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APPENDIX E

TECHNICAL MEMORANDUM – 2010 RIVER CROSSING GEOPHYSICAL SURVEY

TECHNICAL MEMORANDUM

DATE April 26, 2010 **PROJECT No.** 093-81042

TO Bob Dugan, Amy Thorson
Golder Associates Inc.

CC Mark Monier-Williams

FROM Stephane Sol - Golder Associates Ltd. **EMAIL** ssol@golder.com

2010 RIVER CROSSING GEOPHYSICAL SURVEY – PROPOSED RAIL LINE NORTH OF NAKINA, ONTARIO

1.0 INTRODUCTION

As part of a geotechnical investigation for a proposed railway line north of Nakina, Ontario Golder Associates carried out geophysical surveys at ten (10) river crossings along a north south corridor roughly 250 kilometres long. The goals of the study included profiling depth to bedrock beneath the river crossings both on the flanks and beneath the rivers, and characterization of the morphology of the bottom of the rivers. Two geophysical methods were used as part of the investigation: electrical resistivity imaging (ERI) and ground-penetrating radar (GPR).

Table 1: Surveyed River Crossings

River	Easting	Northing
Stinger Lake	524,500E	5,579,000N
Esnagami River	535,400E	5,597,700N
Colpitts Creek	534,300E	5,630,000N
Little Colpitts Creek	533,700E	5,632,500N
Ogoki River South	534,200E	5,638,000N
Ogoki River North	532,400E	5,647,000N
Albany River	521,500E	5691,400N
Wabassi River	511,300E	5,732,900N
Inlet to Fish Trap Lake	539,500E	5,803,200N
Tributary to Muketei River	542,300E	5,833,300N

Datum: UTM NAD 83, Zone 16

Ten (10) ERI lines were acquired across each of the frozen river crossing to image bedrock profiles and structure of the overburden and to complement information from a recent drilling program. Twenty three (23) GPR lines were collected. The GPR lines were oriented both across the rivers and along the mid channel principally for imaging the shallow stratigraphy of the water bottom and depth to bedrock.

Processing and interpretation of the geophysical data were supported by the following:

- LIDAR data provided by Canada Chrome Corporation; and
- Borehole logs drilled at each crossing by Golder Associates

The LIDAR and borehole information supported the analysis and interpretation of the electrical resistivity and GPR data.

This technical memorandum presents the results of the geophysical investigation.

2.0 METHODOLOGY

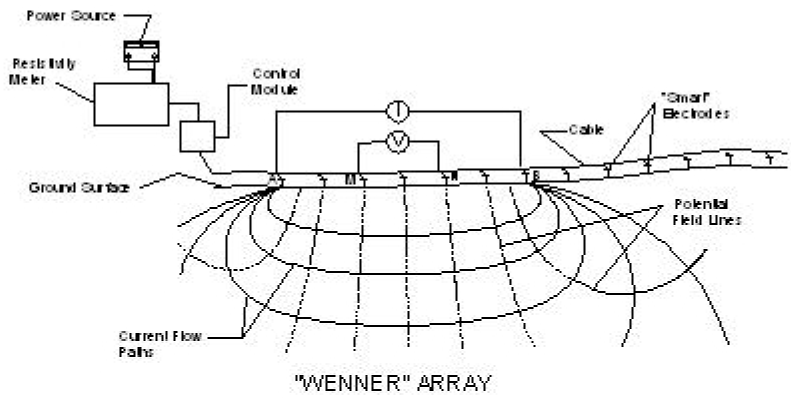
2.1 Electrical Resistivity Imaging (ERI) Method

The electrical resistivity imaging (ERI) technique is used to measure the electrical resistivity (reciprocal of conductivity) of the subsurface to infer rock/soil types, stratigraphy. The physical principles for this technique are the same as that established for direct-current (DC) resistivity, in which the apparent resistivity of the subsurface is calculated for increasing electrode separations by applying a current to the ground using two electrodes and measuring the potential difference (voltage) between two different electrodes.

Apparent resistivity of the subsurface is calculated from the potential to current ratio multiplied by a constant. This constant is a function of the electrode spacing and geometry. The depth of investigation possible is also a function of the electrode separation. Thus, with larger electrode separations, information from greater depths can be acquired, but at the cost of decreased resolution.

ERI differs from the traditional DC sounding techniques in that a “spread” of electrodes (typically 56, 72 or more) are staked along a survey line and connected to a resistivity meter by a cable fitted with multiple takeouts. The resistivity meter is a computer-controlled device consisting of a current supply capable of producing switched +/- constant current and a high impedance voltmeter.

A software routine is loaded on to the resistivity meter and the electrodes are switched on and off as required throughout the measurement process. This equipment and procedure allows for automated collection of high-density data along the entire spread. As the line of resistivity coverage is continued, cables from the start of the electrode array are moved (rolled) to the end and measurements are continued. By “leap-frogging” the array system along the survey line, a semi continuous pseudo-section of apparent resistivity values versus apparent depth beneath the profile line can be generated. These data are then inverted to calculate a 2 dimensional resistivity model for the profile with modelled true depths and resistivity. RES2DINV was the computer program that was used to invert the survey data to determine two-dimensional resistivity models for the subsurface.

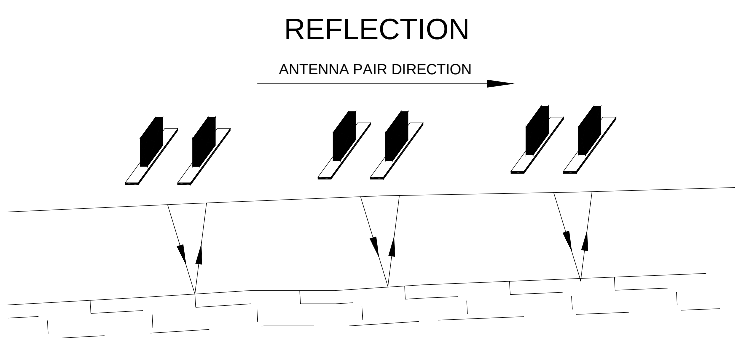


Example 1: Principle of the Wenner- layout for resistivity survey.

2.2 Ground Penetrating Radar (GPR) Method

The GPR system consists of two antennae (transmitter and receiver), a control console and a computer for real-time, graphic display and data recording. In reflection profiling mode, the antennae, separated a fixed distance, are moved stepwise along a traverse and readings are taken at discrete intervals. At each step, pulses of radar frequency electromagnetic energy (megahertz range) are transmitted and reflections received from subsurface horizons. The reflecting horizons occur where there is an abrupt change in the subsurface material dielectric permittivity such as at the interface between host rock and an underground void. The amplitude of received radar energy is recorded as a function of time, processed in real-time for display purposes, and the raw data recorded digitally for later processing and presentation.

GPR sections are presented as time-sections, with the position (in metres) of each trace recorded as the horizontal axis across the top of the section and the GPR travel time (in nanoseconds, increasing downward) as the principal vertical axis. A second vertical axis is included to provide an estimate of depth or elevation and is calculated assuming a constant GPR velocity for the subsurface, which is obtained through common-midpoint tests at several locations along a survey line.



Example 2: Typical GPR Surveying Methods.

Electromagnetic pulses, like those used in a GPR system, are strongly attenuated when travelling through conductive materials. The depth of investigation of a GPR system is therefore strongly influenced by the conductivity of the subsurface, where the greater the conductivity the shallower the depth of investigation. Conductive materials (e.g. clay) will attenuate the GPR signal at the subsurface.

3.0 FIELD WORK AND PROCESSING

The geophysical field work was carried out by Golder personnel from the Mississauga, Winnipeg and Saskatoon offices between February 19 and March 3, 2010. The surveyed locations of the geophysical lines at each site are presented as inserts on each of the river crossing figures (Figures A1 through A10). Each river crossing was accessed by helicopter. Line cutting was provided for all the ERI and GPR lines by Canada Chrome.

Thin snow cover (approximately 0.3 m) and frozen ground was present at the time of the survey mostly on the flanks of the rivers. Each river crossing was frozen at the time of survey. If the ice thickness was too thin for safe crossing, an ice bridge was built by flooding the crossing to increase ice thickness prior to the survey. For safety and to support the electrical resistivity surveying, ice thickness was measured through auger holes that were drilled every 5 metres along the river crossing and the mid-channel profile at the commencement of the geophysical survey.

At each of the 10 river crossings, the resistivity lines were completed along a single alignment, perpendicular to and centered on the river. A shorter GPR profile was also typically collected along the same line, centred on the river. The primary purpose of these lines was to profile the depth to bedrock at the river crossing.

GPR lines were also completed parallel to the river, along the approximate centre line of the river. In several cases, additional short GPR lines were collected over the river, when time allowed. These GPR lines, offset from the flooded portion of the river, were collected to estimate the water bottom river profile.

3.1 Electrical Resistivity

The ERI geophysical survey consisted of three steps: survey design, line layout and ERI surveying. When first arriving in the field, the ERI line was laid out using a dGPS Trimble Geo XH system. The GPS system provides submeter accuracy, and allowed for efficient measurement of line length and position. The ERI survey was carried out using a SYSCAL R1 Plus Switch 72 channel resistivity system (manufactured by IRIS Instruments). The resistivity data were collected using a Wenner type of electrode array and an electrode spacing of 5 metres. The maximum depth of investigation was approximately 60 m below ground surface. To reduce contact resistance between the electrodes and the ground, a water or salt water solution was applied to the ground in the immediate vicinity of electrodes to obtain good electrical current flow into the ground. When electrodes were positioned on or near the river, holes were augered through the ice to allow placement of electrodes into the water, using weighted electrodes.

Prior to staring each ERI survey a continuity check and contact resistance check was made for all electrodes. Contact resistances at the electrodes during the survey were typically 7,500 ohms or less, which is considered acceptable for surveying. Where contact resistances were occasionally higher, the electrode was reinstalled into the ground and additional water or salt water solution was applied to the ground locally in order to reduce the contact resistance to an acceptable level.

The resistivity system was set up to pass enough current at the current electrodes to generate a measurable voltage at the potential electrodes in the range of 300mV, in order to yield data with high signal to noise ratio. Data was analyzed in the field at the time of data collection for quality control and to decide if a GPR survey was required and which GPR antennae was the best suited for the interpreted bedrock depth. Generally, the quality of the data was good.

Upon completion of the survey the ERI data were first processed to remove spurious data points. Spurious data points in a data set can be caused by several factors, including presence of localized buried metal objects, poor coupling of electrodes to the frozen ground, and the undue influence of infrastructure. Generally, less than 1% of the readings along each survey line were removed from the raw data set.

The elevations along the ERI lines were extracted from the LIDAR data provided by Canada Chrome Corporation, using the GPS positions collected along each geophysical line at the time of the survey. The topographic data were combined with the ERI data to include topography along the line in the model results. The ERI survey results were modelled using the inversion program RES2DINV, an industry standard software package developed by Dr. M.H. Loke.

The ERI models were contoured using the Surfer Surface Mapping System (Golden Software) using a Kriging algorithm and a cell size of 2.5 metres. The contoured models were then imported to AutoCAD (Autodesk Inc.) for interpretation and presentation.

3.2 Ground Penetrating Radar

The GPR data were collected using a PulseEkko Pro ground penetrating system manufactured by Sensors and Software Inc. Depending on the anticipated depth to bedrock along the profile, two different frequency systems were used, 50 or 100 MHz. The parameters for each system are summarized in the table below.

Table 2: GPR Collection Parameters

Parameter	50 MHz Antennas	100 MHz Antennas
System Centre Frequency	50 MHz	100 MHz
Antenna Separation	2 metres	1 metres
Step Size along Line	0.50 metres	0.25 metres
Number of Stacks	8	8
Use of System	Estimated depth to bedrock greater than 15 mbgs	Estimated depth to bedrock less than 15 mbgs

Processing of the GPR data was accomplished using the Reflexw software package (Sandmeier, 2005). The radar profiles were processed to improve the presentation quality of the data to aid with the interpretation. Processing included, topographic correction, dewowing (removal of early time data bias), energy decay and low pass filter. For the GPR lines parallel to the resistivity lines along the alignment, a GPR velocity of 0.11 m/ns, typical for soils, was used to estimate the bedrock depth. For the GPR lines exclusively conducted on the river for imaging the river depth profile, a GPR velocity of 0.033 m/ns, typical for water, was used. The complex changes in ice thickness, due to flooding of the river to increase ice thickness, did not allow for direct correction for ice thickness, and as a result the river bottom depth presented on the GPR sections is believed to be underestimated.

4.0 RESULTS AND INTERPRETATION

The GPR and ERI results are presented as inserts on Figures A1 to A10. With the exception of the Tributary to the Albany River where a quick processing of the ERI line in the field revealed relatively deep bedrock surface (Figure A7), a GPR line was completed parallel to the electrical resistivity line. The GPR line is plotted below the resistivity line with a common horizontal chainage (distance mark) to allow direct comparison. For presentation purposes a three time vertical exaggeration was applied to the GPR line along the alignment and a five time vertical exaggeration to the GPR sections on the river. The ERI and GPR data were interpreted with the aid of available borehole records from boreholes located directly on or in the vicinity of the survey lines.

The resistivity lines were determined to be the most suitable to map the depth to bedrock along the river crossings. In the ERI sections the interpreted bedrock profile is presented as a high resistivity layer, with resistivities typically greater than 1000 ohm-metres. The interpreted overburden is presented in the ERI data as a low resistivity layer, with resistivities typically less than 400 ohm-metres. With the exception of the Inlet to Fish Trap Lake (Figure A9) where the RMS error associated with the final resistivity inversion was about 20% due to poor electrode resistance, RMS errors at the other ERI lines were on average about 4% after 5 iterations. An approximate cut-off value of 1,000 ohm-m was used to distinguish the bedrock layer from overlying materials based on calibration of resistivity data and borehole records. Erroneous results may be caused by high resistance between the electrodes and the frozen ground; also the frozen ground would have high conductivity. This is the case for example in ERI Line 9 where subsurface resistive pockets are observed (Figure A9). Good correlation was usually observed between the resistivity data and the depth to bedrock as determined by the drilling.

For several reasons it is much more difficult to identify bedrock reflectors from the GPR data. The flooded river bridges caused ringing in the GPR data due to contrasting layers, making interpretation not possible in the immediate area of the river crossings. (An example is presented in Figure A8 along GPR Line 8A at around 175 metre along the main crossing line). Clayey layers observed in some of the boreholes also limit the depth of investigation. GPR was relatively successful to image the river bottom morphology away from the immediate vicinity of the river crossing ice bridge.

The geophysical results for each crossing are discussed in detail below.

Stinger Lake Crossing (Figure A1)

Excellent correlation is observed between the bedrock surface interpreted from the ERI Line 1 and GPR Line 1A (Figure A1) and the only available borehole (BH-0660D). The ERI section indicates that the interpreted granitic bedrock outcrops or is very near ground surface (less than 1 mbgs) on both flanks of the river crossing alignment. Where the bedrock is near surface, the GPR bedrock reflectors are too shallow to be resolved by the 100 MHz antenna (GPR Line 1A).

