GROUNDWATER POTENTIAL INVESTIGATION AT PESTANA KRUGER LODGE

GEOPHYSICAL REPORT

VERSION 1

CLIENT: DERICK PEACOCK ASSOCIATES

DATE: 30 October 2019

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DISTRICT COUNCIL: Ehlanzeni

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DOCUMENT ISSUE STATUS

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Managing Director		

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APPENDIXES

1. INTRODUCTION

1.1 Background

In-Situ Consulting cc. was appointed by Mr. Derick Peacock, on the 17th of October 2019, to assist in the groundwater potential investigation at Pestana Lodge. A geophysical investigation was completed on the 25th of October 2019.

The aim of the investigations was to identify suitable hydrogeological features for the drilling of a production borehole(s) for domestic purposes.

1.2 Location

The area of investigation is located approximately 5km due north-east of Malelane in the Nkomazi Local Municipality, Mpumalanga Province. It falls on portion 21 of the farm Riverside 173JU according to the 1:50 000 topo-sheet 2531BC (Figure 1 – see Appendix A).

2. INFORMATION CONSULTED

- The Groundwater Resources of the Republic of South Africa Map. Borehole Prospects, sheet 1 (1995);
- The Hydrogeological Map Series of the Republic of South Africa, Nelspruit Map, 1999, scale 1:500 000;
- The 1:250 000, 2530 Barberton Geological Mapsheet, 1986;
- Colour satellite images, provided by Google Earth, 2018 AfriGis (PTY) Ltd. Image @ 2019 Maxar Technologies.

3. LOCAL GEOLOGY AND HYDROGEOLOGICAL CONDITIONS

3.1 General Geology

The area of investigation is underlain by basaltic and peridotitic komatiite, tholeiite, chemical sediments, various mafic and ultramafic schists interlayered with banded iron formation and ferruginous, black, white and grey chert or acid to intermediate volcanic rocks (Zt) which is a combination of the Komati and Theespruit Formations of the Onverwacht Subgroup that form part of the Barberton Sequence. According to the geology map the north-western corner of the investigation area falls on the contact zone between the Komati and Theespruit Formations and Nelspruit Suite. The Nelspruit Suite intrusive rocks are described as grey to white, coarse-grained granite (Zn).

Figure 3, attached in Appendix A, shows a portion of the 1:250 000 Barberton Geological map, indicating the study area.

3.2 Hydrogeological Conditions

Groundwater is usually associated with the following geological features within hard rock terrain:

- Deeply weathered zones underlain by competent, hard bedrock with water being found on the contact zone;
- Secondary fractures found within the hard rock; aperture widths vary from millimetres to meters and may or may not contain groundwater;
- Contact zones found between the country rock and intrusions such as dykes and sills.

Published hydrogeological maps were studied in order to obtain a better understanding of the expected groundwater and geological conditions of the investigation area (see Information Consulted, Section 2).

From these sources of groundwater information, it was concluded that:

- The aquifer type is intergranular and fractured;
- The average borehole yields range from 2.0 to 5.0L/s;
- The probability of drilling a borehole with a yield greater than 2L/s (exploitability) range from 20 to 30% and the probability of drilling a successful borehole (accessibility) range from 40 to 60%.

4. GEOPHYSICAL INVESTIGATION

Geophysical investigations are based on the principal of mapping sub-surface geology by measuring contrasts in physical properties of earth materials. In order to identify possible intrusions, faults or deeply weathered zones usually associated with groundwater occurrence in weathered and fractured bedrock, a geophysical survey was conducted on the terrain. The geophysical methods used on site are briefly discussed in the following paragraphs:

THE SCINTREX ENVI GEOPHYSICAL SYSTEM

A SCINTREX ENVI Geophysical System was used to acquire ground magnetic and electro-magnetic (EM) data. The magnetic data aids in sub-surface lithological mapping, as the magnetometer measures localized fluctuations in the earth's magnetic field caused by more (or less) magnetic rock types. Intrusive lithology's (e.g. dolerite dykes) normally have much higher magnetite content than sedimentary or metamorphic rocks, leading to distinct magnetic anomalies.

ELECTROMAGNETIC (EM) CMD-DUO AND GEONICS EM-34-3

The apparent conductivity of the underlying geology was measured using an EM-34-3, a horizontal loop frequency domain electromagnetic instrument. Anomalies in the field data indicate lateral changes in the conductivity and facilitate the detection of conductor type targets.

The 20 and 40m cable spacing with horizontal and vertical coil configurations were used to investigate the various depths of the resistive terrains by measuring small changes in conductivity – that is 5 to 10 mS/m.

5. DATA INTERPRETATION AND DRILLING TARGET SELECTION

A total of eigh (8) traverses (donated PES-1 to PES-8), with a combined line length of 1 990 metres, were conducted on the 25th of October 2019. Magnetic data was collected at a continuous rate yielding data points at one-meter intervals along each traverse and EM measurements were collected at 10 meters intervals, where possible; EM measurements was difficult to obtain due to electrical interferences.

The data was transferred to PC, and the resultant profiles analysed in isolation and in combination. From detailed analyses, drill locations were selected on the following criteria:

- The anomalies were not caused by man-made structures (i.e. fences, power lines, telephone lines, etc.);
- The anomalies were not caused by excessive terrain effects;
- The EM and magnetic data complimented each other;
- The results were plausible and interpretations geologically sound;
- The results of the survey showed that there is no predominant pattern to the magnetic measurements.

Hard copy results of the 2-dimensional geophysical graphs are attached as Appendix B. Details of the geophysical traverses, methods, site locations and types are indicated in Table 1 below and figure 2 (site maps - attached in Appendix A).

Table 1: *Geophysical Traverses and Proposed Borehole Sites*

Drill Target	Coordinates (S)	Coordinates (E)	Geophysical Method	Geological Site Type / Target	Priority
PES-1-70	-25.461520°	31.536960°	Magnetic and Electromagnetic	Diabase Dyke / Fracturing	4
PES-2-115	-25.461011°	31.537712°	Magnetic and Electromagnetic	Contact Zone	1 (not pegged)
PES-2-150	-25.460745°	31.537547°		Fracturing	3*
PES-3-15	-25.460537°	31.539431°	Magnetic and Electromagnetic	Fracturing & Weathering	5
PES-3-90	-25.460112°	31.538838°		Fracturing	8
PES-4	No targets				
PES-5-234	-25.460545°	31.538804°	Magnetic and Electromagnetic	Fracturing	7
PES-6	No targets				
PES-7-237	-25.461780°	31.539297°	Magnetic and Electromagnetic	Fracturing	6
PES-8-110	-25.463248°	31.537859°	Magnetic and Electromagnetic	Diabase Dyke Contact	2

* Priority 3 should not be drilled if priority 1 is successful due to their close proximity.

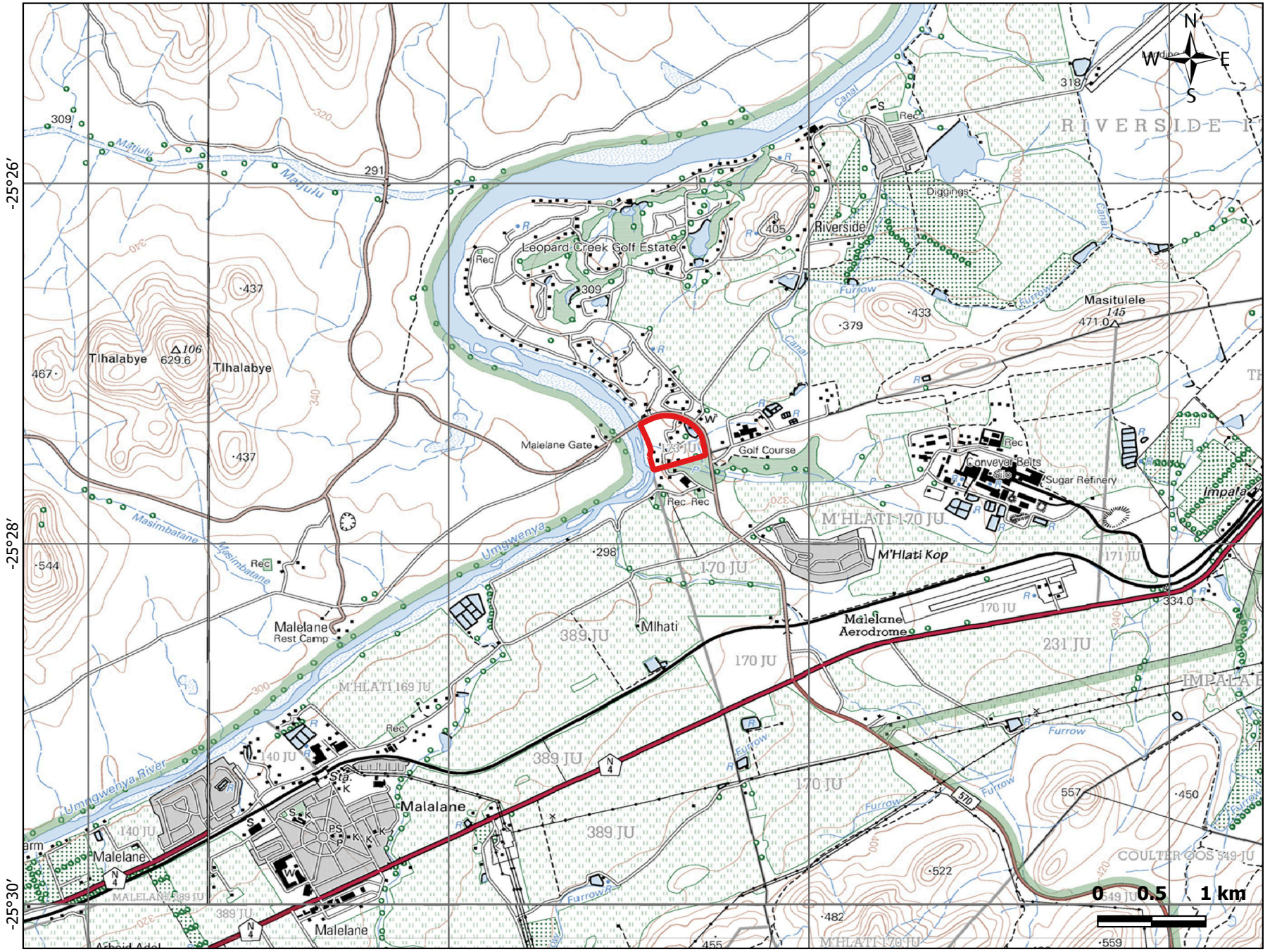
6. RECOMMENDATIONS

- Please note the geophysical survey did not yield very positive results, although there are a few anomalies that might be drilled.
- If the client decides to drill it is recommended that new boreholes be drilled according to the above-mentioned priorities (see table 1) to a minimum depth of 120 meters. Before drilling any of the priorities the positions should be verified to be free of any services (power cables, waterpipes, storm water pipes etc.).
- When the drilling of a new boreholes is implemented, provision need to be made for drilling supervision to ensure that the drilling standards comply with the SANS 10299-2:2003 directive which is presented as the *Development, Maintenance and Management of Groundwater Resources:* Part 2: The design, construction and drilling of boreholes. Drilling records need to be recorded by a competent person as this data must accompany the DWAF application form to utilize the groundwater resources.
- Borehole test pumping should be conducted by experienced test pumping contractors in accordance to the test pumping procedures as set out in the document: - *Development, Maintenance and Management of Groundwater Resources –Part 4: Test-Pumping of water boreholes; SA Code of Practice.*
- Even though In-Situ Consulting have used the above-mentioned geophysical techniques for many years and have great trust in these methods; it would be impossible to guarantee that groundwater will be intercepted, as the equipment indicates optimal geological structures and not water itself. Unfortunately, not all geological structures are water bearing; the use of the equipment does however greatly improve the chances of success and we have been extremely successful in the past.

