We are committed to providing accessible customer service.
If you need accessible formats or communications supports, please contact us.

Nous tenons à améliorer l’accessibilité des services à la clientèle.
Si vous avez besoin de formats accessibles ou d’aide à la communication, veuillez nous contacter.

VLF EM-16

Interpretation Report

Based on

Reconnaissance VLF Surveying

For

Offset Dikes

West of the Sudbury Basin

Prepared For

Hayden Butler, Frank Racicot

Claim Holders

By

Shaun Parent

Superior Exploration, Adventure & Climbing Co. Ltd.

May 13, 2017

Table of Contents

List of Tables & Figures

Executive Summary:

VLF Data was processed and interpreted using VLF2DMF software on a Ground VLF survey that was completed by Frank Racicot in the Hyman Township District in Northern Ontario. The property is located approximately 60 Km West of Sudbury.

A series of VLF EM-16 survey lines were carried out by Frank Racicot in February 2017, using a VLF EM-16 unit and a handheld Garmin GPS-60CSX. Two transmitter stations were read during the course of the survey: NAA 24.0 KHz – Cutler, Maine and NML 25.2 KHz- La Moure. N. Dakota.

VLF Data was processed and interpreted for NAA Cutler Maine only.

The main objective of the 2017 VLF EM-16 survey was to determine if the VLF Survey could delineate economic mineralization and/or structures similar to that of the Parkin Offset Dike held by Wallbridge Mining. This report focuses on some of the VLF –NAA anomalies and compares them with the response of the Parkin Offset Dike and Parkin Ore zone as delineated in a VLF survey carried out in June 2013.

Introduction

A VLF-EM16 survey is a relatively simple and economic geophysical survey that is used to better understand shallow, vertical and sub vertical bedrock conductors.

This report describes the findings and results of the VLF EM-16 survey utilizing the VLF2DMF processing software of which the author of this report has assisted in its development since 2007. It enables the processing and inversion of electromagnetic (EM) induction data acquired along a survey area using a Very Low Frequency (VLF) (Santos 2013)

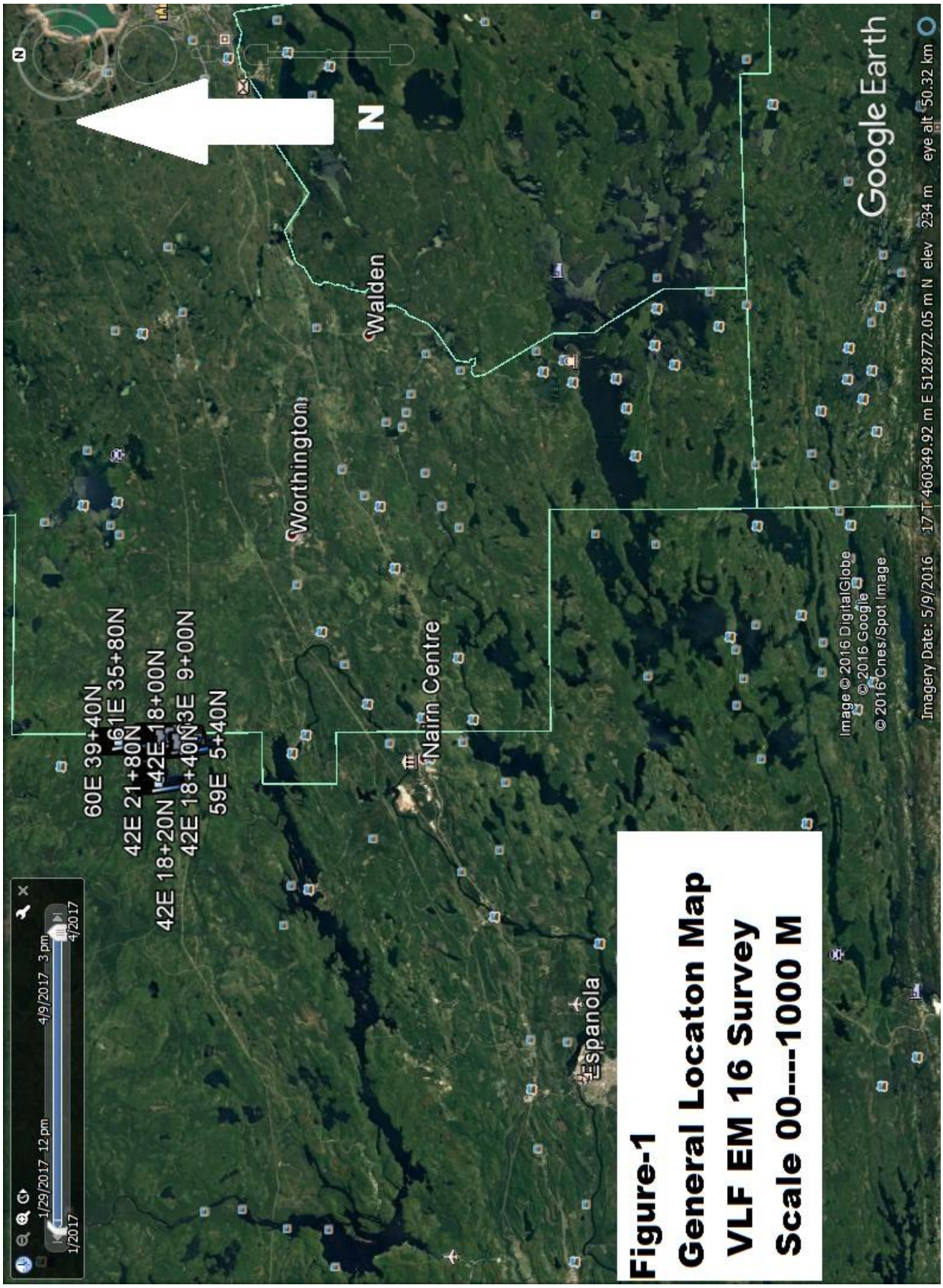
The software generates profiles of Raw Data, Fraser Filtered Data, KH, Resistivity and (2-D) Modelled Inversions.

VLF data collected in the surveyed area was also compiled onto plan maps of contoured Fraser Filter data and contours of Resistivity data. (Figures 5, 6, 7, 8, 9 & 10)

Personnel

The VLF EM-16 operator and GPS field navigator responsible for the collection of all raw data was Ted Lang.
Processing and Interpretation of the VLF data using the VLF2DMF Software was completed by Shaun Parent and Sandra Slater.

Figure 1 General Location Map



Work Performed

The VLF EM-16 survey consisted of running 10 Reconnaissance VLF lines in 3 different areas. West Grid Lines 42E,43E,44E,45E (Figure 2), East Grid Lines 58E,59E,60E,61E,62E,63E (Figure 3), North Grid Lines 60E, 61E (Figure 4). Total kilometers of VLF completed were:
West Grid (3.28Km) East Grid (13.78 Km) North Grid (3.84Km)

The VLF lines were completed while using a handheld Garmin 60-CSX GPS. Each VLF station was located based on a northerly azimuth and distance from the start of the survey line. At each line station, 2 transmitter stations were read using the Geonics VLF- Em-16 receiver. The following parameters were used throughout the survey:

The following parameters were used throughout the survey:

VLF Transmitters Used: NAA - 24.0 KHz. Cutler, Maine (East)
NML - 25.2 KHz. La Moure, North Dakota (West)

VLF survey direction: The VLF Em-16 receiver was facing 00 degrees (True North) along all lines. All lines were read in a south to north direction.

VLF survey stations: All readings were taken at approximately 20 meter stations along the survey lines.

Parameters of Measurement: In-phase and Quad-phase components of vertical magnetic field as a percentage of horizontal primary fields. (Tangent of tilt angle and ellipticity). VLF transmitter NAA was to the east while transmitter NML was to the west. The transmitters are chosen so that the direction to the transmitting station is as close to the orientation of the bedrock strike.

