Assessment Report on IP Resistivity and Seismic work near the Bell and Granisle Properties

Bell and Granisle Mines

Omenica Mining Division, British Columbia

Claims:	704747, 704708, 836013, 836016, 704740, 857339, 929260
NTS Sheets:	093M01 / 093L16
Lat/Long:	55°0' North Latitude, 125° 15' West Longitude
Event Number:	5416889
Operator:	Xstrata Canada Corporation
Owner:	Astorius Resources
Authored by:	Ross Ward & Gordon Maxwell
Report Date:	2013-01-21

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1 Introduction

1.1 Nature of Work

Seismic and IP resistivity work was carried out on the Bell and Granisle Mine properties in October of 2012. Klohn Crippen Berger Ltd. was procured by Xstrata Copper Canada. Klohn Crippen Berger Ltd. subcontracted the work to Frontier Geosciences Inc.

1.2 Scope and Objective

The objective of the work presented in this report was to understand the bedrock profile of locations being considered for possible waste and tailings storage for a potential Bell Mine and Granisle Mine restart.

The geophysical work that was done crosses the mineral tenures of three different mineral tenure holders: Astoruis Resources Ltd., Copper Point Minerals Ltd. and Xstrata Canada Corporation Ltd. While the attached geophysical report (Appendix 1) speaks to the entirety of this geophysical work, this assessment report reports on work done on tenures held by Astorius Resources Ltd only.

2 Property Description

2.1 Location

Bell Mine is located on the Newman Peninsula of Lake Babine in Central British Columbia. The nearest community is the Village of Granisle.

2.2 Access

Bell Mine can be accessed from the Village of Granisle via the following route: Drive the paved road (Central Babine Lake Hwy) to Michelle Bay. Take a Barge operated by the Babine Barge Company Ltd. across Lake Babine to Nose Bay. Drive on radio controlled Canfor owned and operated Jinx logging road to km 10.5. Drive on radio controlled Canfor owned and operated Hagan logging road to km 24.5. Drive on Bell Mine Road to the Bell Mine property. A number of the surveyed lines are accessible from Hagan road before km 24.5.

Granisle Mine and the line surveyed in this report can be accessed from the Village of Granisle via boat in the summer or skidoo in the winter only when the lake ice is thick enough to traverse.

2.3 Physiography

The surveys were taken on properties located on the Newman Peninsula and on Sterrett Island of Lake Babine, which is in the Babine Lake valley. Babine Lake is one of the largest bodies of fresh water in the Cordillera, and stretches for approximately two hundred kilometers, making it also the longest natural lake in the province. Lake elevation is at 711 meters above sea level. The lake drains to the north via the Babine River. The Babine valley lies in the Nechako Plateau physiographic region of the Central Interior of central British Columbia (Ogryzlo, 2010).

Ground cover is varied in the area. Before the commencement of mining, the nearby Bell mine was covered with open aspen parkland with an understory of peavine and cow parsnip, and mixed forests of Balsam Poplar, Engelmann Spruce and Balsam Fir. Marshes were present in low lying areas, with barren outcrops and rocky cliffs in portions of the higher ground. (Ogryzlo, 2010)

2.4 Tenures

The geophysical work described in Appendix 1, below was completed across the mineral tenures of three different tenure holders. This assessment report refers to work done on mineral tenures held by Astorius Resources Ltd. The claim numbers worked on with respect to this assessment report are listed in Table 2.1, below. A property map is also presented in Appendix 2

Table 2.1: Claims List

Mineral Tenure Number	Tenure Type	Owner	NTS Map	Issue Date	Area (ha)
704747	Mineral	Astorius Resources Ltd.	093L16	2010-01-25	388.57
704708	Mineral	Astorius Resources Ltd.	093L16	2010-01-25	462.27
836013	Mineral	Astorius Resources Ltd.	093M01	2010-10-15	221.48
836016	Mineral	Astorius Resources Ltd.	093M01	2010-10-15	221.48
704740	Mineral	Astorius Resources Ltd.	093M01	2010-01-25	442.92
857339	Mineral	Astorius Resources Ltd.	093L16	2011-06-20	203.21
929260	Mineral	Astorius Resources Ltd.	093L16	2011-11-16	461.86

3 History

Exploration of the area dates back nearly 100 years with the first reports of work completed in the area in the early 1900s. In the late 1920s drilling was completed by Cominco and outlines a small copper, gold and silver reserve. Limited exploration was completed in the area until the mid 1950s when Granby Mining Company Limited began prospecting the area. In the late 1950s to early 1960s after low grade bulk tonnage porphyry deposits were proven viable by the inception and success of the Bethlehem Copper Corporation's Highland Valley Mine, interest was brought to the area. By the mid 1960s, Granisle Copper Limited opened the Granisle open pit mine on McDonald Island. In the early 1970s, Noranda's Bell Mine was also opened. Since these two successes, as well as other discoveries in the area, exploration activity has been maintained throughout the region. (McLeod, 1999)

4 Geology

In the Babine Lake the oldest rocks are marine sedimentary, volcaniclastic and volcanics of both the late Triassic Takla Group and early Jurassic Hazleton Group. Topley intrusions from the early Jurassic are coeval with the Hazelton Group and are composed of quartz diorites, granodirites and quartz monzonites and are present throughout the area. The younger clastic marine and non-marine sedimentary rocks of the mid to late Jurassic Bowser Lake Group and the mid-Cretaceous Skeena Group are preserved in basins created by the north-northwest extensional faulting that occurred in the late Cretaceous to early Tertiary. The late Cretaceous Bulkley intrusions utilized the dominant regional faults and associated dilatational zones for emplacement as well as the younger Eocene Babine Igneous Suite. The Babine Igneous Suite is the region's most important unit as it associated with the porphyry copper deposits in the area. (Henneberry, 2007)

5 Results

A discussion of the results of this survey and interpretations is presented in the appended geophysical report (Appendix 1).

6 Statement of Costs

A total cost of $110,495.13 was assumed for the geophysical work conducted on Astorius properties. The total cost of all the survey work conducted on all three tenure holders' tenures was apportioned based on the ratio of total line-meters covering each tenure holders' tenures. A breakdown of costs on Astorius tenures is presented in Table 6.1, below.

Table 6.1: Summary of Costs

Item	Cost	
Frontier - Seismic Refraction Surveys	$	89,630.46
Frontier - Personnel – Frontier	$	7,494.51
Frontier - Food and Accommodations	$	3,200.94
Frontier - Project Management	$	4,701.10
Xstrata - Personnel	$	2,328.16
Xstrata - Vehicles	$	455.07
Xstrata - Food and Accommodations	$	864.63
Xstrata - Project Management	$	1,820.26
Total	**$**	**110,495.13**

7 Conclusions

The purpose of the surveys reported here was to acquire an appreciation of the bedrock profile at certain sites. These surveys identified subsurface density horizons, including probable bedrock. The work therefore, in this context, accomplished its goal.

A more thorough description of observations can be found in the Results section of the attached geophysical report (Appendix 1).

8 References

Henneberry, R. (2007). *Geologic Report - Babine Porphyry; Assessment Report 26929.* Government of British Columbia Department of Energy, Mines and Petroleum Resources.

McLeod, J. (1999). *Report on the LK 7 Claim Group; Assessment Report 25814.* Government of British Columbia Department of Energy, Mines and Petroleum Resouces.

Ogryzlo, P. (2010). *Xstrata Copper Internal Communications.* Timmins.

9 Statement of Qualifications

I, Gordon Maxwell, of the town of Timmins, Ontario do certify,

1. I am a geologist residing at 118 Beregon Court, Timmins, Ontario
2. I graduated from the University of Manitoba in 1982 with BSc Hon. Geology
3. I am a professional geologist, registered (0263) in good standing with the Association of Professional Geoscientists of Ontario (APGO)
4. I have been practicing my profession since 1982 and I currently hold the position of Exploration Manager with Xstrata Canada Corporation.

Dated at Timmins, ON
February 6, 2013

PROFESSIONAL GEOSCIENTIST
GORDON J. MAXWELL
PRACTISING MEMBER
0263
ONTARIO

Gordon Maxwell
Exploration Manager
Xstrata Canada Corporation

Appendix 1

Report on Seismic Refraction and Resistivity Surveys Proposed Mine Site Facilities Bell Mine Project

KLOHN CRIPPEN BERGER LTD.

REPORT ON

SEISMIC REFRACTION AND

RESISTIVITY SURVEYS

PROPOSED MINE SITE FACILITIES

BELL GRANISLE PROJECT

BABINE LAKE, B.C.

by

Caitlin Gugins, B.Sc.

Russell Hillman, P.Eng.

