mgm ENERGY

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April 29, 2015

Inuvialuit Water Board
PO Box 2531
Suite 302, 125 Mackenzie Road
Inuvik, Northwest Territories
X0E 0T0

Attention: Dr. Bijaya Adhikari, Science and Regulatory Coordinator

Re: April 17, 2015 Correspondence Water Licence N7L1-1797

Dr. Adhikari,

MGM Energy ("MGM") has reviewed the April 17, 2015 correspondence sent by the Inuvialuit Water Board regarding Water Licence N7L1-1797 and submits the information below and enclosed as a response.

Thermistor Measurement data was not collected during the 2014 season due to timeframe lapsing and the stable results. From the 2012 annual report, "*Ground temperature and active-layer depth monitoring has not indicated a concern with the sump since the monitoring program began in 2004. The internal thermal regime of the sump, up to when the monitoring stopped in 2009 due to the damaged thermistors, showed a stable and frozen core.*" In regards to the observations of the salinity migration obtained by using electromagnetic induction please see the enclosed report.

If you have any questions regarding the above or enclosed please do not hesitate to contact the undersigned via e-mail at terence.hughes@paramountres.com or via phone at 403-206-3859.

Respectfully,
MGM Energy

Terence Hughes

Terence Hughes
Regulatory and Community Affairs Representative

ENCL.

WorleyParsons

resources & energy

EcoNomics

MGM ENERGY CORP.

2014 Geophysical Investigation Using EM, ERT, and GPR

Umiak N16 Sump

307074-01996-200 – GP-REP-0001

23 January 2015

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WorleyParsons

resources & energy

MGM ENERGY CORP.

2014 GEOPHYSICAL INVESTIGATION USING EM, ERT, AND GPR

UMIAK N16 SUMP

PROJECT 307074-01996-200 - 2014 GEOPHYSICAL INVESTIGATION USING EM, ERT, AND GPR							
REV	DESCRIPTION	ORIG	REVIEW	WORLEY - PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issued as final	LW L. Woods	LP L. Pankratow	KH K. Hume	23-Jan-15		

EcoNomics

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Any questions concerning the information or its interpretation should be directed to Landon Woods or Laurie Pankratow.

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1. INTRODUCTION

WorleyParsons Canada Services Ltd. (WorleyParsons) was retained by MGM Energy Corp. (MGM) to conduct a geophysical investigation at the Umiak N16 sump (the 'Site'), located approximately 115 kilometres (km) north of Inuvik, Northwest Territories (Figure 1). Photo 1 is an aerial shot of the Site facing approximately north. Photo 2 was taken from the western portion of the sump, facing approximately southeast.

There were two main objectives of the geophysical investigation at the Site. The first objective was to laterally delineate zones of elevated terrain conductivity using electromagnetic methods (EM31 and EM38), and image the approximate thickness of these zones of elevated terrain conductivity using electrical resistivity tomography (ERT). Elevated terrain conductivity values can be anthropogenic or naturally occurring, and may be caused by high clay content, groundwater with high total dissolved solids (TDS), and/or elevated concentrations of inorganic constituents (i.e. salts). The second objective was to determine the sump cap thickness and the active layer thickness at the Site using ground penetrating radar (GPR) in conjunction with the ERT results. Previous EM terrain conductivity surveys conducted at the site were completed in August 2011 (KiNiLau 2011) and September 2013 (WorleyParsons 2013). ERT01 was also collected at the Site by WorleyParsons in 2013 (WorleyParsons 2013).

2. GEOPHYSICAL FIELD SURVEY

The geophysical investigation was conducted between July 28 and August 1, 2014. It should be noted that work was conducted at other sites between those dates. Terrain conductivity data were collected approximately every metre (m) using the EM31 and EM38MK2 terrain conductivity instruments in the vertical dipole mode. EM38 survey paths are approximately 5 m apart, and EM31 survey line paths are 5 m to 15 m apart. The EM38MK2 instrument utilized during this program collects data using two coil spacings. The EM38 1 m coil spacing has a depth of investigation of approximately 1.5 metres below ground surface (mbgs), with a peak response coming from a depth of 0.4 mbgs. The EM38 0.5 m coil spacing has a depth of investigation of approximately 0.75 mbgs, with a peak response coming from a depth of approximately 0.2 mbgs. The EM31 instrument has a maximum depth of investigation of 6 mbgs, with a peak response at 1.5 mbgs. Detailed explanations of EM38 and EM31 methodology can be found in Appendix 1.

One ERT line was collected at the Site in 2014 on an approximately northwest to southeast trend (ERT02). Survey parameters included a minimum 1 m electrode spacing utilizing the Wenner array, resulting in a maximum depth of investigation of approximately 10 mbgs. The purpose of the ERT surveys was to vertically delineate changes in conductivity as identified in EM data on, and in direct proximity to the Umiak N16 sump. The Wenner electrode array was used in order to be consistent with the 2013 WorleyParsons data (WorleyParsons 2013). A detailed explanation of ERT methodology can be found in Appendix 1.

Multiple GPR survey lines were collected at the Site using the Sensors and Software pulseEKKO PRO system in free-run mode, and 200 MHz frequency antennas. The transmitter and receiver were fixed to a plastic skid, and towed by hand. The majority of the survey lines are spaced 3 m to 4 m apart, and were collected in a grid pattern over the sump.

In addition to the geophysical surveys conducted at the Site, nine frost probe measurements were taken in order to determine the depth to the bottom of the active layer. These measurements were taken primarily to ground-truth the GPR data.

Positional survey control was provided using a Trimble GeoExplorer 6000 GeoXH global positioning system (GPS). GPS coordinates were referenced to the 1983 North American Datum (NAD83), and projected to the Universal Transverse Mercator (UTM) Zone 8 North coordinate system.

3. GEOPHYSICAL RESULTS AND INTERPRETATION

3.1 Overview

EM38 and EM31 data are displayed as coloured grids in which cool to warm colours (blues to pinks) correspond with low to high terrain conductivity values, respectively. The EM38 and EM31 grids also have been annotated with relevant site features observed while surveying (i.e. approximate sump edge, observed cracks in the ground, etc.). To be consistent with previous data, the EM38 data are displayed at the same colour scale as the 2013 results (WorleyParsons 2013). EM in-phase response data were collected, but did not provide significant results to add to the geophysical interpretation; therefore, the results have not been included in this report. EM results can be found in Figures 2 through 4. ERT data are also displayed such that cool colours (blues) are associated with low conductivity, and warm colours (pinks) are associated with high conductivity values. ERT data collected in 2014 (ERT02) are displayed at the same colour scale as the 2013 ERT data so as to be consistent. EM profiles along the ERT survey line are included on ERT02 (Figure 5). GPR data were processed to produce horizontal time-slices of the squared amplitude with depth at two different constant radar velocities (active layer and cap material velocities). GPR time-slices with the interpreted active layer and sump cap material radar velocities are displayed in Figures 6 through 8, and Figure 9, respectively. Two example radargrams (processed two dimensional [2D] GPR cross-sections) are shown in Appendix 2.

3.2 EM38 and EM31 Terrain Conductivity Results

The EM31 terrain conductivity results are displayed in Figure 2. Background EM31 terrain conductivity values at the Site are considered to be less than 2 millisiemens per metre (mS/m; dark to light blue colours). Multiple zones of elevated EM31 terrain conductivity values (greater than 5 mS/m; light orange to pink colours) are delineated on and around the sump, and south of the sump. Zone A exceeds 20 mS/m, while all other elevated EM31 terrain conductivity zones are less than 15 mS/m. These elevated EM31 terrain conductivity zones have been denoted by a dashed purple line. Similar areas of elevated EM31 terrain conductivity are visible in the 2011 KiNiLau EM31 data (Appendix 3).

The EM38 0.5 m coil spacing terrain conductivity data are displayed in Figure 3, and background values are considered to be less than 6 mS/m (dark blue to light blue colours) at the Site. Multiple zones of elevated EM38 0.5 m coil terrain conductivity (greater than 12 mS/m; orange to pink colours) are shown on Figure 3, and have been denoted by a dashed purple line. Many of these elevated EM38 0.5 m coil terrain conductivity zones overlap with similar values shown in the 2013 WorleyParsons and 2011 KiNiLau EM38 data (Appendix 3). Portions of the elevated EM38 0.5 m coil terrain conductivity Zones B and C have values exceeding 75 mS/m. EM38 0.5 m coil Zone B overlaps with EM31 Zone A.

EM38 1.0 m coil spacing terrain conductivity data are displayed in Figure 4. Background values are similar to the EM38 0.5 m coil spacing (less than 6 mS/m; dark blue to light blue colours). Multiple zones of elevated EM38 1.0 m coil terrain conductivity (greater than 12 mS/m; yellow to pink colours), have been denoted by a dashed purple line. The majority of these elevated conductivity zones overlap with EM38 0.5 m coil spacing elevated zones. Similar to the EM38 0.5 m coil spacing data, Zones B and C exhibit values that exceed 75 mS/m.

3.3 ERT Results

ERT02 (Figure 5) was collected on a northwest to southeast trend, and is approximately 120 m long. Photo 3 was taken from approximately 40 m along the survey line, facing approximately southeast. Several laterally continuous, slightly elevated conductivity zones (greater than 10 mS/m; pink colours) are imaged in the ERT data. These zones correlate with elevated EM31 and EM38 terrain conductivity values and profiles. ERT conductivity values within Zone 2 exceed 40 mS/m, while conductivities within Zones 1 and 3 reach up to 20 mS/m. This ERT line location was chosen based on the 2013 WorleyParsons EM38 data.

3.4 GPR Results

GPR time-slice grids, created for active layer analysis, are shown in Figures 6 through 8. Figures 6 and 7 show GPR time-slices 1 through 6, and 7 through 12, respectively. A constant radar velocity of 0.05 metres per nanosecond (m/ns) was chosen as calibrated to the nine frost probe measurements (black 'X' symbols) taken at the Site. Overlaid on the GPR time-slices are visible polygon cracks observed at the site (dotted black line), interpreted polygon cracks based on the 2D radargrams (inverted red triangles), and the interpreted sump edge based on the 2D radargrams (grey circle symbols). The outline of the sump is easily identified in GPR time-slices 3 through 5, and still evident in GPR time-slices 6 and 7.

GPR time-slice 3 is displayed in Figure 8 because it appears to show the best correlation between the squared amplitude (GPR time-slice values), interpretations from the 2D radargrams (sump edge, interpreted polygon cracks), and visual observations from the site (observed sump edge, observed polygon cracks). A thick purple line has been plotted on Figure 8 to denote interpreted polygon cracks. This interpretation is primarily based on GPR time-slice 3 (0.29 m to 0.57 m depth) and the corresponding interpreted polygon cracks derived from the 2D radargram data. The interpretation correlates well with the observed polygon cracks at the site, and the interpretation (purple line) has been biased towards these observed cracks where appropriate. Interpreted polygon crack depths are posted above the inverted red triangles. These depths were derived from the 2D radargrams, using a radar velocity of 0.05 m/ns (interpreted active layer velocity), and range between approximately 0.36 m and 0.75 m (minimum and maximum) with a mean depth of 0.53 m. The mean depth of the cracks, as measured from the GPR results, is similar to the mean depth of the frost probe measurements (0.45 m). Several polygon cracks are in very close proximity to the sump, particularly on the northern side.

Figure 9 displays GPR time-slices 1 to 6 at a radar velocity of 0.07 m/ns, which is interpreted to be the velocity of the sump cap material. A small intrusive investigation (maximum 0.3 m) on the cap revealed a sandy material. The change in squared amplitude between GPR time-slices 4 and 5 appears to show the transition from the bottom of the sump cap to the sump material. It is interpreted that the sump cap is approximately 0.7 m to 1 m thick as based on the GPR time-slice depth ranges, and analysis of the 2D radargrams.