Figure 2 West Grid Location Map

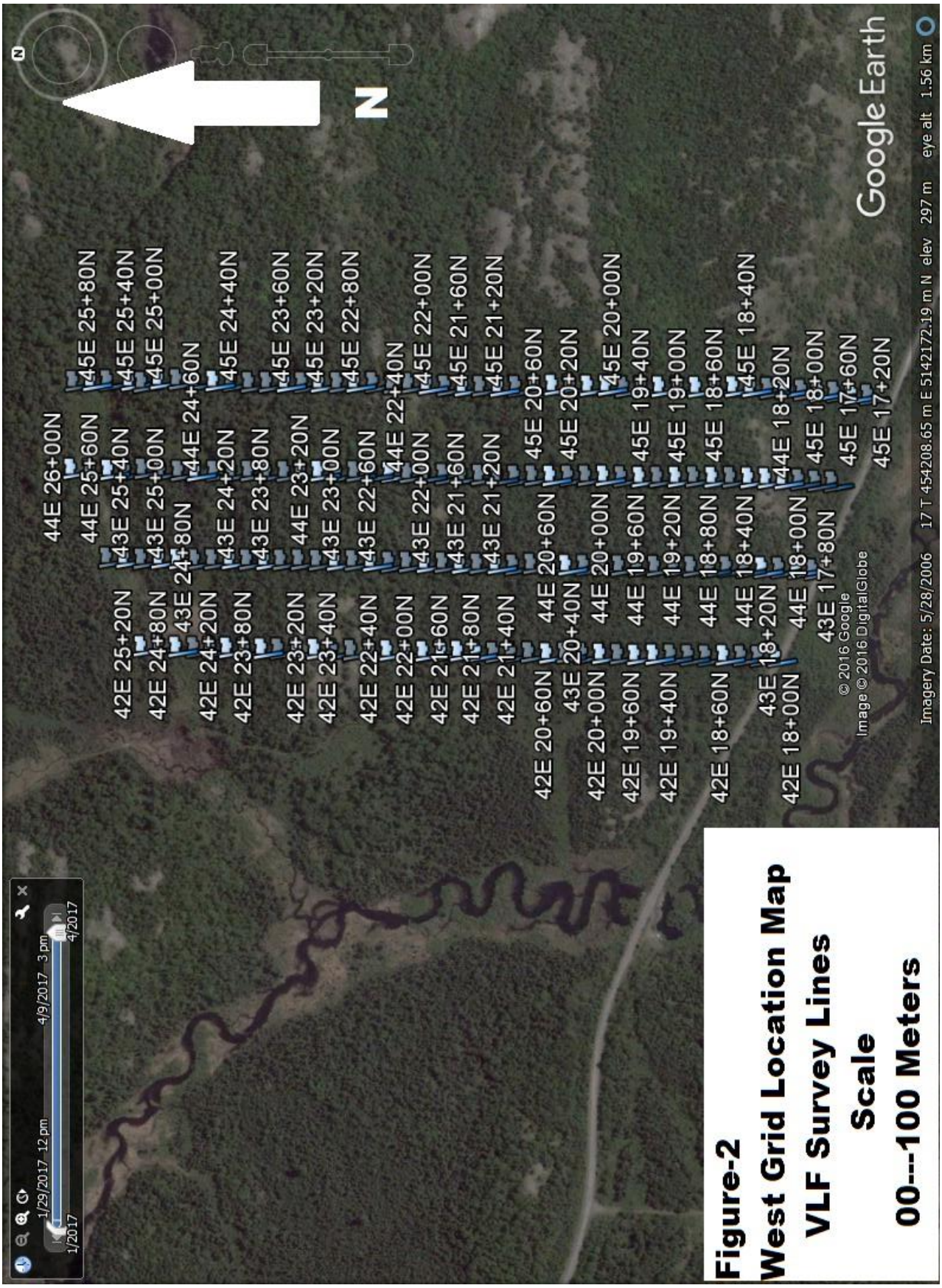


Figure 3 East Grid Location Map

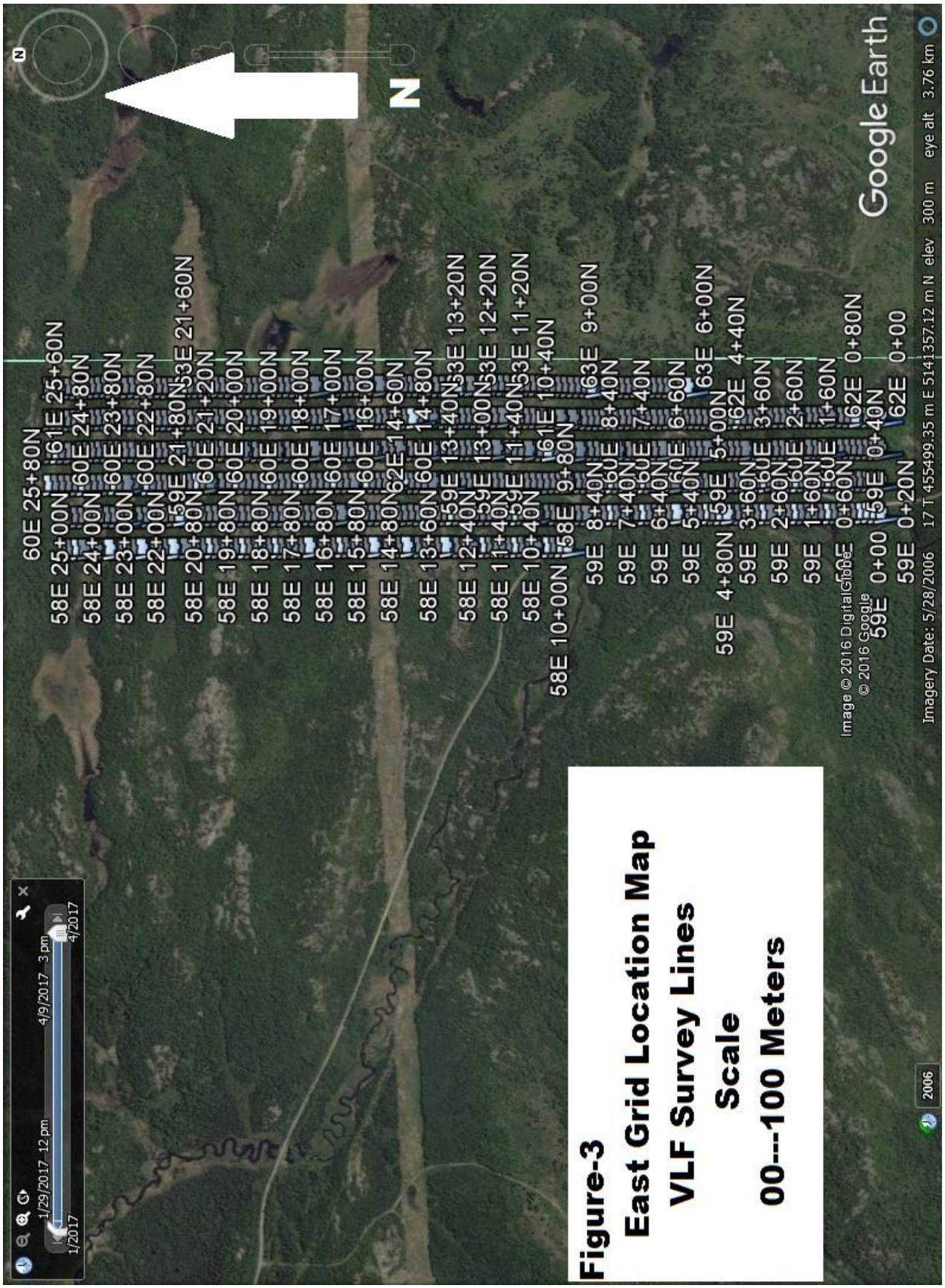
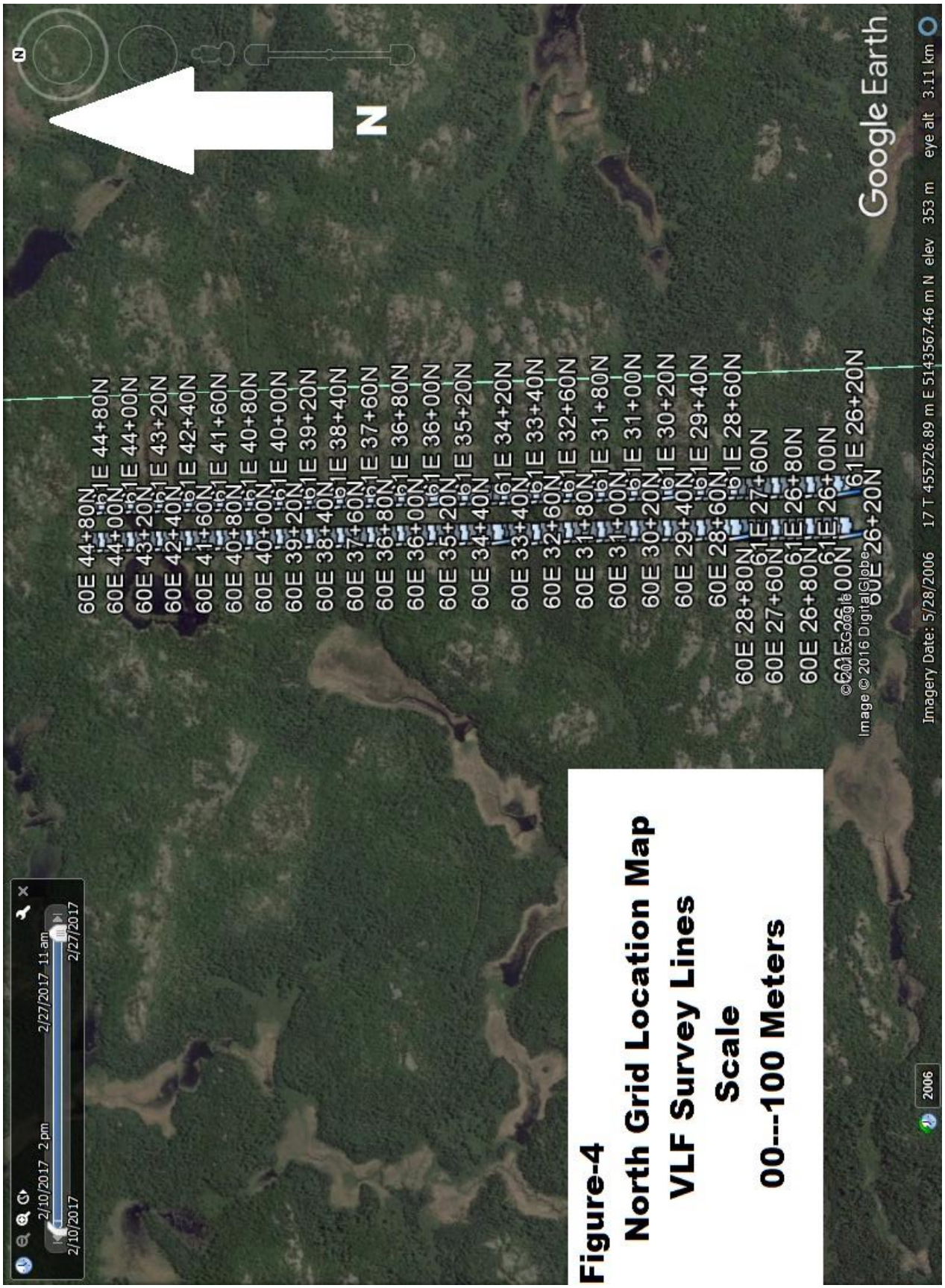


Figure 4 North Grid Location Map



VLF Data Collection Process

Field data was collected as follows on each surveyed line.

- Each station was saved onto the Handheld Garmin 60CSX GPS Unit (including local features such as power lines, fences and geological structures)
- VLF readings for each station were recorded in a notebook as In-Phase and Quadrature corresponding to the line number and station number. (See example in Table 1)
- Field information was transferred to a Garmin map source program where line and station information could be viewed.
- Garmin and VLF data were compiled onto an excel spreadsheet and then inputted into the VLF2DMF processing software. UTM Values are NAD 83.

Table 1 Example of Data Collected

Line 0+00	NAA In phase	NAA Quadrature	NML In phase	NML Quadrature	Notes
2+00N	10	6	4	5	swamp
2+20N	8	4	2	4	oc

VLF2DMF Data Processing

VLF data collected using NAA-24.0 Khz (Cutler Maine) was processed using the VLF2DMF software. Results were interpreted and compared to the Parkin Offset Dike data for Lines 0+00, 0+50S, 1+00S and 1+50S. Inversion Models for Parkin Offset are included in the appendix.

Raw Data Profiles

The raw data for each frequency was plotted for each line surveyed. No filtering or smoothing of the raw data was done. Profiles are included in the appendix.

Fraser Filter Profile

Raw data was run through the Fraser filter. This filter transforms In-Phase cross overs and inflections into positive peak anomalies. (Fraser 1969) In-Phase inflections and cross overs are usually plus to minus, while Quadrature responses are negative to positive giving a negative peak anomaly when the Fraser Filter is applied. VLF anomalies were selected based on their location and other pertinent information from the Fraser Filter profile. All Fraser Peaks are shown on the Models which are included in the appendix.

K-H Profiles

Raw Data was run through the Karous-Hjelt (K-H) filter. The filter is applied to obtain a section of current density. The higher values are generally associated with conductive structures. (Karous, Hjelt 1983) If there is depth extent, this is shown on the In-phase profile as dark blue.

Resistivity Profiles: 2000 Ohm's

The apparent resistivity was calculated. The resistivity can be calculated if the mean environmental resistivity is known at the beginning of the VLF profile. A mean resistivity of 2000 ohm's was used for all lines.

Model 2000 Ohm's with Fraser Peaks

A resistivity of 2000 Ohm's was used to build an initial model used in the inversion to obtain a realistic cross section of the line surveyed. Conductive zones are red/yellow while resistive zones are blue. A depth scale is found on the left side of model profiles. Surface conductive zones show little depth extent, have a horizontal display and are limited in depth. When using a resistivity of 2000 Ohms, the depth of the model is determined to be 144 meters with Transmitter NAA. The vertical exaggeration of all models is 1.0. Fraser Filter Peaks are shown across the top of the models which are included in the appendix.

Discussion of Results

- The maximum depth slice for transmitter NAA 24.0 Khz with a bedrock resistivity of 2000 Ohms is 144.0 meters.
- All Inversion models were calculated at 2000 Ohms while the Parkin Offset data was calculated using 2000 Ohms.
- All Inversion models including the Parkin Offset data have the same color scaling using a minimum resistivity of 10 and a maximum of 10,000.

Parkin Offset:

Appendix: Parkin Offset Figures 1, 2, 3, & 4

- The VLF Inversion Models for data collected over the Parkin Offset Quartz Diorite Dike are shown for lines 1+00S (figure 1), 2+00S (figure 2), 6+00S (figure 3) and 7+00S (figure 4)

West Grid: Lines 42E-45E

Figures 5, 6

Appendix: West Grid Figures 1-8

The west grid has 4 Interesting trends that warrant ground follow up:

- 42EA-43EA-44EB-45EA- Bedrock Trend- Shear or Fault
- 43EB-44EB-45EA- Bedrock Trend-Shear or Fault- Low Resistivity trend
- 42ED-43EC-44EC-45EC- These VLF trends are similar to the Parkin Offset Trend. Low resistivity trend
- 43EF-44EF-45EF-Possible Contact between rock units.

East Grid: Lines 58E-63E

Figures 7, 8

Appendix: East Grid Figures 1-12

The East Grid has 13 interesting trends for ground follow up:

- 60EA-61EB-62EC- Weak Surficial
- 60EB-61EC-62ED- Surficial
- 59EC-60EE-61EF-62EG Possible Contact Conductor- Low Resistivity trend
- 59EI-60EH-61EH-62EI-63EA Similar to Parkin - Low Resistivity trend
- 59EJ-60EI-61EI-62EI-63EA Similar to Parkin - Low resistivity trend
- 59EK-60EJ-61EJ-62EJ-63EB Contact Conductor - follows edge of resistivity low
- 58EA-59EL-60EK-61EK-62EK-63ED Contact
- 58EE-59EO-60EO-61EO-62EO-63EH Weak Surficial
- 58EE-59EO-60EO-61EP-62EP-63EI Weak Surficial
- 58EF-59EP-60EP-61EQ-62EQ-63EJ Similar to Parkin - Follows edge of Resistivity low
- 58EG-59ER-60EQ-61ER-62ER-63EK Similar to Parkin - Low resistivity trend
- 58EI-59ES-60ER-61ES-62ES-63EM Weak surficial - Partial resistivity low
- 58EN-59EW-60EV-61EW-62EW-63EP Surficial, possible contact

North Grid: Lines 60E-61E

Figures 9, 10

Appendix: North Grid Figures 1-4

The North Grid has 8 interesting trends for ground follow up:

- 60EA-61EB Similar to Parkin
- 60EC-61EC Contact at edge of conductive zone
- 60ED-61EE Weak surficial
- 60EG-61EH Contact of weak shear
- 60EJ-61EJ Weak surficial
- 60EK- 61EK Similar to Parkin
- 60ES-61EQ Surficial? Contact?
- 60ET-61ER Shear?