October, 2012 **PROJECT FGI-1278**

Frontier Geosciences Inc. 237 St. Georges Avenue, North Vancouver, B.C., Canada V7L 4T4
Tel: 604.987.3037 Fax: 604.984.3074

CONTENTS

ILLUSTRATIONS

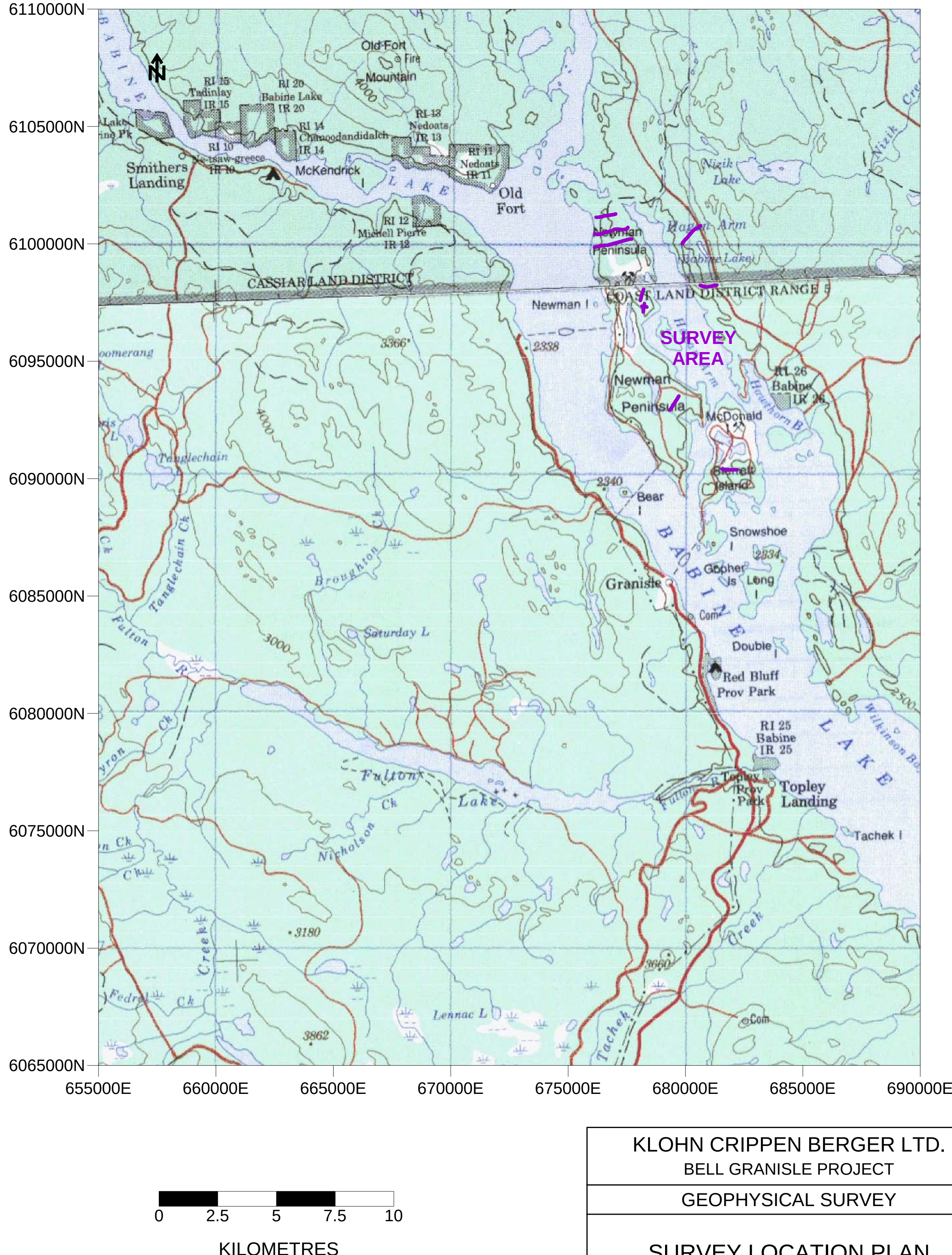
1. INTRODUCTION

In the period October 5 to November 1, 2012, Frontier Geosciences Inc. carried out a geophysical program of seismic refraction and multi-electrode resistivity surveying for Klohn Crippen Berger Ltd. at the Bell-Granisle project located at Babine Lake, B.C. A Survey Location Plan of the area of investigation is shown at 1:250,000 scale in Figure 1.

Seismic and resistivity surveying were carried out along ten traverses; with seven traverses located in the Bell Mine Area; two located in the Hagan Area and one located in the Granisle Mine Area. A Site Plan of the areas of investigation is illustrated at 1:50,000 scale in Figure 2, in the Appendix.

The recording of resistivity data on transects surveyed with the seismic refraction method was carried out to provide a separate parameter and more detailed information on the complex geological conditions in the survey areas. The resisivity method is more sensitive to rapid geological variations and can delineate clay overburden, more permeable, highly fractured bedrock and areas of increased porosity.

A total of approximately 10.7 km of detailed seismic refraction surveying was carried out in the investigation on 77 separate, seismic spreads with approximately 5 km of high resolution resistivity profiling carried out on three separate lines.



KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
GEOPHYSICAL SURVEY		
SURVEY LOCATION PLAN		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:250,000	FIG. 1

2. THE SEISMIC REFRACTION SURVEY

2.1 Equipment

The seismic refraction investigation was carried out using a Geometrics, Geode, 24 channel, signal enhancement seismograph and Mark Products Ltd., 48 Hz geophones. Geophone intervals along the multicored seismic cables varied from 5 m to 10 metres in order to produce high resolution data on subsurface layering. The zero delay or instantaneaous blasting caps in the small explosive charges used for energy input, were detonated electrically with a Geometrics, HVB-1, high voltage, capacitor-type blaster.

2.2 Survey Procedure

For each spread, the seismic cable was laid out in a straight line and the geophones firmly implanted. Six separate "shots" were then initiated: one at either end of the geophone array, two at intermediate locations along the seismic cable, and one off each end of the line to ensure adequate coverage of the basal layer. The shots were detonated individually and arrival times for each geophone were recorded digitally in the seismograph. Data recorded during field surveying operations was generally of good to excellent quality.

Throughout the survey, notes were recorded regarding seismic line positions in relation to topographic and geological features in the area. Individual geophone locations were recorded with a handheld, Garmin 76 Cx, GPS unit. Relative elevations on the seismic lines were recorded by chain and inclinometer and referenced to digital absolute elevation mapping provided by Klohn Crippen Berger Ltd.

2.3 Interpretive Method

The final interpretation of the seismic data was arrived at using the method of differences technique. This method utilizes the time taken to travel to a geophone from shotpoints located to either side of the geophone. Using the total time, a small vertical time is computed which represents the time taken to travel from the refractor up to the ground surface. This time is then multiplied by the velocity of each overburden layer to obtain the thickness of each layer at that point.

3. THE MULTI-ELECTRODE RESISTIVITY SURVEY

3.1 Equipment

The purpose of electrical surveying is to determine the subsurface resistivity distribution by making detailed measurements along survey lines laid out on the ground surface. From these measurements, the true resistivity of the subsurface can be estimated. Ground resistivity is related to various geological parameters such as the sulphide, clay mineral and fluid content, porosity and degree of water saturation in weathered material layering and the underlying materials.

The surface multi-electrode imaging resistivity survey was carried out using the Deep-Pen Resistivity/IP system developed by Frontier Geosciences Inc. This instrument has eight receiver channels, allowing measurements on multiple electrodes to proceed simultaneously, which significantly speeds up the data collection process allowing dense and detailed resistivity and IP profiles to be obtained.

During multi-electrode surveying, a central switching system in both systems is used to address the array of electrodes. This switching is accomplished using a multiplexer that directs the signals from any of the field electrodes to the eight input channels of the receiver. Similarly, a system of high voltage relays in the central switching system allows the transmitter to utilise any pair of electrodes for current injection. By means of a command file programmed in the receiver, electrode arrays including Schlumberger, Wenner, dipole-dipole, pole-dipole and pole-pole, or multiple combinations of arrays, may be chosen for execution by the system.

The high resolution, full waveform receiver records the entire waveform for eight channels simultaneously. With the full 24 bit waveform available for processing, self-potential drift, transient effects, and several other noise sources are accurately identified and removed from the signal. This results in full waveform data acquisition, providing high resolution information in lower signal level situations such as higher current electrode spacings and corresponding deeper penetration in a dipole-dipole survey, or in geologic settings with unfavourable signal-to-noise levels.

3.2 Survey Procedure

For each electrode array, six 70-metre receiver cables were laid out along the survey line and connected to the multiplexing switchbox controller. The switchbox controller allows the electrodes to be in either standby, current or measuring potential modes. Each individual cable consists of 14 electrode takeouts at a spacing of 5 metres, with a full array covering approximately 420 metres and providing high sampling depths up to approximately 70 metres.

The system was configured to permit two different data acquisition procedures. The first procedure, typically the initial array of a new line, collects data files encompassing the full sequence of measurements. After the full array reading, three cables were detached from the front of the receiver line, and three cables were attached to the front of the receiver line, effectively shifting the array 210 metres along the survey line by “rolling” the array. The computer system was shifted to the same relative position within the rolled array, and the process repeated. For each roll array, a reduced set of measurements, representing a 50% overlap, was used in order to reduce redundancy and decrease reading time.

For the Deep-Pen Resistivity/IP system, data quality was monitored in the field through a full-panel display of received waveforms. If the data was suspect, individual channels could be displayed at enhanced scales for closer inspection and field processing.

3.3 Data Processing

The data were downloaded from the instruments and converted into the input file format for the cell-based inversion method developed by M. H. Loke and referred to as the RES2DINV program. This software utilizes a finite-difference modelling approach to calculate the resistivity values that best fit the observed data. The model parameters are the resistivity values of the model cell, while the data is the measured apparent resistivity values. The mathematical link between the model parameters and the model response is provided by the finite-difference or finite-element methods. In all optimization methods, an initial model is modified in an iterative manner so that the difference between the model response and the data values is reduced.

To increase the accuracy of the modelling process, the elevation of each electrode was incorporated into the input data file.

4. GEOPHYSICAL RESULTS

4.1 General

The results of the ten seismic refraction lines are illustrated at 1:1,000 scale in Figures 3 through 7, and 11 through 14 for the Bell Mine Area; Figures 8 to 10 for the Hagan Area and Figure 15 for the Granisle Mine Area. Coincident multi-electrode resistivity surveying was carried out on line RL-2 in the Bell Mine site area and lines RL-4 and RL-5 in the Hagan area. The resulting inverted resistivity sections are shown at a scale of 1:1,000 in Figures 16 to 20 in the Appendix. Ground surface topography along the resistivity and seismic lines was produced from chain and inclinometer measurements and mapping of the area provided by Klohn Crippen Berger Ltd.

