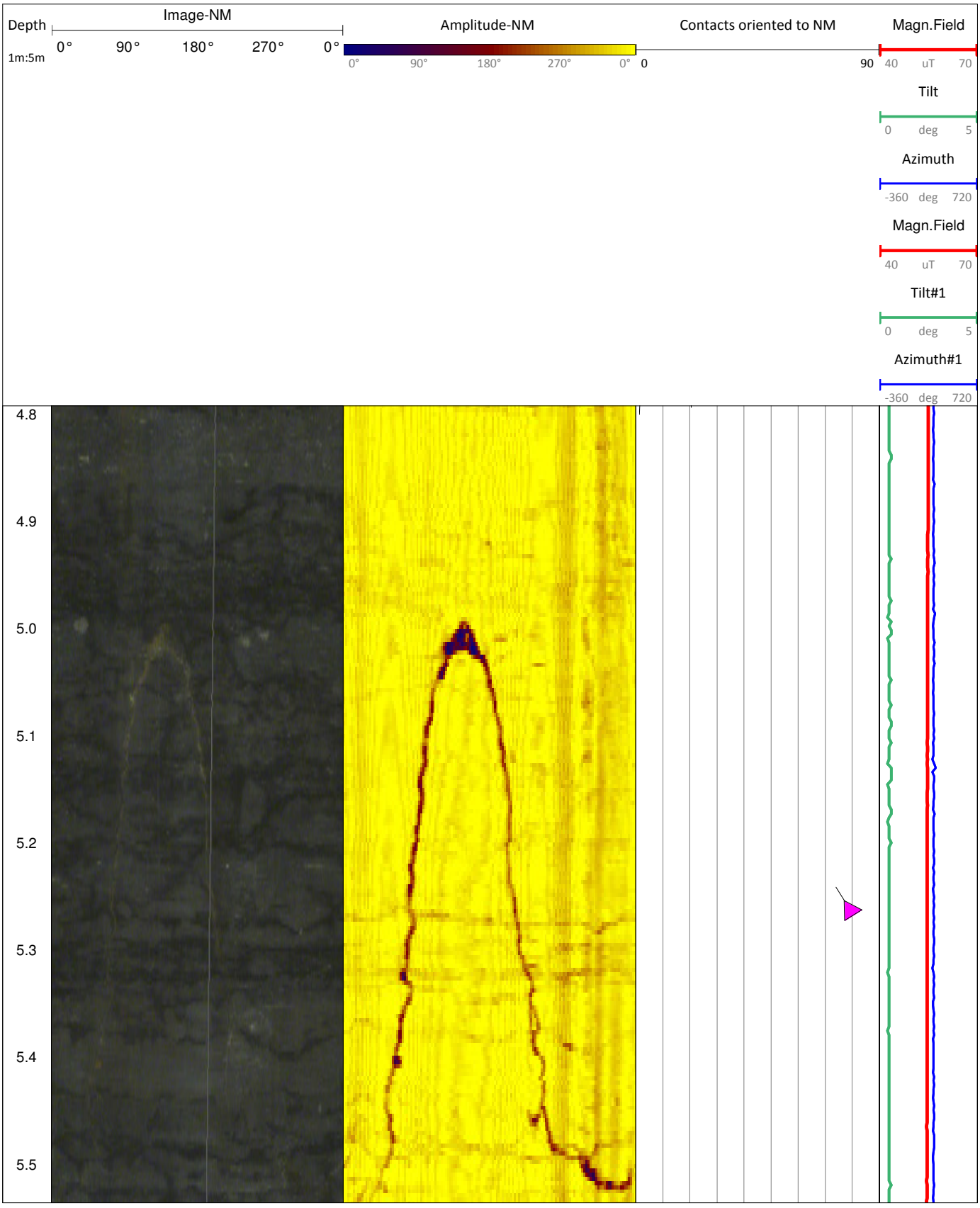
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Contacts oriented to NM
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Magn.Field
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Magn.Field
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Tilt#1
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4.9
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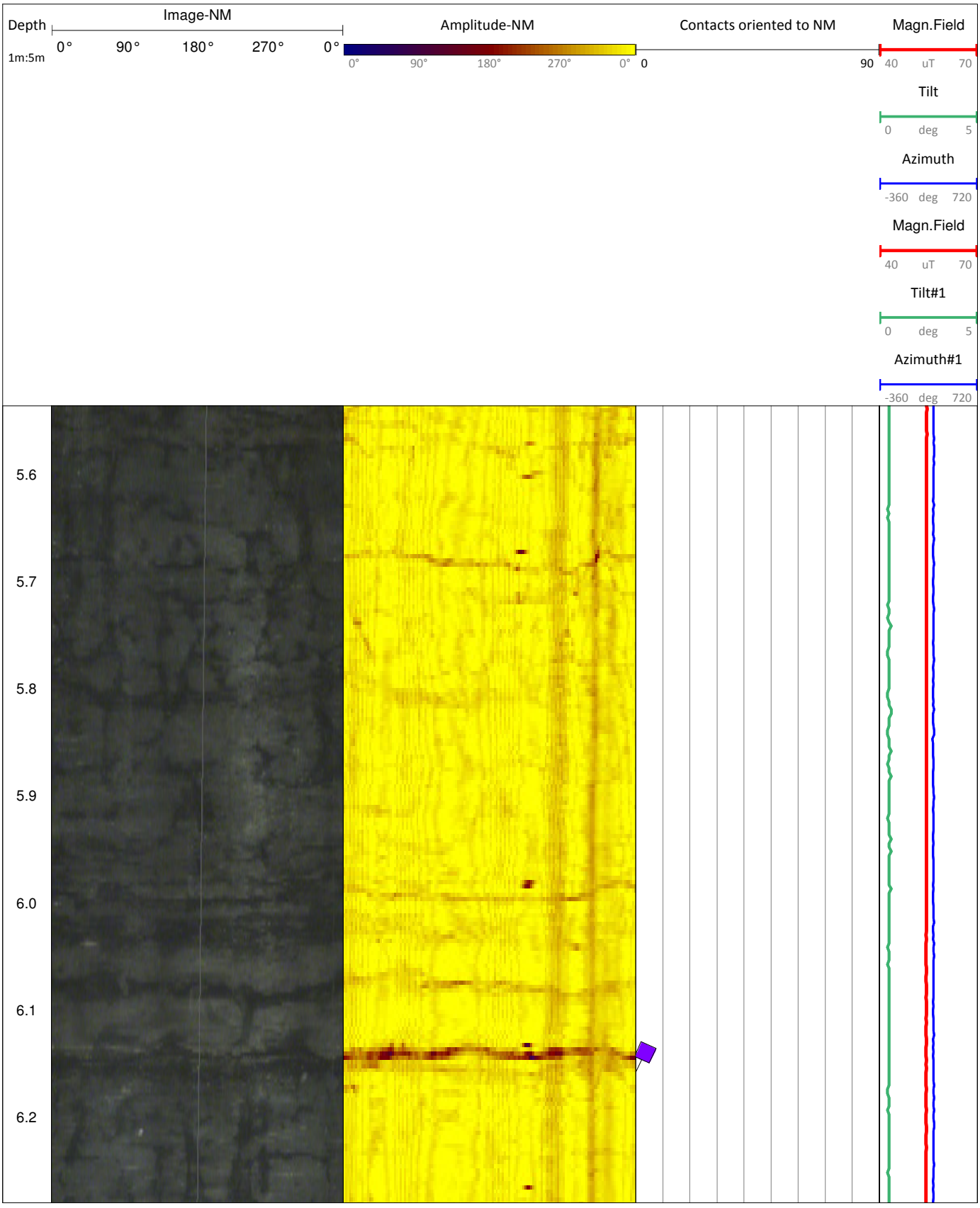
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Contacts oriented to NM
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Magn.Field
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Tilt
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Azimuth
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Magn.Field
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Tilt#1
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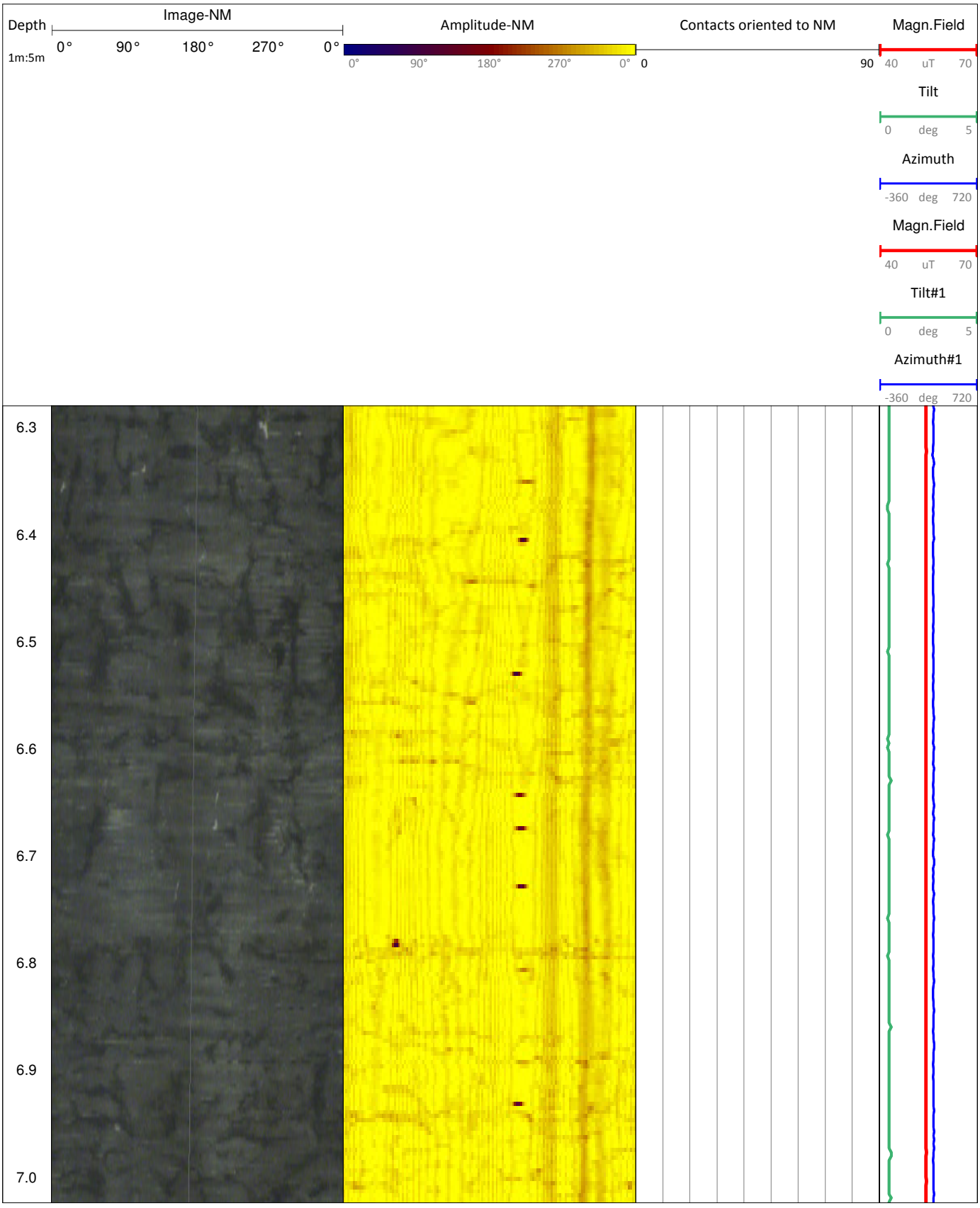
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Contacts oriented to NM
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Magn.Field
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Tilt
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Azimuth
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Magn.Field
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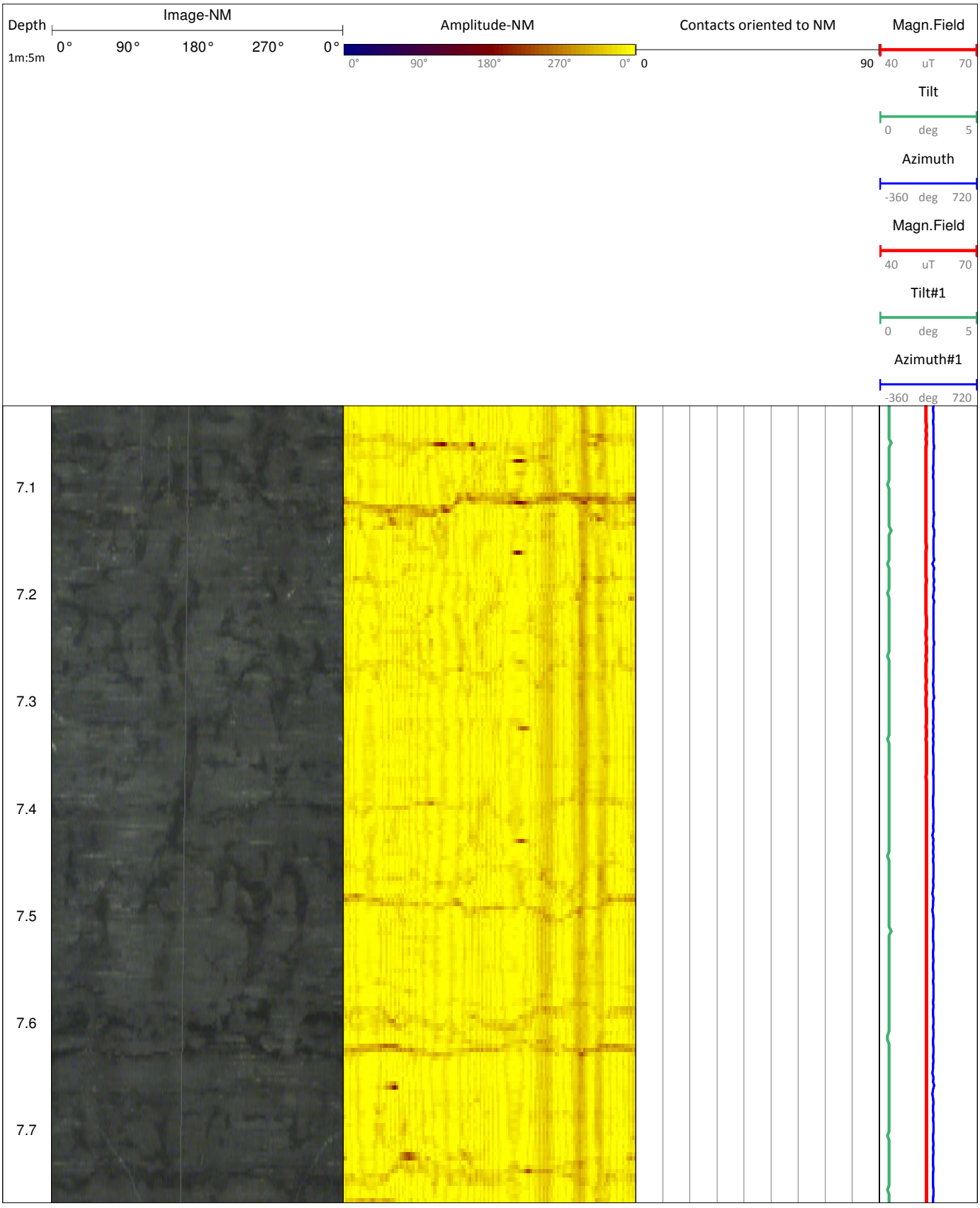
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Contacts oriented to NM
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Magn.Field
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Tilt
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Azimuth
