AGP24120_01

RECEIVED: 18/08/2025

Report on the Geophysical Investigation at Bennettsbridge Quarry, Co. Kilkenny for Bennettsbridge Limestone Quarries.

4TH February 2025

APEX Geophysics Limited
Unit 6, Knockmullen Business Park
Gorey
Co. Wexford

T: 0402 21842
E: info@apexgeophysics.ie
W: www.apexgeophysics.com

RECEIVED: 18/08/2025

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.

PROJECT NUMBER	AGP24120		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
EURGEOL. PETER O'CONNOR PGEO., M. SC. (GEOPHYSICS), DIP EIA MGT.	TONY LOMBARD M.SC.(GEOPHYSICS)	V.01	4TH FEBRUARY 2025

RECEIVED: 18/08/2025

CONTENTS

RECEIVED: 18/08/2025

1. EXECUTIVE SUMMARY

APEX Geophysics Limited was requested by Bennettsbridge Limestone Quarries to carry out a geophysical investigation of lands at Bennettsbridge Quarry, Co. Kilkenny. The lands in question form part of a proposed extension to the quarry. The objectives of the investigation were to provide information on overburden type and thickness, depth to and type of bedrock, quality of bedrock and weathered /fractured karst zones.

Bennettsbridge Limestone Quarry is located approximately 1.3km north-west of the village of Bennettsbridge. The area under investigation is c. 25.1 ha and lies immediately to the west and south-west of the existing quarry. Ground elevations across the site range from approx. 59 mOD to 72 mOD. The Geological Survey of Ireland (GSI) map shows Ballyadams Formation crinoidal wackestone /packstone with some karst features (springs) to the east. The GSI Quaternary Sediments map shows gravels derived from limestones. The GSI database classifies the rock as a "Regionally Important Aquifer – Karstified".

APEX Geoservices Ltd have carried out 10 geophysical surveys at various times since 2003. Rotary percussive and rotary coring have been carried out in conjunction with these surveys and also in 2024. The results of previous surveys along with relevant drilling data have been incorporated into this report.

The survey was carried out between the 11th and 16th September 2024 with the collection of EM conductivity readings, 10 ERT profiles and six seismic refraction profiles.

Overburden thicknesses range from 1 to 20 m with an WNW trending channel, up to 150 m wide, of thick (5 - 20 m) overburden outlined in the northern part of the survey area. This channel is aligned with the zone of weathering and clay filled fissures previously encountered in the quarry to the east. Resistivity values of the overburden indicate a predominantly gravelly CLAY overburden with occasional GRAVEL and highly weathered/fractured LIMESTONE. Seismic velocities of the overburden are typical of a soft-firm soil becoming stiff to very stiff at depth.

Bedrock resistivities show a wider than typical range for limestone with values ranging from 20 to 6400 Ohm-m. The majority of values are above 400 Ohm-m and these have been interpreted as moderately weathered/fractured LIMESTONE with occasional clay filled fissures (400 – 1600 Ohm-m) and slightly weathered to fresh LIMESTONE (1600 – 6400 Ohm-m). Bedrock resistivity values of less than 400 Ohm-m in the vicinity of the overburden channel referred to above have outlined a westerly extension of the weathered/fractured/clay infill zone previously encountered in the quarry to the east and this has been confirmed by drilling results.

Elsewhere very low resistivity values (20 - 400 Ohm-m) occur at depth at various locations on this 2024 and on previous surveys but a significant deterioration in rock quality has not been observed on subsequent boreholes or during extraction, processing and testing. Resistivity values are particulary low in the south of the survey area. While an increase in fracturing at shallow levels has occasionally been observed in the low resistivity areas no significant water flows were encountered. Recent thin section analysis of samples taken from similar very low resistivity Bench 3 material in the quarry classify the rock as bioclastic LIMESTONE with only rare pyrite.

Apart from the weathered/fractured/clay infill zone in the vicinity of the channel bedrock velocities elsewhere range from 4,100 m/s to 6,100 m/s indicating a strong to very strong, medium to thickly bedded bedrock.

Some rotary cored boreholes should be considered to confirm the geological interpretation and obtain samples for testing, and to ensure that the low resistivity material in the south of the survey area continues in compliance with end use standards. This report should be reviewed after any subsequent direct investigation.

RECEIVED: 18/08/2025

2. INTRODUCTION

APEX Geophysics Limited was requested by Bennettsbridge Limestone Quarries to carry out a geophysical investigation of lands at Bennettsbridge Quarry, Co. Kilkenny. The lands in question form part of a proposed extension to the quarry.

2.1 Survey Objectives

The objectives of the investigation were to provide information on the following:

- Overburden type and thickness
- Depth to and type of bedrock.
- Quality of bedrock
- Weathered / fractured / karst zones

2.2 Site Background

Bennettsbridge Limestone Quarry is located approximately 1.3km north-west of the village of Bennettsbridge (Fig. 1). The survey area covered in this report lies immediately to the west and south-west of the existing quarry and its south-eastern boundary is located approximately 50m to the north-west of the M9 Dublin-Waterford motorway.

The area under investigation is c. 25.1 ha in area. Ground elevations across the site range from approx. 59 mOD to 72 mOD. The southern part of this site consists partly of a forestry plantation while the remainder is open agricultural land. Previous geophysical surveys were carried out in between 2006 and 2019 and borehole information is also available.

Fig 2.1: Site location.

RECEIVED: 18/08/2025

2.2.1 Geology

The Geological Survey of Ireland (GSI) 1:100k Geology map (GSI 2019a) shows the survey area as underlain by limestone of the Ballyadams Formation, described as crinoidal wackestone /packstone (Fig 2.2). Rock outcrop is shown immediately east and west of the quarry with some karst features (springs) to the east.

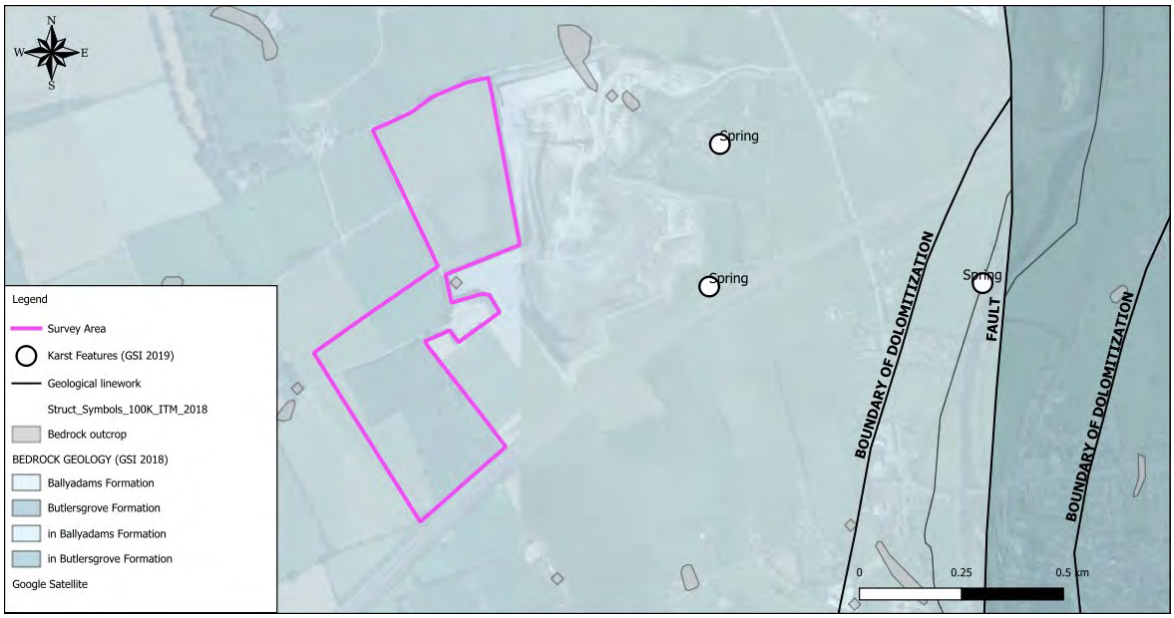


Fig 2.2: Bedrock geology.

2.2.2 Soils

The GSI Quaternary Sediments map for the area (GSI 2019b) indicates that the site is located within an area of gravels derived from limestones.

Fig 2.3: Quaternary sediments.

RECEIVED: 18/08/2025

2.2.3 Aquifer Classification

The GSI database indicates bedrock within the site as “Regionally Important Aquifer – Karstified”.

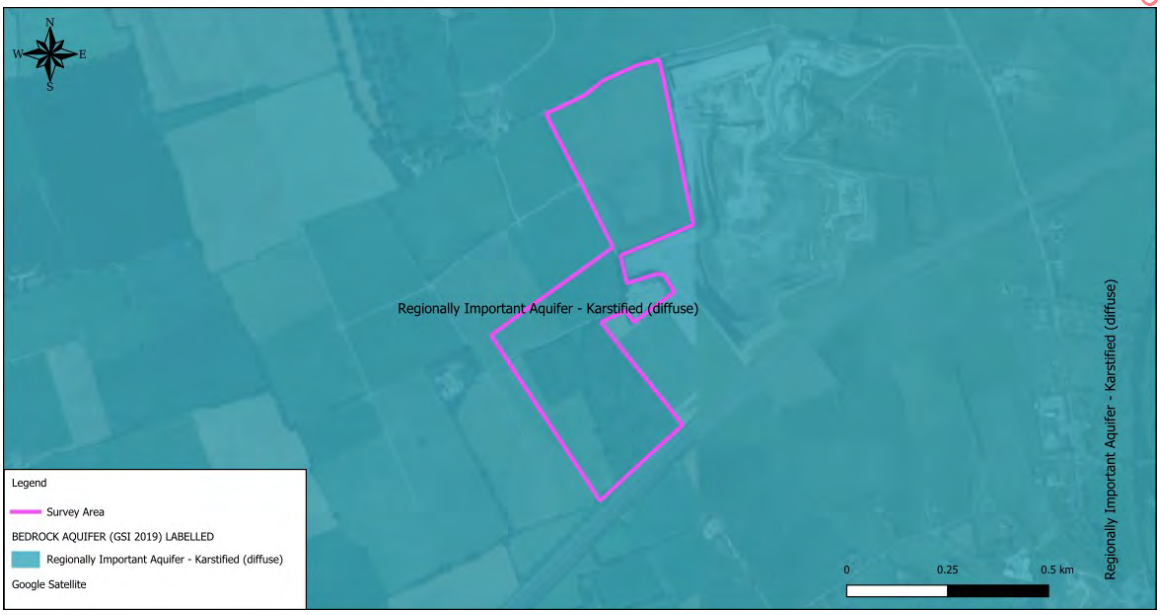


Fig 2.4: Bedrock aquifer.

2.2.4 Historical Data

The 6" Geological Sheet (Fig.2.5) shows rock outcrops in the centre and to the south-west of the survey area. Rock to the west is described as ‘compact’ and ‘exceedingly dense’. Geological dip is shown to the north/northwest.

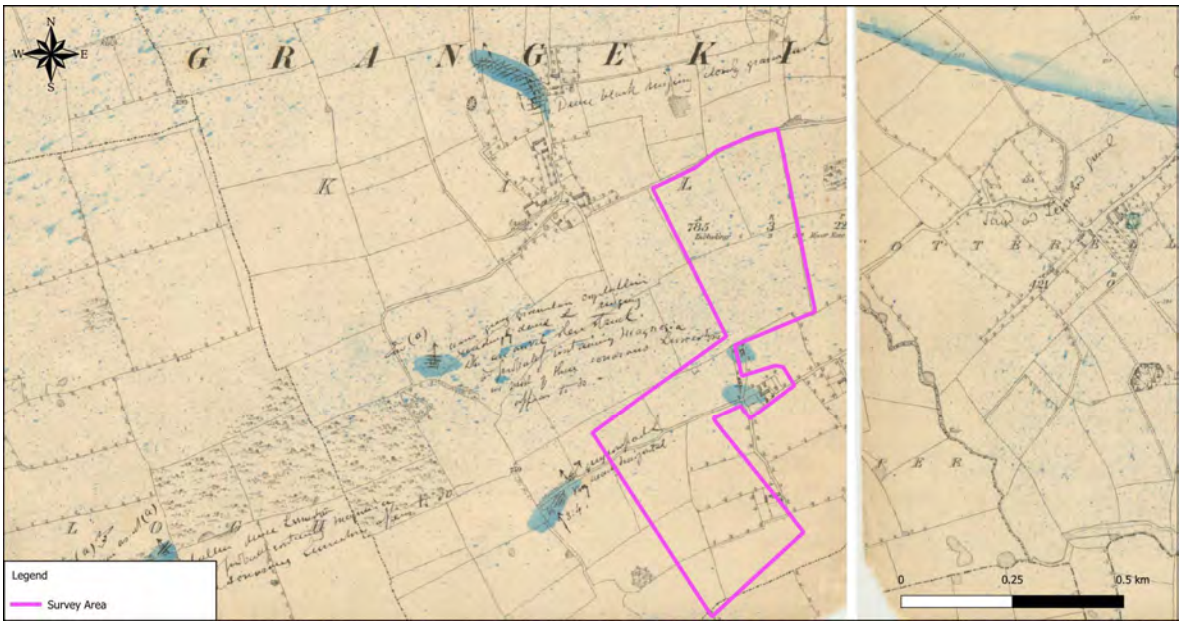


Fig 2.5: The historical 6-inch map.

RECEIVED: 18/08/2025

2.2.5 Previous Investigations

APEX Geoservices Ltd. have carried out a number of surveys since 2003. Relevant geophysical and borehole data have been incorporated into this 2024 report and locations of previous profiles and boreholes are shown on Drawing AGP24120_01. Interpreted profiles from 2006 and 2018 are contained in Appendices D and E.

APEX Geoservices 2003 (AGL03026).
This survey consisted of 15 ERT profiles to the north and northeast of the present quarry in the vicinity of White Williams Well to investigate possible conduits for water inflow into the quarry during high rainfall periods.

APEX Geoservices 2004 (AGL04134).
This survey consisted of CST readings, a further 6 ERT profiles and 4 seismic profiles to assist in investigating the water inflows described above.

APEX Geoservices 2006 (AGL06028).
This survey consisted of 3 ERT Profiles over the quarry extension area to the east (now extracted) to map overburden thickness and rock type. It was followed by 23 rotary percussive boreholes.

APEX Geoservices 2006 (AGL06097).
This was a geophysical survey of greenfield lands (Gibbons' Land) to the north and west of the quarry and consisted of EM conductivity readings and 19 ERT profiles.

APEX Geoservices 2007 (AGL07255).
This survey consisted of 24 Ground Probing Radar profiles along a quarry haul road to map a cavity associated with subsidence of the road.

APEX Geoservices 2007 (AGL07395).
This survey consisted of 2 ERT profiles over the quarry extension area to the east and south (now extracted). A total of 8 rotary cored boreholes to investigate and sample the rock resource were also drilled.

APEX Geoservices 2009 (AGL09133).
This consisted of 9 Trial Pits over the quarry extension area to the east and south (now extracted) to confirm overburden type and thickness.

APEX Geoservices 2014 (AGL14021).
This survey consisted of 5 ERT profiles and 4 GPR profiles on the quarry floor to map possible karst features and clay filled fissures. It was followed by 6 rotary percussive boreholes also drilled on the quarry floor.

APEX Geoservices 2014 (AGL14110).
This survey consisted of additional EM readings on the quarry floor.

APEX Geoservices 2017 (AGL17206).
This survey consisted of EM conductivity, 7 ERT profiles and 11 seismic profiles on a 15 acres greenfield site north of the quarry.

RECEIVED: 18/08/2025

APEX Geoservices 2018 (AGL18010).
This consisted of a 9 ERT profiles 1 seismic profile over the proposed extension area to the west of the quarry. A total of 61 rotary percussive boreholes were carried out at the same time.

Boreholes 2024
As part of the current investigation program a total of 12 rotary percussive boreholes were drilled by Petersen Drilling over and around the western extension area. The results of these boreholes along with relevant historical drilling data have been incorporated into this report.

Thin Sections
Thin section petrographic analysis by SLR in 2024 classified a Bench 1 sample as 100% calcite, bioclastic grainstone with very rare (< 0.1%) pyrite and a darker Bench 2 material as 96% calcite, bioclastic packestone with limonite (2%) and rare (< 1.0%) pyrite.

2.3 Survey Rationale

This 2024 investigation consisted of reconnaissance EM ground conductivity mapping with follow-up 2D ERT and Seismic Refraction profiling:

EM ground conductivity mapping operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). This technique will provide information on the shallow (0-6m below ground level) variation of the superficial deposits and outline shallow bedrock.

ERT images the electrical resistivity of the materials in the subsurface along a profile to produce a cross-section showing the variation in resistivity with depth. Each cross-section will be interpreted to determine the material type along the profile based on 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.

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**.

RECEIVED: 18/08/2025

3. RESULTS

The survey was carried out between the 11th and 16th September 2024 with the collection of EM conductivity readings, 10 ERT profiles and six seismic refraction profiles. The geophysical survey locations are shown on Drawings AGP24120_01 (Appendix B) along with locations from previous investigations.

3.1 EM Ground Conductivity Mapping

The EM ground conductivity results (Drawing AGP24120_02, Appendix B) show the bulk conductivity of the ground materials from 0 - 6.0 m bgl. The recorded conductivity values ranged from 1 to 15 mS/m and have been generally interpreted in conjunction with the ERT, seismic and borehole data as follows:

Conductivity (mS/m)	Interpretation
1.0 – 4.0	Overburden less than 5m
4.0 – 10.0	Overburden greater than 5m
10.0 – 15.0	Overburden greater than 5m and underlying low resistivity bedrock

Note: The correlation between the EM conductivity and the underlying resistivity and borehole data on this site is not always as clear as on other sites, possibly due to the effect of underlying zones of very low resistivity limestone bedrock.

3.2 ERT

The ERT profiles (Drawings AGP24120_R1 – R10) have been interpreted as follows:

Resistivity (Ohm-m)	Interpretation
20 – 400*	OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE (surface)
	Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE (at depth)
400 - 1600	Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
1600 - 6400	Slightly weathered-fresh LIMESTONE

Note: *Resistivity values at depth on parts of profiles R7, R8 and R9 are as low as 20 Ohm-m. Similar values were recorded around the same locations on the 2018 survey.

3.3 Seismic refraction profiling

Seismic profiles S1-S6 (Drawings AGP24120_R1, R2, R3, R5, R7, R10 and Appendix C) indicate up to three velocity layers that have been interpreted as follows:

Layer	P-Wave Seismic Velocity (m/s)	Interpretation	Estimated Stiffness/ Rock Quality
1	400 - 600	OVERBURDEN/sandy gravelly CLAY, highly weathered/fractured LIMESTONE	Soft-firm, Poor
2	1,700-2,100	Gravelly CLAY, moderately weathered/fractured LIMESTONE	Stiff- very stiff, Fair
3	2,700-6,100	Moderately -slightly weathered-fresh LIMESTONE	Fair-good

RECEIVED: 18/08/2025

4. DISCUSSION

The geophysical results are presented on Drawings AGP24120_R1 to AGP24120_R10, and a summary is given on Drawings AGP24120_04.

Overburden

Overburden thickness from interpreted ERT Profiles and borehole logs has been compiled and contoured to produce the overburden thickness map shown on Drawing AGP24120_03A. Thicknesses range from 1 to 20 m with an WNW trending channel, up to 150 m wide, of thick (5 - 20 m) overburden outlined in the northern part of the survey area. This channel is aligned with the zone of weathering and clay filled fissures previously encountered in the quarry to the east (see Drawing AGP24120_04).

Resistivity values of the overburden are generally in the range 50 – 400 Ohm-m indicating a predominantly gravelly CLAY overburden with occasional GRAVEL and highly weathered/fractured LIMESTONE. Seismic velocities of the overburden are typical of a soft-firm soil becoming stiff to very stiff at depth.

The contoured bedrock elevation is shown in Drawing AGP24120_03B.

Rock

The bedrock profile has been interpreted from the ERT and seismic data and shows a generally shallow (< 5m) bedrock apart from the channel discussed above. Bedrock resistivities on this site show a wider than typical range for limestone with values ranging from 50 to 6400 Ohm-m. The majority of values are above 400 Ohm-m and these have been interpreted as moderately weathered/fractured LIMESTONE with occasional clay filled fissures (400 – 1600 Ohm-m) and slightly weathered to fresh LIMESTONE (1600 – 6400 Ohm-m). The outline of the above zones can be seen on interpreted sections AGP24120_R1-R10.

Resistivity values of less than 400 Ohm-m in limestone bedrock is usually associated with significant weathering and clay infill, or the presence of mudstone/shale bands. This is the case on ERT Profiles R3 (300 m – 360 m) and R4 (290 m – 600 m) where boreholes SP2C-24 and BE-RP027 encountered weathered zones and difficult drilling at depth. These are located in a westerly extension of the weathered/fractured/clay infill zone previously encountered in the quarry.

The seismic refraction data typically show three layers. Layer 1 is typically of soft-firm near surface material overburden and is likely to include some highly weathered/fractured rock at the base of the layer. Layer 2 in the northern area (S1/R, S2/R2, S5/R3) indicates stiff to very stiff soil in the thick overburden channel and elsewhere (S4/R5, S3/R7, S6/R10) outlines a 3-4 m thick layer of moderately weathered rock (1700 – 1900 m/s).

Layer 3 bedrock velocities range from 2,700 m/s to 6,100 m/s with the lowest values (2,700 – 3,000 m/s on S2 and S5) over the channel feature in the northern area. Values elsewhere in the northern area (Seis1/ERT 1 from APEX,2018) and from southern area (S4/R5, S3/R7, S6/R10) range from 4,100 m/s to 6,100 m/s indicating a strong to very strong, medium to thickly bedded bedrock.

RECEIVED: 18/08/2025

Low resistivity bedrock

Apart from the area of the thick overburden channel low resistivity values (< 400 Ohm-m) at depth elsewhere in the survey area (around 280 m on R2, around 90 m and 260 m on R3, and around 235 m on R4) coincide with similar values recorded on previous surveys (APEX, 2006b; APEX 2007b; APEX, 2018) but a significant deterioration in rock quality has not been observed on subsequent boreholes or during extraction.

Bands of very low resistivity values (20 – 400 Ohm-m) also occur at depth on parts of Profiles R5, R6, R7, R8, R9 and R10 in the south of the survey area. These coincide with similar values from the APEX, 2018 survey (ERT 6, ERT 7, ERT8). The extent of the very low resistivity bands in the southern area has been outlined on Drawing AGP24120_04. A line (blue dash) has been drawn through the centre of the northernmost low resistivity features observed on this 2024 survey and the previous historical surveys.

Boreholes from 2018 and from 2024 do not record any change in rock type from the dark grey/black LIMESTONE generally recorded but an increase in fracturing at shallow levels has been noted on BE-RP47, BE-RP49, BE-RP50, BE-RP51 and BE-RP52. Borehole SP14-24 (ERT Profile R7) recorded similar very frequent fractures down to 15 m bgl but otherwise medium-strong to strong dark/black limestone to end of hole at 46 m bgl.

No significant water flows were encountered in any of the 2024 boreholes drilled in this area.

A number of ERT profiles were also recorded around the Bench 3 sinking cut in the south of the quarry in late 2024. These also recorded very low resistivity values for (10 – 440 Ohm-m) for a southwesterly dipping bed of dark grey-black LIMESTONE. This material is reported by the client to pass all physical, chemical and mechanical tests when crushed. The only difference observed was being slightly brittle when crushed and having a ringing sound when struck.

Also the results of thin section analysis on samples taken from Bench 1 and Bench 3 in the quarry classify the rock in both cases as bioclastic LIMESTONE. No significant change in material type or composition is noted other than a very marginal change in the pyrite content from very rare to rare and an increase in the limonite content to around 2% on the Bench 3 sample (SLR, 2025a, SLR, 2025b).

RECEIVED: 18/08/2025

5. RECOMMENDATIONS

Some rotary cored boreholes should be considered to confirm the geological interpretation and obtain samples for testing, and to ensure that the low resistivity material in the south of the survey area continues in compliance with end use standards.

RECEIVED: 18/09/2025

REFERENCES

APEX, 2003; Geophysical Survey of a Quarry Site at Bennettsbridge, Co. Kilkenny for Benntsbridge Limestone Quarries Ltd, AGL03026.

APEX, 2004; Report on the Geophysical Survey of a Potential Quarry Reserve Area at Bennettsbridge, Co. Kilkenny for Bennettsbridge Limestone Quarries Ltd AGL04134.

APEX, 2006a; Draft Report on the Geophysical Survey and Drilling Program over the Existing Quarry Reserve Area at Bennettsbridge Co. Kilkenny for BennettsBridge Limestone Quarries Ltd, AGL06028.

APEX, 2006b; Report on the Geophysical Survey of a Potential Quarry Reserve Area (Gibbon's Land) at Kilree Bennettsbridge, Co Kilkenny for Bennettsbridge Limestone Ltd, AGL06097.

APEX, 2007a; Draft Report on The Ground Penetrating Radar Survey for Bennettsbridge Limestone Quarries Ltd, AGL07255.

APEX 2007b; Draft Report on the Resource Evaluation for the Proposed Quarry Extension at Bennettsbridge Co. Kilkenny for Bennettsbridge Limestone Quarries Ltd, AGL07395.

APEX, 2009; Bennettsbridge Limestone Quarry – revised overburden volume estimation for Bennettsbridge Limestone Quarries Ltd, AGL09133.

APEX, 2013; Bennettsbridge EIS report_Soils and Geology_S34 Report for Bennettsbridge Limestone Quarries Ltd, AGL13162.

APEX, 2014a; Report on the Geophysical Survey at Bennettsbridge Quarry Area for Bennettsbridge Limestone Quarries Ltd, AGL14021.

APEX, 2014b; Bennettsbridge Quarry EM Survey for Bennettsbridge Limestone Quarries Ltd.

APEX, 2017; Report on the Geophysical Investigation at the Bennettsbridge 15 acre site for Bennettsbridge Limestone Quarries Ltd, AGL17206.

APEX, 2018a; Report on the Geophysical Investigation at Bennettsbridge Quarry Extension Phase I for Bennettsbridge Limestone Quarries Ltd, AGL18010.

APEX, 2018b; Report on the Geophysical Investigation at Bennettsbridge Quarry Extension Phase II for Bennettsbridge Limestone Quarries Ltd, AGL18010.

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

Geotomo Software, 2006;
'RES2DINV Users Manual', Malaysia.

GSI, 2019a;
Bedrock Geology 1:100,000 Shapefile. http://www.gsi.ie/Mapping.htm

GSI, 2019b;
GSI/Teagasc Subsoils Shapefile. http://www.gsi.ie/Mapping.htm

RECEIVED: 18/08/2025

GSI, 2019b;
GSI/Teagasc Subsoils Shapefile. http://www.gsi.ie/Mapping.htm

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

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

SLR Environmental Consulting (Ireland) Ltd., 2025a; DETAILED PETROGRAPHIC REPORT for SR21: 2014 + A1: 2016 Compliance on Sample No. 43474 Cl804 / SR21 T1.

SLR Environmental Consulting (Ireland) Ltd., 2025b; DETAILED PETROGRAPHIC REPORT for SR21: 2014 + A1: 2016 Compliance on Sample No. 43475 Cl804 / SR21 T1.

Sheriff, R.E., and Geldart, L.P., 1982;
Exploration seismology, volume 1: Cambridge University Press, 253 pp.

Firstpix, 1989;
'Firstpix User Manual'. Interpex.

Gremix, 1989;
'Gremix User Manual'. Interpex.

RECEIVED: 18/08/2025

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.

EM Ground Conductivity Mapping

Principles

This is an electromagnetic technique used to investigate lateral variations in overburden material and to assist with the indication of the depth to bedrock. This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). Readings over material such as organic waste and peat give high conductivity values while readings over dry materials with low clay mineral content such as gravels, limestone or quartzite give low readings. The EM31 survey technique determines the apparent conductivity of the different overburden layers from 0-6m bgl depending on the dipole mode used.

Data collection

The EM31 equipment used was a GF CMD-4 conductivity meter equipped with data logger and integrated GPS. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results. Conductivity and in-phase values were recorded across the site. Local conditions and variations were recorded.

Data processing

The conductivity and in-phase field readings were downloaded, contoured and plotted using the SURFER 12 program (Golden Software, 2015). Data which was affected by metallic objects was removed. Assignation of material types and possible anomaly sources was carried out, with cross-reference to other data.

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 an ABEM LS4 resistivity meter, imaging software, four 21 takeout multicore cables and up to 80 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.

RECEIVED: 18/02/2025

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 FIRSTPIX software program to construct p-wave (Vp) traveltime plots for each spread. Velocity phases were selected from these plots using the GREMIX software program and were used to calculate the thickness of individual velocity units. Topographic data were input. Material types were assigned and estimation made of material properties. The processed seismic data are displayed in Appendix C.

GREMIX interprets seismic refraction data as a laterally varying layered earth structure. It incorporates the slope-intercept method, parts of the Plus-Minus Method of Hagedoorn (1959), Time-Delay Method, and features the Generalized Reciprocal Method (GRM) of Palmer (1980). Up to four layers can be mapped; one deduced from direct arrivals and three deduced from refractions. Phantoming of all possible travel time pairs can be carried out.

Approximate errors for Vp velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are

RECEIVED: 18/08/2025

of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

Spatial Relocation

All ERT and Seismic Refraction 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:	Metres
Survey altitude reference:	MSL
Geoid model:	Republic of Ireland

The EM conductivity locations were acquired using a system integrated GPS receiver to an x,y accuracy of +/-5m or better and converted to ITM.

RECEIVED: 18/08/2025

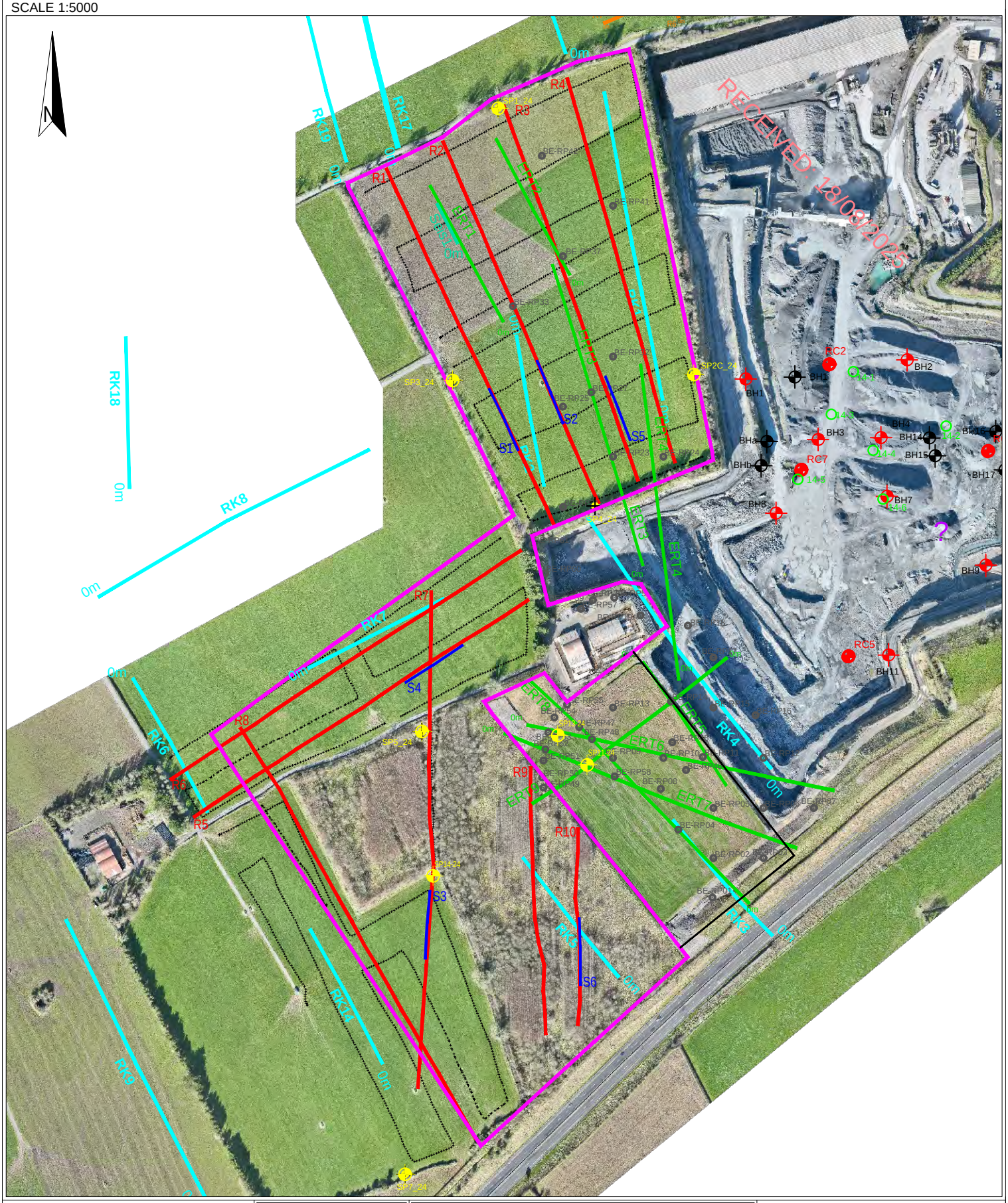
APPENDIX B: DRAWINGS

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

AGP24120_01	Geophysical Locations 2024 Application Area	1:5000 @ A4
AGP24120_02	EM Conductivity (mS/m)	1:5000 @ A4
AGP24120_03A	Overburden Thickness (m)	1:5000 @ A4
AGP24120_03B	Bedrock Elevation (mOD)	1:5000 @ A4
AGP24120_04	Summary Interpretation Map	1:5000 @ A4
AGP24120_R1	Interpretation ERT Profile R1 & Seismic Profile S1	1:2000 @ A4
AGP24120_R2	Interpretation ERT Profile R2 & Seismic Profile S2	1:2000 @ A4
AGP24120_R3	Interpretation ERT Profile R3 & Seismic Profile S5	1:2000 @ A4
AGP24120_R4	Interpretation ERT Profile R4	1:2000 @ A4
AGP24120_R5	Interpretation ERT Profile R5 & Seismic Profile S4	1:2000 @ A4
AGP24120_R6	Interpretation ERT Profile R6	1:2500 @ A4
AGP24120_R7	Interpretation ERT Profile R7 & Seismic Profile S3	1:2500 @ A4
AGP24120_R8	Interpretation ERT Profile R8	1:2500 @ A4
AGP24120_R9	Interpretation ERT Profile R9	1:2000 @ A4
AGP24120_R10	Interpretation ERT Profile R10 & Seismic Profile S6	1:1500 @ A4

GEOPHYSICAL LOCATIONS - 2024 APPLICATION AREA

SCALE 1:5000

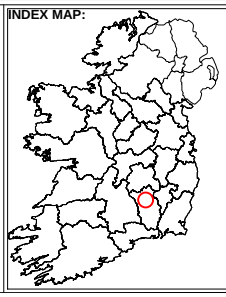


apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

INDEX MAP:



LEGEND:

- Site
- EM conductivity reading
- 2024 ERT resistivity profile
- 2024 Seismic refraction profile
- 2018 ERT resistivity profile
- 2024 ERT resistivity profile
- 2024 RP borehole
- 2018 RP borehole
- 2014 RP borehole (floor)
- 2007 RC borehole
- 2006 RP borehole