An example of the 2D interpretation can be seen on APP2-1 (Appendix 2), which shows two radargrams with the interpreted sump cap bottom denoted with a dashed red line. An example of the active layer bottom and polygon crack interpretation on a 2D radargram is also shown on APP2-1. It should be noted that the depths of the displayed radargrams are calculated with the interpreted radar velocity of the cap material (0.07 m/ns), which is faster than the interpreted active layer velocity of 0.05 m/ns. As a result, the interpreted bottom of the active layer plotted on the radargrams is shallower, and is to be used for visual reference only.

3.5 Geophysical Interpretation

A geophysical interpretation map with topographic relief is provided in Figure 10. Zones A, B, and C of elevated EM38, EM31, and ERT values are denoted on Figure 10. The topographic relief is derived from GPR survey line elevations, and is meant for relative topographic changes, not for absolute elevation values. Interpreted polygon cracks based on the GPR data are also plotted on Figure 10.

Broader zones of EM38 0.5 m coil spacing elevated terrain conductivity values are observed in the southern portion of the Site, south of the annotated ridgeline. Smaller zones of EM38 0.5 m coil spacing terrain conductivity are shown primarily on the southern and northern boundaries of the sump. The same is true for the EM38 1.0 m coil spacing elevated terrain conductivity zones, but overall the zones are generally smaller in area. These elevated EM38 terrain conductivity zones are potentially associated with inorganic impacts (salts). Zones B and C are very likely associated with inorganic impacts (salts), as the EM38 terrain values exceed 75 mS/m within these zones. Generally, the elevated EM31 terrain conductivity zones are located in similar locations to the EM38 zones of elevated terrain conductivity. One exception is the broad EM31 terrain conductivity zone located on the sump; this anomaly is likely associated with sump materials. ERT02 has delineated several zones of elevated ERT electrical conductivity; these zones correlate with the elevated EM38 terrain conductivity profiles. These zones of elevated conductivity along ERT02 are potentially associated with inorganic impact (salts). Table A, with approximate combined surface areas of elevated terrain conductivity, is shown below.

Table A Surface areas of Elevated EM31 and EM38 terrain conductivity

Instrument	Elevated Terrain Conductivity Values	Combined Surface Area (m^2)
EM31	Greater than 5 mS/m	3,208
EM38 0.5 m coil	Greater than 15 mS/m	7,672
EM38 1.0 m coil	Greater than 12 mS/m	3,528

Many of the interpreted polygon cracks from the GPR data have associated elevated EM anomalies, potentially due to many of the cracks being filled with water with elevated total dissolved solids (TDS). These polygon cracks could potentially become preferential pathways for salt impacted water.

Generally, the polygon crack depths are interpreted to be similar to the thickness of the active layer between 0.36 and 0.75 m deep, with a mean depth of 0.53 m. The cap material is approximately 0.7 to 1 m thick, and thins towards the edges. The waste material is interpreted as being frozen based on fast reflections at the base of the sump material indicating highly resistive (i.e. frozen) material.

A qualitative comparison of the WorleyParsons 2014 and 2013 EM38 data (See Appendix 3) shows that, in general terms, the 2013 elevated terrain conductivity zones cover a significantly larger area than the delineated 2014 elevated terrain conductivity zones.

4. CONCLUSIONS

The 2014 geophysical investigation at the Umiak N16 sump has led to the following conclusions:

a) Background EM31 and EM38 terrain conductivity values are observed to be less than 2 mS/m, and 6 mS/m, respectively. Elevated EM31 and EM38 terrain conductivity values are interpreted to be greater than 5 mS/m and 15 mS/m, respectively. Permafrost is considered to have a conductivity of 0 mS/m.

b) Elevated EM38 terrain conductivity values are located south of the ridgeline, and on the north and south sides of the sump, with the EM38 0.5 m coil spacing elevated terrain conductivity covering a larger area. Elevated EM31 terrain conductivity values are located in similar areas to the EM38 anomalies, with the exception of the broad EM31 anomaly on the sump itself. Zones A, B, and C are of particular interest due to EM38 (A and B) and EM31 (C) terrain conductivity values exceeding 75 mS/m and 20 mS/m, respectively. Table A provides a summary of the combined surface areas of elevated terrain conductivity for the 2014 EM31 and EM38 data.

c) The 2013 WorleyParsons EM38 results show elevated terrain conductivity zones over a significantly larger combined area than does the 2014 EM38 results. The general locations of the 2014 EM38 anomalies overlap with 2013 WorleyParsons EM38 anomalies.

d) Zones of elevated ERT conductivity values are interpreted to be greater than 10 mS/m. The zones of elevated ERT conductivity values generally correlate with the EM profiles. ERT conductivity values in permafrost are essentially 0 mS/m.

e) GPR data have successfully delineated the edges of the sump cap. Combining GPR time-slices, interpretations from 2D radargrams, and field observations have helped to laterally delineate interpreted polygon cracks and approximate depths of cracks where a GPR survey line and crack intersect. The sump cap thickness was also successfully imaged using the GPR time-slices and 2D radargrams. The polygon cracks are estimated to be between 0.36 m and 0.75 m with a mean depth of 0.53 m. The cap material is approximately 0.7 m to 1 m thick, and thins towards the edges. The waste material is interpreted as being frozen based on fast reflections at the base of the sump material indicating highly resistive (i.e. frozen) material.

Potential future geophysics could include an ERT line, completed during the next monitoring event, through the long axis of the broad EM38 0.5 m coil spacing elevated terrain conductivity zone south of the ridgeline. Surface sampling of Zones A, B, and C is recommended to confirm the geophysical interpretation.

5. CLOSURE

We trust that this report satisfies your current requirements and provides suitable documentation for your records. If you have any questions or require further details, please contact the undersigned at any time at 403-247-0200.

Report Prepared by

PROFESSIONAL GEOSCIENTIST LANDON WOODS ALBERTA

23-Jan-2015

PERMIT TO PRACTICE
WORLEYPARSONS CANADA SERVICES LTD.
Signature
Date January 27, 2015
PERMIT NUMBER: P 029
NWT/NU Association of Professional Engineers and Geoscientists

Landon Woods, B.Sc. (Hons), P.Geo. (AB)
Staff Geoscientist

Senior Review by

REGISTERED PROFESSIONAL GEOSCIENTIST L.E PANKRATOW LICENSEE NT/NU

23-Jan-2015

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Core Services Manager, Geophysics

Jan. 23, 2015

Paul Bauman, M.Sc., P.Eng. (AB), P.Geoph. (AB)
Principal Geophysicist, Technical Director

Prairie Business Unit
Infrastructure & Environment
WorleyParsons Canada Services Ltd.

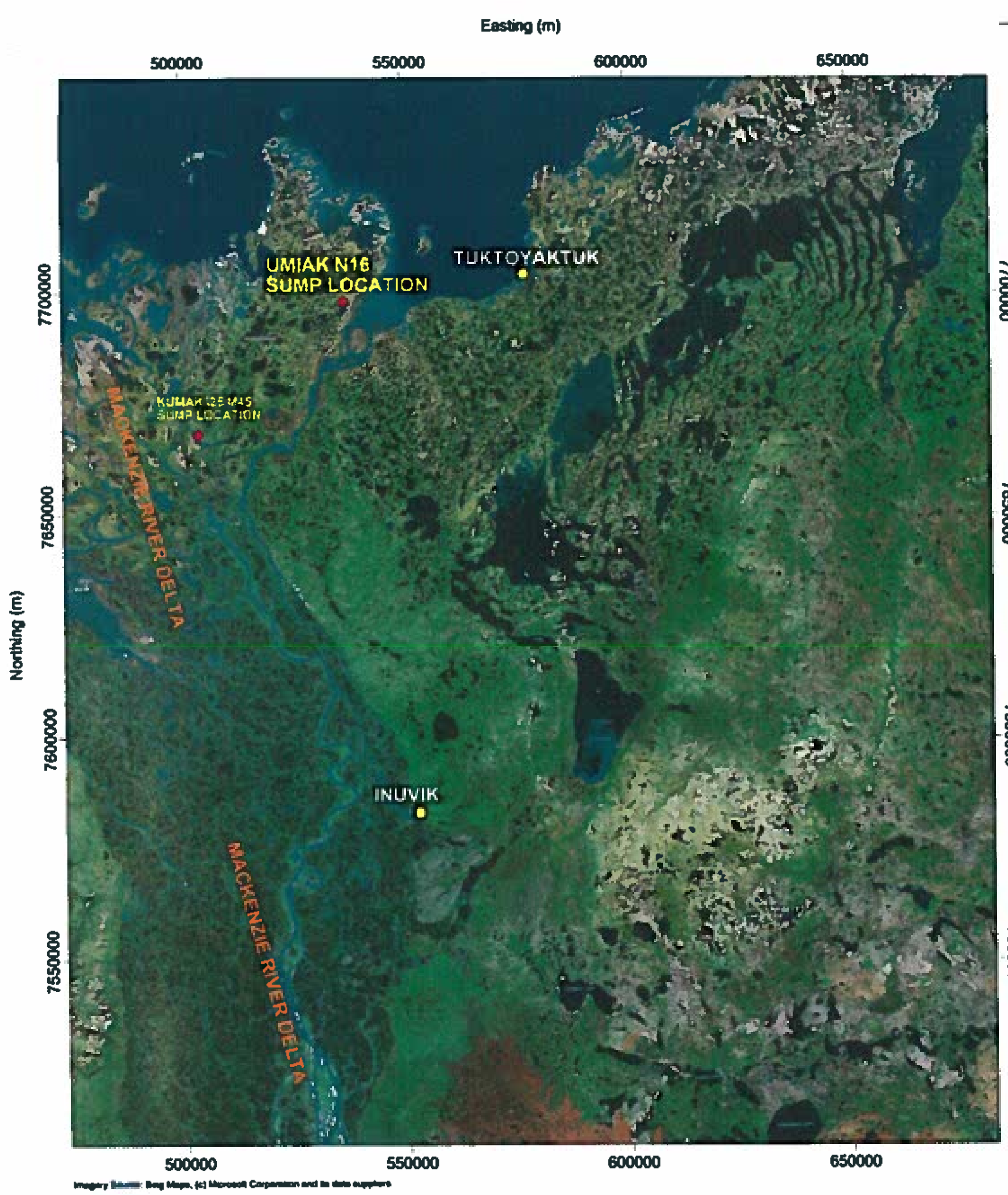
6. REFERENCES

KiNiLau (KiNiLau Physics Inc.). 2011.Umiak N-16 Sump, Lateral Conductivity Detail (EM31 & Aerial Underlay). Project 267, NH. August 23, 2011.

KiNiLau (KiNiLau Physics Inc.) 2011. Umiak N-16 Sump, Lateral Conductivity Detail (EM38 & Aerial Underlay). Project 267, NH. August 23, 2011.

WorleyParsons (WorleyParsons Canada Services Ltd.). 2013. 2013 Electromagnetic and Electrical Resistivity Tomography Geophysical Investigation. Umiak N-16 Sump. 307074-01865-200-GP-REP-0002. October 21, 2013.

