AGP18019_03

REPORT
ON THE
GEOPHYSICAL INVESTIGATION
FOR THE
GREENLINK INTERCONNECTOR,
CO. WEXFORD
FOR
GREENLINK INTERCONNECTOR LTD.

26TH APRIL 2019

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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	AGP18019		
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1. EXECUTIVE SUMMARY

APEX Geophysics Limited was requested by ARUP on behalf of Greenlink Interconnector Ltd. to carry out a geophysical survey for the proposed Greenlink Interconnector on the Hook Head Peninsula in Co Wexford.

The Greenlink Interconnector is a proposed 500 MW HVDC electricity interconnector linking the power grid in Ireland with Great Britain. The geophysical survey was requested as part of the ground investigation to survey the ground conditions at the area of landfall for the connector cable, the cable route towards the Great Island transmission substation in Wexford and the proposed convertor substation. The cable is currently planned to lie approximately 850mm below ground level along the road sections and 1050mm along off-road sections.

The objectives of the geophysical surveying were to aid in the preliminary design of the converter station, identify areas of infilling within the site area and the depth to rockhead by identifying the following:

- Position and depth of any localised variations and changes of stratigraphy in the superficial deposits that could be related to areas of filling; and
- Determine the two-dimensional spatial variation in the superficial deposits and underlying rock to depths not less than 10 m in order to provide the following information:
  - Overburden thickness;
  - Depth to competent bedrock;
  - Determination of overburden and bedrock type and variations;
  - The rock mass and engineering properties of the underlying strata;

The geophysical investigation was carried out at 3 sites and 13 cable route sections, centred on joint bay locations (JB).

Thermal Resistivity Testing was undertaken at 5 locations across the three sites to assess the thermal heat properties of the soil.

The geophysical results and available direct investigation were combined to produce Interpreted geological sections at each site and for each cable route section.

The findings of the geophysical investigation should be reviewed on completion of the direct investigation.

Additional ERT could be carried out on 4 Cable Route Sections to eliminate the ambiguity between soils and weathered bedrock material.

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

2. INTRODUCTION

APEX Geophysics Limited was requested by ARUP on behalf of Greenlink Interconnector Ltd. to carry out a geophysical survey for the proposed Greenlink Interconnector on the Hook Head Peninsula in Co Wexford.

The Greenlink Interconnector is a proposed 500 MW HVDC electricity interconnector linking the power grid in Ireland with Great Britain. The geophysical survey was requested as part of the ground investigation to survey the ground conditions at the area of landfall for the connector cable, the cable route towards the Great Island transmission substation in Wexford and the proposed convertor substation. The cable is currently planned to lie approximately 850mm below ground level along the road sections and 1050mm along off-road sections.

2.1 Survey Objectives

The objectives of the geophysical surveying were to aid in the preliminary design of the converter station, identify areas of infilling within the site area and the depth to rockhead by identifying the following:

- Position and depth of any localised variations and changes of stratigraphy in the superficial deposits that could be related to areas of filling; and
- Determine the two-dimensional spatial variation in the superficial deposits and underlying rock to depths not less than 10 m in order to provide the following information:
  - Overburden thickness;
  - Depth to competent bedrock;
  - Determination of overburden and bedrock type and variations;
  - The rock mass and engineering properties of the underlying strata;

Thermal Resistivity Testing was undertaken at the three sites to assess the thermal heat properties of the soil.

2.2 Site Description

The geophysical investigation was carried out at 3 sites and 13 cable route sections, centred on joint bay locations (JB), as follows (see Fig 2.1):

Survey Locations	
Site 1 - Baginbun Beach	Cable Route Section 6 @JB9
Site 2 - Campile River Estuary Crossing	Cable Route Section 7 @JB10
Site 3 - Great Island Converter Station	Cable Route Section 8 @JB12
Cable Route Section 1 @ JB1	Cable Route Section 9 @JB14
Cable Route Section 2 @JB3	Cable Route Section 10 @JB15
Cable Route Section 3 @JB5	Cable Route Section 11 @JB17
Cable Route Section 4 @JB7	Cable Route Section 12 @JB18
Cable Route Section 5 @JB8	Cable Route Section 13 @JB19

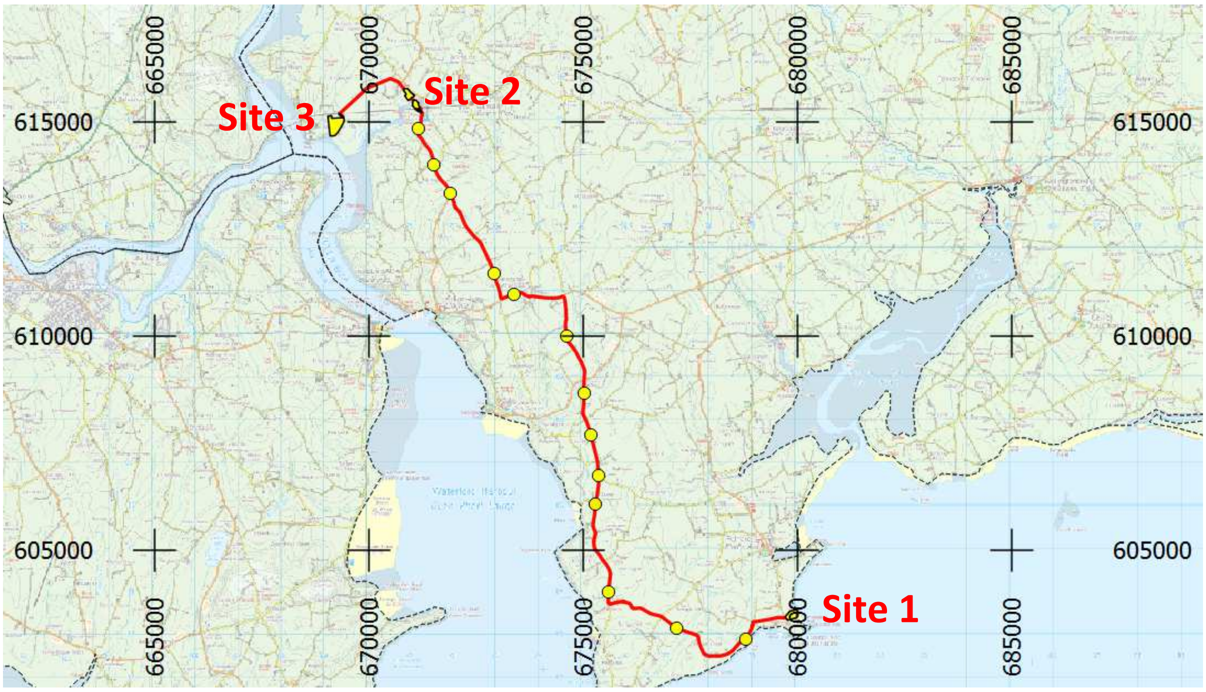

Fig 2.1: Location map (cable route sections marked as yellow circles with Section 1 in the south and Section 13 in the north).

2.2.1 Soils

The Teagasc soils map for the area (Fig. 2.2) indicates a variety of soils predominantly including till derived from shales, alluvium and subcropping/outcopping rock.

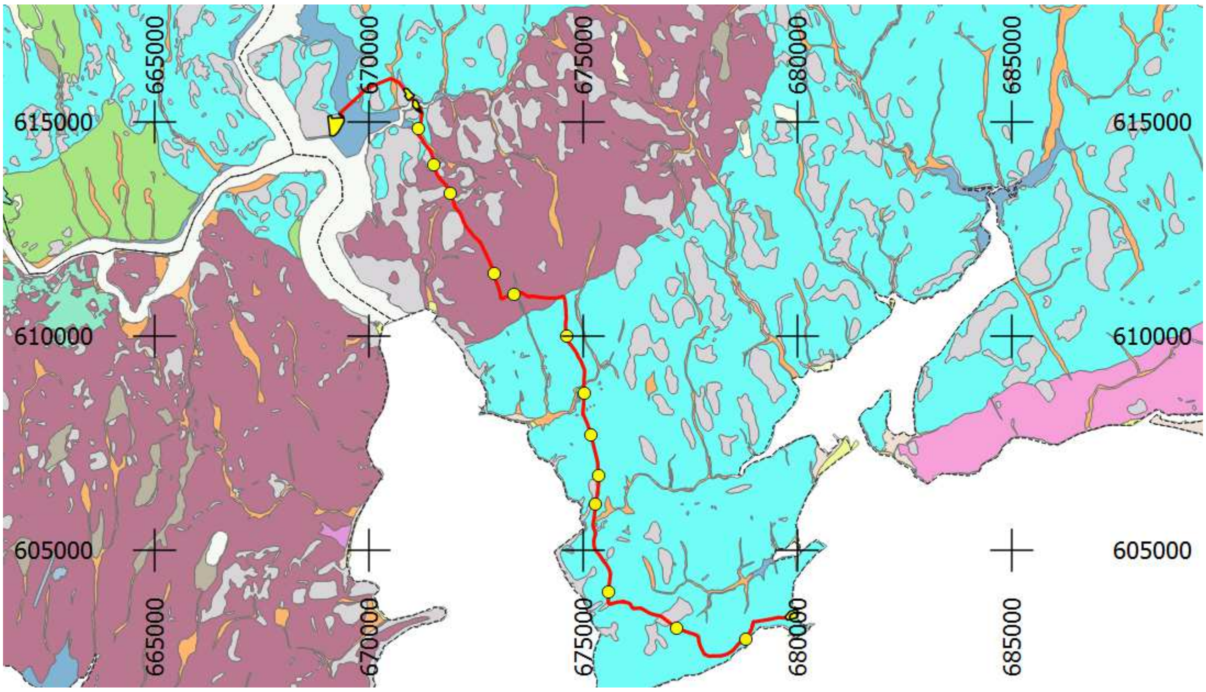

Fig 2.2: The Teagasc soil map (turquoise = till derived from shale, purple = till derived from acidic volcanic rocks, grey = subcrop/outcrop, blue = estuarine silts, orange = alluvium).

2.2.2 Geology

The Geological Survey of Ireland (GSI) 1:100k Bedrock Geology map for the area (Figure 2.3) indicates that the route is predominantly underlain by Booley Bay Formation mudstones with siltstones for Site 1 and the southern half of the route, with slates and siltstones of the Arthurstown and Ballyhack Members through the centre of the route and Campile Formation rhyolitic volcanics and slates and intermediate and felsic volcanic underlying the north of the route and sites 2 and 3.

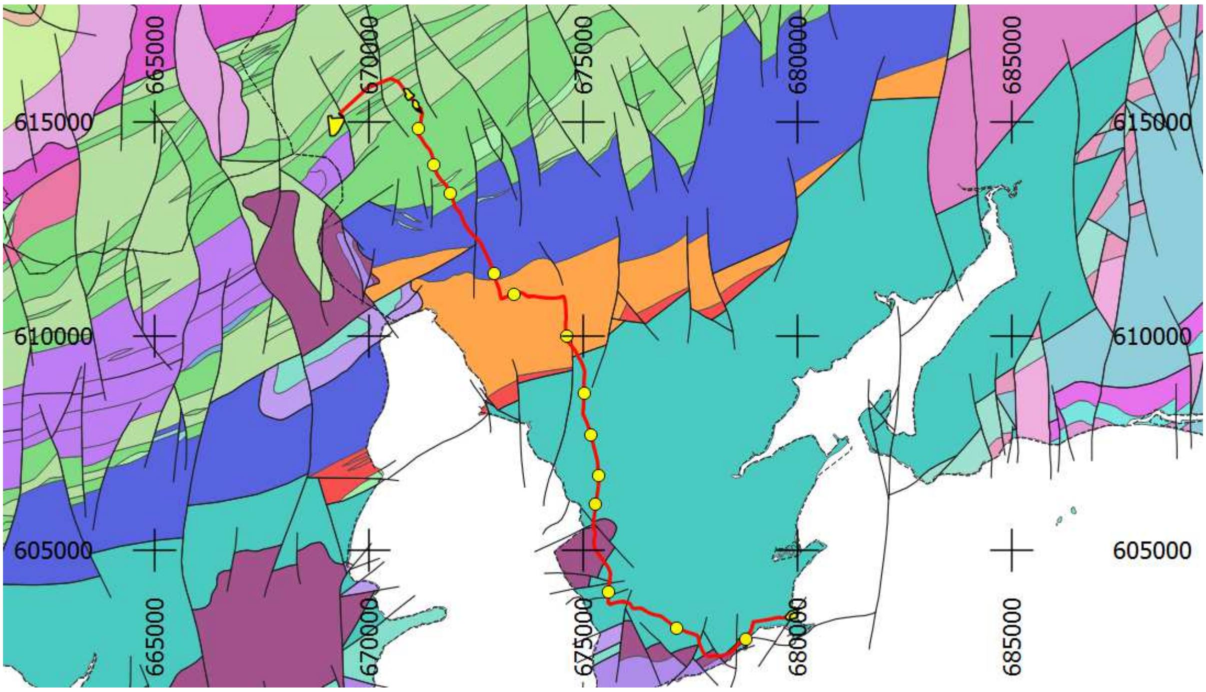

Fig 2.3: The GSI bedrock map (light blue = Booley Bay Fmt., orange = Arthurstown Member, dark blue = Ballyhack Member, green = Campile Formation).

The Booley Bay Formation, Arthurstown Member and Ballyhack Member bedrock is classified as a 'Poor Aquifer- bedrock which is generally unproductive except for local zones'. The Campile Formation bedrock is classified as a 'Regionally Important Aquifer- fissured bedrock.

Subsoil and Bedrock Summary:

The subsoils and bedrock at the 3 sites are summarised as follows:

Site Location	Soils	Bedrock
Baginbun Beach	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones & NE-SW fault through site
Campile River Estuary Crossing	Till derived from shales, estuarine silts and clays & shallow rock/outcrop	Campile Fmtn. volcanics and slates
Great Island Converter Station	Estuarine silts and clays & shallow rock/outcrop	Campile Fmtn. volcanics and slates

The subsoils and bedrock of at the 13 sites cable route sections are summarised as follows:

Road Location	Soils	Bedrock
Section 1 @ JB1	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones & Templetown Fmtn. conglomerates with sandstones
Section 2 @JB3	Till derived from shales & outcrop	Booley Bay Fmtn. mudstones with siltstones
Section 3 @JB5	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones
Section 4 @JB7	Till derived from shales, alluvium & shallow rock/outcrop	Booley Bay Fmtn. mudstones with siltstones
Section 5 @JB8	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones
Section 6 @JB9	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones
Section 7 @JB10	Till derived from shales, alluvium & shallow rock/outcrop	Booley Bay Fmtn. mudstones with siltstones
Section 8 @JB12	Till derived from shales	Arthurstown member slates & siltstones
Section 9 @JB14	Till derived from volcanics & alluvium	Arthurstown member slates & siltstones
Section 10 @JB15	Till derived from volcanics	Ballyhack member slates with thin siltstones
Section 11 @JB17	Till derived from volcanics & shallow rock/outcrop	Campile Fmtn. volcanics
Section 12 @JB18	Till derived from volcanics & shallow rock/outcrop	Campile Fmtn. volcanics
Section 13 @JB19	Till derived from shales, alluvium & shallow rock/outcrop	Campile Fmtn. volcanics

2.2.3 Groundwater Vulnerability

The groundwater vulnerability rating for the site (Fig. 2.4) is classified as high in the west/northwest of the site and medium in the east/southeast.

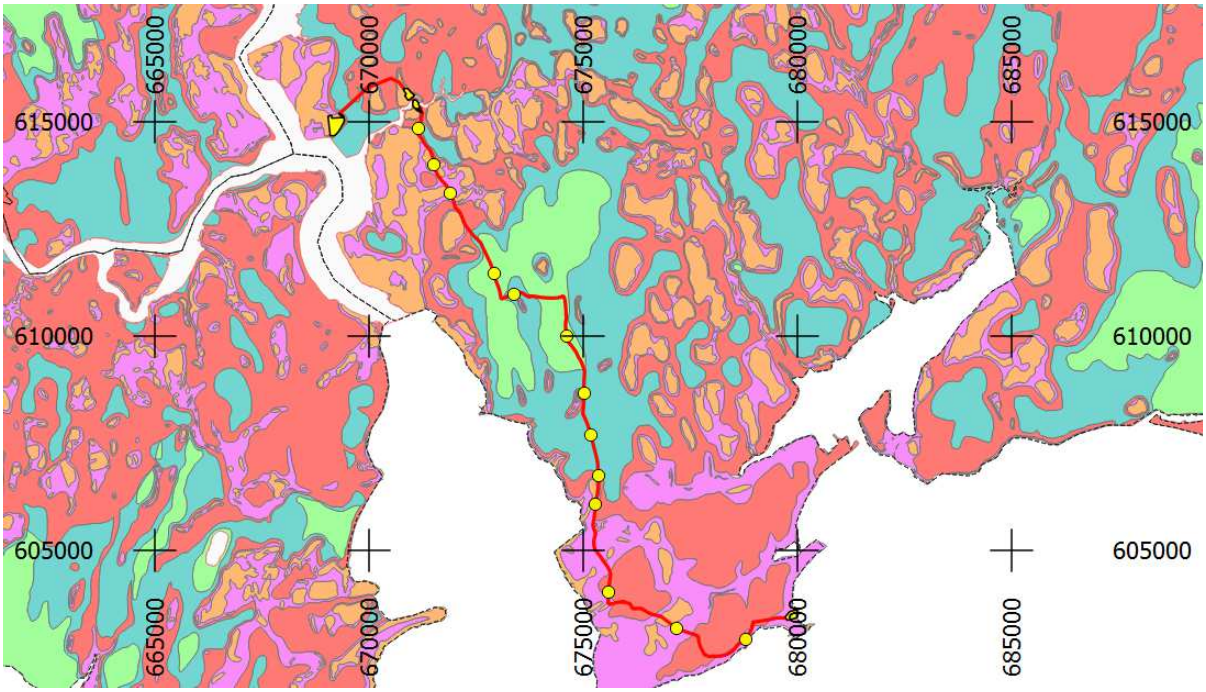

Fig 2.4: The Teagasc groundwater vulnerability map (green=low, blue=medium, red=high, pink/orange=extreme).

2.2.4 Historical Data

The available OSI historical 6’’ inch sheets were examined for each survey area. These sheets, compiled in the 19th century, provide detailed mapping of outcropping rock. Observations for each site and road section are discussed in the Results section of this report.

2.2.5 Direct Investigation Data

Shell and Auger and rotary core borehole information from the 3 site locations was made available to assist with the geophysical interpretation. The borehole locations are plotted on Drawings AGP18019_S1_01, AGP18019_S2_01 and AGP18019_S3_01 and the logs are plotted on the geophysical cross-sections. The borehole data are discussed in more detail in the Results section of this report.

2.3 Survey Rationale

The geophysical investigation consisted of 2D Electrical Resistivity Tomography (ERT) and Seismic Refraction profiling with the addition of reconnaissance EM ground conductivity mapping at the three sites:

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

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

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 the shallow bedrock.

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 METHODOLOGY**.

3. RESULTS

The survey was carried out between the 18th December 2018 and the 24th January 2019 and included the acquisition of EM mapping at the 3 sites, 121 seismic refraction profiles and 18 ERT profiles. Thermal resistivity testing was also undertaken at five locations at the three sites.

3.1 ERT

The range of resistivity values recorded can broadly be interpreted as follows:

Resistivity (Ohm-m)	**Interpretation**
5-50	Estuarine SILT
50 - 100	SILT/CLAY
100 - 250	Sandy Gravelly SILT/CLAY
250-500	Clayey SAND/GRAVEL
50 - 400	Mudstones/Slates
100-1000	Mudstones with Siltstones
400-1000	Siltstones
400-1000	Volcanics

3.2 Seismic Refraction Profiling

The range of seismic velocities recorded can broadly be interpreted as follows:

P-Wave Seismic Velocity (m/s)	**Interpretation**	**Estimated Stiffness/ Rock Quality**	**Estimated Excavatability**
<500	Overburden	Soft /Loose	Diggable
	Completely Weathered Bedrock	Very Poor	*Diggable
500-1000	Overburden	Firm/ Medium Dense	Diggable
	Highly Weathered Bedrock	Poor	*Diggable – Marginally Rippable
1000 - 1800	Overburden	Firm - Stiff / Medium Dense- Dense	Diggable
	Moderately Weathered Rock	Poor-Fair	*Rippable – Marginally Rippable
1800 - 2500	Overburden	Very stiff/ Very Dense	Diggable
	Slightly Weathered Rock	Fair to Good	Breaking/Blasting
>2500	Slightly Weathered – Fresh Rock	Good	Breaking/Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

3.3 Interpretation & Discussion

3.3.1 Baginbun Beach

Site 1 at Baginbun Beach marks the landfall of the interconnector cable from the Irish Sea. The EM, ERT and Seismic Refraction locations are indicated on Drawing AGP18019_S1_01. The EM data is contoured on Drawing AGP18019_S1_02 and a summary interpretation is presented on Drawing AGP18019_S1_03.

The Teagasc subsoils map (GSI) indicates till derived from shales across the site and the GSI bedrock map indicates that the site is underlain by the Booley Bay Formation mudstone with siltstone. A NE-SW fault is mapped through site (see Drawing AGP18019_S1_01). The subsoils and bedrock at the site are summarised as follows:

Site Location	Soils	Bedrock
Baginbun Beach	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones & NE-SW fault through site

Boreholes BH01-1, BH02-1 and BH04-1 encountered stiff to very stiff sandy gravelly clay to refusal at depths from 2.7 to 3.4m bgl. RC01-1, RC02-1 and RC04-1 encountered mudstone with interbedded siltstone and occasional sandstone.

EM Ground Conductivity Mapping

The EM ground conductivity results (Drawing AGP18019_S1_02) are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl. The recorded conductivity values ranged from 5 to 20 mS/m and have been generally interpreted in conjunction with the ERT and Seismic data as follows:

Conductivity (mS/m)	Interpretation
5 - 12	sandy gravelly CLAY
12 - 20	SILT/CLAY with possible saline influence in the east of the site

ERT

Three ERT Profiles (SR1 to SR3) have been acquired across the site. The resistivity values have been interpreted in conjunction with the seismic refraction and boreholes as follows:

Resistivity (Ohm-m)	Interpretation
50 - 100	SILT/CLAY
100 - 250	Sandy Gravelly SILT/CLAY
150-1000	Mudstones with Siltstones

Seismic Refraction

Four seismic refraction spreads were recorded across the site (S1-S4). The seismic refraction data indicated 4 velocity layers which have been interpreted in conjunction with the ERT and boreholes as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	244-433	315	Ave. 0.9	Soil	Soft / Loose	Diggable
2	615-1091	840	Ave. 1.4	Soil	Firm/Medium Dense	
3	1073-1746	1400	Ave. 3.2	Soil	Stiff/ Dense	
				Moderately Weathered Bedrock	Fair	Marginally Rippable
4	2699-3519	3090		Slightly Weathered – Fresh Bedrock	Good	Breaking/ Blasting

Integrated Interpretation

The ERT, Seismic Refraction and direct investigation results have been combined to produce the Interpreted Sections on Drawings AGP18019_S1_SR1 to AGP18019_S1_SR3. The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Average Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	244-433	50 - 100	0.9	SILT/CLAY	Soft	Diggable
		100 - 250		Sandy Gravelly SILT/CLAY		
2	615-1746	50 - 100	3.1	SILT/CLAY	Firm- Stiff	
		100 - 250		Sandy Gravelly SILT/CLAY		
3	1073-1746	100-150	1.4	Moderately Weathered Mudstone with Siltstone	Fair	Marginally Rippable
4	2733-3555	150-1000		Slightly Weathered – Fresh Mudstone with Siltstone	Good	Breaking/ Blasting

The geophysical data indicates 3 subsurface layers:

- Layer 1 has been interpreted as an average of 0.9m of predominantly soft silt/clay and sandy gravelly silt/clay.

- Layer 2 has been interpreted as an average of 3.1 m of firm silt/clay and sandy gravelly silt/clay becoming stiff from 2.3 m BGL.

  The EM and ERT indicate silt/clay along the west and southwest of the site with sandy gravelly clay through the centre of the site and possible silt/clay (or saline influenced sandy gravelly clay) along the east of the site (Drawing AGP18019_S1_03).

- Layer 3 has been interpreted as moderately weathered mudstone with siltstone at an average depth of 4 m BGL.

- Layer 4 has been interpreted as slightly weathered to fresh mudstone with siltstone (Booley Bay Formation). Bedrock resistivity values <350 Ohm-m would be indicative of mudstones with higher bedrock resistivities (350- 1000 Ohm-m) more indicative of siltstones.

The top of slightly weathered to fresh bedrock lies at an average depth of 5.4 m bgl and is generally deeper in the west and east of the site (see SR1 on AGP AGP18019_S1_SR1).

Layers 1 and 2 will be diggable, Layer 3 will be marginally rippable while any excavation of the slightly weathered to fresh bedrock in Layer 4 will require breaking/blasting.

The location of the bedrock fault has been inferred on SR1 and SR2.

3.3.2 Campile River Estuary Crossing

Site 2 is located where the cable will cross the River Suir at the Campile River estuary. Horizontal directional drilling is expected to be utilised under the river. The EM, ERT and Seismic Refraction locations are indicated on Drawing AGP18019_S2_01. The EM data is contoured on Drawing AGP18019_S2_02 and a summary interpretation is presented on Drawing AGP18019_S2_03.

The Teagasc subsoils map (GSI) indicates estuarine silts and clays adjacent to the river and subcropping/ outcropping rock in the surveyed fields north and south of the river. The GSI bedrock map indicates that the site is underlain by Campile Formation volcanic and slates. The subsoils and bedrock at the site are summarised as follows:

Site Location	Soils	Bedrock
Campile River Estuary Crossing	Till derived from shales, estuarine silts and clays & shallow rock/outcrop	Campile Fmtn. volcanics and slates

Boreholes BH01-2, BH03-2, BH04-2 and BH05-2 encountered stiff to very stiff sandy gravelly clay to refusal at depths from 0.8 to 6.2 m bgl. RC01-2, RC03-2, RC04-2 and RC05-2 rhyolitic bedrock.

EM Ground Conductivity Mapping

The EM ground conductivity results (Drawing AGP18019_S2_02) are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl. The recorded conductivity values ranged from 1 to 200 mS/m and have been generally interpreted in conjunction with the ERT and Seismic data as follows:

Conductivity (mS/m)	Interpretation
1 - 11	Rock at or near the surface
>11	Estuarine SILTS & CLAYS

ERT

Two ERT Profiles (SR4 and SR5) have been acquired on either side of the river. The resistivity values have been interpreted in conjunction with the seismic refraction, boreholes and trial pits as follows:

Resistivity (Ohm-m)	Interpretation
50 - 100	SILT/CLAY
100 - 250	Sandy Gravelly SILT/CLAY
250-500	Clayey SAND/GRAVEL
50 - 200	Slates
200-1000	Rhyolite

Seismic Refraction

Four seismic refraction spreads were recorded across the site (S5-S8). The seismic refraction data indicated 4 velocity layers which have been interpreted in conjunction with the ERT and boreholes as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	167-395	260	Ave. 1.5	Soil	Soft / Loose	Diggable
2	400-1148	715	Ave. 4.5	Soil	Firm –Stiff/ Medium dense-dense	Diggable
				Completely-Highly Weathered Bedrock	Poor	Diggabble-Rippable
3	1045-1864	1465	Ave 7.0	Moderately Weathered Bedrock	Fair	Rippable – Marginally Rippable
4	2175-3794	2915		Slightly Weathered – Fresh Bedrock	Good	Breaking/ Blasting

Integrated Interpretation

The ERT, Seismic Refraction and direct investigation results have been combined to produce the Interpreted Sections on Drawing AGP18019_S2_SR4 and AGP18019_S2_SR5. The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	167-395	5-500	Ave. 1.2	Estuarine SILT/CLAY	Soft	Diggable
		100 - 250		Sandy Gravelly SILT/CLAY		
		250-500		Clayey SAND/GRAVEL	Loose	
2	400-1148	5-50	Ave 4.5	SILT/CLAY	Firm –Stiff	Diggable
				Sandy Gravelly SILT/CLAY		
				Clayey SAND/GRAVEL or Completely-Highly Weathered Bedrock	Medium Dense or Poor	Diggable-Rippable
3	1045-1864	50-1000	Ave 7.0	Moderately Weathered Bedrock	Fair	Rippable – Marginally Rippable
4	2175-3794	50-200		Slightly Weathered – Fresh Slate	Good	Breaking/ Blasting
		200-1000		Slightly Weathered – Fresh Rhyolite		

The geophysical data has been interpreted in conjunction with RC03-2 and RC04-2 as indicating 4 subsurface layers; Layer 1, typically 1.2 m thick, of soft silt/clay, sandy gravelly silt/clay and loose clayey sand gravel over Layer 2, typically 4.5m thick of firm to stiff silt/clay and sandy gravelly clay and/or completely to highly weathered rock south of the river. Layer 3, typically 7 m thick, has been interpreted as moderately weathered rhyolite or slate over Layer 4 comprising slightly weathered to fresh slate and rhyolite.

South of the river (Drawing AGP18019_S2_SR4) the geophysical data has been interpreted as indicating rhyolitic bedrock in the field south of the mud flats in agreement with BH/RC04-2 and possible slate bedrock underlying the river. North of the river (Drawing AGP18019_S2_SR5) the geophysical data has been interpreted as indicating rhyolitic in agreement with BH/RC03-2 and possible slate bedrock further to the north.

Layer 1 will be diggable, seismic velocities indicate that Layer 2 should be diggable to rippable though the cut-off velocity for these excavatabilities will be lower in trenches. Layer 3 would be marginally rippable while any excavation of the slightly weathered to fresh bedrock in Layer 4 wouldrequire breaking/blasting.

Any horizontal directional drilling may encounter rock from an average depth of 1.2 m BGL.

3.3.3 Great Island Converter Station Site

Site 3 includes plans for a converter station with associated parking facilities. Excavation is currently proposed under the plant in the north of the site with fill proposed in the low lying area in the south of the site. The EM, ERT and Seismic Refraction locations are indicated on Drawing AGP18019_S3_01. The EM data is contoured on Drawing AGP18019_S3_02 and a summary interpretation is presented on Drawing AGP18019_S3_03.

The Teagasc subsoils map (GSI) indicates subcropping/ outcropping rock across the entire site. The GSI bedrock map indicates that the site is underlain by Campile Formation volcanic and slates. The historical 6inch map indicates outcropping ‘feldstone’ through the centre and south east of the site with slate across the northwest of the site.The subsoils and bedrock at the site are summarised as follows:

Site Location	Soils	Bedrock
Great Island Converter Station	Estuarine silts and clays & shallow rock/outcrop	Campile Fmtn. volcanics and slates

Boreholes BH01-3, BH02-3 and BH05-3 on the elevated ground in the centre-north of the site encountered soft soils to 1.9m and stiff to very stiff sandy gravelly clay to 1m to 3m bgl and borehole BH04-3 in the low-lying ground to the south of the site encountered 1.9m of soft soils over stiff to very stiff sandy gravelly silt/clay to 5.6m bgl. RC01-3 to RC05-3 encountered rhyolitic bedrock.

EM Ground Conductivity Mapping

The EM ground conductivity results (Drawing AGP18019_S3_02) are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl. The recorded conductivity values ranged from 1 to 11 mS/m and have been generally interpreted in conjunction with the ERT and Seismic data as follows:

Conductivity (mS/m)	Interpretation
1 - 4	Rock at or near the surface
4 – 8.5	Up to 6m sandy gravelly CLAY deposits
8.5 - 11	Up to 6m SILT/CLAY deposits

ERT

Five ERT Profiles (SR8 and SR12) were acquired across the site. The resistivity values have been interpreted in conjunction with the seismic refraction and borehole data as follows:

Resistivity (Ohm-m)	Interpretation
50 - 100	SILT/CLAY
100 - 250	Sandy Gravelly SILT/CLAY
250-500	Clayey SAND/GRAVEL
50 - 200	Slates
200-1000	Rhyolite

Seismic Refraction

Four seismic refraction spreads were recorded across the site (S11-S14). The seismic refraction data indicated 3 velocity layers which have been interpreted in conjunction with the ERT and borehole data as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Average Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	151-548	330	0.6-3.1 Ave. 1.5	Soil	Soft/ Loose	Diggable
				Clayey SAND/GRAVEL or completely weathered rock	Very Poor	
2	552-1290	930	1.0-6.5 Ave.3.7	Soil	Firm-Stiff/ Medium dense- Dense	
				Highly- Moderately Weathered Bedrock	Poor	Rippable – Marginally Rippable
3	2133-2669	2670		Slightly Weathered – Fresh Bedrock	Good	Breaking/ Blasting

Integrated Interpretation

The ERT, Seismic Refraction and direct investigation results have been combined to produce the Interpreted Sections on Drawings AGP18019_S3_SR8 to AGP18019_S3_SR12. The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Average Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	151-548	50-100	1.5	SILT/CLAY	Soft	Diggable
		100 - 250		Sandy Gravelly SILT/CLAY		
		250-500		Clayey SAND/GRAVEL or completely weathered rock	Loose	
2	552-1290	50-100	3.7	SILT/CLAY	Firm-Stiff	
		100 - 250		Sandy Gravelly SILT/CLAY		
		250-500		Clayey SAND/GRAVEL	Medium dense- Dense	
				Highly- Moderately Weathered Bedrock	Poor	Rippable – Marginally Rippable
3	2133-2669	50-200		Slightly Weathered – Fresh Slate	Good	Breaking/ Blasting
		200-1000		Slightly Weathered – Fresh Rhyolite		

The EM and ERT indicate up to 6m of sandy gravelly clay in the north and south of the site, a small zone of silt/clay in the southwest of the site and shallow bedrock through the centre of the site (Drawing AGP18019_S3_03).

The geophysical data indicates 3 subsurface layers:

- Layer 1 has been interpreted as an average of 1.5m of soft silt/clay and sandy gravelly silt/clay in the north and south of the site and as loose clayey sand/gravel or completely weathered rock through the centre of the site.
- Layer 2 has been interpreted as firm to stiff silt/clay and sandy gravelly silt/clay in the north and south of the site or medium dense clayey sand/gravel highly to moderately weathered rock through the centre of the site.
- Layer 3 has been interpreted as slightly weathered to fresh rock (Campile Formation). Bedrock resistivity values <200 Ohm-m would be indicative of slates with higher bedrock resistivities (200-1000 Ohm-m) interpreted in conjunction with the rotary cores as rhyolite.

Seismic velocities indicate that the highly to moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/ blasting.

the rail track (Drawings AGP18019_S3_01 and AGP18019_SR6 & SR7). Borehole BH03-3 (on SR6) encountered stiff to very stiff sandy silt to 2m bgl and borehole BH06-3 (on SR7) encountered 1.2m of sandy silt/clay over 9.3m of soft sandy gravelly silt, over firm to stiff sandy gravelly silt/clay to 13.3m bgl.

3.3.4 Great Island Converter Station Rail Track Crossing

Additional surveying was carried out west of Site 3 to examine the ground conditions for possible horizontal directional drilling under the rail track (Drawing AGP18019_S3_01).

The Teagasc subsoils map (GSI) indicates estuarine silts and clays either side of the track. The historical 6inch map from 1862, before the construction of the railway, has mapped this area as 'slob under pasture and tillage'. The GSI bedrock map indicates that the site is underlain by Campile Formation volcanics and slates. Borehole RC/BH03-3 south of the track encountered 2m of stiff sandy silt over rhyolitic bedrock and BH06-3 south of the track encountered soft sandy gravelly silt to 10.5m bgl over firm to very stiff sandy gravelly clay to 13.3m bgl.

ERT

Two ERT Profiles (SR6 and SR7) were acquired either side of the track. The resistivity values have been interpreted in conjunction with the seismic refraction and boreholes as follows:

Resistivity (Ohm-m)	Interpretation
5-50	Estuarine SILT
100 - 250	Sandy Gravelly SILT/CLAY
250-500	Clayey SAND/GRAVEL
50 - 100	Slates
100 - 400	Rhyolite

Seismic Refraction

Two seismic refraction profiles (S9 and S10) were acquired on either side of the track The seismic refraction data indicated 3 velocity layers which have been interpreted in conjunction with the ERT and boreholes as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Average Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	144-213	175	0.7-0.9 Ave. 0.8	Soil	Very Soft/ Very Loose	Diggable
2	506-1111	845	0.5-2.6 Ave. 1.7	Soil	Firm/ Med. dense	
*3a	1569-1727	1630		Soil	Stiff	
**3b	2733-3555	3850		Slightly Weathered – Fresh Bedrock	Good	Breaking/ Blasting

Integrated Interpretation

The ERT, Seismic Refraction and direct investigation results have been combined to produce the Interpreted Sections on Drawing AGP18019_S3_SR6 & SR7. The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Average Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	144-213	5 - 50	0.8	Estuarine SILT	Very Soft	Diggable
		100 - 250		Sandy Gravelly SILT/CLAY		
		250-500		Clayey SAND/GRAVEL	Very Loose	
2	506-1111	5 -50	1.7	Estuarine SILT	Firm	
		100 - 250		Sandy Gravelly SILT/CLAY		
		250-500		Clayey SAND/GRAVEL	Med. dense	
*3a	1569-1727	5-50		Saturated Estuarine SILT	Soft-Firm-Stiff	
**3b	2733-3555	50-100		Slightly Weathered – Fresh Slate	Good	Breaking/ Blasting
		100-400		Slightly Weathered – Fresh Rhyolite		

** on S10 only, ** on S9 only.*

South of the track, SR6 is adjacent to the main Converter Station Site where outcrop is known to occur. The geophysical data has been interpreted as indicating an average of 3m of very soft to firm soils over slightly weathered to fresh slate and rhyolitic bedrock in agreement with RC/BH03-3. (Rhyolite resistivites are slightly lower than observed at Site 2 and the Converter Station site to the west).

North of the track (SR7), the geophysical data has been interpreted as indicating thick saturated estuarine silt deposits in agreement with BH06-3. Bedrock was not interpreted to a depth of 15m bgl.

Any horizontal directional drilling south of the rail track may encounter rock from 2.5 to 3m bgl. No rock is expected north of the rail track.

3.3.5 Onshore Cable Route

Section 1 at JB 1:

The geophysical data is presented on Drawings AGP18019_01a and AGP18019_01b. The geophysical survey consisted of 10 seismic refraction profiles (S15-S24) and 1 ERT profile (RR2). The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 1 @ JB1	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones & Templetown Fmtn. conglomerates with sandstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Resistivity (Ohm-m)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	308-833	500	50-100	0.2 – 2.0 Ave. 0.9	SILT/CLAY	Soft-Firm	Diggable
2	533-2020	1060	50-100	2.0 – 6.3 Ave. 3.7	SILT/CLAY	Firm-Stiff	Diggable
3	2568-3638	3015	100-500		Slightly Weathered to Fresh Mudstone with Siltstone	Good	Breaking/ Blasting

The data indicates an upper soil layer (average thickness 0.9m) of soft to firm silt/clay overlying an average thickness of 3.7m of firm to stiff silt/clay. Both soil layers will be diggable.

The underlying bedrock has been interpreted as slightly weathered to fresh mudstones with siltstones (Booley Bay Formation).

The seismic velocities indicate that any bedrock excavation will require breaking/blasting.

Section 2 at JB 3:

The geophysical data is presented on Drawings AGP18019_02a and AGP18019_02b. The geophysical survey consisted of 10 seismic refraction profiles (S25-S34). The historical Teagasc subsoils map indicates subcropping/outcropping rock along the northern half of this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 2 @JB3	Till derived from shales & outcrop	Booley Bay Fmtn. mudstones with siltstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	400-889	665	0.1 – 2.2 Ave. 0.9	Soil	Firm/ Medium dense	Diggable
2	842-1593	1175	2.2 – 9.7 Ave. 5.4	Moderately Weathered (probable Mudstone with Siltstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2224-3287	2720		Slightly Weathered – Fresh (probable Mudstone with Siltstone) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a firm/medium dense soil layer (average thickness 0.9m) which will be diggable.

The Teagasc subsoils map (GSI) indicates subcropping/outcropping rock for much of this section. As such, Layer 2 has been interpreted as highly to moderately weathered bedrock (with an average thickness of 5.4m) underlain by Layer 3 slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Booley Bay Formation mudstones with siltstones.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 3 at JB 5:

The geophysical data is presented on Drawing AGP18019_03. The geophysical survey consisted of 5 seismic refraction profiles (S35-S39). The historical 6inch map does not indicate any outcropping rock along this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 3 @JB5	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	533-915	725	0.1 – 1.4 Ave. 0.7	Soil	Firm/ Medium dense	Diggable
2	870-1830	1335	1.8 – 6.2 Ave. 3.8	Soil	Stiff/Dense	Diggable
				Moderately Weathered (probable Mudstone with Siltstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	3010-3572	3240		Slightly Weathered – (probable Mudstone with Siltstone) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a firm/medium dense soil layer (average thickness 0.7m) which will be diggable.

Layer 2 has been interpreted as stiff/dense soil and/or moderately weathered bedrock (with an average thickness of 3.8 m). Seismic profiles S38 and S39 in the south of this section have highest Layer 2 velocities (up to 1830 m/s) suggesting predominantly weathered rock to the south while S35 to S37 in the north of the section have a max. velocity of 1466 m/s suggesting that Layer 2 may comprise of soil deposits to the north of the section.

Layer 3 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Booley Bay Formation mudstones with siltstones.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 4 at JB 7:

The geophysical data is presented on Drawings AGP18019_04a and AGP18019_04b. The geophysical survey consisted of 11 seismic refraction profiles (S40-S53) and 1 ERT profile (RR3). The historical 6inch map indicates outcropping shales and slates approx. 200m west of the section and also along the westbound road adjoining the north of the section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 4 @JB7	Till derived from shales, alluvium & shallow rock/outcrop	Booley Bay Fmtn. mudstones with siltstones

The ERT profile returned very low resistivities which indicate that the data has been affected by the presence of underground services and as such cannot be used for the purposes of interpretation. The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	571-1071	810	0.1 – 1.8 Ave. 0.6	Soil	Firm/ Medium dense	Diggable
2	1088-1778	1385	3.8 -12.9 Ave. 6.5	Soil	Stiff/Dense	Diggable
				Moderately Weathered (probable Mudstone with Siltstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2196-3656	2910		Slightly Weathered – Fresh (probable Mudstone with Siltstone) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a firm/medium dense soil layer (average thickness 0.6m) which will be diggable.

Layer 2 has been interpreted as stiff/dense soil and/or moderately weathered bedrock (with an average thickness of 6.5 m). The layer may comprise of stiff/dense soil overlying the moderately weathered bedrock, both of which have similar velocities but cannot be distinguished as individual seismic layers.

Layer 3 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Booley Bay Formation mudstones with siltstones. Seismic profiles S46 to S53 in the southern half of this section have lowest Layer 3 velocities (ave. 2590 m/s) suggesting predominantly mudstone bedrock while S40 to S45 in the north have an average layer 3 velocity of 3330 m/s suggesting an increase in the siltstone content within the bedrock.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 5 at JB 8:

The geophysical data is presented on Drawing AGP18019_05. The geophysical survey consisted of 5 seismic refraction profiles (S54-S58). The historical 6inch map does not indicate any outcropping rock along this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 5 @JB8	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	619-1135	855	0.0 – 1.6 Ave. 0.5	Soil	Firm/ Medium dense	Diggable
2	1240-1851	1555	4.7 -11.4 Ave. 7.2	Soil	Stiff/ Dense	Diggable
				Moderately Weathered (probable Mudstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2293-2878	2490		Slightly Weathered – Fresh (probable Mudstone) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a firm/medium dense soil layer (average thickness 0.5m) which will be diggable.

Layer 2 has been interpreted as stiff/dense soil and/or moderately weathered bedrock (with an average thickness of 7.2 m).

Layer 3 has been interpreted as slightly weathered – fresh bedrock. The layer may comprise of stiff/dense soil overlying the moderately weathered bedrock, both of which have similar velocities but cannot be distinguished as individual seismic layers. The bedrock geological map (GSI) indicates that bedrock comprises of Booley Bay Formation mudstones with siltstones. Layer 3 seismic velocities (ave. 2490 m/s) suggest predominantly mudstone bedrock.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 6 at JB 9:

The geophysical data is presented on Drawing AGP18019_06. The geophysical survey consisted of 5 seismic refraction profiles (S59-S63). The historical 6inch map does not indicate any outcropping rock along this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 6 @JB9	Till derived from shales	Booley Bay Fmtn. mudstones with siltstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	615-1143	925	0.0 – 1.5 Ave. 0.5	Soil	Firm/ Medium dense	Diggable
2	1174-1684	1385	4.5 -13.0 Ave. 7.8	Soil	Stiff/ Dense	Diggable
				Moderately Weathered (probable Mudstone with Siltstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2463-2933	2685		Slightly Weathered – Fresh (probable Mudstone with Siltstone) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a firm/medium dense soil layer (average thickness 0.5m) which will be diggable.

Layer 2 has been interpreted as stiff/dense soil and/or moderately weathered bedrock (with an average thickness of 7.8 m). The layer may comprise of stiff/dense soil overlying the moderately weathered bedrock, both of which have similar velocities but cannot be distinguished as individual seismic layers.

Layer 3 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Booley Bay Formation mudstones with siltstones.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 7 at JB 10:

The geophysical data is presented on Drawings AGP18019_07a and AGP18019_07b. The geophysical survey consisted of 11 seismic refraction profiles (S64-S74) and 1 ERT profile (RR6). The historical 6inch map indicates outcropping slate in the south of this section and a possible fault along the river/stream in the north of the section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 7 @JB10	Till derived from shales, alluvium & shallow rock/outcrop	Booley Bay Fmtn. mudstones with siltstones

The range of seismic velocities have been interpreted as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	423-1048	615	0.0 – 5.3 Ave. 1.9	Soil	Soft-Firm/ Loose-Medium dense	Diggable
2	789-1885	1315	0.7 – 17 Ave. 4.9	Soil	Firm-Stiff/Medium Dense-Dense	Diggable
				Highly - Moderately Weathered Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2022-2901	2420		Slightly Weathered - Fresh Bedrock	Fair-Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The range of resistivity values recorded can broadly be interpreted as follows:

Resistivity (Ohm-m)	Interpretation
100 - 250	Sandy Gravelly SILT/CLAY
100-400	Mudstones with Siltstones

The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	417-1042	100 - 250	0.0 – 6.4 Ave. 1.8	Sandy Gravelly SILT/CLAY	Soft-Firm/ Loose-Medium dense	Diggable
2	707-1702	100-400	0.7 – 9.2 Ave. 3.7	Highly - Moderately Weathered Mudstones	Poor-Fair	*Rippable to Marginally Rippable
3	1624-2901			Slightly Weathered – Fresh Mudstones	Fair-Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a thin, predominantly firm, sandy gravelly clay layer, becoming softer and thicker (possibly up to 4m thick) in the vicinity of the river/stream, in the north of this cable route section. This layer may include some completely to highly weathered rock at its base. This seismic velocities indicate that this layer material will be diggable.

Layer 2 has been interpreted as highly to moderately weathered bedrock (with an average thickness of 3.7 m). This layer is generally thinner in the south of the section, becoming thicker in the vicinity of the river/stream.

Layer 3 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Booley Bay Formation mudstones with siltstones. Bedrock resistivities are low (100-400 Ohm-m) and seismic velocities are also relatively low (ave. 2420 m/s) suggesting predominantly mudstone bedrock.

The seismic velocities indicate that the highly to moderately weathered bedrock should be rippable to marginally rippable and any excavation of the moderately to slightly weathered to fresh bedrock will require breaking/blasting.

Section 8 at JB 12:

The geophysical data is presented on Drawing AGP18019_08. The geophysical survey consisted of 8 seismic refraction profiles (S75-S82). The historical 6inch map indicates outcropping slates and 'grits' (sandstones) at the southern end of this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 8 @JB12	Till derived from shales	Arthurstown member slates & siltstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	242-889	565	0.2 – 2.7 Ave. 1.3	Soil	Soft-Firm/ Loose-Medium dense	Diggable
2	515-2000	1360	1.7 –10.2 Ave. 5.4	Soil	Firm-Stiff/Medium Dense-Dense	Diggable
				Highly - Moderately Weathered (probable Slate and Siltstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2112-2744	2400		Moderately -Slightly Weathered (probable Slate and Siltstone) Bedrock	Fair-Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a soft to firm/loose to medium dense soil layer (average thickness 1.3 m) which will be diggable.

Layer 2 has been interpreted as probable highly to moderately weathered bedrock (with an average thickness of 5.4 m) though this layer may also comprise of firm to stiff/medium dense to dense soil.

Layer 3 has been interpreted as moderately to slightly weathered bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Arthurstown member slates and siltstones. Layer 3 seismic velocities (ave. 2400 m/s) suggesting predominantly slate bedrock.

The seismic velocities indicate that the highly to moderately weathered bedrock should be rippable to marginally rippable and any excavation of the moderately to slightly weathered to fresh bedrock will require breaking/blasting.

Section 9 at JB 14:

The geophysical data is presented on Drawing AGP18019_09. The geophysical survey consisted of 9 seismic refraction profiles (S83-S91) and 1 ERT profile (RR5). The historical 6inch map indicates outcropping grey slate at the southern end of this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 9 @JB14	Till derived from volcanics & alluvium	Arthurstown member slates & siltstones

The range of seismic velocities have been interpreted as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	364-1000	640	0.3 – 2.6 Ave. 1.1	Soil	Soft-Firm/ Loose-Medium dense	Diggable
2+	733-1481	1100	0.9 – 4.5 Ave. 2.1	Soil	Firm-Stiff/Medium Dense-Dense	Diggable
3	762-2078	1595	1.8 – 9.5 Ave. 5.8	Highly - Moderately Weathered Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	3147-4763	3680		Slightly Weathered – Fresh Bedrock	Good	Breaking/ Blasting

+Layer 2 is only interpreted on S87, S88 & S89

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The range of resistivity values recorded can broadly be interpreted as follows:

Resistivity (Ohm-m)	Interpretation
50 - 100	SILT/CLAY
100 - 250	Sandy Gravelly SILT/CLAY
250-500	Clayey SAND/GRAVEL
100-400	Slates
400-1000	Siltstones

The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	364-1000	50 - 100	0.3 – 2.6 Ave. 1.1	SILT/CLAY	Soft-Firm	Diggable
		100 - 250		Sandy Gravelly SILT/CLAY		
		250-500		Clayey SAND/GRAVEL	Loose-Medium Dense	
2	733-1481		0.9 – 4.5 Ave. 2.1	Sandy Gravelly SILT/CLAY	Firm-Stiff	Diggable
3	762-2078	100-400	1.8 – 9.5 Ave. 5.8	Highly - Moderately Weathered Slates	Poor-Fair	*Rippable to Marginally Rippable
		400-1000		Highly - Moderately Weathered Siltstones		
3	3147-4763	100-400		Slightly Weathered – Fresh Slates	Good	Breaking/ Blasting
		400-1000		Slightly Weathered – Fresh Siltstones		

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates up to 4 subsurface layers. Layer 1 has been interpreted loose to medium dense clayey sand/gravel (or completely weathered rock) in the south of the section, with soft to firm sandy gravelly clay through the centre and north of the section. A small pocket of soft to firm silt/clay was interpreted at 145m along this section. Layer 1 has an average thickness of 1.1m.

Layer 2 (only on S87 to s89) has been interpreted as firm to stiff sandy gravelly clay layer (ave. Thickness 2.1m). The seismic velocities indicate that Layers 1 & 2 should be diggable.

Layer 3 has been interpreted as highly to moderately weathered bedrock (with an average thickness of 5.8 m).

Layer 4 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Arthurstowm Member slates and siltstones. Low bedrock resistivities (100-400 Ohm-m) in the north of the section suggest slate bedrock while higher resistivities (400-1000 Ohm-m) in the south of the section suggest siltstone bedrock.

Layer 3 is generally thinner across the siltstones in the south of the section, becoming thicker over in the suspected slates in the north of the section.

The seismic velocities indicate that the highly to moderately weathered bedrock should be rippable to marginally rippable and any excavation of the moderately to slightly weathered to fresh bedrock will require breaking/blasting.

Section 10 at JB 15:

The geophysical data is presented on Drawing AGP18019_10. The geophysical survey consisted of 5 seismic refraction profiles (S92-S96). The historical 6inch map does not indicate any outcropping rock along this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 10 @JB15	Till derived from volcanics	Ballyhack member slates with thin siltstones

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	267-792	435	0.3– 1.0 Ave. 0.6	Soil	Soft-Firm/ Loose-Medium dense	Diggable
2	500-1377	840	0.3 – 1.6 Ave. 1.0	Soil	Firm-Stiff/Medium Dense-Dense	Diggable
3	890-1890	1375	0.3 – 4.6 Ave. 2.6	Moderately Weathered (probable slate with thin siltstone) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
4	2947-3440	3155		Slightly Weathered – Fresh (probable slate with thin siltstone) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 4 subsurface layers. The upper layer has been interpreted as a soft to firm/loose to medium dense soil layer (average thickness 0.6 m) which will be diggable.

Layer 2 has been interpreted as firm to stiff/medium dense to dense soil (with an average thickness of 1.0 m).

Layer 3 has been interpreted as probable moderately weathered bedrock with an average thickness 2.6 m.

Layer 4 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Ballyhack Member slates with thin siltstones.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 11 at JB 17:

The geophysical data is presented on Drawing AGP18019_11. The geophysical survey consisted of 5 seismic refraction profiles (S97-S101). The historical 6inch map indicates outcropping rock in the south of this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 11 @JB17	Till derived from volcanics & shallow rock/outcrop	Campile Fmtn. volcanics

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	233-531	395	0.4 – 1.7 Ave. 0.9	Soil	Soft / Loose	Diggable
2	364-1231	855	0.9 – 3.5 Ave. 1.8	Soil	Firm-Stiff/Medium Dense-Dense	Diggable
3	890-1826	1465	1.2 – 7.1 Ave. 4.3	Moderately Weathered (probable Volcanic) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2589-4086	3155		Slightly Weathered – Fresh (probable Volcanic) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 4 subsurface layers. The upper layer has been interpreted as a soft /loose soil layer (average thickness 0.9 m) which will be diggable.

Layer 2 has been interpreted as firm to stiff/medium dense to dense soil (with an average thickness of 1.8 m).

Layer 3 has been interpreted as probable moderately weathered bedrock with an average thickness 4.3 m.

Layer 4 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Campile Formation volcanics.

The seismic velocities indicate that the moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 12 at JB 18:

The geophysical data is presented on Drawing AGP18019_12. The geophysical survey consisted of 5 seismic refraction profiles (S102-S106). The historical 6inch map does not indicate any outcropping rock along this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 12 @JB18	Till derived from volcanics & shallow rock/outcrop	Campile Fmtn. volcanics

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	320-643	430	0.6 – 3.3 Ave. 1.7	Soil	Soft / Loose	Diggable
2	640-1460	1060	0.3 – 5.9 Ave. 3.5	Highly - Moderately Weathered (probable volcanic) Bedrock	Poor-Fair	*Rippable to Marginally Rippable
3	2840-3724	3095		Slightly Weathered – Fresh (probable volcanic) Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates 3 subsurface layers. The upper layer has been interpreted as a soft /loose soil layer (average thickness 1.7 m) which will be diggable.

The Teagasc subsoils map (GSI) indicates subcropping/outcropping rock for much of this section. As such, Layer 2 has been interpreted as highly to moderately weathered bedrock with an average thickness 3.5 m.

Layer 3 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that bedrock comprises of Campile Formation volcanics.

The seismic velocities indicate that the highly to moderately weathered bedrock should be rippable to marginally rippable and any excavation of the slightly weathered to fresh bedrock will require breaking/blasting.

Section 13 at JB 19:

The geophysical data is presented on Drawings AGP18019_13a, AGP18019_13b and AGP18019_13c. The geophysical survey consisted of 15 seismic refraction profiles (S107-S121) and 2 ERT profiles (RR1 & RR4). The Teagasc subsoils map indicates an alluvium channel in the north of the section and subcropping/outcropping rock through the centre of the section of this section. The subsoils and bedrock are summarised as follows:

Road Location	Soils	Bedrock
Section 13 @JB19	Till derived from shales, alluvium & shallow rock/outcrop	Campile Fmtn. volcanics

The geophysical data at this location has been summarised as follows:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Thickness (m)	Interpretation	Stiffness/ Rock Quality	Excavatibility
1	258-697	435	0.2 – 2.4 Ave. 1.1	Soil	Soft-Firm/ Loose-Medium dense	Diggable
				Completely Weathered Bedrock		*Diggable
2	365-1145	665	1 – 2.6 Ave. 1.8	Soil	Firm /Medium Dense	Diggable
				Completely - Highly Weathered Bedrock		*Rippable
3	726-1789	1300	1.7 – 9.5 Ave. 4.3	Soil	Firm-Stiff/Medium Dense-Dense	Diggable
				Highly - Moderately Weathered Bedrock	Poor-Fair	*Rippable to Marginally Rippable
4	1944-4260	3205		Slightly Weathered – Fresh Bedrock	Good	Breaking/ Blasting

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The range of resistivity values recorded can broadly be interpreted as follows:

Resistivity (Ohm-m)	Interpretation
50 - 100	SILT/CLAY
100 - 250	Sandy Gravelly SILT/CLAY
250-500	Clayey SAND/GRAVEL
100-400	Slate Bedrock
400-1000	Volcanic Bedrock

The combined geophysical results are summarised as follows:

Layer	Seismic Velocity (m/s)	Resistivity (Ohm-m)	Thickness (m)	Interpretation	Stiffness/ Rock Qualiy	Excavatibility
1	258-697	100-250	0.2 – 2.4 Ave. 1.1	Sandy Gravelly SILT/CLAY	Soft-Firm	Diggable
		250-500		Clayey SAND/GRAVEL	Loose-Medium dense	
		250-500		Completely Weathered Volcanic Bedrock		
2	365-1145	50-100	1 – 2.6 Ave. 1.8	Sandy Gravelly SILT/CLAY	Firm	Diggable
		100-250				
		250-500		Clayey SAND/GRAVEL	Medium Dense	
3	726-1789	50-100	1.7 – 9.5 Ave. 4.3	SILT/CLAY	Firm-Stiff	Diggable
		100-250		Sandy Gravelly SILT/CLAY		
				Highly - Moderately Weathered Volcanics	Poor-Fair	*Rippable to Marginally Rippable
4	1944-4260	100-400		Slightly Weathered – Fresh Slates	Good	Breaking/ Blasting
		400-1000		Slightly Weathered – Fresh Volcanics		

**On road sections, the cut-off velocity for excavatability will be lower as it will apply to trenches.*

The data indicates up to 4 subsurface layers. Layer 1 has been interpreted loose to medium dense clayey sand/gravel (or completely weathered rock) in the centre of the section, with soft to firm sandy gravelly clay through in the south and north of the section. Layer 1 has an average thickness of 1.1m.

Layer 2 has been only been interpreted in the south (S116-S121) and north (S107-S109) of the section as firm sandy gravelly clay layer or medium dense clayey sand/gravel (ave. thickness 1.8m). The seismic velocities indicate that Layers 1 & 2 should be diggable.

Layer 3 has been interpreted in the south (S116-S121) and north (S107-S109) of the section as firm to stiff silt/clay and sandy gravelly clay and as highly to moderately weathered bedrock though the centre of the section. This layer has an average thickness of 4.3 m. A localised channel of possible firm to stiff silt/clay has been interpreted at depth interpreted between approx. 580 and 600m along this section.

Layer 4 has been interpreted as slightly weathered to fresh bedrock. The bedrock geological map (GSI) indicates that the bedrock comprises of Campile Formation volcanic while the historical 6inch map indicates the presence of slates. As such the low bedrock resistivities (100-400 Ohm-m) in the south and north of the section have been interpreted as slate bedrock while higher resistivities in the centre of the section (400-1000 Ohm-m) have been interpreted as volcanic bedrock.

The seismic velocities indicate that the highly to moderately weathered bedrock should be rippable to marginally rippable and any excavation of the moderately to slightly weathered to fresh bedrock will require breaking/blasting.

3.4 Thermal Resistivity

Thermal resistivity readings were taken at five locations (TR1 to TP5) as shown on Drawings AGP18019_S1_01, AGP18019_S2_01 and AGP18019_S3_01 with the following results:

Sample ID	Easting	Northing	Thermal Conductivity (K) W/(m·K)	Thermal Resistivity (rho) °C·cm/W	Err	Temp(0) °C	Elevation of test MSL	Depth of test m	Material
Calibration 1			1.122	89.2	0.0122	13.99			
TP1R1	614975.12	669114.95	1.112	89.9	0.1799	9.69	30.648	1.5	in weathered rock
TP1R2			0.883	113.3	0.0382	8.78		1.5	in weathered rock
TP2R1	615043.88	669326.18	0.351	285.0	0.1338	8.26	18.494	1	in weathered rock
TP2R2			0.900	111.1	0.0332	8.19		1	in weathered rock
TP3R1	615619.00	670889.73	1.363	73.4	0.0051	9.19	20.904	1.35	in brown boulder clay
TP3R2			1.421	70.4	0.0043	9.29		1.35	in brown boulder clay
TP4R1	615344.55	671146.19	2.648	37.8	0.0134	9.62	9.062	1.5	in brown boulder clay
TP4R2			2.274	44.0	0.0063	9.78		1.5	in brown boulder clay
TP5R1	603473.91	679830.64	1.739	57.5	0.0039	10.10	14.534	1.5	in brown boulder clay
TP5R2			1.918	52.1	0.0070	10.10		1.5	in brown boulder clay
Calibration 2			0.913	109.5	0.0170	16.33			

Photos from each thermal resistivity location are contained in Appendix C.

RECOMMENDATIONS

The findings of the geophysical investigation should be reviewed on completion of the direct investigation.

Additional ERT could be carried out on selected Cable Route Sections to eliminate the ambiguity between soils and weathered bedrock material as follows:

- North of Section 3
- Centre of Section 4
- Section 5
- Section 6

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

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APPENDIX A: DETAILED METHODOLOGY

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

Electrical Resistivity Tomography (ERT)

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

Principles

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

Data Collection

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

Data Processing

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

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

Seismic refraction profiling

Principles

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

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

Data Collection

A Geode high resolution 24 channel digital seismograph, 24 10HZ vertical geophones and a 10 kg hammer were used to provide first break information, with a 24 take-out cable (2m spacing). Equipment was carried was 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. 46m profile ~15m depth). Shots from seven different positions were taken (2 x off-end, 2 x end, 3 x middle) to ensure optimum coverage of all refractors.

All profiles were surveyed to Irish National Grid using a ProXR dGPS system.

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.

First break picking in digital format was carried out using the FIRSTPIX software program to construct traveltime plots for each spread. The recorded data was processed and interpreted using the GREMIX software program. 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 by adjusting reciprocal times of off shots. Material types were assigned and estimation made of material properties, cross-referenced to borehole data.

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

Thermal Resistivity

Principles

The method used the KD2 Pro Thermal Properties Analyzer to measure both the thermal conductivity and thermal resistivity of the soil at a series of 12. locations around the site at locations as specified by the client. Two readings were recorded at c.1.5m and a second set of readings were recorded where different strata where present within the trial pit.

Data Collection

Two readings of both thermal conductivity and thermal resistivity were taken at each of the no. 5 locations. The TR1 sensor was used to take the readings, with measurements times of five minutes, after excavation of the soil.

Spatial Relocation

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

Projection:	Irish Nation Grid
Datum:	Ordnance
Coordinate units:	Meters
Altitude units:	Meters
Survey altitude reference:	MSL
Geoid model:	Republic of Ireland

APPENDIX B: EXCAVATABILITY

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

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

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

Fig.1 Rippability Rating Chart

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

APPENDIX C: THERMAL RESISTVITY PHOTOGRAPHS

Pit TR1

Pit TR1 Reinstated

Pit TR2

Pit TR2 Reinstated

Pit TR3

Pit TR3 Reinstated

Pit TR4

Pit TR4 Reinstated

Pit TR5

Pit TR5 Reinstated

APPENDIX D: DRAWINGS

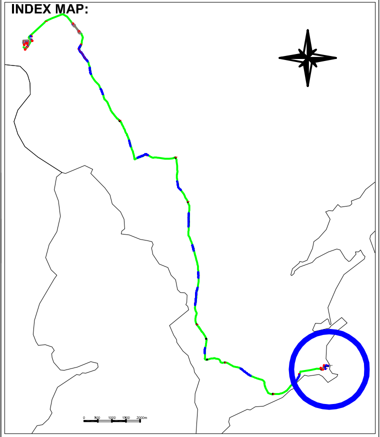
The information derived from the geophysical investigation as well as correlation with the available direct investigation is presented in the following drawings:

AGP18019_S1_01	Site 1 - Geophysical Locations	1:2000	@ A4
AGP18019_S1_02	Site 1 – EM Ground Conductivity Contours (mS/m)	1:2000	@ A4
AGP18019_S1_03	Site 1 – Summary Interpretation Map	1:2000	@ A4a
AGP18019_S1_SR1	Site 1 –Results & Interpretation SR1	1:1000	@ A3
AGP18019_S1_SR2	Site 1 –Results & Interpretation SR2	1:1000	@ A4
AGP18019_S1_SR3	Site 1 –Results & Interpretation SR3	1:1000	@ A4
AGP18019_S2_01	Site 2 - Geophysical Locations	1:2500	@ A4
AGP18019_S2_02	Site 2 – EM Ground Conductivity Contours (mS/m)	1:2500	@ A4
AGP18019_S2_03	Site 2 – Summary Interpretation Map	1:2500	@ A4
AGP18019_S2_SR4	Site 2 –Results & Interpretation SR4	1:1000	@ A4
AGP18019_S2_SR4	Site 2 –Results & Interpretation SR5	1:1000	@ A4
AGP18019_S3_01	Site 3 - Geophysical Locations	1:2500	@ A3
AGP18019_S3_02	Site 3 – EM Ground Conductivity Contours (mS/m)	1:2500	@ A3
AGP18019_S3_03	Site 3 – Summary Interpretation Map	1:2500	@ A3
AGP18019_S3_SR6/7	Site 3 –Results & Interpretation SR6 & SR7	1:1000	@ A3
AGP18019_S3_SR8	Site 3 –Results & Interpretation SR8	1:1000	@ A4
AGP18019_S3_SR9	Site 3 –Results & Interpretation SR9	1:1000	@ A4
AGP18019_S3_SR10	Site 3 –Results & Interpretation SR10	1:1000	@ A4
AGP18019_S3_SR11	Site 3 –Results & Interpretation SR11	1:1000	@ A4
AGP18019_S3_SR12	Site 3 –Results & Interpretation SR12	1:1000	@ A4
AGP18019_R1a	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R1b	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R2a	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R2a	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R3	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R4a	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R4b	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R5	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R6	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R7a	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R7b	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R8	Geophysical Locations, Results & Interpretation	1:1250	@ A3
AGP18019_R9	Geophysical Locations, Results & Interpretation	1:1250	@ A3
AGP18019_R10	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R11	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R12	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R13a	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R13b	Geophysical Locations, Results & Interpretation	1:1000	@ A3
AGP18019_R13c	Geophysical Locations, Results & Interpretation	1:1000	@ A3

SITE 1 - GEOPHYSICAL LOCATIONS

SCALE 1:2000

INDEX MAP:



LEGEND:

- Site
- EM conductivity station
- R1 2D resistivity profile
- S1 Seismic refraction profile
- TR1 Thermal Resistivity Pit
- BH01-1 ○ Borehole
- GSI Mapped Fault

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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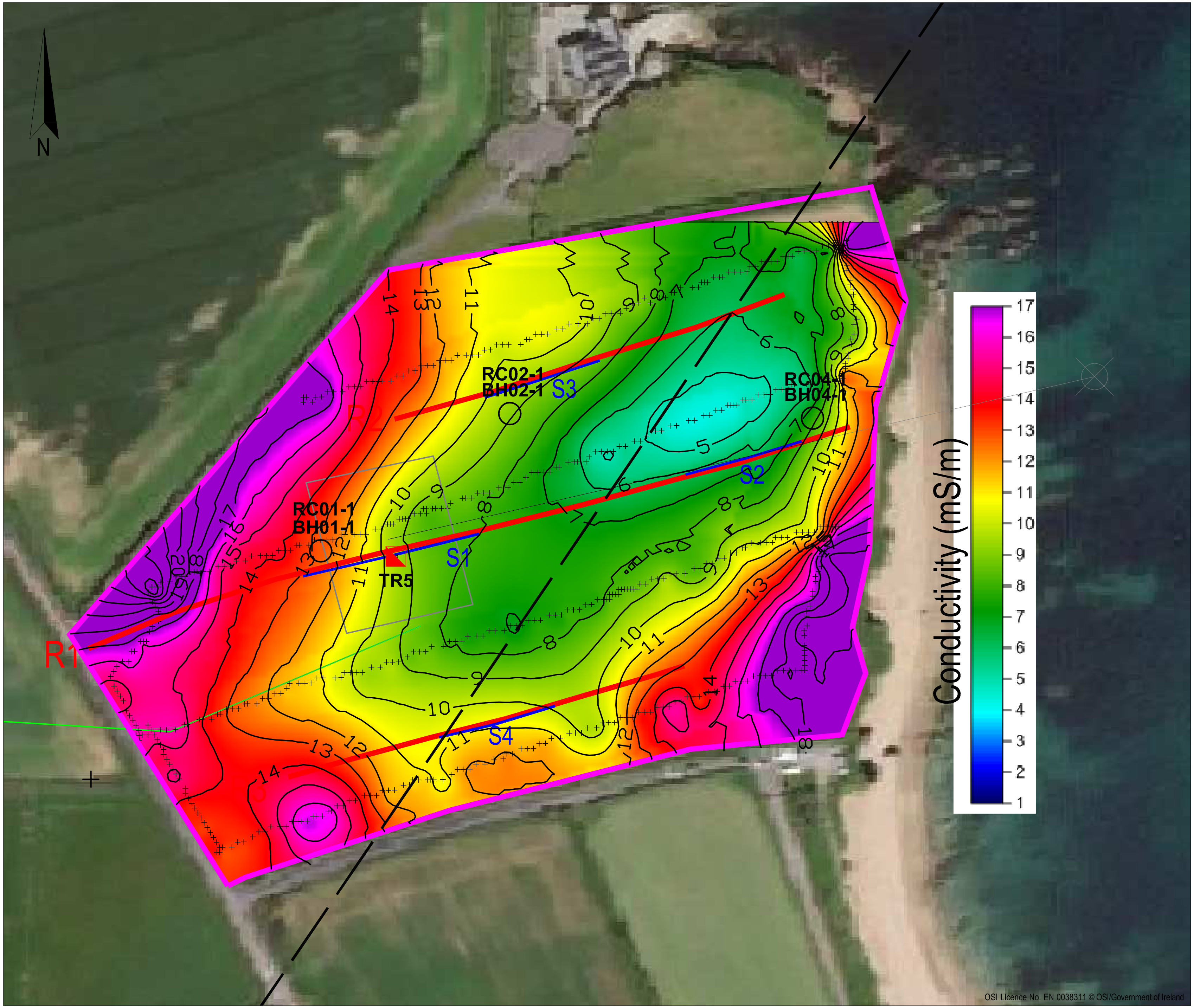
PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S1_01
SCALE:	AS INDICATED @ A4
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 1 - EM GROUND CONDUCTIVITY CONTOURS (mS/m)

SCALE 1:2000



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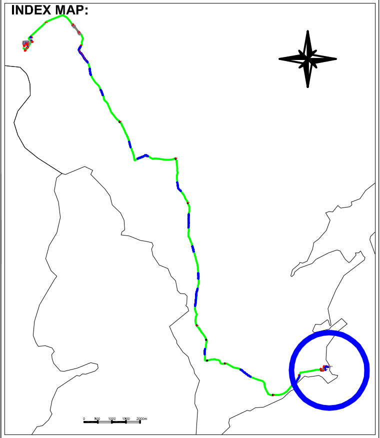

LEGEND:

▭ Site

\+ EM conductivity station

R1 — 2D resistivity profile

S1 — Seismic refraction profile

TR1 ◩ Thermal Resistivity Pit

BH01-1 ○ Borehole

- - - GSI Mapped Fault

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S1_02
SCALE:	AS INDICATED @ A4
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 1 - SUMMARY INTERPRETATION MAP

SCALE 1:2000

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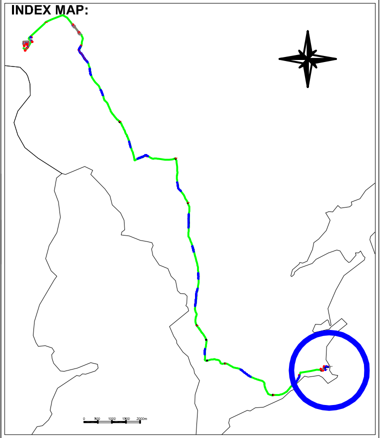
INDEX MAP:



LEGEND:

☐	Site
TR01-1 ◣	Thermal Resistivity Pit
BH01-1 ○	Borehole
▨	SILT/CLAY
▨	sandy gravelly CLAY
- - - -	GSI Mapped Fault

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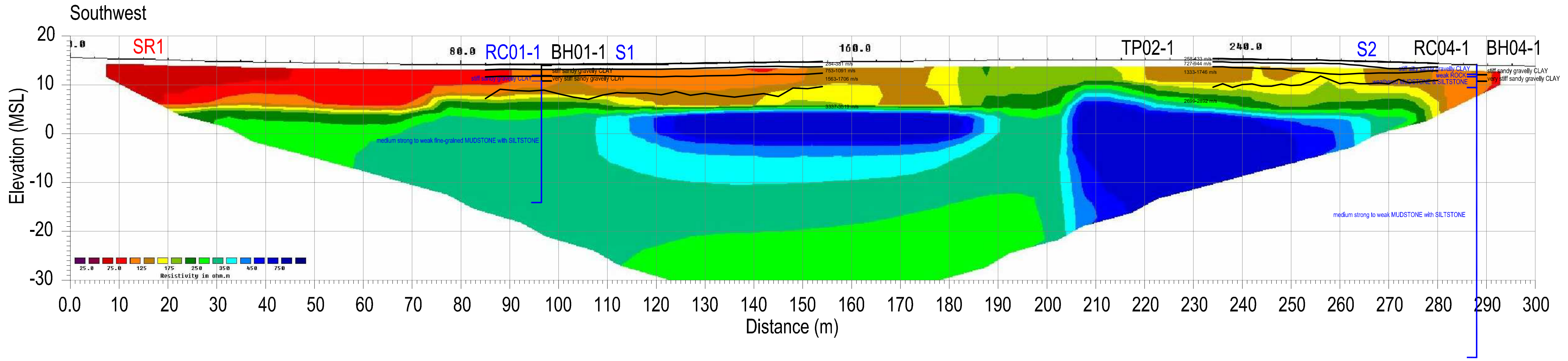
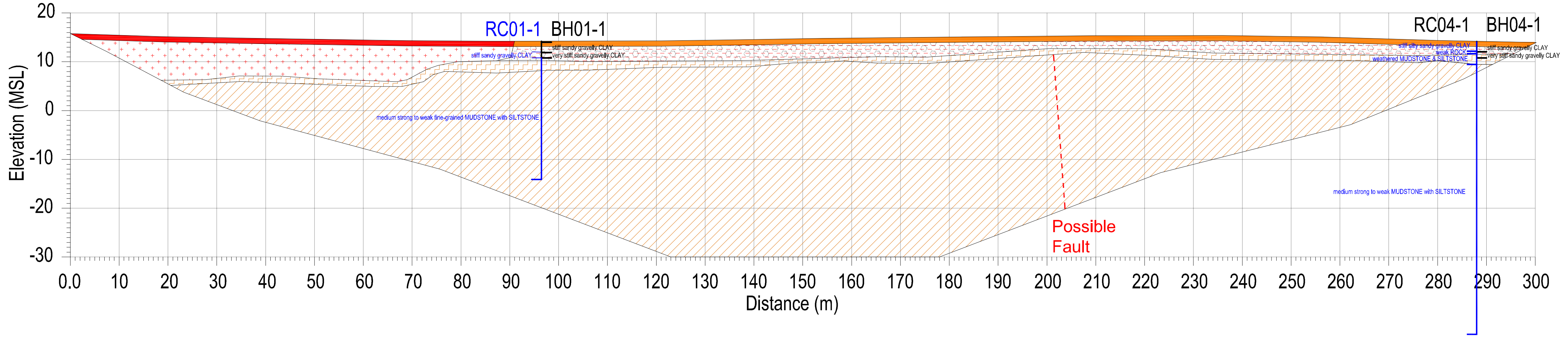
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S1_02
SCALE:	AS INDICATED @ A4
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 1: RESULTS & INTERPRETATION SR1

SCALE 1:1000





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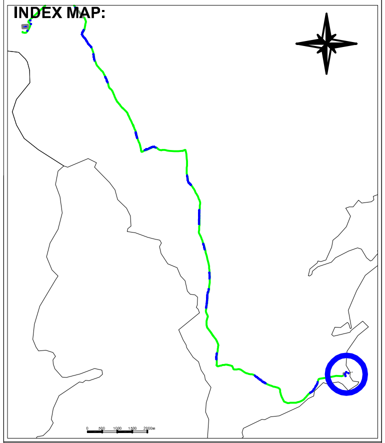

LEGEND:

- 🟥 Soft SILT/CLAY
- ▨ Firm-Stiff SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Highly to Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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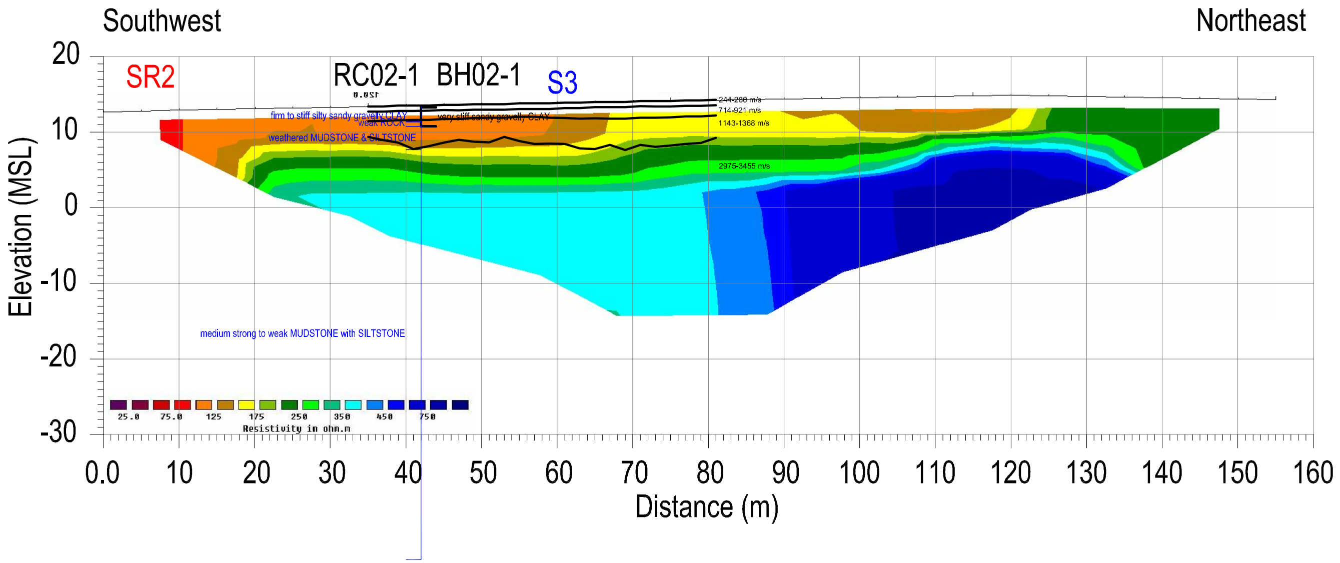
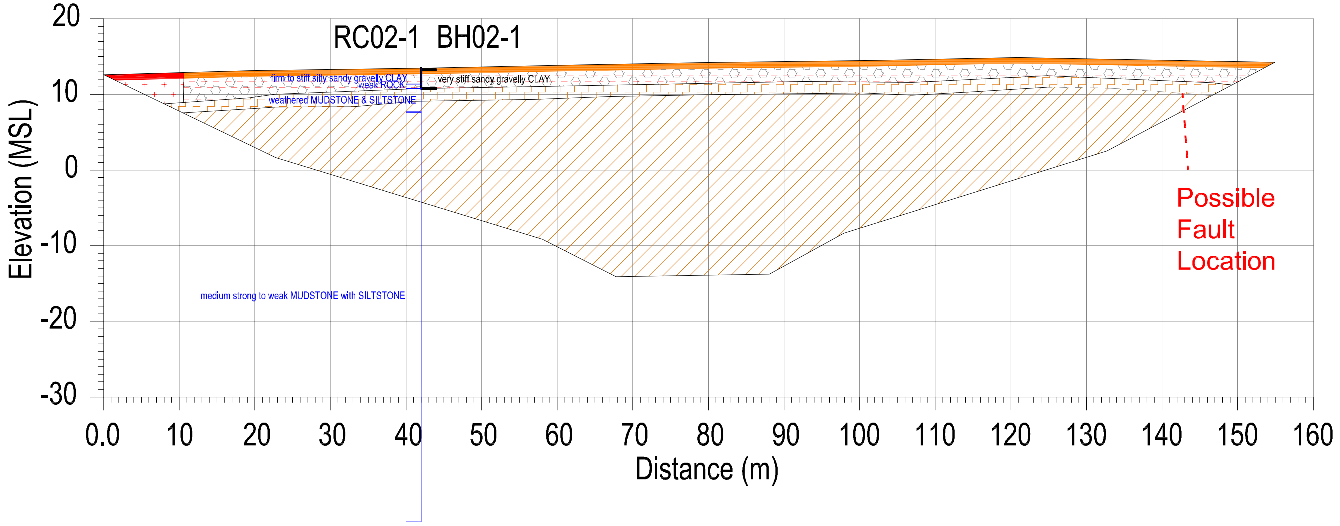
PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_S1_SR1
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TM
02	26-04-2019	YOC	

SITE 1 - RESULTS & INTERPRETATION SR2

SCALE 1:1000





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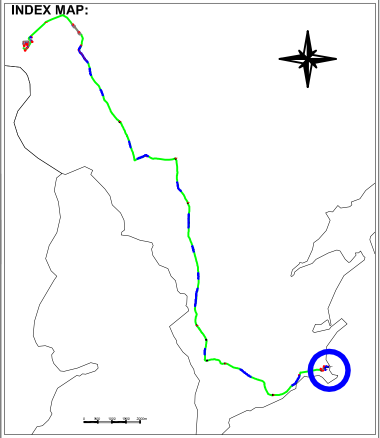

LEGEND:

- 🟥 Soft SILT/CLAY
- ▨ Firm-Stiff SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Highly to Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S1_SR2
SCALE:	AS INDICATED @ A4
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 1 - RESULTS & INTERPRETATION SR2

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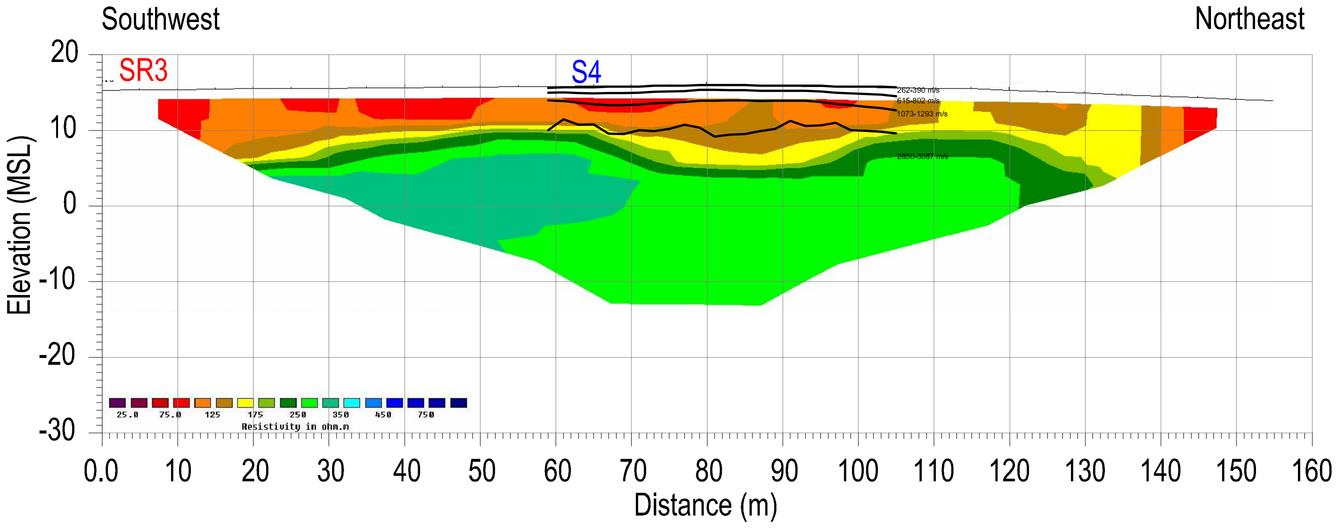

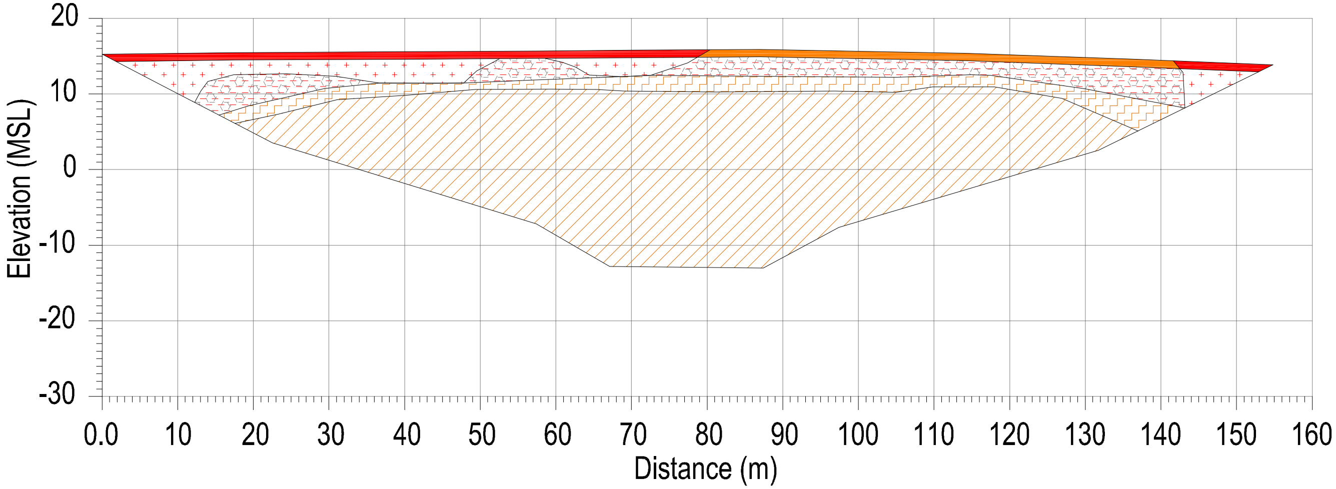

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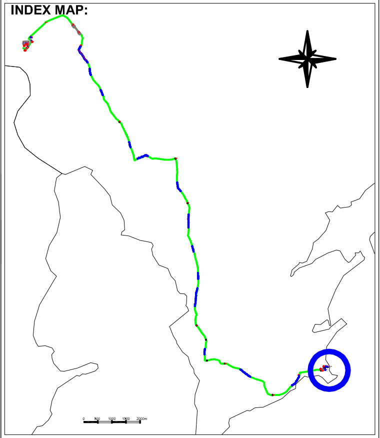

LEGEND:

- 🟥 Soft SILT/CLAY
- ▨ Firm-Stiff SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Highly to Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S1_SR3

SCALE: AS INDICATED @ A4

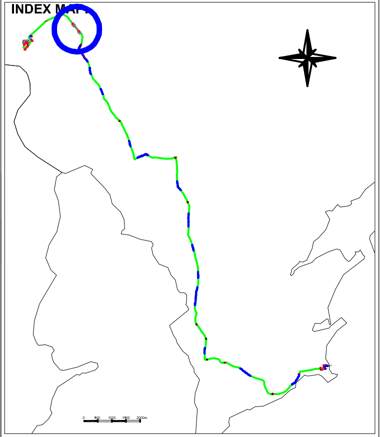
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 2 - GEOPHYSICAL LOCATIONS

SCALE 1:2500

INDEX MAP



LEGEND:

▭	Site
+	EM conductivity station
R1	2D resistivity profile
S1	Seismic refraction profile
TR1	Thermal Resistivity Pit
BH01-1 ○	Borehole

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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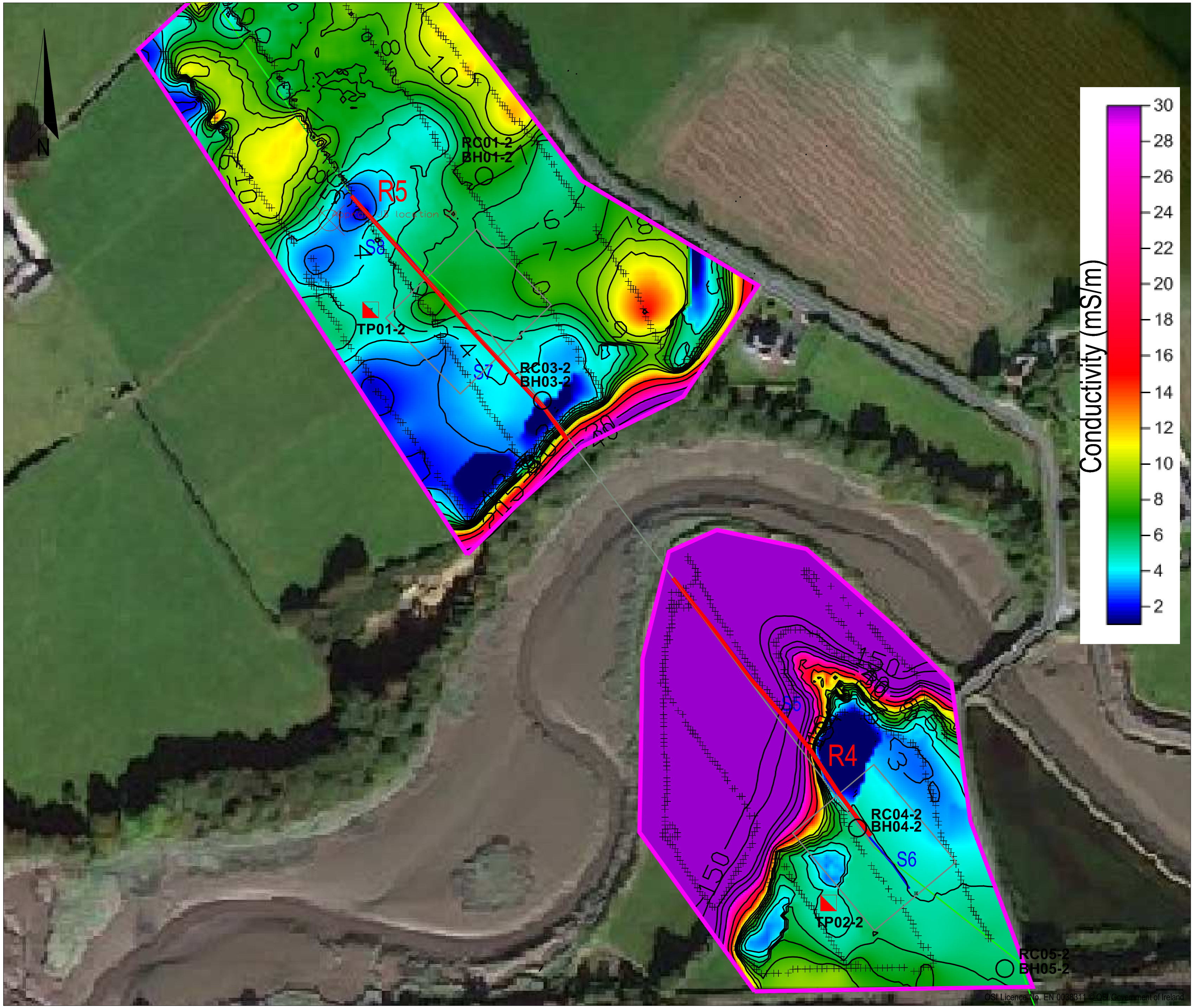
PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S2_01
SCALE:	AS INDICATED @ A4
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

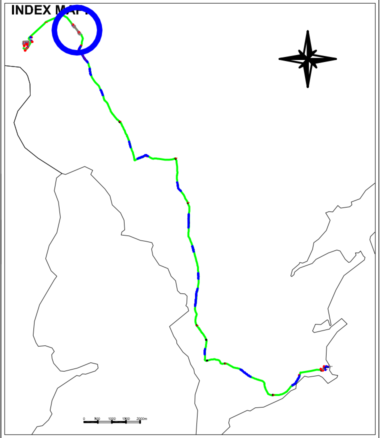
SITE 2 - EM GROUND CONDUCTIVITY CONTOURS (mS/m)

SCALE 1:2500



OSI Licence No. EN 0038311 © OSI/Government of Ireland

INDEX MAP



LEGEND:

▭	Site
+	EM conductivity station
R1	2D resistivity profile
S1	Seismic refraction profile
TR1 ◣	Thermal Resistivity Pit
BH01-1 ○	Borehole

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S2_02

SCALE: AS INDICATED @ A4

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 2 - SUMMARY INTERPRETATION MAP

SCALE 1:2500

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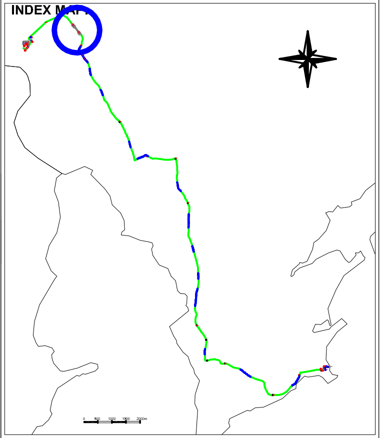

LEGEND:

- ▭ Site
- TR01-1 ◩ Thermal Resistivity Pit
- BH01-1 ○ Borehole
- ▽ Shallow Bedrock
- + Thick estuarine SILT/CLAY

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S2_03

SCALE: AS INDICATED @ A4

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 2 - RESULTS & INTERPRETATION SR4

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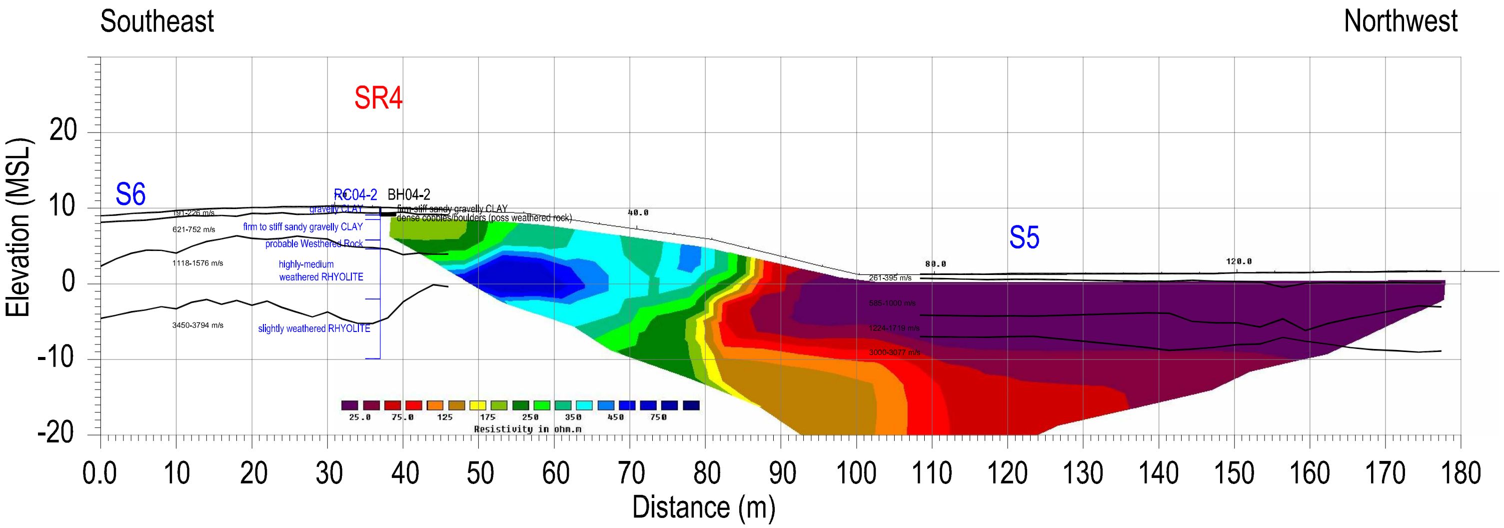

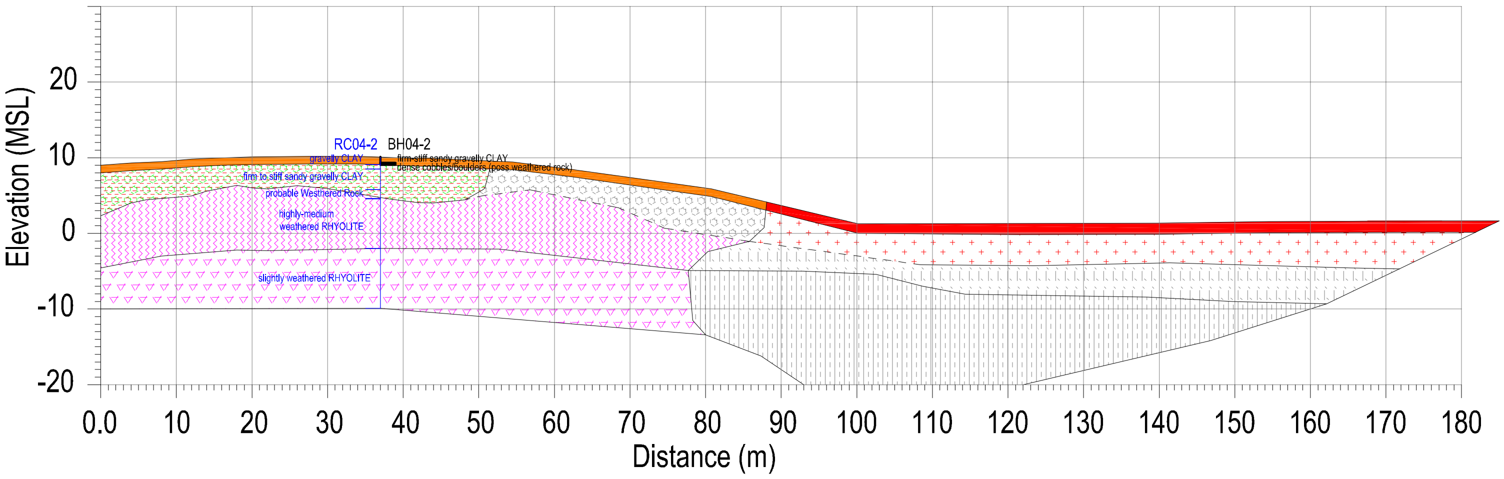

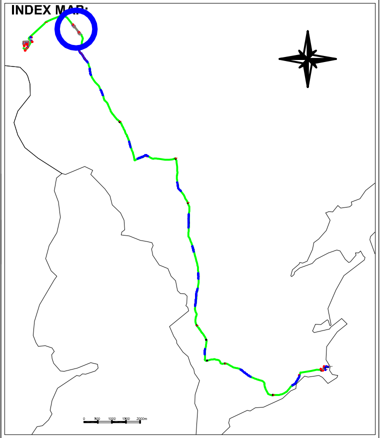

LEGEND:

- 🟥 Soft SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- 🟩 Loose clayey SAND/GRAVEL or completely weathered Volcanics
- ▨ Firm-Stiff SILT/CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Medium Dense SAND/GRAVEL or Completely-highly weathered ROCK
- ▨ Moderately weathered Slates
- ▨ Slightly weathered to Fresh Slates
- ▨ Moderately weathered Rhyolite
- ▨ Slightly weathered to Fresh Rhyolite

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S2_SR4

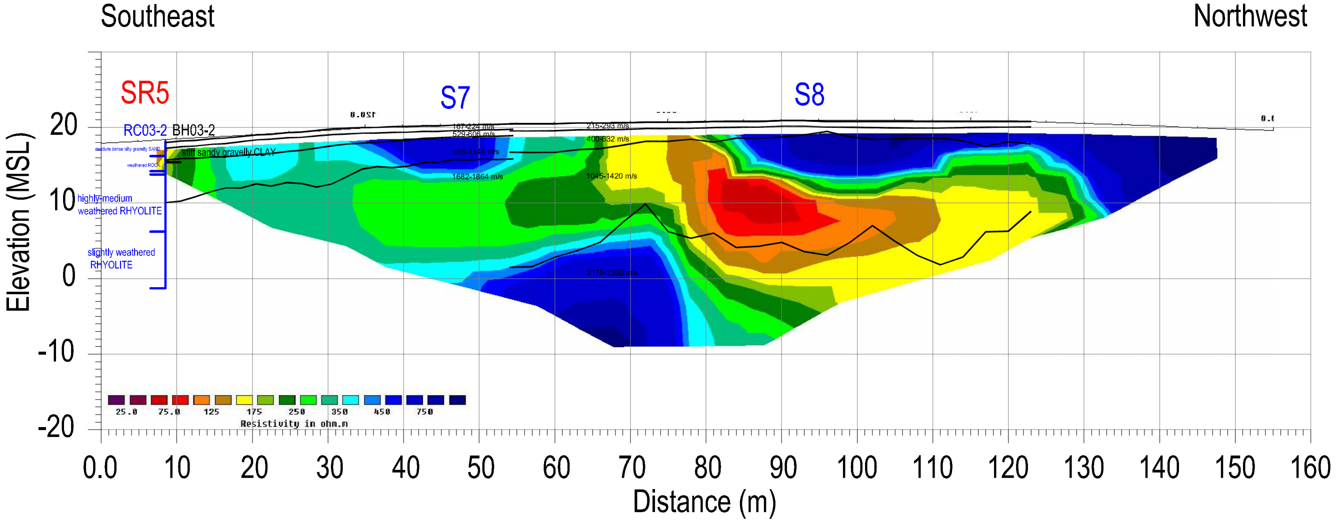
SCALE: AS INDICATED @ A4

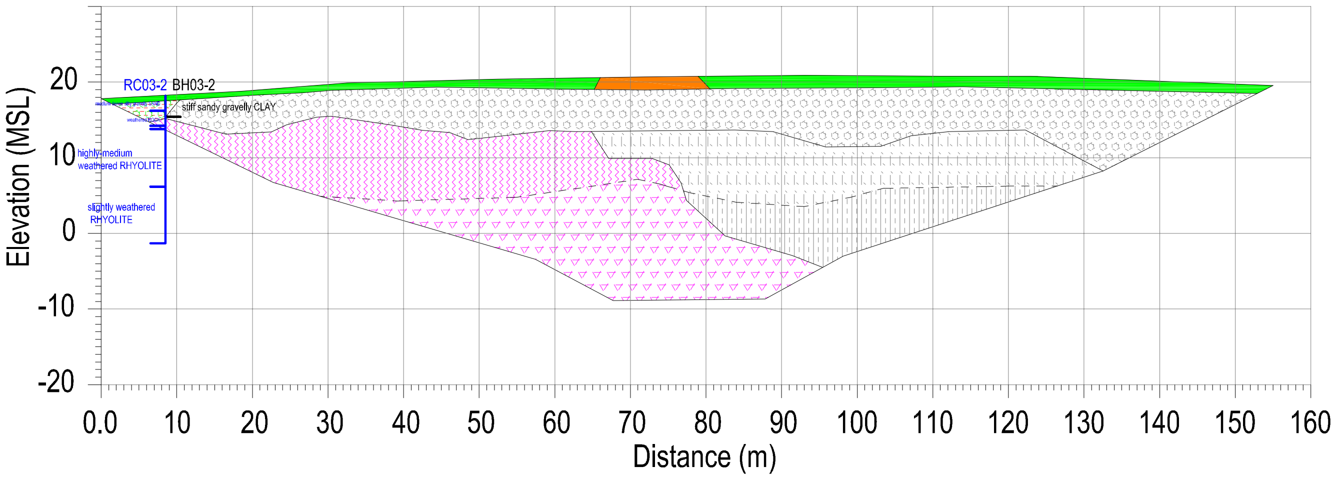
DATE: 26-04-2018

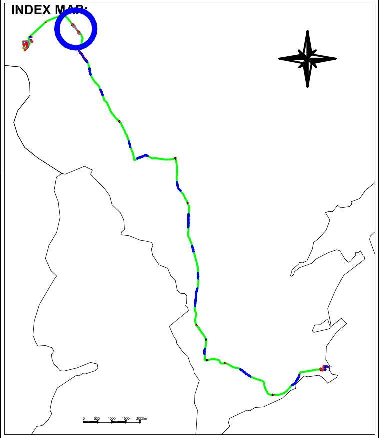
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 2 - RESULTS & INTERPRETATION SR5

SCALE 1:1000







LEGEND:

- 🟥 Soft SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- 🟩 Loose clayey SAND/GRAVEL or completely weathered Volcanics
- ▨ Firm-Stiff SILT/CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Medium Dense SAND/GRAVEL or Completely-highly weathered ROCK
- ▨ Moderately weathered Slates
- ▨ Slightly weathered to Fresh Slates
- ▨ Moderately weathered Rhyolite
- ▨ Slightly weathered to Fresh Rhyolite

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S2_SR4

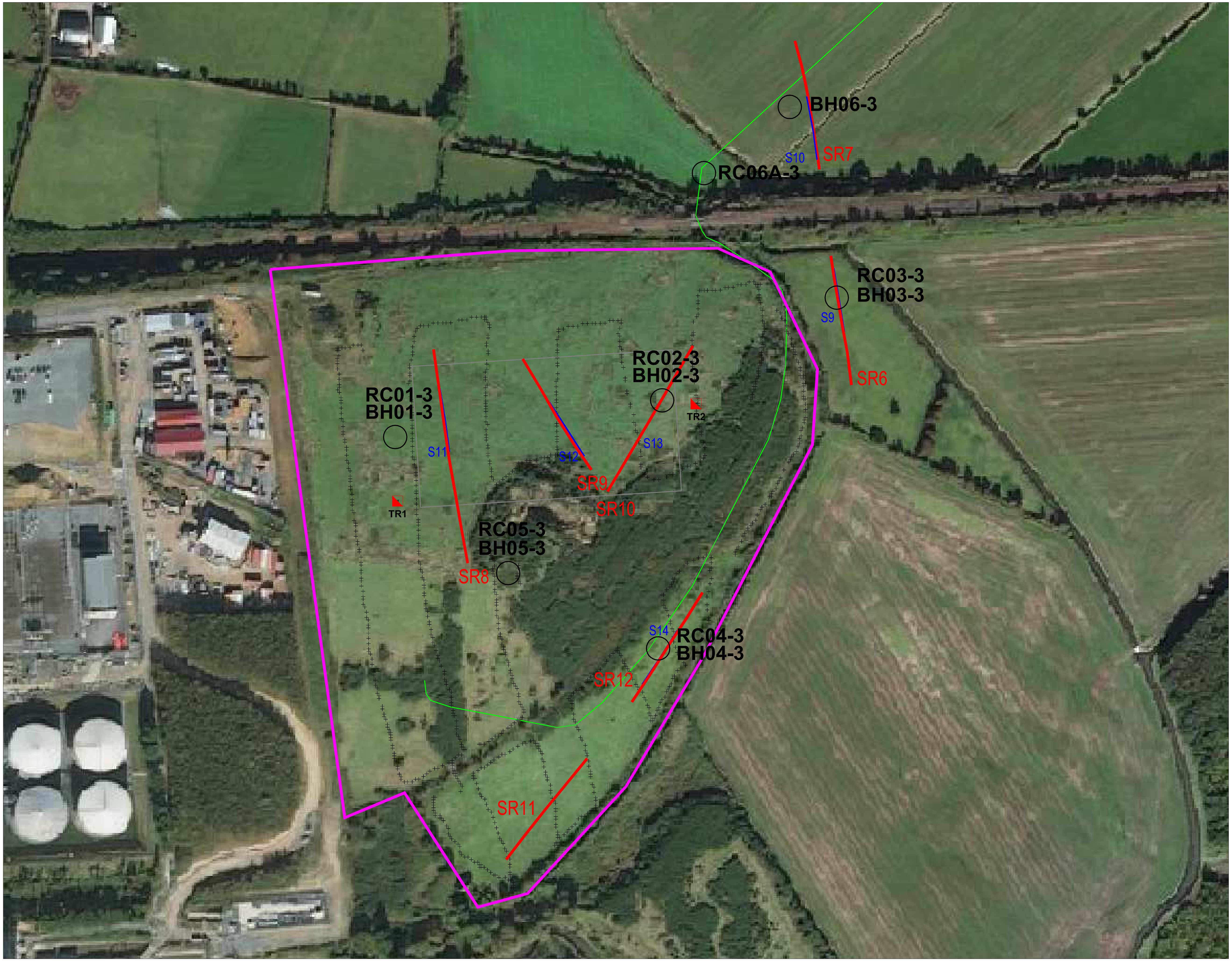
SCALE: AS INDICATED @ A4

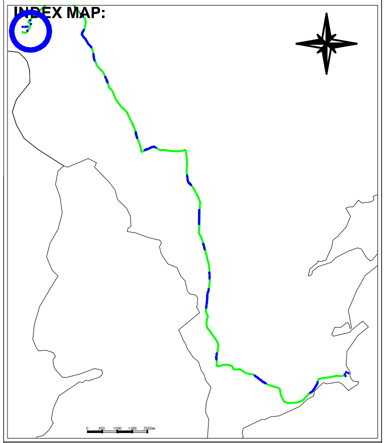
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 3: GEOPHYSICAL LOCATIONS

SCALE 1:2500





LEGEND:

🟪	Site
+	EM conductivity station
R1	2D resistivity profile
S1	Seismic refraction profile
TR1 ◪	Thermal Resistivity Pit
BH01-1	Borehole

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S3_01

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
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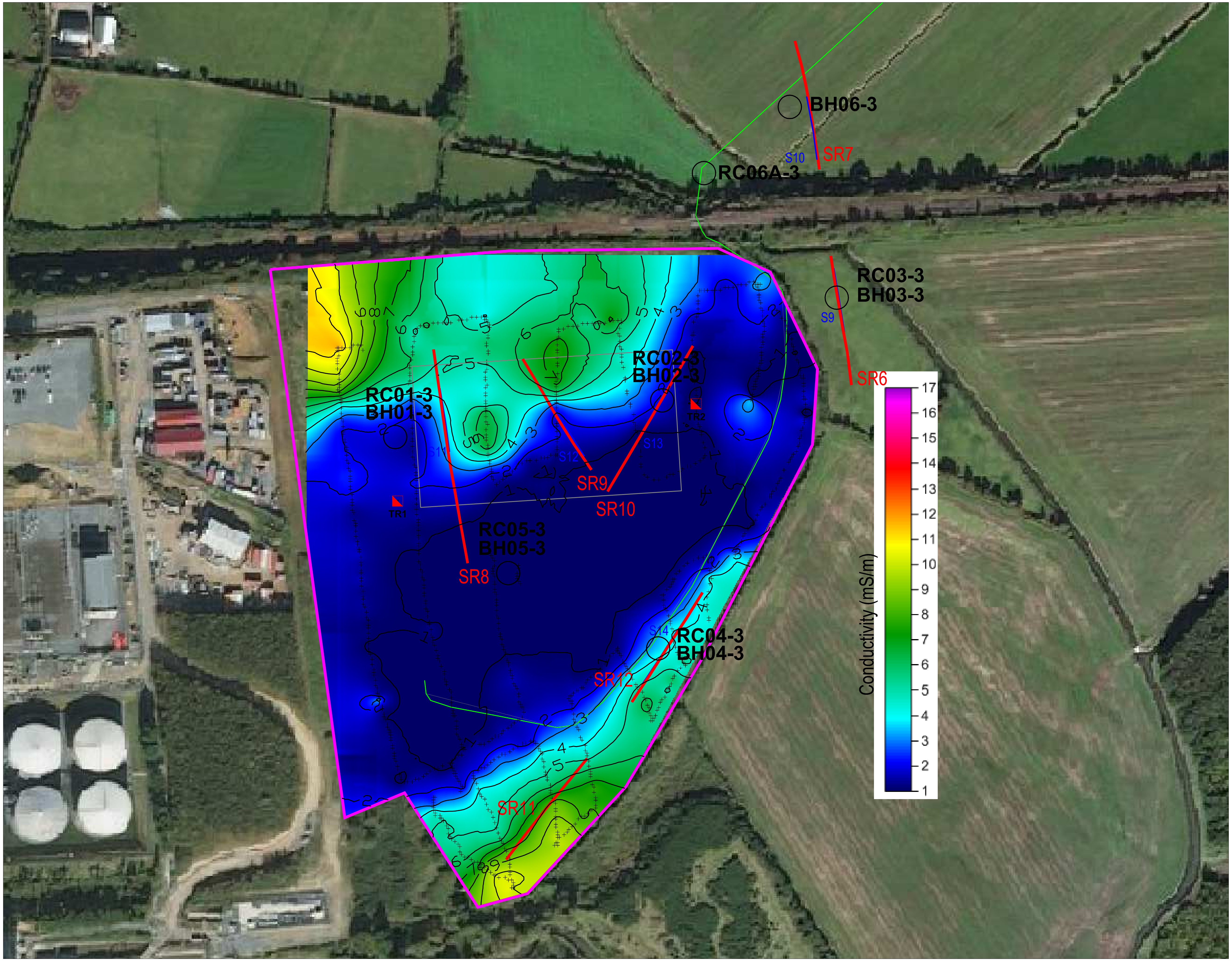
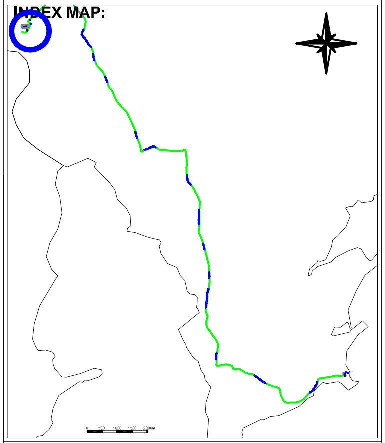
02	26-04-2019	YOC	

SITE 3: EM GROUND CONDUCTIVITY CONTOURS (mS/m)

SCALE 1:2500



INDEX MAP:



LEGEND:

▭	Site
+	EM conductivity station
R1	2D resistivity profile
S1	Seismic refraction profile
TR1 ◩	Thermal Resistivity Pit
BH01-1	Borehole

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S3_02

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
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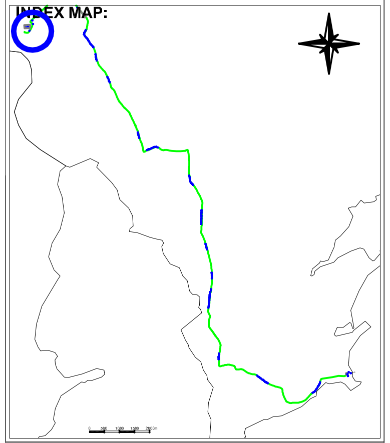
02	26-04-2019	YOC	

SITE 3: SUMMARY INTERPRETATION MAP

SCALE 1:2500

INDEX MAP:



LEGEND:

☐	Site
TR1 ◪	Thermal Resistivity Pit
BH01-1 ○	Borehole
+ + +	thick SILT/CLAY deposits
▨	thick sandy gravelly CLAY deposits
▽ ▽ ▽	shallow Rock

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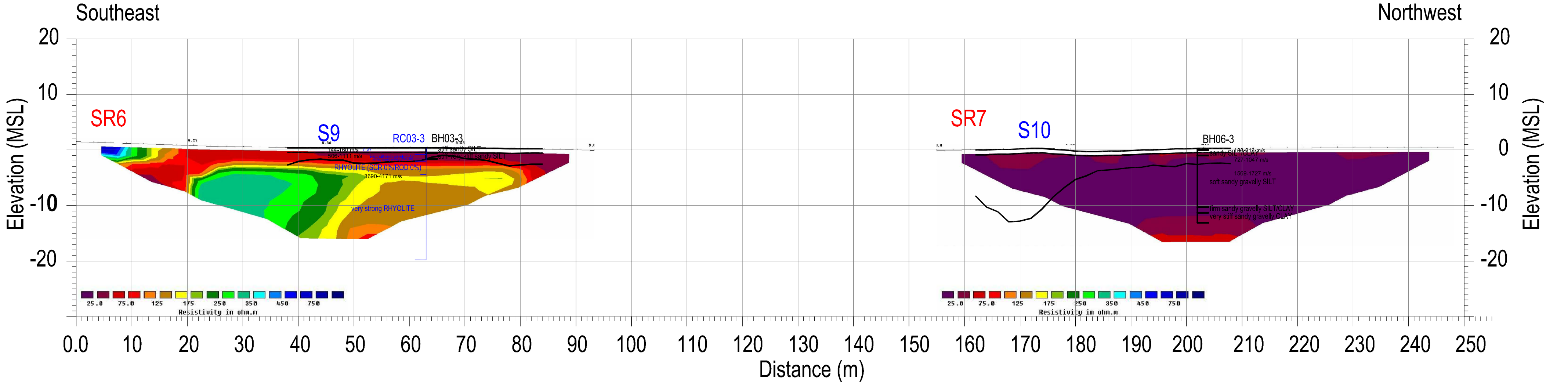
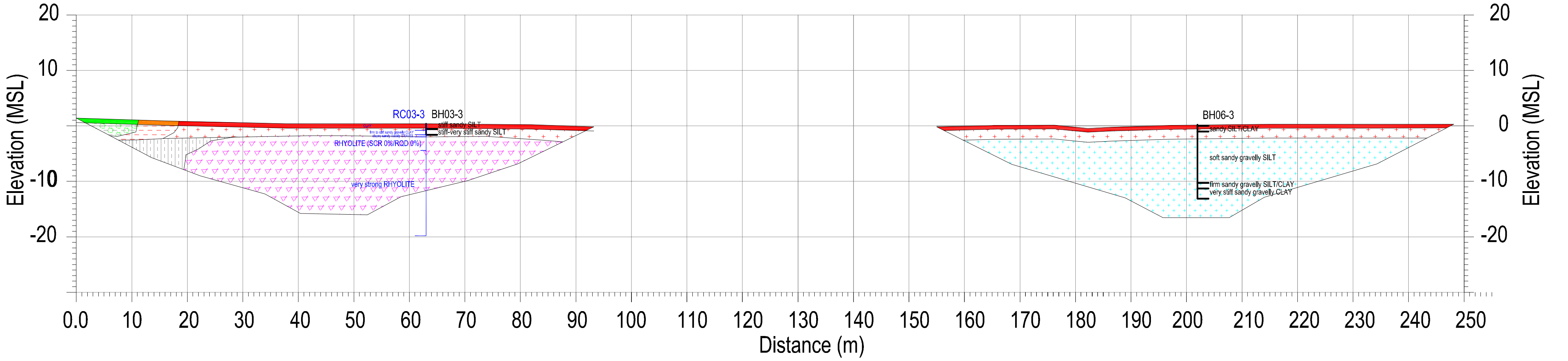
PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S3_03
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TM
02	26-04-2019	YOC	

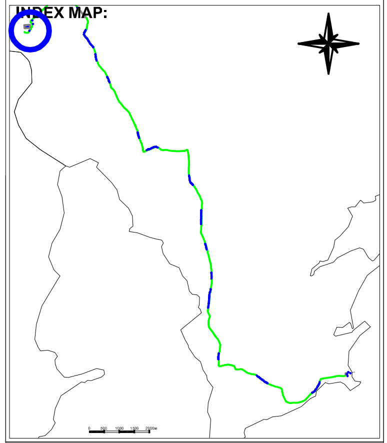
SITE 3: RESULTS & INTERPRETATION SR6 & SR7

SCALE 1:1000





INDEX MAP:



LEGEND:

- 🟥 Very Soft Estuarine SILT
- 🟧 Very Soft sandy gravelly CLAY
- 🟩 Very Loose clayey SAND/GRAVEL
- ▨ Firm Estuarine SILT
- ▨ Firm sandy gravelly CLAY
- ▨ Med. dense-Dense clayey SAND/GRAVEL
- ▨ Saturated Estuarine SILT
- ▨ Slightly weathered to Fresh Slates
- ▨ Slightly weathered to Fresh Rhyolite

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT: GREENLINK

DRAWING NO: AGP18019_S3_SR6 & SR7

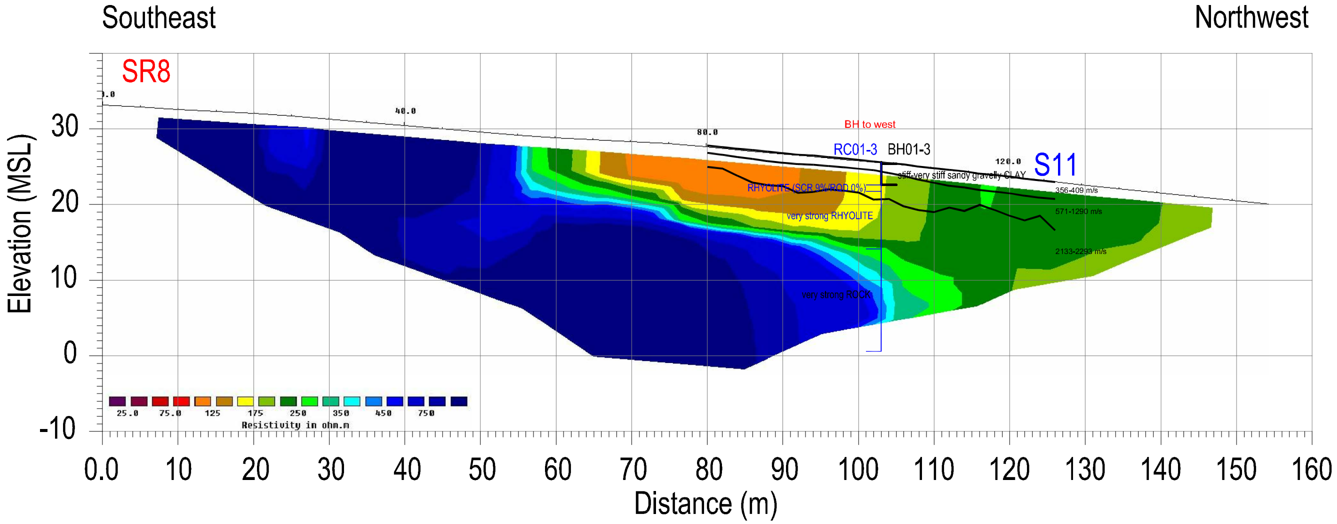
SCALE: AS INDICATED @ A3

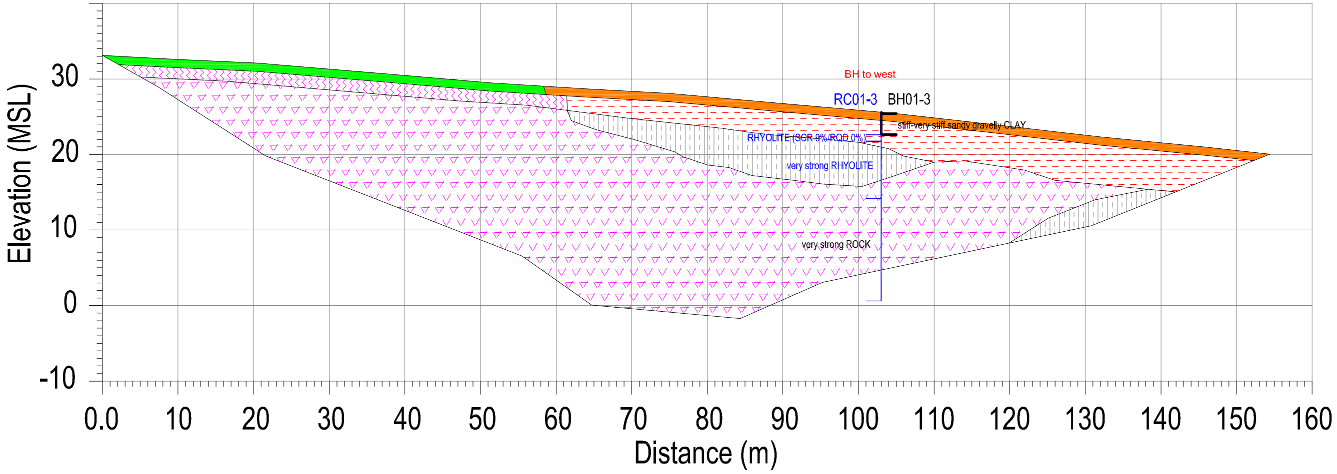
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TM
02	26-04-2019	YOC	

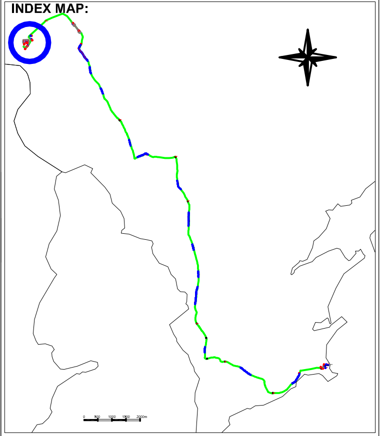
SITE 3 - RESULTS & INTERPRETATION SR8

SCALE 1:1000





INDEX MAP:



LEGEND:

- 🟥 Soft SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- 🟩 Loose clayey SAND/GRAVEL or completely weathered Volcanics
- ▨ Firm-Stiff SILT/CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Med. dense-Dense clayey SAND/GRAVEL
- ▨ Highly to Moderately weathered Slates
- ▨ Slightly weathered to Fresh Slates
- ▨ Highly to Moderately weathered Rhyolite
- ▨ Slightly weathered to Fresh Rhyolite

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S3_SR8

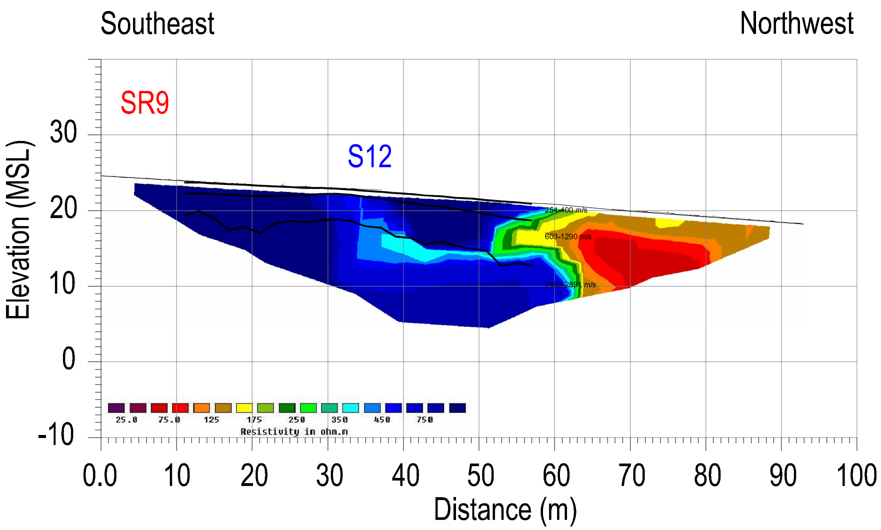
SCALE: AS INDICATED @ A4

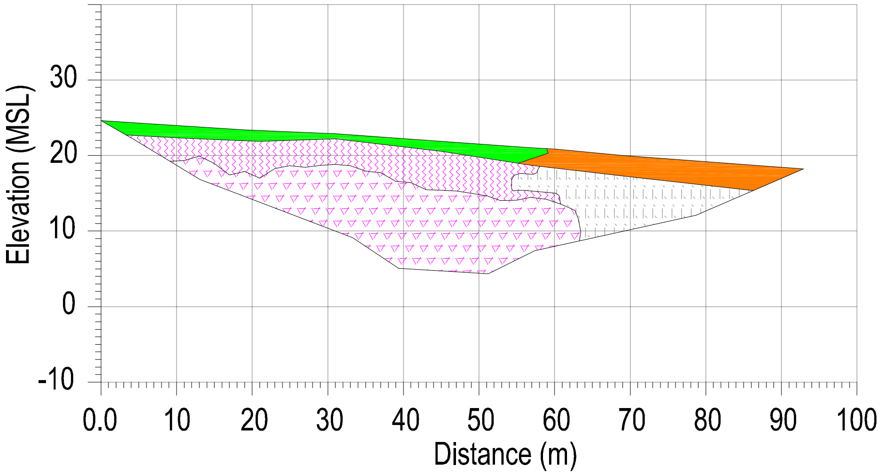
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 3 - RESULTS & INTERPRETATION SR9

SCALE 1:1000





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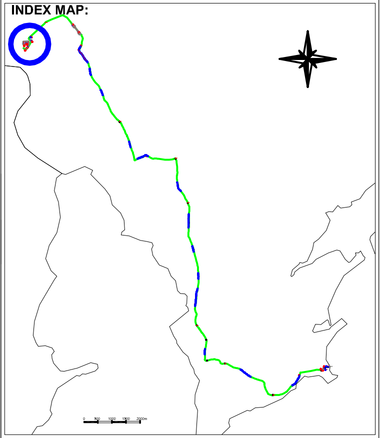

LEGEND:

🟥	Soft SILT/CLAY
🟧	Soft sandy gravelly CLAY
🟩	Loose clayey SAND/GRAVEL or completely weathered Volcanics
▨	Firm-Stiff SILT/CLAY
▨	Firm-Stiff sandy gravelly CLAY
▨	Med. dense-Dense clayey SAND/GRAVEL
▨	Highly to Moderately weathered Slates
▨	Slightly weathered to Fresh Slates
▨	Highly to Moderately weathered Rhyolite
▨	Slightly weathered to Fresh Rhyolite

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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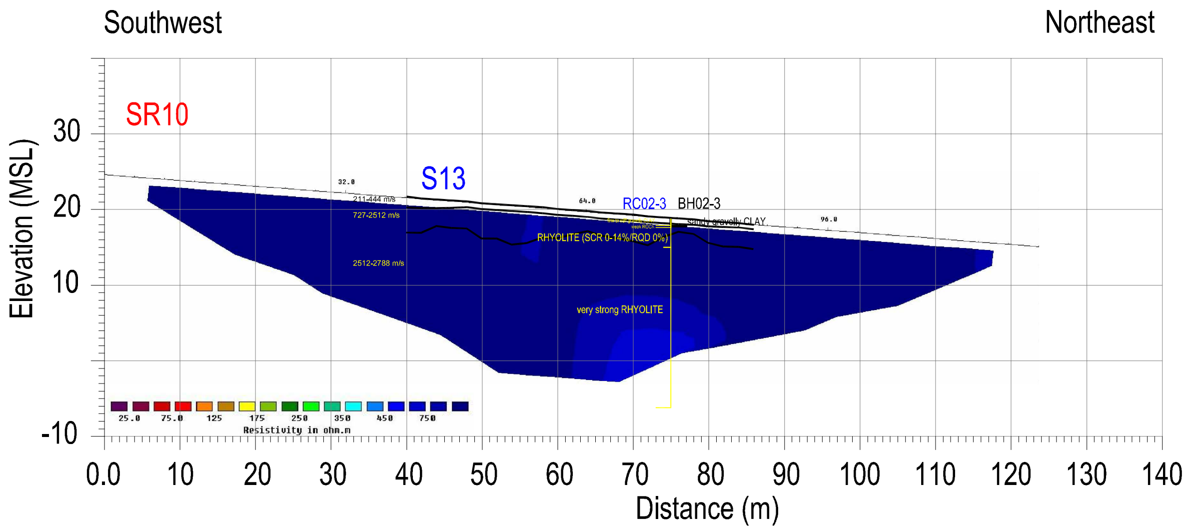
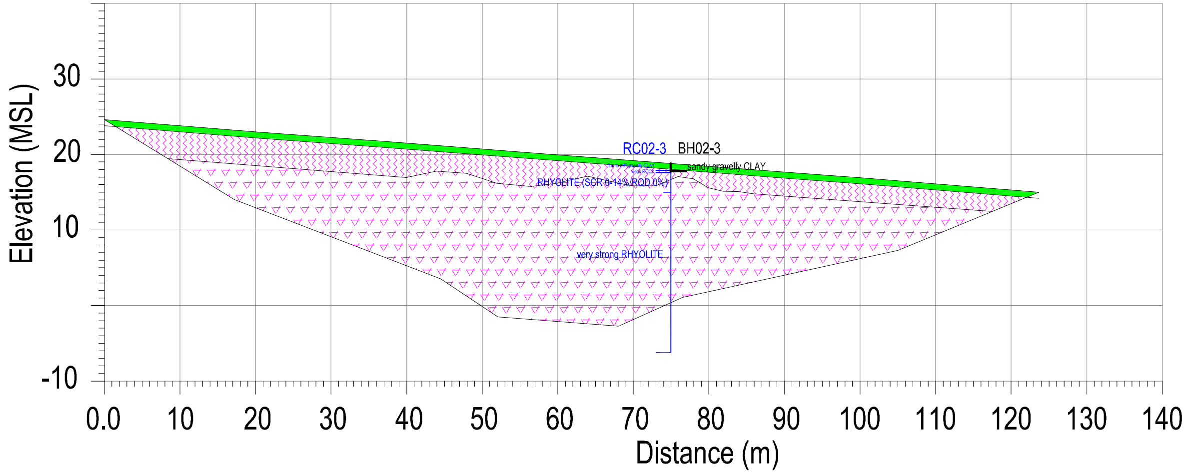
PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_S3_SR9
SCALE:	AS INDICATED @ A4
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 3 - RESULTS & INTERPRETATION SR10

SCALE 1:1000





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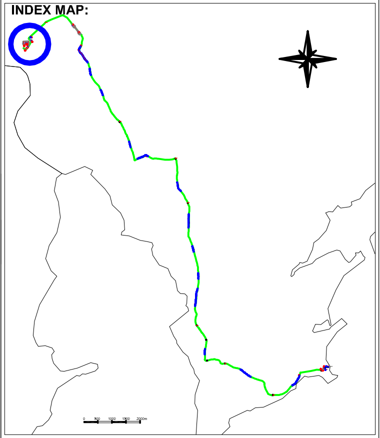

LEGEND:

🟥	Soft SILT/CLAY
🟧	Soft sandy gravelly CLAY
🟩	Loose clayey SAND/GRAVEL or completely weathered Volcanics
▨	Firm-Stiff SILT/CLAY
▨	Firm-Stiff sandy gravelly CLAY
▨	Med. dense-Dense clayey SAND/GRAVEL
▨	Highly to Moderately weathered Slates
▨	Slightly weathered to Fresh Slates
▨	Highly to Moderately weathered Rhyolite
▨	Slightly weathered to Fresh Rhyolite

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S3_SR10

SCALE: AS INDICATED @ A4

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 3 - RESULTS & INTERPRETATION SR11
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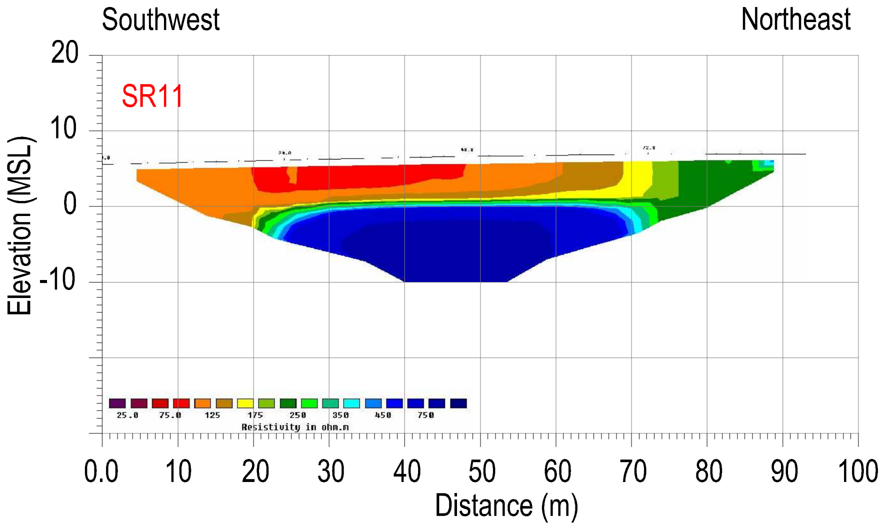

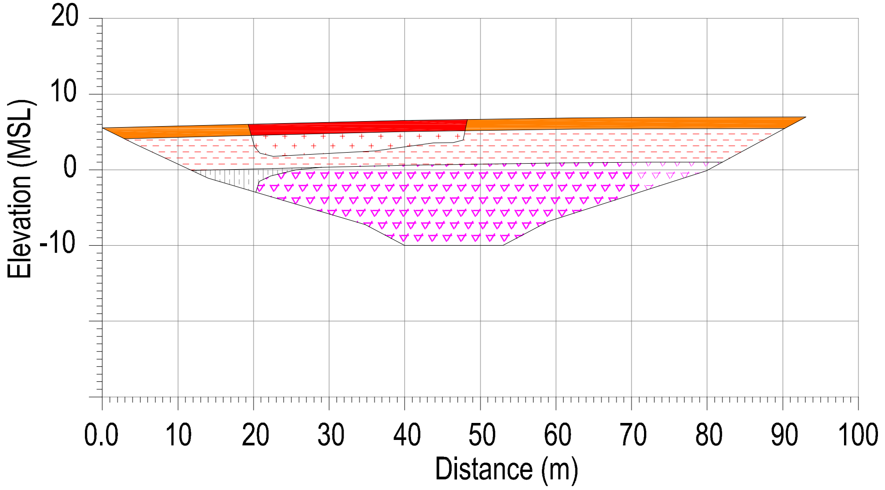

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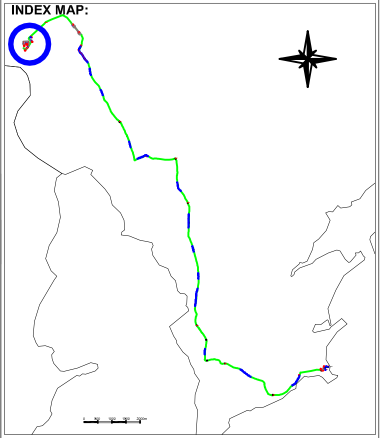

LEGEND:

- 🟥 Soft SILT/CLAY
- 🟧 Soft sandy gravelly CLAY
- 🟩 Loose clayey SAND/GRAVEL or completely weathered Volcanics
- ▨ Firm-Stiff SILT/CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Med. dense-Dense clayey SAND/GRAVEL
- ▨ Highly to Moderately weathered Slates
- ▨ Slightly weathered to Fresh Slates
- ▨ Highly to Moderately weathered Rhyolite
- ▨ Slightly weathered to Fresh Rhyolite