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720
Magn.Field
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uT
70
Tilt#1
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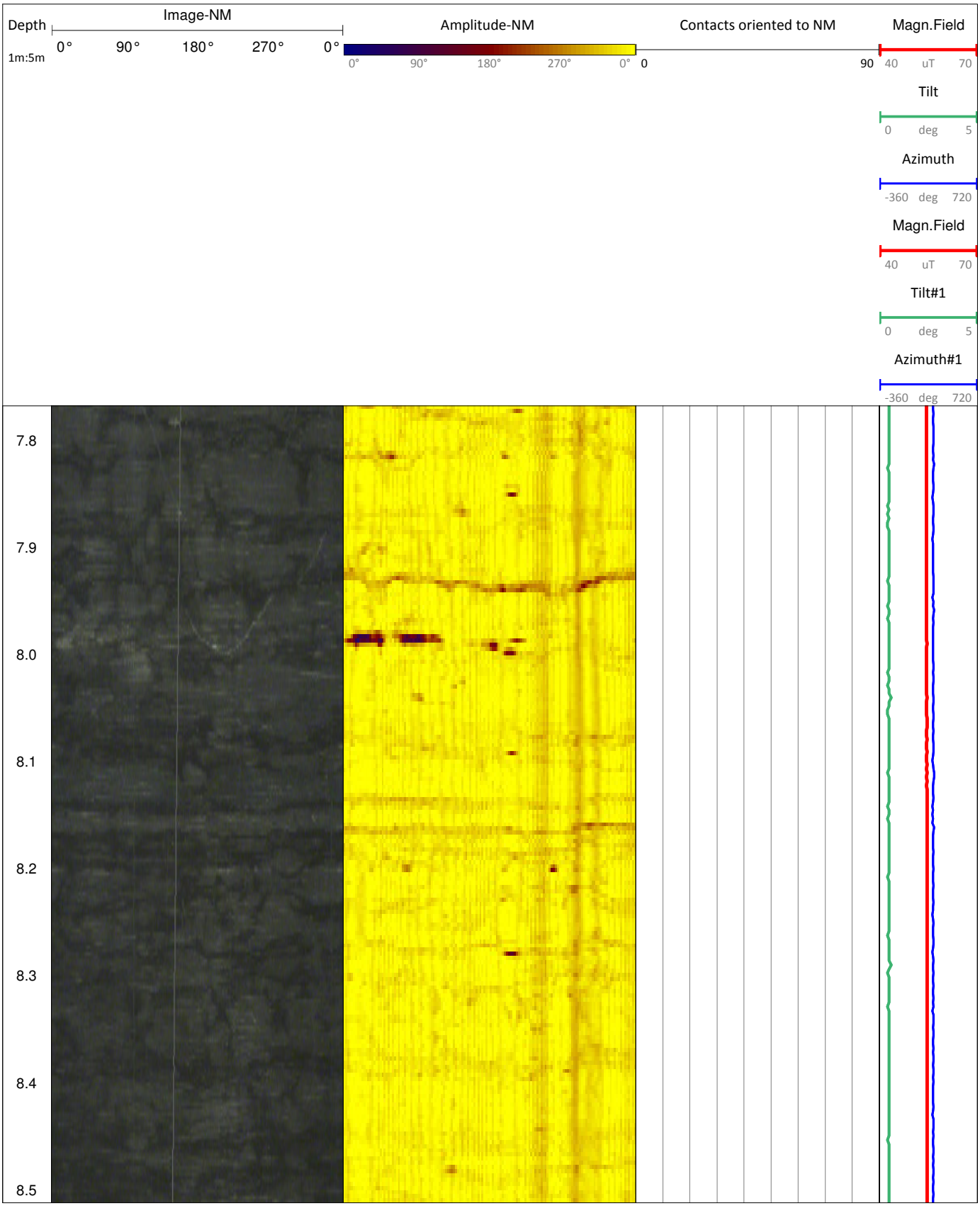
7.7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Contacts oriented to NM
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Tilt
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Azimuth
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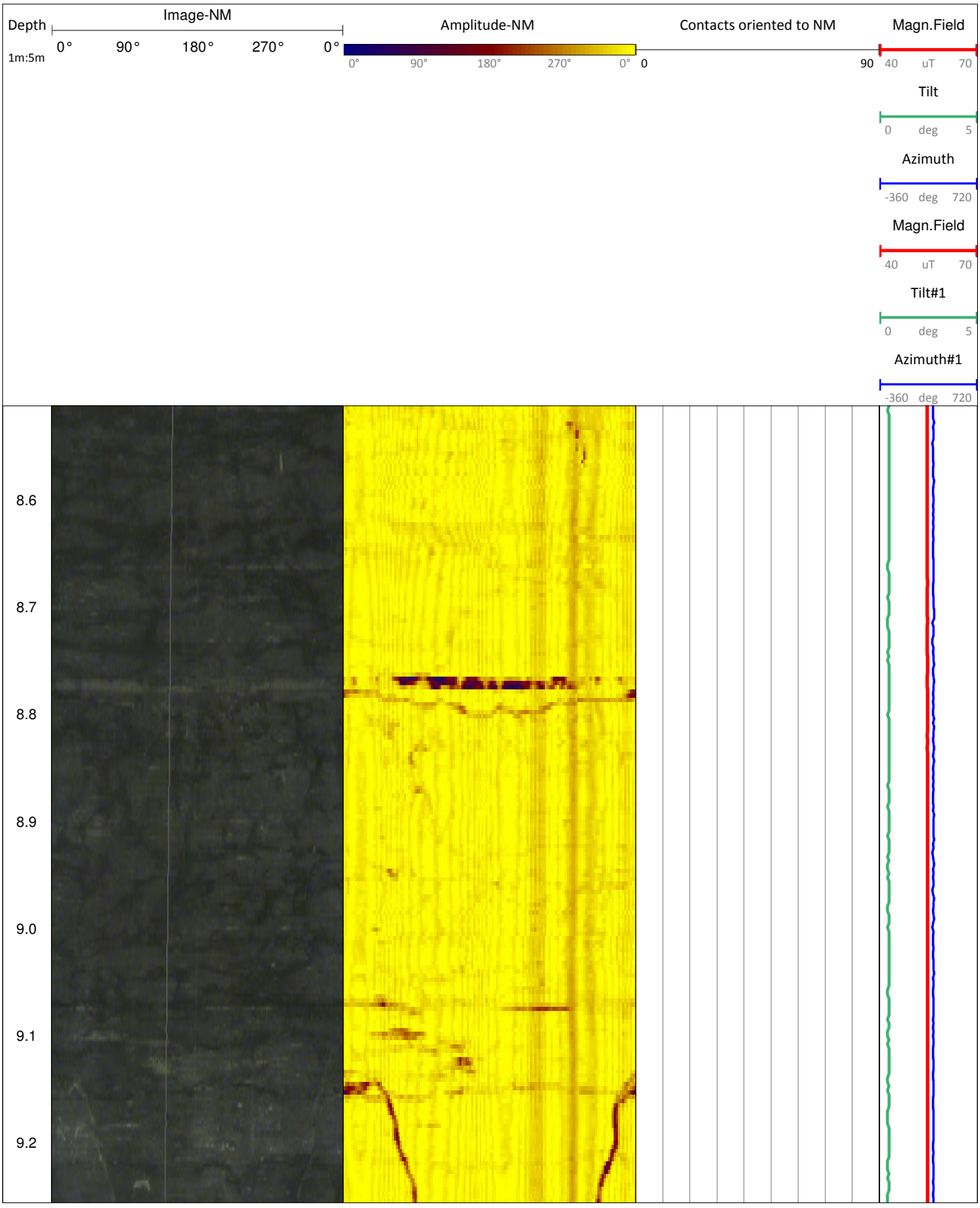
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Contacts oriented to NM
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Magn.Field
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Tilt
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Azimuth
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720
Magn.Field
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Tilt#1
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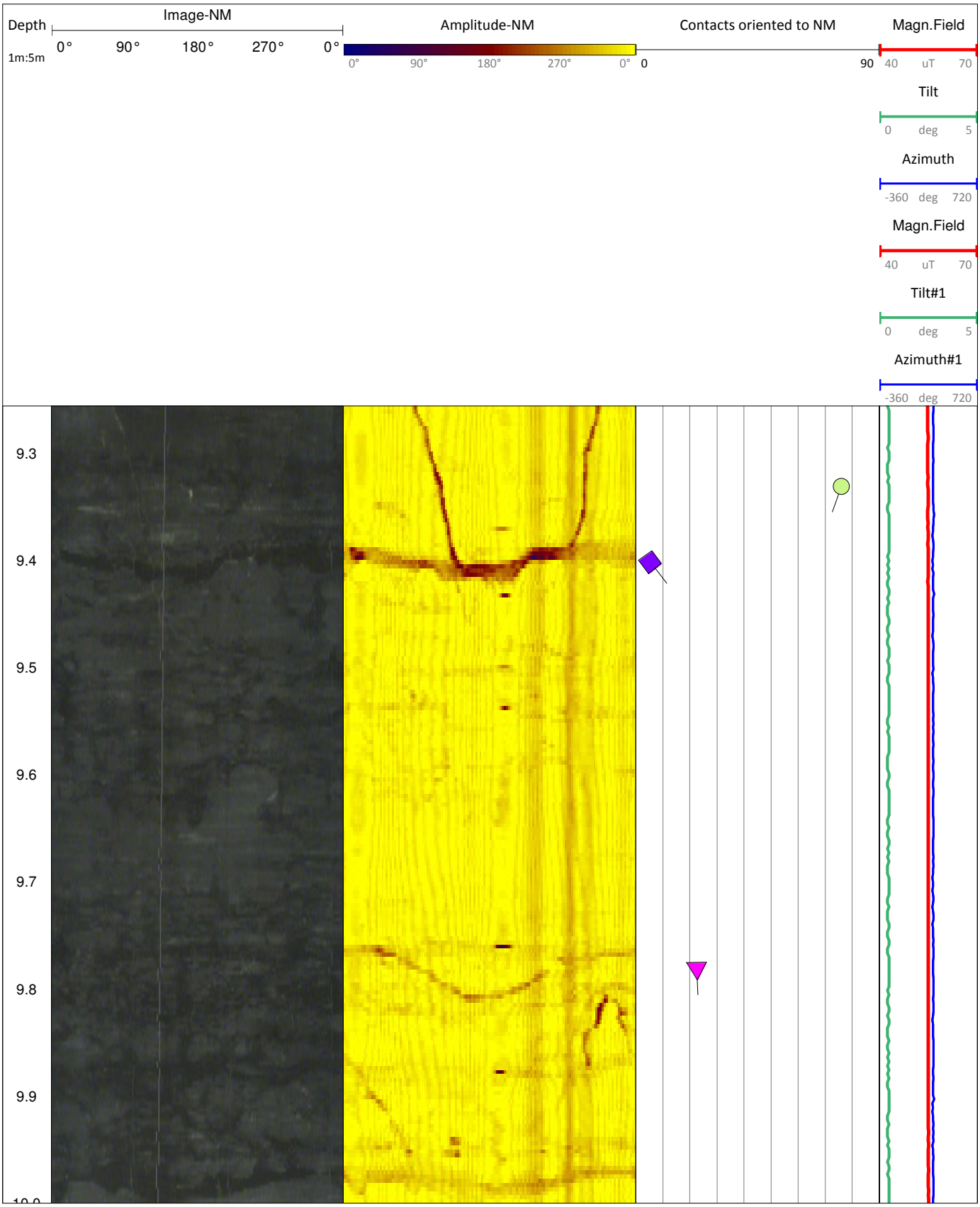
9.2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Contacts oriented to NM
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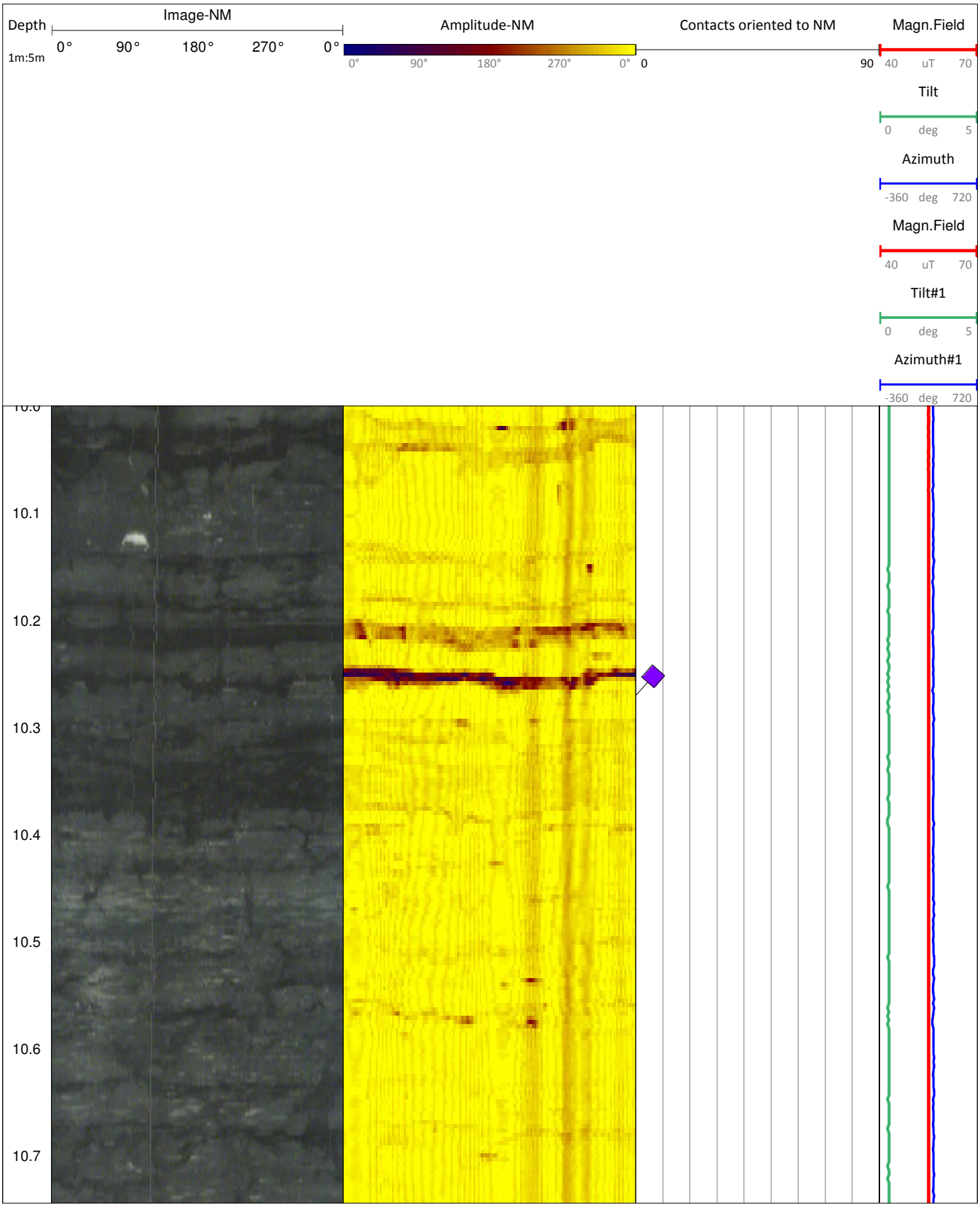
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Contacts oriented to NM
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Azimuth
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Magn.Field
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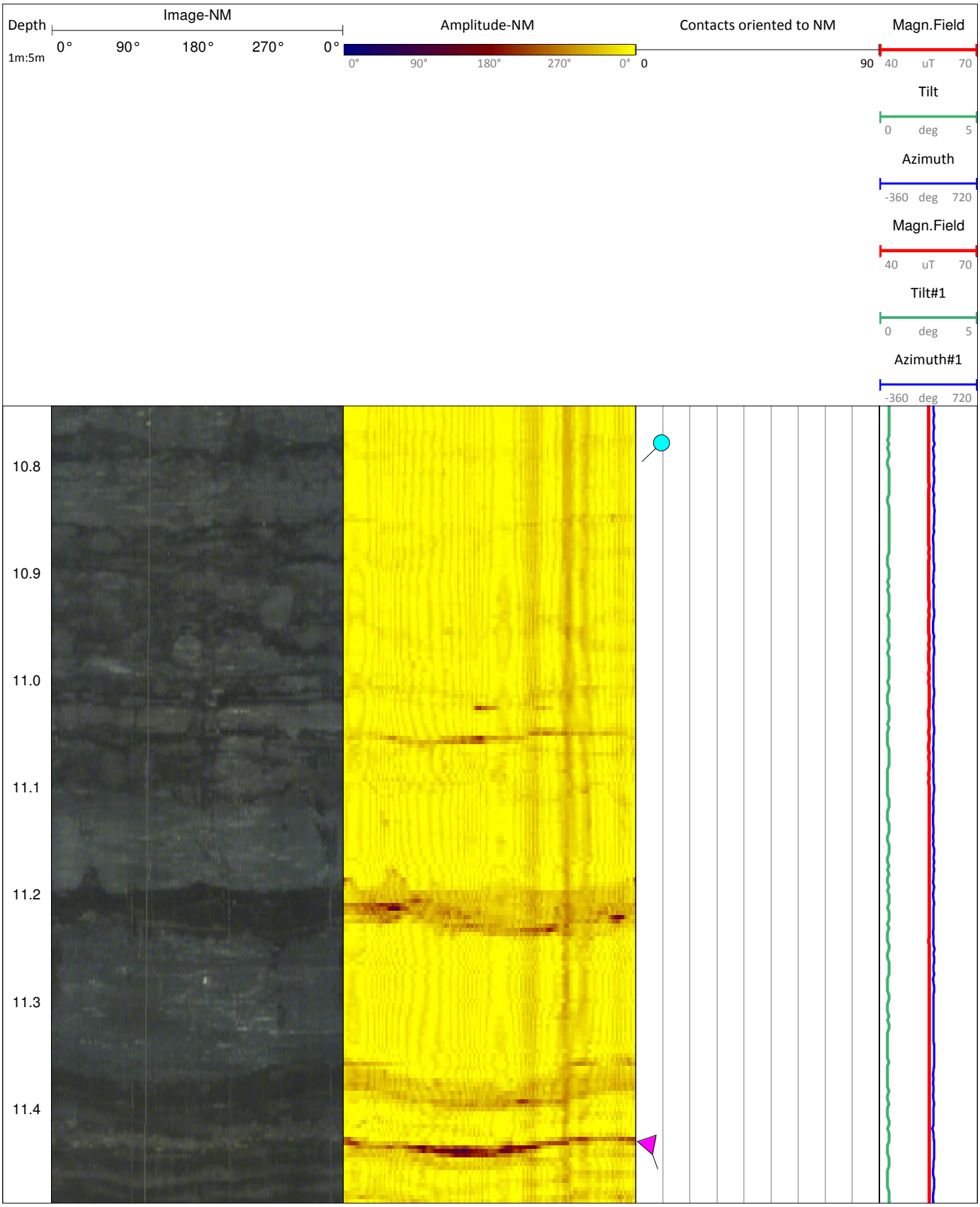
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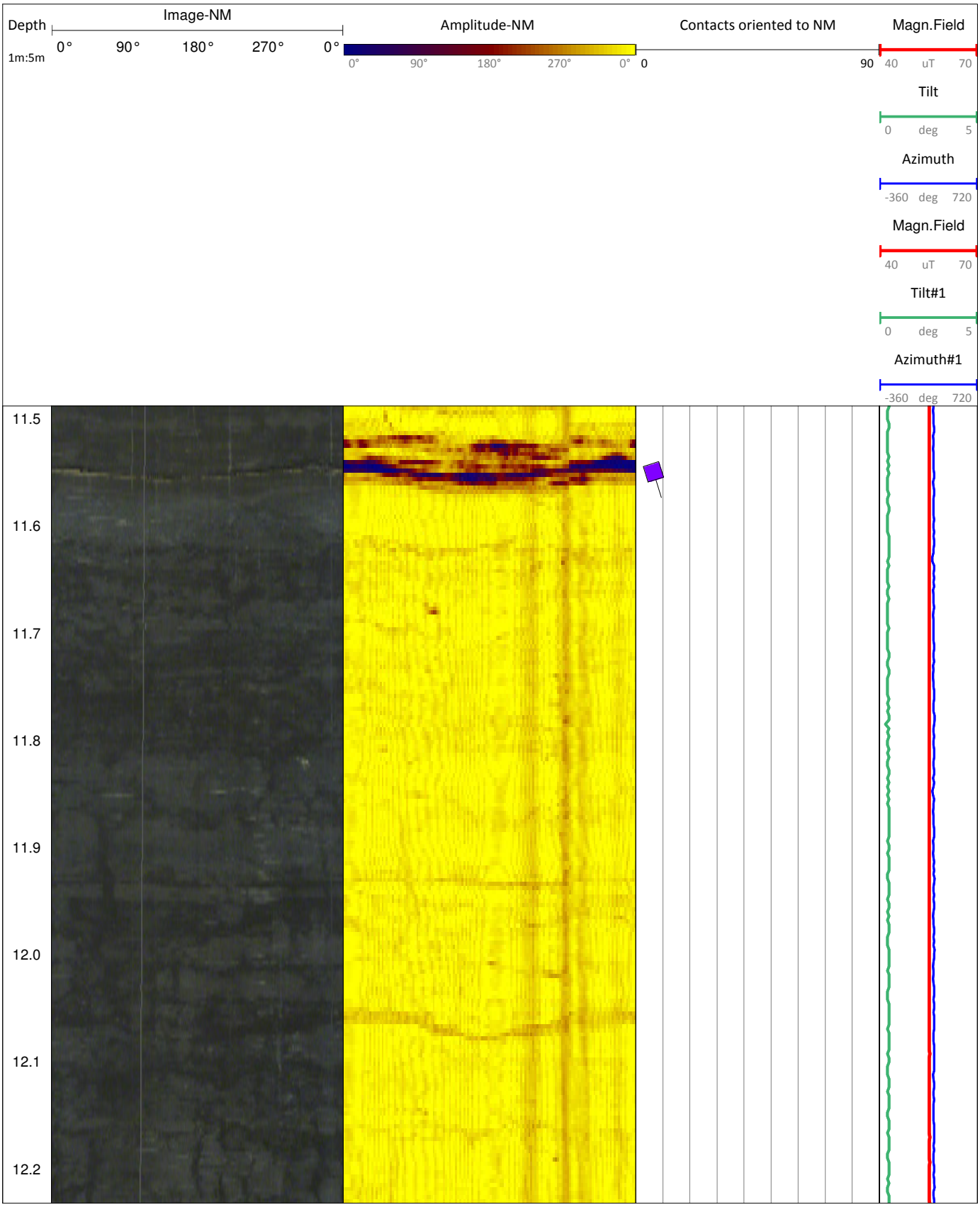