APPENDIX A

FIGURES

FIGURE 1. Locality - Pestana Kruger Lodge:



LEGEND:

- Investigation Area
- Main Roads
- Secondary Roads
- Other Roads
- Railway
- Farm Boundaries
- Perenial River
- Non-perenial River

AREA OF DETAIL - NKOMAZI L/M

SCALE & PROJECTION

Gauss Conform Projection
Central meridian 31° East
Clarke 1880 Spheriod

Ref: 1:50 000 Topo-sheets 2531BC

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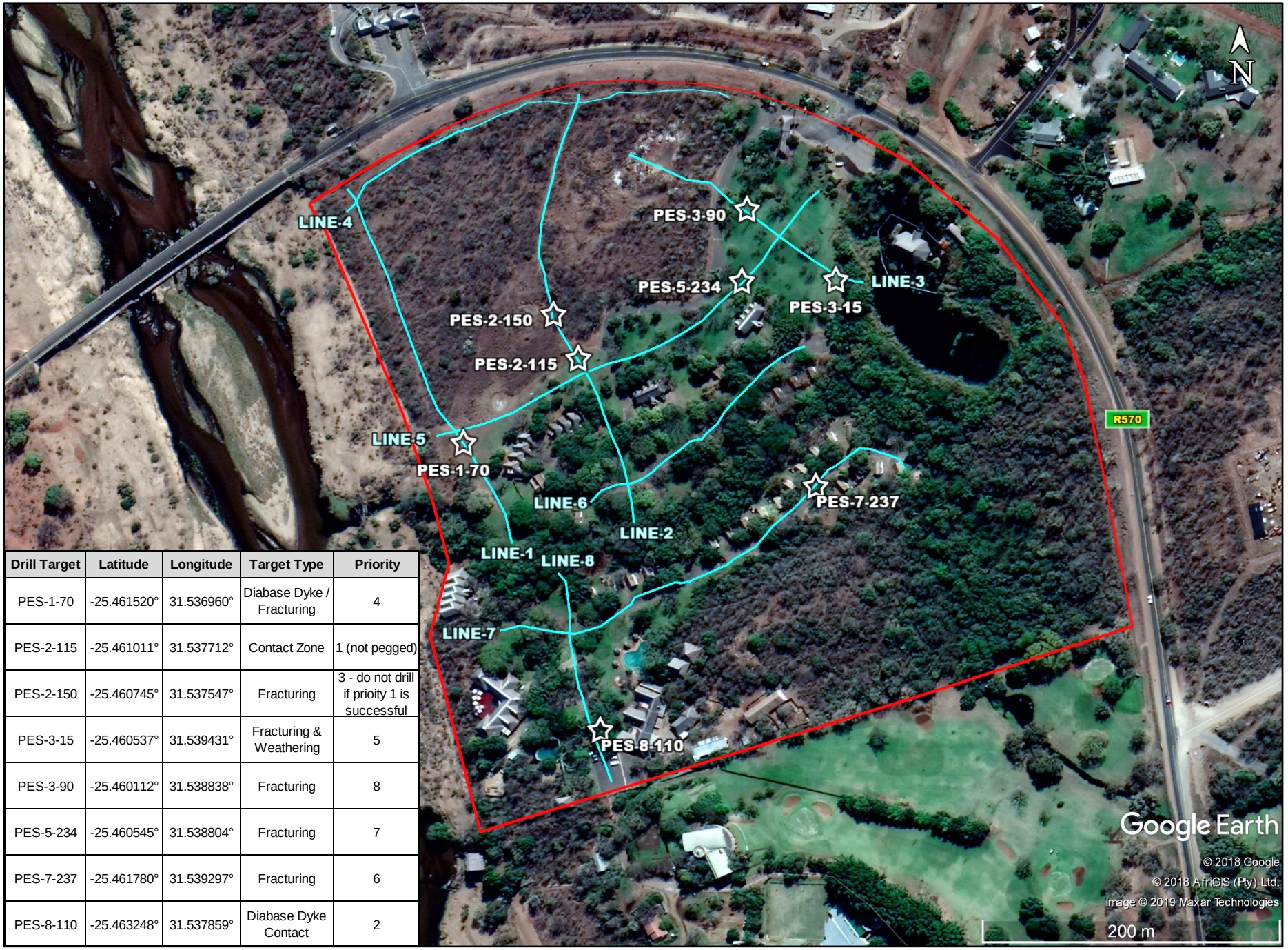
FIGURE 2. Site Map – Pestana Kruger Lodge – Geophysical Investigation:



Drill Target	Latitude	Longitude	Target Type	Priority
PES-1-70	-25.461520°	31.536960°	Diabase Dyke / Fracturing	4
PES-2-115	-25.461011°	31.537712°	Contact Zone	1 (not pegged)
PES-2-150	-25.460745°	31.537547°	Fracturing	3 - do not drill if prioity 1 is successful
PES-3-15	-25.460537°	31.539431°	Fracturing & Weathering	5
PES-3-90	-25.460112°	31.538838°	Fracturing	8
PES-5-234	-25.460545°	31.538804°	Fracturing	7
PES-7-237	-25.461780°	31.539297°	Fracturing	6
PES-8-110	-25.463248°	31.537859°	Diabase Dyke Contact	2

LEGEND:

- Investigation Area
- Geophysical Line
- Drill Target

MAP REFERENCE:
Colour satellite images, provided by Google Earth, 2019 AfriGis (PTY) Ltd. Image @ 2019 Maxar Technologies

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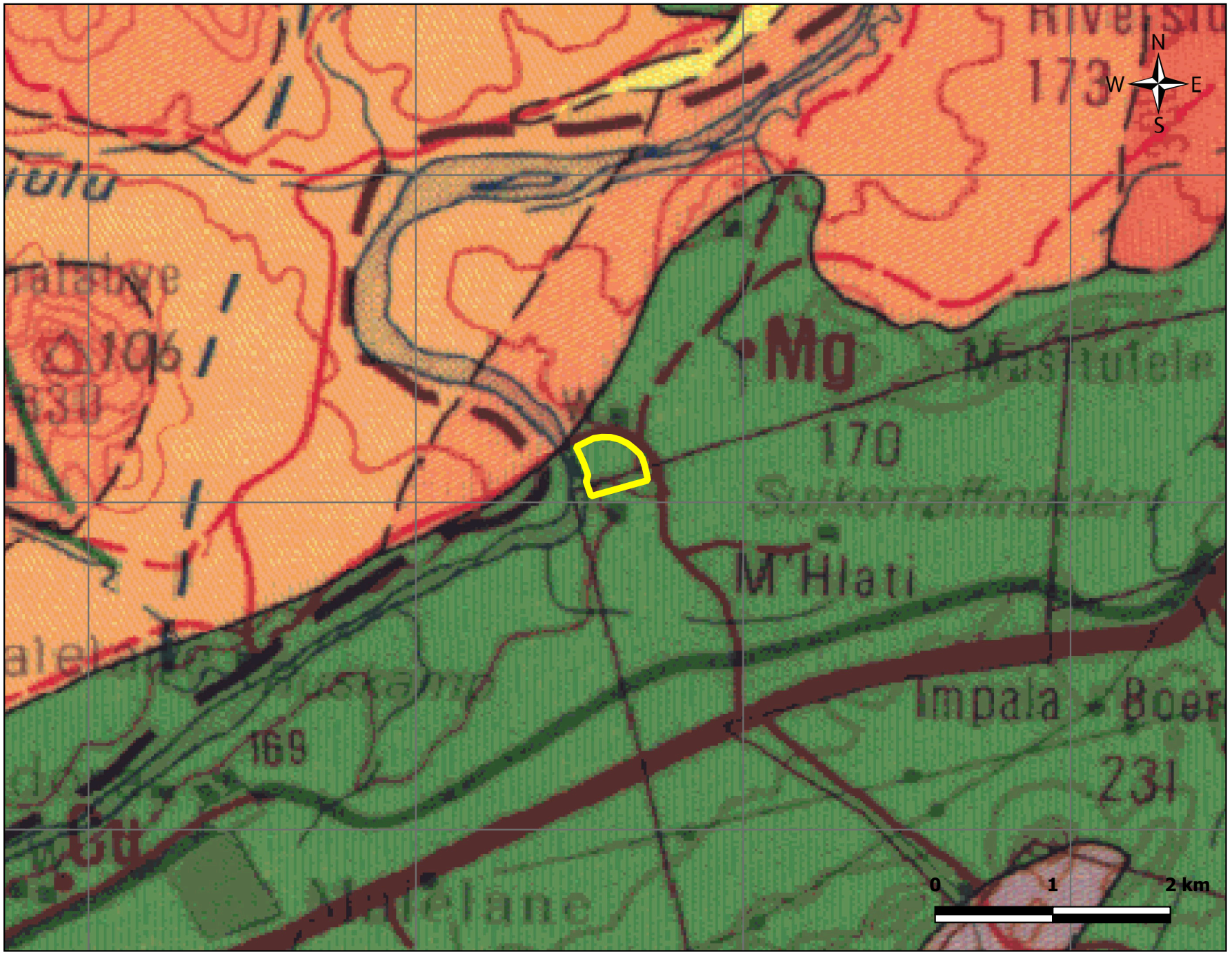
FIGURE 3. General Geology - Pestana Kruger Lodge:



LEGEND:

- Investigation Area
- Main Roads
- Secondary Roads
- Other Roads
- Railway
- Farm Boundaries
- Perennial River copy
- Non-perennial River
- Linear Features
- Diabase Dyke
- Zn — Biotite Granite
- Zg — Biotite-trondhjemite gneiss
- Zt — Komatiite, tholeiite, chemical sediment, schists interlayered with banded iron formation, chert and volcanic rocks

SCALE & PROJECTION

Gauss Conform Projection
Central meridian 31° East
Clarke 1880 Spheriod

Ref: 1:250 000 Geology Map
2530 Barberton

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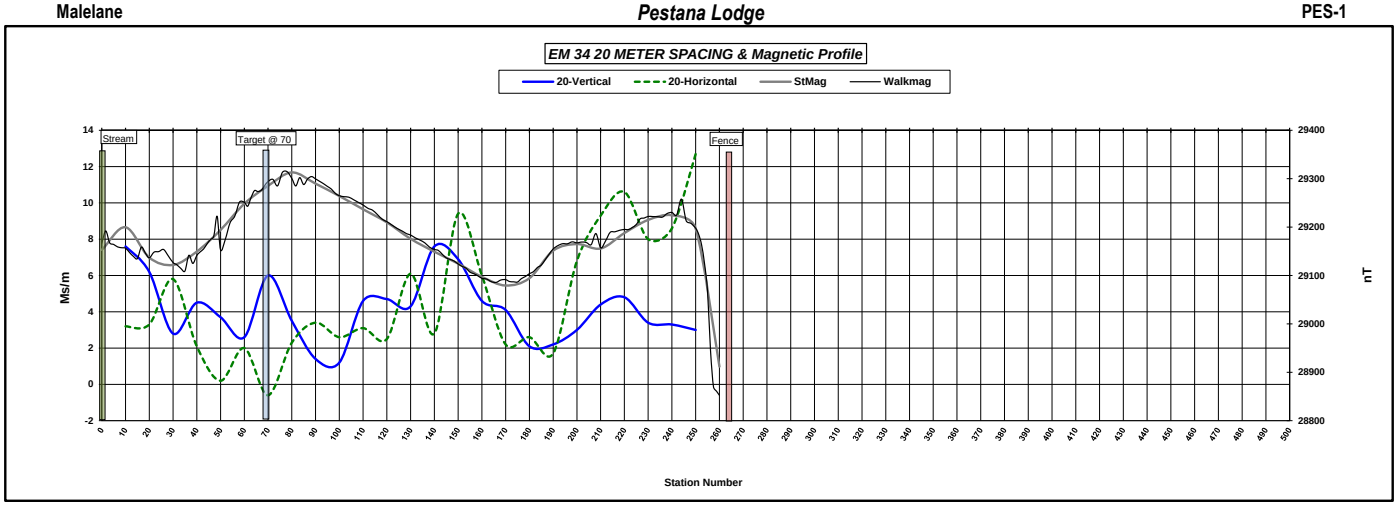
APPENDIX B

