APPENDIX 4-2

APEX GEOPHYSICS PHASE 1 REPORT

AGP22050_01

Report On The Geophysical Investigation At Laurclavagh Wind FArm County Galway For Ghrian Energy Limited

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PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOPHYSICS LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

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1. EXECUTIVE SUMMARY

APEX Geophysics Limited was requested by Ghrian Energy Limited to carry out a geophysical investigation for the Laurclavagh Wind Farm, Co. Galway. The purpose of the survey was to assess the sub-soil conditions at eight proposed turbine bases (T1-T8) and at the substation.

The objectives of the geophysical investigation were to provide information on soil type, thickness and stiffness, depth to and type of bedrock, weathering and excavatability of the bedrock, to identify potential karst features and fault/fissure zones within the bedrock and to propose locations for intrusive investigations.

The site, situated southwest of Tuam, Co. Galway is within open agricultural land with elevation ranging from 23.8 m OD in the west at T1 to 54.3 m OD in the north at T5.

The Geological Survey of Ireland (GSI) Quaternary sediments map for the area indicates till derived from limestones and areas of karstified bedrock outcrop or subcrop at the turbine and substation sites. The GSI bedrock map indicates the turbine and substation sites is underlain by pale grey clean skeletal limestone of the Burren Formation. The GSI karst database shows a spring north of turbine T7 and northeast of the substation, with caves mapped northeast and southwest of the site.

The geophysical data generally indicated thin soils primarily of clayey silty sand/gravel and small areas of sandy gravelly clay across the turbine bases over limestone bedrock. Thicker soils are indicated at the substation.

Some zones of possible karstified limestone were interpreted at bases T1, T2, T6, T8 and the substation. A zone of highly weathered/karstified limestone with possible clay/water infill was also interpreted at T2.

As karstification of limestone typically involves dissolution of the bedrock and subsequent infill with glacial material, any groundwork or an altered surface drainage pattern in the vicinity of karstified limestone may lead to a reactivation of karst features. The normal mitigation measures applying to construction over karstic limestones, such as sealed drainage, and foundations capable of spanning voids that may come to the surface, should therefore be incorporated into any works.

Trial pit and borehole locations have been recommended in the areas of hard standing and close to the turbine bases to confirm nature of the soils, depth to and nature of the bedrock across the site.

The results of the geophysical investigation should be reviewed based on the findings of any direct investigation.

2. INTRODUCTION

APEX Geophysics Limited was requested by Ghrian Energy Limited to carry out a geophysical investigation for the Laurclavagh Wind Farm, Co. Galway. The purpose of the survey was to assess the sub-soil conditions at eight proposed turbine bases (T1-T8) and at a proposed substation.

2.1 Survey Objectives

The objectives of the survey were to provide information on:

- Soil type, thickness and stiffness,
- Depth to and type of bedrock,
- Weathering and excavatability of the bedrock,
- To identify potential karst features and fault/fissure zones within the bedrock,
- To propose locations for intrusive investigations.

2.2 Site Background

The proposed Laurclavagh Wind Farm is located 8.5 km southwest of Tuam, County Galway. The site investigation locations are all within areas of open agricultural land (Figure 2.1) with elevation ranging from 23.8 m OD in the west at T1 to 54.3 m OD in the north at T5.

Fig 2.1: Location map with turbine bases and substation (SuS) in magenta.

2.2.1 Soils

The Geological Survey of Ireland (GSI) Quaternary sediments map for the area (GSIc, 2019) indicates that the soils across the site comprise of till derived from limestones (T1 - T4, T7,T8, SuS) and areas of karstified bedrock outcrop or subcrop (T5 & T6), (Fig. 2.2).

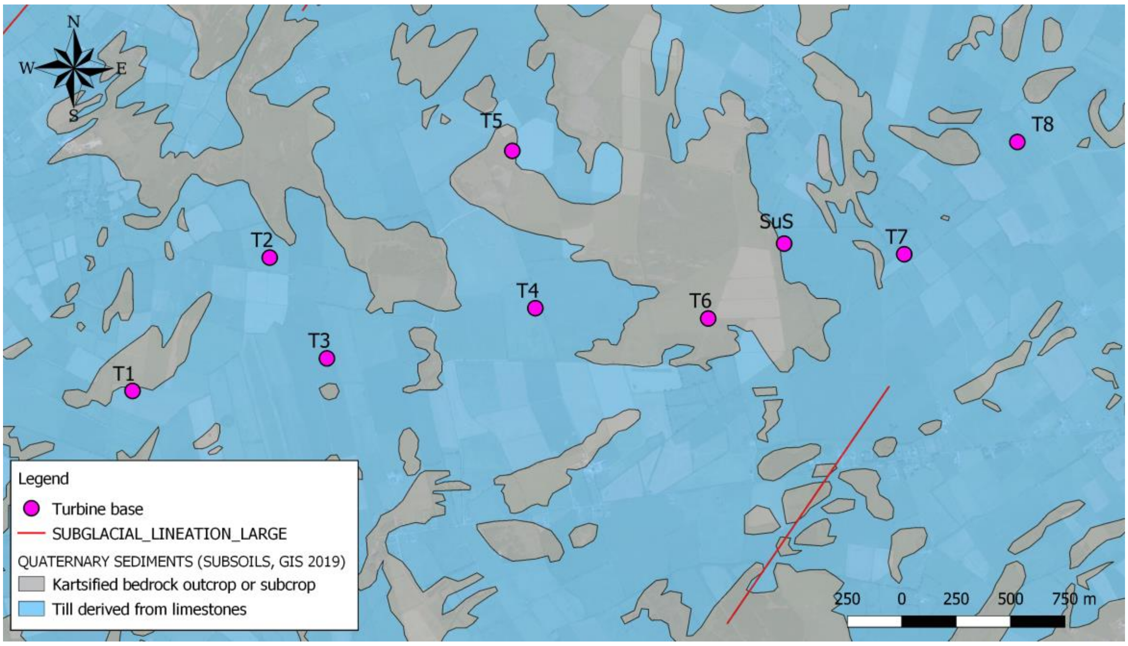

Fig 2.2: The GSI Quaternary sediments map.

2.2.2 Geology

The GSI 1:100k Bedrock Geology map for the area (GSI, 2018) indicates that the survey area is underlain by pale grey clean skeletal limestone of the Burren Formation (Fig. 2.3). Several bedrock outcrops are mapped across the survey area. The GSI karst database shows a spring c. 280 m north of turbine T7. Caves have been mapped northeast of T8 and south of T7.

Fig 2.3: The GSI bedrock geology map with karst features from GSI karst database.

2.2.3 Groundwater

The groundwater vulnerability rating for the site (GSIb, 2019) is predominantly classified as 'extreme' (T1, T3, T7, T8, SuS), with 'high' (T2, T4) to 'rock at or near surface' (T5, T6), (Fig. 2.4). The limestone bedrock is classified as a 'Regionally Important Aquifer - Karstified (conduit).

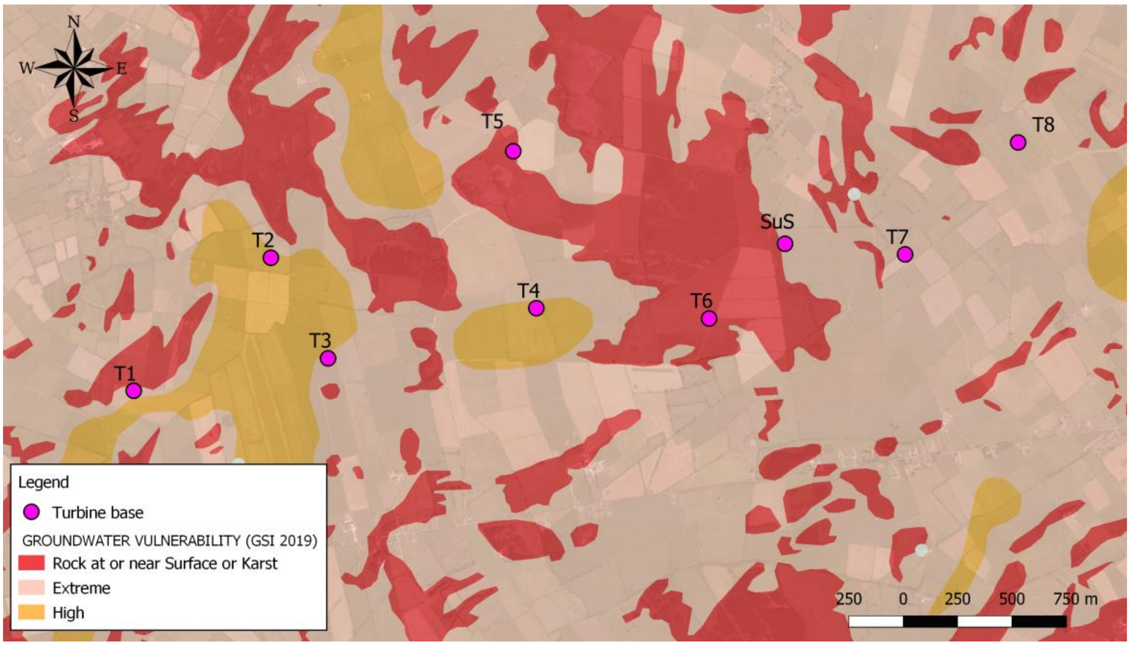

Fig 2.4: The GSI vulnerability classification map.

2.2.4 Historical Data

The historical 6 inch sheet for the area indicates outcropping limestone crags in localised areas across the site (blue areas on Fig. 2.5) as well as large angular blocks of limestone and slightly undulating drift across much of the site.

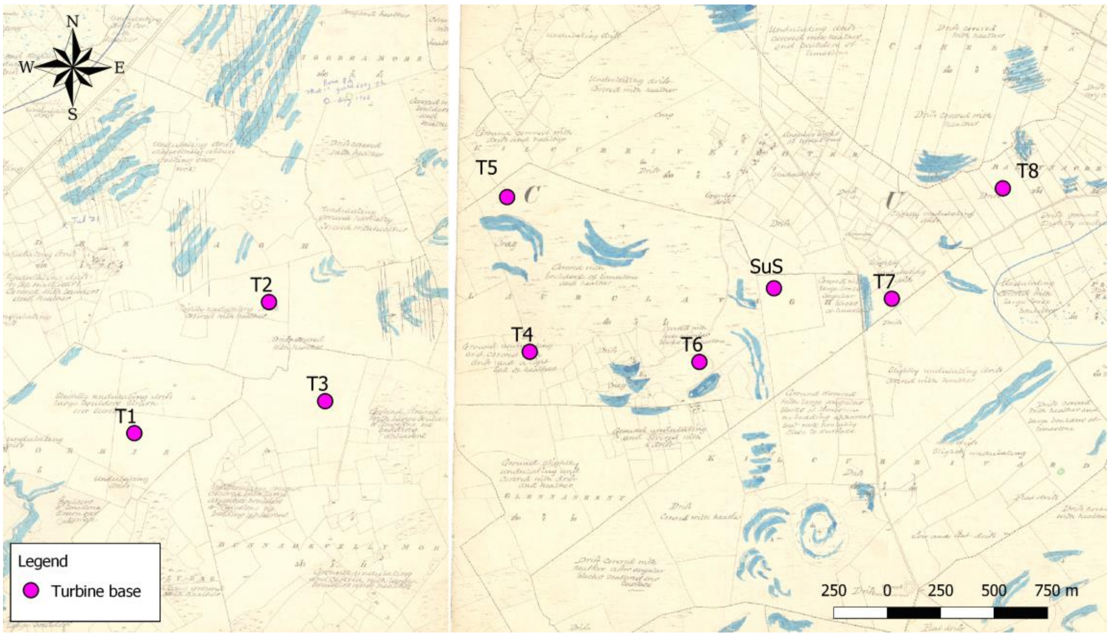

Fig 2.5: The historical 6inch map – limestone outcrops marked with blue.

2.2.5 Direct Investigation Data

No direct investigation information was available at the time of reporting.

2.3 Survey Rationale

The geophysical investigation consisted of 2D Electrical Resistivity Tomography (ERT), Seismic Refraction profiling and Multi-channel Analysis of Surface Waves (MASW) to examine the sub-soil conditions at eight turbine bases (T1-T8) and at a substation (SuS).

ERT images the resistivity of the materials in the subsurface along a profile to produce a cross-section showing the variation in resistivity with depth, depending on the length of the profile. Each cross-section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials.

Seismic Refraction profiling measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph. This method should allow profiling of depth to the top of the bedrock across the site.

The **MASW** method is used to estimate shear-wave (S-wave) velocities in the ground material to indicate possible soft zones. Soil material with an S-wave velocity of <175 m/s is generally classified as soft/loose. The depth of investigation for this method will depend on the source type and geophone spacing. This method may also be used to indicate weathered bedrock depth.

As with all geophysical methods the results are based on indirect readings of the subsurface properties. The effectiveness of the proposed approach will be affected by variations in the ground properties. By combining a number of techniques it is possible to provide a higher quality interpretation and reduce any ambiguities which may otherwise exist. Further information on the detailed methodology of each geophysical method employed in this investigation is given in **APPENDIX A: DETAILED GEOPHYSICAL METHODOLOGY**.

3. RESULTS

The survey was carried out between the 9th and 12th May 2022 and involved the collection of 18 ERT profiles (R1-R18), 18 No. seismic refraction profiles (S1-S18) and 18 No. 1D MASW profiles. The geophysical survey locations are indicated on Drawings AGP22050_T1_01 to AGP22050_SuS (Appendix D.

3.1 ERT

Two orthogonal ERT Profiles were recorded at each turbine base and at the substation. The resistivity values have been interpreted on the following basis;

Resistivity (Ohm-m)	Interpretation
150 - 250	Sandy Gravelly CLAY
250-1,000	Clayey Silty SAND/GRAVEL
150-250	Highly Weathered/karstified LIMESTONE with possible clay/water infill
250-1,500	Weathered/karstified LIMESTONE
>1,500	LIMESTONE

3.2 Seismic Refraction Profiling

Two orthogonal seismic refraction spreads were recorded at each turbine base and at the substation. Each seismic refraction dataset was processed using a tomographic inversion and resultant subsurface velocities have been interpreted, in conjunction with the ERT data, as follows:

Seismic Velocity (m/s)	Interpretation	Stiffness/ Rock Quality	Excavatability
240-500	Soil	Soft/Loose	Diggable
500-1,000	Soil	Firm/Medium Dense	Diggable
1,000-1,800	Soil	Stiff/Dense	Diggable
1,800-2,200	Soil	Very Stiff/Very Dense	Diggable
1,000-2,400	Highly to Moderately Weathered Rock	Poor-Good	Rippable-Breaking/Blasting
1,800-2,400	Moderately to Slightly Weathered Rock	Good	Breaking/Blasting
2,400-5,254	Slightly Weathered to Fresh Rock	Good	Breaking/Blasting

* *It should be noted that the cut-off velocity for excavatability will be lower if excavating in trenches and when excavating parallel to the regional geological strike, due to seismic anisotropy of the bedrock.*

3.3 MASW

Two orthogonal MASW profiles were acquired at each turbine base and at the substation with the aim of resolving a 1D Shear-wave velocity (Vs) profile and calculating a 1D Gmax profile of the soil layers underlying each proposed turbine location. Due to the presence of thin soils and shallow rock at the turbine bases, the Vs and Gmax profiles could not be determined. While thicker soils are present at the substation the data did not yield good definition of soil Vs values indicating the soil may have similar Vs values to rock.