GPR Lines 1A (River Area) and Line 1B (mid-channel) display a strong continuous reflection beneath the river that is interpreted as the river bottom. The mid-channel GPR Line 1B indicates that the interpreted river bed shows lateral variations with depths ranging from 1 to 3 metres. At the crossing, assuming a velocity of 0.033 m/ns, the estimated maximum depth of water bottom is 1.8 metres.

In ERI Line 1 a localized zone of low resistivity is observed within the interpreted bedrock at the north-east edge of the river. Interpreted as a zone of fractured or faulted bedrock, this zone may also represent an artefact from the resistivity modelling.

Esnagami River Crossing (Figure A2)

Excellent correlation is observed between the bedrock surface interpreted from the ERI Line 2 and GPR Line 2A and borehole BH-1402AD (Figure A2). The ERI section indicates that the interpreted granitic bedrock outcrops or is very near surface on both flanks of the river crossing. The high-amplitude reflector observed in GPR Line 2A and interpreted by direct correlation with the borehole log as overburden/bedrock interface is not observed after the 200 metres chainage. This is the location where the bedrock is outcropping and therefore the GPR reflectors are too shallow to be resolved by the 100 MHz antenna.

Below the frozen river a ringing signal characteristic of layered ice is observed in GPR signal Line 2A makes it impossible to observe the river bottom. On the other hand the short mid-channel GPR Line 2B completed outside the flooded ice bridge displays a strong continuous reflector that appears to dip slightly toward the east and which is interpreted as the river bottom.

Colpitts Creek Crossing (Figure A3)

The bedrock surface interpreted from the resistivity survey Line 3 (Figure A3) shows good correlation with the two cored bedrock and one auger refusal boreholes. Auger hole BH-2420D indicates refusal 7 metres above the interpreted bedrock surface which is possibly caused by the presence of a boulder. Significant variations in the bedrock topography are profiled between the south and the north of ERI Line 3 with the interpreted bedrock depth ranging from about 9 metres beneath the south flank of the river and up to about 20 metres beneath the north flank. The time window of the GPR Line 3A was too short to be able to image a reflector at the bedrock depths suggested by both the drilling and the ERI survey but a strong continuous reflector is observed at about 5 metres. Borehole logs at these depths show a change from loose to compact silty sand. At GPR Line 3A layered ice due to flooded ice bridge did not permit to image the water bottom. It was therefore decided to complete a short GPR line perpendicular to the river but away from the flooded ice bridge (GPR Line 3C).

Both the GPR Line 3C and the mid-channel GPR Line 3B image a continuous high-amplitude reflector interpreted as the water/sediment interface. From west to east the interpreted river bottom dips slightly to the east from 0.9 metres to about 1.5 metres. These water depth values are consistent with values measured in the field at the auger holes.

Little Colpitts Creek Crossing (Figure A4)

The bedrock surface interpreted from the resistivity survey Line 4 (Figure A4) shows a relatively good correlation with the one core bedrock (BH-2523-BD) and one auger refusal borehole (BH-2522-BD). A two metres discrepancy exists between the core bedrock borehole BH-2526D and the interpreted bedrock surface. One auger hole BH-2525-D indicates refusal 5.5 metres above the interpreted bedrock surface which can be caused by the presence of a boulder. The ERI Line 4 presents a relatively consistent overburden thickness of around 11 metres, with thinning toward the ends of the line down to 4 metres. The use of a 50 MHz GPR antenna at Line 4A was not successful in imaging the bedrock surface. The data have a low signal-to-noise ratio and contain multiple reflections that prohibit the delineation of any reflectors. A similar statement can be made for the short GPR Line 4C.

The mid-channel GPR Line 4B images a discontinuous and irregular reflector that has a low-amplitude signal to the west but higher amplitude to the east. This radar reflector is interpreted as the water bottom and its approximate depths range from about 1 to 2 metres.

Ogoki River South Crossing (Figure A5)

The bedrock profile determined using resistivity correlates well with drilling data at the two auger holes BH-2750D and BH-2760D (ERI Line 5 – Figure A5). The auger hole BH-2720D encountered refusal within the till which explains the gap between the refusal and the interpreted bedrock surface. Two near surface high resistivity zones are observed, one between chainages 65 and 80 metres and one between chainages 265 and 305 metres. These two anomalous zones are interpreted to be caused by the extremely frozen ground (forest cover) which makes very difficult to get acceptable coupling between the electrodes and the ground. This led to high contact resistance within the near surface. The ERI section indicates strong lateral variations in overburden thickness along the line. The conductive surface layer shows a pronounced thickening between chainages 100 and 150 metres just south of the river. On both sides of this zone the overburden is relatively thin around 3 metres.

A distinct interpreted bedrock reflector is observed in GPR Line 5A. Its signature disappears beyond the 105-m distance mark where the interpreted bedrock surface dips to a depth of about 12 metres and reappears beyond the river where the interpreted bedrock in the resistivity section is closer to the surface. A relatively good match is observed between the GPR reflector and the auger refusal depth at BH-2760D.

Both the GPR Line 5C and the mid-channel GPR Line 3B image a continuous high-amplitude reflector interpreted as the water/sediment interface. The interpreted river bottom undulates from 1 metre to about 2 metres.

Ogoki River North Crossing (Figure A6)

Except at the southern part of the resistivity Line 6 where the interpreted bedrock is located at about 9 metres below the ground surface, the rest of the ERI Line 6 shows that the interpreted bedrock is very near the surface (Figure A6). This was observed in the field where bedrock was exposed directly south of the river. Good correlation is observed between the findings from ERI Line 6 and the depth to bedrock from the two boreholes located along the line.

The short GPR Line 6A shows the presence of only a very narrow near surface reflector north of the river. Most of the line runs above the flooded ice bridge and as observed on other GPR lines, layered ice did not permit to image any reflectors within the river section.

GPR Line 6B displays an irregular medium-amplitude reflector beneath the mid-channel profile that is interpreted as the water bottom. At the crossing, assuming a velocity of 0.033 m/ns, the depth of water bottom is relatively consistent at around 1 metre in line with the approximate water depths measured in the field.

Tributary to Albany River Crossing (Figure A7)

No borehole information is available along this river crossing. Similar to the other river crossings, the 1000 ohm-metres resistivity contour was chosen to represent the interpreted bedrock profile. ERI Line 7 presents a consistent high resistivity layer interpreted as the bedrock, 14-16 metres deep, over the majority of the surveyed line (Figure A7).

Both GPR Lines 7A and 7B image a continuous high-amplitude reflector interpreted as the water bottom. The mid-channel profile indicates that the interpreted water bottom is dipping toward the east with estimated depths ranging from 1.2 to 3 metres. Another deeper high-amplitude reflector image observed in the radar sections is a multiple of the water bottom.

Wabassi River Crossing (Figure A8)

The bedrock surface interpreted from the resistivity survey Line 8 (Figure A8) shows a relatively good correlation with one core bedrock borehole (BH-5621-D) and one auger refusal borehole (BH-5631D). A five-metre discrepancy exists between the core bedrock borehole BH-5601 and the interpreted bedrock surface. One auger hole BH-5591D indicates refusal 3 metres above the interpreted bedrock surface which is possibly caused by the presence of a boulder, or an undulating bedrock surface. ERI Line 8 presents a relatively consistent bedrock depth of around 5-7 metres except below BH-5591D and BH-5601 where the interpreted bedrock presents a topographic depression.

A low amplitude interpreted bedrock reflector is observed in GPR Line 8A south of the river. Its signature disappears beyond the 125-m distance mark where the interpreted surface bedrock has a topographic low. Two high-amplitude reflectors are observed north of the river. The shallower reflector is interpreted to represent the bedrock surface while the deeper dipping reflector is possibly a fracture within the bedrock or changes in rock properties. A relatively good match is observed between the GPR reflector and the bedrock surface interpreted from the ERI data.

The mid-channel GPR Line 8B images an irregular high-amplitude reflector. This radar reflector is interpreted as the water bottom and its approximate depths range from about 1.4 to 3 metres.

Inlet to Fish Trap Lake Crossing (Figure A9)

The bedrock surface interpreted from the resistivity survey Line 9 (Figure A9) shows a good correlation with the cored bedrock (BH-7570). Poor correlation exists between the other boreholes and the 1000 ohm-metres resistivity contour that was chosen to represent the interpreted bedrock profile. This is interpreted to be due to the presence of large resistive surface anomalies at the very near surface of the river and on land southwest of the river. The near surface resistive anomalies on the river are due to poor contact resistance due to thick ice layers while the resistive anomalies on land are due to a poor coupling between the electrodes and the frozen ground. Modelling of synthetic geological structures has indicated that the undulating bedrock surface in the ERI Line 9 is likely related to the modelling, and not actual undulations in the bedrock surface. In the inversion process near surface high resistive anomalies within the conductive overburden tend to depress deeper high resistive anomalies. The interpreted location of the bedrock surface in ERI Line 9 reflects this understanding.

A distinct interpreted bedrock reflector is observed in GPR Line 9A on both flanks of the river. Its signature disappears beyond the 150-m distance mark at the river edge and reappears at the other edge of the river. Two vertically ringing anomalies are observed south-west of the river. These anomalies are caused by large metallic objects present at the surface (e.g. helicopter sling).

GPR Lines 9A and 9B image a large-amplitude reflector beneath the mid-channel and the river crossing profiles. This reflector is interpreted as the water bottom. At the crossing, assuming a velocity of 0.033 m/ns, the depth of water bottom is relatively consistent at around 2 metres. Another deeper high-amplitude reflector image observed in the GPR sections is a multiple of the water bottom.

Tributary to Muketei River Crossing (Figure A10)

Excellent correlation is observed between the bedrock surface interpreted from the ERI Line 10 and GPR Line 10A and boreholes BH-8312 and BH-8342D (Figure A10). The ERI section indicates that the interpreted bedrock is very near surface beneath the river and is deeper towards the flanks. The overburden is thicker toward the south than the north. A large low resistive anomaly within the interpreted bedrock may represent an artefact from the resistivity modelling. Below the frozen river a ringing signal characteristic of layered ice is observed in GPR Line 10A and makes it impossible to observe the river bottom.

The mid-channel GPR Line 10B image a discontinuous reflector interpreted as the water/sediment interface. The interpreted river bottom appears to be very near surface.

5.0 CLOSURE

We trust that this technical memorandum meets your current needs. If you have any questions or require clarification, please contact the undersigned.

Stephane Sol, Ph.D.
Geophysics Group

Mark Monier-Williams, M.Sc.
Senior Geophysicist, Associate

SS/MMW/ss/crp/wlm

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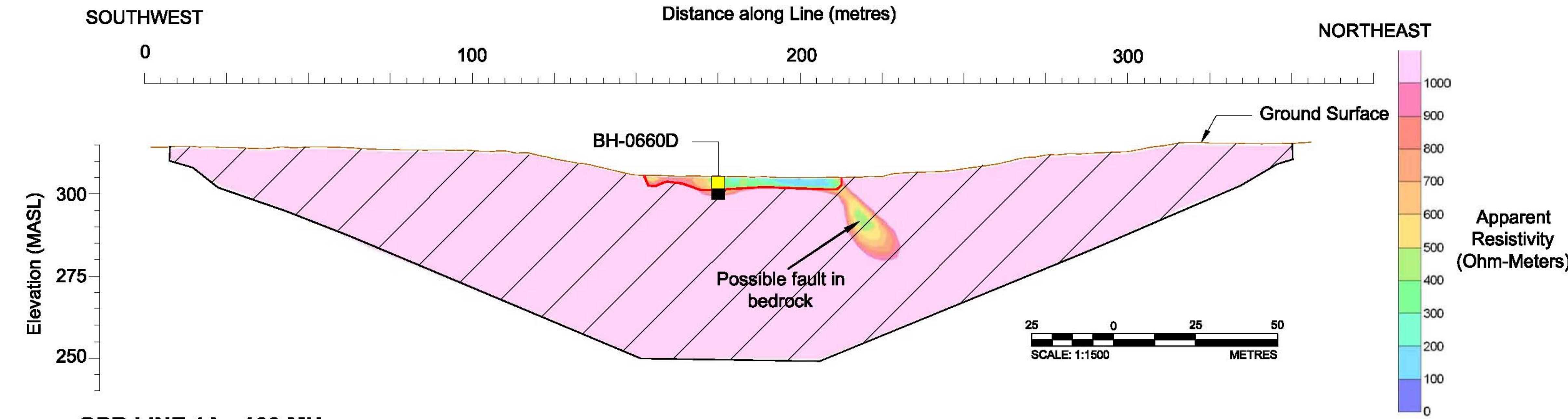
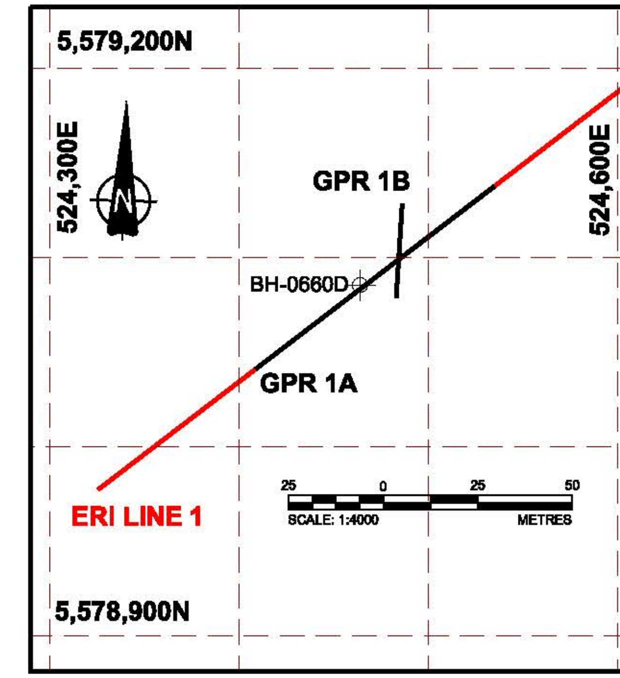
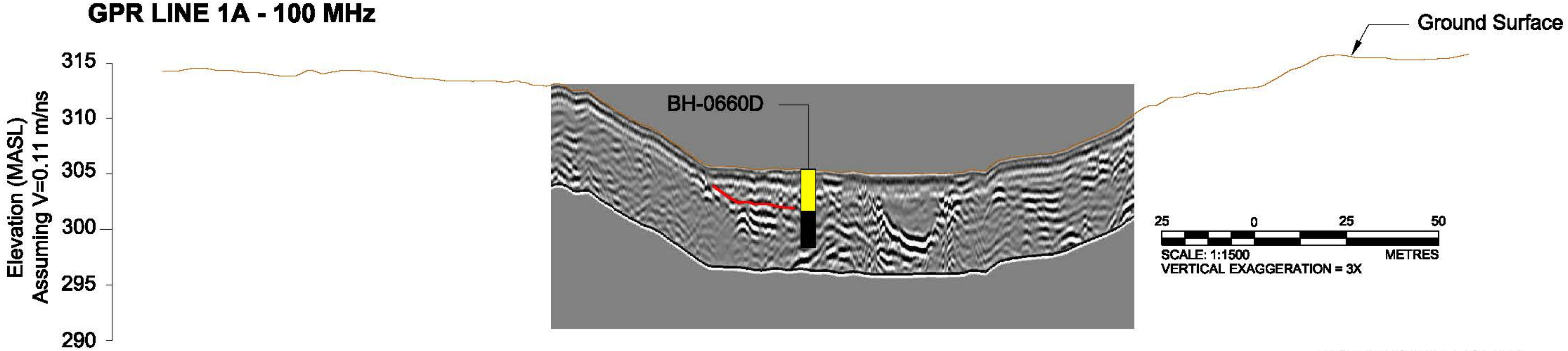
STINGER LAKE - ERI LINE 1