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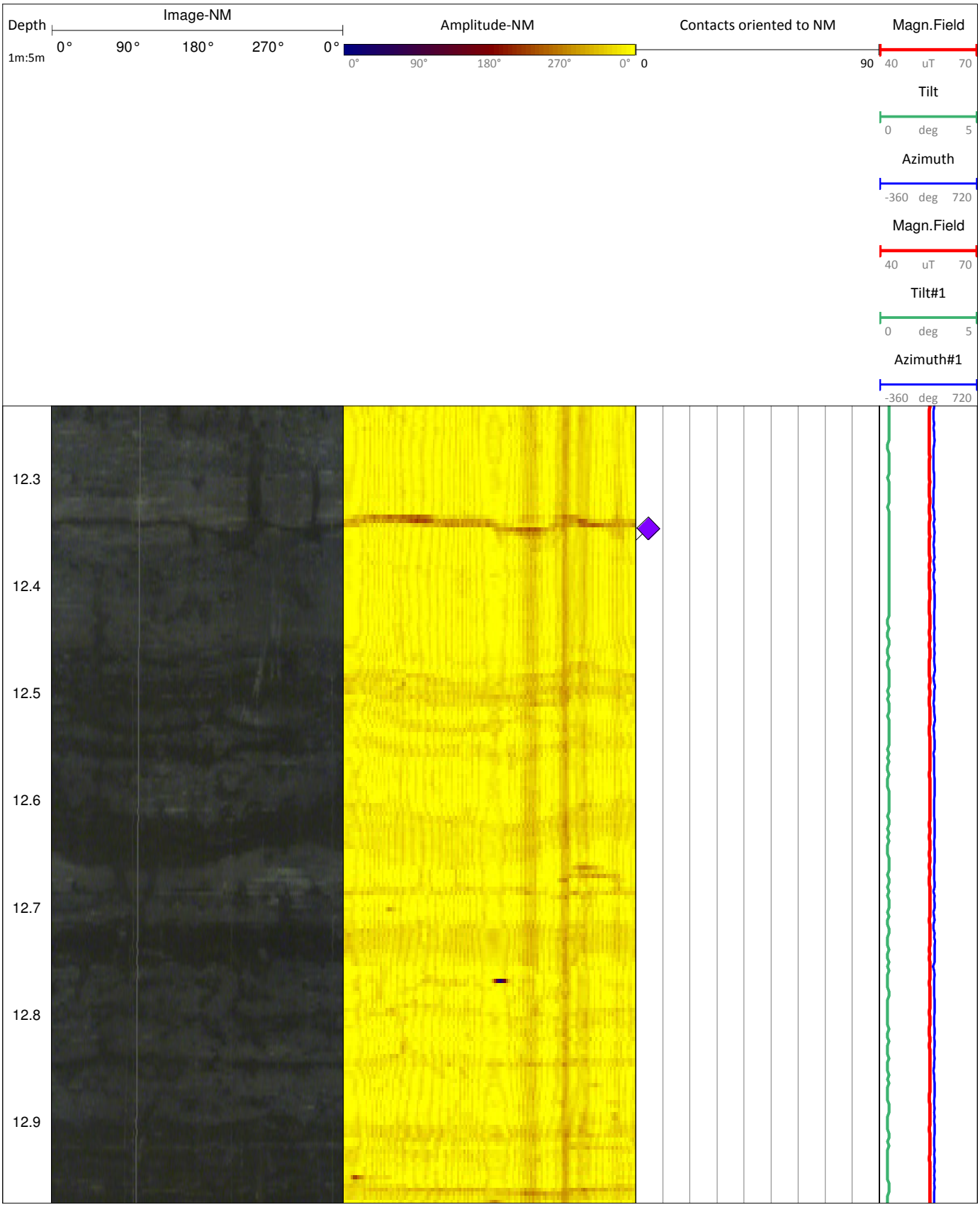
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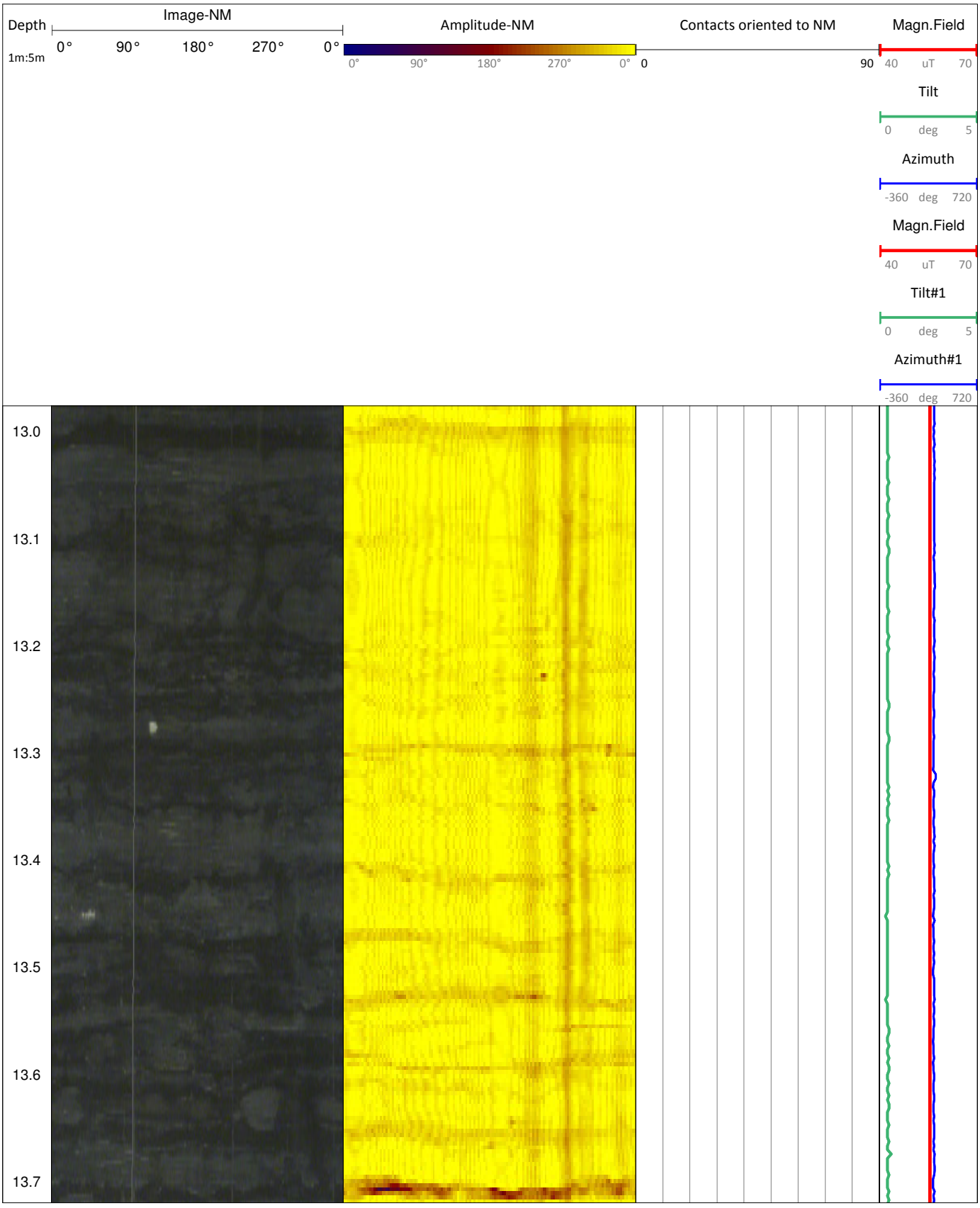
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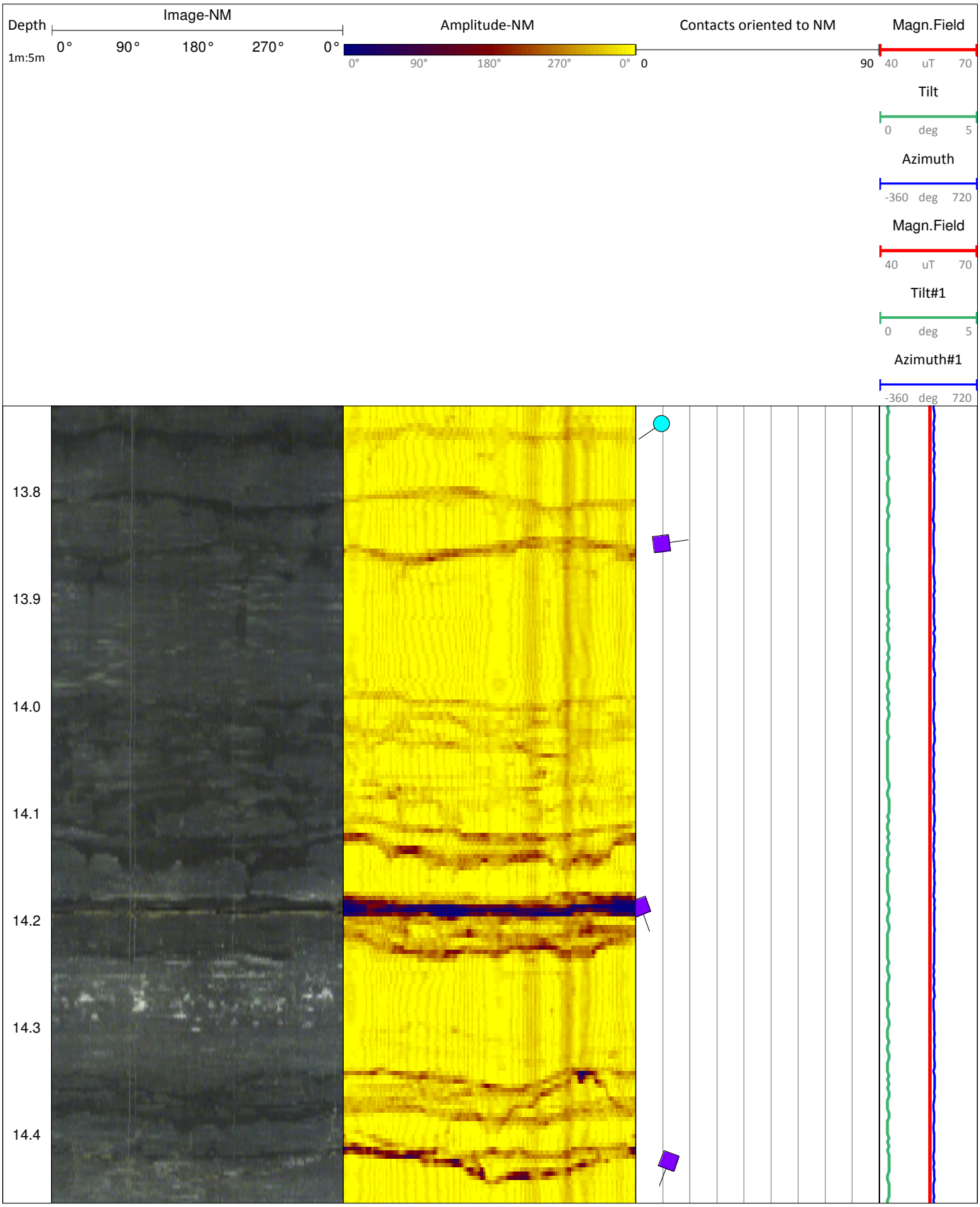
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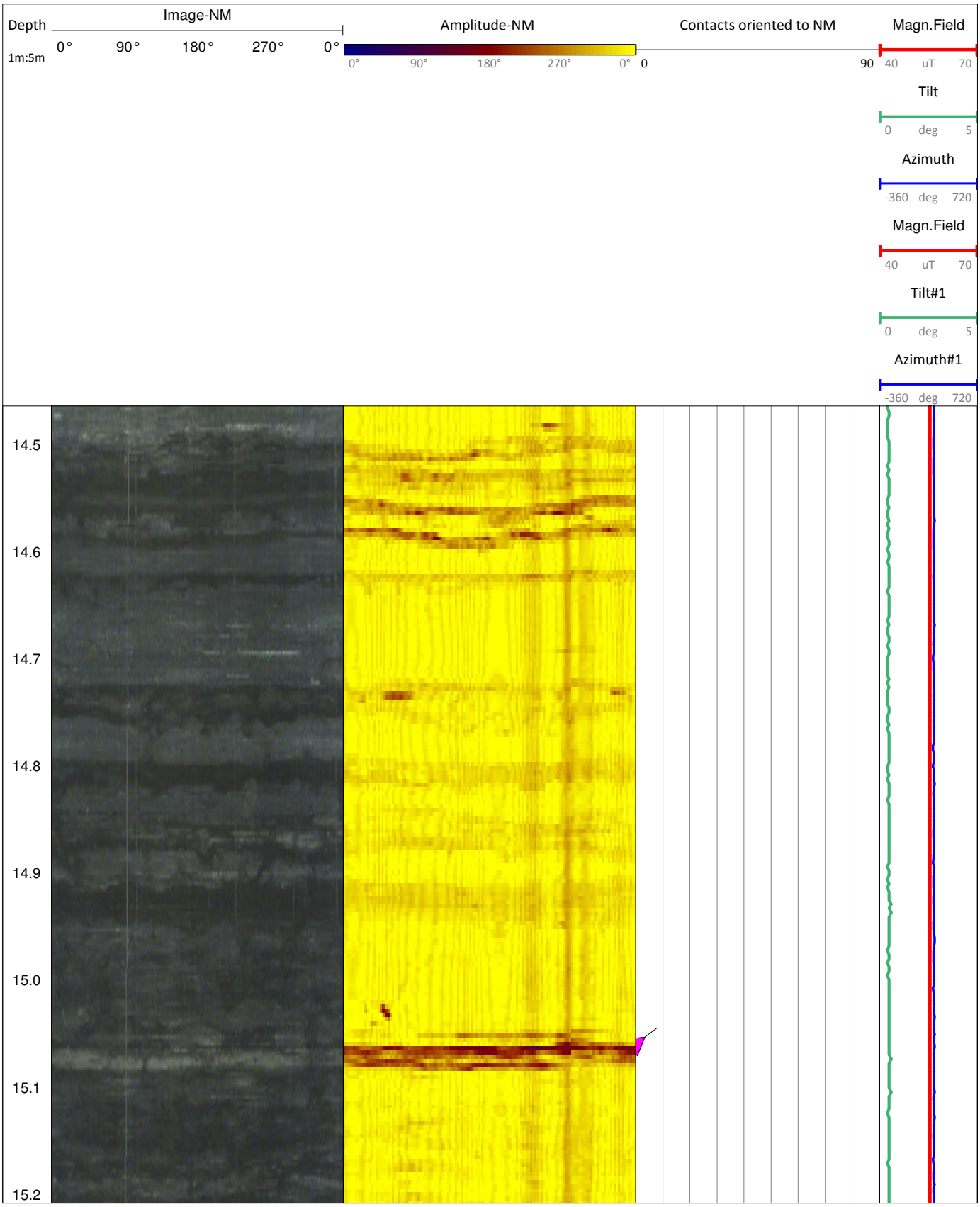
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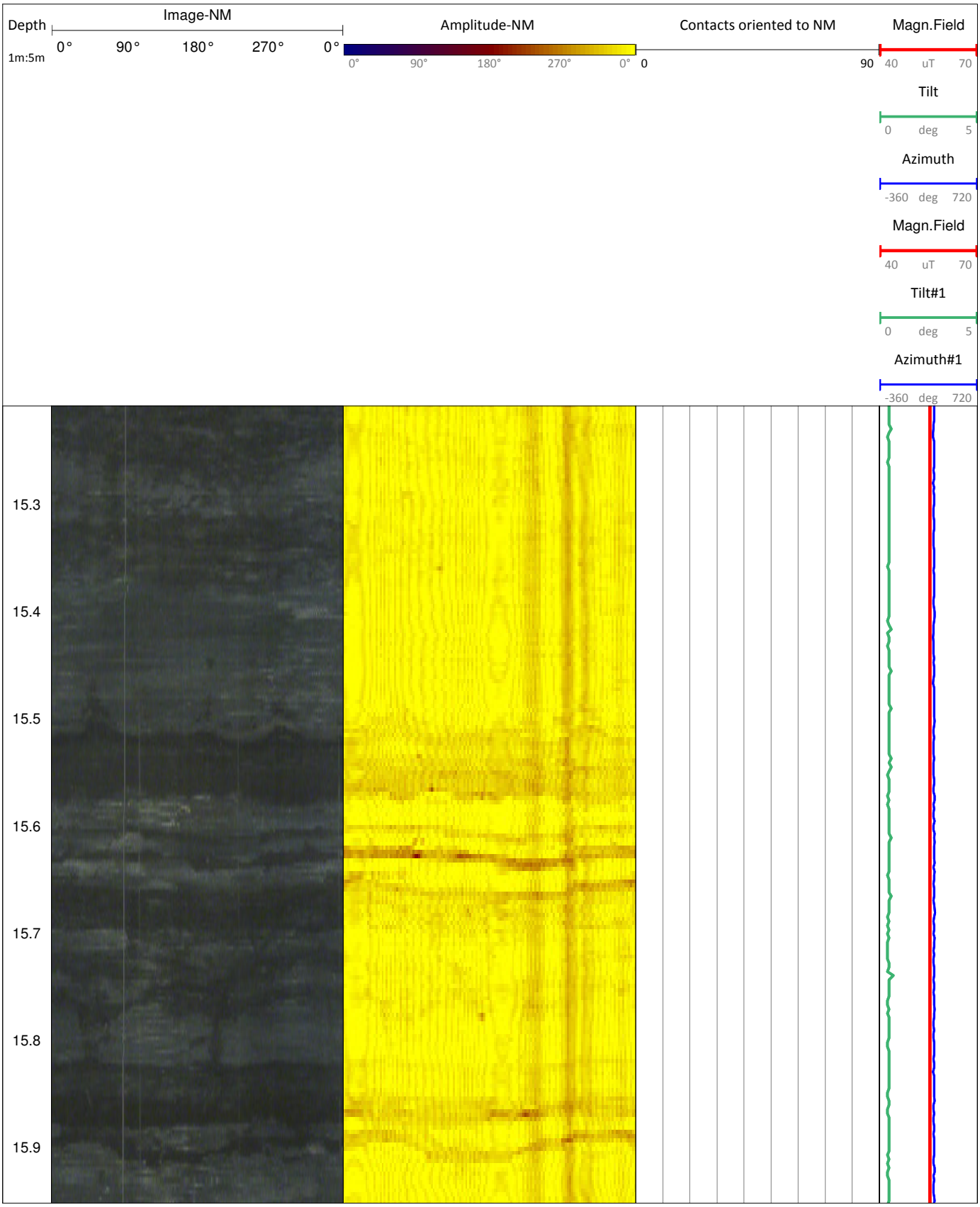
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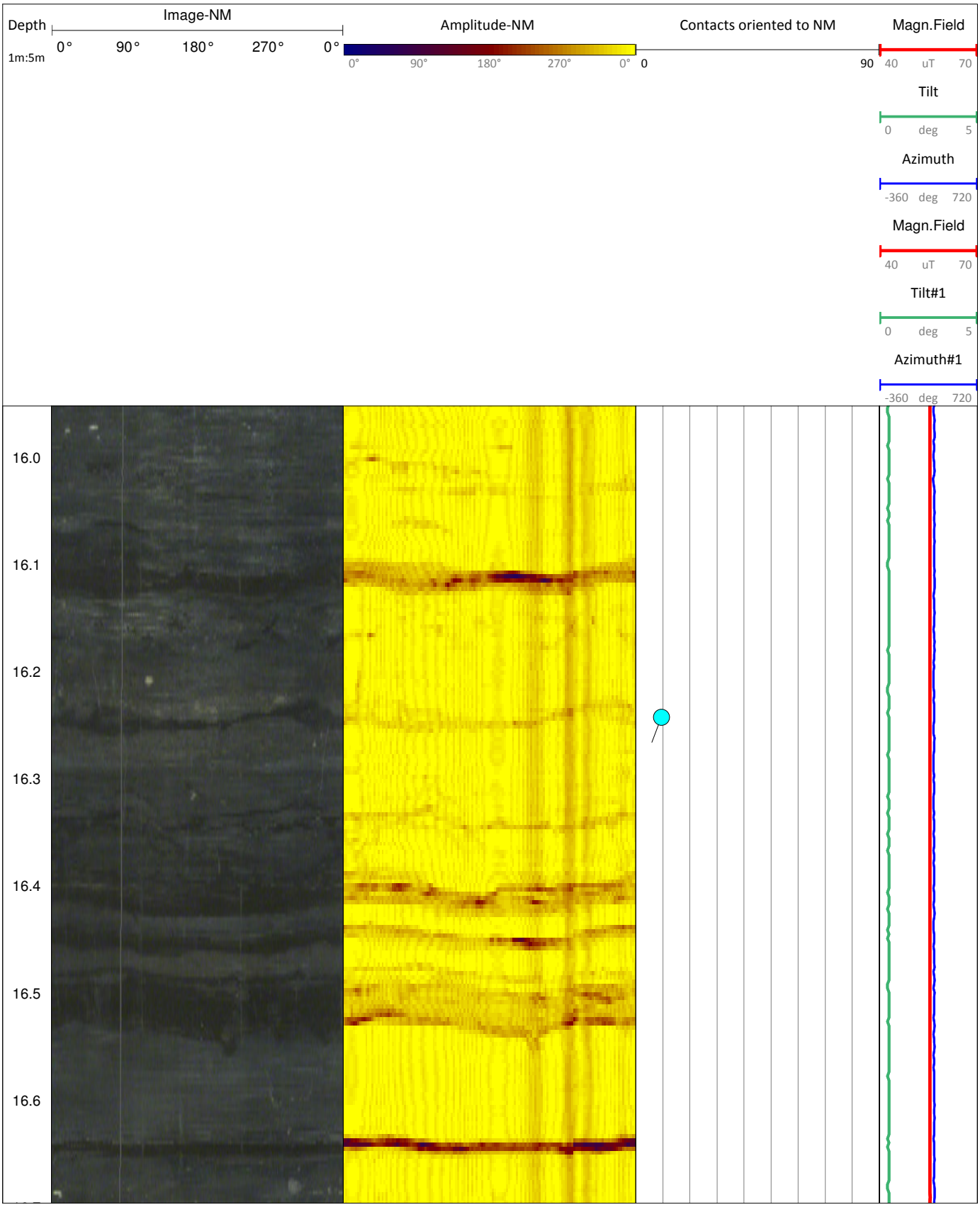
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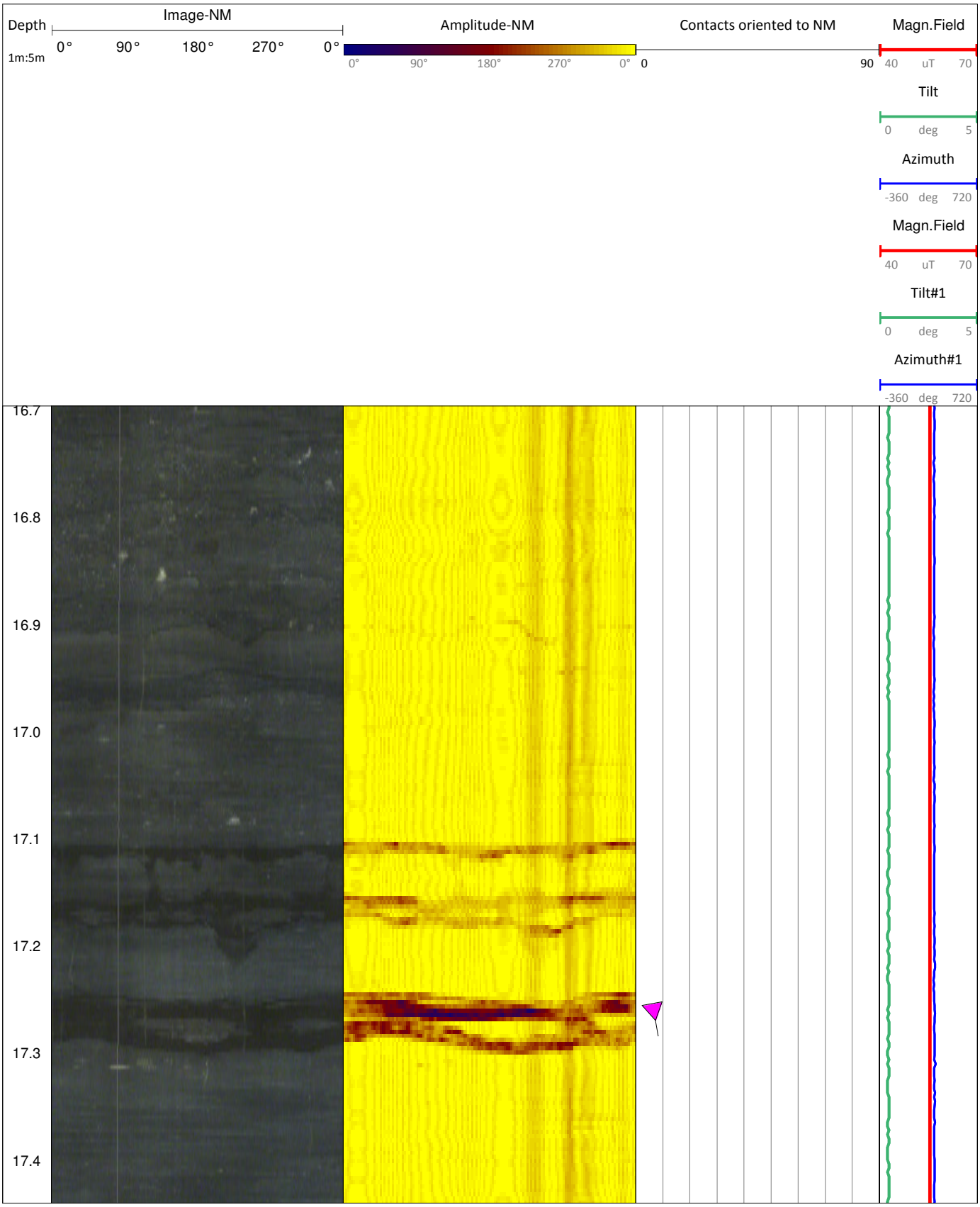
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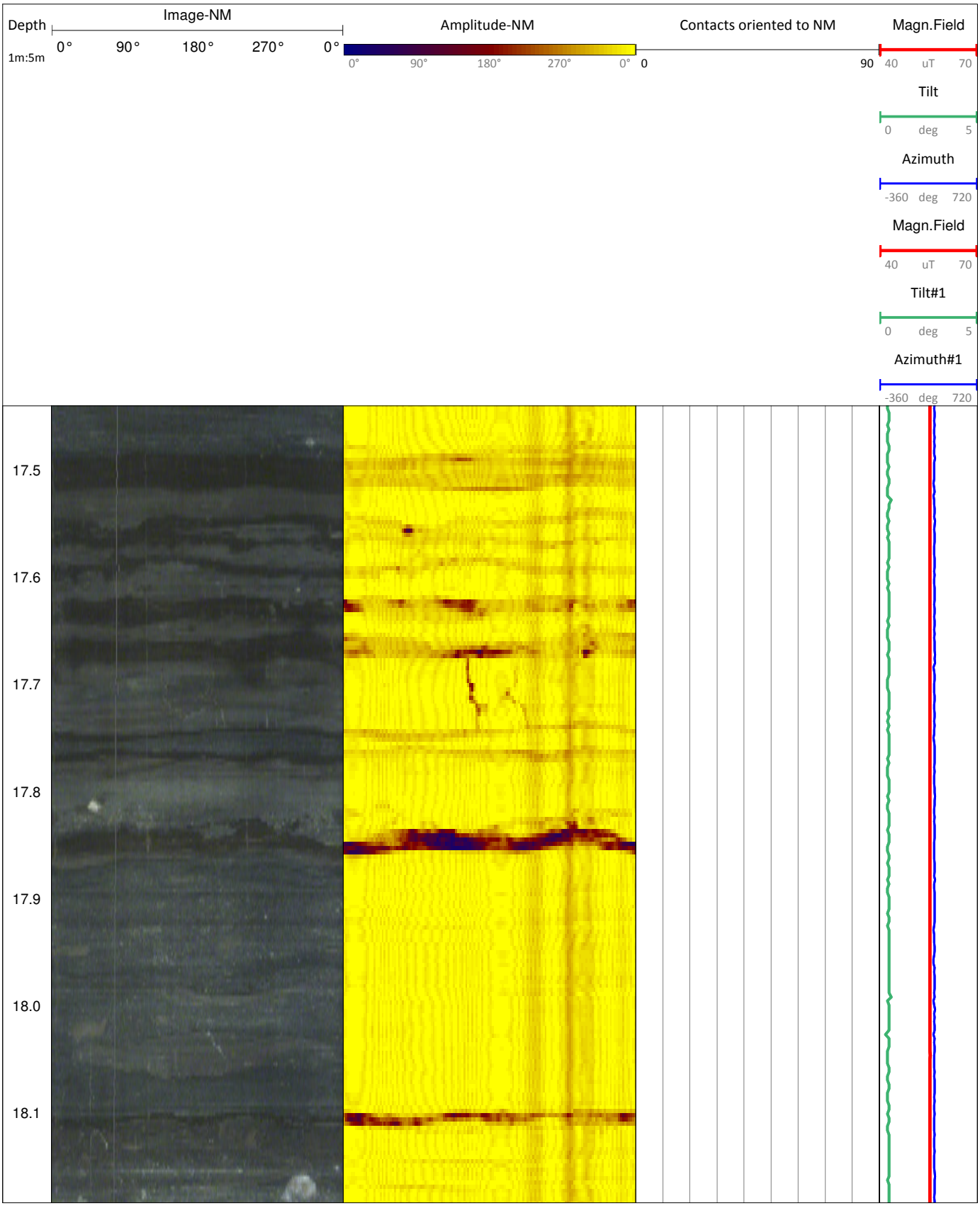
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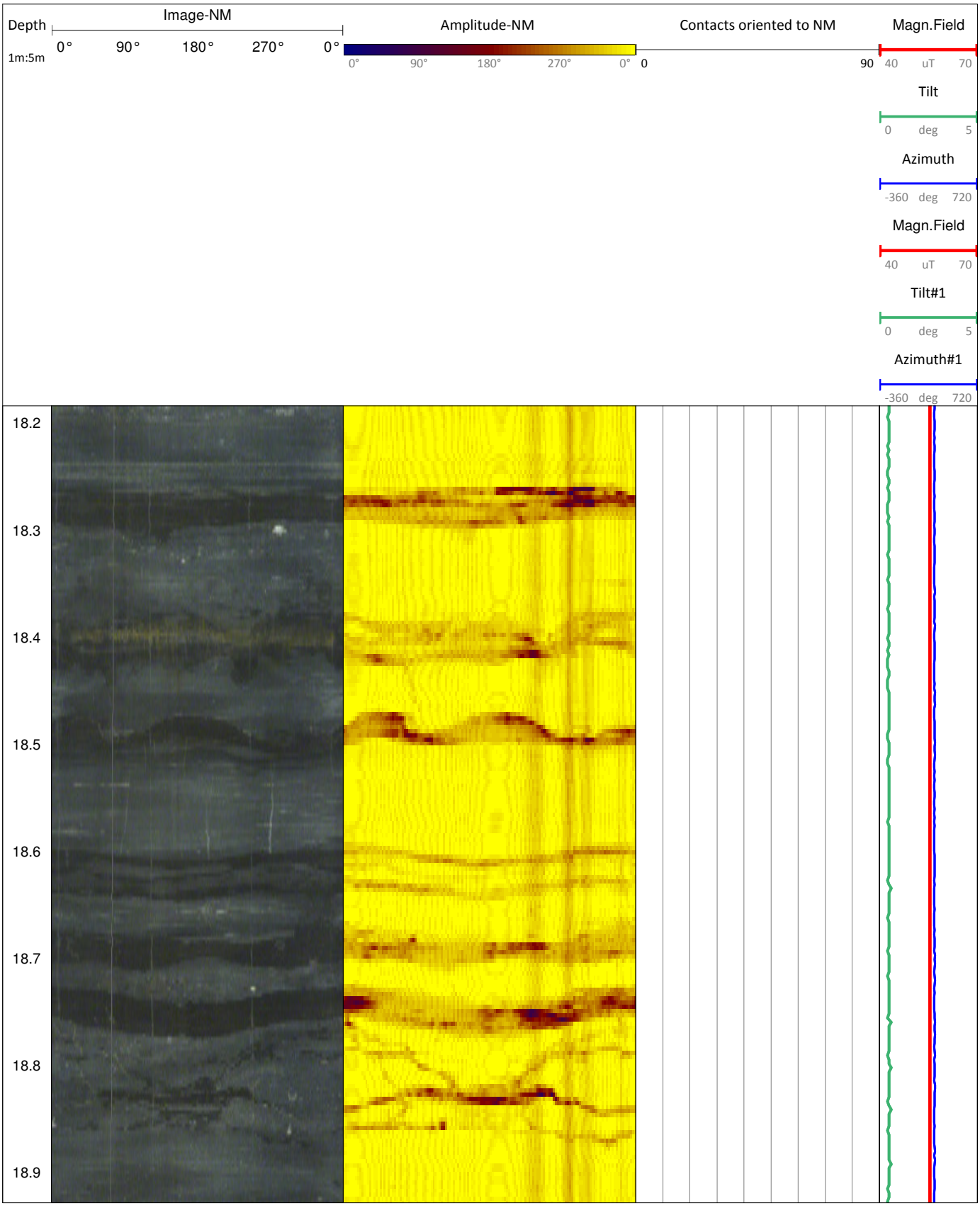
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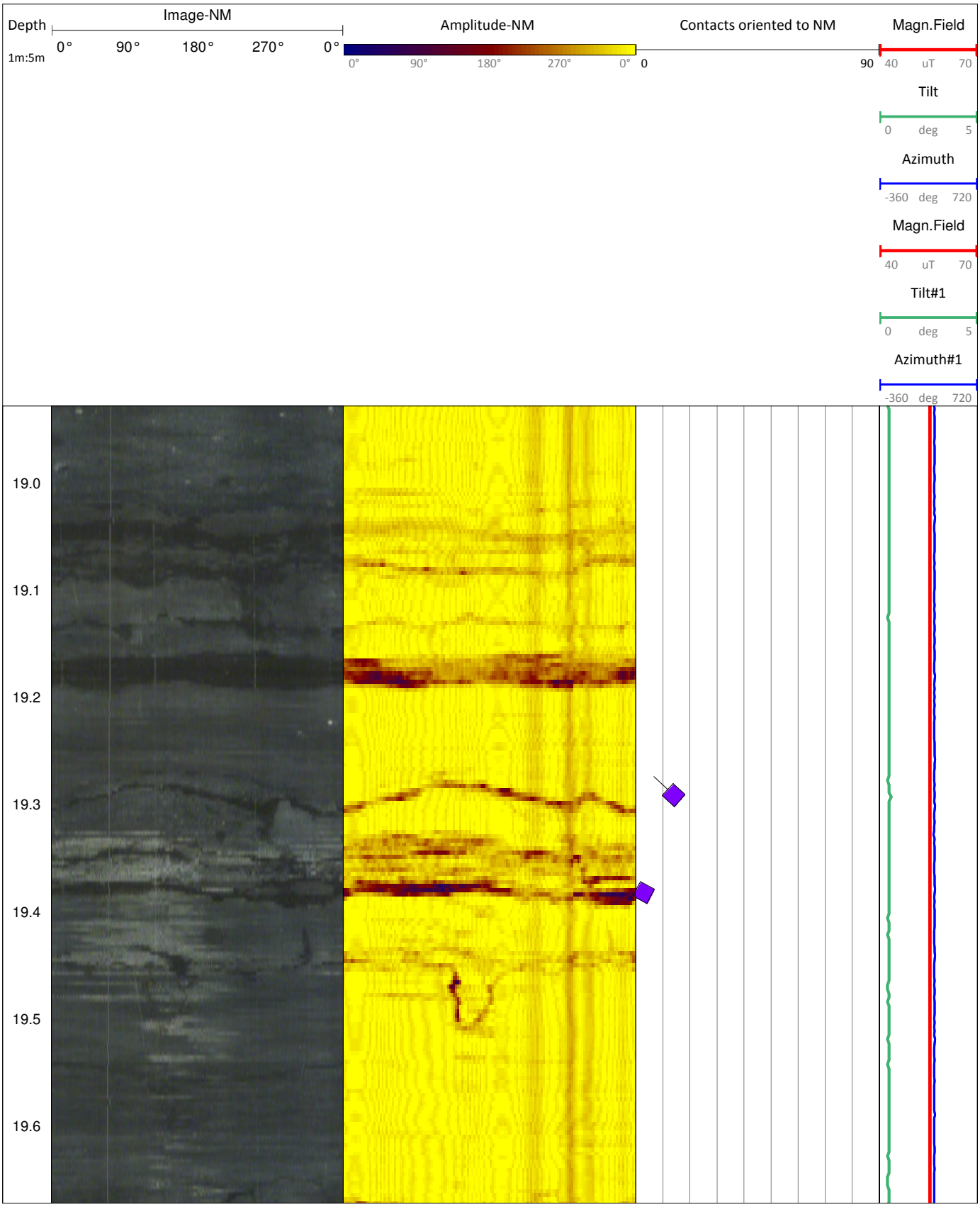
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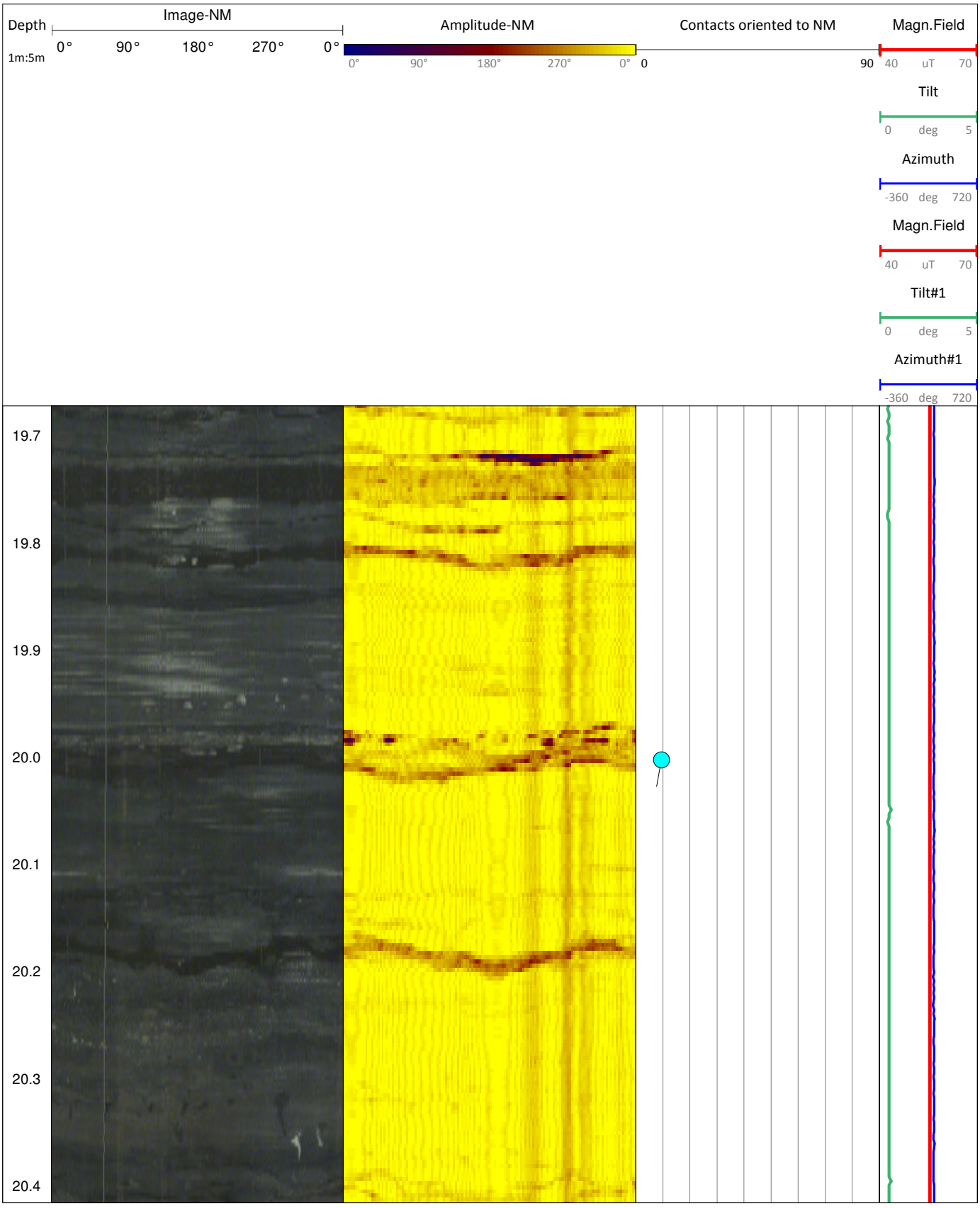
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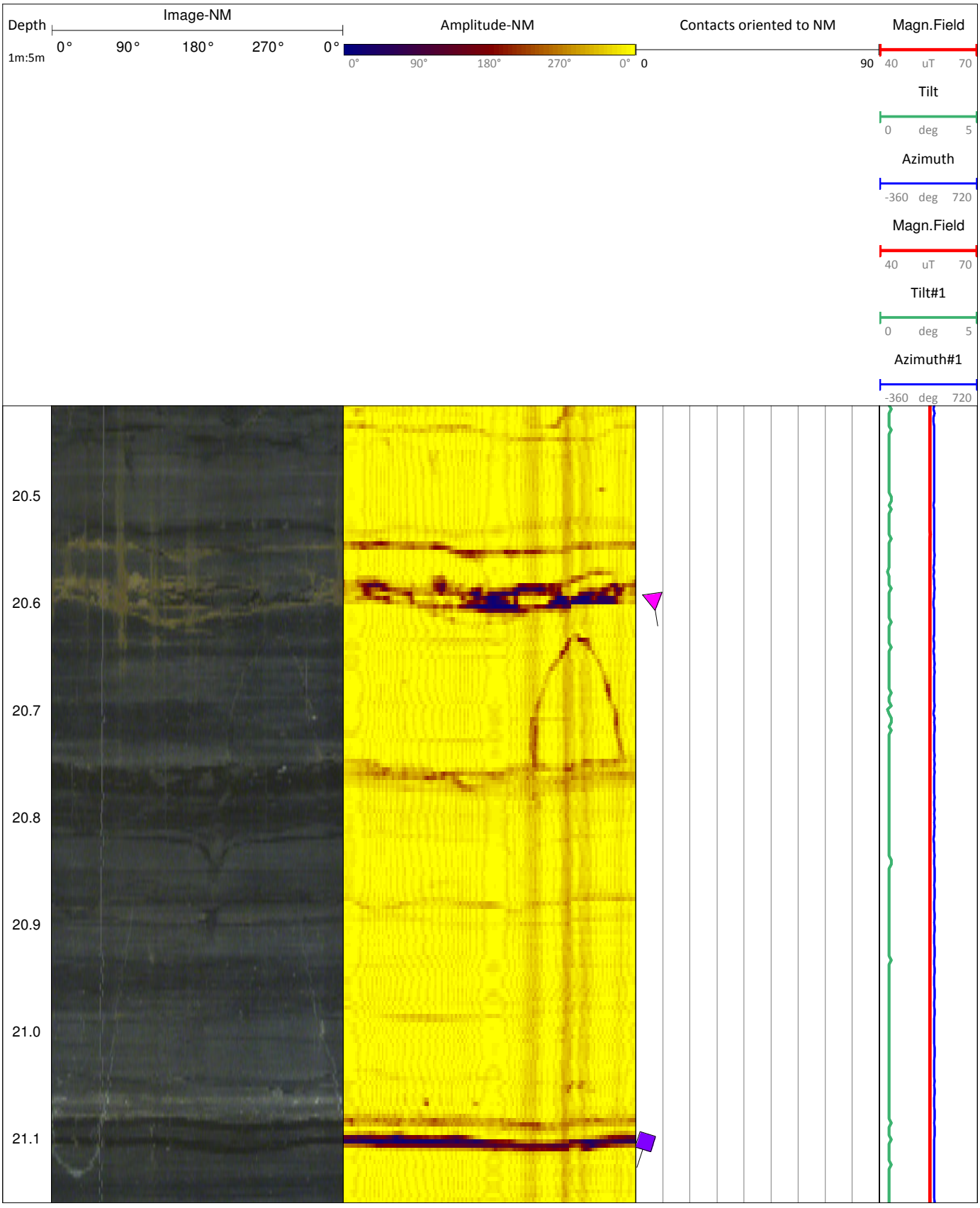
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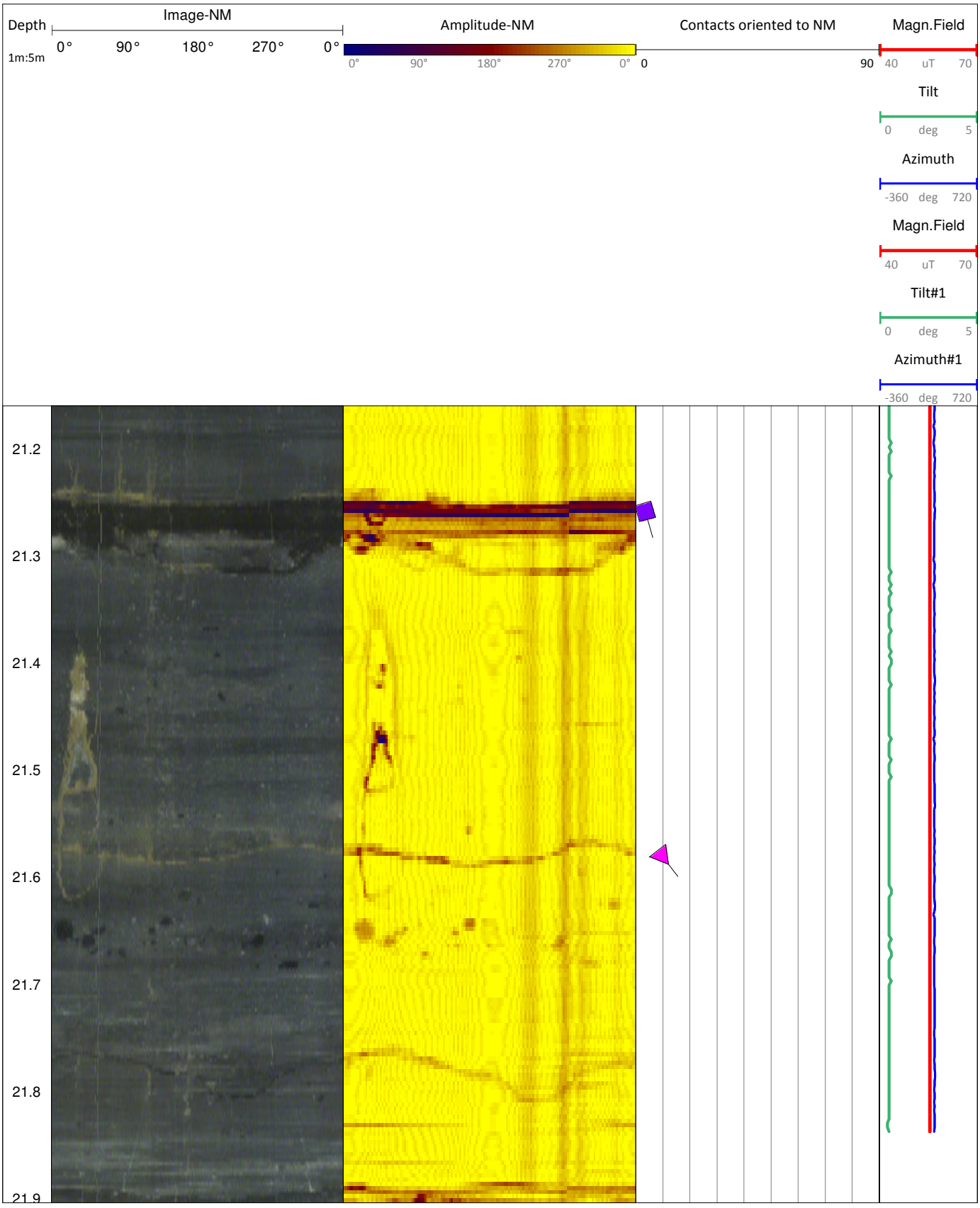
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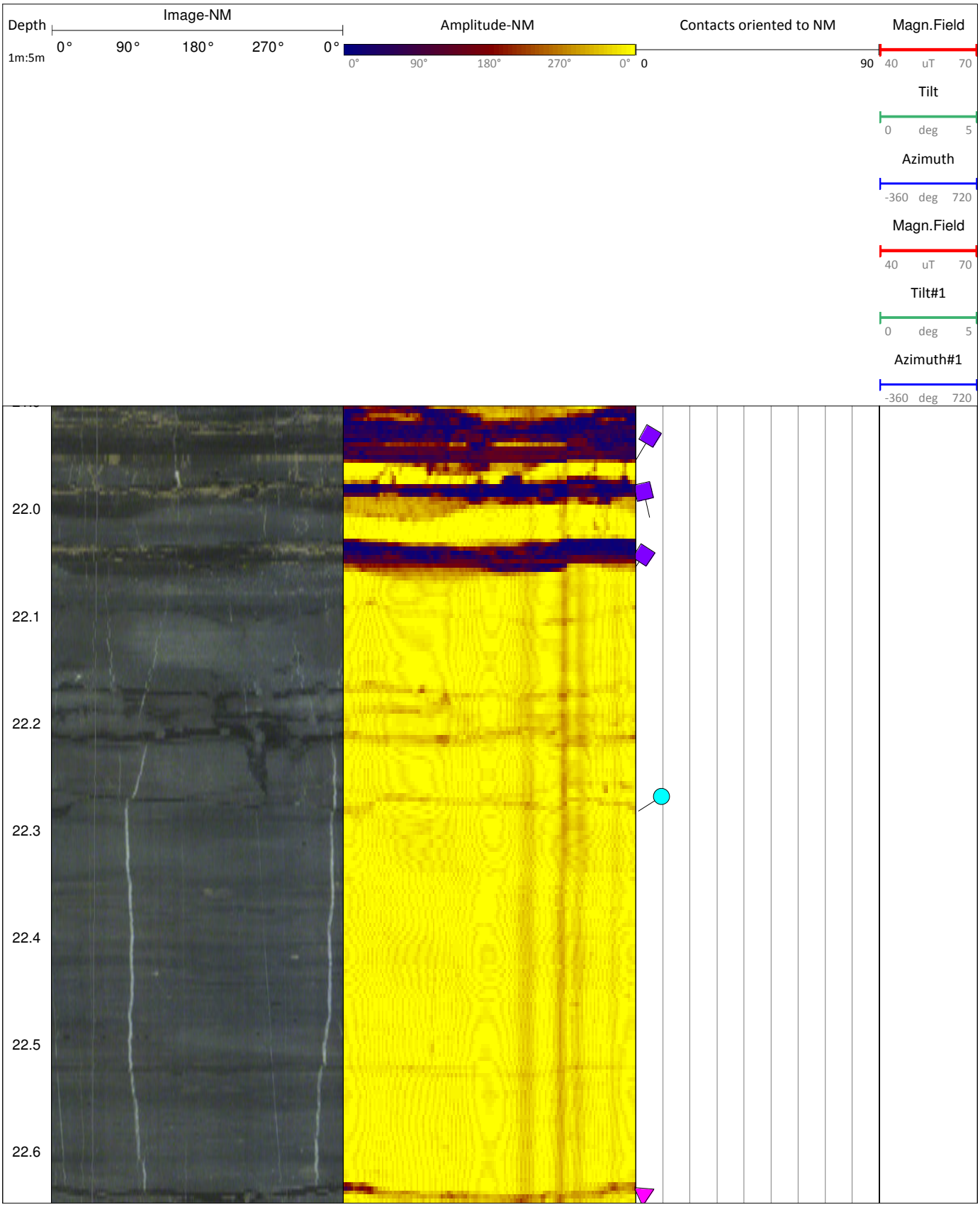
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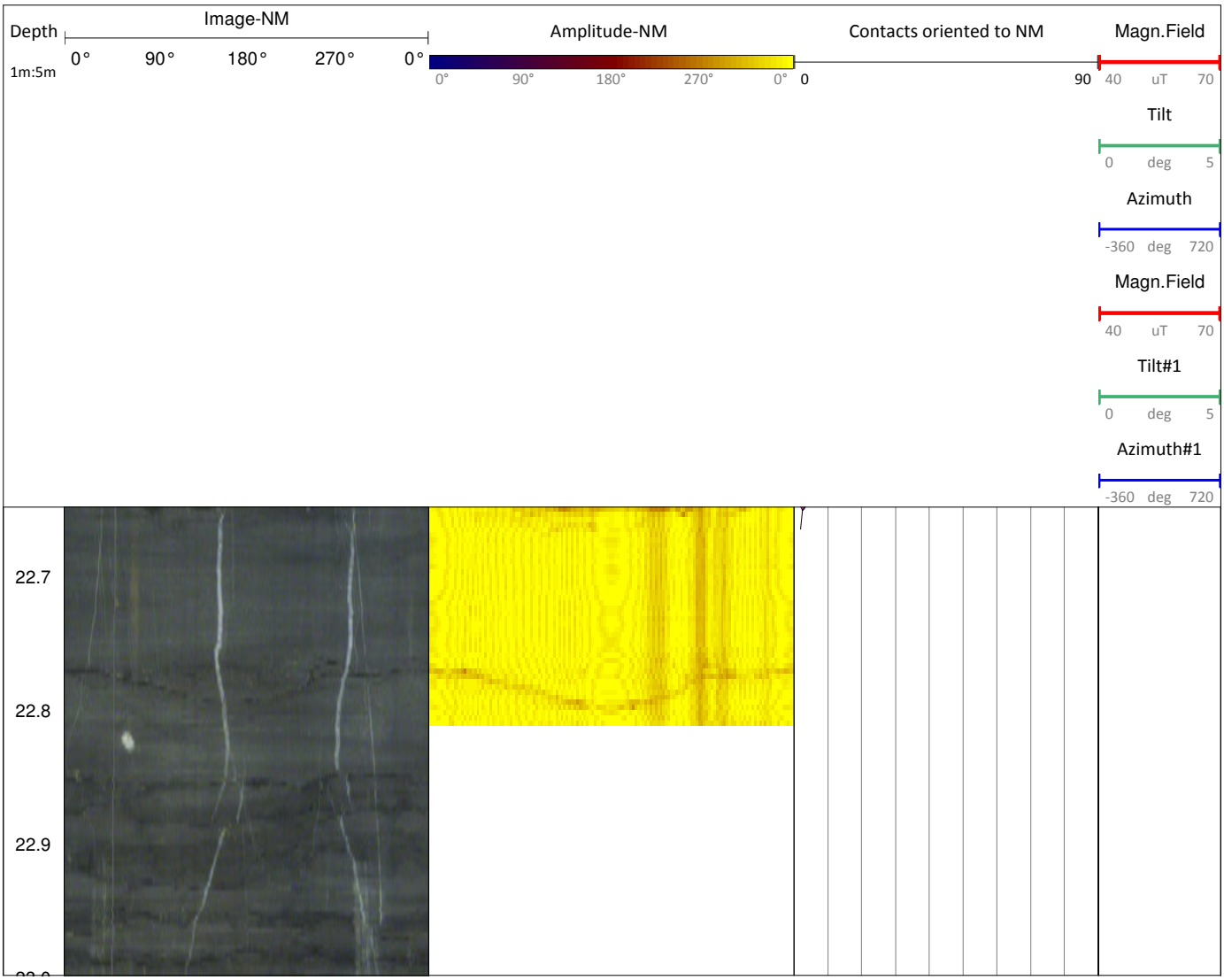
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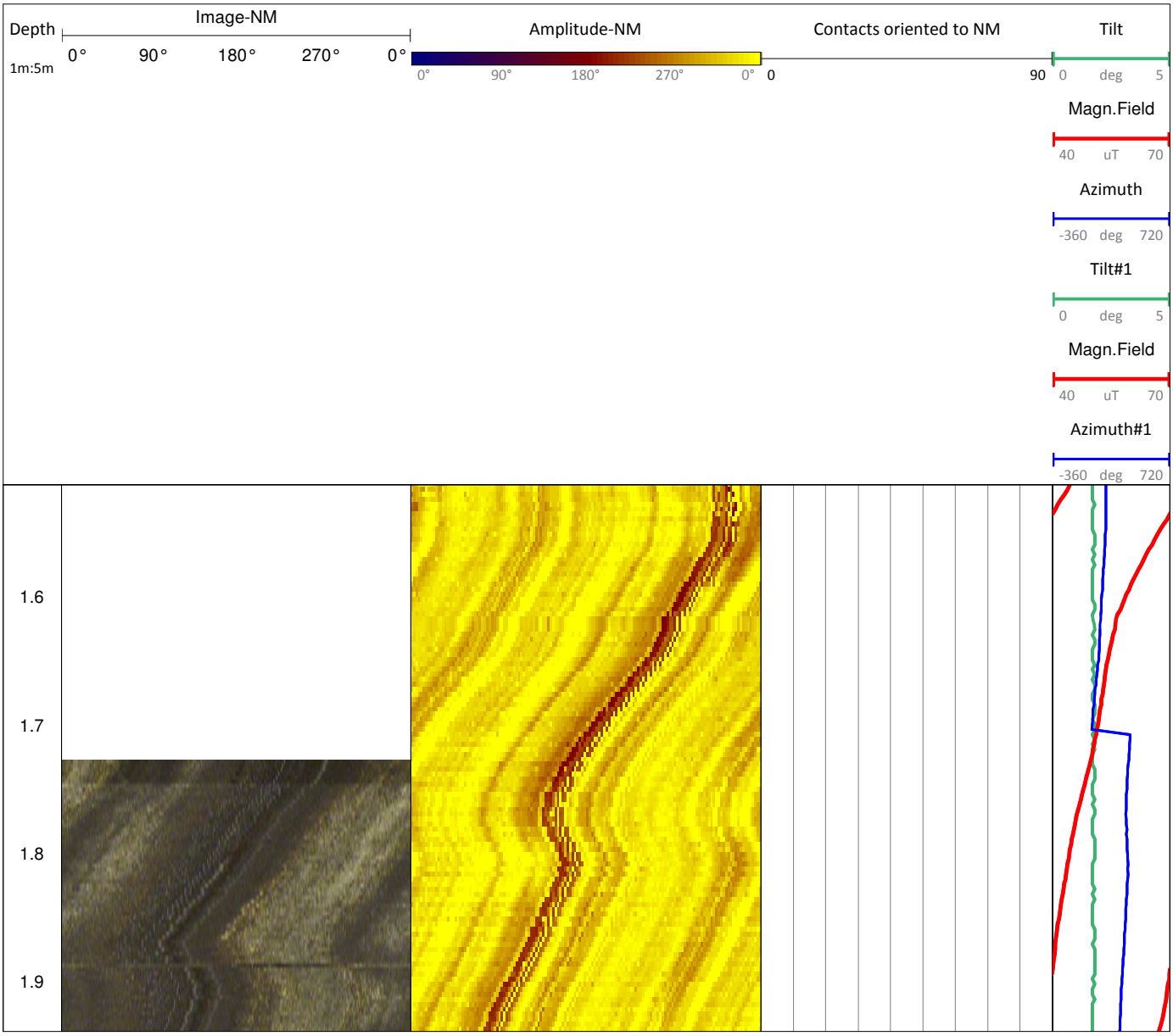
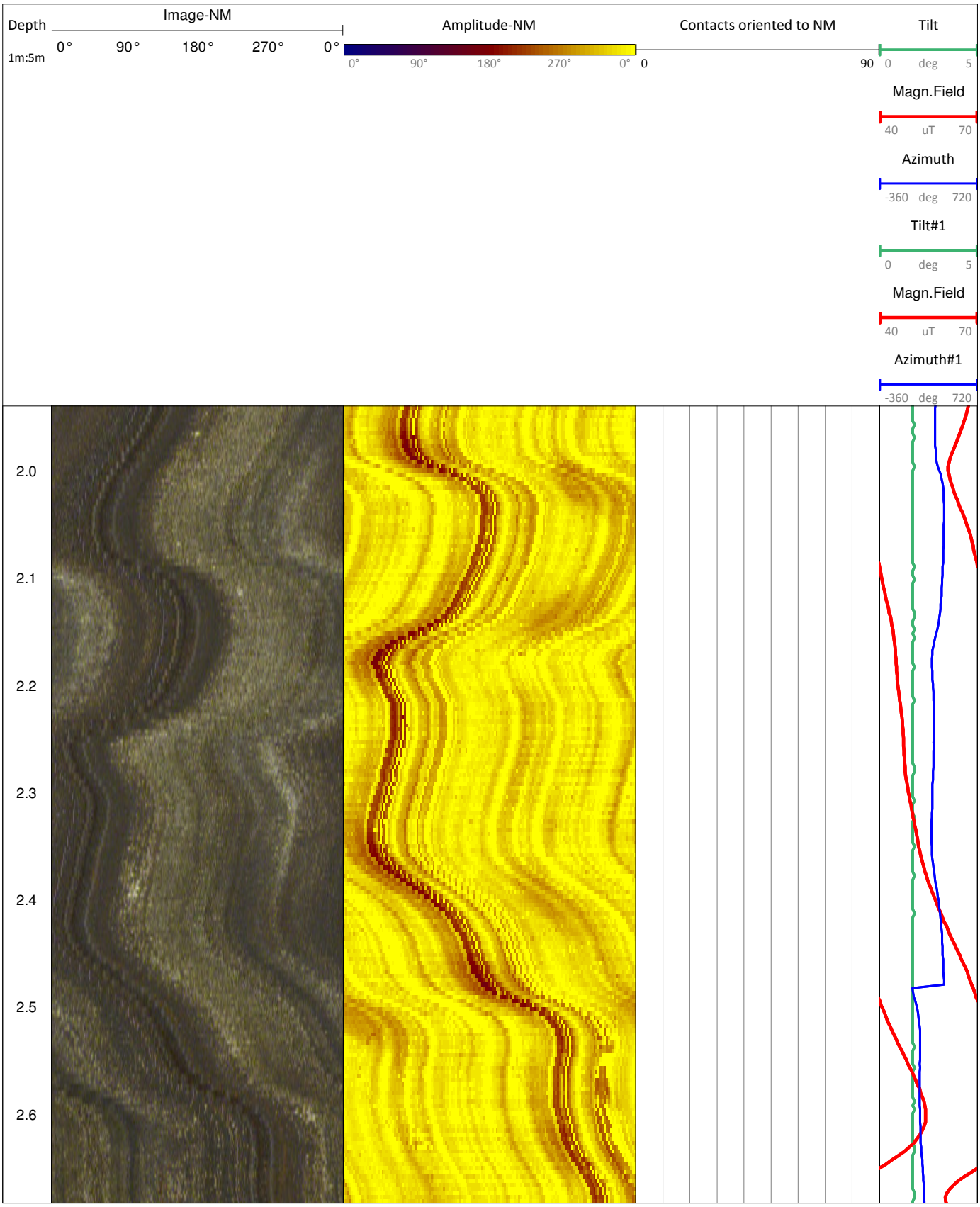
GEOPHYSICS GPR INTERNATIONAL INC.