Figure 5 TX NAA West Grid: In-Phase & Quadrature Values

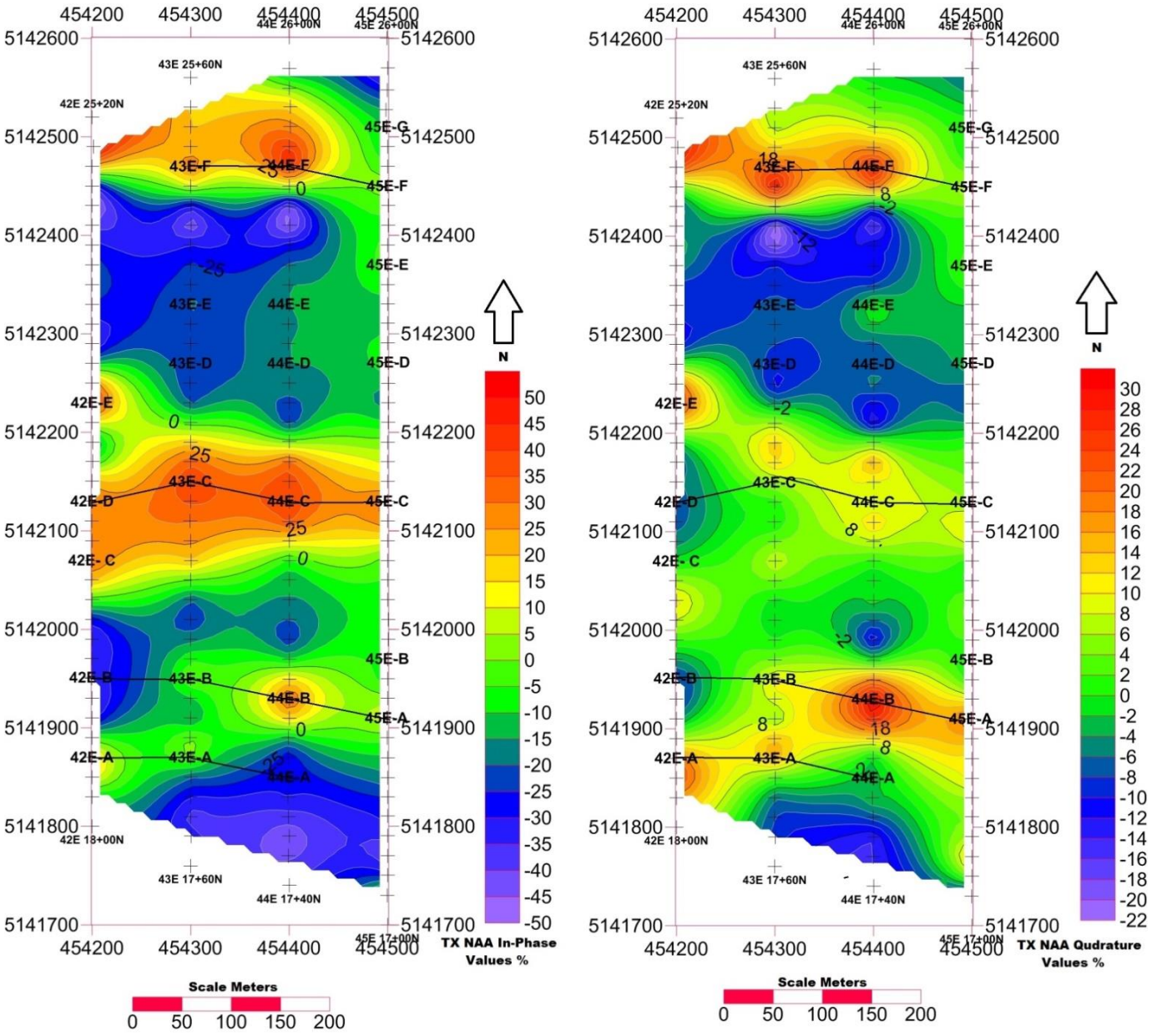


Figure 6 TX NAA West Grid: Resistivity Contours

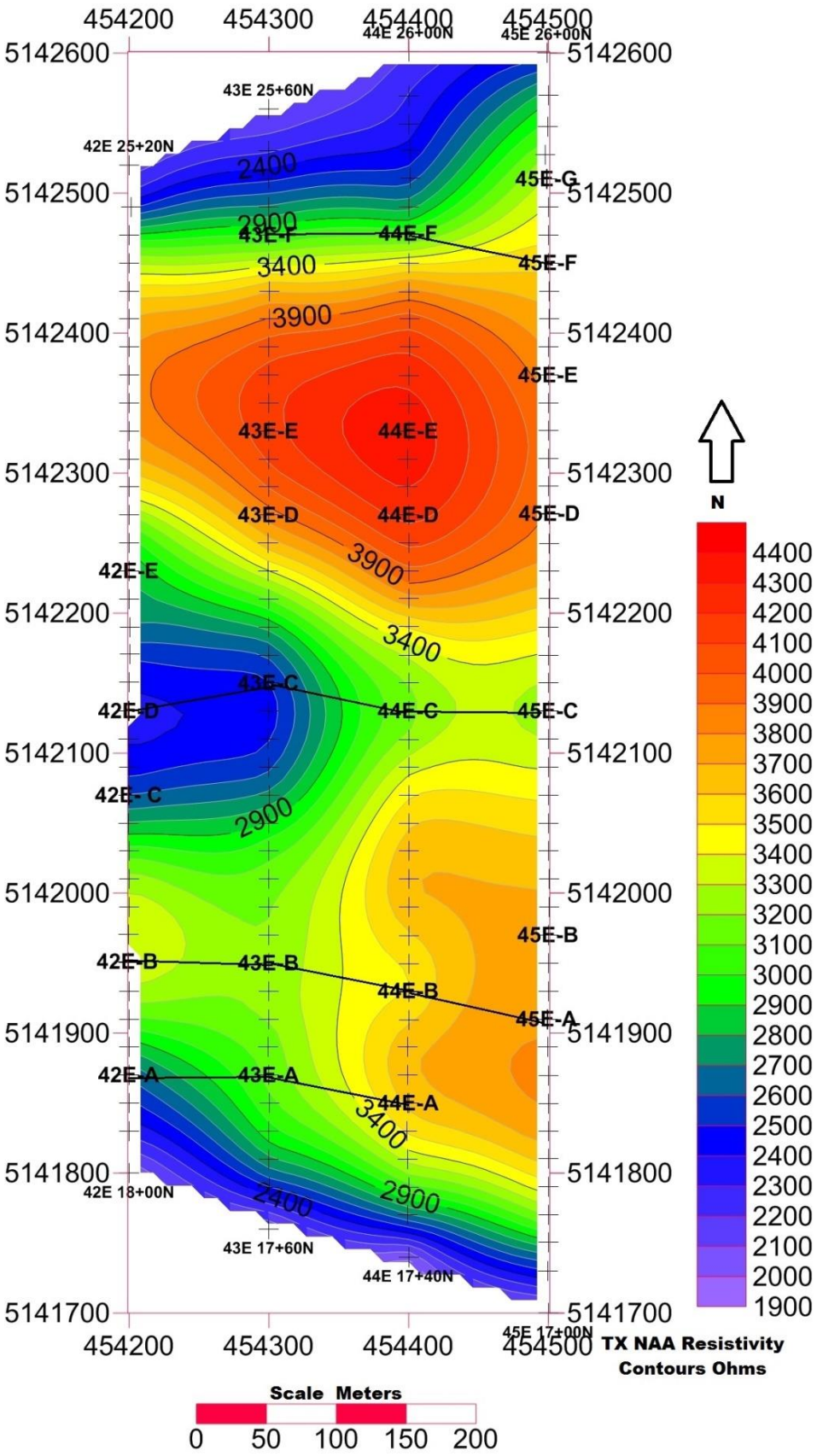


Figure 7 TX NAA East Grid: In-Phase & Quadrature Values

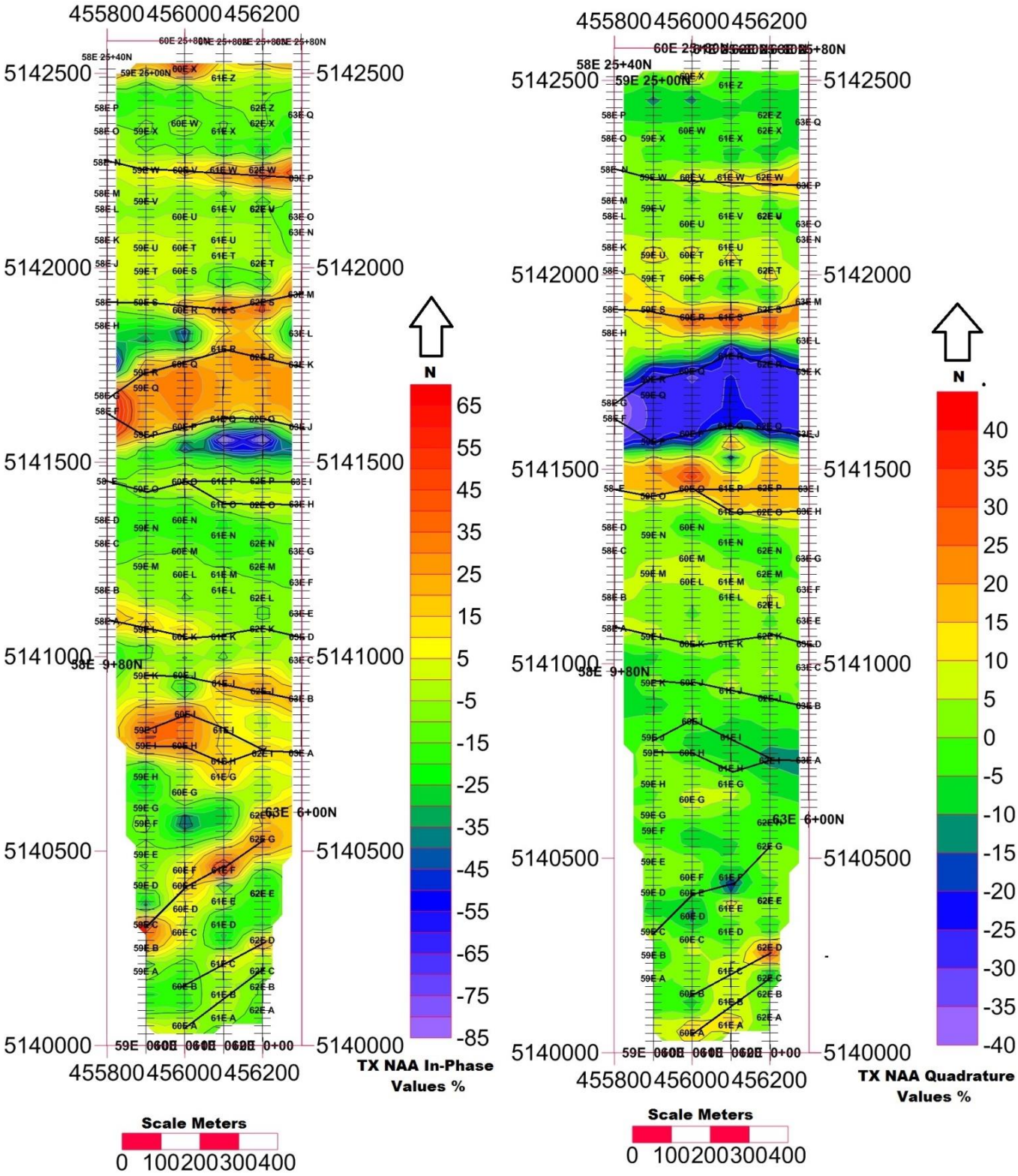


Figure 8 TX NAA East Grid: Resistivity Contours

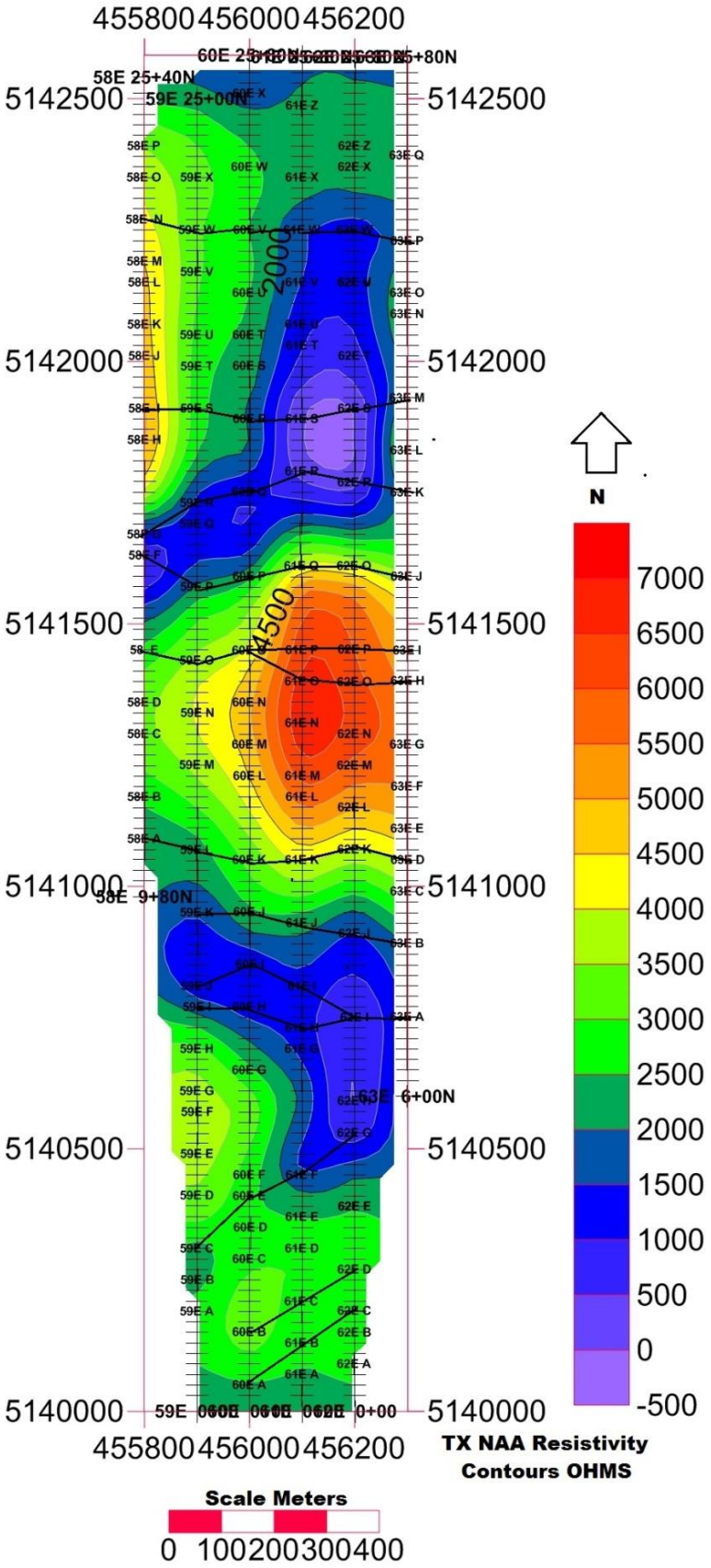


Figure 9 TX NAA North Grid: In-Phase & Quadrature Values

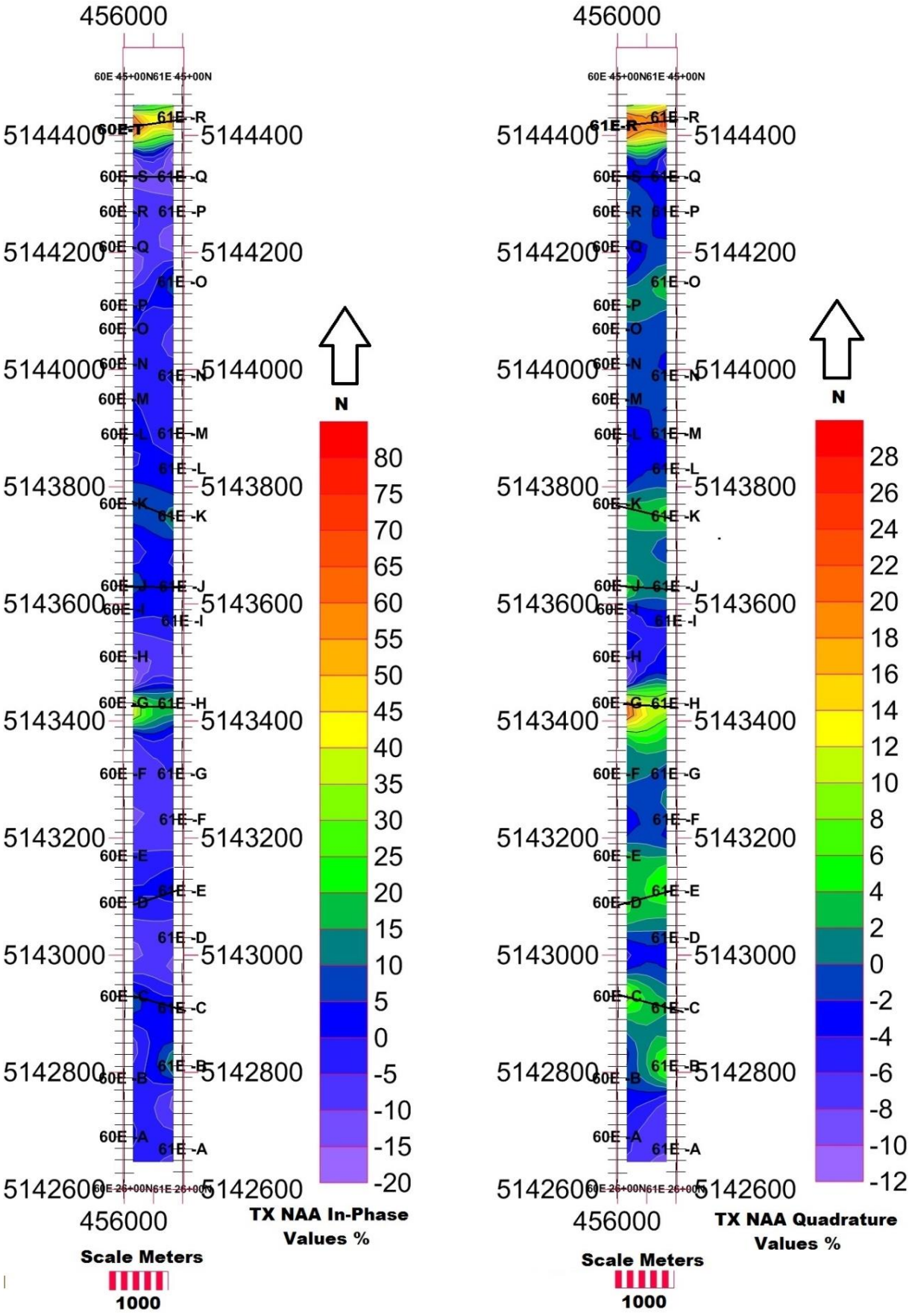
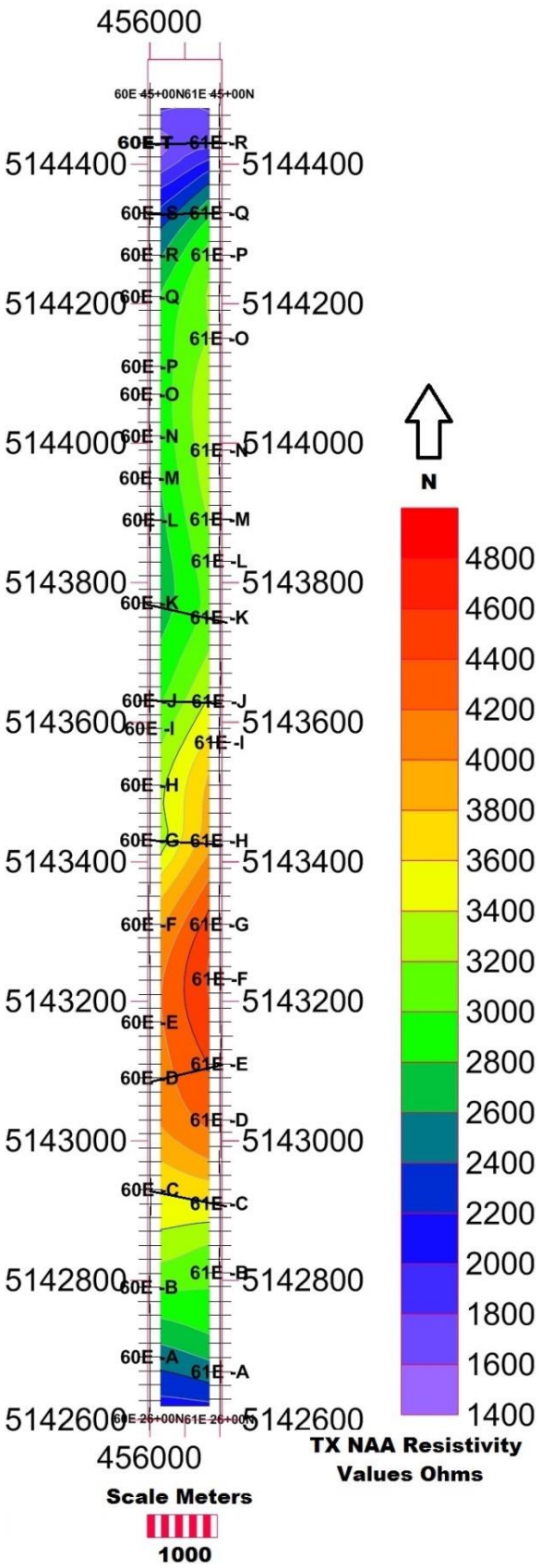


Figure 10 TX NAA North Grid: Resistivity Contours



Conclusions

The Ground VLF EM-16 reconnaissance survey was successful in:

a) Defining Several VLF bedrock conductors similar to that of the Parkin Offset.
b) Several of the reconnaissance lines have similar inversion profiles as the Parkin Offset profiles. This is evident when comparing the model profiles with the 4 Parkin examples.
c) Using a bedrock background resistivity of 2000 ohms gave us a modelled section to 144.0 meters in depth and outlined several highly resistive and minimally resistive rock units.
d) Reconnaissance VLF lines are a fast and low cost exploration tool in the Sudbury area to identify possible mineralized offset dikes.

Recommendations

a) View the Reconnaissance VLF lines on Google earth images in order to identify linear structures that might indicate offset dikes.
b) Compare the location of the VLF picks with local geology map to interpret if there are contacts or shears.
c) Processing of the VLF data into horizontal slices of conductivity at various depths.
d) Ground follow-up of the best VLF conductors that have similar response to the Parkin Offset VLF.
e) Processing of all VLF data for Transmitter NML using the VLF2DMF software in order to compare with the processed NAA data in this report.
f) Process the TX NAA data to obtain the UTM coordinates of the VLF picks to ground proof the best conductive trends.

List of References