3.4 Integrated Interpretation

3.4.1 Turbine Base T1

The results at turbine base T1 are shown on Drawing AGP22050_T1.

The soil layers at Turbine Base T1 have been interpreted as comprising of 0.4 to 1.3 m of soft/loose soil over 0.5 to 2.4 m medium dense soil becoming dense for 0.5 to 0.8 m. Soil type is interpreted primarily as clayey silty sand/gravel with a small area of sandy gravelly clay.

Limestone bedrock has been interpreted at depths from 0.7 to 3.7 m bgl (1.5 m at turbine centre). The geophysical data indicates an upper layer of highly to moderately weathered/karstified limestone ranging from 0.9 to 5.3 m thick over slightly weathered to fresh limestone. A deep zone of highly to moderately weathered/karstified limestone has been interpreted in the east of R2, 20 m away from the turbine centre.

3.4.2 Turbine Base T2

The results at turbine base T2 are shown on Drawing AGP22050_T2.

The soil layers at Turbine Base T2 have been interpreted as comprising of 0.7 to 4.0 m of soft/loose soil, primarily sandy gravelly clay and small areas of silty sand/gravel.

Limestone bedrock has been interpreted at a depth of 2.0 m bgl at the turbine centre. The geophysical data indicates an upper layer of highly to moderately weathered/karstified limestone ranging from 1.8 to 7.7 m thick over moderately to slightly weathered/possible karstified limestone. A zone of highly weathered/karstified limestone with possible clay/water infill has been interpreted offset 20 m to the east of the turbine centre.

3.4.3 Turbine Base T3

The results at turbine base T3 are shown on Drawing AGP22050_T3.

The soil layers at Turbine Base T3 have been interpreted as comprising of 0.3 to 0.9m m of loose soil over 0.3 to 1.6 m medium dense soil becoming dense in places for 0.1 to 1.0 m. Soil type is interpreted as clayey silty sand/gravel.

Limestone bedrock has been interpreted at depths of 0.7 to 3.0 m bgl (1.8 m at turbine centre). The geophysical data indicates an upper layer of highly to moderately weathered/karstified limestone from 0.4 to 3.1 m thick over slightly weathered to fresh Limestone.

3.4.4 Turbine Base T4

The results at turbine base T4 are shown on Drawing AGP22050_T4.

The soil layers at Turbine Base T4 have been interpreted as comprising of 0.4 to 1.4 m loose soil over 0.1 to 1.4 m medium dense soil becoming dense to very dense west and east of the base to 0.3 to 1.5 m thick. Soil type is interpreted as clayey silty sand/gravel.

Limestone bedrock has been at a depth of 0.4 m southwest of the turbine base to 5.2 m bgl northwest of the base (2. m at turbine centre). The geophysical data indicates an upper layer of highly to moderately weathered karstified limestone from 0.3 to 2.7 m thick over slightly weathered to fresh Limestone.

3.4.5 Turbine Base T5

The results at turbine base T5 are shown on Drawing AGP22050_T5.

The soil layers at Turbine Base T5 have been interpreted as comprising of 0.2 to 1.8 m of loose clayey silty sand/gravel.

Limestone bedrock has been interpreted at a depth of 0.4 m bgl. The geophysical data indicates an upper layer of highly to moderately weathered/karstified limestone from 0.9 to 3.3 m thick over slightly weathered to fresh Limestone.

3.4.6 Turbine Base T6

The results at turbine base T5 are shown on Drawing AGP22050_T6.

The soil layers at Turbine Base T6 have been interpreted as comprising of 0.4 to 2.4 m loose clayey silty sand/gravel.

Limestone bedrock has been interpreted at a depth of 1.1 m at the turbine centre. The geophysical data indicates an upper layer of highly to moderately weathered/karstified limestone from 0.6 to 2.3 m thick over slightly weathered to fresh Limestone. Within the bedrock, areas of reduced model resistivity (650-1,5000 Ohm-m) indicate likely increased weathering of the bedrock. These areas are highlighted on ERT profiles T6R1 and T6R2 on Drawing AGP22050_T6.

3.4.7 Turbine Base T7

The results at turbine base T7 are shown on Drawing AGP22050_T7.

The soil layers at Turbine Base T7 have been interpreted as comprising of 0.2 to 0.5m soft/loose soil over 0.7 to 1.1 m firm/medium dense soil becoming dense for 0.5 to 2.1 m. Soil type is interpreted primarily as clayey silty sand/gravel with a small area of sandy gravelly clay southeast of the turbine base.

Limestone bedrock has been interpreted at depths of 1.6 to 3.4 m bgl, (2.2 m at turbine centre). The geophysical data indicates an upper layer of moderately weathered to slightly weathered/possible karstified limestone over slightly weathered to fresh Limestone.

3.4.8 Turbine Base T8

The results at turbine base T8 are shown on Drawing AGP22050_T8.

The soil layers at Turbine Base T8 have been interpreted as comprising of 0.1 to 1.0 soft/loose soil over 0.4 to 1.4 m firm/medium dense soil over 0.2 to 2.6 m dense soil becoming very dese in places for 0.1 to 1.7m. Soil type is interpreted primarily as clayey silty sand/gravel with a small area of sandy gravelly clay southeast of the turbine base.

Limestone bedrock has been interpreted at depths of 1.2 to 5.5 m bgl (4.2 m at turbine centre). The geophysical data indicates 1.3 to 15.8 m of moderately to slightly weathered/possible karstified limestone over slightly weathered to fresh Limestone. The moderately to slightly weathered/possible karstified limestone is thickest within a zone approximately 9.0 to 30 m wide to the east of the turbine centre.

3.4.9 Substation

The results at the substation are shown on Drawing AGP22050_SuS.

The soil layers at the substation have been interpreted as comprising of 0.3 to 1.4m soft/loose soil, 0.7 to 1.4 m firm/medium dense soil over 1.4 to 2.0 m of stiff/dense soil over 1.6 to 2.2 m of very dense soil. Soil type is interpreted primarily as clayey silty sand/gravel with an area of sandy gravelly clay in the north of the substation area (see ERT profile Su_R1 on Drawing AGP22050_SuS.

Limestone bedrock has been interpreted at depths of 0.3 m bgl in the west to 8.0 m bgl in the south and east. Bedrock is generally interpreted as 1.3 to 3.8 m of moderately to slightly weathered/possible karstified limestone, with a zone of increased thickness to 16 m close to the centre of the area, over slightly weathered to fresh Limestone.

Across the site some highly weathered rock may be present towards the base of the soil layers.

Where bedrock excavation is proposed the highly to moderately weathered rock will be rippable to requiring breaking/blasting and the moderately to slightly weathered rock and slightly weathered to fresh rock will require breaking/blasting.

More detailed discussion of velocity and excavatability is contained in Appendix C

4. RECOMMENDATIONS

Trial pits and boreholes to 20 m are recommended in the areas of hard standing and close to the turbine bases respectively to confirm nature of the soils and depth to and nature of the bedrock at the following locations:

No.	Location	Easting	Northing	Target
PTP01	Turbine Base T1	534731	743198	
PTP02	Turbine Base T2	535384	743791	
PTP03	Turbine Base T2	535413	743791	
PTP04	Turbine Base T3	535608	743380	
PTP05	Turbine Base T3	535619	743347	
PTP06	Turbine Base T4	536576	743578	
PTP07	Turbine Base T5	536512	744250	
PTP08	Turbine Base T5	536445	744249	
PTP09	Turbine Base T6	537395	743562	
PTP10	Turbine Base T7	538314	743831	
PTP11	Turbine Base T8	538823	744284	
PTP12	Substation	537686	743856	
PTP13	Substation	537740	743856	
PBH01	Turbine Base T1	534729	743153	Zone of potential bedrock weathering
PBH02	Turbine Base T2	535362	743792	Depth to & nature of bedrock at turbine centre
PBH03	Turbine Base T2	535362	743825	Zone of highly weathered/karstified limestone
PBH04	Turbine Base T3	535624	743329	Depth to & nature of bedrock at turbine centre
PBH05	Turbine Base T4	536582	743560	Depth to & nature of bedrock at turbine centre
PBH06	Turbine Base T5	536478	744282	Nature of shallow rock at turbine centre
PBH07	Turbine Base T6	537377	743513	Nature & possible variation in bedrock at turbine centre
PBH08	Turbine Base T6	537371	743516	Zone of potential bedrock weathering
PBH09	Turbine Base T7	538275	743812	Depth to & nature of bedrock at turbine centre
PBH10	Turbine Base T8	538775	744309	Depth to & nature of bedrock
PBH11	Turbine Base T8	538800	744325	Zone of potential bedrock weathering
PBH12	Substation	537716	743856	Zone of potential bedrock weathering

Where bedrock excavation is proposed, a detailed assessment of excavatability should be carried out combining the results of the geophysical survey, rotary core drilling, strength testing, and trial excavation pits down to formation level using a high powered excavator of similar rating to that to be used during construction.

As karstification of limestone typically involves dissolution of the bedrock and subsequent infill with glacial material, any groundwork or an altered surface drainage pattern in the vicinity of karstified limestone may lead to a reactivation of karst features. The normal mitigation measures applying to construction over karstic limestones, such as sealed drainage, and foundations capable of spanning voids that may come to the surface, should therefore be incorporated into any works.

The geophysical report should be reviewed after the completion of any direct investigation.

REFERENCES

Bell F.G., 1993;
'Engineering Geology', Blackwell Scientific Press.

Geotomo Software, 2011;
'RES2DINV Users Manual', Malaysia.

GSIa, 2019;
Bedrock Aquifer Shapefile. http://www.gsi.ie/Mapping.htm

GSI, 2018;
Bedrock Geology 1:100,000 Shapefile. http://www.gsi.ie/Mapping.htm

GSIb, 2019;
Groundwater Vulnerability Shapefile. http://www.gsi.ie/Mapping.htm

GSIc, 2019;
Quaternary Subsoils Shapefile. http://www.gsi.ie/Mapping.htm

Hagedoorn, J.G., 1959;
'The plus - minus method of interpreting seismic refraction sections', Geophysical Prospecting, 7, 158 - 182.

Palmer, D., 1980;
'The Generalized Reciprocal Method of seismic refraction interpretation', SEG.

Redpath, B.B., 1973;
'Seismic refraction exploration for engineering site investigations', NTIS, U.S. Dept. of Commerce.

SeisImager, 2009;
'SeisImager/2D Manual'

Soske, J.L., 1959;
'The blind zone problem in engineering geophysics', Geophysics, 24, pp 359-365.

APPENDIX A: DETAILED GEOPHYSICAL METHODOLOGY

A combination of geophysical techniques was used to provide a high quality interpretation and reduce any ambiguities, which may otherwise exist.

Electrical Resistivity Tomography (ERT)

Electrical Resistivity Tomography was carried out to provide information on lateral variations in the overburden material as well as on the underlying overburden and bedrock.

Principles
This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. This method involves the use of electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

Data Collection
Profiles were recorded using a Tigre resistivity meter, imaging software, two 32 takeout multicore cables and up to 64 stainless steel electrodes. Saline solution was used at the electrode/ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after surveying.

Data Processing
The field readings were stored in computer files and inverted using the RES2DINV package (Geotomo Software, 2006) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-depth model of the resistivities.

The inverted 2D resistivity models and corresponding interpreted geology are displayed on the accompanying drawings alongside the processed seismic sections. Profiles have been contoured using the same contour intervals and colour codes. Distance is indicated along the horizontal axis of the profiles.

Seismic Refraction Profiling

Principles
This method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities.

Seismic profiling measures the p-wave velocity (Vp) of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher Vp velocities while soft, loose or fractured materials have lower Vp velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

Data Collection
A Geode high resolution 24 channel digital seismograph, 24 10HZ vertical geophones and a 10 kg hammer were used to provide first break information, with a 24 take-out cable. Equipment was carried and operated by a two-person crew.

Readings are taken using geophones connected via multi-core cable to a seismograph. The depth of resolution of soil/bedrock boundaries is determined by the length of the seismic spread, typically the depth of resolution is about one third the length of the profile.(eg. 69m profile ~23m depth, 33m profile ~ 11m depth).

Data Processing
First break picking in digital format was carried out using the SeisImager/2D PICKWIN software program from Geometrics to construct p-wave (Vp) traveltime plots for each spread. The processing and interpretation uses the ray-tracing and tomographic inversion methods, to acquire depths to boundaries and the P-wave velocities of these layers, using the SeisImager/2D PLOTREFA program.

SeisImager/2D interprets seismic refraction data as a laterally varying layered earth structure. The program includes three methods for data analysis, time-term inversion, the reciprocal method and tomography.

The tomography method creates an initial velocity model, then traces rays through the model, comparing the calculated and measured traveltimes. The model is then modified and the process repeated to minimise the difference between the calculated and measured times. The data was processed using this method and was then converted to a layer model for display and interpretation.

Approximate errors for Vp velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

Multichannel Analysis of Surface Waves (MASW)

Principles
The Multi-channel Analysis of Surface Waves (MASW) (Park et al., 1998, 1999) utilizes Surface waves (Rayleigh waves) to determine the elastic properties of the shallow subsurface (<15m). Surface waves carry up to two/thirds of the seismic energy but are usually considered as noise in conventional body wave reflection and refraction seismic surveys. The penetration depth of surface waves changes with wavelength, i.e. longer wavelengths penetrate deeper. When the elastic properties of near surface materials vary with depth, surface waves then become dispersive, i.e. propagation velocity changes with frequency. The propagation (or phase) velocity is determined by the average elastic property of the medium within the penetration depth. Therefore the dispersive nature of surface waves may be used to investigate changes in elastic properties of the shallow subsurface. The MASW method employs multi-channel recording and processing techniques (Sheriff and Geldart, 1982) that have similarities to those used in a seismic reflection survey and which allow better waveform analysis and noise elimination.