4.2 Bell Mine Area

The Bell Mine area includes survey lines SL-1 to SL-3, and SL-6 to SL-9 and encompasses the central peninsula of the survey area. Seismic refraction surveying on lines SL-1 to SL-3 in the northern sector was augmented by resistivity surveying on line SL-2. Seismic lines SL-6, SL-7 and SL-9 are in the tailings expansion pond area, with line SL-8 located at the south end of the peninsula.

The seismic refraction data for the Bell Mine area indicates the site is underlain by three or four distinct velocity layers. A surficial layer was identified in the data with a velocity range of 250 m/s to 450 m/s. Varying in thickness from less than 0.5 metres to 4.3 metres, this layer was directly correlated to exposures of loose organics, sands and gravels and coarse boulders.

Underlying the thin surficial layer in the majority of the area, are two distinct intermediate velocity layers. The relatively thin, shallow layer displays a range in compressional wave velocities that vary from 635 m/s to 1305 m/s. Interpreted thicknesses for this layer range from less than a metre to 9 metres, at approximate chainage 30N on line SL-7. The velocities in this layer are consistent with unsaturated, moderately dense, sand and gravel, lacustrine silts or clays, and highly weathered rock.

With the exception of the northeast segment of line 9, which is underlain by mine rock waste, a deeper intermediate layer is extant throughout the area. Velocities within this layer vary from 1500 m/s to 2060 m/s. Lower velocities within this layer are interpreted as clay till.

Drillhole W22 in proximity to seismic line 3, was drilled to a depth of approximately 15 m in clay till. Velocities from 1800 m/s to 2060 m/s may be consistent with coarser till comprised of sands, gravels and cobbles. Relatively thin zones on lines SL-6, SL-7, SL-8 and SL-9 with velocities from 1780 m/s to 3065 m/s may be consistent with weathered bedrock. These zones are coincident with the highest elevations along the four seismic lines.

The higher velocity intermediate layer varies significantly in thickness from less than a metre to a maximum of 107 metres at 480E on line SL-1. A strong correlation in layer depth occurs between 440E and 520E on line SL-1 and 560E and 620E on line SL-2, where this layer deepens to 107 m and 64 m, respectively. A similar increase in depth is also apparent between 740E and 820E on SL-3, as the layer thickness increases from 13.5 m to 31.5 metres. The coincidence of these deeper zones over a relatively small horizontal distance suggests the existence of a buried channel or a possible shear zone. Additionally, a gradual deepening of this intermediate layer is apparent at the northeastern end of SL-9 from 340NE to 500NE, where the layer thickness increases gradually from 12 m to 73 m depth.

The basal layer with velocities from 2280 m/s to 5560 m/s is the interpreted competent bedrock surface. Interpreted depths to the basal layer in the Bell Mine area range from 2.8 m to a maximum of 110 metres. With the exception of the postulated buried channel or shear zone, relatively shallow competent bedrock is widespread throughout the survey area.

Lower velocities of 2280 m/s to 2700 m/s calculated for the basal layer coincide with the areas of increased depth to bedrock occurring on lines SL-1, SL-2 and SL-3. This further supports the existence of a buried channel or potential shear zone intersecting these three lines in the northern sector of the Bell Mine area.

The single resistivity line in the Bell Mine area, line RL-2, was separated into two sections by a swamp. The western segment of line RL-2A, indicates resistivities up to 100 ohm-m underlain by values ranging from 150 ohm-m to 500 ohm-m. The surficial layer is likely comprised of electrically conductive, partially saturated clays, silts, sands and gravels and glacial till. From approximately 220E to 340E, a relatively high resistive zone of 500 ohm-m is apparent. This increase in resistivity may be due to crystalline intrusive bedrock with few fractures.

Resistivities at depth decrease to the east and at approximately 580E, a resistivity value of 50 ohm-m coincides with an interpreted seismic bedrock depression of approximately 75 metres. The maximum resistivity of 50 ohm-m suggests clay till infills the deep bedrock depression.

The eastern section of line RL-2B exhibits thin, low resistivity values in the middle of the line. High resistivities at either end of the line are consistent with shallow bedrock. The low 2700 m/s velocity zone centred at 1220E appears to be consistent with the low resistivity zone that extends to depth. These coincident geophysical signatures may be indicative of a shear zone in the bedrock.

4.3 Hagan Area

The Hagan area is located to the east of the Bell Mine site, across the inlet. Survey lines in this area include lines 4 and 5, which were surveyed with both the seismic refraction and resistivity methods.

The results of the seismic refraction surveying in the Hagan area indicate the area is underlain by four distinct velocity layers. The surficial layer varies in velocities from 275 m/s to 600 m/s, and varies in interpreted thickness from less than a metre to approximately 4 metres. This layer is consistent with surface exposures of organics, sands, gravels, cobbles and boulders.

The shallow intermediate layer at the site varies in compressional wave velocities from 665 m/s to 1060 m/s and varies in thickness from 0.1 m to 8 metres. Similar to the Bell Mine area, the calculated velocities in this layer are indicative of denser, unsaturated sand and gravel, and possibly lacustrine silts or clays.

With the exception of the zone from 240E to 340E on line SL-5, a deeper intermediate layer underlies lines SL-4 and SL-5. Calculated velocities for this deeper layer range from 1800 m/s to 2150 m/s, with layer thicknesses varying significantly from 0.2 m to 42.4 metres. These velocities are generally higher than the Bell Mine area, and are interpreted as coarse sand, gravel and cobble glacial till or clay till.

The basal layer velocities vary from 3130 m/s to 5670 m/s. Lower velocities from 3130 m/s to 3800 m/s between chainages 560NE and 600NE on line SL-4A; 880NE and 920NE on line SL-4B and 200E to 230 E, 300E to 330E and 620E to 650E on line SL-5, may be indicative of dikes, sedimentary bedrock or shear zones. With the exception of these relatively narrow velocity zones, the majority of the basal layer velocities indicate very competent, crystalline bedrock. The depths to the basal layer range from 2.5 m at the southwestern end of line SL-4 to approximately 46 metres at approximately 880NE on line SL-4.

The resistivity data from the Hagan area indicates generally higher basal resistivities than the Bell Mine area. A range of resistivities overlie a resistive basement with resistivity values that vary from 50 ohm-m to 1200 ohm-m. The moderately high to high surficial resistivity zones on line RL-4 may be due to low porosity sand and gravel glacial till. Lower resistivities of the order of 50 ohm-m may be zones of clay till. Conductive basal layer zones on line RL-4 may be indicative of higher clay content or higher porosities in the bedrock.

The inversion results for line RL-5 indicates a thin, generally conductive surficial layer overlying a resistive basement. Both higher elevation ends of the line, indicate a sharp gradient to shallow, high resistivities reflecting shallow bedrock. A similar feature occurs at approximately 350E, in an area underlain by high velocity 4680 m/s bedrock. More electrically conductive areas in the generally high velocity basal layer are likely due to clay infilling in joints and fractures or greater porosities within the rock.

4.4 Granisle Mine Site

The Granisle Mine area is located on an island to the southeast of the Bell Mine site. Surveying in this area consisted of a single seismic refraction line SL-10, located in the southern part of the island.

The results of the interpretation of line SL-10 indicate the subsurface is comprised of four distinct velocity layers. The thin surficial layer with velocities of 325 m/s to 450 m/s was correlated with exposures of sands, gravels, cobbles and organics.

A thin, shallow intermediate layer was identified in the data with velocities from 770 m/s to 1200 m/s. Varying up to 4.6 m in thickness, this layer is interpreted as unsaturated sands, gravels and cobbles or possibly lacustrine silts or clays.

A deeper intermediate layer underlies the site with velocities that range from 1700 m/s to 2280 m/s. Interpreted thicknesses for this layer vary from 3 m to 18 metres. Velocities in this layer are believed to be consistent with either clay till or coarse till of sand, gravel, cobbles and boulders.

The basal layer with velocities from 3180 m/s to 5575 m/s is the interpreted competent bedrock surface. Apart from the 3180 m/s velocity zone at chainage 470E, which may be a shear zone or dike, the velocities are representative of competent crystalline bedrock. The depths to the basal layer are largely uniform along the line, ranging from 4.5 m to a maximum of approximately 22 metres at chainages 300E and 460E.

5. LIMITATIONS

The depths to subsurface boundaries derived from seismic refraction surveys are generally accepted as accurate to within ten percent of the true depths to the boundaries. In some cases, unusual geological conditions may produce false or misleading data points with the result that computed depths to subsurface boundaries may be less accurate. In seismic refraction surveying difficulties with a ‘hidden layer’ or a velocity inversion may produce erroneous depths. The first condition is caused by the inability to detect the existence of a layer because of insufficient velocity contrasts or layer thicknesses. A velocity inversion exists when an underlying layer has a lower velocity than the layer directly above it.

The multi-electrode resistivity method is successful providing adequate contrasts exist in the subsurface in electrical resistivity between distinct geological materials. Conductors identified in resistivity surveying are diverse and depending on geological settings, may include mineralisation, graphite, argillite, shear or fault zones, clay beds, marl, saturated materials, clay shale, clay till, mineralised leachate and zones of salt water intrusion. Electrically resistive materials include but are not limited to, sand and gravel, dry soils, glacial moraine, coarse glacial till, permafrost, underground voids and competent bedrock. Also affecting resistivity are the degree of saturation of materials and the porosity, the concentration of dissolved electrolytes, the temperature and the amount and composition of colloids. With few exceptions, no unique resistivity value defines a specific geological material.