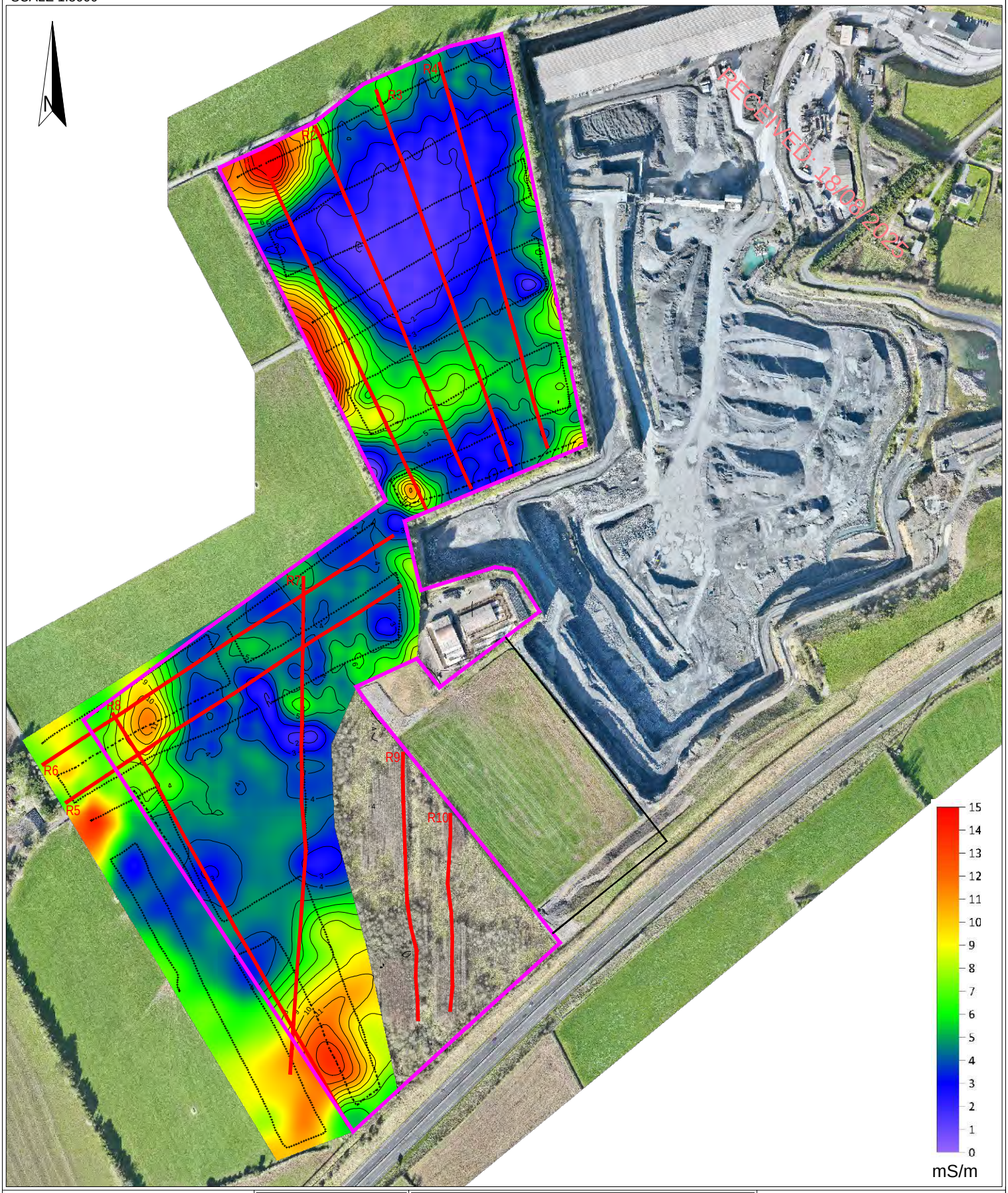
The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_01
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

EM GROUND CONDUCTIVITY (mS/m)

SCALE 1:5000



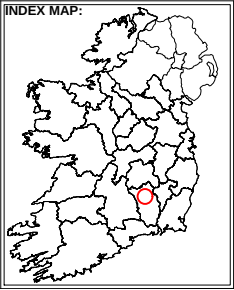
RECEIVED: 18/03/2025

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

INDEX MAP:



LEGEND:

Site

+++ EM conductivity reading

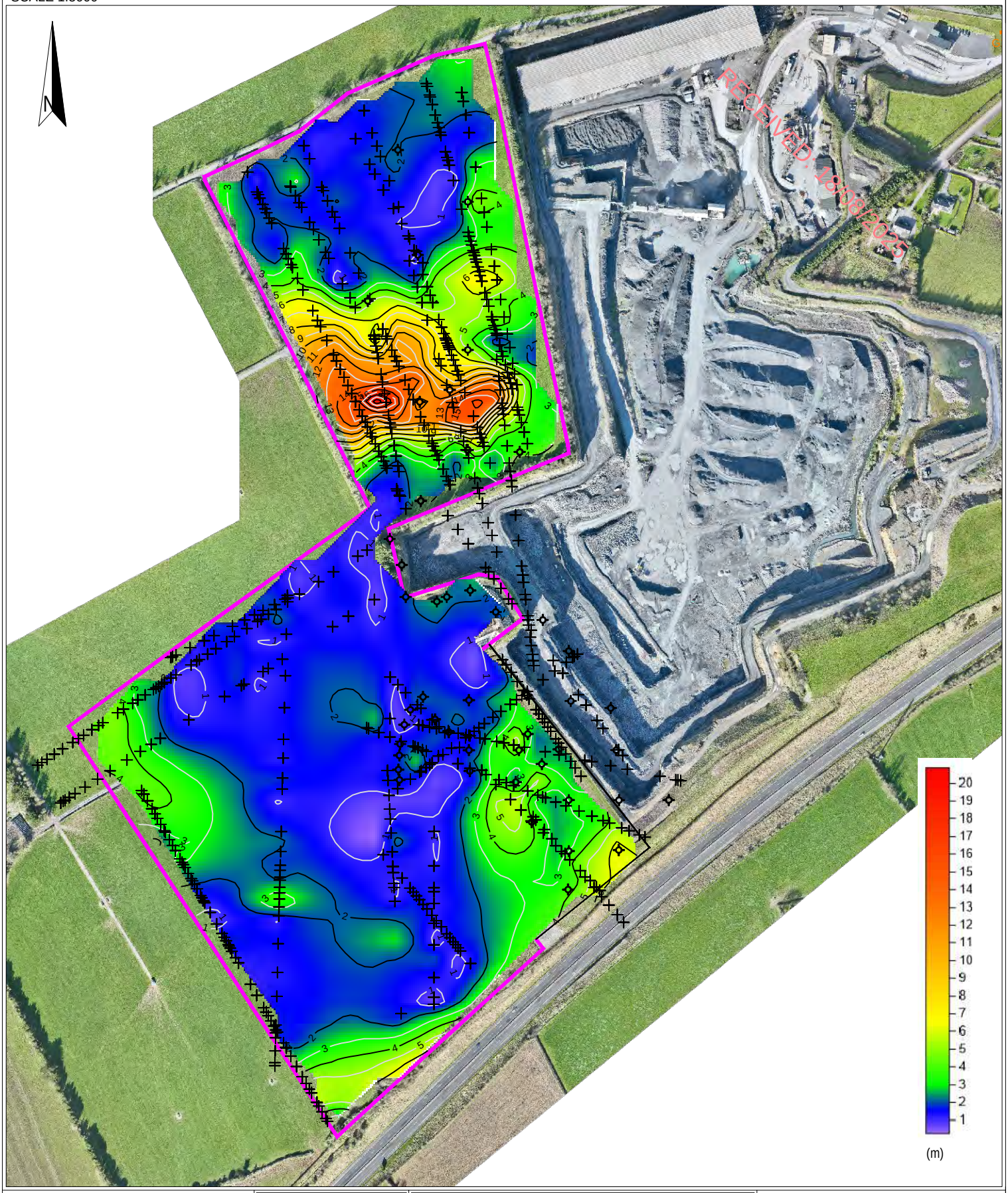
The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_02
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

OVERBURDEN THICKNESS (m)

SCALE 1:5000



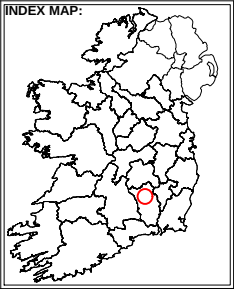
RECEIVED: 18/08/2025

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

INDEX MAP:



LEGEND:

- Site
- +++ Data from geophysics
- Data from borehole

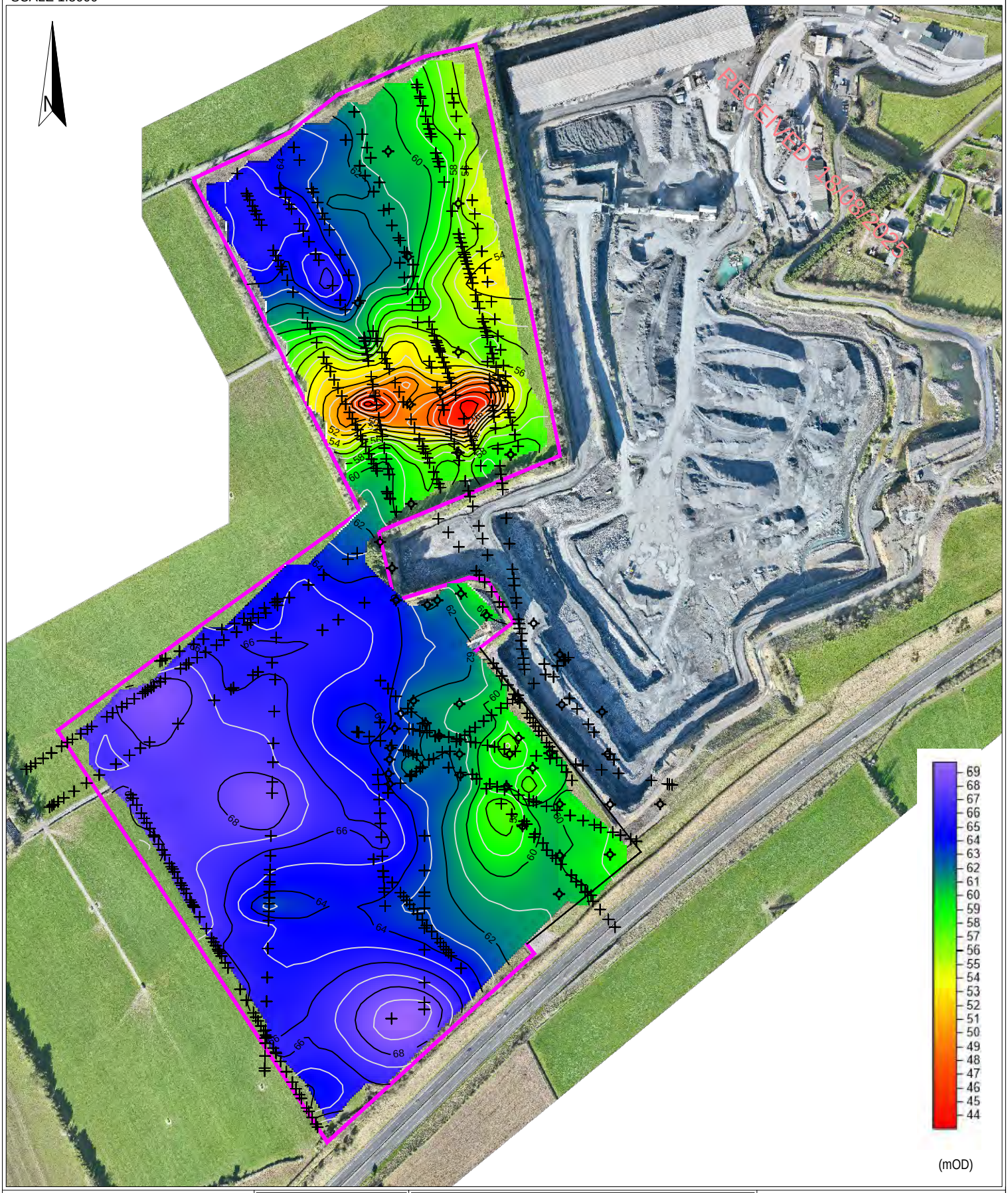
The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_03A
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

BEDROCK ELEVATION (mOD)

SCALE 1:5000

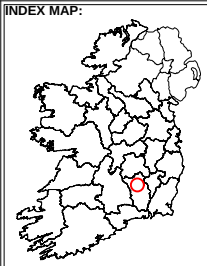


apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

INDEX MAP:



LEGEND:

Site

+++ Data from geophysics

Data from borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_02
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

SUMMARY INTERPRETATION MAP

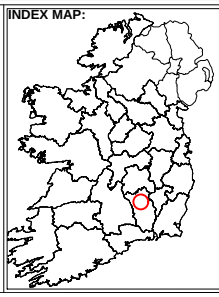
SCALE 1:5000

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

INDEX MAP:



LEGEND:

- Site boundary
- < 5m overburden over LIMESTONE
- centre of low resistivity band
- clay filled fracture zone within quarry
- >5m overburden over LIMESTONE
- low EM conductivity zones
- low resistivity LIMESTONE zone

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

PROJECT: BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY

CLIENT.: BENNETTSBRIDGE LIMESTONE QUARRIES.

DRAWING NO: AGP24120_03

SCALE: AS INDICATED @ A4

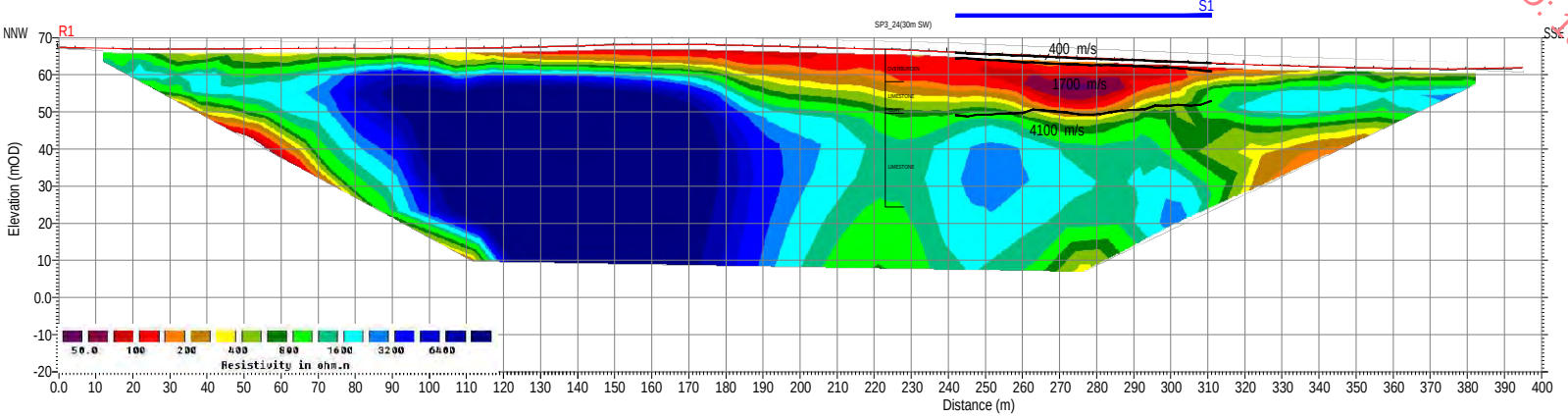
DATE: 04-01-2025

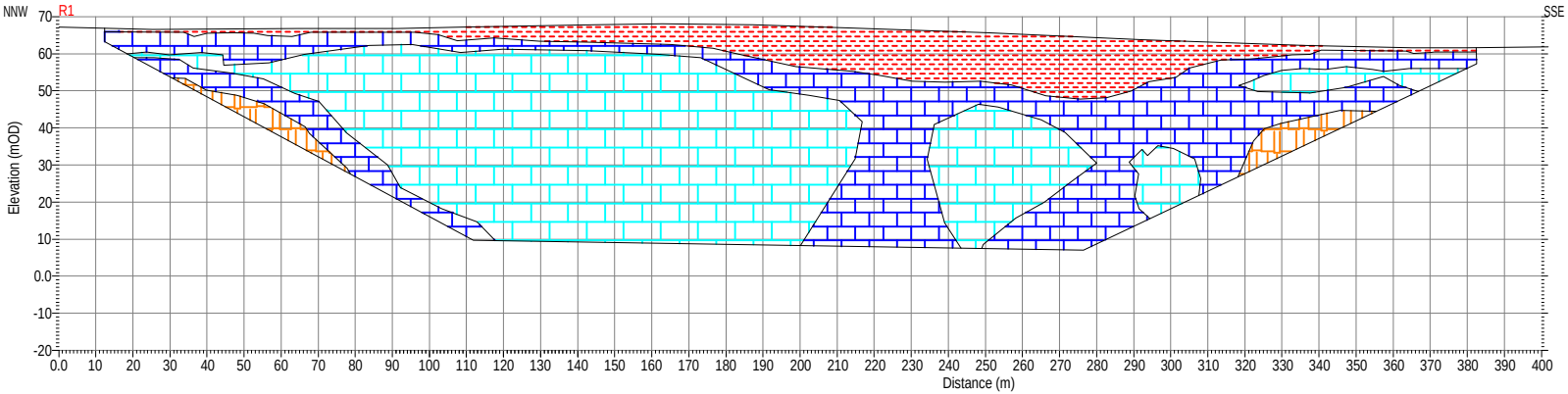
Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R1 AND SEISMIC PROFILE S1

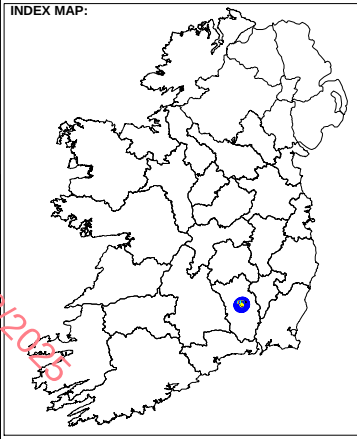
SCALE 1:2,000

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33_SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

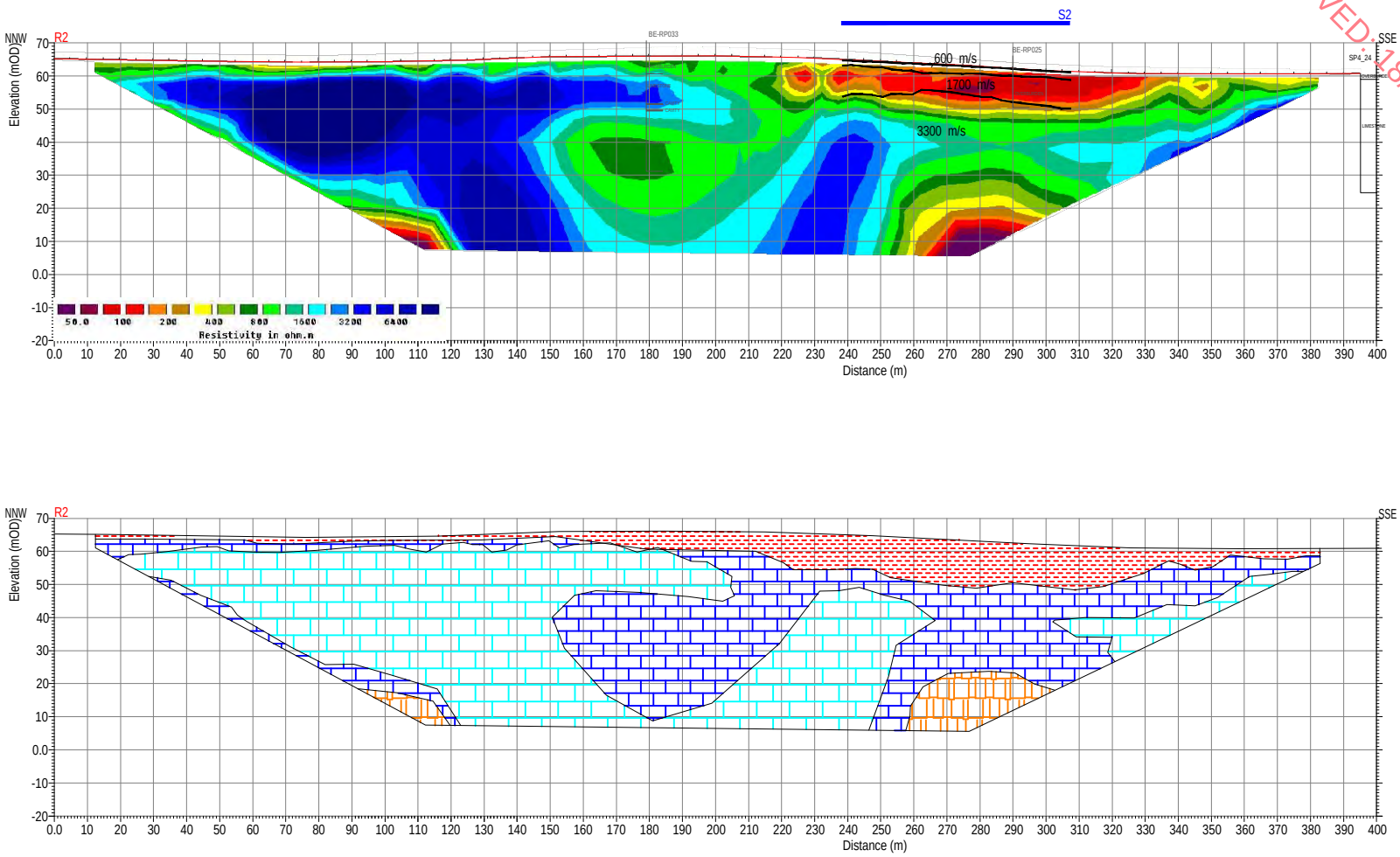
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R1
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

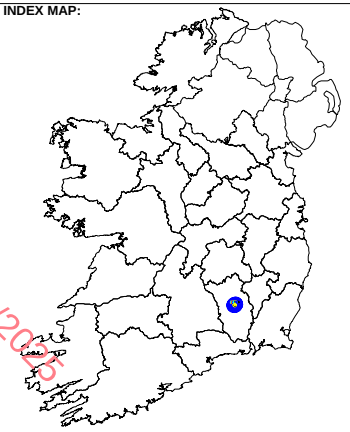
RESULTS AND INTERPRETATION - ERT PROFILE R2 AND SEISMIC PROFILE S2

SCALE 1:2,000

RECEIVED: 18/08/2025



INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33_SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

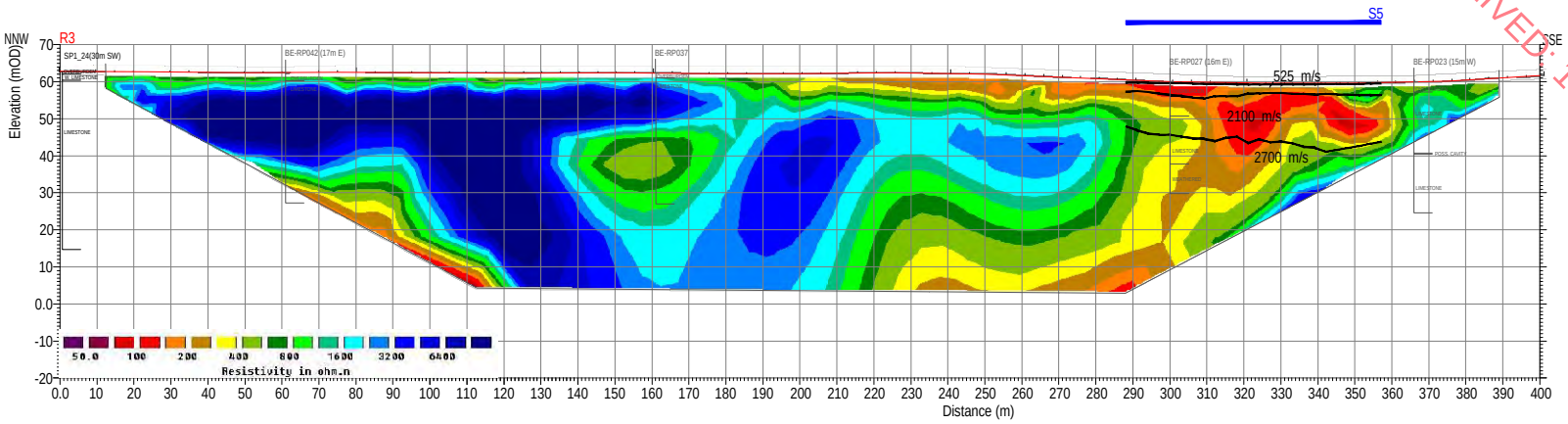
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R2
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

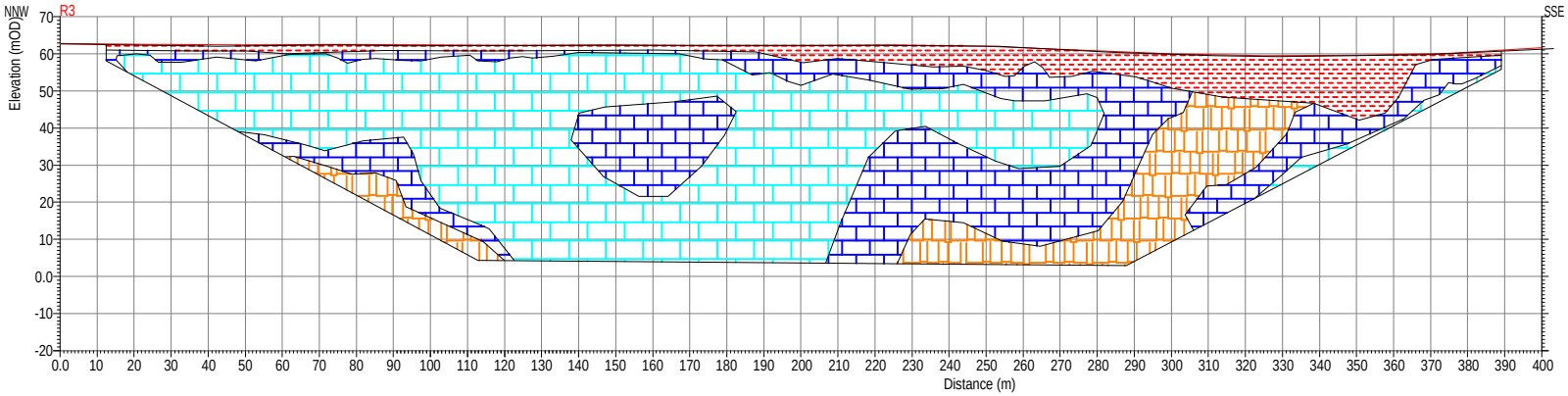
Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R3 AND SEISMIC PROFILE S5

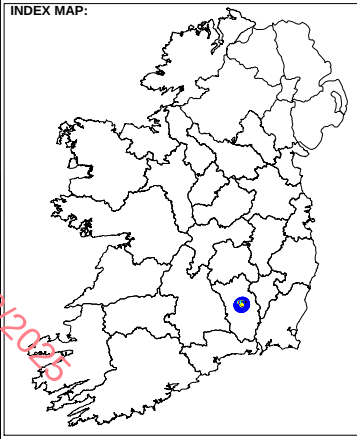
SCALE 1:2,000

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33, SP3_24 — Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

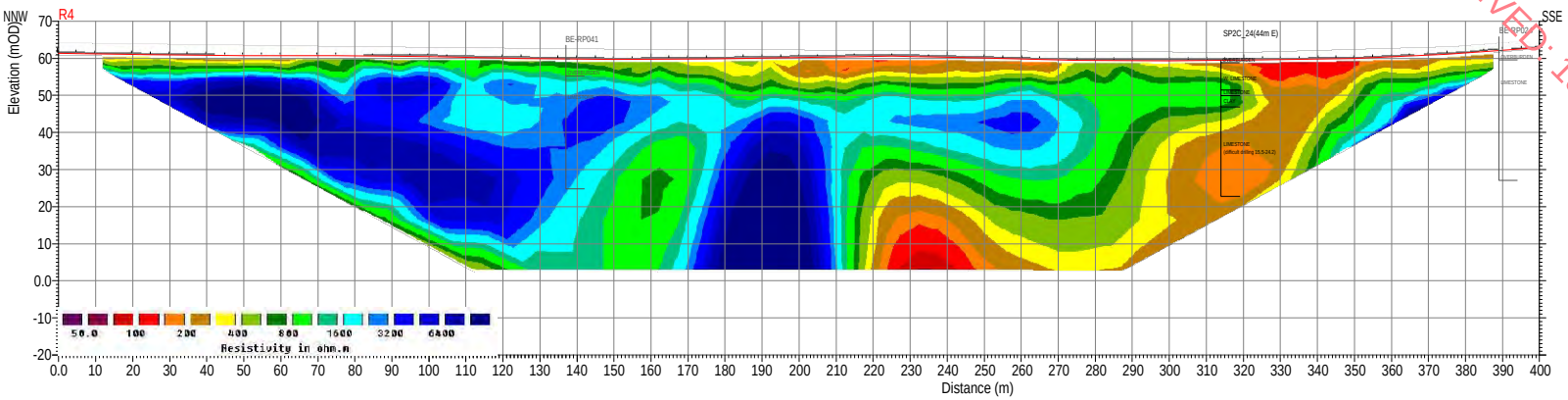
T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

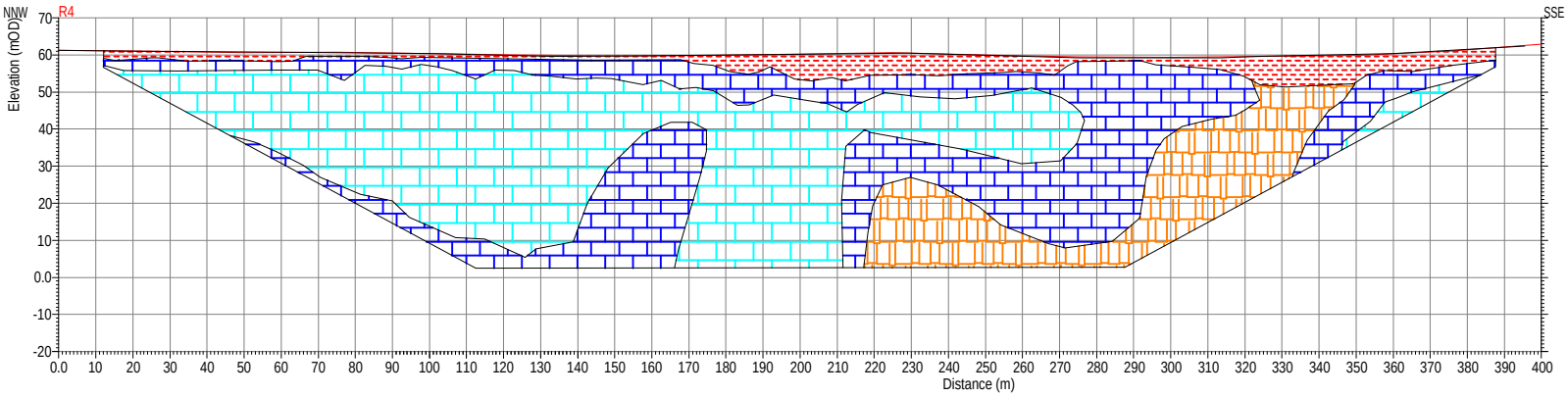
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R3
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R4

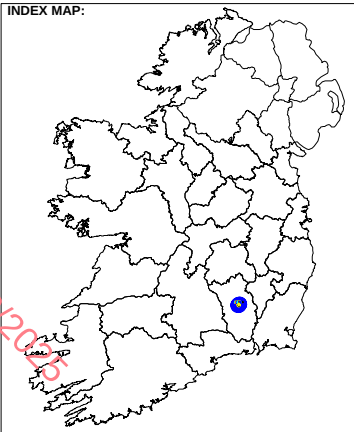
SCALE 1:2,000





RECEIVED: 18/08/2025

INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33, SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

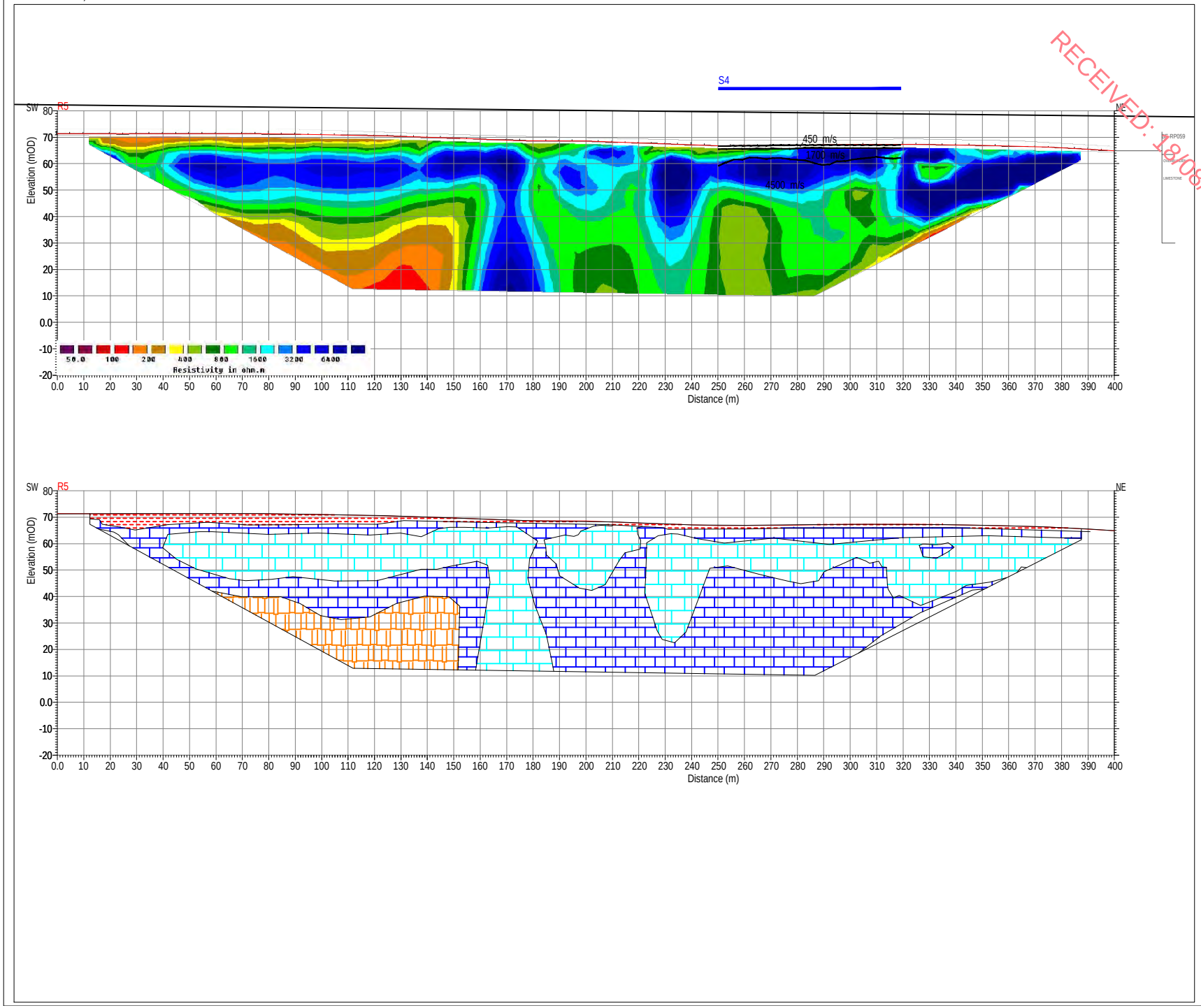
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R4
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