GEOPHYSICAL TRAVERSE DATA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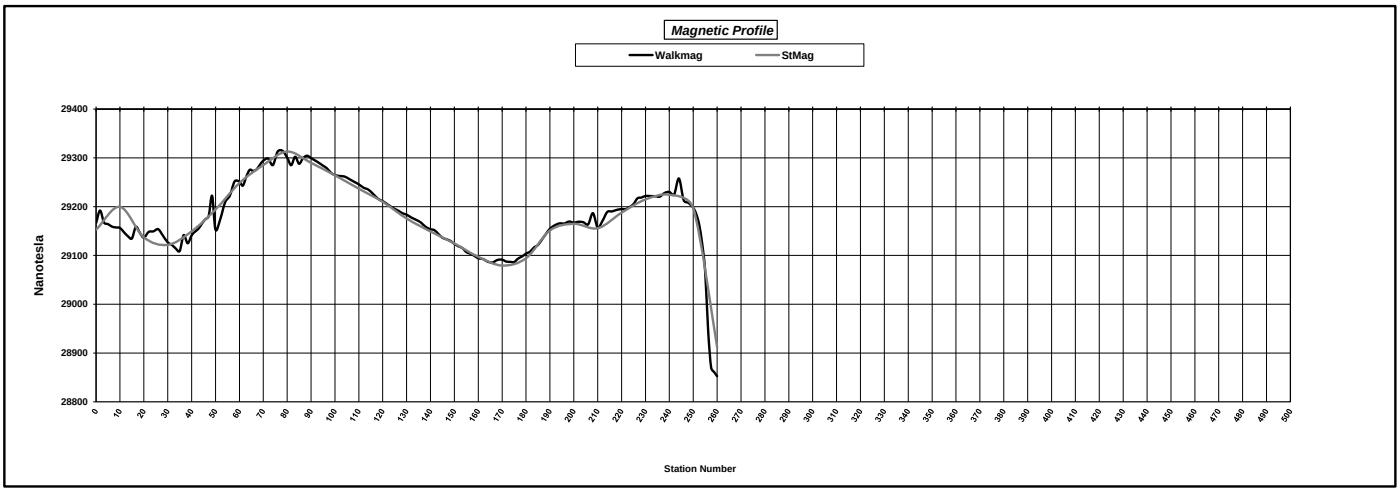
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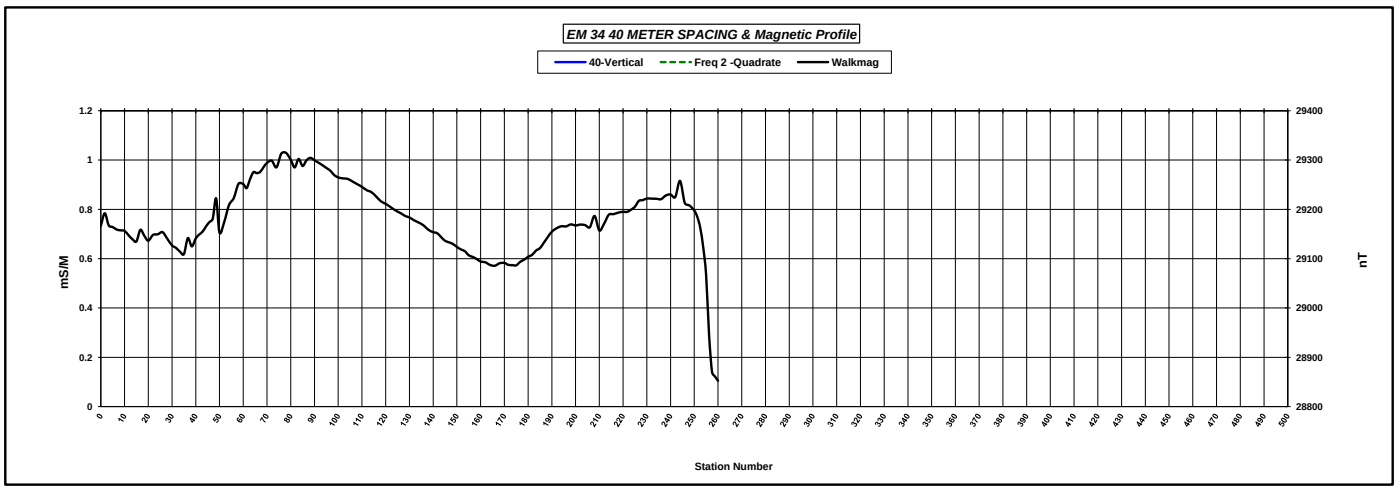
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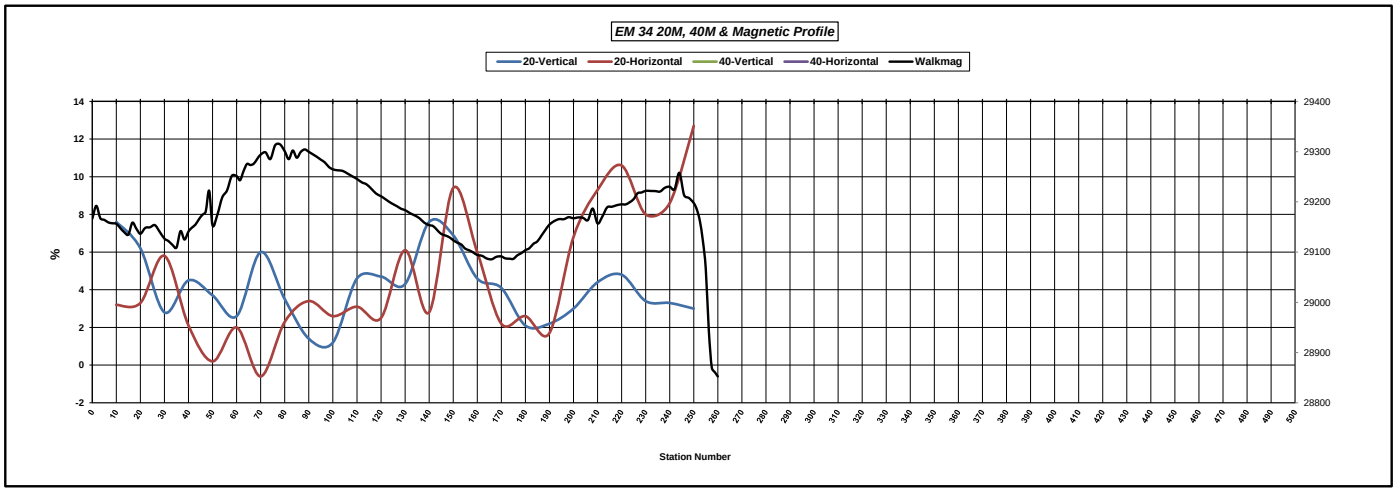
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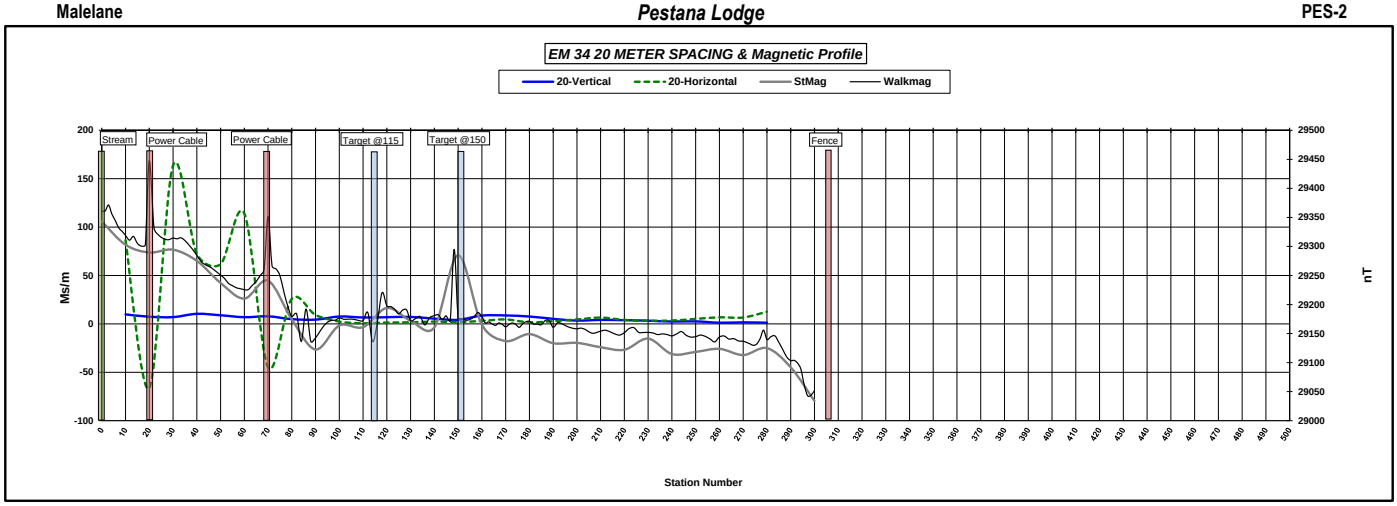
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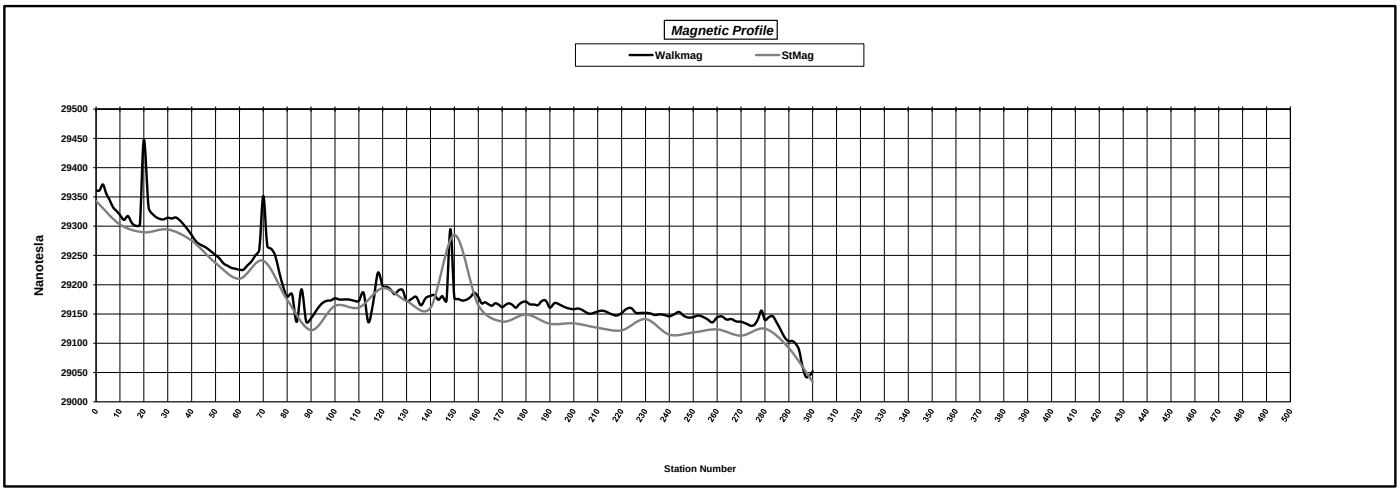