Figures



Scale 1:1,000,000

(metres)

MGM ENERGY CORP
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 DRILL SUMP

SITE LOCATION MAP

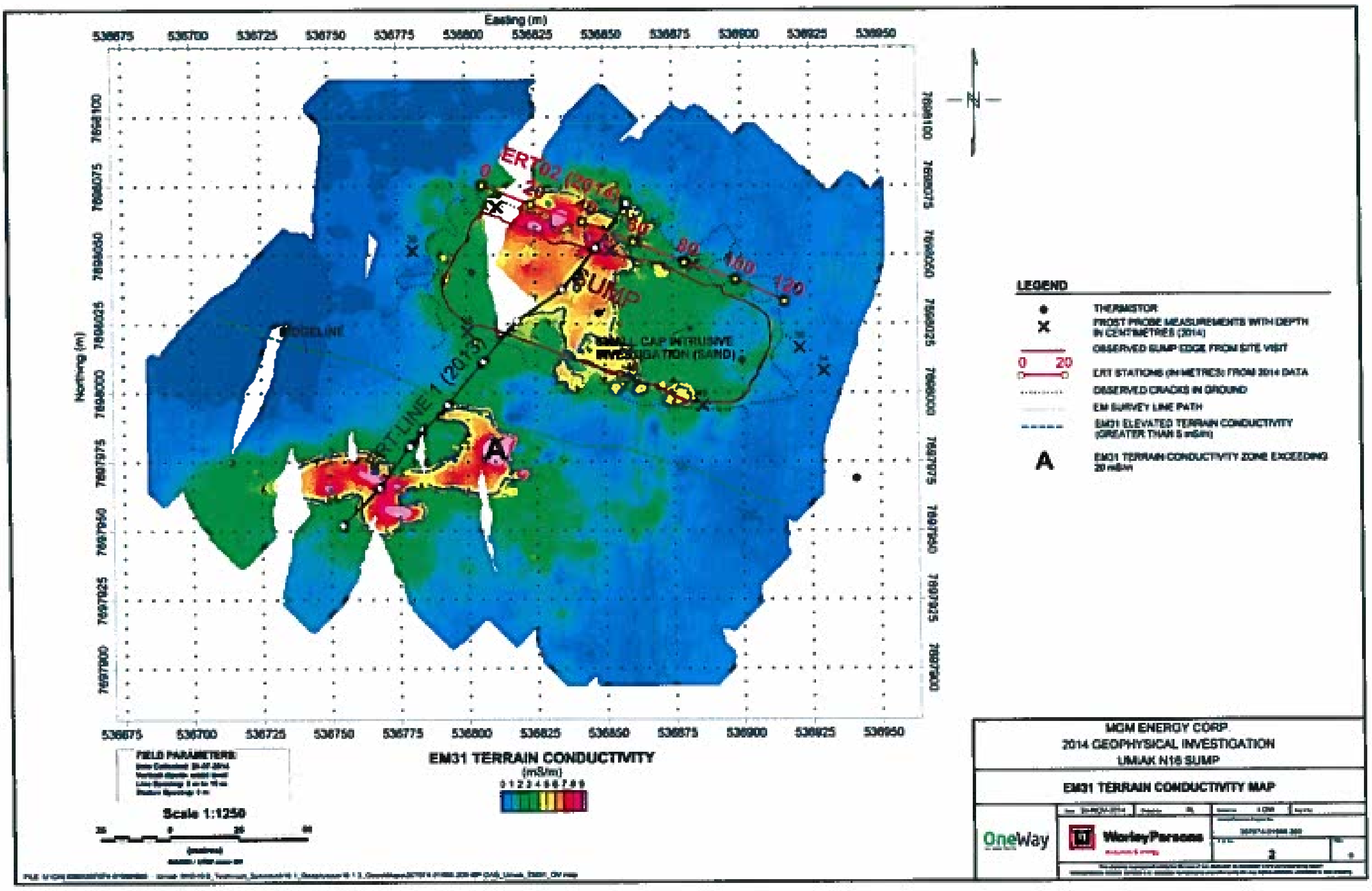
24-NOV-2014 LGW LGW

OneWay

WorleyParsons

307074-01998 200

1 A



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536725
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536775
536800
536825
536850
536875
536900
536925
536950
Northing (m)
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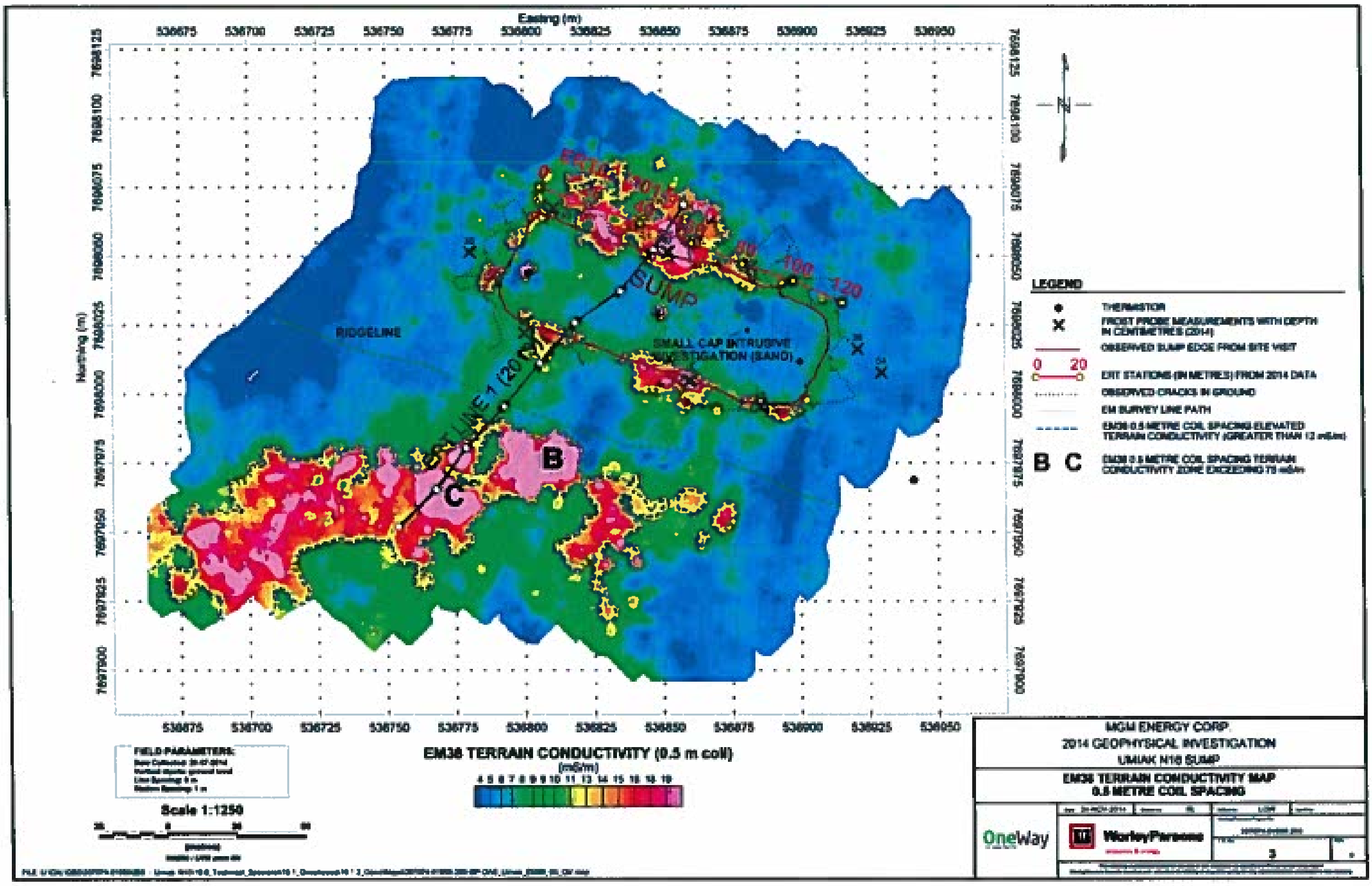
7698050
7698025
7698000
7697975
7697950
7697925
7697900
ERT02 (2014)
0
20
40
60
80
100
120
SUMP
SMALL CAP INTRUSIVE INVESTIGATION (SAND)
ERT LINE 1 (2013)
A
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
ERT STATIONS (IN METRES) FROM 2014 DATA
OBSERVED CRACKS IN GROUND
EM SURVEY LINE PATH
EM31 ELEVATED TERRAIN CONDUCTIVITY (GREATER THAN 5 mS/m)
EM31 TERRAIN CONDUCTIVITY ZONE EXCEEDING 20 mS/m
FIELD PARAMETERS:
EM31 TERRAIN CONDUCTIVITY
(mS/m)
0 1 2 3 4 5 6 7 8 9
Scale 1:1250
(metres)
MGM ENERGY CORP
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
EM31 TERRAIN CONDUCTIVITY MAP
OneWay
WorleyParsons
2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Northing (m)