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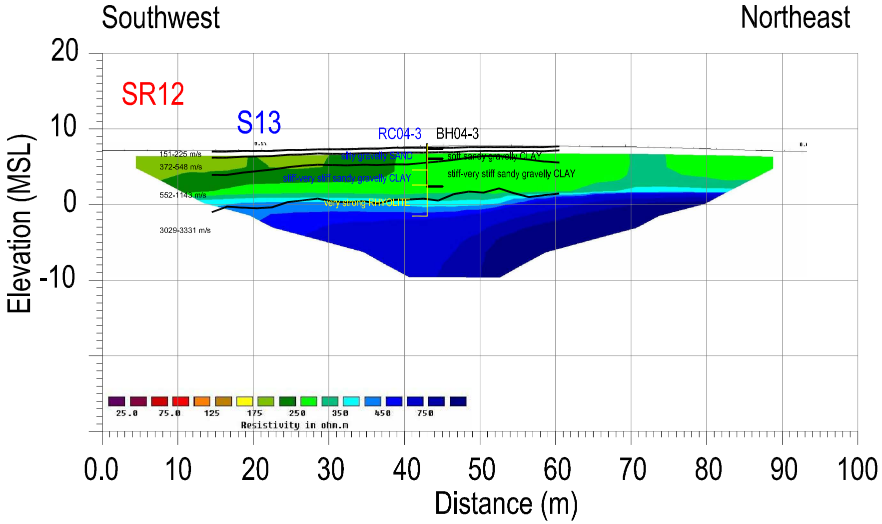
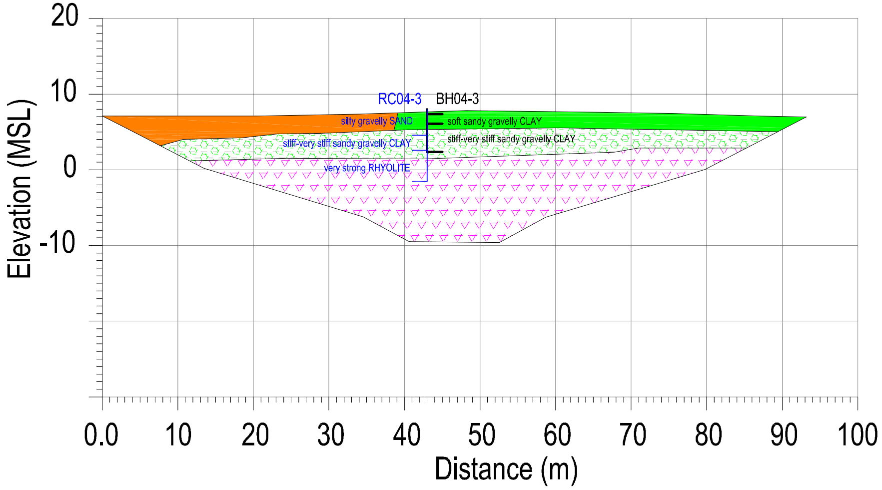
PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY
CLIENT.: GREENLINK
DRAWING NO: AGP18019_S3_SR11
SCALE: AS INDICATED @ A4
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

SITE 3 - RESULTS & INTERPRETATION SR12

SCALE 1:1000





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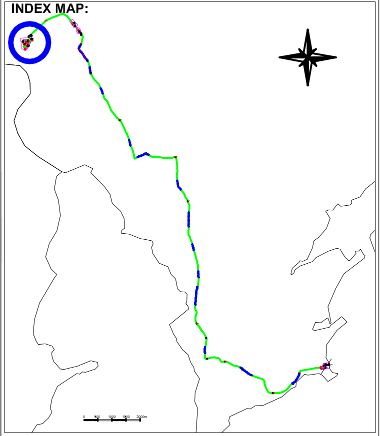

LEGEND:

🟥	Soft SILT/CLAY
🟧	Soft sandy gravelly CLAY
🟩	Loose clayey SAND/GRAVEL or completely weathered Volcanics
▨	Firm-Stiff SILT/CLAY
▨	Firm-Stiff sandy gravelly CLAY
▨	Med. dense-Dense clayey SAND/GRAVEL
▨	Highly to Moderately weathered Slates
▨	Slightly weathered to Fresh Slates
▨	Highly to Moderately weathered Rhyolite
▨	Slightly weathered to Fresh Rhyolite

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_S3_SR12

SCALE: AS INDICATED @ A4

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL
02	26-04-2019	YOC	

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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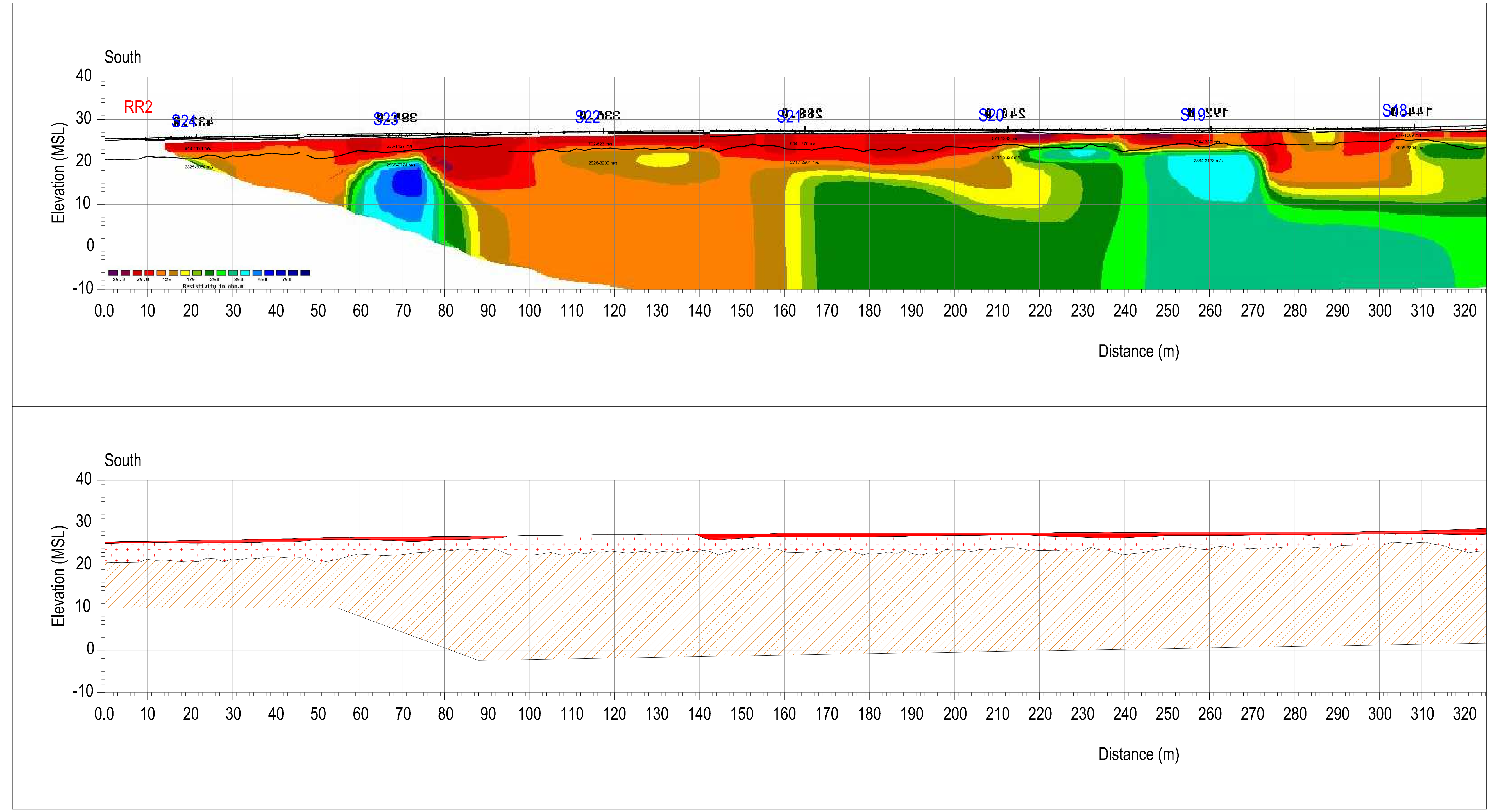
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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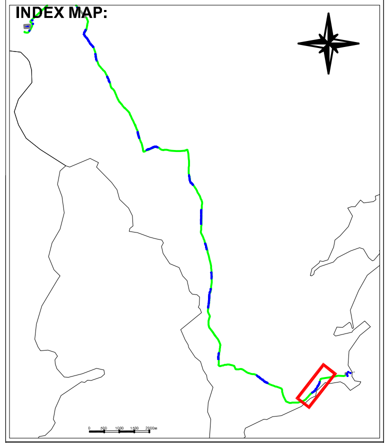

LEGEND:

R1	2D resistivity profile
S1	Seismic refraction profile
🟧	Soft/Loose SOIL
🟥	Soft-Firm SILT/CLAY
⬛	Soft-Firm/Loose-Medium Dense SOIL
🟩	Firm/Medium Dense SOIL
▨	Firm-Stiff/Medium Dense-Dense SOIL
▨	Firm-Stiff SILT/CLAY
▨	Highly to Moderately weathered VOLCANICS
▨	Slightly weathered to Fresh VOLCANICS
▨	Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
▨	Highly to Moderately weathered Slates and Siltstones
▨	Moderately to Slightly weathered Slates and Siltstones
▨	Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
▨	Moderately weathered Mudstones with Siltstones
▨	Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT: GREENLINK

DRAWING NO: AGP18019_R1a

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

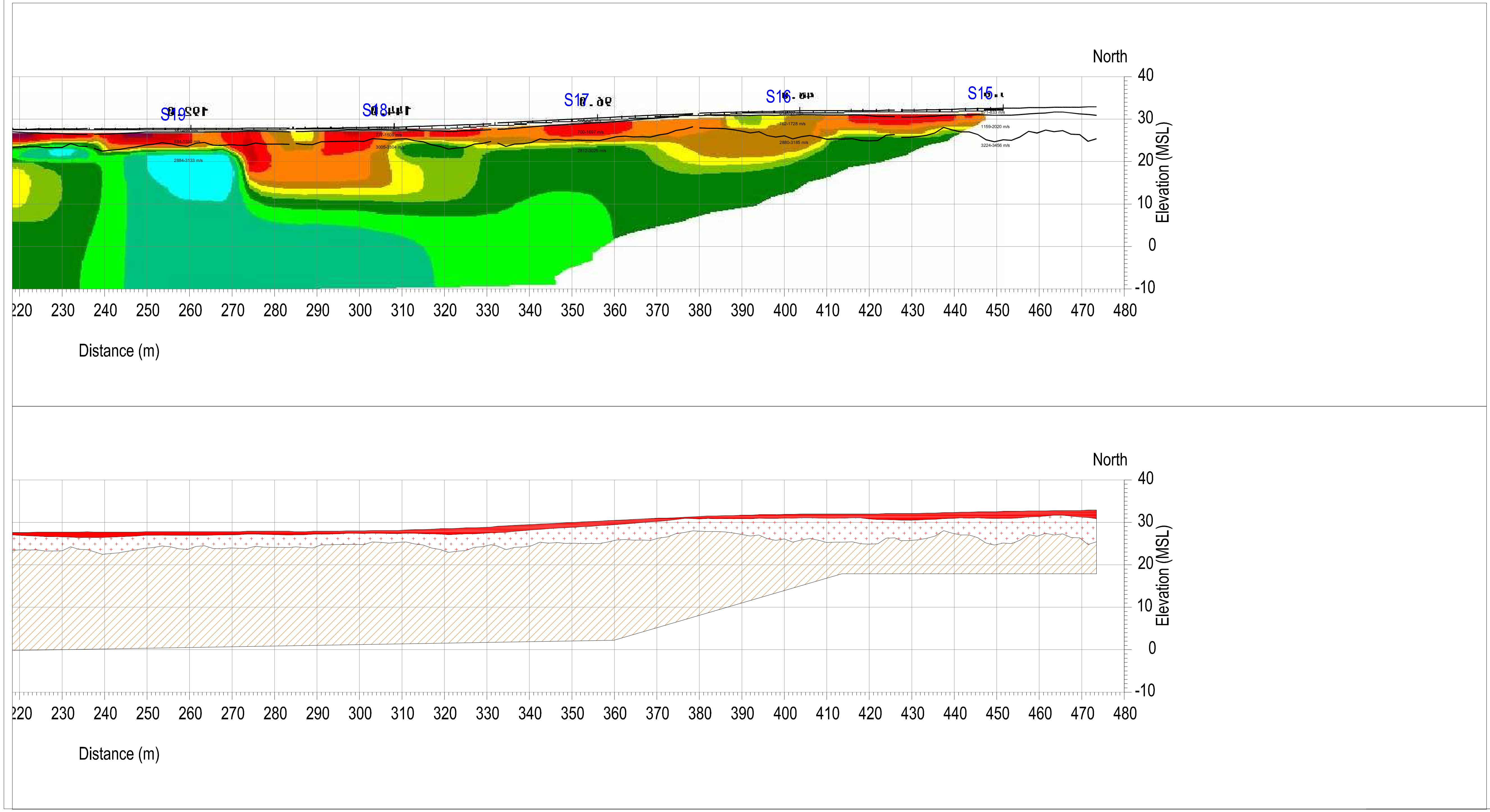
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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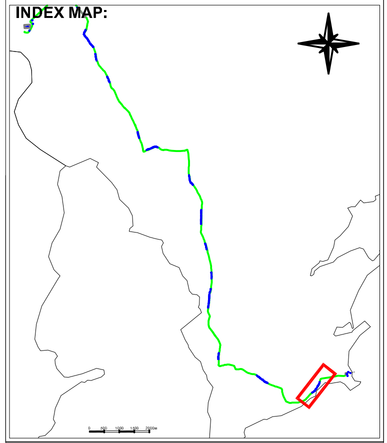

LEGEND:

R1	2D resistivity profile
S1	Seismic refraction profile
🟧	Soft/Loose SOIL
🟥	Soft-Firm SILT/CLAY
⬛	Soft-Firm/Loose-Medium Dense SOIL
🟩	Firm/Medium Dense SOIL
▨	Firm-Stiff/Medium Dense-Dense SOIL
▨	Firm-Stiff SILT/CLAY
▨	Highly to Moderately weathered VOLCANICS
▨	Slightly weathered to Fresh VOLCANICS
▨	Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
▨	Highly to Moderately weathered Slates and Siltstones
▨	Moderately to Slightly weathered Slates and Siltstones
▨	Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
▨	Moderately weathered Mudstones with Siltstones
▨	Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_R1b
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

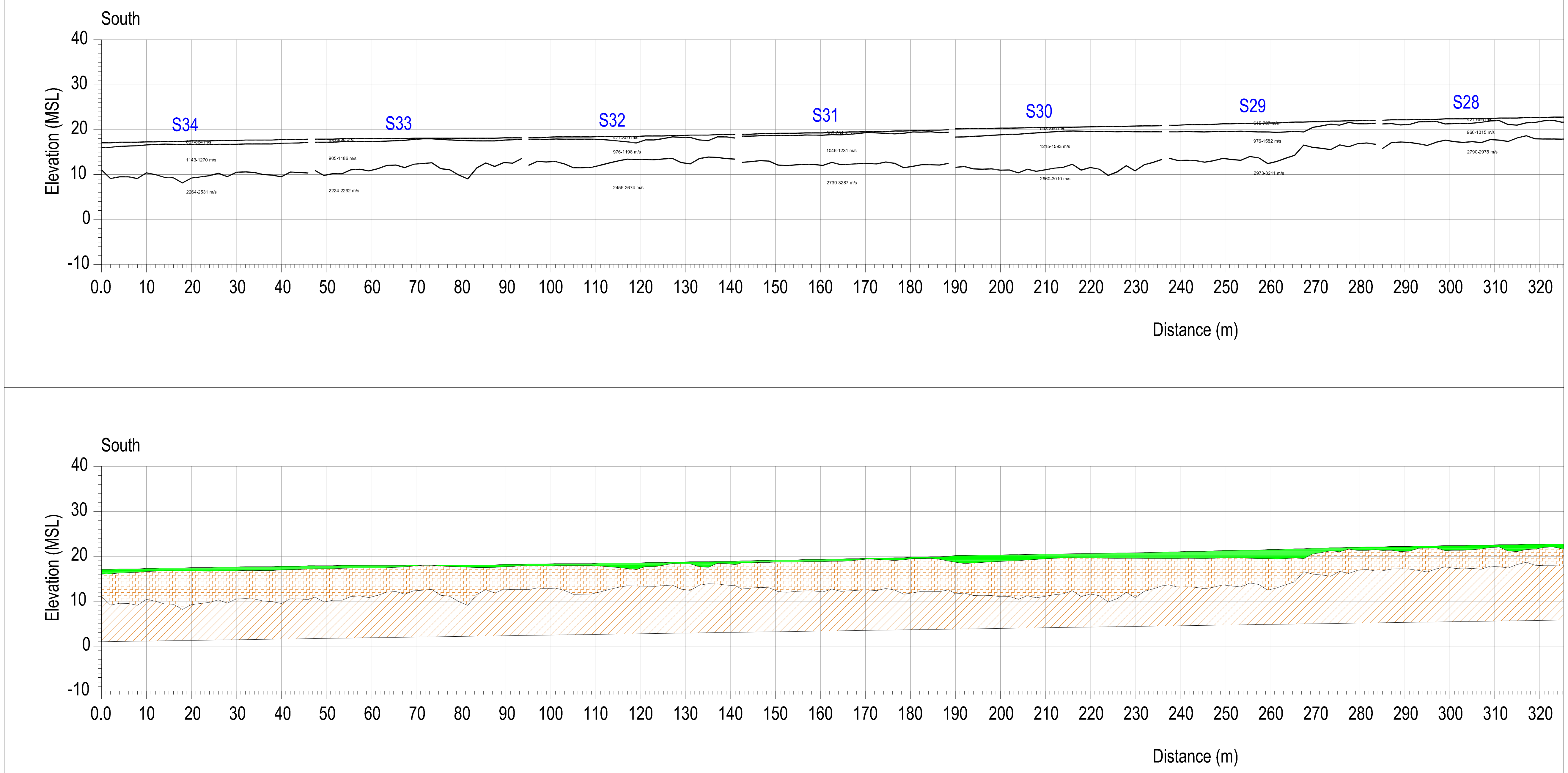
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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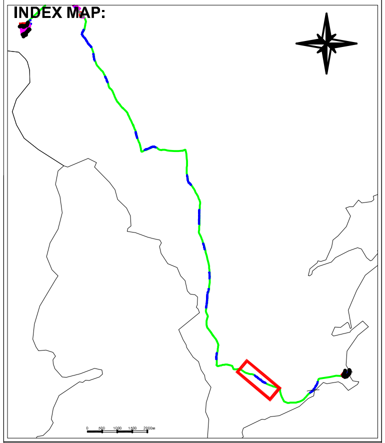

LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ▨ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_R2a
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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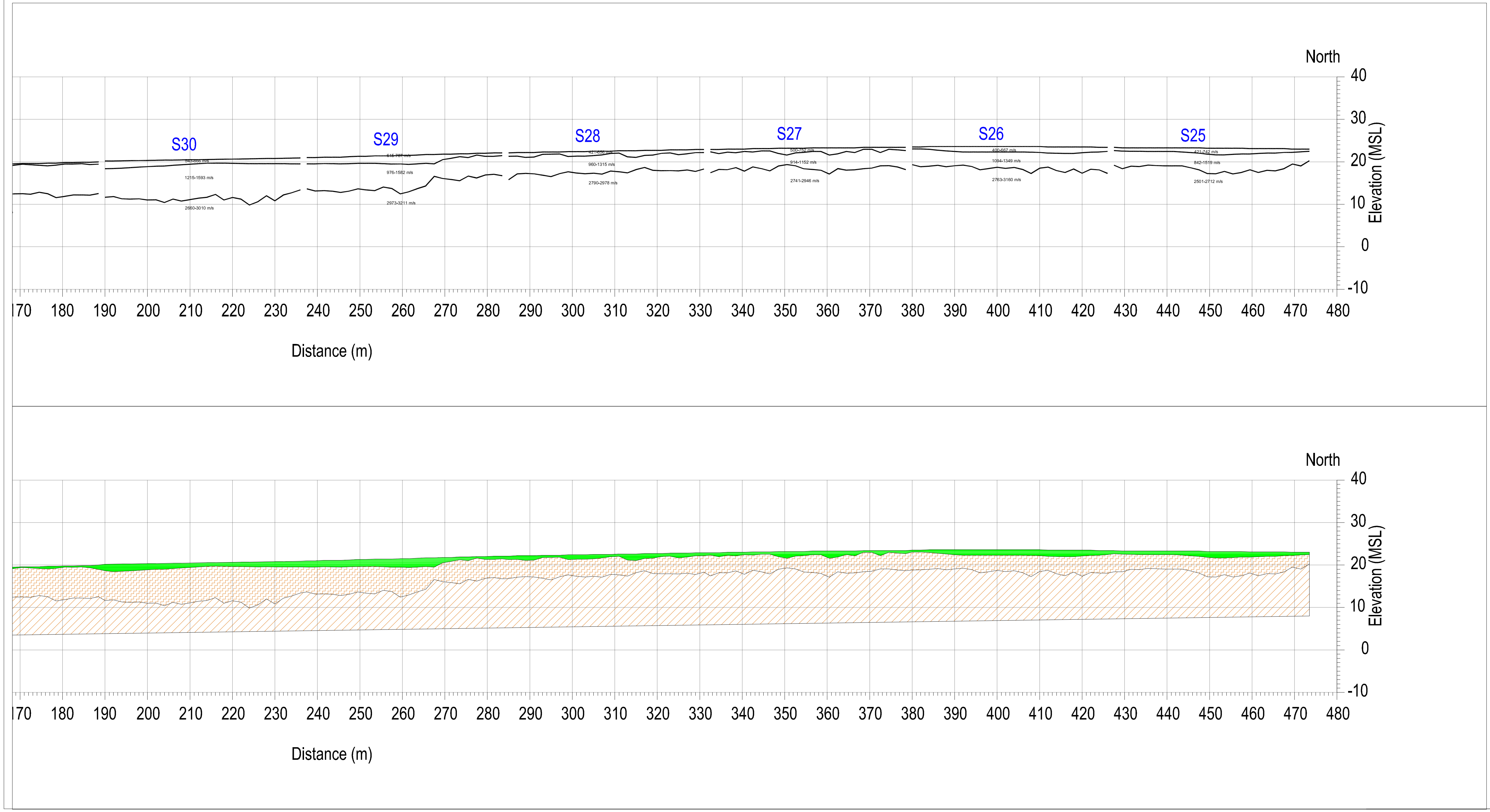
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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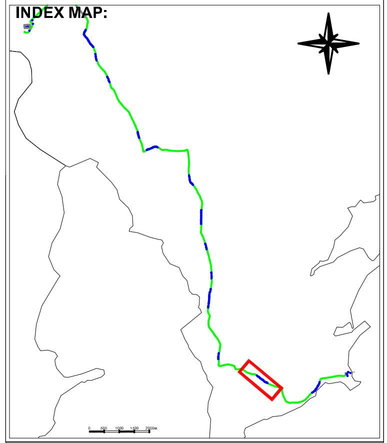

LEGEND:

R1 2D resistivity profile

S1 Seismic refraction profile

🟧 Soft/Loose SOIL

🟥 Soft-Firm SILT/CLAY

⬛ Soft-Firm/Loose-Medium Dense SOIL

🟩 Firm/Medium Dense SOIL

▨ Firm-Stiff/Medium Dense-Dense SOIL

▨ Firm-Stiff SILT/CLAY

▨ Highly to Moderately weathered VOLCANICS

▨ Slightly weathered to Fresh VOLCANICS

▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones

▨ Highly to Moderately weathered Slates and Siltstones

▨ Moderately to Slightly weathered Slates and Siltstones

▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones

▨ Moderately weathered Mudstones with Siltstones

▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT: GREENLINK

DRAWING NO: AGP18019_R2a

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

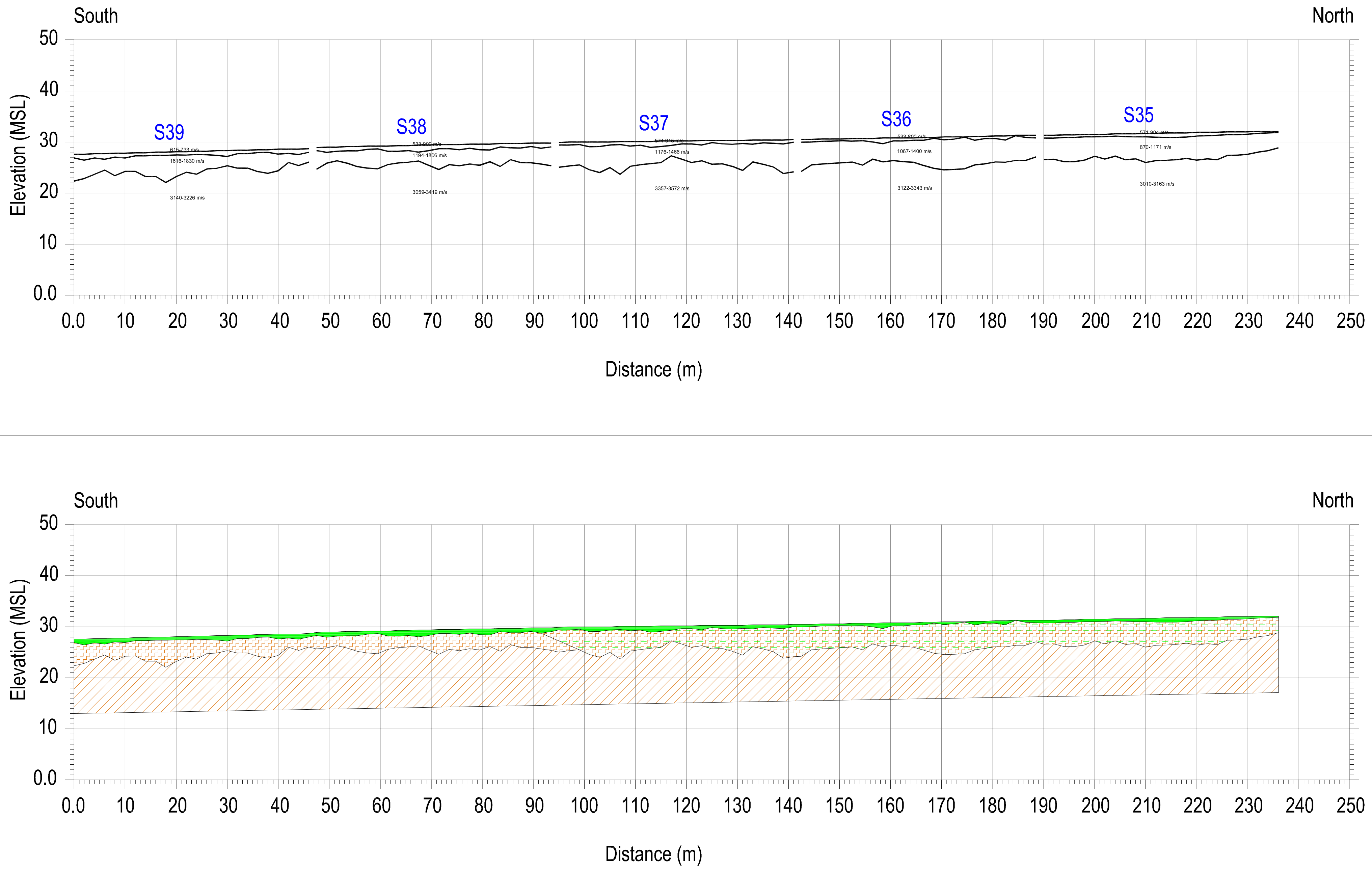
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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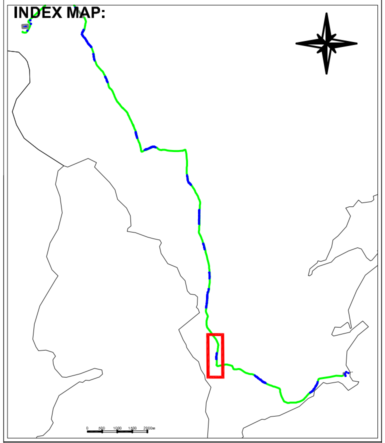

LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ⬛ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_R3
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

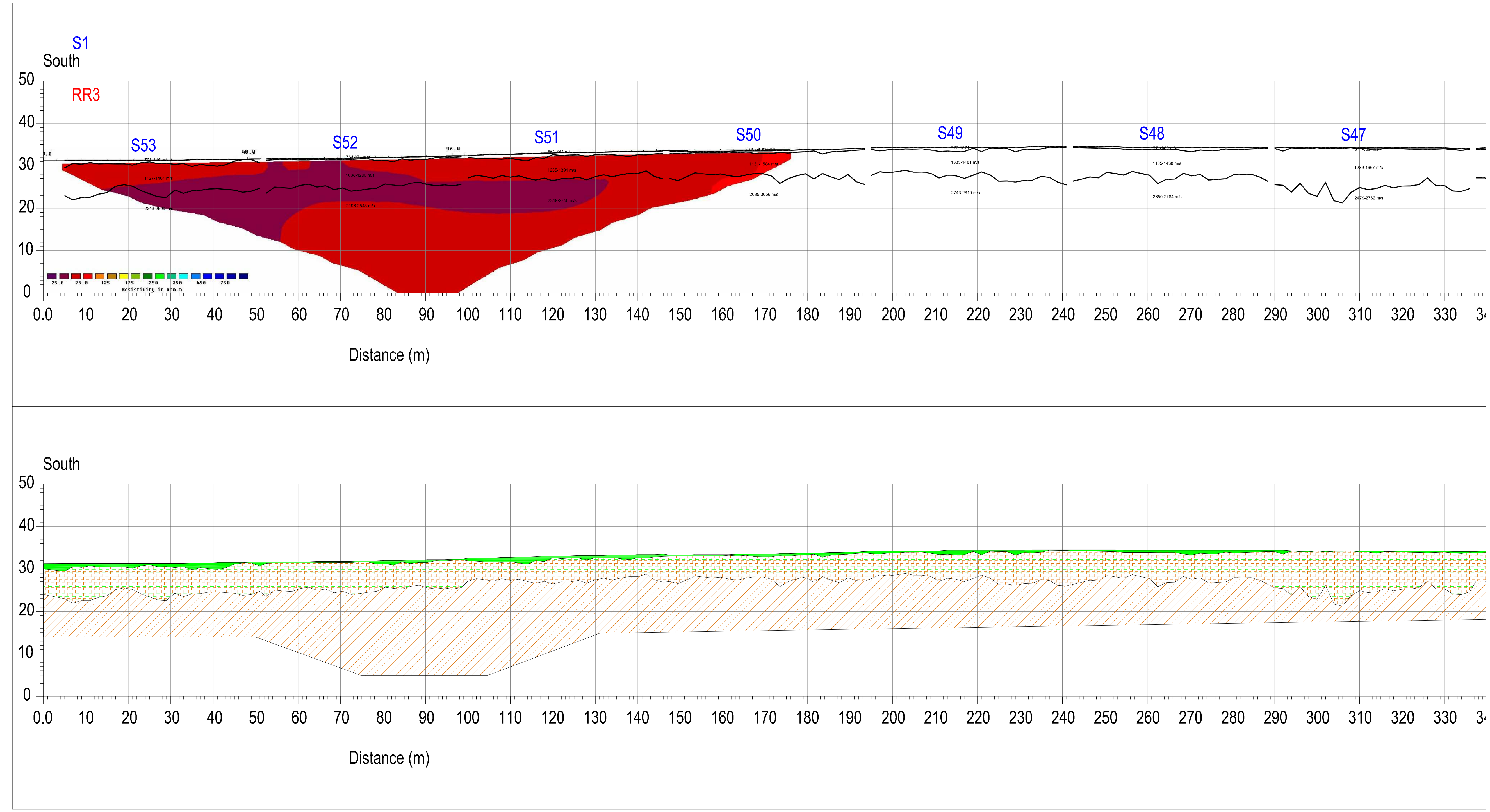
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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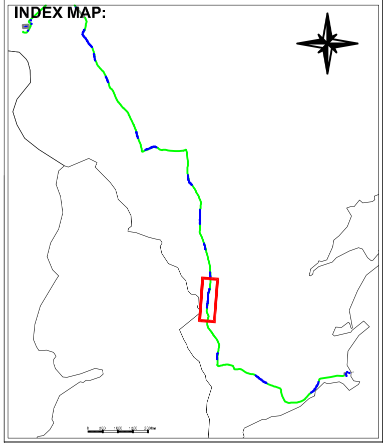

LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile

🟧 Soft/Loose SOIL

🟥 Soft-Firm SILT/CLAY

⬛ Soft-Firm/Loose-Medium Dense SOIL

🟩 Firm/Medium Dense SOIL

▨ Firm-Stiff/Medium Dense-Dense SOIL

▨ Firm-Stiff SILT/CLAY

▨ Highly to Moderately weathered VOLCANICS

▨ Slightly weathered to Fresh VOLCANICS

▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones

▨ Highly to Moderately weathered Slates and Siltstones

▨ Moderately to Slightly weathered Slates and Siltstones

▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones

▨ Moderately weathered Mudstones with Siltstones

▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_R4a

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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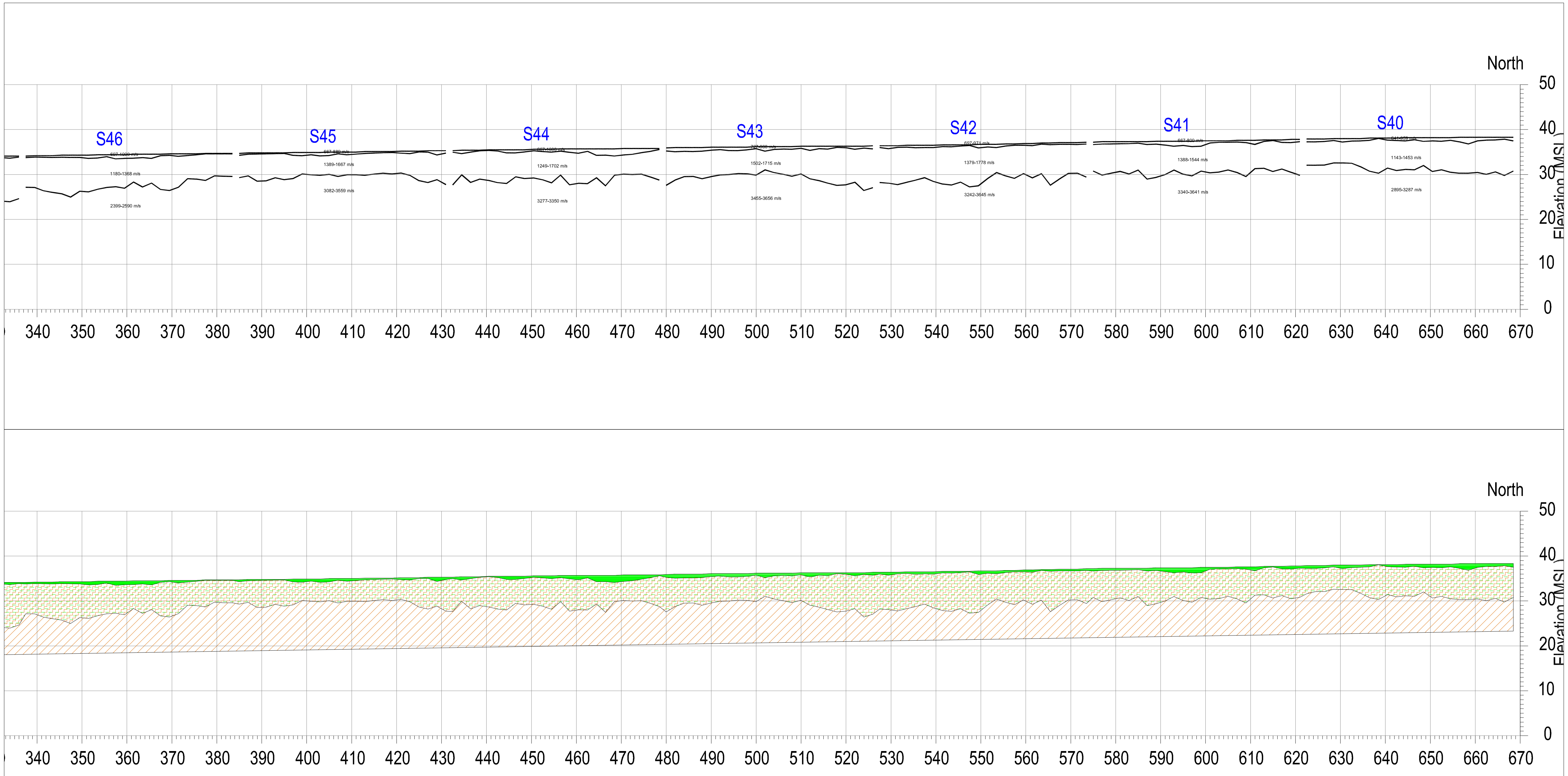
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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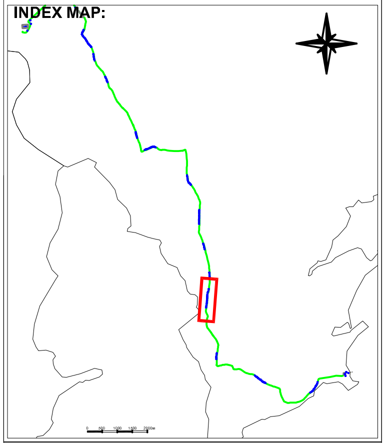

LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ▨ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_R4b

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

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01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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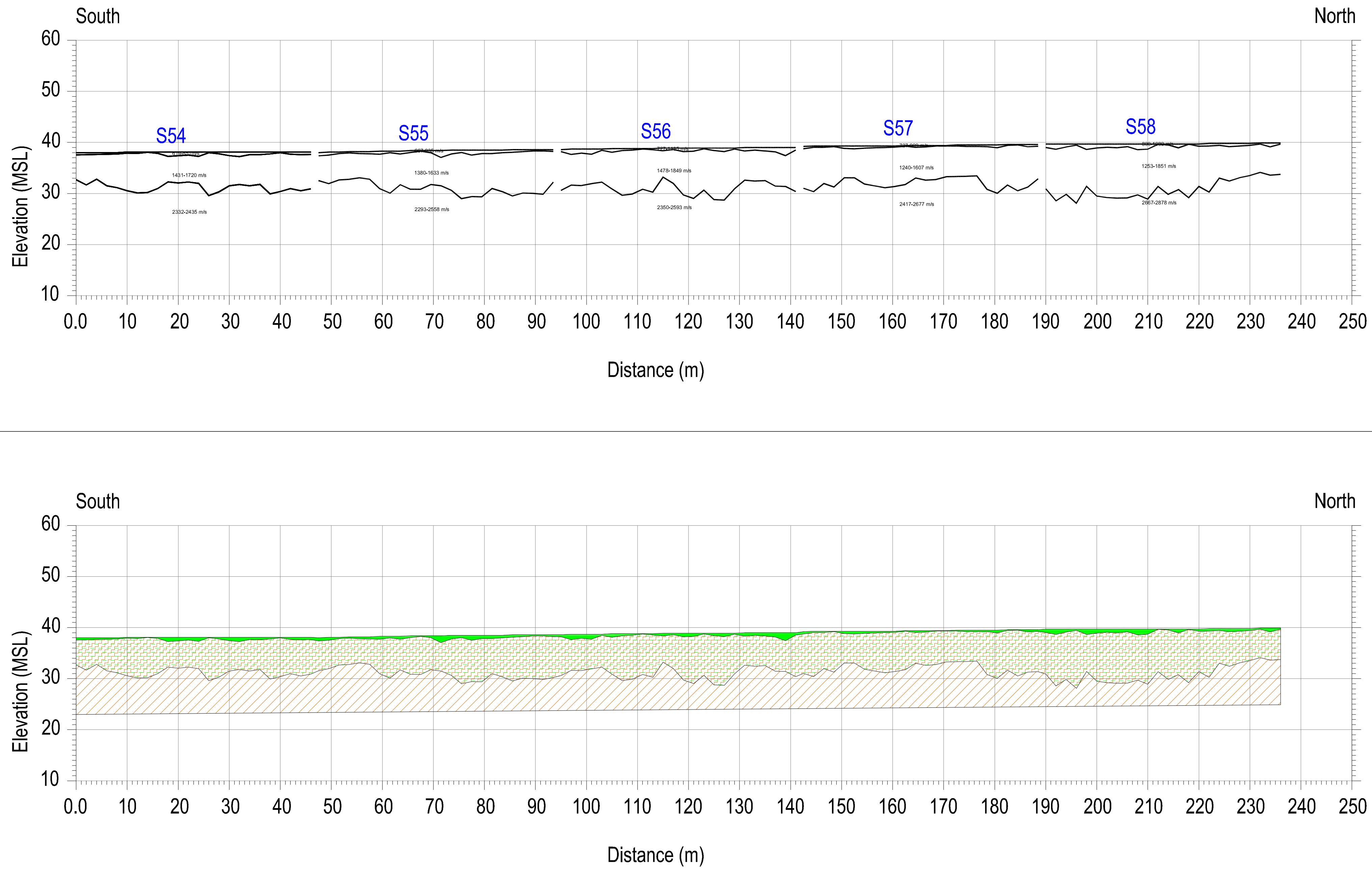
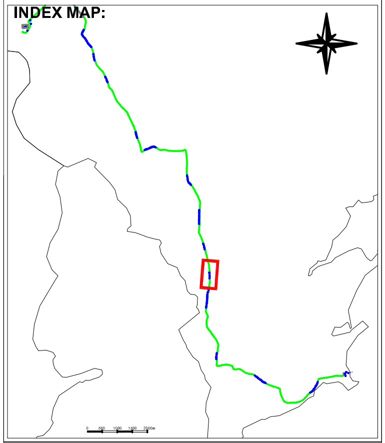
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



INDEX MAP:



LEGEND:

- R1 — 2D resistivity profile
- S1 — Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ⬛ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_R5

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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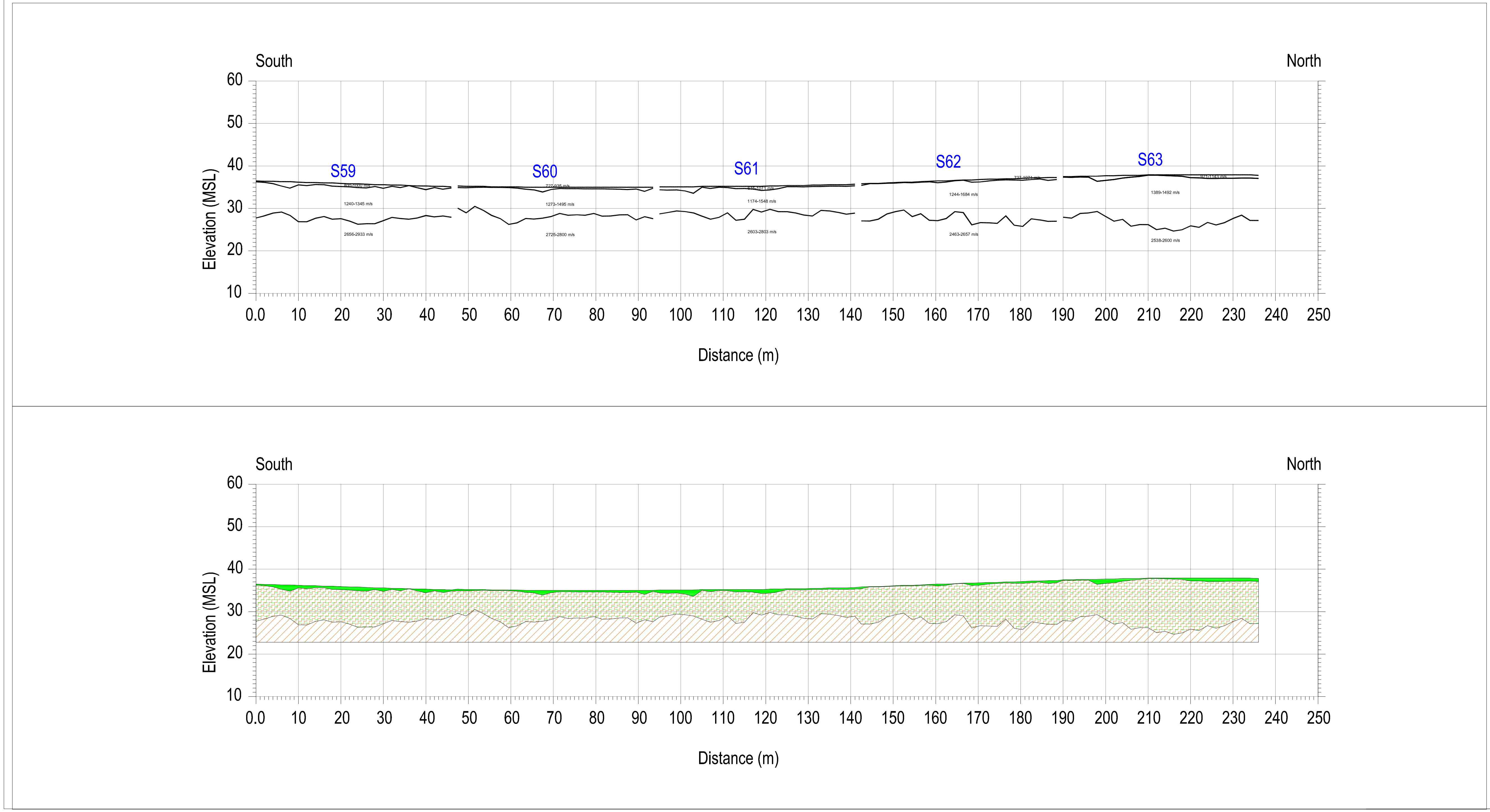
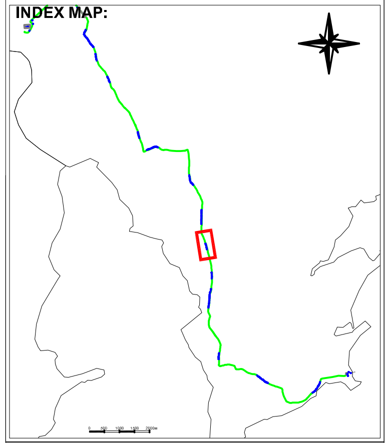
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



INDEX MAP:



LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ⬛ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_R6

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

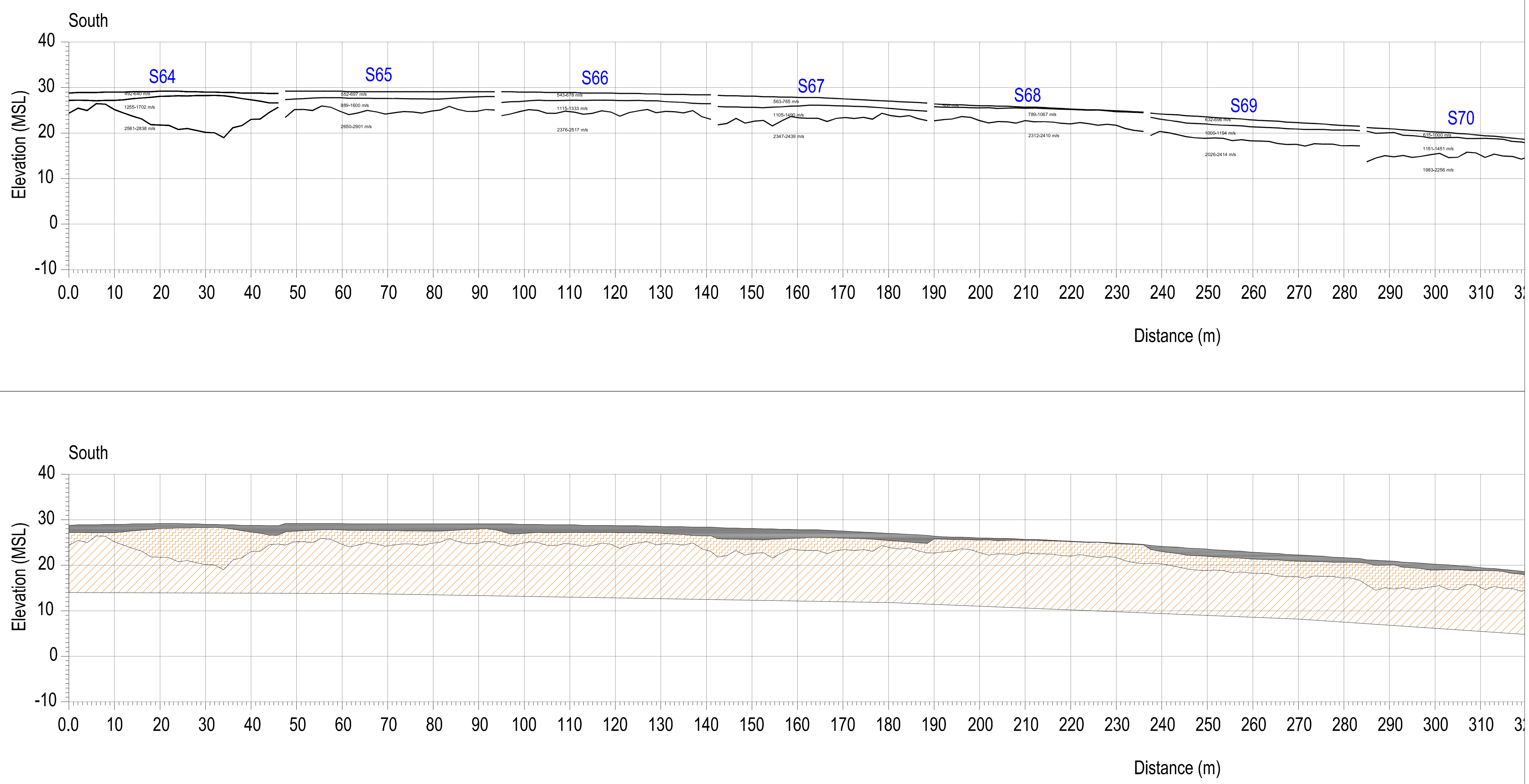
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

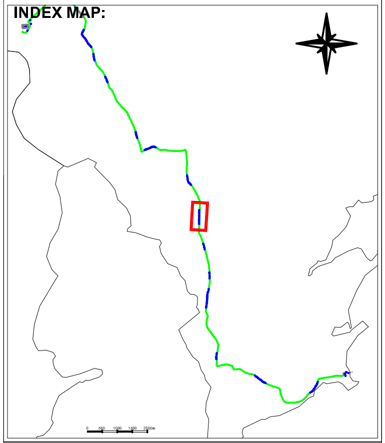
SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



INDEX MAP:



LEGEND:

R1 —	2D resistivity profile
S1 —	Seismic refraction profile
🟧	Soft/Loose SOIL
🟥	Soft-Firm SILT/CLAY
■	Soft-Firm/Loose-Medium Dense SOIL
🟩	Firm/Medium Dense SOIL
▨	Firm-Stiff/Medium Dense-Dense SOIL
▨	Firm-Stiff SILT/CLAY
▨	Highly to Moderately weathered VOLCANICS
▨	Slightly weathered to Fresh VOLCANICS
▨	Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
▨	Highly to Moderately weathered Slates and Siltstones
▨	Moderately to Slightly weathered Slates and Siltstones
▨	Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
▨	Moderately weathered Mudstones with Siltstones
▨	Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT: GREENLINK

DRAWING NO: AGP18019_R7a

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

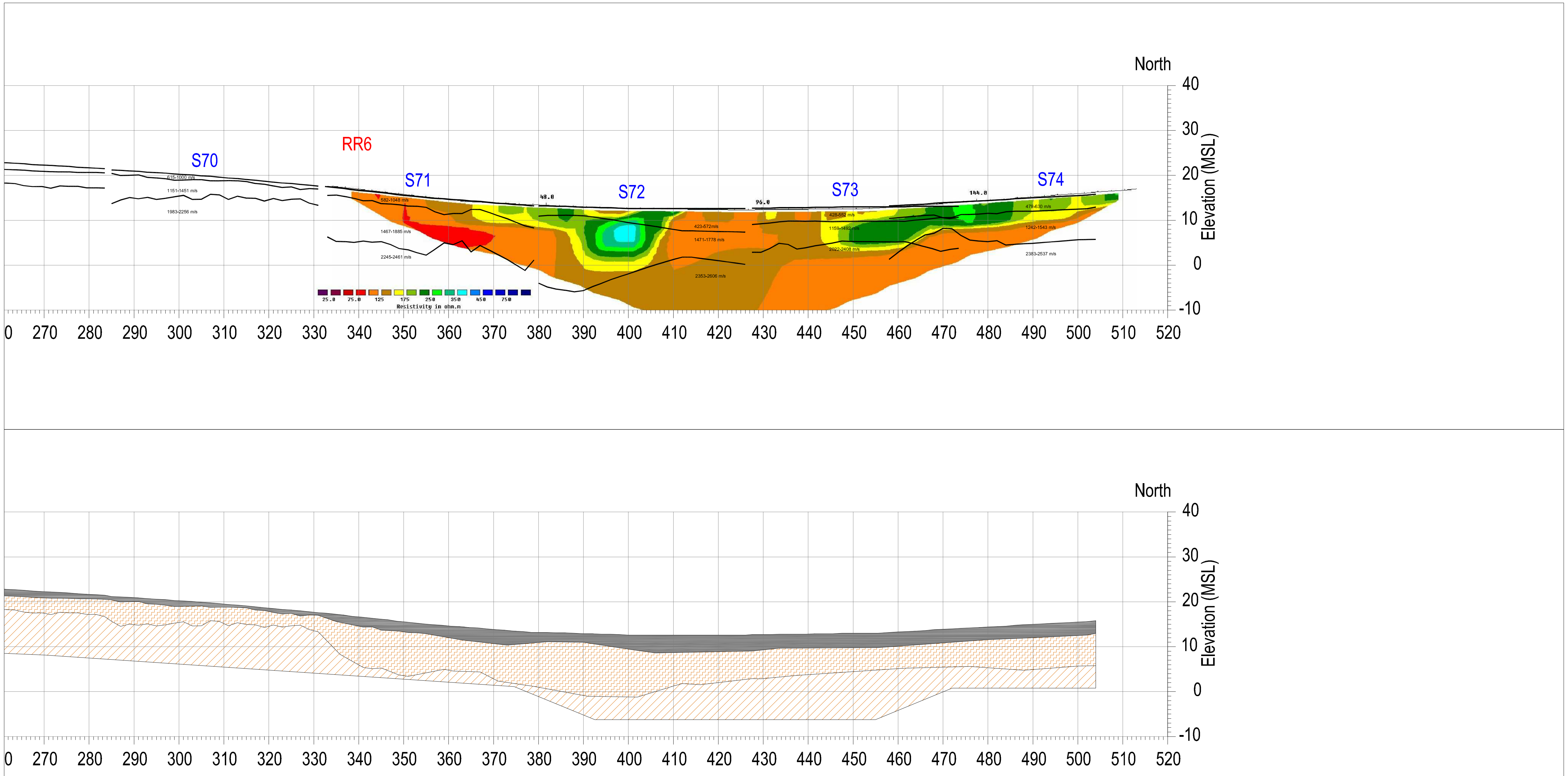
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



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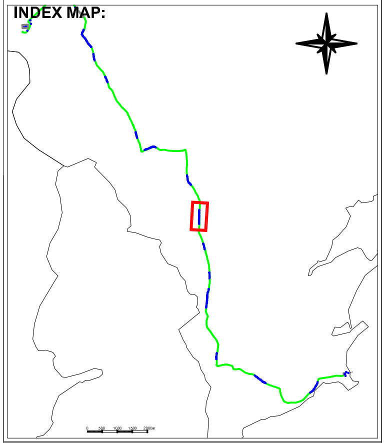

LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ⬛ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_R7b
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
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FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1250

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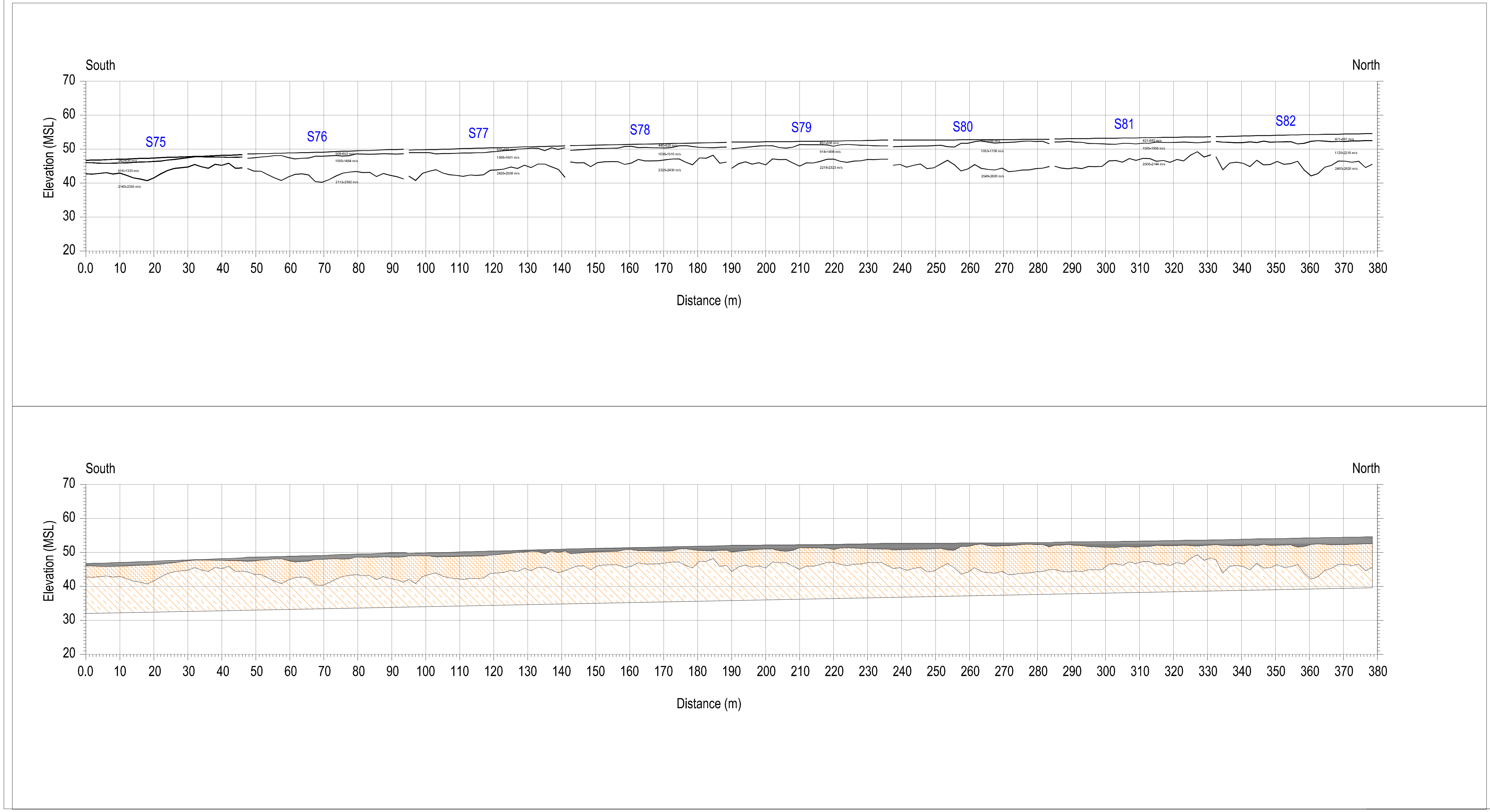
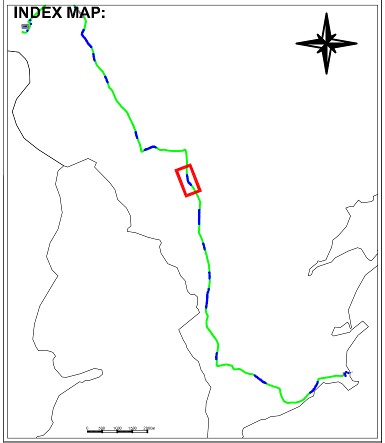
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1250



INDEX MAP:



LEGEND:

R1 🟥 2D resistivity profile
S1 🟦 Seismic refraction profile

🟧 Soft/Loose SOIL
🟥 Soft-Firm SILT/CLAY
⬛ Soft-Firm/Loose-Medium Dense SOIL
🟩 Firm/Medium Dense SOIL
▨ Firm-Stiff/Medium Dense-Dense SOIL
▨ Firm-Stiff SILT/CLAY
▨ Highly to Moderately weathered VOLCANICS
▨ Slightly weathered to Fresh VOLCANICS
▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
▨ Highly to Moderately weathered Slates and Siltstones
▨ Moderately to Slightly weathered Slates and Siltstones
▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
▨ Moderately weathered Mudstones with Siltstones
▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT: GREENLINK
DRAWING NO: AGP18019_R8
SCALE: AS INDICATED @ A3
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1250

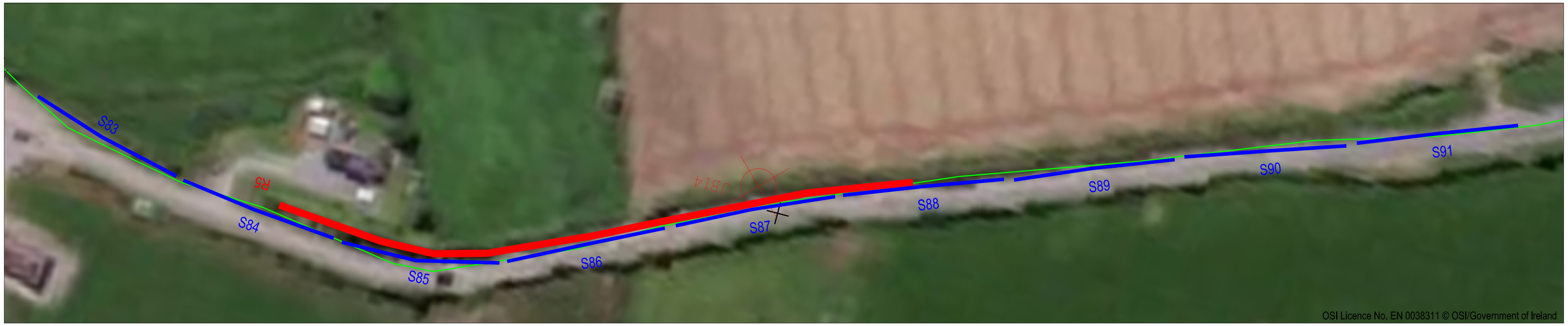

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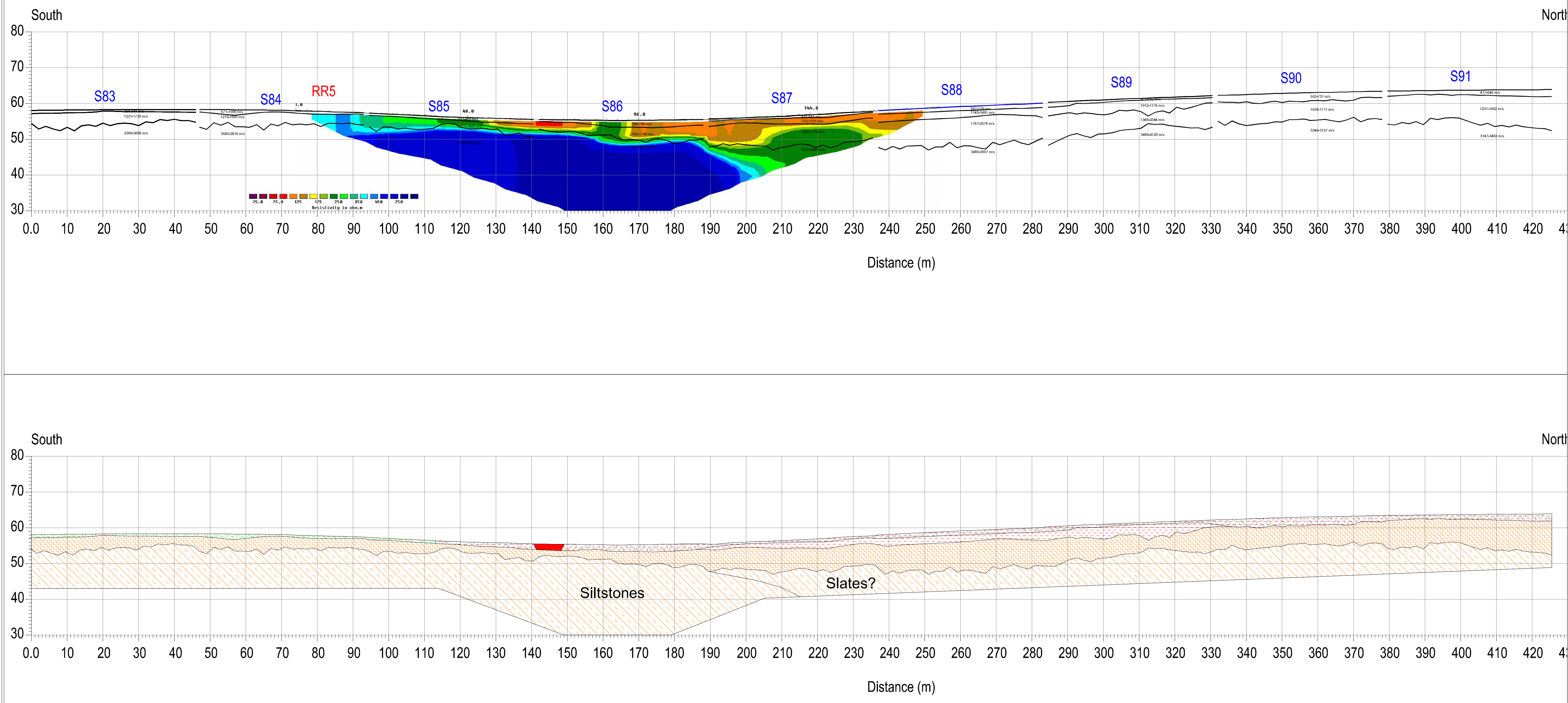
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1250



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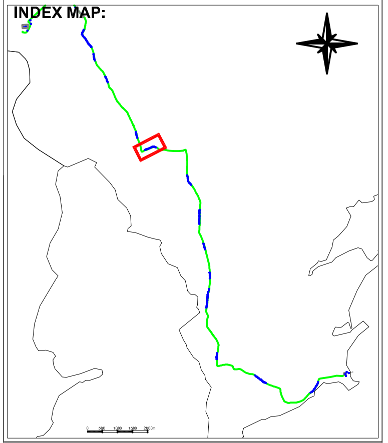

LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile

- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ■ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT.:	GREENLINK
DRAWING NO:	AGP18019_R9
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

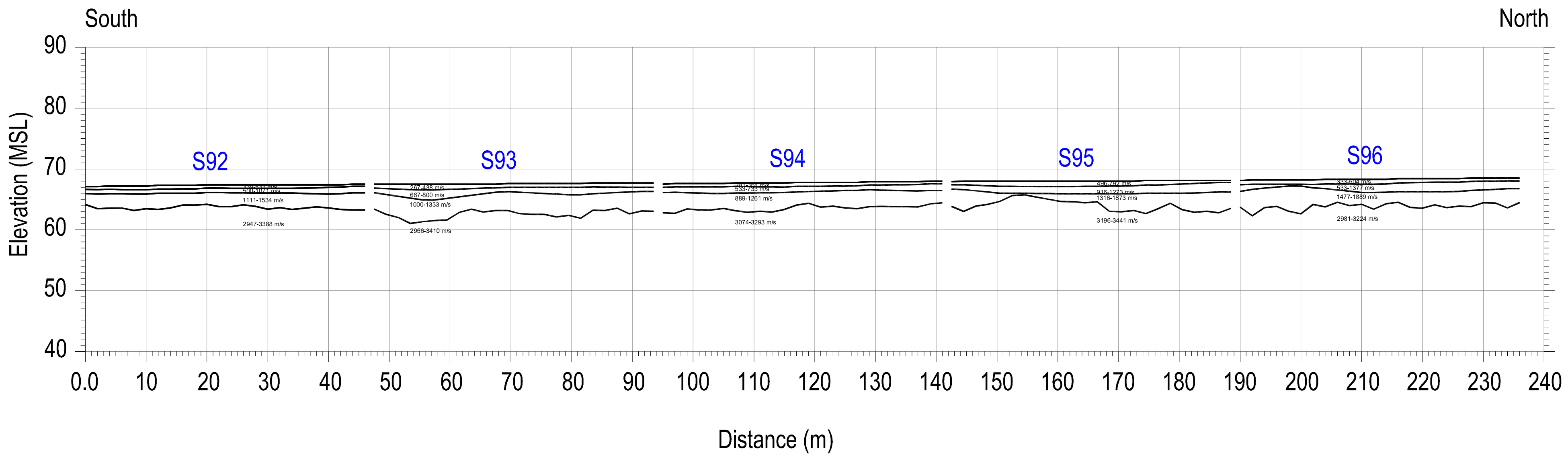
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

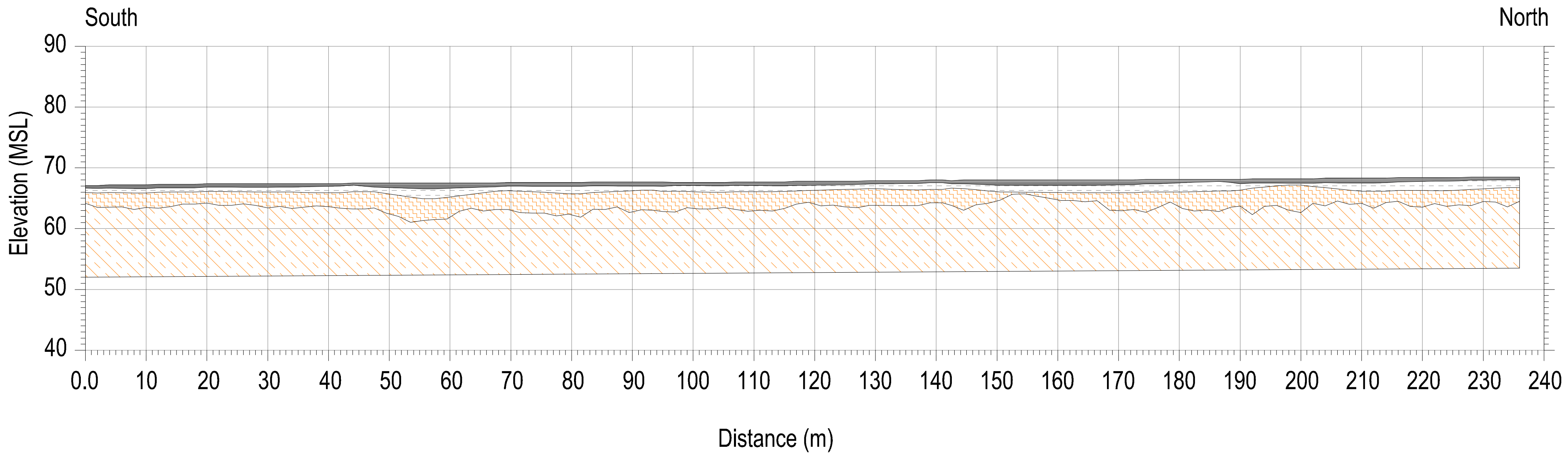
FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

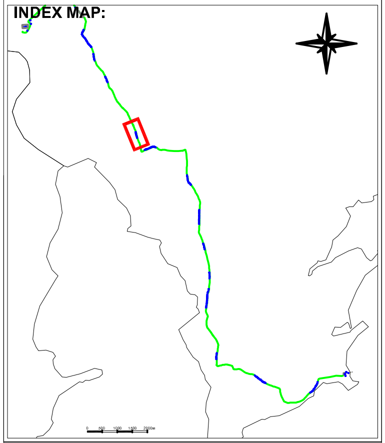
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000





INDEX MAP:



LEGEND:

R1	2D resistivity profile
S1	Seismic refraction profile
🟧	Soft/Loose SOIL
🟥	Soft-Firm SILT/CLAY
⬛	Soft-Firm/Loose-Medium Dense SOIL
🟩	Firm/Medium Dense SOIL
▨	Firm-Stiff/Medium Dense-Dense SOIL
▨	Firm-Stiff SILT/CLAY
▨	Highly to Moderately weathered VOLCANICS
▨	Slightly weathered to Fresh VOLCANICS
▨	Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
▨	Highly to Moderately weathered Slates and Siltstones
▨	Moderately to Slightly weathered Slates and Siltstones
▨	Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
▨	Moderately weathered Mudstones with Siltstones
▨	Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_R10
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
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FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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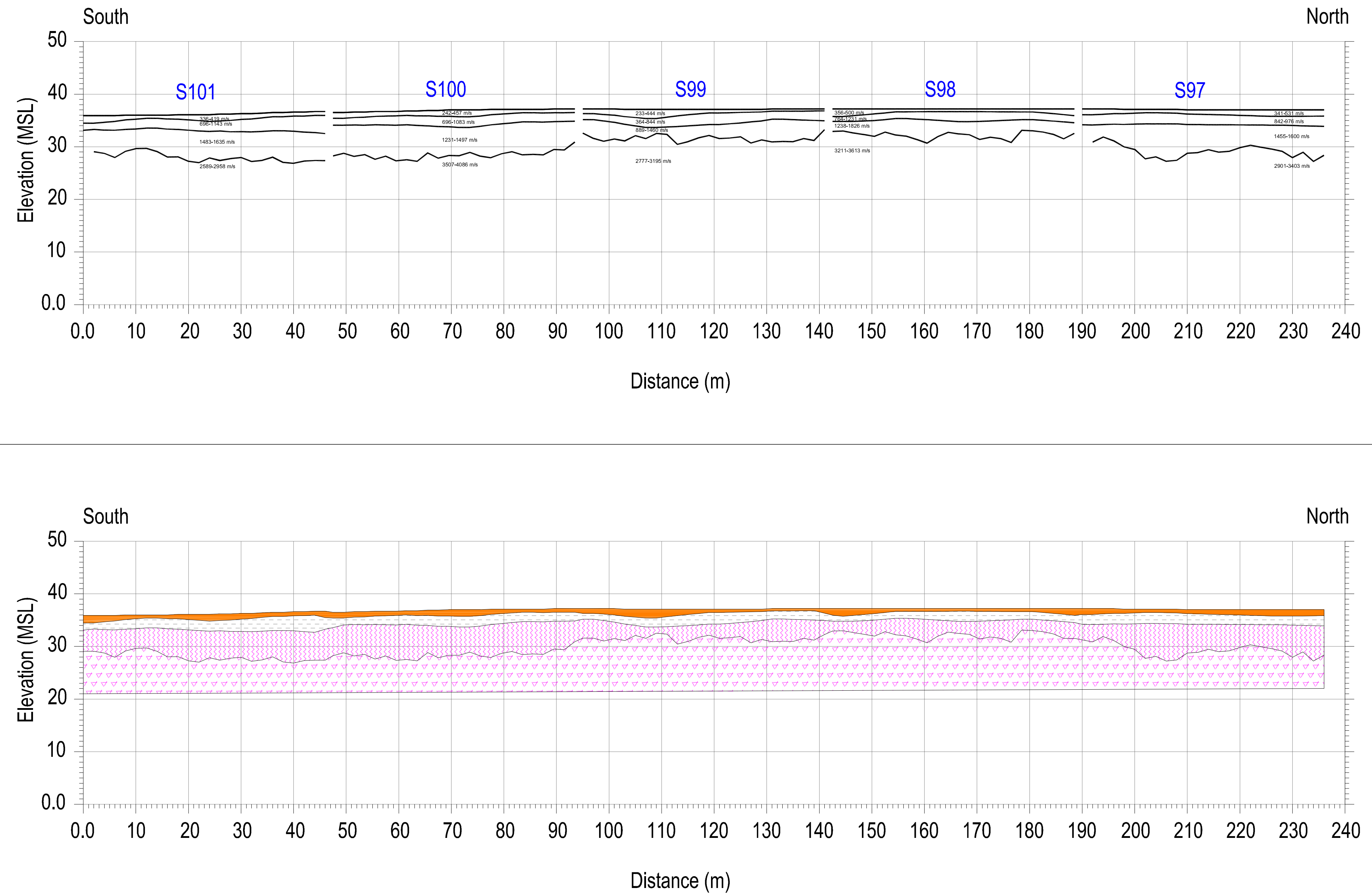
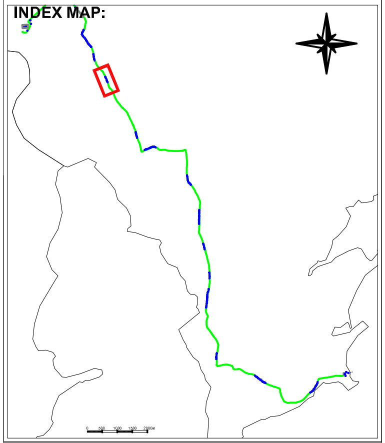
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



INDEX MAP:



LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ⬛ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT: GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_R11

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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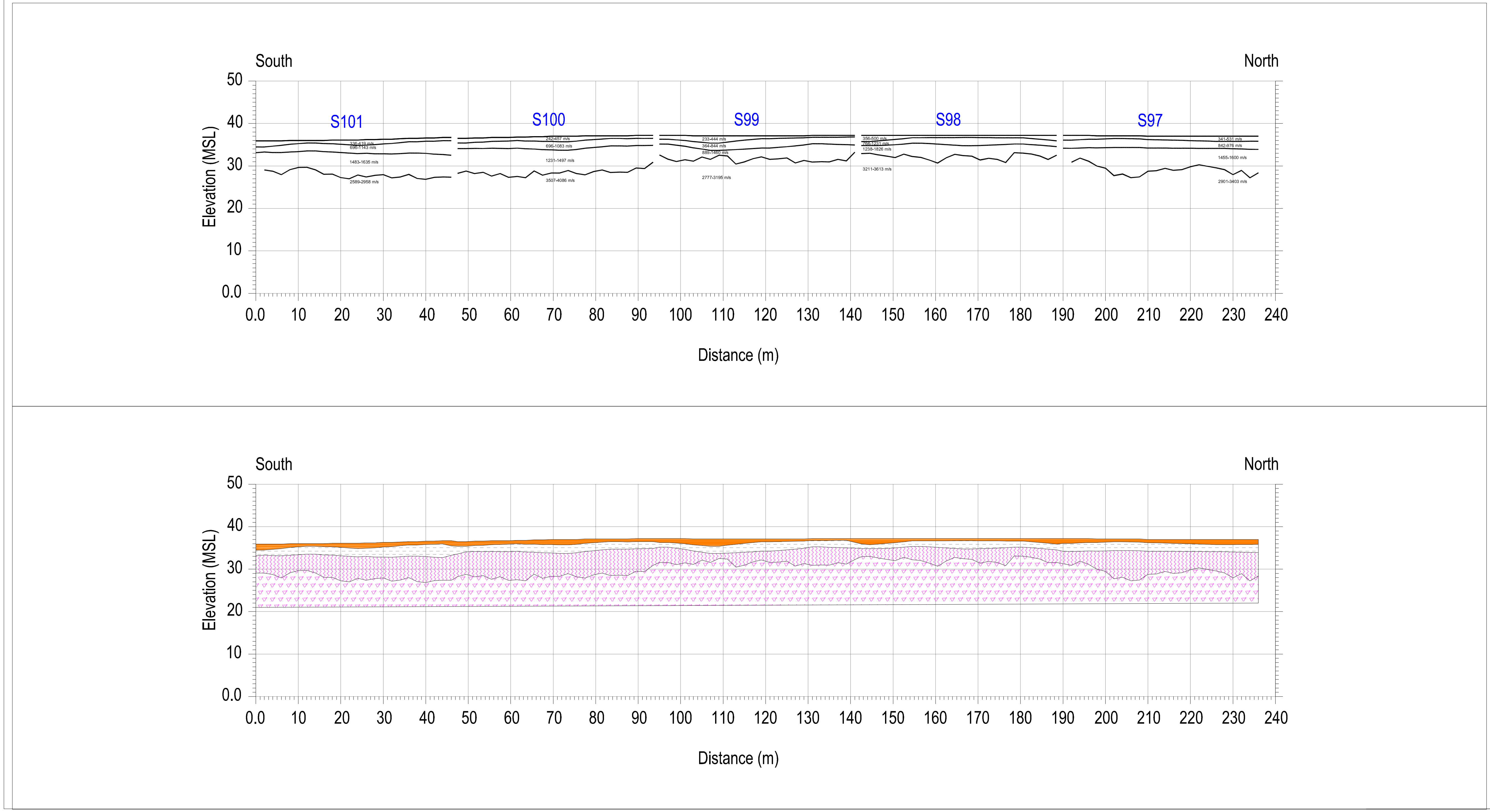
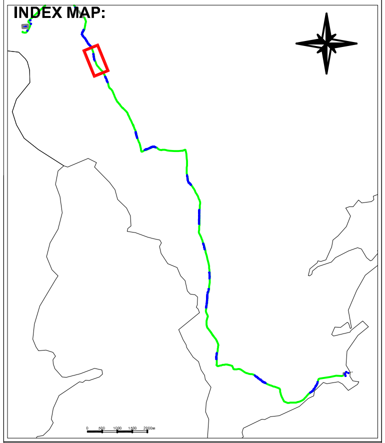
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



INDEX MAP:



LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft/Loose SOIL
- 🟥 Soft-Firm SILT/CLAY
- ▨ Soft-Firm/Loose-Medium Dense SOIL
- 🟩 Firm/Medium Dense SOIL
- ▨ Firm-Stiff/Medium Dense-Dense SOIL
- ▨ Firm-Stiff SILT/CLAY
- ▨ Highly to Moderately weathered VOLCANICS
- ▨ Slightly weathered to Fresh VOLCANICS
- ▨ Firm-Stiff/Medium Dense-Dense SOIL and/or Highly to Moderately weathered Slates and Siltstones
- ▨ Highly to Moderately weathered Slates and Siltstones
- ▨ Moderately to Slightly weathered Slates and Siltstones
- ▨ Stiff/dense SOIL and/or Moderately weathered Mudstones with Siltstones
- ▨ Moderately weathered Mudstones with Siltstones
- ▨ Slightly weathered to Fresh Mudstones with Siltstones

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PROJECT:	GREENLINK INTERCONNECTOR GEOPHYSICAL SURVEY
CLIENT:	GREENLINK
DRAWING NO:	AGP18019_R12
SCALE:	AS INDICATED @ A3
DATE:	26-04-2018

Version:	Date:	Drawn By:	Checked:
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FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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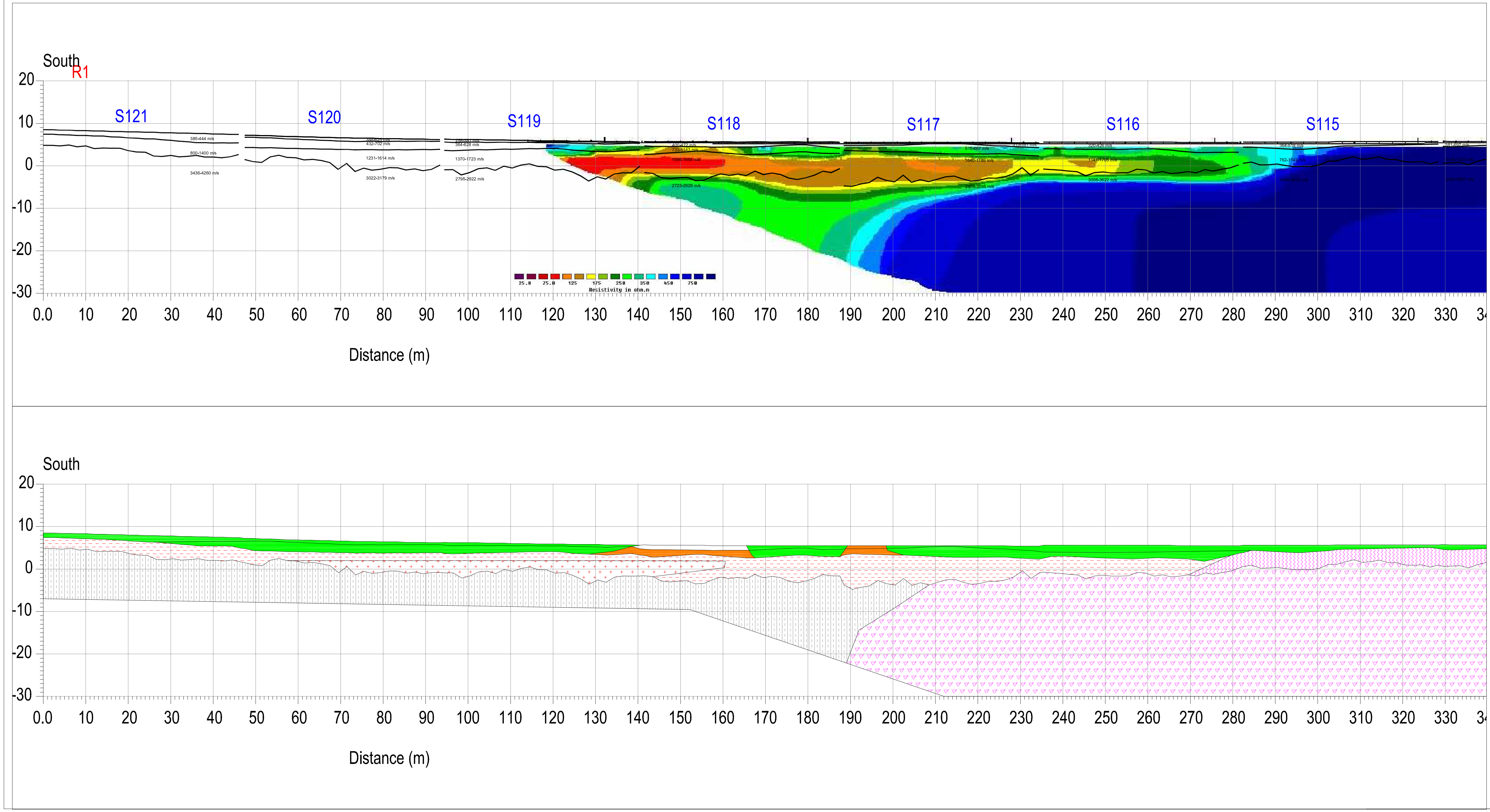
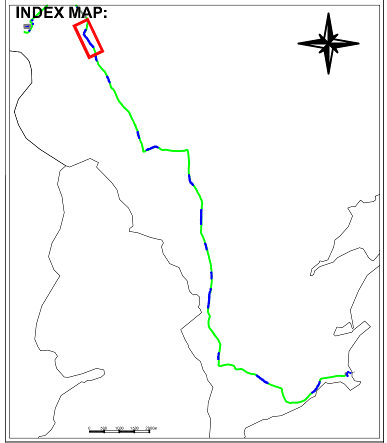
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000





LEGEND:

- 2D resistivity profile (R1)
- Seismic refraction profile (S1)
- 🟧 Soft -Firm sandy gravelly CLAY
- 🟩 Loose -Medium dense clayey SAND/GRAVEL or completely weathered Volcanics
- ▨ Firm-Stiff SILT/CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Slightly weathered to Fresh Slates
- ▨ Slightly weathered to Fresh Volcanics
- ▨ Slightly weathered to Fresh Volcanics

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT.: GREENLINK

DRAWING NO: AGP18019_R13a

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
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FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

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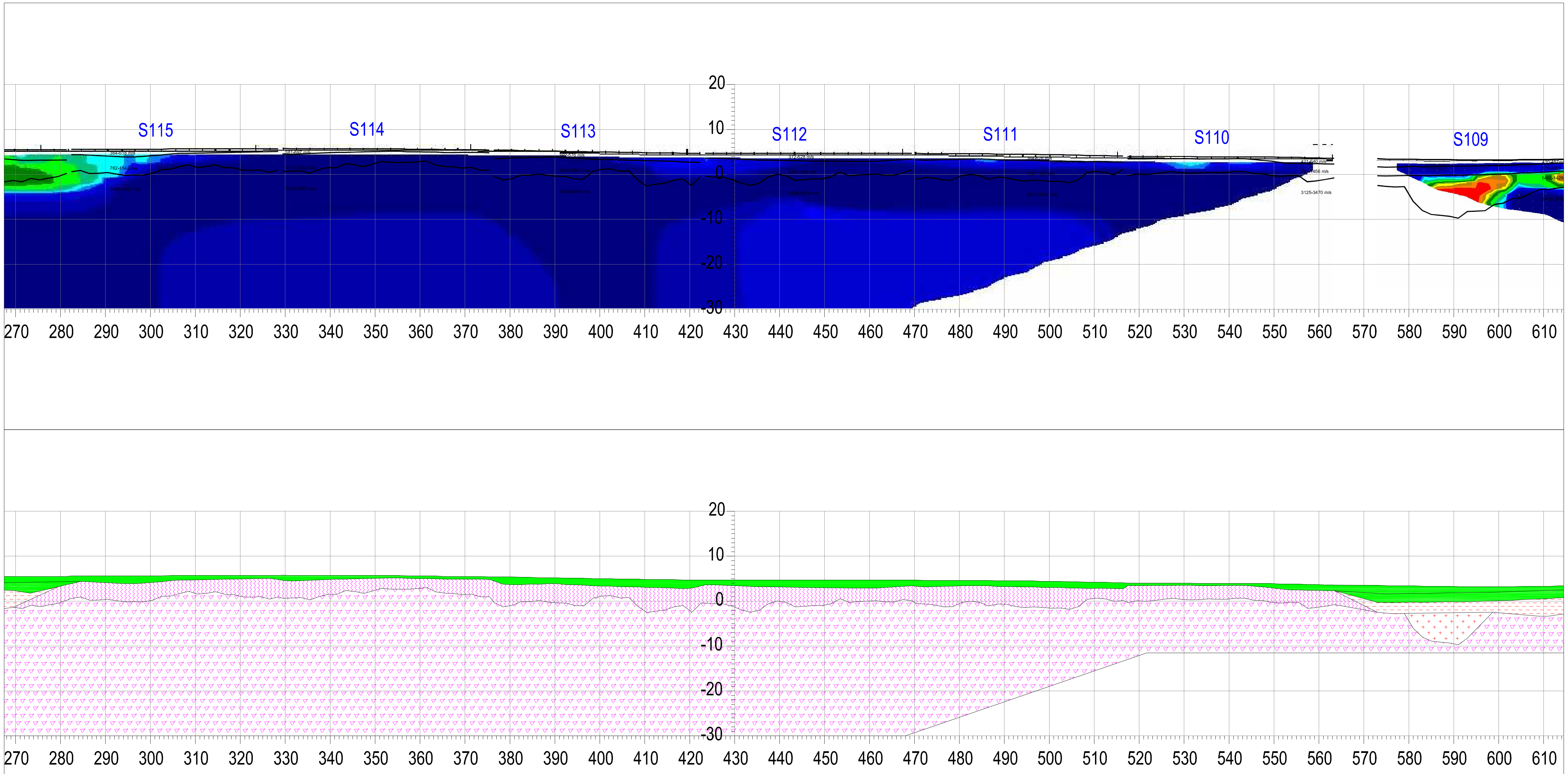
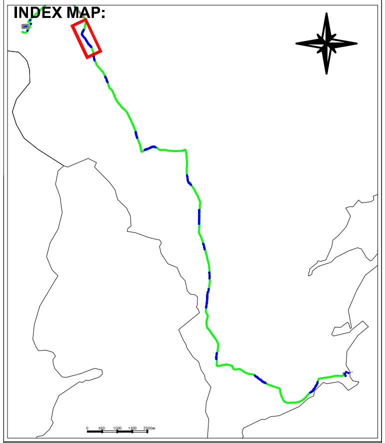
FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000



INDEX MAP:



LEGEND:

- R1 2D resistivity profile
- S1 Seismic refraction profile
- 🟧 Soft -Firm sandy gravelly CLAY
- 🟩 Loose -Medium dense clayey SAND/GRAVEL or completely weathered Volcanics
- ▨ Firm-Stiff SILT/CLAY
- ▨ Firm-Stiff sandy gravelly CLAY
- ▨ Slightly weathered to Fresh Slates
- ▨ Slightly weathered to Fresh Volcanics
- ▨ Slightly weathered to Fresh Volcanics

The information displayed here is to be used in conjunction with Report AGP18019_03 Draft Report on the Geophysical Investigation for the Greenlink Interconnector, Co. Wexford for ARUP. APEX Geophysics Ltd. 26th April 2019

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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY

CLIENT: GREENLINK

DRAWING NO: AGP18019_R13b

SCALE: AS INDICATED @ A3

DATE: 26-04-2018

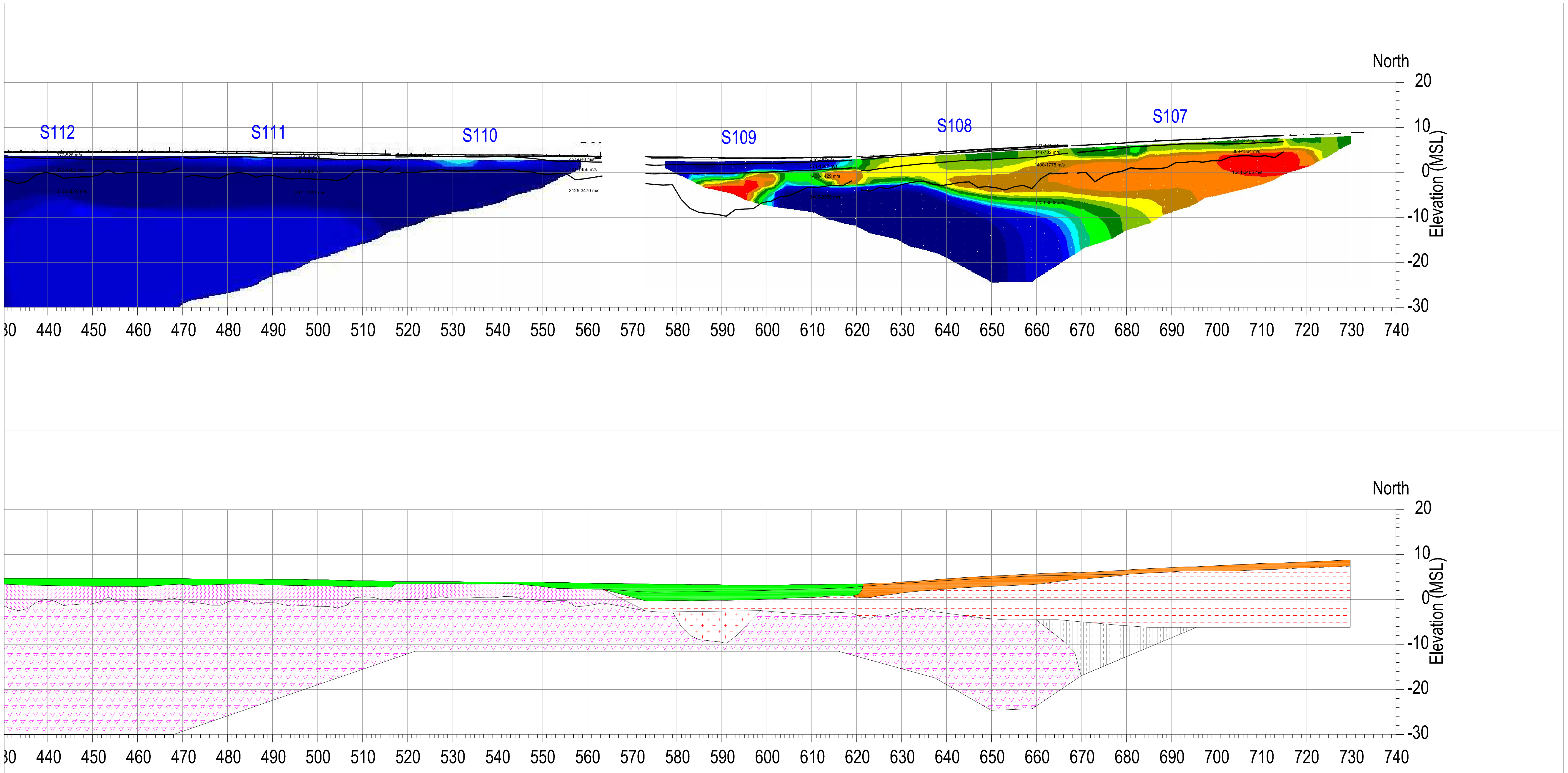
Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

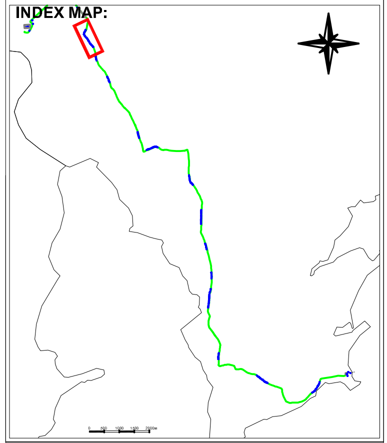
FIGURE 1: GEOPHYSICAL LOCATIONS

SCALE 1:1000

FIGURE 2: RESULTS & INTERPRETATION

SCALE 1:1000





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PROJECT: GREENLINK INTERCONNECTOR
GEOPHYSICAL SURVEY
CLIENT.: GREENLINK
DRAWING NO: AGP18019_R13c
SCALE: AS INDICATED @ A3
DATE: 26-04-2018

Version:	Date:	Drawn By:	Checked:
01	15-01-2019	YOC	TL

GEOPHYSICAL SURVEY REPORT

Project

Seismic refraction to characterise superficial and bedrock geology Baginbun Beach

Location

Baginbun Beach, Wexford

Client

MMT Ltd

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geophysical **innovation**

Report reference: 6113IR
Date: 19th December 2018
Version: 1.1

GEOPHYSICAL SURVEY REPORT

Project

Seismic refraction to characterise superficial and bedrock geology Baginbun Beach

Location

Baginbun Beach, Wexford

Client

MMT Ltd

Project Geophysicist: A Lewis BEng MSc

Reviewer: S Hughes BSc MSc

Report Reference: 6113IR

Date: **19th November 2018**

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Appendices : Seismic Refraction Survey
Seismic velocity tables

1 EXECUTIVE SUMMARY

This report describes a geophysical seismic refraction survey that was carried out to investigate the shallow geology underlying the Ireland cable landing site for the Greenlink Interconnector project, designed to link the existing electricity grids of Republic of Ireland and the United Kingdom (UK).

Four seismic refraction profiles were acquired at Baginbun Beach, in the intertidal zone and within a field approximately 18 mAOD west of the beach. The centreline profile is the preferred cable route (Route A) to be directionally drilled or trenched beneath the beach and into the field. Three cross lines were surveyed to further investigate a corridor ~200 m wide, to better understand the local geological conditions that may have a bearing on the exact proposed route.

The refraction surveys identified up to four distinct layers comprising loose soils and sediments and sand, overlying a possible thin glacial till deposit and or weak, weathered bedrock overlying moderately strong bedrock with finally hard, competent rock at depth. There are no intrusive investigations to calibrate the seismic findings at the time of reporting.

With regard to the layers of concern in the shallower subsurface, P-wave layers P1 and P2 and shear wave layers S1 and S2 are likely to be the most important, being in the depth range where drilling/trenching is likely to occur. These layers represent the weakest materials of sediments/till/beach sands and weathered bedrock. Weathered bedrock is highly likely to be present near the top of the P2 and S2 layer, given their relatively high velocities of 1720 m/s and 610 m/s respectively.

Layer P2 and S2 that probably represent the preferred material to excavate through, are to a depth of 5 to 6 m bgl along the centerline. Thinning slightly where Profile 2 intersects and considerably thinner just north of the centre line on Profile 3. The beach section shows a top layer of sand 2 to 3 m thick nearest the cliff and very thin towards low water, and then a virtually completely eroded away layer (P2/S2) of softer sediment/rock, before going on to the P3/S3 layer of moderately strong rock that is less than 3 m bgl. The beach cross line (Profile 4) shows this layer three thickening rapidly to the south with the hard rock layer getting deeper. The shallow depth of the P3/S3 layer beneath the beach poses the hardest material in the shallow subsurface that will have to be excavated.

With regards to the best route ashore for the cable, there is only a marginally greater thickness of potential weak sediments/rock (layer P2/S2) beneath the field at approximately 50 to 60 m south of the centre line, where the base of this layer is 1 to 2 m deeper. The beach shows no variation in the shallow depth of the moderately strong bedrock within the survey corridor and in fact turns to hard rock close to surface approximately 20 m north of the proposed route.

2 INTRODUCTION

This report describes a geophysical seismic refraction survey that was carried out to investigate the shallow geology underlying the cable landing site for the Greenlink Interconnector project, designed to link the existing electricity grids of Republic of Ireland and the UK.

The UK site is located at the northern section of Freshwater West Beach, Pembrokeshire, Wales and the Ireland site is located at the north section of Baginbun Beach, Hook Head Peninsula, County Wexford.

The survey work was commissioned by MMT Ltd (the Client) on behalf of the "Greenlink" project. Several routes and landing options are being considered in both Wales and Ireland. The survey work undertaken and reported on in this document is based on the Route A scheme, as advised by the client, and is the preferred scheme for the project.

The Baginbun Beach site work took place between 21st and 25th October 2018. The work was designed to provide information on the composition and depth of superficial deposits, depth to weathered/unweathered bedrock and associated seismic velocities, as well as identify any structural features which may cross the site. The results are to be incorporated into the design of the tunnelling and/or trenching aspect of the cable burial as it comes ashore.

3 Site description

3.1 Baginbun Beach, County Wexford, Ireland

The site is located approximately 20km southwest of Waterford on the Hook Head Peninsula. As can be seen in Plate 1 the site is composed of a narrow east-facing sandy beach backed by ~18 m high cliffs and then a relatively flat agricultural field to the west. The relatively small tidal range in this area means that only approximately 70 m of the beach is exposed to the mean low water mark (MLWM) at low tide. Four seismic profiles were acquired (Plate 1), and it can be seen that the centre line was mostly in the field, but a short section was acquired during low water on the beach. One shorter cross line was also acquired on the beach.

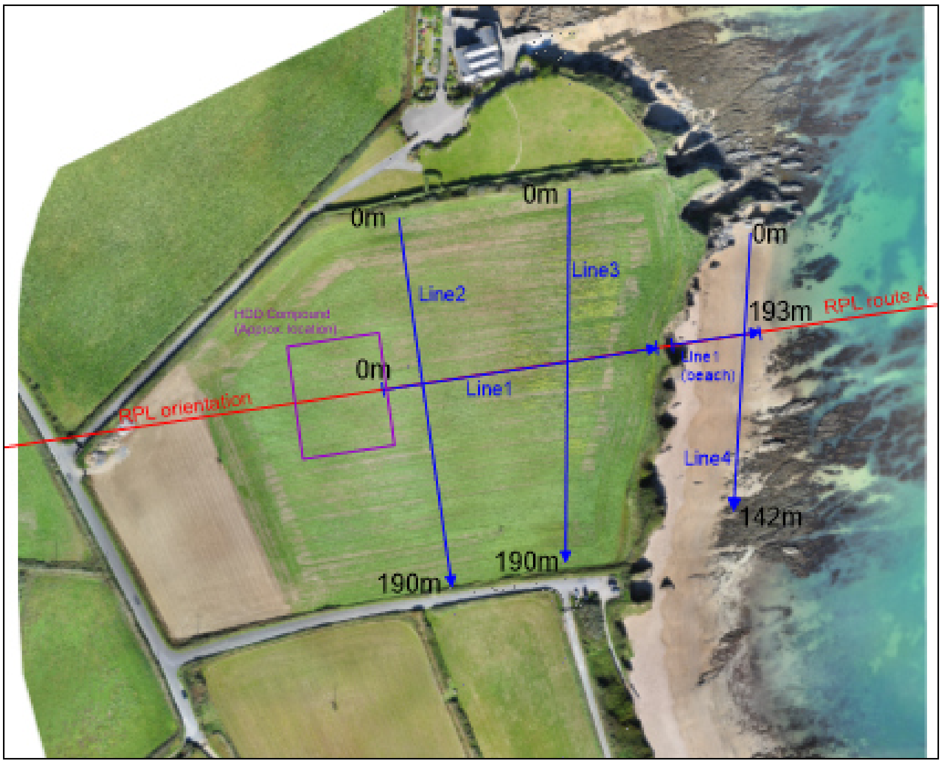

***Plate 1** – Baginbun Beach site and seismic line locations*

Plate 2 shows the survey lines overlaid on a 25cm resolution gridded LIDAR dataset acquired from a drone survey, specifically undertaken for the project. A ridge of high ground can be seen in the field that forms the highest area where Profiles 1 and 3 intersect.

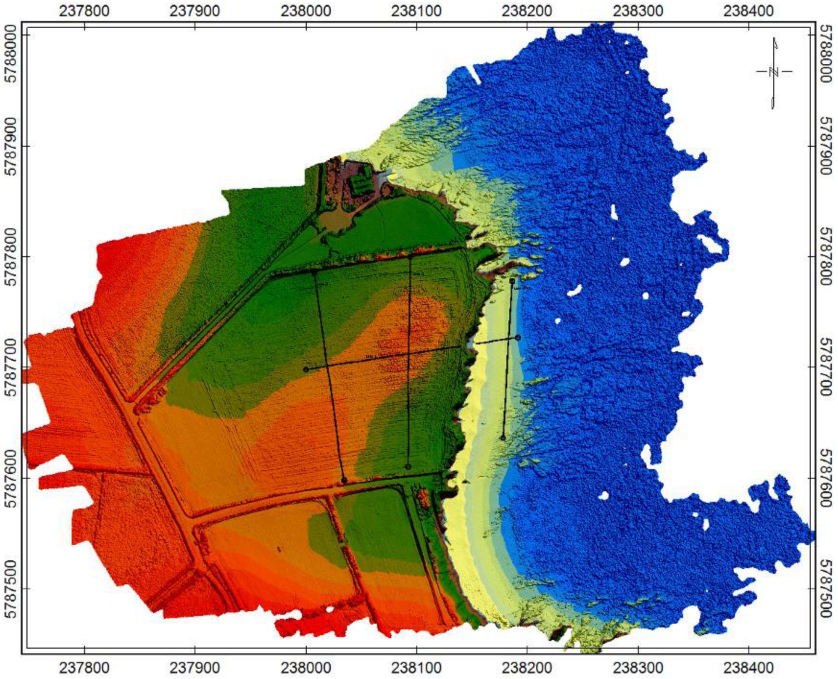

***Plate 2** – Survey profiles at Baginbun Beach shown on the drone data DTM (not to scale)*

The field section is shown in Plate 3, with a short crop still present in the field. The beach area and cliff at the centre line are shown in Plate 4.

***Plate 3** – Profile 1 field section looking west.*

***Plate 4** – Profile 4 on the beach looking south(left) and the centre line cliff area (right)*

3.2 Geological setting

The Irish Geological Survey map for the area is shown in Plate 5 and indicates the whole area is composed of Booley Bay Group sedimentary rocks.

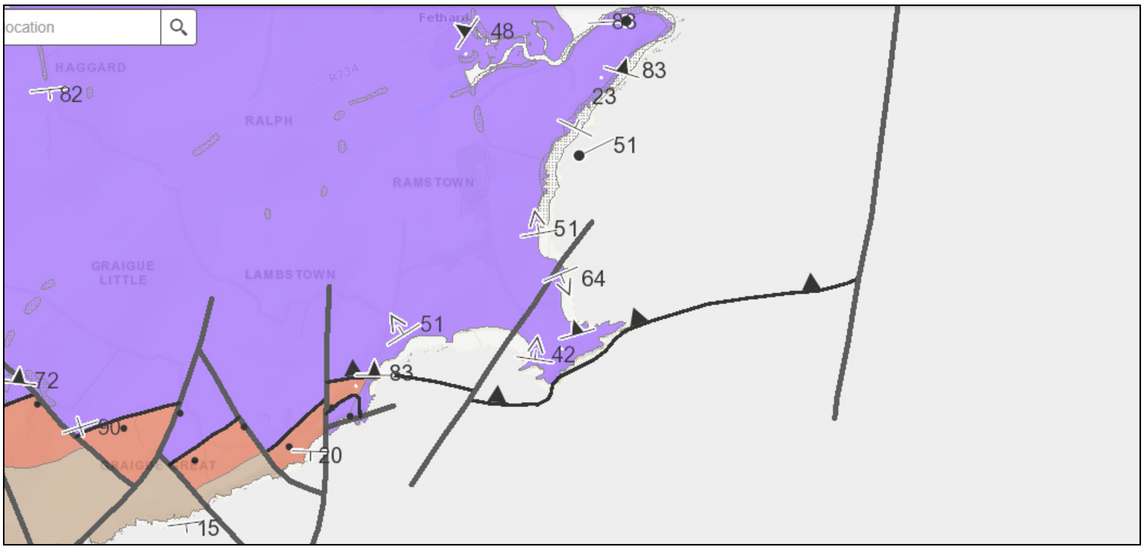

***Plate 5** – Irish Geological Survey map showing rock types, major faults and strata dip*

Bedrock – The bedrock age has been debated but is now believed to be of late Cambrian age (485 to 541 million years old) and comprised of repetitively interbedded fine-grained sandstone and siltstone with some black mudstone and para conglomerates. The beds are of variable and random thickness usually from one to ten centimetres and no more than twenty, usually with continuous flat surfaces (Plate 6). The dip of the rock strata in this area is very steep (over 60 degrees) as shown in Plate 6 and dips to the northwest.

***Plate 6**– Cliff rock strata and cliff (left) and the cliff on the cable route (right)*

There are no boreholes in the area to help confirm the geology at the site.

Superficial deposits – These comprise of beach sand and a possible thin layer of glacial till material.

3.3 Survey objectives

The primary objectives of the survey are as follows:

- Provide detailed P-wave, S-wave data to aid characterisation of the superficial geology and bedrock (depth to weathered/unweathered rock and associated seismic velocities), as well as identify possible structural features.

3.4 Survey design

Given the scope of the survey objectives it was decided, under Client direction, to adopt an integrated survey approach utilising the following seismic methods:

- **P-wave Seismic Refraction** – *to provide compressional mode seismic velocity ('P-wave' or 'Vp') sections along the selected profile lines.*
- **S-wave Seismic Refraction** – *to provide shear mode seismic velocity ('S-wave' or 'Vs') sections along the selected profile lines.*

3.5 Quality control

The geophysical data are collected in line with normal operating procedures as outlined by the instrument manufacturer and TerraDat company policy. On completion of the survey, the data are downloaded from the survey instrument on to a computer and backed-up appropriately. The acquired data set is initially checked for errors that may be caused by instrument noise, low batteries, positional discrepancies etc. and any field notes are either written up or incorporated in the initial data processing stage. The data set is processed using the standard processing routines and once completed, the resulting plots are subject to peer review to ensure the integrity of the interpretation. Our quality control standards are BS EN ISO 9001: 2015 certified.

4 SURVEY DESCRIPTION

The survey was carried out using the following geophysical methods:

- P-wave seismic refraction (employs compressional (P) waves)
- S-wave seismic refraction (employs shear (S) waves)

Background information for the seismic refraction survey method is provided in the appendices and descriptions of the actual survey work carried out on site are provided in the sections below.

4.1 Survey layout and location surveying

The location of the seismic profiles can be seen in Plate 1 and Figure 1. The centre line coordinates were provided by the client and its western extent dictated by the approximate location of the proposed sub-station, ~145 m from the cliff. The cross line coverage was designed to survey the geology across a 200 m wide corridor in the field and on the beach.

All geophone and off-end shot locations were surveyed using a *TOPCON Hyper Pro* dGPS system where possible, with an accuracy of +/- 2.5 cm and referenced to UTM 30N coordinate system using the Topcon network correction.

4.2 Seismic survey - P and S-wave refraction

A seismic survey involves generating a shock wave signal at the surface to investigate the geological structure beneath a chosen profile line. A series of vibration sensors called geophones are deployed along the survey line and are used to record the travel times of incident seismic signal as it returns from below ground. Features such as rockhead, the water table, made ground, soft sediments and dense tills all have distinct velocity ranges and can be imaged in cross-section using a seismic refraction survey. A description of the field activity is provided below. The seismic survey took the form of a normal land survey with geophones placed directly in the ground and carried out at low tide on the beach to achieve the most coverage towards MLWM. Some further background information on the survey method is found in the appendices.

4.2.1 Seismic survey field activity - P-wave Refraction

P-wave seismic data were acquired along four profiles using a 72-channel geophone spread with 2m spaced sensors. This results in spread lengths of 142m. Cables were then leap-frogged along to extend the profiles to approximately 190m. A Geode seismic system was used with contact and radio triggers. The recording setup is shown in Plate 7.

A sledgehammer and HDPE plastic plate were found to be a suitable seismic source on the beach. For the off-end shots required in the dunes and the sea for the centre-line profile, a SID (Seismic Impulse Device) utilising 12 and 8-gauge blank shotgun cartridges were used.

To build up a refraction section, seismic shots were taken at many positions along the geophone spread and set distances beyond each end. In general, shots were taken every eight geophone locations and up to 100 m beyond the end of the cable spread.

Plate 7 *–Seismic recording set-up on Profile 4*

4.2.2 Seismic survey field activity - S-wave Refraction

The S-wave seismic refraction data were acquired using the same geophone cable and *GEODE* seismic recording system as the P-wave survey, but utilising the horizontal component of the geophone sensors. A weighted S-wave plate struck sideways with a sledgehammer was used as the source (Plate 8). At each shot location, the plate was aligned perpendicular to the profile line and subsequently struck on both ends to generate two sets of shear wave recordings that have opposite polarity. This enables clear identification of the shear component of the seismic signal. Shots were deployed at the same locations as the P-wave survey apart from the far off-end shots where the shear wave signal was too weak to be resolved.

***Plate 8** – S-wave survey being carried out at Freshwater West site.*

4.2.3 Seismic survey data processing – P and S-wave Refraction

The data processing was carried out using *PICKWIN* and *PLOTREFA* software. The first stage involved the accurate determination of the first-arrival times of the seismic signal (time from the shot going off to each recording geophone) for every shot record using *PICKWIN*. Time-distance graphs showing the first-arrival times were then generated for each seismic line and analysed using *PLOTREFA* software to determine the number of seismic velocity layers. Modelled depth profiles for the observed seismic velocity layers were produced by a tomographic inversion procedure that was revised iteratively to develop the best-fit model.

The final output of a seismic refraction survey is a velocity model section of the subsurface based on an observed layer sequence with measured velocities that correspond to physical properties such as levels of compaction/saturation in the case of sediments and strength/rippability in the case of bedrock. A transitional velocity model may be considered if distinct layers are not expected or velocity contrasts between layers are marginal, however, a layered model appears most appropriate at this site. The final sections were exported to *CorelDraw* for annotation and presentation.

5 RESULTS

The results of the seismic surveys are presented in Figures 2 to 5 as modelled seismic velocity cross-sections. A general description of the interpretation process and summary findings are given below. References to depth are made in metres below ground level (bgl.) to allow for easy identification of layer thicknesses.

5.1 Seismic Refraction – compressional (P) and shear (S) wave

Interpretation of the refraction sections is based on the widely understood and published velocities of typical sub-surface materials (provided in Figure 2). It is beneficial to correlate model sections with on-site information/observations, but at time of reporting, no invasive investigations had taken place.

5.1.1 Compressional (P) wave

Analysis of the P-wave refraction data has identified up to four distinct layers of contrasting velocity (V_p), and a typical description of each layer is given below (Table 1). It is worth noting that the seismic refraction section represents the measured bulk characteristics of the subsurface and in certain cases, it can prove difficult to correlate with point source data (boreholes/trial pits) where the underlying material is variable.

Layer	P-wave velocity	Soil/Rock Description
P1 (Pink)	400 m/s (low)	Dry soils/sand and unconsolidated near surface sediments
P2 (Orange)	1720 m/s (medium velocity)	Consolidated and/or saturated sediments and weak weathered rock
P3 (Light green)	3285 m/s (medium - high velocity)	Moderately strong bedrock
P4 (Dark Green)	4300 m/s (high velocity)	Strong non-rippable bedrock

***Table 1** – A guide to the composition of the P-wave velocity layers identified*

Layer P1 🟥 has a low velocity and is typical of near-surface unconsolidated material, thin soils and organic material, loose dry sand and unconsolidated sediments.

Layer P2 🟧 has a velocity typical of more consolidated and/or saturated sediments. This layer is likely to contain any thin till deposits and the transition to weak weathered bedrock. This is seen in the cliff exposure where approximately 2 m of material overlies the more competent rock.

***Plate 9** – Cliff exposure on the centre line showing dense sediments overlying bedrock*

Layer P3 🟩 has a velocity typical of moderately strong rock and represents the unweathered bedrock.

Layer P4 🟦 comprises of material with high velocity indicative of a strong and competent bedrock.

5.1.2 Shear (S) wave

By carrying out a similar analysis of the S-wave refraction data, four distinct layers of contrasting velocity (V_s) have been identified and are characterised by their correlation with standard tables provided on each of the accompanying figures (plus Appendix).

Layer	S-wave velocity (m/s)	Soil/Rock Description
S1	150 -160 m/s	Soft soil/sediments
S2	610 -650 m/s	Compacted stiff sediments and weak weathered rock
S3	1182 - 1310 m/s	Moderately strong bedrock
S4	1610 - 1700 m/s	Strong bedrock

***Table 2** – A guide to the composition of the S-wave velocity layers identified*

When comparing the resulting P-wave and S-wave velocity sections, there is a rough 'rule of thumb' with regards to the ratio of the velocities. For unconsolidated sediment, V_p/V_s is usually between 4.0 to 8.0, while for consolidated rocks, the V_p/V_s ratio can vary between 1.5 to 2.0. Even though these are accepted values, they can vary between sites depending on the geology and ground conditions. These results and the calculated Poisson's ratio for corresponding layers can be seen in Table 3.

The Poisson's ratio is used to provide an idea of how sediments and rocks will behave under stress (i.e. how much the rock will expand in a direction perpendicular to the direction of compression). Material with a Poisson's ratio of 0 will show very little expansion when compressed as opposed to material with a Poisson's ratio of 0.5, which will deform at small strains. Most materials have Poisson's ratio values ranging from 0 to 0.5. For example, most clay soils (0.4 – 0.5), gravelly sands (0.3 – 0.4), Sandstone (0.1 – 0.4), Limestone (0.1 – 0.3), Granite (0.1 – 0.3). It can be seen from Table 3 that all the ground layer materials all appear to be compressible but well consolidated.

Layer	Vp	Vs	Vp/Vs	Poisson's Ratio
P1/S1	400	150	2.67	**0.42**
P2/S2	1720	610	2.82	**0.43**
P3/S2	3285	1310	2.51	**0.41**
P4/S3	4300	1700	2.53	**0.41**

***Table 3 –** Vp/Vs ratio and average Poisson's Ratio indicate the weak nature of the bedrock geology at the site.*

A further consideration is the correlation between the respective P-wave and S-wave refraction boundaries. These can vary depending on survey parameters, weathering profile, lithology and bedding structure.

6 INTERPRETATION

The interpretation of the seismic profiles takes the form of a detailed description for the centre line profile (Profile 1), and this understanding is then applied as a more general interpretation for the subsequent cross lines. The layer velocities are consistent in all four profiles.

6.1 Profile 1 Centre line (Route A RPL)

The centre line profile is the proposed cable route and at this site is in two sections, one section in the field west of the beach at elevation ~18 m above the beach and 140 m long, and the beach section which is 48 m long, and starts close to the base of the cliff and ends towards the mean low water mark. The beach profile was acquired along with the eastern part of the field profile to help constrain the model over such a short length and was extended as far as the low tide at the time would allow.

The modelled P-wave and S-wave layers correlate very closely and have produced a four-layer ground velocity model.

Layer P1 has a low velocity of 400 m/s, and the field section shows a laterally continuous thin layer 1 – 2 m thick characteristic of topsoil and loose sediments. The S-wave shows a similar thickness layer with a velocity indicative of soft sediments. The P1 layer on the beach section shows a thickening layer of dry uncompacted sand towards the cliff, thinning to a very thin layer down the beach to the east. On the beach, the shear wave S1 layer encompasses the P1 and P2 layers of sand and possible thin till deposit or weak weathered rock at shallow depth. This layer gets thinner towards the low tide area where it is ~ 1 m thick at the end of the profile.

The P2 and S2 layers extend to very similar depths and are probably of the most significance as they are likely to lie predominantly in the depth range of the proposed ground works and will be the easiest material to excavate. The P and S wave velocities of 1720 m/s and 610 m/s respectively, indicate a very dense material, and in the field section, this layer has a horizontal lower boundary ~ 5m bgl. As rock is visible in the cliff at a shallower depth than this, it is likely to represent compacted sediments overlying a very weathered rockhead.

In the beach section, this layer two is very thin and appears to have been largely eroded away, as would be expected of a weak material within the tidal zone.

Layer P3/S3 marks a considerable rise in velocity of the ground material and represents the more competent bedrock lithology. It is of laterally uniform thickness starting at ~5 m bgl. and going as deep as 12 m bgl. at the west end of the profile. The P-wave velocity of 3285 m/s and S-wave of 1310 m/s indicates a considerably harder, non-rippable rock composition and is relatively shallow along the beach section. Both P and S-wave layers on the beach start at ~3 m bgl. near the cliff, but the S-wave stays ~2 m bgl. towards the low tide mark while the P-wave is shallower probably representing less compressible rock near the surface. This hard rock layer will have to be excavated for the cable burial to be below the uncompacted sands and soft sediments. The thickness of this layer increases away from the cliff, going from ~5.5 m bgl. near the cliff, to 7 m bgl. at the east end of the profile.

Layer P4 and S4 represent a competent rock layer at depth, with velocities of 4300 m/s and 1700 m/s respectively indicating the thinly bedded sedimentary bedrock is very hard and strong. The upper boundaries of the P and S layers correlate relatively closely, between 10 m and 12 m bgl. slightly shallowing near the centre of the field section. On the beach section, the upper boundary is sub-parallel with the surface and from 6 m bgl. near the cliff to 7 m bgl. down the beach.

With regard to the practicality of directional drilling/trenching, it is usually preferable to stay within the same weak material composition that has similar engineering properties. It would, therefore, appear preferable to stay within Layer P2/S2 wherever possible, although any excavation up through the cliff will have to go through the very strong and moderately strong rock layers that are underneath, and this is not possible at all on the beach as layer two has been eroded away.

6.2 Profile 2

This profile is one of three cross profiles orientated approximately perpendicular to the centre line (Profile 1) and is located approximately 20 m from the western start point of Profile 1 close to the HDD area. It is 190 m long and approximately centred on Profile 1.

In general, the P-wave and S-wave models show laterally continuous layers with only minor changes in the different layer thicknesses along the profile.

Layer P1 is ~2 m thick and forms a slightly thicker layer than Layer S1 which indicates stiffer sediments are closer to the surface. The P-wave boundary may be more associated with the transition to weathered rock in this scenario.

Layer P2/S2 is ~3 - 4 m thick with a lower boundary 4 m - 5 m bgl. and can be seen to be shallowest where the centre line crosses at chainage 85 m. The S-wave lower boundary is markedly shallower in the far north indicating a probable transition to stiffer weathered bedrock in this area.

Layers P3/S3 lower boundary is ~15 m deep in the north shallowing to ~12 m bgl. near the centre of the profile before getting slightly deeper again to the south, back to ~15 m bgl.

Layers P4 and S4 show the deeper strong bedrock has a velocity less than that measured along the centre line (P-wave 3890 m/s rather than 4300 m/s and S-wave 1606 m/s rather than 1700 m/s) and is probably associated with the strike orientation of the bedding. The centre line refraction signal is travelling predominantly along the bedding of a few consistent beds, while the cross lines are a bulk representation crossing many different beds of varying thickness and composition.

6.3 Profile 2

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Layers P3/S3 lower boundary is ~15 m deep in the north shallowing to ~12 m bgl. near the centre of the profile before getting slightly deeper again to the south, back to ~15 m bgl.

6.4 Profile 3

Profile 3 is located in the field area and approximately 50 m west of the cliff line and 75 m east of Profile 2. It is orientated approximately perpendicular to the centre line and is 190 m long centred on Profile 1.

This profile shows a distinct thinning of the weaker materials to the north of the centre line (P1 on the section) with the hard rock becoming very shallow.

As observed in Profile 2, Layer P1 is ~2 m thick and slightly thicker than Layer S1. The P-wave boundary may be more associated with the transition to weathered rock in this scenario.

The lower S2 boundary is generally not as deep as the corresponding P-wave boundary indicating a shallower depth to stronger material. The deeper P-wave boundary has identified, the less compressible rock boundary. Both P2 and S2 boundaries become considerably shallower between chainage 40 – 80 m chainage to ~3 m bgl. and the layer three velocity nearly disappears in this region. The depth of this layer gradually increases to the north and south to ~5-6 m bgl.

Layers P3/S3 forms a highly changing thickness of moderately strong rock with a lower depth of >10 m bgl. in the north shallowing to ~3 m bgl as described above and pinching out at, before rapidly thickening to >20 m bgl. in the south.

Layer P4 representing the competent bedrock can be seen to rise close to the surface between 40 and 80 m chainage and should probably be avoided. The proposed route location (P1) is approximately 10 m to the south where the layer 2/3 boundary is at ~6 m bgl. and the layer four boundary at ~10 m bgl.

6.5 Profile 4

Profile 4 is located on the beach ~90 m east of Profile 3 and ~50 m from the cliff as close as was deemed safe and practical, to the low tide mark at the time of the survey. It is shorter than the other cross lines due to the rocky beach exposure, and is 142 m long and orientated approximately perpendicular to the centre line

This profile only has three P-wave layers with no P1 layer, as the ground surface is directly on to compacted wet sand. The S1 layer therefore corresponds to the P2 layer and the S2 layer is virtually non-existent as any soft sediments or highly weathered rock have been eroded by the sea, resulting in a shallow depth to moderately strong rock beneath the sand.

Layer P2/S1 forms a very thin layer of wet sand <1 m thick at the surface and is laterally continuous along the profile.

Layer P3/S3 begins at a very shallow depth of <1 m bgl. and corresponds in shape to Profile 3 in rapidly deepening to the south; going from the near surface at 30 m chainage to over 20 m at the end of the profile.

Layer P4/S4 shows the very hard bedrock coming to the surface at chainage 30 m and staying shallow to the start of the profile in the north. Where the centre line is located this layer occurs at ~9 m depth.

7 CONCLUSIONS

- Analysis of the P-wave and S-wave refraction has provided detailed information to assist with the bulk characterisation of the shallow sub-surface within the corridor of interest. As there are no boreholes at time of reporting, the modelled layers are based on a general interpretation of the likely geology at the site.

- Four calculated P-wave and S-wave velocities have been identified which increase in velocity with depth. Layer P1/S1 represents a thin, unconsolidated layer of surface soils and sediment. Layer P2/S2 velocities can represent dense sediments, till and very likely the weathered bedrock. Layer P3/S3 is interpreted as moderately strong bedrock and Layer P4/S4 as very competent, strong bedrock.

- With regard to the layers of concern in the shallower subsurface where drilling/trenching is likely to take place, Layers P2 and S2 are likely to be of the most importance as this represents weak material overlying a considerably harder rock layer, as indicated by the large change to higher P and S-wave velocities between Layers 2 and 3.

- Layer P2 and S2 that probably represent the preferred material to excavate within, are to a depth of 5 to 6 m bgl along the centre line. Thinning slightly where Profile 2 intersects and considerably thinner just north of the centre line on Profile 3. The beach section shows a thin <1 m layer of sand before encountering the moderately strong bedrock which is layer 3. Layer 2 material is not present and has probably been eroded away. The beach cross line (Profile 4) shows layer 3 thickening rapidly to the south with the very hard rock Layer 4 getting deeper. The shallow depth of the P3/S3 layer beneath the beach poses the hardest material in the shallow subsurface that will have to be excavated.

- With regards to the best positioning of the cable route, the field section only has a marginally greater thickness of weak sediment/rock (layer P2/S2) approximately 50 to 60 m south of the centre line, where the base of this layer is 1 to 2 m deeper. Profile 3 shows the very hard rock layer becomes relatively shallow (~5 m bgl.) just north of the centre line and coincident with the northern extent of a topographic rise in the ground level, and probably should be avoided.

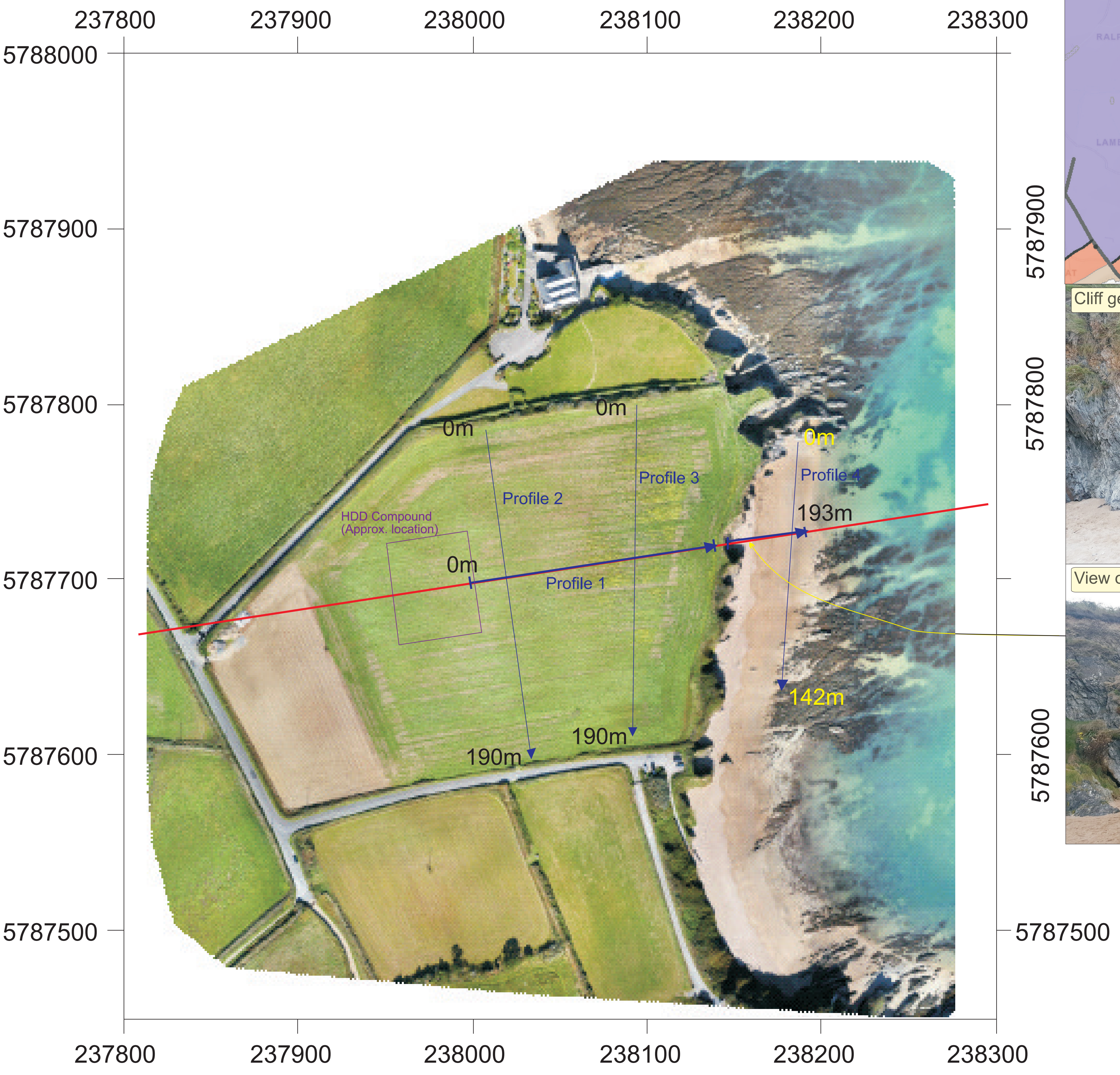
- The beach shows no variation in the shallow depth of the moderately strong rock layer within the survey corridor and in fact turns to very hard rock close to surface approximately 20 m north of the proposed route.

Disclaimer

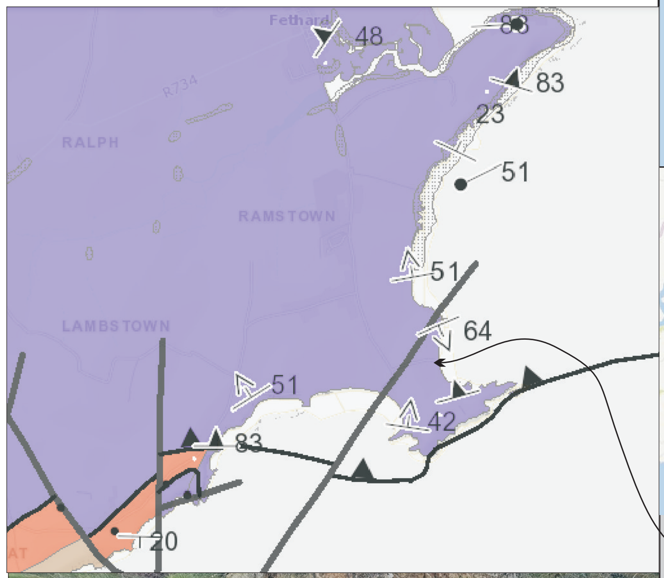
This report represents an opinionated interpretation of the geophysical data. It is intended for guidance with follow-up invasive investigation. Features that do not produce measurable geophysical anomalies or are hidden by other features may remain undetected. Geophysical surveys compliment invasive/destructive methods and provide a tool for investigating the subsurface; they do not produce data that can be taken to represent all of the ground conditions found within the surveyed area. Areas that have not been surveyed due to obstructed access or any other reason are excluded from the interpretation.

