Immingham Combined Heat and Power (CHP) Power Plant

Environmental Permit Variation Application
Appendix C - Site Condition Report

VPI Immingham LLP

Project number: 60668866

March 2023

Delivering a better world

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	8/03/2023	Final	Kirsty Cobb	Kirsty Cobb	Project Manager

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1. Site Details

Name of the applicant	VPI Immingham LLP
Name of the installation	Immingham Combined Heat and Power (CHP) Plant
Activity address	Immingham CHP Power Plant, Rosper Road, Immingham, North Lincolnshire, DN40 3DZ
Environmental Permit Reference	EPR/BJ8022IZ

The location of the Installation is shown in Figure 1 (Annex A).

This Site Condition Report (SCR) is only concerned with the area of currently undeveloped land to the south of the existing Installation Site Boundary on which the PCC plants are proposed to be installed (the 'PCC plant area'). The existing Installation Site Boundary is shown in Figure 2 and the Extended Installation Site Boundary is shown in Figure 3 (Annex A).

2. Condition of the PCC Plant Area at Permit Issue

Environmental setting including:

- Geology
- Hydrogeology
- Surface waters

2.1 Existing Site Condition

OS mapping provided in the Envirocheck Report (285387654_1_1) (Annex B) indicates the PCC plant area is mostly covered in rough grassland, apart from an area immediately south of the existing VPI Immingham CHP Plant. Google Maps[1] satellite imagery indicates these areas may consist of hardstanding. Several pipelines are shown orientated north-west to south-east immediately adjacent to the southern Existing Installation Site boundary. A drain is identified through the centre of the PCC plant area, orientated roughly east to west and some hardstanding is located immediately south, parallel to the drain which is associated with a track. A small patch of hardstanding is located to the south of the drain and track. The PCC plant area appears to be relatively flat with elevations of approximately 4m above ordinance datum (AOD).

2.2 Geology

The following information sources were reviewed to assess the geological setting of the Site:

- Published British Geological Survey BGS Solid and Drift for Partington (Sheet 81 (and including parts of Sheet 82 and 90)) 1:50,000 Map;
- BGS's online Geo-Index Onshore Map Application (http://mapapps2.bgs.ac.uk/geoindex/home.html);
- BGS Lexicon of Named Rock Units (https://webapps.bgs.ac.uk/lexicon/);
- Geology of the Country around Grimsby and Partington: memoir for 1:50,000 Geological Sheets 90 and 91 and 81 and 82 (England & Wales);.Across most of the additional land proposed to be added to the Installation Site Boundary, superficial deposits comprise Tidal Flat deposits consisting of Clay and Silt.

[1] Google Maps (https://www.google.co.uk/maps)

Superficial deposits of Till, Devensian – Diamicton underlay the whole PCC plant area.

The bedrock across the entire PCC plant area consists of Burnham Chalk Formation.

2.3 Hydrogeology

The superficial Tidal Flat deposits (Clay and Silt) are classified as an Unproductive Aquifer. The Environment Agency (EA) defines an Unproductive Aquifer as *"largely unable to provide usable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them*".

The superficial Devensian Till (Diamicton) deposits are classified as a Secondary Undifferentiated Aquifer. The EA defines a Secondary Undifferentiated Aquifer as *"where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value"*.

The Burnham Chalk Formation underlying the Devensian Till (Diamicton) deposits is classified as a Principal Aquifer. The EA defines a Principal Aquifer as an aquifer that can "*provide significant quantities of drinking water, and water for business needs. They may also support rivers, lakes and wetlands*".

2.3.1 Groundwater Vulnerability

The Envirocheck Report indicates the Principal Bedrock Aquifer within the Burnham Chalk Formation has a combined vulnerability of 'Low' in the areas where it is underlain by the Tidal Flat deposits (Clay and Silt). This is due to the combination of a productive bedrock aquifer and an unproductive superficial aquifer associated with the Tidal Flat deposits (Clay and Silt). The EA describe Low vulnerability as *"areas that provide the greatest protection to groundwater from pollution. They are likely to be characterised by low leaching soils and/or the presence of low permeability superficial deposits"*. The 1:100,000 Groundwater Vulnerability Map on Magic Maps[2] also suggests this area has a 'Low' vulnerability.

The Secondary Undifferentiated Aquifer within the Devensian Till (Diamicton) deposits has a vulnerability of 'Medium' in the northern third of the PCC plant area as well as in a small part of the south-western boundary of the PCC plant area. The remainder of the aquifer is classified as 'Low' groundwater vulnerability. This is due to the combination of a productive bedrock rock aquifer and a productive superficial aquifer. The EA describes 'Medium' vulnerability as *"areas that offer some groundwater protection. Intermediate between high and low vulnerability"*.

A thin strip within the aquifer in the south-eastern boundary of the PCC plant area has a vulnerability of 'Medium-High' due to the combination of the productive bedrock aquifer and a productive superficial aquifer. The EA describe 'High' vulnerability as *"areas able to easily transmit pollution to groundwater. They are characterised by high leaching soils and the absence of low permeability superficial deposits"*. The 1:100,000 Groundwater Vulnerability Map on Magic Maps suggests this area has a 'Medium – High' vulnerability.

The BGS Flood Data (from the Envirocheck Report) for groundwater flooding indicates that there is potential for groundwater flooding to occur in areas of the PCC plant area that are not overlain by the superficial Tidal Flat Deposits (Clay and Silt).

The Envirocheck Report indicates there are no groundwater abstractions located within the PCC plant area. There are 19 groundwater abstractions within 1km of the PCC plant area which are listed below:

- Phillips 66 Limited hold 2 permits located 757m east from the PCC plant area and 2 permits 765m east of the PCC plant area for *"industrial/ commercial/ public services: general use"* purposes. No end dates for the permits were supplied;

[2] Available at www.magic.gov.uk

- A further 7 permits are held by Phillips 66 Limited for "*petrochemicals: process water"* located 829m west and 909m west from the PCC plant area. No end dates for the permits were supplied;
- Calor Gas Limited hold 2 permits for "*industrial/ commercial/ public services: general use"* purposes 757m and 765m east of the PCC plant area. No end dates for the permits were supplied;
- Conocophillips Limited hold 2 permits for *"petrochemicals: process water"* located 829m and 909m west from the PCC plant area. No end dates for the permits were supplied; and
- Conoco Limited hold 5 permits for *"petrochemicals: process water*" located 829m west and 909m west from the PCC plant area. No end dates for the permits are provided.

There are a further 13 groundwater abstractions between 1km and 2km of the PCC plant area.

The Envirocheck Report indicates the entire PCC plant area is within an area classified as a Source Protection Zone (SPZ) SPZ3 (total catchment). The EA defines an SPZ3 as *"the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point"*. This may be associated with extensive industrial, commercial and public services groundwater abstraction and private water undertaking (raw water supply) groundwater abstraction located within 2km southeast of the PCC plant area.

2.4 Hydrology

The EA's Catchment Data Explorer indicates the PCC plant area is located within the North Beck Drain Water Body catchment. It is assumed that the North Beck Drain is pumped.

The current (2019) classification of North Beck Drain has a 'Moderate' ecological status and a chemical status of 'Fail' due to priority hazardous substances Mercury and its Compounds and Polybrominated Diphenyl Ethers (PBDE). This is also designated as a heavily modified water body.

The Envirocheck Report indicates there are eighteen OS Water Network Lines within the PCC plant area boundary which all are designated as inland rivers. Of the eighteen inland rivers, fourteen are located on the ground surface and four are located underground.

The Humber Estuary is located approximately 1.7km east of the PCC plant area.

The Envirocheck Report suggests the entire PCC plant area has the potential to be affected by river and coastal flooding that do not have defences. Areas in the east of the PCC plant area have been identified as potential areas affected by extreme river or coastal flooding without defences.

The risk of surface water flooding identified within the Envirocheck Report suggests there is a 'High Risk' (30-year return period) associated with the drain that is currently located within the centre of the PCC plant area, orientated northeast to southwest, and a small area in the southeast near the PCC plant area boundary. The drain running through the centre of the Site will be realigned to facilitate the construction of the PCC plant. Areas within the centre and south of the eastern half of the PCC plant area are at 'Low Risk' (1,000-year return period) of surface water flooding, although there are small areas in the southeast that are of 'Medium Risk' (100-year return period).

There are no surface water abstractions on the PCC plant area. There are two surface water abstractions operated by Immingham Town Council 1.5km southeast from the PCC plant area and one surface water abstraction operated by Drax Biomass (Immingham) Limited approximately 1.9km northeast of the PCC plant area.

Pollution history including: • Pollution incidents that may have affected land • Historical land-uses and associated contaminants • Any visual/ olfactory evidence of existing contamination • Evidence of damage to pollution prevention measures	A summary of historical land use on and in the vicinity of the PCC plant area is shown below.

Period	Land-use details
1887	The PCC plant area consists of agricultural fields and two linear features assumed to be footpaths orientated east to west and northeast to southwest. A 'Foot Bridge' is identified adjacent to the PCC plant area boundary in the east.
1892	No significant changes.
1907	No significant changes.
1908-1910	The 'Foot Bridge' is no longer denoted.
1910	No significant changes.
1932	A building is shown along the centre of the eastern boundary of the PCC plant area. The 'L.N.E.R. Ulceby & Immingham Line' railway line is denoted in the area of Network Rail land to the south of the PCC plant area. The railway line is orientated northwest to southeast.
1938-1951	A building is shown near the eastern boundary of the PCC plant area.
1956	No significant changes.
1964-1965	The linear feature depicted through the centre of the PCC plant area orientated east to west is now denoted as a '*Drain*'.
1966	No significant changes.
1968	The building is no longer denoted near the centre of the eastern boundary of the PCC plant area. A *'Path'* is denoted parallel to the northern boundary of the PCC plant area in the northwest. A *'Drain'* is identified parallel to the eastern boundary of the PCC Plant area.
1971	No coverage.
1971-1973	Partial coverage, but no significant changes.
1973-1985	A *'Pipeline'* is shown to intersect the western corner of the PCC plant area, orientated north to south, and extends into the existing Installation Site Boundary. A second pipeline is shown to extend along the western boundary of the PCC plant area.
1973-1988	Partial coverage. A *'Track'* is identified immediately adjacent, and parallel to the *'Drain'* running through the PCC plant area. A linear feature labelled *'Tk'*, assumed to be a track, is identified within the centre of the PCC plant area near the eastern boundary of the PCC plant area.
1974	No significant changes.
1985	No significant changes.
1994	The building is no longer shown adjacent to the centre of the eastern boundary of the PCC plant area.

1999 (Aerial)	No significant changes.
2000	No significant changes.
2006	A *'Chimney'*, several buildings and a surface water feature are denoted as part of this development. An extension of the *'Drain'* in the centre of the PCC plant area is shown in the northern corner of the PCC plant area, with a pond. The *'Pipeline'* through the western corner of the PCC plant area is no longer denoted although the Pipeline along the western boundary of the PCC plant area is still shown to be in place.
2021	The extension of the *'Drain'* in the northern corner of the PCC plant area with a pond is no longer shown, however, the rest of the drain is still present through the centre of the PCC plant area. *'Rough Grassland'* covers most of the PCC plant area.

Source: Phase I Geo-Environmental and Geotechnical Desk Study, VPI Immingham LLP and Phillips 66 Ltd, November 2022

The Coal Authority Interactive Map Viewer indicates that the PCC plant area is not within a Coal Mining Reporting Area and it is not in a Development High Risk Area.

No historical mineral extraction or non-coal mining records are present on PCC plant are based on information provided in the Envirocheck Report, although two records for extractive industries or potential excavations are noted for a railway embankment on the Network Rail land located 4m south and a dock located 94m south-east of the PCC plant area. However, the dock was only recorded on historical maps in 1964 and 1965.

The railway land to the south-west dividing the PCC plant area and the Phillips 66 site is a potentially contaminative land use in the vicinity of the Extended Installation Site Boundary.

The land use immediately north-west and within 100m south-west of the PCC plant area comprises industrial infrastructure with tanks, pipelines, a fire station and silos associated with oil refineries.

There are no landfill sites or waste management facilities located on the PCC plant area. There is one Historical Landfill located 130m north-west, which was operated by Lindsey Oil Refinery and includes liquid sludge waste. There are two records for Lindsey Oil Refinery Ltd located 250m north-west for both a Licenced Waste Management Facility and a Registered Waste Treatment or Disposal site for the same location.

Additional potential contaminative land uses outside of the Extended Installation Site Boundary are:

- Five Historical Landfill Sites located between 250m and 800m from the Installation Site Boundary;
- Four Licenced Waste Management Facilities, of which one is also designated as Registered Landfill Site, located between 500m and 1km from the Installation Site Boundary;
- Three Registered Landfill Sites, of which one is also designated as a Licenced Waste Management Facility, located between 500m and 700m from the Installation Site Boundary; and
- One Registered Waste Treatment or Disposal Site located approximately 300m south-west from the Installation Site Boundary.

Evidence of historic contamination, for example, historical site investigation,	The historical maps show that the PCC plant area to be added to the Installation Site Boundary has remained undeveloped and has had no permitted or other industrial activities undertaken on it.

assessment, remediation and verification reports (where available)	
Baseline soil and groundwater reference data	**Geotechnics Limited. (2022). Site Investigation Factual and Interpretive Report. (November 2022) (DRAFT)** Geotechnics Limited carried out a geotechnical and geo-environmental investigation on the PCC plant area for the project engineers, Worley Group Limited in November 2022. Key aspects of the report are summarised here: • 20 Inspections Pits were excavated to a depth of 1.2m below ground level; • 10 Static Cone Penetration Tests were completed to depths ranging between 14.58m and15.30m below ground level; • 4 boreholes were sunk to depths of 21.75m and 23.08m below ground level. Soil samples taken were analysed for a range of determinants, however there was no indication that contamination is present. Ground water samples taken from two boreholes were analysed for heavy metals, PAHs, speciated TPH, VOCs and SVOCs. Slightly elevated levels of relatively long-chain TPH fractions for both aliphatic and aromatic TPH. Ground gas monitoring which indicated that there is no significant source of ground gases at depth.
Supporting information	Envirocheck Report (285387654_1_1) – Annex B of this Appendix Environmental Statement Submitted for the Humber Zero Projects, provided in Appendix B of the Main Supporting Document (see Volume I, Chapter 10 Geology, Hydrology and Land Contamination and Volume II, Appendix 10A Phase I Geo-Environmental and Geotechnical Desk Study).

3. Permitted Activities

Permitted activities	Section 1.1 Part A(1)(a): Burning of any fuel in an appliance with a rated thermal input of 50MW or more.
Non-permitted activities undertaken	N/A
Document references for: • Plan showing activity layout; and • Envirocheck Report	Annex A, Figures Annex B, Envirocheck (285387654_1_1)

4. Changes to the Activity

Have there been any changes to the activity boundary?	Yes, the area for the PCC plants and CO_2 compression is to the south of the existing Installation Site Boundary and therefore will be added to the Installation Site Boundary. The PCC plant area comprises grassland with an open ditch currently running west-east through the centre, areas of hardstanding and existing below ground utilities.
Have there been any changes to the permitted activities?	The existing Installation currently only carries out a combustion activity (Section 1.1 Part A(1)(a): Burning of any fuel in an appliance with a rated thermal input of 50MW or more.). There will be no change to this activity. The proposed PCC plants' operation will comprise a Section 6.10 A(1)(a) - Capture of carbon dioxide streams from an installation for the purposes of geological storage pursuant to Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide activity.
Have any 'dangerous substances' not identified in the Application Site Condition Report been used or produced as a result of the permitted activities?	The use of an amine based solvent will be added to the list of 'dangerous substances' used at the Installation, as part of the PCC plants' operations.
Document references for:	
• Plan showing any changes to the boundary (where relevant)	Annex A, Figures 2 and 3
• Description of the changes to the permitted activities (where relevant)	Section 2.2, Environmental Permit Variation Application, Main Supporting Document
• List of 'dangerous substances' used/ produced by the permitted activities that were not identified in the Application Site Condition Report (where relevant)	Annex D

As demonstrated in the Environmental Risk Assessment, provided in 0, the activities proposed to be undertaken in the PCC plant area and the associated pollution prevention and containment measures are considered to represent a negligible risk of pollution to the underlying soil and groundwater.

A Phase II Site Investigation has been carried out for the PCC plant area, however additional investigations are planned, which will provide baseline data.

5. Measures Taken to Protect Land

Use records that you collected during the life of the permit to summarise whether pollution prevention measures	There will be no changes to the existing permitted activities, and these activities are reported to not have resulted in any pollution events.

worked. If you can't, you need to collect land and/ or groundwater data to assess whether the land has deteriorated.	Additional land is proposed to be added to the Installation Site Boundary by this variation application for the installation of PCC plants. The additional land to be added to the Installation has not been used for any permitted activities in the past. The additional land will be added to the Installation Site Boundary and the associated Environment Permit. The existing pollution prevention measures for the Installation to prevent pollution events, including but not limited to, concrete hardstanding across the operational areas, bunding for all chemical storage containers, closed drainage for operational areas and monitoring of all process emissions from the Installation will be extended and applied to the new operations. In line with the existing Environmental Permit, records related to any potential pollution events, remediation measures and maintenance of pollution prevention measures will be retained at the Installation in line with the existing Installation procedures throughout the lifetime of the operations. Losses of containment or near misses will be logged, and whether the loss was contained to the site systems (as expected) or managed to enter the underlying soil and groundwater (in which case the clean-up and remediation activities undertaken) will be recorded. The Installation will also continue to maintain an infrastructure monitoring log to record the schedule inspection and maintenance of containment systems e.g. solvent storage tank, bunding, and any significant maintenance or repair activities required. Details of any additional routine inspection and maintenance activities, specific to the PCC plants, will be developed prior to commencement of their operation, and will be in line with industry best practice
Document references for: • Inspection records and summary of findings of inspections for all pollution prevention measures • Records of maintenance, repair and replacement of pollution prevention measures	Environmental Permit Variation Application, Main Supporting Document.

6. Pollution incidents that may have had an impact on land, and their remediation

Summarise any pollution incidents that may have damaged the land. Describe how you investigated and remedied each one. If you can't, you need to collect land and /or groundwater reference data to assess whether the land has deteriorated while you've been there.	Additional land is proposed to be added to the Installation Site Boundary by this Environmental Permit variation application. The additional land proposed to be added has not been used for any permitted activities previously. No records of pollution history and/ or remediation of the additional land (PCC plant area) exist. Existing pollution prevention measures in place at the Installation will be amended as required to cover the new operations. Records related to any potential pollution events, remediation measures and maintenance of pollution prevention measures will be retained at the Installation in line with the existing procedures.
Document references for:	N/A

• Records of pollution incidents that may have impacted on land • Records of their investigation and remediation	

7. Soil Gas and Water Quality Monitoring (where undertaken)

Provide details of any soil gas and/ or water monitoring you did. Include a summary of the findings. Say whether it shows that the land deteriorated as a result of the permitted activities. If it did, outline how you investigated and remedied this.	The additional land proposed to be added to the Installation Site Boundary has not been used for any permitted activities previously. The Installation is regulated under the Industrial Emissions Directive and will continue to be so. Therefore, soil and groundwater will be monitored periodically as required by the existing Environmental Permit, with the data maintained for the lifetime of the Installation. Since the additional land proposed to be added to the Installation has not been used for permitted activities, monitoring has only been undertaken as part of the ground investigations to set a baseline for the land.
Document references for: • Description of soil gas and/ or water monitoring undertaken • Monitoring results (including graphs)	Geotechnics Limited. (2022). Site Investigation Factual and Interpretive Report. (November 2022) (DRAFT)

Annex A - Figures

Revision: 2 Drawn: ER Checked: LC Approved: KC Date: 2023-01-11

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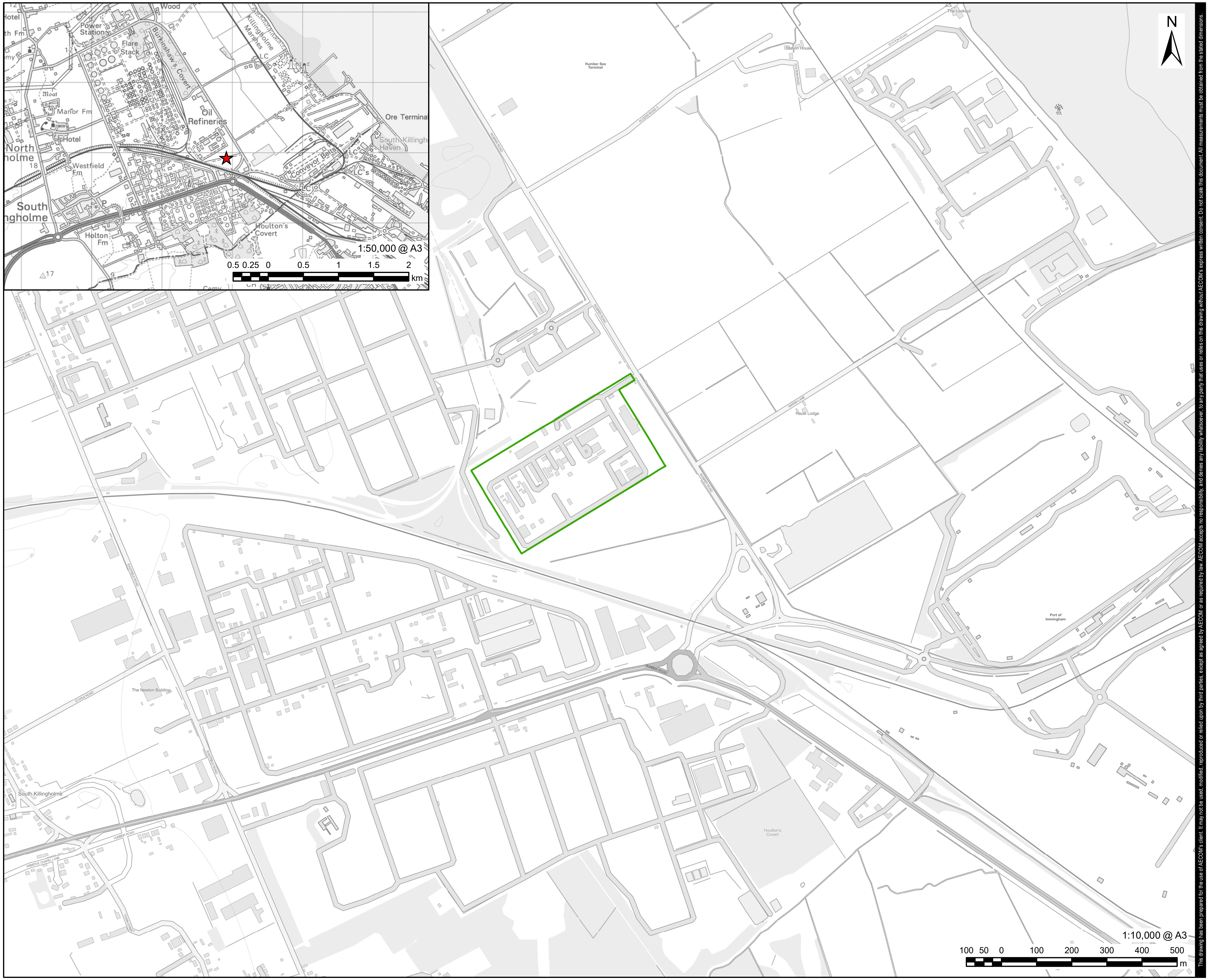

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Environmental Permit Variation Application

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LEGEND

Existing Installation Site Boundary

Site Location

NOTES

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ISSUE PURPOSE

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PROJECT NUMBER

60668866

FIGURE TITLE

Site Location Plan

FIGURE NUMBER

Figure 1

Revision: 1 Drawn: ER Checked: LC Approved: KC Date: 2022-12-19

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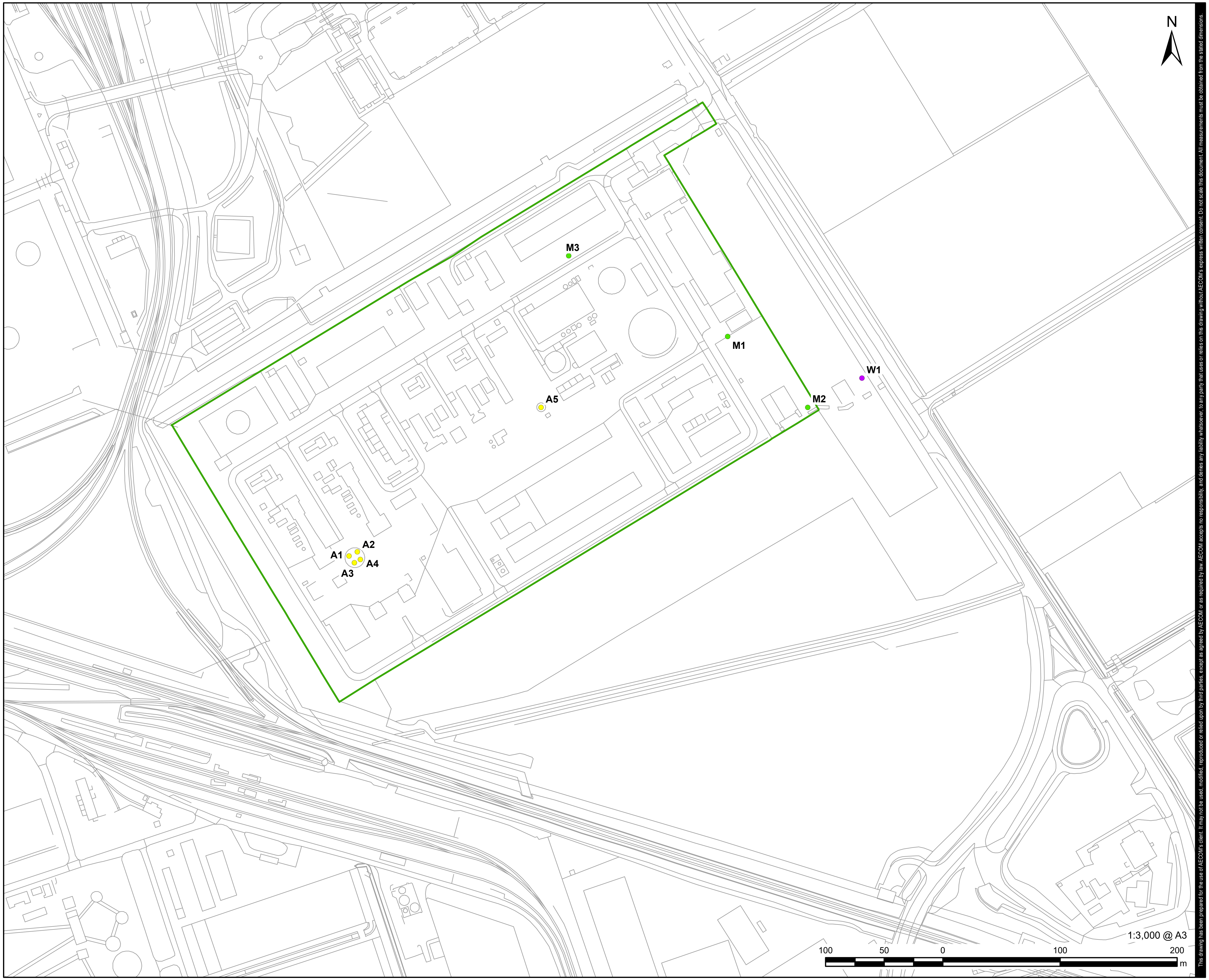

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LEGEND

- Existing Installation Site Boundary
- Emission Point to Air
- Emission Point to Water
- Holding Pond

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60668866

FIGURE TITLE

Existing Installation Site Boundary

FIGURE NUMBER

Figure 2

Revision: 1 Drawn: ER Checked: LC Approved: KC Date: 2023-03-02

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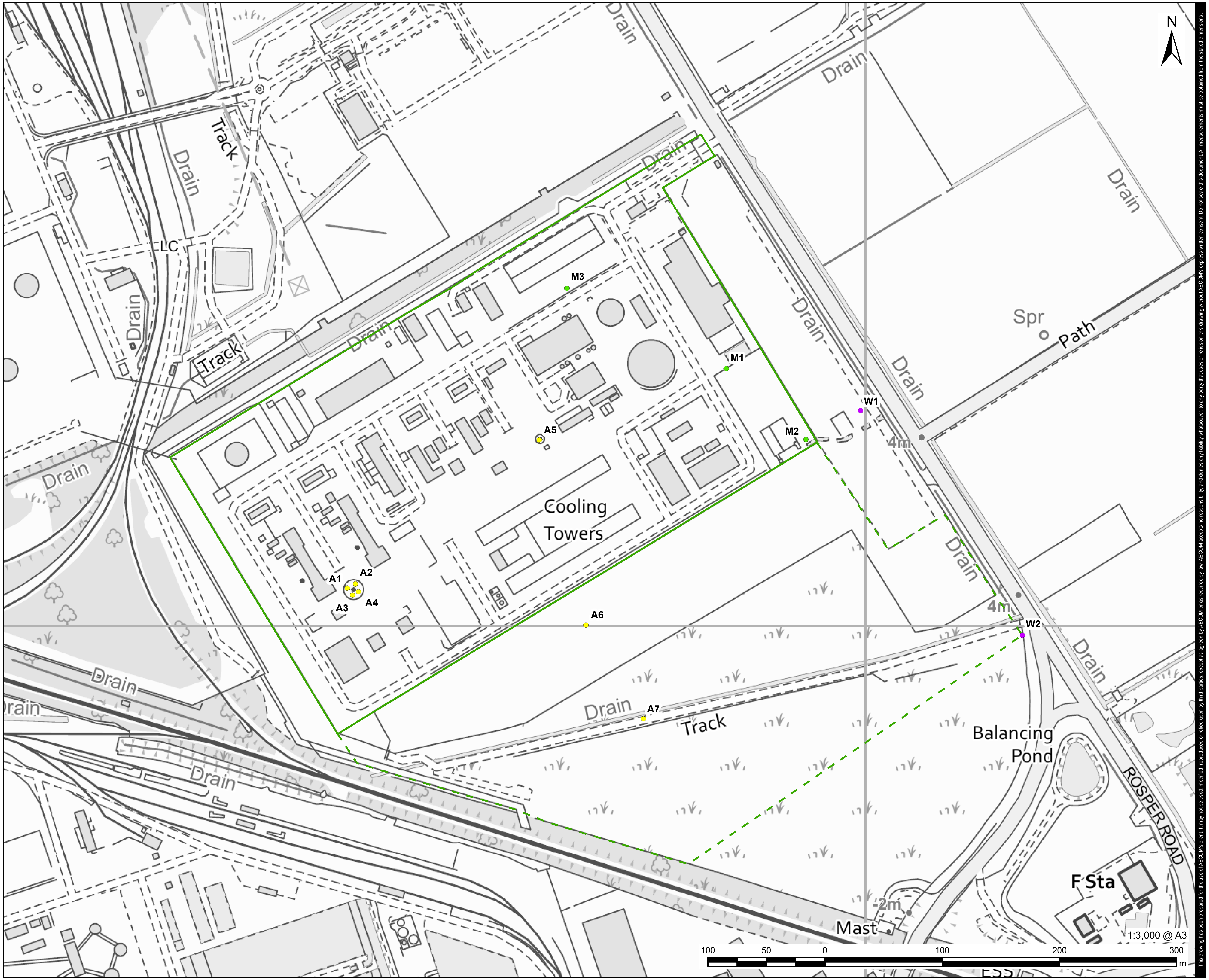

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Environmental Permit Variation Application

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LEGEND

- Existing Installation Site Boundary
- Indicative Extended Installation Boundary
- Emission Point to Air
- Emission Point to Water
- Holding Pond

NOTES

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ISSUE PURPOSE

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PROJECT NUMBER

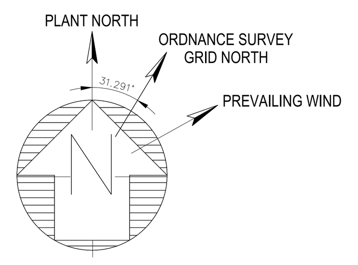
60668866

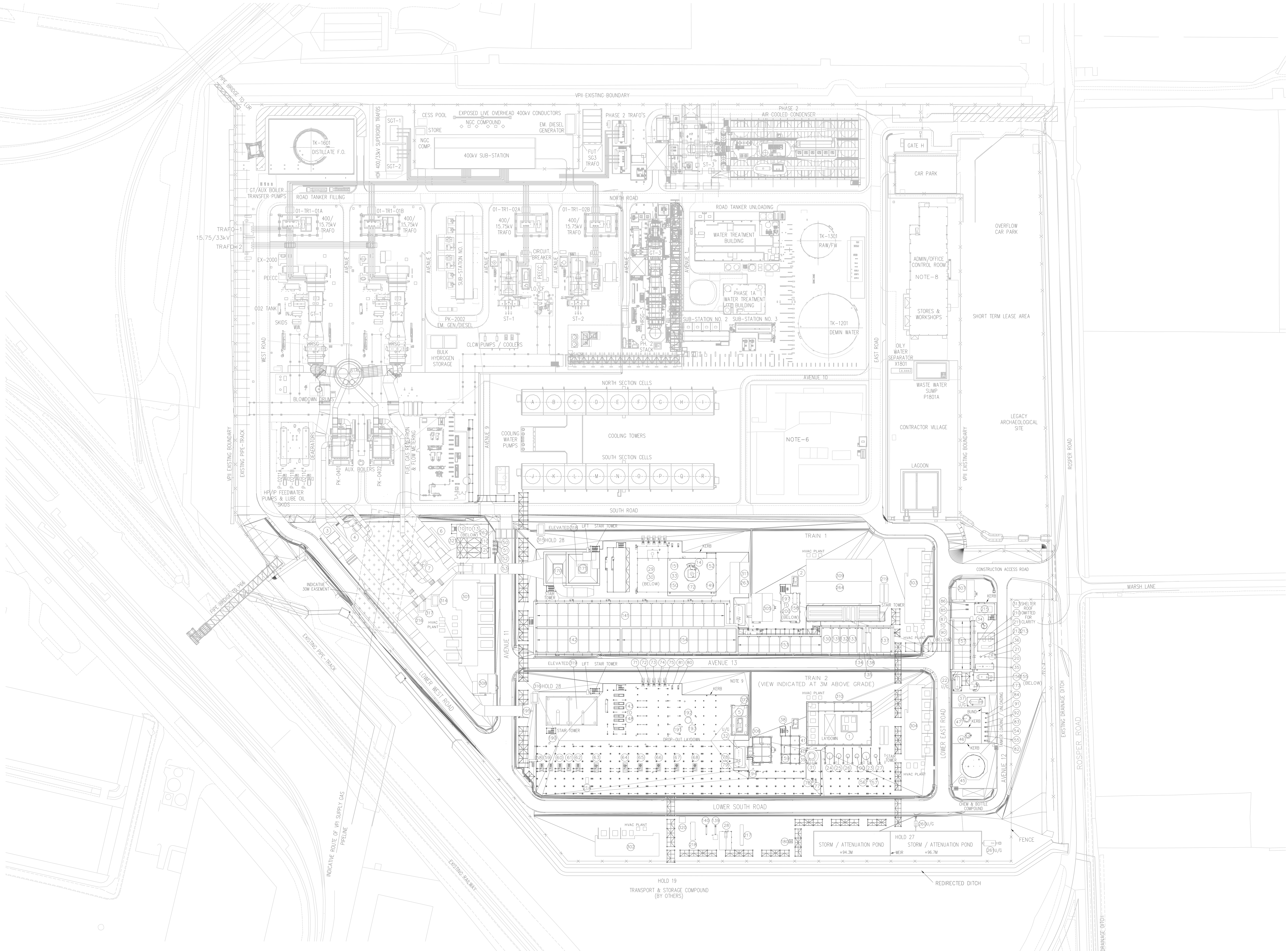
FIGURE TITLE

Installation Location

FIGURE NUMBER

Figure 3





0 50m 100m 150m

SCALE 1:1000 AT A0

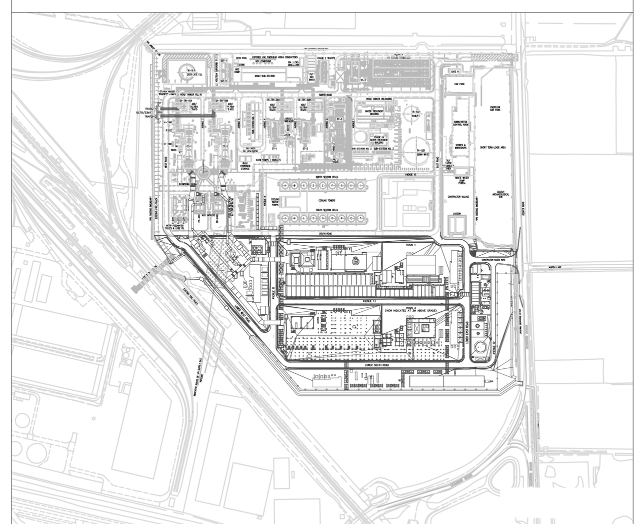
NOTES:

1. EXISTING SITE LAYOUT REFLECTS BEST AVAILABLE INFORMATION FROM PRE-FEED PHASE AND LEGACY DOCUMENTS FROM PHASE 1 (BY FOSTER WHEELER) AND PHASE 2 (BY BLACK & VEATCH LIMITED). THIS IS AUGMENTED BY LASER SCAN DATA CAPTURED DURING THE FEED (BY SCOPUS) FOR AREAS LOCAL TO TIE-INS. SEE 'REFERENCES' SECTION FOR DRAWING / DOCUMENT NUMBERS.
2. ACCURACY OF INFRASTRUCTURE (ROADS, RAILWAYS, BOUNDARIES, ETC.) IS NOT CONFIRMED.
3. DELETED.
4. DELETED.
5. THE SITE IS CENTERED AT NGR: TA 16678 17462.
6. LOCATION OF EXISTING RUBB TENT AREA IS AVAILABLE FOR OPTIONAL USE OF HZ-VPI-I PCC PROJECT.
7. TAGS MARKED THUS * ARE DUPLICATED IN TRAINS 1 / 2.
8. CCR TO BE INTEGRATED WITH EXISTING BUILDING.
9. EXISTING PLANT NOMINAL GRADE IS +100.00M. THIS IS EQUIVALENT TO +4.90 ABOVE O/S NEWLYN.
10. NEW SCOPE IS SHOWN IN BOLD.

HOLDS:

1. CLEARED.
2. PIPE RACK GRID NUMBERS.
3. CLEARED.
4. CLEARED.
5. CLEARED.
6. CLEARED.
7. CLEARED.
8. CLEARED.
9. MAINTENANCE CRANE / LAYDOWN AREA / HARD-STANDING LOCATIONS.
10. FIRE MONITOR AND HYDRANT LOCATION.
11. CLEARED.
12. CLEARED.
13. CLEARED.
14. CLEARED.
15. CLEARED.
16. CLEARED.
17. CLEARED.
18. CLEARED.
19. TERMINAL LOCATION OF CO2 EXPORT LINE (T&S COMPOUND).
20. CLEARED.
21. CLEARED.
22. CLEARED.
23. CLEARED.
24. REQUIREMENT FOR ADDITIONAL WASTE STORAGE LAYDOWN.
25. REQUIREMENT FOR ADDITIONAL WAREHOUSE FOR CAPITAL SPARES.
26. LOCATION FOR STEAM TURBINE COOLING EQUIPMENT.
27. LOCATION / TAG NUMBERS OF STORM WATER POND WEIR PUMPS.
28. LOCATION OF ANALYSER HOUSES 30-BD-1715 / 30-BD-2716.

KEY PLAN



MECHANICAL EQUIPMENT

REF	TAG NUMBER	DESCRIPTION
COMPRESSORS / BLOWERS		
1	70-C-1101	LP CO2 COMPRESSOR
2	70-C-1103	REGENERATION COMPRESSOR
3	70-B-1001	GT FLUE GAS BLOWER
4	70-B-1002	AUX BOILER FLUE GAS BLOWER
5	70-B-1003	MVR COMPRESSOR
6	70-B-2001	GT FLUE GAS BLOWER
7	70-B-2002	AUX BOILER FLUE GAS BLOWER
DESUPERHEATERS		
REF	TAG NUMBER	DESCRIPTION
10	05-DS-0001	LP STEAM DESUPERHEATER
11	05-DS-0002	STEAM TURBINE DESUPERHEATER
12	05-DS-0003A	MP STEAM DESUPERHERTER
13	05-DS-0003B	MP STEAM DESUPERHERTER
14	70-DS-1001	MVR DESUPERHEATER
DRUMS		
REF	TAG NUMBER	DESCRIPTION
20	14-D-0001	WET AIR RECEIVER
21	14-D-0002	IA RECEIVER
22	18-D-0001	DRAIN DRUM
23	70-D-1101	LP CO2 COMPRESSOR SUCTION KNOCK OUT DRUM
24	70-D-1102	LP CO2 COMPRESSOR 2ND STAGE KNOCK OUT DRUM
25	70-D-1103	LP CO2 COMPRESSOR 3RD STAGE KNOCK OUT DRUM
26	70-D-1104	LP CO2 COMPRESSOR 4TH STAGE KNOCK OUT DRUM
27	70-D-1105	DEHYDRATION DISCHARGE KNOCK OUT DRUM
28	70-D-0101	VENT KNOCK OUT DRUM
29	70-D-1001	LEAN SOLVENT FLASH VESSEL
30	70-D-1002	CONDENSATE FLASH VESSEL
31	70-D-1003	CO2 STRIPPER REFLUX DRUM
32	70-D-1004	SOLVENT DRAIN VESSEL
33	70-D-1005	REBOILER CONDENSATE DRUM
34	70-D-0001	THERMAL RECLAIMER REFLUX DRUM
35	70-D-0002	DEGRADED SOLVENT DRUM
36	70-D-0003	RECLAIMER REBOILER CONDENSATE DRUM
37	70-D-0004	TRU SOLVENT DRAIN VESSEL
38	70-D-1111	REGENERATION KNOCK OUT DRUM
39	70-D-1113A	DESSICANT BED
40	70-D-1113B	DESSICANT BED
41	70-D-1113C	DESSICANT BED
TANKS		
REF	TAG NUMBER	DESCRIPTION
45	70-TK-0001	SOLVENT STORAGE TANK
46	70-TK-0002	FRESH SOLVENT TANK
47	70-TK-0003	CAUSTIC TANK
PUMPS		
REF	TAG NUMBER	DESCRIPTION
50	05-P-0002A	LP DESUPERHEATER WATER PUMP
51	05-P-0002B	LP DESUPERHEATER WATER PUMP
52	05-P-0003A	MP DESUPERHEATER WATER PUMP
53	05-P-0003B	MP DESUPERHEATER WATER PUMP
54	70-P-0101A	CAUSTIC UNLOADING PUMP
55	70-P-0101B	CAUSTIC UNLOADING PUMP
56	70-P-1101A	LP CO2 COMPRESSION CONDENSATE RETURN PUMP
57	70-P-1101B	LP CO2 COMPRESSION CONDENSATE RETURN PUMP
58	70-P-1001A	DCC WATER CIRCULATING PUMP
59	70-P-1001B	DCC WATER CIRCULATING PUMP
60	70-P-1001C	DCC WATER CIRCULATING PUMP
61	70-P-1001D	DCC WATER CIRCULATING PUMP
62	70-P-1001E	DCC WATER CIRCULATING PUMP
63	70-P-1002A	WASH WATER PUMP
64	70-P-1002B	WASH WATER PUMP
65	70-P-1003A	RICH SOLVENT PUMP
66	70-P-1003B	RICH SOLVENT PUMP
67	70-P-1003C	RICH SOLVENT PUMP
68	70-P-1003D	RICH SOLVENT PUMP
71	70-P-1004A	LEAN SOLVENT PUMP
72	70-P-1004B	LEAN SOLVENT PUMP
73	70-P-1004C	LEAN SOLVENT PUMP
74	70-P-1004D	LEAN SOLVENT PUMP
75	70-P-1004E	LEAN SOLVENT PUMP
76	70-P-1005A	CO2 STRIPPER REFLUX PUMP
77	70-P-1005B	CO2 STRIPPER REFLUX PUMP
78	70-P-1006A	SOLVENT DRAIN PUMP
79	70-P-1006B	SOLVENT DRAIN PUMP
80	70-P-1007A	STRIPPER CONDENSATE PUMP
81	70-P-1007B	STRIPPER CONDENSATE PUMP
82	70-P-0001	SOLVENT TRANSFER PUMP
83	70-P-0002	SOLVENT MAKE-UP PUMP
84	70-P-0003	FRESH SOLVENT CONTAINER PUMP
85	70-P-0004A	THERMAL RECLAIMER REFLUX PUMP
86	70-P-0004B	THERMAL RECLAIMER REFLUX PUMP
87	70-P-0005A	THERMAL RECLAIMER BOTTOM PUMP
88	70-P-0005B	THERMAL RECLAIMER BOTTOM PUMP
89	70-P-0006A	THERMAL RECLAIMER DEGRADED SOLVENT PUMP
90	70-P-0006B	THERMAL RECLAIMER DEGRADED SOLVENT PUMP
91	70-P-0007A	CAUSTIC PUMP
92	70-P-0007B	CAUSTIC PUMP
REACTORS		
REF	TAG NUMBER	DESCRIPTION
100	70-RE-1101	OXYGEN REMOVAL REACTOR
STEAM TURBINES		
REF	TAG NUMBER	DESCRIPTION
110	03-ST-0001A	STEAM TURBINE
GENERATORS		
REF	TAG NUMBER	DESCRIPTION
120	03-G-0001A	STEAM TURBINE GENERATOR
HEAT EXCHANGERS		
REF	TAG NUMBER	DESCRIPTION
130	70-E-1101	CO2 COMPRESSOR 1ST STAGE INTERCOOLER
131	70-E-1102	CO2 COMPRESSOR 2ND STAGE INTERCOOLER
132	70-E-1103	CO2 COMPRESSOR 3RD STAGE INTERCOOLER
133	70-E-1104	CO2 COMPRESSOR 4TH STAGE INTERCOOLER
134	70-E-1105	CO2 COMPRESSOR 5TH STAGE INTERCOOLER
135	70-E-1106	CO2 COMPRESSOR 6TH STAGE INTERCOOLER
137	70-E-1108	CO2 COMPRESSOR AFTER COOLER
138	70-E-1109	RECYCLE COOLER
139	70-E-1110	FINAL CO2 COOLER
140	70-E-2110	FINAL CO2 COOLER
141	70-E-1001	DCC WATER COOLER
142	70-E-1002	WASH WATER COOLER
143	70-E-1003A	LEAN/RICH EXCHANGER
144	70-E-1003B	LEAN/RICH EXCHANGER
145	70-E-1003C	LEAN/RICH EXCHANGER
146	70-E-1003D	LEAN/RICH EXCHANGER
147	70-E-1003E	LEAN/RICH EXCHANGER
148	70-E-1003F	LEAN/RICH EXCHANGER
149	70-E-1004A	CO2 STRIPPER REBOILER
150	70-E-1004B	CO2 STRIPPER REBOILER
151	70-E-1004C	CO2 STRIPPER REBOILER
152	70-E-1004D	CO2 STRIPPER REBOILER
153	70-E-1005	CO2 STRIPPER CONDENSER
154	70-E-1006	LEAN SOLVENT COOLER
155	70-E-0001	THERMAL RECLAIMER PREHEATER
156	70-E-0002	THERMAL RECLAIMER REBOILER
157	70-E-0003	THERMAL RECLAIMER CONDENSER
158	70-E-1111	REGENERATION AIR COOLER
159	70-E-1112	REGENERATION HEATER
TOWERS		
REF	TAG NUMBER	DESCRIPTION
170	70-T-1001	DIRECT CONTACT COOLER
171	70-T-1002	CO2 ABSORBER
172	70-T-1003	CO2 STRIPPER
173	70-T-0001	THERMAL RECLAIMER COLUMN
STACKS		
REF	TAG NUMBER	DESCRIPTION
180	70-SK-0101	CO2 VENT STACK
FILTERS		
REF	TAG NUMBER	DESCRIPTION
190	70-F-1001	DCC MECHANICAL FILTER
191	70-F-1002	SOLVENT MECHANICAL FILTER
192	70-F-1003	CARBON BED FILTER
193	70-F-1004	CARBON BED AFTER FILTER
194	70-F-1005	SOLVENT RETURN FILTER
195	70-F-0101	DCC EFFLUENT FILTER
196	70-F-0001	TRU SOLVENT RETURN FILTER
197	70-F-1101A	REGENERATION FILTER
198	70-F-1101B	REGENERATION FILTER
199	70-F-1102A	DRY CO2 FILTER
200	70-F-1102B	DRY CO2 FILTER

REF	TAG NUMBER	DESCRIPTION
PACKAGES		
REF	TAG NUMBER	DESCRIPTION
210	14-C-0001A	IA COMPRESSOR
211	14-C-0001B	IA COMPRESSOR
212	14-DR-0001A	IA DRYER
213	14-DR-0001B	IA DRYER
214	70-PK-1001	ANTI FOAM DOSING
215	70-PK-0001	THERMAL RECLAIMER VACUUM PACKAGE
216	70-PK-0004	DAMPER SEAL AIR PACKAGE
217	70-PK-0105	REFRIGERATION PACKAGE
218	70-PK-0106	CO2 (FISCAL) METERING PACKAGE
219	70-PK-1111	HYDROGEN GENERATION PACKAGE
MICELLANEOUS		
REF	TAG NUMBER	DESCRIPTION
260	18-X-0001	OILY WATER SEPARATOR
261	18-X-0002	HIGH EFFICIENCY OILY WATER SEPARATOR
262	03-CR-0001	OVERHEAD CRANE
263	70-CR-1003	OVERHEAD CRANE
264	70-CR-1101	OVERHEAD CRANE
STEAM TURBINE COOLING EQUIPMENT - HOLD 26		
REF	TAG NUMBER	DESCRIPTION
280	03-D-0001	STG COOLING WATER EXPANSION DRUM
281	03-E-0001	STG COOLING WATER AIR COOLER
282	03-P-0001A	STG COOLING WATER PUMP
283	03-P-0001B	STG COOLING WATER PUMP

BUILDINGS

REF	TAG NO.	BUILDING NAME	ARCHITECTURAL DRG. NO.
300	30-BD-0001	EXISTING CONTROL BUILDING	415000-00201-8330-47-0015
301	30-BD-0701	SUBSTATION 04	415000-00201-8330-47-0003
302	30-BD-0702	SUBSTATION 05	415000-00201-8330-47-0003
303	30-BD-0703	SUBSTATION 06	415000-00201-8330-47-0003
304	30-BD-0704	SUBSTATION 07	415000-00201-8330-47-0003
305	30-BD-0705	FIELD INSTRUMENT ROOM 1	415000-00201-8330-47-0001
306	30-BD-0706	FIELD INSTRUMENT ROOM 2	415000-00201-8330-47-0001
307	30-BD-0707	FIELD INSTRUMENT ROOM 3	415000-00201-8330-47-0001
308	30-BD-0708	FIELD INSTRUMENT ROOM 4	415000-00201-8330-47-0001
309	30-BD-1709	TRAIN 1 CO2 COMPRESSOR HOUSE	415000-00201-8330-47-0005
310	30-BD-2710	TRAIN 2 CO2 COMPRESSOR HOUSE	415000-00201-8330-47-0005
311	30-BD-1711	TRAIN 1 MVR COMPRESSOR HOUSE	415000-00201-8330-47-0006
312	30-BD-2712	TRAIN 2 MVR COMPRESSOR HOUSE	415000-00201-8330-47-0006
313	30-BD-0713	INSTRUMENT AIR COMPRESSOR SHELTER	N/A
314	30-BD-1714	ANALYSER HOUSE 1A	415000-00201-8330-47-0002
315	30-BD-1715	ANALYSER HOUSE 2	415000-00201-8330-47-0002
316	30-BD-2716	ANALYSER HOUSE 3	415000-00201-8330-47-0002
317	30-BD-2717	ANALYSER HOUSE 1B	415000-00201-8330-47-0002
318	30-BD-1718	CEMS HOUSE 1	BY VENDOR
319	30-BD-2719	CEMS HOUSE 2	BY VENDOR
320	30-BD-0720	FISCAL METERING ANALYSER HOUSE	BY VENDOR
321	30-BD-0721	STG ACOUSTIC ENCLOSURE	BY VENDOR

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
									415000-00201-8100-EL-0001	EQUIPMENT LIST
									415000-00201-8820-RP-0002	BUILDINGS LIST
									415000-00201-8230-01-0003	TIE-IN LOCATION PLAN
									415000-00201-8230-01-0002	HZ-VPI-I PCC PROJECT - PLOT PLAN
D	30/01/23	ISSUED FOR INFORMATION	NG		RRK	AG	NG		145646-CSTA-G1000	GENERAL ARRANGEMENT - SITE OVERALL SITE PLOT PLAN
C	24/11/22	ISSUED FOR REVIEW	NG		RRK	AC	AG		145646-3BSA-M1005	PLANT ARRANGEMENT INDEX DRAWING
B	21/10/22	ISSUED FOR REVIEW	NG		RRK	AC	AG		9140-8230-02-0002	IMMINGHAM CHP PROJECT KEY PLAN PLOT PLANS
A	20/07/22	ISSUED FOR DISCIPLINE CHECK	RAS	RAS	RRK	RRK	NG		2180-8310-40-001	VPII CARBON CAPTURE PLANT TOPOGRAPHICAL SURVEY LAYOUT

A0 SHT SCALE: 1:1000

Worley
energy | chemicals | resources

WORLEY PROJECT No.
415000-00201

ENGINEERING AND PERMIT STAMPS (As Required)

CUSTOMER
HUMBERZERO
VPI Immingham

DRG TITLE
HZ-VPI-I PCC PROJECT
SITE PLAN

DRG No 415000-00201-8230-01-0001
REV D

Worley_A0

Annex B – Envirocheck Report

See separate Electronic Folder

Annex C - Environmental Risk Assessment

Qualitative Risk Assessment of Materials Stored at the Installation

Substances	Relevant activity	Potential for pollution	Primary containment details		Secondary containment details		Tertiary containment details		Pollution prevention measures adequate?	Residual Pollution potential
PCC solvent	Delivery by vehicle	Spillage during off-loading e.g. flex hose/ connection failure	Road tanker/ retractable delivery hoses	Visual inspection of road tanker and delivery hoses to be carried out. Deliveries via reputable supplier using vehicles which are fit for purpose	Concrete hardstanding draining via a collection sump. Any spills will be contained, and uncontaminated rainwater will be pumped to a attenuation tank/ pond	Visual inspection of concrete hardstanding, and the sump to ensure it is in good working condition	Spill kits to be available on site	Scheduled inspections	Yes	Negligible
PCC Solvent	Storage	Leak from bulk storage	1 x approx. 75m^3 above ground bulk tank for lean solvent	Newly built above ground storage tanks. Will be subject to routine visual checks and inspection in line with manufacturer guidance	The tanks will be installed in a concrete bund in compliance with CIRIA C736 guidelines, with level alarms to identify high levels of accumulated water	Regular visual inspection of tanks and bunding, and testing of alarms	Site hardstanding	Scheduled inspections	Yes	Negligible
Caustic	Storage		1 x 9.9 m^3							
PCC Solvent	Use in PCC plant	Leak from process equipment	PCC plant equipment ad pipelines	Visual inspection of infrastructure as part on the site Infrastructure Monitoring Plan	PCC plant located on concrete hardstanding within a kerbed area, with sealed drainage	Regular visual inspection of plant infrastructure.	Containment sumps	Scheduled inspections and sampling prior to discharge to surface water drainage	Yes	Negligible
Small quantities of waste	Maintenance	Leak from storage	Dedicated waste containers, with segregated	New storage containers. Will be subject to routine	Appropriate bunding or kerbing of hazardous waste storage containers	Regular visual inspection of bunding and storage areas	Site hardstanding and	Scheduled inspections and sampling prior to	Yes	Negligible

Substances	Relevant activity	Potential for pollution	Primary containment details		Secondary containment details		Tertiary containment details		Pollution prevention measures adequate?	Residual Pollution potential
chemicals and oils			storage of hazardous and non-hazardous waste	visual checks and inspection			Containment sump	discharge to surface water drainage		
Reclaimer Waste (comprising Denatured Amine and Salts formed from corrosion products)	Storage	Leak from storage	Approximately 74m^3 dedicated Degraded Solvent Drum.	New storage drum. Will be subject to routine visual checks and inspection	Appropriate bunding or kerbing of hazardous waste storage containers	Regular visual inspection of storage	Site hardstanding and containment sump	Scheduled inspections	Yes	Negligible
Water treatment chemicals (including corrosion inhibitors, oxygen scavenger, phosphate, and biocides)	Storage	Leak from storage containers	<20m^3 (Typical storage quantities limited to between 0.1m^3 to 2m^3)	Chemicals to be stored in intermediate bulk containers (IBCs) within drip trays and other suitable bunds, in the dedicated store. These will be subject to routine visual checks and inspection in line with manufacturer guidance	Drip trays and other appropriate bund for small containers.	Regular visual inspection of storage containers and drip trays.	Sealed drainage system draining to the attenuation pond via oil water interceptors and wastewater sump.	Scheduled inspections	Yes	Negligible

Annex D – Raw Materials

The following hazardous raw materials will be used at the Installation in addition to the raw materials used at present.

Material	Purpose	Estimated Maximum Storage Quantity (m^3)	Indicative Annual Consumption (tpa)
47% Sodium hydroxide (caustic)	DCC wastewater stripper dosing and thermal Reclaimer pH control	10 m^3	220 tonnes
CANSOLV DC-103 Fresh solvent	100% solvent delivery to site - CO_2 scrubbing solvent.	74 m^3	Commercially confidential.
Antifoam agent	Added to the re-circulating amine to prevent foaming in the Absorber.	1m^3 - Stored in IBCs	Extent of potential foaming not known until operation commences.
Oxygen removal catalyst	For use in Oxygen Removal Reactor	Not held on site, brought in for change over when required.	2.5 m^3 (based on replacement every 4 years)
Silica Gel	Dehydration Package	Not held on site, brought in for change over when required	12 m^3 (based on replacement every 4 years)
Activated Carbon	Solvent filtration units	Not held on site, brought in for change over when required	Extent of usage not known until operation commences
47% Sodium hydroxide (caustic)	DCC wastewater stripper dosing and thermal Reclaimer pH control	10 m^3	220 tonnes

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VPI IMMINGHAM

Humber Zero VPI-Immingham Post-Combustion Carbon Capture Project FEED

Assessment of Geotechnical Interpretative Report

Document no. Rev 0: 415000-00201-8310-RP-0001

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Rev	Description	Originator	Reviewer	Worley Approver	Revision Date
Rev A	Issued for Review	Peter Adcock	Suchi Basu	Peter Adcock	10/03/2023
Rev 0	Issued for Design	Peter Adcock	Andy George	Peter Adcock	24/03/2023

Holds

Hold No.	Section	Description of Hold
1		
2		

Document Revisions

Rev.		Section	Description of Change

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1. Project Description

Humber Zero is a combined set of projects that aim to decarbonise the world-scale industrial complex at Immingham, comprising VPI's 1260 MW Combined Heat and Power plant and the adjacent Humber Oil Refinery operated by Phillips 66.

Humber Zero's initial phase focuses on the post-combustion carbon capture at VPI-Immingham. This phase will deliver up to 3.3 MTPA of abated CO_2 emissions via a post-combustion carbon capture retrofit to two gas turbines and two auxiliary gas boilers.

Shell have been selected as the carbon capture technology provider for the VPI-Immingham project.

Worley, as the selected FEED contractor for the VPI-Immingham project, will deliver an overall FEED package integrating the Shell Process Design Package (PDP). The project scope includes the existing site flue gas, utility and power tie-ins as well as CO_2 treatment, conditioning and compression for export into a regional dense phase CO_2 Transport & Storage (T&S) system.

2. Purpose of this Document

Intrusive site investigations were conducted for the project by Geotechnics Ltd during September 2022. This investigation is described in, “Factual and Interpretative Report for VPI Immingham Ltd”, PY220483 dated November 2022. The report contains desk study, factual data and geo-environmental assessment.

A separate report, “Immingham Power Station Geotechnics Limited, Ground Investigation Report”, P22-039-R02 dated February 2023, issued under cover of Geotechnics Ltd subcontractor OTBe provides geotechnical interpretative recommendations.

These reports became available late in the FEED schedule so FEED was undertaken using geotechnical parameters derived from the information pertaining to the original construction of the CHP plant.

This original data consisted of:

- Conoco O&M VOL 159 which includes Foster Wheeler Energy Ltd. “Civil / Structural Design Guide” 9140-8310-SP-0001 Rev 01. Dated March 2002.
- Wilkinson Associates, “Report. Geotechnical site investigation CHP Development South Killingholme for Conoco Global Power Developments UK Limited”. 92-01-03 Dated 24 August 2001.

Both documents were reviewed and used to develop the summary data included in the Engineering Basis of Design (415000-00201-8820-PH-0001). It remains fully valid for the works undertaken during FEED.

This document summarises the geotechnical data applied to the FEED design and indicates where this deviates from recommendations stated or inferred in the latest reports. It then indicates the consequences in respect of EPC scope. Where possible, the FEED Material Take Off and subsequent estimate include relevant allowances and this is indicated in this report.

The scope of work for the geotechnical and geo-environmental assessments were presented in Worley document, “Contract requisition: Scope of Work for geotechnical investigation”, 415000-00201-8310-FS-001 Rev 4, Issued March 2022.

3. The works undertaken

Intrusive investigations commenced following mobilization on 5th September. The anticipated works were curtailed following a near miss incident.

The original scope and reduced scope are tabulated below:

Original scope	Scope as executed
20 Inspection pits to 1.2m depth	20 Inspection pits to 1.2m depth
20 Static cone penetration tests	10 Static cone penetration tests
5 Cable percussive boreholes to 25m depth	3 Cable percussive boreholes to 20+m depth 1 Cable percussive borehole abandoned at 0.9m depth due to obstruction
Disturbed samples from inspection pits	Disturbed samples from inspection pits
SPT testing on boreholes	SPT testing on boreholes
Collection of disturbed and undisturbed samples from boreholes	Collection of disturbed and undisturbed samples from boreholes
Installation of 5 standpipes for water monitoring	Installation of 2 standpipes for water monitoring
Laboratory testing of samples as scheduled in 415000-00201-8310-FS-001 and associated spreadsheet and subsequently modified by Geotechnics Ltd in agreement with Worley.	Laboratory testing of samples as scheduled in 415000-00201-8310-FS-001 and associated spreadsheet and subsequently modified by Geotechnics Ltd in agreement with Worley.

Please refer to the referenced reports for greater detail.

4. The recommendations

This section provides key recommendations and parameters required for design.

Parameter	Latest Recommendation	Parameter used in FEED	Action
Stratification	Varying thickness of Made Ground. Alluvium. Glacial Till. Chalk (at 16.0 to 18.7m depth) with possible "discontinuity" in North West..	Generally, as proven but chalk head discontinuity not anticipated.	To be further investigated by EPC through more extensive site investigation work.
Major foundation piling	Specific piling recommendations not made. Chalk identified at 16 – 18.7m depth. Anomalous feature identified to northwest with chalk head at 24.1 to 27.2m depth and requiring further investigation.	1000kN CFA piles 450mm diameter and 25m length end bearing into chalk. This is based on 1000kN piles being used on CHP at approx. 18m total length.	Further site investigation required to confirm Burnham Chalk Formation design parameters and establish required socketing. Basis of 1000kN is expected to be viable but length may vary.
Groundwater level	Water strikes at 7.0 to 18.7m depth but rising over time. Highest recorded level of 0.64m in BH01.	Groundwater assumed to be capable of rising to surface level	None required.
Ground bearing capacity for non-critical foundations	Not provided but "rule of thumb" of $2S_u$ could be used for indication. This would be 40kPa to 240kPa depending on soil at founding depth.	Not provided. Only major structures considered for FEED.	To be further investigated by EPC through more extensive site investigation work. Design of imported fill materials and selective site stripping is anticipated to allow for realistic support of noncritical structures etc.
SPT testing	Glacial Till (cohesive) 27 (Ave) Glacial Till (non-cohesive)	Not directly used.	No action required.

	23 Burnham Chalk 49 (Ave)		
SPT (etc.) Strength parameter correlations – Shear strength.	Undrained shear strength of Alluvium, C_u 20 to 50kPa (from Wilkinson report) Undrained shear strength of Glacial Till, C_u 122 (from SPT).	Undrained shear strength of Alluvium, C_u 20 to 50kPa Undrained shear strength of Glacial Till, C_u 90 to 175.	No action required.
SPT (etc.) Strength parameter correlations – Friction angle.	Effective angle of friction of Alluvium 25-30° Effective angle of friction of Glacial Till 25° (Ave)	Effective angle of friction of Alluvium 25° Effective angle of friction of Glacial Till 27 to 36°	No action required for FEED. EPC to review findings in Glacial Till and undertake further investigations and testing.
Working platform	Design to BR470 (2004) with C_u = 40 to 50kPa and soft spots removed and replaced with suitable fill.	Geogrid and 200mm type 1 granular mixture assumed for laydown on the basis that formation could be repaired during construction. This is supported by BR470 for a sample rig. Main development formed with import fill material of varying thickness under road and hardstandings.	No action required at FEED. EPC to develop working platform strategy specific to the equipment to be used.
Suitability for use as fill	Considered to be not suitable for re-use.	Material considered as not suitable.	None required.
Ground improvement	Improvement required with target of CBR > 8%	CBR values assumed to be adequate.	1m depth of ground improvement works has been added to MTO for FEED. EPC to develop strategy following further site investigation works.
Ground aggressivity	Design sulphate class DS-1 ACEC class AC-1 (i.e. Benign)	Non-aggressive.	None required.

Further investigations	BH at critical equipment to 30m depth (or deeper). A minimum of 10 No. trial pits to 3m depth. Onsite CBR and hand vane testing at shallow depth on roads. Waste acceptance testing of materials to be removed from site.	7 BH 34 CPT including seismic piezo cone tests. Ground resistivity.	EPC to plan a further site investigation based on the findings available to date and FEED layout etc. Scope should include both deeper boreholes and more near surface sampling and testing.

Immingham Power Station

Geotechnics Limited

Ground Investigation Report

Document No: P22-039-R02

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Issue and approval control sheet

Document title:	Ground Investigation Report
Document reference:	P22-039-P01
Project:	Immingham Power Station
Client:	Geotechnics Limited

Issued for/Revision details	Version No.	Date	Format
Draft	1	21/11/22	pdf
Final updated with Client comments	2	03/02/23	pdf

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Appendices

Appendix 1 – Borehole Location Plan and Geological Cross Section

Appendix 2 – Geotechnical Parameters

List of Abbreviations

bgl – below ground level

BGS – British Geological Survey

BRE – British Research Establishment

BS EN – British Standard European Norm

CIRIA – Construction Industry Research Information Association

CPT – Cone Penetration Test

EA – Environment Agency

GDR - Geotechnical Design Report

GIR – Ground Investigation Report

GI – Ground Investigation

MG – Made Ground

NERC – Natural Environment Research Council

OD – Ordnance Datum

OS – Ordnance Survey

1. Introduction

1.1 Project background

VPI Immingham LLP are proposing to redevelop the site as a combined heat and carbon capture facility. The site is located on land adjacent to the Humber Oil Refinery near Immingham, Lincolnshire. The development will comprise multistorey structures, earthworks, roadways, sumps and a storm pond.

Humber Zero is a combined set of projects that aim to decarbonise the industrial complex at Immingham, comprising VPI's 1260 MW Combined Heat and Power plant and the adjacent Humber Oil Refinery, operated by Phillips 66.

Humber Zero's initial phase focuses on the post-combustion carbon capture at VPI-Immingham. This phase will deliver up to 3.3 MTPA of abated CO_2 emissions via a post-combustion carbon capture retrofit to two gas turbines and two auxiliary gas boilers.

Shell have been selected as the carbon capture technology provider for the VPI-Immingham project.

Worley, as the selected FEED contractor for the VPI-Immingham project, will deliver an overall FEED package integrating the Shell Process Design Package (PDP). The project scope includes the existing site flue gas, utility and power tie-ins as well as CO_2 treatment, conditioning and compression for export into a regional dense phase CO_2 Transport & Storage (T&S) system.

1.2 Scope of work

OTB Engineering Ltd (OTB) have been commissioned by Geotechnics Limited to produce a Ground Investigation Report (GIR). Geotechnics have been selected as the Contractor to perform the ground investigation at this site for their Client - Worley. The scope of this GIR evaluates the available geological, geotechnical and geohazard data at the time of writing and provides recommendations for any further works or enquiries to be undertaken prior to the construction works.

This report has been written in accordance with the requirements of BS EN 1997-1:2004+A1:2013 and BS EN 1997-2:2007 whilst also taking into consideration the client's requirements for their scope of works for the ground investigation and subsequent reporting detailed in Document 415000-00202-8310-FS-001: Scope of Works for Geotechnical Investigation.

1.3 Existing structures

Present structures include those associated with the surface water drain that crosses the site, barriers associated with former roadways, and lamp posts. A boundary fence approximately 2.4m high separates land north of the surface water drain. Several pipes cross the site.

1.4 Geotechnical category

The combined heat and carbon capture facility is classified as a Geotechnical Category 2 structure (Brtish Standards Institute, 1997). There is negligible risk in terms of overall ground stability and ground movements as the structures will be constructed on Glacial Till. The cohesive layers of the Glacial Till acts as an aquitard, restricting ground water flow. Groundwater is found as perched groundwater in some of the discontinuous non-cohesive layers of Glacial Till.

A site-specific ground investigation has been undertaken with boreholes in the north and east of the site, and Cone Penetration tests (CPTs) across the site.

1.5 Limitations

This GIR has been written based on preliminary ground investigation data made available through the recent exploration activities. Due to the aborting of the ground investigation works on site before the completion of the investigation there is limited information on the ground conditions on the site and the geotechnical parameters of those materials.

Two of five cable percussive boreholes and 10no. CPTs were not completed on site, which in turn has left a large area, primarily the south-western section of the site uncovered by the ground investigation. Due to the inherent unpredictability of geological ground conditions in glacially affected regions, the conceptual ground models provided in this study cannot be confirmed without additional data collected in the missing areas.

This report will need to be reviewed and updated as appropriate when additional information becomes available.

2. Existing Information

2.1 Site description

The site is approximately triangular in shape with an area of 29.46 Ha. It is centred on National Grid Reference 516870, 416940. The site is currently not in use with the exception of active pipelines and infrastructure associated with oil refinery activities being undertaken nearby.

A shallow ditch crosses the site in a WNW-ESE orientation with a boundary fence to on its north bank. The majority of the north of the site is bare, with a veneer of gravel and areas of asphalt and concrete hardstanding associated with former roadways. The south of the site is heavily vegetated which was stripped back and partially flattened prior to the ground investigation to allow vehicular access.

The site is generally flat with an elevation of approximately 4mOD.

Figure 2-1 Site Location south of VPI. The site boundary is shown by the red line. Google Earth 2021.

2.2 Previous land use

Previous land use on and off-site is summarised below in Table 2-1 and 2-2 respectively. Historical maps showing the location of features can be found in Appendix 3 of the Desk Study for Proposed Combined Heat & Power and Carbon Capture Facility (Old Maps, 2019).

On-site features and description	Date appears on historical maps	Date no longer shown on maps
Field boundaries and a footpath located in the north	1887	Field boundaries – 1964 Footpath - 1971
Drain orientated approximately west-south-west to east-north-east.	1887	-
Pipelines marked as being present in the west and adjacent to the southern boundary in the west.	1973	-
Track shown adjacent to the drain crossing the site	1973	-
Several relatively small structures especially located in the northeast.	2006	2021

Table 2-1 Summary of pervious on-site land use (Old Maps, 2019)

Off-site features and description	Distance from site (m)	Direction from site	Date appears on historical maps	Date no longer shown on maps
Spring	~170	NE	1910	-
Surface water drains	Various	All	1887	-
Railway line (LNER – Ulceby & Immingham Line)	<5	Adjacent to S	1932	-
Evidence of earthworks to the east of Killingholme School	~300	E	1971	Shown as surface water feature surrounded by marshy ground to E and S in 2021.
Oil Refinery Complex including tanks, pipelines, drains, ponds/water tanks, flare stacks and chimneys	~250	W, NW, S and SW.	1974	-
Pipelines	<5	Adjacent to N and SW	1974	-
Additional Oil Refinery related infrastructure	<10	NW	2006	-

Table 2-2 Summary of previous off-site land use (Old Maps, 2019)

2.3 Pipelines

There are several pipelines passing through and close to the site which are summarised in Table 2-3, below. Several pipelines were observed close to the boundaries of the site with a mixture of above and below ground installations. It is also assumed that buried electrical and drainage pipes may be present close to these underground pipelines.

Description	Location
Disused above ground pipeline (P83334A). Purpose of pipeline unknown, marked as L.O.R.	Along northern and adjacent to eastern site boundaries.
Below ground pipeline. Marked as '8" Air Products Oxygen Line'	Adjacent to the southern site boundary.
Above ground pipeline. Marked as containing 3 separate pipelines transporting avtur (aviation fuel), gasoline and butane.	North-eastern corner.
Pipeline marked as 'Buncefield line' transporting unknown substances	
Pipelines transporting crude oil, distillate and motor spirit export.	

Table 2-3 Pipelines (Old Maps, 2019)

2.4 Geology

British Geological Survey (BGS) mapping and historical borehole records in the north of the site [3] show the superficial geology comprising Glacial Till with Alluvium/Tidal flat deposits in the central, eastern and southern parts of the site, and bedrock geology comprising the Burnham Chalk Formation.

The Alluvium/Tidal flat deposits comprise a soft silty clay with layers of sand, gravel and peat and overly the Glacial Till. The Till is typically unsorted, generally over consolidated heterogenous mixture of clay, sand, gravel and boulders. The bedrock is the Burnham Chalk Formation, which is typically a wite, thinly-bedded chalk with common tabular and discontinuous flint bands and sporadic marl seams.

2.5 Groundwater

The Envirocheck Report in the 2022 Desk Study [2] indicate that the superficial geology on site are classified as a Secondary undifferentiated aquifer (Alluvium) and Unproductive strata (Glacial Till), and the bedrock is a Principle aquifer.

The nearest surface water feature is an open drain located in the centre of the site orientated approximately west-south-west to east-north-east. The central and eastern parts of the site is at risk from 1:1,000 year surface water flood events with some smaller areas at risk from 1:100 and 1:30 year flooding from surface water events. The entire site is at risk of flooding from rivers or sea without defences (Zone 3) [3].

2.6 Ground investigations

A 2001 historical ground investigation [2] covering the northern section of the site and an area to the north was carried out by Wilkinson Associates, with partial Appendices available. The partially complete ground investigation comprised of:

- Six cable percussive boreholes to a maximum depth of 28.70m bgl, three of which had shallow groundwater and gas standpipes installed.
- Three shallower cable percussive boreholes to depths between 14.0m and 15.0m bgl.
- Four Cone Penetration Tests (CPTs) to a maximum depth of 21.58m bgl.
- Two seismic CPTs with shear wave velocity measurements.
- Four electrical resistivity tests using Wenner array.
- Six trial pits with field testing and soil sampling.
- Laboratory analysis of soil classification, strength and thermal conductivity of the materials.

The preliminary ground conditions that were encountered during the ground investigation have been summarised as alluvial deposits overlying thick layers of glacial till comprising various lithologies, which in turn overly a bedrock of Chalk.

3. Fieldwork and Laboratory Testing

The fieldwork was carried out between 5th and 14th September 2022 and comprised four Cable Percussive Boreholes to a maximum depth of 23.31m bgl and 10 Cone Penetration Tests (CPT) to a maximum depth of 15.30m bgl. CAT Scans were completed at each location, with hand dug inspection pits to 0.9-1.2m bgl.

Location of the exploratory holes and the detailed results of the strata materials, depths, level of changes, thickness of strata, samples and groundwater observations are given in the Engineer's logs included in the Appendices.

Samples were collected from the materials encountered for geotechnical testing. Environmental samples for testing were taken for a separate environmental report.

A testing programme was agreed with the Project Engineer and the tests were carried out as specified by BS EN 17892-12:2018, BS EN 17892-1:2014 and BS 1377:1990 Methods of Test for Soils for Civil Engineering Purposes.

The following were scheduled on the geotechnical samples:

- 15no. Water Content
- 15no. Atterberg Limits
- 7no. Particle Size Distribution (sieve)
- 5no. Particle Size Distribution (pipette)
- 3no. Oedometer
- 3no. Multistage Quick Undrained Triaxial
- 3no. Multistage Effective Stress Triaxial
- 1no. Compaction (2.5kg)
- 4no. compaction (4.5kg)
- 3no. California Bearing Ratio (CBR)
- 3no. Organic Content
- 3no. BRE SD1

4. Ground Conditions

4.1 Ground model

Information obtained from the previous ground investigations and the ground investigation on the proposed site has been supplemented with publicly available ground information. The ground model shown in Table 3-1 has been created using information from the site-specific ground investigation, BGS Geoindex (British Geological Society, n.d.) and historical exploratory hole logs. The exploratory holes are shown on the plans included in Appendix 1 along with four geological cross sections of the site.

Superficial/ Bedrock	Geological Unit	Geological Formation	Depth from (m bgl)	Depth to (m bgl)	Description
Superficial	Made Ground / Topsoil	N/A	Ground level	0.3 - 1.7	Mixed sands and gravels including sandstone, chalk, clinker, concrete and flint.
	Alluvium		0.3 - 0.6	1.2 - 2.5	Very soft to stiff mottled sandy slightly gravelly CLAYS with occasional rootlets, pockets of organic material.
	Glacial Till (cohesive and non-cohesive		1.2 - 2.2	16.0 - 18.7	Firm to stiff sandy gravelly CLAY with occasional non-cohesive material. Non-cohesive material is clayey gravelly SAND and clayey sandy GRAVEL. Gravels are of mixed lithologies.
Bedrock	Chalk	Burnham Chalk Formation	16.0 - 18.7	>23.31 Depth unproven	Structureless cream CHALK recovered as weak to moderately weak, medium to high density silty sandy gravel and some flint. CIRIA Grade V - VI

Table 4-1 Geological Ground Model

Made Ground is found across the majority of the site in varying thicknesses, with the greatest thickness in the north of the site. The Made Ground is expected to comprise of granular material composed of man-made materials mixed with local superficial deposits.

Alluvium is found in the east of the site and generally comprises very soft to stiff, mottled sandy slightly gravelly clays, with organic pockets to depths between 1.2m and 2.5m.

The Glacial Till underlies the whole site to depths between 16.0-18.7m bgl and generally comprises firm to stiff sandy, gravelly clay, with lenses of sands and gravels of varying depths and thicknesses between 0.2 and 1.44m. Within the predominantly cohesive glacial till deposits there are lenses of clayey gravelly sand and gravel of mixed lithologies. It is anticipated that these lenses are discontinuous across the site and have the potential to contain perched groundwater.

The Burnham Chalk Formation underlies the Glacial Till and comprises structureless weak to moderately weak, medium to high density chalk. The 2022 ground investigation highlights that the top of the Chalk is shown to be between 16.0m and 18.7m bgl (-12.3m to -15.0m OD). The grade of the Chalk has been determined between CIRIA Grade V – VI based on the Munford scale (CIRIA, 2002).

Historical boreholes conducted by Wilkinson Associates (2001) in the site to the north of the current proposed site show the top of the Chalk to be significantly lower, at between 24.1m bgl (WA. 2001 – BH25) and 27.2m bgl (W.A. 2001 – BH24). When compared with the investigation data collected in 2022 by Geotechnics, the difference in geological strata levels may suggest the presence of a fault or a glacially influenced feature such as a large chalk raft or a deep scour feature in the top of the bedrock. Further deep ground investigation would be required across the site to determine the geometry and nature of this feature.

4.2 Groundwater

Water strikes were recorded in three Cable Percussive Boreholes and summarised in Table 4-2.

Exploratory Hole ID	Strike depth (m bgl)	Strike depth after 20 min rise (m bgl)	Strata	Remarks
BH01	9.9	8.9	Cohesive Glacial Till with frequent lenses of sand	Moderate inflow
	14.9	1.7	Non-cohesive Glacial Till	Fast inflow
BH02A	7.0	No rise.	Cohesive Glacial Till	Seepage
	13.1	No rise.	Cohesive Glacial Till	Seepage
	18.7	3.9	Chalk	Fast inflow
BH05	12.5	11.5	Cohesive Glacial Till	Moderate inflow
	15.0	5.0	Chalk	Fast inflow

Table 4-2 Groundwater strikes

Groundwater strikes were encountered in both the Glacial Till, with the fastest flow associated with granular layers, and in the Chalk. Standpipe piezometers were installed in two of the boreholes during the 2022 ground investigation. The groundwater monitoring data from these boreholes is summarised below:

Exploratory Hole ID	Response Zone (m bgl)	Depth to water (m bgl)			
		30 Sept 22	7 Oct 22	13 Oct 22	31 Oct 22
BH01	9.0 – 10.0	0.64	1.73	0.92	0.96
BH02	18.4 – 19.4	1.81	1.02	1.74	1.70

Table 4-3 - Groundwater Monitoring Data

It can be seen from the monitoring data that the groundwater pressure head within the Burnham Chalk Formation is approximately 1.5bar (15m of head).

5. Geotechnical Properties

SPT tests were undertaken within each borehole at regular 1.5m where undisturbed samples were not collected, allowing for the selection of soil strength and stiffness parameters based on SPT N value relationships. Interrogating the SPT N values, correlations are made between the representative classification data and SPT N_{60} values to provide indicative strength parameters with characteristic geotechnical properties summarised throughout the tables below.

The parameters provided below are based off the geotechnical testing that was carried out from the Geotechnics 2022 GI before the early termination of the investigation. The ground investigation was terminated before it was complete due to encountering a gas main running through the site, therefore there was a limited number of samples, primarily undisturbed samples collected from site to conduct testing on. Where possible, widely known references and parameter correlations have been used to provide a full suite of parameters for the site.

OTB have also reviewed a previous ground investigation and its related reports conducted by Wilkinson Associates (2001) for the Conoco Global Power Developments UK Ltd site located directly to the north of the site. A review of the data within the report highlights similar materials were encountered, with the only main difference being the level to the top of the chalk bedrock boundary. Geological cross sections of the area suggests an approximate 8m level difference in the Chalk boundary over approximately 140m The report provides some recommendations for Engineering Design Parameters in Table 3: the geotechnical parameters have been derived from in-situ and laboratory tests as well as correlation with literature; however, no reference has been made to which parameters have been derived from site specific testing. These parameters have been considered by OTB and used where appropriate for this report. Where these parameters have been used due to the limited test data for this GI, reference to the report has been made.

5.1 In-situ testing

SPT tests were conducted throughout the superficial deposits and underlying Chalk present at the site to a depth of 20m bgl. A summary of SPT N_{60} values are included in Table 5-1 for each unit and plotted with Depth in Appendix 2.

SPT N_{60}	Glacial Till (cohesive)	Glacial Till (non-cohesive)	Burnham Chalk Formation
SPT N_{60}	12 to 55 Av: 27	23	36 - 61 Av: 49

Table 5-1 Summary of In-situ test results. Av = Average,

5.2 Classification parameters

A range of classification tests were conducted on the three boreholes undertaken during the recent ground investigation with the results displayed in Table 5-2 below. Only moisture content tests were undertaken on samples of the chalk bedrock encountered at the site.

Geology	Moisture Content w (%)	Plastic Limit P_L (%)	Liquid Limit L_L (%)	Plasticity Index I_P (%)	Bulk Density ρ (Mg/m^3)	Dry Denisty P_d (Mg/m^3)
Alluvium	10 - 41 Av: 28	17 - 36 Av: 26	45 - 98 Av: 65	28 - 62 Av: 40	-	2.06
Glacial Till (cohesive)	10 – 20 Av: 14	12 – 18 Av: 16	26 – 38 Av: 32	12 – 20 Av: 16	2.21 – 2.25 Av: 2.23	1.79 – 2.10 Av: 2.00
Chalk	16 – 19 Av: 17.5	-	-	-	-	-

Table 5-2 Summary of indicative Classification parameters

Av = Average

Plots of water content vs depth with liquid limit and plastic limit ranges and density vs depth can be found in Appendix 2. The plots indicate the glacial till deposits encountered show a fairly similar range of liquid and plastic limits, whereas the variation in the alluvial materials is greater. This is assumed to be caused by shallow, perched groundwater found in these deposits causing localised softening and increased water content of the ground.

The bulk and dry densities of the glacial till deposits also show a fairly uniform range of values with the average results of 2.23Mg/m^3 and 2.00Mg/m^3 for bulk and dry density respectively.

Particle Size Distribution (PSD) plots (2no.) show that the cohesive glacial till deposits are comprised predominantly of clay and silt with low percentages of sands and gravels (15% and 4% respectively).

5.3 Strength & stiffness parameters

Relationships between SPT N values are documented by Clayton (Clayton, 1995) and have been used to provide characteristic strength and stiffness parameters including undrained shear strength c_u, effective angle of friction Φ' and undrained modulus E_u summarised in Table 5-3.

The N_{60} values through the cohesive glacial till show an increasing N relationship with depth below the superficial deposits as shown in Appendix 2. A Stroud factor (Stroud, 1989) f_1 = 4.5 for assumed high plasticity clay was adopted for the determination of c_u.

The undrained modulus correlation used for the glacial till deposits has been taken from Jamiolkowski et al., 1979 (Barnes, 2000) using a plasticity index <30% and an Over Consolidation Ratio (OCR) <2.

Soil Strength Parameter	Superficial Deposits		Bedrock
	Alluvium	Glacial Till	Chalk
Undrained Shear Strength c_u ii (kPa)	20 – 50* *Wilkinson Associates Report values	Triaxial Results – 90 – 162 (4) Av. 132 SPN N_{60} – 70 – 223 (14) Av. 122	Triaxial Results – None SPN N_{60} – see text below
Effective angle of Friction Φ' i *(°)*	25 – 30* *Wilkinson Associates Report values	24 – 27 (3) Av. 25	-
Undrained Modulus E_u iii *(Mpa)*		$600.c_u$ iii	$300.c_u$ iii

Table 5-3 Summary of indicative characteristic strength / stiffness parameters based on SPT N correlations

I = direct test result
ii = relationship with SPT N_{60}
iii = Undrained modulus correlation from Jamiolkowski et al., 1979 (Barnes, 2000)

The results for the SPT correlation for N_{60} with undrained shear strength for the Chalk bedrock (highlighted in red in Table 5-3 above) is recommended with caution. Stroud's research (1989) recommends a correlation factor (f_1) of 25 for chalk bedrock. However, this correlation does not define what classification of chalk this is appropriate for. The paper states "*N is also likely to vary from one chalk to another even if the degree of weathering is the same (as measured by fracture spacing etc) if the strength of the intact Chalk itself varies*". It is assumed from the test data used in Stroud's research, based off description and location of the test sites, that the chalk was a better-quality grade than the material found during the 2022 investigation. Therefore a reduced Stroud f_1 is likely to be more appropriate.

Modern research into chalk deposits and its engineering qualities is provided in CIRIA guide (2002) on Engineering within Chalk. This document provides guidance on Piled Foundations in Chapter 8.0 where it details guidance on the shortcomings of using SPT N values of the bedrock material for use in foundation design and strength correlation. It is no longer recommended to rely solely upon SPT N counts for use in pile design.

Due to the lack of undisturbed samples collected in the chalk bedrock, the Graph detailing Undrained Shear Strength vs. Depth (m bgl) is included in Appendix 2. Data from the SPT N_{60} results from the chalk bedrock is included in this plot using a reduced f_1 Stroud Factor of 4.5 due to the extremely poor grade of chalk present at the site. As detailed in the text above, no indicative design line for strength has been provided for these results due to the recommendations from CIRIA (2002) to not solely use SPT tests for use in foundation design. This is discussed further in Section 7.1.1.

5.4 California Bearing Ratio (CBR)

Three laboratory California Bearing Ratio (CBR) test were carried out at shallow depths in a range of materials as seen in the table below:

Geology	CBR Top (%)	CBR Base (%)
Made Ground	57	41
Alluvium	0.96	0.96
Glacial Till	1.8	1.8

Table 5-4 - Summary of CBR tests

The CBR value for made ground shows an abnormally high result which may be the result of the test being carried out on a sample that contains inorganic, hard materials and will be discounted from average values. The following analysis is based on the Design Manual for Roads and Bridges: CD 255, Design for new pavement foundations, p10.

It can be assumed that subgrade surface modulus is;

$$E = 17.6(CBR)^{0.64}$$

Therefore E at the site is between 17MPa for Alluvium and 25.6MPa for Glacial Till. The minimum permitted Design CBR is 2.5% according to the Highways Agency for use as subgrade material for pavements.

Where the subgrade is lower than this value, it is considered unsuitable support for a pavement foundation; consequently, it must be permanently improved. Details on ground improvement for the site are detailed further in Section 7.

5.5 Ground Aggressivity

Analysis of the sulphate and pH levels from samples of both soil and groundwater from the made ground and river terrace deposits show the Aggressive Chemical Environment for Concrete (ACEC) for the site have a Design Sulphate Class of DS-1 and a ACEC class of AC-1 (BRE Construction Division, 2005).

6. Geohazards

Several geohazards may exist within the vicinity of the proposed works due to regional or local variations to the expected ground conditions. The geohazards considered relevant to the project are discussed below and there may be a requirement for further work to investigate and reduce risks to the scheme.

- Mixed Lithologies – Both cohesive fine soil and non-cohesive soil materials are anticipated within the area of the proposed works. Sand and gravel lenses have been identified within the exploratory holes conducted on site. The thickness and extent of these lenses has not fully been identified across the site, however analysis of the CPT data also shows them present across much of the site at shallower depths. It is possible that these lenses will be relatively small and discontinuous in nature. However, it is also possible that larger, thicker layers will be present that may also be water bearing.

- Unexpected ground obstructions – There is a risk of encountering obstructions contained within the made ground deposits including brick and concrete as encountered during the recent drilling and early termination of exploratory borehole BH02A.

- Rockhead anomalies – Irregular rockhead surface formed due to tectonic structures, and minor ice features or a combination of these that may have modified the ground conditions at the level of the bedrock boundary and is considered to be anomalous. Variations in bedrock boundaries have been identified at the site, however due to the lack of deep exploratory boreholes it is not possible to accurately predict where these variations in boundaries may occur.

- Scour hollows – Erosional depressions in the solid geology formed during periods of higher energy surface water run-off and commonly attributed to rivers flowing during glacial periods. These depressions are commonly infilled with sands and gravels (glaciofluvial deposits) making predictions of their location and extent difficult.

- Unexploded Ordnance – Historically, the land surrounding the site contained documented Luftwaffe targets during World War II due to the industrial nature of the area. These targets are outside a 500m radius of the site, however it should still be considered that there is a possibility of encountering UXO on site.

7. Foundation Design Considerations

Following the conclusion of this preliminary ground investigation at the site, a conceptual ground model and initial preliminary geotechnical parameters have been provided in Section 4 and Section 5 respectively in this report.

Due to the early curtailment of the ground investigation and, therefore, the limited number of geotechnical samples collected, only a small range of strength testing could be carried out on the materials at the site. The design of the ground investigation has also not allowed for collection of adequate samples within the chalk bedrock; consequently, no strength testing has been conducted in the chalk. This is discussed further in Section 8 – Further Ground Investigation Recommendations.

After a review of available documentation on the preliminary structural plans for the site, it is evident that the structures range from complex deep foundations to shallow foundations, earthworks and pavements. Document No. 215000-00201-8310-PH-0001 – *Site Development Aspects for Geotechnical Recommendations* has been provided by Worley which provides initial details for the most critical and complex structures present on site. These are as follows:

- Absorbed tower (SR No. 2)
    - Concrete structures 19m2, 65m in height. Estimated weight of 65.2MN and imposed load of 37.3MN

- CO_2 Compressor (SR No 19)
    - Housed in sheds with overhead travelling cranes.
    - Compressor size estimated at 19m by 13m with an estimated weight of 600kN.

- CO_2 Stripper column (SR No. 12)
    - Process columns are located at height within a multistorey structure with structural columns braced in both directions and supported on pile caps.
    - Estimated maximum vertical load in the columns of 8,000kN, estimated horizontal forces per pile less than 50kN.
    - Column spacing approximately 10m by 10m.

- Piperacks
    - Traverse the site in multiple locations.
    - Column loads estimated between 500kN to 750kN at 8m cross spacing and 10m longitudinal spacing.

The recent 2022 GI exploratory hole layout has been overlain on the general arrangement layout drawing provided by Worley in Figure 7-1 below. The critical structure above have been highlighted in red boxes with the relevant SR number designations. The substation buildings are highlighted in yellow boxes.

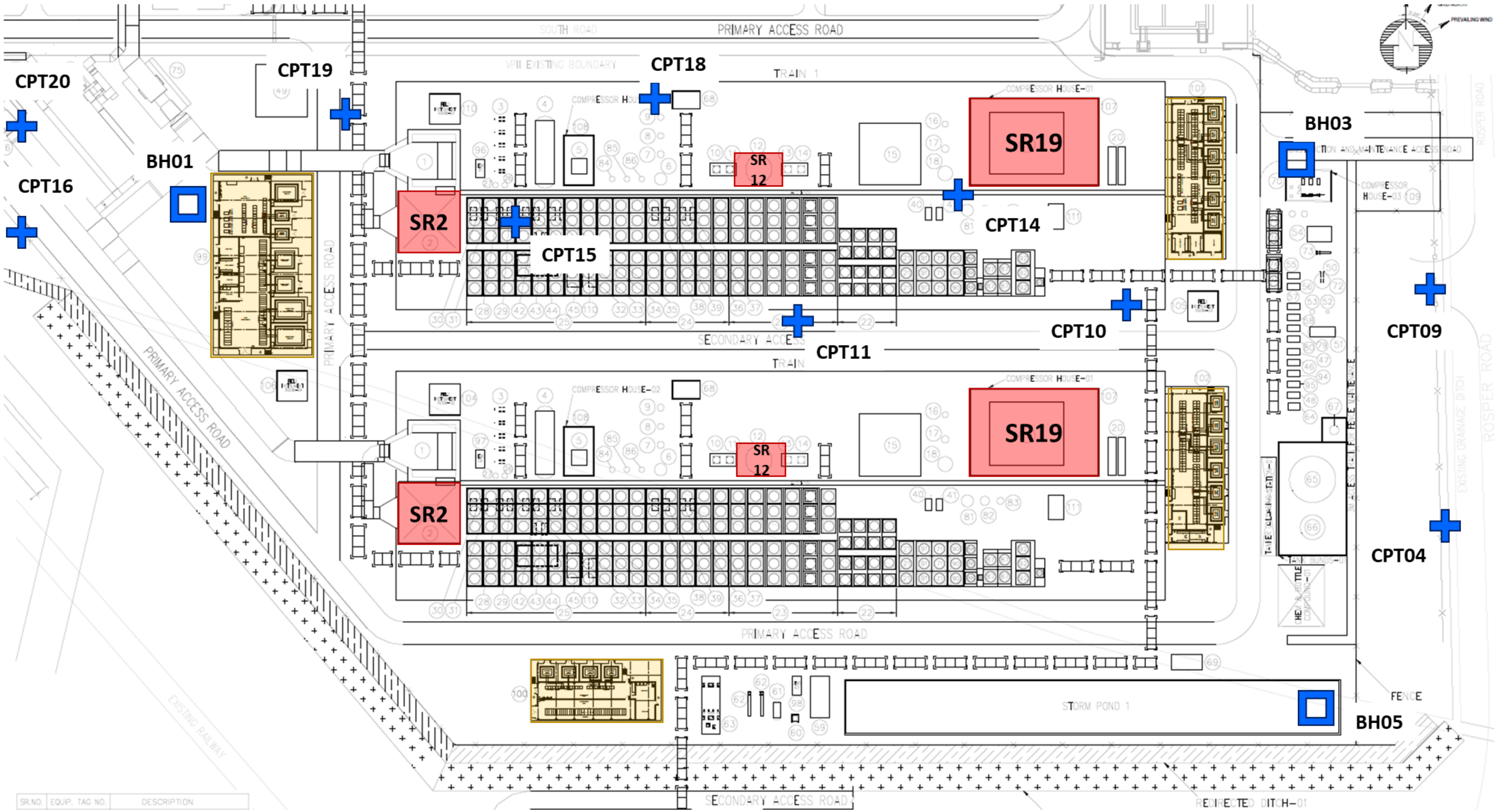

Figure 7-1 - 2022 GI exploratory hole layout

7.1 Preliminary Foundation Recommendations

7.1.1 Deep Foundations

Based off the information provided on the critical structures it is recommended that these structures are founded on piles assuming end bearing in the chalk bedrock. Driven piles are not recommended for this site; therefore, bored or Contiguous Flight Auger (CFA) piles would be considered a more suitable selection. Records show that the site directly to the north has its large, highly loaded structures founded on deep CFA piles.

The depth to top of chalk bedrock at the site varies from 16.0m bgl to 18.7m bgl and is described as structureless cream CHALK recovered as weak to moderately weak, medium to high density silty sandy gravel and some flint. The material is considered to be a Grade V to VI according to the Munford Scale (CIRIA, 2002). There were no samples recovered from the chalk during the 2022 that would allow for strength testing of this material. As detailed in Section 5.3 – Strength and Stiffness parameters, the use of designing foundations in Chalk based off SPT N results alone is not recommended due to a number of factors that make the results highly unreliable (CIRIA, 2002).

Further deep glacial till and chalk bedrock strength testing would be required to further design of the deep foundations for the required structures on site. This is discussed further in Section 8.

7.1.2 Shallow Foundations

Limited information for the other structures proposed for the site has been provided, but are assumed to relatively small, simply loaded and not highly sensitive to settlement and, therefore, shallow foundations are likely to be suitable. However, this assumption will need to be validated during the design process and foundations selected accordingly.

It is recommended that shallow foundations bear onto the glacial till; consequently, removal or conditioning of the overlying layers of made ground and softer alluvial clays and silts may be required. This is to be assessed on a structure-by-structure bases during detailed design.

Correlated SPT N_{60} vales for the upper 6m of glacial till indicates a characteristic shear strength between 70kPa and 120kPa. The shallowest triaxial test for the glacial till is located at 10.55m bgl with a characteristic undrained shear strength of 116kPa. Further shallow triaxial testing would be required for detailed foundation design.

7.1.3 Working Platforms

Working platforms should be designed in accordance with B470 (2004) – Working Platforms for Tracked Plant. For a working platform, the soil and groundwater conditions in the upper 2-3m of ground are of particular importance.

The presence of soft to firm, alluvial silts and clays and pockets of perched groundwater, which has been encountered across the site will have a great impact on the design of the working platform due to the softening of the subgrade material. The design calculations for the working platforms in B470 (2004) uses undrained shear strength of the material for use in the bearing resistance calculations.

Due to the lack of test data (in-situ and laboratory) at these shallow depths, it is reasonable to anticipate a characteristic undrained shear strength of 40-50kPa for the purpose of the working platform design. These values are based on the correlation between material description and their general related strength (Barnes, 2000).

Due to the variability of the subgrade materials, there is potential for localised soft spots that will require excavating and replaced with suitable engineered fill that is compacted sufficiently.

7.2 Ground Improvement

As detailed above in Section 5.4 – California Bearing Ratio (CBR) test results, the samples tested on site have produced lower than anticipated values for the alluvium (0.96%) and upper glacial till deposits (1.8%). The minimum permitted Design CBR is 2.5% according to the Highways Agency for use as subgrade material for pavements. Where the subgrade is lower than this value, it is considered unsuitable support for a pavement foundation; therefore, it must be permanently improved.

Industry standards suggest a minimum CBR value of 8% should be achieved for use in construction roads, which reduces the thickness of the sub-base or capping design to an acceptable level of approximately 200mm.

Options for improvement of the subgrade include excavation and replacing between 500 to 1000mm of the soft subgrade with granular fill, mechanical stabilisation (geogrids and/or geotextiles) and soil stabilisation/mixing. The upper limit on the design surface modulus for areas of improvement of the subgrade should be 50 MPa (DMRB, 2020). A testing regime shall then be detailed to establish the construction subgrade surface modulus. The method chosen should be suitable to improve the bearing resistance of the ground to a CBR value of 8%.

It is detailed that across the site, areas of imported fill will be required to marginally raise the site to construction features such as drainage slopes. It is expected that there will be a minimum of 300mm of topsoil stripping and a maximum depth of fill would be 1.0m. Due to the predicted low bearing resistance of the materials on site, the upper layers of soft material may be required before the imported fill is lain on site.

It is recommended that additional on-site CBR and in-situ hand vane tests are conducted at various locations across the site prior to a method of ground improvement being selected. This will provide a more accurate predicted model of the subgrade materials on site. On-site CBR tests, generally are carried out along the centreline of the proposed construction at 20-30m intervals.

Following the re-testing of the existing material and the trial areas of ground improvement, trials of the ground improvement should then be carried out to recheck the measured improvement in the bearing resistance of the ground.

7.3 Earthworks and Excavations

The proposed site will be laid to fall towards the south east so that the site follows the natural ground slope. An existing drainage ditch runs across the site which is to be diverted to the south of the development. The existing ditch alignment will be excavated to remove soft material and backfilled with appropriate engineered fill.

Various sumps are required across the site for collection and storage of oily water and chemically contaminated water. The major below ground level earthworks structure is the storm water balancing pond. This pond is required to hold water for major storm events, the initial design details for this pond is approximately 4m in depth and 34m in length. It is anticipated that the pond will be constructed from driven sheet piles with a concrete base slab that may require tension piles to resist uplift forces.

7.3.1 Slope Stability

Slope stability assessments of the proposed earthworks and excavations will be required for the detailed design phase of the project when requirements and loadings are better understood. Characteristic geotechnical parameters that can be used in slope stability assessments have been provided in Section 5. However, additional targeted GI at location of slopes is recommended to obtained more representative site/location specific parameters.

7.3.2 Material Re-use

Initial testing of the sub-surface made ground and alluvial material on site would suggest that it is not suitable for re-use in earthwork structures for the proposed development due to its low strength and presence of organic material. Following additional geo-environmental testing of the material, it would be recommended that that material is used for landscaping where possible or removed from site to an appropriate landfill.

The deeper glacial till material may be suitable for use in earthwork structures with angles no greater than 25° based on the internal friction angle of the laboratory test results. Any excavated material should be appropriately examined and tested to determine its suitability for re-use in the earthworks.

8. Further Ground Investigation Recommendations

Following the review of the ground investigation data collected in the 2022 investigation that was aborted before completion, it is recommended that further targeted GI is completed to be able to further design of the structures proposed on site.

The original scope of the ground investigation included a larger number of boreholes and CPT exploratory holes across the site which was later reduced. The original scope of the ground investigation did not include deeper exploration into the chalk bedrock which should be reconsidered for the Phase 2 GI. It is recommended that the Phase 2 GI is designed according to the specification listed in Eurocode 7.

OTB's recommendations for the Phase 2 GI include (but are not limited to) the following key points:

- Cable percussive with rotary follow on boreholes that extend into the chalk bedrock
  - These should be located at each of the critical structures identified by Worley (absorber towers, CO_2 column strippers and CO_2 compressors).
  - The borehole depth according to Eurocode 7 should be determined based on the length of the proposed piles + 5m or 5 times the diameter of the base of the pile.
  - High quality rotary coring of the chalk bedrock is required to conduct rock strength testing on the material to get strength and stiffness parameters.
  - Alternating SPT and undisturbed samples collected throughout the hole for use in triaxial testing to gather further information on the strength of the materials on site.
  - Deep and shallow groundwater installations will be required in all boreholes.
- Additional cable percussive boreholes to top of bedrock should be conducted across the site to comply with borehole spacing as defined in Eurocode 7.
- A minimum of 10no. trial pits across the site to a minimum depth of 3m to take geotechnical samples of the subsurface materials for testing
- A suite of onsite CBR tests and hand vane tests of the subsurface materials at shallow depth to be conducted along the centreline of the main road/pavement structures through the site.
- WAC testing of the made ground, alluvial and glacial till deposits to ensure compliance with removal and disposal of the material off site.