RIDGELINE
SUMP
SMALL CAP INTRUSIVE INVESTIGATION (SAND)
B
C
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
ERT STATIONS (IN METRES) FROM 2014 DATA
OBSERVED CRACKS IN GROUND
EM SURVEY LINE PATH
EM38 TERRAIN CONDUCTIVITY (0.5 m coil)
(mS/m)
Scale 1:1250
FIELD PARAMETERS:
MGM ENERGY CORP.
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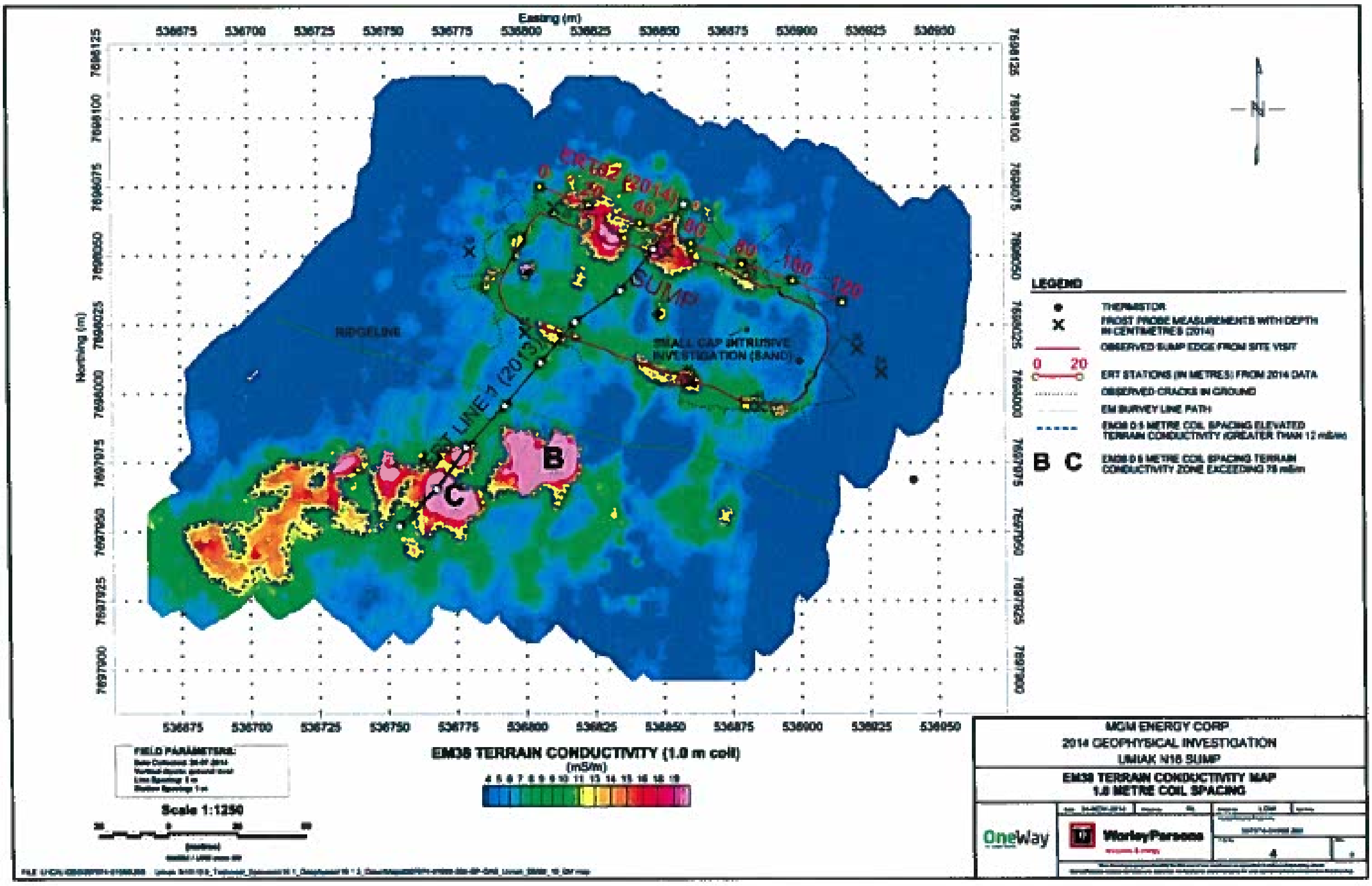
UMIAK N16 SUMP
EM38 TERRAIN CONDUCTIVITY MAP
0.5 METRE COIL SPACING
OneWay
WorleyParsons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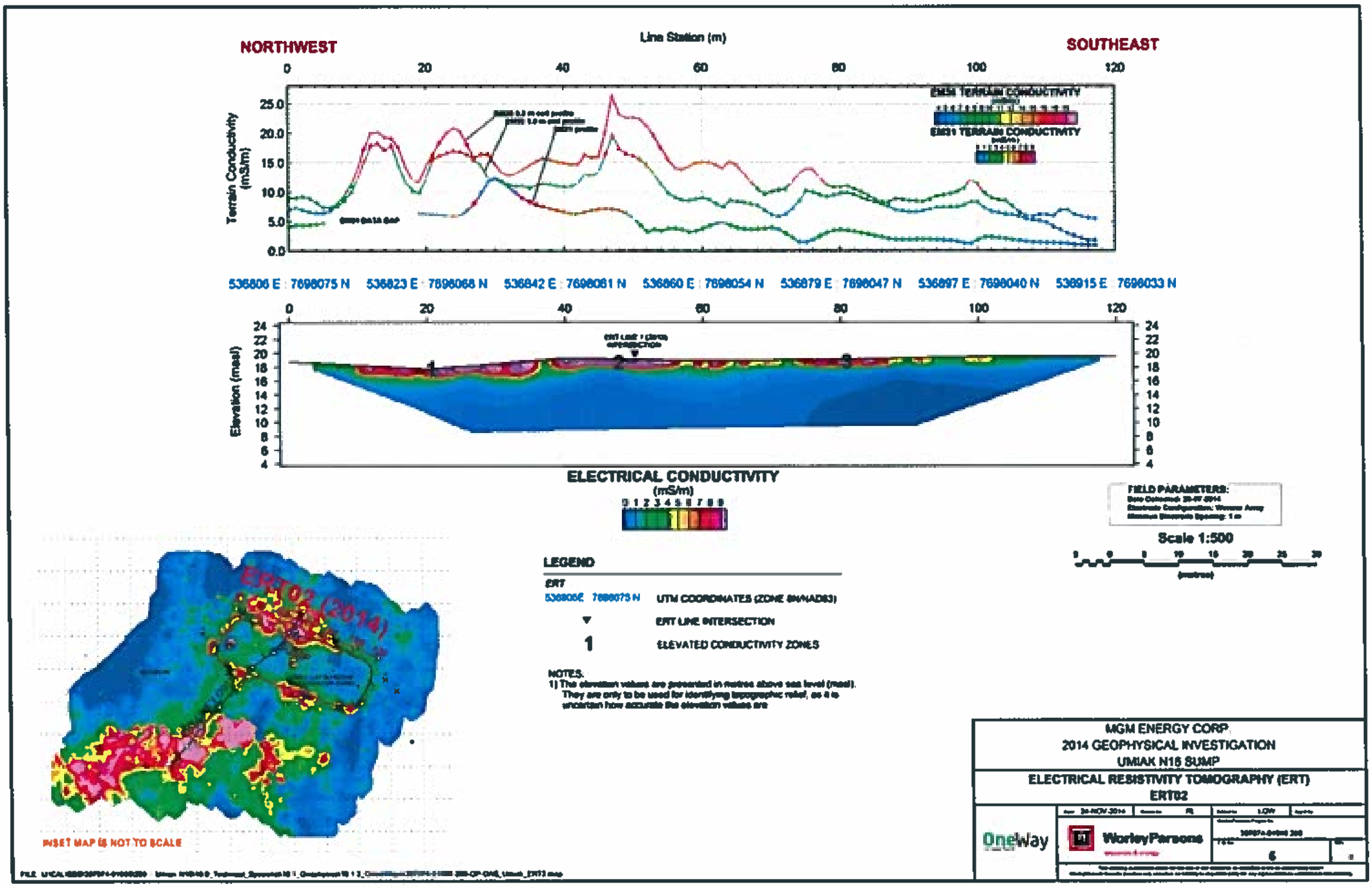
ERT02 (2014)
SUMP
RIDGELINE
SMALL CAP INTRUSIVE INVESTIGATION (SAND)
ERT LINE 1 (2013)
B
C
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
ERT STATIONS (IN METRES) FROM 2014 DATA
OBSERVED CRACKS IN GROUND
EM SURVEY LINE PATH
EM38 0.5 METRE COIL SPACING ELEVATED TERRAIN CONDUCTIVITY (GREATER THAN 12 mS/m)
EM38 0.5 METRE COIL SPACING TERRAIN CONDUCTIVITY ZONE EXCEEDING 75 mS/m
FIELD PARAMETERS:
EM38 TERRAIN CONDUCTIVITY (1.0 m coil)
(mS/m)
Scale 1:1250
MGM ENERGY CORP
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
EM38 TERRAIN CONDUCTIVITY MAP
1.0 METRE COIL SPACING
OneWay
WorleyParsons
4