COMPANY :	VISITORS WELCOME CENTRE PHASE 1
LOCATION :	Parliament Hill, Ottawa, Ontario

Well	BH7V		
Date	December 6 2013	BH Fluid	
Casing	3 3/4" inside diameter		
File Name	BH7V.wcl		
Depth Driller			
Depth Logger	23 m		
Logged by	C. Coatsworth		
Witnessed by			

NOTES:
Tool zeroed at sidewalk.
Casing is 0.015m below sidewalk.
Water is 2.78 m below sidewalk.

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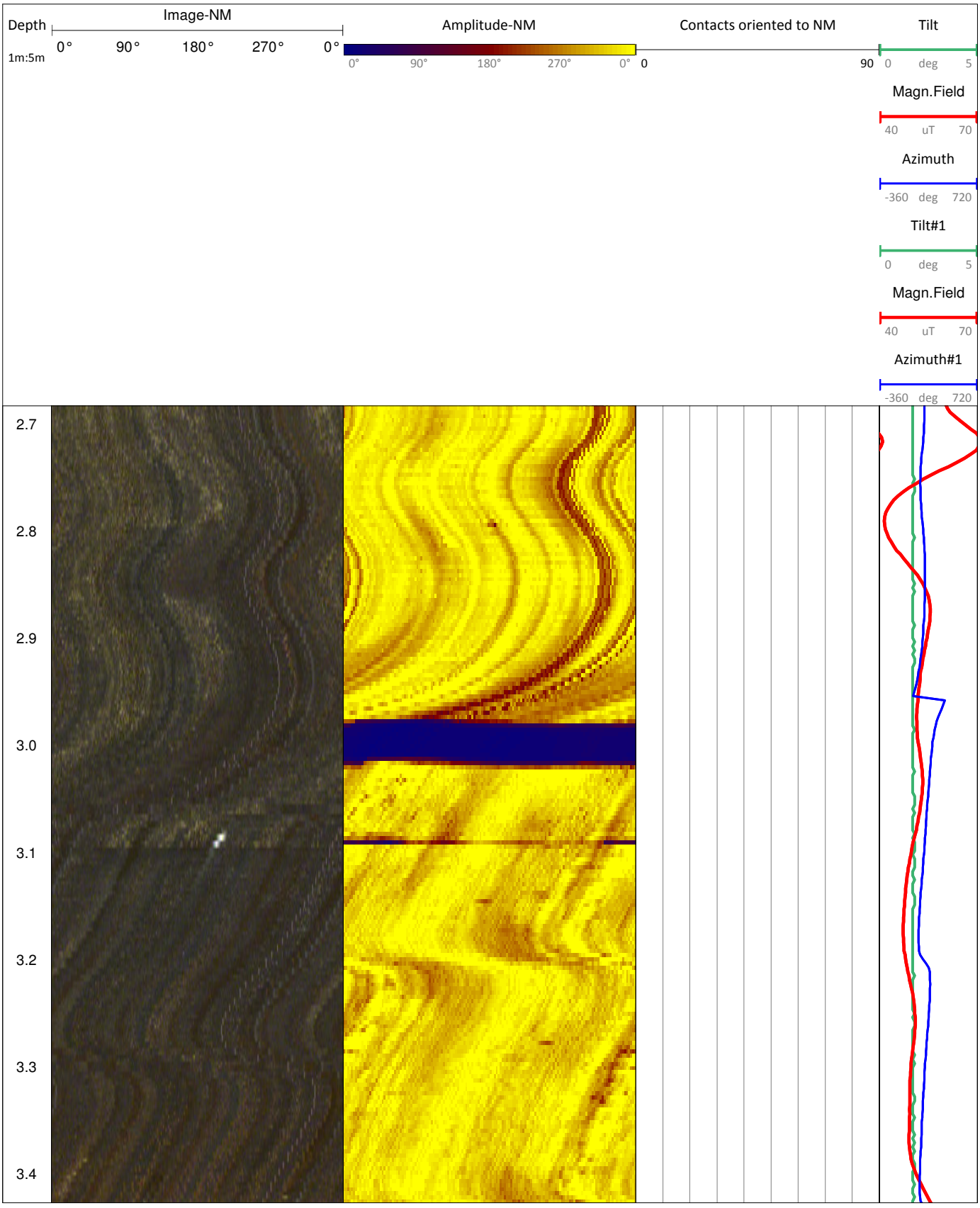
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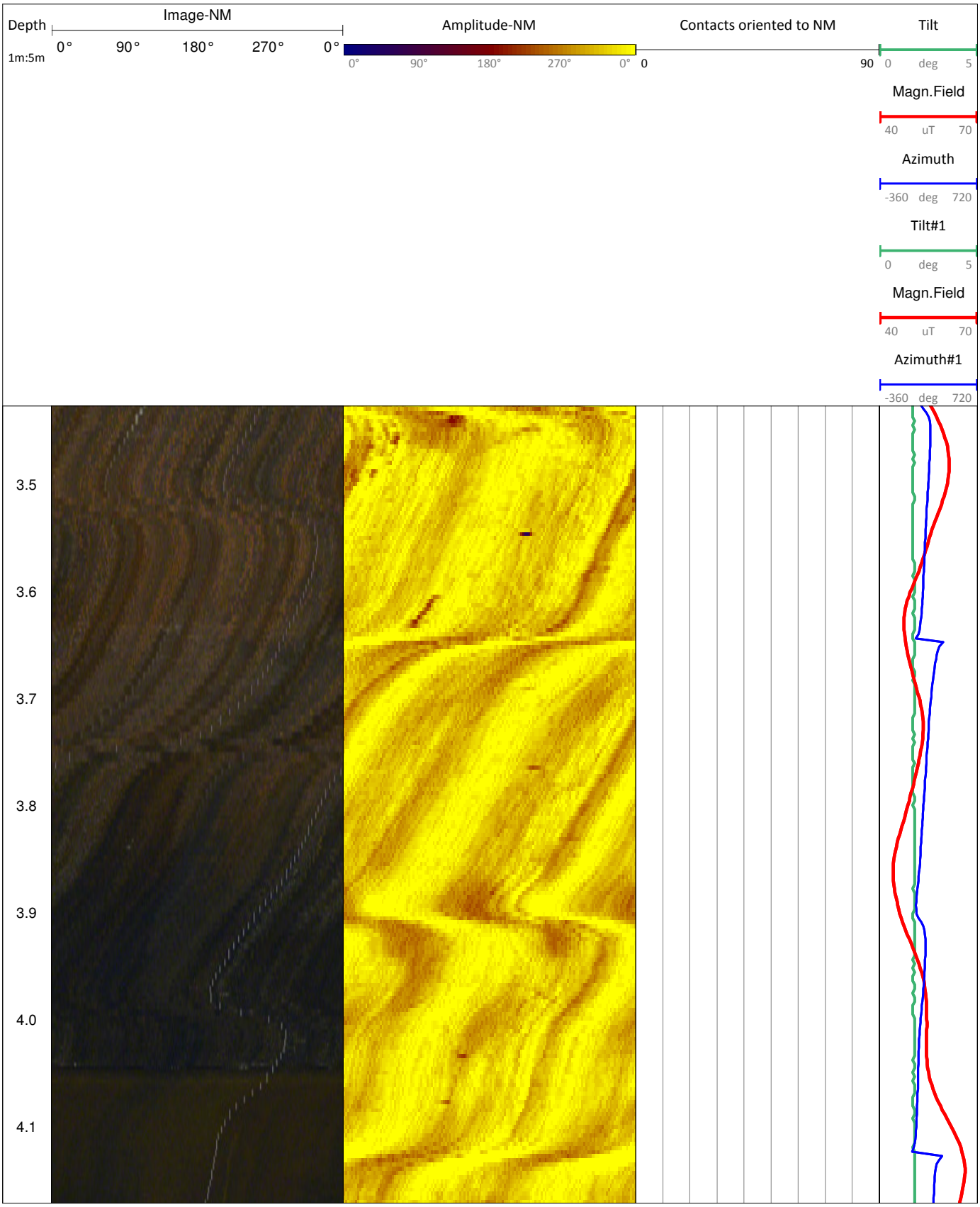
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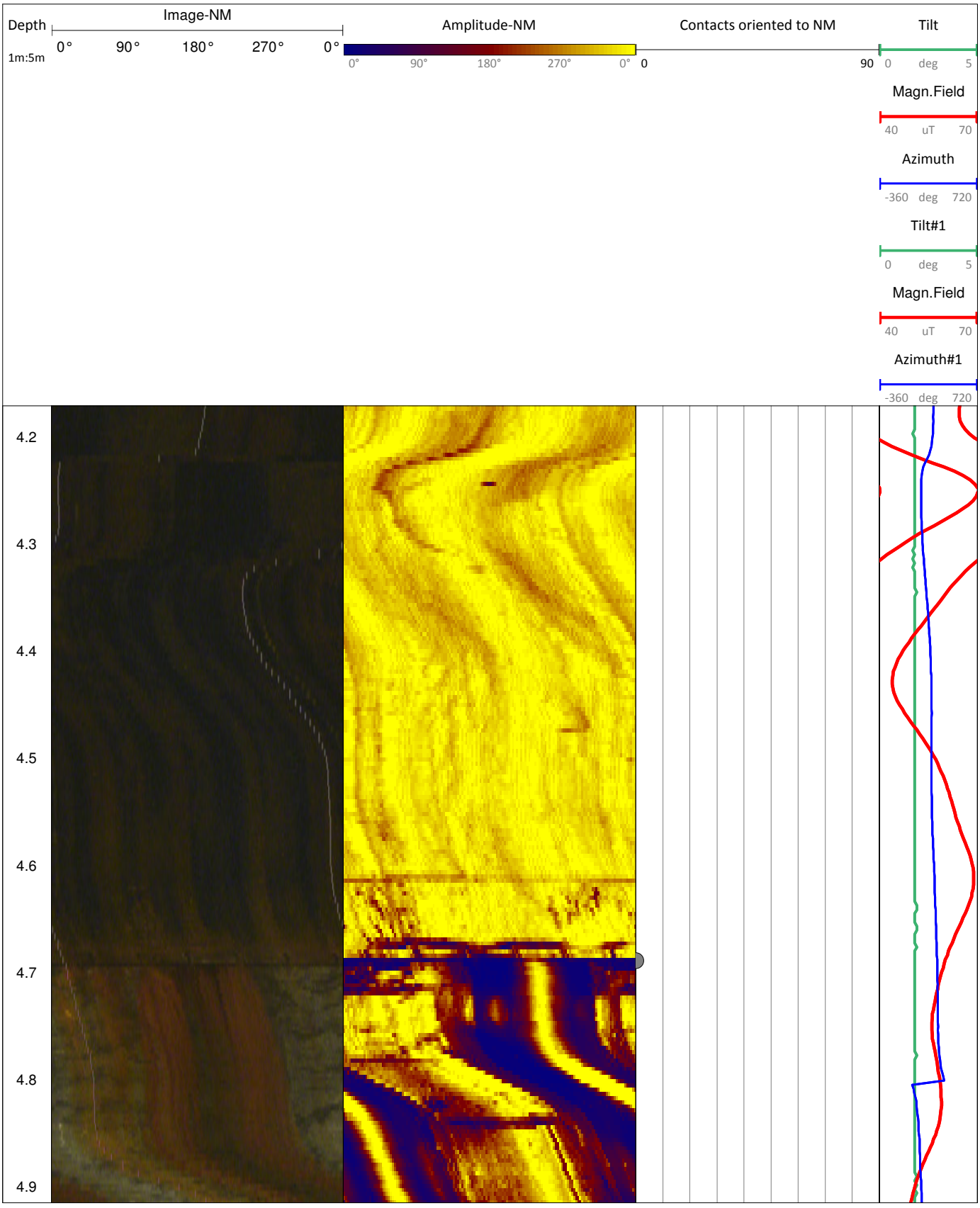
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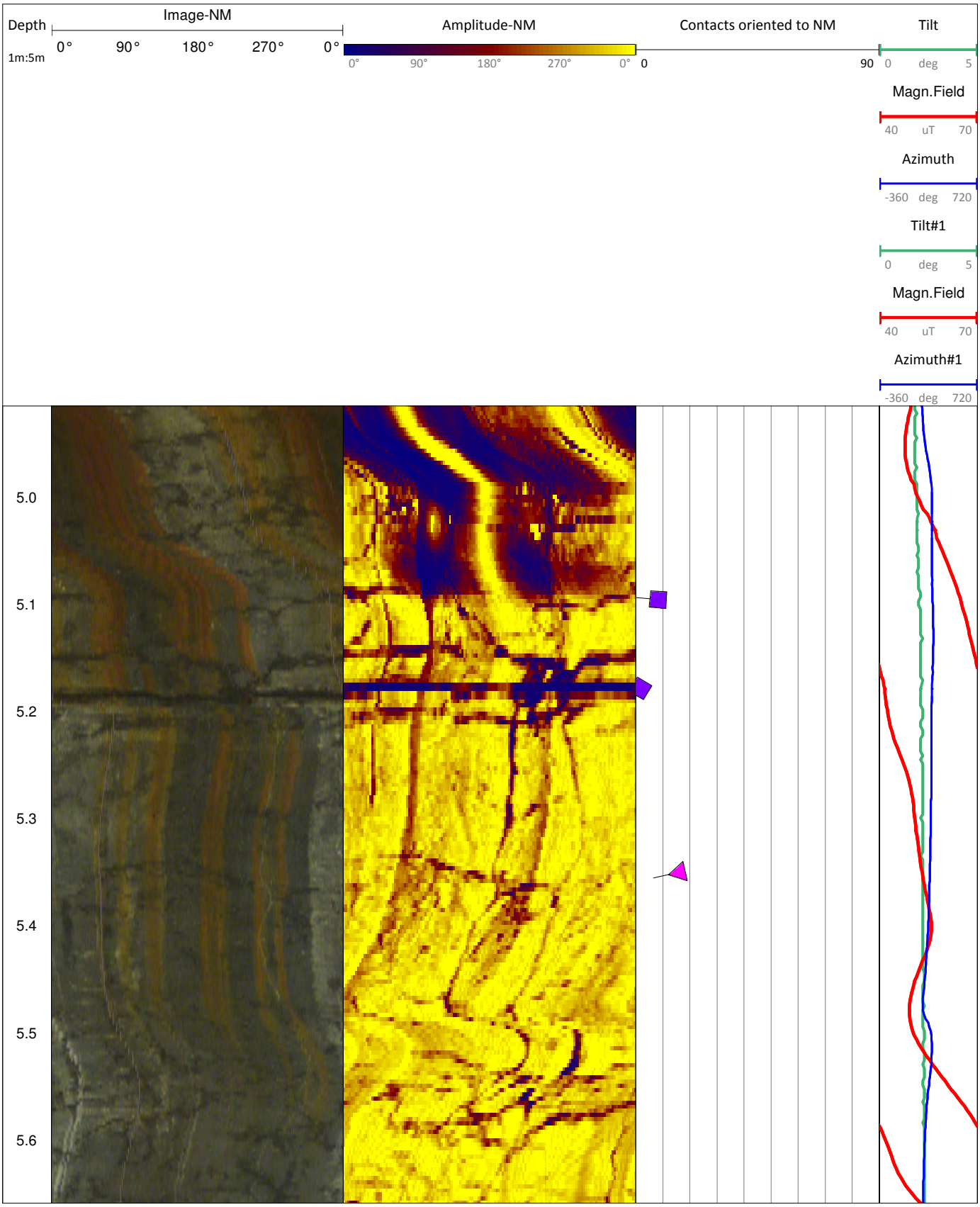
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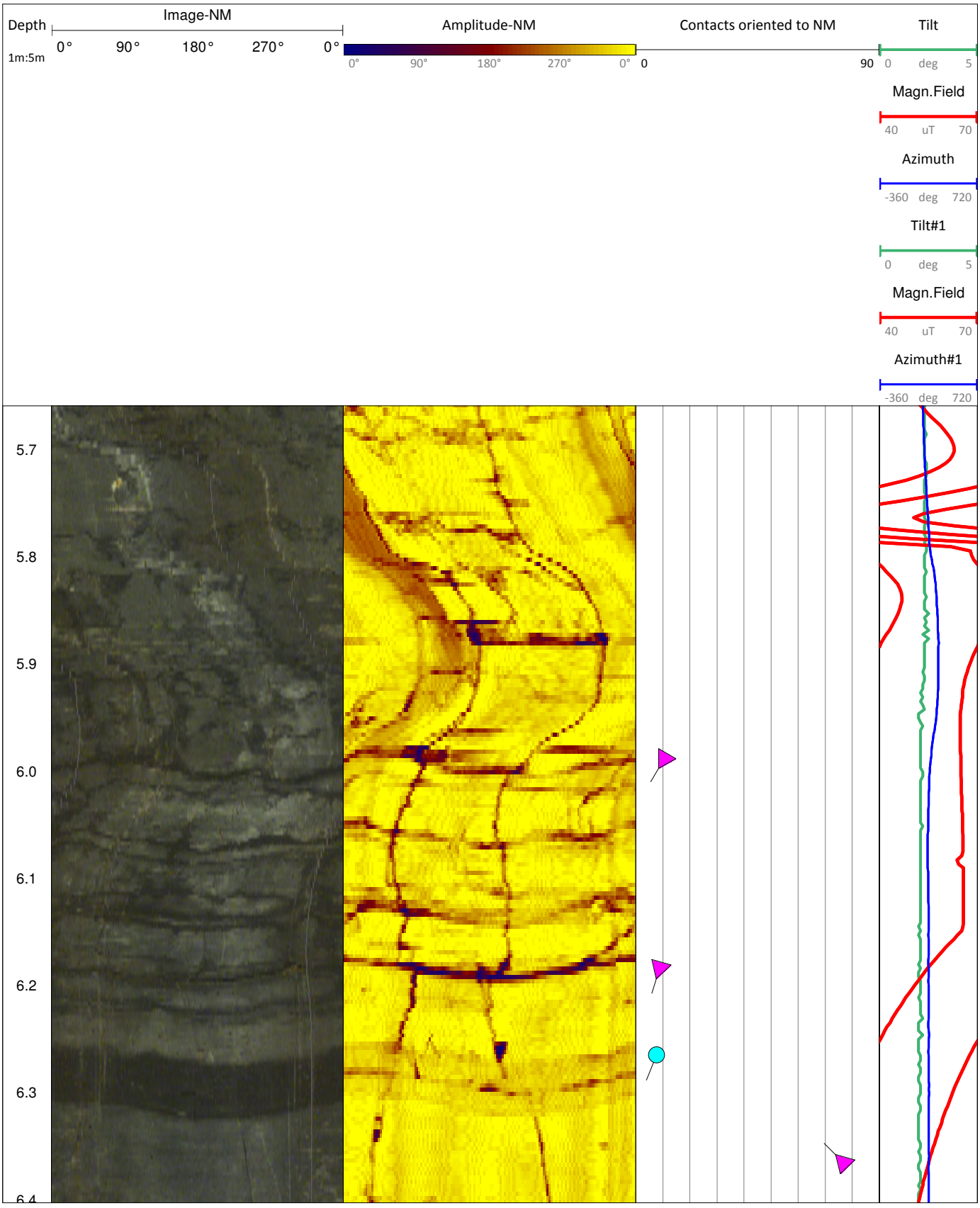
