

Chorlton Baths, Manchester

Final Phase 2 Geo-Environmental Investigation Risk Assessment & Remediation Strategy

Job Number: LKC241317

Date: December 2024

Client: Caddick Construction (NW) Ltd



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EXECUTIVE SUMMARY

Site Details

Location	Former Chorlton Leisure Centre, in between Manchester Road and the South Manchester Rail Line, Chorlton-Cum-Hardy. National Grid Reference 381706E 394517N.
Area	3,400m ² .
Topography	28 metres above ordnance datum (AOD). Site is formed of two levels with the floor slab of the former building being higher than the original ground level. The base of the former swimming pool is lower than the current ground level.
Current Site Use	Former building has been demolished. Eastern corner of site has been stripped of surfacing and treated for Japanese Knotweed. This area has been filled in with crush. Enabling works have now been completed creating a level platform for development.
Proposed Development	Residential apartments including soft landscaping and car parking.

Site Setting

Main Historical Features	Onsite: Field, Public baths. Surrounding Area: Agricultural fields, marl pits (150m S), brick kilns, railway.
Geology / Hydrogeology	Artificial: No BGS recorded artificial. Superficial: Glaciofluvial sheet deposits (sand and gravel). Secondary A Aquifer. Bedrock: Wilmslow Sandstone Formation (sandstone). Principle Aquifer.
Landfills / Infilled Ground	No recorded landfills or made ground within influencing distance of site.

Ground Investigation Work Undertaken

Date of Investigation:	12 th September 2024.	28 th October – 3 rd December 2024
	Post Demolition Investigation	Post Enabling Works Investigation
Intrusive Investigation Work Undertaken:	5no. mechanically excavated trial pits. Contamination and geotechnical testing.	6no. Cable Percussion Boreholes. 5no. Window Sample Boreholes. 6no. Cone Penetrometer Tests. Contamination and geotechnical testing.

Ground Conditions

Made Ground	Sandy gravel with brick and sandy gravel with ash, brick, concrete, tarmacadam, glass and ceramic encountered to maximum depths of 2.50mbgl.	Gravelly sand with frequent brick and concrete encountered to depths between 0.60-3.33mbgl. Rare ash, clinker, plastic fragments, slate fragments, coal fragments, textile fragments and timber fragments noted within the made ground.
Superficial	Gravelly sand from depths of between 0.30-1.00mbgl in the north and centre of the site. Soft to stiff sandy clay encountered in the south of the site from ground level to depths greater than 3.00mbgl.	Gravelly sand from depths of between 0.80-3.10mbgl. Firm consistency gravelly sandy silty clay encountered site wide from depths of between 3.00-4.70mbgl. Deeper boreholes encountered stiff to very stiff gravelly sandy silty clay to base of boreholes with bands of gravelly

		sand and sand and gravel present.
Bedrock	Not encountered.	Not encountered.
Groundwater	None encountered.	Encountered in window sample boreholes between 2.80-3.00mbgl. Encountered within cable percussion boreholes at 13.90mbgl and 16.60mbgl.
Obstructions	Brick floor at 1.80mbgl within TP104. Foundations of recently demolished building likely still in place.	None encountered.
Permeability	No soakaway tests undertaken. Natural sand deposits likely have good drainage characteristics.	No soakaway tests undertaken. Natural sand deposits likely have good drainage characteristics.
Other Observations	No visual and olfactory evidence of contamination encountered.	No visual and olfactory evidence of contamination encountered.

Geotechnical Assessment

Anticipated Foundation Type	Piled foundations or Vibro Stone Columns supporting traditional shallow foundations.
Shallow Groundwater	No groundwater encountered during the investigation.
Concrete Requirements	Based on BRE Digest 2005 ¹ – DS-1 AC-1 across most of the site. DS-3 AC-2 may be required in the vicinity of TP04, CP104 and WS105 in the south of the site.
Services	Services – consideration to the presence of services running through the site. Services may need to be re-routed.
Temporary support of excavation	Trial pits recorded as unstable in natural sand. Open excavations likely to require support.
Plasticity	Consideration will need to be given to the shrink / swell of the clay strata if it is to be used as founding strata, particularly where trees/hedges are present. Foundations may need to be deepened. The clay is classed as having a medium volume change potential..
Road / Pavement Design	A design CBR value of 2.0% should be adopted for the made ground and gravelly natural sand.
Slope Stability	No significant slopes on site. No further consideration required.

Contamination Risk Assessment

PL	Contaminant	Risk	Recommendations
1	Metals, PAHs, Petroleum hydrocarbons	Moderate	Further site investigation recommended. Remediation is soft landscaping likely.
	Asbestos	Low	No remediation recommended at this stage.
	SVOC and VOCs	Low	Further site investigation recommended. No remediation recommended at this stage.
2	Naphthalene and other volatile contaminants	Low	Further site investigation recommended. No remediation recommended at this stage.
3	Carbon dioxide, methane	Moderate	Further site investigation required. Remediation to be confirmed following further SI.
4	Groundwater (mobile contaminants)	Low	No remediation recommended at this stage..
	Surface Water: (mobile contaminants)	Low	No remediation recommended at this stage..
5	Organic contaminants.	Moderate	Utility provider risk assessment to be completed. The site will likely require barrier piping.

Recommendations and Remedial Strategy

PL	Recommendation
1	Environmental cover system required in soft landscaping areas.
2	No specific remediation required.
3	No remediation required.
4	No remediation required.
5	Potable water pipe assessment required. Barrier pipe likely.

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Figure 3 – Site Investigation Location Plan

Figure 4 – Exceedances Location Plan

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Appendix A – Risk Matrix

Appendix B – Profile Logs

Appendix C – Certificates of Analysis (Soil)

Appendix D – Certificates of Analysis (Geotechnical)

Appendix E – Generic Assessment Criteria Values

Appendix F – Hazwaste Online Certificates

Appendix G – References

1. Introduction

1.1. Background

LK Consult Ltd (LKC) has been commissioned to carry out a post demolition Phase 2 Geo-Environmental Investigation and Risk Assessment for Chorlton Baths, Manchester. The investigation was undertaken in support of a planning application (136791/FO/2023) to develop the site for residential end use.

The following work has previously been undertaken:

- Phase 1 Preliminary Risk Assessment (PRA) report, undertaken by Carley and Daines and Partners Ltd (Ref: 23-B-13672/Chorlton Baths dated 6th March 2023).
- Phase 2 Geoenvironmental Report, undertaken by CC Geotechnical Ltd (Ref: CCG-C-24-14500 dated May 2024).
- Interim Phase 2 Geo-environmental Investigation & Risk Assessment, undertaken by LKC (Ref: LKC241317-BX-GI-Chorlton Baths, Manchester R0 dated 4th October 2024).

The interim investigation report was undertaken post demolition of the buildings on site. This report encompasses the findings of that report plus additional 'post-enabling works' site investigation.

This investigation has been undertaken to confirm the ground conditions below previously inaccessible areas of the site and to allow a contamination and geotechnical assessment to be undertaken.

The investigation will aim to confirm the risks of the potential pollutant linkages identified in the PRA and recommend further assessment, as required.

A summary of the site details is presented in Table 1-1. Figure 1 indicates the site location and boundary plan. Figure 2 indicates the proposed development.

Location	Former Chorlton Leisure Centre, in between Manchester Road and the South Manchester Rail Line, Chorlton-Cum-Hardy. National Grid Reference 381706E 394517N.
Area	3,400m ² .
Topography	28 metres above ordnance datum (AOD). Site is formed of two levels with the floor slab of the former building being higher than the original ground level. The base of the former swimming pool is lower than the current ground level.
Current Site Use	Former building has been demolished. Eastern corner of site has been stripped of surfacing and treated for Japanese Knotweed. This area has been filled in with crush. Enabling works have now been completed creating a level platform for development.
Proposed Development	Residential apartments including soft landscaping and car parking.

Table 1-1: Summary of site details.

2. Summary of Previous Work

Pertinent information has been summarised from the PRA conducted by Carley Daines and Partners Ltd in Table 2-1.

Main Historical Features	Onsite: Field, Public baths. Surrounding Area: Agricultural fields, marl pits (150m S), brick kilns, railway.
Geology / Hydrogeology	Artificial: No BGS recorded artificial. Superficial: Glaciofluvial sheet deposits (sand and gravel). Secondary A Aquifer. Bedrock: Wilmslow Sandstone Formation (sandstone). Principle Aquifer.
Landfills / Infilled Ground	No recorded landfills or made ground within influencing distance of site.

Table 2-1: Summary of site details, historical review, environmental settings, and site reconnaissance.