In the modelling process, a number of limitations constrain modelling of subsurface resistivity. For instance, due to non-uniqueness, more than one model can produce the same response that agrees with the observed data. The resulting model thus depends to a significant extent on the constraints used and will closely approximate the true subsurface conditions only if the constraints closely correspond to actual subsurface conditions.

The information in this report is based upon geophysical measurements and field procedures and our interpretation of the data. The results are interpretive in nature and are considered to be a reasonably accurate presentation of existing subsurface conditions within the limitations of the seismic refraction and multi-electrode resistivity methods

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For: Frontier Geosciences Inc.

Caitlin Gugins, B.Sc. Russell Hillman, P.Eng.

Russell A. Hillman, P.Eng.
Engineering Geophysicist

FIELDS OF SPECIAL INTEREST	Land and marine engineering geophysics. High resolution surveys for the identification and delineation of soil types, contaminants, bedrock, groundwater and permafrost in support of geotechnical studies, environmental investigations, groundwater investigations and mineral, oil, coal and potash exploration.
EDUCATION	**B.Sc. in Geophysics**, University of British Columbia, 1969
ASSOCIATIONS	Association of Professional Engineers and Geoscientists of British Columbia Registration no. 13042, November 4, 1981 Association of Profession Engineers, Geologists and Geophysicists of Alberta Member no. M75499, September 20, 2002 Member, European Association of Exploration Geophysicists
1985-Present	**President, Frontier Geosciences Inc.** Testing of a unique overwater ultrasonic signal processing device for borrow identification, Beaufort Sea, N.W.T. Borehole seismic investigations for dynamic parameters, John Hart, W.A.C. Bennett, Mica, Keenleyside, Stave Falls, Ophir Creek, Ruskin, Seymour, Myra Falls and Botanie Lake Dams, B.C. Seismic refraction investigations for geological conditions on Merritt to Peachland extension of Coquihalla Highway. Detailed seismic refraction surveying for geological conditions, Roseau River damsite, St. Lucia. Seismic refraction surveys, gold exploration, Pogo Project, Alaska and Hope Bay Project, Nunavut. Seismic refraction surveying of proposed tailings dam sites, Pueblo Viejo, Dominican Republic. High resolution seismic reflection surveys for geothermal exploration in Terrace, B.C., industrial minerals in Powell River, B.C., Cleveland dam site abutment stability evaluation in North Vancouver, B.C., Fraser delta earthquake assessment study in Vancouver, B.C., gold exploration in Tulsequah, B.C., kimberlite exploration in the Northwest Territories, tailings disposal sites Prosperity Project, B.C., and proposed Aluminum Smelter site, Kitimat, B.C. Groundwater geophysical investigations for hazardous waste sites in Cache Creek area, B.C., water supply in Timor, Indonesia, environmental assessment in Multnomah County, Portland, Oregon, and several municipal, industrial and mine-related water supply schemes in Western Canada. Overwater acoustic profiling surveys for proposed oil pipeline crossing, Pastaza River, Peru, mineral exploration in Ontario, Manitoba and Northwest Territories, proposed docking facilities, Pagan Island, Marianas. Seismic refraction investigations of placer gold channels in Likely, Cranbrook and Quesnel areas, B.C. Extensive geophysical investigations at the W.A.C. Bennett Dam Sinkhole Project, Hudson's Hope, B.C.

1984-1985 **Head, Engineering Geophysics Division, White Geophysical Inc.**
Seismic refraction investigations of debris slides, river crossings and borrow locations for the Coquihalla Highway project. Regional EM induction surveys for gravel exploration. Borehole seismic investigation of foundation conditions for proposed ALRT crossing of Fraser River. Seismic refraction investigation of placer channels in Likely area, B.C.

1983-1984 **Engineering Geophysicist, R.A. Hillman and Associates**
Impulse radar investigations of a large peat deposit in the Vancouver Area for landfill development, massive concrete wall retaining structure in West Virginia and drag line stability assessment in northern Alberta. Seismic refraction investigations in support of placer exploration in the Wells area, B.C., and in the Whitehorse area, Yukon.

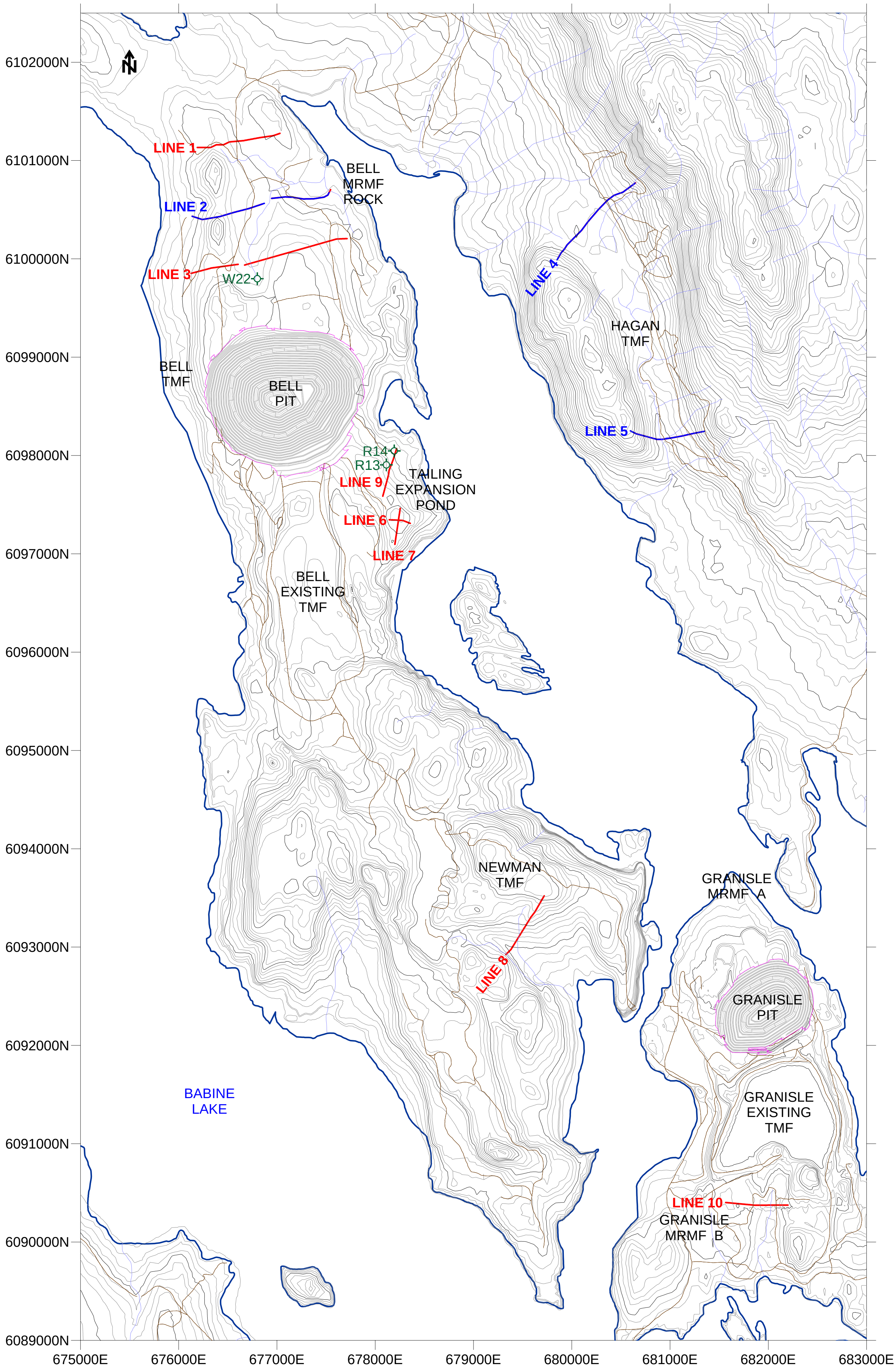
1980-1982 **Head Geophysicist, D.R. Piteau and Associates, Ltd.**
Seismic refraction investigations of the Northeast Coal Branch railspur and the proposed Connaught Tunnel in Glacier National Park, B.C. and the Coalspur Project in Robb, Alberta; over-ice Impulse Radar investigation of artificial island sites in the McKenzie River, N.W.T. Seismic and electrical surveys for groundwater resources for fish hatcheries at Likely, Clearwater and Prince George, B.C.

1975-1980 **Intermediate Engineer, Golder Associates**
Seismic refraction investigations of damsites near Red Deer, Alberta, and Dawson Creek, Fort Nelson, Liard Hot Springs and Fording, B.C. In situ elastic moduli foundation studies for proposed pulp mill, Akdeniz, Turkey. Continuous overwater sub-bottom reflection surveys in connection with a submarine landslide, Kitimat, B.C., proposed coal terminal, Prince Rupert, B.C., and proposed grain terminal, Vancouver, B.C. Evaluation of geophysical parameters relating to underground storage of nuclear waste in bedded salt environments, U.S.A. Resistivity and self-potential surveys for contaminant plume delineation, Cantung, N.W.T. and Fording, B.C.

1974-1975 **Intermediate Engineer, Klohn Leonoff Consultants Ltd.**
Responsible for geophysical investigations of Civil Engineering projects.

1971-1974 **Engineering Geophysicist, Geo-Recon Explorations Ltd.**
Special assignments included: The Boardman Nuclear Project in Oregon for Portland General Electric Company, the Washington Public Power Supply System Nuclear Project No. 1 on the Hanford Reservation near Richland, Washington; Geophysical investigations in connection with five possible coastal nuclear sites in Oregon for Portland General Electric, Downie Slide near Revelstoke and the Seven Mile Project on the Pend O'Reille River near Trail for the British Columbia Hydro and Power Authority.