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Appendices

Appendix 1

Borehole Location Plan and Geological Cross Section

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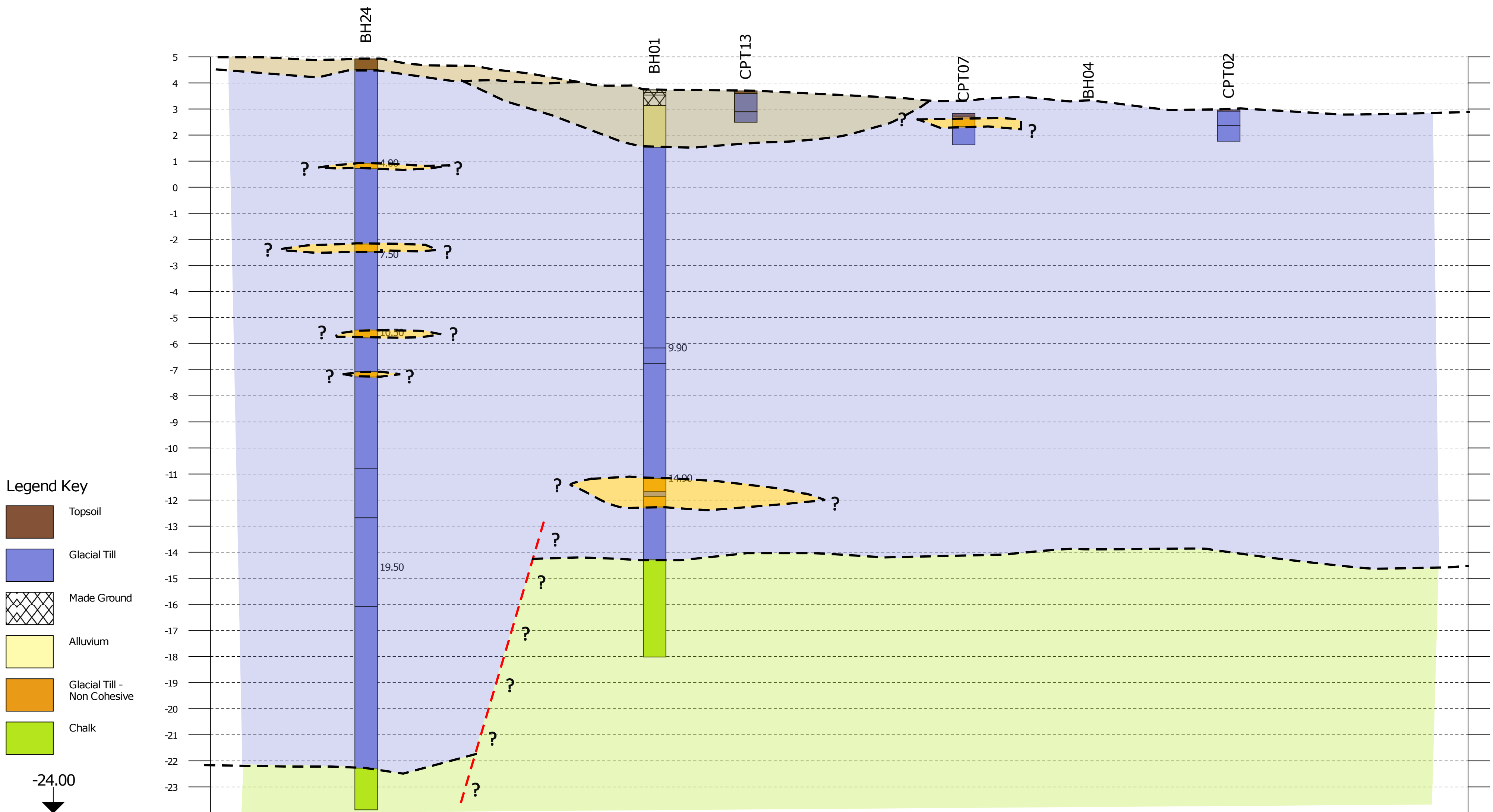
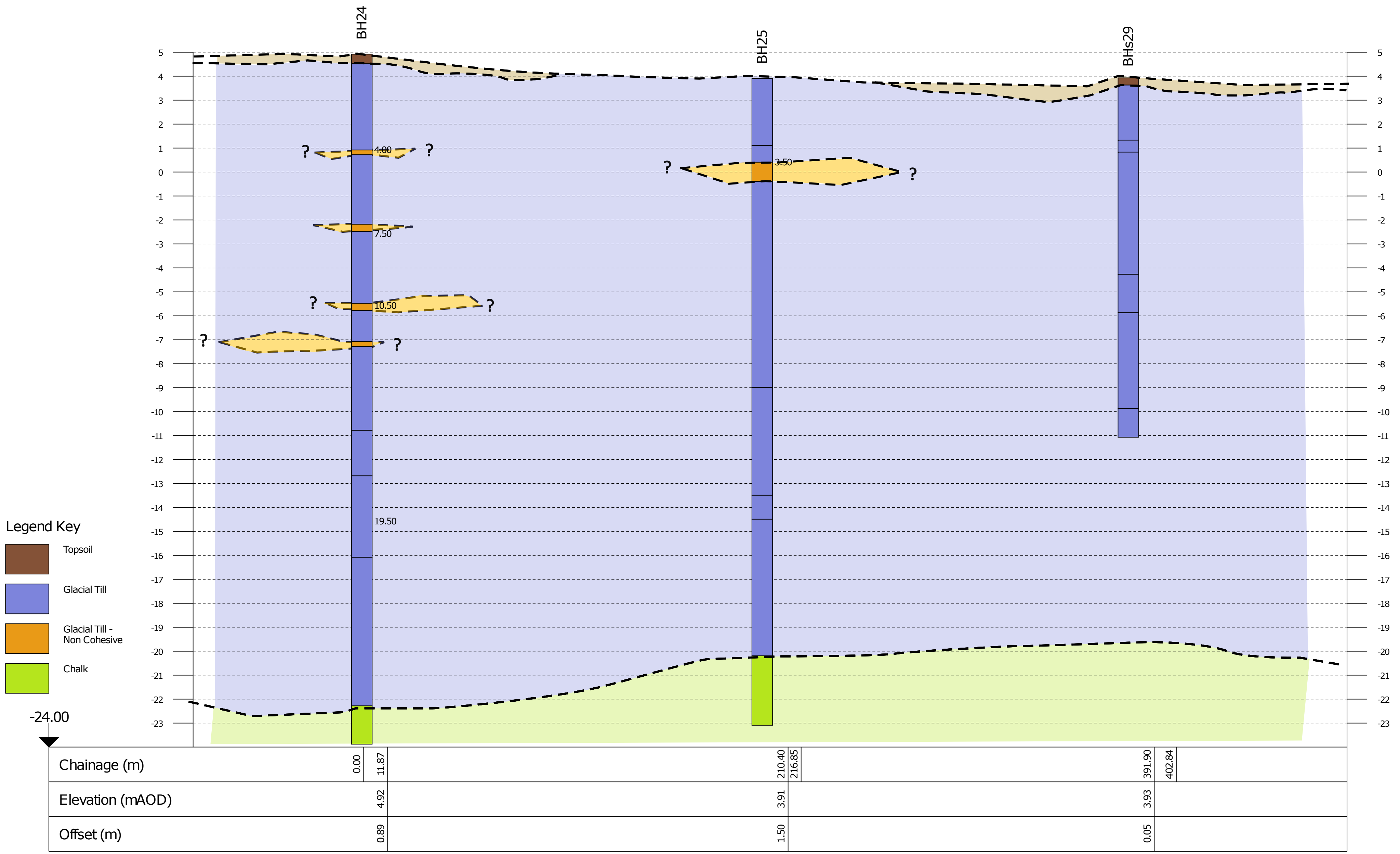
Project Title: Immingham Power Station	Vertical Scale: 1:216
Location: Immingham	Horizontal Scale: 1:2891
Client: Geotechnics	Engineer:



Chainage (m)	[illegible]	[illegible]	193.73	305.55	[illegible]	441.53	454.33
Elevation (mAOD)	4.92	3.73	3.69	2.83	2.78	2.96	
Offset (m)	1.60	2.48	22.08	20.15	2.18	5.76	

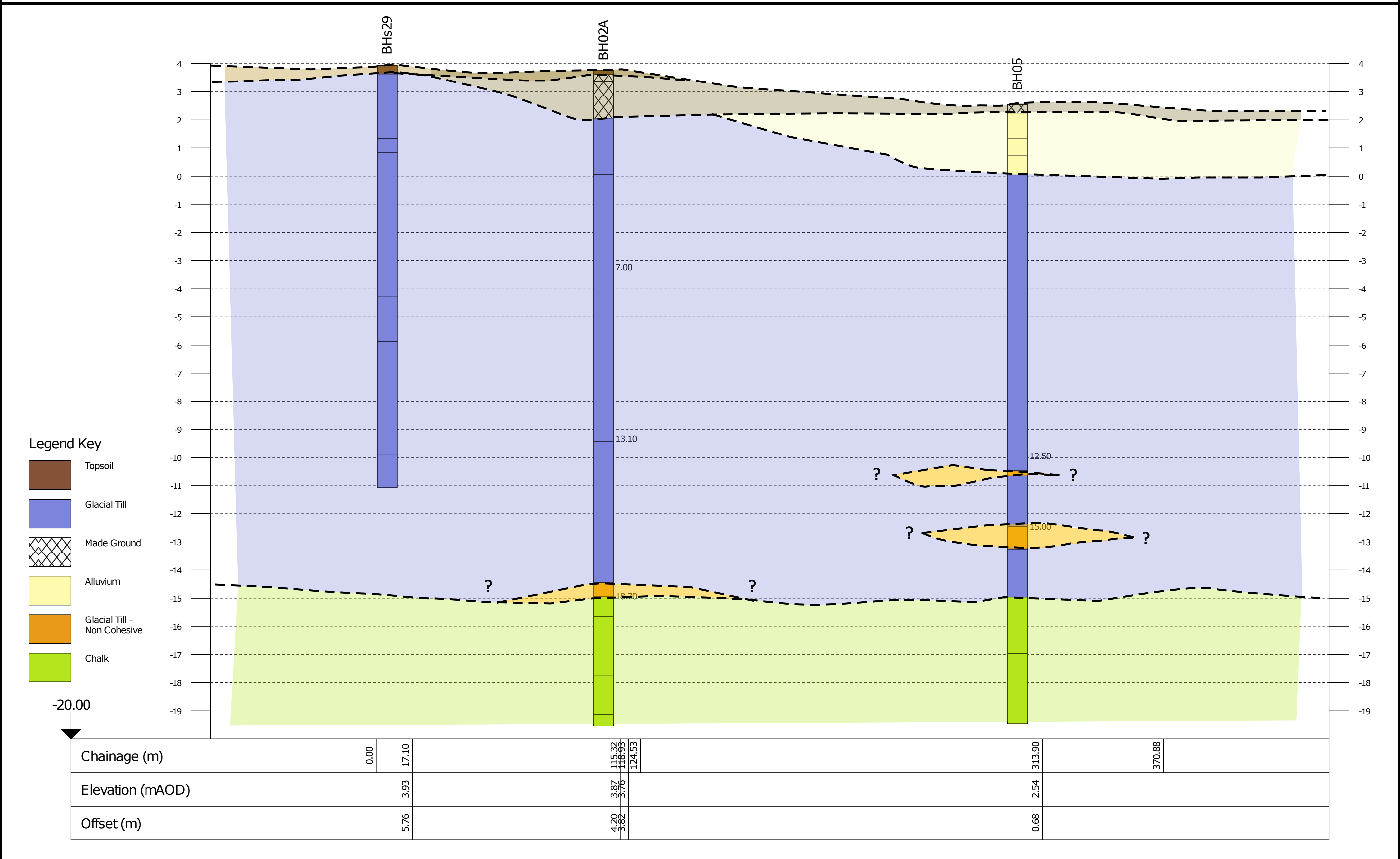
Project Id: P22-039
Project Title: Immingham Power Station
Location: Immingham
Client: Geotechnics

Title: Section Line
Vertical Scale: 1:216
Horizontal Scale: 1:2563
Engineer:



Project Id: P22-039
Project Title: Immingham Power Station
Location: Immingham
Client: Geotechnics

Title: Section Line
Vertical Scale: 1:178
Horizontal Scale: 1:2360
Engineer:



Project Id: P22-039

Project Title: Immingham Power Station

Location: Immingham

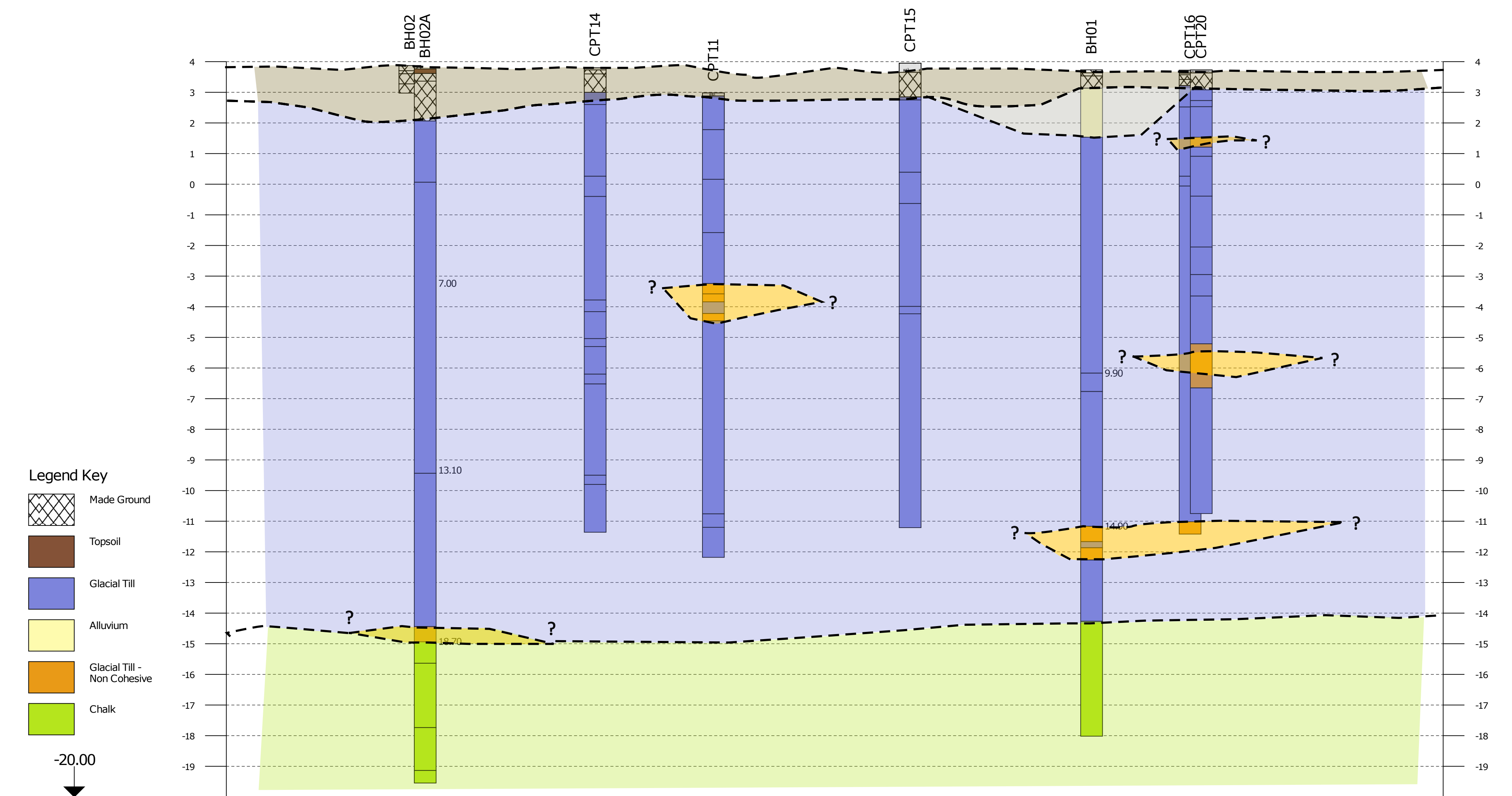
Client: Geotechnics

Title: Section Line

Vertical Scale: 1:178

Horizontal Scale: 1:2841

Engineer:



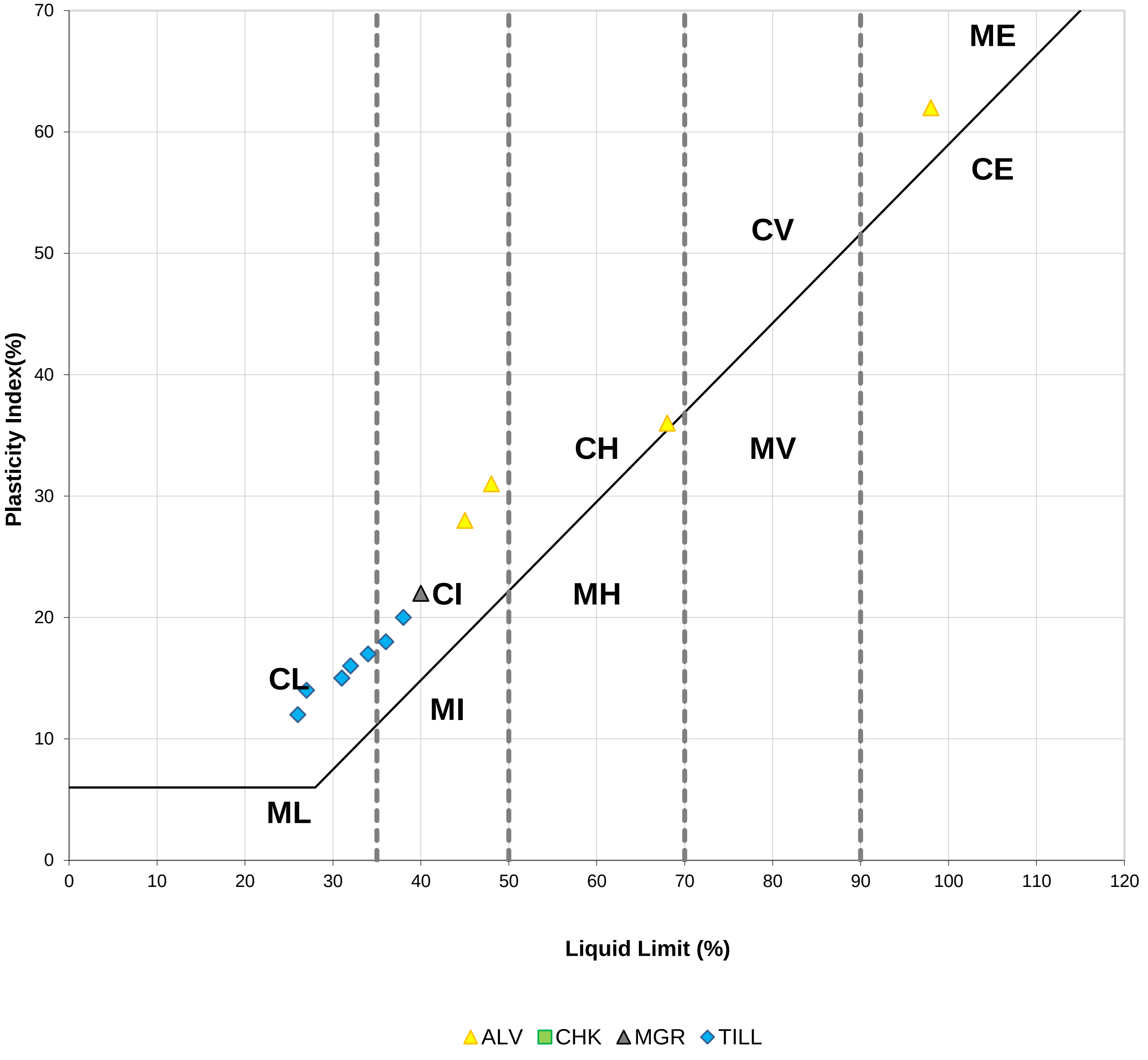
Chainage (m)	0.00	16.08	24.08	112.65	174.25	183.75	191.73	276.79	371.35	422.68	428.50	446.46
Elevation (mAOD)		3.87	3.76	3.80	2.98		2.85	3.95	3.73	3.72	3.73	
Offset (m)		1.74	5.40	21.05	16.57		6.57	17.14	4.08	15.50	20.35	

Appendix 2

Geotechnical Parameters

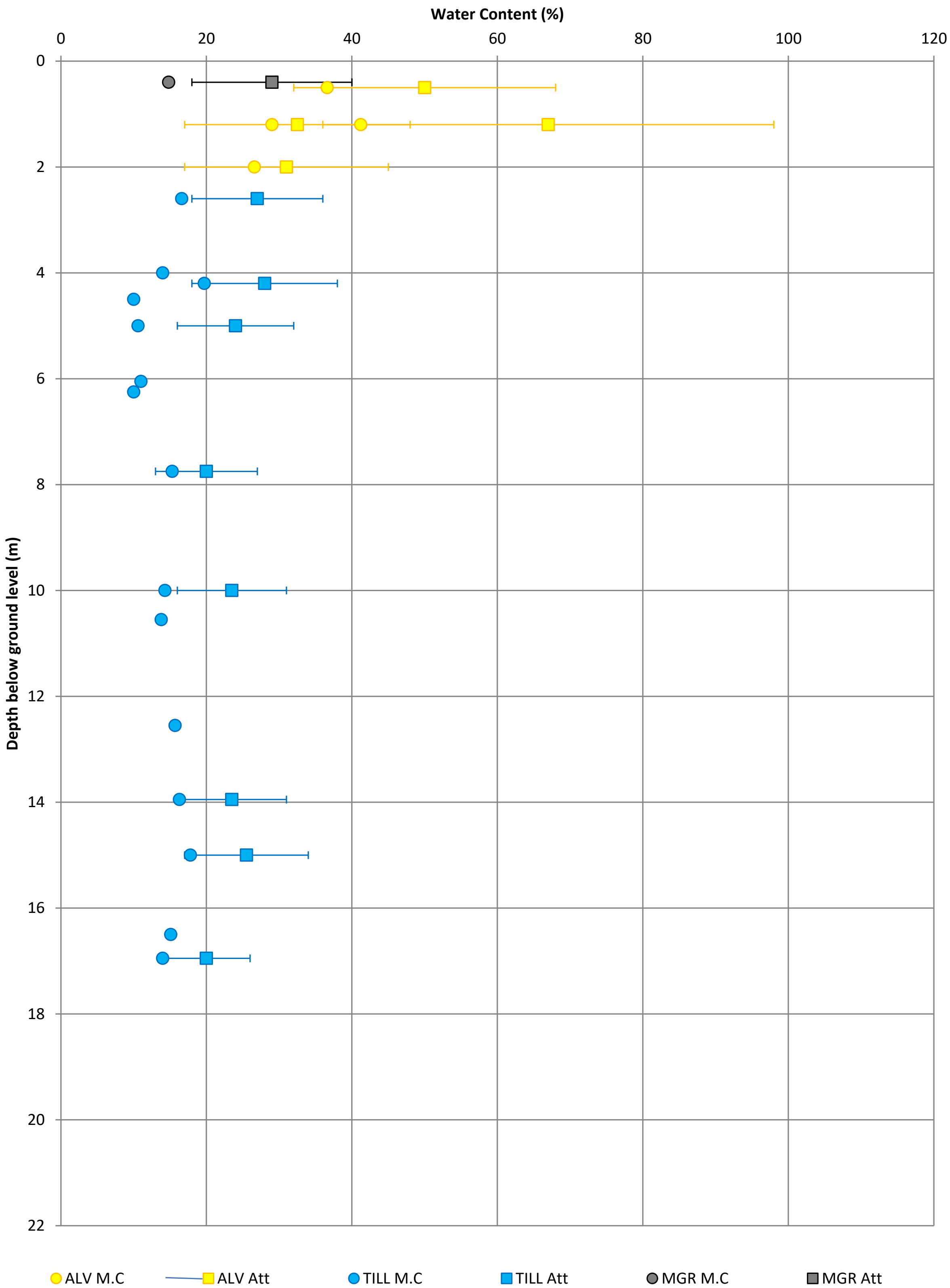
A Line Plot

Project ID: **P22-039**	Project Title: **Immingham Power Station**
Client: **Geotechnics**	Location: **Immingham**

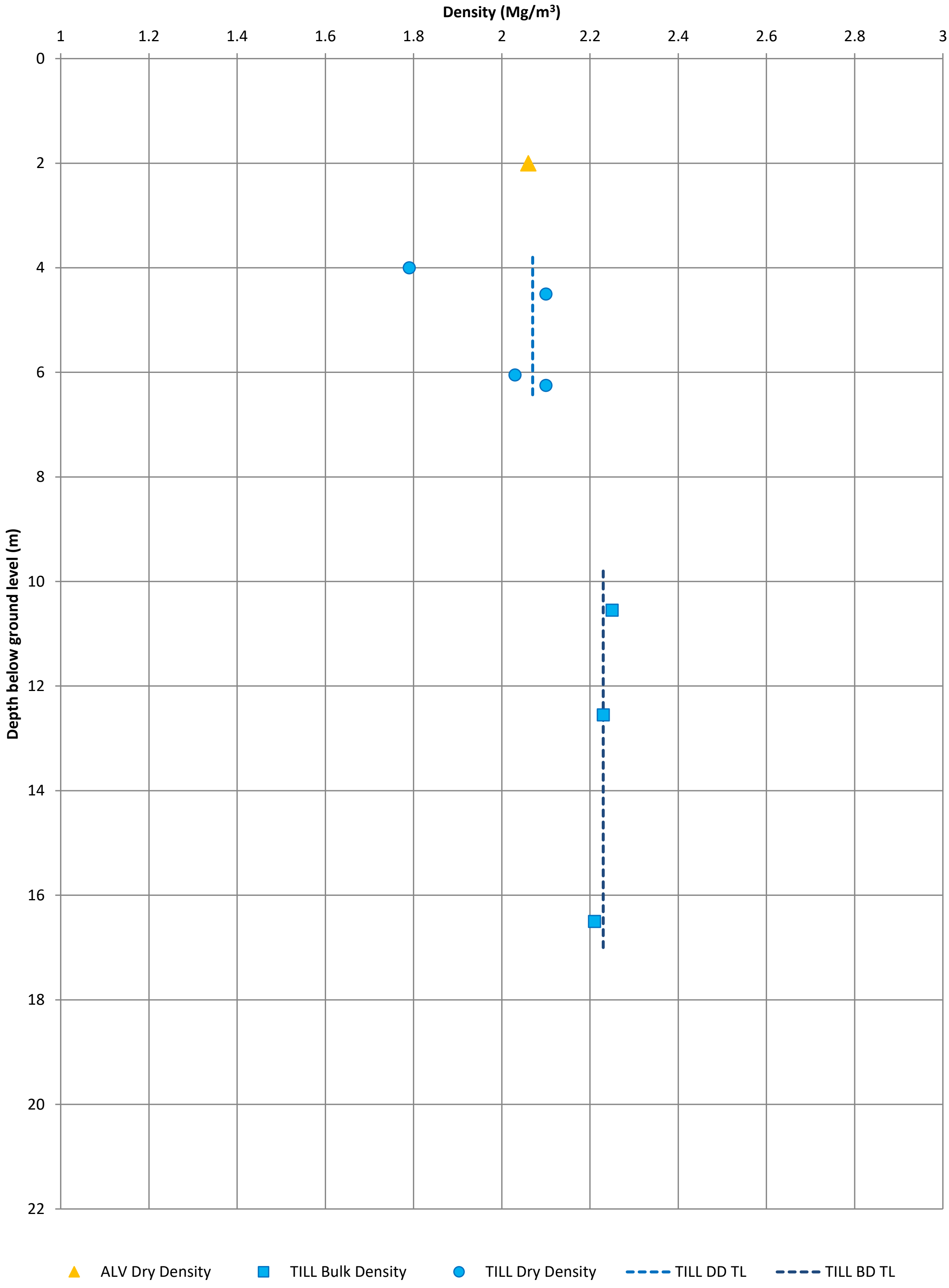


Date Reported: **18/11/2022**

Data Status: **FINAL**

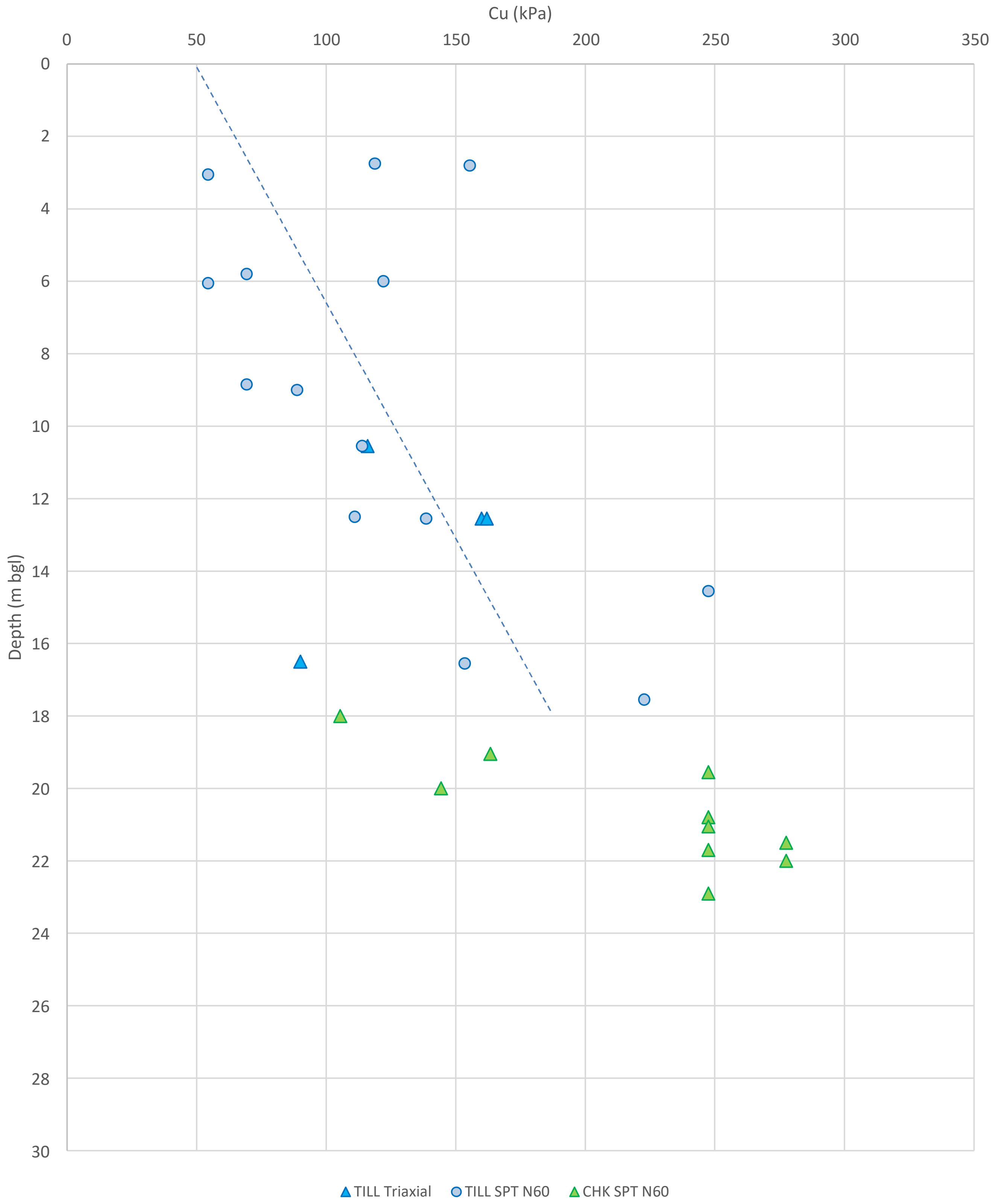


OTBe extraordinary ingenuity	Client: **Geotechnics**		Title: **Water Content vs Depth**		
	Project: **Immingham Power Station**	Sheet size A4	Drawn: HN Date: 18/11/22	Checked: HN Date: 18/11/22	Reviewed: SB Date: 18/11/22
46 Loman Street London, SE1 0EH		Status FINAL	Figure Number		Rev 1



OTBe extraordinary ingenuity	Client **Geotechnics**		Title **Density vs Depth**		
46 Loman Street London, SE1 0EH	Project **Immingham Power Station**	Sheet size A4	Drawn: HN Date: 18/11/22	Checked: HN Date: 18/11/22	Reviewed: SB Date: 18/11/22
		Status FINAL	Figure Number		Rev 1

extraordinary ingenuity	Undrained Shear Strength		46 Loman Street London SE1 0EH
Project ID: **P22-039**	Project Title:	Immingham Power Station	Figure
Client: **Geotechnics**	Location:	Immingham	Drawn by



Date Reported: **18/11/2022**

Data Status: **FINAL**

SPT N60 Value

46 Loman Street
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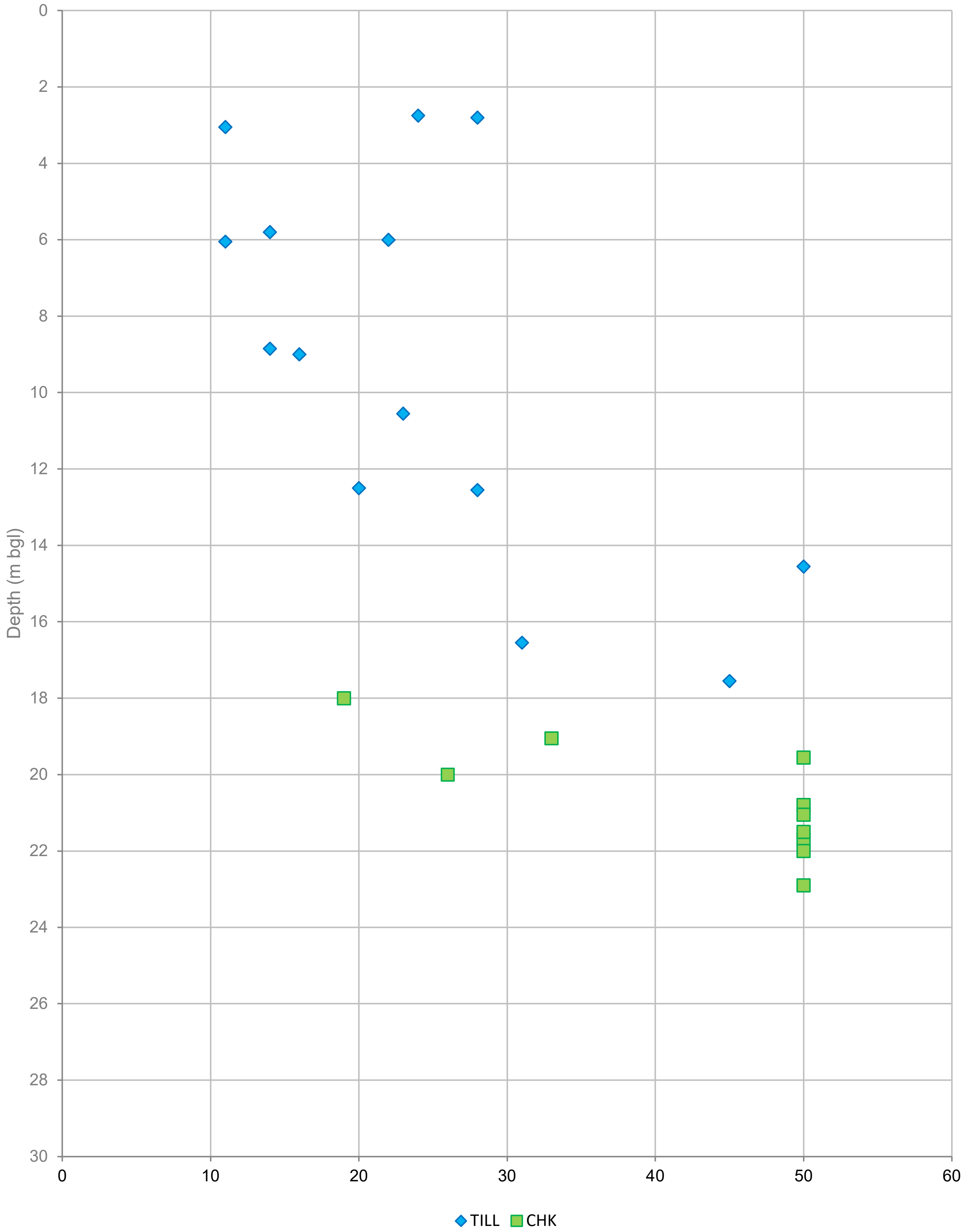
Project ID:	Project Title:	Figure
Client:	Location:	Drawn by



Date Reported: **18/11/2022**

Data Status: **FINAL**

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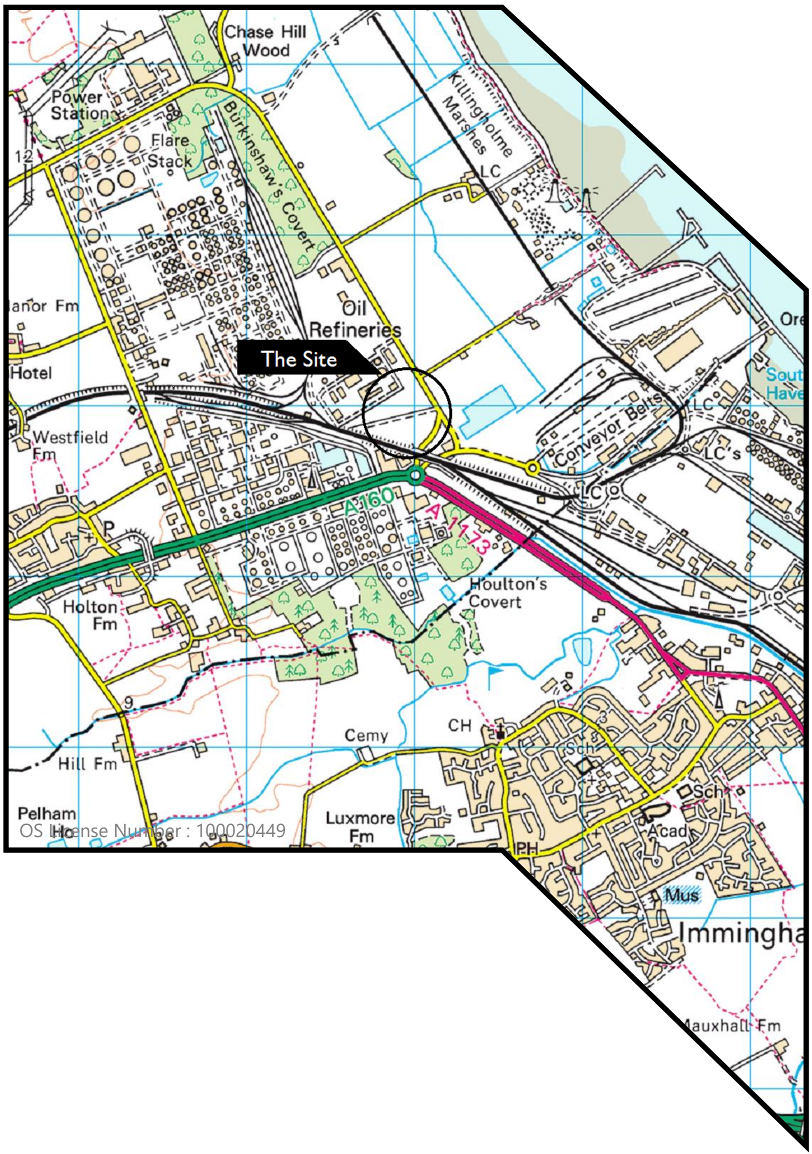

VPI Immingham Humber Zero PCC FEED

Factual and Interpretative Report

for
VPI Immingham Limited

Engineer : Worley Group Limited

Project Number PY220483

November 2022

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Ground Investigation
at

Factual and Interpretative Report

VPI Immingham Humber Zero PCC FEED
for
VPI Immingham Limited

Engineer :
Worley Group Limited

Project No:
PY220483
November 2022

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1.0 INTRODUCTION

A geotechnical and geo-environmental investigation was undertaken by Geotechnics Limited at the site of proposed new gas turbines and gas boilers as part of the VPI Immingham Humber Zero Project. The investigation was carried out to the instructions of the Engineer, Worley Group Limited, on behalf of the Client, VPI Immingham Limited. This report describes the work undertaken and presents the data obtained.

2.0 OBJECT AND SCOPE OF THE INVESTIGATION

The object of the investigation was to obtain information on the ground and groundwater conditions relating to the design of the proposed works within the limitations posed by trial hole numbers, locations, depths, methods adopted and the scope of approved in situ and laboratory testing. The investigation comprised inspection pits and cone penetration tests (CPTs), cable percussive boreholes, in situ and laboratory testing and reporting. A Factual Report and geo-environmental interpretation was also commissioned.

3.0 PRESENTATION

A description of the site and a summary of the procedures followed during the investigation process are presented in Sections 4 to 6. The factual data so obtained are presented in Appendices 2 to 10 of this report. Attention is drawn to the General Notes and Investigation Procedures presented in Appendix 11 to aid an understanding of the procedures followed and the context in which the report should be read.

In addition, data in electronic format in accordance with "The Electronic Transfer of Geotechnical Data from Ground Investigations" published by the AGS (the AGS Format) are presented separately.

4.0 THE SITE

4.1 Location

The site is located immediately south of the existing VPI Immingham site and adjacent to the Humber Oil Refinery, approximately 300m northwest of Humber Road (A160) and approximately 2.5km north of Immingham town centre. The approximate Ordnance Survey National Grid Reference for the centre of the site is TA 169 169 and an extract from the relevant 1:50,000 Scale O.S. Map is included as Appendix 1.

4.2 Description

The site comprises an irregular shaped area of disused land situated immediately south the existing VPI Immingham facility, with maximum dimensions of approximately 400m from north to south and approximately 550m from east to west.

The northern part of the site is generally covered in short field grass, with several areas of hard standing (asphalt and concrete) associated with former roadways, and some spoil piles. The southern part of the site is heavily vegetated. The northern and southern areas are separated by a roughly east-west orientated (partially culverted) surface water drain and a palisade fence. There is evidence of several above and below ground services on the site.

The northern part of the site is accessed from the north via the VPI Immingham southern car park. The southern part of the site can be accessed from the east via Rosper Road or from the northern area through a vehicle gate in the existing perimeter fence.

The site is bounded;

- to the north by the VPI Immingham site,
- to the east by Rosper Road and agricultural land, and
- to the south and west by a railway and the Humber Oil Refinery Infrastructure.

4.3 Site Geology

The British Geological Survey Onshore GeoIndex website, https://mapapps2.bgs.ac.uk/geoindex/home.html, accessed on 3rd November 2022, shows the northern area of the site (north of the drainage ditch) to be underlain by Glacial Till, consisting of *clay, silt, sand, gravel and cobbles* of Quaternary age. The southern area of the site (south of the drainage ditch) is shown to be underlain by Tidal Flat Deposits, consisting of *clay and silt* also of Quaternary age.

The superficial deposits are shown to be underlain by rock strata of the Burnham Chalk Formation, a member unit of the White Chalk Supergroup, of Cretaceous age. The Burnham Chalk Formation rocks are typically described as *white, thinly-bedded chalk with common tabular and discontinuous flint bands and sporadic marl seams.*

No geological faults are shown to be present within the immediate vicinity of the site.

Made Ground is not noted on or adjacent to the site on the website consulted. However, a thickness of Made Ground would be anticipated to be present above the natural strata, associated with the historical use of the site and the construction of the existing roads on the site.

4.4 Hydrogeology

The DEFRA Magic Map website, https://magic.defra.gov.uk/MagicMap.aspx, accessed on 3rd November 2022, shows the superficial deposits to be a Secondary (undifferentiated) Aquifer. The underlying Burnham Chalk Formation is shown to be a Principal Aquifer.

5.0 PROCEDURE

5.1 Commissioning

The work was awarded following submission of a tender for work designed by the Engineer for ground investigation of the site in accordance with the Client's requirements.

5.2 General

The procedures followed in this site investigation are based on *BS 5930: 2015+A1:2020 – Code of Practice for Site Investigations* and *BS 10175:2011+A2:2017 - Investigation of Potentially Contaminated Sites*. The soils and rocks encountered have been described in accordance with BS5930:2015+A1:2020 and BS EN ISO 14688-1:2018 and BS EN ISO 14689:2018.

The exploratory hole locations were specified by the Engineer and their locations are shown on the Exploratory Hole Location Plan in Appendix 10. The coordinates and levels shown on the Exploratory Hole Records were measured using a Leica GPS survey device. The depths quoted on the exploratory hole records are in metres below ground level.

Prior to the commencement of any intrusive investigative works, available plans and records of buried services were provided by the Engineer and checked by the Site Supervisor. A PAS128 compliant buried services survey was carried out by a specialist contractor, CMS Surveys Limited, to check for the presence of buried services (see Section 5.3).

Additionally, each exploratory hole location was checked using a Cable Avoidance Tool (CAT) and Signal Generator (Genny), where appropriate, to check for the presence of buried services. As an additional precaution, an inspection pit was excavated at each cable percussion borehole location using hand digging tools to a depth of 1.20m below ground level to check for the presence of buried services.

5.3 PAS128 Utility Survey

A PAS128 Utility Survey was carried out by a specialist contractor, CMS Surveys, to detect, locate and record all existing utilities and highlight any anomalies at each exploratory hole location. The works were carried out between 5th and 16th September 2022.

The survey was carried out by a suitably qualified surveyor using a combination of Ground Penetration Radar (GPR), Cable Avoidance Tool (CAT) and Signal Generator (Genny) survey techniques following the PAS128 (M4) Survey Methodology. A report prepared by CMS Surveys Limited outlining the survey works, techniques and equipment used, and the results of the survey are included in Appendix 2.

5.4 Inspection Pits

Twenty (20 No.) Inspection Pits (numbered CPT01 to CPT20) were excavated to a depth of 1.20m below ground level using hand digging tools between 6th and 12th September 2022. The excavations were carried out at each Cone Penetration Test (CPT) location to check for the presence of buried services. The excavation works were supervised on site by a geotechnical / geo-environmental engineer.

The profiles of strata or other features were recorded as excavation proceeded and measurements taken from ground level. Representative small (D) and bulk (B) disturbed samples were taken, where appropriate, for laboratory examination and analysis and in addition, Environmental Soil (ES) samples were recovered at the depths indicated on the Inspection Pit Records, presented in Appendix 3. Samples were taken directly from excavated materials deposited at the surface. Groundwater observations are included on the Inspection Pit Records.

5.5 Static Cone Penetration Tests

Ten (10 No.) Static Cone Penetration Tests (numbered CPT04, CPT09, CPT10, CPT11, CPT14, CPT15, CPT16, CPT18, CPT19 and CPT20) were completed to depths ranging between 14.58m and 15.30m below ground level by Lankelma Limited. The test locations were specified by the Engineer and the works were carried out on 12th and 13th September 2022.

N.B. An additional ten (10 No.) Static Cone Penetration Tests were originally specified by the Engineer. However, these tests were cancelled by the Client during the site works, and it is understood that these tests are to be completed during a future phase of investigation.

The static cone penetration tests were undertaken in accordance with BS EN ISO 22476-1:2012 using heavy track-truck mounted 17 tonne capacity hydraulic penetrometer equipment, ballasted to provide a reaction weight of about 20.5 tonnes. A five tonne capacity, 15cm^2 electric cone was used for each of the tests and measurements of local side friction and the pore pressure were made in addition to cone end resistance. The tests were terminated at the depths scheduled by the Engineer.

The CPT Records together with an interpreted identification of the soils tested and an estimate of the undrained shear strength, coefficient of volume compressibility, overconsolidation ratio, SPT N Value, peak friction angle, relative density and Young's Modulus are presented in a Report prepared by Lankelma Limited which is included in Appendix 4.

5.6 Cable Percussion Boreholes

Four (4 No.) boreholes (numbered BH01, BH02, BH02A and BH05) were sunk using a combination of 200mm and 150mm diameter Cable Percussion Tool techniques to depths ranging between 21.75m and 23.08m below ground level. The work was carried out between 5th and 12th September 2022.

N.B. Borehole BH02 was terminated at 0.90m depth due to the presence of a concrete obstruction. The drilling rig was moved to the location of BH02A. An additional two (2 No.) boreholes were originally specified by the Engineer (numbered BH03 and BH04). However, these boreholes were cancelled by the Client during the site works, and it is understood that these boreholes are to be completed during a future phase of investigation.

Samples were taken from the service inspection pit, where appropriate, for laboratory examination and analysis. Representative small (D) and bulk disturbed (B) and driven open-tube thin-walled (UT) samples of the soils encountered were obtained at regular intervals. In addition, Environmental Soil (ES) samples were recovered at the depths indicated on the Cable Percussion Borehole Records, presented in Appendix 5.

Standard Penetration Tests (SPTs) were undertaken at the depths indicated on the borehole records in accordance with BS EN ISO 22476-3:2005+A1:2011 to obtain a measure of the engineering properties of the proved strata. A full summary of the SPTs are included on the SPT Results Summary Sheets, included with the Cable Percussion Borehole Records and relevant SPT Hammer Energy Test Reports.

On encountering groundwater, boring operations were suspended for twenty minutes in order to record any rise in water level. Full details of groundwater observations during site work are included on the Cable Percussion Borehole Records. It should be noted that the addition of water to the borehole as part of the drilling process may have masked the presence of groundwater in the borehole. Where water was added it has been noted on the Borehole Records.

On completion, standpipes were installed in Boreholes BH01 and BH02A (see Section 5.7). Borehole BH05 was backfilled with bentonite pellets and its service inspection pit reinstated with arisings.

5.7 Instrumentation and Monitoring

Long-term monitoring of the gas and groundwater levels was made possible by the installation of standpipes as follows:

Exploratory Hole	Standpipe Slotted Pipe & Filter Zone (m)
BH01	9.00 to 10.00
BH02A	18.40 to 19.40

Monitoring of the gas and groundwater levels at the site commenced on 30th September 2022 with further visits on 7th, 13th and 31st October 2022.

On each of the monitoring visits a record of the groundwater level in the standpipes was obtained. On the fourth visit where water was recorded, samples were obtained (where possible) following a purging of three well volumes of water in the standpipe.

In addition to the groundwater levels, the following parameters were measured and recorded in each standpipe using a Gas Data GFM436 Gas Analyser:

- Concentrations (% Vol) of CH_4, O_2, CO_2, along with (ppm) H_2S, CO
- Flow Rate
- Differential Pressure
- Barometric Pressure
- Air Temperature

The results of the monitoring are presented in Appendix 6.

6.0 LABORATORY TESTING

6.1 Geotechnical

The laboratory testing schedule was specified by OTB Engineering Limited. Unless otherwise stated, the tests were carried out in Geotechnics Limited's UKAS accredited Laboratory (Testing No. 1365) and were undertaken in accordance with the appropriate Standards as indicated below and on the Laboratory Test Certificate in Appendix 7. Any descriptions, opinions and interpretations are outside the scope of UKAS accreditation.

The tests undertaken can be summarised as follows:

Standard	Test Description	Quantity
BS EN ISO 17892-1:2014	Water Content Determination	15
BS EN ISO 17892-4:2016	Particle Size Distribution Determination – Sieving Method	7
	Particle Size Distribution Determination – Pipette Method	5
BS EN ISO 17892-5:2017	Incremental Loading Oedometer Test	1
BS EN ISO 17892-12:2018	Determination of Liquid and Plastic Limits	13
BS 1377:1990 Part 4: 3.3	Dry Density/Moisture Content relationship determination. Compaction Test - British Standard (2.5 kg Hammer)	1
BS 1377:1990 Part 4: 3.5	Dry Density/Moisture Content relationship determination. Compaction Test - Modified (4.5 kg Hammer).	4
BS 1377:1990 Part 4: 7	California Bearing Ratio (CBR) Measurement - recompacted	3
BS 1377:1990 Part 7: 9	Shear Strength Measurement - 100mm diameter (Multi-Stage) Quick Undrained Triaxial Compression Test	3

The following testing was carried out at the laboratories of Professional Soils Laboratory (PSL) Limited (UKAS Accredited Laboratory, Number 4043).

Standard	Test Description	Quantity
BS 1377:1990 Part 5: 3	One-Dimensional Consolidation Test	2
BS 1377:1990 Part 8: 7.1	Shear Strength Measurement - Consolidated Undrained Triaxial Compression Test with pore water pressure measurement.	3

The following testing was carried out at the laboratories of Derwentside Environmental Testing Services (DETS) Limited (UKAS Accredited Laboratory, Number 2139).

Standard	Test Description	Quantity
BS 1377:1990 Part 3: 3	Organic Matter Content	6
BRE Special Digest 1 Suite	Suites comprising: Soluble Sulphate pH	7

6.2 Contamination

Selected samples of soil and groundwater were tested at the laboratories of Derwentside Environmental Testing Services (DETS) Limited (UKAS Accredited Laboratory, Number 2139) for a number of determinands in order to check on potential site contamination. The determinands were selected by Geotechnics Limited and are detailed on the results sheets in Appendices 8 (soil) and 9 (groundwater) together with the test result as well as the test method, accreditation and detection limit.

7.0 ENVIRONMENTAL ASSESSMENT

7.1 Introduction

The UK approach to the assessment of contaminated land is based upon the principles of risk assessment, which is founded on the use of 'source-pathway-receptor' principles in order to establish the potential presence of 'pollutant linkage' as detailed in the LCRM.

Geotechnics Limited adopts a tiered approach to risk assessment in accordance with current UK guidance and good practice. The initial step of this process, known as Tier 1 or Generic Quantitative Risk Assessment (GQRA), is the comparison of site-derived data with relevant guideline levels.

Should the adopted criteria be exceeded, then two courses of action are available. The first is to break the pollutant linkage by undertaking remedial works such as removing or treating the contaminated soil. Alternatively, a more detailed risk assessment (DQRA) can be carried out to determine whether a contamination risk exists.

The UK approach to the assessment of human health risk from contaminated land is set out in the CLEA (Contaminated Land Exposure Assessment) framework, which was first published in 2002 by the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA). The original guidance was withdrawn, and revised guidance issued in 2009, which is set out in the following documents published by the EA:

'Human Health Toxicological Assessment of Contaminants in Soil', Science Report SC050021/SR2; and

'Updated Technical Background to the CLEA Model', Science Report SC050021/SR3.

The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment and a generic conceptual model for site conditions together with human behaviour to estimate long term human exposure to soil contaminants. Soil Guideline Values (SGV) were previously derived using the CLEA Model by comparing estimated exposure with 'Health Criteria Values' (HCV) that represent a tolerable risk to health from chronic exposure.

The CLEA model has also been used to determine other generic assessment criteria (GACs), including those used within this assessment.

7.2 Risk Assessment Methodology

Based on site size, homogeneous ground conditions and site history, the site has been considered as one averaging zone. Relevant guidance issued by the Chartered Institute of Environmental Health (CIEH), in association with LQM, published November 2015 has been adopted.

Laboratory testing results were directly compared to the adopted GAC for commercial end-use, and results are shown in full in Appendix 9.

7.3 Risk Assessment for Human Health

None of the seven samples analysed exceeded the relevant SGV/GAC or the S4UL for any contaminant analysed for. Concentrations of heavy metals were typically in the range that would be considered typical of background concentrations. Many PAH compounds were not detected above the laboratory limit of detection, or were detected at slightly higher concentrations that the laboratory limit of detection. Speciated TPH only showed detectable concentrations of the Aliphatic >C5-C6 fraction. All VOC and SVOC contaminants were not detected above the laboratory limit of detection.

The seven samples were laboratory screened for asbestos; and asbestos was not detected in any of the samples.

7.4 Risk Assessment for Phytotoxic Effects

Concentrations of the phytotoxic metals copper, nickel and zinc nickel do not exceed the guideline values for the protection of plants as presented in the Defra Sewage Sludge Code of Practice. Any risks to plants are assessed as being very low. The results of the phytotoxic screening are presented in the tables below.

Determinand	Number of samples	GAC (mg/kg)	Results Exceeding GAC (mg/kg)	Exceeds GAC (Y/N)
Arsenic	7	All pH - 50	-	N
Copper	7	pH>7 - 200	-	N
Cadmium	7	All pH – 3	-	N
Chromium	7	All pH - 400	-	N
Nickel	7	pH>7 – 110	-	N
Mercury	7	All pH - 1	-	N
Lead	7	All pH – 300	-	N
Zinc	7	pH>7 – 300	-	N
Selenium	7	All pH - 3	-	N

7.5 Assessment for the Protection of Controlled Waters

The risks to controlled waters (groundwater and surface waters) from contaminants on-site have been assessed in accordance with the Environment Agency (EA) documents (The Environment Agency's Approach to Groundwater Protection, 2017 and Remedial Targets Methodology, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Agency's 'limit' pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)).

Two groundwater samples were taken from BH01 and BH02A and were analysed for heavy metals, PAHs, Speciated TPH, VOCs and SVOCs. The analytical results were screened against Environmental Quality Standards (EQS) and Drinking Water Standards (DWS). DWS and EQS are both considered appropriate screening criteria as the site is located on a Principal Aquifer and there is a surface water feature located of the site, with others located off-site.

Exceedances of the relevant guidance criteria are summarised in the table below:

Determinand	Unadjusted EQS GAC (µg/l)	DWS GAC (µg/l)	Results Exceeding EQS (µg/l)	Results Exceeding DWS (µg/l)
Zinc	10.9	3000	BH01 – 20	N/A
Aliphatic >C16-C21	10	10	BH02A - 26	BH02A - 26
Aliphatic >C21-C34	10	10	BH02A - 14	BH02A - 14
Aromatic >C16-C21	10	10	BH02A - 19	BH02A - 19

The groundwater sample from BH01 shows an exceedance of the EQS value for copper. However, using the m-BAT tool, using the chemical data from BH01, the modified EQS is 23.9µg/l, higher than the concentration recorded of 20µg/l.

The groundwater sample from BH02A, shows slight exceedances of DWS/EQS for relatively long-chain TPH fraction for both aliphatic and aromatic TPH. The exceedances are relatively minor and there does not appear to be gross petroleum hydrocarbon contamination present where groundwater has been analysed.

All VOC and SVOC compounds were not detected above the laboratory limit of detection.

7.6 Ground Gas Risk Assessment

Four rounds of ground gas monitoring results obtained on the 30th September 2022, with further readings taken on 7th, 13th, and 31st November 2022 are presented in Appendix 6. None of the rounds of the monitoring were undertaken when atmospheric pressure was less than 1000mbar. On the basis of there not being any significant sources of ground gases on and in the environs of the site, monitoring wells were installed relatively deep to monitor groundwater at depth. Resting groundwater levels are much shallower than the slotted screen section of the monitoring wells.

The conceptual model in the Desk Study has not shown any significant sources of ground gas to be present, such as active or recently closed landfills, thick Made Ground containing labile carbon or bedrock subject to mining and possibly mineshafts. As discussed above, resting groundwater levels are above the slotted section of the monitoring well. The measured flow rates and concentrations of methane and carbon dioxide show that there is no significant source of ground gases at depth.

8.0 REVISED CONTAMINANT LINKAGE ASSESSMENT

An updated assessment of pollutant linkages has been made following the completion of a ground investigation and generic quantitative risk assessment to assess potential sources.

Hazard Identification				Hazard Assessment			
Link	Contaminant	Pathway	Receptor	Probability	Consequence	Risk	Contaminant Linkage Assessment
1	Contaminated soil / groundwater	Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	Humans using the site during construction.	Negligible / Not credible	Medium	Low	NAR: However, it should be noted that the extent of the investigation does not cover the entire site. In addition, stockpiles of materials have not been investigated
2		Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	Humans using the site after development completion.	Negligible / Not credible	Medium	Low	NAR: See above.
3		Downward / Lateral migration	Surface water features on and off site. Secondary (undifferentiated) drift aquifer and Principal	Low/ Unlikely	Medium	Medium / Low	NAR: No evidence of gross contamination present. Some TPH detected just above EQS/DWS, distribution of contaminants is not known.
4		Inhalation	Humans using the site after development completion.	Negligible / Not credible	Medium	Low	NAR: See Linkage 1 and 2

5	Gas – methane & carbon dioxide, radon	Ingestion, inhalation, dermal / direct contact	Ecology (Flora/Fauna)	No significant sources of ground gases identified (Natural alluvium deposits are not considered a significant source)		Low	NAR
6		Ingestion, inhalation, dermal / direct contact	Humans using the site after development completion.	No significant sources of ground gases identified (Natural alluvium deposits are not considered a significant source)		Low	NAR
7	Contaminated soil / waste / groundwater	Secondary (Undifferentiated) Strata	Ecology (Flora/Fauna)	Negligible / Not credible	Negligible	Low	NAR
8	Contaminated soil and groundwater	Direct contact.	Building structures.	Negligible / Not credible	Medium	Low	NAR: See Linkage 1 and 2

NAR – No Action Required

9.0 CONCLUSIONS

9.1 Updated Environmental Risk Assessment

A preliminary risk assessment has been carried out based on the contaminant-pathway-receptor model as defined in Statutory Guidance to Part IIA of the Environment Protection Act, 1990, in accordance with BS 10175: 2011 +A2 2017 "Investigation of Potentially Contaminated Sites – Code of Practice" and LCRM. In order to make a more detailed assessment of the potential hazards, a Phase 2 intrusive investigation was carried out to reduce uncertainty and produce a more comprehensive conceptual site model of the site. This detailed the characteristic ground conditions and elements of the surrounding environment and has assisted with identifying contaminant linkages.

There were no exceedances of human health GACs for future site users or construction staff. Concentrations of contaminants in groundwater shows that petroleum hydrocarbons are present just above the laboratory limit of detection in one monitoring well (BH2A) although concentrations in BH01 are all below the laboratory limit of detection. The distribution of petroleum hydrocarbons in the wider environment is not known. From the data available currently, there are no significant risks to controlled water receptors.

Ground gas monitoring has confirmed that there are no significant sources of ground gases present affecting the site and the ground gas regime is classified as Gas Regime A for methane and carbon dioxide and no ground gas protection measures are required for any proposed structures. However, it should be noted that the slotted sections of monitoring wells were below the resting water level.

It should be noted that the scale of the investigation is spatially limited compared to the size of the site. In addition, existing stockpiles have not been characterised. Based on the scope of the works undertaken during this investigation, there are no anticipated abnormal costs relating to geoenvironmental conditions, unless localised areas of contaminant impact exist. However, there may be special conditions appertaining to the site which were not revealed by this investigation and which have not been taken into account in this report.

Signed for and on behalf of Geotechnics Limited.

Factual Report prepared by:
Tom Birch BSc (Hons), MSc, FGS
Senior Engineer

Geo-environmental Interpretation prepared by:
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Principal Geo-environmental Engineer

Reviewed by:
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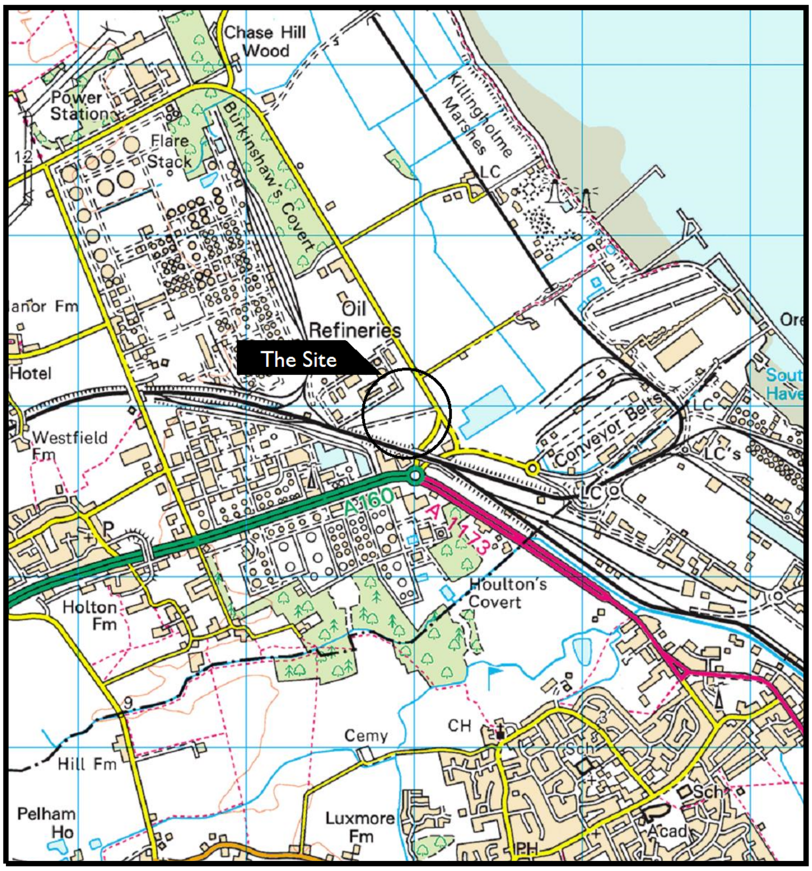
Principal Engineer

APPENDIX 1

Site Location Plan

SITE LOCATION PLAN



Ground Investigation
at
VPI Immingham Humber Zero PCC FEED
for
VPI Immingham Limited

GEOTECHNICS
geotechnical and geoenvironmental specialists

APPENDIX 2

PAS128 Utility Survey Report and Drawings

Report No EN22052

PAS128 UTILITY DETECTION SURVEY REPORT

VPI IMMINGHAM

Document Register

Rev	Date	Prepared by	Role	Checked by	Role	Revision Reason
0	05/10/22	CS	PM	DS	CM	Issue

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1. INTRODUCTION

1.0 TERMS OF REFERENCE

Location: VPI Immingham

Client: Geotechnics

Survey Dates: 05/09/22 - 16/09/22

This report should be viewed with the following drawings:

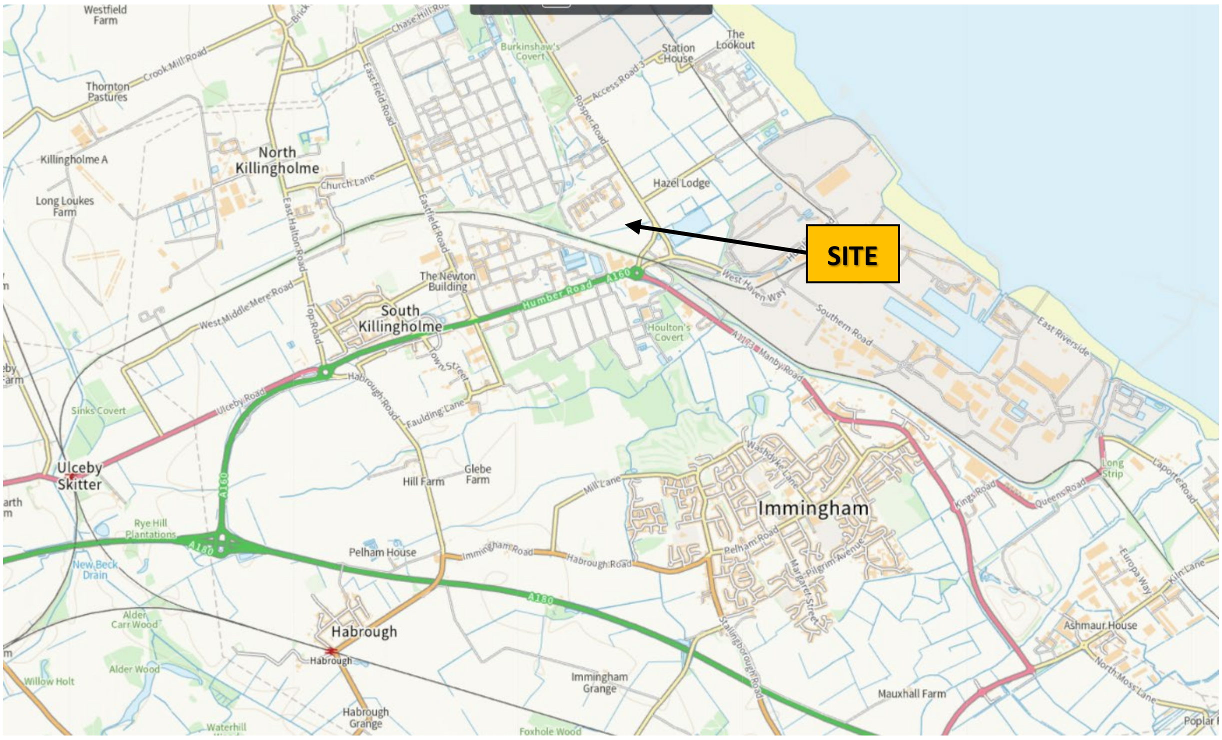
EN22052-U

1.1 BACKGROUND/PURPOSE OF INVESTIGATION

CMS Surveys Limited were requested to carry out a full M4 PAS128 Utility Survey on behalf of Geotechnics. The intention of this survey is to detect, locate and record all existing Utilities and highlight any anomalies in the required areas for upcoming works.

1.2 SCOPE AND OBJECTIVE PROJECT

SURVEY AREA



UTILITY SURVEY SPECIFICATION								
PAS128								Other
M1	M1P	M2	M2P	M3	M3P	M4	M4P	
☐	☐	☐	☐	☐	☐	☒	☐	☐
If other was selected								
Spacing	<1.0	**Post Processing**		N/A	**Notes**			

1.3 SCOPE OF SURVEY COTROL WORKS

Existing control network and topographical surveys were provided by Geotechnics and used for the base-map on this project.

1.4 GRID ESTABLISHMENT

Existing control network and topographical surveys were provided by Geotechnics and used for the base-map on this project

2. PROJECT PARTICULARS

2.0 KEY PERSONNEL

Project Manager: **Calvin Scouler**
Responsible for the management of the project overall.

Senior Surveyor: **George Gilbert**
Daily Task briefings, toolbox talks, signing and guarding on site and management of daily activities.

Safety Advisor: **Lynda Scouler**
Responsible for safety inductions (internal requirements only), site visitations and advising on safe-working practices; and for environment-related tasks and issues in conjunction with the Environmental Advisor.

Office Processing Manager: **Dai Shipton**
Responsible for processing and quality assessment of data.

2.1 SPECIFICATIONS AND INTERNATIONAL STANDARDS

All survey works were carried out in accordance with the following guidelines and standards:

- European GPR Association - Policy on the Use of GPR in Utility Detection
- The Survey Association - The Essential Guide to Utility Surveys Rev. 4
- RICS - Surveys of Land, Buildings and Utility Surveys
- PAS128: 2022 – Publicly Available Specification 128 2022

3. SURVEY REPORT

3.1 EQUIPMENT USED

- RD8000/RD8200 ☒
- IDS Opera Duo ☐
- IDS Stream C ☐
- Other GPR ☒
- Leica TS 15 ☒
- Leica TS 16 ☒
- Spectra SP60 ☒
- Other ☐
- If other GPR/Other was selected: MALA HDR PRO

3.4 SURVEYORS INVOLVED

Senior Surveyor: George Gilbert **Assistant Surveyor(s):** N/A

3.6 SOFTWARE USED FOR PROCESSING

- IDS GRED HD ☐
- Carlson Survey ☐
- AutoCAD ☐
- GPR Slice ☐
- GeoPal ☐
- Other: ☐
- If other was selected: NOT REQUIRED

3.7 QUALITY ASSURANCE SITE PROCEDURES

Equipment used was calibrated and tested in line with manufacturer guidelines.

Calibration certificates can be provided on request. Distance & angle checks were carried out on site regularly.

3.8 SURVEYORS FINDINGS

Drainage, SW/FW/CW

Comments	Quality Level QL-A, B, C, D
Site drainage has been successfully traced.	QL-B2 QL-D

Water Mains

Comments	Quality Level QL-A, B, C, D
Water mains located within the verges of Rosper Road, have been traced with limited success.	QL-B2 QL-D

Electricity, HV, LV, Street lighting

Comments	Quality Level QL-A, B, C
Electric cables have been successfully traced. The surveyor was unable to locate electricity & data cable line shown on record drawings.	QL-B QL-D

Fibre optic/ British Telecom (BT) & Comms

Comments	Quality Level QL-A, B, C
Telecoms cables have been successfully traced. The surveyor was unable to locate electricity & data cable line shown on record drawings.	QL-B2 QL-D

Gas & Fuel mains

Comments	Quality Level QL-A, B, C
The surveyor was unable to locate line of Gas Main shown on record drawings due to the depth of the main. As built coordinates were supplied by to us by VPI and Setout by our surveyor onsite.	QL-D

GROUND PENETRATING RADAR SURVEY

Comments	Quality Level QL-A, B, C
(Please Refer to Drawing EN22052-GPR) The maximum resolution of the radar antennas used, i.e. the minimum thickness of the layer that can be reasonably identified, was in the order of 0.1 metres. The maximum depth of penetration was in the order of 4 metres. Therefore, it is possible that buried services /obstructions are present outside the detectable range of the radar system. Anomalies associated with Underground Utilities have been included in drawing EN22052-U. The Mala HDR PRO Ground Penetration Radar system uses an impulse technique where electromagnetic waves are propagated to the ground and reflected off changes in the subsurface material. These reflections are recorded and displayed in real time allowing any anomalous features to be interpreted and identified on site. The depth of penetration of the emitted electromagnetic pulse is dependent on the properties of the near surface materials and the frequency of the antenna. A high frequency antenna provides better resolution where as a lower frequency antenna gives lower resolution but deeper penetration. For this survey both 250MHZ & 750MHZ antenna's were used and calibrated to an estimated velocity of 0.10 metres per nanosecond (m/ns) as this provided the optimum signal penetration and resolution to meet the proposed objectives. A survey grid with 0.5 metre line spacings with the distance along each transect line controlled by the odometer wheel which triggered the radar at a set interval of 0.02 metres. The start and end of each transect line was positioned by the SPECTRA SP60 GPS. GPR highlighted several consistent linear features within the survey area but there was no evidence of markers, manhole covers or pipes to indicate whether a potential service existed. These lines are marked as GPR on the survey drawings but may constitute a disused or unrecorded service. GPR was used to further interrogate and prove services positioned with Radio Detection equipment, and also provide a blind sweep of the open field areas.	GPR QL-B2

3.9 SURVEY RESTRICTIONS

Areas of dense vegetation made it difficult to manoeuvre the GPR antenna. Such areas are annotated in drawing EN22052-U.

3.10 TRAFFIC MANAGEMENT (TM)

None Required.

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-Processing	Location Accuracy		Supporting Data
				Horizontal 1)	Vertical 2)	
D	Desktop utility records search	QL-D	-	Undefined	Undefined	-
C	Site reconnaissance	QL-C	-	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar).
B	Detection 3)	QL-B4	-	Undefined	Undefined	A utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route.
B	Detection 3)	QL-B3	No	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used
B	Detection 3)	QL-B3P	Yes	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used
B	Detection 3)	QL-B2	No	±250 mm or ±40% of detected depth whichever is greater	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. 4)
B	Detection 3)	QL-B2P	Yes	±250 mm or ±40% of detected depth whichever is greater	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. 4)
B	Detection 3)	QL-B1	No	±150 mm or ±15% of detected depth whichever is greater	±15% of detected depth	Horizontal and vertical location of the utility detected by multiple geophysical techniques used. 5)
B	Detection 3)	QL-B1P	Yes	±150 mm or ±15% of detected depth whichever is greater	±15% of detected depth	Horizontal and vertical location of the utility detected by multiple geophysical techniques used. 5)
A	Verification	QL-A	-	±50 mm	±25 mm	Horizontal and vertical location of the top and/or bottom of the utility.

1) Horizontal location is to the centreline of the utility.
2) Vertical location is to the top of the utility.
3) For detection, it is a requirement that a minimum of GPR and EML techniques are used (see 8.2.1.1.2).
4) Electronic depth readings using EML equipment are not normally sufficient to achieve a QL-B2 or higher.
5) Some utilities can only be detected by one of the existing detection techniques. As a consequence, such utilities cannot be classified as a QL-B1.

Method 1) (to be determined in consultation with the client)	Survey Grid/Search Resolution 2)				Quality Levels achievable	Typical Application (informative)
	EML 3)	GPR		Other Techniques 4)		
		General	Post-Processing			
M1	Orthogonal search transect at ≤10 m intervals and when following a utility trace, search transects at ≤5 m intervals	Use as applicable	No	≤5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of an undeveloped area
M1P			Yes		B1P, B2P, B3P	
M2	Orthogonal search transect at ≤5 m intervals and when following a utility trace, search transects at ≤2 m intervals	Either: a) ≤2 m orthogonal; or b) high density array 5)	No	≤2 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a suburban area or where the utility services cross a boundary of a survey area
M2P			Yes		B1P, B2P, B3P	
M3	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤1 m intervals	Either: a) ≤1 m orthogonal; or b) high density array 5)	No	≤1 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a busy urban area or for clearance surveys prior to operations such as borehole/drilling/fencing/ tree planting
M3P			Yes		B1P, B2P, B3P	
M4	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤0.5 m intervals	Either: a) ≤0.5 m orthogonal; or b) high density array 5)	No	≤0.5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a congested city area
M4P			Yes		B1P, B2P, B3P	

NOTE 1 In general the effort increases from M1 to M4 and the addition of post-processing. For areas with a greater density of utilities or areas considered high risk by the client, a detection method that has a higher level of effort should be selected.

NOTE 2 "P" indicates off-site post-processing has been included.

1) It is a requirement that a minimum of GPR and EML techniques are used.
2) The tolerance for orthogonal transect centres and survey grids shall be ±0.1 m.
3) It is a requirement that passive EML is deployed over the whole survey area and that where an active EML method can be used, it is used.
4) The transect centre depends on technique used.
5) A high density array comprises 100 mm or closer antenna separation.

DISCLAIMERS

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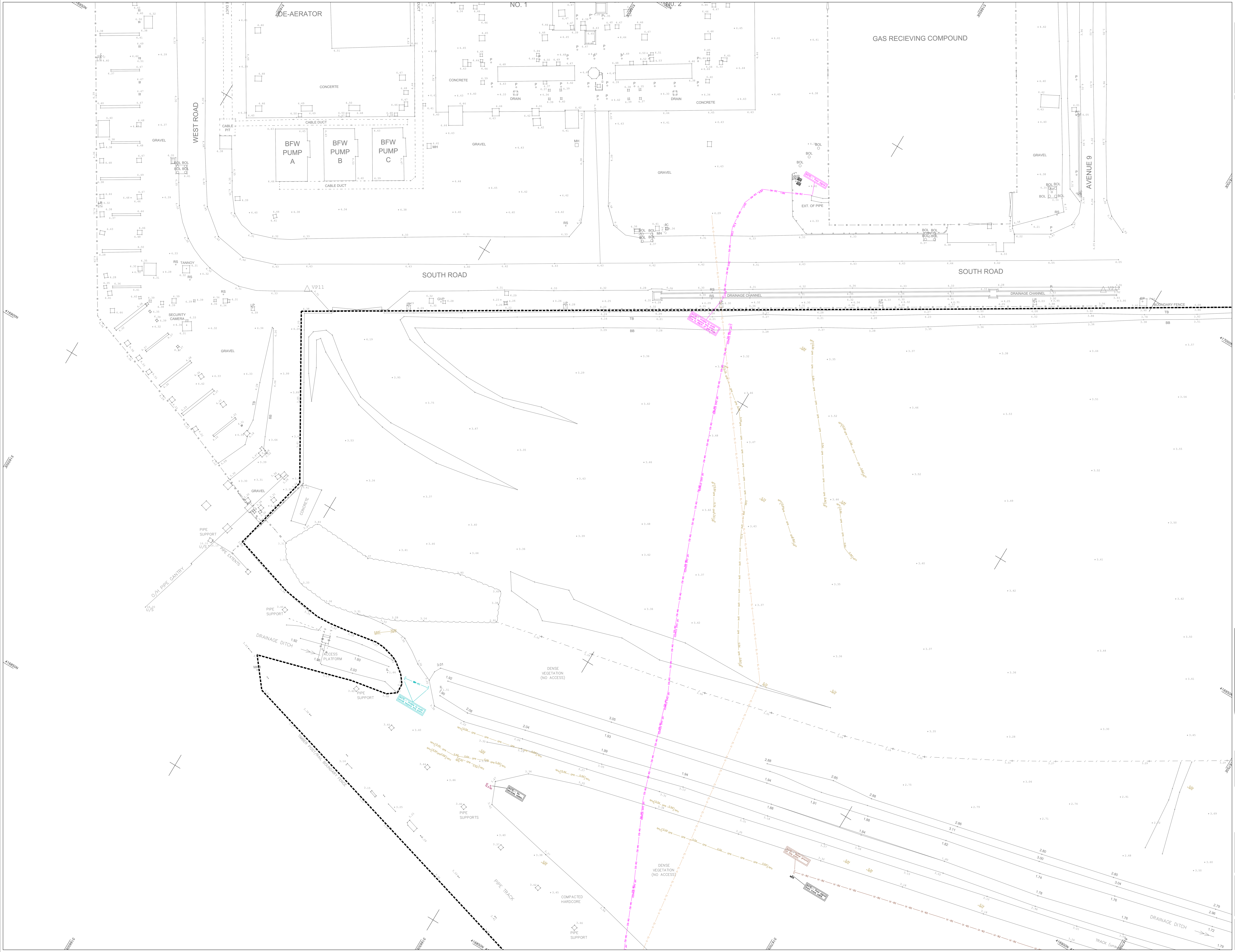
The results of any indirect geophysical method are based on an interpretation and as such cannot be definitive. There are apparent ambiguities in the results of this survey but these are due to the target depths being close to the penetration capabilities of the high frequency antenna. The lower frequency antenna has clearly achieved greater penetration but the resolution appears to be about 100mm, i.e. no better than 10 – 15% of the target depth. A single velocity has been assumed based on a physical calibration where ground surface thickness had been measured. Interpreted depths could be in error where transmission characteristics differ from those at the calibration position. Different constructions materials or variations in moisture content would contribute to such variations.



PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

AV AIR VALVE
BT BT INSPECTION COVER
CB CONTROL BOX
CCTV CCTV CAMERA POST
COM COMMUNICATIONS COVER
CTV CABLE TV COVER
DC DRAINAGE CHANNEL
DP DOWN PIPE
DR DRAIN
EIC ELEC INSPECTION COVER
ELB ELECTRIC BOX
ER EARTH ROD
EP ELECTRICITY POLE
FL FINISHED FLOOR LEVEL
FH FIRE HYDRANT
G GULLY
GLT GROUND LIGHT
GST GAS TAP
GSV GAS VALVE
IC INSPECTION COVER
IL INVERT LEVEL
KO KERB OUTLET
LP LAMP POST
MH MANHOLE
MKR MARKER
OP OUTFALL PIPE
PN PYLON
PP PETROL PUMP
RE RODDING EYE
RWP RAINWATER PIPE
SOF SOFFIT LEVEL
SV STOP VALVE
TCB TELEPHONE CALL BOX
TL TRAFFIC LIGHT
TLB TRAFFIC LIGHT BOX
TP TELEGRAPH POLE
WM WATER METER
WO WATER OUTLET
WST WATER STOP TAP
WSV WATER STOP VALVE

EOT END OF TRACE
OSA OUT OF SURVEY AREA
UTL UNABLE TO LIFT
UTS UNABLE TO SONDE
UTT UNABLE TO TRACE
S/L SIGNAL LOSS
BLK BLOCKED
NFH NO FURTHER GPR CONTACTS
BD BACKDROP PIPE
NVP NO VISIBLE PIPE
ToP TOP OF PIPE
EOT SYMBOL
FITTING FROM RECORDS

BT — BT-A — BT-A
BT STAT RECORD — BT-D — BT-D
CABLE DUCT — DU-A — DU-A
CABLE DUCT STAT RECORD — DU-D — DU-D
CABLE TV — CA-A — CA-A
CABLE TV STAT RECORD — CA-D — CA-D
CCTV — CC-A — CC-A
CCTV STAT RECORD — CC-D — CC-D
TELECOMS — TC-A — TC-A
TELECOMS STAT RECORD — TC-D — TC-D
EARTH ROD STRIP — ER-A — ER-A
EARTH ROD STAT RECORD — ER-D — ER-D
ELECTRIC — EL-A — EL-A
ELECTRIC STAT RECORD — EL-D — EL-D
FIBRE—OPTICS — FO-A — FO-A
FIBRE—OPTICS STAT RECORD — FO-D — FO-D
FUEL LINE — FL-A — FL-A
FUEL LINE STAT RECORD — FL-D — FL-D
GPR DETECTION LINE — GPR — GPR
MAINS GAS — GM-A — GM-A
MAINS GAS STAT RECORD — GM-D — GM-D
MAINS WATER — WM-A — WM-A
MAINS WATER STAT RECORD — WM-D — WM-D
SEWER CW — CW-A — CW-A
SEWER CW STAT RECORD — CW-D — CW-D
SEWER FW — FW-A — FW-A
SEWER FW STAT RECORD — FW-D — FW-D
SEWER SW — SW-A — SW-A
SEWER SW STAT RECORD — SW-D — SW-D
TRAFFIC SIGNAL CABLE — TS-A — TS-A
TSC STAT RECORD — TS-D — TS-D
UNIDENTIFIED TRACE — UI-A — UI-A
UNIDENTIFIED CABLE — UC-A — UC-A
UNIDENTIFIED PIPE — UP-A — UP-A
VEHICLE DETECTION CABLE — VD-A — VD-A
VDC STAT RECORD — VD-D — VD-D
SURVEY BOUNDARY
LIMITED/IMPEDED SURVEY

QUALITY LEVEL

A — Verification
B1 — Horizontal/Vertical location using multiple techniques
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SHEET LAYOUT

0 2m 4m 8m 12m 16m
SCALE BAR

REV	DATE	DESCRIPTION

CMS SURVEYS
www.cmssurveys.co.uk

Client
Geotechnics
Unit 1B, Borders Industrial Park
River Lane
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Chester
CH4 8RJ

Project Title
Utility Survey of Land at:
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South Killingholme
North Killingholme
DN40 3DZ

Surveyed	Drawn	Checked
G.Gilbert	C.Scouler	C.Scouler

Scale	Date	Drawing Ref.	No.	Size	Rev
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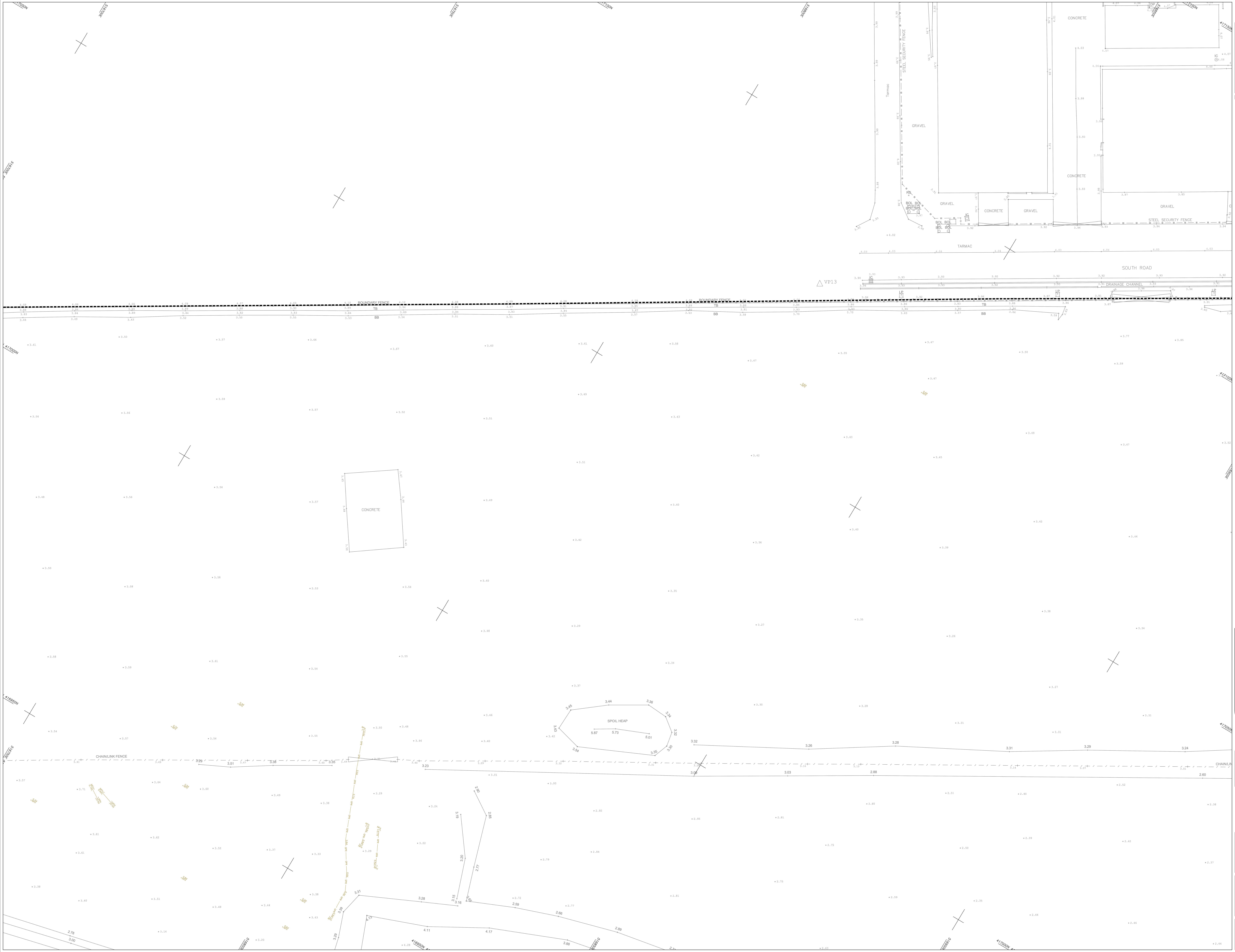

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PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

AV	AIR VALVE
BT	BT INSPECTION COVER
CB	CONTROL BOX
CCTV	CCTV CAMERA POST
COM	COMMUNICATIONS COVER
CTV	CABLE TV COVER
DC	DRAINAGE CHANNEL
DP	DOWN PIPE
DR	DRAIN
EIC	ELEC INSPECTION COVER
ELB	ELECTRIC BOX
ER	EARTH ROD
EP	ELECTRICITY POLE
FL	FINISHED FLOOR LEVEL
FH	FIRE HYDRANT
G	GULLY
GLT	GROUND LIGHT
GST	GAS TAP
GSV	GAS VALVE
IC	INSPECTION COVER
IL	INVERT LEVEL
KO	KERB OUTLET
LP	LAMP POST
MH	MANHOLE
MKR	MARKER
OP	OUTFALL PIPE
PN	PYLON
PP	PETROL PUMP
RE	RODDING EYE
RWP	RAINWATER PIPE
SOF	SOFFIT LEVEL
SV	STOP VALVE
TCB	TELEPHONE CALL BOX
TL	TRAFFIC LIGHT
TLB	TRAFFIC LIGHT BOX
TP	TELEGRAPH POLE
WM	WATER METER
WO	WATER OUTLET
WST	WATER STOP TAP
WSV	WATER STOP VALVE
EOT	END OF TRACE
OSA	OUT OF SURVEY AREA
UTL	UNABLE TO LIFT
UTS	UNABLE TO SONDE
UTT	UNABLE TO TRACE
S/L	SIGNAL LOSS
BLK	BLOCKED
NFH	NO FURTHER GPR CONTACTS
BD	BACKDROP PIPE
NVP	NO VISIBLE PIPE
ToP	TOP OF PIPE
	EOT SYMBOL
	FITTING FROM RECORDS

BT	BT-A
BT STAT RECORD	BT-D
CABLE DUCT	DU-A
CABLE DUCT STAT RECORD	DU-D
CABLE TV	CA-A
CABLE TV STAT RECORD	CA-D
CCTV	CC-A
CCTV STAT RECORD	CC-D
TELECOMS	TC-A
TELECOMS STAT RECORD	TC-D
EARTH ROD STRIP	ER-A
EARTH ROD STAT RECORD	ER-D
ELECTRIC	EL-A
ELECTRIC STAT RECORD	EL-D
FIBRE—OPTICS	FO-A
FIBRE—OPTICS STAT RECORD	FO-D
FUEL LINE	FL-A
FUEL LINE STAT RECORD	FL-D
GPR DETECTION LINE	GPR
MAINS GAS	GM-A
MAINS GAS STAT RECORD	GM-D
MAINS WATER	WM-A
MAINS WATER STAT RECORD	WM-D
SEWER CW	CW-A
SEWER CW STAT RECORD	CW-D
SEWER FW	FW-A
SEWER FW STAT RECORD	FW-D
SEWER SW	SW-A
SEWER SW STAT RECORD	SW-D
TRAFFIC SIGNAL CABLE	TS-A
TSC STAT RECORD	TS-D
UNIDENTIFIED TRACE	UI-A
UNIDENTIFIED CABLE	UC-A
UNIDENTIFIED PIPE	UP-A
VEHICLE DETECTION CABLE	VD-A
VDC STAT RECORD	VD-D
SURVEY BOUNDARY	
LIMITED/IMPEDED SURVEY	

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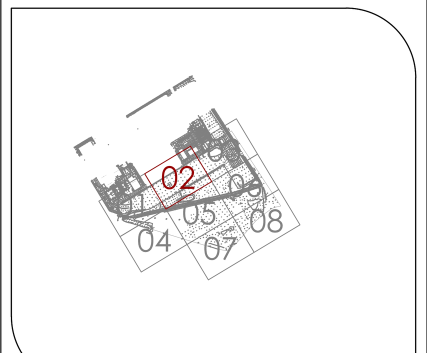

SHEET LAYOUT

0 2m 4m 8m 12m 16m

SCALE BAR

REV	DATE	DESCRIPTION

CMS SURVEYS
www.cmssurveys.co.uk

Client
Geotechnics
Unit 1B, Borders Industrial Park
River Lane
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CH4 8RJ

Project Title
Utility Survey of Land at:
Rosper Road
South Killingholme
North Killingholme
DN40 3DZ

Surveyed	Drawn	Checked
G.Gilbert	C.Scouler	C.Scouler

Scale	Date	Drawing Ref.	No.	Size	Rev
1:200	Oct 22	EN22052-U	02	A0	0

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PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

AV	AIR VALVE
BT	BT INSPECTION COVER
CB	CONTROL BOX
CCTV	CCTV CAMERA POST
COM	COMMUNICATIONS COVER
CTV	CABLE TV COVER
DC	DRAINAGE CHANNEL
DP	DOWN PIPE
DR	DRAIN
EIC	ELEC INSPECTION COVER
ELB	ELECTRIC BOX
ER	EARTH ROD
EP	ELECTRICITY POLE
FL	FINISHED FLOOR LEVEL
FH	FIRE HYDRANT
G	GULLY
GLT	GROUND LIGHT
GST	GAS TAP
GSV	GAS VALVE
IC	INSPECTION COVER
IL	INVERT LEVEL
KO	KERB OUTLET
LP	LAMP POST
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MKR	MARKER
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PN	PYLON
PP	PETROL PUMP
RE	RODDING EYE
RWP	RAINWATER PIPE
SOF	SOFFIT LEVEL
SV	STOP VALVE
TCB	TELEPHONE CALL BOX
TL	TRAFFIC LIGHT
TLB	TRAFFIC LIGHT BOX
TP	TELEGRAPH POLE
WM	WATER METER
WO	WATER OUTLET
WST	WATER STOP TAP
WSV	WATER STOP VALVE
EOT	END OF TRACE
OSA	OUT OF SURVEY AREA
UTL	UNABLE TO LIFT
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S/L	SIGNAL LOSS
BLK	BLOCKED
NFH	NO FURTHER GPR CONTACTS
BD	BACKDROP PIPE
NVP	NO VISIBLE PIPE
ToP	TOP OF PIPE
	EOT SYMBOL
	FITTING FROM RECORDS

BT	BT-A	BT-A
BT STAT RECORD	BT-D	BT-D
CABLE DUCT	DU-A	DU-A
CABLE DUCT STAT RECORD	DU-D	DU-D
CABLE TV	CA-A	CA-A
CABLE TV STAT RECORD	CA-D	CA-D
CCTV	CC-A	CC-A
CCTV STAT RECORD	CC-D	CC-D
TELECOMS	TC-A	TC-A
TELECOMS STAT RECORD	TC-D	TC-D
EARTH ROD STRIP	ER-A	ER-A
EARTH ROD STAT RECORD	ER-D	ER-D
ELECTRIC	EL-A	EL-A
ELECTRIC STAT RECORD	EL-D	EL-D
FIBRE-OPTICS	FO-A	FO-A
FIBRE-OPTICS STAT RECORD	FO-D	FO-D
FUEL LINE	FL-A	FL-A
FUEL LINE STAT RECORD	FL-D	FL-D
GPR DETECTION LINE	GPR	GPR
MAINS GAS	GM-A	GM-A
MAINS GAS STAT RECORD	GM-D	GM-D
MAINS WATER	WM-A	WM-A
MAINS WATER STAT RECORD	WM-D	WM-D
SEWER CW	CW-A	CW-A
SEWER CW STAT RECORD	CW-D	CW-D
SEWER FW	FW-A	FW-A
SEWER FW STAT RECORD	FW-D	FW-D
SEWER SW	SW-A	SW-A
SEWER SW STAT RECORD	SW-D	SW-D
TRAFFIC SIGNAL CABLE	TS-A	TS-A
TSC STAT RECORD	TS-D	TS-D
UNIDENTIFIED TRACE	UI-A	UI-A
UNIDENTIFIED CABLE	UC-A	UC-A
UNIDENTIFIED PIPE	UP-A	UP-A
VEHICLE DETECTION CABLE	VD-A	VD-A
VDC STAT RECORD	VD-D	VD-D
SURVEY BOUNDARY		
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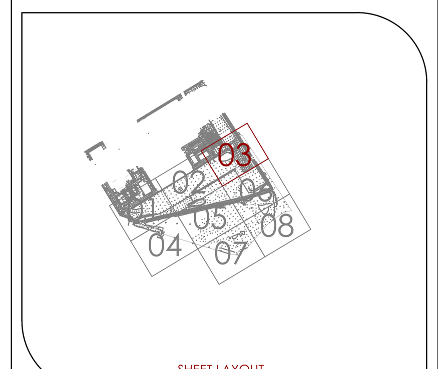

SHEET LAYOUT

0 2m 4m 8m 12m 16m

SCALE BAR

REV	DATE	DESCRIPTION

CMS SURVEYS
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Client
Geotechnics
Unit 1B, Borders Industrial Park
River Lane
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Chester
CH4 8RJ

Project Title
Utility Survey of Land at:
Rosper Road
South Killingholme
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DN40 3DZ

Surveyed	Drawn	Checked
G.Gilbert	C.Scouler	C.Scouler

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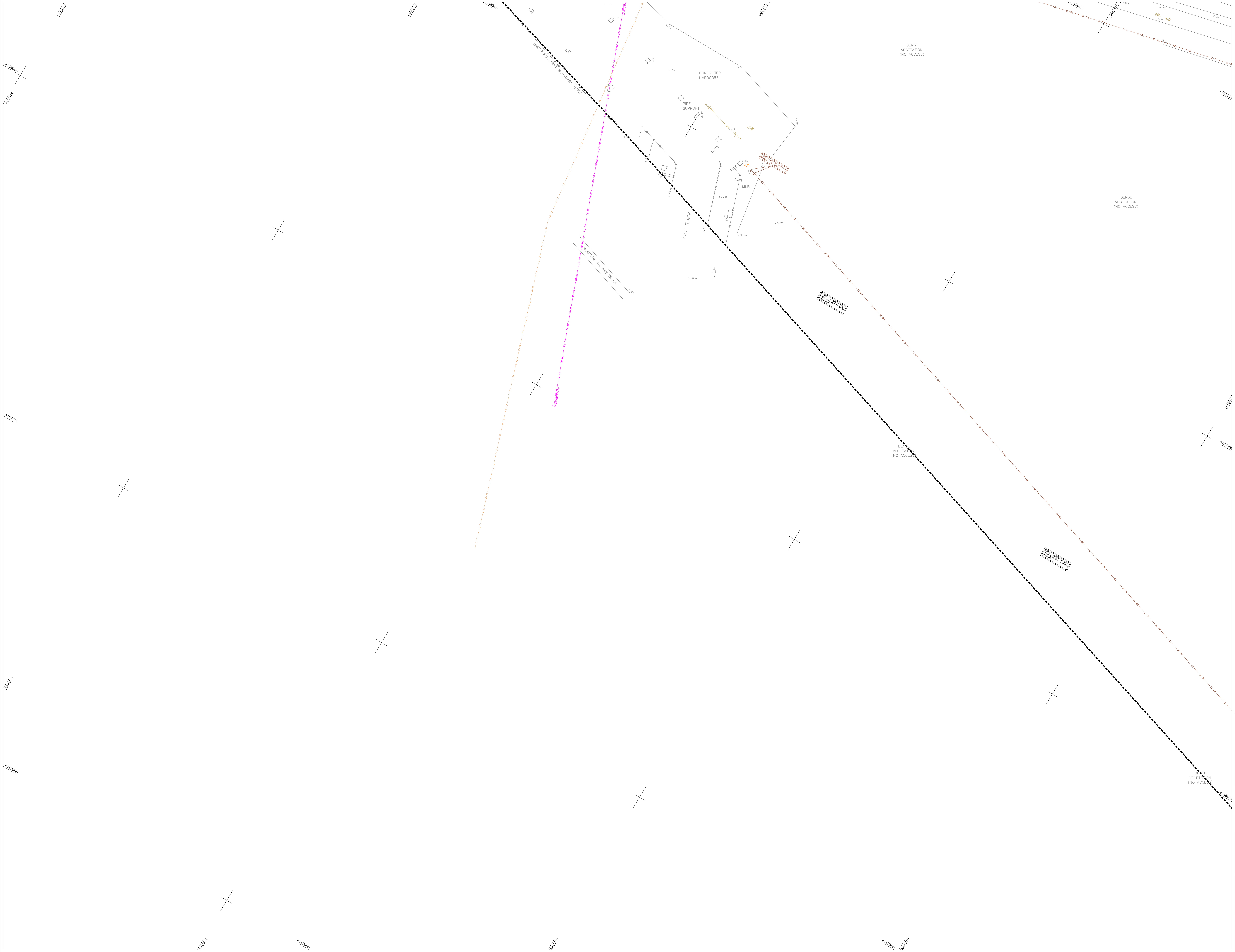

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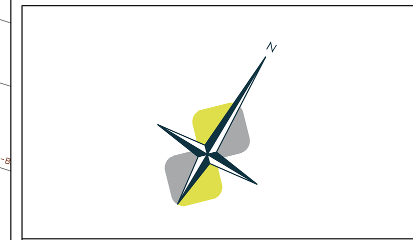

PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

AV	AIR VALVE
BT	BT INSPECTION COVER
CB	CONTROL BOX
CCTV	CCTV CAMERA POST
COM	COMMUNICATIONS COVER
CTV	CABLE TV COVER
DC	DRAINAGE CHANNEL
DP	DOWN PIPE
DR	DRAIN
EIC	ELEC INSPECTION COVER
ELB	ELECTRIC BOX
ER	EARTH ROD
EP	ELECTRICITY POLE
FL	FINISHED FLOOR LEVEL
FH	FIRE HYDRANT
G	GULLY
GLT	GROUND LIGHT
GST	GAS TAP
GSV	GAS VALVE
IC	INSPECTION COVER
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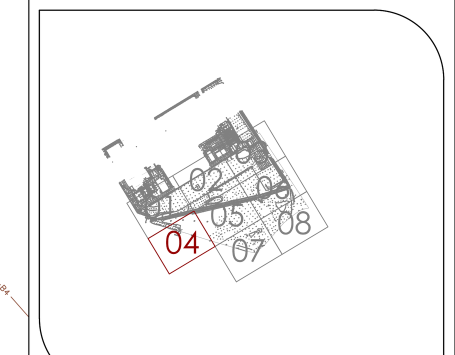

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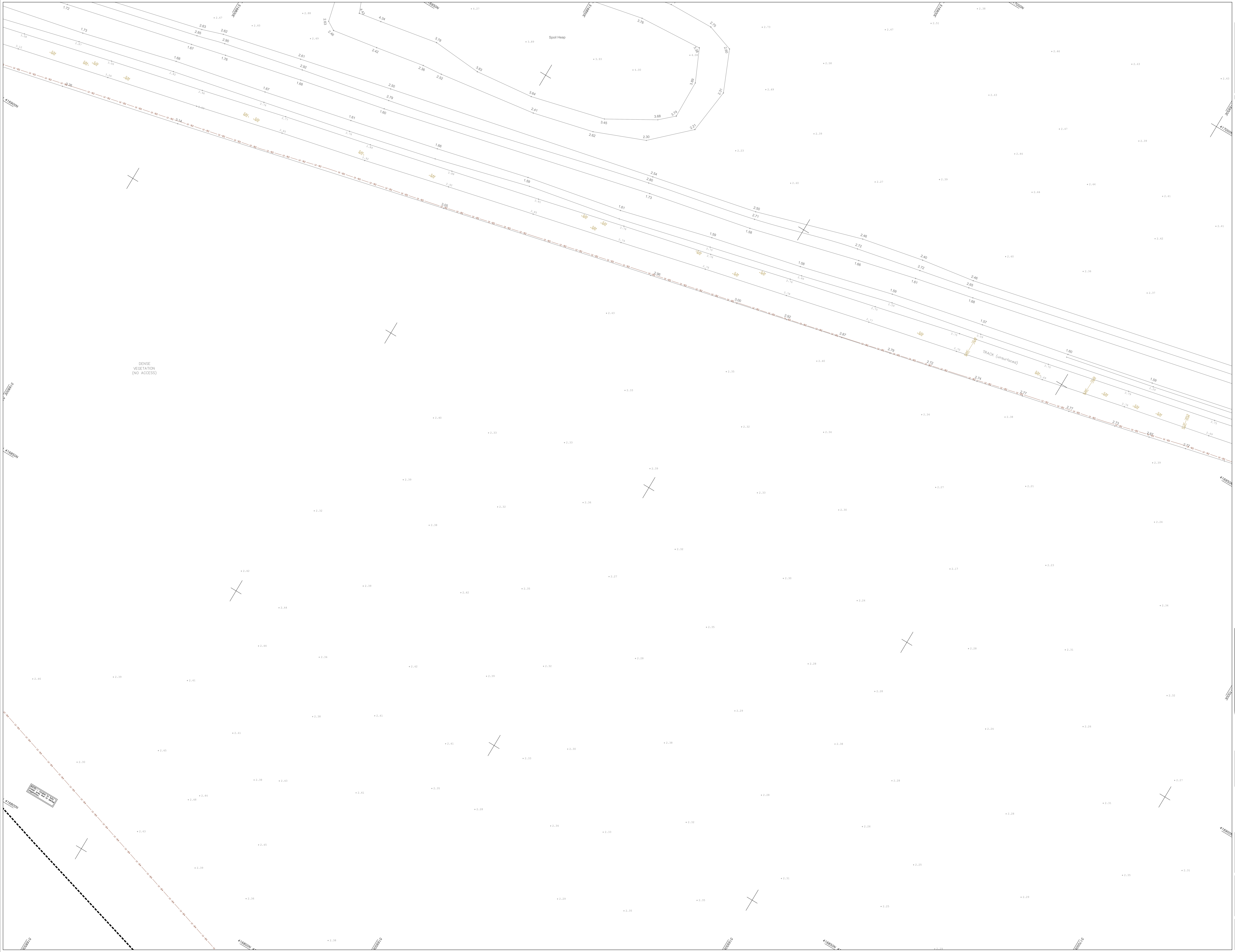

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EARTH ROD STAT RECORD	ER-D	ER-D
ELECTRIC	EL-A	EL-A
ELECTRIC STAT RECORD	EL-D	EL-D
FIBRE-OPTICS	FO-A	FO-A
FIBRE-OPTICS STAT RECORD	FO-D	FO-D
FUEL LINE	FL-A	FL-A
FUEL LINE STAT RECORD	FL-D	FL-D
GPR DETECTION LINE	GPR	GPR
MAINS GAS	GM-A	GM-A
MAINS GAS STAT RECORD	GM-D	GM-D
MAINS WATER	WM-A	WM-A
MAINS WATER STAT RECORD	WM-D	WM-D
SEWER CW	CW-A	CW-A
SEWER CW STAT RECORD	CW-D	CW-D
SEWER FW	FW-A	FW-A
SEWER FW STAT RECORD	FW-D	FW-D
SEWER SW	SW-A	SW-A
SEWER SW STAT RECORD	SW-D	SW-D
TRAFFIC SIGNAL CABLE	TS-A	TS-A
TSC STAT RECORD	TS-D	TS-D
UNIDENTIFIED TRACE	UI-A	UI-A
UNIDENTIFIED CABLE	UC-A	UC-A
UNIDENTIFIED PIPE	UP-A	UP-A
VEHICLE DETECTION CABLE	VD-A	VD-A
VDC STAT RECORD	VD-D	VD-D
SURVEY BOUNDARY		
LIMITED/IMPEDED SURVEY		

QUALITY LEVEL

A – Verification

B1 – Horizontal/Vertical location using multiple techniques

B2 – Horizontal/Vertical location using a single technique

B3 – Horizontal location using a single technique

B4 – Assumed route

C – Site Reconnaissance

D – Desktop utility records search

NOTES:

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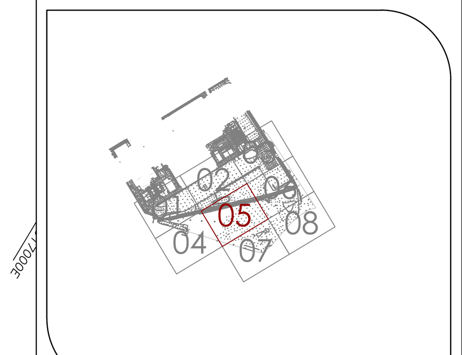

SHEET LAYOUT

0 2m 4m 8m 12m 16m

SCALE BAR

REV	DATE	DESCRIPTION

CMS SURVEYS
www.cmssurveys.co.uk

Client
Geotechnics
Unit 1B, Borders Industrial Park
River Lane
Saltney
Chester
CH4 8RJ

Project Title
Utility Survey of Land at:
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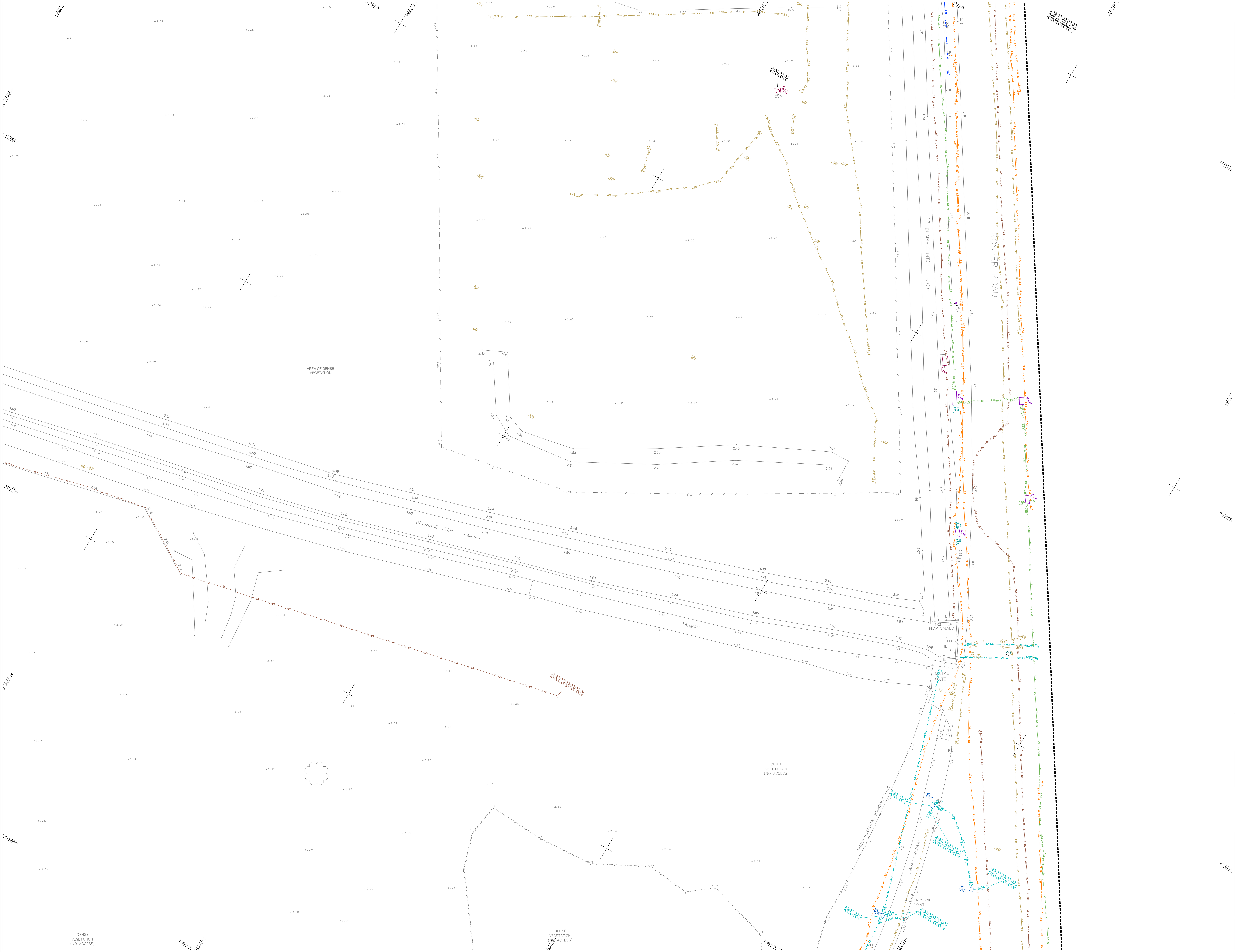
South Killingholme
North Killingholme
DN40 3DZ

Surveyed	Drawn	Checked
G.Gilbert	C.Scouler	C.Scouler

Scale	Date	Drawing Ref.	No.	Size	Rev
1:200	Oct 22	EN22052-U	05	A0	0



PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

AV	AIR VALVE	BT	BT-A
BT	BT INSPECTION COVER	BT STAT RECORD	BT-D
CB	CONTROL BOX	CABLE DUCT	DU-A
CCTV	CCTV CAMERA POST	CABLE DUCT STAT RECORD	DU-D
COM	COMMUNICATIONS COVER	CABLE TV	CA-A
CTV	CABLE TV COVER	CABLE TV STAT RECORD	CA-D
DC	DRAINAGE CHANNEL	CCTV	CC-A
DP	DOWN PIPE	CCTV STAT RECORD	CC-D
DR	DRAIN	TELECOMS	TC-A
EIC	ELEC INSPECTION COVER	TELECOMS STAT RECORD	TC-D
ELB	ELECTRIC BOX	EARTH ROD STRIP	ER-A
ER	EARTH ROD	EARTH ROD STAT RECORD	ER-D
EP	ELECTRICITY POLE	ELECTRIC	EL-A
FL	FINISHED FLOOR LEVEL	ELECTRIC STAT RECORD	EL-D
FH	FIRE HYDRANT	FIBRE–OPTICS	FO-A
G	GULLY	FIBRE–OPTICS STAT RECORD	FO-D
GLT	GROUND LIGHT	FUEL LINE	FL-A
GST	GAS TAP	FUEL LINE STAT RECORD	FL-D
GSV	GAS VALVE	GPR DETECTION LINE	GPR
IC	INSPECTION COVER	MAINS GAS	GM-A
IL	INVERT LEVEL	MAINS GAS STAT RECORD	GM-D
KO	KERB OUTLET	MAINS WATER	WM-A
LP	LAMP POST	MAINS WATER STAT RECORD	WM-D
MH	MANHOLE	SEWER CW	CW-A
MKR	MARKER	SEWER CW STAT RECORD	CW-D
OP	OUTFALL PIPE	SEWER FW	FW-A
PN	PYLON	SEWER FW STAT RECORD	FW-D
PP	PETROL PUMP	SEWER SW	SW-A
RE	RODDING EYE	SEWER SW STAT RECORD	SW-D
RWP	RAINWATER PIPE	TRAFFIC SIGNAL CABLE	TS-A
SOF	SOFFIT LEVEL	TSC STAT RECORD	TS-D
SV	STOP VALVE	UNIDENTIFIED TRACE	UI-A
TCB	TELEPHONE CALL BOX	UNIDENTIFIED CABLE	UC-A
TL	TRAFFIC LIGHT	UNIDENTIFIED PIPE	UP-A
TLB	TRAFFIC LIGHT BOX	VEHICLE DETECTION CABLE	VD-A
TP	TELEGRAPH POLE	VDC STAT RECORD	VD-D
WM	WATER METER	SURVEY BOUNDARY	
WO	WATER OUTLET	LIMITED/IMPEDED SURVEY	
WST	WATER STOP TAP		
WSV	WATER STOP VALVE		

EOT	END OF TRACE
OSA	OUT OF SURVEY AREA
UTL	UNABLE TO LIFT
UTS	UNABLE TO SONDE
UTT	UNABLE TO TRACE
S/L	SIGNAL LOSS
BLK	BLOCKED
NFH	NO FURTHER GPR CONTACTS
BD	BACKDROP PIPE
NVP	NO VISIBLE PIPE
ToP	TOP OF PIPE
	EOT SYMBOL
	FITTING FROM RECORDS

QUALITY LEVEL

A – Verification
B1 – Horizontal/Vertical location using multiple techniques
B2 – Horizontal/Vertical location using a single technique
B3 – Horizontal location using a single technique
B4 – Assumed route
C – Site Reconnaissance
D – Desktop utility records search

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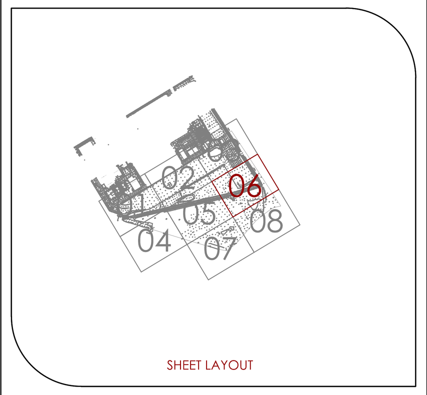

SHEET LAYOUT

0 2m 4m 8m 12m 16m
SCALE BAR

REV	DATE	DESCRIPTION

CMS SURVEYS
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Unit 1B, Borders Industrial Park
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Project Title
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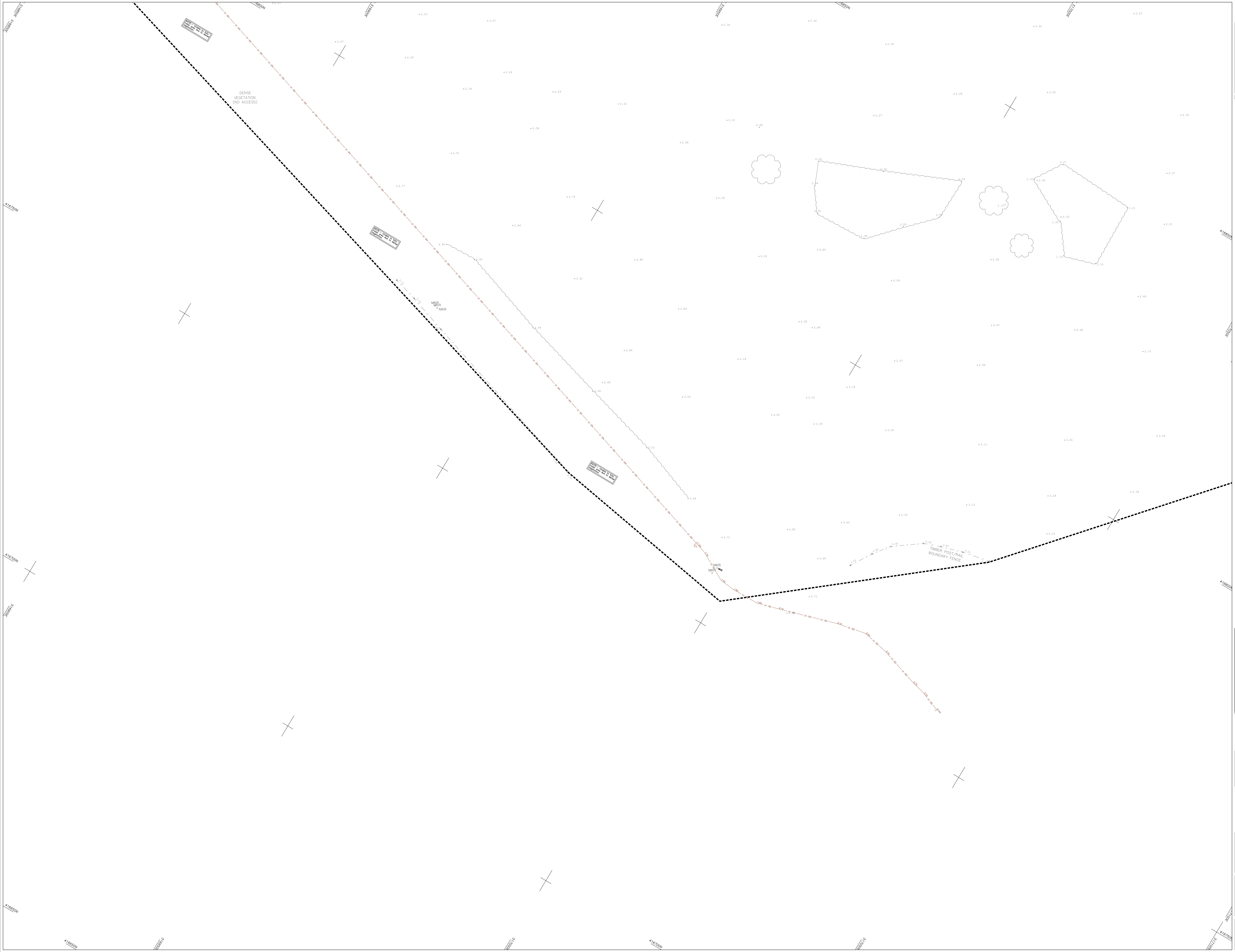
North Killingholme
DN40 3DZ

Surveyed	Drawn	Checked
G.Gilbert	C.Scouler	C.Scouler

Scale	Date	Drawing Ref.	No.	Size	Rev
1:200	Oct 22	EN22052-U	06	A0	0



PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

AV	AIR VALVE	BT	BT-A
BT	BT INSPECTION COVER	BT STAT RECORD	BT-D
CB	CONTROL BOX	CABLE DUCT	DU-A
CCTV	CCTV CAMERA POST	CABLE DUCT STAT RECORD	DU-D
COM	COMMUNICATIONS COVER	CABLE TV	CA-A
CTV	CABLE TV COVER	CABLE TV STAT RECORD	CA-D
DC	DRAINAGE CHANNEL	CCTV	CC-A
DP	DOWN PIPE	CCTV STAT RECORD	CC-D
DR	DRAIN	TELECOMS	TC-A
EIC	ELEC INSPECTION COVER	TELECOMS STAT RECORD	TC-D
ELB	ELECTRIC BOX	EARTH ROD STRIP	ER-A
ER	EARTH ROD	EARTH ROD STAT RECORD	ER-D
EP	ELECTRICITY POLE	ELECTRIC	EL-A
FL	FINISHED FLOOR LEVEL	ELECTRIC STAT RECORD	EL-D
FH	FIRE HYDRANT	FIBRE–OPTICS	FO-A
G	GULLY	FIBRE–OPTICS STAT RECORD	FO-D
GLT	GROUND LIGHT	FUEL LINE	FL-A
GST	GAS TAP	FUEL LINE STAT RECORD	FL-D
GSV	GAS VALVE	GPR DETECTION LINE	GPR
IC	INSPECTION COVER	MAINS GAS	GM-A
IL	INVERT LEVEL	MAINS GAS STAT RECORD	GM-D
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LP	LAMP POST	MAINS WATER STAT RECORD	WM-D
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MKR	MARKER	SEWER CW STAT RECORD	CW-D
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PN	PYLON	SEWER FW STAT RECORD	FW-D
PP	PETROL PUMP	SEWER SW	SW-A
RE	RODDING EYE	SEWER SW STAT RECORD	SW-D
RWP	RAINWATER PIPE	TRAFFIC SIGNAL CABLE	TS-A
SOF	SOFFIT LEVEL	TSC STAT RECORD	TS-D
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TP	TELEGRAPH POLE	VDC STAT RECORD	VD-D
WM	WATER METER	SURVEY BOUNDARY	
WO	WATER OUTLET	LIMITED/IMPEDED SURVEY	
WST	WATER STOP TAP		
WSV	WATER STOP VALVE		

EOT	END OF TRACE
OSA	OUT OF SURVEY AREA
UTL	UNABLE TO LIFT
UTS	UNABLE TO SONDE
UTT	UNABLE TO TRACE
S/L	SIGNAL LOSS
BLK	BLOCKED
NFH	NO FURTHER GPR CONTACTS
BD	BACKDROP PIPE
NVP	NO VISIBLE PIPE
ToP	TOP OF PIPE
	EOT SYMBOL
	FITTING FROM RECORDS

QUALITY LEVEL

A – Verification
B1 – Horizontal/Vertical location using multiple techniques
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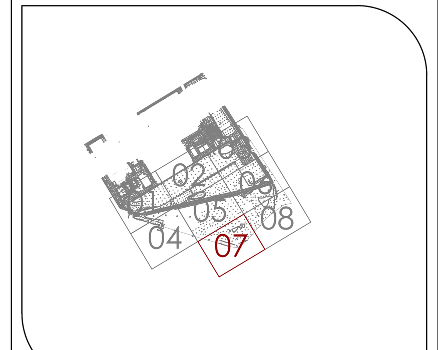

SHEET LAYOUT

0 2m 4m 8m 12m 16m

SCALE BAR

REV	DATE	DESCRIPTION

CMS SURVEYS
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Client
Geotechnics
Unit 1B, Borders Industrial Park
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Project Title
Utility Survey of Land at:
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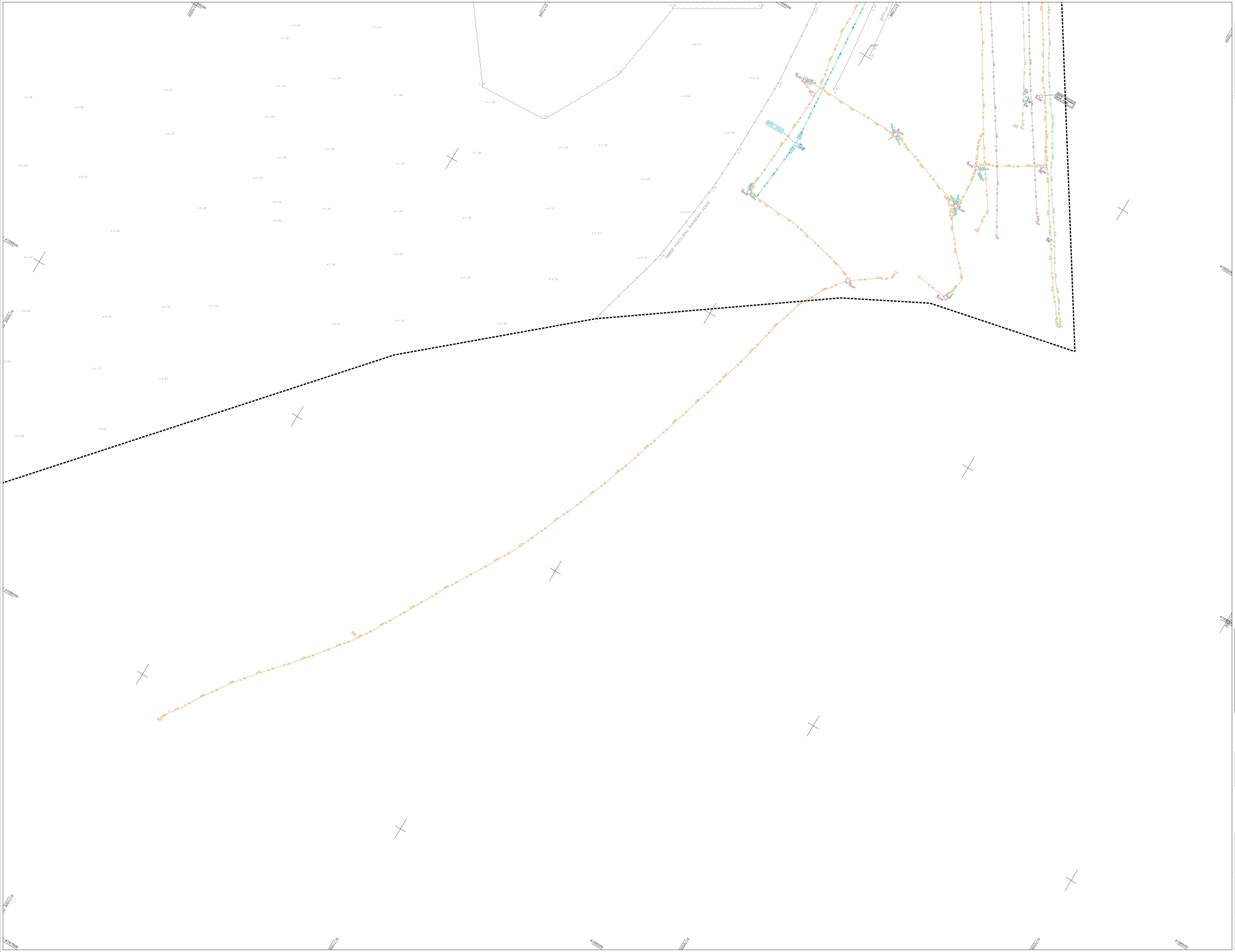
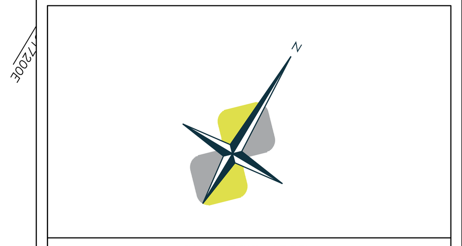
North Killingholme
DN40 3DZ

Surveyed	Drawn	Checked
G.Gilbert	C.Scouler	C.Scouler

Scale	Date	Drawing Ref.	No.	Size	Rev
1:200	Oct 22	EN22052-U	07	A0	0





PLAN GRID NORTH

File Name: EN22052-2DU.dwg

LEGEND

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BT	BT INSPECTION COVER
CB	CONTROL BOX
CCTV	CCTV CAMERA POST
COM	COMMUNICATIONS COVER
CTV	CABLE TV COVER
DC	DRAINAGE CHANNEL
DP	DOWN PIPE
DR	DRAIN
EIC	ELEC INSPECTION COVER
ELB	ELECTRIC BOX
ER	EARTH ROD
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FL	FINISHED FLOOR LEVEL
FH	FIRE HYDRANT
G	GULLY
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BD	BACKDROP PIPE
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BT	BT-A / BT-A
BT STAT RECORD	BT-D / BT-D
CABLE DUCT	DU-A / DU-A
CABLE DUCT STAT RECORD	DU-D / DU-D
CABLE TV	CA-A / CA-A
CABLE TV STAT RECORD	CA-D / CA-D
CCTV	CC-A / CC-A
CCTV STAT RECORD	CC-D / CC-D
TELECOMS	TC-A / TC-A
TELECOMS STAT RECORD	TC-D / TC-D
EARTH ROD STRIP	ER-A / ER-A
EARTH ROD STAT RECORD	ER-D / ER-D
ELECTRIC	EL-A / EL-A
ELECTRIC STAT RECORD	EL-D / EL-D
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FIBRE-OPTICS STAT RECORD	FO-D / FO-D
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SEWER CW STAT RECORD	CW-D / CW-D
SEWER FW	FW-A / FW-A
SEWER FW STAT RECORD	FW-D / FW-D
SEWER SW	SW-A / SW-A
SEWER SW STAT RECORD	SW-D / SW-D
TRAFFIC SIGNAL CABLE	TS-A / TS-A
TSC STAT RECORD	TS-D / TS-D
UNIDENTIFIED TRACE	UI-A / UI-A
UNIDENTIFIED CABLE	UC-A / UC-A
UNIDENTIFIED PIPE	UP-A / UP-A
VEHICLE DETECTION CABLE	VD-A / VD-A
VDC STAT RECORD	VD-D / VD-D
SURVEY BOUNDARY	
LIMITED/IMPEDED SURVEY	

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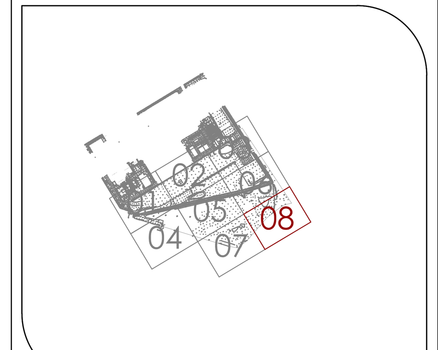

SHEET LAYOUT

0 2m 4m 8m 12m 16m

SCALE BAR

REV	DATE	DESCRIPTION

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G.Gilbert	C.Scouler	C.Scouler

Scale	Date	Drawing Ref.	No.	Size	Rev
1:200	Oct 22	EN22052-U	08	A0	0

APPENDIX 3

Inspection Pit Records

DATA SHEET - *Symbols and Abbreviations used on Records*

Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecone Probe Test
PID	Photo Ionisation Detection (ppm)
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content

(All other strengths from undrained triaxial testing)

S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/- (mm)	Total blows/penetration
( )	Extrapolated value

Groundwater

Water Strike ▽

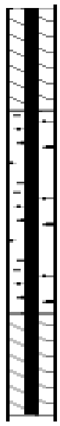
Depth Water Rose To ▼

Instrumentation

Seal

Filter

Seal



Strata — Legend

Made Ground Granular

Made Ground Cohesive

Topsoil

Cobbles and Boulders

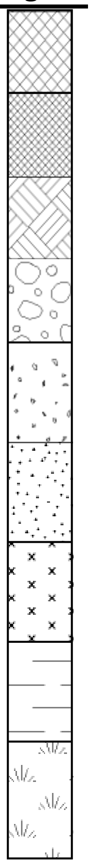
Gravel

Sand

Silt

Clay

Peat



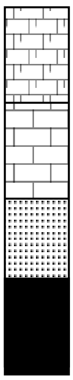
Note: Composite soil types shown by combined symbols

Chalk

Limestone

Sandstone

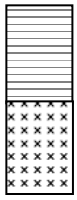
Coal



Strata, Continued

Mudstone

Siltstone

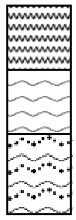


Metamorphic Rock

Fine Grained

Medium Grained

Coarse Grained

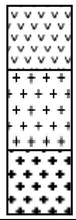


Igneous Rock

Fine Grained

Medium Grained

Coarse Grained



Backfill Materials

Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

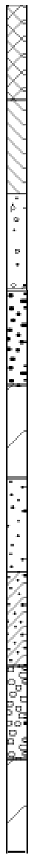
General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam



Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	Fractures/metre
FRACTURE SPACING (m)	Maximum / Minimum
NA	Non-applicable
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss

(where core recovery is unknown it is assumed to be at the base of the run)

TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT01
Client	VPI Immingham Limited	**National Grid Coordinates**	517076.8 E 416878.9 N	**Ground Level**	2.43 m OD

Samples and Tests — Strata — Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.05	D			TOPSOIL: Soft dark brown slightly sandy organic clay with many rootlets.	0.05		2.38
0.05 - 0.70	D			Firm bluish grey mottled orange and brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone and sandstone.			
0.50 - 1.00	B				0.70		1.73
0.70 - 1.00	D			Firm orangish brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone.	1.00		1.43
1.00 - 1.20	D			Firm grey mottled orange slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and chalk.	1.20		1.23
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Logged by JZW

Figure — Sheet 1 of 1

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT02
Client	VPI Immingham Limited	**National Grid Coordinates**	516948.1 E 416798.2 N	**Ground Level**	2.96 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.05	D			TOPSOIL: Soft brown slightly gravelly sandy clay with many rootlets. Gravel is subangular to subrounded fine to medium of mudstone, sandstone, quartzite and chalk.	0.05		2.91
0.05 - 0.60	D			Firm dark brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone and chalk. Some rootlets.	0.60		2.36
0.60 - 0.80	D			Firm orangish brown slightly gravelly sandy CLAY with occasional pockets of sand. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone.	1.20		1.76
0.80 - 1.20	B D						
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	09/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	09/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT03
Client	VPI Immingham Limited	**National Grid Coordinates**	517009.1 E 416891.9 N	**Ground Level**	2.62 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00	D			TOPSOIL: Brown mottled orange very clayey fine to coarse sand with many rootlets.			
0.05	D			Firm grey mottled orangish brown sandy CLAY with many rootlets.	0.05		2.57
0.10 - 0.40	D						
0.40 - 1.00	D						
0.40 - 1.20	B						
1.00 - 1.20	D			Below 1.00m, orangish brown mottled grey.			
				End of Excavation	1.20		1.42

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks AGS Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Logged by JZW

Figure Sheet 1 of 1
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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT04
Client	VPI Immingham Limited	**National Grid Coordinates**	517109.9 E 417014.0 N	**Ground Level**	2.61 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Firm dark grey mottled dark brown slightly sandy clay with many rootlets.			
0.10 - 0.30	D			Firm brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone. Some rootlets.	0.10		2.51
0.30 - 0.50	D			Below 0.30m, grey mottled orangish brown. Gravel is absent.			
0.50 - 1.20	B D						
				End of Excavation	1.20		1.41

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	07/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	07/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT05
Client	VPI Immingham Limited	**National Grid Coordinates**	517028.0 E 416963.9 N	**Ground Level**	3.07 m OD

Scale 1:10

Samples and Tests				Strata			
Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Dark brown gravelly slightly clayey fine to coarse sand with many rootlets. Gravel is subangular to subrounded fine to medium of mudstone, sandstone and quartizite.			
0.10 - 0.40	D			Soft to firm orangish brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to medium of mudstone.	0.10		2.97
0.40 - 1.20	B D			Below 0.40m, slightly sandy.			
				End of Excavation	1.20		1.87

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	07/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	07/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT06
Client	VPI Immingham Limited	**National Grid Coordinates**	516896.8 E 416884.1 N	**Ground Level**	2.56 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Dark brown clayey fine to medium sand with many rootlets.			
0.10 - 0.40	D			Firm brown mottled orange slightly sandy CLAY with some rootlets.	0.10		2.46
0.40 - 1.20	B D			Below 0.40m, bluish grey mottled orange and brown.			
				End of Excavation	1.20		1.36

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT07
Client	VPI Immingham Limited	**National Grid Coordinates**	516813.1 E 416832.0 N	**Ground Level**	2.83 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Dark brown clayey fine to medium sand with many rootlets.			
0.10 - 0.50	D			Light brown mottled orange clayey fine to coarse SAND with some rootlets.	0.10		2.73
0.50 - 0.90 0.50 - 1.20	D B			Firm light brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to medium of mudstone, sandsonte and quartzite.	0.50		2.33
0.90 - 1.20	D			Below 0.90m, gravel includes chalk.			
				End of Excavation	1.20		1.63

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	09/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	09/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT08
Client	VPI Immingham Limited	**National Grid Coordinates**	516956.0 E 416979.9 N	**Ground Level**	2.72 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Firm orangish brown clay with many rootlets.			
0.10 - 0.30	D			Below 0.10m, orangish brown mottled orange.			
0.30 - 0.50	D			Firm grey mottled orange sandy CLAY with many rootlets.	0.30		2.42
0.50 - 1.10	B						
0.50 - 1.20	D						
				Firm light grey mottled orange sandy CLAY. Occasional rootlets.	1.10		1.62
				End of Excavation	1.20		1.52

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	07/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	07/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks AGS Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

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Figure Sheet 1 of 1

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT09
Client	VPI Immingham Limited	**National Grid Coordinates**	517057.7 E 417099.0 N	**Ground Level**	2.97 m OD

Samples and Tests / Strata — Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			MADE GROUND: Dark brown mottled light brown gravelly fine to coarse sand with frequent rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone, quartzite and clinker. Occasional fragments of plastic.			
0.10 - 0.30	D			At 0.10m, much moss.			
0.30 - 0.40	D			Soft orangish brown mottled black slightly sandy slightly gravelly CLAY with some rootlets. Gravel is subangular to subrounded fine of sandstone and quartzite.	0.30		2.67
0.40 - 0.70	D			Below 0.40m, grey mottled black.			
0.70 - 1.20	B D			Below 0.70m, grey mottled orange.			
				End of Excavation	1.20		1.77

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	07/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	07/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks AGS Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

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Figure Sheet 1 of 1

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT10
Client	VPI Immingham Limited	**National Grid Coordinates**	516972.0 E 417047.7 N	**Ground Level**	2.69 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Firm orangish brown sandy clay with many rootlets.			
0.10 - 0.40	D						
0.40 - 1.20	B D			Firm bluish grey mottled orange slightly sandy CLAY.	0.40		2.29
				End of Excavation	1.20		1.49

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	06/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	06/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

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Figure Sheet 1 of 1
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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT11
Client	VPI Immingham Limited	**National Grid Coordinates**	516887.0 E 416995.0 N	**Ground Level**	2.98 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			MADE GROUND: Soft brown slightly sandy slightly gravelly clay with many rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, limestone, quartzite and clinker.	0.10		2.88
0.10 - 0.40	D			Firm greyish brown mottled orange slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to medium of mudstone and sandstone.	1.20		1.78
0.40 - 1.20	B D						
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	06/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	06/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Logged by JZW

Figure Sheet 1 of 1

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT12
Client	VPI Immingham Limited	**National Grid Coordinates**	516802.6 E 416943.9 N	**Ground Level**	3.68 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.20	D			MADE GROUND: Light brown gravelly slightly clayey fine to coarse sand with many rootlets. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone, chalk, flint and clinker.			
0.30 - 1.00	B						
0.50 - 1.00	D						
				Below 0.60m, rootlets absent.			
					1.00		2.68
				Firm dark brown slightly sandy gravelly CLAY with some rootlets.			
					1.20		2.48
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	09/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	09/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT13
Client	VPI Immingham Limited	**National Grid Coordinates**	516718.4 E 416890.3 N	**Ground Level**	3.69 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Dark brown clayey fine to coarse sand with many rootlets.			
0.10 - 0.80	D			Firm dark brown slightly sandy slightly gravelly CLAY with many rootlets. Gravel is subangular to subrounded fine of sandstone and chalk.	0.10		3.59
0.80 - 1.20	D			Firm yellowish brown slightly sandy CLAY with some rootlets.	0.80		2.89
				End of Excavation	1.20		2.49

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Logged by JZW

Figure Sheet 1 of 1
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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT14
Client	VPI Immingham Limited	**National Grid Coordinates**	516904.9 E 417064.9 N	**Ground Level**	3.80 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.07	D			MADE GROUND: Yellowish brown gravelly clayey fine to coarse sand. Gravel is subangular to subrounded fine to medium of sandstone, mudstone and clinker.	0.07		3.73
0.07 - 0.20	D			MADE GROUND: Bluish grey gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of sandstone, chalk, clinker and concrete.	0.20		3.60
0.20 - 0.80	B D			POSSIBLE MADE GROUND: White and cream gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of chalk and flint.	0.80		3.00
0.80 - 1.20	D			Firm dark brown mottled white slightly sandy CLAY.	1.20		2.60
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks AGS Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT15
Client	VPI Immingham Limited	**National Grid Coordinates**	516774.9 E 416987.0 N	**Ground Level**	3.95 m OD

Samples and Tests / Strata — Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.30	D			MADE GROUND: Dark bluish grey gravelly fine to coarse sand. Gravel is subangular to subrounded fine to coarse of clinker, tarmacadam and concrete.	0.30		3.65
0.30 - 0.35	D			MADE GROUND: White mottled grey sandy slightly clayey subangular to subrounded fine to coarse gravel of limestone, sandstone and chalk.	1.10		2.85
0.35 - 1.10	B D						
1.10 - 1.20	D			Soft dark brown mottled black slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of chalk. Some decayed roots.	1.20		2.75
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Logged by JZW

Figure Sheet 1 of 1

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Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT16
Client	VPI Immingham Limited	**National Grid Coordinates**	516646.9 E 416909.9 N	**Ground Level**	3.72 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
				MADE GROUND: Soft dark brown gravelly slightly organic clay. Gravel is subangular to subrounded fine to medium of sandstone, clinker and concrete.	0.10		3.62
				MADE GROUND: Bluish grey angular to subangular fine to coarse gravel of concrete.	0.15		3.57
				MADE GROUND: Yellowish brown gravelly slightly clayey fine to coarse sand. Gravel is subangular to subrounded fine to coarse of sandstone, chalk, clinker and concrete.	0.30		3.42
				MADE GROUND: Cream and white clayey subangular to subrounded fine to coarse gravel of chalk, clinker and concrete.	0.50		3.22
				Soft dark brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of sandstone and chalk.	1.20		2.52
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	09/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	09/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 1 of 1

16/11/2022

GEOTECHNICS
geotechnical and geoenvironmental specialists

TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT17
Client	VPI Immingham Limited	**National Grid Coordinates**	516882.8 E 417097.9 N	**Ground Level**	4.16 m OD

Samples and Tests				Strata			Scale 1:10
Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.25	D			MADE GROUND: Bluish grey mottled white sandy subangular to subrounded fine to coarse gravel of clinker, tarmacadam and concrete.			
0.25 - 0.45	D			MADE GROUND: Soft yellowish brown gravelly clay. Gravel is subangular to subrounded fine to coarse of sandstone, limestone and chalk.	0.25		3.91
0.45 - 0.55	D			MADE GROUND: Light grey sandy subangular to subrounded fine to coarse gravel of clinker and concrete. Low subangular cobble content of concrete.	0.45		3.71
0.55 - 0.85	D			MADE GROUND: Light grey and white subangular to subrounded fine to coarse gravel of chalk.	0.55		3.61
0.85 - 1.20	D			Soft brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine of sandstone and chalk.	0.85		3.31
				End of Excavation	1.20		2.96

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks AGS Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 1 of 1

16/11/2022

GEOTECHNICS
geotechnical and geoenvironmental specialists

TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT18
Client	VPI Immingham Limited	**National Grid Coordinates**	516797.9 E 417045.8 N	**Ground Level**	3.97 m OD

Samples and Tests | Strata | Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.15	D			MADE GROUND: Bluish grey gravelly fine to coarse sand. Gravel is angular to subrounded fine to coarse of clinker, concrete and tarmacadam.			
0.15 - 0.35	D			Below 0.15m, gravel includes mudstone and sandstone.			
0.35 - 0.50	D			MADE GROUND: White mottled dark brown gravelly fine to coarse sand. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone, clinker and chalk.	0.35		3.62
0.50 - 1.10	D			Firm to stiff yellowish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and chalk.	0.50		3.47
0.50 - 1.20	B						
1.10 - 1.20	D						
				End of Excavation	1.20		2.77

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	08/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	08/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Logged by JZW

Figure Sheet 1 of 1
16/11/2022

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT19
Client	VPI Immingham Limited	**National Grid Coordinates**	516703.8 E 416993.8 N	**Ground Level**	3.90 m OD

Scale 1:10

Samples and Tests: Depth	Sample Type	Stratum No.	Results	Strata: Description	Depth	Legend	Level (m OD)
0.00 - 0.30	D			MADE GROUND: Bluish grey sandy clayey angular to subangular fine to coarse gravel of clinker and concrete.			
0.30 - 0.75	B D			MADE GROUND: Light grey and white gravelly fine to coarse sand. Gravel is subangular to subrounded fine to coarse of chalk and concrete.	0.30		3.60
0.75 - 1.20	D			Firm dark brown gravelly CLAY. Gravel is subangular to subrounded fine to medium of chalk.	0.75		3.15
				End of Excavation	1.20		2.70

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	09/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	09/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 1 of 1

16/11/2022

GEOTECHNICS
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TRIAL PIT RECORD - *Inspection Pit follow by Static Cone Penetrometer*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Location ID	CPT20
Client	VPI Immingham Limited	**National Grid Coordinates**	516630.0 E 416942.0 N	**Ground Level**	3.73 m OD

Scale 1:10

Depth	Sample Type	Stratum No.	Results	Description	Depth	Legend	Level (m OD)
0.00 - 0.10	D			TOPSOIL: Dark brown slightly gravelly fine to coarse sand with many rootlets. Gravel is subangular to subrounded fine to medium of mudstone and sandstone.	0.10		3.63
0.10 - 0.65	D			MADE GROUND: Grey mottled white sandy subangular to subrounded fine to coarse gravel of chalk, clinker and concrete.	0.65		3.08
0.65 - 1.00	D			Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of chalk. Some rootlets.	1.00		2.73
1.00 - 1.20	D			Soft to firm yellowish brown sandy CLAY.	1.20		2.53
				End of Excavation			

Excavation

Plant	Hand tools.	**Width (B)**	0.40
Date	12/09/2022	**Length (C)**	0.40
Shoring	None.	**Date Backfilled**	12/09/2022
Stability	Stable during excavation.		