2.1. Previous Site Investigations

Scope	2 No. Cable percussive boreholes undertaken to depths of 15.45mbgl. 2 No. Dynamic sampling boreholes undertaken to depths of 5.45mbgl. 2No. Dynamic probing undertaken between 5.00m and 10.00mbgl. 1 No. trial pit undertaken to a depth of 2.00mbgl.		
Ground Conditions	Surfacing: Tarmac to 0.10mbgl. Artificial: Loose to medium dense sands and gravels and soft sandy gravelly clay with brick, glass, ash, clinker, ceramic and coal. Superficial: Very loose to medium dense sand and gravels to depths of between 3.60m and 4.20mbgl. Soft to stiff gravelly sandy clay encountered to a maximum depth of 15.45mbgl. Bedrock: Not encountered. Groundwater: Not encountered. No visual or olfactory evidence of contamination was encountered at the site.		
Geo-Environmental Assessment	Contaminant	Elevated Results	Locations
	Heavy metals	Lead (280-370mg/kg).	TP01, BH02
	PAHs	Naphthalene (38mg/kg).	TP01
		Benzo(a)pyrene (15-180mg/kg)	TP01, WS02, BH01, BH02
	TPHs	Aromatic EC16-21 (2000mg/kg) Aromatic EC21-35 (2500 mg/kg)	TP01
	VOC/SVOC	None above screening values.	-
	Asbestos	None detected.	-
Geotechnical Assessment	Ground Gas conditions classified as CS2 based on GSV of 0.00069l/hr (6.9%) for CO ₂ . This is only based on two monitoring visits from one location.		
	Concrete Classification	AC-1s, DS-2.	
	Foundations	Piled foundations installed using CFA methods, end bearing at 15mbgl.	
	Soakaways	Soil infiltration rate of 3.72x10 ⁻⁵ m/sec.	

Table 2-2: Summary of previous SI undertaken by CC Geotechnical Ltd.

2.2. Conceptual Model

The contamination conceptual model in the CC Geotechnical Ltd report has been updated to be in line with LKC current risk assessment methodology (detailed below). The model is based on the contamination sources, pathways and receptors identified in the original report. LKC also consider the following should be considered:

The conceptual model is based on the future use of the site (post development), in line with proposed development scheme.

Due to the minor consequence associated with the phytotoxic effect to flora (i.e., loss of plants in a landscaping scheme), the overall risk for most sites will be very low to low. here soils contain significant concentrations of heavy metals, in general there will other pollutant linkages (i.e., the risk to human health) that will trigger the requirement for remediation (e.g., a clean environmental cover system). As such the risk to flora associated with phytotoxic contaminants will not be considered further.

The risk to buildings associated with elevated sulphate will be considered as part of the geotechnical assessment and will not be included in the contamination risk assessment.

PL	Contaminants of Concern (source)	Pathway	Receptor	Probability	Consequence	Risk	Recommendation
1	PAHs, TPHs, Heavy Metals (ash, car park).	Dermal contact. Inhalation of soil, fibres, and dust. Ingestion of soils, dust. Windblown dust.	Future site users. Offsite receptors.	Likely	Medium	Moderate	Some elevated metals (lead), PAHs, and non-volatile TPH present. Further site investigation recommended. Remediation may be required in soft landscaping areas.
	Asbestos (Demolition material)			Unlikely	Medium	Low	
	SVOCs, VOCs			Unlikely	Medium	Low	
2	Naphthalene (made ground)	Inhalation of vapours. Migration via permeable strata and preferential pathways.	Future site users. Offsite receptors.	Likely	Medium	Moderate	Elevated naphthalene (based on old assessment criteria) in one location. recommended. Remediation may be required.
3	Hazardous / ground gas: methane, carbon dioxide (made ground, marl pit)	Migration via permeable strata and preferential pathways. Inhalation of gas. Explosion in confined spaces.	Future site users. Buildings.	Unlikely	Severe	Moderate/Low	Gas monitoring required if putrescible material encountered during ground investigation.
4	Mobile contamination (made ground)	Surface run-off. Migration via permeable strata and preferential pathways. Perched waters migration.	Groundwater Surface water	Unlikely	Medium	Low	No mobile contamination encountered. No remediation recommended.
5	TPHs and PAHs (Ash, Made Ground)	Ingestion of tainted water supply.	Future site users. Water pipes.	Likely	Medium	Moderate	Elevated organic contamination encountered. Further site investigation recommended. Remediation may be required.

Table 2-2: Preliminary Contamination Conceptual Model.

3. Ground Investigation

3.1. Site Investigation Design and Methodology

The post demolition investigation was carried out on the 12th September 2024 and comprised the following:

- 5no. trial pits (using 10t tracked machine) excavated to 1.10-3.00mbgl (ref. TP101 to TP105).

The post enabling works investigation was carried out between 28th October – 3rd December 2024 and comprised the following:

- 6no. cable percussion boreholes drilled to 20.05-20.25mbgl (ref. CP101-CP106).
- 5no. window sample boreholes drilled to 3.33-5.45mbgl (ref. WS101-WS105).
- 7no. Cone Penetration Testing (CPT101-CPT107) drilled to depths of between 10.48m-15.00mbgl.

CPT101 and CPT107 had to be repositioned due to shallow refusals. The post enabling works site investigation was undertaken once finished remediation levels were in place.

All site investigation locations are shown in Figure 3.

The locations were chosen to allow adequate assessment of ground conditions across the site. Table 3-1 details the site investigation locations.

Site Investigation Locations	Rationale
TP101-TP105	General site coverage.
TP102-TP104, WS101-WS105	In previously inaccessible areas due to buildings.
CP101-CP106, CPT101-CPT107	In footprint of proposed buildings and specified by the client's structural engineer.

Table 3-1: Summary of Sampling Locations.

The investigation locations allow an adequate assessment of ground conditions across the site. The number of sampling points corresponds to one location per 25m square centres.

All profile logs are provided in Appendix B and are in line with BS14688-1³ and BS5930⁴.

3.2. Sampling Protocol

3.2.1. Soil Sampling (Contamination)

Standard sampling protocol and preservation of samples was undertaken as described in the EA guidance on site investigation⁵.

Soil was collected for onsite testing for total volatile organic compounds (TVOCs) using a photoionisation detector (PID) fitted with a 10.6eV lamp and moisture trap. A plastic zip bag was half filled with soil allowing a suitably sized headspace. The bag was sealed and stored for at least 20 minutes before being tested. Results of the PID readings are presented on the profile logs (Appendix B). The onsite monitoring was carried out in line CIRIA C665⁶ to aid in screening samples for volatile analysis.

Soil samples of approximately 500g were recovered in amber jars and plastic tubs. All the samples were sent to DETS laboratory for chemical testing.

Many of the contamination tests are UKAS or MCERTS accredited and further details are given in the Certificate of Analysis presented in Appendix C. Table 3-2 shows the soil testing undertaken.

Testing	No. Samples	Justification
Metals / metalloids, pH, water soluble sulphate, speciated PAHs, SOM and asbestos screen.	7	A basic suite with a broad selection of contaminants where no significant evidence of contamination was identified.
Metals / metalloids, pH, water soluble sulphate, cyanide suite, phenol, TPHCWG, BTEX, MTBE, speciated PAHs, SOM and asbestos screen.	6	Although no evidence of contamination identified, detailed suite undertaken to confirm the absence of contamination and to support waste classification.
Waste Acceptance Criteria (WAC)	3	Samples of representative material which may be earmarked for disposal.

Table 3-2: Summary of Soil Testing.

Notes:

If asbestos present during screen identification and quantification will be undertaken.

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc, and boron; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, BTEX=benzene, toluene, ethylbenzene, and xylenes; MTBE=Methyl tert-butyl ether, SOM=Soil Organic Matter.

3.2.2. Soil Sampling (Geotechnical)

Soil samples taken during the investigation were collected in tubs and bulk bags for and sent to Murray Rix Laboratories and DETS for geotechnical testing.

Further details are given in the laboratory report presented in Appendix D. Table 3-3 shows the geotechnical testing undertaken.

Testing	No. Samples
Moisture Condition Value	5
2.5kg Rammer	1
OMC/MDD Vibrating Hammer	4
Atterberg Limits (plasticity testing)	15
Moisture Content	11
Remoulded Single Stage Triaxial	2
Incremental Loading Oedometer Test	1
Particle Size Distribution (PSD)	18
Triaxial	9
BRE Suite Short	13

Table 3-3: Summary of Geotechnical Testing Undertaken.

3.2.3. Water Sampling

Groundwater sampling was not carried out as part of this investigation.

A low risk was identified in the preliminary contamination conceptual model for controlled waters (Pollutant Linkage 4) and further action was only recommended if significant soil contamination was identified on site. Based on the ground conditions encountered, LKC did not consider testing to be required. This is discussed further in Section 5.4.

3.3. In-situ Testing

3.3.1. Geotechnical Testing

In-situ geotechnical tests were performed in the boreholes to further characterise the sub-soil conditions. The following tests were undertaken:

- Standard Penetration Tests (SPTs) were performed in the window sample boreholes and cable percussion boreholes at approximately 1m intervals.
- Shear vane and pocket penetrometer tests (giving undrained shear strength) were performed within the window sample boreholes and trial pits within cohesive strata.
- The CPT recorded cone resistance (q_c), sleeve friction (f_s), porewater pressure (u_2), and inclination (I_x , I_y).

The results are provided within Appendix B.

3.4. Gas Monitoring

Gas monitoring was not carried out as part of this investigation. A moderate/low risk was identified and gas monitoring was only required should significant putrescible material be encountered.

CC Geotechnical Ltd has undertaken gas monitoring as part of their investigation and determined the site lies in CS2 conditions. This is discussed further in section 6.3.

4. Ground Conditions

4.1. Geology

The ground conditions beneath the site are summarised below. Logs are provided in Appendix B.