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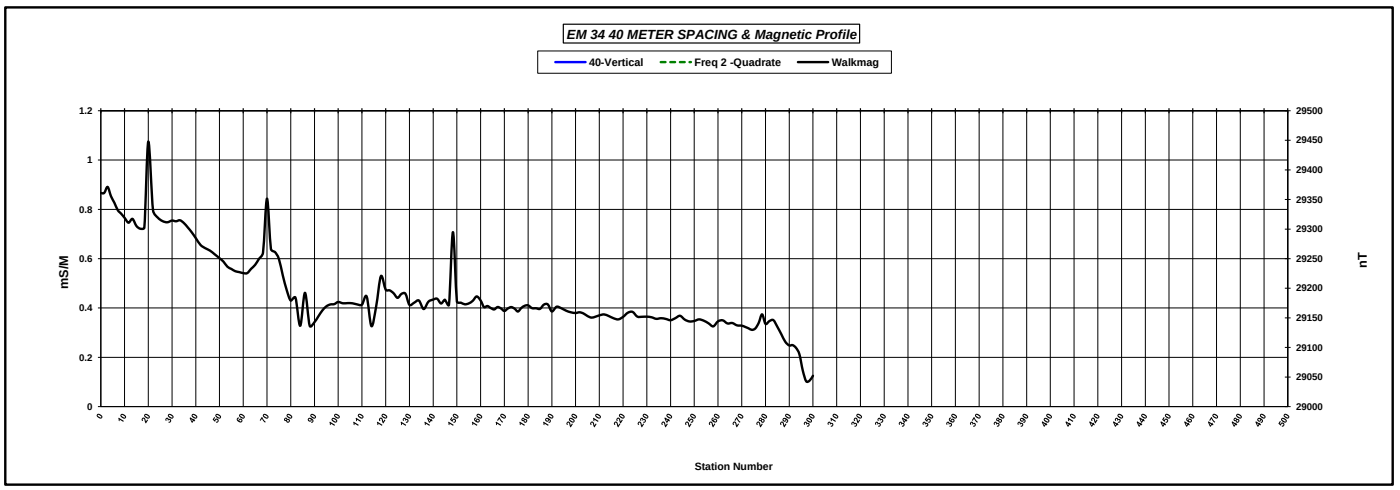
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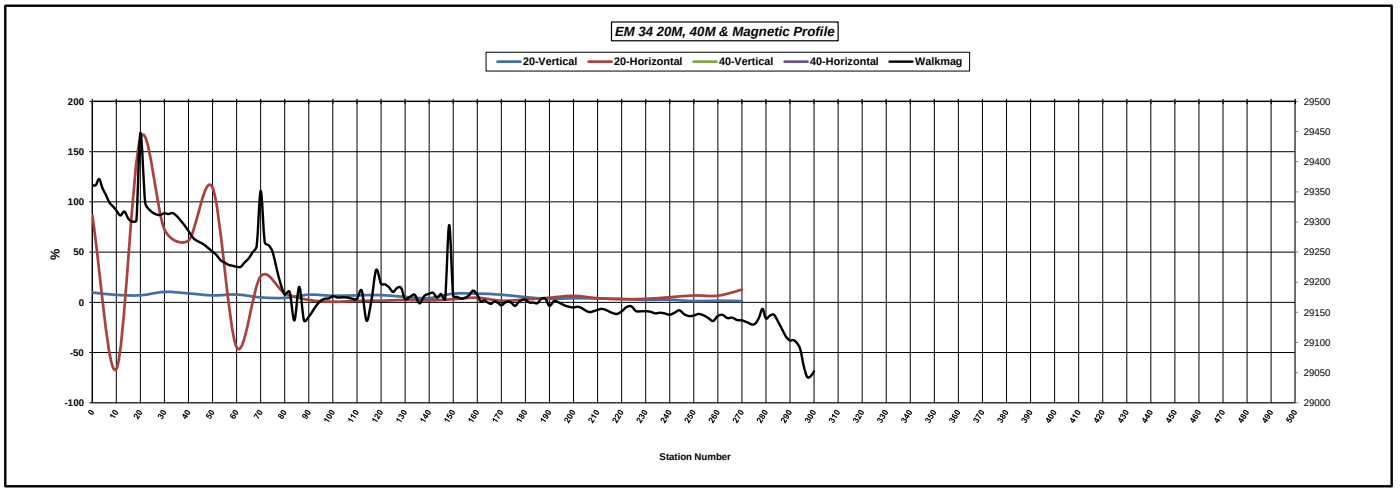
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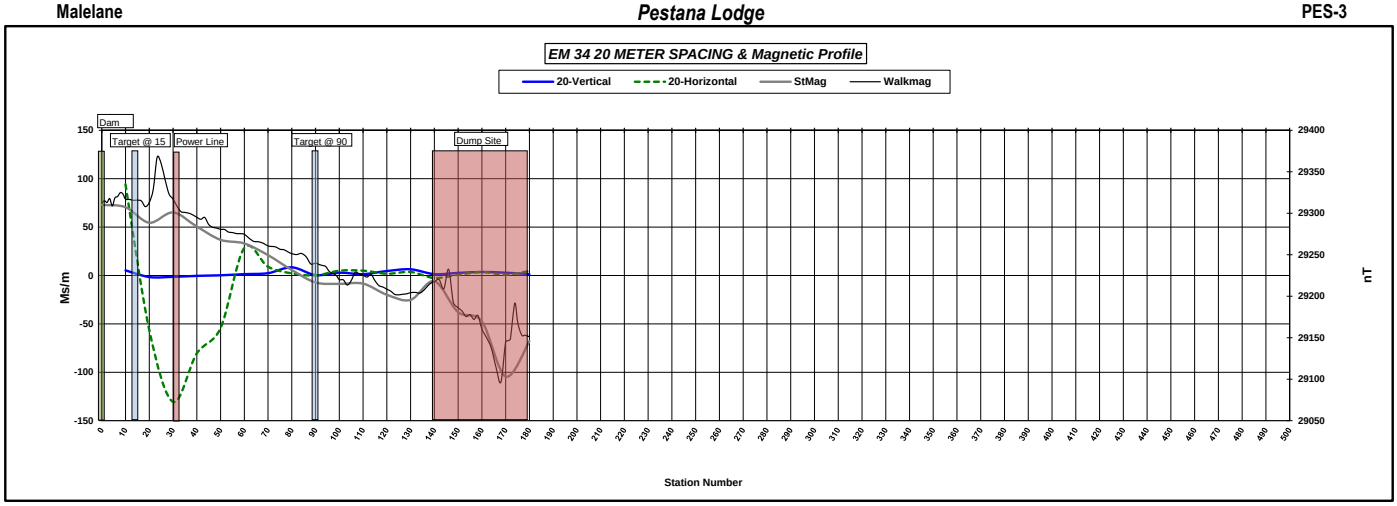
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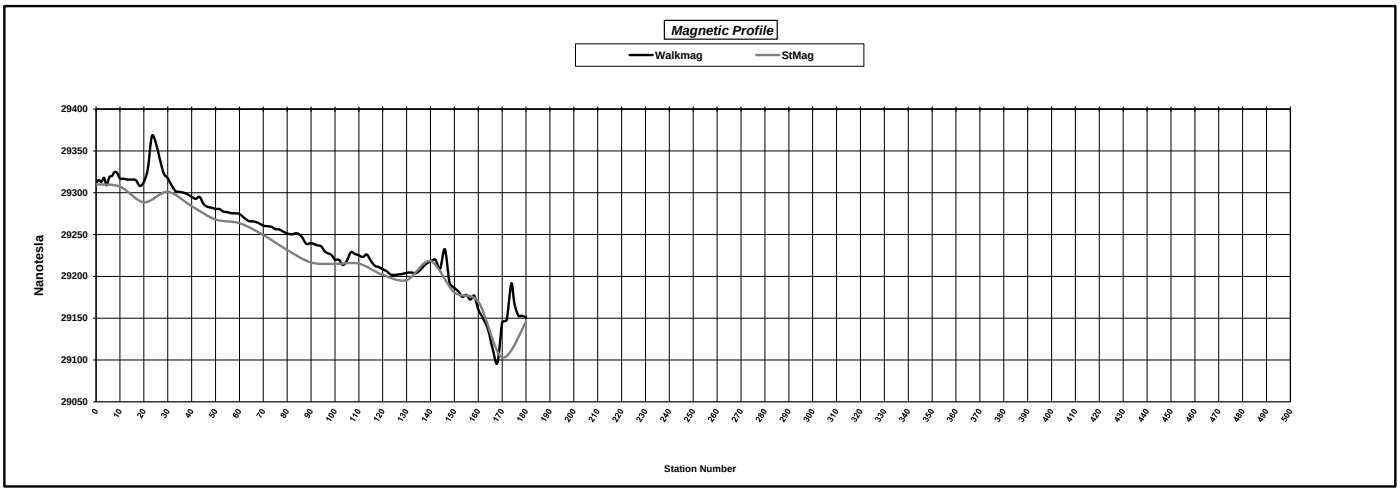
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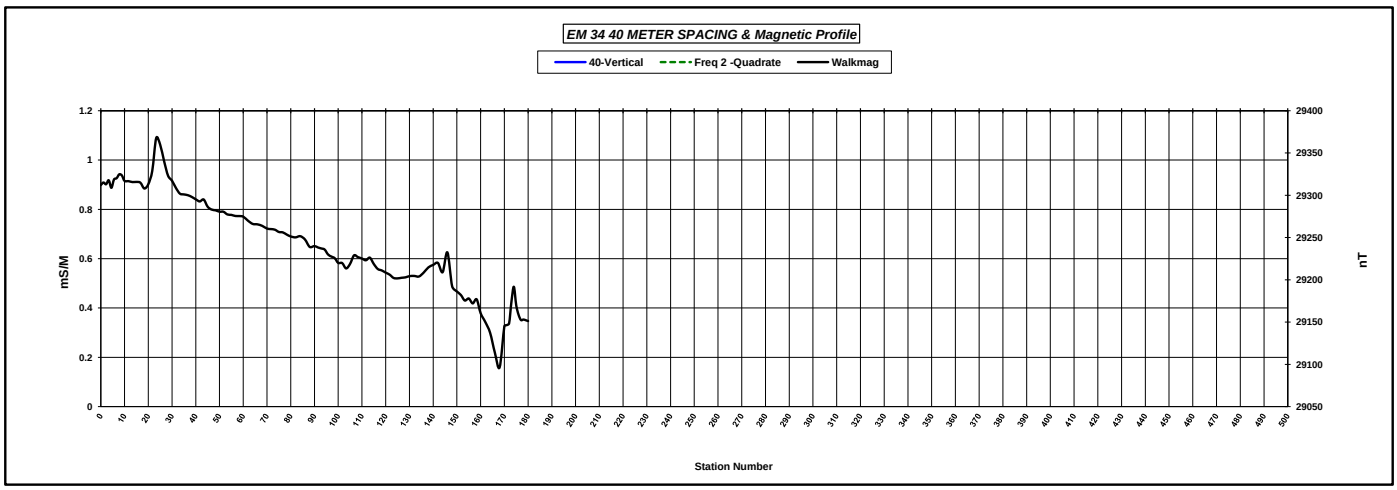
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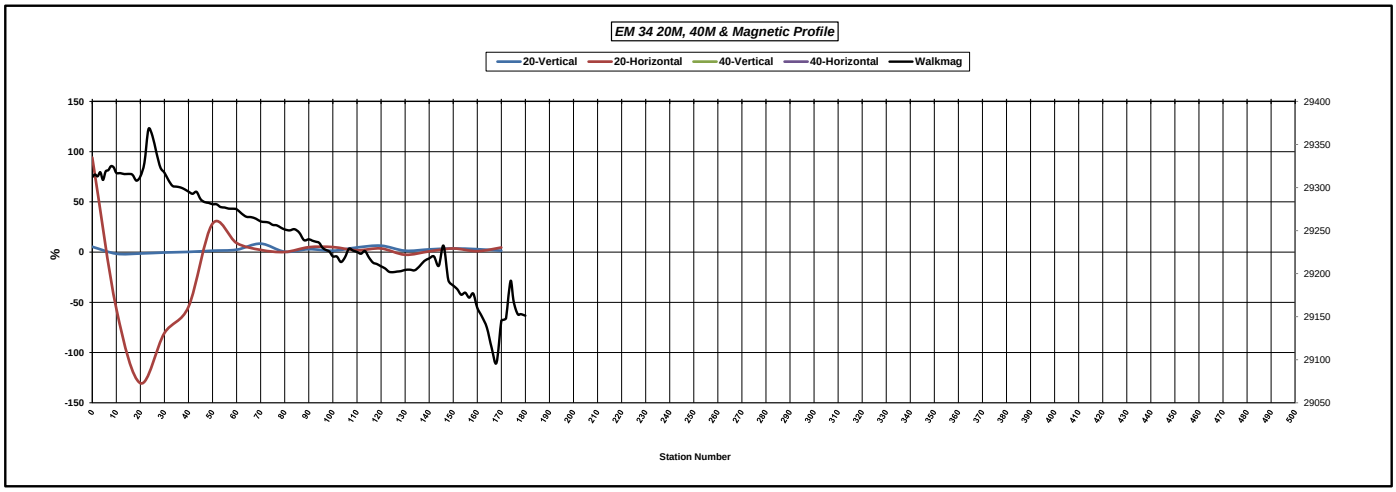