Groundwater

Depth Observed	Depth of Pit	Rose to	in Mins	Remarks
				None encountered.

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
Static Cone Penetration Test carried out following excavation of inspection pit.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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4

APPENDIX 4

Cone Penetration Test Report

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HUMBER ZERO VPI IMMINGHAM

SOIL INVESTIGATION

CPT REPORT

Cone penetration testing
Parameter interpretation

Project Reference.: P-108071-1

Report Issue No.: 01 P-108071_01

PROJECT:	Humber Zero VPI Immingham

CLIENT:	Geotechnics

FIELDWORK

CPT rig(s)	20.5-tonne track-truck mounted CPT unit (UK15)
Date fieldwork started	12th September 2022
Date fieldwork completed	14th September 2022
Lankelma's representative	Emma Stickland
Client's representative	Dave Portsmouth

DOCUMENT CHECKING

Action	Date	Name
Completed	31/10/2022	Christopher Player
Checked	31/10/2022	Joseph Hobbs
Approved	31/10/2022	Joseph Hobbs

Issue	Date	Status
01_01	31/10/2022	Final

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Appendix G	**PENETROMETER TEMPERATURE RESULTS**

1 INTRODUCTION

At the request of Geotechnics, a soils investigation was carried out on project *Humber Zero VPI Immingham*.

Site location:

(In the general region of)

Rosper Road
South Killingholme
Immingham
DN40 3DZ

2 DISCLAIMER

The investigation information, raw data and interpretations provided in this report are for the sole benefit of the Client identified at the front of the report.

Lankelma has exercised reasonable skill and care in the fieldwork and preparation of this report. This report has been completed based on information available to Lankelma at the time of preparation. The measurement and interpreted data in this report do not constitute recommendations for design purposes. An appropriately qualified person must review and interpret the data given in this report, together with any assumptions we have made that affect the data, before using the data for design or recommendation. Lankelma accepts no responsibility for the accuracy or suitability of any assumptions, derived soil parameters, soil classification descriptions or soil layer boundaries contained in this report.

3 COMPLETED WORKS

- 10 nr. cone penetration tests with pore pressure measurement (CPTu)
- Factual report including point data interpretation of selected parameters

Appendix A contains tabulated details of the works completed together with analysis results where applicable.

4 FIELDWORK GENERAL

Fieldwork was performed with a 20.5-tonne track-truck mounted CPT unit (UK15) equipped with a 17.0-tonne capacity hydraulic ram set.

The Client was responsible for the positioning and re-survey of all investigative locations.

The target depth for the investigation was 15 m below ground level. Table 1 details the final test depths and reasons for test termination (*refusal factor)*. Where penetration refusal was encountered the termination depth was advised to, and agreed with, the Client's on-site representative.

5 CONE PENETRATION TESTS

Cone penetration testing was carried out in general accordance with BS ISO 22476-1:2012.

Penetrometer measurements included cone tip resistance, friction sleeve resistance and dynamic pore water pressure sampled at a 10 mm resolution.

Penetrometers were calibrated in accordance with ISO 376:2011. The management of calibration records is in accordance with ISO 10012. Copies of all calibration certificates for the cones used are provided in Appendix B.

The penetrometer used was a digital model (down-hole digitisation) with internal measurement of load cell temperature. The temperature data was used for QA during the test and QC during processing. The test operative aimed to keep the rate of temperature change to less than 0.5°/min in low strength soils to maintain acceptable measurement error. The temperature data can be used to assess ground temperature at depths where the cone has paused for more than 10 minutes with an accuracy of ~+- 0.5°.

The piezometer filter element was in the u_2 position and was vacuum saturated in a > 99.9% vacuum under 1000 cSt silicone oil for > 7 days prior to mobilisation. The pore pressure system was vacuum saturated in the disassembled state under 500 cSt glycerine oil (dipropylene glycol or propylene glycol) and assembled under oil prior to each test.

5.1 GLOSSARY OF CPT TERMS AND SYMBOLS

<u>SYMBOLS & ABBREVIATIONS</u>

B_q	**Pore pressure ratio.** The net pore pressure normalized with respect to the net cone resistance: $B_q = (u_2 - u_0)/(q_t - \sigma_v)$
F_r	**Normalised friction sleeve resistance:** $F_r = f_s / (q_c - \sigma_v)$
f_s	**Friction sleeve resistance:** The total frictional force acting on the friction sleeve, F_s, divided by its surface area A_s: $f_s = F_s/A_s$.
G	**Shear modulus**
g	**Gravitational constant:** $g = 9.81\ m/s^2$
G_0	**Small strain shear modulus**
Gs	**Specific gravity of solids**
HOC	**Heavily overconsolidated**
I_c	**Soil Behaviour Type Index:** Continuous numerical representation of Robertson (1990) soil behaviour type classification chart.
LOC	**Lightly overconsolidated**
NC	**Normally consolidated**
OC	**Overconsolidated**

q_c	**Cone resistance:** The total force acting on the cone Q_c, divided by the projected area of the cone, A_c: $q_c = Q_c/A_c$.
Q_t	**Normalised cone resistance** (Method 1): $Q_t = (q_c - \sigma_v)/\sigma'v$
q_t	**Corrected tip resistance:** The cone tip resistance q_c corrected for pore water pressure effects on the cone shoulder.
$q_{t\text{-net}}$	**Net cone resistance:** $q_{t\text{-net}} = q_t - \sigma_v$. Where q_t is unavailable q_c is applied.
q_{t1}	**Normalised cone resistance** (Method 2): $q_{t1} = (q_t)/(\sigma'_v)^{0.5}(\frac{q_t}{\sigma_{atm}})/(\frac{\sigma_{v0}'}{\sigma_{atm}})^{0.5}$
R_f	**Friction ratio:** The ratio, expressed as a percentage, of the sleeve friction, f_s, to the cone resistance, q_c, at a given depth: $R_f = (f_s/q_c) \cdot 100$
SBT or SBTn	**Soil behaviour type classification**
SPT	**Standard Penetration Test**
u_0	**Equilibrium pore pressure**
u_2	**Pore pressure:** Dynamic pore pressure measured at the shoulder position (u_2) during penetration and during dissipation tests. $u_2 = \Delta u_2 + u_0$
Δu_2	**Excess pore pressure:** $\Delta u_2 = u_2 - u_0$
V_s, V_p	**Shear wave velocity, V_s, and pressure wave velocity, V_p.** Measured with use of a seismic receiver.
z	**Depth below ground level:** Depth as penetration length without correction for inclination, or true depth after correction for inclination.
<u>Greek</u>	
γ	**Unit weight of soil**
γ_w	**Unit weight of water**
ρ	**Volumetric mass density (or specific mass) of soil:** $\rho = \gamma/g$
σ_v	**Total overburden stress**
σ'_v	**Effective overburden stress**
σ_{atm}, or, P_a	**Reference atmospheric stress:** σ_{atm} = 101.3 kPa

<u>TERMS</u>

Cone or 'tip': The conical tip of the cone penetrometer.

Friction sleeve: The section of the cone penetrometer upon which the sleeve friction is measured, located behind the cone tip.

Piezocone: A cone penetrometer with a pore pressure sensor (u_2 or u_1)

Seismic cone: A cone penetrometer with a seismic receiver incorporated inside or behind.

Dynamic pore pressure: The pore pressure measured during penetration (u_2 or u_1) .

Soil behaviour type, or 'SBT': Soil classification scheme or classified soil type according to Robertson (1990, 2016) often abbreviated to SBT or according to normalised cone parameters SBTn.

Rod string: The series of hollow tube push rods that transmit force to the penetrometer.

5.2 CPT DATA REDUCTION AND PRESENTATION

The CPT results are presented in Appendix C. The corrected cone resistance (q_t), local side friction (f_s), dynamic pore water pressure (u_2), friction ratio (R_f) and inclination are all presented against depth and elevation in accordance BS ISO 22476-1:2012. CPT data and the associated derived geotechnical parameters are included in the 4.0 data file provided.

The cone tip and sleeve force measurements were converted to pressure using the nominal dimensions of the penetrometer.

Zero load output values were recorded before and after each test. The set of zero values applied to the measurements (subtracted from the raw output measurement) were those deemed to be obtained at a temperature closest to ground temperature, or the average of the two sets where appropriate.

For tests performed with digital cones, the tip sleeve and pore pressure measurements were corrected for static and transient temperature effects using parameters obtained from the *TEMERATURE EFFECTS* section of the calibration certificate. For each CPT, the dataset was first grouped into penetration strokes (max 1.2 m) and then locally sub-grouped by tip resistance above and below 2 MPa. For each sub-group of qc < 2 MPa, the slope of the temperature (T) profile with time (t) was determined by regression to obtain the rate of temperature change $\Delta T/\Delta t$. For each recorded value, the static and transient temperature error component (apparent sensor output due to change in temperature) was subtracted from the reading.

For subtraction type cones incorporating traditional temperature compensation wiring in the strain gauge circuit, the residual apparent cone tip resistance ($q_{c:a}$) and sleeve resistance ($f_{s:a}$) due to static and transient temperature effects can be approximated by

$q_{c:a} = a(\Delta T/\Delta t) + b(\Delta T)$,

$f_{s:a} = a(\Delta T/\Delta t) + b(\Delta T) - q_{c:a}$

and

$u_a = b(\Delta T)$

Where $q_{c:a}$ is the apparent tip resistance, $f_{s:a}$ is the apparent sleeve resistance, a is the apparent resistance due to unit transient temperature change $\Delta T/\Delta t$, and b is the change in apparent resistance per unit static temperature change relative to the temperature of the penetrometer at the time of zero load output measurement. Note that for the piezometer sensor only the static temperature component is considered and is only applied to piezometer sensors without temperature compensation circuitry.

Parameter a is established by subjecting the cone to a positive and negative nominal temperature change ($\Delta T \sim +- 9^\circ$) in water and measuring the apparent output corresponding to the maximum rate of temperature change at the load cells. Parameter b is established by measuring the apparent output after the cone has temperature stabilised.

The temperature corrected tip ($q_{c:c}$), sleeve resistance ($f_{s:c}$) and pore pressure ($u_{:c}$) are then found from

$q_{c:c} = q_{c:m} - q_{c:a}$,

$f_{s:c} = f_{s:m} - f_{s:a}$

$u_{:c} = u_{:m} - u_{:a}$

Where subscript '$_{:m}$', denotes the field measured resistance/pressure as recorded in the raw data files.

Notes:

1. Depending on the temperature performance of the individual cone, temperature correction of the sleeve is often not warranted as it does not substantially improve accuracy. This is because for subtraction type cones the errors in the sleeve force largely cancel with errors in the tip force when they have the same sign.

2. There is currently no recognised nomenclature for CPT parameters with temperature correction applied during post processing. To avoid confusion the nomenclature is kept unchanged in the logs and AGS data (q_c/q_t, f_s, and u_2) and unless stated otherwise, temperature correction has been applied using the parameters reported in the calibration certificate.

For piezocone tests the total cone resistance (or 'corrected cone resistance') was calculated according to the formula

$$q_t = q_c + u_2 \times (1 - a)$$

Where a is the 'area ratio' and (1- a) is the proportion of cross-sectional area between the cone tip and penetrometer body where pore pressures (positive or negative) can act to add or subtract from the total external axial force on the tip. The difference between measured and corrected values is largest in low strength collapsible soils with large excess pore pressures. The percentage adjustment is described by the curves on the chart below for a = 0.8:

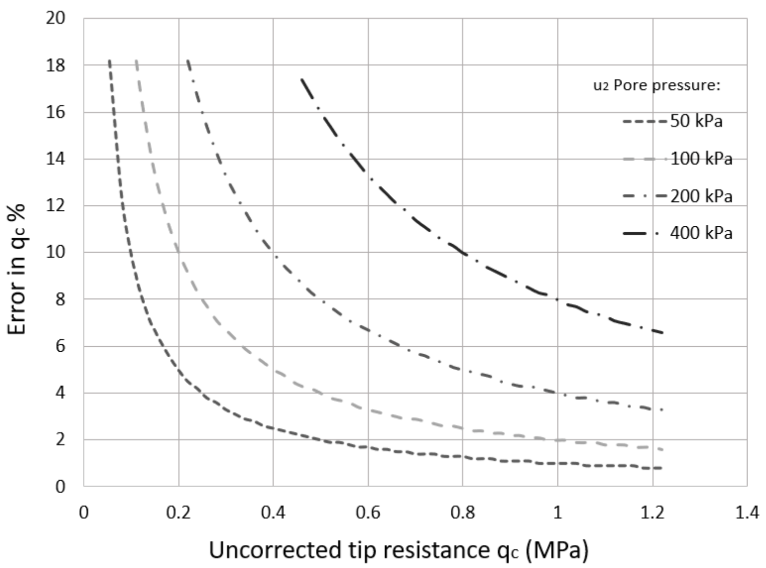


Figure 5-1 Uncorrected tip with measured tip resistance

Penetration length readings were corrected for inclination and sleeve readings were depth corrected for the dimensional offset between cone tip and sleeve during post processing. Rod spikes (artefacts of the pause for push rod addition) were filtered from the cone tip and sleeve data. The data was re-sampled from 10 mm resolution to 20 mm to reduce the size of the data set to a more manageable size for end users. A 20 mm resolution is well within the intrinsic influence zone of the cone tip measurement and the loss of meaningful resolution is negligible.

The raw data are presented in Appendix C. For piezocone tests q_t is reported on all logs, and q_c only appears in the digital AGS data.

Geotechnical parameters appropriate for drained and undrained cone penetration conditions were derived for corresponding drained and undrained derived soil behaviour types (SBTs) respectively, however, to account for uncertainty in the SBT correlation with drainage behaviour, all parameters were derived over a range of transitional soils within the range 2.4 < *Ic* < 2.7 (see section 6.3).

In general, the engineering parameters derived for fine grain soils (undrained) are suitable for soils of both silicate and carbonate composition, whereas parameters derived for coarse soils are intended for non-cemented predominantly silicate composition.

5.3 IN-SITU STRESS CONDITIONS

An estimate of the equilibrium pore pressure and total and effective vertical stress states is required for derivation of many parameters obtained from the CPT and dissipation test.

The total vertical stress with depth was calculated as the sum of the calculated soil unit weight above a given depth. See section 5.4 for information on the empirical estimate of soil unit weight.

An arbitrary phreatic surface of 3.00 mBGL was applied in the calculation of effective stress.

Note: The term phreatic surface is used here, however when it is based on piezometer measurements (piezocone) it is assumed that the piezometric level (under hydrostatic conditions) and phreatic surface coincide. The phreatic or piezometric level reported is intended to provide information about the assumed pore pressure distribution and may not represent the true position of the groundwater table or perched water bodies. Complex groundwater pressure distributions will be applied if they are observed from the measurements and are sufficiently well defined.

5.4 SOIL UNIT WEIGHT

The soil unit weight was estimated using the following method proposed by Robertson (2010b).

$$\frac{y}{y_w} = 0.27\,Log(R_f) + 0.36\,(Log(q_t/R_f)) + 1.236$$

Throughout pre-drilled zones (inspection pits or drill-out) the soil was assigned a nominal unit weight of 17 kN/m^3.

For depths where the friction sleeve resistance measurement was less than zero due to measurement limitations, the friction sleeve resistance input parameter was substituted with a nominal 1.0 kPa resistance for the purpose of obtaining an approximate soil unit weight necessary for estimation of total vertical stress over the entire profile.

5.5 SOIL BEHAVIOUR TYPE

The data have been interpreted using 4 soil behaviour type schemes: Robertson (1990, 2010, 2016) and Schneider et al, 2008. The Robertson (1990) scheme is widely used and forms the bases of the layer analysis whereby the profile is split into zones of common classification. The Robertson (2010 & 2016) and Schneider at al methods are less widely used but can provide better or more relevant classification in many instances. Differences in classification between the Robetson 1990, 2016 and Schneider et al schemes can also help to identify significant structure/cementation (Robertson 2016).

A dedicated soil behaviour type comparison log is provided in Appendix D.

Robertson (1990, 2010)

The soil behaviour type (SBT) was interpreted using the Robertson (1990) classification system based on the normalised cone resistance (Qt) and normalised friction sleeve resistance (Fr) for silicate and organic soils.

While the classification based on normalised parameters is more accurate, particularly for NC soils exceeding 15 m depth, the classification is often significantly in error (artificially granular/drained) at shallow depth (< 1-3 m). The error at shallow depth is associated with the potentially large difference between the estimated vertical effective stress (applied in normalisation) and the unknown horizontal stress influencing penetration resistance.

Robertson (2010) proposed a non-normalised version of the 1990 chart which uses dimensionless cone resistance (q_c/Pa) and friction ratio (Rf). The classification according to this chart can be more reliable at shallow depth.

It should be noted that:

- The SBT classification provides a general soil type and tends to show biased towards the soil fraction that dominates the mechanical behaviour.
- If fine cohesive soils are dry and overconsolidated, the classification tends to shift towards a coarser soil type (or lower I_c index)

While the repeatability and behavioural bias of the SBT is usually beneficial, the classification is not always an appropriate substitute for classification based on particle size and plasticity index tests.

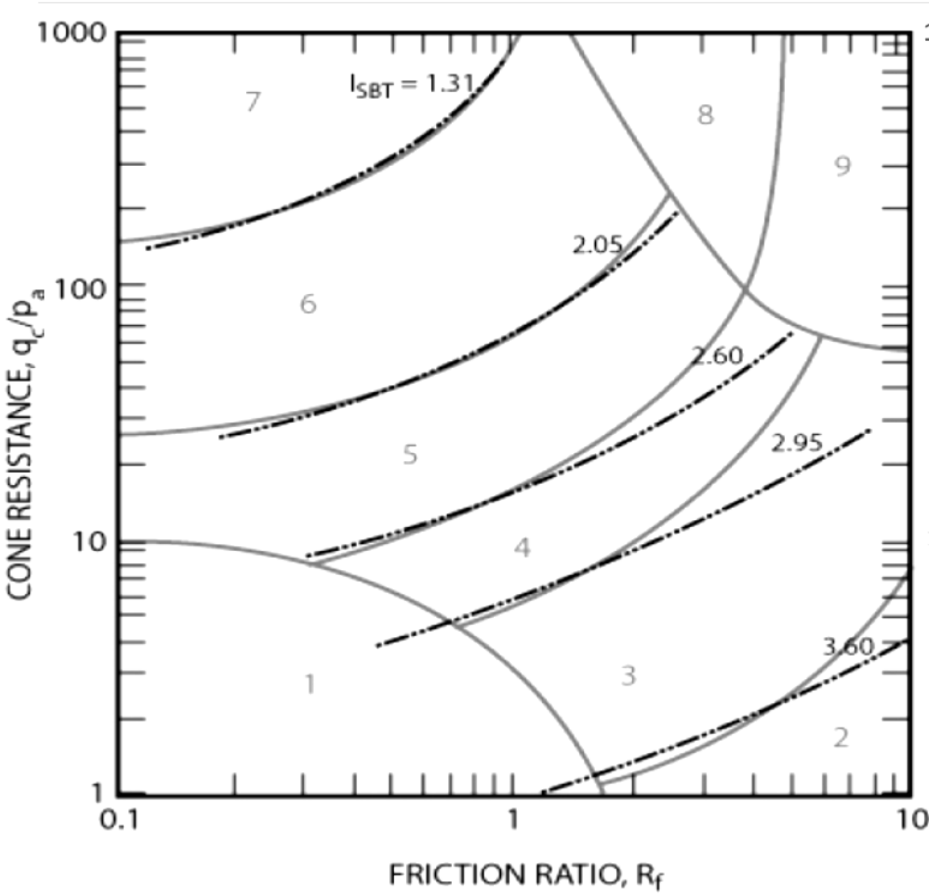


Figure 5-2 Non-normalised SBT chart by Robertson et al. (2010) based on dimensionless cone resistance (qc/Pa) and friction ration, Rf, showing contours of SBT index ISBT (denoted Ic on the test plots). The chart is also applicable to normalised tip (Q_t) and sleeve (F_r) values.

Table 1 Robertson (1990, 2010) soil behaviour type zone descriptions

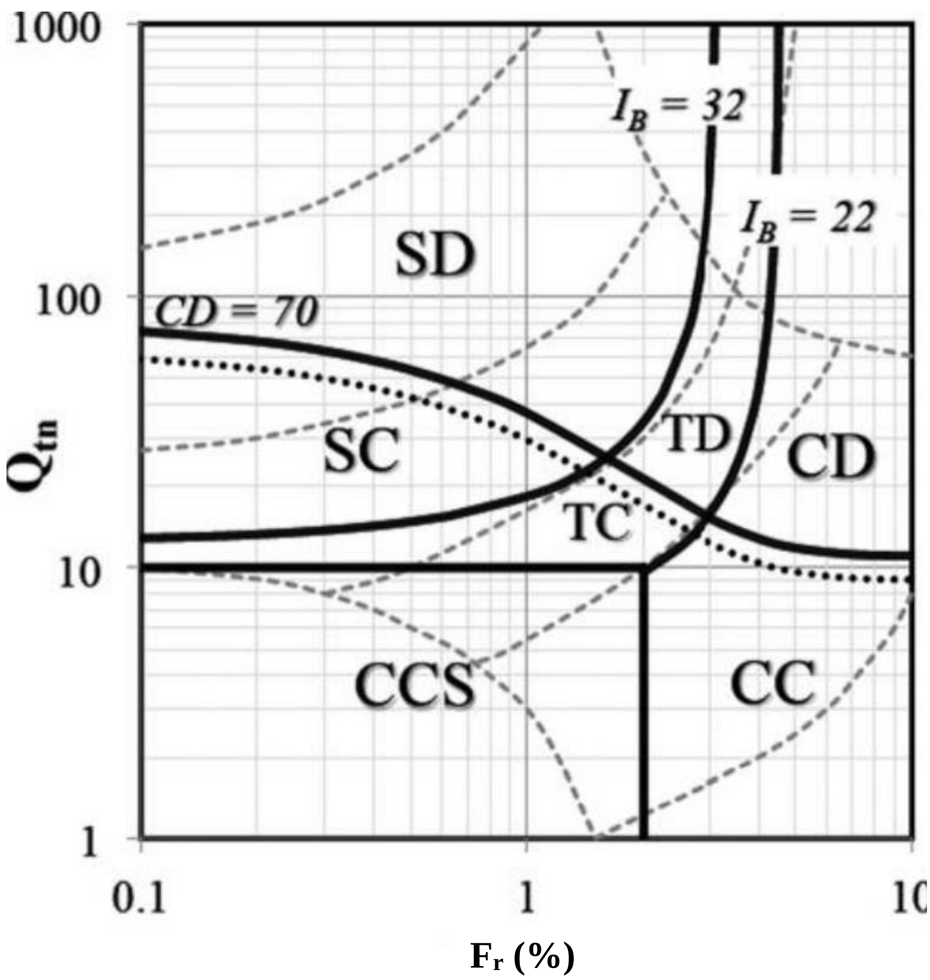
Zone	**Soil Behaviour Type (SBT)**		
1	Sensitive fine-grained	6	Sands - clean sand to silty sand
2	Organic soils	7	Gravelly sand to sand
3	Clays – clay to silty clay	8*	Very stiff/dense sand to clayey sand[1]
4	Silt mixtures - clayey silt to silty clay	9*	Very stiff fine grained[1]
5	Sand mixtures – silty sand to sandy silt	*Heavily overconsolidated or cemented*	

[1]Note zones 8 and 9 appear as ‘*Very stiff/dense sand to clayey sand – HOC or cemented*’ and ‘*Very stiff fine grained – HOC or cemented*’ within the soil unit descriptions of plots in Appendix D.

Results are presented in Appendix D.

<u>Robertson 2016</u>

Using the same Q_t - F_r space as above, Robertson (2016) proposed an alternative purely behavioural classification system that places less emphasis on classification according to composition/textural properties and more emphasis on mechanical behaviour – namely the tendency of the soil to dilate or collapse during large strain shear, and sensitivity.



Zone	Soil Behaviour Type (SBT)
CCS	Clay-like – contractive - sensitive
CC	Clay-like – Contractive
CD	Clay-like – Dilative
TC	Transitional - Contractive
TD	Transitional - Dilative
SC	Sand-like - Contractive
SD	Sand-like - Dilative

Figure 5-3 Robertson 2016 soil behaviour type classification chart and zone descriptions

Schneider *et al.* (2008)

Schneider *et al.* (2008) proposed a classification system based on the normalised pore pressure B_q and tip resistance Q_t. This system is particularly useful for soils of very low strength or that exhibit drainage behaviour or u_2 response inconsistent with the SBT derived from tip and sleeve measurements. However, for onshore CPTs care must be taken that the u_2 piezometer is not affected by desaturation and that the response is dynamic. A set of logs showing both the Robertson and Schneider et al. classification results are provided for comparison in Appendix D.

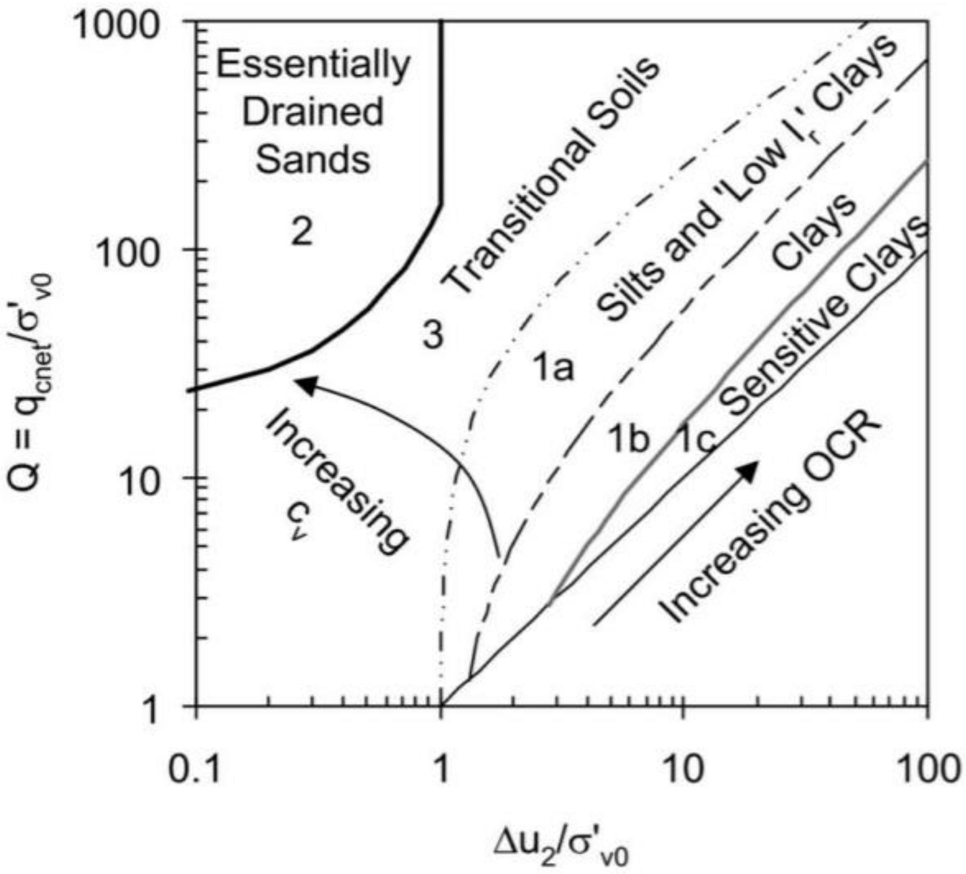


Figure 5-4 Schneider 2008 soil behaviour type classification chart and zone descriptions

<u>Layer Analysis</u>

The layer boundaries are manually interpreted based on broad changes in Robertson 1990 SBT classification or variance with depth. Once layer boundaries are defined, the SBT zones classified within each layer are listed together with the corresponding percentage of data points within the layer (excluding null/filtered data). The modal classification is reported in full, with abbreviated short descriptions for all secondary zones, for example - '*Clays – clay to silty clay [74%]; *Silt mixtures [20%]*', where the asterisk represents an abbreviation of the full description '*Silt mixtures – clayey silt to silty clay*'. It is important to consider that the classification zone boundaries do not exist in nature and small shifts in the cone response can lead to multiple classifications within layers of relatively uniform behaviour; especially were the layer data plot close to a zone junction and/or has spurious spikes or very thin layers. Therefore, some system to limit the number of classified zones is usually necessary for clarity in the plot. The logic used by Lankelma for each layer is:

For LT >= 1, C = 85
For 0.5 <= LT < 1, C = 75
For 0 < LT < 0.5, C = 65

Where
C = Minimum % SBT zone classification coverage within the layer
LT = Layer thickness (m)

For layers having a thickness of less than 1 m then 10% of data at the top and bottom of the layer are excluded to limit the effect of transition zone data (mobilised resistance influenced by overlying or underlying strata) being included in the classification.

The continuous SBT index I_c should be used to assess the classification distribution and variation not accounted for by the layer description.

5.6 SOIL BEHAVIOUR TYPE INDEX - I_C

The principal trend in soil behaviour type (SBT) variation can be expressed by a continuous index, I_C, proposed by Robertson and Wride (1998) based on a similar index proposed by Jefferies and Davies (1993). The index provides a continuous profile of SBT variation with depth for end-user analysis of soil units and variation within units. The equivalent non-normalised version proposed by Robertson (2010) is provided for comparison.

The basis of I_c and its approximation of the original chart classification zones may be seen from Figure 5-2. The method does not identify zones 1 (*sensitive fine grained)* or zones 8 & 9 (*heavily overconsolidated or cemented*).

Normalised SBT index I_C (Robertson and Wride, 1998)*:*

$$I_c = \ [(3.47 - \log\ Q_t)^2 + (logF_r + 1.22)^2]^{0.5}$$

Non-normalised SBT index I_C (Robertson, 2010)*:*

$$I_c = \left[\left(3.47 - \log\left(\frac{q_c}{\sigma_{atm}}\right)\right)^2 + (logR_f + 1.22)^2\right]^{0.5}$$

The normalised version of I_c is generally more accurate, while the non-normalised version is intended for compatibility with the non-normalised Robertson's (2010) SBT chart and may be more accurate at shallow depths in overconsolidated soils.

The results are presented in Appendix D.

5.7 RELATIVE DENSITY

The relative density of sands was calculated based on an empirical relationship proposed by Jamiolkowski *et al*. (2001) based on a large database of undisturbed frozen samples and calibration chamber tests. The expected accuracy may be evaluated from the figures presented below.

$$D_r = 100\left[0.268 \cdot \ln\left(\frac{q_t/\sigma_{atm}}{\sqrt{\sigma_{vo}'/\sigma_{atm}}}\right) - k\right]$$

k = Compressibility dependant constant can be taken as -0.675 for medium compressibility (applied value in our interpretation), <= 1 for high compressibility and >= 2 for compressible sands.

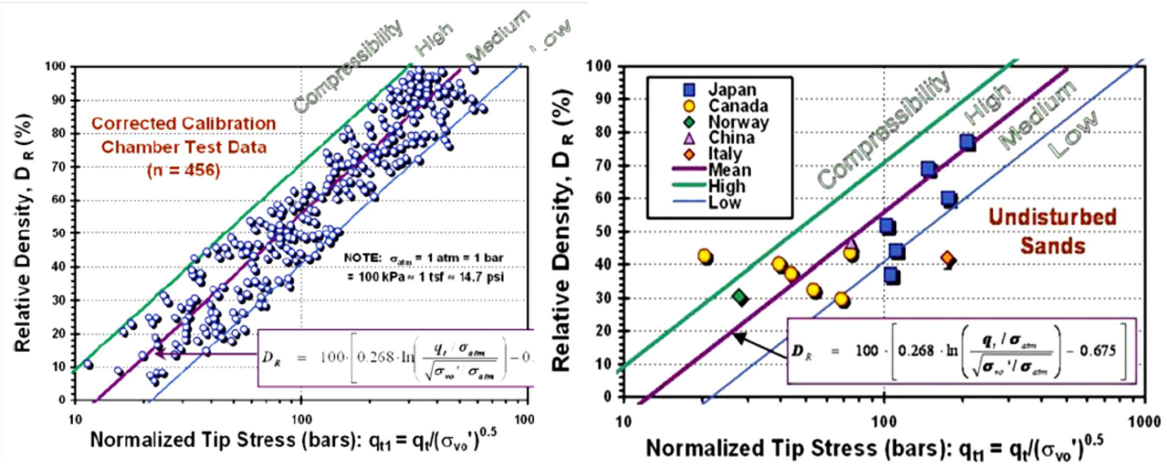


Figure 5-5 Relative density with normalised tip stress and sand compressibility from calibration chamber tests (left) and undisturbed frozen samples (right). Jamiolkowski *et al.* (2001). Reproduced from Mayne (2007).

The results are presented in Appendix F.

5.8 UNDRAINED SHEAR STRENGTH

The undrained shear strength s_u is usually estimated by the bearing capacity method, whereby the net tip resistance is divided by a factor N_k (Lunne *et al*, 1981):

$$s_u = \frac{q_c - \sigma_{v0}}{N_k}$$

Where N_k is an empirical factor which varies with soil type, stress history, structure/fabric, plasticity, and the mode of shear.

Mayne and Peuchen (2018) performed an evaluation of 407 high-quality undrained anisotropically consolidated triaxial compression tests (CAUC) with net tip resistance data pairs, resulting in N_{kt} factors with regression analysis details for five categories of clays shown in Table 2.

Table 2 Summary of CAUC s_u versus q_{net} for clays. Reproduced from Mayne and Peuchen (2018).

Clay Group	Number of sites	Nr Data	Correlation Coefficient r^2	Factor N_{kt}	Mean Pore Pressure Parameter B_q
Offshore NC-LOC	17	115	0.98	12.32	0.51
Onshore NC-LOC	30	191	0.867	12	0.53
Sensitive NC-LOC	5	43	0.507	10.33	0.84
OC Intact	5	36	0.862	13.57	0.49
OC Fissured	5	22	0.393	22.47	-0.01
All clays	62	407	0.923	13.33	0.55

Alternatively, a variable N_{kt} factor can be estimated for the profile as a function of the pore pressure parameter B_q, applicable for B_q values of > -0.01. The following equation proposed by Mayne and Peuchen is based on the same database evaluation:

$$N_{kt} = 10.5 - 4.6 \cdot \ln(B_q + 0.1)$$

Where the pore pressure parameter B_q is the ratio of excess pore pressure to net tip resistance:

$$B_q = \frac{u_2 - u_0}{q_t - \sigma_{v0}}$$

The N_{kt} estimate has a standard error of 2.4 N_k and correlation coefficient of 0.645.

The estimate based on B_q is presented as 's_u5' on the parameter plots and is only suitable for tests that have a high-quality pore pressure data, often indicated by a positive, repeatable, and dynamic response.

Note: N_{kt} (with subscript 't') indicates a N_k factor that has been established using the corrected tip resistance q_t. N_{kt} can be applied to the uncorrected tip resistance q_c (non-piezocone tests) but results in a slightly lower estimate of s_u depending on the correction magnitude (q_c - q_t) in lower strength soils.

Undrained shear strengths corresponding to selected values of N_k are presented on the plots of Appendix D. '*s_u3*' on the logs (N_k = 15) has been included as a reference for comparison to traditionally applied N_k values of 15 and 20.

The results are presented in **Error! Reference source not found.Error! Reference source not found.**.

5.9 OVERCONSOLIDATION RATIO

The preconsolidation stress σ'_p was calculated based on the method proposed by Mayne et al (2009):

$$\sigma'_p = k \cdot (q_t - \sigma_{vo})^{m\prime}$$

$$OCR = \sigma_p{}'/\sigma'_{v0}{}'$$

Mayne *et al* found that the trend with mean grain size followed a power law through the addition of exponent m' and that its value can be estimated by relation to soil behaviour type index I_c:

$$m' = 1 - \frac{0.28}{1 + \frac{I_c}{2.65}^{25}}$$

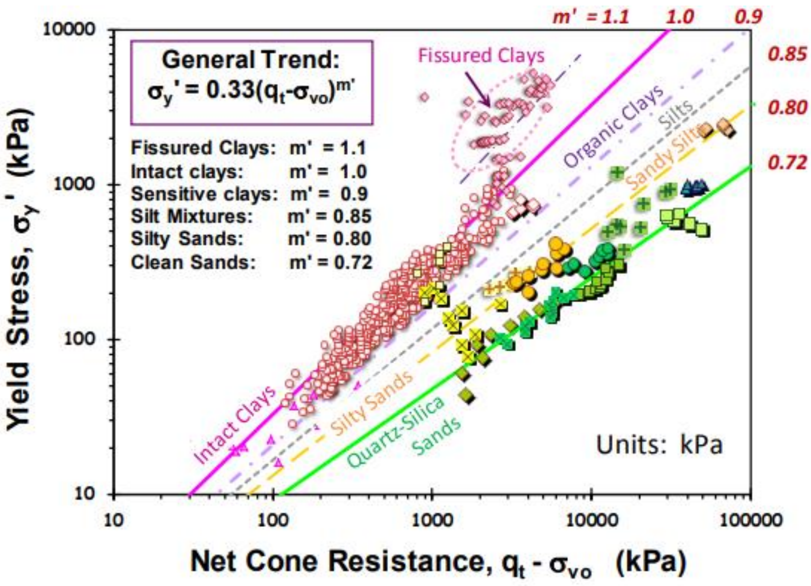


Figure 5-6 Preconsolidation stress with net cone resistance power law, reproduced from Mayne (2014).

An additional set of σ_p' and OCR values were calculated for m' = 1.1 to reflect the upper trend for over consolidated fissured clays not captured by the correlation with I_c.

The results are presented in **Error! Reference source not found.**.

5.10 SPT N60 VALUES

Equivalent SPT N60 values, defined as the non-normalised SPT blow count over a 30 cm interval, were derived for two correlations.

Method 1 - Jefferies and Davies (1993) cited in Lunne *et al.* (1997):

$$N_{60} = \frac{q_t}{8.5 \cdot \sigma_{atm} \cdot \left(1 - \frac{I_c}{4.6}\right)}$$

Method 2 - Robertson (2012):

$$\frac{\left(\frac{q_t}{p_a}\right)}{N_{60}} = 10^{(1.268 - 0.2817 I_c)}$$

The correlations are intended for clays, silts and sands and not for carbonates or cemented geo-materials.

The results are presented in Appendix F.

5.11 FRICTION ANGLE

Sands

The peak friction angle of granular materials was calculated using the Kulhawy and Mayne (1990) method. The relationship is based on a calibration chamber database from 24 sands of varying mineralogy and is found from:

$$\phi' = 17.6 + 11.0 \cdot \log(q_{t1})$$

Where:

ϕ' = Peak friction angle (degrees)

q_{t1} = stress normalised cone resistance:

$$q_{t1} = \left(\frac{q_t}{\sigma_{atm}}\right) / \left(\frac{\sigma_{v0}'}{\sigma_{atm}}\right)^{0.5}$$

The presence of compressible minerals tends to reduce tip resistance resulting in lower estimate of friction angle, while very coarse (sand) or larger grain size tends to increase tip resistance resulting in higher estimate. Increased penetration resistance due to high k_0 conditions also results in an overestimate of friction angle.

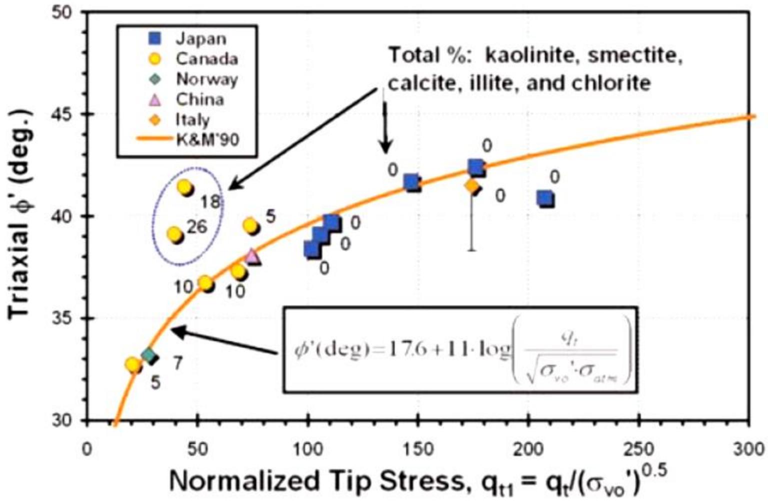


Figure 5-7 Peak triaxial friction angle from undisturbed sands with normalised cone resistance.

Fine grained soils

The effective friction angle for fine grained soils was calculated based on the Senneset *et al.* (1988, 1989) method by applying the approximate closed form solution by Mayne & Campanella (2005) as a direct function of the pore pressure parameter Bq and normalised tip resistance Q. The method is applicable where $0.1 < B_q < 1.0$ and $20° < \phi' < 45°$ and generally appropriate for non-cemented normally consolidated to lightly overconsolidated soils.

$$\phi' = 29.5° \, B_q^{0.121} [0.256 + 0.336 \, B_q + \log Q]$$

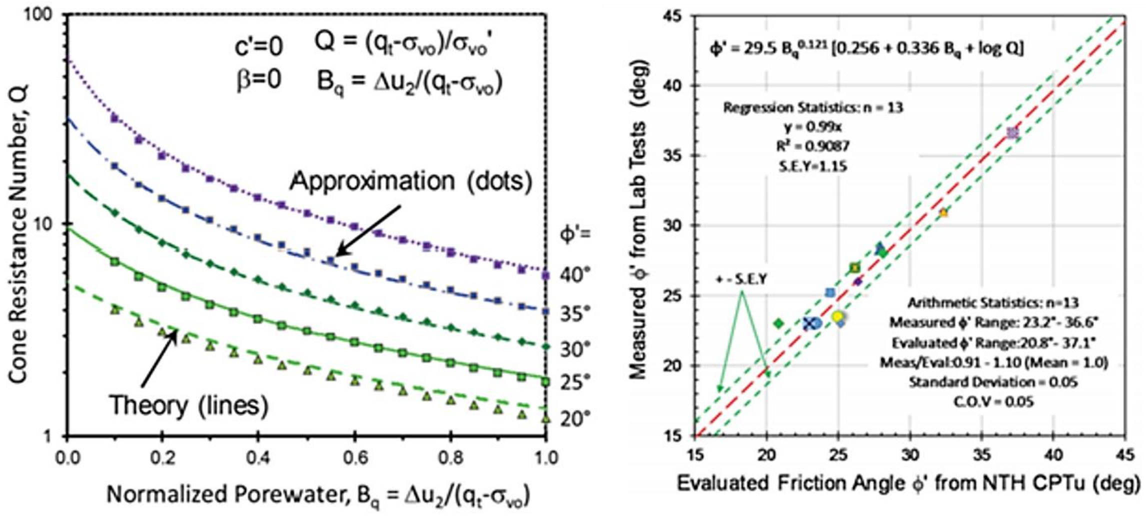


Figure 5-8 [Left] Theoretical curves with function approximation (dots) overlay [Right] calibration data from geotechnical centrifuge tests for a variety of soils. Redrawn from Ouyang & Mayne (2018).

The results are presented in Appendix F.

5.12 COEFFICIENT OF VOLUME CHANGE

Coefficient of volume change m_v defined as the inverse of the constrained modulus M, is evaluated for all soil types using the constrained modulus method proposed by Mayne (2006) cited in Mayne (2007). The value may be used to predict settlement at the end of primary consolidation and is applicable to the present state of vertical effective stress up to the pre-consolidation stress for overconsolidated soils.

$$m_v = \frac{1}{M}$$

Where:

$$M = \alpha \cdot (q_t - \sigma_v)$$

$$\alpha = 5$$

An alpha factor of 8.25 reported by Kulhawy & Mayne (1990) for fine grained soils appears to provide a better fit through the data for intact non-organic clays, reducing to around 1 to 2 for organic plastic clays.

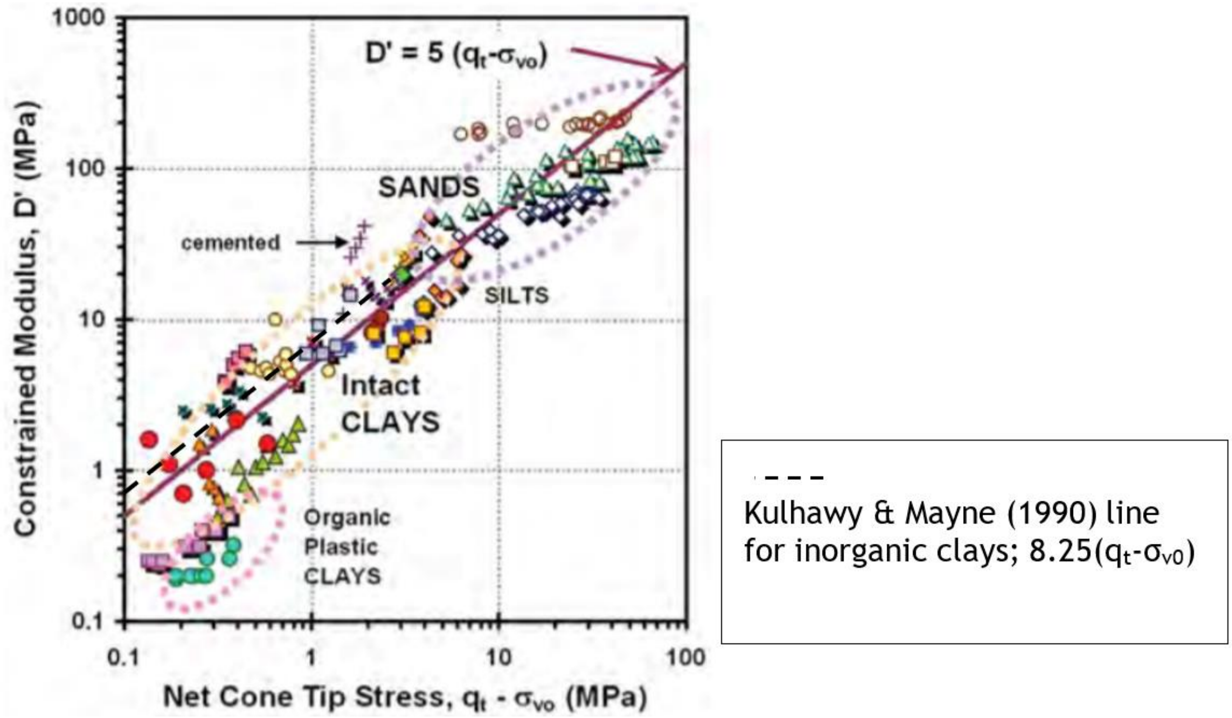


Figure 5-9 Constrained modulus of Mayne (2006). Annotated/redrawn from NCHRP Synthesis 368 (2007).

The results are presented in **Error! Reference source not found.**.

5.13 YOUNG'S MODULUS

The secant Young's modulus E' at 25% mobilised shear strength (FOS = 4) was calculated according to the method proposed by Robertson (2009):

$$E' = \alpha(q_t - \sigma_v)$$

Where:

$$\alpha = 0.015(10^{0.55\boldsymbol{Ic}+1.68})$$

The method described by Robertson may be adapted to estimate E' for loading at different percentages of mobilised shear strength.

The results are presented in Appendix F.

6 CPT INTERPRETATION NOTES

Provided below is a non-exhaustive set of notes on interpretation of the acquired CPT data with reference to examples within the dataset where appropriate.

DRAINED AND UNDRAINED SOIL BEHAVIOUR

Geotechnical parameters appropriate for drained and undrained cone penetration conditions are derived for drained and undrained soil behaviour types (SBTs) respectively, however, to help mitigate the uncertainty in the SBT correlation with drainage behaviour, all parameters are derived over the Soil Behaviour Type range $2.4 < I_c < 2.7$. For partially drained conditions, error will be introduced within derived parameters.

Piezocone dynamic pore pressure and dissipation tests may be used to identify drainage conditions. Dissipation t_{50} values exceeding 50 seconds indicate undrained penetration behaviour based on the findings of Kim *et al.* (2008).

In partially drained materials the friction sleeve resistance may rise significantly immediately following a pause in penetration due to consolidation and increased effective stress on the friction sleeve.

DYNAMIC PORE PRESSURE u_2 (CPTu)

While the piezo system is saturated before use, testing through unsaturated soils may result in some degree of desaturation leading to a less accurate and more ‘sluggish’ pore pressure response. Desaturation can also occur during penetration due to suction pressure causing cavitation during dilative shear at the cone shoulder. Dissipation tests that are undertaken following desaturation are likely to have a more pronounced initial rise and the results of analysis may have some degree of error.

If the piezometer system becomes desaturated it may re-saturate at higher excess pressures later in the test as gas dissolves under pressure. The pore pressure response in saturated contractive soils should normally have a dynamic ‘peaky’ appearance.

The tip resistance in lower strength contractive soils <u>without</u> pore pressure measurement in the u_2 position is likely to be significantly lower (up to 20%, typically ~10%) than the equivalent corrected tip resistance depending on the magnitude of excess pore pressure generated during penetration.

CONE TIP AND SLEEVE OFFSET

The accuracy of the SBT over thin layers and at layer boundaries is sensitive to offset error in the friction ratio often resulting in sharp peaks or troughs at boundaries. The friction ratio is often inaccurate in heavily disturbed soils with a ‘blocky’ macro fabric. The last ~8 cm of data is also not included in the SBT material description as no friction sleeve measurements are recorded.

FRICTION SLEEVE DATA

There are three common causes of friction sleeve measurement error; 1) unequal pore pressure acting on the sleeve end areas as the sleeve passes though materials of different permeability and hence excess pore pressure Δu_2, often resulting in a negative/positive spike, 2) Accuracy limitations and temperature effects in very low strength or sensitive soils, and 3) error associated with bending strain that occurs while the cone inclination deviates rapidly. Temperature effects are generally mitigated by temperature stabilisation during the test and at the time of zero output measurement.

CONE TYPE

The reference cone type has a 10 cm^2 projected cone tip area and 150 cm^2 friction sleeve area, however it is common to use a larger 15 cm^2 cone with a 225 cm^2 friction sleeve area for improved sensitivity, temperature stability, damage prevention and penetration depth potential due to the higher bending strength. Use of a 15 cm^2 cone does however require higher penetration force (reaction force) for a given penetration pressure and produces more pronounced transitions zones and thin layer effects due to the larger influence zone.

TRANSITION ZONES AND THIN LAYER EFFECTS

During penetration at the boundary between soils of contrasting stiffness, a transition zone is often evident prior to mobilisation of the true soil stiffness. These should be cautiously ignored in assessment of soil behaviour type and parameter evaluation. Where the stiff layer is thin (<~1 m) mobilised resistance may be significantly less than that of an equivalent thick layer. The effect for thin low stiffness layers is less significant. Procedures for thin-layer effect correction are provided by Robertson and Wride (1998) and Boulanger & DeJong (2018).

GRAVELS

The presence of gravel or larger clasts in a soil is often characterised by short peaks in the CPT tip and sleeve readings, possibly with associate inclinometer ‘shake’ and/or short sharp reductions in pore water readings due to dilation effects. Frequent gravels in soft or loose soils may generate localised erroneous friction ratio values.

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APPENDICES

Appendix A	**SUMMARY TABLES**
Appendix B	**GENERAL INFORMATION**
Appendix C	**CONE PENETRATION TEST RESULTS**
Appendix D	**SOIL BEHAVIOUR TYPE RESULTS**
Appendix E	**PARAMETER RESULTS 1 – s_u, m_v, OCR, SBT, I_c**
Appendix F	**PARAMETER RESULTS 2 – SPT N60, Phi, D_r, E, I_c**
Appendix G	**PENETROMETER TEMPERATURE RESULTS**

APPENDIX A SUMMARY TABLES

Table 3 CPT summary

Location ID	Stroke number	Final depth (m)	Cone ID	Piezocone test	Pre-drilled (m)	Pre-drilling details	Rig	Primary refusal factor	Applied zero values: qc, fs, u2	Tip zero drift (kPa)	Sleeve zero drift (subtraction) (kPa)	Piezo zero drift (kPa)	Nr dissipation tests	Raw File Name	Easting (m)	Northing (m)	Elevation (m)	Date	Remarks
CPT04	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	-48.80	0.90	0.60		108071-V1-120922-UK15-LP77.L11	517109.955	417014.039	2.606	13/09/2022	
CPT09	1	15.30	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	-5.00	-0.90	-0.60		108071-V1-120922-UK15-LP77.L01	517057.758	417099.047	2.972	12/09/2022	
CPT10	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	27.60	0.30	0.60		108071-V1-120922-UK15-LP77.L10	516972.019	417047.790	2.686	13/09/2022	
CPT11	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	13.80	-2.00	-2.40		108071-V1-120922-UK15-LP77.L09	516887.009	416995.047	2.979	13/09/2022	
CPT14	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	1.40	-1.80	-1.10		108071-V1-120922-UK15-LP77.L02	516904.912	417064.974	3.804	12/09/2022	
CPT15	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	-11.40	-0.50	-0.20		108071-V1-120922-UK15-LP77.L07	516774.966	416987.078	3.953	12/09/2022	
CPT16	1	15.24	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	-10.80	0.50	1.10		108071-V1-120922-UK15-LP77.L06	516646.925	416909.913	3.718	12/09/2022	
CPT18	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	-7.60	1.20	0.40		108071-V1-120922-UK15-LP77.L03	516797.980	417045.885	3.986	12/09/2022	
CPT19	1	15.26	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Target depth	pre, pre, pre	-3.20	-0.40	3.60		108071-V1-120922-UK15-LP77.L04	516703.892	416993.845	3.908	12/09/2022	
CPT20	1	14.58	S15-CFIPTT.1646	YES	1.20	IP-BF	UK15	Lateral support at surface	pre, pre, pre	9.20	0.80	-3.00		108071-V1-120922-UK15-LP77.L05	516630.051	416942.072	3.734	12/09/2022	

Note: Coordinates and levels have been provided by the Client for inclusion in this report.

CPT test plots are presented in Appendix C.

APPENDIX B GENERAL INFORMATION

LIST OF FIGURES

Cone calibration certificate: S15-CFIIP.1646

Data sheet: 20.5-tonne track-truck mounted CPT unit (UK15)

CERTIFICATE OF CALIBRATION

Certificate Number: 1426

Cone Serial Number: S15-CFIIPTT.1646

Instrument:	**Digital-Geopoint-S15-150kN-2MPa**	**Location:**	**Lankelma Calibration Laboratory**
Serial number:	**S15-CFIIPTT.1646**	**Temperature (°C):**	**23.1**
Manufacturer:	**Geopoint**	**Temperature change (°C):**	**0.20**
Calibration standard:	**Conforms to ISO 376:2011 & ISO 22476-1:2012**	**Calibration engineer:**	**P Metcalf**
ISO 22476-1:2012 application class:	**Class 1**	**Calibration re-verification date:**	**26/09/2022 to 26/11/2022**
Date of calibration:	**26/07/2022**	**Calibration verification completed:**	**-**
Calibration expiry:	**26/11/2022**		

This calibration certificate is valid for 6 months, with a verification of the calibration being performed between 2 and 4 months from the date of calibration.

Calibration signed and dated by:	**Calibration checked and dated by:**	**Calibration verification signed and dated by:**
P Metcalf	A Harman	

REFERENCE INSTRUMENTS	SERIAL NUMBER	UNCERTAINTY OF RECORDED VALUE	CALIBRATION DATE
AM DSCCHA-100kN Load Cell	66914	0.02%	29/04/2021
AM DSCCHA-5kN Load Cell	61065	0.05%	29/04/2021
Omega MMG750V	502273	0.01%	01/09/2021
Keithley 3706A Multimeter	4067652	10ppm	27/08/2021
LD Solar2-45	105775	0.04°	02/09/2020
ETI Ref Thermometer	D20345255	0.01°C	27/08/2021

The calibration tests were made in the Lankelma force standards machine. The applied forces of which are within an uncertainty of:
± 0.050 % of nominal value from 0.5kN up to 10kN, then 0.02% of nominal from 10kN up to 100kN.

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MEASUREMENTS
1. The forces applied, and the resulting deflections are given in Tables 1. No corrections for temperature have been applied to these results.
2. The cone was loaded to full range 3 times for no less than 1 minute before calibration and after each rotation.
3. The cone was calibrated in low and high range using two reference load cells. The low range calibration consisted of a maximum load of 5kN with 4 sets of increasing forces and 2 sets of decreasing forces. The high range calibration consisted of a maximum load of 100kN with 3 sets of increasing forces and 2 sets of decreasing forces.
4. The difference in deflection for each applied force with rotation is the relative reproducibility error b, shown as a percentage of the recorded value and in units of pressure MPa. The uncertainty relating to the difference in deflection for increasing forces against degreasing forces is the reversibility uncertainty U_rev, shown as a percentage of the recorded value and in units of pressure MPa.
5. For each application of force, the coefficients of a linear and third order equation relating the estimate of the mean deflection as a function of the applied calibration force were calculated. Table 2.
6. The combined expanded uncertainty of deflection U for each force is shown as a percentage of the recorded value and in units of pressure MPa.
7. The coefficients of a third order equation relating a given applied force to the estimate of the mean deflection were also calculated. The coefficients are given in Table 3.
8. In use the forces acting on the sleeve load cell element are a combination of tip resistance and sleeve friction, with the tip resistance from the tip load cell element being subtracted to give the sleeve friction value. The resultant error values for differing tip and sleeve values are shown in Table 4.
* The combined expanded uncertainties shown are to k=2 with a 95% coverage factor.

The calibration uncertainty is the uncertainty in the force value calculated from the interpolation equation at any deflection.

At each calibration point a combined standard uncertainty *uc* is calculated from the readings obtained during the calibration.

$$uc = \sqrt{\sum_{i=1}^{8} ui^2}$$

and

$$U = k \times uc$$

where

u1 is the standard uncertainty associated with the applied calibration force.
u2 is the standard uncertainty associated with the reproducibility of the calibration results.
u3 is the standard uncertainty associated with the repeatability of the calibration results.
u4 is the standard uncertainty associated with the resolution and noise of the system.
u5 is the standard uncertainty associated with the creep of the instrument.
u6 is the standard uncertainty associated with the drift in zero output.
u7 is the standard uncertainty associated with temperature of the instrument.
u8 is the standard uncertainty associated with interpolation best fit of the linear or 3rd order polynomial equation.

Symbols and their designations

Symbol	**Designation**
Ref LC	Reference load cell with calibration force in kN
cts	Counts. Base digital cone units.
0.1N	Interpolated digital cone units from counts
b	Relative reproducibility error
U_rev	Reversibility uncertainty
Uc	Combined standard uncertainty
Uc_sub	Combined standard uncertainty including sleeve subtraction
U	Combined expanded uncertainty
k=2	95% uncertainty coverage factor

Cone tempreture effect profile:

This section deals with the apparent pressure readings obtained from sensors due to static and transient temperature change. The parameters for post-processing temperature correction are established and the apparent pressures after correction are presented. Depending on the design or temperature performance, correction of the friction sleeve and/or piezometer readings may not be warranted

CONE END RESISTANCE CALIBRATION

Table 1-a.

Low range calibration									High range calibration							
	Tip change In output (cts)				Reproducibility error *b*		Reversibility error *U_rev*			Tip change in output (cts)			Reproducibility error *b*		Reversibility error *U_rev*	
Ref LC (kN)	1 0°	2 120°	3 240°	4 240°	MPa	%	MPa	%	Ref LC (kN)	1 0°	2 120°	3 240°	MPa	%	MPa	%
0.100	1.156E+05	1.150E+05	1.171E+05	1.171E+05	0.000	0.55			5.000	5.751E+06	5.752E+06	5.755E+06	0.001	0.02		
0.500	5.714E+05	5.733E+05	5.709E+05	5.756E+05	0.000	0.13			10.000	1.150E+07	1.150E+07	1.150E+07	0.001	0.01		
1.000	1.148E+06	1.149E+06	1.147E+06	1.151E+06	0.000	0.07			15.000	1.725E+07	1.725E+07	1.725E+07	0.001	0.01		
1.500	1.724E+06	1.725E+06	1.722E+06	1.728E+06	0.001	0.06			20.000	2.300E+07	2.300E+07	2.301E+07	0.001	0.01		
2.000	2.300E+06	2.302E+06	2.297E+06	2.303E+06	0.001	0.06			30.000	3.451E+07	3.450E+07	3.451E+07	0.001	0.01		
2.500	2.875E+06	2.876E+06	2.873E+06	2.879E+06	0.001	0.03			40.000	4.600E+07	4.599E+07	4.600E+07	0.002	0.01		
3.000	3.451E+06	3.452E+06	3.448E+06	3.455E+06	0.001	0.03			50.000	5.748E+07	5.747E+07	5.749E+07	0.002	0.01		
3.500	4.027E+06	4.027E+06	4.025E+06	4.029E+06	0.000	0.02			60.000	6.895E+07	6.894E+07	6.895E+07	0.002	0.01		
4.000	4.601E+06	4.602E+06	4.601E+06	4.606E+06	0.000	0.01			80.000	9.186E+07	9.185E+07	9.187E+07	0.004	0.01		
5.000	5.753E+06	5.753E+06	5.754E+06	5.757E+06	0.000	0.00			100.000	1.147E+08	1.147E+08	1.147E+08	0.005	0.01		
4.000	4.603E+06	4.602E+06			0.000	0.01	0.000	-0.01	80.000	9.186E+07	9.185E+07		0.003	0.01	0.000	0.00
3.500	4.027E+06	4.028E+06			0.000	0.01	0.000	-0.01	60.000	6.897E+07	6.896E+07		0.002	0.01	-0.005	-0.01
3.000	3.452E+06	3.452E+06			0.000	0.00	0.000	-0.01	50.000	5.750E+07	5.749E+07		0.002	0.00	-0.006	-0.02
2.500	2.875E+06	2.876E+06			0.000	0.01	0.000	0.00	40.000	4.602E+07	4.602E+07		0.002	0.01	-0.008	-0.03
2.000	2.301E+06	2.301E+06			0.000	0.00	0.000	0.01	30.000	3.453E+07	3.453E+07		0.001	0.00	-0.008	-0.04
1.500	1.726E+06	1.727E+06			0.000	0.02	-0.001	-0.06	20.000	2.303E+07	2.303E+07		0.000	0.00	-0.008	-0.06
1.000	1.150E+06	1.152E+06			0.000	0.03	-0.001	-0.11	15.000	1.727E+07	1.727E+07		0.000	0.00	-0.007	-0.07
0.500	5.750E+05	5.765E+05			0.000	0.09	-0.001	-0.34	10.000	1.152E+07	1.152E+07		0.000	0.00	-0.004	-0.07
0.100	1.151E+05	1.152E+05			0.000	0.03	0.000	0.05	5.000	5.757E+06	5.757E+06		0.000	0.00	-0.002	-0.06

Table 2-a.

Low range calibration							
Reference output		Linear equation			3rd order equation		
Ref Load Cell Nom. (MPa)	Ref Load Cell (0.1N)	Cone output (0.1N)	Expanded uncertainty *U** MPa	%	Equation output (0.1N)	Expanded uncertainty *U** MPa	%
0.067	1000	1009	0.001	2.19	1003	0.001	1.33
0.333	5000	4980	0.003	1.03	4964	0.006	1.71
0.667	10000	9997	0.003	0.43	9968	0.005	0.77
1.000	15000	15012	0.005	0.51	14971	0.006	0.57
1.333	20000	20029	0.006	0.48	19975	0.005	0.40
1.667	25000	25034	0.007	0.42	24968	0.006	0.35
2.000	30000	30046	0.009	0.46	29968	0.007	0.33
2.333	35000	35061	0.010	0.42	34971	0.006	0.24
2.667	40000	40071	0.012	0.45	39969	0.007	0.25
3.333	50000	50100	0.018	0.53	49975	0.011	0.32
2.667	40000	40081	0.012	0.43	39979	0.005	0.18
2.333	35000	35073	0.010	0.44	34983	0.004	0.18
2.000	30000	30062	0.009	0.44	29984	0.004	0.18
1.667	25000	25038	0.006	0.34	24973	0.004	0.26
1.333	20000	20035	0.005	0.38	19982	0.003	0.23
1.000	15000	15035	0.005	0.50	14994	0.002	0.18
0.667	10000	10023	0.003	0.50	9994	0.001	0.22
0.333	5000	5014	0.002	0.65	4997	0.001	0.35
0.067	1000	1003	0.001	0.77	997	0.000	0.73

High range calibration							
Reference output		Linear equation			3rd order equation		
Ref Load Cell Nom. (MPa)	Ref Load Cell (0.1N)	Cone output (0.1N)	Expanded uncertainty *U** MPa	%	Equation output (0.1N)	Expanded uncertainty *U** MPa	%
3.333	50000	50094	0.016	0.49	49969	0.011	0.32
6.667	100000	100166	0.026	0.39	99929	0.016	0.24
10.000	150000	150245	0.038	0.38	149909	0.021	0.21
13.333	200000	200333	0.051	0.38	199910	0.025	0.19
20.000	300000	300482	0.073	0.37	299929	0.033	0.16
26.667	400000	400549	0.085	0.32	399931	0.041	0.15
33.333	500000	500558	0.091	0.27	499948	0.050	0.15
40.000	600000	600434	0.084	0.21	599915	0.060	0.15
53.333	800000	799935	0.079	0.15	799880	0.080	0.15
66.667	1000000	999053	0.163	0.24	999896	0.099	0.15
53.333	800000	799908	0.078	0.15	799853	0.080	0.15
40.000	600000	600543	0.094	0.24	600025	0.058	0.15
33.333	500000	500698	0.107	0.32	500088	0.050	0.15
26.667	400000	400754	0.111	0.41	400135	0.043	0.16
20.000	300000	300678	0.098	0.49	300125	0.034	0.17
13.333	200000	200515	0.074	0.55	200092	0.024	0.18
10.000	150000	150420	0.060	0.60	150083	0.020	0.20
6.667	100000	100282	0.041	0.61	100045	0.014	0.21
3.333	50000	50136	0.021	0.63	50010	0.010	0.29

Table 3-a. Third order equation

For a given cone indicated output of D (0.1N units), the corrected applied force

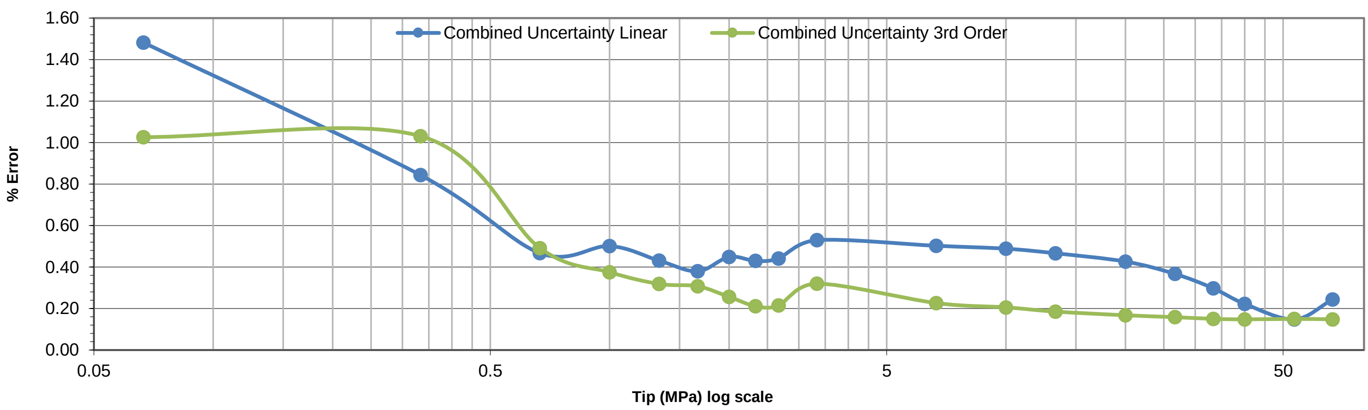
F (in 0.1N units) is calculated from :

F = (a3 x D³) + (a2 x D²) + (a1 x D) + a0

a0	=	-3.59498
a1	=	0.99747
a2	=	1.88990E-09
a3	=	1.49390E-15

Maximum tip zero drift during the calibration (MPa) =	0.001
Maximum load cell zero drift during the calibration (MPa) =	0.000
Factor used to convert from counts to 0.1N units =	0.0087082
Maximum tip full scale reading (MPa) =	100.00
Tip resolution (Pa) =	66.7
Tip area (cm²) =	15
Tip area ratio factor =	0.790

COMBINED EXPANDED UNCERTAINTY TIP



* The combined expanded uncertainties shown are to k=2 with a 95% coverage factor.

SLEEVE FRICTION CALIBRATION

Table1-b.

Low range calibration									High range calibration							
	Sleeve change In output (cts)				Reproducibility error *b*		Reversibility error *U_rev*			Sleeve change in output (cts)			Reproducibility error *b*		Reversibility error *U_rev*	
Ref LC (kN)	1 0°	2 120°	3 240°	4 240°	kPa	%	kPa	%	Ref LC (kN)	1 0°	2 120°	3 240°	kPa	%	kPa	%
0.100	1.174E+05	1.191E+05	1.195E+05	1.195E+05	0.025	0.56			5.000	5.906E+06	5.920E+06	5.915E+06	0.161	0.07		
0.500	5.935E+05	5.897E+05	5.925E+05	5.950E+05	0.043	0.19			10.000	1.181E+07	1.184E+07	1.183E+07	0.340	0.08		
1.000	1.184E+06	1.183E+06	1.187E+06	1.187E+06	0.037	0.08			15.000	1.772E+07	1.776E+07	1.774E+07	0.478	0.07		
1.500	1.776E+06	1.772E+06	1.780E+06	1.783E+06	0.089	0.14			20.000	2.362E+07	2.368E+07	2.365E+07	0.664	0.08		
2.000	2.369E+06	2.364E+06	2.371E+06	2.377E+06	0.085	0.10			30.000	3.543E+07	3.552E+07	3.546E+07	0.961	0.07		
2.500	2.960E+06	2.957E+06	2.968E+06	2.971E+06	0.121	0.11			40.000	4.723E+07	4.734E+07	4.727E+07	1.229	0.07		
3.000	3.551E+06	3.547E+06	3.561E+06	3.565E+06	0.150	0.11			50.000	5.902E+07	5.915E+07	5.907E+07	1.448	0.07		
3.500	4.144E+06	4.138E+06	4.155E+06	4.157E+06	0.184	0.12			60.000	7.080E+07	7.095E+07	7.085E+07	1.656	0.06		
4.000	4.735E+06	4.729E+06	4.747E+06	4.752E+06	0.198	0.11			80.000	9.432E+07	9.451E+07	9.438E+07	2.065	0.06		
5.000	5.917E+06	5.914E+06	5.936E+06	5.939E+06	0.258	0.12			100.000	1.178E+08	1.180E+08	1.179E+08	2.338	0.05		
4.000	4.738E+06	4.729E+06			0.114	0.06	-0.025	-0.01	80.000	9.432E+07	9.452E+07		2.608	0.07	-0.137	0.00
3.500	4.146E+06	4.138E+06			0.109	0.07	-0.017	-0.01	60.000	7.081E+07	7.098E+07		2.163	0.08	-0.474	-0.02
3.000	3.553E+06	3.547E+06			0.087	0.07	-0.023	-0.02	50.000	5.904E+07	5.918E+07		1.893	0.09	-0.604	-0.03
2.500	2.963E+06	2.953E+06			0.135	0.12	0.004	0.00	40.000	4.725E+07	4.738E+07		1.600	0.09	-0.693	-0.04
2.000	2.370E+06	2.362E+06			0.113	0.13	-0.001	0.00	30.000	3.545E+07	3.555E+07		1.307	0.10	-0.645	-0.05
1.500	1.780E+06	1.771E+06			0.114	0.17	-0.034	-0.05	20.000	2.365E+07	2.372E+07		0.887	0.10	-0.635	-0.07
1.000	1.186E+06	1.180E+06			0.073	0.17	0.011	0.03	15.000	1.774E+07	1.779E+07		0.689	0.10	-0.547	-0.08
0.500	5.944E+05	5.893E+05			0.067	0.30	-0.006	-0.03	10.000	1.182E+07	1.186E+07		0.512	0.12	-0.385	-0.09
0.100	1.206E+05	1.172E+05			0.046	1.04	-0.015	-0.34	5.000	5.914E+06	5.934E+06		0.259	0.12	-0.236	-0.11

Table 2-b.

Low range calibration							
Reference output		Linear factor output			3rd order equation		
Ref Load Cell Nom. (kPa)	Ref Load Cell (0.1N)	Cone output (0.1N)	Expanded uncertainty *U** kPa	%	Equation output (0.1N)	Expanded uncertainty *U** kPa	%
4	1000	1005	0.070	1.59	999	0.053	1.20
22	5000	5015	0.188	0.85	4995	0.138	0.62
44	10000	10037	0.346	0.79	10001	0.106	0.24
66	15000	15049	0.488	0.74	14996	0.229	0.35
88	20000	20063	0.634	0.72	19993	0.314	0.36
110	25000	25093	0.875	0.79	25007	0.321	0.29
132	30000	30104	0.997	0.75	30002	0.400	0.30
154	35000	35126	1.193	0.77	35008	0.445	0.29
176	40000	40141	1.337	0.76	40007	0.506	0.29
220	50000	50181	1.792	0.81	50017	0.836	0.38
176	40000	40108	1.010	0.57	39975	0.407	0.23
154	35000	35093	0.879	0.57	34976	0.376	0.24
132	30000	30080	0.749	0.57	29978	0.320	0.24
110	25000	25064	0.648	0.59	24979	0.365	0.33
88	20000	20049	0.501	0.57	19979	0.317	0.36
66	15000	15044	0.463	0.70	14991	0.259	0.39
44	10000	10025	0.272	0.62	9988	0.192	0.44
22	5000	5015	0.191	0.87	4995	0.145	0.66
4	1000	1007	0.113	2.57	1001	0.093	2.11

High range calibration							
Reference output		Linear factor output			3rd order equation		
Ref Load Cell Nom. (kPa)	Ref Load Cell (0.1N)	Cone output (0.1N)	Expanded uncertainty *U** kPa	%	Equation output (0.1N)	Expanded uncertainty *U** kPa	%
220	50000	50108	1.190	0.54	49944	0.866	0.39
441	100000	100217	2.194	0.50	99911	1.331	0.15
661	150000	150319	3.169	0.48	149891	1.753	0.13
881	200000	200407	4.083	0.46	199877	2.229	0.13
1322	300000	300545	5.557	0.42	299873	3.007	0.11
1762	400000	400601	6.384	0.36	399869	3.749	0.11
2203	500000	500574	6.641	0.30	499870	4.459	0.10
2643	600000	600444	6.387	0.24	599859	5.199	0.10
3524	800000	799909	6.582	0.19	799838	6.686	0.09
4405	1000000	999034	11.568	0.26	999869	7.923	0.09
3524	800000	800070	7.241	0.21	800000	7.215	0.10
2643	600000	600690	8.354	0.32	600105	5.802	0.11
2203	500000	500855	9.002	0.41	500152	5.104	0.12
1762	400000	400905	8.956	0.51	400173	4.358	0.12
1322	300000	300821	7.933	0.60	300148	3.505	0.13
881	200000	200658	6.213	0.71	200128	2.498	0.14
661	150000	150534	5.017	0.76	150106	1.979	0.15
441	100000	100356	3.397	0.77	100050	1.383	0.16
220	50000	50196	1.904	0.86	50032	0.855	0.19

Table 3-b. Third order equation

For a given cone indicated output of D (0.1N units), the corrected applied force

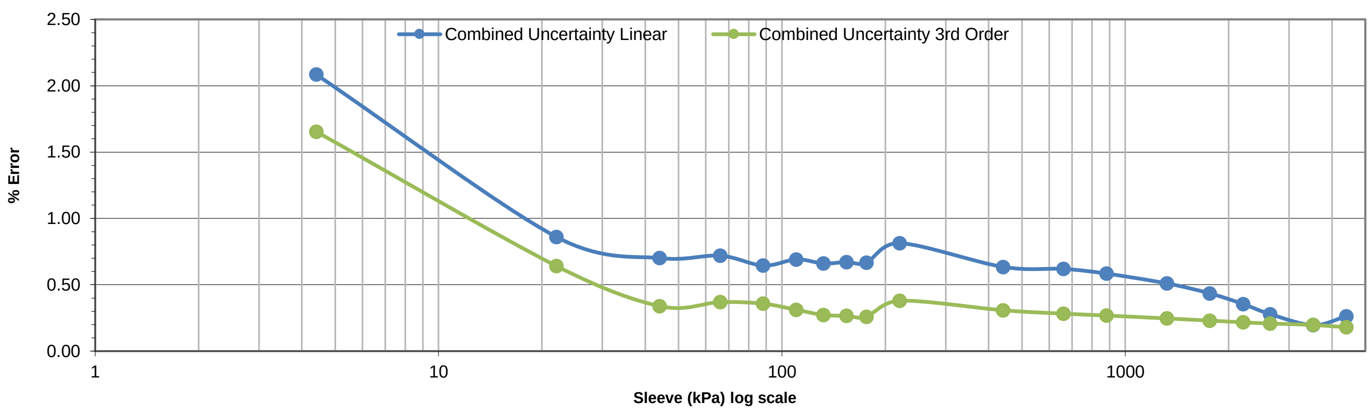
F (in 0.1N units) is calculated from :

$$F = (a3 \times D^3) + (a2 \times D^2) + (a1 \times D) + a0$$

a0	=	-2.98662
a1	=	0.99660
a2	=	3.75104E-09
a3	=	4.92591E-16

Maximum sleeve zero drift during the calibration (kPa) =	0.084
Maximum load cell zero drift during the calibration (kPa) =	0.001
Factor used to convert from counts to 0.1N units =	0.0084732
Physical strength limited maximum sleeve reading (MPa) =	1.333
Sleeve resolution (Pa) =	4.4
Sleeve area (cm²) =	227
Sleeve area ratio factor =	-0.001

COMBINED EXPANDED UNCERTAINTY SLEEVE



* The combined expanded uncertainties shown are to k=2 with a 95% coverage factor.

Table 4-b Sleeve friction - tip subtraction combined standard uncertainty Uc_sub

Sleeve linear equation subtraction error (%)

Tip MPa ↓ / Sleeve kPa →	4	22	44	66	110	154	220	661
0.07	2.8	0.8	0.5	0.5	0.4	0.4	0.4	0.3
0.33	5.3	1.3	0.8	0.6	0.5	0.5	0.4	0.3
0.67	6.9	1.6	0.9	0.7	0.6	0.5	0.5	0.3
1.00	10.2	2.3	1.3	1.0	0.7	0.6	0.6	0.3
1.67	14.4	3.1	1.7	1.3	0.9	0.7	0.7	0.4
2.33	20.3	4.3	2.3	1.6	1.1	0.9	0.8	0.4
3.33	34.6	7.1	3.7	2.6	1.7	1.3	1.1	0.5
10.00	84.1	17.0	8.7	5.9	3.7	2.7	2.1	0.7
13.33	106.1	21.4	10.9	9.7	4.5	3.3	3.2	1.0

Sleeve 3rd order equation subtraction error (%)

Tip MPa ↓ / Sleeve kPa →	4	22	44	66	110	154	220	661
0.07	2.2	0.6	0.3	0.3	0.2	0.2	0.2	0.2
0.33	5.0	1.2	0.6	0.5	0.3	0.3	0.3	0.2
0.67	5.0	1.2	0.6	0.5	0.3	0.3	0.3	0.2
1.00	6.4	1.4	0.7	0.6	0.4	0.3	0.3	0.2
1.67	8.6	1.9	0.9	0.7	0.5	0.4	0.3	0.2
2.33	9.2	2.0	1.0	0.7	0.5	0.4	0.4	0.2
3.33	18.3	3.8	1.9	1.4	0.9	0.6	0.5	0.3
10.00	37.4	7.6	3.8	2.6	1.6	1.2	0.9	0.4
13.33	46.2	9.4	4.7	4.3	2.0	1.4	1.1	0.4

PORE PRESSURE CALIBRATION

Table1-c.

Ref PR (kPa)	PWP change in output (cts) 1 0°	2 120°	3 240°	Reproducibility error b kPa	%	Reversibility error U_rev kPa	%
50	1.978E+07	1.985E+07	1.995E+07	0.1	0.24		
100	3.965E+07	3.970E+07	3.973E+07	0.1	0.06		
200	7.946E+07	7.944E+07	7.954E+07	0.1	0.04		
300	1.191E+08	1.191E+08	1.193E+08	0.1	0.04		
400	1.588E+08	1.588E+08	1.589E+08	0.0	0.01		
500	1.984E+08	1.985E+08	1.986E+08	0.2	0.03		
600	2.379E+08	2.381E+08	2.381E+08	0.1	0.02		
800	3.171E+08	3.172E+08	3.172E+08	0.1	0.01		
1000	3.961E+08	3.962E+08	3.963E+08	0.2	0.02		
1200	4.751E+08	4.753E+08	4.753E+08	0.2	0.02		
1000	3.962E+08	3.961E+08		0.1	0.01	0.0	0.00
800	3.171E+08	3.171E+08		0.1	0.01	0.1	0.01
600	2.380E+08	2.381E+08		0.1	0.02	-0.1	-0.01
500	1.983E+08	1.984E+08		0.1	0.01	0.2	0.04
400	1.587E+08	1.587E+08		0.0	0.01	0.2	0.05
300	1.190E+08	1.190E+08		0.0	0.01	0.2	0.07
200	7.932E+07	7.943E+07		0.1	0.05	0.1	0.05
100	3.963E+07	3.956E+07		0.1	0.07	0.1	0.11
50	1.973E+07	1.976E+07		0.0	0.06	0.1	0.20

Table 2-c.

Reference output: Ref Pressure (kPa)	Ref Pressure (0.1Pa)	Linear factor output: Cone output (0.1Pa)	Expanded uncertainty U* kPa	%	3rd order equation: Equation output (0.1N)	Expanded uncertainty U* kPa	%
50	500000	501312	0.449	0.90	501423	0.457	0.91
100	1000000	1002142	0.538	0.54	1000844	0.361	0.36
200	2000000	2006538	1.383	0.69	2002860	0.693	0.35
300	3000000	3008724	1.840	0.61	3003257	0.824	0.27
400	4000000	4010470	2.202	0.55	4003794	0.940	0.23
500	5000000	5012089	2.543	0.51	5004773	1.203	0.24
600	6000000	6008810	1.965	0.33	6001416	0.893	0.15
800	8000000	8007604	1.876	0.23	8001704	1.127	0.14
1000	10000000	10003442	1.668	0.17	10001184	1.537	0.15
1200	12000000	11998562	2.677	0.22	12002033	2.693	0.22
1000	10000000	10002262	1.565	0.16	10000001	1.495	0.15
800	8000000	8005613	1.566	0.20	7999710	1.072	0.13
600	6000000	6009102	2.030	0.34	6001708	0.891	0.15
500	5000000	5006955	1.575	0.31	4999641	0.678	0.14
400	4000000	4006506	1.420	0.35	3999833	0.554	0.14
300	3000000	3004099	0.956	0.32	2998640	0.535	0.18
200	2000000	2003936	0.911	0.46	2000264	0.416	0.21
100	1000000	999690	0.332	0.33	998398	0.457	0.46
50	500000	498458	0.419	0.84	498577	0.391	0.78

Table 3-c. Third order equation

For a given cone indicated output of D (0.1N units), the corrected applied force

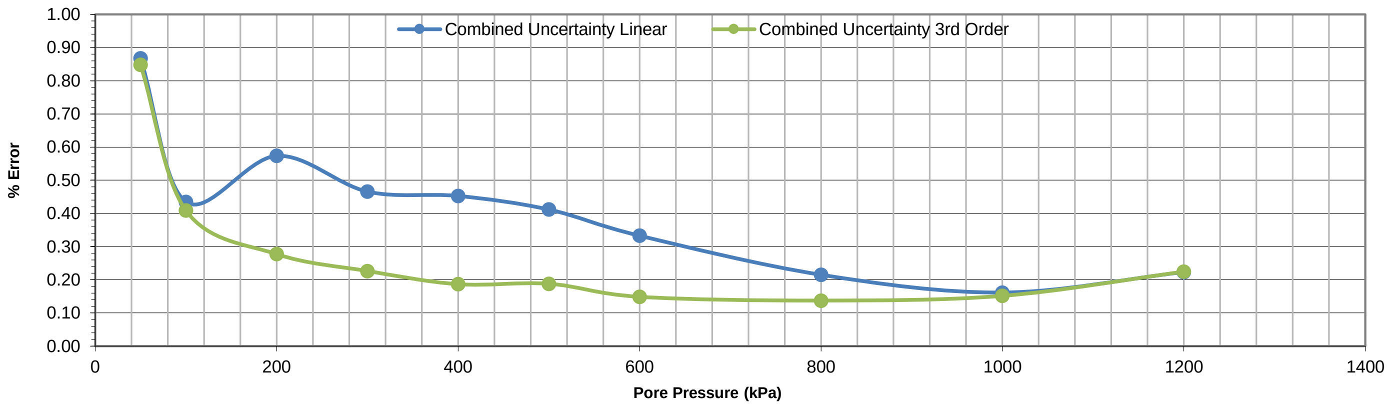
F (in 0.1N units) is calculated from :

$F = (a3 \times D^3) + (a2 \times D^2) + (a1 \times D) + a0$

a0	=	1669.66406
a1	=	0.99674
a2	=	2.98674E-10
a3	=	-1.20905E-18

Maximum PWP zero drift during the calibration (kPa) =	0.25
Maximum reference zero drift during the calibration (kPa) =	0.097
Factor used to convert from counts to 0.1Pa units =	0.0252464
Maximum PWP full scale reading (kPa) =	2000
PWP resolution (Pa) =	0.1

COMBINED EXPANDED UNCERTAINTY PORE PRESSURE



* The combined expanded uncertainties shown are to k=2 with a 95% coverage factor.

LANKELMA

CERTIFICATE OF CALIBRATION

Certificate Number: 1426

Cone Serial Number: S15-CFIIPTT.1646

INCLINATION CALIBRATION

Ref Inclination (°C)	Cone inclination output X Inc (cts)	Y Inc (cts)
-25	-25010	-27737
0	541	-1788
25	25774	23611

Ref Inclination (°)	Cone inclination output X Inc (°)	Y Inc (°)
-25	-25.2	-25.3
0	0.0	0.0
25	24.8	24.7

	X inc	Y inc
Factor used to convert from counts to 0.1m° units =	9.84549199	9.73710522
Inclination error (°) =	0.2	0.3

TEMPERATURE CALIBRATION

Recorded temp (°C)	Cone output 1 FS (cts)	Cone output 2 QC (cts)
7.15	6921715	6904436
10.27	7002156	6984821
15.12	7131121	7112021
20.28	7261363	7243221
25.13	7387153	7368395

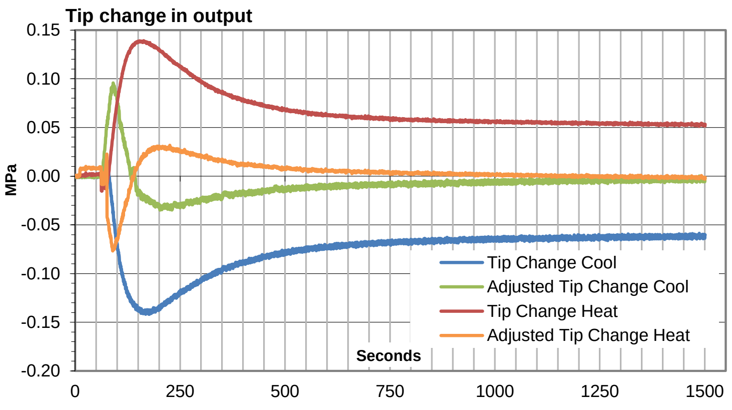
Recorded temp (°C)	Cone output 1 FS (°C)	Cone output 2 QC (°C)
7.15	7.13	7.13
10.27	10.24	10.25
15.12	15.22	15.18
20.28	20.25	20.27
25.13	25.11	25.12

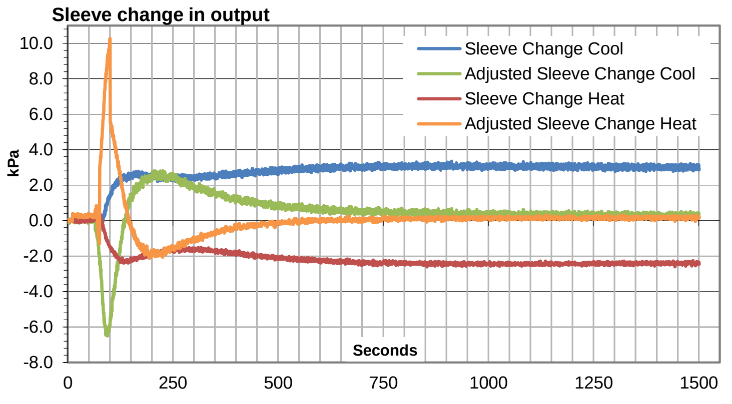
Factor used to convert from counts to 0.00001°C units =	0.386433841	0.387630819
Temperature error (°C) =	0.10	0.06

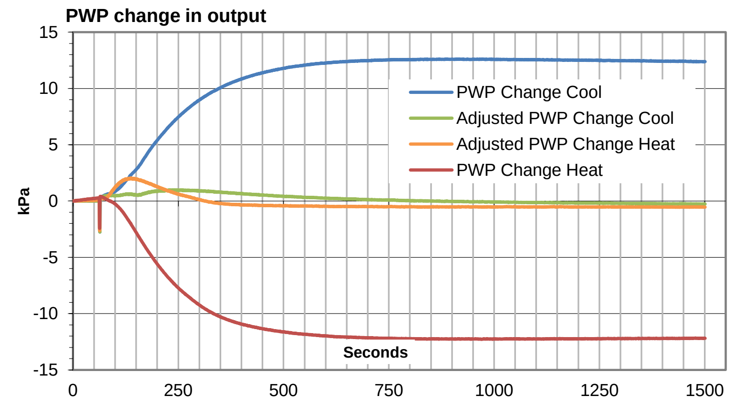
CONE TEMPERATURE EFFECT

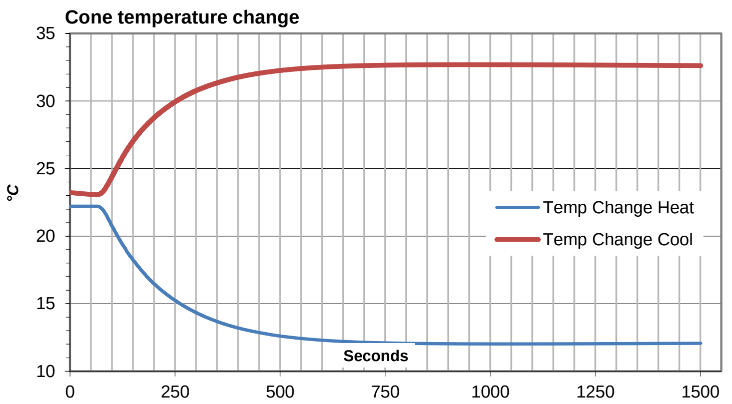
	Cooling	Heating
Start temperature =	22.22	23.06
End temperature =	12.02	32.69
Temperature change =	-10.20	9.63

	Cooling	Heating
Tip maximum rate of change (MPa/°C/min) =	0.039	0.039
Tip end change (MPa/°C) =	-0.006	0.006
Adjusted tip end change (MPa/°C) =	0.000	0.000
Sleeve maximum rate of change (kPa/°C/min) =	2.90	3.20
Sleeve end change (kPa/°C) =	0.28	-0.27
Adjusted sleeve end change (kPa/°C) =	0.02	0.02
PWP end change (kPa/°C) =	1.21	-1.27
Adjusted PWP end change (kPa/°C) =	0.03	-0.06









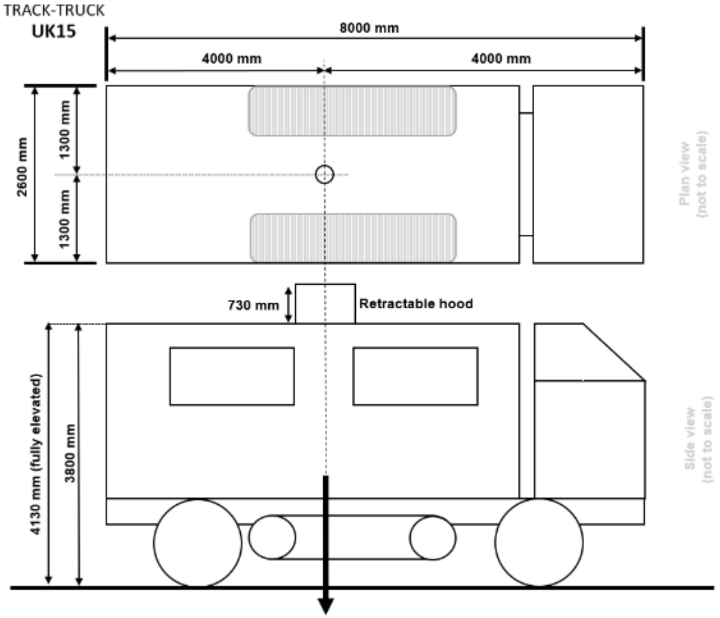
UK15
Track-truck

Rig weight	20.5 T
Max. operating ram capacity	17 T
Max. travelling speed	86 km/h
Track material	Steel
Track length	3300 mm
Track width	650 mm
Jack plate dimensions	Tracks act as jacks
Jack arrangements	1nr. on each side
Max. ground clearance on jacks	210 mm
Max. ground bearing pressure	Tracking/testing: 46 kPa Rod extraction: 81 kPa
Max. testing gradient	10 degrees
Max. traversing gradient	20 degrees (operator assessed)
Noise output at 2 m	Testing - 69.5 dBA Driving – 78.7 dBA
Clamp arrangement	Hydraulic catching – semi automatic
Ram stroke	1.2 m
Max. casing size	55 mm

Lankelma's versatile track-truck is suitable for most geotechnical sites. The rig is driven to site as a self-contained HGV with tracks that can be deployed to cope with soft or uneven terrain.

Typical production
An expected 100m+ of standard CPTu testing can be executed in a day (depending on conditions and access).