1970-1971 **Project Geophysicist, Northway Survey Corporation, Toronto, Ontario**
Responsible for interpretation of airborne and ground geophysical surveys for massive sulphide deposits and petroleum. Majority of interpretation reports on the application of helicopter-borne magnetic and electromagnetic instrumentation to the search for massive sulphide deposits in the Canadian Shield. Specific projects included the planning of airborne surveying, ground follow-up and interpretation of data for Rio Tinto Zinc's large option in the Padang area of Sumatra, Indonesia, and interpretation of ground magnetometer work in the Canadian Arctic and gravity surveys in Ontario.



SEISMIC REFRACTION LINE

SEISMIC REFRACTION AND RESISTIVITY LINE

BOREHOLE

0 0.5 1 1.5 2

KILOMETRES

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
GEOPHYSICAL SURVEY		
SITE PLAN		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:50,000	FIG. 2

SEISMIC LINE SL-1

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD.		
BELL GRANISLE PROJECT		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL-1		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1000	FIG. 3

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD.

BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-2A

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:1000	FIG. 4

SEISMIC LINE SL-2B

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-2B

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:1000	FIG. 5

SEISMIC LINE SL-3A

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL-3A		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1000	FIG. 6

SEISMIC LINE SL-3B

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-3B

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:1000	FIG. 7

SEISMIC LINE SL-4A

INSTRUMENT: GEOMETRICS GEODE

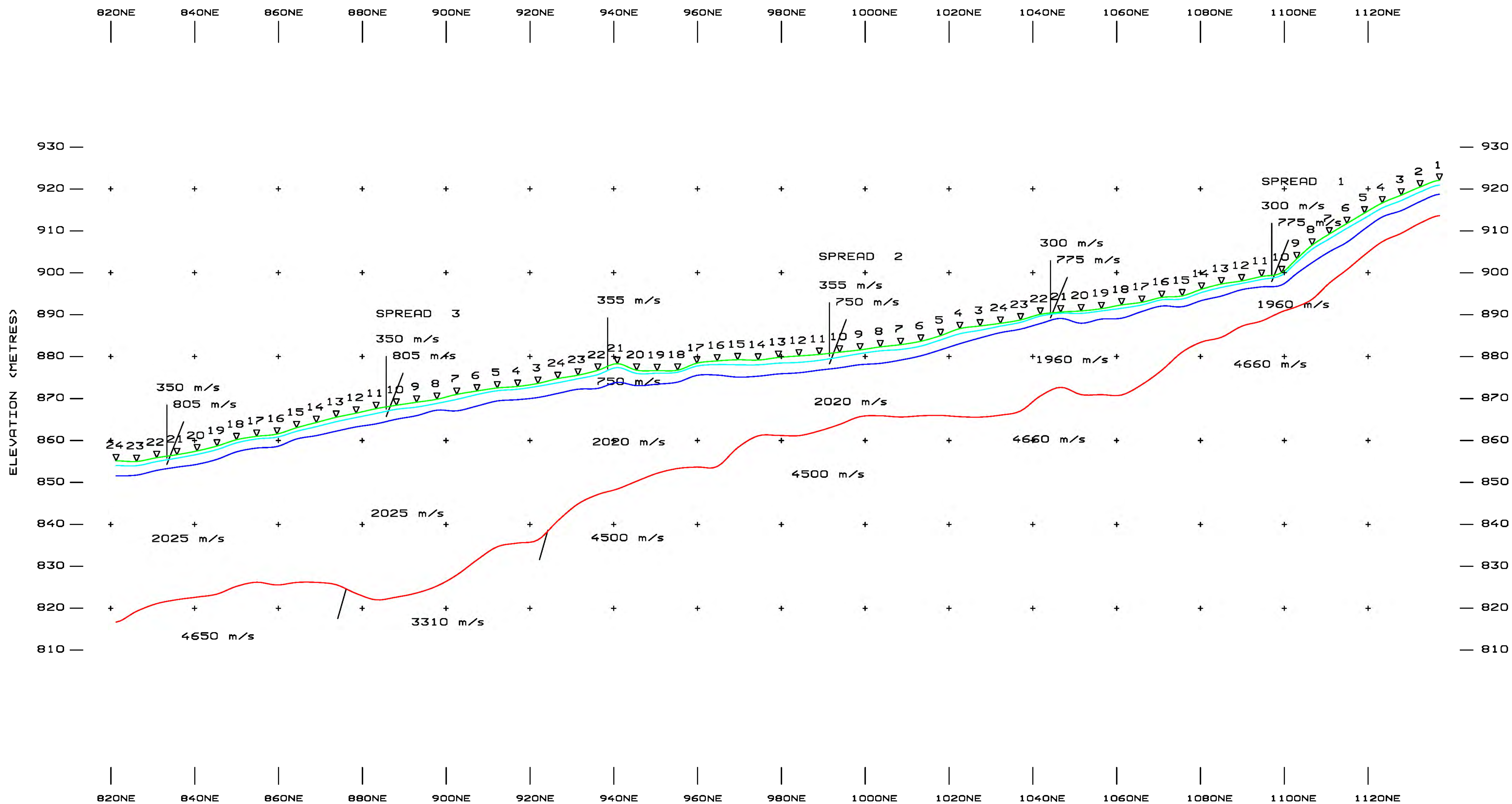
KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-4A

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012 | SCALE 1:1000 | FIG. 8



SEISMIC LINE SL-4B

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL-4B		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1000	FIG. 9

SEISMIC LINE SL-5

INSTRUMENT: GEOMETRICS GEODE

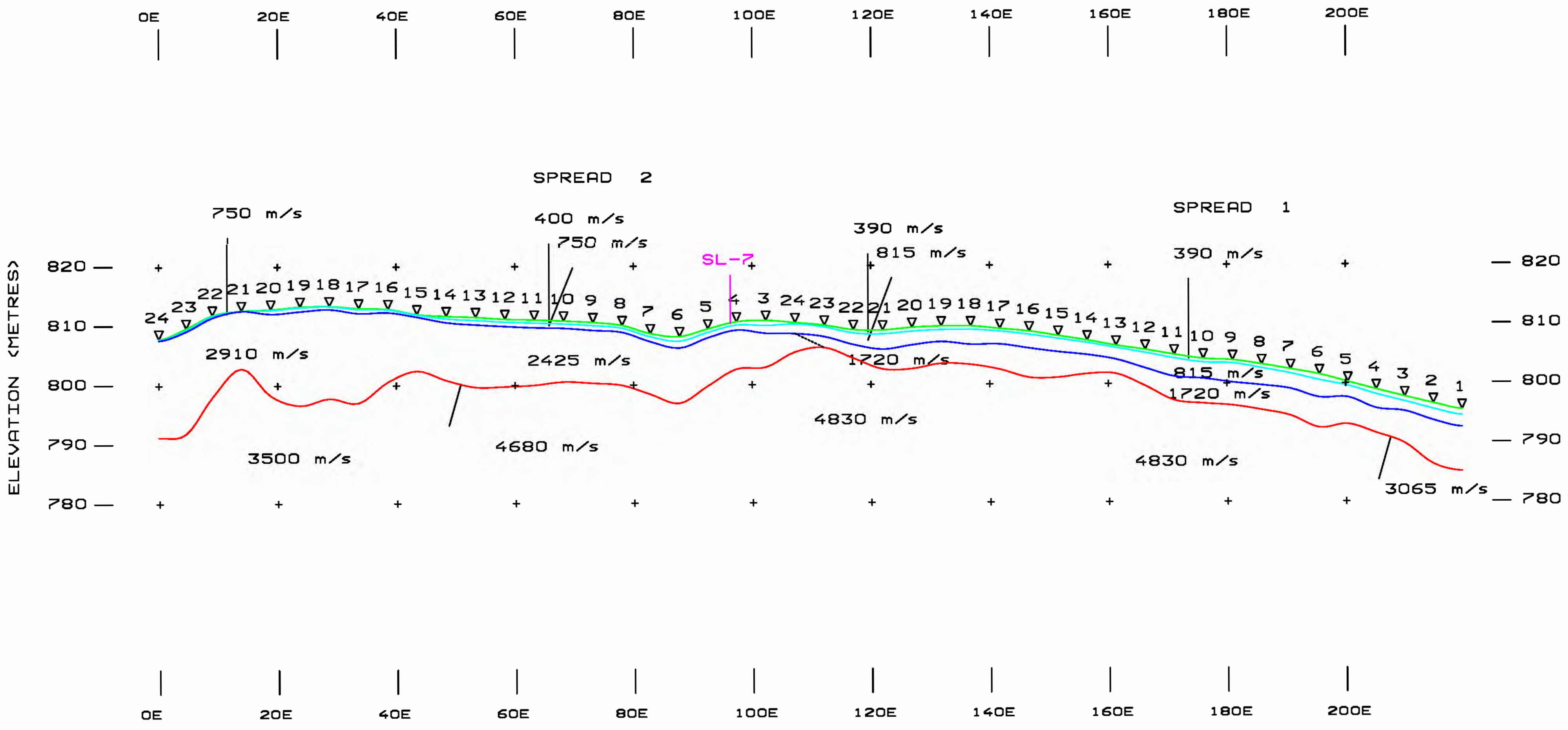
KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-5

FRONTIER GEOSCIENCES INC.