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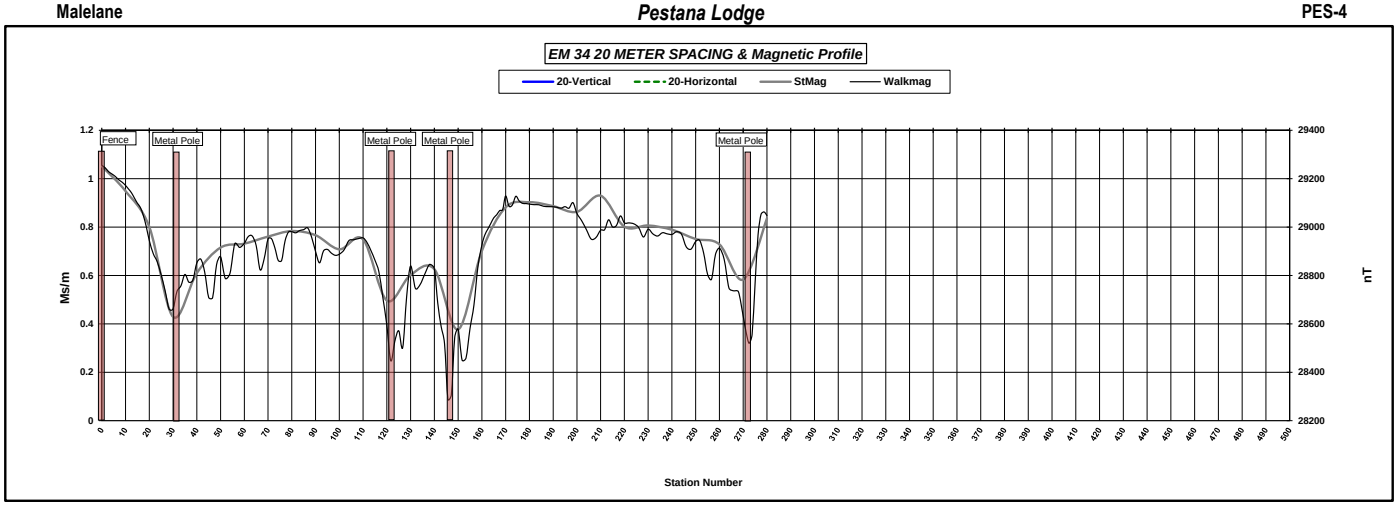
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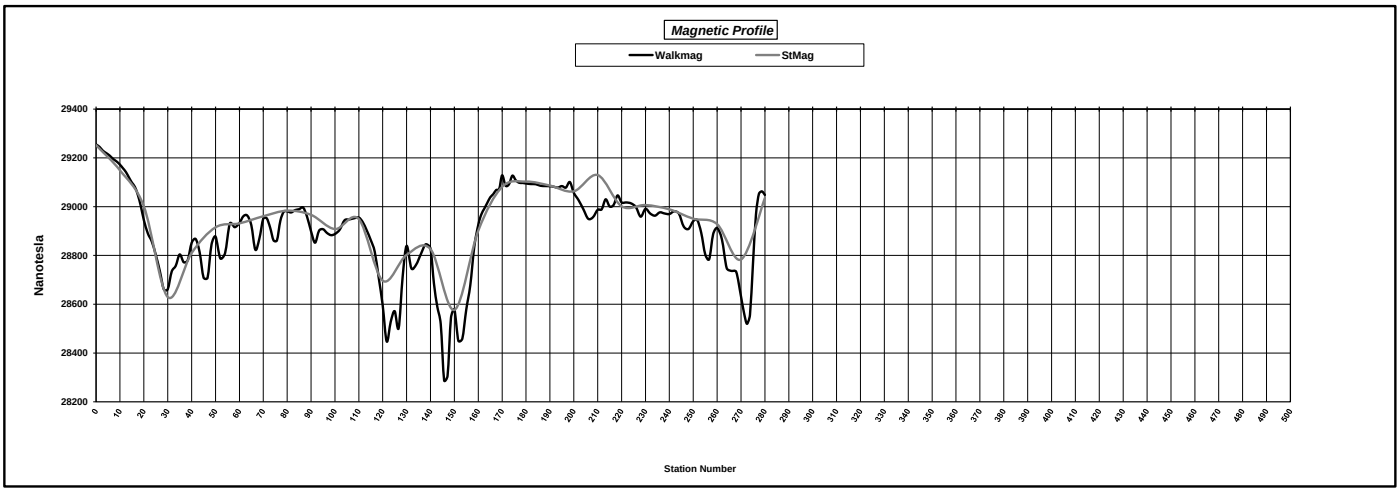
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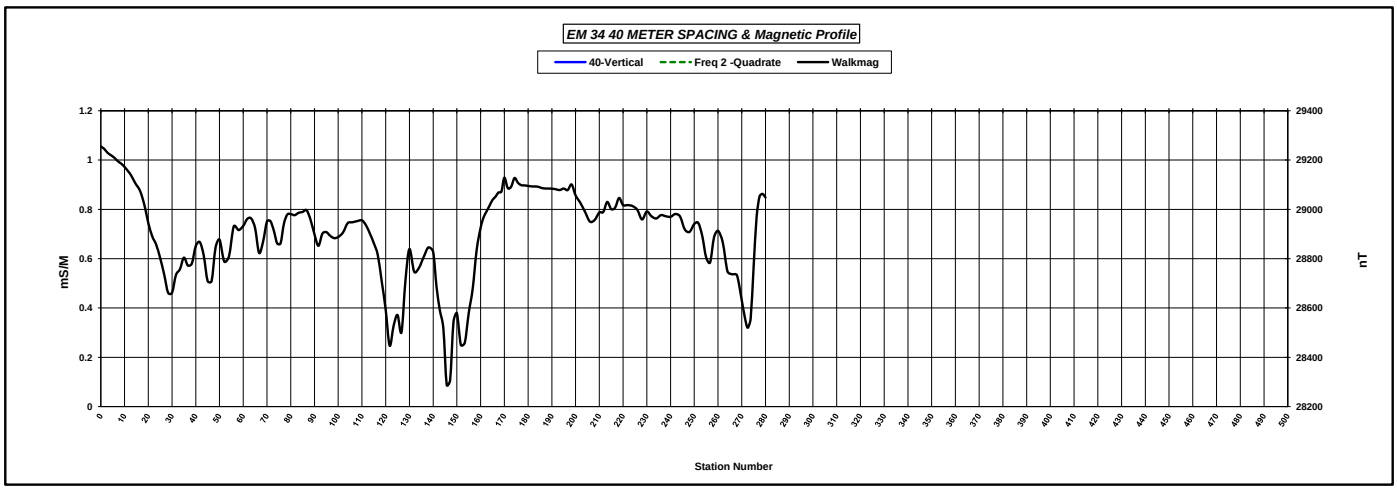
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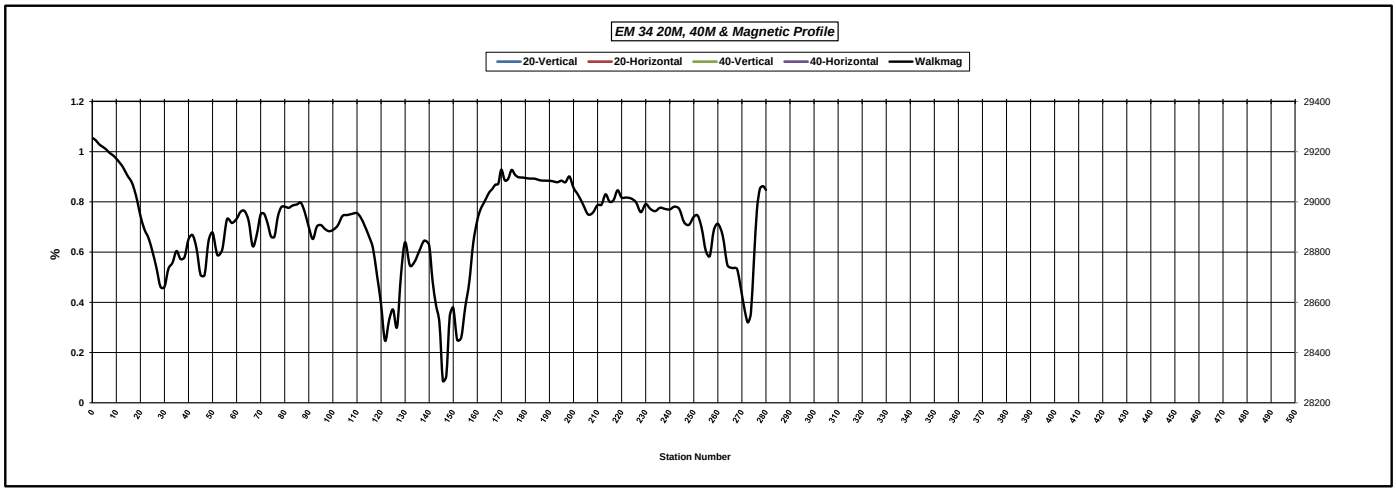
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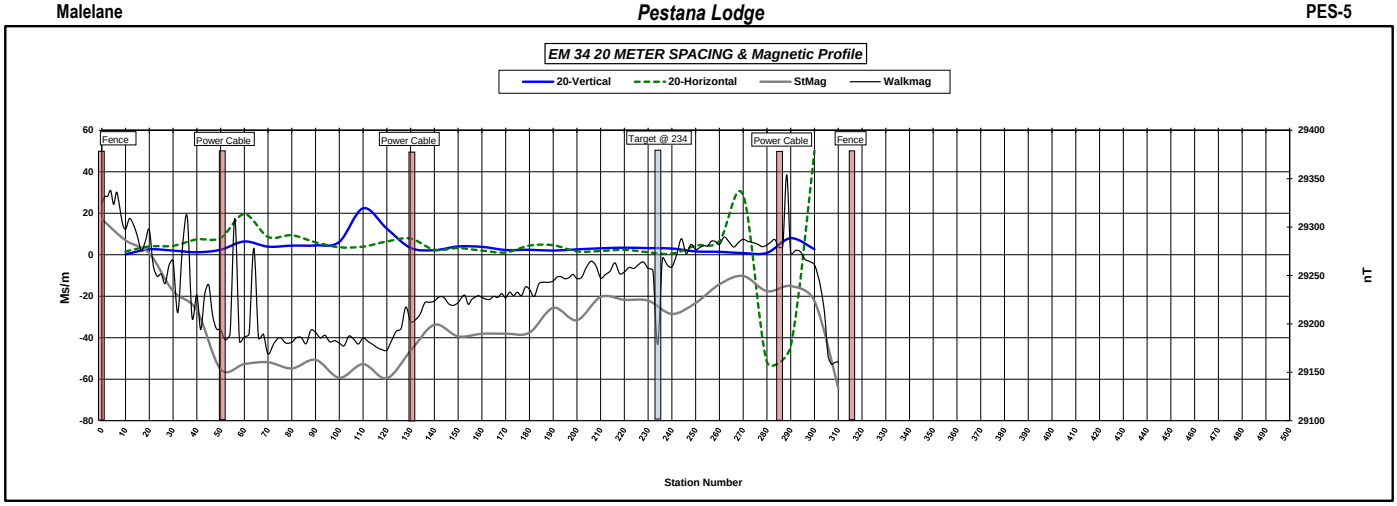
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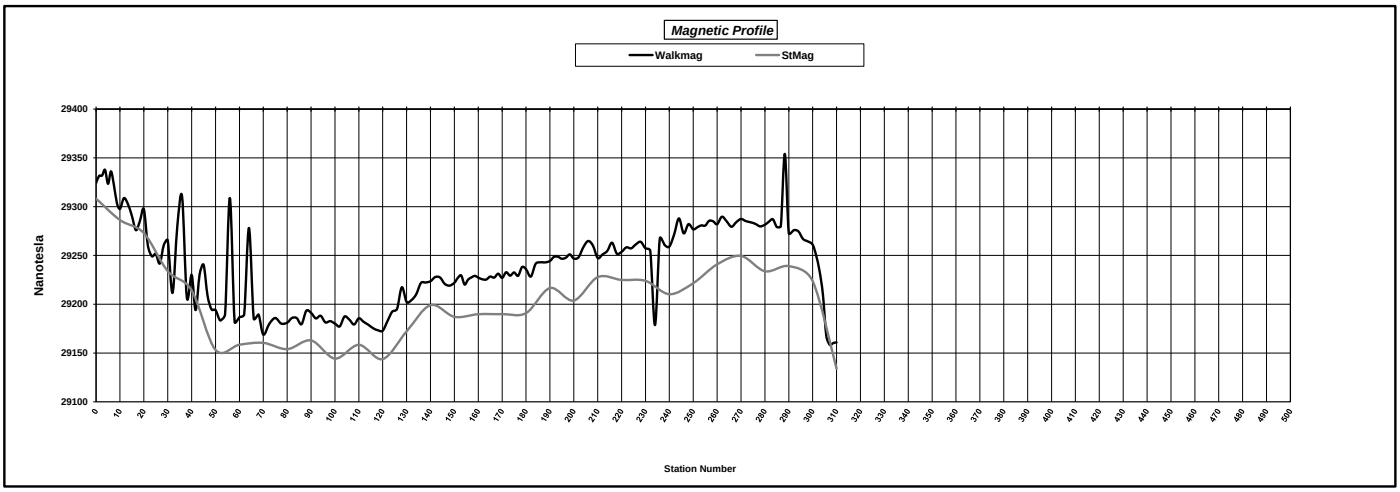