Baker, H.A,. and J.O. Myers, 1979, VLF-EM model studies and some simple quantitative applications to field results: Geoexploration 17, 55-63

Fraser, D.C., 1969. Contouring of VLF-EM data. Geophysics, 34 958-967

Geonics Ltd., 1997: Operating Manual for VLF Em-16

Karous, M and Hjelt, S.E., 1983: Linear filtering of VLF dip-angle measurements, Geophysical Prospecting 31, 782-794

McNeil, J.D. and Labson; 1991: Geological Mapping using VLF radio fields. In Nabghian, M.N Ed, Electrical Methods in Applied Geophysics 11. Soc. Expl. Geoph, 521-640

Sayden, A.S, Boniwell, J.B; 1989: VLF Electromagnetic Method, Canadian Institute of Mining and Metalurgy, Special Volume 41, 111-125 of VLF-EM Data

Monteiro Santos, F.A; 2013: VLF 2D V1.6 A program for 2D inversion

Certificate of Qualifications

I, Shaun Parent, P. Geo . Residing at 282 B Whispering Pines Road, Batchawana Bay, Ontario do certify that:

1. I am a consulting Geoscientist with Superior Exploration, Adventure & Climbing Co. Ltd.

2. I graduated with a Geological Technician Diploma from Sir Sandford Fleming College in 1986.

3. I graduated with a BSc. from the University of Toronto in 1986

4. I am a member in good standing with the Association of Professional Geoscientists of Ontario #1955 and a member of the Prospectors and Developers Association of Canada.

5. I have been employed continuously as a Geoscientist for the past 26 years since my graduation from University.

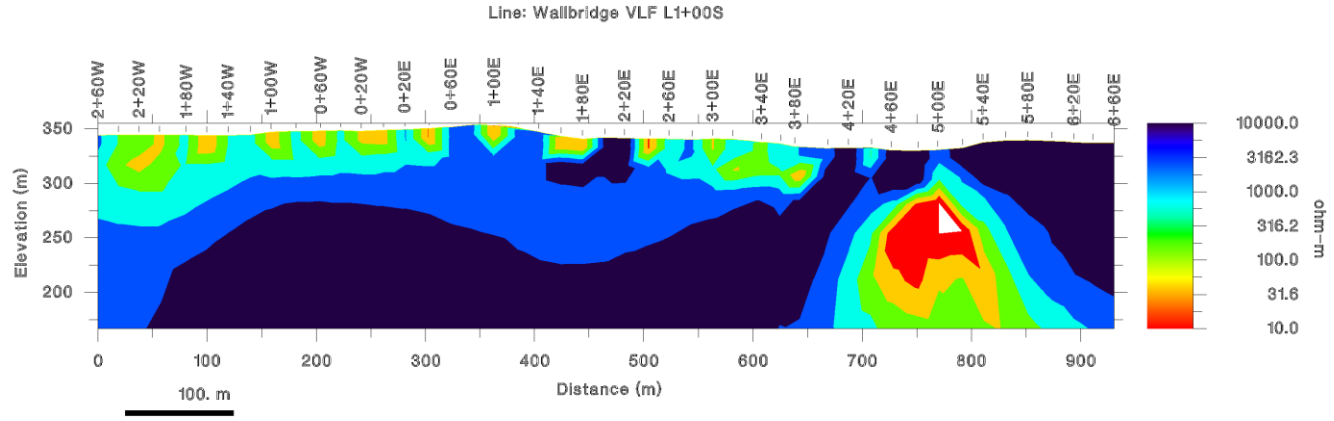
6. The nature of my involvement with this project was to carry out the interpretation of the VLF data using the EMTOMO VLF2D Software of which I have been developing with Dr. Fernando Santos of Lisbon, Portugal.

Dated this 13th day of May 2017

Shaun Parent, Diploma-Geo, BSc. P. Geo (Limited)
Superior Exploration, Adventure & Climbing Co. Ltd.

Appendicies

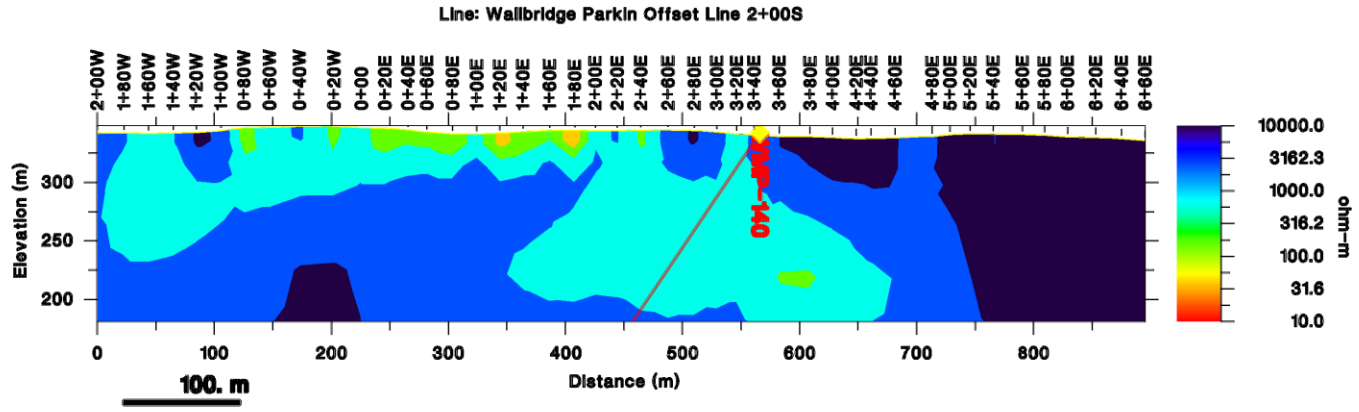
Parkin Offset Figure 1 Line 1+00S Model 2000 Ohm