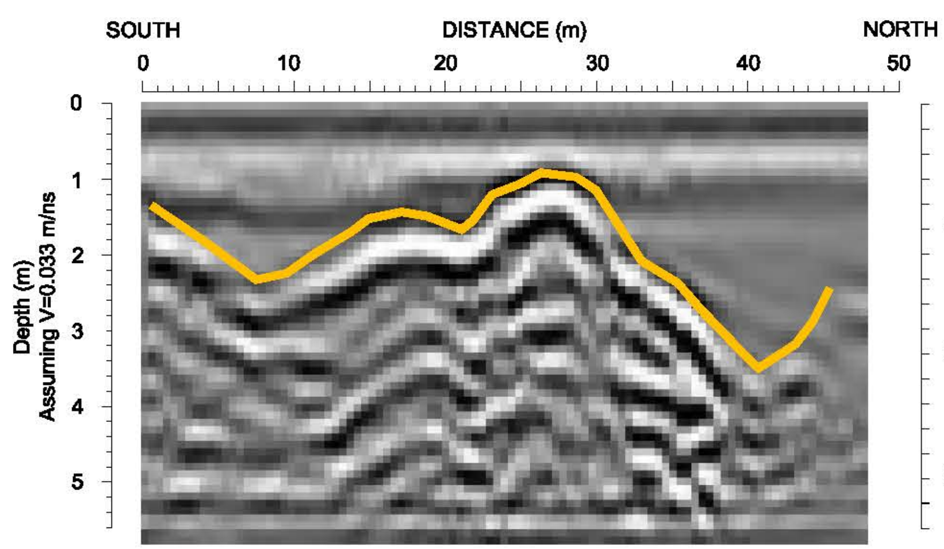




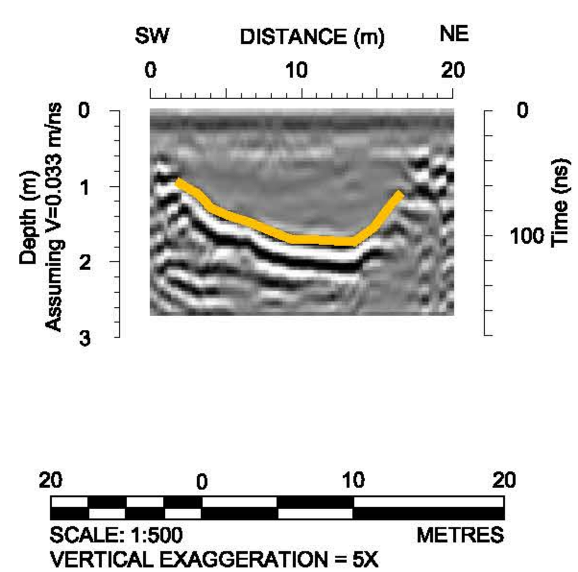
GPR LINE 1A - 100 MHz



GPR LINE 1B - MID CHANNEL - 50 MHz



GPR LINE 1A - RIVER AREA - 100 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

NOTES

1. This Figure is to be analyzed in conjunction with the accompanying report.
2. ERI section generated using the Res2D Software Package.
3. Elevations presented obtained from LiDAR data.
4. Line Locations are presented in UTM NAD 83, Zone 16.

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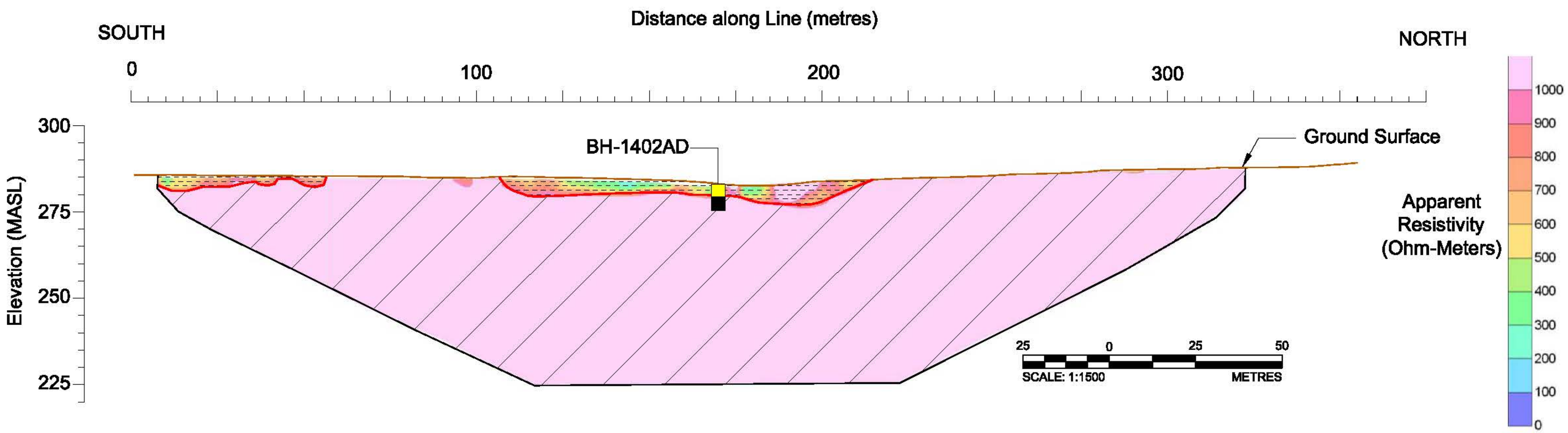
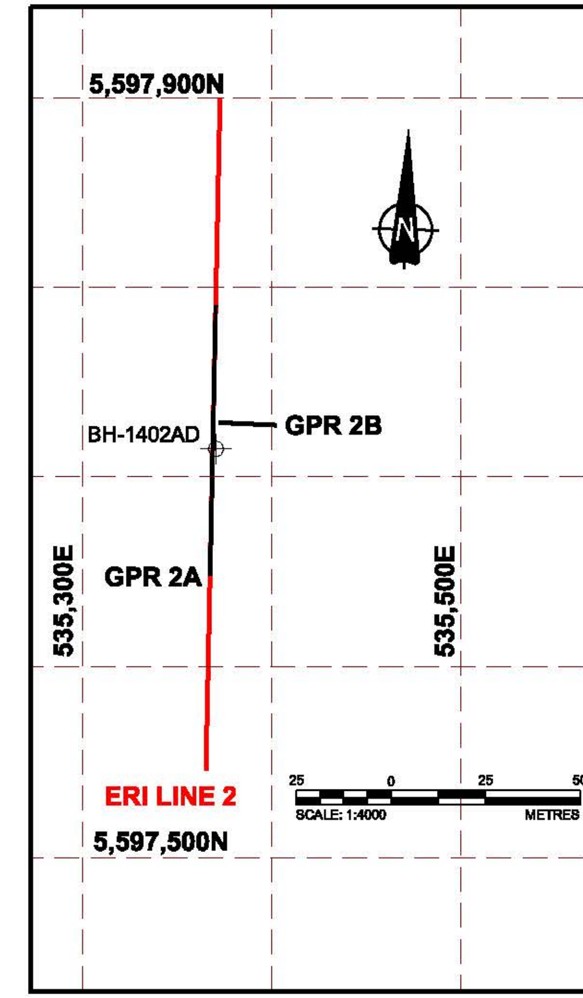
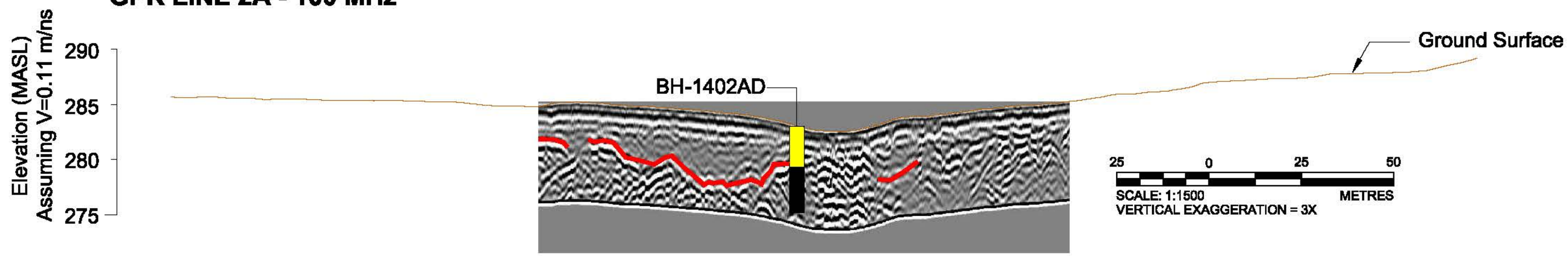
	DATE: APRIL 2010		
	DESIGN: SS		
	CAD: SS		
FILE No.	CHECK: CRP	CANADA CHROME, ON, CANADA	FIGURE A1
PROJECT No. 09381042 REV.	REVIEW: MMW		

ESNAGAMI RIVER - ERI LINE 2

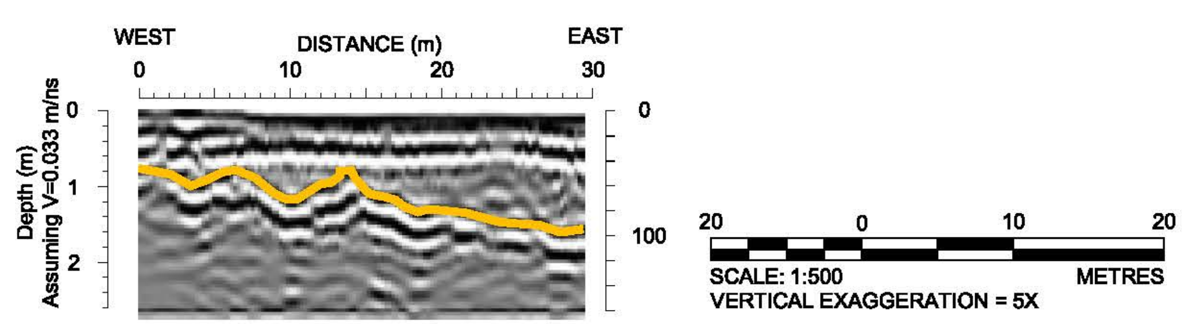




GPR LINE 2A - 100 MHz



GPR LINE 2B - MID CHANNEL - 100 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

NOTES

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Golder Associates, Mississauga, Ontario, Canada	SCALE: As Shown	TITLE: ESNAGAMI RIVER INTERPRETED GEOPHYSICAL SURVEY RESULTS
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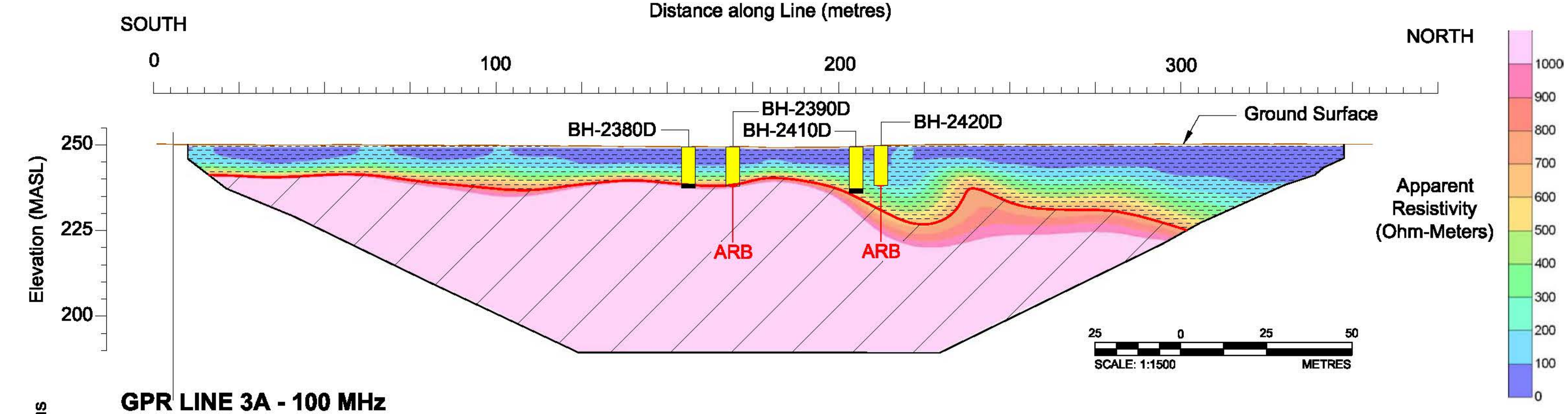
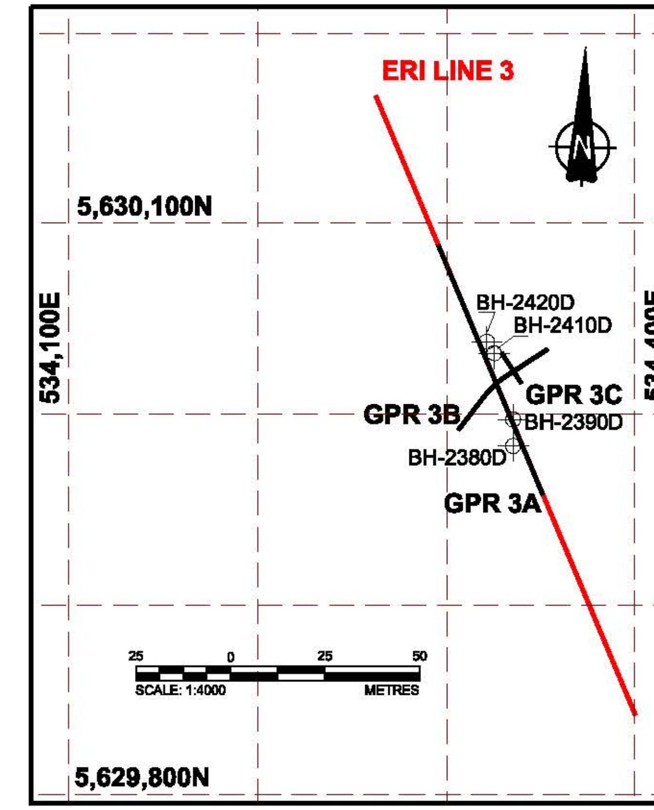
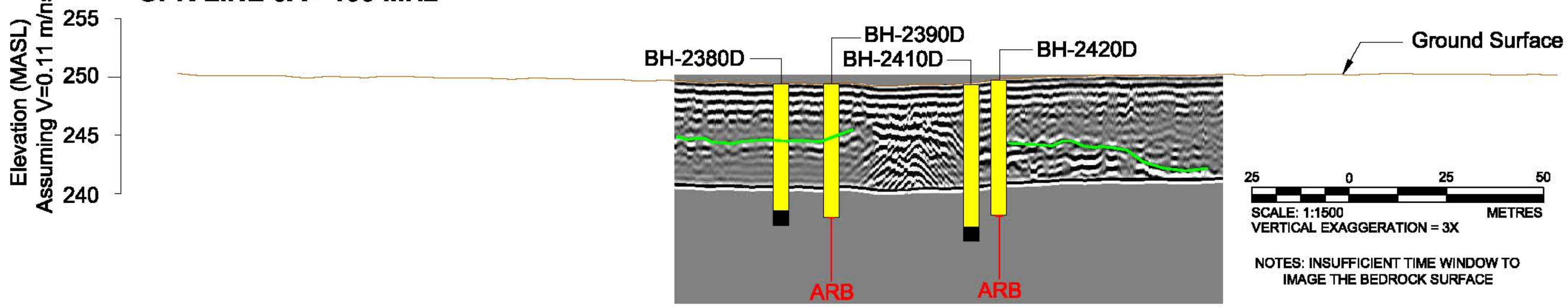
FILE No.	CHECK: CRP	CANADA CHROME, ON, CANADA
PROJECT No. 09381042 REV.	REVIEW: MMW	FIGURE: A2