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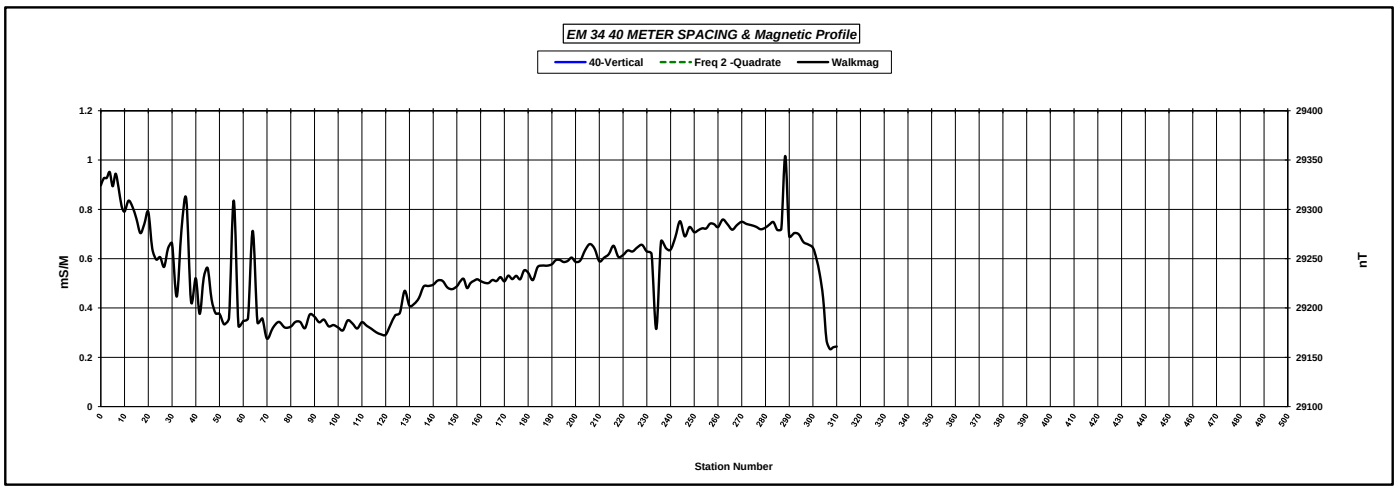
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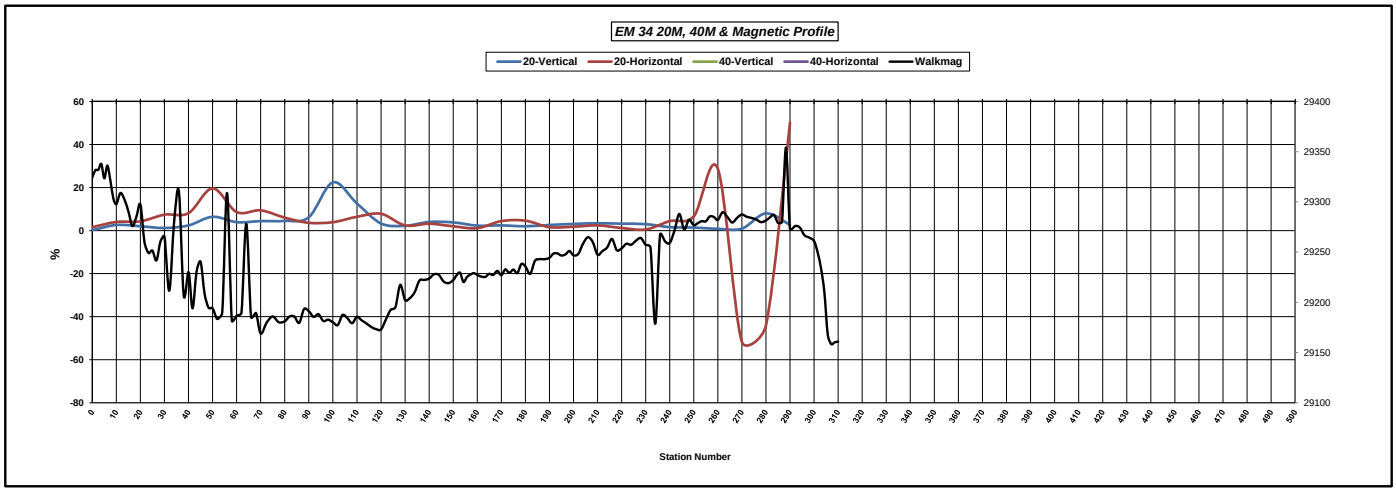
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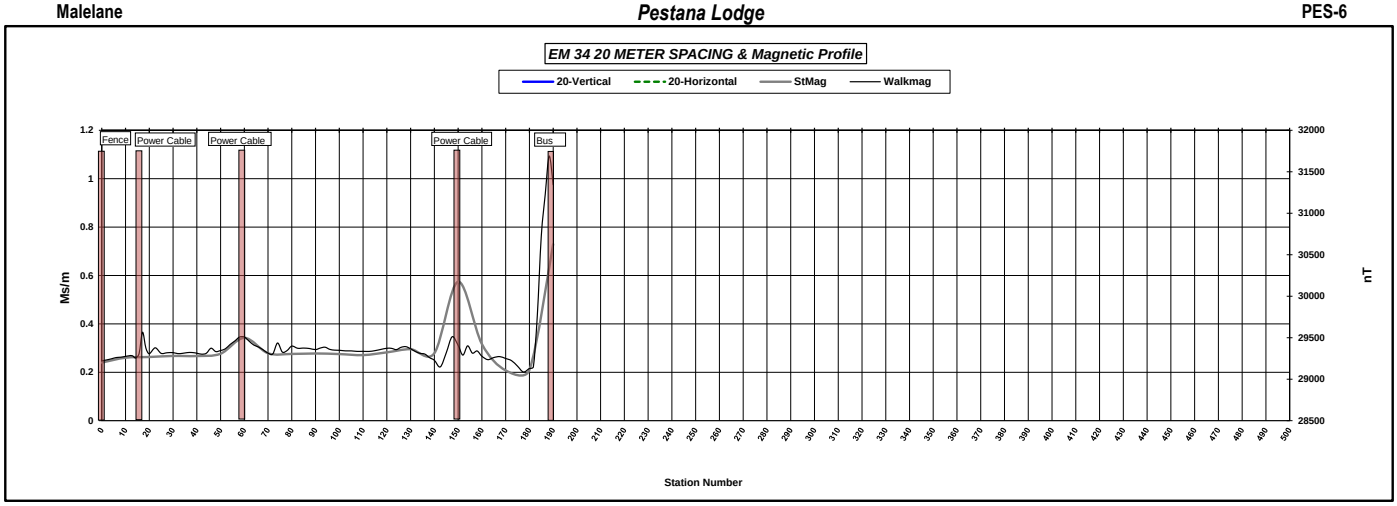
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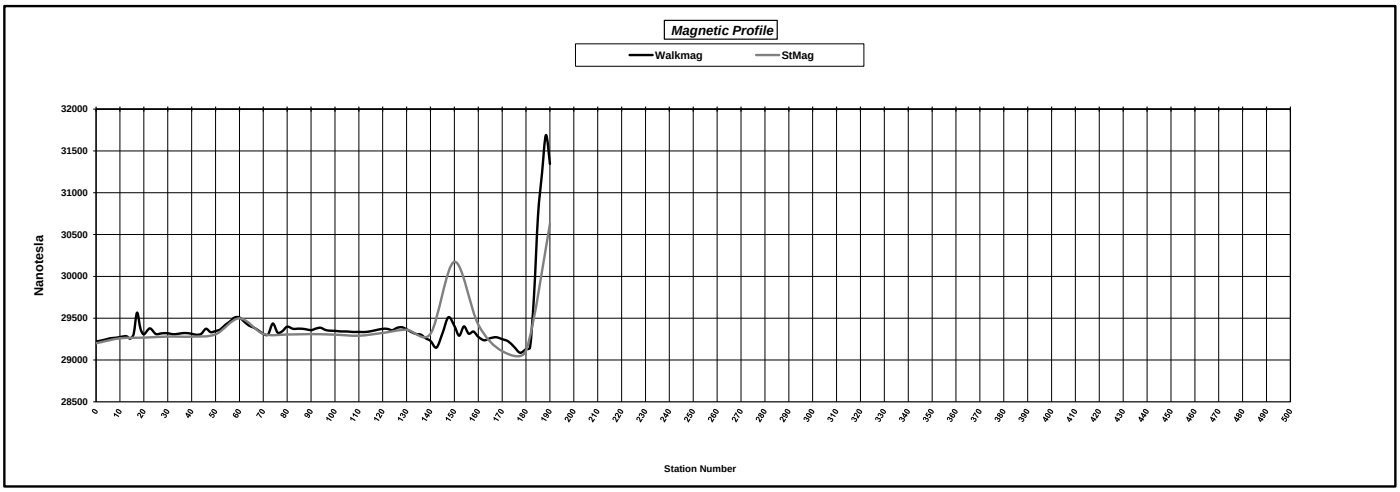
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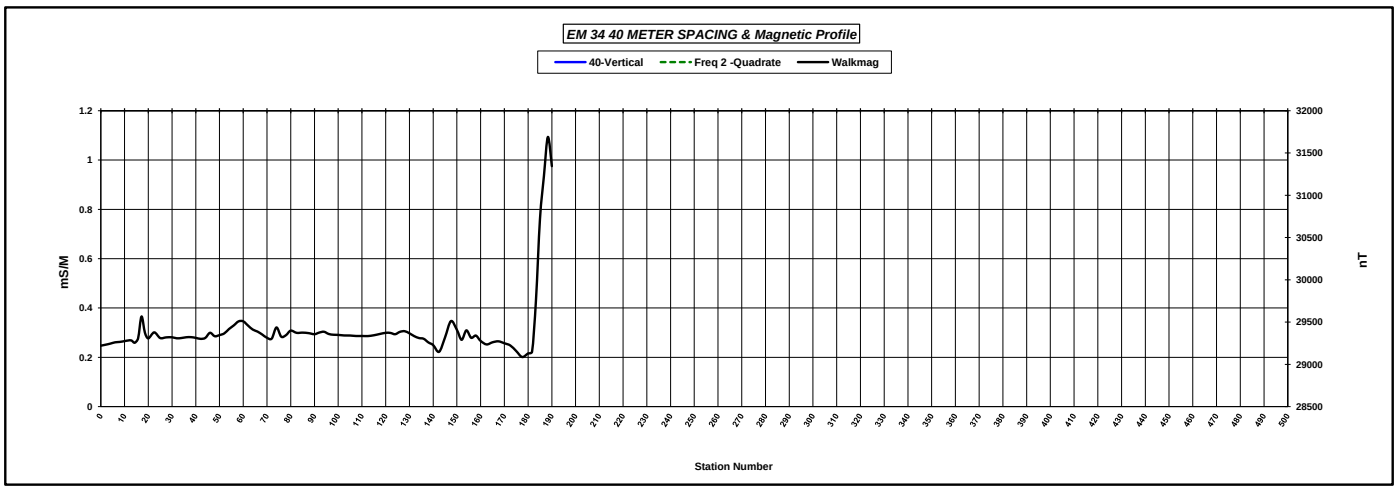