Transmitter: NAA

Vertical Exaggeration: 1.0

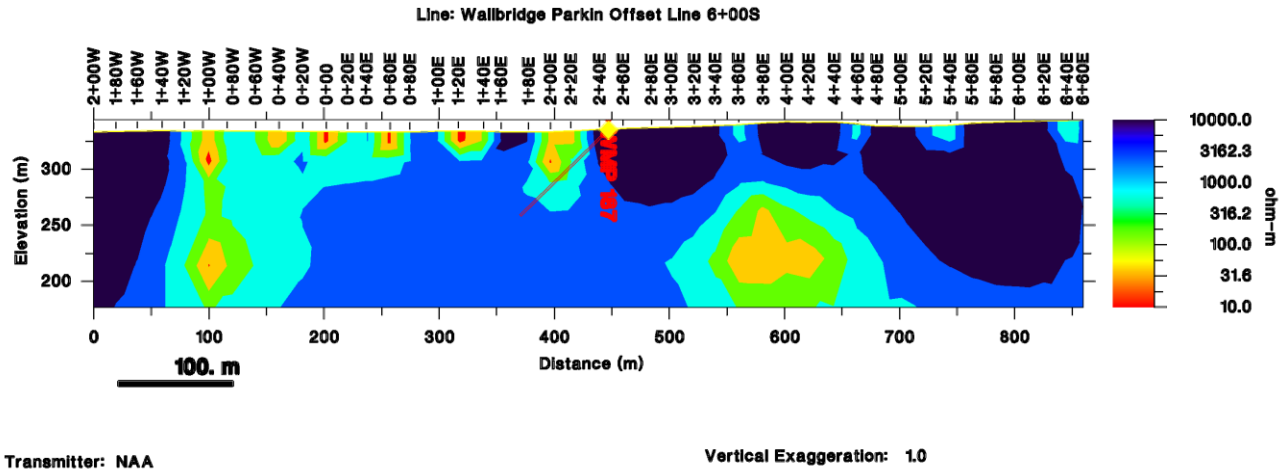
Parkin Offset Figure 2 Line 2+00S Model 2000 Ohm



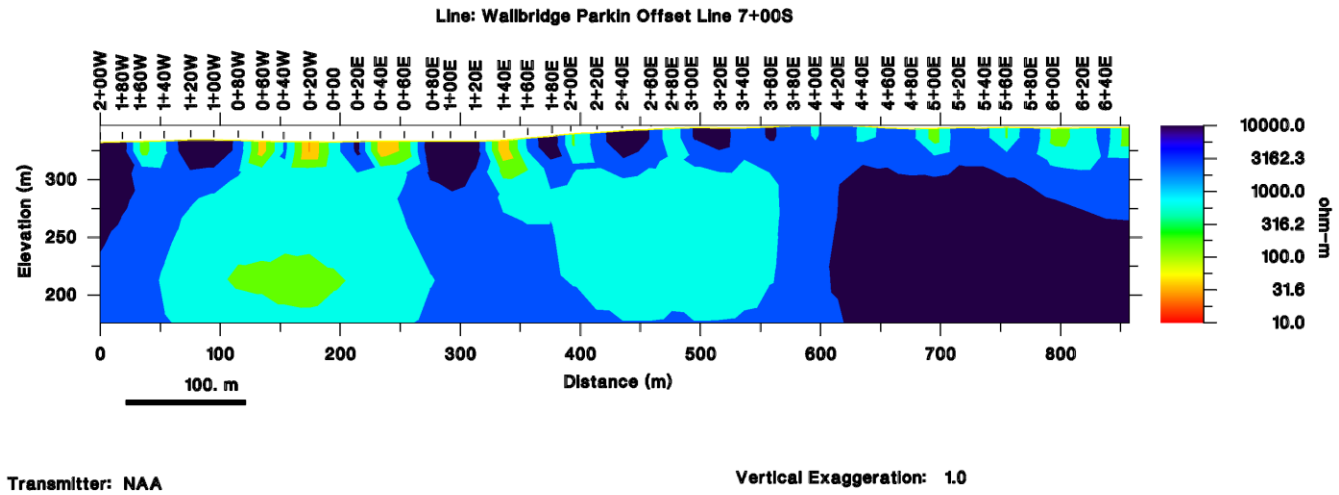
Transmitter: NAA

Vertical Exaggeration: 1.0

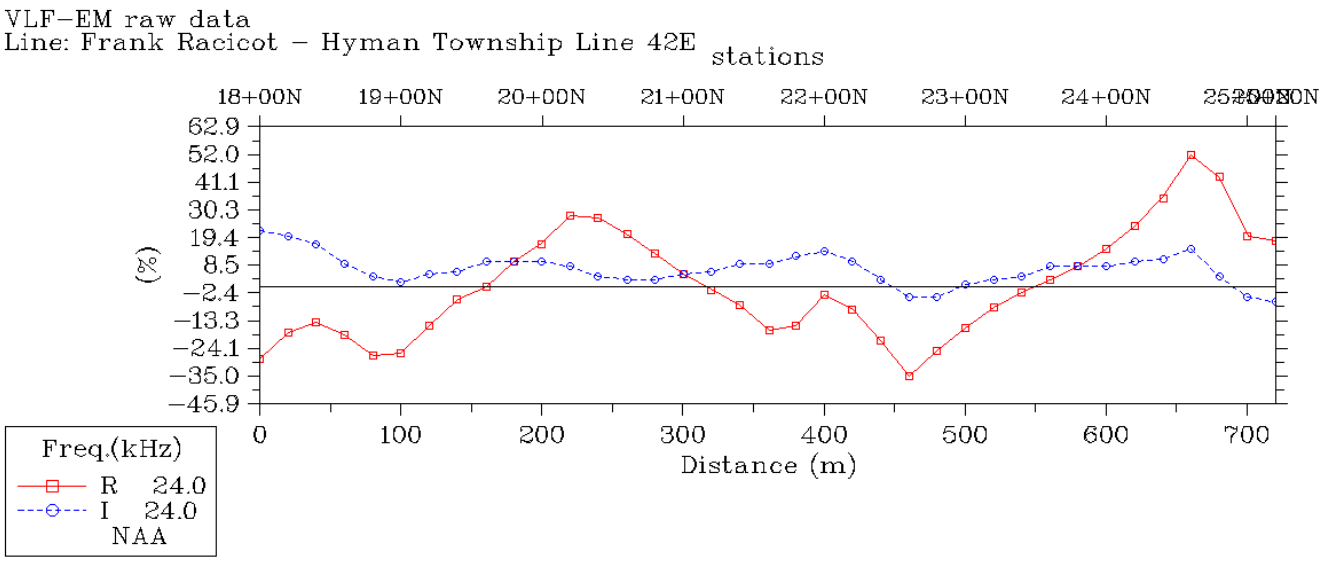
Parkin Offset Figure 3 Line 6+00S Model 2000 Ohm



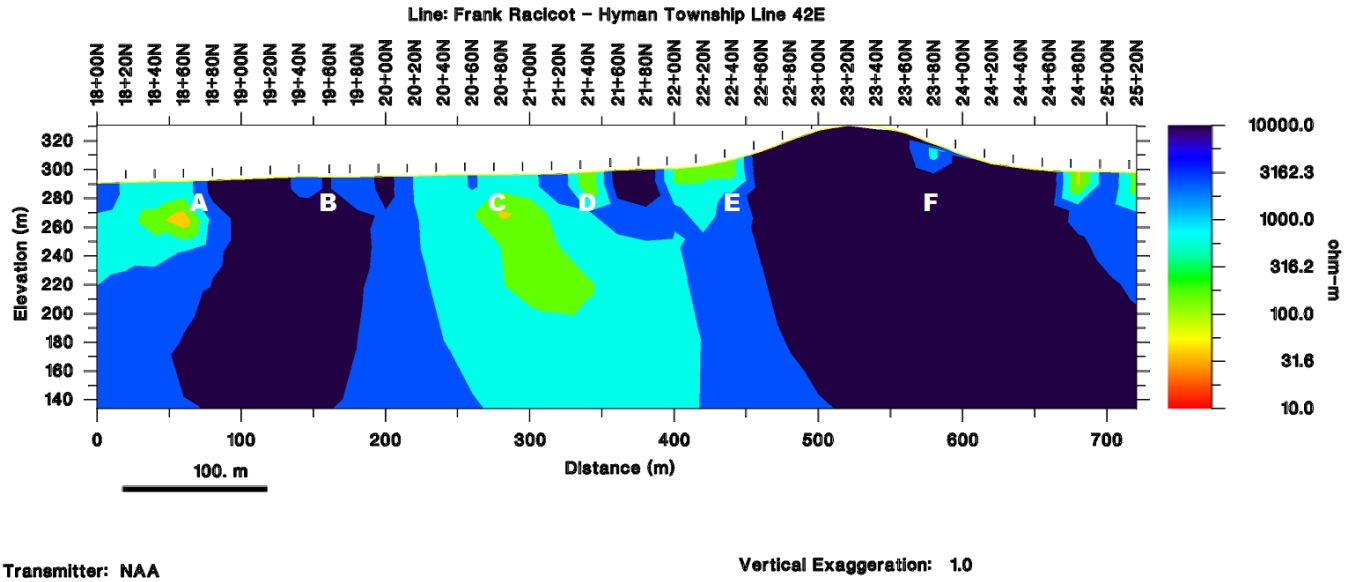
Parkin Offset Figure 4 Line 7+00S Model 2000 Ohm



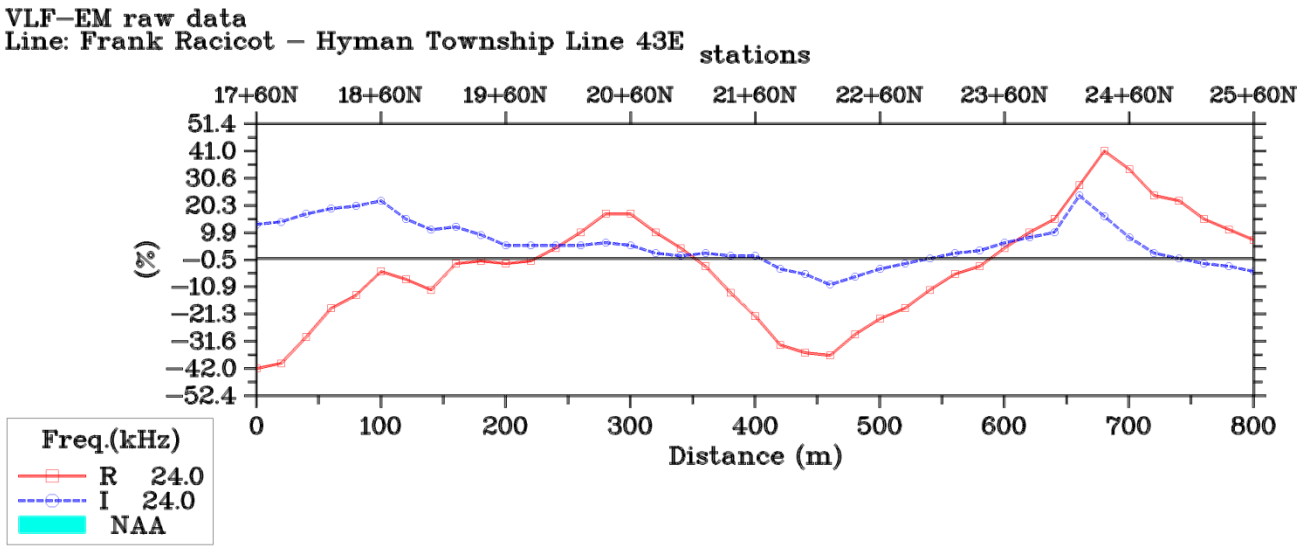
West Grid: Figure 1 Line 42E Raw Data Profile



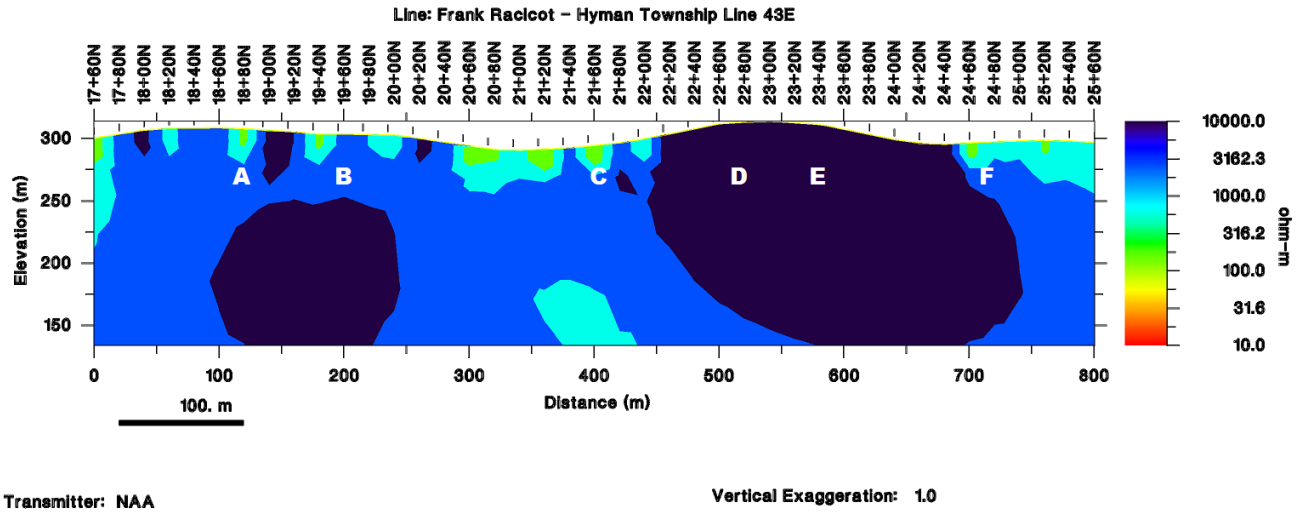
West Grid: Figure 2 Line 42E Model 2000 Ohm with Fraser Picks