To produce a shear wave velocity (Vs) profile and a stiffness profile of the subsurface using Surface waves the following basic procedure is followed:
(i) A point source (eg. a sledgehammer) is used to generate vertical ground motions,
(ii) The ground motions are measured using low frequency geophones, which are disposed along a straight line directed toward the source,
(iii) the ground motions are recorded using either a conventional seismograph, oscilloscope or spectrum analyzer,

(iv) a dispersion curve is produced from a spectral analysis of the data showing the variation of Surface wave velocity with wavelength,
(iv) the dispersion curve in inverted using a modeling and least squares minimization process to produce a subsurface profile of the variation of Surface wave and shear wave velocity with depth.

Data Collection
The recording equipment consisted of a Geode 24 channel digital seismograph, 24 no. 10HZ vertical geophones, hammer energy source with mounted trigger and a 24 take-out cable.

Data Processing
MASW processing was carried out using the SURFSEIS processing package developed by Kansa Geological Survey (KGS, 2000). SURFSEIS is designed to generate a shear wave (Vs) veolocity profile.

SURFSEIS data processing involves three steps:
(i) Preparation of the acquired multichannel record. This involves converting data file into the processing format.
(ii) Production of a dispersion curve from a spectral analysis of the data showing the variation of Raleigh wave phase velocity with wavelength. Confidence in the dispersion curve can be estaimated through a measure of signal to noise ratio (S/N), which is obtained from a coherency analysis. Noise includes both body waves and higher mode surface waves. To obtain an accurate dispersion curve the spectral content and phase velocity characteristics are examined through an overtone analysis of the data.
(iii) Inversion of the dispersion curve is then carried out to produce a subsurface profile of the variation of shear wave velocity with depth.

Spatial Relocation

All the geophysical investigation locations were acquired using a Trimble Geo 7X high-accuracy GNSS handheld system using the settings listed below. This system allows collection of GPS data with c.20mm accuracy.

Projection:	Irish Transverse Mercator
Datum:	Ordnance
Coordinate units:	Metres
Altitude units:	Meteres
Survey altitude reference:	MSL
Geoid model:	Republic of Ireland

APPENDIX B: SEISMIC REFRACTION DATA

The tomographic inversions of the seismic refraction datasets are shown below.

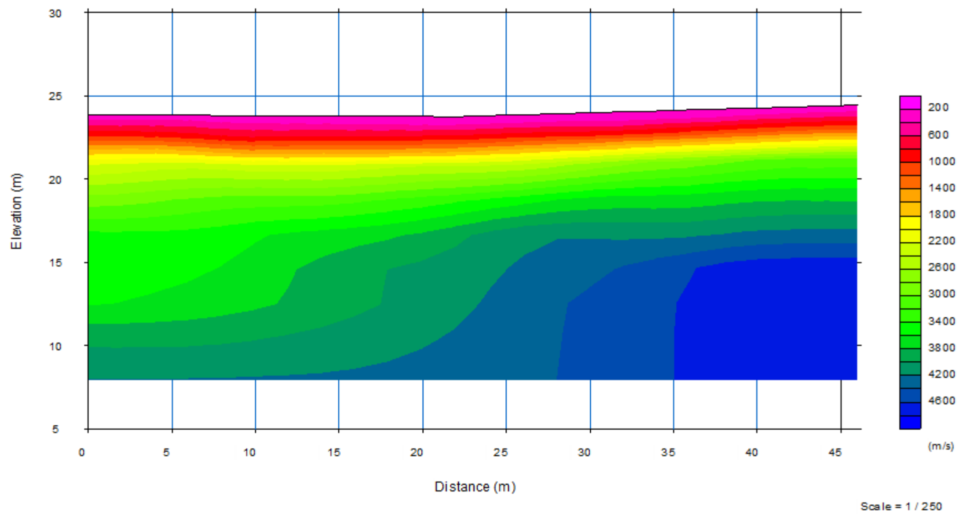

Fig B.1: Seismic Refraction T1S1 Tomographic Inversion.

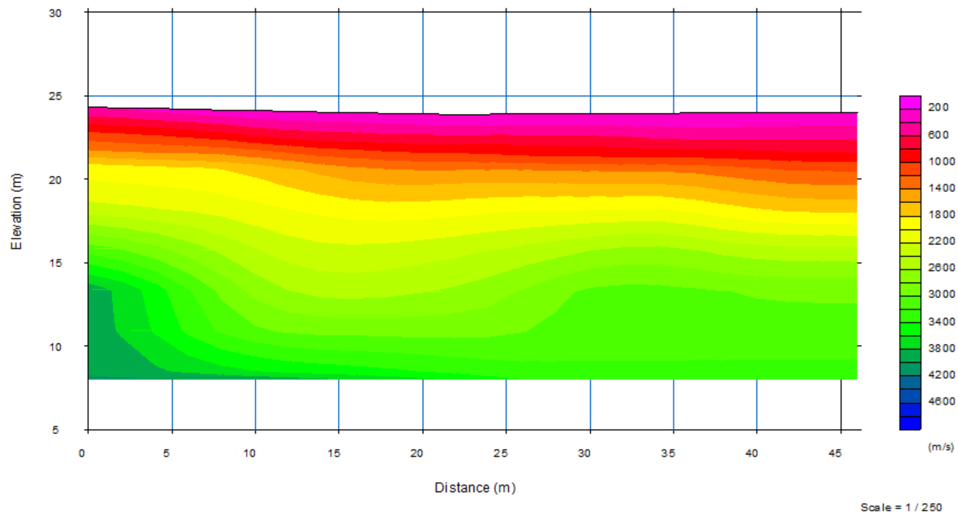

Fig B.2: Seismic Refraction T1S2 Tomographic Inversion.

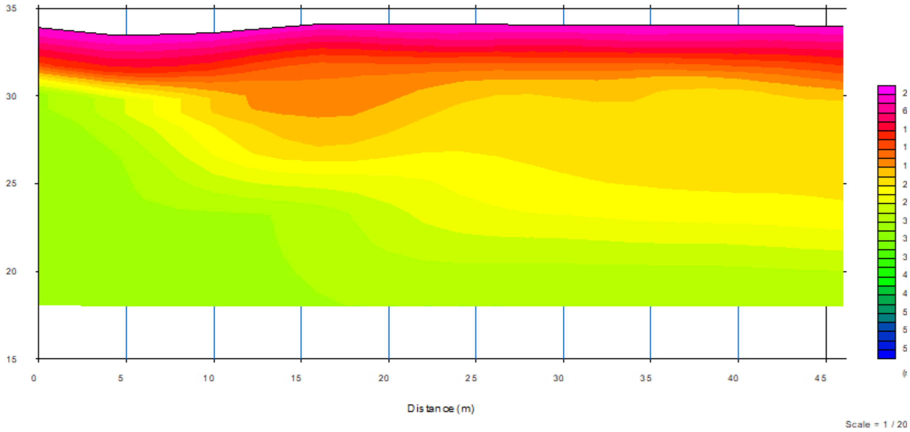

Fig B.3: Seismic Refraction T2S1 Tomographic Inversion.

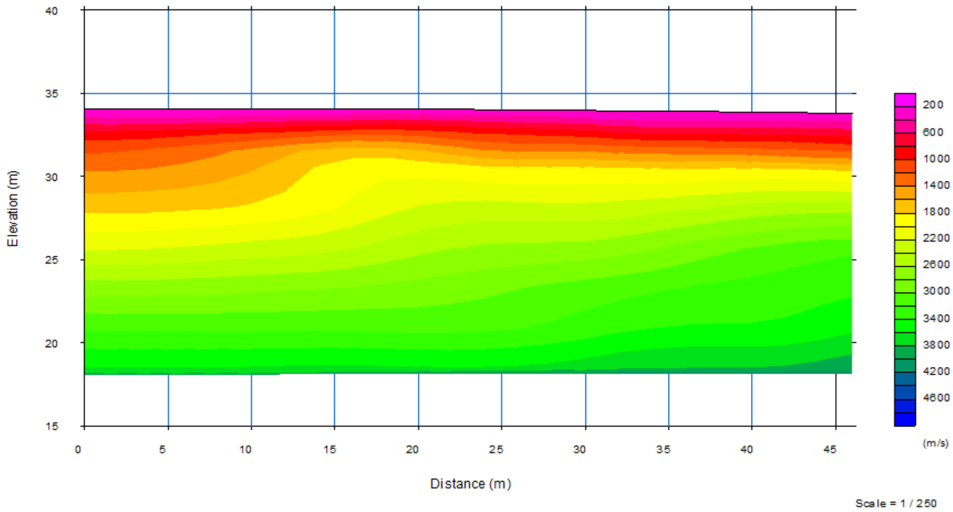

Fig B.4: Seismic Refraction T2S2 Tomographic Inversion.

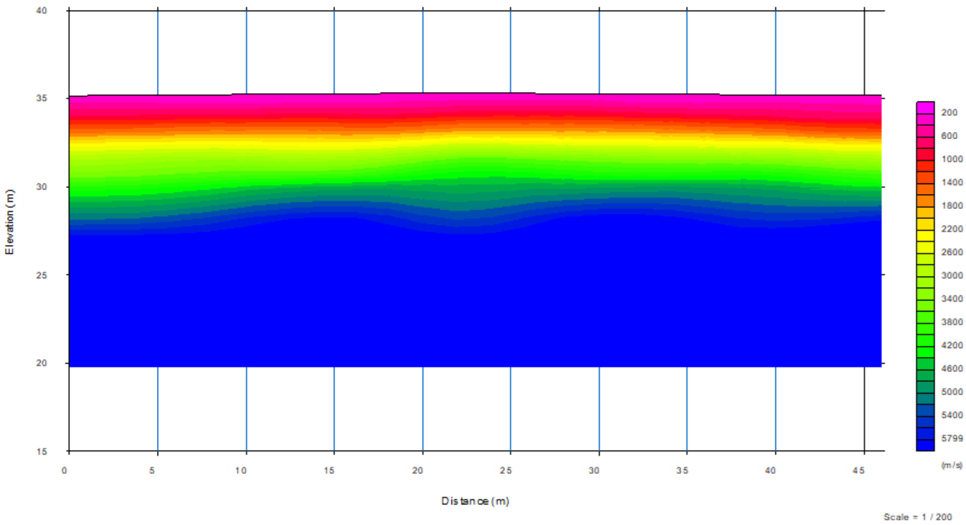

Fig B.5: Seismic Refraction T3S1 Tomographic Inversion.

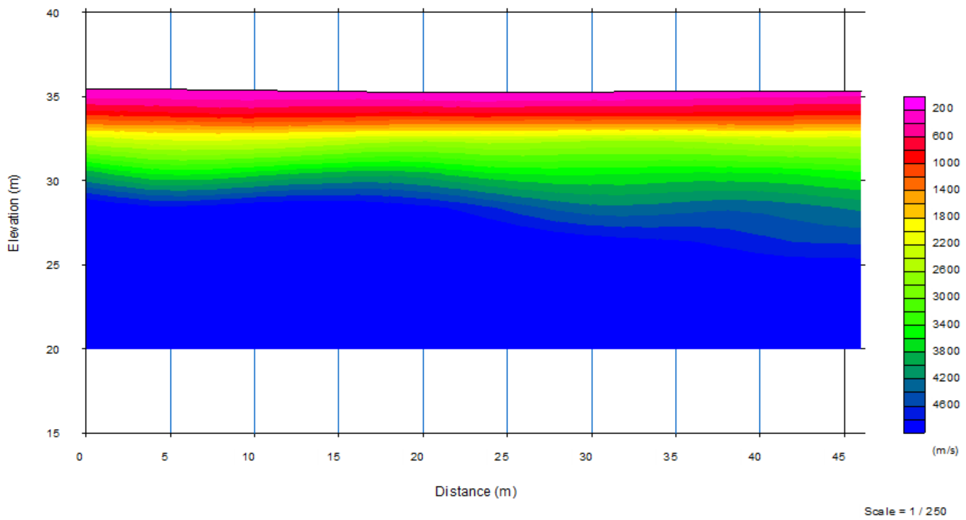

Fig B.6: Seismic Refraction T3S2 Tomographic Inversion.

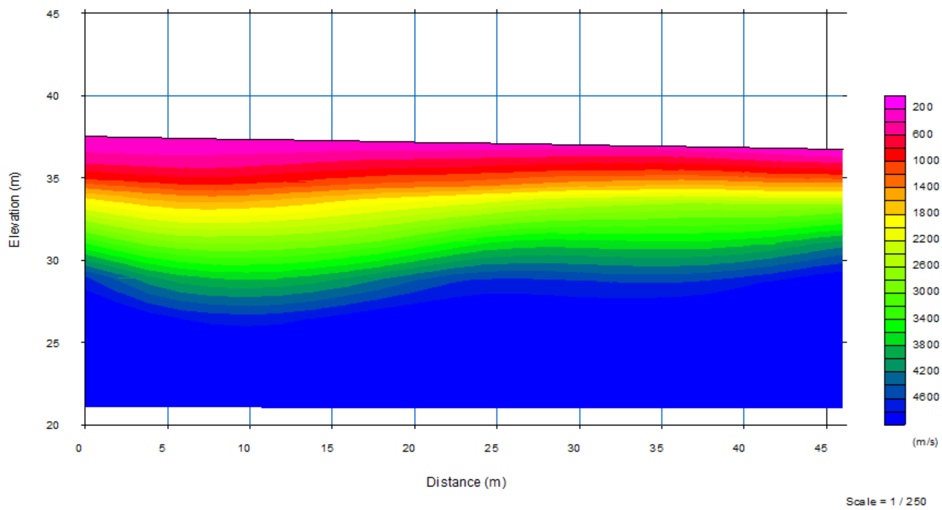

Fig B.7: Seismic Refraction T4S1 Tomographic Inversion.

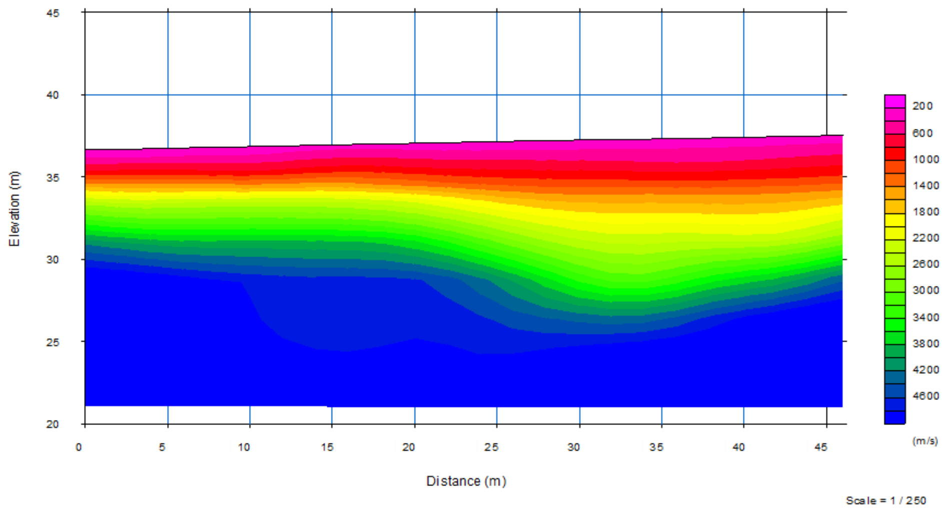

Fig B.8: Seismic Refraction T4S2 Tomographic Inversion.