COLPITTS CREEK - ERI LINE 3

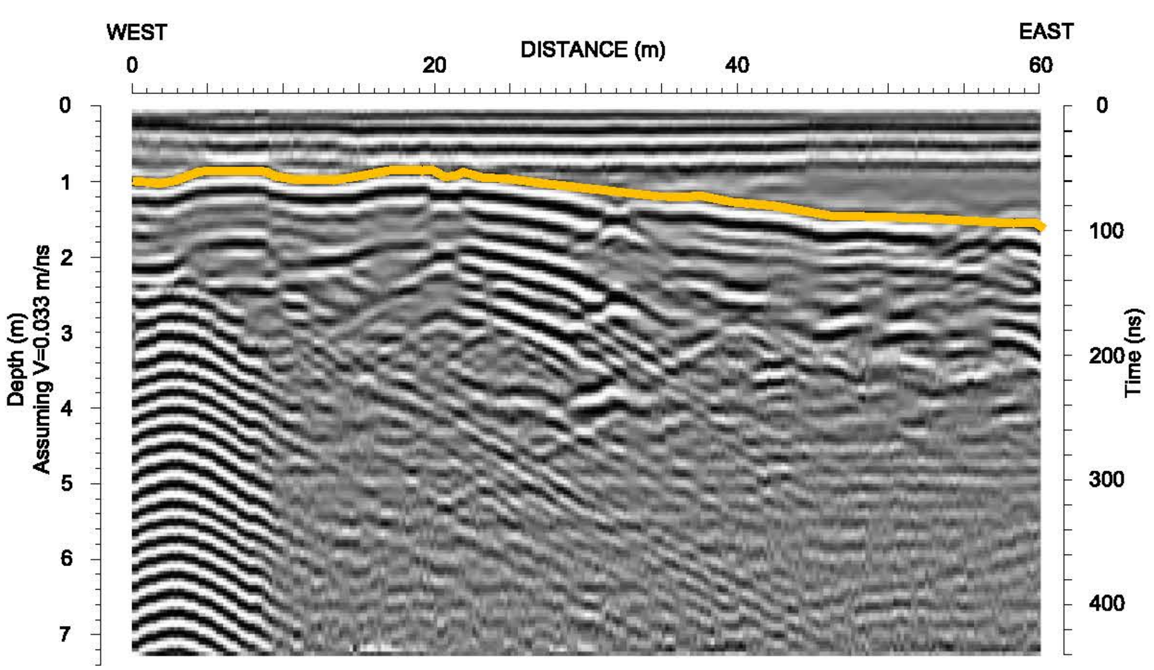




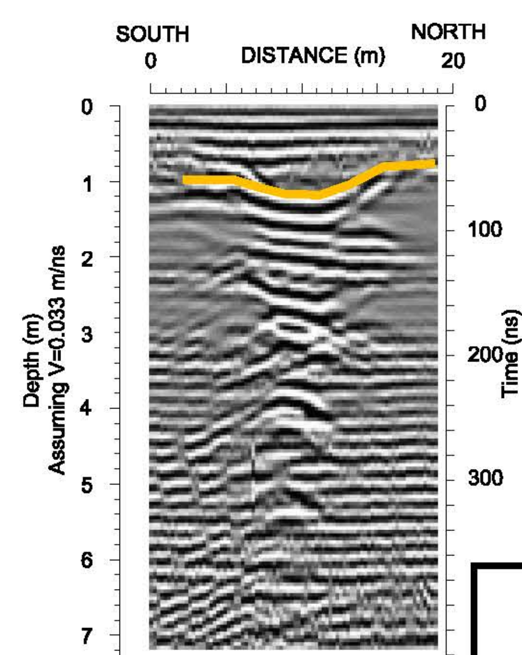
GPR LINE 3A - 100 MHz



GPR LINE 3B - MID CHANNEL - 100 MHz



GPR LINE 3C - 100 MHz



20 0 10 20
SCALE: 1:500
METRES
VERTICAL EXAGGERATION = 5X

BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

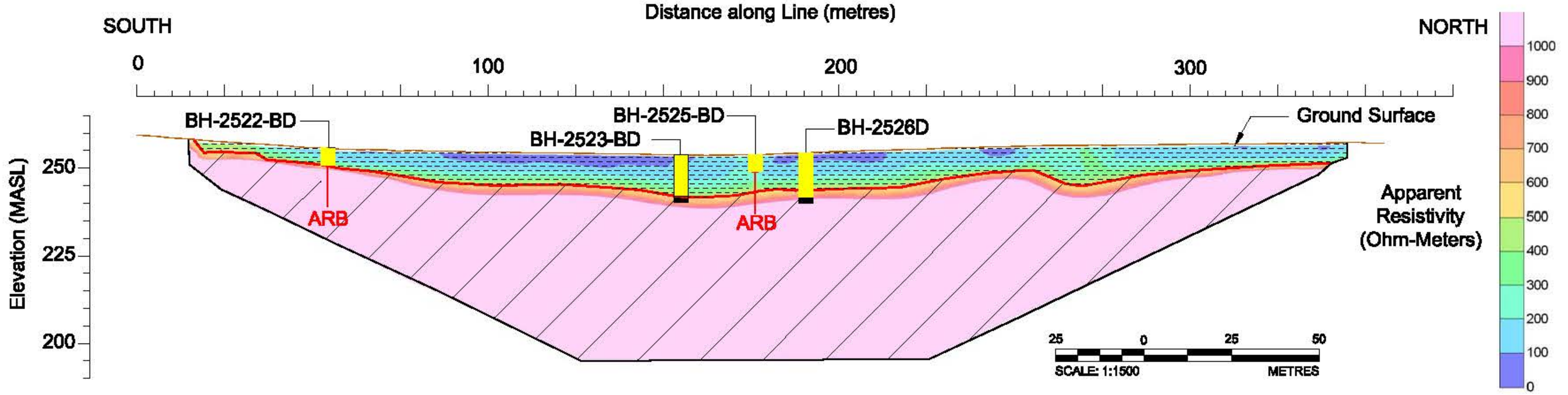
- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

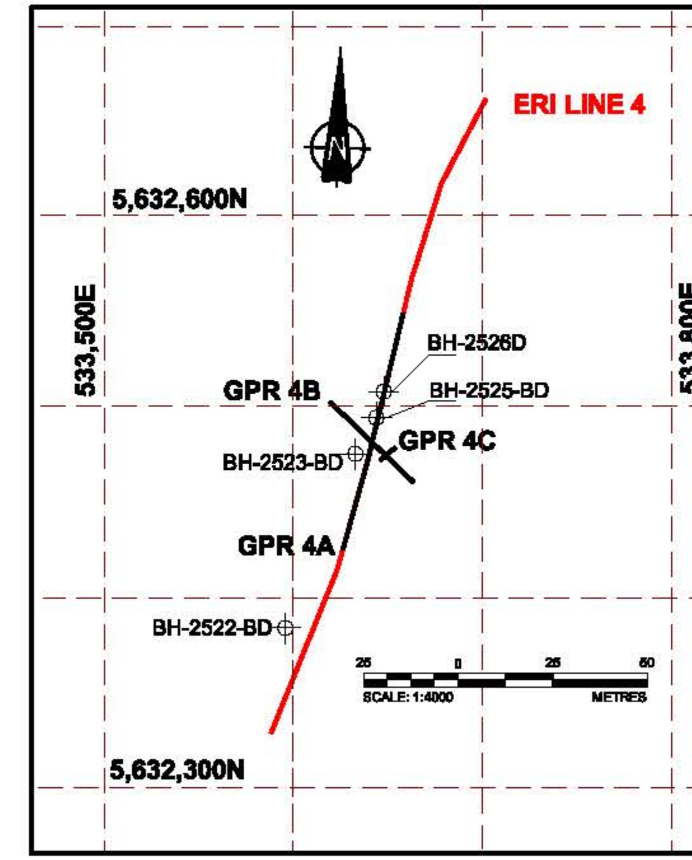
NOTES

1. This Figure is to be analyzed in conjunction with the accompanying report.
2. ERI section generated using the Res2D Software Package.
3. Elevations presented obtained from LiDAR data.
4. Line locations are presented in UTM NAD83, Zone 16.

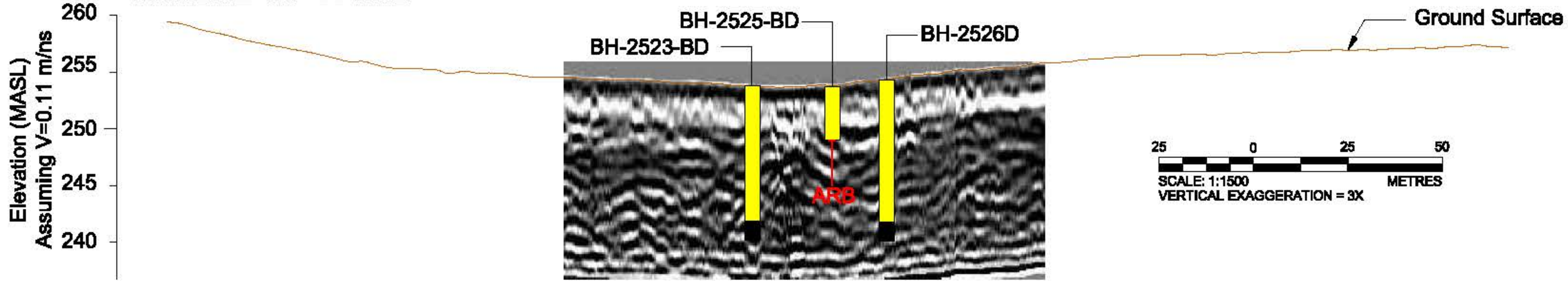
Golder Associates, Mississauga, Ontario, Canada	SCALE: As Shown	TITLE: COLPITTS CREEK INTERPRETED GEOPHYSICAL SURVEY RESULTS
	DATE: APRIL 2010	
	DESIGN: SS	
	CAD: SS	
FILE No.	CHECK: CRP	CANADA CHROME, ON, CANADA
PROJECT No. 09381042 REV.	REVIEW: MMW	FIGURE A3