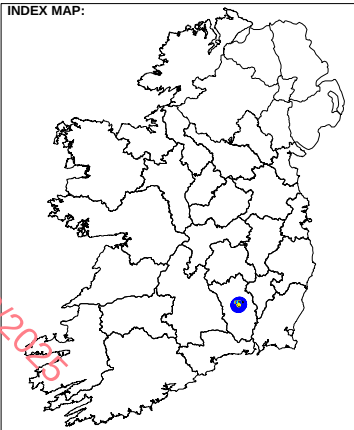
RESULTS AND INTERPRETATION - ERT PROFILE R5 AND SEISMIC PROFILE S4

SCALE 1:2,000

RECEIVED: 18/08/2025



INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33_SP3_24 — Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

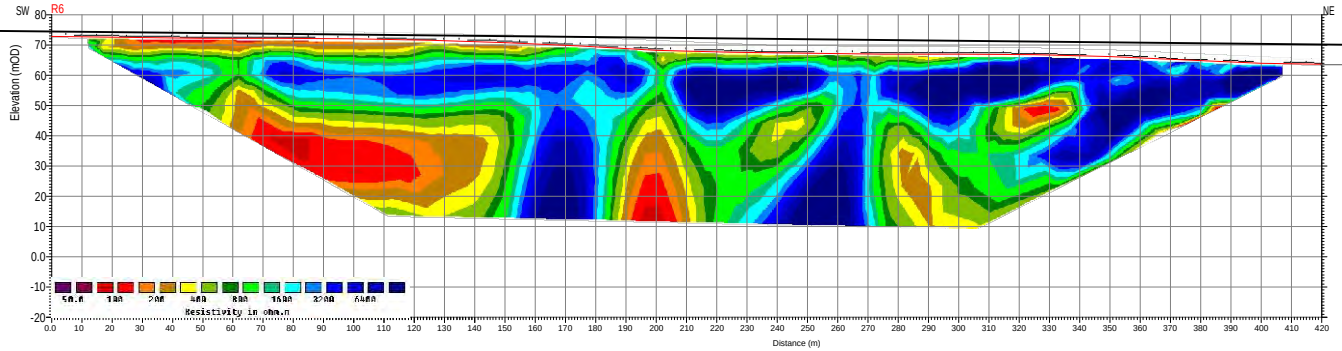
T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

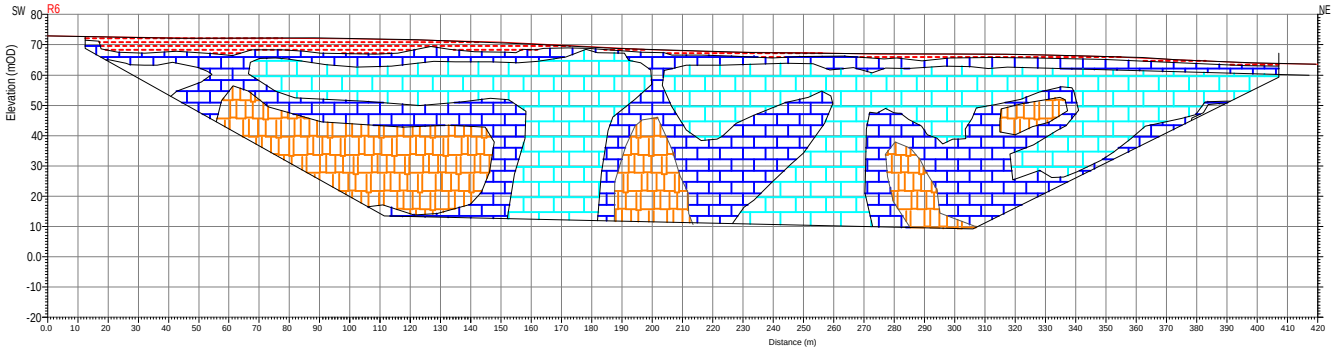
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R5
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R6

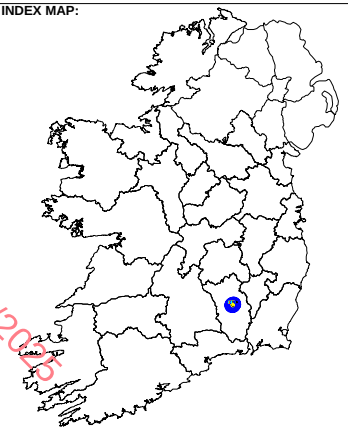
SCALE 1:2,500





RECEIVED: 18/08/2025

INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33, SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

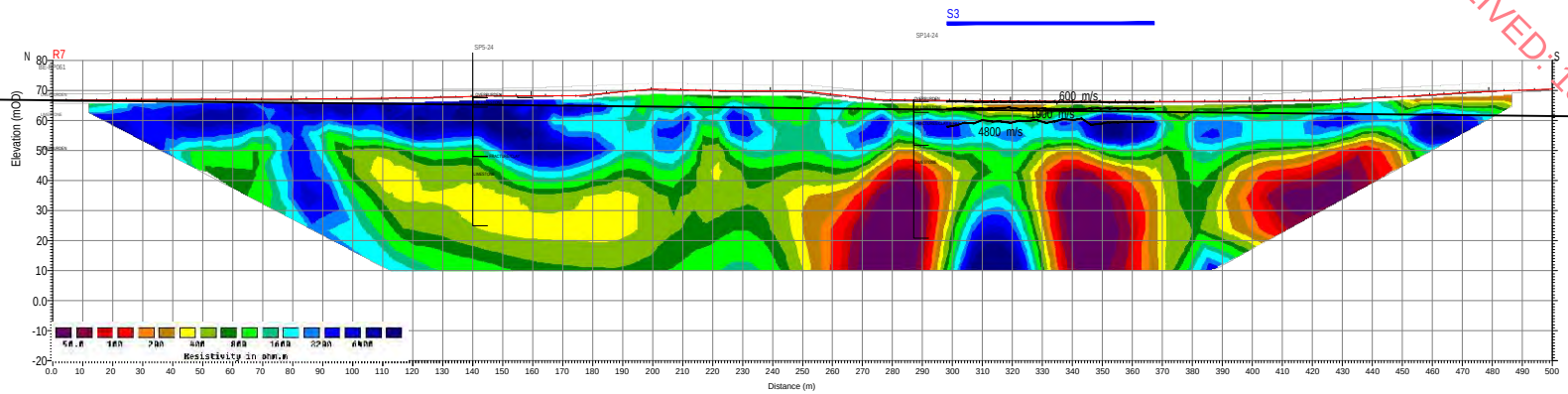
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R6
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

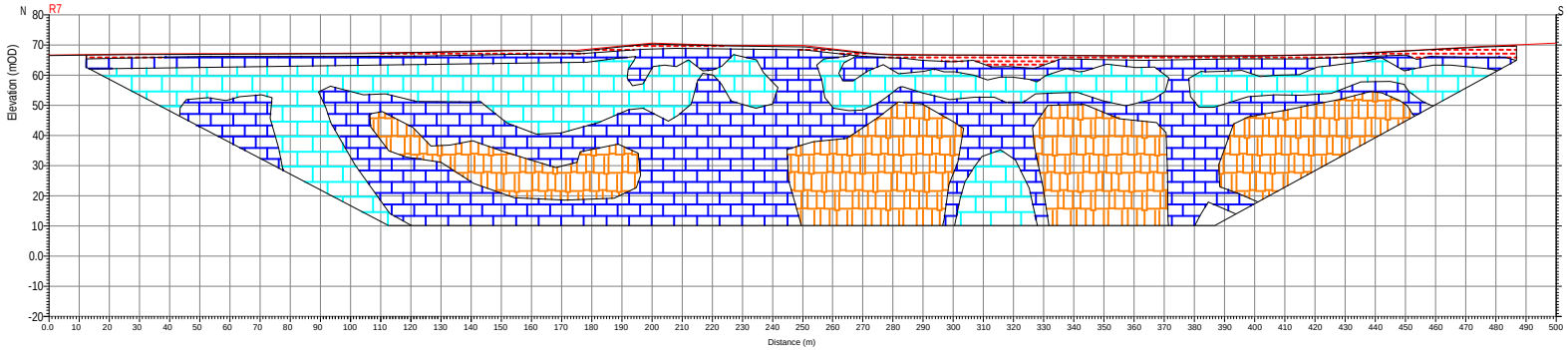
Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R7 AND SEISMIC PROFILE S3

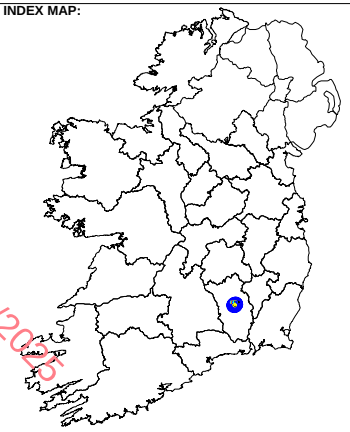
SCALE 1:2,500

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33_SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

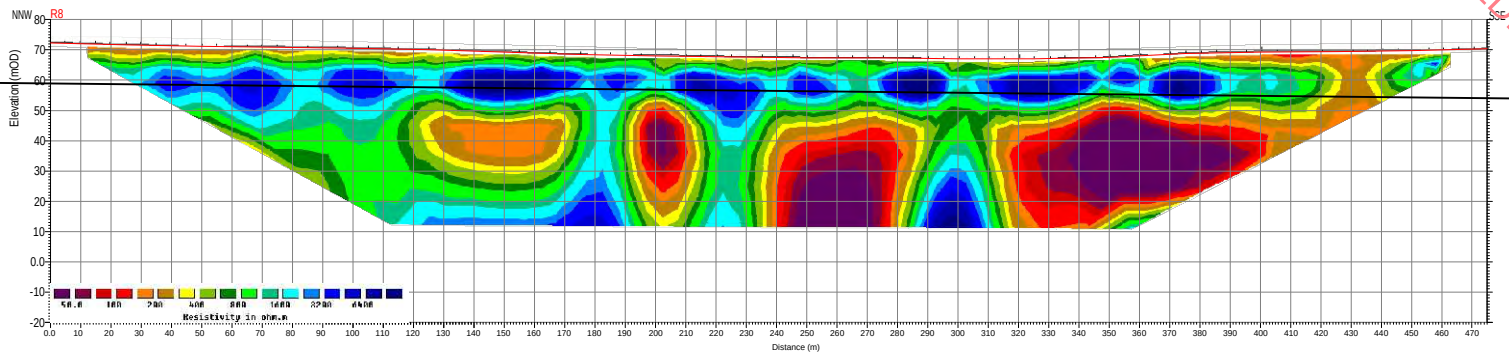
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R7
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

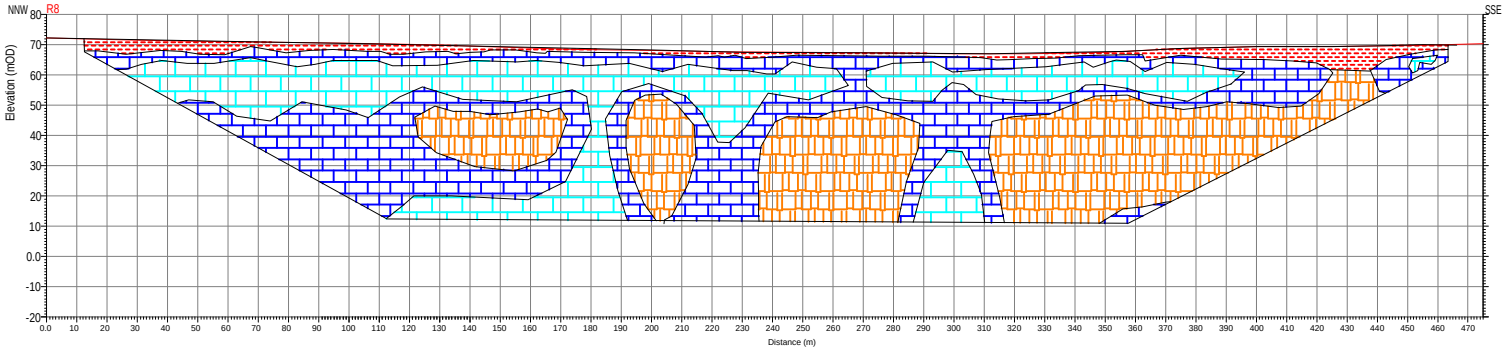
Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R8

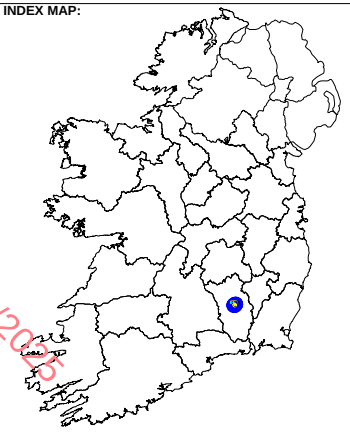
SCALE 1:2,500

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE
- Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE
- Moderately weathered/fractured LIMESTONE with occasiona clay filled fissures, dark LIMESTONE
- Slightly weathered - fresh LIMESTONE
- BE-RP33_SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

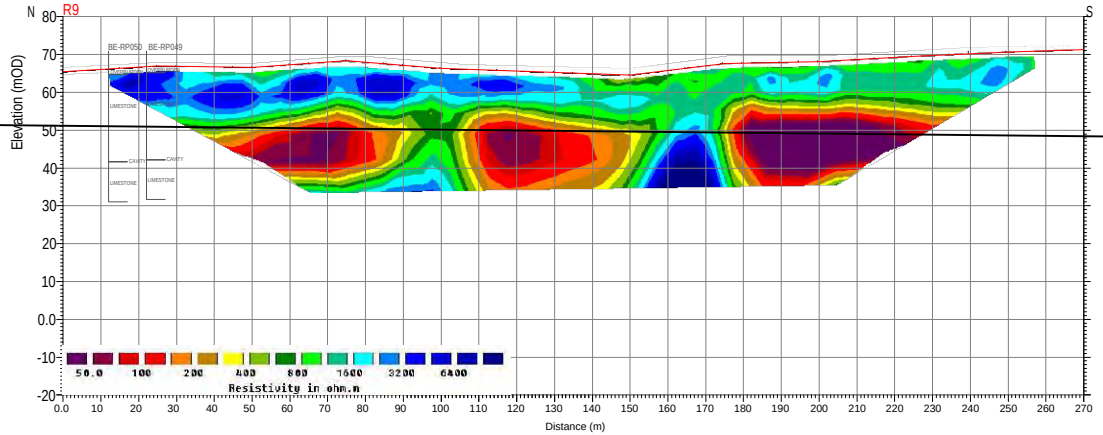
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R8
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

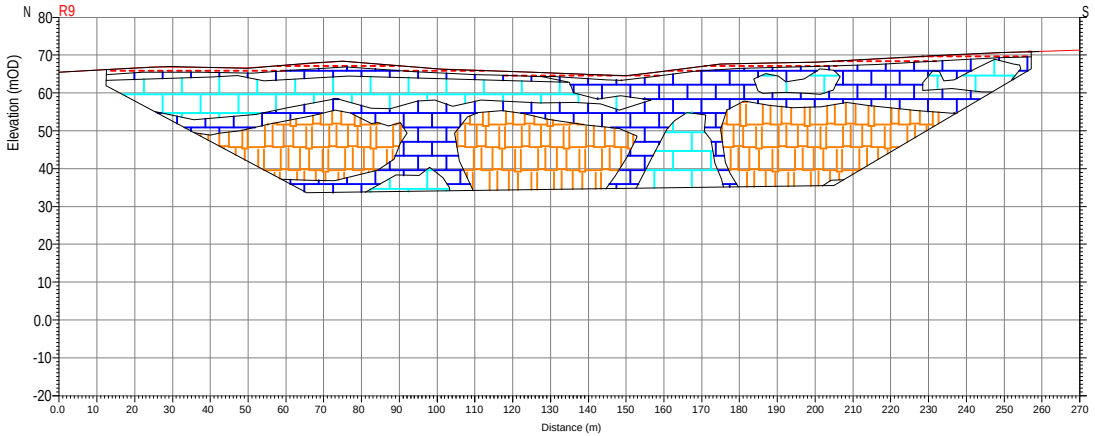
Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R9

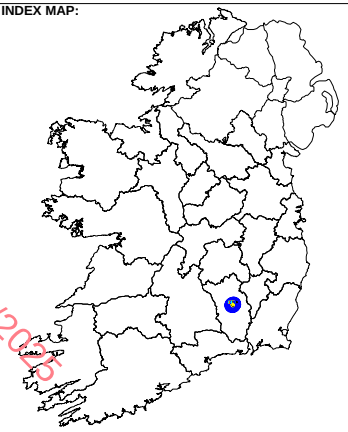
SCALE 1:2,000

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE

Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE

Moderately weathered/fractured LIMESTONE with occasional clay filled fissures, dark LIMESTONE

Slightly weathered - fresh LIMESTONE

BE-RP33, SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

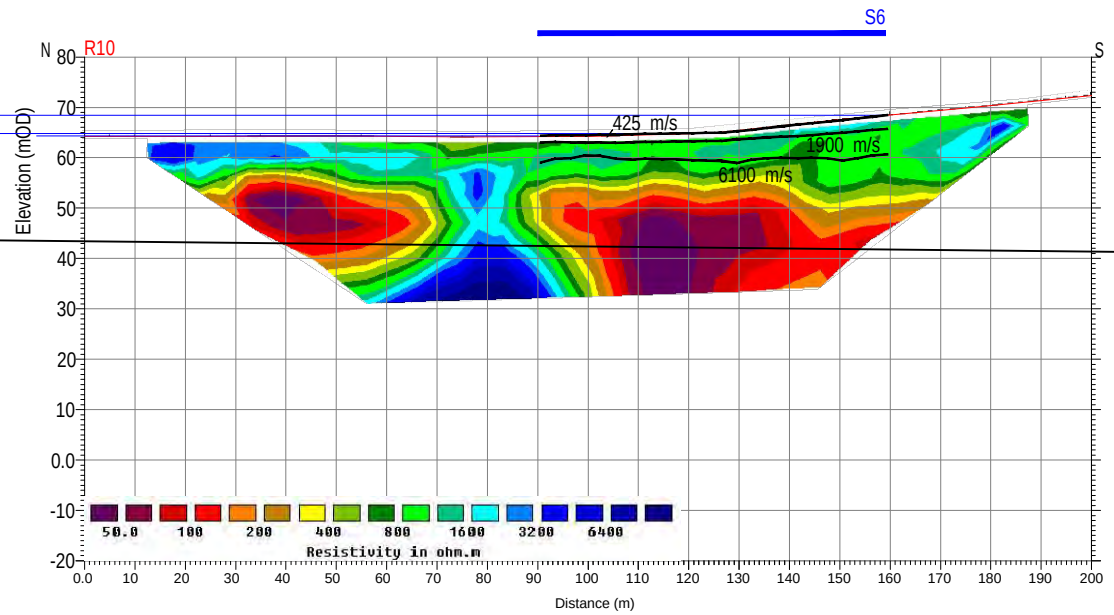
T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

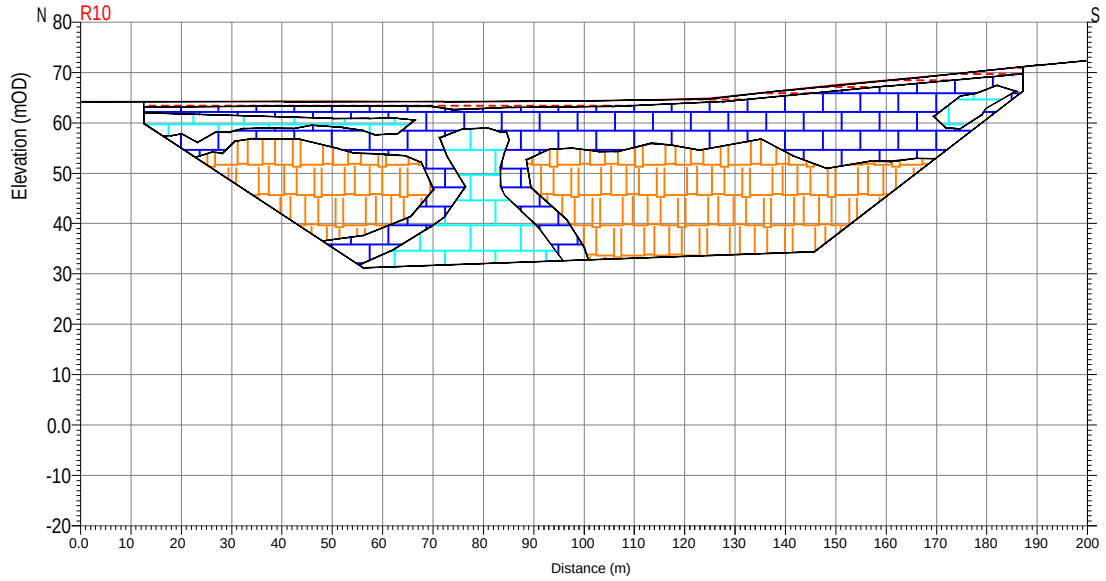
PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R9
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

RESULTS AND INTERPRETATION - ERT PROFILE R10

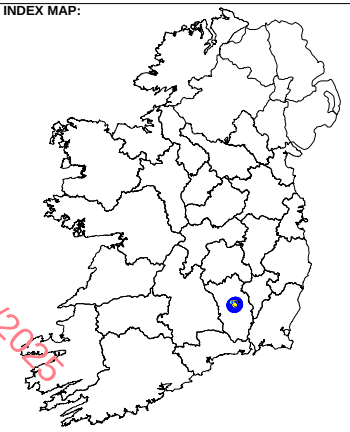
SCALE 1:1,500





RECEIVED: 18/08/2025

INDEX MAP:



LEGEND:

OVERBURDEN/Sandy gravelly CLAY, highly weathered/fractured LIMESTONE

Highly-moderately weathered/ fractured LIMESTONE with clay filled fissures, dark LIMESTONE

Moderately weathered/fractured LIMESTONE with occasiona clay filled fissures, dark LIMESTONE

Slightly weathered - fresh LIMESTONE

BE-RP33, SP3_24 Rotary percussive borehole

The information displayed here is to be used in conjunction with AGP24120_01 Report on the Geophysical Investigation at Bennettsbridge Quarry for Bennettsbridge Limestone Quarries, APEX Geophysics Ltd. 4th February 2025.

apex geophysics

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland

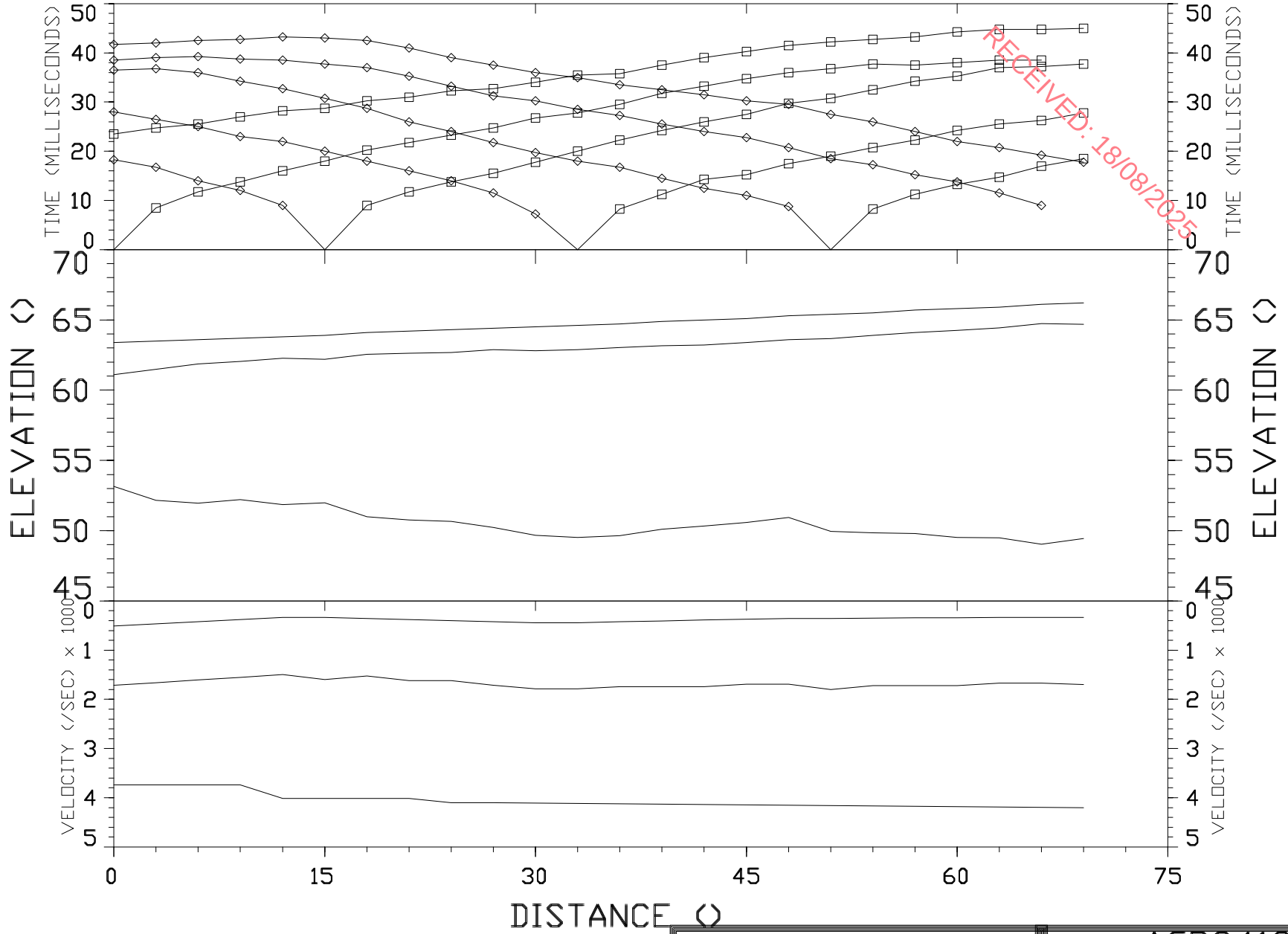
T +353 (0)402-21842
E info@apexgeophysics.ie
www.apexgeophysics.ie

PROJECT:	BENNETTSBRIDGE QUARRY GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE LIMESTONE QUARRIES.
DRAWING NO:	AGP24120_R10
SCALE:	AS INDICATED @ A4
DATE:	04-01-2025

Version:	Date:	Drawn By:	Checked:
001	04-01-2025	POC	TL

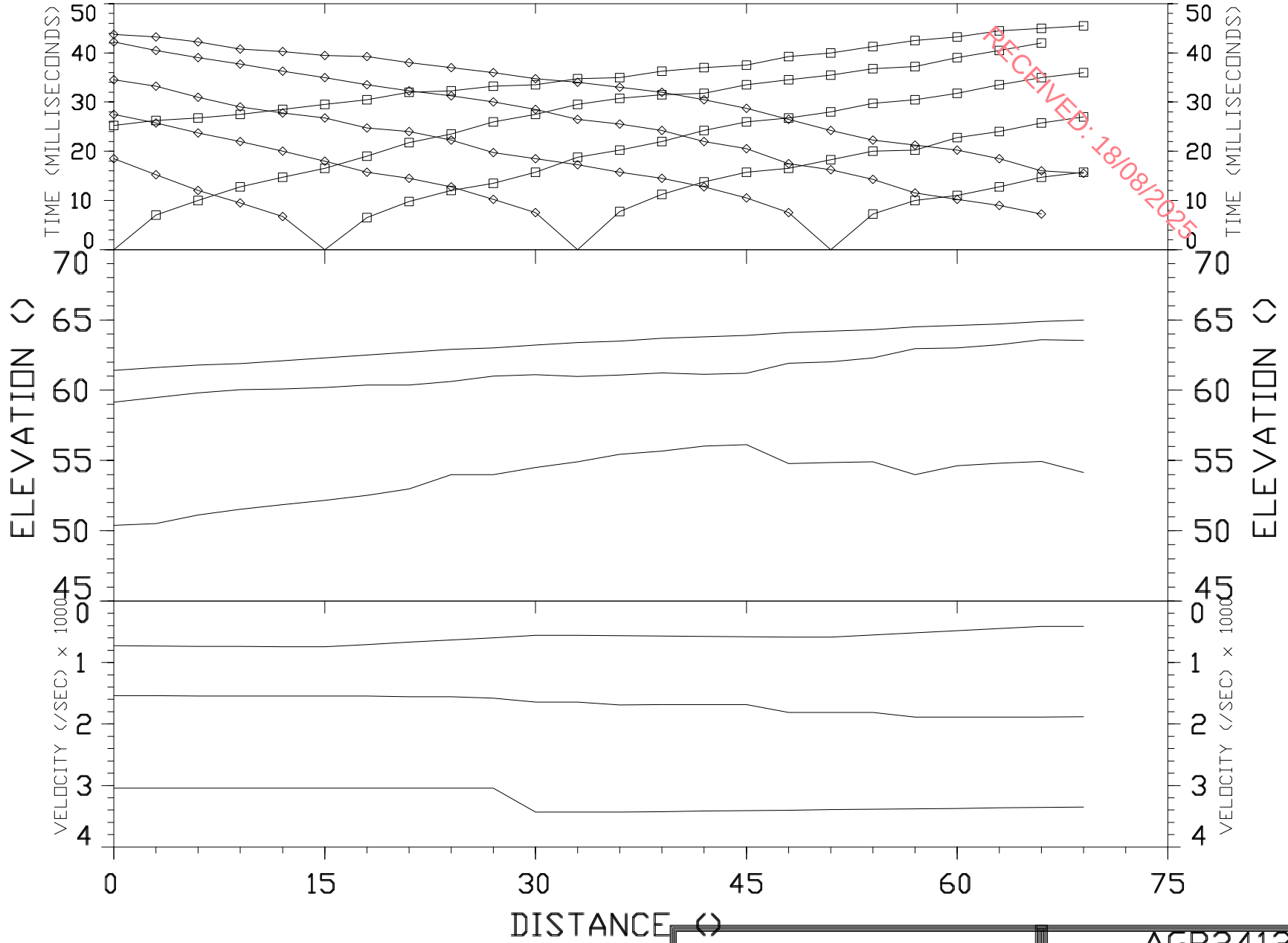
RECEIVED: 18/08/2025

APPENDIX C: SEISMIC PLATES 2024



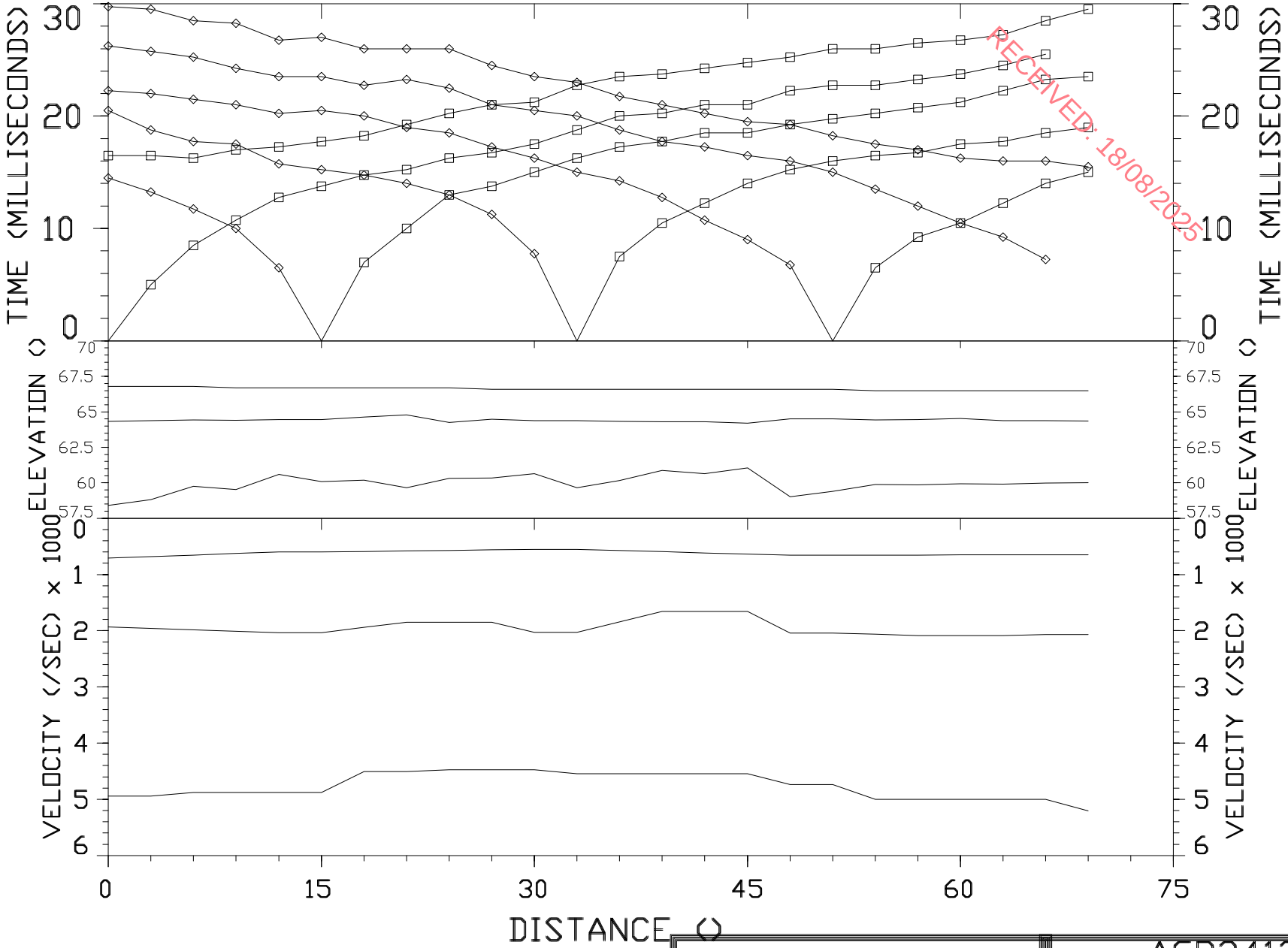
RECEIVED: 18/08/2025

for: Bennettsbridge Limestone	AGP24120
by: APEX Geophysics Ltd.	Bennettsbridge Kilkenny
Data SetS1 / Date: October 24	
Equipment: Geode / Spread: S1	Azimuth:



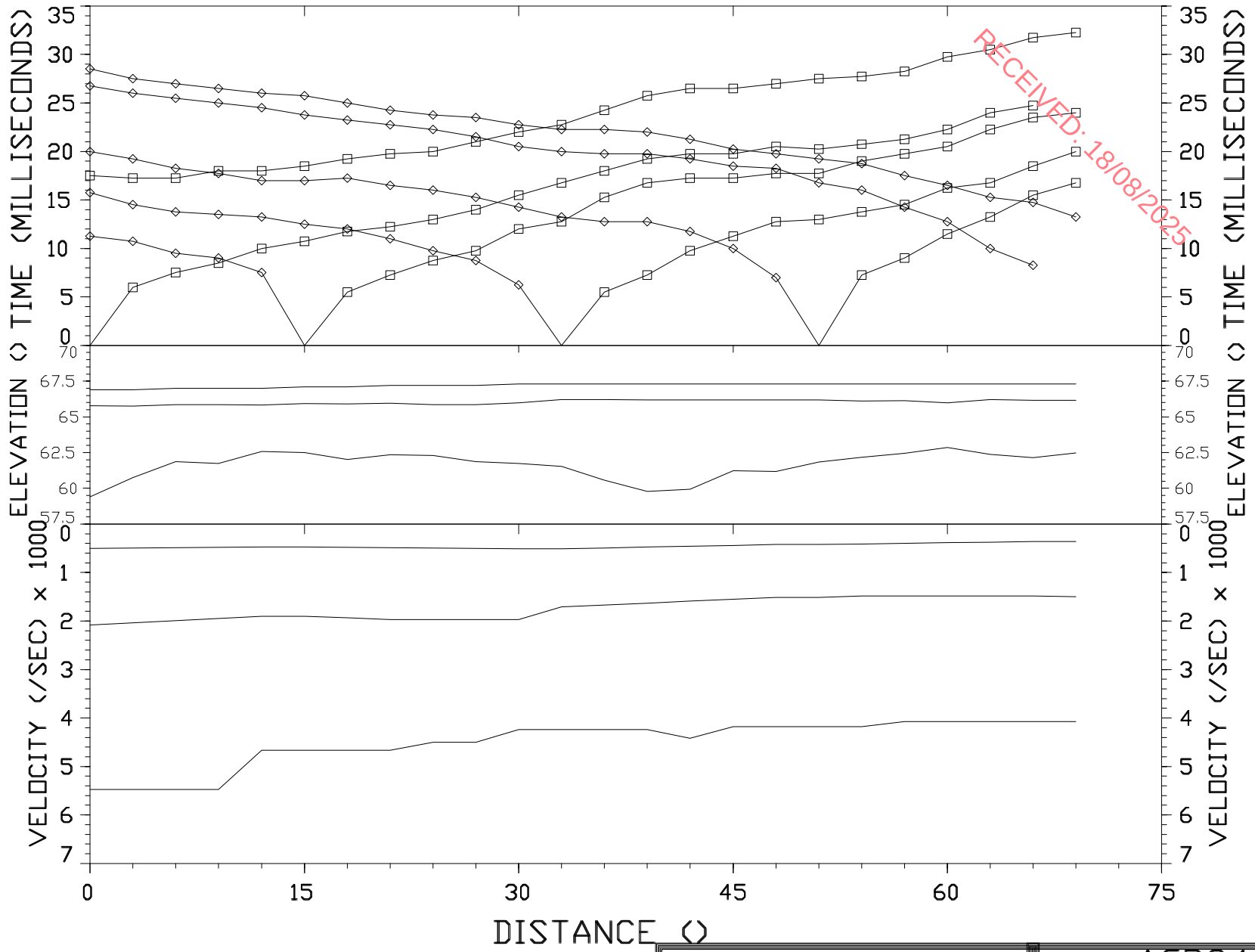
RECEIVED: 18/08/2025

for: Bennettsbridge Limestone	AGP24120
by: APEX Geophysics Ltd	Bennettsbridge Kilkenny
Data SetS2 / Date: October 24	
Equipment: Geode / Spread: S2	Azimuth:

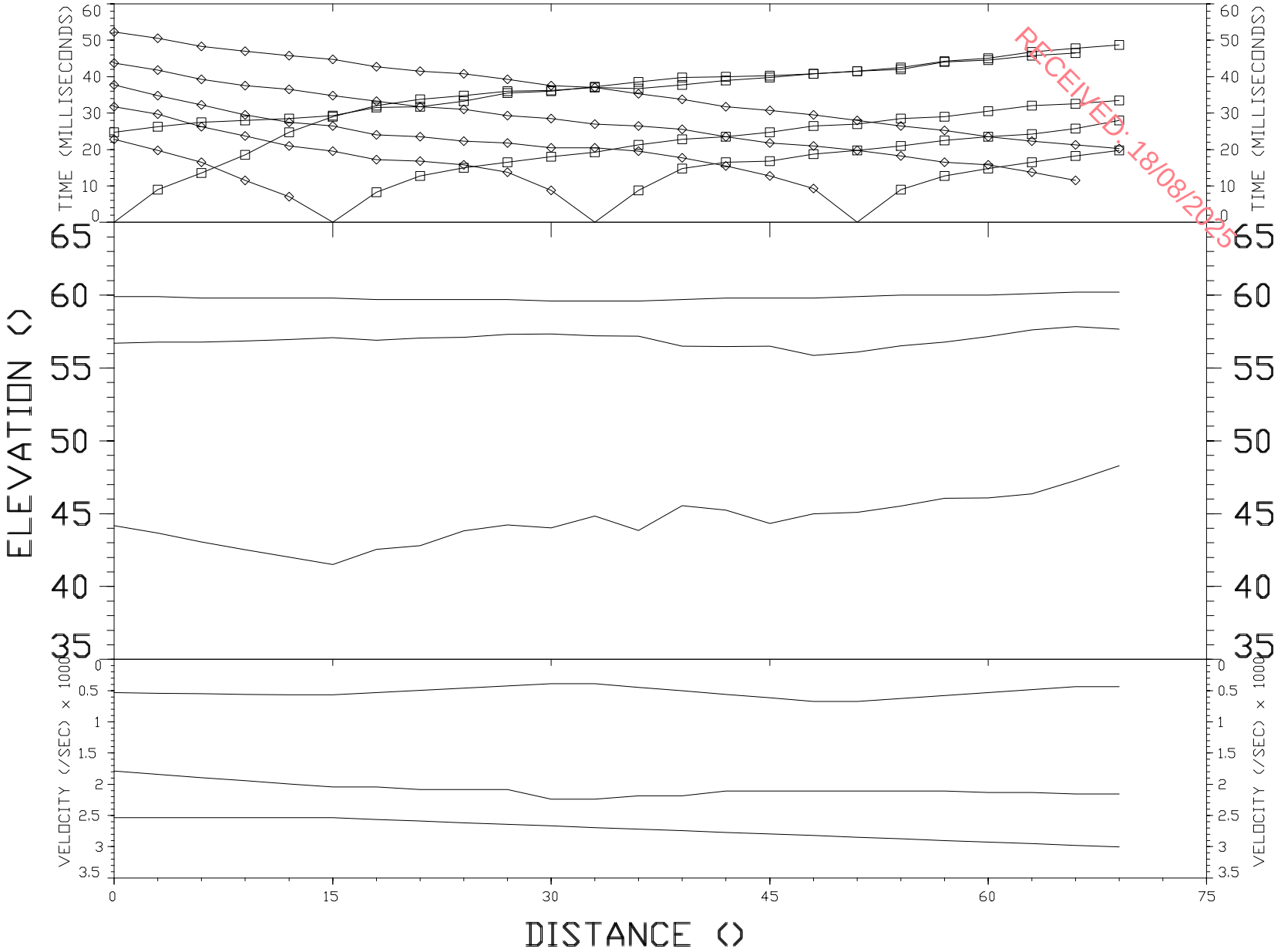


RECEIVED: 18/08/2025

for: Bennettsbridge Limestone	AGP24120
by: APEX Geophysicsl Ltd.	Bennettsbridge Kilkenny
Data SetS3 / Date: October 24	
Equipment: Geode / Spread: S3	Azimuth:

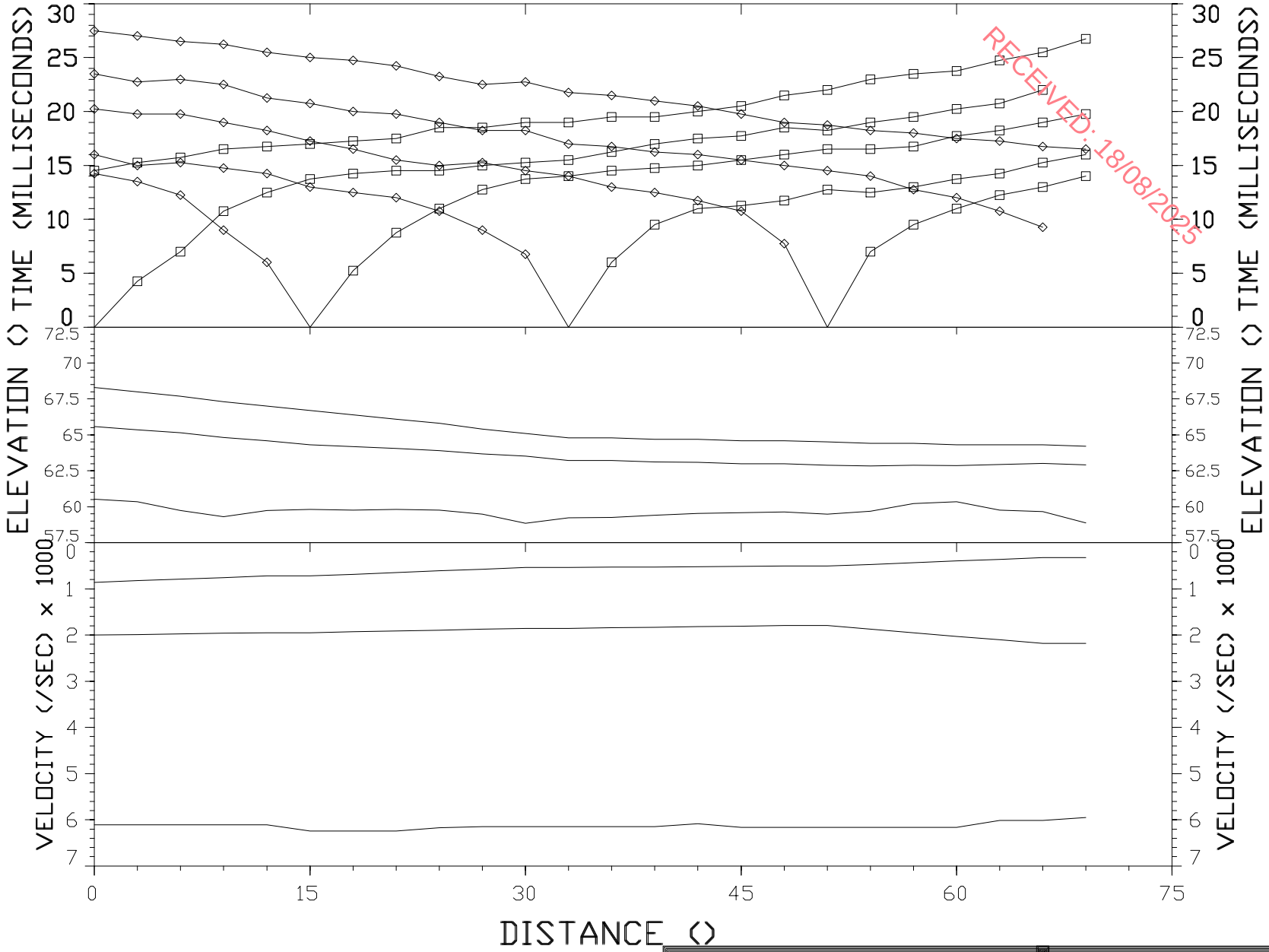


for: Bennettsbridge Limestone		AGP24120
by: APEX Geophysics Ltd.		Bennettsbridge Kilkenny
Data SetS4	Date: October 24	
Equipment: Geode	Spread: S4	Azimuth:



RECEIVED: 18/08/2025

for: Bennettsbridge Limestone	AGP24120
by: APEX Geophysics Ltd	Bennettsbridge Kilkenny
Data SetS5 / Date: October 24	
Equipment: Geode / Spread: S5	Azimuth:



for: Bennettsbridge Limestone	AGP24120
by: APEX Geophysics Ltd.	Bennettsbridge Kilkenny
Data SetS6 / Date: October 24	
Equipment: Geode / Spread: S6	Azimuth:

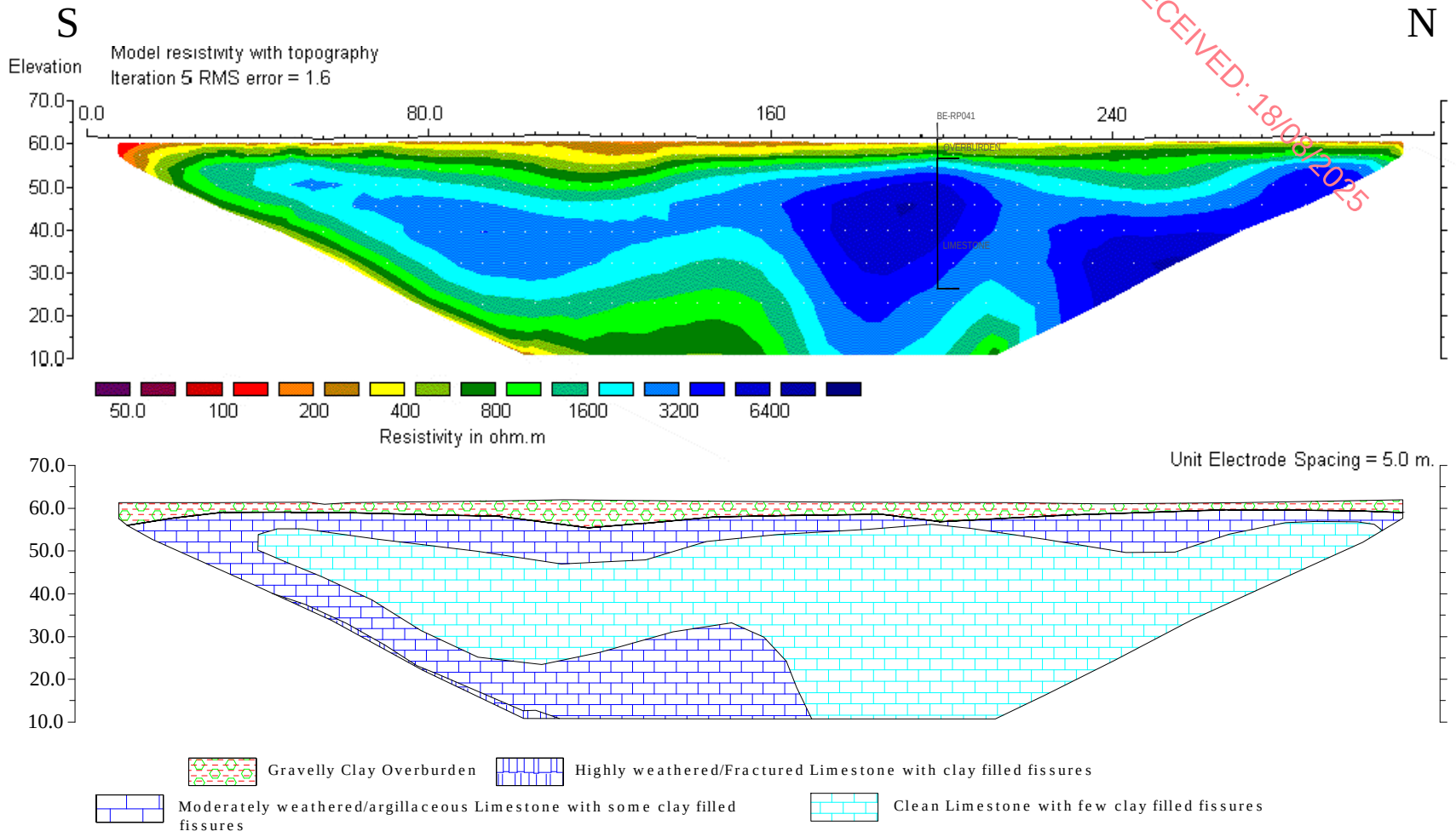
RECEIVED: 18/08/2025

APPENDIX D: 2006 PROFILES

Note: The original 2006 interpretation indicated potential clay wayboards and other low-quality bedrock. Subsequent drilling in 2018 and recent extraction have not encountered any significant weathering or change in material type. The interpretation of the 2018 survey was changed to reflect this.

INVERSE MODEL RESISTIVITY - 2DRES PROFILE RK1

RECEIVED: 18/09/2025

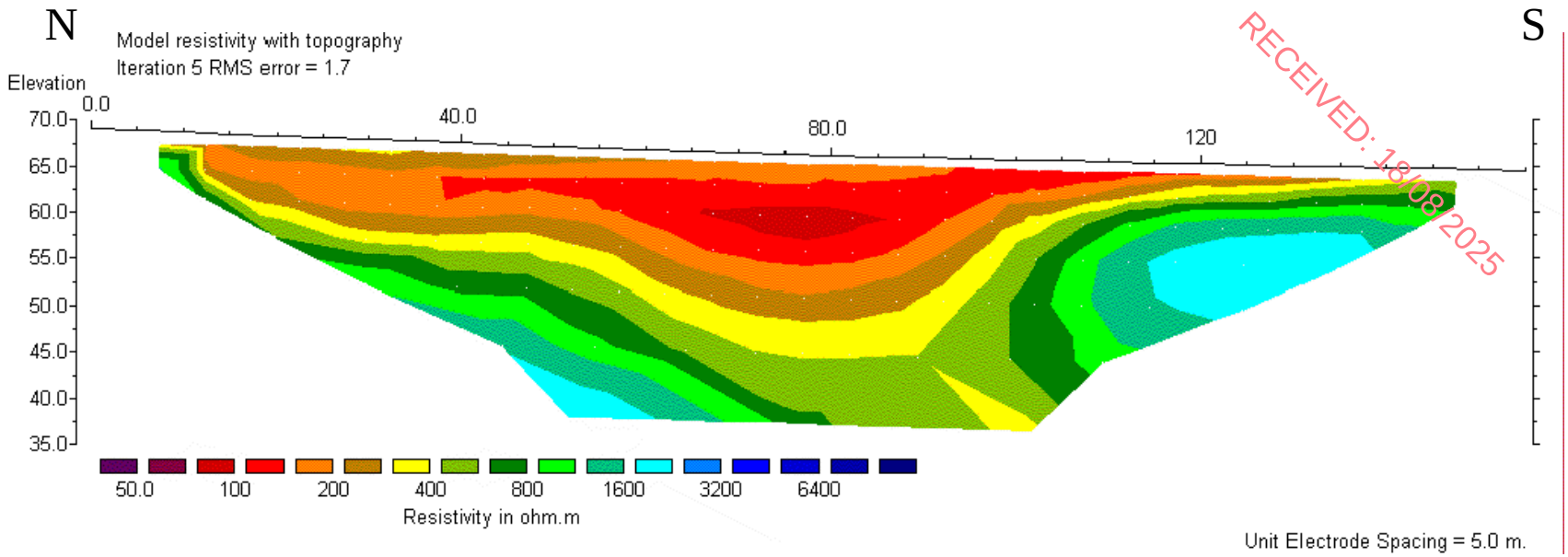


APEX Geoservices Ltd.

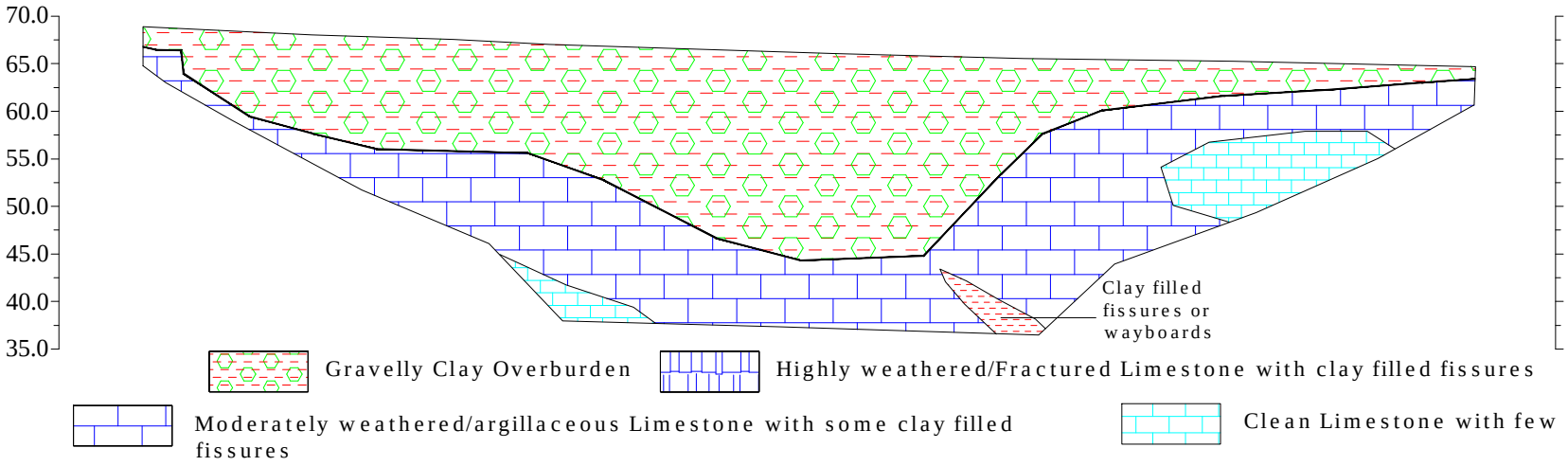
Kilanerin
Gorey
Co. Wexford
Ireland
Tel. 353-402-21842
Fax. 353-402-21843
www.apexgeoservices.ie

PROJECT:	Bennettsbridge Quarry Extension
DRAWING TITLE:	Profile RK1
DATE:	May 2006 - Rev. 03 Oct. 2024
CLIENT:	Bennettsbridge Limestone
SCALE:	1:1500

INVERSE MODEL RESISTIVITY - 2DRES PROFILE RK2



RECEIVED: 18/08/2025



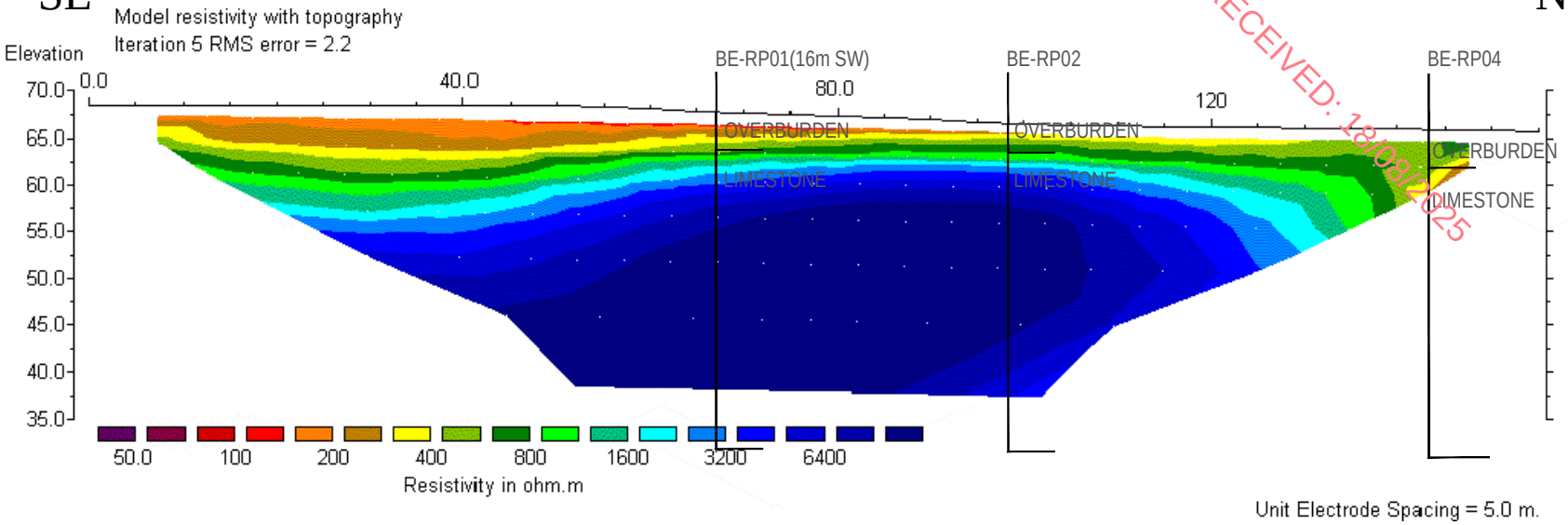
APEX Geoservices Ltd.

Kilanerin
Gorey
Co. Wexford
Ireland
Tel. 353-402-21842
Fax. 353-402-21843
www.apexgeoservices.ie

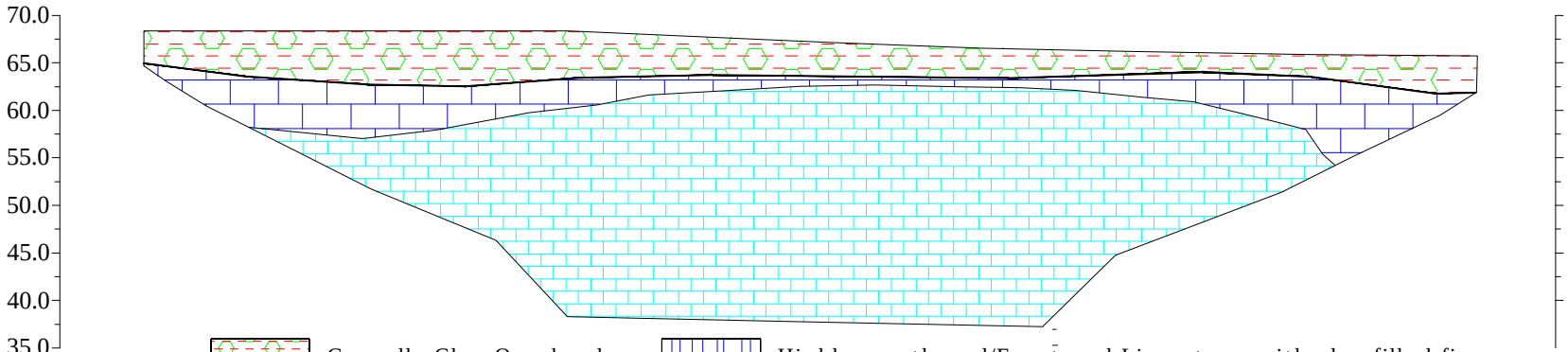
PROJECT:	Bennettsbridge Quarry Extension
DRAWING TITLE:	Profile RK2
DATE:	May 2006 Rev. 03 October 2024
CLIENT:	Bennettsbridge Limestone
SCALE:	1:750

INVERSE MODEL RESISTIVITY - 2DRES PROFILE RK3

SE NW



RECEIVED: 18/08/2025



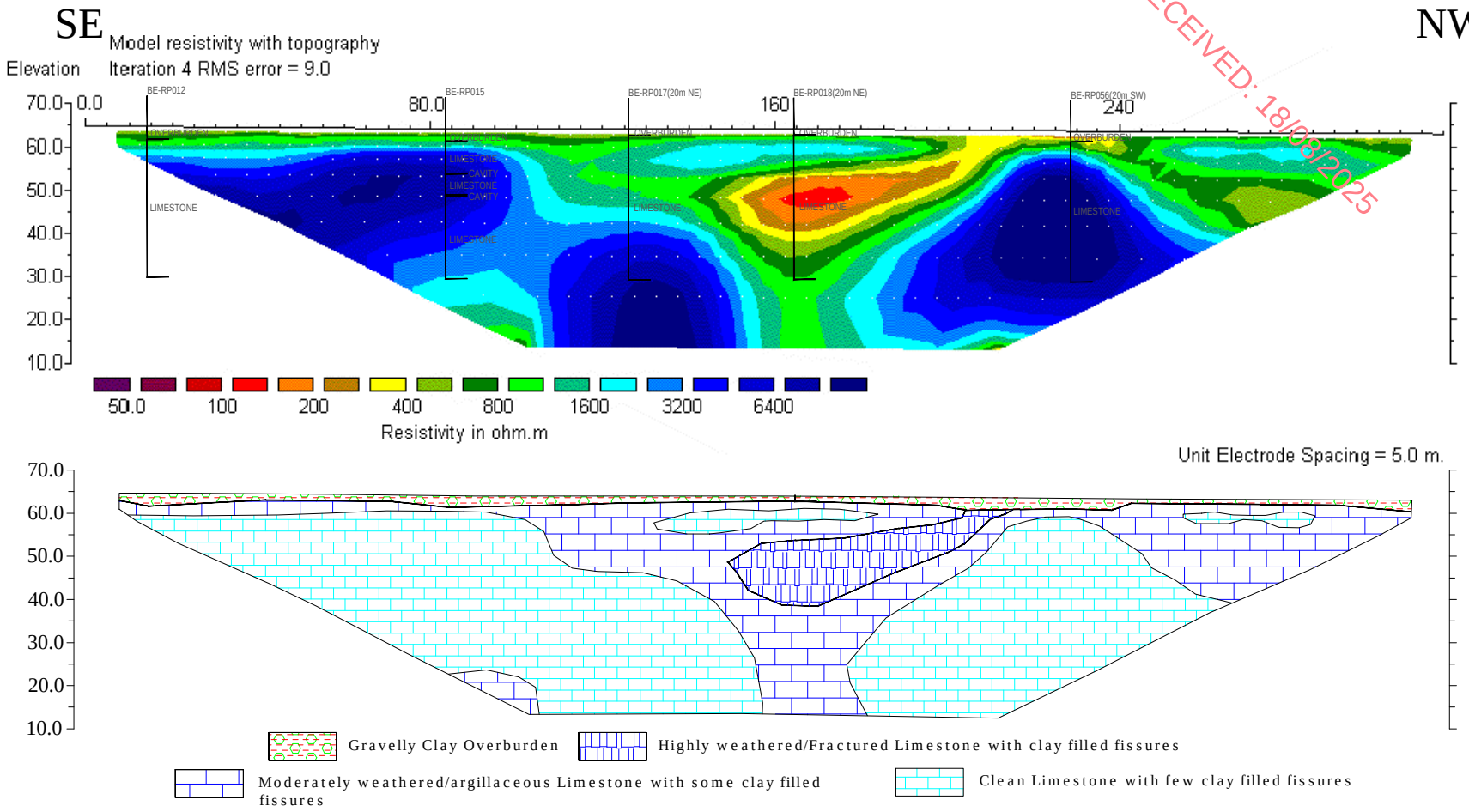
APEX Geoservices Ltd.

Kilanerin
Gorey
Co. Wexford
Ireland
Tel. 353-402-21842
Fax. 353-402-21843
www.apexgeoservices.ie

PROJECT:	Bennettsbridge Quarry Extension
DRAWING TITLE:	Profile RK3
DATE:	May 2006 Rev. 03 Ocotber 2024
CLIENT:	Bennettsbridge Limestone
SCALE:	1:750

INVERSE MODEL RESISTIVITY - 2DRES PROFILE RK4

RECEIVED: 18/06/2025



APEX Geoservices Ltd.

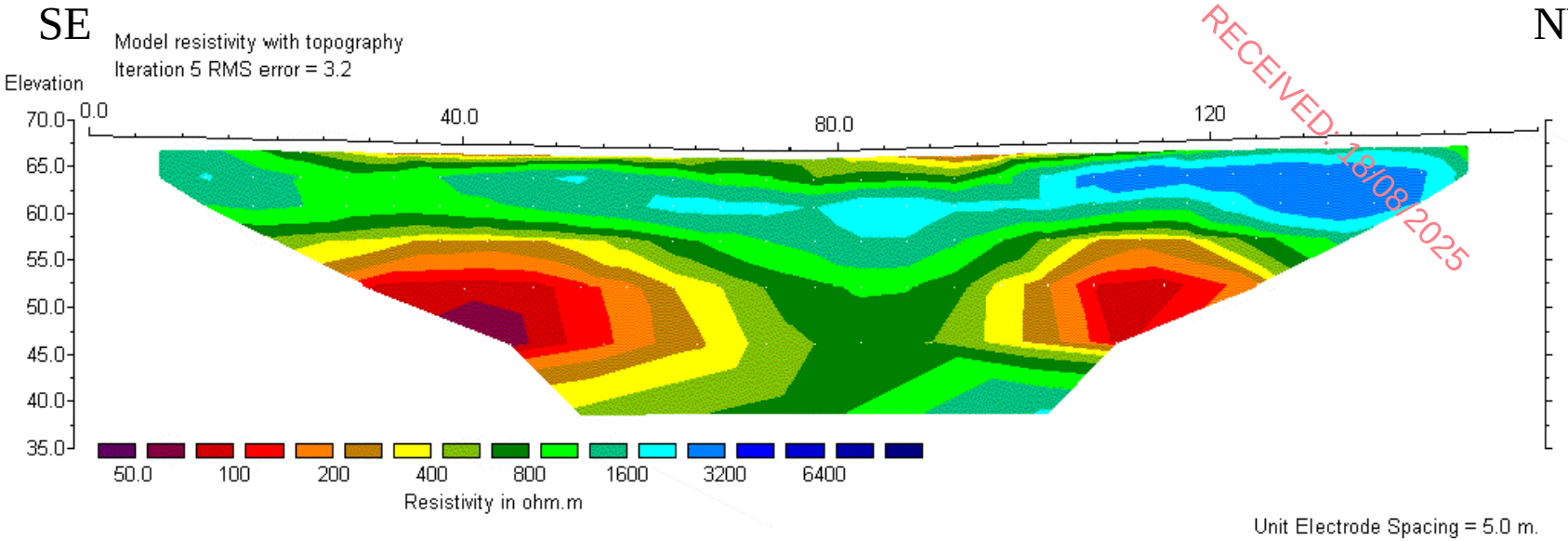
Kilanerin
Gorey
Co. Wexford
Ireland
Tel. 353-402-21842
Fax. 353-402-21843
www.apexgeoservices.ie

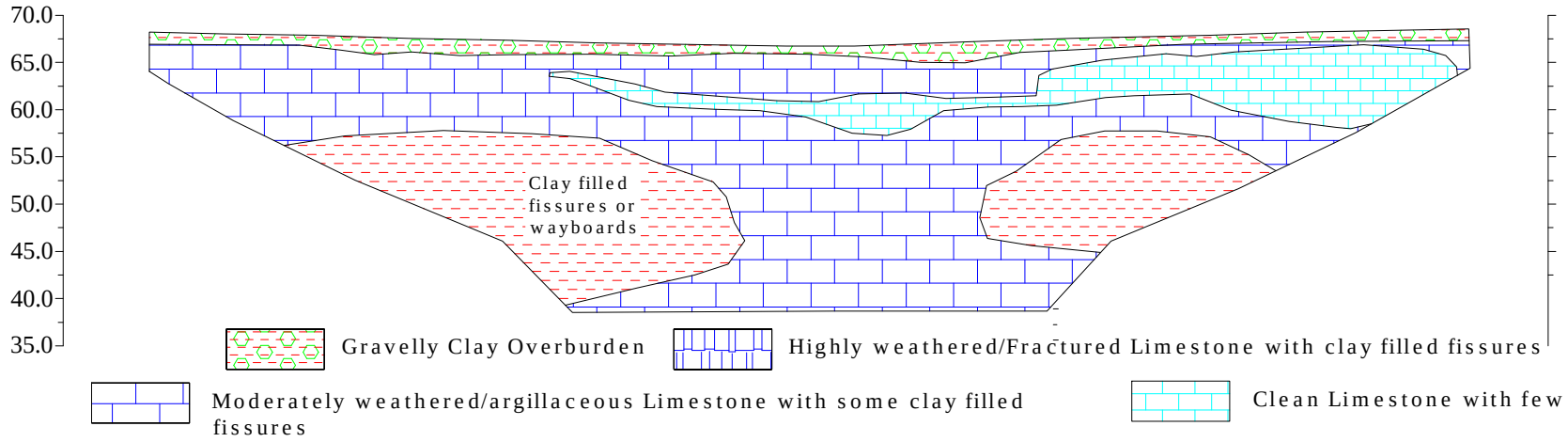
PROJECT:	Bennettsbridge Quarry Extension
DRAWING TITLE:	Profile RK4
DATE:	May 2006 Rev. 03 October 2024
CLIENT:	Bennettsbridge Limestone
SCALE:	1:1500

INVERSE MODEL RESISTIVITY - 2DRES PROFILE RK5

SE NW

RECEIVED: 18/08/2025





APEX Geoservices Ltd.