4.1.1. Made Ground – Post Demolition Works

The western portion of the site is surfaced with 0.05m of tarmac. The swimming pool base was still present in the centre of the site with demolition rubble surrounding the feature. The south of the site is surfaced with concrete of the former floor slab.

Made ground in the south eastern corner of the site (TP105) has been stripped and removed from site during the Japanese Knotweed remediation.

Made ground was recorded in all trial pits to depths of between 0.60-2.50mbgl and comprised the following:

- Gravelly sand with brick fragments was encountered within TP102 and TP104 to depths of 2.50mbgl.
- Gravelly silty sand with ash, brick fragments, concrete fragments, tarmac and glass was encountered with TP101 to a depth of 1.00mbgl.

TP104 contained rare tarmac.

No made ground was encountered below the swimming pool (TP103).

4.1.2. Made Ground – Post Enabling Works

The made ground across all of the site comprised crushed demolition material from the former building to depths between 0.60-3.33mbgl depending on the height of rubble present to ground level, the eastern side of site had a lower elevation and less demolition material present leading to shallower made ground.

The material comprised gravelly silty SAND with generally frequent brick fragments and concrete fragments. Other anthropogenic material present within the made ground included clinker, ash, slate fragments, plastic fragments, coal fragments, textile fragments and timber fragments.

4.1.3. Natural Strata – Post Demolition Works

Two populations of superficial strata were encountered during the investigation.

- Slightly gravelly occasionally clayey sand was encountered within TP101-TP103 and TP105 from depths of between 0.30-1.00mbgl to an observed depth of 2.70mbgl.
- Firm to stiff consistency low to high strength sandy clay was encountered within TP104 and TP105 from depths of between ground level and 2.50mbgl to depths of greater than 3.00mbgl.

Bedrock was not encountered during this investigation.

4.1.4. Natural Strata – Post Enabling Works

Multiple superficial strata were encountered during the post enabling investigation:

- Loose to very dense gravelly sand was encountered below the made ground in all locations (except WS103) from depths of between 0.80-3.10mbgl.
- Firm to stiff consistency low to very high strength slightly gravelly sandy silty clay was encountered in all locations (except WS103) from depths of between 1.20-4.70mbgl to a maximum depth of 20.20mbgl.
- Very dense sand and gravel was encountered within CP101 and CP104 between the depths of 16.60m-18.70mbgl.
- Medium dense gravelly sand was encountered at the base of WS104 and WS105 at between 4.00-4.50mbgl down to the base of the boreholes.
- Within WS102 and WS104, a strata of medium dense sand and gravel was encountered below the sand at depths of between 1.80-2.70mbgl.
- Deeper bands of dense silty sand and very dense sand were present within CP103 and CP106 between 13.90-14.90mbgl and 19.5-20.05mbgl.

4.1.5. Contamination

Except for the anthropogenic material encountered in the made ground (as described above), no further contamination was identified.

There was no visual or olfactory evidence of hydrocarbons or volatile contaminants in any locations. The PID recorded a maximum of 0.5ppm TVOC in the samples.

4.1.6. Obstructions

The following obstructions were encountered prior to enabling works:

- TP104: Brick floor encountered between 1.80m to 1.90mbgl.
- CPT101-CPT101B and CPT107 refused within the placed demolition rubble.

The brick floor was not present within the post enabling works as site turnover had taken place.

4.2. Groundwater

4.2.1. Groundwater Levels

Groundwater strikes were recorded within all window sample boreholes, apart from WS103, at depths between 2.80-3.00mbgl. 2no. groundwater strikes were recorded in CP103 at 13.90mbgl and 19.60mbgl. 1no. groundwater strike as recorded in CP104 at 16.50mbgl.

No groundwater strikes were observed within any of the exploratory holes within the post demolition works.

CC Geotechnical Ltd did not record any groundwater strikes within the boreholes.

5. Geotechnical Assessment

5.1. Proposed Development

It is understood that the proposed development will comprise residential apartments with associated landscaping and infrastructure.

The depths of any underground engineering works (sewers etc.) are unknown and therefore have not been considered in the following assessment. Any such works should be designed so as not to influence, or compromise, proposed or existing foundations or ground stability.

Given the nature of the proposed development the structure meets the criteria of Geotechnical Category 2 of Eurocode 7⁷.

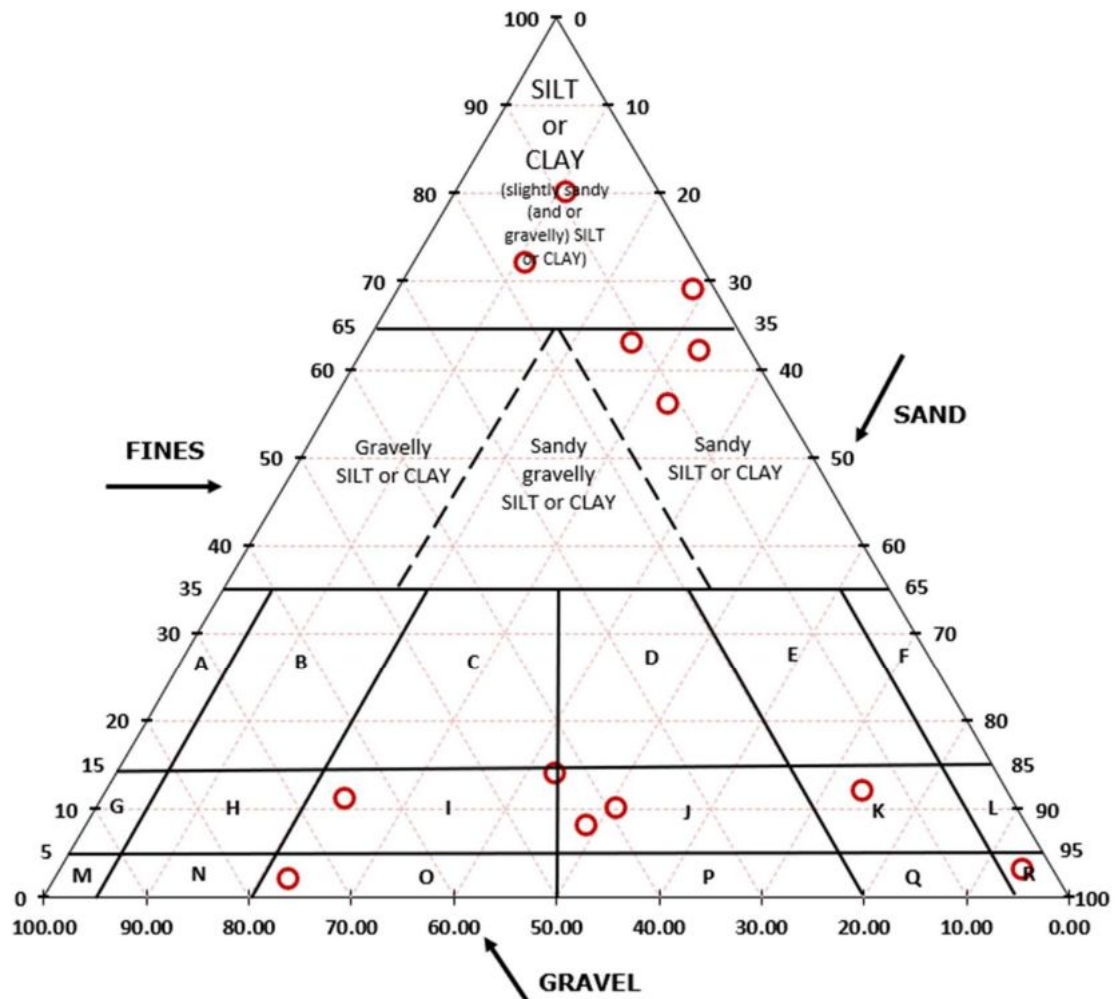
5.2. Summary of Ground Conditions

Ground conditions identified at the site are detailed in Section 4.1, and typically comprises made ground to depths of between 0.30 - 3.30mbgl over natural granular and cohesive superficial deposits of sand and clay to the completion depths investigated.

Groundwater strikes were recorded during the investigation between 13.90-19.60mbgl within bands of granular strata within the cable percussive boreholes. Shallow groundwater strikes were recorded between 2.80-3.00mbgl within the window samples boreholes.

18 no. samples were tested for Particle Size Distribution (PSD) with the results showing that the material is predominantly granular with fines fractions of between 2-12%.

Cohesive samples from the site works, logged as soft to very stiff slightly gravelly sandy clay, returned a clay fraction of 56-80%. The plots of the PSD tests are shown on the ternary plot reproduced in Graph 5-1.



Graph 5-1: Ternary plot of the PSD results.

Clay samples were subjected to Atterberg Limits (plasticity) and Moisture Content testing. Results are provided in Appendix D. The clay ranged from low to high plasticity.

The modified plasticity index as detailed in Chapter 4.2-D5 of the NHBC standards (modified plasticity index = plasticity index x % less than 425µm sieve / 100%) characterises the clay as having a low medium volume change potential, ranging between 7.92% and 27%. It is recommended that a medium volume change potential of the clay is assigned for this site

5.3. Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works⁸. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,

- Buried structures and old foundations are likely to be present under the site. These should be excavated from below the proposed development footprint with the resulting void backfilled.