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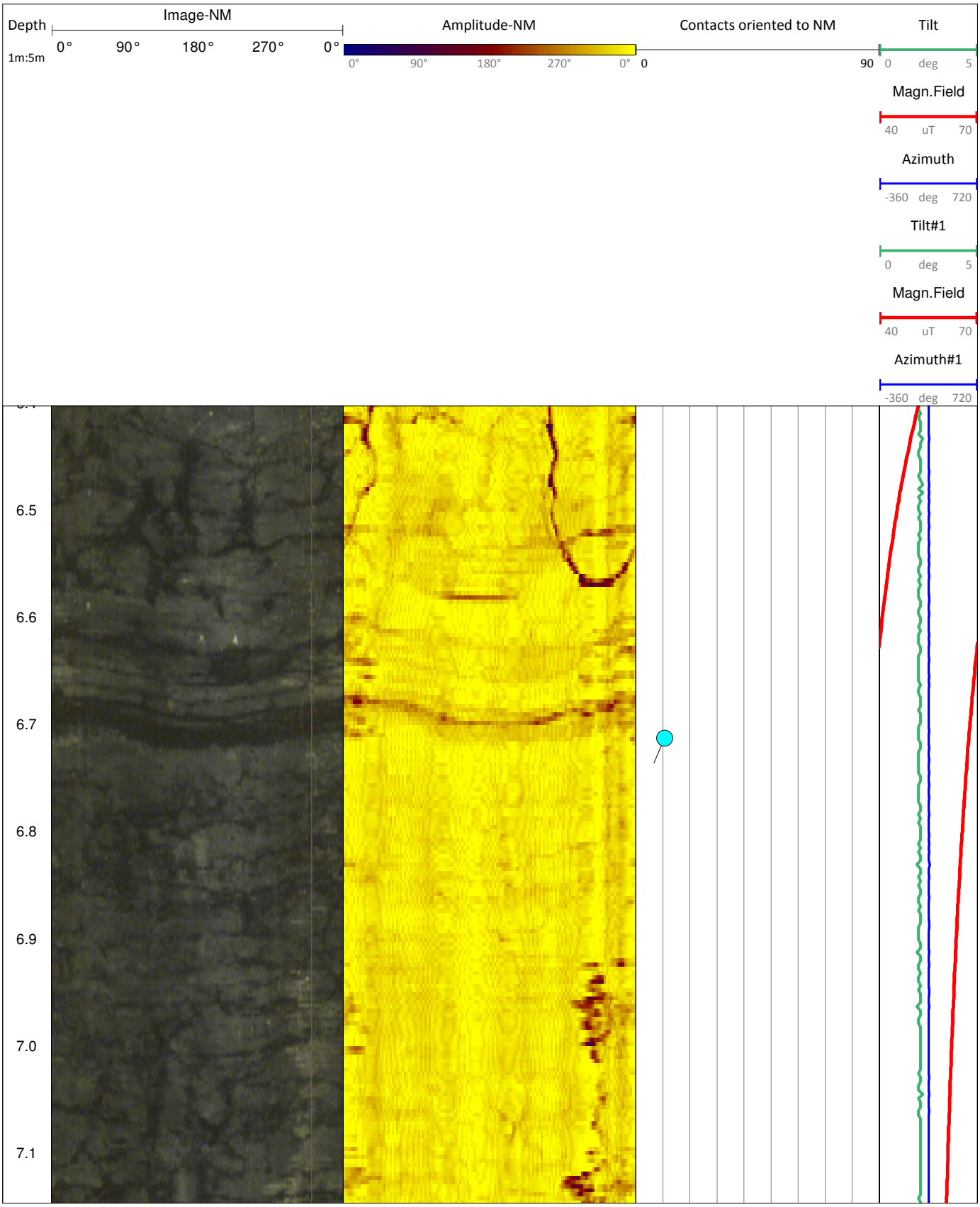
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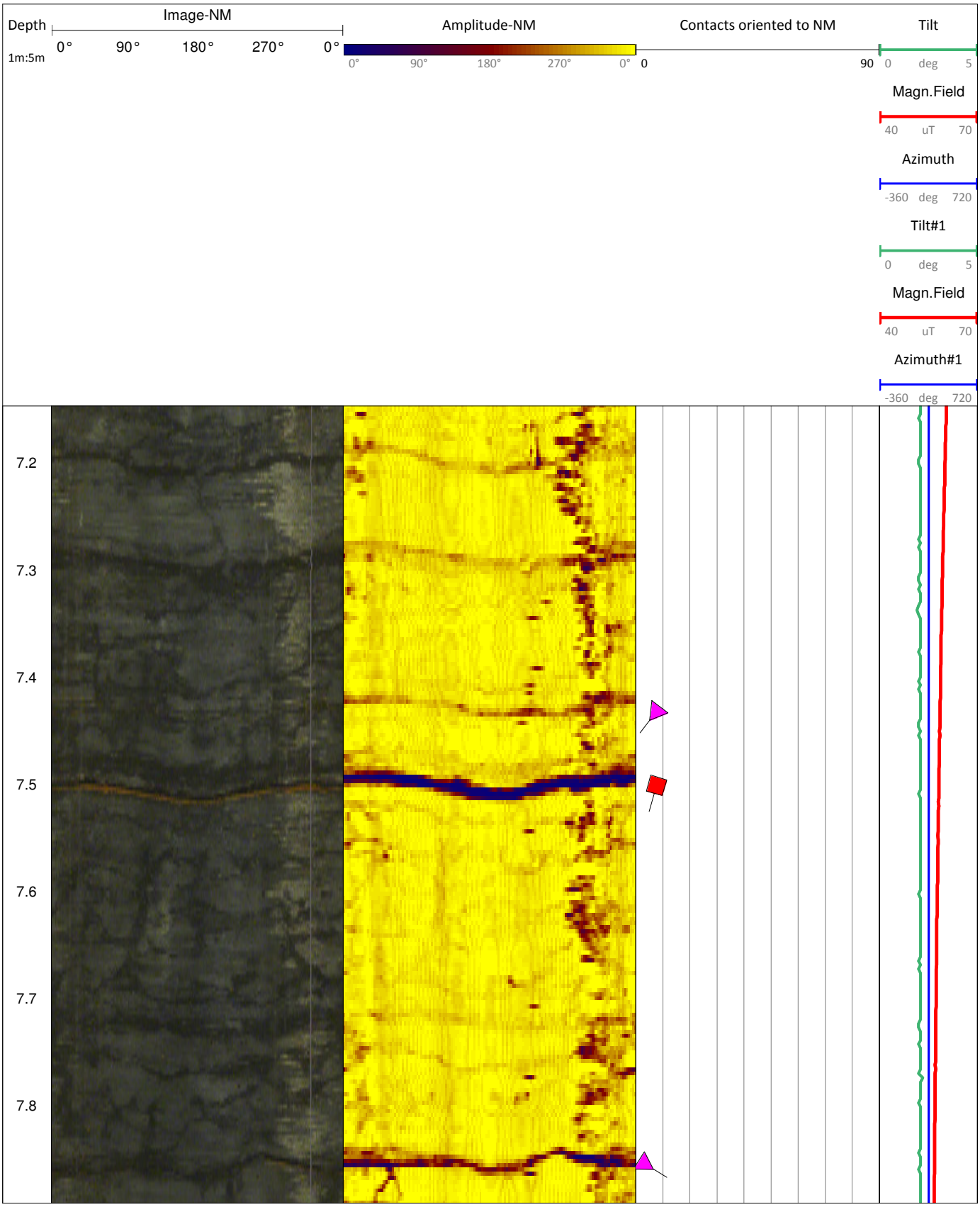
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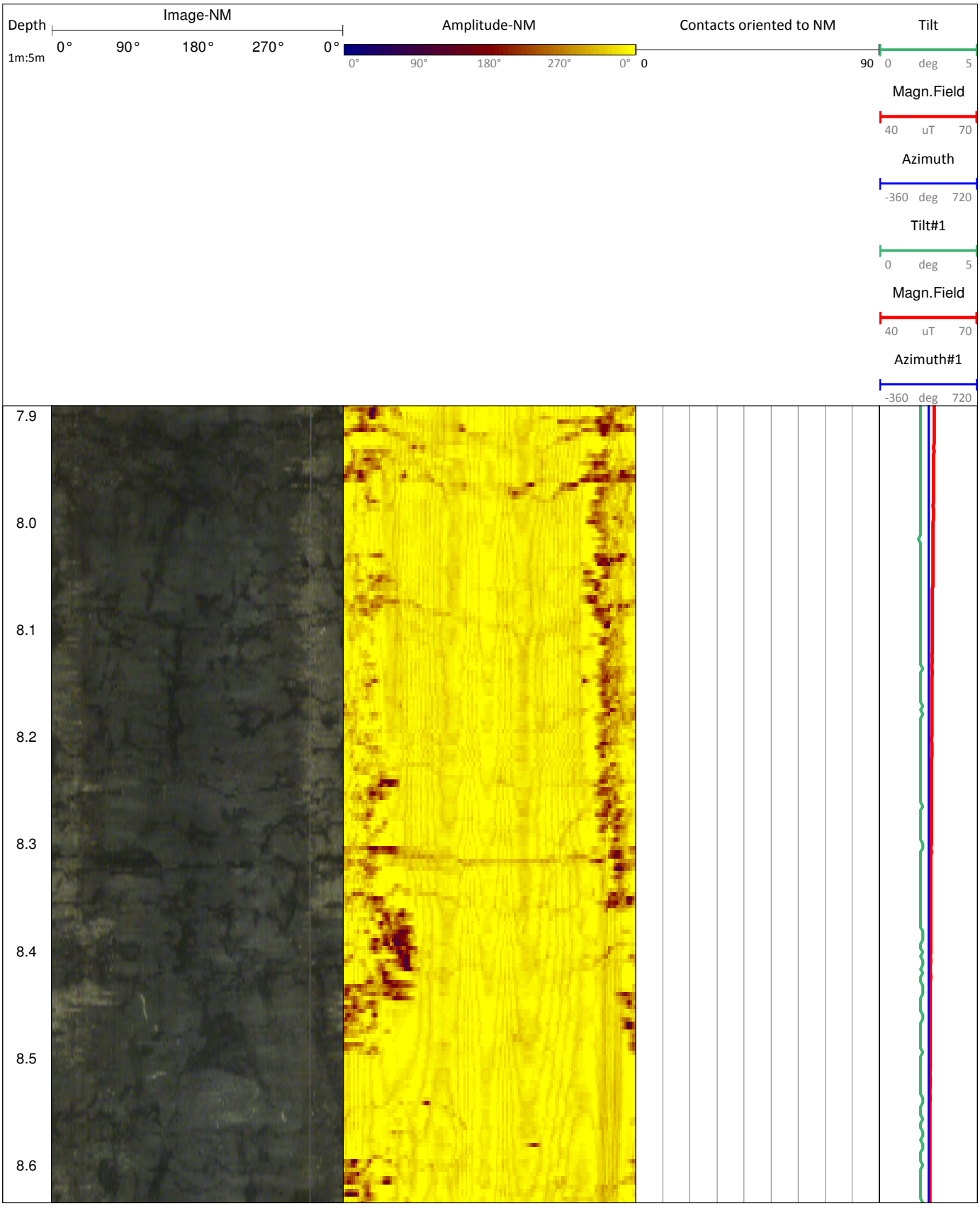
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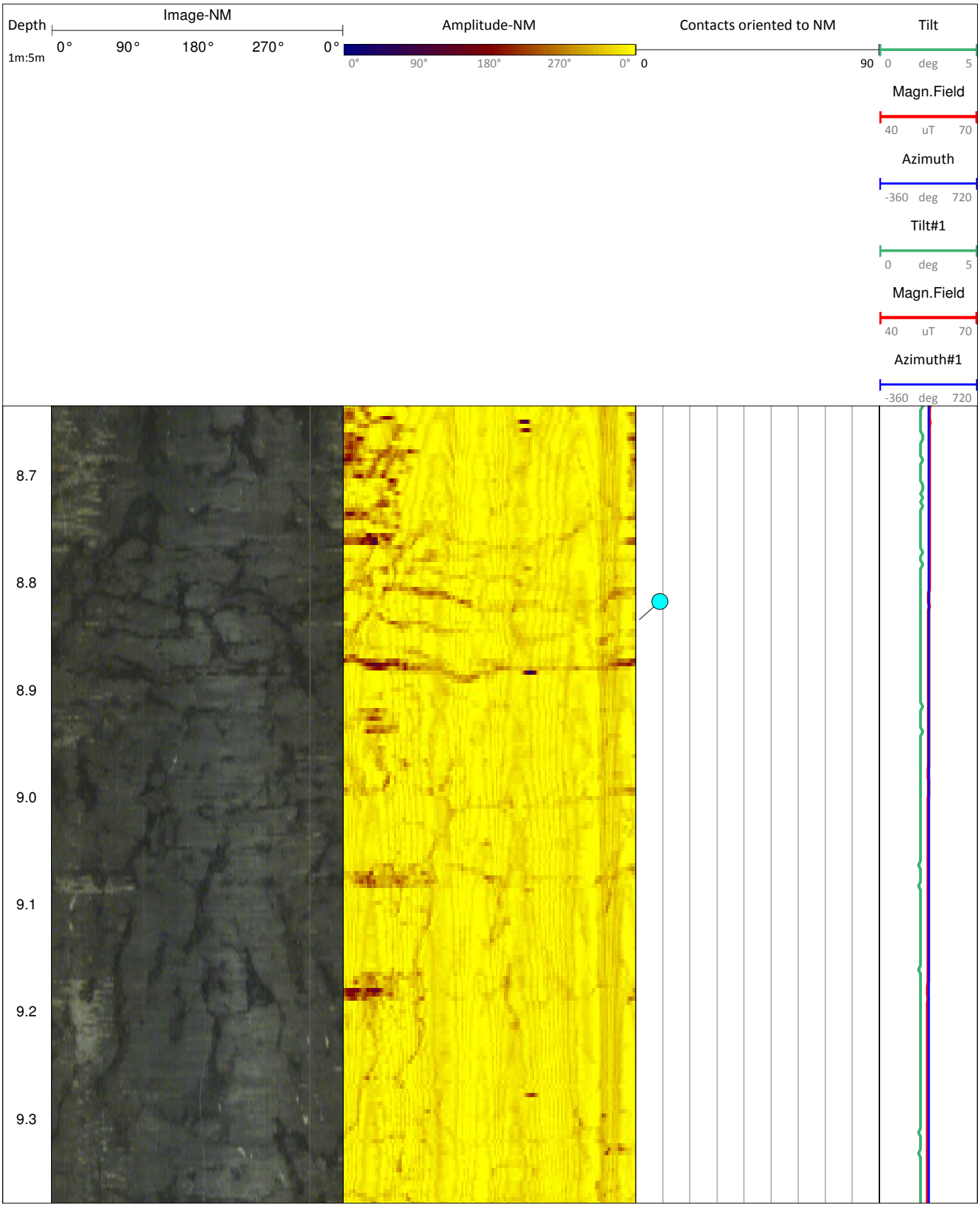
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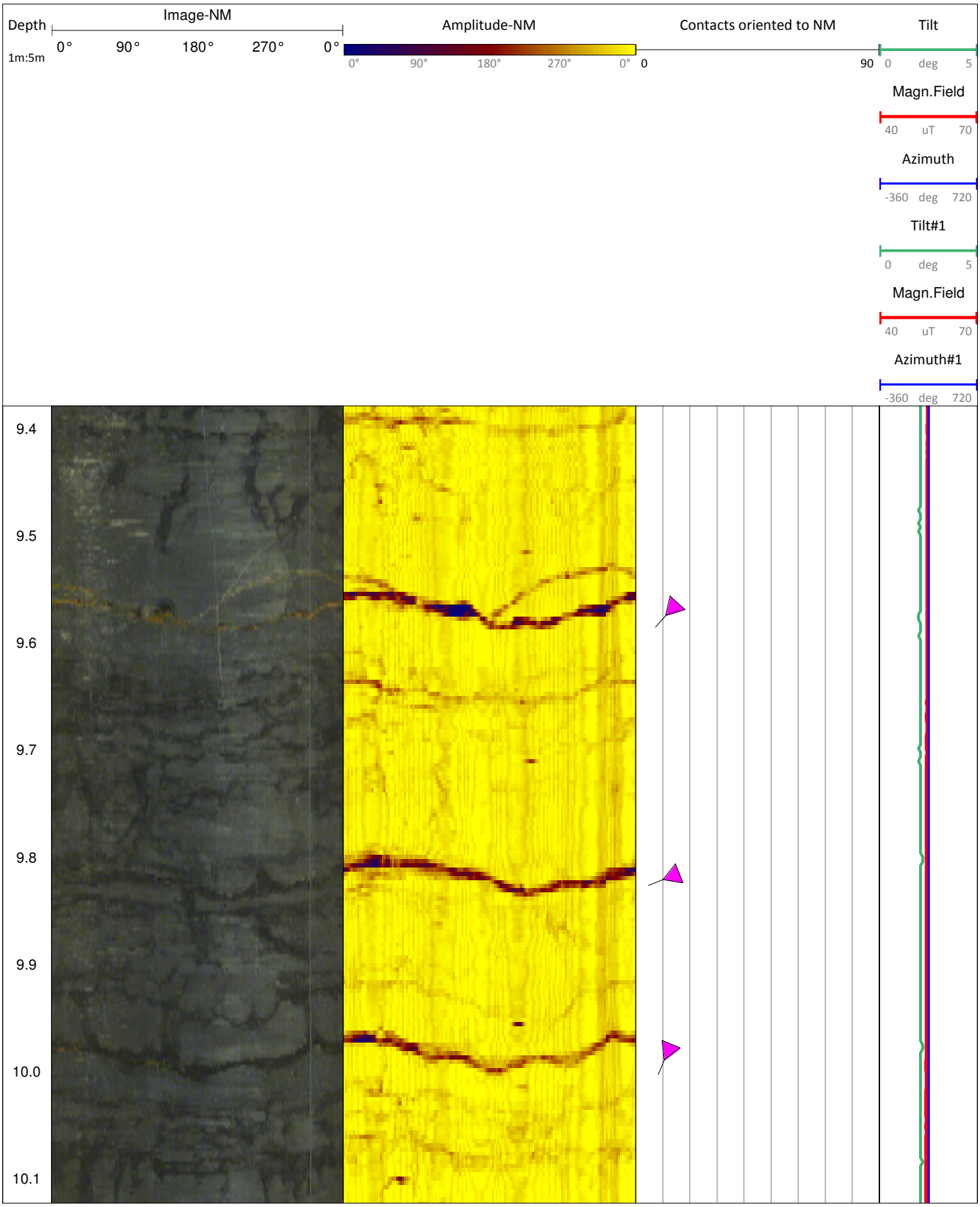
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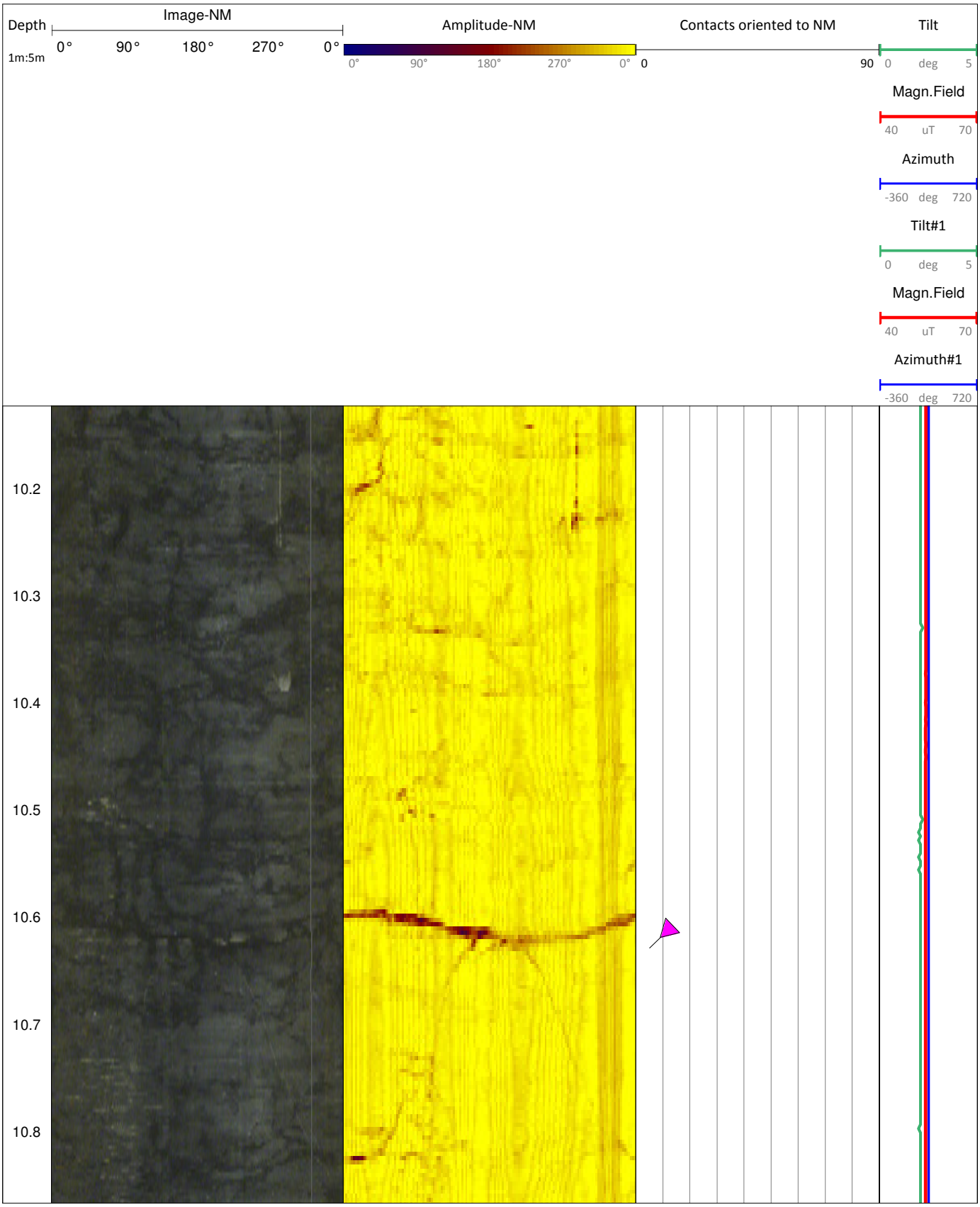
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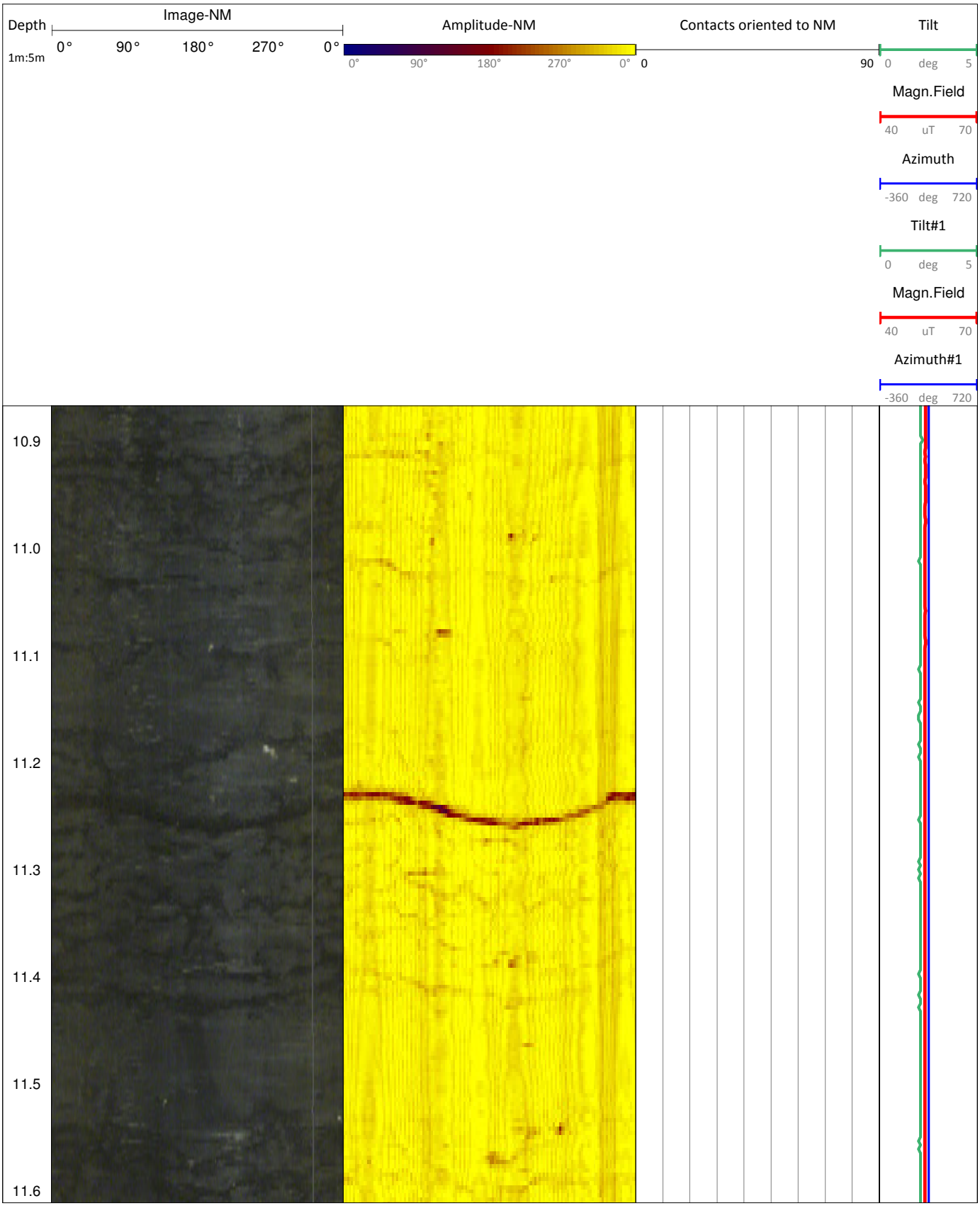
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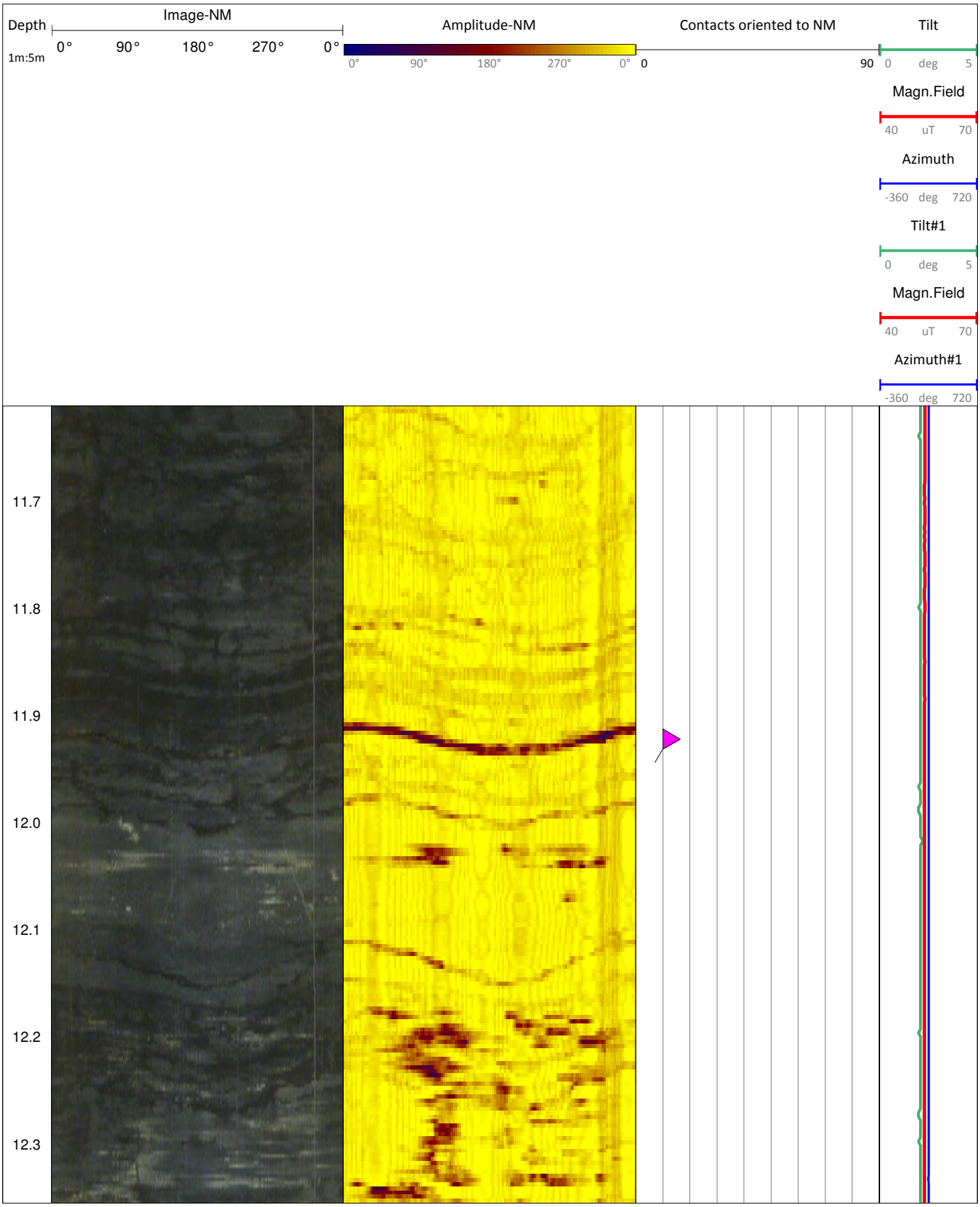