Specialist testing	Installations	Sampling
Seismic	**VWP**	**MOSTAP**
Pressuremeter	**Piezometer**	**Shelby**
Magnetometer	**Inclinometer**	
Video cone		
Wing cone		
Push-in shear vane		



APPENDIX C CONE PENETRATION TEST RESULTS

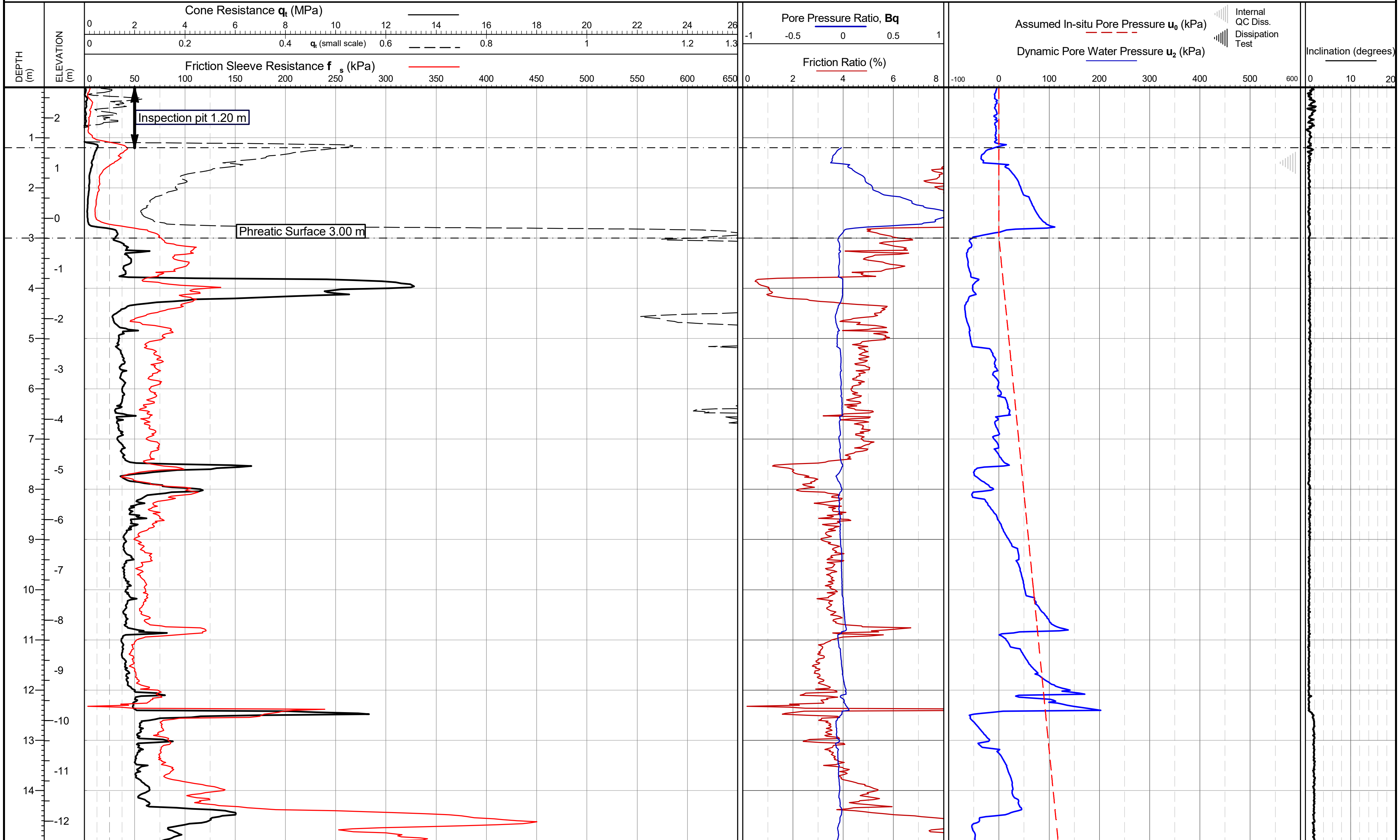
Measured CPT parameters

intermediate parameters R_f and B_q

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



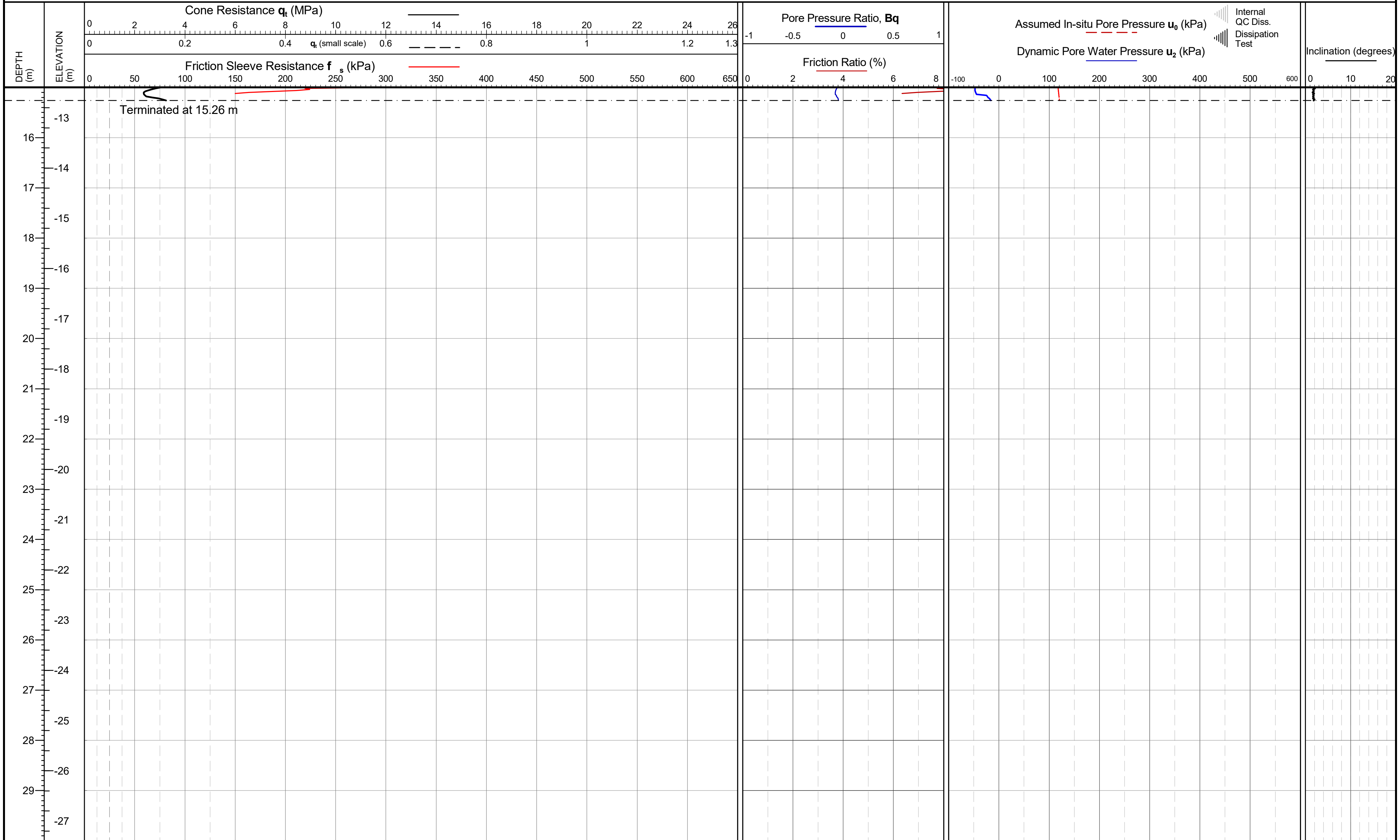
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 11:24:25	Zero drift (Pre/post test) q_c (kPa): -48.8 f_s (kPa): 0.9 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 517109.955, 417014.039 Elevation: 2.606 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

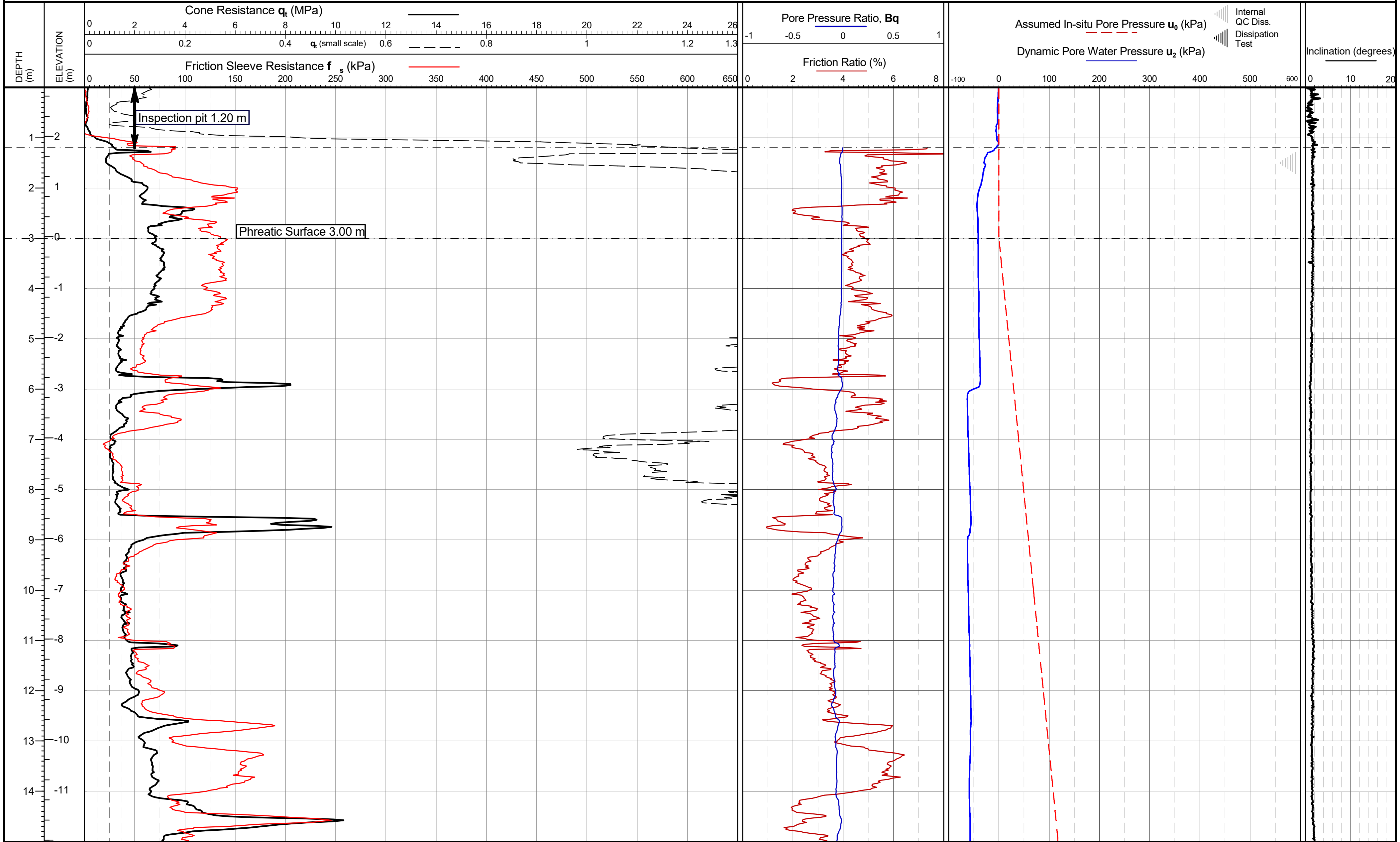


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 11:24:25	Zero drift (Pre/post test) q_c (kPa): -48.8 f_s (kPa): 0.9 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 517109.955, 417014.039 Elevation: 2.606 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT04** Page 2 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



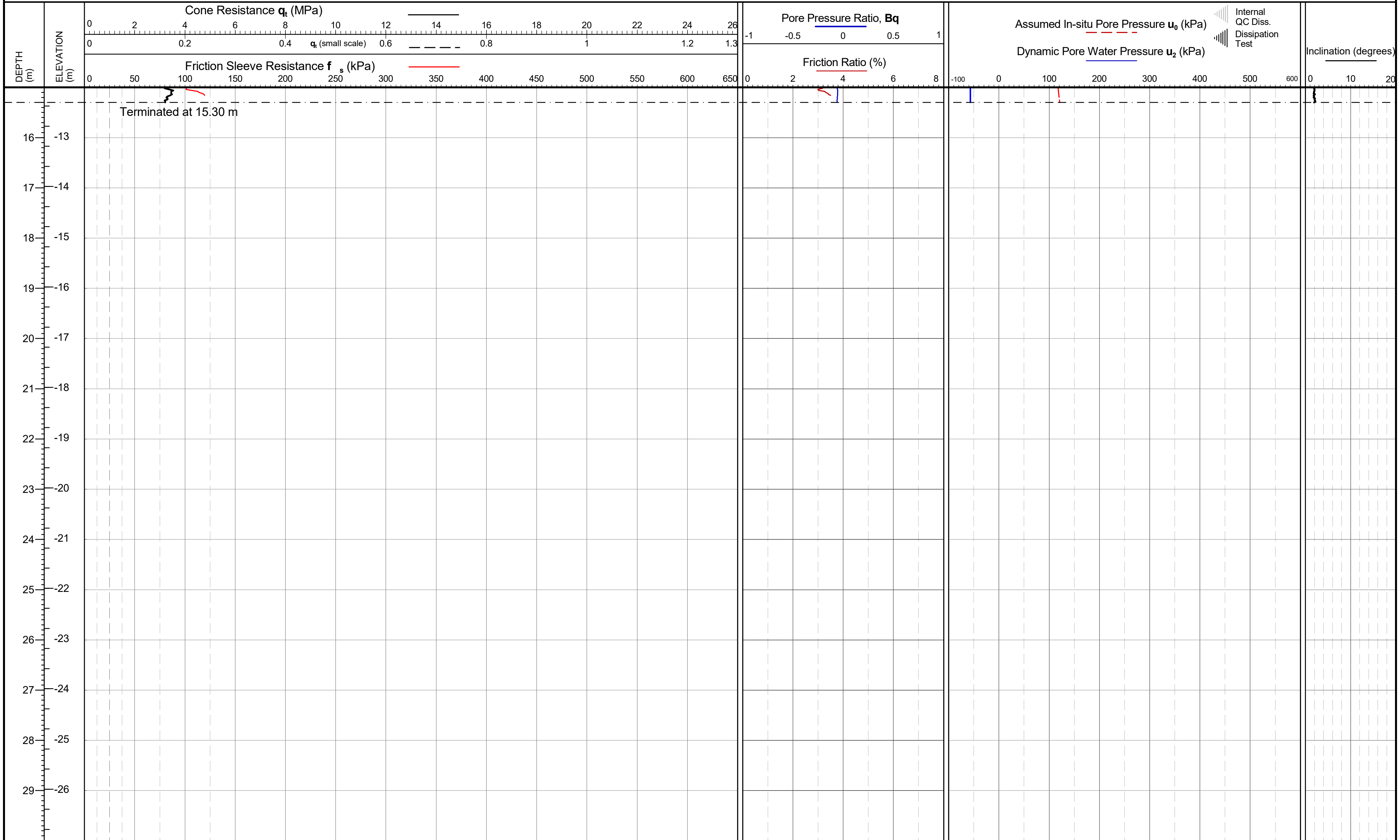
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 09:12:31	Zero drift (Pre/post test) q_c (kPa): -5.0 f_s (kPa): -0.9 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.6	Location: Lincolnshire, UK Coordinates: 517057.758, 417099.047 Elevation: 2.972 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



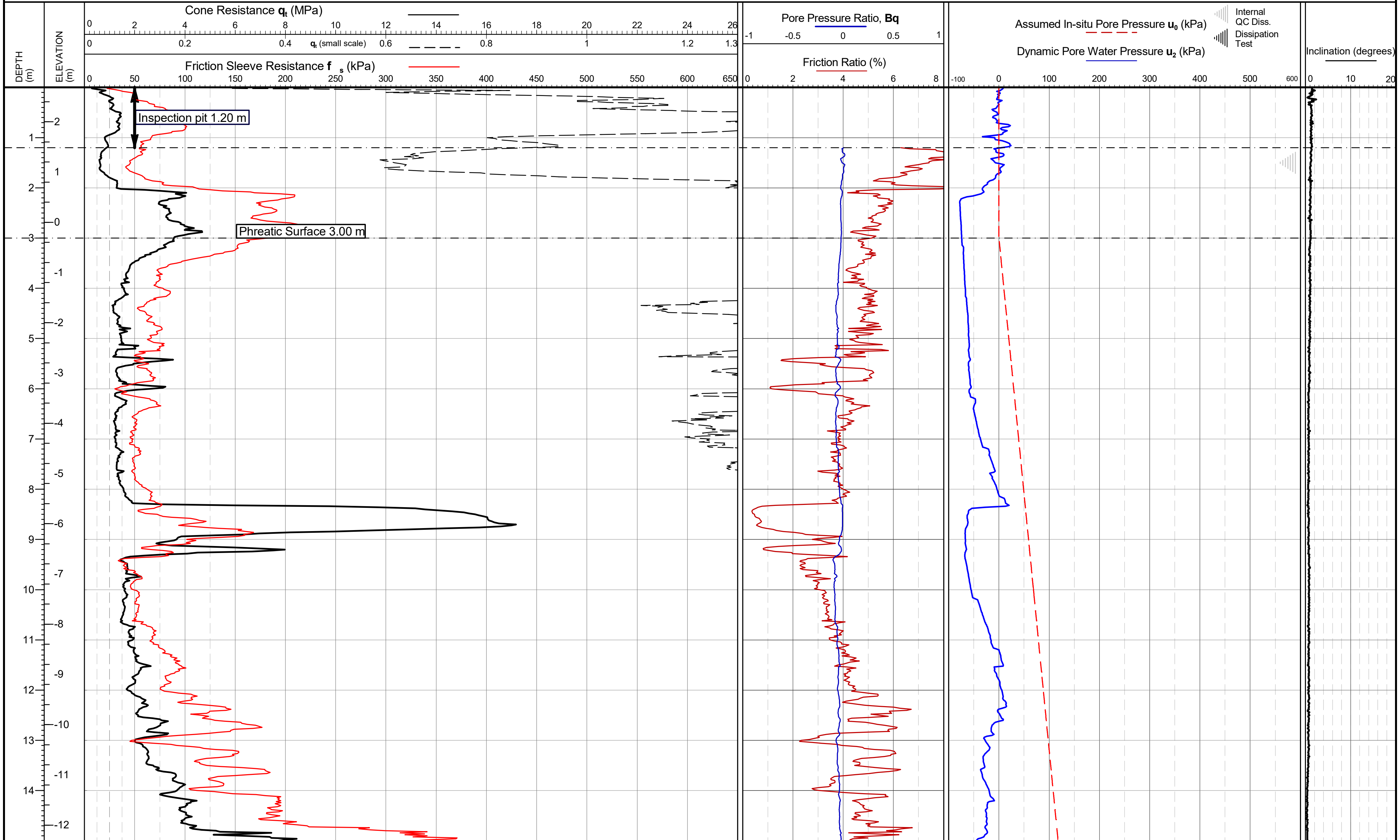
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 09:12:31	Zero drift (Pre/post test) q_c (kPa): -5.0 f_s (kPa): -0.9 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.6	Location: Lincolnshire, UK Coordinates: 517057.758, 417099.047 Elevation: 2.972 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 10:26:25	Zero drift (Pre/post test) q_c (kPa): 27.6 f_s (kPa): 0.3 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 516972.019, 417047.79 Elevation: 2.686 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

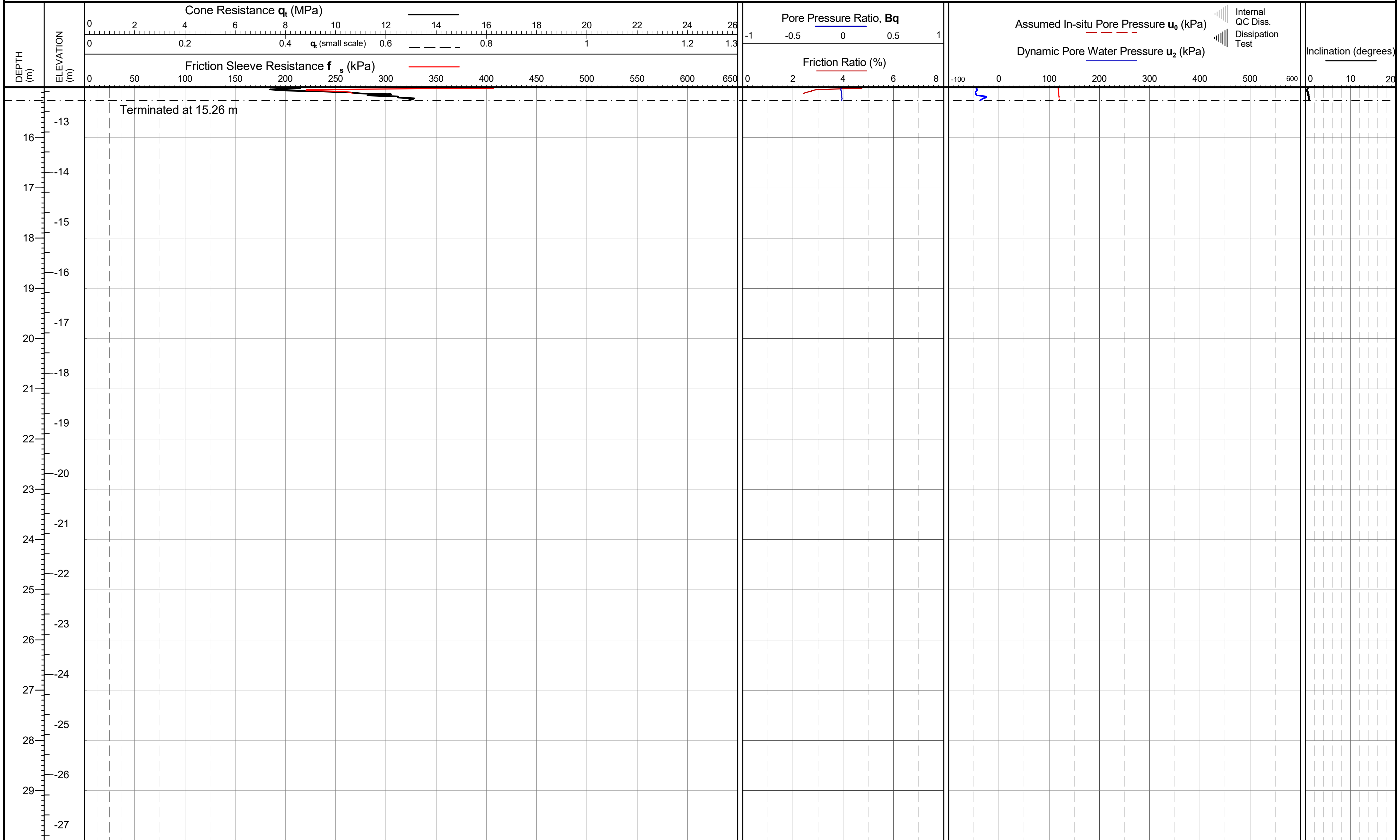
TEST ID: CPT10

Page 1 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

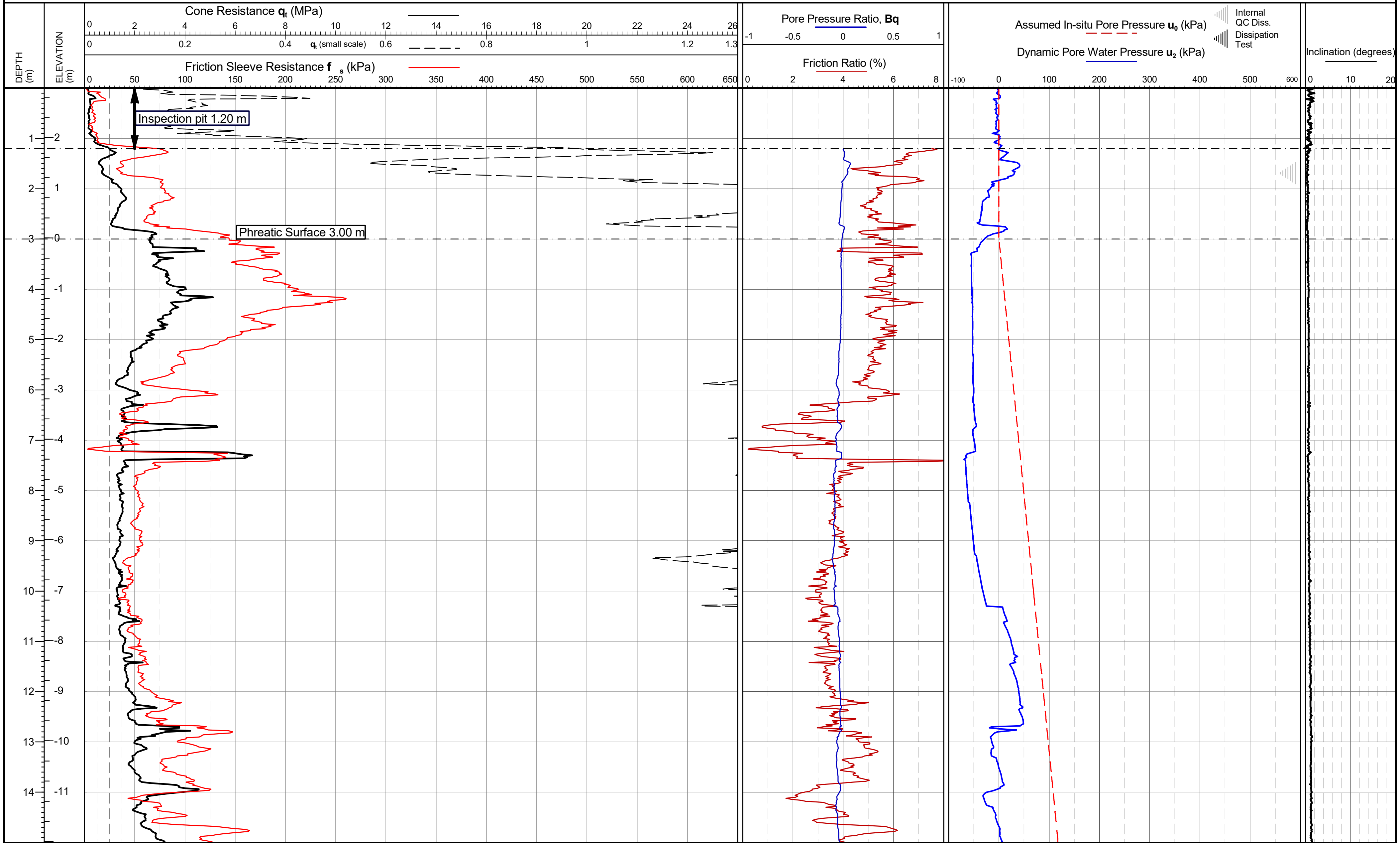
Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 10:26:25	Zero drift (Pre/post test) q_c (kPa): 27.6 f_s (kPa): 0.3 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 516972.019, 417047.79 Elevation: 2.686 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT10

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



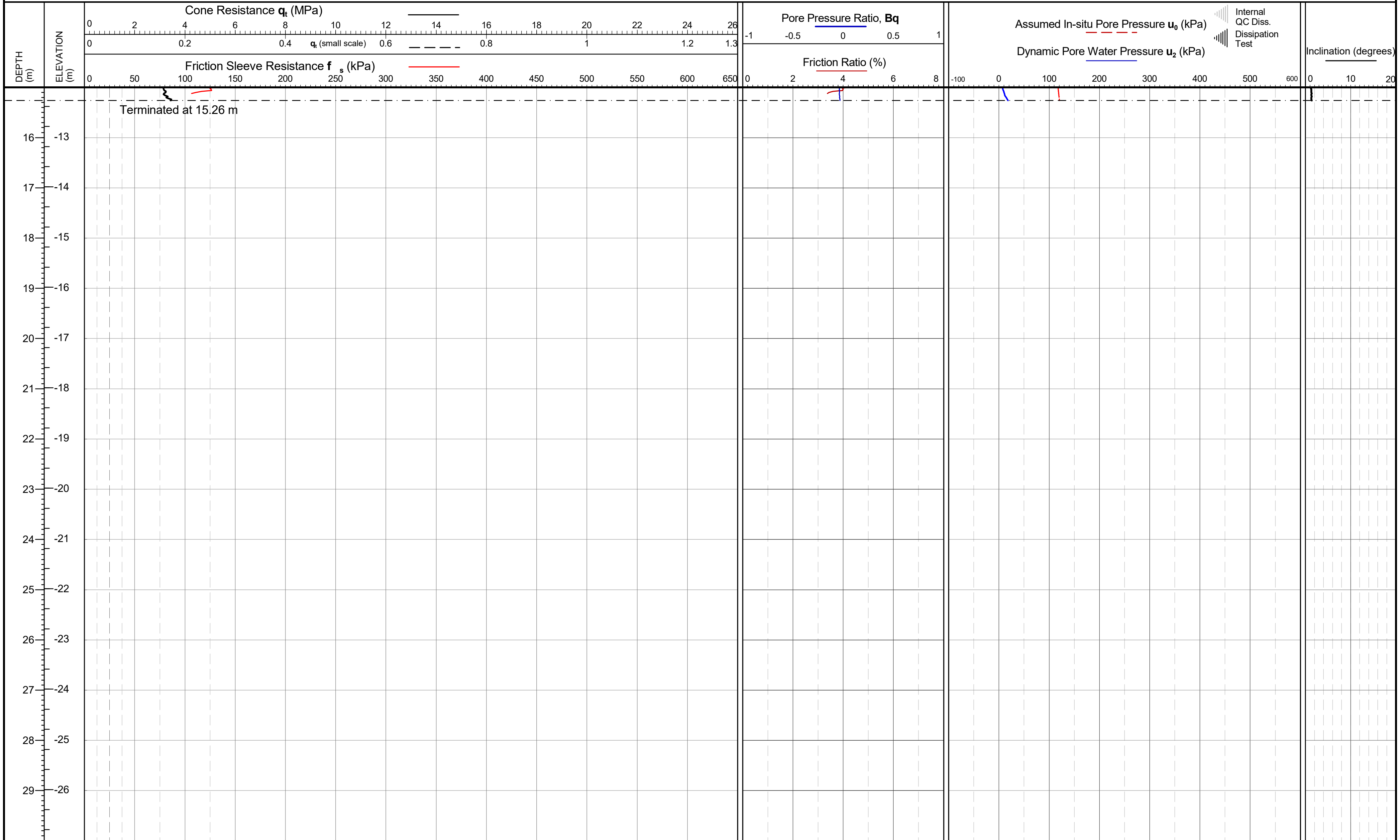
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 09:30:06	Zero drift (Pre/post test) q_c (kPa): 13.8 f_s (kPa): -2.0 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -2.4	Location: Lincolnshire, UK Coordinates: 516887.009, 416995.047 Elevation: 2.979 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT11

Page 1 of 2

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

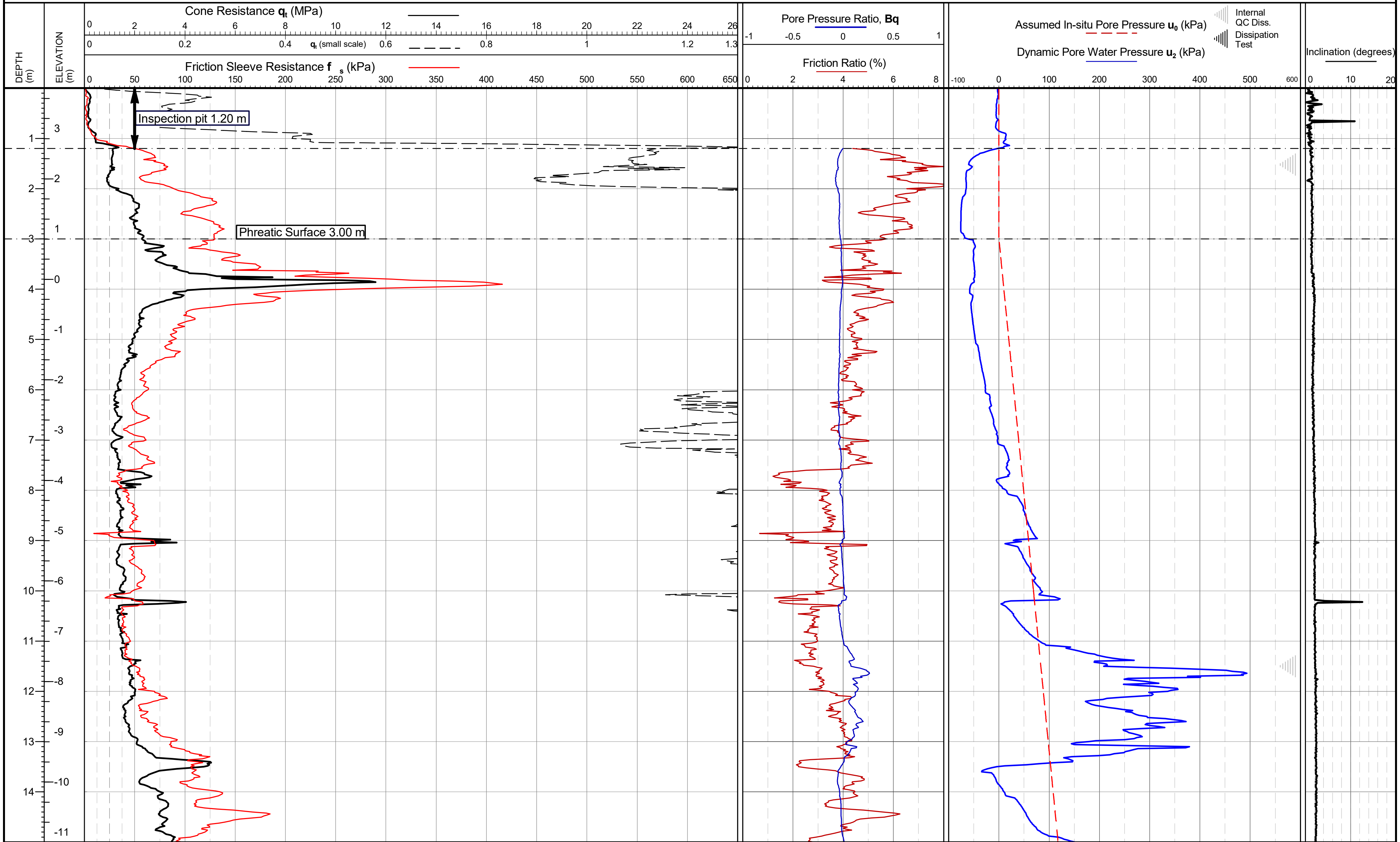


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 09:30:06	Zero drift (Pre/post test) q_c (kPa): 13.8 f_s (kPa): -2.0 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -2.4	Location: Lincolnshire, UK Coordinates: 516887.009, 416995.047 Elevation: 2.979 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT11** Page 2 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



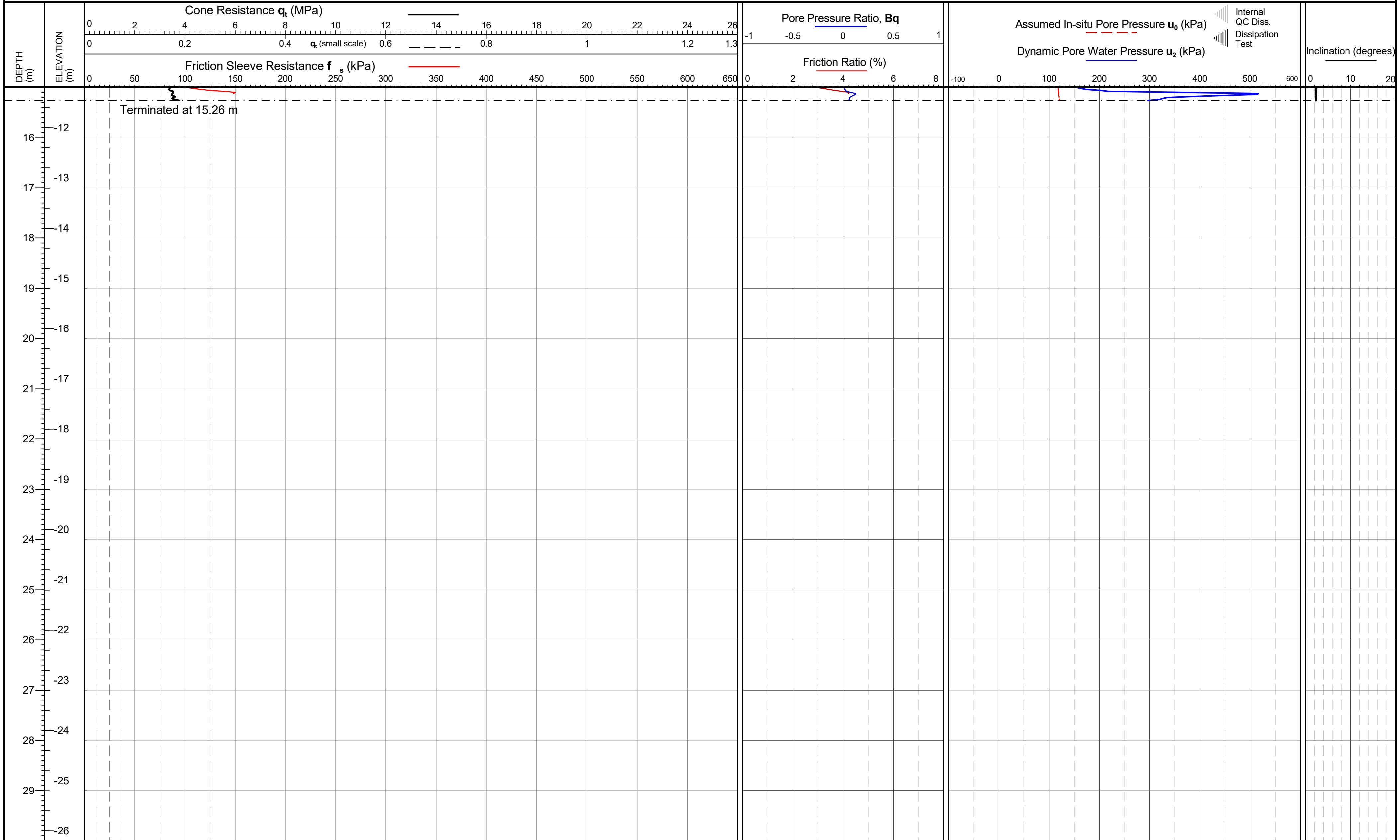
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 10:25:48	Zero drift (Pre/post test) q_c (kPa): 1.4 f_s (kPa): -1.8 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -1.1	Location: Lincolnshire, UK Coordinates: 516904.912, 417064.974 Elevation: 3.804 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT14

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

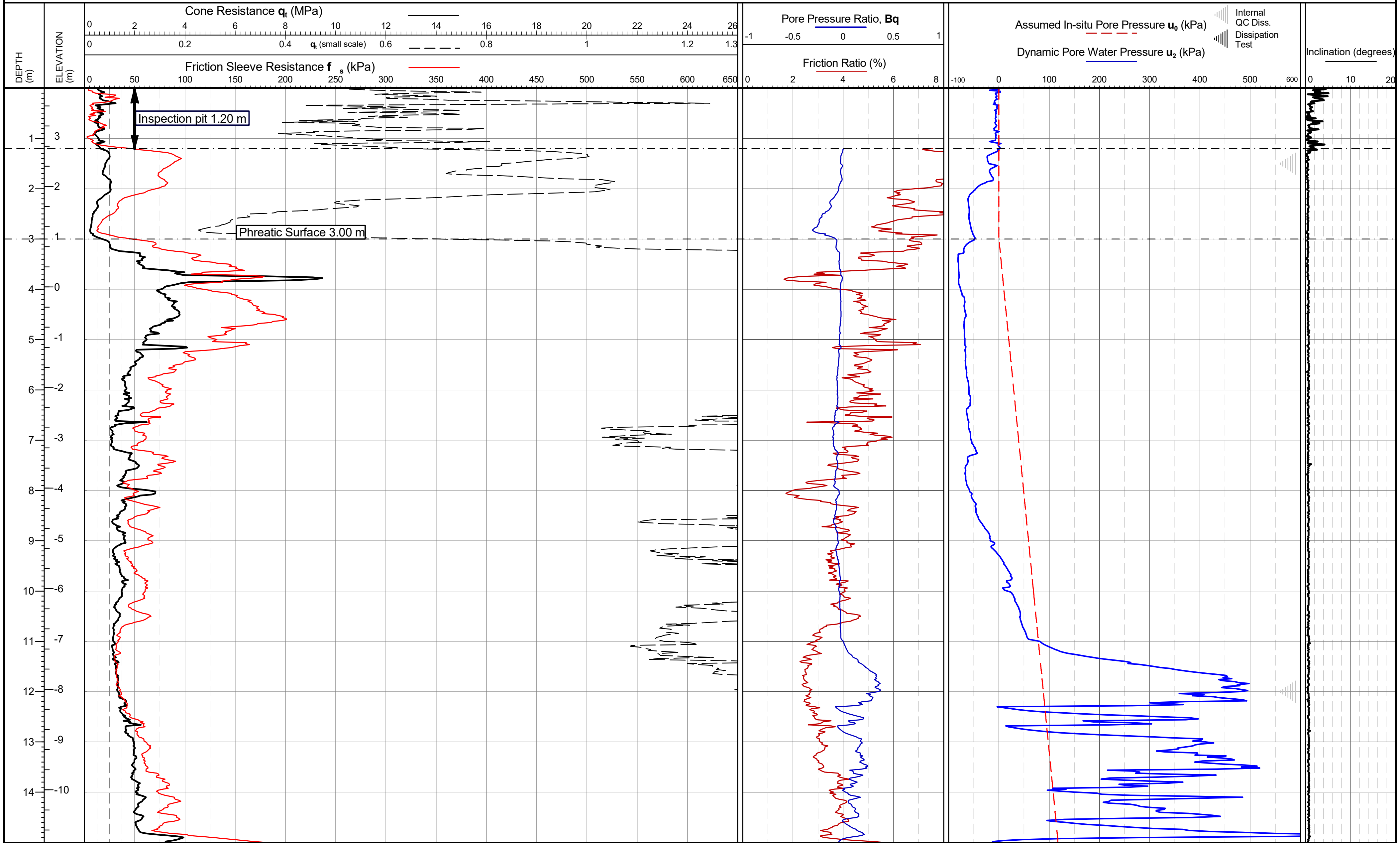
Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 10:25:48	Zero drift (Pre/post test) q_c (kPa): 1.4 f_s (kPa): -1.8 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -1.1	Location: Lincolnshire, UK Coordinates: 516904.912, 417064.974 Elevation: 3.804 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT14** Page 2 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS

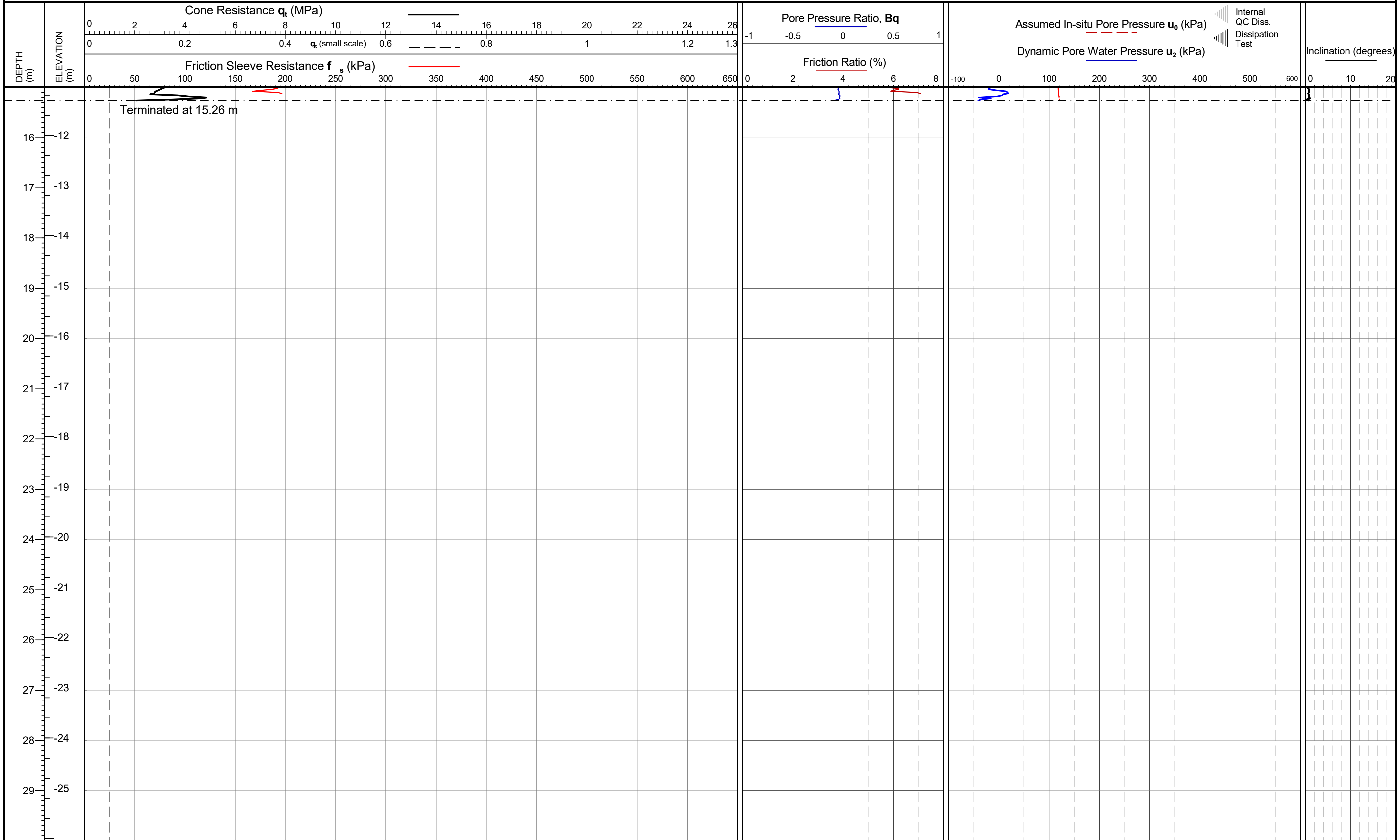


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 15:51:04	Zero drift (Pre/post test) q_c (kPa): -11.4 f_s (kPa): -0.5 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): -0.2	Location: Lincolnshire, UK Coordinates: 516774.966, 416987.078 Elevation: 3.953 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT15

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

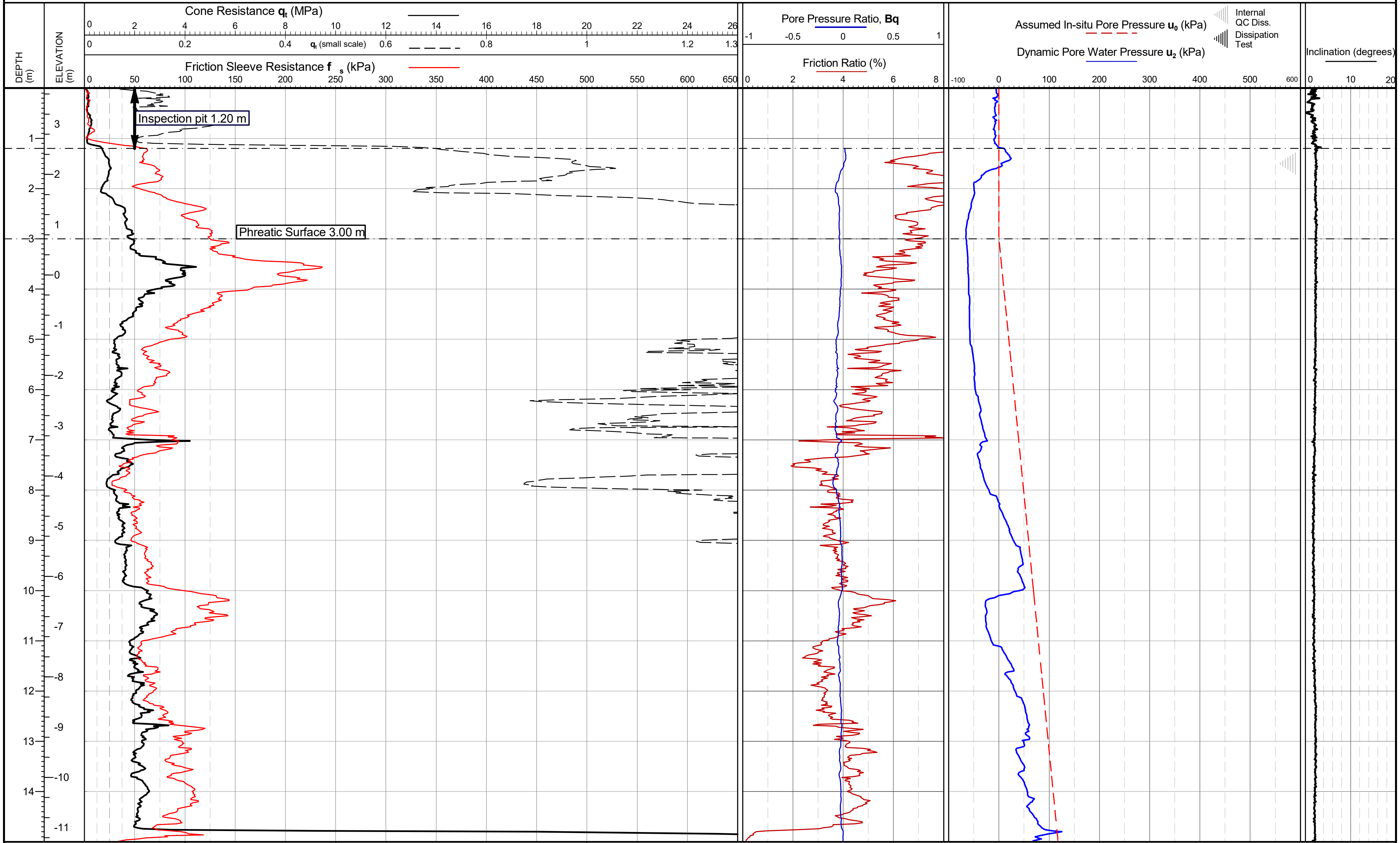


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 15:51:04	Zero drift (Pre/post test) q_c (kPa): -11.4 f_s (kPa): -0.5 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.2	Location: Lincolnshire, UK Coordinates: 516774.966, 416987.078 Elevation: 3.953 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT15** Page 2 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

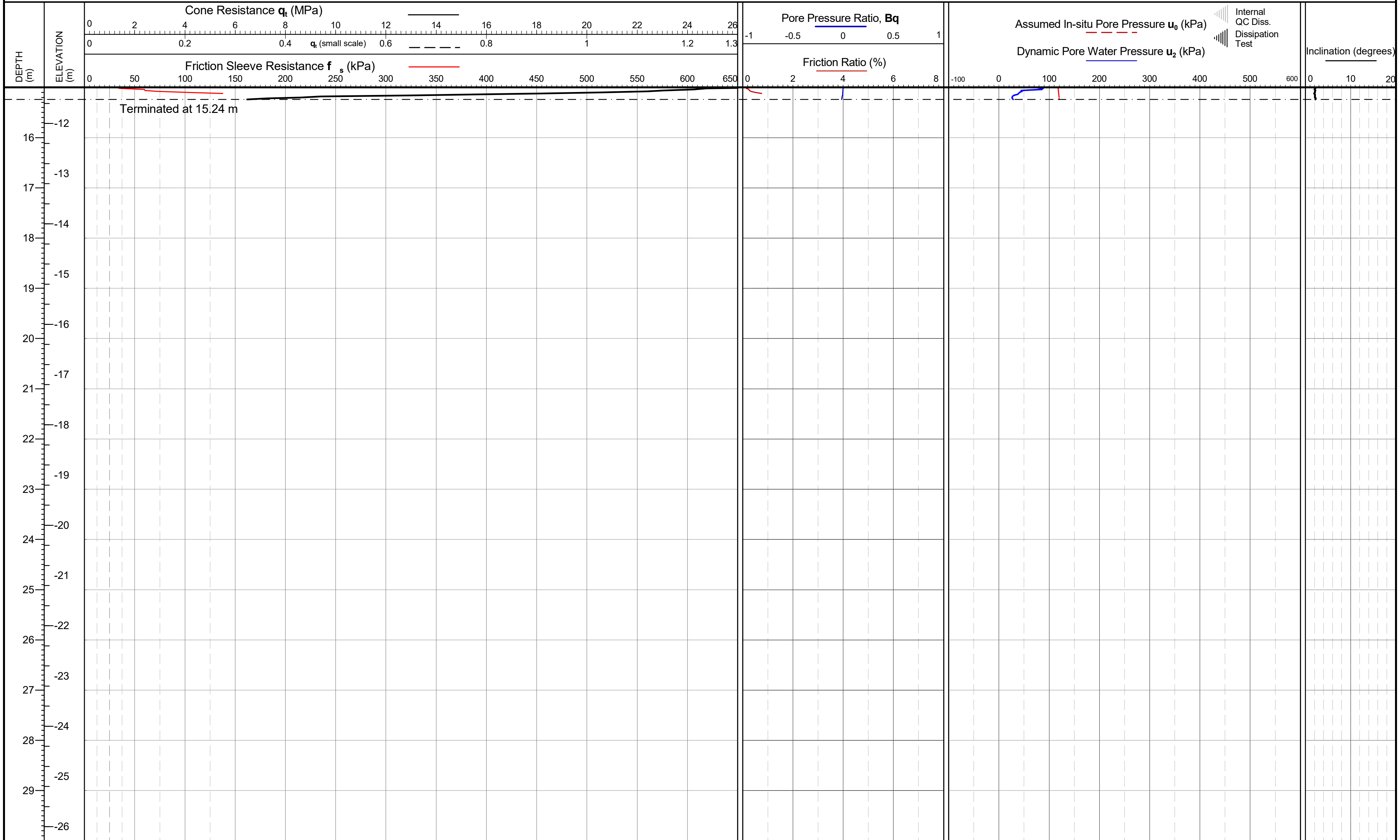


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 14:52:09	Zero drift (Pre/post test) q_c (kPa): -10.8 f_s (kPa): 0.5 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 1.1	Location: Lincolnshire, UK Coordinates: 516646.925, 416909.913 Elevation: 3.718 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT16

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



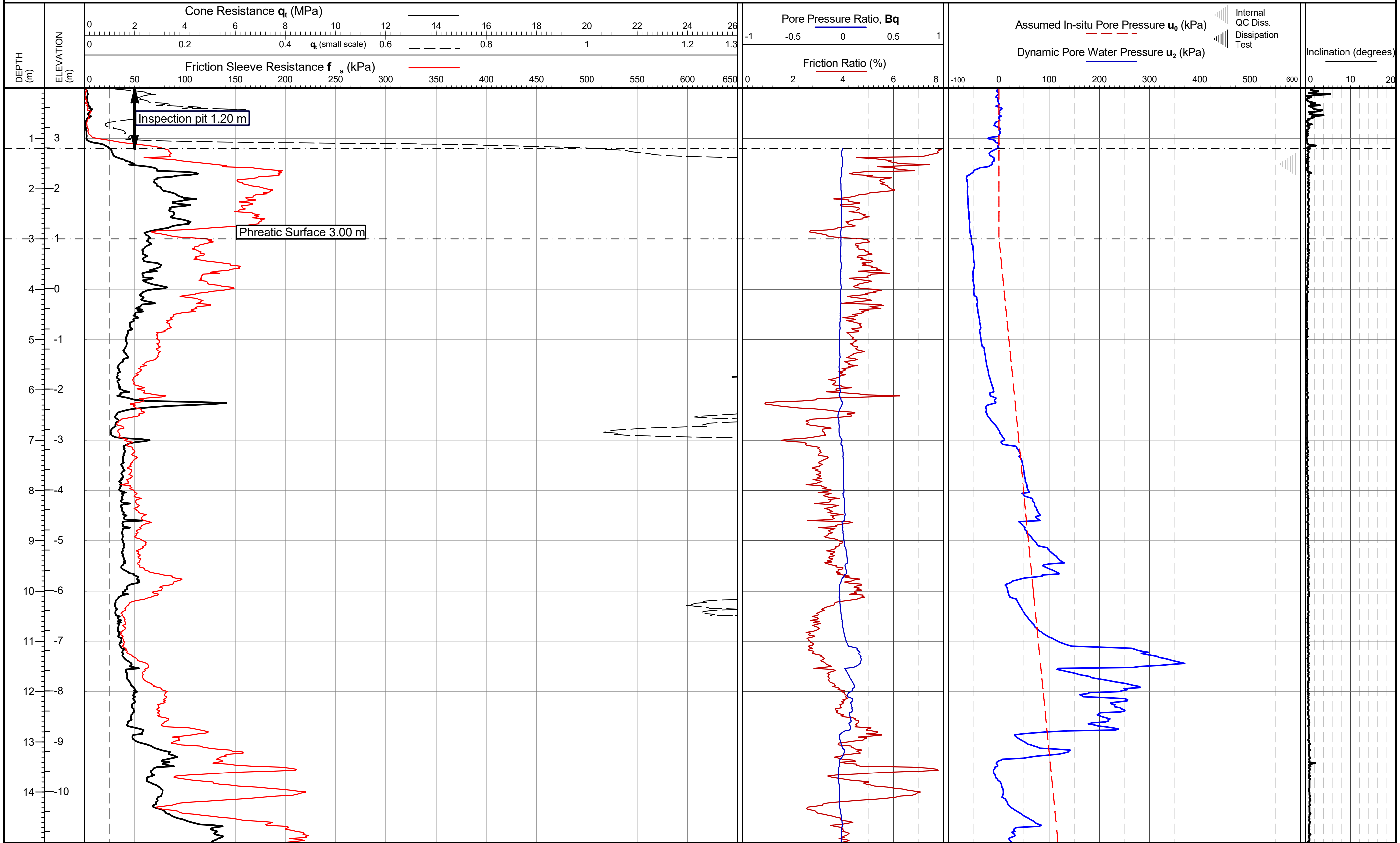
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 14:52:09	Zero drift (Pre/post test) q_c (kPa): -10.8 f_s (kPa): 0.5 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 1.1	Location: Lincolnshire, UK Coordinates: 516646.925, 416909.913 Elevation: 3.718 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT16

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 11:43:23	Zero drift (Pre/post test) q_c (kPa): -7.6 f_s (kPa): 1.2 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.4	Location: Lincolnshire, UK Coordinates: 516797.98, 417045.885 Elevation: 3.986 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

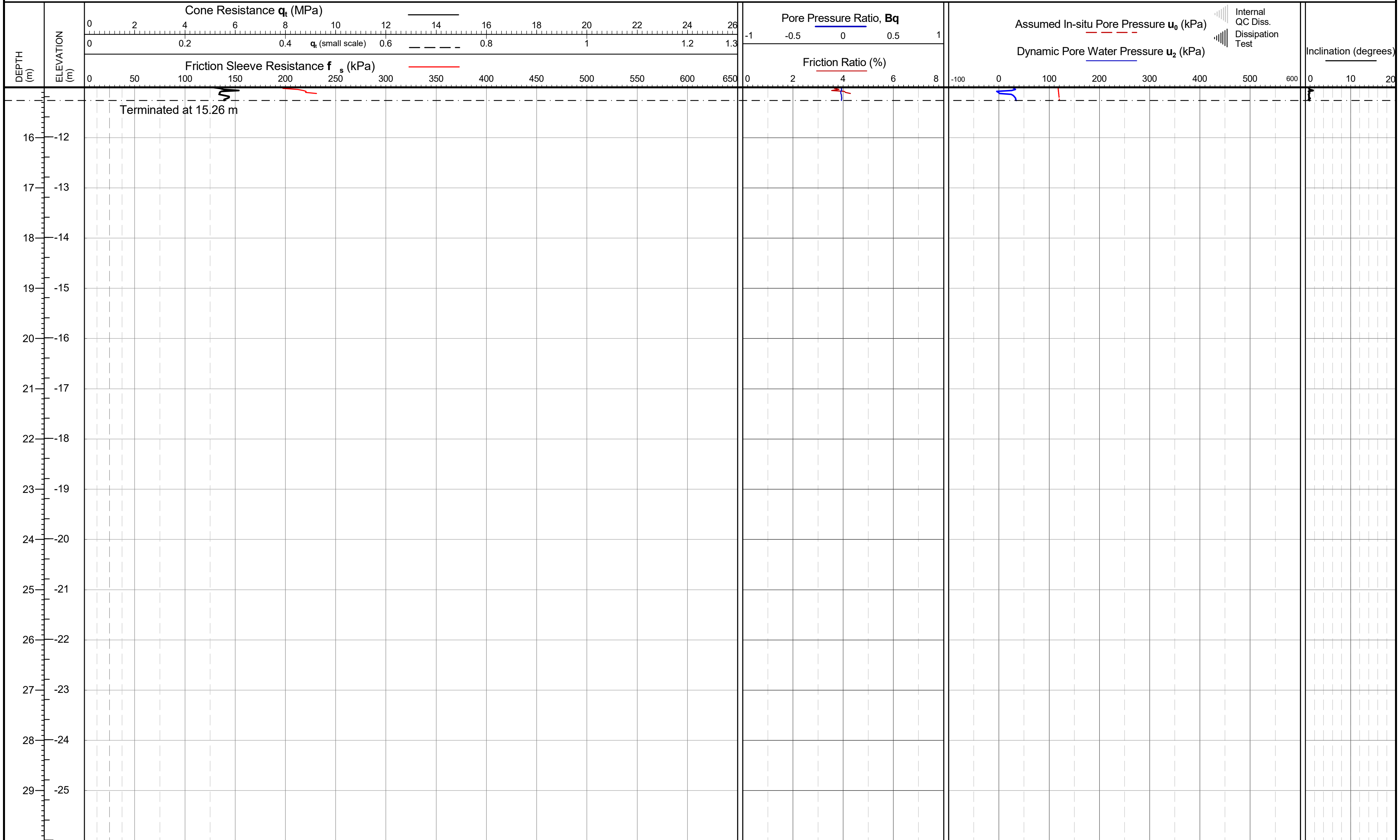
TEST ID: CPT18

Page 1 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

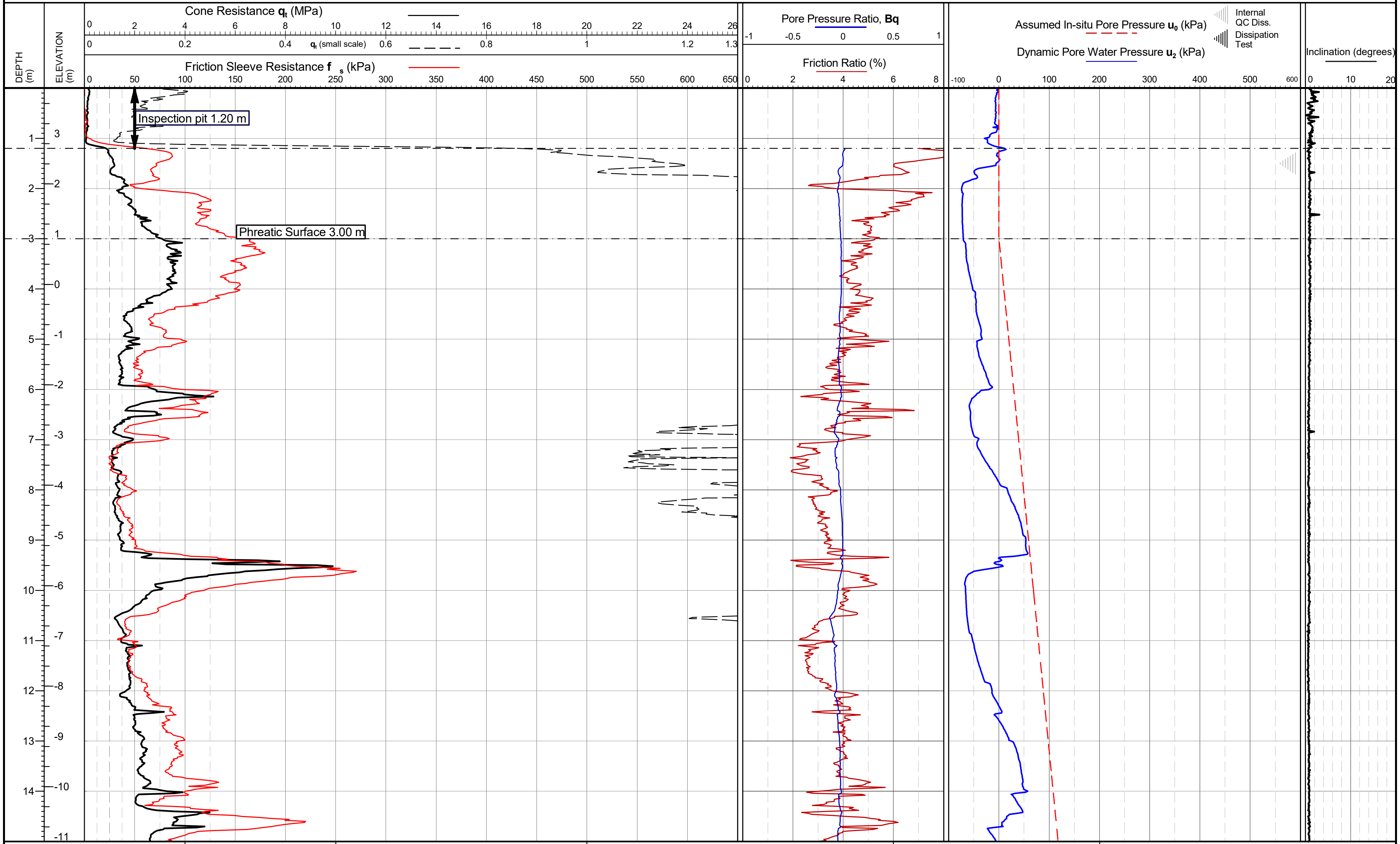


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 11:43:23	Zero drift (Pre/post test) q_c (kPa): -7.6 f_s (kPa): 1.2 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.4	Location: Lincolnshire, UK Coordinates: 516797.98, 417045.885 Elevation: 3.986 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT18

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

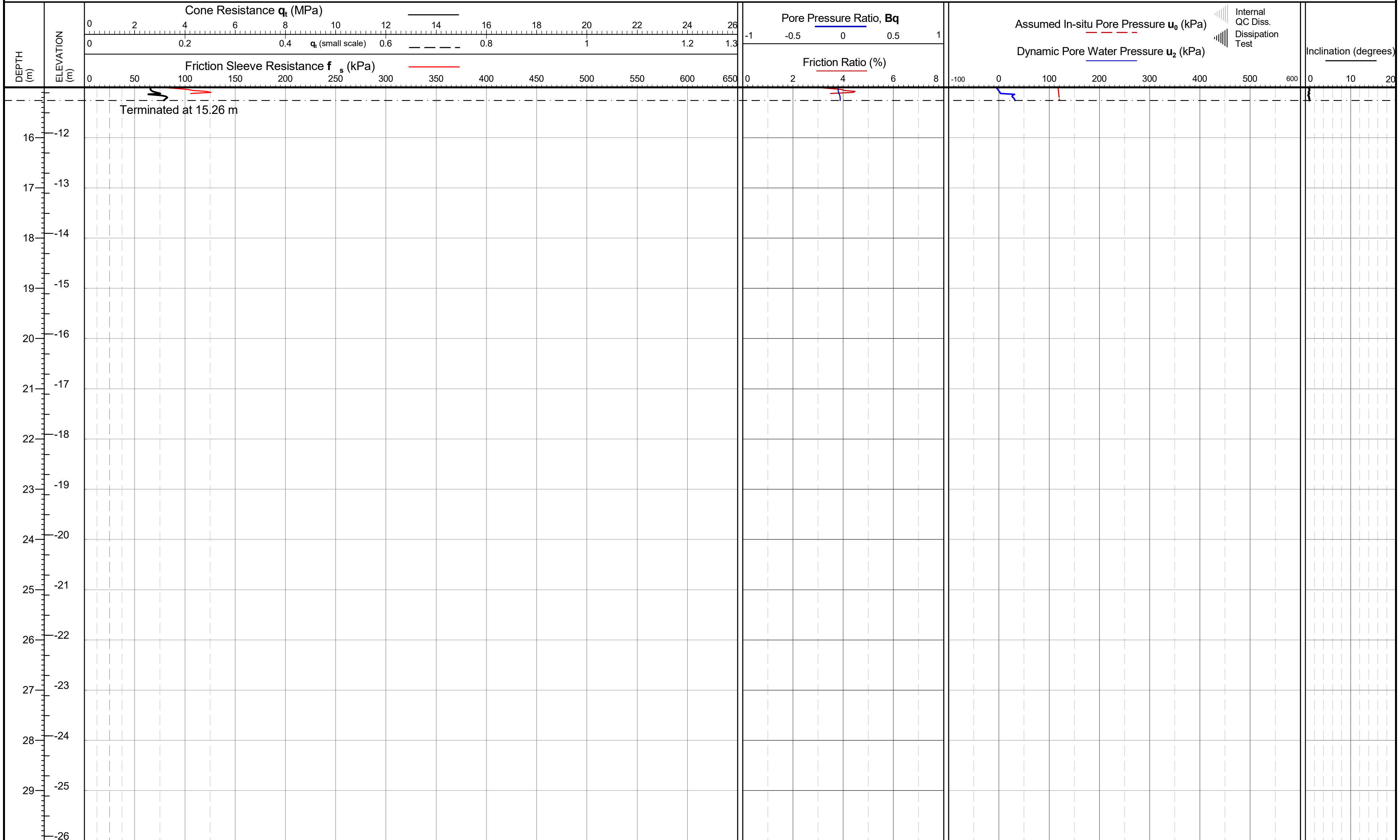


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 12:49:35	Zero drift (Pre/post test) q_c (kPa): -3.2 f_s (kPa): -0.4 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 3.6	Location: Lincolnshire, UK Coordinates: 516703.892, 416993.845 Elevation: 3.908 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



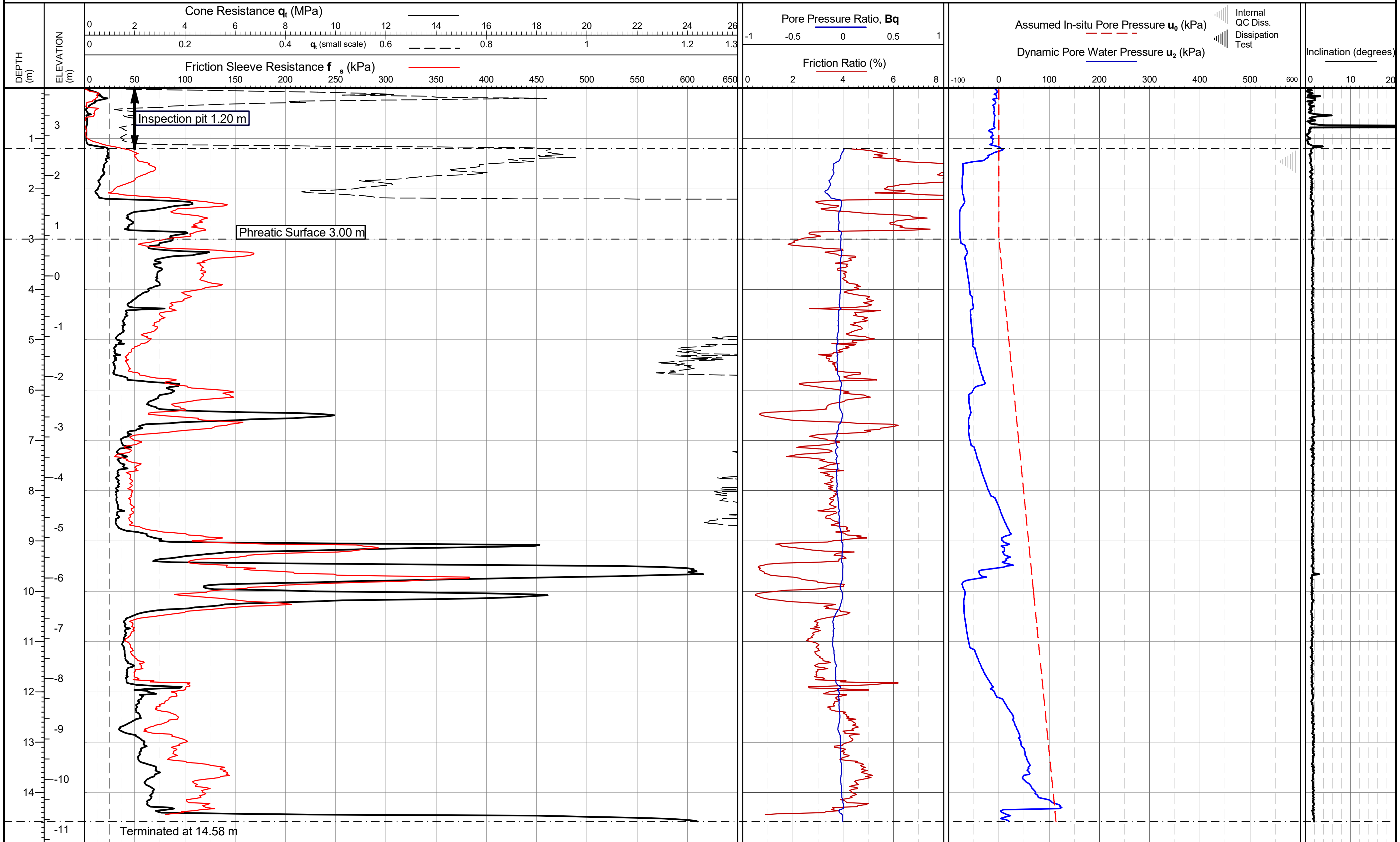
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 12:49:35	Zero drift (Pre/post test) q_c (kPa): -3.2 f_s (kPa): -0.4 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 3.6	Location: Lincolnshire, UK Coordinates: 516703.892, 416993.845 Elevation: 3.908 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 13:50:45	Zero drift (Pre/post test) q_c (kPa): 9.2 f_s (kPa): 0.8 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): -3.0	Location: Lincolnshire, UK Coordinates: 516630.051, 416942.072 Elevation: 3.734 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Lateral support at surface	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT20** Page 1 of 1

APPENDIX D SOIL BEHAVIOUR TYPE RESULTS

Soil behaviour type (SBT) point data evaluation according to:

Schneider et al (2008)

Robertson (2016)

Robertson (2010) with aggregate layer descriptions

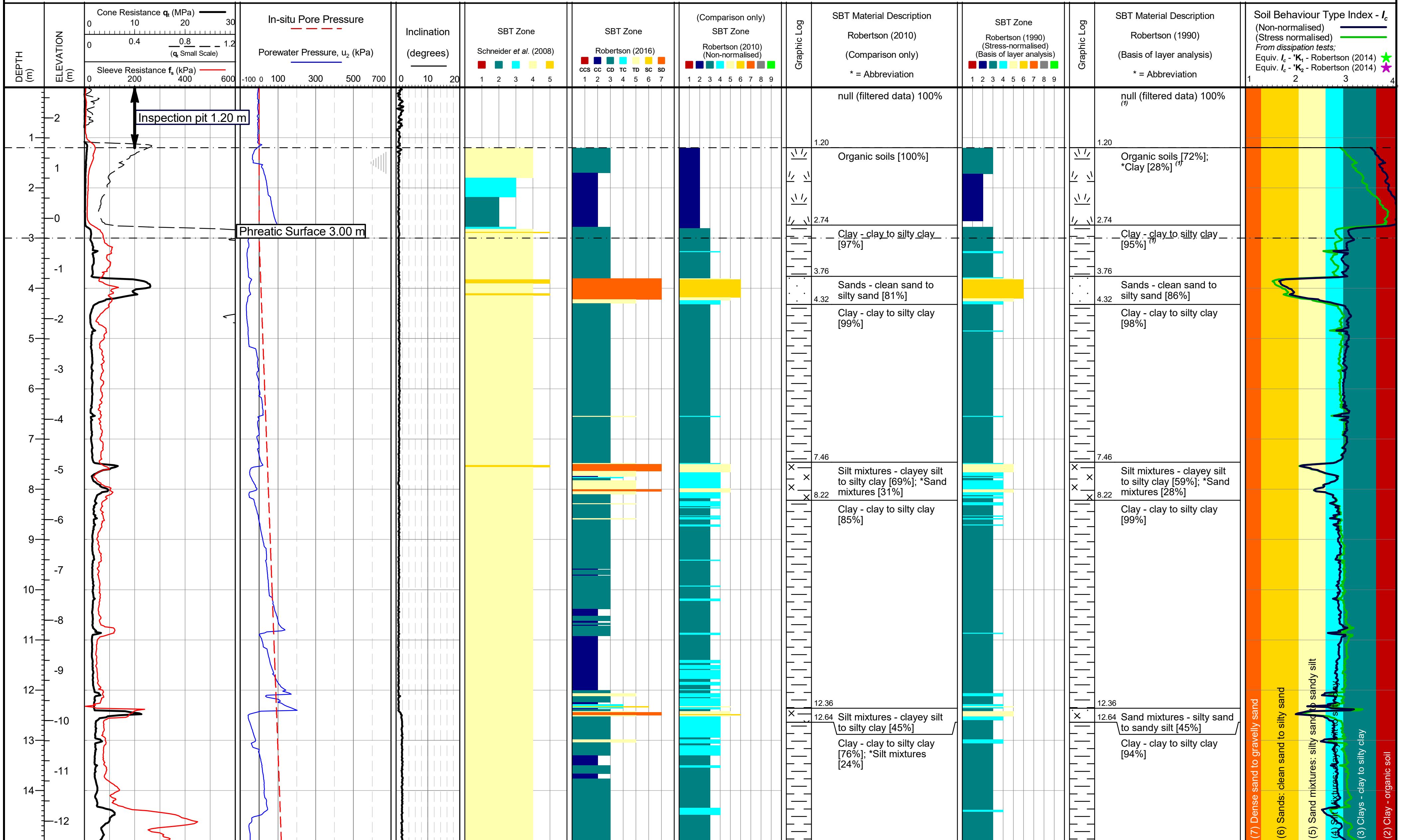
Robertson (1990) with aggregate layer descriptions

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 13/09/2022 11:24:25

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 517109.955, 417014.039
Elevation: 2.606

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I, clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - CCS - Clay-like - Contractive - Sensitive
2 - CC - Clay-like - Contractive
3 - CD - Clay-like - Dilative
4 - TC - Transitional - Contractive
5 - TD - Transitional - Dilative
6 - SC - Sand-like - Contractive
7 - SD - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss. Dissipation Test

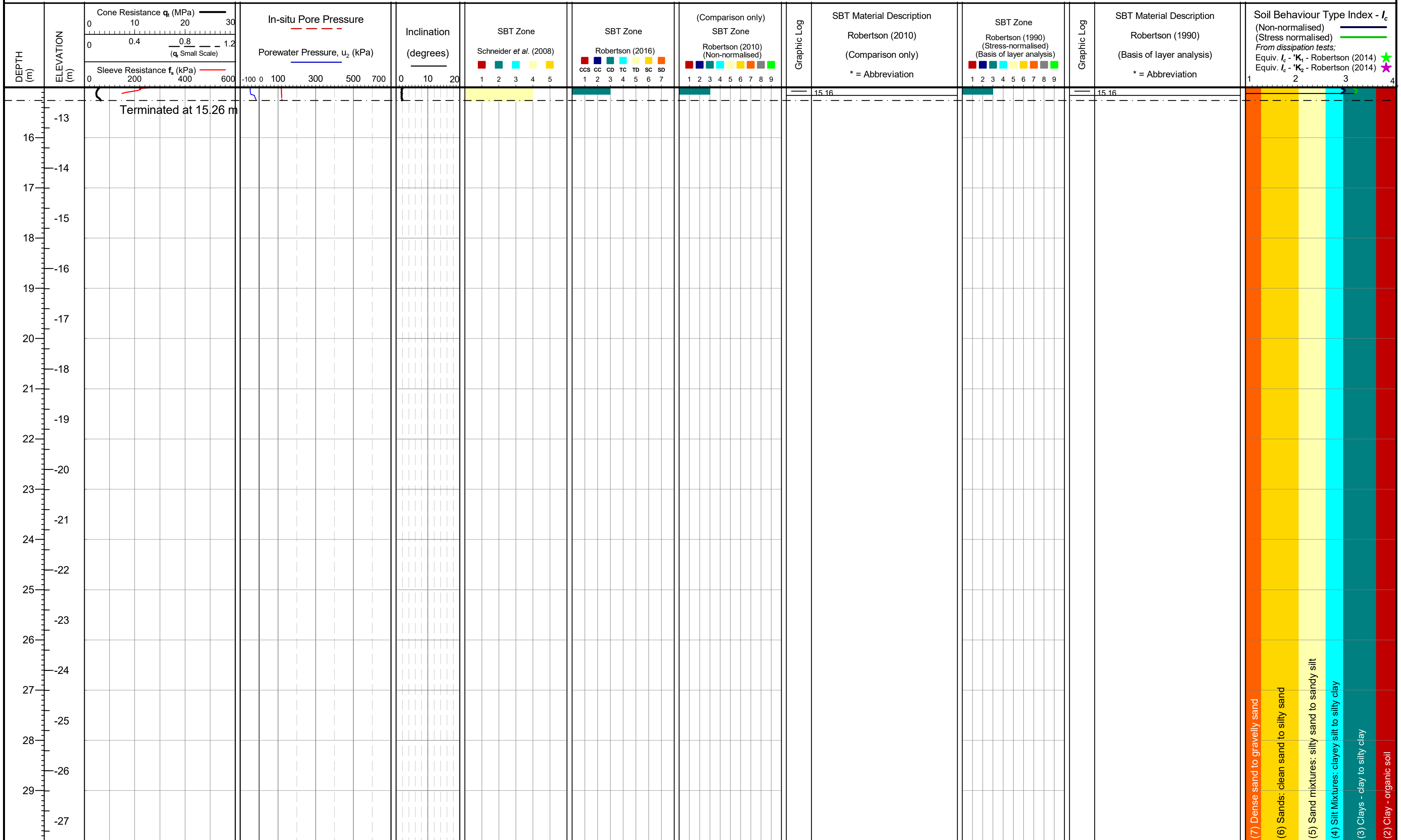
TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 13/09/2022 11:24:25

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 517109.955, 417014.039
Elevation: 2.606

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

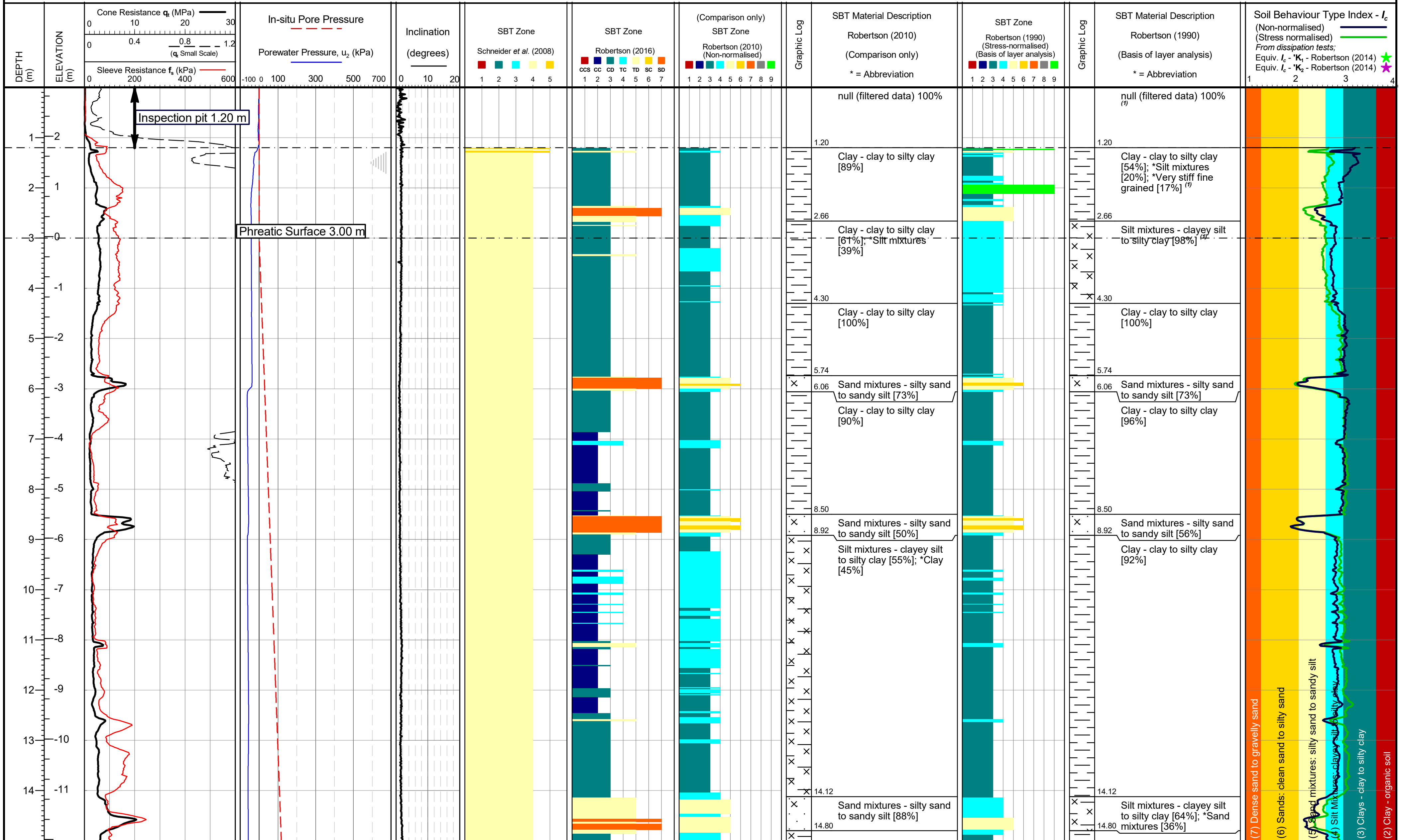
TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 09:12:31

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 517057.758, 417099.047
Elevation: 2.972

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

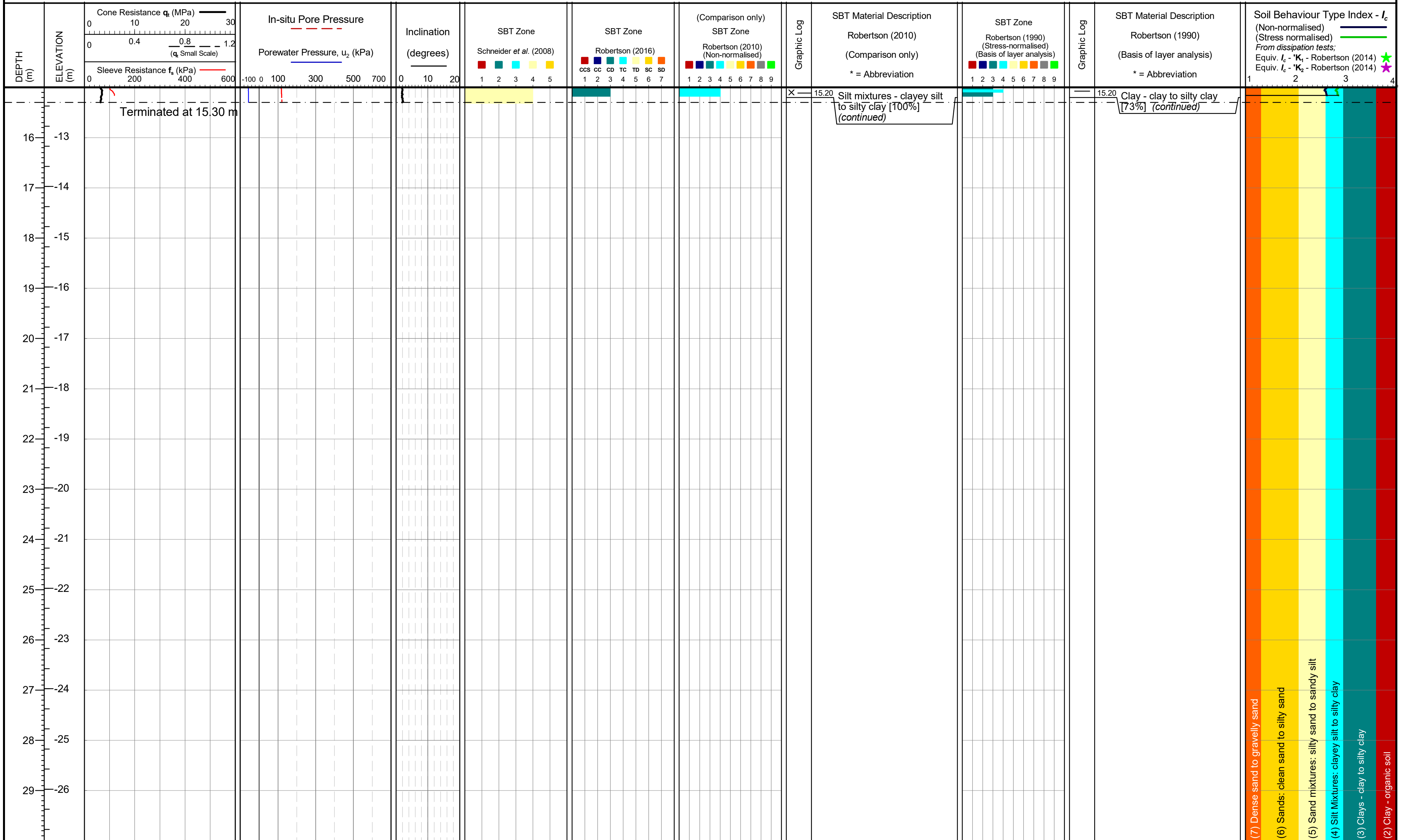
TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 09:12:31

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 517057.758, 417099.047
Elevation: 2.972

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

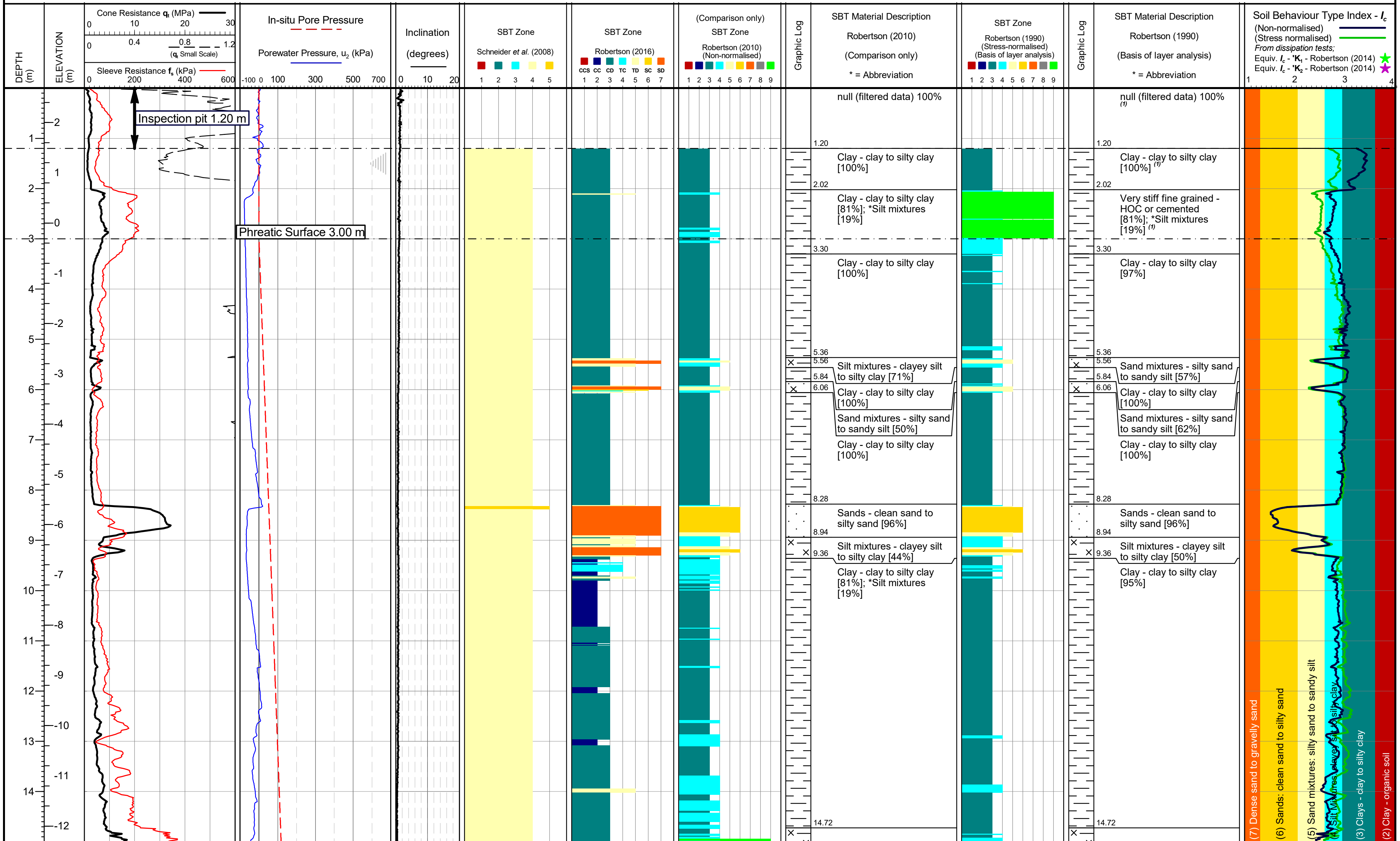
TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 13/09/2022 10:26:25

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516972.019, 417047.79
Elevation: 2.686

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I, clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

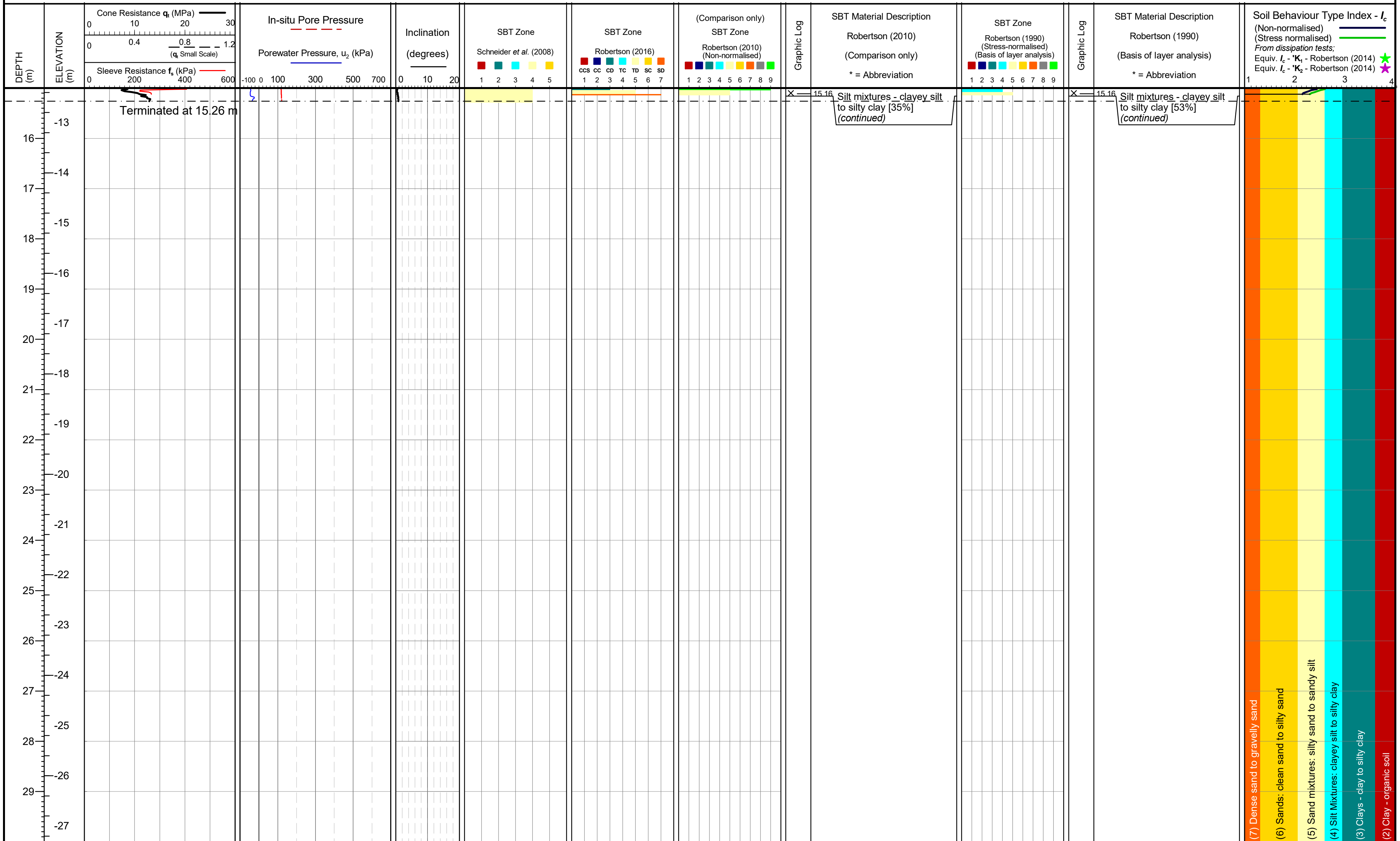
Internal QA Diss. | Dissipation Test

TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 13/09/2022 10:26:25

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516972.019, 417047.79
Elevation: 2.686

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(*) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

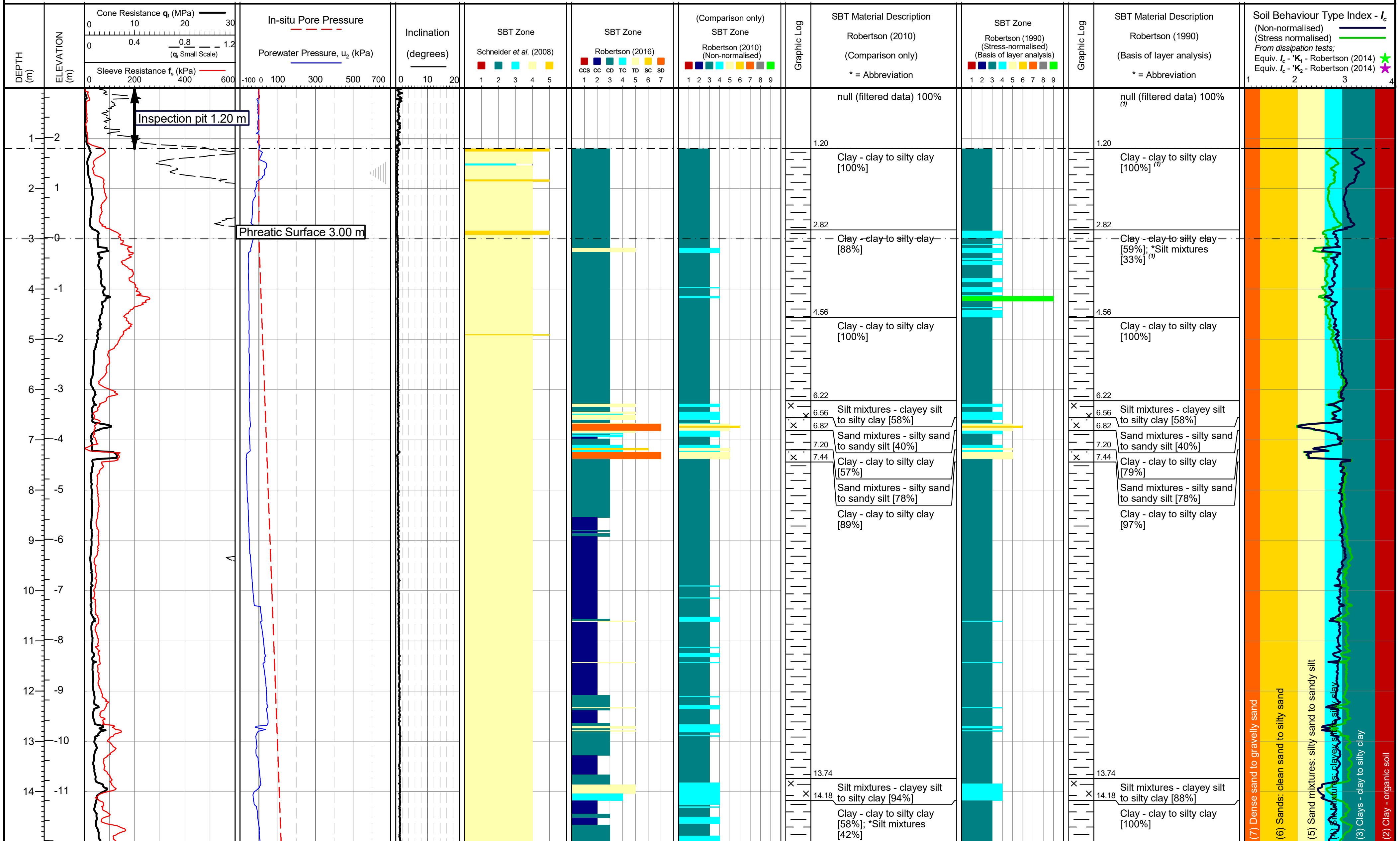
TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 13/09/2022 09:30:06

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516887.009, 416995.047
Elevation: 2.979

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

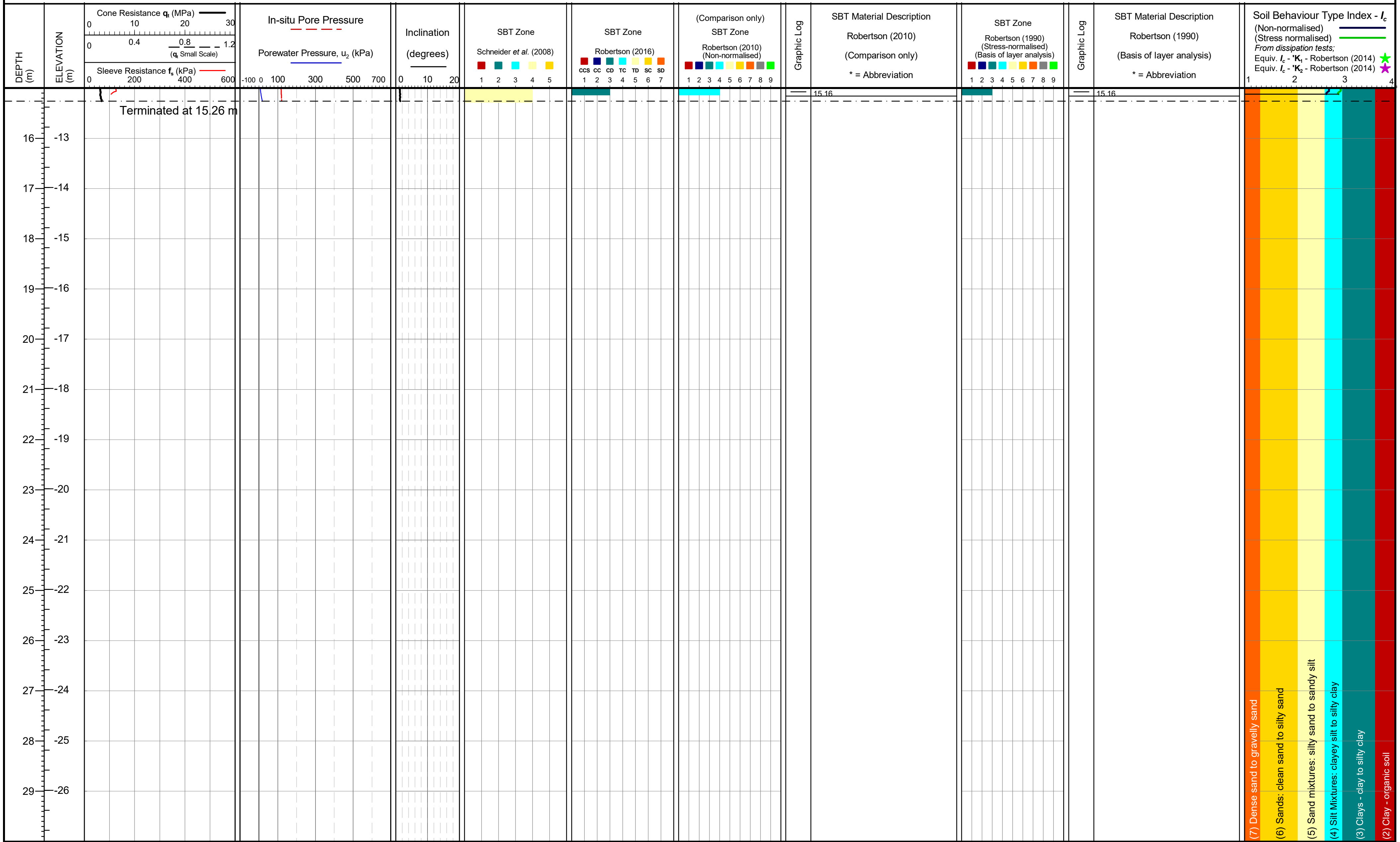
Internal QA Diss.
Dissipation Test

TEST ID: CPT11

Lankelma Project Ref: P-108071-1

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 13/09/2022 09:30:06

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516887.009, 416995.047
Elevation: 2.979

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

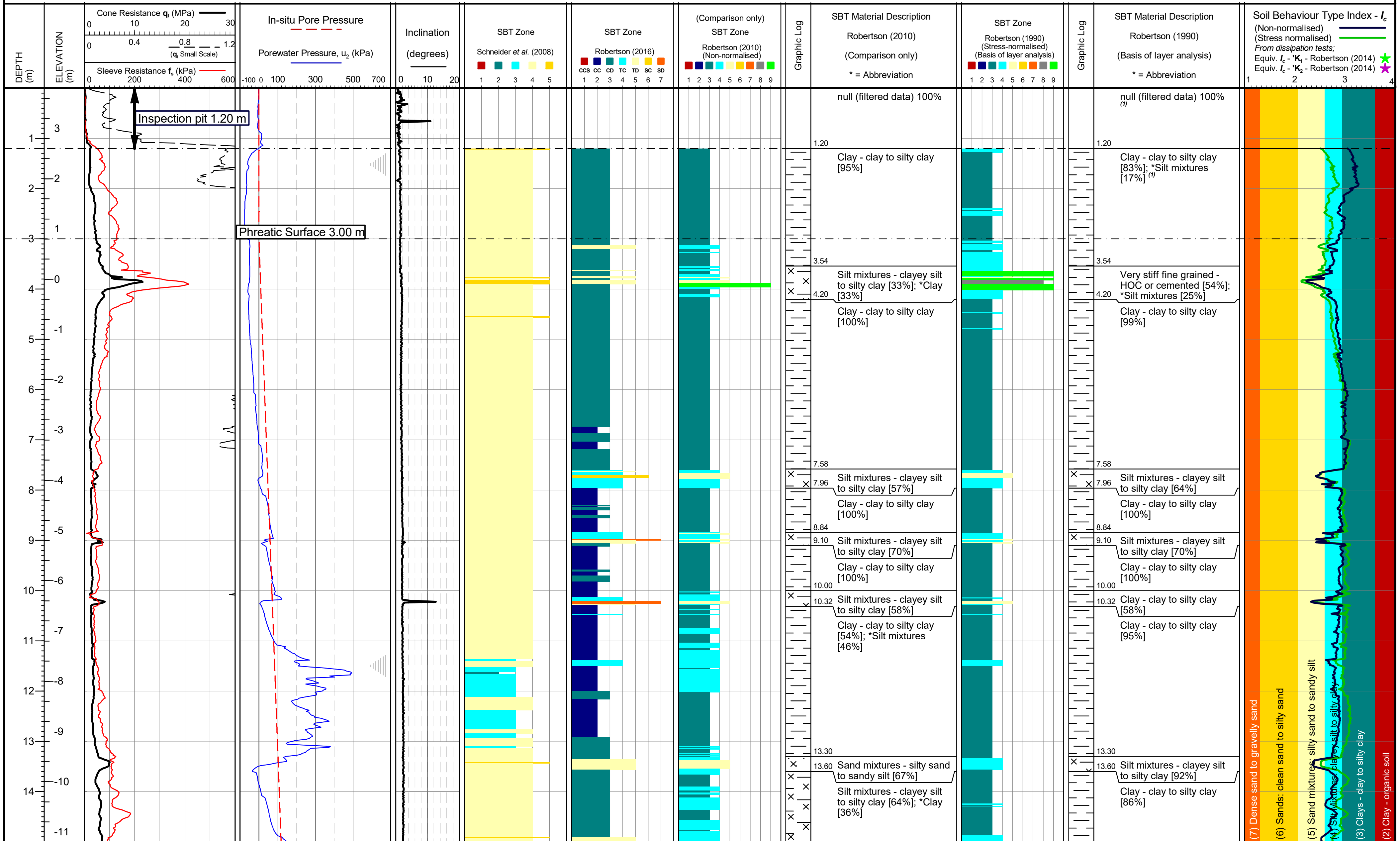
Internal QA Diss.
Dissipation Test

TEST ID: CPT11

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 10:25:48

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516904.912, 417064.974
Elevation: 3.804

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss. Dissipation Test

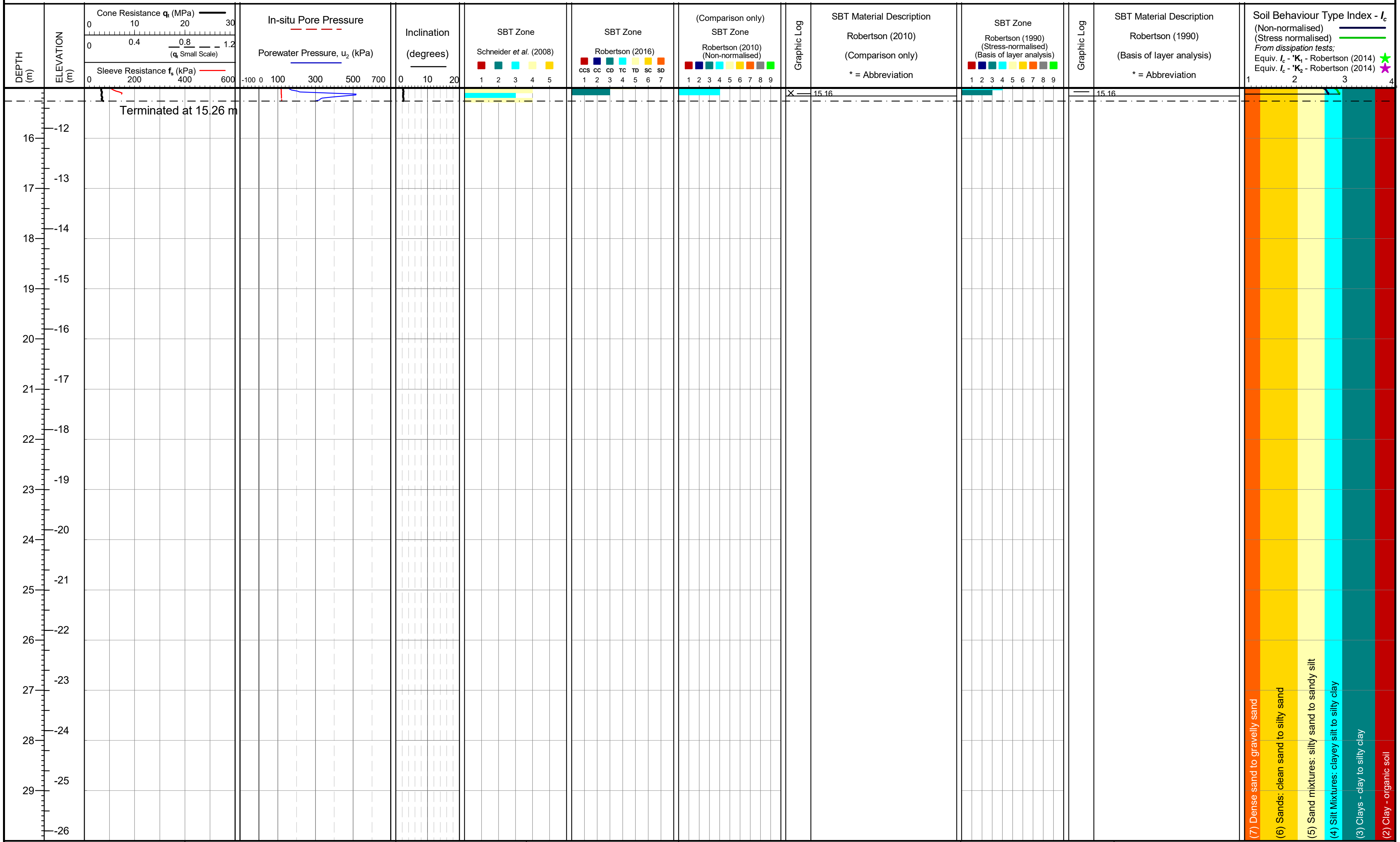
TEST ID: CPT14

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 10:25:48

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516904.912, 417064.974
Elevation: 3.804

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

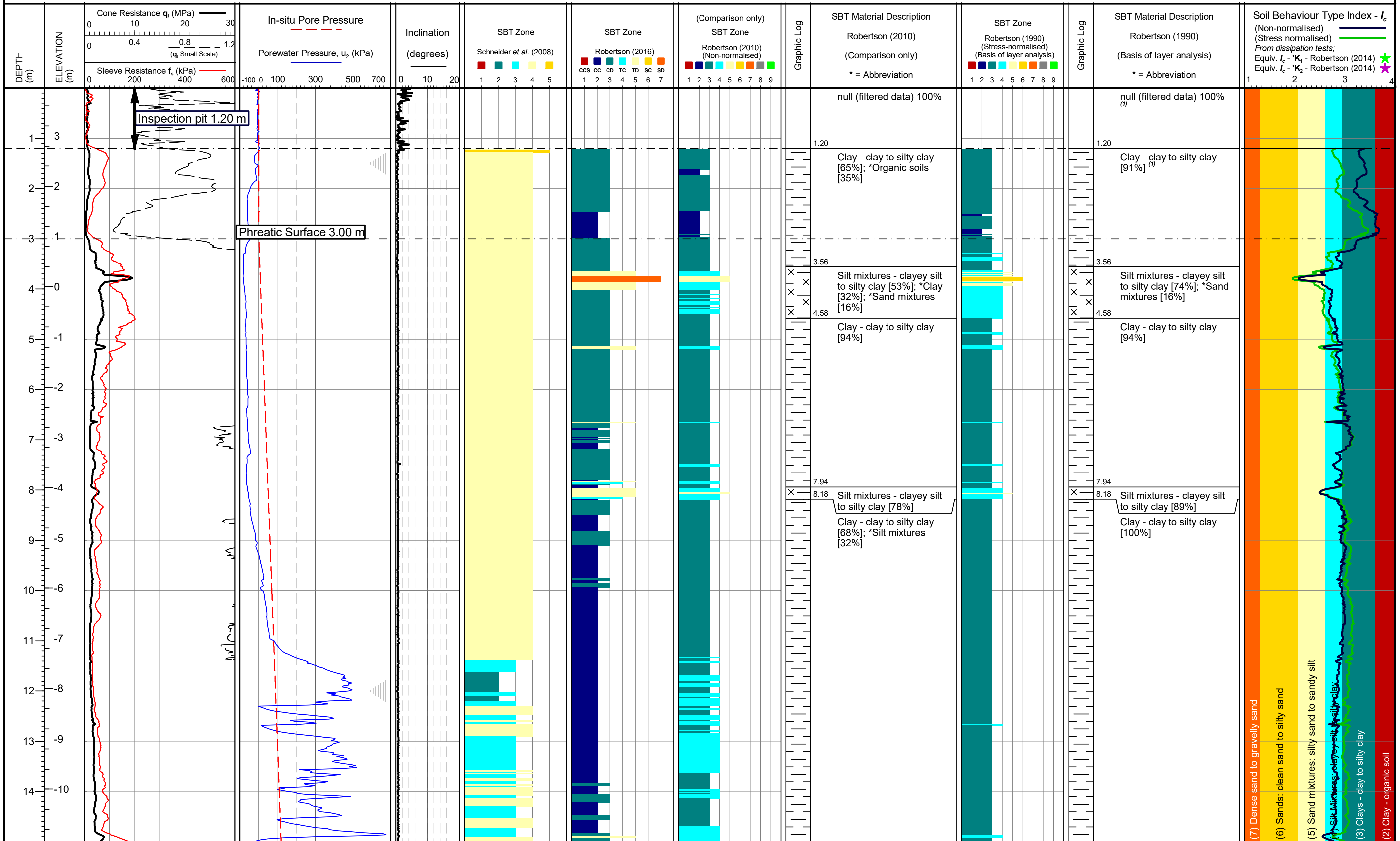
TEST ID: CPT14

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 15:51:04

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516774.966, 416987.078
Elevation: 3.953

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss. Dissipation Test

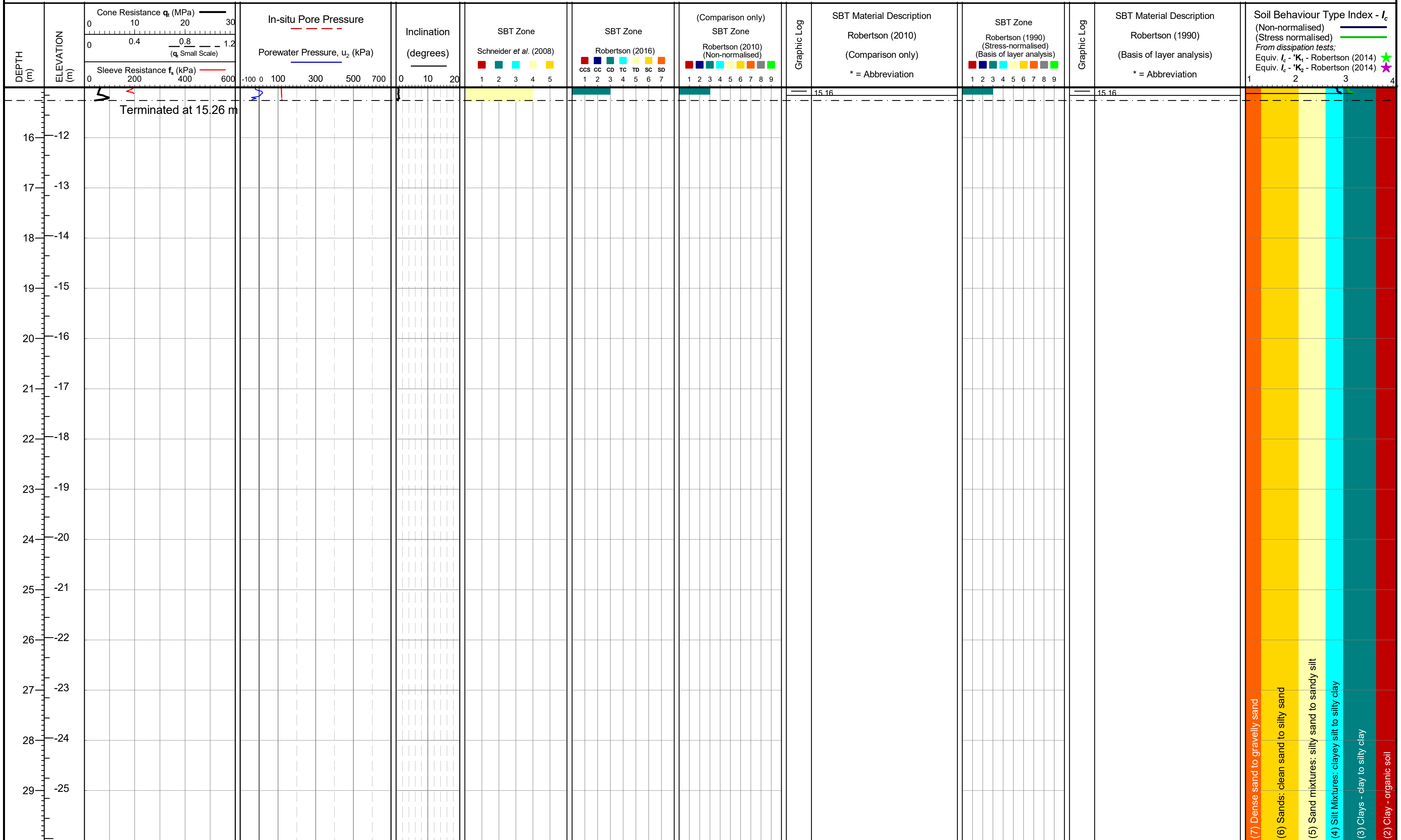
TEST ID: CPT15

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 15:51:04

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516774.966, 416987.078
Elevation: 3.953

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(*) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.