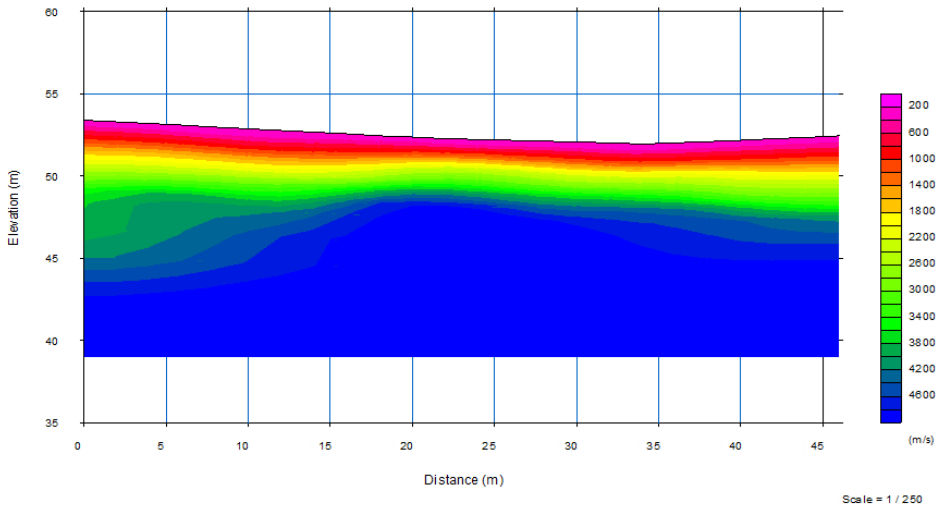

Fig B.9: Seismic Refraction T5S1 Tomographic Inversion.

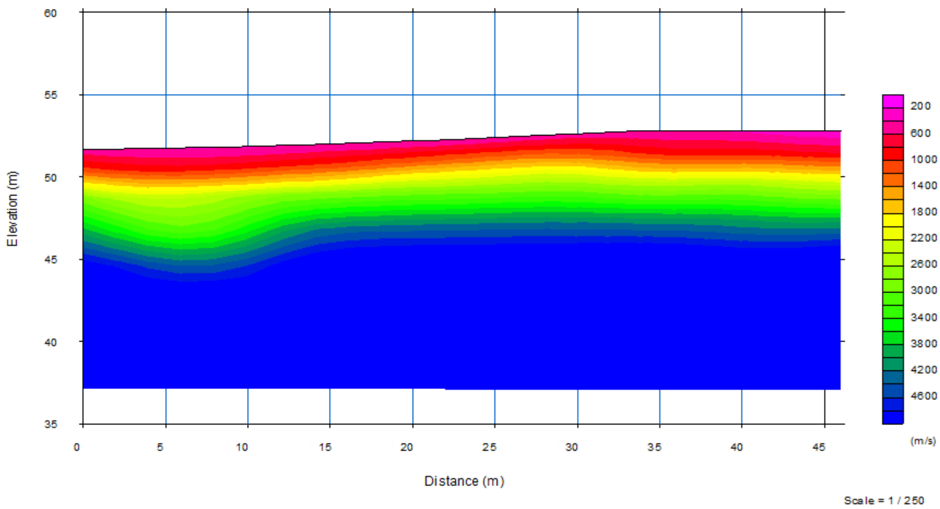

Fig B.10: Seismic Refraction T5S2 Tomographic Inversion.

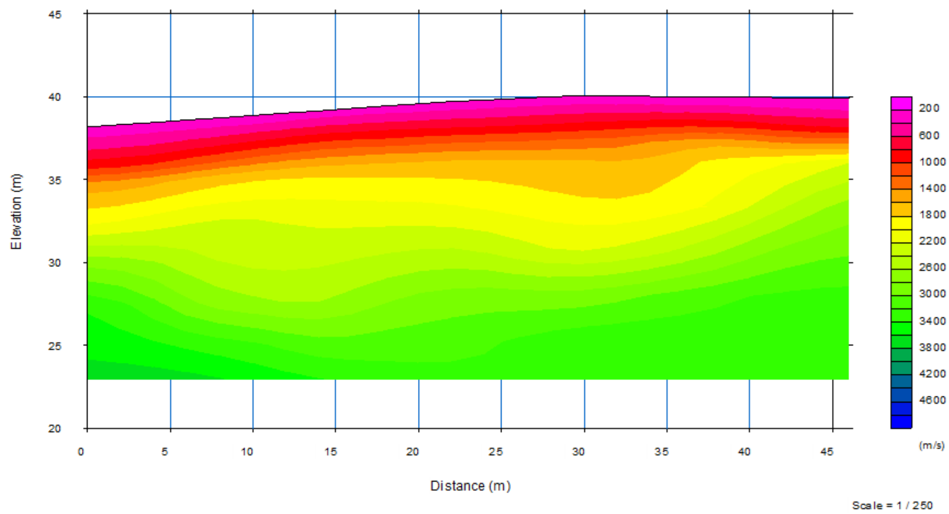

Fig B.11: Seismic Refraction T6S1 Tomographic Inversion.

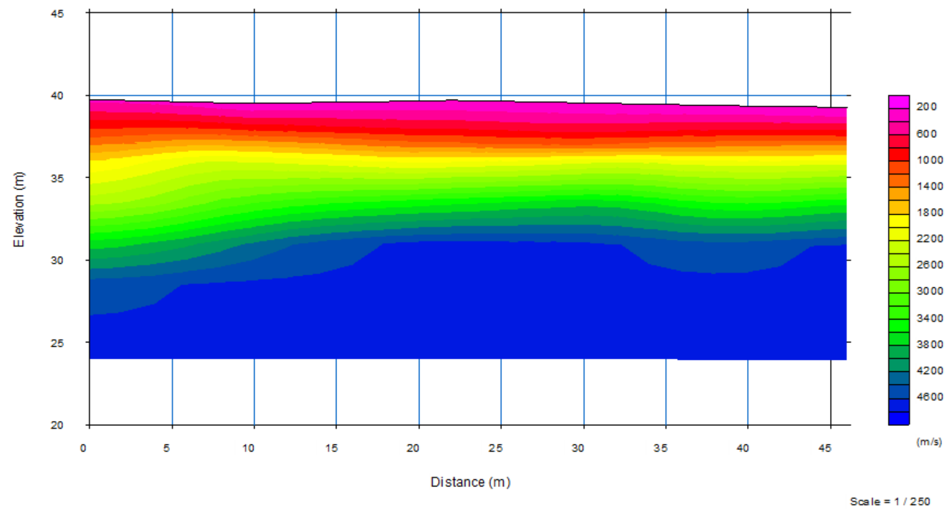

Fig B.12: Seismic Refraction T6S2 Tomographic Inversion.

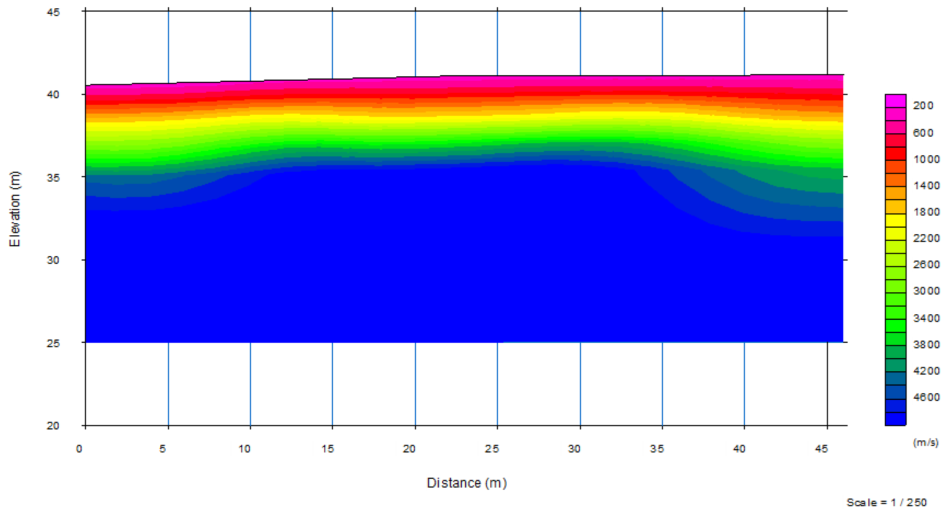

Fig B.13: Seismic Refraction T7S1 Tomographic Inversion.

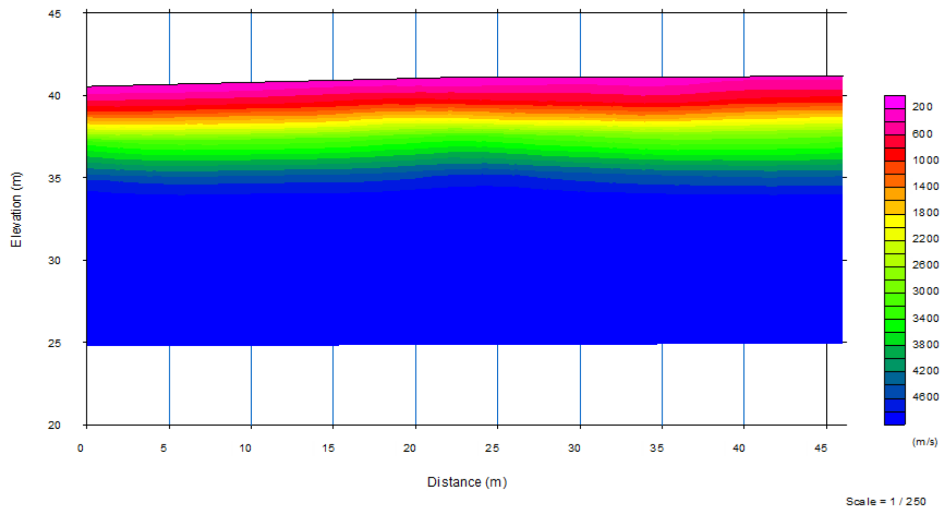

Fig B.14: Seismic Refraction T7S2 Tomographic Inversion.

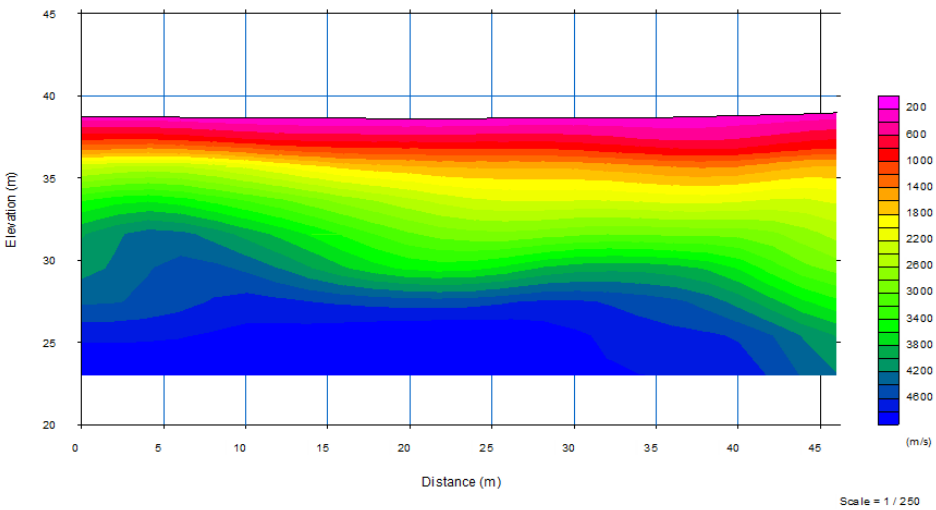

Fig B.15: Seismic Refraction T8S1 Tomographic Inversion.

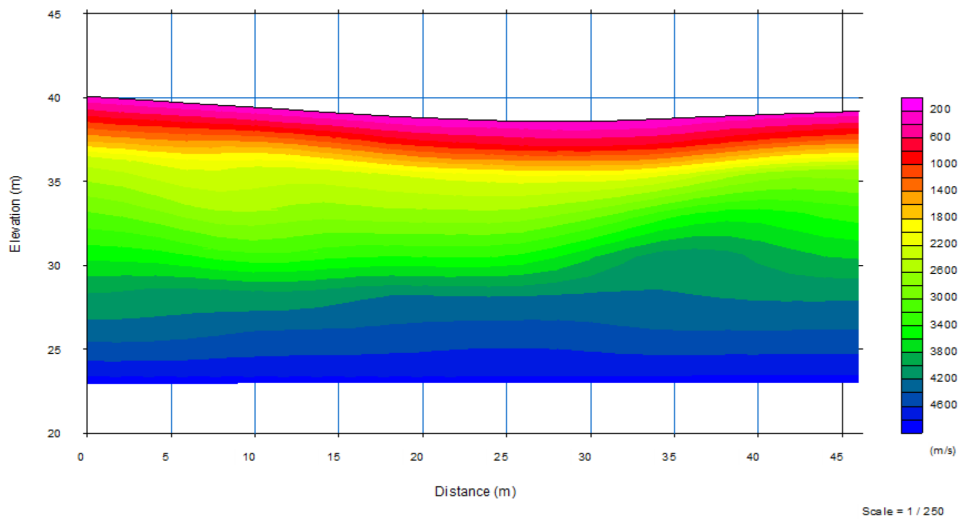

Fig B.16: Seismic Refraction T8S2 Tomographic Inversion.

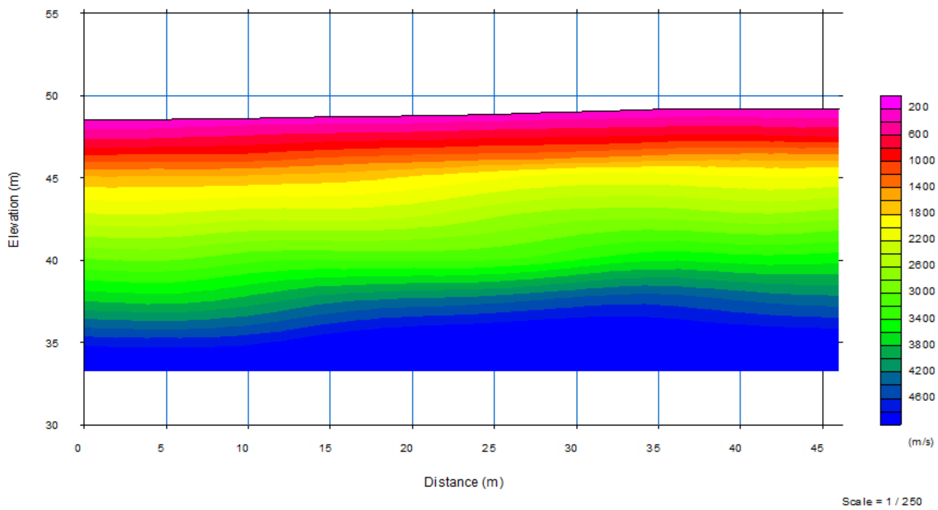

Fig B.17: Seismic Refraction SuSS1 Tomographic Inversion.