NORTHWEST
Line Station (m)
SOUTHEAST
Terrain Conductivity (mS/m)
EM31 TERRAIN CONDUCTIVITY
EM31 DATA GAP
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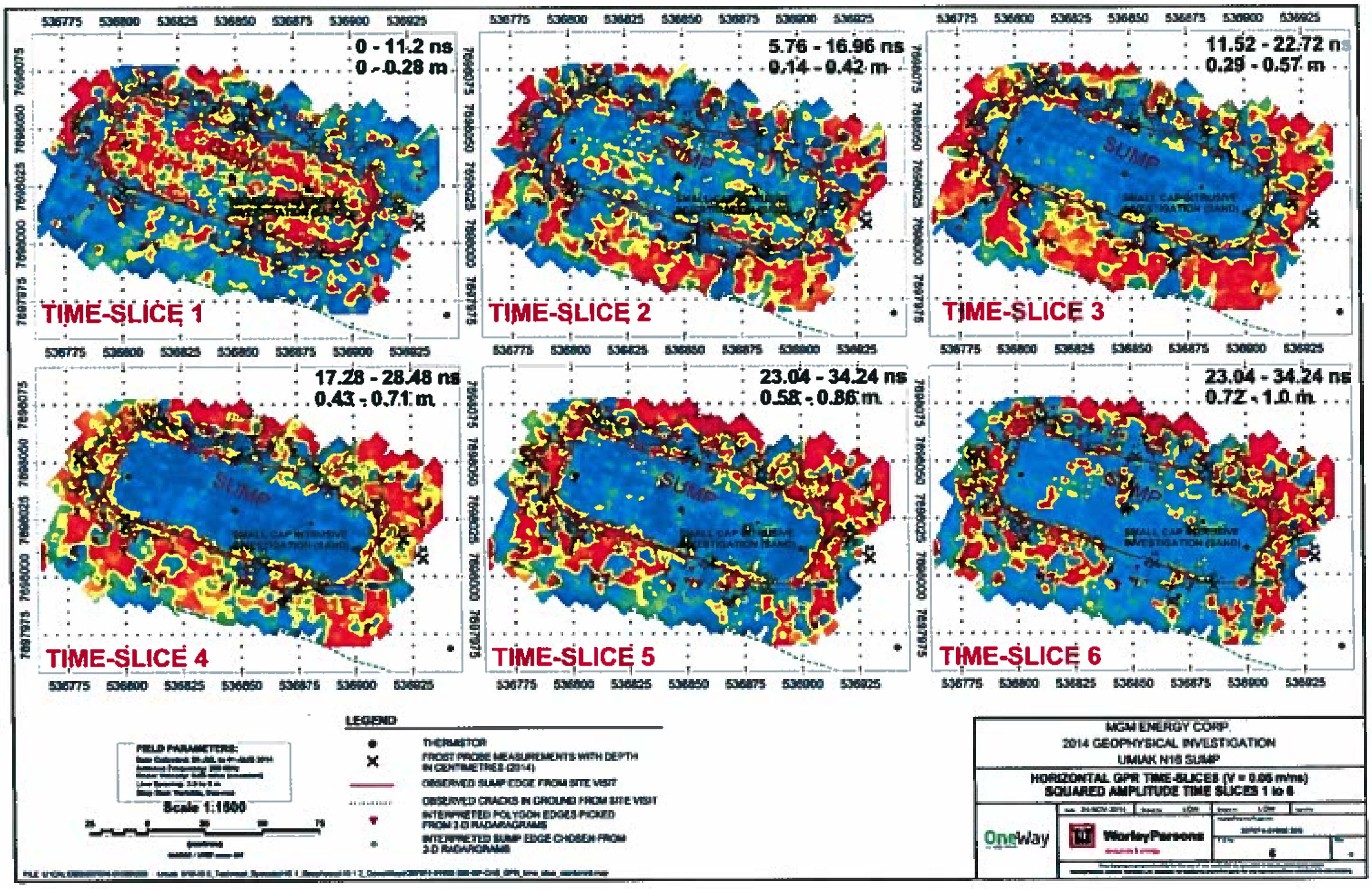
Elevation (masl)
ELECTRICAL CONDUCTIVITY
(mS/m)
FIELD PARAMETERS:
Scale 1:500
LEGEND
ERT
536806E 7698075 N UTM COORDINATES (ZONE 8N/NAD83)
ERT LINE INTERSECTION
1 ELEVATED CONDUCTIVITY ZONES
NOTES
1) The elevation values are presented in metres above sea level (masl). They are only to be used for identifying topographic relief, as it is uncertain how accurate the elevation values are
ERT02 (2014)
INSET MAP IS NOT TO SCALE
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
ELECTRICAL RESISTIVITY TOMOGRAPHY (ERT)
ERT02
OneWay
WorleyParsons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TIME-SLICE 3
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23.04 - 34.24 ns
0.72 - 1.0 m
SUMP
TIME-SLICE 6
536775 536800 536825 536850 536875 536900 536925
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
OBSERVED CRACKS IN GROUND FROM SITE VISIT
INTERPRETED POLYGON EDGES PICKED FROM 3-D RADARGRAMS
INTERPRETED SUMP EDGE CHOSEN FROM 3-D RADARGRAMS
FIELD PARAMETERS:
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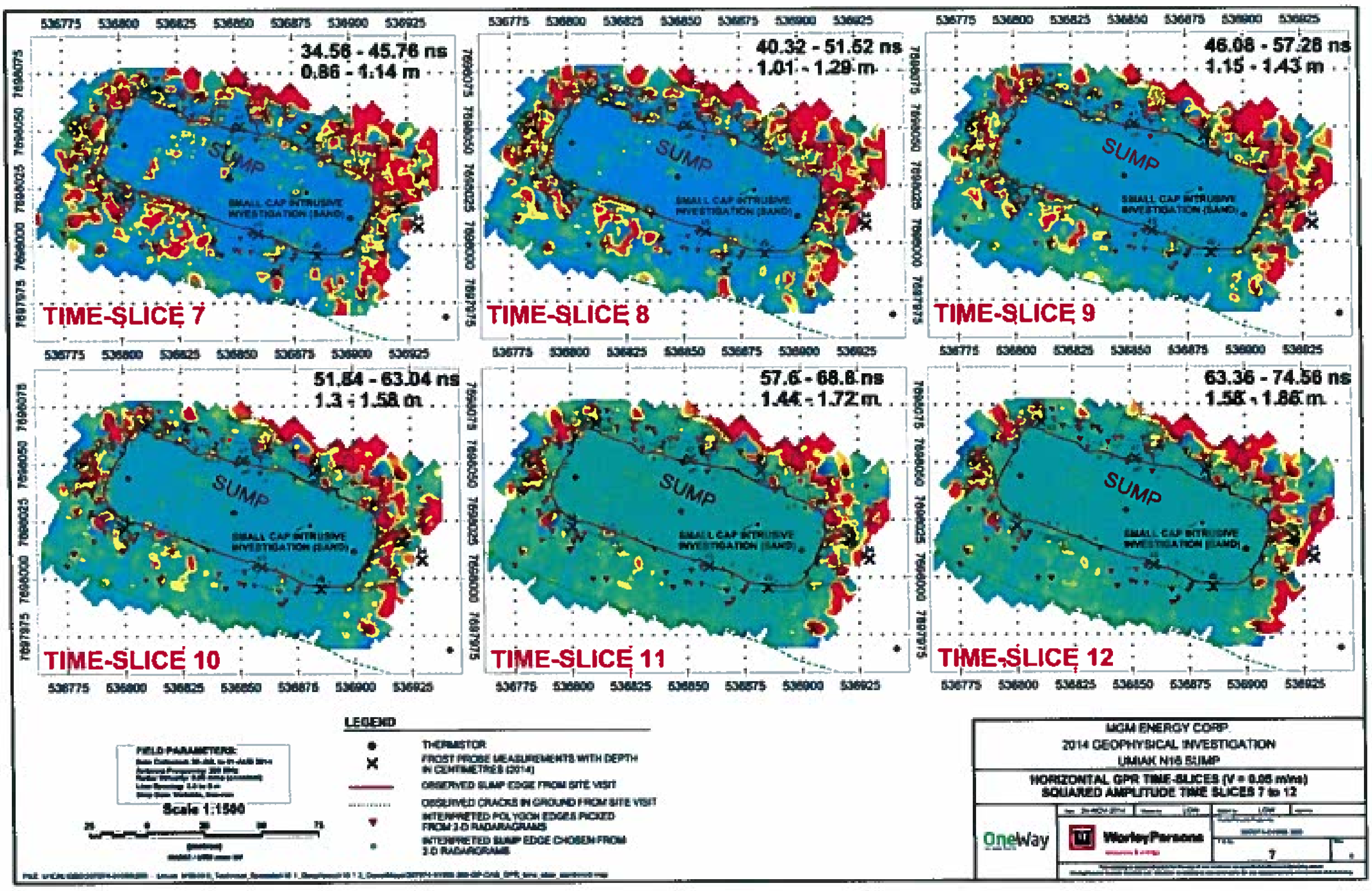
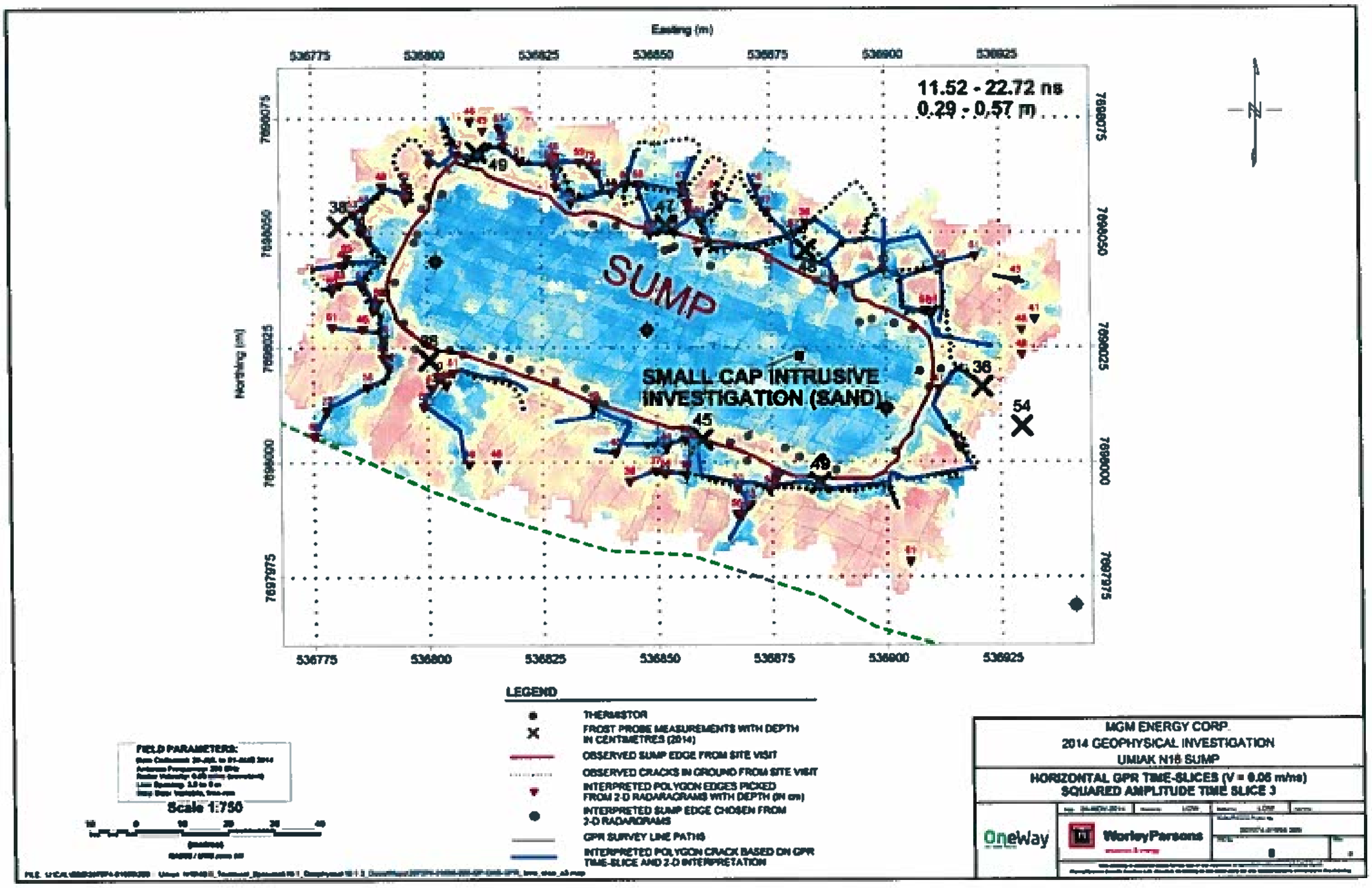
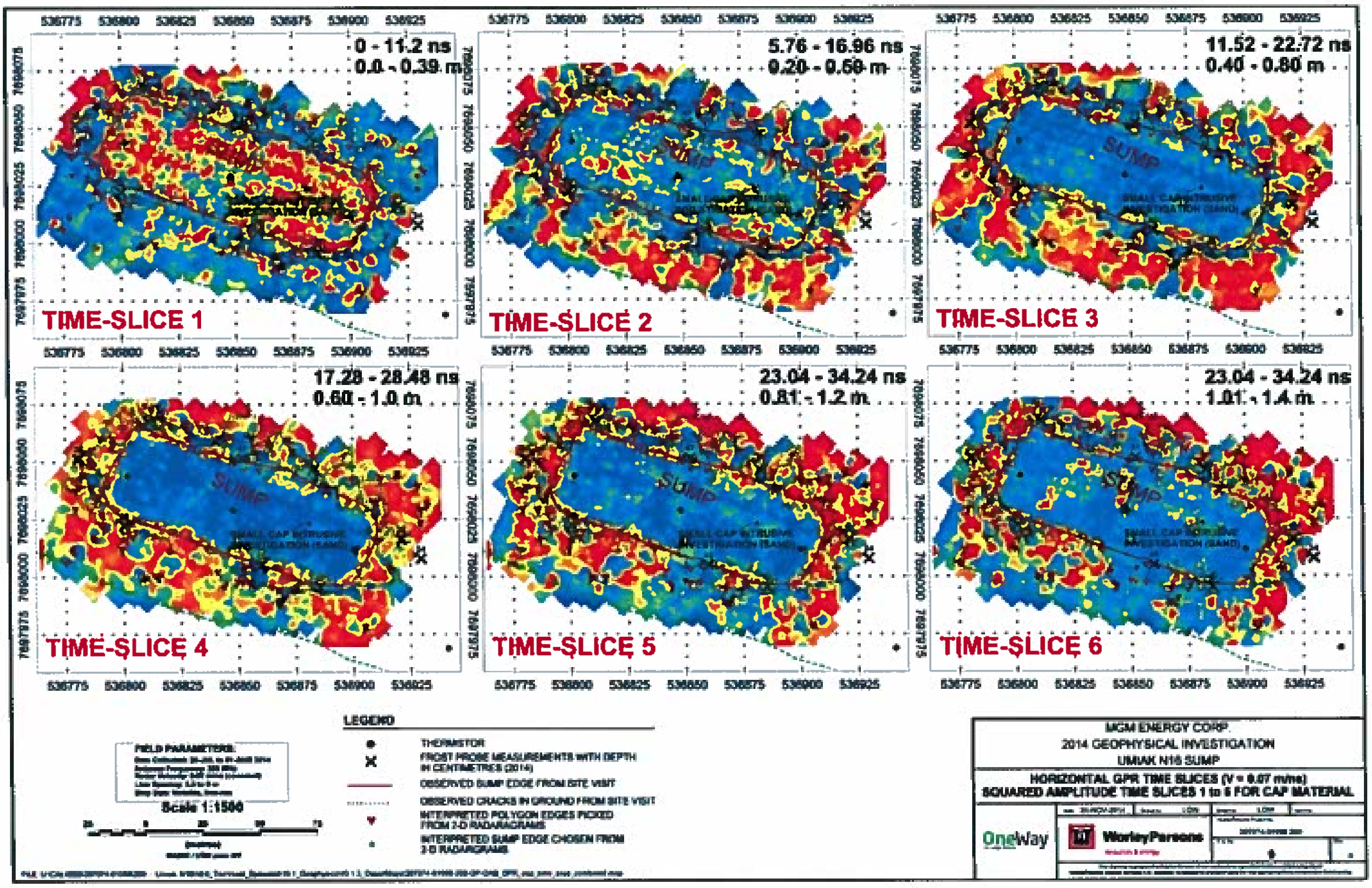
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
HORIZONTAL GPR TIME-SLICES (V = 0.05 m/ns)
SQUARED AMPLITUDE TIME SLICES 1 to 6
OneWay
WorleyParsons