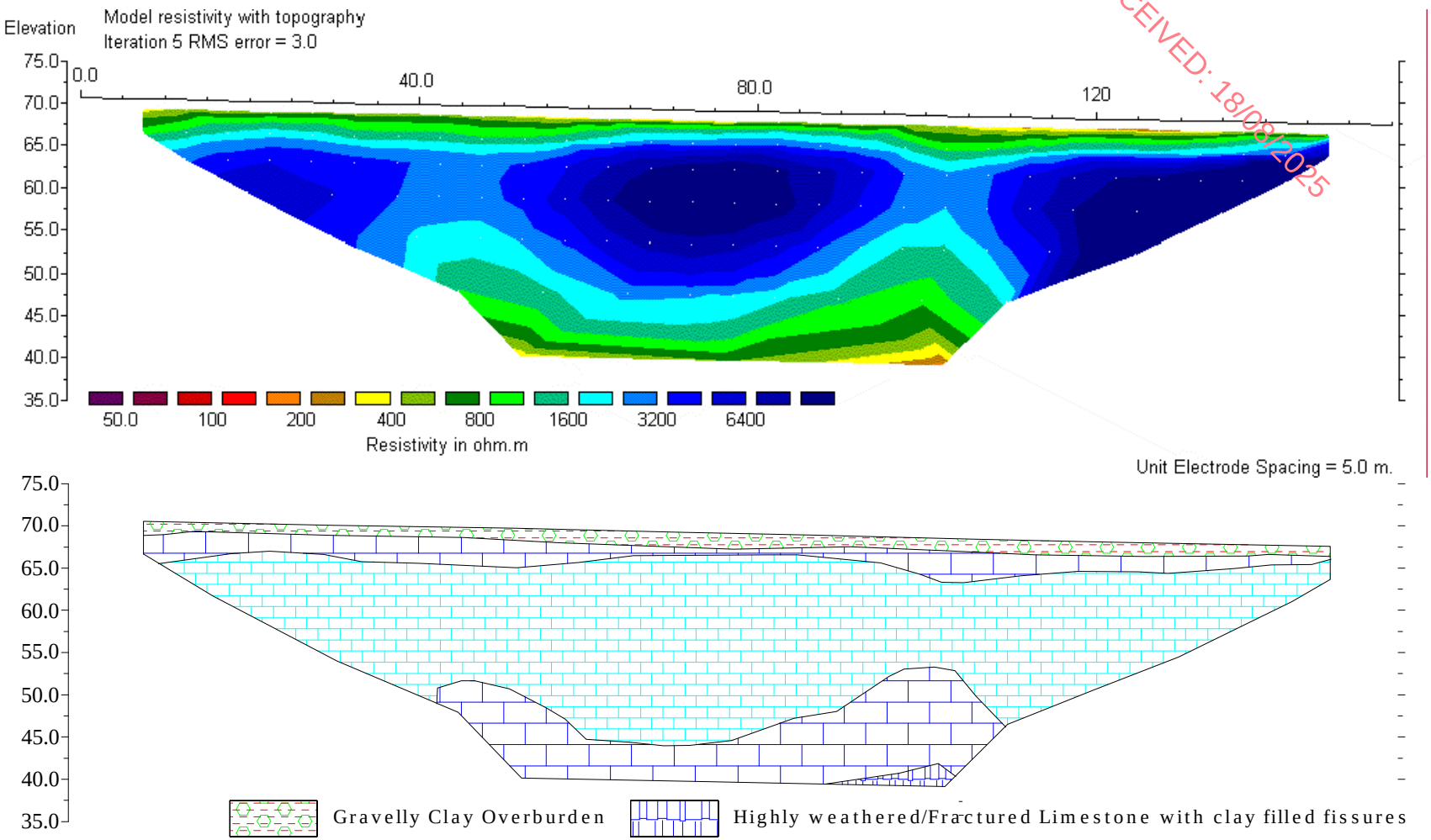
Kilanerin
Gorey
Co. Wexford
Ireland
Tel. 353-402-21842
Fax. 353-402-21843
www.apexgeoservices.ie

PROJECT:	Bennettsbridge Quarry Extension
DRAWING TITLE:	Profile RK5
DATE:	May 2006 Rev. 03 October 2024
CLIENT:	Bennettsbridge Limestone
SCALE:	1:750

INVERSE MODEL RESISTIVITY - 2DRES PROFILE RK7

WSW ENE

RECEIVED: 18/08/2025



Gravelly Clay Overburden

Highly weathered/Fractured Limestone with clay filled fissures

Moderately weathered/argillaceous Limestone with some clay filled fissures

Clean Limestone with few clay filled fiss

APEX Geoservices Ltd.

Kilanerin
Gorey
Co. Wexford
Ireland
Tel. 353-402-21842
Fax. 353-402-21843
www.apexgeoservices.ie

PROJECT:	Bennettsbridge Quarry Extension
DRAWING TITLE:	Profile RK7 Rev. 03 October 2024
DATE:	June 2006
CLIENT:	Bennettsbridge Limestone
SCALE:	1:750

RECEIVED: 18/08/2025

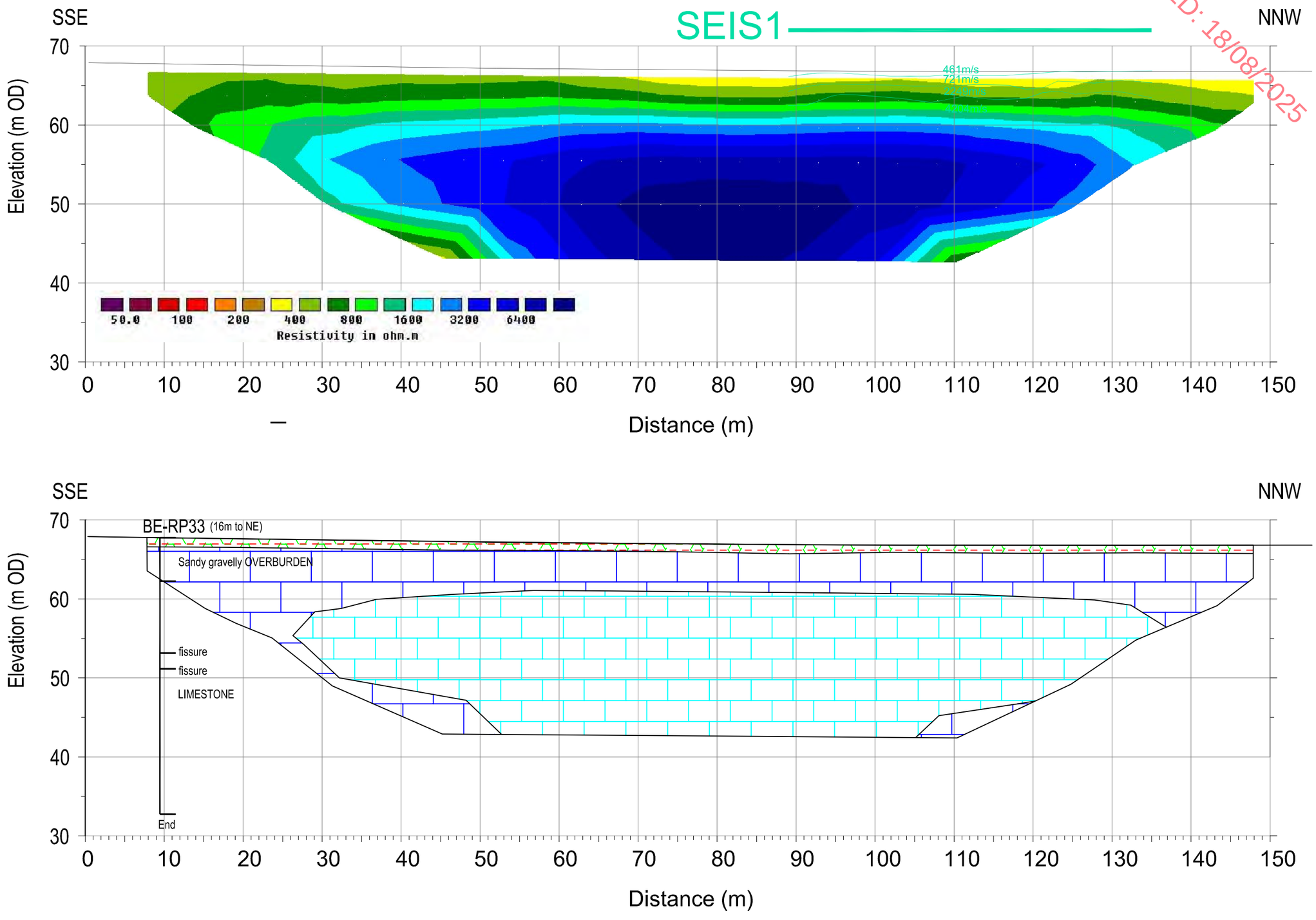
APPENDIX E: 2018 PROFILES

FIGURE 3: ERT PROFILE

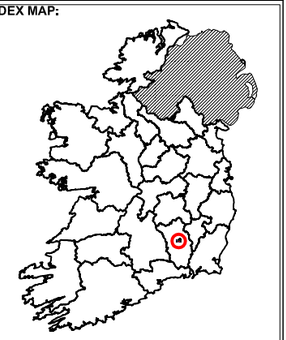
SCALE 1:500

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT1

RECEIVED: 18/08/2025



INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_14
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

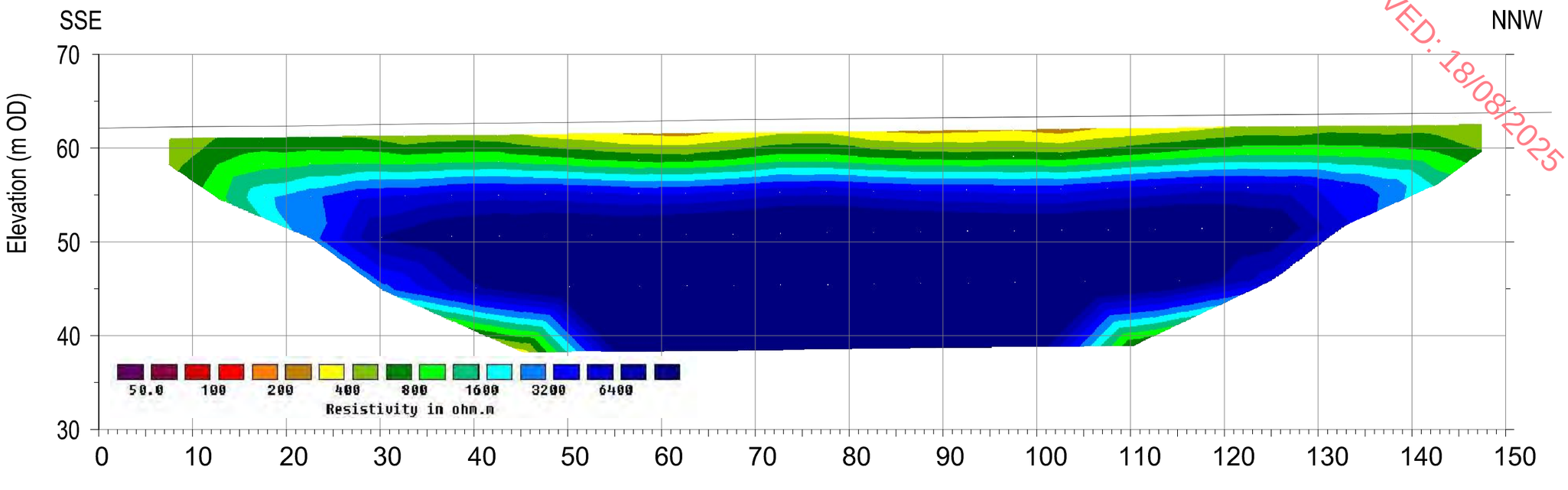
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	TL
2	25/05/18	MF	KG
3	05/06/18	MF	TL
4	30/07/18	MF	TL

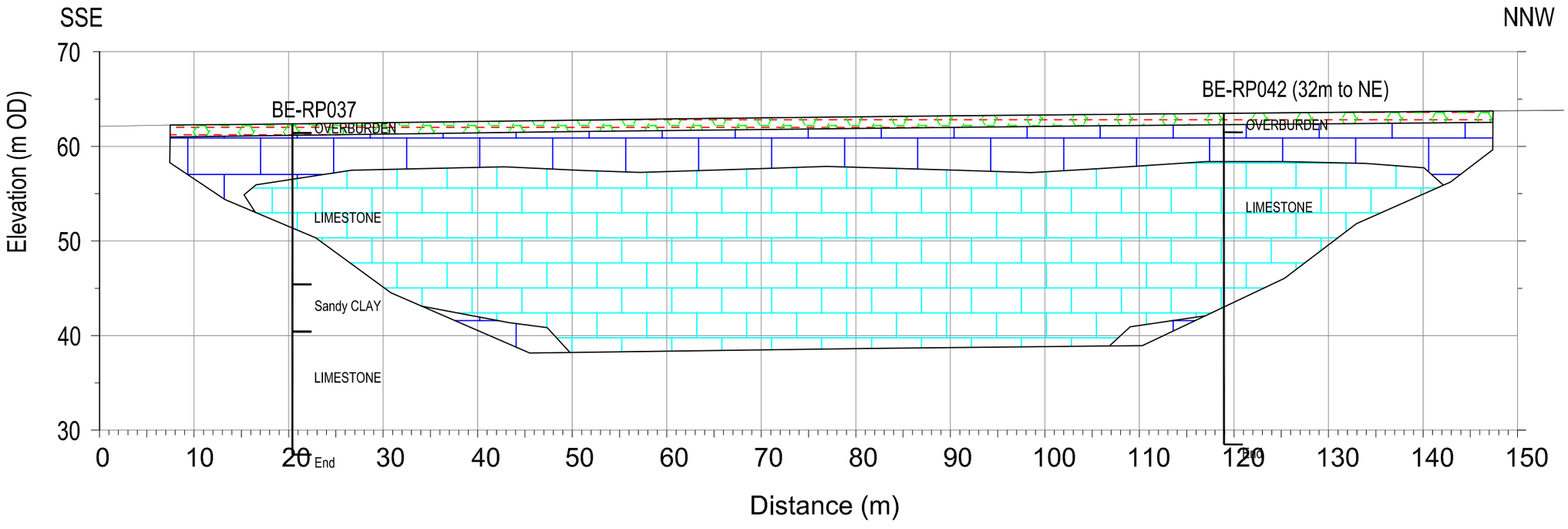
FIGURE 4: ERT PROFILE

SCALE 1:500

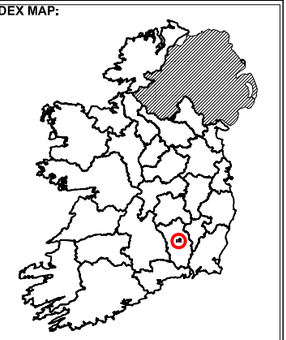
INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT2

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_15
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

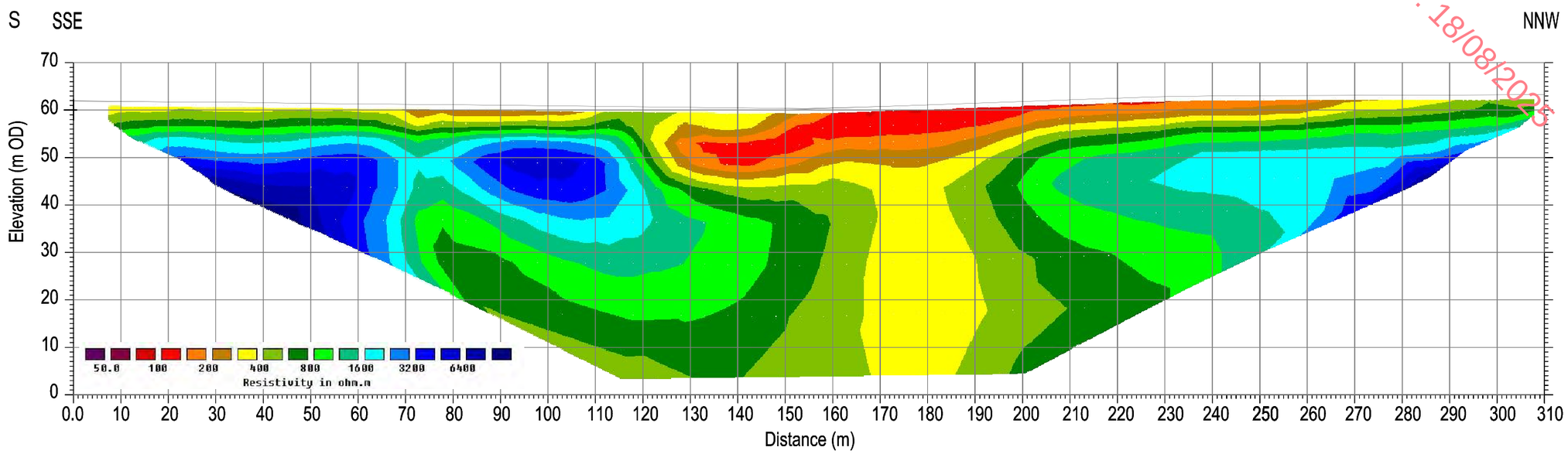
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	TL
2	25/05/18	MF	KG
3	05/06/18	MF	TL
4	30/07/18	MF	TL

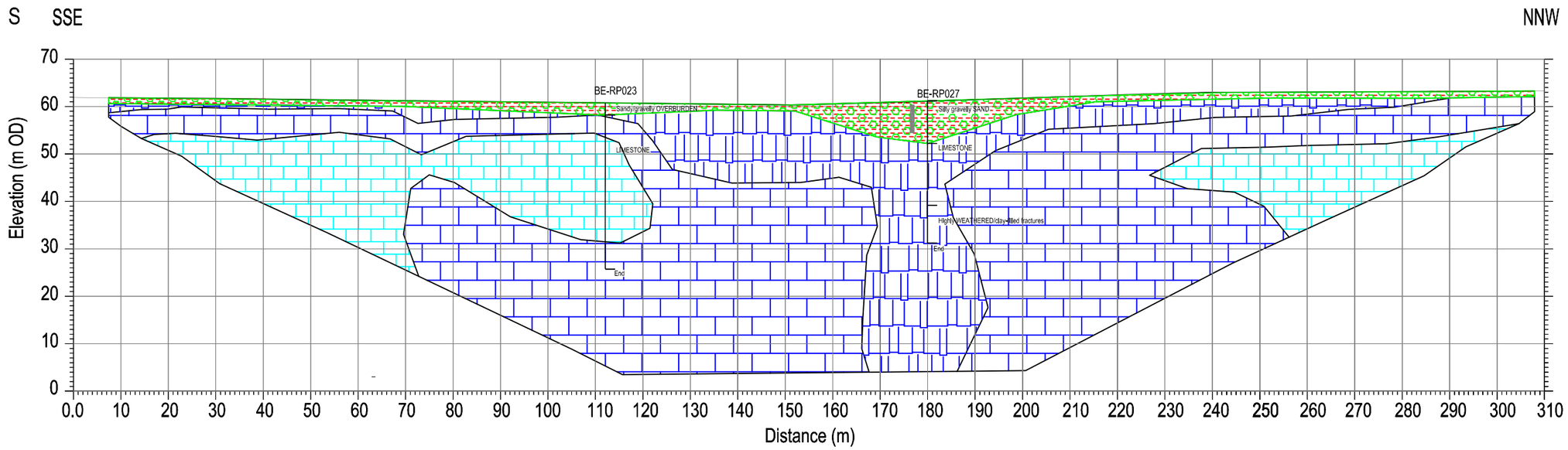
FIGURE 3: ERT PROFILE

SCALE 1:1000

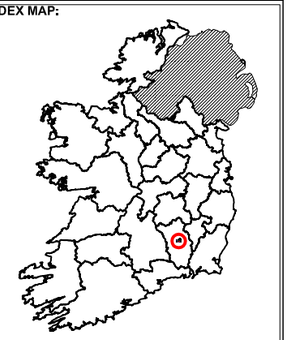
INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT3

RECEIVED: 18/08/2022





INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT03
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

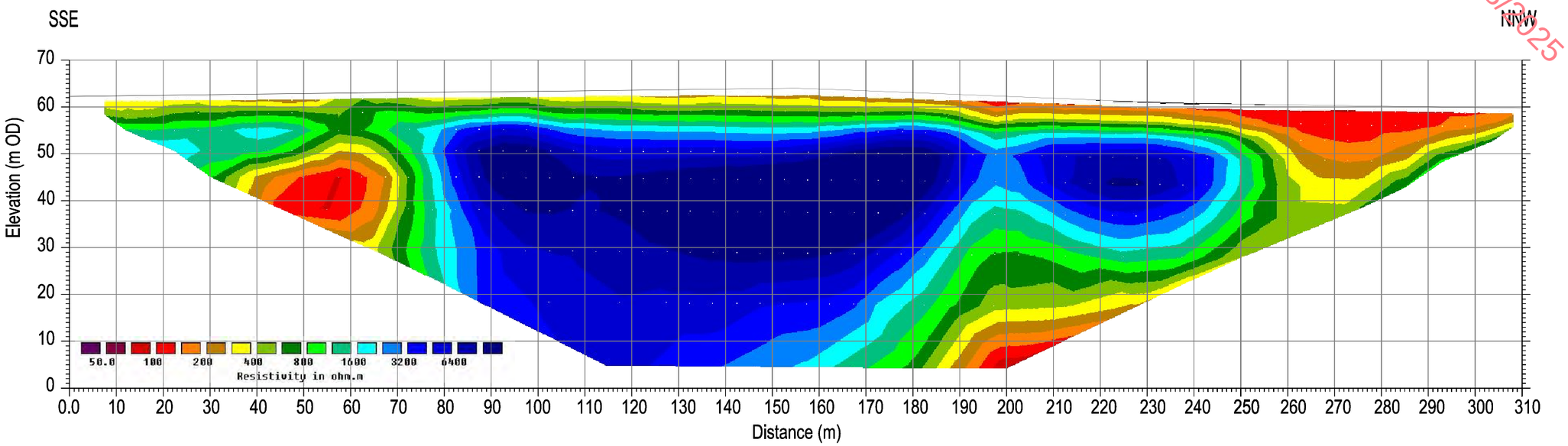
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL

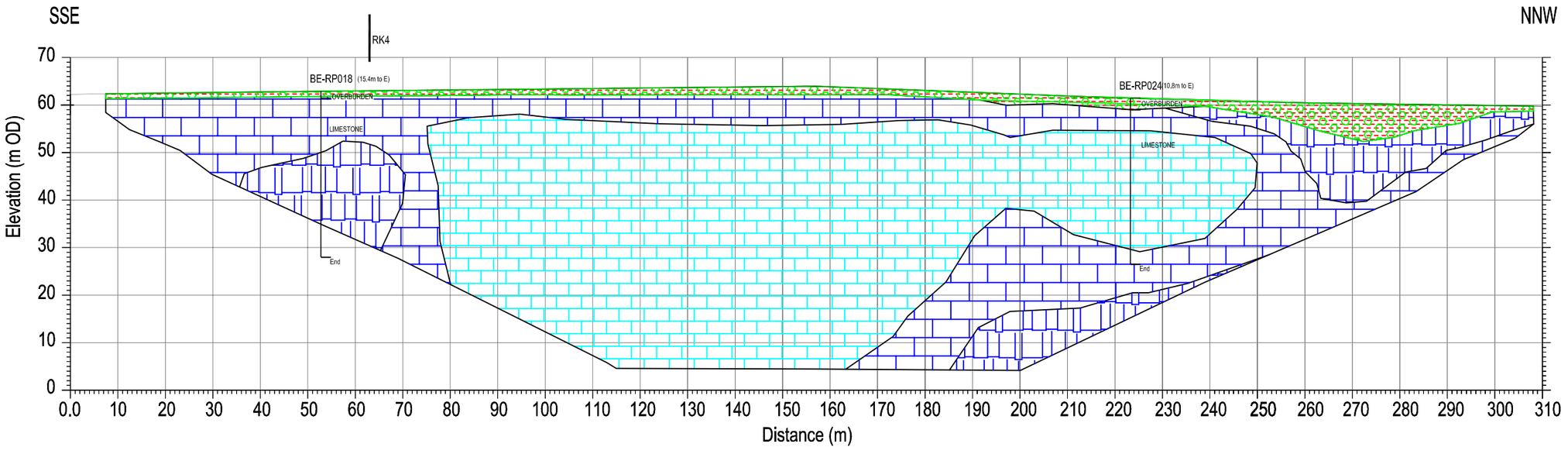
FIGURE 4: ERT PROFILE

SCALE 1:1000

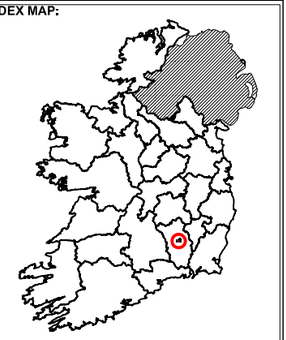
RECEIVED: 18/08/2025

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT4





INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT04
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

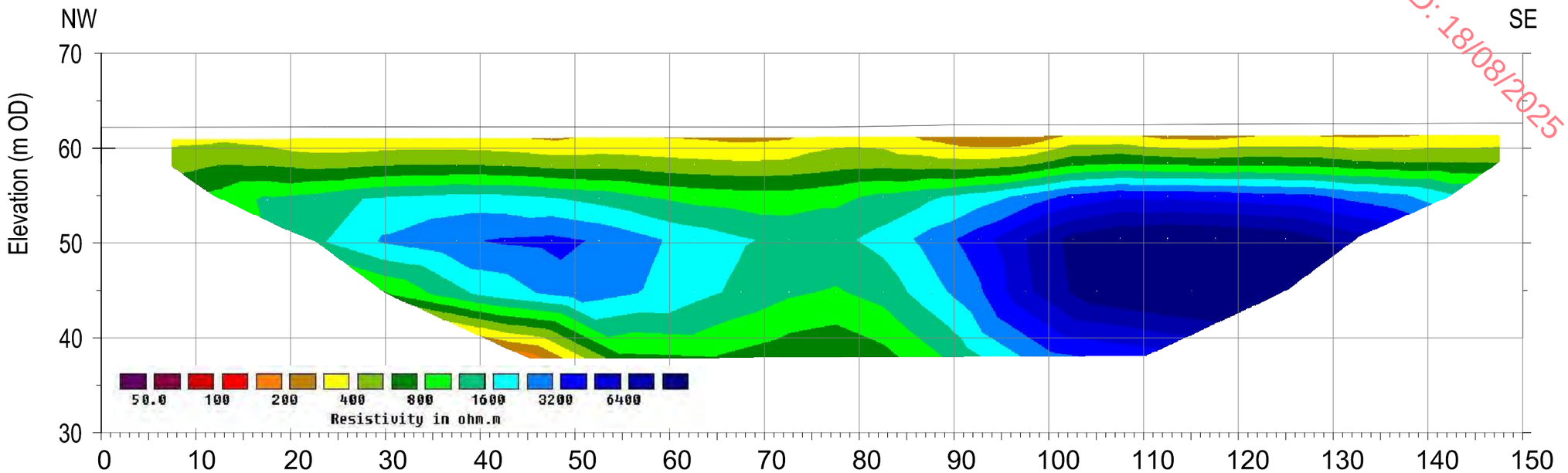
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL

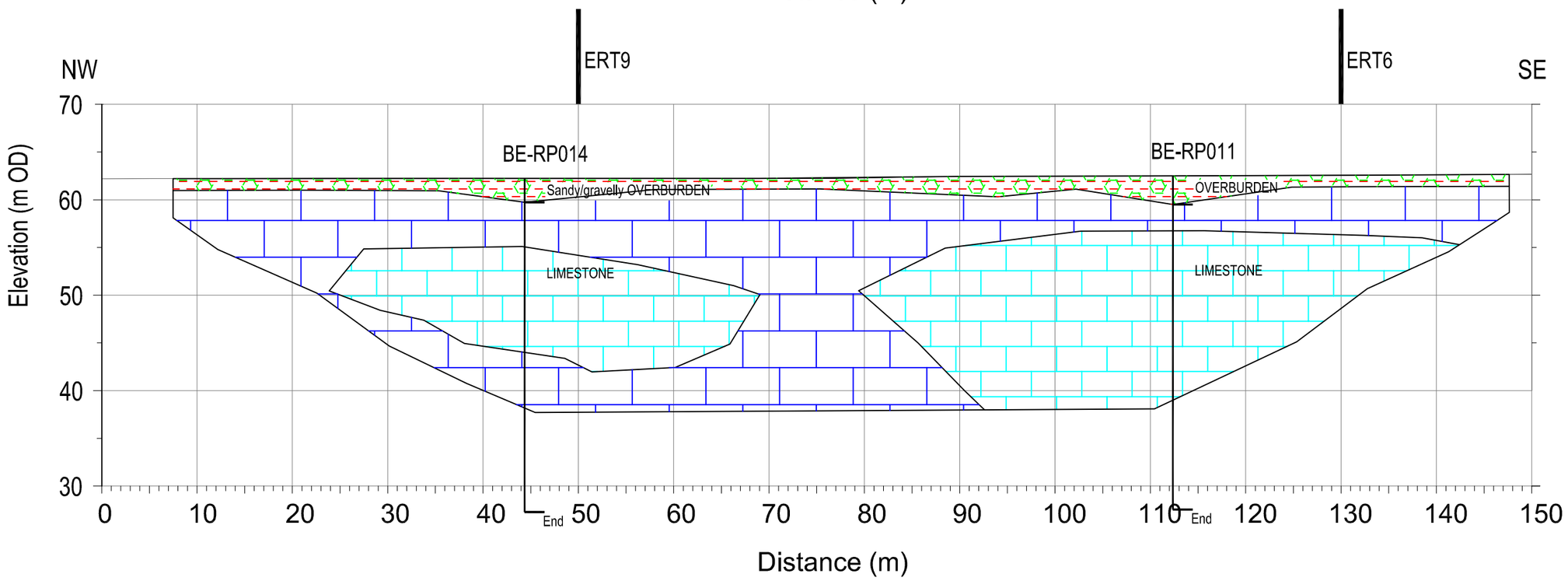
FIGURE 5: ERT PROFILE

SCALE 1:500

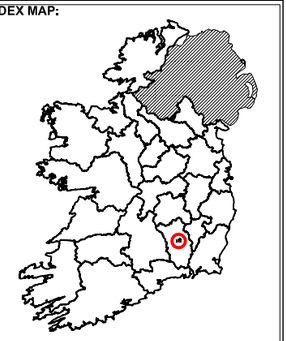
INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT5

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT::	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT05
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

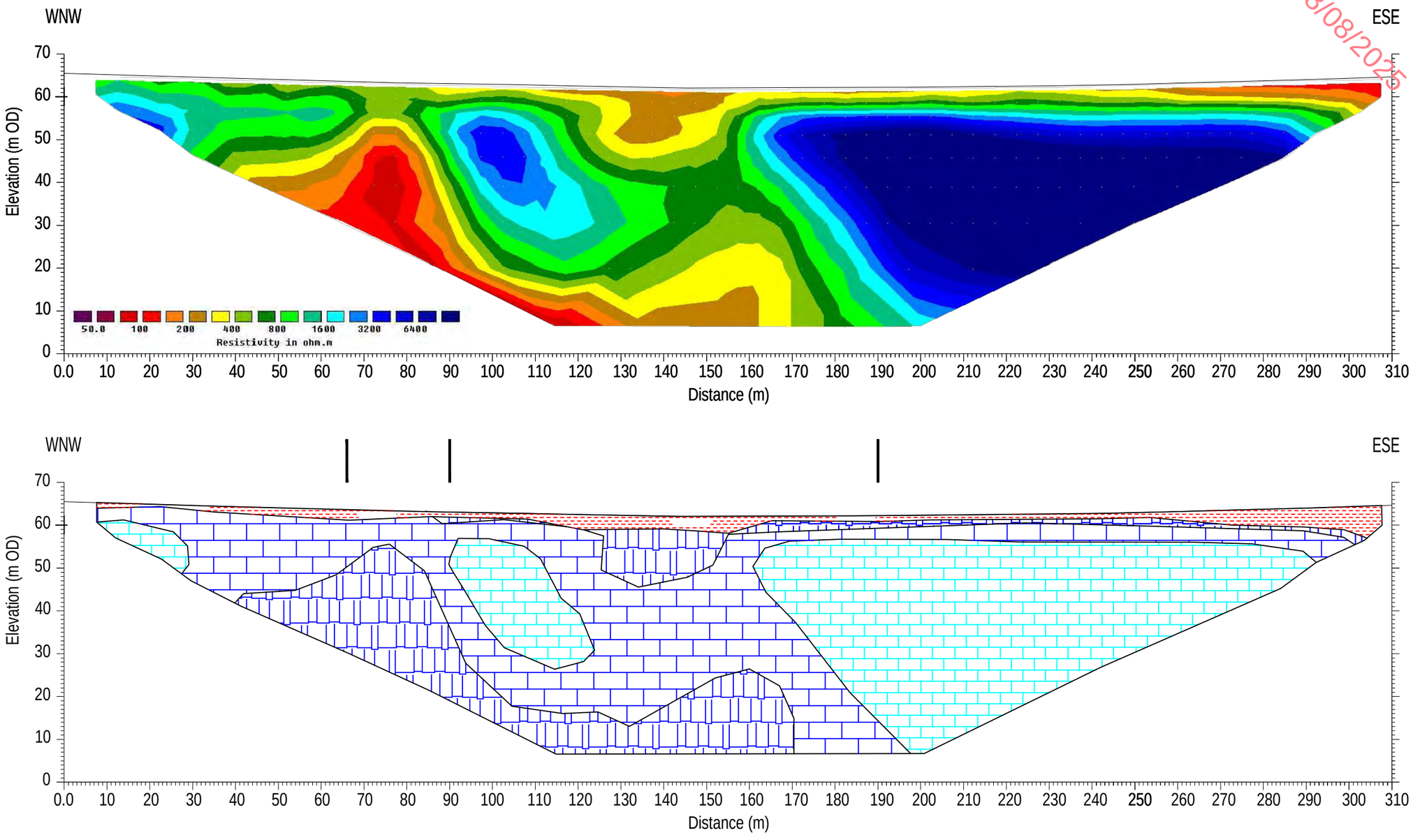
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL

FIGURE 6: ERT PROFILE

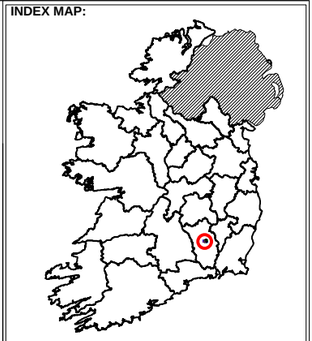
SCALE 1:1000

RECEIVED: 18/08/2025

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT6



INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

The information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

X:\APEX Admin\APEX Templates\Cad Templates\apex_colour_logo for CAD_rev250810.JPG

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT::	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT06
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