The near surface soils may potentially be disturbed by weathering and site traffic. Precautions should be taken to avoid this, as excessive disturbance may result in more onerous floor slab design, road cap thickness and increased amount of site disposal etc. Based on site observations the near surface soils may require at least some treatment or reinforcing to allow safe movement of construction plant and labour. A working platform will be required for piling plant.

Japanese Knotweed has been encountered in the south-east corner of the site. This has been treated by LK Remediate. Made ground in this area has been stripped and removed from site. A separate verification report will be provided.

5.4. Foundation Conditions and Bearing Capacity

5.4.1. General

The natural cohesive material has been assessed using in-situ testing by Hand Shear Vane (HV) to obtain the undrained shear strength (s_u) of the material. Pocket penetrometers (PP) were undertaken at regular intervals within the window samples and cable percussive boreholes to obtain undrained shear strength (s_u) of the material.

The clay encountered in the south of the site (TP104 and TP105) returned HV results of between 35kPa and 75kPa.

Clay encountered between 1.20-7.50m generally returned undrained shear strength values of between 12.30-61.30kPa. Between 7.50-20.00mbgl the PP returned readings of between 49.00-220.70kPa. The clay generally gets more competent with depth. Deeper bands of sand and gravel returned SPT results of >50 between 16.60-18.40mbgl in CP101 and CP104.

Nine sample was tested for undrained shear strength in triaxial compression. The results are provided in Appendix D.

5.4.2. Foundations Options

Due to the proposed development and the inherent variability of the made ground, traditional strip footings are not considered a viable option. Foundation options are therefore:

- Ground improvement by vibro stone columns; and,
- Deeper pile foundations.

5.4.3. Ground Improvement

The use of ground improvement techniques such as Vibro Stone Columns (VSC) will allow shallow foundations to be utilised with the Made Ground. The VSC should provide a bearing capacity of around 150kN/m² but will also remove variability within the Made Ground.

Specialist advice should be sought from a suitably experienced contractor with regard to whether the ground conditions are suitable, the allowable bearing capacity that can be achieved and settlements.

5.4.4. Piled Foundations

It is proposed to undertake a full site turnover which will remove and grub out any obstructions and historical foundations/infrastructure. Post site turnover works, driven pile foundations should be suitable however, due to the presence of infrastructure and historic buildings in the local area, consideration will need to be given to the effects vibrations may have on neighbouring properties should a driven pile solution be used. A bored pile solution may cause less disturbance on neighbouring properties.

Static load tests should be undertaken on the first few piles installed to confirm the pile design. Shaft friction in fine grained soils in generally take as no more than 100kN/m², unless higher values can be proven either using pile testing, or through experience in similar ground conditions¹⁰. Negative skin friction imposed on the piles by the made ground needs to be considered.

Dynamic load tests may also be recommended to ensure the concrete has cured well and that there is no bulging or thinning of the pile shaft once it has been drilled.

Should a bored pile solution be adopted then casing will be required while drilling the piles due to the presence of sands. This will help minimise ground disturbance and prevent collapse into the borehole causing areas of weakness. Arisings from bored piles will require off-site disposal unless they can be proven suitable for reuse on site.

Should a piled foundation solution be the preferred option, then warranty providers such as the NHBC or LABC, may require further information on ground conditions to a minimum of 5m below the base of the pile.

5.5. Ground Floor Slabs

Due to the presence of substantial thickness of made ground across the site ground bearing floor slabs, whilst viable, will require detailed design to accommodate variability of the formation and account for differential settlement.

Following suitable preparation of the sub-grade, by a combination of excavation and re-compaction, a ground bearing floor slab should be suitable for the proposed structure. Floor slabs should be designed by a suitably experienced structural engineer.

Where suspended floor slabs are employed ventilation of the under-floor void will be required to address condensation issues. This would also assist in the mitigation of potential gas ingress issues.

5.6. Pavement Construction

It is understood that a site turnover is to be undertaken which will remove obstructions in the ground and that the material will not be replaced to a compaction specification. Based on this it is considered that a design CBR of less than 1% may be required to account for the disturbance from the turnover works. It is recommended that the CBR value of the strata is assessed post turn-over using on site plate tests of the formation.

Following excavation, the sub formation should be proof rolled and any soft material inspected and removed.

5.7. Drainage

The presence of substantial depths of made ground in the south of the site may result in settlement. It is therefore recommended that drain runs, in this area, are designed using steeper gradients and flexible joints to allow for some differential settlement.

5.8. Concrete Durability

Based upon the results of the chemical analyses (Appendix D), subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 across majority of the site in accordance with the recommendations provided in BRE Special Digest 1 (2005). DS-3 AC-2 may be required in the vicinity of TP04, WS105 and CP104 located in the south of the site.

5.9. Excavations

Some of the exploratory holes were observed to be unstable during the excavation. The short- and long-term stability of near vertically sided excavations can therefore not be guaranteed and random and sudden instability within these soils should be anticipated.

Due to the variability of the made ground all excavations should be supported or battered back in accordance with guidance contained in CIRIA R97¹¹.

5.10. Construction Activity and Inspection

The following activities and inspections should be incorporated in to the site works:

- Due to the variability of the soils at the site it is recommended that sufficient allowance is made for the inspection of formation and sub formations to foundations and pavement construction;
- Excavations where access is required should be subject to a risk assessment from a competent person and where appropriate mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 utilised;
- It is considered that de-watering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond;
- Where access to confined spaces is required appropriate mitigation measures should be addressed within the Construction Stage Health and Safety Plan. Particular account should be taken of the gas results;
- The presence of potential contamination and mitigation measures should be addressed as part of the Construction Stage Health and Safety Plan and should include measures to design out the risks, reduce their impact and finally the use of Personnel Protective Equipment (PPE).

6. Generic Risk Assessment

6.1. Introduction

Current good practice requires that the findings from a site investigation should be evaluated on a site-specific basis, using a risk-based approach. Risk assessment involves identification and evaluation of the hazards presented by the concentrations of contaminants measured followed by an evaluation of the risks which are associated with these hazards (LCRM¹³). Information gathered from the risk assessment has been collated in the revised contamination conceptual model in Section 6.6.

6.2. Soil Risk Assessment

6.2.1. Methodology

With regards to the soil risk assessment LKC will use the following hierarchy:

- Category 4 Screening Levels (C4SLs) ^{14, 15}.
- LQM Suitable 4 Use Levels (S4ULs) ^{16, 17, 18, 19}.

The proposed development is for residential apartments with limited shared soft landscaping, therefore the assessment criteria for residential without plant uptake has been used.

All criteria have been generated using the CLEA V1.06 model²⁰ based either on 1%, 2.5% and 6% Soil Organic matter (SOM). Results will be compared to the nearest appropriate SOM.

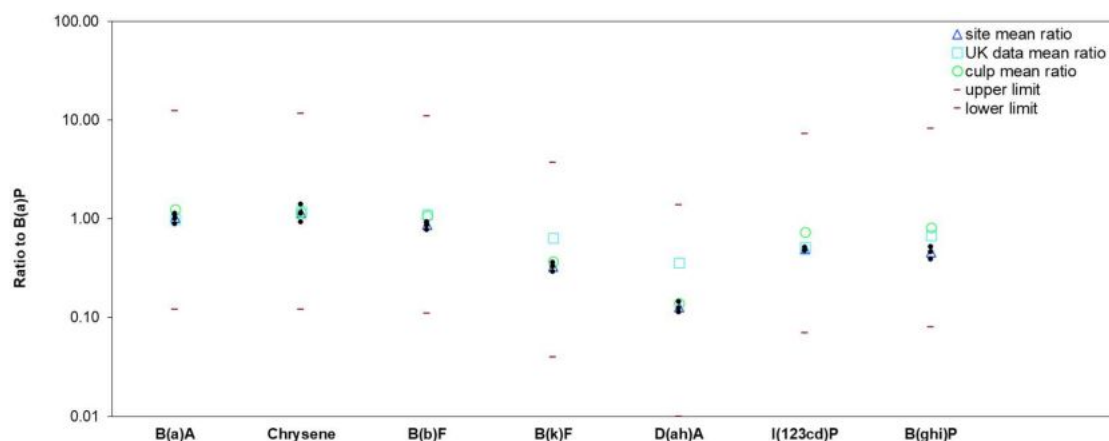
A summary of the generic assessment criteria used in this assessment is provided in Appendix E.

B(a)P as Surrogate Marker

LKC consider the main risk drivers for PAHs are benzo(a)pyrene (B(a)P) and naphthalene. This is due to B(a)P possibly being a carcinogen and most toxic of the PAHs^{21,22} and naphthalene the most volatile and soluble²³. The C4SLs indicate B(a)P as a surrogate marker for carcinogenic PAHs, if it falls within appropriate limits, since the risk from other non-carcinogenic PAHs are considered negligible²⁴. For B(a)P to be used as a surrogate marker it should follow the profile described by the HPA (2008)²⁵ and CL:AIRE (2013). Naphthalene will be treated separately using the LQM S4ULs.

LKC undertook an assessment of the PAH data for the site with regards to using B(a)P as a surrogate marker for carcinogenic PAHs as per HPA and CL:AIRE guidelines. The primary toxicological study related to Culp *et al.*²⁶, which was based on coal tar mixtures (>80,000mg/kg of total PAHs) fed in food to mice over a two-year carcinogenicity study.

Graph 6-1 summarises the study site data with respect to how the ratios of carcinogenic PAHs relate to B(a)P, within the confidence limits provided in the HPA document.