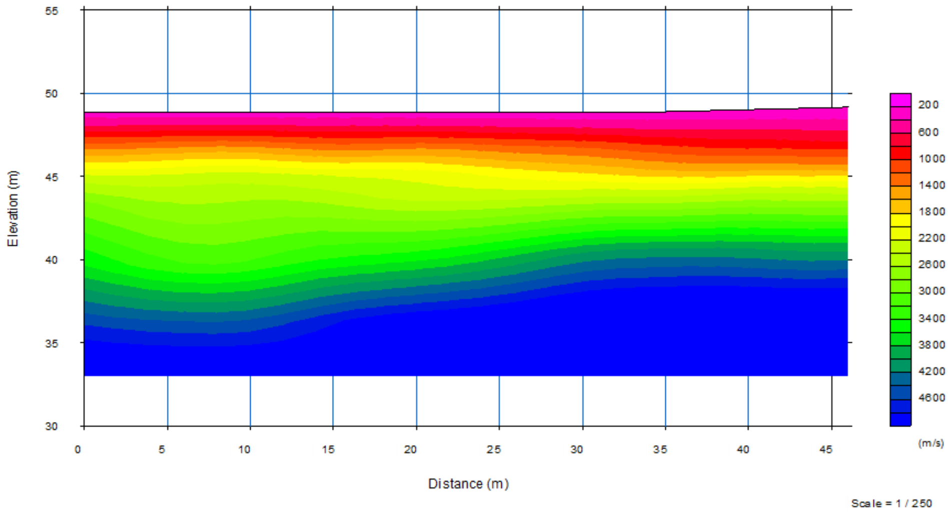

Fig B.18: Seismic Refraction SuSS2 Tomographic Inversion.

APPENDIX C: EXCAVATABILITY

The seismic velocity of a rock formation is related to characteristics of the rock mass which include rock hardness and strength, degree of weathering and discontinuities. Usually the velocity is just one of several parameters used in the assessment of excavatability. The excavatability of a rock formation is favoured by the following factors:

- Open fractures, faults and other planes of weakness of any kind
- Weathering
- Brittleness and crystalline nature
- High degree of stratification or lamination
- Large grain size
- Low compressive strength

Weaver (1975) presented a comprehensive rippability rating chart (Fig.1) in which the p-wave velocity value and the relevant geological factors could be entered and assigned appropriate weightings. The total weighted index was found to correlate very well with actual rippability.

Fig.1 Rippability Rating Chart

Rock class	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock
Seismic velocity (m/s)	>2150	2150-1850	1850-1500	1500-1200	1200-450
Rating	26	24	20	12	5
Rock hardness	Extremely hard rock	Very hard rock	Hard rock	Soft rock	Very soft rock
Rating	10	5	2	1	0
Rock weathering	Unweathered	Slightly weathered	Weathered	Highly weathered	Completely weathered
Rating	9	7	5	3	1
Joint spacing (mm)	>3000	3000-1000	1000-300	300-50	<50
Rating	30	25	20	10	5
Joint continuity	Non continuous	Slightly continuous	Continuous- no gouge	Continuous- some gouge	Continuous- with gouge
Rating	5	5	3	0	0
Joint gouge	No separation	Slight separation	Separation <1mm	Gouge <5mm	Gouge >5mm
Rating	5	5	4	3	1
Strike and dip orientation	Very unfavourable	Unfavourable	Slightly unfavourable	Favourable	Very favourable
Rating	15	13	10	5	3
Total rating	100-90	90-70*	70-50	50-25	<25
Rippability assessment	Blasting	Extremely hard ripping and blasting	Very hard ripping	Hard ripping	Easy ripping
Tractor horsepower		770/385	385/270	270/180	180
Tractor kilowatts		575/290	290/200	200/135	135

APPENDIX D: DRAWINGS

The information derived from the geophysical investigation is presented in the following drawings:

AGP22050_01	Geophysical Investigation Locations	1:20000@ A4
AGP22050_T1	Fig. 1 Turbine Base T1 Results and Interpretation T1R1 & T1S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T1R2 & T1S2	1:1250 @ A4
AGP22050_T2	Fig. 1 Turbine Base T1 Results and Interpretation T2R1 & T2S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T2R2 & T2S2	1:1250 @ A4
AGP22050_T3	Fig. 1 Turbine Base T1 Results and Interpretation T3R1 & T3S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T3R2 & T3S2	1:1250 @ A4
AGP22050_T4	Fig. 1 Turbine Base T1 Results and Interpretation T4R1 & T4S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T4R2 & T4S2	1:1250 @ A4
AGP22050_T5	Fig. 1 Turbine Base T1 Results and Interpretation T5R1 & T5S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T5R2 & T5S2	1:1250 @ A4
AGP22050_T6	Fig. 1 Turbine Base T1 Results and Interpretation T6R1 & T6S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T6R2 & T6S2	1:1250 @ A4
AGP22050_T7	Fig. 1 Turbine Base T1 Results and Interpretation T7R1 & T7S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T7R2 & T7S2	1:1250 @ A4
AGP22050_T8	Fig. 1 Turbine Base T1 Results and Interpretation T8R1 & T8S1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation T8R2 & T8S2	1:1250 @ A4
AGP22050_SuS	Fig. 1 Turbine Base T1 Results and Interpretation SuSR1 & SuSS1	1:1250 @ A4
	Fig. 2 Turbine Base T1 Results and Interpretation SuSR2 & SuSS2	1:1250 @ A4

GEOPHYSICAL INVESTIAGTION LOCATIONS

SCALE 1:20000

INDEX MAP:

LEGEND:

	Proposed Turbine Centre
	Proposed Hard Standing
T1R1	2D resistivity profile
T1S1	Seismic refraction profile
MT1M1/M2	MASW Locations
BH1	Proposed Borehole
TP1	Proposed Trial pit

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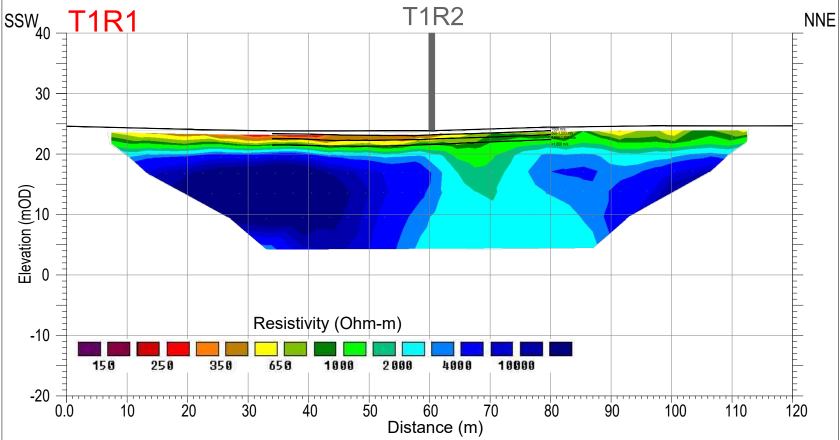
01	24-06-2022	FP	TL

FIG. 1: TURBINE BASE T1 RESULTS AND INTERPRETATION T1R1 & T1S1

SCALE 1:1250



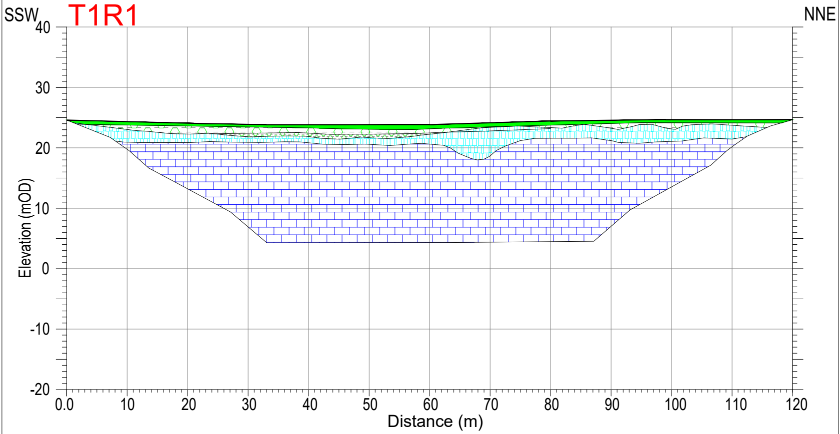
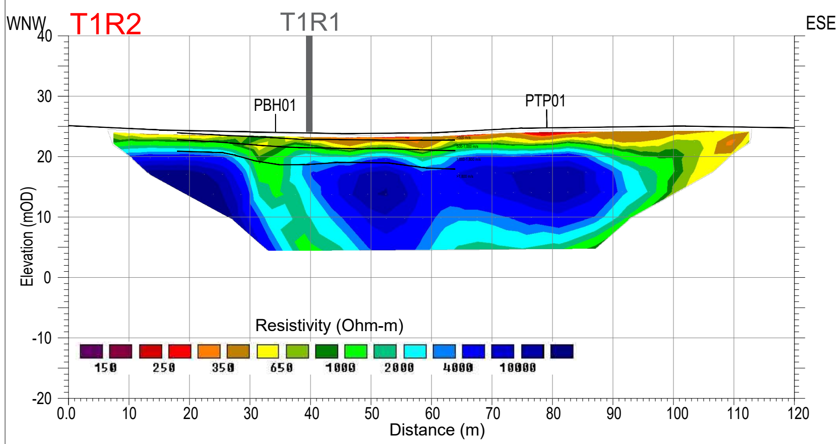
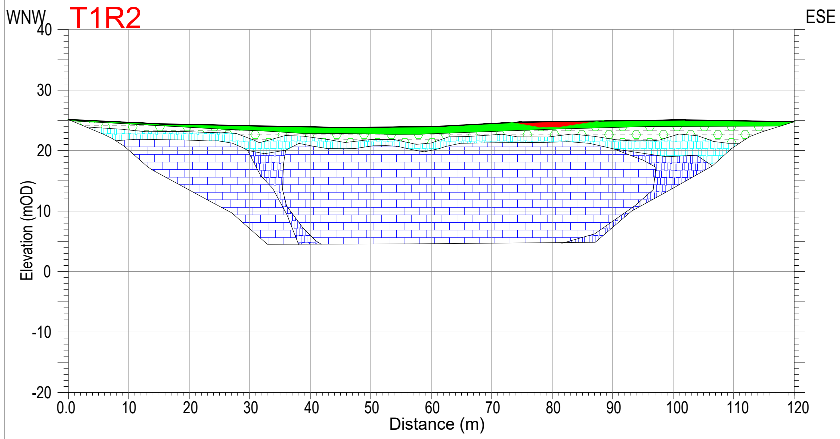


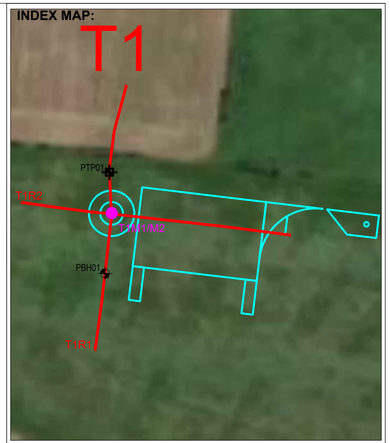
FIG. 2: TURBINE BASE T1 RESULTS AND INTERPRETATION T1R2 & T1S2

SCALE 1:1250





INDEX MAP:



LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
- Very dense clayey silty SAND/GRAVEL
- Highly-moderately weathered/karstified LIMESTONE
- Moderately-slightly weathered/possible karstified LIMESTONE
- Slightly weathered-fresh LIMESTONE

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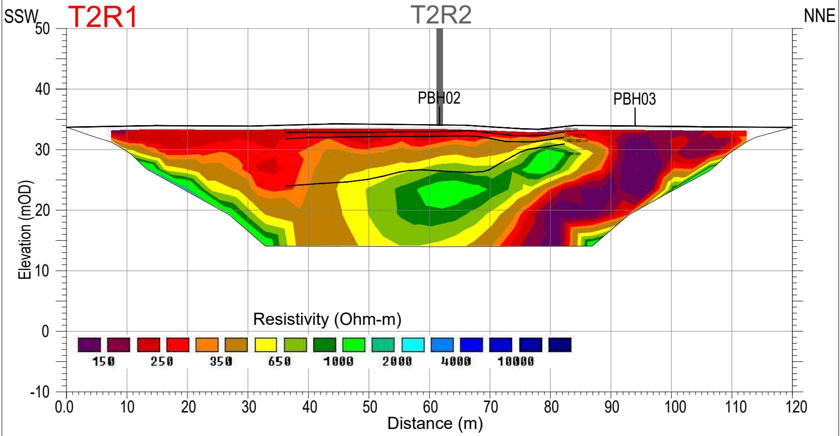
FIG. 1: TURBINE BASE T2 RESULTS AND INTERPRETATION T2R1 & T2S1