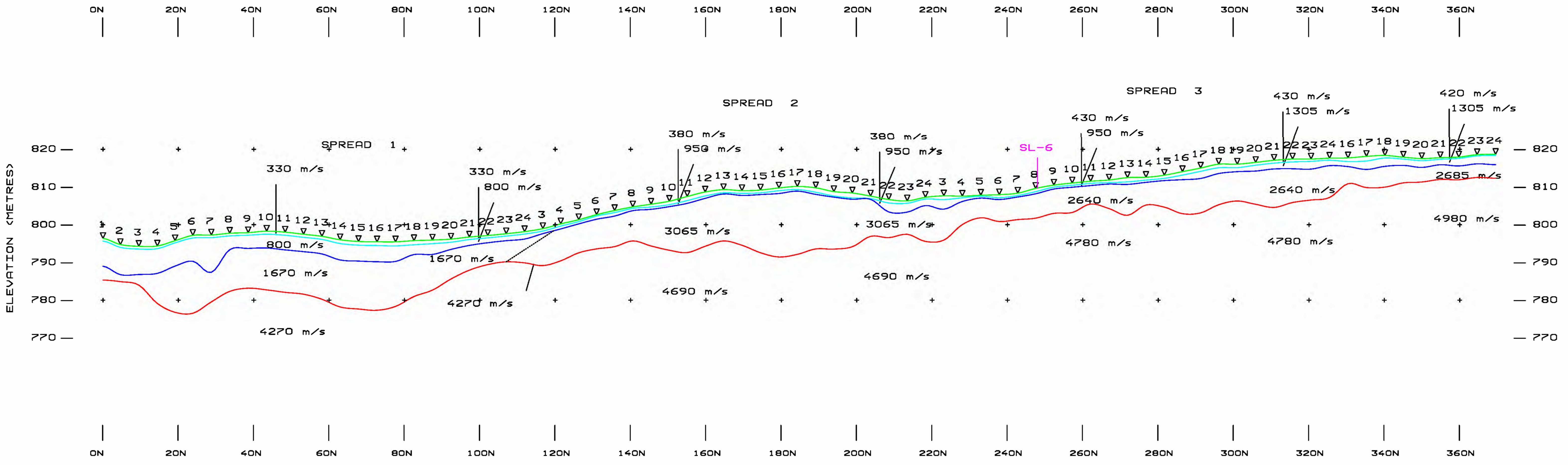
DATE: OCT. 2012	SCALE 1:1000	FIG. 10



SEISMIC LINE SL-6

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL-6		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1000	FIG. 11



SEISMIC LINE SL-7

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD.

BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-7

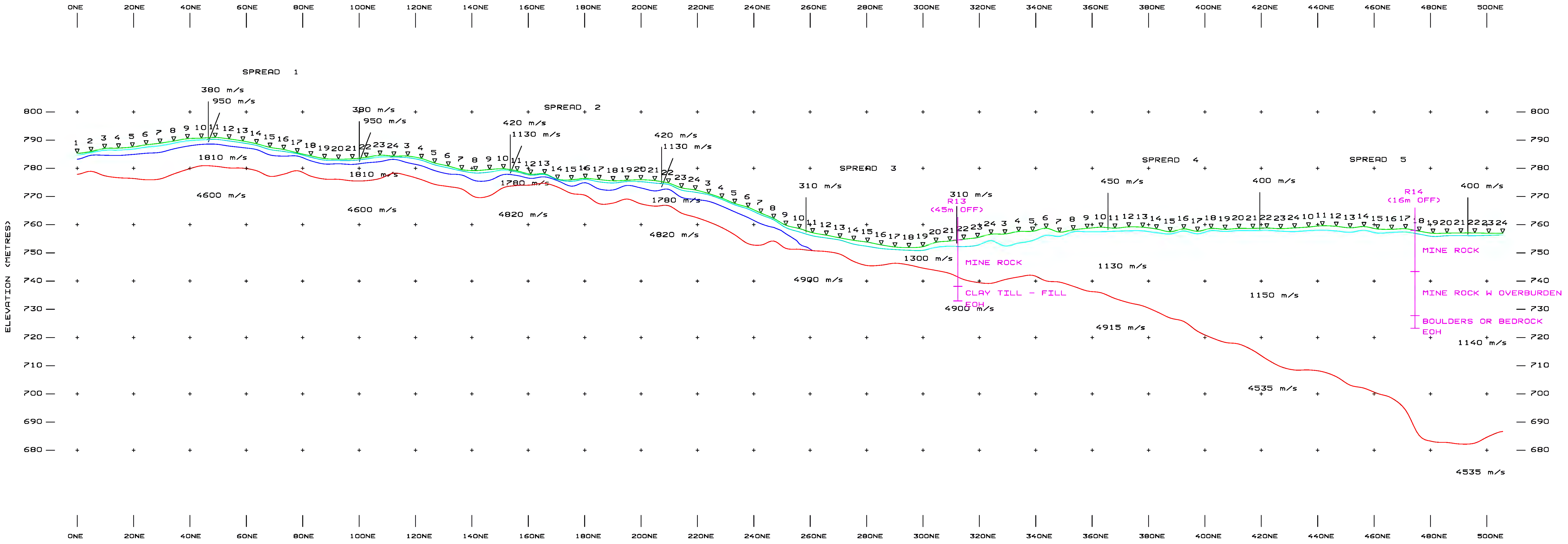
FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:1000	FIG. 12

SEISMIC LINE SL-8

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL-8		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1000	FIG. 13



SEISMIC LINE SL-9

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL-9

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:1000	FIG. 14

SEISMIC LINE SL-10

INSTRUMENT: GEOMETRICS GEODE

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL-10		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1000	FIG. 15

0.0 46.8 74.8 102.6 150.0 221.0 311.5 503.8 800.0

INVERTED RESISTIVITY (Ohm-m)

LEGEND

ELECTRODE

FIRST SEISMIC VELOCITY LAYER

SECOND SEISMIC VELOCITY LAYER

BASAL SEISMIC VELOCITY LAYER

0 10 20 30 40

METRES

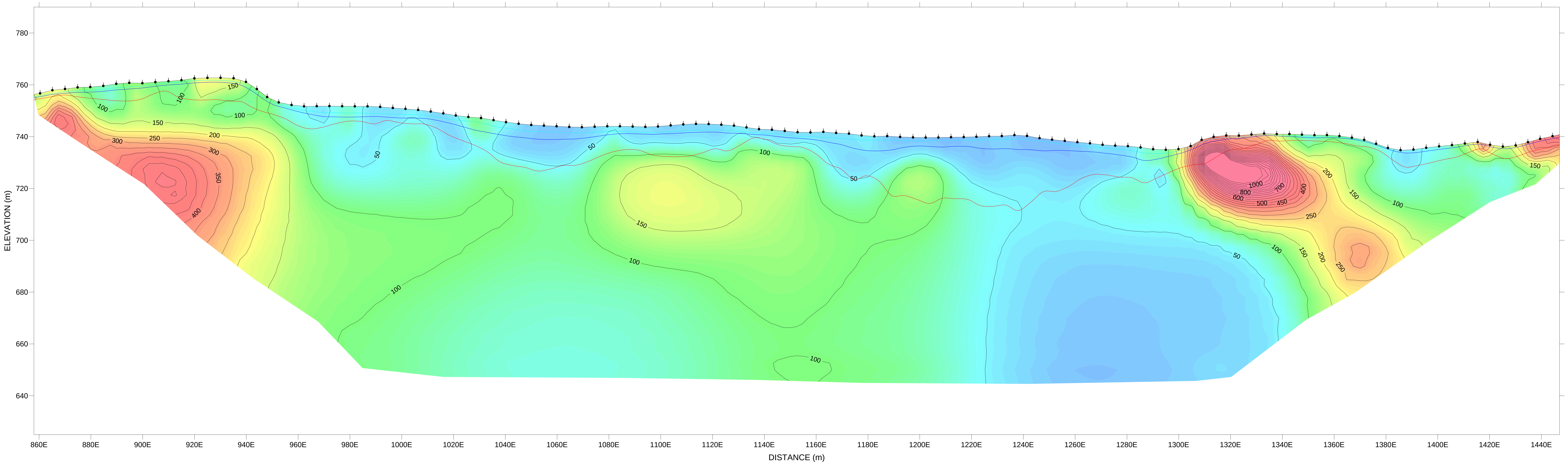
KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

RESISTIVITY SURVEY

RESISTIVITY INVERTED SECTION
LINE 2A

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:1,000	FIG. 16



0.0 41.6 68.1 94.8 129.1 179.5 250.0 350.0 550.0 800.0

INVERTED RESISTIVITY (Ohm-m)

LEGEND

ELECTRODE

FIRST SEISMIC VELOCITY LAYER

SECOND SEISMIC VELOCITY LAYER

BASAL SEISMIC VELOCITY LAYER

0 10 20 30 40

METRES

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
RESISTIVITY SURVEY		
RESISTIVITY INVERTED SECTION LINE 2B		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1,000	FIG. 17

0.0 41.6 68.1 94.8 129.1 179.5 250.0 350.0 550.0 800.0

INVERTED RESISTIVITY (Ohm-m)