Graph 6-1: The ratio of PAH to B(a)P in soil for all available data at the site based on 4 samples (where values were >LOD to allow the calculation of a ratio).

Notes:

B(a)P=Benzo(a)pyrene; D(ah)A=Dibenzo(ah)anthracene; B(a)A=Benzo(a)anthracene; B(b)F=Benzo(b)fluoranthene; B(k)F=Benzo(k)fluoranthene; I(123cd)P=Indeno(123cd)pyrene; B(ghi)P=Benzo(ghi)perylene.

All the data points that could be used to calculate ratios fall inside the upper or lower limits.

Based on this distribution of data LKC considers B(a)P can be used as a surrogate marker for carcinogenic PAHs and the C4SL criteria is suitable for this dataset.

6.2.2. Soil Results Comparison against Assessment Criteria

All analysis sheets are presented in Appendix C . All the data has been compared to relevant assessment criteria and is presented in Appendix E. Elevated results are presented in Table 6-1.

Sample Location / Depth (mbgl)	Contaminant	Criteria, 6%	Total No. of Samples Tested	Sample Result > Criteria
TP101	Benzo(a)pyrene	5.30	4	17.50

Table 6-1: Summary of Elevated Results.

Notes:

All units in mg/kg.

Only results that exceeded assessment criteria have been shown and results from all depths are noted.

Results have been compared to the nearest appropriate SOM for the assessment criteria hierarchy described in Section 6.2.

No asbestos was identified in any soil samples analysed.

6.2.3. Direct Contact Risk – Pollutant Linkage 1

Elevated PAHs have been identified on site as part of this investigation. The source of the contamination is expected to the ash noted in the made ground.

CC Geotechnical Ltd encountered elevated PAHs and non-volatile TPHs within TP01, WS02, BH01 and BH02 located in the north of the site. The source is expected to be ash, coal and 'cinders' noted in made ground.

At the concentrations identified, the contaminants are considered to pose a potential risk to future site users (residents) in soft landscaped areas, where made ground may be exposed. The principal pathways are the ingestion pathways (soil, dust) and dermal contact.

The probability of PAH contamination affecting site users is likely. With a medium consequence, the risk is considered to be moderate, and remediation is recommended.

No asbestos was identified in any of the samples; therefore, the probability of asbestos affected site users is considered to be unlikely. With a severe consequence, the risk is moderate / low. At this stage, a low risk is assumed (as no asbestos identified) and remediation is not required. However, as a precaution, construction workers should be and vigilant for any suspected ACM during groundworks.

No elevated hydrocarbons were identified by The LK Group. CC Geotechnical identified elevated heavy end hydrocarbons within TP01 in the north. Therefore, the probability of these contaminants posing a risk to site users is considered likely. With a medium consequence, the risk is considered to be medium, and remediation is recommended.

No elevated SVOCs or VOCs were identified by The LK Group. Therefore the probability of these contaminants posing a risk to site users is considered unlikely. With a medium consequence, the risk is considered to be low, and no remediation is recommended.

6.2.4. Risk from Inhalation of Vapours – Pollutant Linkage 2

LKC encountered no elevations of volatile contaminants within any of the samples tested. CC Geotechnical Ltd encountered elevation of naphthalene (38mg/kg) within TP01 in the north of the site. However, the assessment criteria for naphthalene has been revised since the CC Geotechnical Ltd assessment and the result is no longer considered to be elevated based on the SOM content of the sample.

No visual or olfactory evidence of volatile contaminants was identified during the investigation. The PID did not detect any significant TVOCs.

LKC consider the probability of volatile contaminants affecting site users as unlikely. The consequence is expected to be medium, giving a low risk and remediation is required.

6.3. Gas Risk Assessment

Gas monitoring was not carried out as part of this assessment. The PRA identified a moderate/ low risk.

Gas monitoring was undertaken in one borehole by CC Geotechnical Ltd. No methane or flow was recorded and a maximum CO₂ reading of 7.25 was reported. Gas screening Values of 0.00072l/hr for carbon dioxide and <0.00001l/hr for methane were calculated. Characteristic Situation 2 was recommended. Although no discussion as to the rationale is provided within the report it is assumed that this is a function of the CO₂, which ranged between 4.2-7.2% across the six visits.

The desk study did not identify any significant sources of ground contamination on the site. The LKC conceptual model recommended gas monitoring only if significant putrescible material was encountered. BS8587²⁷ Figure 6 describes “*made ground with low degradable organic content (e.g. up to 5% organic material such as pieces of wood, pieces of paper, rags, etc. with a high proportion of ash and no food or other easily degradable waste) and natural soil strata with a low degradable organic content, e.g. alluvium, peat*” as “*very low generation potential*”.

No such material has been encountered during any of the site investigation phases or during enabling works (which included a full turnover of made ground).

The CCG gas monitoring data does not report any flow readings above limits of detection and CO₂ marginally above 5%v/v. In accordance with CIRIA C665²⁸, if carbon dioxide and methane are recorded above 5%v/v and 1%v/v respectively, you should consider upgrading the characteristic situation from CS1 to CS2, although upgrading the CS is not mandatory.

Wilson *et al*²⁹ suggests there is no need to increase the classification if the carbon dioxide is caused by biological respiration of small quantities of organic material. Plate 6-2 summarises the gas monitoring data using the methodology described by Wilson *et al*.

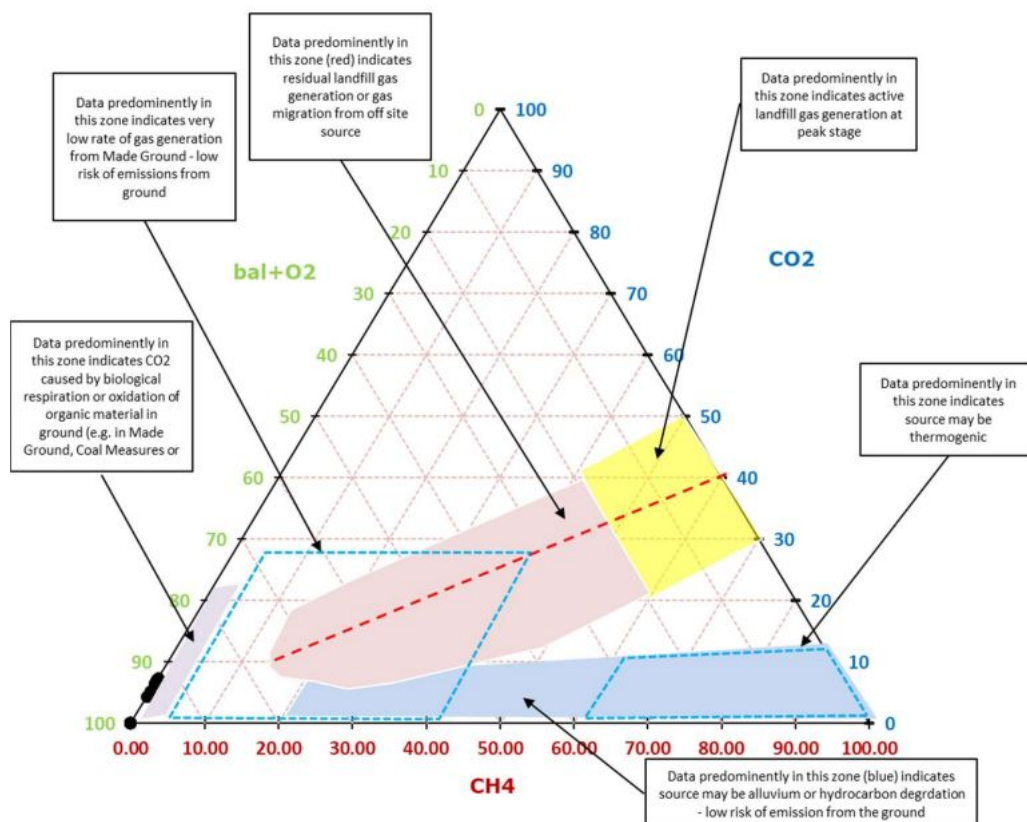


Plate 6-1: Gas Ternary Plot based on CCG data.

Wilson *et al* goes on to say:

“where gas monitoring results plot within the zone shown...for microbial respiration there is no requirement to increase the Characteristic Situation simply because CO₂ concentrations exceed 5%”

All the data from the CCG gas monitoring (plotted above) falls within the area of the ternary plot which is indicative of microbial respiration. This indicates the CO₂ is likely to be from microbial degradation of organic material and it does not warrant upgrading of the classification.

Gas can potentially migrate into buildings, accumulate in confined spaces, and cause explosions (methane) and asphyxiation. LKC consider the probability of carbon dioxide and / or methane gas affecting site users and buildings as unlikely. Assuming a severe consequence, there is a moderate / low risk and no remediation is required.

6.4. Controlled Water Assessment

The PRA conducted by Carley Daines and Partners Ltd identified a moderate to high risk with respect to controlled waters due to the Principal Aquifer underlying the site. No abstractions have been identified within influencing distance and the site is not located in a Source Protection Zone. Surface water is not considered to be a significant receptor.

CC Geotechnical undertook leachate testing and no leachable contaminant was above guideline criteria.