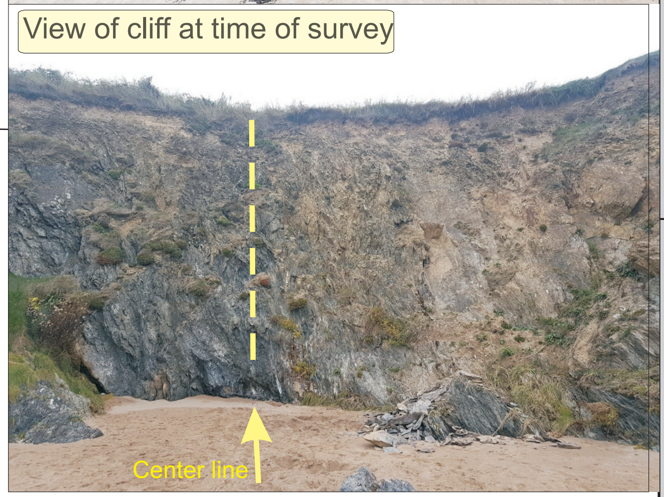
Figures

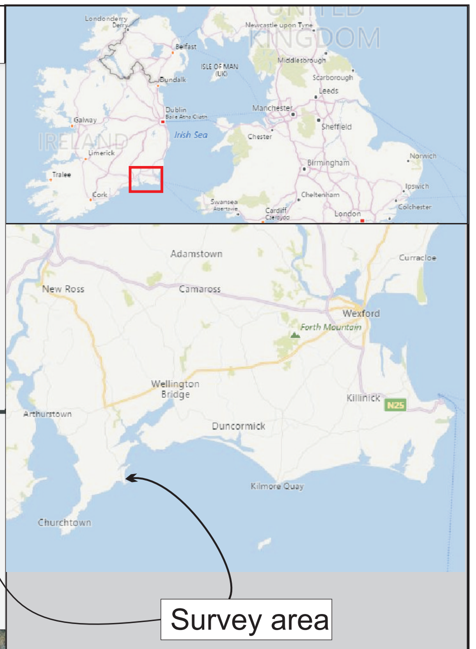
Coordinate system:
UTM 30N



Geology map of survey area







KEY

↘ Seismic refraction profiles (P and S wave)

Geological KEY

🟪 Boolin Bay Group (Cambrian)

Comprised of repetitively interbedded grey siltstone and mudstone succession with fine sandstones and paraconglomerates

Dip 64

\ Fault

Notes

Source: Microsoft® Bing™ Maps May 2018

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Title:

LOCATION MAP

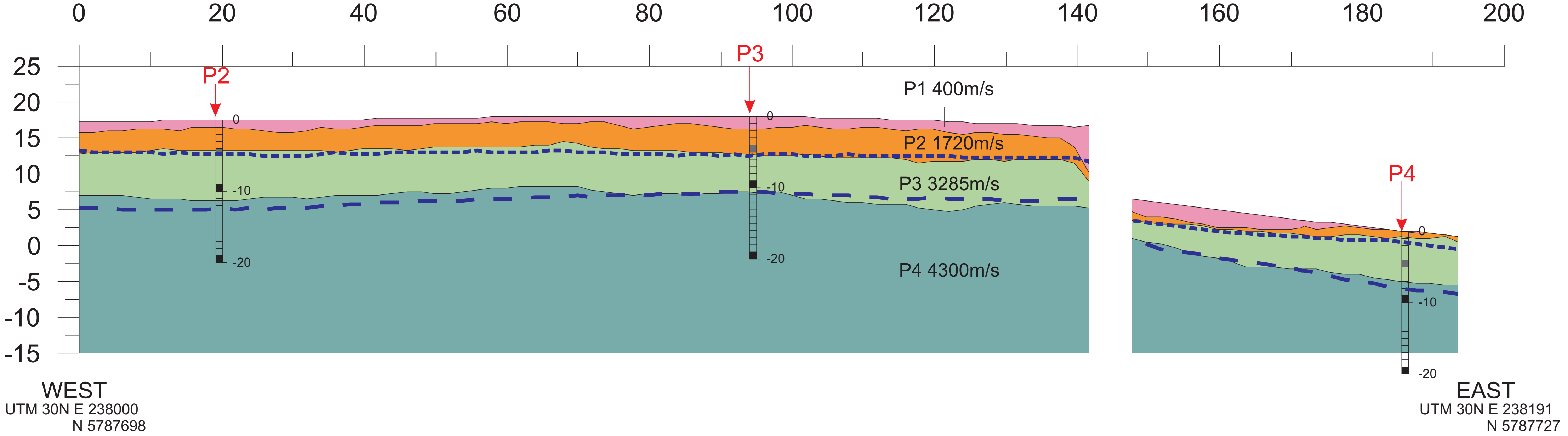
Project:

Baginbun Beach cable landfall MMT (Greenlink Project)

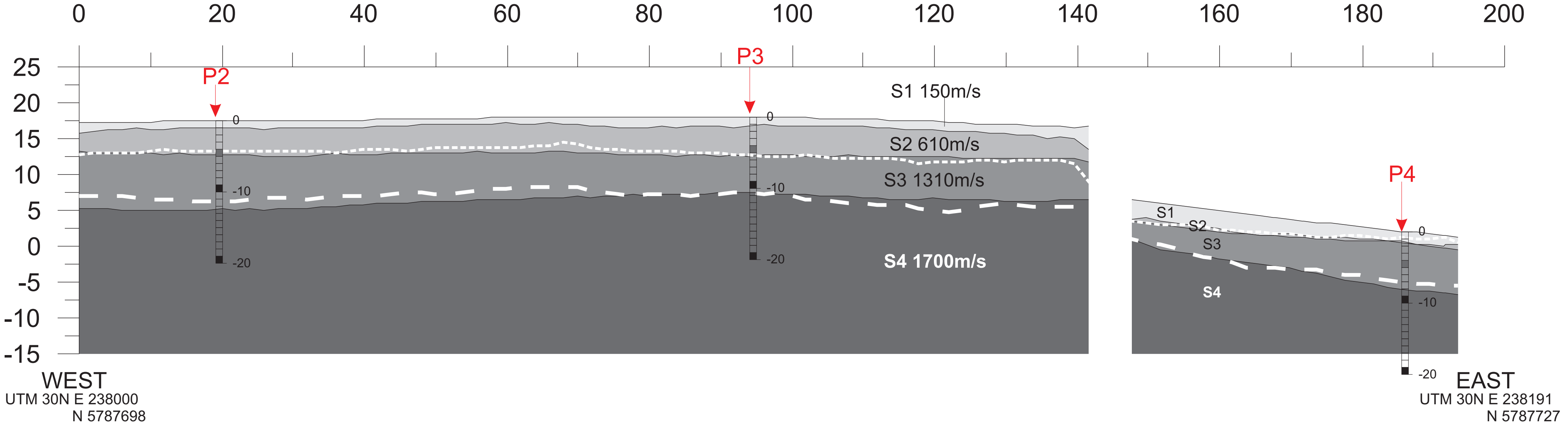
Scale:	1:2500 at A3
Drawn by/Ref:	AL/6113IR/1
Date:	December 2018

FIGURE 1

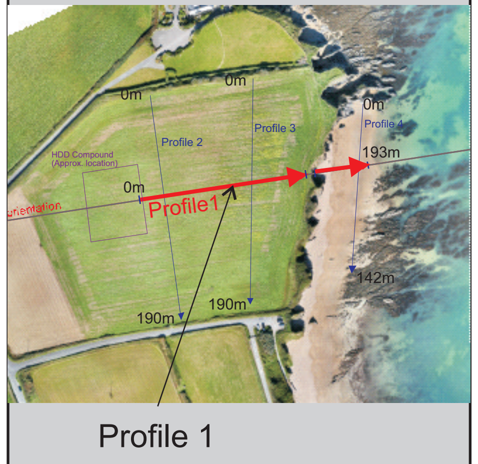
Seismic P-wave Refraction Profile 1 RPL center line



Seismic S-wave Refraction Profile 1 RPL center line



Location Plan (NTS)



Compressional P-wave velocity

🟪 Layer 1 (400 m/s)

🟧 Layer 2 (1720 m/s)

🟩 Layer 3 (3285 m/s)

🟦 Layer 4 (3890 - 4300 m/s)

Major shear wave boundaries overlain

Shear S-wave seismic velocity

⬜ Layer 1 (150 - 160 m/s)

⬜ Layer 2 (610 - 633 m/s)

⬛ Layer 3 (1182 - 1310 m/s)

⬛ Layer 4 (1610 - 1700 m/s)

Major P-wave boundaries overlain

Note:

The numbers overlaid on the refraction surveys refer to the modelled velocities for that section in Plotrefa (m/s)

Key:

P* Indicates the intersection of the profile and its number

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Title:
SEISMIC RESULTS PROFILE 1 (RPL CENTRE LINE)

Project:
Baginbun Beach cable landfall MMT (Greenlink Project)

Scale: 1:750 at A3
Drawn by/Ref: AL/6113IR/2
Date: December 2018

FIGURE 2

VERSION 1 PENDING
ADDITIONAL INVASIVE WORK

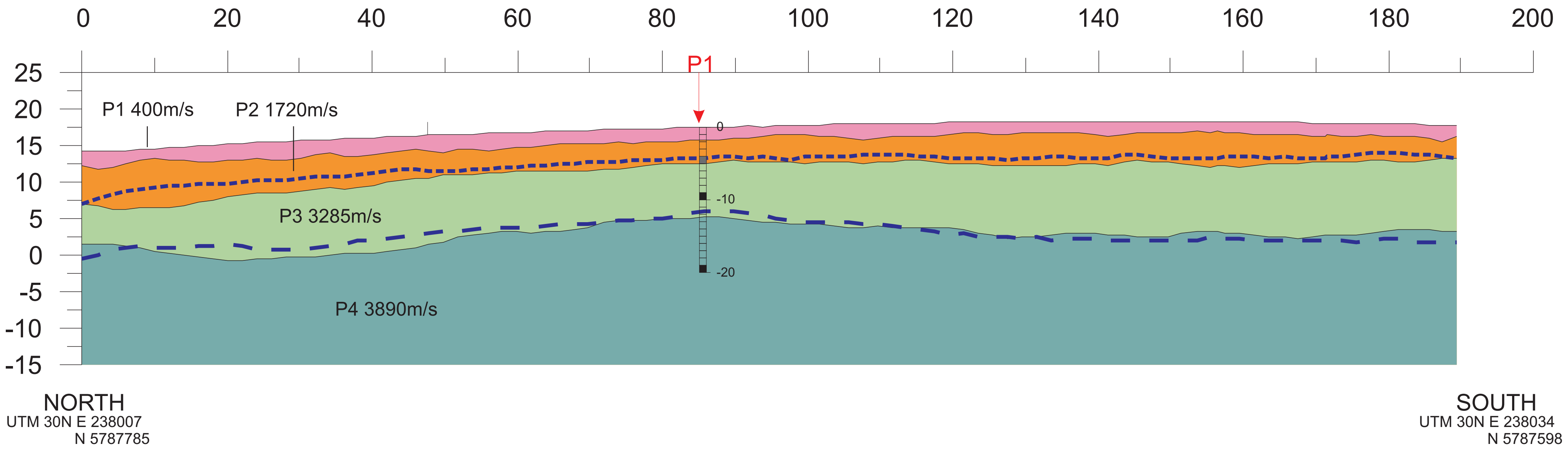
Compressional P-wave Layer Model

Layer P1	🟪	Soil and uncosildated sediments
Layer P2	🟧	Dense wet sediment / glacial material including weathered rock
Layer P3	🟩	Bedrock (moderately strong)
Layer P4	🟦	Bedrock (strong)

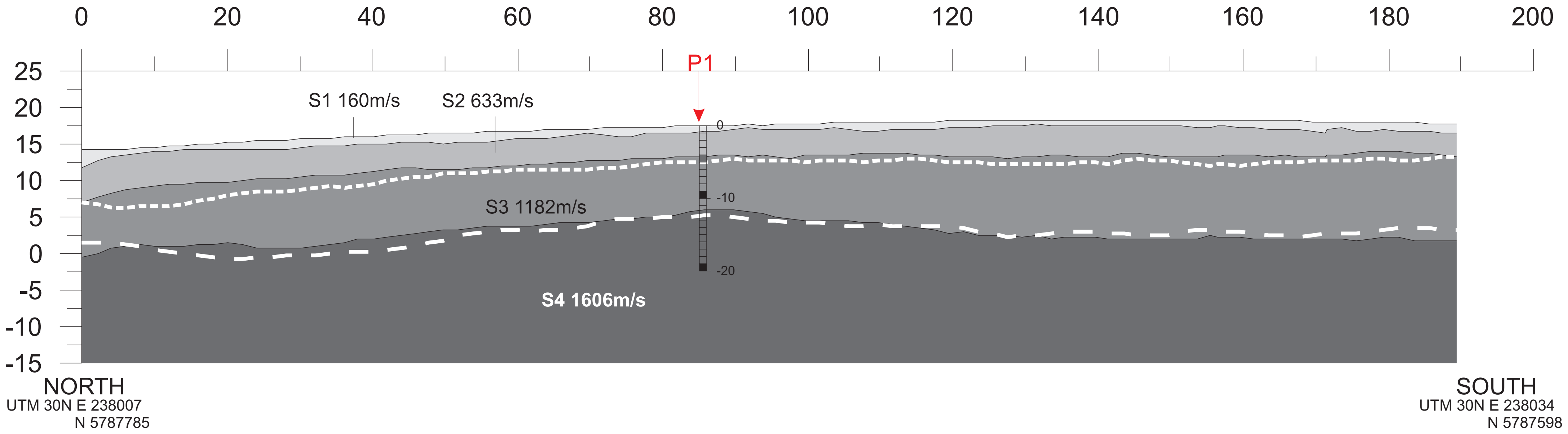
Shear S-wave Layer Model

Layer S1	⬜	Soft sediment
Layer S2	⬜	Very dense sediment but likely weathered rock
Layer S3	⬛	Bedrock (moderately strong)
Layer S4	⬛	Rock (strong)

Seismic P-wave Refraction Profile 2



Seismic S-wave Refraction Profile 2



Compressional P-wave Layer Model

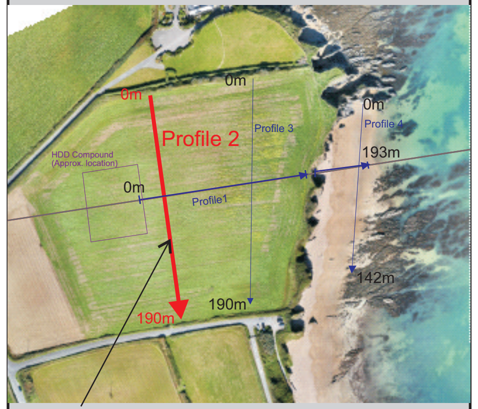
Layer P1	🟪	Soil and uncosildated sediments
Layer P2	🟧	Dense wet sediment / glacial material including weathered rock
Layer P3	🟩	Bedrock (moderately strong)
Layer P4	🟦	Bedrock (strong)

Shear S-wave Layer Model

Layer S1	⬜	Soft sediment
Layer S2	▨	Very dense sediment but likely weathered rock
Layer S3	▨	Bedrock (moderately strong)
Layer S4	⬛	Rock (strong)

VERSION 1 PENDING
ADDITIONAL INVASIVE WORK

Location Plan (NTS)



Profile 2

Compressional P-wave velocity

🟪 Layer 1 (400 m/s)
🟧 Layer 2 (1720 m/s)
🟩 Layer 3 (3285 m/s)
🟦 Layer 4 (3890 - 4300 m/s)

Major shear wave boundaries overlain

Shear S-wave seismic velocity

⬜ Layer 1 (150 - 160 m/s)
▨ Layer 2 (610 - 633 m/s)
▨ Layer 3 (1182 - 1310 m/s)
⬛ Layer 4 (1610 - 1700 m/s)

Major P-wave boundaries overlain

Note:

The numbers overlaid on the refraction surveys refer to the modelled velocities for that section in Plotrefa (m/s)

Key:

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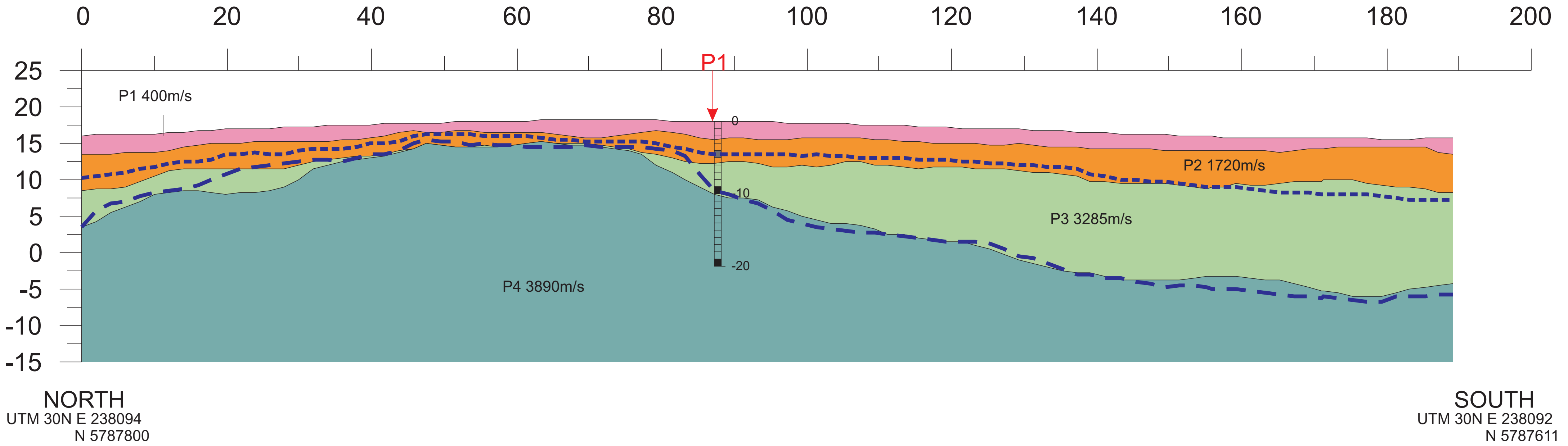
SEISMIC RESULTS
PROFILE 2 CROSS LINE

Project:
Baginbun Beach cable landfall
MMT (Greenlink Project)

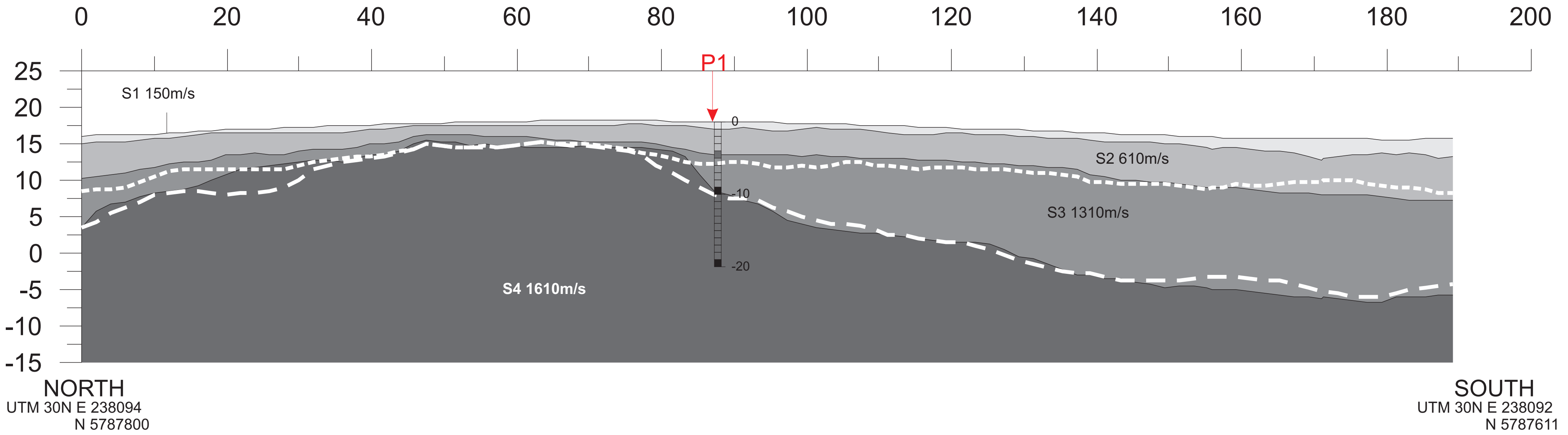
Scale: 1:750 at A3
Drawn by/Ref: AL/6113IR/3
Date: December 2018

FIGURE 3

Seismic P-wave Refraction Profile 3



Seismic S-wave Refraction Profile 3



Compressional P-wave Layer Model

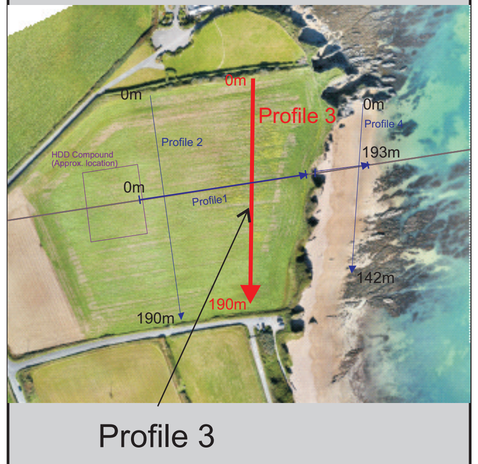
Layer P1	🟥	Soil and uncosildated sediments	
Layer P2	🟧	Dense wet sediment / glacial material including weathered rock	
Layer P3	🟩	Bedrock (moderately strong)	┈┈
Layer P4	🟦	Bedrock (strong)	- - -

Shear S-wave Layer Model

Layer S1	⬜	Soft sediment	
Layer S2	⬜	Very dense sediment but likely weathered rock	
Layer S3	⬛	Bedrock (moderately strong)	┈┈
Layer S4	⬛	Rock (strong)	- - -

VERSION 1 PENDING
ADDITIONAL INVASIVE WORK

Location Plan (NTS)



Compressional P-wave velocity

- 🟥 Layer 1 (400 m/s)
- 🟧 Layer 2 (1720 m/s)
- 🟩 Layer 3 (3285 m/s) ┈┈
- 🟦 Layer 4 (3890 - 4300 m/s) - - -

Major shear wave boundaries overlain

Shear S-wave seismic velocity

- ⬜ Layer 1 (150 - 160 m/s)
- ⬜ Layer 2 (610 - 633 m/s)
- ⬛ Layer 3 (1182 - 1310 m/s) ┈┈
- ⬛ Layer 4 (1610 - 1700 m/s) - - -

Major P-wave boundaries overlain

Note:

The numbers overlaid on the refraction surveys refer to the modelled velocities for that section in Plotrefa (m/s)

Key:

↓P* Indicates the intersection of the profile and its number

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**SEISMIC RESULTS
PROFILE 3 CROSS LINE**

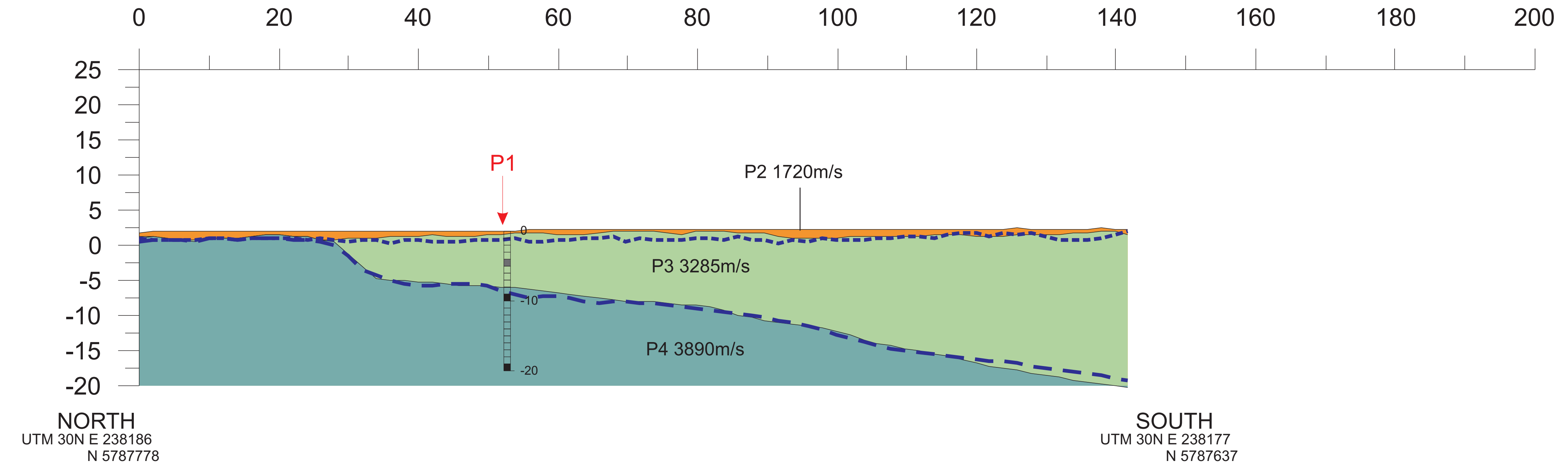
Project:

**Baginbun Beach cable landfall
MMT (Greenlink Project)**

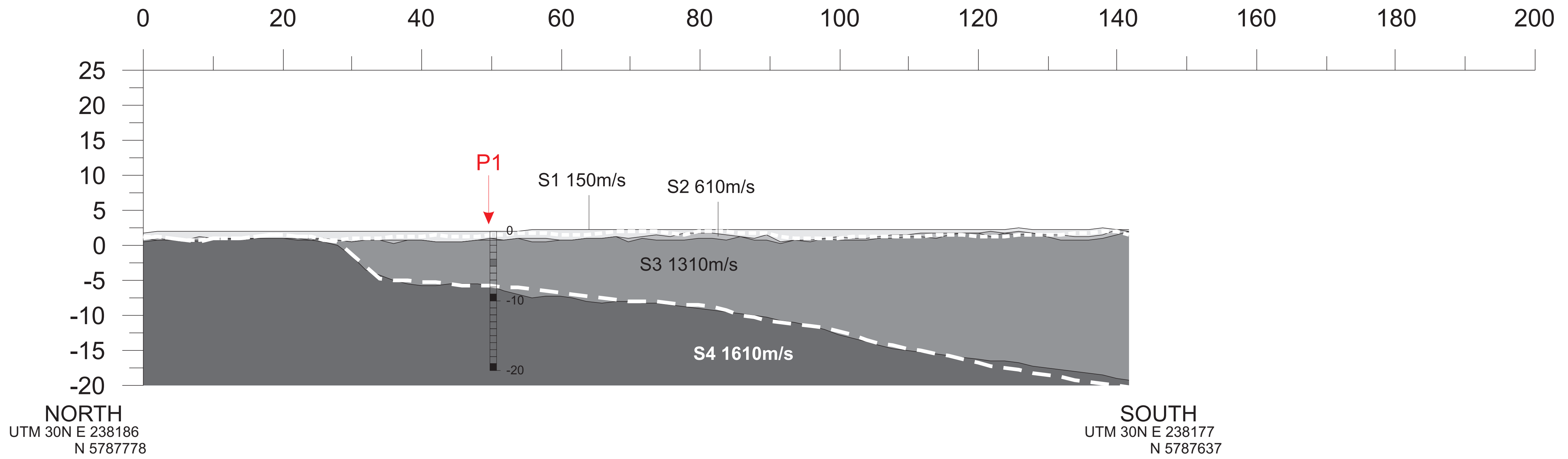
Scale: 1:750 at A3
Drawn by/Ref: AL/6113IR/4
Date: December 2018

FIGURE 4

Seismic P-wave Refraction Profile 4 (beach cross line)



Seismic S-wave Refraction Profile 4 (beach cross line)



Compressional P-wave Layer Model

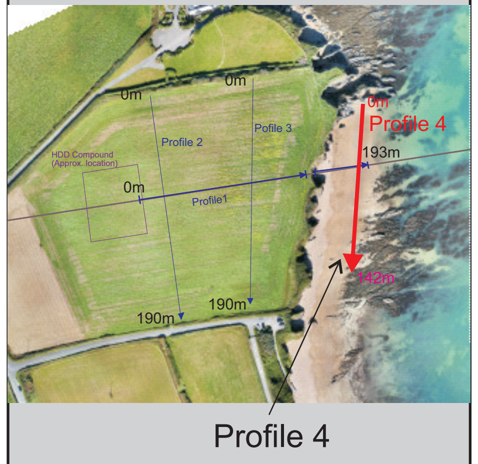
Layer P1	🟪	Soil and uncosildated sediments
Layer P2	🟧	Dense wet sediment / glacial material including weathered rock
Layer P3	🟩	Bedrock (moderately strong)
Layer P4	🟦	Bedrock (strong)

Shear S-wave Layer Model

Layer S1	⬜	Soft sediment
Layer S2	▨	Very dense sediment but likely weathered rock
Layer S3	▨	Bedrock (moderately strong)
Layer S4	⬛	Rock (strong)

VERSION 1 PENDING
ADDITIONAL INVASIVE WORK

Location Plan (NTS)



Compressional P-wave velocity

🟧 Layer 2 (1720 m/s)

🟩 Layer 3 (3285 m/s)

🟦 Layer 4 (3890 - 4300 m/s)

Major shear wave boundaries overlain

Shear S-wave seismic velocity

⬜ Layer 1 (150 - 160 m/s)

▨ Layer 2 (610 - 633 m/s)

▨ Layer 3 (1182 - 1310 m/s)

⬛ Layer 4 (1610 - 1700 m/s)

Major P-wave boundaries overlain

Note:

The numbers overlaid on the refraction surveys refer to the modelled velocities for that section in Plotrefa (m/s)

Key:

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Title:
SEISMIC RESULTS
PROFILE 4 BEACH CROSS LINE

Project:
Baginbun Beach cable landfall
MMT (Greenlink Project)

Scale: 1:750 at A3
Drawn by/Ref: AL/6113IR/5
Date: December 2018

FIGURE 5

Appendices

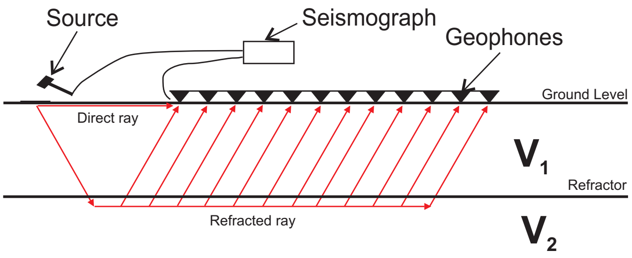
Appendix - Seismic Refraction Survey

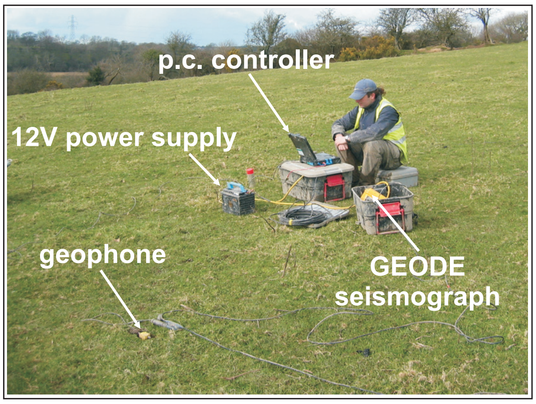
Seismic refraction is a useful method for investigating geological structure and rock properties. The technique involves the observation of a seismic signal that has been refracted between layers of contrasting seismic velocity, i.e., at a geological boundary between a high velocity layer and an overlying lower velocity layer.

Shots are deployed at the surface and recordings made via a linear array of sensors (geophones or hydrophones). Refracted seismic signal travels laterally through the higher velocity layer (refractor) and generates a 'head-wave' that returns to surface. Beyond a certain distance away from the shot, the signal that has been refracted at depth is observed as first-arrival signal at the geophones. Observation of the travel-times of refracted signal from selectively deployed shots enables derivation of the depth profile of the refractor layer. Shots are typically fired at locations at and beyond both ends of the geophone spread and at regular intervals along its length.

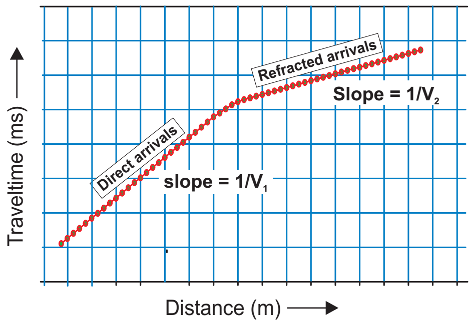
The results of the seismic refraction survey are usually presented in the form of seismic velocity boundaries on interpreted cross-sections. Seismic sections represent the measured bulk properties of the subsurface and enable correlation between point source datasets (boreholes/trialpits) where underlying material is variable. Reference to the published seismic velocity tables enables derivation of rippability values.

Typical field set-up

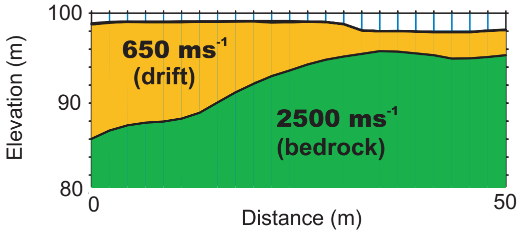




Travel-time curve



Modelled velocity section

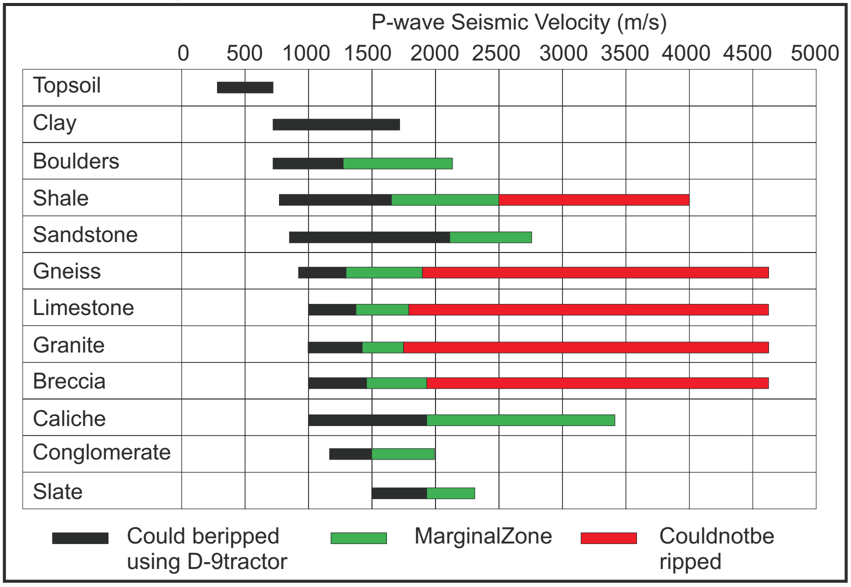


The data processing is carried out using PICKWIN & PLOTREFA (OYO ver2.2) software. The first stage involves accurate determination of the first-arrival times of the seismic signal (time from the hammer blow to each recording hydrophone) for every shot record, using PICKWIN. Time-distance graphs showing the first-arrival times were then generated for each seismic shot record and analysed using PLOTREFA software to determine the number of seismic velocity layers. Modelled depth profiles for the observed seismic velocity layers are produced by a tomographic inversion procedure that is revised iteratively to develop a best fit-model. The final output of a seismic refraction survey is a velocity model section of the subsurface based on an observed layer sequence with measured velocities that correspond to physical properties such as levels of compaction/ saturation in the case of sediments and strength/rippability in the case of bedrock.

Constraints

Layer velocity (density) must increase with depth; true in most instances. Layers must be of sufficient thickness to be detectable. Data collected directly over loose fill (landfills) or in the presence of excessive cultural noise may result in sub-standard results. In places where compact clay-rich tills and/or shallow water overly weak bedrock an S-wave survey may be used to profile rockhead where insufficient velocity contrast may prevent use of a P-wave survey.

Rippability Chart



Ground preparation by ripping in open pit mining, Mining Magasine, 122, 458-469. Atkinson, 1970

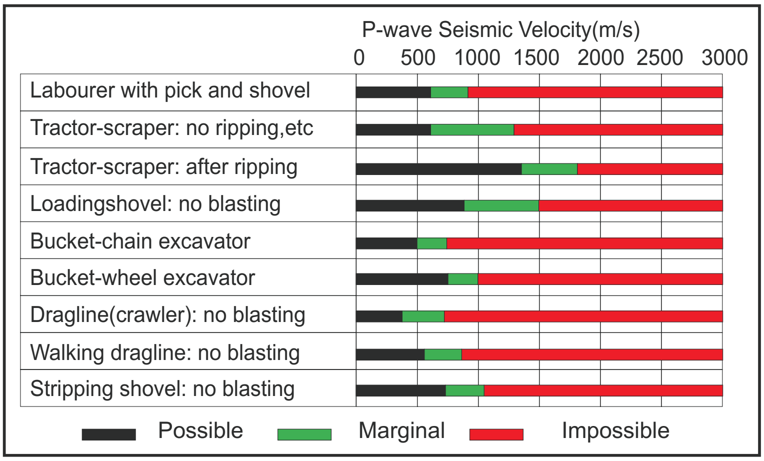
Compressional P-wave

Typical P-wave seismic velocity

Natural Soil and Rock	**Velocity (m/s)**
Weathered surface material	240 to 610
Gravel or dry sand	460 to 915
Sand (saturated)	1220 to 1830
Clay (saturated)	915 to 2750
Water	1430 to 1665
Sea water	1460 to 1525
Sandstone	1830 to 3960
Shale	2750 to 4270
Chalk	1830 to 3960
Limestone	2134 to 6100
Granite	4575 to 5800
Metamorphic rock	3050 to 7000

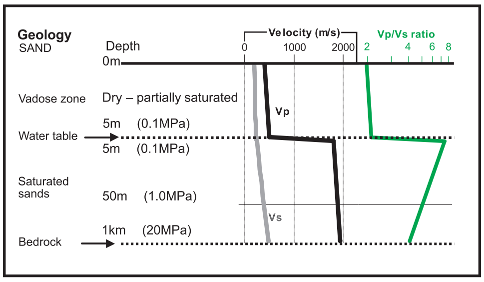
ASTM D577 - 00(2011)e1
Standard guide for using the seismic refraction method for subsurface investigation

Diggability Chart



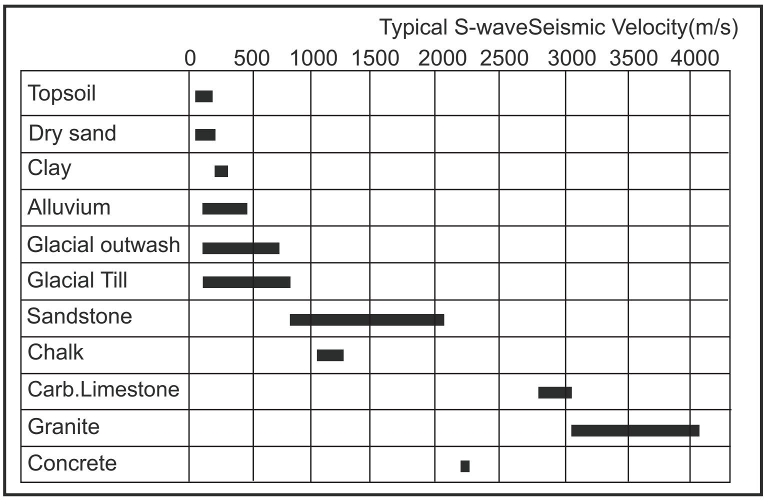
Selection of open pit excavation and loading equipment.
Transactions of the Institute of Mining and Metallurgy, 80, A101-A129, Atkinson 1971

Effect of ground water



Prasad et al., Measurement of velocities and attenuation in shallow soils,
Near-Surface Geophysics Volume II Case Histories, SEG, Tulsa (2004)

Shear Waves



Rock / Soil Description (top 30m)	**S-wave velocity (m/s)**
Hard rock (*strong**)	> 1,500
Rock (*moderately strong**)	760 - 1,500
Very dense soil / soft (*weak**) rock	360 - 760
Stiff soil	180 - 360
Soft soil	<180

The NEHRP Recommended Provisions for seismic regulation for new buildings, (FEMA-222A and FEMA-223A, 1994)

** UK equivalent classification (Waltham, 1994)*

Applied Geophysics, Telford et al, 1990
Shear wave velocity determination of unlithified geologic materials (CUSEC region) Illinois State Geological Survey, Bauer, 2004.

Bauer et al., 2007, Illinois State Geological Survey.

Shear Wave Velocity, Geology and Geotechnical Data of Earth Materials in the Central U.S. Urban Hazard Mapping Areas.

An Introduction to Geophysical Exploration, 3rd Edition, Keary and Brooks.

Conceptual Overview of Rock and Fluid Factors that Impact Seismic Velocity and Impedance, Stanford Rock Physics Laboratory, n.d.

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APPENDIX - SEISMIC VELOCITY TABLES

IGSL Ltd

Client: Greenlink Interconnector Limited
Engineer: Arup

Greenlink Interconnector Onshore Ireland Intrusive Ground Investigation

Project No. 21475

April 2019

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DOCUMENT ISSUE REGISTER

Distribution	Copies	Rev.	Date of Issue	Prepared By:
Arup	***Draft*** Factual Report – by email (PDF)	0	08th of April 2019	Ciaran Killaly Chartered Geotechnical Engineer BE CEng MIEI
Arup	Factual Report (PDF by email)	0	26/04/2019	Ciaran Killaly Chartered Geotechnical Engineer BE CEng MIEI

TABLE OF CONTENTS

FOREWORD

The following conditions and notes on the geotechnical site investigation procedures should be read in conjunction with this report.

Standards

The ground investigation works for this project have been carried out by IGSL in accordance with Eurocode 7 - Part 2: Ground Investigation & Testing (EN 1997-2:2007). This has been used together with complementary documents such as BS 5930:2015 and BS 1377 (Parts 1 to 9) and the following European Norms:

- EN 1997-2 Eurocode 7: 2007 – Geotechnical Design – Part 2: Ground Investigation & Testing
- EN ISO 22475-1:2006 Geotechnical Investigation and Sampling – Sampling Methods & Groundwater Measurements
- EN ISO 14688-1:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description
- EN ISO 14688-2:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Classification Principles
- EN ISO 14689-1:2018 Geotechnical Investigation and Testing - Identification & Classification of Rock, Part 1: Identification & Description

Reporting

This report has been prepared for Greenlink Interconnector Limited and Arup and the information should not be used without prior written permission of either party. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended. No responsibility can be held by IGSL Ltd for ground conditions between exploratory hole locations.

The engineering logs provide ground profiles and configuration of strata relevant to the investigation depths achieved and caution should be taken when extrapolating between exploratory points. No liability is accepted for ground conditions extraneous to the investigation points. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction, mining works or karstification below or close to the site.

Boring Procedures

Unless otherwise stated, 'shell and auger' or cable percussive boring technique has been employed as defined by Section 6.3 of IS EN ISO 22475-1:2006. The boring operations, sampling and in-situ testing complies with the recommendations of IS EN 1997-2:2007 and BS 1377:1990 and EN ISO 22476-3:2005+A1:2011. The shell and auger boring technique allows for continuous sampling in clay and silt above the water table and sand and gravel below the water table (Table 2 of IS EN ISO 22475-1:2006).

It is highlighted that some disturbance and variations is unavoidable in particular ground (e.g. blowing sands, gravel / cobble dominant glacial deposits etc). Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

Rotary Drilling Procedures

Rotary drilling methods are used to recover very heavily over-consolidated glacial till and bedrock samples in line with Section 3.5 of IS EN 1997-2:2007 and IS EN ISO 22475-1. Open hole drilling methods (odex or symmetrix) are utilized to advance the drillholes through granular dominant superficial deposits, with coring in hard ('cemented') fine grained or cohesive glacial deposits and bedrock.

In-Situ Testing

Standard penetration tests are conducted by IGSL strictly in accordance with Section 4.6 of IS EN 1997-2:2007. The SPT equipment (hammer energy test) has been calibrated in accordance with EN ISO 22476-3:2005+A1:2011 and the Energy Ratio (E_r) is defined as the ratio of the actual energy E_{meas} (measured energy during calibration) delivered to the drive weight assembly into the drive rod below the anvil, to the theoretical energy (E_{theor}) as calculated from the drive weight assembly. The measured number of blows (N) reported on the engineering logs are uncorrected. In sands, the energy losses due to rod length and the effect of the overburden pressure should be taken into account (see IS EN ISO 22476-3:2005+A1:2011).

Groundwater

The depth of entry of any influx of groundwater is recorded during the course of boring or drilling operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level. Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc.

Soil Sampling

Three categories of sampling methods are outlined in EN ISO 22475-1:2006. The categories are referenced A, B and C for any given ground conditions and are shown in Tables 1 and 2 of EN ISO 22475-1:2006. Reference should be made to EN 1997-2:2007 for guidelines on sample class and quality for strength and compressibility testing. Samples of quality classes 1 or 2 can only be obtained by using Category A sampling methods.

Where appropriate Class 1 thin wall undisturbed tube samples (UT100) are obtained in fine grained soils and strictly meet the requirements of EN 1997-2:2007 and EN ISO 22475-1:2006. Soil samples for laboratory tests are divided into five classes with respect to the soil properties that are assumed to remain unchanged during sampling, handling transport and storage. The minimum sample quality required for testing purposes to Eurocode 7 compatibility (EN 1997-2:2007) is shown in Table A.

Table A – Details of Sample Quality Requirements

EN 1997 Clause	Test	Minimum Sample Quality Class
5.5.3	Water Content	3
5.5.4	Bulk Density	2
5.5.5	Particle Density	N/S
5.5.6	Particle Size Analysis	N/S
5.5.7	Consistency Limits	4
5.5.8	Density Index	N/S
5.5.9	Soil Dispersivity	N/S
5.5.10	Frost Susceptibility	N/S
5.6.2	Organic Content	4
5.6.3	Carbonate Content	3
5.6.4	Sulphate Content	3
5.6.5	pH	3
5.6.6	Chloride Content	3
5.7	Strength Index	1
5.8	Strength Tests	1
5.9	Compressibility Tests	1
5.10	Compaction Tests	N/S
5.11	Permeability	2

N/S – not stated. Presume a representative sample of appropriate size.

Samples recovered from trial pits or trenches meet the requirements of IS EN ISO 22475-1. It is highlighted that unforeseen circumstances such as variations in geological strata may lead to lower quality sample classes being obtained.

Engineering Logging

Soil and rock identification is based on the examination of the samples recovered and conforms with IS EN ISO 14688-1:2018 and IS EN ISO 14689-1:2018. Rock weathering classification conforms to IS EN ISO 14689-1:2018 while discontinuities (bedding planes, joints, cleavages, faults etc) are classified in accordance with 4.3.3 of IS EN ISO 14689-1:2018. Rock mechanical indices (TCR, SCR, RQD) are defined in accordance with IS EN ISO 22475-1:2006.

Retention of Samples

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material will be discarded. Unless a period of retention of samples is agreed, it is company policy to discard soil samples one month after submission of our final report.

1. INTRODUCTION

At the instruction of Arup, working on behalf of Greenlink Interconnector Limited, IGSL has undertaken a programme of geotechnical site investigation works for the proposed development of an electricity interconnector between the high voltage grid systems of the United Kingdom(UK) and Ireland.

The site was split in four components as follows:

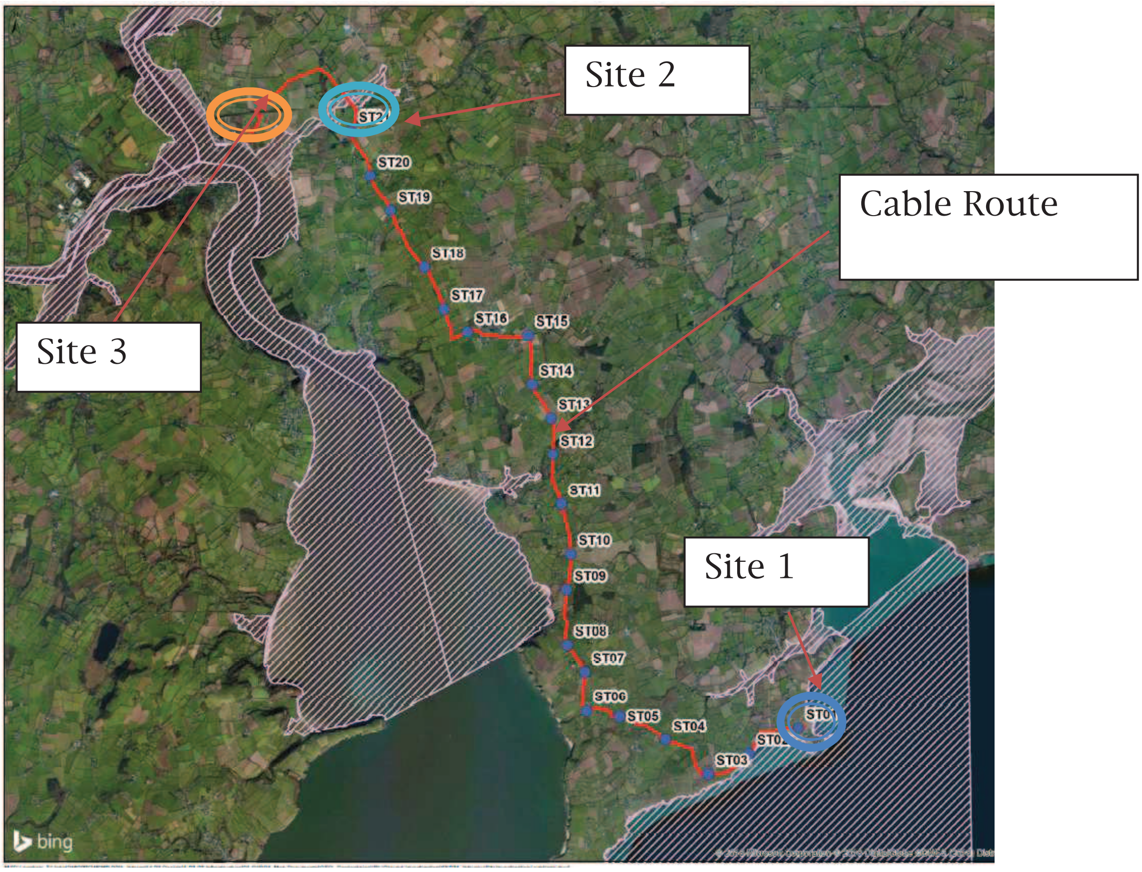
1. The proposed onshore cable route
2. Site 1 – Baginbun Beach, which consists of the landfall for the subsea cable
3. Site 2 – River Campile, works consist of HDD river crossing
4. Site 3 – Great Island, comprises of a convertor station

This report relates to the geotechnical investigation works acquired during the 2019 site investigation works. The geotechnical investigatory works included cable percussive boreholes, Geobore s rotary coreholes, trial pits, slit trenches, a foundation inspection pit, associated laboratory testing and surveying.

The field investigations were executed in accordance with BS 5930, Code of Practice for Site Investigations (2015) and EN 1997-2 Eurocode 7 Part 2 Ground Investigation & Testing. Chemical laboratory testing was conducted by Chemtest on samples selected by the Employer's Representative. .

This report presents the factual geotechnical data acquired from the site investigation.

Figure 1: Site Location Plan (Bing Map Image 2018)



2.0 CONTRACT OUTLINE & OBJECTIVES

The scope of work for this project was performed in one phase.

The primary objectives of the works were as follows:

- Determine the composition, consistency and strength / stiffness of the superficial soils
- Establish the rockhead elevation, weathering profile, discontinuity characteristics and strength of the bedrock
- Recover samples for geotechnical and Environmental laboratory testing in accordance with the requirements of the Employer's Representative
- Installation of groundwater monitoring infrastructure

2.1 Scope of Works

Exploratory drilling consisted of 14 no. cable percussive boreholes, 14 no. Geobore S rotary coreholes, 6 no. Trial Pits, 12 no. slit trenches and 1 no. foundation inspection pit.

Two types of drilling rig were used to advance the boreholes. The principal drilling methods consisted of:

1. Cable percussive drilling of overburden soils using a Dando 2000 rig
2. Overburden "Geobor S" coring with soil and rock core recovery using two Knebel rig with a polymer gel flush medium

Table 1 summarises the techniques used at each BH/RC location while Table 2 summarises the trial pits depths.

Table 1 – Summary of Drilling Techniques

Location	Depth (m BGL)	Drilling Rigs	Drilling Techniques	Additional	Site
BH01-1	3.4	Dando 2000	Cable Percussive	SPT's	SITE 1 BAGINBUN BEACH
BH02-1	2.7	Dando 2000	Cable Percussive	SPT's	
BH04-1	3.4	Dando 2000	Cable Percussive	SPT's,	
RC01-1	29.70	Knebel H79	Geobore S	Standpipe Installed	
RC02-1	60.00	Knebel H79	Geobore S		
RC04-1	60.00	Knebel H79	Geobore S	Standpipe Installed	

BH01-2	4.3	Dando 2000	Cable Percussive	SPT’s,	SITE 2 HDD RIVER CAMPILE CROSSING
BH03-2	2.8	Dando 2000	Cable Percussive	SPT’s,	
BH04-2	1.0	Dando 2000	Cable Percussive	SPT’s,	
BH05-2	6.2	Dando 2000	Cable Percussive	SPT’s,	
BH06-2	5.0	Dando 2000	Cable Percussive	SPT’s,	
RC01-2	19.8	Knebel H79	Geobore S	Standpipe Installed	
RC03-2	19.50	Knebel H79	Geobore S		
RC04-2	20.00	Knebel H79	Geobore S	Standpipe Installed	
RC05-2	17.90	Knebel H79	Geobore S		
RC06-2	21.10	Knebel H79	Geobore S		
BH01-3	3.0	Dando 2000	Cable Percussive	SPT’s,	SITE 3 GREAT ISLAND CONVERTOR STATION
BH02-3	1.0	Dando 2000	Cable Percussive	SPT’s,	
BH03-3	2.0	Dando 2000	Cable Percussive	SPT’s,	
BH04-3	5.6	Dando 2000	Cable Percussive	SPT’s,	
BH05-3	1.8	Dando 2000	Cable Percussive	SPT’s,	
BH06-3	13.3	Dando 2000	Cable Percussive	SPT’s,	
RC01-3	25.0	Knebel H79	Geobore S	Standpipe Installed	
RC02-3	25.00	Knebel H79	Geobore S	Standpipe Installed	
RC03-3	20.20	Knebel H79	Geobore S		
RC04-3	9.50	Knebel H79	Geobore S		
RC05-3	18.45	Knebel H79	Geobore S		
RC06A-3	20	Knebel H79	Geobore S	Standpipe Installed	

Table 2– Summary of Trial Pits

Location	Depth (m BGL)	Excavator Type	SI Activity	Site
TP01-1	2.20	8 Ton 360 Tracked excavator	Trial Pitting	SITE 1 BAGINBUN BEACH
TP02-1	1.05	8 Ton 360 Tracked excavator	Trial Pitting	
TP01-2	2.40	8 Ton 360 Tracked excavator	Trial Pitting	SITE 2 HDD RIVER CAMPILE CROSSING
TP02-2	2.70	8 Ton 360 Tracked excavator	Trial Pitting	
TP01-3	3.00	8 Ton 360 Tracked excavator	Trial Pitting	SITE 3 GREAT ISLAND CONVERTOR STATION
TP02-3	3.10	8 Ton 360 Tracked excavator	Trial Pitting	

3. FIELDWORKS

3.1 General

The geotechnical investigation was carried out from January 2019 to March 2019 and comprised the following:

- Cable Percussive Boreholes
- Geobore S Boreholes
- Trial Pits
- Slit Trenches
- A Foundation Inspection Pit
- Associated soil sampling
- Setting Out & Surveying

The ground investigations were executed in accordance with BS 5930, Code of Practice for Site Investigations (2015), EN 1997-2 Eurocode 7 Part 2 Ground Investigation & Testing and the Engineers Ireland Specification for Ground Investigation & related documents (2nd Edition 2016)

3.2 Cable Percussive Boreholes

The cable percussion boreholes (200mm diameter) were sunk using a Dando 2000 rig and employed conventional cable tool boring methods as outlined in the Foreword.

Representative bulk disturbed samples were taken at approximately 1.00m intervals or change of stratum and double sealed in polyethene bags. Environmental samples were taken as directed by the Employer's Representative and these included glass jars, a glass vial and a plastic tub.

Standard Penetration Tests (SPT's) were performed in the boreholes in accordance with Section 3.3, Part 9 of BS 1377 (1990). The SPT measures the number of blows required by a 63 kg hammer falling through a drop height of 760mm to drive a cone or a split spoon a distance of 300mm through the soil. Prior to the commencement of the test, the cone or split spoon is driven an initial distance of 150mm into the soil and the number of blows for this penetration depth are recorded as the "seating blows". The subsequent blowcounts for each 75mm increment (300mm) of penetration are recorded and summated to give the 'N-Value' as reported on the borehole log. The seating and test blow counts are reported in brackets with the N-Value recorded accordingly (e.g. BH01-1 at 1.2m where N=28 (4,5,5,7,7,9). The Energy Ratio for the SPT Hammer used on the contract is 74.10%(SPT Hammer No: SA1).

Details of the soils (strata) encountered, SPT N-Values, samples recovered and chiseling durations (hard strata boring) are presented on the boring records in Appendix 1.

3.3 Rotary Geobore S Drilling

Rotary Geobore S Drilling was carried out using two Knebel rotary rig. The drilling unit employed triple tube Geobore S coring techniques producing 102mm diameter core samples. Water flush with polymer gel was used to promote sample recovery throughout coring. Drilling was undertaken following both a CAT scan of the area and the excavation of a hand dug pit.

The core samples were placed in 2m capacity timber boxes. The boxes were transported from site to IGSL's laboratory in Naas to facilitate sub-sampling for laboratory testing. Photographs of the cores were taken with a digital camera prior to logging by a senior engineering geologist. The core photographs are presented in Appendix 2.

The core log records include engineering geological descriptions of the cores, details of discontinuities and mechanical indices (TCR, SCR and RQD's) for each core run. It is noted that core comprised of glacial till / overburden does not form part of the SCR and RQD percentage values. Comments on casing details are included on the rotary records. The rotary drillhole records are presented in Appendix 2 and reference should be made to the Foreword which provides details on the logging of the cores. Photographic records of the inspection pits are presented in Appendix 2.

Standpipes were installed in selected coreholes to establish an equilibrium groundwater level. Each standpipe (50mm diameter uPVC with proprietary 1mm slots and filter sock) incorporated a pea gravel filter pack and cement/bentonite grout seal. A protective flush cover was concreted/tarmacadam in place.

3.4 Trial Pits

The trial pits were undertaken using an 8 tonne tracked excavator. The pits were logged and sampled by an IGSL geotechnical engineer.

Representative disturbed bulk and environmental samples were taken as the pits were excavated, these were placed in heavy-duty polyethene bags and tubs and returned to the site laboratory for examination and laboratory testing. Environmental samples were taken as directed by the Employer's Representative and these included glass jars, a glass vial and a plastic tub.

The trial pits were backfilled with the as-dug arisings and reinstated to the satisfaction of the Employer's Representative. The trial pit logs are presented in Appendix 3 and include engineering descriptions of the soils encountered, samples recovered, groundwater strikes and stability of the pit sidewalls.

3.5 Slit Trenches

Slit trenches were excavated at locations specified by the Employer's Representative. Trenches were performed using a rubber tracked excavator and dug to a maximum depth of 1.25mbgl. The Slit Trenches were backfilled in accordance with the Department of the Environment "Guidelines for the opening, backfilling and reinstatement of trenches in public roads".

A detailed record of the depth, diameter and type of each service encountered within the trench is presented in Appendix 4. The soil profile provided on the slit trench logs describes the majority of the soils across the transverse trench. Where services have been located the material above the service and bedding material is described as Made Ground.

3.6 Foundation Inspection Pit

A single inspection pit was excavated at a location specified by the Employer's Representative. The inspection pit was performed using a combination of hand digging with excavator machine assist and dug to a maximum depth of 1.25mbgl, to expose and inspect existing foundation dimensions and condition. A detailed record of the inspection pit is presented in Appendix 5.

3.7 Groundwater Monitoring

The site was revisited post-fieldworks in order to measure the groundwater levels in the standpipes. In total, 4 visits were undertaken and the results are tabulated in Appendix 6.

3.8 Setting Out & Surveying

Following completion of the exploratory works, surveying was carried out using GPS and total station techniques. Co-ordinates (x, y) were measured to Irish Transverse Mercator Grid (ITM), the geographic coordinate system for Ireland with ground levels (z) established to Malin Head. The co-ordinates and ground levels are shown on the exploratory logs while the 'as-built' exploratory plans are presented in Appendix 10.

4. LABORATORY ANALYSIS

A programme of soil and rock laboratory testing has been carried out in accordance with BS 1377. The test schedule was prepared by the Employer's Representative.

The soil laboratory testing comprised the following and the results are presented in Appendix 7:

- Moisture Content
- Atterberg Limits
- Particle Size Distribution
- Hydrometer
- Sulpahte Content
- pH
- Thermal Resistivity Testing

The rock laboratory testing comprised the following and the results are presented in Appendix 8:

- uniaxial compressive strength
- point load strength index

Chemical analyses were carried out on selected soil samples, by a specialist accredited environment laboratory, Chemtest. The chemical testing was scheduled by the Employer's Representative and the results are presented in Appendix 9.

References

1. BS 5930 (2015) Code of Practice for Site Investigation, British Standards Institution (BSI).

2. BS 1377 (1990) Methods of Testing of Soils for Civil Engineering Purposes, BSI.

3. Brown E.T., (1984) Rock Characterization Testing and Monitoring, ISRM Suggested Methods.

4. Site Investigation Practice: Assessing BS 5930 (1986), Geological Society Special Publication, No. 2.

5. IS EN 1997-2 Eurocode 7: 2007 – Geotechnical Design – Part 2: Ground Investigation & Testing

6. IS EN ISO 22475-1:2006 Geotechnical Investigation and Sampling – Sampling Methods & Groundwater Measurements

7. IS EN ISO 14688-1:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description

8. IS EN ISO 14688-2:2018 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Classification Principles

9. IS EN ISO 14689-1:2018 Geotechnical Investigation and Testing - Identification & Classification of Rock, Part 1: Identification & Description

10. Specification and related documents for Ground Investigation in Ireland, 2nd Edition(Engineers Ireland, 2016)

11. CIRIA C665:2007, Assessing risks posed by hazardous ground gases to buildings

Appendix 1 - Cable Percussive Borehole Records

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH01-1**
		SHEET	Sheet 1 of 1
CO-ORDINATES	679,802.32 E 603,476.12 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	13.91	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	3.40
		DATE COMMENCED	17/01/2019
		DATE COMPLETED	17/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
		BORED BY	P.Thomas
		PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		13.71	0.20						
	Stiff brown sandy gravelly CLAY with occasional cobbles				AA110642	ENV	0.50			
1					AA110643	B	1.00			
					AA110644	ENV	1.50		N = 28 (4, 5, 5, 7, 7, 9)	
2			11.61	2.30	AA110645	B	2.00			
	Very stiff brown sandy gravelly CLAY with angular cobbles								N = 16 (3, 3, 3, 4, 4, 5)	
3			10.51	3.40	AA110646	B	3.00		N = 50/100 mm (19, 6, 35, 15)	
	Obstruction End of Borehole at 3.40 m									
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.2	3.4	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.30	3.30	No	1.40	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH02-1**
		SHEET	Sheet 1 of 1
CO-ORDINATES	679,873.60 E 603,527.59 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	13.78	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	2.70
DATE COMMENCED	16/01/2019	**DATE COMPLETED**	16/01/2009
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		13.58	0.20						
	Very stiff brown sandy gravelly CLAY with angular cobbles				AA110638	ENV	0.50			
1					AA110639	B	1.00			
					AA110640	ENV	1.50		N = 48 (4, 7, 14, 16, 10, 8)	
2					AA110641	B	2.00			
			11.08	2.70					N = 19/30 mm (25, 3, 19)	
3	Obstruction End of Borehole at 2.70 m									
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.5	2.7	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH04-1**
		SHEET	Sheet 1 of 1
CO-ORDINATES	679,987.35 E 603,525.89 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	14.49	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	3.40
		DATE COMMENCED	16/01/2019
		DATE COMPLETED	16/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	TOPSOIL	▨	14.39	0.10						
	Stiff brown sandy gravelly CLAY with occasional cobbles	▨			AA110633	ENV	0.50			
1					AA110634	B	1.00			
					AA110635	ENV	1.50		N = 30 (5, 7, 6, 8, 7, 9)	
2			12.39	2.10	AA110636	B	2.00			
	Very stiff brown sandy gravelly CLAY with angular cobbles	▨							N = 50/240 mm (8, 14, 15, 15, 16, 4)	
3			11.09	3.40	AA110637	B	3.00		N = 50/200 mm (14, 11, 16, 18, 16)	
	Obstruction End of Borehole at 3.40 m									
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3	3.4	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend

D - Small Disturbed (tub)	UT - Undisturbed 100mm Diameter Sample
B - Bulk Disturbed	P - Undisturbed Piston Sample
LB - Large Bulk Disturbed	W - Water Sample
Env - Environmental Sample (Jar + Vial + Tub)	

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH01-2**
		SHEET	Sheet 1 of 1
CO-ORDINATES	670,943.17 E 615,682.02 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	19.99	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	4.30
DATE COMMENCED	29/01/2019	**DATE COMPLETED**	29/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		19.89	0.10						
	Stiff to very stiff brown sandy gravelly CLAY				AA115617	ENV	0.50			
1					AA115618	B	1.00			
					AA115619	ENV	1.50		N = 32 (4, 5, 7, 7, 8, 10)	
2					AA115620	B	2.00			
									N = 21 (3, 4, 5, 4, 5, 7)	
3					AA115621	B	3.00			
									N = 48 (5, 8, 10, 12, 12, 14)	
4					AA115622	B	4.00		N = 50/190 mm (9, 15, 17, 18, 15)	
			15.69	4.30						
	Obstruction End of Borehole at 4.30 m									
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.8	4.3	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out. Tracked dumper used to minimise rutting

Sample Legend

D - Small Disturbed (tub)	UT - Undisturbed 100mm Diameter Sample
B - Bulk Disturbed	P - Undisturbed Piston Sample
LB - Large Bulk Disturbed	W - Water Sample
Env - Environmental Sample (Jar + Vial + Tub)	

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH03-2**
		SHEET	Sheet 1 of 1
CO-ORDINATES	670,970.41 E 615,576.32 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	19.16	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	2.80
		DATE COMMENCED	23/01/2019
		DATE COMPLETED	23/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		19.06	0.10						
	Stiff brown sandy gravelly CLAY with occasional angular cobbles				AA115613	ENV	0.50			
1					AA115614	B	1.00			
					AA115615	ENV	1.50		N = 22 (3, 3, 5, 5, 5, 7)	
2					AA115616	B	2.00			
			16.36	2.80					N = 50/180 mm (6, 14, 15, 21, 14)	
3	Obstruction End of Borehole at 2.80 m									
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.6	2.8	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out. Rig and tracked dumper demobilised by request of landowner to allow slurry spreading. (tracking 1.5 hours to safe location).

Sample Legend

D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH04-2**
		SHEET	Sheet 1 of 1
CO-ORDINATES	671,118.61 E 615,375.16 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	150
GROUND LEVEL (m AOD)	10.08	**BOREHOLE DEPTH (m)**	1.00
		DATE COMMENCED	21/01/2019
		DATE COMPLETED	21/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
TOPSOIL		9.98	0.10						
Firm to stiff brown sandy gravelly CLAY		9.28	0.80	AA115603	ENV	0.50			
Dense angular COBBLES and BOULDERS (possible weathered rock)		9.08	1.00	AA115604	B	0.80		N = 19/40 mm (25, 31, 19)	
Obstruction End of Borehole at 1.00 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
0.8	1	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

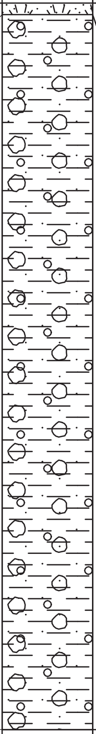
Sample Legend

D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH05-2**
		SHEET	Sheet 1 of 1
CO-ORDINATES	671,188.03 E 615,309.02 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	4.94	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	6.20
		DATE COMMENCED	21/01/2019
		DATE COMPLETED	22/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C



Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		4.84	0.10						
	Stiff to very stiff brown sandy gravelly CLAY with occasional angular cobbles				AA115605	ENV	0.50			
1					AA115606	B	1.00			
					AA115607	ENV	1.50		N = 24 (3, 5, 5, 5, 7, 7)	
2					AA115608	B	2.00			
									N = 29 (3, 4, 6, 9, 8, 6)	
3					AA115609	B	3.00			
									N = 31 (5, 5, 7, 8, 7, 9)	
4					AA115610	B	4.00			
									N = 50 (2, 5, 10, 10, 15, 15)	
5					AA115611	B	5.00			
					AA115612	B	5.50		N = 50/225 mm (9, 12, 15, 17, 18)	
6			-1.27	6.20					N = 18/35 mm (25, 32, 18)	
	Obstruction End of Borehole at 6.20 m									
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.9	6.2	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
5.50	5.50	No	4.40	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out . 2 hrs mobilisation on sloping and saturated ground

Sample Legend

D - Small Disturbed (tub)	UT - Undisturbed 100mm Diameter Sample
B - Bulk Disturbed	P - Undisturbed Piston Sample
LB - Large Bulk Disturbed	W - Water Sample
Env - Environmental Sample (Jar + Vial + Tub)	

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH06-2**
		SHEET	Sheet 1 of 1
CO-ORDINATES	671,186.86 E 615,256.30 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	6.47	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	5.00
DATE COMMENCED	17/01/2019	**DATE COMPLETED**	18/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Description	Elevation	Depth (m)	Samples Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
TOPSOIL	6.37	0.10						
Stiff brown sandy gravelly CLAY with occasional cobbles			AA110647	ENV	0.50			
			AA110648	B	1.00			
			AA110649	ENV	1.50		N = 36 (6, 7, 9, 8, 9, 10)	
			AA110650	B	2.00			
							N = 25 (4, 5, 6, 5, 7, 7)	
			AA110651	B	3.00			
	2.77	3.70					N = 24 (5, 7, 5, 5, 6, 8)	
Stiff to very stiff brown sandy gravelly CLAY with angular cobbles			AA110652	B	4.00			
							N = 50 (8, 10, 10, 12, 14, 14)	
	1.47	5.00						
Obstruction End of Borehole at 5.00 m								

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.1	4.3	0.5	
4.8	5	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
4.50	4.50	No	1.90	20	Rapid

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector Onshore Ireland

BOREHOLE NO. BH01-3
SHEET Sheet 1 of 1

CO-ORDINATES 669,113.17 E
615,020.32 N
GROUND LEVEL (m AOD) 26.68

RIG TYPE Dando 2000
BOREHOLE DIAMETER (mm) 150
BOREHOLE DEPTH (m) 3.00

DATE COMMENCED 10/01/2019
DATE COMPLETED 10/01/2019

CLIENT Greenlink Interconnector Limited
ENGINEER ARUP

SPT HAMMER REF. NO. SA2
ENERGY RATIO (%) 75

BORED BY P.Thomas
PROCESSED BY F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		26.48	0.20						
	Stiff to very stiff brown sandy gravelly CLAY with angular cobbles				AA110609	ENV	0.50			
1					AA110610	B	1.00			
					AA110611	ENV	1.50		N = 31 (3, 5, 8, 8, 7, 8)	
2					AA110612	B	2.00			
									N = 50/225 mm (7, 5, 12, 17, 21)	
			23.68	3.00						
3	Obstruction End of Borehole at 3.00 m				AA110613	B	3.00			
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2.8	3	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH02-3**
		SHEET	Sheet 1 of 1
CO-ORDINATES	669,302.15 E 615,046.30 N	**RIG TYPE**	Dando 2000
		BOREHOLE DIAMETER (mm)	150
GROUND LEVEL (m AOD)	19.27	**BOREHOLE DEPTH (m)**	1.00
		DATE COMMENCED	11/01/2019
		DATE COMPLETED	11/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		19.17	0.10						
	Brown sandy gravelly CLAY with angular cobbles				AA110614	ENV	0.50			
			18.27	1.00						
1	Obstruction End of Borehole at 1.00 m				AA110615	B	1.00			
2										
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
0.7	1	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland			**BOREHOLE NO.**	**BH03-3**
				SHEET	Sheet 1 of 1
CO-ORDINATES	669,425.95 E 615,118.97 N	**RIG TYPE**	Dando 2000	**DATE COMMENCED**	30/01/2019
GROUND LEVEL (m AOD)	0.36	**BOREHOLE DIAMETER (mm)**	150	**DATE COMPLETED**	30/01/2019
		BOREHOLE DEPTH (m)	2.00		
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2	**BORED BY**	P.Thomas
ENGINEER	ARUP	**ENERGY RATIO (%)**	75	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		0.26	0.10						
	Stiff brown sandy SILT with occasional fibres				AA115623	ENV	0.50			
			-0.64	1.00						
1	Stiff to very stiff grey sandy SILT with shells				AA115624	B	1.00			
					AA115625	ENV	1.50		N = 26 (2, 2, 3, 4, 8, 11)	
			-1.64	2.00						
2	Obstruction End of Borehole at 2.00 m				AA115626	B	2.00		N = 50/75 mm (25, 50)	
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.8	2	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
1.70	1.70	No	1.00	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out . 4 hrs moving rig and tracked dumper to position with assistance from digger. 2 hrs demobilsation on completion of borehole.

Sample Legend

D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH04-3**
		SHEET	Sheet 1 of 1
CO-ORDINATES	669,299.35 E 614,870.70 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	8.05	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	5.60
		DATE COMMENCED	09/01/2019
		DATE COMPLETED	09/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
		BORED BY	P.Thomas
		PROCESSED BY	F.C

Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
TOPSOIL		7.95	0.10						
Brown sandy SILT/CLAY with occasional gravel and shell fragments		7.45	0.60	AA110601	ENV	0.50			
Soft light brown sandy gravelly CLAY with occasional cobbles		6.15	1.90	AA110602	B	1.00			
				AA110603	ENV	1.50		N = 6 (1, 1, 1, 1, 2, 2)	
Stiff to very stiff light brown sandy gravelly CLAY with angular cobbles		2.45	5.60	AA110604	B	2.00			
								N = 21 (1, 3, 3, 3, 5, 10)	
				AA110605	B	3.00			
								N = 29 (3, 5, 7, 7, 8, 7)	
				AA110606	B	4.00			
								N = 28 (5, 5, 5, 7, 8, 8)	
				AA110607 AA110608	B B	5.00 5.00			
Obstruction End of Borehole at 5.60 m								N = 50/75 mm (25, 50)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.2	3.4	0.5	
5.4	5.6	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Hand dug inspection pit carried out .

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH05-3**
		SHEET	Sheet 1 of 1
CO-ORDINATES	669,193.30 E 614,924.03 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	32.78	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	1.80
		DATE COMMENCED	09/01/2019
		DATE COMPLETED	09/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		32.58	0.20						
	Stiff to very stiff brown sandy gravelly CLAY with angular cobbles				AA110651 AA110652	ENV B	0.50 0.50			
1					AA110653	B	1.00			
			30.98	1.80	AA110654 AA110655	B ENV	1.50 1.50		N = 50/225 mm (7, 12, 15, 18, 17)	
2	Obstruction End of Borehole at 1.80 m									
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
1.5	1.8	1.5	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend

D - Small Disturbed (tub)	UT - Undisturbed 100mm Diameter Sample
B - Bulk Disturbed	P - Undisturbed Piston Sample
LB - Large Bulk Disturbed	W - Water Sample
Env - Environmental Sample (Jar + Vial + Tub)	

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH06-3**
		SHEET	Sheet 1 of 2
CO-ORDINATES	669,392.50 E 615,254.13 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	0.21	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	13.30
DATE COMMENCED	11/01/2019	**DATE COMPLETED**	14/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL		0.01	0.20						
	Grey sandy SILT/CLAY with some gravel and shell fragments				AA110616	ENV	0.50			
1			-0.99	1.20	AA110617	B	1.00			
	Soft grey slightly gravelly sandy SILT				AA110618	ENV	1.50		N = 2 (0, 0, 0, 0, 1, 1)	
2					AA110619	B	2.00			
					AA110620	U	2.50	95%rec		
3					AA110621	B	3.00			
									N = 2 (1, 0, 0, 1, 0, 1)	
4					AA110622	B	4.00			
					AA110623	U	4.50	95%rec		
5					AA110624	B	5.00			
									N = 1 (1, 0, 0, 0, 1, 0)	
6					AA110625	B	6.00			
7					AA110626	B	7.00			
									N = 2 (1, 0, 0, 1, 0, 1)	
8					AA110627	B	8.00			
					AA110628	U	8.50	90%rec		
9					AA110629	B	9.00			
									N = 5 (1, 0, 1, 1, 1, 2)	

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
12.7	12.8	0.5	
13.1	13.2	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.50	3.50	No	1.40	20	Moderate

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug inspection pit carried out .

Sample Legend

D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**BOREHOLE NO.**	**BH06-3**
		SHEET	Sheet 2 of 2
CO-ORDINATES	669,392.50 E 615,254.13 N	**RIG TYPE**	Dando 2000
GROUND LEVEL (m AOD)	0.21	**BOREHOLE DIAMETER (mm)**	150
		BOREHOLE DEPTH (m)	13.30
DATE COMMENCED	11/01/2019	**DATE COMPLETED**	14/01/2019
CLIENT	Greenlink Interconnector Limited	**SPT HAMMER REF. NO.**	SA2
ENGINEER	ARUP	**ENERGY RATIO (%)**	75
BORED BY	P.Thomas	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
10	Soft grey slightly gravelly sandy SILT *(continued)*		-10.29	10.50	AA110630	B	10.00			
11	Firm grey slightly gravelly sandy SILT/CLAY		-11.29	11.50	AA110631	B	11.00		N = 15 (2, 2, 3, 3, 4, 5)	
12 13	Very stiff brown and blue/grey sandy gravelly CLAY		-13.09	13.30	AA110632	B	12.00		N = 33 (5, 7, 7, 8, 8, 10) N = 50/255 mm (9, 12, 14, 14, 15, 7) N = 50/225 mm (10, 15, 16, 19, 15)	
14 15 16 17 18 19	End of Borehole at 13.30 m									

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
12.7	12.8	0.5	
13.1	13.2	1	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Hand dug inspection pit carried out .

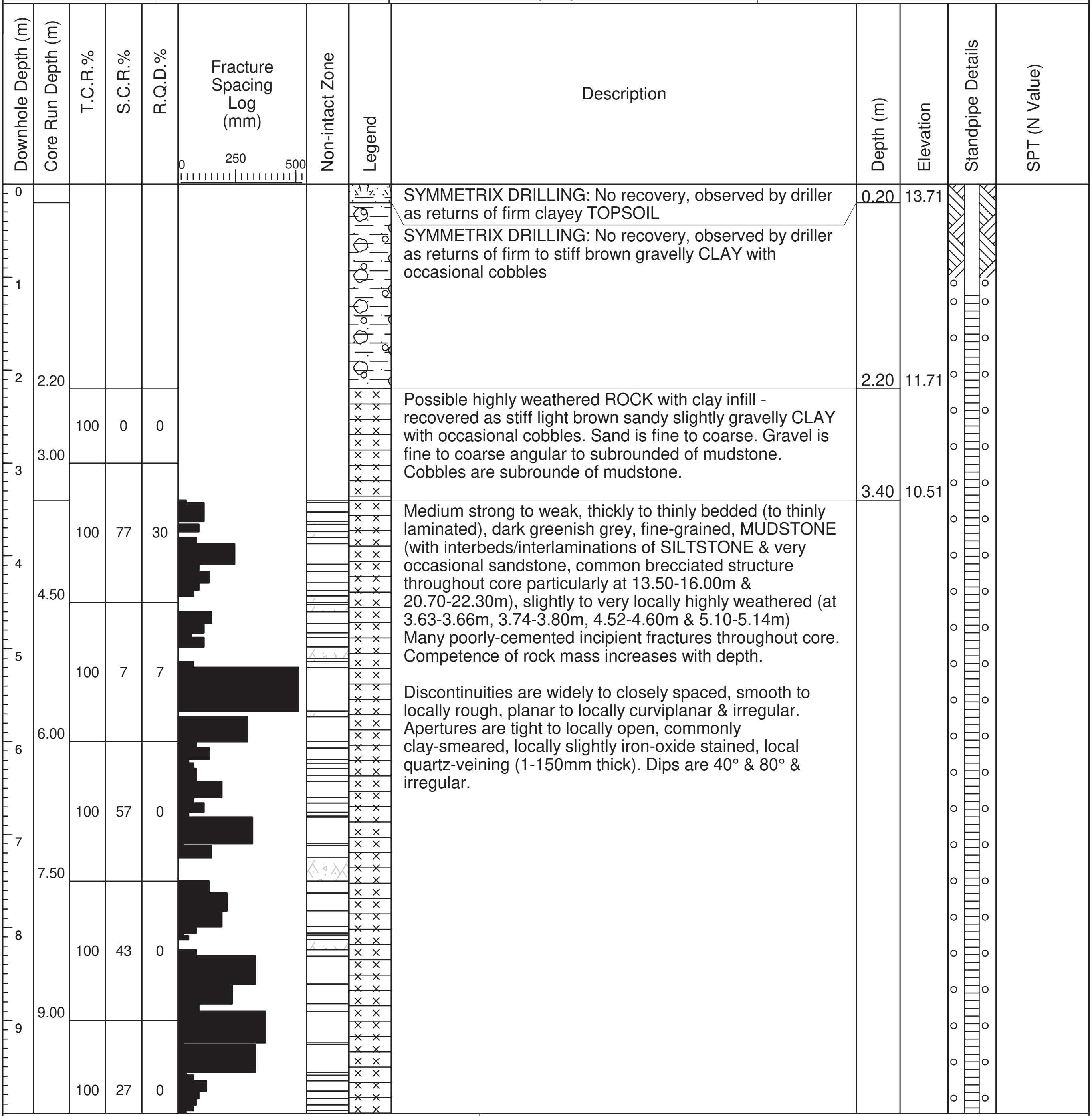
Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

Appendix 2 - Geobore S Rotary Coreholes

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC01-1**
		SHEET	Sheet 1 of 3
CO-ORDINATES	679,802.32 E 603,476.12 N	**DATE COMMENCED**	28/02/2019
GROUND LEVEL (mOD)	13.91	**DATE COMPLETED**	07/03/2019
RIG TYPE	Knebel	**DRILLED BY**	Peteresen
FLUSH	P. Gel	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		
CLIENT	Greenlink Interconnector Ltd.		
ENGINEER	Arup		



Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
2.20			
3.00	100	0	0
4.50	100	77	30
6.00	100	7	7
7.50	100	57	0
9.00	100	43	0
	100	27	0

Description	Depth (m)	Elevation
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.20	13.71
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm to stiff brown gravelly CLAY with occasional cobbles	2.20	11.71
Possible highly weathered ROCK with clay infill - recovered as stiff light brown sandy slightly gravelly CLAY with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of mudstone. Cobbles are subrounde of mudstone.	3.40	10.51
Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 13.50-16.00m & 20.70-22.30m), slightly to very locally highly weathered (at 3.63-3.66m, 3.74-3.80m, 4.52-4.60m & 5.10-5.14m) Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-150mm thick). Dips are 40° & 80° & irregular.		

REMARKS

Hole cased 0.00-2.20m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

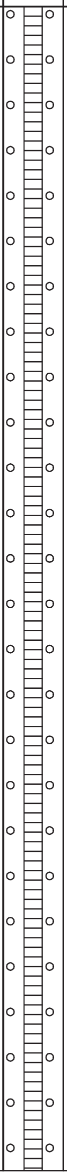
Date	Tip Depth	RZ Top	RZ Base	Type
19-02-19	29.70	1.00	29.70	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC01-1**
		SHEET	Sheet 2 of 3
CO-ORDINATES	679,802.32 E 603,476.12 N	**DATE COMMENCED**	28/02/2019
GROUND LEVEL (mOD)	13.91	**DATE COMPLETED**	07/03/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	Peteresen
INCLINATION (deg)	-90		
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	SPT (N Value)
10	10.50				Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 13.50-16.00m & 20.70-22.30m), slightly to very locally highly weathered (at 3.63-3.66m, 3.74-3.80m, 4.52-4.60m & 5.10-5.14m) Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-150mm thick). Dips are 40° & 80° & irregular. *(continued)*			
11	12.00	100	20	0				
12–13	13.50	100	40	0				
14	15.00	100	41	11				
15–16	16.50	100	30	23				
17	18.00	100	31	21				
18–19	19.50	100	49	28				



REMARKS

Hole cased 0.00-2.20m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

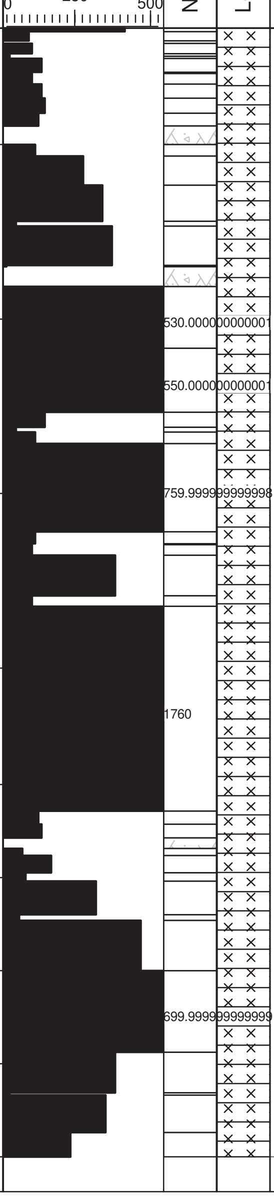
Date	Tip Depth	RZ Top	RZ Base	Type
19-02-19	29.70	1.00	29.70	50mm SP

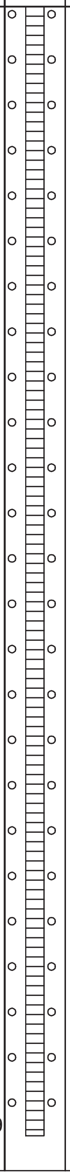
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC01-1**
		SHEET	Sheet 3 of 3
CO-ORDINATES	679,802.32 E 603,476.12 N	**DATE COMMENCED**	28/02/2019
GROUND LEVEL (mOD)	13.91	**DATE COMPLETED**	07/03/2019
RIG TYPE	Knebel	**DRILLED BY**	Peteresen
FLUSH	P. Gel	**LOGGED BY**	D.O'Shea
CLIENT	Greenlink Interconnector Ltd.	**INCLINATION (deg)**	-90
ENGINEER	Arup	**CORE DIAMETER (mm)**	80

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation
20	21.00	100	69	40	Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 13.50-16.00m & 20.70-22.30m), slightly to very locally highly weathered (at 3.63-3.66m, 3.74-3.80m, 4.52-4.60m & 5.10-5.14m) Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-150mm thick). Dips are 40° & 80° & irregular. *(continued)*		
21, 22	22.50	100	63	47			
23	24.00	93	71	50			
24, 25	25.50	100	88	79			
26	26.50	95	95	95			
27	27.30	87	25	25			
28	28.10	106	92	92			
	28.90	100	81	81			
29	29.70	100	100	100		29.70	-15.79
					End of Borehole at 29.70 m		





SPT (N Value)

REMARKS

Hole cased 0.00-2.20m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
19-02-19	29.70	1.00	29.70	50mm SP

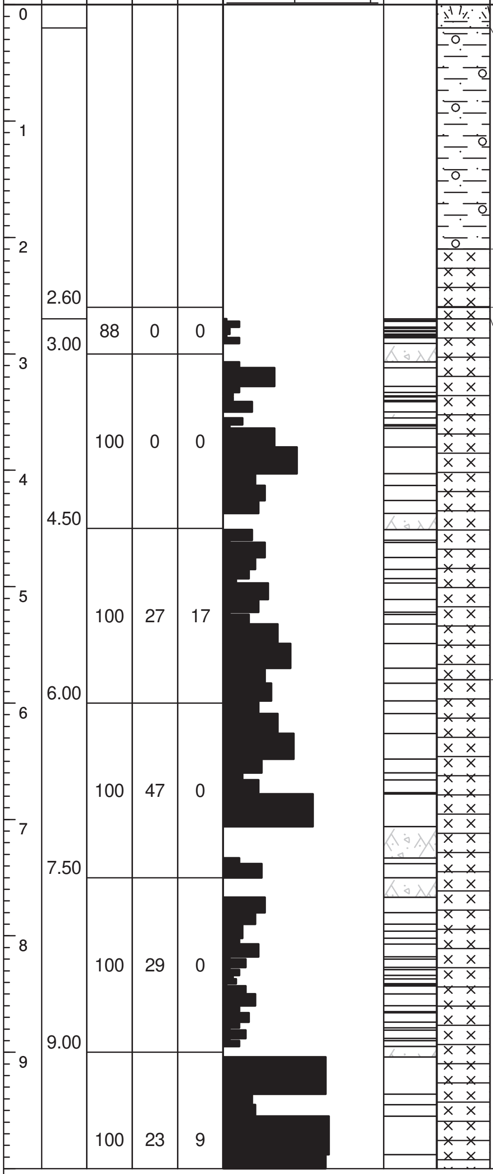
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-1**
		SHEET	Sheet 1 of 6
CO-ORDINATES	679,873.60 E 603,527.59 N	**DATE COMMENCED**	13/02/2019
GROUND LEVEL (mOD)	13.78	**DATE COMPLETED**	19/02/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
2.60			
3.00	88	0	0
4.50	100	0	0
6.00	100	27	17
7.50	100	47	0
9.00	100	29	0
	100	23	9



Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm TOPSOIL	0.20	13.58		
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm to stiff brown silty sandy gravelly CLAY	2.10	11.68		
SYMMETRIX DRILLING: No recovery, observed by driller as returns of weak ROCK	2.60	11.18		
Probable highly weathered ROCK - recovered as very clayey gravel.	2.70	11.08		
Medium strong to weak, thickly to thinly bedded (to thinly laminated), pale greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally moderately weathered. Many incipient fractures throughout.	5.80	7.98		
Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally highly weathered (at 3.50-3.55m, 7.06-7.33m, 12.85-12.88m, 23.92-23.99m, 30.50-30.55m, 32.52-32.59m, 32.67-33.48m & 35.39-35.47m) Many poorly-cemented incipient fractures throughout core Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-30mm thick). Dips are 40° & 80°.				

REMARKS

Hole cased 0.00-2.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC02-1**
SHEET Sheet 2 of 6

CO-ORDINATES 679,873.60 E
603,527.59 N
GROUND LEVEL (mOD) 13.78

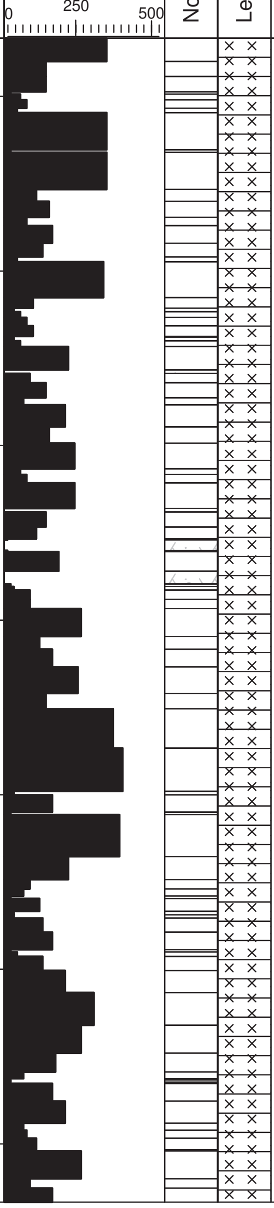
RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

DATE COMMENCED 13/02/2019
DATE COMPLETED 19/02/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY IGSL
LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
10	10.50			
11		100	34	19
12	12.00	100	33	21
13	13.50	100	11	8
14				
15	15.00	100	39	39
16	16.50	100	23	16
17				
18	18.00	100	49	30
19	19.50			



Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally highly weathered (at 3.50-3.55m, 7.06-7.33m, 12.85-12.88m, 23.92-23.99m, 30.50-30.55m, 32.52-32.59m, 32.67-33.48m & 35.39-35.47m)
Many poorly-cemented incipient fractures throughout core

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-30mm thick). Dips are 40° & 80°. *(continued)*

Depth (m) | Elevation | Standpipe Details | SPT (N Value)

REMARKS

Hole cased 0.00-2.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

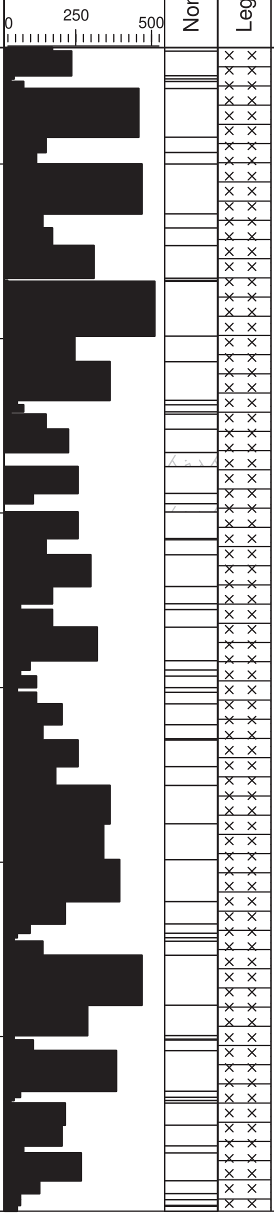
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-1**
		SHEET	Sheet 3 of 6
CO-ORDINATES	679,873.60 E 603,527.59 N	**DATE COMMENCED**	13/02/2019
GROUND LEVEL (mOD)	13.78	**DATE COMPLETED**	19/02/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
20	21.00	100	42	35
21–22	22.50	100	58	42
23	24.00	100	31	27
24–25	25.50	100	65	41
26	27.00	100	35	9
27–28	28.50	100	63	47
29	30.00	100	39	31



Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally highly weathered (at 3.50-3.55m, 7.06-7.33m, 12.85-12.88m, 23.92-23.99m, 30.50-30.55m, 32.52-32.59m, 32.67-33.48m & 35.39-35.47m)
Many poorly-cemented incipient fractures throughout core

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-30mm thick). Dips are 40° & 80°. *(continued)*

Depth (m) | Elevation | Standpipe Details | SPT (N Value)

REMARKS

Hole cased 0.00-2.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

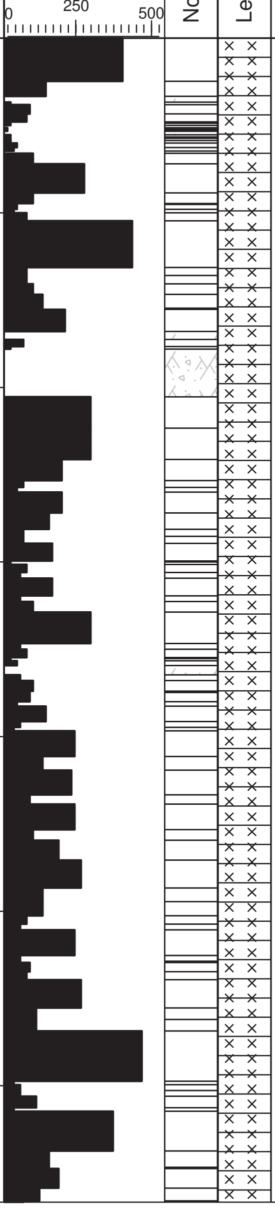
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-1**
		SHEET	Sheet 4 of 6
CO-ORDINATES	679,873.60 E 603,527.59 N	**DATE COMMENCED**	13/02/2019
GROUND LEVEL (mOD)	13.78	**DATE COMPLETED**	19/02/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
30		100	22	17	Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally highly weathered (at 3.50-3.55m, 7.06-7.33m, 12.85-12.88m, 23.92-23.99m, 30.50-30.55m, 32.52-32.59m, 32.67-33.48m & 35.39-35.47m) Many poorly-cemented incipient fractures throughout core Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-30mm thick). Dips are 40° & 80°. *(continued)*				
31	31.50	100	98	7					
32									
33	33.00	100	83	11					
34	34.50	100	33	10					
35									
36	36.00	100	81	12					
37	37.50	100	53	13					
38									
39	39.00	100	45	10					

Fracture Spacing Log (mm) | Non-intact Zone | Legend



REMARKS

Hole cased 0.00-2.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

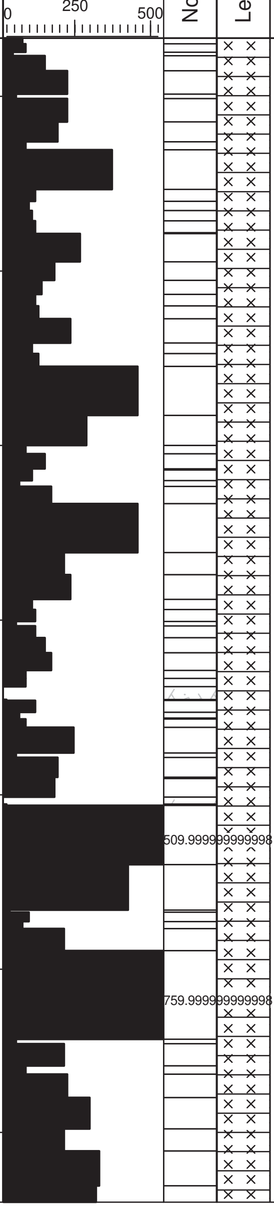
Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-1**
		SHEET	Sheet 5 of 6
CO-ORDINATES	679,873.60 E 603,527.59 N	**DATE COMMENCED**	13/02/2019
GROUND LEVEL (mOD)	13.78	**DATE COMPLETED**	19/02/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
40	40.50			
41	42.00	100	67	23
42	43.50	100	35	35
43, 44	45.00	100	47	13
45, 46	46.50	100	19	7
47	48.00	100	69	66
48, 49	49.40	100	25	25



Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally highly weathered (at 3.50-3.55m, 7.06-7.33m, 12.85-12.88m, 23.92-23.99m, 30.50-30.55m, 32.52-32.59m, 32.67-33.48m & 35.39-35.47m)
Many poorly-cemented incipient fractures throughout core

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-30mm thick). Dips are 40° & 80°. *(continued)*

REMARKS

Hole cased 0.00-2.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

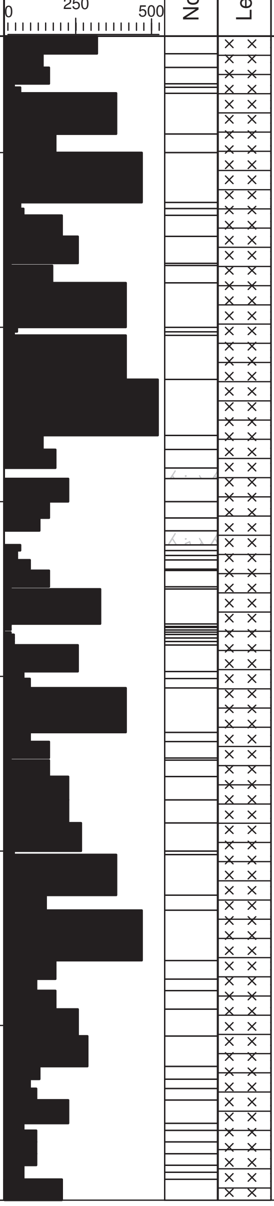
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-1**
		SHEET	Sheet 6 of 6
CO-ORDINATES	679,873.60 E 603,527.59 N	**DATE COMMENCED**	13/02/2019
GROUND LEVEL (mOD)	13.78	**DATE COMPLETED**	19/02/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Depth (m)	Elevation
50	51.00	100	38	30		
51	52.50	100	48	48		
52						
53	54.00	100	65	65		
54	55.50	100	23	23		
55						
56	57.00	100	0	0		
57	58.50	100	0	0		
58						
59	60.00	100	56	0	60.00	-46.22



Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally highly weathered (at 3.50-3.55m, 7.06-7.33m, 12.85-12.88m, 23.92-23.99m, 30.50-30.55m, 32.52-32.59m, 32.67-33.48m & 35.39-35.47m)
Many poorly-cemented incipient fractures throughout core

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-30mm thick). Dips are 40° & 80°. *(continued)*

End of Borehole at 60.00 m

REMARKS

Hole cased 0.00-2.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

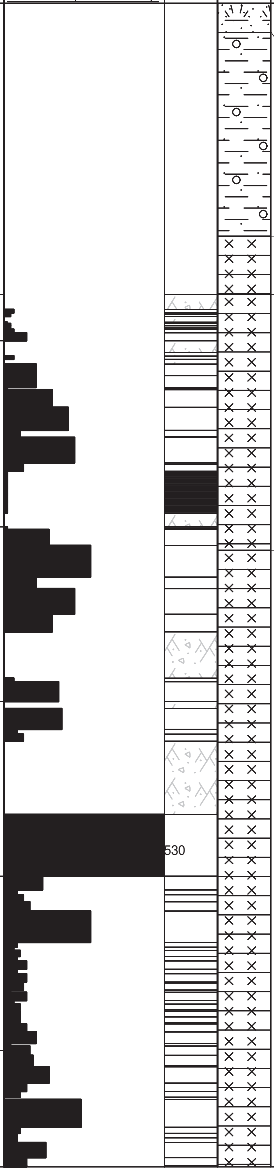
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC04-1**
		SHEET	Sheet 1 of 6
CO-ORDINATES	679,987.35 E 603,525.89 N	**DATE COMMENCED**	20/02/2019
GROUND LEVEL (mOD)	14.49	**DATE COMPLETED**	27/02/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
2.50			
2.90	100	0	0
4.50	100	23	13
6.00	97	53	30
7.50	87	35	15
9.00	100	40	13
	100	41	7



Description	Depth (m)	Elevation
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.25	14.24
SYMMETRIX DRILLING: No recovery, observed by driller as returns of stiff brown silty sandy gravelly CLAY	2.00	12.49
SYMMETRIX DRILLING: No recovery, observed by driller as returns of weak ROCK	2.50	11.99
Medium strong to weak, thickly to thinly bedded (to thinly laminated), pale greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone), slightly to very locally moderately weathered. Many incipient fractures throughout.	4.70	9.79
Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 25.00-28.00m), slightly to very locally highly weathered (at 4.39-4.50m, 6.34-6.97m, 11.30-11.75m, 19.00-19.50m, 25.50-28.40m, 33.95-34.88m, 49.50-49.63m) Incipient, poorly cemeneted fractures throughout core. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-100mm thick). Dips are 40° & 80° & irregular.		

Downhole Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

REMARKS

Hole cased 0.00-2.50m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-02-19	59.00	1.00	59.00	50mm SP

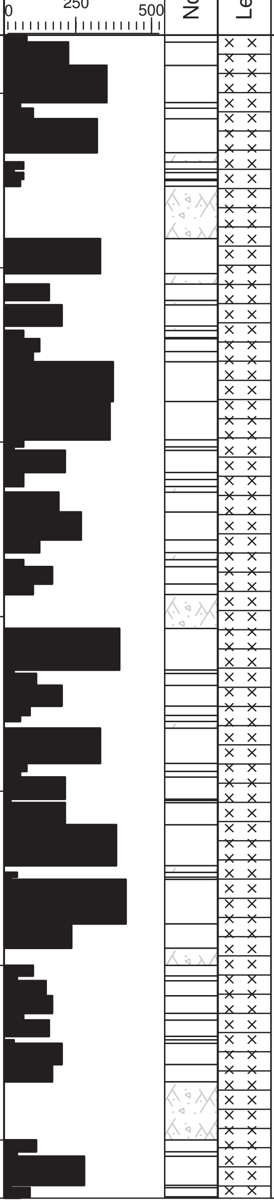
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

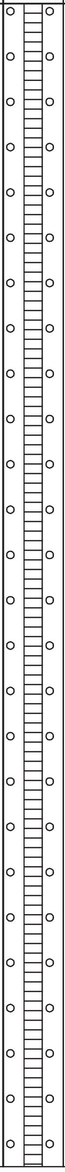
CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC04-1**
		SHEET	Sheet 2 of 6
CO-ORDINATES	679,987.35 E 603,525.89 N	**DATE COMMENCED**	20/02/2019
GROUND LEVEL (mOD)	14.49	**DATE COMPLETED**	27/02/2019
RIG TYPE	Knebel	**DRILLED BY**	IGSL
FLUSH	P. Gel	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		
CLIENT	Greenlink Interconnector Ltd.		
ENGINEER	Arup		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	SPT (N Value)
10	10.50				Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 25.00-28.00m), slightly to very locally highly weathered (at 4.39-4.50m, 6.34-6.97m, 11.30-11.75m, 19.00-19.50m, 25.50-28.40m, 33.95-34.88m, 49.50-49.63m) Incipient, poorly cemeneted fractures throughout core. Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-100mm thick). Dips are 40° & 80° & irregular. *(continued)*			
11		100	7	0				
12	12.00							
		100	38	27				
13	13.50							
14		100	54	41				
15	15.00							
		100	57	27				
16	16.50							
17		100	74	54				
18	18.00							
		100	73	27				
19	19.50							

Fracture Spacing Log (mm) / Non-intact Zone / Legend



Standpipe Details



REMARKS

Hole cased 0.00-2.50m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-02-19	59.00	1.00	59.00	50mm SP

GROUNDWATER DETAILS

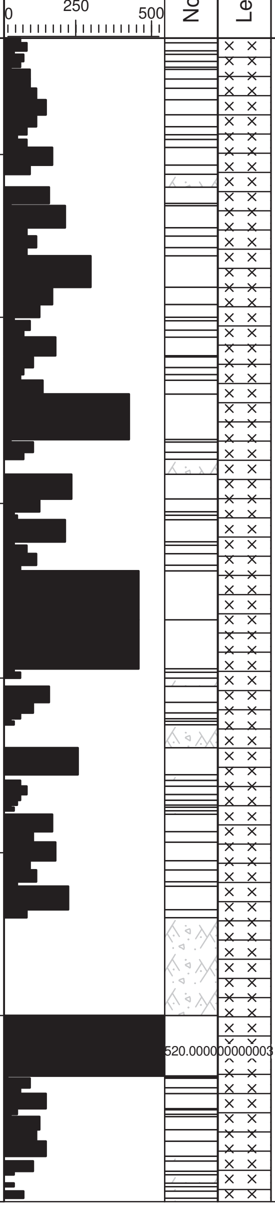
Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC04-1**
		SHEET	Sheet 3 of 6
CO-ORDINATES	679,987.35 E 603,525.89 N	**DATE COMMENCED**	20/02/2019
GROUND LEVEL (mOD)	14.49	**DATE COMPLETED**	27/02/2019
RIG TYPE	Knebel	**DRILLED BY**	IGSL
FLUSH	P. Gel	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		
CLIENT	Greenlink Interconnector Ltd.		
ENGINEER	Arup		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
20		100	65	7
21	21.00	100	44	7
22	22.40			
23		100	41	11
24	24.00	100	57	7
25	25.50			
26		100	27	7
27	27.00	71	36	15
28	28.40			
29		100	48	14
	30.00			



Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 25.00-28.00m), slightly to very locally highly weathered (at 4.39-4.50m, 6.34-6.97m, 11.30-11.75m, 19.00-19.50m, 25.50-28.40m, 33.95-34.88m, 49.50-49.63m)
Incipient, poorly cemeneted fractures throughout core.

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-100mm thick). Dips are 40° & 80° & irregular. *(continued)*

Depth (m) | Elevation | Standpipe Details | SPT (N Value)

REMARKS

Hole cased 0.00-2.50m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

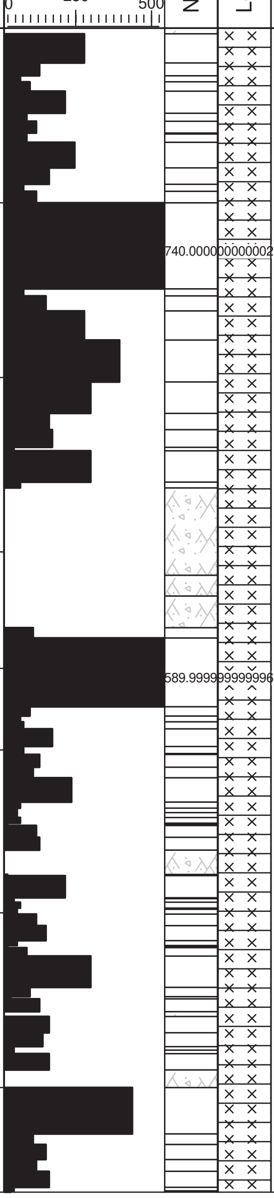
Date	Tip Depth	RZ Top	RZ Base	Type
27-02-19	59.00	1.00	59.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	21475
CONTRACT	Greenlink Interconnector
DRILLHOLE NO	**RC04-1**
SHEET	Sheet 4 of 6
CO-ORDINATES	679,987.35 E 603,525.89 N
GROUND LEVEL (mOD)	14.49
RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102
DATE COMMENCED	20/02/2019
DATE COMPLETED	27/02/2019
CLIENT	Greenlink Interconnector Ltd.
ENGINEER	Arup
DRILLED BY	IGSL
LOGGED BY	D.O'Shea

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
31.50	100	74	54
33.00	100	85	67
34.50	73	65	29
35.50	90	71	15
36.20	100	29	29
37.60	100	79	70
39.10	100	72	24
	100	59	46

Downhole Depth (m): 30, 31, 32, 33, 34, 35, 36, 37, 38, 39

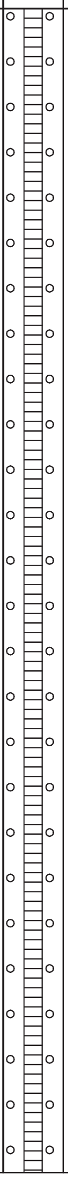


Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 25.00-28.00m), slightly to very locally highly weathered (at 4.39-4.50m, 6.34-6.97m, 11.30-11.75m, 19.00-19.50m, 25.50-28.40m, 33.95-34.88m, 49.50-49.63m)
Incipient, poorly cemeneted fractures throughout core.

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-100mm thick). Dips are 40° & 80° & irregular. *(continued)*

Depth (m) | Elevation | Standpipe Details | SPT (N Value)



REMARKS

Hole cased 0.00-2.50m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

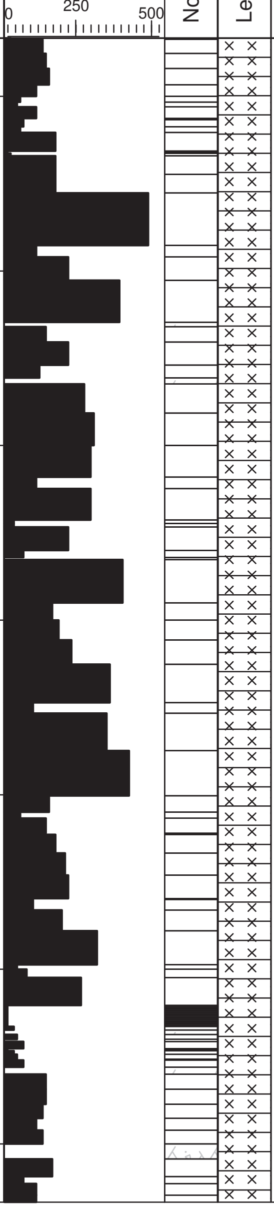
Date	Tip Depth	RZ Top	RZ Base	Type
27-02-19	59.00	1.00	59.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC04-1**
		SHEET	Sheet 5 of 6
CO-ORDINATES	679,987.35 E 603,525.89 N	**DATE COMMENCED**	20/02/2019
GROUND LEVEL (mOD)	14.49	**DATE COMPLETED**	27/02/2019
RIG TYPE	Knebel	**DRILLED BY**	IGSL
FLUSH	P. Gel	**LOGGED BY**	D.O'Shea
CLIENT	Greenlink Interconnector Ltd.	**INCLINATION (deg)**	-90
ENGINEER	Arup	**CORE DIAMETER (mm)**	102

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
40	40.50			
41		100	29	29
42	42.00	100	65	65
43	43.50	100	39	39
44				
45	45.00	100	87	62
46	46.50	100	45	39
47				
48	48.00	100	0	0
49	49.50			

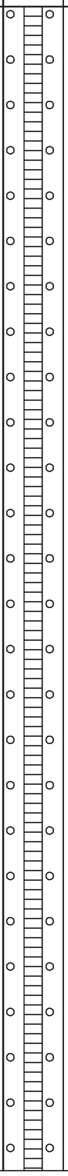


Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 25.00-28.00m), slightly to very locally highly weathered (at 4.39-4.50m, 6.34-6.97m, 11.30-11.75m, 19.00-19.50m, 25.50-28.40m, 33.95-34.88m, 49.50-49.63m)
Incipient, poorly cemeneted fractures throughout core.

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-100mm thick). Dips are 40° & 80° & irregular. *(continued)*

Depth (m) | Elevation | Standpipe Details | SPT (N Value)



REMARKS

Hole cased 0.00-2.50m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-02-19	59.00	1.00	59.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO RC04-1

SHEET Sheet 6 of 6

CO-ORDINATES 679,987.35 E
603,525.89 N

GROUND LEVEL (mOD) 14.49

RIG TYPE Knebel

FLUSH P. Gel

INCLINATION (deg) -90

CORE DIAMETER (mm) 102

DATE COMMENCED 20/02/2019

DATE COMPLETED 27/02/2019

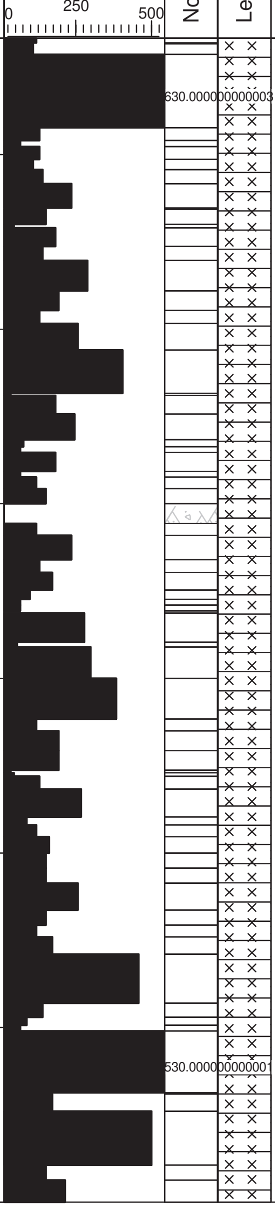
CLIENT Greenlink Interconnector Ltd.

ENGINEER Arup

DRILLED BY IGSL

LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
50	51.00	100	37	37
51	52.50	100	23	13
52 53	54.00	100	17	0
54 55	55.50	100	29	17
56	57.00	100	12	0
57 58	58.50	100	55	41
59	60.00	100	98	80

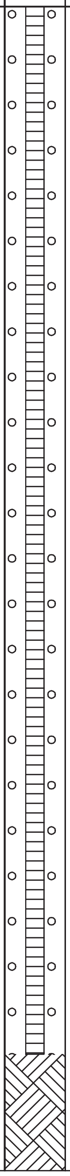


Description

Medium strong to weak, thickly to thinly bedded (to thinly laminated), dark greenish grey, fine-grained, MUDSTONE (with interbeds/interlaminations of SILTSTONE & very occasional sandstone, common brecciated structure throughout core particularly at 25.00-28.00m), slightly to very locally highly weathered (at 4.39-4.50m, 6.34-6.97m, 11.30-11.75m, 19.00-19.50m, 25.50-28.40m, 33.95-34.88m, 49.50-49.63m)
Incipient, poorly cemeneted fractures throughout core.

Discontinuities are widely to closely spaced, smooth to locally rough, planar to locally curviplanar & irregular. Apertures are tight to locally open, commonly clay-smeared, locally slightly iron-oxide stained, local quartz-veining (1-100mm thick). Dips are 40° & 80° & irregular. *(continued)*

Depth (m)	Elevation
60.00	-45.51



End of Borehole at 60.00 m

REMARKS

Hole cased 0.00-2.50m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-02-19	59.00	1.00	59.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO RC01-2

SHEET Sheet 1 of 2

CO-ORDINATES 670,943.17 E
615,682.02 N

GROUND LEVEL (mOD) 19.99

RIG TYPE Knebel

FLUSH P. Gel

INCLINATION (deg) -90

CORE DIAMETER (mm) 102

DATE COMMENCED 19/03/2019

DATE COMPLETED 20/03/2019

CLIENT Greenlink Interconnector Ltd.

ENGINEER Arup

DRILLED BY Peteresen

LOGGED BY D.O'Shea

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
4.20 – 4.70	100	0	0
4.70 – 6.20	100	0	0
6.20 – 7.70	100	0	0
7.70 – 9.20	100	12	0
9.20 –	100	18	8

Description	Depth (m)	Elevation
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.30	19.69
SYMMETRIX DRILLING: No recovery, observed by driller as returns of stiff brown silty gravelly CLAY	3.00	16.99
SYMMETRIX DRILLING: No recovery, observed by driller as returns of light brown weathered ROCK	4.20	15.79
Possible highly weathered ROCK - recovered as dense brown gravelly SAND with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of rhyolite. Cobbles are subrounded of rhyolite.	10.00	9.99

REMARKS

Hole cased 0.00-4.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

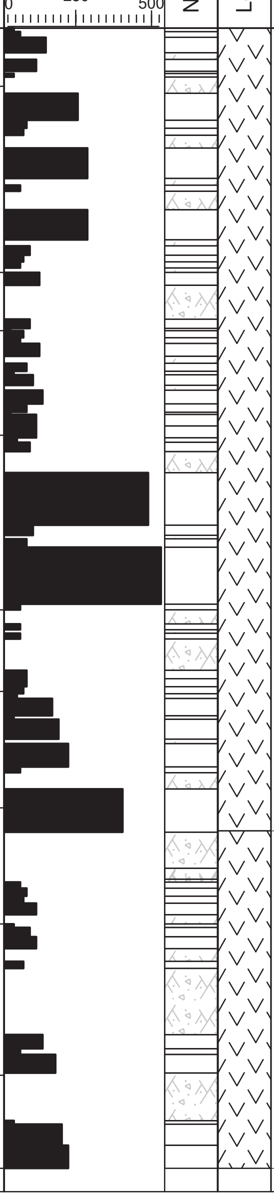
Date	Tip Depth	RZ Top	RZ Base	Type
20-03-19	19.80	1.80	19.80	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC01-2**
		SHEET	Sheet 2 of 2
CO-ORDINATES	670,943.17 E 615,682.02 N	**DATE COMMENCED**	19/03/2019
GROUND LEVEL (mOD)	19.99	**DATE COMPLETED**	20/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	Peteresen
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102



Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.50				Medium strong to strong, medium to thinly (flow) banded, dark blueish grey, fine to medium-grained, RHYOLITE (Volcanics with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 45-50° & locally 70° & irregular.				
11	12.10	100	53	15					
12	12.60	100	56	22					
13	13.50	100	86	28					
14	15.00	100	97	69					
15	15.70	100	37	0					
16	16.70	80	68	39		16.90	3.09		
17	17.70	120	51	33	Medium strong, medium to thinly (flow) banded, dark brownish green, fine-grained, RHYOLITE (Volcanics with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 45-50° & locally 70° & irregular.				
18	19.00	100	51	13					
19	19.80	100	51	40		19.80	0.19		

End of Borehole at 19.80 m

REMARKS

Hole cased 0.00-4.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
20-03-19	19.80	1.80	19.80	50mm SP

IGSL RC FI 10M 21475.GPJ IGSL.GDT 10/4/19

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC03-2**
SHEET Sheet 1 of 2

CO-ORDINATES 670,970.41 E
615,576.32 N
GROUND LEVEL (mOD) 19.16

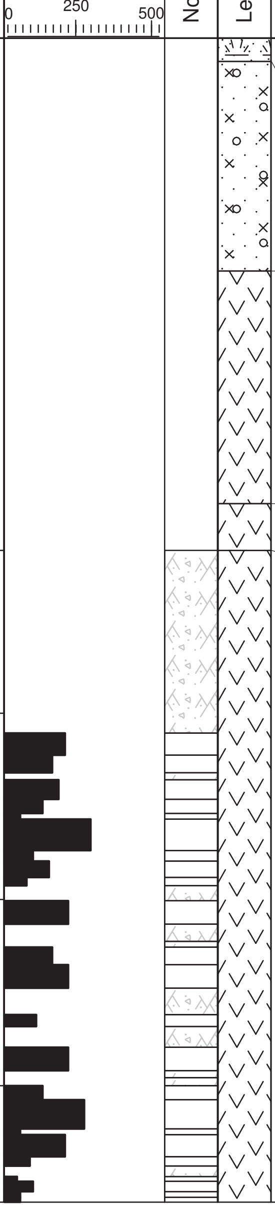
RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

DATE COMMENCED 14/03/2019
DATE COMPLETED 19/03/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY Peteresen
LOGGED BY D.O'Shea

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
4.40			
5.80	100	13	0
7.40	100	54	35
9.00	100	46	20
	100	26	12



Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.20	18.96		
SYMMETRIX DRILLING: No recovery, observed by driller as returns of medium dense yellow/brown silty gravelly SAND.	2.00	17.16		
SYMMETRIX DRILLING: No recovery, observed by driller as returns of possible weathered ROCK recovered as brown/cream silty gravelly sand	4.00	15.16		
SYMMETRIX DRILLING: No recovery, observed by driller as returns of light green highly weathered ROCK	4.40	14.76		N = 50/120 mm (9, 16, 27, 23)
Weak, structureless, blueish grey, fine-grained, RHYOLITE (Volcanics, with abundant closely spaced fractures leading to a brittle, non-intact nature), medium to highly weathered.				

REMARKS

Hole cased 0.00-4.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

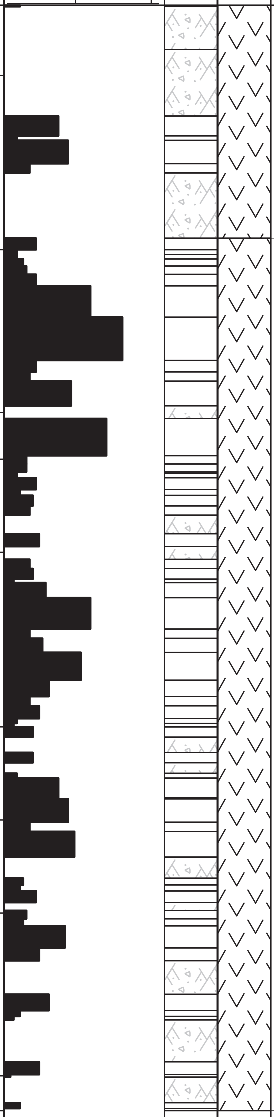
INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC03-2**
		SHEET	Sheet 2 of 2
CO-ORDINATES	670,970.41 E 615,576.32 N	**RIG TYPE**	Knebel
GROUND LEVEL (mOD)	19.16	**FLUSH**	P. Gel
CLIENT	Greenlink Interconnector Ltd.	**INCLINATION (deg)**	-90
ENGINEER	Arup	**CORE DIAMETER (mm)**	102
DATE COMMENCED	14/03/2019	**DRILLED BY**	Peteresen
DATE COMPLETED	19/03/2019	**LOGGED BY**	D.O'Shea



Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.60				Weak, structureless, blueish grey, fine-grained, RHYOLITE (Volcanics, with abundant closely spaced fractures leading to a brittle, non-intact nature), medium to highly weathered. *(continued)*				
11	12.10	100	28	10		12.00	7.16		
12 13	13.50	100	78	61	Very strong, medium to thinly (flow) banded, dark blueish grey, fine to medium-grained, RHYOLITE (Volcanics with high quartz content), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 45-50° & locally 70°				
	13.90	100	90	90					
14	14.70	100	66	26					
15	16.20	100	81	49					
16	17.00	100	52	14					
17	17.80	100	72	30					
18	19.20	100	51	30					
19	19.50	100	37	0		19.50	-0.34		
					End of Borehole at 19.50 m				

REMARKS

Hole cased 0.00-4.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

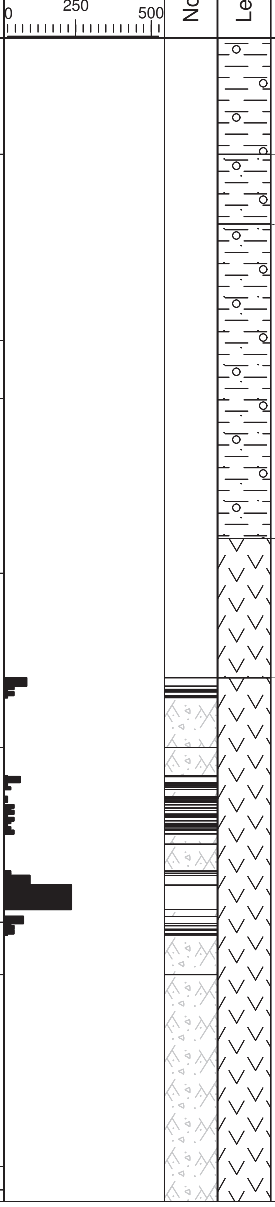
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

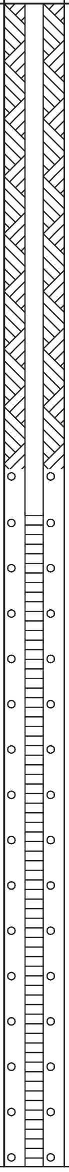
CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC04-2**
		SHEET	Sheet 1 of 2
CO-ORDINATES	671,118.61 E 615,375.16 N	**DATE COMMENCED**	25/03/2019
GROUND LEVEL (mOD)	10.08	**DATE COMPLETED**	27/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
1.00	0	0	0
2.60	66	0	0
3.10	100	0	0
4.60	65	0	0
6.10	53	0	0
7.60	100	0	0
8.05	100	0	0
9.70	35	0	0
9.90	100	0	0



Description	Depth (m)	Elevation
SYMMETRIX DRILLING: No recovery, observed by driller as returns of brown gravelly CLAY	1.00	9.08
Firm to stiff, light brown, very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics.	1.60	8.48
Stiff, light brown, very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics.	4.30	5.78
Probable weathered ROCK - recovered as green and orange layers of clayey sandy cobbly GRAVEL. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of volcanics. Cobbles are subrounded of volcanics.	5.50	4.58
Weak, structureless, blueish grey, fine-grained, RHYOLITE (Volcanics, with abundant closely spaced fractures leading to a brittle, non-intact nature), medium to highly weathered.		



REMARKS

Hole cased 0.00-1.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-03-19	20.00	4.00	20.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC04-2**

SHEET Sheet 2 of 2

CO-ORDINATES 671,118.61 E
615,375.16 N

GROUND LEVEL (mOD) 10.08

RIG TYPE Knebel

FLUSH P. Gel

INCLINATION (deg) -90

CORE DIAMETER (mm) 102

DATE COMMENCED 25/03/2019

DATE COMPLETED 27/03/2019

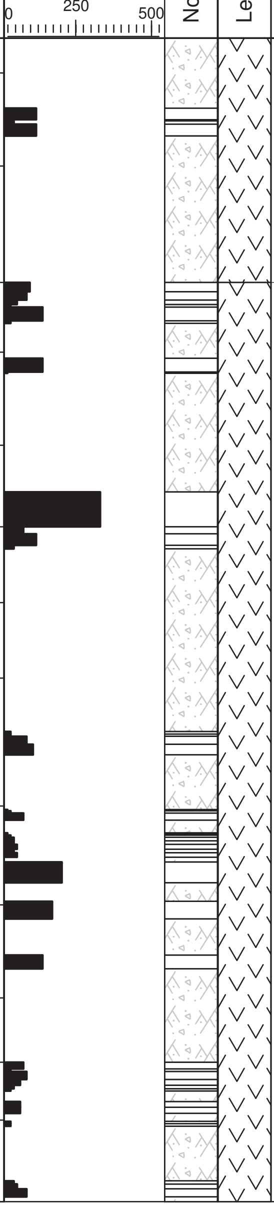
CLIENT Greenlink Interconnector Ltd.

ENGINEER Arup

DRILLED BY IGSL

LOGGED BY D.O'Shea

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
10.30	100	0	0
11.10	100	20	0
12.10	30	0	0
12.70	100	32	0
13.50	100	11	0
14.20	100	0	0
14.85	100	0	0
15.50	100	0	0
16.60	100	0	0
17.45	99	0	0
18.25	100	0	0
18.80	100	0	0
19.30	100	0	0
20.00	86	0	0



Description	Depth (m)	Elevation
Weak, structureless, blueish grey, fine-grained, RHYOLITE (Volcanics, with abundant closely spaced fractures leading to a brittle, non-intact nature), medium to highly weathered. *(continued)*	12.10	-2.02
Medium strong, medium to thinly (flow) banded, dark brownish green, fine-grained, RHYOLITE (Volcanics with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 30-50° & locally 70°.	20.00	-9.92

End of Borehole at 20.00 m

REMARKS

Hole cased 0.00-1.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
27-03-19	20.00	4.00	20.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC05-2**
		SHEET	Sheet 1 of 2
CO-ORDINATES	671,188.03 E 615,309.02 N	**DATE COMMENCED**	21/03/2019
GROUND LEVEL (mOD)	4.94	**DATE COMPLETED**	22/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	Peteresen
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
						SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.10	4.84		
4.30						SYMMETRIX DRILLING: No recovery, observed by driller as returns of stiff brown silty sandy gravelly CLAY with occasional cobbles	4.30	0.64		
4.70	100	0	0			Stiff to very stiff, light brown, sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics.				
6.20	100	0	0				6.30	-1.37		
7.70	53	0	0			Firm to stiff, light brown, very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics.				
9.20	33	0	0							

REMARKS

Hole cased 0.00-4.30m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC05-2**
SHEET Sheet 2 of 2

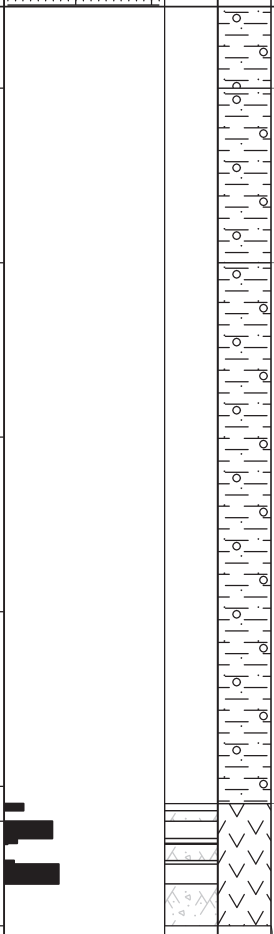
CO-ORDINATES 671,188.03 E
615,309.02 N
GROUND LEVEL (mOD) 4.94

RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

DATE COMMENCED 21/03/2019
DATE COMPLETED 22/03/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY Peteresen
LOGGED BY D.O'Shea



Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.70	13	0	0				Firm to stiff, light brown, very sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics. *(continued)*	10.70	-5.77		
11 12	12.20	33	0	0				Firm, light brown, very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz, shale and volcanics.	12.20	-7.27		
13	13.70	27	0	0				Firm, light brown, very sandy very gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz, shale and volcanics.				
14 15	15.20	33	0	0								
16	16.70	97	0	0					16.85	-11.92		
	17.00	100	17	0				Medium strong, medium to thinly (flow) banded, dark blueish grey, fine to medium-grained, RHYOLITE (Volcanics with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Discontinuities are medium to closely spaced, smooth to locally rough, planar to irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 30-45° & subvertical.				
17	17.90	89	39	33					17.90	-12.97		
18 19								End of Borehole at 17.90 m				

REMARKS

Hole cased 0.00-4.30m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC06-2**
		SHEET	Sheet 1 of 3
CO-ORDINATES	671,186.86 E 615,256.30 N	**DATE COMMENCED**	28/03/2019
GROUND LEVEL (mOD)	6.47	**DATE COMPLETED**	01/04/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0	0.60	0	0	0				SYMMETRIX DRILLING: No recovery, observed by driller as returns of brown CLAY	0.60	5.87		
1	1.60	100	0	0				Firm to stiff, light brown, sandy gravelly (becoming more gravelly with depth) CLAY with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics.				
2 3	3.10	37	0	0								
4	4.60	71	0	0								
5 6	6.10	47	0	0								
7	7.60	65	0	0								
8 9	9.10	35	0	0								
		29	0	0								

REMARKS

Hole cased 0.00-1.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC06-2**
		SHEET	Sheet 2 of 3
CO-ORDINATES	671,186.86 E 615,256.30 N	**DATE COMMENCED**	28/03/2019
GROUND LEVEL (mOD)	6.47	**DATE COMPLETED**	01/04/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								Firm to stiff, light brown, sandy gravelly (becoming more gravelly with depth) CLAY with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics. *(continued)*				
	10.60											
11		60	0	0								
12	12.10											
13		56	0	0								
	13.60											
14		65	0	0								
15	15.10											
16		77	0	0								
	16.60											
17		27	0	0								
18	18.10											
19		50	0	0								
	19.60											

REMARKS

Hole cased 0.00-1.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER
21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC06-2**
SHEET Sheet 3 of 3

CO-ORDINATES 671,186.86 E
615,256.30 N
GROUND LEVEL (mOD) 6.47

RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

DATE COMMENCED 28/03/2019
DATE COMPLETED 01/04/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY IGSL
LOGGED BY D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20		53	0	0				Firm to stiff, light brown, sandy gravelly (becoming more gravelly with depth) CLAY with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of quartz and volcanics. *(continued)*				
21	21.10								21.10	-14.63		
								End of Borehole at 21.10 m				
22												
23												
24												
25												
26												
27												
28												
29												

REMARKS

Hole cased 0.00-1.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

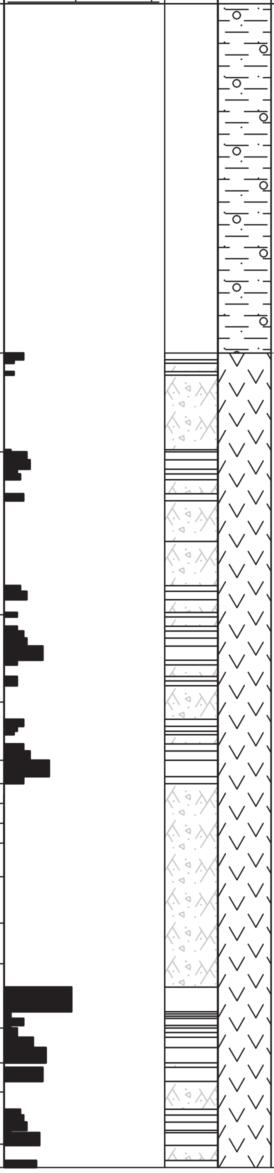
Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

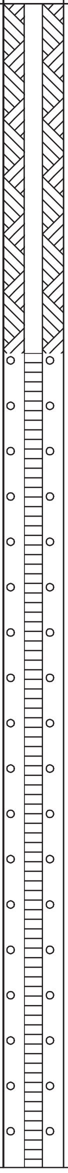
REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**DRILLHOLE NO**	**RC01-3**
		SHEET	Sheet 1 of 3
CO-ORDINATES	669,113.17 E 615,020.32 N	**DATE DRILLED**	26/02/2019
GROUND LEVEL (mOD)	26.68	**DATE LOGGED**	04/03/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Limited	**DRILLED BY**	IGSL
INCLINATION (deg)	-90		
ENGINEER	ARUP	**LOGGED BY**	D.O'Shea
CORE DIAMETER (mm)	80		

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
3.00			
3.85	100	9	0
5.25	100	23	0
6.00	100	51	0
6.50	100	28	0
6.70	100	100	60
6.80	100	100	0
6.90	100	90	0
7.00	0	0	0
7.50	100	14	0
7.90	100	0	0
8.25	100	11	0
8.80	100	47	38
9.10	100	90	0
9.35	100	68	0
9.80	100	62	0



Downhole Depth (m)	Description	Depth (m)	Elevation
0	Stiff to very stiff brown sandy gravelly CLAY with angular cobbles (cable percussive borehole description)	3.00	23.68
3	Very strong (where competent), medium to thinly (flow) banded, dark green/blue to brownish green, fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and beds of mudstone/siltstone), slightly to locally moderately weathered (predominantely at ash layers at 3.19-3.83m, 4.62-5.00m & 5.68-5.78m). Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 60°, subvertical & irregular.		



REMARKS

Hole cased 0.00-3.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
17.00	3.00	N/S			Seepage

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

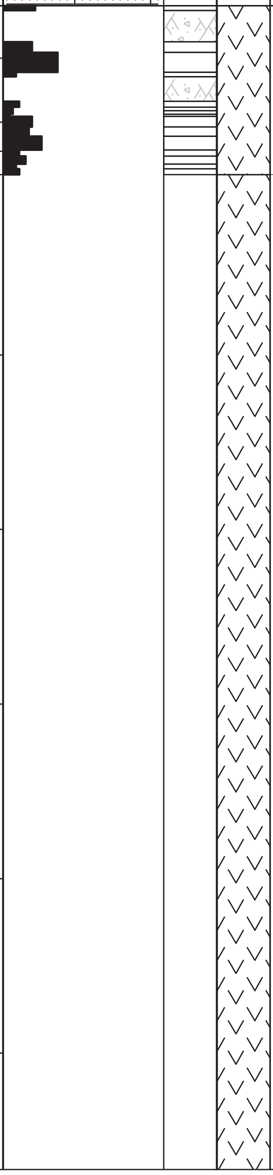
Date	Tip Depth	RZ Top	RZ Base	Type
04-03-19	25.00	3.00	25.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**DRILLHOLE NO**	**RC01-3**
		SHEET	Sheet 2 of 3
CO-ORDINATES	669,113.17 E 615,020.32 N	**DATE DRILLED**	26/02/2019
GROUND LEVEL (mOD)	26.68	**DATE LOGGED**	04/03/2019
CLIENT	Greenlink Interconnector Limited	**DRILLED BY**	IGSL
ENGINEER	ARUP	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	80



Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation
10	10.45	100	51	15			
	11.00	100	40	0			
11	11.25	100	92	44			
	11.45	100	85	0		11.45	15.23
12	13.00	0	0	0	SYMMETRIX DRILLING: No recovery, observed by driller as returns of very strong ROCK		
13, 14	14.50	0	0	0			
15	16.00	0	0	0			
16, 17	17.50	0	0	0			
18	19.00	0	0	0			
19		0	0	0			

Standpipe Details

SPT (N Value)

REMARKS

Hole cased 0.00-3.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
17.00	3.00	N/S			Seepage

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
04-03-19	25.00	3.00	25.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	21475
CONTRACT	Greenlink Interconnector Onshore Ireland
DRILLHOLE NO	**RC01-3**
SHEET	Sheet 3 of 3
CO-ORDINATES	669,113.17 E 615,020.32 N
GROUND LEVEL (mOD)	26.68
RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	80
DATE DRILLED	26/02/2019
DATE LOGGED	04/03/2019
CLIENT	Greenlink Interconnector Limited
ENGINEER	ARUP
DRILLED BY	IGSL
LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20	20.50							SYMMETRIX DRILLING: No recovery, observed by driller as returns of very strong ROCK *(continued)*				
21	22.00	0	0	0								
22–23	23.50	0	0	0								
24	25.00	0	0	0					25.00	1.68		
25								End of Borehole at 25.00 m				
26												
27												
28												
29												

REMARKS

Hole cased 0.00-3.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
17.00	3.00	N/S			Seepage

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
04-03-19	25.00	3.00	25.00	50mm SP

GROUNDWATER DETAILS

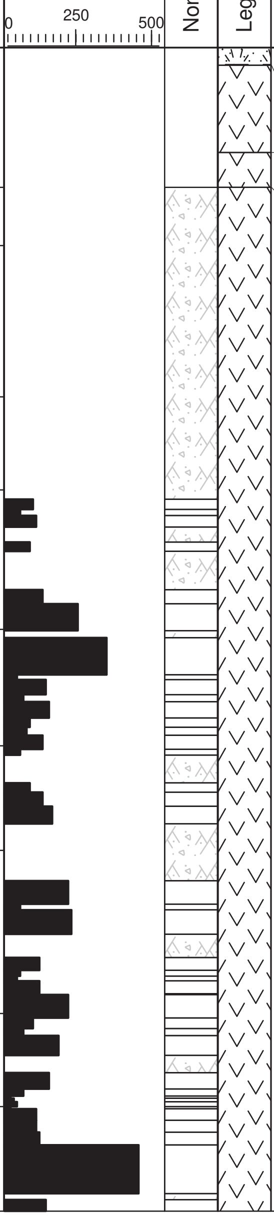
Date	Hole Depth	Casing Depth	Depth to Water	Comments
04-03-19	25.00	3.00	Dry	Water level recorded 5 mins after end of drilling.

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-3**
		SHEET	Sheet 1 of 3
CO-ORDINATES	669,302.15 E 615,046.30 N	**DATE COMMENCED**	08/03/2019
GROUND LEVEL (mOD)	19.27	**DATE COMPLETED**	12/03/2019
RIG TYPE	Knebel		
FLUSH	P. Gel		
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
1.20 – 1.70	100	0	0
1.70 – 3.00	100	5	0
3.00 – 3.80	100	14	0
3.80 – 5.00	100	27	0
5.00 – 6.00	100	56	25
6.00 – 6.90	100	47	27
6.90 – 8.30	100	44	17
8.30 – 9.10	100	64	18
9.10 –	100	67	29



Description	Depth (m)	Elevation
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.15	19.12
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm to stiff brown gravelly CLAY	0.90	18.37
SYMMETRIX DRILLING: No recovery, observed by driller as returns of weak ROCK	1.20	18.07
Very strong (where competent), medium to thinly (flow) banded, (0.90-9.00m - pinkish purple, 9.00-25.00m - dark green/blue to brownish green), fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 60°, subvertical & irregular.		

Standpipe Details | SPT (N Value)

REMARKS

Hole cased 0.00-3.80m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC02-3**
SHEET Sheet 2 of 3

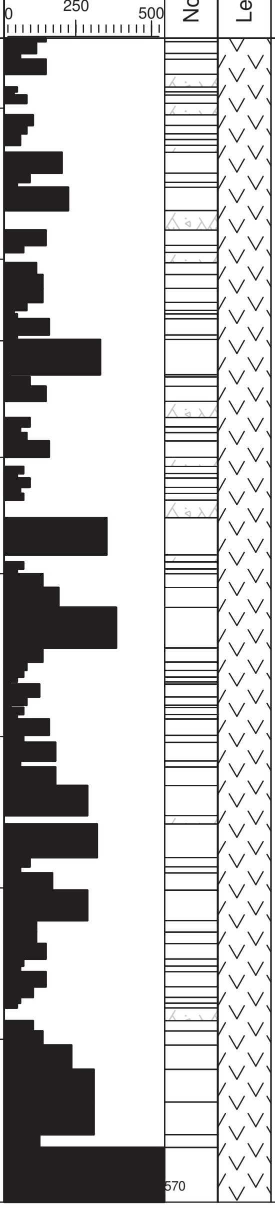
CO-ORDINATES 669,302.15 E
615,046.30 N
GROUND LEVEL (mOD) 19.27

RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

DATE COMMENCED 08/03/2019
DATE COMPLETED 12/03/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY IGSL
LOGGED BY D.O'Shea



Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.60				Very strong (where competent), medium to thinly (flow) banded, (0.90-9.00m - pinkish purple, 9.00-25.00m - dark green/blue to brownish green), fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 60°, subvertical & irregular. *(continued)*				
11	11.90	100	28	13					
12	12.60	100	71	24					
13	13.60	100	49	0					
14	14.60	100	57	17					
15	16.00	100	83	34					
16									
17	17.30	100	95	58					
18	18.60	100	75	46					
19		100	95	61					

REMARKS

Hole cased 0.00-3.80m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

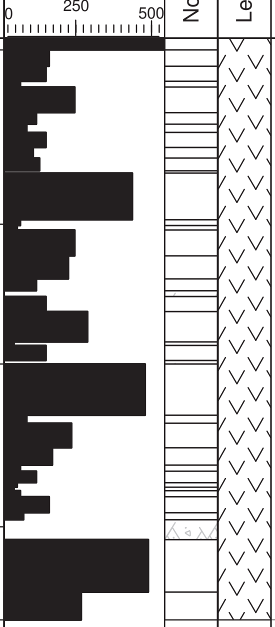
IGSL RC FI 10M 21475.GPJ IGSL.GDT 10/4/19

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC02-3**
		SHEET	Sheet 3 of 3
CO-ORDINATES	669,302.15 E 615,046.30 N	**RIG TYPE**	Knebel
GROUND LEVEL (mOD)	19.27	**FLUSH**	P. Gel
CLIENT	Greenlink Interconnector Ltd.	**INCLINATION (deg)**	-90
ENGINEER	Arup	**CORE DIAMETER (mm)**	102
DATE COMMENCED	08/03/2019	**DRILLED BY**	IGSL
DATE COMPLETED	12/03/2019	**LOGGED BY**	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20	20.10				Very strong (where competent), medium to thinly (flow) banded, (0.90-9.00m - pinkish purple, 9.00-25.00m - dark green/blue to brownish green), fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 60°, subvertical & irregular. *(continued)*				
21		100	69	37					
	21.60								
22		100	72	51					
	22.80								
23		100	86	37					
24	24.20								
		100	90	90					
25	25.00				End of Borehole at 25.00 m	25.00	-5.73		
26									
27									
28									
29									



REMARKS

Hole cased 0.00-3.80m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC03-3**
SHEET Sheet 1 of 3

CO-ORDINATES 669,425.95 E
615,118.97 N
GROUND LEVEL (mOD) 0.36

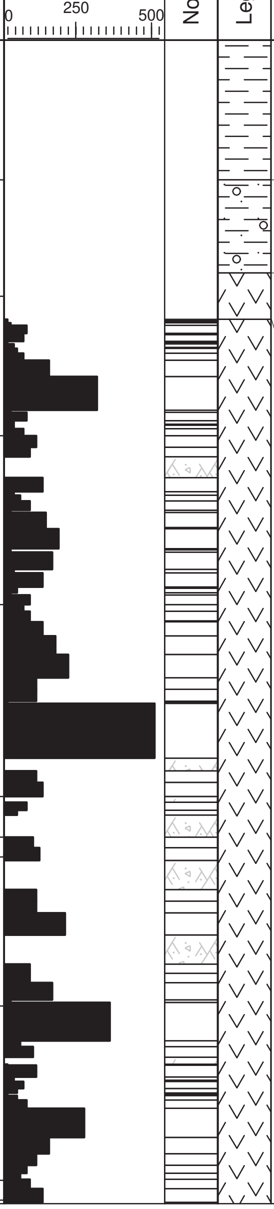
RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 96

DATE COMMENCED 13/03/2019
DATE COMPLETED 19/03/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY IGSL
LOGGED BY D.O'Shea

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
1.20			
2.20	95	0	0
3.40	88	0	0
4.85	100	0	0
6.50	100	71	67
6.85	100	57	57
7.00	100	0	0
8.30	65	41	28
9.80	100	46	33
9.95	100	67	67



Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
SYMMETRIX DRILLING: No recovery, observed by driller as returns of grey CLAY	1.20	-0.84		
Firm to stiff, dark brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of volcanics.	2.00	-1.64		
Possible weathered ROCK - recovered as clayey sandy cobbly GRAVEL. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of volcanics. Cobbles are subrounded of volcanics.	2.40	-2.04		
Very strong, medium to thinly (flow) banded, dark greenish grey (becoming reddish brown from 13.00m), fine to medium-grained, RHYOLITE (Volcanics with high quartz content), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 30-50° & locally 70°.				