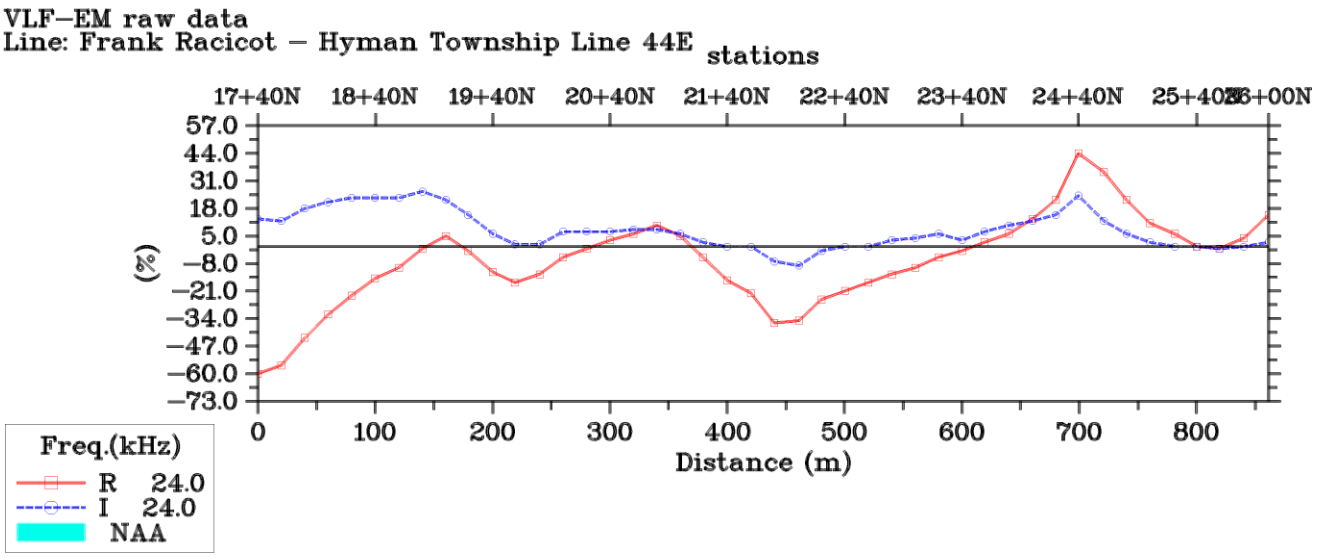
West Grid: Figure 3 Line 43E Raw Data Profile



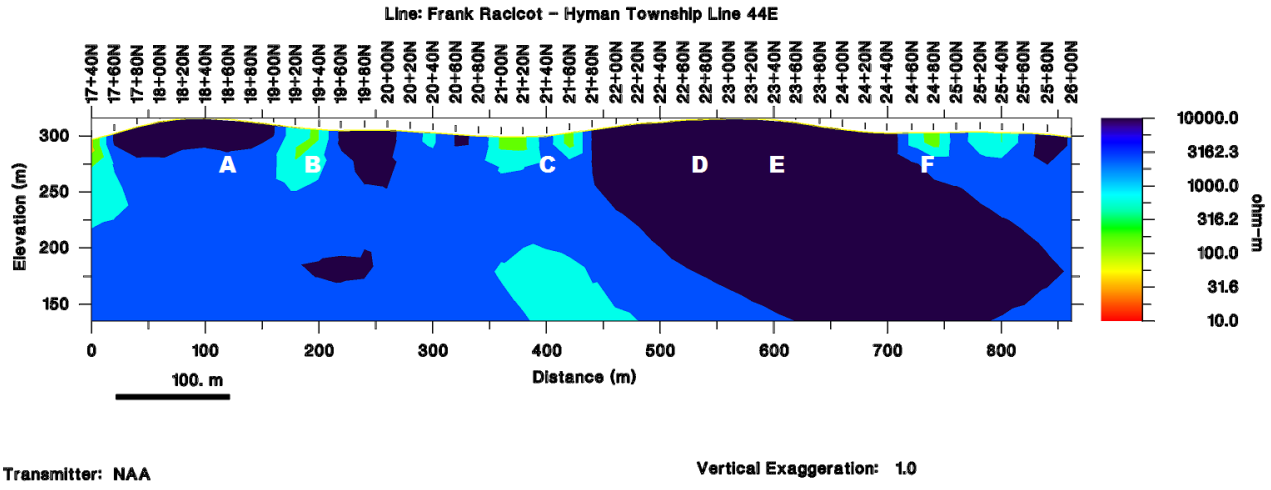
West Grid: Figure 4 Line 43E Model 2000 Ohm with Fraser Picks



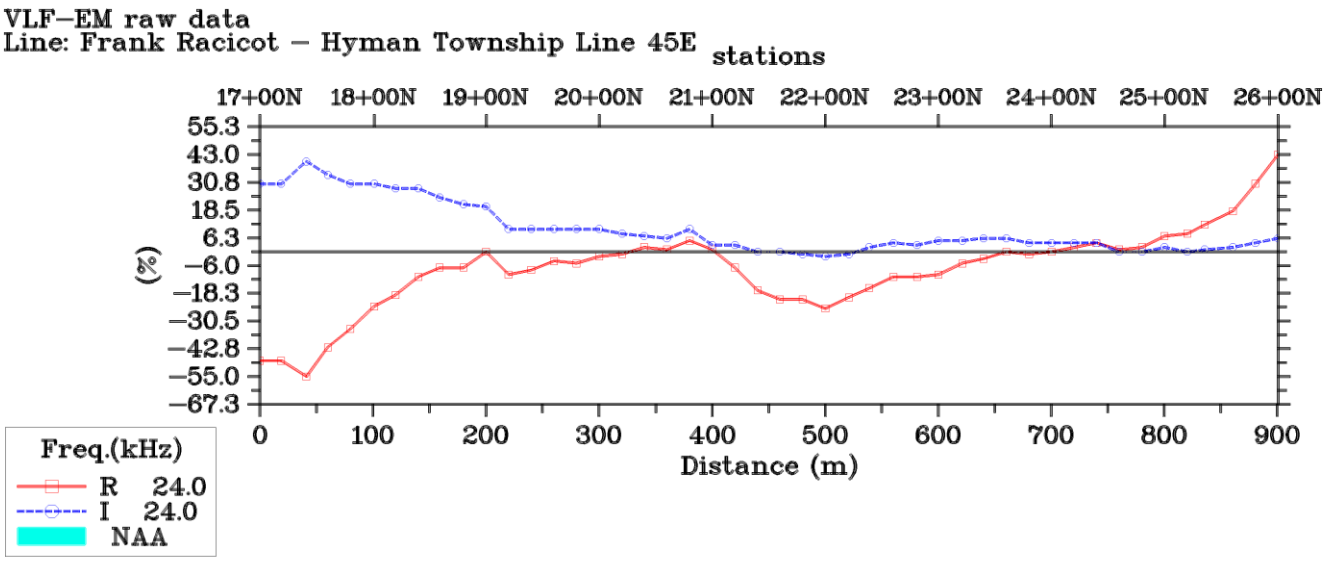
West Grid: Figure 5 Line 44E Raw Data Profile



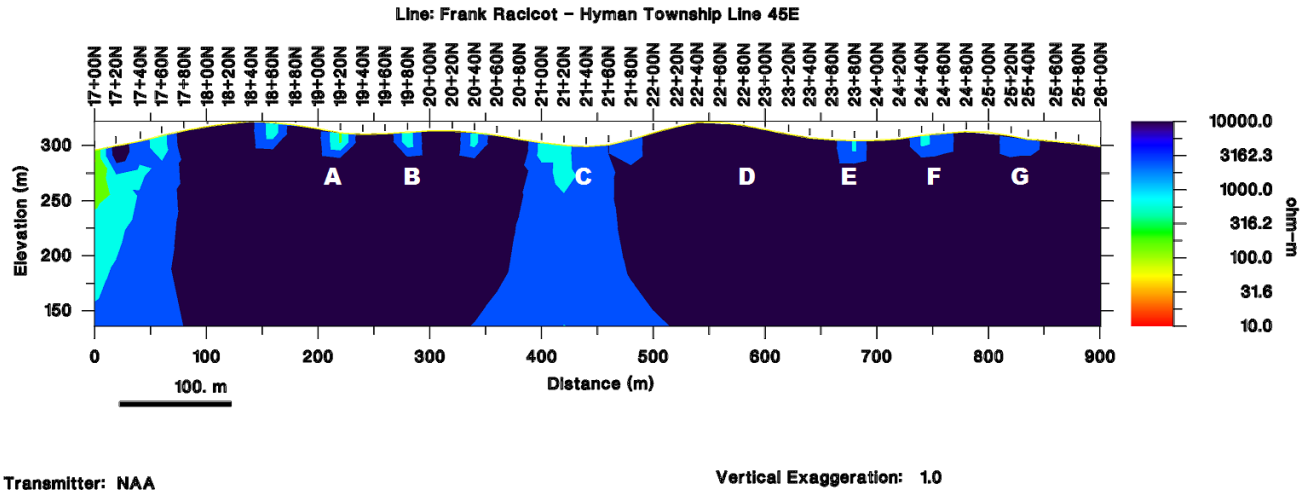
West Grid: Figure 6 Line 44E Model 2000 Ohm with Fraser Picks



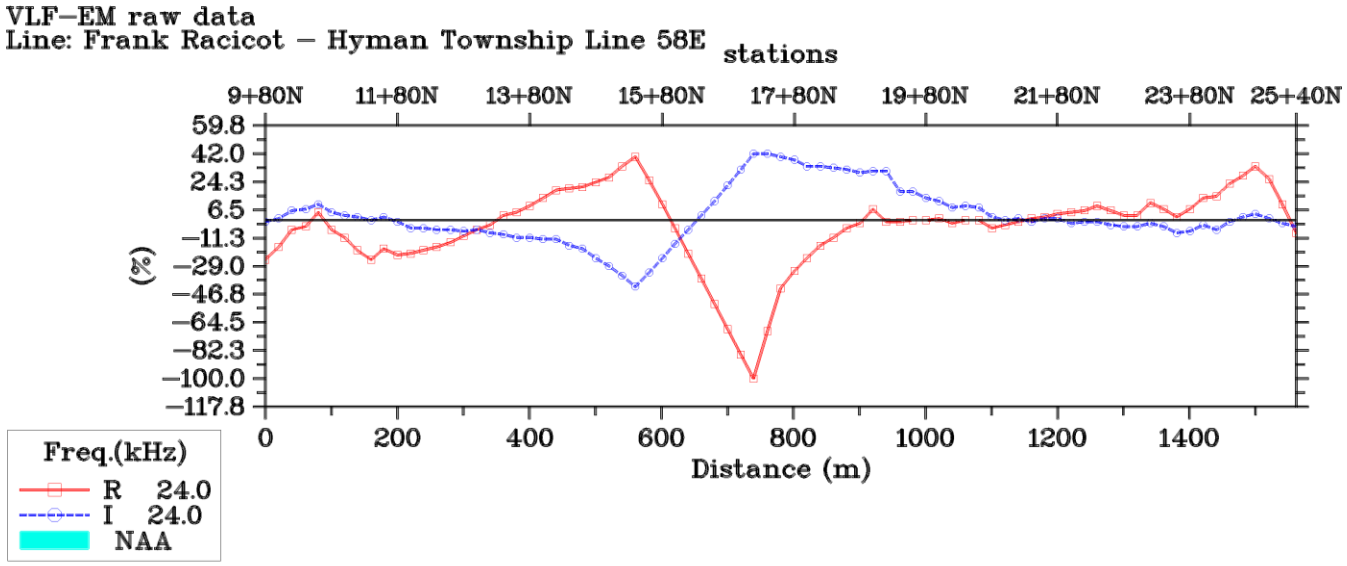
West Grid: Figure 7 Line 45E Raw Data Profile



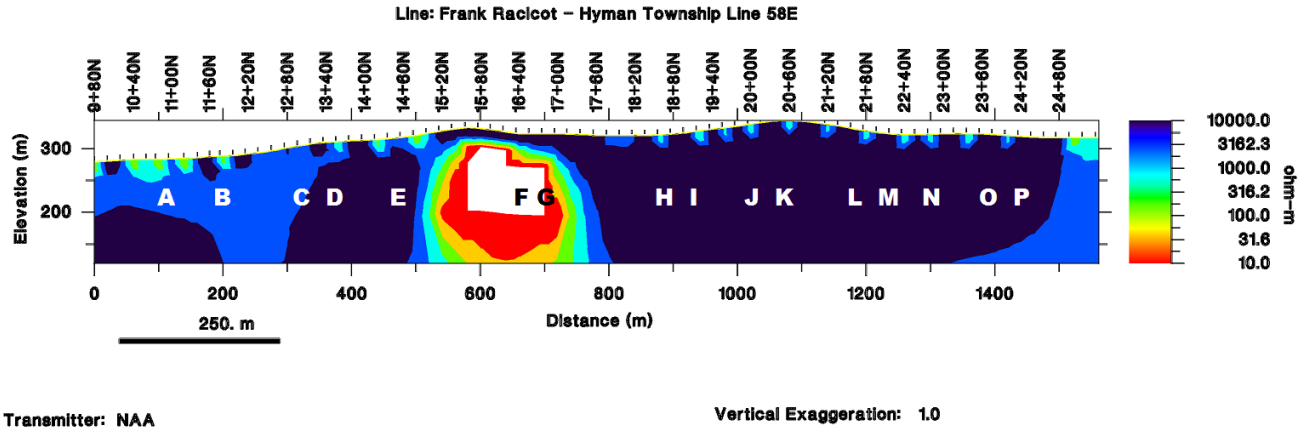
West Grid: Figure 8 Line 45E Model 2000 Ohm with Fraser Picks