LITTLE COLPITTS CREEK - ERI LINE 4

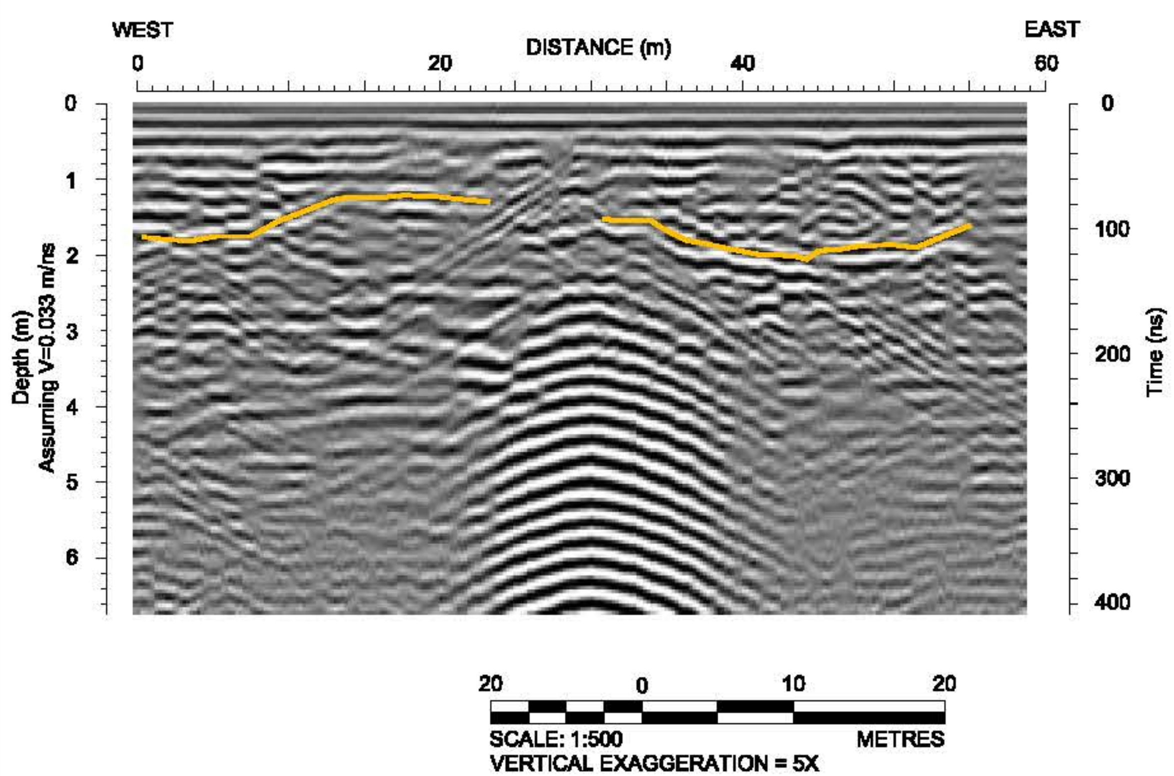




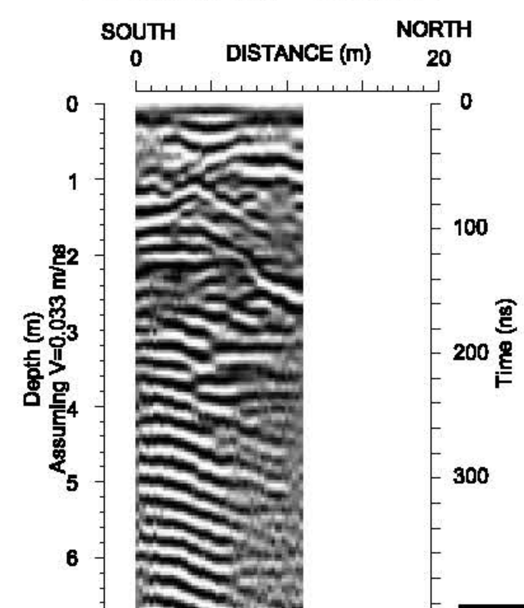
GPR LINE 4A - 50 MHz



GPR LINE 4B MID CHANNEL - 100 MHz



GPR LINE 4C - 100 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

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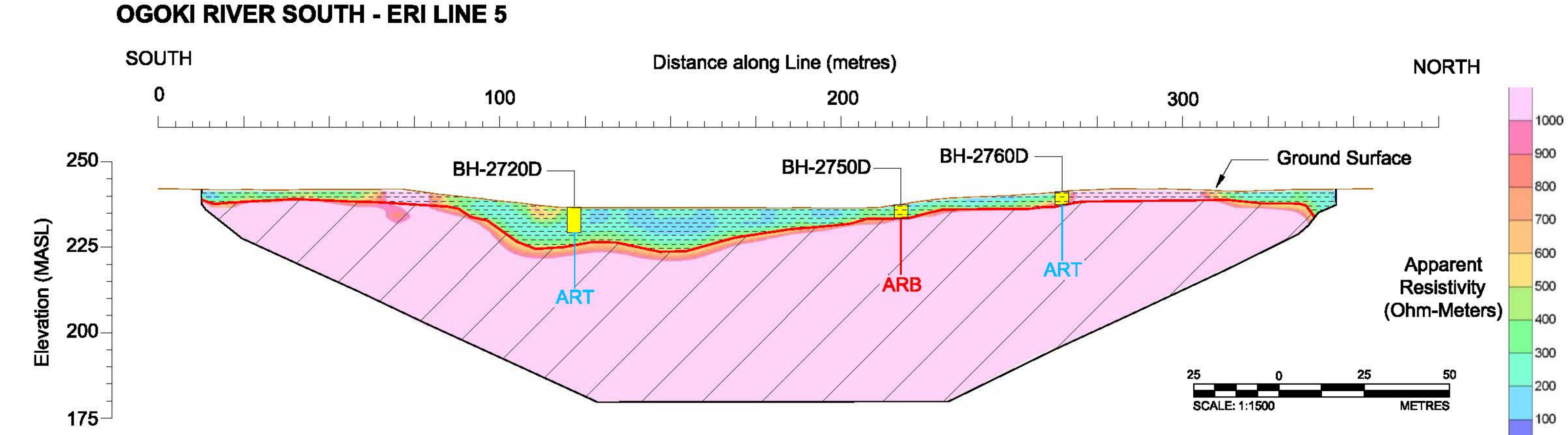
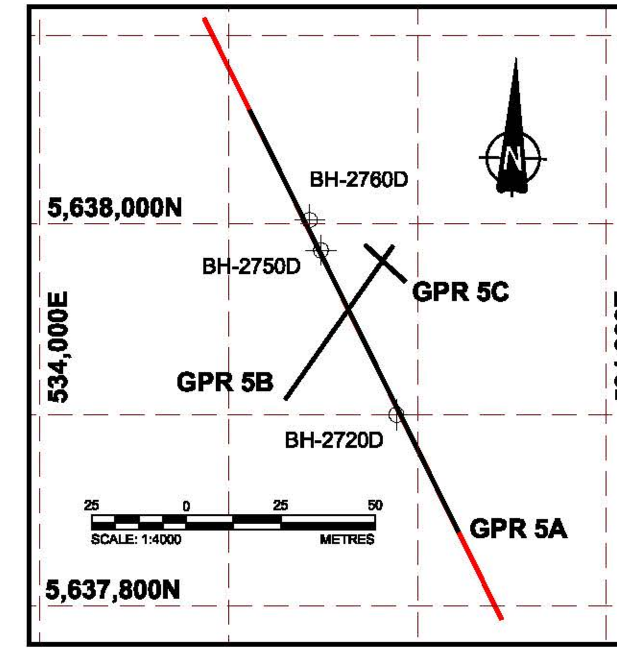
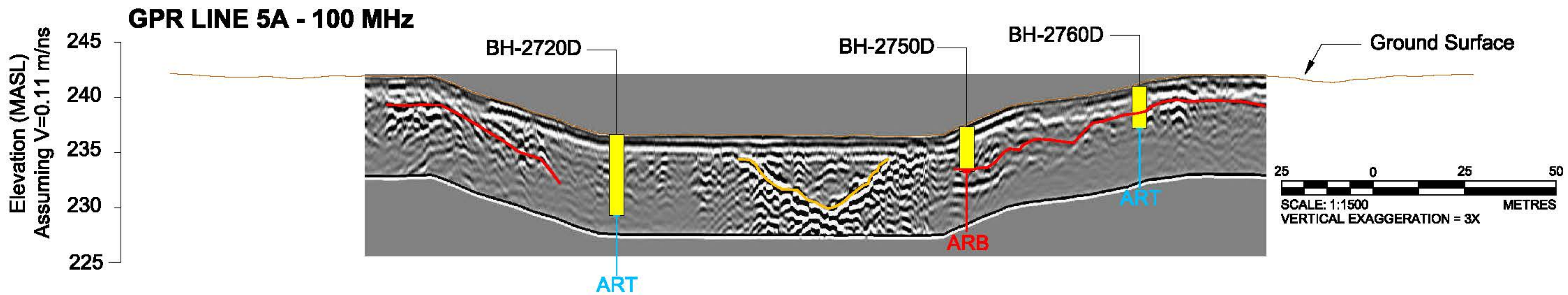
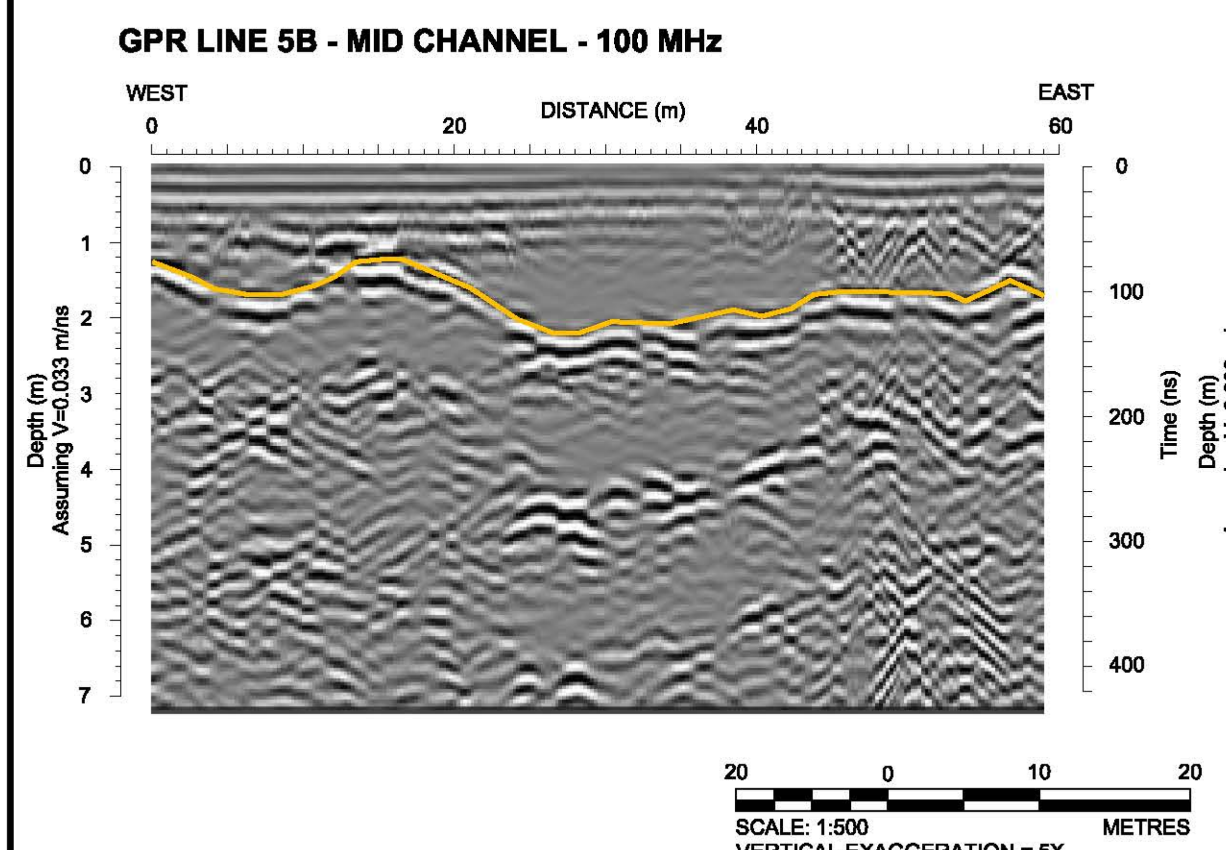
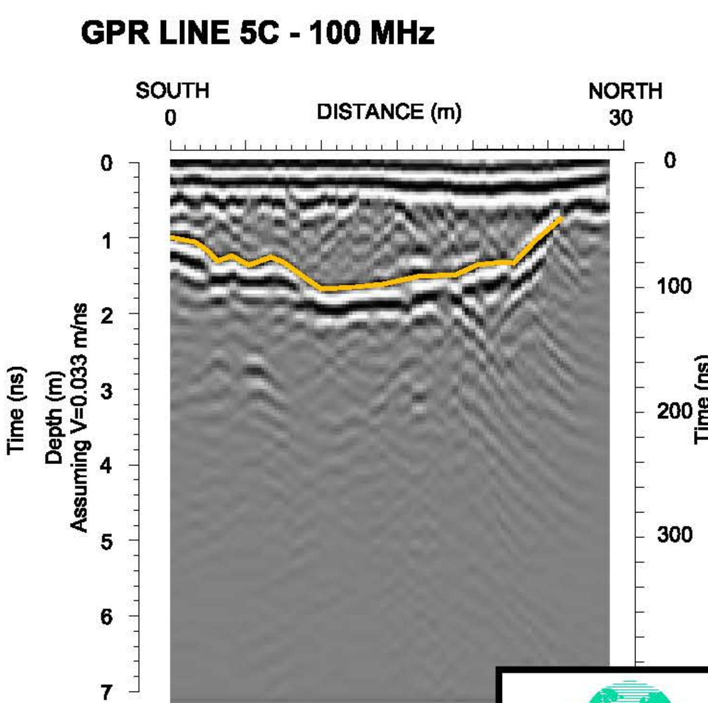
Golder Associates, Mississauga, Ontario, Canada	SCALE: As Shown	TITLE	LITTLE COLPITTS CREEK INTERPRETED GEOPHYSICAL SURVEY RESULTS
	DATE: APRIL 2010		
	DESIGN: SS		
	CAD: SS		
FILE No.	CHECK: CRP	CANADA CHROME, ON, CANADA	FIGURE A4
PROJECT No. 09381042 REV.	REVIEW: MMW		











BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

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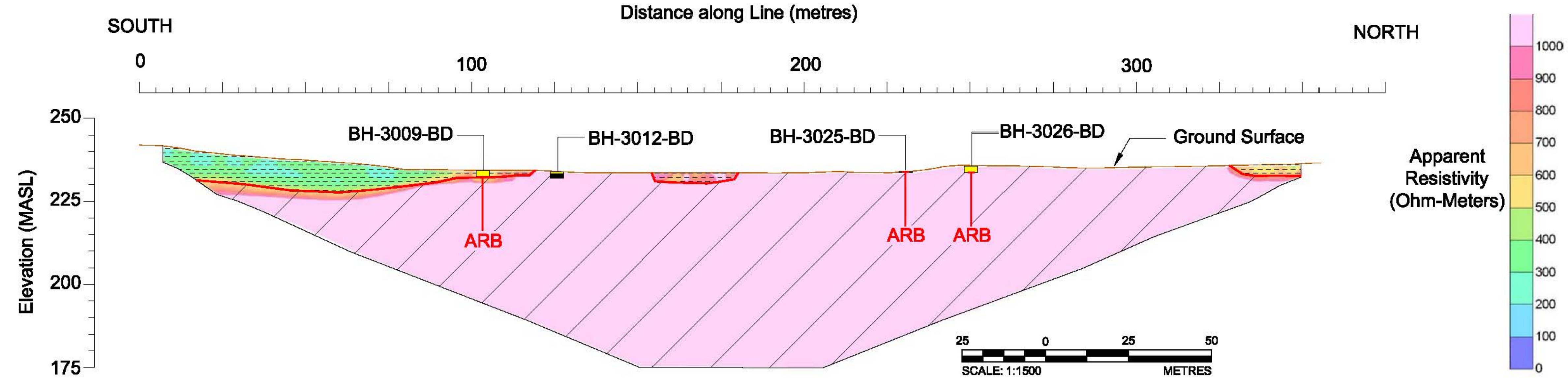
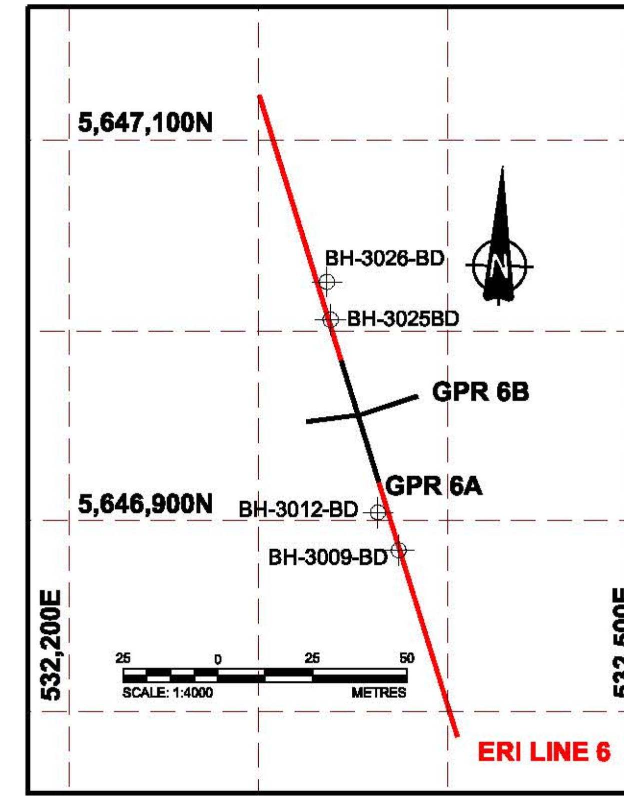
SCALE	As Shown	TITLE	OGOKI RIVER SOUTH INTERPRETED GEOPHYSICAL SURVEY RESULTS
DATE	APRIL 2010		
DESIGN	SS		
CAD	SS		
CHECK	CRP		CANADA CHROME, ON, CANADA
REVIEW	MMW	FIGURE	A5