Downhole Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

REMARKS

Hole cased 0.00-2.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.60	0.60	N/S			Seepage

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

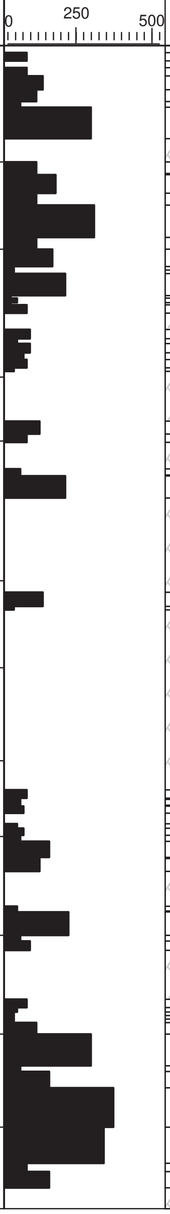
INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC03-3**
		SHEET	Sheet 2 of 3
CO-ORDINATES	669,425.95 E 615,118.97 N	**RIG TYPE**	Knebel
GROUND LEVEL (mOD)	0.36	**FLUSH**	P. Gel
CLIENT	Greenlink Interconnector Ltd.	**INCLINATION (deg)**	-90
ENGINEER	Arup	**CORE DIAMETER (mm)**	96
DATE COMMENCED	13/03/2019	**DATE COMPLETED**	19/03/2019
DRILLED BY	IGSL	**LOGGED BY**	D.O'Shea



Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
10		100	47	10
11	11.00	93	0	0
12	11.75	100	0	0
13	12.85	100	0	0
14	13.40	100	0	0
15	14.60	100	0	0
	15.35	100	0	0
16	16.15	100	0	0
17	16.80	100	11	0
18	17.65	100	0	0
19	18.50	100	43	43
	19.30	100	68	68

Description

Very strong, medium to thinly (flow) banded, dark greenish grey (becoming reddish brown from 13.00m), fine to medium-grained, RHYOLITE (Volcanics with high quartz content), slightly weathered.
Many poorly-cemented incipient fractures throughout core.
Competence of rock mass increases with depth.

Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 30-50° & locally 70°. *(continued)*

REMARKS

Hole cased 0.00-2.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.60	0.60	N/S			Seepage

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER	21475
CONTRACT	Greenlink Interconnector
DRILLHOLE NO	**RC03-3**
SHEET	Sheet 3 of 3
CO-ORDINATES	669,425.95 E 615,118.97 N
GROUND LEVEL (mOD)	0.36
RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	96
DATE COMMENCED	13/03/2019
DATE COMPLETED	19/03/2019
CLIENT	Greenlink Interconnector Ltd.
ENGINEER	Arup
DRILLED BY	IGSL
LOGGED BY	D.O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20	20.20				■				20.20	-19.84		
								End of Borehole at 20.20 m				
21												
22												
23												
24												
25												
26												
27												
28												
29												

REMARKS

Hole cased 0.00-2.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.60	0.60	N/S			Seepage

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
19-03-19	20.20	2.00	0.60	Water level recorded 5 mins after end of drilling.

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC04-3**
		SHEET	Sheet 1 of 1
CO-ORDINATES	669,299.35 E 614,870.70 N	**DATE COMMENCED**	13/03/2019
GROUND LEVEL (mOD)	8.05	**DATE COMPLETED**	13/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	Peteresen
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm TOPSOIL	0.50	7.55		
1 2 3								SYMMETRIX DRILLING: No recovery, observed by driller as returns of dense brown silty gravelly SAND	3.40	4.65		
4	3.40 4.50	91	0	0				Possible highly weathered ROCK - recovered as dense brown gravelly SAND with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of rhyolite. Cobbles are subrounded of rhyolite.	5.40	2.65		
5	4.50 6.00	100	0	0								
6 7 8 9	6.00 7.50 8.40 9.50	100 100 91	0 0 0	0 0 0				Very strong (where competent), medium to thinly (flow) banded, light pinkish green and brown, fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and thin beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 30-45°, subhorizontal, subvertical & irregular.	9.50	-1.45		
								End of Borehole at 9.50 m				

REMARKS

Hole cased 0.00-3.40m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector

DRILLHOLE NO **RC05-3**
SHEET Sheet 1 of 2

CO-ORDINATES 669,193.30 E
614,924.03 N
GROUND LEVEL (mOD) 32.78

RIG TYPE Knebel
FLUSH P. Gel
INCLINATION (deg) -90
CORE DIAMETER (mm) 102

DATE COMMENCED 04/03/2019
DATE COMPLETED 12/03/2019

CLIENT Greenlink Interconnector Ltd.
ENGINEER Arup

DRILLED BY IGSL
LOGGED BY D.O'Shea

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
0.90			
1.00	100	40	0
1.70	100	0	0
1.90	100	40	0
2.20	100	0	0
2.80	100	0	0
3.20	100	28	0
3.70	100	0	0
4.25	100	44	24
4.50	100	80	80
5.30	100	61	19
5.85	100	60	0
7.25	100	70	16
8.80	100	83	59
9.75	100	93	84
9.90	100	100	0

Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
SYMMETRIX DRILLING: No recovery, observed by driller as returns of firm clayey TOPSOIL	0.90	31.88		
Medium to highly weathered ROCK - recovered as sand layers and occasional gravelly cobbles	3.95	28.83		
Very strong (where competent), medium to thinly (flow) banded, light pinkish green and brown, fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 60°, subvertical & irregular.				

Downhole Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

REMARKS

Hole cased 0.00-0.90m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

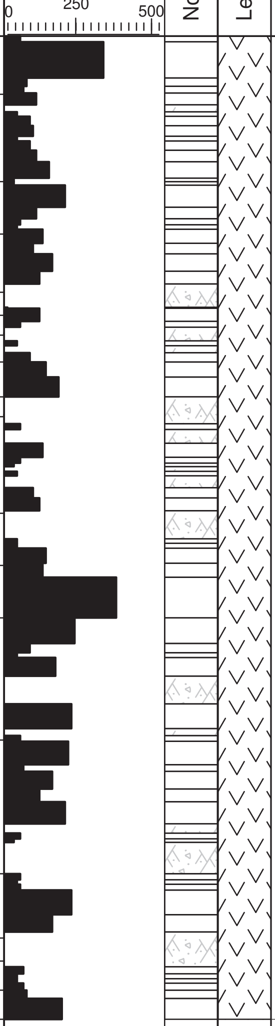
Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC05-3**
		SHEET	Sheet 2 of 2
CO-ORDINATES	669,193.30 E 614,924.03 N	**DATE COMMENCED**	04/03/2019
GROUND LEVEL (mOD)	32.78	**DATE COMPLETED**	12/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102



Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
10.50	83	70	42
11.25	100	65	0
11.70	100	76	27
12.20	100	82	26
12.40	100	70	0
12.55	100	87	0
12.80	100	68	40
13.10	100	97	40
13.25	100	80	0
14.10	100	54	0
14.55	100	40	0
15.00	100	100	62
16.05	100	54	38
17.20	100	67	52
17.75	100	84	27
17.95	100	35	0
18.20	100	60	0
18.45	100	88	64

Downhole Depth (m): 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
Very strong (where competent), medium to thinly (flow) banded, light pinkish green and brown, fine to medium-grained, RHYOLITE (Volcanics with high quartz content, with occasional weak ash layer and beds of mudstone/siltstone), slightly weathered. Many poorly-cemented incipient fractures throughout core. Competence of rock mass increases with depth. Discontinuities are medium to closely spaced, smooth to locally rough, planar to locally stepped & irregular. Apertures are tight to open, commonly clay-smeared, commonly strongly iron-oxide stained. Dips are 60°, subvertical & irregular. *(continued)*	18.45	14.33		
End of Borehole at 18.45 m				

REMARKS

Hole cased 0.00-0.90m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

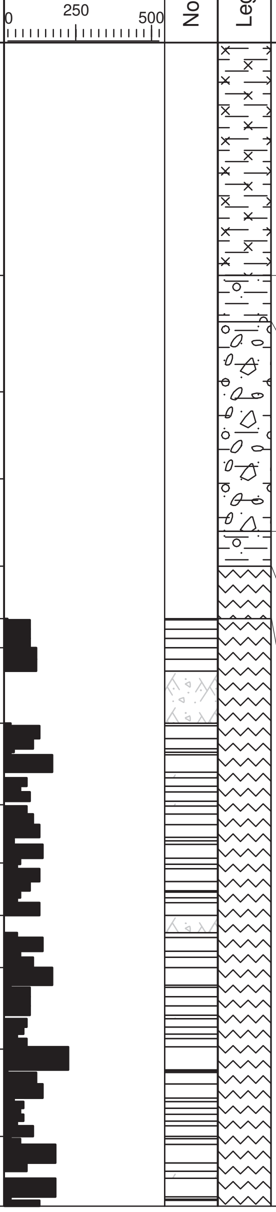
Date	Hole Depth	Casing Depth	Depth to Water	Comments

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC06A-3**
		SHEET	Sheet 1 of 2
CO-ORDINATES	669,392.50 E 615,254.13 N	**DATE COMMENCED**	20/03/2019
GROUND LEVEL (mOD)	0.21	**DATE COMPLETED**	22/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea
RIG TYPE	Knebel		
FLUSH	P. Gel		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	102		

Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
2.00			
	100	0	0
3.00			
	100	0	0
3.75			
	73	0	0
4.50			
	100	0	0
4.95			
	100	32	0
5.20			
	100	22	22
5.85			
	100	13	0
6.55			
	100	46	46
7.05			
	100	20	0
7.50			
	100	22	0
7.95			
	100	70	41
8.65			
	100	41	37
9.40			
	100	49	43



Description	Depth (m)	Elevation	SPT (N Value)
SYMMETRIX DRILLING: No recovery, observed by driller as returns of brown silty CLAY	2.00	-1.79	N = 17 (2, 1, 4, 4, 5, 4)
Firm to stiff, dark brown, slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of sandstone.	2.40	-2.19	
Possible weathered ROCK - recovered as clayey sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of sandstone.	4.20	-3.99	N = 75/90 mm (10, 15, 25, 50)
Soft, light brown, sandy gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of sandstone.	4.50	-4.29	N = 50/10 mm (25, 50)
Possible weathered ROCK - recovered as clayey sandy gravelly COBBLES. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded of sandstone. Cobbles are subrounded of sandstone.	4.95	-4.74	
Strong to very strong, medium to thinly bedded, blueish grey, fine-grained, SANDSTONE (Metamorphosed - Psammite), fresh to locally slightly weathered. Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 30°, 50° & 70°			

REMARKS

Hole cased 0.00-2.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-03-19	20.00	2.00	20.00	50mm SP

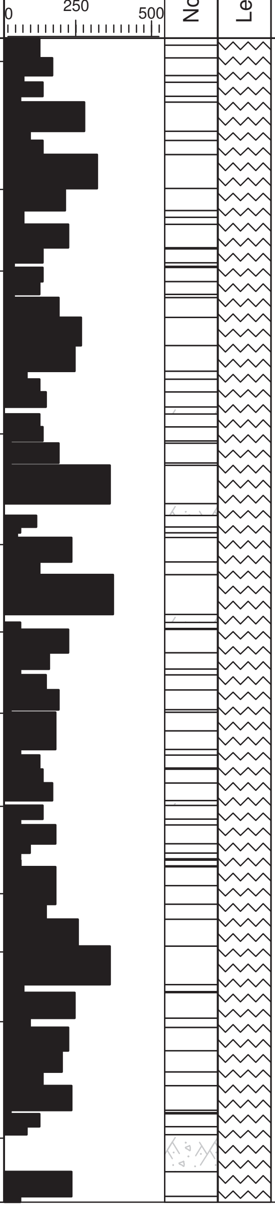
GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector	**DRILLHOLE NO**	**RC06A-3**
		SHEET	Sheet 2 of 2
CO-ORDINATES	669,392.50 E 615,254.13 N	**DATE COMMENCED**	20/03/2019
GROUND LEVEL (mOD)	0.21	**DATE COMPLETED**	22/03/2019
CLIENT	Greenlink Interconnector Ltd.	**DRILLED BY**	IGSL
ENGINEER	Arup	**LOGGED BY**	D.O'Shea

RIG TYPE	Knebel
FLUSH	P. Gel
INCLINATION (deg)	-90
CORE DIAMETER (mm)	102

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%
10	10.20			
	11.30	100	75	71
11	12.00	100	77	77
12, 13	13.40	100	50	26
14	14.35	100	32	27
15	15.10	87	69	69
	15.80	100	54	46
16	16.60	100	52	40
17	17.35	100	9	0
	17.85	100	80	42
18	18.45	100	42	42
19	19.45	100	71	61
	20.00	100	22	22

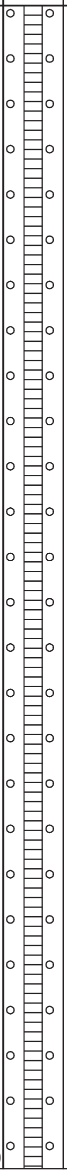


Description

Strong to very strong, medium to thinly bedded, blueish grey, fine-grained, SANDSTONE (Metamorphosed - Psammite), fresh to locally slightly weathered.

Discontinuities are medium to closely spaced, smooth to locally rough, planar. Apertures are tight to moderately open, locally clay-smeared, commonly strongly iron-oxide stained. Dips are 30°, 50° & 70° *(continued)*

Depth (m)	Elevation
20.00	-19.79



SPT (N Value)

End of Borehole at 20.00 m

REMARKS

Hole cased 0.00-2.00m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
22-03-19	20.00	2.00	1.00	Water level recorded 5 mins after end of drilling.

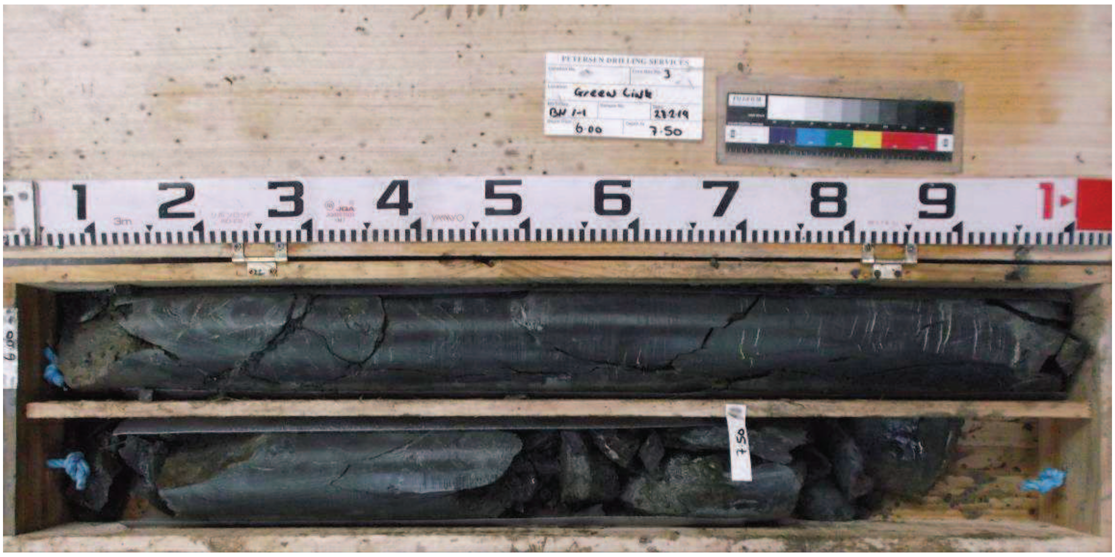
INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-03-19	20.00	2.00	20.00	50mm SP

RC01-1 Box 1 of 18 – 2.20-4.10m

RC01-1 Box 2 of 18 – 4.10-6.00m

RC01-1 Box 3 of 18 – 6.00-7.50m



RC01-1 Box 4 of 18 – 7.50-9.00m

RC01-1 Box 5 of 18 – 9.00-10.50m

RC01-1 Box 6 of 18 – 10.50-12.00m

RC01-1 Box 7 of 18 – 12.00-13.50m

RC01-1 Box 8 of 18 – 13.50-15.00m

RC01-1 Box 9 of 18 – 15.00-16.50m

RC01-1 Box 10 of 18 – 16.50-18.00m

RC01-1 Box 11 of 18 – 18.00-19.50m

RC01-1 Box 12 of 18 – 19.50-21.00m

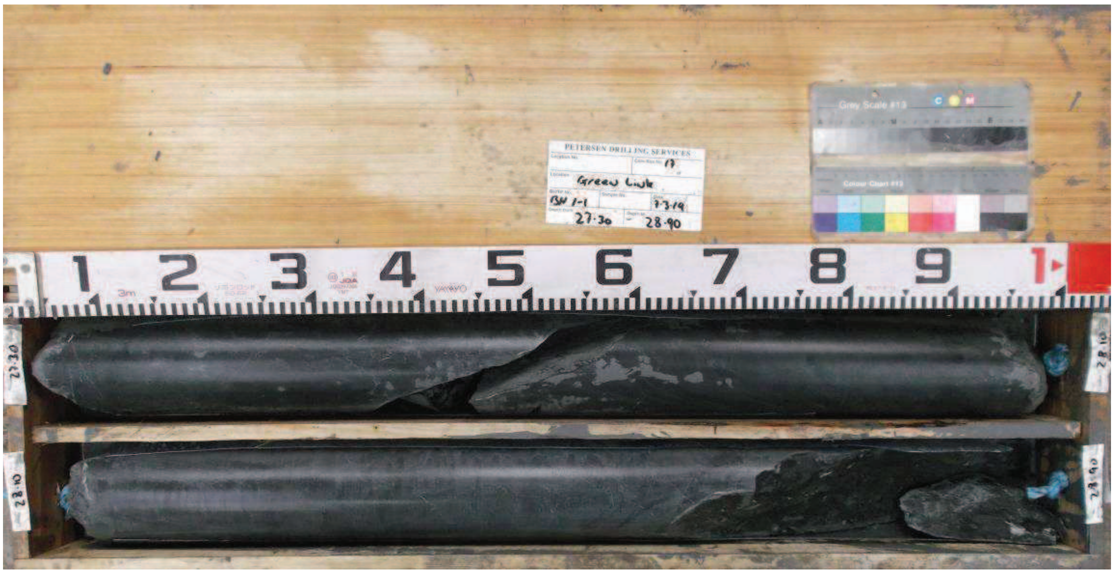
RC01-1 Box 13 of 18 – 21.00-22.50m

RC01-1 Box 14 of 18 – 22.50-24.00m

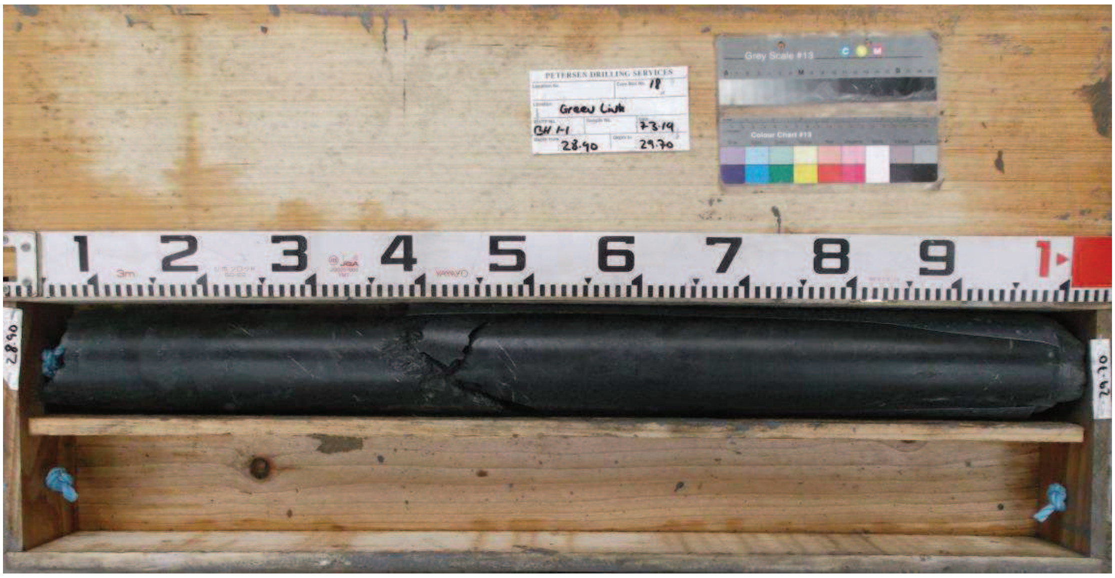
RC01-1 Box 15 of 18 – 24.00-25.50m

RC01-1 Box 16 of 18 – 25.50-27.30m

RC01-1 Box 17 of 18 – 27.30-28.90m

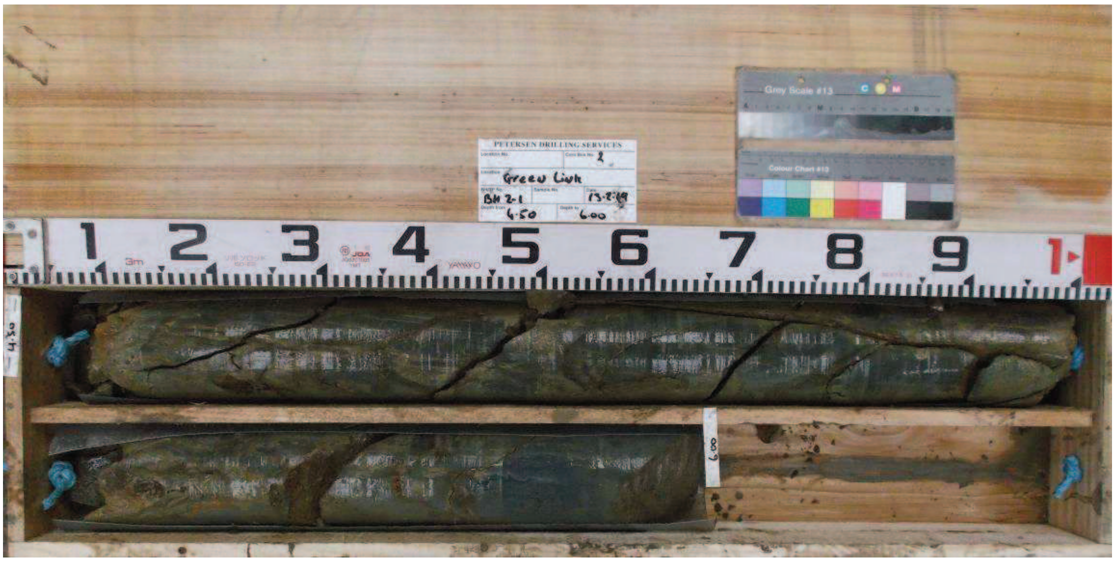


RC01-1 Box 18 of 18 – 28.90-29.70m



RC02-1 Box 1 of 38 – 2.60-4.50m

RC02-1 Box 2 of 38 – 4.50-6.00m



RC02-1 Box 3 of 38 – 6.00-7.50m

RC02-1 Box 4 of 38 – 7.50-9.00m

RC02-1 Box 5 of 38 – 9.00-10.50m

RC02-1 Box 6 of 38 – 10.50-12.00m

RC02-1 Box 7 of 38 – 12.00-13.50m

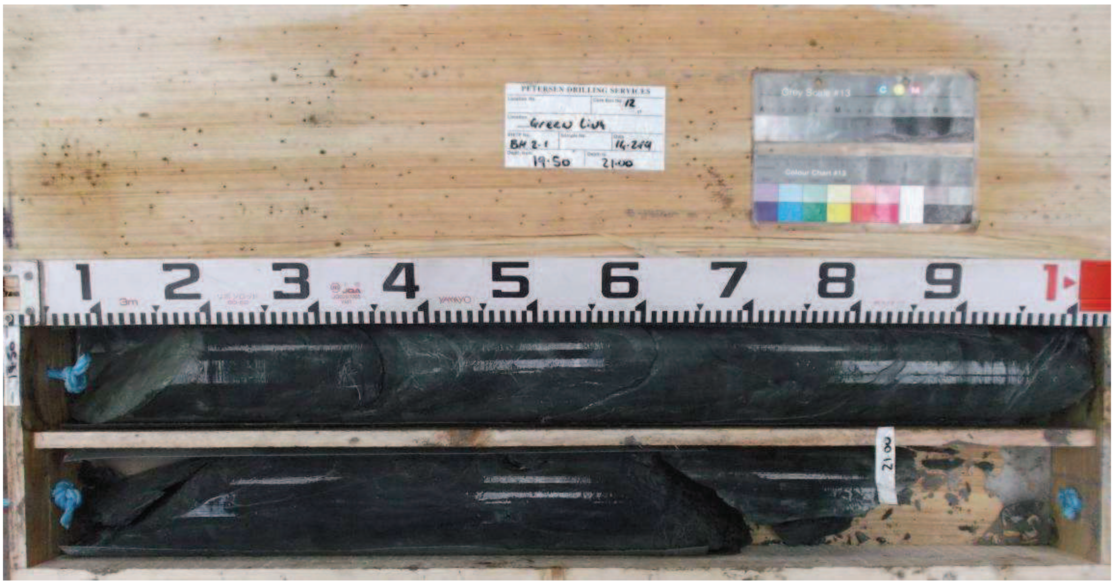
RC02-1 Box 8 of 38 – 13.50-15.00m

RC02-1 Box 9 of 38 – 15.00-16.50m

RC02-1 Box 10 of 38 – 16.50-18.00m

RC02-1 Box 11 of 38 – 18.00-19.50m

RC02-1 Box 12 of 38 – 19.50-21.00m



RC02-1 Box 13 of 38 – 21.00-22.50m

RC02-1 Box 14 of 38 – 22.50-24.00m

RC02-1 Box 15 of 38 – 24.00-25.50m

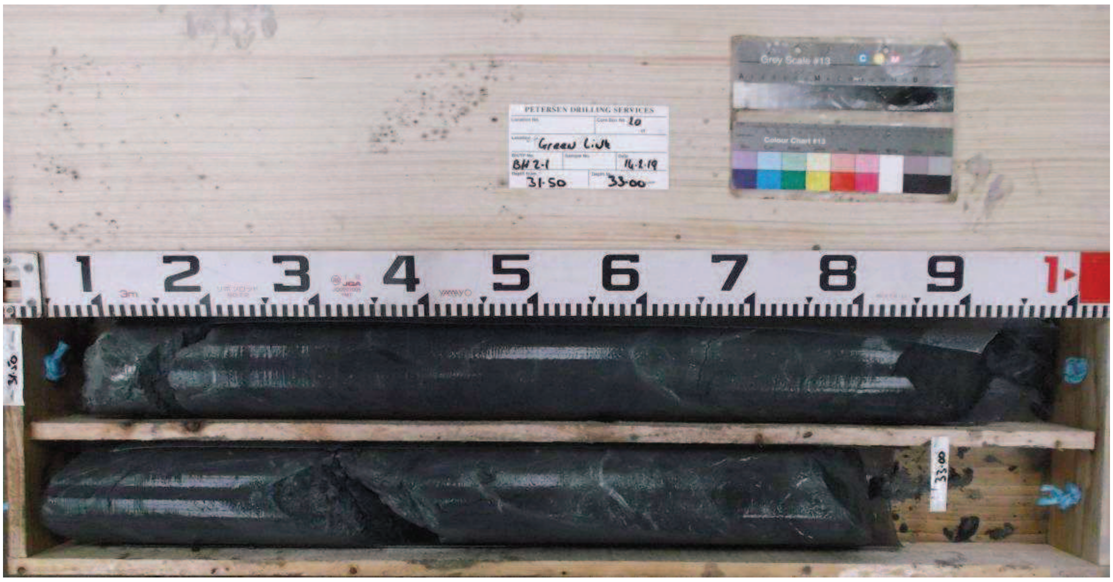
RC02-1 Box 16 of 38 – 25.50-27.00m

RC02-1 Box 17 of 38 – 27.00-28.50m

RC02-1 Box 18 of 38 – 28.50-30.00m

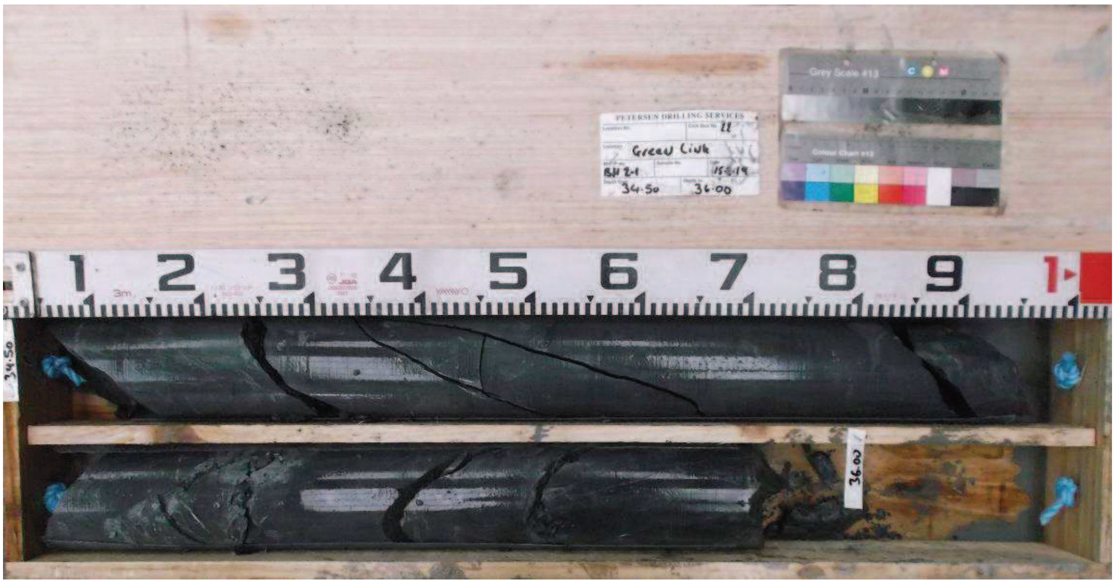
RC02-1 Box 19 of 38 – 30.00-31.50m

RC02-1 Box 20 of 38 – 31.50-33.00m

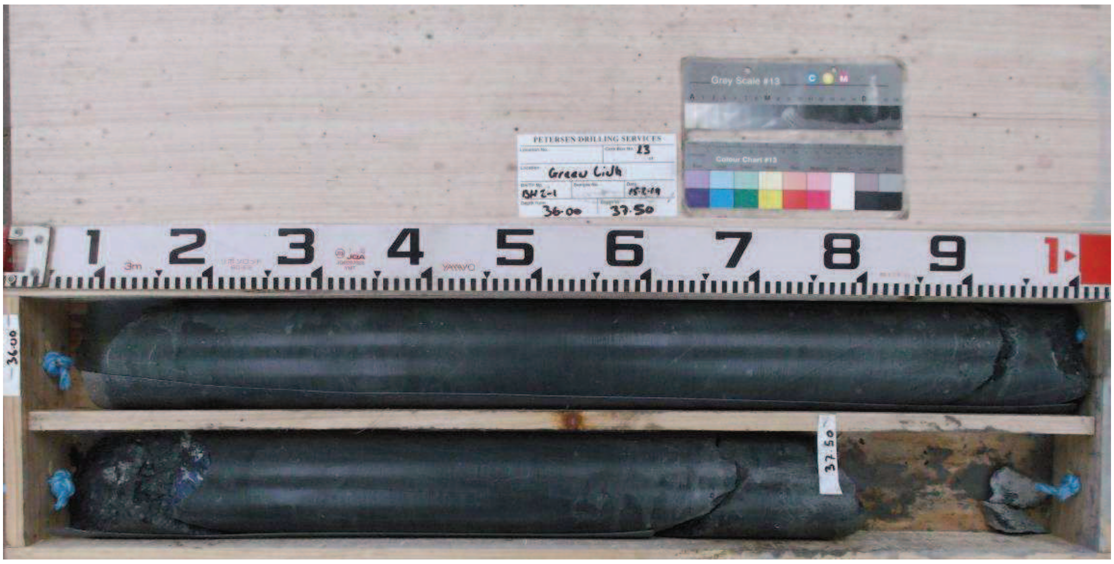


RC02-1 Box 21 of 38 – 33.00-34.50m

RC02-1 Box 22 of 38 – 34.50-36.00m



RC02-1 Box 23 of 38 – 36.00-37.50m



RC02-1 Box 24 of 38 – 37.50-39.00m

RC02-1 Box 25 of 38 – 39.00-40.50m

RC02-1 Box 26 of 38 – 40.50-42.00m

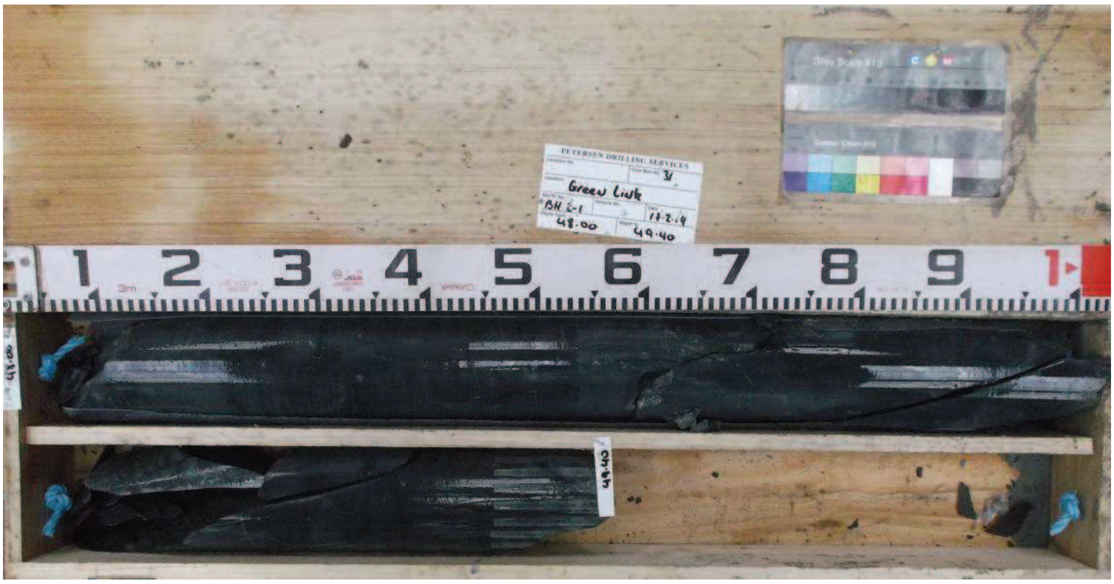
RC02-1 Box 27 of 38 – 42.00-43.50m

RC02-1 Box 28 of 38 – 43.50-45.00m

RC02-1 Box 29 of 38 – 45.00-46.50m

RC02-1 Box 30 of 38 – 46.50-48.00m

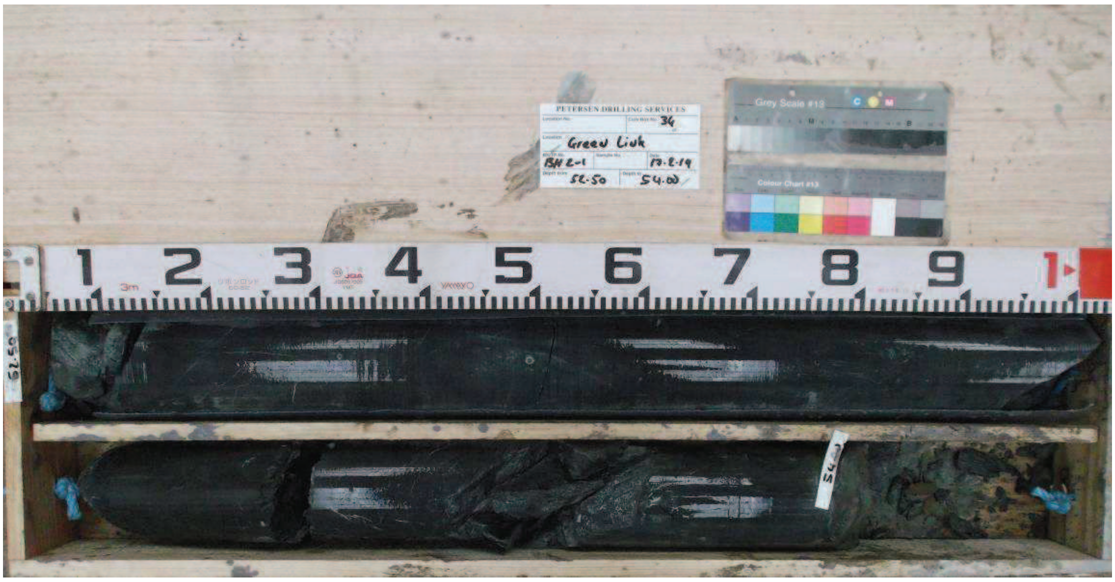
RC02-1 Box 31 of 38 – 48.00-49.40m



RC02-1 Box 32 of 38 – 49.40-51.00m

RC02-1 Box 33 of 38 – 51.00-52.50m

RC02-1 Box 34 of 38 – 52.50-54.00m



RC02-1 Box 35 of 38 – 54.00-55.50m

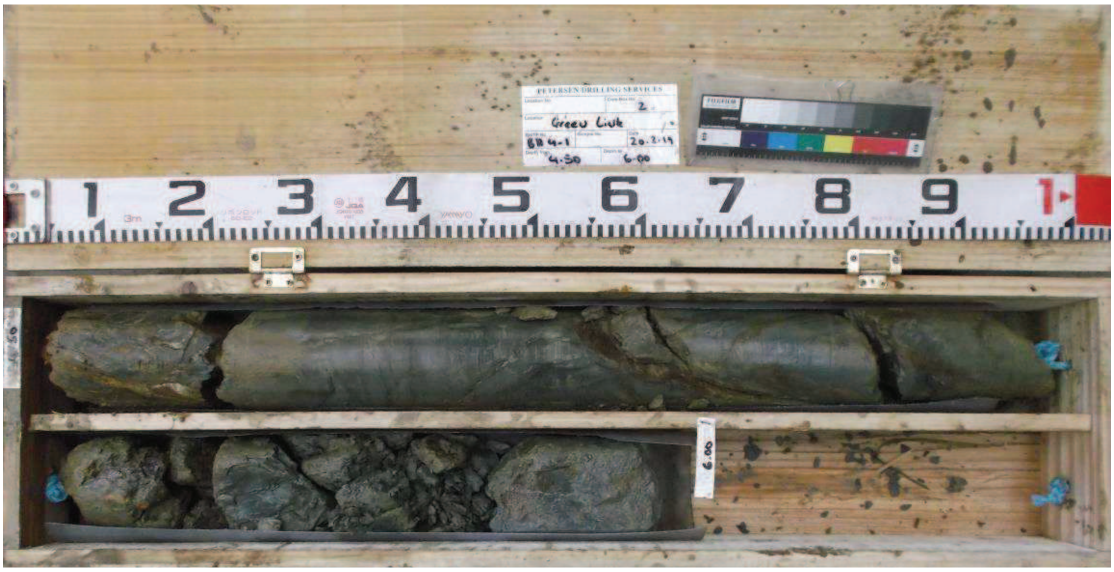
RC02-1 Box 36 of 38 – 55.50-57.00m

RC02-1 Box 37 of 38 – 57.00-58.50m

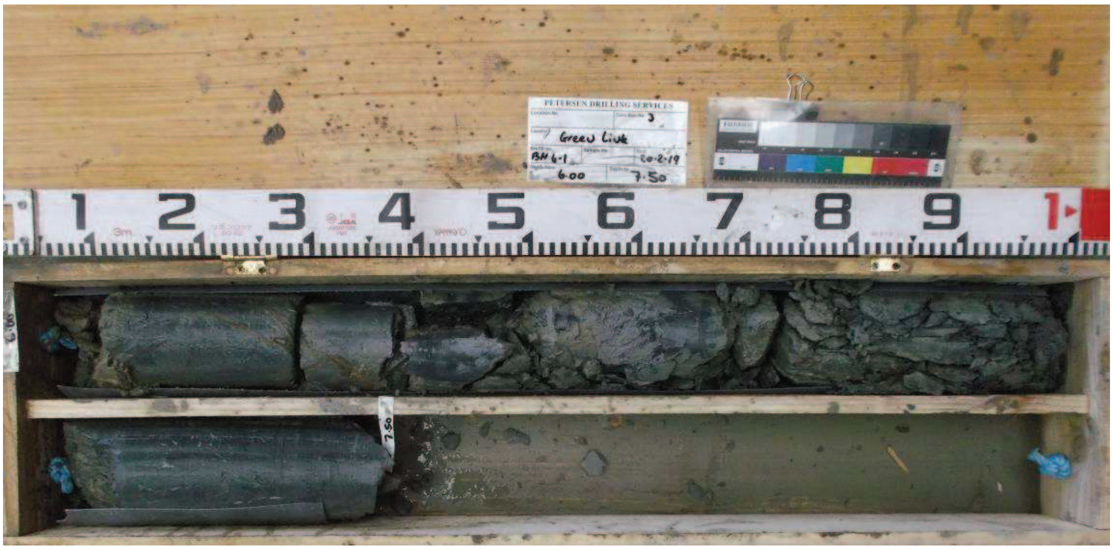
RC02-1 Box 38 of 38 – 58.50-60.00m

RC04-1 Box 1 of 37 – 2.50-4.50m

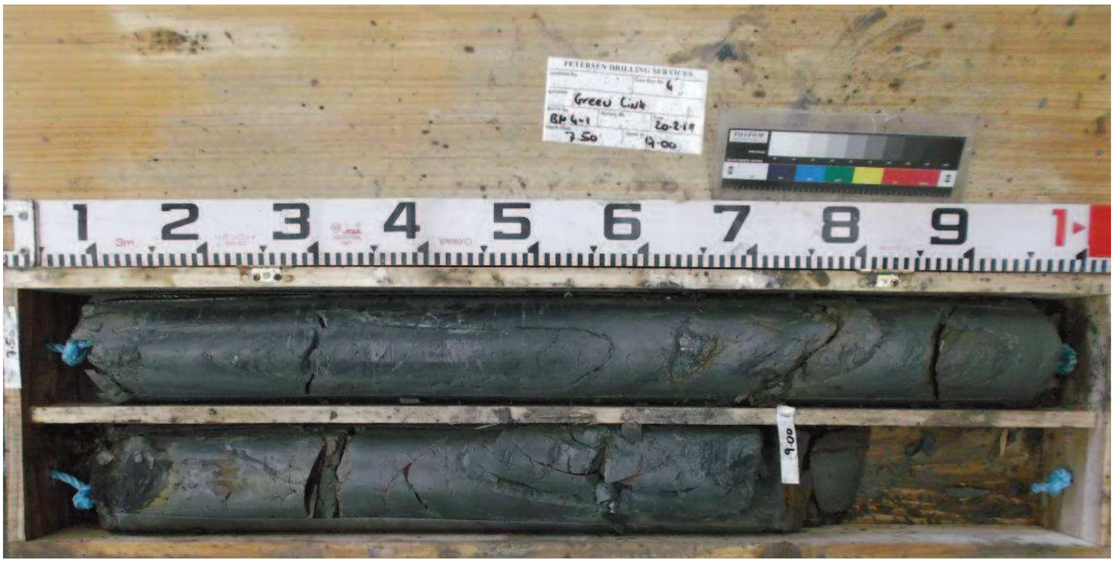
RC04-1 Box 2 of 37 – 4.50-6.00m



RC04-1 Box 3 of 37 – 6.00-7.50m

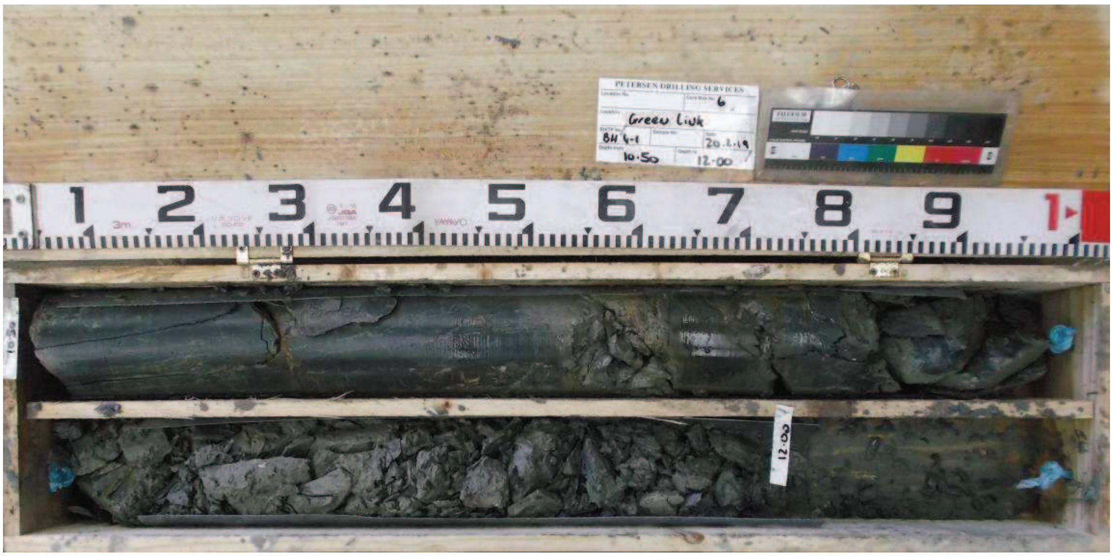


RC04-1 Box 4 of 37 – 7.50-9.00m



RC04-1 Box 5 of 37 – 9.00-10.50m

RC04-1 Box 6 of 37 – 10.50-12.00m



RC04-1 Box 7 of 37 – 12.00-13.50m

RC04-1 Box 8 of 37 – 13.50-15.00m

RC04-1 Box 9 of 37 – 15.00-16.50m

RC04-1 Box 10 of 37 – 16.50-18.00m

RC04-1 Box 11 of 37 – 18.00-19.50m

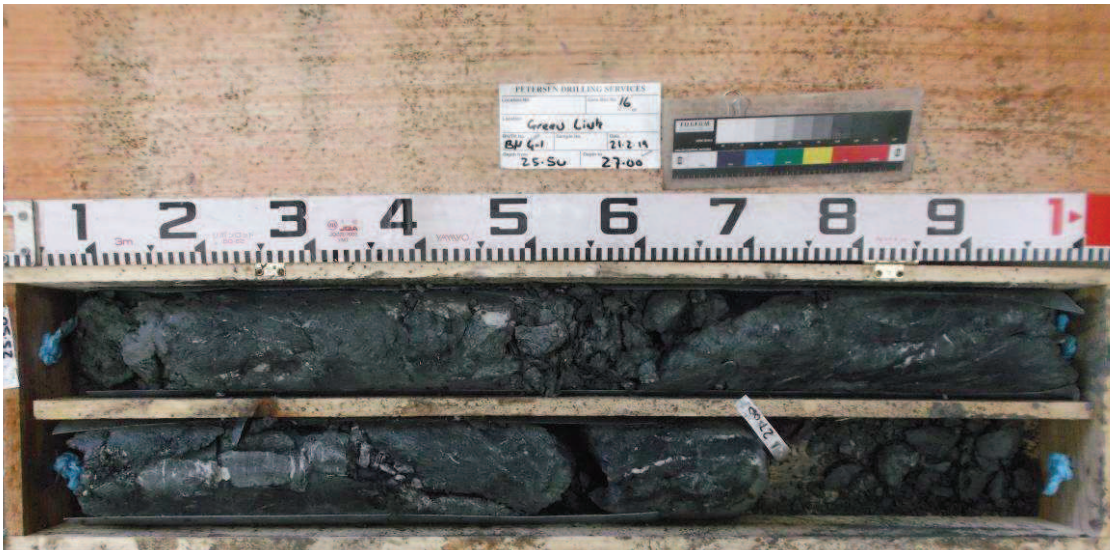
RC04-1 Box 12 of 37 – 19.50-21.00m

RC04-1 Box 13 of 37 – 21.00-22.40m

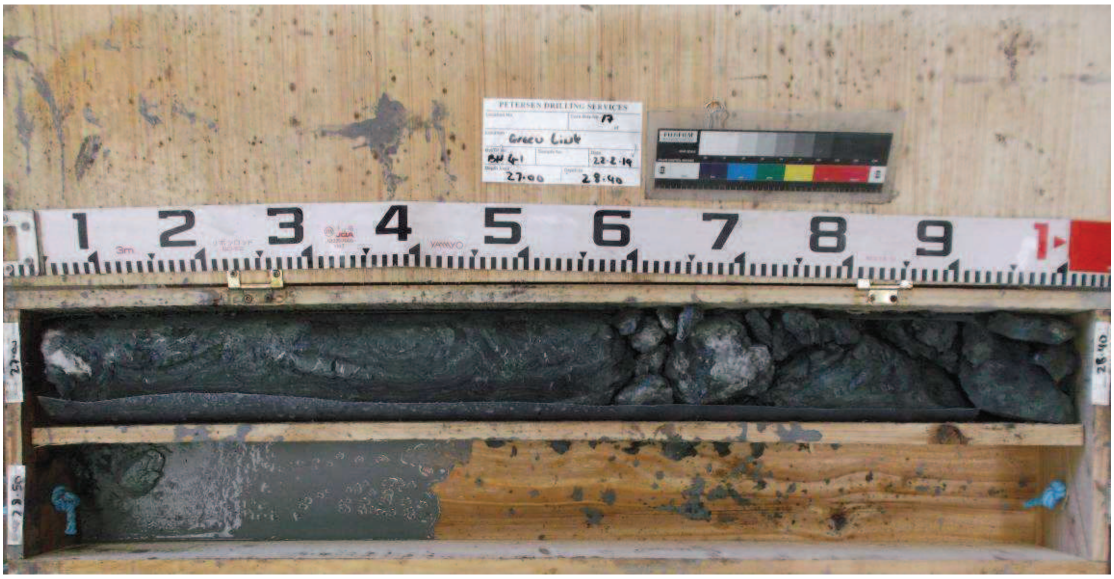
RC04-1 Box 14 of 37 – 22.40-24.00m

RC04-1 Box 15 of 37 – 24.00-25.50m

RC04-1 Box 16 of 37 – 25.50-27.00m



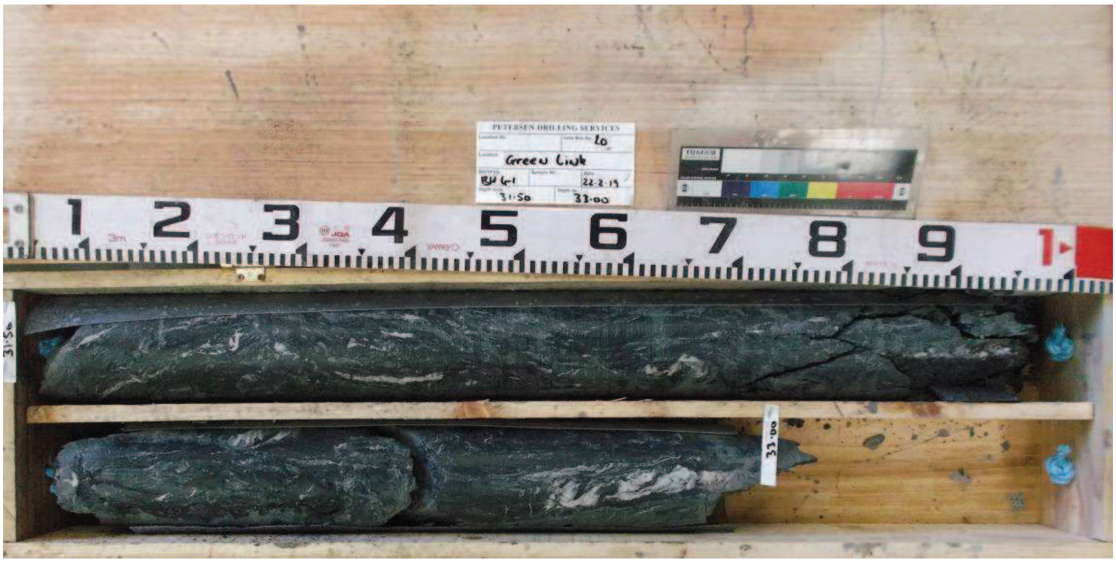
RC04-1 Box 17 of 37 – 27.00-28.40m



RC04-1 Box 18 of 37 – 28.40-30.00m

RC04-1 Box 19 of 37 – 30.00-31.50m

RC04-1 Box 20 of 37 – 31.50-33.00m



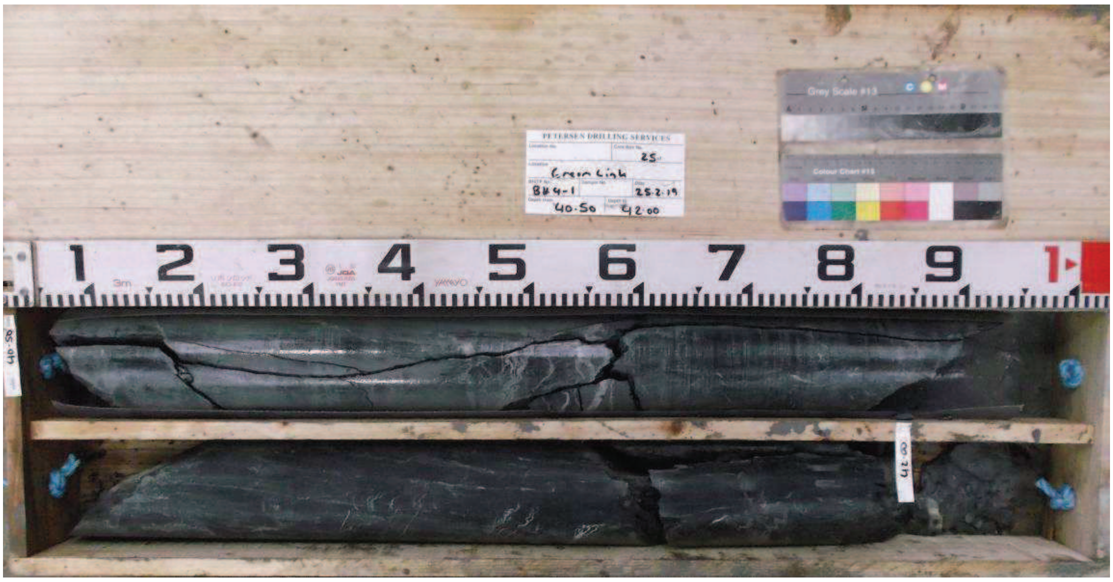
RC04-1 Box 21 of 37 – 33.00-35.50m

RC04-1 Box 22 of 37 – 35.50-37.10m

RC04-1 Box 23 of 37 – 37.10-39.00m

RC04-1 Box 24 of 37 – 39.00-40.50m

RC04-1 Box 25 of 37 – 40.50-42.00m



RC04-1 Box 26 of 37 – 42.00-43.50m

RC04-1 Box 27 of 37 – 43.50-45.00m

RC04-1 Box 28 of 37 – 45.00-46.50m

RC04-1 Box 29 of 37 – 46.50-48.00m

RC04-1 Box 30 of 37 – 48.00-49.50m

RC04-1 Box 31 of 37 – 49.50-51.00m

RC04-1 Box 32 of 37 – 51.00-52.50m

RC04-1 Box 33 of 37 – 52.50-54.00m

RC04-1 Box 34 of 37 – 54.00-55.50m

RC04-1 Box 35 of 37 – 55.50-57.00m

RC04-1 Box 36 of 37 – 57.00-58.50m

RC04-1 Box 37 of 37 – 58.50-60.00m

RC01-2 Box 1 of 9 – 4.20-6.00m

RC01-2 Box 2 of 9 – 6.00-7.70m

RC01-2 Box 3 of 9 – 7.70-9.20m

RC01-2 Box 4 of 9 – 9.20-10.50m

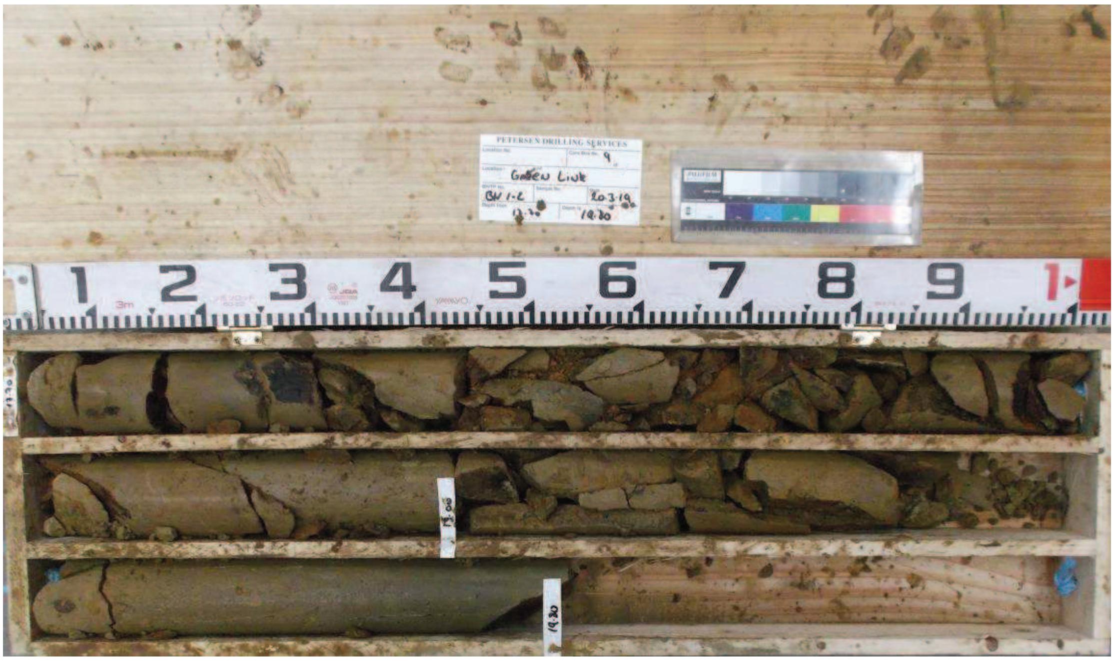
RC01-2 Box 5 of 9 – 10.50-12.10m

RC01-2 Box 6 of 9 – 12.10-12.60m

RC01-2 Box 7 of 9 – 12.60-15.20m

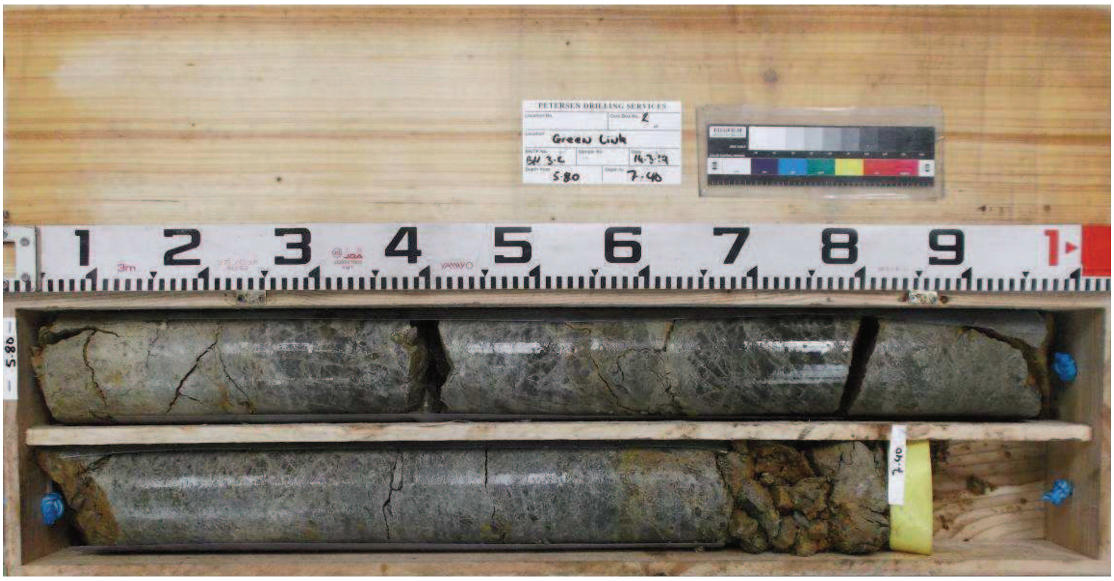
RC01-2 Box 8 of 9 – 15.20-17.70m

RC01-2 Box 9 of 9 – 17.70-19.30m



RC03-2 Box 1 of 9 – 4.40-5.80m

RC03-2 Box 2 of 9 – 5.80-7.40m



RC03-2 Box 3 of 9 – 7.40-9.00m

RC03-2 Box 4 of 9 – 9.00-10.60m

RC03-2 Box 5 of 9 – 10.60-12.10m

RC03-2 Box 6 of 9 – 12.10-13.90m

RC03-2 Box 7 of 9 – 13.90-16.60m

RC03-2 Box 8 of 9 – 16.60-19.20m

RC03-2 Box 9 of 9 – 19.20-19.50m

RC04-2 Box 1 of 8 – 1.00-3.10m

RC04-2 Box 2 of 8 – 3.10-6.10m

RC04-2 Box 3 of 8 – 6.10-7.60m

RC04-2 Box 4 of 8 – 7.60-10.45m

RC04-2 Box 5 of 8 – 10.45-13.95m

RC04-2 Box 6 of 8 – 13.95-16.60m

RC04-2 Box 7 of 8 – 16.60-19.30m

RC04-2 Box 8 of 8 – 19.30-20.00m

RC05-2 Box 1 of 5 – 4.30-6.20m

RC05-2 Box 2 of 5 – 6.20-9.20m

RC05-2 Box 3 of 5 – 9.20-15.20m

RC05-2 Box 4 of 5 – 15.20-17.00m

RC05-2 Box 5 of 5 – 17.00-17.90m

RC06-2 Box 1 of 7 – 0.60-3.50m

RC06-2 Box 2 of 7 – 3.50-6.10m

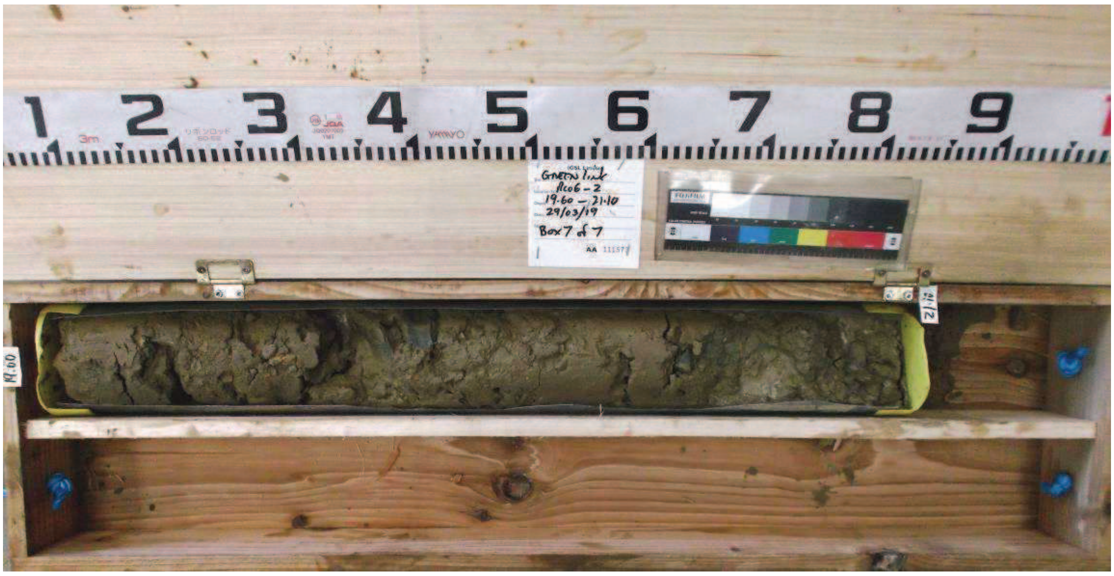
RC06-2 Box 3 of 7 – 6.10-10.60m

RC06-2 Box 4 of 7 – 10.60-13.60m

RC06-2 Box 5 of 7 – 13.60-16.10m

RC06-2 Box 6 of 7 – 16.10-19.60m

RC06-2 Box 7 of 7 – 16.10-19.60m



RC01-3 Box 1 of 3 – 3.00-5.85m

RC01-3 Box 2 of 3 – 5.85-8.80m

RC01-3 Box 3 of 3 – 8.80-11.45m

RC02-3 Box 1 of 10 – 1.20-3.00m

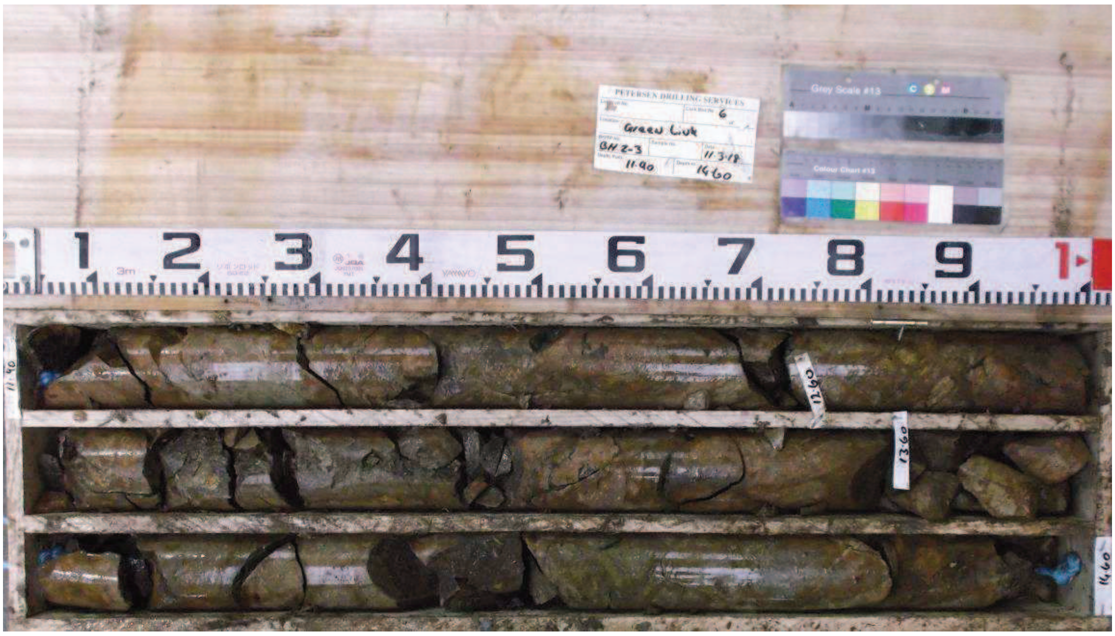
RC02-3 Box 2 of 10 – 3.00-3.80m

RC02-3 Box 3 of 10 – 3.80-6.40m

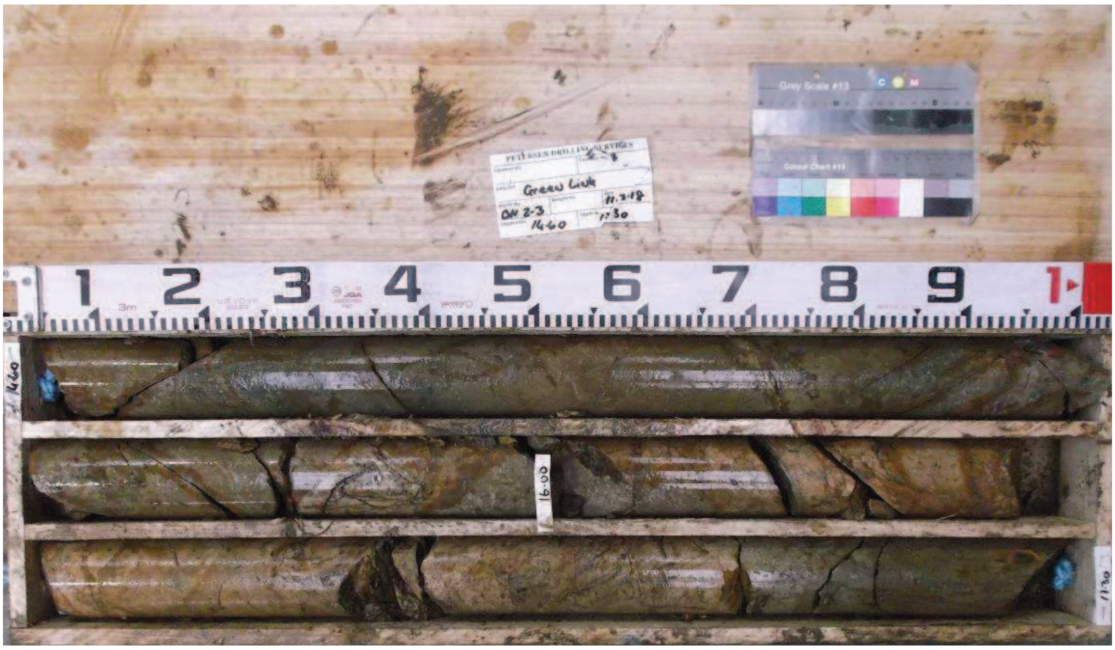
RC02-3 Box 4 of 10 – 6.40-9.10m

RC02-3 Box 5 of 10 – 9.10-11.90m

RC02-3 Box 6 of 10 – 11.90-14.60m



RC02-3 Box 7 of 10 – 14.60-17.30m



RC02-3 Box 8 of 10 – 17.30-20.10m

RC02-3 Box 9 of 10 – 20.10-22.80m

RC02-3 Box 10 of 10 – 22.80-25.00m

RC03-3 Box 1 of 9 – 1.20-3.10

RC03-3 Box 2 of 9 – 3.10-4.85m

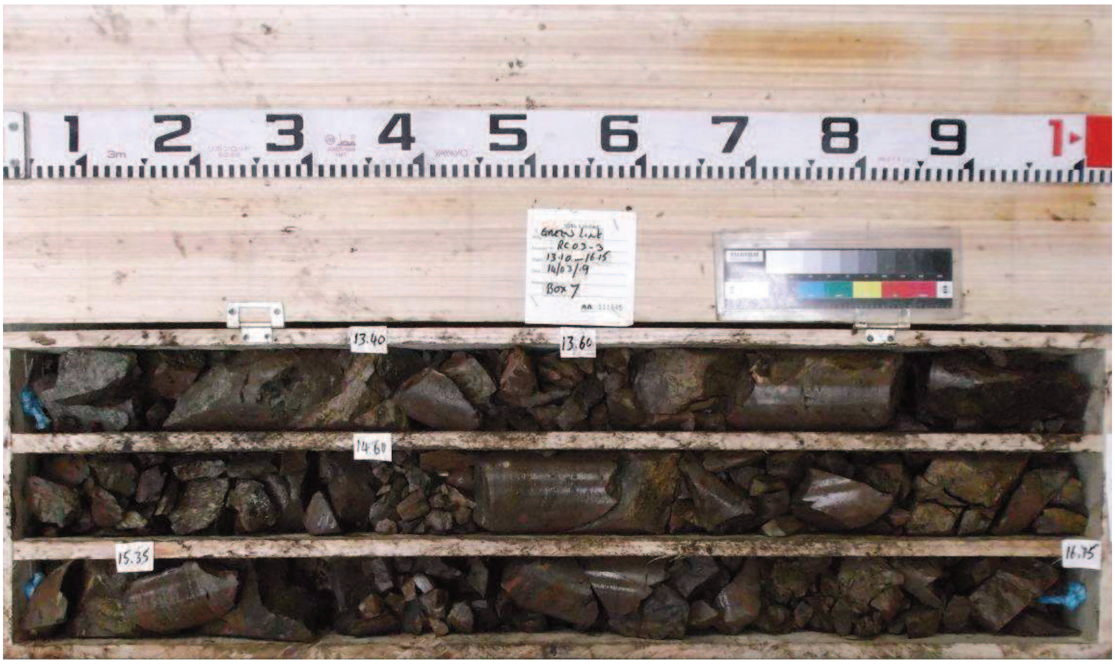
RC03-3 Box 3 of 9 – 4.85-6.35m

RC03-3 Box 4 of 9 – 6.35-8.00m

RC03-3 Box 5 of 9 – 8.00-10.40m

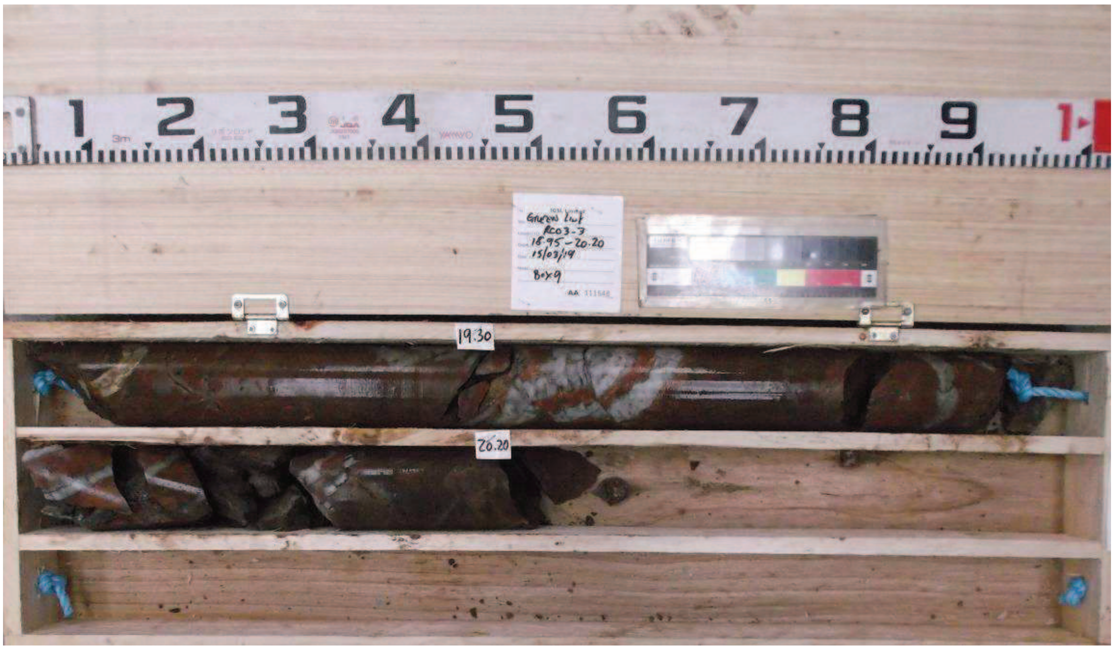
RC03-3 Box 6 of 9 – 10.40-13.10m

RC03-3 Box 7 of 9 – 13.10-16.15m

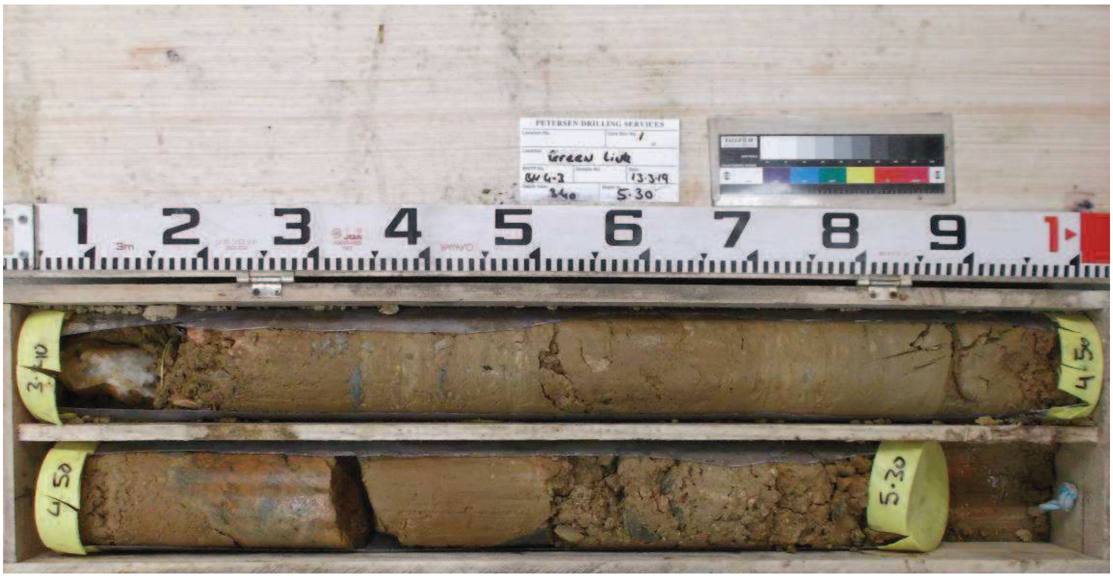


RC03-3 Box 8 of 9 – 16.15-18.95m

RC03-3 Box 9 of 9 – 18.95-20.20m



RC04-3 Box 1 of 4 – 3.40-5.30m

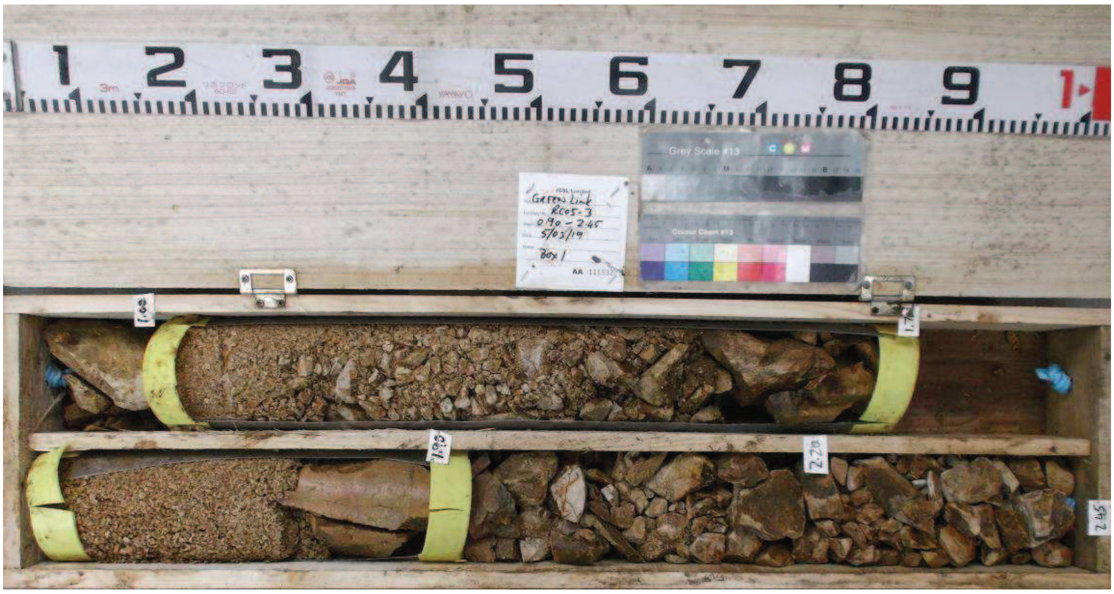


RC04-3 Box 2 of 4 – 5.30-6.90m

RC04-3 Box 3 of 4 – 6.90-8.40m

RC04-3 Box 4 of 4 – 6.90-8.40m

RC05-3 Box 1 of 8 – 0.90-2.45m



RC05-3 Box 2 of 8 – 2.45-3.85m

RC05-3 Box 3 of 8 – 3.85-5.30m

RC05-3 Box 4 of 8 – 5.30-8.00m

RC05-3 Box 5 of 8 – 8.00-10.90m

RC05-3 Box 6 of 8 – 10.90-13.75m

RC05-3 Box 7 of 8 – 13.75-16.55m

RC05-3 Box 8 of 8 – 16.55-18.45m

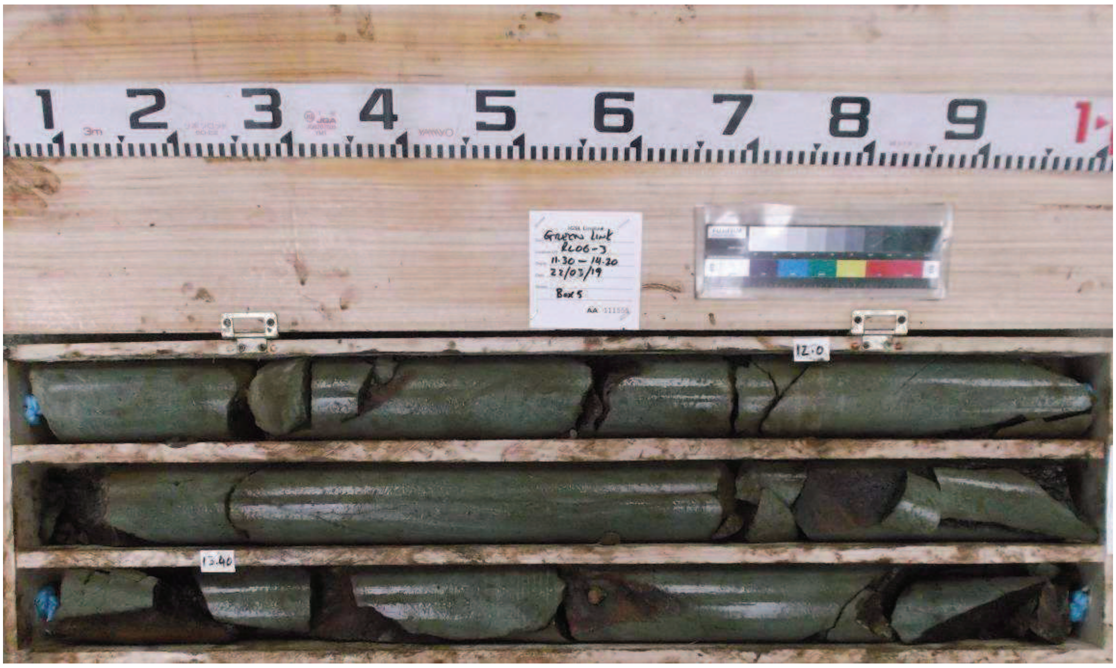
RC06-3 Box 1 of 8 – 2.00-3.75m

RC06-3 Box 2 of 8 – 3.75-5.85m

RC06-3 Box 3 of 8 – 5.85-8.50m

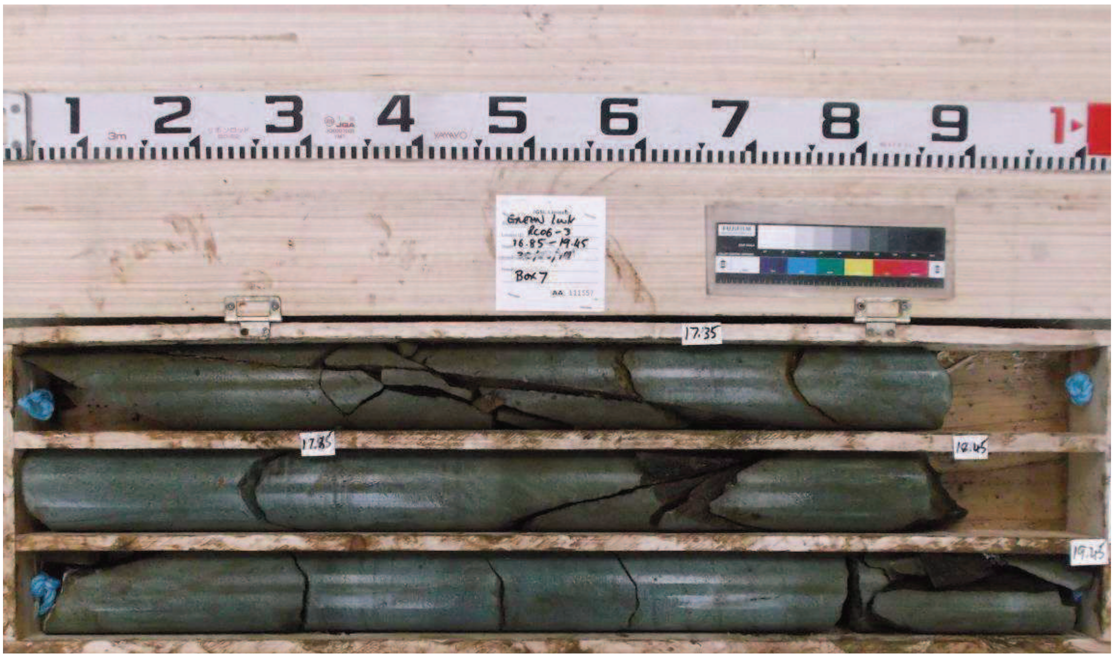
RC06-3 Box 4 of 8 – 8.50-11.30m

RC06-3 Box 5 of 8 – 11.30-14.20m



RC06-3 Box 6 of 8 – 14.20-16.85m

RC06-3 Box 7 of 8 – 16.85-19.45m



RC06-3 Box 8 of 8 – 19.45-20.00m

Appendix 4 - Slit Trench Records

TRIAL PIT RECORD

REPORT NUMBER	21475		
CONTRACT	Greenlink Interconnector Onshore Ireland	**TRIAL PIT NO.**	**TP01-1**
		SHEET	Sheet 1 of 1
LOGGED BY	K. Kinsella	**DATE STARTED**	13/03/2019
CO-ORDINATES	679,827.35 E 603,510.94 N	**DATE COMPLETED**	13/03/2019
GROUND LEVEL (m)	13.13	**EXCAVATION METHOD**	8T excavator
CLIENT	Greenlink Interconnector Limited		
ENGINEER	ARUP		

	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	TOPSOIL: Firm brown slightly sandy clay/silt with rare subrounded gravel		0.60	12.53		AA109865	Env	0.50-0.50	80	
1.0	Firm light brown CLAY/SILT with mottled light grey/grey sandy SILT with occasional gravel		1.30	11.83		AA109866	B	0.80-0.90	120 110	
2.0	Firm light brown CLAY/SILT with mottled light grey/grey sandy slightly gravelly SILT with rare cobbles up to 350mm, gravel is subangular to subrounded and black volcanics		2.20	10.93		AA109867	B	1.80-1.90		
3.0 4.0	End of Trial Pit at 2.20m									

Groundwater Conditions
Dry

Stability
Stable sidewalls

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector Onshore Ireland

TRIAL PIT NO. TP02-1
SHEET Sheet 1 of 1

LOGGED BY K. Kinsella

CO-ORDINATES 679,925.22 E
603,499.98 N

GROUND LEVEL (m) 15.29

DATE STARTED 13/03/2019
DATE COMPLETED 13/03/2019

CLIENT Greenlink Interconnector Limited
ENGINEER ARUP

EXCAVATION METHOD 8T excavator

	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Sample Ref	Type	Depth		
0.0	TOPSOIL: Firm brown slightly sandy clay/silt with rare subrounded gravel		0.30	14.99		AA109868	Env	0.20-0.30		
	Firm light brown CLAY/SILT with mottled light grey/grey sandy SILT with occasional gravel and rare cobbles (up to 120mm)		0.60	14.69		AA109869	B	0.40-0.50	55 82	
	Medium dense grey angular to subangular GRAVEL(very fractured rockhead)		1.05	14.24		AA109870	B	1.00-1.05		
1.0	Rockhead End of Trial Pit at 1.05m									
2.0										
3.0										
4.0										

Groundwater Conditions
Dry

Stability
Stable sidewalls

General Remarks

TRIAL PIT RECORD

REPORT NUMBER	21475
CONTRACT	Greenlink Interconnector Onshore Ireland
TRIAL PIT NO.	**TP01-2**
SHEET	Sheet 1 of 1
LOGGED BY	K. Kinsella
CO-ORDINATES	670,890.76 E 615,618.81 N
GROUND LEVEL (m)	20.87
DATE STARTED	19/03/2019
DATE COMPLETED	19/03/2019
CLIENT	Greenlink Interconnector Limited
ENGINEER	ARUP
EXCAVATION METHOD	8T excavator

	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
						Sample Ref	Type	Depth		
0.0	TOPSOIL: Firm brown slighlty gravelly clay/silt with rootlets		0.30	20.57						
	Firm to locally soft light brown sandy gravelly SILT with rare subangular cobbles (up to 110mm)		1.40	19.47		AA109889	B	1.20-1.30	32 50 52	
1.0										
	Firm light brown sandy very gravelly cobbly SILT, gravel is angular to subrounded of black volcanics		2.20	18.67		AA109890	B	2.00-2.10		
2.0										
	Firm light brown sandy gravelly very cobbly SILT, gravel is angular to subrounded of black volcanics andgular cobbles (up to 350mm)		2.40	18.47						
	End of Trial Pit at 2.40m									
3.0										
4.0										

Groundwater Conditions
Damp down to 0.60m

Stability
Unstable from 2.0 to 2.4mbgl

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 21475

CONTRACT Greenlink Interconnector Onshore Ireland

TRIAL PIT NO. **TP02-2**
SHEET Sheet 1 of 1

LOGGED BY K. Kinsella

CO-ORDINATES 671,104.94 E
615,339.75 N

GROUND LEVEL (m) 10.22

DATE STARTED 13/03/2019
DATE COMPLETED 13/03/2019

CLIENT Greenlink Interconnector Limited
ENGINEER ARUP

EXCAVATION METHOD 8T excavator

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
					Sample Ref	Type	Depth		
TOPSOIL: Firm brown slightly sandy clay/silt with rare gravel and rootlets		0.35	9.87		AA109871	Env	0.30-0.35		
Firm brown/light brown with mottled grey/light grey sandy slightly gravelly SILT		1.40	8.82		AA109872	B	1.00-1.10	82 110	
Firm brown with mottled grey/light grey sandy SILT with occasional gravel and rare cobbles (up to 170mm), rare subrounded boulder at 2.6mbgl(up to 350mm)		2.70	7.52	1 (Seepage)	AA109873	B	2.00-2.10		
End of Trial Pit at 2.70m									

Groundwater Conditions
Seepage at 1.70m

Stability
Stable sidewalls

General Remarks

TRIAL PIT RECORD

REPORT NUMBER	21475		
CONTRACT	Greenlink Interconnector Onshore Ireland	**TRIAL PIT NO.**	**TP01-3**
		SHEET	Sheet 1 of 1
LOGGED BY	K. Kinsella	**DATE STARTED**	19/03/2019
CO-ORDINATES	669,232.27 E 614,791.27 N	**DATE COMPLETED**	19/03/2019
GROUND LEVEL (m)	8.41	**EXCAVATION METHOD**	8T excavator
CLIENT	Greenlink Interconnector Limited		
ENGINEER	ARUP		

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples			Vane Test (KPa)	Hand Penetrometer (KPa)
					Sample Ref	Type	Depth		
TOPSOIL: Firm dark brown slightly sandy clay/silt with rootlets		0.30	8.11						
Soft to firm light brown sandy gravelly cobbly SILT		1.30	7.11					32 44	
Firm light brown sandy gravelly cobbly SILT with occasional boulders (up to 400mm)		2.70	5.71		AA109891	B	1.40-1.50		
Firm light brown sandy gravelly slightly cobbly SILT, subangular to subrounded cobbles (up to 320mm)		3.00	5.41		AA109892	B	2.80-2.90		
End of Trial Pit at 3.00m									

Groundwater Conditions
Dry

Stability
Stable sidewalls

General Remarks

TRIAL PIT RECORD

REPORT NUMBER 21475

CONTRACT	Greenlink Interconnector Onshore Ireland	**TRIAL PIT NO.**	**TP02-3**
		SHEET	Sheet 1 of 1
LOGGED BY	K. Kinsella	**CO-ORDINATES**	669,333.58 E 614,899.96 N
GROUND LEVEL (m)	5.82	**DATE STARTED**	19/03/2019
		DATE COMPLETED	19/03/2019
CLIENT	Greenlink Interconnector Limited	**EXCAVATION METHOD**	8T excavator
ENGINEER	ARUP		

	Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0	TOPSOIL: Firm dark brown slightly sandy clay/silt with rootlets		0.35	5.47						
	Firm brown/reddish brown sandy gravelly SILT		0.75	5.07		AA109893	Env	0.50-0.60	36	
1.0 2.0	Firm light brown sandy gravelly cobbly SILT with occasional boulders (up to 300mm), boulder content increases with depth		2.30	3.52		AA109894	B	2.00-2.10	38	
3.0	Firm light brown sandy gravelly SILT with occasional cobbles, high boulder content at base of pit which are angular (up to 500mm)		3.10	2.72		AA109895	B	3.00-3.10		
4.0	Obstruction - Possible very fractured rockhead End of Trial Pit at 3.10m									

Groundwater Conditions
Dry

Stability
Stable sidewalls

General Remarks

Baginbun Beach

TP01-1

TP01-1

TP01-1

TP01-1

TP01-1

TP02-1

TP02-1

TP02-1

TP02-1

River Campile Crossing

TP01-2

TP01-2

TP01-2

TP01-2

TP02-2

TP02-2

TP02-2

TP02-2

Great Island Convertor Station

TP01-3

TP01-3

TP01-3

TP01-3

TP01-3

TP02-3

TP02-3

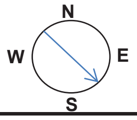
TP02-3

TP02-3

TP02-3

Appendix 4 - Slit Trench Records

Report No.	SLIT TRENCH RECORD	FACING DIRECTION:



			Survey				
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST01
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	679724.111	603412.016	15.88	Date Commenced	12/03/2019
Crew:	IGSL & Flanagans	End of Trench	679718.823	603408.314	15.889	Date Completed	12/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.08	Tar
0.08	0.25	Grey slightly sandy GRAVEL (Clause 804) fill.
0.25	0.5	Firm grey sandy gravelly SILT with occasional subrounded
		cobbles (up to 120mm) and red brick fragments fill.
0.5	1.33	Firm to stiff light brown with light grey/brown/grey mottling sandy
		slightly gravelly SILT, gravel content decreases with depth.

Photograph

Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	6.20
Trench Depth (m)	1.33
Trench Width (m)	0.9
Facing Direction	South-east
Facing Features	Facing martello tower
Groundwater	Dry (seepages from verges)

Location

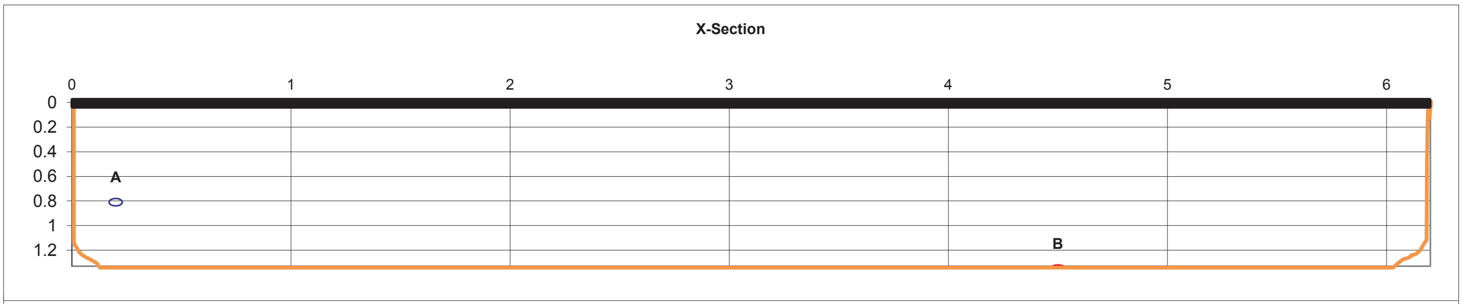
SAMPLES

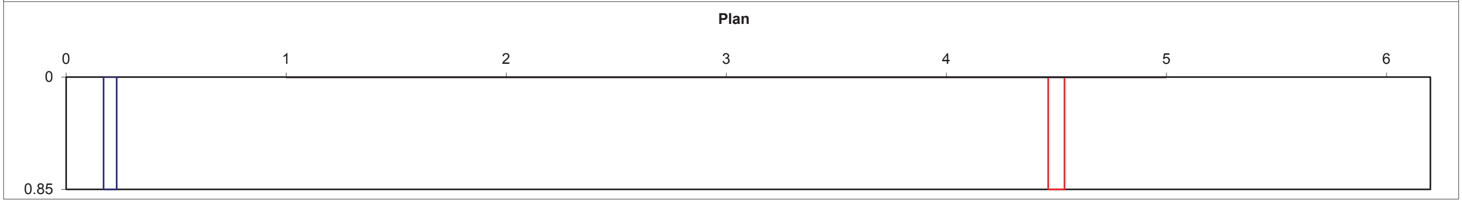
0.40 & 0.50m (ENV)
0.6-0.7m (AA109861)
1.2-1.25m (AA109862)

Excavation Quantities

Surface	Length (m)	Material
Road	0-6.2	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	6.2	

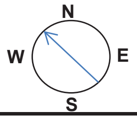
Zero Metres Taken As: Edge of road





	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A	60	Black plastic	Possible water feed	0.2	0.78	90
Service B	75	Blue PVC	Water	4.5	1.32	90
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No.	SLIT TRENCH RECORD	FACING DIRECTION:



Project:	Greenlink Interconnector Onshore		Survey			Slit Trench No.	ST04
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	677184.753	603176.264	17.876	Date Commenced	11/03/2019
Crew:	IGSL & Flanagans	End of Trench	677185.941	603178.924	18.002	Date Completed	11/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.1	Tar
0.1	0.27	Red/reddish purple slightly sandy GRAVEL (Clause 804) fill.
0.27	0.9	Firm to stiff light brown with local light grey/grey mottling sandy slightly gravelly
		SILT with rare subangular to subrounded cobbles and boulders (up to
		260mm).
0.9	1.3	Firm to stiff light brown with local light grey/brown mottling sandy SILT
		with occasional gravel.

Photograph

Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	3.00
Trench Depth (m)	1.30
Trench Width (m)	0.5
Facing Direction	North-west
Facing Features	Facing crossroads
Groundwater	Dry

Location

SAMPLES

0.5-0.6m (AA109855)

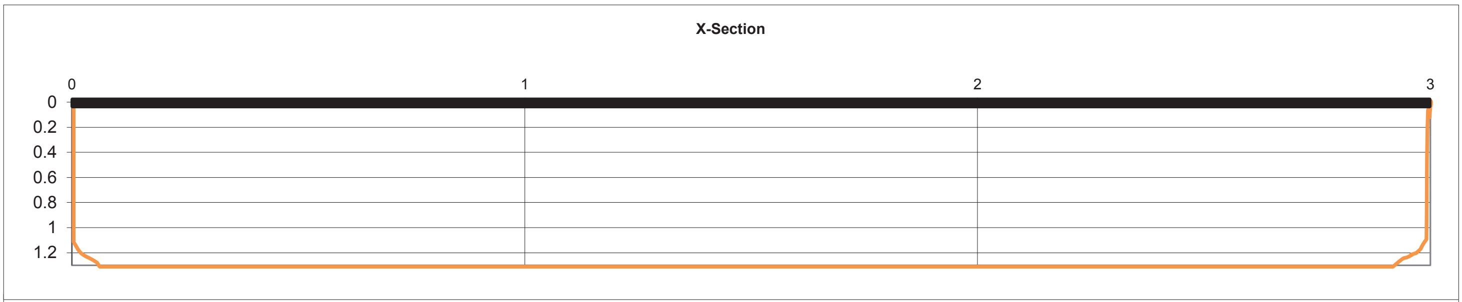
0.6-0.7m (AA109856)

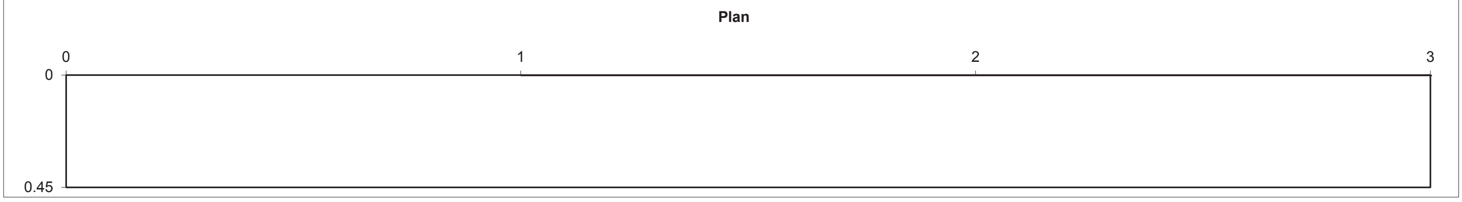
1.2-1.25m (AA109857)

Excavation Quantities

Surface	Length (m)	Material
Road	0-3.0	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.0	

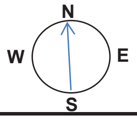
Zero Metres Taken As: Edge of road





	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No Services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No.	SLIT TRENCH RECORD	FACING DIRECTION:



			Survey				
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST07
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	675625.918	604477.54	34.307	Date Commenced	11/03/2019
Crew:	IGSL & Flanagans	End of Trench	675628.677	604478.412	34.421	Date Completed	11/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.09	Tar
0.09	0.16	Grey slightly sandy GRAVEL (Clause 804) fill.
0.16	1.3	Firm to stiff brown with orangish brown mottling sandy slightly gravelly
		SILT with rare subangular to subrounded cobbles and boulders (up to
		240mm).

Photograph

Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	3.10
Trench Depth (m)	1.30
Trench Width (m)	0.5

Location

Excavation Quantities

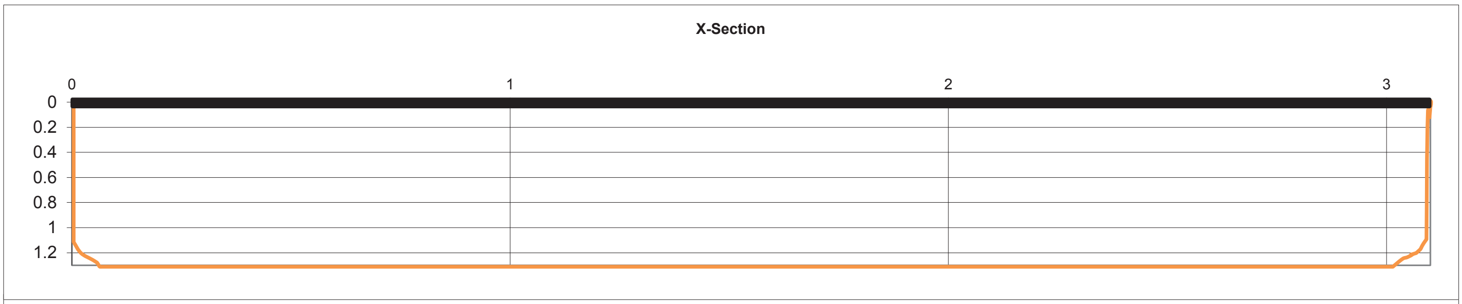
Surface	Length (m)	Material
Road	0-3.1	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.1	

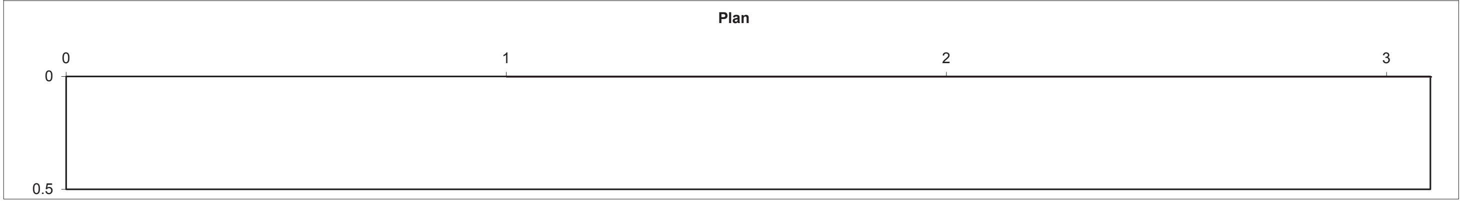
Facing Direction	North
Facing Features	Facing away from Hook lighthouse
Groundwater	Damp

SAMPLES

0.5-0.6m (AA98849)
0.6-0.7m (AA98850)
1.2-1.25m (AA109854)

Zero Metres Taken As: Edge of road





	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No Services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No.	SLIT TRENCH RECORD	FACING DIRECTION: N W E S

Project: Greenlink Interconnector Onshore		Survey			Slit Trench No.	ST08
Engineer: ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client: Greenlink Interconnector Limited	Start of Trench	675297.058	604977.434	48.974	Date Commenced	11/03/2019
Crew: IGSL & Flanagans	End of Trench	675299.226	604979.007	48.905	Date Completed	11/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.1	Tar
0.1	0.28	Grey slightly sandy GRAVEL (Clause 804) fill
0.28	1.3	Firm reddish brown/purplish brown sandy slightly gravelly
		SILT with rare subangular to subrounded cobbles and rare boulders from
		1.10m (up to 220mm).

Photograph

Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	2.90
Trench Depth (m)	1.30
Trench Width (m)	0.5

Location

Excavation Quantities

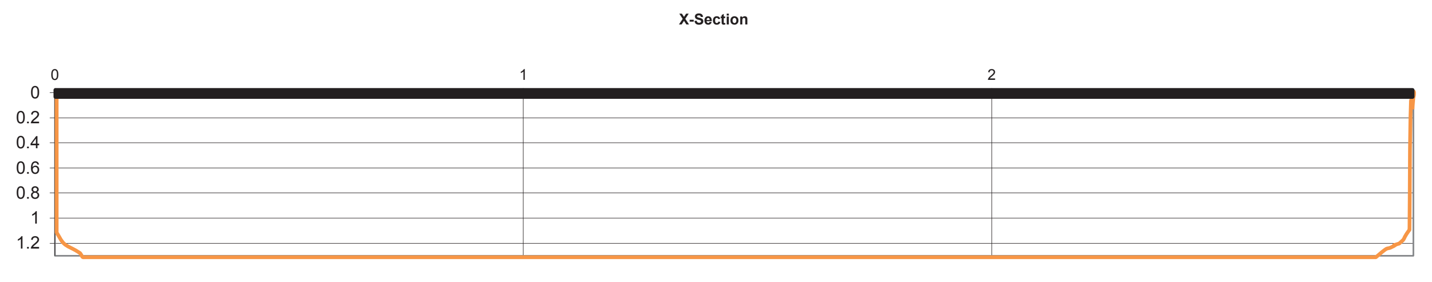
Surface	Length (m)	Material
Road	0-2.9	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	2.9	

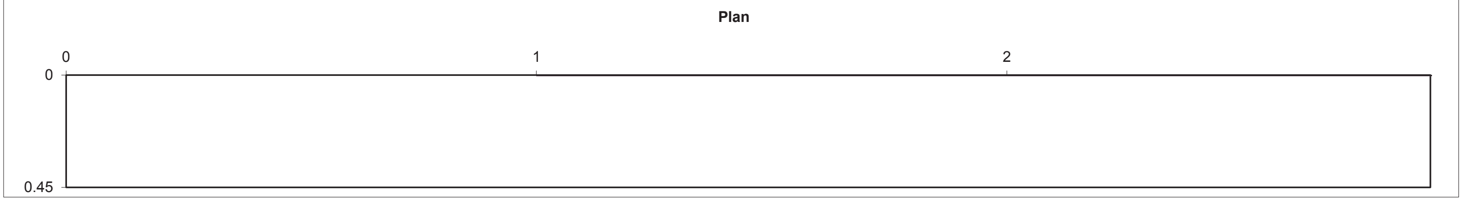
Facing Direction	North
Facing Features	Facing New Ross
Groundwater	Seepage at 1.25m

SAMPLES

0.5-0.6m (AA109858)
0.6-0.7m (AA109859)
1.2-1.25m (AA109860)

Zero Metres Taken As: Edge of road





	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No Services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No. 21475	SLIT TRENCH RECORD	FACING DIRECTION: N W E S

Project:	Greenlink Interconnector Onshore		Survey			Slit Trench No.	ST09
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	675275.813	606032.915	34.713	Date Commenced	13/03/2019
Crew:	IGSL & Flanagans	End of Trench	675278.716	606032.909	34.782	Date Completed	13/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.1	Tar
0.1	0.35	Grey slightly sandy GRAVEL (Clause 804) fill
0.35	1.25	Firm to stiff light brown with light grey/brown mottling sandy gravelly
		SILT with occasional cobbles.

Photograph

Trench Dimensions	
LHS of Trench (m)	0.0
RHS of Trench (m)	3.00
Trench Depth (m)	1.25
Trench Width (m)	0.9

Location

Excavation Quantities

Surface	Length (m)	Material
Road	0-3.0	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.0	

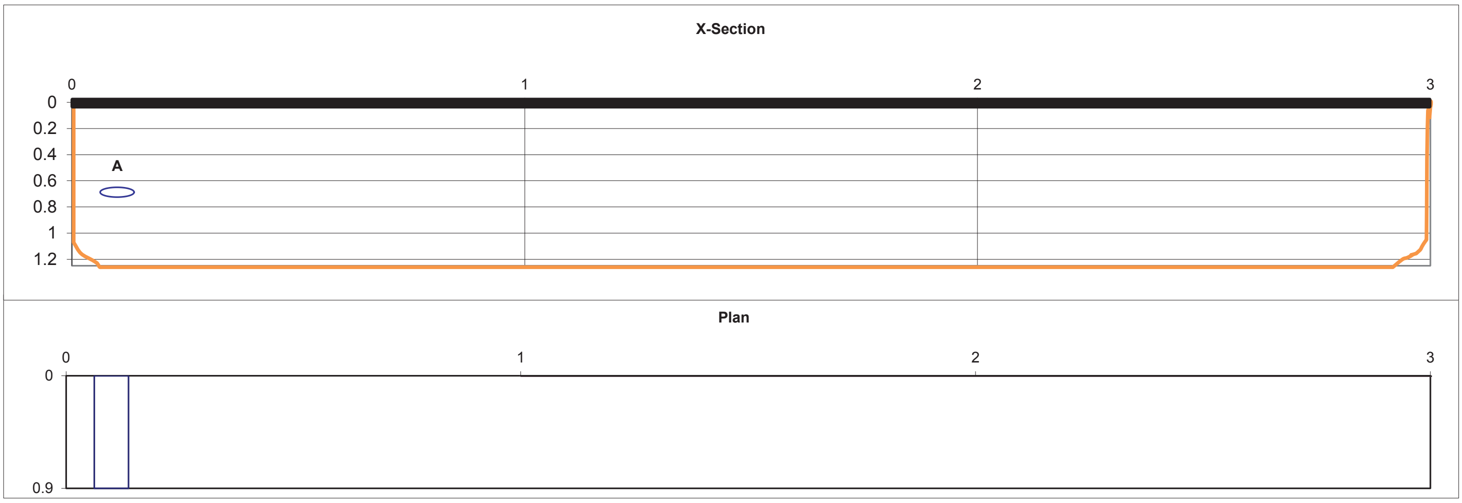
Facing Direction	North
Facing Features	Facing Ramsgrange
Groundwater	Seepage at 1.25m

SAMPLES

0.5m (AA111773)

1.25m (AA111774)(AA111775)

Zero Metres Taken As: Edge of road



	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A	75	Wavin	Water	0.1	0.65	90
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No.	SLIT TRENCH RECORD	FACING DIRECTION: N W E S

			Survey				
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST10
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	675354.684	606732.504	38.894	Date Commenced	12/03/2019
Crew:	IGSL & Flanagans	End of Trench	675357.558	606732.757	39.033	Date Completed	12/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.1	Tar
0.1	0.15	Grey slightly sandy GRAVEL (Clause 804) fill.
0.15	0.25	Second Layer of Tar.
0.25	0.6	Grey slightly sandy GRAVEL (Clause 804) fill.
0.6	1.25	Firm light brown with light grey/brown/grey mottling sandy
		slightly gravelly SILT with rare subrounded cobbles (up to 130mm).

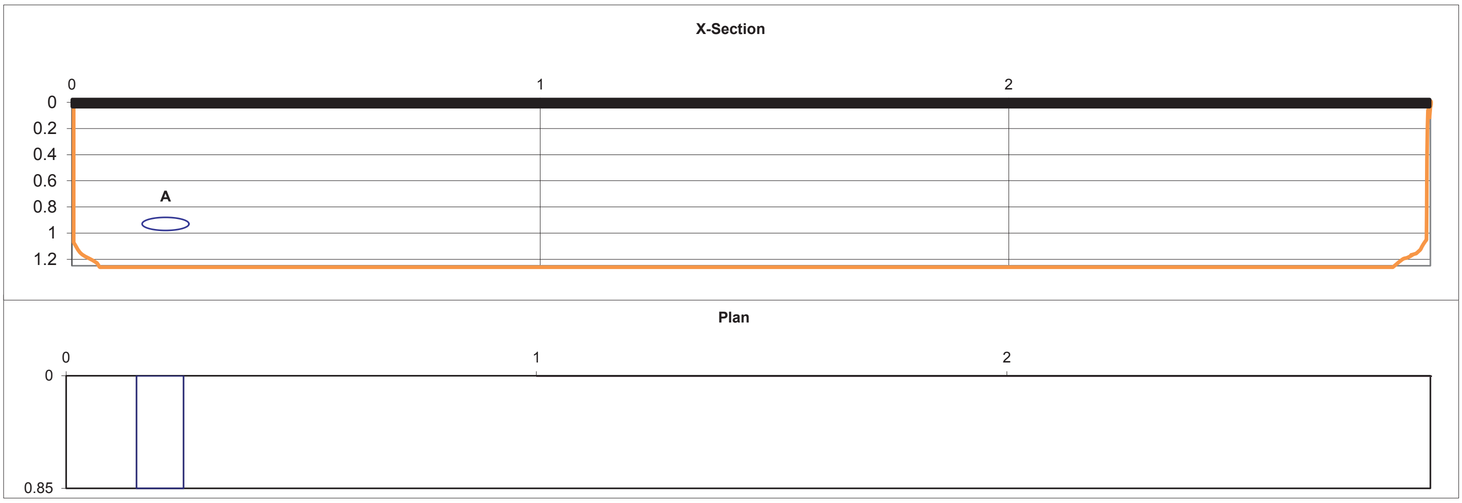
Photograph

Trench Dimensions		Location
LHS of Trench (m)	0.0	
RHS of Trench (m)	2.90	
Trench Depth (m)	1.25	
Trench Width (m)	0.9	
Facing Direction	North	**SAMPLES**
Facing Features	Facing away from junction	0.40 (ENV)
Groundwater	Dry (Seepage from ditch)	1.0-1.1m (AA109864) 1.2-1.25m (AA109863)

Excavation Quantities

Surface	Length (m)	Material
Road	0-2.9	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	2.9	

Zero Metres Taken As: Edge of road



	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A	100	Black Plastic	Watermain	0.2	0.88	90
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

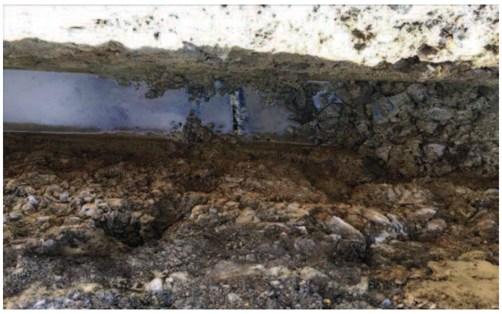
Report No.	SLIT TRENCH RECORD	FACING DIRECTION: W ← E (N, S)

			Survey				
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST16
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	673404.535	610988.998	55.345	Date Commenced	13/03/2019
Crew:	IGSL & Flanagans	End of Trench	673403.109	610991.712	55.586	Date Completed	13/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.12	Tar
0.12	0.65	Grey slightly sandy GRAVEL (Clause 804) fill.
0.65	0.9	Firm grey very sandy gravelly SILT.
0.9	1.25	Firm to stiff brown sandy gravelly SILT.

Photograph



Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	3.30
Trench Depth (m)	1.25
Trench Width (m)	0.9

Location

Excavation Quantities

Surface	Length (m)	Material
Road	0-3.3	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.3	

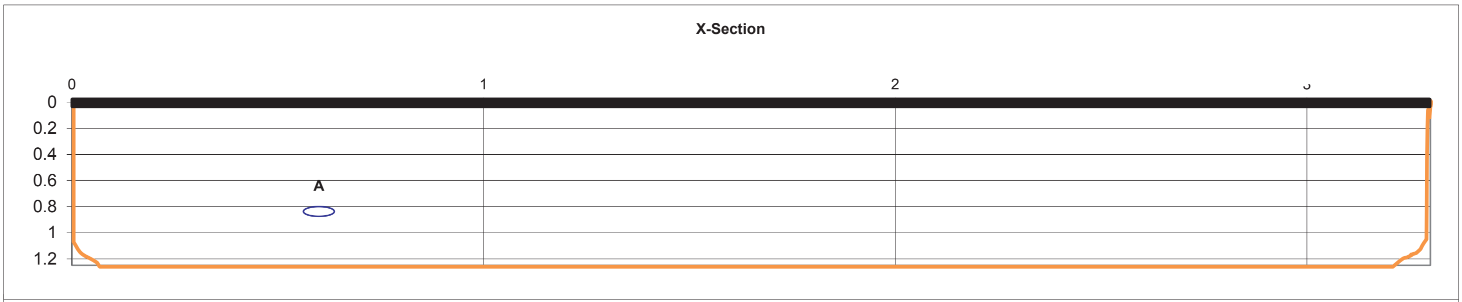
Facing Direction	North
Facing Features	Facing away from Ramsgrange
Groundwater	Seepage at 1.20m

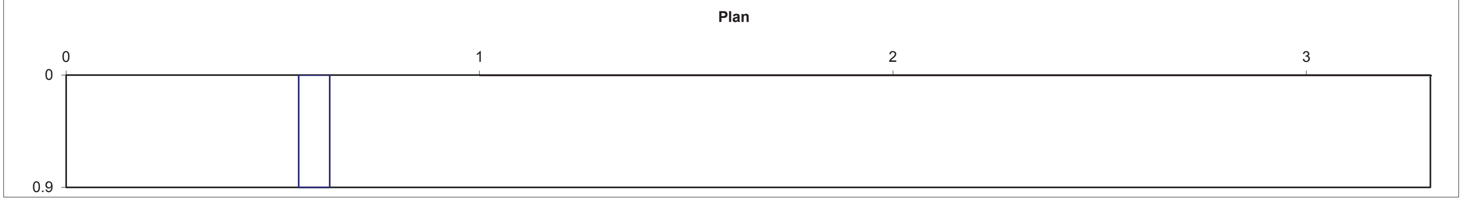
SAMPLES

0.5m (AA111776)

1.25m (AA111777)(AA111778)

Zero Metres Taken As: Edge of road





	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A	75	Asbestos	Watermain	0.6	0.8	90
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

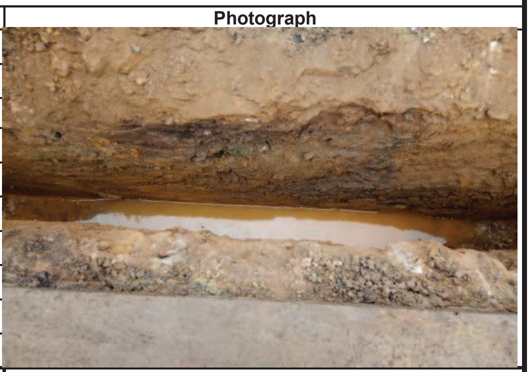
Report No. 21475	SLIT TRENCH RECORD	FACING DIRECTION: N / W E / S

			Survey				
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST17
Engineer:	ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	672921.753	611405.683	67.742	Date Commenced	14/03/2019
Crew:	IGSL & Flanagans	End of Trench	672924.736	611406.234	67.872	Date Completed	14/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.1	Tar
0.1	0.25	Grey/greyish purple slightly sandy GRAVEL (Clause 804) fill
0.25	1.4	Firm to stiff light brown with brown/light grey mottling with oxidation spots,
		sandy SILT with occasional subangular to subrounded gravel and cobbles
		(up to 170mm)

Photograph



Trench Dimensions	
LHS of Trench (m)	0.0
RHS of Trench (m)	3.20
Trench Depth (m)	1.40
Trench Width (m)	0.8

Location

Excavation Quantities

Surface	Length (m)	Material
Road	0-3.2	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.2	

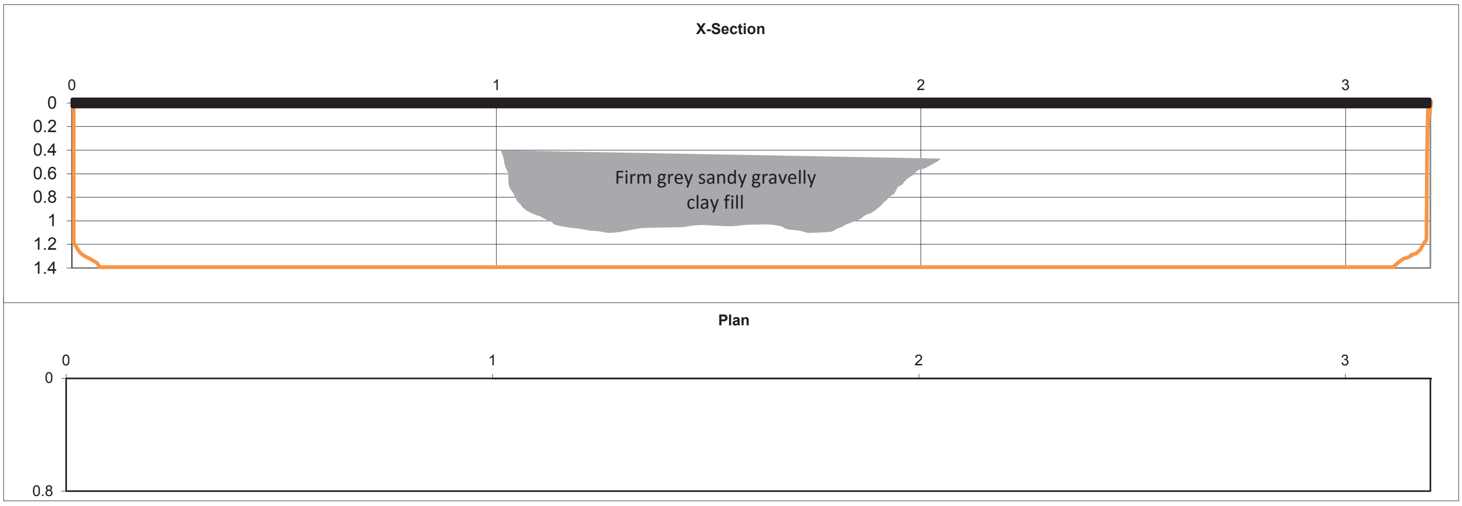
Facing Direction	North
Facing Features	Facing away from Ramsgrange
Groundwater	Seepage at 1.3m, rose 100mm in 15mins

SAMPLES

0.6-0.7m (AA109874)

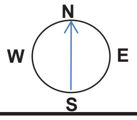
1.3-1.4m (AA109875)

Zero Metres Taken As: Edge of road



	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No. 21475	SLIT TRENCH RECORD	FACING DIRECTION:



Project: Greenlink Interconnector Onshore		Survey			Slit Trench No.	ST18
Engineer: ARUP		Easting (m)	Northing (m)	Elevation (mOD)	Sheet	1 of 1
Client: Greenlink Interconnector Limited	Start of Trench	672545.007	612231.855	68.89	Date Commenced	14/03/2019
Crew: IGSL & Flanagans	End of Trench	672547.257	612234.018	68.966	Date Completed	14/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.1	Tar
0.1	0.2	Grey slightly sandy GRAVEL (Clause 804) fill
0.2	0.25	Firm dark grey gravelly CLAY
0.25	1.1	Firm light brown sandy slightly gravelly SILT, gravel is subangular
		to subrounded.
1.1	1.3	Firm light brown sandy slightly gravelly SILT with occasional subrounded
		cobbles (up to 170mm)

Photograph

Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	3.10
Trench Depth (m)	1.30
Trench Width (m)	0.8

Location

Excavation Quantities

Surface	Length (m)	Material
Road	0-3.1	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.1	

Facing Direction	North
Facing Features	Facing away from Ramsgrange
Groundwater	Dry

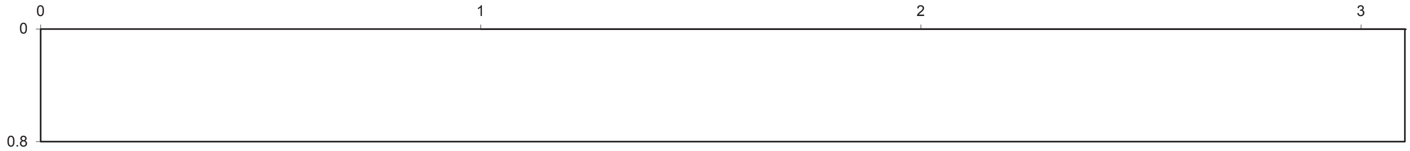
SAMPLES

0.5-0.6m (AA109876)
1.0-1.1m (AA109877)
1.2-1.3m (AA109878)

Zero Metres Taken As: Edge of road

X-Section

Plan



	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

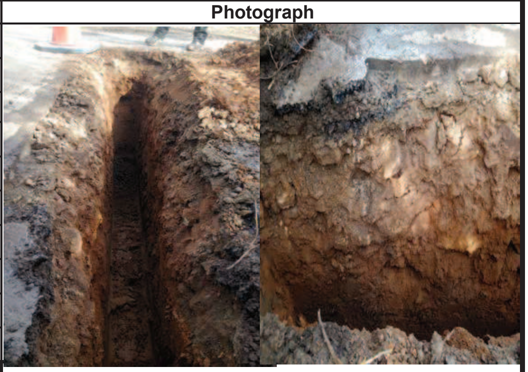
Report No. 21475	SLIT TRENCH RECORD	FACING DIRECTION: N W E S	

			Survey				
			Easting (m)	Northing (m)	Elevation (mOD)		
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST19
Engineer:	ARUP					Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	671918.038	613281.627	38.161	Date Commenced	14/03/2019
Crew:	IGSL & Flanagans	End of Trench	671920.993	613282.862	38.347	Date Completed	14/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.12	Tar
0.12	0.15	Grey slightly sandy GRAVEL (Clause 804) fill
0.15	0.28	Firm brown/greyish brown silty sandy gravelly COBBLES fill, cobbles
		are angular to subangular (up to 150mm)
0.28	1.1	Firm brown/light brown slightly sandy CLAY with occasional subangular to
		subrounded gravel, gravel content decreases with depth
1.1	1.3	Firm greyish brown slightly sandy CLAY

Photograph



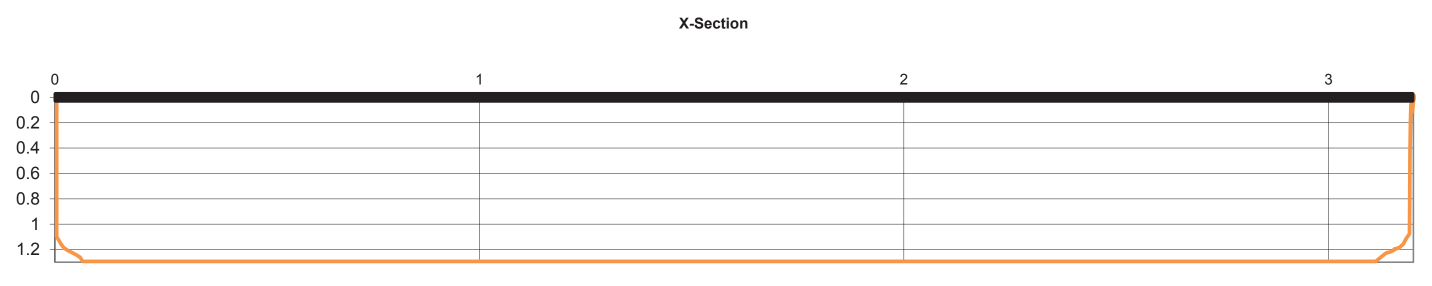
Trench Dimensions		Location
LHS of Trench (m)	0.0	
RHS of Trench (m)	3.20	
Trench Depth (m)	1.30	
Trench Width (m)	0.8	

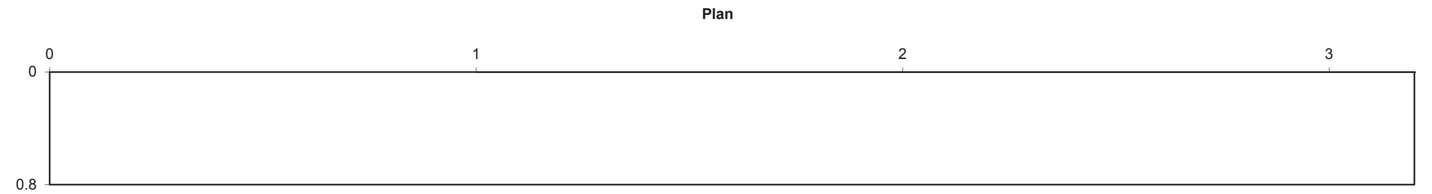
Excavation Quantities

Surface	Length (m)	Material
Road	0-3.2	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.2	

		SAMPLES
Facing Direction	North	
Facing Features	Facing fork in road	0.3-0.4m (AA109879)
Groundwater	Dry	0.9-1.0m (AA109880) 1.2-1.3m (AA109881)

Zero Metres Taken As: Edge of road



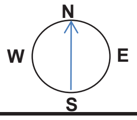


	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Report No. 21475

SLIT TRENCH RECORD

FACING DIRECTION:



			Survey				
			Easting (m)	Northing (m)	Elevation (mOD)		
Project:	Greenlink Interconnector Onshore					Slit Trench No.	ST20
Engineer:	ARUP					Sheet	1 of 1
Client:	Greenlink Interconnector Limited	Start of Trench	671508.888	613976.347	16.006	Date Commenced	14/03/2019
Crew:	IGSL & Flanagans	End of Trench	671511.997	613976.689	16.01	Date Completed	14/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.3	Tar
0.3	0.4	Grey slightly sandy GRAVEL (Clause 804) fill
0.4	1.1	Firm to stiff light brown sandy gravelly SILT with occasional subangular
		to subrounded cobbles (up to 150mm)
1.1	1.3	Firm to stiff light brown sandy slightly gravelly SILT with rare subangular
		to subrounded cobbles (up to 150mm)

Photograph

Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	3.00
Trench Depth (m)	1.30
Trench Width (m)	0.8
Facing Direction	North
Facing Features	Facing into crossroads
Groundwater	Dry

Location

SAMPLES

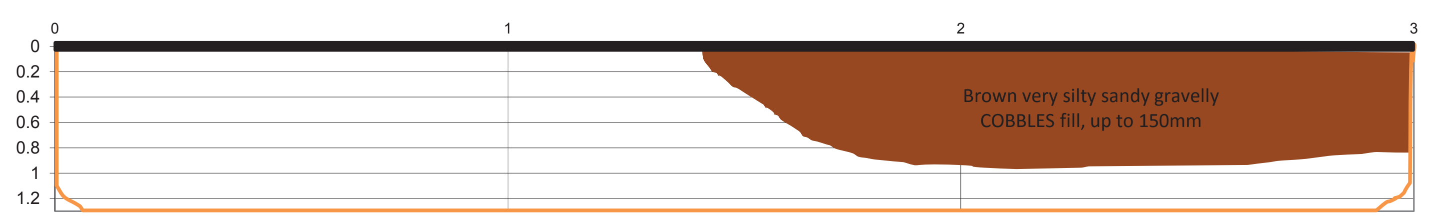
0.4-0.5m (AA109882)
0.9-1.0m (AA109883)
1.2-1.3m (AA109884)

Excavation Quantities

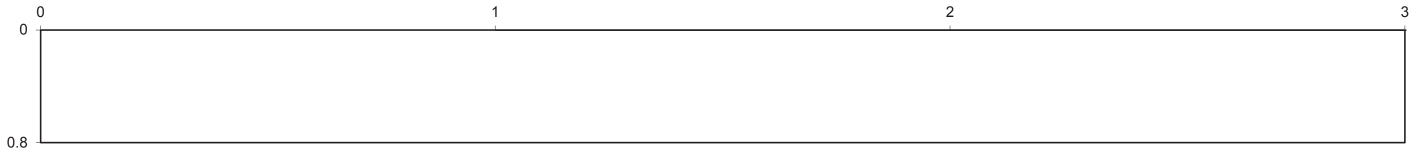
Surface	Length (m)	Material
Road	0-3.0	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	3.0	

Zero Metres Taken As: Edge of road

X-Section



Plan



	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

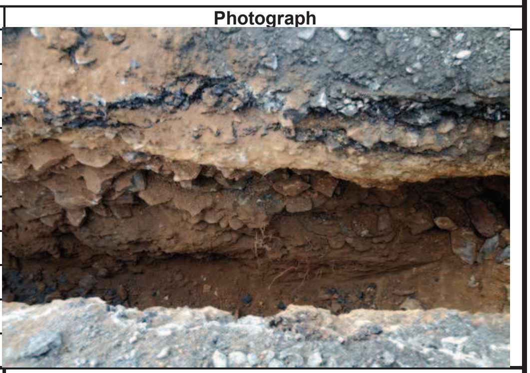
Report No. 21475	SLIT TRENCH RECORD	FACING DIRECTION: N W E S

			Survey				
Project: Greenlink Interconnector Onshore						Slit Trench No.	ST21
Engineer: ARUP		Easting (m)	Northing (m)	Elevation (mOD)		Sheet	1 of 1
Client: Greenlink Interconnector Limited	Start of Trench	671127.312	614825.951	3.455		Date Commenced	15/03/2019
Crew: IGSL & Flanagans	End of Trench	671129.513	614824.62	3.373		Date Completed	15/03/2019

Ground Conditions

From (m)	To (m)	Soil Description
0	0.35	Tar
0.35	0.95	Medium dense light brown very silty sandy gravelly COBBLES fill, cobbles
		are angular to subrounded(up to 180mm), rare roots present
0.95	1.35	Firm to stiff light brown sandy gravelly very cobbly SILT, cobbles are
		subangular to subrounded (up to 150mm)

Photograph



Trench Dimensions

LHS of Trench (m)	0.0
RHS of Trench (m)	2.60
Trench Depth (m)	1.35
Trench Width (m)	0.8
Facing Direction	North
Facing Features	Facing abbey ruin
Groundwater	Dry

Location

SAMPLES

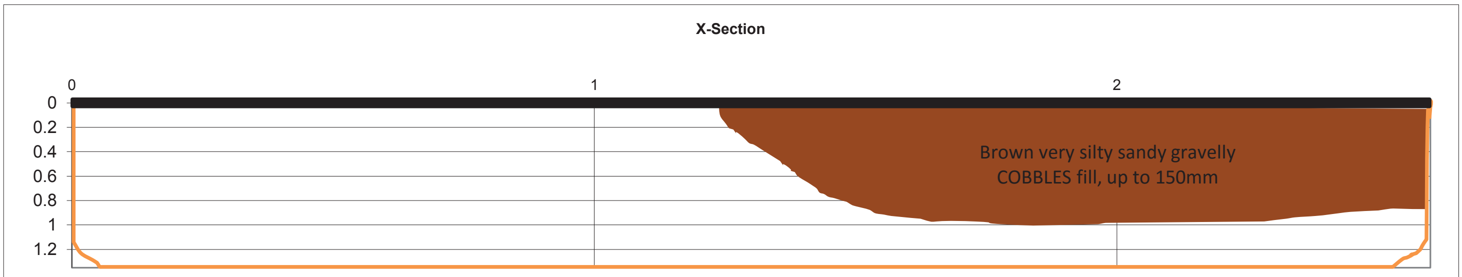
0.5-0.6m (AA109885)
1.1-1.2m (AA109886)
1.2-1.3m (AA109887)

Excavation Quantities

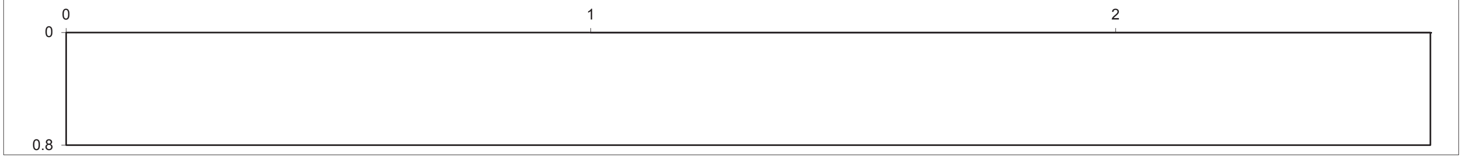
Surface	Length (m)	Material
Road	0-2.6	Tar
Path (LHS)		
Path (RHS)		
Grass Verge (LHS)		
Grass Verge (RHS)		
Other		
Total Length	2.6	

Zero Metres Taken As: Edge of road

X-Section



Plan



	Diameter (mm)	Material	Description	Distance (m)	Depth to crown (m)	Angle (deg.)
Service A			No services			
Service B						
Service C						
Service D						
Service E						
Service F						
Service G						
Service H						
Service I						
Service J						
Service K						
Service L						
Service M						

Appendix 5 - Foundation Inspection Pit Record

FOUNDATION INSPECTION PIT RECORD

REPORT NUMBER 21475

TRIAL PIT NO.	**Foundation Pit**
SHEET	Sheet 1 of 1

CONTRACT Greenlink Interconnector Onshore Ireland

LOCATION Ramsgrange, Co. Wexford

LOGGED BY K. Kinsella

Date of survey 15/03/2019

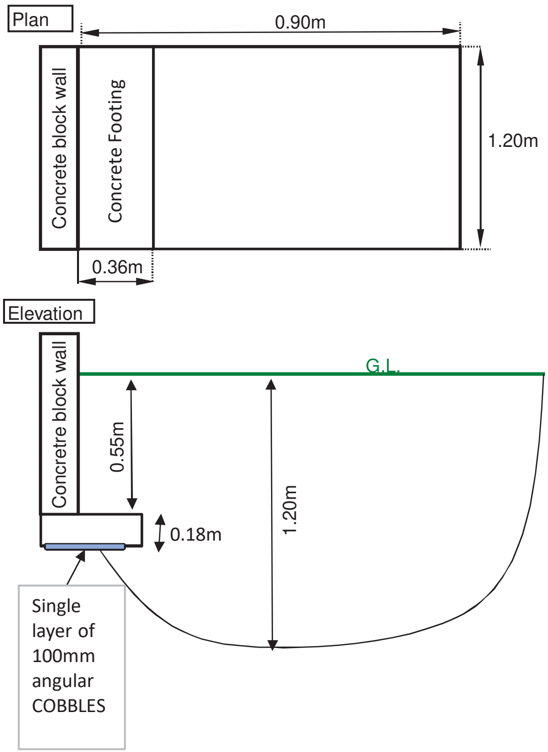
Summary of ground conditions

from	to	Description	Ground water
0.00	0.20	Soft dark brown TOPSOIL	Dry
0.20	0.65	Firm brown/light brown sandy gravelly very cobbly SILT, cobbles up to 140mm	
0.65	1.20	Firm brown/light brown sandy gravelly SILT with rare cobbles up to 100mm	

NOTE: Sample has been taken at 1.0-1.1m (Ref . No AA109888)

LOCATION **Railway Bridge FIP1**

DETAIL



Appendix 6 - Groundwater Monitoring

Groundwater Monitoring

Site Location	**Greenlink Interconnector Onshore Ireland**
Project No.	**21475**
Client	**ARUP**

	Date of Reading					
	29/03/2019	**12/04/2019**	**18/04/2019**	**26/04/2019**		
BH01-1	1.1	1.25	0.63	0.85		
BH04-1	6.1	6.9	5.2	6.15		
BH04-2	9.6	9.4	8.9	9		
BH01-2	9.8	10.9	10.1	10.1		
BH01-3	13.7	15.6	14	13.5		
BH06A-3	0.6	0.85	0.1	0.3		
TIME	2-3pm	2-3pm	11-12pm	10-11am		
COMMENTS	Dry weather for the previous 7 days	Dry weather for the previous 7 days	Wet days earlier within the week	Wet days later within the week		

Appendix 7 - Geotechnical Soil Laboratory Test Records

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

Report No. **R98508** Contract No. 21475 Contract Name: Greenlink Interconnector

Customer Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Samples Received: 07/02/19 Date Tested: 11/02/19

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH01-1	AA110643	1.0	A19/0422	B	14	38	20	18	51	WS	4.4	C I	Brown slightly sandy, slightly gravelly, CLAY
BH02-1	AA110641	2.0	A19/0423	B	10								Brown clayey/silty, very sandy, GRAVEL
BH04-1	AA110637	3.0	A19/0424	B	16	34	19	15	38	WS	4.4	C L	Light brown slightly sandy, gravelly, CLAY
BH01-2	AA115621	3.0	A19/0425	B	11	48	25	23	47	WS	4.4	C I	Brown slightly sandy, gravelly, CLAY with many cobbles
BH03-2	AA115616	2.0	A19/0426	B	15	40	NP	NP	26	WS	4.4		Orange/brown silty, sandy, GRAVEL
BH04-2	AA115604	0.8	A19/0427	B	18	43	22	21	49	WS	4.4	C I	Brown slightly sandy, slightly gravelly, CLAY
BH05-2	AA15608	2.0	A19/0428	B	15	33	19	14	66	WS		C L	Mottled orange/brown slightly sandy, slightly gravelly, CLAY
BH05-2	AA115611	5.0	A19/0429	B	13	32	15	17	62	WS	4.4	C L	Brown slightly sandy, slightly gravelly, CLAY
BH06-2	AA110650	2.0	A19/0430	B	13	34	21	13	62	WS	4.4	C L	Brown slightly sandy, slightly gravelly, CLAY with many cobbles
BH01-3	AA110610	1.0	A19/0431	B	6.3								Brown clayey/silty, sandy, GRAVEL
BH02-3	AA110615	1.0	A19/0432	B	8.5								Orange/brown gravelly sandy SILT/CLAY
BH03-3	AA115626	2.0	A19/0433	B	10	32	NP	NP	58	WS	4.4		Brown slightly sandy, slightly gravelly, SILT
BH04-3	AA110602	1.0	A19/0434	B	11	34	18	16	57	WS	4.4	C L	Orange/brown slightly sandy, gravelly, CLAY
BH04-3	AA110604	2.0	A19/0435	B	10	36	19	17	62	WS	4.4	C I	Orange/brown sandy, slightly gravelly, CLAY
BH05-3	AA110654	1.5	A19/0436	B	7.1	47	NP	NP	9.8	WS	4.4		Orange/brown slightly silty, sandy, GRAVEL with many cobbles

Notes: Preparation: WS - Wet sieved
AR - As received
NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method
4.4 Cone Penetrometer one point method

Sample Type: B - Bulk Disturbed
U - Undisturbed

Remarks:

NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory	Persons authorized to approve reports H Byrne (Laboratory Manager)	Approved by	Date	Page
		H Byrne	28/2/19	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

ISO 17025
INAB
ACCREDITED
TESTING
DETAILED IN SCOPE REG NO.133T

Report No. **R98509** Contract No. 21475 Contract Name: Greenlink Interconnector

Customer Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Samples Received: 07/02/19 Date Tested: 11/02/19

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
BH06-3	AA110617	1.0	A19/0437	B	33								Mottled grey/brown slightly gravelly sandy SILT/CLAY
BH06-3	AA110622	4.0	A19/0438	B	47	39	26	13	96	WS	4.4	M I	Grey sandy slightly gravelly SILT
BH06-3	AA110629	9.0	A19/0440	B	46								Mottled grey/brown slightly gravelly sandy SILT/CLAY
BH06-3	AA110632	12.0	A19/0442	B	28	35	18	17	58	WS	4.4	C L	Grey/brown slightly gravelly sandy CLAY

Notes: Preparation: WS - Wet sieved
AR - As received
NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method
4.4 Cone Penetrometer one point method

Sample Type: B - Bulk Disturbed
U - Undisturbed

Remarks:

NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory	Persons authorized to approve reports H Byrne (Laboratory Manager)	Approved by H Byrne	Date 28/2/19	Page 1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

Report No. **R100311** Contract No. 21475 Contract Name: Greenlink Interconnector

Customer Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Samples Received: 26/03/19 Date Tested: 2/4/19

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
TP01-1	AA109866	0.8	A19/1411	B	17	47	25	22	57	WS	4.4	C I	Orange/brown slightly sandy, gravelly, CLAY
TP01-1	AA109867	1.8	A19/1412	B	14								Mottled brown sandy gravelly SILT/CLAY
TP02-1	AA109869	0.4	A19/1413	B	12	45	23	22	34	WS	4.4	C I	Brown clayey, sandy, GRAVEL with some cobbles
TP02-1	AA109870	1.0	A19/1414	B	6.7								Grey/brown slightly clayey/silty, sandy, GRAVEL with occasional cobbles
TP01-2	AA109889	1.2	A19/1415	B	16	44	23	21	45	WS	4.4	C I	Mottled brown slightly sandy, gravelly, CLAY
TP01-2	AA109890	2.0	A19/1416	B	16								Orange/brown sandy gravelly SILT/CLAY
TP02-2	AA109872	1.0	A19/1417	B	19	36	20	16	61	WS	4.4	C I	Mottled grey/brown slightly sandy, slightly gravelly, CLAY
TP02-2	AA109873	2.0	A19/1418	B	16								Brown sandy gravelly SILT/CLAY
TP01-3	AA109891	1.4	A19/1419	B	13								Orange/brown sandy gravelly SILT/CLAY
TP01-3	AA109892	2.8	A19/1420	B	12	32	17	15	51	WS	4.4	C L	Orange/brown slightly sandy, gravelly, CLAY
TP02-3	AA109894	2.0	A19/1421	B	16								Mottled brown sandy gravelly SILT/CLAY
TP02-3	AA109895	3.0	A19/1422	B	15	34	NP	NP	24	WS	4.4		Orange/brown slightly sandy, gravelly, SILT

Notes: Preparation:
WS - Wet sieved
AR - As received
NP - Non plastic

Liquid Limit Clause:
4.3 Cone Penetrometer definitive method
4.4 Cone Penetrometer one point method

Sample Type:
B - Bulk Disturbed
U - Undisturbed

Remarks:

NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory	Persons authorized to approve reports	Approved by	Date	Page
	H Byrne (Laboratory Manager)	H Byrne	15/4/19	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

Report No. **R100489** Contract No. 21475 Contract Name: Greenlink Interconnector

Customer Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Samples Received: 26/03/19 Date Tested: 8/4/19

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
ST01	AA109861	0.6	A19/1443	B	21	49	25	24	77	WS	4.4	C I	Mottled orange/brown slightly sandy, slightly gravelly, CLAY
ST04	AA109855	0.5	A19/1444	B	15	45	23	22	59	WS	4.4	C I	Mottled brown slightly sandy, slightly gravelly, CLAY
ST07	AA98850	0.6	A19/1445	B	11	44	22	22	61	WS	4.4	C I	Brown slightly sandy, gravelly, CLAY
ST08	AA19858	0.5	A19/1446	B	14	48	26	22	34	WS	4.4	C I	Redish/brown slightly sandy, gravelly, CLAY
ST09	AA111773	0.5	A19/1447	B	20								Mottled Brown sandy gravelly SILT/CLAY
ST09	AA111774	1.3	A19/1448	B	18	55	25	30	69	WS	4.4	C H	Mottled grey/brown slightly sandy, slightly gravelly, CLAY
ST10	AA109864	1.0	A19/1449	B	11	49	25	24	39	WS	4.4	C I	Mottled grey/brown slightly sandy, gravelly, CLAY
ST16	AA111776	0.5	A19/1450	B	17								Brown sandy gravelly SILT/CLAY
ST16	AA111777	1.3	A19/1451	B	15								Brown sandy gravelly SILT/CLAY
ST17	AA109874	0.6	A19/1452	B	16								Mottled Brown sandy gravelly SILT/CLAY
ST18	AA109876	0.5	A19/1453	B	15	42	NP	NP	45	WS	4.4		Mottled orange/brown slightly sandy, gravelly, SILT with some cobbles
ST18	AA109877	1.0	A19/1454	B	17								Orange brown sandy gravelly SILT/CLAY
ST19	AA109879	0.3	A19/1455	B	19								Orange brown sandy gravelly SILT/CLAY
ST19	AA109880	0.9	A19/1456	B	23	26	NP	NP	71	WS	4.4		Mottled orange/brown slightly sandy, slightly gravelly, SILT
ST20	AA109882	0.4	A19/1457	B	8.8								Brown sandy gravelly SILT/CLAY

Notes: Preparation: WS - Wet sieved
AR - As received
NP - Non plastic
Liquid Limit Clause: 4.3 Cone Penetrometer definitive method
4.4 Cone Penetrometer one point method

Sample Type: B - Bulk Disturbed
U - Undisturbed

Remarks:

NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory	Persons authorized to approve reports	Approved by	Date	Page
	H Byrne (Laboratory Manager)		24/4/19	1 of 1

IGSL Ltd
Materials Laboratory
Unit J5, M7 Business Park
Newhall, Naas
Co. Kildare
045 846176

Test Report

Determination of Moisture Content, Liquid & Plastic Limits

Tested in accordance with BS1377:Part 2:1990, clauses 3.2*, 4.3, 4.4 & 5.3

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

Report No. **R100493** Contract No. 21475 Contract Name: Greenlink Interconnector

Customer Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Samples Received: 26/03/19 Date Tested: 8/4/19

BH/TP	Sample No.	Depth (m)	Lab. Ref	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425µm	Preparation	Liquid Limit Clause	Classification (BS5930)	Description
ST20	AA109883	0.9	A19/1458	B	11								Brown sandy gravelly SILT/CLAY
ST21	AA109885	0.5	A19/1459	0	5.9								Orange brown slightly silty/clayey sandy GRAVEL
ST21	AA109885	1.1	A19/1460	0	11								Brown sandy gravelly SILT/CLAY

Notes:

Preparation:
WS - Wet sieved
AR - As received
NP - Non plastic

Liquid Limit Clause:
4.3 Cone Penetrometer definitive method
4.4 Cone Penetrometer one point method

Sample Type:
B - Bulk Disturbed
U - Undisturbed

Remarks:

NOTE: *Clause 3.2 of BS1377 is a "withdrawn" standard due to publication of ISO17892-1:2014
Opinions and interpretations are outside the scope of accreditation.
The results relate to the specimens tested. Any remaining material will be retained for one month.