SCALE 1:1250



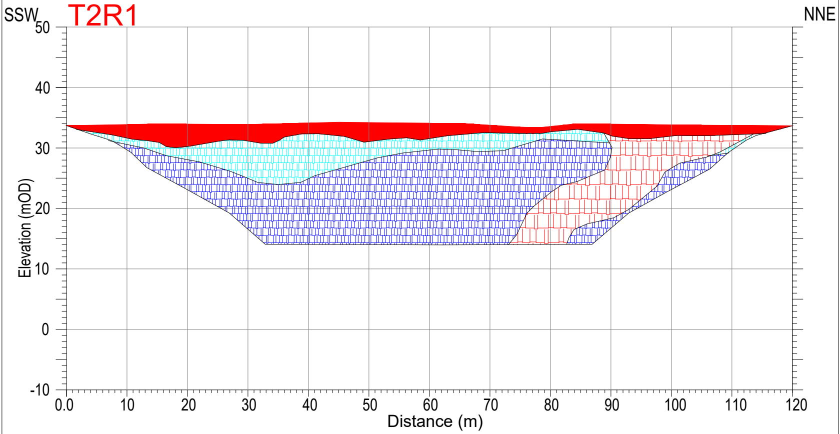
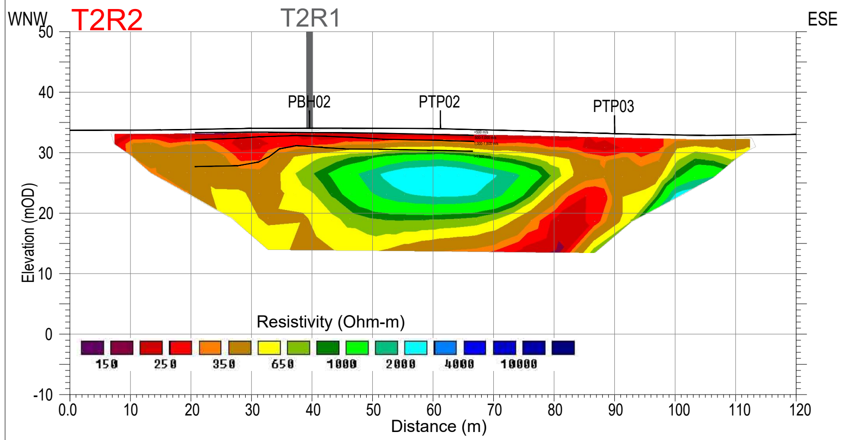
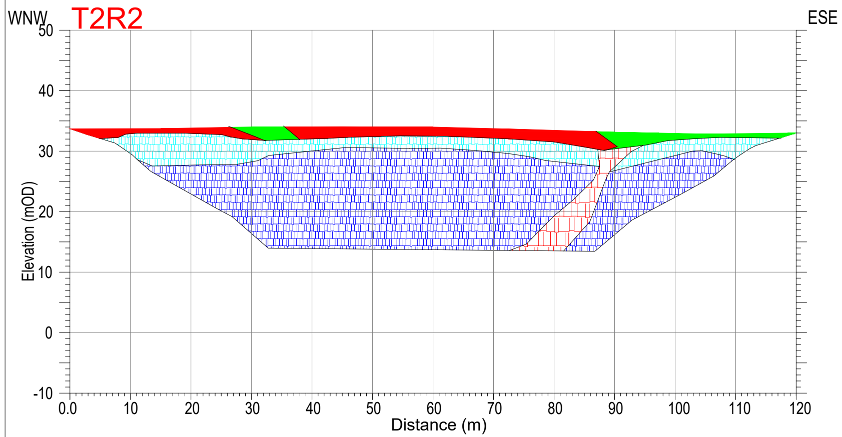


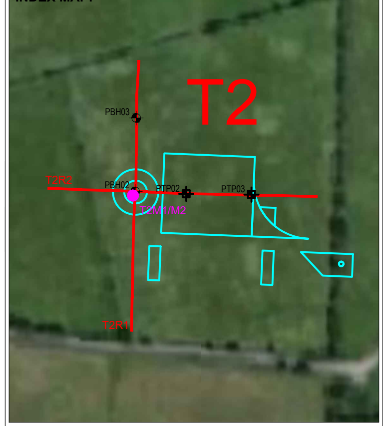
FIG. 2: TURBINE BASE T2 RESULTS AND INTERPRETATION T2R2 & T2S2

SCALE 1:1250





INDEX MAP:



LEGEND:

- Seismic Refraction layer with Vp velocity (1254-1288 m/s)
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
- Very dense clayey silty SAND/GRAVEL
- Highly weathered/karstified LIMESTONE with possible clay/water infill
- Highly-moderately weathered/karstified LIMESTONE
- Moderately-slightly weathered/possible karstified LIMESTONE
- Slightly weathered-fresh LIMESTONE

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FIG. 1: TURBINE BASE T3 RESULTS AND INTERPRETATION T3R1 & T3S1

SCALE 1:1250

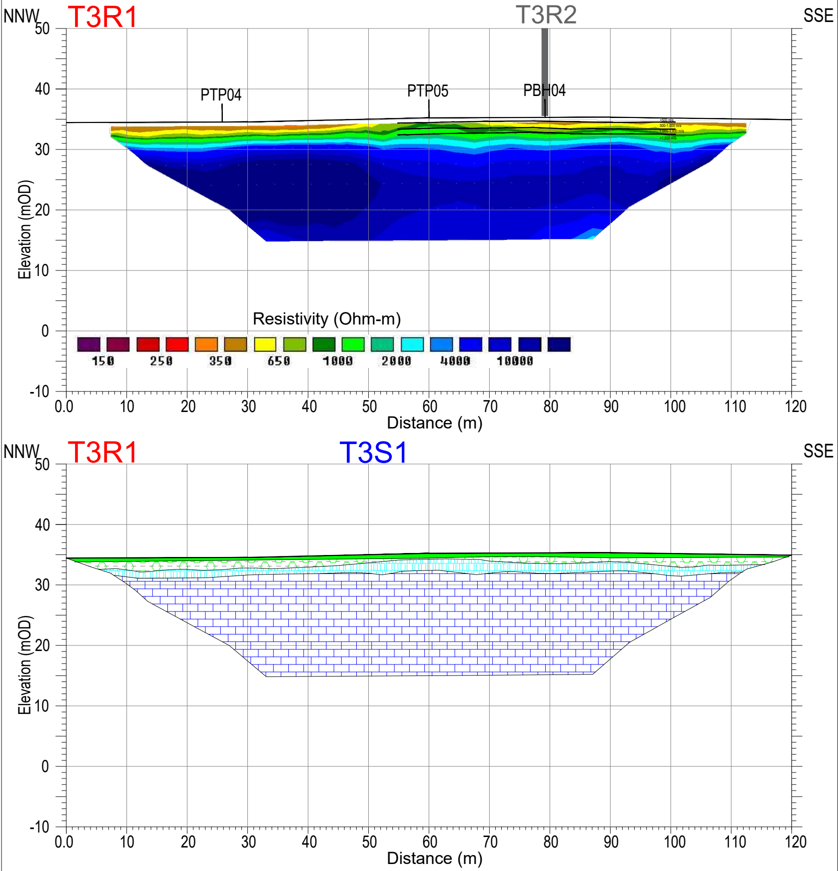
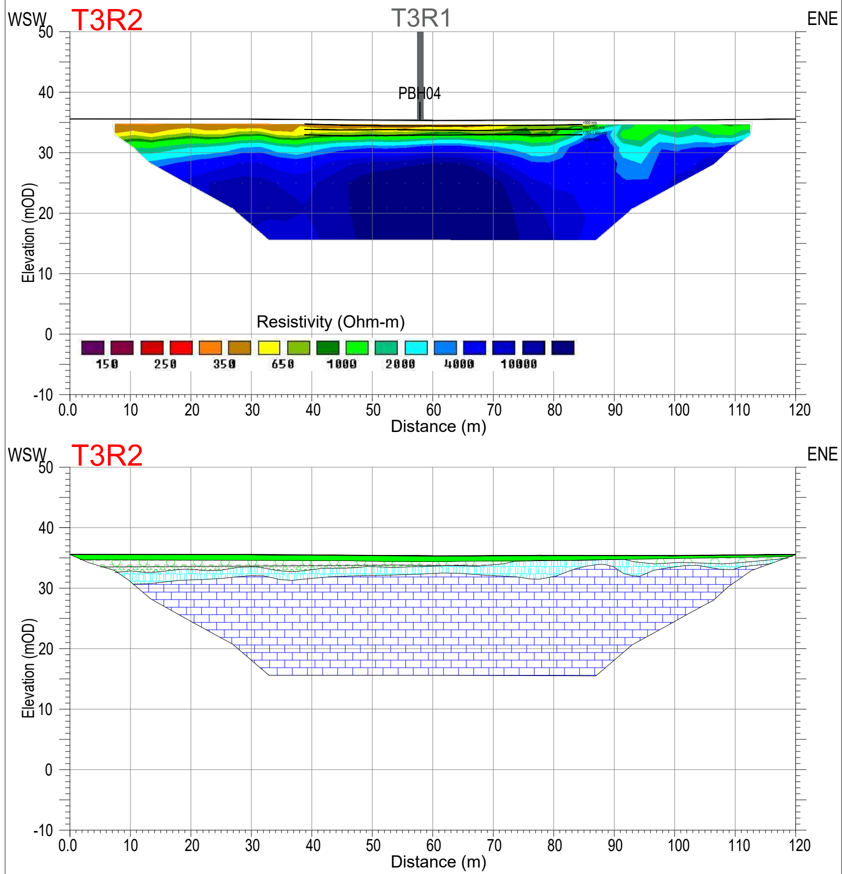


FIG. 2: TURBINE BASE T3 RESULTS AND INTERPRETATION T3R2 & T3S2

SCALE 1:1250



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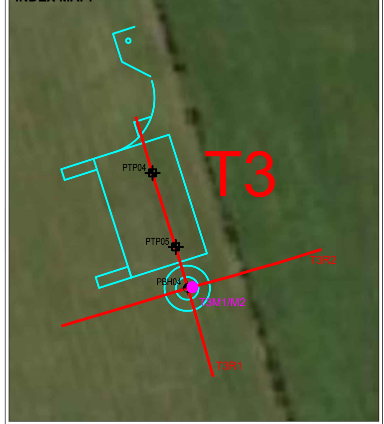

LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
- Very dense clayey silty SAND/GRAVEL
- Highly-moderately weathered/karstified LIMESTONE
- Moderately-slightly weathered/possible karstified LIMESTONE
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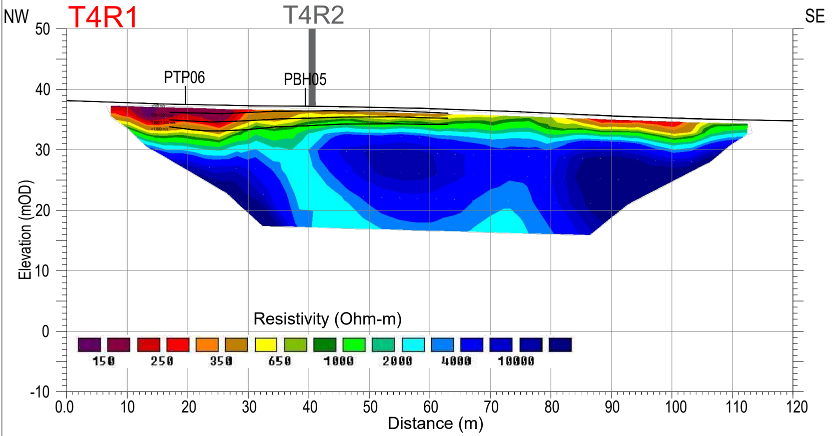
FIG. 1: TURBINE BASE T4 RESULTS AND INTERPRETATION T4R1 & T4S1

SCALE 1:1250



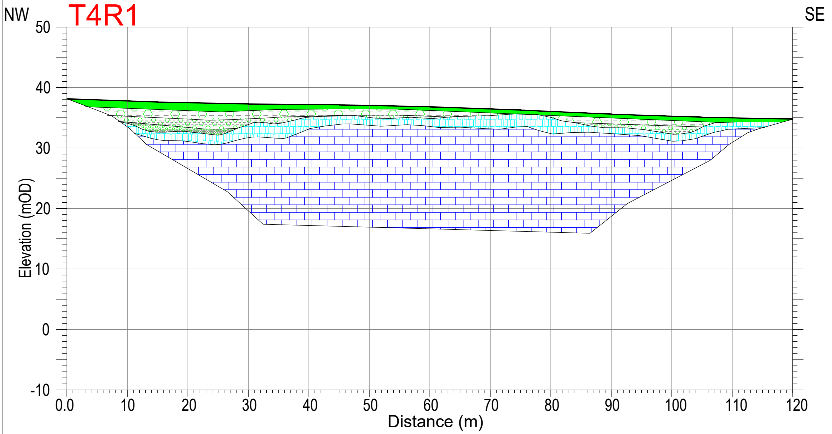
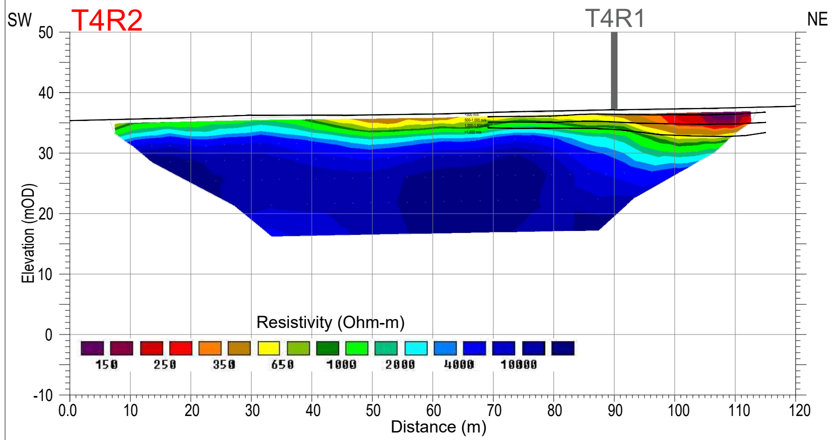
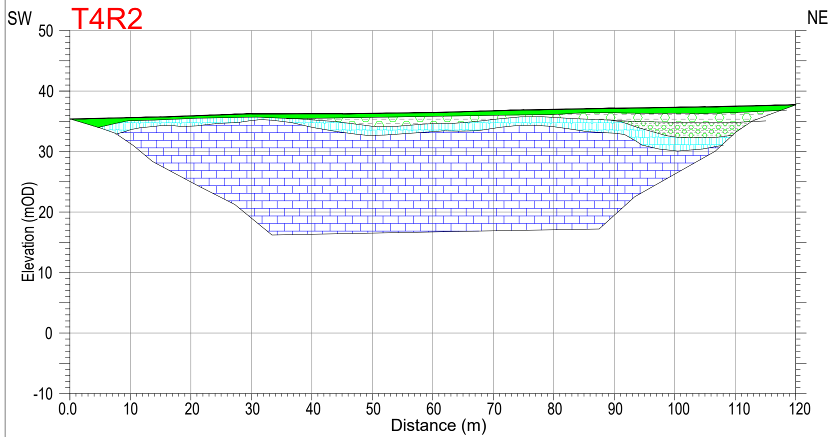


FIG. 2: TURBINE BASE T4 RESULTS AND INTERPRETATION T4R2 & T4S2

SCALE 1:1250





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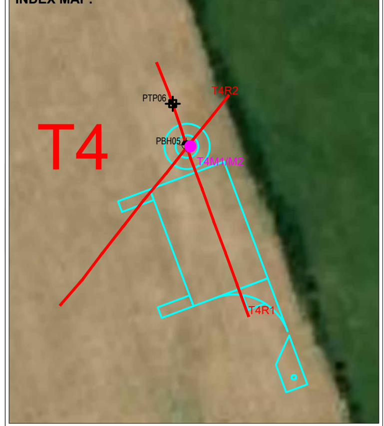

LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
- Very dense clayey silty SAND/GRAVEL
- Highly-moderately weathered/karstified LIMESTONE
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FIG. 2: TURBINE BASE T5 RESULTS AND INTERPRETATION T5R1 & T5S1

SCALE 1:1250

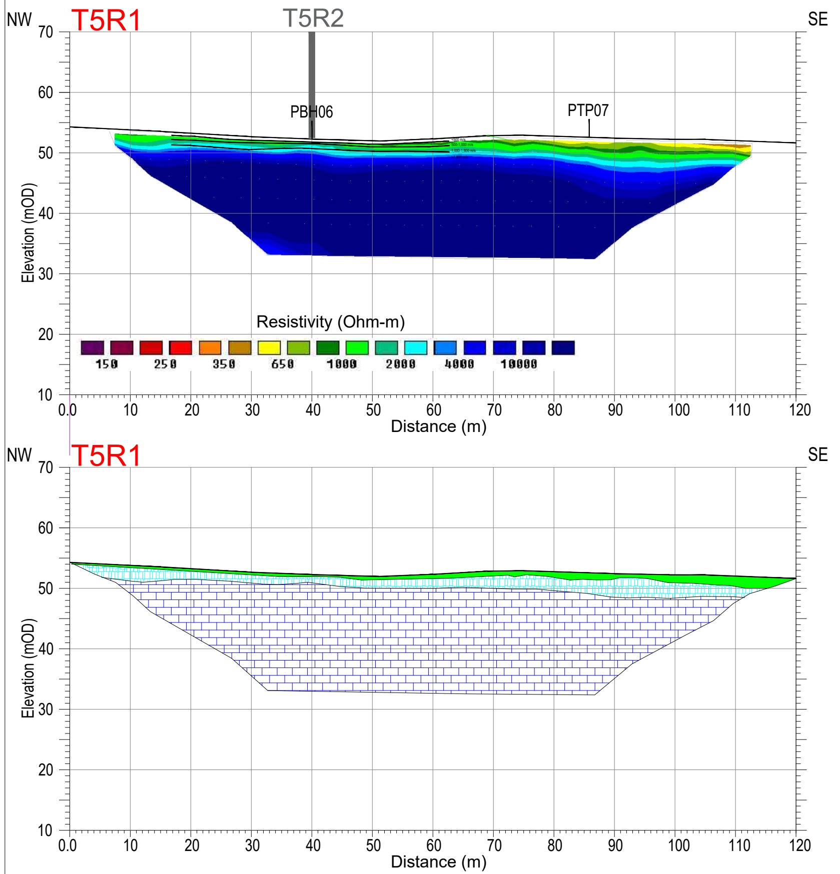
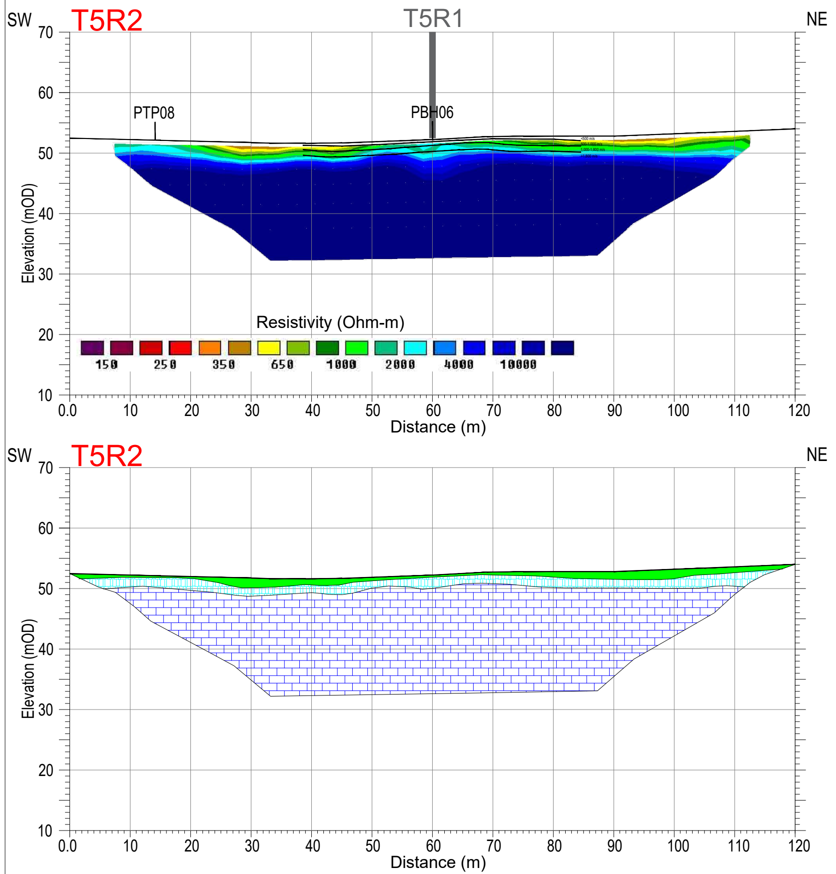
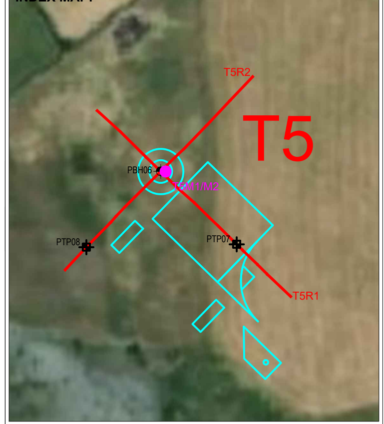


FIG. 2: TURBINE BASE T5 RESULTS AND INTERPRETATION T5R2 & T5S2

SCALE 1:1250



INDEX MAP:



LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
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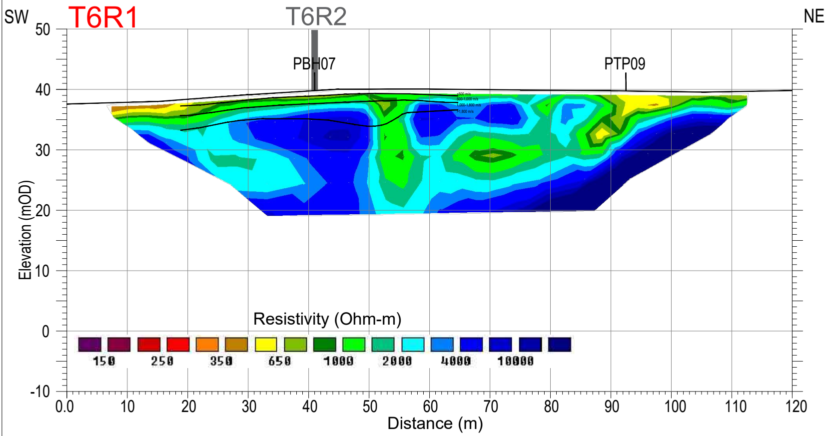
PROJECT:	LAURCLAVAGH WIND FARM GEOPHYSICAL SURVEY
CLIENT.:	GHRIAN ENERGY LIMITED
DRAWING 01:	AGP22050_T5
SCALE:	AS INDICATED @ A4
DATE:	24-06-2022

Version:	Date:	Drawn By:	Checked:
01	24-06-2022	FP	TL

FIG.1: TURBINE BASE T6 RESULTS AND INTERPRETATION T6R1 & T6S1

SCALE 1:1250



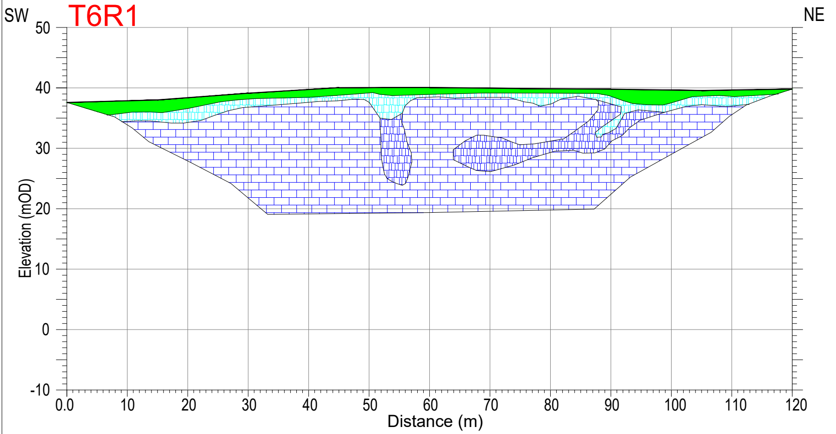
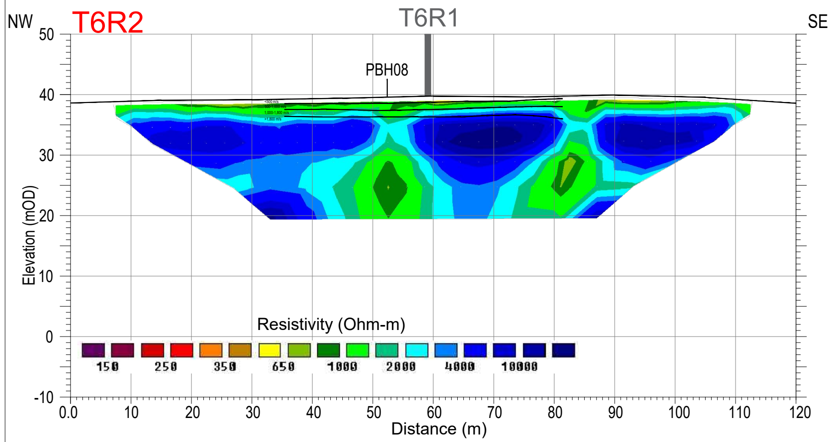
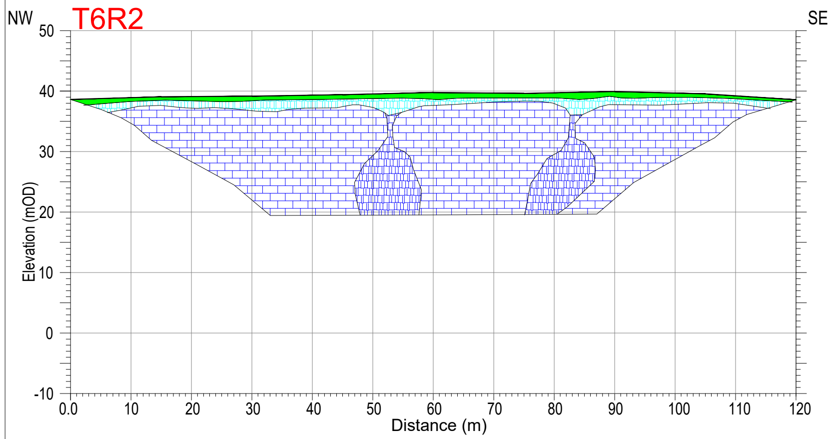


FIG. 2: TURBINE BASE T6 RESULTS AND INTERPRETATION T6R2 & T6S2

SCALE 1:1250





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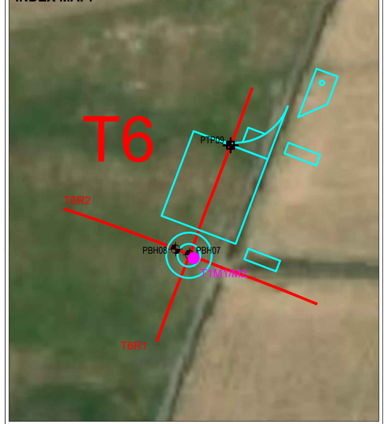

LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
- Very dense clayey silty SAND/GRAVEL
- Highly-moderately weathered/karstified LIMESTONE
- Moderately-slightly weathered/possible karstified LIMESTONE
- Slightly weathered-fresh LIMESTONE

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PROJECT:	LAURCLAVAGH WIND FARM GEOPHYSICAL SURVEY
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DRAWING 01:	AGP22050_T6
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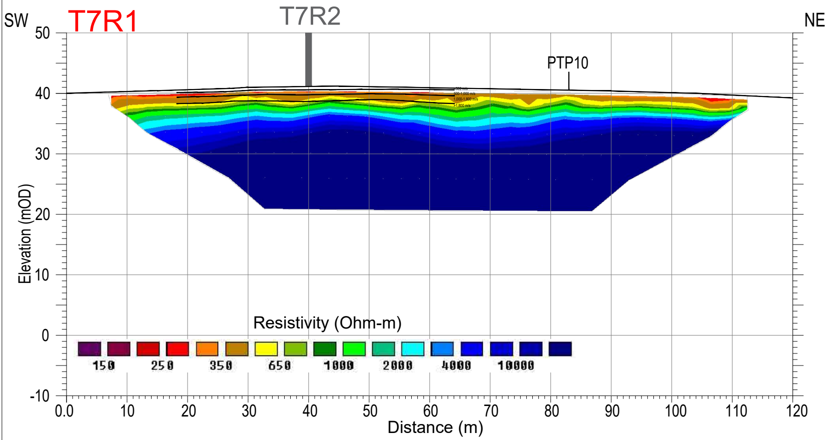
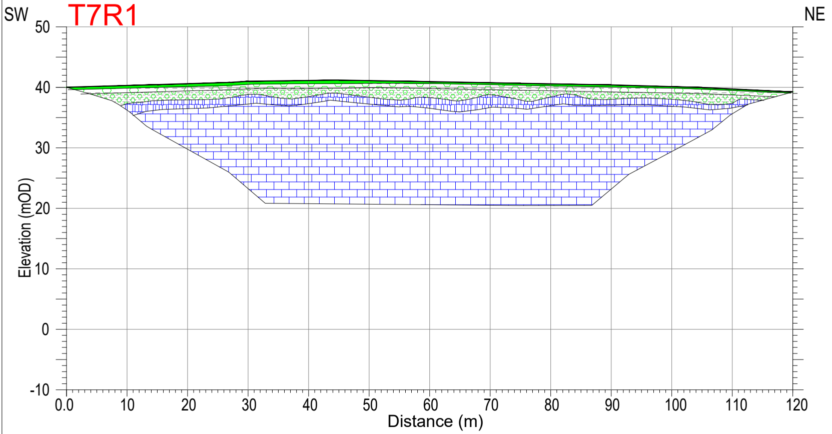
FIG. 1: TURBINE BASE T7 RESULTS AND INTERPRETATION T7R1 & T7S1