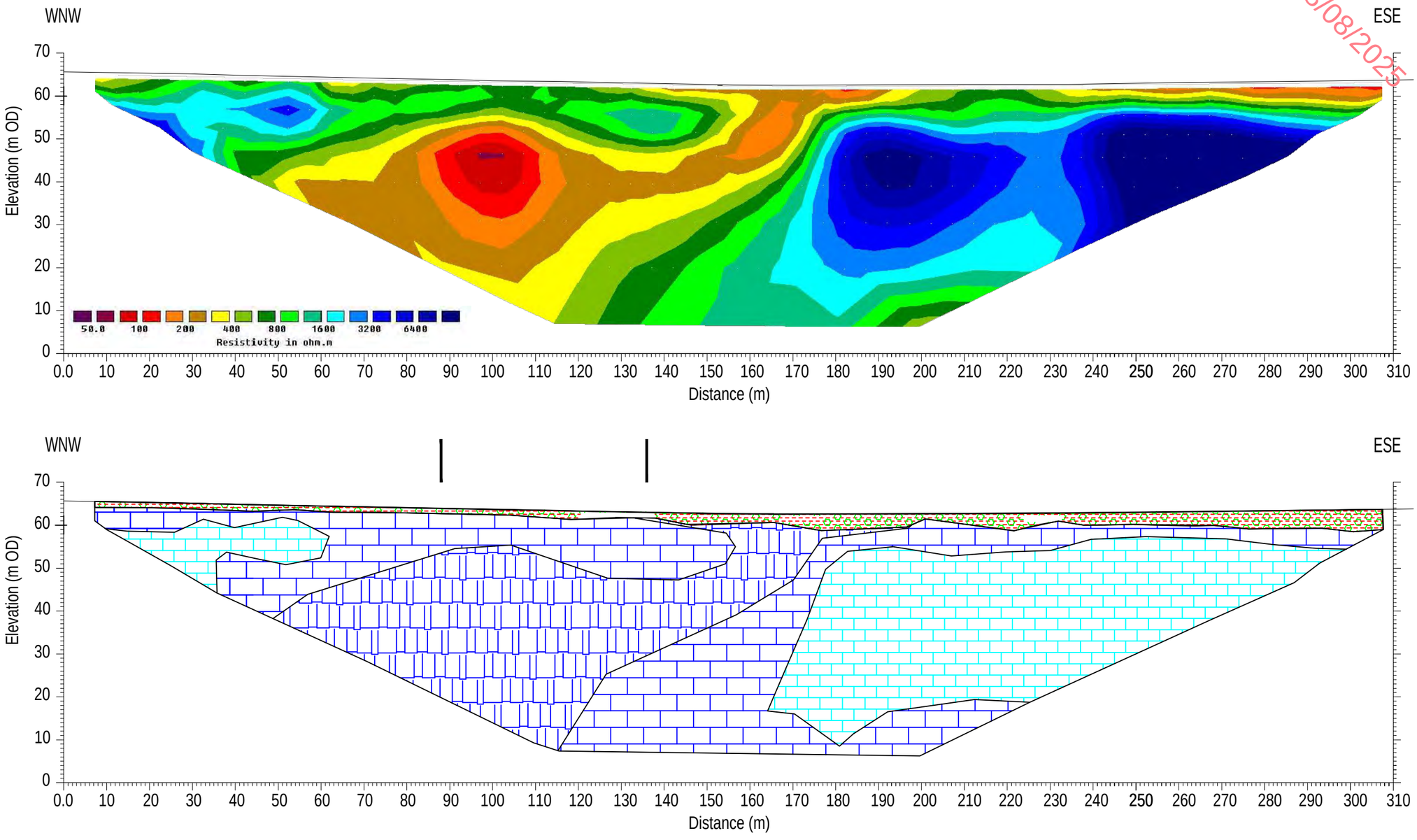
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL
5	04/02/25	POC	TL

FIGURE 7: ERT PROFILE

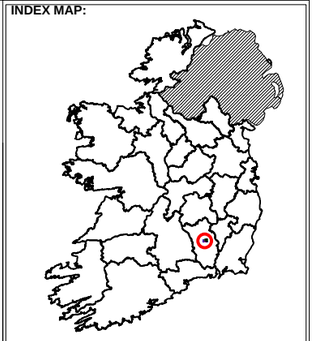
SCALE 1:1000

RECEIVED: 18/08/2025

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT7



INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

The information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

X:\APEX Admin\APEX Templates\Cad Templates\apex_colour_logo for CAD_rev250810.JPG

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT07
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

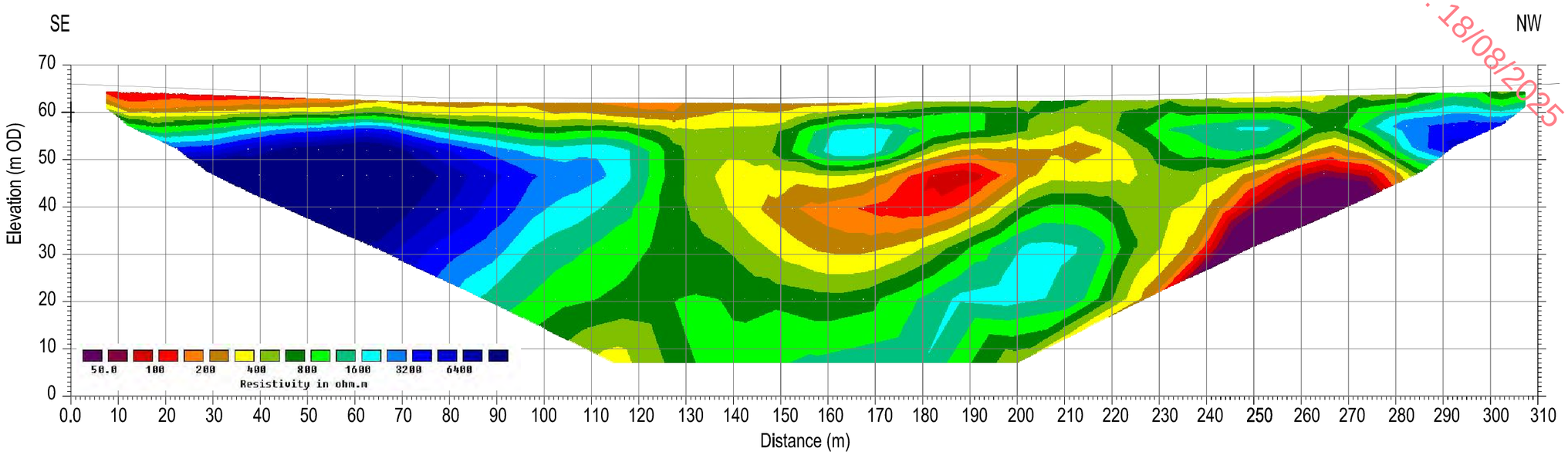
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL
5	04/02/25	POC	TL

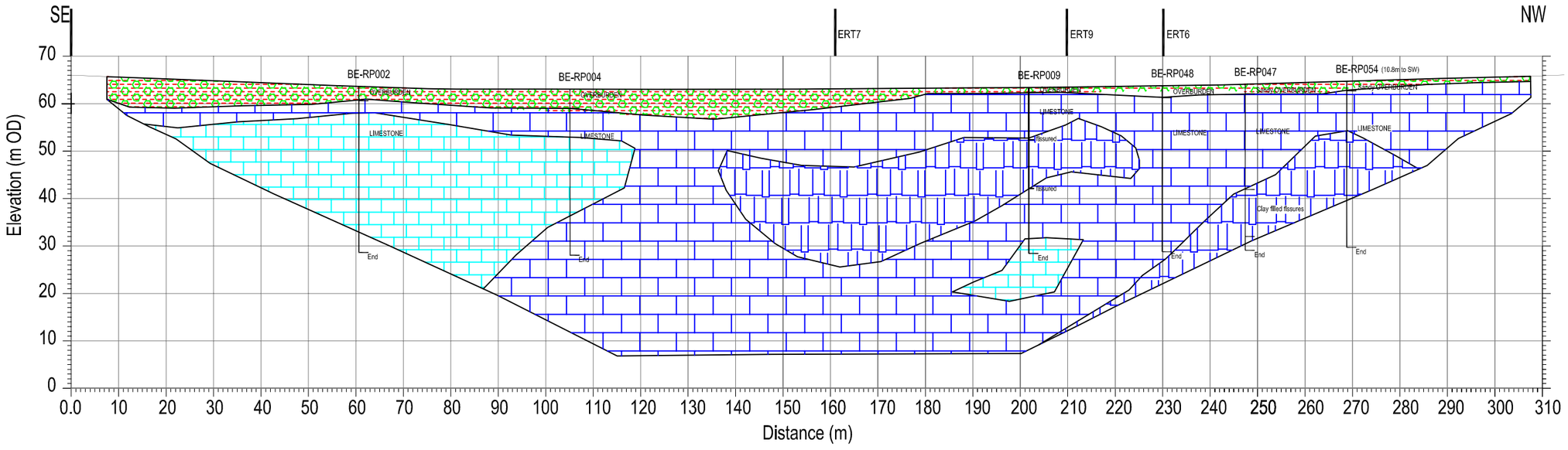
FIGURE 8: ERT PROFILE

SCALE 1:1000

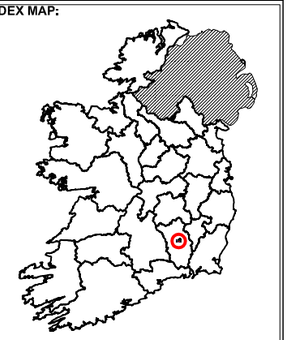
INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT8

RECEIVED: 18/08/2025





INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT08
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

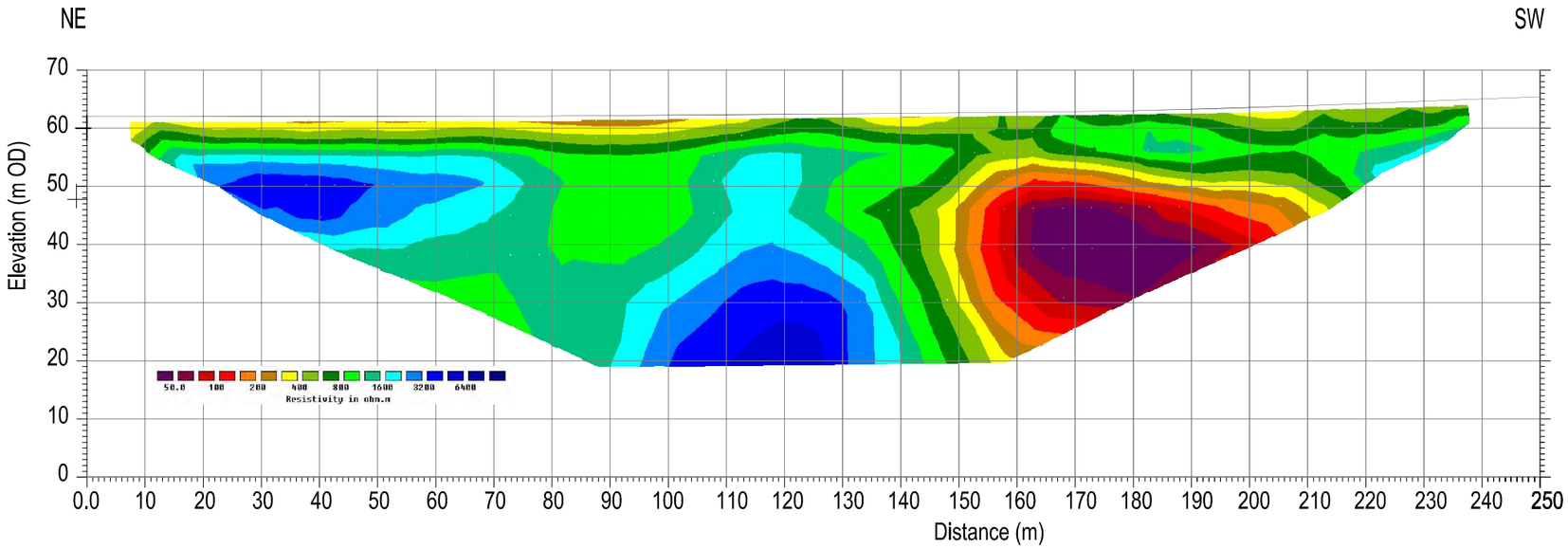
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL

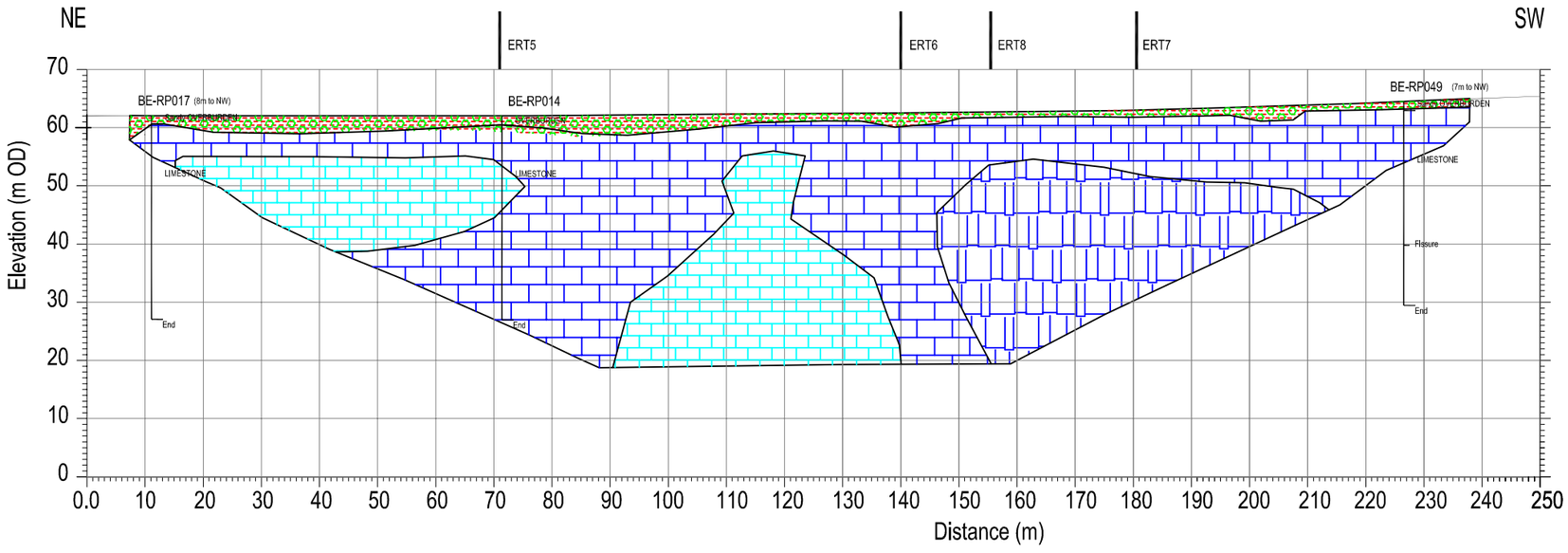
FIGURE 9: ERT PROFILE

SCALE 1:1000

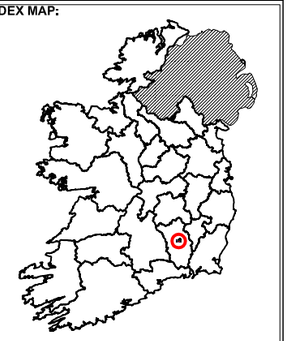
RECEIVED: 18/08/2025

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT9





INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- BE-RP33 Rotary percussive borehole (2018)

The Information displayed here is to be used in conjunction with Report AGL18010 Report on Bennettsbridge Limestone Quarry Extension Geophysical Investigation for Bennettsbridge Limestone Quarries Ltd.
APEX Geoservices Ltd. 30/07/2018.

apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY
CLIENT.:	BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO:	AGL18010_ERT09
SCALE:	AS INDICATED @ A3
DATE:	20/04/2018

Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL
4	30/07/18	MF	TL

RECEIVED: 18/08/2025

Appendix 7-5 Drillers Records and Borehole Details (2018 & 2024).

RECEIVED: 18/08/2025

Greenfield Application Area

2025

Bennettsbridge Limestone

7 Petersen Drilling SI 2024 BHs holding dataloggers in the GREENFIELD AREA:

- SP1_24
- SP2_24
- SP3_24
- SP4_24
- SP5_25
- SP6_24
- SP7_24

= Monitored Existing site wells and some of the local area wells monitored.

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	48.00		0000		100	grey											0.00	Dry
0.20	Stiff brown silty sandy CLAY																						
0.70	Weak weathered dark grey LIMESTONE with frequent clay infill																						
2.30	Strong to Very strong dark grey blackish LIMESTONE rare fractures occasional kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0845			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1545			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	2.50					Sim. Casing			
RO	154.00	0.00	2.50				DTH Button Bit		115	Air	No
RO	120.00	2.50	48.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1015	19.00	2.50	Seepage	0.00	0.00	0.00	0.00	N/S
1320	31.00	2.50	Seepage	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0845		CAT Scanned: Yes
0845		Permit Completed: Yes
		DREM (19.00m - 19.50m): kalside vein, some iron staining
		DREM (31.00m - 31.30m): minor fractured zone

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

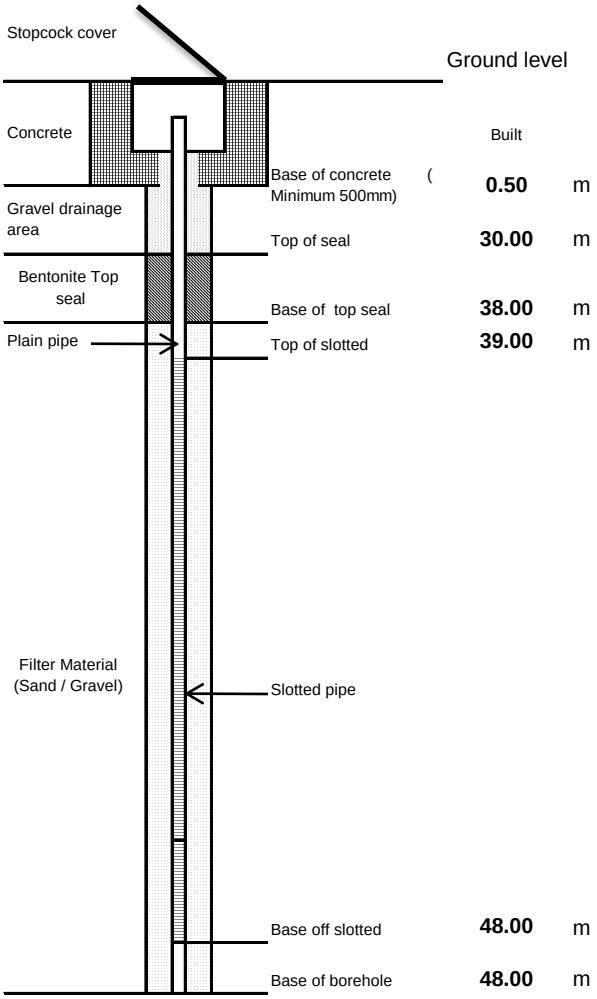
Weather	Rain	Project No	35/24
Date	26/09/2024	Day	Thursday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP1_24
Sheet	1 of 1	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	Single	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	Dry	m
Time of Initial reading	1520	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	30.00	0.50
Borehole seal top	38.00	30.00
Filter zone	48.00	38.00
Plain pipe	39.00	GL
Slotted zone	48.00	39.00
Base of borehole	48.00	

Remarks

2nd Bentonite seal 3.5 to 1.5m

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Thursday	**Date**	September 26, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP1_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	4.00		0000		100	grey											0.00	Dry
0.30	Firm to stiff brown very very sandy gravelly CLAY																						
3.30	Strong dark grey blackish LIMESTONE																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0820			
Finish time (hhmm)	**Hole (m)**	**Water (m)**	**Casing (m)**
0825	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	4.00					Sim. Casing			
RO	154.00	0.00	4.00				DTH Button Bit		115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)
Arisings	4.00	0.00

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0820		CAT Scanned: Yes
0820		Permit Completed: Yes

SPT I.D. Number	PD1	**Calibration Date**	01/02/2021
SPT Rod Type	2 3/8 Regular	**SPT Energy Ratio**	0.00
Drilling Crew Details		**CSCS No**	
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	**Project No**	35/24
Date	27/09/2024	**Day**	Friday
Rig type	**Knebel HY79**	**Borehole Number**	
Inclination		**Orientation**	SP2A_24
Sheet	1 of 1	**Completed**	Y

AGS

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	5.00		0000		100	grey											0.00	0.00
0.20	Firm to stiff brown very very sandy gravelly CLAY																						
0.50	Very weak weathered dark grey LIMESTONE with frequent orangish brown clay infill																						
4.10	Strong dark grey blackish LIMESTONE																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0825			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
0940	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	5.00					Sim. Casing			
RO	154.00	0.00	5.00				DTH Button Bit		115	Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)
Arisings	5.00	0.00

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0825		CAT Scanned: Yes
0825		Permit Completed: Yes

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	Project No	35/24
Date	27/09/2024	Day	Friday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP2B_24
Sheet	1 of 1	Completed	Y

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description
0.00	Firm brown TOPSOIL
0.20	Firm to stiff brown very sandy gravelly CLAY
0.50	Very weak highly weathered grey LIMESTONE with very frequent clay infill
7.80	Strong dark grey LIMESTONE
9.40	Soft to firm orangish brown CLAY
12.40	Strong dark grey blackish LIMESTONE

Sample / Hole / Test Details

No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)
	RO		0.00	36.50	

Drilling Details

Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour
0000		100	grey

Standard Penetration Test

Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
										0.00	0.00

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1000			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1635			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	8.00					Sim. Casing			
RO	154.00	0.00	8.00				DTH Button Bit		115	Air	No
RO	120.00	8.00	36.50				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1000		CAT Scanned: Yes
1000		Permit Completed: Yes
		DREM (35.90m - 36.50m): fractured rock zone, with some clay infill
1045	0230	Difficult drilling conditions between 15.5 and 24.2 m, loss of flush return in clay, reamed borehole repeatedly to clear blockage

SPT I.D. Number	PD1	**Calibration Date**	01/02/2021
SPT Rod Type	2 3/8 Regular	**SPT Energy Ratio**	0.00
Drilling Crew Details			**CSCS No**
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	**Project No**	35/24
Date	27/09/2024	**Day**	Friday
Rig type	**Knebel HY79**	**Borehole Number**	
Inclination		**Orientation**	SP2C_24
Sheet	1 of 2	**Completed**	Y

AGS

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
15.50	Firm orangish brown CLAY with frequent limestone fracments fault infill																						
24.20	Medium strong to Strong dark grey blackish fractured LIMESTONE occasional fractures with clay infill																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1000			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1635			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1435	36.00	8.00	Seepage	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

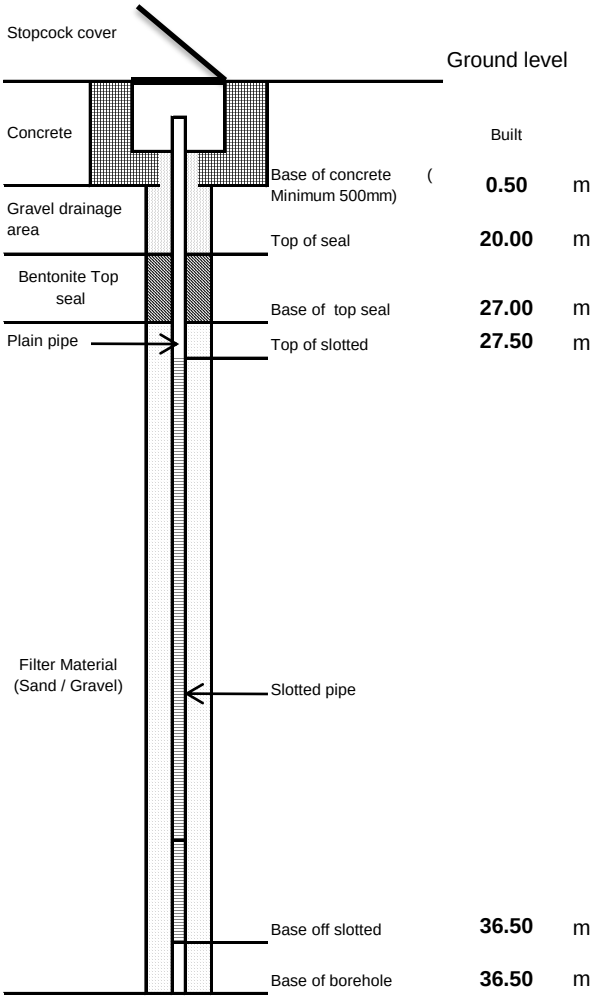
Weather	Variable	Project No	35/24
Date	27/09/2024	Day	Friday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP2C_24
Sheet	2 of 2	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	0.00	m
Time of Initial reading	1635	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	20.00	0.50
Borehole seal top	27.00	20.00
Filter zone	36.50	27.00
Plain pipe	27.50	GL
Slotted zone	36.50	27.50
Base of borehole	36.50	

Remarks

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Friday	**Date**	September 27, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP2C_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	42.50		0000		100	grey											0.00	0.00
0.20	Firm to stiff brown sandy silty CLAY high cobble content limestone fracments possible highly weathered rock																						
8.70	Weak to Medium strong dark grey blackish LIMESTONE frequent fractures occasional kalside veins																						
16.10	Firm orangish brown CLAY																						
17.20	Weak to Medium strong dark grey blackish LIMESTONE with frequent fractures occasional kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0800			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1320			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	9.70					Sim. Casing			
RO	154.00	0.00	9.70				DTH Button Bit		115	Air	No
RO	120.00	9.70	42.50				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1005	37.00	9.70	Slow	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0800		CAT Scanned: Yes
0800		Permit Completed: Yes
		DREM (19.50m - 20.00m): fractured rock zone, with some clay infill
		DREM (26.80m - 27.40m): fractured rock zone, with some clay infill
		DREM (34.00m - 34.50m): highly fractured rock with clay infill
		DREM (37.00m - 37.50m): highly fractured rock with clay infill

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

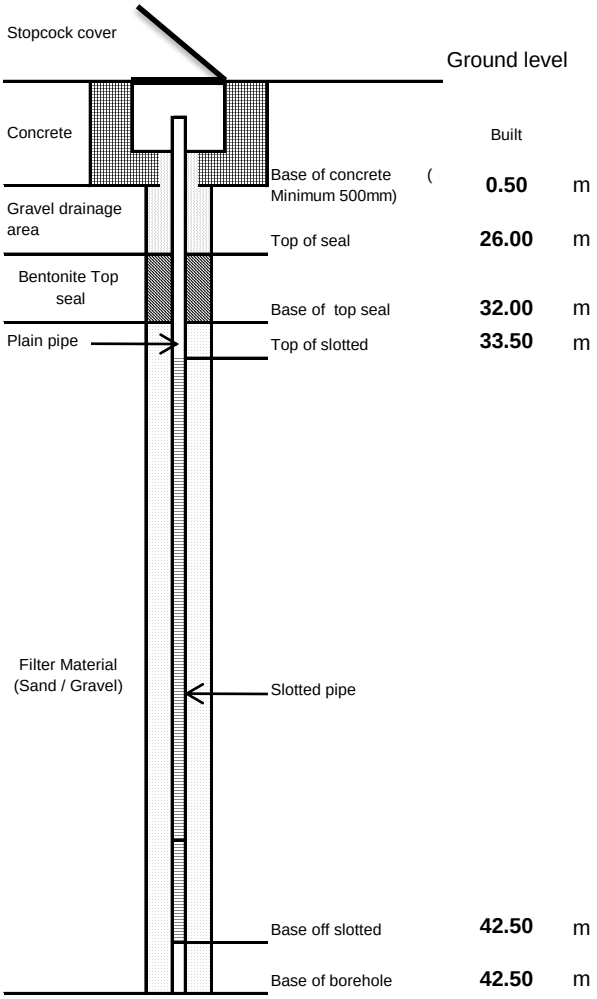
Weather	Variable	Project No	35/24
Date	01/10/2024	Day	Tuesday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP3_24
Sheet	1 of 1	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	36.00	m
Time of Initial reading	1220	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	26.00	0.50
Borehole seal top	32.00	26.00
Filter zone	42.50	32.00
Plain pipe	33.50	GL
Slotted zone	42.50	33.50
Base of borehole	42.50	

Remarks

2nd bentonite seal 9.5 to 7.5

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Tuesday	**Date**	October 1, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP3_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	36.00		0000		100	grey											0.00	Dry
0.20	Firm to stiff orangish brown silty sandy CLAY with frequent limestone fracments possible highly weathered rock																						
1.80	Medium strong grey very fractured LIMESTONE																						
3.50	Medium strong to Strong dark grey blackish LIMESTONE with frequent kalside veins occasional fractures																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0805			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1530			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	5.50					Sim. Casing			
RO	154.00	0.00	5.50				DTH Button Bit		115	Air	No
RO	120.00	5.50	36.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0805		CAT Scanned: Yes
0805		Permit Completed: Yes
		DREM (20.50m - 21.00m): minor fracture, change in flush to brown
		DREM (33.40m - 33.70m): minor fracture, change in flush to brown

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

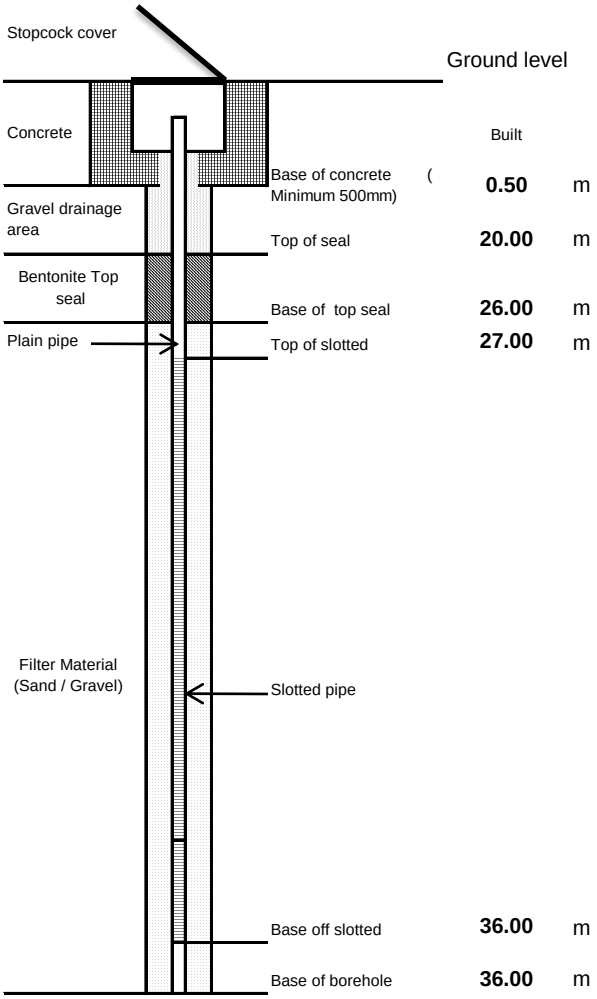
Weather	Variable	Project No	35/24
Date	30/09/2024	Day	Monday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP4_24
Sheet	1 of 1	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	Single	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	Dry	m
Time of Initial reading	1730	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	20.00	0.50
Borehole seal top	26.00	20.00
Filter zone	36.00	26.00
Plain pipe	27.00	GL
Slotted zone	36.00	27.00
Base of borehole	36.00	

Remarks

2nd bentonite seal 5 to 2m

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Monday	**Date**	September 30, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP4_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	43.00		0000		100	grey											0.00	Dry
0.40	Weak dark grey weathered LIMESTONE																						
3.50	Medium strong to Strong dark grey blackish LIMESTONE with occasional fractures and kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1335			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1715	43.00	Dry	2.50

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	2.50					Sim. Casing			
RO	154.00	0.00	2.50				DTH Button Bit		115	Air	No
RO	120.00	2.50	43.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1335		CAT Scanned: Yes
1335		Permit Completed: Yes
		DREM (19.80m - 20.20m): highly fractured rock with clay infill
		DREM (40.00m - 41.00m): minor fractured zone

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Fine	Project No	35/24
Date	01/10/2024	Day	Tuesday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP5_24
Sheet	1 of 2	Completed	Y

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0815	43.00	0.00	2.50
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1335			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

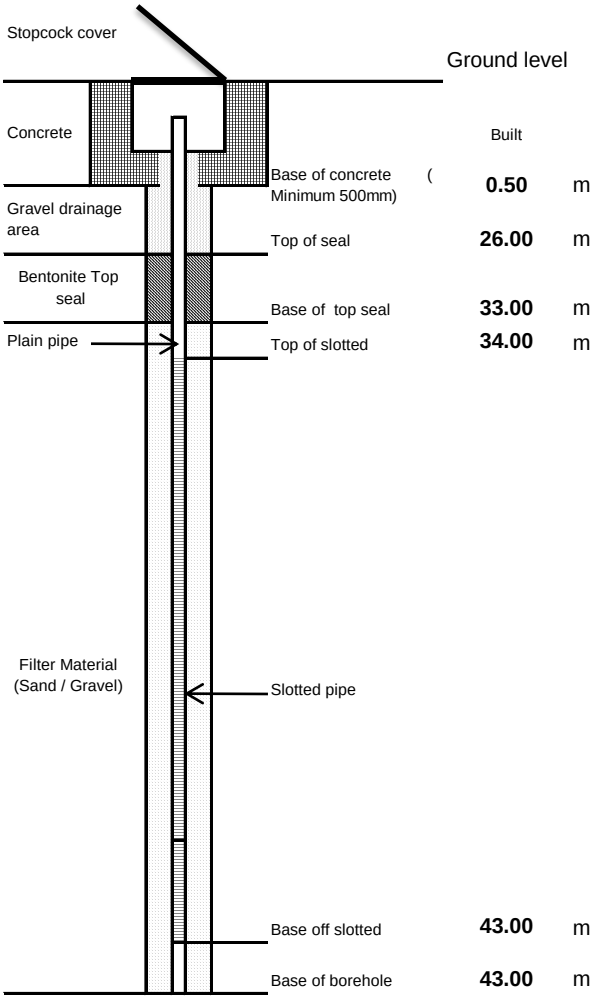
Weather	Variable	Project No	35/24
Date	02/10/2024	Day	Wednesday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP5_24
Sheet	2 of 2	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	0.00	m
Time of Initial reading	1335	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	26.00	0.50
Borehole seal top	33.00	26.00
Filter zone	43.00	33.00
Plain pipe	34.00	GL
Slotted zone	43.00	34.00
Base of borehole	43.00	

Remarks

2nd bentonite seal 4 to 3m

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Wednesday	**Date**	October 2, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP5_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	52.00		0000		100	grey											0.00	Dry
0.40	Firm to stiff orangish brown silty gravelly CLAY with frequent limestone fracments possible highly weathered rock																						
1.50	Medium strong to Strong dark grey blackish LIMESTONE occasional fractures and kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1335			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1710	52.00	Dry	2.00

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	2.00					Sim. Casing			
RO	154.00	0.00	2.00				DTH Button Bit		115	Air	No
RO	120.00	2.00	52.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1335		CAT Scanned: Yes
1335		Permit Completed: Yes
		DREM (49.50m - 49.80m): minor fractured zone

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details		CSCS No	
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	Project No	35/24
Date	02/10/2024	Day	Wednesday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP6_24
Sheet	1 of 2	Completed	Y

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0815	52.00	45.30	2.00
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1025			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0815		CAT Scanned: Yes

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

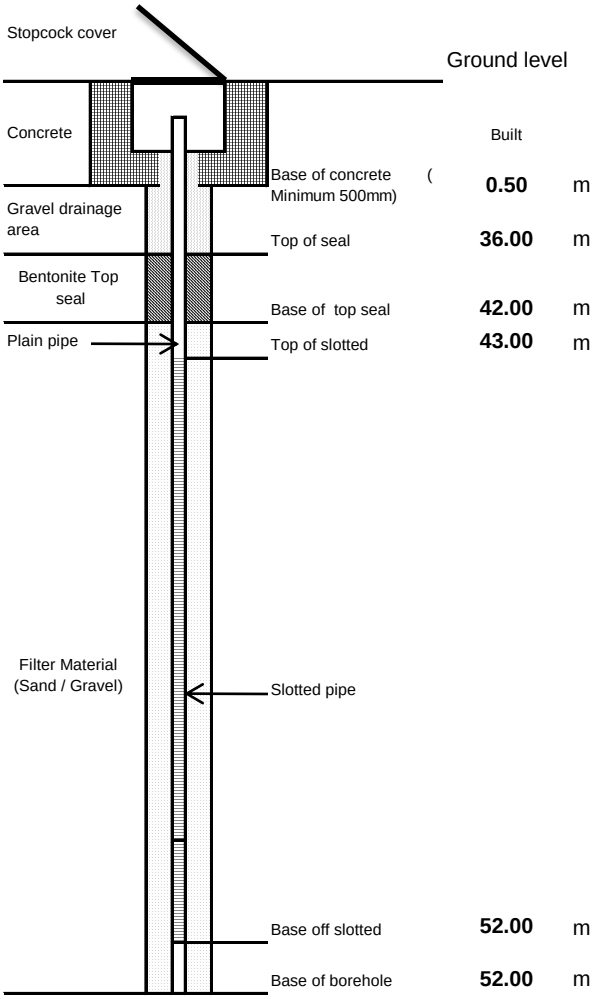
Weather	Variable	Project No	35/24
Date	03/10/2024	Day	Thursday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP6_24
Sheet	2 of 2	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	None	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	45.30	m
Time of Initial reading	1020	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	36.00	0.50
Borehole seal top	42.00	36.00
Filter zone	52.00	42.00
Plain pipe	43.00	GL
Slotted zone	52.00	43.00
Base of borehole	52.00	

Remarks

2nd bentonite seal 5 to 3m

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Thursday	**Date**	October 3, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP6_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	42.00		0000		100	grey											0.00	0.00
0.30	Firm to stiff orangish brown sandy gravelly CLAY high cobble content with limestone fracments																						
1.20	Weak to Medium strong weathered dark grey LIMESTONE frequent clay filled fractures																						
9.00	Medium strong to Strong dark grey blackish LIMESTONE occasional fractures and kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1025			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1630			

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	3.60					Sim. Casing			
RO	154.00	0.00	3.60				DTH Button Bit		115	Air	No
RO	120.00	3.60	42.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)
1305	38.10	3.60	Slow	0.00	0.00	0.00	0.00	N/S

Backfill (m)

Type	From (m)	To (m)

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1025		CAT Scanned: Yes
1025		Permit Completed: Yes
		DREM (38.00m - 39.50m): minor fractured zone

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

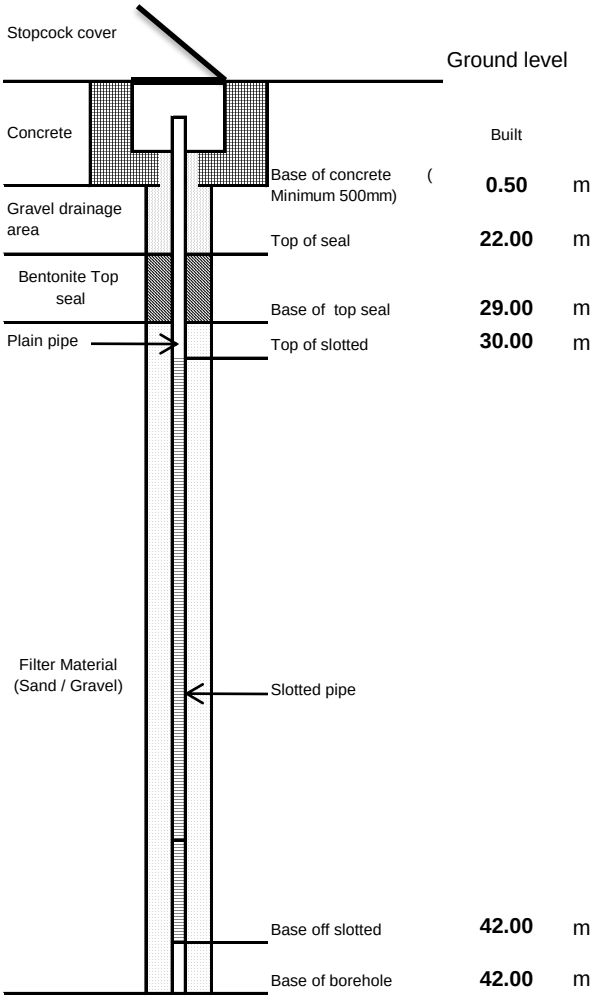
Weather	Fine	Project No	35/24
Date	03/10/2024	Day	Thursday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP7_24
Sheet	1 of 1	Completed	Y

Petersen Drilling Services Ltd.