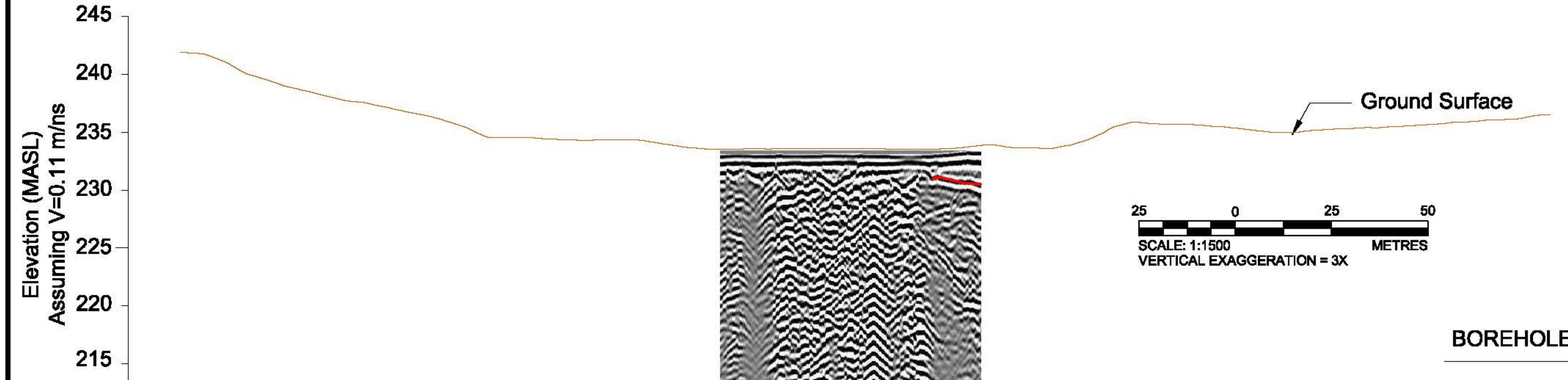
FILE No.
PROJECT No. 09381042 REV.

OGOKI RIVER NORTH - ERI LINE 6

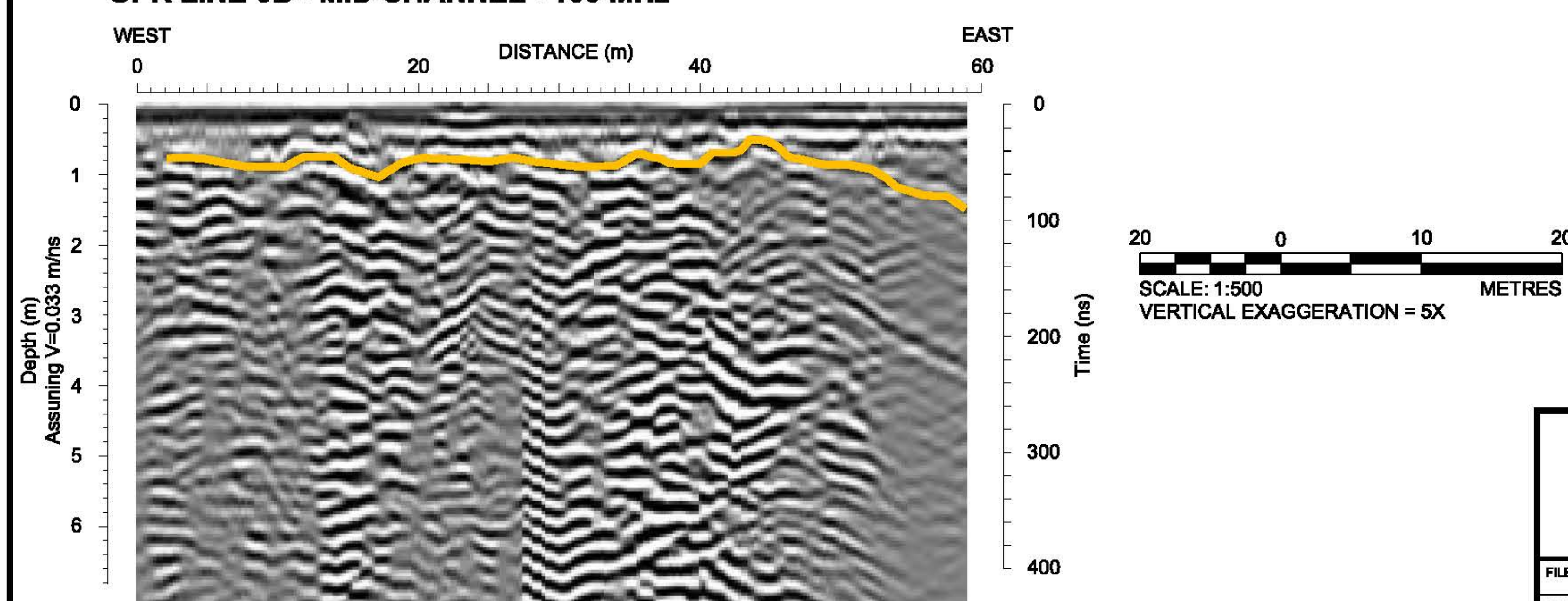




GPR LINE 6A - 100 MHz



GPR LINE 6B - MID CHANNEL - 100 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

NOTES

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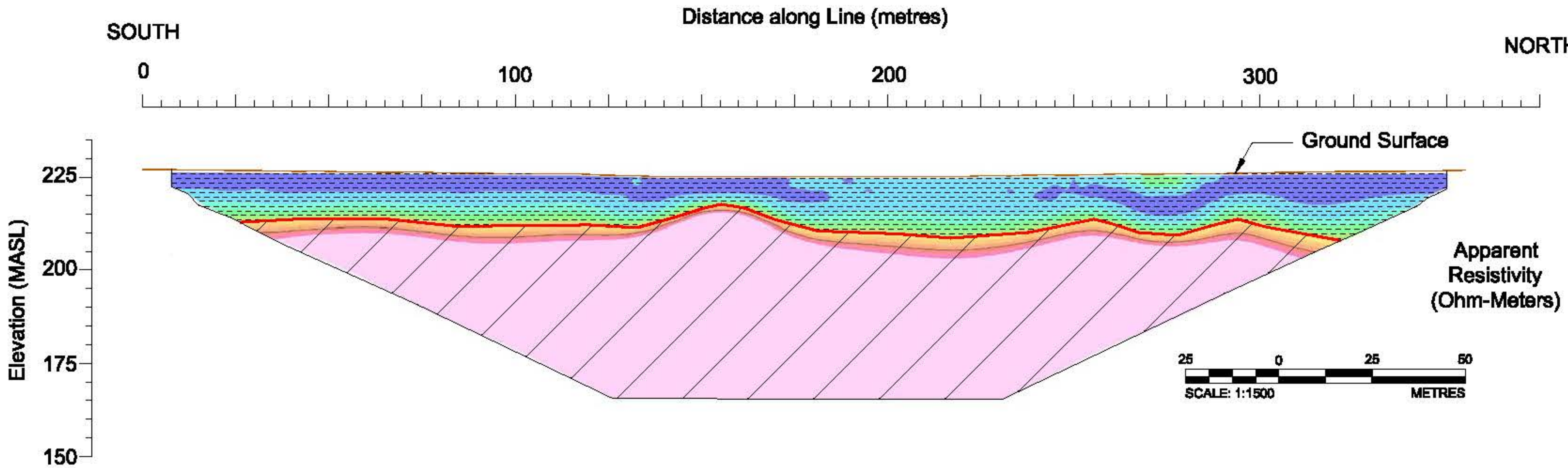
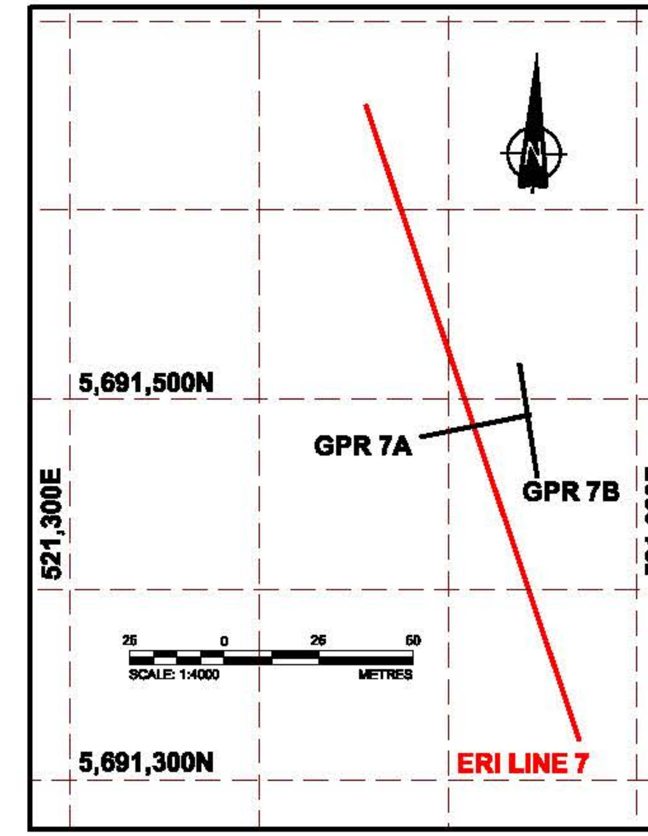
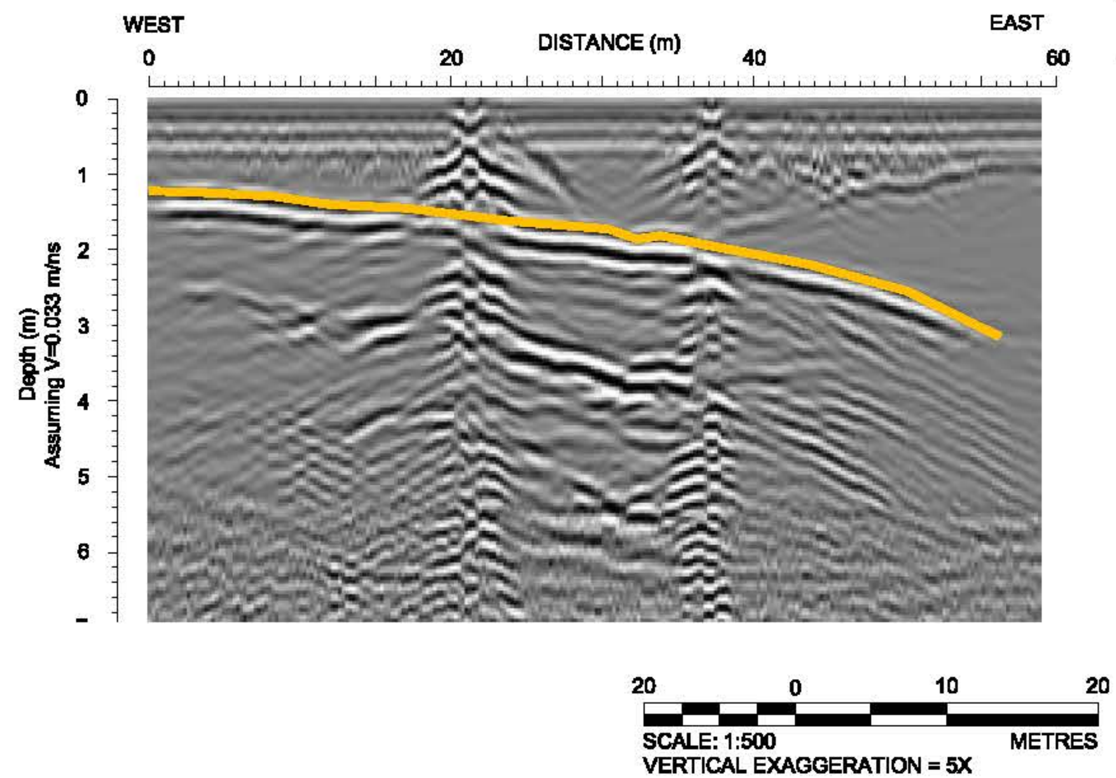
Golder Associates, Mississauga, Ontario, Canada	SCALE: As Shown	TITLE: OGOKI RIVER NORTH INTERPRETED GEOPHYSICAL SURVEY RESULTS	
	DATE: APRIL 2010		
	DESIGN: SS		
	CAD: SS		
FILE No.	CHECK: CRP	CANADA CHROME, ON, CANADA	FIGURE: A6
PROJECT No. 09381042 REV.	REVIEW: MMW		

TRIBUTARY TO ALBANY RIVER - ERI LINE 7

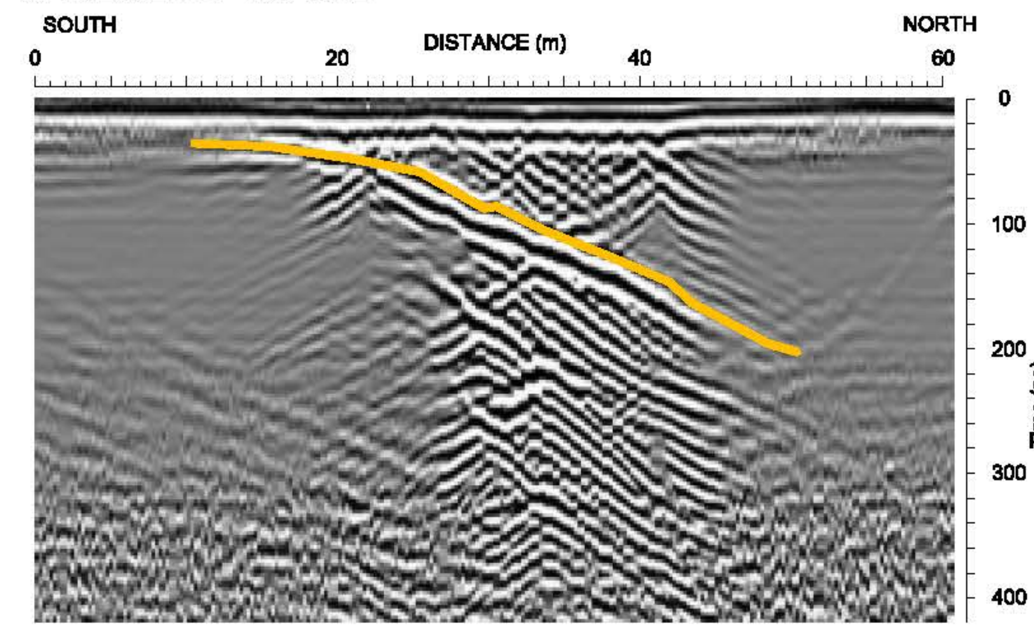




GPR LINE 7A - MID CHANNEL - 100 MHz



GPR LINE 7B - 100 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

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FILE No.	
PROJECT No.	09381042
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DATE	APRIL 2010
DESIGN	SS
CAD	SS
CHECK	CRP
REVIEW	MMW