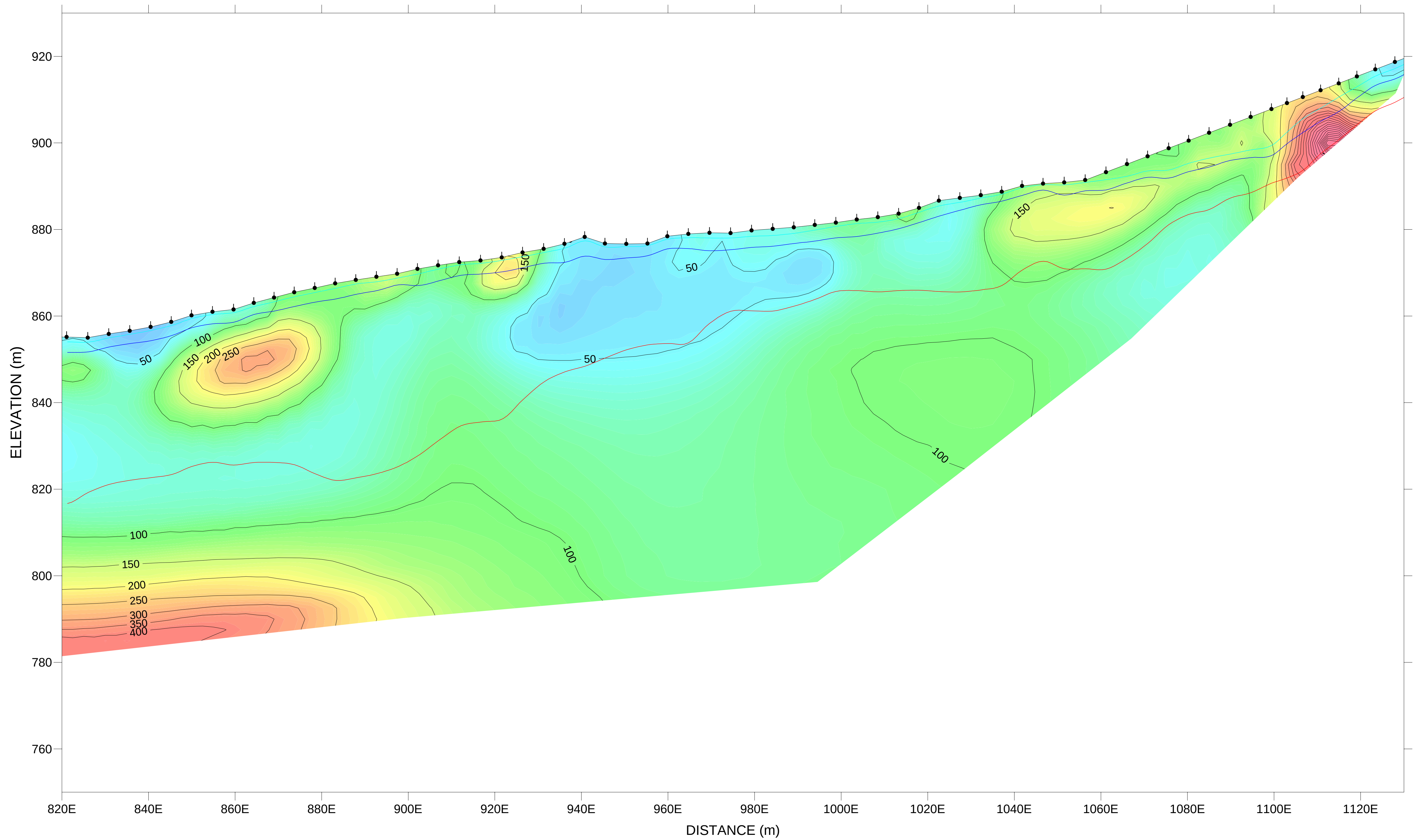
LEGEND

- ELECTRODE
- FIRST SEISMIC VELOCITY LAYER
- SECOND SEISMIC VELOCITY LAYER
- BASAL SEISMIC VELOCITY LAYER

0 10 20 30 40

METRES

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
RESISTIVITY SURVEY		
RESISTIVITY INVERTED SECTION LINE 4A		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1,000	FIG. 18



LEGEND

ELECTRODE

FIRST SEISMIC VELOCITY LAYER

SECOND SEISMIC VELOCITY LAYER

BASAL SEISMIC VELOCITY LAYER

0.0 41.6 68.1 94.8 129.1 179.5 250.0 350.0 550.0 800.0

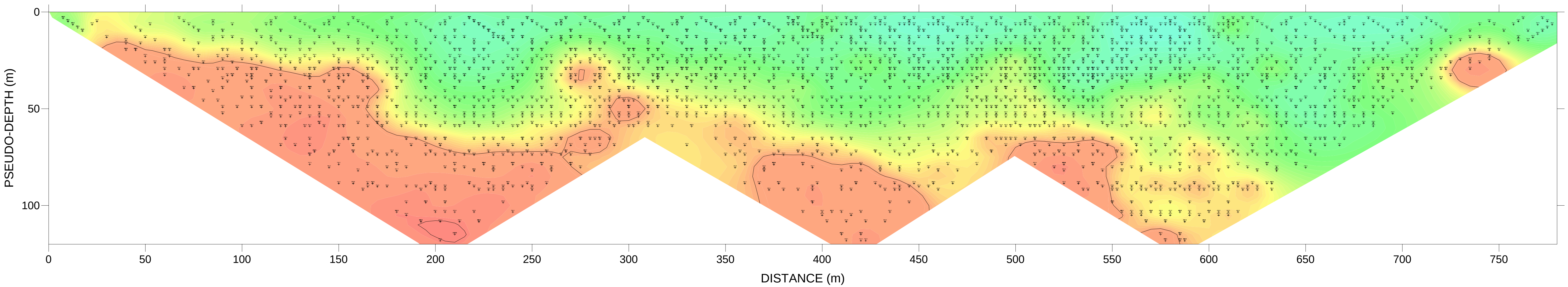
INVERTED RESISTIVITY (Ohm-m)

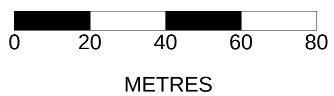
0 10 20 30 40

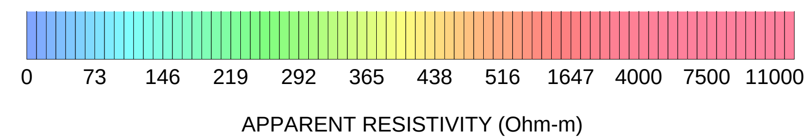
METRES

KLOHN CRIPPEN BERGER LTD. BELL GRANISLE PROJECT		
RESISTIVITY SURVEY		
RESISTIVITY INVERTED SECTION LINE 4B		
FRONTIER GEOSCIENCES INC.		
DATE: OCT. 2012	SCALE 1:1,000	FIG. 19

ELEVATION (m)
920
900
880
860
840
820
800
780
760
740
720
0E
20E
40E
60E
80E
100E
120E
140E
160E
180E
200E
220E
240E
260E
280E
300E
320E
340E
360E
380E
400E
420E
440E
460E
480E
500E
520E
540E
560E
580E
600E
620E
640E
660E
680E
700E
720E
740E
760E
DISTANCE (m)
0.0 41.6 68.1 94.8 129.1 179.5 250.0 350.0 550.0 800.0
INVERTED RESISTIVITY (Ohm-m)
LEGEND
ELECTRODE
FIRST SEISMIC VELOCITY LAYER
SECOND SEISMIC VELOCITY LAYER
BASAL SEISMIC VELOCITY LAYER
0 10 20 30 40
METRES
KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT
RESISTIVITY SURVEY
RESISTIVITY INVERTED SECTION
LINE 5
FRONTIER GEOSCIENCES INC.
DATE: OCT. 2012
SCALE 1:1,000
FIG. 20







KLOHN CRIPPEN BERGER LTD.