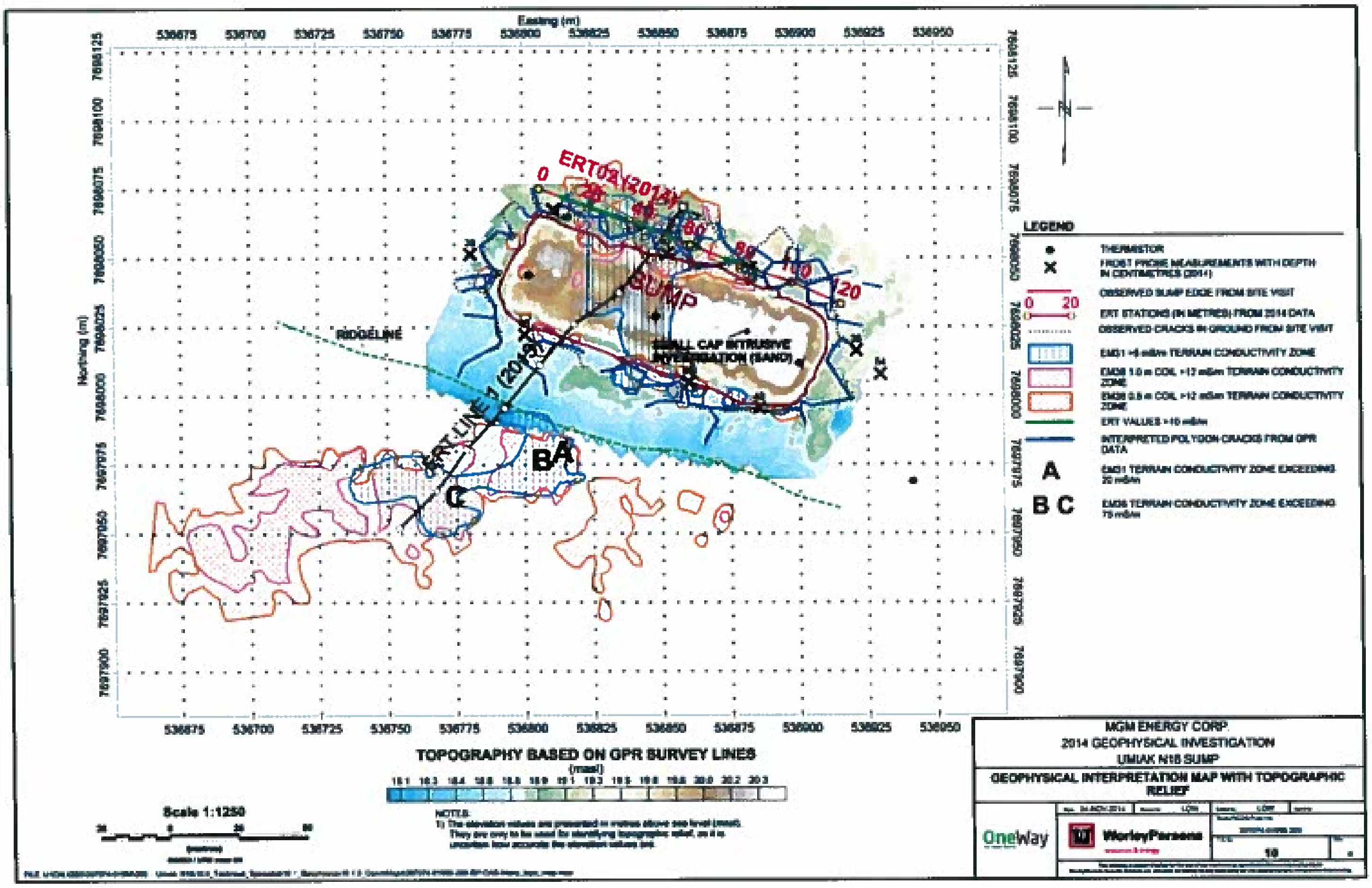


34.56 - 45.76 ns
0.86 - 1.14 m
SUMP
SMALL CAP INTRUSIVE INVESTIGATION (SAND)
TIME-SLICE 7
40.32 - 51.52 ns
1.01 - 1.29 m
TIME-SLICE 8
46.08 - 57.28 ns
1.15 - 1.43 m
TIME-SLICE 9
51.84 - 63.04 ns
1.3 - 1.58 m
TIME-SLICE 10
57.6 - 68.8 ns
1.44 - 1.72 m
TIME-SLICE 11
63.36 - 74.56 ns
1.58 - 1.86 m
TIME-SLICE 12
536775
536800
536825
536850
536875
536900
536925
7698075
7698050
7698025
7698000
7697975
FIELD PARAMETERS:
Scale 1:1500
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
OBSERVED CRACKS IN GROUND FROM SITE VISIT
INTERPRETED POLYGON EDGES PICKED FROM 2-D RADARGRAMS
INTERPRETED SUMP EDGE CHOSEN FROM 2-D RADARGRAMS
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
HORIZONTAL GPR TIME-SLICES (V = 0.05 m/ns)
SQUARED AMPLITUDE TIME SLICES 7 to 12
OneWay
WorleyParsons
7


Easting (m)
536775
536800
536825
536850
536875
536900
536925
Northing (m)
7698075
7698050
7698025
7698000
7697975
11.52 - 22.72 ns
0.29 - 0.57 m
SUMP
SMALL CAP INTRUSIVE INVESTIGATION (SAND)
38
49
47
45
66
45
49
36
54
FIELD PARAMETERS:
Scale 1:750
(metres)
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
OBSERVED CRACKS IN GROUND FROM SITE VISIT
INTERPRETED POLYGON EDGES PICKED FROM 2-D RADARAGRAMS WITH DEPTH (IN cm)
INTERPRETED SUMP EDGE CHOSEN FROM 2-D RADARGRAMS
GPR SURVEY LINE PATHS
INTERPRETED POLYGON CRACK BASED ON GPR TIME-SLICE AND 2-D INTERPRETATION
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
HORIZONTAL GPR TIME-SLICES (V = 0.06 m/ns)
SQUARED AMPLITUDE TIME SLICE 3
OneWay
WorleyParsons



0 - 11.2 ns
0.0 - 0.39 m
TIME-SLICE 1
5.76 - 16.96 ns
0.20 - 0.60 m
TIME-SLICE 2
11.52 - 22.72 ns
0.40 - 0.80 m
TIME-SLICE 3
17.28 - 28.48 ns
0.60 - 1.0 m
TIME-SLICE 4
23.04 - 34.24 ns
0.81 - 1.2 m
TIME-SLICE 5
23.04 - 34.24 ns
1.01 - 1.4 m
TIME-SLICE 6
SUMP
536775
536800
536825
536850
536875
536900
536925
Scale 1:1500
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
OBSERVED CRACKS IN GROUND FROM SITE VISIT
INTERPRETED POLYGON EDGES PICKED FROM 2-D RADARGRAMS
INTERPRETED SUMP EDGE CHOSEN FROM 2-D RADARGRAMS
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
HORIZONTAL GPR TIME SLICES (V = 0.07 m/ns)
SQUARED AMPLITUDE TIME SLICES 1 to 6 FOR CAP MATERIAL
OneWay
WorleyParsons



Easting (m)
536675
536700
536725
536750
536775
536800
536825
536850
536875
536900
536925
536950
Northing (m)
7698125
7698100
7698075
7698050
7698025
7698000
7697975
7697950
7697925
7697900
ERT02A (2012)
SUMP
RIDGELINE
SMALL CAP INTRUSIVE INVESTIGATION (SAND)
ERT LINE 1 (2013)
A
B
C
LEGEND
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED SUMP EDGE FROM SITE VISIT
ERT STATIONS (IN METRES) FROM 2014 DATA
OBSERVED CRACKS IN GROUND FROM SITE VISIT
EM31 >6 mS/m TERRAIN CONDUCTIVITY ZONE
EM38 1.0 m COIL >12 mS/m TERRAIN CONDUCTIVITY ZONE
EM38 0.5 m COIL >12 mS/m TERRAIN CONDUCTIVITY ZONE
ERT VALUES >10 mS/m
INTERPRETED POLYGON CRACKS FROM GPR DATA
EM31 TERRAIN CONDUCTIVITY ZONE EXCEEDING 20 mS/m
EM38 TERRAIN CONDUCTIVITY ZONE EXCEEDING 75 mS/m
TOPOGRAPHY BASED ON GPR SURVEY LINES
(masl)
Scale 1:1250
NOTES:
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
GEOPHYSICAL INTERPRETATION MAP WITH TOPOGRAPHIC RELIEF
OneWay
WorleyParsons
10

Photographs

WorleyParsons
resources & energy

MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION USING EM, ERT, AND GPR
UMIAK N16 SUMP

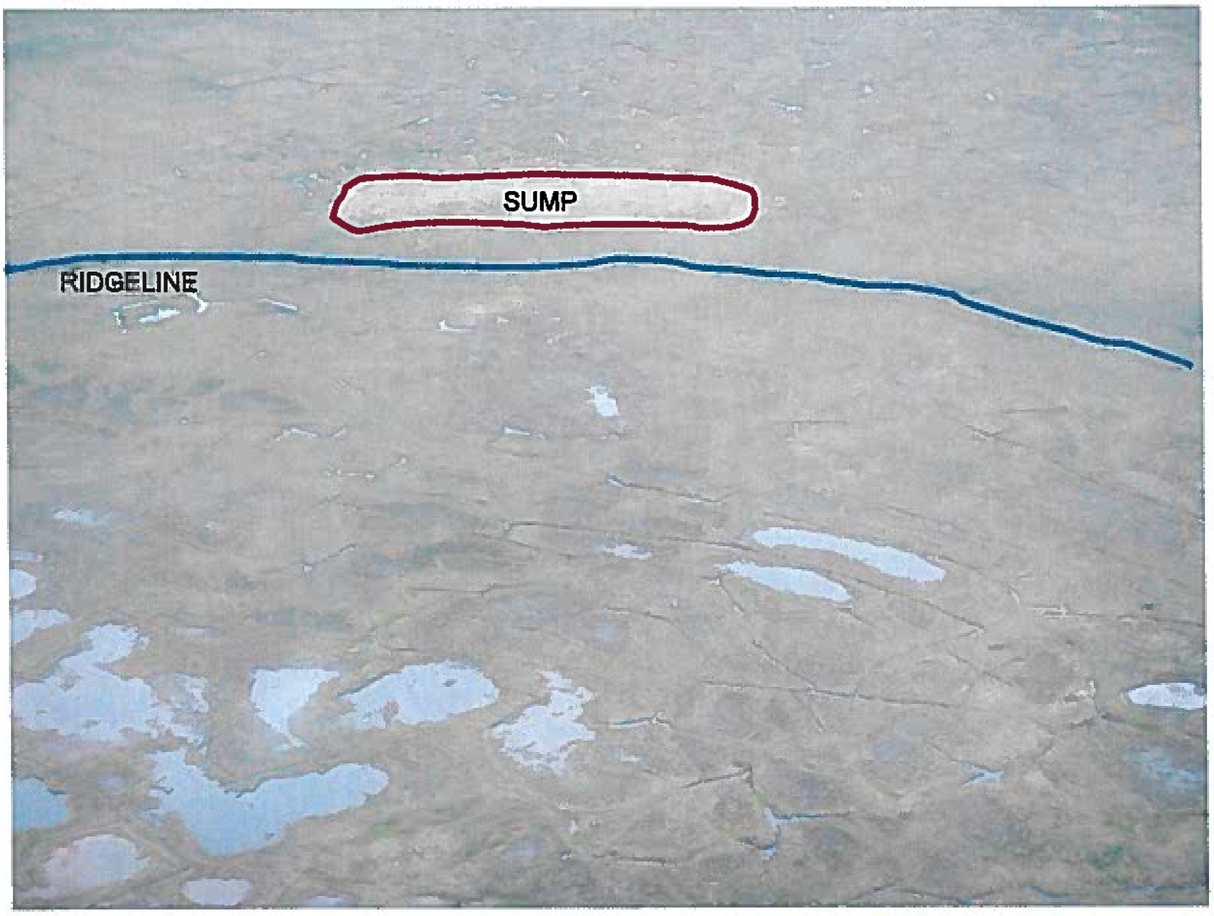


Photo 1 Aerial photo of Umiak N16 sump looking approximately north

Photo 2 Looking approximately southeast from the western end of the sump

Photo 3 **Taken from 40 m on ERT02 looking approximately southeast**

Appendices

Appendix 1 Geophysical Methodologies

APPENDIX 1
GEOPHYSICAL METHODOLOGIES

EM31 and EM38 Terrain Conductivity Surveys

The Geonics EM31 and EM38 terrain conductivity meters are portable electromagnetic (EM) survey instruments that can be used to collect terrain conductivity data over relatively large areas in a short period of time. Terrain conductivity is defined as the bulk electrical conductivity of the subsurface. It is a measure of the combined electrical conductivity of the soil matrix and pore fluids. Typically, electrical conductivity is greater for finer matrix grain sizes. Clays and shales are generally more conductive than sands and sandstones. In addition, high total dissolved solids (i.e. "salts") in the pore fluids will increase terrain conductivity. Thus, terrain conductivity surveys are often useful for defining the extent of inorganic soil and/or groundwater quality impacts. Conductivity is reported in units of millisiemens per metre (mS/m).

Terrain conductivity instruments use the principles of EM induction to measure the conductivity of the soil. A transmitter coil induces an alternating electrical current to flow in subsurface conductors. A receiver coil measures the strength of the magnetic field caused by the induced alternating current (secondary field), as well as the magnetic field from the transmitter (primary field). Of the combined fields measured by the receiver, the components in-phase with, and 90 degrees out-of-phase (quadrature) with the primary field are recorded by the EM instruments. Under a limited range of conditions, the quadrature component is directly proportional to the conductivity of the soil. The in-phase component response is primarily due to very high conductivity objects such as pipelines, buried metallic debris, and extremely conductive soil and groundwater.