IGSL Ltd Materials Laboratory

Persons authorized to approve reports

H Byrne (Laboratory Manager)

Approved by	Date	Page
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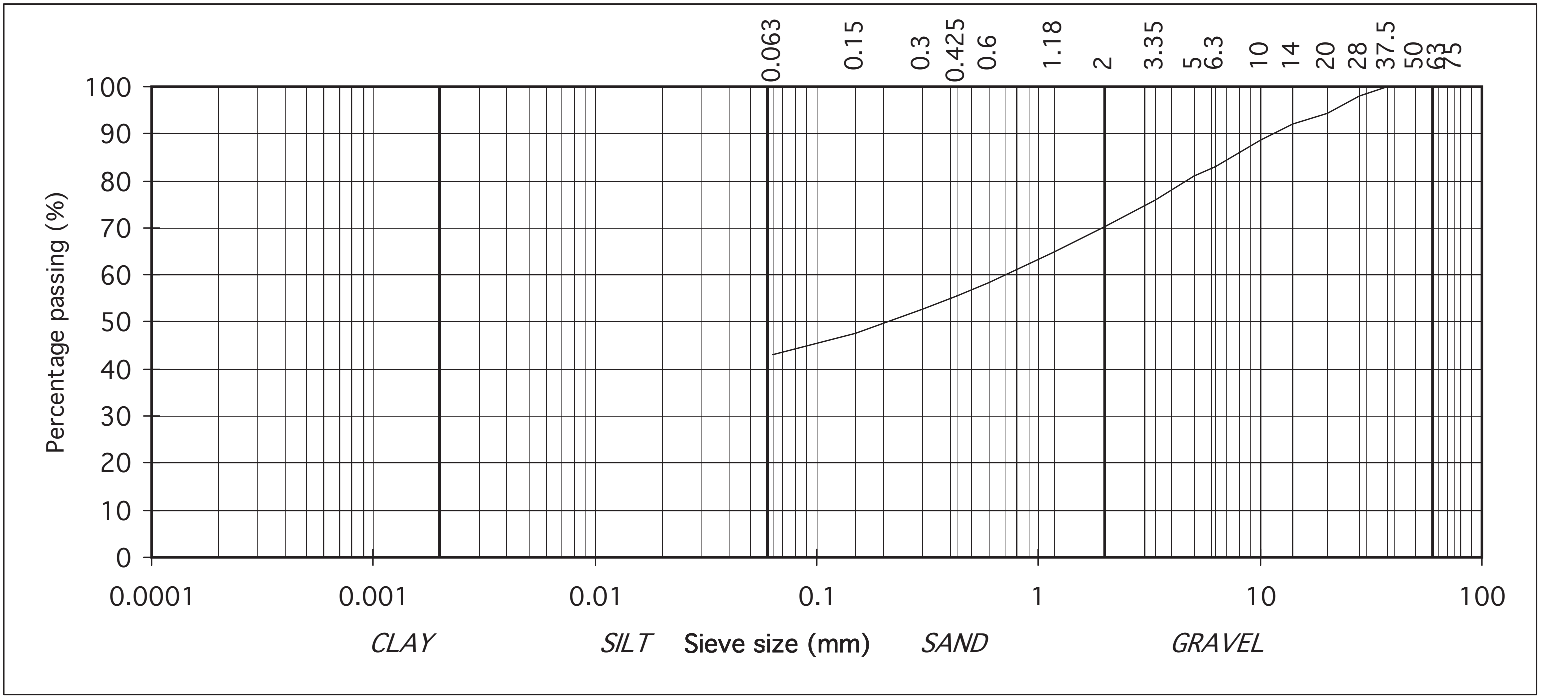
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	98	
20	94	
14	92	
10	89	
6.3	83	
5	81	
3.35	76	
2	70	
1.18	65	SAND
0.6	58	
0.425	56	
0.3	53	
0.15	48	
0.063	43	SILT/CLAY

Contract No: 21475 Report No. R98573
Contract: Greenlink Interconnector
BH/TP : BH01-1
Sample No. AA110643 Lab. Sample No. A19/0422
Sample Type: B
Depth (m) 1.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Brown slightly sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



IGSL Ltd Materials Laboratory

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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

ISO 17025
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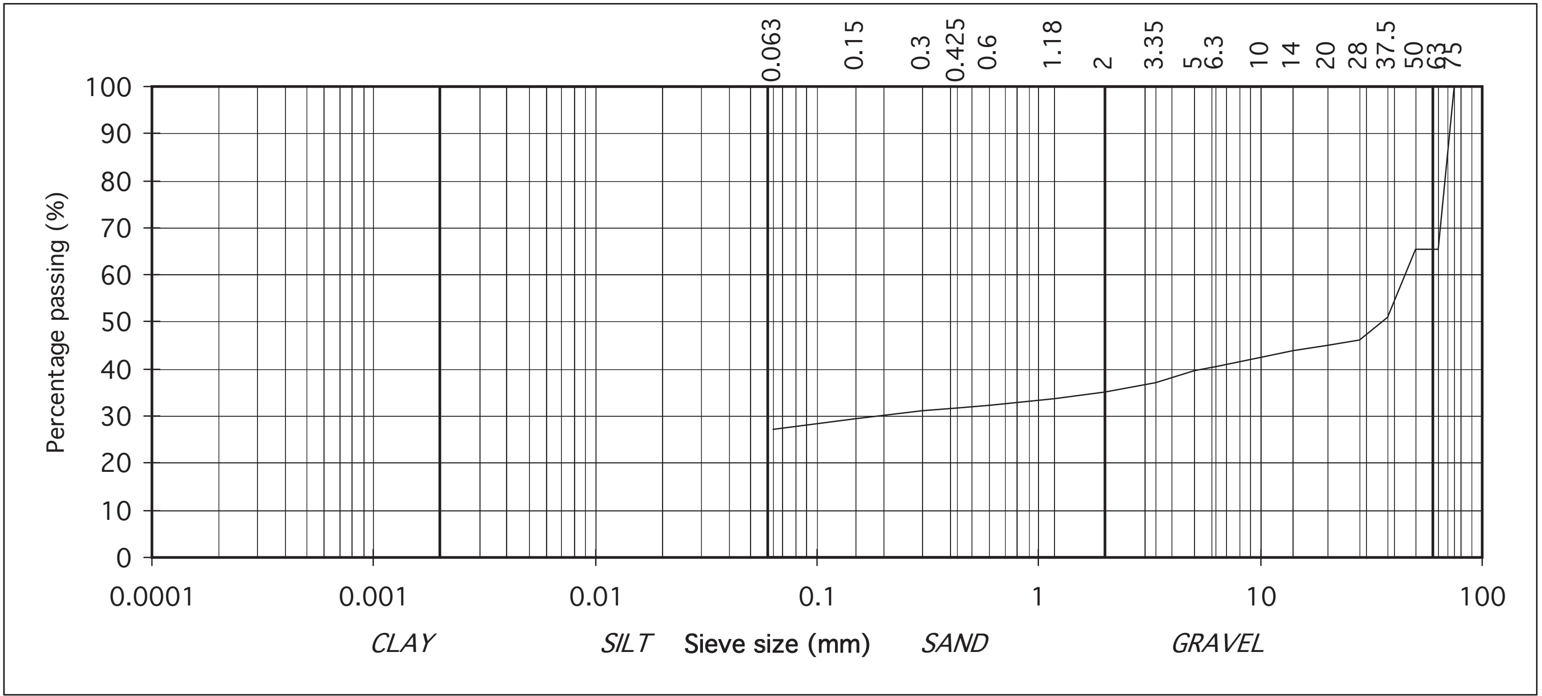
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	65	
50	65	GRAVEL
37.5	51	
28	46	
20	45	
14	44	
10	42	
6.3	40	
5	40	
3.35	37	
2	35	
1.18	34	SAND
0.6	32	
0.425	32	
0.3	31	
0.15	30	
0.063	27	SILT/CLAY

Contract No:	21475	Report No.	R99017
Contract:	Greenlink Interconnector		
BH/TP :	BH01-2		
Sample No.	AA115621	Lab. Sample No.	A19/0425
Sample Type:	B		
Depth (m)	3.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	07/02/2019	Date Testing started	22/02/2019
Description:	Brown slightly sandy, gravelly, CLAY with many cobbles		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		Sample size did not meet the requirements of BS1377



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Approved by:	Date:	Page no:
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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

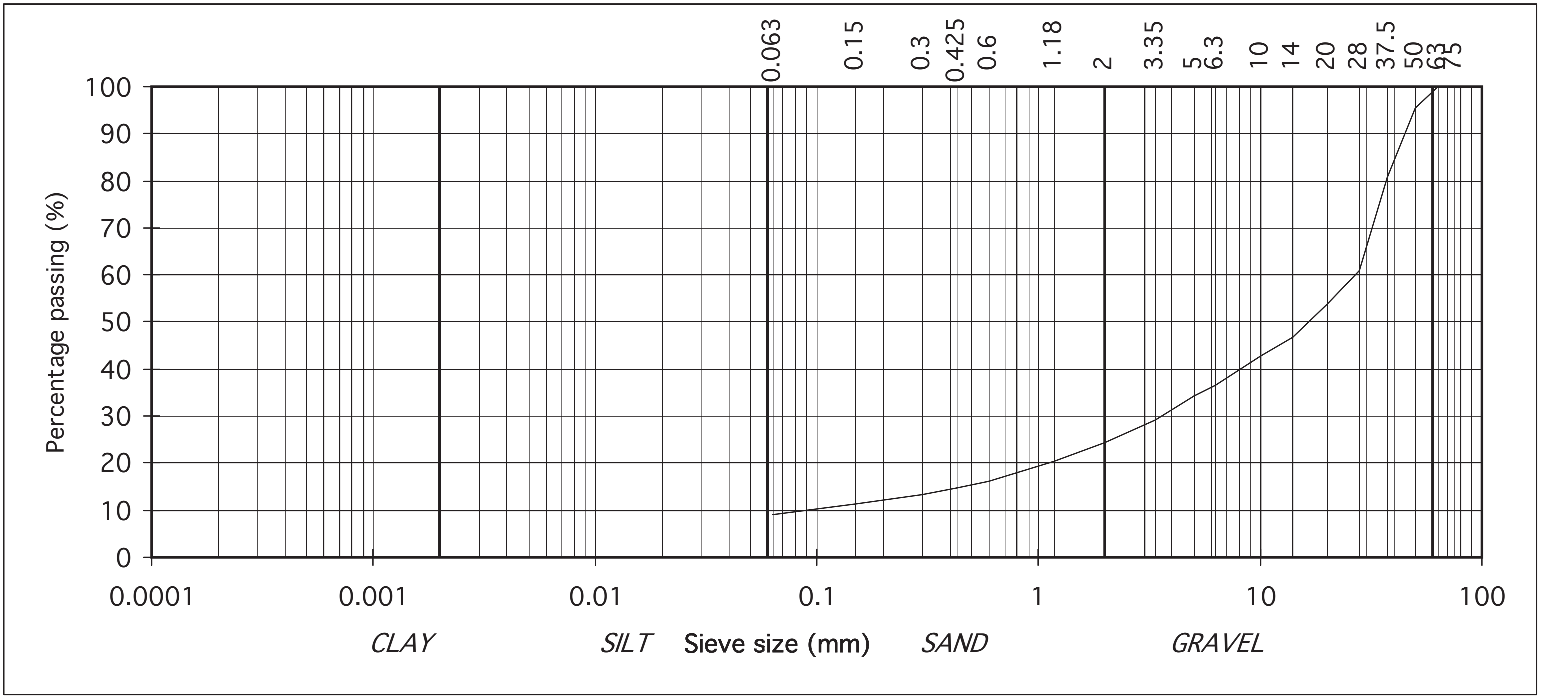
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R98673
Contract: Greenlink Interconnector
BH/TP : BH01-3
Sample No. A110610 Lab. Sample No. A19/0431
Sample Type: B
Depth (m) 1.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Brown clayey/silty, sandy, GRAVEL

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	96	GRAVEL
37.5	81	
28	61	
20	54	
14	47	
10	43	
6.3	36	
5	34	
3.35	29	
2	24	SAND
1.18	20	
0.6	16	
0.425	15	
0.3	13	
0.15	11	
0.063	9	SILT/CLAY



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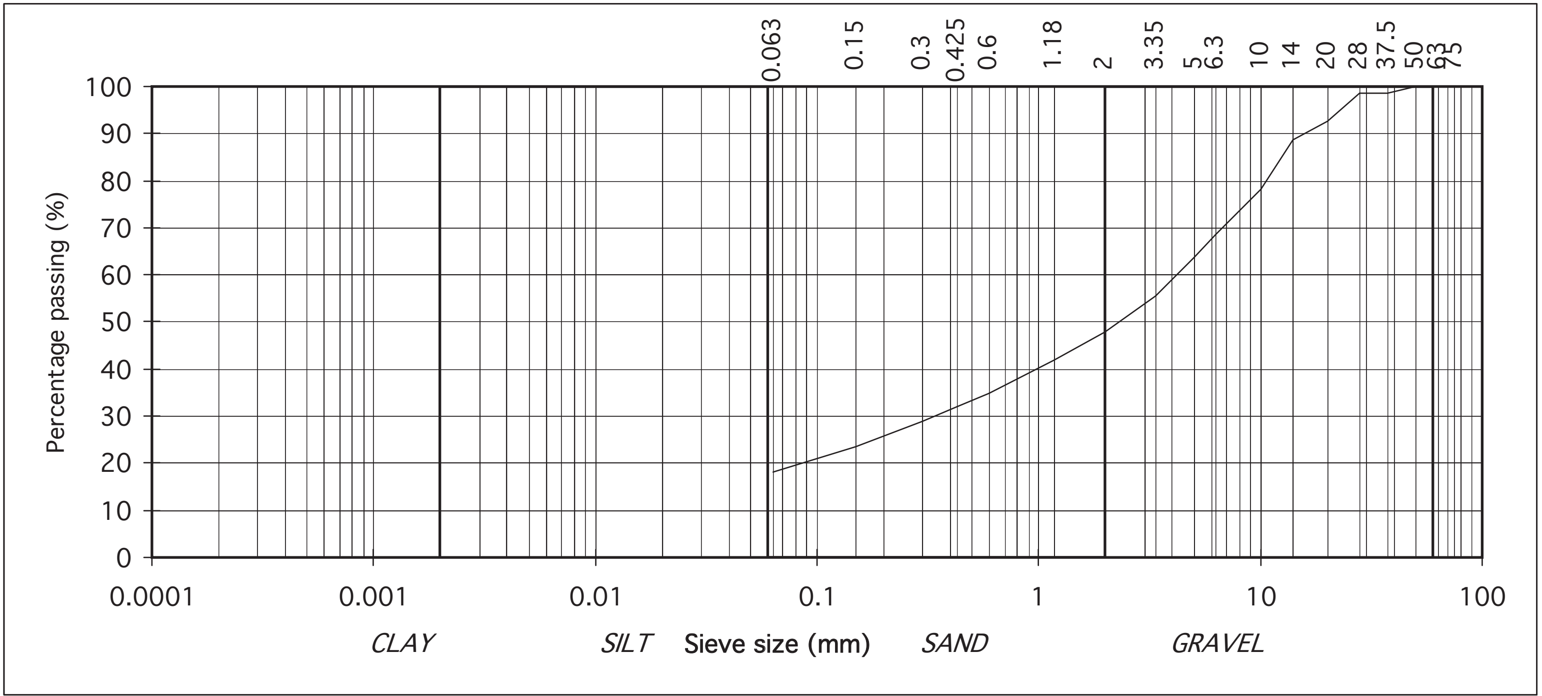
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No:	21475	Report No.	R98618
Contract:	Greenlink Interconnector		
BH/TP :	BH02-1		
Sample No.	AA110641	Lab. Sample No.	A19/0423
Sample Type:	B		
Depth (m)	2.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	07/02/2019	Date Testing started	11/02/2019
Description:	Brown clayey/silty, very sandy, GRAVEL		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	99	
28	99	
20	93	
14	89	
10	78	
6.3	69	
5	64	
3.35	56	
2	48	SAND
1.18	42	
0.6	35	
0.425	32	
0.3	29	
0.15	24	
0.063	18	SILT/CLAY



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing
75	100
63	100
50	100
37.5	100
28	100
20	96
14	90
10	84
6.3	70
5	65
3.35	44
2	31
1.18	23
0.6	18
0.425	17
0.3	16
0.15	16
0.063	16

COBBLES

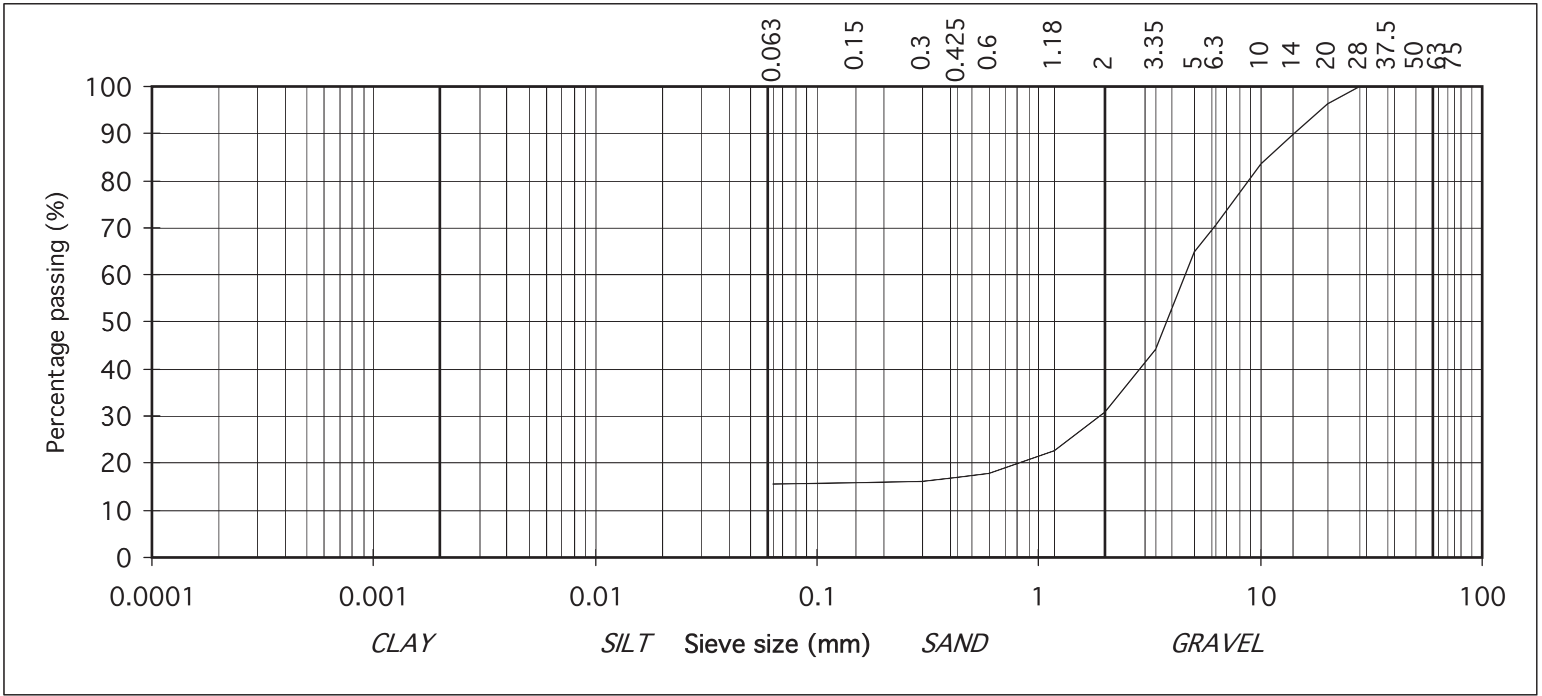
GRAVEL

SAND

SILT/CLAY

Contract No:	21475	Report No.	R98696
Contract:	Greenlink Interconnector		
BH/TP :	BH03-2		
Sample No.	AA115616	Lab. Sample No.	A19/0426
Sample Type:	B		
Depth (m)	2.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	07/02/2019	Date Testing started	11/02/2019
Description:	Orange/brown silty, sandy, GRAVEL		

Remarks: Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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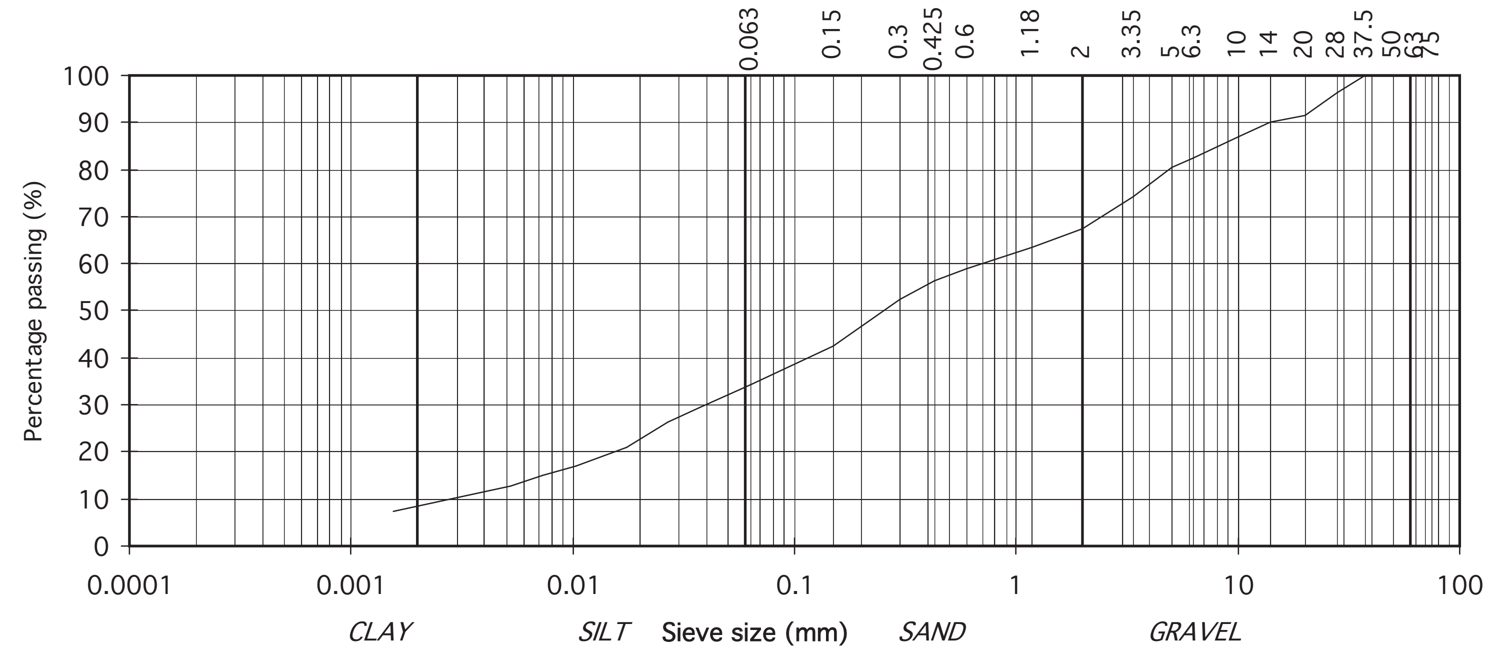
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No:	21475	Report No.	R99087
Contract:	Greenlink Interconnector		
BH/TP :	BH03-3		
Sample No.	AA115626	Lab. Sample No.	A19/0433
Sample Type:	B		
Depth (m)	2.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	07/02/2019	Date Testing started	11/02/2019
Description:	Brown slightly sandy, slightly gravelly, SILT		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	96	
20	91	
14	90	
10	87	
6.3	83	
5	80	
3.35	74	
2	68	
1.18	63	SAND
0.6	59	
0.425	56	
0.3	52	
0.15	43	
0.063	34	SILT/CLAY
0.037	30	
0.027	26	
0.017	21	
0.010	17	
0.007	15	
0.005	13	
0.002	7	



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

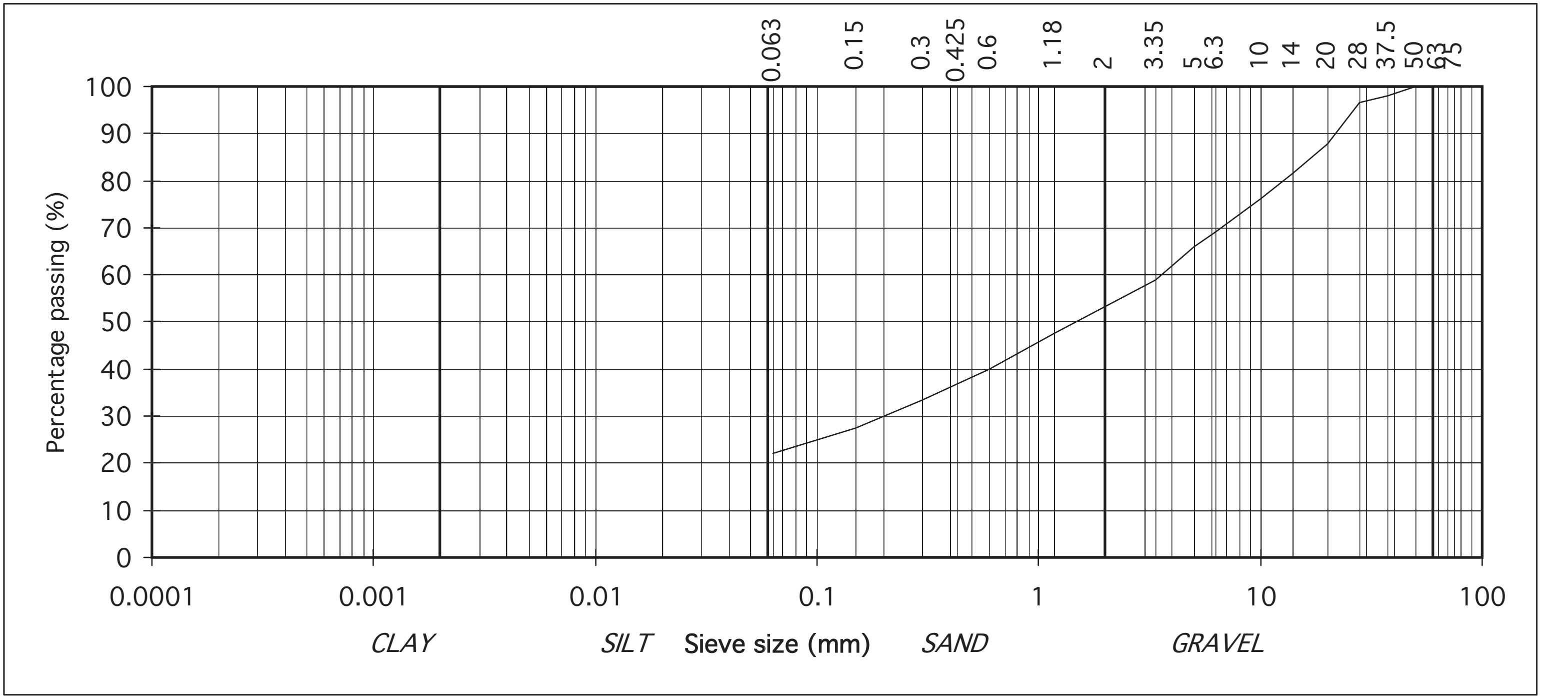
TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	98	
28	97	
20	88	
14	82	
10	76	
6.3	69	
5	66	
3.35	59	
2	53	
1.18	47	SAND
0.6	40	
0.425	37	
0.3	33	
0.15	28	
0.063	22	SILT/CLAY

Contract No: 21475 Report No. R98676
Contract: Greenlink Interconnector
BH/TP : BH04-1
Sample No. AA110637 Lab. Sample No. A19/0424
Sample Type: B
Depth (m) 3.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Light brown slightly sandy, gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

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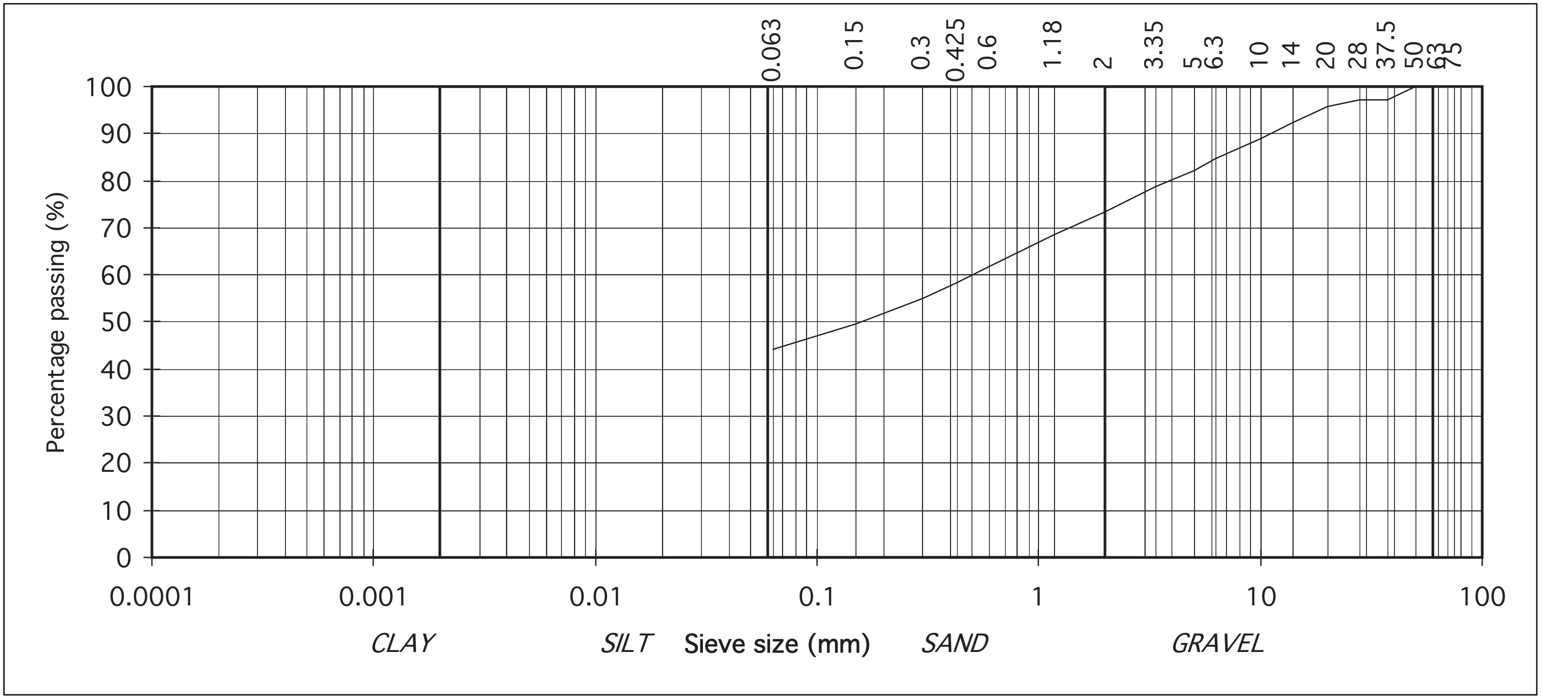
TESTING
DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R98574
Contract: Greenlink Interconnector
BH/TP : BH04-2
Sample No. AA115604 Lab. Sample No. A19/0427
Sample Type: B
Depth (m) 0.80 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Brown slightly sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	97	
28	97	
20	96	
14	92	
10	89	
6.3	85	
5	82	
3.35	79	
2	73	
1.18	69	SAND
0.6	62	
0.425	58	
0.3	55	
0.15	50	
0.063	44	SILT/CLAY



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

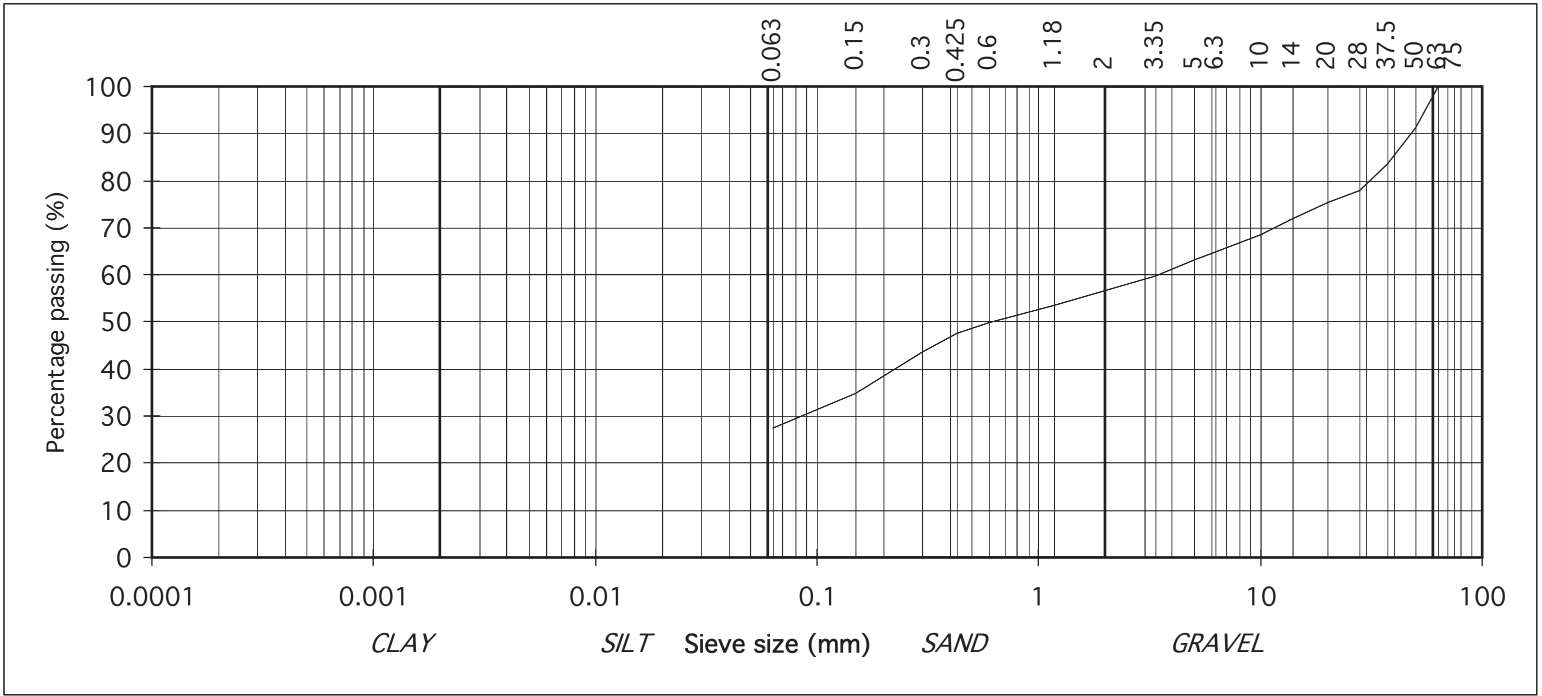
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R98674
Contract: Greenlink Interconnector
BH/TP : BH04-3
Sample No. AA110602 Lab. Sample No. A19/0434
Sample Type: B
Depth (m) 1.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Orange/brown slightly sandy, gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	91	GRAVEL
37.5	83	
28	78	
20	75	
14	72	
10	69	
6.3	65	
5	63	
3.35	60	
2	57	
1.18	54	SAND
0.6	50	
0.425	48	
0.3	44	
0.15	35	
0.063	27	SILT/CLAY



IGSL Ltd Materials Laboratory

Approved by: H Byrne

Date: 28/02/19

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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

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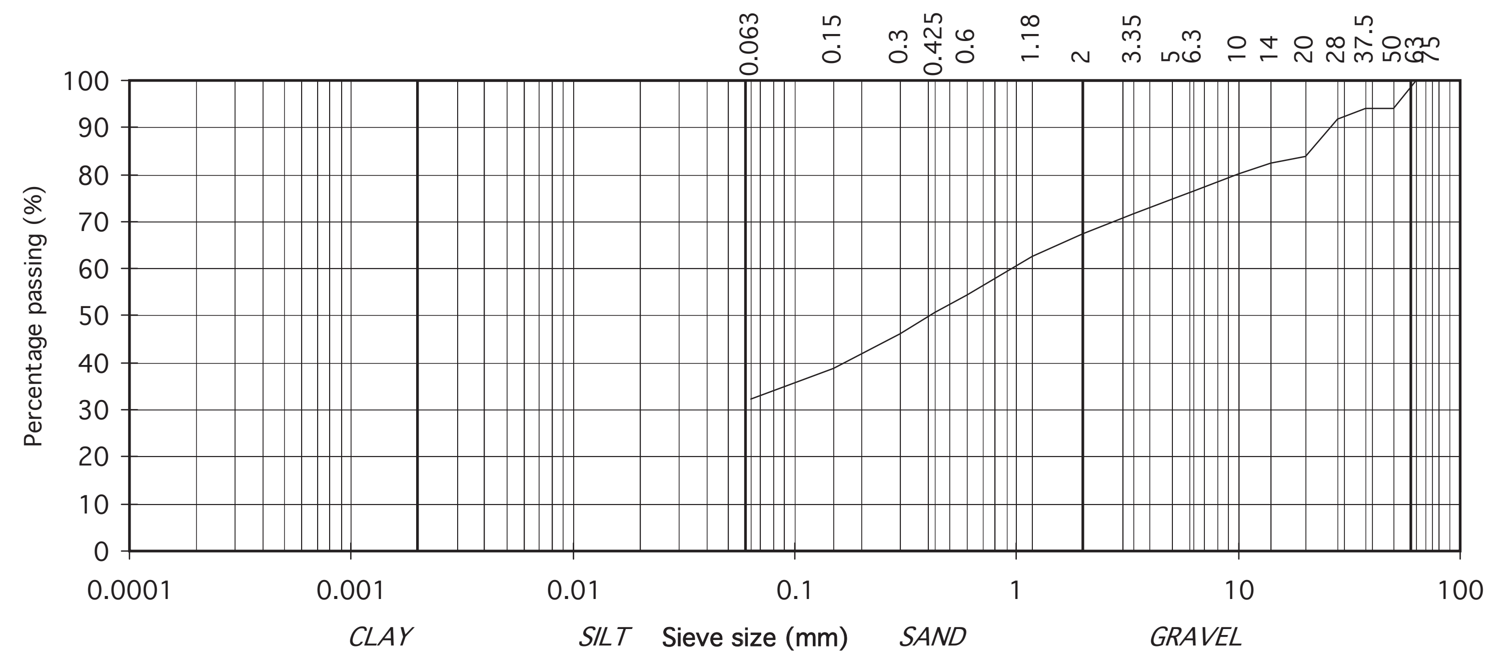
TESTING
DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R98675
Contract: Greenlink Interconnector
BH/TP : BH04-3
Sample No. AA110604 Lab. Sample No. A19/0435
Sample Type: B
Depth (m) 2.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Orange/brown sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	94	GRAVEL
37.5	94	
28	92	
20	84	
14	82	
10	80	
6.3	76	
5	75	
3.35	72	
2	67	
1.18	62	SAND
0.6	55	
0.425	51	
0.3	46	
0.15	39	
0.063	32	SILT/CLAY



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing
75	100
63	100
50	100
37.5	100
28	93
20	91
14	90
10	87
6.3	84
5	82
3.35	78
2	73
1.18	69
0.6	62
0.425	59
0.3	56
0.15	50
0.063	43

COBBLES

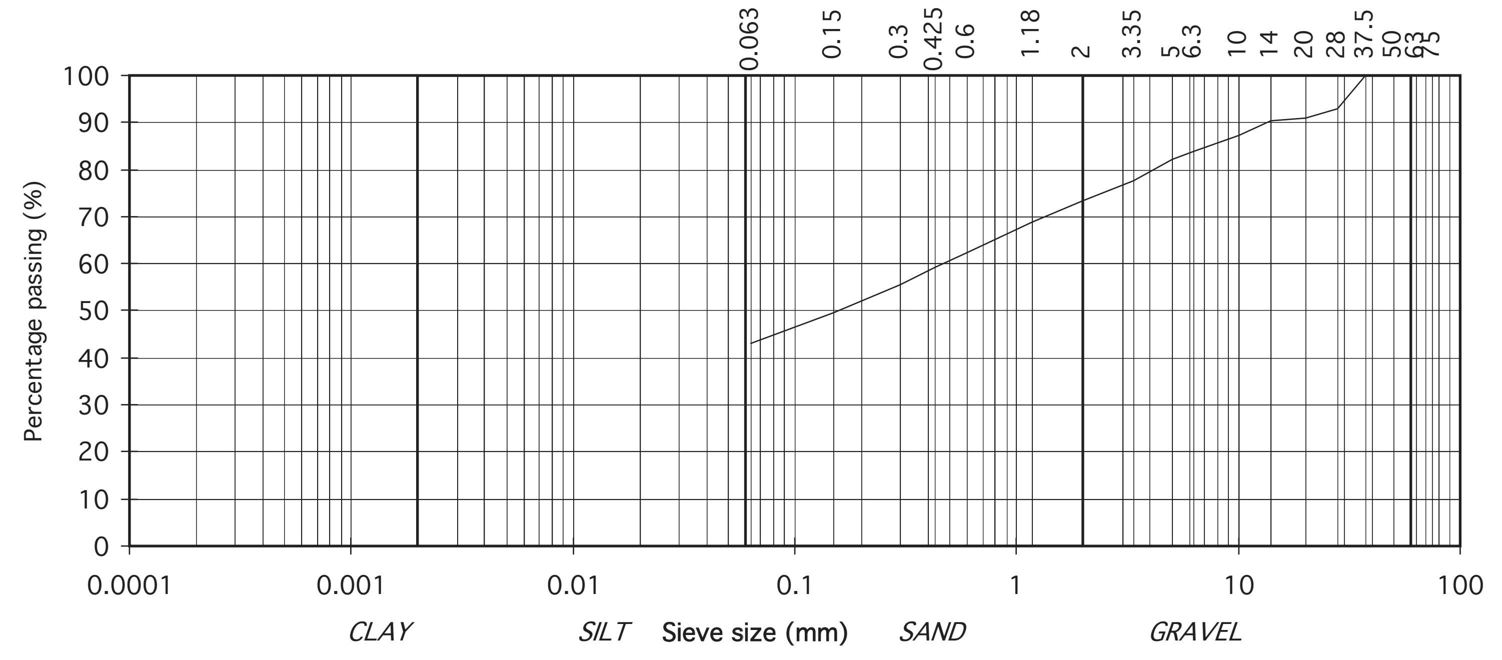
GRAVEL

SAND

SILT/CLAY

Contract No: 21475 Report No. R98677
Contract: Greenlink Interconnector
BH/TP : BH05-2
Sample No. AA115608 Lab. Sample No. A19/0428
Sample Type: B
Depth (m) 2.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Mottled orange/brown slightly sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

IGSL Ltd, M7 Business Park, Newhall, Naas, Co Kildare

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

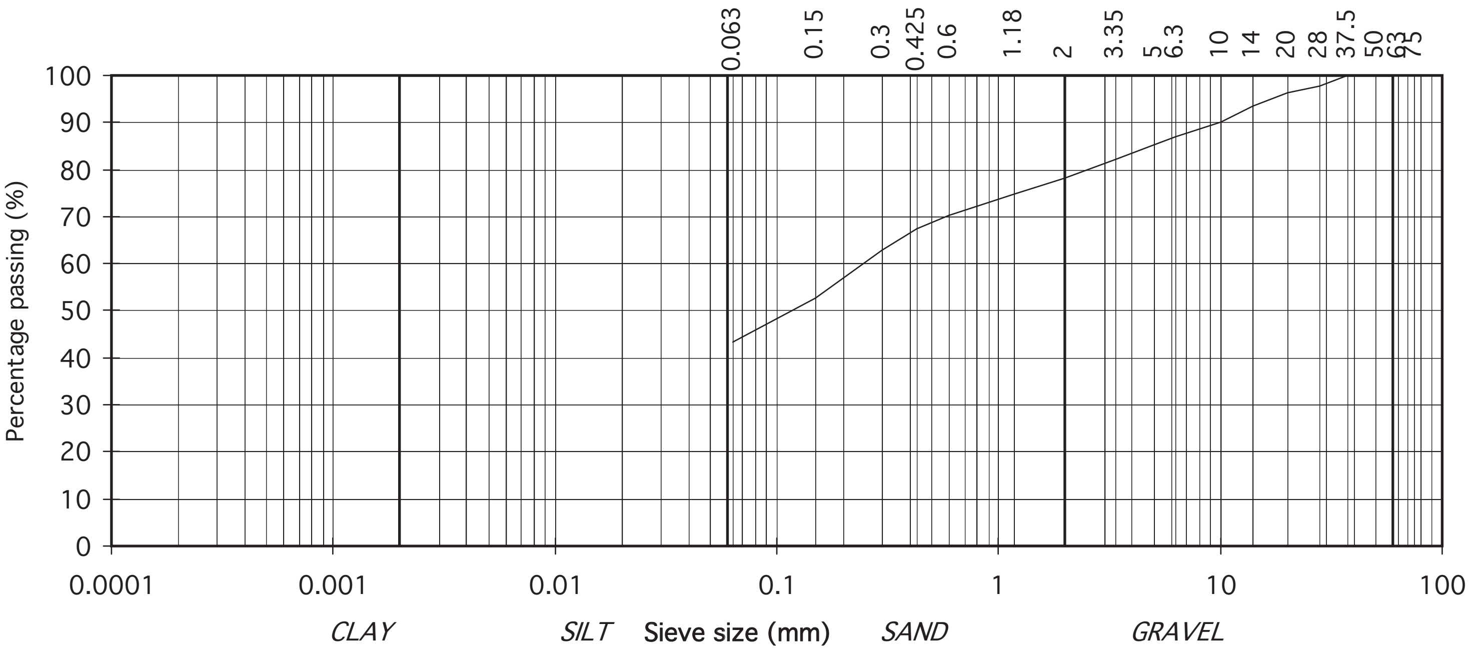
particle size	% passing
75	100
63	100
50	100
37.5	100
28	98
20	96
14	94
10	90
6.3	87
5	85
3.35	82
2	78
1.18	75
0.6	70
0.425	68
0.3	63
0.15	53
0.063	43

COBBLES
GRAVEL
SAND
SILT/CLAY

Contract No:	21475	Report No.	R98678
Contract:	Greenlink Interconnector		
BH/TP :	BH05-2		
Sample No.	AA115611	Lab. Sample No.	A19/0429
Sample Type:	B		
Depth (m)	5.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	07/02/2019	Date Testing started	11/02/2019
Description:	Brown slightly sandy, slightly gravelly, CLAY		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

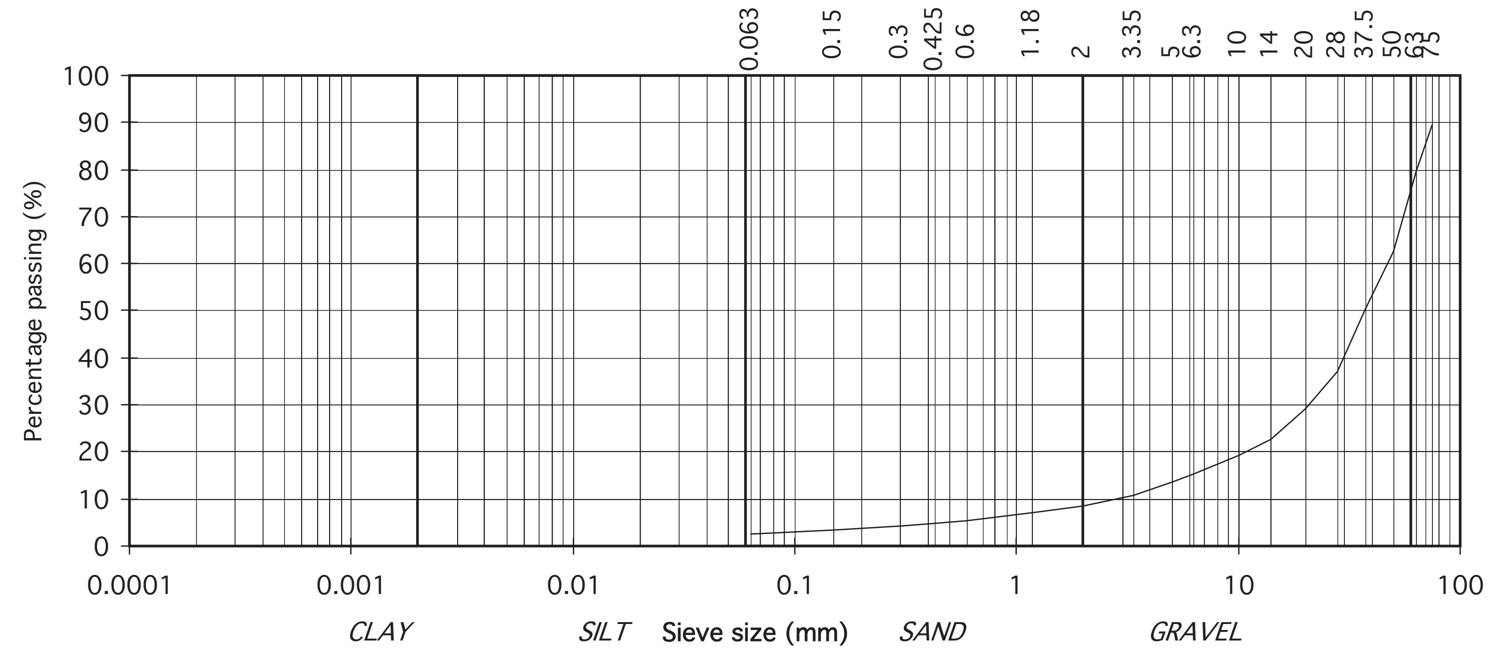
ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing
75	90
63	80
50	63
37.5	50
28	37
20	29
14	23
10	19
6.3	15
5	14
3.35	11
2	9
1.18	7
0.6	5
0.425	5
0.3	4
0.15	3
0.063	3

COBBLES
GRAVEL
SAND
SILT/CLAY

Contract No: 21475 Report No. R98617
Contract: Greenlink Interconnector
BH/TP : BH05-3
Sample No. AA110654 Lab. Sample No. A19/0436
Sample Type: B
Depth (m) 1.50 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Orange/brown slightly silty, sandy, GRAVEL with many cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

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TESTING
DETAILED IN SCOPE REG NO. 133T

Contract No:	21475	Report No.	R98575
Contract:	Greenlink Interconnector		
BH/TP :	BH06-2		
Sample No.	AA110650	Lab. Sample No.	A19/0430
Sample Type:	B		
Depth (m)	2.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	07/02/2019	Date Testing started	11/02/2019
Description:	Brown slightly sandy, slightly gravelly, CLAY with many cobbles		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		Sample size did not meet the requirements of BS1377

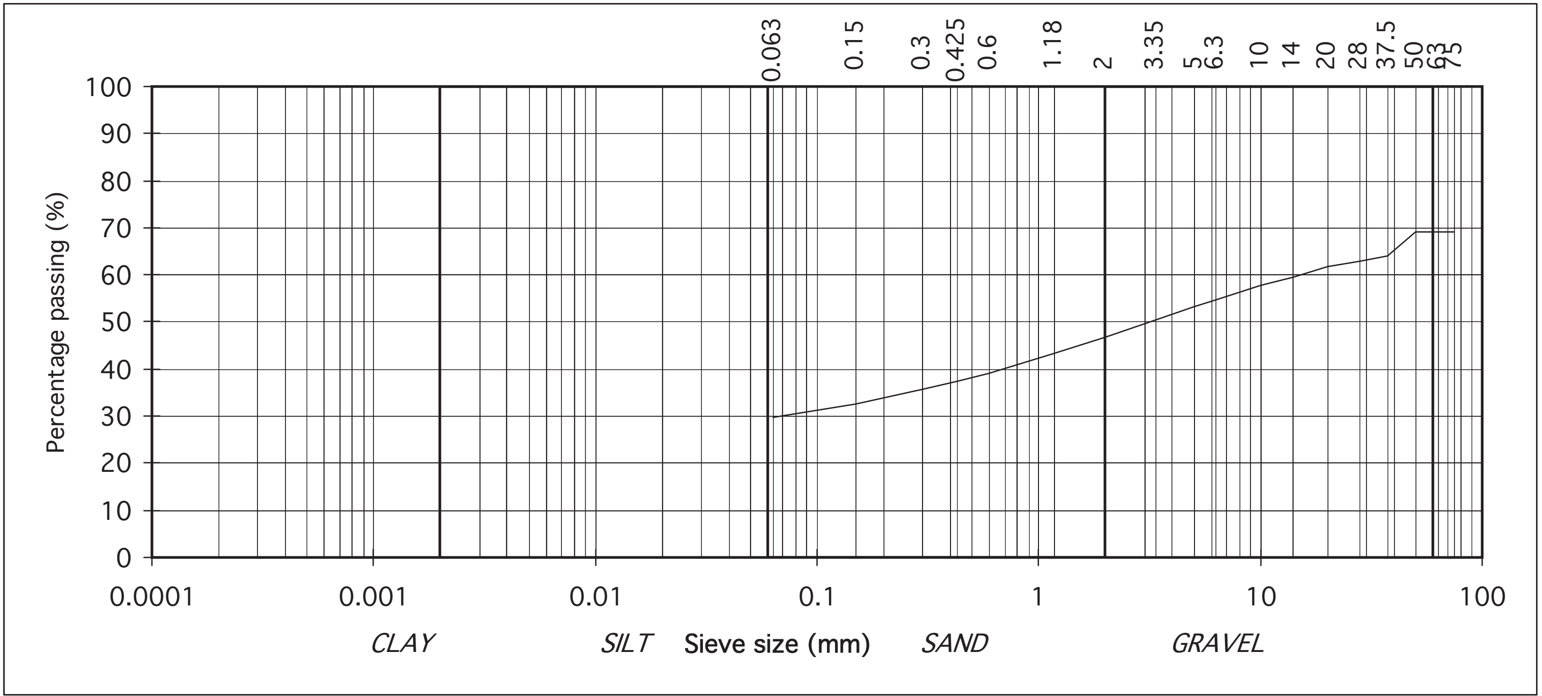
particle size	% passing
75	69
63	69
50	69
37.5	64
28	63
20	62
14	60
10	58
6.3	55
5	53
3.35	50
2	47
1.18	43
0.6	39
0.425	37
0.3	36
0.15	33
0.063	30

COBBLES

GRAVEL

SAND

SILT/CLAY



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

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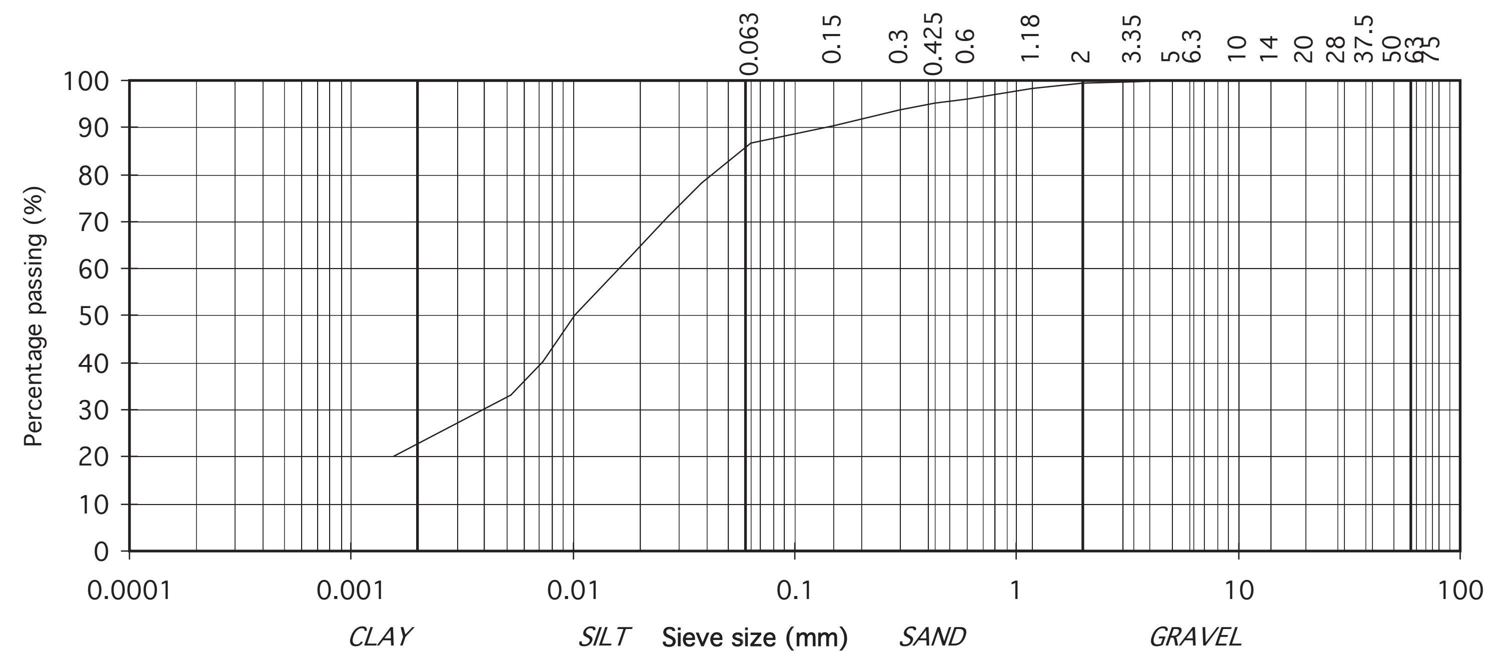
DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R98694
Contract: Greenlink Interconnector
BH/TP : BH06-3
Sample No. AA110625 Lab. Sample No. A19/0439
Sample Type: B
Depth (m) 6.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Grey slightly sandy, slightly gravelly, SILT/CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	100	
10	100	
6.3	100	
5	100	
3.35	100	
2	99	
1.18	98	SAND
0.6	96	
0.425	95	
0.3	94	
0.15	90	
0.063	87	SILT/CLAY
0.038	78	
0.027	71	
0.017	62	
0.010	50	
0.007	40	
0.005	33	
0.002	20	



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

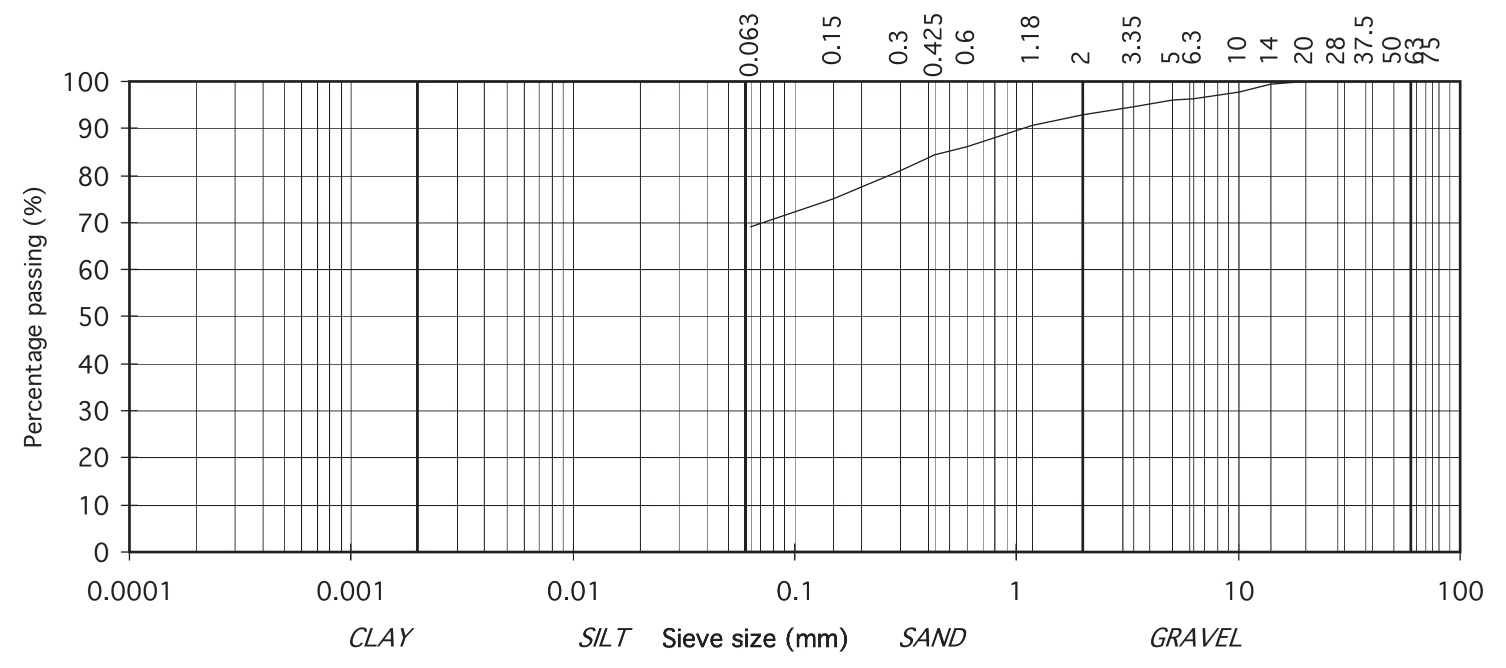
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R98695
Contract: Greenlink Interconnector
BH/TP : BH06-3
Sample No. AA110630 Lab. Sample No. A19/0441
Sample Type: B
Depth (m) 10.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 07/02/2019 Date Testing started 11/02/2019
Description: Grey slightly sandy, slightly gravelly, SILT/CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	99	
10	98	
6.3	96	
5	96	
3.35	95	
2	93	
1.18	91	SAND
0.6	86	
0.425	84	
0.3	81	
0.15	75	
0.063	69	SILT/CLAY



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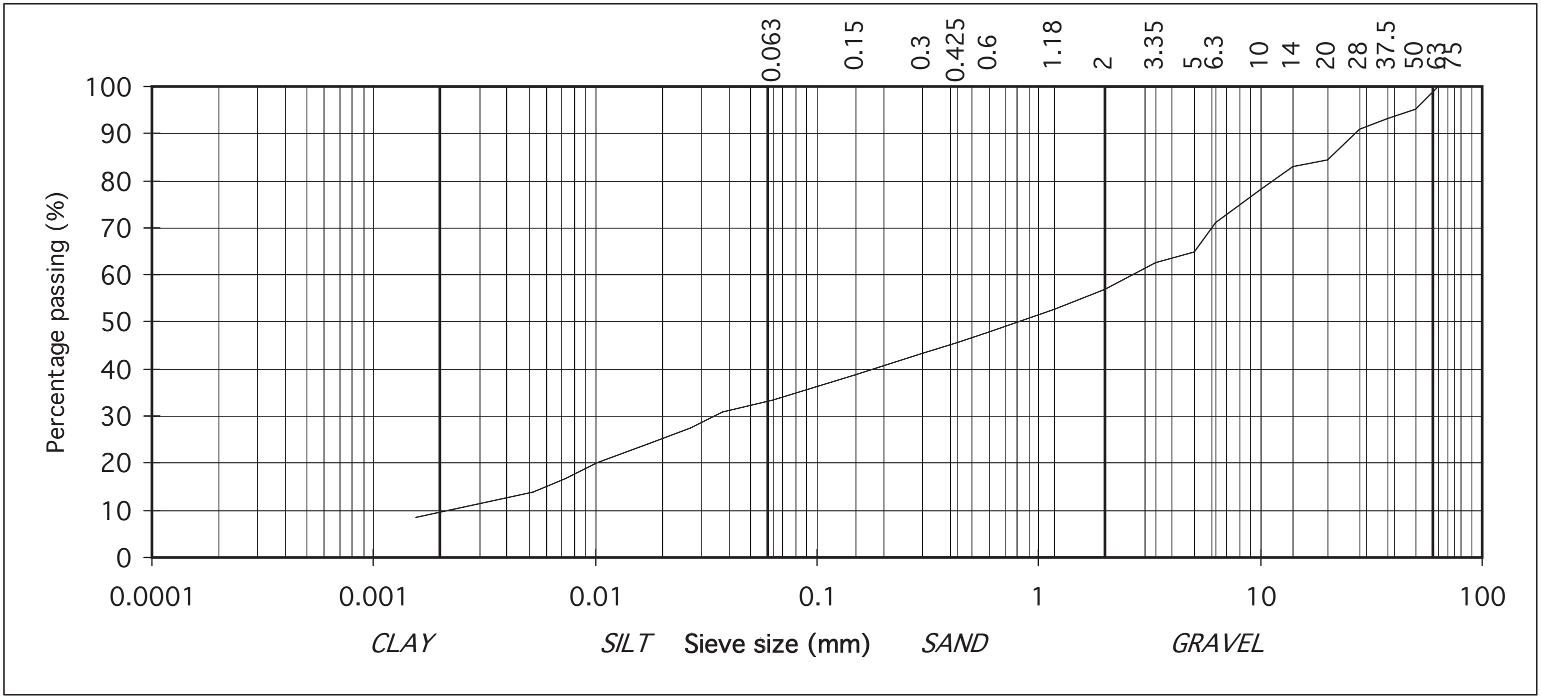
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	95	GRAVEL
37.5	93	
28	91	
20	85	
14	83	
10	78	
6.3	71	
5	65	
3.35	63	
2	57	
1.18	53	SAND
0.6	48	
0.425	46	
0.3	43	
0.15	39	
0.063	34	SILT/CLAY
0.037	31	
0.027	28	
0.017	24	
0.010	20	
0.007	17	
0.005	14	
0.002	9	

Contract No:	21475	Report No.	R100647
Contract:	Greenlink Interconnector		
BH/TP :	TP01-1		
Sample No.	AA109866	Lab. Sample No.	A19/1411
Sample Type:	B		
Depth (m)	0.80	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	26/03/2019	Date Testing started	03/04/2019
Description:	Orange/brown slightly sandy, gravelly, CLAY		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

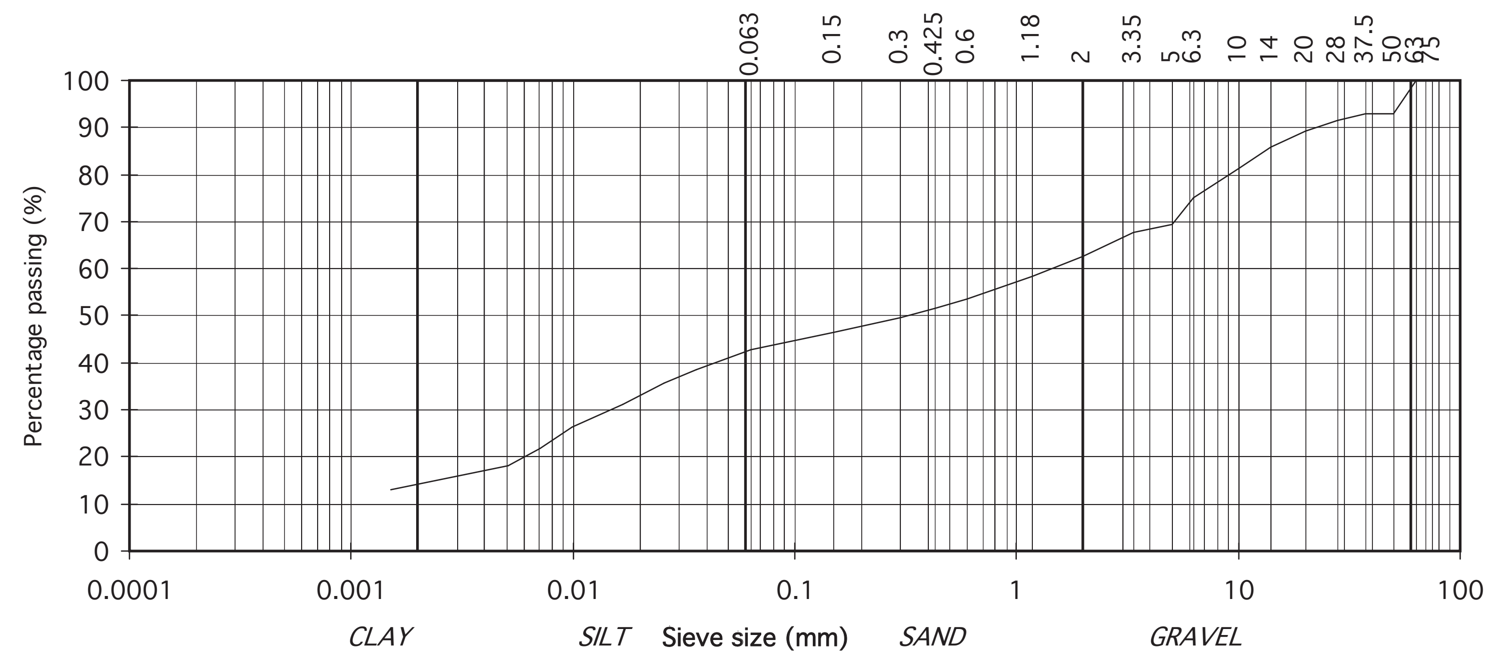
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R100648
Contract: Greenlink Interconnector
BH/TP : TP01-2
Sample No. AA100648 Lab. Sample No. A19/1415
Sample Type: B
Depth (m) 1.20 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 08/04/2019
Description: Mottled brown slightly sandy, gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	93	GRAVEL
37.5	93	
28	91	
20	89	
14	86	
10	81	
6.3	75	
5	69	
3.35	68	
2	63	SAND
1.18	58	
0.6	53	
0.425	51	
0.3	49	
0.15	46	
0.063	43	SILT/CLAY
0.036	38	
0.026	36	
0.017	31	
0.010	26	
0.007	22	
0.005	18	
0.002	13	



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

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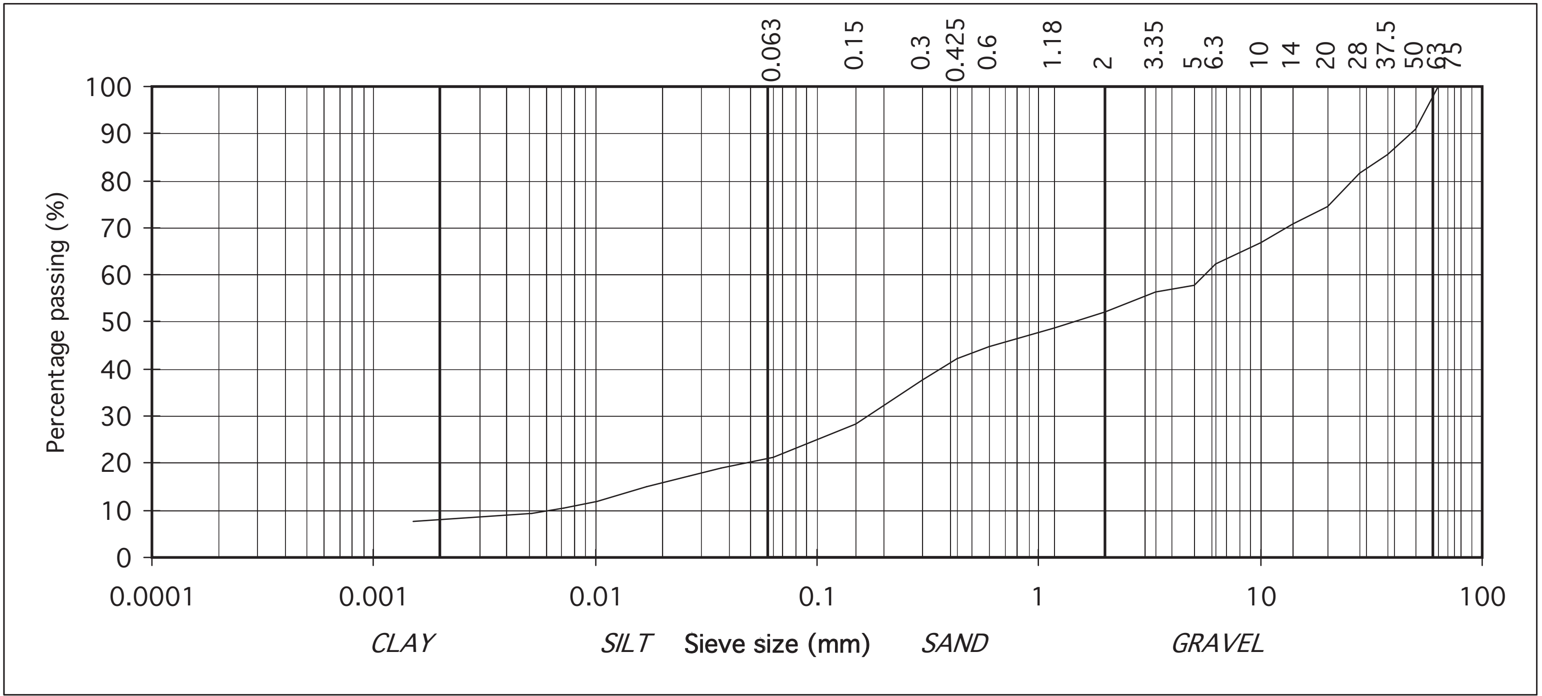
TESTING
DETAILED IN SCOPE REG NO. 133T

Contract No:	21475
Report No.	R100535
Contract:	Greenlink Interconnector
BH/TP :	TP01-3
Sample No.	AA109892
Lab. Sample No.	A19/1420
Sample Type:	B
Depth (m)	2.80
Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	26/03/2019
Date Testing started	03/04/2019
Description:	Orange/brown slightly sandy, gravelly, CLAY
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	91	GRAVEL
37.5	86	
28	82	
20	74	
14	71	
10	67	
6.3	62	
5	58	
3.35	56	
2	52	
1.18	49	SAND
0.6	45	
0.425	42	
0.3	38	
0.15	28	
0.063	21	SILT/CLAY
0.037	19	
0.027	17	
0.017	15	
0.010	12	
0.007	11	
0.005	9	
0.002	8	



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

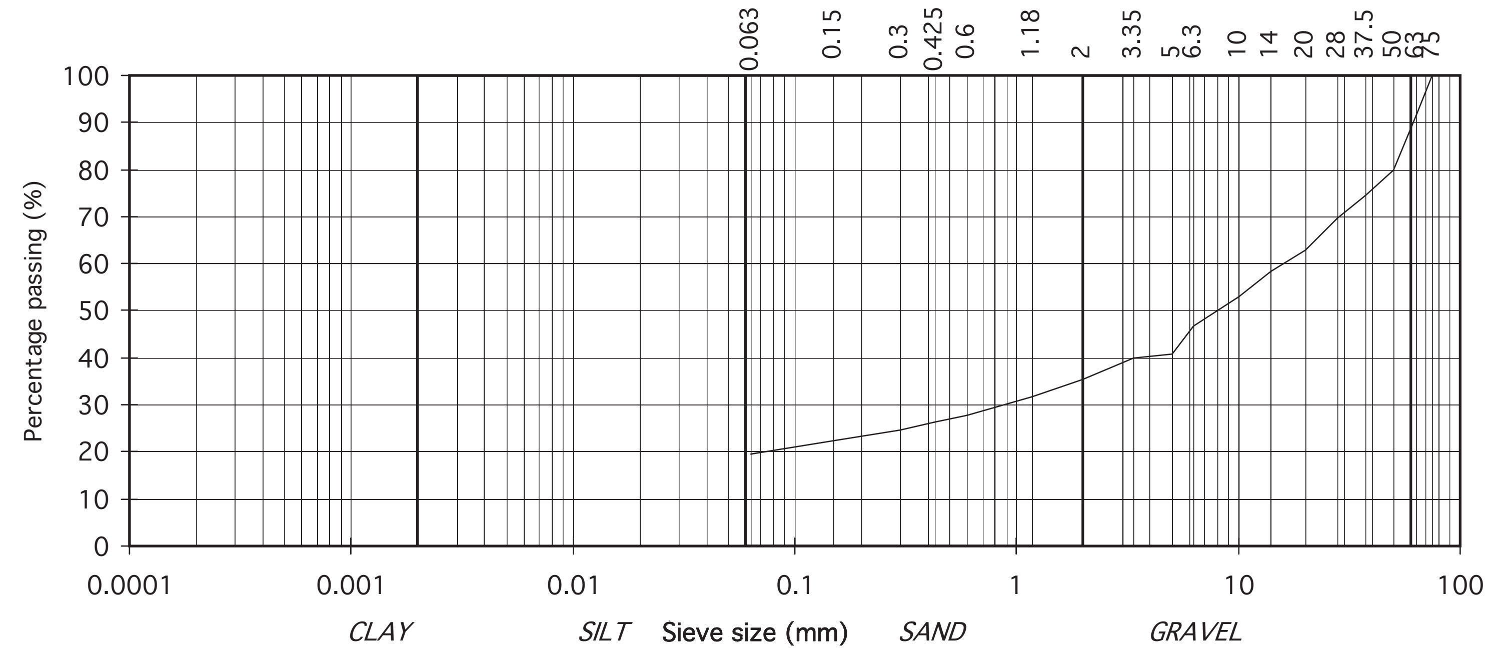
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R100480
Contract: Greenlink Interconnector
BH/TP : TP02-1
Sample No. AA109869 Lab. Sample No. A19/1413
Sample Type: B
Depth (m) 0.40 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Brown clayey, sandy, GRAVEL with some cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	92	
50	80	GRAVEL
37.5	75	
28	70	
20	63	
14	58	
10	53	
6.3	47	
5	41	
3.35	40	
2	35	SAND
1.18	32	
0.6	28	
0.425	26	
0.3	25	
0.15	22	
0.063	19	SILT/CLAY



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

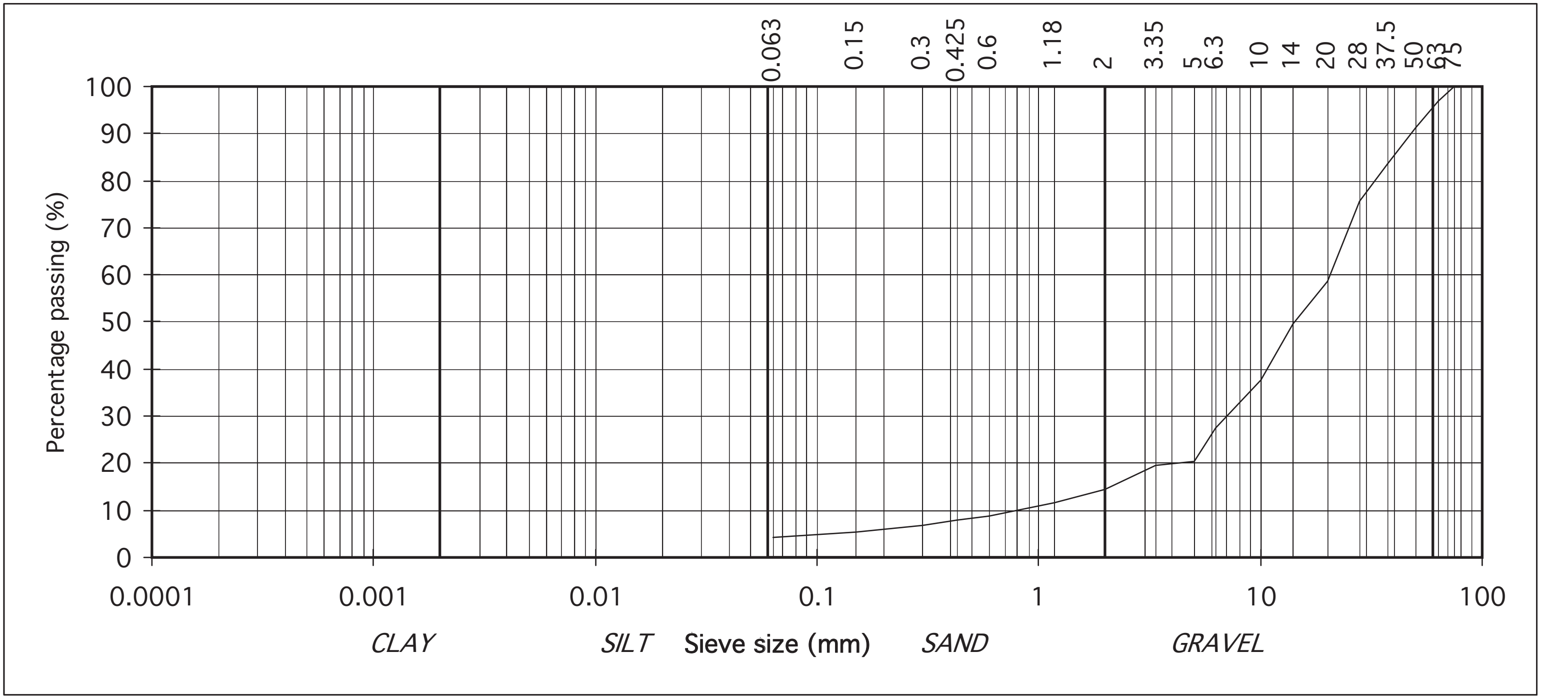
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	97	
50	91	GRAVEL
37.5	84	
28	76	
20	59	
14	49	
10	38	
6.3	27	
5	20	
3.35	20	
2	15	SAND
1.18	12	
0.6	9	
0.425	8	
0.3	7	
0.15	5	
0.063	4	SILT/CLAY

Contract No: 21475 Report No. R100481
Contract: Greenlink Interconnector
BH/TP : TP02-1
Sample No. AA109870 Lab. Sample No. A19/1414
Sample Type: B
Depth (m) 1.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Grey/brown slightly clayey/silty, sandy, GRAVEL with occasional cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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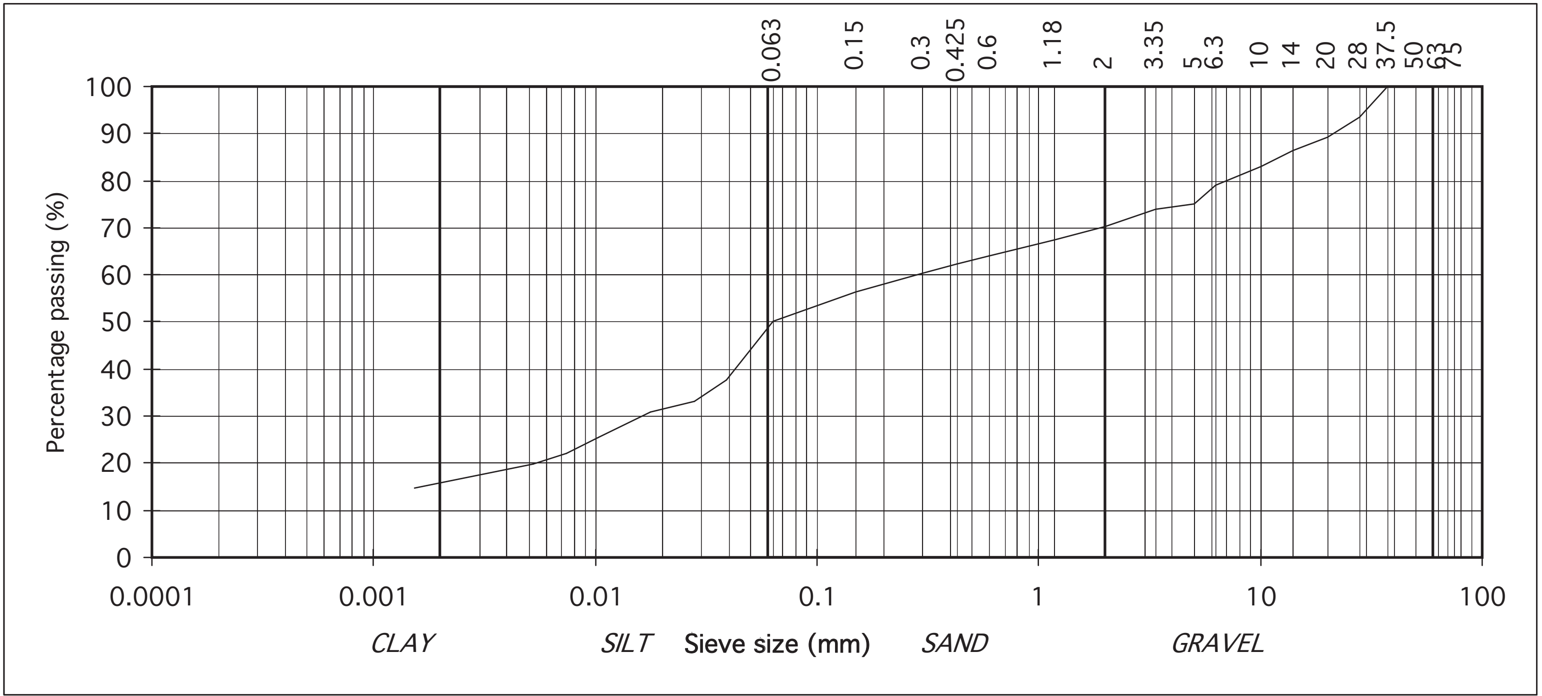
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	93	
20	89	
14	86	
10	83	
6.3	79	
5	75	
3.35	74	
2	70	
1.18	67	SAND
0.6	64	
0.425	62	
0.3	60	
0.15	56	
0.063	50	SILT/CLAY
0.039	38	
0.028	33	
0.018	31	
0.010	26	
0.007	22	
0.005	20	
0.002	15	

Contract No:	21475	Report No.	R100649
Contract:	Greenlink Interconnector		
BH/TP :	TP02-2		
Sample No.	AA109872	Lab. Sample No.	A19/1417
Sample Type:	B		
Depth (m)	1.00	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	26/03/2019	Date Testing started	08/04/2019
Description:	Mottled grey/brown slightly sandy, slightly gravelly, CLAY		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	97	GRAVEL
37.5	94	
28	86	
20	83	
14	72	
10	61	
6.3	53	
5	50	
3.35	47	
2	44	
1.18	42	SAND
0.6	39	
0.425	38	
0.3	36	
0.15	31	
0.063	22	
0.041	16	SILT/CLAY
0.029	15	
0.019	13	
0.011	10	
0.008	8	
0.005	6	
0.002	4	

Contract No: 21475 Report No. R100784

Contract: Greenlink Interconnector

BH/TP : TP02-3

Sample No. AA109895 Lab. Sample No. A19/1422

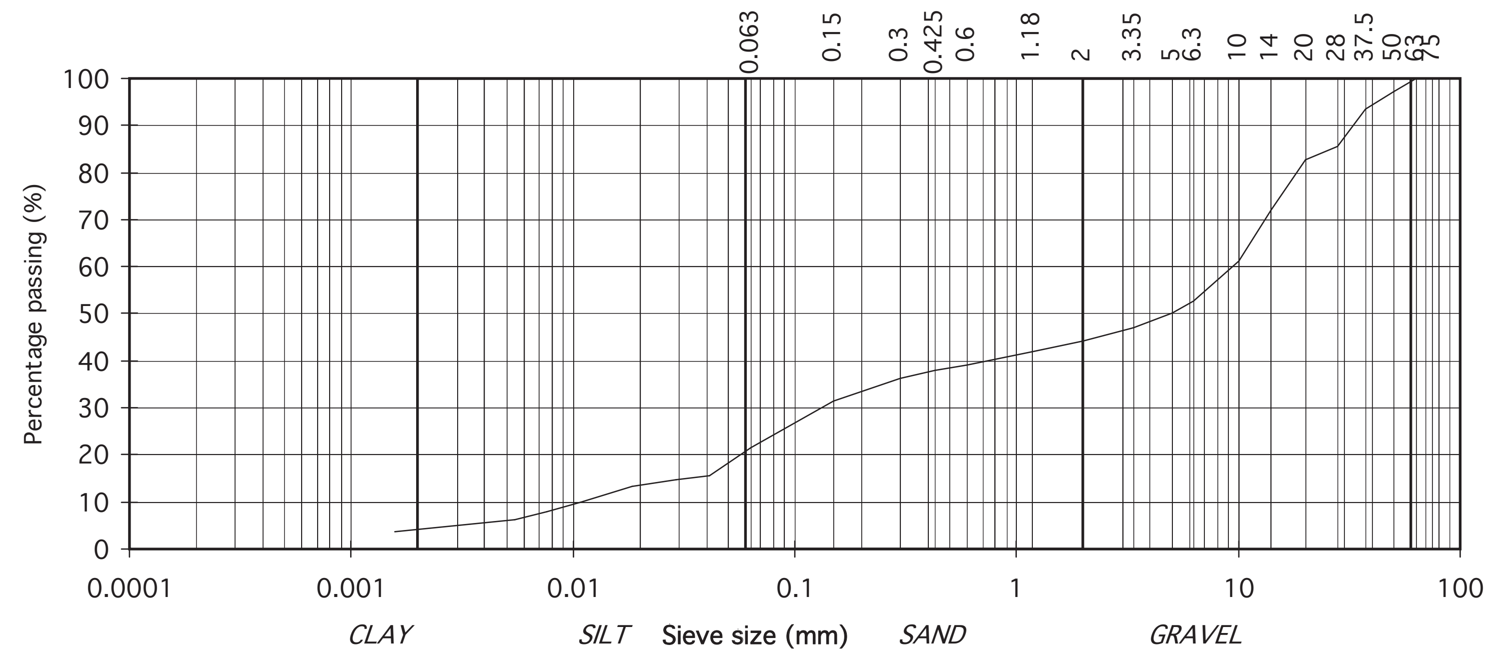
Sample Type: B

Depth (m) 3.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Date Received 26/03/2019 Date Testing started 08/04/2019

Description: Orange/brown slightly sandy, gravelly, SILT

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

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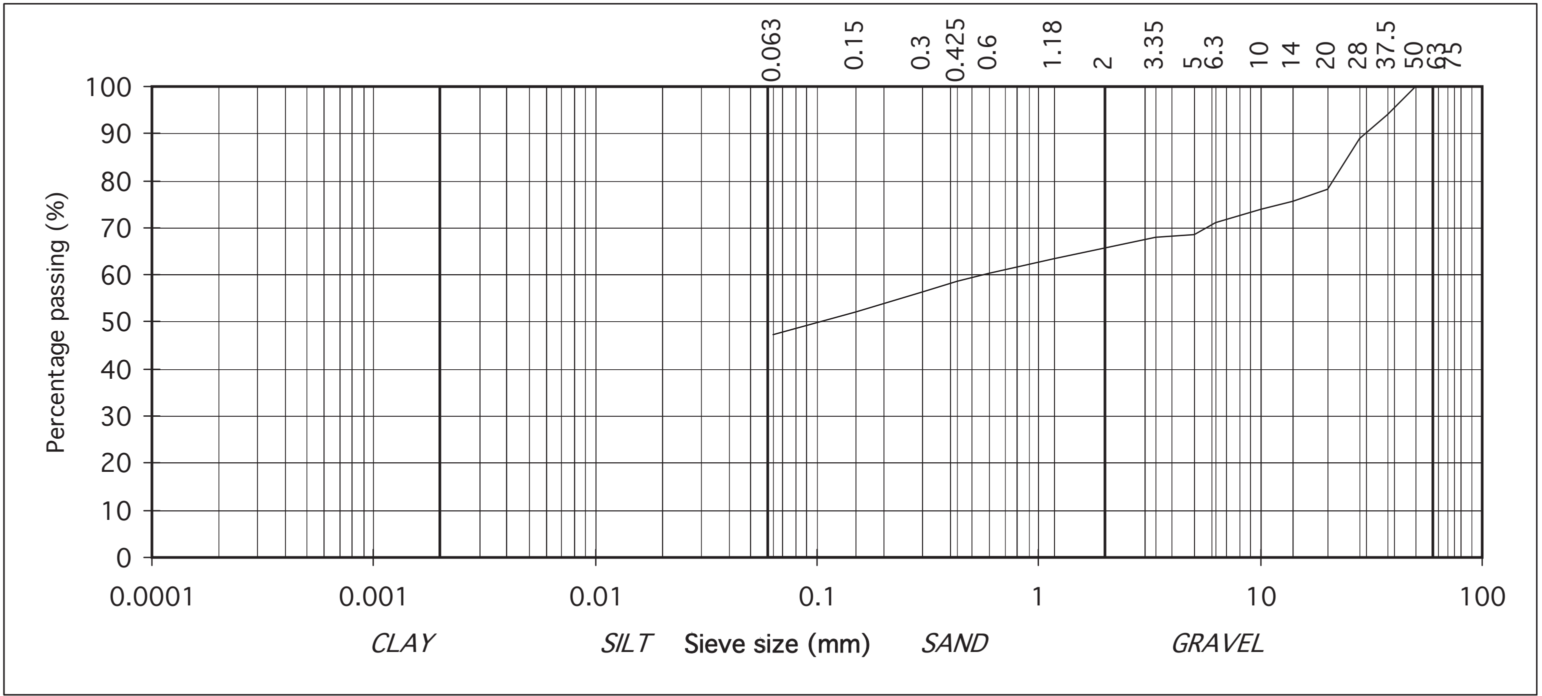
TESTING
DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R100482
Contract: Greenlink Interconnector
BH/TP : ST01
Sample No. AA109861 Lab. Sample No. A19/1443
Sample Type: B
Depth (m) 0.60 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Mottled orange/brown slightly sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing
75	100
63	100
50	100
37.5	94
28	89
20	78
14	76
10	74
6.3	71
5	68
3.35	68
2	66
1.18	63
0.6	60
0.425	59
0.3	56
0.15	52
0.063	47

COBBLES
GRAVEL
SAND
SILT/CLAY



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R100483

Contract: Greenlink Interconnector

BH/TP : ST04

Sample No. AA109855 Lab. Sample No. A19/1444

Sample Type: B

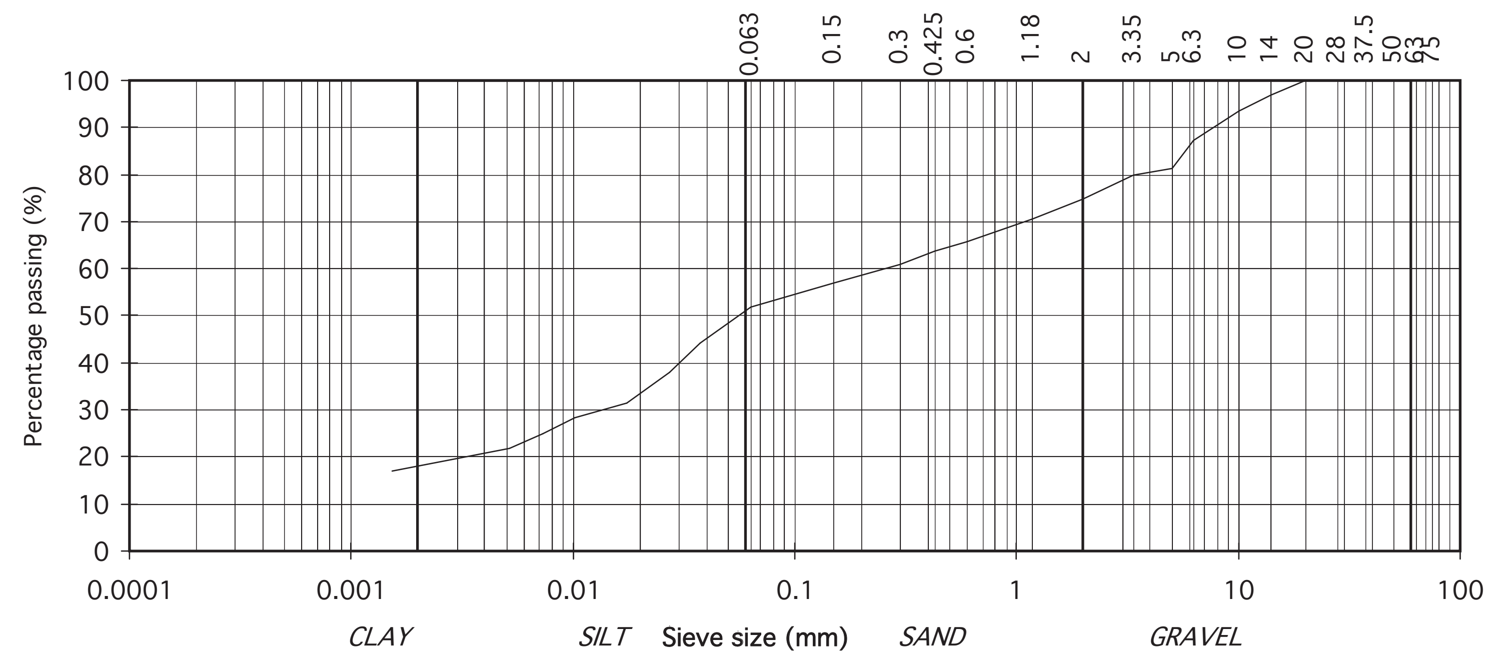
Depth (m) 0.50 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4

Date Received 26/03/2019 Date Testing started 02/04/2019

Description: Mottled brown slightly sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	100	
28	100	
20	100	
14	97	
10	93	
6.3	87	
5	81	
3.35	80	
2	75	
1.18	71	SAND
0.6	66	
0.425	64	
0.3	61	
0.15	57	
0.063	52	
0.038	44	SILT/CLAY
0.027	38	
0.018	32	
0.010	28	
0.007	25	
0.005	22	
0.002	17	



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT

Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5

(note: Sedimentation stage not accredited)

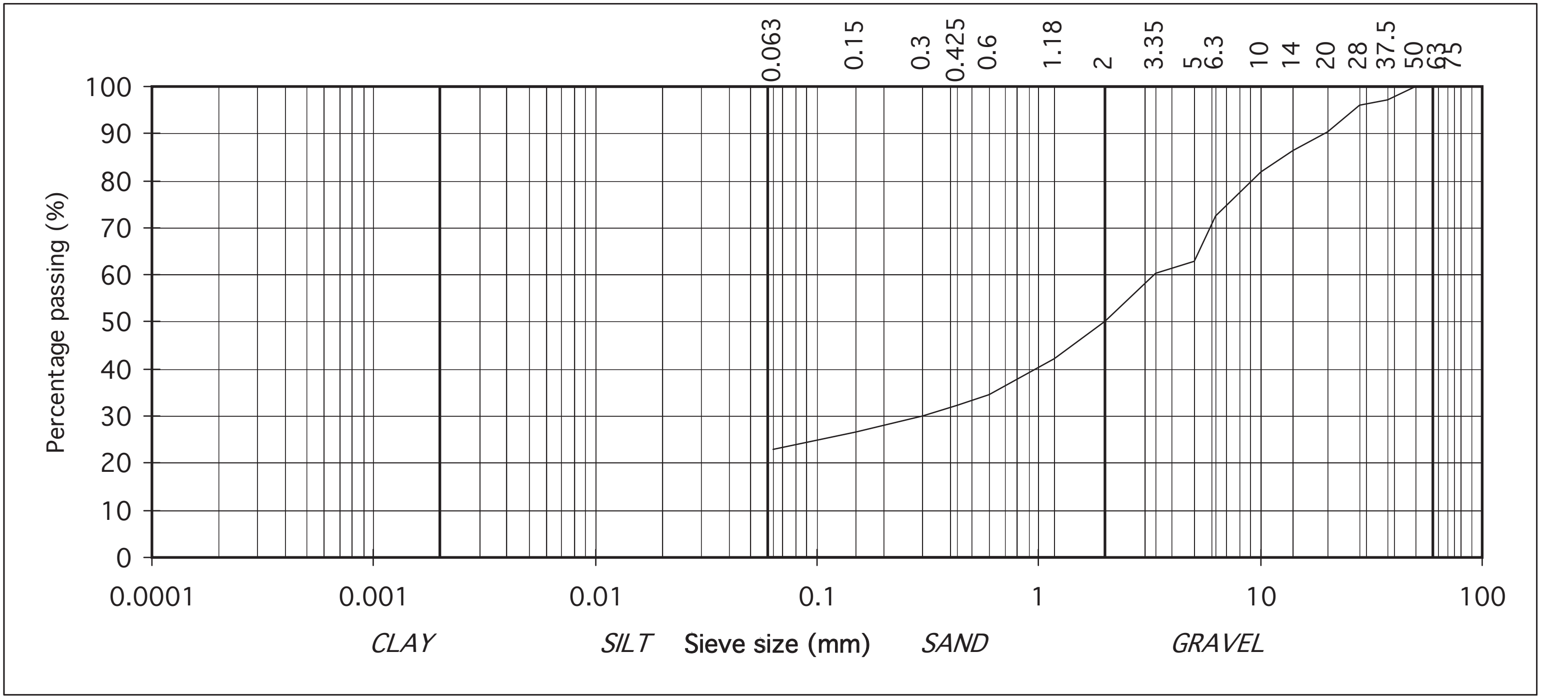
ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	97	
28	96	
20	90	
14	87	
10	82	
6.3	73	
5	63	
3.35	60	
2	50	SAND
1.18	42	
0.6	34	
0.425	32	
0.3	30	
0.15	27	
0.063	23	SILT/CLAY

Contract No:	21475	Report No.	R100484
Contract:	Greenlink Interconnector		
BH/TP :	ST07		
Sample No.	AA98850	Lab. Sample No.	A19/1445
Sample Type:	B		
Depth (m)	0.60	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	26/03/2019	Date Testing started	02/04/2019
Description:	Brown slightly sandy, gravelly, CLAY		

Remarks

Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016



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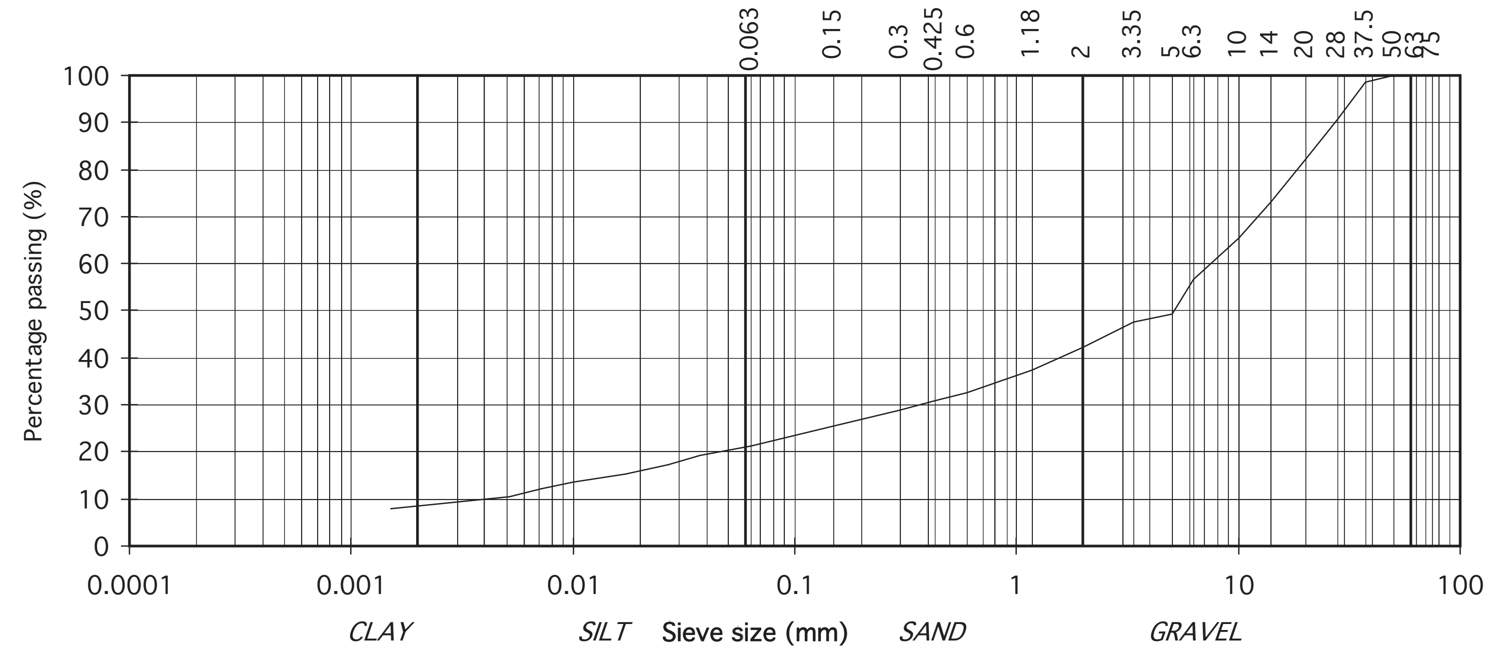
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

Contract No: 21475 Report No. R100485
Contract: Greenlink Interconnector
BH/TP : ST08
Sample No. AA109858 Lab. Sample No. A19/1446
Sample Type: B
Depth (m) 0.50 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Redish/brown slightly sandy, gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	99	
28	91	
20	82	
14	73	
10	66	
6.3	57	
5	49	
3.35	48	
2	42	
1.18	37	SAND
0.6	33	
0.425	31	
0.3	29	
0.15	25	
0.063	21	SILT/CLAY
0.037	19	
0.027	17	
0.017	15	
0.010	14	
0.007	12	
0.005	10	
0.002	8	



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

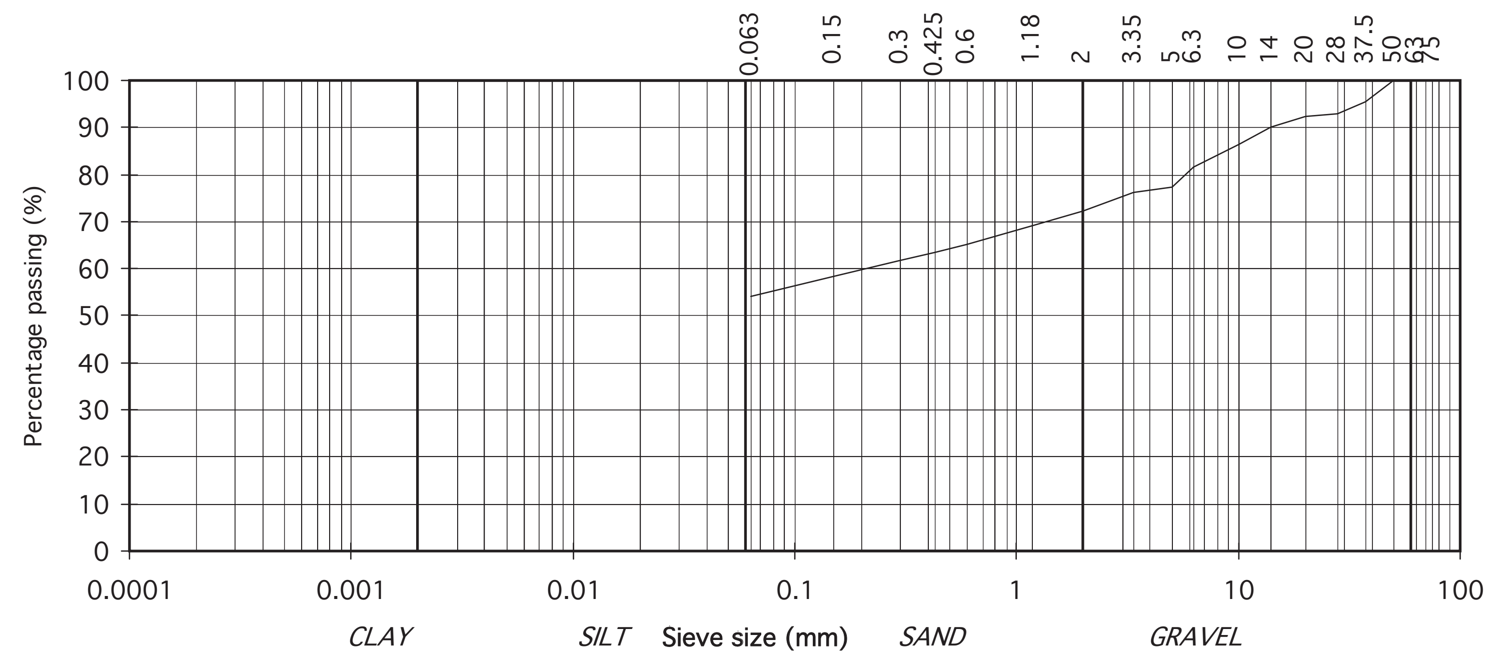
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 133T

Contract No: 21475 Report No. R100486
Contract: Greenlink Interconnector
BH/TP : ST09
Sample No. AA111774 Lab. Sample No. A19/1448
Sample Type: B
Depth (m) 1.25 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Mottled grey/brown slightly sandy, slightly gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	96	
28	93	
20	92	
14	90	
10	86	
6.3	81	
5	77	
3.35	76	
2	72	
1.18	69	SAND
0.6	65	
0.425	64	
0.3	62	
0.15	58	
0.063	54	SILT/CLAY



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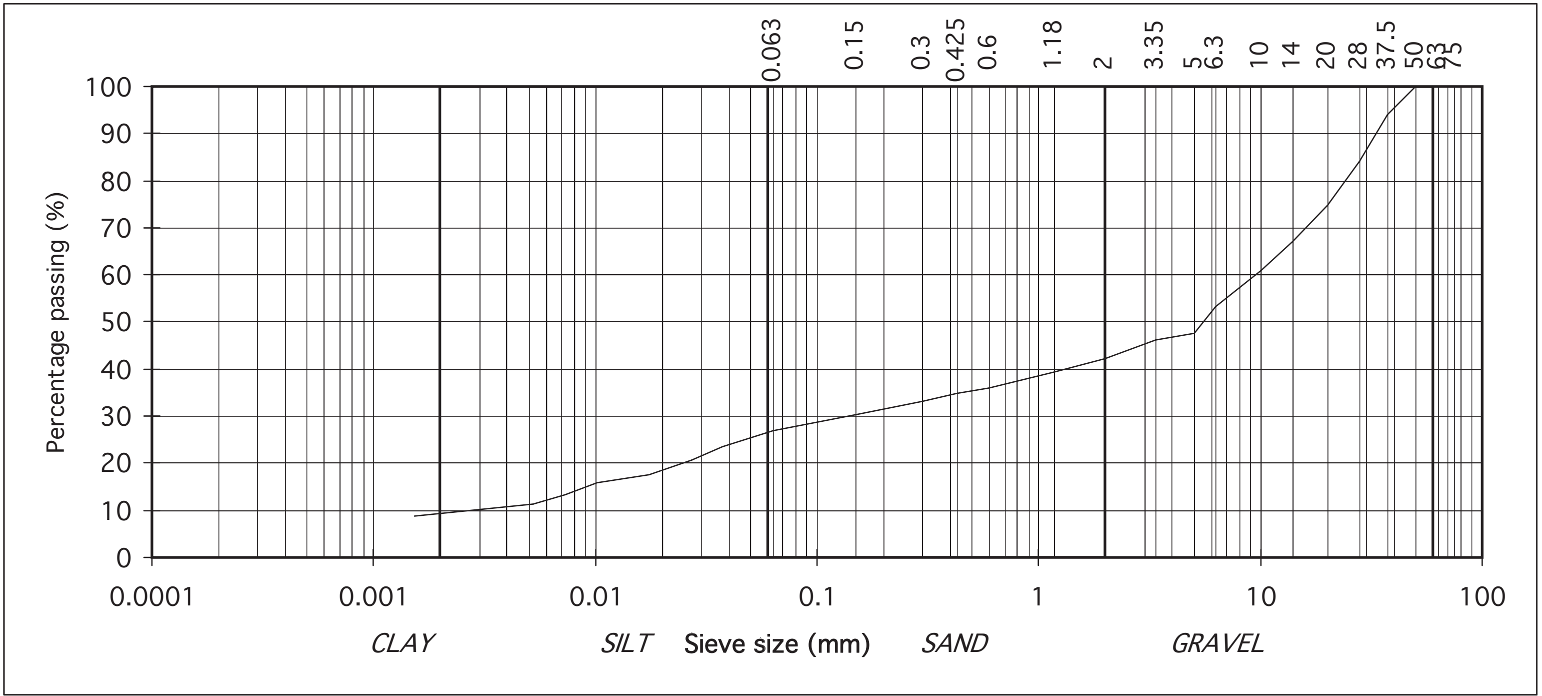
Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

Contract No: 21475 Report No. R100536
Contract: Greenlink Interconnector
BH/TP : ST10
Sample No. AA109864 Lab. Sample No. A19/1449
Sample Type: B
Depth (m) 1.00 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Mottled grey/brown slightly sandy, gravelly, CLAY

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	94	
28	84	
20	75	
14	67	
10	61	
6.3	53	
5	48	
3.35	46	
2	42	
1.18	39	SAND
0.6	36	
0.425	35	
0.3	33	
0.15	30	
0.063	27	SILT/CLAY
0.038	24	
0.027	21	
0.017	18	
0.010	16	
0.007	13	
0.005	11	
0.002	9	



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Approved by: H Byrne
Date: 24/04/19
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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

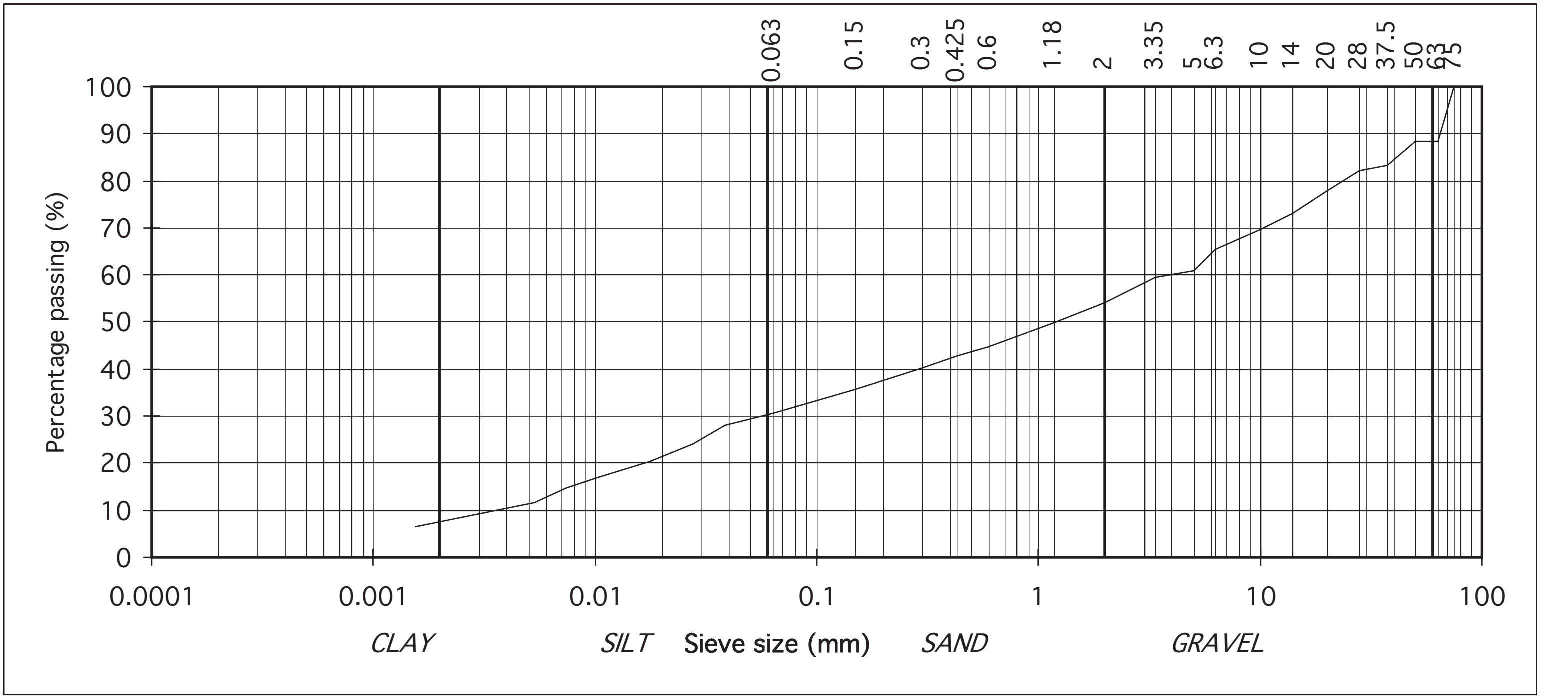
TEST REPORT
Determination of Particle Size Distribution
Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025
INAB
ACCREDITED
TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	88	
50	88	GRAVEL
37.5	83	
28	82	
20	78	
14	73	
10	70	
6.3	65	
5	61	
3.35	59	
2	54	
1.18	50	SAND
0.6	45	
0.425	43	
0.3	40	
0.15	36	
0.063	31	SILT/CLAY
0.038	28	
0.028	24	
0.018	20	
0.010	17	
0.007	15	
0.005	12	
0.002	6	

Contract No: 21475 Report No. R100487
Contract: Greenlink Interconnector
BH/TP : ST18
Sample No. AA109876 Lab. Sample No. A19/1453
Sample Type: B
Depth (m) 0.50 Customer: Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received 26/03/2019 Date Testing started 02/04/2019
Description: Mottled orange/brown slightly sandy, gravelly, SILT with some cobbles

Remarks Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016 Sample size did not meet the requirements of BS1377



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Approved by:	Date:	Page no:
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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

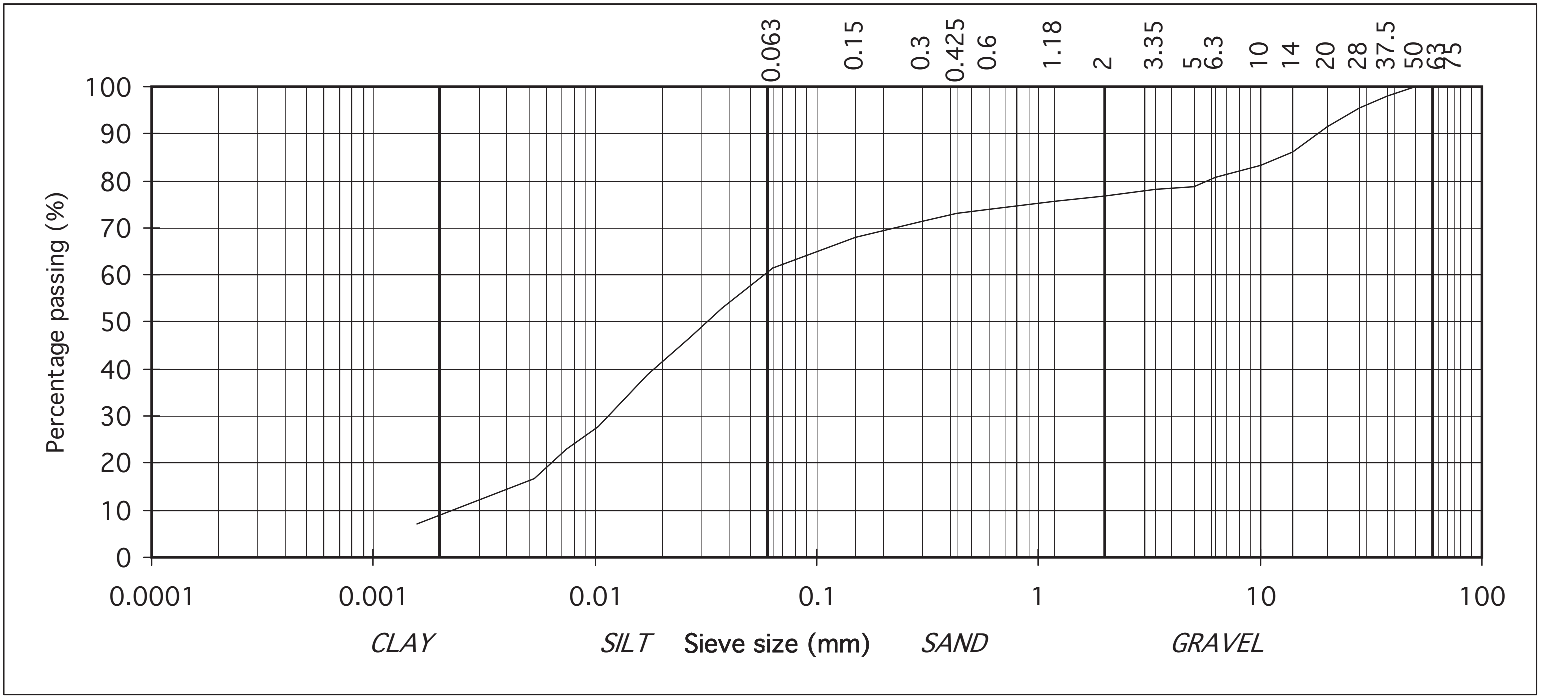
TEST REPORT
Determination of Particle Size Distribution

Tested in accordance with: BS1377:Part2:1990 , clause 9.2 & 9.5
(note: Sedimentation stage not accredited)

ISO 17025
INAB
ACCREDITED
TESTING
DETAILED IN SCOPE REG NO. 133T

particle size	% passing	
75	100	COBBLES
63	100	
50	100	GRAVEL
37.5	98	
28	95	
20	91	
14	86	
10	83	
6.3	81	
5	79	
3.35	78	
2	77	
1.18	76	SAND
0.6	74	
0.425	73	
0.3	71	
0.15	68	
0.063	62	SILT/CLAY
0.037	53	
0.027	47	
0.017	39	
0.010	28	
0.007	23	
0.005	17	
0.002	7	

Contract No:	21475	Report No.	R100488
Contract:	Greenlink Interconnector		
BH/TP :	ST19		
Sample No.	AA109880	Lab. Sample No.	A19/1456
Sample Type:	B		
Depth (m)	0.90	Customer:	Arup, 50 Ringsend Rd, Grand Canal Dock, Dublin 4
Date Received	26/03/2019	Date Testing started	02/04/2019
Description:	Mottled orange/brown slightly sandy, slightly gravelly, SILT		
Remarks	Note: Clause 9.2 and Clause 9.5 of BS1377:Part 2:1990 have been superseded by ISO17892-4:2016		



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Persons authorised to approve report: J Barrett (Quality Manager) H Byrne (Laboratory Manager)

IGSL Ltd
Materials Laboratory
Unit F, M7 Business Park
Naas
Co. Kildare

045-899324

Test Report

Undrained shear strength in triaxial compression (without pore pressure measurement)

Tested in accordance with BS1377:Part 7:1990 clause 8
(definitive method)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

Report no: R98974

Contract Name: Greenlink Interconnector

Contract No: 21475

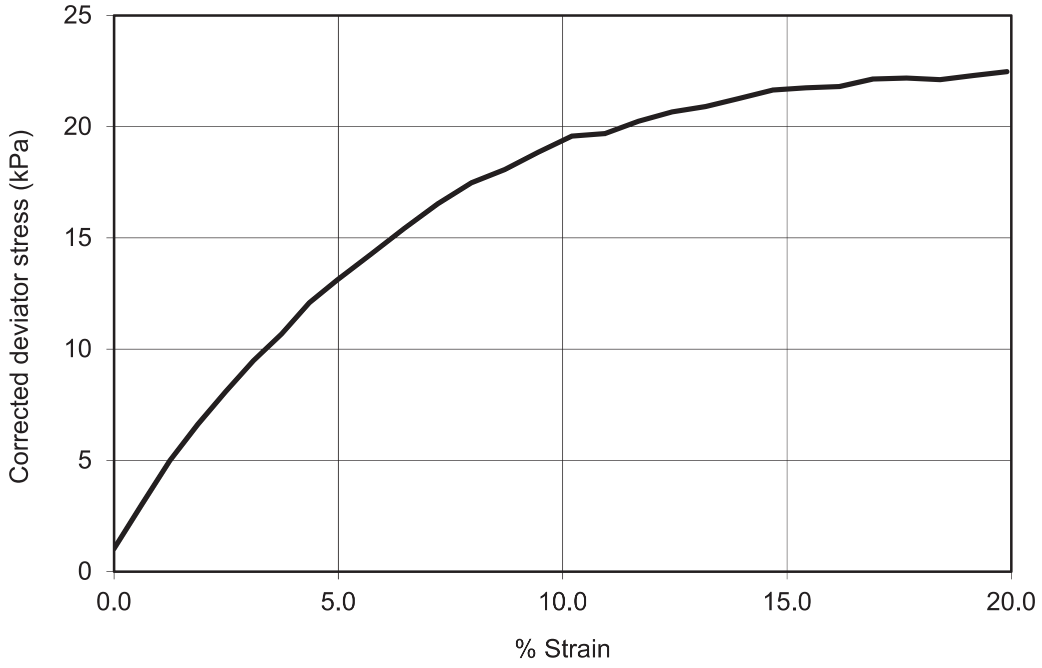
Location: BH06-3 @ 4.5m

Sample No. -

Description: Grey sandy organic SILT/CLAY

Customer: ARUP

Height (mm)	201	Diameter	102	Cell pressure(kPa)	90
Moisture Content %	51	Bulk density (Mg/m^3)	1.72	Dry density (Mg/m^3)	1.14



Strain at failure % 19.9

Cohesion C_u (kPa) 11
(Undrained shear strength kPa)

Rate of strain (%/minute) 2.1

Thickness of membrane 0.2

Membrane correction (at failure) 0.75

Date received -

Date tested 22/02/19

The result relates to the specimen tested.
Any remaining material will be retained for one month.

Person authorised to approve report: J Barrett (Quality Manager)

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IGSL Ltd
Materials Laboratory
Unit F, M7 Business Park
Naas
Co. Kildare

045-899324

Test Report

Undrained shear strength in triaxial compression (without pore pressure measurement)

Tested in accordance with BS1377:Part 7:1990 clause 8
(definitive method)

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.133T

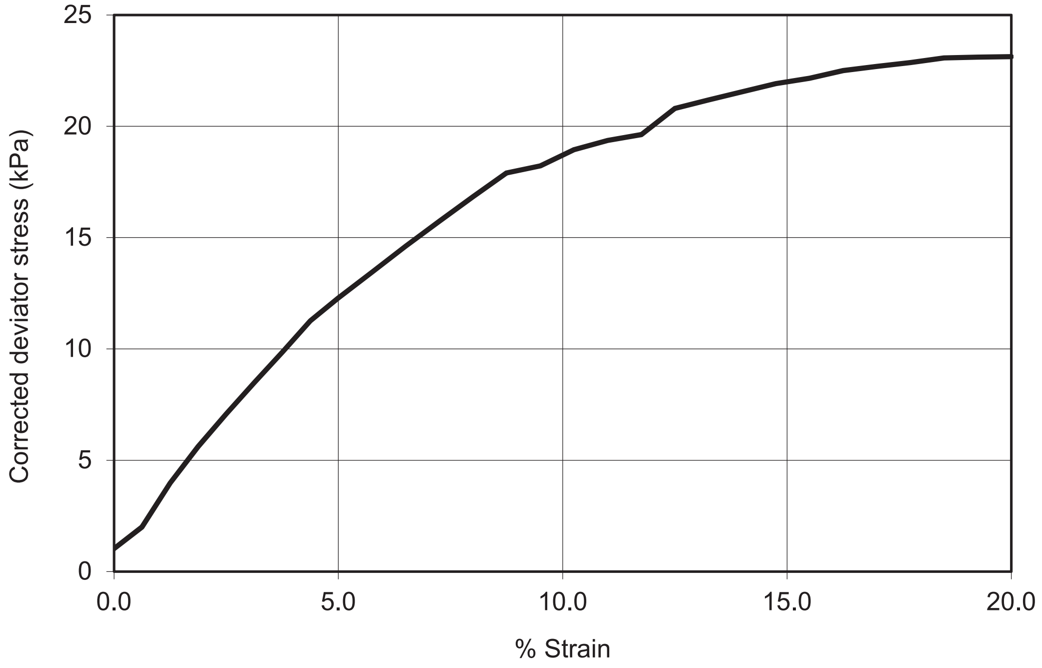
Report no: R98975

Contract Name:	Greenlink Interconnector	Contract No:	21475
Location:	BH06-3 @ 8.5m	Sample No.	-

Description: Grey sandy organic SILT/CLAY

Customer: ARUP

Height (mm)	200	Diameter	102	Cell pressure(kPa)	170
Moisture Content %	49	Bulk density (Mg/m^3)	1.73	Dry density (Mg/m^3)	1.16



Strain at failure %	20	Cohesion C_u (kPa) (Undrained shear strength kPa)	12
Rate of strain (%/minute)	2.1		
Thickness of membrane	0.2	Membrane correction (at failure)	0.75
Date received	-	Date tested	27/02/19

The result relates to the specimen tested.
Any remaining material will be retained for one month.