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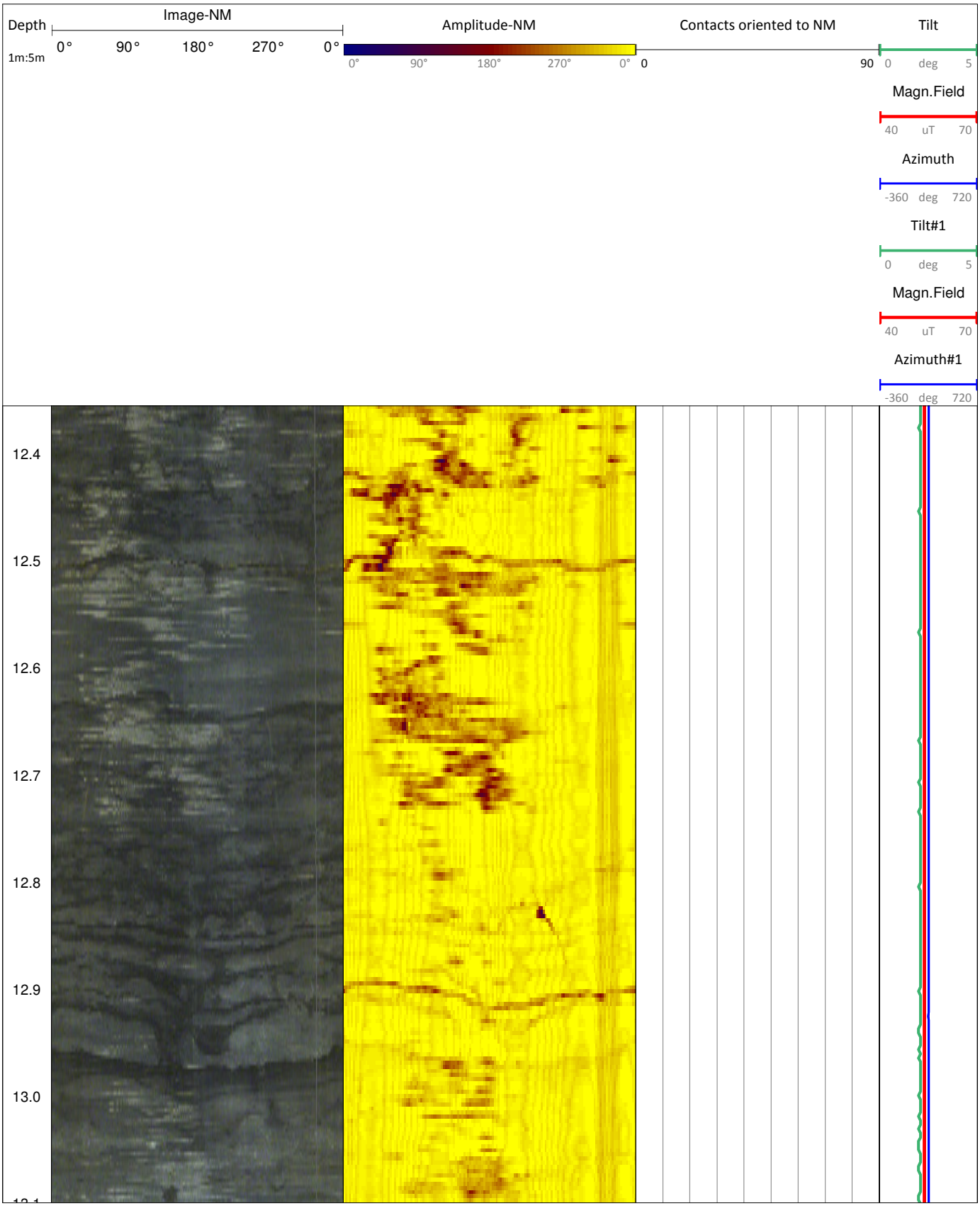
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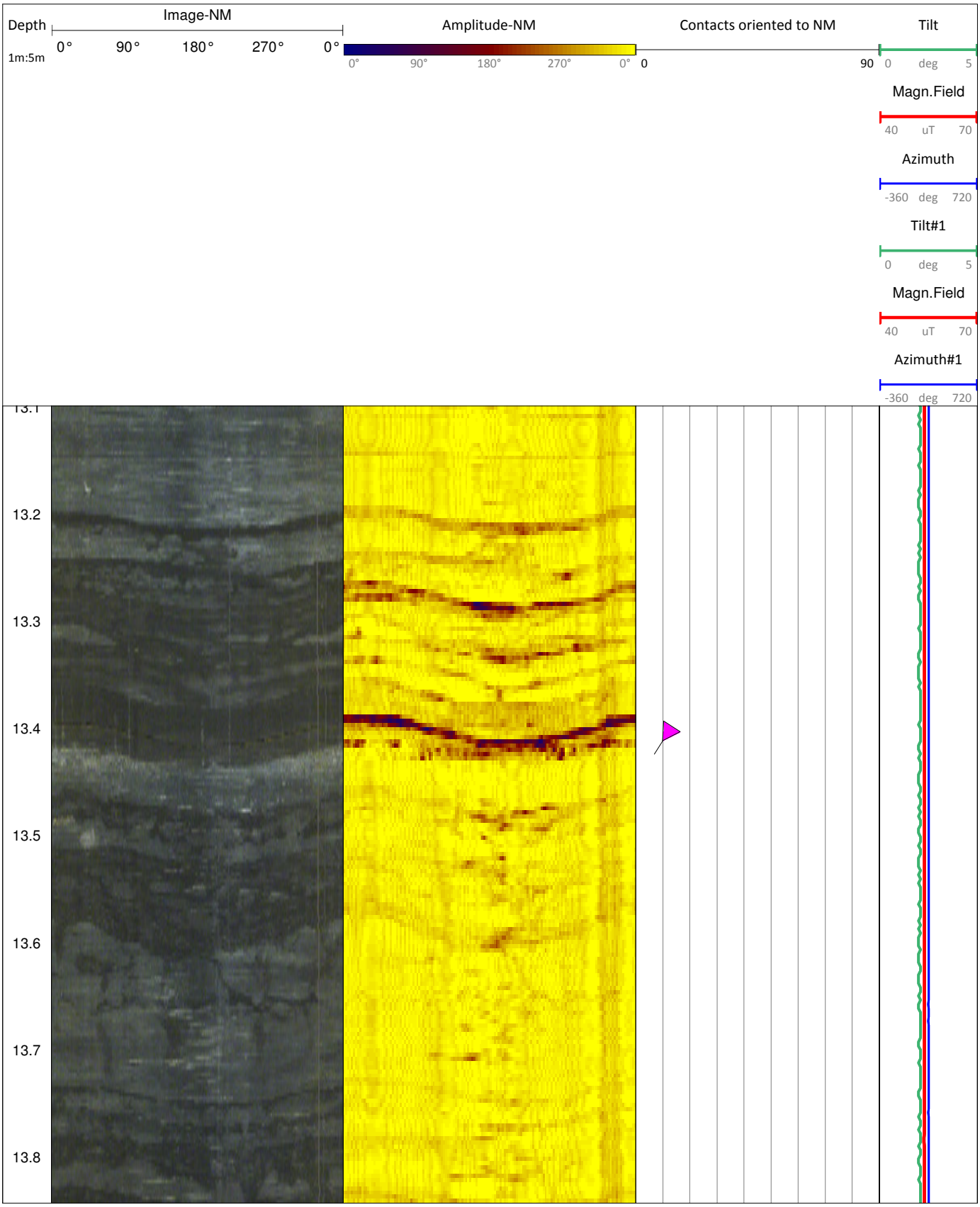
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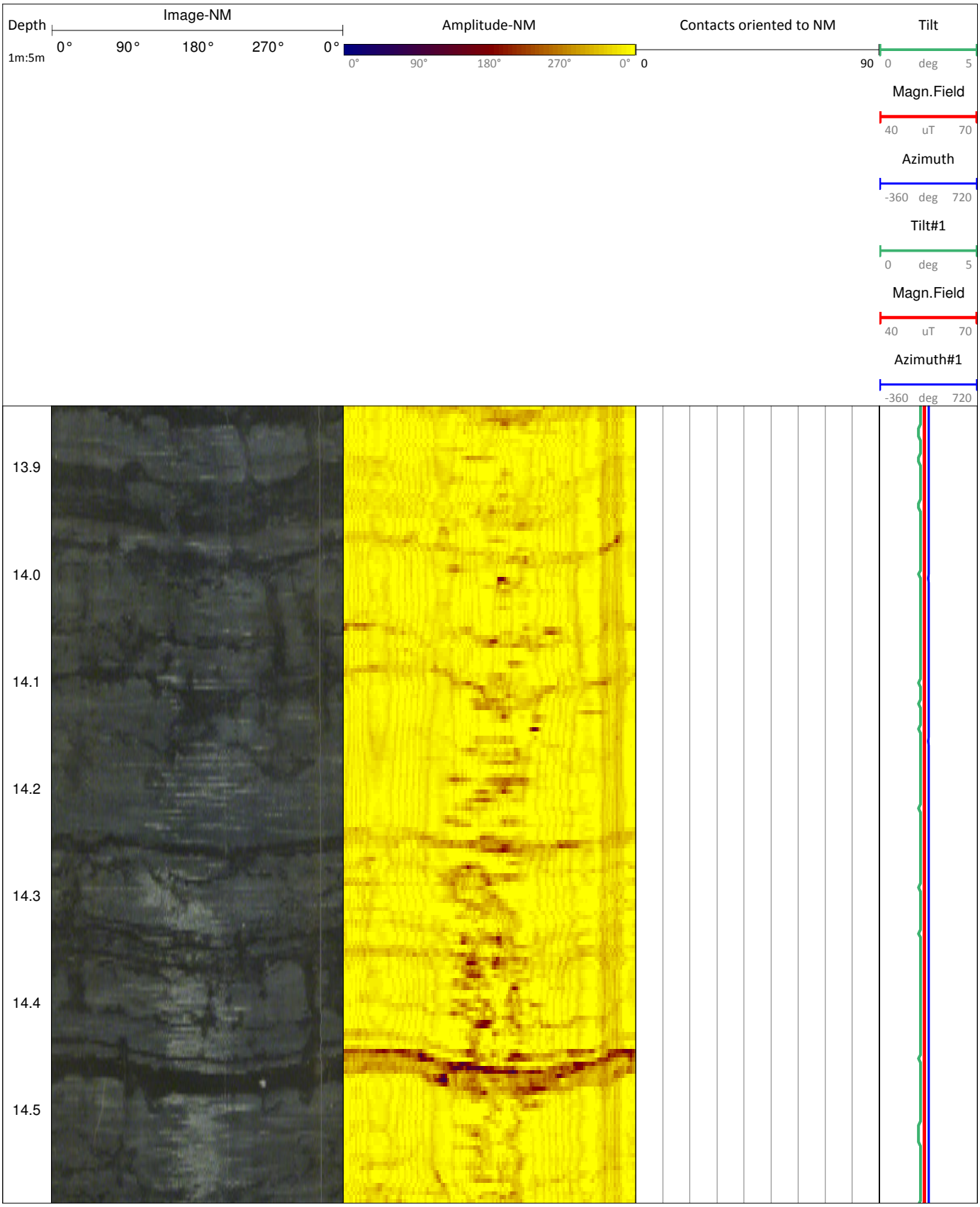
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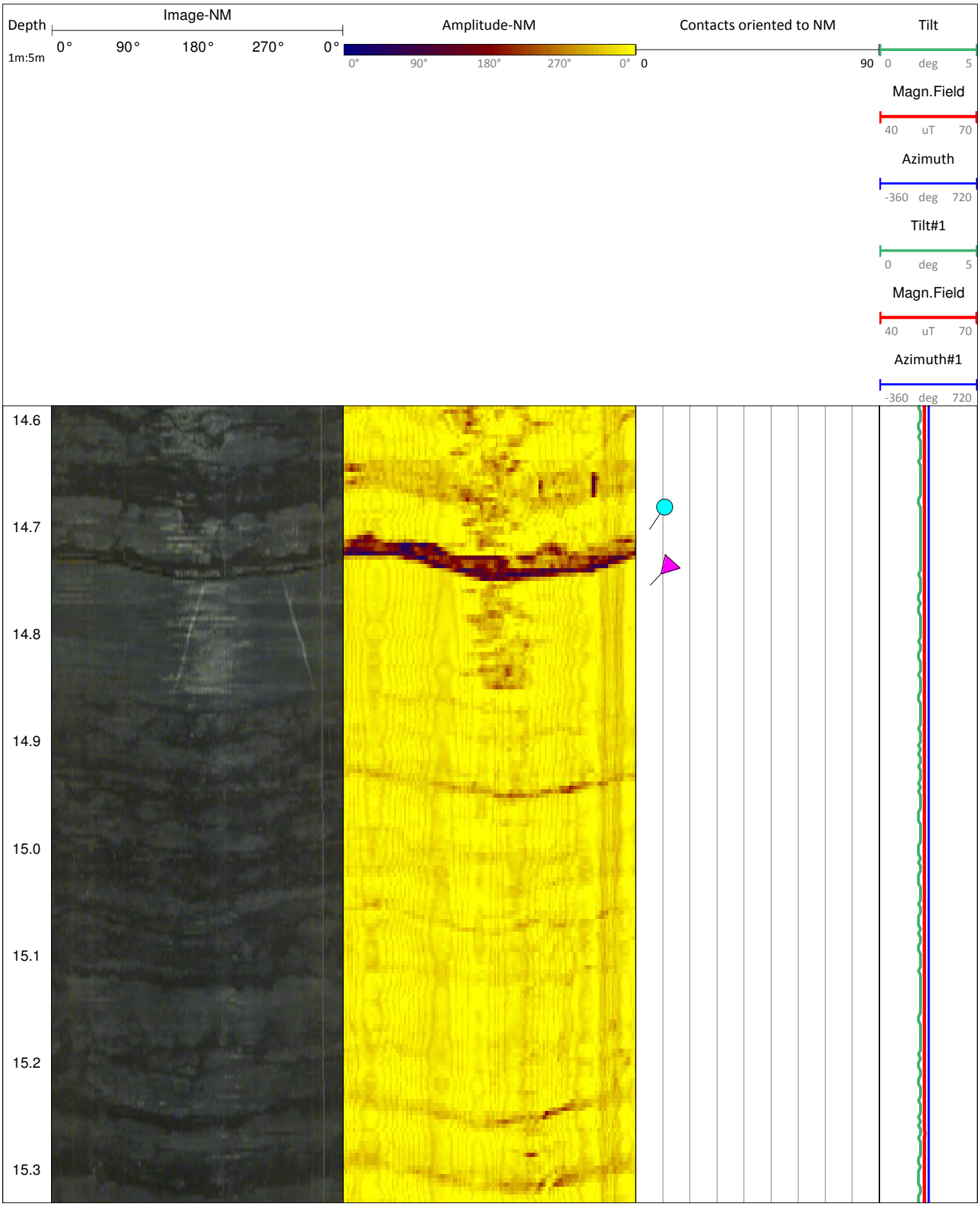
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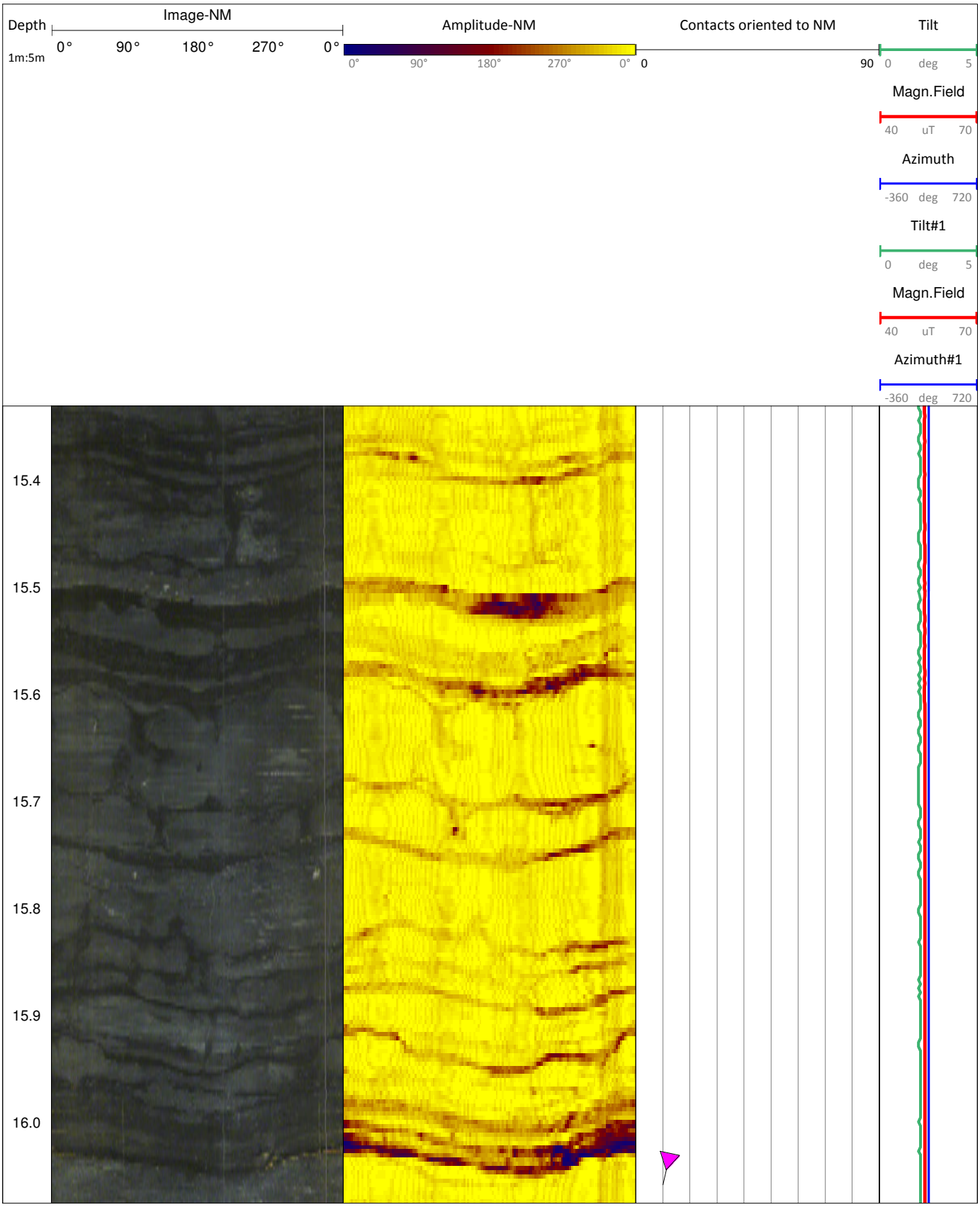
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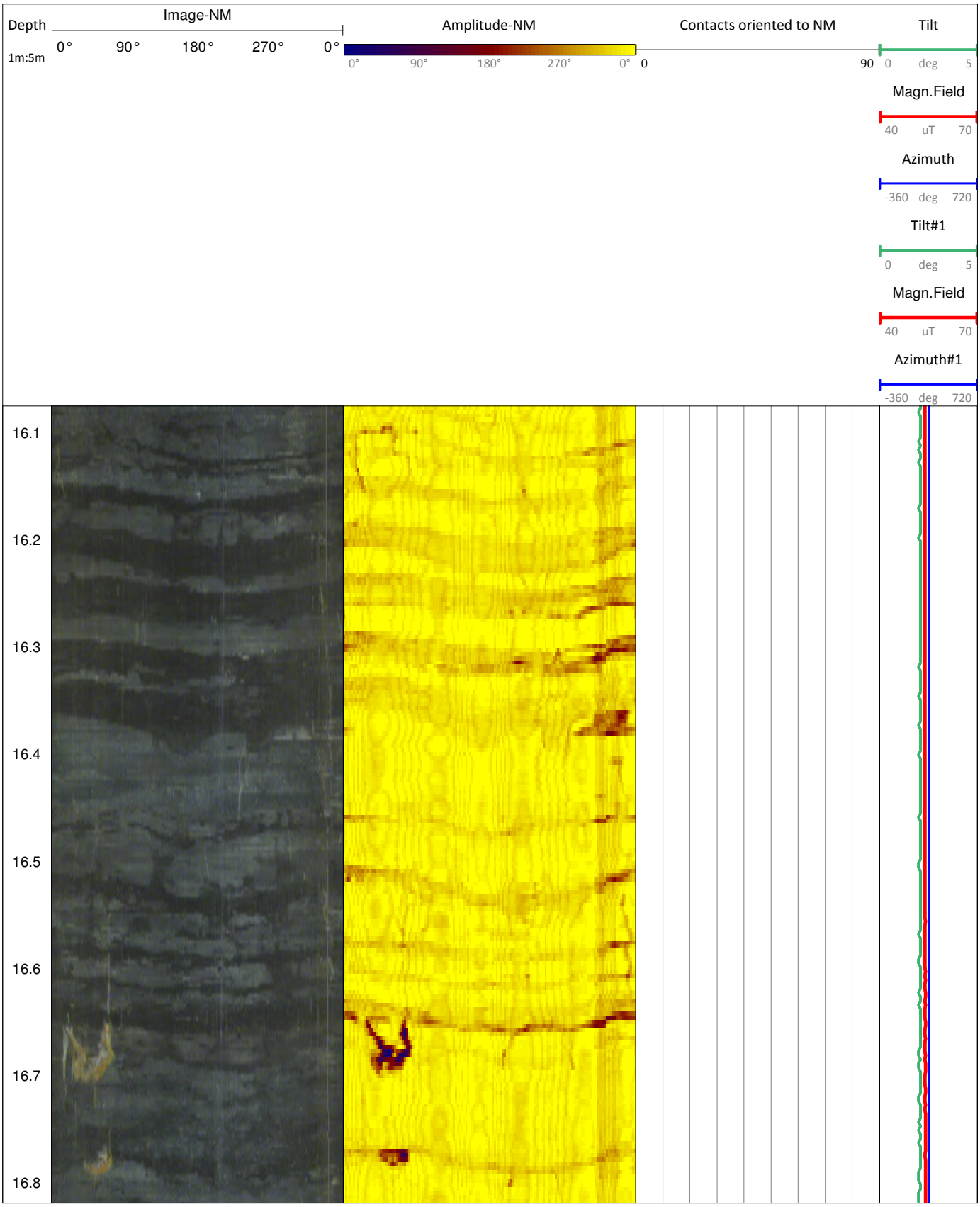
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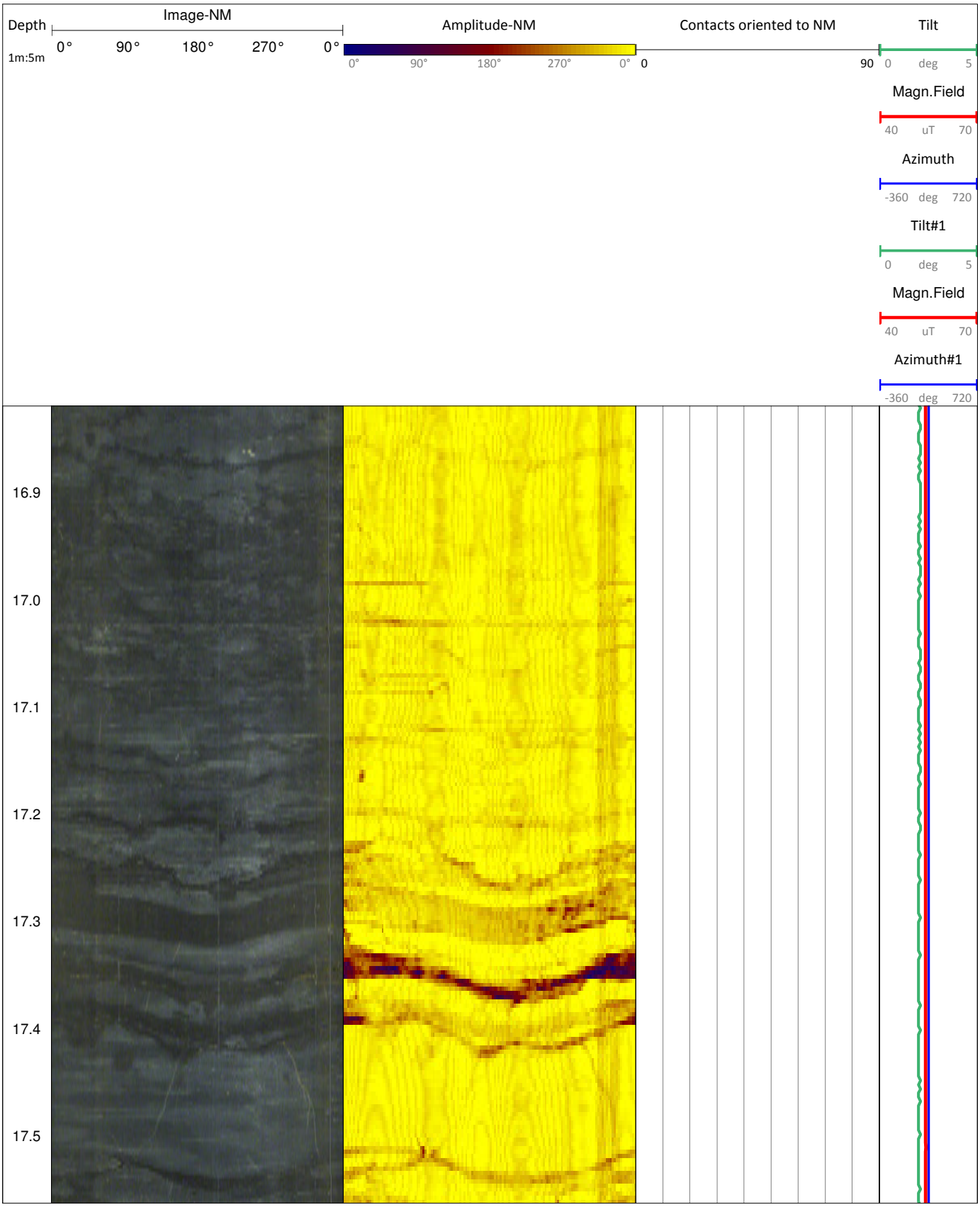
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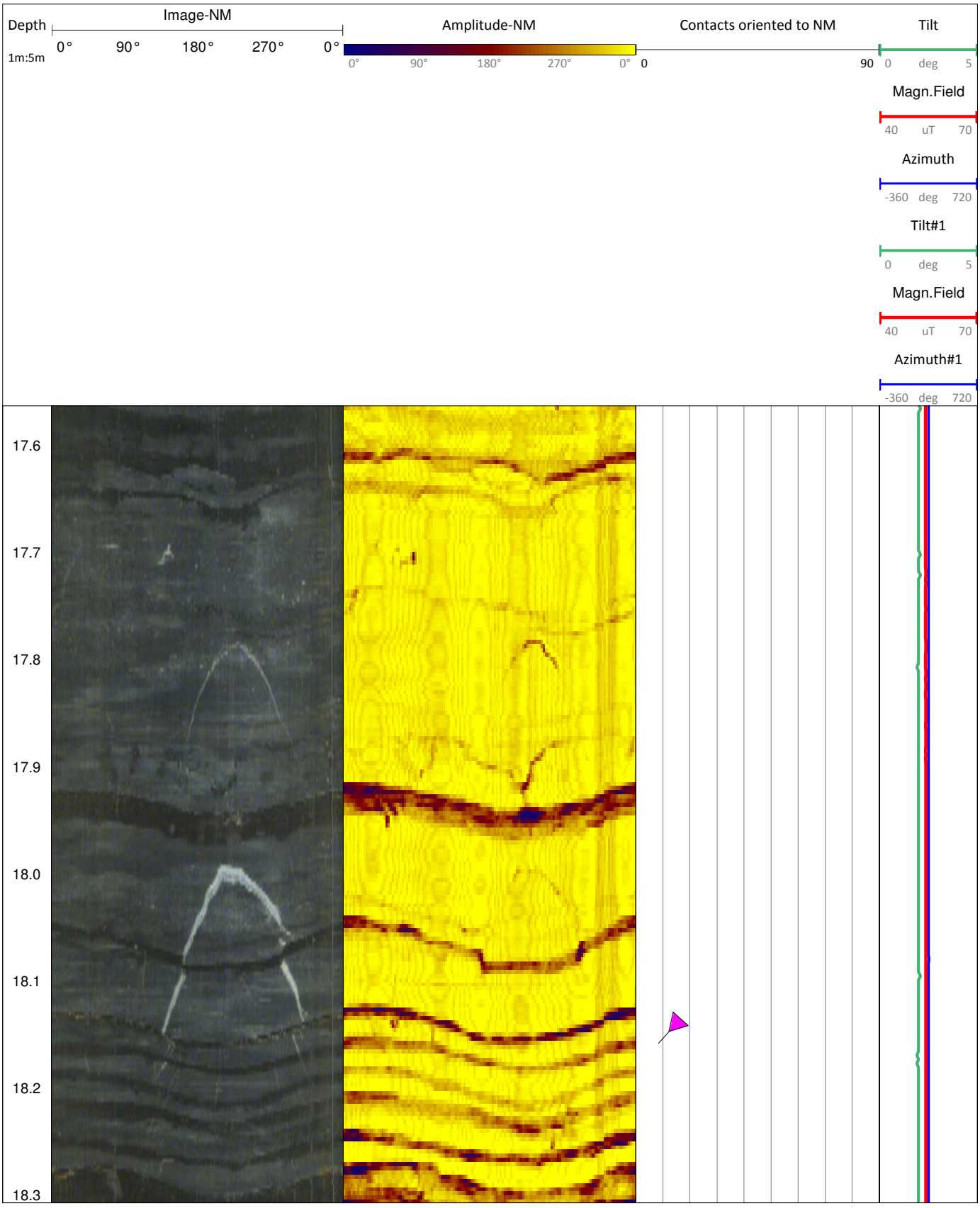