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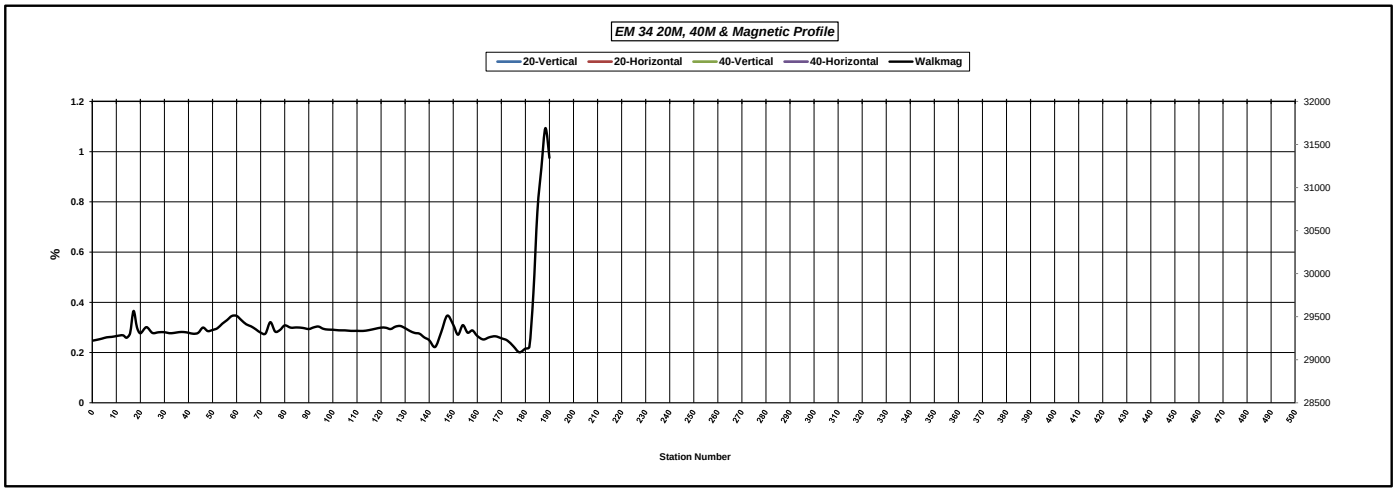
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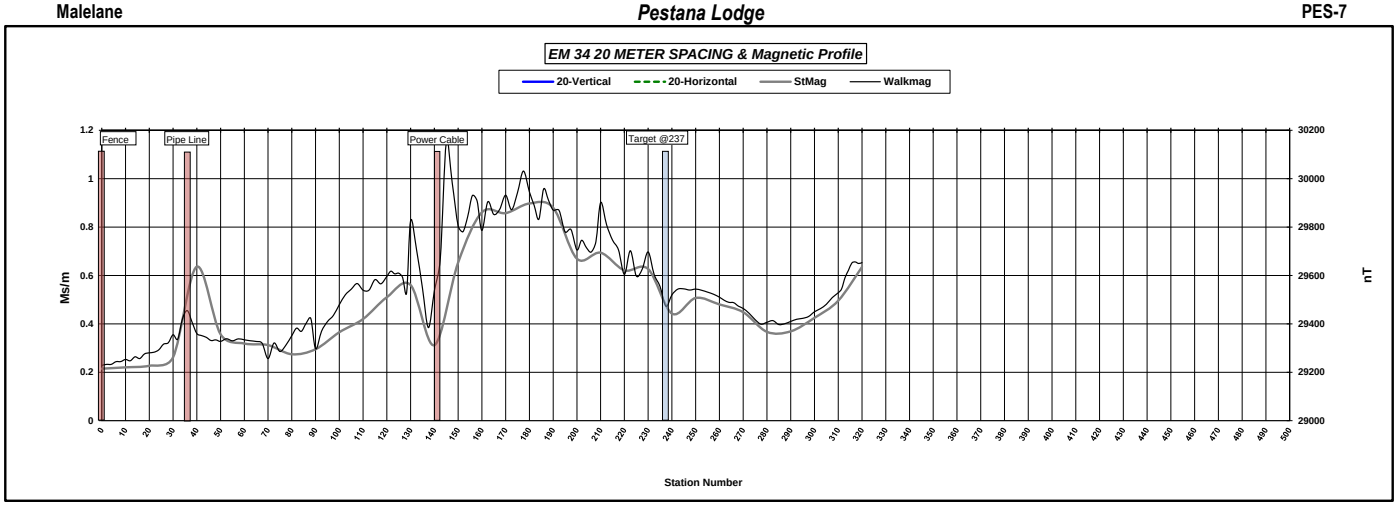
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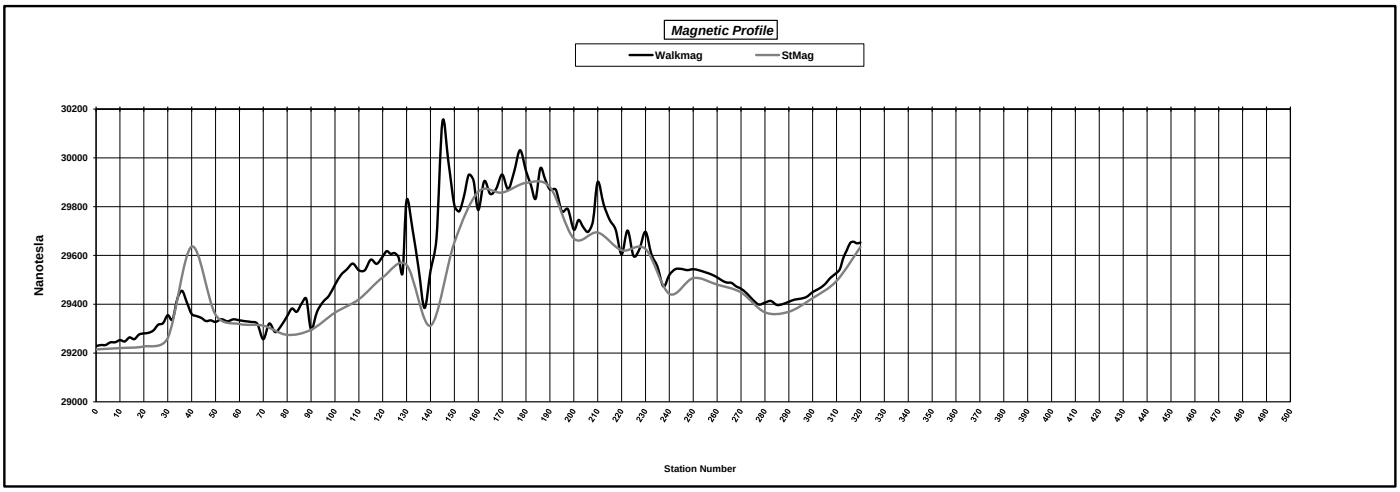
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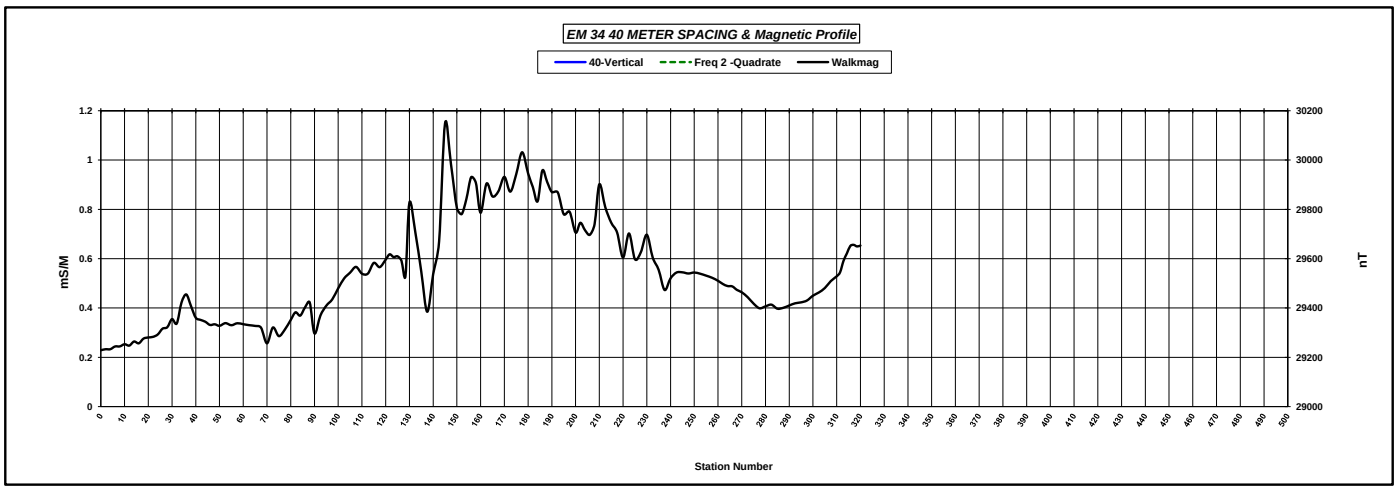
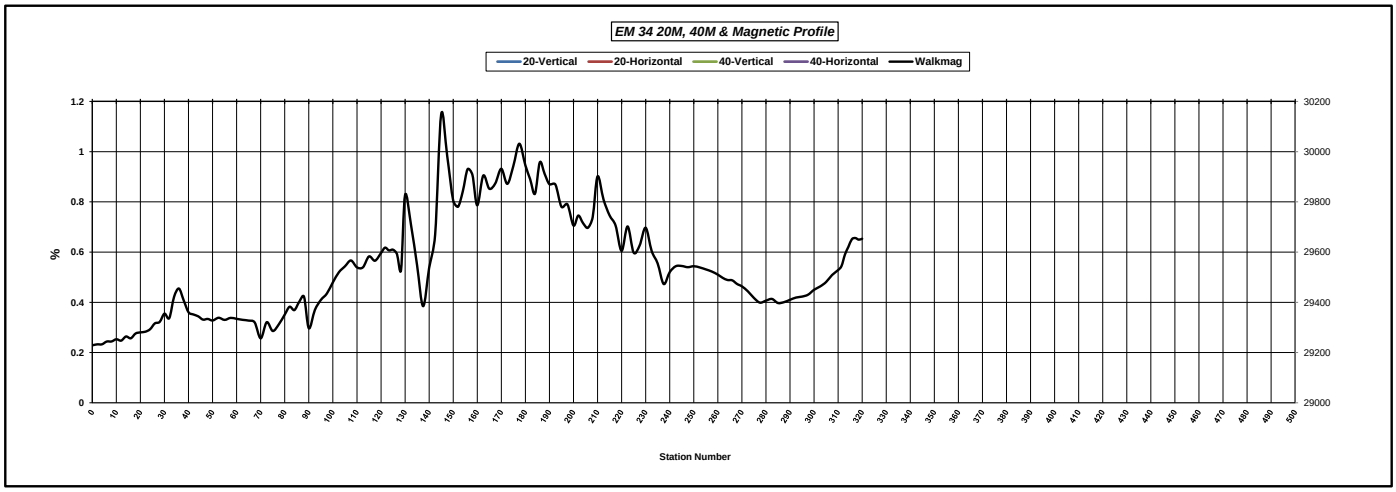
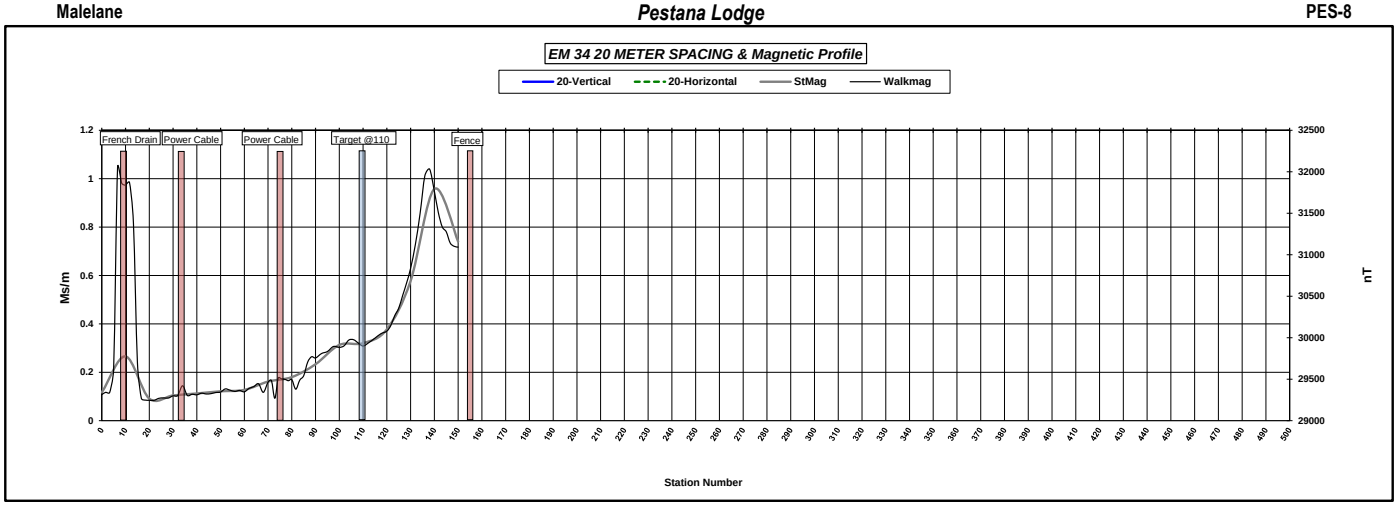
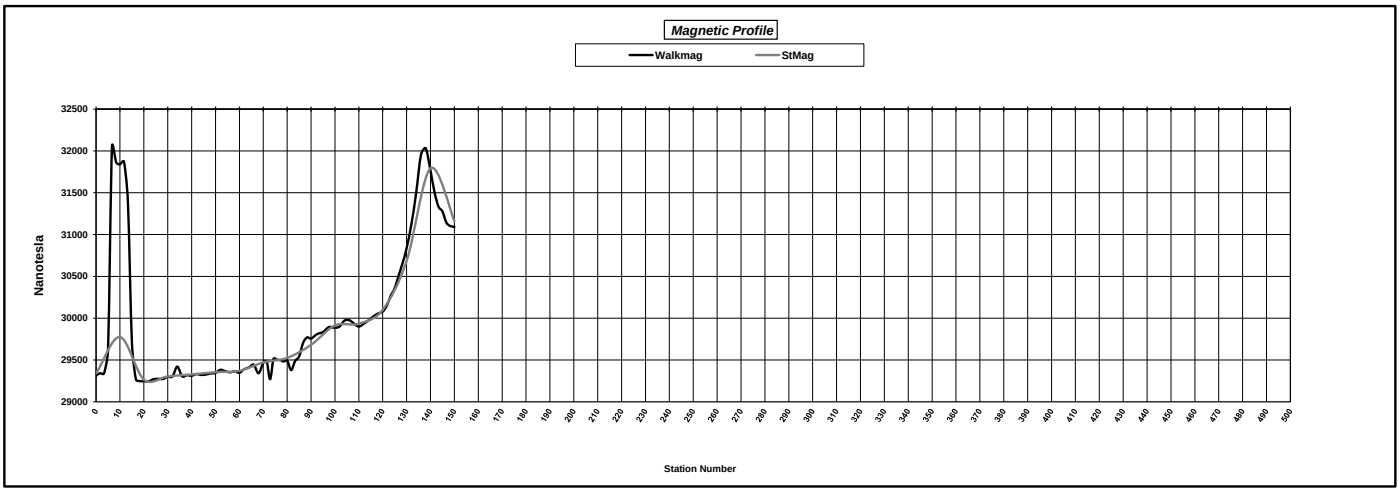
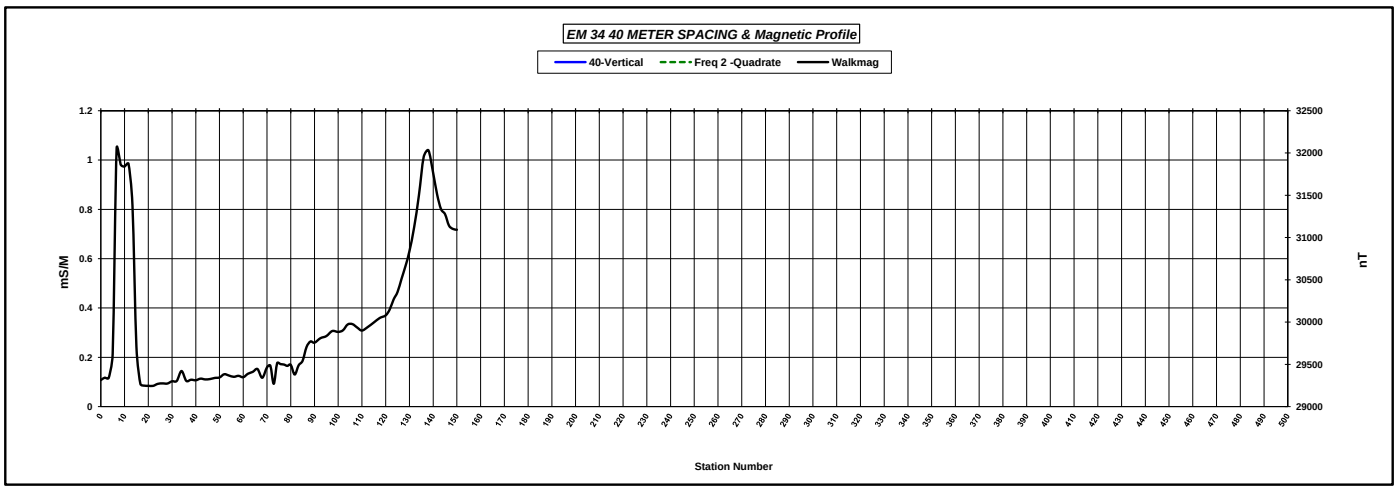
Station Number