Person authorised to approve report: J Barrett (Quality Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100336**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109862
Location	ST1 at 1.2m
Soil description	Orangish brown mottled grey slightly sandy slightly gravelly SILT/CLAY
Preparation	<8mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	05/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.13	0.88
2	1.07	0.93
3	1.00	1.00
4	0.97	1.03
5	1.14	0.87
Average	1.06	0.94

Bulk density (Mg/m3)	1.80
Dry density (Mg/m3)	1.42
Water Content (%)	26.6
Porosity	0.46
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100337**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109856
Location	ST4 at 1.2m
Soil description	Brown mottled greyish brown slightly sandy slightly gravelly SILT/CLAY
Preparation	<20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.57	0.64
2	1.51	0.66
3	1.41	0.71
Average	1.50	0.67

Bulk density (Mg/m3)	1.90
Dry density (Mg/m3)	1.58
Water Content (%)	20.4
Porosity	0.40
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100338**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109854
Location	ST7 at 1.2m
Soil description	Brown mottled orangish brown slightly sandy slightly gravelly SILT/CLAY
Preparation	<20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.65	0.60
2	1.58	0.63
3	1.58	0.63
Average	1.60	0.62

Bulk density (Mg/m3)	2.16
Dry density (Mg/m3)	1.90
Water Content (%)	13.6
Porosity	0.28
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
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H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100339**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109860
Location	ST8 at 1.2m
Soil description	Reddish brown slightly sandy gravelly SILT/CLAY
Preparation	<8mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	05/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.88	0.53
2	1.55	0.64
3	1.94	0.51
4	1.89	0.53
5	1.72	0.58
Average	1.80	0.56

Bulk density (Mg/m3)	2.08
Dry density (Mg/m3)	1.74
Water Content (%)	19.2
Porosity	0.34
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100549**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA111775
Location	ST9 at 1.2m
Soil description	Yellowish brown mottled grey slightly sandy slightly gravelly SILT/CLAY
Preparation	<8mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	09/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.32	0.76
2	1.15	0.87
3	1.42	0.70
Average	1.30	0.78

Bulk density (Mg/m3)	2.07
Dry density (Mg/m3)	1.77
Water Content (%)	17.1
Porosity	0.33
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100340**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109864
Location	ST10 at 1.2m
Soil description	Yellowish brown mottled grey slightly sandy slightly gravelly SILT/CLAY
Preparation	<8mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	05/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.16	0.86
2	1.22	0.82
3	1.19	0.84
Average	1.19	0.84

Bulk density (Mg/m3)	1.92
Dry density (Mg/m3)	1.60
Water Content (%)	19.7
Porosity	0.40
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100341**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA111778
Location	ST16 at 1.2m
Soil description	Yellowish brown mottled grey slightly sandy slightly gravelly SILT/CLAY
Preparation	<20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.66	0.60
2	1.97	0.51
3	2.11	0.47
4	1.76	0.57
Average	1.88	0.54

Bulk density (Mg/m3)	2.13
Dry density (Mg/m3)	1.84
Water Content (%)	15.9
Porosity	0.30
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No. **R100342**

Contract No. 21475

Contract Name: Greenlink Interconnector

Client: ARUP

Sample No. AA109875

Location ST17 at 1.3m

Soil description Yellowish brown mottled grey slightly sandy slightly gravelly SILT/CLAY

Preparation <8mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.

Date Tested: 05/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.68	0.59
2	1.73	0.58
3	1.72	0.58
Average	1.71	0.58

Bulk density (Mg/m3)	2.00
Dry density (Mg/m3)	1.65
Water Content (%)	21.2
Porosity	0.38
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Co. Kildare

Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No. **R100343**

Contract No. 21475

Contract Name: Greenlink Interconnector

Client: ARUP

Sample No. AA109878

Location ST18 at 1.2m

Soil description Yellowish brown mottled grey slightly sandy slightly gravelly SILT/CLAY

Preparation <20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.

Date Tested: 02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.80	0.56
2	1.85	0.54
3	1.87	0.54
Average	1.84	0.55

Bulk density (Mg/m3)	2.17
Dry density (Mg/m3)	1.89
Water Content (%)	15.1
Porosity	0.29
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100344**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109881
Location	ST19 at 1.2m
Soil description	Brown slightly sandy slightly gravelly SILT/CLAY
Preparation	<20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.67	0.60
2	1.50	0.66
3	1.76	0.57
Average	1.64	0.61

Bulk density (Mg/m3)	2.00
Dry density (Mg/m3)	1.66
Water Content (%)	20.6
Porosity	0.37
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100345**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109884
Location	ST20 at 1.2m
Soil description	Brown slightly sandy slightly gravelly SILT/CLAY
Preparation	<20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.89	0.53
2	1.72	0.58
3	1.44	0.69
Average	1.68	0.60

Bulk density (Mg/m3)	2.07
Dry density (Mg/m3)	1.86
Water Content (%)	11.3
Porosity	0.30
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

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Test Report

Determination of Thermal Conductivity of Soil by Thermal Needle Probe

Report No.	**R100346**
Contract No.	21475
Contract Name:	Greenlink Interconnector
Client:	ARUP
Sample No.	AA109887
Location	ST21 at 1.2m
Soil description	Brown sandy slightly gravelly SILT/CLAY
Preparation	<20mm soil remoulded into 200x100mm container at as received moisture content. Left for 24hrs before testing.
Date Tested:	02/04/2019

Test No.	Thermal Conductivity K (W/m.k)	Thermal Resistivity R (m K/W)
1	1.35	0.74
2	1.46	0.69
3	1.36	0.74
Average	1.39	0.72

Bulk density (Mg/m3)	1.87
Dry density (Mg/m3)	1.59
Water Content (%)	17.3
Porosity	0.40
Particle density (assumed)	2.65

Notes: Water content measured in accordance with ISO 17892-1:2014. Bulk density measured by linear measurement. Porosity calculated (voids ratio/1+voids ratio). Thermal measurements undertake using a TEMPOS and TR3 probe (manufactured by METER Group). Needle probe inserted into pre-drilled hole.

The result relates to the specimen tested.
Any remaining material will be retained for one month.
Opinions and interpretations are outside the scope of accreditation.

Persons authorised to approve report
J Barrett (Quality Manager)
H Byrne (Laboratory Manager)

IGSL Materials Laboratory	Approved by	Date	Page
		06/04/19	1 of 1

Appendix 8 - Geotechnical Rock Laboratory Test Records

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

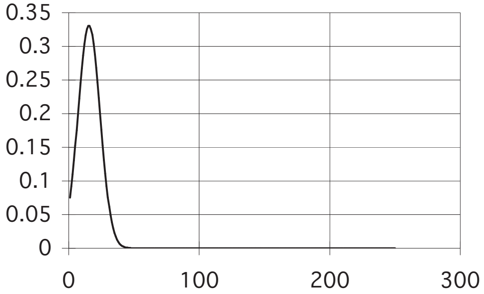
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC01-1	4.0	102	4.0	1.378	0.38	0.53	11	d	//
	9.5	102	8.0	1.378	0.77	1.06	21	d	//
	16.4	102	4.0	1.378	0.38	0.53	11	d	//
	20.0	102	2.0	1.378	0.19	0.26	5	d	//
	24.2	102	11.0	1.378	1.06	1.46	29	d	//
	25.4	102	4.0	1.378	0.38	0.53	11	d	//
	28.6	102	8.0	1.378	0.77	1.06	21	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	7	7
Minimum	0.26	5
Average	0.78	16
Maximum	1.46	29
Standard Dev.	0.42	8
Upper 95% Confidence Limit	1.60	32.06
Lower 95% Confidence Limit	-0.05	-1.02

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

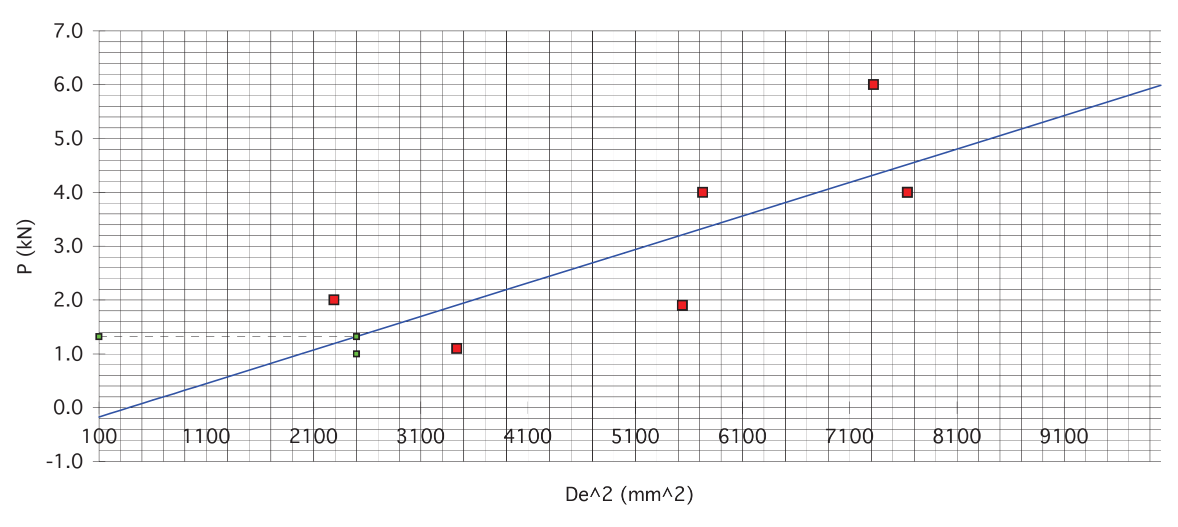
Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

Sample Type: Irregular Sample

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC01-1	4.0	40.0	50.0	60	1.1	3438	59	0.32
	9.5	80.0	80.0	75	4.0	7640	87	0.52
	16.4	70.0	75.0	60	1.9	5539	74	0.34
	20.0	110.0	120.0	50	6.0	7321	86	0.82
	24.2	50.0	40.0	40	2.0	2292	48	0.87
	25.4	80.0	70.0	80	4.0	7640	87	0.52
	28.6	90.0	60.0	60	4.0	5730	76	0.70



9135228642197987655

Calculation of Is(50)

Equation of Best Fit P = 0.00062 De^2 + -0.235253347

P(50) at D(50) from graph = 1.32 kN

Is(50) = (P(50)/2500) x 1000 = 0.5 MN/m^2

IS(50) X 20 = UCS approximately = 10.5661788 MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 12/03/19

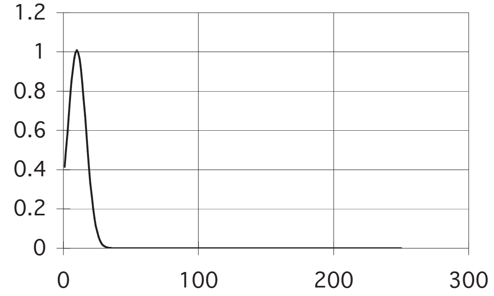
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC02-1	5.5	102	2.0	1.378	0.19	0.26	5	d	//
	9.9	102	7.0	1.378	0.67	0.93	19	d	//
	14.3	102	7.0	1.378	0.67	0.93	19	d	//
	19.4	102	2.0	1.378	0.19	0.26	5	d	//
	21.8	102	2.0	1.378	0.19	0.26	5	d	//
	26.7	102	3.0	1.378	0.29	0.40	8	d	//
	27.7	102	5.0	1.378	0.48	0.66	13	d	//
	29.1	102	2.0	1.378	0.19	0.26	5	d	//
	32.1	102	1.0	1.378	0.10	0.13	3	d	//
	36.7	102	1.0	1.378	0.10	0.13	3	d	//
	38.9	102	2.0	1.378	0.19	0.26	5	d	//
	43.1	102	3.0	1.378	0.29	0.40	8	d	//
	45.3	102	4.0	1.378	0.38	0.53	11	d	//
	47.2	102	10.0	1.378	0.96	1.32	26	d	//
	51.2	102	5.0	1.378	0.48	0.66	13	d	//
	56.9	102	2.0	1.378	0.19	0.26	5	d	//
	59.9	102	6.0	1.378	0.58	0.79	16	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	17	17
Minimum	0.13	3
Average	0.50	10
Maximum	1.32	26
Standard Dev.	0.34	7
Upper 95% Confidence Limit	1.16	23.15
Lower 95% Confidence Limit	-0.16	-3.21

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

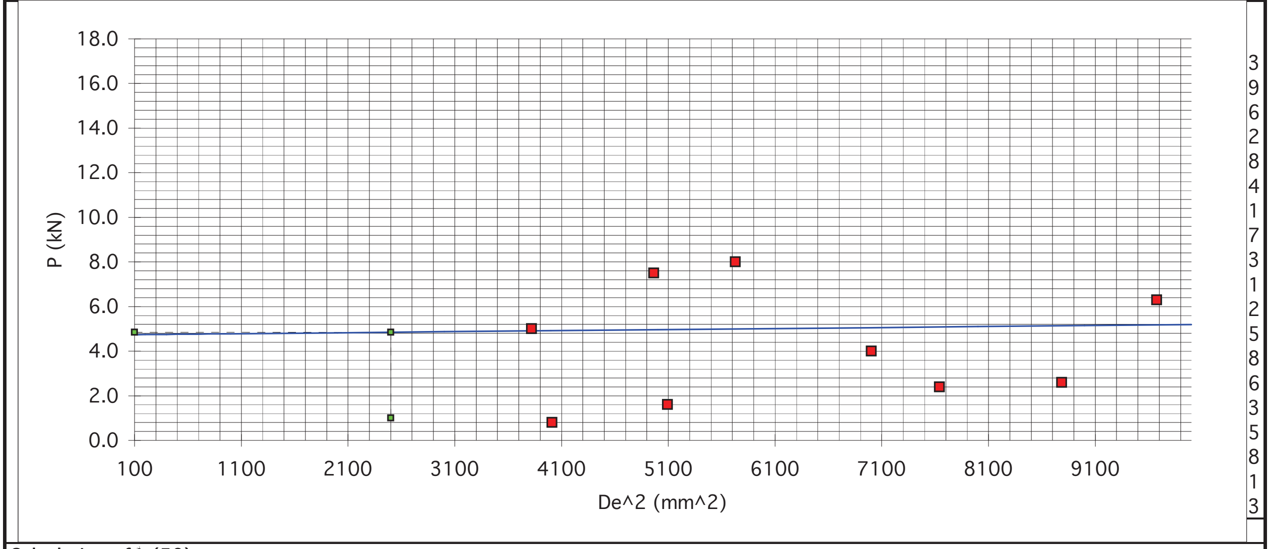
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 12/03/2019

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC02-1	5.5	120.0	90.0	30	0.8	4011	63	0.20
	9.9	80.0	70.0	60	8.0	5730	76	1.40
	14.3	70.0	80.0	80	2.4	7640	87	0.31
	19.4	70.0	100.0	200	3.0	21646	147	0.14
	21.8	50.0	60.0	100	4.0	7003	84	0.57
	26.7	80.0	70.0	40	5.0	3820	62	1.31
	27.7	110.0	80.0	100	3.0	12096	110	0.25
	29.1	80.0	80.0	50	1.6	5093	71	0.31
	32.1	80.0	150.0	70	1.8	10250	101	0.18
	36.7	100.0	130.0	60	2.6	8786	94	0.30
	38.9	120	70	80	6.3	9677	98	0.65
	43.1	70	60	150	1.2	12414	111	0.10
	45.3	80	100	100	7	11459	107	0.61
	47.2	80	80	100	16	10186	101	1.57
	51.2	110	50	120	15	12223	111	1.23
	56.9	90	70	120	2.6	12223	111	0.21
	59.9	80	50	60	7.5	4966	70	1.51



Calculation of Is(50)

Equation of Best Fit	P =	4.6E-05	De^2 +	4.732675347
P(50) at D(50) from graph =		4.85	kN	
Is(50) = (P(50)/2500) x 1000 =		1.9	MN/m^2	
IS(50) X 20 = UCS approximately =		38.783946	MPa	

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 12/03/19

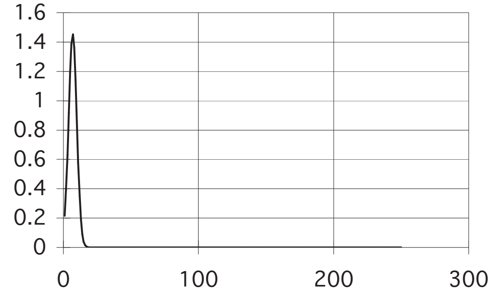
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC04-1	4.8	102	3.8	1.378	0.37	0.50	10	d	//
	9.8	102	4.2	1.378	0.40	0.56	11	d	//
	13.7	102	2.0	1.378	0.19	0.26	5	d	//
	18.4	102	2.4	1.378	0.23	0.32	6	d	//
	23.5	102	3.7	1.378	0.36	0.49	10	d	//
	29.0	102	2.5	1.378	0.24	0.33	7	d	//
	35.6	102	2.0	1.378	0.19	0.26	5	d	//
	40.0	102	0.7	1.378	0.06	0.09	2	d	//
	45.8	102	1.5	1.378	0.14	0.20	4	d	//
	50.1	102	2.0	1.378	0.19	0.26	5	d	//
	53.6	102	3.9	1.378	0.37	0.52	10	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	11	11
Minimum	0.09	2
Average	0.35	7
Maximum	0.56	11
Standard Dev.	0.15	3
Upper 95% Confidence Limit	0.64	12.82
Lower 95% Confidence Limit	0.05	0.98

Comments:
*UCS taken as k x Point Load Is(50):   k=   20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

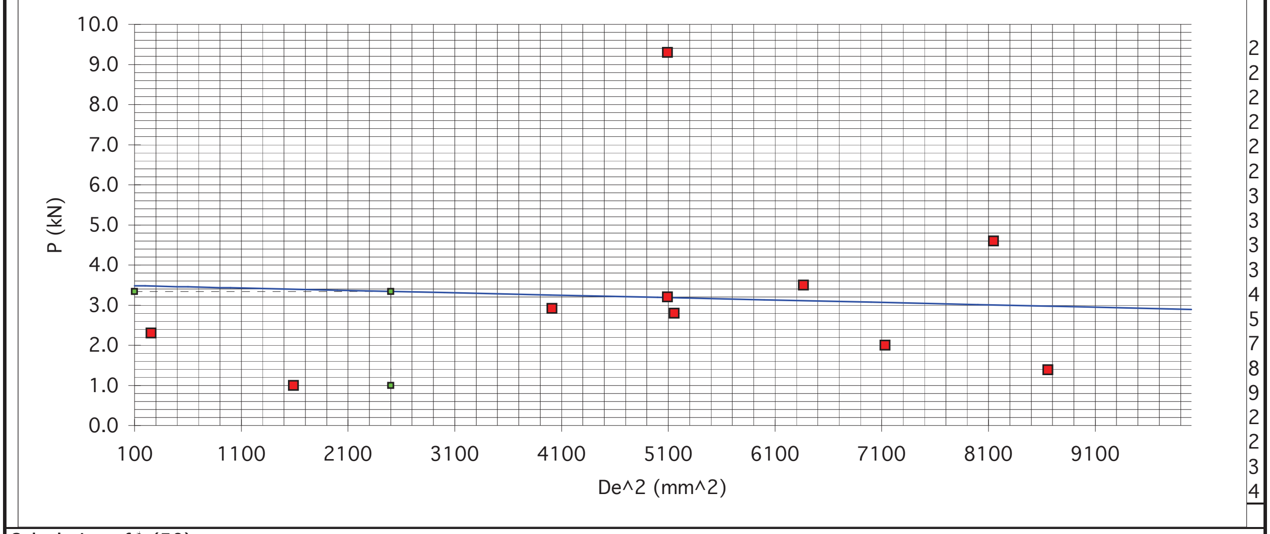
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 12/03/2019

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC04-1	4.8	100.0	100.0	120	1.4	15279	124	0.09
	9.8	80.0	80.0	70	2.0	7130	84	0.28
	13.7	80.0	90.0	80	1.4	8658	93	0.16
	18.4	30.0	40.0	90	2.9	4011	63	0.73
	23.5	80.0	80.0	80	4.6	8149	90	0.56
	29.0	80.0	80.0	50	3.2	5093	71	0.63
	35.6	50.0	40.0	90	2.8	5157	72	0.54
	40.0	60.0	40.0	100	3.5	6366	80	0.55
	45.8	40.0	40.0	100	9.3	5093	71	1.83
	50.1	20.0	32.0	48	1.0	1589	40	0.63
	53.6	20	20	10	2.3	255	16	9.03



Calculation of Is(50)

Equation of Best Fit	P =	-6E-05	De^2 +	3.491807112
P(50) at D(50) from graph =			3.34	kN
Is(50) = (P(50)/2500) x 1000 =			1.3	MN/m^2
IS(50) X 20 = UCS approximately =			26.7365449	MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

IGSL

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

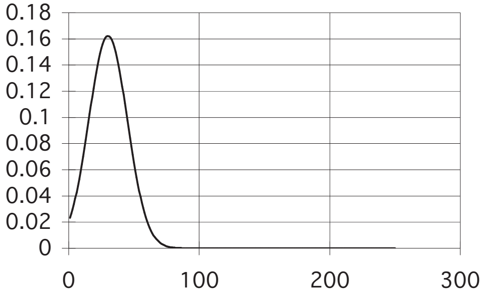
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC01-2	10.6	78	7.0	1.222	1.15	1.41	28	d	//
	12.2	78	9.0	1.222	1.48	1.81	36	d	//
	13.8	78	9.0	1.222	1.48	1.81	36	d	//
	14.6	78	7.0	1.222	1.15	1.41	28	d	//
	16.2	78	12.0	1.222	1.97	2.41	48	d	//
	17.9	78	1.0	1.222	0.16	0.20	4	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	6	6
Minimum	0.20	4
Average	1.51	30
Maximum	2.41	48
Standard Dev.	0.74	15
Upper 95% Confidence Limit	2.95	59.03
Lower 95% Confidence Limit	0.06	1.20

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

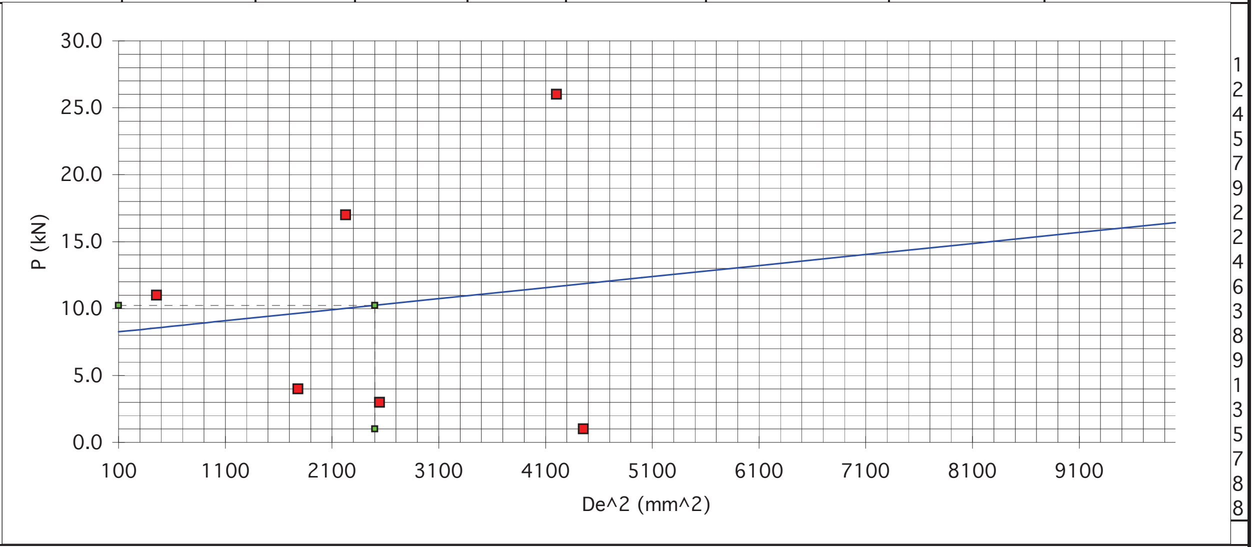
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC01-2	10.6	10.0	55.0	11	11.0	455	21	24.17
	12.2	90.0	10.0	40	3.0	2547	50	1.18
	13.8	40.0	30.0	40	4.0	1783	42	2.24
	14.6	40.0	30.0	50	17.0	2228	47	7.63
	16.2	60.0	50.0	60	26.0	4202	65	6.19
	17.9	60.0	40.0	70	1.0	4456	67	0.22



Calculation of Is(50)

Equation of Best Fit P = 0.00083 De^2 + 8.177125628

P(50) at D(50) from graph = 10.24 kN

Is(50) = (P(50)/2500) x 1000 = 4.1 MN/m^2

IS(50) X 20 = UCS approximately = 81.9282214 MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

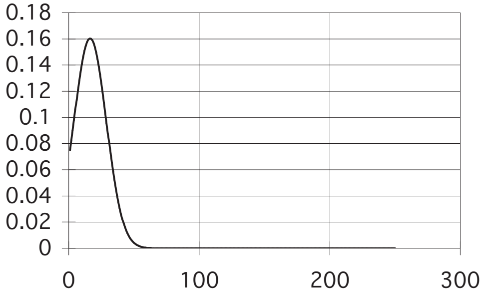
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC03-2	8.0	95	1.5	1.335	0.17	0.22	4	d	//
	12.0	95	1.2	1.335	0.13	0.18	4	d	//
	13.1	95	10.0	1.335	1.11	1.48	30	d	//
	14.9	78	7.0	1.222	1.15	1.41	28	d	//
	17.9	78	4.0	1.222	0.66	0.80	16	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	5	5
Minimum	0.18	4
Average	0.82	16
Maximum	1.48	30
Standard Dev.	0.62	12
Upper 95% Confidence Limit	2.04	40.73
Lower 95% Confidence Limit	-0.40	-8.04

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

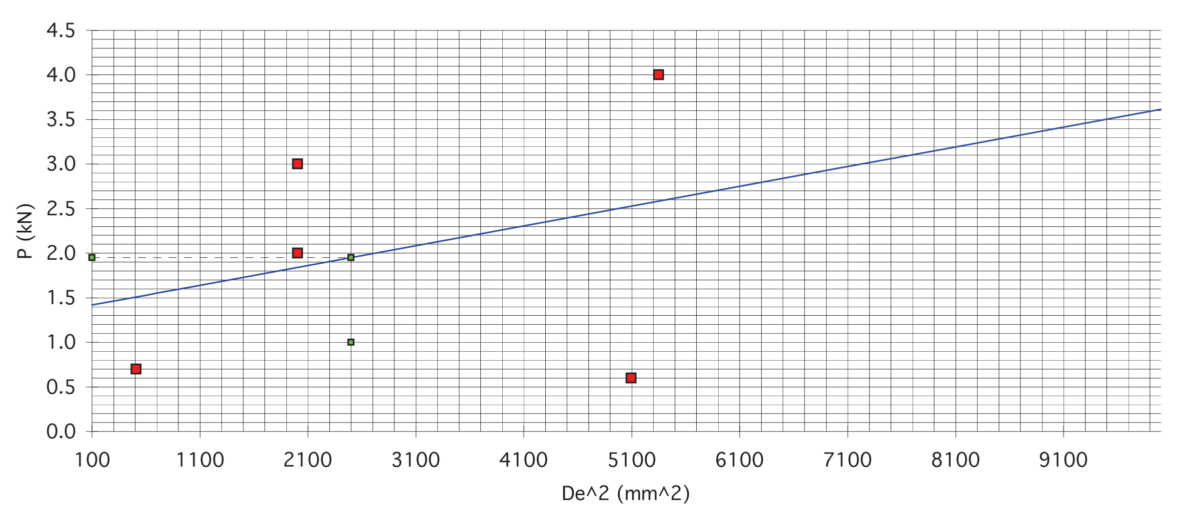
Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

Sample Type: Irregular Sample

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC03-2	8.0	70.0	90.0	50	0.6	5093	71	0.12
	12.0	70.0	10.0	10	0.7	509	23	1.37
	13.1	40.0	50.0	35	2.0	2005	45	1.00
	14.9	55.0	50.0	30	3.0	2005	45	1.50
	17.9	80.0	40.0	70	4.0	5348	73	0.75



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Calculation of Is(50)

Equation of Best Fit P = 0.00022 De^2 + 1.396024218
P(50) at D(50) from graph = 1.95 kN
Is(50) = (P(50)/2500) x 1000 = 0.8 MN/m^2
IS(50) X 20 = UCS approximately = 15.6062361 MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

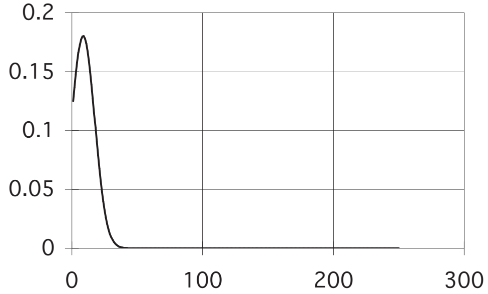
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC04-2	7.6	102	1.0	1.378	0.10	0.13	3	d	//
	10.6	78	0.6	1.222	0.10	0.12	2	d	//
	17.1	78	2.0	1.222	0.33	0.40	8	d	//
	17.2	78	5.3	1.222	0.87	1.06	21	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	4	4
Minimum	0.12	2
Average	0.43	9
Maximum	1.06	21
Standard Dev.	0.44	9
Upper 95% Confidence Limit	1.30	25.94
Lower 95% Confidence Limit	-0.44	-8.75

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

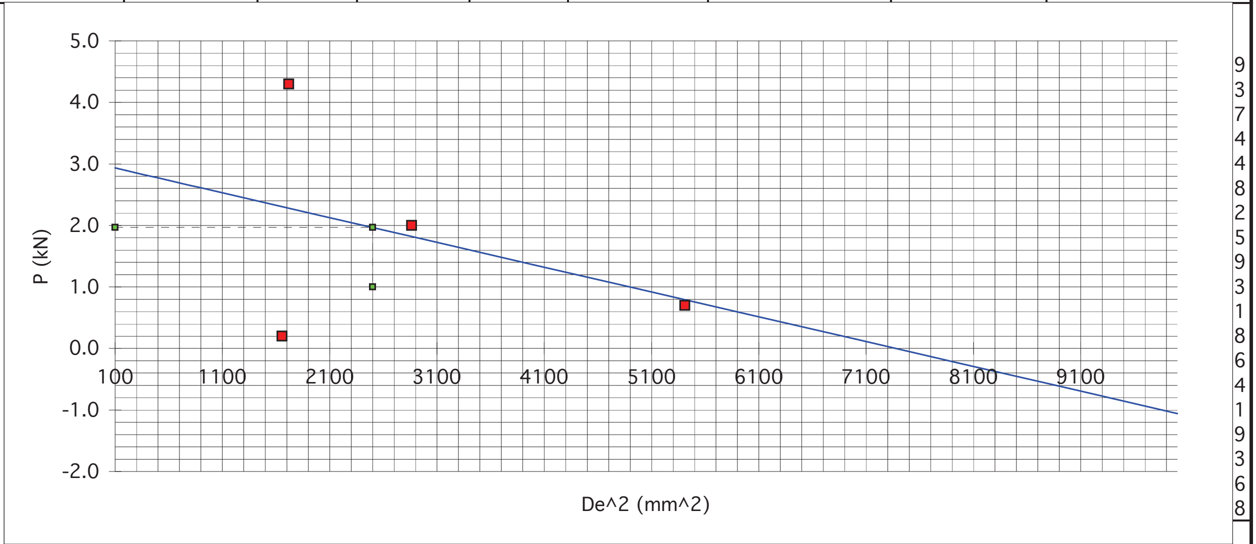
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC04-2	7.6	80.0	90.0	50	0.7	5411	74	0.13
	10.6	70.0	80.0	30	2.0	2865	54	0.70
	17.1	60.0	70.0	20	0.2	1655	41	0.12
	17.2	40.0	50.0	30	4.3	1719	41	2.50



Calculation of Is(50)

Equation of Best Fit	P =	-0.0004	De^2 +	2.974438725
P(50) at D(50) from graph =			1.97	kN
Is(50) = (P(50)/2500) x 1000 =			0.8	MN/m^2
IS(50) X 20 = UCS approximately =			15.7310306	MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

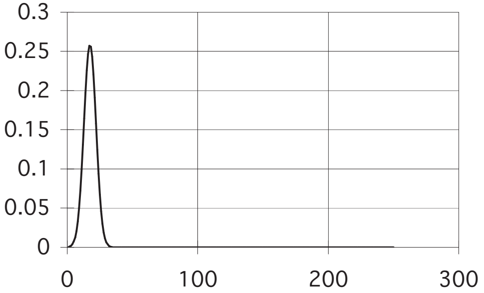
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC05-2	17.0	78	5.0	1.222	0.82	1.00	20	d	//
	17.5	78	3.0	1.222	0.49	0.60	12	d	//
	17.6	78	5.0	1.222	0.82	1.00	20	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	3	3
Minimum	0.60	12
Average	0.87	17
Maximum	1.00	20
Standard Dev.	0.23	5
Upper 95% Confidence Limit	1.32	26.49
Lower 95% Confidence Limit	0.42	8.31

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

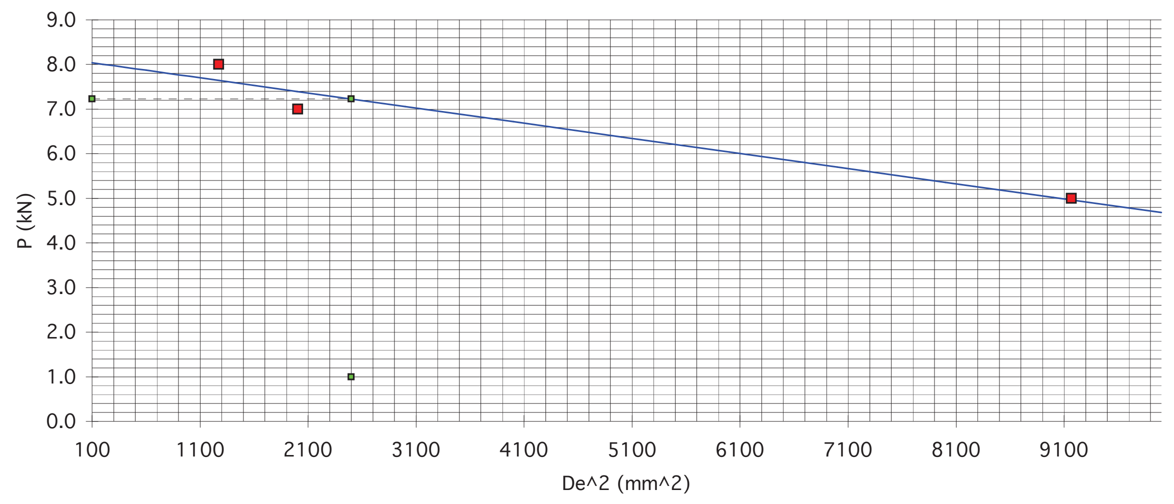
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC05-2	17.0	100.0	80.0	80	5.0	9168	96	0.55
	17.5	70.0	30.0	20	8.0	1273	36	6.28
	17.6	60.0	30.0	35	7.0	2005	45	3.49



4692581479876542199

Calculation of Is(50)

Equation of Best Fit P = -0.0003 De^2 + 8.074606331

P(50) at D(50) from graph = 7.23 kN

Is(50) = (P(50)/2500) x 1000 = 2.9 MN/m^2

IS(50) X 20 = UCS approximately = 57.8095732 MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 12/03/19

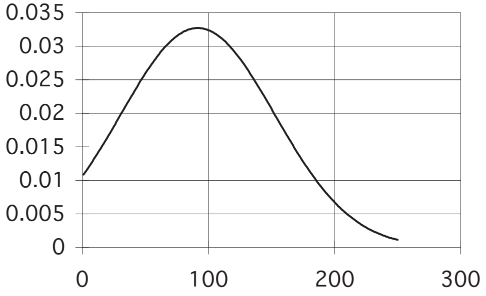
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC01-3	4.0	78	4.0	1.222	0.66	0.80	16	d	//
	6.6	78	27.0	1.222	4.44	5.42	108	d	//
	8.4	78	10.0	1.222	1.64	2.01	40	d	//
	9.7	78	39.0	1.222	6.41	7.83	157	d	//
	11.3	78	34.0	1.222	5.59	6.83	137	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	5	5
Minimum	0.80	16
Average	4.58	92
Maximum	7.83	157
Standard Dev.	3.05	61
Upper 95% Confidence Limit	10.55	211.10
Lower 95% Confidence Limit	-1.40	-27.99

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

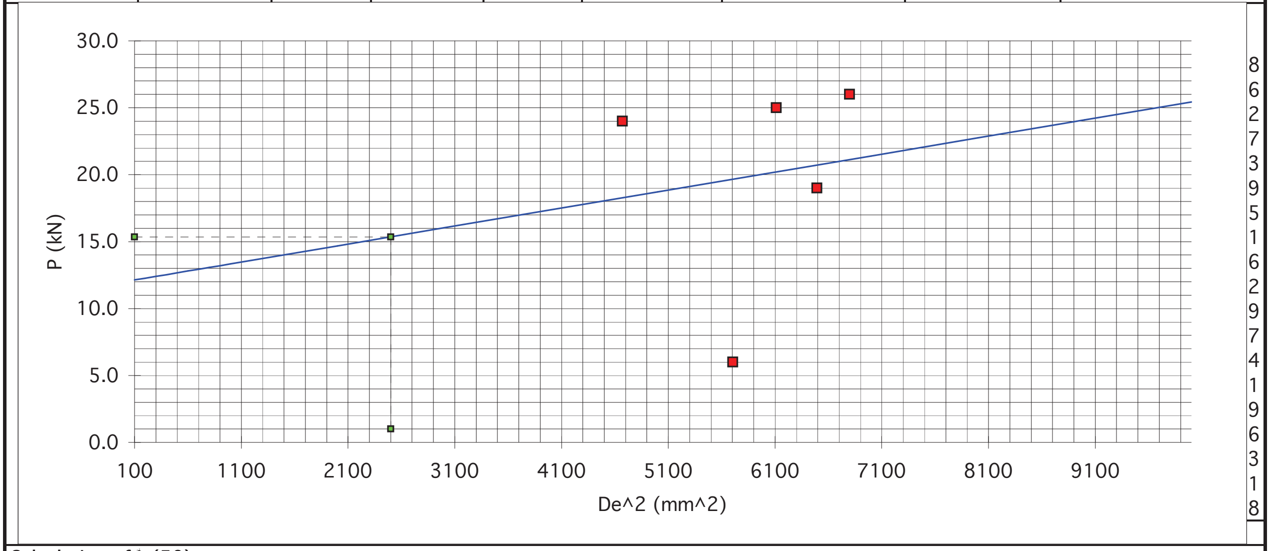
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 12/03/2019

Tested by: D.O'Shea

RC Hole No.	Depth	W1	W2	D	P	De^2	De	Is
		mm	mm	mm	kN	mm^2	mm	MN/m^2
RC01-3	4.0	82.0	78.0	56	6.0	5704	76	1.05
	6.6	78.0	82.0	60	25.0	6112	78	4.09
	8.4	65.0	66.0	56	24.0	4670	68	5.14
	9.7	54.0	46.0	102	19.0	6494	81	2.93
	11.3	88.0	90.0	60	26.0	6799	82	3.82



Calculation of Is(50)

Equation of Best Fit	P =	0.00134	De^2 +	11.99793104
P(50) at D(50) from graph =		15.36	kN	
Is(50) = (P(50)/2500) x 1000 =		6.1	MN/m^2	
IS(50) X 20 = UCS approximately =		122.8546	MPa	

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 27/3/19

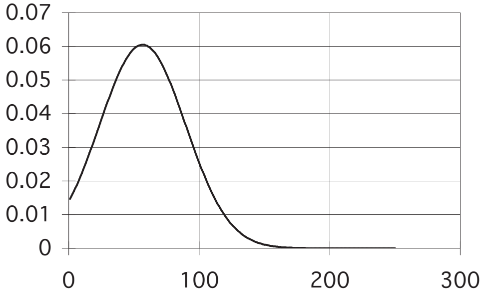
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC02-3	1.8	95	6.0	1.335	0.66	0.89	18	d	//
	7.6	78	6.0	1.222	0.99	1.20	24	d	//
	14.8	78	21.0	1.222	3.45	4.22	84	d	//
	19.9	78	18.0	1.222	2.96	3.61	72	d	//
	23.7	78	21.0	1.222	3.45	4.22	84	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	5	5
Minimum	0.89	18
Average	2.83	57
Maximum	4.22	84
Standard Dev.	1.65	33
Upper 95% Confidence Limit	6.06	121.19
Lower 95% Confidence Limit	-0.40	-8.08

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of <u>weakness/bedding</u>

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

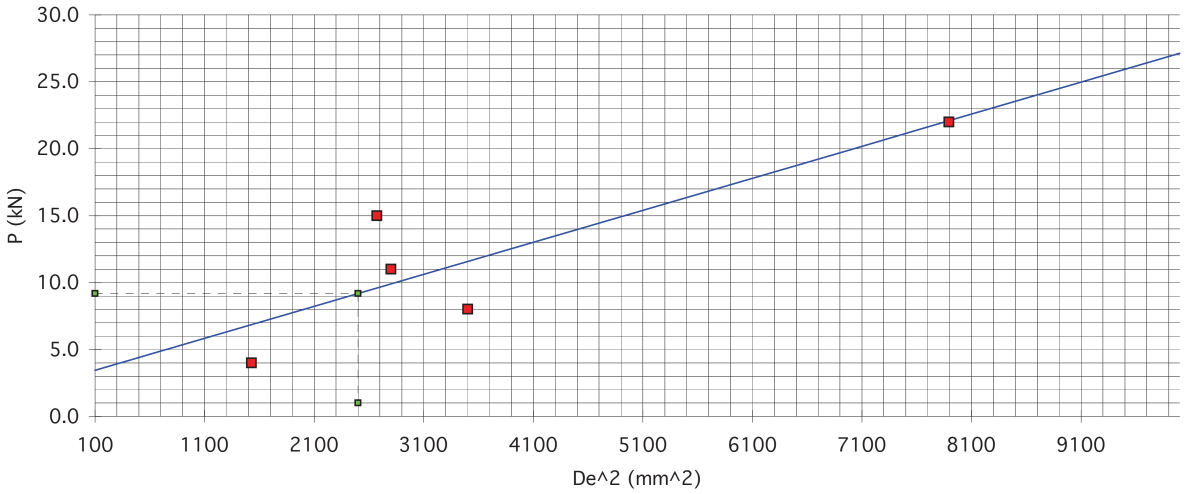
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 27/03/2019

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC02-3	1.8	70.0	50.0	35	15.0	2674	52	5.61
	7.6	60.0	50.0	50	8.0	3502	59	2.28
	14.8	40.0	40.0	30	4.0	1528	39	2.62
	19.9	50.0	60.0	40	11.0	2801	53	3.93
	23.7	80.0	75.0	80	22.0	7894	89	2.79



Calculation of Is(50)

Equation of Best Fit P = 0.00239 De^2 + 3.193744977

P(50) at D(50) from graph = 9.18 kN

Is(50) = (P(50)/2500) x 1000 = 3.7 MN/m^2

IS(50) X 20 = UCS approximately = 73.4130224 MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

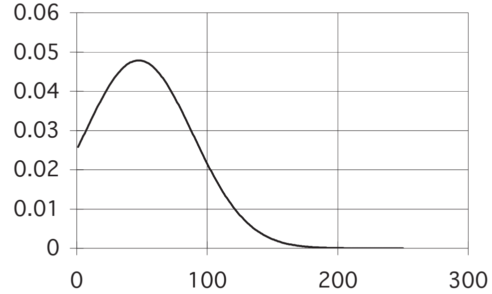
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC03-3	6.4	78	6.0	1.222	0.99	1.20	24	d	//
	9.5	78	15.0	1.222	2.47	3.01	60	d	//
	11.8	78	28.0	1.222	4.60	5.62	112	d	//
	17.0	78	1.0	1.222	0.16	0.20	4	d	//
	20.1	78	9.0	1.222	1.48	1.81	36	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	5	5
Minimum	0.20	4
Average	2.37	47
Maximum	5.62	112
Standard Dev.	2.08	42
Upper 95% Confidence Limit	6.45	129.06
Lower 95% Confidence Limit	-1.71	-34.30

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

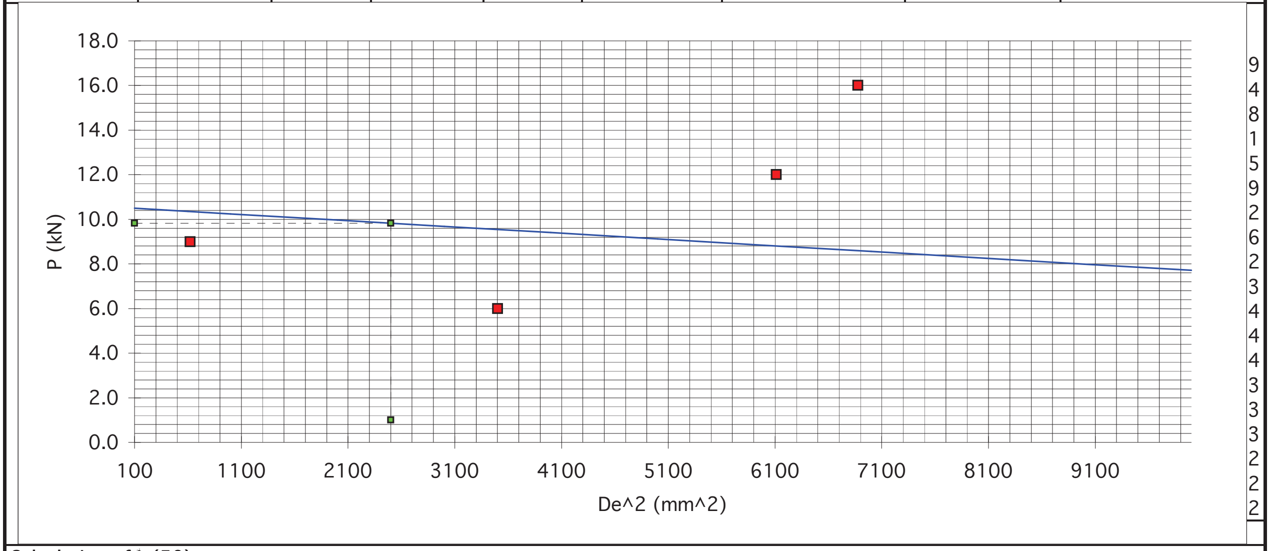
Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

Sample Type: Irregular Sample

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC03-3	6.4	90.0	90.0	60	16.0	6876	83	2.33
	9.5	35.0	30.0	15	9.0	621	25	14.50
	11.8	85.0	90.0	90	2.0	10027	100	0.20
	17.0	60.0	50.0	50	6.0	3502	59	1.71
	20.1	80.0	80.0	60	12.0	6112	78	1.96



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Calculation of Is(50)

Equation of Best Fit P = -0.0003 De^2 + 10.52812086

P(50) at D(50) from graph = 9.82 kN

Is(50) = (P(50)/2500) x 1000 = 3.9 MN/m^2

IS(50) X 20 = UCS approximately = 78.5937743 MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

Sample Type: Core

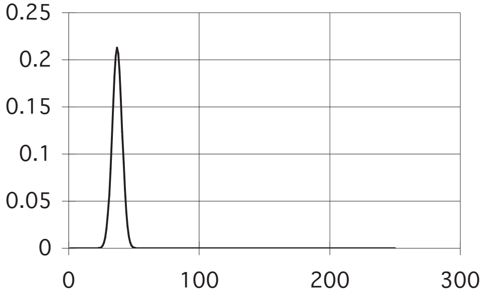
RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC04-3	8.2	102	13.0	1.378	1.25	1.72	34	d	//
	8.7	102	15.0	1.378	1.44	1.99	40	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	2	2
Minimum	1.72	34
Average	1.85	37
Maximum	1.99	40
Standard Dev.	0.19	4
Upper 95% Confidence Limit	2.22	44.44
Lower 95% Confidence Limit	1.49	29.75

Comments:

*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

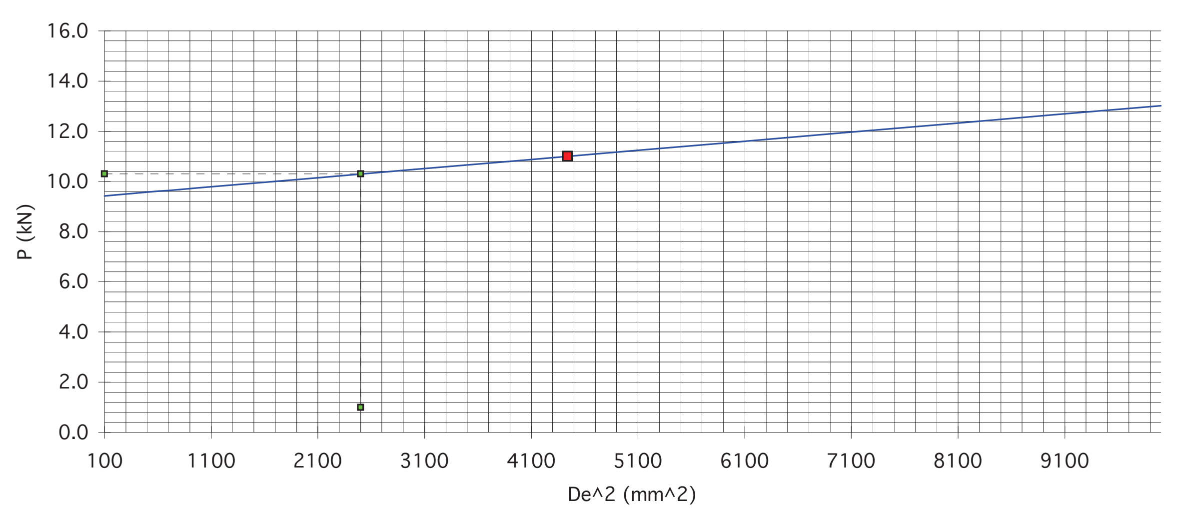
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 3/4/19

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC04-3	8.2	75.0	80.0	45	11.0	4441	67	2.48
	8.7	130.0	140.0	90	15.0	15470	124	0.97



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Calculation of Is(50)

Equation of Best Fit	P =	0.00036	De^2 +	9.38961039
P(50) at D(50) from graph =			10.30	kN
Is(50) = (P(50)/2500) x 1000 =			4.1	MN/m^2
IS(50) X 20 = UCS approximately =			82.3699856	MPa

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 27/3/19

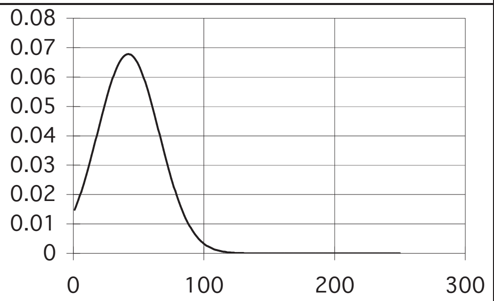
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC05-3	4.2	95	17.0	1.335	1.88	2.51	50	d	//
	7.9	95	21.0	1.335	2.33	3.11	62	d	//
	11.8	78	2.0	1.222	0.33	0.40	8	d	//
	15.1	65	9.0	1.125	2.13	2.40	48	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	4	4
Minimum	0.40	8
Average	2.10	42
Maximum	3.11	62
Standard Dev.	1.18	24
Upper 95% Confidence Limit	4.41	88.24
Lower 95% Confidence Limit	-0.20	-4.05

Comments:
*UCS taken as k x Point Load Is(50):   k=   20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of <u>weakness/bedding</u>

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

Contract: Greenlink Interconnector

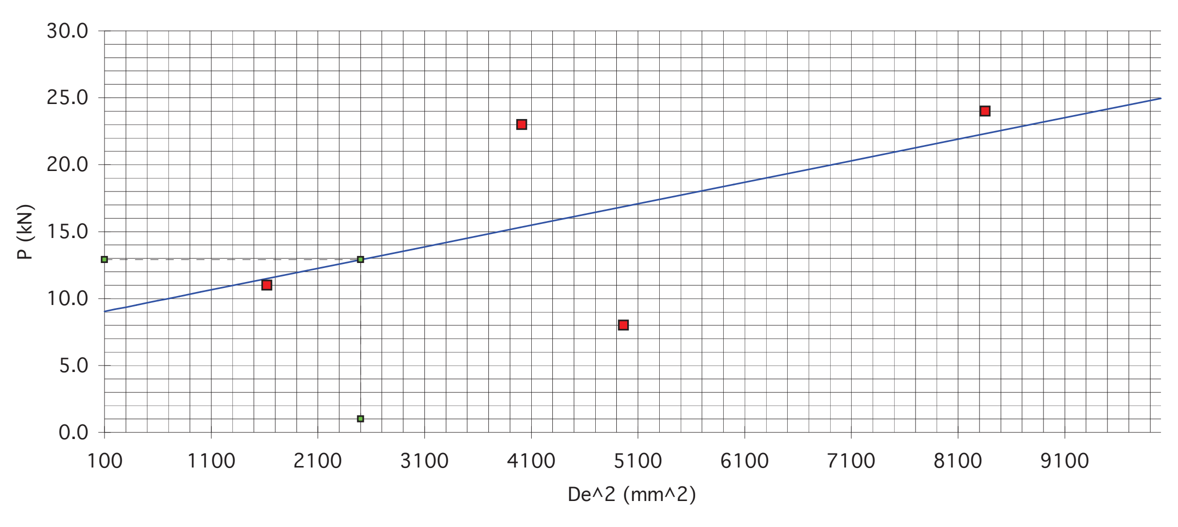
Sample Type: Irregular Sample

Contract No.: 21475

Date of Test: 27/03/2019

Tested by: D.O'Shea

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC05-3	4.2	50.0	55.0	60	23.0	4011	63	5.73
	7.9	40.0	45.0	30	11.0	1623	40	6.78
	11.8	80.0	95.0	75	24.0	8356	91	2.87
	15.1	55.0	65.0	65	8.0	4966	70	1.61



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Calculation of Is(50)

Equation of Best Fit	P =	0.00161	De^2 +	8.87525303
P(50) at D(50) from graph =		12.90	kN	
Is(50) = (P(50)/2500) x 1000 =		5.2	MN/m^2	
IS(50) X 20 = UCS approximately =		103.180889	MPa	

(Diametrial) POINT LOAD STRENGTH INDEX TEST DATA

Contract: Greenlink Interconnector
Contract no. 21475
Date of test: 3/4/19

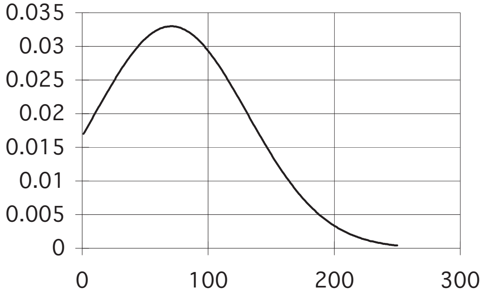
Sample Type: Core

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC06-3	7.8	78	10.0	1.222	1.64	2.01	40	d	//
	10.3	78	40.0	1.222	6.57	8.03	161	d	//
	11.9	78	8.0	1.222	1.31	1.61	32	d	//
	14.4	78	4.0	1.222	0.66	0.80	16	d	//
	18.8	78	26.0	1.222	4.27	5.22	104	d	//

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	5	5
Minimum	0.80	16
Average	3.53	71
Maximum	8.03	161
Standard Dev.	3.02	60
Upper 95% Confidence Limit	9.46	189.20
Lower 95% Confidence Limit	-2.39	-47.85

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations

i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Point Load Axial - Test Results

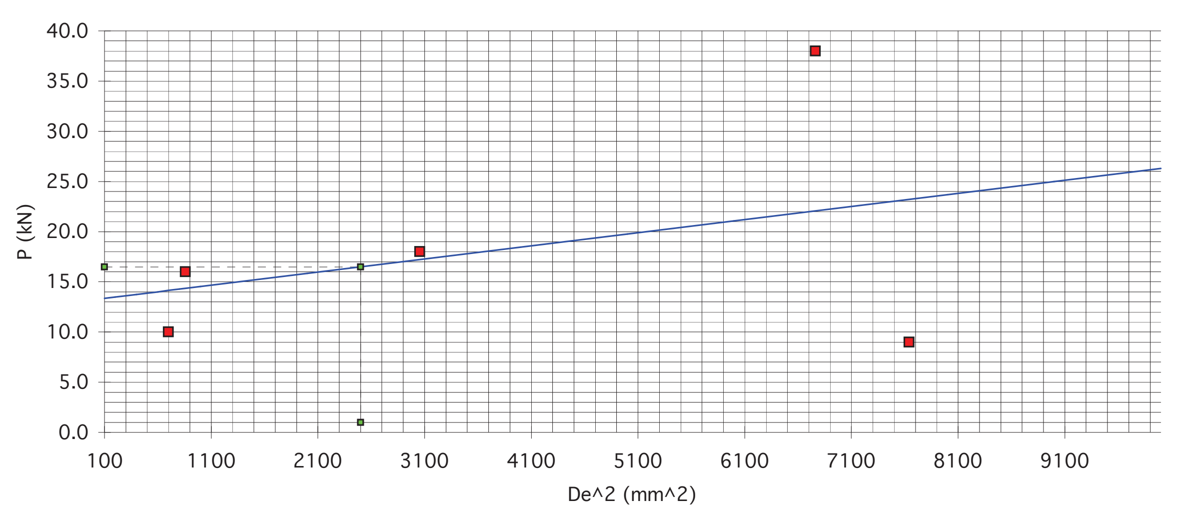
Contract: Greenlink Interconnector

Contract No.: 21475

Date of Test: 3/4/19 Tested by: D.O'Shea

Sample Type: Irregular Sample

RC Hole No.	Depth	W1 mm	W2 mm	D mm	P kN	De^2 mm^2	De mm	Is MN/m^2
RC06-3	7.8	50.0	70.0	100	9.0	7640	87	1.18
	10.3	20.0	35.0	20	10.0	700	26	14.28
	11.9	50.0	75.0	85	38.0	6764	82	5.62
	14.4	30.0	15.0	30	16.0	859	29	18.62
	18.8	50.0	70.0	40	18.0	3056	55	5.89



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Calculation of Is(50)

Equation of Best Fit	P =	0.00131	De^2 +	13.22226331
P(50) at D(50) from graph =		16.49	kN	
Is(50) = (P(50)/2500) x 1000 =		6.6	MN/m^2	
IS(50) X 20 = UCS approximately =		131.949755	MPa	

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC01-1
Depth (m):	19.8m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

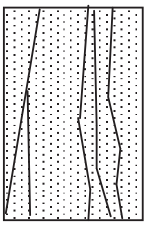
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	212	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	58	kN

Strength Calculations

Uniaxial Compressive Strength = $\dfrac{58000}{8167.14}$

= $\dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

= 7.10 (Mpa)

Bulk Density = 2.71 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC01-1
Depth (m):	23.8m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

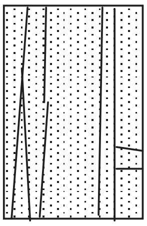
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	239	
Diameter (Ø)	102.1	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	154	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{154000}{8183.16185}$

$= \frac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 18.81 (Mpa)

Bulk Density = 2.77 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC01-1
Depth (m):	28.2m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

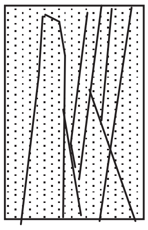
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	194	
Diameter (Ø)	102.1	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	42	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{42000}{8183.16185}$

$= \frac{1000 \times P}{\pi \times (Ø/2)^2}$

= 5.13 (Mpa)

Bulk Density = 2.70 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	21.20m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

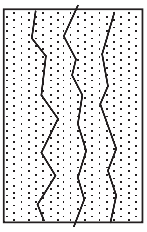
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	262	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	88	kN

Strength Calculations

Uniaxial Compressive Strength = $\dfrac{88000}{8167.14}$

$= \dfrac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 10.77 (Mpa)

Bulk Density = 2.77 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	26.90m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

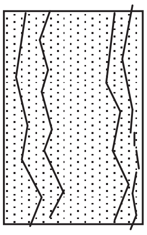
Sample Measurements

Length	254	
Diameter (Ø)	102.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	112	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{112000}{8183.16185}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 13.68 (Mpa)

Bulk Density = 2.75 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	28.20m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

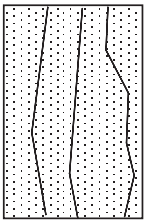
Sample Measurements

Length	211	
Diameter (Ø)	102	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	89	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $$\frac{89000}{8167.14}$$

$$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$$

= 10.89 (Mpa)

Bulk Density = 2.75 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	28.80m

Sample Description

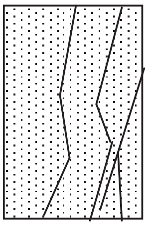
Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Sketch of Failure Surfaces



Length	188	
Diameter (Ø)	102.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	125	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{125000}{8183.16185}$

= $\frac{1000 \times P}{\pi \times (\text{Ø}/2)^2}$

= 15.27 (Mpa)

Bulk Density = 2.76 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	31.80m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

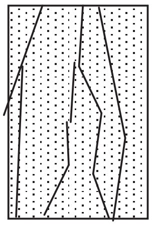
Sample Measurements

Length	256	
Diameter (Ø)	102.1	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	48	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{48000}{8183.16185}$

= $\frac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 5.86 (Mpa)

Bulk Density = 2.75 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	32.10m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

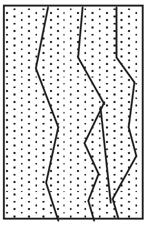
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	184	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	78	kN

Strength Calculations

Uniaxial Compressive Strength = $$\frac{78000}{8167.14}$$

= $$\frac{1000 \times P}{\prod \times (Ø/2)^2}$$

= 9.55 (Mpa)

Bulk Density = 2.76 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-1
Depth (m):	46.70m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

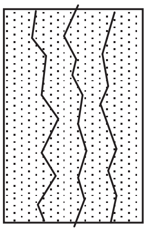
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	257	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	82	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{82000}{8167.14}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

= 10.04 (Mpa)

Bulk Density = 2.74 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC04-1
Depth (m):	39.3m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

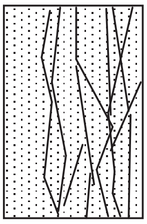
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	196	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	27	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{27000}{8167.14}$

= $\frac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 3.30 (Mpa)

Bulk Density = 2.77 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC04-1
Depth (m):	45.5m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

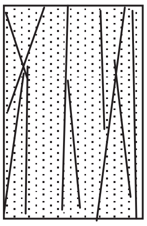
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	221	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	266	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{266000}{8167.14}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 32.55 (Mpa)

Bulk Density = 2.78 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC04-1
Depth (m):	50.4m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

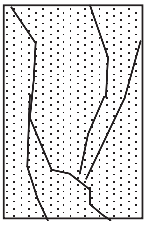
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	215	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	96	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{96000}{8167.14}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 11.75 (Mpa)

Bulk Density $=$ 2.75 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC04-1
Depth (m):	53.0m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	MUDSTONE/SILTSTONE

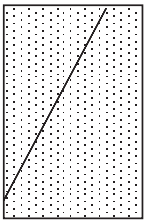
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	255	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	10	kN

Strength Calculations

Uniaxial Compressive Strength $= \frac{10000}{8167.14}$

$= \frac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 1.22 (Mpa)

Bulk Density = 2.74 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC01-2
Depth (m):	14.0m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	VOLCANICS

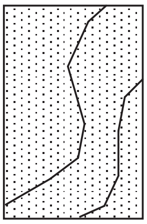
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	201	
Diameter (Ø)	78.1	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	66	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{66000}{4788.19385}$

= $\frac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 13.78 (Mpa)

Bulk Density = 2.52 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC01-2
Depth (m):	14.8m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	VOLCANICS

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

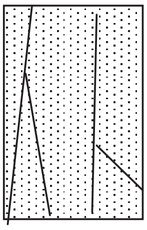
Sample Measurements

Length	194	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	99	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{99000}{4775.94}$

= $\frac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 20.72 (Mpa)

Bulk Density = 2.52 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC01-2
Depth (m):	16.7m

Sample Description

Colour:	Dark blueish grey
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	VOLCANICS

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

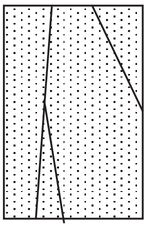
Sample Measurements

Length	198	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	48	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\dfrac{48000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

= 10.05 (Mpa)

Bulk Density = 2.52 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC03-2
Depth (m):	12.80m

Sample Description

Colour:	Blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

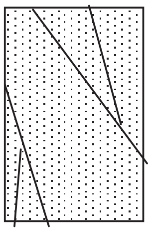
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	211	
Diameter (Ø)	102	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	38	kN

Strength Calculations

Uniaxial Compressive Strength =

$$\frac{38000}{8167.14}$$

$$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$$

= 4.65 (Mpa)

Bulk Density = 2.61 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-3
Depth (m):	15.20m

Sample Description

Colour:	Orangeish Pink
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

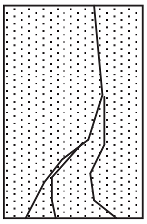
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	201	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	33	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{33000}{4775.94}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 6.91 (Mpa)

Bulk Density = 2.58 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-3
Depth (m):	19.80m

Sample Description

Colour:	Blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

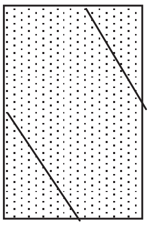
Sample Measurements

Length	194	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	93	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength =

$$\frac{93000}{4775.94}$$

$$= \frac{1000 \times P}{\Pi \times (Ø/2)^2}$$

= 19.46 (Mpa)

Bulk Density = 2.54 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC02-3
Depth (m):	23.00m

Sample Description

Colour:	Blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

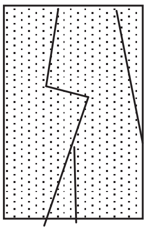
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	199	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	141	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{141000}{4775.94}$

$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 29.51 (Mpa)

Bulk Density = 2.56 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC03-3
Depth (m):	6.00m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

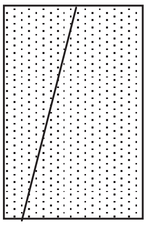
Sample Measurements

Length	241	
Diameter (Ø)	102	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	111	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{111000}{8167.14}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 13.58 (Mpa)

Bulk Density = 2.54 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC03-3
Depth (m):	8.50m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

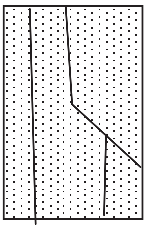
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	184	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	98	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{98000}{4775.94}$

$= \dfrac{1000 \times P}{\Pi \times (Ø/2)^2}$

= 20.51 (Mpa)

Bulk Density = 2.56 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC03-3
Depth (m):	19.10m

Sample Description

Colour:	Dark blueish green
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

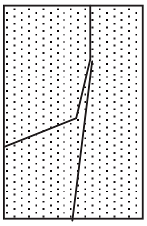
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	199	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	135	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{135000}{4775.94}$

$$= \frac{1000 \times P}{\Pi \times (Ø/2)^2}$$

= 28.25 (Mpa)

Bulk Density = 2.55 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC05-3
Depth (m):	7.6m

Sample Description

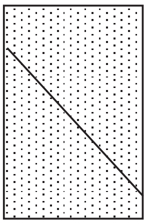
Colour:	Orangeish Pink
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Sketch of Failure Surfaces



Length	202	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	36	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{36000}{4775.94}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 7.53 (Mpa)

Bulk Density = 2.55 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC05-3
Depth (m):	14.9m

Sample Description

Colour:	Orangeish Pink
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

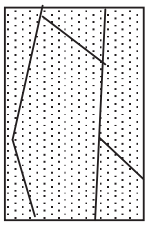
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	199	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	67	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{67000}{4775.94}$

$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 14.02 (Mpa)

Bulk Density = 2.55 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name: Greenlink Interconnector
Job Number: 21475
Hole No: RC06-3
Depth (m): 11.2m

Sample Description

Colour:	Greenish blue
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

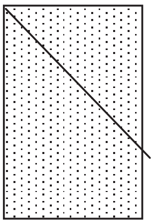
Sample Measurements

Length	204	
Diameter (Ø)	78	mm

Testing

Load Rate	4.3	kN/min
Load at Failure (P)	103	kN

Sketch of Failure Surfaces



Strength Calculations

Uniaxial Compressive Strength = $\frac{103000}{4775.94}$

= $\frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 21.56 (Mpa)

Bulk Density = 2.86 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC06-3
Depth (m):	14.8m

Sample Description

Colour:	Greenish blue
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

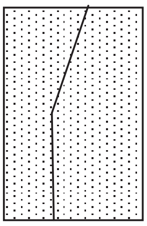
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	218	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	204	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{204000}{4775.94}$

= $\frac{1000 \times P}{\pi \times (Ø/2)^2}$

= 42.69 (Mpa)

Bulk Density = 2.79 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	Greenlink Interconnector
Job Number:	21475
Hole No:	RC06-3
Depth (m):	18.9m

Sample Description

Colour:	Greenish blue
Grain size:	Fine-grained
Weathering Grade:	Fresh
Rock Type:	RHYOLITE

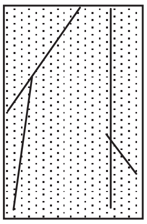
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	199	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	4.3	kN/min
Load at Failure (P)	194	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{194000}{4775.94}$

= $\frac{1000 \times P}{\pi \times (Ø/2)^2}$

= 40.60 (Mpa)

Bulk Density = 2.80 (Mg/m^3)

Notes:

Appendix 9 - Chemical Laboratory Test Records

UKAS
TESTING
2183

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.: 19-05347-1

Initial Date of Issue: 28-Feb-2019

Client IGSL

Client Address:
M7 Business Park
Naas
County Kildare
Ireland

Contact(s): Darren Keogh

Project Green Link

Quotation No.:

Date Received: 13-Feb-2019

Order No.:

Date Instructed: 14-Feb-2019

No. of Samples: 8

Turnaround (Wkdays): 7

Results Due: 22-Feb-2019

Date Approved: 28-Feb-2019

Approved By:

Details: Robert Monk, Technical Manager

Chemtest
The right chemistry to deliver results

Results - Leachate

Project: Green Link

Client: IGSL	**Chemtest Job No.:**				19-05347	19-05347	19-05347
Quotation No.:	**Chemtest Sample ID.:**				773930	773931	773934
	Sample Location:				BH01-1	BH02-3	BH04-1
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				1.50	0.50	2.00
	Date Sampled:				08-Feb-2019	08-Feb-2019	08-Feb-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Total Dissolved Solids	N	1020	mg/l	1.0	22	44	37
Dissolved Oxygen	N	1150	mg O2/l	0.50	8.2	8.3	8.3
Chloride	U	1220	mg/l	1.0	1.3	< 1.0	2.5
Fluoride	U	1220	mg/l	0.050	0.19	0.11	0.13
Sulphate	U	1220	mg/l	1.0	1.8	9.5	1.7
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Barium (Dissolved)	U	1450	µg/l	5.0	< 5.0	< 5.0	< 5.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030	< 0.030

Results - Soil

Project: Green Link

Client: IGSL	**Chemtest Job No.:**				19-05347	19-05347	19-05347	19-05347	19-05347	19-05347	19-05347	19-05347
Quotation No.:	**Chemtest Sample ID.:**				773929	773930	773931	773932	773933	773934	773935	773936
	Sample Location:				BH01-1	BH01-1	BH02-3	BH02-3	BH03-2	BH04-1	BH04-2	BH06-2
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				1.00	1.50	0.50	1.00	2.00	2.00	0.80	2.00
	Date Sampled:				08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019
	Asbestos Lab:					DURHAM	DURHAM			DURHAM		
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
ACM Type	U	2192		N/A		-	-			-		
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected	No Asbestos Detected			No Asbestos Detected		
ACM Detection Stage	U	2192		N/A		-	-			-		
Moisture	N	2030	%	0.020	11	11	8.9	6.7	9.0	8.4	14	17
pH	U	2010		N/A	8.1	8.1	7.9	7.9	7.6	8.4	6.6	8.3
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010			0.022	< 0.010		< 0.010	< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010	0.027			0.016	< 0.010		< 0.010	< 0.010
Arsenic	U	2450	mg/kg	1.0		36	24			15		
Barium	U	2450	mg/kg	10		54	44			27		
Cadmium	U	2450	mg/kg	0.10		< 0.10	0.13			0.11		
Mercury Low Level	U	2450	mg/kg	0.05		0.20	0.20			0.05		
Molybdenum	U	2450	mg/kg	2.0		< 2.0	< 2.0			3.0		
Antimony	N	2450	mg/kg	2.0		2.5	< 2.0			5.6		
Copper	U	2450	mg/kg	0.50		39	25			34		
Nickel	U	2450	mg/kg	0.50		33	24			27		
Lead	U	2450	mg/kg	0.50		41	21			22		
Selenium	U	2450	mg/kg	0.20		0.29	0.31			0.29		
Zinc	U	2450	mg/kg	0.50		89	63			55		
Chromium (Trivalent)	N	2490	mg/kg	1.0		32	23			28		
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50	< 0.50			< 0.50		
LOI	U	2610	%	0.10		3.4	3.9			4.0		
Total Organic Carbon	U	2625	%	0.20		0.45	0.53			0.26		
Mineral Oil	N	2670	mg/kg	10		< 10	< 10			< 10		
Aliphatic TPH >C5-C6	N	2680	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Aliphatic TPH >C6-C8	N	2680	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Aliphatic TPH >C8-C10	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aliphatic TPH >C10-C12	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aliphatic TPH >C12-C16	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aliphatic TPH >C16-C21	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aliphatic TPH >C21-C35	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aliphatic TPH >C35-C44	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Total Aliphatic Hydrocarbons	N	2680	mg/kg	1.0		< 1.0	< 1.0			< 1.0		
Aromatic TPH >C5-C7	N	2680	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Aromatic TPH >C7-C8	N	2680	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Aromatic TPH >C8-C10	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aromatic TPH >C10-C12	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aromatic TPH >C12-C16	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aromatic TPH >C16-C21	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		

Results - Soil

Project: Green Link

Client: IGSL	**Chemtest Job No.:**				19-05347	19-05347	19-05347	19-05347	19-05347	19-05347	19-05347	19-05347
Quotation No.:	**Chemtest Sample ID.:**				773929	773930	773931	773932	773933	773934	773935	773936
	Sample Location:				BH01-1	BH01-1	BH02-3	BH02-3	BH03-2	BH04-1	BH04-2	BH06-2
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				1.00	1.50	0.50	1.00	2.00	2.00	0.80	2.00
	Date Sampled:				08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019	08-Feb-2019
	Asbestos Lab:					DURHAM	DURHAM			DURHAM		
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Aromatic TPH >C21-C35	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Aromatic TPH >C35-C44	N	2680	mg/kg	0.10		< 0.10	< 0.10			< 0.10		
Total Aromatic Hydrocarbons	N	2680	mg/kg	1.0		< 1.0	< 1.0			< 1.0		
Total Petroleum Hydrocarbons	N	2680	mg/kg	2.0		< 2.0	< 2.0			< 2.0		
Benzene	U	2760	µg/kg	1.0		< 1.0	< 1.0			< 1.0		
Toluene	U	2760	µg/kg	1.0		< 1.0	< 1.0			< 1.0		
Ethylbenzene	U	2760	µg/kg	1.0		< 1.0	< 1.0			< 1.0		
m & p-Xylene	U	2760	µg/kg	1.0		< 1.0	< 1.0			< 1.0		
o-Xylene	U	2760	µg/kg	1.0		< 1.0	< 1.0			< 1.0		
Naphthalene	N	2800	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Acenaphthylene	N	2800	mg/kg	0.010		0.010	0.010			< 0.010		
Acenaphthene	N	2800	mg/kg	0.010		< 0.010	0.020			0.010		
Fluorene	N	2800	mg/kg	0.010		< 0.010	0.010			0.010		
Phenanthrene	N	2800	mg/kg	0.010		1.2	0.29			0.020		
Anthracene	N	2800	mg/kg	0.010		0.19	0.020			0.020		
Fluoranthene	N	2800	mg/kg	0.010		1.1	0.16			< 0.010		
Pyrene	N	2800	mg/kg	0.010		0.95	0.12			< 0.010		
Benzo[a]anthracene	N	2800	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Chrysene	N	2800	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Benzo[b]fluoranthene	N	2800	mg/kg	0.010		0.010	< 0.010			< 0.010		
Benzo[k]fluoranthene	N	2800	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Benzo[a]pyrene	N	2800	mg/kg	0.010		0.010	< 0.010			< 0.010		
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010		0.010	< 0.010			< 0.010		
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010		0.010	< 0.010			< 0.010		
Coronene	N	2800	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Total Of 17 PAH's	N	2800	mg/kg	0.20		3.5	0.63			< 0.20		
PCB 28	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
PCB 52	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
PCB 90+101	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
PCB 118	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
PCB 153	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
PCB 138	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
PCB 180	U	2815	mg/kg	0.010		< 0.010	< 0.010			< 0.010		
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10		< 0.10	< 0.10			< 0.10		

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1150	Dissolved Oxygen	Dissolved Oxygen (DO)	Electrometric determination (on site preferred), using oxygen sensitive membrane electrode.
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

2183

The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	19-06563-1		
Initial Date of Issue:	13-Mar-2019		
Client	IGSL		
Client Address:	M7 Business Park Naas County Kildare Ireland		
Contact(s):	Darren Keogh		
Project	Greenlink		
Quotation No.:		**Date Received:**	22-Feb-2019
Order No.:		**Date Instructed:**	26-Feb-2019
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	04-Mar-2019
Date Approved:	13-Mar-2019		

Approved By:

Details: Martin Dyer, Laboratory Manager

Results - Leachate

Project: Greenlink

Client: IGSL	**Chemtest Job No.:**				19-06563
Quotation No.:	**Chemtest Sample ID.:**				780201
	Sample Location:				BH4-2
	Sample Type:				SOIL
	Top Depth (m):				0.50
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Dissolved Solids	N	1020	mg/l	1.0	19
Chloride	U	1220	mg/l	1.0	1.7
Fluoride	U	1220	mg/l	0.050	0.12
Sulphate	U	1220	mg/l	1.0	16
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0
Barium (Dissolved)	U	1450	µg/l	5.0	< 5.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50
Molybdenum (Dissolved)	U	1450	µg/l	1.0	< 1.0
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0
Antimony (Dissolved)	U	1450	µg/l	1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	4.6
Dissolved Organic Carbon	U	1610	mg/l	2.0	7.8
Total Phenols	U	1920	mg/l	0.030	< 0.030

Results - Soil

Project: Greenlink

Client: IGSL	**Chemtest Job No.:**	19-06563
Quotation No.:	**Chemtest Sample ID.:**	780201
	Sample Location:	BH4-2
	Sample Type:	SOIL
	Top Depth (m):	0.50
	Asbestos Lab:	DURHAM

Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	7.7
pH	U	2010		N/A	[A] 8.0
Arsenic	U	2450	mg/kg	1.0	23
Barium	U	2450	mg/kg	10	14
Cadmium	U	2450	mg/kg	0.10	< 0.10
Mercury Low Level	U	2450	mg/kg	0.05	< 0.05
Molybdenum	U	2450	mg/kg	2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0
Copper	U	2450	mg/kg	0.50	6.6
Nickel	U	2450	mg/kg	0.50	4.5
Lead	U	2450	mg/kg	0.50	6.5
Selenium	U	2450	mg/kg	0.20	0.20
Zinc	U	2450	mg/kg	0.50	17
Chromium (Trivalent)	N	2490	mg/kg	1.0	2.1
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
LOI	U	2610	%	0.10	1.3
Total Organic Carbon	U	2625	%	0.20	[A] 0.27
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[A] < 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[A] < 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[A] < 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[A] < 5.0

Results - Soil

Project: Greenlink

Client: IGSL	**Chemtest Job No.:**				19-06563
Quotation No.:	**Chemtest Sample ID.:**				780201
	Sample Location:				BH4-2
	Sample Type:				SOIL
	Top Depth (m):				0.50
	Asbestos Lab:				DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[A] < 10
Benzene	U	2760	µg/kg	1.0	[A] < 1.0
Toluene	U	2760	µg/kg	1.0	[A] < 1.0
Ethylbenzene	U	2760	µg/kg	1.0	[A] < 1.0
m & p-Xylene	U	2760	µg/kg	1.0	[A] < 1.0
o-Xylene	U	2760	µg/kg	1.0	[A] < 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	[A] < 0.010
PCB 52	U	2815	mg/kg	0.010	[A] < 0.010
PCB 90+101	U	2815	mg/kg	0.010	[A] < 0.010
PCB 118	U	2815	mg/kg	0.010	[A] < 0.010
PCB 153	U	2815	mg/kg	0.010	[A] < 0.010
PCB 138	U	2815	mg/kg	0.010	[A] < 0.010
PCB 180	U	2815	mg/kg	0.010	[A] < 0.010
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10	[A] < 0.10

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
780201			BH4-2		A	Amber Glass 250ml
780201			BH4-2		A	Amber Glass 60ml

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
640	Characterisation of Waste (Leaching)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
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U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

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The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

UKAS TESTING
2183

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	19-10946-1		
Initial Date of Issue:	09-Apr-2019		
Client	IGSL		
Client Address:	M7 Business Park Naas County Kildare Ireland		
Contact(s):	Darren Keogh		
Project	21475 Greenlink Interconnector		
Quotation No.:		**Date Received:**	29-Mar-2019
Order No.:		**Date Instructed:**	01-Apr-2019
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	09-Apr-2019
Date Approved:	09-Apr-2019		
Approved By:			
Details:	Glynn Harvey, Laboratory Manager		

Results - Leachate

Project: 21475 Greenlink Interconnector

Client: IGSL	**Chemtest Job No.:**				19-10946
Quotation No.:	**Chemtest Sample ID.:**				802247
	Sample Location:				ST10
	Sample Type:				SOIL
	Top Depth (m):				0.40
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Dissolved Solids	N	1020	mg/l	1.0	61
Chloride	U	1220	mg/l	1.0	18
Fluoride	U	1220	mg/l	0.050	0.13
Sulphate	U	1220	mg/l	1.0	43
Arsenic (Dissolved)	U	1450	µg/l	1.0	6.0
Barium (Dissolved)	U	1450	µg/l	5.0	< 5.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	4.2
Mercury (Dissolved)	U	1450	µg/l	0.50	0.72
Molybdenum (Dissolved)	U	1450	µg/l	1.0	1.0
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0
Antimony (Dissolved)	U	1450	µg/l	1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	1.3
Zinc (Dissolved)	U	1450	µg/l	1.0	2.2
Dissolved Organic Carbon	U	1610	mg/l	2.0	21
Total Phenols	U	1920	mg/l	0.030	< 0.030

Results - Soil

Project: 21475 Greenlink Interconnector

Client: IGSL	**Chemtest Job No.:**				19-10946	19-10946	19-10946	19-10946
Quotation No.:	**Chemtest Sample ID.:**				802245	802246	802247	802248
	Sample Location:				TP01-3	ST04	ST10	ST19
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				2.80	0.50	0.40	0.90
	Bottom Depth (m):				2.90	0.60		1.00
	Asbestos Lab:						DURHAM	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
ACM Type	U	2192		N/A			-	
Asbestos Identification	U	2192	%	0.001			No Asbestos Detected	
ACM Detection Stage	U	2192		N/A			-	
Moisture	N	2030	%	0.020	11	14	18	20
pH	U	2010		N/A	[A] 8.4	[A] 8.3	[A] 6.1	[A] 6.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010		0.016
Sulphate (Acid Soluble)	U	2430	%	0.010	[A] 0.011	[A] 0.022		[A] 0.034
Arsenic	U	2450	mg/kg	1.0			25	
Barium	U	2450	mg/kg	10			35	
Cadmium	U	2450	mg/kg	0.10			< 0.10	
Mercury Low Level	U	2450	mg/kg	0.05			0.05	
Molybdenum	U	2450	mg/kg	2.0			< 2.0	
Antimony	N	2450	mg/kg	2.0			< 2.0	
Copper	U	2450	mg/kg	0.50			30	
Nickel	U	2450	mg/kg	0.50			42	
Lead	U	2450	mg/kg	0.50			21	
Selenium	U	2450	mg/kg	0.20			0.36	
Zinc	U	2450	mg/kg	0.50			80	
Chromium (Trivalent)	N	2490	mg/kg	1.0			54	
Chromium (Hexavalent)	N	2490	mg/kg	0.50			< 0.50	
LOI	U	2610	%	0.10			3.8	
Total Organic Carbon	U	2625	%	0.20			[A] 0.44	
Mineral Oil	N	2670	mg/kg	10			< 10	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0			[A] < 1.0	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0			[A] < 1.0	
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0			[A] < 5.0	
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0			[A] < 1.0	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0			[A] < 1.0	
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0			[A] < 1.0	
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0			[A] < 1.0	
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0			[A] < 1.0	
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0			[A] < 1.0	

Results - Soil

Project: 21475 Greenlink Interconnector

Client: IGSL				**Chemtest Job No.:**	19-10946	19-10946	19-10946	19-10946
Quotation No.:				**Chemtest Sample ID.:**	802245	802246	802247	802248
				Sample Location:	TP01-3	ST04	ST10	ST19
				Sample Type:	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	2.80	0.50	0.40	0.90
				Bottom Depth (m):	2.90	0.60		1.00
				Asbestos Lab:			DURHAM	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0			[A] < 1.0	
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0			[A] < 1.0	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0			[A] < 5.0	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0			[A] < 10	
Benzene	U	2760	µg/kg	1.0			[A] < 1.0	
Toluene	U	2760	µg/kg	1.0			[A] < 1.0	
Ethylbenzene	U	2760	µg/kg	1.0			[A] < 1.0	
m & p-Xylene	U	2760	µg/kg	1.0			[A] < 1.0	
o-Xylene	U	2760	µg/kg	1.0			[A] < 1.0	
Naphthalene	U	2800	mg/kg	0.10			< 0.10	
Acenaphthylene	N	2800	mg/kg	0.10			< 0.10	
Acenaphthene	U	2800	mg/kg	0.10			< 0.10	
Fluorene	U	2800	mg/kg	0.10			< 0.10	
Phenanthrene	U	2800	mg/kg	0.10			0.45	
Anthracene	U	2800	mg/kg	0.10			0.10	
Fluoranthene	U	2800	mg/kg	0.10			0.69	
Pyrene	U	2800	mg/kg	0.10			0.53	
Benzo[a]anthracene	U	2800	mg/kg	0.10			< 0.10	
Chrysene	U	2800	mg/kg	0.10			< 0.10	
Benzo[b]fluoranthene	U	2800	mg/kg	0.10			< 0.10	
Benzo[k]fluoranthene	U	2800	mg/kg	0.10			< 0.10	
Benzo[a]pyrene	U	2800	mg/kg	0.10			< 0.10	
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10			< 0.10	
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10			< 0.10	
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10			< 0.10	
Coronene	N	2800	mg/kg	0.10			< 0.10	
Total Of 17 PAH's	N	2800	mg/kg	2.0			< 2.0	
PCB 28	U	2815	mg/kg	0.010			[A] < 0.010	
PCB 52	U	2815	mg/kg	0.010			[A] < 0.010	
PCB 90+101	U	2815	mg/kg	0.010			[A] < 0.010	
PCB 118	U	2815	mg/kg	0.010			[A] < 0.010	
PCB 153	U	2815	mg/kg	0.010			[A] < 0.010	
PCB 138	U	2815	mg/kg	0.010			[A] < 0.010	
PCB 180	U	2815	mg/kg	0.010			[A] < 0.010	
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10			[A] < 0.10	

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
802245			TP01-3		A	Amber Glass 250ml
802246			ST04		A	Amber Glass 250ml
802247			ST10		A	Amber Glass 250ml
802247			ST10		A	Amber Glass 60ml
802248			ST19		A	Amber Glass 250ml

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	19-12513-1		
Initial Date of Issue:	23-Apr-2019		
Client	IGSL		
Client Address:	M7 Business Park Naas County Kildare Ireland		
Contact(s):	Darren Keogh		
Project	Greenlink		
Quotation No.:		**Date Received:**	10-Apr-2019
Order No.:		**Date Instructed:**	11-Apr-2019
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	23-Apr-2019
Date Approved:	23-Apr-2019		
Approved By:			
Details:	Robert Monk, Technical Manager		

Results - Leachate

Project: Greenlink

Client: IGSL				**Chemtest Job No.:**	19-12513
Quotation No.:				**Chemtest Sample ID.:**	809042
				Sample Location:	RC05-3
				Sample Type:	SOIL
				Top Depth (m):	2.20
				Bottom Depth (m):	3.20
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Dissolved Solids	N	1020	mg/l	1.0	37
Chloride	U	1220	mg/l	1.0	3.9
Fluoride	U	1220	mg/l	0.050	0.13
Sulphate	U	1220	mg/l	1.0	1.4
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0
Barium (Dissolved)	U	1450	µg/l	5.0	< 5.0
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080
Chromium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Copper (Dissolved)	U	1450	µg/l	1.0	1.1
Mercury (Dissolved)	U	1450	µg/l	0.50	5.6
Molybdenum (Dissolved)	U	1450	µg/l	1.0	1.5
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0
Antimony (Dissolved)	U	1450	µg/l	1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	< 1.0
Dissolved Organic Carbon	U	1610	mg/l	2.0	12
Total Phenols	U	1920	mg/l	0.030	< 0.030

Results - Soil

Project: Greenlink

Client: IGSL				**Chemtest Job No.:**	19-12513
Quotation No.:				**Chemtest Sample ID.:**	809042
				Sample Location:	RC05-3
				Sample Type:	SOIL
				Top Depth (m):	2.20
				Bottom Depth (m):	3.20
				Asbestos Lab:	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	3.4
pH	U	2010		N/A	[A] 8.3
Arsenic	U	2450	mg/kg	1.0	6.0
Barium	U	2450	mg/kg	10	11
Cadmium	U	2450	mg/kg	0.10	< 0.10
Mercury Low Level	U	2450	mg/kg	0.05	0.36
Molybdenum	U	2450	mg/kg	2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0
Copper	U	2450	mg/kg	0.50	17
Nickel	U	2450	mg/kg	0.50	7.8
Lead	U	2450	mg/kg	0.50	3.7
Selenium	U	2450	mg/kg	0.20	0.32
Zinc	U	2450	mg/kg	0.50	3.7
Chromium (Trivalent)	N	2490	mg/kg	1.0	2.6
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
LOI	U	2610	%	0.10	0.46
Total Organic Carbon	U	2625	%	0.20	[A] < 0.20
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	[A] < 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[A] < 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[A] < 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	[A] < 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[A] < 1.0

Results - Soil

Project: Greenlink

Client: IGSL				**Chemtest Job No.:**	19-12513
Quotation No.:				**Chemtest Sample ID.:**	809042
				Sample Location:	RC05-3
				Sample Type:	SOIL
				Top Depth (m):	2.20
				Bottom Depth (m):	3.20
				Asbestos Lab:	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[A] < 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[A] < 10
Benzene	U	2760	µg/kg	1.0	[A] < 1.0
Toluene	U	2760	µg/kg	1.0	[A] < 1.0
Ethylbenzene	U	2760	µg/kg	1.0	[A] < 1.0
m & p-Xylene	U	2760	µg/kg	1.0	[A] < 1.0
o-Xylene	U	2760	µg/kg	1.0	[A] < 1.0
Naphthalene	N	2800	mg/kg	0.010	[A] < 0.010
Acenaphthylene	N	2800	mg/kg	0.010	[A] < 0.010
Acenaphthene	N	2800	mg/kg	0.010	[A] < 0.010
Fluorene	N	2800	mg/kg	0.010	[A] < 0.010
Phenanthrene	N	2800	mg/kg	0.010	[A] < 0.010
Anthracene	N	2800	mg/kg	0.010	[A] < 0.010
Fluoranthene	N	2800	mg/kg	0.010	[A] < 0.010
Pyrene	N	2800	mg/kg	0.010	[A] < 0.010
Benzo[a]anthracene	N	2800	mg/kg	0.010	[A] < 0.010
Chrysene	N	2800	mg/kg	0.010	[A] < 0.010
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	[A] < 0.010
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	[A] < 0.010
Benzo[a]pyrene	N	2800	mg/kg	0.010	[A] < 0.010
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	[A] < 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	[A] < 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	[A] < 0.010
Coronene	N	2800	mg/kg	0.010	[A] < 0.010
Total Of 17 PAH's	N	2800	mg/kg	0.20	[A] < 0.20
PCB 28	N	2815	mg/kg	0.0010	[A] < 0.0010
PCB 52	N	2815	mg/kg	0.0010	[A] < 0.0010
PCB 90+101	N	2815	mg/kg	0.0010	[A] < 0.0010
PCB 118	N	2815	mg/kg	0.0010	[A] < 0.0010
PCB 153	N	2815	mg/kg	0.0010	[A] < 0.0010
PCB 138	N	2815	mg/kg	0.0010	[A] < 0.0010
PCB 180	N	2815	mg/kg	0.0010	[A] < 0.0010
Total PCBs (7 congeners)	N	2815	mg/kg	0.0010	[A] < 0.0010

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
809042			RC05-3		A	Amber Glass 250ml
809042			RC05-3		A	Amber Glass 60ml

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
640	Characterisation of Waste (Leaching)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
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N	Unaccredited
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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Nicholls Colton Group
7 - 11 Harding Street
Leicester
LE1 4DH

IGSL
Unit F
M7 Business Park
Nass

Analytical Test Report: L19/1005/IGS/001

Your Project Reference:	**21475 - Greenlink Interconnector**	Samples Received on:	17/04/2019
Your Order Number:	15678	Testing Instruction Received:	17/04/2019
Report Issue Number:	1	Sample Tested:	17/04 to 01/05/2019
Samples Analysed:	1 aggregate sample	Report issued:	01/05/2019

Signed

Peter Swanston
Environmental Laboratories Manager
Nicholls Colton Group

Notes:

General

Please refer to Methodologies tab for details pertaining to the analytical methods undertaken.

Samples will be retained for 14 days after issue of this report unless otherwise requested.

Samples were supplied by customer, results are representative of the material provided

Accreditation Key

UKAS = UKAS Accreditation, u = Unaccredited

Date of Issue 24.01.2017
Owned by Emily Blissett - Customer Services Supervisor
Authorised by James Gane - Commercial Manager
J:\Public\Projects\2019\L19\IGS\L19-1005-IGS\[L19-1005-IGS-001.xlsx]Cover Sheet

L19/1005/IGS/001

Project Reference - 21475 - Greenlink Interconnector

Analytical Test Results - Aggregate Testing

NC Reference			**34307**
Client Sample Reference			RC05-3
Material			Core
Source/Client Ref.			RC05-3 - 3.70-4.50m
Sample Description			Brown crushed rock
EN 1744 Determinations	**Units**	**Accreditation**	
Total Sulphur content (as S)	(%)	UKAS	< 0.01
Acid soluble sulphate content (as SO_3)	(%)	UKAS	< 0.01
Acid soluble sulphate content (as SO_4)	(%)	u	< 0.01
Water soluble sulphate content (as SO_3)	(%)	UKAS	0.01
Water soluble sulphate content (as SO_3)	(mg/l)	u	66
Water soluble sulphate content (as SO_4)	(%)	u	0.02
Water soluble sulphate content (as SO_4)	(mg/l)	u	79

Nicholls Colton Group
7 - 11 Harding Street
Leicester
LE1 4DH

L19/1005/IGS/001

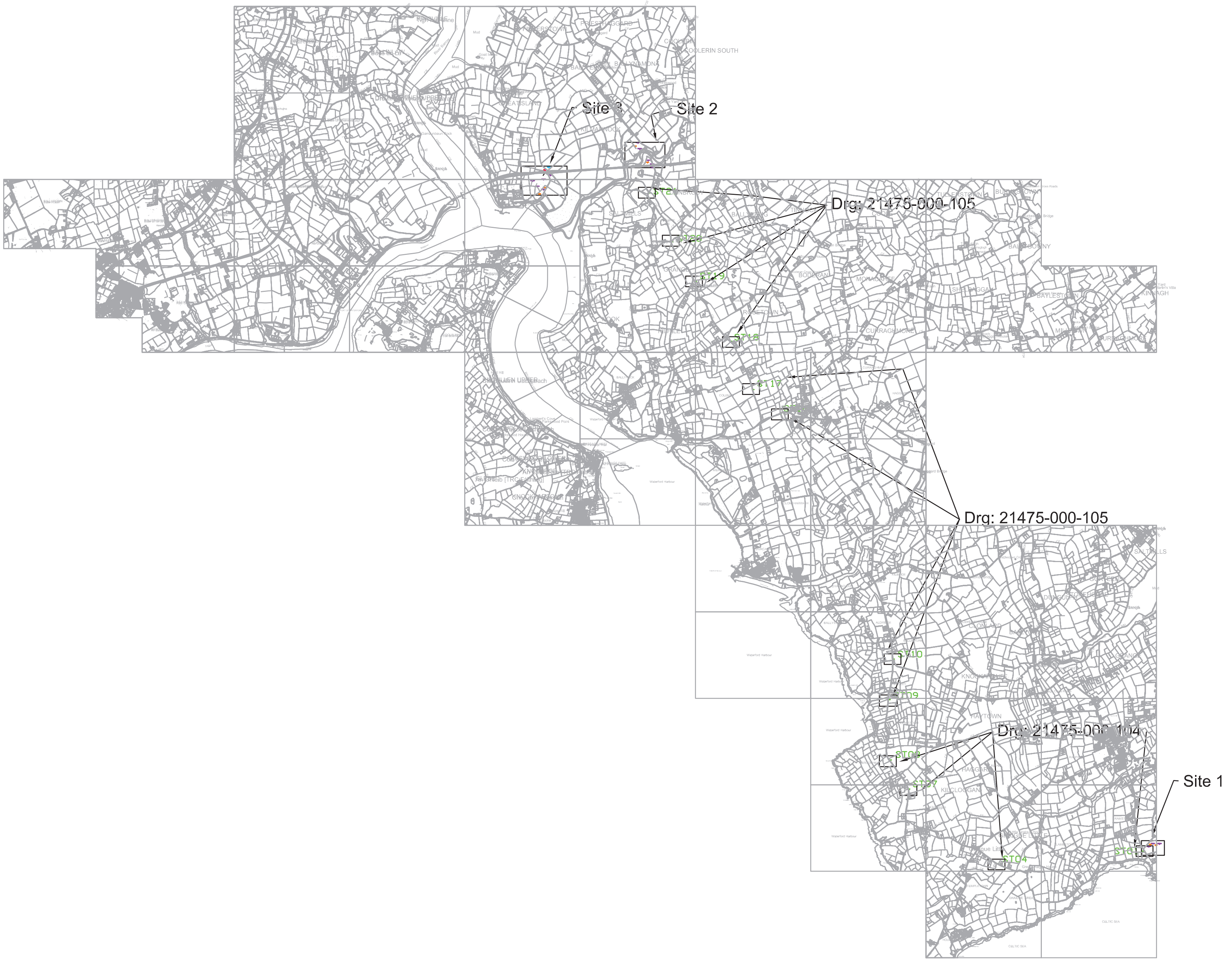
Project Reference - 21475 - Greenlink Interconnector

Analysis Methodologies and Notes

Determinant	**Test method and notes**
EN 1744 Total Sulphur	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 11.
EN 1744 Acid Soluble Sulphate	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 12.
EN 1744 Water Soluble Sulphate	Testing was in accordance with BS EN 1744-1:2009 + A1:2012 clause 10.

Appendix 10 - Exploratory Hole Site Plan

1



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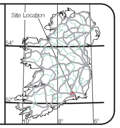
GRID SYSTEM:
- ITM



◔	S&A Borehole Location	▽	Inspection Pit Location
⊗	Geobore S Borehole Location	▨	Trial Pit Location
◕	Borehole/Geobore S Location	▰	Slit Trench Location

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SITE INVESTIGATION
&
GEOTECHNICAL SPECIALISTS

Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project: **Greenlink Interconnector ireland**
Component: **Ground Investigation Contract**
Title: **Key Plan**

Designed:	CK	Date:	11/04	File Name:	21475	Drawing No:
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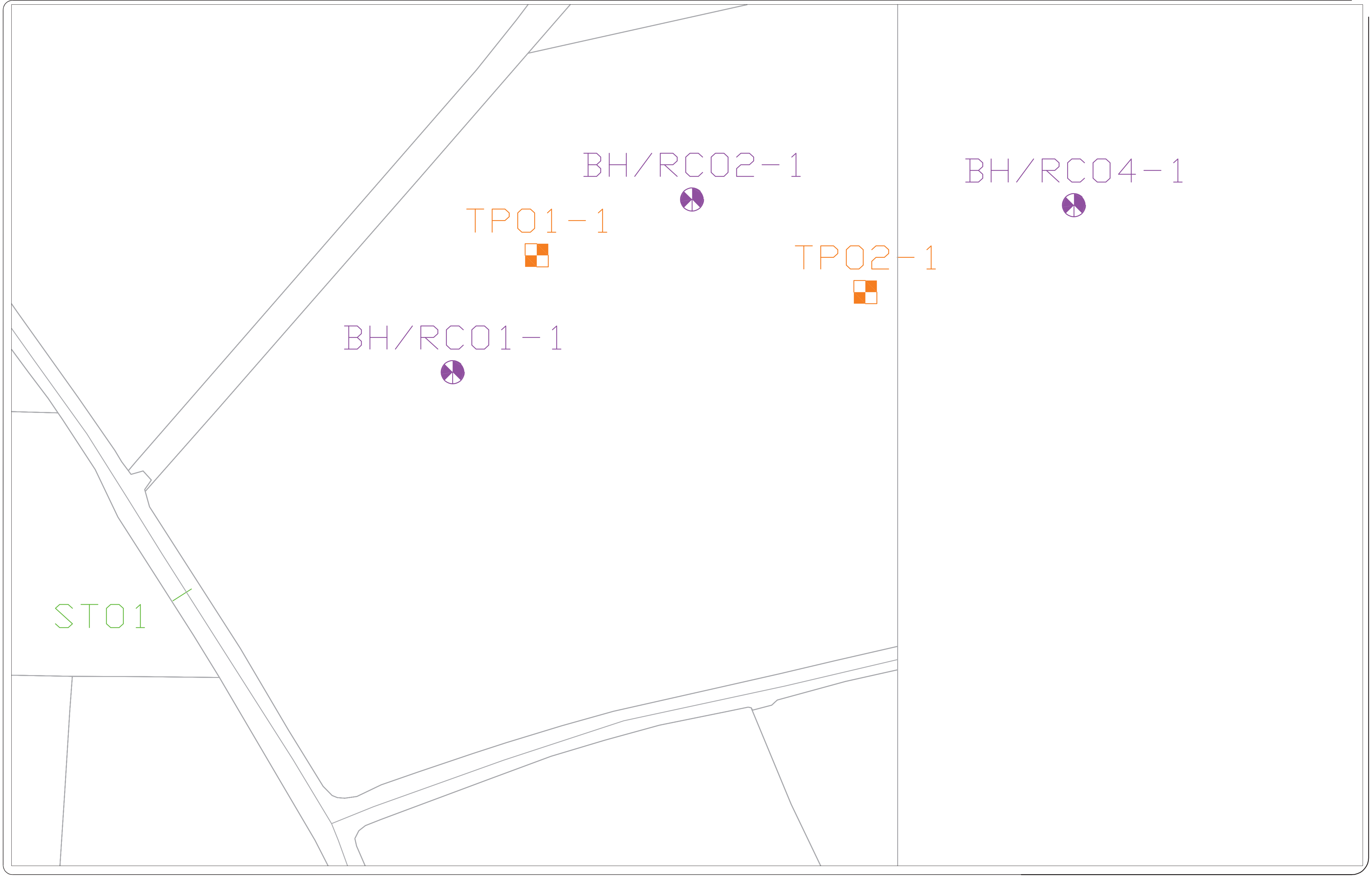

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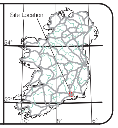
- ITM



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⊗	Geobore S Borehole Location	▞	Trial Pit Location
⊗	Borehole/Geobore S Location	◆	Slit Trench Location

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SITE INVESTIGATION
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Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project: **Greenlink Interconnector Ireland**
Component: **Ground Investigation Contract**
Title: **Location Plan Site 1**

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Drawing No:
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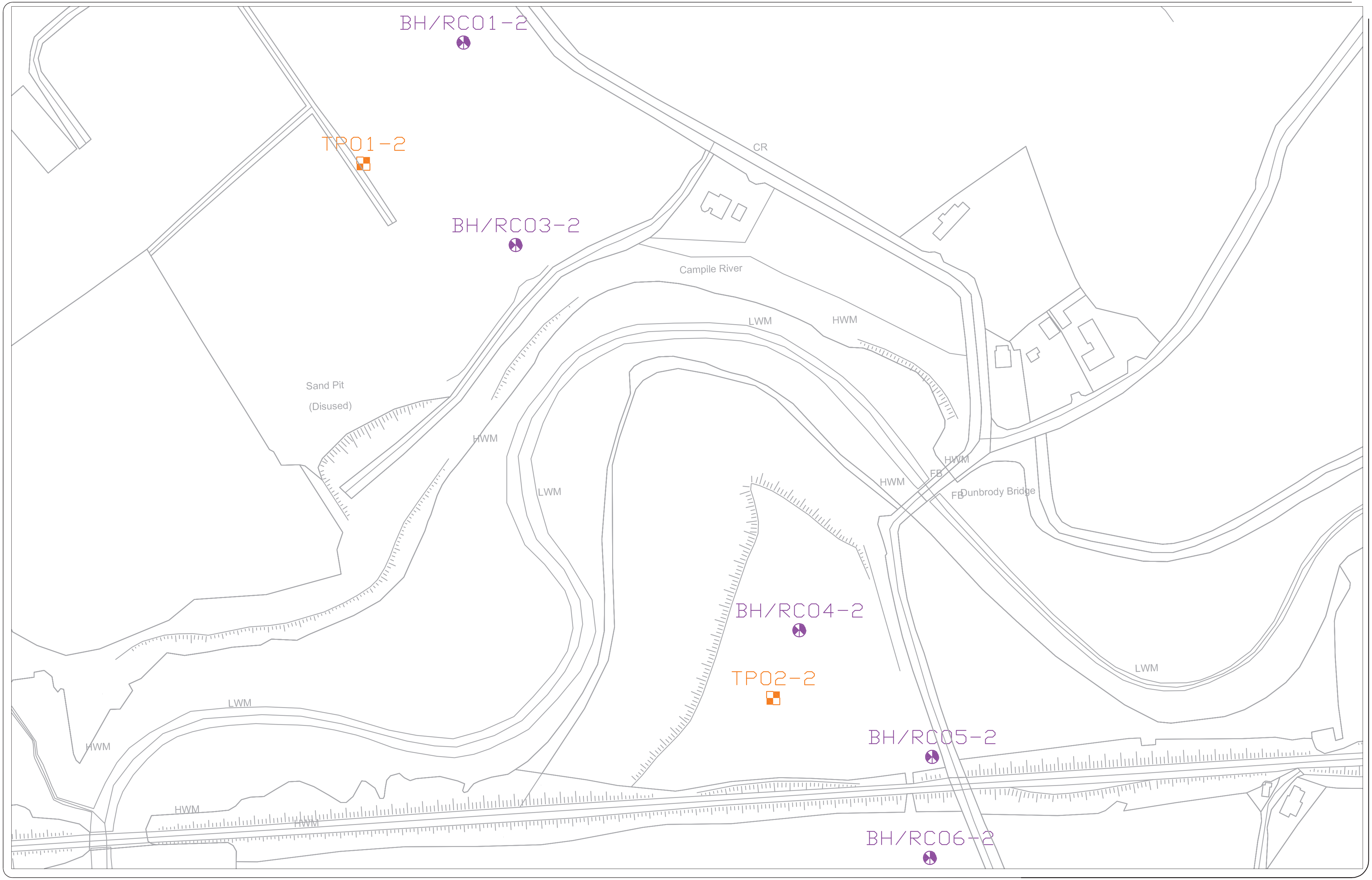

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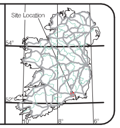
- ITM



⊕	S&A Borehole Location	▽	Inspection Pit Location
⊗	Geobore S Borehole Location	▨	Trial Pit Location
●	Borehole/Geobore S Location	🟩	Slit Trench Location

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SITE INVESTIGATION
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Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project: **Greenlink Interconnector ireland**

Component: **Ground Investigation Contract**

Title: **Location Plan Site 2**

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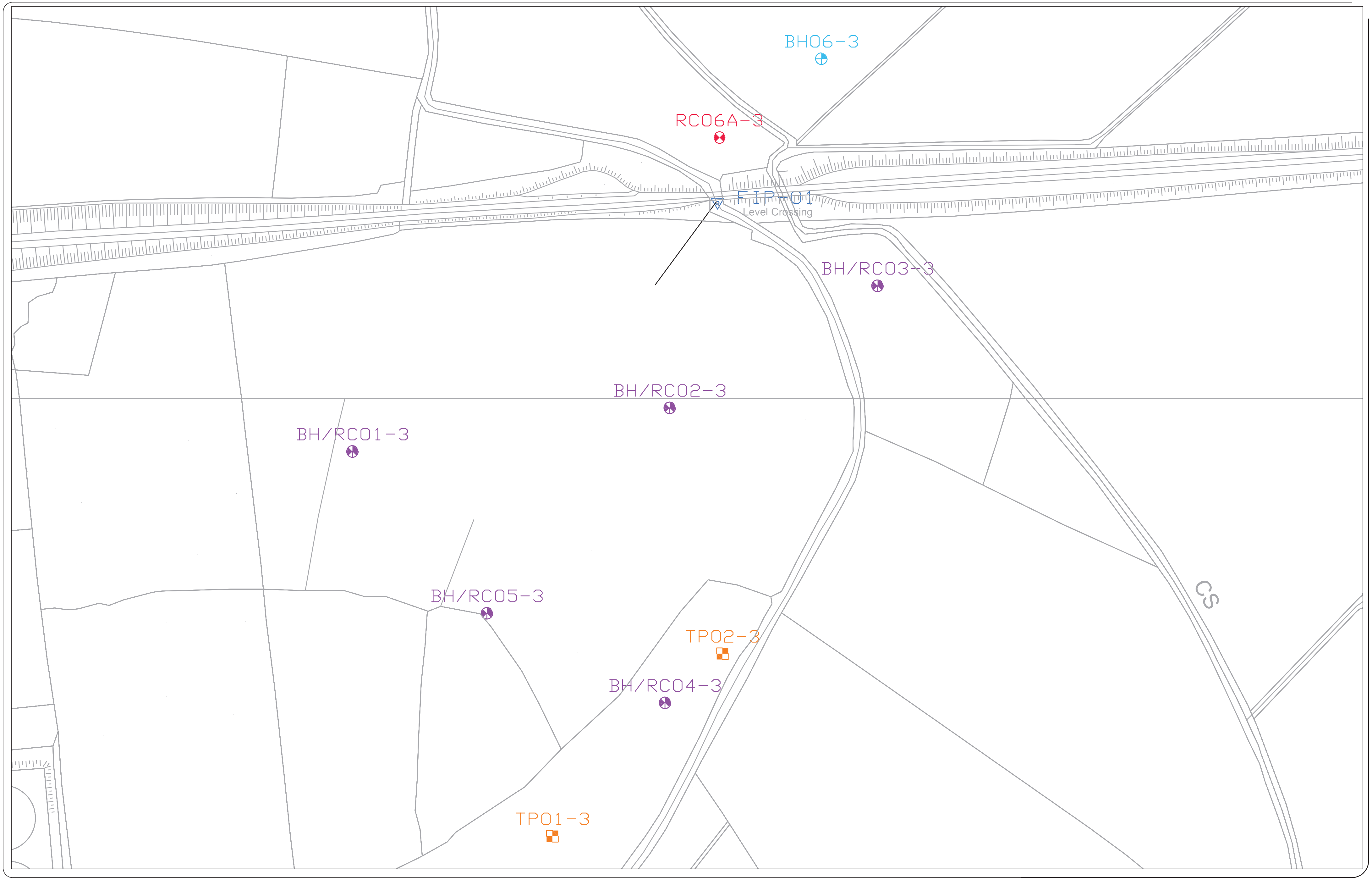

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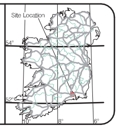

🔵	S&A Borehole Location	▽	Inspection Pit Location
🔴	Geobore S Borehole Location	🟧	Trial Pit Location
🟣	Borehole/Geobore S Location	🟩	Slit Trench Location

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SITE INVESTIGATION
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GEOTECHNICAL SPECIALISTS

Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project: **Greenlink Interconnector ireland**

Component: **Ground Investigation Contract**

Title: **Location Plan Site 3**

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Checked:	DG	Date:	11/04	Date:	11/04/2019

Drawing No:
21475-000-103

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GRID SYSTEM:
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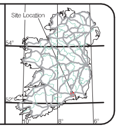

◔	S&A Borehole Location	▽	Inspection Pit Location
⊗	Geobore S Borehole Location	▨	Trial Pit Location
◕	Borehole/Geobore S Location	🟩	Slit Trench Location

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SITE INVESTIGATION
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GEOTECHNICAL SPECIALISTS

Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project:	**Greenlink Interconnector Ireland**				
Component:	**Ground Investigation Contract**				
Title:	**Location Plan Cable Route**				
Designed: CK	Date: 11/04	File Name:	21475	Drawing No:	
Drawn: CK	Date: 11/04	Original Scale:	1:1500 @A3	**21475-000-104**	
Checked: DG	Date: 11/04	Date:	11/04/2019		

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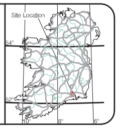

⊕	S&A Borehole Location	▽	Inspection Pit Location
⊗	Geobore S Borehole Location	▦	Trial Pit Location
◐	Borehole/Geobore S Location	◆	Slit Trench Location

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SITE INVESTIGATION
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GEOTECHNICAL SPECIALISTS

Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project: **Greenlink Interconnector ireland**

Component: **Ground Investigation Contract**

Title: **Location Plan Cable Route**

Designed:	CK	Date: 11/04	File Name:	21475	Drawing No:	**21475-000-105**
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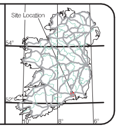

North

DATUM:
- Malin Hd
GRID SYSTEM:
- ITM

⊕ S&A Borehole Location	▽ Inspection Pit Location
⊗ Geobore S Borehole Location	▨ Trial Pit Location
◐ Borehole/Geobore S Location	◆ Slit Trench Location

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SITE INVESTIGATION
&
GEOTECHNICAL SPECIALISTS

Rev	By	Date	Description
0	CK	11/04	Layout Plan

Project: **Greenlink Interconnector Ireland**

Component: **Ground Investigation Contract**

Title: **Location Plan Cable Route**

Designed:	CK	Date:	11/04	File Name:	21475	Drawing No:
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Checked:	DG	Date:	11/04	Date:	11/04/2019	

GEOTECHNICAL REPORT

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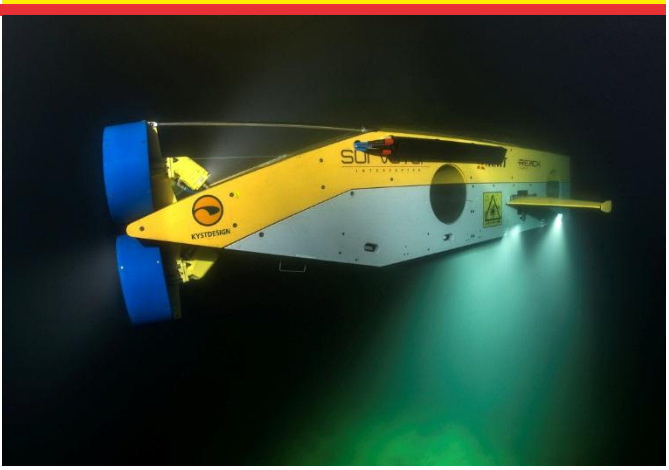
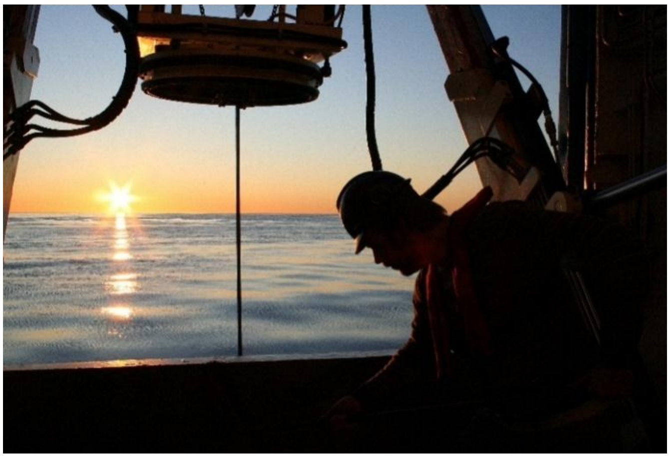
REVISION 03 | CLIENT REVIEW
SEPTEMBER 2019





GREENLINK INTERCONNECTOR

UK - IRELAND
SEPTEMBER 2018 - APRIL 2019

MMT SWEDEN AB | SVEN KÄLLFELTS GATA 11 | SE-426 71 VÄSTRA FRÖLUNDA, SWEDEN
PHONE: +46 (0)31 762 03 00 | **EMAIL:** INFO@MMT.SE **WEBSITE:** MMT.SE

REVISION HISTORY

REVISION	DATE	STATUS	CHECK	APPROVAL	CLIENT APPROVAL
03	2019-09-25	Issue for Review	RC	MG	
02	2019-04-24	Issue for Review	RC	MG	
01	2019-04-19	Issue for Internal Review	RC		

DOCUMENT CONTROL

RESPONSIBILITY	POSITION	NAME
Content	Principal Geologist	Rob Cooke
Check	Project Report Coordinator	Maria Blom
Check	Reporting Quality Controller	Hampus Arvidsson
Approval	Project Manager	Martin Godfrey

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ABBREVIATIONS AND DEFINITIONS

ASTM	American Society for Testing and Materials
AT	Atterberg Limits
BD	Bulk Density
cm	Centimetre
CPT	Cone Penetration Test
DD	Dry Density
HVDC	High Voltage Direct Current
IRE	Ireland
km	Kilometre
KP	Kilometre Post
kPa	Kilopascal
LV	Laboratory Vane
m	Metre
MC	Moisture Content
MM	Min Max Dry Density
M/V	Motor Vessel
MW	Megawatt
MPa	Megapascal
MMT	MMT Sweden AB
OD	Outside diameter
PD	Particle Density
PSD	Particle Size Distribution
PVC	Polyvinyl chloride
q_c	Cone resistance (MPa)
q_t	Corrected cone resistance (MPa)
SED	Sedimentation
SBX	Shearbox
TR	Thermal Resistivity
TV	Torvane
UK	United Kingdom
µm	micron
UU	Unconsolidated Undrained Triaxial Test
VC	Vibrocore

1| INTRODUCTION

1.1| PROJECT INFORMATION

Greenlink is a proposed 500MW HVDC cable system to interconnect the existing electricity grids in Ireland and Great Britain. The proposed landfall in the UK is at Freshwater West, on the Pembrokeshire coast in Wales. In Ireland, the proposed landfall is at Baginbun beach, in County Wexford. Greenlink is being developed by Greenlink Interconnector Ltd.

The purpose of the cable route survey is to confirm the viability of the proposed route to allow the further development of detailed engineering plans for cable installation. The project entailed a marine geophysical and geotechnical subsea and nearshore survey, with laboratory analysis, for the entire route.

An overview of the survey area is presented in Figure 1.

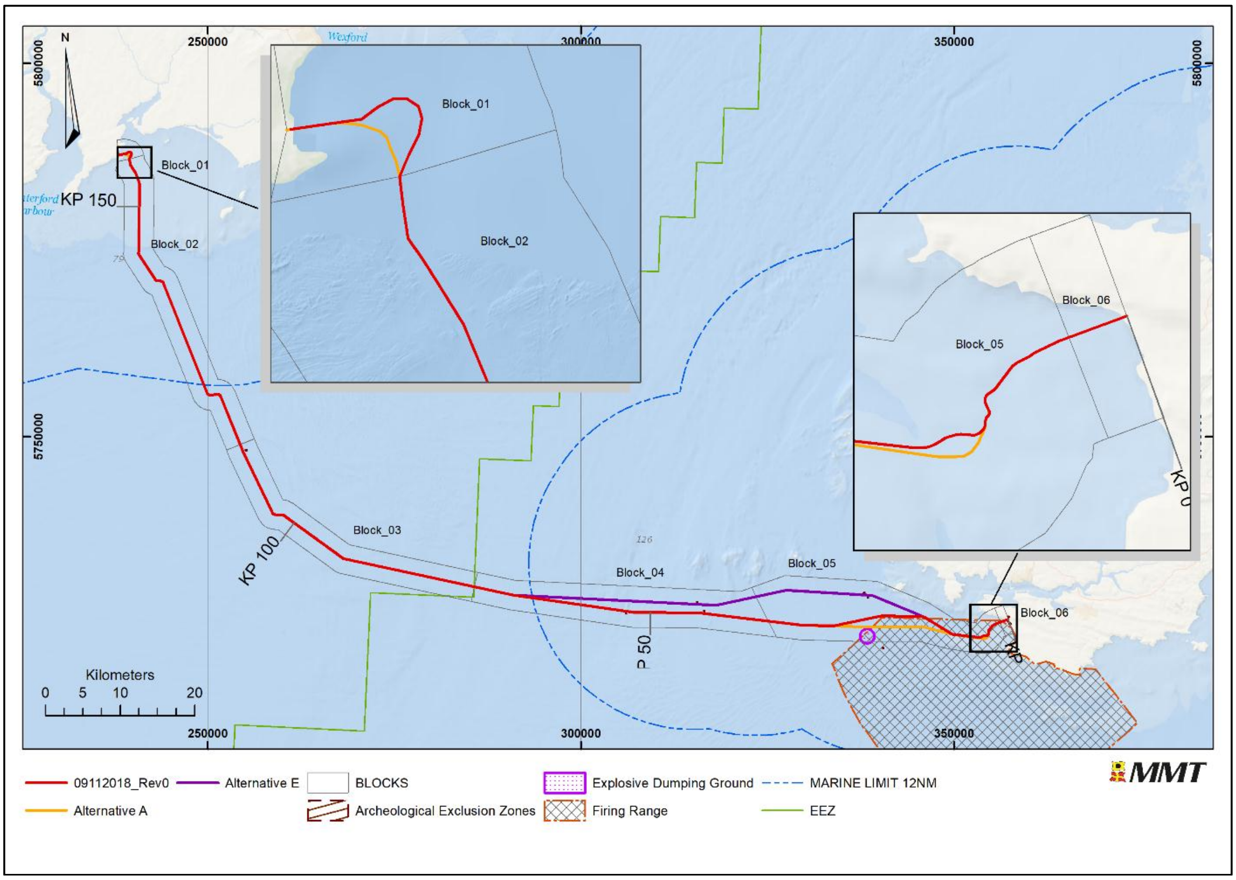

Figure 1 Greenlink route overview.

During the survey work, the route was divided into separate survey blocks. However, for the purpose of reporting the route is split into two parts, the UK section, from KP 0 to KP 73 and the Irish section, from KP 73 to KP 159.

The final survey Route Position List is Greenlink_WGS84_UTM30N_09112018_RPL_Rev0. KP 0.000 is at the UK landfall, with KP increasing towards Ireland.

1.2| SCOPE OF WORK

1.2.1| OFFSHORE GEOTECHNICAL SURVEY

The offshore geotechnical survey consisted of vibrocore samples (VC) and cone penetration tests (CPT).

In total, 105 CPT locations were carried out, with 23 re-attempts required. In the UK section, there were 47 locations with 18 re-attempts required. In the Irish section there were 58 locations with only five re-attempts. A summary of the re-attempts is provided in Section 2.3.1|.

For the vibrocores, a total of 105 locations were carried out with 60 re-attempts required. In the UK section, there were 47 locations, with 36 re-attempts required. In the Irish section there were 58 locations with 24 re-attempts. A summary of the reattempts is provided in Section 2.2.1|.

The completed fieldwork activity is shown below (see Table 1), with total locations presented, followed by the number of re-attempts in brackets. The final VC and CPT locations are shown within the relevant parts of Section 4| of this report.

Table 1. Fieldwork activity – offshore geotechnical survey.

SURVEY BLOCK	ACTIVITY	FIELDWORK PERIOD	LOCATIONS (re-attempts)	SURVEY VESSEL
UK	**VC**	26/12/2018 – 06/01/2019	**47 (36)**	Olympic Challenger
	CPT	16/12/2018 – 28/12/2018	**47 (18)**	
IRELAND	**VC**	21/12/2018 – 05/01/2019	**58 (24)**	
	CPT	07/12/2018 – 24/12/2018	**58 (5)**	

1.2.2| NEARSHORE GEOTECHNICAL SURVEY

The nearshore geotechnical survey comprised the drilling of boreholes (BH) from a jack up barge platform. In total four boreholes were carried, two at each landfall location. The completed fieldwork activity is shown below.

The final BH locations are shown within the relevant part of Section 4 of this report.

Table 2. Fieldwork activity - nearshore survey.

SURVEY AREA	ACTIVITY	FIELDWORK PERIOD	LOCATIONS	SURVEY VESSEL
UK FRESHWATER WEST	**BH**	24/03/2019 – 26/03/2019	**BH04A-FWW** **BH05A-FWW**	Sandpiper
IRELAND BAGINBUN BAY	**BH**	21/04/2019 – 24/04/2019	**BH05-BB** **BH06-BB**	

1.3| STANDARDS AND SPECIFICATION

The investigation was carried out in accordance with the contract technical specification; issued to MMT by Greenlink Interconnector Ltd. The general technical standards, identified below, were applied to the relevant aspects of the geotechnical survey (see also 5| References). This list is not exhaustive, and where additional Standards or methodologies have been applied, these are referred to in the text. This applies in particular to some laboratory testing methods, where alternate standards, such as American Society for Testing and Materials (ASTM) are used by convention.

- Eurocode 7, Part 2 EN 1997-2 (fieldwork and overall data analysis)
- BS EN ISO 19901-8 (all aspects)
- BS EN ISO 14688-1 & 14688-2 (soil description and classification)
- BS EN ISO 14689-1 (rock description)
- BS 1377 (geotechnical laboratory testing, sediment)
- ISRM, 2007 (geotechnical laboratory testing, rock)
- BS EN ISO 22476-1 (cone penetration testing)
- ISSMGE, 1999 (cone penetration testing)

2| FIELDWORK

2.1| SUMMARY

The geotechnical locations were selected by MMT, and approved by Greenlink Interconnector Ltd. The coordinates and water depths, shown on the records, were obtained by MMT during the fieldwork.

The offshore fieldwork was carried out from the vessel Olympic Challenger. This is an offshore survey vessel, owned by Olympic Subsea ASA, of Norway, on short term charter to MMT.

Figure 2. M/V Olympic Challenger.

The nearshore fieldwork was carried out from the vessel Sandpiper. This is a combifloat C-5 jack up barge (JUB), owned and operated by Lankelma, of the UK. During the works, the barge was supported by the tug vessel MTS Taktow.

Figure 3. JUB Sandpiper.

2.2| VIBROCORES

2.2.1| GENERAL

The vibrocores were recovered using electrically powered vibrocoring units, either a High Power vibrocore unit or the MMT owned VKG-3/6 vibrocore unit. The corers were fitted with either a 3 or 6m long core barrel and used clear PVC 100mm OD liner. A 'basket-spring type' core catcher was fitted above the cutting shoe, in the base of the vibrocore barrel, to maximise retention of the penetrated sediment during retraction from the seabed and subsequent retrieval of the unit to the vessel deck. The 6m cores were required in the Traffic Separation Zone, defined by Greenlink, at approximately KP 53 to KP 68.

During VC operations, there were instances of re-attempts being required largely due to initial poor recovery. Poor penetration and subsequent low material recovery were generally a function of dense to very dense coarse granular material or high strength cohesive material being encountered. A summary of the re-attempts is provided below.

Table 3. Summary of VC location re-attempts.

NO. OF ATTEMPTS	LOCATIONS	REMARKS (not ground related)
UK		
Two	001, 002, 004, 005, 006, 007, 008, 009, 011, 012, 015, 016, 018, 019, 023, 024, 025, 026, 028, 092, 093, 095, 096, 097, 098, 099, 100, 106	095 – corer motor stoppage
Three	003, 010, 021, 022	010 – umbilical severed and corer fell over twice on seabed due to strong currents 003 – corer fell over
IRELAND		
Two	034, 035, 036, 037, 041, 048, 054, 055, 060, 061, 062, 063, 069, 084, 086, 087, 088, 091	035 – corer motor stoppage 051 – material lost during recovery of corer to deck 035 – no power to corer
Three	039, 051, 067	051 – corer motor stoppage

Summaries of the recovered vibrocores are provided in the separate UK and Ireland appendices. The sampling was carried out in general accordance with BS EN ISO 19901-8.

2.2.2| SAMPLE HANDLING AND LOGGING

Following an acceptable recovery (>75% of either 3m or 6m) of a vibrocore sample to the vessel deck, each liner was successively cut into 1.0m sections. Offshore processing comprised the production of a field log from the visual inspection of the cut liner ends (included in the MMT Field Survey Reports). In-situ thermal measurements also carried out on the exposed material in the cut liner ends, at 1.00m intervals where possible.

Upon completion of the offshore processing, the complete vibrocore samples were then appropriately labelled, sealed and placed into secure storage crates. These crates were transported to the Rotherham, UK facility of InSitu SI. Upon their arrival at the facility, each vibrocore liner in turn was removed from storage, split longitudinally, photographed and logged. Where multiple attempts had been carried out at a single location, the attempt with the longest material recovery was logged.

Shear strength measurements were taken on any suitable cohesive strata using a torvane (TV), and where possible a laboratory vane (LV).

In-situ thermal measurements were also carried out on some selected vibrocores during logging to validate the offshore measurements (for further details, see 3.2.3|). Following logging, the recovered material was sub-sampled in readiness for the laboratory testing, details of which are provided in Section 3.

The vibrocore records are presented in the appendices. The records provide descriptions of the materials encountered in accordance with BS EN ISO 14688-1 (2018) and 14688-2 (2018), for soils. Photographs of the recovered cores are also presented within the records.

2.3| CONE PENETRATION TESTING

2.3.1| GENERAL

CPTs were carried out to a maximum depth of 6.02m using 10cm^2 electric piezocones operated from a ROSON seabed CPT unit, ballasted to fourteen tonnes in air weight.

The aim at each CPT location was to reach the target penetration depth of either 3 or 6m, depending on location KP. Re-attempts were required due to either initial failure to reach the required depth, concern with the overall test application class, or due to electrical power and/or communication issues with the seabed CPT unit. The re-attempts are summarised below, with remarks when re-attempts were required due to 'system' issues. Only a single cone was lost during the operations, at location 086A.

Table 4 Summary of CPT location re-attempts.

NO. OF ATTEMPTS	LOCATIONS	REMARKS (NOT GROUND RELATED)
UK		
Two	002, 003, 004, 006, 007, 008, 009, 010, 011, 012, 013, 014, 015, 019, 022, 029, 099, 100	022 – water depth discrepancy 086 – data interuption
IRELAND		
Two	047, 048, 081, 086, 091	

The program of testing is summarised in the route appendices. Remarks regarding the tests are provided in the summary tables and on the CPT plots. A discussion regarding the termination of the tests is also provided below, in Section 2.3.4|.

This report presents the factual CPT fieldwork records, together with an interpretation of the soils penetrated. Testing was carried out in accordance with BS EN ISO 22476-1 and ISSMGE (1999). Calibration certificates for the cones were provided during the fieldwork and included details of the manufacturer, cone dimensions, capacity and geometry.

2.3.2| DATA PROCESSING

Test control and data acquisition was carried out using the Control and Data acquisition software supplied by AP Van den Berg, manufacturers of the ROSON CPT system. The measured cone end resistance, sleeve friction and dynamic porewater pressure was recorded at 2cm intervals of penetration.

A data quality review and preliminary soil type interpretation was carried out using InSitu SI in-house data reduction spreadsheets and Datgel (CPTtool) software during the fieldwork period. The CPT data was corrected for the 10cm^2 cone sleeve/tip offset of 80mm, In addition, a depth correction was applied to the data to take into account the 'air-gap' between the cone tip position within the ROSON unit when the push is initiated, and the actual base level of the ROSON seabed frame, i.e. the level at which the cone tip actually measures resistance as it enters the seabed. In theory, this difference is approximately 30cm including the seabed frame ballast plates, although in reality it can vary between ~5 and 45cm depending on settlement and/or tilt of the ROSON unit on the seabed.

2.3.3| ZERO DRIFT AND TEST CLASSIFICATION

During the CPT testing program, the cone zero drift data were recorded. Following on from the zero drift data, each CPT attempt was assigned an application class, as per the guidelines set out by BS EN ISO 22476-1. A summary table below shows the overall application class split for the tests. The accuracy class for each CPT attempt is shown on the CPT plots.

Table 5 Summary of overall CPT application classes.

APPLICATION CLASS	NO. OF TESTS
Class 1	**72**
Class 2	**46**
Class 3	**6**
Class 4	**4**

2.3.4| TEST TERMINATION CRITERIA

A detailed discussion of the technical capability of the ROSON straight push rod CPT system is beyond the remit of this factual report. However, some salient points regarding the termination criteria applied during the field acquisition of data are as follows.

The push capability of the straight rod CPT system is largely governed by the support provided to the rod string during the course of a test. In relatively homogeneous sediment profiles, in cohesive or granular material, there is normally enough support provided to the rod such that the cone can be advanced through medium dense to dense and very dense granular, or stiff to very stiff cohesive material. Difficulties arise, however, where the cone and rod pass from one sediment type into another which has markedly different properties, i.e. strength/density or constituent changes such as increased gravel component. Similarly, if a very dense gravelly material is encountered at a shallow level, seabed to say 1m depth, there can be a reduced chance of the straight rod system being able to penetrate further.

The plot below for the reported tests illustrates that maximum cone resistances for the tests are in the extremely large range 0.82 to 83.35MPa. The maximum cone resistance values show a very large scatter over the entire depth range investigated, which illustrates the highly variable nature of the penetrated sediments. The depths to dense and very dense granular strata are also spread over the depth range penetrated.

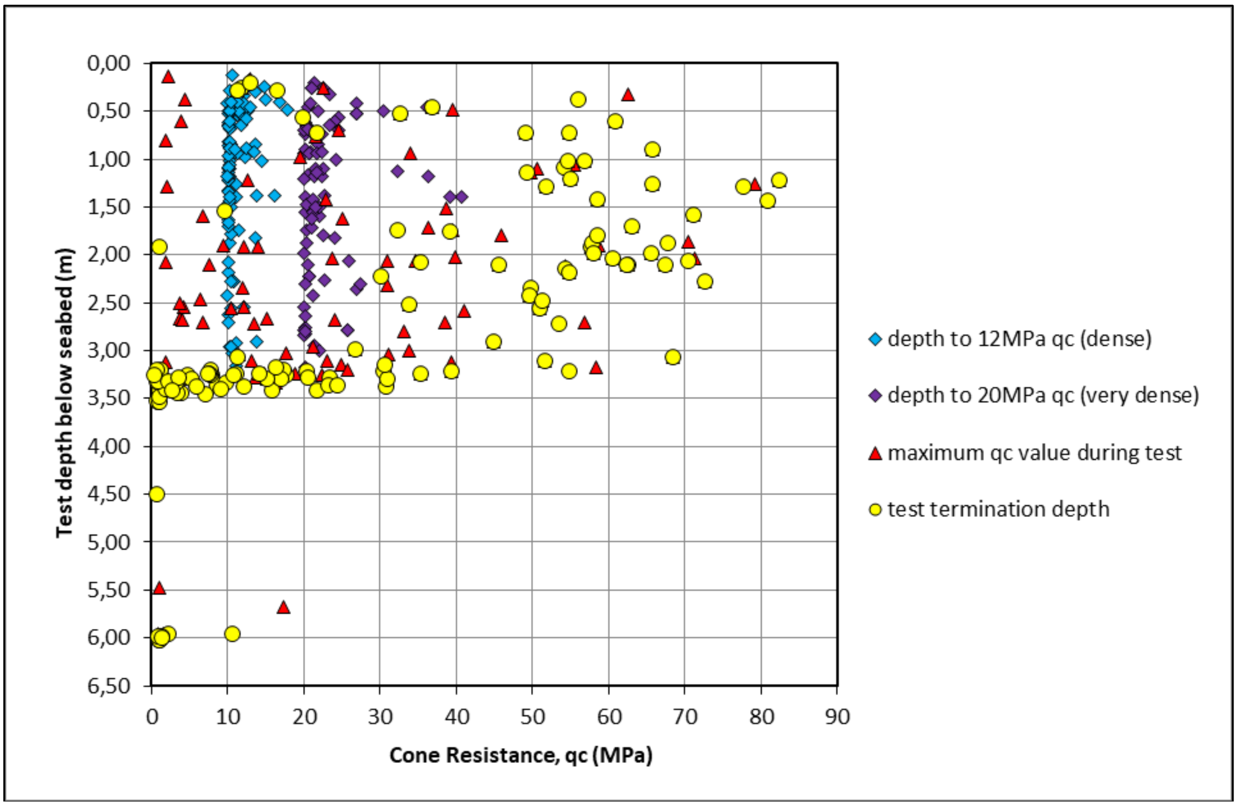

Figure 4. Plot of cone resistances for all CPT.

2.3.5| DATA INTERPRETATION AND SEDIMENT PARAMETERS

Final sediment or soil type interpretation was carried out by InSitu SI upon completion of fieldwork. The interpretation follows the recommendations of Lunne et al (1997), to derive (where appropriate) parameters including soil type, friction ratio, pore pressure ratio, undrained shear strength and relative density. The soil classification uses the normalised CPT soil classification chart of Robertson et al. (1986), see CPT Key, included in the appendices.

An explanation of the terms used and derivations of the cone and soil parameters are given in the CPT Key. For cone resistance, the calculated values of corrected cone resistance (q_t), taking into account cone end area and pore water effects were plotted. There is only a relatively minor difference between q_c and q_t in the majority of tests carried out.

For shear strength, Nk factors of 15, 17.5 and 20 have been applied to the data. Further discussion is provided in Section 4 with regards to the applicability of Nk factors for any encountered cohesive sediments. Indicated cohesive soil strengths on the test plots have been determined from the calculated lower and upper bound shear strength range. The derivation of relative density (Density Index) for a given granular soil is fraught with ambiguity due to the inherent variability in factors which contribute to sand compressibility and material interaction with the penetrating cone, such as grain size, grain shape, mineralogy and their vertical and lateral distribution within the profile. Assignment on the CPT logs of a granular density description for a given strata has been determined from cone resistance (q_c) values, as per EN 1997-2. The table below summarises the material density and strength descriptors used in this report and their approximate correlation with cone resistance parameters. Note, the correlation of shear strength with cohesive material consistency, as determined from VC logging, is approximate only.

Table 6 Summary of material density and strength descriptors.