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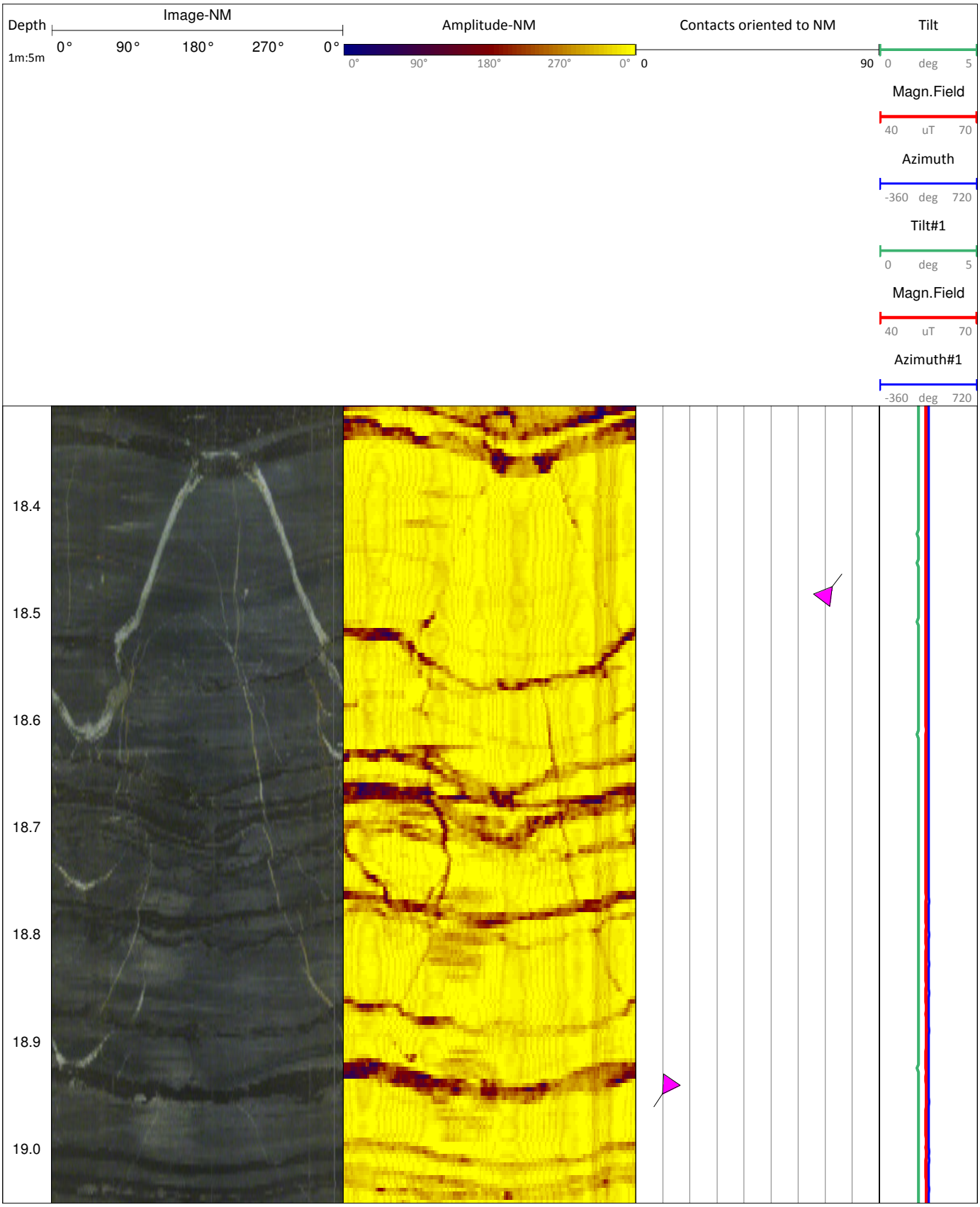
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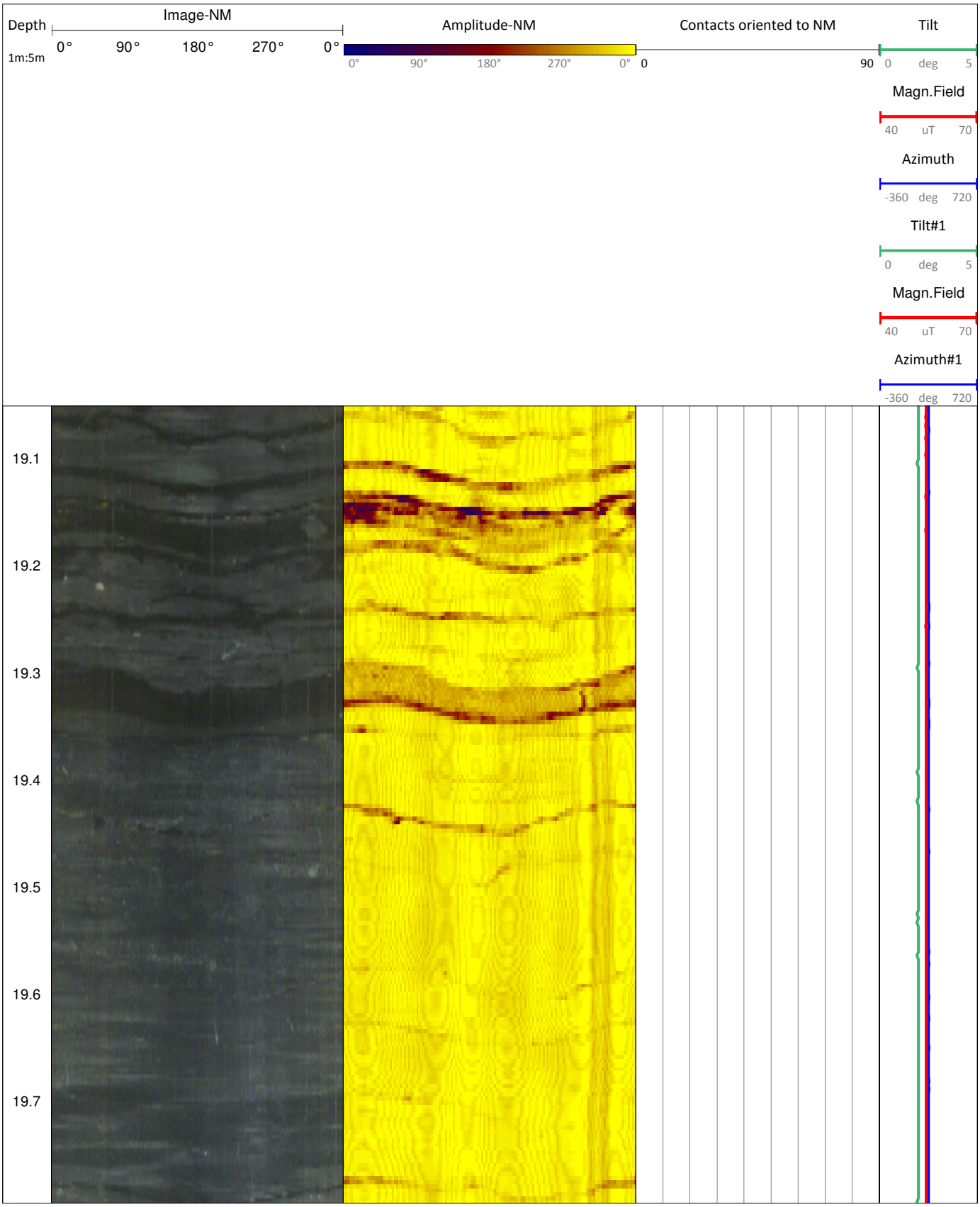
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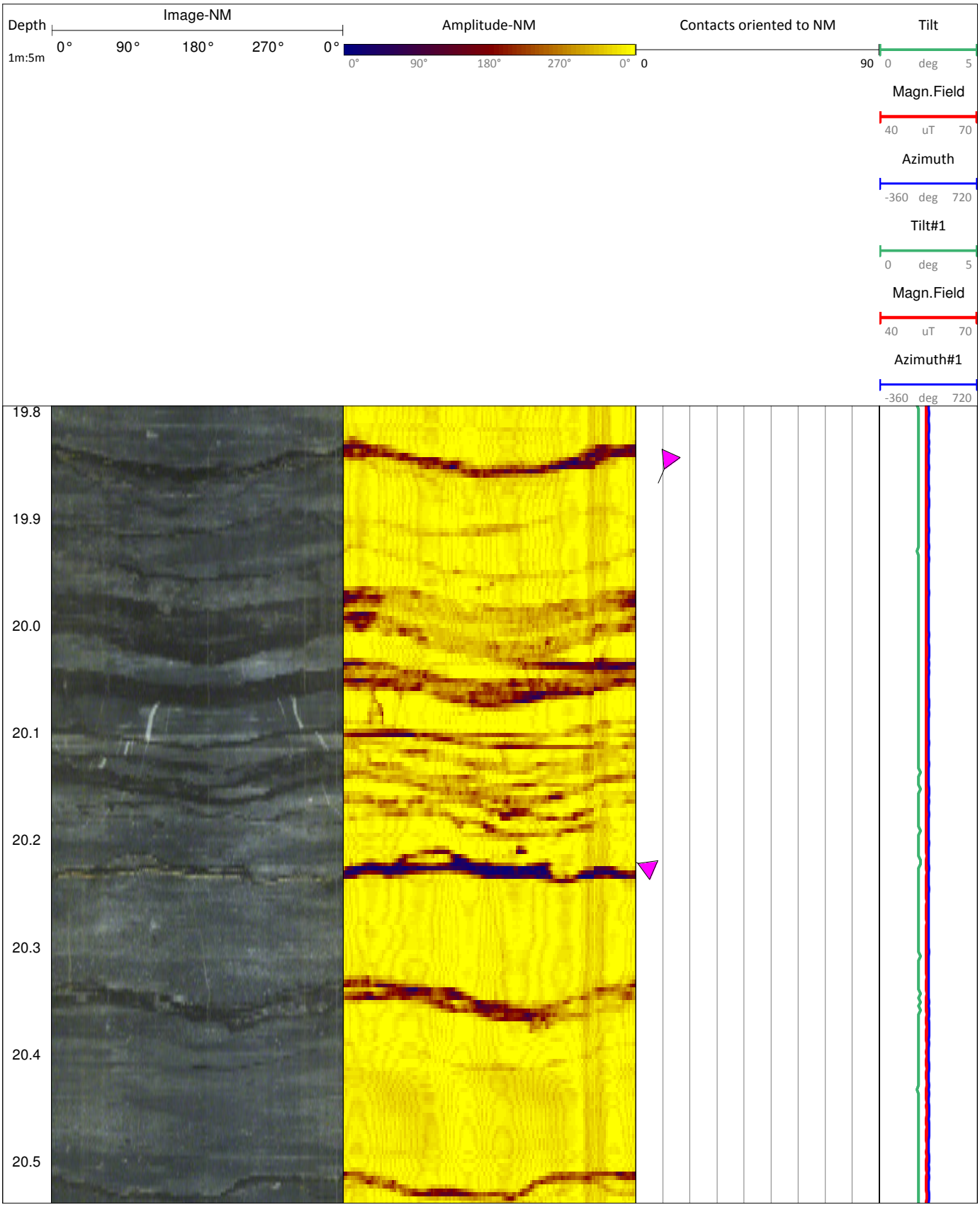
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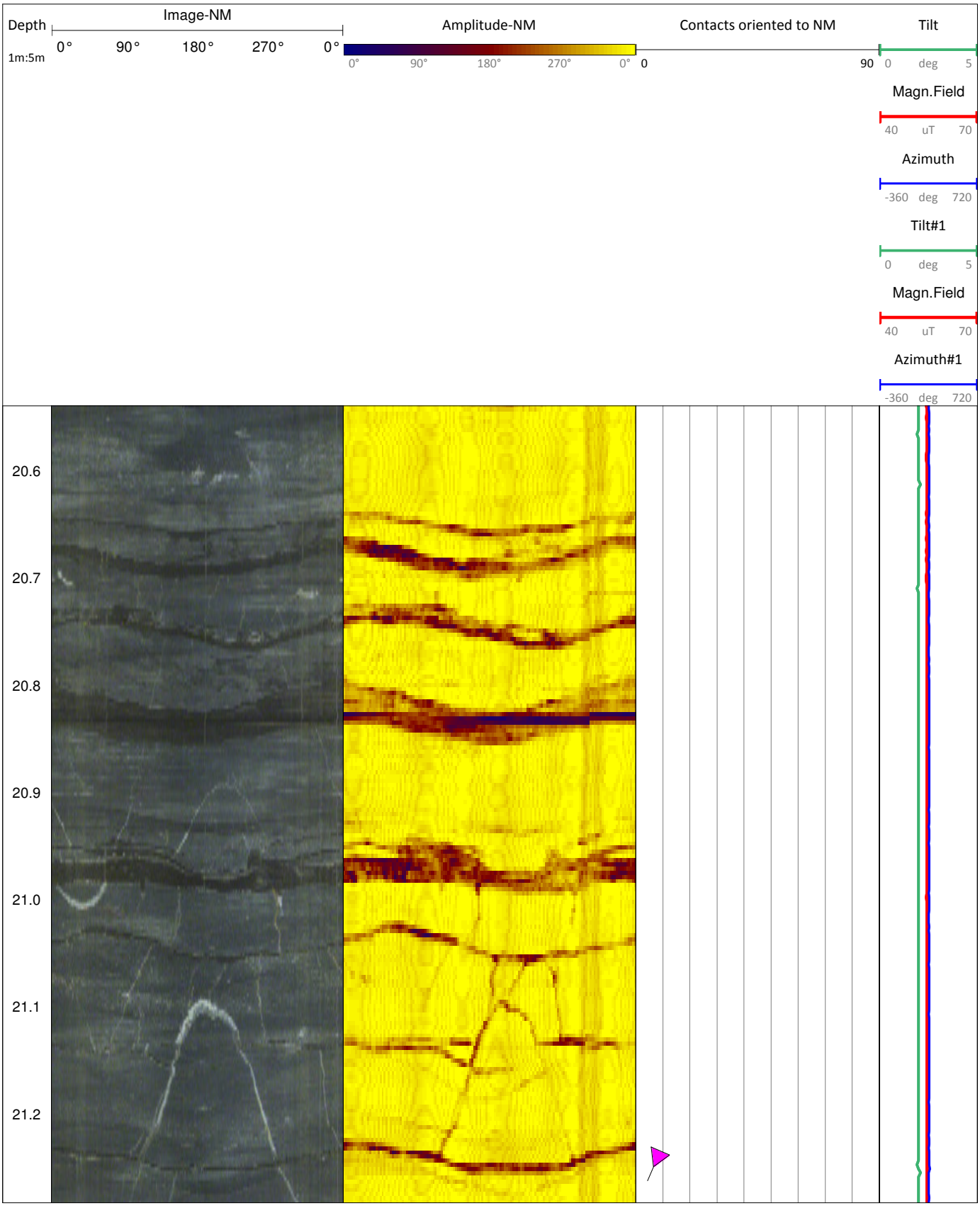
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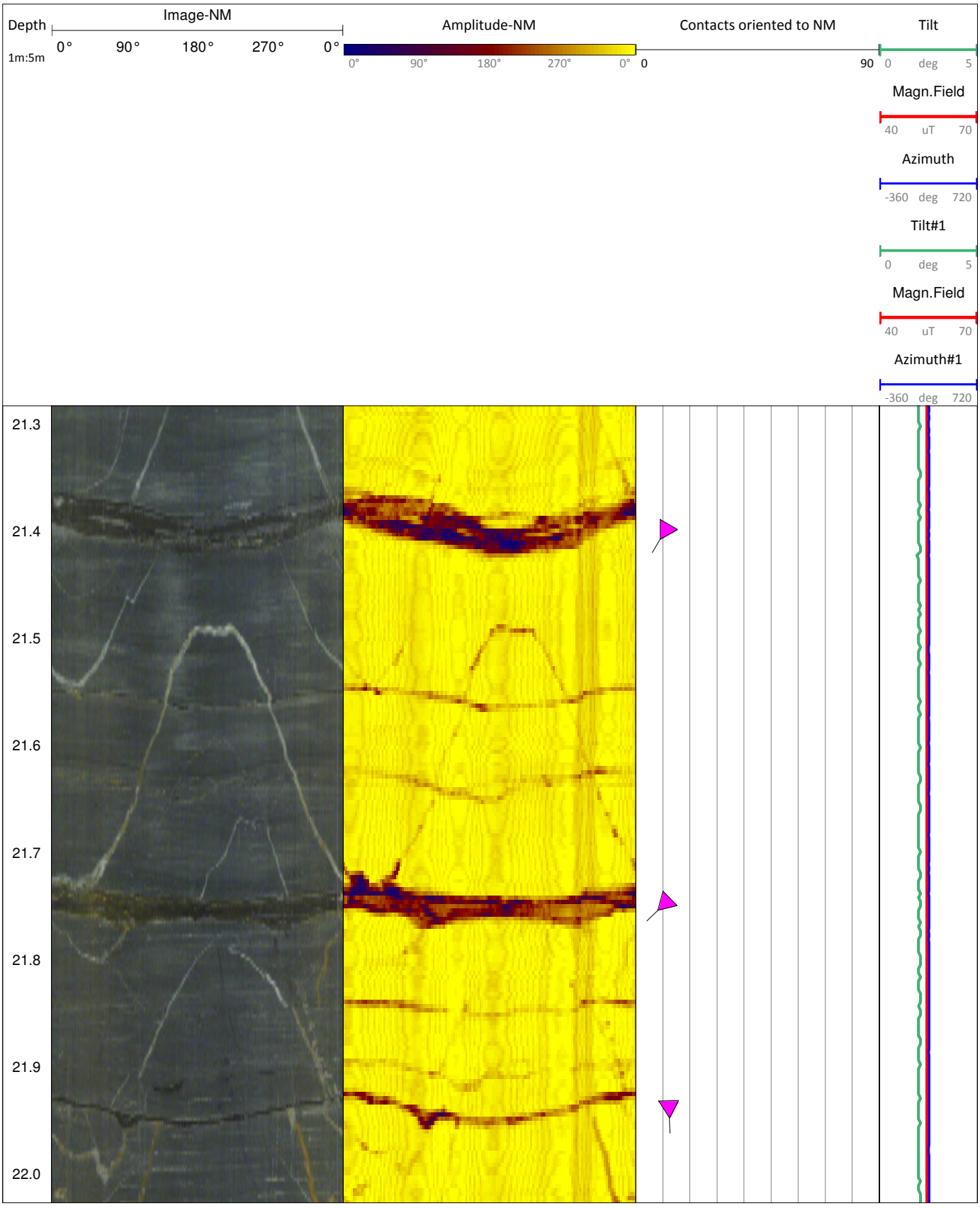
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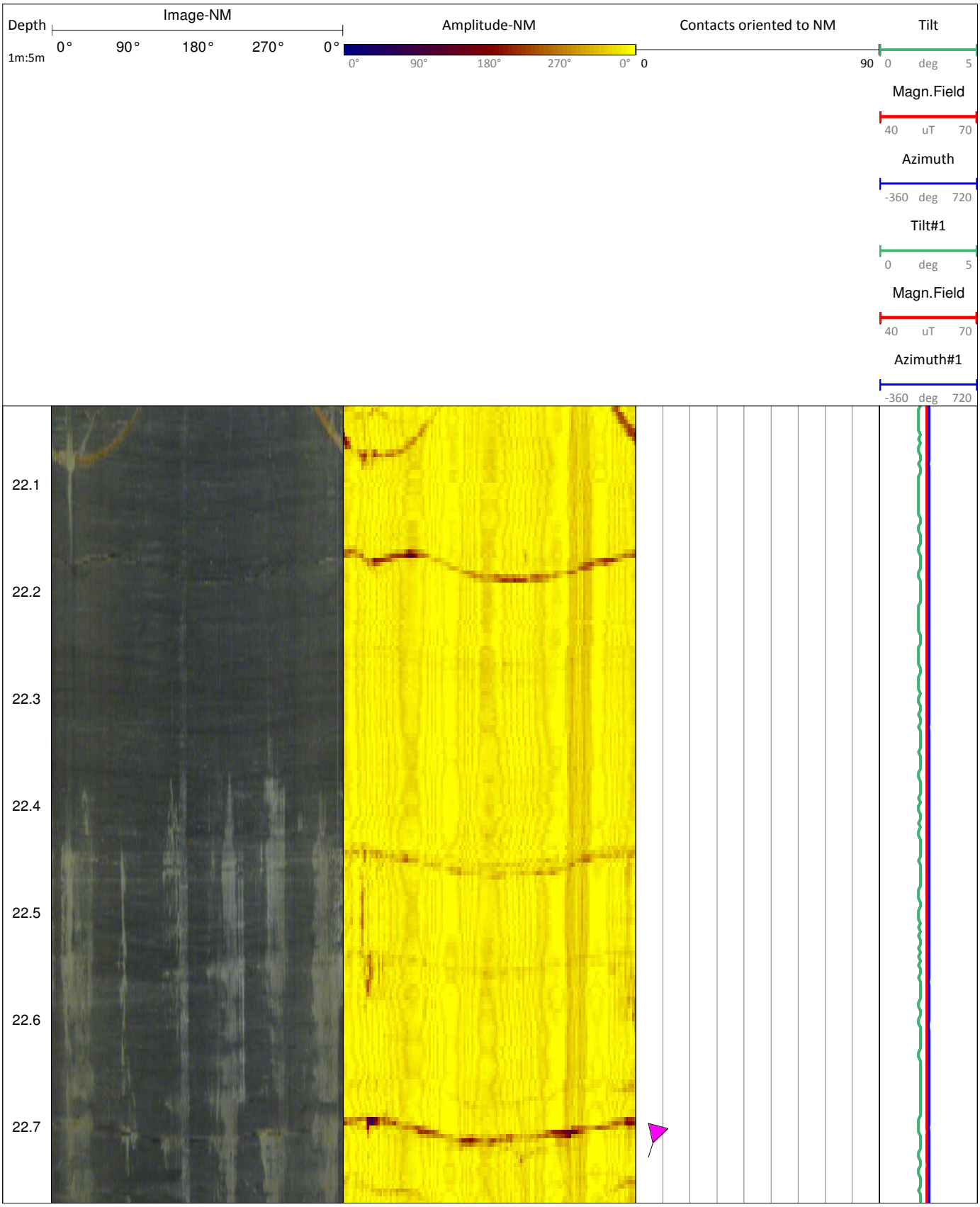
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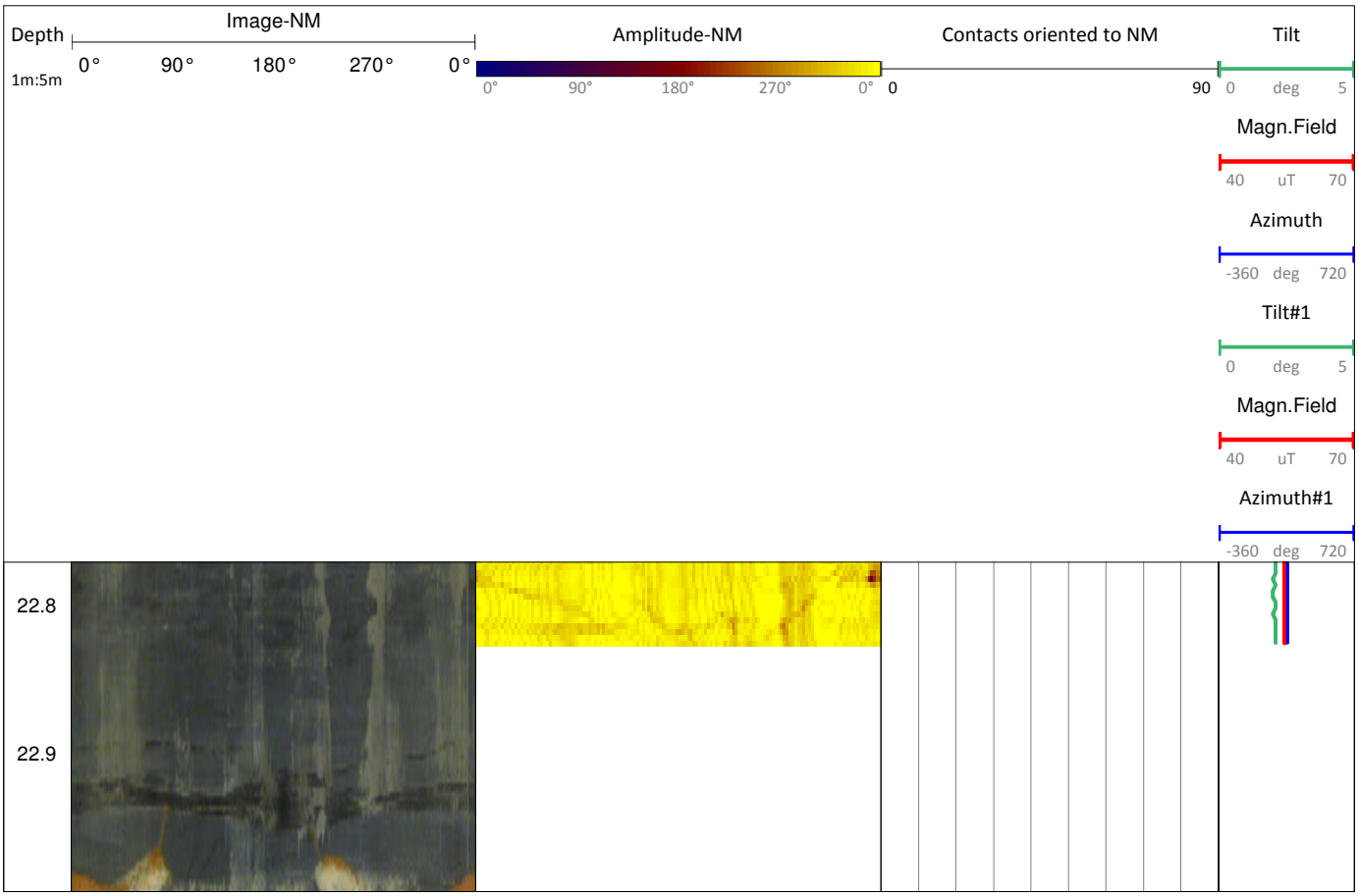
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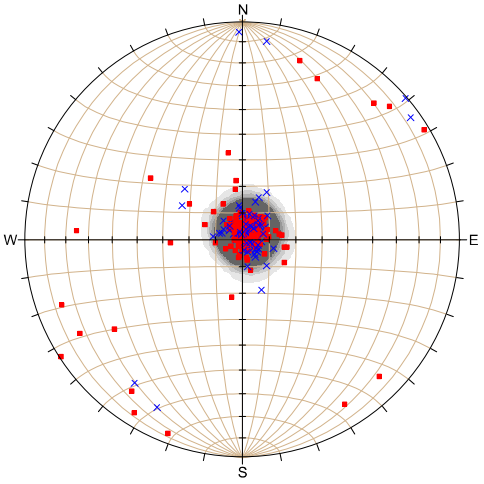
DETAILED GEOTECHNICAL INVESTIGATION
STEREOGRAPHIC PROJECTION
ALL TELEVIEWER DATA