Generally, the depth of investigation of an EM device is a function of the transmitter/receiver inter-coil spacing and the dipole (or coil) orientation. The EM31, with an inter-coil spacing of 3.66 m, has a maximum depth of investigation of approximately 6 m in the vertical dipole mode, although the peak response is from a depth of 1.5 m. The EM38, with a dual inter-coil spacing of 1.0 m and 0.5 m, has maximum depths of investigation of approximately 1.5 m and 0.75 m, respectively, in the vertical dipole mode, with peak responses from depths of 0.4 m and 0.2 m.

The EM31 and EM38 are each coupled to a data logger, which enables near continuous and accurate recording. Automated data collection provides greater speed in data handling, thus affording cost savings as well as improving overall data quality. Both instruments are also coupled to a differential global positioning system (DGPS) for real time spatial control. GPS mapping provides more accurate and precise positioning while saving time by eliminating the need to grid a site.

Electrical Resistivity Tomography

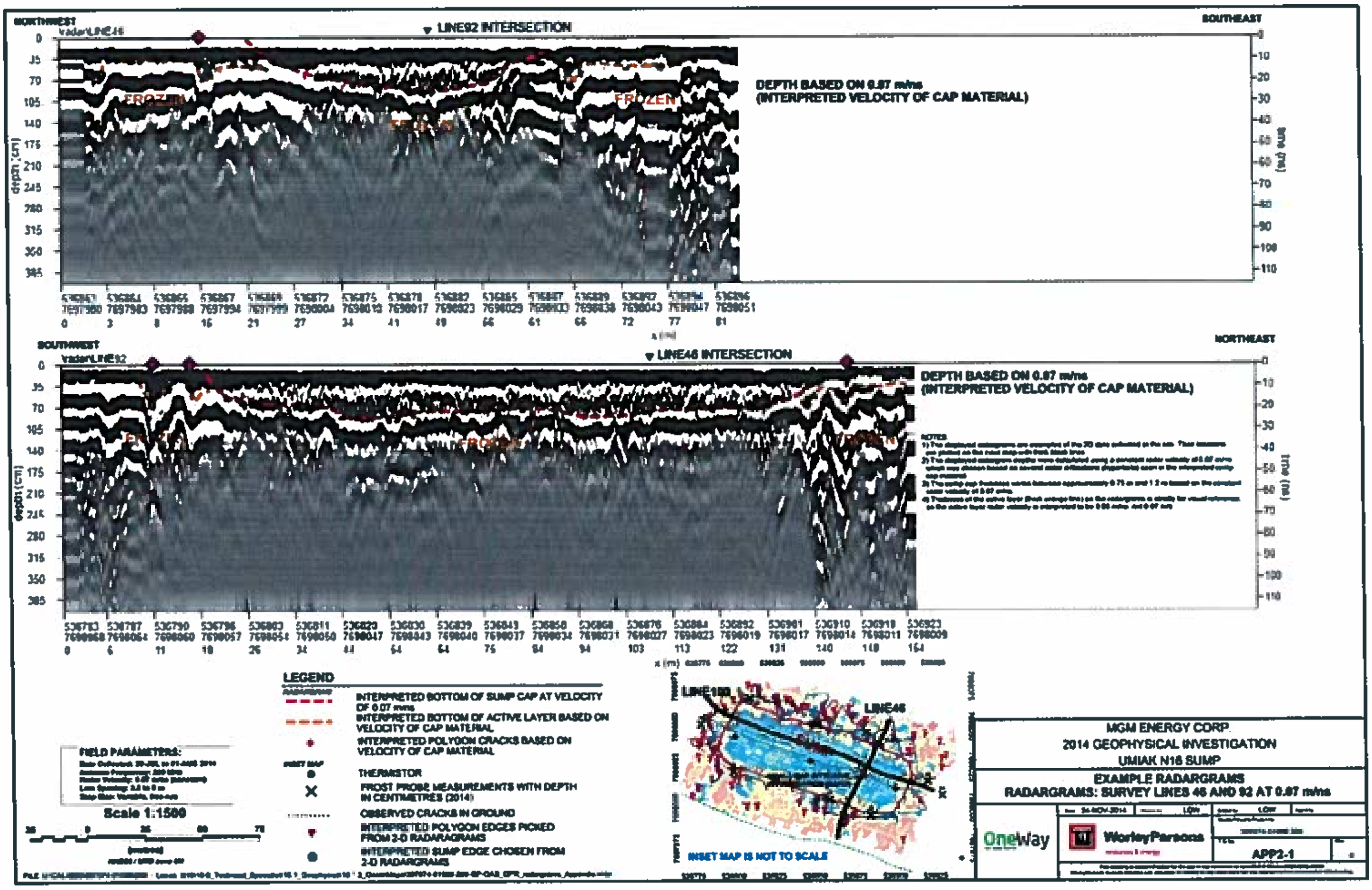
Electrical resistivity tomography (ERT) is a technique for mapping the distribution of subsurface electrical resistivity (or its inverse, conductivity) in a cross-sectional format. Resistivity data are collected through a linear array of 81 electrodes coupled to a direct current (DC) resistivity transmitter and receiver, and an electronic switching box. Data collection is carried out in a sequential and automated fashion that takes advantage of all possible combinations of current and measure electrodes. The data are downloaded to a computer for processing and analysis. The data are inverted using a two-dimensional (2-D) finite difference or finite element inversion routine. The final product is a 2-D cross-section plotting resistivity (in ohm-m), or conductivity (in mS/m), versus depth.

Ground Penetrating Radar

Ground penetrating radar (GPR) is a shallow, non-invasive, subsurface investigation technique capable of mapping interfaces in a cross-sectional format. GPR measures the propagation time of high frequency electromagnetic pulses that are reflected from interfaces between materials of different electrical properties. Typically, radar reflections occur with abrupt changes in moisture content, grain size, porosity, or soil texture, or off of massive buried objects such as pipelines or underground storage tanks. GPR is analogous to the reflection seismic technique that uses the travel time of acoustic pulses to identify interfaces. GPR is best suited to investigations in coarse-grained materials, i.e., sand size or larger.

GPR investigations for geological applications can be performed at frequencies ranging from 12.5 MHz to 500 MHz. Higher frequencies provide data of higher vertical resolution, while lower frequencies improve the depth of investigation. For example, 500 MHz would provide a resolution of approximately 10 cm and a depth of investigation of approximately 1 m in a sandy soil. Conversely, 12.5 MHz antennas may provide a depth of investigation of 40 m or greater with a resolution of 3 m in a sandy soil.

Appendix 2 Example GPR 2D Radargrams

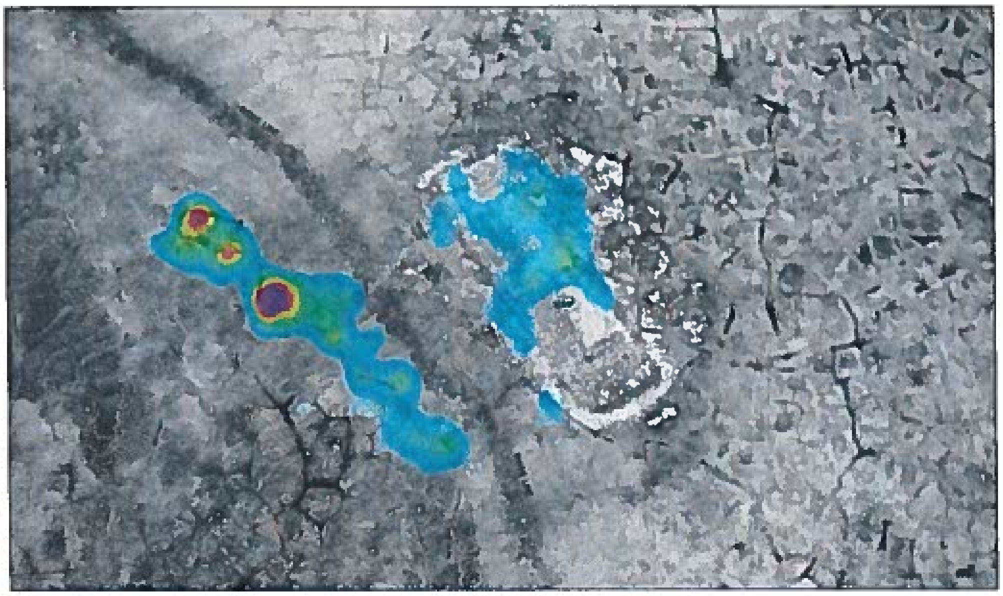

NORTHWEST
SOUTHEAST
LINE92 INTERSECTION
FROZEN
DEPTH BASED ON 0.07 m/ns
(INTERPRETED VELOCITY OF CAP MATERIAL)
depth (cm)
time (ns)
SOUTHWEST
NORTHEAST
LINE46 INTERSECTION
DEPTH BASED ON 0.07 m/ns
(INTERPRETED VELOCITY OF CAP MATERIAL)
LEGEND
INTERPRETED BOTTOM OF SUMP CAP AT VELOCITY OF 0.07 m/ns
INTERPRETED BOTTOM OF ACTIVE LAYER BASED ON VELOCITY OF CAP MATERIAL
INTERPRETED POLYGON CRACKS BASED ON VELOCITY OF CAP MATERIAL
THERMISTOR
FROST PROBE MEASUREMENTS WITH DEPTH IN CENTIMETRES (2014)
OBSERVED CRACKS IN GROUND
INTERPRETED POLYGON EDGES PICKED FROM 2-D RADARGRAMS
INTERPRETED SUMP EDGE CHOSEN FROM 2-D RADARGRAMS
FIELD PARAMETERS:
Scale 1:1500
LINE46
INSET MAP IS NOT TO SCALE
MGM ENERGY CORP.
2014 GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
EXAMPLE RADARGRAMS
RADARGRAMS: SURVEY LINES 46 AND 92 AT 0.07 m/ns
OneWay
WorleyParsons
APP2-1

Appendix 3 2011 KiNiLau EM31 and EM38, and 2013 WorleyParsons EM38 Results

Lateral Conductivity Detail (EM31 & Aerial Underlay)

MGM Energy Corp.
Umiak N-16 Sump

Inuvik, Northwest Territories
August 23, 2011



Legend

- Curved Feature (road, berm)
- Straight Feature (fence, house)
- Buried Pipe / Utility Line
- Point Feature (sign, pole, tree)
- Geophysical Measurement Station
- Outline (sump, trees, scrap)

Apparent conductivity (mS/m)

4 6 8 10 12 14 16 18 20

This single-page Lateral Conductivity Detail serves as all-in-one, comprehensive and graphical reporting tool. Please visit WWW.KINILAU.CA to download a traditional report.

Bluish colors indicate target onset, transitioning to deep maroon with increased significance.

The color soil conductivity image is derived using EM induction and DGPS positioning data. It reveals the conductivity distribution from surface to the varying skindepth of the inductive EM signal. The image does not represent data from any specific depth. Use VC (Vertical Conductivity) data for depth information.

While presented geophysical data have high intrinsic accuracy, their interpretation has multiple solutions (equivalence). Such data must always be correlated to some form of analytics.

Respectfully submitted,
KiNiLau Physics Inc.