No evidence of significant mobile contamination was identified on the site by The LK Group. Although elevated PAHs (compared to human health criteria) were identified within the soils, the source is anticipated to be ash noted within the made ground. Contamination associated with ash and clinker is not anticipated to be mobile due to the residual crystalline nature of the matrix.

The site investigation did not identify any significant sources of likely mobile contamination within the soils. This confirms an unlikely probability of onsite contamination affecting controlled waters. With a medium consequence the risk is anticipated to be low, and no remediation is required.

6.5. Potable Water Supply (Pollutant Linkage 5)

Soil results were compared to United Utilities (UU) guidelines for the selection of potable water pipes in land potentially affected by contamination. Only contaminants of concern, based on the preliminary conceptual model and ground conditions encountered, were analysed.

Elevated TPH EC10-16 and EC16-44 and VOCs (naphthalene) have been identified within the made ground of TP101 and TP104.

The probability of organic contaminants affecting potable water pipes is a likely probability. Given the consequence is considered to be medium, the risk (Pollutant Linkage 5) is anticipated to be moderate and remediation may be required.

Once details of the pipeline location and depths are known a UU Water Pipe Risk Assessment in line with the utility provider should be undertaken to confirm the most appropriate pipework for potable water.

6.6. Revised Contamination Conceptual Model

The preliminary contamination conceptual model (Table 2-3) has been revised following the risk assessments undertaken in Sections 6.1-6.4. The revised contamination conceptual model follows the same methodology and guidance used in the preliminary contamination conceptual model. The risk matrix is provided in Appendix A.

The revised contamination conceptual model is presented in Table 6 2.

Where a very low risk or low risk is identified no specific remediation is required.

Where there is a moderate / low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

PL	Contaminants of Concern	Pathway	Receptor	Probability	Consequence	Risk	Recommendations
1	PAHs, Non-volatile TPHs, Heavy Metals.	Dermal contact. Inhalation of soil, fibres, and dust. Ingestion of soils, dust. Windblown dust.	Future site users. Offsite receptors.	Likely	Medium	Moderate	Elevated concentrations identified. Remediation in soft landscaping.
	Asbestos			Unlikely		Low	No asbestos identified. Further site investigation recommended. No remediation recommended.
	SVOCs, VOCs			Unlikely		Low	No evidence encountered during site investigation. No elevated concentration identified. No remediation recommended.
2	Naphthalene	Inhalation of vapours. Migration via permeable strata and preferential pathways.	Future site users. Offsite receptors.	Unlikely	Medium	Low	No elevated concentrations based on updated assessment criteria and SOM. No remediation recommended.
3	Hazardous / ground gas: methane, carbon dioxide	Migration via permeable strata and preferential pathways. Inhalation of gas. Explosion in confined spaces.	Future site users. Buildings.	Unlikely	Severe	Moderate/low	No significant putrescible material encountered. Previous monitoring did not identify significant concentrations of gas or flow. No remediation recommended.
4	Mobile contamination	Surface run-off. Migration via permeable strata and preferential pathways. Perched waters migration.	Groundwater Surface water	Unlikely	Medium	Low	No significant elevated concentrations of likely mobile contamination encountered. No remediation recommended.
5	TPHs and PAHs	Ingestion of tainted water supply.	Future site users. Water pipes.	Likely	Medium	Moderate	Some elevated concentrations identified. UU risk assessment will be required. Remediation (barrier pipe) likely

Table 6-22: Revised Contamination Conceptual Model.

7. Waste Disposal Assessment

7.1. HazWaste Assessment

The soil contamination results as presented in Appendix C have been used to help determine the waste classification of material for off-site disposal. Hazwaste online certificates are included in Appendix F.

As an initial screen the soil results were inputted into HazWasteOnline™. This is a web-based facility that allows an assessment waste as either hazardous or non-hazardous waste based on relevant guidance and legislation.

HazWasteOnline™. has been designed to cover, amongst other waste types, the List of Waste (LoW) code number 17 "Construction and Demolition Waste (Including Excavated Soil from Contaminated Sites)".

Where less than limits of detection (LOD) were recorded, the value of the LOD was inputted.

Where applicable, contaminants were selected based on observations during sampling, site history, ground conditions and likely species present in soils (e.g., metal oxides relating to an ash-based source).

The following samples summarised in Table 7-1 are classified as hazardous.

Location and Depth	Contaminant	Hazard Property
TP104 0.2-1m	TPH	HP3 Flammable HP7 Carcinogenic HP11 Mutagenic

Table 7-1: Summary of Hazard Properties Based on HazWasteOnline™ Findings.

7.2. Waste Acceptance Criteria (WAC) Testing

Waste Acceptance Criteria (WAC) testing was also undertaken on 2no. samples representative of material which may be earmarked for off-site disposal. WAC test results are included in Appendix C.

CC Geotechnical undertook WAC on 2 no. samples.

The WAC limits cannot be used to assess whether a waste is non-hazardous or hazardous. It is recommended that waste assessment and WAC data is forwarded to a licensed waste disposal operator.

8. Summary Conclusions

8.1. Ground Conditions

Ground conditions are summarised in Table 8-1 below.

Made Ground	Gravelly sand with frequent brick and concrete encountered to depths between 0.60-3.33mbgl. Rare ash, clinker, plastic fragments, slate fragments, coal fragments, textile fragments and timber fragments noted within the made ground.
Superficial	Gravelly sand from depths of between 0.30-3.10mbgl. Firm consistency gravelly sandy silty clay encountered site wide from depths of between 3.00-4.70mbgl. Deeper boreholes encountered stiff to very stiff gravelly sandy silty clay to base of boreholes with bands of gravelly sand and sand and gravel present.
Bedrock	Not encountered.
Groundwater	Groundwater strikes were recorded at depths between 2.80-3.00mbgl within the window sample boreholes. 2no. groundwater strikes were recorded in CP103 at 13.90mbgl and 19.60mbgl. 1no. groundwater strike as recorded in CP104 at 16.50mbgl.
Obstructions	Brick floor at 1.80mbgl within TP104. Has been removed during site turnover.
Other Observations	No visual and olfactory evidence of contamination encountered.

Table 8-1: Summary of Ground Conditions.

8.2. Geotechnical

Geotechnical observations and conclusions are contained in Table 8-2 below, more detailed discussions are contained within Section 5.

Anticipated Foundation Type	Piled foundations or Vibro Stone Columns supporting traditional shallow foundations.
Shallow Groundwater	Groundwater strikes were recorded at depths between 2.80-3.00mbgl within the window sample boreholes.
Concrete Requirements	Based on BRE Digest 2005 ³² – DS-1 AC-1 across most of the site. DS-3 AC-2 may be required in the vicinity of WS105, CP104 and TP04.
Services	Services – consideration to the presence of services running through the site. Services may need to be re-routed.
Temporary support of excavation	Trial pits recorded as unstable in natural sand. Open excavations likely to require support.
Plasticity	Consideration will need to be given to the shrink / swell of the clay strata if it is to be used as founding strata, particularly where trees/hedges are present. Foundations may need to be deepened. The clay is classed as having a medium volume change potential.
Road / Pavement Design	A design CBR value of <1% should be adopted for the ground post turnover of the site.
Slope Stability	No significant slopes on site. No further consideration required.

Table 8-2: Geotechnical Conclusions Table.

8.3. Contamination Assessment

A revised contamination conceptual model has been produced by LKC which is summarised in Table 8-3 below (more detailed model provided in Section 6).

PL	Contaminant	Risk	Recommendations
1	PAHs, Non-volatile TPHs, Heavy metals.	Moderate	Remediation recommended in soft landscaping.
	Asbestos	Low	No remediation recommended.
	SVOCs and VOCs	Low	No remediation recommended.
2	Naphthalene and other volatile contaminants	Low	No remediation recommended.
3	Carbon dioxide, methane	Moderate/Low	No remediation recommended.
4	Groundwater (mobile contaminants)	Low	No remediation recommended.
	Surface Water: (mobile contaminants)	Low	No remediation recommended.
5	Organic contaminants.	Moderate	Utility provider risk assessment to be completed. The site will likely require barrier piping.

Table 8-3: Summary Risk Table.

PL=Pollutant Linkage, see Table 6-2 for details.

8.4. Waste Assessment

The following samples summarised in Table 8-4 are classified as hazardous.

Location and Depth	Contaminant	Hazard Property
TP104 0.2-1m	TPH	HP3 Flammable HP7 Carcinogenic HP11 Mutagenic

Table 8-4: Summary of Hazard Properties Based on HazWasteOnline™ Findings.

Waste Acceptance Criteria (WAC) testing was also undertaken on 2no. samples. The WAC limits cannot be used to assess whether a waste is non-hazardous or hazardous. It is recommended that waste assessment and WAC data is forwarded to a licensed waste disposal operator.

9. Recommendations and Remediation Strategy

The recommendations/requirements provided below are considered appropriate for the site based on the site investigation work undertaken. LKC should stress that no remediation, enabling works or designing works should take place until Regulatory approval has been obtained.

A summary of remediation requirements is included in Table 9-1.

PL	Recommendation
1	Environmental cover system required in soft landscaping areas.
2	No specific remediation required.
3	No remediation required.
4	No remediation required.
5	Potable water pipe assessment required. Barrier pipe likely.

Table 9-1: Remediation Summary.