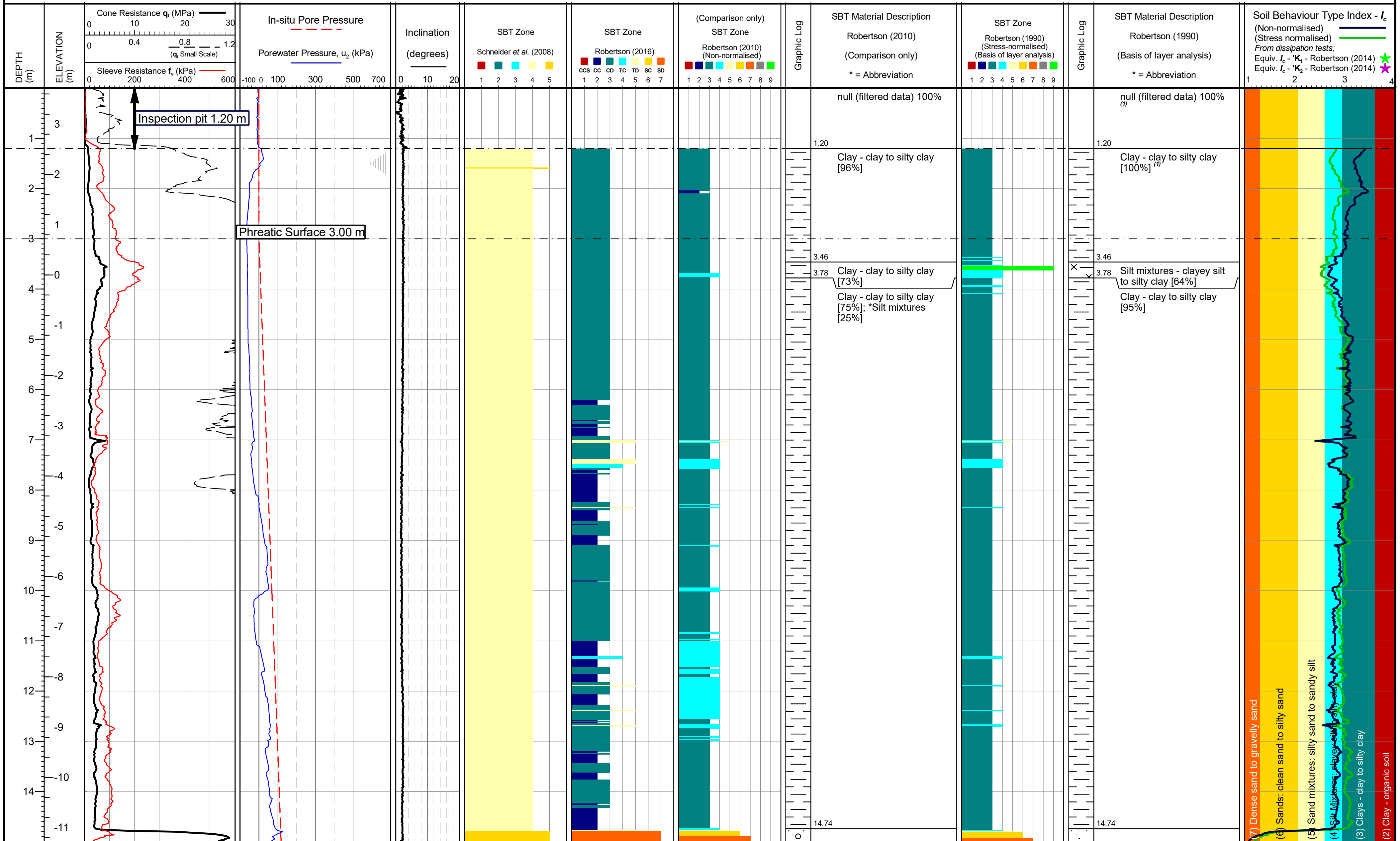
Dissipation Test

TEST ID: CPT15

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 14:52:09

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516646.925, 416909.913
Elevation: 3.718

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I, clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss. Dissipation Test

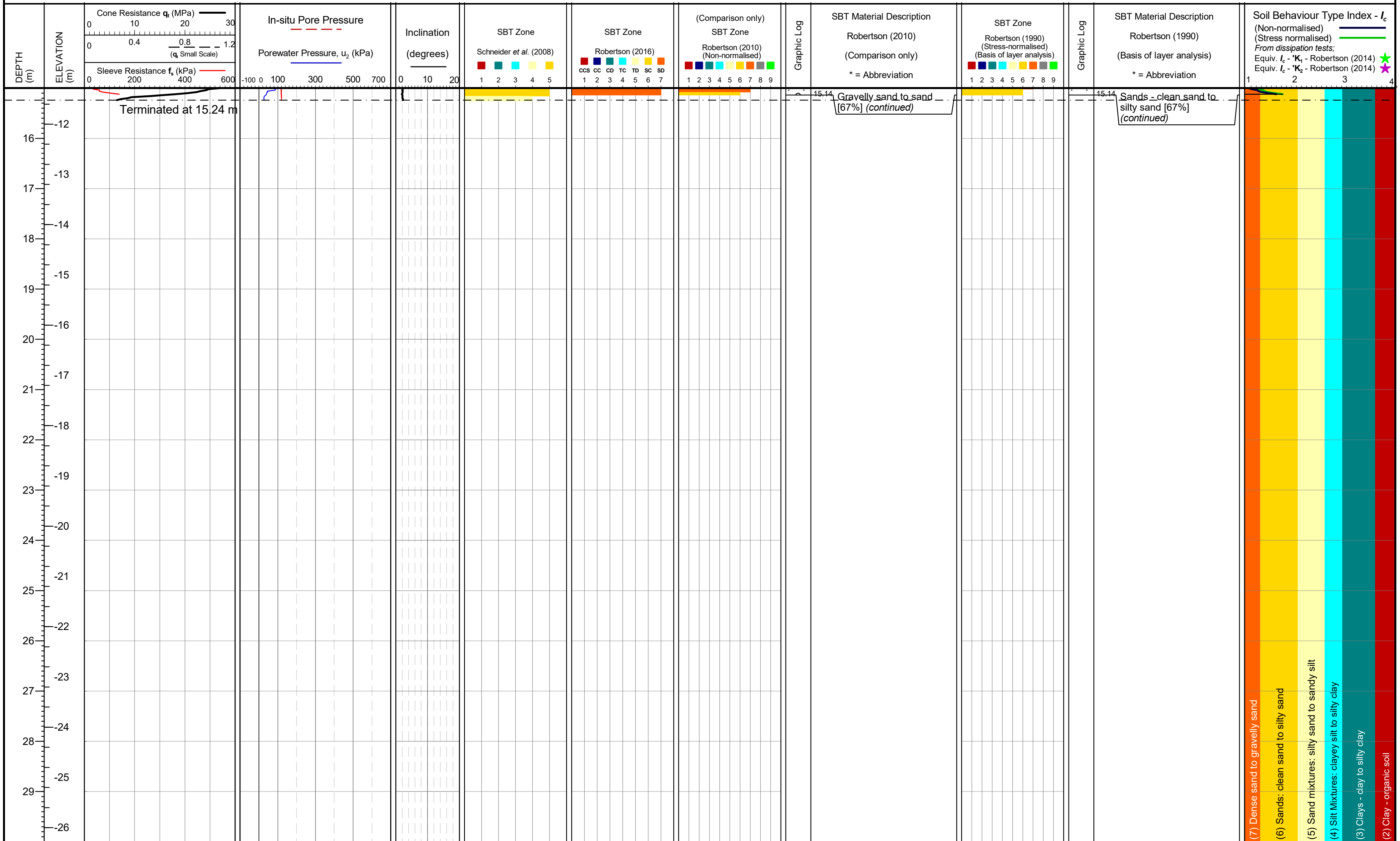
TEST ID: CPT16

Lankelma Project Ref: P-108071-1

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 14:52:09

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516646.925, 416909.913
Elevation: 3.718

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(*) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

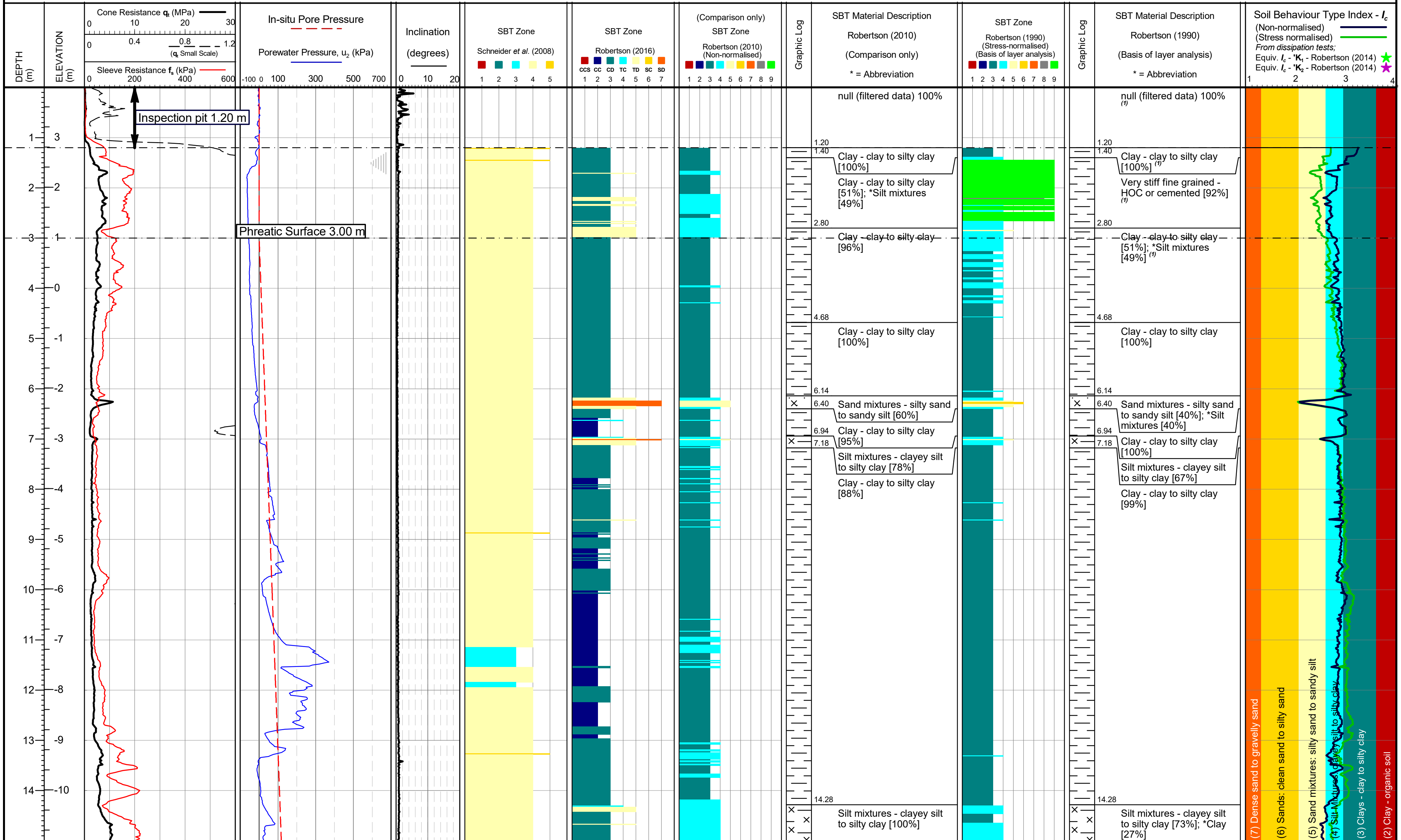
TEST ID: CPT16

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 11:43:23

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516797.98, 417045.885
Elevation: 3.986

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

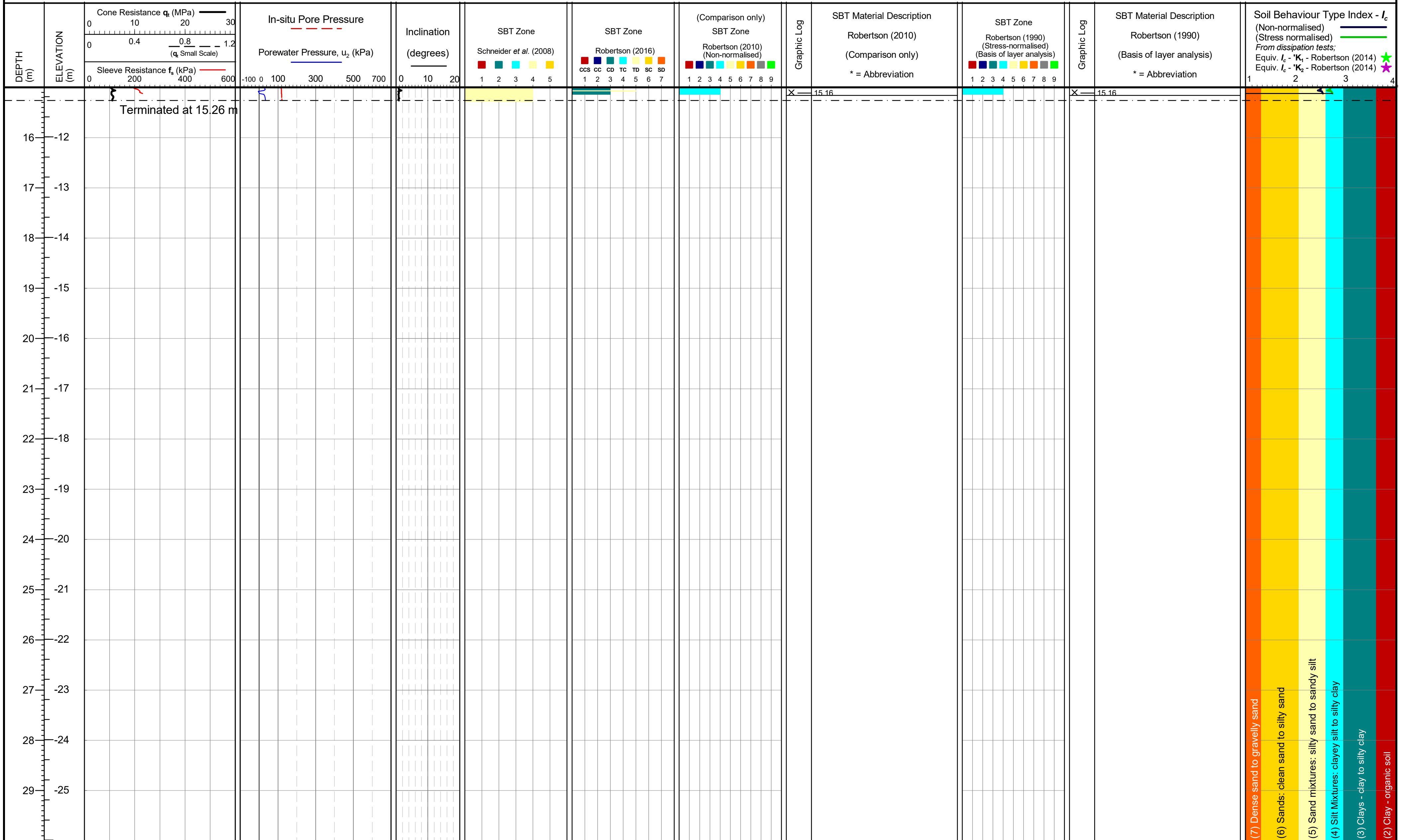
Internal QA Diss.
Dissipation Test

TEST ID: CPT18

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 11:43:23

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516797.98, 417045.885
Elevation: 3.986

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

[1] 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

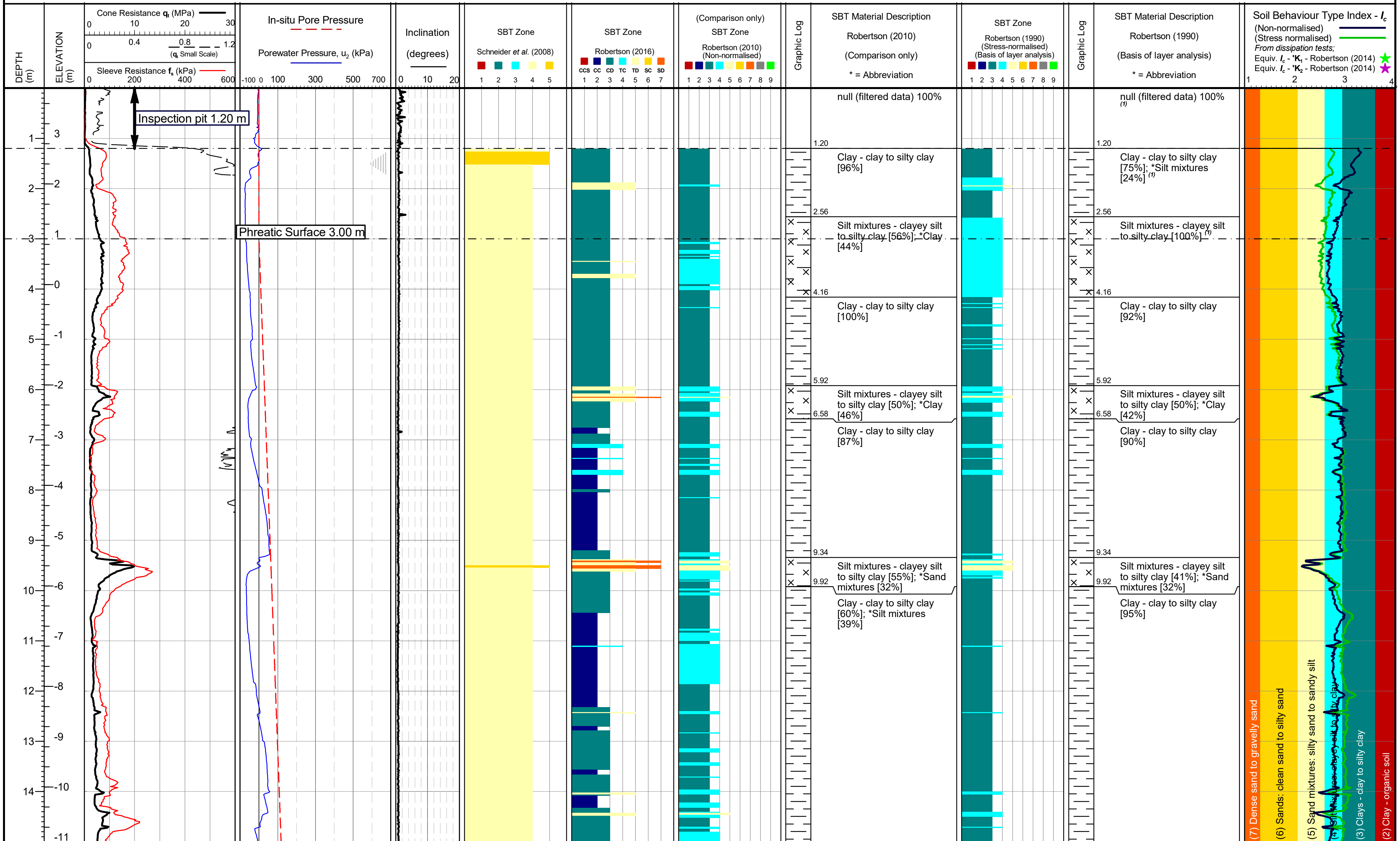
Internal QA Diss.
Dissipation Test

TEST ID: CPT18

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 12:49:35

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516703.892, 416993.845
Elevation: 3.908

Schneider *et al.* (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I, clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

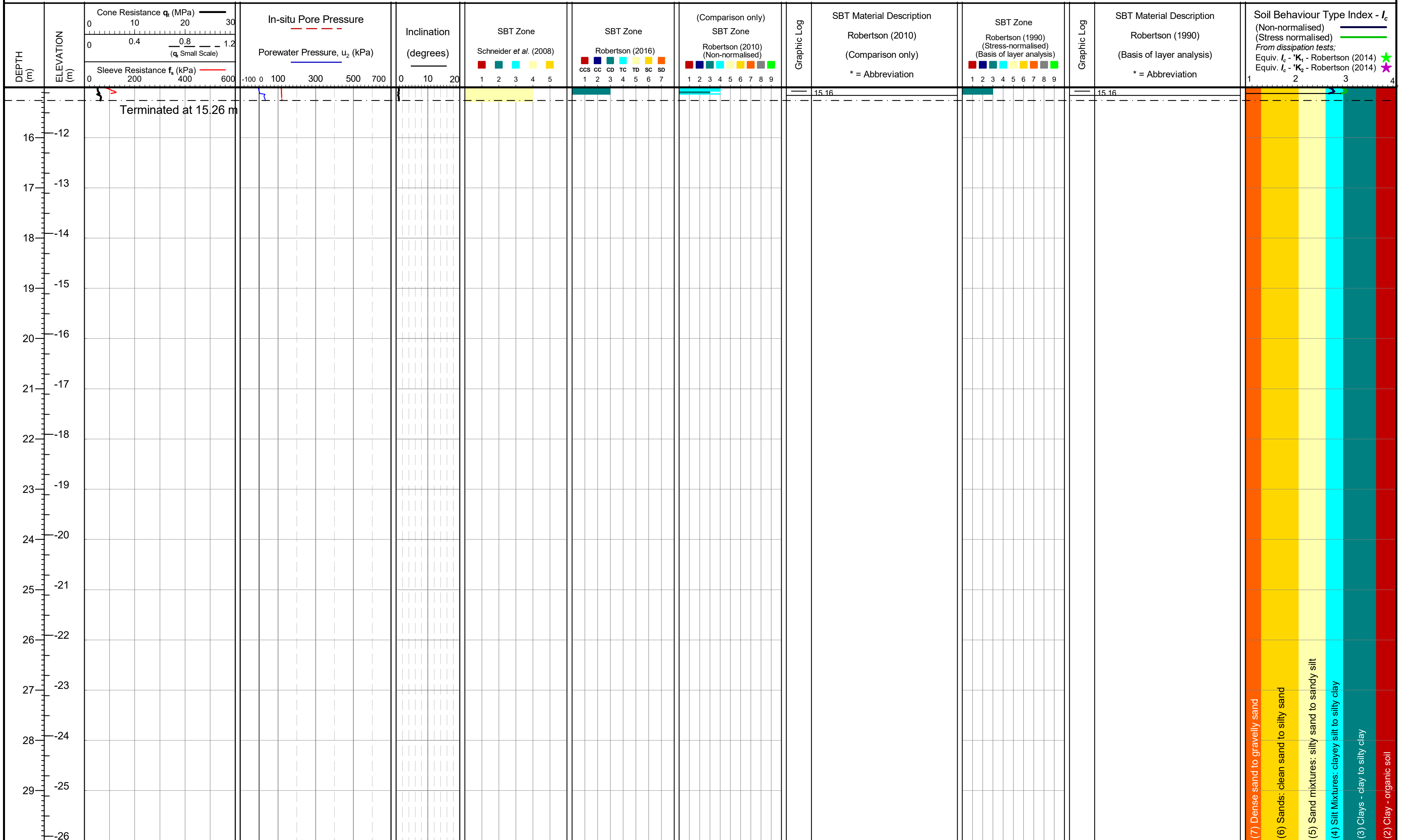
TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 12:49:35

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516703.892, 416993.845
Elevation: 3.908

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I_r clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(!) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

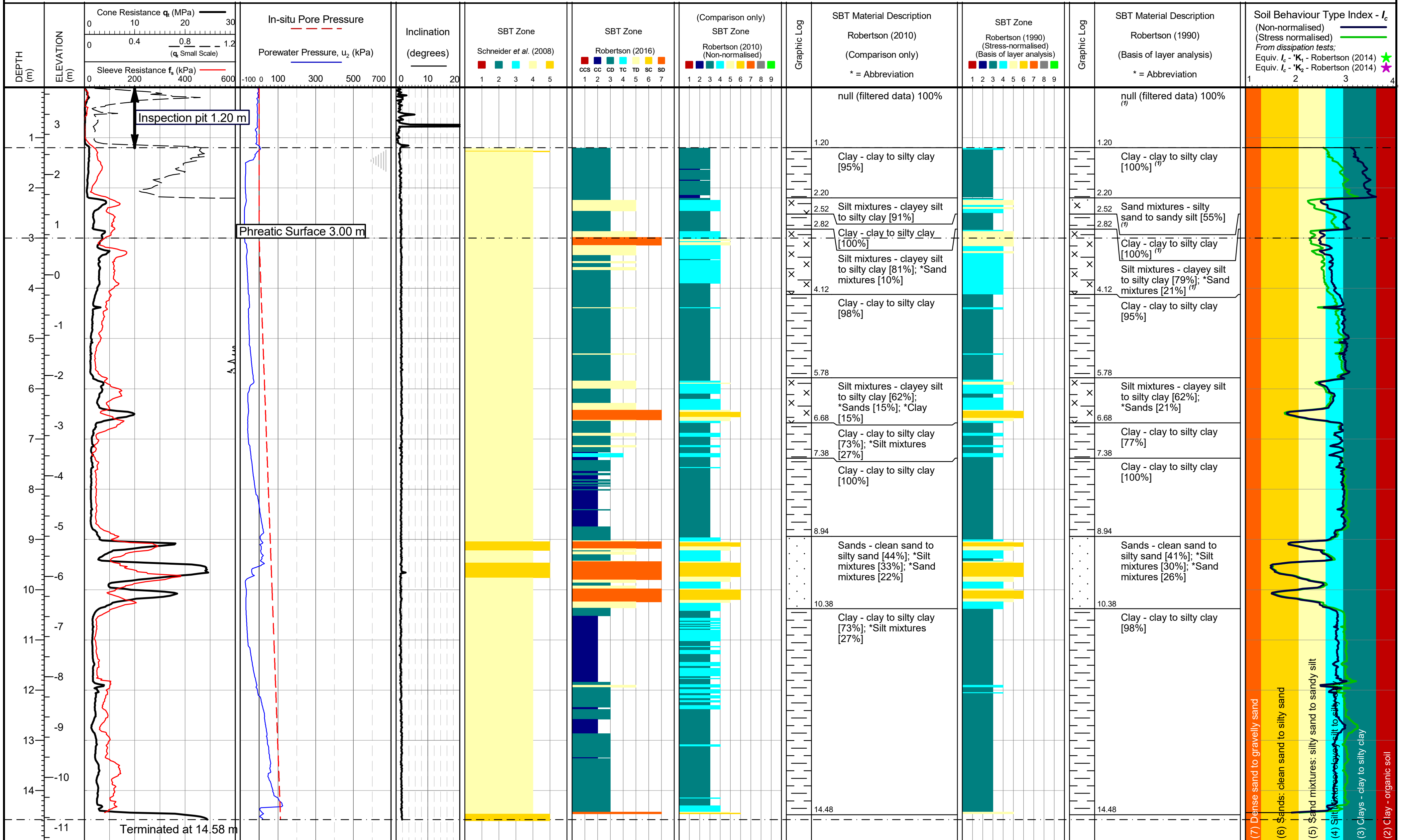
TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

Lankelma Project Ref: P-108071-1



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Location: Lincolnshire, UK
Rig Used: UK15
Date of test: 12/09/2022 13:50:45

Remarks: *Phreatic surface origin: Arbitrary value

Coordinates: 516630.051, 416942.072
Elevation: 3.734

Schneider et al. (2008) Material Type
1 - (1c) Sensitive clays
2 - (1b) Clays
3 - (1a) Silts & low I, clays
4 - (3) Transitional soils
5 - (2) Essentially drained sands

Robertson (2016) Material Type
1 - **CCS** - Clay-like - Contractive - Sensitive
2 - **CC** - Clay-like - Contractive
3 - **CD** - Clay-like - Dilative
4 - **TC** - Transitional - Contractive
5 - **TD** - Transitional - Dilative
6 - **SC** - Sand-like - Contractive
7 - **SD** - Sand-like - Dilative

Robertson (1990 & 2010) Material Type
1 - Sensitive fine-grained
2 - Organic soils
3 - Clays - clay to silty clay
4 - Silt mixtures - clayey silt to silty clay
5 - Sand mixtures - silty sand to sandy silt
6 - Sands - clean sand to silty sand
7 - Gravelly sand to sand
8 - Very stiff/dense sand to clayey sand
9 - Very stiff fine grained

(1) 0-3 m: Normalised SBT often artificially coarse/stiff at very low in-situ stresses

Internal QA Diss.
Dissipation Test

TEST ID: CPT20

Page 1 of 1

APPENDIX E PARAMETER RESULTS 1 – S_U, M_V, OCR, SBT, I_C

Undrained shear strength

Coefficient of volume change

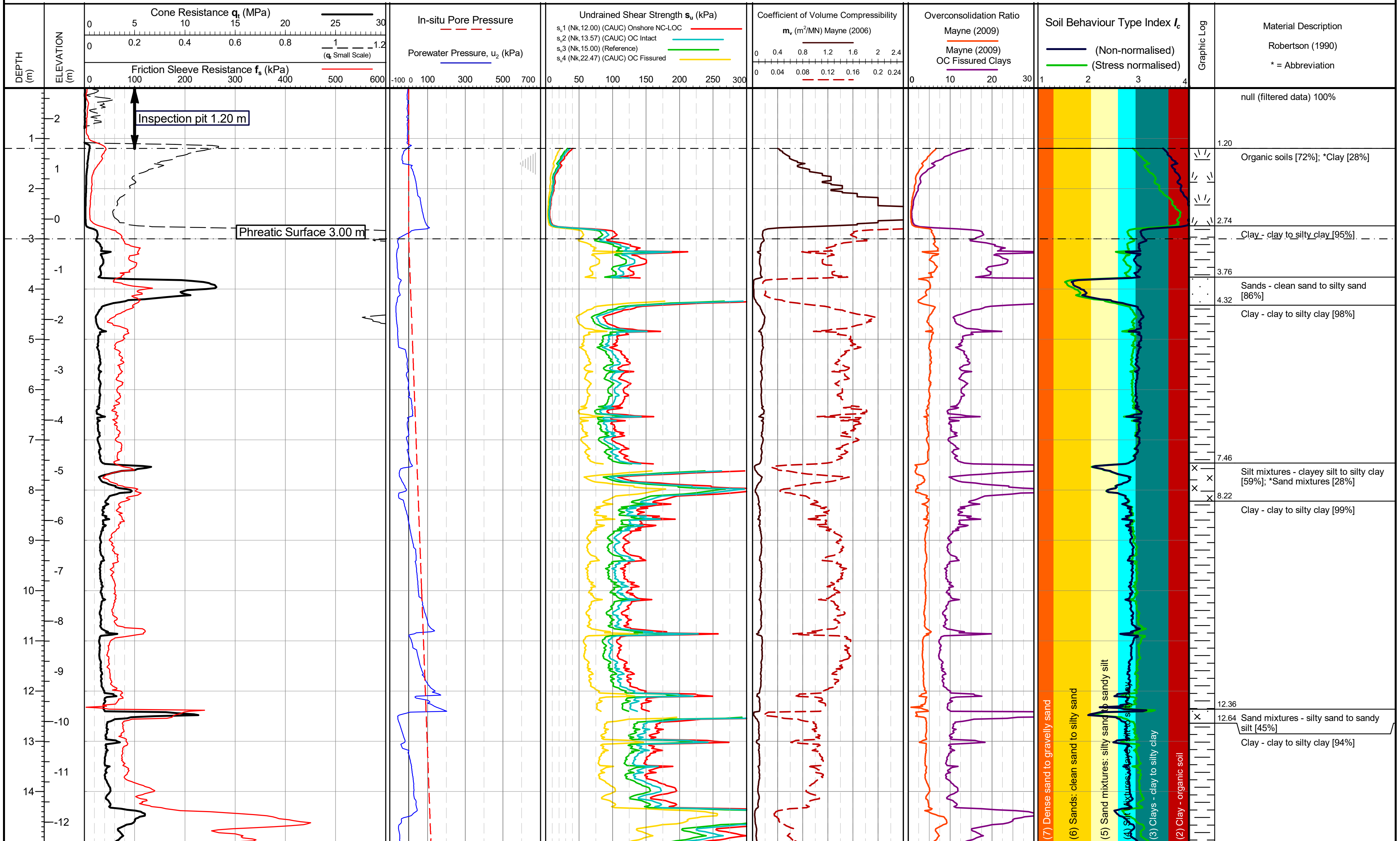
Overconsolidation ratio

Robertson 1990 SBT descriptions & SBT index I_c

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

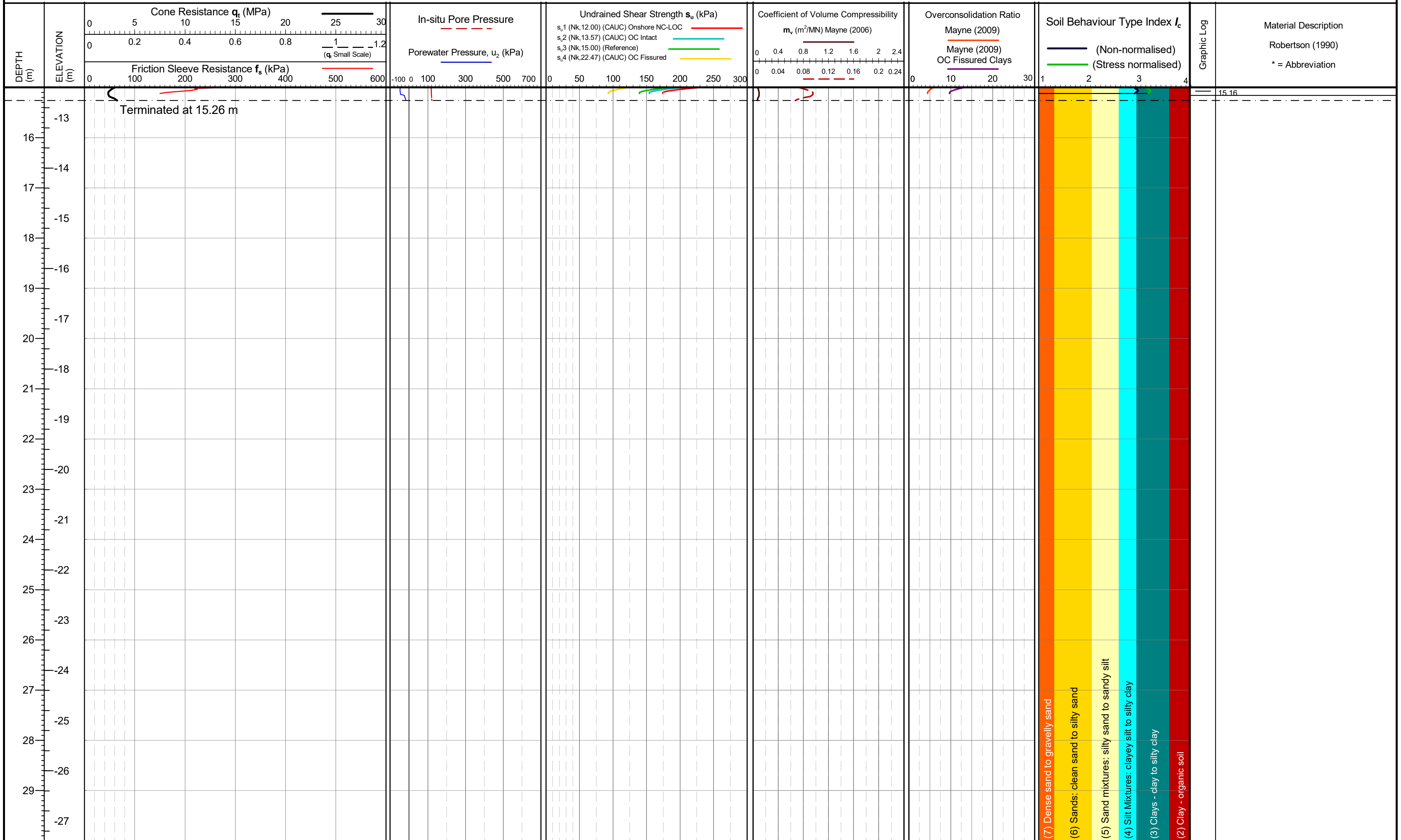


Cone area (mm2): ConeID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 11:24:25	Location: Lincolnshire, UK Coordinates: 517109.955, 417014.039 Elevation: 2.606 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Internal QA Diss. Dissipation Test Penetration Pause (<1cm/s) Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 13/09/2022 11:24:25

Location: Lincolnshire, UK
Coordinates: 517109.955, 417014.039
Elevation: 2.606
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

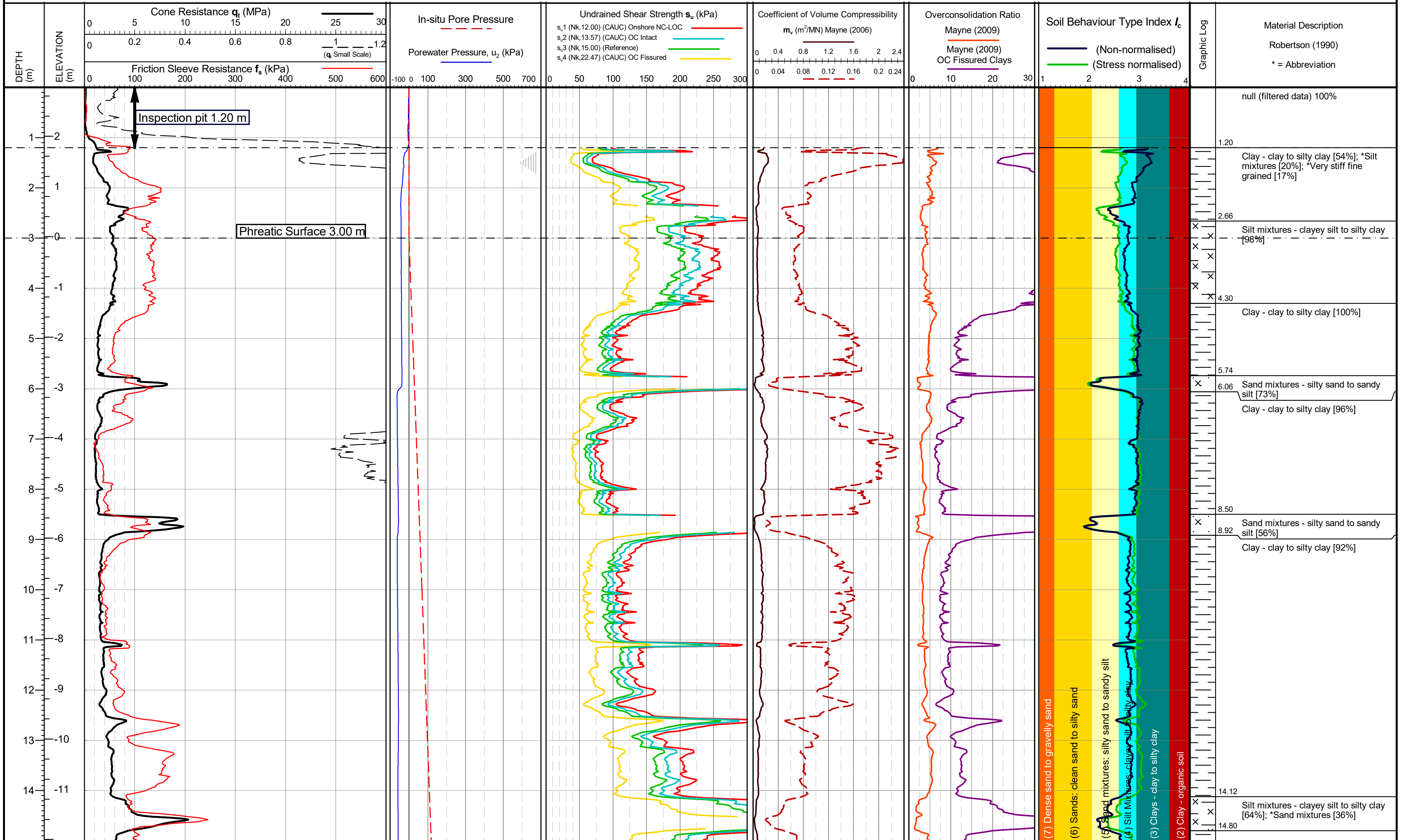
Lankelma Project Ref:
P-108071-1

TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Jamie Butterworth
Rig Used: UK15
Date of test: 12/09/2022 09:12:31

Location: Lincolnshire, UK
Coordinates: 517057.758, 417099.047
Elevation: 2.972
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

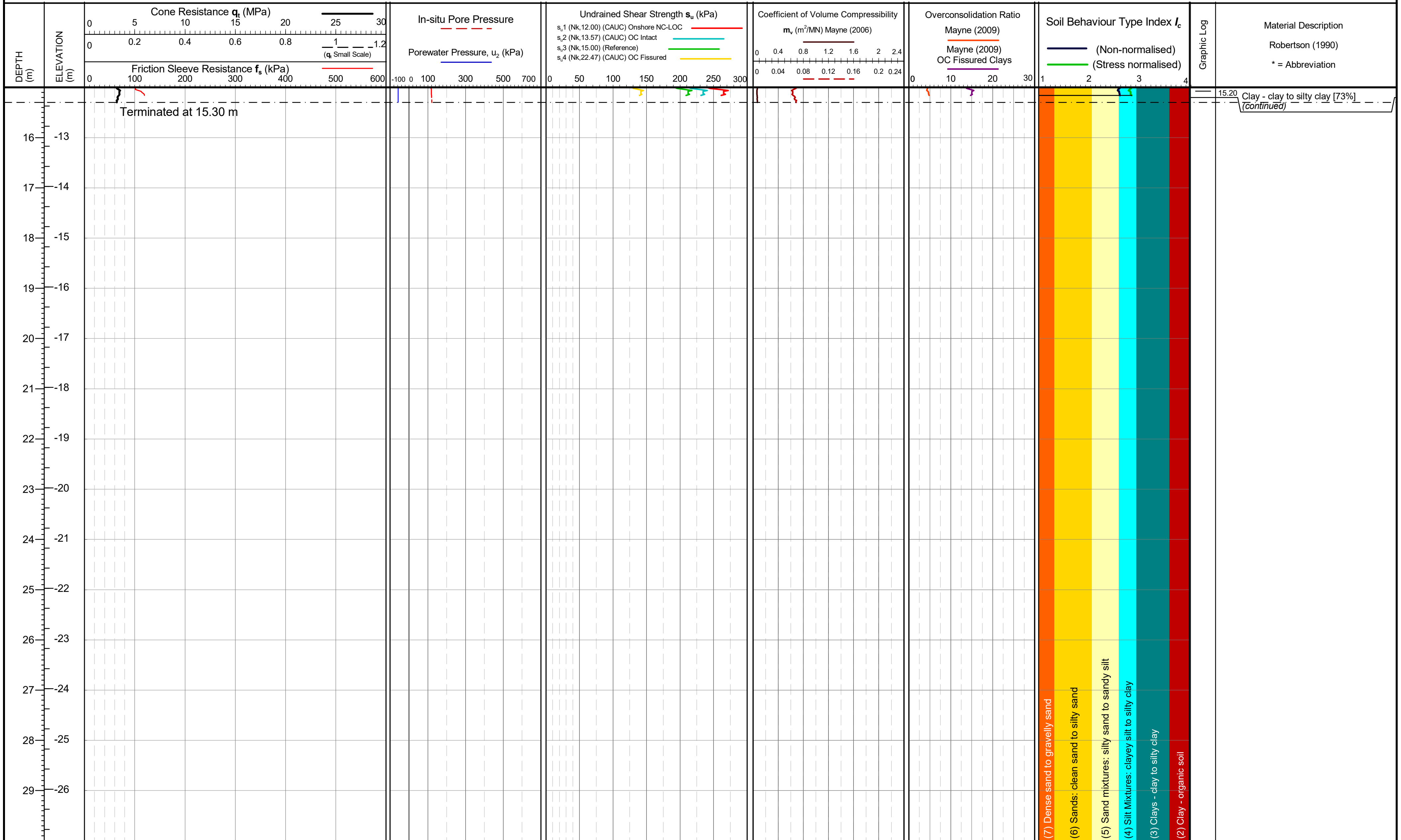
Lankelma Project Ref:
P-108071-1

TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Jamie Butterworth
Rig Used: UK15
Date of test: 12/09/2022 09:12:31

Location: Lincolnshire, UK
Coordinates: 517057.758, 417099.047
Elevation: 2.972
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

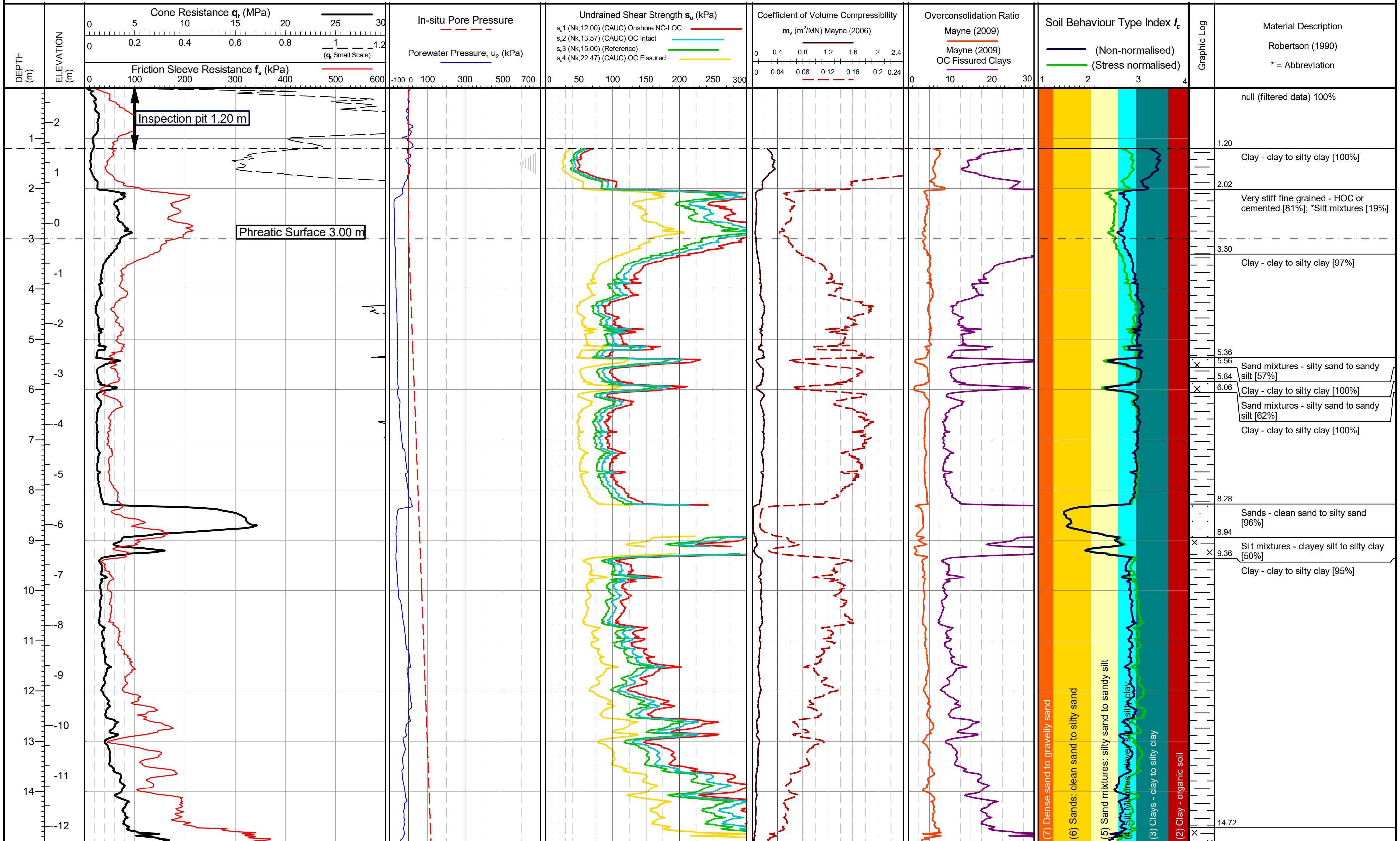
Lankelma Project Ref:
P-108071-1

TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 13/09/2022 10:26:25

Location: Lincolnshire, UK
Coordinates: 516972.019, 417047.79
Elevation: 2.686
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

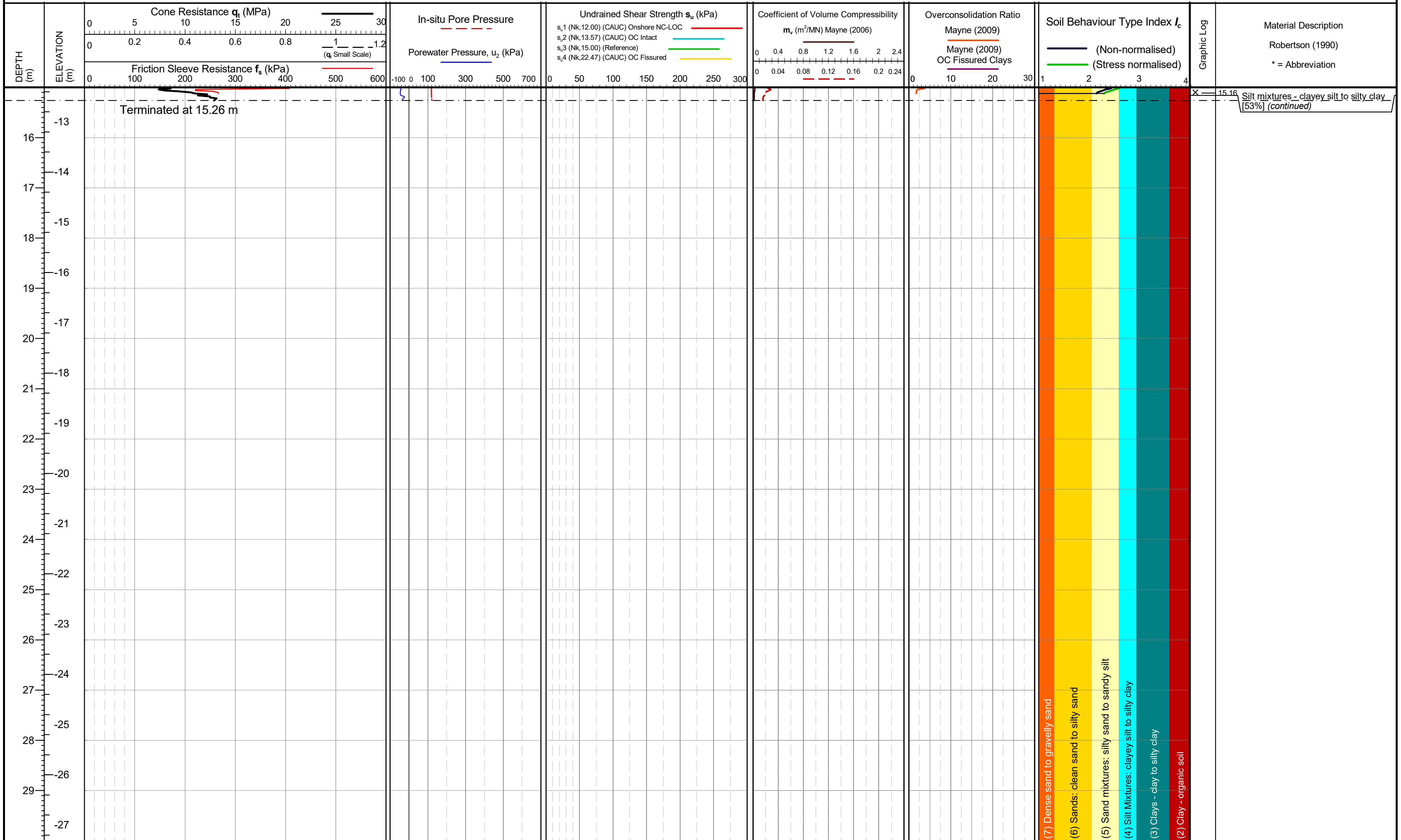
Lankelma Project Ref:
P-108071-1

TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 13/09/2022 10:26:25

Location: Lincolnshire, UK
Coordinates: 516972.019, 417047.79
Elevation: 2.686
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

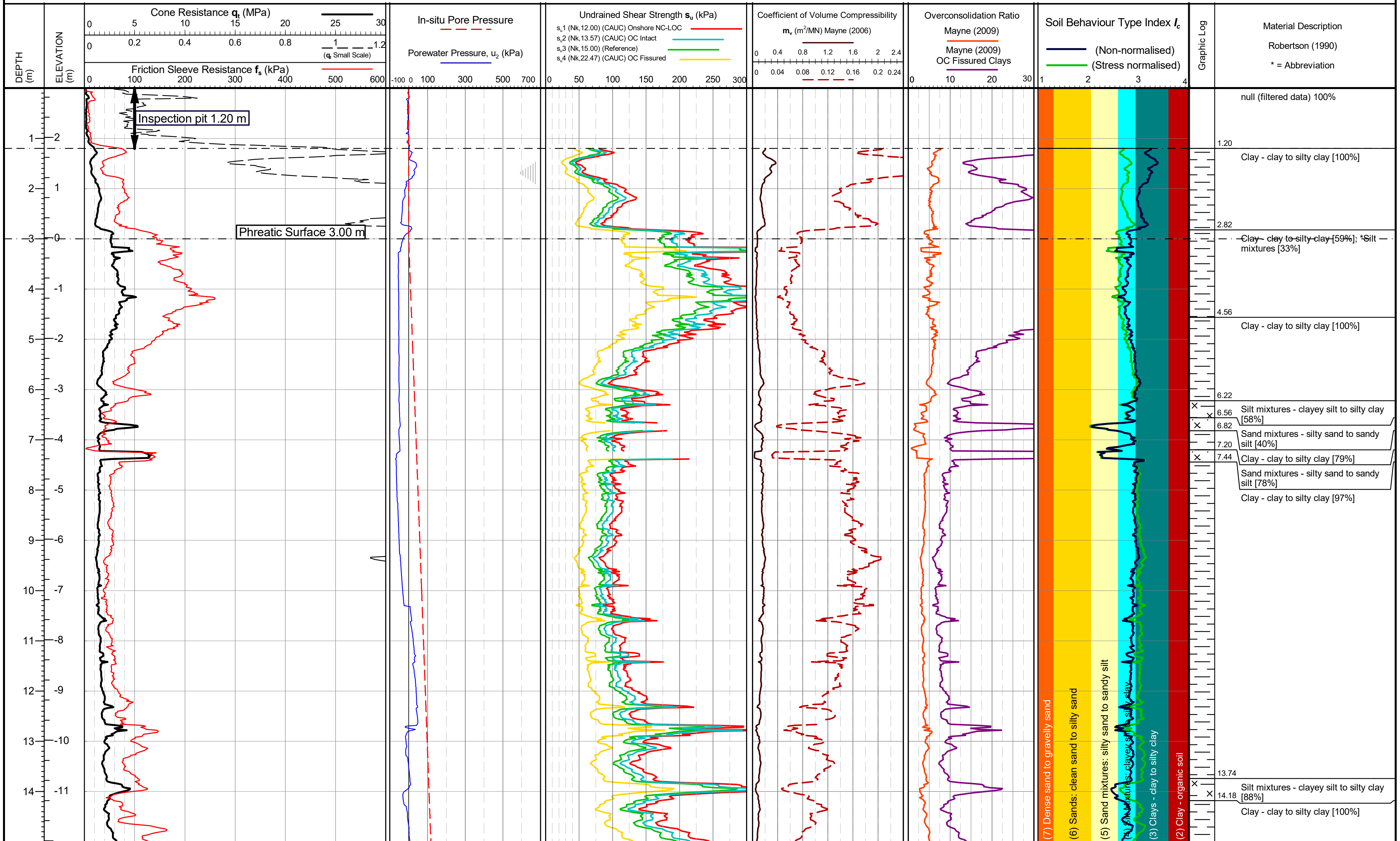
Lankelma Project Ref:
P-108071-1

TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

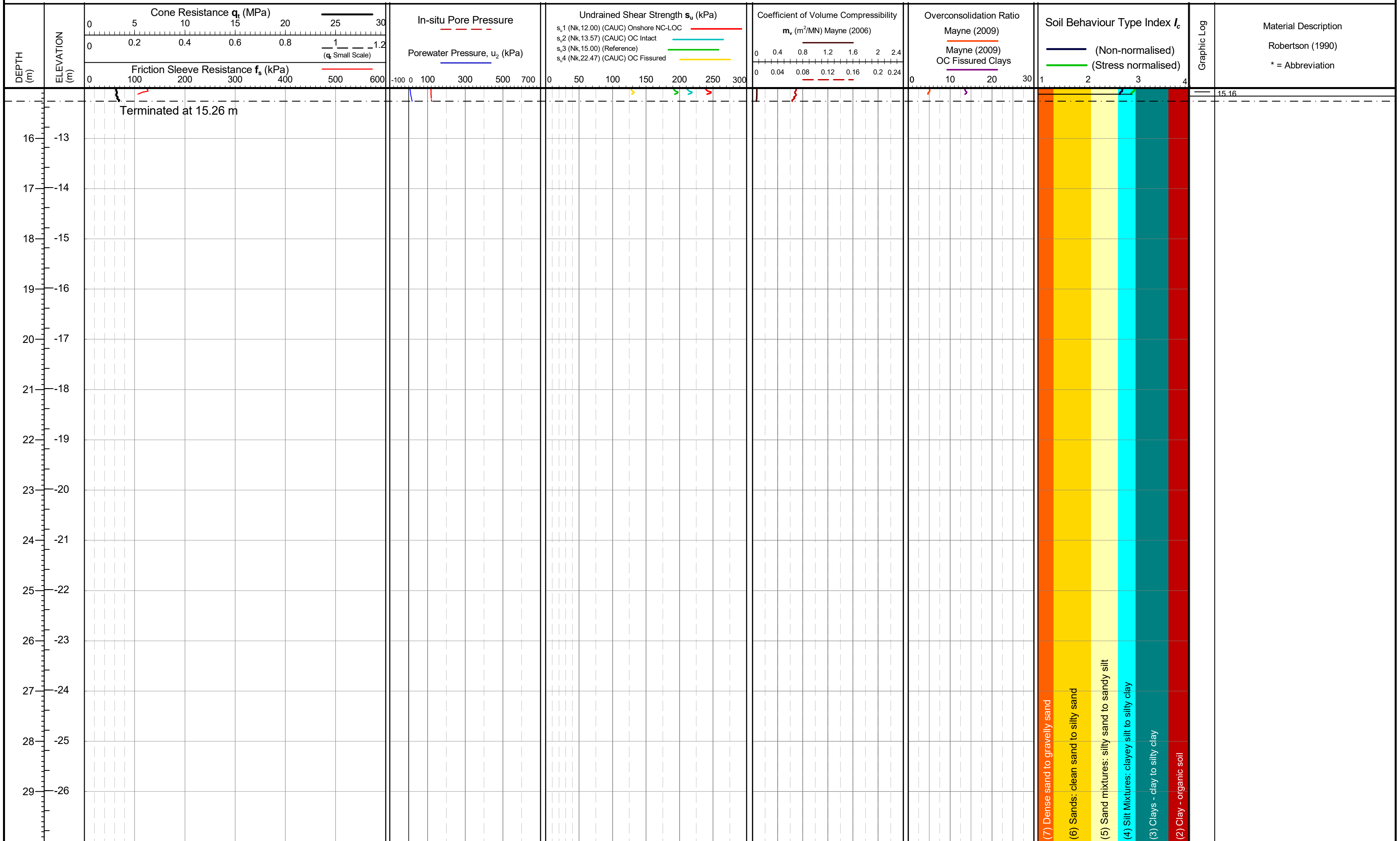


Cone area (mm2): ConeID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 09:30:06	Location: Lincolnshire, UK Coordinates: 516887.009, 416995.047 Elevation: 2.979 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Internal QA Diss. Dissipation Test Penetration Pause (<1cm/s) Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT11

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 13/09/2022 09:30:06

Location: Lincolnshire, UK
Coordinates: 516887.009, 416995.047
Elevation: 2.979
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

Checked by: Chris Player

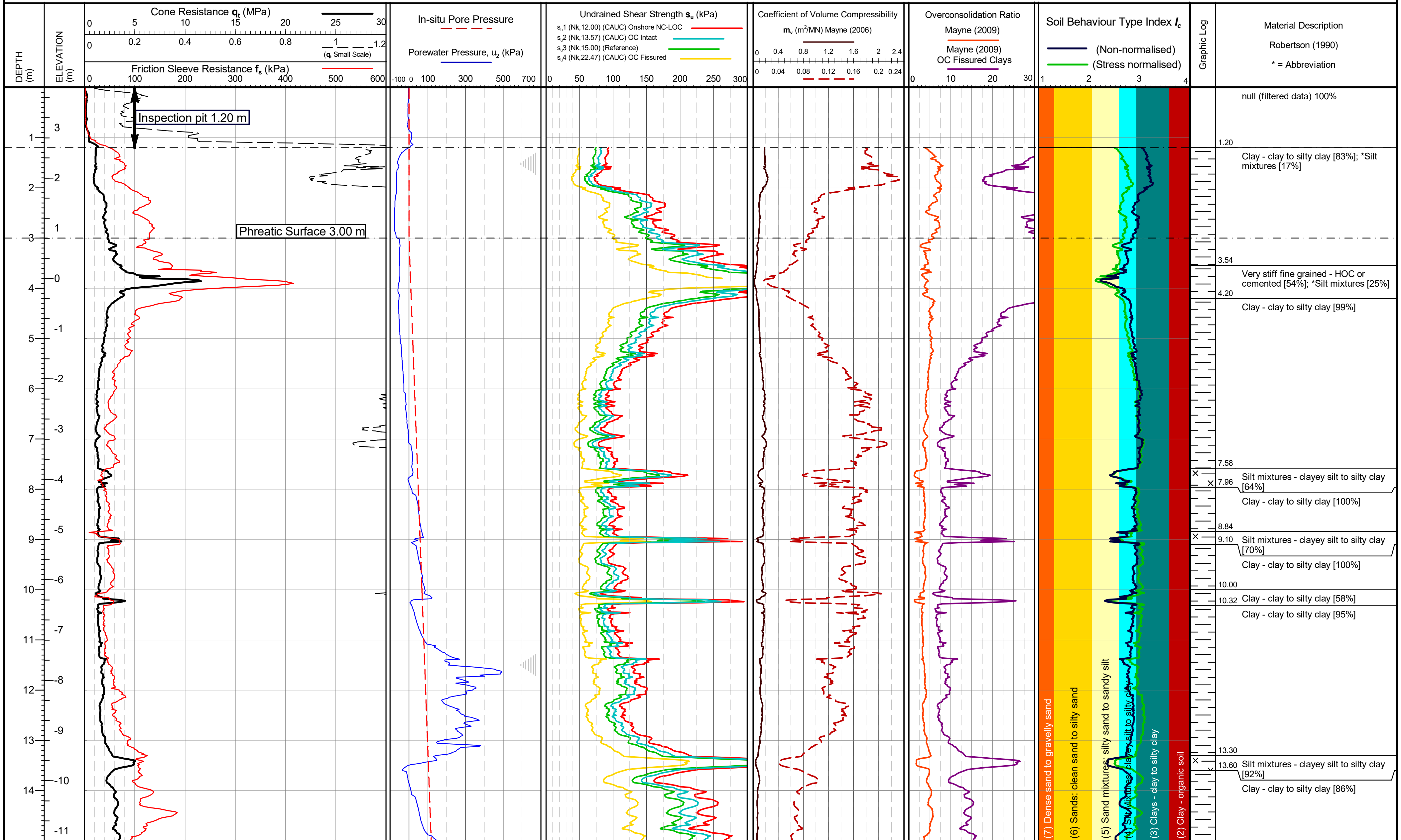
Lankelma Project Ref: P-108071-1

TEST ID: CPT11

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

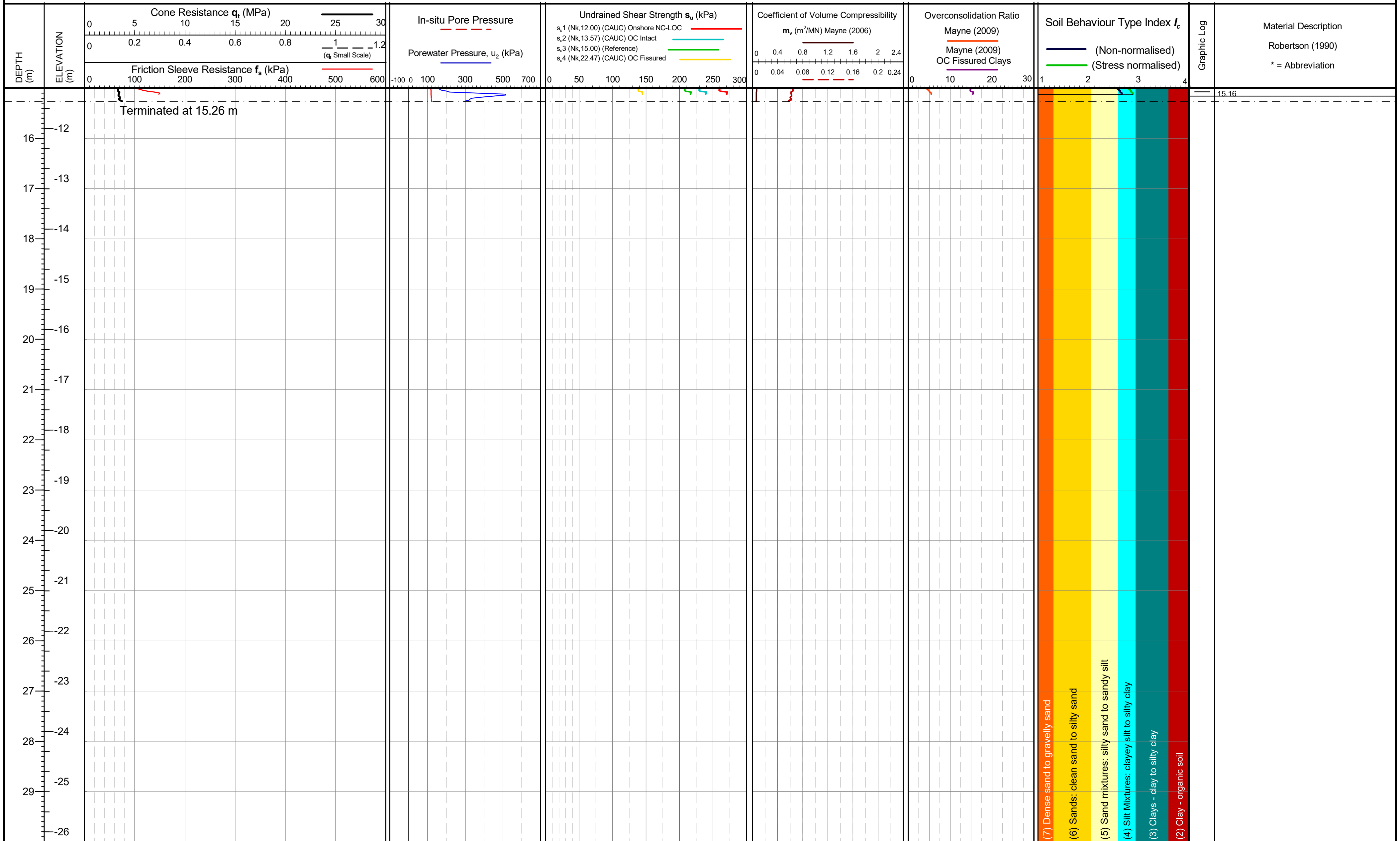
Client: GEOTECHNICS



Cone area (mm2): ConeID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 10:25:48	Location: Lincolnshire, UK Coordinates: 516904.912, 417064.974 Elevation: 3.804 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Internal QA Diss. Dissipation Test Penetration Pause (<1cm/s) Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT14

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 10:25:48

Location: Lincolnshire, UK
Coordinates: 516904.912, 417064.974
Elevation: 3.804
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

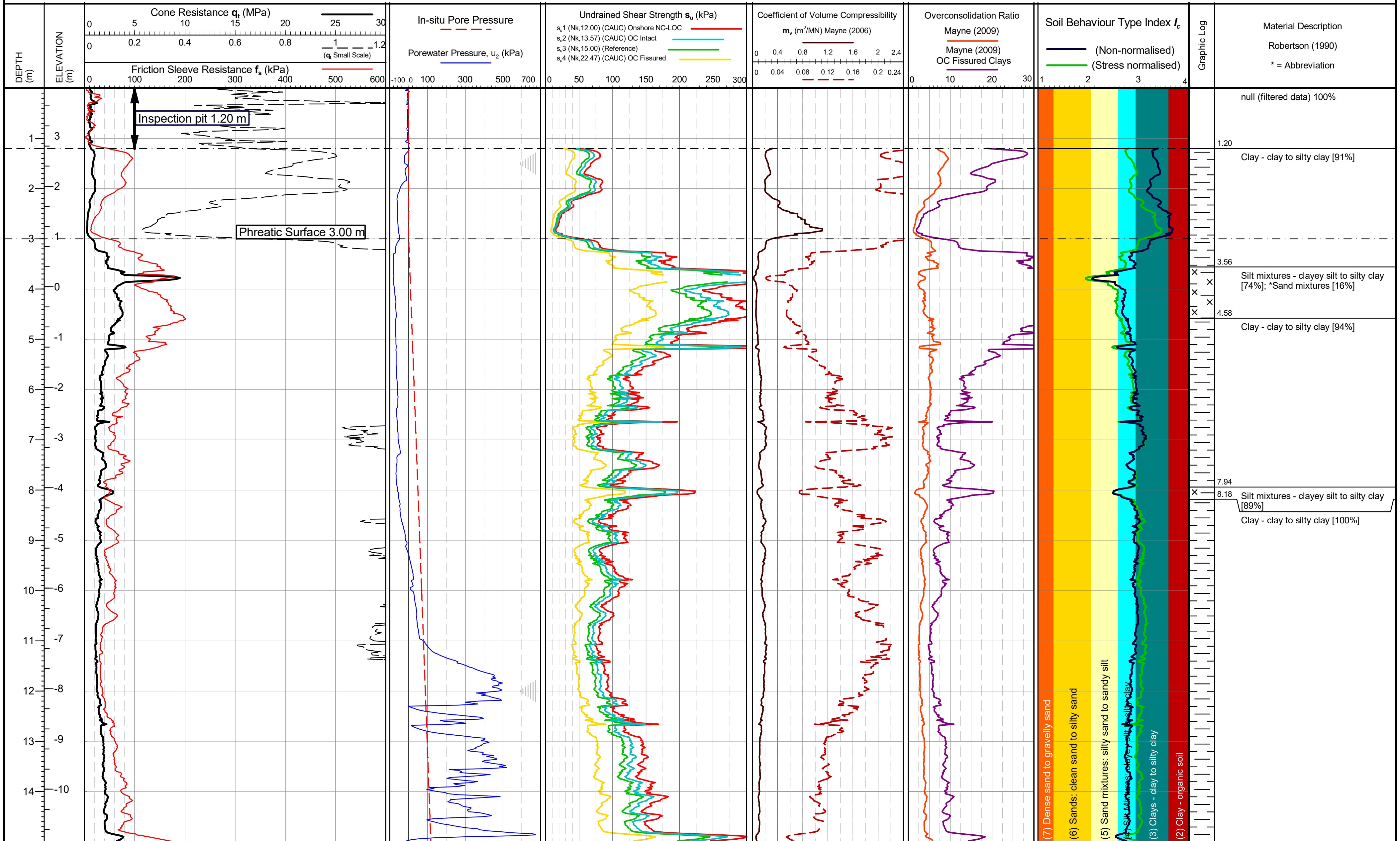
Lankelma Project Ref:
P-108071-1

TEST ID: CPT14

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Jamie Butterworth
Rig Used: UK15
Date of test: 12/09/2022 15:51:04

Location: Lincolnshire, UK
Coordinates: 516774.966, 416987.078
Elevation: 3.953
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

Checked by: Chris Player

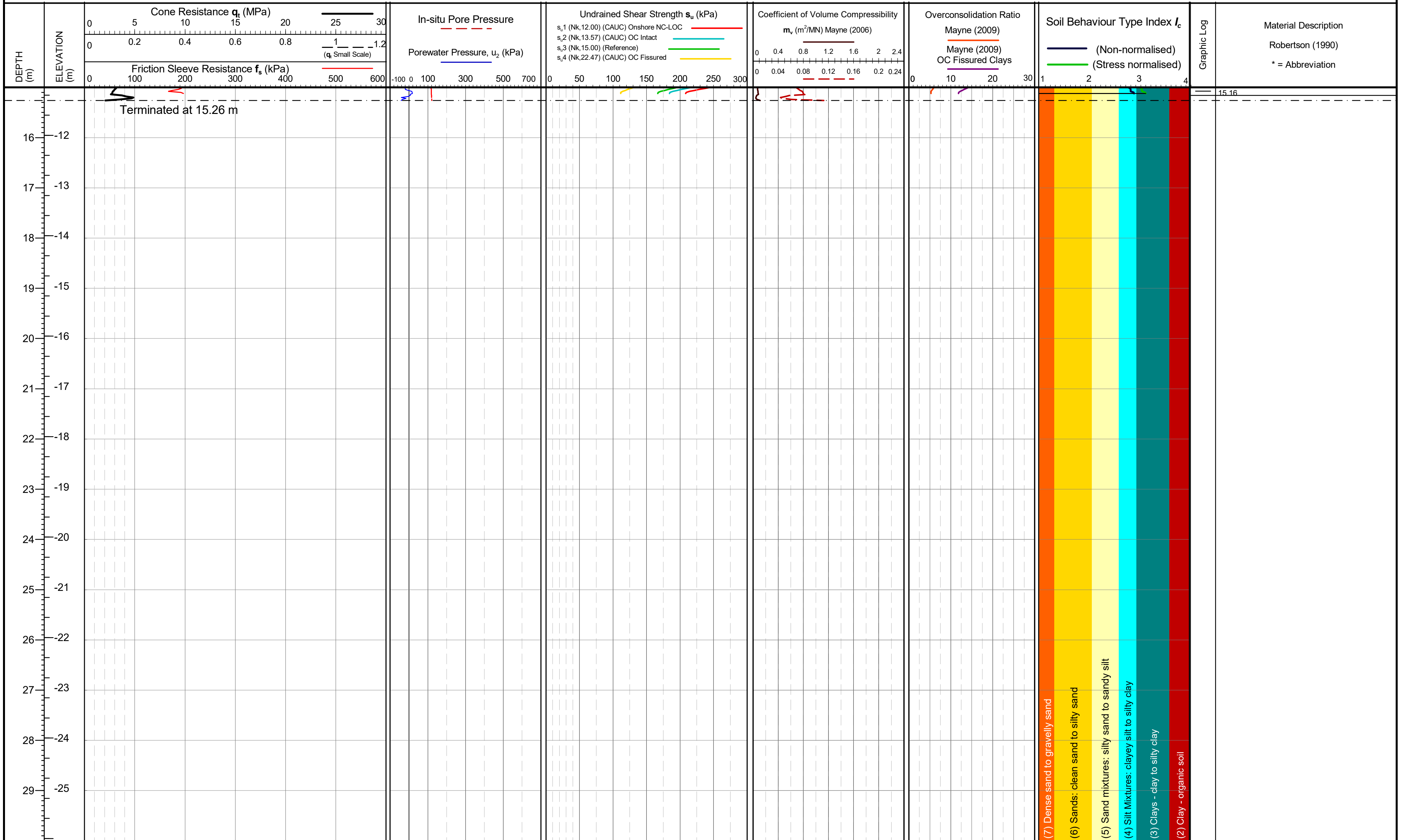
Lankelma Project Ref: P-108071-1

TEST ID: CPT15

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



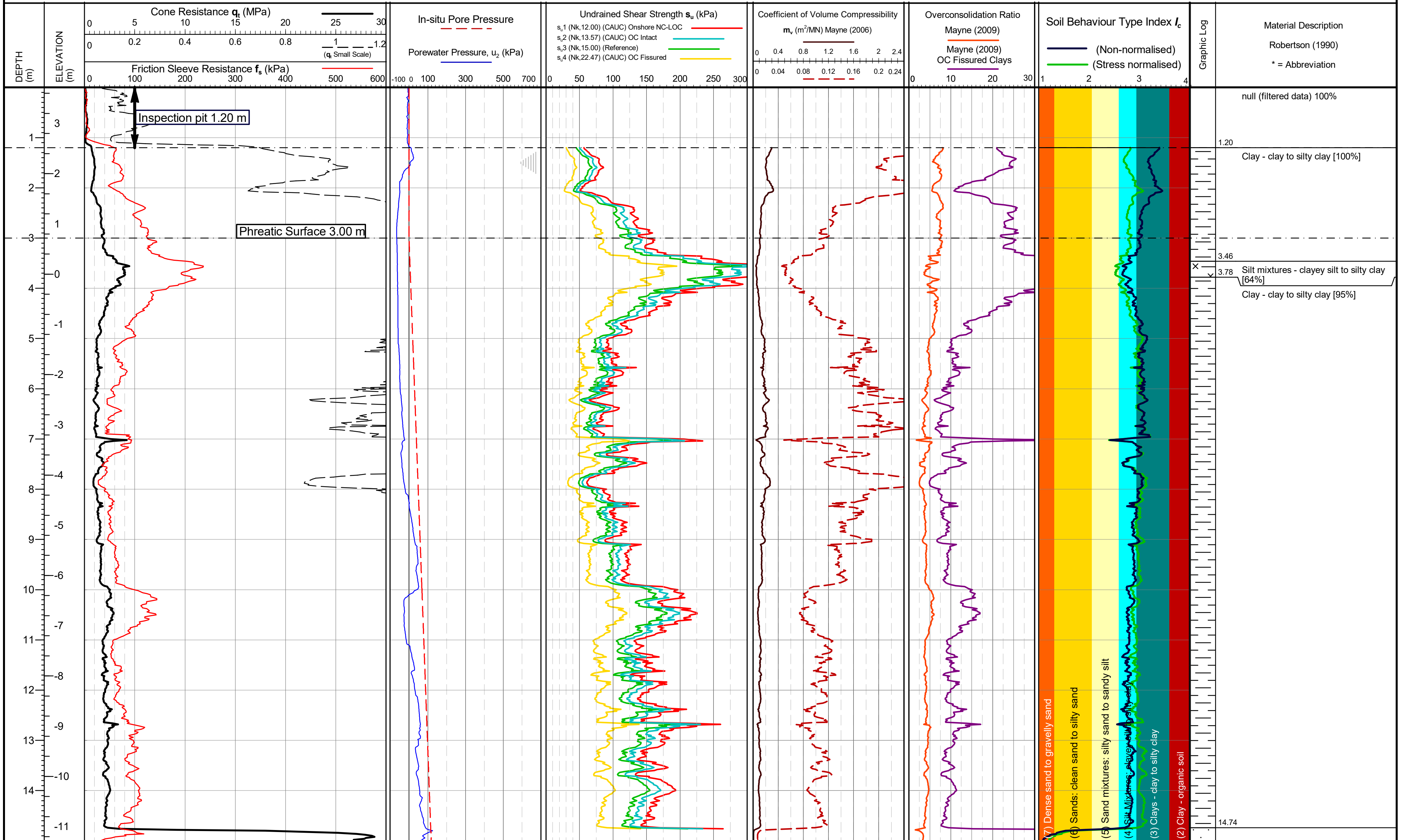
Cone area (mm2): ConeID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 15:51:04	Location: Lincolnshire, UK Coordinates: 516774.966, 416987.078 Elevation: 3.953 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Internal QA Diss. Dissipation Test Penetration Pause (<1cm/s) Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player
				Lankelma Project Ref: P-108071-1

TEST ID: CPT15

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 14:52:09

Location: Lincolnshire, UK
Coordinates: 516646.925, 416909.913
Elevation: 3.718
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

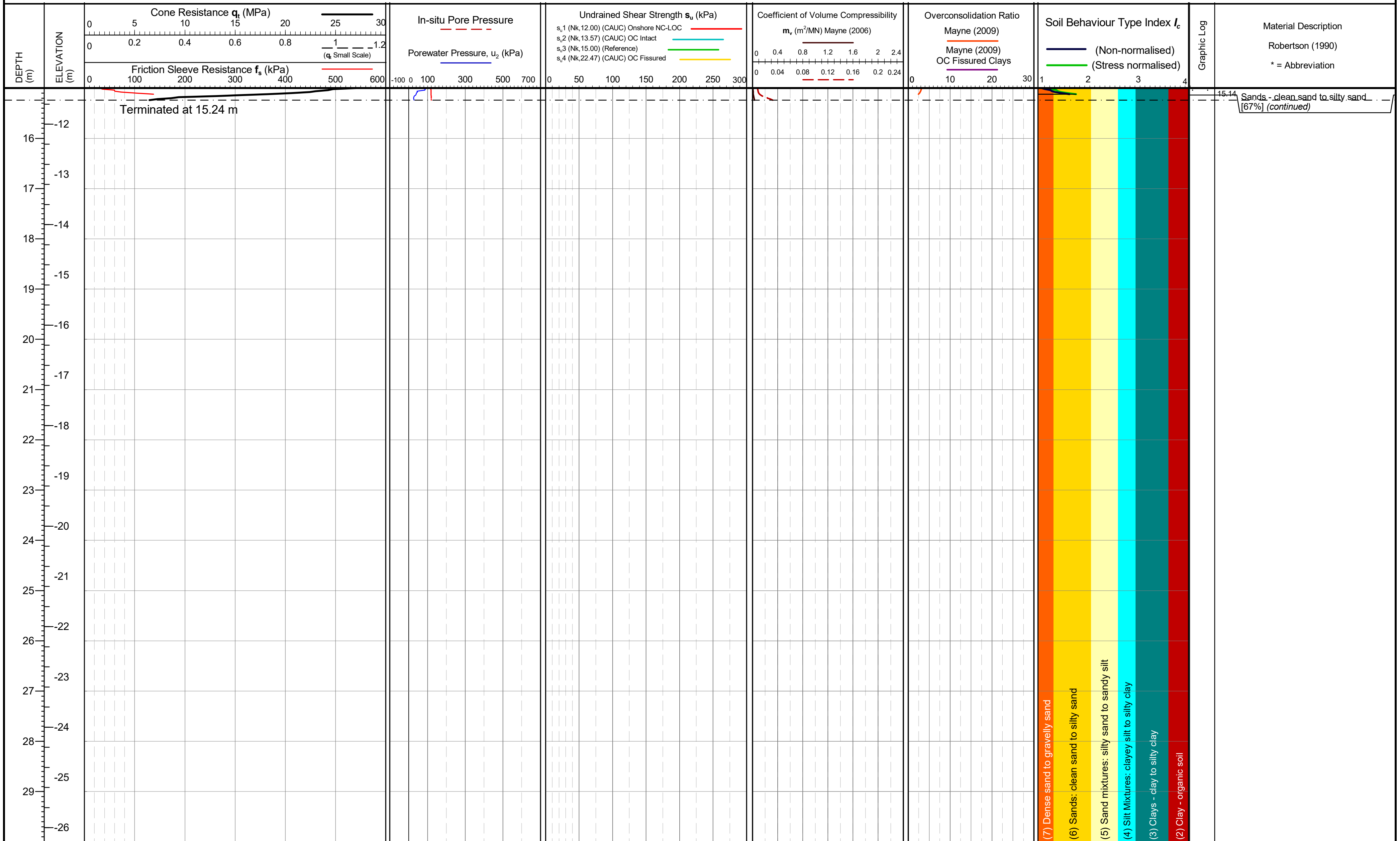
Checked by:
Chris Player

Lankelma Project Ref:
P-108071-1

TEST ID: CPT16

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 14:52:09

Location: Lincolnshire, UK
Coordinates: 516646.925, 416909.913
Elevation: 3.718
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

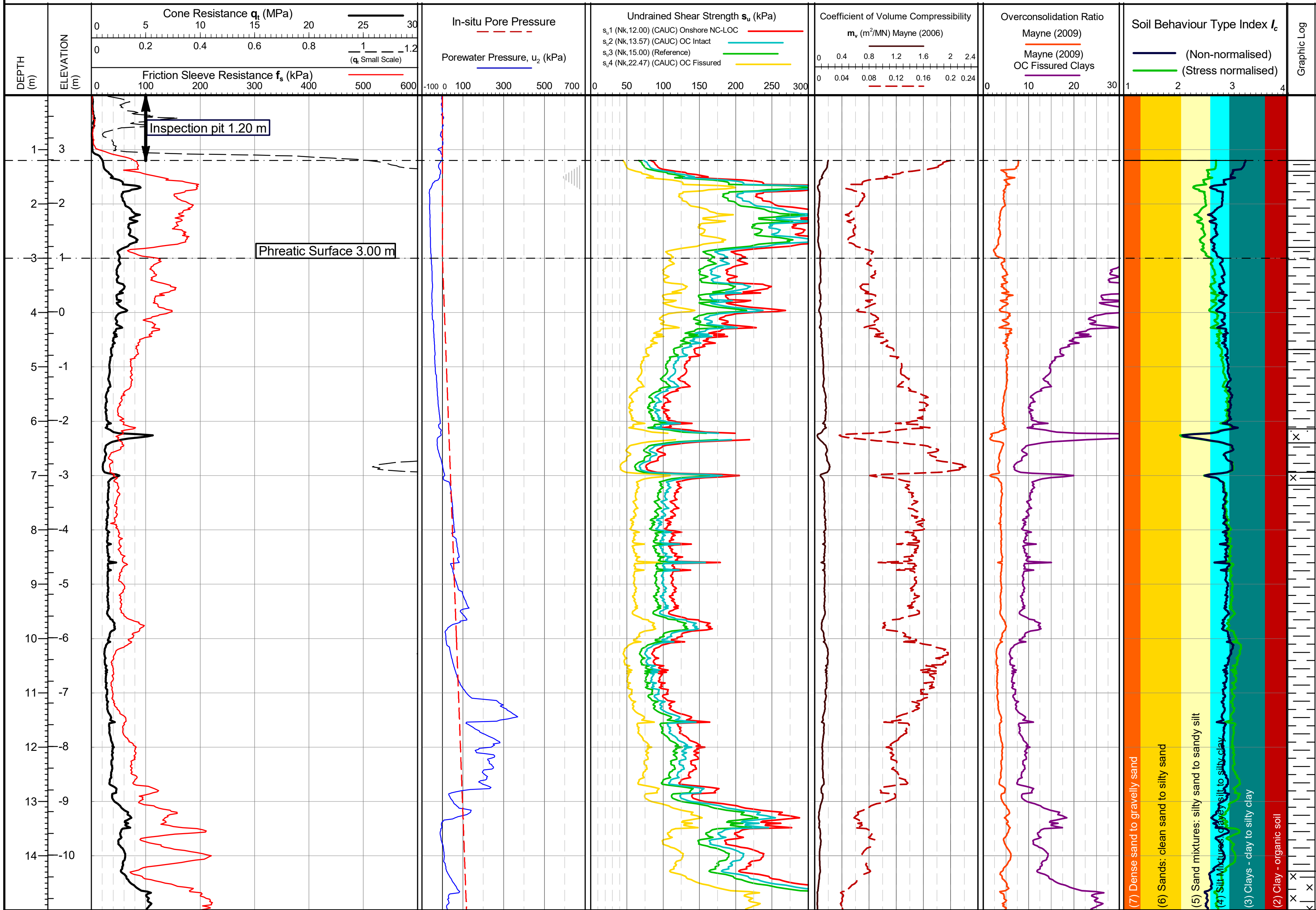
Checked by:
Chris Player

Lankelma Project Ref:
P-108071-1

TEST ID: CPT16

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Depth (m)	Material Description Robertson (1990) * = Abbreviation
	null (filtered data) 100%
1.20 – 1.40	Clay - clay to silty clay [100%]
	Very stiff fine grained - HOC or cemented [92%]
2.80	Clay - clay to silty clay [51%]; *Silt mixtures [49%]
4.68	Clay - clay to silty clay [100%]
6.14 – 6.40	Sand mixtures - silty sand to sandy silt [40%]; *Silt mixtures [40%]
6.94	Clay - clay to silty clay [100%]
7.18	Silt mixtures - clayey silt to silty clay [67%]
	Clay - clay to silty clay [99%]
14.28	Silt mixtures - clayey silt to silty clay [73%]; *Clay [27%]

Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 11:43:23

Location: Lincolnshire, UK
Coordinates: 516797.98, 417045.885
Elevation: 3.986
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

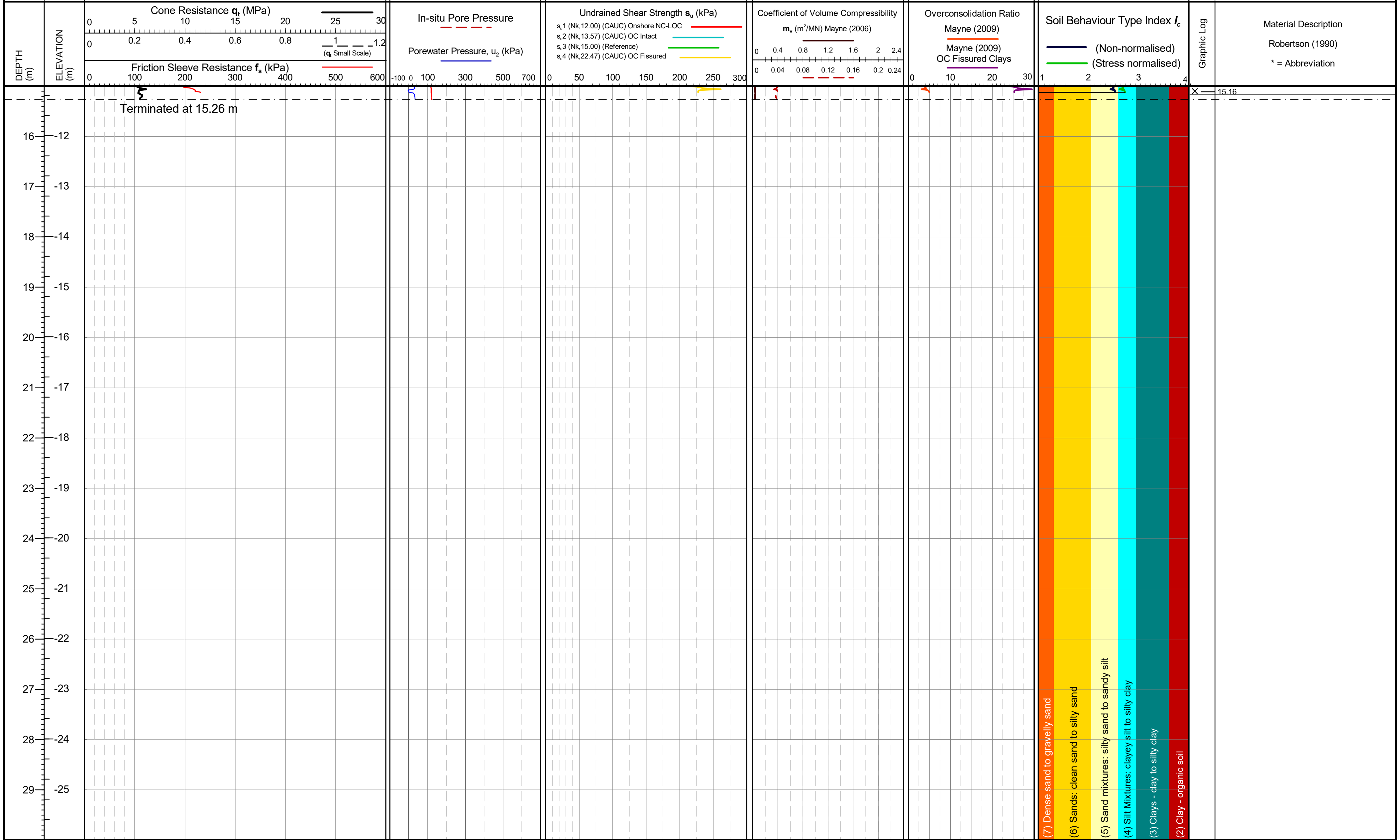
Lankelma Project Ref:
P-108071-1

TEST ID: CPT18

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 11:43:23

Location: Lincolnshire, UK
Coordinates: 516797.98, 417045.885
Elevation: 3.986
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

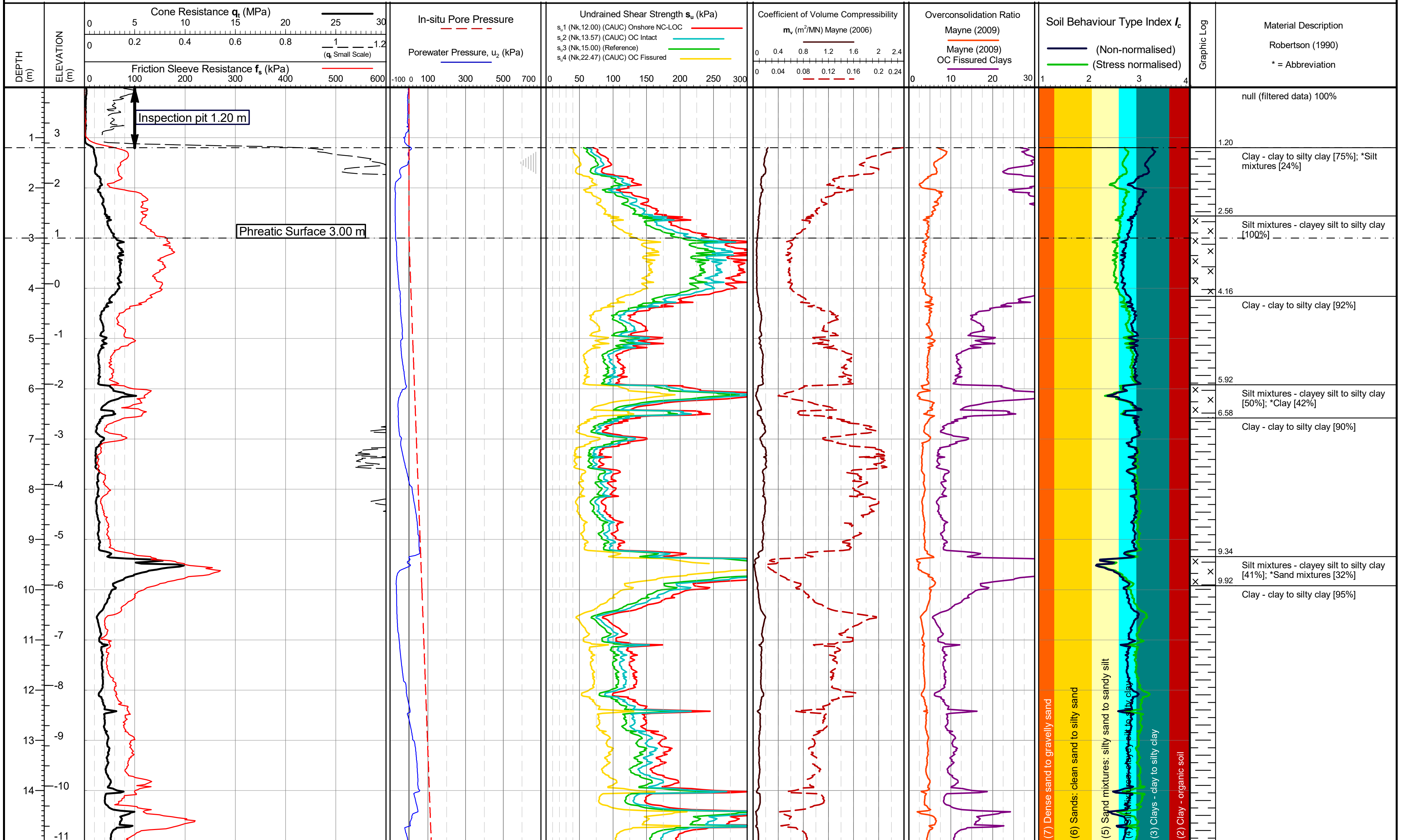
Checked by:
Chris Player

Lankelma Project Ref:
P-108071-1

TEST ID: CPT18

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 12:49:35

Location: Lincolnshire, UK
Coordinates: 516703.892, 416993.845
Elevation: 3.908
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

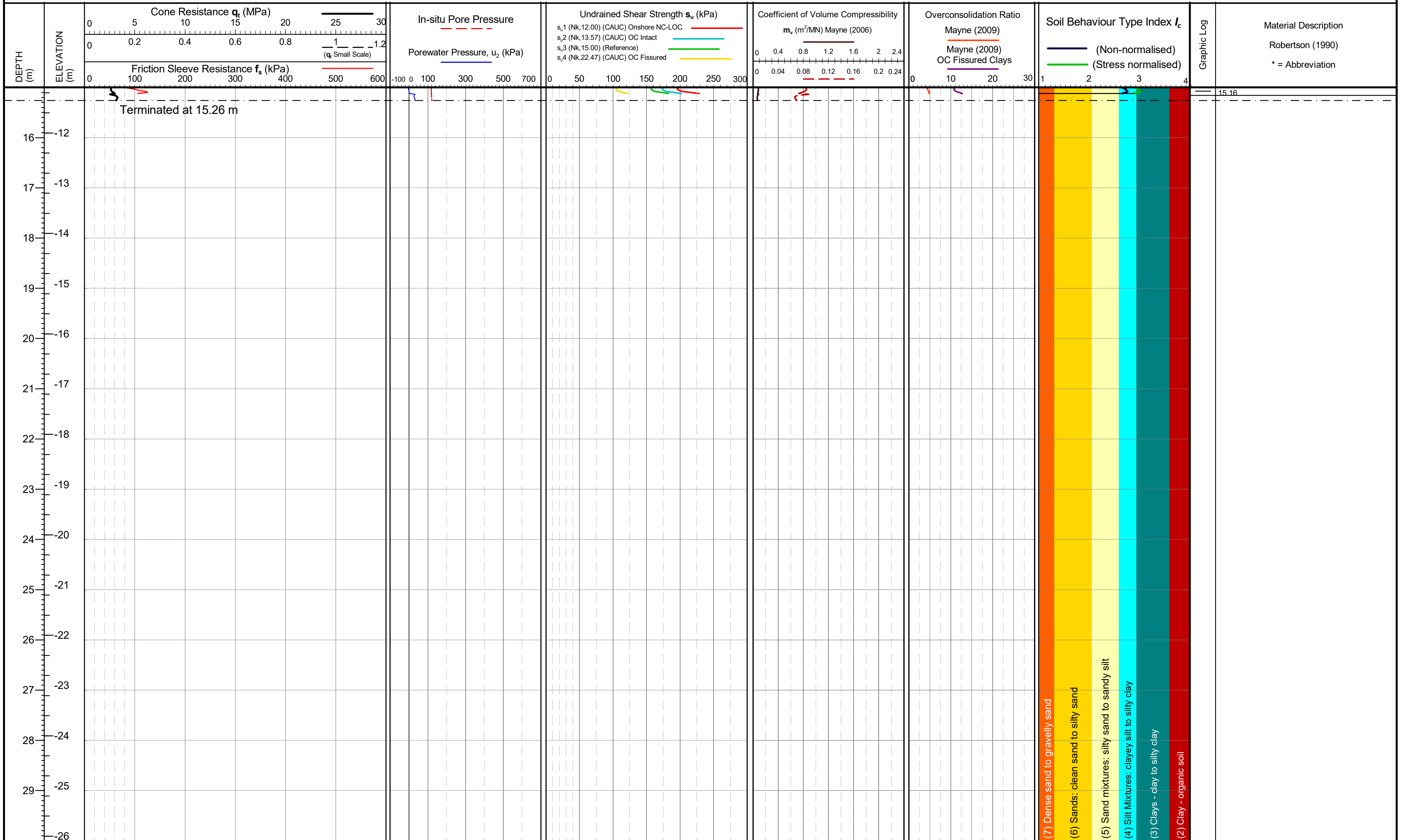
Lankelma Project Ref:
P-108071-1

TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 12:49:35

Location: Lincolnshire, UK
Coordinates: 516703.892, 416993.845
Elevation: 3.908
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Target depth

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

Checked by: Chris Player

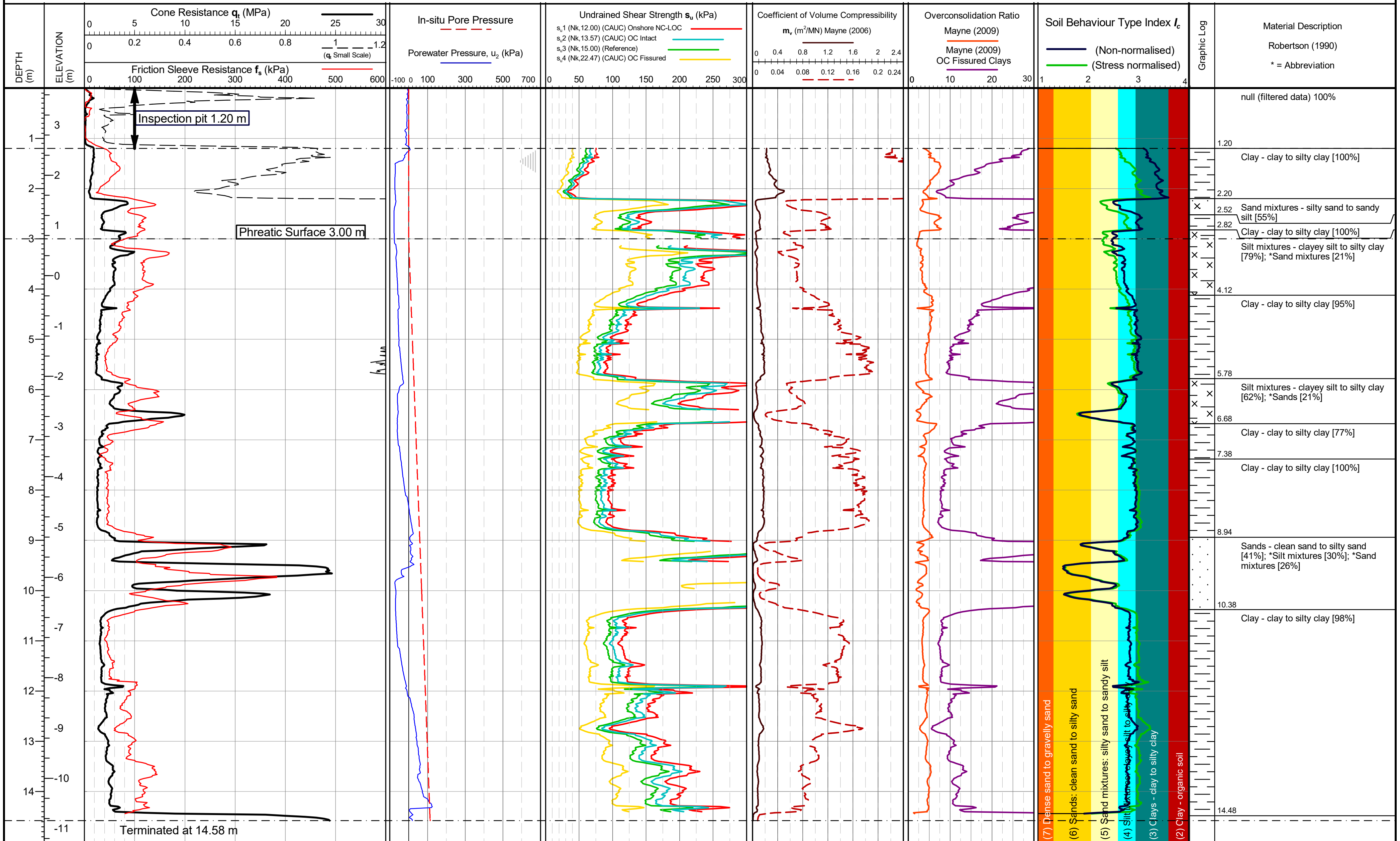
Lankelma Project Ref: P-108071-1

TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
ConeID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 13:50:45

Location: Lincolnshire, UK
Coordinates: 516630.051, 416942.072
Elevation: 3.734
Coordinate system:

Remarks: *Phreatic surface origin: Arbitrary value

Termination Remark:
Lateral support at surface

Internal QA Diss.
Dissipation Test
Penetration Pause (<1cm/s)

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot:
31-10-22

Checked by:
Chris Player

Lankelma Project Ref:
P-108071-1

TEST ID: CPT20

APPENDIX F PARAMETER RESULTS 2 – SPT N60, PHI, D_R, E, I_C

Equivalent SPT N60

Peak friction angle

Relative density

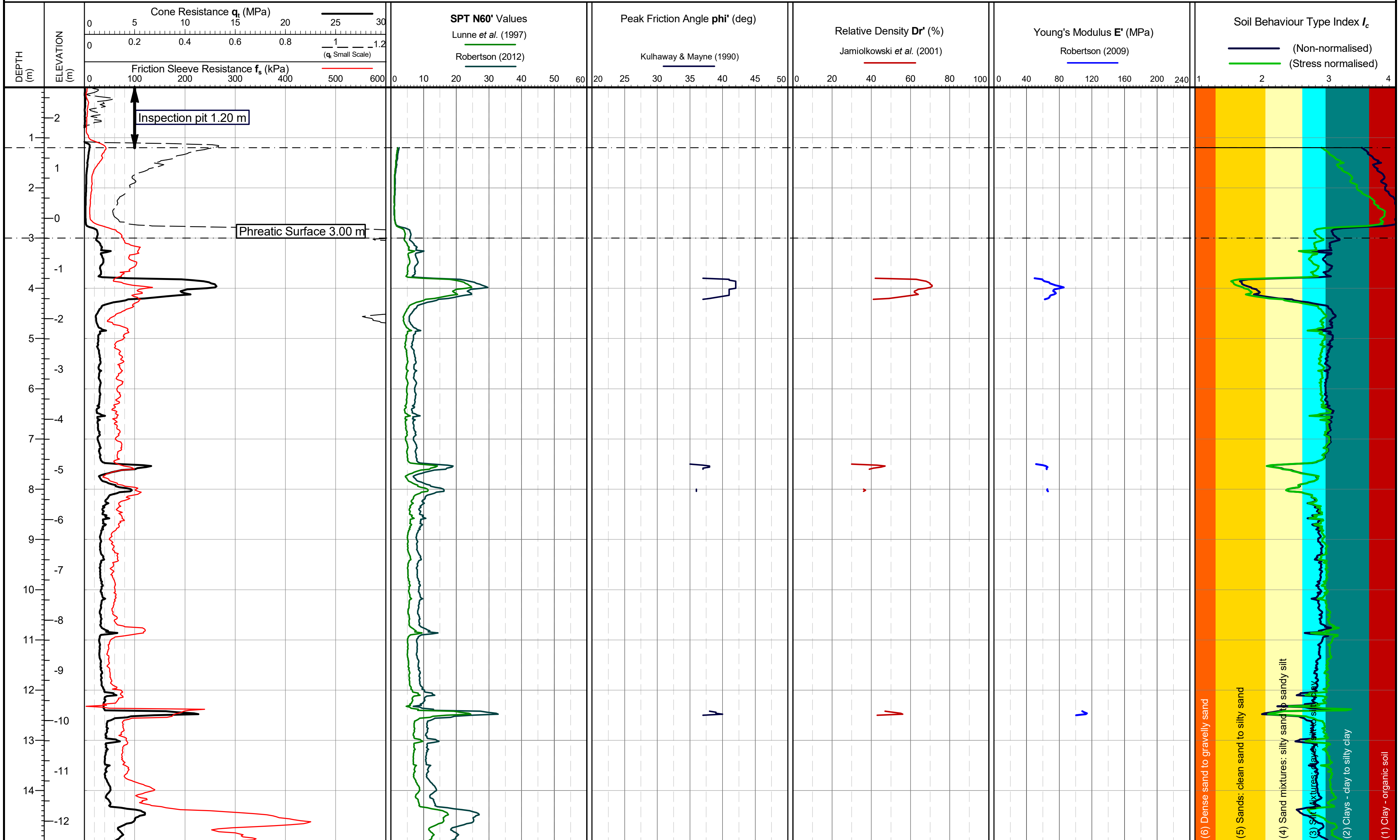
Young's modulus

SBT index I_c

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 13/09/2022 11:24:25

Location: Lincolnshire, UK
Coordinates: 517109.955, 417014.039
Elevation: 2.606
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

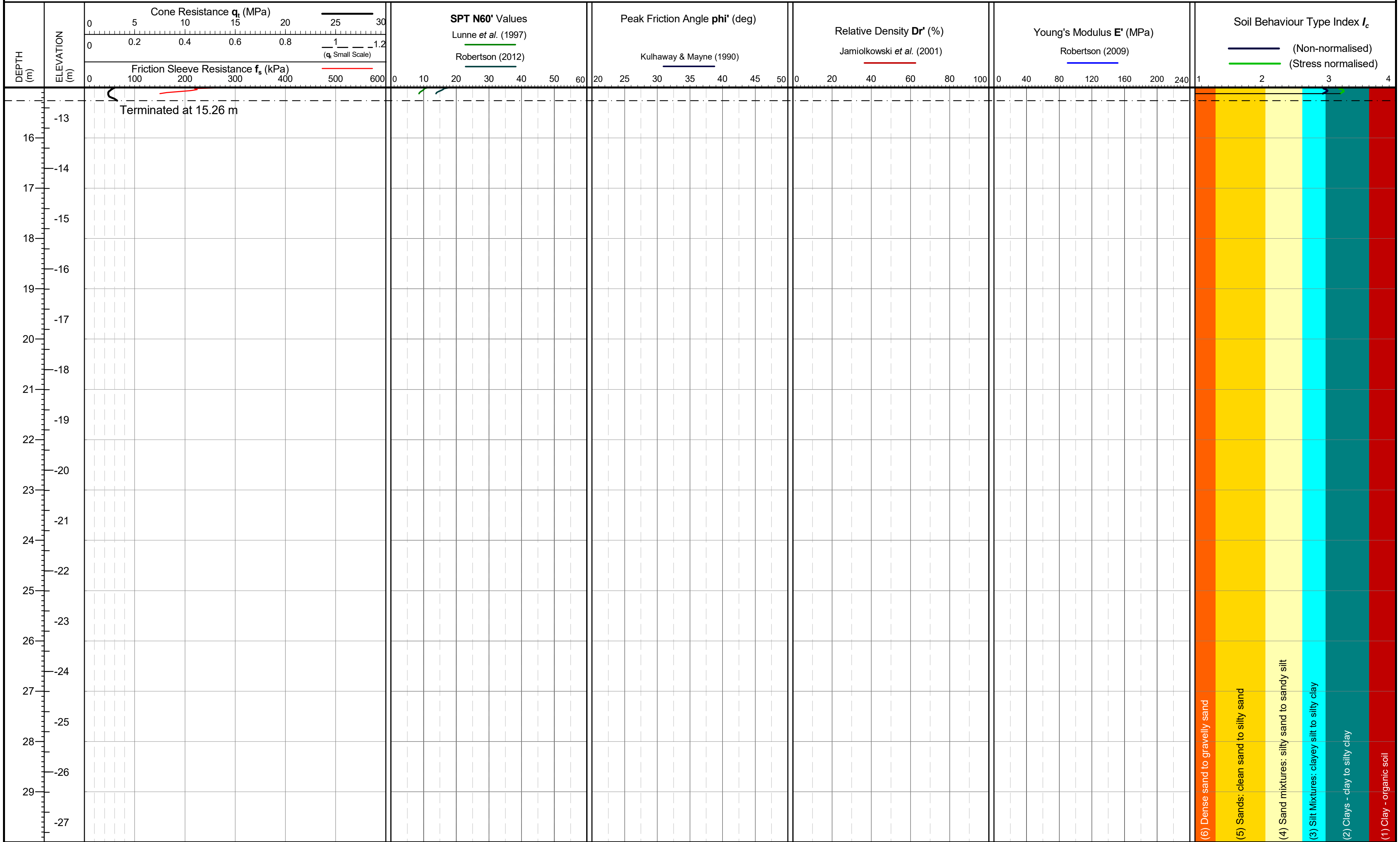
Checked by: Chris Player

Lankelma Project Ref: P-108071-1

TEST ID: CPT04

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



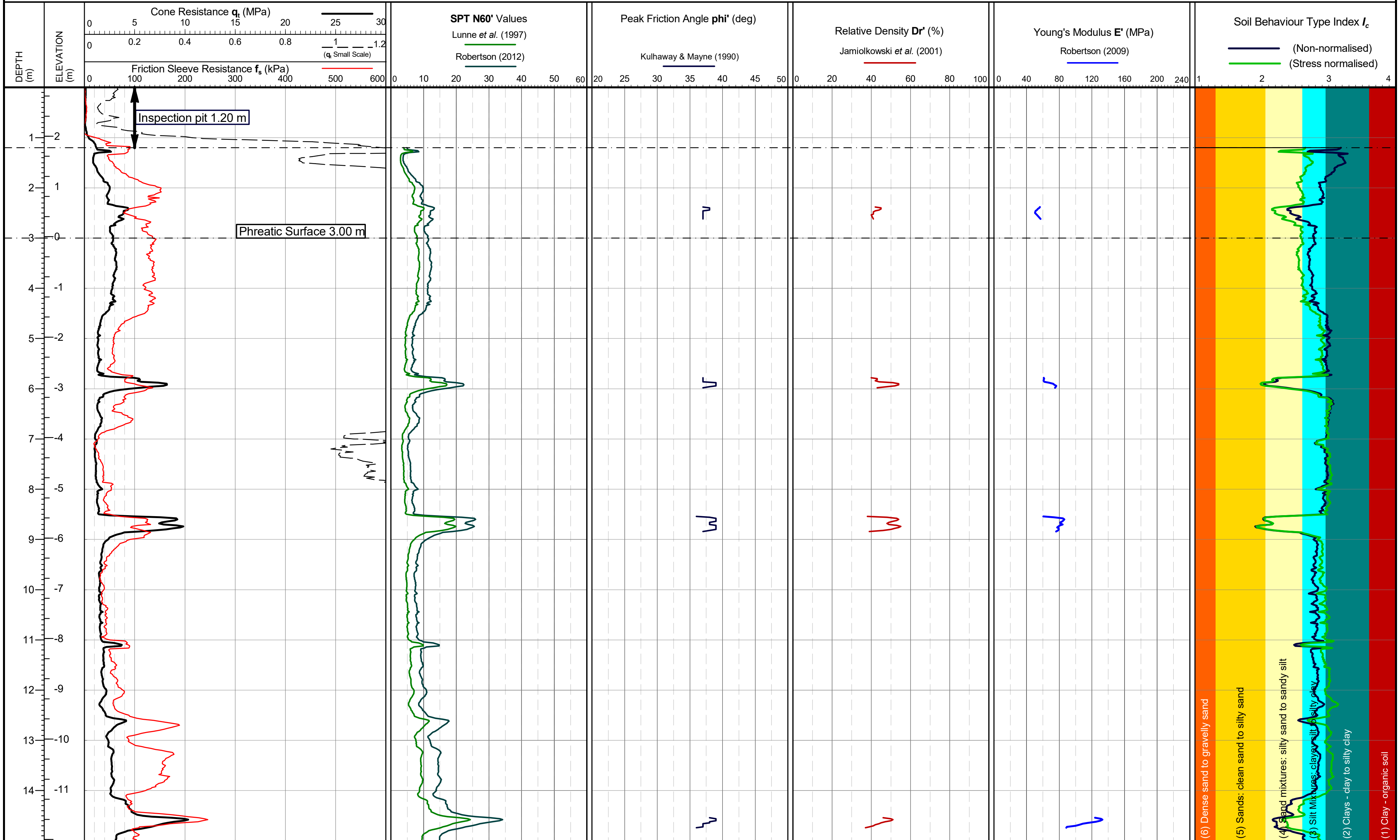
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Date of test: 13/09/2022 11:24:25	Location: Lincolnshire, UK Coordinates: 517109.955, 417014.039 Elevation: 2.606 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.		Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Jamie Butterworth
Date of test: 12/09/2022 09:12:31

Location: Lincolnshire, UK
Coordinates: 517057.758, 417099.047
Elevation: 2.972
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

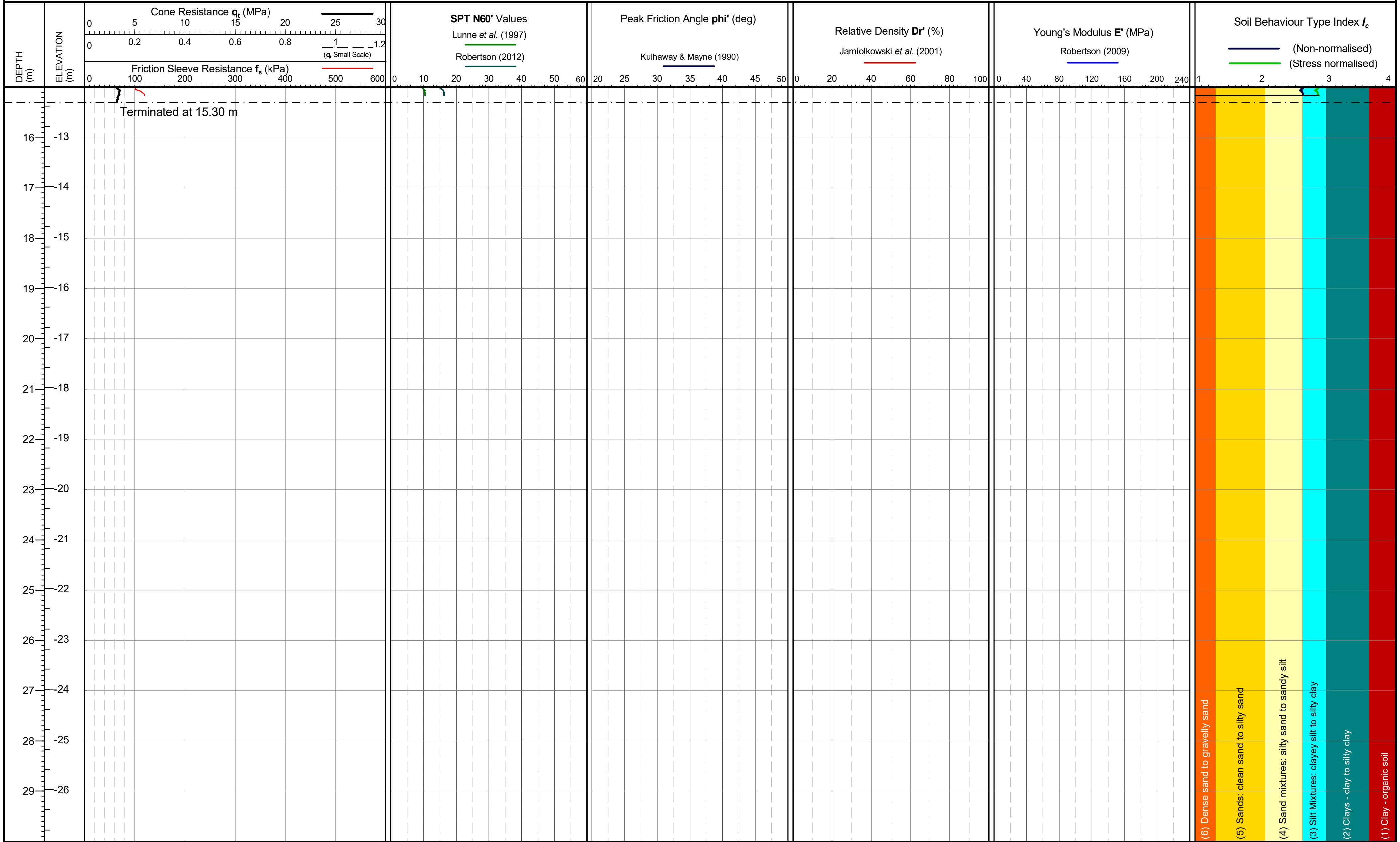
Date of plot: 31-10-22

Lankelma Project Ref: P-108071-1

Checked by: Chris Player

TEST ID: CPT09

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Jamie Butterworth
Date of test: 12/09/2022 09:12:31

Location: Lincolnshire, UK
Coordinates: 517057.758, 417099.047
Elevation: 2.972
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22
Checked by: Chris Player

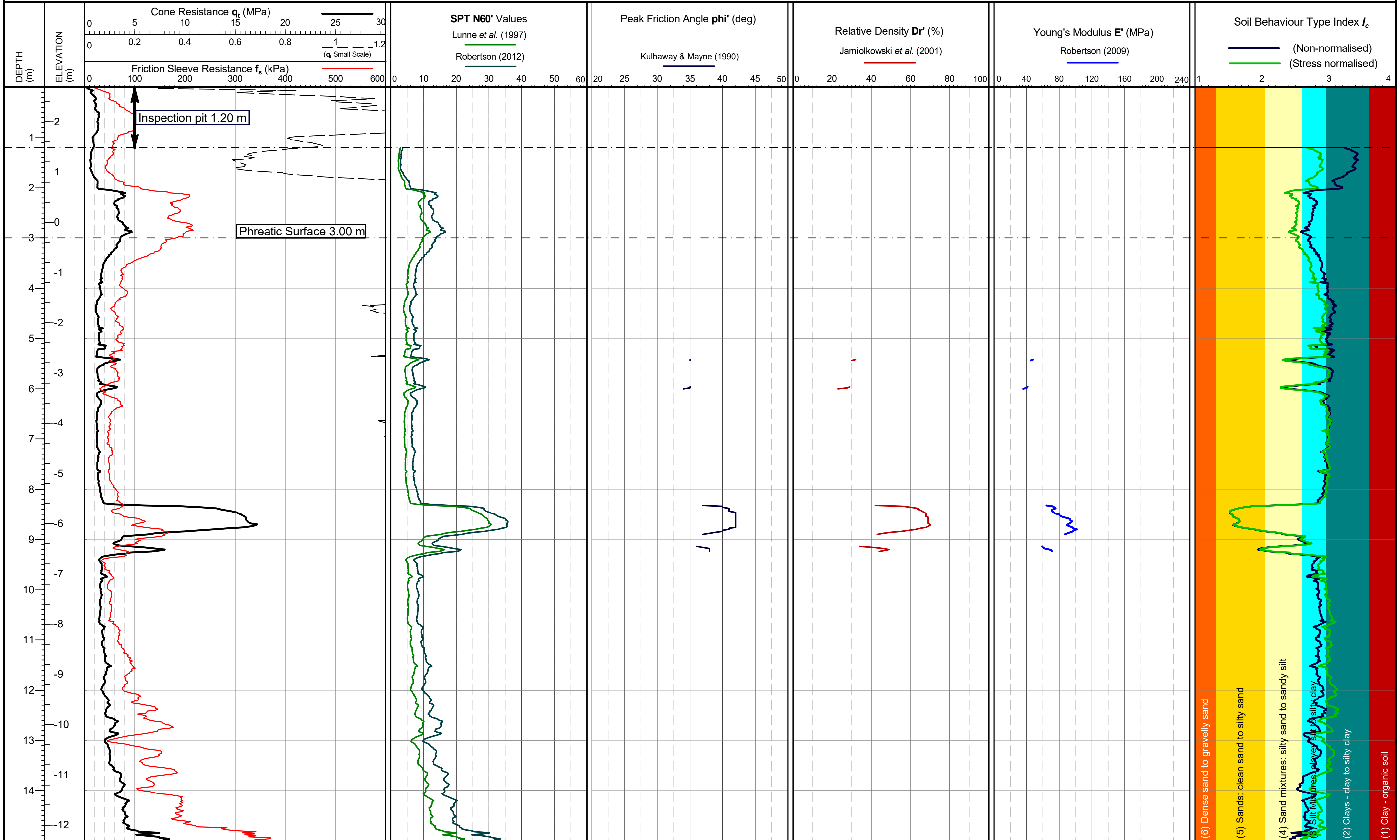
Lankelma Project Ref: P-108071-1

TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



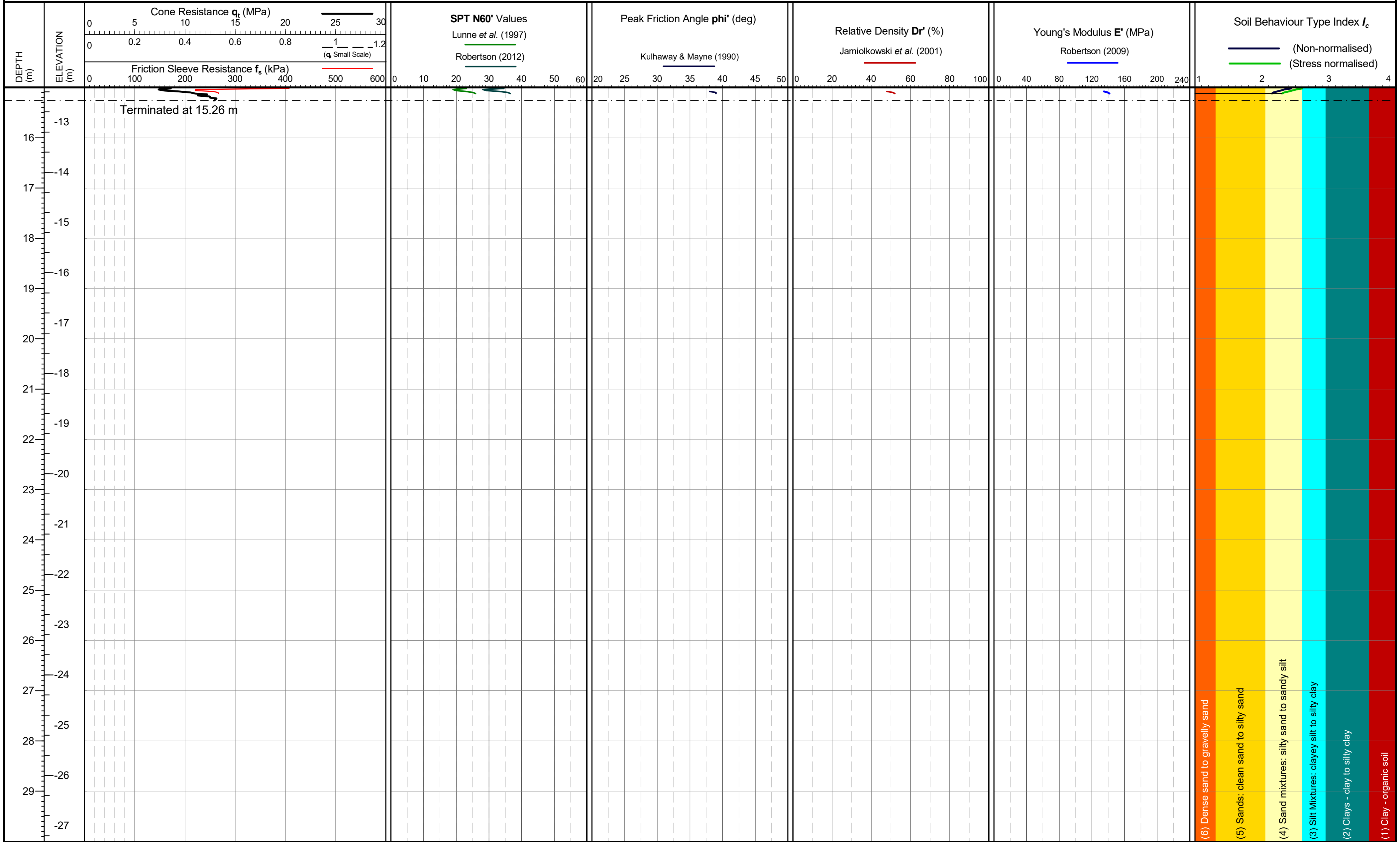
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Date of test: 13/09/2022 10:26:25	Location: Lincolnshire, UK Coordinates: 516972.019, 417047.79 Elevation: 2.686 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 13/09/2022 10:26:25

Location: Lincolnshire, UK
Coordinates: 516972.019, 417047.79
Elevation: 2.686
Coordinate system:

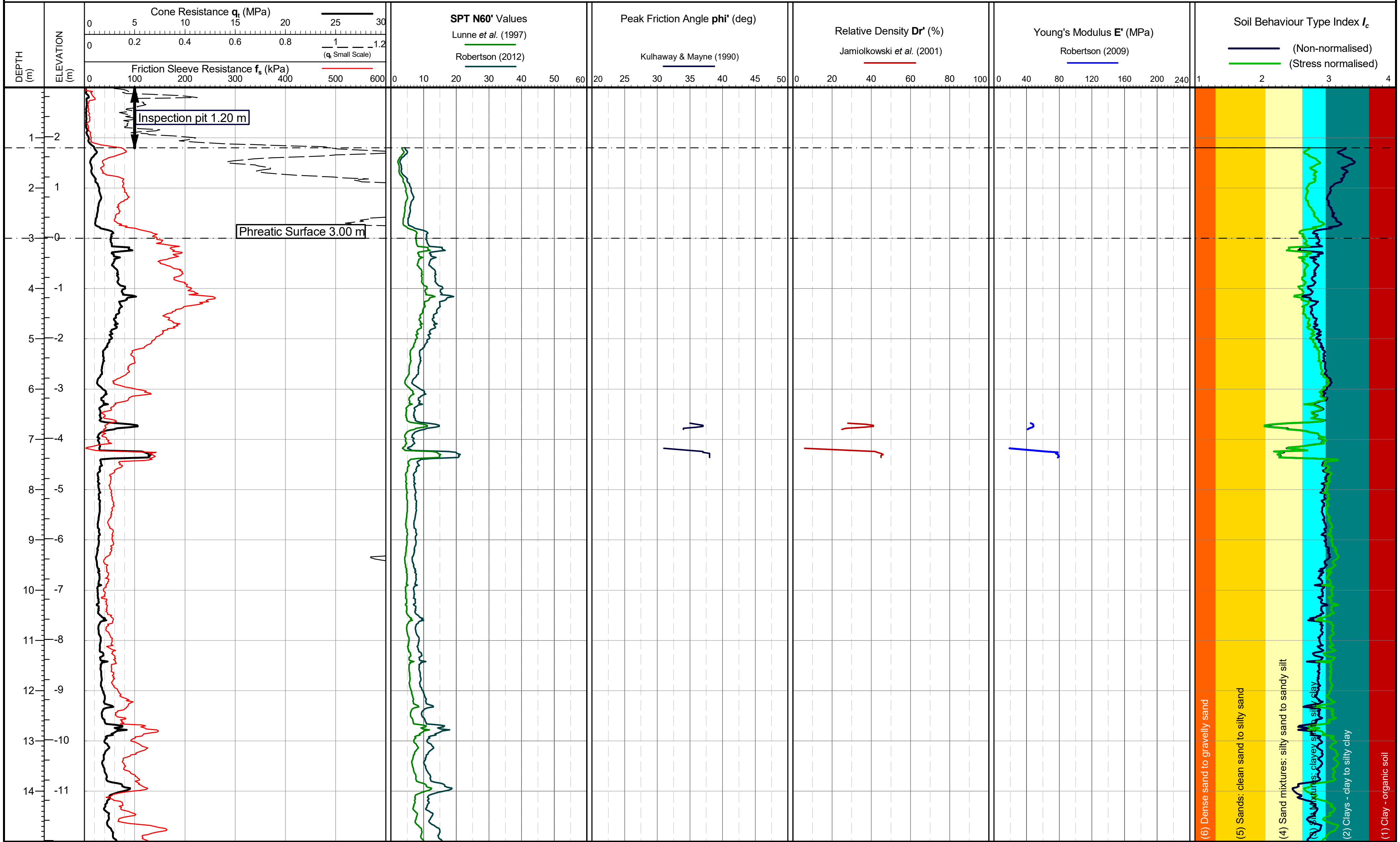
Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22
Checked by: Chris Player

Lankelma Project Ref: P-108071-1

TEST ID: CPT10

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 13/09/2022 09:30:06

Location: Lincolnshire, UK
Coordinates: 516887.009, 416995.047
Elevation: 2.979
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

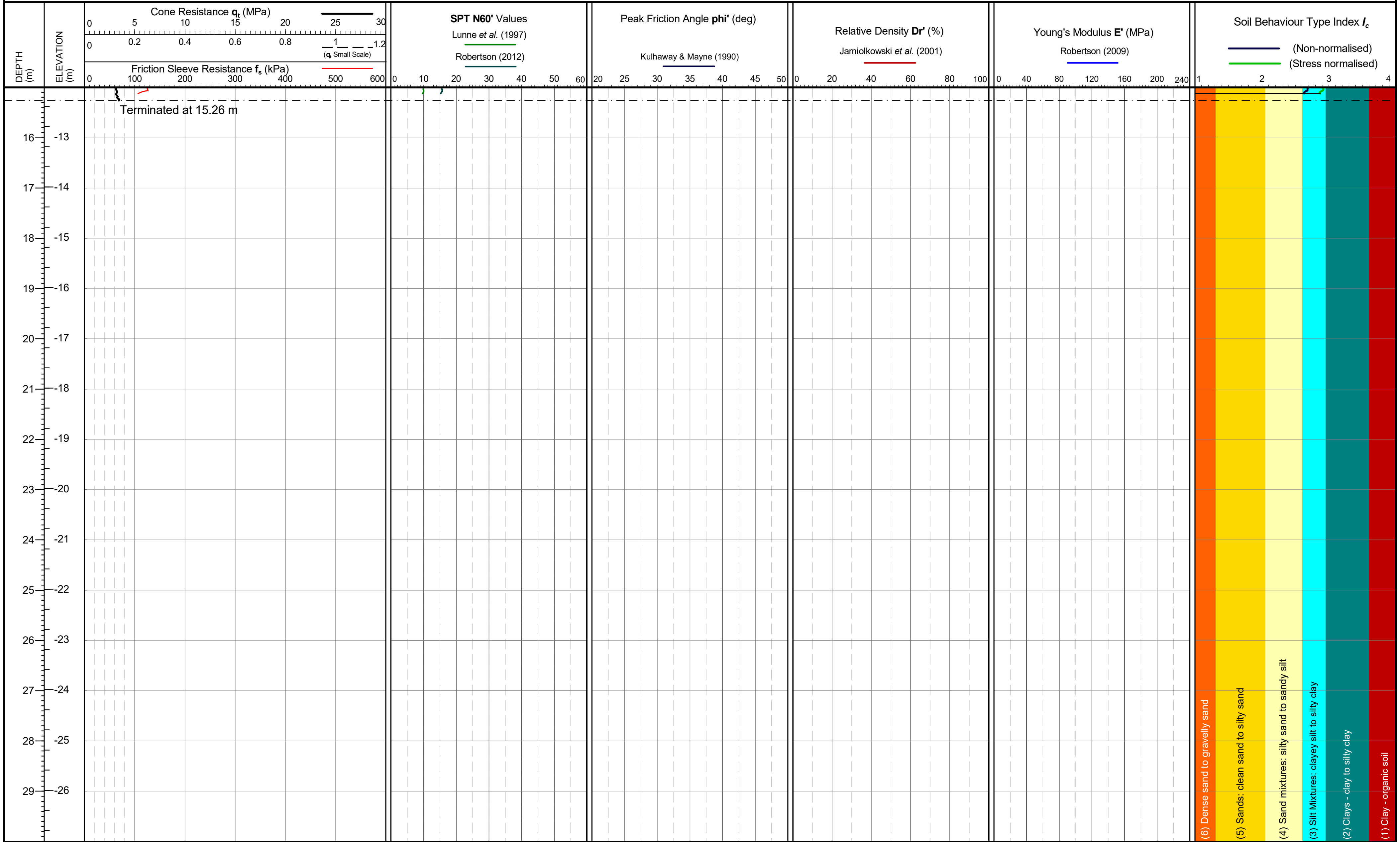
Date of plot: 31-10-22
Checked by: Chris Player

Lankelma Project Ref: P-108071-1

TEST ID: CPT11

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 13/09/2022 09:30:06

Location: Lincolnshire, UK
Coordinates: 516887.009, 416995.047
Elevation: 2.979
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