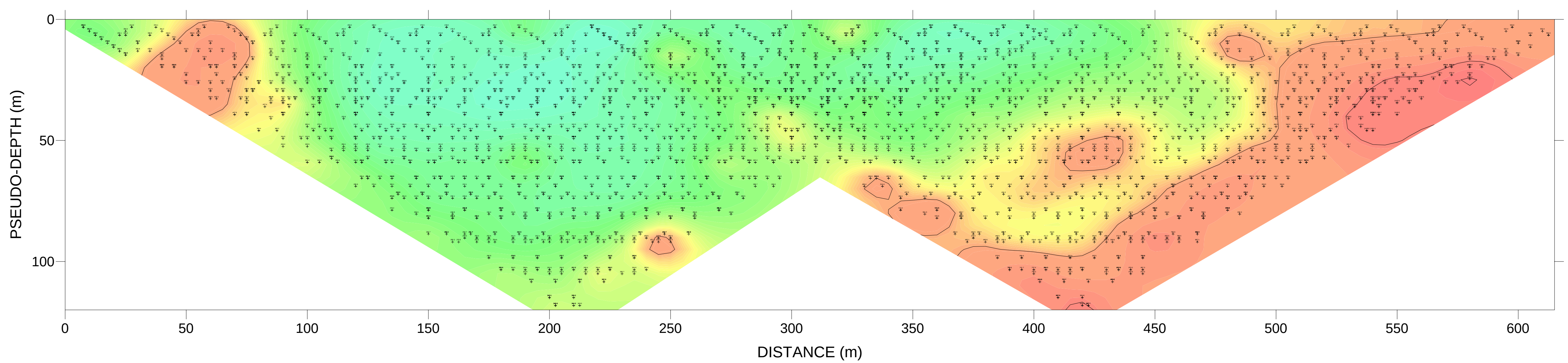
BELL GRANISLE PROJECT

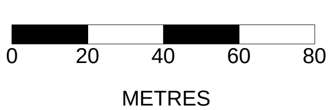
GEOPHYSICAL SURVEY

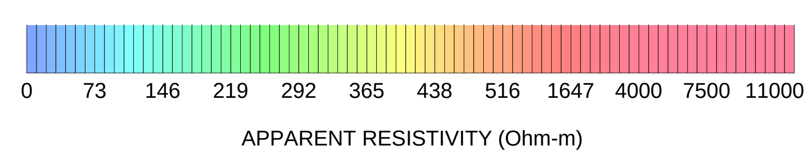
RL2A PSEUDOSECTION

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:2,000	







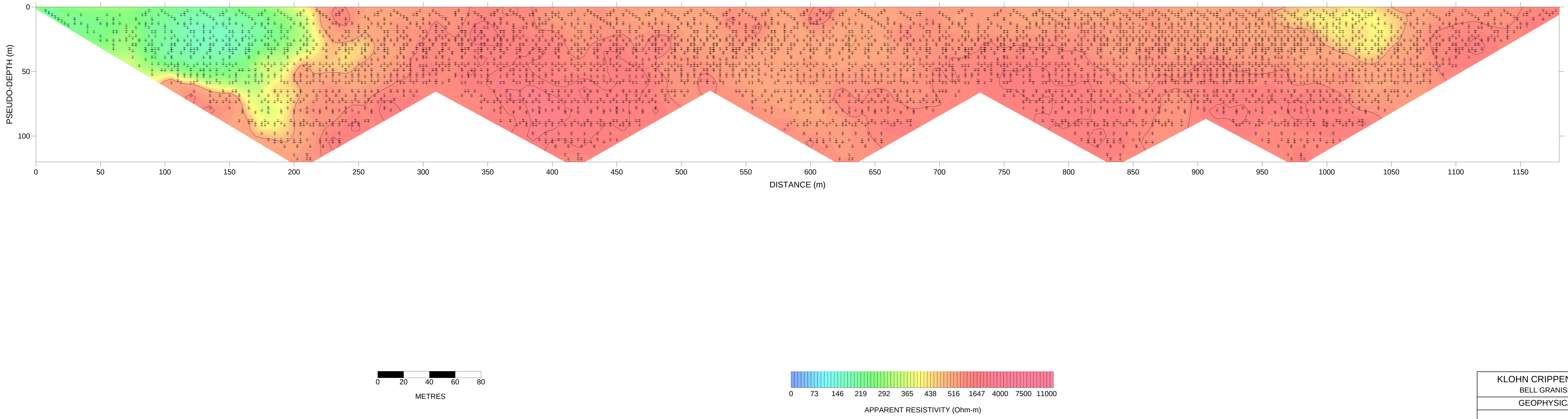
KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

GEOPHYSICAL SURVEY

RL2B PSEUDOSECTION

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012 | SCALE 1:2,000



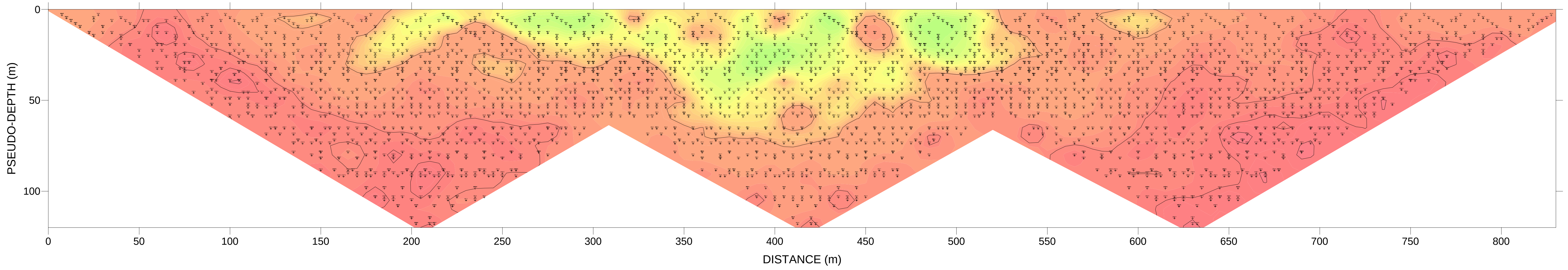
KLOHN CRIPPEN BERGER LTD.
BELL GRANISLE PROJECT

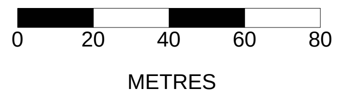
GEOPHYSICAL SURVEY

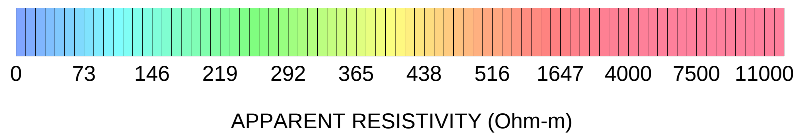
RL4 PSEUDOSECTION

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012	SCALE 1:2,000	







KLOHN CRIPPEN BERGER LTD.

BELL GRANISLE PROJECT

GEOPHYSICAL SURVEY

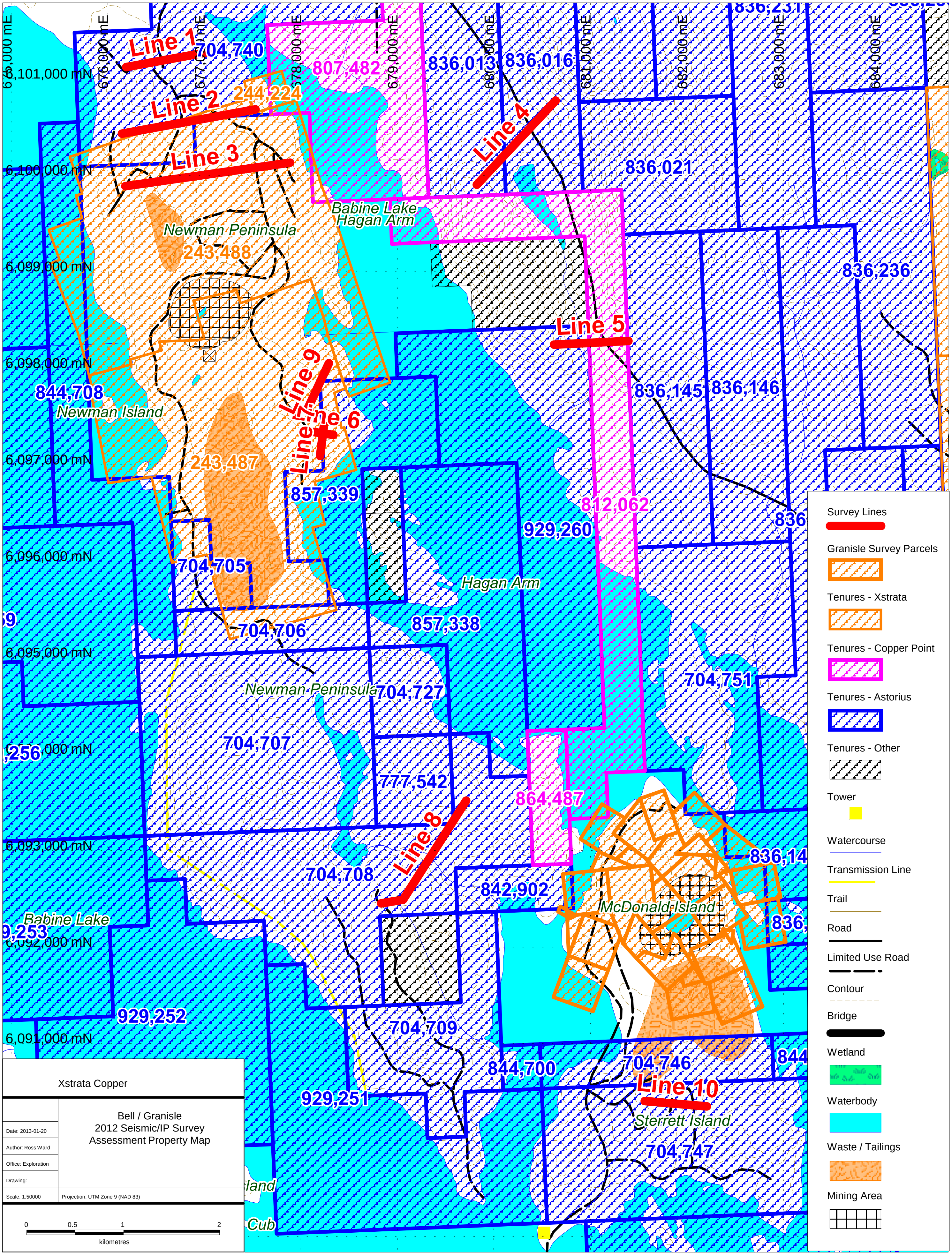
RL5 PSEUDOSECTION

FRONTIER GEOSCIENCES INC.

DATE: OCT. 2012 | SCALE 1:2,000

Appendix 2

Property Map


Xstrata Copper
Bell / Granisle
2012 Seismic/IP Survey
Assessment Property Map
Date: 2013-01-20
Author: Ross Ward
Office: Exploration
Drawing:
Scale: 1:50000
Projection: UTM Zone 9 (NAD 83)
0
0.5
1
2
kilometres
Survey Lines
Granisle Survey Parcels
Tenures - Xstrata
Tenures - Copper Point
Tenures - Astorius
Tenures - Other
Tower
Watercourse
Transmission Line
Trail
Road
Limited Use Road
Contour
Bridge
Wetland
Waterbody
Waste / Tailings
Mining Area
Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
Line 7
Line 8
Line 9
Line 10
Babine Lake
Hagan Arm
Newman Peninsula
Newman Island
McDonald Island
Sterrett Island
675,000 mE
676,000 mE
677,000 mE
678,000 mE
679,000 mE
680,000 mE
681,000 mE
682,000 mE
683,000 mE
684,000 mE
6,101,000 mN
6,100,000 mN
6,099,000 mN
6,098,000 mN
6,097,000 mN
6,096,000 mN
6,095,000 mN
6,093,000 mN
6,092,000 mN
6,091,000 mN
704,740
807,482
836,013
836,016
836,231
244,224
836,021
243,488
836,236
844,708
836,145
836,146
243,487
857,339
812,062
929,260
704,705
857,338
704,706
704,727
704,751
704,707
777,542
864,487
704,708
842,902
929,252
704,709
844,700
704,746
929,251
704,747