GRANULAR MATERIAL	
RELATIVE DENSITY	**CONE RESISTANCE (q_c, MPa)**
Very loose	0 - 2.5
Loose	2.5 - 5
Medium dense	5 - 10
Dense	10 - 20
Very dense	> 20

COHESIVE MATERIAL			
STRENGTH DESCRIPTION	**UNDRAINED SHEAR STRENGTH (kPa)**	**CONSISTENCY DESCRIPTOR**	**APPROXIMATE q_c RANGE (MPa)**
Extremely low	< 10	Very soft	0 - 0.4
Very low	10 - 20		
Low	20 - 40	Soft	0.4 - 0.8
Medium	40 - 75	Firm	0.8 - 1.5
High	75 - 150	Stiff	1.5 - 3.0
Very high	150 - 300	Very stiff	> 3.0
Extremely high	> 300	Hard	

An alternate assignment of relative density descriptor from the calculated Density Index (as per BS EN 14688-2:2004+A1, (2013) has not been applied, due to the large variation and uncertainty which can result from the methods that could be utilised, e.g. Jamiolkowski et al. (1985); Baldi et al. (1986); Kulhawy and Mayne (1990). Applying all the methods stated above provides Density Index ranges varying by up to 40% for a single data point, and as such, the simpler assignment of the descriptor from the measured qc data is preferred. The relative density trend lines shown on the individual test plots are 1: Baldi et al. (1986); 2: Jamiolkowski et al. (2001), 3: Kulhawy and Mayne (1990)

The data is presented graphically relative to depth below seabed level on the CPT logs. The strata descriptions provided on the logs are based on manual interpretation of the data, combined with the automated estimation of soil type carried out by the Datgel (CPTtool) software, and cross correlation with soil descriptions from the vibrocores carried out during the investigation. However, it must be expected that there are always localised lithological variations within any given geological succession, which combined with any soil interpretation based on CPT data, may result in subtle differences in the assignment of actual soil type in an apparently uniform stratum. The interpretation of main soil type, for example silty CLAY, as opposed to clayey SILT, or minor proportions such as silty SAND, as opposed to clayey SAND, can be an extremely difficult task and is based on very slight variations in soil proportions or measured CPT parameters. This should always be taken into account during any comparative review of the information provided. The descriptions of the materials encountered are in general accordance with BS EN ISO 14688-1 (2018), for soils.

2.4| BOREHOLES

2.4.1| GENERAL

The boreholes were constructed using a combination of cable percussive boring and rotary core drilling.

Cable percussive boring was carried out in unconsolidated sediments from seabed level. A Dando 4000 rig was used for sampling and testing. The hole was advanced using 8” (200mm) steel boring casing with an undersize 7” shell tool. Standard penetration tests (SPT) were carried out at 1.5m intervals, in general accordance with BS EN ISO 22476-3 (2005). Samples taken during percussive boring comprised bulk bags, typically over a 0.50 to 1.00m depth range, and tubs of the material recovered in the SPT split spoon.

Upon encountering competent material, the drilling method was changed to rotary coring. A Dando 9000 rig was used in combination with a wireline Geobor-S triple tube drill string (146mm OD hole). Water was used as the flushing medium. The core runs were undertaken with a standard 1.50m long barrel, fitted with internal plastic core line to produce nominal 102mm rock cores. The actual core run length was occasionally reduced in less competent material, particularly close to rockhead level.

2.4.2| SAMPLE HANDLING AND LOGGING

Upon recovery, the core liners were placed in plastic core trays and appropriately labelled. Preliminary logging of the ends of the recovered core liners was carried out onboard the jack up barge. Once complete the entire samples and cores recovered from the nearshore operation were transported to the Rotherham, UK facility of InSitu SI.

Upon their arrival at the facility, the sediment samples derived from percussive boring (bulks and tubs) were examined. Each completed cored section of the boreholes were carefully laid out, split longitudinally, photographed and logged, such that a complete borehole description was produced.

The borehole records are presented in the appendices. The records provide descriptions of the materials encountered in accordance with BS EN ISO 14688-1 (2018) and 14688-2 (2018), for soils and rocks. Photographs of the recovered cores are also presented within the records.

3| LABORATORY TESTING

3.1| SUMMARY

Laboratory testing schedules were initially compiled by InSitu SI during logging. The actual testing programme was then confirmed, amended where required and approved by the Client. The samples required for geotechnical testing were transferred to the Doncaster, UK, laboratory of PSL Limited. Some of the rock testing was carried out by the Structural Soils laboratory, located at Bristol, UK.

The geotechnical testing is summarised in Table 7 and 7, and the results are presented in the relevant appendices. Testing was carried out in general accordance with the Standards as indicated below.

Table 7. Summary of geotechnical testing quantities (sediment).

SEDIMENT (SOIL) TESTING				
TEST TYPE	**OFFSHORE UK**	**OFFSHORE IRELAND**	**NEARSHORE UK**	**NEARSHORE IRELAND**
MC	187	192	7	2
BD/DD	153	178	3	
PD	7	5	2	
AT	25	14	5	2
PSD	54	74	9	3
SED	24	6	4	1
MM	6	5	2	
TV	101	24		
UU	15	4	1	
LV	30	7		
SBX	4	5	2	
TR	Offshore – 126 Onshore - 5	Offshore – 152 Onshore - 14		
ORG			3	

Table 8 Key to sediment geotechnical testing.

TYPE	CARRIED OUT ON	REMARKS & TEST STANDARD
Moisture Content (MC)	Granular / Cohesive	Carried out on intact liner material together with bulk & dry density. Data also obtained from UU, AT, SBX & OED tests. BS 1377: Part 2.
Bulk Density (BD)	Granular / Cohesive	Carried out on intact liner material together with dry density & moisture content. Data also obtained from UU, SBX & OED tests BS 1377: Part 2.
Dry Density (DD)	Granular / Cohesive	As above. BS 1377: Part 2.
Particle Density (PD)	Granular / Cohesive	BS 1377: Part 2.
Atterberg Limits (AT)	Cohesive	BS 1377: Part 2.
Particle Size Distribution Analysis (PSD)	Granular/ Cohesive	By wet sieve BS 1377: Part 2.
PSD sedimentation (SED)	Granular / Cohesive	<63µm size, by pipette. BS 1377: Part 2.
Min/Max Dry Density (MIN/MAX)	Granular	BS 1377: Part 4.
Shear Strength (Torvane, TV)	Cohesive	Carried out during logging.
Unconsolidated Undrained Triaxial Compression Test (UU)	Cohesive	BS 1377: Part 7.
Shear Strength (Lab Vane, LV)	Cohesive	Carried out during logging. BS 1377: Part 7.
Shearbox (small, SBX)	Granular	BS 1377: Part 7. Peak & residual.
Thermal Resistivity (TR)	Granular / Cohesive	Carried out in undisturbed liner material using Needle Probe. MC/BD/DD also carried out for each TR test. ASTM D5334-14
Organic Content (ORG)	Cohesive	BS 1377: Part 3.

Table 9. Summary of geotechnical testing (rock).

ROCK TESTING				
TYPE	**NEARSHORE UK**	**NEARSHORE IRELAND**	**CARRIED OUT ON**	**REMARKS**
Bulk Density (BD)	4	15	Intact rock	ISRM (2007).
Dry Density (DD)	4	15	Intact rock	ISRM (2007).
Moisture Content (MC)	4	15	Intact rock	ISRM (2007).
Porosity (PO)	1	4	Intact rock	ISRM (2007).
Point Load (PL)	6	11	Intact rock	ISRM (2007).
Uniaxial Compressive Strength (UCS)		4	Intact rock	ISRM (2007).
Cerchar Abrasion Test (CE)	3	9	Thick rock slice	ISRM (2007) carried out by Structural Soils
Thermal Resistivity (TR)		3	Drilled hole in intact rock	ASTM D5334-14

3.2| TESTING OVERVIEW

3.2.1| CLASSIFICATION TESTS

MOISTURE CONTENT

Water (moisture) content has been determined from intact sediment samples taken directly from the split vibrocore liners using a thin walled stainless steel cutting ring to ensure optimal sample quality and minimal disturbance. Water content was also determined on samples used for more advanced tests (e.g. AT, UU, SBX, OED). Whilst due care is taken to ensure an undisturbed sample is utilised for moisture content determination, it must be considered that the original in-situ moisture content, especially in granular material, could have been modified by the initial physical act of sampling (i.e. vibration and grain packing/pore space readjustment), together with potential free drainage during handling, sample transport and storage, prior to being tested. The results are summarised in the appendices, and are shown the VC logs.

BULK AND DRY DENSITY

Natural bulk and dry densities were determined from the same intact samples as used for moisture contents, taken directly from the split vibrocore liners using a thin walled stainless steel cutting ring to ensure optimal sample quality and minimal disturbance. Densities were also determined on samples used for more advanced tests (e.g. UU, SBX, OED). The results are summarised in the appendices, and are shown the VC logs.

PARTICLE DENSITY

The particle density was determined on samples which were also scheduled for minimum and maximum dry densities. The particle density was directly determined via the gas pyknometer method. The results are summarised in the appendices.

ATTERBERG LIMITS

The liquid (wL) and plastic (wP) limits were determined from intact samples taken directly from the split vibrocore liners. The samples were removed from the liners as intact blocks to ensure optimal sample quality and minimal disturbance. The results are provided in the appendices, and are also plotted on a Plasticity Charts in Section 4.

PARTICLE SIZE DISTRIBUTION (SIEVE & SEDIMENTATION)

Particle size distribution (PSD) tests were performed on a range of sediment types from the vibrocores, which together with the logging, provides a complete sediment description profile. The samples for PSD were taken over a representative range in any given strata, typically a minimum of 0.50m if possible. The fines component (<63µm fraction) was determined via sedimentation using the pipette method, where the total fines content from the sieving was >10%. The results are summarised in the appendices, followed by the individual test reports.

MINIMUM AND MAXIMUM DRY DENSITY

The minimum and maximum dry densities are determined as the loosest and densest states, respectively, that can be achieved in the laboratory without physically crushing the constituent soil grains. The results are summarised in the appendices, and shown on the VC logs.

3.2.2| STRENGTH AND CONSOLIDATION TESTS

SHEAR STRENGTH (TORVANE)

Shear strength determinations were made during logging with a torvane (TV). The results are provided on the VC logs and summarised in the appendices.

UNCONSOLIDATED UNDRAINED TRIAXIAL TESTS

Triaxial compression testing was undertaken on undisturbed samples to determine the value of undrained shear strength. The tests were carried out as a single-stage. Unfortunately, in those vibrocores containing cohesive material, it was often too low strength to remove from the liner as a single competent sample, or where there was high silt content the samples tended to split apart upon handling. The individual test results are provided in the appendices, and shown on the VC logs.

SHEAR STRENGTH (LAB VANE)

Shear strength determinations were made on the ends of the undisturbed liners prior to splitting using a laboratory vane to determine both peak and residual shear strengths. Each sample was tested three times, and the average calculated. The results are provided on the VC logs and in the appendices.

SMALL SHEARBOX

Small shearbox (direct shear) testing (SBX) was carried out on samples taken over a representative range in granular strata. The testing was carried out on three subsamples from each sample, to provide peak and residual friction angles, and values of cohesion. The samples were tested under in-situ stress conditions, with stages at nominal 10, 20 and 40kPa. The results are provided in the appendices, followed by the individual test reports.

3.2.3| THERMAL RESISTIVITY TESTING

THERMAL RESISTIVITY

Thermal tests were carried out both offshore and onshore. It must be noted that thermal testing offshore can often be difficult and provide spurious values. This is due largely to sample disturbance when the intact VC cores are cut into 1.00m sections. As the cut ends of the cores are the only exposed part of the sample which can be tested, it is often the case, especially in granular material, that dewatering and slumping, together with material disturbance occurs such that the thermal needle probe is not fully confined by intact undisturbed sediment that has retained close to its natural water content. This then often provides either a low result (e.g. <0.250), or in many cases in granular material a high result (e.g. >0.600 for SAND). The typical range of resistivity for saturated marine granular material is 0.300 to 0.500.

Onshore thermal testing was carried out to try to 'validate' the offshore results. During onshore logging the offshore data was assessed and in general, where the material condition allowed, any value greater than approximately 0.700 was the subject of a validation test. Two readings were taken at each depth, and the average values are presented. The data are provided in the appendices, and shown on the VC logs.

Thermal testing was also carried out on three rock cores. The needle probe was inserted into small pilot holes, 100mm in length, drilled into intact pieces of rock core. The amount of material which could be tested was restricted due to frequent fracturing of the rock material during attempts to drill the pilot holes.

3.2.4| ORGANIC MATTER

The testing comprised organic matter (via titration) on a dried sample that has been crushed to pass a 425µm sieve. If the result is >25%, the maximum that can be obtained by titration, then a loss on ignition, at 440°C, is carried out.

3.2.5| ROCK TESTING

MOISTURE CONTENT, POROSITY, BULK AND DRY DENSITY

From the rock cores, small intact pieces of core were taken from the split liners and immediately sealed in small, airtight plastic tubs.

POINT LOAD TESTING

Point load testing (PLT) was carried out on any medium size, intact pieces of core which could be taken from the split liners. They were immediately sealed in large, airtight plastic tubs, or wrapped in several layers of PVC cling film. The core pieces were between 100 to 200mm in length and contained no visible open fractures, such that hopefully both axial and diametral tests could be carried out on as many samples as possible. Where valid axial (A) or diametral (D) tests could not be carried out, the test was carried out on as an irregular lump (I).

In the absence of a site specific correlation from a large data set, Point Load Index values (Is_{50}) are typically converted to uniaxial compressive strengths (UCS) using a conversion factor, *k*, of 20. This value is that typically advocated in the UK ground investigation industry (see review in Norbury, 1986). A plot below shows common UK rock types with values of *k* determined from correlation tests. This illustrates the wide variation, and also general validity of using a *k* value of 20, when a site specific correlation cannot be undertaken.

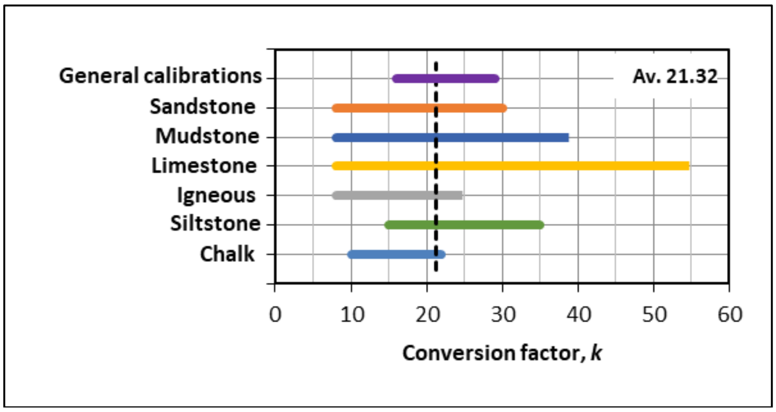

Figure 10. Plot of typical UCS - Point Load Index conversion factors.

UNIAXIAL COMPRESSIVE STRENGTHS

Uniaxial compressive strength testing (UCS) was carried out on any large intact pieces of core taken from the split liners and immediately sealed by wrapping in several layers of PVC cling film. The core pieces were generally greater than 200mm in length and contained no visible open fractures, such that they did not degrade prior to being tested. It must be considered that extremely weak to weak rock might be poorly represented in the recovered cores, or might be difficult to prepare and test in the laboratory due to the inherent fracturing, and such the suitability of the recovered cores for UCS testing was compromised.

The rock strength descriptors used in this report are those stated in BS EN ISO 14689-1 (2018).

Table 10. Description of rock strength and estimation of unconfined compressive strength (UCS).

ROCK STRENGTH TERMS	IDENTIFICATION BY HAND TEST	UCS (MPa)
EXTREMELY WEAK	Scratched by thumbnail, gravel size lumps can be crushed between finger and thumb	**0.6 to 1**
VERY WEAK	Scratched by thumbnail. Lumps broken by heavy hand pressure, can be peeled by knife, crumbles under firm blows with point of hammer	**1 to 5**
WEAK	Thin slabs, corners or edges can be broken with hand pressure, can be peeled with difficulty by knife, easily scratched by knife, shallow indentations made by point of hammer by firm blow	**5 to 12.5**
MODERATELY WEAK	Thin slabs, corners or edges can be broken with heavy hand pressure, can be scratched with difficulty by knife, can be broken in hand by one firm hammer blow	**12.5 to 25**
MEDIUM STRONG	Cannot be scraped or peeled with knife, can be broken on solid surface by a single firm hammer blow	**25 to 50**
STRONG	Requires more than one hammer blow to fracture	**50 to 100**
VERY STRONG	Many hammer blows to fracture	**100 to 250**
EXTREMELY STRONG	Only chipped with hammer	**>250**

CERCHAR ABRASIVITY

Cerchar abrasivity testing was carried out small intact pieces of core taken from the split liners and immediately sealed by wrapping in several layers of PVC cling film. The samples were tested at the Structural Soils laboratory, Bristol, UK.

4| DISCUSSION OF RESULTS

4.1| INTRODUCTION

A discussion of the encountered ground conditions during the survey follows. The two sections of the route, UK and Ireland are treated separately. Within each section, analysis has been undertaken in KP order, and it is possible to separate the survey line into ‘route sections’, based on similarities between the ground conditions encountered in adjacent locations. Analysis of the route has been undertaken from the UK end of the survey line.

A scale has been derived for the purpose of this discussion called the Seabed Index (SI). The SI can be viewed as a semi-quantitative scale in respect of the encountered ground conditions, and to some respect, the likely difficulties for engineering activities in the investigated depth below seabed level. For this report, the Seabed Index values provided are based on the geological and geotechnical characteristics of the encountered material at depths of 0.50, 1.00 and 1.50m. This is due to the indicated trenching depth being approximately 1.00 to 1.50m depth. For a detailed assessment of the sediment below this depth, the reader should consult the relevant complete VC and CPT records, together with the laboratory testing results provided in the appendices. Note is made that where a VC or CPT has terminated at less than 1.50m, the Seabed Index provided is to the next nearest depth (0.50, 1.00 or 1.50m).

A summary of the SI scale used to quantify each survey location is presented in below.

Table 11. Summary of the Seabed Index (SI) scale.

SI	Typical Seabed Sediment
1	Shallow Bedrock (<1.00m)
2	Bedrock / Obstruction (>1.00m)
3	Very dense granular, very to extremely high strength cohesive
4	Medium to high strength cohesive
5	Dense granular
6	Medium dense granular
7	Loose granular, low to medium strength cohesive
8	Very loose granular, low strength cohesive
9	Very low strength sandy cohesive
10	Extremely low strength cohesive

The following summary discusses the survey results in each section. A brief summary of the geotechnical characteristics of the encountered ground conditions is presented, together with any pertinent laboratory testing results. Note, that the KP range given for each defined route section are the KP values of the actual sampling and testing locations. This report cannot comment on the specific ground conditions present in those intervening parts of the route where no testing or sampling was carried out. The discussion is not exhaustive and reference should be made to the relevant complete VC and CPT records, together with the laboratory testing results provided in the appendices.

4.2| UK ROUTE SECTION

The geotechnical locations in the UK offshore section of the Greenlink survey are shown below.

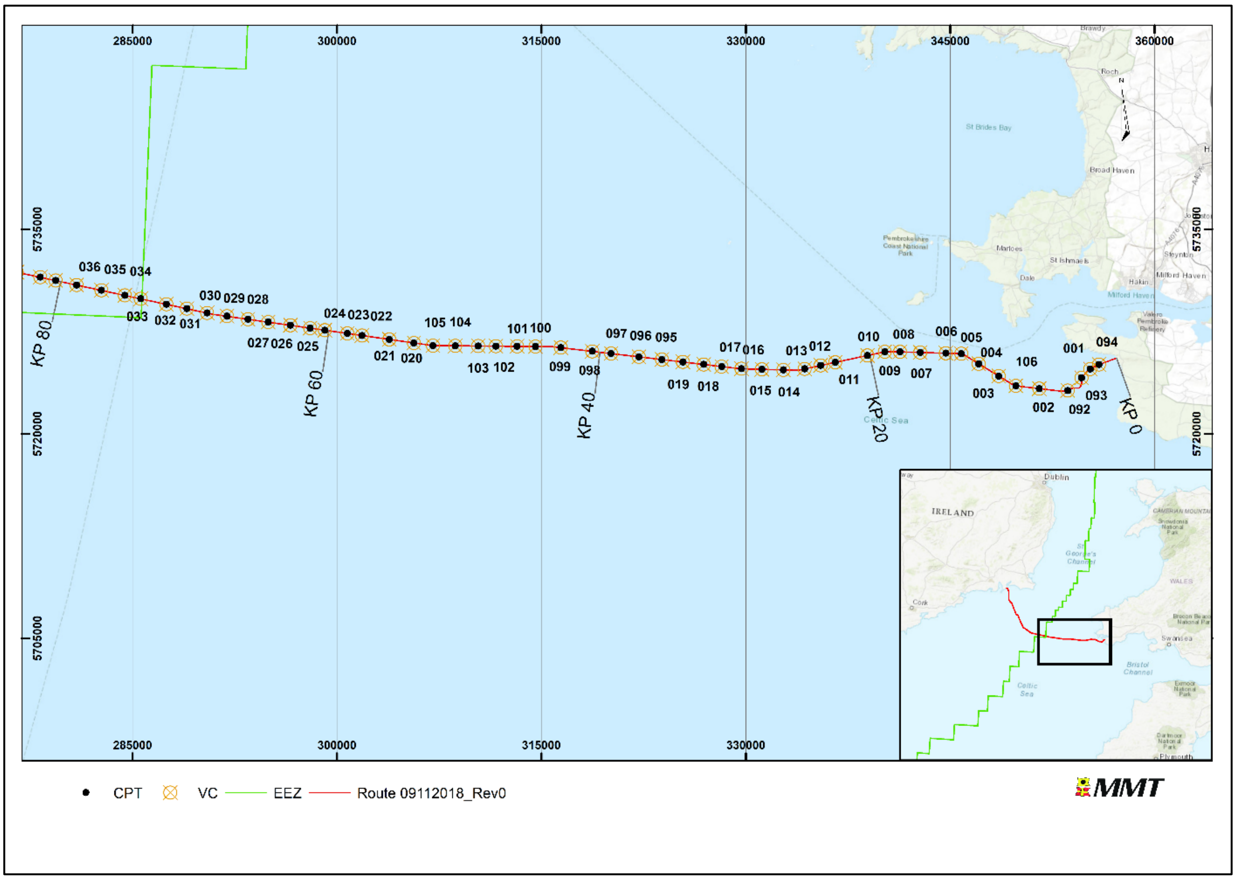

Figure 5. Summary of geotechnical locations in the UK section of the Greenlink route.

The UK section extends for approximately 73km, from KP 0 at the proposed landfall at Freshwater West, on the Pembrokeshire coast in Wales.

In total forty seven locations were carried out with thirty six VC and eighteen CPT re-attempts required. The Seabed Index summary table for the UK section is shown below. Based on the encountered ground conditions, the UK section has been divided into three route sections.

Table 12. Summary of Seabed Index for the entire UK section.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
1.374	953-CPT-094	CPT			3.26	0.52	1.36	6	5	5
1.374	953-VC-094	VC	2.90	2.75				6	5	5
2.096	953-VC-001A	VC	3.00	1.92				6	6	5
2.097	953-CPT-001	CPT			3.22	1.40	2.26	6	6	5
3.015	953-CPT-093	CPT			2.56	1.02	2.06	7	5	6
3.016	953-VC-093	VC	3.00	1.89				7	5	6
4.737	953-CPT-092	CPT			3.24	2.62		6	7	6
4.738	953-VC-092A	VC	3.00	2.42				6	7	6
6.848	953-VC-002A	VC	3.00	2.54				6	5	5
6.849	953-CPT-002A	CPT			3.26	0.90	2.82	6	5	5
6.852	953-CPT-002	CPT			1.54	0.82		6	5	5
8.576	953-CPT-106	CPT			3.42	1.46		7	6	5
8.577	953-VC-106A	VC	3.00	2.20				7	6	5
10.036	953-VC-003B	VC	0.72	0.37				3		
10.039	953-CPT-003A	CPT			0.38	0.18	0.20	3		
10.040	953-CPT-003	CPT			0.46	0.40	0.42	3		
11.754	953-CPT-004A	CPT			2.08	0.38	0.46	5	3	1
11.758	953-CPT-004	CPT			2.08	0.54	0.70	6	1	1
11.758	953-VC-004	VC	1.19	0.74				6	1	
13.238	953-CPT-005	CPT			2.90	1.50	1.60	7	7	6
13.239	953-VC-005A	VC	3.00	1.96				7	7	6
14.382	953-CPT-006A	CPT			1.22	0.62	1.18	6	5	3
14.382	953-VC-006A	VC	1.50	0.82				6	5	
14.383	953-CPT-006	CPT			1.92	0.98	1.12	6	5	3
16.259	953-CPT-007	CPT			0.56	0.24	0.46	3		
16.259	953-CPT-007A	CPT			0.72	0.52	0.70	6	3	
16.263	953-VC-007	VC	1.00	0.49				3		
17.743	953-CPT-008A	CPT			1.20	0.34	0.94	6	3	3
17.743	953-VC-008A	VC	1.80	1.25				6	3	3
17.745	953-CPT-008	CPT			1.26	0.30	0.42	5	3	3
18.861	953-CPT-009	CPT			1.28	0.66	1.16	6	5	3
18.861	953-CPT-009A	CPT			1.28	0.50	0.74	5	3	3

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
18.861	953-VC-009A	VC	2.00	1.64				3	3	3
20.166	953-CPT-010	CPT			0.28	0.24	0.26	3		
20.167	953-CPT-010A	CPT			0.72	0.52	0.62	5	3	
20.169	953-VC-010	VC	0.60	0.27				3		
22.585	953-CPT-011	CPT			0.90	0.26	0.26	3	3	
22.586	953-VC-011	VC	1.02	0.57				3	3	
22.589	953-CPT-011A	CPT			0.60	0.28	0.32	3	3	
23.675	953-VC-012A	VC	1.86	1.48				4	4	3
23.676	953-CPT-012	CPT			1.42	1.38	1.40	8	4	3
23.678	953-CPT-012A	CPT			1.44	1.38	1.40	4	4	3
24.872	953-VC-013	VC	2.65	2.29				5	3	3
24.874	953-CPT-013A	CPT			1.88	0.30	0.90	5	3	3
24.876	953-CPT-013	CPT			0.26	0.26		3		
26.447	953-VC-014	VC	2.52	2.33				5	3	3
26.450	953-CPT-014A	CPT			1.02	0.50	0.56	5	3	3
26.451	953-CPT-014	CPT			1.02	0.50	0.60	5	3	3
28.031	953-CPT-015	CPT			2.14	0.94	1.18	8	3	3
28.031	953-CPT-015A	CPT			1.76	0.64	1.18	8	3	3
28.032	953-VC-015	VC	1.85	0.71				3	3	
29.530	953-CPT-016	CPT			3.20	1.88	2.10	7	8	4
29.532	953-VC-016A	VC	1.85	0.80				3	3	
30.994	953-CPT-017	CPT			2.72	0.86	2.22	7	5	5
30.994	953-VC-017	VC	3.00	2.69				7	5	5
32.317	953-VC-018A	VC	2.70	2.31				6	5	5
32.320	953-CPT-018	CPT			3.30	0.92	1.40	6	5	3
33.856	953-CPT-019	CPT			1.14	0.52	0.52	5	3	3
33.858	953-CPT-019A	CPT			0.28	0.28		3		
33.862	953-VC-019	VC	2.31	1.36				3	3	3
35.403	953-VC-095A	VC	3.12	2.82				6	5	5
35.406	953-CPT-095	CPT			3.28	0.38	1.56	6	5	5
37.106	953-VC-096	VC	1.04	0.36				4		
37.107	953-CPT-096	CPT			2.34	0.42	2.22	6	4	4
39.162	953-VC-097	VC	1.00	0.27				3		

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
39.167	953-CPT-097	CPT			3.26	0.46	1.38	5	6	3
40.555	953-CPT-098	CPT			3.20	0.84	0.92	7	5	3
40.556	953-VC-098A	VC	1.26	0.22				3		
42.871	953-CPT-099A	CPT			0.52	0.48	0.50	3	3	
42.880	953-CPT-099	CPT			0.72	0.58	0.64	7	3	
44.735	953-CPT-100	CPT			1.88	0.50	0.64	5	3	3
44.735	953-VC-100	VC	2.12	1.91				5	3	3
44.740	953-CPT-100A	CPT			1.74	0.52	0.66	5	3	3
46.090	953-VC-101	VC	3.00	3.00				4	4	4
46.092	953-CPT-101	CPT			3.34	0.64		6	5	4
47.643	953-CPT-102	CPT			3.42	2.78	2.78	4	4	4
47.645	953-VC-102	VC	3.00	2.32				4	4	4
48.947	953-CPT-103	CPT			3.36	2.54		8	4	4
48.947	953-VC-103	VC	2.84	2.30				8	4	4
50.627	953-CPT-104	CPT			2.42	1.64	2.36	8	8	6
50.628	953-VC-104	VC	3.00	3.00				8	8	6
52.257	953-CPT-105	CPT			3.34			8	8	8
52.260	953-VC-105	VC	3.00	3.00				8	8	4
53.668	953-CPT-020	CPT			6.00	2.56		7	8	6
53.671	953-VC-020	VC		4.94				7	8	6
55.504	953-CPT-021	CPT			6.00			8	7	7
55.506	953-VC-021B	VC	5.82	5.68				8	7	7
57.520	953-VC-022B	VC	5.96	5.54				8	8	4
57.522	953-CPT-022	CPT			1.92			8	8	4
57.523	953-CPT-022A	CPT			5.96			8	8	4
58.608	953-CPT-023	CPT			5.98	1.44	1.98	8	8	5
58.608	953-VC-023A	VC	4.50	3.71				8	8	5
60.283	953-CPT-024	CPT			5.96	2.18		8	7	7
60.283	953-VC-024	VC	6.00	2.25				8	7	7
61.364	953-VC-025A	VC	6.00	5.11				8	6	5
61.366	953-CPT-025	CPT			6.02	1.32		8	6	5
62.825	953-CPT-026	CPT			5.98			8	7	7
62.827	953-VC-026A	VC	6.00	4.68				8	7	7

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
64.472	953-CPT-027	CPT			6.02	1.26	1.74	8	7	5
64.473	953-VC-027	VC	6.00	5.95				8	7	4
65.975	953-CPT-028	CPT			5.98			8	7	7
65.978	953-VC-028A	VC	5.70	4.75				8	7	7
67.528	953-VC-029	VC	6.00	5.42				8	7	7
67.531	953-CPT-029A	CPT			6.00			8	7	7
67.533	953-CPT-029	CPT			4.50			8	7	7
69.006	953-VC-030	VC	3.00	2.12				8	8	8
69.008	953-CPT-030	CPT			3.54			8	8	8
70.536	953-VC-031	VC	3.00	2.64				8	8	8
70.538	953-CPT-031	CPT			3.42			8	8	8
72.063	953-CPT-032	CPT			3.52			8	8	8
72.063	953-VC-032	VC	3.00	2.45				8	8	8

4.2.1| ROUTE SECTION 01 (KP 1.374 - KP 8.577)

This first route section covers the locations 094 (KP 1.374) to 106A (KP 8.577). The seabed index summary for this section is shown below.

Table 13. Seabed Index summary for route section 01, UK.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
1.374	953-CPT-094	CPT			3.26	0.52	1.36	**6**	**5**	**5**
1.374	953-VC-094	VC	2.90	2.75				**6**	**5**	**5**
2.096	953-VC-001A	VC	3.00	1.92				**6**	**6**	**5**
2.097	953-CPT-001	CPT			3.22	1.40	2.26	**6**	**6**	**5**
3.015	953-CPT-093	CPT			2.56	1.02	2.06	**7**	**5**	**6**
3.016	953-VC-093	VC	3.00	1.89				**7**	**5**	**6**
4.737	953-CPT-092	CPT			3.24	2.62		**6**	**7**	**6**
4.738	953-VC-092A	VC	3.00	2.42				**6**	**7**	**6**
6.848	953-VC-002A	VC	3.00	2.54				**6**	**5**	**5**
6.849	953-CPT-002A	CPT			3.26	0.90	2.82	**6**	**5**	**5**
6.852	953-CPT-002	CPT			1.54	0.82		**6**	**5**	**5**
8.576	953-CPT-106	CPT			3.42	1.46		**7**	**6**	**5**
8.577	953-VC-106A	VC	3.00	2.20				**7**	**6**	**5**

The encountered ground conditions across this section are largely coarse granular with the material being typically described as slightly gravelly to gravelly slightly silty to silty SAND, through to sandy silty GRAVEL. The basal material at 1.36m in the shallow VC-093 (KP 3.016) is noteworthy due to the presence of reddish brown silty sandy GRAVEL, which possibly represents shallow weathered bedrock. Cohesive material is largely absent in the recovered cores, with the exception of a basal stratum of slightly sandy slightly gravely clayey SILT seen below 1.33m at location 094. Vibrocore recovery was moderate across this route section, from 1.89 (VC-093) to 2.75m (VC-094).

The PSD data for those samples tested from this route section are shown schematically below. This illustrates the dominance of granular material, both SAND and GRAVEL strata being seen, over the investigated depth. Silt contents in the SAND are low, <9%. The SILT stratum at location 094 is clearly highlighted, with a total fines content of 76%.

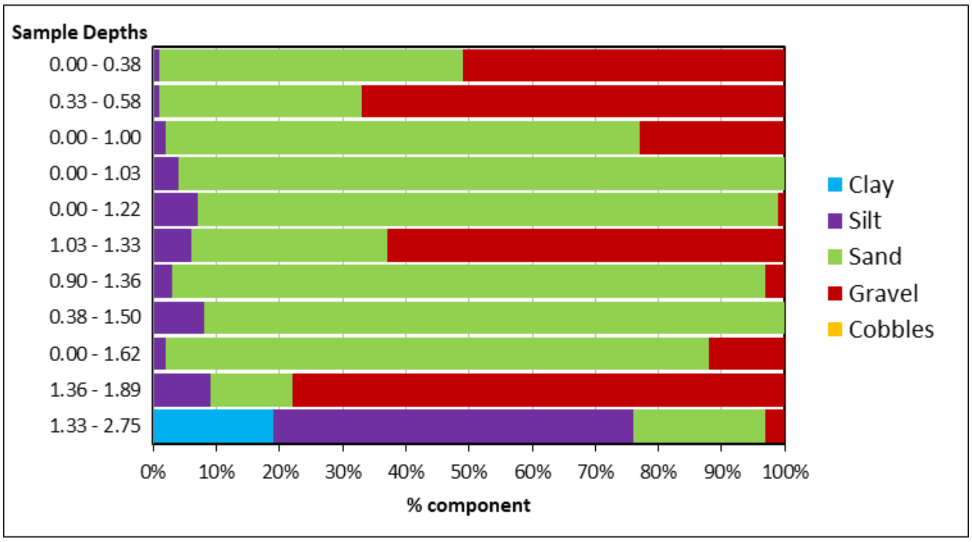

Figure 6. Summary of PSD data for route section 01, UK.

PSD plots for the varying material types, granular or cohesive, are shown below.

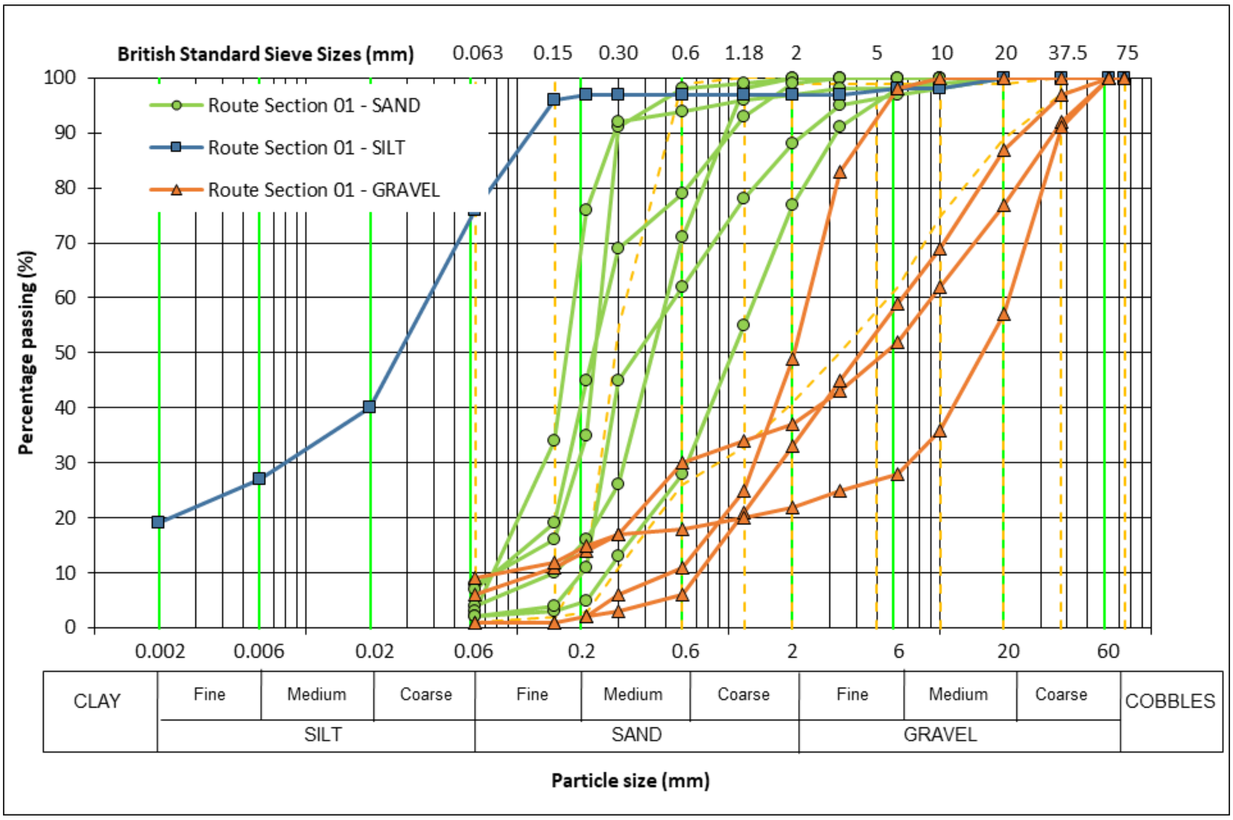

Figure 7 PSD plots for tested material in route section 01, UK.

Laboratory data for this route section are shown below. There is a general increase in density and moisture content with depth, reflecting the granular material, with low moisture contents at the top of the recovered cores probably reflecting some post-sampling drainage. Highest moisture contents of 25 to 27% were obtained from the SILT at location 094, at a highest bulk density of 2.16Mg/m^3.

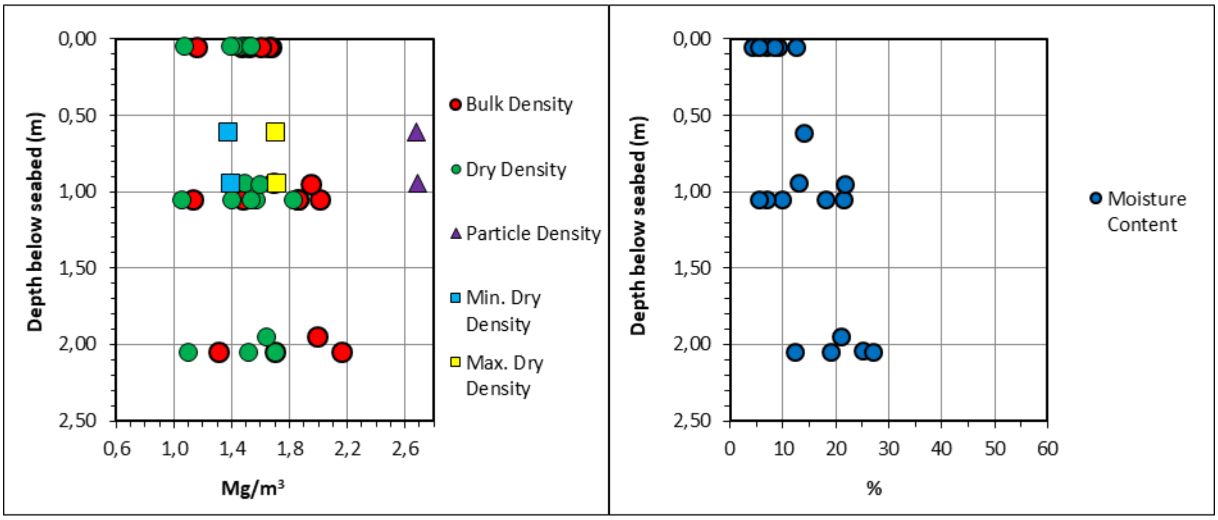

Figure 8 Summary of laboratory test data for route section 01, UK.

Only a single Atterberg test was carried out on material from this route section, at location 094. The test returned as SILT of intermediate plasticity.

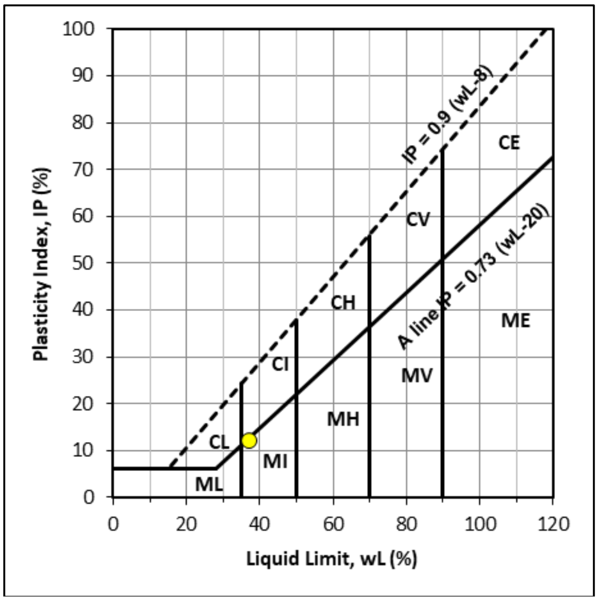

Figure 9. Plasticity Chart for route section 01, UK.

A single shearbox test was carried out on material from VC-002A described as silty SAND. The result indicates peak and residual friction angles of 37° and 34°, respectively.

Sixteen thermal resistivity measurements were taken in the recovered vibrocores during the offshore processing. The reliable data are shown below and follow a general transition from low values of resistivity at low moisture contents, to higher values of resistivity in higher moisture content material. Four of the offshore readings are considered erroneous, ranging from 0.770 to 3.640, generally at very low moisture contents, 4 to 8%. When the samples were assessed onshore the material was disturbed and gravelly such that onshore validation tests of these three samples could not be undertaken.

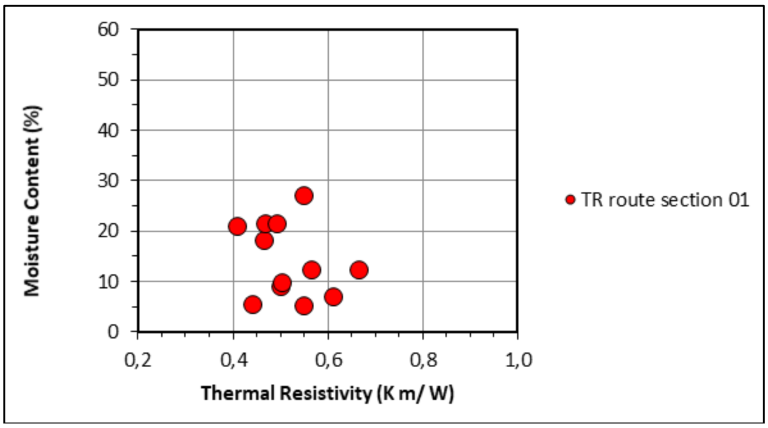

Figure 10 Thermal resistivity data for route section 01, UK.

Seven CPT attempts were undertaken in this route section. A single re-attempt was only required due to shallow penetration at location 002. The depth to dense granular strata is typically <1.50m, with very dense granular strata in the range from 1.36 to 2.82m, where encountered.

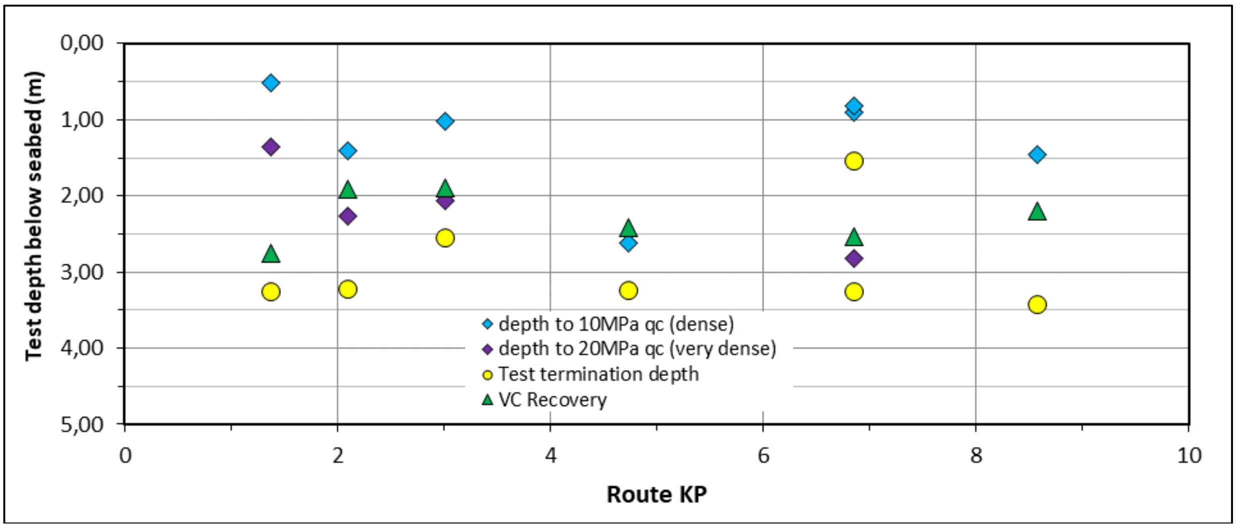

Figure 11. Summary of CPT depths and VC recovery for route section 01, UK.

A plot below shows the measured cone resistances for the CPT carried out in route section 01. The plot confirms that dense granular material in the majority of the tests is encountered below 1.00m, with a general increase in granular relative density with depth. The test at location 094 contrasts in that the SILT stratum is indicated by a clear drop in cone resistance below 1.62m.

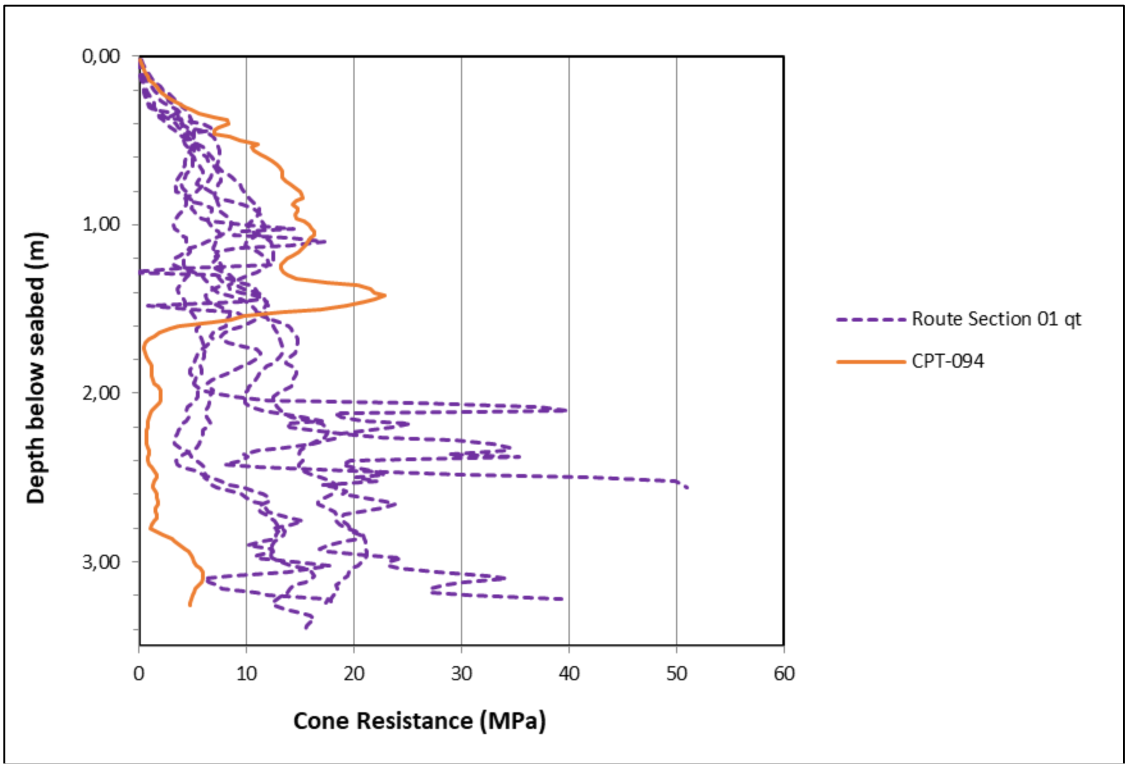

Figure 12. Plot of measured CPT cone resistance for route section 01, UK.

4.2.2| ROUTE SECTION 02 (KP 10.036 - KP 44.740)

This second route section covers the locations 003 (KP 10.036) to 100 (KP 44.740). The seabed index summary for this section is shown below.

Table 14. Seabed Index summary for route section 02, UK.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
10.036	953-VC-003B	VC	0.72	0.37				3		
10.039	953-CPT-003A	CPT			0.38	0.18	0.20	3		
10.040	953-CPT-003	CPT			0.46	0.40	0.42	3		
11.754	953-CPT-004A	CPT			2.08	0.38	0.46	5	3	1
11.758	953-CPT-004	CPT			2.08	0.54	0.70	6	1	1
11.758	953-VC-004	VC	1.19	0.74				6	1	
13.238	953-CPT-005	CPT			2.90	1.50	1.60	7	7	6
13.239	953-VC-005A	VC	3.00	1.96				7	7	6
14.382	953-CPT-006A	CPT			1.22	0.62	1.18	6	5	3
14.382	953-VC-006A	VC	1.50	0.82				6	5	
14.383	953-CPT-006	CPT			1.92	0.98	1.12	6	5	3
16.259	953-CPT-007	CPT			0.56	0.24	0.46	3		
16.259	953-CPT-007A	CPT			0.72	0.52	0.70	6	3	
16.263	953-VC-007	VC	1.00	0.49				3		
17.743	953-CPT-008A	CPT			1.20	0.34	0.94	6	3	3
17.743	953-VC-008A	VC	1.80	1.25				6	3	3
17.745	953-CPT-008	CPT			1.26	0.30	0.42	5	3	3
18.861	953-CPT-009	CPT			1.28	0.66	1.16	6	5	3
18.861	953-CPT-009A	CPT			1.28	0.50	0.74	5	3	3
18.861	953-VC-009A	VC	2.00	1.64				3	3	3
20.166	953-CPT-010	CPT			0.28	0.24	0.26	3		
20.167	953-CPT-010A	CPT			0.72	0.52	0.62	5	3	
20.169	953-VC-010	VC	0.60	0.27				3		
22.585	953-CPT-011	CPT			0.90	0.26	0.26	3	3	
22.586	953-VC-011	VC	1.02	0.57				3	3	
22.589	953-CPT-011A	CPT			0.60	0.28	0.32	3	3	
23.675	953-VC-012A	VC	1.86	1.48				4	4	3
23.676	953-CPT-012	CPT			1.42	1.38	1.40	8	4	3
23.678	953-CPT-012A	CPT			1.44	1.38	1.40	4	4	3

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
24.872	953-VC-013	VC	2.65	2.29				5	3	3
24.874	953-CPT-013A	CPT			1.88	0.30	0.90	5	3	3
24.876	953-CPT-013	CPT			0.26	0.26		3		
26.447	953-VC-014	VC	2.52	2.33				5	3	3
26.450	953-CPT-014A	CPT			1.02	0.50	0.56	5	3	3
26.451	953-CPT-014	CPT			1.02	0.50	0.60	5	3	3
28.031	953-CPT-015	CPT			2.14	0.94	1.18	8	3	3
28.031	953-CPT-015A	CPT			1.76	0.64	1.18	8	3	3
28.032	953-VC-015	VC	1.85	0.71				3	3	
29.530	953-CPT-016	CPT			3.20	1.88	2.10	7	8	4
29.532	953-VC-016A	VC	1.85	0.80				3	3	
30.994	953-CPT-017	CPT			2.72	0.86	2.22	7	5	5
30.994	953-VC-017	VC	3.00	2.69				7	5	5
32.317	953-VC-018A	VC	2.70	2.31				6	5	5
32.320	953-CPT-018	CPT			3.30	0.92	1.40	6	5	3
33.856	953-CPT-019	CPT			1.14	0.52	0.52	5	3	3
33.858	953-CPT-019A	CPT			0.28	0.28		3		
33.862	953-VC-019	VC	2.31	1.36				3	3	3
35.403	953-VC-095A	VC	3.12	2.82				6	5	5
35.406	953-CPT-095	CPT			3.28	0.38	1.56	6	5	5
37.106	953-VC-096	VC	1.04	0.36				4		
37.107	953-CPT-096	CPT			2.34	0.42	2.22	6	4	4
39.162	953-VC-097	VC	1.00	0.27				3		
39.167	953-CPT-097	CPT			3.26	0.46	1.38	5	6	3
40.555	953-CPT-098	CPT			3.20	0.84	0.92	7	5	3
40.556	953-VC-098A	VC	1.26	0.22				3		
42.871	953-CPT-099A	CPT			0.52	0.48	0.50	3	3	
42.880	953-CPT-099	CPT			0.72	0.58	0.64	7	3	
44.735	953-CPT-100	CPT			1.88	0.50	0.64	5	3	3
44.735	953-VC-100	VC	2.12	1.91				5	3	3
44.740	953-CPT-100A	CPT			1.74	0.52	0.66	5	3	3

The encountered ground conditions across this section are again largely coarse granular with the material being typically described as slightly gravelly to gravelly slightly silty to silty SAND. In many cores, there is a general increase in silty SAND content with increasing depth. GRAVEL bands are also common, generally in the upper metre of recovered material, although deeper layers below 1.00m can be seen in VC-005A and VC-019. Similar to the first route section, brownish red clayey GRAVEL at location 003B (KP 10.036) is possibly derived from shallow weathered bedrock. At the next location VC-004 (KP 11.758), very weak to weak thinly laminated dark grey black carbonaceous MUDSTONE was recovered intact at a shallow depth of 0.30m. The adjacent CPT suggests the depth to bedrock may be slightly deeper, at 0.72m. Further highly weathered bedrock is also suggested by dark grey clayey sandy GRAVEL at 0.37m in VC-007 (KP 16.623).

Cohesive strata are also seen at some locations in this route section (VC-012A, VC-015, VC-016, VC-095A, VC-096 and VC-100). The material is high to very high strength stiff brown to grey slightly sandy slightly gravelly silty CLAY. Vibrocore recovery was low to moderate across this route section, from only 0.22m (VC-098) to 2.82m (VC-095A).

The PSD data for those samples tested from this route section are shown schematically below. This illustrates the general dominance of granular material, both SAND and GRAVEL. Cohesive strata are also evident, with CLAY contents up to 37%.

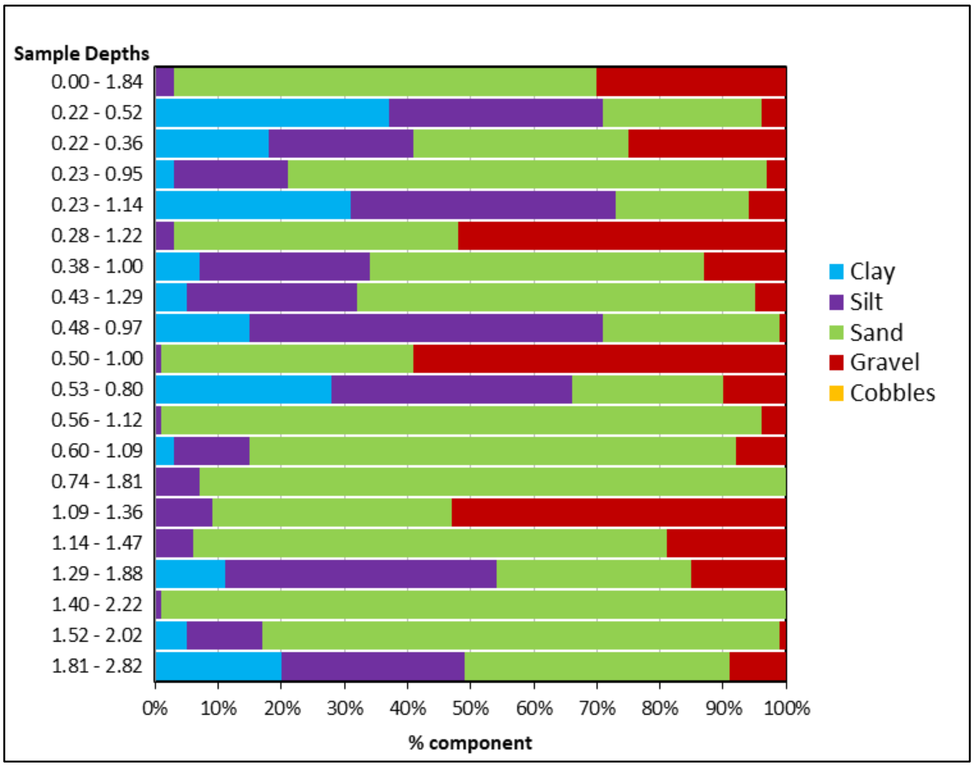

Figure 13. Summary of PSD data for route section 02, UK.

PSD plots are shown below for the varying material types.

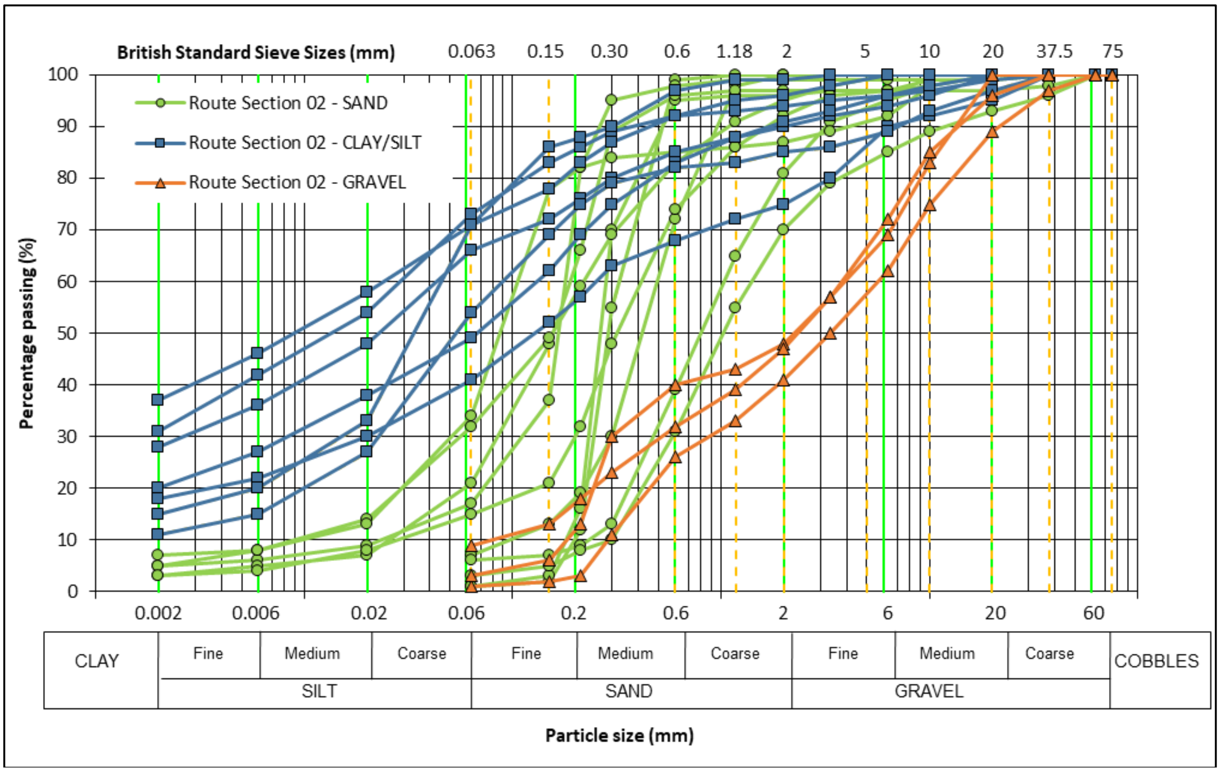

Figure 14. PSD plots for tested material in route section 02, UK.

Laboratory data for this route section are shown below. Determined moisture contents are in the range 2 to 25%, reflecting the granular nature of much of the tested material. Low moisture contents are presumably a function of some post-sampling drainage of the recovered material. Determined bulk and dry densities are highest in cohesive material, typically >2.15 and 1.76Mg/m^3, respectively.

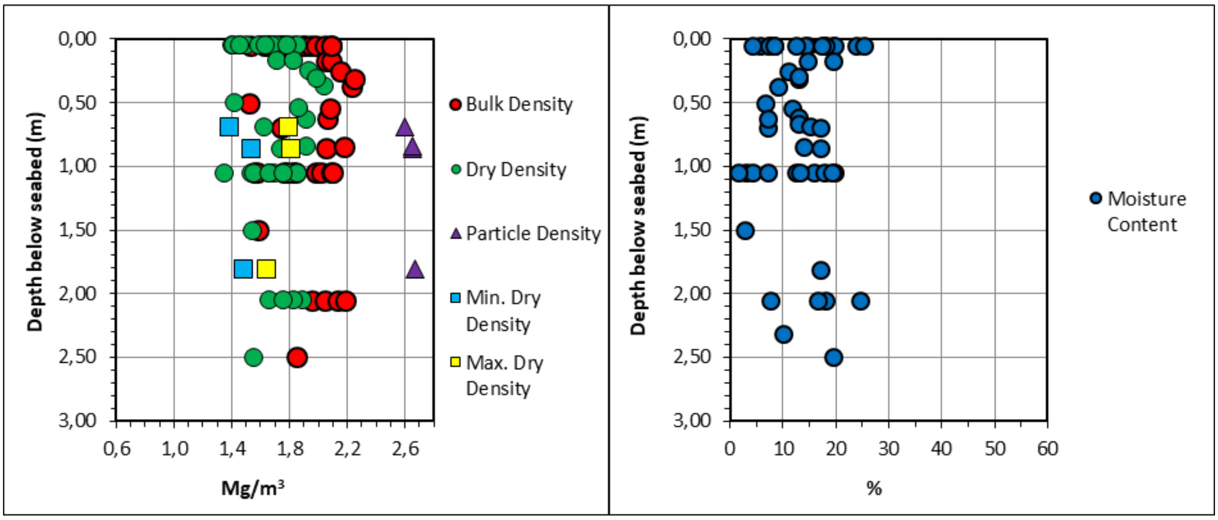

Figure 15 Summary of laboratory test data for route section 02, UK.

Five Atterberg tests were carried out on cohesive material from route section 02. The samples returned as low to intermediate plasticity CLAY.

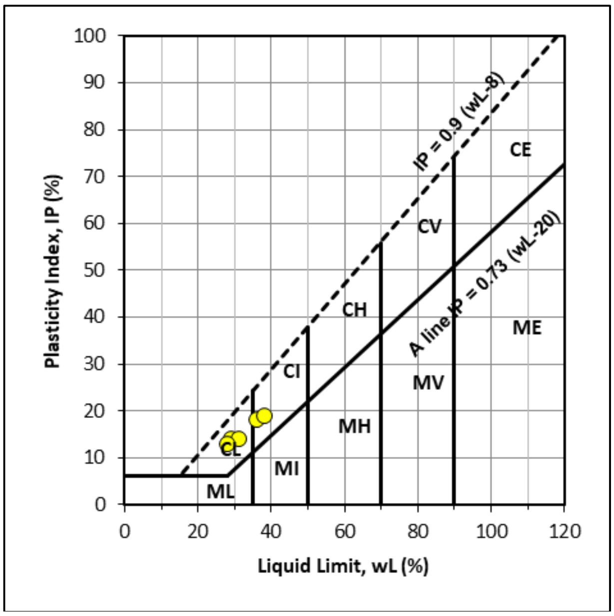

Figure 16. Plasticity Chart for route section 02, UK.

Shear strength data obtained from cohesive material in route section 02 are shown below. The data are almost all in the high to very high strength range (75 to 300kPa). A single lower value of 40kPa was obtained from an extremely thin CLAY band in VC-014. The highest result of 265kPa was obtained from very stiff silty CLAY in VC-016A.

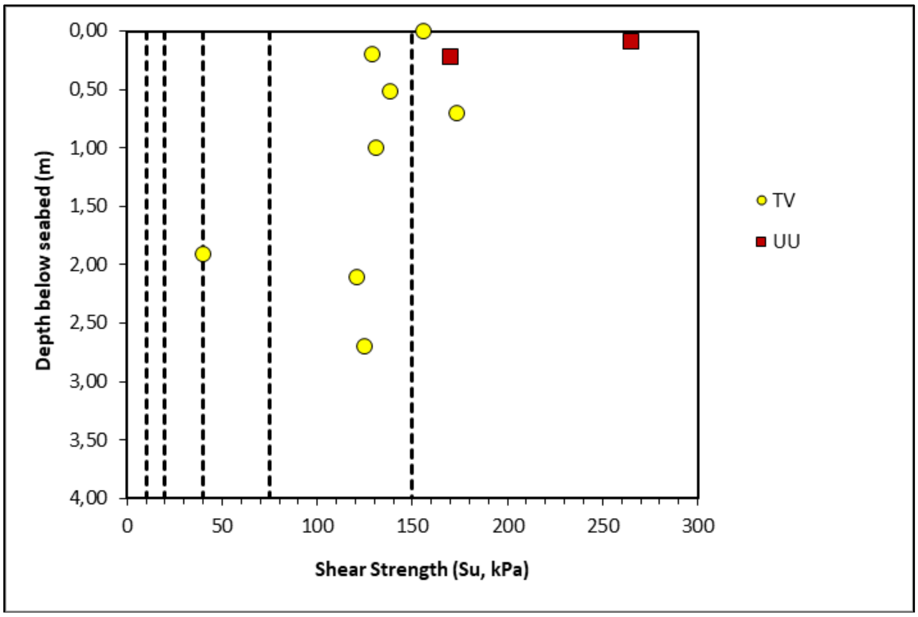

Figure 17. Summary of shear strength data for route section 02, UK.

Two shearbox tests were carried out on material from VC-017 and VC-019, both described as gravelly silty to very silty SAND. The results indicate peak and residual friction angles in the ranges 37° to 34° and 32° to 31°, respectively.

Thirty four thermal resistivity measurements were taken in the recovered vibrocores in this route section, with two onshore validation tests additionally carried out. The data are shown below and follow the same expected transition as seen in route section 01. Those four results obtained offshore which were greater than 0.735 are considered erroneous as they were carried in SAND at very low moisture contents, <7%.

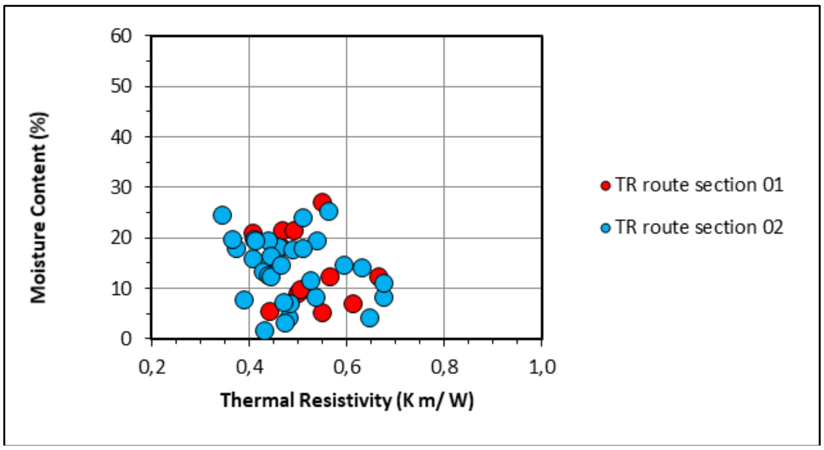

Figure 18 Thermal resistivity data for route sections 01 & 02, UK.

Thirty eight CPT attempts were undertaken in this route section with fifteen of those being re-attempts due to poor initial penetration. This is marked by the shallow depth to dense and very dense strata across much of this route section, <1.50m, together with the generally poor VC recovery. The VC recovery and CPT penetration was only >2.00m in the section from KP 25 through to KP 41.

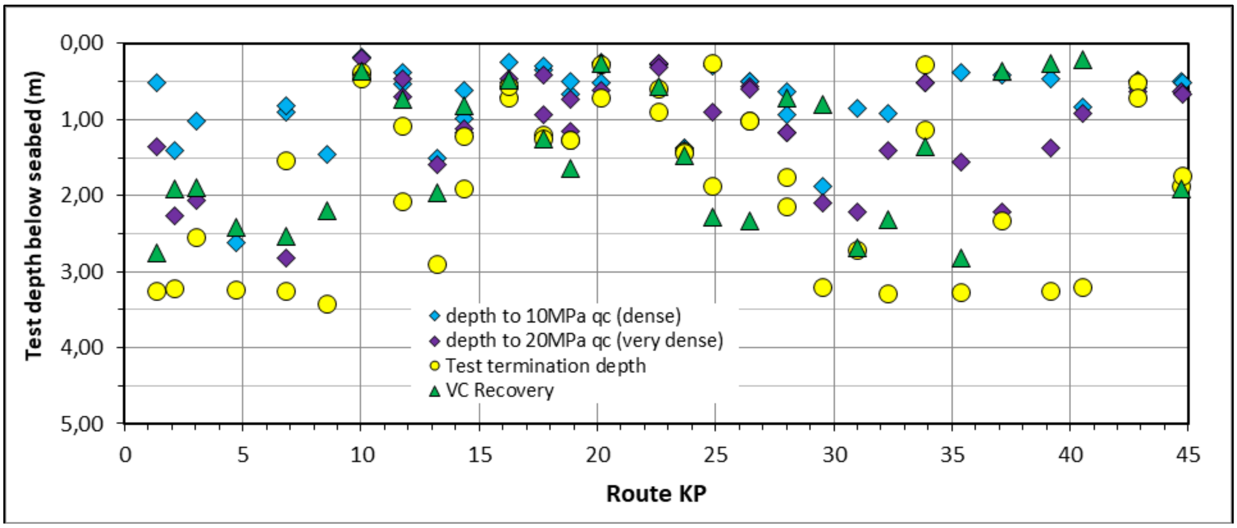

Figure 19. Summary of CPT depths and VC recovery for route sections 01 & 02, UK.

A plot below shows the measured cone resistances in route section 02. The plot is rather cluttered due to the large amount of data, but does illustrate the high cone resistances, and hence high granular material relative density, encountered in the upper 1.00m of penetrated material. Lower cone resistances, typically <6MPa, were encountered at those locations where CLAY was present.

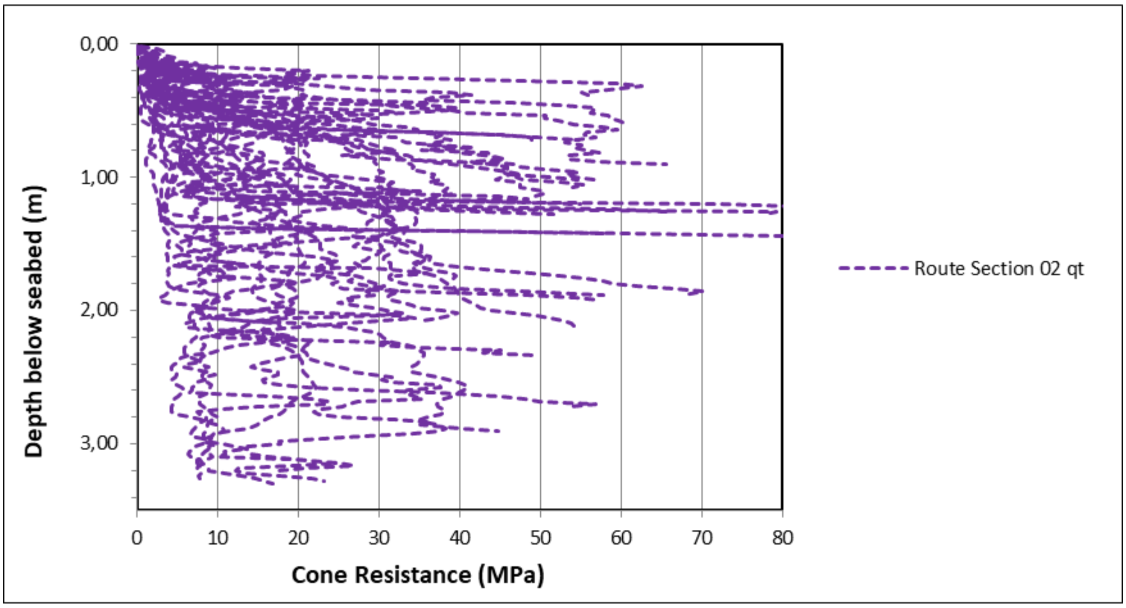

Figure 20. Plot of measured CPT cone resistance for route section 02, UK.

A plot below shows the derived CPT shear strength (Nk - 17.5) for tests containing cohesive material. In general, the laboratory shear strength data is much lower than the CPT derived data, especially for the TV. This is to be expected considering that the realistic measuring range for a TV is only up to approximately 150 to 200kPa. At those locations where CLAY is present, cone resistances are up 6MPa, which is consistent with very high to extremely high strength, very stiff overconsolidated CLAY.

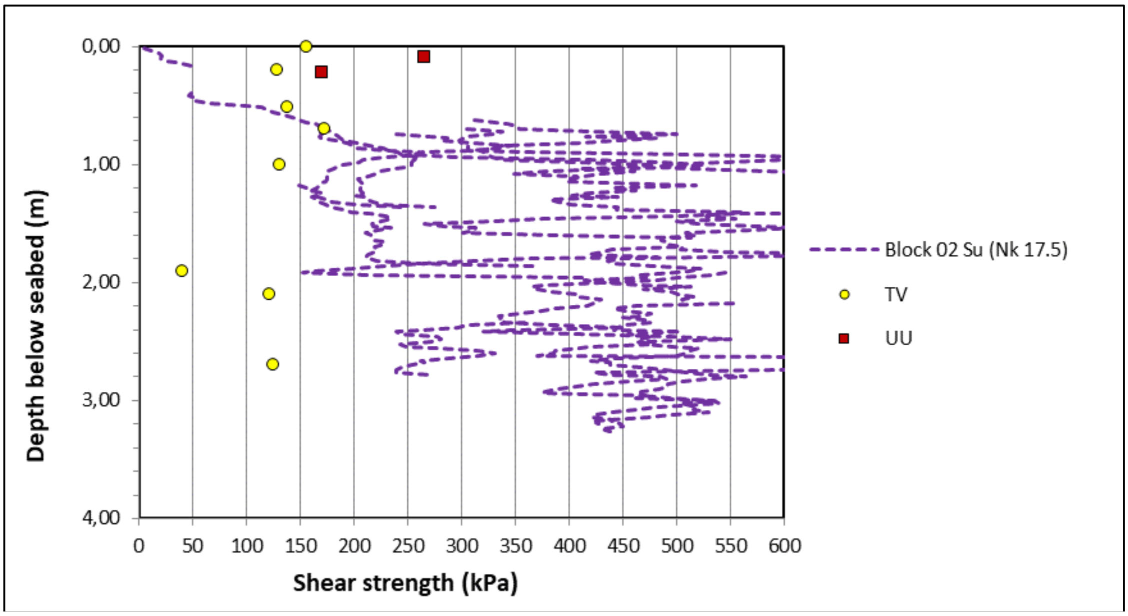

Figure 21. Plot of CPT derived shear strength and laboratory data for route section 02, UK.

4.2.3| ROUTE SECTION 03 (KP 46.090 – KP 72.063)

This third route section covers the remaining locations in the UK part of the survey route, locations 101 (KP 46.090) to 032 (KP 72.063). The seabed index summary for this section is shown below.

Table 15. Seabed Index summary for route section 03, UK.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
46.090	953-VC-101	VC	3.00	3.00				4	4	4
46.092	953-CPT-101	CPT			3.34	0.64		6	5	4
47.643	953-CPT-102	CPT			3.42	2.78	2.78	4	4	4
47.645	953-VC-102	VC	3.00	2.32				4	4	4
48.947	953-CPT-103	CPT			3.36	2.54		8	4	4
48.947	953-VC-103	VC	2.84	2.30				8	4	4
50.627	953-CPT-104	CPT			2.42	1.64	2.36	8	8	6
50.628	953-VC-104	VC	3.00	3.00				8	8	6
52.257	953-CPT-105	CPT			3.34			8	8	8
52.260	953-VC-105	VC	3.00	3.00				8	8	4
53.668	953-CPT-020	CPT			6.00	2.56		7	8	6
53.671	953-VC-020	VC		4.94				7	8	6
55.504	953-CPT-021	CPT			6.00			8	7	7
55.506	953-VC-021B	VC	5.82	5.68				8	7	7
57.520	953-VC-022B	VC	5.96	5.54				8	8	4
57.522	953-CPT-022	CPT			1.92			8	8	4
57.523	953-CPT-022A	CPT			5.96			8	8	4
58.608	953-CPT-023	CPT			5.98	1.44	1.98	8	8	5
58.608	953-VC-023A	VC	4.50	3.71				8	8	5
60.283	953-CPT-024	CPT			5.96	2.18		8	7	7
60.283	953-VC-024	VC	6.00	2.25				8	7	7
61.364	953-VC-025A	VC	6.00	5.11				8	6	5
61.366	953-CPT-025	CPT			6.02	1.32		8	6	5
62.825	953-CPT-026	CPT			5.98			8	7	7
62.827	953-VC-026A	VC	6.00	4.68				8	7	7
64.472	953-CPT-027	CPT			6.02	1.26	1.74	8	7	5
64.473	953-VC-027	VC	6.00	5.95				8	7	4
65.975	953-CPT-028	CPT			5.98			8	7	7
65.978	953-VC-028A	VC	5.70	4.75				8	7	7

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
67.528	953-VC-029	VC	6.00	5.42				8	7	7
67.531	953-CPT-029A	CPT			6.00			8	7	7
67.533	953-CPT-029	CPT			4.50			8	7	7
69.006	953-VC-030	VC	3.00	2.12				8	8	8
69.008	953-CPT-030	CPT			3.54			8	8	8
70.536	953-VC-031	VC	3.00	2.64				8	8	8
70.538	953-CPT-031	CPT			3.42			8	8	8
72.063	953-CPT-032	CPT			3.52			8	8	8
72.063	953-VC-032	VC	3.00	2.45				8	8	8

The encountered ground conditions across this final part of the UK section are dominated by cohesive material. At most locations low to medium, locally high strength, slightly sandy slightly gravelly silty CLAY can be seen. The CLAY is occasionally thinly laminated. The CLAY is often at shallow depths (0.19m at VC-022B) with a varying thickness of granular material forming a seabed veneer. CLAY was not seen at a single location, VC-024 at KP 60.283.

The granular material overlying the CLAY is typically <0.70m thick, although thicker seabed deposits are seen at VC-100 (1.84m), VC-104 (1.15m) and VC-105 (1.11m). The granular material is variable ranging from silty SAND through to gravelly SAND. Location VC-102 is noteworthy as the seabed material is black very silty GRAVEL with a strong organic odour and frequent plant debris. True PEAT material is however absent.

Vibrocore recovery was generally good in this route section. A 6m long VC barrel and a requirement for 6m CPT penetration were used from location VC-020 (KP 53.671) through to VC-029 (KP 67.528).

The PSD data for those samples tested from this route section are shown schematically below. This illustrates the general sequence of granular SAND and GRAVEL overlying CLAY. Total fines content in the tested material is in the range 73 to 90%.

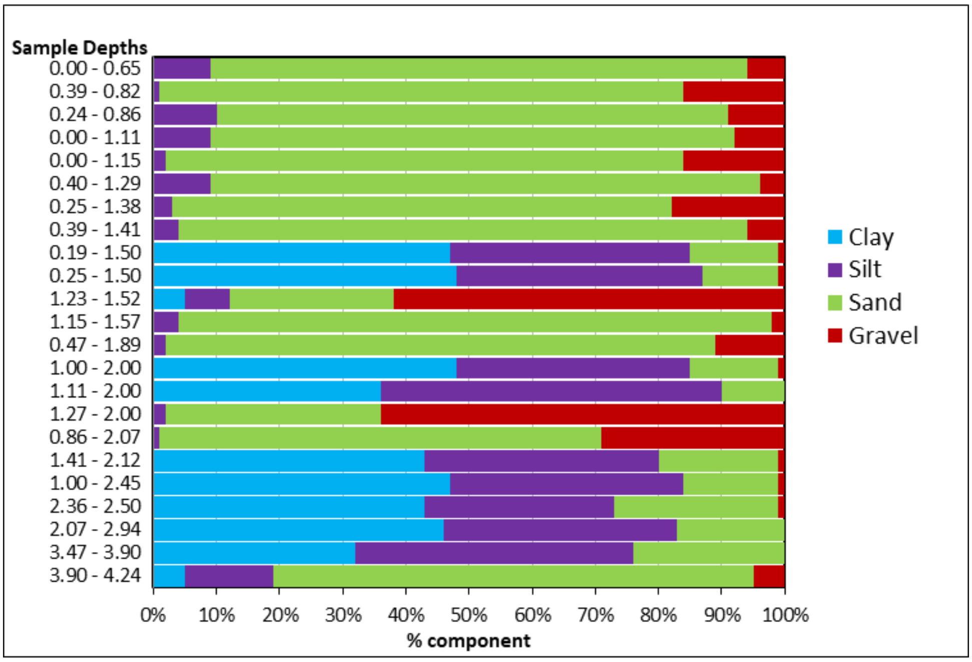

Figure 22. Summary of PSD data for route section 03, UK.

PSD plots are shown below for the varying material types.

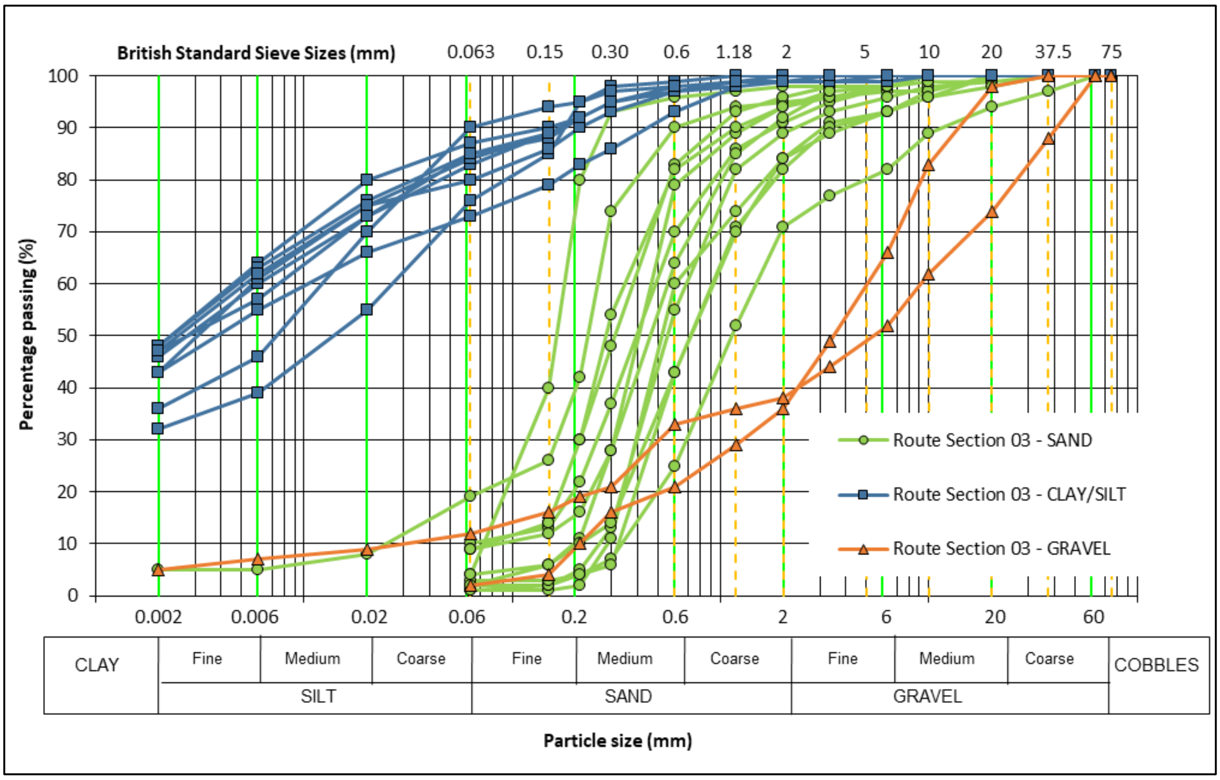

Figure 23. PSD plots for tested material in route section 03, UK.

Laboratory data for this route section are shown below. Determined moisture contents are in the large range 3 to 36%. Very low moisture contents are presumably a function of some post-sampling drainage of the recovered granular material. Moisture contents generally increase with depth, reflecting the change from granular to cohesive strata at most locations. Determined bulk and dry densities are highest in cohesive material, up to 2.16 and 1.76Mg/m^3, respectively.

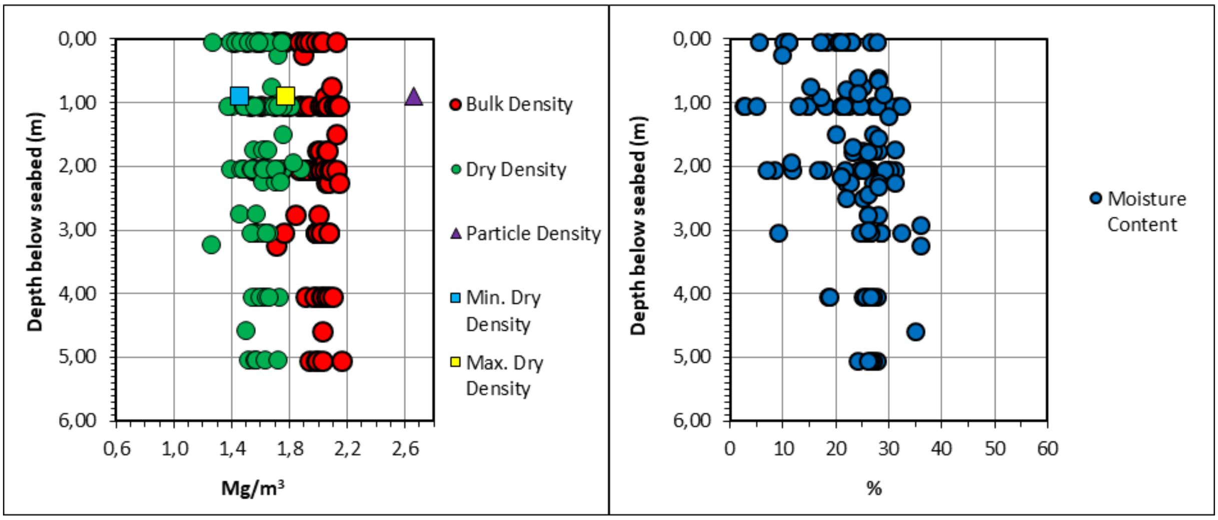

Figure 24 Summary of laboratory test data for route section 03, UK.

Nineteen Atterberg tests were carried out on cohesive material from route section 03. All the samples returned as low to intermediate plasticity CLAY.

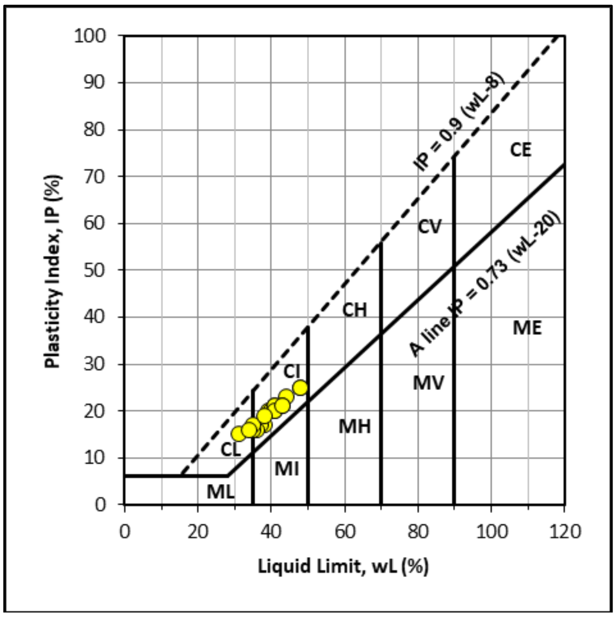

Figure 25. Plasticity Chart for route section 03, UK.

Shear strength data obtained from cohesive material in route section 03 are shown below. The majority of the data spans the low to medium strength range (20 to 75kPa). Shear strength values >75kPa, in the high strength range, are provided from the material at locations VC-102 through to VC-105 (KP 47.645 to KP 52.260).

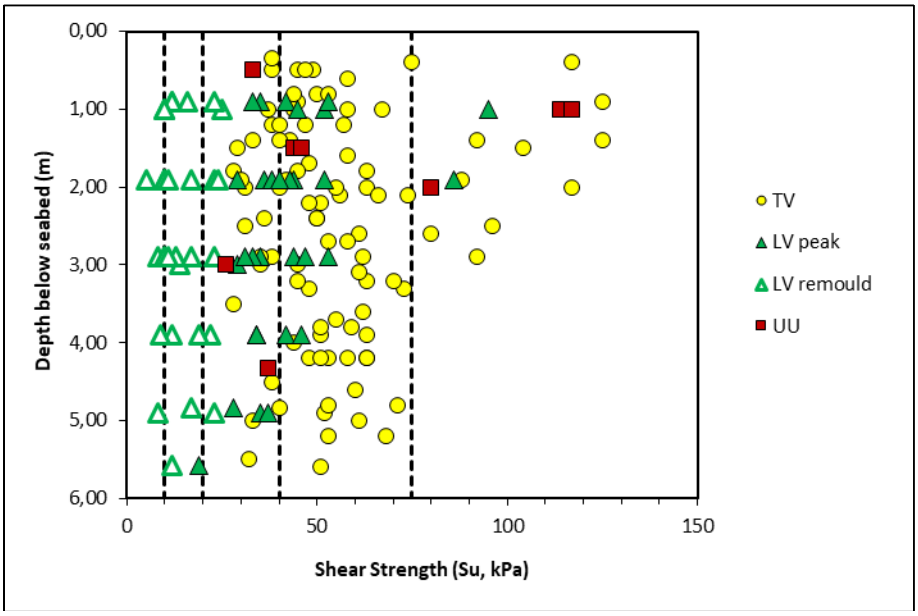

Figure 26. Summary of shear strength data for route section 03, UK.

A single shearbox test was carried out on material from VC-024, described as gravelly silty SAND. The results indicate peak and residual friction angles of 31° and 27°, respectively.

Seventy nine thermal resistivity measurements were taken in the recovered vibrocores in this route section, with three onshore validation tests carried out. The data are shown below and follow the expected transition of increasing resistivity with increasing moisture content. Four results obtained offshore which were greater than 0.795 are considered erroneous as they were carried in SAND at low moisture contents, <7%. Two validation tests reduced erroneous results down to 0.493 and 0.430, from the original offshore values of 0.795 and 0.987, respectively.

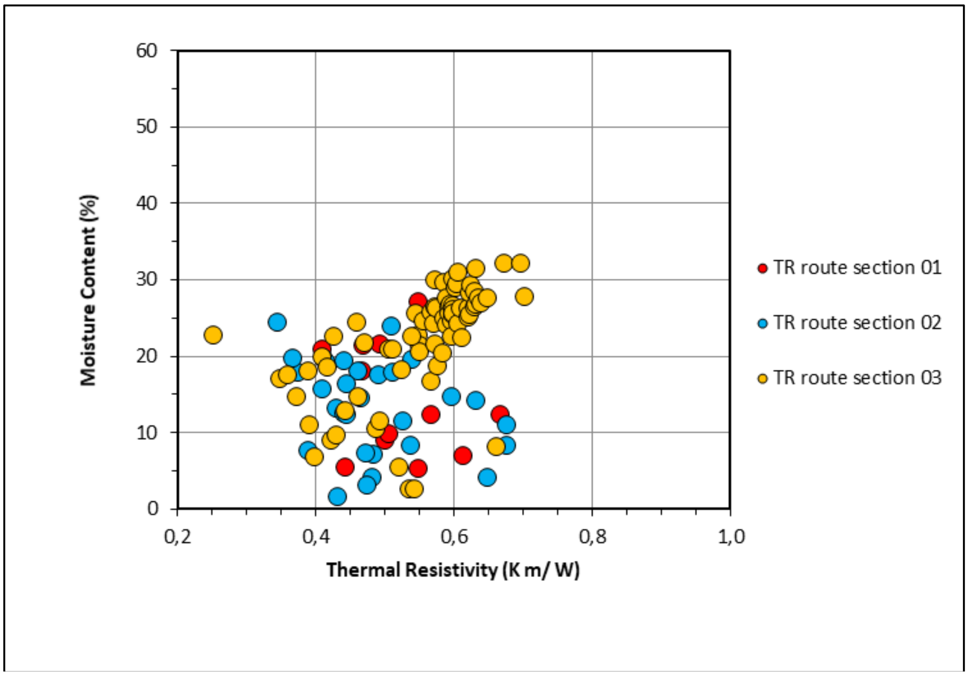

Figure 27 Thermal resistivity data for the entire UK section.

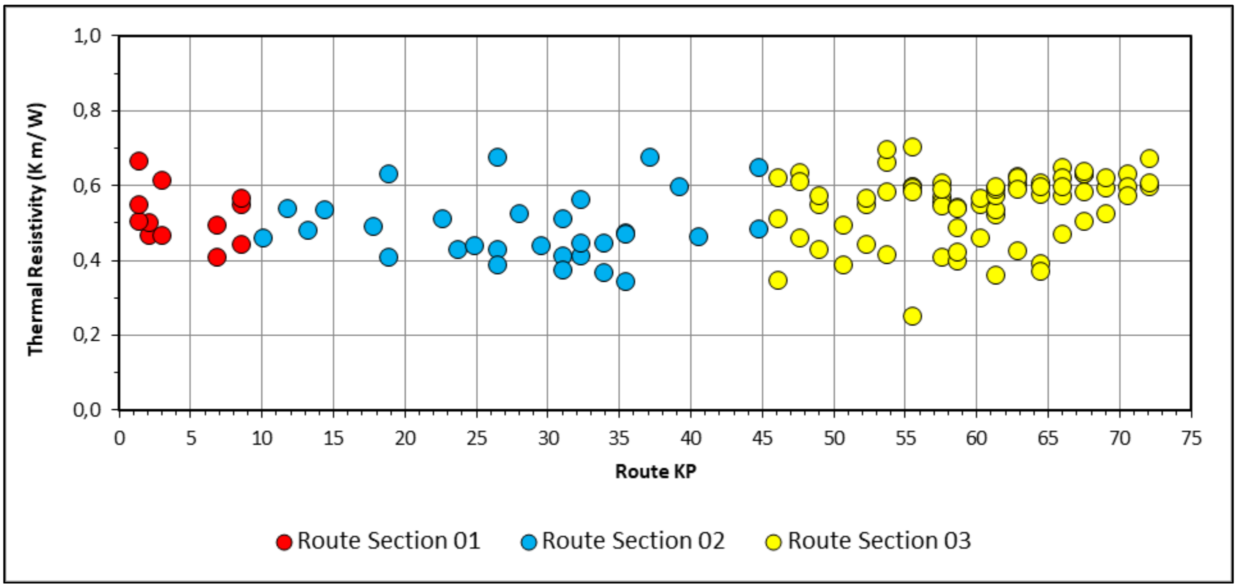

Figure 28. Plot of thermal data against route KP for the entire UK section.

The thermal resistivity data for the entire UK section are shown above. The results, which were largely obtained during the offshore fieldwork, are generally consistent with the change in material types along the route. Higher resistivity values, typically >0.550, are characteristic of CLAY-rich sediments, whilst values from 0.250 to 0.550 are typical from granular materials, with their lower moisture contents.

Twenty CPT attempts were undertaken in this route section with only two re-attempts required due to initial poor penetration. The presence of CLAY across much of route section 03 is reflected in the good CPT penetration. Dense granular strata are present, typically at 1.00 to 2.00m depth. Very dense granular material was only encountered at four locations, at >1.74m depth.

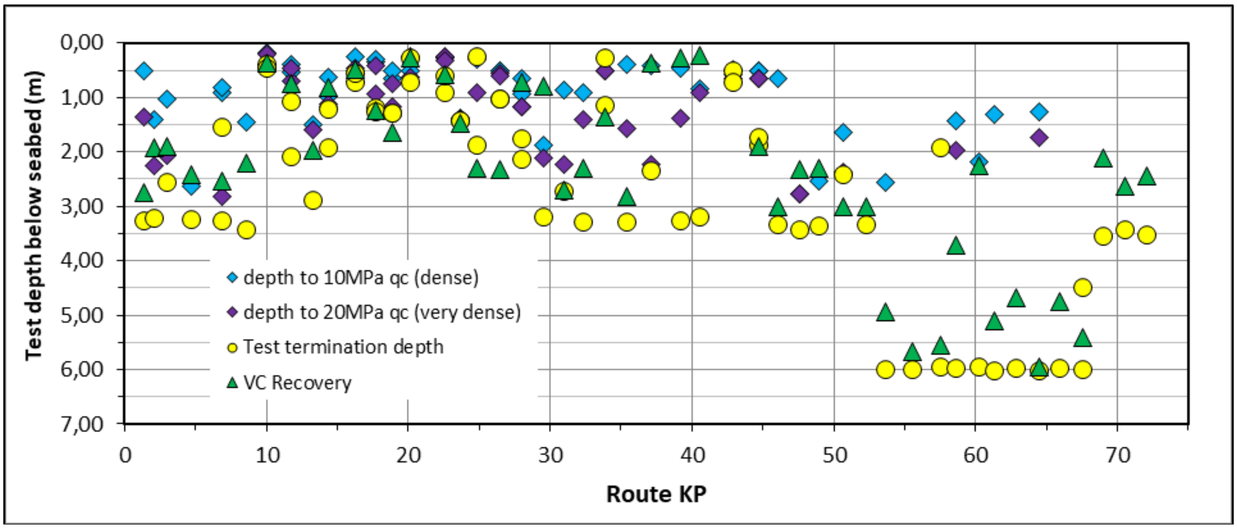

Figure 29. Summary of CPT depths and VC recovery for the entire UK section.

A plot below shows the measured cone resistances in route section 03. The plot highlights the presence of medium dense to dense granular material in the upper parts of the penetrated sediment. The presence of CLAY at almost all locations is shown by the low cone resistances, typically <2MPa. CPT-024, the only location which lacked cohesive material, contrasts with the general pattern of CPT data, interpreted as very loose to loose SAND, becoming medium dense to dense below 2.00m.

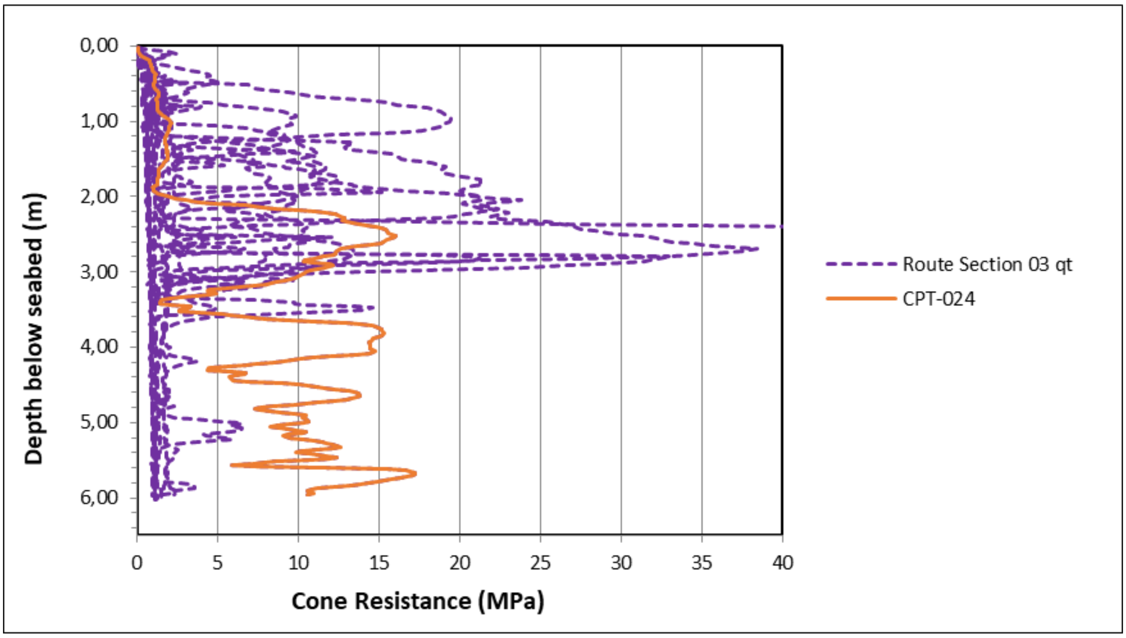

Figure 30. Plot of measured CPT cone resistance for route section 03, UK.

A plot below shows the derived CPT shear strength (Nk - 17.5) for tests containing cohesive material. In general, the laboratory shear strength data, obtained from all test types correlates well with the CPT. There is an offset on some of the lower strength material which may be a result of softening/disturbance of the material during and post-sampling.

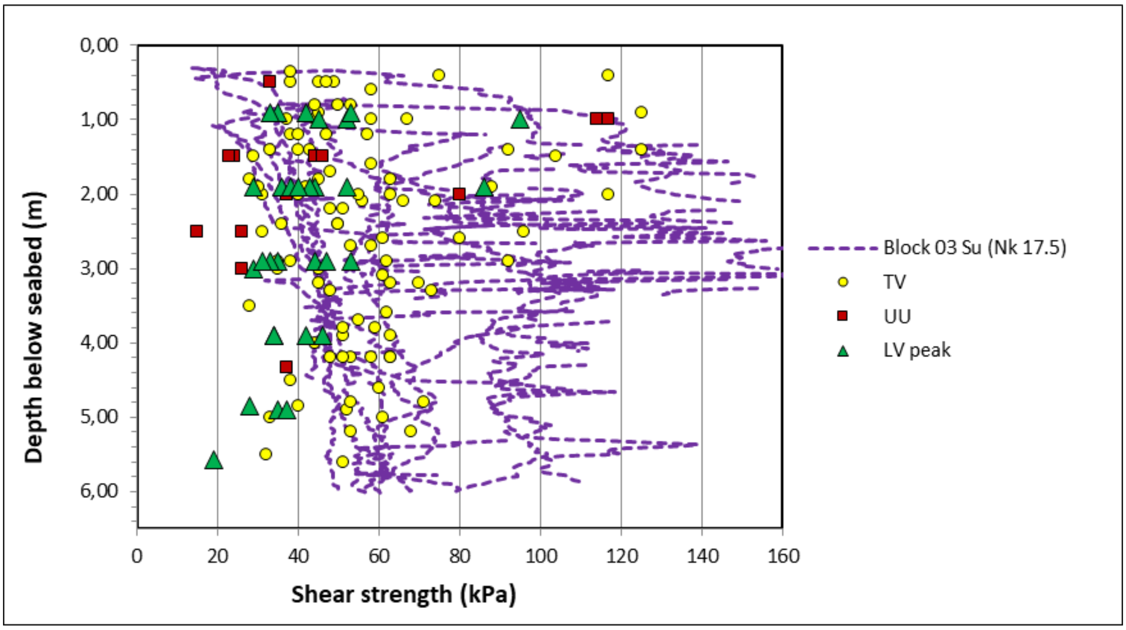

Figure 31. Plot of CPT derived shear strength and laboratory data for route section 03, UK.

4.3| IRELAND ROUTE SECTION

The geotechnical locations in the Ireland offshore section of the Greenlink survey are shown below.

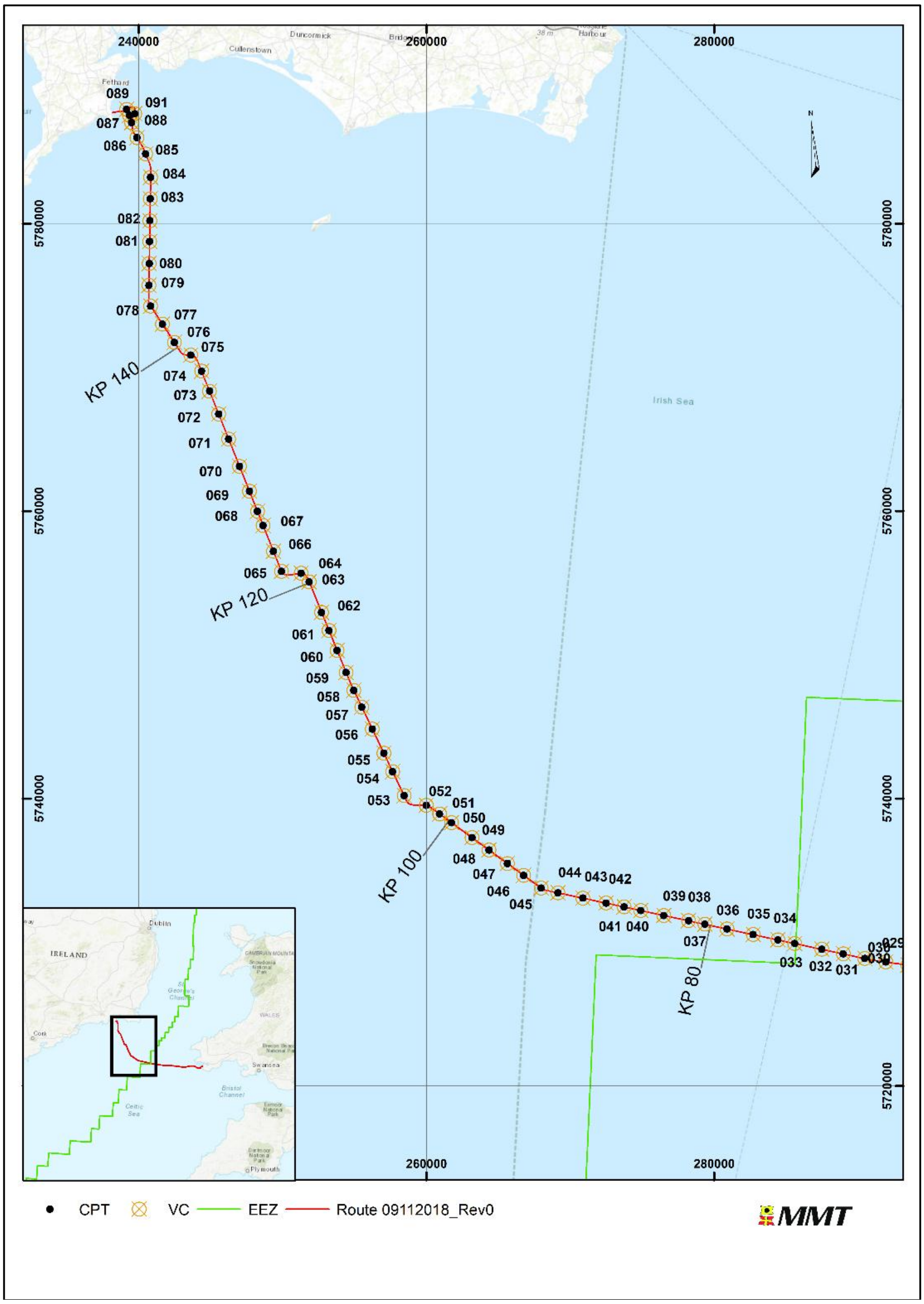

Figure 32. Summary of geotechnical locations in the Ireland section of the Greenlink route.

The Irish section extends for approximately 85km, from KP 73 to KP 158 at the proposed landfall at Baginbun beach, in County Wexford, Ireland.

In total fifty eight locations were carried out with twenty four VC and five CPT re-attempts required. The Seabed Index summary table for the Ireland section is shown below. Based on the encountered ground conditions, the Ireland section has been divided into four route sections.

Table 16. Summary of Seabed Index for the entire Ireland section.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
73.994	953-CPT-033	CPT			3.54			8	4	4
73.996	953-VC-033	VC	3.00	2.24				8	4	4
75.188	953-VC-034A	VC	3.73	2.29				8	7	4
75.188	953-CPT-034	CPT			3.48	1.82	1.88	8	7	4
76.948	953-VC-035A	VC	3.52	2.74				7	7	4
76.949	953-CPT-035	CPT			3.32			7	7	4
78.809	953-VC-036A	VC	3.00	3.00				8	8	8
78.809	953-CPT-036	CPT			3.36	2.28		8	8	8
80.380	953-VC-037A	VC	3.00	2.19				7	7	7
80.380	953-CPT-037	CPT			3.40			7	7	7
81.536	953-CPT-038	CPT			3.46	2.42		7	6	6
81.538	953-VC-038	VC	3.00	2.10				7	6	6
83.293	953-VC-039B	VC	3.00	2.88				7	7	5
83.298	953-CPT-039	CPT			3.38	1.34		7	7	5
84.934	953-VC-040	VC	3.00	2.74				8	6	5
84.937	953-CPT-040	CPT			3.34	1.22		8	6	5
86.122	953-VC-041A	VC	2.29	1.38				6	5	6
86.123	953-CPT-041	CPT			3.44	0.68	1.10	6	5	6
87.405	953-VC-042	VC	3.00	3.00				5	3	3
87.406	953-CPT-042	CPT			2.48	0.42	0.50	5	3	3
89.058	953-VC-043	VC	3.00	3.00				6	6	6
89.059	953-CPT-043	CPT			3.26			6	6	6
90.819	953-VC-044	VC	3.00	2.25				7	6	6
90.822	953-CPT-044	CPT			3.24	2.28	2.54	7	6	6
92.046	953-VC-045	VC	3.00	3.00				7	6	5
92.047	953-CPT-045	CPT			3.42	1.10	2.76	7	6	5
93.549	953-VC-046	VC	3.00	3.00				7	5	3
93.552	953-CPT-046	CPT			3.38	0.84	1.48	7	5	3
94.951	953-VC-047	VC	2.48	2.10				6	5	3
94.953	953-CPT-047	CPT			1.98	0.98	1.20	6	5	3
94.955	953-CPT-047A	CPT			1.70	0.88	1.10	7	5	3
96.534	953-VC-048A	VC	2.42	1.83				7	6	5

Route KP	**Location**	**Type**	**Vibrocoring**		**Cone Penetration Testing**			**Seabed Index**		
			Pen. (m)	**Rec. (m)**	**Refusal Depth (m)**	**Depth to 10MPa (Dense)**	**Depth to 20MPa (V Dense)**	**0.50m**	**1.00m**	**1.50m**
96.537	953-CPT-048A	CPT			2.10	1.18	1.56	**7**	**6**	**5**
96.538	953-CPT-048	CPT			2.28	1.22	1.72	**7**	**7**	**5**
97.997	953-VC-049	VC	3.00	3.00				**7**	**6**	**5**
97.997	953-CPT-049	CPT			3.32	1.14		**7**	**6**	**5**
99.763	953-VC-050	VC	3.00	3.00				**6**	**6**	**5**
99.765	953-CPT-050	CPT			3.36	1.02	2.78	**6**	**6**	**5**
100.785	953-VC-051B	VC	3.00	3.00				**7**	**6**	**5**
100.786	953-CPT-051	CPT			3.06	1.06	2.42	**7**	**6**	**5**
101.901	953-VC-052	VC	3.00	2.30				**7**	**7**	**6**
101.903	953-CPT-052	CPT			3.22	2.08	2.64	**7**	**7**	**6**
103.778	953-VC-053	VC	2.50	2.15				**6**	**5**	**3**
103.778	953-CPT-053	CPT			2.06	0.82	1.14	**6**	**5**	**3**
105.629	953-VC-054	VC	2.20	1.78				**6**	**3**	**3**
105.630	953-CPT-054	CPT			3.40	0.66	0.84	**6**	**3**	**3**
107.052	953-CPT-055	CPT			3.22	1.10	1.50	**7**	**6**	**5**
107.053	953-VC-055A	VC	2.80	2.06				**7**	**6**	**5**
108.905	953-VC-056	VC	3.00	2.19				**7**	**6**	**5**
108.905	953-CPT-056	CPT			3.36	1.18	2.30	**7**	**6**	**5**
110.606	953-VC-057	VC	3.00	2.13				**7**	**5**	**5**
110.607	953-CPT-057	CPT			2.10	0.96	1.62	**7**	**5**	**5**
111.893	953-VC-058	VC	3.00	2.12				**5**	**5**	**5**
111.894	953-CPT-058	CPT			3.30	0.50	2.84	**5**	**5**	**5**
113.253	953-VC-059	VC	3.00	2.29				**8**	**7**	**6**
113.254	953-CPT-059	CPT			3.14	2.28	2.80	**8**	**7**	**6**
114.905	953-CPT-060	CPT			3.20	0.88	1.42	**7**	**5**	**3**
114.906	953-VC-060A	VC	3.00	1.95				**7**	**5**	**3**
116.398	953-VC-061A	VC	2.80	2.10				**8**	**6**	**5**
116.399	953-CPT-061	CPT			2.04	1.08	1.80	**8**	**6**	**5**
117.762	953-CPT-062	CPT			3.24	0.40	0.74	**5**	**3**	**3**
117.765	953-VC-062A	VC	1.98	1.18				**5**	**3**	**3**
120.056	953-VC-063A	VC	2.32	2.07				**8**	**7**	**3**
120.057	953-CPT-063	CPT			2.10	1.18	1.50	**8**	**7**	**3**
120.941	953-VC-064	VC	2.73	2.10				**8**	**8**	**6**

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
120.941	953-CPT-064	CPT			2.10	1.74	1.82	8	8	6
122.412	953-VC-065	VC	3.00	2.27				8	8	5
122.413	953-CPT-065	CPT			3.22	1.40	3.22	8	8	5
123.920	953-VC-066	VC	3.00	2.10				8	8	7
123.922	953-CPT-066	CPT			3.24	2.96		8	8	7
125.849	953-VC-067A	VC	3.00	0.87				8	8	7
125.850	953-CPT-067	CPT			3.32	1.78		8	8	7
126.914	953-VC-068	VC	3.00	2.22				8	8	8
126.915	953-CPT-068	CPT			3.30	3.02		8	8	8
128.419	953-VC-069A	VC	3.00	2.36				8	8	8
128.420	953-CPT-069	CPT			3.28	2.70	3.18	8	8	8
130.285	953-VC-070	VC	3.00	2.47				8	8	8
130.285	953-CPT-070	CPT			2.98	2.90	2.94	8	8	8
132.330	953-VC-071	VC	3.00	2.12				8	8	8
132.331	953-CPT-071	CPT			3.24	3.16		8	8	8
134.198	953-VC-072	VC	3.00	2.50				8	8	8
134.199	953-CPT-072	CPT			3.10	2.92	3.00	8	8	8
135.918	953-VC-073	VC	3.00	2.20				8	8	8
135.920	953-CPT-073	CPT			3.44			8	8	8
137.410	953-VC-074	VC	2.87	2.28				8	8	8
137.411	953-CPT-074	CPT			3.36			8	8	8
138.846	953-VC-075	VC	2.90	2.43				8	7	8
138.846	953-CPT-075	CPT			3.34			8	7	8
140.409	953-VC-076	VC	3.00	2.39				8	8	8
140.410	953-CPT-076	CPT			3.30			8	8	8
141.922	953-VC-077	VC	3.00	2.20				7	7	7
141.924	953-CPT-077	CPT			3.32			7	7	7
143.427	953-VC-078	VC	3.00	2.12				7	7	7
143.428	953-CPT-078	CPT			3.28			7	7	7
144.913	953-VC-079	VC	3.00	2.16				7	7	6
144.914	953-CPT-079	CPT			3.42			7	7	6
146.421	953-VC-080	VC	3.00	2.62				8	8	8
146.422	953-CPT-080	CPT			3.38			8	8	8

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
147.952	953-VC-081	VC	2.60	2.34				8	3	3
147.952	953-CPT-081A	CPT			1.80	0.88	1.00	8	3	3
147.954	953-CPT-081	CPT			1.98	0.92	0.94	8	3	3
149.400	953-VC-082	VC	3.00	2.12				6	5	5
149.401	953-CPT-082	CPT			3.24	0.90	2.30	6	5	5
150.922	953-VC-083	VC	3.00	2.52				5	6	3
150.933	953-CPT-083	CPT			3.20	0.50	0.70	5	6	3
152.419	953-VC-084A	VC	3.00	2.90				5	3	3
152.421	953-CPT-084	CPT			2.18	0.46	0.74	5	3	3
154.117	953-VC-085	VC	3.00	2.08				7	6	6
154.119	953-CPT-085	CPT			3.06	1.70		7	6	6
155.403	953-VC-086	VC	1.67	1.48				5	3	3
155.403	953-CPT-086	CPT			1.58	0.40	0.94	5	3	3
155.406	953-CPT-086A	CPT			2.22	0.28	0.92	6	3	3
156.535	953-VC-087A	VC	2.88	2.20				6	5	3
156.536	953-CPT-087	CPT			2.52	0.60	0.68	6	5	3
156.954	953-VC-091A	VC	2.87	1.39				8	8	8
156.954	953-CPT-091	CPT			0.20	0.12		3		
156.954	953-CPT-091A	CPT			3.26			8	8	8
157.209	953-VC-088A	VC	2.88	1.83				6	7	6
157.212	953-CPT-088	CPT			0.20	0.12		6	7	6
158.223	953-CPT-089	CPT			3.18	2.96		6	7	7
158.226	953-VC-089	VC	2.89	2.31				6	7	7

4.3.1 | ROUTE SECTION 04 (KP 73.994 – KP 76.949)

This first short route section covers the locations 033 (KP 73.994) to 035 (KP 76.949). The seabed index summary for this section is shown below.

Table 17. Seabed Index summary for route section 04, IRE.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
73.994	953-CPT-033	CPT			3.54			**8**	**4**	**4**
73.996	953-VC-033	VC	3.00	2.24				**8**	**4**	**4**
75.188	953-VC-034A	VC	3.73	2.29				**8**	**7**	**4**
75.188	953-CPT-034	CPT			3.48	1.82	1.88	**8**	**7**	**4**
76.948	953-VC-035A	VC	3.52	2.74				**7**	**7**	**4**
76.949	953-CPT-035	CPT			3.32			**7**	**7**	**4**

This short first section is a continuation of the previous route section 03 in the UK sector. The ground conditions comprise a thin seabed veneer of gravelly SAND to gravelly silty SAND overlying low to medium, locally high strength, soft to firm slightly sandy silty CLAY. The CLAY has rare mudstone gravel and is occasionally thickly laminated. The CLAY is encountered at depths from 0.29m (VC-034A) to 0.90m (VC-035A). Vibrocore recovery was moderate across this route section, from 2.24m to 2.74m. Only a single PSD was carried out on granular material from this short route section. The plot is shown below.

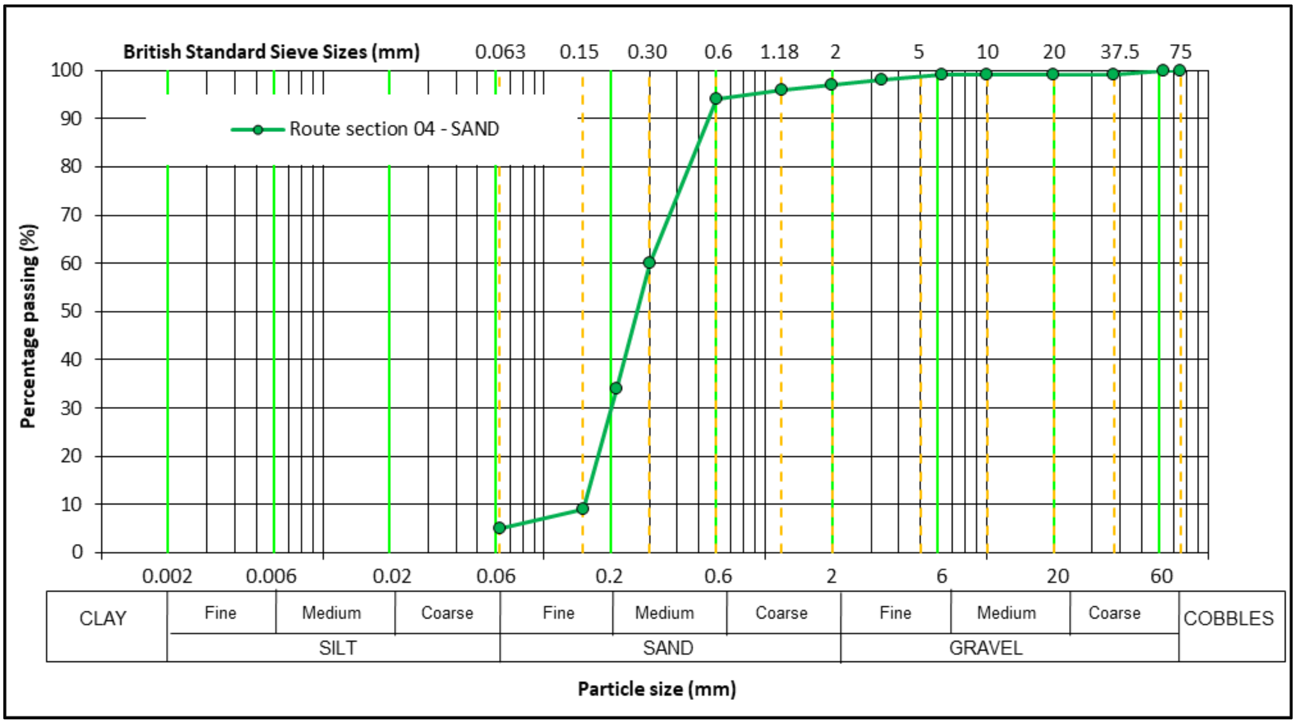

Figure 33. PSD plot for tested material in route section 04, IRE.

Laboratory data for this route section are shown below. There is a general increase in density and moisture content with depth, reflecting the cohesive material below the seabed granular veneer.

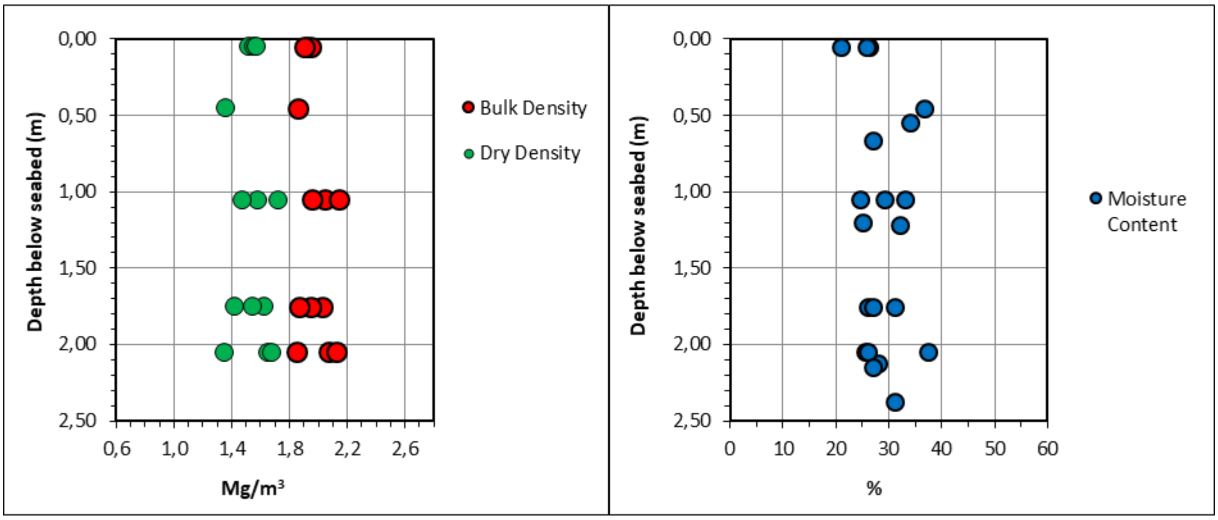

Figure 34. Summary of laboratory test data for route section 04, IRE.

Seven Atterberg tests were carried out on material from this route section. The tests returned as CLAY of intermediate to high plasticity.

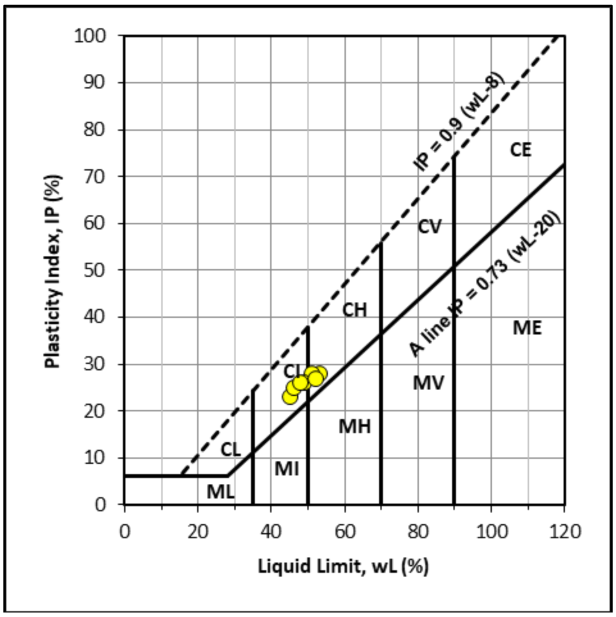

Figure 35. Plasticity Chart for route section 04, IRE.

Shear strength data obtained from cohesive material in route section 04 are shown below. Almost all the data spans the low to medium strength range (20 to 75kPa).

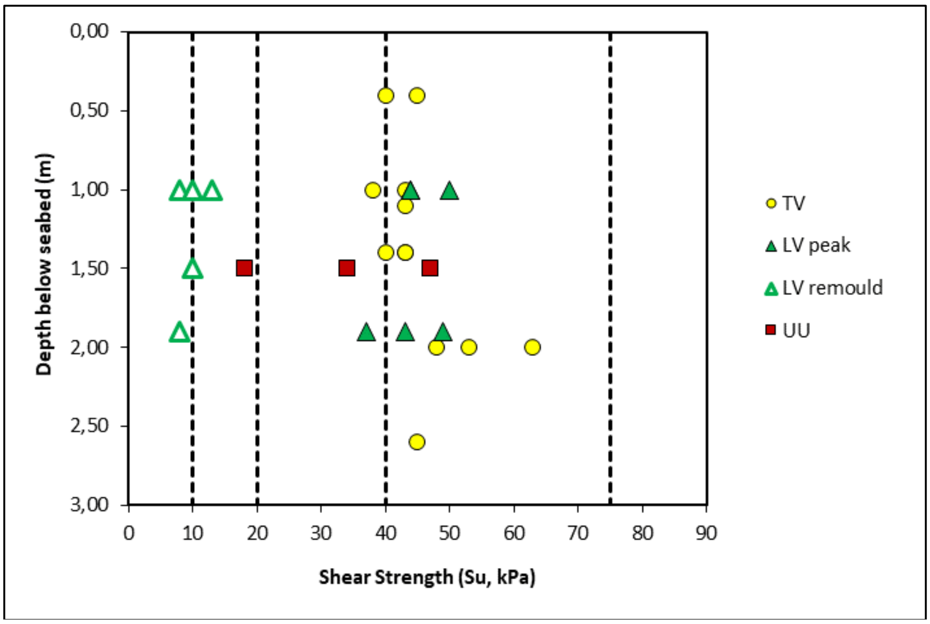

Figure 36. Summary of shear strength data for route section 04, IRE.

Ten thermal resistivity measurements were taken in the recovered vibrocores in this route section, with two onshore validation tests carried out. A high offshore result of 0.850 from SAND (VC-033) was re-tested onshore which provided a more reliable value of 0.457. The data are shown below and follow the expected transition of increasing resistivity with increasing moisture content, with the CLAY having highest resistivity. The data from the preceding UK section are also shown which illustrates the similarity in resistivity ranges in the identical material types.

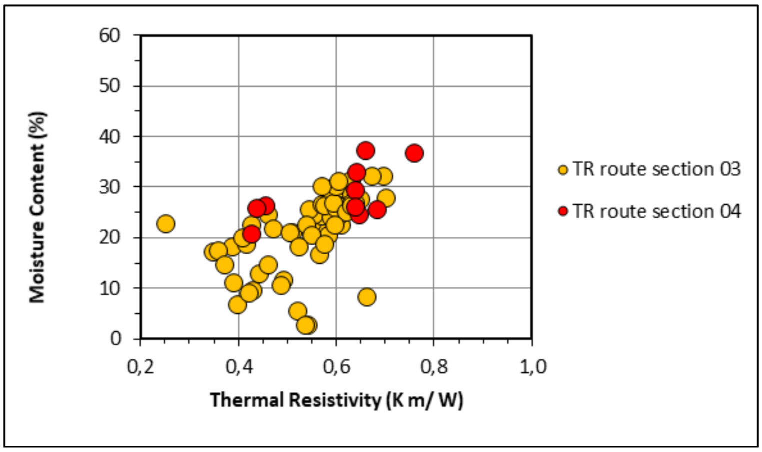

Figure 37. Thermal resistivity data for route section 04, IRE and 03, UK.

Three CPT attempts were undertaken in this route section with no re-attempts required, due to the presence of CLAY. The granular seabed veneer material is very loose to loose. At location CPT-034 (KP 75.188) a thin band of dense to very dense gravelly SAND was encountered within the CLAY.

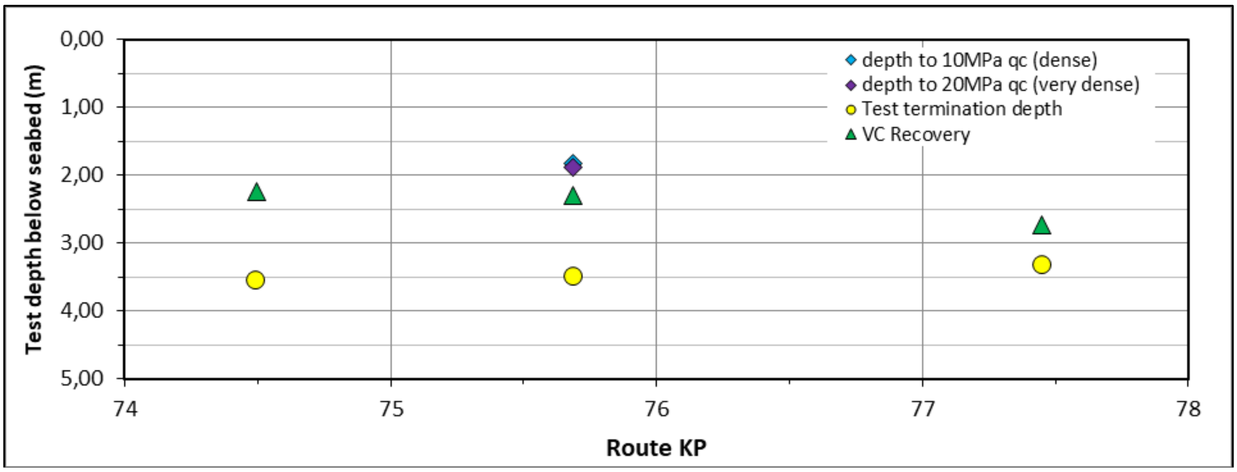

Figure 38. Summary of CPT depths and VC recovery for route section 04, IRE.

A plot below shows the measured cone resistances in route section 04. The plot highlights the granular material in the upper 1.00m of the tests, with cone resistances up to 4MPa (loose). At location CPT-034, the band of dense to very dense SAND at 1.78m is clear. Cone resistances in the CLAY are below 1.5MPa.

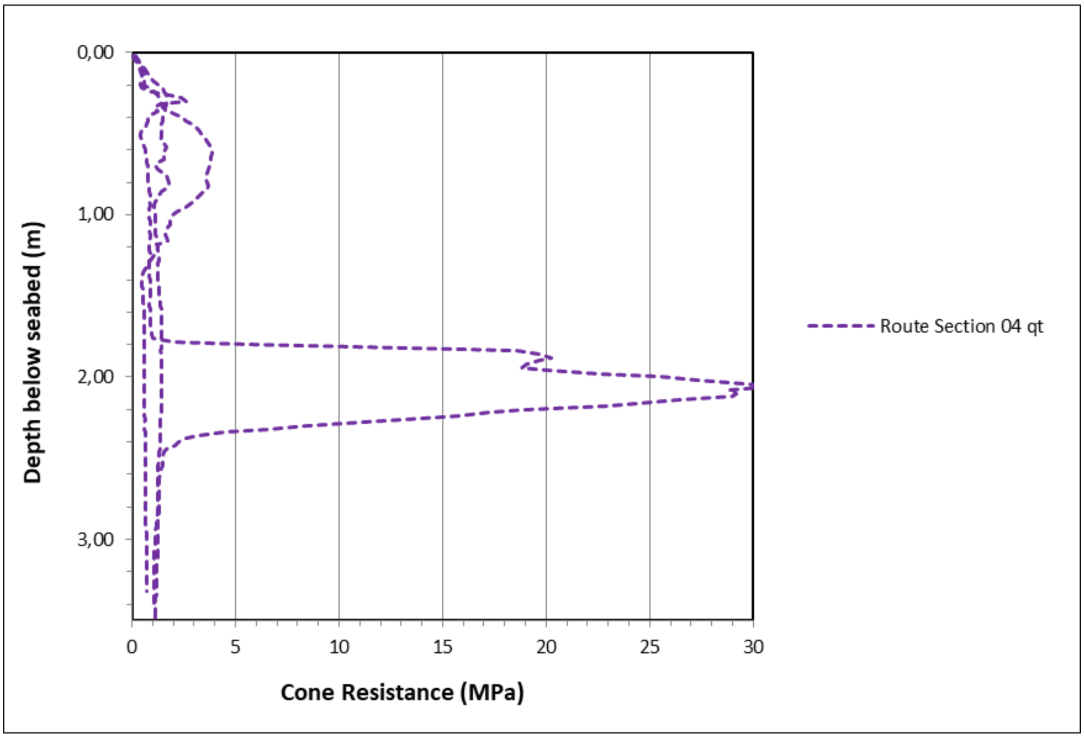

Figure 39. Plot of measured CPT cone resistance for route section 04, IRE.

A plot below shows the derived CPT shear strength (Nk - 17.5) for the tests. In general, the laboratory shear strength data, obtained from all test types correlates with the CPT. There is an offset for some parts of CPT-033 and CPT-034 which may be a result of softening/disturbance of the CLAY during and post-sampling.

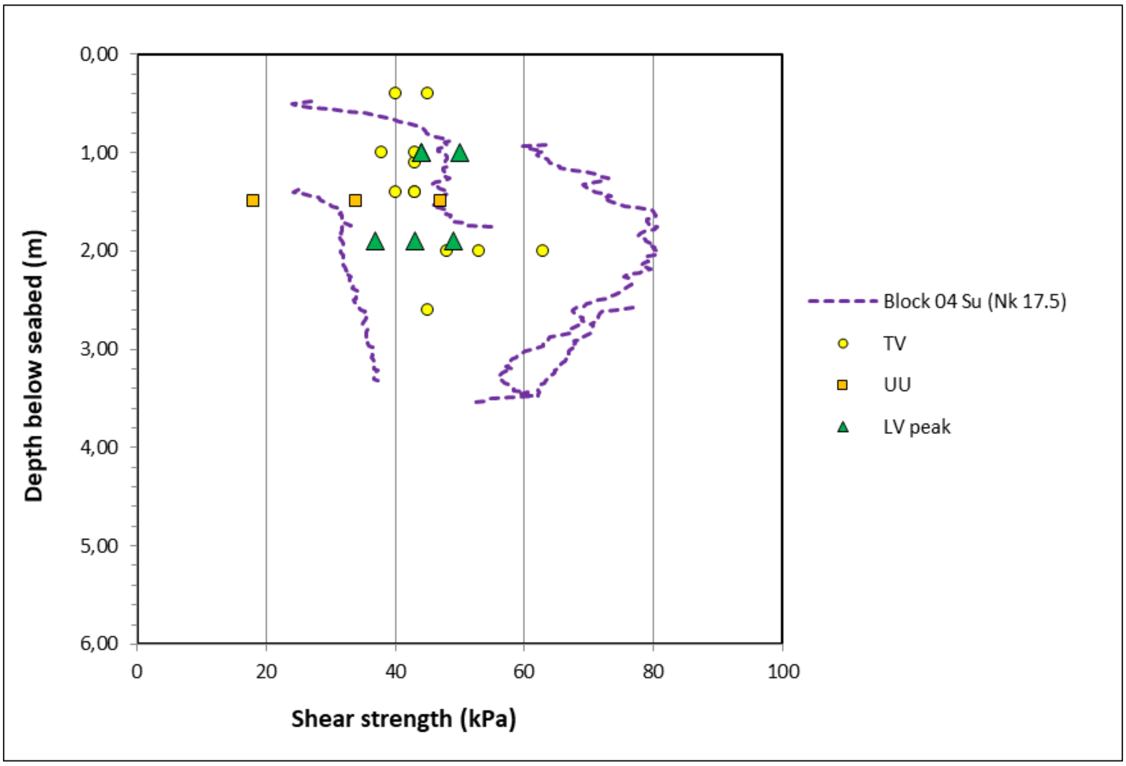

Figure 40. Plot of CPT derived shear strength and laboratory data for route section 04, IRE.

4.3.2| ROUTE SECTION 05 (KP 78.809 - KP 122.413)

This longer route section covers the locations 036A (KP 78.809) to 065 (KP 122.413). The seabed index summary for this section is shown below.