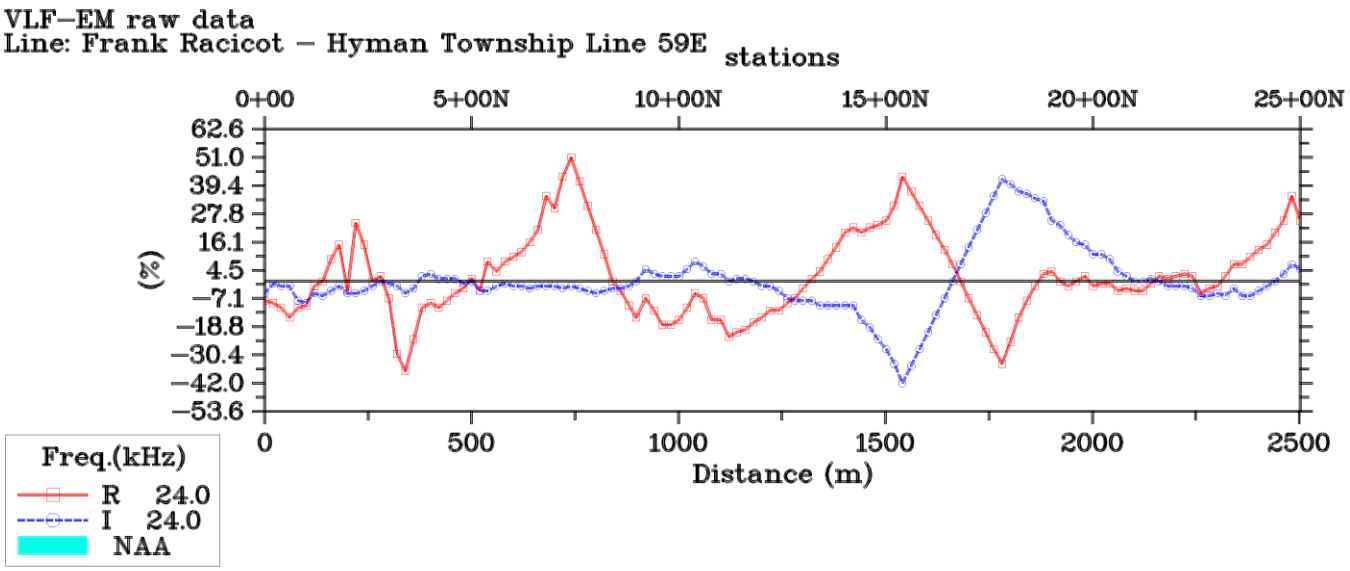
East Grid Figure 1 Line 58E Raw Data Profile



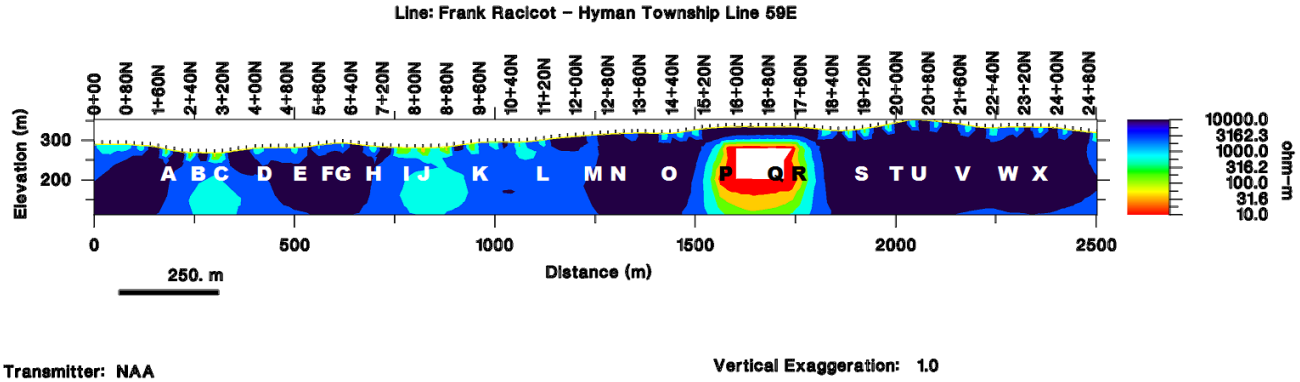
East Grid Figure 2 Line 58E Model 2000 Ohm with Fraser Picks



East Grid Figure 3 Line 59E Raw Data Profile



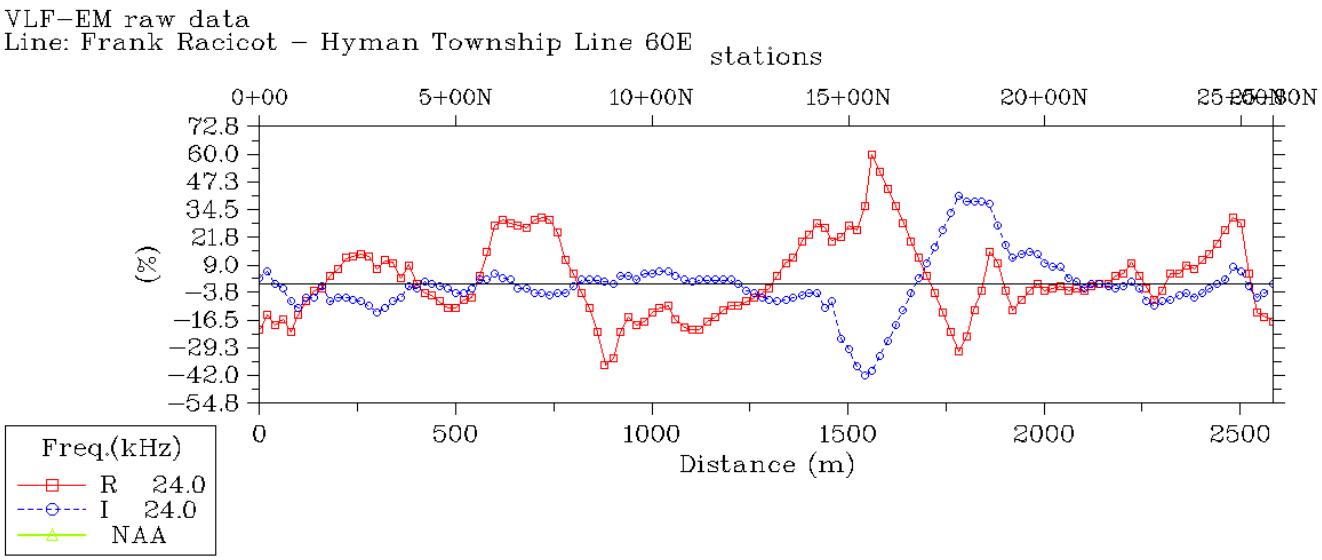
East Grid Figure 4 Line 59E Model 2000 Ohm with Fraser Picks



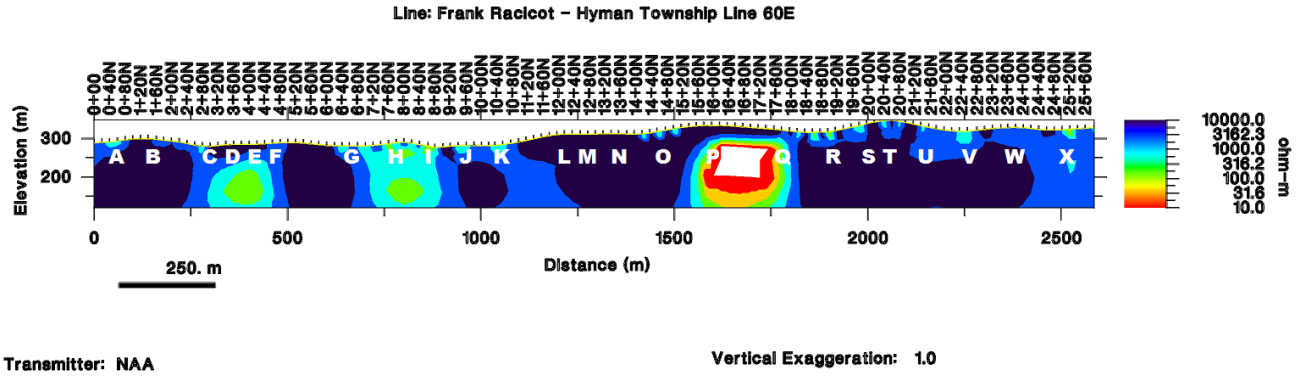
Transmitter: NAA

Vertical Exaggeration: 1.0

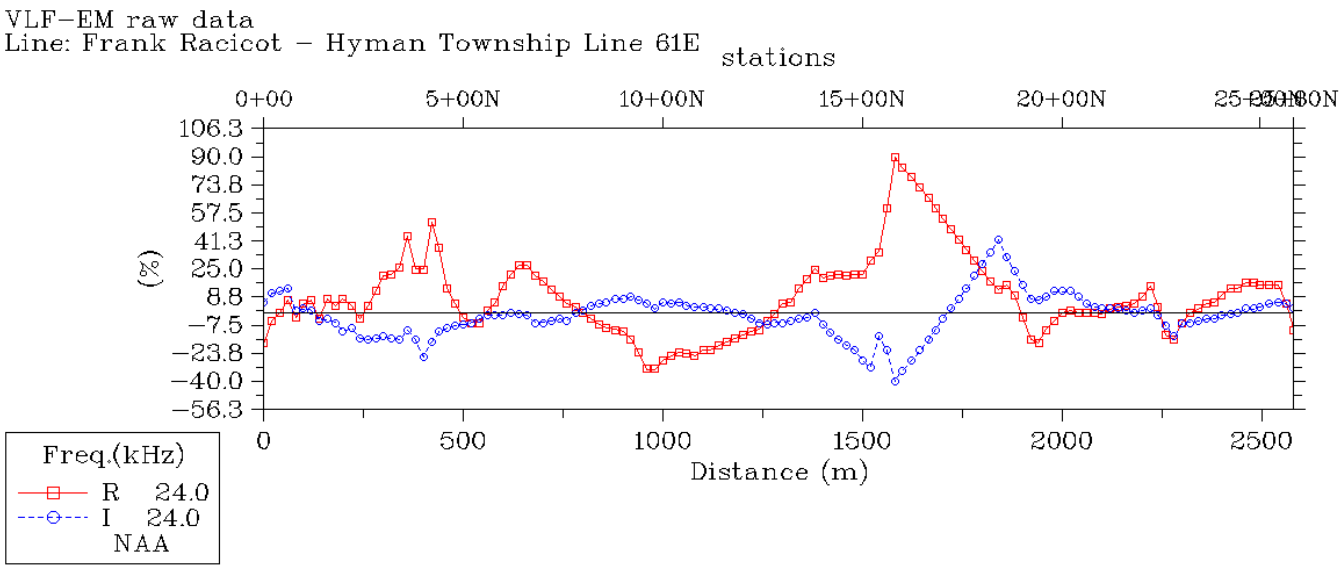
East Grid Figure 5 Line 60E Raw Data Profile



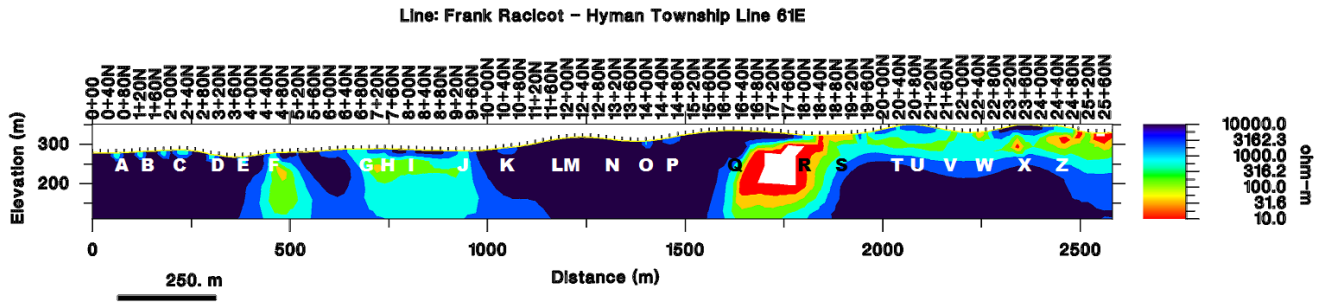
East Grid Figure 6 Line 60E Model 2000 Ohm with Fraser Picks



East Grid Figure 7 Line 61E Raw Data Profile



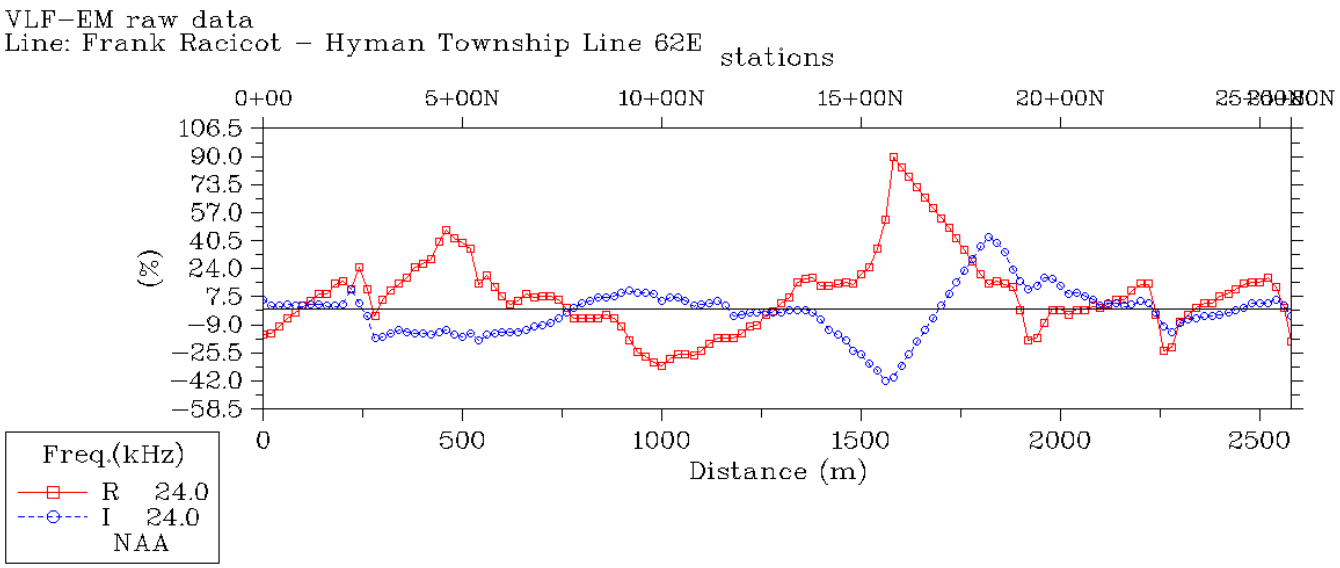
East Grid Figure 8 Line 61E Model 2000 Ohm with Fraser Picks