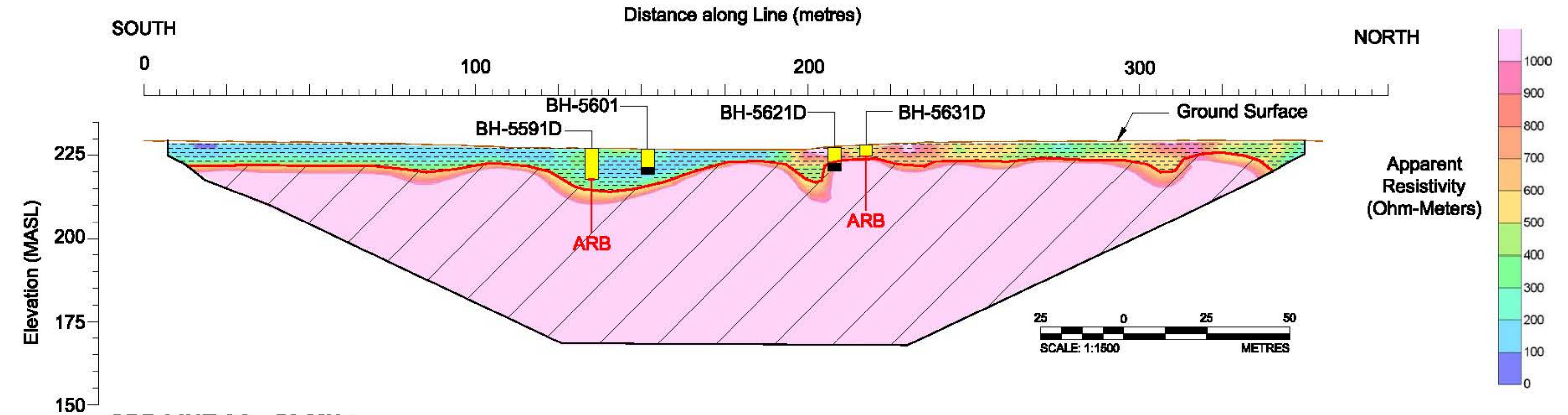
TITLE

TRIBUTARY TO ALBANI RIVER INTERPRETED GEOPHYSICAL SURVEY RESULTS

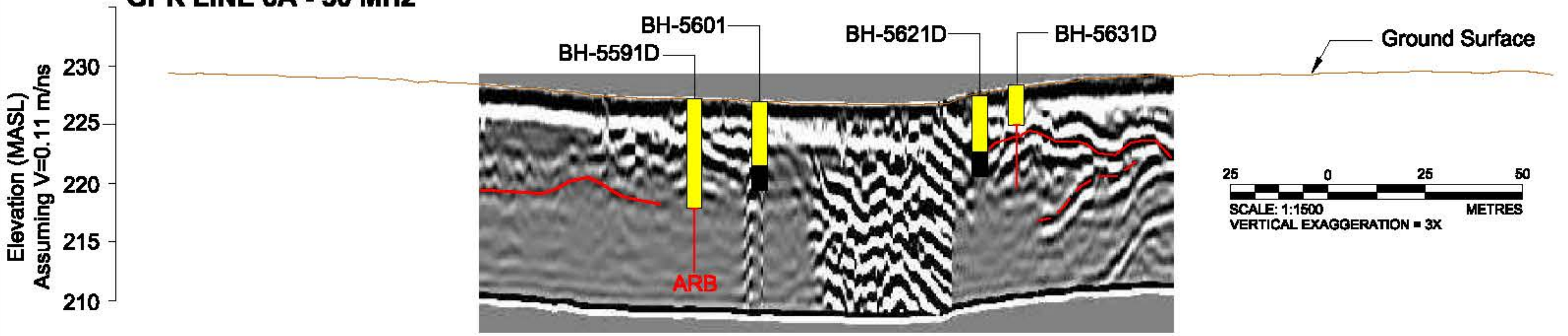
CANADA CHROME, ON, CANADA

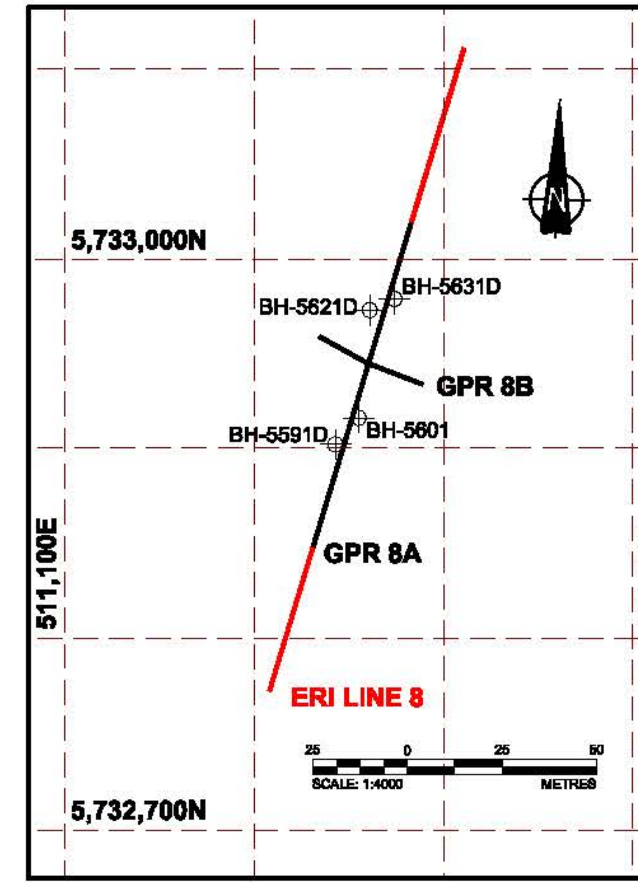
FIGURE **A7**

WABASSI RIVER - ERI LINE 8

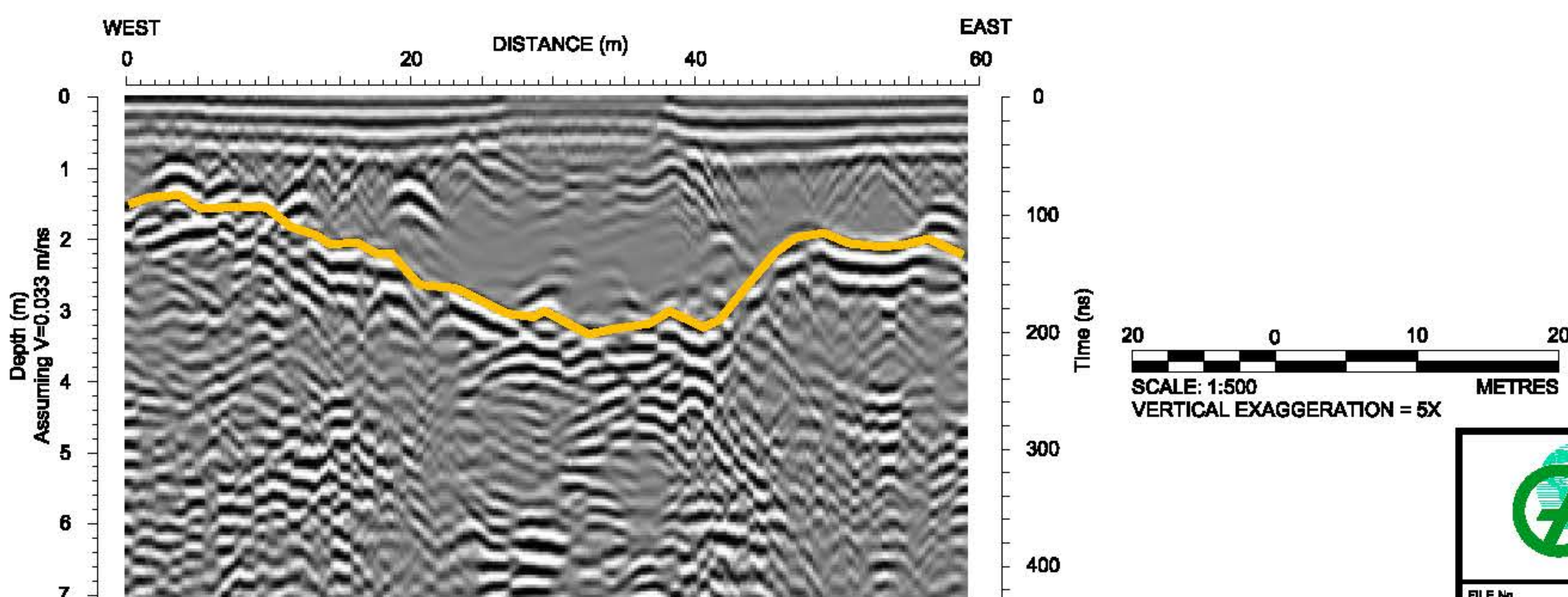


GPR LINE 8A - 50 MHz





GPR LINE 8B - MID CHANNEL - 100 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

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Golder Associates
Mississauga, Ontario, Canada