Summary of Standpipe Installation

RECEIVED: 18/08/2025

Schematic Diagram (not to scale)



Installation Details

Standpipe diameter (id)	50	mm
Borehole diameter	120	mm
Slot size	1	mm
Geosock	No	
Gas tap	Single	
Filter type	Gravel	
Type of cover	Upright	
Initial reading	0.00	m
Time of Initial reading	1930	hhmm

	Base (m)	Top (m)
Concrete	0.50	GL
Gravel drainage	22.00	0.50
Borehole seal top	29.00	22.00
Filter zone	42.00	29.00
Plain pipe	30.00	GL
Slotted zone	42.00	30.00
Base of borehole	42.00	

Remarks

2nd bentonite seal 6 to 4m

Rig type	Knebel HY79	**Project Title**			
Drilling Crew Details		Bennettsbridge Limestone			
Support Operative	John Whyte				
Lead Driller	Stephan Petersen	**Project No**		35/24	
Site category	Green	**Day**	Thursday	**Date**	October 3, 2024
Engineer				**Borehole Number**	
Lead Driller's signature				**SP7_24**	

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	25.00		0000		100	grey											0.00	Dry
0.20	Firm to stiff brown very sandy gravelly high cobble content CLAY frequent limestone fracments possible highly weathered rock																						
0.70	Weak highly weathered grey LIMESTONE with frequent and clay infill																						
2.10	Medium strong to Strong dark greyish black LIMESTONE occasional fractures and kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1350			
Finish time (hhmm)	**Hole (m)**	**Water (m)**	**Casing (m)**
1715	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	2.30					Sim. Casing			
RO	154.00	0.00	2.30				DTH Button Bit		115	Air	No
RO	120.00	2.30	25.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)
Arisings	25.00	0.00

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1350		CAT Scanned: Yes
1350		Permit Completed: Yes
		DREM (11.50m - 11.80m): minor fractured zone

SPT I.D. Number	PD1	**Calibration Date**	01/02/2021
SPT Rod Type	2 3/8 Regular	**SPT Energy Ratio**	0.00
Drilling Crew Details			**CSCS No**
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	**Project No**	35/24
Date	17/10/2024	**Day**	Thursday
Rig type	**Knebel HY79**	**Borehole Number**	
Inclination		**Orientation**	SP 11_24
Sheet	1 of 1	**Completed**	Y

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Soft to firm brown TOPSOIL		RO		0.00	21.00		0000		100	grey											0.00	Dry
0.20	Firm to stiff brown silty sandy CLAY frequent limestone fracments																						
1.60	Weak to Medium strong dark grey blackish occasional weathered LIMESTONE with occasional clay filled fractures																						
5.00	Medium strong to Strong dark greyish black LIMESTONE rare fractures occasional kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
0750			
Finish time (hhmm)	Hole (m)	Water (m)	Casing (m)
1015	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	2.20					Sim. Casing			
RO	154.00	0.00	2.20				DTH Button Bit		115	Air	No
RO	120.00	2.20	21.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)
Arisings	21.00	0.00

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
0750		CAT Scanned: Yes
0750		Permit Completed: Yes

SPT I.D. Number	PD1	Calibration Date	01/02/2021
SPT Rod Type	2 3/8 Regular	SPT Energy Ratio	0.00
Drilling Crew Details			CSCS No
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	Project No	35/24
Date	17/10/2024	Day	Thursday
Rig type	Knebel HY79	Borehole Number	
Inclination		Orientation	SP13_24
Sheet	1 of 1	Completed	Y

Petersen Drilling Services Ltd. on behalf of BBL — Rotary Drilling Log

RECEIVED: 18/08/2025

Depth of Stratum Top (m)	Driller's Stratum Description	Sample / Hole / Test Details: No	Type	Insitu test	From (m)	To (m)	Liner Dia (mm)	Drilling Details: Core run time (hhmm)	Total core Recovery (m)	Flush Return %	Flush Colour	Standard Penetration Test: Self Weight Pen (mm)	75 mm	150 mm	Seating Pen (mm)	75 mm	150 mm	225 mm	300 mm	Main Pen (mm)	N value	Casing Depth (m)	Water/ flush level (m)
0.00	Firm brown TOPSOIL		RO		0.00	46.00		0000		100	grey											0.00	Dry
0.50	Weak grey weathered LIMESTONE occasional fractures with clay infill																						
4.10	Medium strong blackish dark grey LIMESTONE with very frequent fractures slight clay infill occasional kalside veins																						
15.00	Medium strong to Strong dark greyish black LIMESTONE occasional fractures and kalside veins																						

Shift details

Start time (hhmm)	Hole (m)	Water (m)	Casing (m)
1015			
Finish time (hhmm)	**Hole (m)**	**Water (m)**	**Casing (m)**
1350	0.00		

Drilling Equipment Details

Casing (C) Open Hole (RO) Coring (RC)	Dia. (mm)	From (m)	To (m)	Barrel	Liner Type	Core Dia (mm)	Bit Type	Casing Type	Bit serial No	Flush	Polymer
C	140.00	0.00	2.10					Sim. Casing			
RO	154.00	0.00	2.10				DTH Button Bit		115	Air	No
RO	120.00	2.10	46.00				DTH Button Bit			Air	No

Ground Water Record

Time of strike	Depth Struck (m)	Casing (m)	Inflow	5 min	10 min	15 min	20 min	Depth Sealed (m)

Backfill (m)

Type	From (m)	To (m)
Arisings	46.00	0.00

Time from	Duration (hhmm)	Remarks or details of any additional testing information, Dayworks
1015		CAT Scanned: Yes
1015		Permit Completed: Yes
		DREM (3.00m - 4.10m): fractured rock zone, with some clay infill
		DREM (5.00m - 5.70m): fractured rock zone, with some clay infill

SPT I.D. Number	PD1	**Calibration Date**	01/02/2021
SPT Rod Type	2 3/8 Regular	**SPT Energy Ratio**	0.00
Drilling Crew Details			**CSCS No**
Support Operative	John Whyte		
Lead Driller	Stephan Petersen		
Site category	Green		
Project Engineer			
Lead Driller's signature			

Project Title

Bennettsbridge Limestone

Weather	Variable	**Project No**	35/24
Date	17/10/2024	**Day**	Thursday
Rig type	**Knebel HY79**	**Borehole Number**	
Inclination		**Orientation**	SP 14_24
Sheet	1 of 1	**Completed**	Y

RECEIVED: 19/08/2025

Appendix 7-6 Bedrock Permeability Report (Envirologic, 2025)

RECEIVED: 18/09/2025

APPENDIX 8: BEDROCK PERMEABILITY TESTING

1.1 INTRODUCTION

Bedrock hydraulic response testing was carried out in 7 bedrock boreholes on a greenfield site that adjoins an existing, active limestone quarry. The site is located within the townland of Kilree, 1.3 km northwest of Bennettsbridge and 6.5 km southeast of Kilkenny City. The proposed quarry extension area is currently in greenfield condition and slopes generally from west to east.

Aquifer testing was completed to achieve the following objectives:

i. Establishing the hydraulic properties of the limestone bedrock formation in terms of transmissivity and saturated hydraulic conductivity (K_{sat}), along with

ii. Progressive development of the conceptual understanding of the groundwater regime at the site.

The tests planned included:

1. Constant rate pumping test = The constant discharge test is used to determine hydraulic properties of the well, and to investigate the potential for drawdown in nearby wells. Transmissivity (T) is the rate water is transmitted through the bedrock in terms of a unit width and a unit hydraulic gradient. The aquifer's hydraulic conductivity (permeability) multiplied by the aquifer thickness provides the T value.
2. Recovery test = Analysis of groundwater levels during water level recovery after the test pumping phase allows application of formulae to further characterise properties of the subsurface targeted by the boreholes.
3. Falling head test = Analysis of groundwater levels following introduction of a 'slug' into the water column, this being a HDPE rod of known volume. The subsequent decrease in water level over time enabled the application of formulae to further characterise properties of the subsurface targeted by the boreholes..

1.2 METHODOLOGY

Seven monitoring wells were tested in total at Bennettsbridge by Envirologic personnel on the 19th - 20th of March and 8th May 2025. Small-scale pumping tests were performed at 4 of the boreholes at the site; slugs testing was utilised at the remaining three wells.

The drilled diameter of each borehole was c.120 mm and each borehole was installed with industry standard 50 mm diameter piezometric BOODE casing used for monitoring wells.

A Grundfos MP1 submersible pump was used to abstract groundwater from each wall at a rate of 0.7 - 4.5 l/min. The pump inlet was positioned as close to the base of each borehole as was feasible. Flowrates were measured manually throughout the tests. Pumping continued until the groundwater level was reduced to the pump inlet. Groundwater levels were recorded with an automatic pressure transducer type groundwater level logger at 5 second intervals during the pumping phase and for approximately 24 hours following cessation of pumping.

Field response tests to pumping and recovery were analysed using the Cooper-Jacob approach and the Bouwer-Rice method. The latter is considered to be more appropriate because not all test conditions were entirely satisfied, e.g. the achievement of steady-state pumping conditions; this is typical of Irish bedrock conditions.

General information for the installed wells is included in

Table 1, with well locations illustrated in Table 2 – Summary Pumping Test input data

RECEIVED 18/08/2025

Well ID	Pre-Test GW Level (mbtoc inner)	Pumping Rate (m^3/s)	Pumping Duration (mins)	Saturated Aquifer Thickness (m)
SP1-24	26.32	0.00005	12.50	22.38
SP2-24	28.11	0.00006	24.00	8.39
SP4-24	32.04	0.00003	9.00	3.96
SP5-24	30.84	0.00001	30.00	12.17

Table 3 – Summary Falling Head Test input data

Well ID	Pre-Test GW Level (mbtoc inner)	GW Level at start of Test (mbtoc inner)	Post-Test GW Level (mbtoc inner)	Volume Introduced
SP3-24	39.23 @ 9:24 am	38.94 @ 9.28 am	39.18 @ 9:36 am	30 l (water)
SP6-24	41.07 @ 12:26 pm	31.00 @ 12:29 pm	40.60 @ 1:46 pm	30 l (water)
SP7-24	27.81 @ 11:36 am	17.55 @ 11:40 am	27.84 @ 1:38 pm	30 l (water)

Figure 1. Summary information regarding pumping durations and pumping rates are stated in Table 2.

Groundwater level dataloggers have been installed for long-term monitoring in a number of these wells.

RECEIVED: 18/08/2025

Table 1 – Survey information for each monitoring well

Well ID	Easting (m)	Northing (m)	Ground Elevation (mOD)	Top of Inner Casing (mOD)	Top of Outer Casing (mOD)	Well Depth mbgl
SP1-24	653,858	650,249	63.26	63.63	63.67	48.7
SP2-24	654,053	649,983	60.18	60.55	60.60	36.5
SP3-24	653,812	649,978	67.93	68.44	68.46	42.5
SP4-24	653,954	649,853	60.75	61.30	61.36	36.0
SP5-24	653,782	649,628	68.28	68.66	68.71	43.0
SP6-24	653,286	649,484	76.31	76.71	76.73	52.0
SP7-24	653,765	649,187	71.20	71.55	71.64	42.0

Table 2 – Summary Pumping Test input data

Well ID	Pre-Test GW Level (mbtoc inner)	Pumping Rate (m^3/s)	Pumping Duration (mins)	Saturated Aquifer Thickness (m)
SP1-24	26.32	0.00005	12.50	22.38
SP2-24	28.11	0.00006	24.00	8.39
SP4-24	32.04	0.00003	9.00	3.96
SP5-24	30.84	0.00001	30.00	12.17

Table 3 – Summary Falling Head Test input data

Well ID	Pre-Test GW Level (mbtoc inner)	GW Level at start of Test (mbtoc inner)	Post-Test GW Level (mbtoc inner)	Volume Introduced
SP3-24	39.23 @ 9:24 am	38.94 @ 9.28 am	39.18 @ 9:36 am	30 l (water)
SP6-24	41.07 @ 12:26 pm	31.00 @ 12:29 pm	40.60 @ 1:46 pm	30 l (water)
SP7-24	27.81 @ 11:36 am	17.55 @ 11:40 am	27.84 @ 1:38 pm	30 l (water)

RECEIVED: 18/08/2025

Figure 1 – Monitoring Well Locations

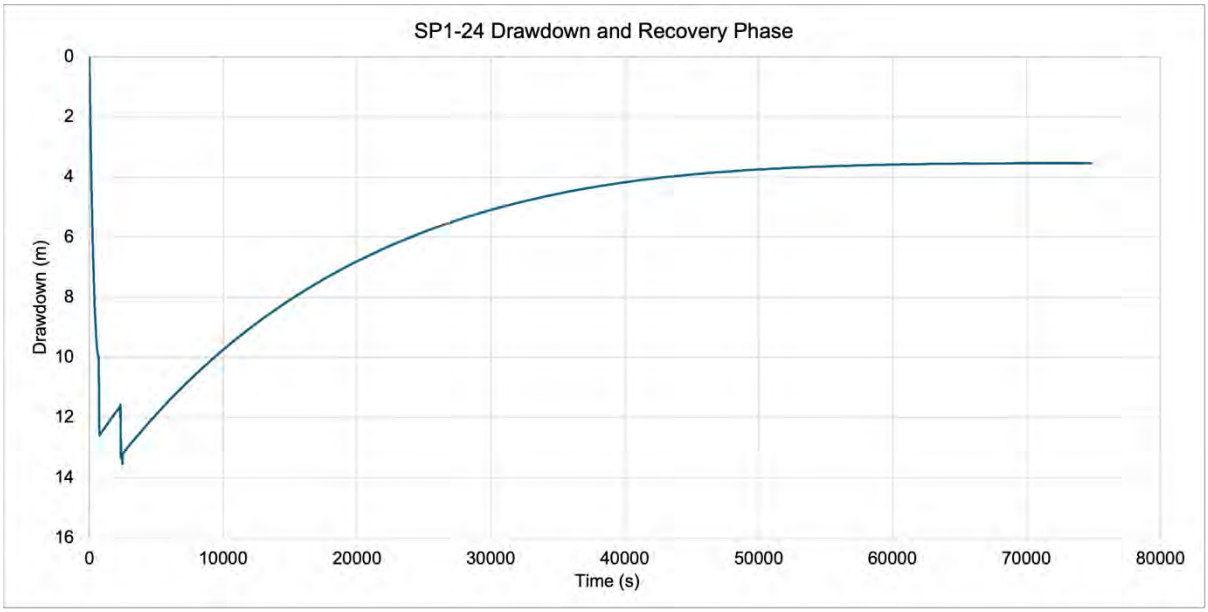
RECEIVED: 18/08/2025

2 PERMEABILITY TESTING ANALYSIS

2.1 SP1-24

Drawdown invoked during the pumping and recovery phase at SP1-24 is shown in Graph 1. The data shows that following cessation of pumping and removal of pump the water level in the borehole stabilised after approximately 17 hours.

Graph 1 – Small-scale pumping test drawdown and recovery over time at SP1-24



2.1.1 Pumping Phase

Drawdown of 12.58 m was reached over a pumping period of 12.5 minutes and steady-state drawdown conditions were not reached by the time water level had reached the pump inlet. The volume of water in the HDPE casing (50 mm) prior to start of test was 44 L. Approximately 37.5 L was removed by pumping. From Graph 1 the straight-line nature of drawdown over such a short timeframe suggests that the borehole was merely dewatered by pumping and that there was negligible recharge to the well during this phase.

Drawdown was plotted against time on a log scale (Graph 2) which shows drawdown over one log cycle to be 8.01 m.

Graph 2 – SP1-24 small-scale pumping test drawdown plotted against time on a log scale

RECEIVED: 18/08/2025

Transmissivity can be calculated using the Cooper-Jacob Method (Cooper & Jacob, 1946):

$$T = (2.30\ Q) / (4\ \pi\ \Delta s)$$

where: Q = discharge = 0.00005 m^3/s

Δs = drawdown over one log cycle = x – y (60 - 600 secs) = 8.01 m

$$T = \frac{2.3 \times 0.00005}{4 \times \pi\ (8.01)}$$

$$T = 1.14 \times 10^{-6}\ m^2/s$$

$$T = 0.098\ m^2/d$$

The saturated thickness for the screen section of well SP1-24 was 22.38 m at the start of testing, resulting in a hydraulic conductivity value for the pumping phase of:

$$K = T / \text{Saturated Thickness}$$

$$= 0.098\ m^2/d / 22.38\ m$$

$$K = 0.00440\ m/d$$

$$K = 5.10 \times 10^{-8}\ m/s$$

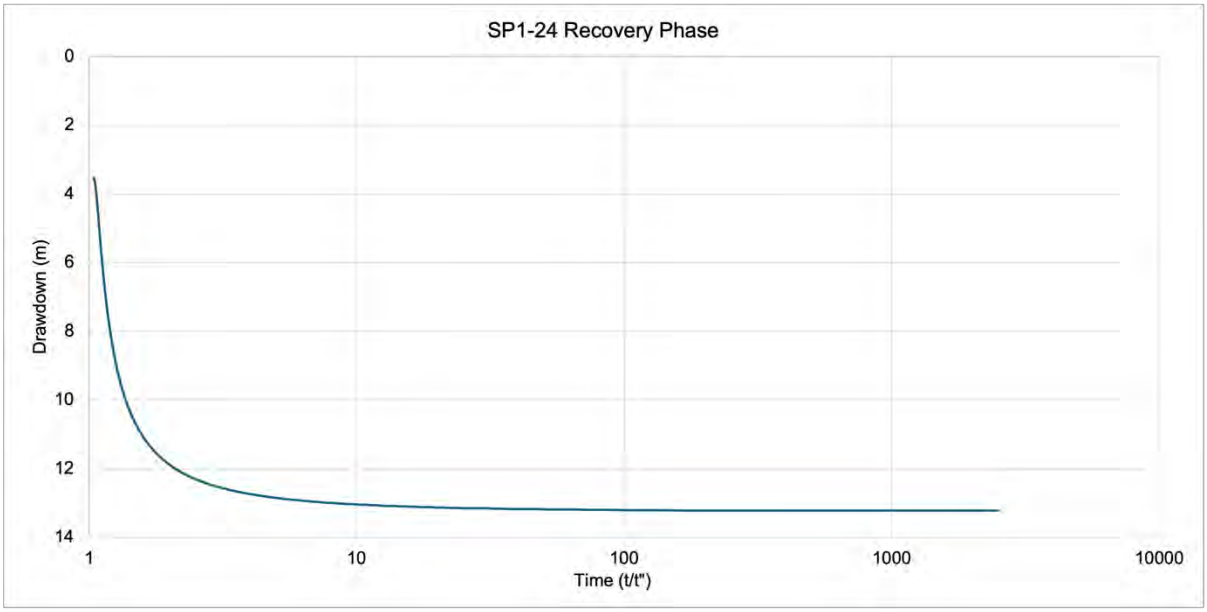
RECEIVED: 19/08/2025

2.1.2 Recovery Phase

Groundwater level recovery at SP1-24 was monitored following the end of the constant rate test. The response of residual drawdown recovered to stable levels 20 hours following cessation of pumping

The recovery drawdown when plotted against t/t" on a log scale is shown in Graph 3**Error! Reference source not found.** (where t = time since start of pumping and t'' = time since cessation of pumping).

Graph 3 – SP1-24 small-scale pumping test recovery plotted against time on a log scale



Given the slug-like nature of water removal during pumping the Bouwer-Rice Method was considered the most suitable method to estimate aquifer properties. This procedure involves calculating the difference in water level after cessation of the pumping phase (i.e. recovery) for a fixed time step (i.e. 5 seconds). The log of the change in drawdown (ht) is plotted against time (s) and a tangent is fitted to the curve. Using the slope of this tangent along with variables such as well depth, well radius, screen depth and distance from the base of the well to the screened section, a hydraulic conductivity value is calculated.

Bouwer-Rice analysis yielded the following hydraulic conductivity value:

$$K = \left(\frac{(r_c{}^2)(\ln(\frac{Re}{rw}))}{2Le}\right)\left(\frac{1}{t}\right)\ln\left(\frac{Y_0}{Y_t}\right)$$

K = 0.00574 m/d

K = 6.64 x 10^{-9} m/s

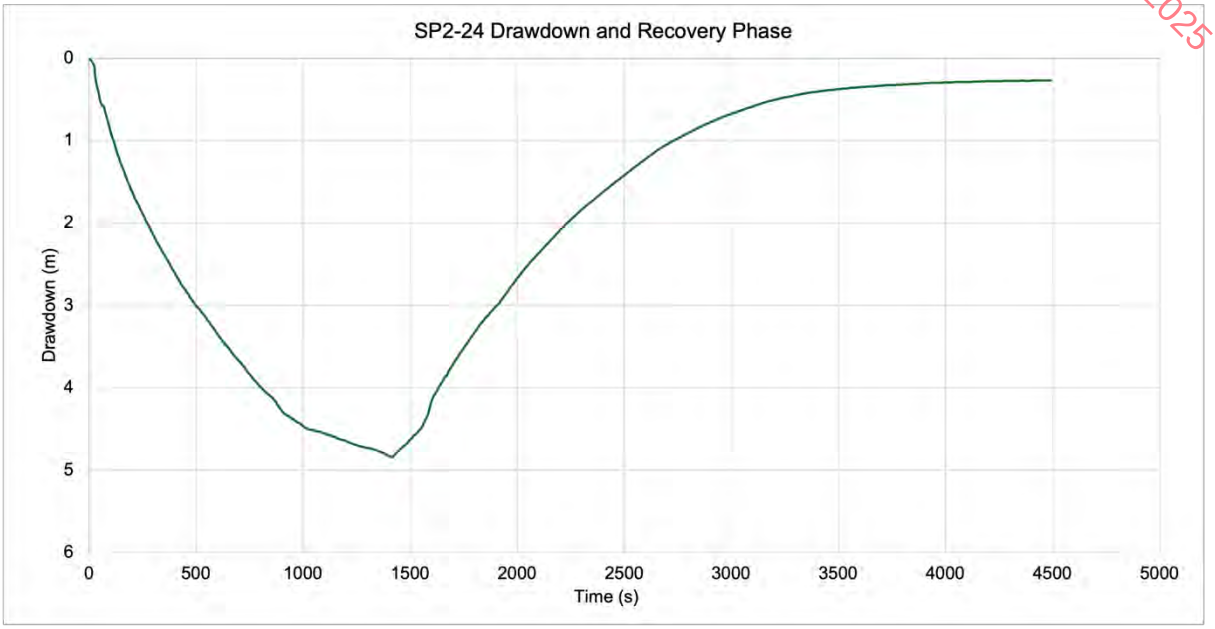
The above results correspond with the drilling log which suggests that the bedrock tested at SP1-24 is a competent, massive strong limestone. No significant water bearing zones, or potentially transmissive features were encountered during drilling. Weathered limestone with frequent clay infill zones were noted in the upper 2.3 m of the borehole though this layer is unsaturated. The rapid drawdown and slow recovery of water levels during testing is indicative of low permeability in the surrounding bedrock, correlating with the calculated permeability values.

RECEIVED: 18/08/2025

2.2 SP2-24

Drawdown invoked during the pumping and recovery phase is shown in Graph 4. The data shows that the water level reached the pump inlet after 24 minutes of pumping. During the recovery phase, water levels stabilised 0.27 m below pre-test water levels after 75 minutes.

Graph 4 – SP2-24 small-scale pumping test drawdown and recovery over time



2.2.1 Pumping Phase

Drawdown of 4.83 m was observed over a pumping period of 24 minutes. Steady-state conditions were close to being achieved. Drawdown was plotted against time on a log scale which showed drawdown over one log cycle as being equivalent to 12.43 m (Graph 5).

Transmissivity can be calculated using the Cooper Jacob's Method (Cooper & Jacob, 1946):

$$T = (2.30\ Q) / (4\ \pi\ \Delta s)$$

where: Q = discharge = 0.00006 m^3/s

Δs = drawdown over one log cycle = x – y (100 - 1000 secs) = 3.58 m

$$T = \frac{2.3 \times 0.00006}{4 \times \pi\ (3.58)}$$

$$T = 2.98 \times 10^{-6}\ m^2/s$$

$$T = 0.25\ m^2/d$$

Given the saturated thickness of well SP2-24 was 8.39 m at the start of testing. The hydraulic conductivity value of the well arrived at for the pumping period is obtained from:

$$K = \frac{T\ (m^2/d)}{\text{Saturated Thickness (m)}}$$

RECEIVED: 18/08/2025

$$= \frac{0.25}{8.39}$$

K = 0.0306 m/d

K = 3.55 x 10^{-7} m/s

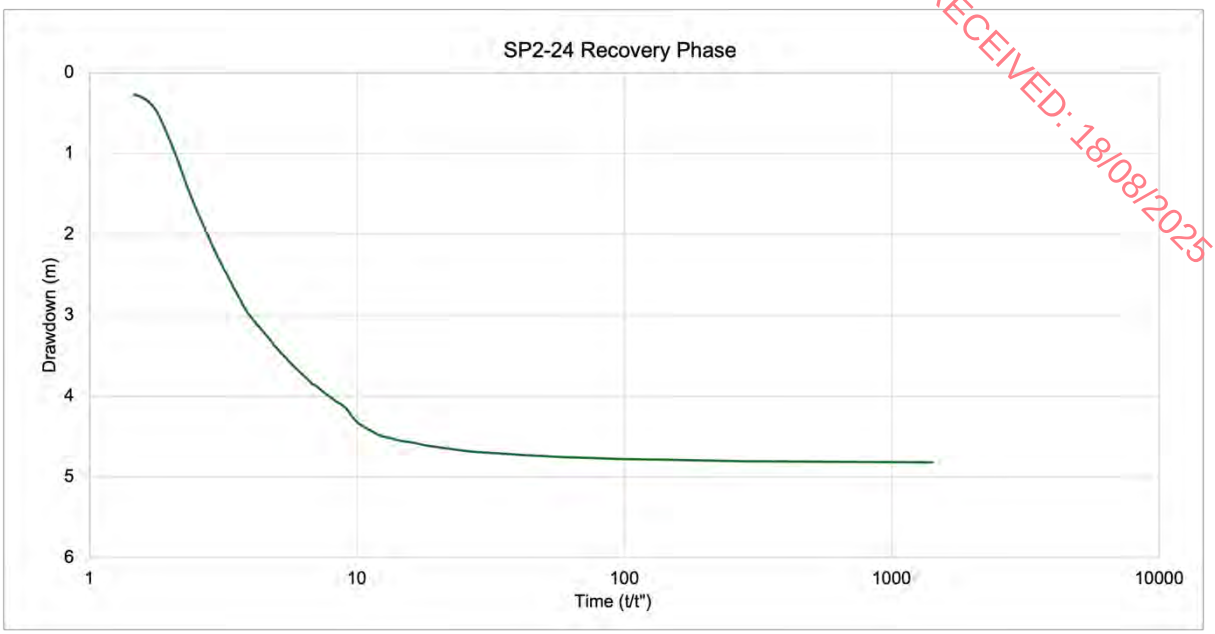
Graph 5 – SP2-24 small-scale pumping test drawdown plotted against time on a log scale

2.2.2 Recovery Phase

Groundwater level recovery at SP2-24 was monitored after the end of the constant rate test. The response of residual drawdown stabilised after 75 minutes. The recovery curve is shown in Graph 6**Error! Reference source not found.**.

Graph 6 – SP2-24 small-scale pumping test recovery plotted against time on a log scale

RECEIVED: 18/08/2025



Permeability analysis was performed on water levels recorded during the recovery period using the Cooper-Jacob method:

$$T = (2.30\ Q) / (4\ \pi\ \Delta s)$$

where: Q = discharge = 0.00006 m^3/s

Δs = recovery over one log cycle = x – y (100 - 1000 secs) = 2.99 m

$$T = \frac{2.3 \times 0.00006}{4 \times \pi\ (2.99)}$$

$$T = 3.57 \times 10^{-6}\ m^2/s$$

$$T = 0.31\ m^2/d$$

Given the saturated thickness of well SP2-24 was 8.39 m at the start of testing. The hydraulic conductivity value of the well arrived at for the recovery period is obtained from:

$$K = \frac{T\ (m^2/d)}{\text{Saturated Thickness (m)}}$$

$$= \frac{0.31}{8.39}$$

$$K = 0.0367\ m/d$$

$$K = 4.25 \times 10^{-7}\ m/s$$

The above results correspond with the drilling log which suggests that the bedrock tested at SP2-24 is a more locally fractured region of bedrock. Highly weathered limestone with clay infills were reported between 0.5 m and

7.8 m depth. A 3 m unit of clay was also encountered at 9.4 m depth. A clay laden fault infill strata was encountered at 15.5 m depth.

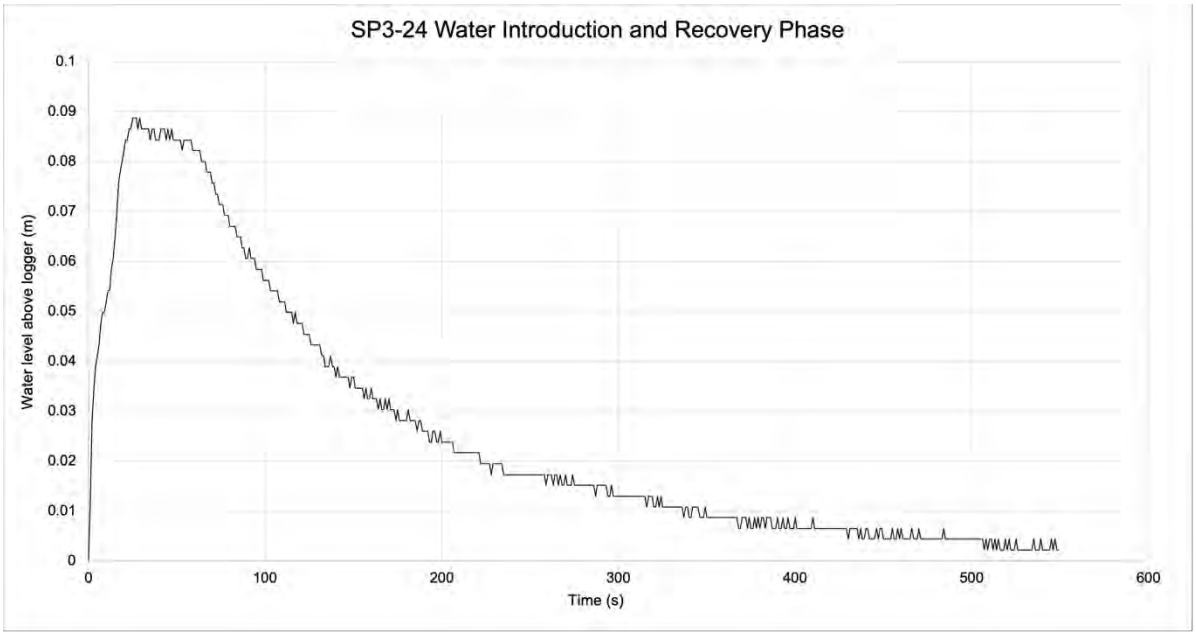
The variability with respect to depth encountered in borehole SP2-24, along with the high occurrence of clay infill and fault infill zones may be indicative of potentially transmissive features. The slightly quicker recovery of water levels following pumping is indicative of medium permeability in the surrounding bedrock, correlating with the calculated permeability values.