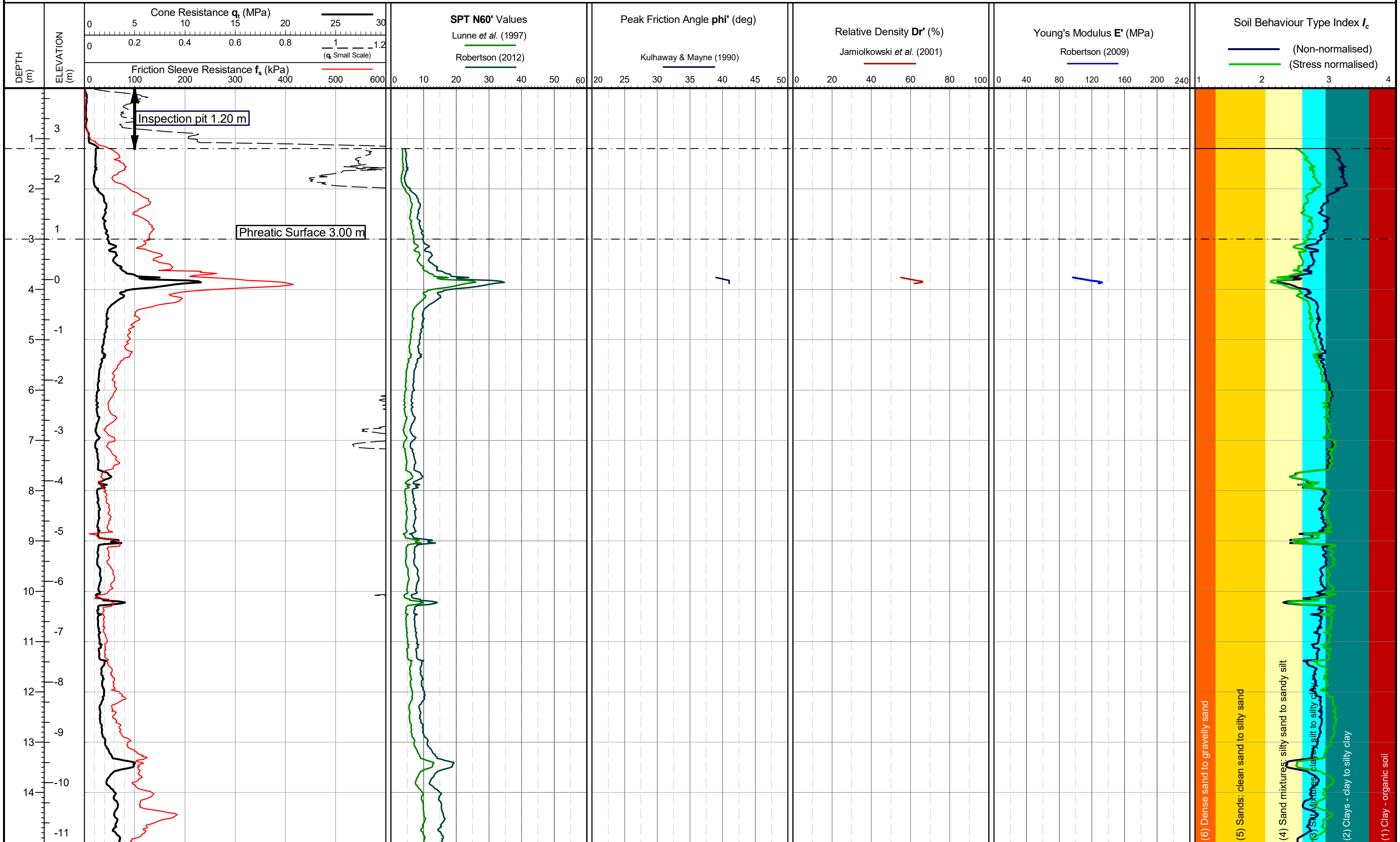
Lankelma Project Ref: P-108071-1

Checked by: Chris Player

TEST ID: CPT11

Project: HUMBER ZERO VPI IMMINGHAM

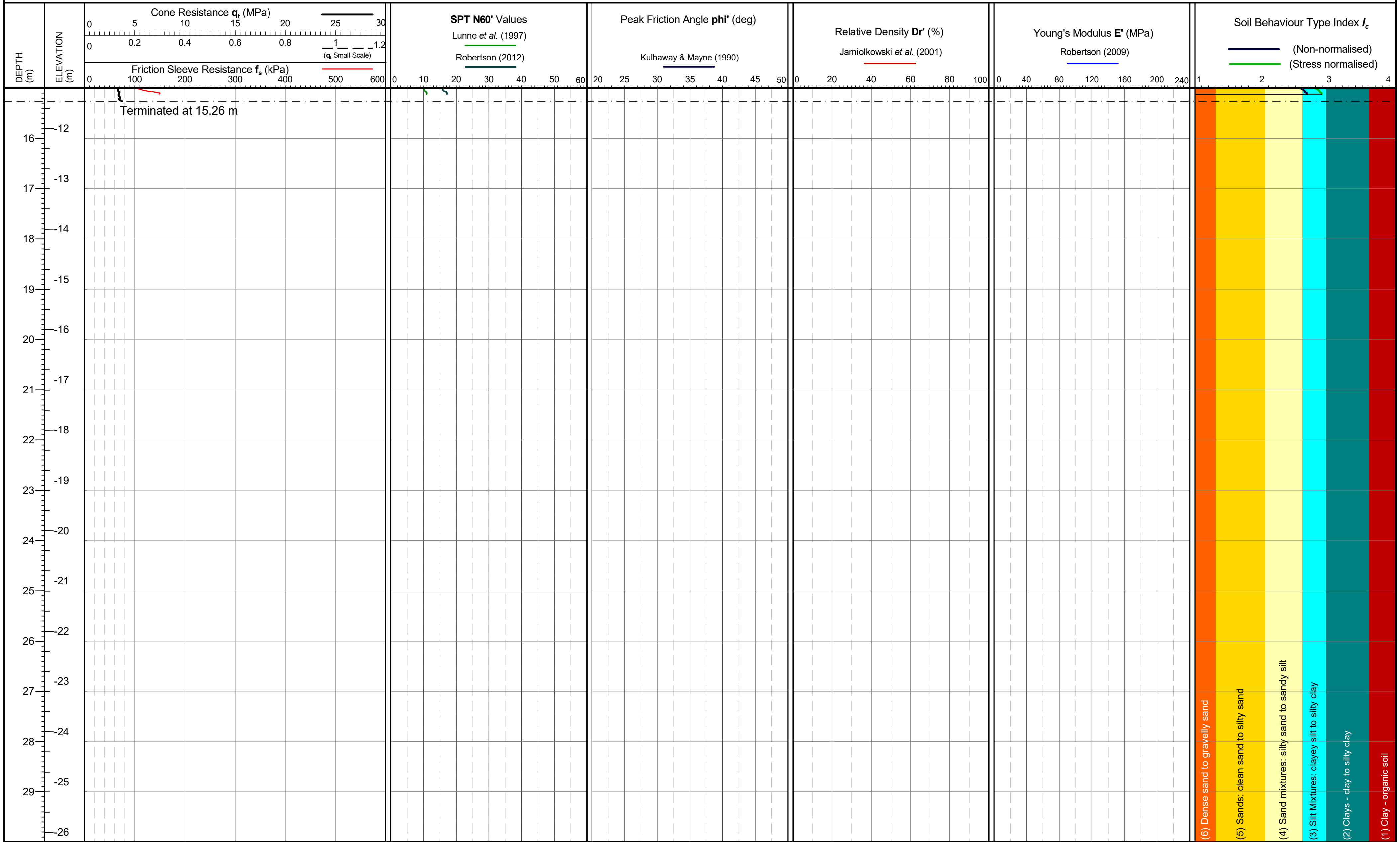
Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Date of test: 12/09/2022 10:25:48	Location: Lincolnshire, UK Coordinates: 516904.912, 417064.974 Elevation: 3.804 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT14

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 12/09/2022 10:25:48

Location: Lincolnshire, UK
Coordinates: 516904.912, 417064.974
Elevation: 3.804
Coordinate system:

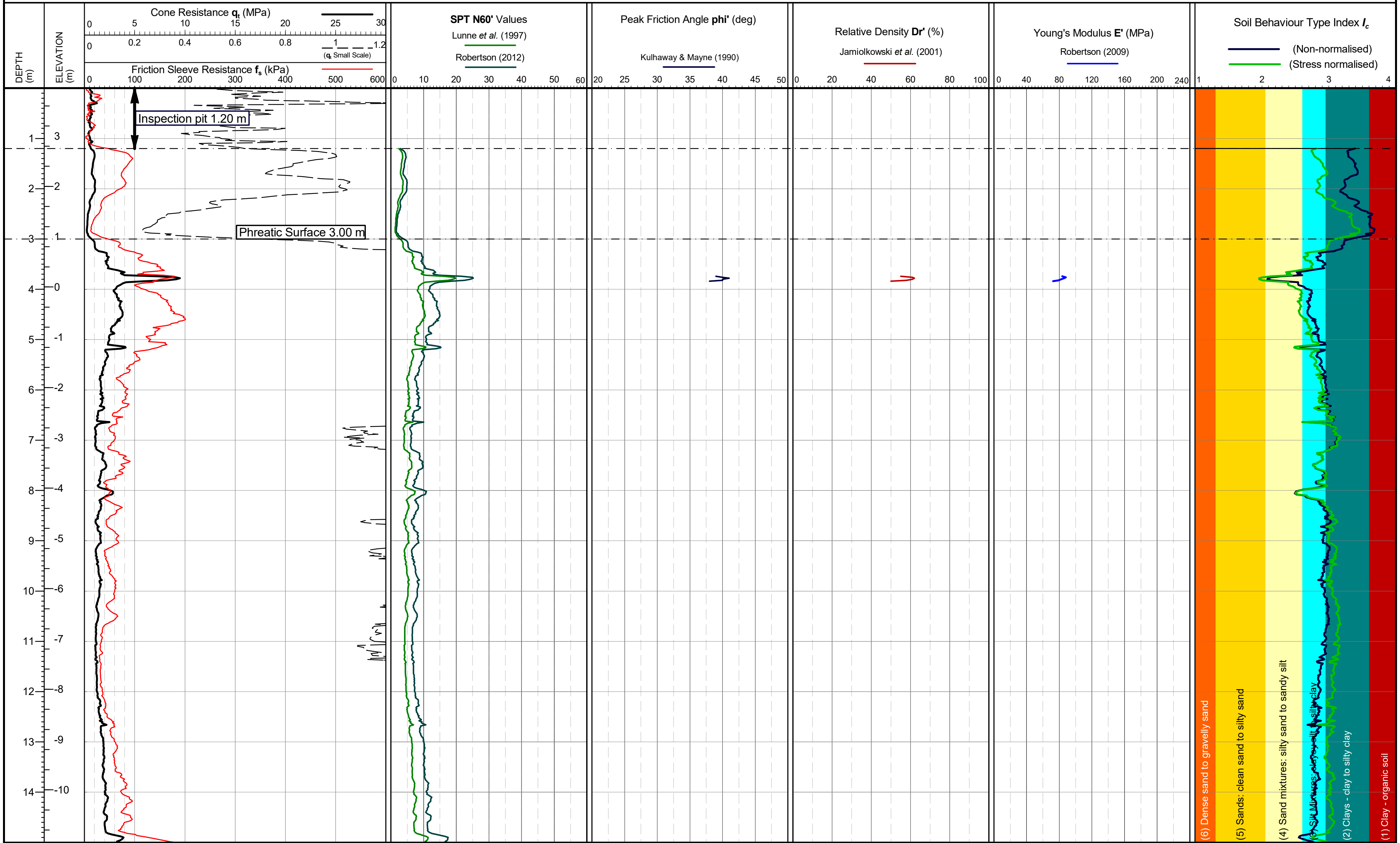
Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22
Lankelma Project Ref: P-108071-1
Checked by: Chris Player

TEST ID: CPT14

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Jamie Butterworth
Date of test: 12/09/2022 15:51:04

Location: Lincolnshire, UK
Coordinates: 516774.966, 416987.078
Elevation: 3.953
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

Lankelma Project Ref: P-108071-1

Checked by: Chris Player

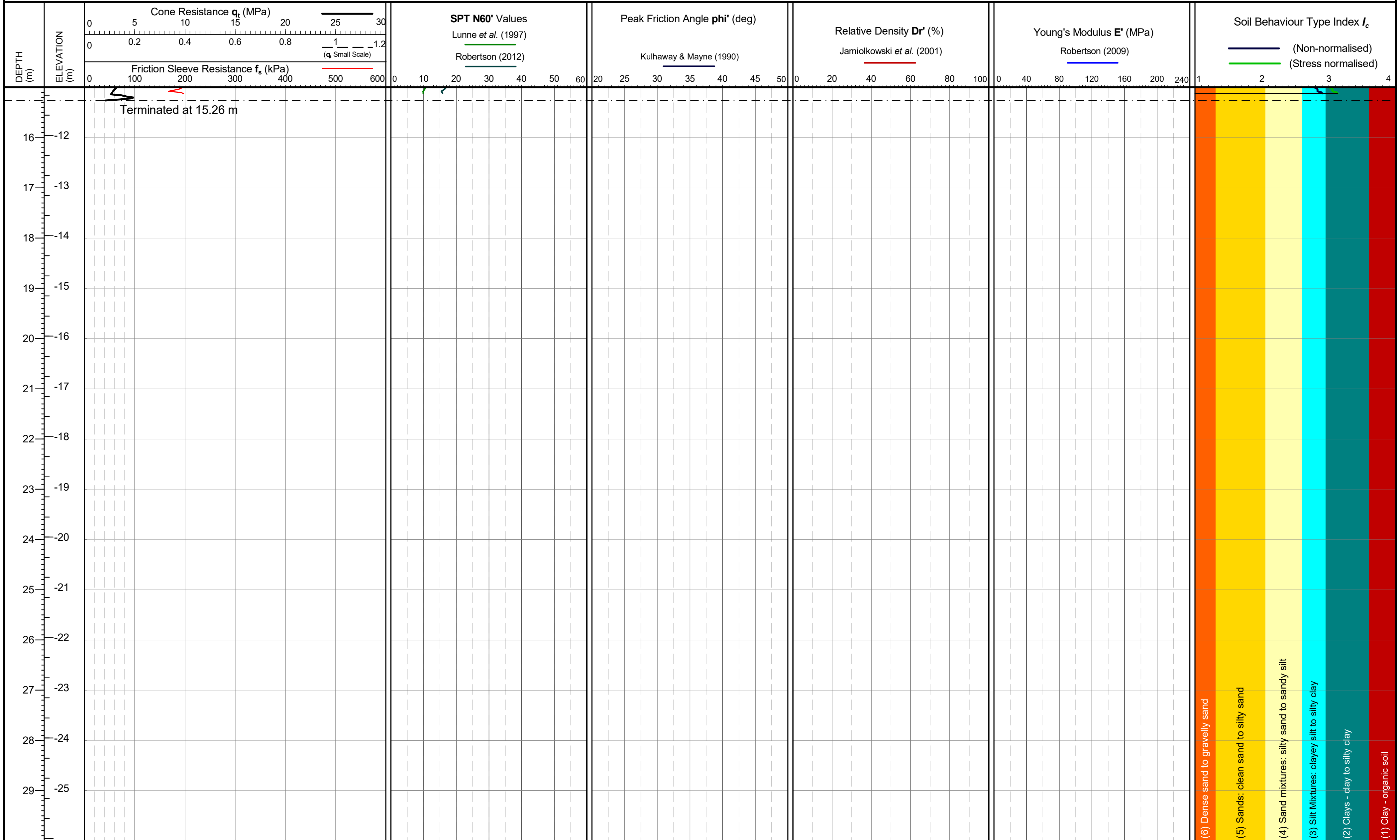
TEST ID: CPT15

Page 1 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

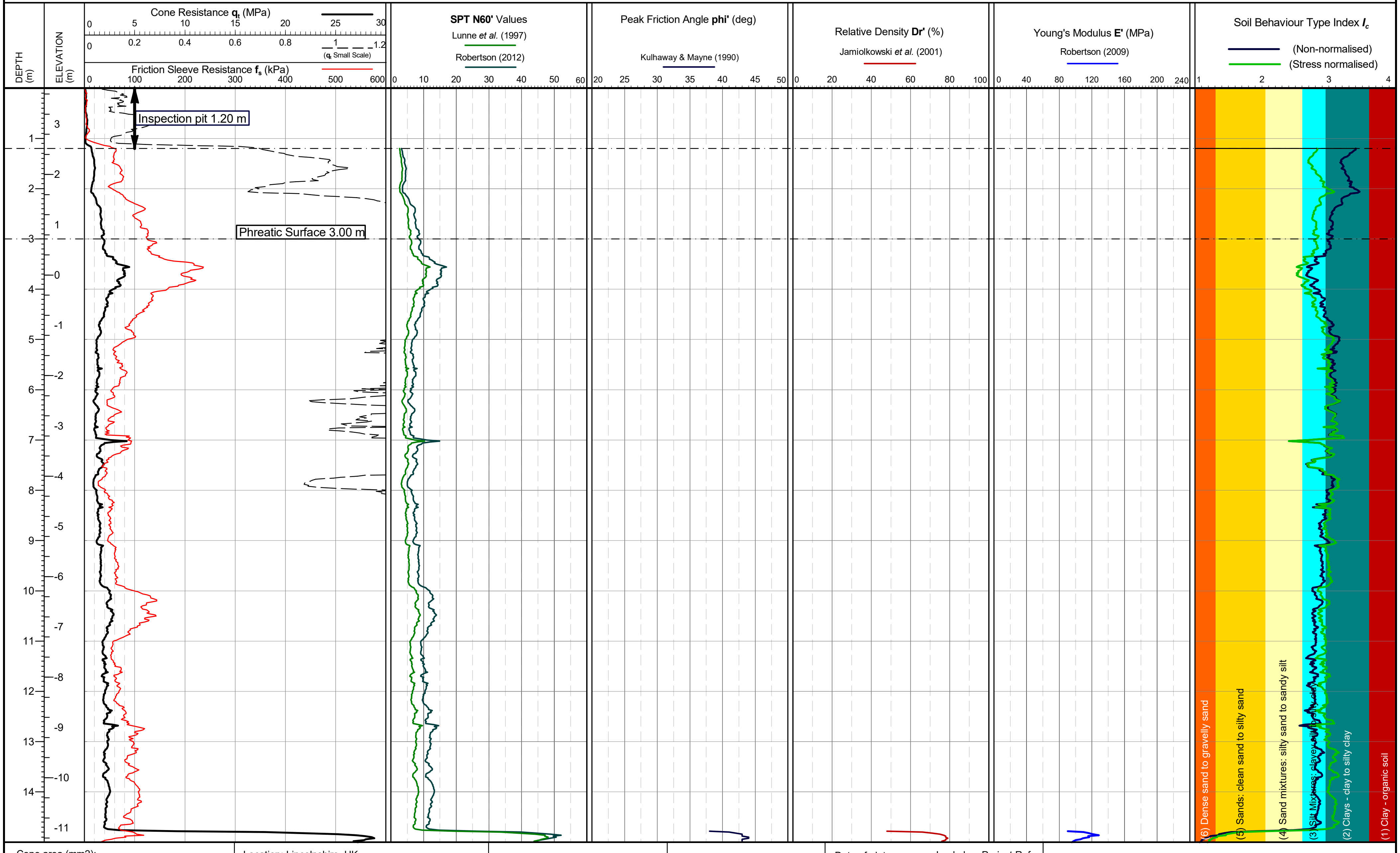


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Date of test: 12/09/2022 15:51:04	Location: Lincolnshire, UK Coordinates: 516774.966, 416987.078 Elevation: 3.953 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT15

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS

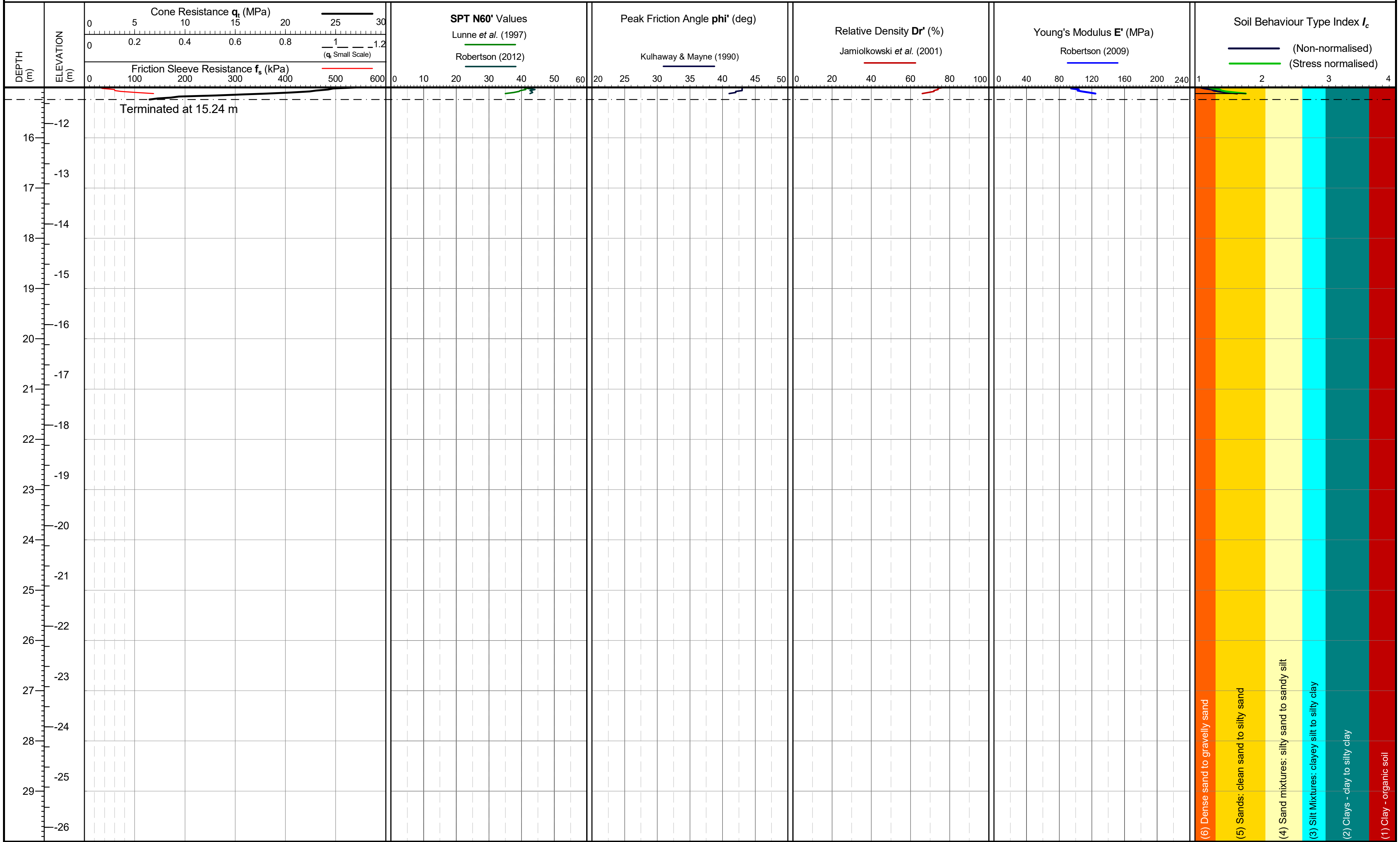


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Date of test: 12/09/2022 14:52:09	Location: Lincolnshire, UK Coordinates: 516646.925, 416909.913 Elevation: 3.718 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT16** Page 1 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

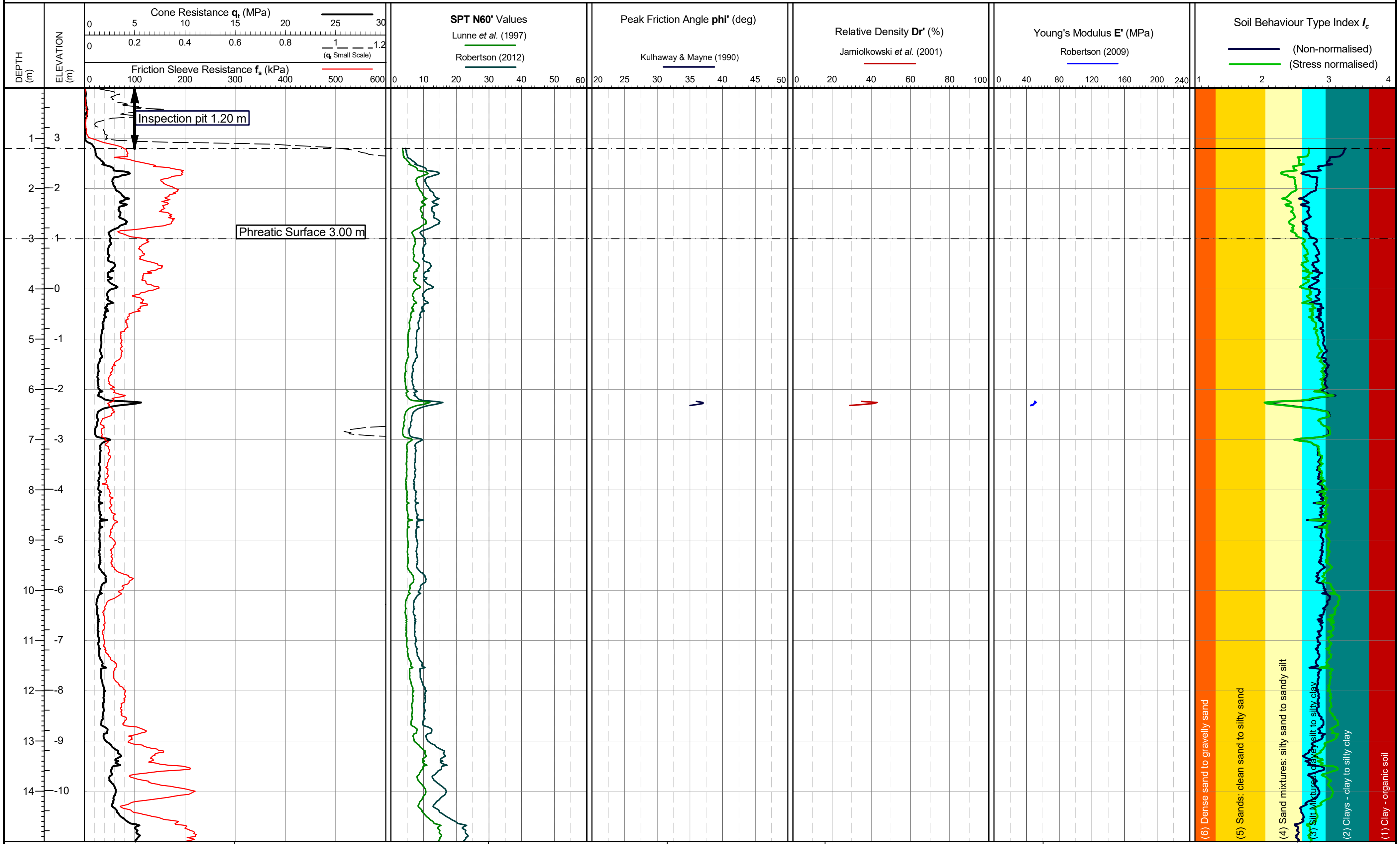


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Date of test: 12/09/2022 14:52:09	Location: Lincolnshire, UK Coordinates: 516646.925, 416909.913 Elevation: 3.718 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.		Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT16

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 12/09/2022 11:43:23

Location: Lincolnshire, UK
Coordinates: 516797.98, 417045.885
Elevation: 3.986
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

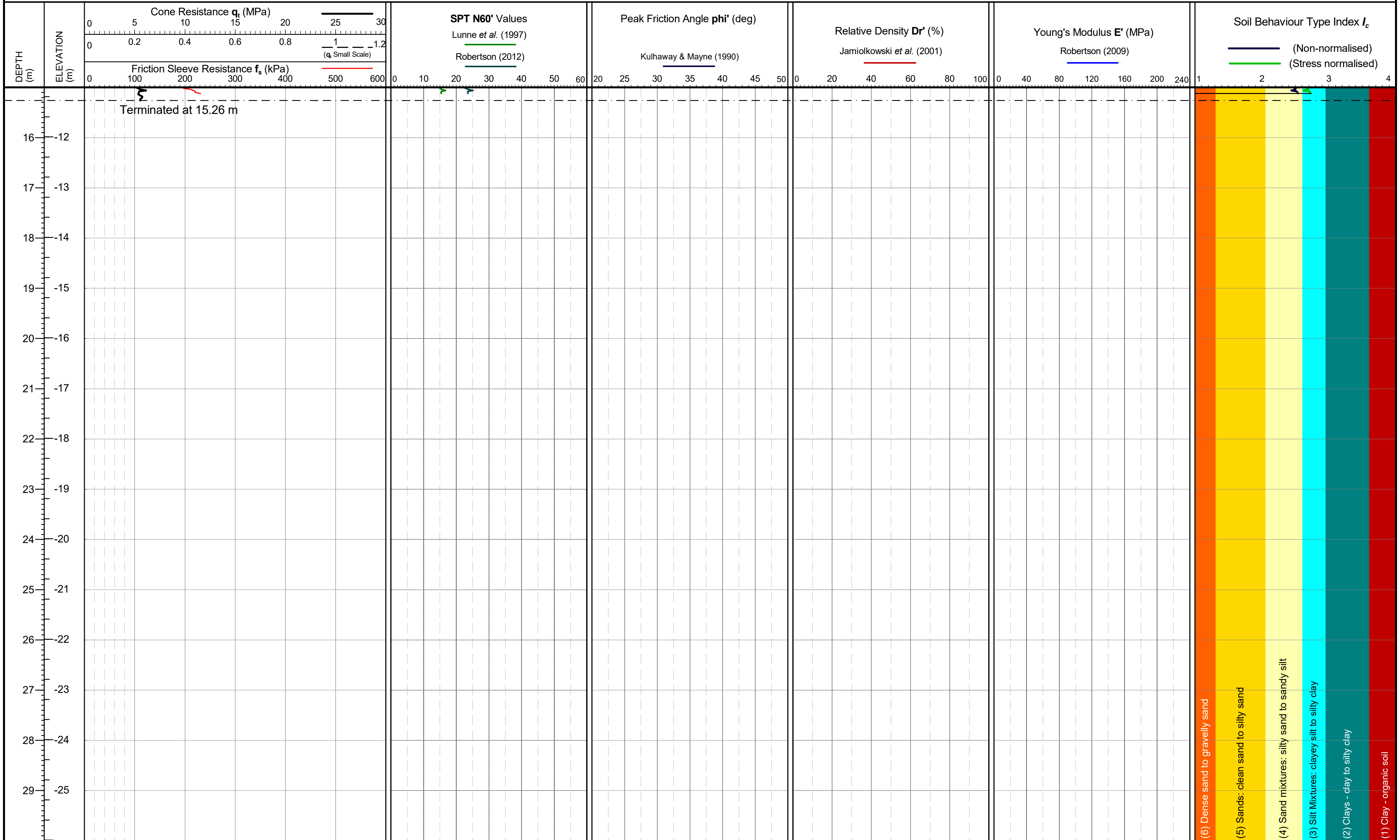
Date of plot: 31-10-22
Checked by: Chris Player

Lankelma Project Ref: P-108071-1

TEST ID: CPT18

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 12/09/2022 11:43:23

Location: Lincolnshire, UK
Coordinates: 516797.98, 417045.885
Elevation: 3.986
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

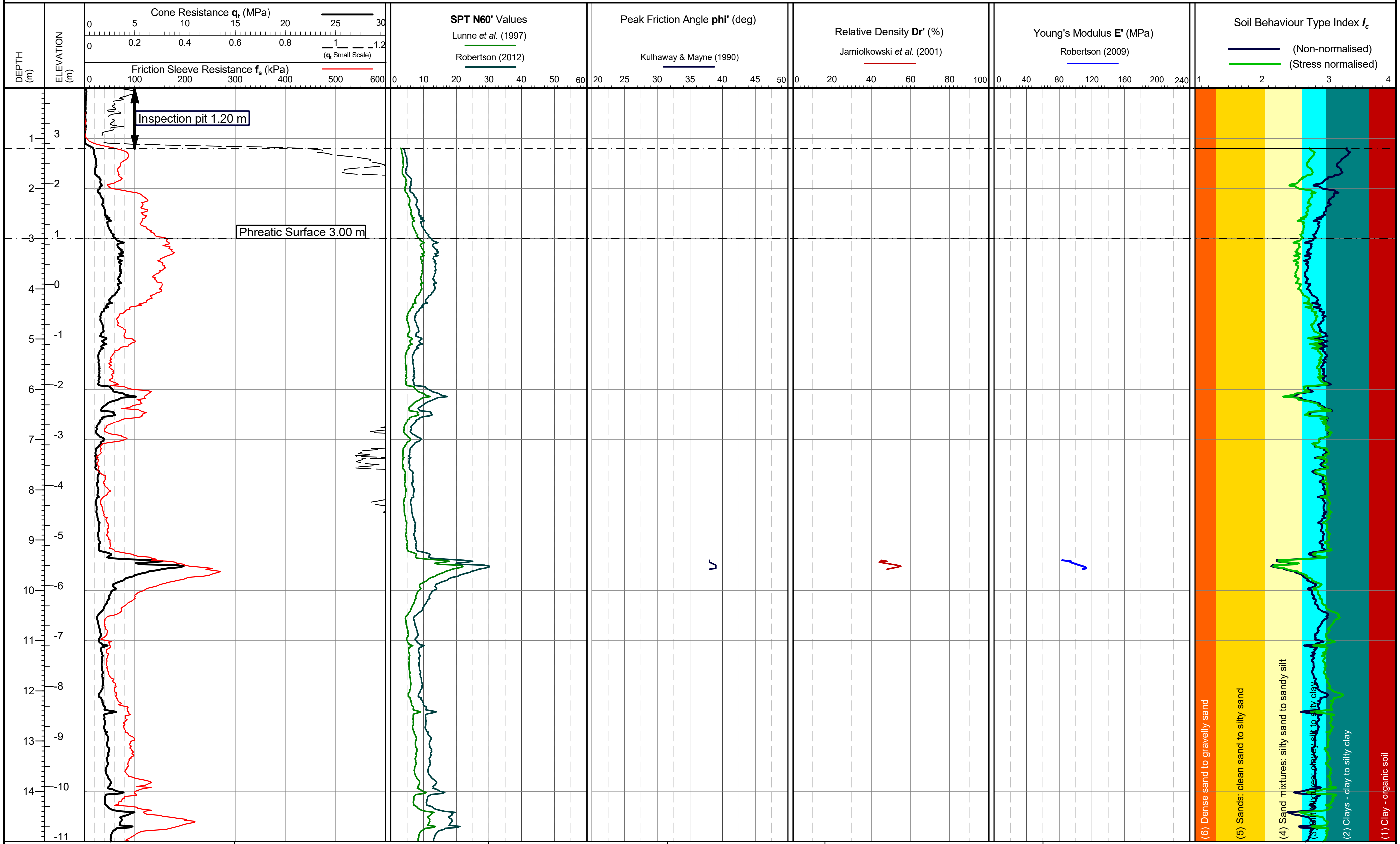
Lankelma Project Ref: P-108071-1

Checked by: Chris Player

TEST ID: CPT18

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 12/09/2022 12:49:35

Location: Lincolnshire, UK
Coordinates: 516703.892, 416993.845
Elevation: 3.908
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

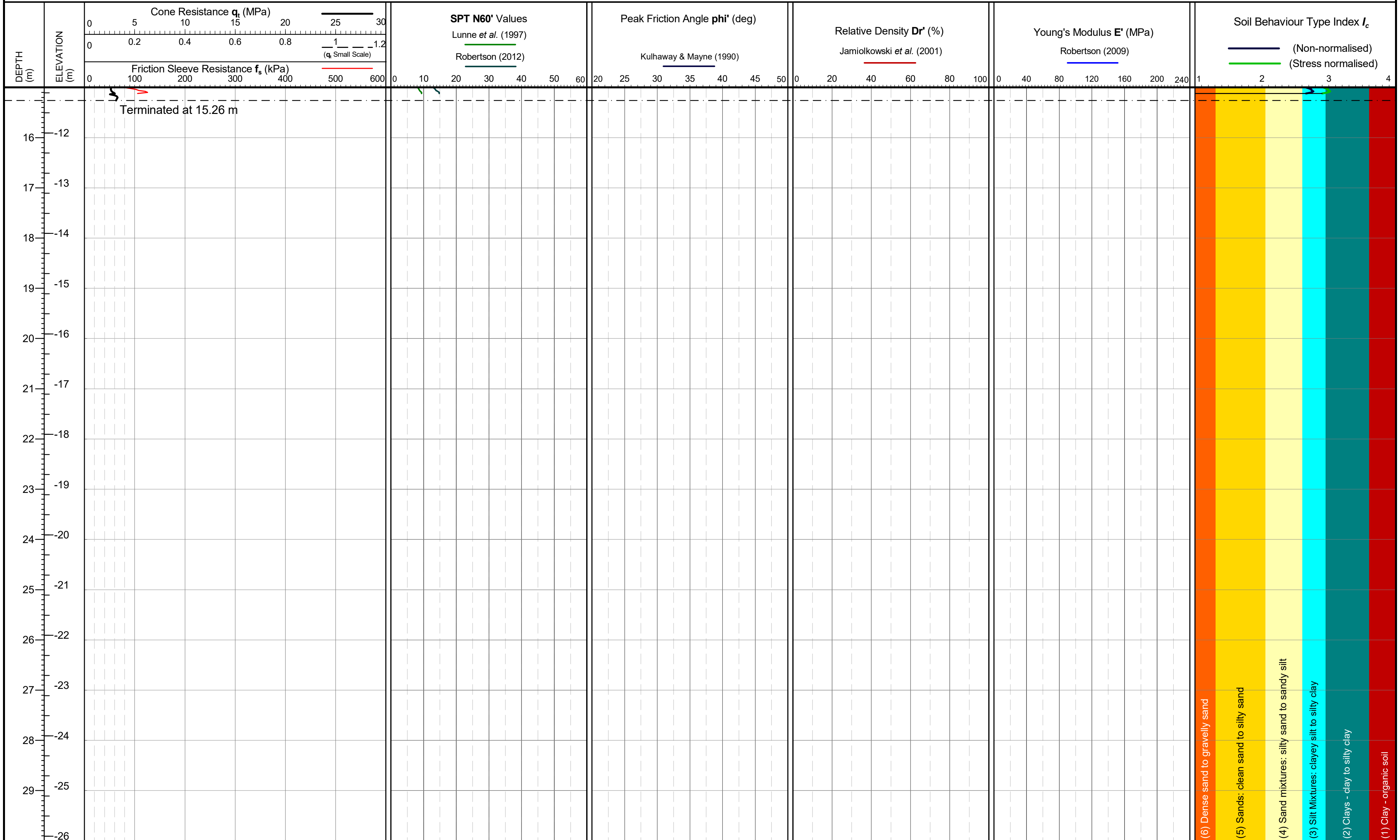
Date of plot: 31-10-22

Lankelma Project Ref: P-108071-1

Checked by: Chris Player

TEST ID: CPT19

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



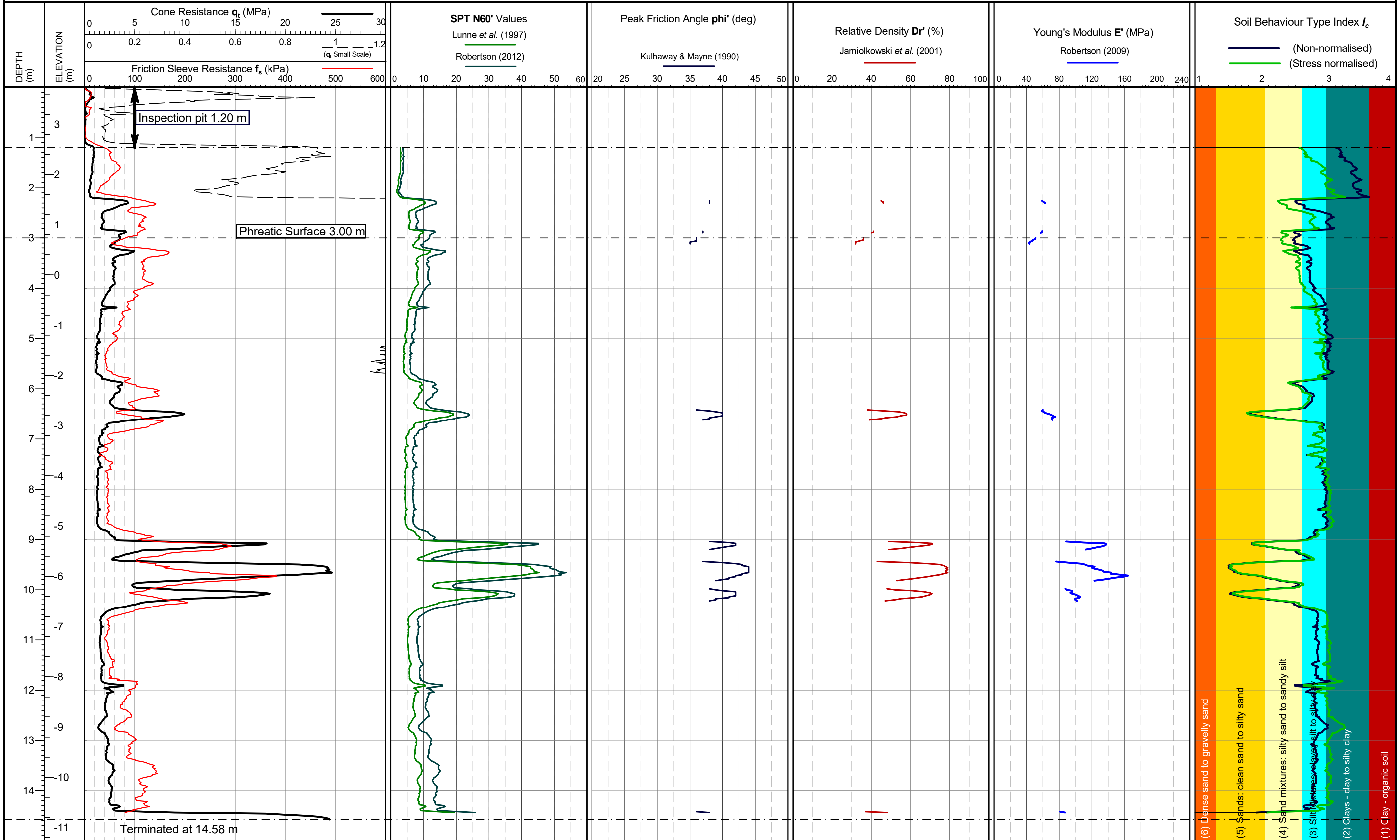
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Date of test: 12/09/2022 12:49:35	Location: Lincolnshire, UK Coordinates: 516703.892, 416993.845 Elevation: 3.908 Coordinate system:	Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Date of test: 12/09/2022 13:50:45

Location: Lincolnshire, UK
Coordinates: 516630.051, 416942.072
Elevation: 3.734
Coordinate system:

Both drained and undrained parameters are calculated for mixed SBTs = Ic 2.40-2.70. See report text for methods and discussion of parameter evaluation.

Date of plot: 31-10-22

Lankelma Project Ref: P-108071-1

Checked by: Chris Player

TEST ID: CPT20

Page 1 of 1

APPENDIX G PENETROMETER TEMPERATURE RESULTS

The temperature values in these logs represent the internal load cell temperature of the penetrometer and are used for QC purposes by comparison to the measured temperature response indicated on the calibration certificate. The CPT results have been corrected for transient and static temperature effects during post processing.

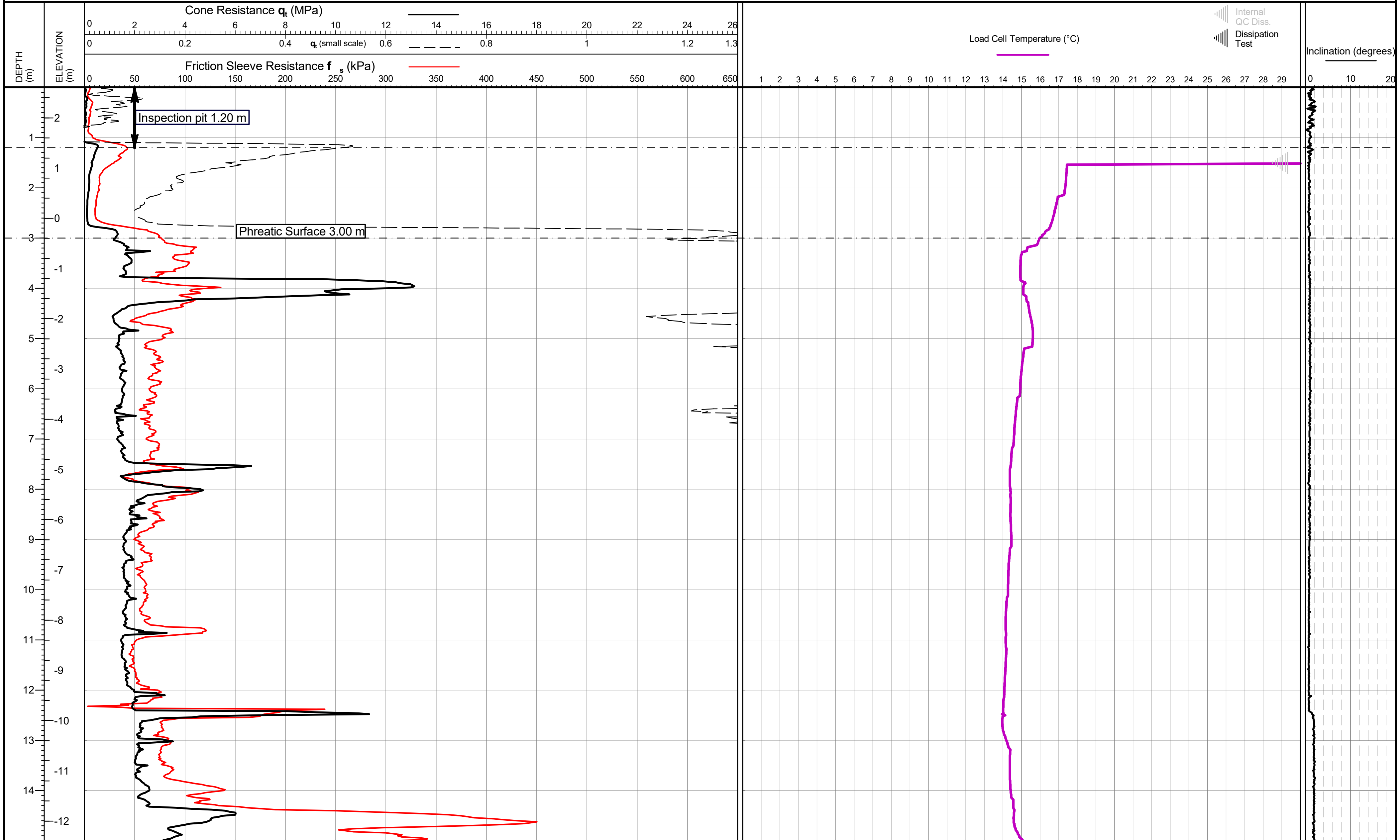
Ground temperature is only represented following a penetration pause of > 11 minutes.

Plots are provided for locations performed with a digital penetrometer measuring internal load cell temperature.

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 13/09/2022 11:24:25

Zero drift (Pre/post test)
q_c (kPa): -48.8
f_s (kPa): 0.9 ($f_{s\,drift} - q_{c\,drift}$)
u_2 (kPa): 0.6

Location: Lincolnshire, UK
Coordinates: 517109.955, 417014.039
Elevation: 2.606
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Target depth

Date of plot:
31-10-22

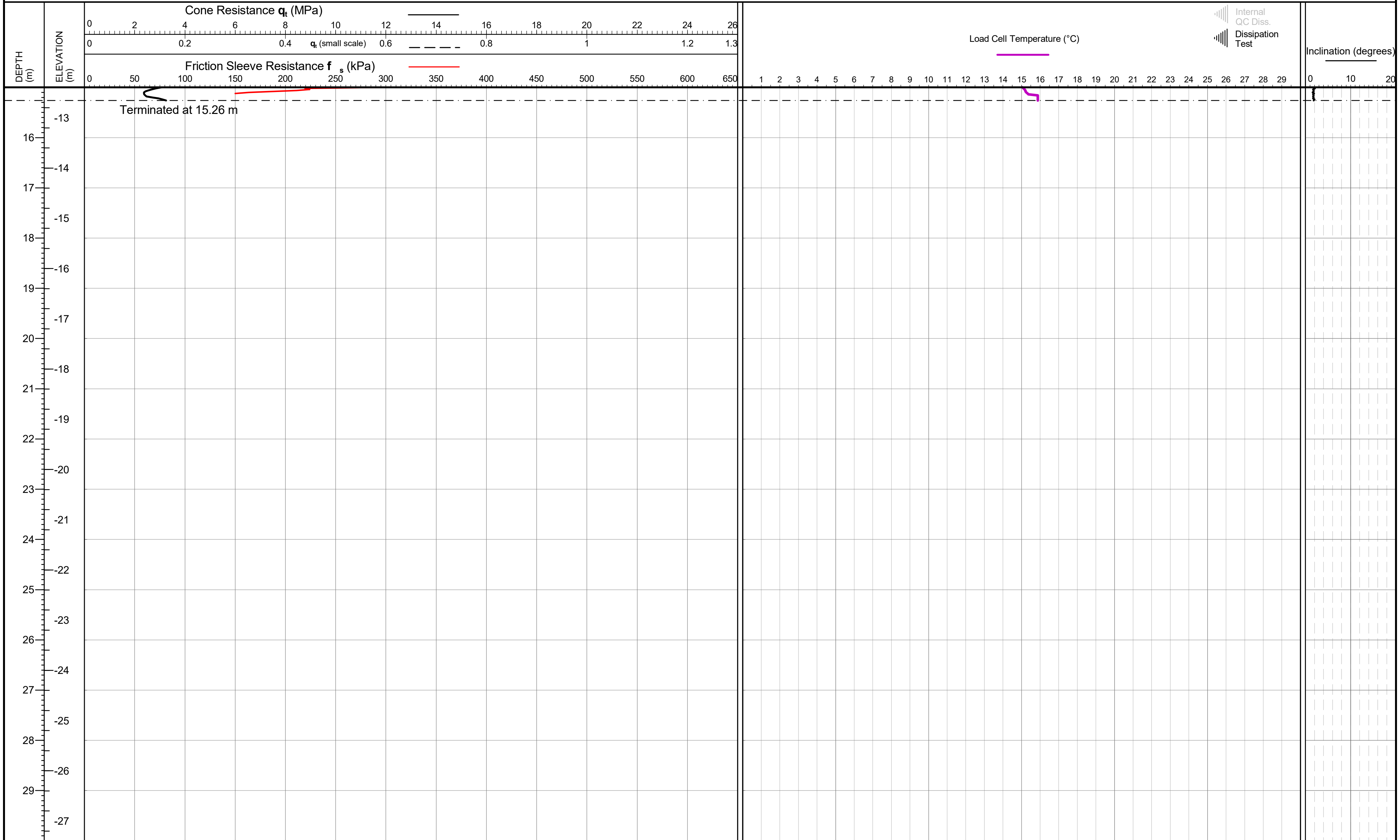
Lankelma Project Ref:
P-108071-1

Checked by:
Chris Player

TEST ID: CPT04

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



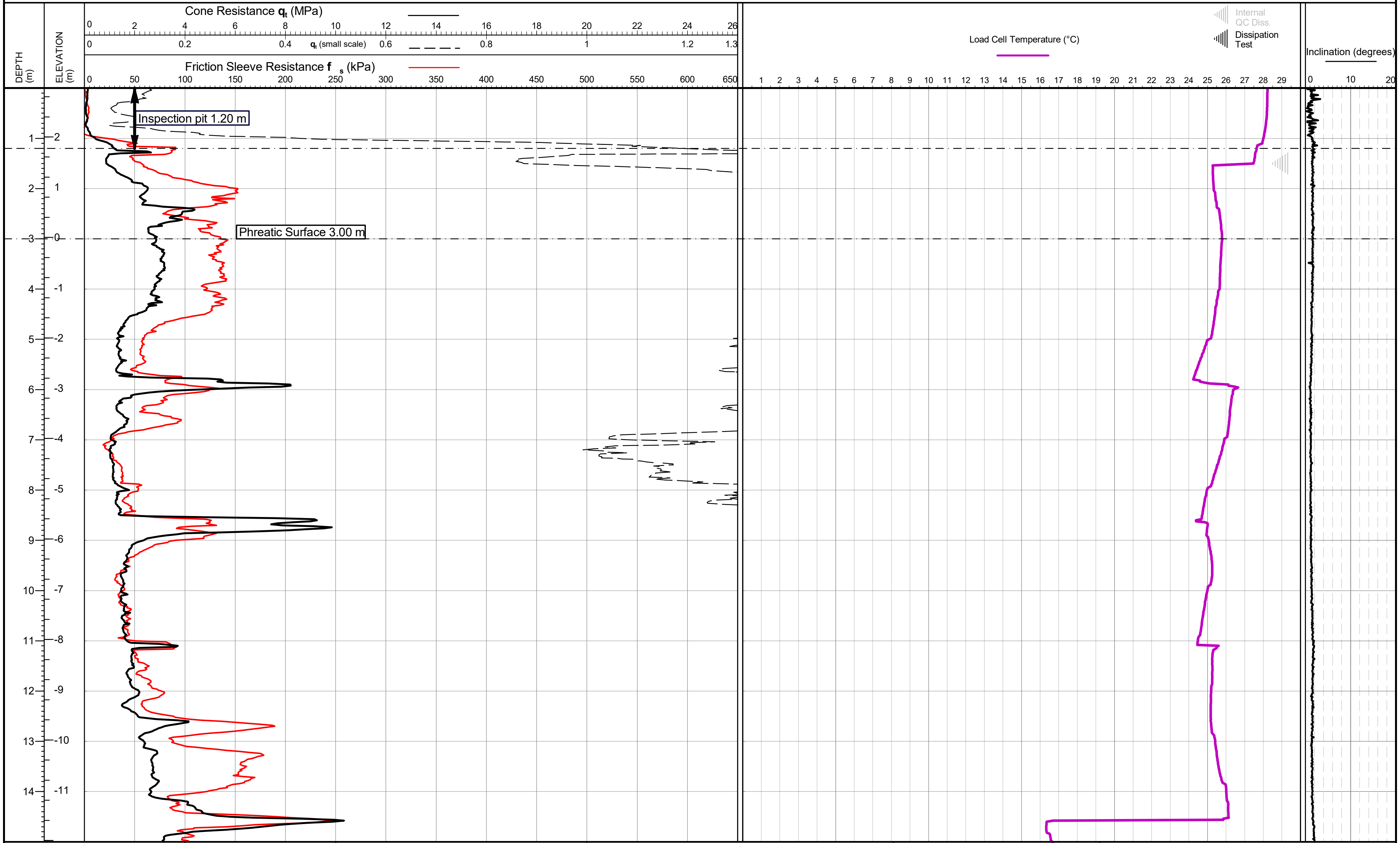
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 11:24:25	Zero drift (Pre/post test) q_c (kPa): -48.8 f_s (kPa): 0.9 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 517109.955, 417014.039 Elevation: 2.606 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT04

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



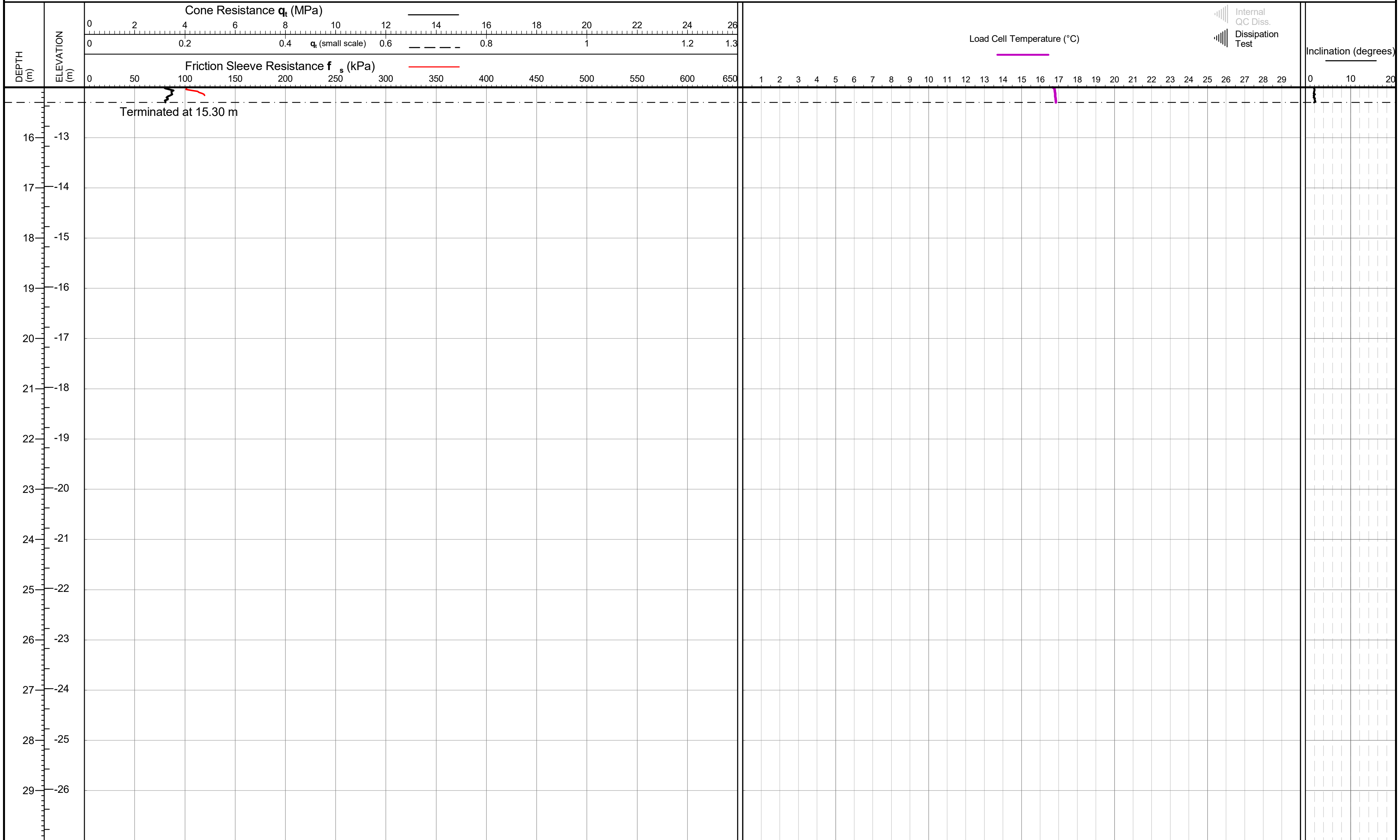
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 09:12:31	Zero drift (Pre/post test) q_c (kPa): -5.0 f_s (kPa): -0.9 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.6	Location: Lincolnshire, UK Coordinates: 517057.758, 417099.047 Elevation: 2.972 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT09

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

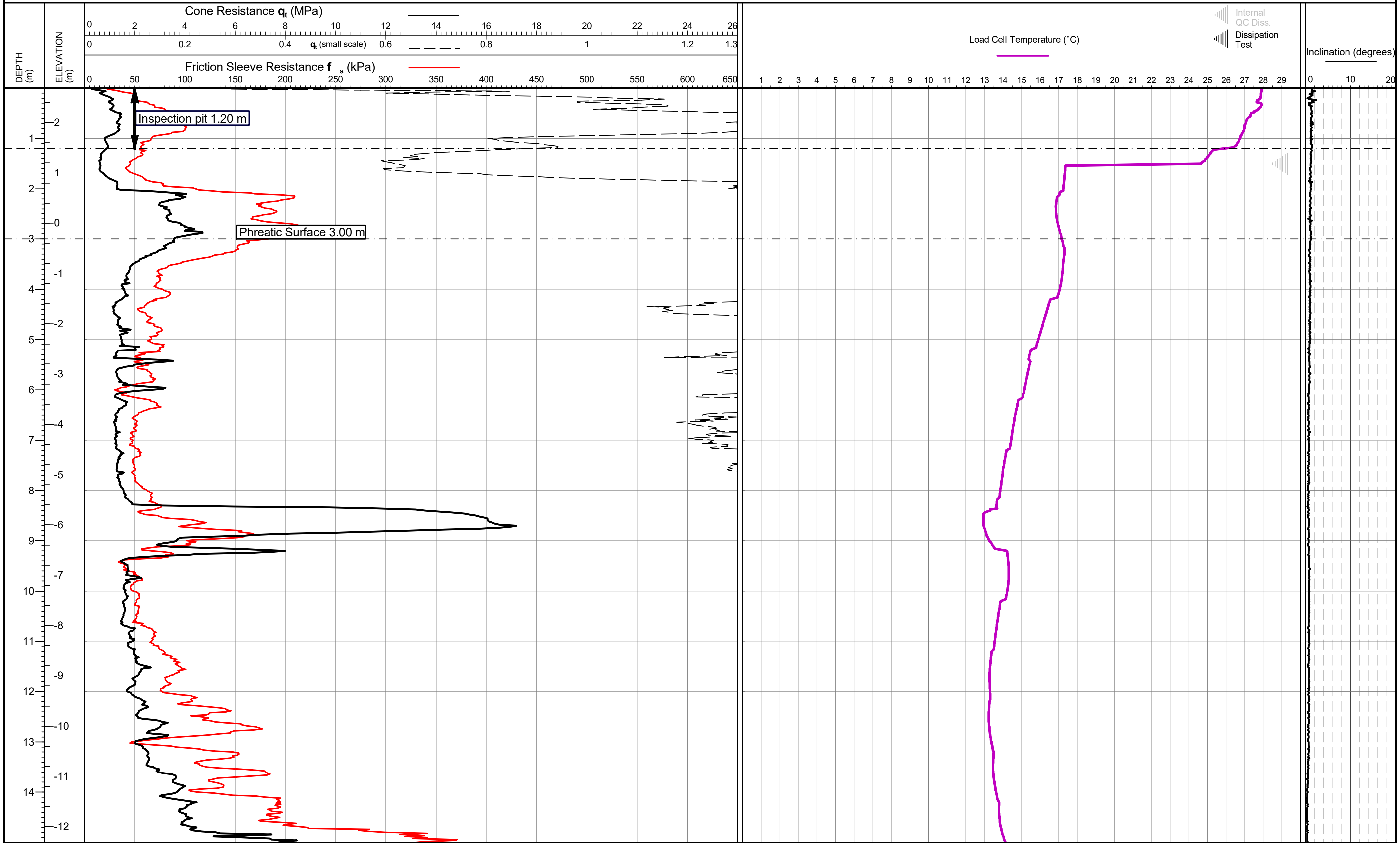
Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 09:12:31	Zero drift (Pre/post test) q_c (kPa): -5.0 f_s (kPa): -0.9 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.6	Location: Lincolnshire, UK Coordinates: 517057.758, 417099.047 Elevation: 2.972 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT09

Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



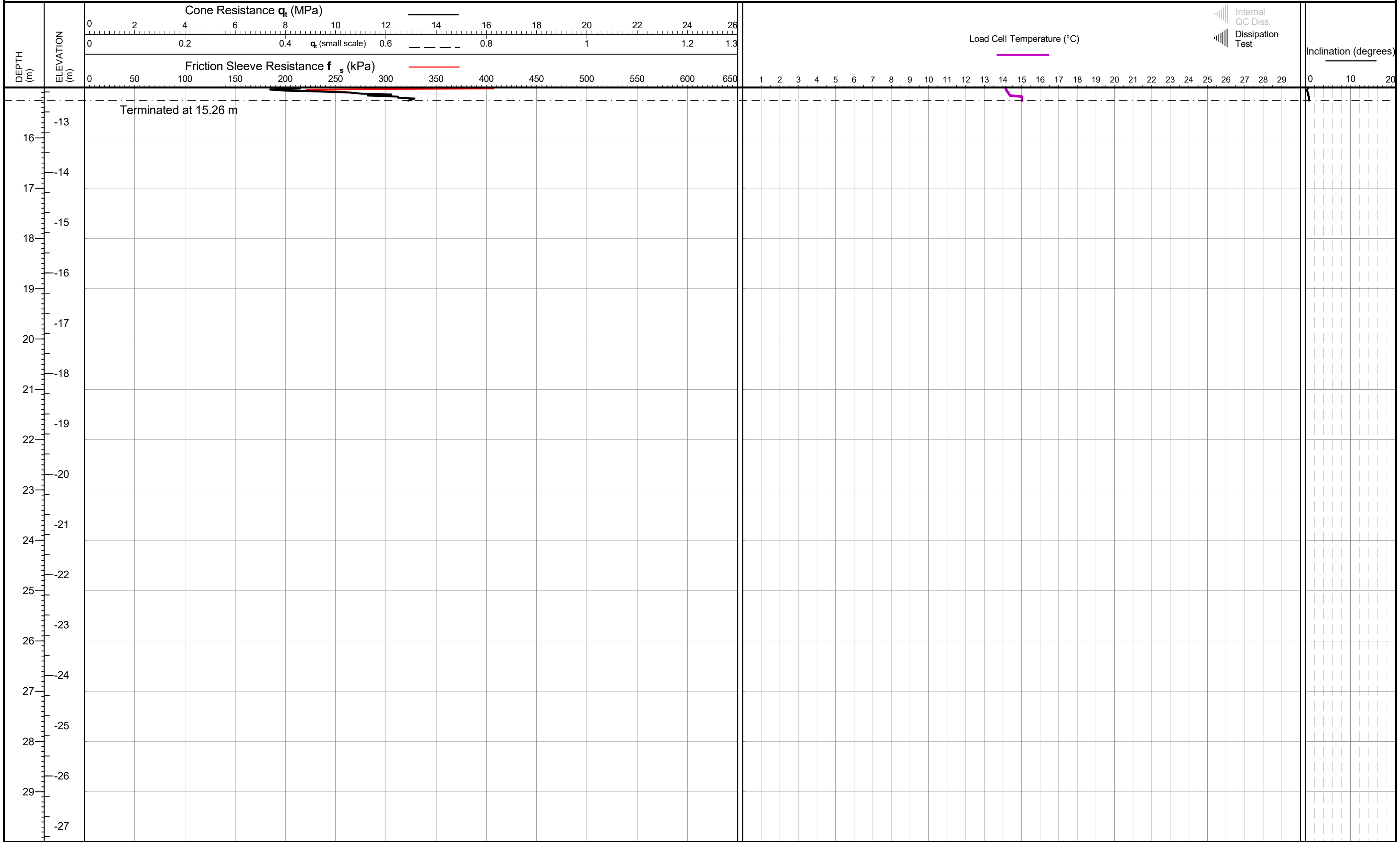
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 10:26:25	Zero drift (Pre/post test) q_c (kPa): 27.6 f_s (kPa): 0.3 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 516972.019, 417047.79 Elevation: 2.686 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



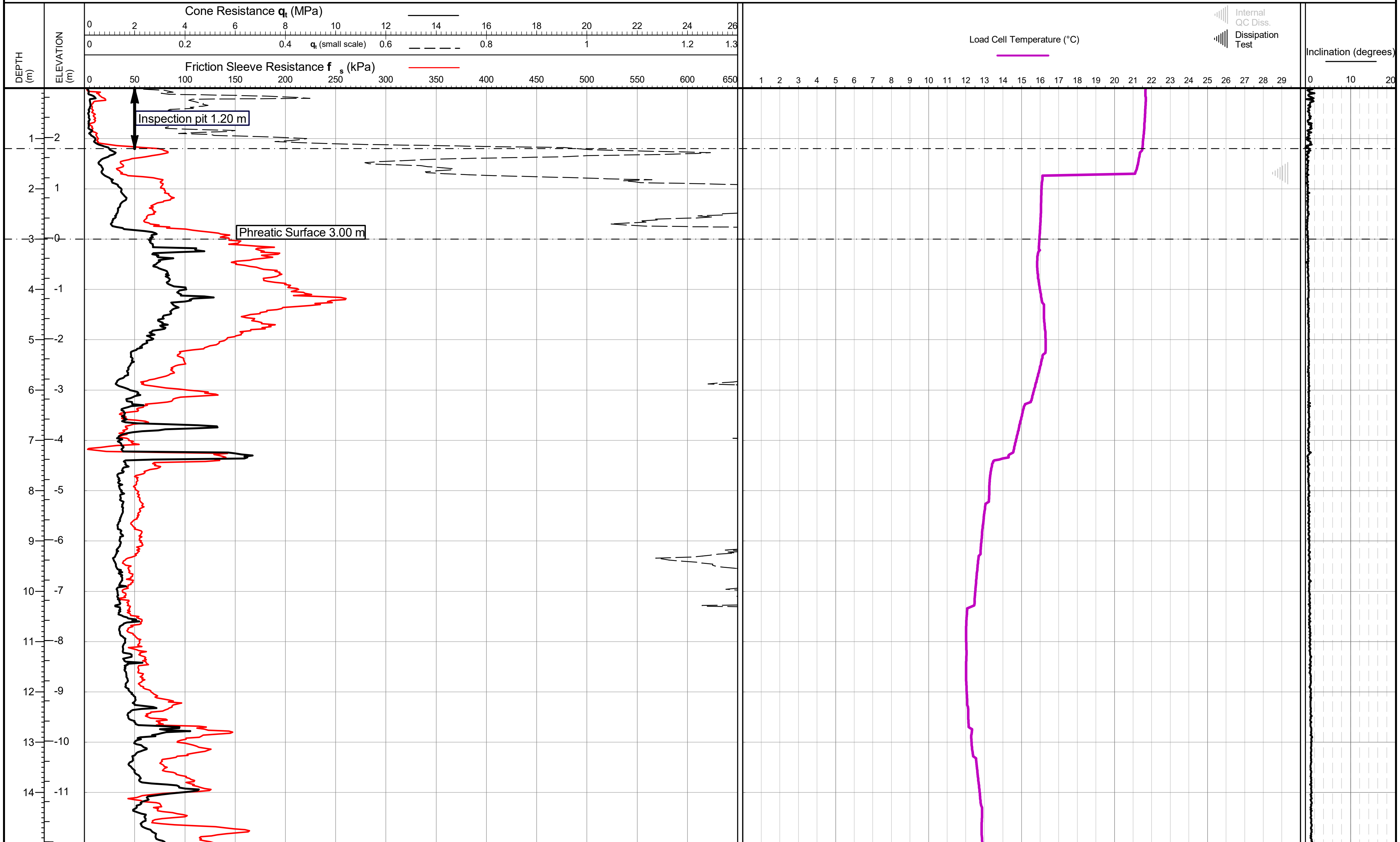
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 10:26:25	Zero drift (Pre/post test) q_c (kPa): 27.6 f_s (kPa): 0.3 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 0.6	Location: Lincolnshire, UK Coordinates: 516972.019, 417047.79 Elevation: 2.686 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT10

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

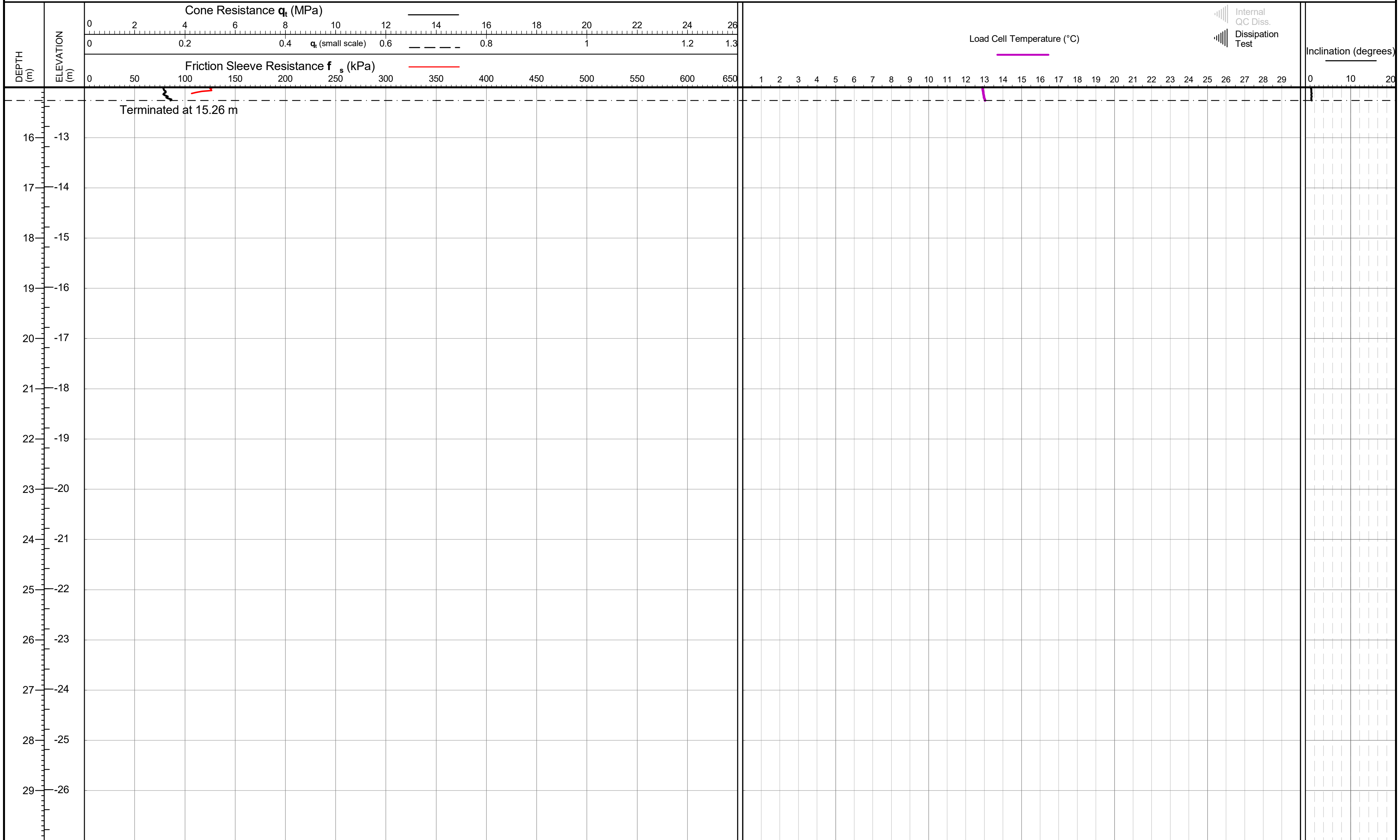


Cone area (mm2):	Zero drift (Pre/post test)	Location: Lincolnshire, UK	Remarks:	Date of plot:	Lankelma Project Ref:	**TEST ID: CPT11**
Cone ID: S15-CFIPTT.1646	q_c (kPa): 13.8	Coordinates: 516887.009, 416995.047	*Phreatic surface origin: Arbitrary value	31-10-22	P-108071-1	
Operator: Michelle Harper	f_s (kPa): -2.0 ($f_{s\ drift}$ - $q_{c\ drift}$)	Elevation: 2.979		Checked by:		Page 1 of 2
Rig Used: UK15	u_2 (kPa): -2.4	Coordinate system:	Termination Remark: Target depth	Chris Player		
Date of test: 13/09/2022 09:30:06						

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



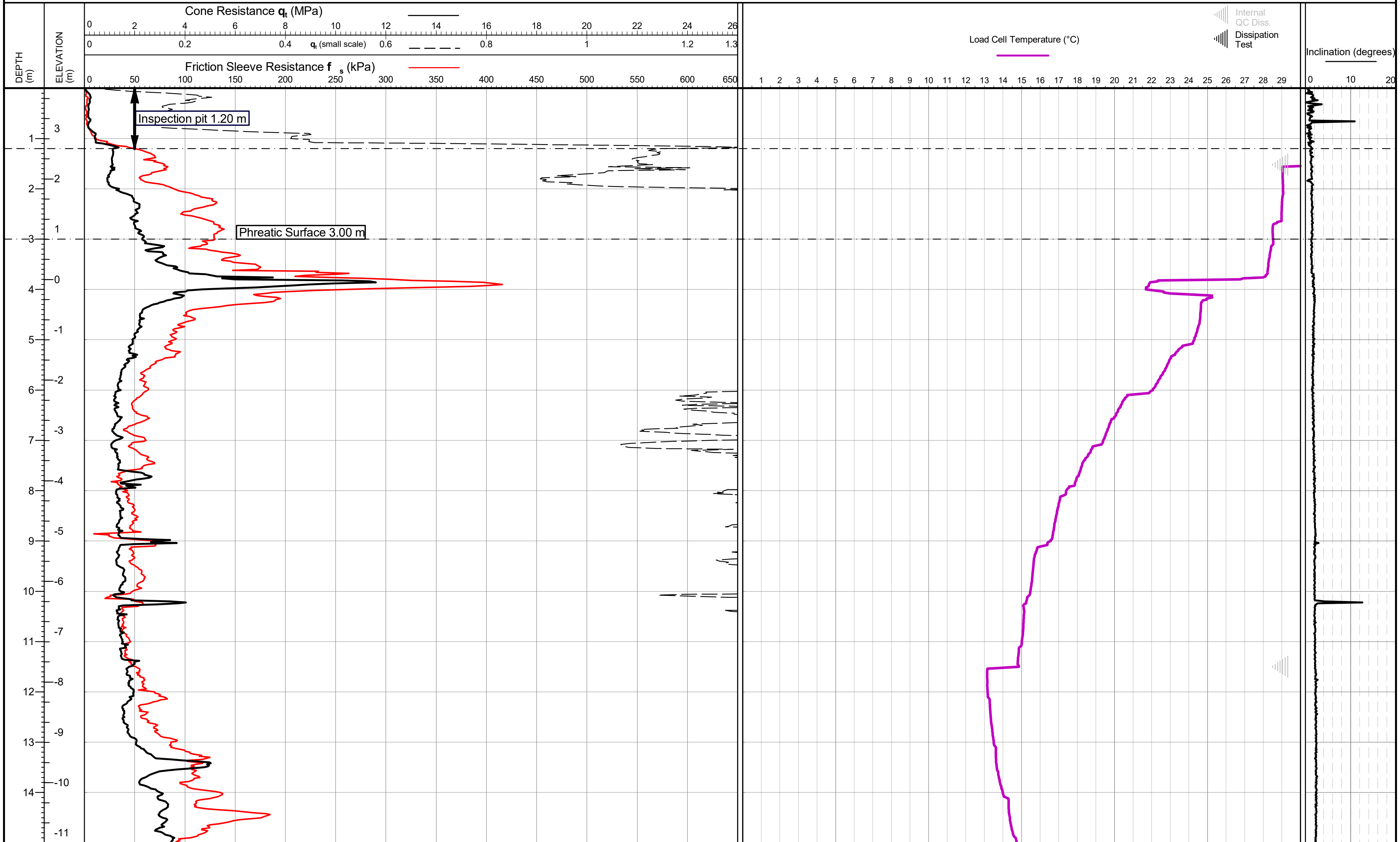
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 13/09/2022 09:30:06	Zero drift (Pre/post test) q_c (kPa): 13.8 f_s (kPa): -2.0 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -2.4	Location: Lincolnshire, UK Coordinates: 516887.009, 416995.047 Elevation: 2.979 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT11

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



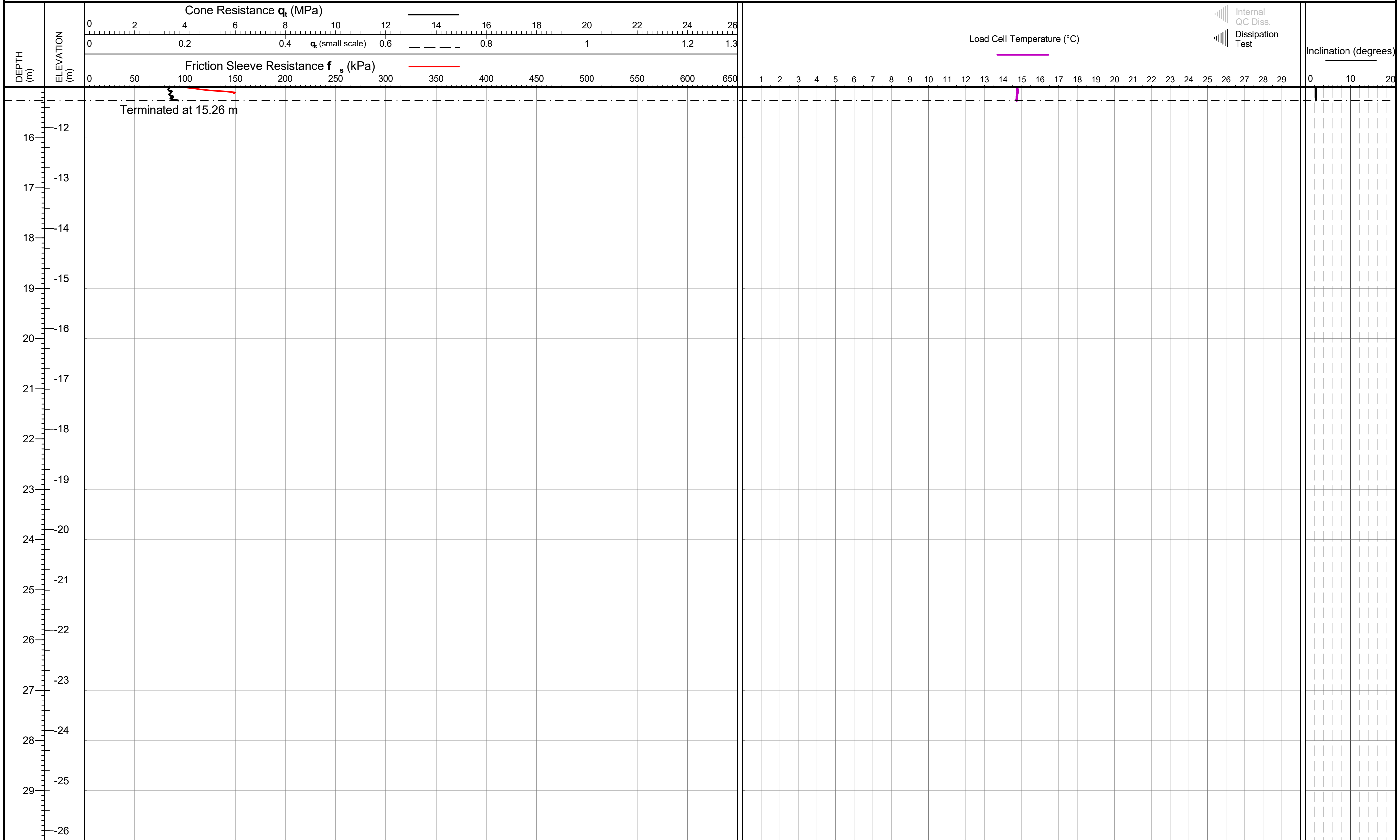
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 10:25:48	Zero drift (Pre/post test) q_c (kPa): 1.4 f_s (kPa): -1.8 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -1.1	Location: Lincolnshire, UK Coordinates: 516904.912, 417064.974 Elevation: 3.804 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT14

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



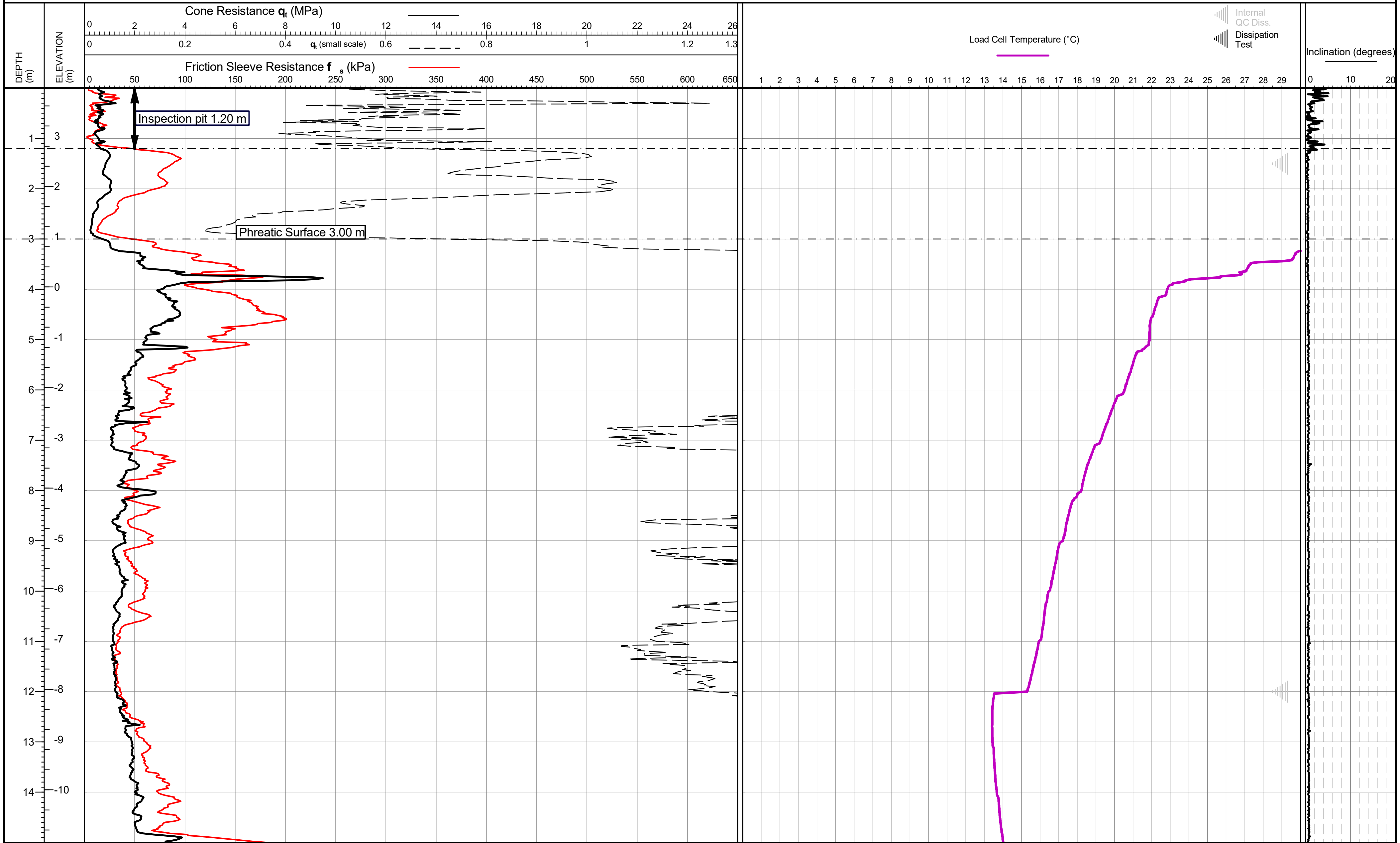
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 10:25:48	Zero drift (Pre/post test) q_c (kPa): 1.4 f_s (kPa): -1.8 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -1.1	Location: Lincolnshire, UK Coordinates: 516904.912, 417064.974 Elevation: 3.804 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT14

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



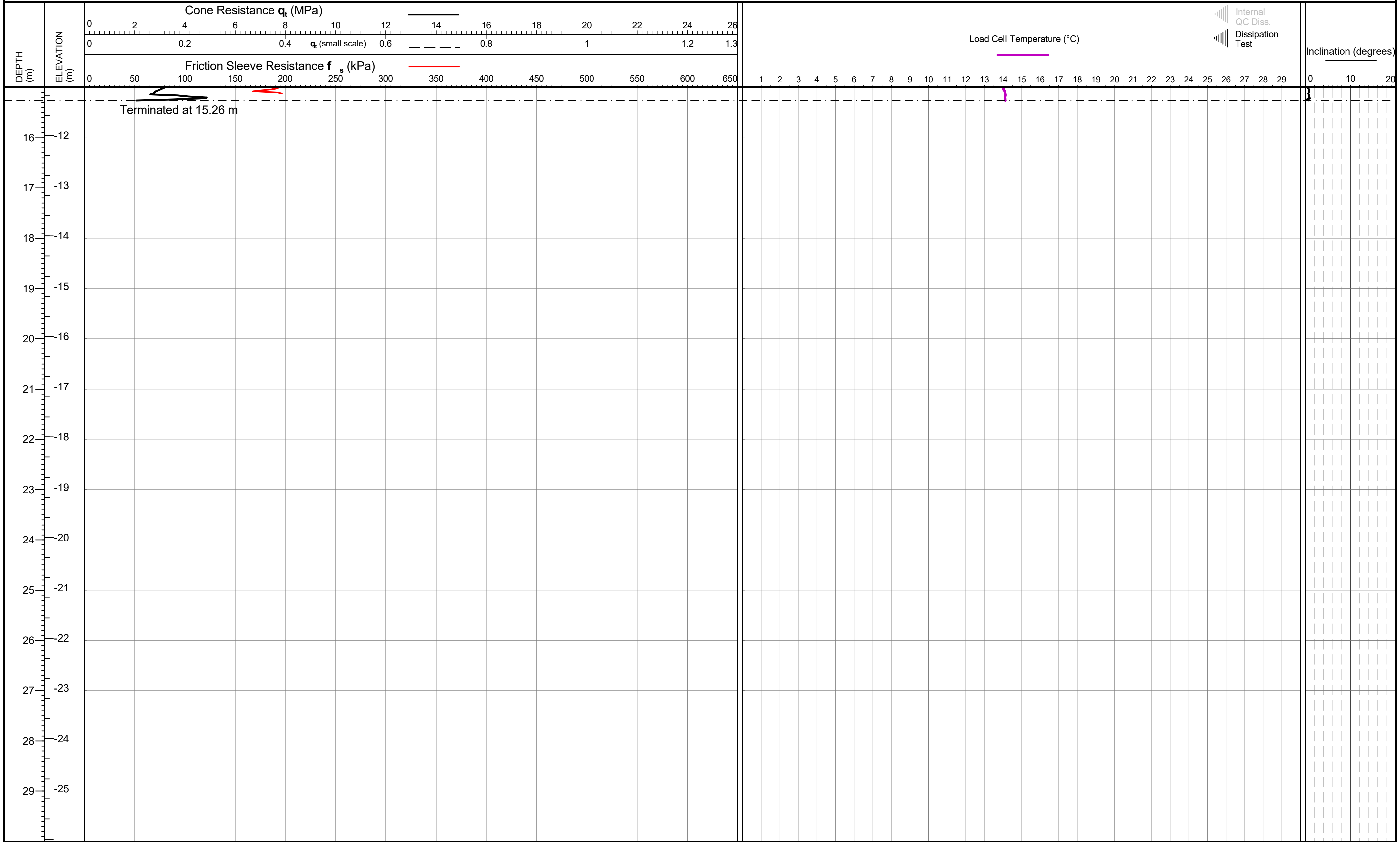
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 15:51:04	Zero drift (Pre/post test) q_c (kPa): -11.4 f_s (kPa): -0.5 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.2	Location: Lincolnshire, UK Coordinates: 516774.966, 416987.078 Elevation: 3.953 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT15

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

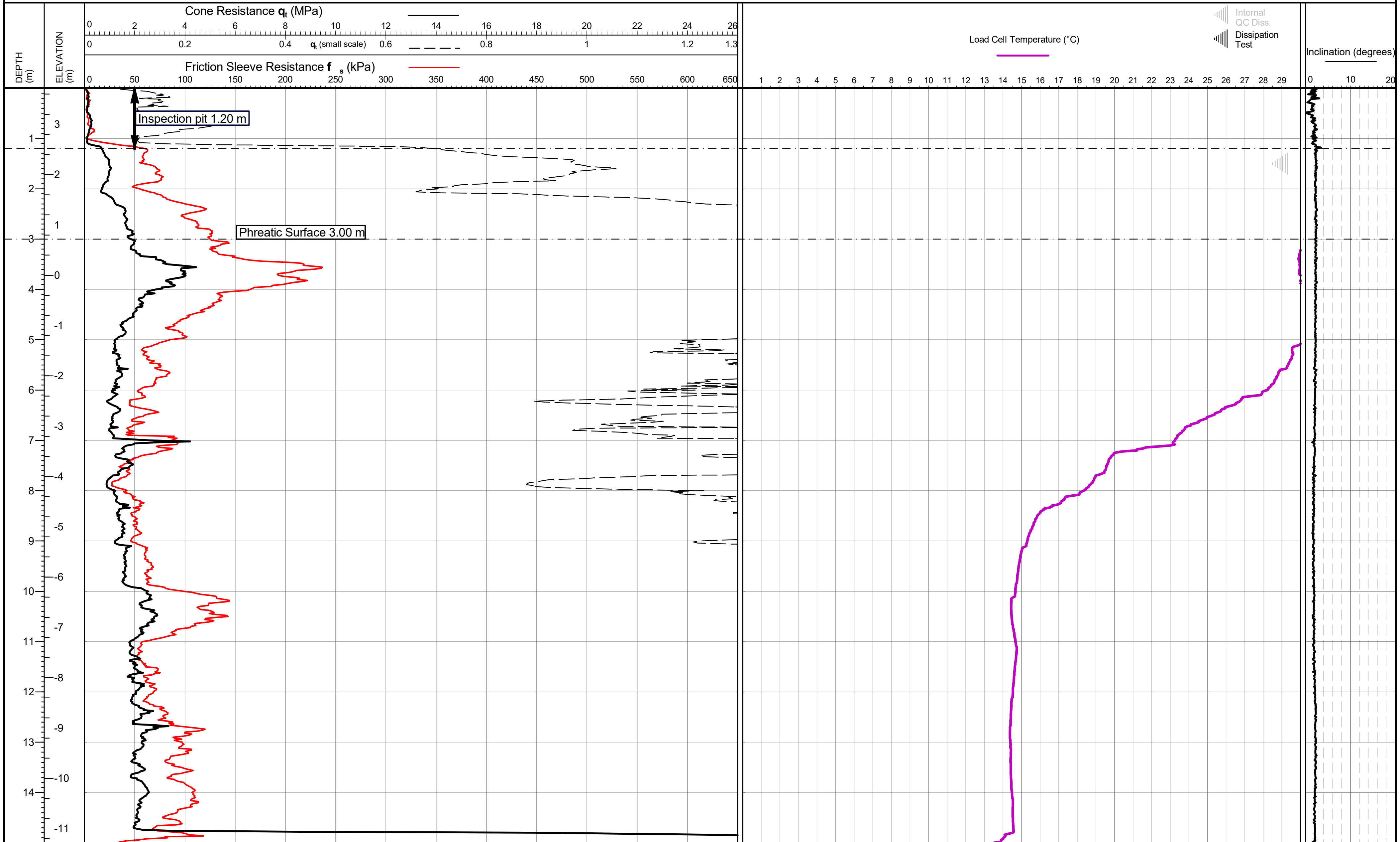
Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Jamie Butterworth Rig Used: UK15 Date of test: 12/09/2022 15:51:04	Zero drift (Pre/post test) q_c (kPa): -11.4 f_s (kPa): -0.5 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): -0.2	Location: Lincolnshire, UK Coordinates: 516774.966, 416987.078 Elevation: 3.953 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT15

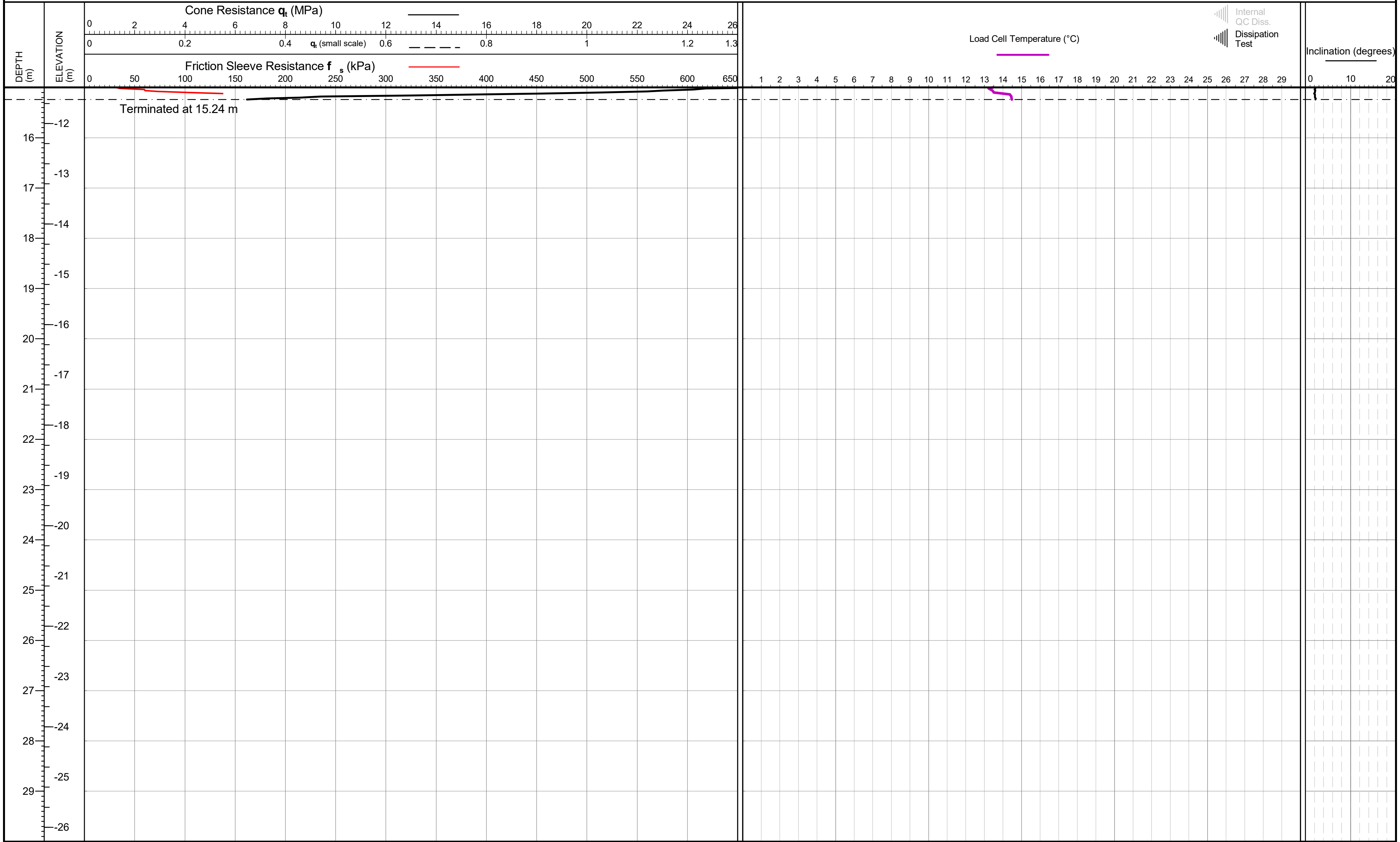
Project: HUMBER ZERO VPI IMMINGHAM
Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 14:52:09	Zero drift (Pre/post test) q_c (kPa): -10.8 f_s (kPa): 0.5 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 1.1	Location: Lincolnshire, UK Coordinates: 516646.925, 416909.913 Elevation: 3.718 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Lankelma Project Ref: P-108071-1 Checked by: Chris Player	**TEST ID: CPT16** Page 1 of 2

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



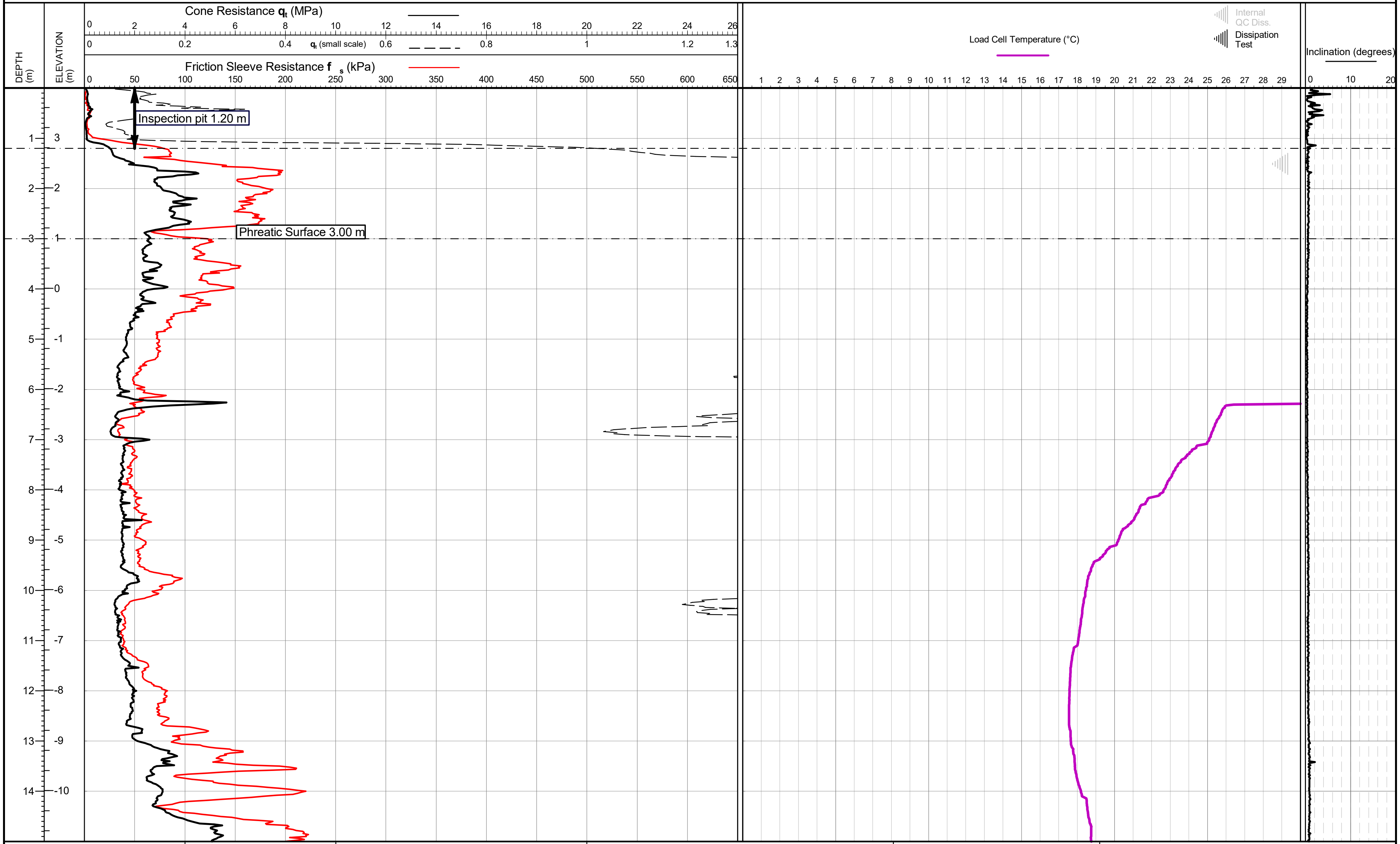
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 14:52:09	Zero drift (Pre/post test) q_c (kPa): -10.8 f_s (kPa): 0.5 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 1.1	Location: Lincolnshire, UK Coordinates: 516646.925, 416909.913 Elevation: 3.718 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT16

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

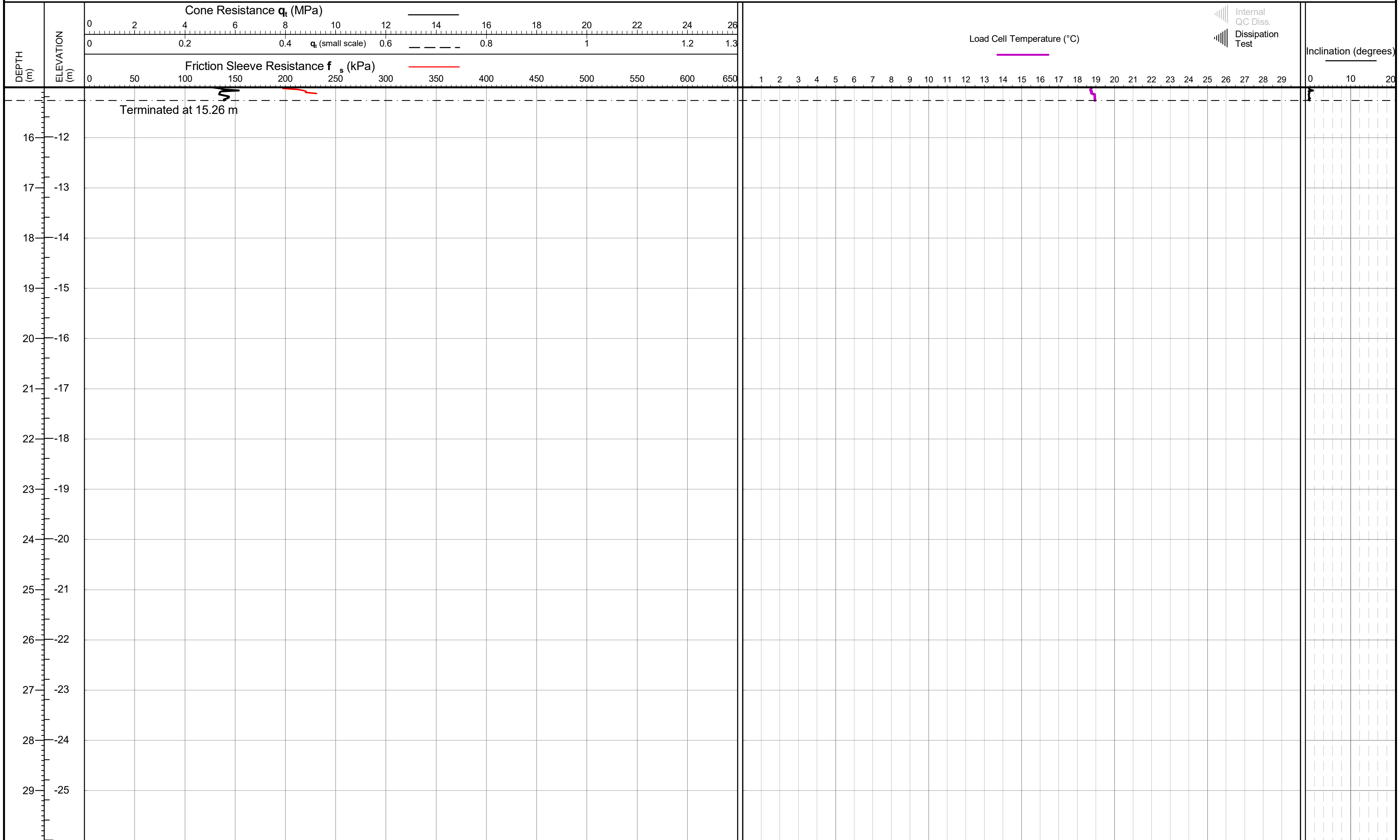


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 11:43:23	Zero drift (Pre/post test) q_c (kPa): -7.6 f_s (kPa): 1.2 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): 0.4	Location: Lincolnshire, UK Coordinates: 516797.98, 417045.885 Elevation: 3.986 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT18** Page 1 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2):
Cone ID: S15-CFIPTT.1646
Operator: Michelle Harper
Rig Used: UK15
Date of test: 12/09/2022 11:43:23

Zero drift (Pre/post test)
q_c (kPa): -7.6
f_s (kPa): 1.2 ($f_{s\,drift} - q_{c\,drift}$)
u_2 (kPa): 0.4

Location: Lincolnshire, UK
Coordinates: 516797.98, 417045.885
Elevation: 3.986
Coordinate system:

Remarks:
*Phreatic surface origin: Arbitrary value

Termination Remark: Target depth

Date of plot:
31-10-22

Checked by:
Chris Player

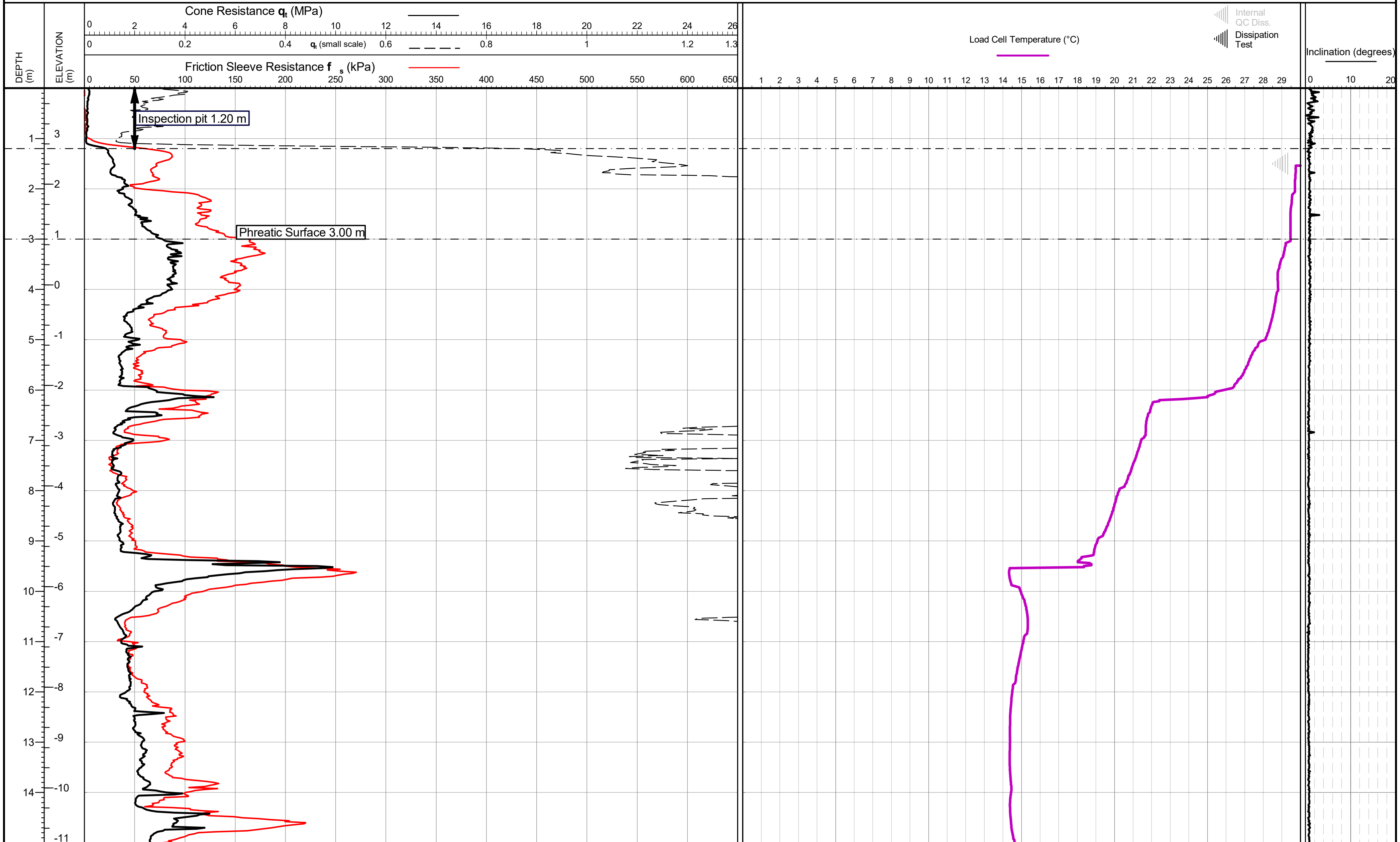
Lankelma Project Ref:
P-108071-1

TEST ID: CPT18

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS

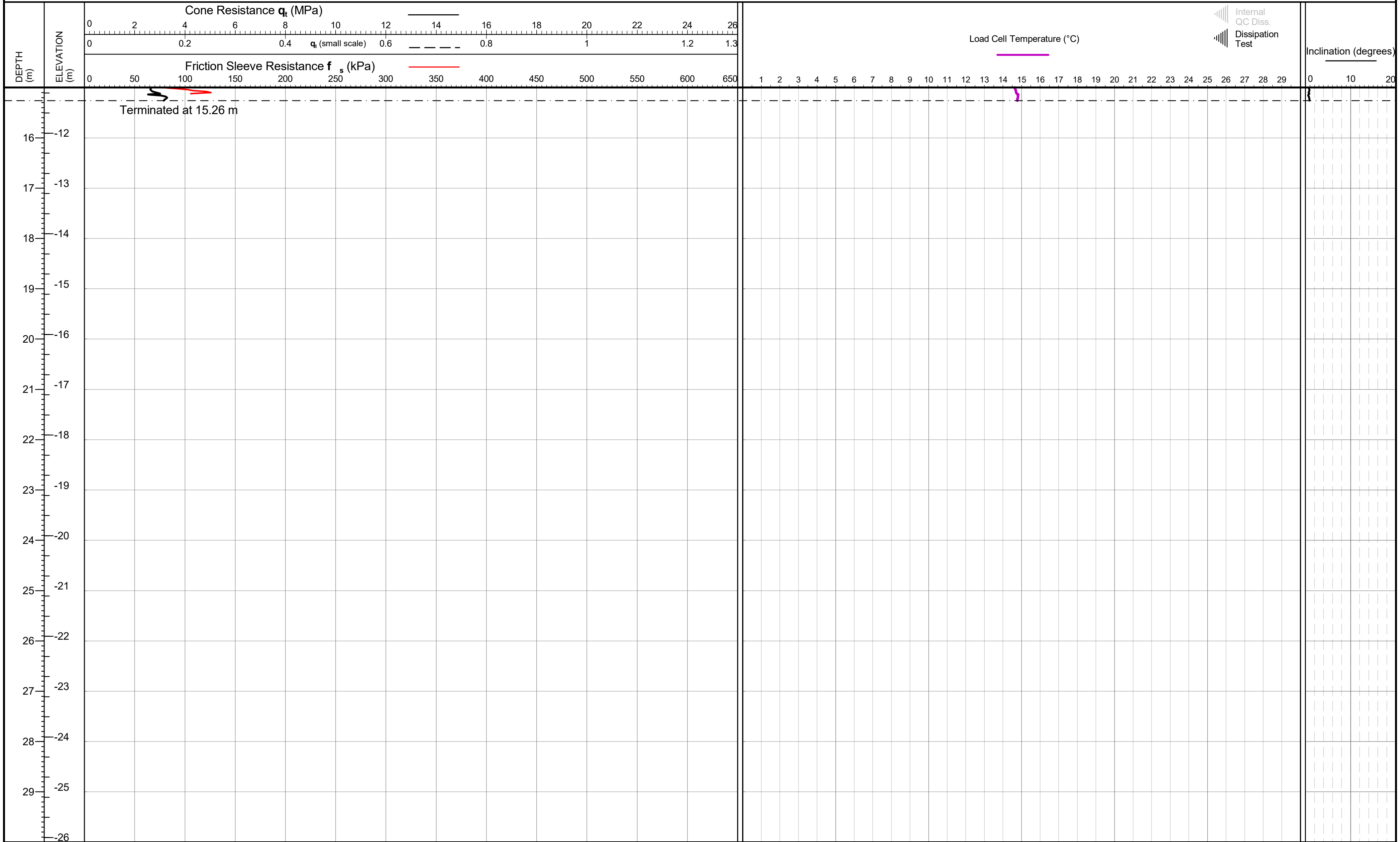


Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 12:49:35	Zero drift (Pre/post test) q_c (kPa): -3.2 f_s (kPa): -0.4 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 3.6	Location: Lincolnshire, UK Coordinates: 516703.892, 416993.845 Elevation: 3.908 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1	**TEST ID: CPT19** Page 1 of 2

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



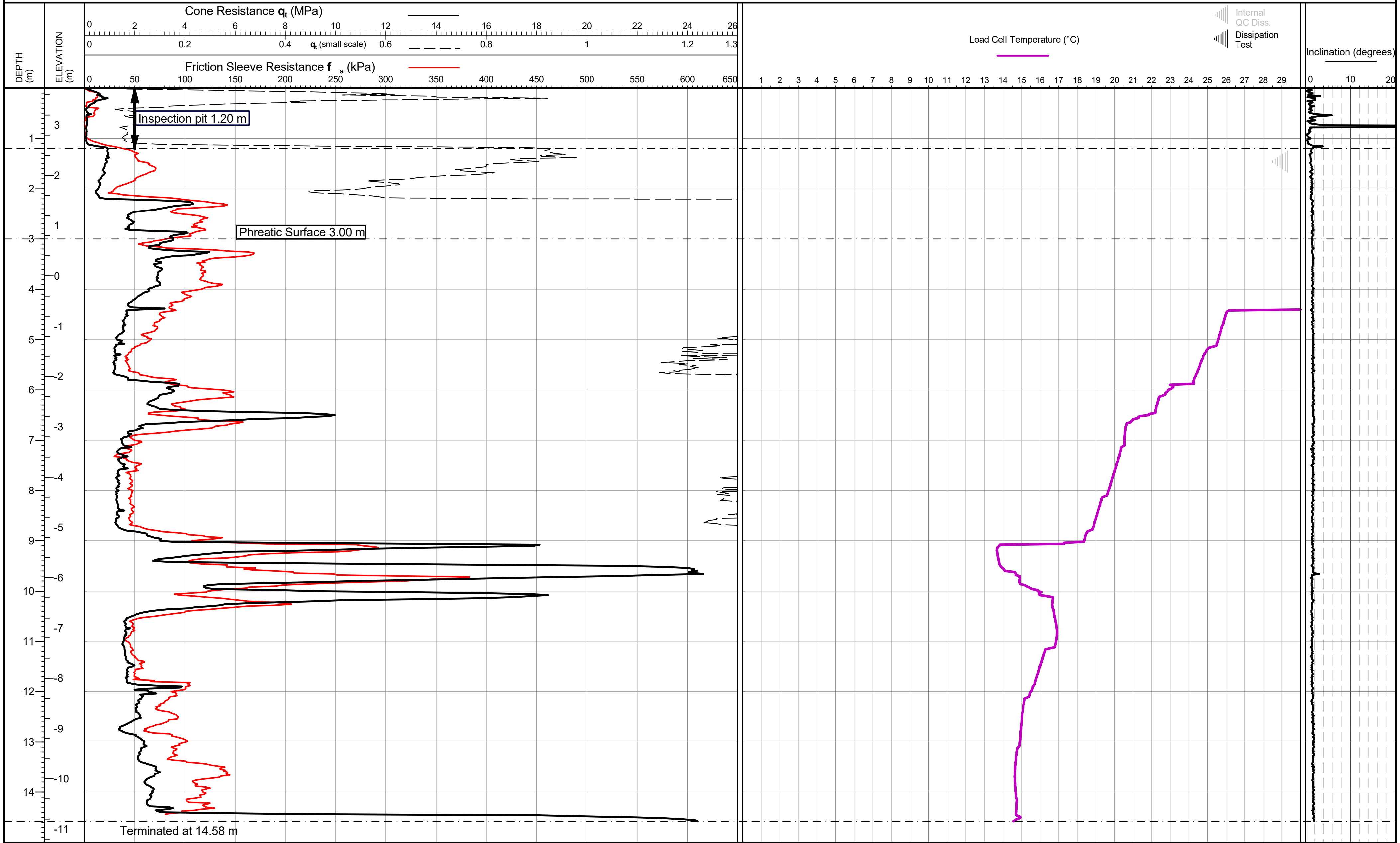
Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 12:49:35	Zero drift (Pre/post test) q_c (kPa): -3.2 f_s (kPa): -0.4 ($f_{s\ drift}$ - $q_{c\ drift}$) u_2 (kPa): 3.6	Location: Lincolnshire, UK Coordinates: 516703.892, 416993.845 Elevation: 3.908 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Target depth	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT19

LANKELMA

Project: HUMBER ZERO VPI IMMINGHAM

Client: GEOTECHNICS



Cone area (mm2): Cone ID: S15-CFIPTT.1646 Operator: Michelle Harper Rig Used: UK15 Date of test: 12/09/2022 13:50:45	Zero drift (Pre/post test) q_c (kPa): 9.2 f_s (kPa): 0.8 ($f_{s\,drift}$ - $q_{c\,drift}$) u_2 (kPa): -3.0	Location: Lincolnshire, UK Coordinates: 516630.051, 416942.072 Elevation: 3.734 Coordinate system:	Remarks: *Phreatic surface origin: Arbitrary value Termination Remark: Lateral support at surface	Date of plot: 31-10-22 Checked by: Chris Player	Lankelma Project Ref: P-108071-1

TEST ID: CPT20

5

APPENDIX 5

Cable Percussion Borehole Records, SPT Results Summary Sheets and SPT Hammer Energy Test Reports

DATA SHEET - Symbols and Abbreviations used on Records

Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecone Probe Test
PID	Photo Ionisation Detection (ppm)
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content

(All other strengths from undrained triaxial testing)

S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/- (mm)	Total blows/penetration
( )	Extrapolated value

Groundwater

Water Strike

Depth Water Rose To

Instrumentation

Seal

Filter

Seal

Strata — Legend

Made Ground Granular

Made Ground Cohesive

Topsoil

Cobbles and Boulders

Gravel

Sand

Silt

Clay

Peat

Note: Composite soil types shown by combined symbols

Chalk

Limestone

Sandstone

Coal

Strata, Continued

Mudstone

Siltstone

Metamorphic Rock

Fine Grained

Medium Grained

Coarse Grained

Igneous Rock

Fine Grained

Medium Grained

Coarse Grained

Backfill Materials

Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	Fractures/metre
FRACTURE SPACING (m)	Maximum Minimum
NA	Non-applicable
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss

(where core recovery is unknown it is assumed to be at the base of the run)

BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH01
Client	VPI Immingham Limited	**National Grid Coordinates**	516692.1 E 416936.9 N	**Ground Level**	3.73 m OD

Sampling / Properties

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N
0.00 - 0.10	B				
0.10 - 0.20	B				
0.15	D				
	ES				
0.20 - 0.60	B				
0.30	D				
0.50	ES				
0.60 - 1.00	B				
1.00	D				
	ES				
1.20	D			41	
	ES				
1.55 - 2.00	UT10	1.50 (DRY)			
2.00 - 2.15	D				
2.50 - 3.00	D				
3.00	D				
3.05 - 3.50	D				
3.05 - 3.50		3.00 (DRY)			S11
4.00	D				
4.00 - 4.40	B				
4.55	U				
4.55 - 5.00	UT16	3.00 (DRY)			
5.00 - 5.15	D			11	
6.00	D				
6.05 - 6.50	B				
6.05 - 6.50		3.00 (DRY)			S11
7.00	D				
7.55 - 8.00	UT15	3.00 (DRY)			
8.00 - 8.15	D				
8.00 - 8.50	B				
8.90	EW				
9.00	D				
9.05 - 9.50	UT9	9.00 (DRY)			
9.50 - 9.65	D				
10.00	D			14	

Strata — Scale 1:50

Description	Depth	Legend	Level (m OD)
MADE GROUND: Cream sandy clayey subangular to subrounded fine to coarse gravel of sandstone, chalk, clinker and concrete. Frequent rootlets.	0.10		3.63
MADE GROUND: Dark grey gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of mudstone, sandstone, chalk, clinker and concrete.	0.20		3.53
MADE GROUND: White very sandy clayey subangular to subrounded fine to coarse gravel of sandstone, chalk, flint, clinker and concrete. Some fragments of plastic. At 0.40m, geotextile.	0.60		3.13
Soft to firm brownish grey mottled orange and brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone and chalk. Some rootlets. Below 1.20m, brown mottled orange and grey.	2.20		1.53
Firm brown mottled orange and black slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and chalk. Below 4.40m, dark greyish brown. Gravel includes mudstone and siltstone.	9.90		-6.17
Firm to stiff brown sandy CLAY with frequent lenses of sand. At 9.90m, lens of brown fine to medium sand.			

Boring

Depth	Hole Dia.	Technique	Crew
1.20	0.40	Inspection Pit	CR/BB
17.50	0.20	Cable Percussion	CR/BB
21.75	0.15	Cable Percussion	CR/BB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
0.00			07/09/22	08:00
7.00	7.00	DRY	07/09/22	18:00
7.00	7.00	DRY	08/09/22	08:00
13.15	10.50	DRY	08/09/22	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
9.90	9.00	8.90	20	10.50	Moderate inflow.
14.90	13.50	1.70	20		Fast inflow.