FILE No.		SCALE	As Shown
PROJECT No.	09381042	DATE	APRIL 2010
REV.		DESIGN	SS
		CAD	SS
		CHECK	CRP
		REVIEW	MMW

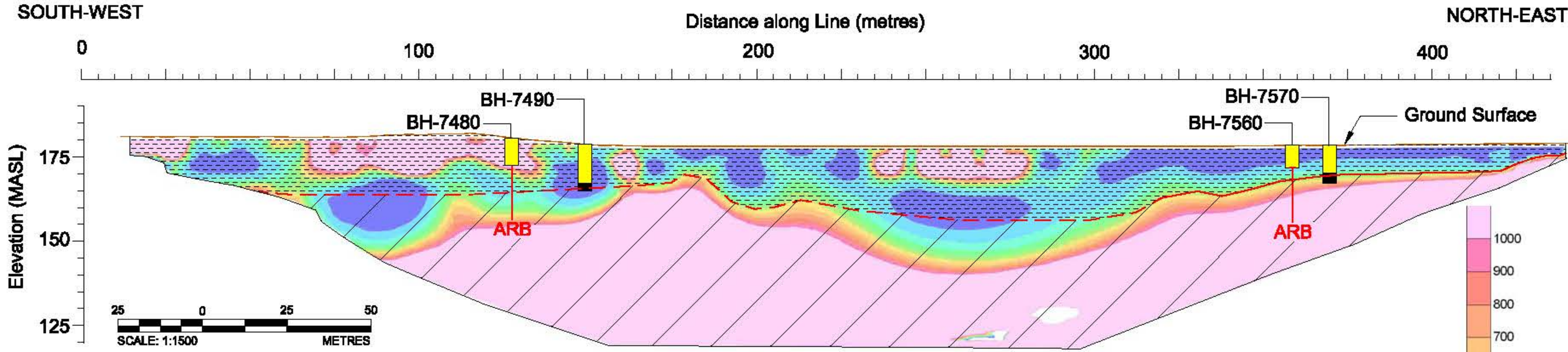
TITLE

WABASSI RIVER INTERPRETED GEOPHYSICAL SURVEY RESULTS

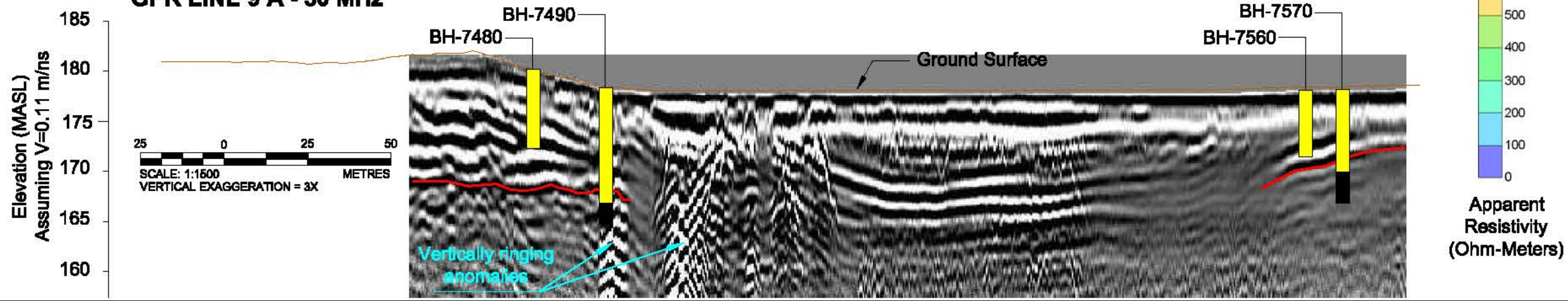
CANADA CHROME, ON, CANADA

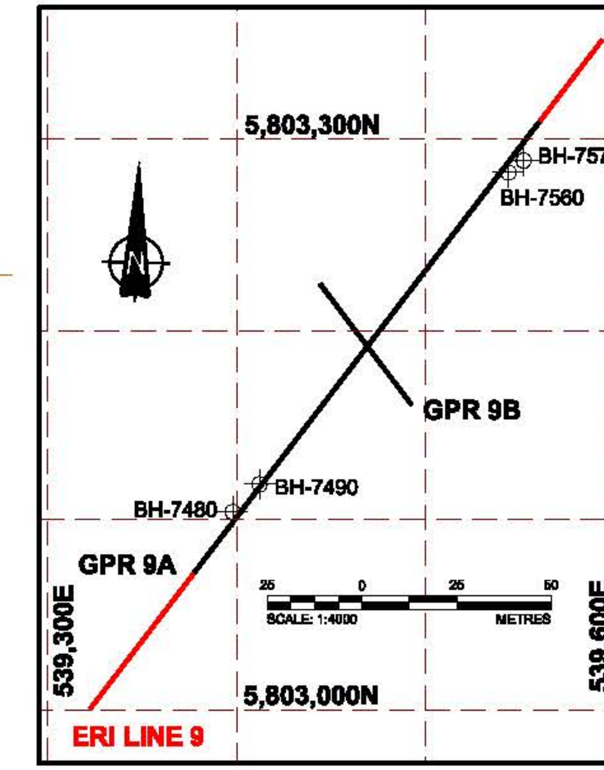
FIGURE A8

INLET TO FISH TRAP LAKE - ERI LINE 9

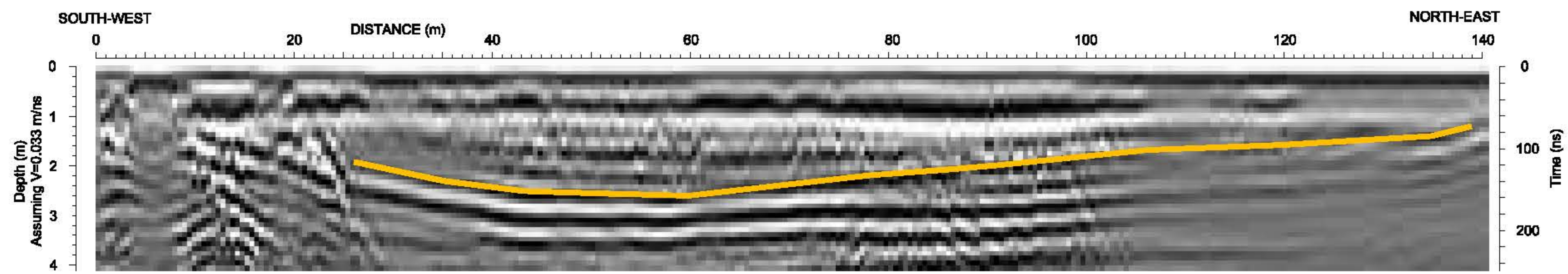


GPR LINE 9 A - 50 MHz

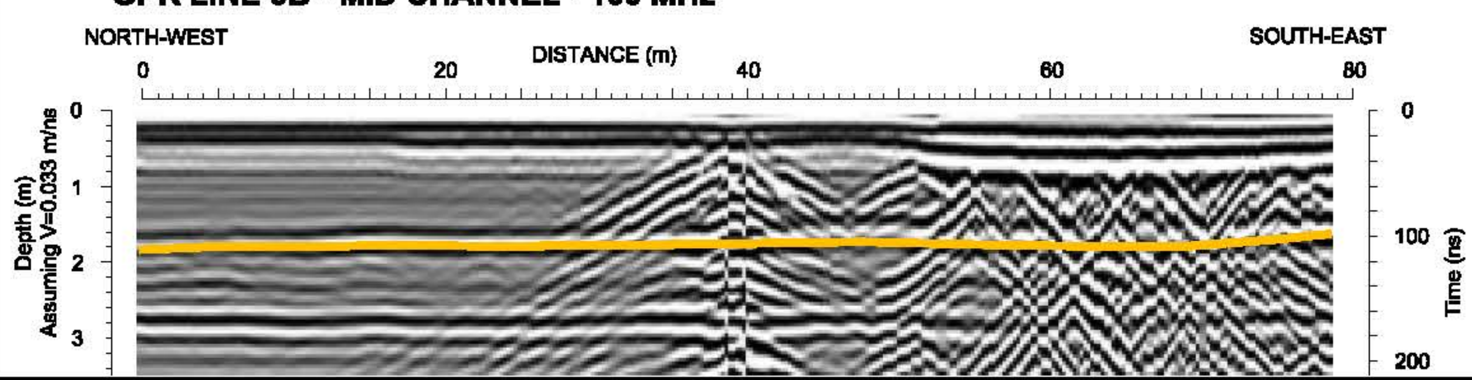




GPR LINE 9A - RIVER AREA - 50 MHz



GPR LINE 9B - MID CHANNEL - 100 MHz



20 0 10 20
SCALE: 1:500 METRES
VERTICAL EXAGGERATION = 5X

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

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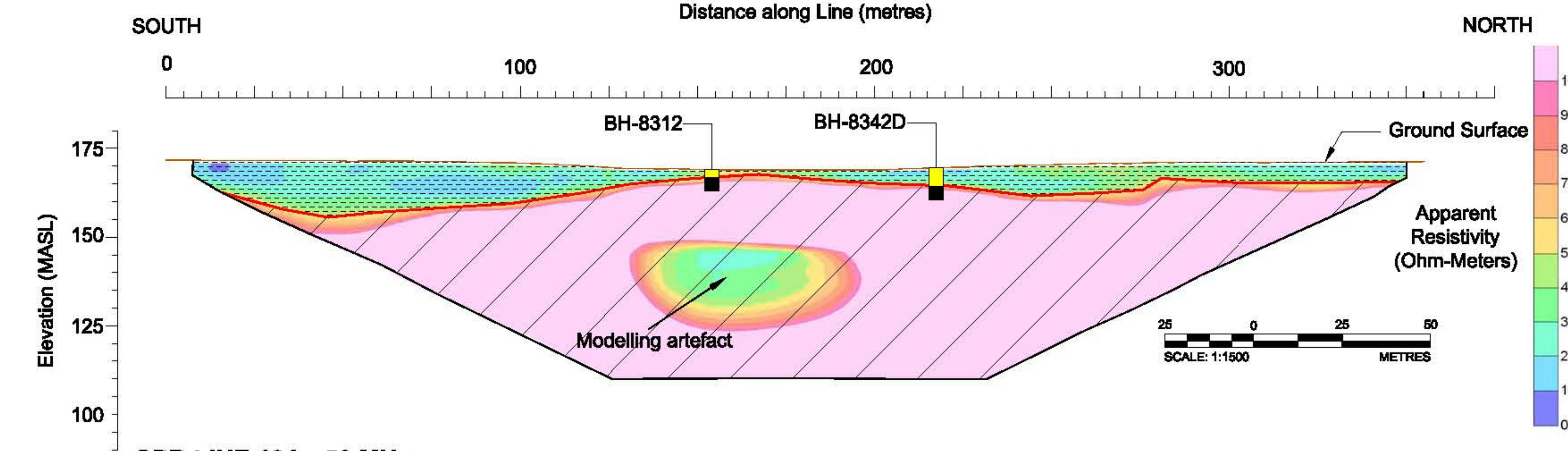
FILE No.		SCALE	As Shown
PROJECT No.	09381042	DATE	APRIL 2010
REV.		DESIGN	SS
		CAD	SS
		CHECK	CRP
		REVIEW	MMW

TITLE
INLET TO FISH TRAP LAKE INTERPRETED GEOPHYSICAL RESULTS

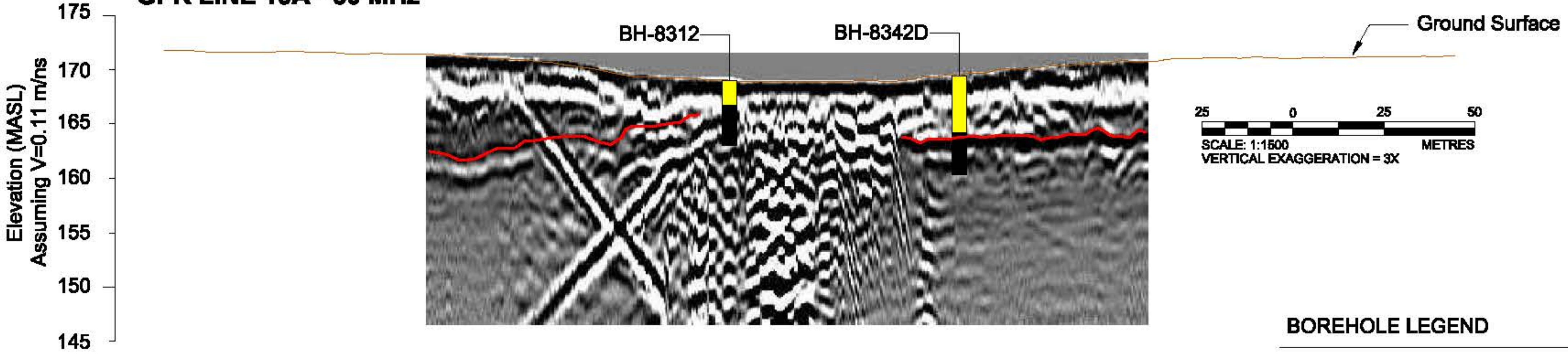
CANADA CHROME, ON, CANADA

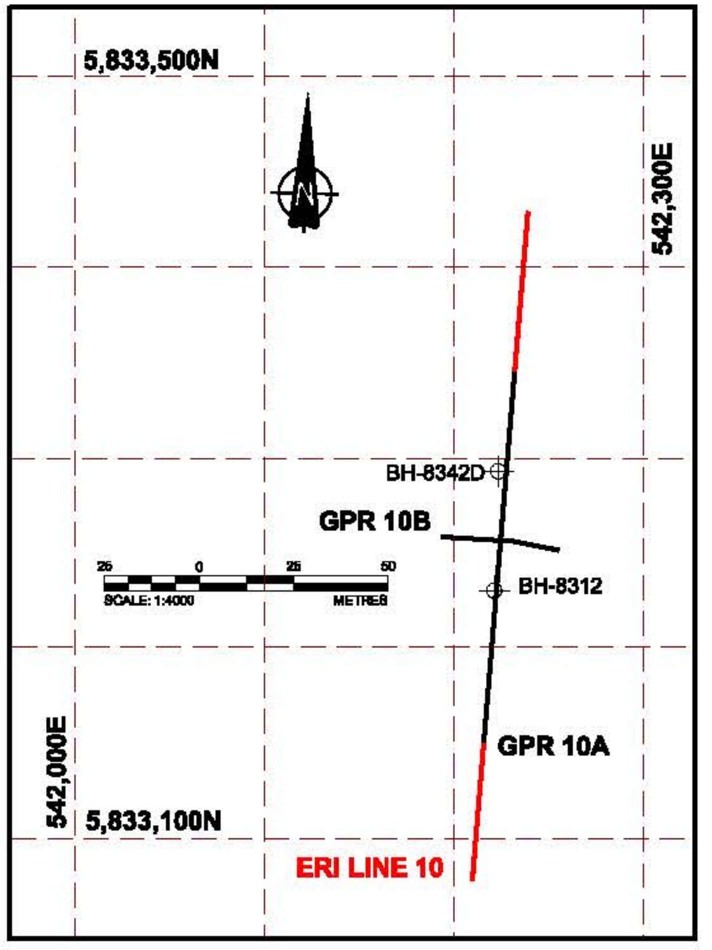
FIGURE **A9**

TRIBUTARY TO MUKETEI RIVER - ERI LINE 10

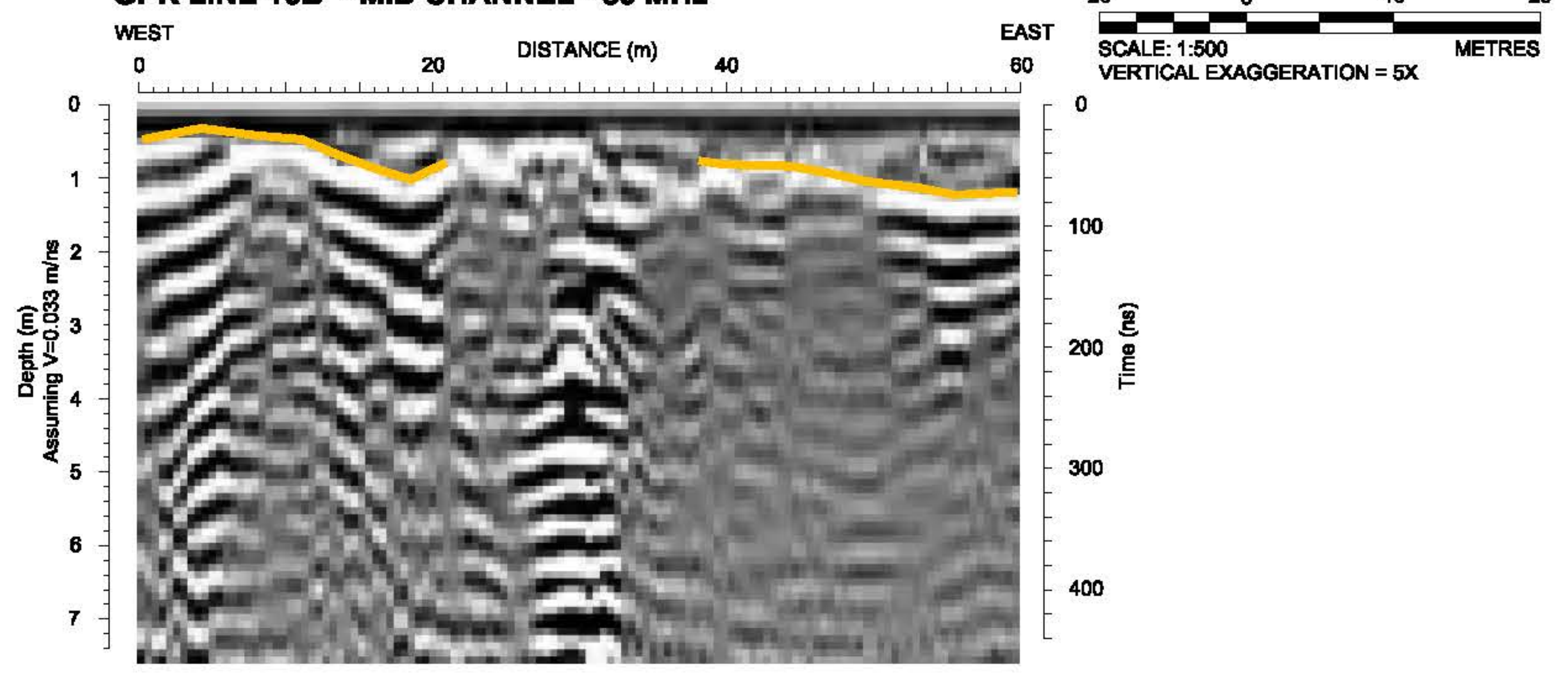


GPR LINE 10A - 50 MHz





GPR LINE 10B - MID CHANNEL - 50 MHz



BOREHOLE LEGEND

- Overburden: Silty sand and clayey soils
- Auger Refusal Assumed Bedrock (ARB)
- Cored Bedrock
- Auger Refusal Assumed Till (ART)

LEGEND

- Ground Surface
- Interpreted Bedrock Surface
- Interpreted Overburden layer
- Interpreted River Bottom
- Overburden
- Bedrock
- Borehole

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Mississauga, Ontario, Canada

SCALE	As Shown	TITLE	TRIBUTARY TO MUKETEI RIVER INTERPRETED GEOPHYSICAL SURVEY RESULTS
DATE	APRIL 2010		
DESIGN	SS		
CAD	SS		
CHECK	CRP		CANADA CHROME, ON, CANADA
REVIEW	MMW	FIGURE	A10

FILE No.
PROJECT No. 09381042 REV.