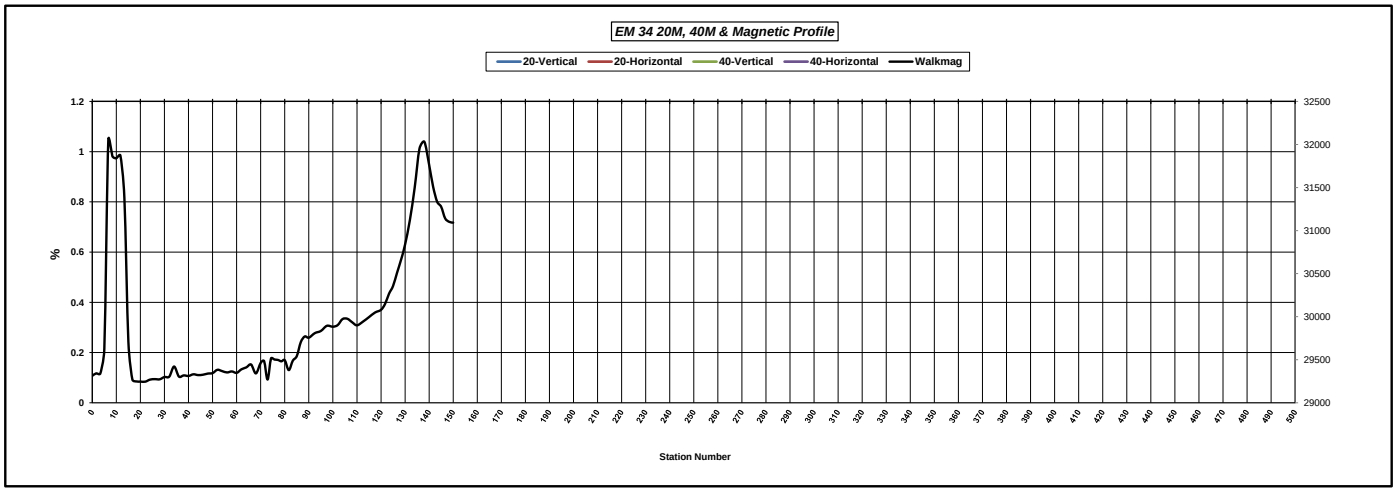

EM 34 40 METER SPACING & Magnetic Profile
40-Vertical
Freq 2 -Quadrate
Walkmag
mS/M
nT
Station Number


EM 34 20M, 40M & Magnetic Profile
20-Vertical
20-Horizontal
40-Vertical
40-Horizontal
Walkmag
%
Station Number


EM 34 20 METER SPACING & Magnetic Profile
20-Vertical
20-Horizontal
StMag
Walkmag
French Drain
Power Cable
Power Cable
Target @110
Fence
Ms/m
nT
Station Number


Magnetic Profile
Walkmag
StMag
Nanotesla
Station Number


EM 34 40 METER SPACING & Magnetic Profile
40-Vertical
Freq 2 -Quadrate
Walkmag
mS/M
nT
Station Number


EM 34 20M, 40M & Magnetic Profile
20-Vertical
20-Horizontal
40-Vertical
40-Horizontal
Walkmag
%
Station Number