Table 18. Seabed Index summary for route section 05, IRE.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
78.809	953-VC-036A	VC	3.00	3.00				8	8	8
78.809	953-CPT-036	CPT			3.36	2.28		8	8	8
80.380	953-VC-037A	VC	3.00	2.19				7	7	7
80.380	953-CPT-037	CPT			3.40			7	7	7
81.536	953-CPT-038	CPT			3.46	2.42		7	6	6
81.538	953-VC-038	VC	3.00	2.10				7	6	6
83.293	953-VC-039B	VC	3.00	2.88				7	7	5
83.298	953-CPT-039	CPT			3.38	1.34		7	7	5
84.934	953-VC-040	VC	3.00	2.74				8	6	5
84.937	953-CPT-040	CPT			3.34	1.22		8	6	5
86.122	953-VC-041A	VC	2.29	1.38				6	5	6
86.123	953-CPT-041	CPT			3.44	0.68	1.10	6	5	6
87.405	953-VC-042	VC	3.00	3.00				5	3	3
87.406	953-CPT-042	CPT			2.48	0.42	0.50	5	3	3
89.058	953-VC-043	VC	3.00	3.00				6	6	6
89.059	953-CPT-043	CPT			3.26			6	6	6
90.819	953-VC-044	VC	3.00	2.25				7	6	6
90.822	953-CPT-044	CPT			3.24	2.28	2.54	7	6	6
92.046	953-VC-045	VC	3.00	3.00				7	6	5
92.047	953-CPT-045	CPT			3.42	1.10	2.76	7	6	5
93.549	953-VC-046	VC	3.00	3.00				7	5	3
93.552	953-CPT-046	CPT			3.38	0.84	1.48	7	5	3
94.951	953-VC-047	VC	2.48	2.10				6	5	3
94.953	953-CPT-047	CPT			1.98	0.98	1.20	6	5	3
94.955	953-CPT-047A	CPT			1.70	0.88	1.10	7	5	3
96.534	953-VC-048A	VC	2.42	1.83				7	6	5
96.537	953-CPT-048A	CPT			2.10	1.18	1.56	7	6	5
96.538	953-CPT-048	CPT			2.28	1.22	1.72	7	7	5
97.997	953-VC-049	VC	3.00	3.00				7	6	5

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
97.997	953-CPT-049	CPT			3.32	1.14		7	6	5
99.763	953-VC-050	VC	3.00	3.00				6	6	5
99.765	953-CPT-050	CPT			3.36	1.02	2.78	6	6	5
100.785	953-VC-051B	VC	3.00	3.00				7	6	5
100.786	953-CPT-051	CPT			3.06	1.06	2.42	7	6	5
101.901	953-VC-052	VC	3.00	2.30				7	7	6
101.903	953-CPT-052	CPT			3.22	2.08	2.64	7	7	6
103.778	953-VC-053	VC	2.50	2.15				6	5	3
103.778	953-CPT-053	CPT			2.06	0.82	1.14	6	5	3
105.629	953-VC-054	VC	2.20	1.78				6	3	3
105.630	953-CPT-054	CPT			3.40	0.66	0.84	6	3	3
107.052	953-CPT-055	CPT			3.22	1.10	1.50	7	6	5
107.053	953-VC-055A	VC	2.80	2.06				7	6	5
108.905	953-VC-056	VC	3.00	2.19				7	6	5
108.905	953-CPT-056	CPT			3.36	1.18	2.30	7	6	5
110.606	953-VC-057	VC	3.00	2.13				7	5	5
110.607	953-CPT-057	CPT			2.10	0.96	1.62	7	5	5
111.893	953-VC-058	VC	3.00	2.12				5	5	5
111.894	953-CPT-058	CPT			3.30	0.50	2.84	5	5	5
113.253	953-VC-059	VC	3.00	2.29				8	7	6
113.254	953-CPT-059	CPT			3.14	2.28	2.80	8	7	6
114.905	953-CPT-060	CPT			3.20	0.88	1.42	7	5	3
114.906	953-VC-060A	VC	3.00	1.95				7	5	3
116.398	953-VC-061A	VC	2.80	2.10				8	6	5
116.399	953-CPT-061	CPT			2.04	1.08	1.80	8	6	5
117.762	953-CPT-062	CPT			3.24	0.40	0.74	5	3	3
117.765	953-VC-062A	VC	1.98	1.18				5	3	3
120.056	953-VC-063A	VC	2.32	2.07				8	7	3
120.057	953-CPT-063	CPT			2.10	1.18	1.50	8	7	3
120.941	953-VC-064	VC	2.73	2.10				8	8	6
120.941	953-CPT-064	CPT			2.10	1.74	1.82	8	8	6
122.412	953-VC-065	VC	3.00	2.27				8	8	5
122.413	953-CPT-065	CPT			3.22	1.40	3.22	8	8	5

This longer second section of the Ireland part of the route sees a return to largely coarse granular material. The ground conditions comprise typically slightly gravelly silty SAND which becomes gravelly to very gravelly with depth. At many locations the granular material becomes slightly silty very sandy GRAVEL. There are a few occasional very silty SAND bands with low gravel content.

Cohesive material can be seen at four locations. Very low to medium strength silty CLAY, locally slightly sandy, can be seen at locations VC-038, 049 and 060A. Thickest CLAY strata are seen at VC-060A, where 0.95m of medium strength CLAY was seen at the base of the recovered sample, and at VC-049, where 0.83m of medium strength CLAY was recovered, again at the base of the VC. A very thin SILT band, 0.19m thick, was seen at VC-041A at 1.19m.

A summary of the PSD data is shown below, which highlights the dominance of coarse granular material, with the gravel content increasing below 1.00m depth at most tested locations.

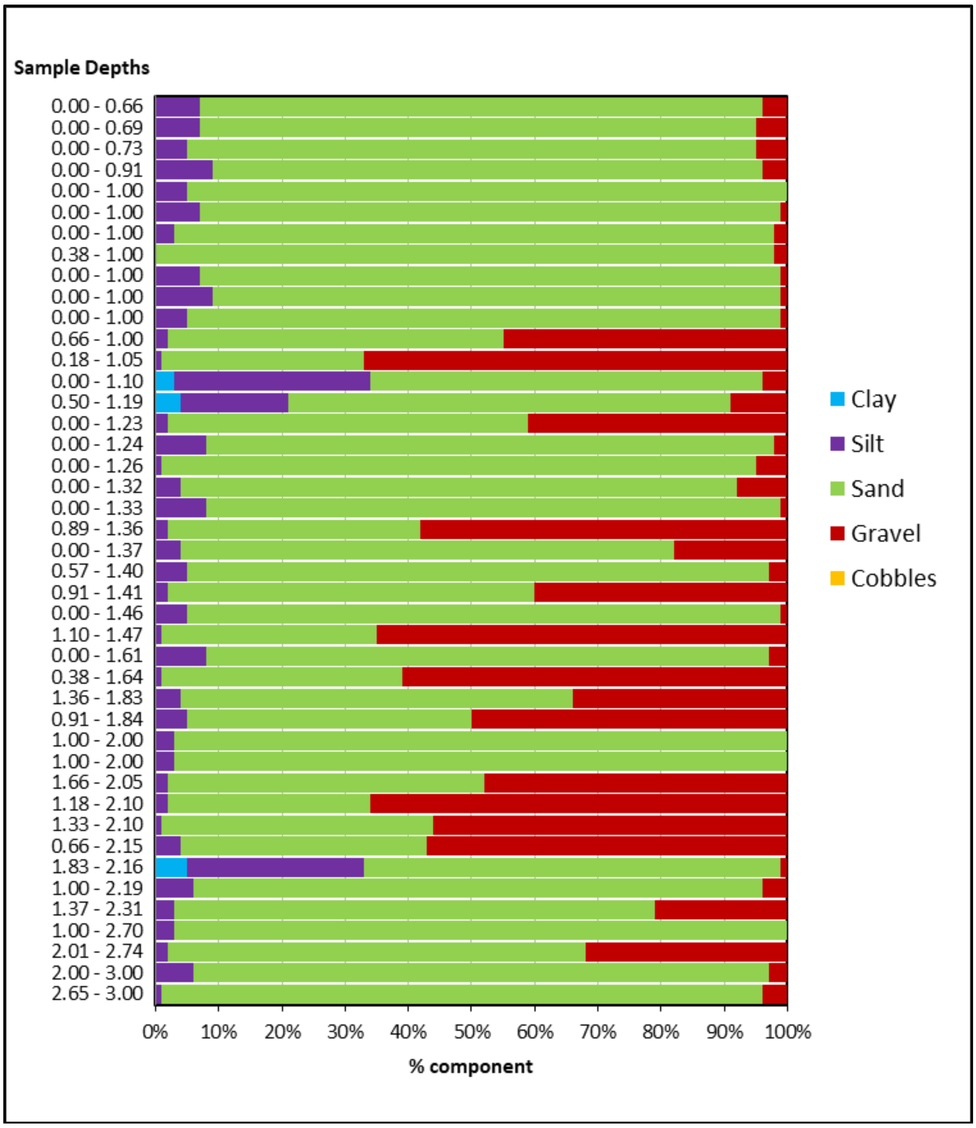

Figure 41. Summary of PSD data for route section 05, IRE.

Plots of the PSD data for the different material types are shown below.

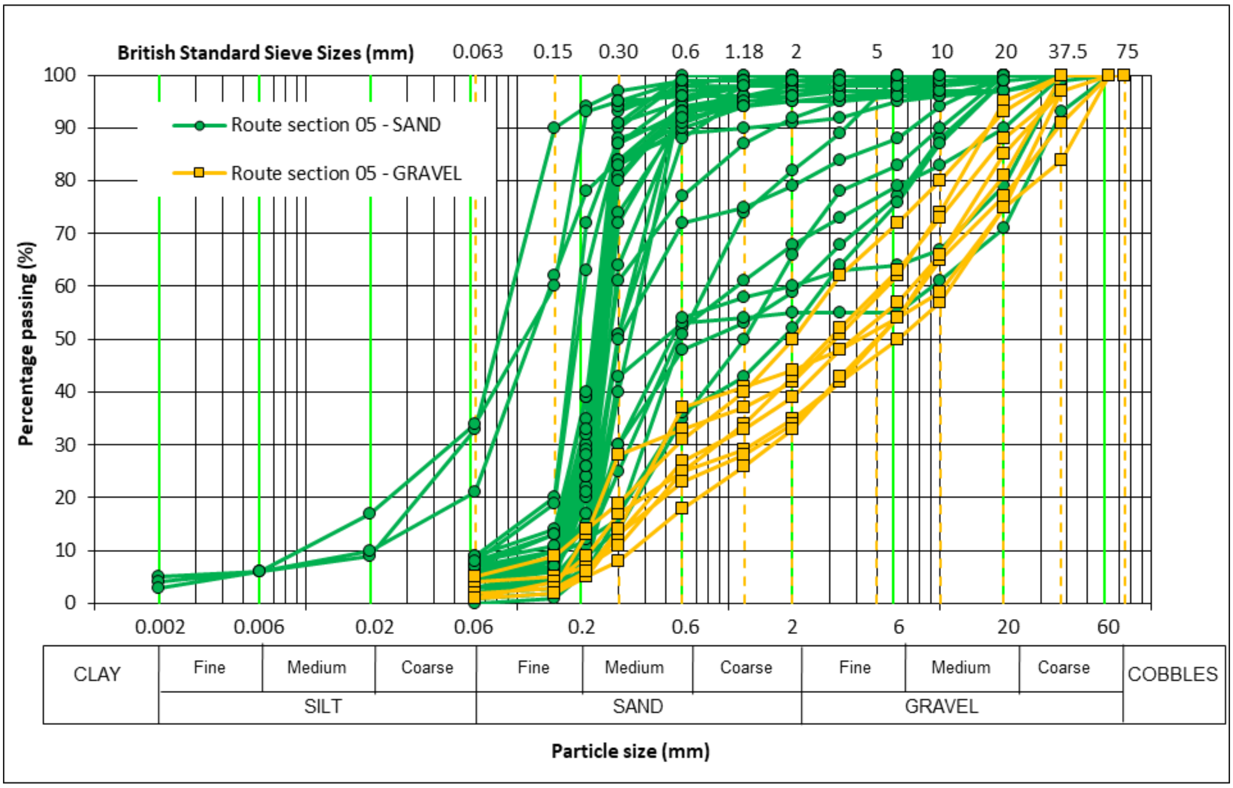

Figure 42. PSD plot for tested material in route section 05, IRE.

Laboratory data for this route section are shown below. The highest moisture contents of >23% were obtained from cohesive material, with the single highest value of 61% being obtained from very low strength CLAY with black, probable organic, clayey SILT laminae.

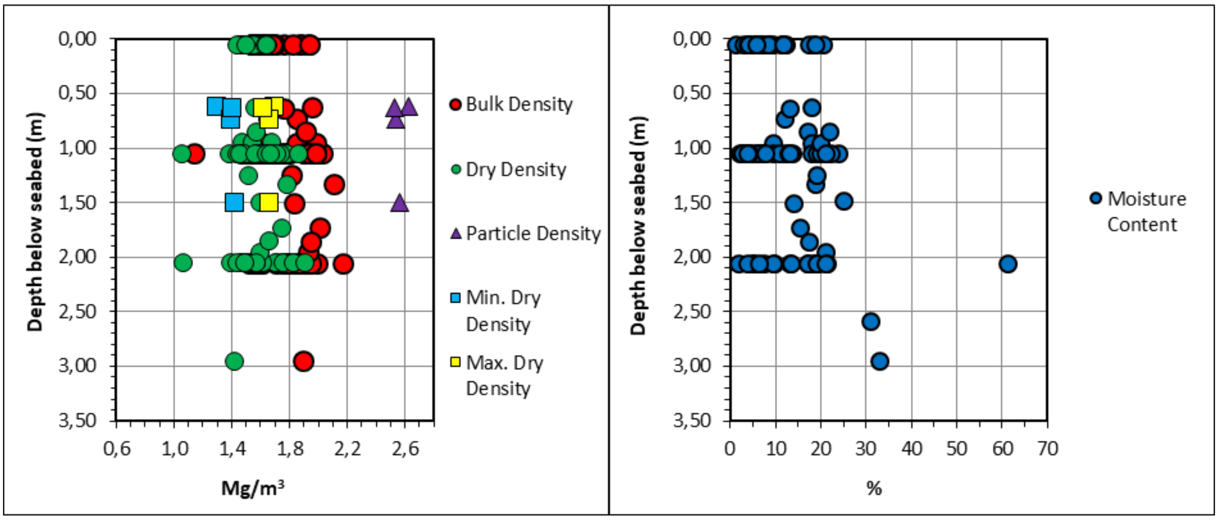

Figure 43. Summary of laboratory test data for route section 05, IRE.

Only three Atterberg tests were carried out on material from this route section. A single sample from VC-041A returned as non-plastic with the material subsequently being logged as very silty fine SAND. The remaining tests returned as CLAY of intermediate to high plasticity.

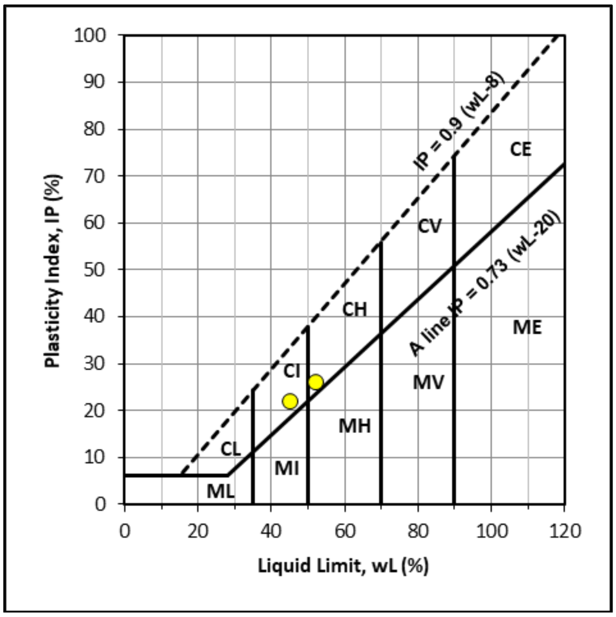

Figure 44. Plasticity Chart for route section 05, IRE.

Shear strength data obtained from the sparse cohesive material in route section 05 are shown below. The data shows a general increase in shear strength with depth, in the medium strength range. The low strength result of 15kPa was obtained from a single test in the thin CLAY band in VC-038.

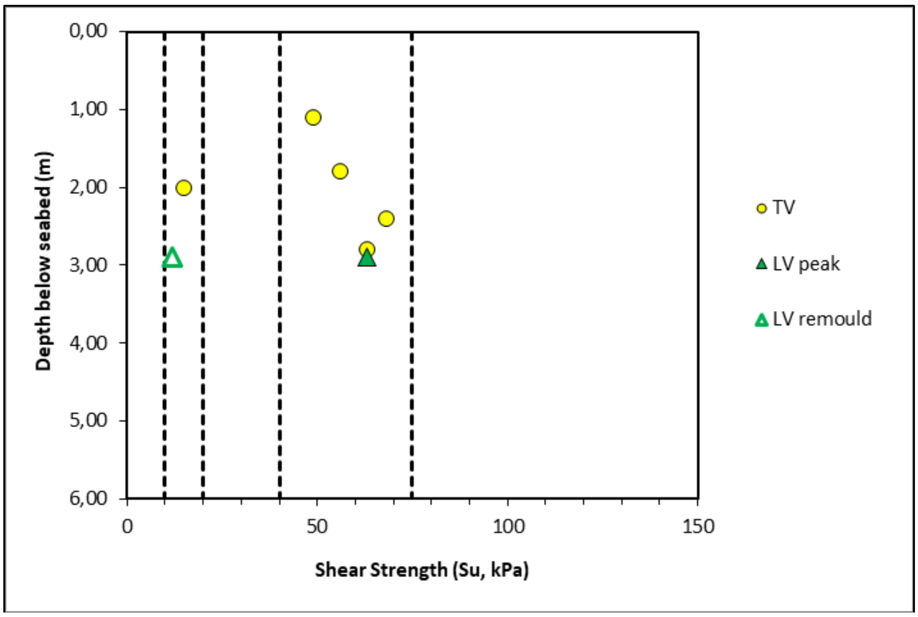

Figure 45. Summary of shear strength data for route section 05, IRE.

Four shearbox tests were carried out on material from this route section. The results provide a range of peak and residual friction angles of 38° to 31° and 33° to 28°, respectively.

Eighty six thermal resistivity measurements were taken in the recovered vibrocores in this route section, with eight onshore validation tests carried out. The data are shown below and follow the expected transition of increasing resistivity with increasing moisture content, with the CLAY having highest resistivity. As with other route sections, the results obtained from those samples at low moisture contents, typically <10%, should be treated with caution, especially where the values are >0.600.

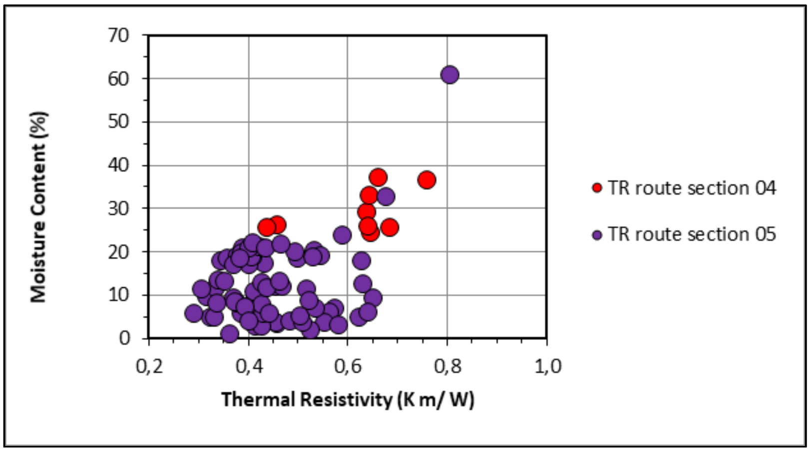

Figure 46. Thermal resistivity data for route sections 04 & 05, IRE.

Thirty three CPT attempts were undertaken in this route section with re-attempts only required at two locations (CPT-047 and CPT-048). Across the majority of the route section dense granular material was typically encountered at 0.42 to 1.50m depth. The depth to very dense granular material is more variable, from 0.52 to 2.84m.

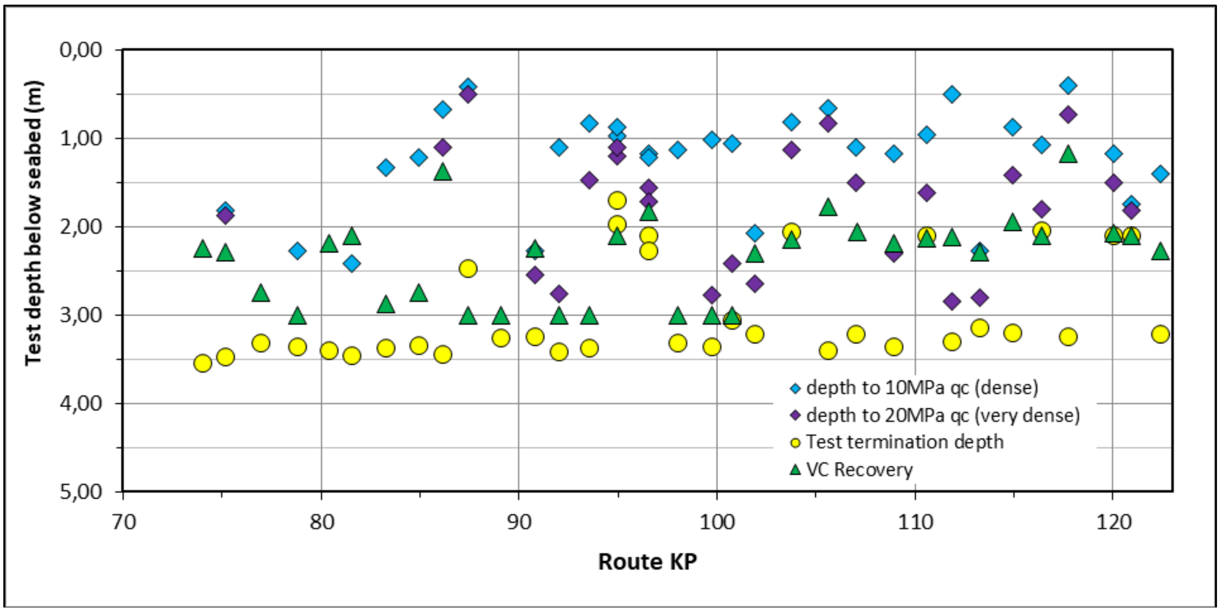

Figure 47. Summary of CPT depths and VC recovery for route sections 04 & 05, IRE.

A plot below shows the measured cone resistances in route section 05. The common feature in many tests is the progressive increase in cone resistance with depth, reflecting the increase in relative density of the granular material. Shallow test refusals were largely due to a sudden rapid increase in cone resistance.

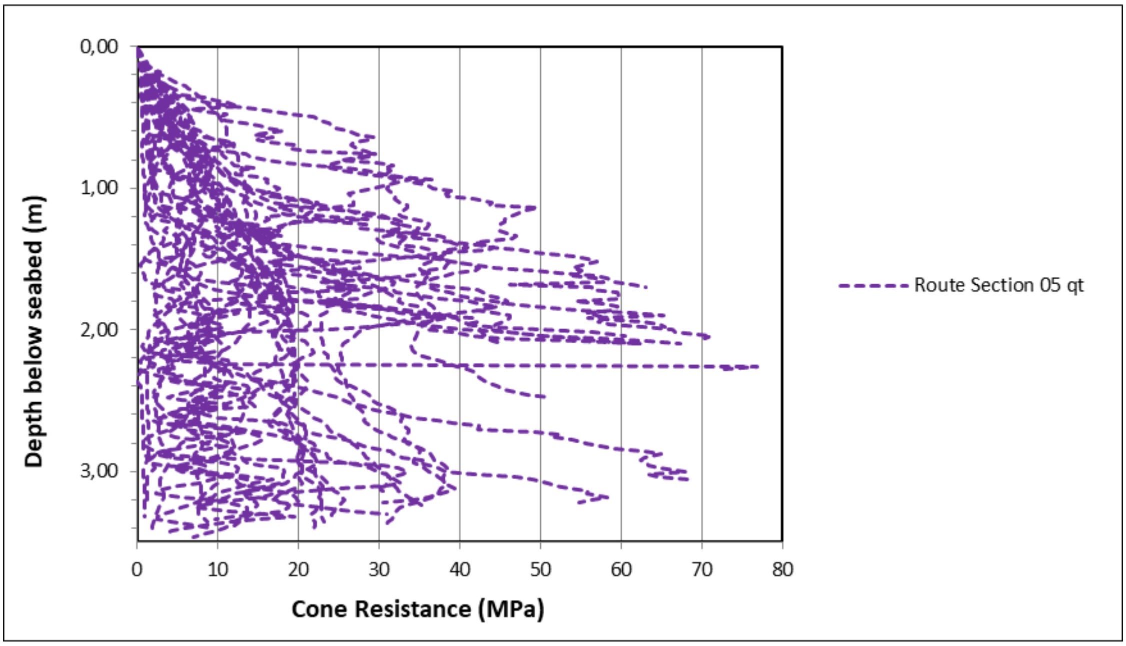

Figure 48. Plot of measured CPT cone resistance for route section 05, IRE

A plot below shows the derived CPT shear strength (Nk - 17.5) for those few locations where CLAY was encountered. The laboratory shear strength data correlates with the CPT, indicating low to medium strength CLAY.

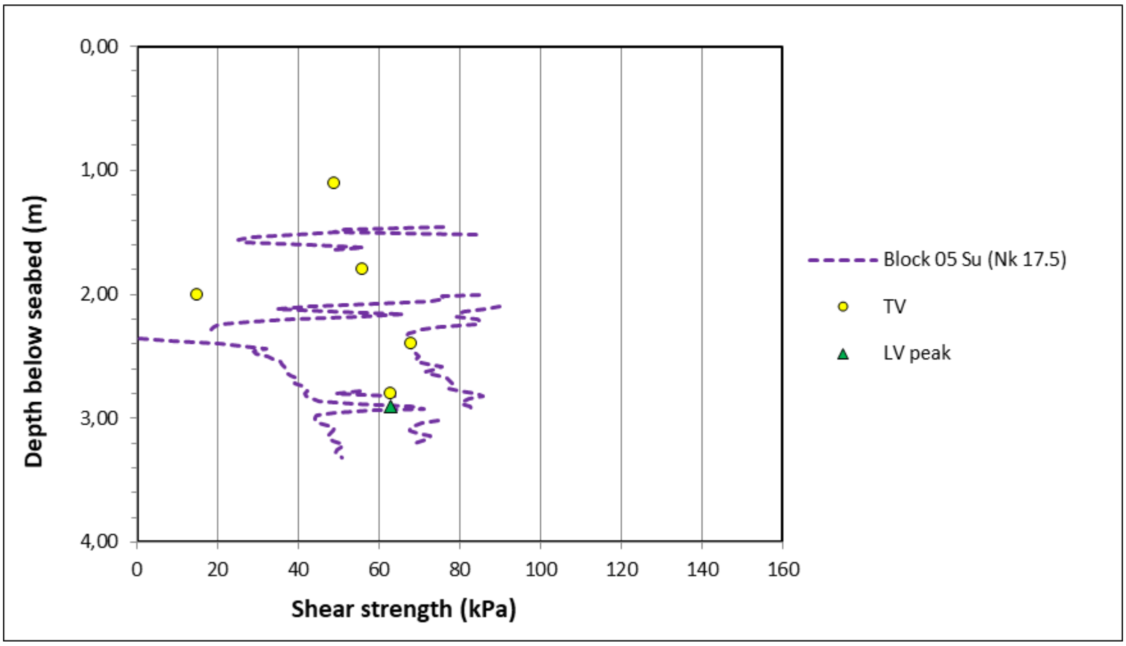

Figure 49. Plot of CPT derived shear strength and laboratory data for route section 05, IRE.

4.3.3| ROUTE SECTION 06 (KP 123.920 - KP 146.421)

This third route section covers the locations 066 (KP 123.920) to 080 (KP 146.421). The seabed index summary for this section is shown below.

Table 19. Seabed Index summary for route section 06, IRE.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
123.920	953-VC-066	VC	3.00	2.10				8	8	7
123.922	953-CPT-066	CPT			3.24	2.96		8	8	7
125.849	953-VC-067A	VC	3.00	0.87				8	8	7
125.850	953-CPT-067	CPT			3.32	1.78		8	8	7
126.914	953-VC-068	VC	3.00	2.22				8	8	8
126.915	953-CPT-068	CPT			3.30	3.02		8	8	8
128.419	953-VC-069A	VC	3.00	2.36				8	8	8
128.420	953-CPT-069	CPT			3.28	2.70	3.18	8	8	8
130.285	953-VC-070	VC	3.00	2.47				8	8	8
130.285	953-CPT-070	CPT			2.98	2.90	2.94	8	8	8
132.330	953-VC-071	VC	3.00	2.12				8	8	8
132.331	953-CPT-071	CPT			3.24	3.16		8	8	8
134.198	953-VC-072	VC	3.00	2.50				8	8	8
134.199	953-CPT-072	CPT			3.10	2.92	3.00	8	8	8
135.918	953-VC-073	VC	3.00	2.20				8	8	8
135.920	953-CPT-073	CPT			3.44			8	8	8
137.410	953-VC-074	VC	2.87	2.28				8	8	8
137.411	953-CPT-074	CPT			3.36			8	8	8
138.846	953-VC-075	VC	2.90	2.43				8	7	8
138.846	953-CPT-075	CPT			3.34			8	7	8
140.409	953-VC-076	VC	3.00	2.39				8	8	8
140.410	953-CPT-076	CPT			3.30			8	8	8
141.922	953-VC-077	VC	3.00	2.20				7	7	7
141.924	953-CPT-077	CPT			3.32			7	7	7
143.427	953-VC-078	VC	3.00	2.12				7	7	7
143.428	953-CPT-078	CPT			3.28			7	7	7
144.913	953-VC-079	VC	3.00	2.16				7	7	6
144.914	953-CPT-079	CPT			3.42			7	7	6
146.421	953-VC-080	VC	3.00	2.62				8	8	8
146.422	953-CPT-080	CPT			3.38			8	8	8

In this route section granular ground conditions still dominate. The material is remarkably consistent, comprising slightly gravelly slightly silty to silty SAND. Cohesive material is absent. A summary of the PSD data is shown below. Silt contents are low, <7%, whilst gravel contents are <4%.

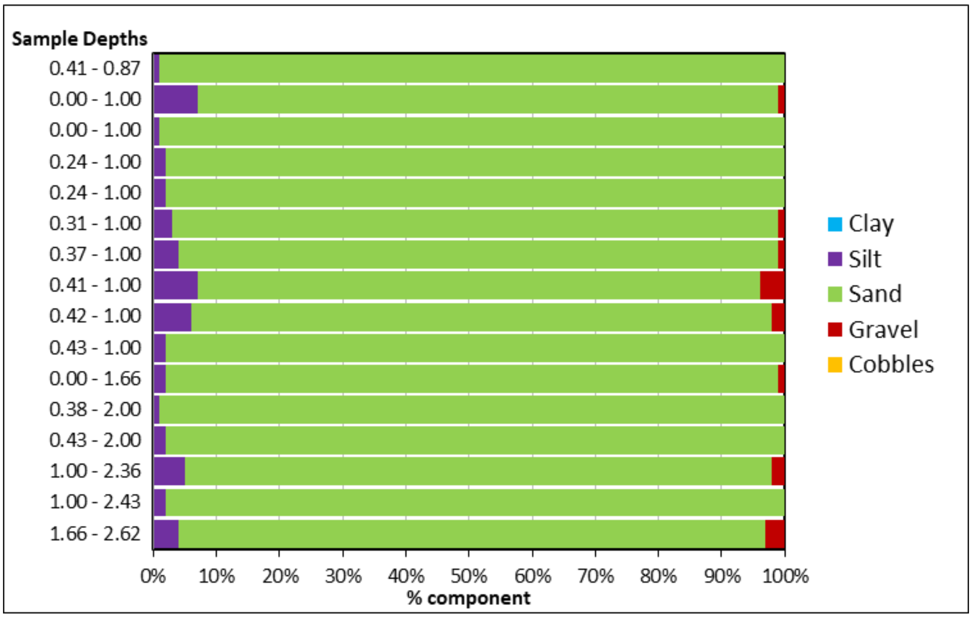

Figure 50. Summary of PSD data for route section 06, IRE.

Plots of the PSD data for the SAND in this route section are shown below. The SAND is almost entirely fine grained, apart from a single tested sample from VC-080, below 1.66m, which comprises medium to coarse SAND.

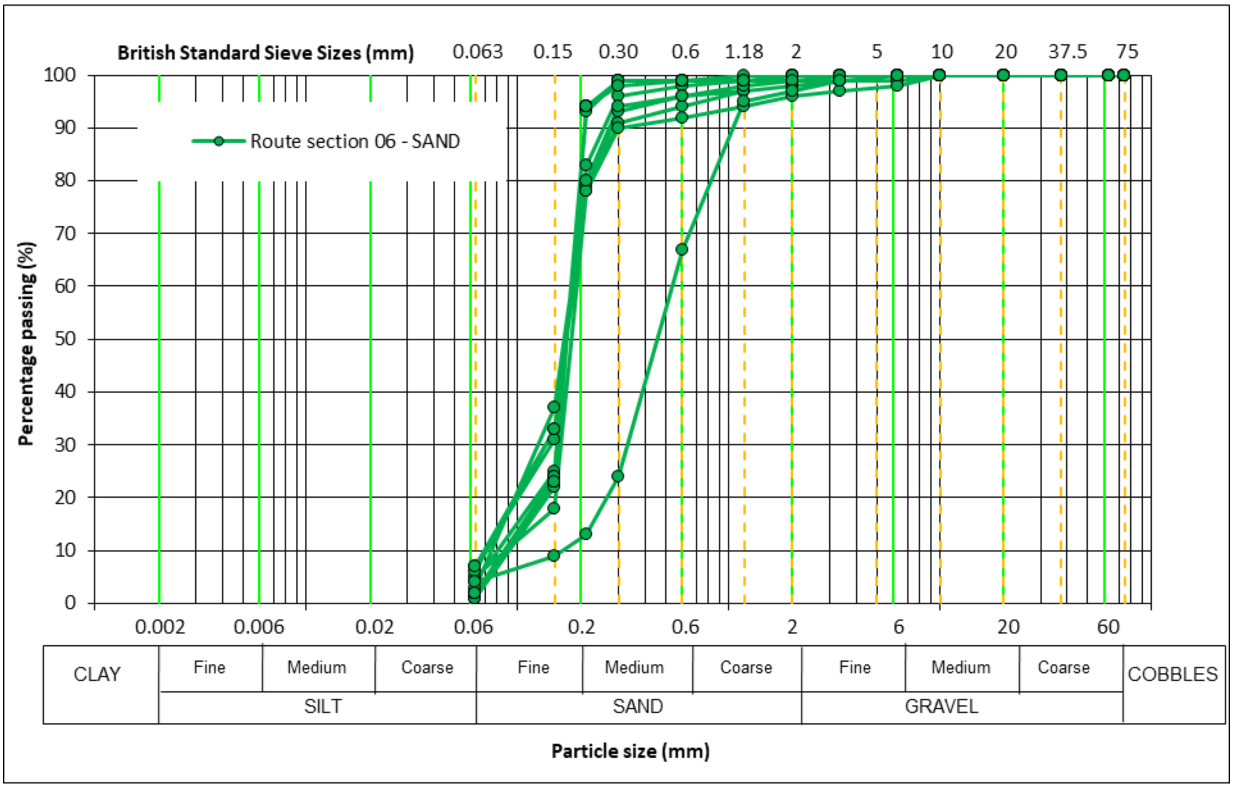

Figure 51. PSD plot for tested material in route section 06, IRE.

Laboratory data for this route section are shown below. The moisture contents and densities generally increase with depth, and are in fairly close ranges. An exception is a single high moisture content of 41%, obtained from VC-078.

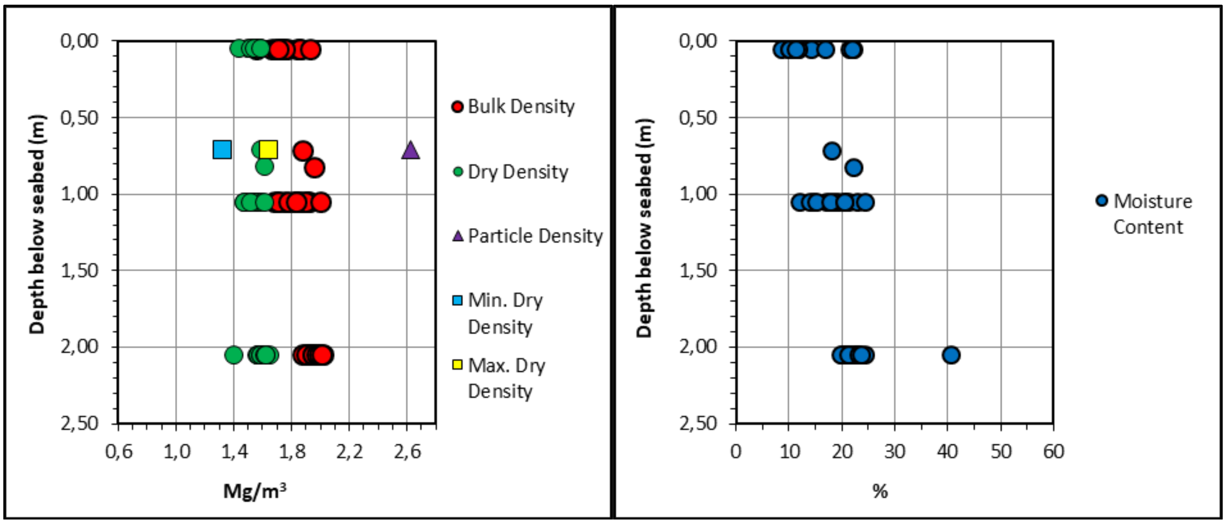

Figure 52. Summary of laboratory test data for route section 06, IRE.

A single shearbox test was carried out on material from VC-073, described as slightly gravelly silty SAND. The result indicates peak and residual friction angles of 39° and 32°, respectively.

Forty four thermal resistivity measurements were taken in the recovered vibrocores in this route section, with three onshore validation tests carried out. The data are shown below and span the range 0.327 to 0.596, consistent with silty SAND. The data also follow the expected transition of increasing resistivity with increasing moisture content.

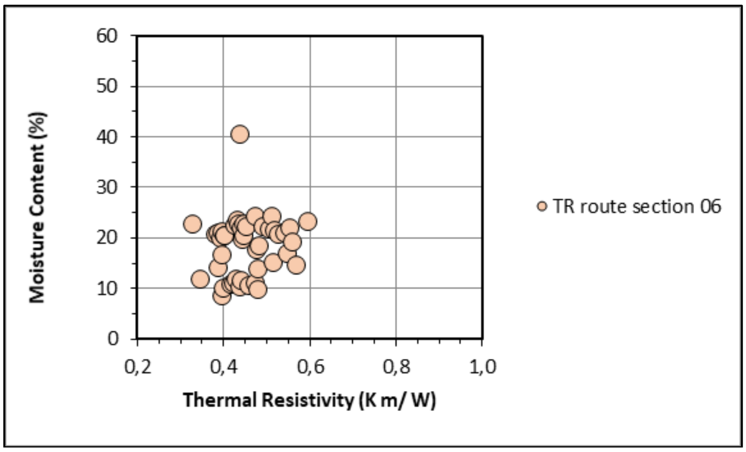

Figure 53. Thermal resistivity data for route sections 06, IRE.

Fifteen CPT attempts were undertaken in this route section with no re-attempts required. This section of the route clearly contrasts with the preceding granular section 05 (KP 78.809 to 122.413), due to the lack of dense to very dense granular material from 0.00 to 2.70m. Only at location CPT-067 (KP 125.850) can dense granular material be seen at a shallower depth of 1.78m.

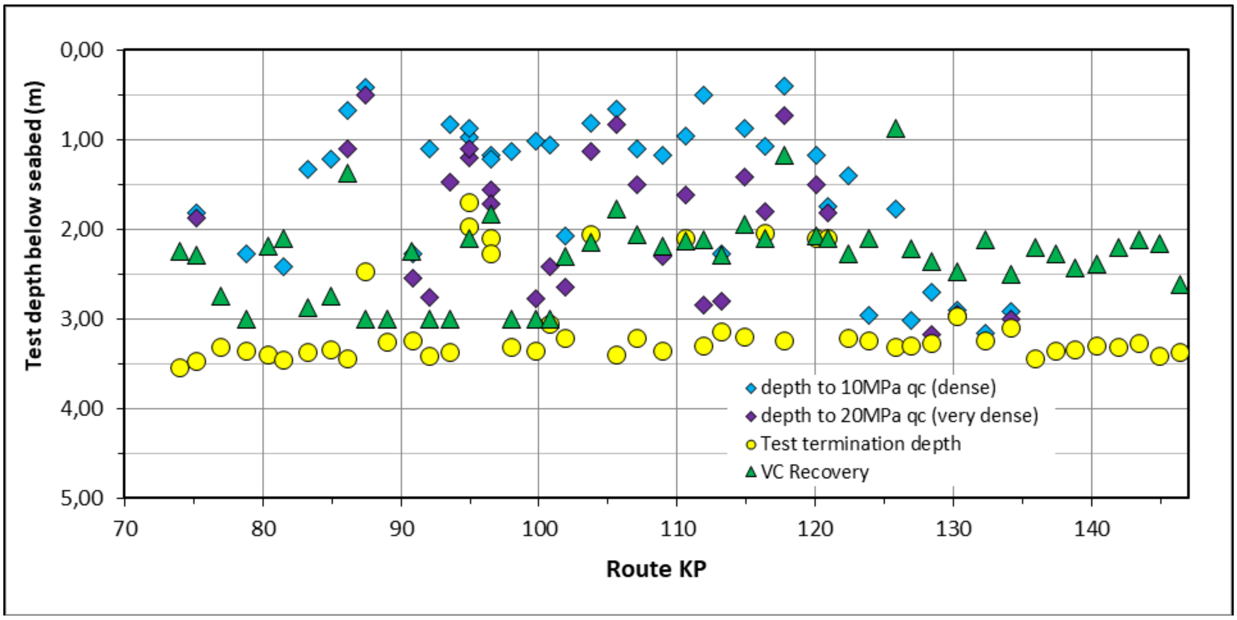

Figure 54. Summary of CPT depths and VC recovery for route sections 04, 05 & 06, IRE.

A plot below shows the measured cone resistances in route section 06. The tests are consistent with a steady increase in cone resistance with depth, albeit largely at values of <5MPa, i.e. very loose to loose. The dense granular material in CPT-067 at 1.74m can be seen. Dense to very dense strata at the other locations is below 2.70m.

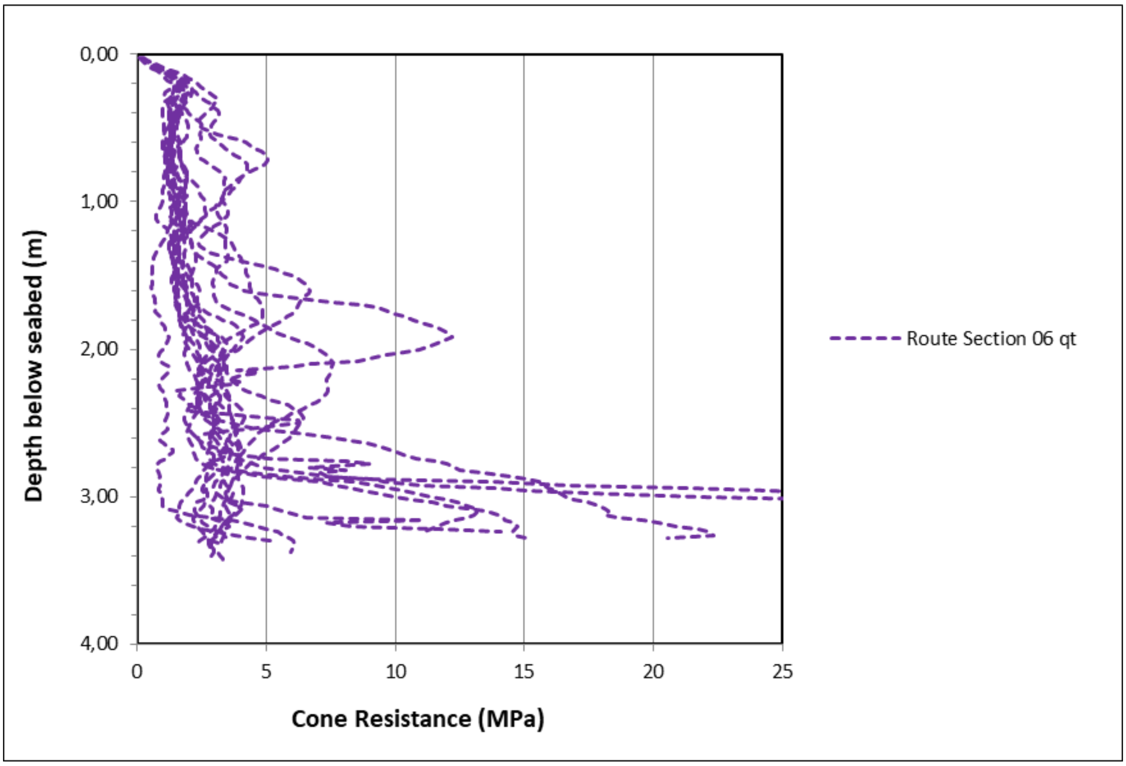

Figure 55. Plot of measured CPT cone resistance for route section 06, IRE

4.3.4| ROUTE SECTION 07 (KP 147.952 - KP 158.226)

This final short route section covers the remaining locations on the Ireland survey route, locations 081 to 091A. Note, no geotechnical work was carried out at location 090, and location 091A is located between locations 087 and 088. The seabed index summary for this section is shown below.

Table 20. Seabed Index summary for route section 07, IRE.

Route KP	Location	Type	Vibrocoring		Cone Penetration Testing			Seabed Index		
			Pen. (m)	Rec. (m)	Refusal Depth (m)	Depth to 10MPa (Dense)	Depth to 20MPa (V Dense)	0.50m	1.00m	1.50m
147.952	953-VC-081	VC	2.60	2.34				8	3	3
147.952	953-CPT-081A	CPT			1.80	0.88	1.00	8	3	3
147.954	953-CPT-081	CPT			1.98	0.92	0.94	8	3	3
149.400	953-VC-082	VC	3.00	2.12				6	5	5
149.401	953-CPT-082	CPT			3.24	0.90	2.30	6	5	5
150.922	953-VC-083	VC	3.00	2.52				5	6	3
150.933	953-CPT-083	CPT			3.20	0.50	0.70	5	6	3
152.419	953-VC-084A	VC	3.00	2.90				5	3	3
152.421	953-CPT-084	CPT			2.18	0.46	0.74	5	3	3
154.117	953-VC-085	VC	3.00	2.08				7	6	6
154.119	953-CPT-085	CPT			3.06	1.70		7	6	6
155.403	953-VC-086	VC	1.67	1.48				5	3	3
155.403	953-CPT-086	CPT			1.58	0.40	0.94	5	3	3
155.406	953-CPT-086A	CPT			2.22	0.28	0.92	6	3	3
156.535	953-VC-087A	VC	2.88	2.20				6	5	3
156.536	953-CPT-087	CPT			2.52	0.60	0.68	6	5	3
156.954	953-VC-091A	VC	2.87	1.39				8	8	8
156.954	953-CPT-091	CPT			0.20	0.12		3		
156.954	953-CPT-091A	CPT			3.26			8	8	8
157.209	953-VC-088A	VC	2.88	1.83				6	7	6
157.212	953-CPT-088	CPT			0.20	0.12		6	7	6
158.223	953-CPT-089	CPT			3.18	2.96		6	7	7
158.226	953-VC-089	VC	2.89	2.31				6	7	7

The ground conditions in this final route section are slightly variable as would be expected closer to the landfall. In general coarse granular material is typical, varying from gravelly silty SAND to sandy silty GRAVEL. Cohesive material is also present at some locations. Both SILT and CLAY can be seen at VC-083, VC-089 and VC-091A. The material varies from slightly sandy clayey SILT to slightly sandy slightly gravelly silty CLAY.

A summary of the PSD data is shown below, which shows the predominance of SAND through to coarse granular material, with frequent GRAVEL bands.

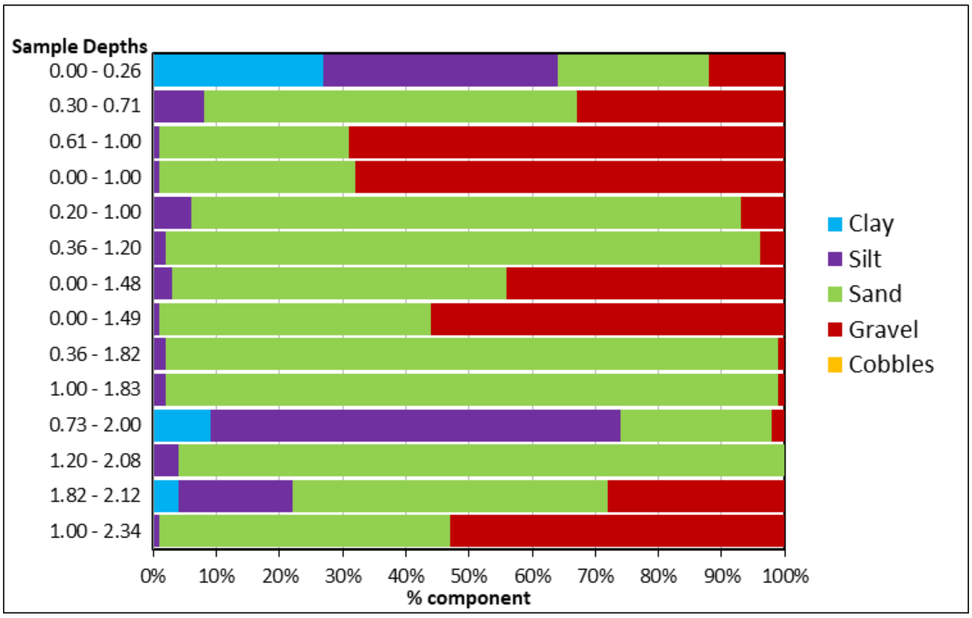

Figure 56. Summary of PSD data for route section 07, IRE.

Plots of the PSD data for the different material types are shown below.

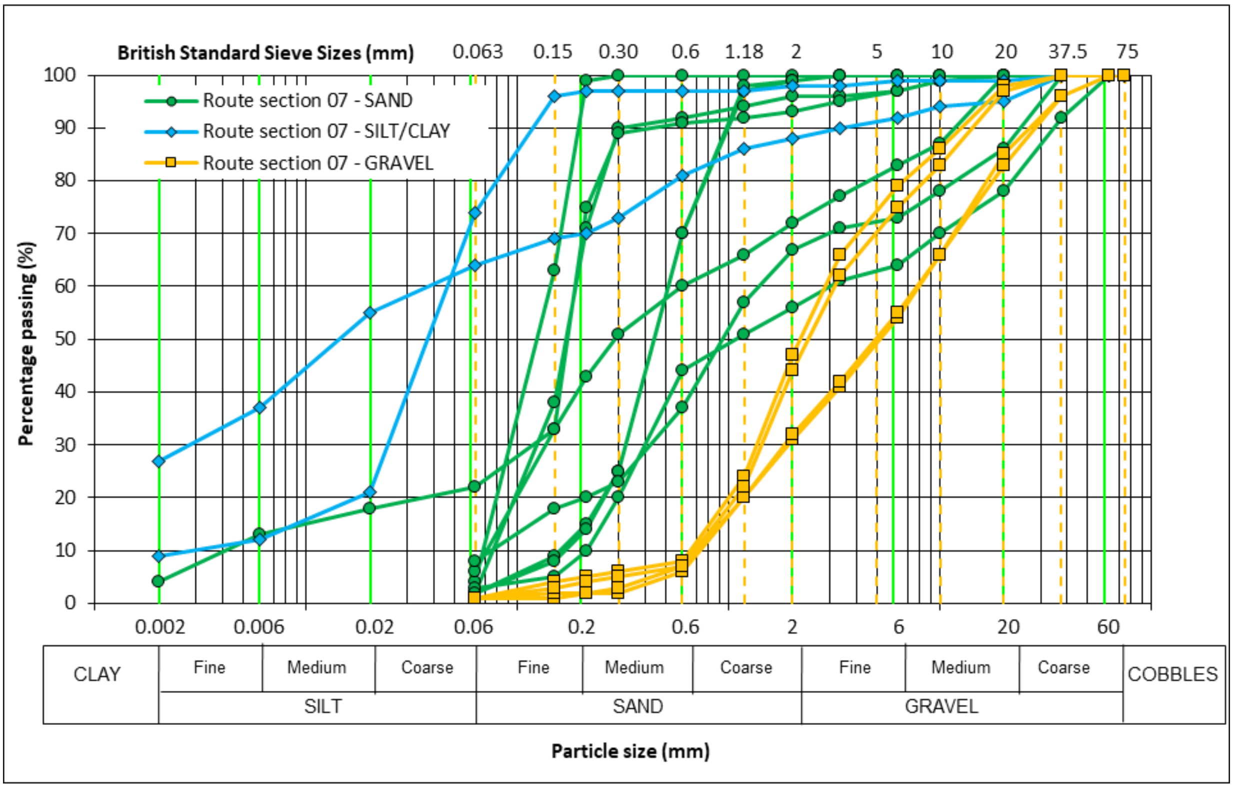

Figure 57. PSD plot for tested material in route section 07, IRE.

Laboratory data for this route section are shown below. There is a variation in moisture content and density which reflects the varying material types. The highest moisture contents of >26% were obtained from cohesive material, both SILT and CLAY.

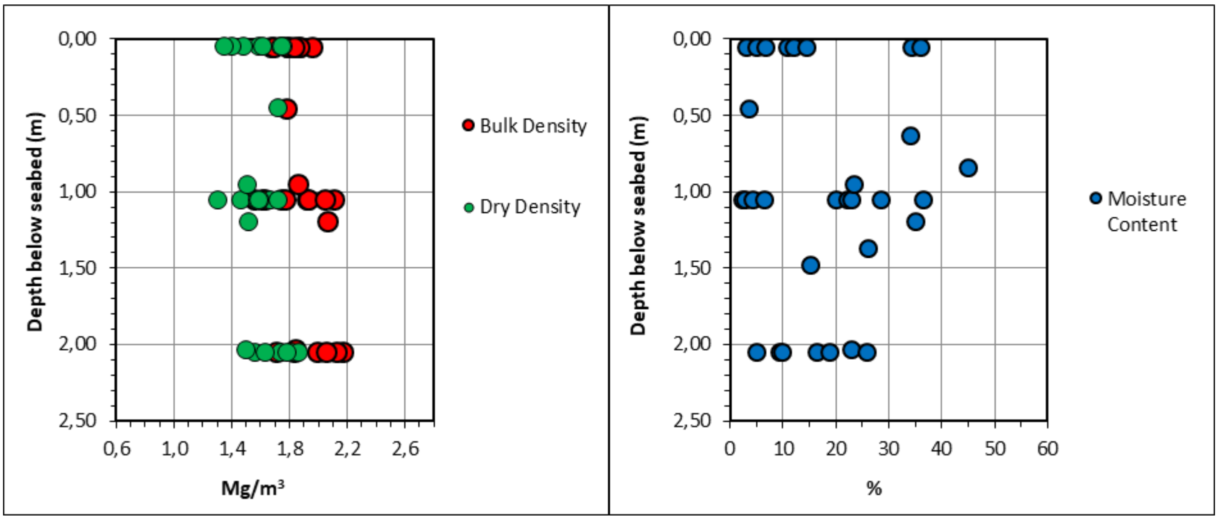

Figure 58. Summary of laboratory test data for route section 07, IRE.

Four Atterberg tests were carried out on material from this route section. A single SILT sample from VC-083 returned as non-plastic. The remaining tests returned as CLAY of intermediate to borderline high plasticity.

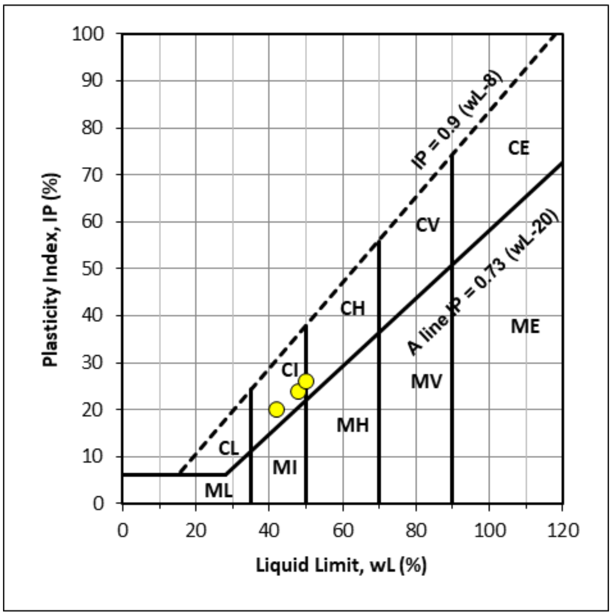

Figure 59. Plasticity Chart for route section 07, IRE.

Shear strength data obtained from the cohesive material in route section 07 are shown below. The data in the low strength range (20 to 40kPa) were obtained from VC-091A, and the top of the CLAY in VC-089. The data in the high strength range, >75kPa, were obtained from the rest of the CLAY profile in VC-089.

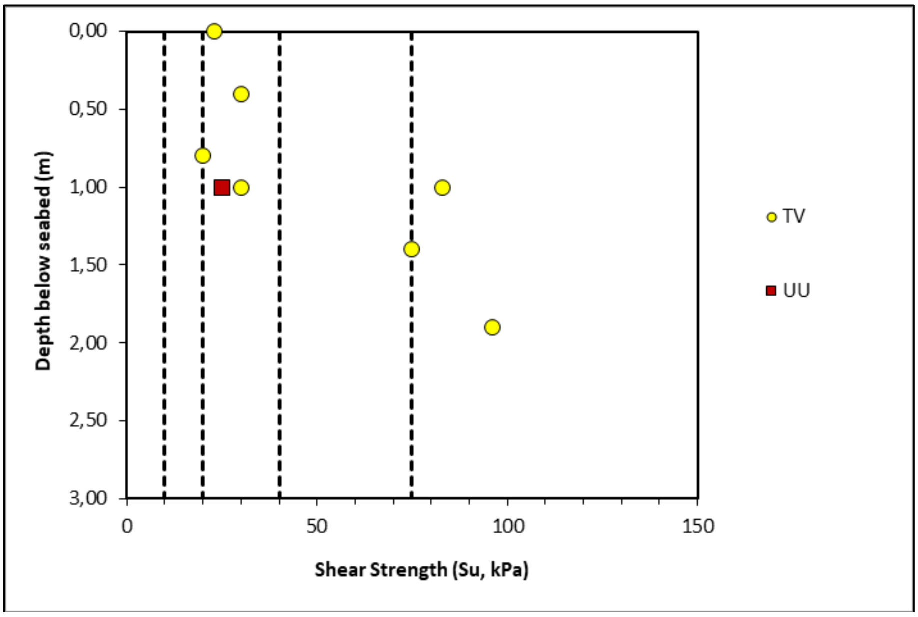

Figure 60. Summary of shear strength data for route section 07, IRE.

Twenty four thermal resistivity measurements were taken in the recovered vibrocores in this route section, with one onshore validation tests carried out. The data are shown below, combined with the previous route sections, and follow the expected transition of increasing resistivity with increasing moisture content. Four results obtained offshore which were greater than 0.910 are considered erroneous as they were carried in very gravelly SAND to GRAVEL at low moisture contents, <9%. The validation test increased an initial erroneous result up from 0.155 to 0.533.

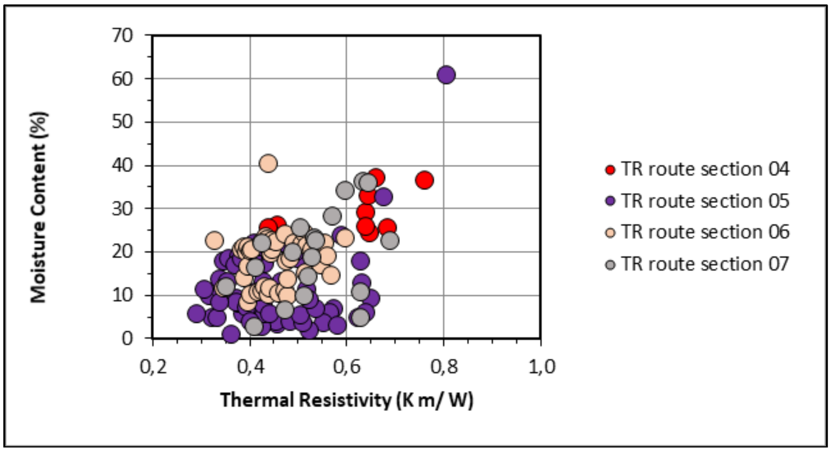

Figure 61 Thermal resistivity data for the entire IRELAND section.

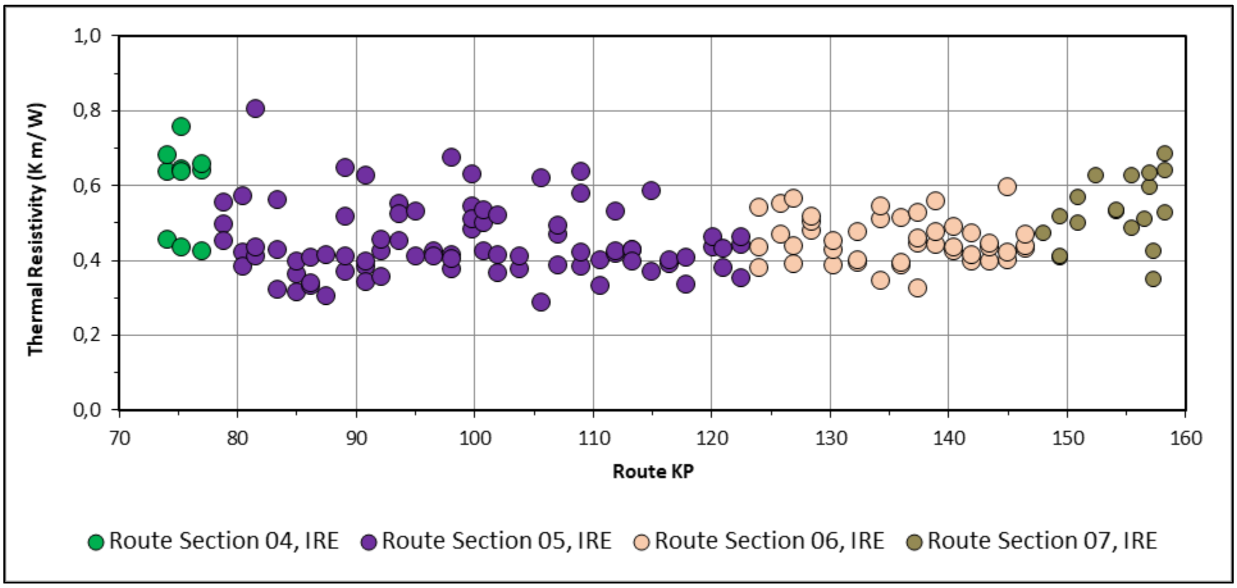

Figure 62. Plot of thermal data against route KP for the entire IRELAND section.

The thermal resistivity data for the entire Ireland section are shown above. The results, which were largely obtained during the offshore fieldwork are generally consistent with the change in material types along the route. Higher resistivity values, typically >0.550, are characteristic of CLAY-rich sediments, whilst values from 0.300 to 0.550 are typical from granular materials, with lower moisture contents.

Twelve CPT attempts were undertaken in this route section with re-attempts only required at two locations (CPT-086 and CPT-091). The depth to dense and very dense strata in this final route section is shallow, at <1.00m, and also decreases with increasing KP towards the landfall.

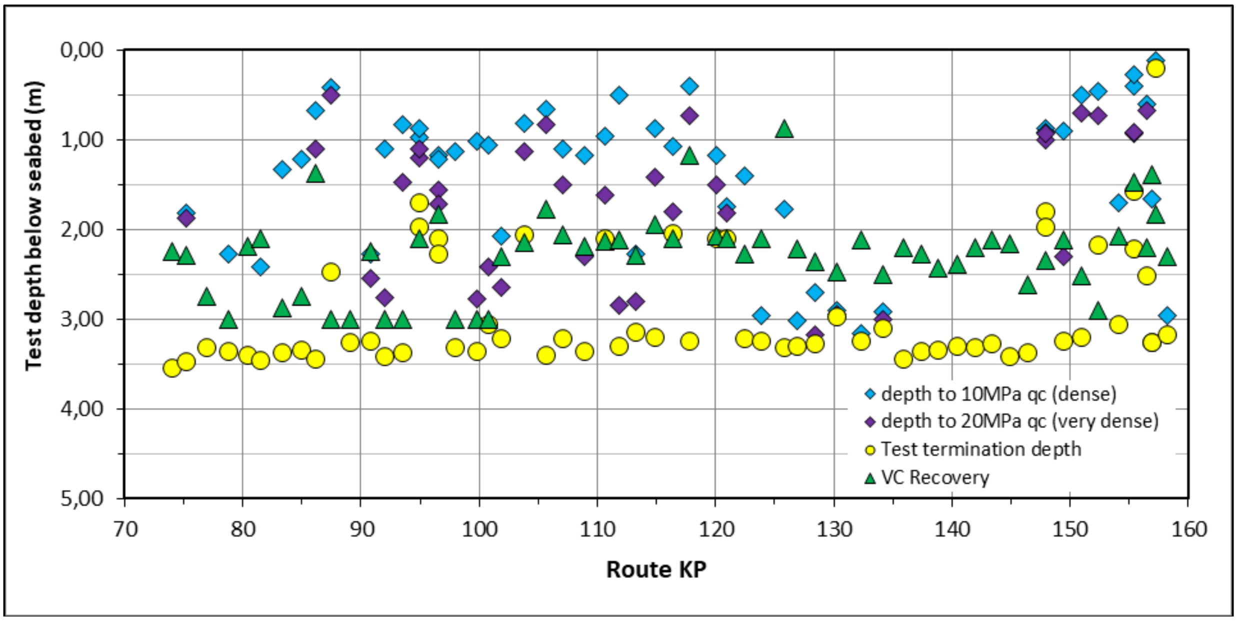

Figure 63. Summary of CPT depths and VC recovery for the entire IRELAND section.

A plot below shows the measured cone resistances in route section 07. The progressive increase in cone resistance with depth in most of the tests reflects the increase in relative density of the granular material. Those three locations where cohesive material was encountered contrast, with cone resistances <4MPa, albeit with dense GRAVEL overlying the SILT in CPT-083.

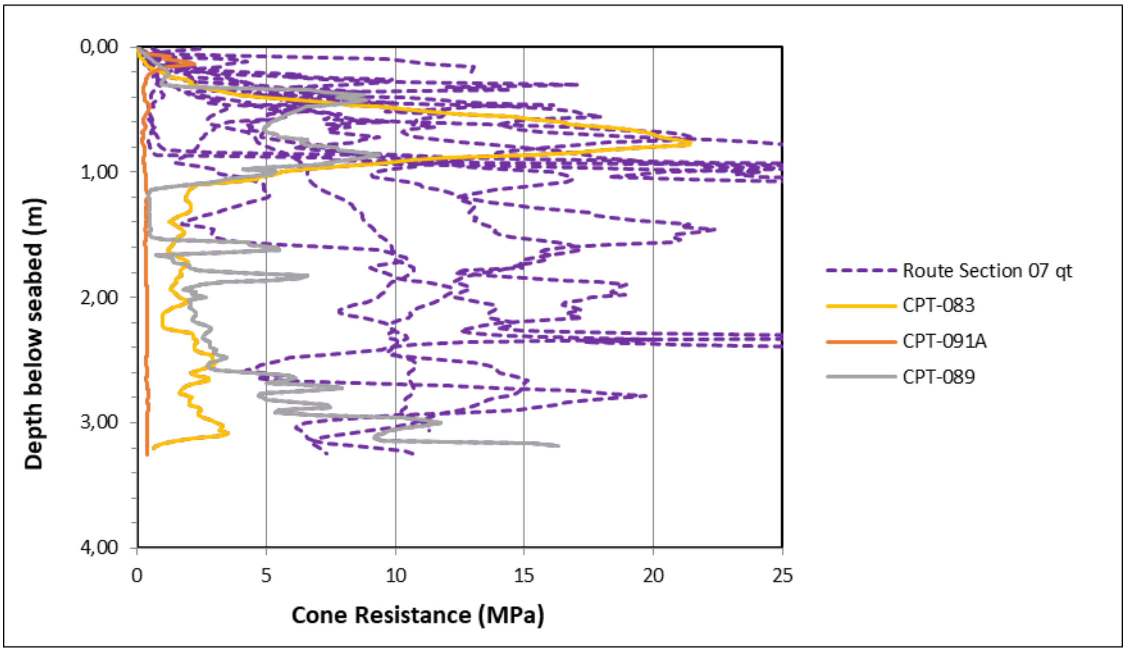

Figure 64. Plot of measured CPT cone resistance for route section 07, IRE

A plot below shows the derived CPT shear strength (Nk - 17.5) for those few locations where CLAY was encountered. The laboratory shear strength data correlates well with the CPT data.

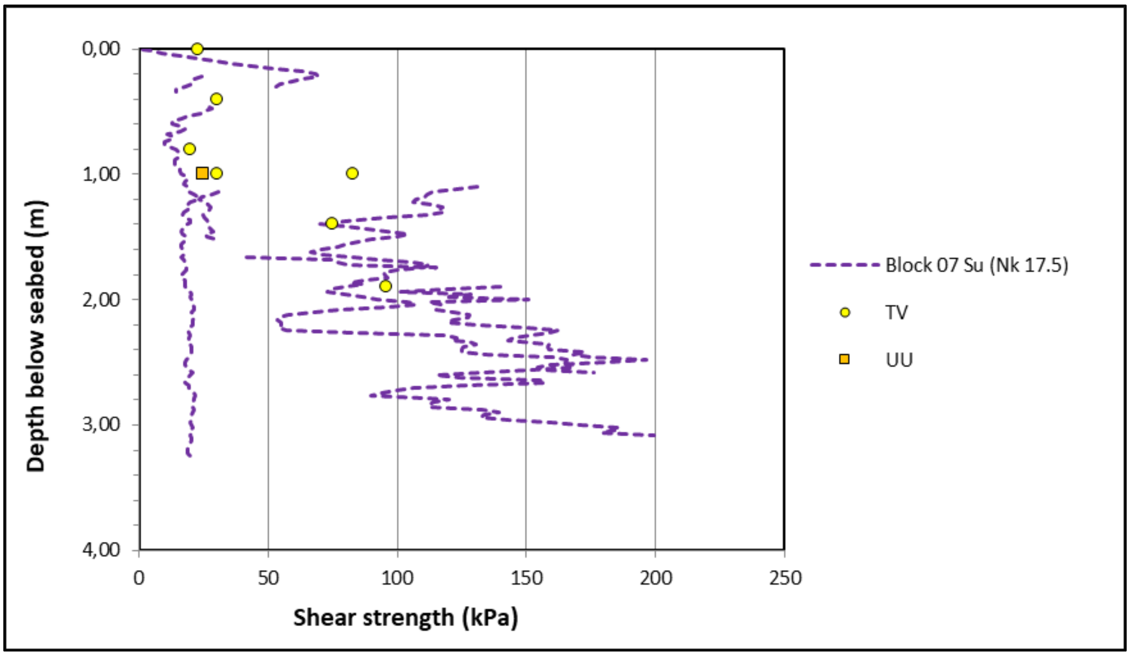

Figure 65. Plot of CPT derived shear strength and laboratory data for route section 07

4.4| UK NEARSHORE

4.4.1| BOREHOLE GROUND CONDITIONS

The two borehole locations at Freshwater West, Pembrokeshire, are shown below.

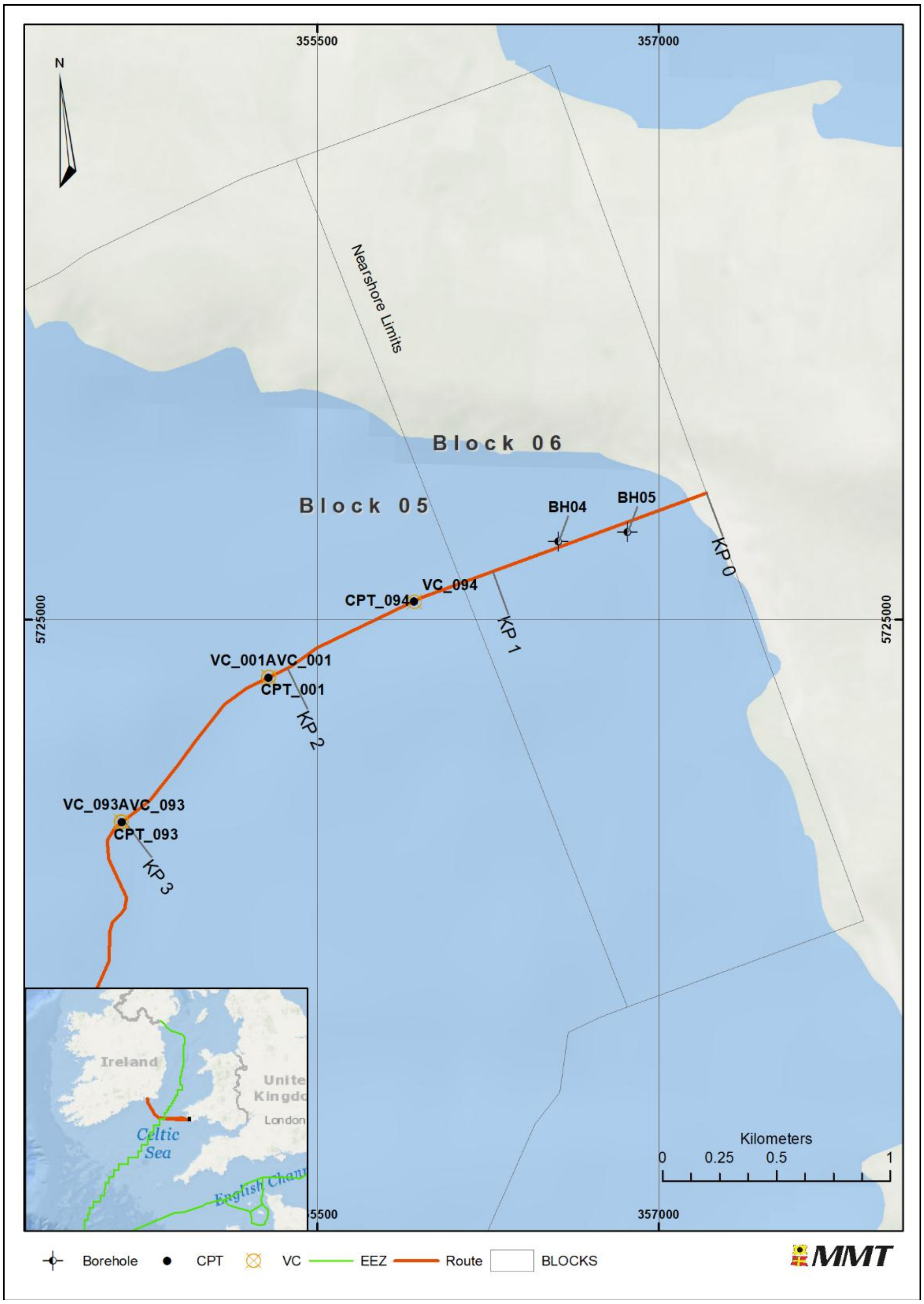

Figure 66. Nearshore borehole locations at Freshwater West, UK.

The encountered sediment ground conditions in the two boreholes were variable. In BH04A-FWW, furthest offshore, granular sediment comprising gravelly silty SAND to 4.50m, overlies very sandy GRAVEL. Bedrock was encountered at 6.80m. In BH05A-FWW, granular material extends to 4.50m, with slightly gravelly silty SAND to 2.00m, sandy GRAVEL to 2.50m and gravelly SAND with CLAY pockets. Below 4.50m, cohesive material was encountered with soft to firm organic silty CLAY to 6.50m, over medium strength soft to firm slightly sandy silty CLAY with organic material to 10.00m, Below 10.00m, a stiff slight sandy gravely CLAY extends to 11.10m, where a thin stiff CLAY represents weathered bedrock.

A summary of the PSD data is shown below, which shows the predominance of SAND and GRAVEL in the upper parts of the boreholes, with CLAY evident in BH05A-FWW.

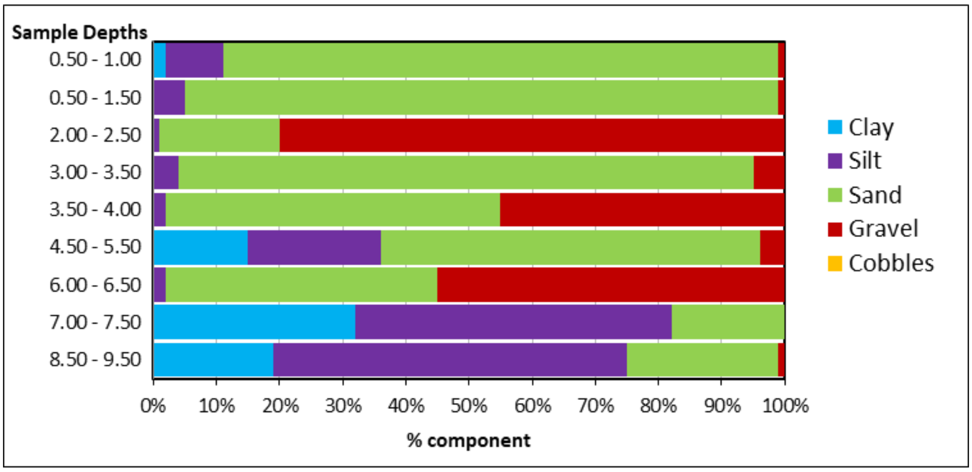

Figure 67. Summary of PSD data for the nearshore UK boreholes.

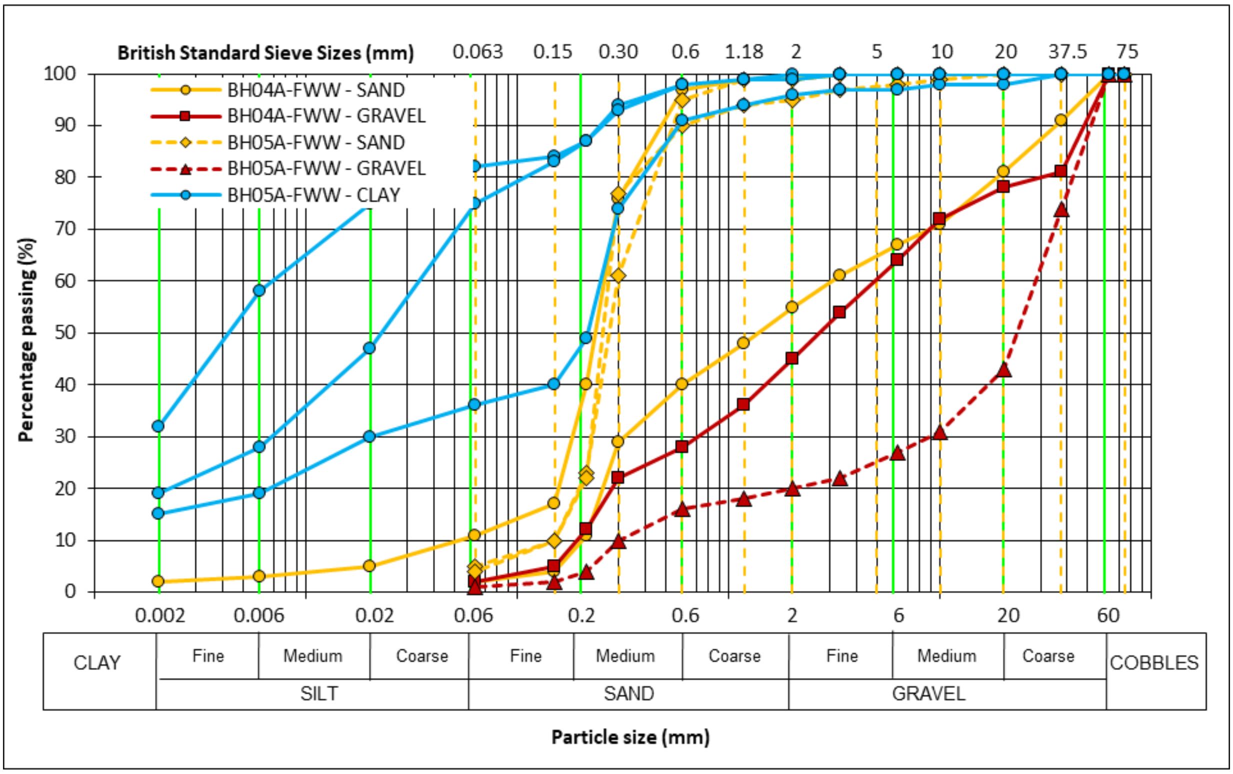

Figure 68. PSD plot for tested material from the nearshore UK boreholes.

Laboratory data for the sediment are shown below. The data in the uppermost granular material (<4.50m depth) is consistent, with moisture contents in the range 21 to 31%. In the cohesive material from the deeper BH05A-FWW there is a larger variation in moisture content reflecting changes in the CLAY and SILT. Organic contents range from 3 to 15%.

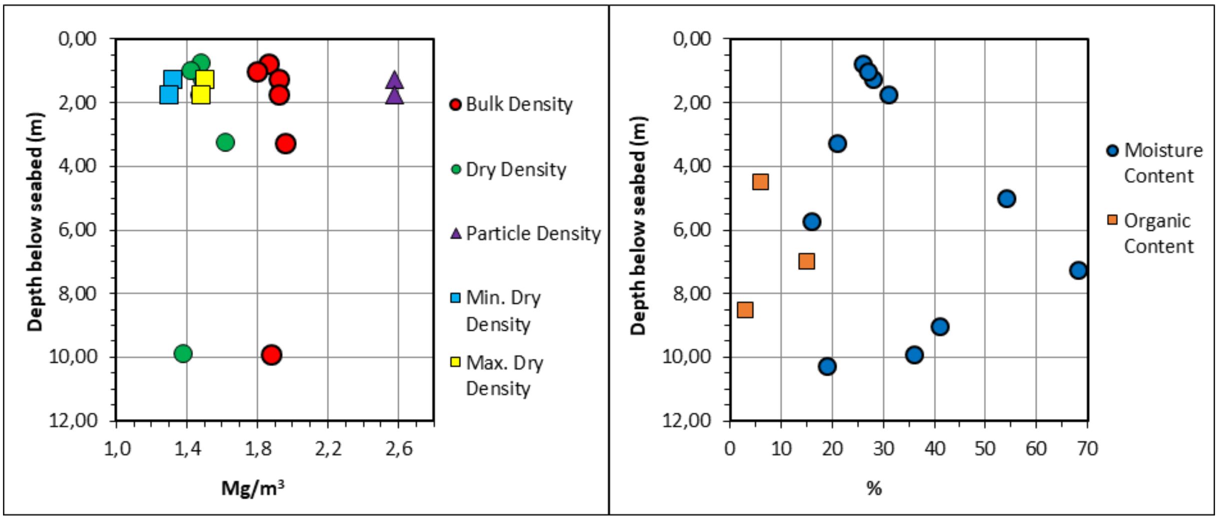

Figure 69. Summary of laboratory test data for the nearshore UK boreholes.

Five Atterberg tests were carried out on material from BH05A-FWW. A single CLAY from 5.50m returned as non-plastic, presumably due to the presence of SAND bands and possibly fine GRAVEL. Three tests returned as CLAY of intermediate to extremely high plasticity. The extremely high plasticity CLAY was at 7.00m and is an organic-rich material (15%) with high moisture content (68%). A single test from 8.50m returned as a borderline intermediate plasticity SILT.

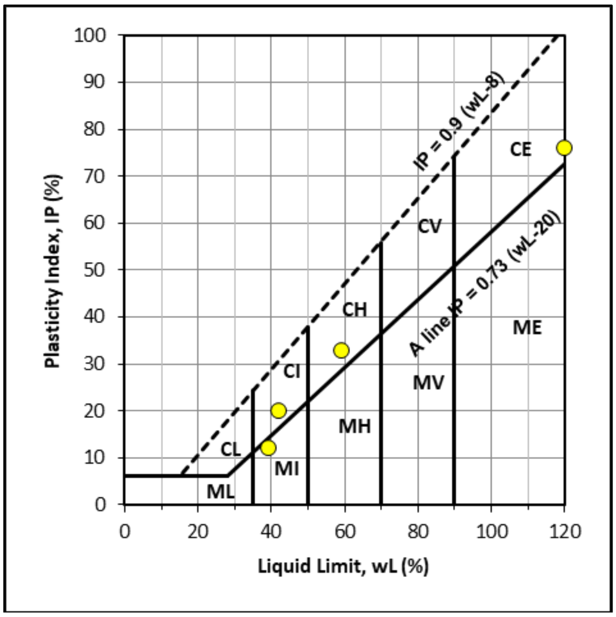

Figure 70. Plasticity Chart for BH05A-FWW.

A single triaxial result from 9.70m in BH05A-FWW indicated an undrained shear strength of 61kPa, corresponding to medium strength soft to firm CLAY. Two shearbox tests carried out in granular material provide peak friction angles of 34° to 35°, with residual values of 31° to 34°.

The encountered bedrock in the boreholes is a relatively uniform sedimentary sequence comprising silty MUDSTONE together with some SILTSTONE. The rock is probably mid Paleozoic age (Silurian to Devonian in age).

The rock is typically extremely weak, through very weak to weak. The rock is often thinly to thickly laminated. Whilst the main mechanical fracture set is often subhorizontal, the rock has frequent open and incipient high angle, subvertical fracture sets. In addition, strong white mineralisation is also present, as thin subvertical veins and pockets.

Total core recovery (TCR) during drilling was often 100%, with only a single core run in BH05A-FWW being less, at 87%. However, due to the strength and fracture state of the rock, solid core recovery (SCR) and the rock quality designation (RQD) were often low and variable (see Figure 71 below). There is a subtle increase in rock competency with increasing depth. During coring and subsequent handling during logging, the rock has often fragmented into thin pieces which has resulted in the scarcity of material available for laboratory testing. Large parts of the recovered core are non-intact.

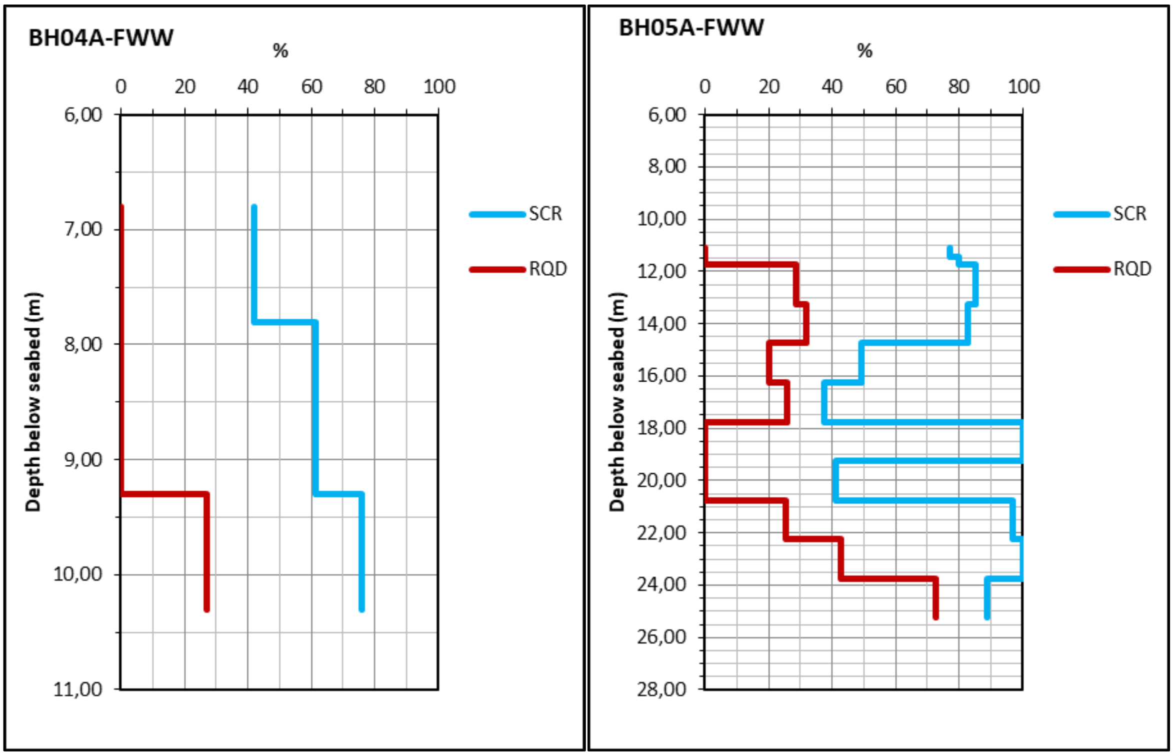

Figure 71. Plot of SCR and RQD values against depth for the nearshore UK boreholes.

Point load test data are shown below. The lack of data reflects the scarcity of large pieces of intact core which could be tested. The data at 8.00 to 10.00m depth was obtained from BH04A-FWW, whilst that at 16.00m was obtained from BH05A-FWW. The data show a large spread, from 1.0 to 13.8MPa, in the range very weak to weak.

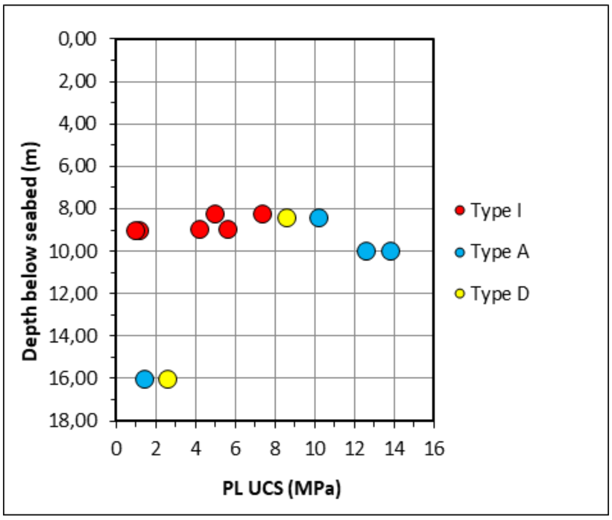

Figure 72. Summary of Point Load test data for the nearshore UK boreholes.

Laboratory data from the rock cores are shown below, with generally low moisture contents and a single porosity value of 10%. Slightly elevated moisture content and lower bulk densities are seen in BH05A-FWW.

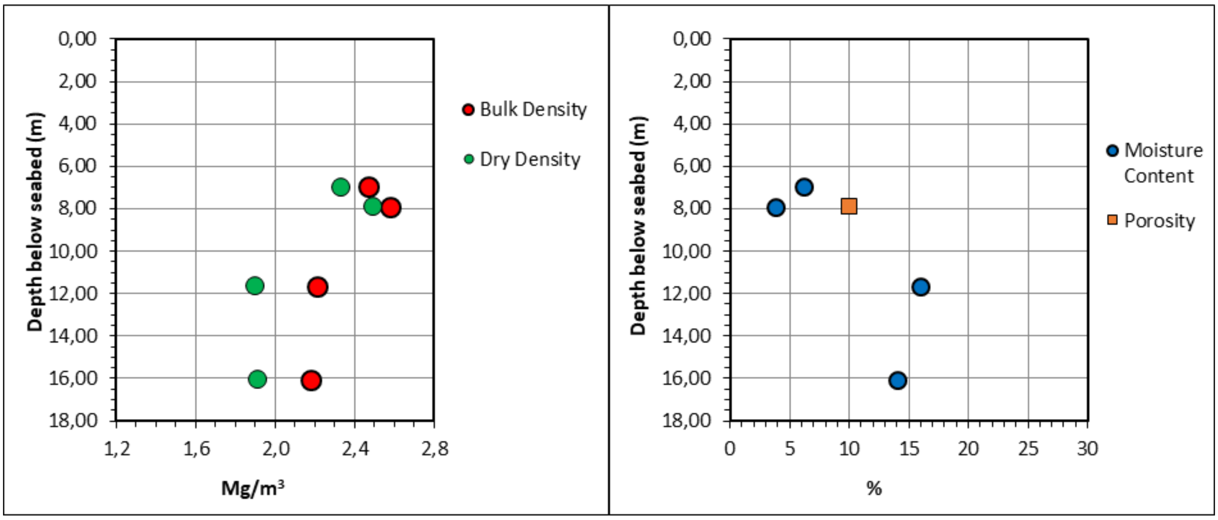

Figure 73. Summary of laboratory testing for the nearshore UK boreholes.

Cerchar abrasivity tests on material from the UK boreholes are extremely low.

4.5 | IRELAND NEARSHORE

4.5.1 | BOREHOLE GROUND CONDITIONS

The two borehole locations at Baginbun Bay, Ireland, are shown below.

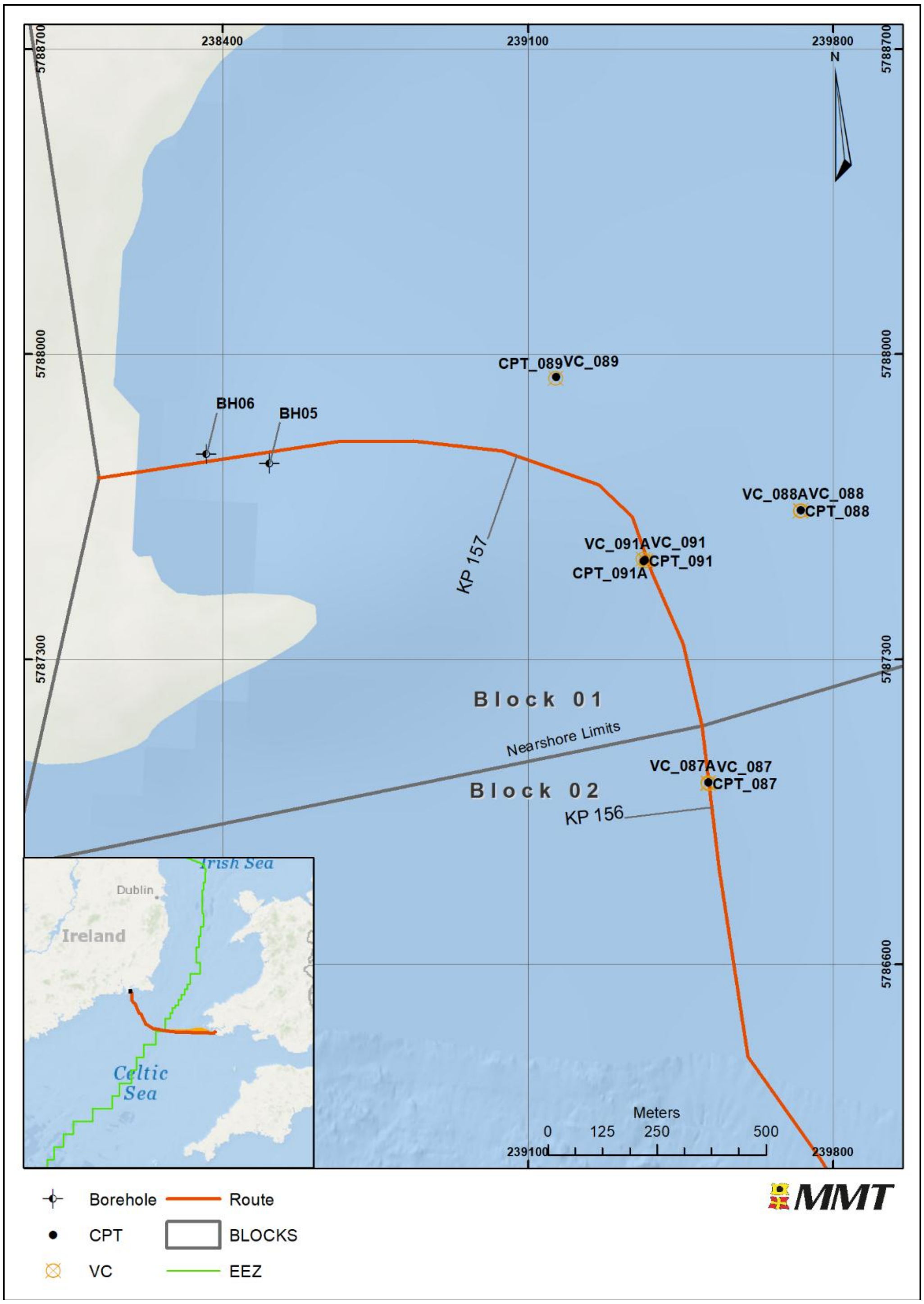

Figure 74. Nearshore borehole locations at Baginbun Bay, Ireland.

The encountered sediment ground conditions in the two boreholes were variable. In BH06-BB there is only a thin, 0.50m veneer of silty gravelly SAND. At 0.50m, very weak to weak MUDSTONE was encountered. In BH05-BB, furthest offshore, the granular sediment is thicker with 1.60m of silty SAND to silty gravelly SAND overlying stiff slightly sandy gravelly CLAY. The CLAY extends to 3.30m where it overlies very dense GRAVEL. Bedrock, of MUDSTONE with thin SILTSTONE bands was encountered at 4.40m depth.

A summary of the PSD data is shown below, which shows the predominance of SAND and GRAVEL in the upper parts of the boreholes.

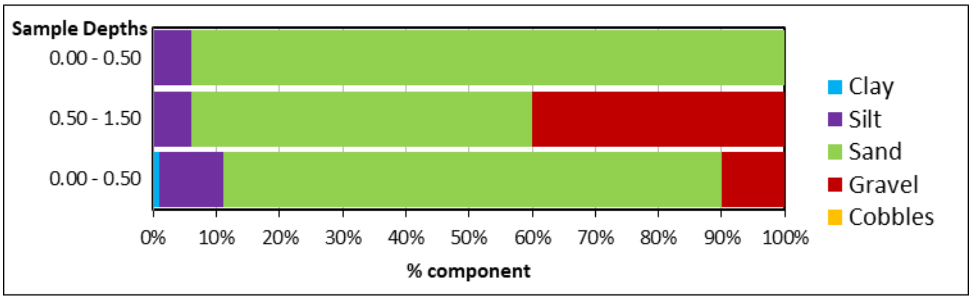

Figure 75. Summary of PSD data for the nearshore IRE boreholes.

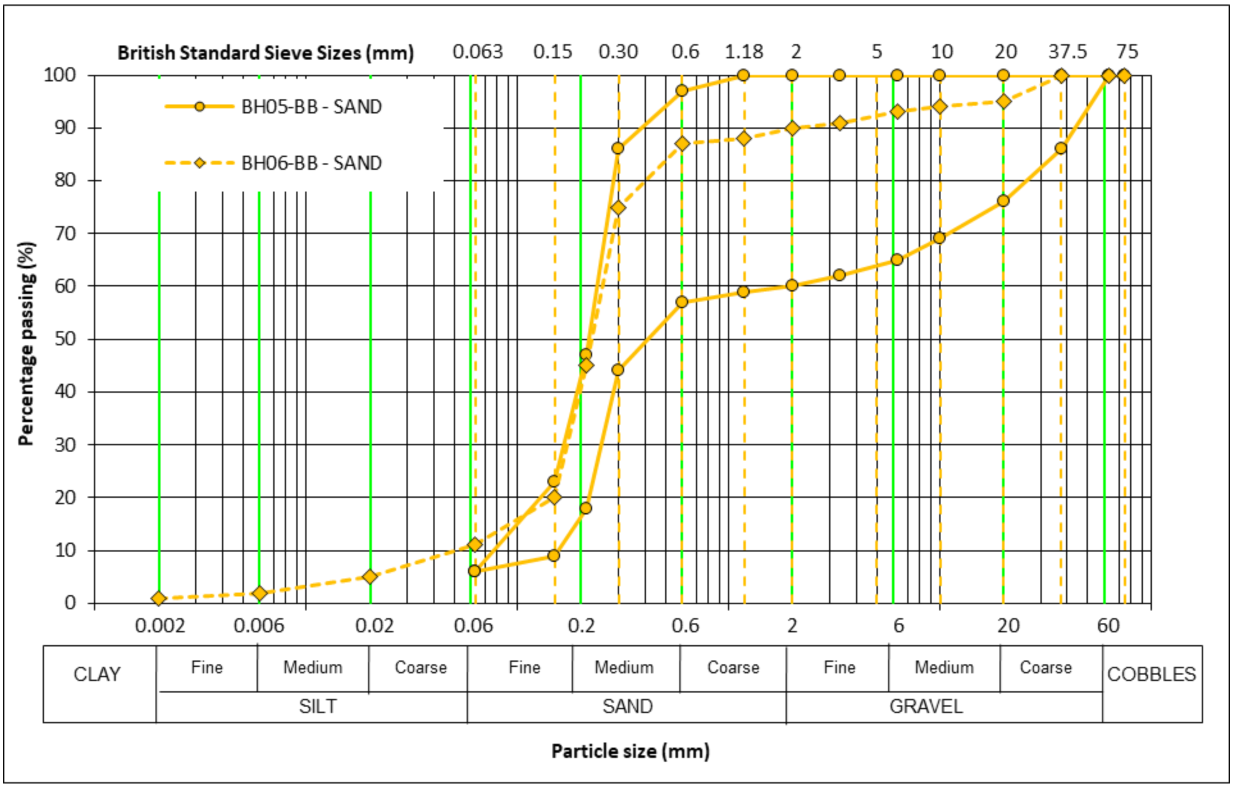

Figure 76. PSD plot for tested material from the nearshore IRE boreholes.

Laboratory data for the sediment only comprises two Atterberg tests in the CLAY from BH05-BB which returned as low to intermediate plasticity CLAY, at moisture contents of 11 and 15%.

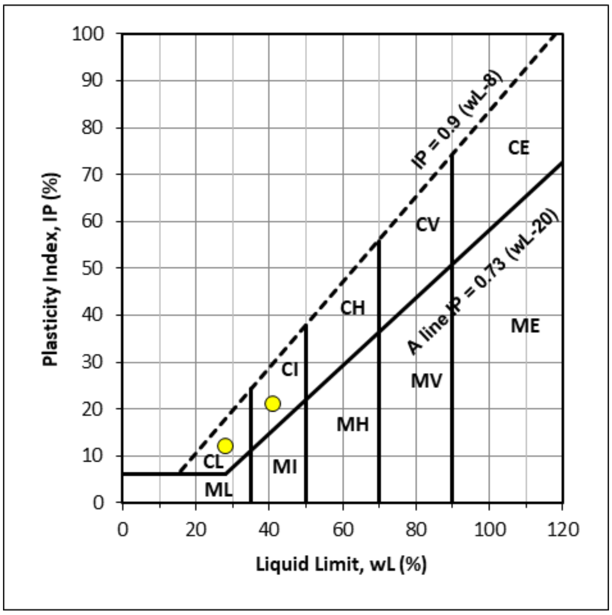

Figure 77. Plasticity Chart for BH05-BB.

The encountered bedrock in the boreholes is a relatively uniform sedimentary sequence comprising silty MUDSTONE together with some SILTSTONE bands. The rock is Cambrian in age and belongs to the Booley Bay Formation of Ireland.

The rock is typically weak to moderately weak, with some medium strong layers with increasing depth. The rock can be thinly laminated. The main fracture sets in the recovered cores are typically open and incipient high angle, subvertical fracture sets. In addition, strong white mineralisation (probably quartz) is frequently present, as thin subvertical veins and pockets.

Total core recovery during drilling was often variable, presumably due to the fracture state of the rock with some probable scrubbing of core due to blocked drilling bits. In BH05-BB the TCR increased with depth, although almost none of the recovered core had an RQD classification. The % of SCR in BH05-BB was also relatively low apart from core below 7.00m depth, with much of the material being recovered as non-intact, <7.00m depth.

In BH06-BB, the TCR was generally better, >80%. Solid core recovery was also generally >60%, increasing to >88% below 17.00m. The RQD in BH06-BB was generally from 20-40% representing the closely spaced nature of the subvertical fracture sets. At 6.50 to 9.50m, the RQD increased reflecting higher strength, moderately weak to medium strong rock with subhorizontal fractures.

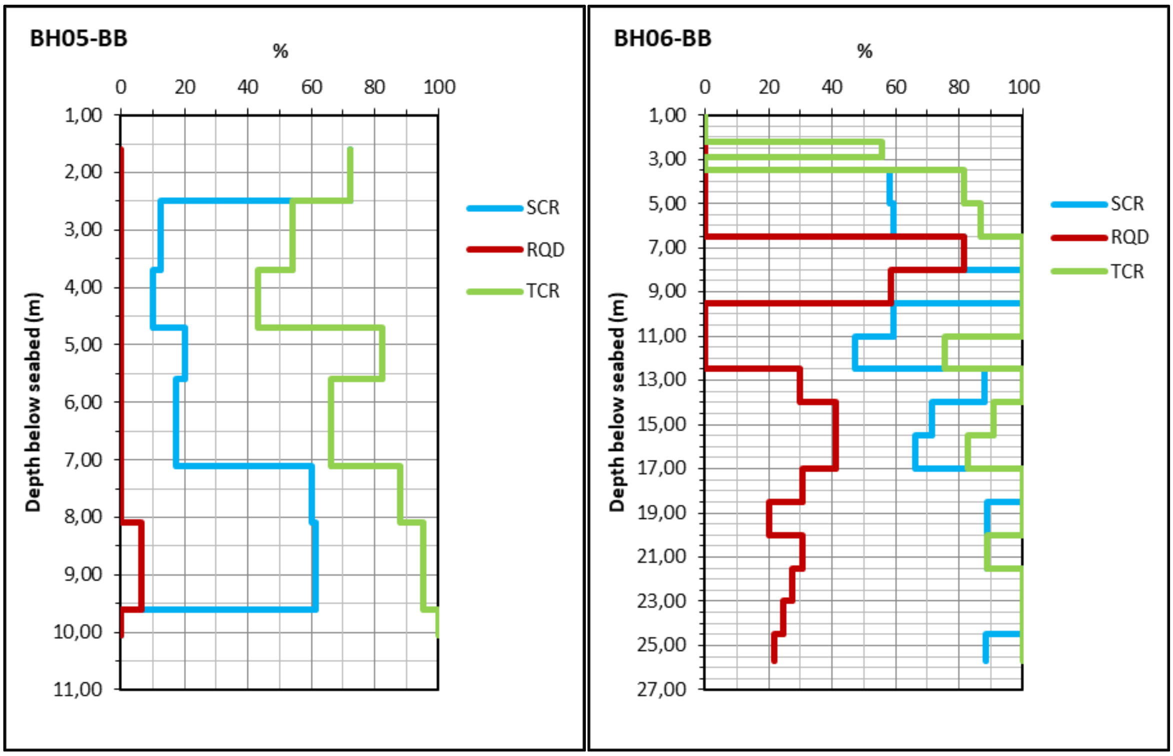

Figure 78. Plot of TCR, SCR & RQD values against depth for the nearshore IRE boreholes.

Point load and UCS test data are shown below. The data show a large spread, up to 35MPa, in the range very weak to medium strong. Note, is made that highest results are provided by axial (A) test types, which would be expected in rock with high angle fractures. The UCS test results are generally low which also possibly reflects the frequent high angle fractures within the rock, which will result in failure in compression.

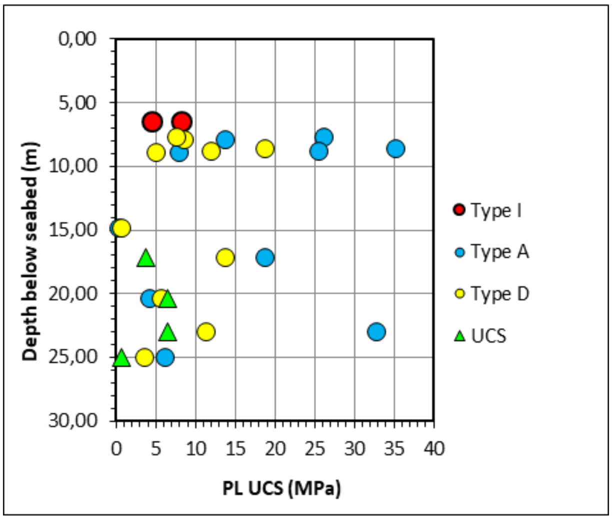

Figure 79. Summary of Point Load & UCS test data for the nearshore IRE boreholes.

Laboratory data from the rock cores are shown below, with a general increase in densities and decrease in moisture content. Measured porosities also decrease with decreasing moisture contents.

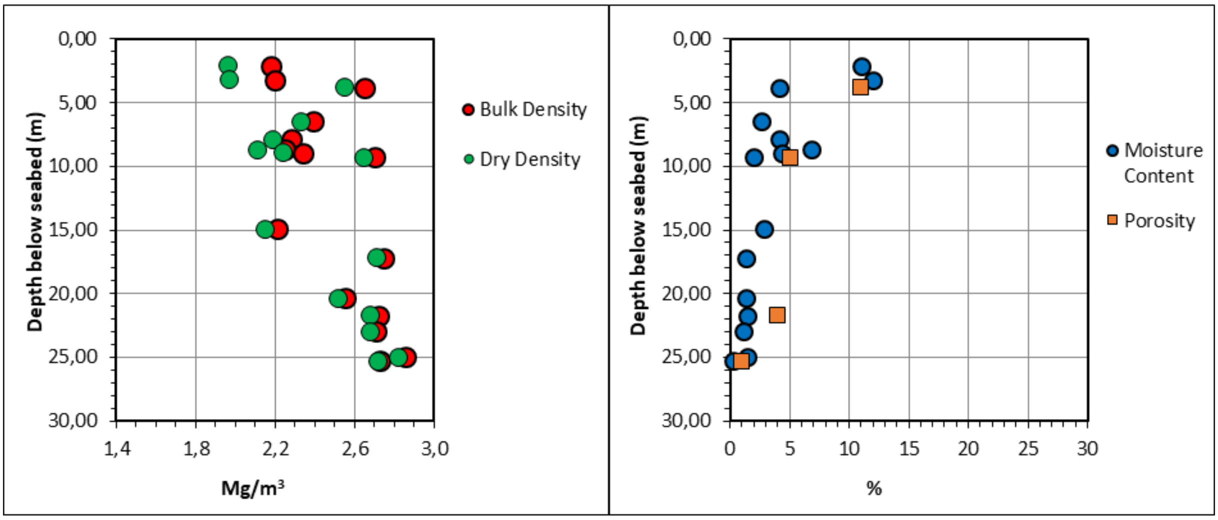

Figure 80. Summary of laboratory testing for the nearshore IRE boreholes.

Cerchar abrasivity tests on material from the Irish boreholes are generally extremely low to low. The exception is BH05-BB, where medium and high abrasivities have been determined, presumably due to the presence of thin medium strong SILTSTONE bands interbedded with the MUDSTONE.

Three thermal tests could be carried out on unfractured pieces of intact core from BH06-BB. The results are summarised below.

Table 21. Thermal data from BH06-BB.

THERMAL RESISTIVITY (K m/W)	**SAMPLE DESCRIPTION**
0.662	Moderately weak blackish grey thinly laminated MUDSTONE
0.405	Medium strong, in parts thinly bedded, dark grey sandy SILTSTONE
0.369	Moderately weak becoming moderately strong dark grey silty MUDSTONE

4.6| CONCLUTIONS

4.6.1| CONCLUSIONS TO THE ROUTE SECTION SUMMARY

From the Route Section Summary and discussion above, it is clear the entire Greenlink route crosses a variety of seabed conditions. The ultimate selection of a burial depth for a cable is often difficult and it may be that the features highlighted in this report, could lead to the selection of variable burial depths along the proposed route, dependant on the particular seabed conditions, i.e. material types and assessed sediment density or strength.

The selection of an installation methodology, and the likely operation risks inherent in using a particular technique, are beyond the scope of this report, and must be considered in tandem with the finalisation of burial depth(s). Again, the different geological and geotechnical characteristics of the sections along the proposed route, must be considered when assessing installation methods and their likely success, or potential failure, when faced with the seabed conditions identified here.

Engineering within the top two to three metres of the seabed during installation of a cable should consider the following observations, which are neither exhaustive or prescriptive:

Figure 81 below summarises the assigned Seabed Indices across the entire route at 1.50m depth, together with a plot of the depth to very dense granular strata, derived from the CPT data.

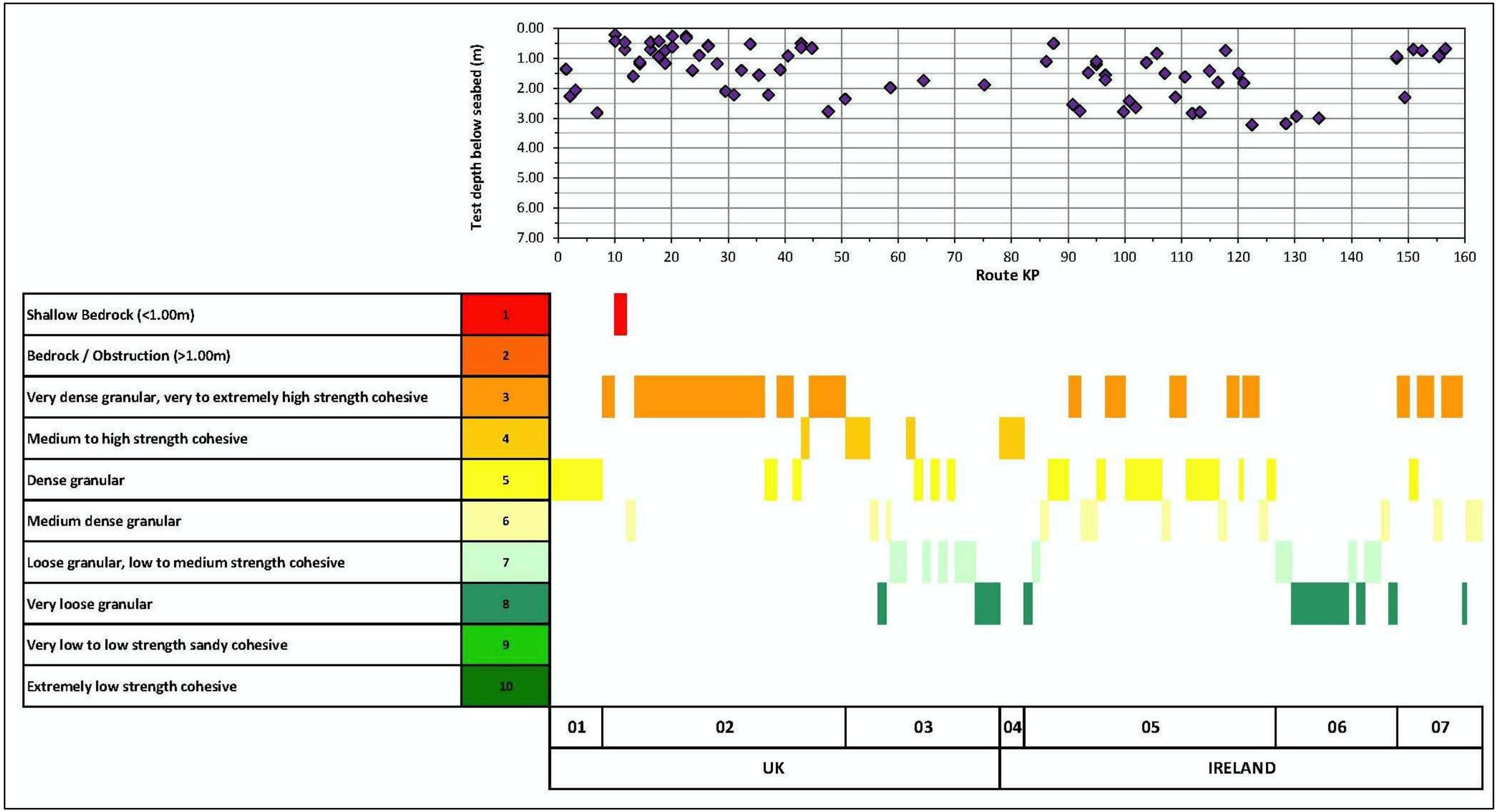

Figure 81. Summary of the Seabed Indices for the entire route (1.50m depth).

UK OFFSHORE SECTION

In the first route section 01, UK, the ground conditions are largely coarse granular, typically slightly gravelly to gravelly slightly silty to silty SAND, through to sandy silty GRAVEL. There are indications for the presence of shallow weathered bedrock. Cohesive material is largely absent in this section, with the exception of SILT seen below 1.33m at KP 1.374. The depth to dense granular strata is typically <1.50m, with very dense granular strata in the range from 1.36 to 2.82m, where encountered.

From KP 10.036 into route section 02, UK, the encountered ground conditions are again largely coarse granular with the material being typically described as slightly gravelly to gravelly slightly silty to silty SAND. In many cores, there is a general increase in silty SAND content with increasing depth. GRAVEL bands are also common, generally in the upper metre of recovered material. Shallow weathered bedrock is indicated at KP 10.036, with intact carbonaceous MUDSTONE being seen at KP 11.758. Further shallow bedrock is suggested at KP 16.623. High to very high strength silty CLAY is also seen at KP 23.675 to KP 29.532, KP 35.403 to KP 37.106 and at KP 44.735. The depth to dense and very dense strata is shallow across much of this route section, <1.50m. VC recovery and CPT penetration was only >2.00m in the section from KP 25 through to KP 41.

In the final route section 03 of the UK sector, the encountered ground conditions are dominated by cohesive material. At most locations low to medium, locally high strength, slightly sandy slightly gravelly silty CLAY can be seen. The CLAY is often at shallow depths (e.g. KP 57.520) with a varying thickness of granular material forming a seabed veneer. CLAY was not seen at KP 60.283. Granular material overlying the CLAY is typically <0.70m thick, although thicker seabed deposits are seen in the range KP 44.735 to KP 52.260. The granular material is variable ranging from silty SAND through to gravelly SAND. KP 47.645 is noteworthy as the seabed material is black very silty GRAVEL with a strong organic odour and frequent plant debris. Very dense granular material was only encountered at KP 47.643 to KP 50.627, KP 58.608 and KP 64.472.

IRELAND OFFSHORE SECTION

The first route section 04, Ireland, is a continuation of the previous route section 03 in the UK sector. The ground conditions comprise a thin seabed veneer of gravelly SAND to gravelly silty SAND overlying low to medium, locally high strength, silty CLAY

The second longer route section 05 from KP 78.809 sees a return to largely coarse granular material. The ground conditions comprise typically slightly gravelly silty SAND which becomes gravelly to very gravelly with depth. At many locations the granular material becomes slightly silty very sandy GRAVEL. There are a few occasional very silty SAND bands with low gravel content. Cohesive material, silty CLAY, locally slightly sandy, can be seen at some locations and is low to medium strength. Across the majority of the route section dense granular material was typically encountered at 0.42 to 1.50m depth. The depth to very dense granular material is more variable, from 0.52 to 2.84m.

From KP123.920, into route section 06, the ground conditions are remarkably consistent, comprising slightly gravelly slightly silty to silty SAND. Cohesive material is absent. This section of the route clearly contrasts with the preceding section due to the lack of dense to very dense granular material from 0.00 to 2.70m depth.

The final route section 07, approaching the Ireland landfall are slightly variable. In general coarse granular material is typical, varying from gravelly silty SAND to sandy silty GRAVEL. Cohesive material is also present at some locations with both SILT and CLAY at KP 150.922, KP 156.954 and KP 158.226.

POTENTIAL ISSUES ALONG THE ROUTE

Particular 'exotic' features along a cable route may affect cable installation and subsequent cable use, i.e. highly organic material, high gravel and/or cobble contents. Along the route, sporadic COBBLES are encountered in the recovered material, as well as coarse GRAVEL deposits. The geophysical data and interpretation should be consulted as to whether there are significant deposits of coarse GRAVEL and/or COBBLES on the seabed along intervening sections of the proposed route. The presence of GRAVEL and shallow dense to very dense material particularly across route section 02, UK and route section 05, Ireland should be considered for cable installation techniques, especially with regard to the reduced CPT penetration and often reduced VC recovery.

The presence of organic-rich CLAY and PEAT along a cable route must also be taken into consideration, due to the undesirable thermal regime which such cohesive material can generate, together with their tendency for compressibility under load and typically low material strength. PEAT has not been identified at any locations along the survey route, although its potential presence, especially close to the landfalls, should not be discounted. The only organic material observed was within seabed GRAVEL at KP 47.645. Shallow thick extremely low to very low strength CLAY strata are also relatively absent across the route survey, which suggests potential consolidation issues of the ground under loading via cable installation could be considered minimal.

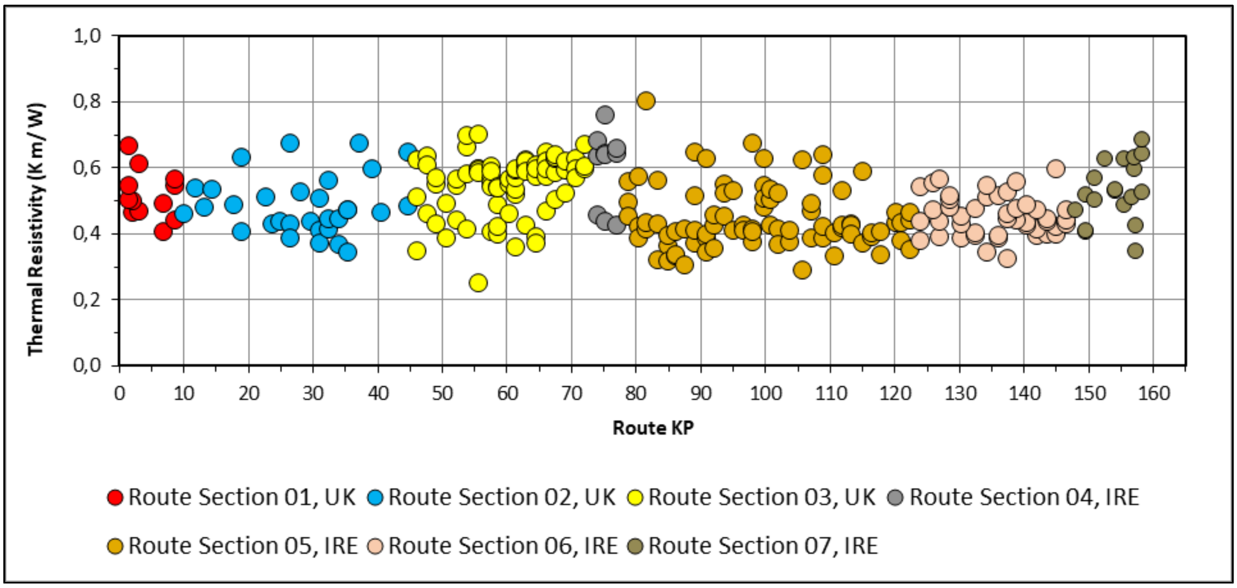

Figure 82. Summary of thermal data for the entire route.

A summary of the acquired thermal resistivity data, shown above, is entirely consistent with the observed material types. An increase in resistivity, >0.600 at increased moisture contents correlates with increased cohesive sediment types, especially in route section 03, UK and the short route section 04, Ireland. There is no evidence of PEAT or other material with potentially hazardous high thermal resistivities, >1.000, along the surveyed route.

Other than those where lower class data was achieved, the CPT data obtained from the survey is generally of high quality, largely application classes 1 and 2, with good cone response in all the penetrated sediment types. In general, the correlation between the interpreted strata and material parameters, to that ascertained from the vibrocores is good. Penetration along the route was however variable and illustrates the potential difficulties that could be encountered due to the shallow depth to dense and very dense granular strata, particularly across route section 02, UK and route section 05, Ireland.

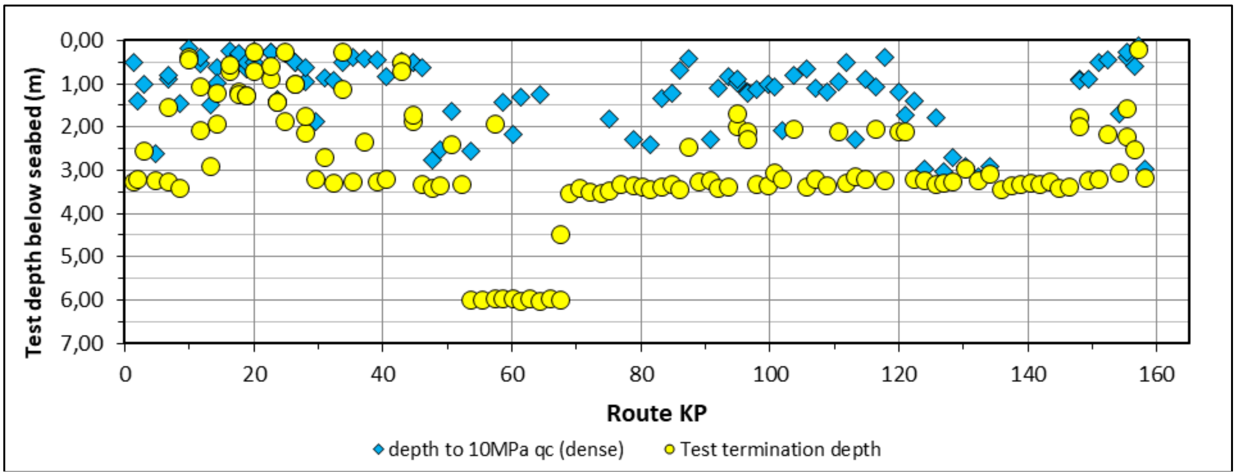

Figure 83. Summary of CPT termination depths across the entire route.

NEARSHORE SECTIONS: UK AND IRELAND

The nearshore sections at both the UK and Ireland where rock coring was specified, was carried out due to the potential for some form of interaction with bedrock during cable installation, or if horizontal directional drilling (HDD) is being considered as a potential option. Geotechnical considerations for any interaction with rock can be broadly considered as:

- Characterisation of the geology along the proposed route. This includes material types, lateral and vertical variation of strata.
- Control and steering of the vertical and horizontal alignment of a HDD bore
- Rock cutting and spoil handling
- HDD bore stability and flush (mud) control
- Design of starter pits (where applicable)

A summary of geotechnical risks associated with encountering bedrock is provided in below. An assessment of the cuttability of the rock material is largely dependent on the rock strength, abrasivity and the potential for change during the length of the proposed engineering. The encountered rock material is entirely sedimentary, being MUDSTONE with thin SILTSTONE bands. Rock strengths are within expected ranges for these lithological types, being extremely weak to weak on the UK side. On the Ireland side, the rock is generally stronger, up to medium strong at depth. Abrasivities in those samples tested are classified as extremely low to low, as would be expected from the MUDSTONE. In BH05-BB, two abrasivity results are medium and high, presumably due to the presence of medium strong thin SILTSTONE bands.

The potential for rock strata variation cannot be adequately quantified, based on the spatial and depth restriction of the investigated locations. There is some horizontal variation in the rock cores, as would be expected in a bedded rhythmic sedimentary sequence of MUDSTONE and SILTSTONE. Coarser grained SANDSTONE has not been identified in the recovered cores.

There is no evidence in any of the recovered material for extremely high strength igneous or even metamorphic rock sequences. The potential presence of thin igneous intrusions within the sedimentary sequences should not be wholly discounted, and a review of the regional geological context of the nearshore landfall areas should be carried out.

Table 22. Summary of geotechnical risks in rock.

GEOTECHNICAL RISKS		
RISK CATEGORY	**CAUSE / FACTOR**	**COMMENT / OBSERVATION**
Cuttability of ground	Variable rock types & strengths. Abrasivity. Variable sediment conditions.	Encountered rock strengths vary from very weak through to medium strong. Possible competence contrasts between rock types in terms of strength and structure, in the case of bedded sedimentary sequence. Presence of frequent thin quartz mineralisation. Determined abrasivities generally extremely low to low. Two results in BH05-BB medium & high. Overlying sediment cover of variable thickness.
Control of horizontal and vertical alignment (HDD steering)	Dipping strata High angle fractures, veins, potential folding Interbedded strata of differing rock strengths Deeper sediment pockets	Uncertainty in strata dip over large areal extent, although recovered material indicates relatively high regional dip, <50°. High angle fractures within recovered material & associated mineralisation. No deformation/folding observed. Potential for encountering stronger, less fractured rock at depth. Variability in depth to rockhead along possible HDD routes.
Stability of HDD bore and mud control	Fracture state of rock Variable strata conditions Initial HDD bore on land	Generally highly fractured. Potential blowout to seabed through any persistent subvertical fractures and shallow sediment cover, dependent on depth and orientation of HDD bore. If nearshore HDD considered likely, then ground conditions on land need thorough characterisation
Starter pit stability (land)	Temporary works design Excavation methods Groundwater	Unable to comment due to lack of information. Risk dependant on HDD starter pit location. No groundwater information on land available, although if present in depth range of HDD, it is likely to be tidally influenced.

An assessment of the mass structural and fracture state of the bedrock is difficult from the limited recovery of high quality intact rock core. In most cases, where observed, the rock is highly fractured, which are largely subvertical, <50°, with both open and incipient fractures seen, often hosting quartz mineralisation.

If HDD is considered then further work may be required to assess the vertical and horizontal lithological variation along any proposed HDD route. It is recommended that discussions are held at an early stage with specialist HDD contractors to assess the feasibility and performance of their various proprietary systems relative the ground conditions at any potential site for HDD. An understanding of the potential risks involved with respect to the particular equipment and HDD methodology should be addressed as well, as their knowledge and experience.

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APPENDIX 01 | UK OFFSHORE SECTION

DESCRIPTION	**PAGES INCLUDED**
UK SECTION - VIBROCORES	
Table UK - VC - Summary of Vibrocores	3
Figure VC Key - Key to Vibrocore Records	1
UK Vibrocore Logs	47
UK SECTION - LABORATORY TESTING	
Table UK - PSD - Summary of Particle Size Distribution Tests	2
Particle Size Distribution Results	54
Table UK - MC/DEN - Summary of Moisture Content and Density related Tests	5
Table UK - AT - Summary of Atterberg Limits	1
Table UK - SHEAR - Summary of Shear Strength Test Results	4
Triaxial Test Result Plots	15
Table UK - SBX - Summary of Shearbox Tests	1
Shearbox Test Results	8
Table UK - TR - Summary of Thermal Data	4
UK SECTION - CONE PENETRATION TESTS	
Table UK - CPT - Summary of Cone Penetration Tests	5
Figure CPT Key - Key to Cone Penetration Tests	2
UK Cone Penetration Test Plots	130

APPENDIX 02 | IRELAND OFFSHORE SECTION

DESCRIPTION	PAGES INCLUDED
IRELAND SECTION - VIBROCORES	
Table IRE - VC - Summary of Vibrocores	4
Figure VC Key - Key to Vibrocore Records	1
IRE Vibrocore Logs	58
IRELAND SECTION - LABORATORY TESTING	
Table IRE - PSD - Summary of Particle Size Distribution Tests	2
Particle Size Distribution Results	74
Table IRE - MC/DEN - Summary of Moisture Content and Density related Tests	5
Table IRE - AT - Summary of Atterberg Limits	1
Table IRE - SHEAR - Summary of Shear Strength Test Results	1
Triaxial Test Result Plots	4
Table IRE - SBX - Summary of Shearbox Tests	1
Shearbox Test Results	10
Table IRE - TR - Summary of Thermal Data	5
IRELAND SECTION - CONE PENETRATION TESTS	
Table IRE - CPT - Summary of Cone Penetration Tests	4
Figure CPT Key - Key to Cone Penetration Tests	2
IRE Cone Penetration Test Plots	126

APPENDIX 03 | UK NEARSHORE

APPENDIX 04 | IRELAND NEARSHORE

DESCRIPTION	PAGES INCLUDED
IRELAND NEARSHORE - BOREHOLES	
Table IRE - BH - Summary of Boreholes	1
Figure BH Key - Key to Borehole Records	1
BH Logs & Core Photographs	16
IRELAND NEARSHORE – SEDIMENT LABORATORY TESTING	
Table IRE BH - PSD - Summary of Particle Size Distribution Tests	1
Particle Size Distribution Results	3
Table IRE BH - MC/DEN - Summary of Moisture Content and Density related Tests	1
Table IRE BH - AT - Summary of Atterberg Limits	1
IRELAND NEARSHORE – ROCK LABORATORY TESTING	
Table IRE BH – PL/UCS - Summary of Point Load & UCS Test Results	1
Table IRE BH – MC/DEN – Summary of Rock Moisture Content, Density & Porosity Tests	1
Table IRE – BH – TR – Summary of Rock Thermal Data	1
Table IRE BH – CE – Summary of Cerchar Abrasivity Results	1
Cerchar Test Results	9

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Legend

- Borehole
- Foundation Inspection Pit
- Trial Pit
- Site Boundary

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Kilometers
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Ground Investigation

Great Island Convertor Station

Sheet 1 of 3

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Job No
246369-00

Drawing Status
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Drawing No
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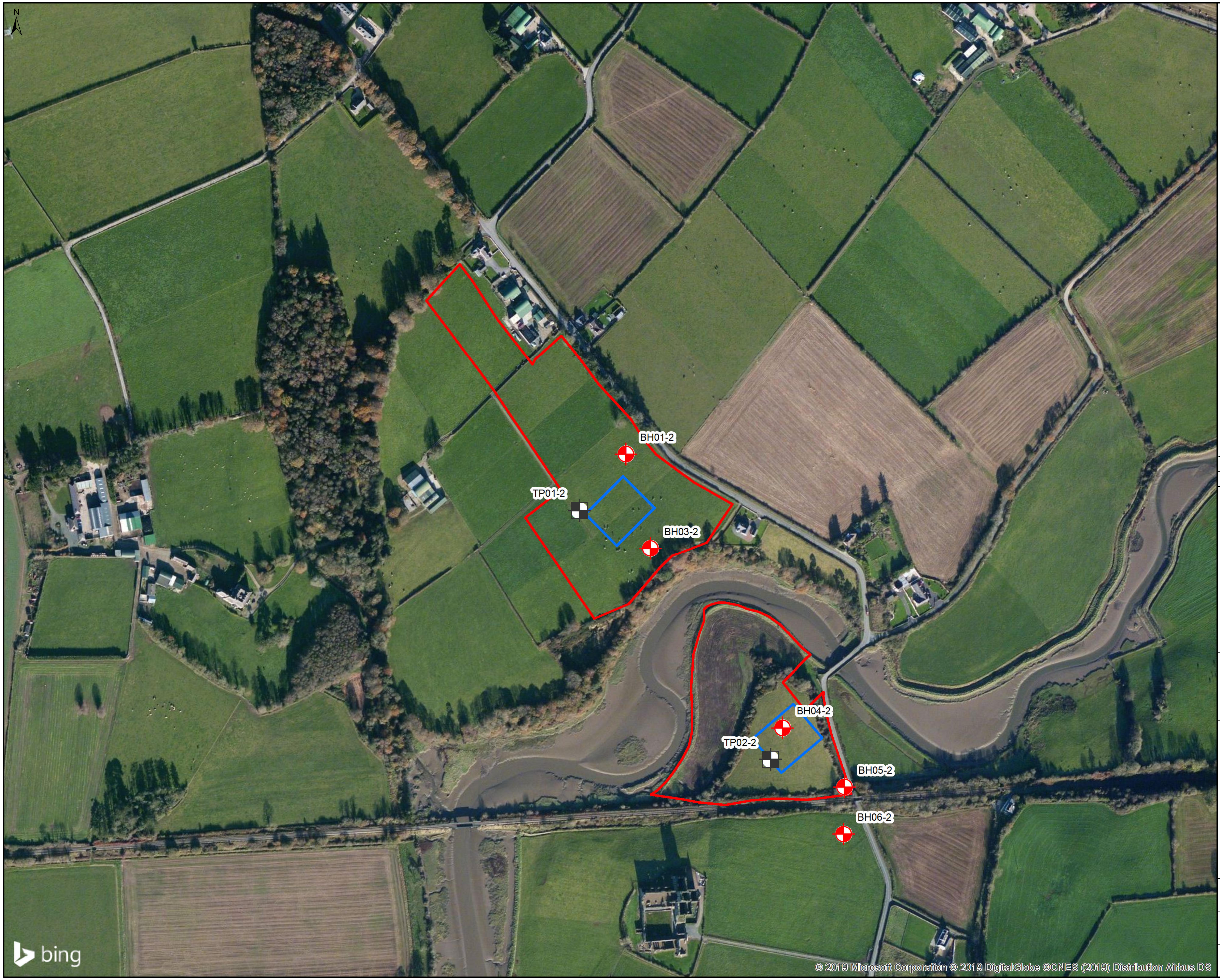

Legend

⊕ Borehole

▩ Trial Pit

🟦 Proposed HDD Compounds

🟥 Site Boundary

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Campile Estuary HDD Crossing

Sheet 2 of 3

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Legend

⊕	Borehole
▚	Trial Pit
▭	Proposed HDD Compound
●	Proposed HDD Exit Point
-·-	Proposed Line of HDD
▭	Site Boundary

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Baginbun Beach

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Scale at A3
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Legend

◎	Proposed Converter Station Site
★	Landfall at Baginbun Beach
▨	Special Area of Conservation (SAC)
⊞	Slit Trench
—	Preferred Cable Route

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Intrusive Site Investigation Locations
Onshore Cable Route

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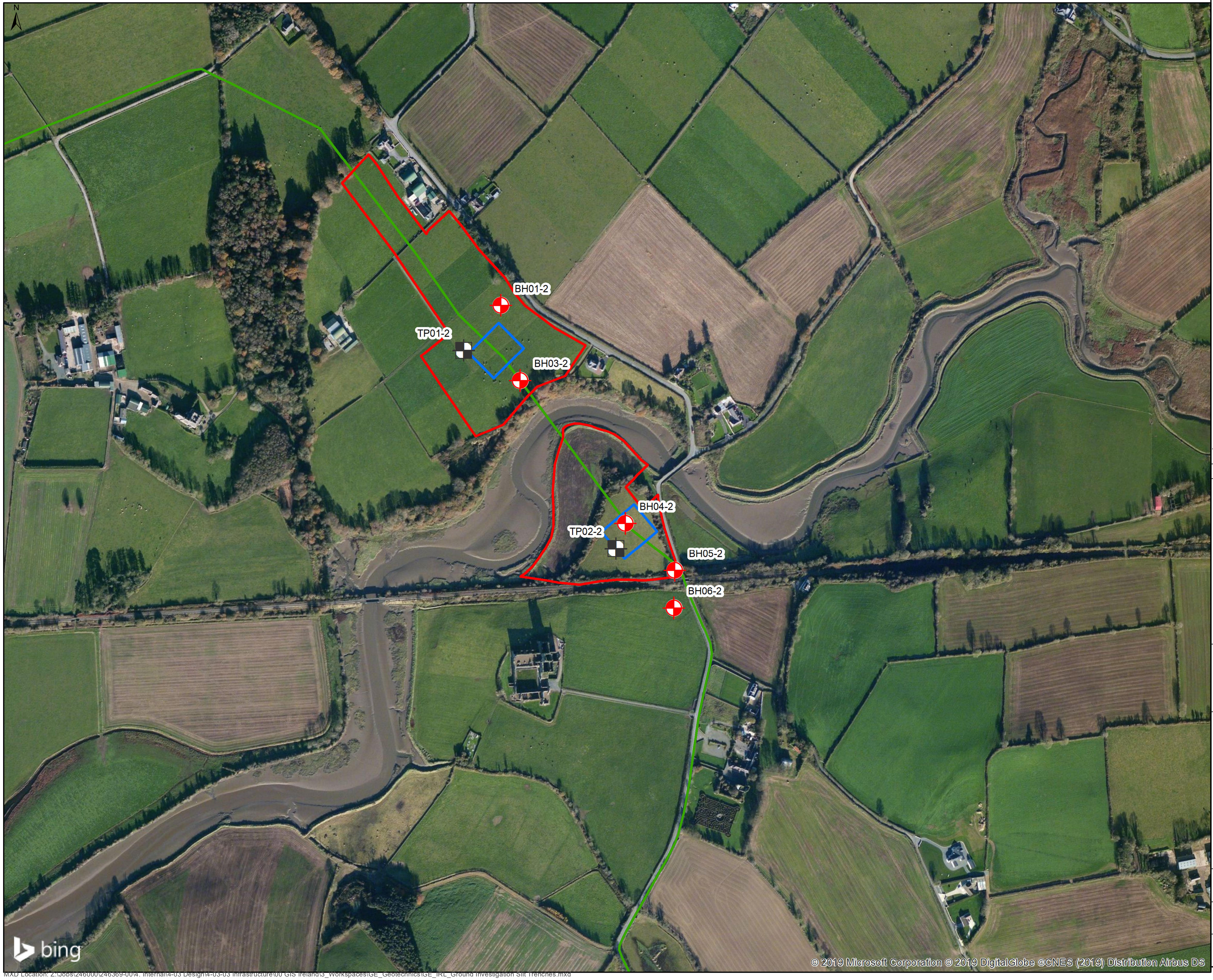

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Legend

⊕ Borehole

▚ Trial Pits

🟦 Proposed HDD Compounds

🟥 Site Boundary

— Preferred Cable Route

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▞ Slit Trench

— Preferred Cable Route

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- ▚ Slit Trench
- ━ Preferred Cable Route

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▣ Slit Trench

🟩 Preferred Cable Route

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▞ Slit Trench

🟩 Preferred Cable Route

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Kilometers
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Legend

▭	Proposed HDD Compound
●	Proposed HDD Exit Point
-·-	Proposed Line of HDD
◩	Slit Trench
—	Preferred Cable Route

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Kilometers
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