The local authority may require a standalone Build-Phase Remediation Strategy and Verification Plan in accordance with LCRM Stage 3 remediation and verification³³. This should be produced once details of design, contractors and installation are known.

All the remediation and validation work should be documented in a Site Completion Report. The Completion Report will be provided to satisfy the outstanding contaminated land planning condition.

9.1. Remediation and Validation Recommendations

9.1.1. Environmental Cover System (PL1)

In gardens and soft landscaping areas, an environmental cover system will be required and should comprise 600mm depth in private back gardens and 450mm in private front gardens / soft landscaping. The environmental cover system should be constructed as shown in Plate 9-1.

Either (physical break layer)		Or (geotextile membrane)	
600mm rear gardens.	Chemically validated TOPSOIL ¹	600mm rear gardens.	Chemically validated TOPSOIL ¹
450mm front gardens & shared landscaping	Chemically validated SUBSOIL	450mm front gardens & shared landscaping	Chemically validated SUBSOIL
(minimum)	100mm (minimum) PHYSICAL BREAK LAYER ²	(minimum)	GEOTEXTILE MEMBRANE (at base of subsoil)
Existing MADE GROUND			

Plate 9-1: Typical Environmental Cover System Construction.

Notes:

Hardstood Areas – No Remediation Required.

¹NHBC recommend 100mm minimum topsoil depth.

²Gravel break layer, minimal fines.

Where there are TPO's in influencing distance of environmental cover systems it is likely the arboriculture officer may only allow a 100mm clean cover system over a geotextile membrane.

Validation of environmental cover soils will be required and should include measuring depth using a staff and providing photographic evidence. Photographic evidence of the granular physical break or geotextile layer should also be collected.

Chemical validation of imported soils is required, details are included in Section 9.3.

9.1.2. Potable Water Pipe Remediation (PL5)

It is recommended that a Water Pipeline Assessment³⁹ is undertaken once the location and depth of potable water pipes are known. Barrier pipe maybe required.

Validation of pipeline installation should include delivery notes of pipe materials, photographs of installed pipe and confirmation of connections.

9.2. Other Considerations

9.2.1. Unexpected Contamination

The relevant contractors should be briefed that during development works at the site should any unusual ground conditions and / or visual or olfactory evidence of contamination (including asbestos containing material) be encountered at the site, LKC and the Local Authority should be informed, and further assessment of the material may be required.

Impacted soils should be placed on an impermeable surface to await further assessment, treatment, or removal from site (this may be subject to chemical testing to confirm suitable waste facility). The work should be done under the supervision and instruction of an environmental consultant.

To determine that significantly impacted soils have been removed, verification samples will be collected from the base and sides of the excavation. If all impacted ground cannot be removed and contamination remains on the ground, further remediation may need to be considered.

Validation requirements should include a log of work undertaken, including photographs and details of any sampling undertaken and validation of any potential additional remedial work.

9.2.2. Stockpile Management

Stockpiled material should be suitably managed. Material should be segregated by type and source. For example, construction / demolition arisings, site won subsoil. Stockpiles may also require covering to minimise the generation of vapours, fibres, dust, and possible nuisance to adjacent receptors, and to prevent rainwater ingress. The source of each stockpile should be recorded and appropriate validation testing for re-use or potential offsite disposal should be undertaken as required.

9.2.3. Disposal

Material required to be removed from site should be undertaken under an appropriate duty of care and the results of chemical analysis should be provided to a licensed landfill for confirmation of waste classification.

Waste records such as disposal tickets and waste carrier licences should be provided in the Site Completion Report. Photographic evidence of removal and waste removal tickets should be retained and included in the validation report.

9.2.4. Health and Safety Considerations

In working with, removing, or treating any contaminating material it is important that any potential risks associated with the actual site works are mitigated by good environmental management of the site during the remedial phases. Standard health and safety precautions (as per HSE guidance⁴⁰) should be adopted by all workers involved with site enabling and construction works.

9.2.5. Piling in Contaminated Land

If a piled foundation is being considered this may provide a preferential pathway for contaminants to the underlying aquifer. A piling risk assessment may be required. Good practice for the drilling of piles on contaminated sites should be adhered to, such as guidance provided by the Environment Agency⁴¹.

9.3. Validation of Imported / Site Won Soils

Chemical validation of all imported and site-won soils to be used on site in gardens and soft landscaping areas should be undertaken. Imported soils should be accompanied by a certificate of analysis and source details.

A summary of the required imported material sampling requirements is presented in Table 9-2, based on MCC 'Guidelines to Developer' (2021)⁴². LKC consider no testing, but proof of provenance is sufficient for natural, virgin, quarried material.

Ideally, the material should be sampled at source to prevent double handling if soil fails, with confirmatory sampling undertaken on importation to site. Where this is not possible then material imported should be segregated based on source and soil type. Validation samples should be taken prior to placement in gardens / soft landscaping to ensure suitability for use.

Material Type	Source	Suite of Analysis	Sampling Rate (min. 3 per source)		
			Garden	Landscape	Other *
Topsoil / subsoil / Fill material	Greenfield	Suite A	200m ³	200m ³	200m ³
	Remediated / Site-won	Suite A / B dependent upon original SI	100m ³	150m ³	200m ³
	Brownfield / Unknown	Suite B	50m ³	150m ³	200m ³
Quarried Fill	First Generation i.e., quarried sand (subsoil) or stone (break layer)	No testing is required.	Certification of material provenance is required.		

Table 9-2: Sampling Requirements for Imported and Site Won Soils.

Notes:

Suite A - Heavy metals, pH, water soluble sulphate, speciated PAH, soil organic matter and asbestos screen.

Suite B - Heavy metals, pH, water soluble sulphate, speciated PAH, phenol, total and free cyanide, soil organic matter, asbestos screen, banded petroleum hydrocarbons (TPH CWG), BTEX, MTBE.

*Other assumed to be stone / 6F2 / mass fill etc.

Any soil with visual or olfactory evidence of hydrocarbons should be rejected.

In addition, it should be ensured that the matrix of the topsoil is suitable as a growing medium and no undesirable material is present (in line with BS3882⁴³). LKC advise this information is provided by the supplier before material is imported onto site.

Imported material to be used in gardens will be compared against residential without plant uptake criteria (as used in the contamination risk assessment in Section 6).

9.4. Site Completion Report

All remediation and validation work should be documented in a Site Completion Report. The Site Completion Report will allow discharge of relevant planning conditions.

Figures



Client: Caddick Construction Ltd				Title: Site Location & Boundary Plan			
Site: Chorlton Baths, Manchester				Scale (see scale bar): 1:25,000 & 1:1,250 @ A4			
Job No.: LKC241317	Drawn By: MB	Checked By: PD	Drawn: Nov 2024	Figure: 1	Revision:		



KEY

- Site Boundary
- Root Protection Area
- Approx retained tree canopy line
- Existing tree removed where hatched in red
- Works to crown
- Proposed tree
- Refer to Tree Survey and reports by Lally Tree Management
- Application Site Boundary

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

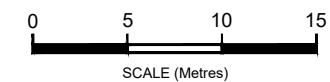
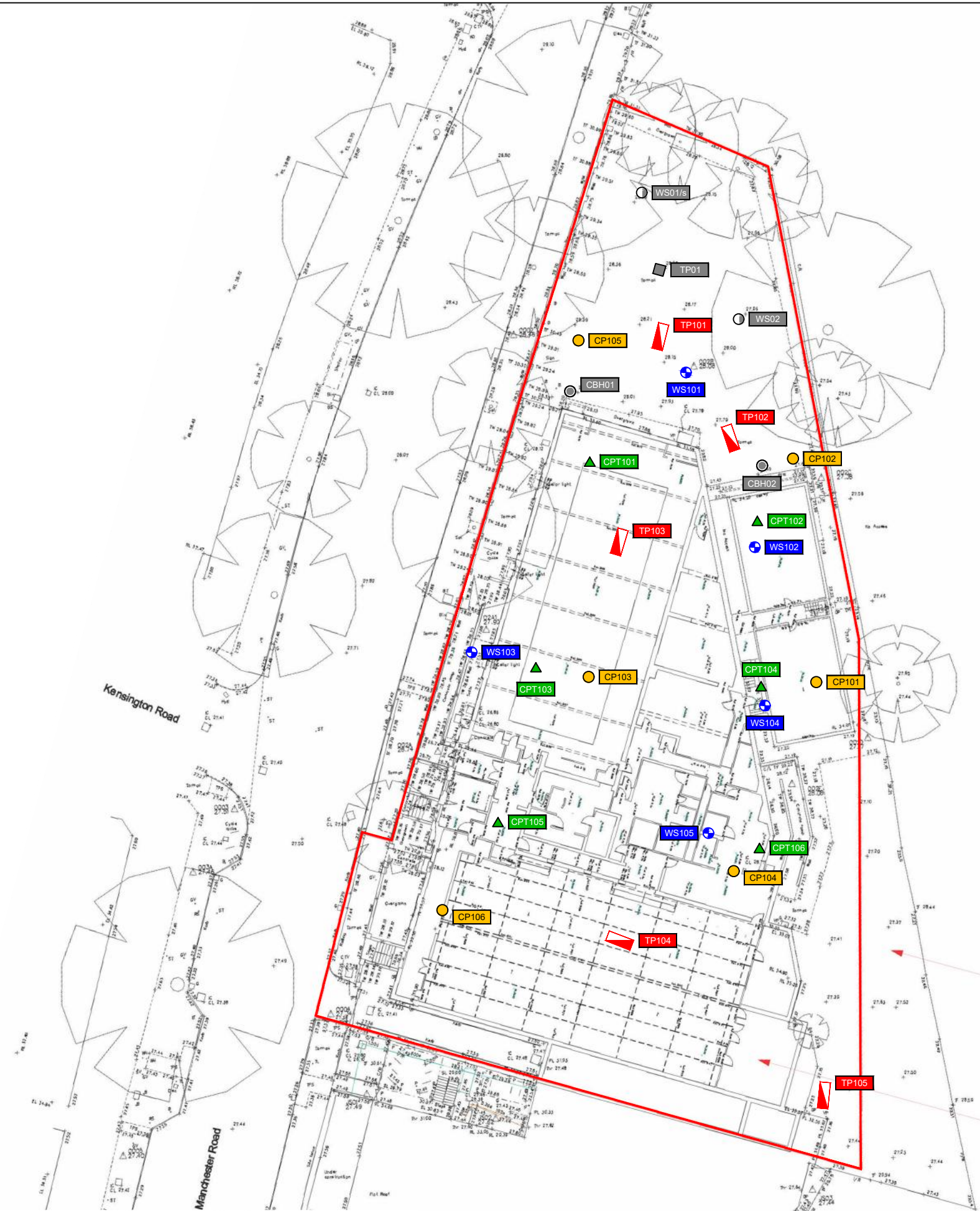
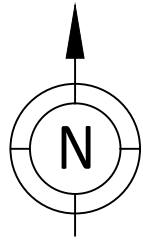