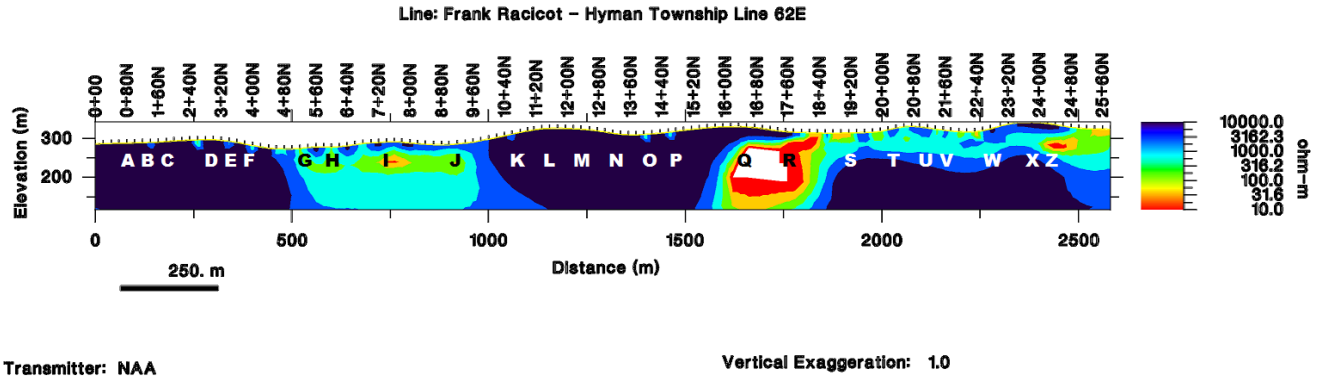
Transmitter: NAA

Vertical Exaggeration: 1.0

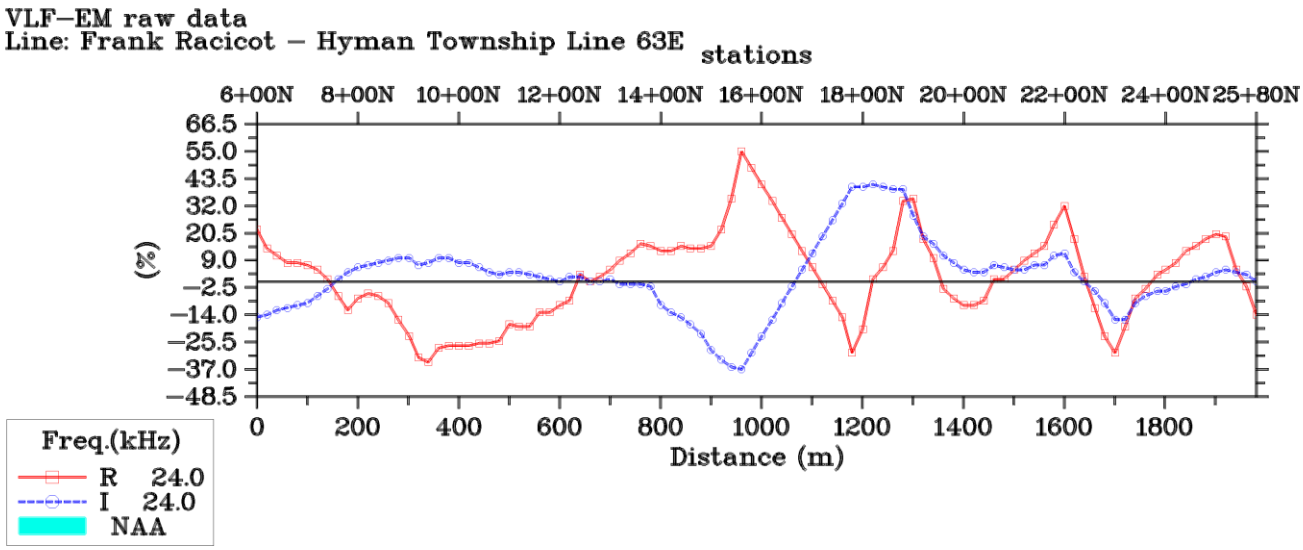
East Grid Figure 9 Line 62E Raw Data Profile



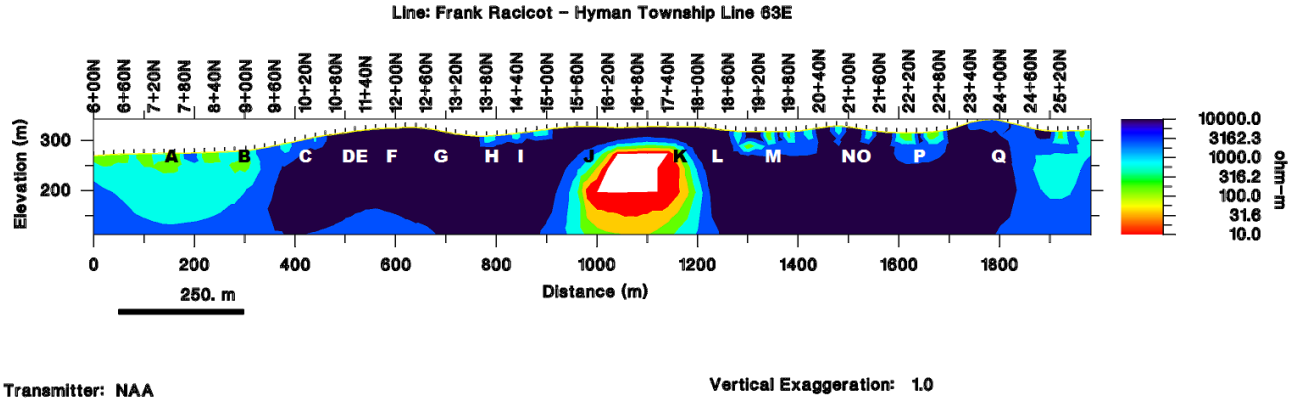
East Grid Figure 10 Line 62E Model 2000 Ohm with Fraser Picks



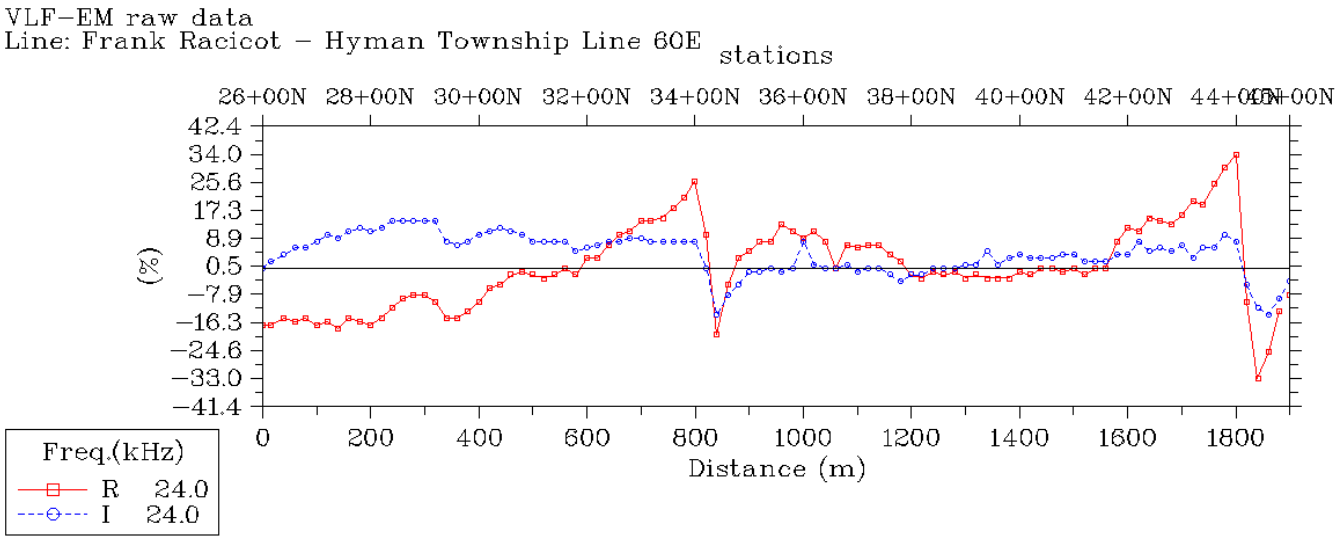
East Grid Figure 11 Line 63E Raw Data Profile



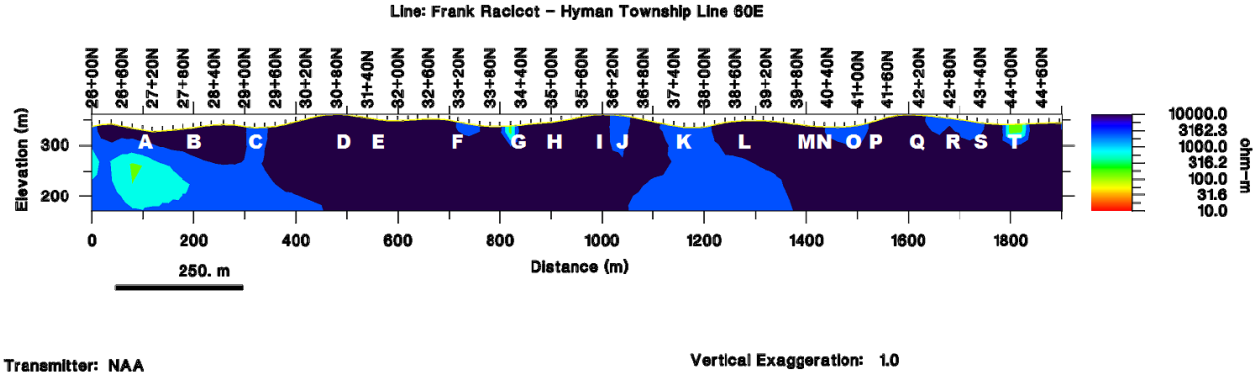
East Grid Figure 12 Line 63E Model 2000 Ohm with Fraser Picks



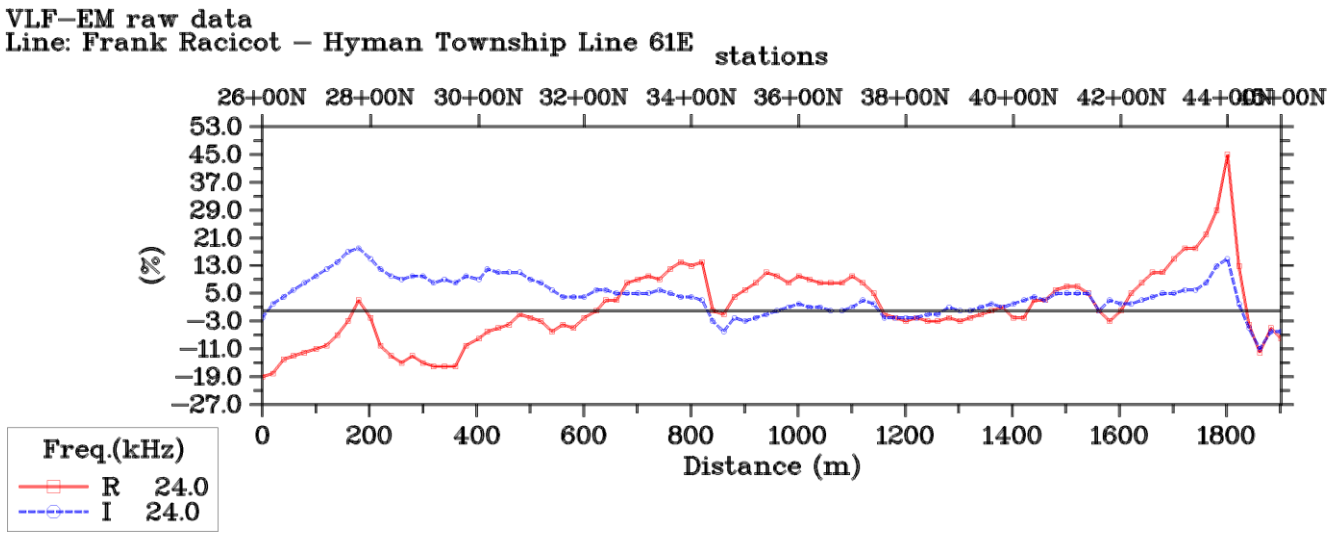
North Grid Figure 1 Line 60E Raw Data Profile



North Grid Figure 2 Line 60E Model 2000 Ohm with Fraser Picks



North Grid Figure 3 Line 61E Raw Data Profile



North Grid Figure 4 Line 61E Model 2000 Ohm with Fraser Picks