FIGURE 8



ROCK UNIT

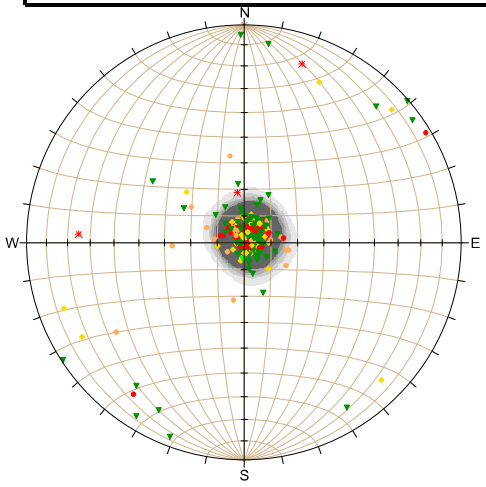
1 [168]

2 [109]

No Bias Correction
Max. Conc. = 66.3484%

Equal Area
Lower Hemisphere
277 Poles
277 Entries

a) All data: symbolic poles (rock unit) and contours



CONTACT TYPE

Foliation [49]

HFZ - Footwall [2]

HFZ - Hanging Wall [1]

Infilled Fracture [122]

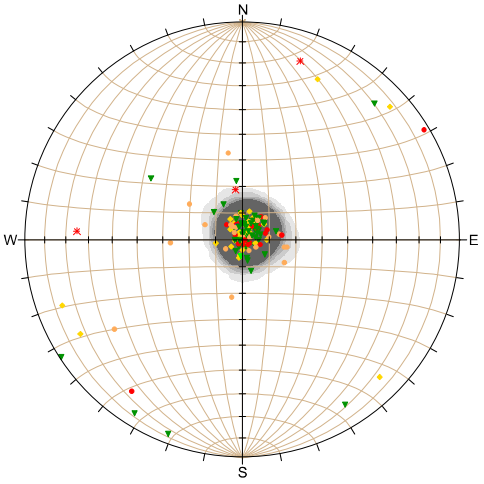
Major Fracture - J [28]

Minor Fracture - J [72]

Truncated Fracture [3]

Equal Area
Lower Hemisphere
277 Poles
277 Entries

b) All data: symbolic poles (joint type) and contours



CONTACT TYPE

Foliation [26]

HFZ - Footwall [2]

HFZ - Hanging Wall [1]

Infilled Fracture [62]

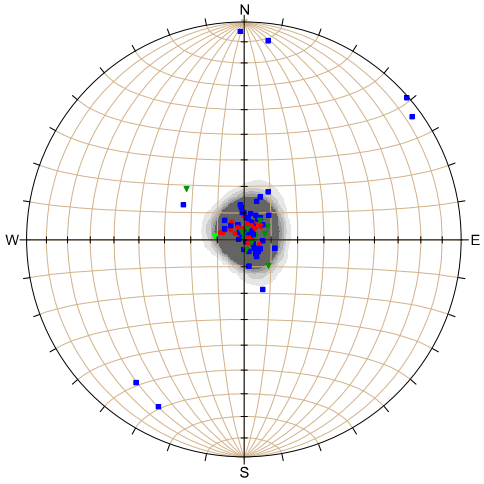
Major Fracture - J [27]

Minor Fracture - J [47]

Truncated Fracture [3]

Equal Area
Lower Hemisphere
168 Poles
168 Entries

c) Rock Unit 1 data: symbolic poles (joint type) and contours



CONTACT TYPE

Foliation [23]

Infilled Fracture [60]

Major Fracture - J [1]

Minor Fracture - J [25]

Equal Area
Lower Hemisphere
109 Poles
109 Entries

b) Rock Unit 2 data: symbolic poles (joint type) and contours

LEGEND: Fisher concentrations (% of total per 1% area)

0.00 ~ 2.00 %	6.00 ~ 8.00 %
2.00 ~ 4.00 %	8.00 ~ 10.00 %
4.00 ~ 6.00 %	>10.00 %

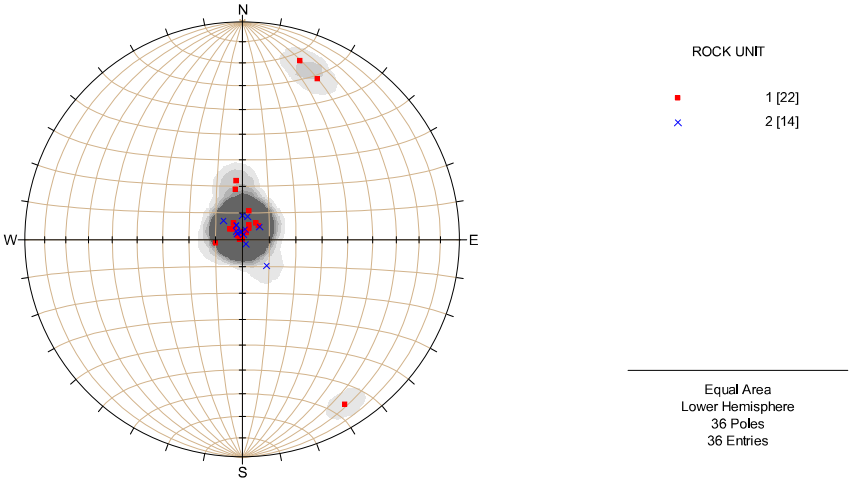
Public Works and Government Services Canada
Visitors' Welcome Centre Phase 1
Parliamentary Precinct, Ottawa, ON

DATE: March 2014 **DOC:** Véronique Boivin, ing. M.A.Sc.

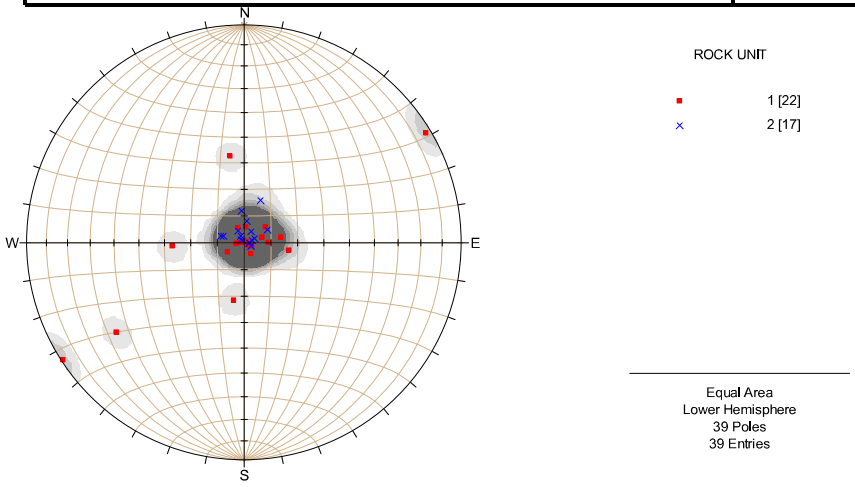
PROJECT: OTT-00212365-A0

DETAILED GEOTECHNICAL INVESTIGATION
STEREOGRAPHIC PROJECTION
TELEVIEWER DATA PER BOREHOLE (no. 1V to 5V)

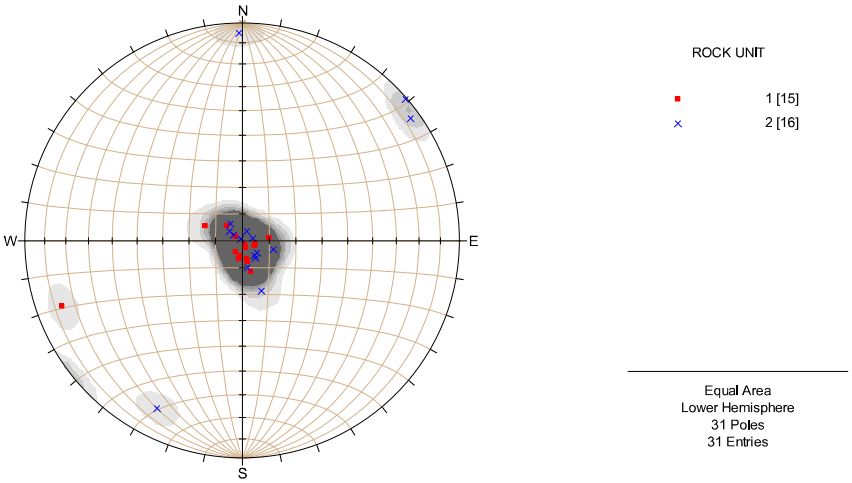
FIGURE 9



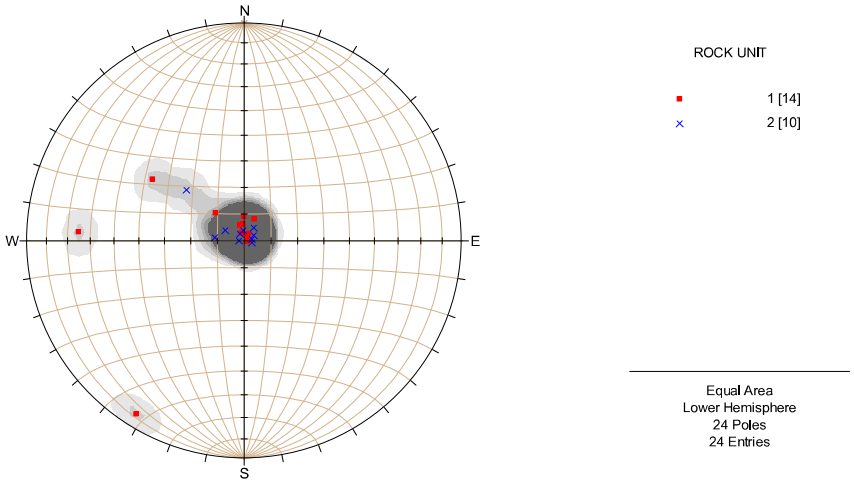
a) Borehole 1V: symbolic poles (rock unit) and contours



b) Borehole 3I: symbolic poles (rock unit) and contours



c) Borehole 4I: symbolic poles (rock unit) and contours



b) Borehole 5V: symbolic poles (rock unit) and contours

LEGEND: Fisher concentrations (% of total per 1% area)

0.00 ~ 2.00 %	6.00 ~ 8.00 %
2.00 ~ 4.00 %	8.00 ~ 10.00 %
4.00 ~ 6.00 %	>10.00 %

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Visitors' Welcome Centre Phase 1
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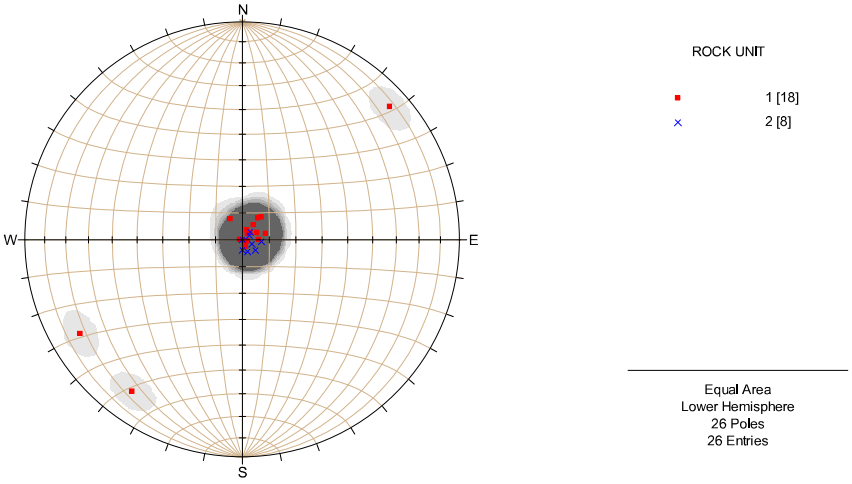
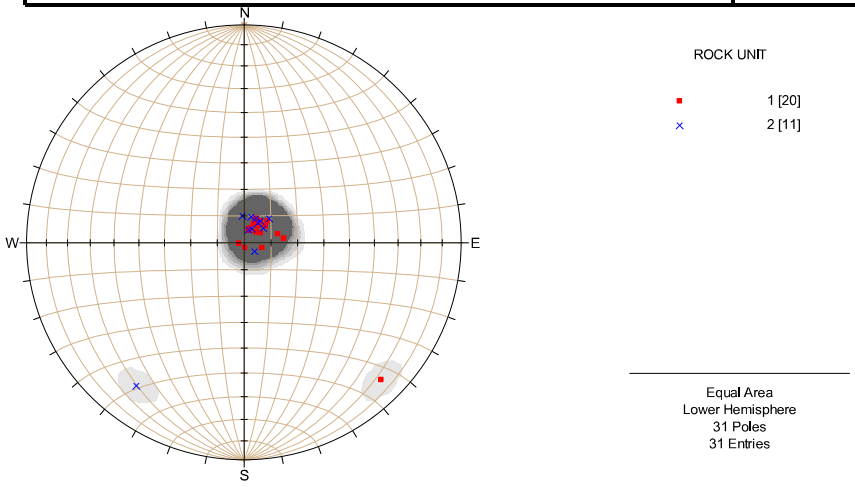
DETAILED GEOTECHNICAL INVESTIGATION
STEREOGRAPHIC PROJECTION
TELEVIEWER DATA PER BOREHOLE (no. 6V to 9V)

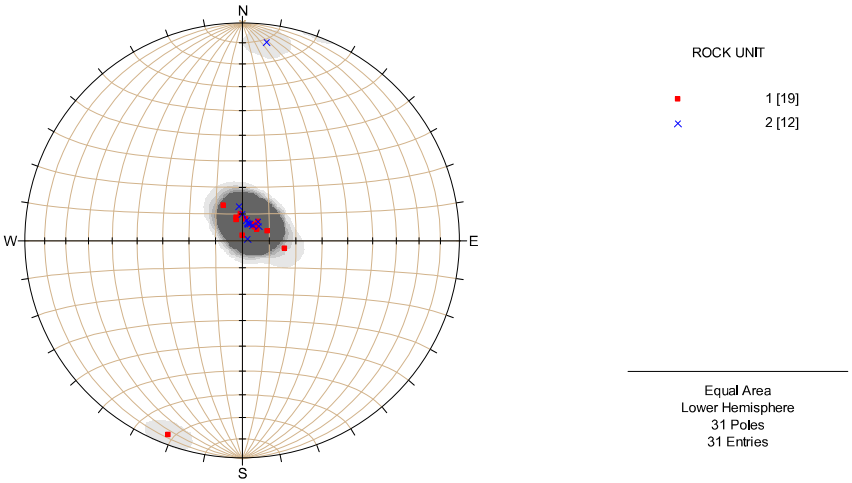
FIGURE 10



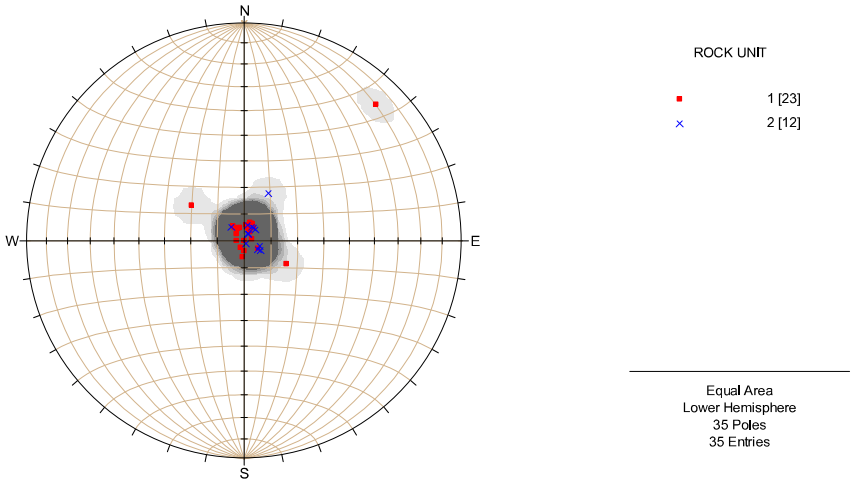
a) Borehole 6V: symbolic poles (rock unit) and contours



b) Borehole 7V: symbolic poles (rock unit) and contours



c) Borehole 8I: symbolic poles (rock unit) and contours



b) Borehole 9V: symbolic poles (rock unit) and contours

LEGEND: Fisher concentrations (% of total per 1% area)

0.00 ~ 2.00 %	6.00 ~ 8.00 %
2.00 ~ 4.00 %	8.00 ~ 10.00 %
4.00 ~ 6.00 %	>10.00 %

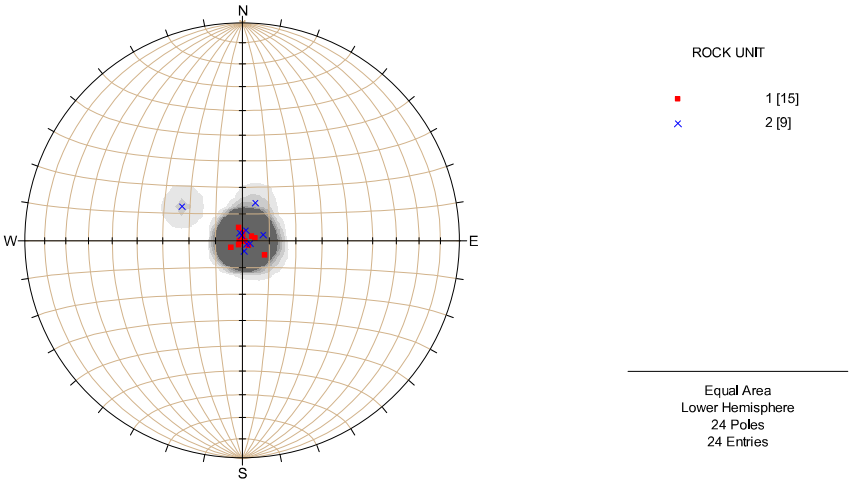
Public Works and Government Services Canada
Visitors' Welcome Centre Phase 1
Parliamentary Precinct, Ottawa, ON

DATE: March 2014 **DOC:** Véronique Boivin, ing. M.A.Sc.

PROJECT: OTT-00212365-A0

DETAILED GEOTECHNICAL INVESTIGATION
STEREOGRAPHIC PROJECTION
TELEVIEWER DATA PER BOREHOLE (no. 10V)

FIGURE 11



a) Borehole 10V: symbolic poles (rock unit) and contours

Summary of horizontal joint set orientations per borehole and rock unit:

Borehole	Rock Unit	Horizontal joint set	
		Dip (°)	Dip Direction (°)
All	All	3	214
	1	3	215
	2	3	212
1V	All	4	176
	1	5	173
	2	3	184
3I	All	2	199
	1	3	260
	2	4	190
4I	All	3	337
	1	3	358
	2	3	317
5V	All	3	169
	1	4	175
	2	2	154
6V	All	3	246
	1	4	227
	2	3	294
7V	All	7	223
	1	7	229
	2	8	213
8I	All	7	204
	1	7	207
	2	7	200
9V	All	3	202
	1	3	187
	2	3	232
10V	All	1	240
	1	1	278
	2	4	172

LEGEND: Fisher concentrations (% of total per 1% area)

0.00 ~ 2.00 %
2.00 ~ 4.00 %
4.00 ~ 6.00 %
6.00 ~ 8.00 %
8.00 ~ 10.00 %
>10.00 %

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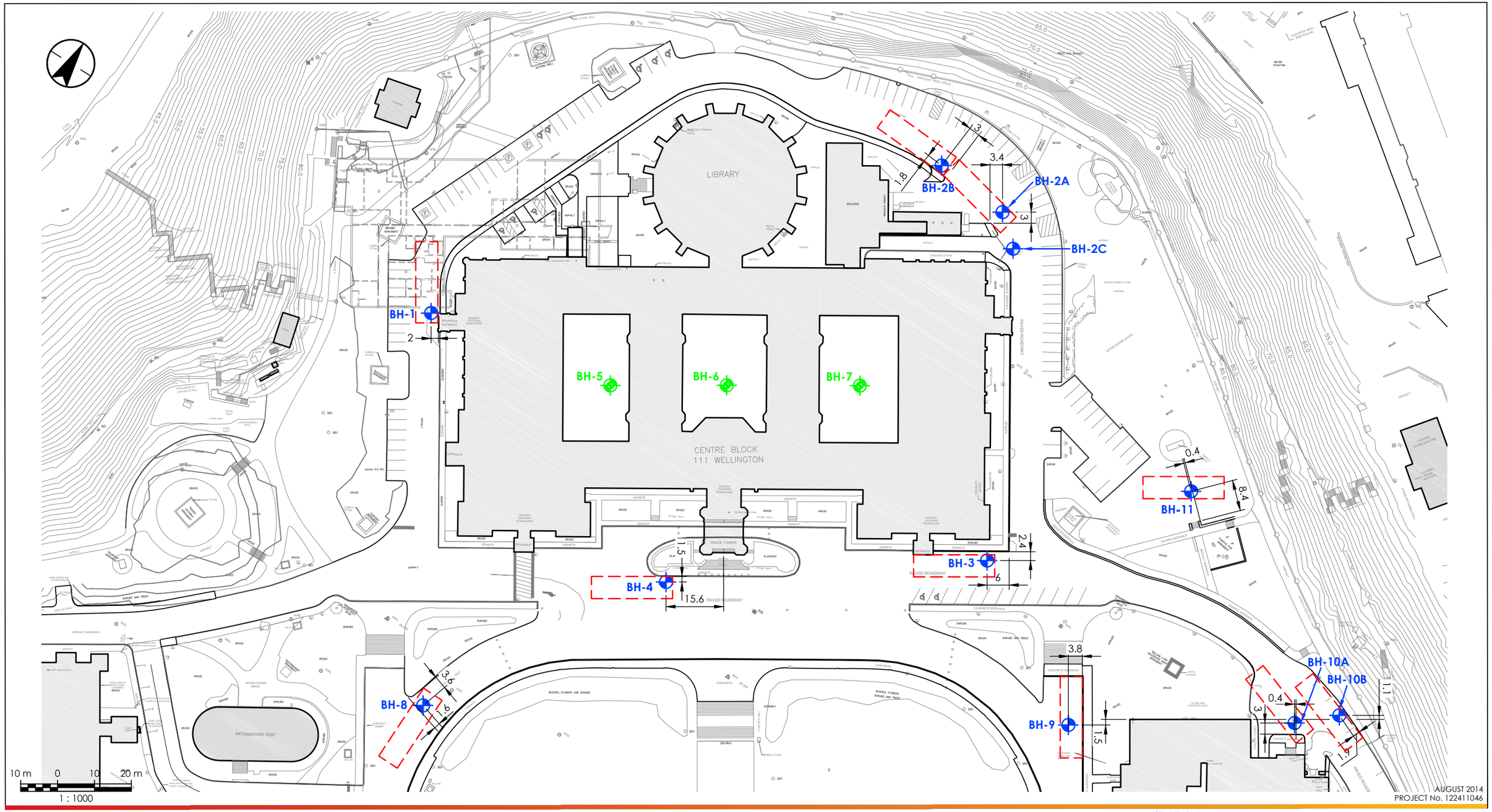
Parliamentary Precinct, Ottawa, ON

DATE: March 2014 DOC: Véronique Boivin, ing. M.A.Sc.
PROJECT: OTT-00212365-A0

APPENDIX E

Suggested Borehole Locations, Phase II



T:\Autocad\Drawings\Project Drawings\2014\122411046\122411046_Boreholes.dwg
2014/08/06 1:48 PM By: Briones, Gliceria

AUGUST 2014
PROJECT No. 122411046

Stantec
400 - 1331 CLYDE AVENUE
OTTAWA, ON, CANADA K2C 3G4
www.stantec.com

LEGEND

- PROPOSED BOREHOLE (EXTERIOR)
- PROPOSED BOREHOLE (INTERIOR)
- HOARDING OUTLINE

NOTES

1. COORDINATE SYTEM: NAD 1983 MTM ZONE 9.
2. BASEPLAN PROVIDED BY PWGSC.
3. DIMENSIONS IN METERS UNLESS OTHERWISE NOTED.

Client/Project
PWGSC
GEOTECHNICAL INVESTIGATION
CENTREBLOCK, 111 WELLINGTON ST., OTTAWA, ON

Drawing No.
8

Title
PROPOSED BOREHOLE LOCATION PLAN