Remarks AGS

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
Borehole terminated at 21.75m depth upon encountering bedrock.
A 50mm standpipe was installed to 10.00m with a geowrapped slotted section from 9.00m to 10.00m with a flush cover installed.
Backfill details from base of hole: bentonite seal up to 10.00m, gravel filter up to 9.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure

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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH01
Client	VPI Immingham Limited	**National Grid Coordinates**	516692.1 E 416936.9 N	**Ground Level**	3.73 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Level (m OD)
						Stiff dark brownish grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, siltstone, sandstone, chalk and flint.	10.50	-6.77
10.55 - 11.00	B							
10.55 - 11.00	D	10.50 (DRY)			S23			
11.00	D							
12.00	D							
12.00 - 12.50	B							
12.55 - 13.00	UT21	10.50 (DRY)	161					
13.00 - 13.15	D							
14.00	D							
14.00 - 14.50	B							
14.55 - 15.00	D							
14.55 - 15.00		13.50 (13.10)			S50/ 296mm			
						Brown gravelly clayey fine to coarse SAND. Gravel is angular to subangular fine to medium of mudstone, sandstone and chalk.	14.90	-11.17
14.90 - 15.40	B							
15.40	D					Stiff dark brown gravelly CLAY. Gravel is angular to subangualr fine to medium of sandstone, chalk and flint.	15.40	-11.67
15.60	D					Light brown mottled white and grey slightly sandy clayey angular to subrounded fine to medium GRAVEL of mudstone, siltstone, sandstone, quartzite, chalk and flint.	15.60	-11.87
15.60 - 16.00	B							
						Stiff to very stiff yellowish brown slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone, siltstone, sandstone and chalk.	16.00	-12.27
16.10	D							
16.55 - 17.00	UT32	16.00 (2.00)						
17.00	EW							
17.00 - 17.15	D							
17.20 - 17.55	B					Below 17.10m, gravel is predominantly of chalk.		
17.55 - 18.00	D							
17.55 - 18.00		16.00 (4.80)			S45			
						Structureless CHALK composed of dense cream clayey fine to coarse gravel. Gravel is moderately weak, high density, angular to subrounded, cream. Matrix is cream and brown. Some angular cobbles of chalk and flint. [Grade Dc].	18.00	-14.27
18.50	D							
19.55 - 19.82	D							
19.55 - 19.82		19.50 (8.40)			S50/ 136mm	Below 19.55m, very dense.		

Boring

Depth	Hole Dia.	Technique	Crew

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
13.15	10.50	1.20	12/09/22	08:00
21.75	21.65	8.40	12/09/22	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks AGS

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 2 of 3
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GEOTECHNICS
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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH01
Client	VPI Immingham Limited	**National Grid Coordinates**	516692.1 E 416936.9 N	**Ground Level**	3.73 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
20.50	D								
20.80 - 21.10	D								
20.80 - 21.10		20.75 (8.10)			S50/ 150mm				
21.70 - 21.75	#								
21.70 - 21.75		21.65 (8.40)			S50/ 36mm	End of Borehole	21.75		-18.02

Boring

Depth	Hole Dia.	Technique	Crew

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks AGS

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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Figure Sheet 3 of 3

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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH02
Client	VPI Immingham Limited	**National Grid Coordinates**	516989.6 E 417116.4 N	**Ground Level**	3.87 m OD

Scale 1:50

Sampling Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Strata Description	Depth	Legend	Level (m OD)
0.00 - 0.17	B					MADE GROUND: Light yellowish brown gravelly fine to coarse sand with some rootlets. Gravel is angular to subangular fine to coarse of limestone, sandstone and concrete.	0.17		3.70
0.15	ES					MADE GROUND: Grey concrete.	0.27		3.60
0.27 - 0.60	B					MADE GROUND: Light brown sandy clayey subangular to subrounded fine to coarse gravel of sandstone, mudstone, limestone, chalk, clinker and concrete. Frequent pockets of firm reddish brown mottled black clay. Occasional rootlets. At 0.60m, geotextile.	0.60		3.27
0.50	ES					MADE GROUND: Brown very sandy clayey subangular to subrounded fine to coarse gravel of chalk, sandstone, clinker, slag and concrete. At 0.90m, concrete slab.	0.90		2.97
0.60 - 0.90	B					End of Borehole			
0.80	ES								

Boring

Depth	Hole Dia.	Technique	Crew
0.90	0.30	Inspection Pit	CR/BB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
0.00			05/09/22	08:00
0.90		DRY	05/09/22	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks AGS

Inspection pit hand excavated to 0.90m depth and no services were found.
ES sample = 2 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
Inspection pit terminated at 0.90m depth due to the presence of a concrete obstruction. The drilling equipment was moved to the location of BH02A.
Inspection pit backfilled with arisings.

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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Figure Sheet 1 of 1
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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH02A
Client	VPI Immingham Limited	**National Grid Coordinates**	516986.8 E 417107.8 N	**Ground Level**	3.76 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N
0.00 - 0.15	B				
0.10	D				
0.15 - 0.30	B				
0.20	D				
0.25	ES				
0.30 - 0.60	B				
0.40	D			15	
0.50	ES				
0.60 - 1.00	B				
0.70	D				
1.00	ES				
1.20 - 1.65	U18	(DRY)			
1.70	D				
1.80	ES				
2.00 - 2.50	B				
2.60	D			17	
2.75 - 3.20	D				
2.75 - 3.20		1.50 (DRY)			S24
3.70	D				
4.00 - 4.30	B				
4.30 - 4.80	U16	3.00 (DRY)			
4.80 - 4.95	D				
5.70	D				
5.80 - 6.25	D				
5.80 - 6.25		4.30 (DRY)			S14
6.25 - 6.70	B				
6.70	D				
7.30 - 7.75	U11	6.00 (DRY)			
7.75 - 7.90	D			15	
8.00 - 8.50	B				
8.70	D				
8.85 - 9.30	D				
8.85 - 9.30		7.50 (DRY)			S14
9.70	D				
10.00 - 10.50	B				

Description	Depth	Level (m OD)
TOPSOIL: Light yellowish brown sandy clayey subangular to subrounded fine to coarse gravel of limestone, sandstone and mudstone. Some rootlets.	0.15	3.61
MADE GROUND: Brown gravelly slightly clayey fine to coarse sand. Gravel is subangular to subrounded fine to medium of sandstone, mudstone, quartzite, limestone and clinker. Occasional fragments of plastic.	0.40	3.36
MADE GROUND: Stiff brown gravelly clay with a low subangular cobble content of clinker. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone, quartzite, limestone and clinker. At 0.70m, dark brown.	1.70	2.06
Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone, quartzite and chalk.	3.70	0.06
Stiff reddish brown mottled grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone, quartzite and chalk. Below 4.50m, dark reddish brown mottled dark grey. Below 5.80m, firm.		

Boring

Depth	Hole Dia.	Technique	Crew
1.20	0.30	Inspection Pit	CR/BB
19.00	0.20	Cable Percussion	CR/BB
23.08	0.15	Cable Percussion	CR/BB

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
0.00			05/09/22	08:00
2.00	2.00	DRY	05/09/22	18:00
2.00	2.00	DRY	06/09/22	08:00
21.50	21.00	4.00	06/09/22	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
7.00	7.00	No rise.			Seepage.
13.10	13.10	No rise.			Seepage.
18.70	13.50	3.90	20		Fast inflow.

Remarks AGS

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 2 x 60ml glass vial, 2 x 258ml amber glass jar and 1 x 1L plastic tub.
Borehole terminated at 23.31m depth upon encountering bedrock.
A 50mm standpipe was installed to 19.40m with a geowrapped slotted section from 19.40m to 18.40m with a flush cover installed.
Backfill details from base of hole: bentonite seal up to 19.40m, gravel filter up to 18.40m, bentonite seal up to 0.50m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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Figure Sheet 1 of 3
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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH02A
Client	VPI Immingham Limited	**National Grid Coordinates**	516986.8 E 417107.8 N	**Ground Level**	3.76 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
10.55 - 11.00	U11	7.50 (DRY)	116						
11.00 - 11.15	D								
11.80	D								
12.00 - 12.50	B								
12.55 - 13.00	D					At 12.55m, stiff.			
12.55 - 13.00		7.50 (DRY)			S28				
13.10	D					Between 13.10-13.20m, band of yellowish brown slightly gravelly clayey sand.	13.20		-9.44
13.40	D					Stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fines of chalk.			
14.00 - 14.50	B								
14.55	UT								
14.55 - 15.00	U21	13.50 (DRY)							
15.00 - 15.15	D			18					
16.00	D								
16.00 - 16.50	B								
16.55 - 17.00	D					At 16.55m, very stiff.			
16.55 - 17.00		13.50 (DRY)			S31				
17.00	D								
18.00 - 18.50	D								
18.05	D								
						Greyish brown sandy slightly clayey angular to subrounded fine to coarse GRAVEL of chalk, sandstone and flint.	18.20		-14.44
18.55 - 19.00	UF								
18.80	D					Structureless CHALK composed of dense cream sandy angular to subangular gravel. Gravel is moderately weak, high density, white, some flint. Matrix is brown. [Grade Dc]. Below 19.05m, much flint.	18.70		-14.94
19.05 - 19.50	D			16					
19.05 - 19.50		13.50 (3.90)			S33				
						Structureless CHALK composed of stiff light grey gravelly sandy silt. Gravel is weak, high density, white, some flint. [Grade Dm].	19.40		-15.64
19.80	D								

Boring | **Progress** | **Groundwater**

Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
				21.50	21.00	3.20	07/09/22	08:00						
				23.08	22.85	7.00	07/09/22	18:00						

Remarks AGS

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure

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GEOTECHNICS
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BORHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH02A
Client	VPI Immingham Limited	**National Grid Coordinates**	516986.8 E 417107.8 N	**Ground Level**	3.76 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
20.80	D								
21.05 - 21.50	B								
21.05 - 21.44	D	21.00 (4.00)			S50/ 239mm	At 21.05m, very stiff.			
						Structureless CHALK composed of dense cream sandy angular to subangular gravel. Gravel is moderately weak, high density, white, some flint. Matrix is cream and brown. [Grade Dc].	21.50		-17.74
22.00	D								
22.90 - 23.31	D					Structureless CHALK composed of very stiff light grey and cream gravelly sandy silt. Gravel is weak, high density, white, subangular, some flint. [Grade Dm].	22.90		-19.14
22.90 - 23.08		22.85 (7.00)			S50/ 55mm	End of Borehole	23.08		-19.32

Boring

Depth	Hole Dia.	Technique	Crew

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks AGS

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 3 of 3
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GEOTECHNICS
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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH05
Client	VPI Immingham Limited	**National Grid Coordinates**	517093.8 E 416946.0 N	**Ground Level**	2.54 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N
0.00 - 0.30	B				
0.10 - 0.20	D				
0.30 - 0.40	D				
	ES				
0.30 - 0.50	B				
0.50 - 0.60	D			37	
	ES				
1.00 - 1.10	D				
	ES				
1.20 - 1.30	D			29	
1.20 - 1.50	B				
1.50 - 1.95	UT20	1.50 (DRY)			
1.95 - 2.00	D				
2.00 - 2.10	D			27	
	ES				
2.00 - 2.50	B				
2.50 - 2.60	D				
2.50 - 2.80	B				
2.80 - 3.25	D				
2.80 - 3.25		2.80 (DRY)			S28
3.30 - 3.40	D				
	ES				
4.20 - 4.30	D			20	
4.30	U				
4.30 - 4.75	UT60	3.00 (DRY)			
4.50 - 4.90	B				
4.75 - 4.80	D				
5.00	EW				
5.30 - 5.40	D				
6.00 - 6.45	D				
6.00 - 6.45		3.00 (DRY)			S22
6.50 - 6.80	B				
7.00 - 7.10	D				
7.60 - 8.05	UT70	3.00 (DRY)			
8.05 - 8.10	D				
8.50 - 8.80	B				
8.80 - 8.90	D				
9.00 - 9.45	D				
9.00 - 9.45		3.00 (DRY)			S16
9.80 - 9.90	D				

Description	Depth	Legend	Level (m OD)
MADE GROUND: Light brown sandy clayey angular to subangular fine to coarse gravel of mudstone, sandstone and chalk. Medium subangular cobble content. Many rootlets.	0.30		2.24
Stiff reddish brown mottled dark grey slightly sandy CLAY. Below 0.50m, firm.	1.20		1.34
Firm dark greyish brown slightly gravelly organic CLAY with frequent pockets of organic material. Gravel is subangular to subroudned fine of sandstone.	1.80		0.74
Firm yellowish brown slightly gravelly sandy organic CLAY. Gravel is subangular to subrounded fine of sandstone and quartzite.	2.50		0.04
Stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone, sandstone and chalk. Occasional pockets of decayed organic material. Below 3.30m, organic pockets absent. At 9.00m, firm.			

Boring

Depth	Hole Dia.	Technique	Crew
1.20	0.40	Inspection Pit	DC
13.00	0.20	Cable Percussion	DC
22.00	0.15	Cable Percussion	DC

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
0.00			12/09/22	08:00
13.00	13.00	11.50	12/09/22	18:00
13.00	13.00	10.50	13/09/22	08:00
22.00	22.00	4.50	13/09/22	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
12.50	3.00	11.50	20	13.30	Slow inflow.
15.00	13.30	5.00	20		Fast inflow.

Remarks AGS

Inspection pit hand excavated to 1.20m depth and no services were found.
ES sample = 1 x 60ml glass vial, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
Borehole terminated at 22.00m depth upon encountering bedrock.

Logged by JZW

Figure Sheet 1 of 3
18/11/2022

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH05
Client	VPI Immingham Limited	**National Grid Coordinates**	517093.8 E 416946.0 N	**Ground Level**	2.54 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Level (m OD)
10.50	EW							
10.50 - 10.95	UT55	3.00 (DRY)						
10.50 - 11.00	B							
10.95 - 11.00	D							
11.80 - 11.90	D					Below 11.80m, sandy.		
12.50 - 12.95	#					At 12.50m, band of brown fine sand.		
12.50 - 13.20	B							
12.50 - 12.95		3.00 (11.50)			S20			
13.00 - 13.10	D					Brown silty fine SAND.	13.00	-10.46
13.20 - 13.30	D					Stiff dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone, sandstone and chalk.	13.20	-10.66
13.20 - 13.50	B							
13.50 - 13.95	UT70	13.30 (DRY)						
13.95 - 14.00	D			16				
14.70 - 14.80	D							
15.00 - 15.10	D					Medium dense brown slightly clayey angular to subangular fine to coarse GRAVEL of mudstone, chalk and flint.	15.00	-12.46
15.10 - 15.55	B							
15.10 - 15.55		13.30 (5.00)			C19			
15.80 - 15.90	D					Stiff yellowish brown gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone and chalk.	15.80	-13.26
15.80 - 16.50	B							
16.50 - 16.95	UT80	16.50 (15.50)	90					
16.95 - 17.00	D			14		Below 16.95m, grey.		
17.50 - 17.60	D					Structureless CHALK composed of stiff light grey and white sandy gravelly silt. Gravel is weak, medium density, white, subangular. [Grade Dm].	17.50	-14.96
17.50 - 18.50	B							
18.00 - 18.45	D							
18.00 - 18.45		18.00 (12.60)			S19			
19.00 - 19.10	D			19				
19.50 - 20.50	B					Structureless CHALK composed of very dense cream sandy slightly clayey subangular to subrounded gravel. Gravel is weak, medium density, white. Matrix is white/cream. [Grade Dc].	19.50	-16.96
20.00 - 20.45	D							

Boring | **Progress** | **Groundwater**

Depth	Hole Dia.	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 2 of 3

18/11/2022

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BOREHOLE RECORD - *Cable Percussion*

Project	VPI Immingham Humber Zero PCC Feed	**Engineer**	Worley Group Limited	**Project No.**	PY220483
				Borehole	BH05
Client	VPI Immingham Limited	**National Grid Coordinates**	517093.8 E 416946.0 N	**Ground Level**	2.54 m OD

Sampling | Properties | Strata | Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w(%)	SPT N	Description	Depth	Legend	Level (m OD)
20.00 - 20.45		20.00 (4.00)			S26				
20.50 - 20.60	D					Below 20.50m, gravel include flint.			
21.50 - 21.65	D								
21.50 - 22.00	B								
21.50 - 21.65		21.50 (4.30)			S50/ 0mm				
						End of Borehole	22.00		-19.46
21.90 - 22.00	D								
22.00 - 22.00		22.00 (4.50)			C50/ 0mm				

Boring

Depth	Hole Dia.	Technique	Crew

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks AGS

Symbols and abbrevations are explained on the accompanying key sheets.
All dimensions are in metres.

Logged in accordance with BS5930:2015 + A1:2020

Logged by JZW

Figure Sheet 3 of 3
18/11/2022

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FIELDWORK RESULTS - SPT Results Summary

Project VPI Immingham Humber Zero PCC Feed **Engineer** Worley Group Limited **Project No.** PY220483

Client VPI Immingham Limited

Hole	Depth (m bgl)	Level (m OD)	SPT Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N' value
					0 - 75 (mm)	75 - 150 (mm)	0 - 75 (mm)	75 - 150 (mm)	150 - 225 (mm)	225 - 300 (mm)		10 20 30 40 50
BH01	3.05	0.68	S		2	2	2	3	3	3	11	
BH01	6.05	-2.32	S		2	2	3	2	3	3	11	
BH01	10.55	-6.82	S		3	5	5	5	6	7	23	
BH01	14.55	-10.82	S		4	7	8	10	14	18	50/296	
BH01	17.55	-13.82	S		5	8	10	10	11	14	45	
BH01	19.55	-15.82	S		6	19	17	33			50/136	
BH01	20.80	-17.07	S		11	14	17	33			50/150	
BH01	21.70	-17.97	S		25		50				50/36	

Hammer No.:	AR2475	**Remarks**
Energy Ratio, Er (%):	66	

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - SPT with split spoon sampler

C - SPT with cone

L - Split Spoon liner used

FIELDWORK RESULTS - *SPT Results Summary*

Project VPI Immingham Humber Zero PCC Feed **Engineer** Worley Group Limited **Project No.** PY220483

Client VPI Immingham Limited

Hole	Depth (m bgl)	Level (m OD)	SPT Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N' value
					0 - 75 (mm)	75 - 150 (mm)	0 - 75 (mm)	75 - 150 (mm)	150 - 225 (mm)	225 - 300 (mm)		10 20 30 40 50
BH02A	2.75	1.01	S		2	3	4	5	8	7	24	
BH02A	5.80	-2.04	S		2	2	3	3	4	4	14	
BH02A	8.85	-5.09	S		2	2	3	4	3	4	14	
BH02A	12.55	-8.79	S		3	4	5	6	8	9	28	
BH02A	16.55	-12.79	S		3	4	5	8	9	9	31	
BH02A	19.05	-15.29	S		3	3	4	6	12	11	33	
BH02A	21.05	-17.29	S		11	11	12	12	18	8	50/239	
BH02A	22.90	-19.14	S		25		50				50/55	

Hammer No.:	AR2475	**Remarks**
Energy Ratio, Er (%):	66	

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - SPT with split spoon sampler

C - SPT with cone

L - Split Spoon liner used

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FIELDWORK RESULTS - *SPT Results Summary*

Project VPI Immingham Humber Zero PCC Feed **Engineer** Worley Group Limited **Project No.** PY220483

Client VPI Immingham Limited

Hole	Depth (m bgl)	Level (m OD)	SPT Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N' value
					0 - 75 (mm)	75 - 150 (mm)	0 - 75 (mm)	75 - 150 (mm)	150 - 225 (mm)	225 - 300 (mm)		10 20 30 40 50
BH05	2.80	-0.26	S		2	4	4	7	8	9	28	
BH05	6.00	-3.46	S		2	2	4	6	6	6	22	
BH05	9.00	-6.46	S		2	2	3	4	4	5	16	
BH05	12.50	-9.96	S		1	2	2	4	6	8	20	
BH05	15.10	-12.56	C		2	3	4	5	5	5	19	
BH05	18.00	-15.46	S		1	2	3	4	4	8	19	
BH05	20.00	-17.46	S		5	6	6	6	7	7	26	
BH05	21.50	-18.96	S		5	20	50				50/0	
BH05	22.00	-19.46	C		25		50				50/0	

Hammer No.:	AR1962	**Remarks**
Energy Ratio, Er (%):	74	

-/- Blows/penetration (mm) after seating
-*/- Total blows/penetration (mm)
SWP Penetration under own weight (mm)

S - SPT with split spoon sampler
C - SPT with cone
L - Split Spoon liner used

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SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

CRAIG'S RIG

SYD 06

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref:	AR2475
Test Date:	08/11/2021
Report Date:	08/11/2021
File Name:	AR2475.spt
Test Operator:	KM

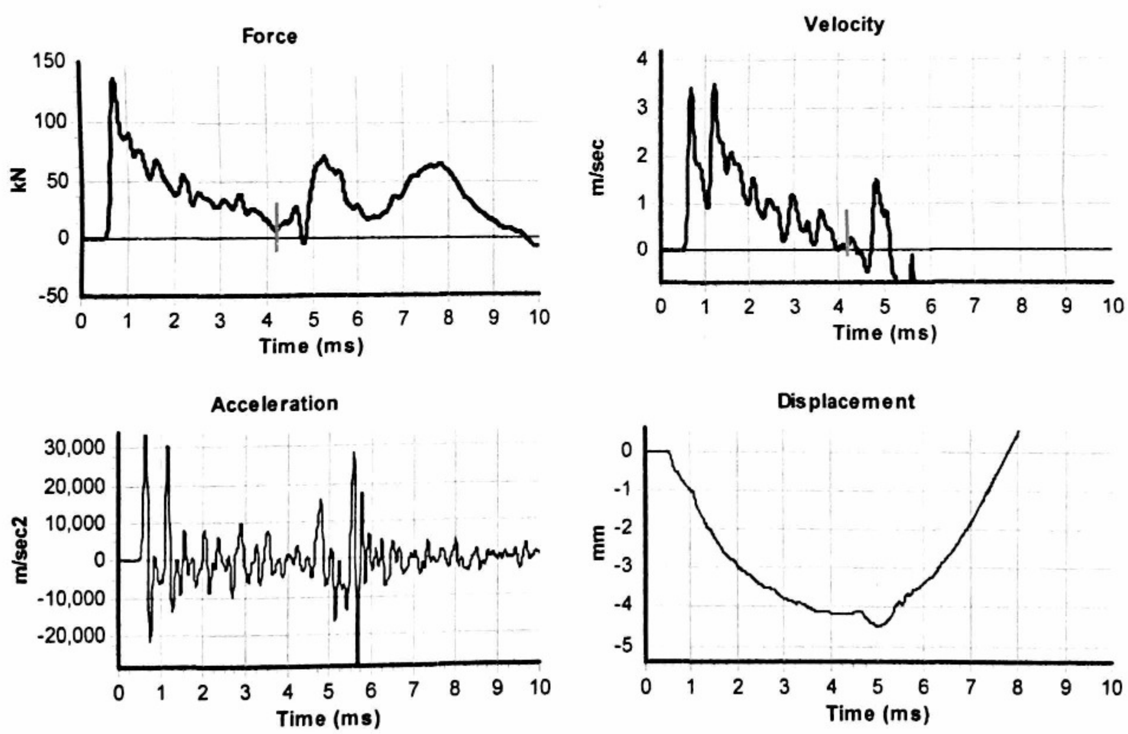
Instrumented Rod Data

Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	7080
Accelerometer No.2:	11609

SPT Hammer Information

Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	12.0

Comments / Location



Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	310

Energy Ratio E_r (%): 66

Signed: K.McDONALD

Title: SALES

The recommended calibration interval is 12 months

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Unit 8
Orton Enterprise Centre
Orton Southgate
Peterborough
PE2 6XU

SPT Hammer Ref: AR1962
Test Date: 24/03/2022
Report Date: 24/03/2022
File Name: AR1962B.spt
Test Operator: PR

Instrumented Rod Data

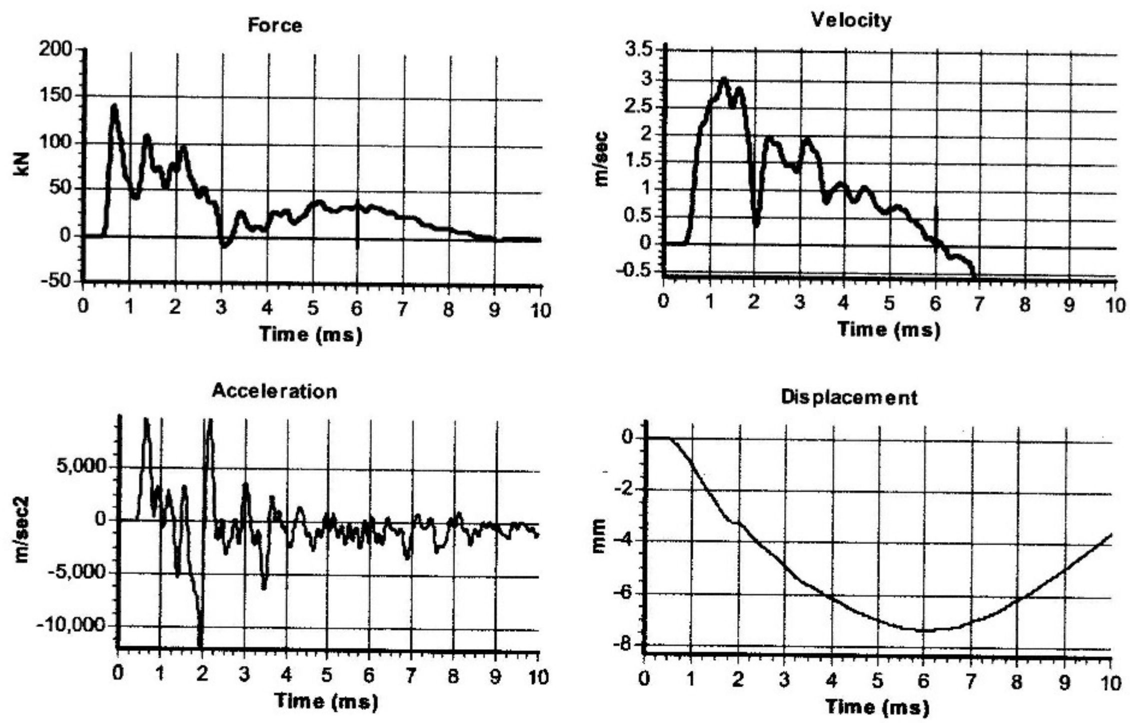
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.3
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	11853
Accelerometer No.2:	10332

SPT Hammer Information

Hammer Mass m (kg):	63.0
Falling Height h (mm):	760
SPT String Length L (m):	15.0

Comments / Location

Maximum calibration interval is 12 months



Calculations

Area of Rod A (mm2):	944
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	349

Energy Ratio E_r (%): 74

Signed: PR
Title: Operator

APPENDIX 6

Monitoring Results

6

FIELDWORK - Water Level Monitoring

Project VPI Immingham Humber Zero PCC Feed **Project No.** PY220483

Client VPI Immingham Limited **Sheet No.** 1

Location ID		**BH01**		**BH02A**									
Instrument diameter		50 mm		50 mm									
Depth to base (m bgl)		10.00		19.40									
Filter zone (m bgl)		9.00 - 10.00		18.40 - 19.40									
Level (m OD)		3.73		3.76									
Date	Time	Depth (m)	Level (m OD)	Depth (m)	Level (m OD)								
30 Sep 2022	12:00	0.64	3.09	1.81	1.95								
07 Oct 2022	12:00	1.73	2.00	1.02	2.74								
13 Oct 2022	12:00	0.92	2.81	1.74	2.02								
31 Oct 2022	12:00	0.96	2.77	1.70	2.06								

Symbols and abbrevations are explained on the accompanying key sheets.

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FIELDWORK - *In Situ Gas Monitoring - Hole Record*

Project VPI Immingham Humber Zero PCC Feed | **Project No.** PY220483

Client VPI Immingham Limited | **Location ID** BH01 (P1)

Sheet No. 1

Installation Details	Type	SP (50mm)					
	Depth to Base (m)	10.00					
	Ground Level (mOD)	0.00					
	Filter Zone (m)	9.00 - 10.00					
	Date Installed	13/09/2022					
	Cover Type	Flush lockable					
Date of Reading	*(dd/mm/yyyy)*	**30/09/2022**	**07/10/2022**	**13/10/2022**	**31/10/2022**		
	(hh:mm:ss)	**12:00:00**	**12:00:00**	**12:00:00**	**12:00:00**		
Weather	Wind	Strong	Strong	Light	Light		
	Precipitation	Slight	None	None	Slight		
	Cloud Cover	Overcast	Slight	None	Cloudy		
Atmospheric Pressure Trend		Steady	Steady	Steady	Steady		
Site Conditions	Temperature (°C)	13	16	12	13		
	Ground Condition	Dry	Moist	Moist	Moist		
Equipment used		Gas Data GFM436	Gas Data GFM436	Gas Data GFM436	Gas Data GFM436		
Monitored by		JZW	JZW	JZW	JZW		
Depth to Water	m bgl	0.64	1.73	0.92	0.96		
Methane (Peak) (CH_4)	% VOL	0.0	0.0	0.0	0.0		
Methane (Steady) (CH_4)	% VOL	0.0	0.0	0.0	0.0		
Carbon Dioxide (Peak)	% VOL	0.7	0.3	0.6	0.7		
Carbon Dioxide (Steady)	% VOL	0.7	0.3	0.6	0.7		
Oxygen (Peak)	% VOL	20.5	19.9	19.8	19.6		
Oxygen (Steady)	% VOL	20.5	19.9	19.0	18.6		
Hydrogen Sulphide (H_2S)	ppm	0	0	0	0		
Carbon Monoxide (CO)	ppm	0	0	0	0		
Barometric Pressure	mbar	1001	1016	1020	1014		
Differential Pressure	Pa	0	0	3	1		
Flow Rate (Peak)	l/hr	0.9	12.5	0.9	0.4		
Flow Rate (Steady)	l/hr	0.0	0.0	0.7	0.3		
PID Reading	ppm	1.0	1.0	1.0	1.0		
Remarks							

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FIELDWORK - In Situ Gas Monitoring - Hole Record

Project VPI Immingham Humber Zero PCC Feed **Project No.** PY220483

Client VPI Immingham Limited **Location ID** BH02A (P1)

Sheet No. 2

Installation Details	Type	SP (50mm)					
	Depth to Base (m)	19.40					
	Ground Level (mOD)	0.00					
	Filter Zone (m)	18.40 - 19.40					
	Date Installed	07/09/2022					
	Cover Type	Flush lockable					
Date of Reading	*(dd/mm/yyyy)*	**30/09/2022**	**07/10/2022**	**13/10/2022**	**31/10/2022**		
	(hh:mm:ss)	**12:00:00**	**12:00:00**	**12:00:00**	**12:00:00**		
Weather	Wind	Strong	Strong	Light	Light		
	Precipitation	Slight	None	None	Slight		
	Cloud Cover	Overcast	Slight	None	Cloudy		
Atmospheric Pressure Trend		Steady	Steady	Steady	Steady		
Site Conditions	Temperature (°C)	13	16	12	13		
	Ground Condition	Dry	Moist	Moist	Moist		
Equipment used		Gas Data GFM436	Gas Data GFM436	Gas Data GFM436	Gas Data GFM436		
Monitored by		JZW	JZW	JZW	JZW		
Depth to Water	m bgl	1.81	1.02	1.74	1.70		
Methane (Peak) (CH_4)	% VOL	0.0	0.0	0.0	0.0		
Methane (Steady) (CH_4)	% VOL	0.0	0.0	0.0	0.0		
Carbon Dioxide (Peak)	% VOL	0.2	0.5	0.3	0.4		
Carbon Dioxide (Steady)	% VOL	0.1	0.4	0.3	0.4		
Oxygen (Peak)	% VOL	20.5	19.7	19.8	20.0		
Oxygen (Steady)	% VOL	18.2	19.7	19.6	19.2		
Hydrogen Sulphide (H_2S)	ppm	0	0	0	0		
Carbon Monoxide (CO)	ppm	0	0	0	0		
Barometric Pressure	mbar	1001	1015	1018	1014		
Differential Pressure	Pa	0	0	5	1		
Flow Rate (Peak)	l/hr	0.9	0.3	1.5	0.3		
Flow Rate (Steady)	l/hr	0.3	0.0	1.0	0.3		
PID Reading	ppm	0.9	1.0	0.9	1.0		
Remarks							

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APPENDIX 7

Laboratory Test Results - Geotechnical

DATA SHEET - Laboratory Test Symbols

Classification and Strength

Symbol **C - Clay** **M - Silt**
(0 - containing organic matter)
Plasticity
- L - Low
- I - Intermediate
- H - High
- V - Very High
- E - Extremely High

Ip	Plasticity Index
%	% retained on 425 µm sieve, shown under Ip value
w_L	Liquid Limit
w_P	Plastic Limit
NP	Non-Plastic
NAT	Sample tested in natural state
w	Water Content
P_d	Particle Density
Test	**Quick undrained triaxial tests**
	SS Single stage - 102mm diameter.
	S3 Single stage - set of 3 38mm diameter.
	MS Multistage - 102mm diameter.
	D Drained Test
	HV Hand Vane
	PP Pocket Penetrometer (kg/cm²)
	NST Not suitable for test
γ_b	Bulk Density
σ_3	Triaxial Cell Pressure
$\sigma_1 - \sigma_3$	Deviator Stress
##	Excessive Strain
c_u	Undrained Cohesion
c	Cohesion Intercept
ϕ	Angle of Shearing Resistance
Linear Shrink	Linear Shrinkage
Stab add-	Stabiliser which is added

Consolidation

m_v	Coefficient of Volume Compressibility
c_{v50}	Coefficient of Consolidation - Log t
c_{v90}	Coefficient of Consolidation - $\sqrt{t}$

Rock

UF	Unacceptable Failure

Chemical Analysis

Acid Soluble	Total sulphate in specimen, expressed as SO_3 %, value in brackets expressed as SO_4 %
Water Soluble	Soluble sulphate in 2:1 water : soil extract, expressed as SO_3 g/l, value in brackets expressed as SO_4 g/l
In Water	Sulphate content of groundwater, expressed as SO_3 g/l, value in brackets expressed as SO_4 g/l
pH	pH value
Organic content	Organic content expressed as a percentage of dry weight
Chloride	Chloride Ion content expressed as a percentage of dry weight

MCV, Compaction, CBR

MCV	Moisture Condition Value at natural water content
MCC	Moisture Condition Calibration
CCV	Chalk Crushing Value

Compaction

Type	2.5	= 2.5 kg Rammer
	4.5	= 4.5 kg Rammer
	V	= Vibrating Hammer
γ_b	Bulk Density	
γ_d	Dry Density	

CBR California Bearing Ratio

Type	2.5	= Test on Specimen Recompacted using 2.5 kg Rammer
	4.5	= As above but using 4.5 kg Rammer
	V	= As above but using Vibrating Hammer
	M	= Test on open drive mould specimen cut in field
	S	= Soaked Specimen
Top	CBR at top of mould	
Bottom	CBR at bottom of mould	
ND	None Detected	
*	In the Sample Description denotes a laboratory only description	

Laboratory Test Certificate

Form REP008 Rev 3

Issued To	Geotechnics Ltd The Geotechnical Centre Unit 1, Bypass Park Estate Sherburn-in-Elmet Yorkshire, LS25 6EO	**Date of issue**	10.11.22
		Issue No.	2
		Client Ref. No.	N/A
		Samples / Material Source	
		Samples Recv'd	13.09.22
Testing Start Date	15.09.22	Sample State	As received
Testing Complete	09.11.22	Sampled by	Geotechnics Limited
Comments			

Project No	PY220483
Project Name	Humber Zero VPI-Immingham

Summary of Tests

Standard	Test Description	Test Quantity	UKAS
BS EN ISO 17892-1:2014	Water Content	15	Yes
BS EN ISO 17892-12:2018 Cl. 5.3 & 5.5	Liquid Limit and Plastic Limit (4 Points Method)	13	Yes
BS EN ISO 17892-4:2016 Cl. 5.2	Particle Size Distribution by Sieving Method	7	Yes
BS EN ISO 17892-4:2016 Cl. 5.4	Particle Size Distribution by Pipette Method	5	Yes
BS EN ISO 17892-5:2017	Incremental Loading Oedometer	1	Yes
BS 1377-7:1990 Cl. 9	Shear Strength by Quick Undrained Triaxial Test - Multistage	3	Yes
BS 1377-4:1990 Cl. 3.3	2.5 kg Rammer Dry Density/Moisture Content Relationship (Compaction)	1	Yes
BS 1377-4:1990 Cl. 3.5	4.5 kg Rammer Dry Density/Moisture Content Relationship (Compaction)	4	Yes
BS 1377-4:1990 Cl. 7.2	California Bearing Ratio (CBR)	3	Yes

Note: Any descriptions, opinions or interpretations are outside the scope of UKAS accreditation.
The results within this report relate only to the samples tested and received from the client.

UKAS TESTING 1365

Test Results checked and approved for issue.
Signed for and on behalf of Geotechnics Limited

Paul Smart (Laboratory Testing Manager)

GEOTECHNICS
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203 Torrington Avenue, Tile Hill,
Coventry, CV4 9UT

LABORATORY RESULTS - *Classification and Strength*

Project VPI IMMINGHAM HUMBER ZERO PCC FEED **Project No:** PY220483

Sample					Classification					Strength					
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Symbol	I_p (>425) %	w_L %	w_p %	w (ρ_d) %	Test	γ_b (γ_d) Mg/m^3	σ_3 kN/m^2	$\sigma_1-\sigma_3$ kN/m^2	c_u kN/m^2	c_{Avg} kN/m^2
BH01	1.20 (1.20)	D	Y19885	Stiff brownish grey slightly gravelly CLAY.	CE	62 (2%)	98	36	41.2						
BH01	5.00- 5.15 (5.00)	D	Y19891	Very stiff dark greyish brown slightly sandy slightly gravelly CLAY.	CL	16 (20%)	32	16	10.6						
BH01	10.00 (10.00)	D	Y19893	Very stiff brown slightly sandy CLAY.	CL	15 (1%)	31	16	14.3						
BH01	12.55- 13.00 (12.82)	UT	Y19894	Stiff very high strength slightly sandy slightly gravelly CLAY.					15.7 15.7 15.7	MS	2.23 2.23 2.23	125 250 500	320 324	160 162	161
BH02A	0.40 (0.40)	D	Y19872	MADE GROUND: Very stiff brown slightly gravelly clay.	CI	22 (29%)	40	18	14.8						
BH02A	2.60 (2.60)	D	Y19875	Very stiff reddish brown slightly gravelly CLAY.	CI	18 (10%)	36	18	16.6						
BH02A	7.75- 7.90 (7.75)	D	Y19877	Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY.	CL	14 (15%)	27	13	15.3						
BH02A	10.55- 11.00 (10.79)	U	Y19878	Stiff high strength slightly sandy slightly gravelly CLAY.					13.8 13.8 13.8	MS	2.25 2.25 2.25	100 200 400	232	116 ##	116
BH02A	15.00- 15.15 (15.00)	D	Y19880	Stiff reddish brown slightly sandy slightly gravelly CLAY.	CL	17 (3%)	34	17	17.8						
BH02A	19.05- 19.50 (19.05)	D	Y19881	Structureless CHALK composed of cream sandy fine to coarse gravel.					15.9						
BH05	0.50- 0.60 (0.50)	D	Y19899	Stiff reddish brown slightly sandy CLAY.	CH	36 (4%)	68	32	36.6						
BH05	1.20- 1.30 (1.20)	D	Y19902	Firm dark greyish brown slightly sandy CLAY.	CI	31 (4%)	48	17	29.0						
BH05	2.00- 2.10 (2.00)	D	Y19905	Firm yellowish brown slightly sandy slightly gravelly CLAY.	CI	28 (8%)	45	17	26.6						
BH05	4.20- 4.30 (4.20)	D	Y19908	Stiff dark brown slightly sandy slightly gravelly CLAY.	CI	20 (4%)	38	18	19.7						
BH05	13.95- 14.00 (13.95)	D	Y19913	Stiff dark brown slightly sandy slightly gravelly CLAY.	CL	15 (10%)	31	16	16.3						
BH05	16.50- 16.95 (16.74)	UT	Y19914	Stiff high strength slightly sandy slightly gravelly CLAY.					15.1 15.1 15.1	MS	2.21 2.21 2.21	175 350 700	181	90 ##	90

Remarks NST - Not suitable for Test
For Standards followed see Laboratory Test Certficate
w% - ^ = Rock water content test; x = Aggregate moisture content test
QUT Water Contents: <Failure Zone>, [After test]

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LABORATORY RESULTS - Classification and Strength

Project VPI IMMINGHAM HUMBER ZERO PCC FEED **Project No:** PY220483

Sample					Classification					Strength					
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Symbol	I_p (>425) %	w_L %	w_p %	w (p_d) %	Test	γ_b (γ_d) Mg/m^3	σ_3 kN/m^2	$\sigma_1-\sigma_3$ kN/m^2	c_u kN/m^2	c_{Avg} kN/m^2
BH05	16.95-17.00 (16.95)	D	Y19915	Very stiff yellowish brown slightly sandy slightly gravelly CLAY.	CL	12 (21%)	26	14	14.0						
BH05	19.00-19.10 (19.00)	D	Y19916	Structureless CHALK composed of cream sandy gravelly silt.					19.4						

Remarks NST - Not suitable for Test
For Standards followed see Laboratory Test Certficate
w% - ^ = Rock water content test; x = Aggregate moisture content test
QUT Water Contents: <Failure Zone>, [After test]

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LABORATORY RESULTS - *Atterberg Limit*

Project VPI IMMINGHAM HUMBER ZERO PCC FEED **Project No:** PY220483

Sample					Results								
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Test Type	Point Data		Symbol	Ip %	>425 sieve µm	wL %	wp %
						Cone Pene.	Water % (Factor)					
BH01	1.20 (1.20)	D	Y19885	Stiff brownish grey slightly gravelly CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CE	62	2%	98	36
BH01	5.00-5.15 (5.00)	D	Y19891	Very stiff dark greyish brown slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CL	16	20%	32	16
BH01	10.00 (10.00)	D	Y19893	Very stiff brown slightly sandy CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CL	15	1%	31	16
BH02A	0.40 (0.40)	D	Y19872	MADE GROUND: Very stiff brown slightly gravelly clay.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CI	22	29%	40	18
BH02A	2.60 (2.60)	D	Y19875	Very stiff reddish brown slightly gravelly CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CI	18	10%	36	18
BH02A	7.75-7.90 (7.75)	D	Y19877	Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CL	14	15%	27	13
BH02A	15.00-15.15 (15.00)	D	Y19880	Stiff reddish brown slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CL	17	3%	34	17
BH05	0.50-0.60 (0.50)	D	Y19899	Stiff reddish brown slightly sandy CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CH	36	4%	68	32
BH05	1.20-1.30 (1.20)	D	Y19902	Firm dark greyish brown slightly sandy CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CI	31	4%	48	17
BH05	2.00-2.10 (2.00)	D	Y19905	Firm yellowish brown slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with decreasing water content, cone type: 80g/30, washed over 425um sieve			CI	28	8%	45	17
BH05	4.20-4.30 (4.20)	D	Y19908	Stiff dark brown slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CI	20	4%	38	18

Remarks AGS

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LABORATORY RESULTS - Atterberg Limit

Project VPI IMMINGHAM HUMBER ZERO PCC FEED **Project No:** PY220483

Sample					Results								
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Test Type	Point Data: Cone Pene.	Point Data: Water % (Factor)	Symbol	I_p %	>425 sieve µm	w_L %	w_p %
BH05	13.95-14.00 (13.95)	D	Y19913	Stiff dark brown slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CL	15	10%	31	16
BH05	16.95-17.00 (16.95)	D	Y19915	Very stiff yellowish brown slightly sandy slightly gravelly CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CL	12	21%	26	14

Remarks

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LABORATORY RESULTS - *Particle Size Distribution*

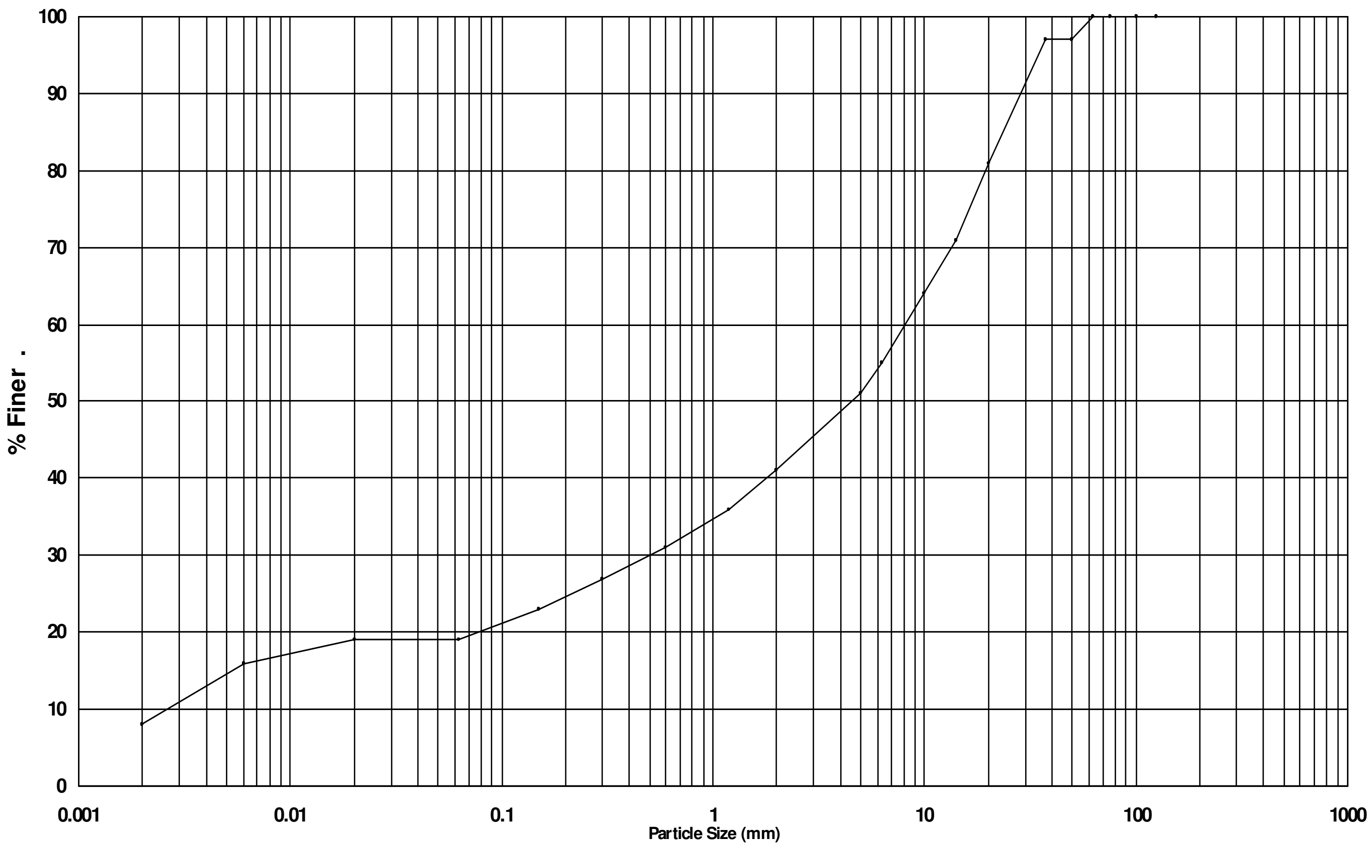
Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH01
Sample Depth 0.20-0.60m
Sample Type B
Sample Ref Y19882

Sample Description

MADE GROUND: White very sandy clayey fine to coarse gravel.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	8
SILT	11
SAND	22
GRAVEL	59
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	97
37.5 mm	97
20 mm	81
14 mm	71
10 mm	64
6.3 mm	55
5 mm	51
2 mm	41
1.18 mm	36
600 µm	31
300 µm	27
150 µm	23

Size	% Finer
63 µm	19
20 µm	19
6 µm	16
2 µm	8

Uniformity Coefficient	
2961.76	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.00
Particle Density	2.65 (Assumed)

Remarks Sieve:-Test performed in accordance with BS EN ISO 17892-4:2016
Pipette:-Test performed in accordance with BS EN ISO 17892-4:2016

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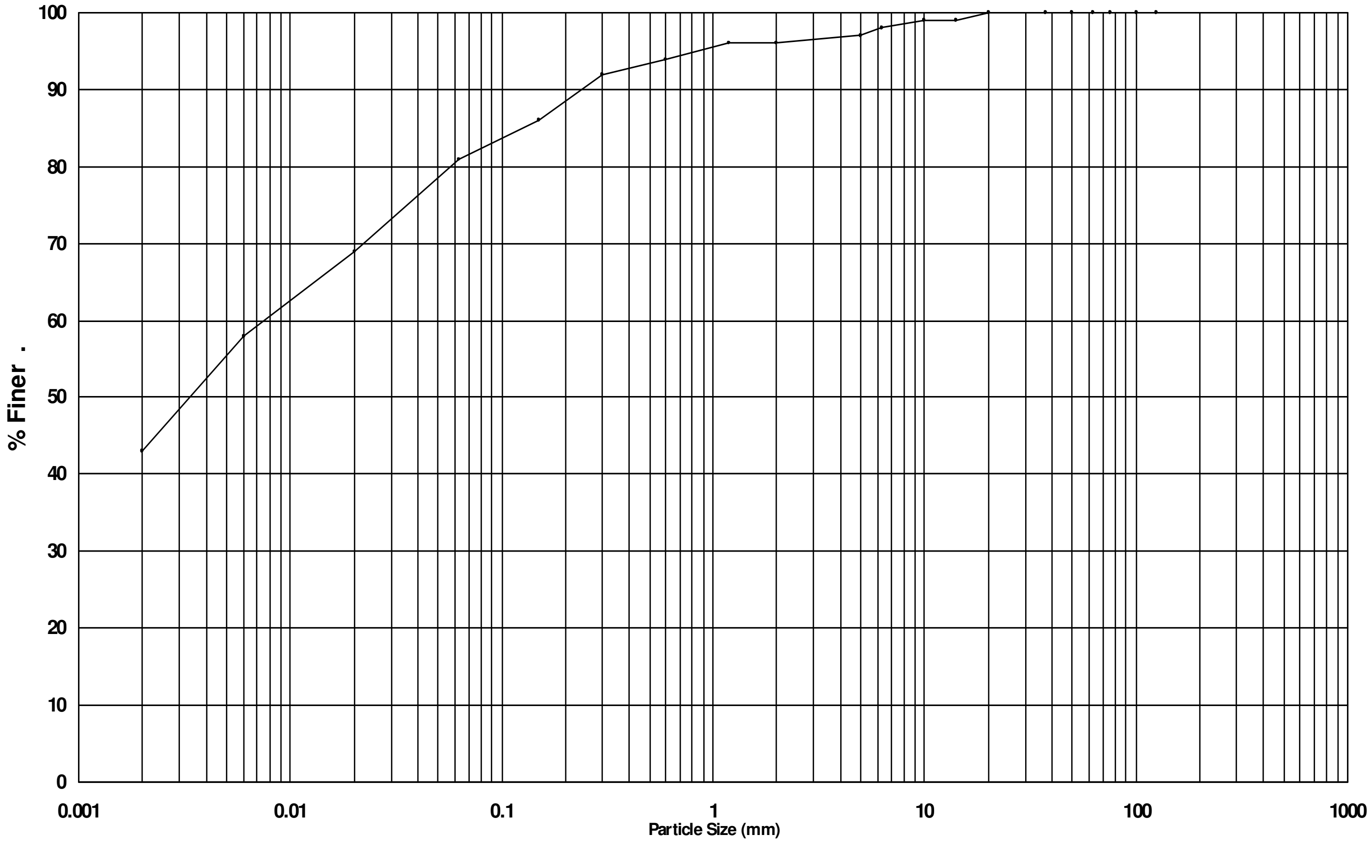
LABORATORY RESULTS - Particle Size Distribution

Project:	VPI IMMINGHAM HUMBER ZERO PCC FEED	**Hole**	BH01
		Sample Depth	4.00-4.40m
Project No:	PY220483	**Sample Type**	B
		Sample Ref	Y19889

Sample Description

Stiff brown slightly sandy slightly gravelly CLAY.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	43
SILT	38
SAND	15
GRAVEL	4
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
20 mm	100
14 mm	99
10 mm	99
6.3 mm	98
5 mm	97
2 mm	96
1.18 mm	96
600 µm	94
300 µm	92
150 µm	86

Size	% Finer
63 µm	81
20 µm	69
6 µm	58
2 µm	43

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.00
Particle Density	2.65 (Assumed)

Remarks Sieve:-Test performed in accordance with BS EN ISO 17892-4:2016
Pipette:-Test performed in accordance with BS EN ISO 17892-4:2016

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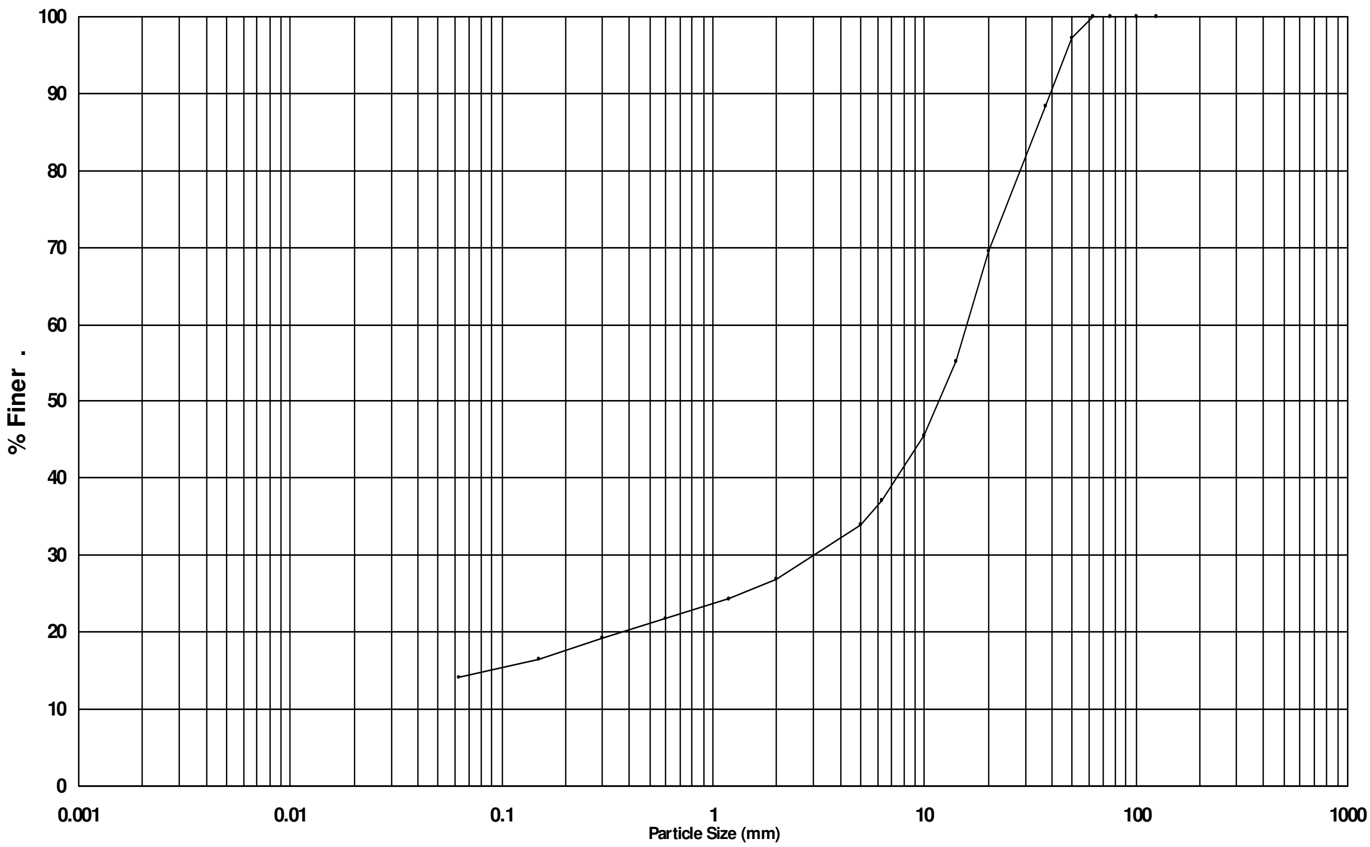
LABORATORY RESULTS - Particle Size Distribution

Project:	VPI IMMINGHAM HUMBER ZERO PCC FEED	**Hole**	BH02
		Sample Depth	0.27-0.60m
Project No:	PY220483	**Sample Type**	B
		Sample Ref	Y19869

Sample Description

MADE GROUND: Light brown sandy clayey fine to coarse gravel.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
SILT (including CLAY)	14
SAND	13
GRAVEL	73
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	97
37.5 mm	88
20 mm	70
14 mm	55
10 mm	46
6.3 mm	37
5 mm	34
2 mm	27
1.18 mm	24
600 µm	22
300 µm	19
150 µm	16

Size	% Finer
63 µm	14

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	
Pre-treated with	
% loss on Pre-treatment	
Particle Density	

Remarks Sieve:-Test performed in accordance with BS EN ISO 17892-4:2016

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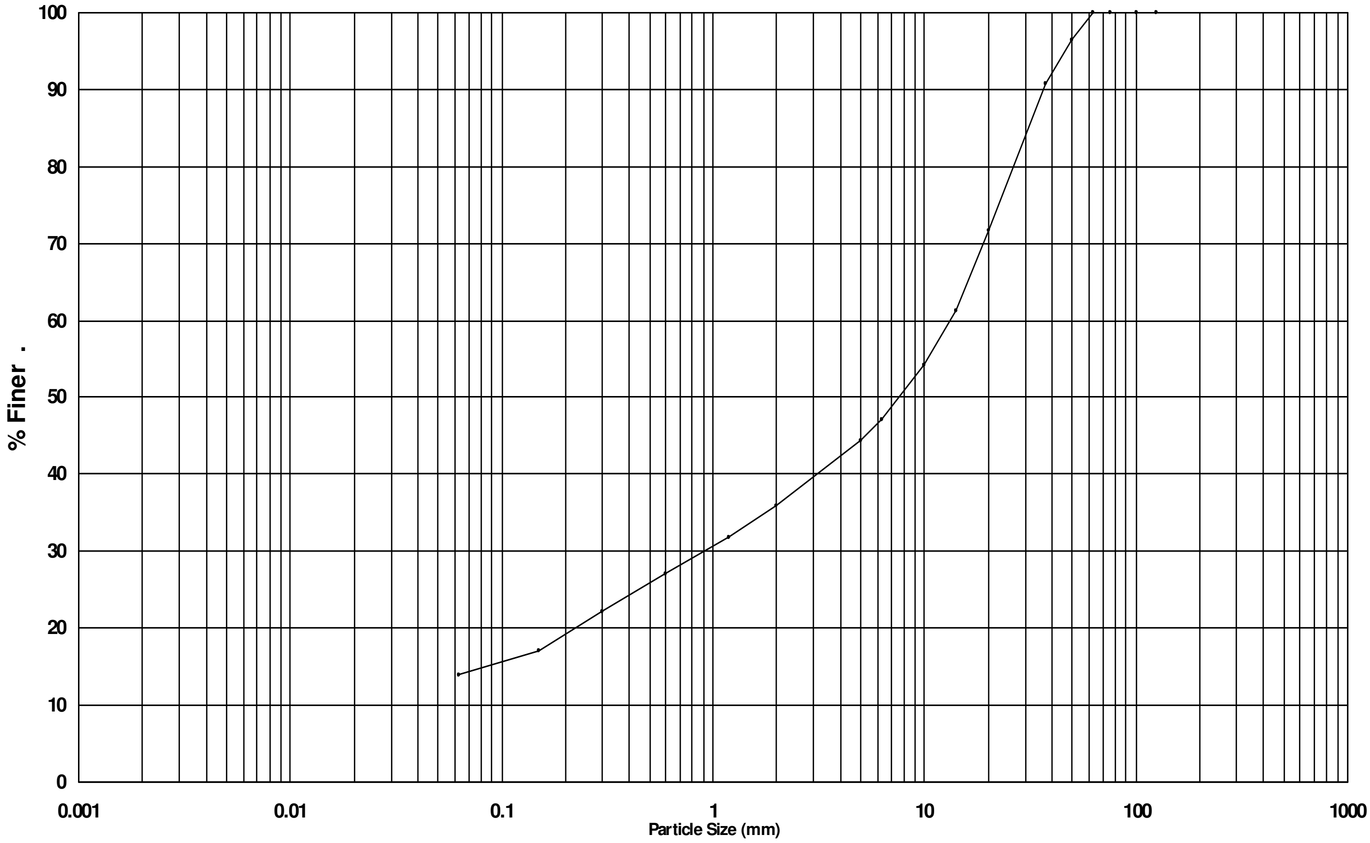
LABORATORY RESULTS - Particle Size Distribution

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH02
Sample Depth 0.60-0.90m
Sample Type B
Sample Ref Y19870

Sample Description
MADE GROUND: Brown very sandy clayey fine to coarse gravel.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
SILT (including CLAY)	14
SAND	22
GRAVEL	64
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	97
37.5 mm	91
20 mm	72
14 mm	61
10 mm	54
6.3 mm	47
5 mm	44
2 mm	36
1.18 mm	32
600 µm	27
300 µm	22
150 µm	17

Size	% Finer
63 µm	14

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	
Pre-treated with	
% loss on Pre-treatment	
Particle Density	

Remarks Sieve:-Test performed as "Non Standard" due to sample mass not being in accordance with BS EN ISO 17892-4:2016

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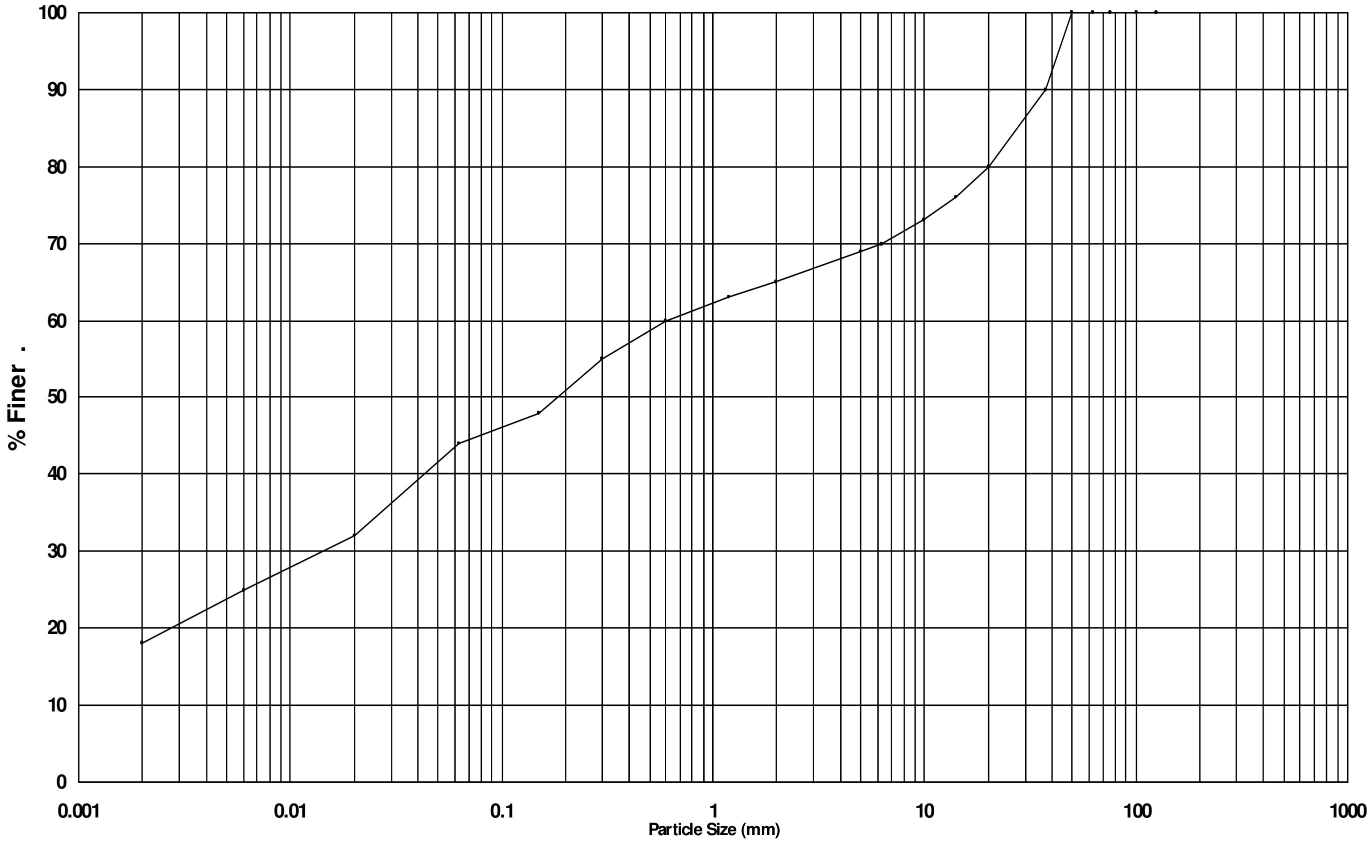
LABORATORY RESULTS - *Particle Size Distribution*

Project:	VPI IMMINGHAM HUMBER ZERO PCC FEED	**Hole**	BH02A
		Sample Depth	0.60-1.00m
Project No:	PY220483	**Sample Type**	B
		Sample Ref	Y19873

Sample Description

MADE GROUND: Stiff brown slightly sandy gravelly clay.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	18
SILT	26
SAND	21
GRAVEL	35
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	90
20 mm	80
14 mm	76
10 mm	73
6.3 mm	70
5 mm	69
2 mm	65
1.18 mm	63
600 µm	60
300 µm	55
150 µm	48

Size	% Finer
63 µm	44
20 µm	32
6 µm	25
2 µm	18

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.00
Particle Density	2.65 (Assumed)

Remarks Sieve:-Test performed as "Non Standard" due to sample mass not being in accordance with BS EN ISO 17892-4:2016
Pipette:-Test performed in accordance with BS EN ISO 17892-4:2016

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LABORATORY RESULTS - Particle Size Distribution

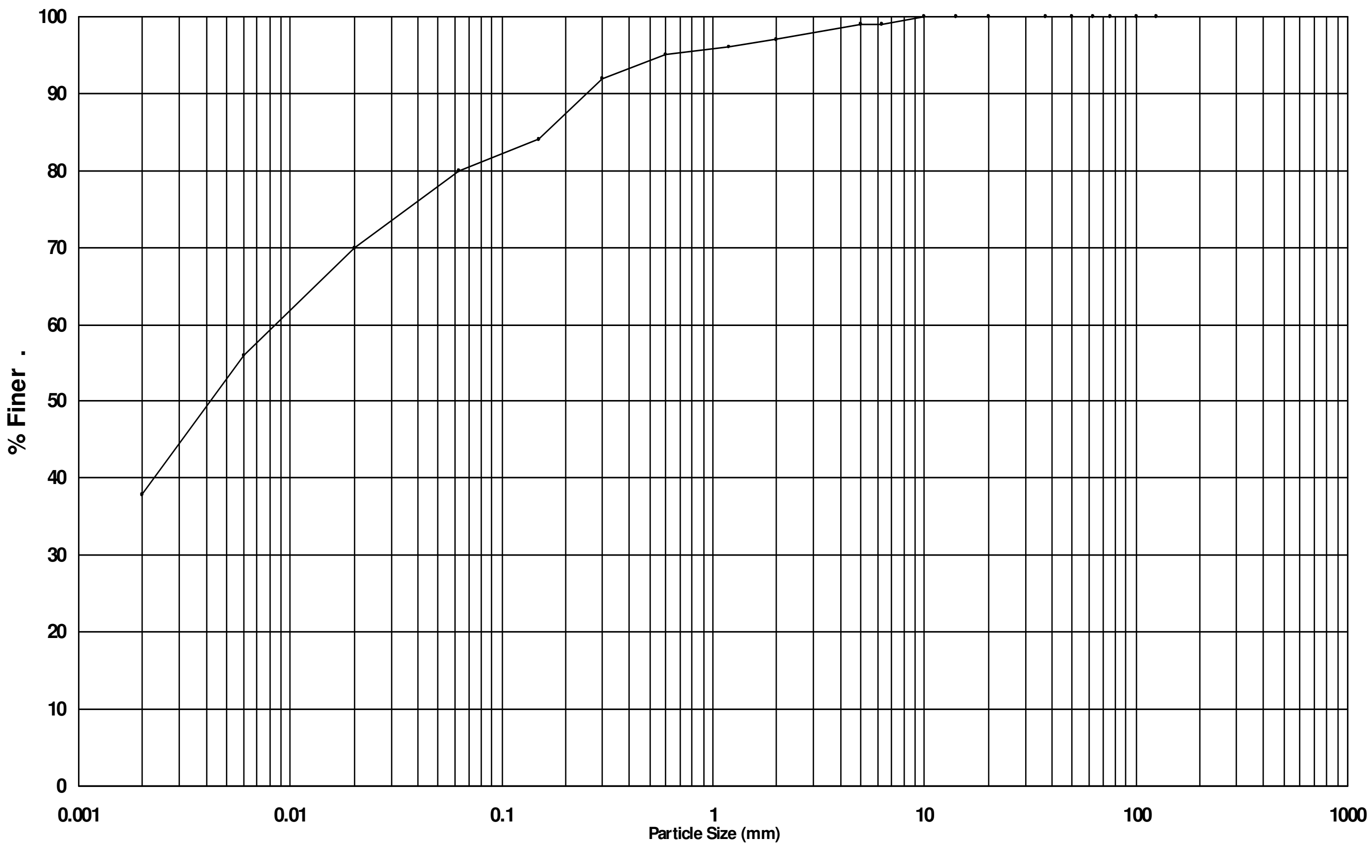
Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH02A
Sample Depth 2.00-2.50m
Sample Type B
Sample Ref Y19874

Sample Description

Stiff reddish brown slightly sandy slightly gravelly CLAY.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	38
SILT	42
SAND	17
GRAVEL	3
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
20 mm	100
14 mm	100
10 mm	100
6.3 mm	99
5 mm	99
2 mm	97
1.18 mm	96
600 µm	95
300 µm	92
150 µm	84

Size	% Finer
63 µm	80
20 µm	70
6 µm	56
2 µm	38

Uniformity Coefficient	
Not Available	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.00
Particle Density	2.65 (Assumed)

Remarks Sieve:-Test performed in accordance with BS EN ISO 17892-4:2016
Pipette:-Test performed in accordance with BS EN ISO 17892-4:2016

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LABORATORY RESULTS - Particle Size Distribution

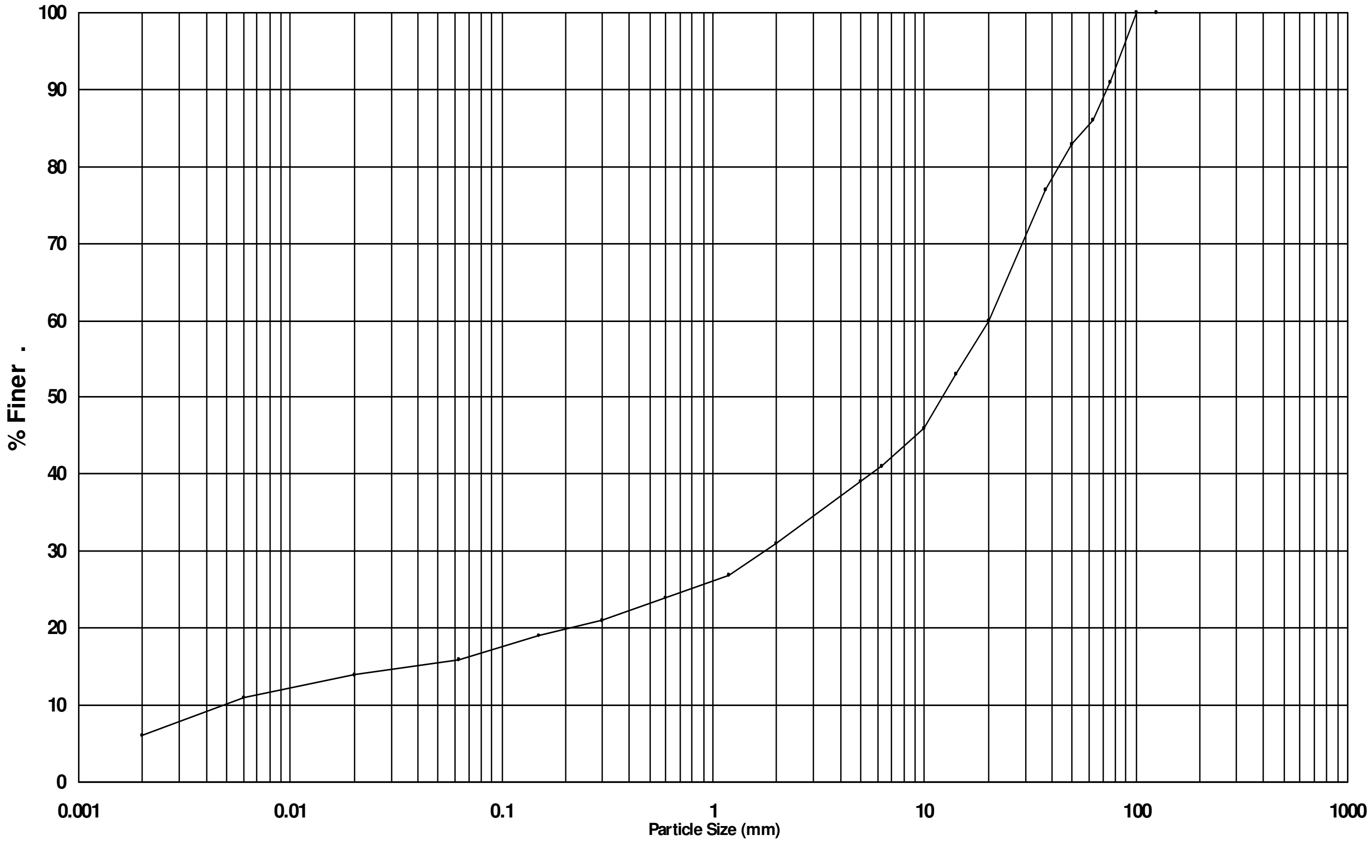
Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH05
Sample Depth 0.00-0.30m
Sample Type B
Sample Ref Y19897

Sample Description

MADE GROUND: Light brown sandy clayey fine to coarse gravel with a medium cobble content.



Classification	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
		SILT			SAND			Gravel				

Classification	% of each
CLAY	6
SILT	10
SAND	15
GRAVEL	55
COBBLES	14
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	91
63 mm	86
50 mm	83
37.5 mm	77
20 mm	60
14 mm	53
10 mm	46
6.3 mm	41
5 mm	39
2 mm	31
1.18 mm	27
600 µm	24
300 µm	21
150 µm	19

Size	% Finer
63 µm	16
20 µm	14
6 µm	11
2 µm	6

Uniformity Coefficient	
4270.23	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	Pipette
Pre-treated with	Hydrogen Peroxide
% loss on Pre-treatment	0.00
Particle Density	2.65 (Assumed)

Remarks Sieve:-Test performed as "Non Standard" due to sample mass not being in accordance with BS EN ISO 17892-4:2016
Pipette:-Test performed in accordance with BS EN ISO 17892-4:2016

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LABORATORY RESULTS - MCV, Compaction, CBR

Project VPI IMMINGHAM HUMBER ZERO PCC FEED **Project No:** PY220483

Sample					MCV		Compaction					CBR				
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	MCV	w %	Type	w (Opt) %	ρ_d Mg/m^3	γ_b Mg/m^3	γ_d (Max) Mg/m^3	Type	Top CBR %	Top w %	Bottom CBR %	Bottom w %
BH01	0.20-0.60 (0.20-0.60)	B	Y19882	MADE GROUND: White very sandy clayey fine to coarse gravel.						2.02	1.77	2.5kg	57	14.2	41	14.2
BH01	6.05-6.50 (6.05-6.50)	B	Y19892	Firm brown mottled orange slightly sandy slightly gravelly CLAY.			4.5kg	(10.5) 14.9* 17.7 5.6 9.2 11.6	2.72a	 *2.21 2.13 2.00 2.16 2.26	(2.03) *1.93 1.81 1.89 1.98 2.02					
BH02A	4.00-4.30 (4.00-4.30)	B	Y19895	Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY.			2.5kg	(14.0) 20.0* 12.2 15.4 21.7 7.0	2.65a	 *2.04 1.99 2.05 2.01 1.84	(1.79) *1.70 1.77 1.78 1.65 1.72					
BH02A	6.25-6.70 (6.25-6.70)	B	Y19896	Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY.			4.5kg	(10.0) 14.0* 8.2 10.0 12.3 6.1	2.75a	 *2.22 2.20 2.30 2.28 2.10	(2.10) *1.95 2.04 2.09 2.03 1.98					
BH05	1.20-1.50 (1.20-1.50)	B	Y19901	Firm dark greyish brown slightly gravelly organic CLAY.						1.74	1.28	2.5kg	0.96	34.8	0.95	37.2
BH05	2.00-2.50 (2.00-2.50)	B	Y19904	Brown slightly gravelly CLAY.*			4.5kg	(10.0) 23.6* 8.2 11.0 13.3 16.0 4.6	2.65a	 *2.01 2.17 2.27 2.19 2.11 2.04	(2.06) *1.63 2.01 2.04 1.94 1.81 1.95					
BH05	2.50-2.80 (2.50-2.80)	B	Y19906	Stiff dark brown slightly sandy slightly gravelly CLAY.						2.08	1.73	2.5kg	1.8	20.3	1.8	20.5
BH05	4.50-4.90 (4.50-4.90)	B	Y19910	Stiff dark brown slightly sandy slightly gravelly CLAY.			4.5kg	(10.0) 14.5* 5.3 8.4 10.4 11.7	2.70a	 *2.21 2.01 2.15 2.31 2.25	(2.10) *1.93 1.91 1.99 2.09 2.01					

Remarks

Particle Density - a=assumed, m=measured
w% - * = at natural moisture content; x = aggregate moisture content
# = stabilised, see relevant test plot for details
NST = Not suitable for Test
For Standards followed see Laboratory Test Certficate

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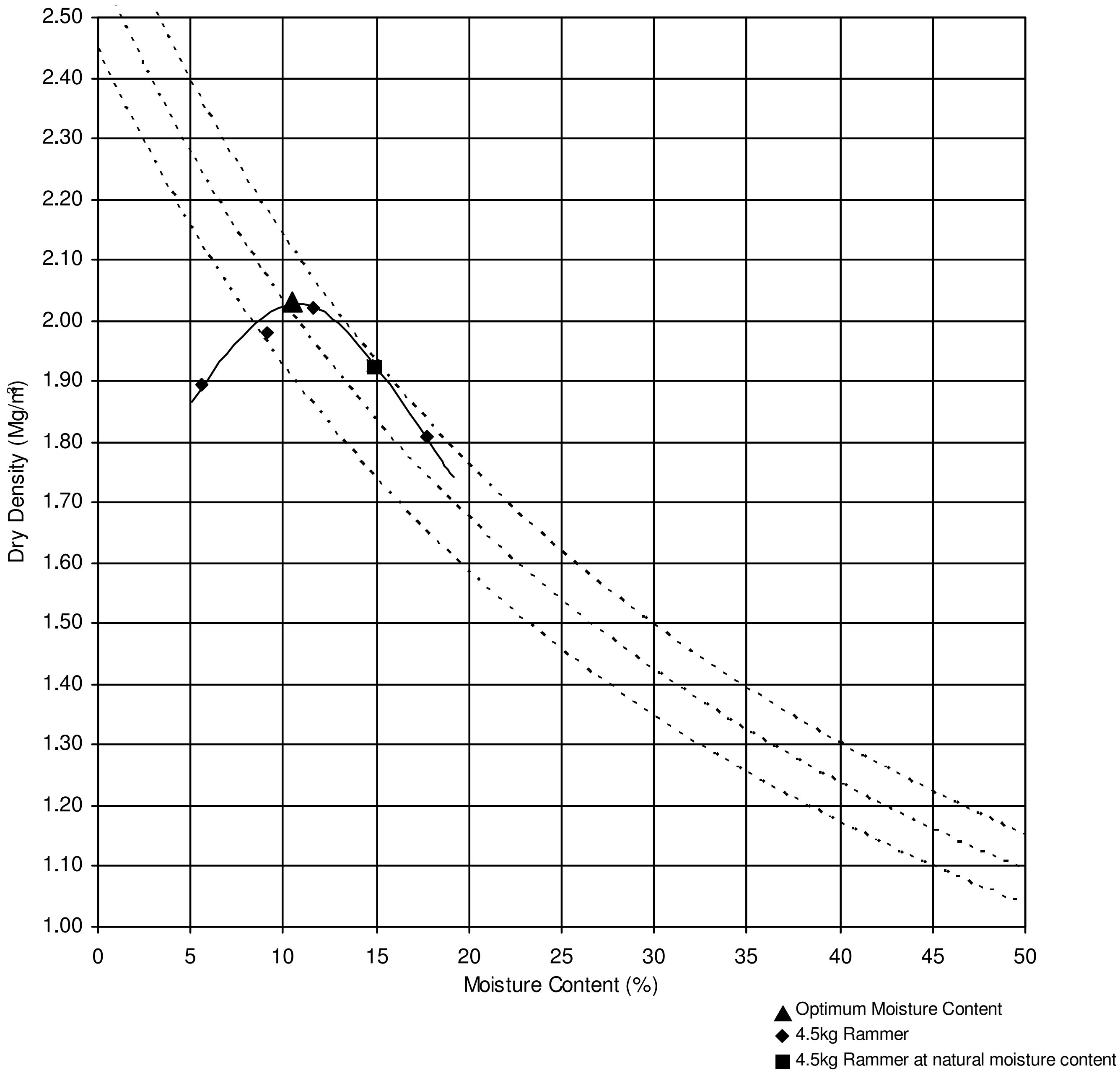
LABORATORY RESULTS - *Compaction*

Project:	VPI IMMINGHAM HUMBER ZERO PCC FEED	**Hole**	BH01
		Sample Depth	6.05-6.50m
Project No:	PY220483	**Sample Type**	B
		Sample Ref	Y19892



Optimum Moisture Content	10.5	Particles retained on	37.5mm sieve	0 %
Maximum Dry Density	2.03 Mg/m^3		20mm sieve	0 %

Particle Density	2.72 (Ass'm)	Mg/m^3	Description	Firm brown mottled orange slightly sandy slightly gravelly CLAY.
Preparation	Single Sample 4.5kg Rammer			

Remarks BS1377 Part 4 1990 : Clause 3.5 and 3.6

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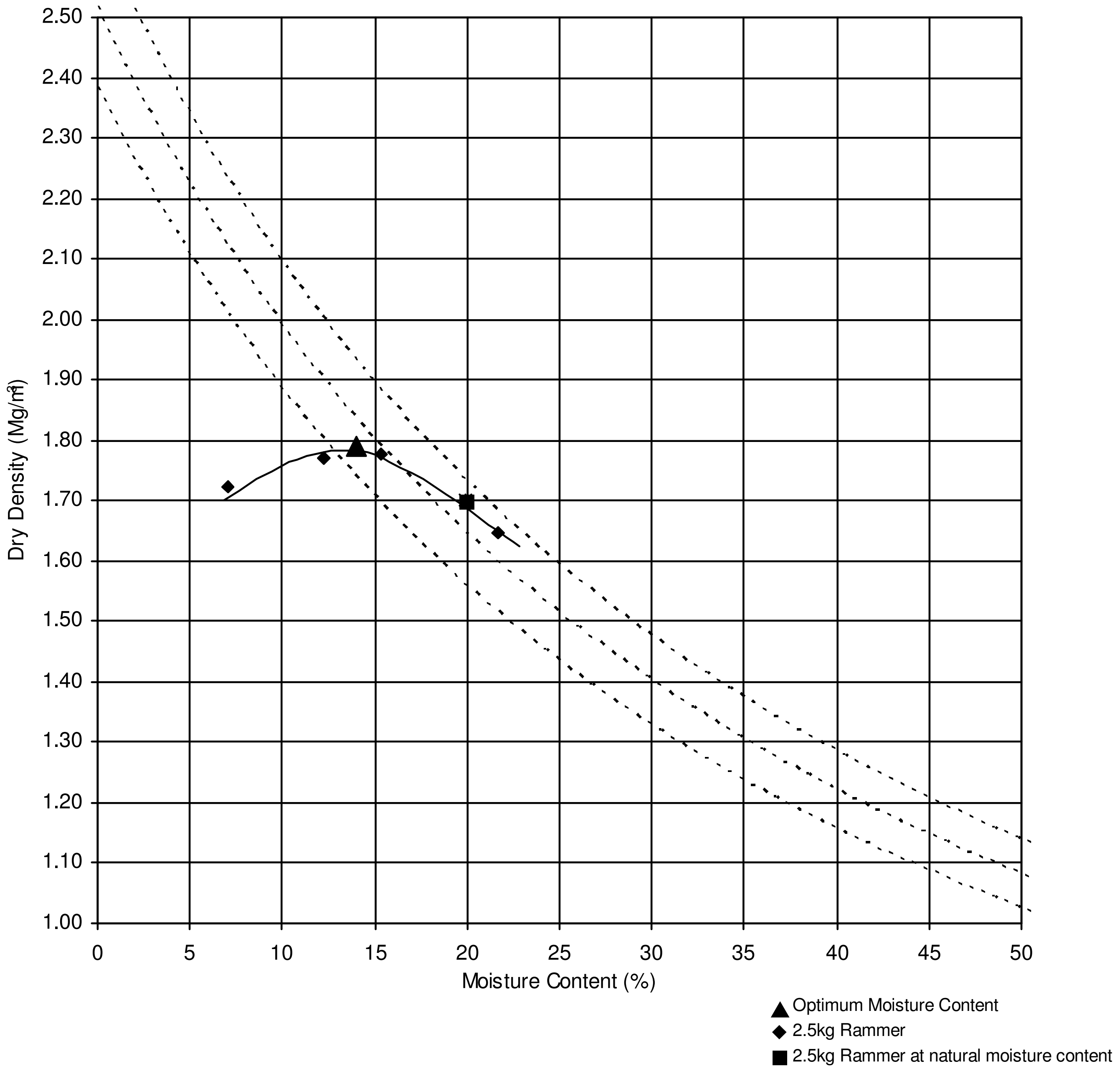
LABORATORY RESULTS - *Compaction*

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH02A
Sample Depth 4.00-4.30m
Sample Type B
Sample Ref Y19895



Optimum Moisture Content	14.0	Particles retained on	37.5mm sieve	0 %
Maximum Dry Density	1.79 Mg/m^3		20mm sieve	0 %

Particle Density	2.65 (Ass'm)	Mg/m^3	Description	Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY.
Preparation	Single Sample 2.5kg Rammer			

Remarks AGS BS1377 Part 4 1990 : Clause 3.3 and 3.4

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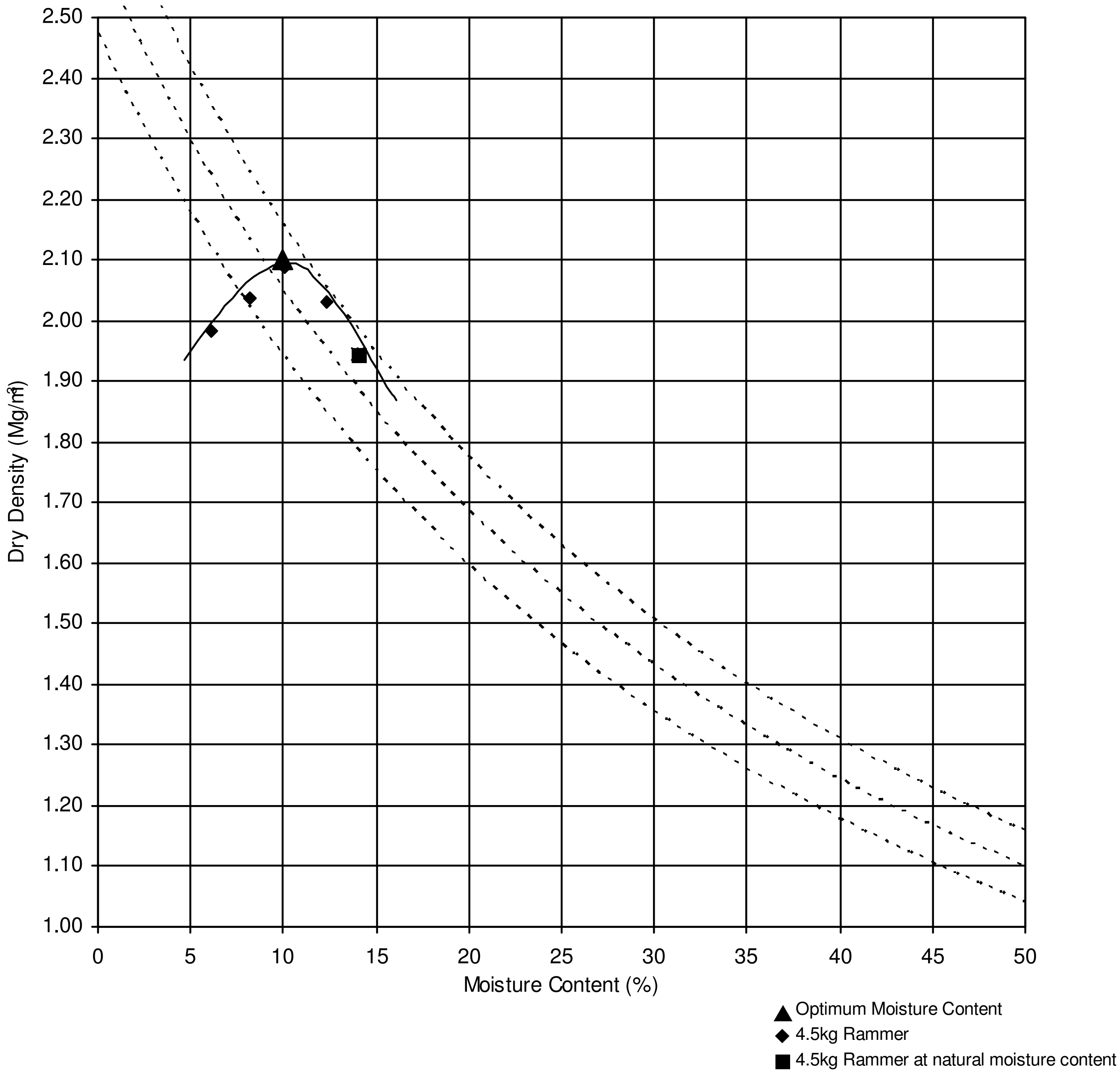
LABORATORY RESULTS - *Compaction*

Project:	VPI IMMINGHAM HUMBER ZERO PCC FEED	**Hole**	BH02A
		Sample Depth	6.25-6.70m
Project No:	PY220483	**Sample Type**	B
		Sample Ref	Y19896



Optimum Moisture Content	10.0	Particles retained on	37.5mm sieve	0 %
Maximum Dry Density	2.10 Mg/m^3		20mm sieve	0 %

Particle Density	2.75 (Ass'm)	Mg/m^3	Description	Stiff reddish brown mottled grey slightly sandy slightly gravelly CLAY.
Preparation	Single Sample 4.5kg Rammer			

Remarks AGS BS1377 Part 4 1990 : Clause 3.5 and 3.6

GEOTECHNICS
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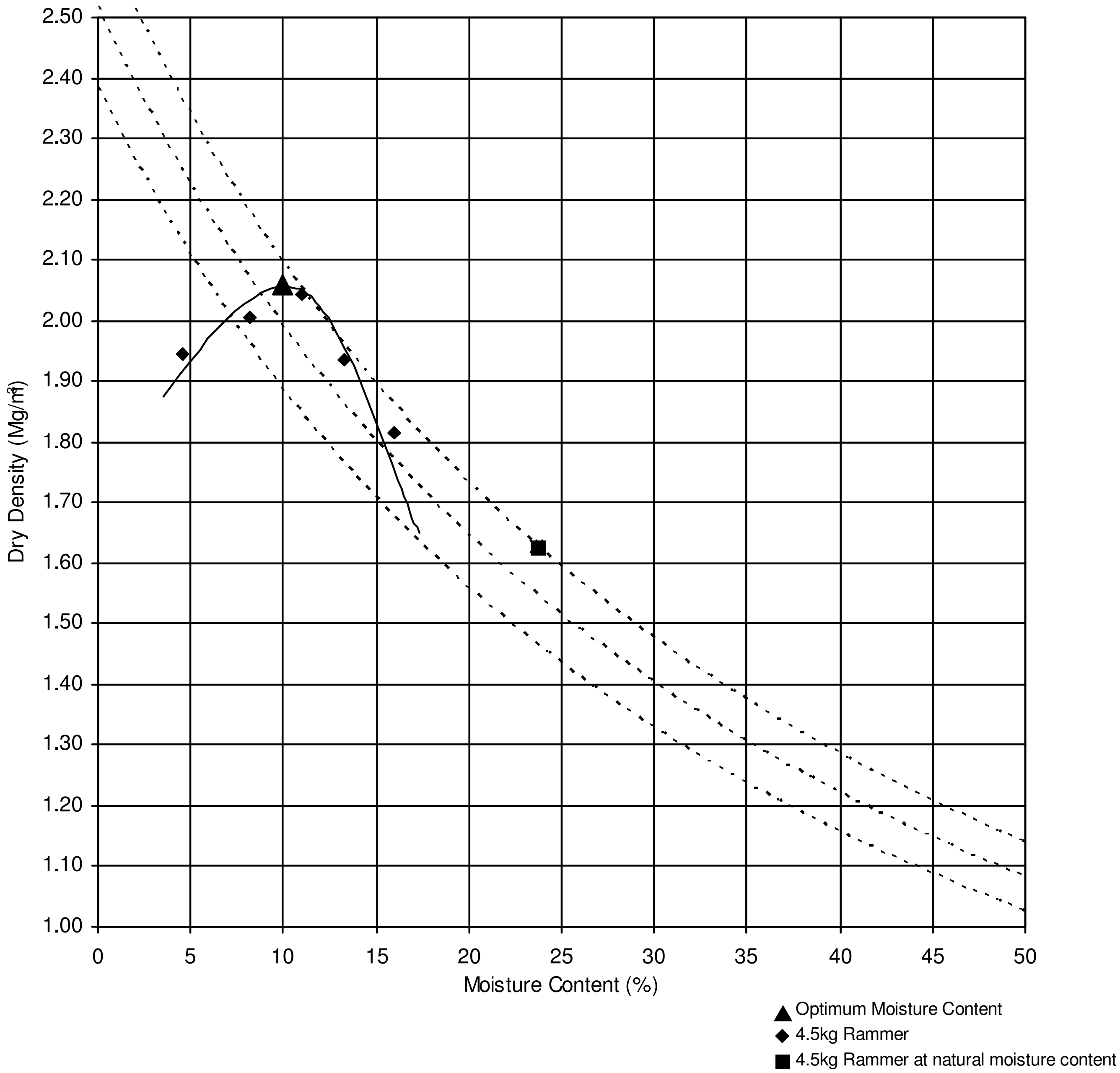
14/11/2022

LABORATORY RESULTS - *Compaction*

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH05
Sample Depth 2.00-2.50m
Sample Type B
Sample Ref Y19904



Optimum Moisture Content	10.0		Particles retained on	37.5mm sieve	0 %
Maximum Dry Density	2.06 Mg/m^3			20mm sieve	0 %
Particle Density	2.65 (Ass'm)	Mg/m^3	Description	Brown slightly gravelly CLAY. *	
Preparation	Single Sample 4.5kg Rammer				

Remarks BS1377 Part 4 1990 : Clause 3.5 and 3.6

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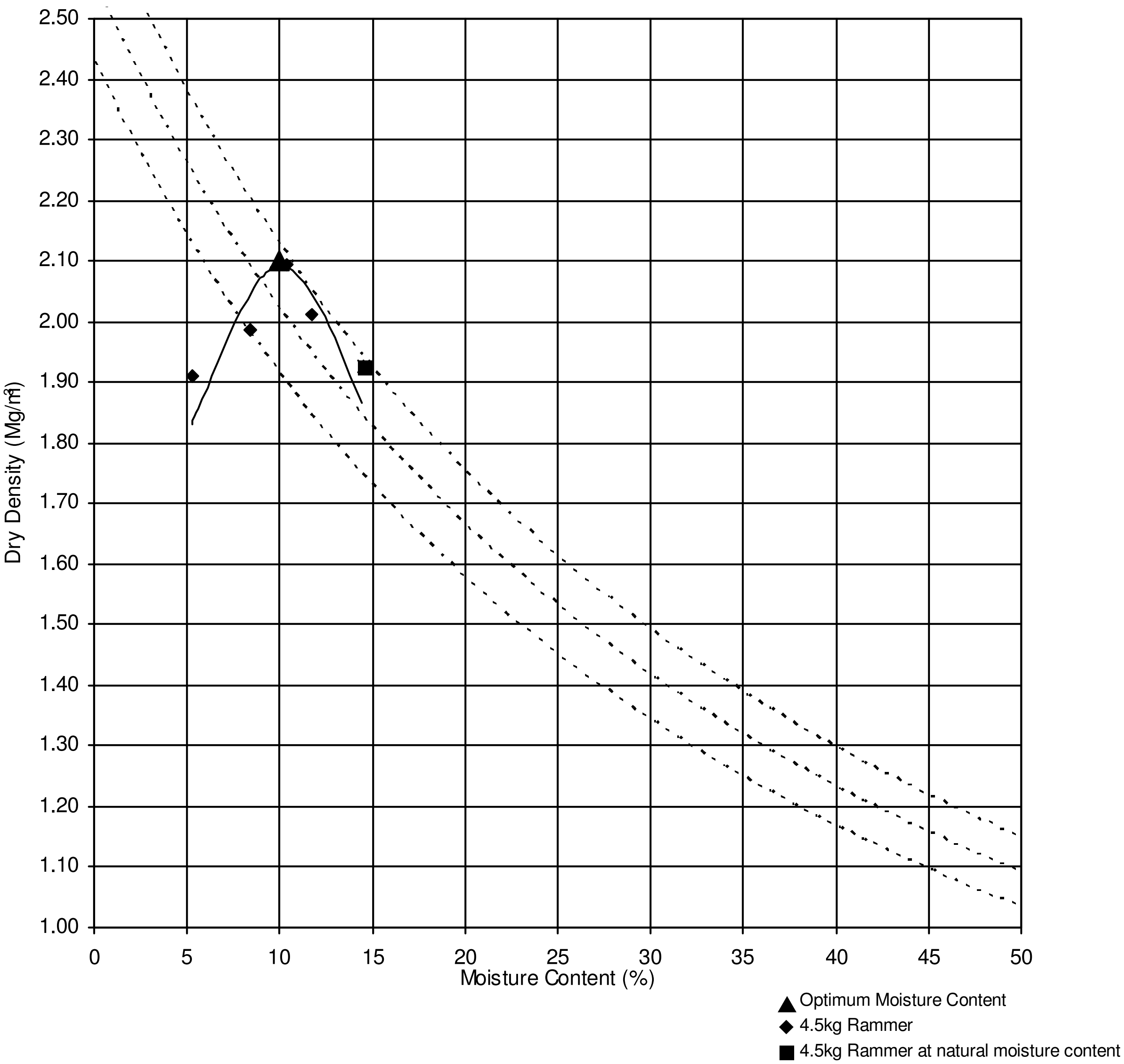
LABORATORY RESULTS - *Compaction*

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH05
Sample Depth 4.50-4.90m
Sample Type B
Sample Ref Y19910



Optimum Moisture Content	10.0	
Maximum Dry Density	2.10 Mg/m^3	
Particle Density	2.70 (Ass'm)	Mg/m^3
Preparation	Single Sample 4.5kg Rammer	

Particles retained on	37.5mm sieve	0 %
	20mm sieve	1 %
Description	Stiff dark brown slightly sandy slightly gravelly CLAY.	

Remarks BS1377 Part 4 1990 : Clause 3.5 and 3.6

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LABORATORY RESULTS - *CBR Force Penetration*

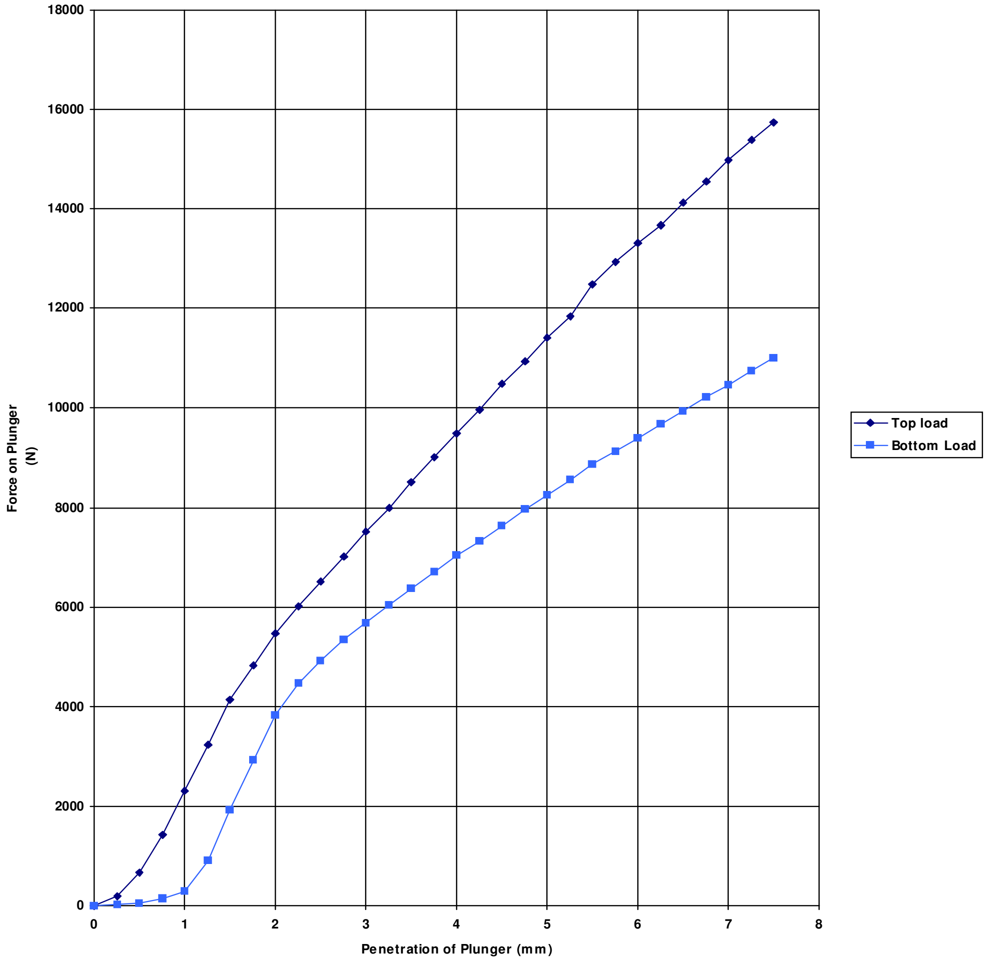
Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH01
Sample Depth 0.20-0.60m
Sample Type B
Sample Ref Y19882

Sample Description

MADE GROUND: White very sandy clayey fine to coarse gravel.



Penetration	Top (N)	Bottom (N)
0.25mm	185	25
0.50mm	672	55
0.75mm	1415	139
1.00mm	2317	296
1.25mm	3232	908
1.50mm	4143	1925
1.75mm	4819	2923
2.00mm	5469	3818
2.25mm	6013	4478
2.50mm	6520	4927
2.75mm	7015	5345
3.00mm	7508	5686
3.25mm	7982	6041
3.50mm	8503	6371
3.75mm	9013	6700

Penetration	Top (N)	Bottom (N)
4.00mm	9478	7029
4.25mm	9960	7334
4.50mm	10487	7622
4.75mm	10931	7969
5.00mm	11403	8243
5.25mm	11852	8559
5.50mm	12480	8864
5.75mm	12943	9140
6.00mm	13313	9389
6.25mm	13681	9686
6.50mm	14128	9945
6.75mm	14562	10228
7.00mm	14981	10468
7.25mm	15390	10742
7.50mm	15745	11007

Test Type	2.5kg		
Method	BS1377 Part 4 1990 : Clause 7.0		
Surcharge		13.60	kg
		18.6	%
Bulk Density	(Mg/m^3)	2.02	
Dry Density	(Mg/m^3)	1.77	
Hand Calculation		No	

CBR	Top	Bottom
Value	57	41
w%	14.2	14.2

Remarks

14/11/2022

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LABORATORY RESULTS - *CBR Force Penetration*

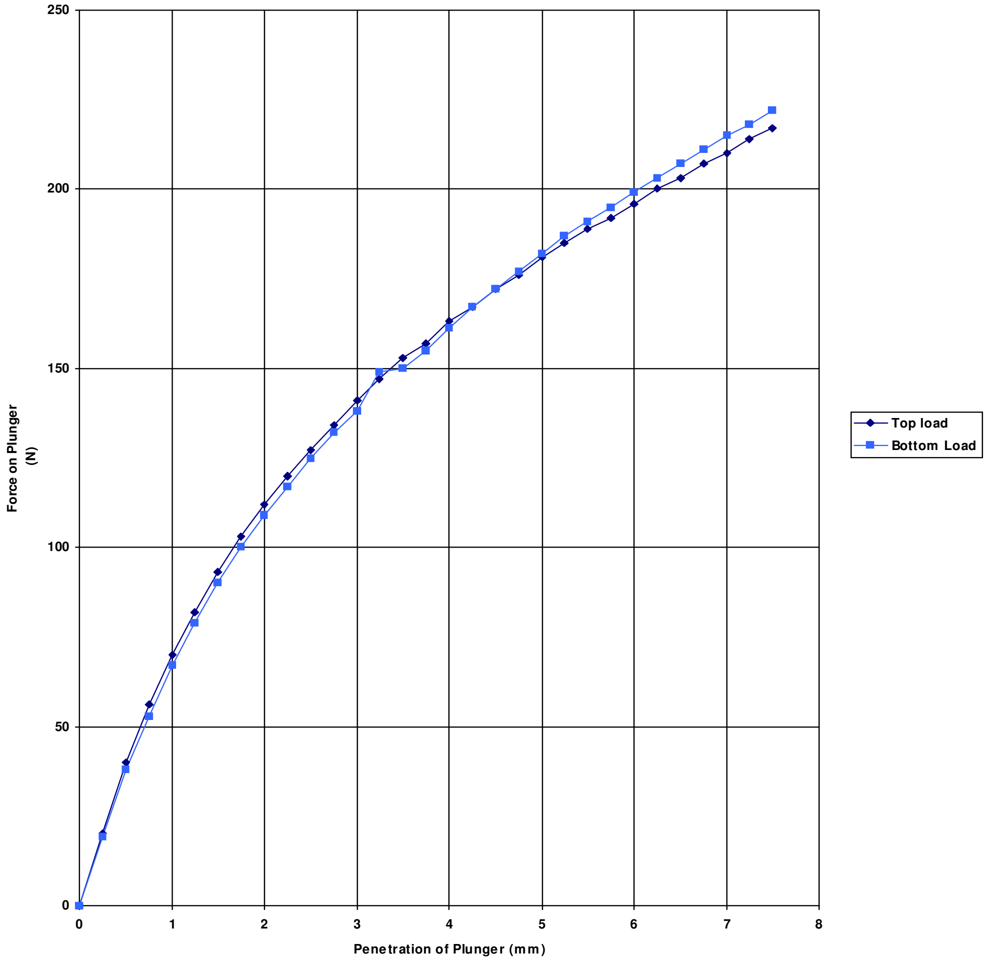
Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH05
Sample Depth 1.20-1.50m
Sample Type B
Sample Ref Y19901

Sample Description

Firm dark greyish brown slightly gravelly organic CLAY.



Penetration	Top (N)	Bottom (N)
0.25mm	20	19
0.50mm	40	38
0.75mm	56	53
1.00mm	70	67
1.25mm	82	79
1.50mm	93	90
1.75mm	103	100
2.00mm	112	109
2.25mm	120	117
2.50mm	127	125
2.75mm	134	132
3.00mm	141	138
3.25mm	147	149
3.50mm	153	150
3.75mm	157	155

Penetration	Top (N)	Bottom (N)
4.00mm	163	161
4.25mm	167	167
4.50mm	172	172
4.75mm	176	177
5.00mm	181	182
5.25mm	185	187
5.50mm	189	191
5.75mm	192	195
6.00mm	196	199
6.25mm	200	203
6.50mm	203	207
6.75mm	207	211
7.00mm	210	215
7.25mm	214	218
7.50mm	217	222

Test Type	2.5kg	
Method	BS1377 Part 4 1990 : Clause 7.0	
Surcharge	13.60	kg
	0.0	%
Bulk Density (Mg/m^3)	1.74	
Dry Density (Mg/m^3)	1.28	
Hand Calculation	No	

CBR	Top	Bottom
Value	0.96	0.95
w%	34.8	37.2

Remarks AGS

14/11/2022

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LABORATORY RESULTS - *CBR Force Penetration*

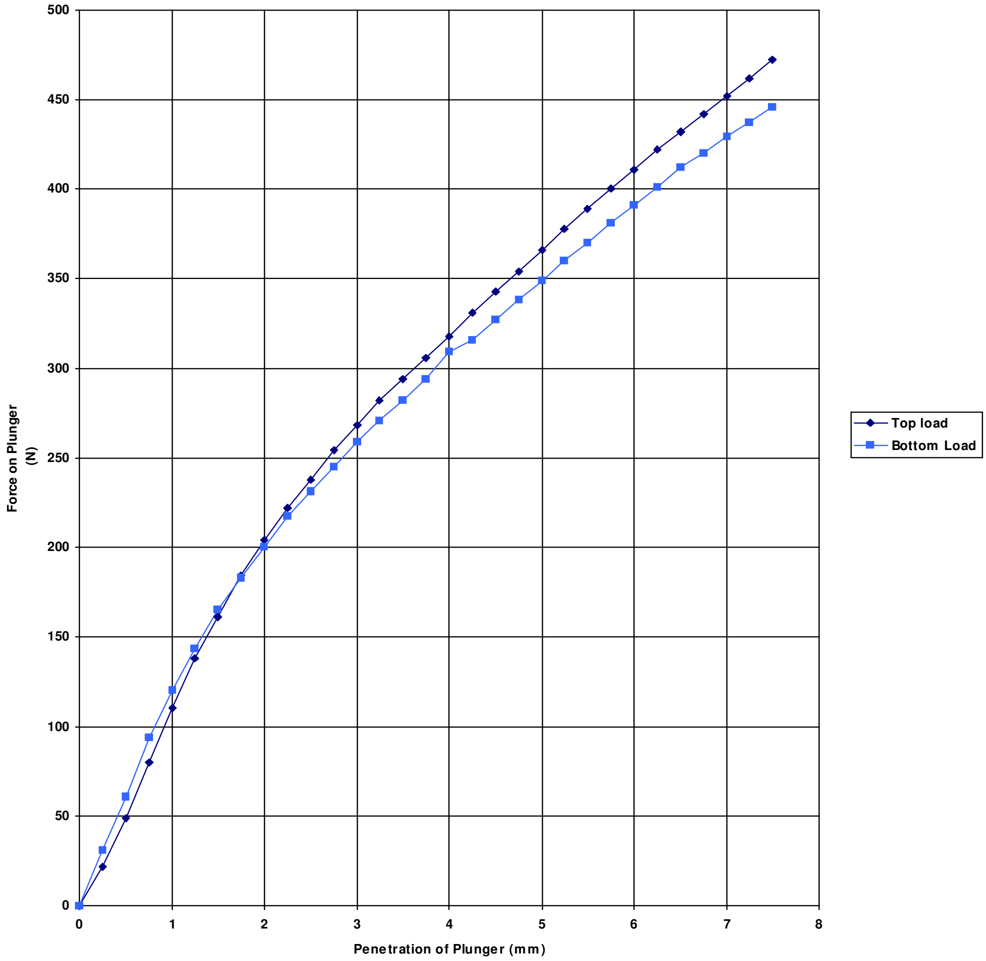
Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

Hole BH05
Sample Depth 2.50-2.80m
Sample Type B
Sample Ref Y19906

Sample Description

Stiff dark brown slightly sandy slightly gravelly CLAY.



Penetration	Top (N)	Bottom (N)
0.25mm	22	31
0.50mm	49	61
0.75mm	80	94
1.00mm	110	120
1.25mm	138	143
1.50mm	161	165
1.75mm	184	183
2.00mm	204	200
2.25mm	222	217
2.50mm	238	231
2.75mm	254	245
3.00mm	268	259
3.25mm	282	271
3.50mm	294	282
3.75mm	306	294

Penetration	Top (N)	Bottom (N)
4.00mm	318	309
4.25mm	331	316
4.50mm	343	327
4.75mm	354	338
5.00mm	366	349
5.25mm	378	360
5.50mm	389	370
5.75mm	400	381
6.00mm	411	391
6.25mm	422	401
6.50mm	432	412
6.75mm	442	420
7.00mm	452	429
7.25mm	462	437
7.50mm	472	446

Test Type 2.5kg
Method BS1377 Part 4 1990 : Clause 7.0

Surcharge 13.60 kg
0.5 %

Bulk Density (Mg/m^3) 2.08
Dry Density (Mg/m^3) 1.73
Hand Calculation No

CBR	Top	Bottom
Value	1.8	1.8
w%	20.3	20.5

Remarks

14/11/2022

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LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

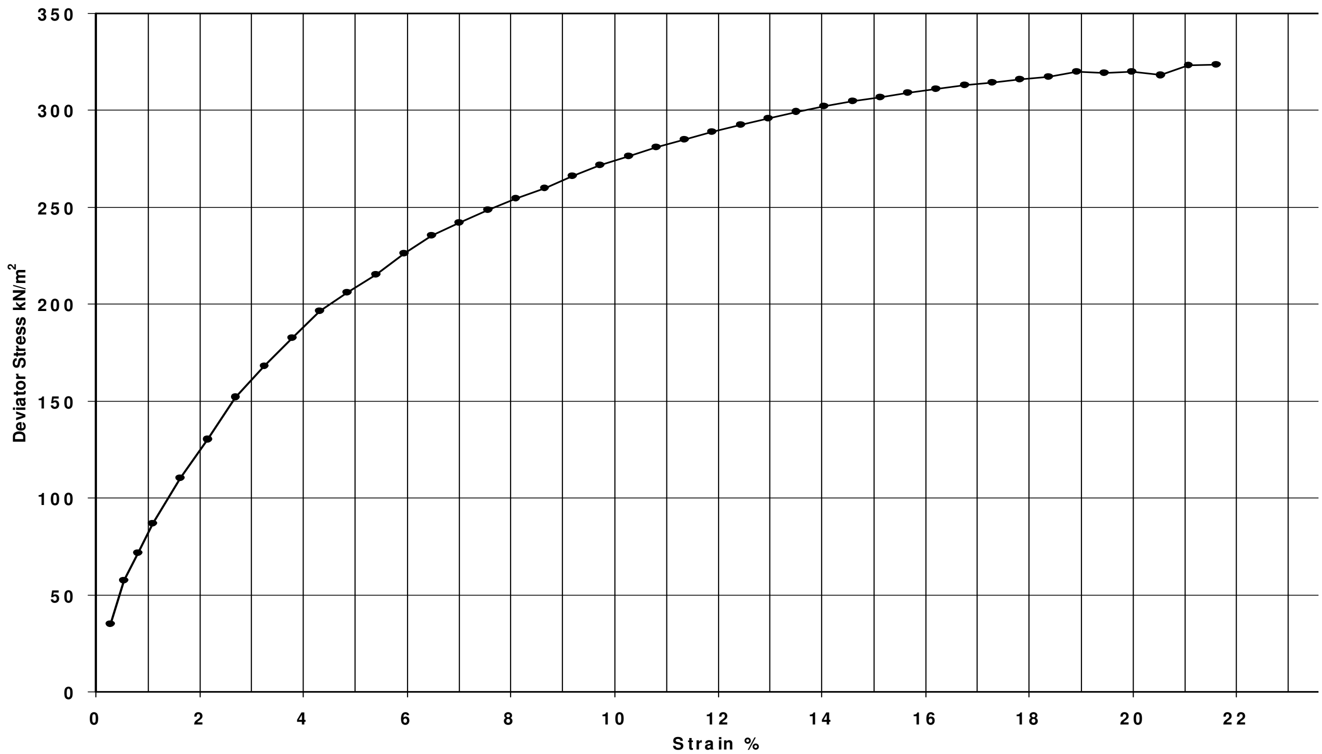
Hole BH01
Sample Depth 12.55-13.00m
Sample Type UT
Sample Ref Y19894

Sample Description

The following samples were combined to perform this test:

Stiff very high strength slightly sandy slightly gravelly CLAY.

BS1377 Part 8 1990 : Clause 9.0



	Stage 1	Stage 2	Stage 3
Test Type	Multi-stage		
Sample Condition	Undisturbed		
Orientation of sample	Vertical		
Initial Diameter (mm)	103.17	103.17	103.17
Initial Length (mm)	185.07	185.07	185.07
Initial Water Content (%)	15.7	15.7	15.7
Initial Bulk Density (Mg/m^3)	2.23	2.23	2.23
Initial Dry Density (Mg/m^3)	1.93	1.93	
Particle Density (Mg/m^3)			
Cell Pressure (kPa)	125	250	500
'Specimen Height' at start of Shearing Stage (mm)			
Membrane Thickness/Correction (mm/kPa)	0.30 / 1.10	0.30 / 1.16	0.30 /
Rate of Strain (%/min)	1.86	1.86	1.86
Corrected Deviator Stress (kPa)	320	324	
Undrained Shear Strength (kPa)	160	162	
Strain at Failure (%)	20.0	21.6	
Failure Zone Water Content (%)			
Water Content (after test) (%)			
Mode of Failure	Plastic		

Strain %	Corrected Deviator Stress kN/m^2	Strain %	Corrected Deviator Stress kN/m^2
0.3	34.7	11.3	285.1
0.5	57.4	11.9	289.0
0.8	71.8	12.4	292.6
1.1	86.6	13.0	296.1
1.6	110.2	13.5	299.4
2.2	130.1	14.0	302.3
2.7	151.8	14.6	304.8
3.2	167.8	15.1	306.9
3.8	182.6	15.7	309.0
4.3	196.5	16.2	310.9
4.9	205.9	16.8	312.9
5.4	215.2	17.3	314.6
5.9	226.0	17.8	316.1
6.5	235.1	18.4	317.5
7.0	242.2	18.9	319.7
7.6	248.5	19.5	319.4
8.1	254.7	20.0	319.7
8.6	260.1	20.5	318.1
9.2	266.3	21.1	323.3
9.7	271.7	21.6	323.7
10.3	276.5		
10.8	281.1		

Remarks AGS

14/11/2022

GEOTECHNICS

LABORATORY RESULTS - *Unconsolidated Undrained Triaxial Test*

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

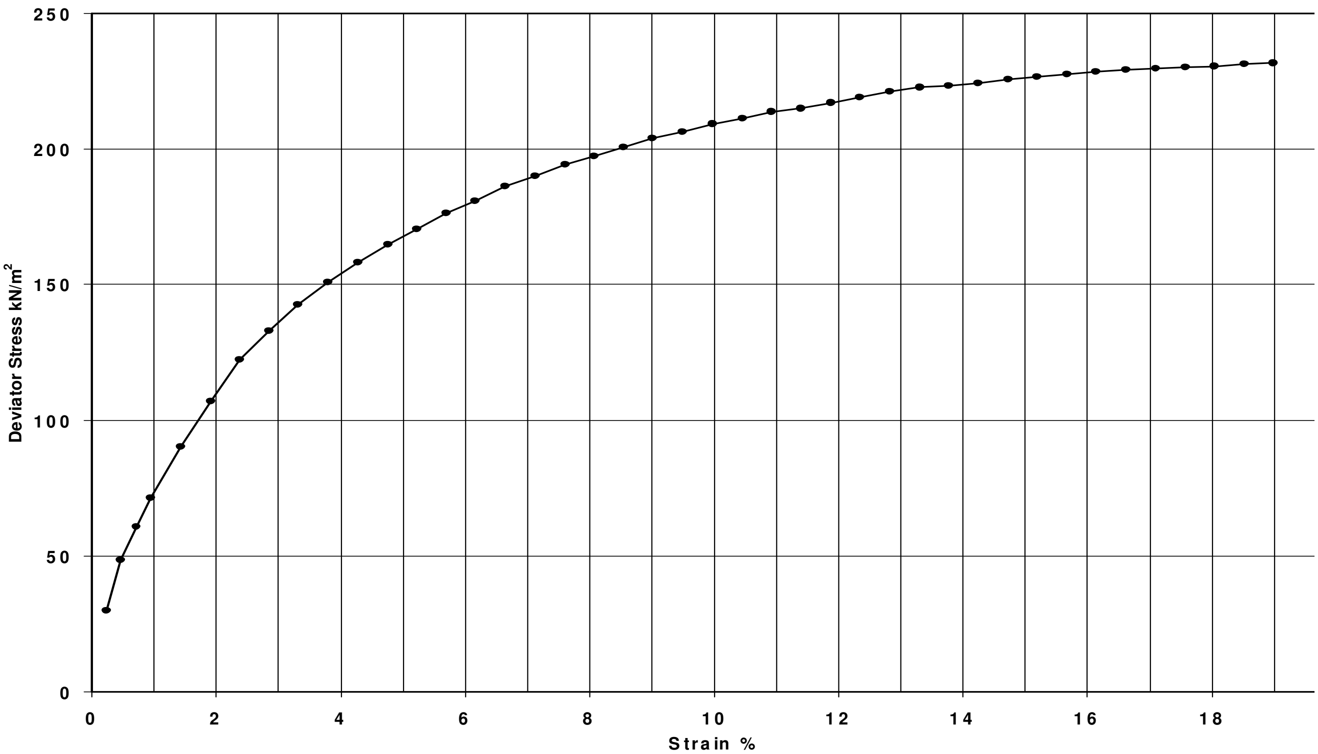
Hole BH02A
Sample Depth 10.55-11.00m
Sample Type U
Sample Ref Y19878

Sample Description

The following samples were combined to perform this test:

Stiff high strength slightly sandy slightly gravelly CLAY.