RECEIVED: 18/08/2025

2.3 SP3-24

Due to the shallow depth of groundwater in SP3-24, it was deemed suitable to carry out a falling head test to derive bedrock permeability values. Thirty litres of water was introduced rapidly, and a pressure transducer logging at 1 s intervals recorded water levels as they returned to pre-test levels. The introduction and recovery phases are shown in Graph 7. Approximately 9 minutes after the introduction of water, water levels had returned to pre-test levels.

Graph 7 – SP3-24 falling head and recovery test over time

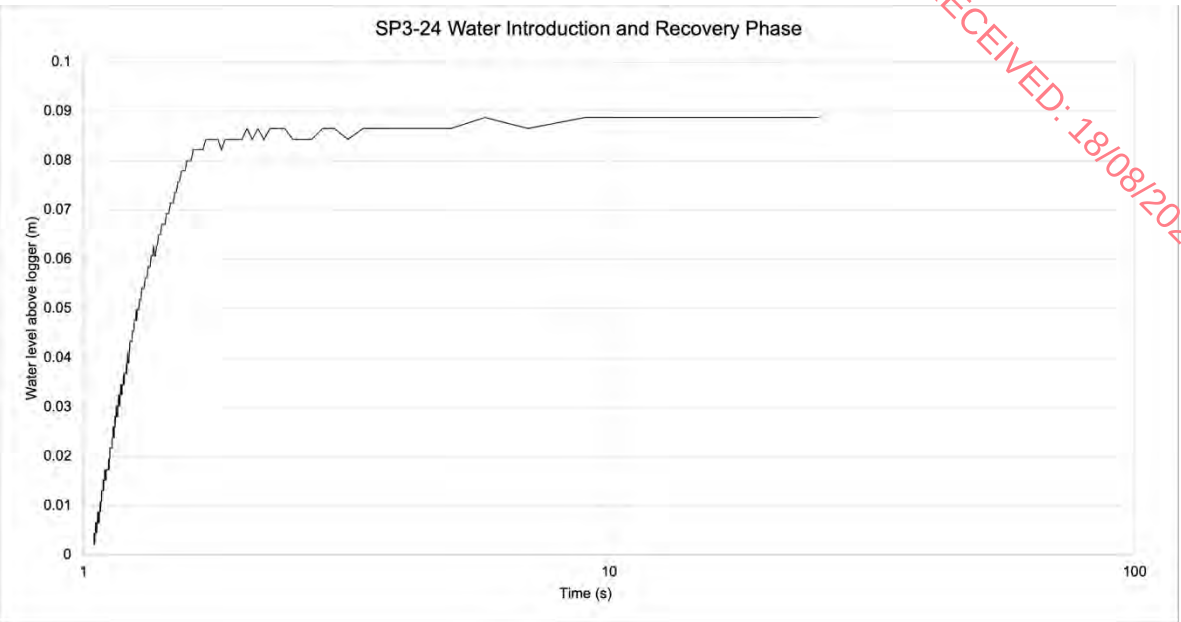


2.3.1 Recovery Phase

Groundwater level recovery at SP3-24 was monitored following introduction of 30 litres of water into the borehole. The Bouwer-Rice Method was used to estimate aquifer properties. The log of the change in water level (h_t) was plotted against time (s) and a tangent fitted to the curve. Using the slope of this tangent along with variables such as well depth, well radius, screen depth and distance from the base of the well to the screened section, a hydraulic conductivity value was calculated. The recovery curve is shown in Graph 8.

Graph 8 - SP6-24 small-scale falling head test recovery plotted against time on a log scale

RECEIVED: 18/08/2025



Permeability was calculated by application of the Bouwer Rice method to drawdown levels recorded during the recovery period.

$$K = \left(\frac{(r_c{}^2)(\ln(\frac{Re}{rw})}{2Le}\right)\left(\frac{1}{t}\right)\ln\left(\frac{Y_0}{Y_t}\right)$$

K = 0.093 m/d

K = 1.07 x 10^{-6} m/s

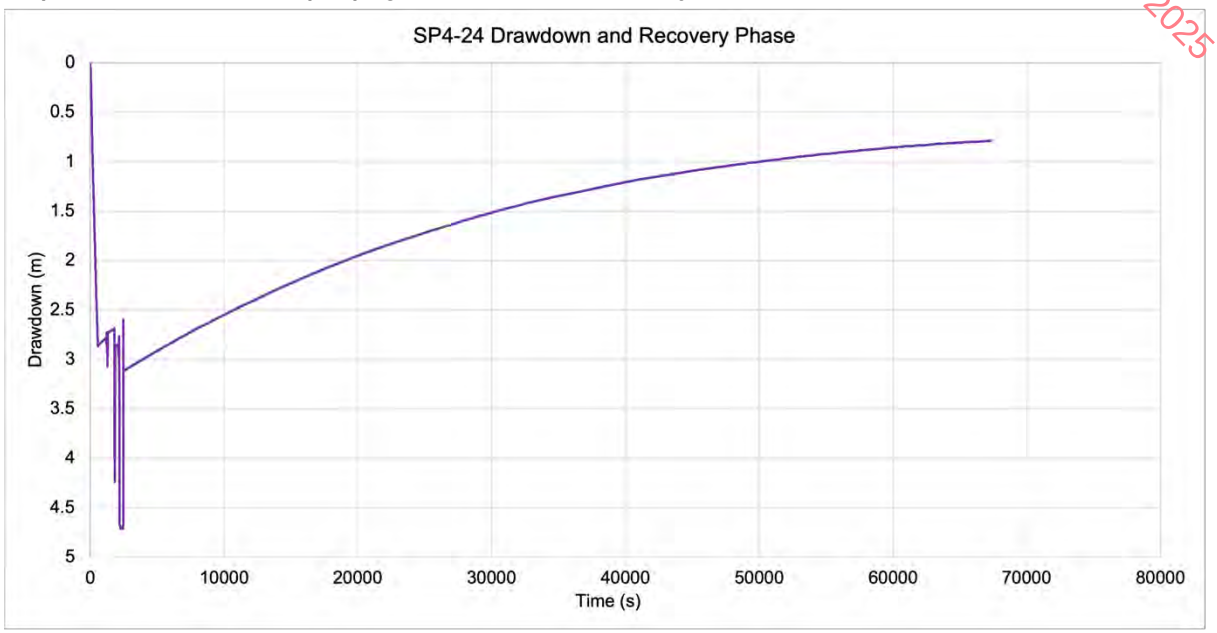
The above permeability value derived from a falling head test corresponds with the bedrock encountered during drilling. Four clay infilled fractured zones were encountered between 19.50 m to 37.50 m depth. An attempt at pumping SP3-24 was made on the 19th of March, but was abandoned due to the pumps inability at 40 m depth. The multiple potentially transmissive zones encountered in this borehole correlate with the highest permeability value derived from all the boreholes investigated.

2.4 SP4-24

RECEIVED: 18/08/2025

Drawdown invoked during the pumping and recovery phase is shown in Graph 9. The noise in logger level recordings between 560 and 2480 seconds is attributed to the removal of the pump from the slotted screen of the well. Calculations did not include this period of the test when deriving hydraulic conductivity values.

Graph 9 – SP4-24 small-scale pumping test drawdown and recovery over time



2.4.1 Pumping Phase

Drawdown of 2.87 m was reached over a pumping period of 9 minutes. Drawdown was plotted against time on a log scale which showed drawdown over one log cycle as being equivalent to 2.38 m (Graph 10).

Graph 10 – SP4-24 small-scale pumping test drawdown plotted against time on a log scale

RECEIVED: 18/08/2025

Transmissivity was initially calculated using the Cooper Jacob's Method (Cooper & Jacob, 1946):

$$T = (2.30\ Q) / (4\ \pi\ \Delta s)$$

where: Q = discharge = 0.00003 m^3/s

Δs = drawdown over one log cycle = x – y (50 - 500 secs) = 2.38 m

$$T = \frac{2.3 \times 0.00003}{4 \times \pi\ (2.38)}$$

$$T = 2.3 \times 10^{-6}\ m^2/s$$

$$T = 0.19\ m^2/d$$

Considering the saturated thickness for the screen section of well SP4-24 was 3.96 m at the time of testing, the hydraulic conductivity value of the well arrived at for the pumping period is;

$$K = \frac{T\ (m^2/d)}{\text{Saturated Thickness (m)}}$$

$$= \frac{0.19}{3.96}$$

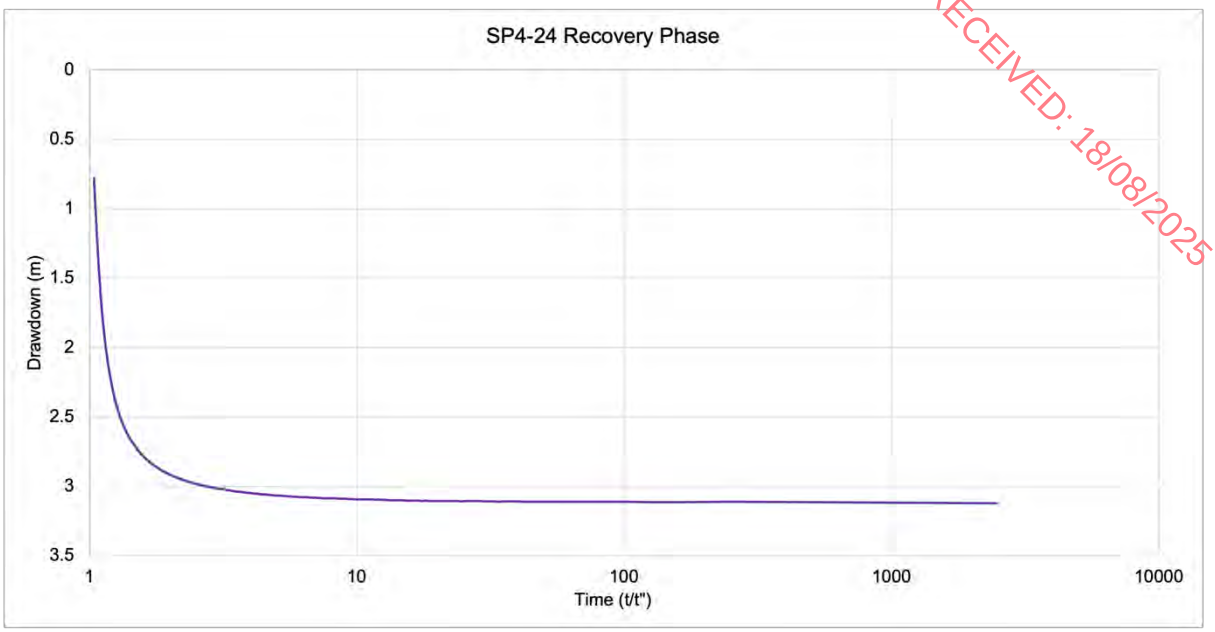
$$K = 0.05\ m/d$$

$$K = 5.8 \times 10^{-7}\ m/s$$

2.4.2 Recovery Phase

Groundwater level recovery at SP4-24 was monitored at the end of the constant rate test. The response of residual drawdown recovered to within 0.7 m of pre-test levels over the 19 hours for which it was monitored. The Bouwer-Rice Method was used to estimate aquifer properties. This procedure involved calculating the difference in water level from the cessation of the pumping phase for a fixed time step (5s). The log of the change in water level (ht) is plotted against time (s) and a tangent is fitted to the curve. Then, using the slope of this tangent along with variables such as well depth, well radius, screen depth and distance from the base of the well to the screened section, a hydraulic conductivity value is calculated. The recovery curve is shown in Graph 11.

Graph 11 – SP4-24 small-scale pumping test recovery plotted against time on a log scale



RECEIVED: 18/08/2025

Permeability was calculated by application of the Bouwer-Rice method to drawdown levels recorded during the recovery period.

$$K = \left(\frac{(r_c{}^2)(\ln(\frac{Re}{rw}))}{2Le}\right)\left(\frac{1}{t}\right)\ln\left(\frac{Y_0}{Y_t}\right)$$

K = 0.00022 m/d

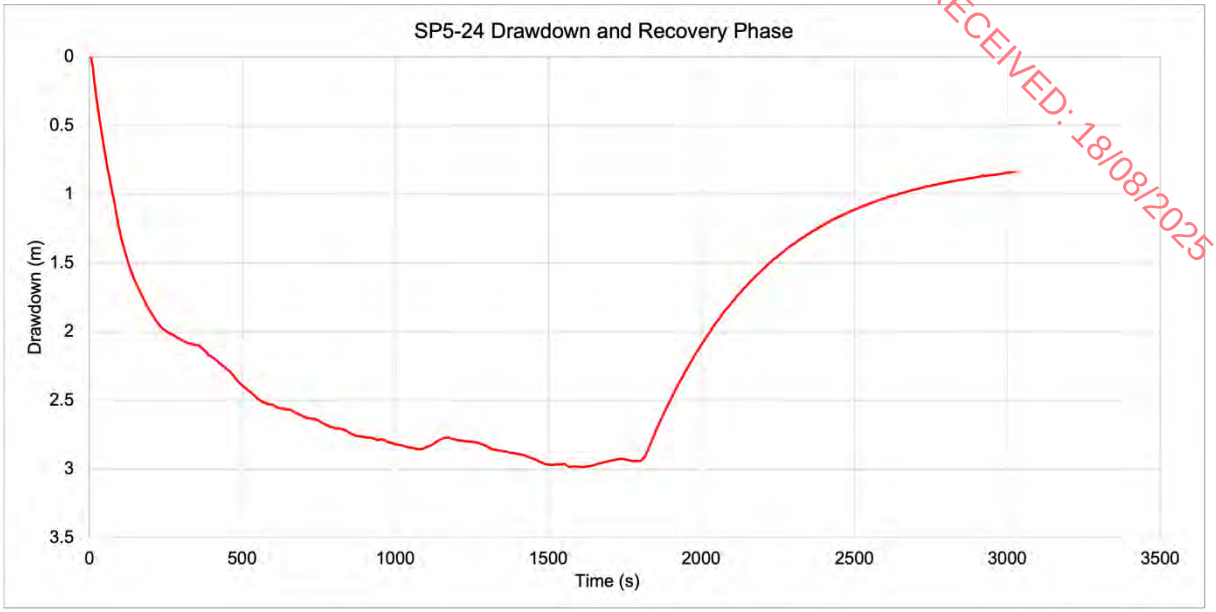
K = 2.615 x 10^{-9} m/s

This discrepancy between the K value derived from drawdown phase analysis versus K value derived from recovery phase is attributed to the lack of water available (saturated depth) in the borehole to confidently complete drawdown analysis on the surrounding bedrock. The K value derived from drawdown phase analysis is therefore considered to be slightly erroneous and precedence is instead given to the K-value derived from recovery phase data for SP4-24. The drilling log corresponds with the above permeability values, as only two minor fractures were recorded at 20.5 m and 33.4 m depth. Apart from this, strong limestone was recorded below 3.5 m depth.

2.5 SP5-24

Drawdown invoked during the pumping and recovery phase is shown in Graph 12. The water level in SP5-24 returned to within 0.8 m of the water level prior to pumping after 50 minutes. Water level prior to pumping was 30.83 mbtoc and as the drawdown phase progressed, the pumping rate decreased due to the pumps lift capacity at such depths.

Graph 12 – SP5-24 small-scale pumping test drawdown and recovery over time



RECEIVED: 18/08/2025

2.5.1 Pumping Phase

Drawdown of 2.94 m was observed over a pumping period of 30 minutes. The removal of water from the well screen was rapid, but levelled out after 18 minutes. Drawdown was plotted against time on a log scale which showed drawdown over one log cycle as being equivalent to 1.54 m (Graph 13). Transmissivity can be calculated using the Cooper Jacob's Method (Cooper & Jacob, 1946):

$$T = (2.30\ Q) / (4\ \pi\ \Delta s)$$

where: Q = discharge = 0.00001 m^3/s

Δs = drawdown over one log cycle = x – y (100 - 1000 secs) = 1.54 m

$$T = \frac{2.3 \times 0.00001}{4 \times \pi\ (1.54)}$$

$$T = 1.55 \times 10^{-6}\ m^2/s$$

$$T = 0.13\ m^2/d$$

Given the saturated thickness of well SP5-24 was 12.16 m at the start of testing. The hydraulic conductivity value of the well arrived at for the pumping period is obtained from:

$$K = \frac{T\ (m^2/d)}{\text{Saturated Thickness (m)}}$$

$$= \frac{0.13}{}$$

12.16

K = 0.011 m/d

K = 1.27 x 10^{-7} m/s

RECEIVED: 18/08/2025

Graph 13 – SP5-24 small-scale pumping test drawdown plotted against time on a log scale

2.5.2 Recovery Phase

Groundwater level recovery at SP5-24 was monitored at the end of the constant rate test. The response of residual drawdown recovered to within 0.8 m of the pre pumping water level after 50 minutes. The recovery curve is shown in Graph 14. Permeability analysis was performed on water levels recorded during the recovery period using the Cooper-Jacob method:

$$T = (2.30\ Q) / (4\ \pi\ \Delta s)$$

where: Q = discharge = 0.00001 m^3/s

Δs = recovery over one log cycle = x – y (100 - 1000 secs) = 1.64 m

$$T = \frac{2.3 \times 0.00001}{4 \times \pi\ (1.64)}$$

T = 1.45 x 10^{-6} m^2/s

T = 0.12 m^2/d

Given the saturated thickness of well SP5-24 was 12.16 m at the start of testing. The hydraulic conductivity value of the well arrived at for the recovery period is obtained from:

$$K = \frac{T\ (m^2/d)}{\text{Saturated Thickness (m)}}$$

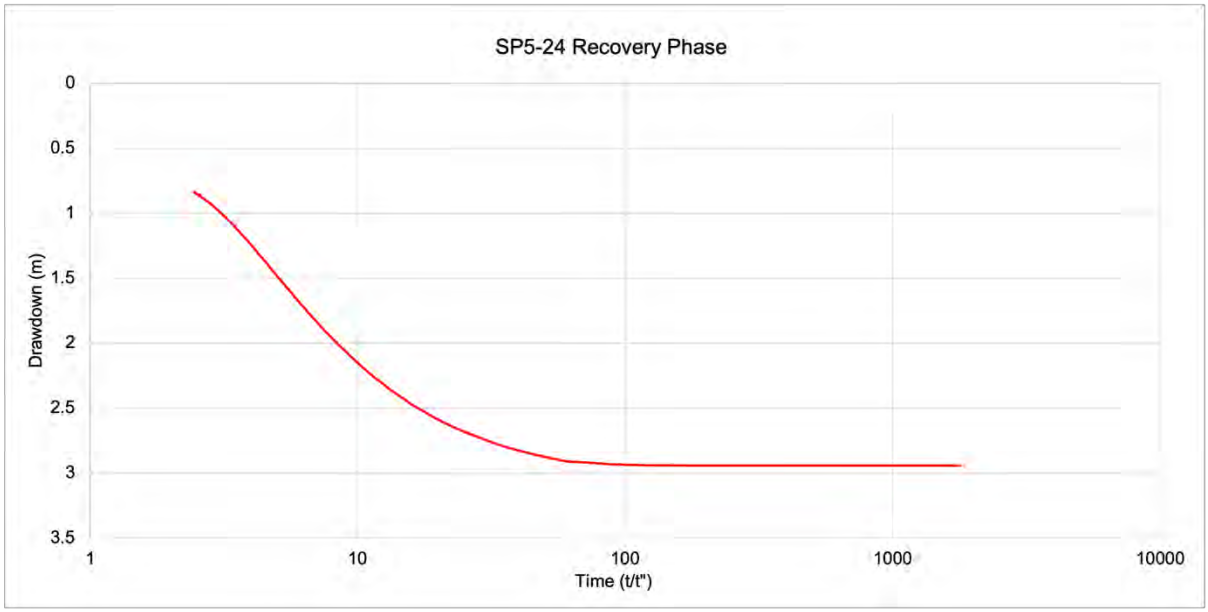
RECEIVED: 18/08/2025

$$= \frac{0.12}{12.16}$$

K = 0.0103 m/d

K = 1.19 x 10^{-7} m/s

Graph 14 – SP5-24 small-scale pumping test recovery plotted against time on a log scale



The above permeability results correspond with the drilling log which suggests that the bedrock tested at SP5-24 is a locally fractured region of bedrock. Highly weathered limestone with clay infills were reported between 0.4 m and 3.5 m depth. Occasional fractures were noted from 3.5 m to 43 m depth. A 0.4 m clay infill zone was recorded at 19.8 m depth.

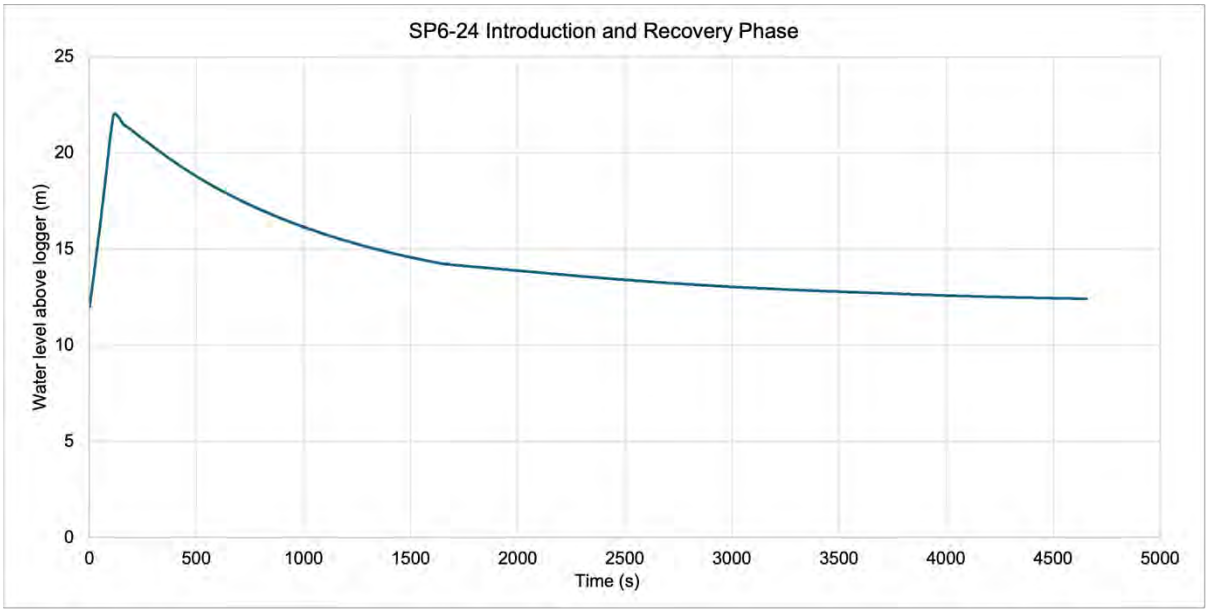
The rapid drawdown and recovery of water levels during testing is indicative of medium permeability in the surrounding bedrock, correlating with the calculated permeability values.

2.6 SP6-24

RECEIVED: 28/08/2025

Due to the shallow depth of groundwater in SP6-24, it was deemed suitable to carry out a falling head test to derive bedrock permeability values. Thirty litres of water was introduced rapidly, and a pressure transducer logging at 1 s intervals recorded water levels as they returned to pre-test levels. The introduction and recovery phases are shown in Graph 15. Approximately one hour after the introduction of water, water levels had returned to within 0.47 m of pre-test levels.

Graph 15 – SP6-24 falling head and recovery test over time

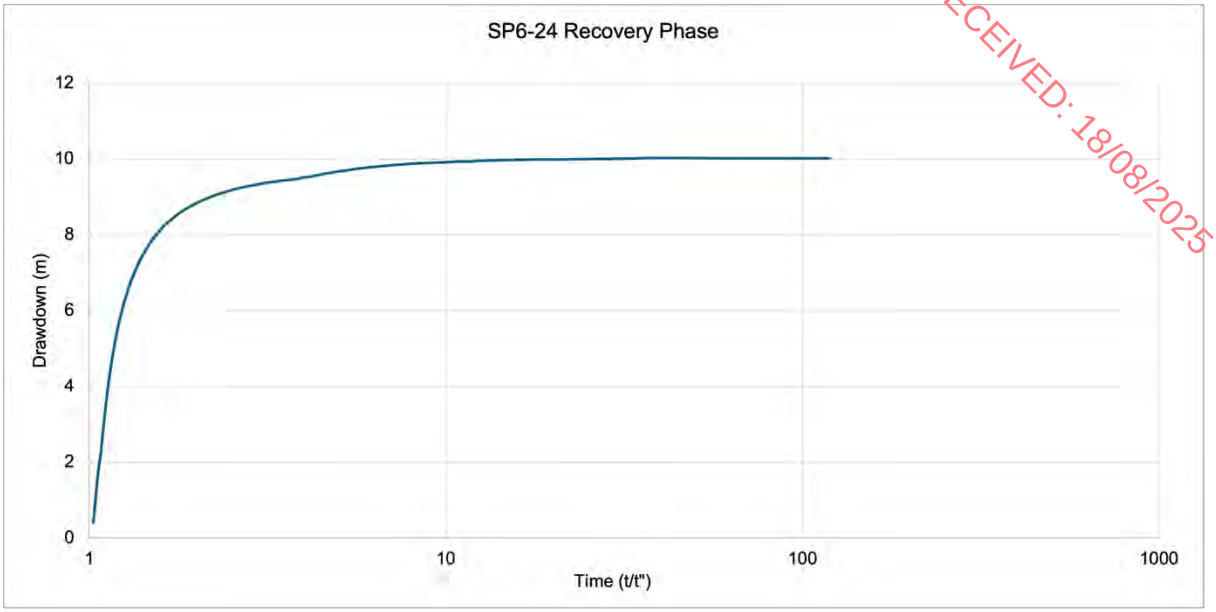


2.6.1 Recovery Phase

Groundwater level recovery at SP6-24 was monitored following introducing 30 litres of water into the borehole. The Bouwer-Rice Method was used to estimate aquifer properties. The log of the change in water level (h_t) was plotted against time (s) and a tangent fitted to the curve. Using the slope of this tangent along with variables such as well depth, well radius, screen depth and distance from the base of the well to the screened section, a hydraulic conductivity value was calculated. The recovery curve is shown in Graph 16.

Graph 16 – SP6-24 small-scale falling head test recovery plotted against time on a log scale

RECEIVED: 18/08/2025



Permeability was calculated by application of the Bouwer Rice method to drawdown levels recorded during the recovery period.

$$K = \left(\frac{(r_c{}^2)(\ln(\frac{Re}{rw}))}{2Le}\right)\left(\frac{1}{t}\right)\ln\left(\frac{Y_0}{Y_t}\right)$$

K = 0.00112 m/d

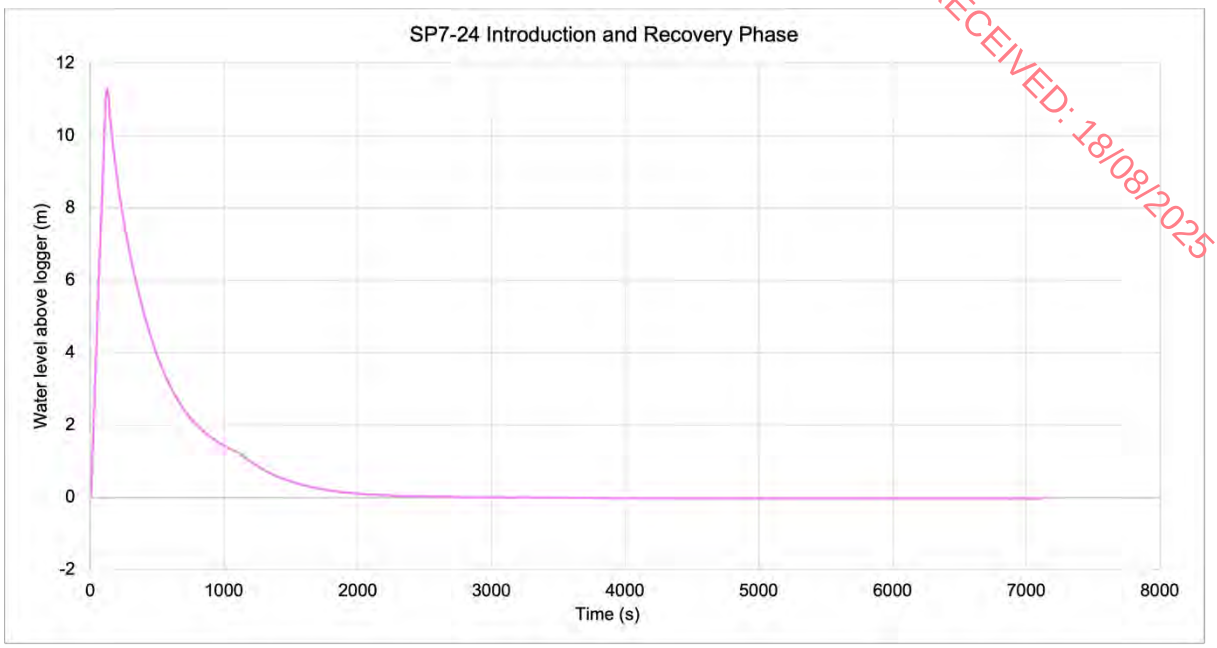
K = 1.29 x 10^{-8} m/s

The above permeability value derived from a falling head test corresponds with the largely homogenous bedrock encountered during drilling. A minor 0.3 m fractured zone was observed at 49.5 m depth. There were no other potentially transmissive features encountered.

2.7 SP7-24

Due to the depth of water in SP7-24, it was deemed suitable to carry out a falling head test to determine bedrock permeability. The introduction and recovery phases are shown in Graph 17. Two hours after the introduction of water, water levels had returned to pre-test levels.

Graph 17 – SP7-24 falling head and recovery test over time



RECEIVED: 18/08/2025

2.7.1 Recovery Phase

The Bouwer-Rice Method was used to estimate aquifer properties. This procedure involved calculating the difference in water level following the introduction phase for a fixed time step (1 second). The log of the change in water level (h_t) is plotted against time (s) and a tangent is fitted to the curve. Then, using the slope of this tangent along with variables such as well depth, well radius, screen depth and distance from the base of the well to the screened section, a hydraulic conductivity value is calculated. The recovery curve is shown in Graph 18.

Permeability was calculated by application of the Bouwer Rice method to drawdown levels recorded during the recovery period.

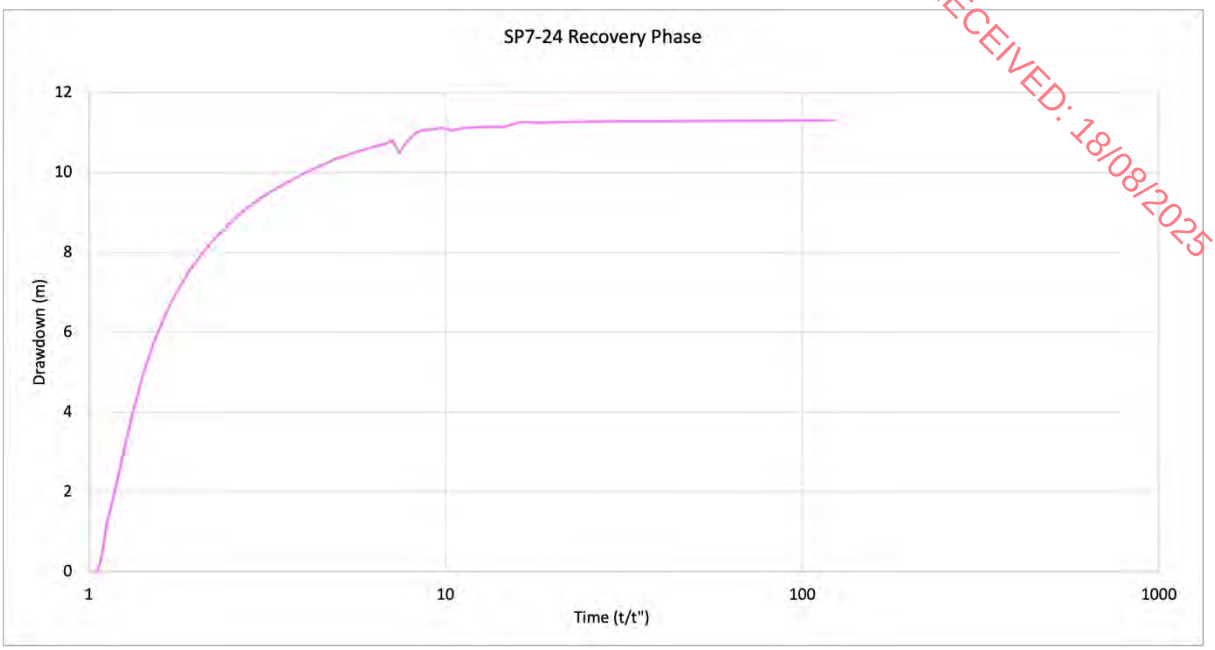
$$K = \left(\frac{(r_c{}^2)(\ln(\frac{Re}{rw}))}{2Le}\right)\left(\frac{1}{t}\right)\ln\left(\frac{Y_0}{Y_t}\right)$$

K = 0.00069 m/d

K = 8.05 x 10^{-9} m/s

Graph 18 – SP7-24 small-scale pumping test recovery plotted against time on a log scale

RECEIVED: 18/08/2025



The above results correspond with the drilling log which suggests that the bedrock tested at SP7-24 is a competent, massive strong limestone.

2.8 SUMMARY

RECEIVED: 28/08/2025

The results from bedrock permeability testing at seven monitoring boreholes in a greenfield area adjoining the active bedrock quarry at Bennettsbridge Limestone Quarries are summarised below in Table 4. Analysis of the pumping phase data using the Cooper-Jacob approach may not be entirely appropriate at all wells as necessary criteria were not always satisfied (e.g. achievement of steady-state pumping conditions). Where steady-state conditions were not achieved the Bouwer-Rice method was considered to be more appropriate.

In terms of practical water management at quarries bedrock hydraulic conductivity values of the order of 10^{-8} to 10^{-10} m/s can essentially be regarded as impermeable and groundwater inflows to the void are likely to be negligible.

Table 4 – Summary bedrock permeability data

Well ID	Test Phase	Bedrock K, m/s
SP1-24	Pumping	5.1×10^{-8}
	Recovery	**6.6×10^{-9}**
SP2-24	Pumping	3.6×10^{-7}
	Recovery	**4.3×10^{-8}**
SP3-24	Pumping	**1.1×10^{-6}**
SP4-24	Pumping	5.8×10^{-7}
	Recovery	**2.5×10^{-9}**
SP5-24	Pumping	1.3×10^{-7}
	Recovery	**1.2×10^{-7}**
SP6-24	Falling Head	**1.3×10^{-8}**
SP7-24	Falling Head	**8.1×10^{-9}**