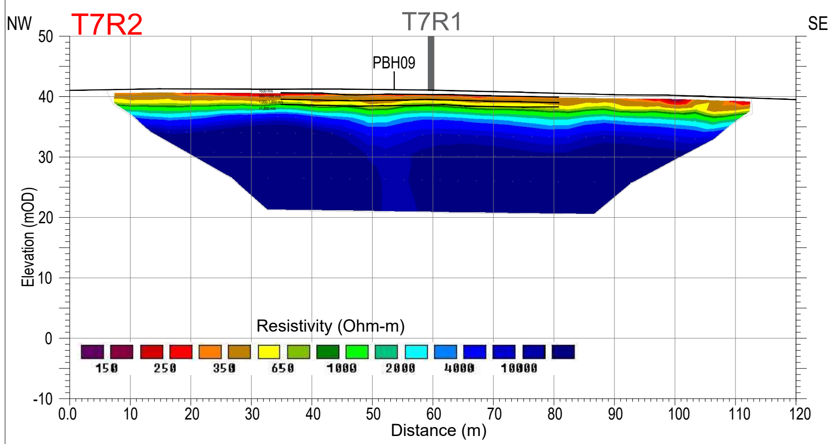
SCALE 1:1250

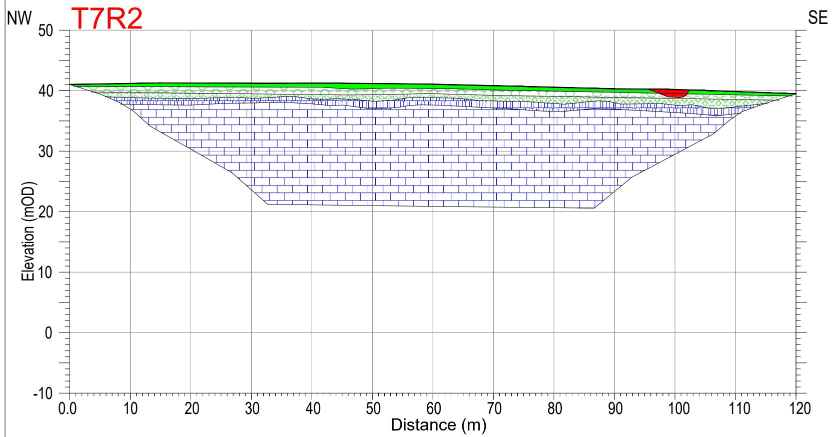




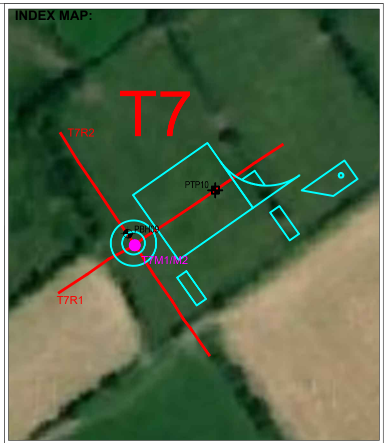
GIG. 2: TURBINE BASE T7 RESULTS AND INTERPRETATION T7R2 &T7S2

SCALE 1:1250





INDEX MAP:



LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
- Medium dense clayey silty SAND/GRAVEL
- Dense clayey silty SAND/GRAVEL
- Very dense clayey silty SAND/GRAVEL
- Highly-moderately weathered/karstified LIMESTONE
- Moderately-slightly weathered/possible karstified LIMESTONE
- Slightly weathered-fresh LIMESTONE

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CLIENT.:	GHRIAN ENERGY LIMITED
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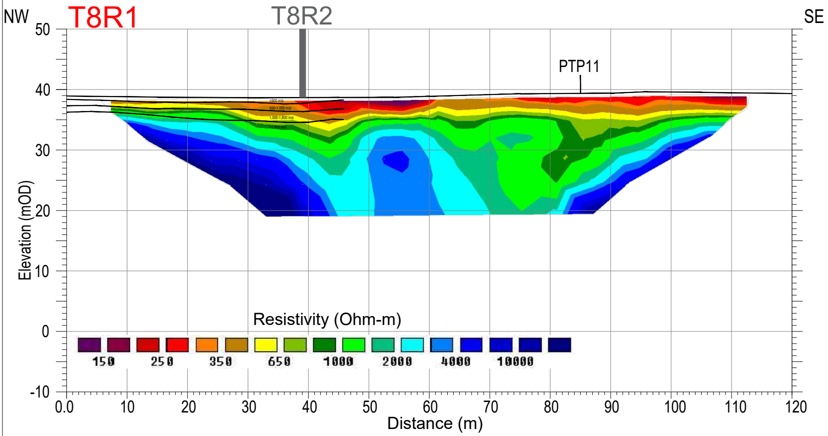
FIG. 1: TURBINE BASE T8 RESULTS AND INTERPRETATION T8R1 & T8S1

SCALE 1:1250



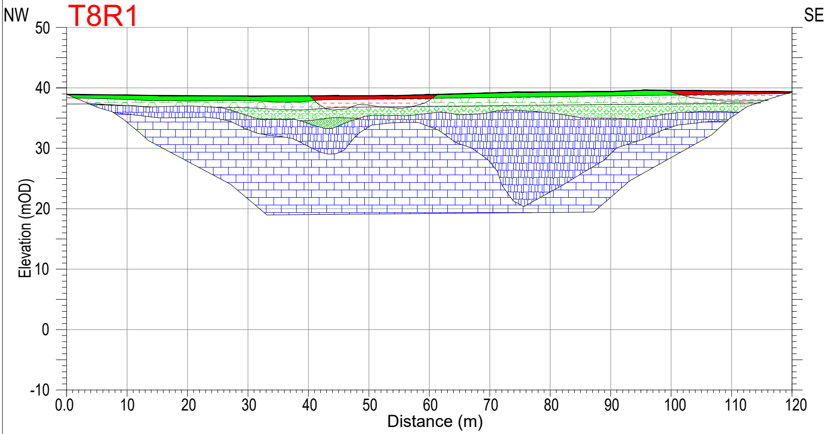
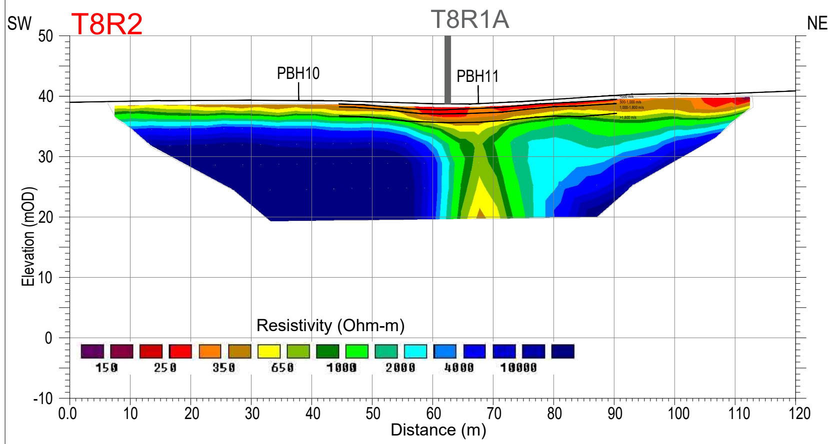
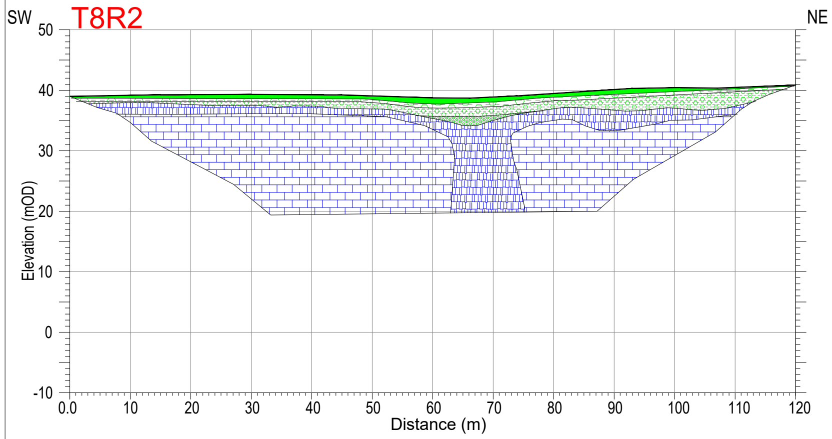


FIG. 2: TURBINE BASE T8 RESULTS AND INTERPRETATION T8R2 & T8S2

SCALE 1:1250





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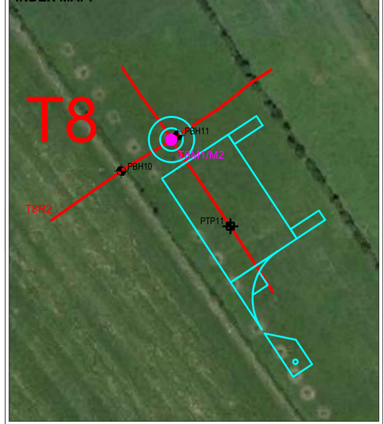

LEGEND:

- Seismic Refraction layer with Vp velocity
- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
- Loose clayey silty SAND/GRAVEL
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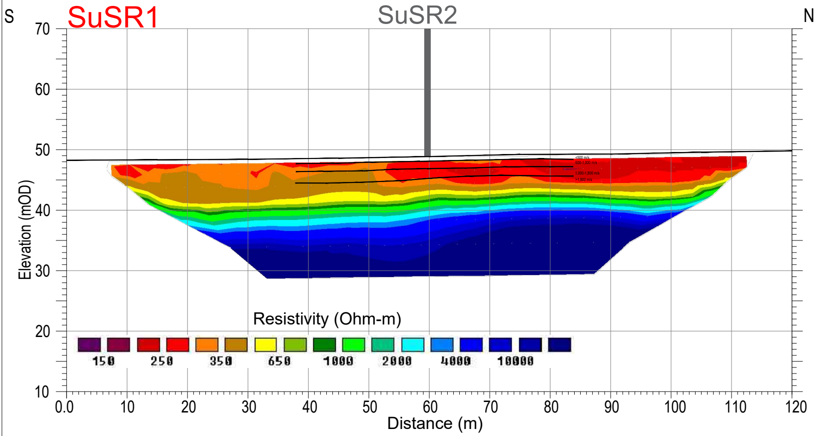
FIG. 1: SUBSTATION RESULTS AND INTERPRETATION SuSR1 &SuSS1

SCALE 1:1250



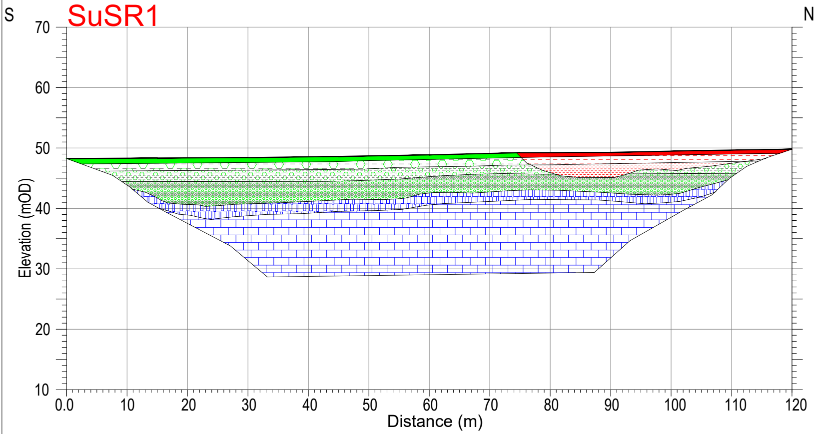
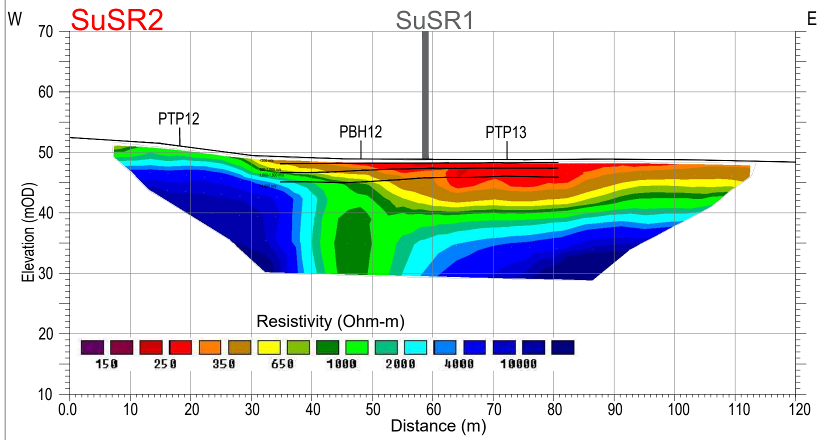
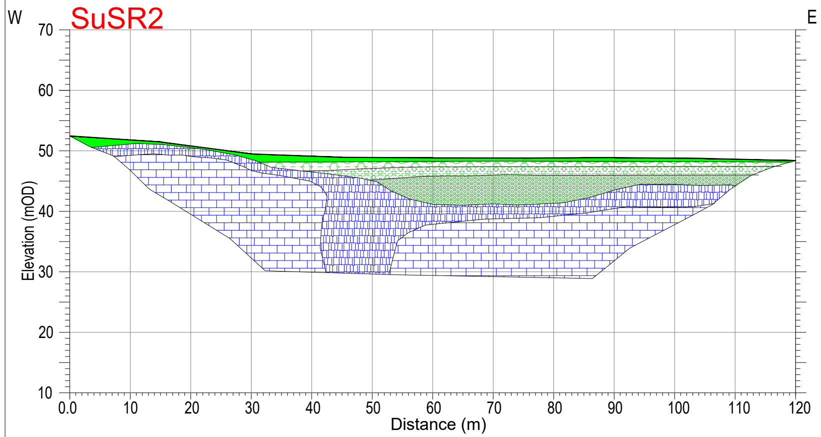


FIG. 2: SUBSTATION RESULTS AND INTERPRETATION SuSR2 & SuSS2

SCALE 1:1250





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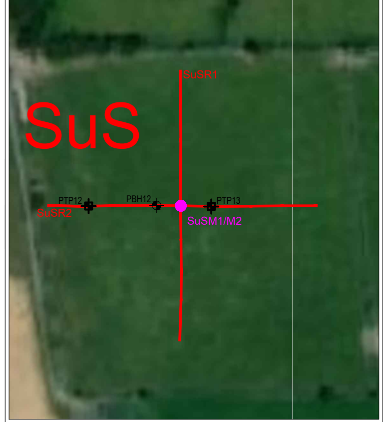

LEGEND:

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- Soft sandy gravelly CLAY
- Firm sandy gravelly CLAY
- Stiff sandy gravelly CLAY
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