Per:

Sean [illegible] P.Geoph.
Sr. Geophysicist

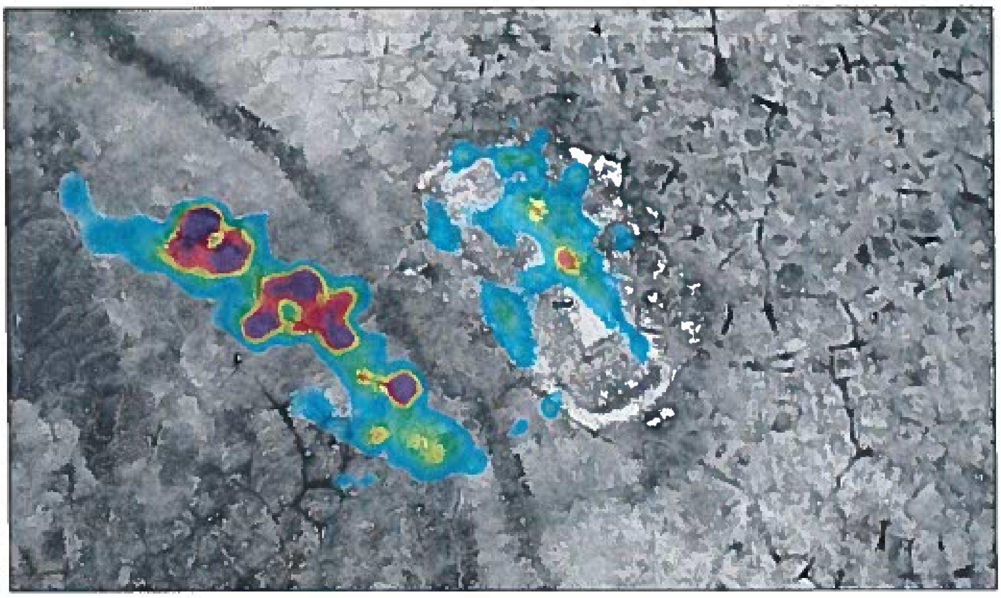
PERMIT TO PRACTICE
KiNiLau Physics Inc.
Signature
Date August 23, 2011
PERMIT NUMBER P10762
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

KiNiLau
Project 367, MH

Lateral Conductivity Detail (EM38 & Aerial Underlay)

MGM Energy Corp.
Umiak N-16 Sump

Inuvik, Northwest Territories
August 23, 2011



Legend

- Curved Feature (road, bush)
- Straight Feature (fence, house)
- Buried Pipe / Utility Line
- Point Feature (sign, pole, tree)
- Geophysical Measurement Station
- Outline (swamp, trees, scrap)

Apparent conductivity (mS/m)

4 6 8 10 12 14 16 18 20

This single-page Lateral Conductivity Detail serves as all-in-one, comprehensive and graphical reporting tool. Please visit www.kinilau.ca to download a traditional report.

Bluish colors indicate target onset, transitioning to deep maroon with increased significance.

The color soil conductivity image is derived using EM induction and DGPS positioning data. It reveals the conductivity distribution from surface to the varying skindepth of the inductive EM signal. The image does not represent data from any specific depth. Use VC (Vertical Conductivity) data for depth information.

While presented geophysical data have high intrinsic accuracy, their interpretation has multiple solutions (equivalence). Such data must always be correlated to some form of analytics.

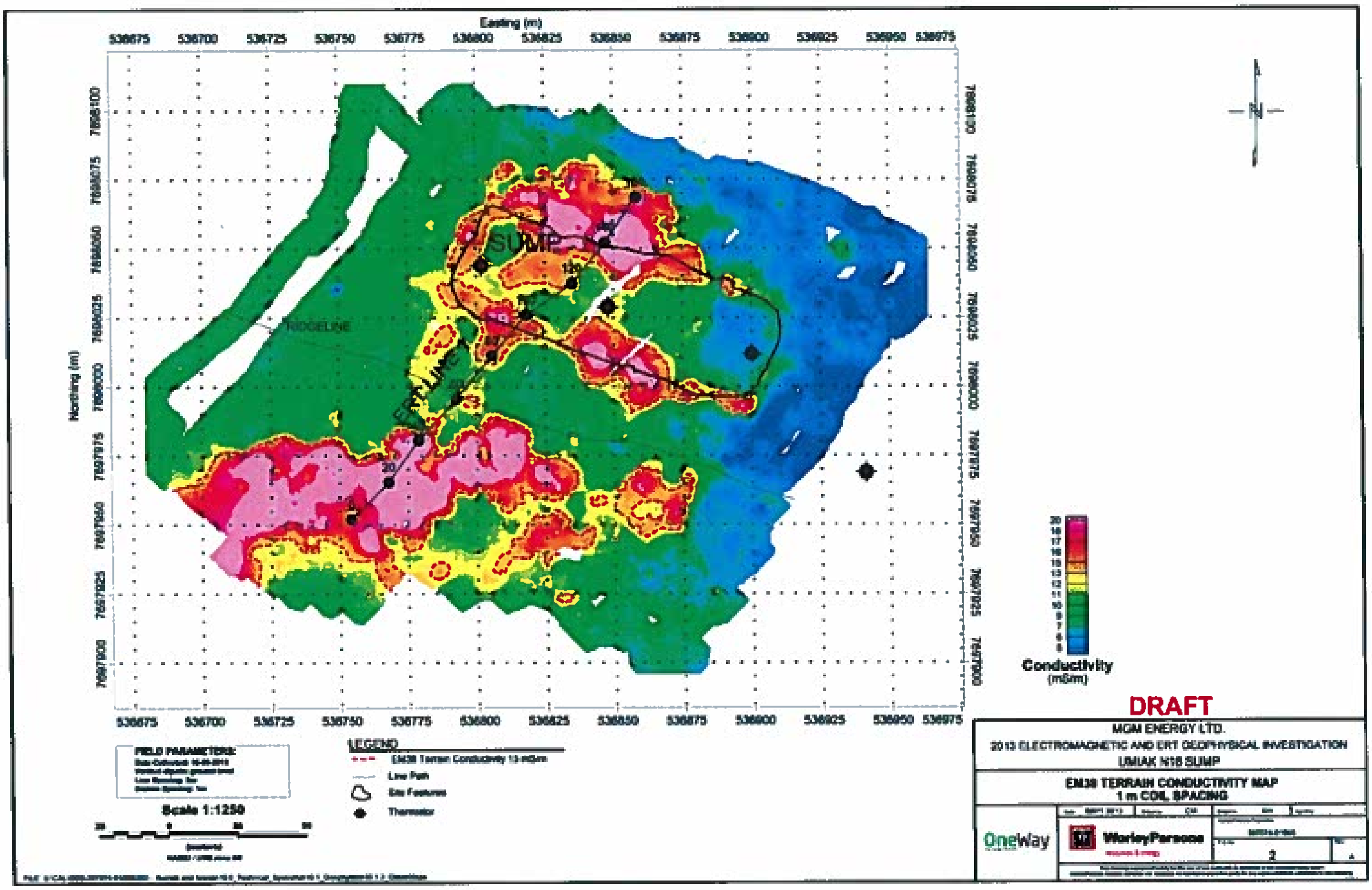
Respectfully submitted,
KiNiLau [illegible]

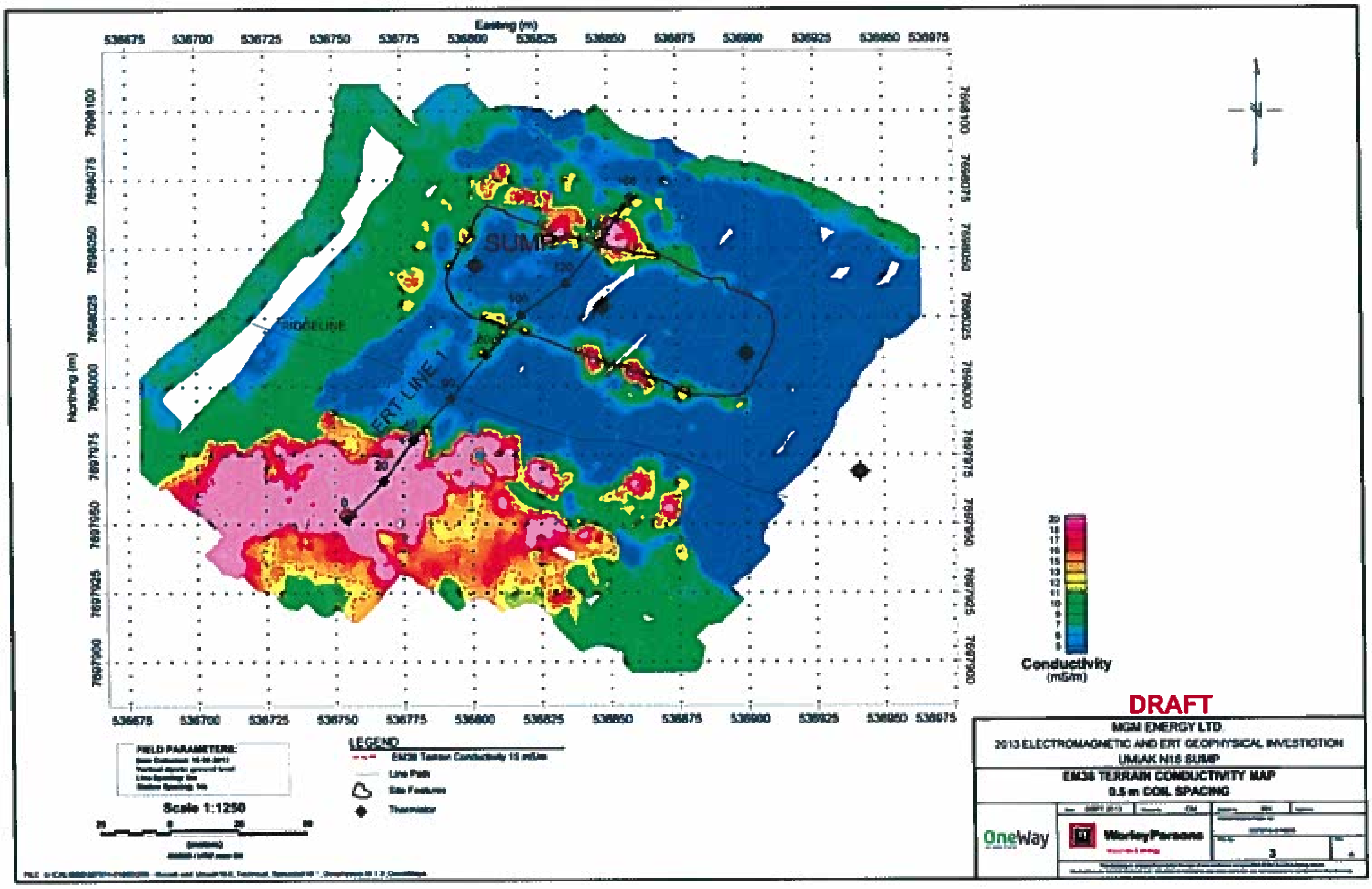
Per:

Sean [illegible] B.Geoph.
Sr. Geophysicist

PERMIT TO PRACTICE
KiNiLau Physics Inc.
Signature
Date August 23, 2011
PERMIT NUMBER P10762
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

KiNiLau
Project 367, NH.


Easting (m)
536675
536700
536725
536750
536775
536800
536825
536850
536875
536900
536925
536950
536975
Northing (m)
SUMP
RIDGELINE
ERT LINE
Conductivity
(mS/m)
DRAFT
MGM ENERGY LTD.
2013 ELECTROMAGNETIC AND ERT GEOPHYSICAL INVESTIGATION
UMIAK N16 SUMP
EM38 TERRAIN CONDUCTIVITY MAP
1 m COIL SPACING
FIELD PARAMETERS:
Scale 1:1250
LEGEND
Line Path
Site Features
Thermistor
OneWay
WorleyParsons


Easting (m)
536675
536700
536725
536750
536775
536800
536825
536850
536875
536900
536925
536950
536975
Northing (m)
7698100
7698075
7698050
7698025
7698000
7697975
7697950
7697925
7697900
SUMP
RIDGELINE
ERT LINE 1
Conductivity
(mS/m)
DRAFT
MGM ENERGY LTD
2013 ELECTROMAGNETIC AND ERT GEOPHYSICAL INVESTIGTION
UMIAK N16 SUMP
EM38 TERRAIN CONDUCTIVITY MAP
0.5 m COIL SPACING
OneWay
WorleyParsons
3
FIELD PARAMETERS:
Scale 1:1250
LEGEND
Line Path
Site Features
Thermistor