BS1377 Part 8 1990 : Clause 9.0



		Stage 1	Stage 2	Stage 3
Test Type		Multi-stage		
Sample Condition		Undisturbed		
Orientation of sample		Vertical		
Initial Diameter	(mm)	103.48	103.48	103.48
Initial Length	(mm)	210.60	210.60	210.60
Initial Water Content	(%)	13.8	13.8	13.8
Initial Bulk Density	(Mg/m^3)	2.25	2.25	2.25
Initial Dry Density	(Mg/m^3)	1.98		
Particle Density	(Mg/m^3)			
Cell Pressure	(kPa)	100	200	400
'Specimen Height' at start of Shearing Stage	(mm)			
Membrane Thickness/Correction	(mm/kPa)	0.30 / 1.05	0.30 /	0.30 /
Rate of Strain	(%/min)	1.86	1.86	1.86
Corrected Deviator Stress	(kPa)	232		
Undrained Shear Strength	(kPa)	116		
Strain at Failure	(%)	19 (excess)		
Failure Zone Water Content	(%)			
Water Content (after test)	(%)			
Mode of Failure		Plastic		

Strain %	Corrected Deviator Stress kN/m^2	Strain %	Corrected Deviator Stress kN/m^2
0.2	29.9	10.0	209.3
0.5	48.6	10.4	211.6
0.7	60.7	10.9	213.9
0.9	71.6	11.4	215.0
1.4	90.4	11.9	217.2
1.9	106.9	12.3	219.1
2.4	122.3	12.8	221.2
2.8	133.0	13.3	222.7
3.3	142.6	13.8	223.5
3.8	150.9	14.2	224.4
4.3	158.3	14.7	225.7
4.7	164.8	15.2	226.8
5.2	170.5	15.7	227.7
5.7	176.3	16.1	228.5
6.2	181.1	16.6	229.4
6.6	186.3	17.1	229.5
7.1	190.1	17.6	230.2
7.6	194.3	18.0	230.6
8.1	197.5	18.5	231.3
8.5	200.6	19.0	231.9
9.0	203.8		
9.5	206.4		

Remarks

14/11/2022

GEOTECHNICS

LABORATORY RESULTS - *Unconsolidated Undrained Triaxial Test*

Project: VPI IMMINGHAM HUMBER ZERO PCC FEED

Project No: PY220483

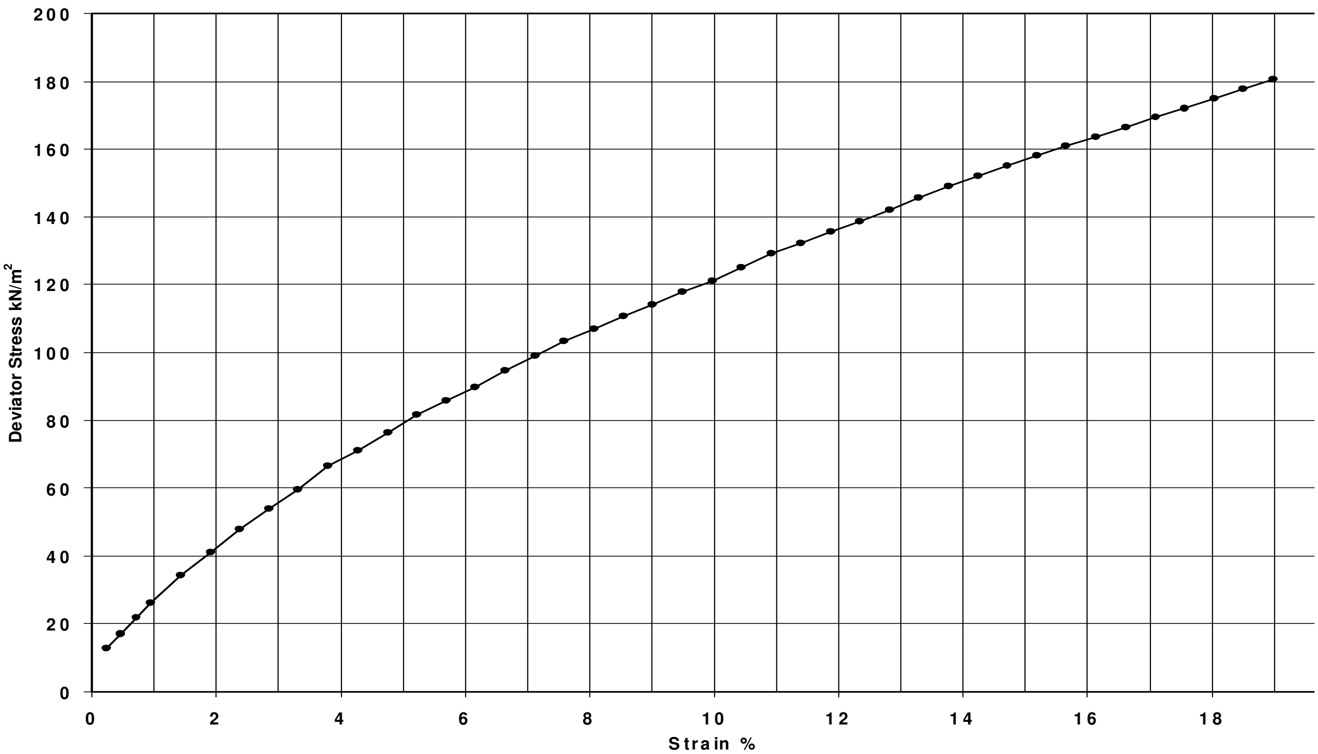
Hole BH05
Sample Depth 16.50-16.95m
Sample Type UT
Sample Ref Y19914

Sample Description

The following samples were combined to perform this test:

Stiff high strength slightly sandy slightly gravelly CLAY.

BS1377 Part 8 1990 : Clause 9.0



	Stage 1	Stage 2	Stage 3
Test Type	Multi-stage		
Sample Condition	Undisturbed		
Orientation of sample	Vertical		
Initial Diameter (mm)	104.03	104.03	104.03
Initial Length (mm)	210.68	210.68	210.68
Initial Water Content (%)	15.1	15.1	15.1
Initial Bulk Density (Mg/m^3)	2.21	2.21	2.21
Initial Dry Density (Mg/m^3)	1.92		
Particle Density (Mg/m^3)			
Cell Pressure (kPa)	175	350	700
'Specimen Height' at start of Shearing Stage (mm)			
Membrane Thickness/Correction (mm/kPa)	0.30 / 1.04	0.30 /	0.30 /
Rate of Strain (%/min)	1.86	1.86	1.86
Corrected Deviator Stress (kPa)	181		
Undrained Shear Strength (kPa)	90		
Strain at Failure (%)	19 (excess)		
Failure Zone Water Content (%)			
Water Content (after test) (%)			
Mode of Failure	Plastic		

Strain %	Corrected Deviator Stress kN/m^2	Strain %	Corrected Deviator Stress kN/m^2
0.2	12.6	10.0	121.0
0.5	16.9	10.4	125.0
0.7	21.8	10.9	129.1
0.9	26.1	11.4	132.4
1.4	34.3	11.9	135.6
1.9	41.2	12.3	138.9
2.4	48.0	12.8	142.2
2.8	53.7	13.3	145.7
3.3	59.7	13.8	149.0
3.8	66.6	14.2	152.0
4.3	71.0	14.7	155.0
4.7	76.2	15.2	158.2
5.2	81.6	15.7	160.9
5.7	85.8	16.1	163.6
6.2	89.8	16.6	166.5
6.6	94.7	17.1	169.5
7.1	99.2	17.6	172.0
7.6	103.3	18.0	174.8
8.1	107.0	18.5	177.7
8.5	110.7	19.0	180.7
9.0	114.1		
9.5	117.9		

Remarks AGS

14/11/2022

GEOTECHNICS

LABORATORY REPORT

PSL
Professional Soils Laboratory

UKAS TESTING
4043

Contract Number: PSL22/5956

Report Date:	14 October 2022
Client's Reference:	PY220483
Client Name:	Geotechnics 203 Torrington Avenue Tile Hill Coventry CV4 9UT
For the attention of:	**Paul Smart**
Contract Title:	Humber Zero VPI-Immingham
Date Received:	14/9/2022
Date Commenced:	14/9/2022
Date Completed:	14/10/2022
Notes:	**Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins (Director)	R Berriman (Quality Manager)	S Royle (Laboratory Manager)
L Knight (Senior Technician)	S Eyre (Senior Technician)	D Burton (Advanced Testing Manager)

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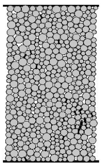
Effective Stress Triaxial Compression

Consolidated Undrained

Summary Report

Sample Details



sketch showing specimen location in original sample

Depth	14.55-15.00m		
Description	Brown sandy very silty CLAY.		
Type	Undisturbed, vertical orientation.		
Initial Sample Length	L_0	(mm)	204.1
Initial Sample Diameter	D_0	(mm)	104.8
Initial Sample Weight	W_0	(gr)	3706.0
Initial Bulk Density	ρ_0	(Mg/m3)	2.10
Particle Density	ρ_s	(Mg/m3)	2.66

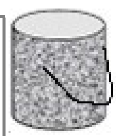
Initial Conditions

			Stage 1	2	3	4
Initial Cell Pressure	σ_{3i}	(kPa)	640	780	1060	
Initial Back Pressure	U_{bi}	(kPa)	500	500	500	
Membrane Thickness	m_b	(mm)	0.600			
Displacement Input	L_{IP}	(mm)	CH 2			
Load Input	N_{IP}	(N)	CH 1			
Pore Water Pressure Input	u_{pwp}	(kPa)	CH 3			
Sample Volume	V	(cc)	CH 6			
Initial Moisture	ω_i	(%)	19			
Initial Dry Density	ρ_{di}	(Mg/m3)	1.77			
Initial Voids Ratio	e_i	.	0.500			
Initial Degree of Saturation	S_i	(%)	100			
B Value	B	.	0.95			

Final Conditions

			Stage 1	2	3	4
Final Moisture	ω_f	(%)	18			
Final Dry Density	ρ_{df}	(Mg/m3)	1.92			
Final Voids Ratio	e_f	.	0.385			
Final Degree of Saturation	S_f	(%)	100.0			
Failure Criteria		.	Max. Dev. Stress	Max. Dev. Stress	Max. Dev. Stress	
Strain At Failure	ε_f	(%)	3.70	5.75	9.44	
Stress At Failure	$(\sigma_1-\sigma_3)$	(kPa)	290.8	484.0	810.8	
Minor Stress At Failure	σ_3'	(kPa)	132.0	248.9	442.6	
Major Stress At Failure	σ_1'	(kPa)	422.8	732.9	1253.4	
Principal Stress Ratio At Failure	σ_1'/σ_3'		3.203	2.945	2.832	

Notes



Plastic

4043

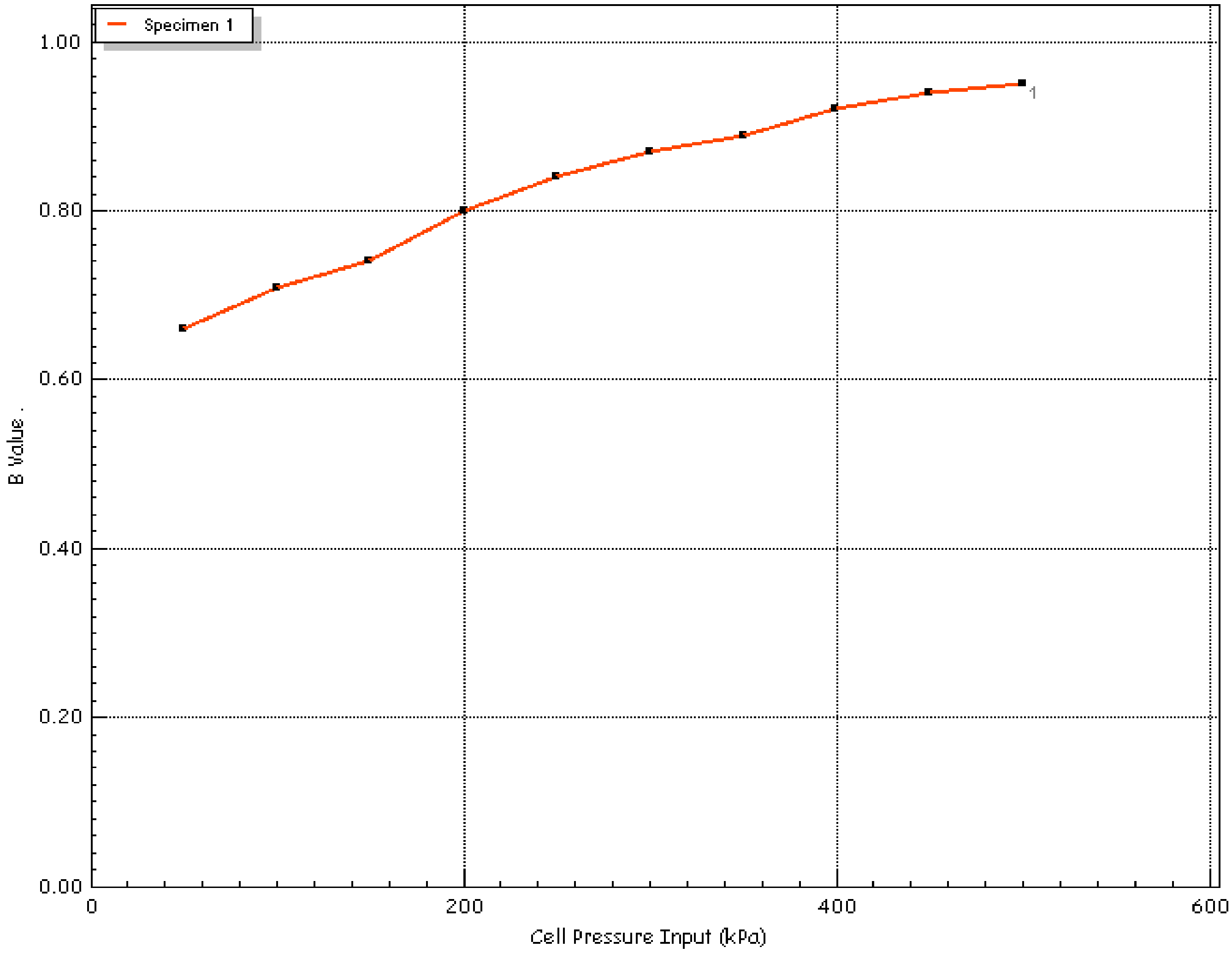
Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH02A 14.55-15m
		Test Date	23/09/2022
		Borehole	BH02A
Jobfile	Humber Zero VPI Immingham	Sample	14.55-15m
Client	Geotechnics	Depth	14.55-15.00m

Effective Stress Triaxial Compression

Consolidated Undrained

Saturation Plots

Saturation Method			Stepped
Cell Pressure Input	σ	(kPa)	500
Pore Water Pressure Input	u_{pwp}	(kPa)	482
B Value	B	.	0.95



Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH02A 14.55-15m
		Test Date	23/09/2022
		Borehole	BH02A
Jobfile	Humber Zero VPI Immingham	Sample	14.55-15m
Client	Geotechnics	Depth	14.55-15.00m

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY

Effective Stress Triaxial Compression

Consolidated Undrained

Consolidation Plots

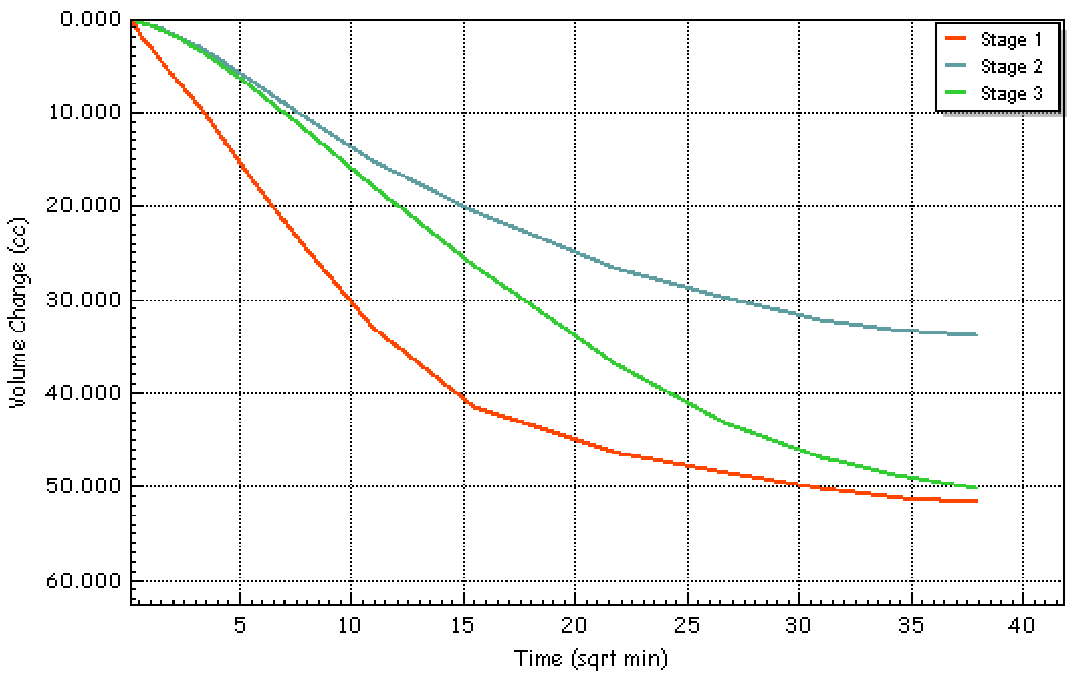
Initial Conditions

			Stage 1	2	3
Initial Cell Pressure	σ_3	(kPa)	640	780	1060
Initial Back Pressure	u_{bi}	(kPa)	500	500	500
Pore Water Pressure Input	u_{pwp}	(kPa)	613	665	859
Drainage Method			none		

Final Conditions

			Stage 1	2	3
PWP Dissipation %	U%	(%)	100.00	100.00	100.00
Volumetric Strain	ε_v%	(%)	2.93	1.92	2.84
Corrected Length	L_c	(mm)	202.1	193.3	184.8
Corrected Area	A_c	(cm2)	84.57	86.65	87.97
Corrected Volume	V_c	(cc)	1708.969	1675.119	1625.073
t100	t_{100}	(min)	261.43	462.65	675.83
Consolidation	c_v	(m2/year)	69.403	39.218	26.847
Compressibility	m_v	(m2/MN)	0.259	0.117	0.079
Test Time	t_F	(h:m:s)	04:21:25	07:42:39	11:15:49
Estimated Strain to Failure	ε%	(%)	5.0	5.0	5.0
Shear Machine Speed	d_r	(mm/min)	0.03865	0.03865	0.03865

Notes



Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH02A 14.55-15m
		Test Date	23/09/2022
		Borehole	BH02A
Jobfile	Humber Zero VPI Immingham	Sample	14.55-15m
Client	Geotechnics	Depth	14.55-15.00m

UKAS TESTING 4043

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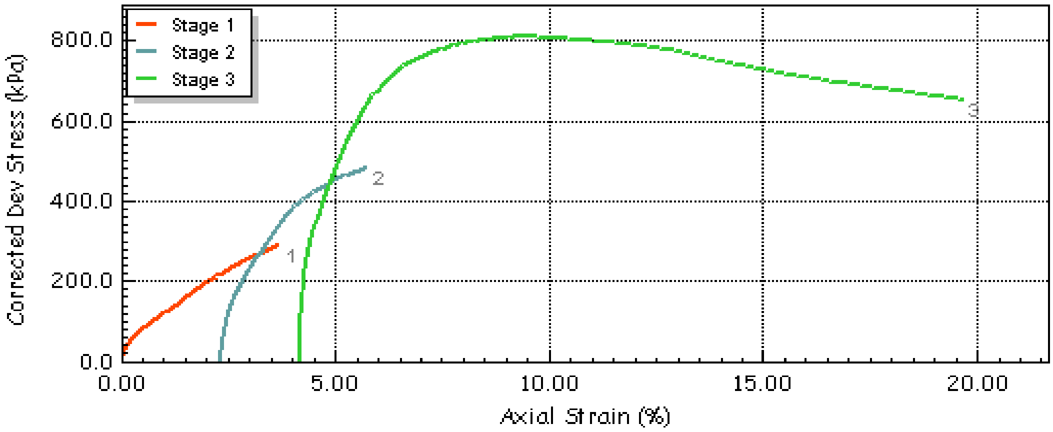
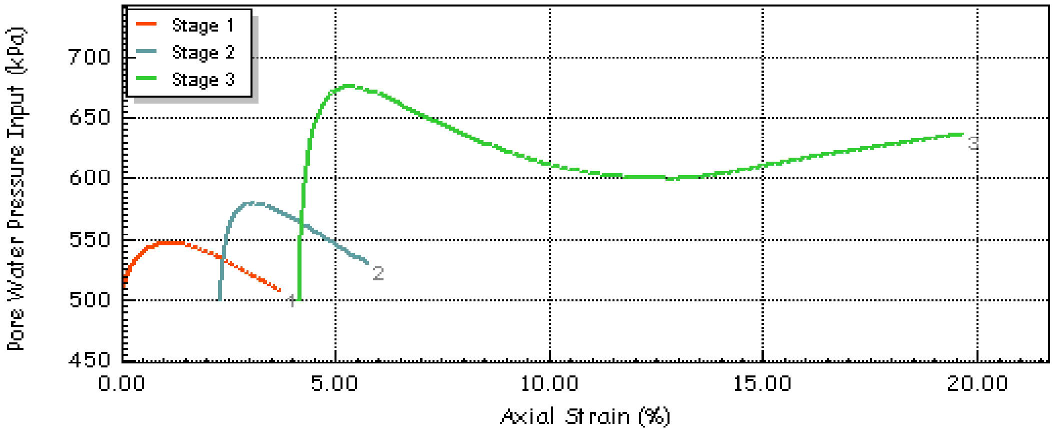
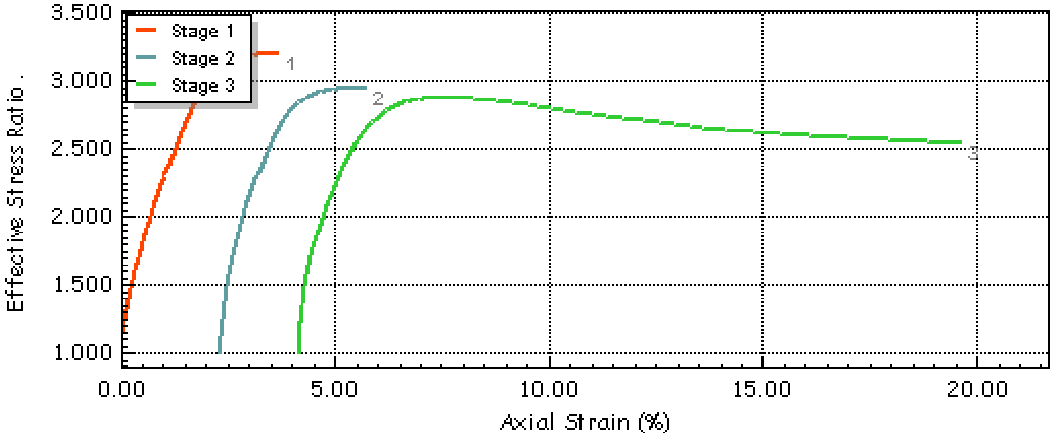
Effective Stress Triaxial Compression

Consolidated Undrained

Shear Stage Plots







UKAS TESTING 4043	Test Method	BS1377-8 : 1990 : Clause 7	Test Name Test Date	BH02A 14.55-15m 23/09/2022
	Jobfile Client	Humber Zero VPI Immingham Geotechnics	Borehole Sample Depth	BH02A 14.55-15m 14.55-15.00m

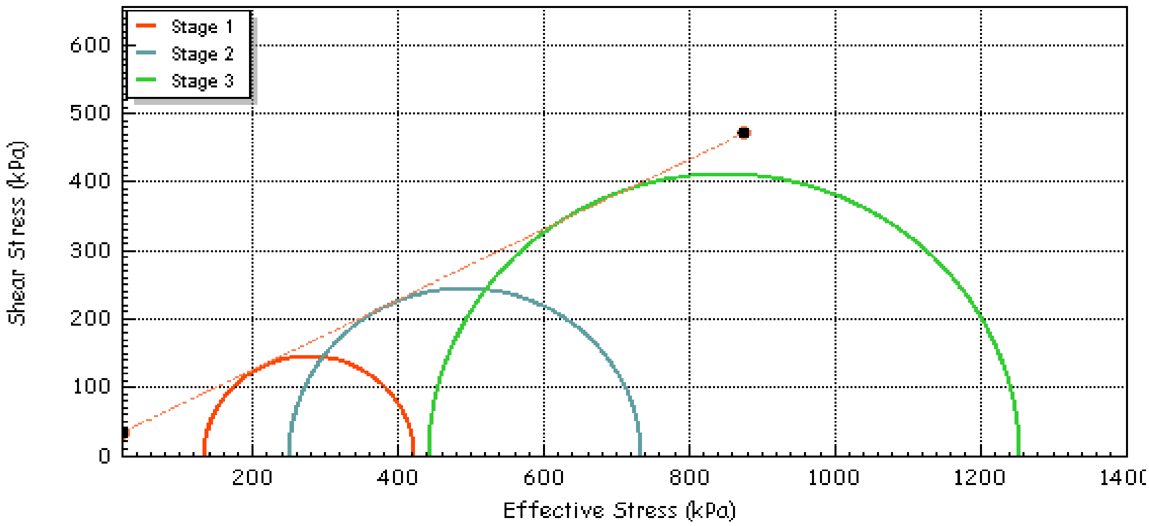
PSL PROFESSIONAL SOILS LABORATORY

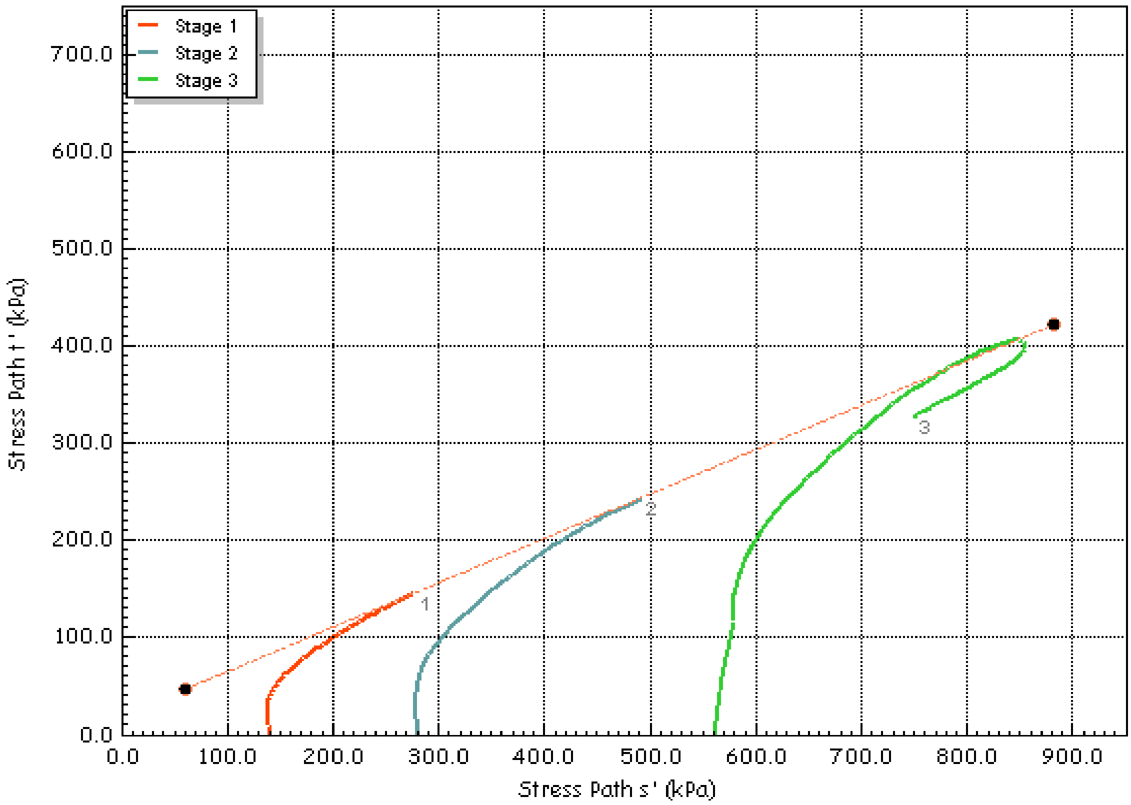
Effective Stress Triaxial Compression

Consolidated Undrained

Shear Stage Plots

Effective	c'	(kPa)	23.21	Effective Cohesion	c'	(kPa)	23.21
Effective Friction	ϕ '	(deg)	27.1	Effective Friction	ϕ '	(deg)	27.1





Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH02A 14.55-15m
		Test Date	23/09/2022
		Borehole	BH02A
Jobfile	Humber Zero VPI Immingham	Sample	14.55-15m
Client	Geotechnics	Depth	14.55-15.00m

UKAS TESTING 4043

PSL PROFESSIONAL SOILS LABORATORY

LABORATORY REPORT

4043

Contract Number: PSL22/6934

Report Date: 10 November 2022

Client's Reference: PY220483

Client Name: Geotechnics Chester
Unit 1 Bypass Park Estate
Sherburn in Elmet
North Yorkshire
LS25 6EP

For the attention of: Tom Birch

Contract Title: VPI Immingham

Date Received: 26/10/2022
Date Commenced: 26/10/2022
Date Completed: 10/11/2022

Notes: **Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins (Director)	R Berriman (Quality Manager)	S Royle (Laboratory Manager)
L Knight (Senior Technician)	S Eyre (Senior Technician)	D Burton (Advanced Testing Manager)

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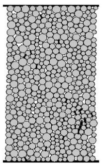
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Effective Stress Triaxial Compression

Consolidated Undrained

Summary Report

Sample Details



sketch showing specimen location in original sample

Depth	4.55-5.00m		
Description	Brown slightly gravelly sandy CLAY.		
Type	Undisturbed, vertical orientation.		
Initial Sample Length	L_o	(mm)	211.5
Initial Sample Diameter	D_o	(mm)	105.2
Initial Sample Weight	W_o	(gr)	3915.0
Initial Bulk Density	ρ_0	(Mg/m3)	2.13
Particle Density	ρ_s	(Mg/m3)	2.66

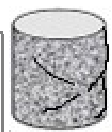
Initial Conditions

			Stage 1	2	3	4
Initial Cell Pressure	σ_{3i}	(kPa)	550	600	700	
Initial Back Pressure	U_{bi}	(kPa)	500	500	500	
Membrane Thickness	m_b	(mm)	0.400			
Displacement Input	L_{IP}	(mm)	CH 2			
Load Input	N_{IP}	(N)	CH 1			
Pore Water Pressure Input	u_{pwp}	(kPa)	CH 3			
Sample Volume	V	(cc)	CH 6			
Initial Moisture	ω_i	(%)	14			
Initial Dry Density	ρ_{di}	(Mg/m3)	1.87			
Initial Voids Ratio	e_i	.	0.422			
Initial Degree of Saturation	S_i	(%)	87			
B Value	B	.	0.96			

Final Conditions

			Stage 1	2	3	4
Final Moisture	ω_f	(%)	15			
Final Dry Density	ρ_{df}	(Mg/m3)	1.98			
Final Voids Ratio	e_f	.	0.345			
Final Degree of Saturation	S_f	(%)	100.0			
Failure Criteria		.	Max. Dev.	Max. Dev.	Max. Dev.	
Strain At Failure	ε_f	(%)	1.93	3.33	7.35	
Stress At Failure	$(\sigma_1-\sigma_3)$	(kPa)	127.5	182.7	376.0	
Minor Stress At Failure	σ_3'	(kPa)	25.0	53.6	153.0	
Major Stress At Failure	σ_1'	(kPa)	152.5	236.3	529.0	
Principal Stress Ratio At Failure	σ_1'/σ_3'		6.103	4.405	3.457	
PwP At Failure Criteria	u_f		525.2	546.4	547.0	

Notes



Plastic

Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH01 4.55-5.00m UT
		Test Date	01/11/2022
		Borehole	BH01
Jobfile	VPI Immingham	Sample	4.55-5.00m UT
Client	Geotechnics	Depth	4.55-5.00m

UKAS TESTING

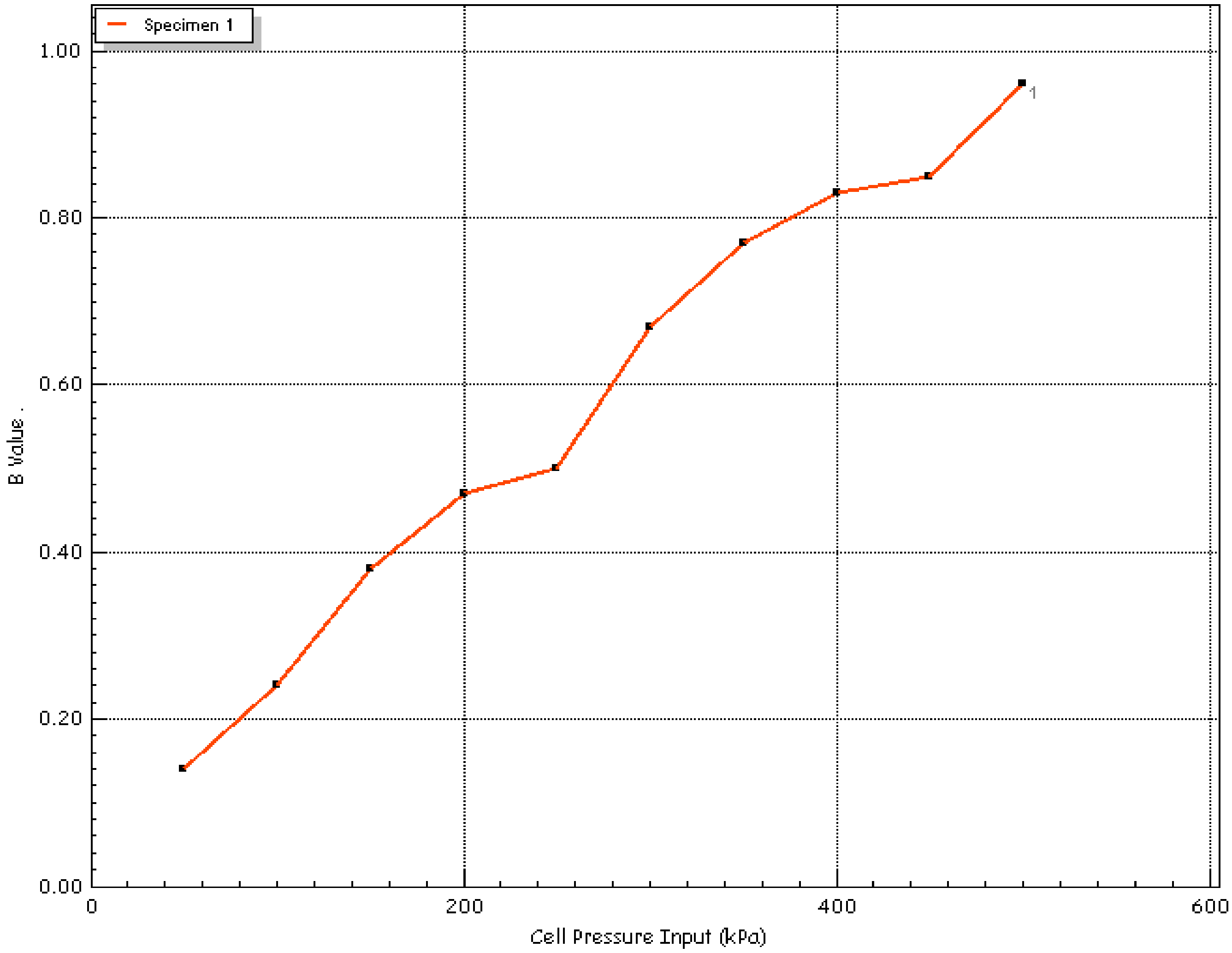
PSL PROFESSIONAL SOILS LABORATORY

Effective Stress Triaxial Compression

Consolidated Undrained

Saturation Plots

Saturation Method			Stepped
Cell Pressure Input	σ	(kPa)	500
Pore Water Pressure Input	u pwp	(kPa)	488
B Value	B	.	0.96



Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH01 4.55-5.00m UT
		Test Date	01/11/2022
		Borehole	BH01
Jobfile	VPI Immingham	Sample	4.55-5.00m UT
Client	Geotechnics	Depth	4.55-5.00m

UKAS TESTING

PSL PROFESSIONAL SOILS LABORATORY

Effective Stress Triaxial Compression

Consolidated Undrained

Consolidation Plots

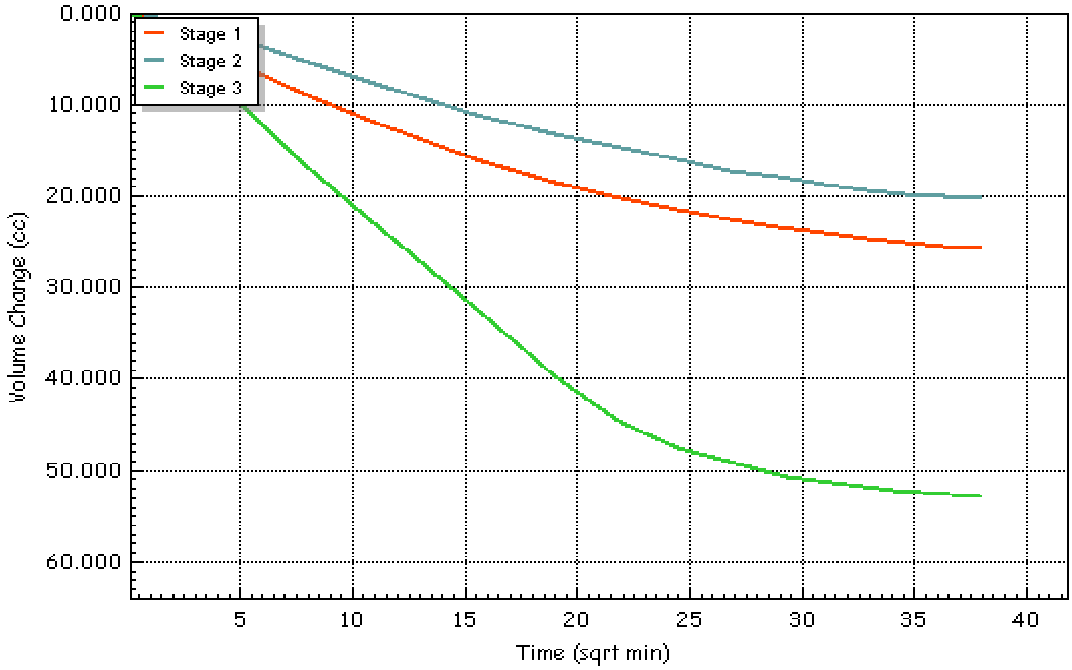
Initial Conditions

			Stage 1	2	3
Initial Cell Pressure	σ_3	(kPa)	550	600	700
Initial Back Pressure	u_{bi}	(kPa)	500	500	500
Pore Water Pressure Input	u_{pwp}	(kPa)	539	558	629
Drainage Method			Radial+One End		

Final Conditions

			Stage 1	2	3
PWP Dissipation %	U%	(%)	100.00	100.00	100.00
Volumetric Strain	ε_v%	(%)	1.40	1.10	2.87
Corrected Length	L_c	(mm)	210.5	205.7	199.6
Corrected Area	A_c	(cm2)	86.11	87.15	87.16
Corrected Volume	V_c	(cc)	1812.683	1792.544	1739.709
t100	t_{100}	(min)	512.64	872.85	626.09
Consolidation	c_v	(m2/year)	0.004	0.003	0.004
Compressibility	m_v	(m2/MN)	0.357	0.188	0.223
Test Time	t_F	(h:m:s)	15:22:45	26:11:07	18:46:57
Estimated Strain to Failure	ε%	(%)	5.0	5.0	5.0
Shear Machine Speed	d_r	(mm/min)	0.01141	0.01141	0.01141

Notes



Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH01 4.55-5.00m UT
		Test Date	01/11/2022
		Borehole	BH01
Jobfile	VPI Immingham	Sample	4.55-5.00m UT
Client	Geotechnics	Depth	4.55-5.00m

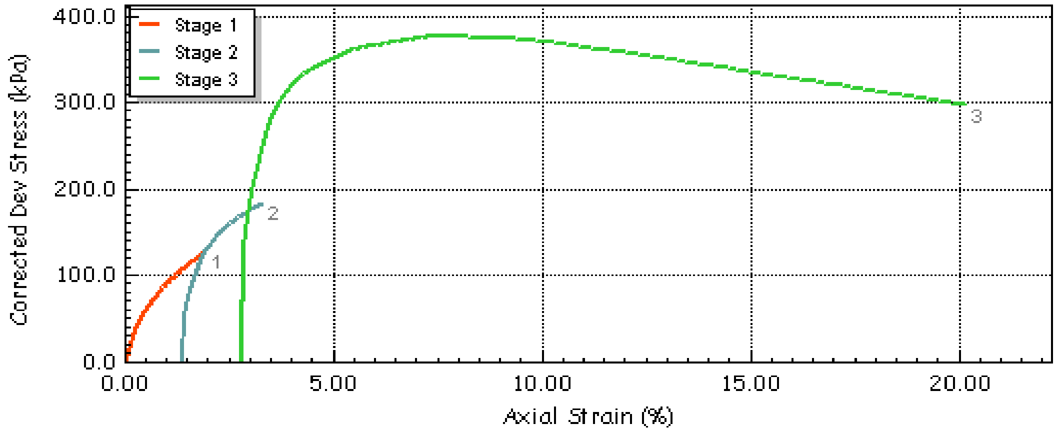
UKAS TESTING

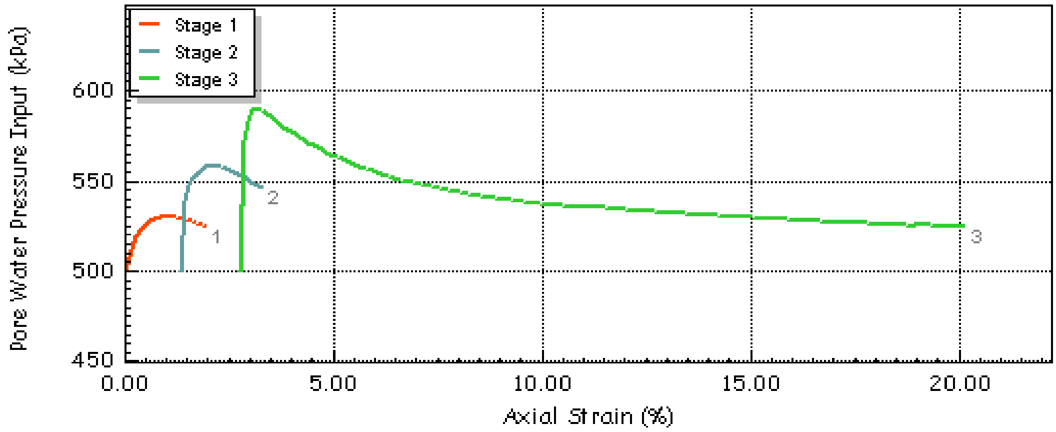
PSL PROFESSIONAL SOILS LABORATORY

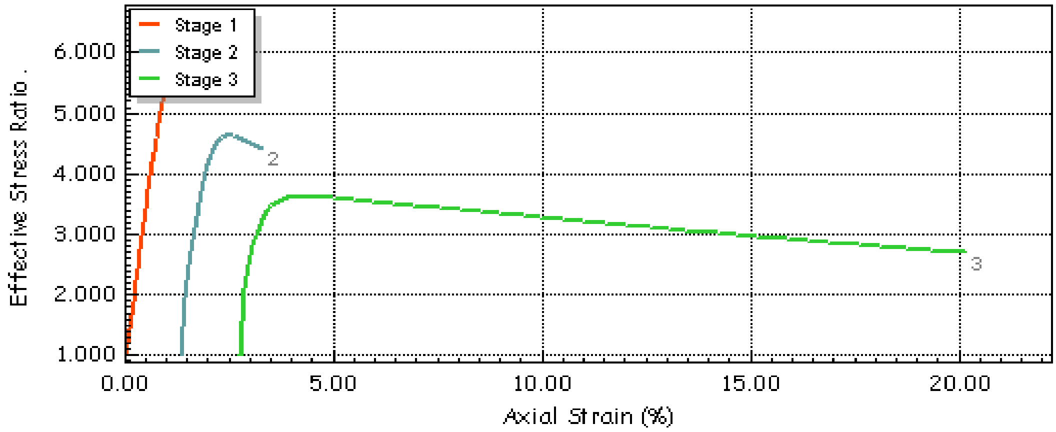
Effective Stress Triaxial Compression

Consolidated Undrained

Shear Stage Plots







UKAS TESTING	Test Method	BS1377-8 : 1990 : Clause 7	Test Name Test Date	BH01 4.55-5.00m UT 01/11/2022
	Jobfile Client	VPI Immingham Geotechnics	Borehole Sample Depth	BH01 4.55-5.00m UT 4.55-5.00m

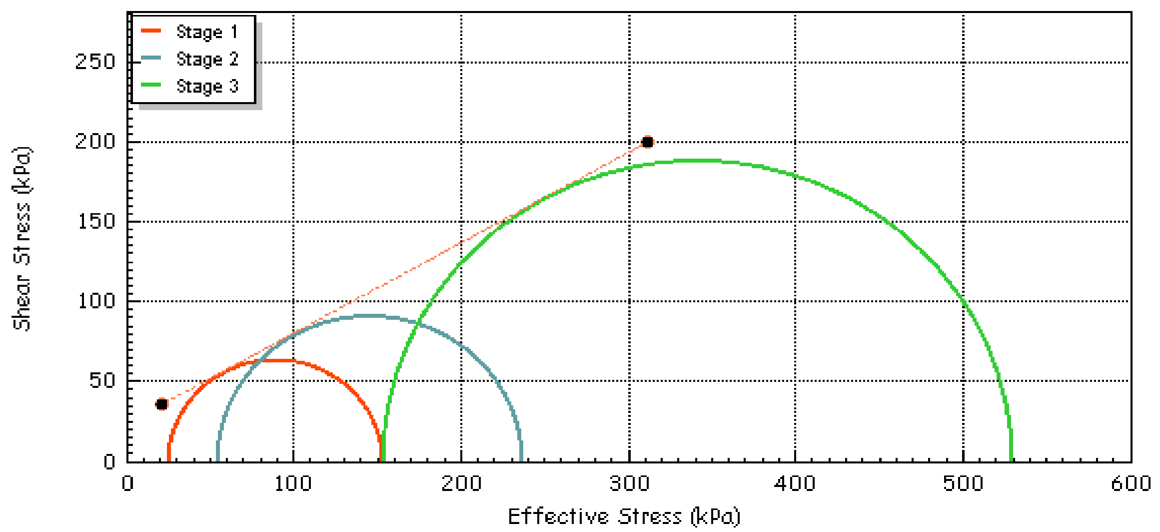
PSL PROFESSIONAL SOILS LABORATORY

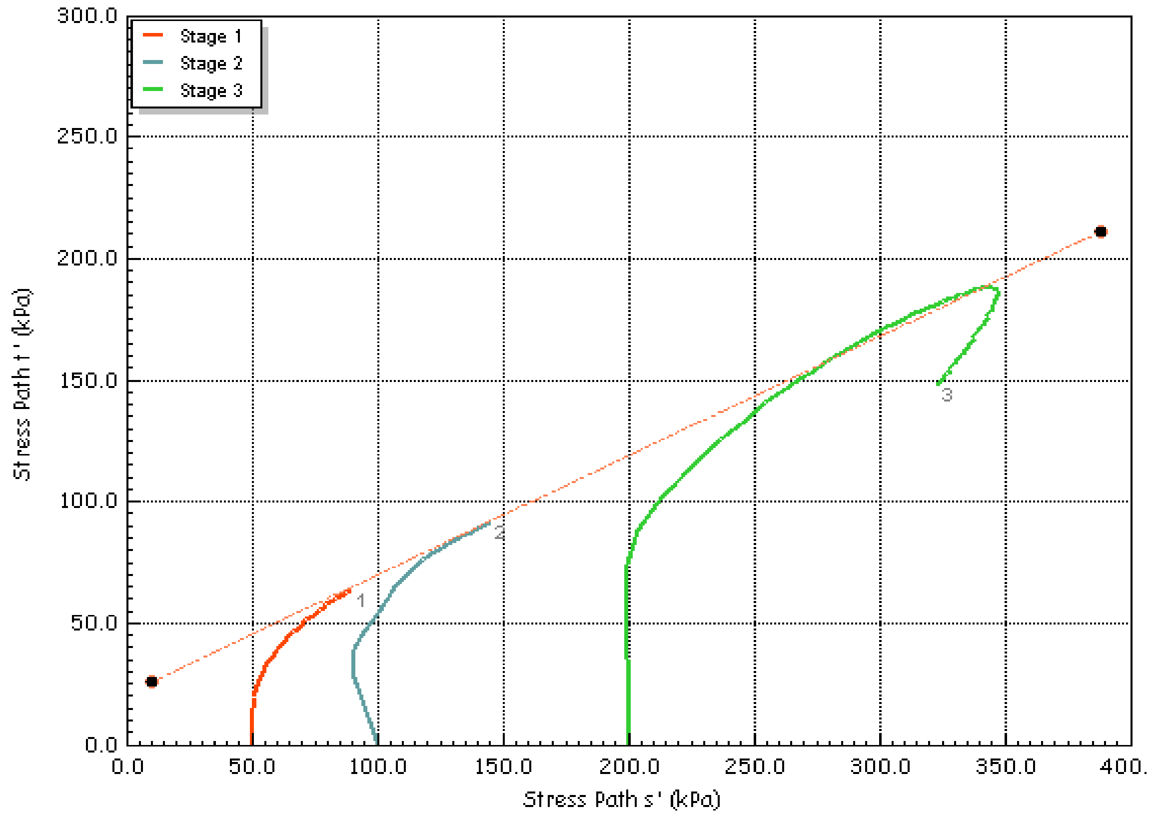
Effective Stress Triaxial Compression

Consolidated Undrained

Shear Stage Plots

Effective	c'	(kPa)	23.91	Effective Cohesion	c'	(kPa)	23.69
Effective Friction	ϕ '	(deg)	23.91	Effective Friction	ϕ '	(deg)	23.69





Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH01 4.55-5.00m UT
		Test Date	01/11/2022
		Borehole	BH01
Jobfile	VPI Immingham	Sample	4.55-5.00m UT
Client	Geotechnics	Depth	4.55-5.00m

UKAS TESTING

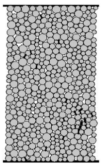
PSL PROFESSIONAL SOILS LABORATORY

Effective Stress Triaxial Compression

Consolidated Undrained

Summary Report

Sample Details



sketch showing specimen location in original sample

Depth	4.30-4.75m		
Description	Brown gravelly sandy CLAY.		
Type	Undisturbed, vertical orientation.		
Initial Sample Length	L_0	(mm)	200.0
Initial Sample Diameter	D_0	(mm)	100.0
Initial Sample Weight	W_0	(gr)	3186.0
Initial Bulk Density	ρ_0	(Mg/m3)	2.03
Particle Density	ρ_s	(Mg/m3)	2.66

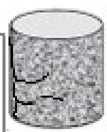
Initial Conditions

			Stage 1	2	3	4
Initial Cell Pressure	σ_{3i}	(kPa)	700	750	850	
Initial Back Pressure	U_{bi}	(kPa)	650	650	650	
Membrane Thickness	m_b	(mm)	0.600			
Displacement Input	L_{IP}	(mm)	CH 2			
Load Input	N_{IP}	(N)	CH 1			
Pore Water Pressure Input	u_{pwp}	(kPa)	CH 3			
Sample Volume	V	(cc)	CH 2			
Initial Moisture	ω_i	(%)	15			
Initial Dry Density	ρ_{di}	(Mg/m3)	1.77			
Initial Voids Ratio	e_i	.	0.505			
Initial Degree of Saturation	S_i	(%)	78			
B Value	B	.	0.96			

Final Conditions

			Stage 1	2	3	4
Final Moisture	ω_f	(%)	15			
Final Dry Density	ρ_{df}	(Mg/m3)	1.82			
Final Voids Ratio	e_f	.	0.459			
Final Degree of Saturation	S_f	(%)	85.5			
Failure Criteria		.	Max. Dev.	Max. Dev.	Max. Dev.	
Strain At Failure	ε_f	(%)	4.84	8.94	19.39	
Stress At Failure	$(\sigma_1 - \sigma_3$	(kPa)	82.9	145.3	281.0	
Minor Stress At Failure	σ_3'	(kPa)	40.0	79.0	168.0	
Major Stress At Failure	σ_1'	(kPa)	122.9	224.3	449.0	
Principal Stress Ratio At Failure	σ_1'/σ_3'		3.072	2.840	2.673	
PwP At Failure Criteria	u_f		660.0	671.0	682.0	

Notes



Plastic

UKAS TESTING

Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH05 4.3-4.75m
		Test Date	01/11/2022
		Borehole	BH05
Jobfile	VPI Immingham	Sample	4.3-4.75m
Client	Geotechnics	Depth	4.30-4.75m

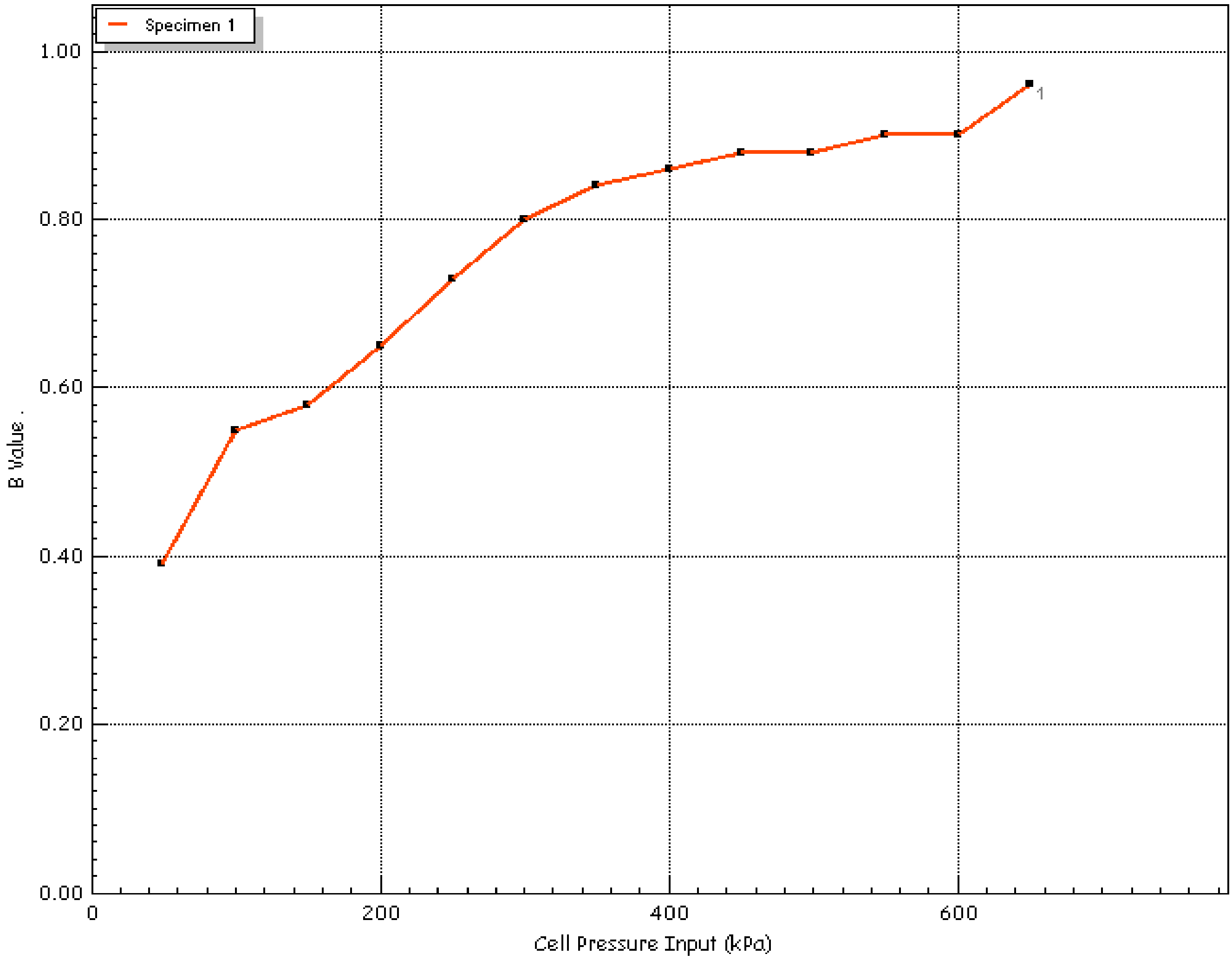
PSL PROFESSIONAL SOILS LABORATORY

Effective Stress Triaxial Compression

Consolidated Undrained

Saturation Plots

Saturation Method			Stepped
Cell Pressure Input	σ	(kPa)	650
Pore Water Pressure Input	u pwp	(kPa)	630
B Value	B	.	0.96



Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH05 4.3-4.75m
		Test Date	01/11/2022
		Borehole	BH05
Jobfile	VPI Immingham	Sample	4.3-4.75m
Client	Geotechnics	Depth	4.30-4.75m

UKAS TESTING

PSL PROFESSIONAL SOILS LABORATORY

Effective Stress Triaxial Compression

Consolidated Undrained

Consolidation Plots

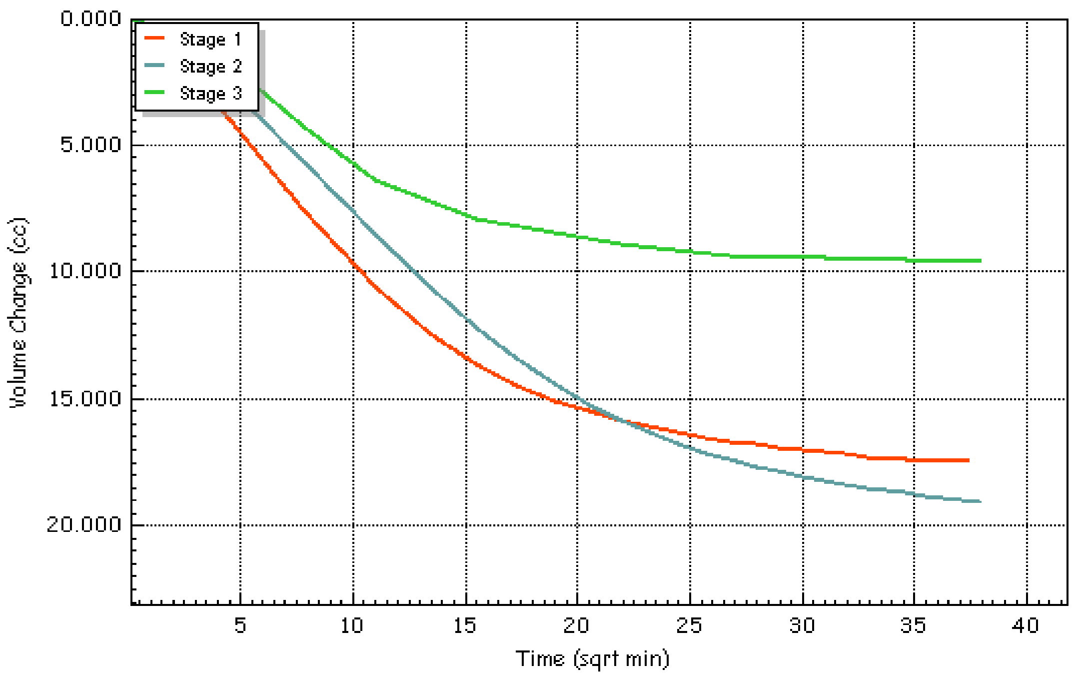
Initial Conditions

			Stage 1	2	3
Initial Cell Pressure	σ_3	(kPa)	700	750	850
Initial Back Pressure	u_{bi}	(kPa)	650	650	650
Pore Water Pressure Input	u_{pwp}	(kPa)	677	707	760
Drainage Method			Radial+One End		

Final Conditions

			Stage 1	2	3
PWP Dissipation %	U%	(%)	100.00	100.00	100.00
Volumetric Strain	ε_v%	(%)	1.11	1.21	0.61
Corrected Length	L_c	(mm)	199.3	188.8	179.3
Corrected Area	A_c	(cm2)	77.96	81.25	85.05
Corrected Volume	V_c	(cc)	1553.311	1534.242	1524.672
t100	t_{100}	(min)	294.35	602.49	282.98
Consolidation	c_v	(m2/year)	0.007	0.004	0.008
Compressibility	m_v	(m2/MN)	0.412	0.213	0.055
Test Time	t_F	(h:m:s)	08:49:49	18:04:28	08:29:21
Estimated Strain to Failure	ε%	(%)	5.0	5.0	5.0
Shear Machine Speed	d_r	(mm/min)	0.01880	0.0188	0.0188

Notes



Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH05 4.3-4.75m
		Test Date	01/11/2022
		Borehole	BH05
Jobfile	VPI Immingham	Sample	4.3-4.75m
Client	Geotechnics	Depth	4.30-4.75m

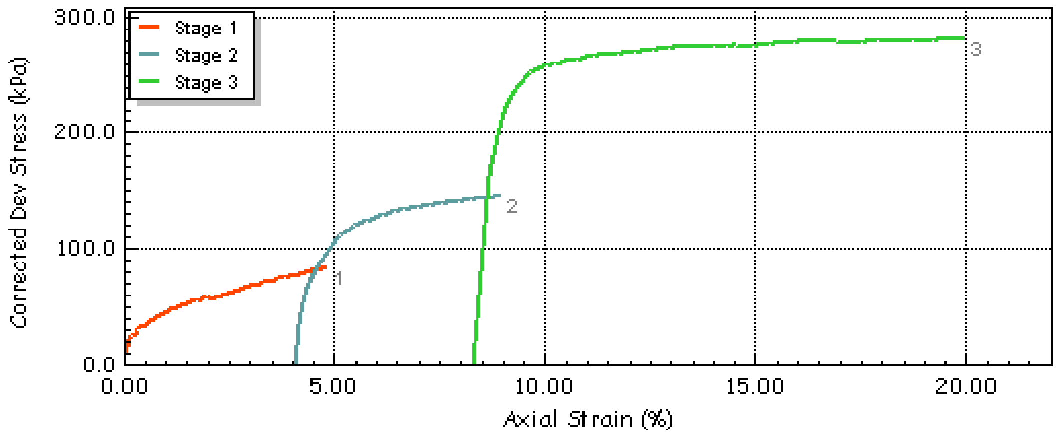
UKAS TESTING

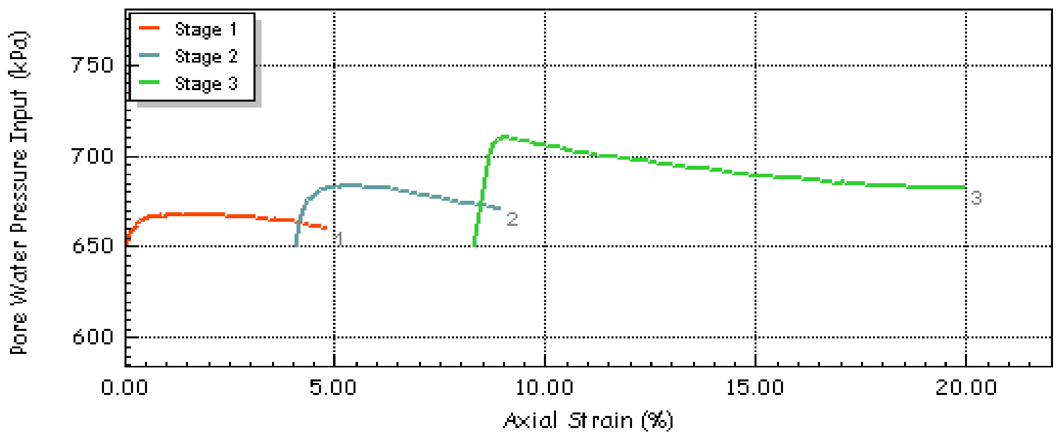
PSL PROFESSIONAL SOILS LABORATORY

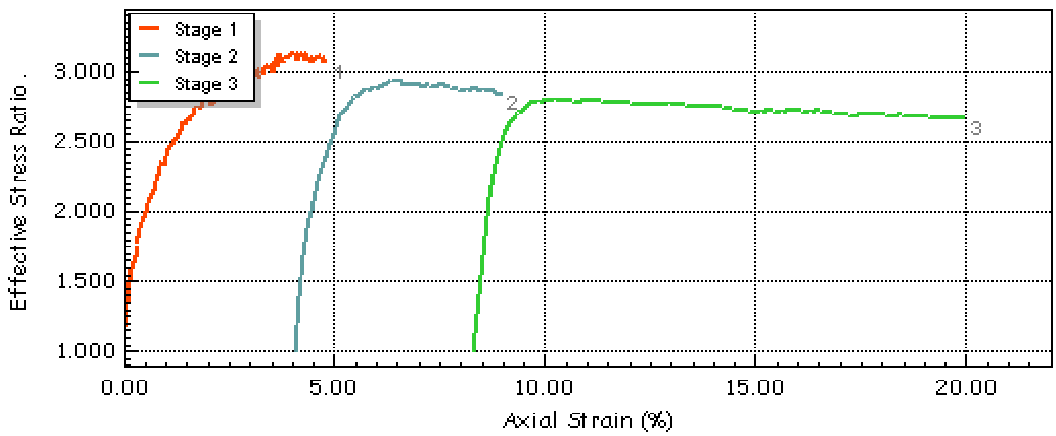
Effective Stress Triaxial Compression

Consolidated Undrained

Shear Stage Plots







Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH05 4.3-4.75m
		Test Date	01/11/2022
		Borehole	BH05
Jobfile	VPI Immingham	Sample	4.3-4.75m
Client	Geotechnics	Depth	4.30-4.75m

UKAS TESTING

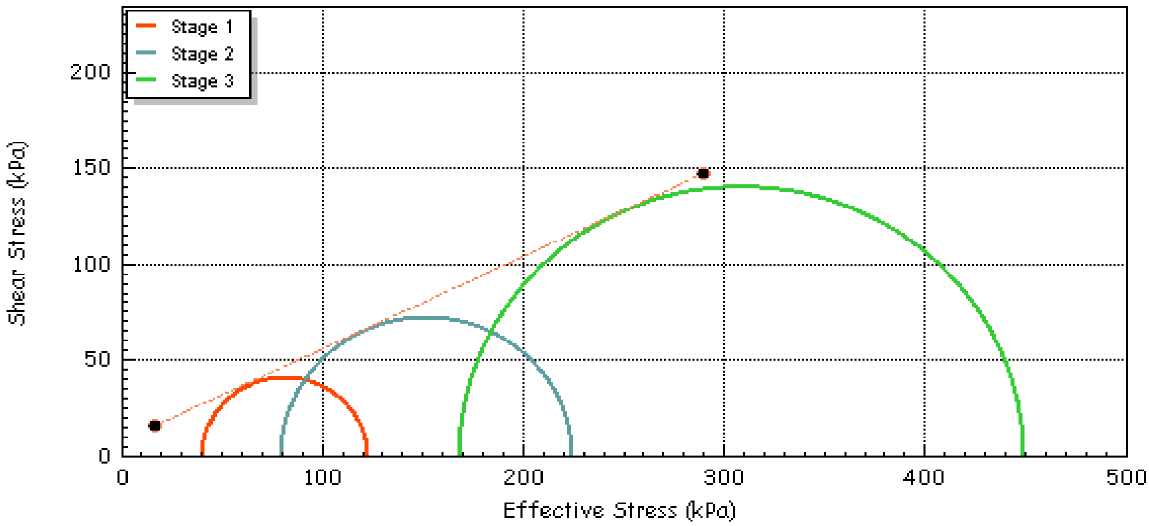
PSL PROFESSIONAL SOILS LABORATORY

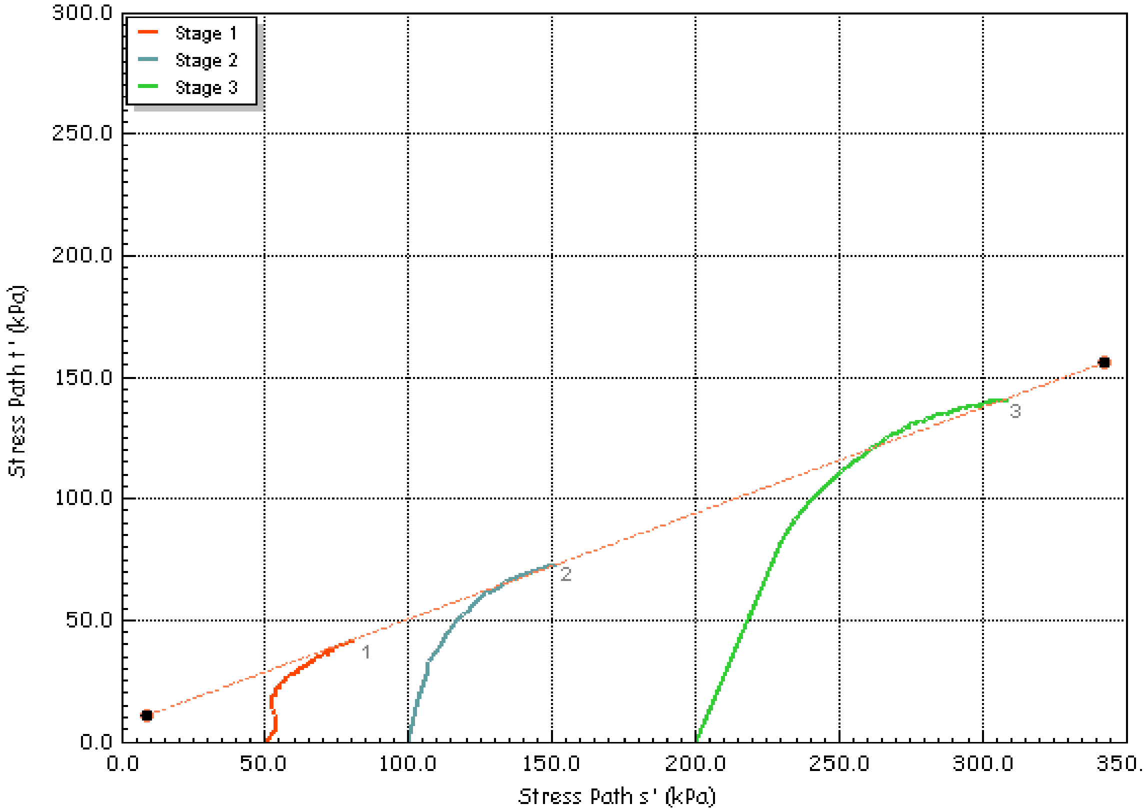
Effective Stress Triaxial Compression

Consolidated Undrained

Shear Stage Plots

Effective	c'	(kPa)	7.43	Effective Cohesion	c'	(kPa)	7.43
Effective Friction	ϕ '	(deg)	25.8	Effective Friction	ϕ '	(deg)	25.8





Test Method	BS1377-8 : 1990 : Clause 7	Test Name	BH05 4.3-4.75m
		Test Date	01/11/2022
		Borehole	BH05
Jobfile	VPI Immingham	Sample	4.3-4.75m
Client	Geotechnics	Depth	4.30-4.75m

LABORATORY REPORT

4043

Contract Number: PSL22/7076

Report Date: 16 November 2022

Client's Reference: PY220483

Client Name: Geotechnics
203 Torrington Avenue
Tile Hill
Coventry
CV4 9UT

For the attention of: Paul Smart

Contract Title: VPI-Immingham Humber Zero

Date Received: 2/11/2022
Date Commenced: 2/11/2022
Date Completed: 16/11/2022

Notes: **Opinions and Interpretations are outside the UKAS Accreditation**

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Checked and Approved Signatories:

A Watkins (Director)	R Berriman (Quality Manager)	S Royle (Laboratory Manager)
L Knight (Assistant Laboratory Manager)	S Eyre (Senior Technician)	T Watkins (Senior Technician)

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awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH01	Y19886	UT	1.55	2.00	Brown CLAY.
BH05	Y19912	UT	7.60	8.05	Brown gravelly sandy CLAY.

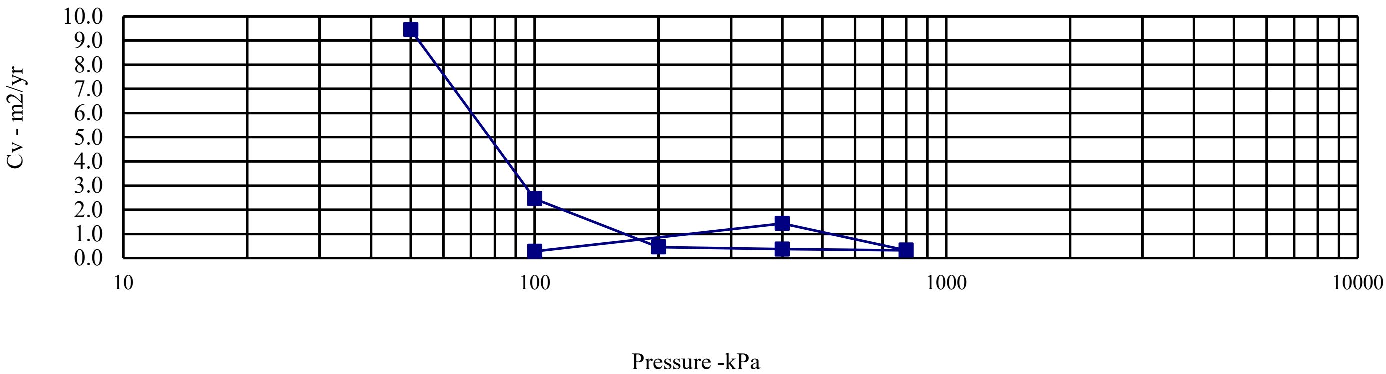
UKAS TESTING 4043	PSL Professional Soils Laboratory	VPI Immingham Humber Zero	Contract No: PSL22/7076
			Client Ref: PY220483

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number:	**BH01**	**Top Depth (m):**	**1.55**
Sample Number:	**Y19886**	**Base Depth (m) :**	**2.00**
Sample Type:	**UT**		

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	45						
Bulk Density (Mg/m3):	1.77	0	50	0.557	9.444	Method used to determine CV:	T90
Dry Density (Mg/m3):	1.22	50	100	0.404	2.456		
Voids Ratio:	1.175	100	200	0.340	0.454	Nominal temperature during test ' C:	20
Degree of saturation:	101.8	200	400	0.195	0.375		
Height (mm):	20.006	400	800	0.135	0.325	Remarks:	
Diameter (mm)	75.023	800	400	0.031	1.433	See summary of soil descriptions	
Particle Density (Mg/m3): Assumed	2.65	400	100	0.130	0.281		



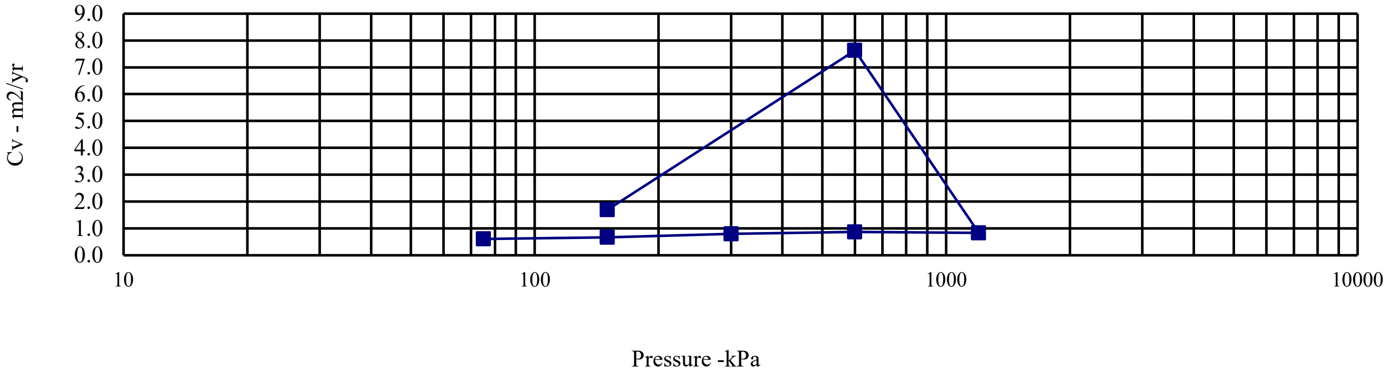
UKAS TESTING 4043	PSL Professional Soils Laboratory	**VPI Immingham Humber Zero**	**Contract No:** **PSL22/7076** **Client Ref:** **PY220483**

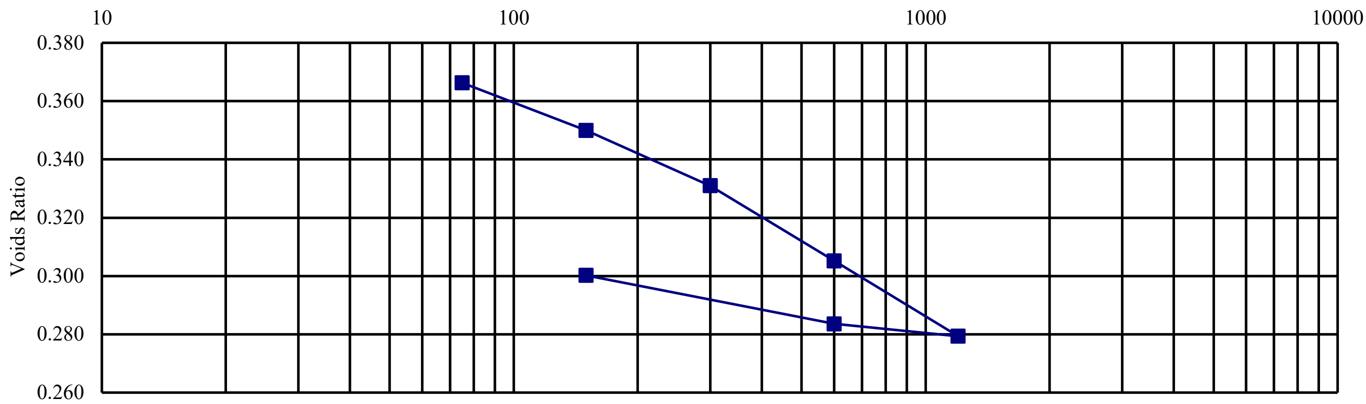
ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number:	**BH05**	**Top Depth (m):**	**7.60**
Sample Number:	**Y19912**	**Base Depth (m) :**	**8.05**
Sample Type:	**UT**		

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	15						
Bulk Density (Mg/m3):	2.19	0	75	0.222	0.614	Method used to determine CV:	T90
Dry Density (Mg/m3):	1.91	75	150	0.159	0.667		
Voids Ratio:	0.389	150	300	0.094	0.797	Nominal temperature during test ' C:	20
Degree of saturation:	99.8	300	600	0.064	0.873		
Height (mm):	20.02	600	1200	0.033	0.837	Remarks:	
Diameter (mm)	75.01	1200	600	0.006	7.631	See summary of soil descriptions	
Particle Density (Mg/m3): Assumed	2.65	600	150	0.029	1.692		





DETS

Certificate of Analysis

Certificate Number	22-18415	*Issued:*	22-Sep-22
Client	Geotechnics LTD Unit 1 Bypass Park Est Sherburn-in-Elmet Yorkshire LS25 6EP		
Our Reference	22-18415		
Client Reference	PY220483		
Order No	(not supplied)		
Contract Title	VPI Immingham		
Description	One Soil sample.		
Date Received	16-Sep-22		
Date Started	16-Sep-22		
Date Completed	22-Sep-22		
Test Procedures	Identified by prefix DETSn (details on request).		
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.		

Approved By

Kirk Bridgewood
General Manager

ilac-MRA

UKAS TESTING
2139

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Soil Samples

Our Ref 22-18415
Client Ref PY220483
Contract Title VPI Immingham

			Lab No	2059132
			.Sample ID	BH02A
			Depth	0.20
			Other ID	
			Sample Type	D
			Sampling Date	n/s
			Sampling Time	n/s
Test	**Method**	**LOD**	**Units**	
Inorganics				
pH	DETSC 2008#		pH	9.2
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	580

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 22-18415
Client Ref PY220483
Contract VPI Immingham

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2059132	BH02A 0.20 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (30 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub
DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

Certificate of Analysis

Certificate Number	22-20949	*Issued:*	24-Oct-22

Client Geotechnics LTD
Unit 1
Bypass Park Est
Sherburn-in-Elmet
Yorkshire
LS25 6EP

Our Reference	22-20949
Client Reference	PY220483
Order No	OY35086
Contract Title	VPI Immingham
Description	12 Soil samples.
Date Received	18-Oct-22
Date Started	18-Oct-22
Date Completed	24-Oct-22
Test Procedures	Identified by prefix DETSn (details on request).
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager

2139

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Soil Samples

Our Ref 22-20949
Client Ref PY220483
Contract Title VPI Immingham

			Lab No	2073112	2073113	2073114	2073115	2073116	2073117	2073118	2073119	2073120	2073121	2073122	2073123
			.Sample ID	BH01	BH01	BH01	BH01	BH01	BH05	BH05	BH05	BH05	BH05	BH05	BH05
			Depth	0.30	1.00	2.00-2.15	2.50-3.00	4.00	0.10-0.20	0.50-0.60	1.00-1.10	1.20-1.30	1.95-2.00	2.50-2.60	4.75-4.80
			Other ID												
			Sample Type	D	D	D	D	D	D	D	D	D	D	D	D
			Sampling Date	07/09/2022	07/09/2022	07/09/2022	07/09/2022	07/09/2022	12/09/2022	12/09/2022	12/09/2022	12/09/2022	12/09/2022	12/09/2022	12/09/2022
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**												
Inorganics															
pH	DETSC 2008#		pH	9.8		8.4		8.4	8.6		8.3				8.7
Organic matter	DETSC 2002#	0.1	%		1.4		1.8			0.3		3.2	< 0.1	0.3	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	80		44		56	28		22				100

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 22-20949
Client Ref PY220483
Contract VPI Immingham

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2073112	BH01 0.30 SOIL	07/09/22	PT 1L	Anions 2:1 (30 days), pH + Conductivity (7 days)	
2073113	BH01 1.00 SOIL	07/09/22	PT 1L	Organic Matter (Manual) (28 days)	
2073114	BH01 2.00-2.15 SOIL	07/09/22	PT 1L	Anions 2:1 (30 days), pH + Conductivity (7 days)	
2073115	BH01 2.50-3.00 SOIL	07/09/22	PT 1L	Organic Matter (Manual) (28 days)	
2073116	BH01 4.00 SOIL	07/09/22	PT 1L	Anions 2:1 (30 days), pH + Conductivity (7 days)	
2073117	BH05 0.10-0.20 SOIL	12/09/22	PT 1L	Anions 2:1 (30 days), pH + Conductivity (7 days)	
2073118	BH05 0.50-0.60 SOIL	12/09/22	PT 1L	Organic Matter (Manual) (28 days)	
2073119	BH05 1.00-1.10 SOIL	12/09/22	PT 1L	Anions 2:1 (30 days), pH + Conductivity (7 days)	
2073120	BH05 1.20-1.30 SOIL	12/09/22	PT 1L	Organic Matter (Manual) (28 days)	
2073121	BH05 1.95-2.00 SOIL	12/09/22	PT 1L	Organic Matter (Manual) (28 days)	
2073122	BH05 2.50-2.60 SOIL	12/09/22	PT 1L	Organic Matter (Manual) (28 days)	
2073123	BH05 4.75-4.80 SOIL	12/09/22	PT 1L	Anions 2:1 (30 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

APPENDIX 8

Laboratory Test Results - Contamination (Soil)

8

Certificate of Analysis

Certificate Number	22-20449	*Issued:*	19-Oct-22
Client	Geotechnics LTD Unit 1 Bypass Park Est Sherburn-in-Elmet Yorkshire LS25 6EP		
Our Reference	22-20449		
Client Reference	PY220483		
Order No	OY35072		
Contract Title	VPI Immingham Humber Zero		
Description	7 Soil samples.		
Date Received	12-Oct-22		
Date Started	12-Oct-22		
Date Completed	19-Oct-22		
Test Procedures	Identified by prefix DETSn (details on request).		
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.		

Approved By

Kirk Bridgewood
General Manager

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Summary of Chemical Analysis
Soil Samples

Our Ref 22-20449
Client Ref PY220483
Contract Title VPI Immingham Humber Zero

			Lab No	2070348	2070349	2070350	2070351	2070352	2070353	2070354
			.Sample ID	BH01	BH01	BH02	BH02A	BH02A	BH05	BH05
			Depth	0.50	1.00	0.80	0.50	1.00	0.30-0.40	3.30-3.40
			Other ID							
			Sample Type	ES	ES	ES	ES	ES	ES	ES
			Sampling Date	07/09/2022	07/09/2022	05/09/2022	05/09/2022	05/09/2022	12/09/2022	12/09/2022
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg	1.6	15	3.4	4.5	6.0	13	7.3
Barium	DETSC 2301#	1.5	mg/kg	28	94	210	120	150	82	99
Beryllium	DETSC 2301#	0.2	mg/kg	0.3	1.0	3.4	1.4	2.0	1.1	0.5
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.9	2.2	5.2	2.6	2.8	3.2	1.6
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	0.3	0.1	< 0.1	0.1	< 0.1	0.2
Chromium	DETSC 2301#	0.15	mg/kg	9.5	36	20	23	21	37	16
Copper	DETSC 2301#	0.2	mg/kg	4.8	27	11	11	12	21	18
Lead	DETSC 2301#	0.3	mg/kg	2.6	28	4.9	6.8	11	23	11
Mercury	DETSC 2325#	0.05	mg/kg	0.07	0.08	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	3.5	26	5.6	13	11	35	23
Selenium	DETSC 2301#	0.5	mg/kg	1.1	0.5	1.0	< 0.5	0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	9.8	55	25	28	28	58	27
Zinc	DETSC 2301#	1	mg/kg	14	82	20	30	35	92	45
Inorganics										
pH	DETSC 2008#		pH	10.0	7.7	10.2	9.7	10.0	8.3	9.2
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.10	0.12	0.49	0.11	0.28	0.03	0.06
Petroleum Hydrocarbons										
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	0.31	0.25	0.30	0.29	0.30	0.31	0.32
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10	< 10
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10	< 10

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 22-20449
Client Ref PY220483
Contract Title VPI Immingham Humber Zero

			Lab No	2070348	2070349	2070350	2070351	2070352	2070353	2070354
			.Sample ID	BH01	BH01	BH02	BH02A	BH02A	BH05	BH05
			Depth	0.50	1.00	0.80	0.50	1.00	0.30-0.40	3.30-3.40
			Other ID							
			Sample Type	ES	ES	ES	ES	ES	ES	ES
			Sampling Date	07/09/2022	07/09/2022	05/09/2022	05/09/2022	05/09/2022	12/09/2022	12/09/2022
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.14	0.05	0.04	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	0.04	< 0.03	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.05	0.04	0.26	0.08	0.05	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	0.05	0.04	0.25	0.07	0.04	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	0.11	0.04	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.04	0.03	0.10	0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	0.09	0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.04	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.06	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.14	< 0.10	1.1	0.26	0.13	< 0.10	< 0.10

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 22-20449
Client Ref PY220483
Contract Title VPI Immingham Humber Zero

Test	Method	LOD	Units			
			Lab No	2070349	2070352	2070354
			.Sample ID	BH01	BH02A	BH05
			Depth	1.00	1.00	3.30-3.40
			Other ID			
			Sample Type	ES	ES	ES
			Sampling Date	07/09/2022	05/09/2022	12/09/2022
			Sampling Time	n/s	n/s	n/s
VOCs						
Vinyl Chloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
2,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Bromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Chloroform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,1-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Benzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Trichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Dibromomethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Bromodichloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
cis-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
trans-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,1,2-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Tetrachloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,3-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Dibromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2-dibromoethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Chlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,1,1,2-tetrachloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
m+p-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
o-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Styrene	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Bromoform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Isopropylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Bromobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2,3-trichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
n-propylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
2-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,3,5-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
4-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Tert-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2,4-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 22-20449
Client Ref PY220483
Contract Title VPI Immingham Humber Zero

			Lab No	2070349	2070352	2070354
			.Sample ID	BH01	BH02A	BH05
			Depth	1.00	1.00	3.30-3.40
			Other ID			
			Sample Type	ES	ES	ES
			Sampling Date	07/09/2022	05/09/2022	12/09/2022
			Sampling Time	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
sec-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
p-isopropyltoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,3-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,4-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
n-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2-dibromo-3-chloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2,4-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
1,2,3-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
SVOCs						
Phenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Aniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2-Chlorophenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Benzyl Alcohol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2-Methylphenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Bis(2-chloroisopropyl)ether	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
3&4-Methylphenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,4-Dimethylphenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Bis-(dichloroethoxy)methane	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,4-Dichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
1,2,4-Trichlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
4-Chloro-3-methylphenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2-Methylnaphthalene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Hexachlorocyclopentadiene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,4,6-Trichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,4,5-Trichlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2-Chloronaphthalene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,4-Dinitrotoluene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
3-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
4-Nitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Dibenzofuran	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,6-Dinitrotoluene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,3,4,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Diethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
4-Chlorophenylphenylether	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
4-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2-Methyl-4,6-Dinitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Diphenylamine	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
4-Bromophenylphenylether	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 22-20449
Client Ref PY220483
Contract Title VPI Immingham Humber Zero

Test	Method	LOD	Units			
			Lab No	2070349	2070352	2070354
			.Sample ID	BH01	BH02A	BH05
			Depth	1.00	1.00	3.30-3.40
			Other ID			
			Sample Type	ES	ES	ES
			Sampling Date	07/09/2022	05/09/2022	12/09/2022
			Sampling Time	n/s	n/s	n/s
Hexachlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Pentachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Di-n-butylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Butylbenzylphthalate	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Bis(2-ethylhexyl)phthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Di-n-octylphthalate	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
1,4-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Dimethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
1,3-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
1,2-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
2,3,5,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Azobenzene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Carbazole	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1	< 0.1

Key: * -not accredited. n/s -not supplied.

Summary of Asbestos Analysis
Soil Samples

Our Ref 22-20449
Client Ref PY220483
Contract Title VPI Immingham Humber Zero

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
2070348	BH01 0.50	SOIL	NAD	none	Vicky Convery
2070349	BH01 1.00	SOIL	NAD	none	Vicky Convery
2070350	BH02 0.80	SOIL	NAD	none	Vicky Convery
2070351	BH02A 0.50	SOIL	NAD	none	Vicky Convery
2070352	BH02A 1.00	SOIL	NAD	none	Vicky Convery
2070353	BH05 0.30-0.40	SOIL	NAD	none	Vicky Convery
2070354	BH05 3.30-3.40	SOIL	NAD	none	Vicky Convery

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 22-20449
Client Ref PY220483
Contract VPI Immingham Humber Zero

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2070348	BH01 0.50 SOIL	07/09/22	GJ 250ml x2, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Total Sulphate ICP (30 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days)	
2070349	BH01 1.00 SOIL	07/09/22	GJ 250ml x2, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Total Sulphate ICP (30 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days), SVOC (14 days)	
2070350	BH02 0.80 SOIL	05/09/22	GJ 250ml x2, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Total Sulphate ICP (30 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days)	
2070351	BH02A 0.50 SOIL	05/09/22	GJ 250ml x2, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Total Sulphate ICP (30 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days)	
2070352	BH02A 1.00 SOIL	05/09/22	GJ 250ml x2, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Total Sulphate ICP (30 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days), SVOC (14 days)	
2070353	BH05 0.30-0.40 SOIL	12/09/22	GJ 250ml, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days)	
2070354	BH05 3.30-3.40 SOIL	12/09/22	GJ 250ml, GJ 60ml x2, PT 1L	Aliphatics/Aromatics (14 days), BTEX (14 days), Mercury (28 days), Naphthalene (14 days), PAH MS (14 days), pH + Conductivity (7 days), SVOC (14 days)	

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Information in Support of the Analytical Results

Our Ref	22-20449
Client Ref	PY220483
Contract	VPI Immingham Humber Zero

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

APPENDIX 9

Laboratory Test Results - Contamination (Groundwater)

Certificate of Analysis

Certificate Number	22-22378	*Issued:*	11-Nov-22
Client	Geotechnics LTD Unit 1 Bypass Park Est Sherburn-in-Elmet Yorkshire LS25 6EP		
Our Reference	22-22378		
Client Reference	PY220483		
Order No	OY35265		
Contract Title	VPI Immingham		
Description	2 Water samples.		
Date Received	03-Nov-22		
Date Started	03-Nov-22		
Date Completed	11-Nov-22		
Test Procedures	Identified by prefix DETSn (details on request).		
Notes	Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.		

Approved By

Kirk Bridgewood
General Manager

UKAS TESTING 2139

Derwentside Environmental Testing Services Limited
Unit 2, Park Road Industrial Estate South, Consett, Co Durham, DH8 5PY
Tel: 01207 582333 • email: info@dets.co.uk • www.dets.co.uk

Summary of Chemical Analysis
Water Samples

Our Ref 22-22378
Client Ref PY220483
Contract Title VPI Immingham

			Lab No	2080424	2080425
			.Sample ID	BH01	BH02A
			Depth		
			Other ID		
			Sample Type	EW	EW
			Sampling Date	31/10/2022	31/10/2022
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Metals					
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	0.68	0.64
Barium, Dissolved	DETSC 2306	0.26	ug/l	54	47
Beryllium, Dissolved	DETSC 2306*	0.1	ug/l	< 0.1	< 0.1
Boron, Dissolved	DETSC 2306*	12	ug/l	160	57
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	< 0.03	< 0.03
Calcium, Dissolved	DETSC 2306	0.09	mg/l	59	41
Chromium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	< 0.25
Copper, Dissolved	DETSC 2306	0.4	ug/l	< 0.4	< 0.4
Lead, Dissolved	DETSC 2306	0.09	ug/l	< 0.09	< 0.09
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01	< 0.01
Nickel, Dissolved	DETSC 2306	0.5	ug/l	1.7	1.4
Selenium, Dissolved	DETSC 2306	0.25	ug/l	3.8	2.9
Vanadium, Dissolved	DETSC 2306	0.6	ug/l	< 0.6	0.7
Zinc, Dissolved	DETSC 2306	1.3	ug/l	20	4.1
Inorganics					
pH	DETSC 2008		pH	7.2	7.4
Dissolved Organic Carbon	DETSC 2085	2	mg/l	4.4	6.8
Sulphate as SO4	DETSC 2055	0.1	mg/l	140	110
Petroleum Hydrocarbons					
Aliphatic C5-C6	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C6-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	26
Aliphatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	14
Aliphatic C5-C35	DETSC 3072*	10	ug/l	< 10	40
Aromatic C5-C7	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C7-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	1.2
Aromatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	11
Aromatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	6.3
Aromatic C5-C35	DETSC 3072*	10	ug/l	< 10	19
TPH Ali/Aro Total C5-C35	DETSC 3072*	10	ug/l	< 10	59
PAHs					
Naphthalene	DETSC 3304	0.05	ug/l	< 0.05	0.08
Acenaphthylene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 22-22378
Client Ref PY220483
Contract Title VPI Immingham

Test	Method	LOD	Units		
			Lab No	2080424	2080425
			.Sample ID	BH01	BH02A
			Depth		
			Other ID		
			Sample Type	EW	EW
			Sampling Date	31/10/2022	31/10/2022
			Sampling Time	n/s	n/s
Acenaphthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Fluorene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Phenanthrene	DETSC 3304	0.01	ug/l	< 0.01	0.04
Anthracene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(a)anthracene	DETSC 3304*	0.01	ug/l	< 0.01	< 0.01
Chrysene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(b)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(k)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(a)pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Dibenzo(a,h)anthracene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(g,h,i)perylene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
PAH Total	DETSC 3304	0.2	ug/l	< 0.20	< 0.20

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 22-22378
Client Ref PY220483
Contract Title VPI Immingham

Test	Method	LOD	Units	2080424	2080425
			Lab No	2080424	2080425
			.Sample ID	BH01	BH02A
			Depth		
			Other ID		
			Sample Type	EW	EW
			Sampling Date	31/10/2022	31/10/2022
			Sampling Time	n/s	n/s
VOCs					
Dichlorodifluoromethane	DETSC 3432	1	ug/l	< 1	< 1
Chloromethane	DETSC 3432	1	ug/l	< 1	< 1
Vinyl Chloride	DETSC 3432	1	ug/l	< 1	< 1
Bromomethane	DETSC 3432	1	ug/l	< 1	< 1
Chloroethane	DETSC 3432	1	ug/l	< 1	< 1
Trichlorofluoromethane	DETSC 3432*	1	ug/l	< 1	< 1
1,1-dichloroethylene	DETSC 3432	1	ug/l	< 1	< 1
Methylene Chloride	DETSC 3432*	27	ug/l	< 27	< 27
Trans-1,2-dichloroethylene	DETSC 3432	1	ug/l	< 1	< 1
1,1-dichloroethane	DETSC 3432	1	ug/l	< 1	< 1
Cis-1,2-dichloroethylene	DETSC 3432	1	ug/l	< 1	< 1
2,2-dichloropropane	DETSC 3432*	2	ug/l	< 2	< 2
Bromochloromethane	DETSC 3432	4	ug/l	< 4	< 4
Chloroform	DETSC 3432	1	ug/l	< 1	< 1
1,1,1-trichloroethane	DETSC 3432	1	ug/l	< 1	< 1
1,1-dichloropropene	DETSC 3432	1	ug/l	< 1	< 1
Carbon tetrachloride	DETSC 3432	1	ug/l	< 1	< 1
Benzene	DETSC 3432	1	ug/l	< 1	< 1
1,2-dichloroethane	DETSC 3432	1	ug/l	< 1	< 1
Trichloroethylene	DETSC 3432*	1	ug/l	< 1	< 1
1,2-dichloropropane	DETSC 3432	1	ug/l	< 1	< 1
Dibromomethane	DETSC 3432	1	ug/l	< 1	< 1
Bromodichloromethane	DETSC 3432	4	ug/l	< 4	< 4
cis-1,3-dichloropropene	DETSC 3432	1	ug/l	< 1	< 1
Toluene	DETSC 3432	1	ug/l	< 1	< 1
trans-1,3-dichloropropene	DETSC 3432	1	ug/l	< 1	< 1
1,1,2-trichloroethane	DETSC 3432	1	ug/l	< 1	< 1
Tetrachloroethylene	DETSC 3432	1	ug/l	< 1	< 1
1,3-dichloropropane	DETSC 3432	1	ug/l	< 1	< 1
Dibromochloromethane	DETSC 3432	1	ug/l	< 1	< 1
1,2-dibromoethane	DETSC 3432	1	ug/l	< 1	< 1
Chlorobenzene	DETSC 3432	1	ug/l	< 1	< 1
1,1,1,2-tetrachloroethane	DETSC 3432	1	ug/l	< 1	< 1
Ethylbenzene	DETSC 3432	1	ug/l	< 1	< 1
m+p-Xylene	DETSC 3432	2	ug/l	< 2	< 2
o-Xylene	DETSC 3432	1	ug/l	< 1	< 1
Styrene	DETSC 3432	1	ug/l	< 1	< 1
Bromoform	DETSC 3432	1	ug/l	< 1	< 1
Isopropylbenzene	DETSC 3432	1	ug/l	< 1	< 1

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 22-22378
Client Ref PY220483
Contract Title VPI Immingham

			Lab No	2080424	2080425
			.Sample ID	BH01	BH02A
			Depth		
			Other ID		
			Sample Type	EW	EW
			Sampling Date	31/10/2022	31/10/2022
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
1,1,2,2-tetrachloroethane	DETSC 3432	1	ug/l	< 1	< 1
Bromobenzene	DETSC 3432	1	ug/l	< 1	< 1
1,2,3-trichloropropane	DETSC 3432	1	ug/l	< 1	< 1
n-propylbenzene	DETSC 3432	1	ug/l	< 1	< 1
2-chlorotoluene	DETSC 3432	1	ug/l	< 1	< 1
1,3,5-trimethylbenzene	DETSC 3432	1	ug/l	< 1	< 1
4-chlorotoluene	DETSC 3432	1	ug/l	< 1	< 1
Tert-butylbenzene	DETSC 3432	1	ug/l	< 1	< 1
1,2,4-trimethylbenzene	DETSC 3432	1	ug/l	< 1	< 1
sec-butylbenzene	DETSC 3432	1	ug/l	< 1	< 1
p-isopropyltoluene	DETSC 3432	1	ug/l	< 1	< 1
1,3-dichlorobenzene	DETSC 3432	2	ug/l	< 2	< 2
1,4-dichlorobenzene	DETSC 3432	1	ug/l	< 1	< 1
n-butylbenzene	DETSC 3432	1	ug/l	< 1	< 1
1,2-dichlorobenzene	DETSC 3432	1	ug/l	< 1	< 1
1,2-dibromo-3-chloropropane	DETSC 3432	1	ug/l	< 1	< 1
1,2,4-trichlorobenzene	DETSC 3432	1	ug/l	< 1	< 1
Hexachlorobutadiene	DETSC 3432	1	ug/l	< 1	< 1
1,2,3-trichlorobenzene	DETSC 3432	1	ug/l	< 1	< 1
MTBE	DETSC 3432*	1	ug/l	< 1	< 1
SVOCs					
Phenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Aniline	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2-Chlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Benzyl Alcohol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2-Methylphenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Bis(2-chloroisopropyl)ether	DETSC 3434*	1	ug/l	< 1.0	< 1.0
3&4-Methylphenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Bis(2-chloroethoxy)methane	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,4-Dimethylphenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,4-Dichlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
1,2,4-Trichlorobenzene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
4-Chloro-3-methylphenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2-Methylnaphthalene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Hexachlorocyclopentadiene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,4,6-Trichlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,4,5-Trichlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2-Chloronaphthalene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2-Nitroaniline	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,4-Dinitrotoluene	DETSC 3434*	1	ug/l	< 1.0	< 1.0

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 22-22378
Client Ref PY220483
Contract Title VPI Immingham

Test	Method	LOD	Units		
			Lab No	2080424	2080425
			.Sample ID	BH01	BH02A
			Depth		
			Other ID		
			Sample Type	EW	EW
			Sampling Date	31/10/2022	31/10/2022
			Sampling Time	n/s	n/s
3-Nitroaniline	DETSC 3434*	1	ug/l	< 1.0	< 1.0
4-Nitrophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Dibenzofuran	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,6-Dinitrotoluene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,3,4,6-Tetrachlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Diethylphthalate	DETSC 3434*	1	ug/l	< 1.0	< 1.0
4-Chlorophenylphenylether	DETSC 3434*	1	ug/l	< 1.0	< 1.0
4-Nitroaniline	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Diphenylamine	DETSC 3434*	1	ug/l	< 1.0	< 1.0
4-Bromophenylphenylether	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Hexachlorobenzene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Bis(2-ethylhexyl)ester	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Pentachlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Di-n-butylphthalate	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Butylbenzylphthalate	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Bis(2-ethylhexyl)phthalate	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Di-n-octylphthalate	DETSC 3434*	1	ug/l	< 1.0	< 1.0
1,4-Dinitrobenzene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Dimethylphthalate	DETSC 3434*	1	ug/l	< 1.0	< 1.0
1,3-Dinitrobenzene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
2,3,5,6-Tetrachlorophenol	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Azobenzene	DETSC 3434*	1	ug/l	< 1.0	< 1.0
Carbazole	DETSC 3434*	1	ug/l	< 1.0	< 1.0
1-Methylnaphthalene	DETSC 3434*	1	ug/l	< 1.0	< 1.0

Key: * -not accredited. n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 22-22378
Client Ref PY220483
Contract VPI Immingham

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2080424	BH01 WATER	31/10/22	GJ 250ml, GJ 60ml, GB 1L x2, GV x2	pH/Cond/TDS (1 days)	
2080425	BH02A WATER	31/10/22	GJ 250ml, GJ 60ml, GB 1L x2, GV x2	pH/Cond/TDS (1 days)	

Key: G-Glass J-Jar B-Bottle V-Vial
DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Disposal

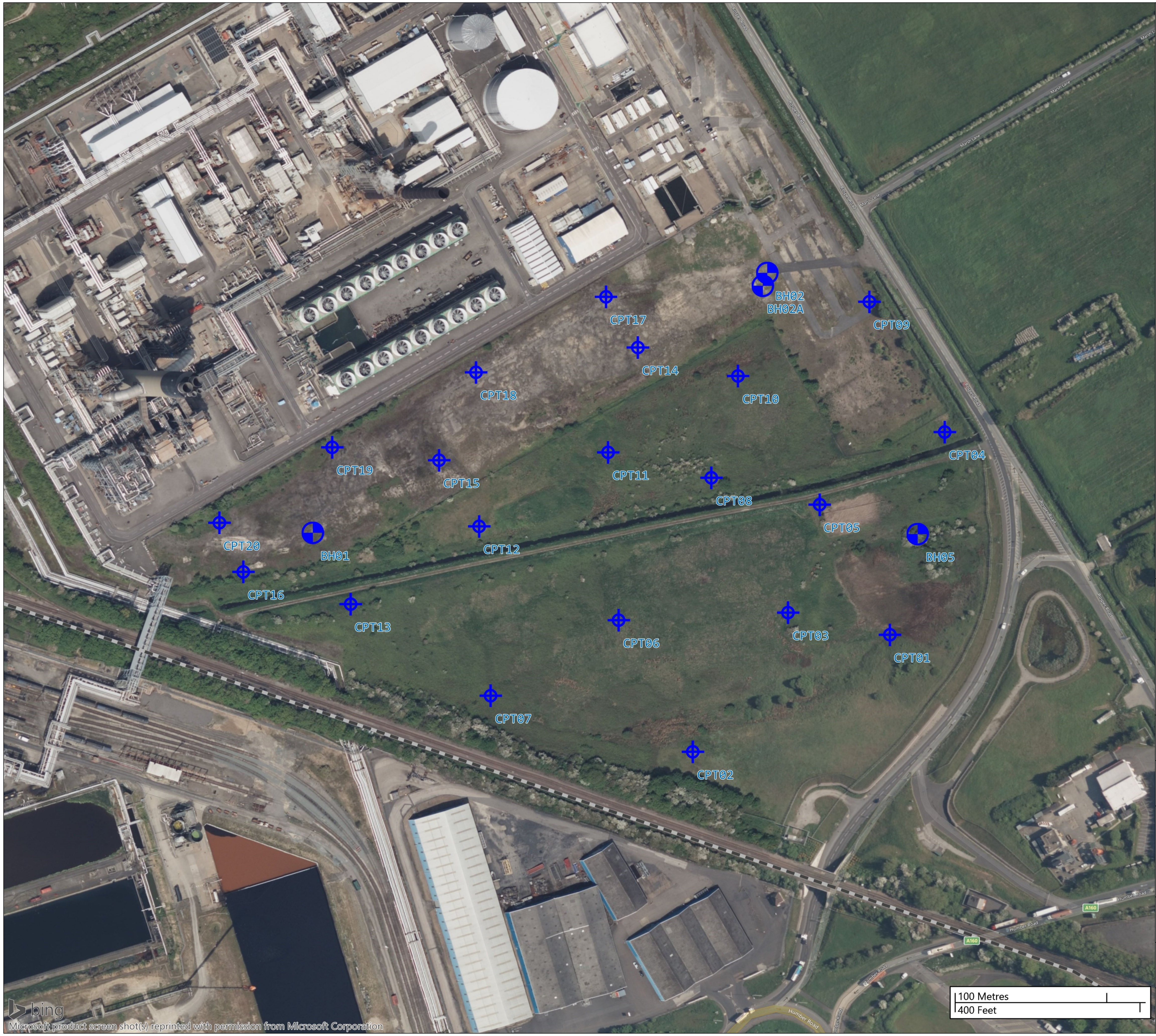
From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

APPENDIX 10

Exploratory Hole Location Plan

10



N

Legend

- Locations By Type - CP
- Locations By Type - IP+SCP

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Client:
VPI Immingham Limited

Project:
VPI Immingham Humber Zero PCC Feed

Drawing Title:
Exploratory Hole Location Plan

Scale:	Date:
1:2500 at A3	**16/11/2022**
Project No.: **PY220483**	**Exploratory Hole Location Plan**

APPENDIX 11

Investigation Techniques and General Notes

INVESTIGATION TECHNIQUES

INTRODUCTION

The following brief review of Ground Investigation techniques, generally used as part of most Site Investigations in the UK, summarises their methodology, advantages and limitations. Detailed descriptions of the techniques are available and can be provided on request. This review should be read in conjunction with the accompanying General Notes.

TRIAL PITS

The trial pit is amongst the simplest yet most effective means of identifying shallow ground conditions on a site. Its advantages include simplicity, speed, potential accuracy and cost-effectiveness. The trial pit is most commonly formed using a back-acting excavator which can typically determine ground conditions to some 4 metres below ground level. Hand excavation is often used to locate, expose and detail existing foundations, features or services. In general, it is difficult to extend pits significantly below the water table in predominantly granular soils, where flows can cause instability. Unless otherwise stated, the trial pits will not have been provided with temporary side support during their construction. Under such circumstances, entrance into the pit is not permitted and hence observations will have been made from the ground surface and samples taken from the excavator bucket.

Where access for personnel is required to allow close observation of the exposed strata, the taking of samples and the carrying out of in situ tests, the sides of the trial pits (Observation Pits in BS 5930:2015) will be made safe using temporary supports or the sides battered back to a stable angle. Some limited access to such Trial Pits (Observation Pits) at depths less than 1m may be allowed in stable conditions or where the sides are benched or battered back to a safe angle.

Trends in strata type, level and thickness can be determined, shear surfaces identified and the behaviour of plant, excavation sides and excavated materials can be related to the construction process. They are particularly valuable in land slip investigations. Some types of in situ test can be undertaken in such pits and large disturbed or block samples obtained.

CABLE PERCUSSION BORING

The light Cable Percussion technique of soft ground boring, typically at a diameter of 150mm, is a well-established simple and flexible method of boring vertical holes and generally allows data to be obtained in respect of strata conditions other than rock. A tubular cutter (for cohesive soils) or shell with a flap valve (for granular soils) is repeatedly lifted and dropped using a winch and rope operating from an "A" frame. Soil which enters these tools is regularly removed and either sampled for subsequent examination or test, or laid to one side for later removal off site and licensed disposal or, if permitted by the Client, use as backfill. Steel casing will have been used to prevent collapse of the borehole sides where necessary. A degree of disturbance of soil and mixing of layers is inevitable and the presence of very thin layers of different soils within a particular stratum may not be identified. Changes in strata type can only be detected on recognition of a change in soil samples at the surface, after the interface has been passed. For the foregoing reasons, depth measurements should not be considered to be more accurate than 0.10 metre. The technique can determine ground conditions to depths in excess of 30 metres under suitable circumstances and usually causes less surface disturbance than trial pitting.

In cohesive soils cylindrical samples are retrieved by driving or pushing in 100mm nominal diameter tubes. In soft soils, piston sampling or vane testing may be undertaken. In granular soils and often in cohesive materials, in situ Standard Penetration Tests (SPT's) are performed. The SPT records the number of standard blows required to drive a 50mm diameter open or cone ended probe for 300mm after an initial 150mm penetration. A modified method of recording is used in denser strata. Small disturbed samples are obtained throughout.

ROTARY DRILLING

Rotary Drilling to produce cores by rotating an annular diamond-impregnated tube or barrel into the ground is the technique most appropriate to the forming of site investigation boreholes through rock or other hard strata. It has the advantage of being able to be used vertically or at an angle. Core diameters of less than 100mm are most common for site investigation purposes. Core is normally retrieved in plastic lining tubes. A flushing fluid such as air, water or foam is used to cool the bit and carry cuttings to the surface. Depths in excess of 60 metres can be achieved under suitable circumstances using rotary techniques, with minimal surface disturbance.

Examination of cores allows detailed rock description and generally enables angled discontinuity surfaces to be observed. However, vertical holes do not necessarily reveal the presence of vertical or near-vertical fissures or joint discontinuities. The core type and/or techniques used will depend on the ground conditions. Where open hole rotary drilling is employed, descriptions of strata result from examination at the surface of small particles ejected from the borehole in the flushing medium. In consequence, no indication of fissuring, bedding, consistency or degree of weathering can be obtained.

DYNAMIC SAMPLING

This technique involves the driving of an open-ended tube into the ground and retrieval of the soil which enters the tube. It was previously called window or windowless sampling. The term "window sample" arose from the original device which had a "window" or slot cut into the side of the tube through which samples were taken. This was superseded by the use of a thin-walled plastic liner to retrieve the soil sample from within a sampler (windowless sampling) which has a solid wall. Line diameters range from 36 to 86mm. Such samples can be used for qualitative logging, selection of samples for classification and chemical analysis and for obtaining a rudimentary assessment of strength.

Driving devices can be hand-held or machine mounted and the drive tubes are typically in 1m lengths. Depending on the type of rig used, the hole formed can be cased to prevent collapse of the borehole sides. Where the type of rig does not allow the insertion of casing, the success of this technique can be limited when soils and groundwater conditions are such that the sides of the hole collapse on withdrawal of the sampler. Obstructions within the ground, the density of the material or its strength can also limit the depth and rate of penetration of this light-weight investigation technique. Nevertheless, it is a valuable tool where access is constrained such as within buildings or on embankments. Depths of up to 10m can be achieved in suitable circumstances depending on the rig type but depths of 5m to 6m are more common.

EXPLORATORY HOLE RECORDS

The data obtained by these techniques are generally presented on Trial Pit, Borehole, Drillhole or Dynamic Sample Records. The descriptions of strata result from information gathered from a number of sources which may include published geological data, preliminary field observations and descriptions, in situ test results, laboratory test results and specimen descriptions. A key to the symbols and abbreviations used accompanies the records. The descriptions on the exploratory hole records accommodate but may not necessarily be identical to those on any preliminary records or the laboratory summaries.

The records show ground conditions at the exploratory hole locations. The degree to which they can be used to represent conditions between or beyond such holes, however, is a matter for geological interpretation rather than factual reporting and the associated uncertainties must be recognised.

DYNAMIC PROBING

This technique typically measures the number of blows of a standard weight falling over a standard height to advance a cone-ended rod over sequential standard distances (typically 100mm). Some devices measure the penetration of the probe per standard blow. It is essentially a profiling tool and is best used in conjunction with other investigation techniques where site-specific correlation can be used to delineate the distribution of soft or loose soils or the upper horizon of a dense or strong layer such as rock.

Both machine-driven and hand-driven equipment is available, the selection depending upon access restrictions and the depth of penetration required. It is particularly useful where access for larger equipment is not available, disturbance is to be minimised or where there are cost constraints. No samples are recovered and some techniques leave a sacrificial cone head in the ground. As with other lightweight techniques, progress is limited in strong or dense soils. The results are presented both numerically and graphically. Depths of up to 10m are commonly achieved in suitable circumstances.

The hand-driven DCP probing device has been calibrated by the Highways Agency to provide a profile of CBR values over a range of depths.

INSTRUMENTATION

The most common form of instrument used in site investigation is either the standpipe or else the standpipe piezometer which can be installed in investigation holes. They are used to facilitate monitoring of groundwater levels and water sampling over a period of time following site work. Normally a standpipe would be formed using rigid plastic tubing which has been perforated or slotted over much of its length whilst a standpipe piezometer would have a filter tip which would be placed at a selected level and the hole sealed above and sometimes below to isolate the zone of interest. Groundwater levels are determined using an electronic "dip meter" to measure the depth to the water surface from ground level. Piezometers can also be used to measure permeability. They are simple and inexpensive instruments for long term monitoring but response times can limit their use in tidal areas and access to the ground surface at each instrument is necessary. Remote reading requires more sophisticated hydraulic, electronic or pneumatic equipment.

Settlement can be monitored using surface or buried target plates whilst lateral movement over a range of depths is monitored using slip indicator or inclinometer equipment.

GENERAL NOTES

1. *The report is prepared for the exclusive use of the Client named in the document and copyright subsists with Geotechnics Limited. Prior written permission must be obtained to reproduce all or part of the report. It is prepared on the understanding that its contents are only disclosed to parties directly involved in the current investigation, preparation and development of the site.*

2. *Further copies may be obtained with the Client's written permission, from Geotechnics Limited with whom the master copy of the document will be retained.*

3. *The report and/or opinion is prepared for the specific purpose stated in the document and in relation to the nature and extent of proposals made available to Geotechnics Limited at that time. Re-consideration will be necessary should those details change. The recommendations should not be used for other schemes on or adjacent to the site without further reference to Geotechnics Limited.*

4. *The assessment of the significance of the factual data, where called for, is provided to assist the Client and their Engineer and/or Advisers in the preparation of their designs.*

5. *The report is based on the ground conditions encountered in the exploratory holes together with the results of field and laboratory testing in the context of the proposed development. The data from any commissioned desk study and site reconnaissance are also drawn upon. There may be special conditions appertaining to the site, however, which are not revealed by the investigation and which may not be taken into account in the report.*

6. *Methods of construction and/or design other than those proposed by the designers or referred to in the report may require consideration during the evolution of the proposals and further assessment of the geotechnical and any geoenvironmental data would be required to provide discussion and evaluations appropriate to these methods.*

7. *The accuracy of results reported depends upon the technique of measurement, investigation and test used and these values should not be regarded necessarily as characteristics of the strata as a whole (see accompanying notes on Investigation Techniques). Where such measurements are critical, the technique of investigation will need to be reviewed and supplementary investigation undertaken in accordance with the advice of the Company where necessary.*

8. *The samples selected for laboratory test are prepared and tested in accordance with the relevant Clauses and Parts of BS EN ISO 17892 and BS 1377 Parts 1 to 8, where appropriate, in Geotechnics Limited's UKAS accredited Laboratory, where possible. A list of tests is given.*

9. *Tests requiring the use of another laboratory having UKAS accreditation where possible are identified.*

10. *Any unavoidable variations from specified procedures are identified in the report.*

11. *Specimens are cut vertically, where this is relevant and can be identified, unless otherwise stated*

12. *All the data required by the test procedures are recorded on individual test sheets but the results in the report are presented in summary form to aid understanding and assimilation for design purposes. Where all details are required, these can be made available.*

13. *Whilst the report may express an opinion on possible configurations of strata between or beyond exploratory holes, or on the possible presence of features based on either visual, verbal, written, cartographical, photographic or published evidence, this is for guidance only and no liability can be accepted for its accuracy.*

14. *The Code of Practice for Ground Investigations – BS 5930:2015 calls for man-made soils to be described as Anthropogenic Ground with soils placed in an un-controlled manner classified as Made Ground and soils placed in a controlled manner as Fill. In view of the difficulty in always accurately determining the origin of man-made soils in exploratory holes, Geotechnics Limited classify such materials as Made Ground. Where soils can be clearly identified as being placed in a controlled manner then further classification of the soils as Fill has been added to the Exploratory Hole Records.*

15. *Classification of man-made soils is based on the inspection of retrieved samples or exposed excavations. Where it is obvious that foreign matter such as paper, plastic or metal is present, classification is clear. Frequently, however, for man-made soils that arise from the adjacent ground or from the backfilling of excavations, their visual characteristics can closely resemble those of undisturbed ground. Other evidence such as site history, exploratory hole location or other tests may need to be drawn upon to provide clarification. For these reasons, classification of soils on the exploratory hole records as either Made Ground or naturally occurring strata, the boundary between them and any interpretation that this gives rise to should be regarded as provisional and subject to re-evaluation in the light of further data.*

16. *The classification of materials as Topsoil is generally based on visual description and should not be interpreted to mean that the material so described complies with the criteria for Topsoil used in BS 3882:2015. Specific testing would be necessary where such a definition is a requirement.*

17. *Ground conditions should be monitored during the construction of the works and the report should be re-evaluated in the light of these data by the supervising geotechnical engineers.*

18. *Any comments on groundwater conditions are based on observations made at the time of the investigation, unless specifically stated otherwise. It should be noted, however, that the observations are subject to the method and speed of boring, drilling or excavation and that groundwater levels will vary due to seasonal or other effects.*

19. *Any bearing capacities for conventional spread foundations which are given in the report and interpreted from the investigation are for bases at a minimum depth of 1m below finished ground level in naturally occurring strata and at broadly similar levels throughout individual structures, unless otherwise stated. Typically they are based on serviceability criteria taking account of an assessment of the shear strength and/or density data obtained by the investigation. The foundations should be designed in accordance with the good practice embodied in BS 8004:2015 - Foundations, supplemented for housing by NHBC Standards. Foundation design is an iterative process and bearing pressures may need adjustment or other measures may need to be taken in the context of final layouts and levels prior to finalisation of proposals.*

20. *Unless specifically stated, the investigation does not take account of the possible effects of mineral extraction or of gases from fill or natural sources within, below or outside the site.*

21. *The costs or economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, will depend on very many factors in addition to geotechnical or geoenvironmental considerations and hence their evaluation is outside the scope of the report.*