Client:
Caddick Construction (NW) Ltd

Site:
Chorlton Baths, Manchester

Title:
Proposed Development Plan

Job No.:	Scale (See Scale Bar):	Figure:	Revision:
LKC241317	See Scale Bar	2	
Drawn By:	Checked By:	Drawn:	
AC	MB	Oct 2024	



KEY

Site Boundary

LKC Site Investigations:

Cable Percussion Borehole Location (CP)

Window Sample Borehole (WS)

Cone Penetrometer Test (CPT)

Trial Pit (TP)

CCG Site Investigation Locations:

Window Sample Borehole (WS)

Trial Pit (TP)

Cable Percussive Borehole (CBH)

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client: Caddick Construction Ltd

Site: Chorlton Baths, Manchester

Title: Site Investigation Location Plan

Job No.: LKC241317	Scale (See Scale Bar): See Scale Bar	Figure: 3	Revision: A
Drawn By: CC	Checked By: MB	Drawn: Dec 2024	



KEY

- Site Boundary
- Trial Pit (TP)

CCG Site Investigation Locations, April 2024:

- Window Sample Borehole (WS)
- Trial Pit (TP)
- Cable Percussive Borehole (CBH)

CONTAMINANTS:

- Lead (Pb) (>200mg/kg)
- Benzo(a)Pyrene (BaP) (>5.3mg/kg)

ADDITIONAL MAPPING:

Extract From: Buttress
Drawing Ref: Proposed Site Plan, No.04100,
Rev:P04 (07/08/2023)

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client:
Caddick Construction (NW) Ltd

Site:
Chorlton Baths, Manchester

Title:
Exceedances Location Plan

Job No.: LKC241317	Scale (See Scale Bar): See Scale Bar	Figure: 4	Revision:
Drawn By: AC	Checked By: MB	Drawn: Oct 2024	

Extract From: Buttress
Drawing Ref: Topographical Plan, No.01104, Rev:P01 (31/03/2023)

Appendix A – Risk Matrix

RISK EVALUATION

The method for risk evaluation is a qualitative method of interpreting the output from the risk estimation stage of the assessment, based on CIRIA 552⁴⁴. It involves the classification of the:

- Magnitude of the potential consequence (severity) of the risk occurring (Table A).
- Magnitude of the probability (likelihood) of the risk occurring (Table B).

Consequence (Severity)		
Classification	Definition	Example
Severe	Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short term risk of pollution (note: water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings/properties. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definition of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High Concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled waters. Explosion, causing building collapse (can also equate to short term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health ('significant harm' as defined in DETR, 2000). Pollution of sensitive water resources (note Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem.	Concentrations of a contaminant from site exceed generic, or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer (Principal and Secondary). Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services ('significant harm' as defined in DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (e.g., foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Table A. Classification of Consequence

Probability (Likelihood)	
Classification	Definition
High Likelihood	There is a pollutant linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage, and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollutant linkage, but circumstances are such that it is improbable that an event would occur in the very long term.

Table B. Classification of Probability.

These classifications are then compared to indicate the risk presented by each pollutant linkage (Table C). It is important that this classification is only applied where there is a possibility (which can range from high likelihood to unlikely) of a pollutant linkage existing.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate / Low Risk
	Likely	High Risk	Moderate Risk	Moderate / Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate / Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate / Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table C. Comparison of Consequence against Probability

Once the risk has been determined the corresponding action can be assessed (Table D).

Risk	Action Required
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not already undertaken) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table D. Description of the Classification and Likely Action Required.

Where a very low risk is identified no specific remediation is required.

Where a low risk is identified, some form of remediation may be required depending on the pollutant linkage, the type and concentration of contaminants present and the proposed development.

Where there is a moderate/low risk identified, an assessment will be undertaken to establish what category the pollutant linkage will fall into.

Where LKC identifies a moderate or higher risk, remediation or further investigation work is recommended.

Appendix B – Profile Logs

		Cable Percussion Drilling Log					Location Number: CP101			
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 19/11/2024 - 20/11/2024				
Project ID:LKC241317			Contractor: D & I Drilling Ltd							
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level		Logged By MB		Scale 1:100		Page Number Sheet 1 of 2	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description				Level (m)	Water Strikes	
0.20 - 1.00	D	0.90 1.20		MADE GROUND: Reddish brown sandy GRAVEL with frequent brick fragments, concrete fragments, occasional metal fragments and rare ash. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular comprising sandstone. (Demolition rubble) Brown slightly gravelly clayey SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded comprising quartzite and sandstone.				1		
1.00 - 1.20	D									
1.20 - 1.65	D	1.20		Firm to very stiff consistency low to very high strength brownish grey slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular comprising quartzite, sandstone and mudstone.				2		
1.20 - 1.65	N=14 (2,2/3,3,4,4)									
1.70 - 2.00	B	1.20						3		
1.70 - 2.00	PP=36.8kPa									
2.20 - 2.65	D	1.20						4		
2.20 - 2.65	N=12 (3,3/3,3,3,3)									
2.20 - 2.65	PP=49.0kPa	1.20						5		
2.20 - 2.65	PP=49.0kPa									
3.40 - 3.70	B	1.20						6		
3.40 - 3.70	D									
3.40 - 3.85	N=22 (4,5/5,5,5,7)	1.20						7		
3.40 - 3.85	PP=61.3kPa									
3.40 - 3.85	PP=61.3kPa	1.20						8		
3.40 - 3.85	D									
4.30 - 4.75	D	1.20						9		
4.30 - 4.75	N=19 (3,4/4,5,5,5)									
4.30 - 4.75	PP=98.1kPa	1.20						10		
4.30 - 4.75	PP=73.6kPa									
5.50 - 5.95	D	1.20						11		
5.50 - 5.95	PP=49.0kPa									
5.50 - 5.95	N=19 (4,4/4,5,5,5)	1.20						12		
5.50 - 5.95	PP=98.1kPa									
7.00 - 7.45	D	1.20						13		
7.00 - 7.45	PP=36.8kPa									
7.00 - 7.45	N=16 (3,3/4,4,4,4)	1.20						14		
7.00 - 7.45	PP=49.0kPa									
8.50 - 8.95	U	1.20						15		
8.50 - 8.95	D									
9.00 - 9.65	PP=171.7kPa	1.20						16		
9.00 - 9.65	N=34 (5,5/7,7,8,12)									
9.00 - 9.65	B	1.20						17		
9.00 - 9.65	PP=98.1kPa									
10.50 - 11.05	U	1.20						18		
10.50 - 11.05	PP=220.7kPa									
11.05 - 11.50	D	1.20						19		
11.05 - 11.50	PP=196.2kPa									
11.50 - 12.00	PP=220.7kPa	1.20						20		
11.50 - 12.00	D									
12.00 - 12.60	50 (7,10/50 for 285mm)	1.20								
12.00 - 12.60	PP=147.2kPa									
12.60 - 13.50	D	1.20								
12.60 - 13.50	PP=147.2kPa									
13.50 - 14.20	50 (8,11/50 for 275mm)	1.20								
13.50 - 14.20	D									
14.20 - 15.00	PP=24.5kPa	1.20								
14.20 - 15.00	D									
15.00 - 15.60	N=50 (7,9/50 for 245mm)	1.20								
15.00 - 15.60	D									
15.60 - 17.00	D	1.20								
15.60 - 17.00	50 (6,9/50 for 245mm)									
17.00 - 17.50	B	1.20								
17.00 - 17.50	D									
17.50 - 18.50	N=50 (8,10/50 for 255mm)	1.20								
17.50 - 18.50	D									
18.50 - 19.80	D	1.20								
18.50 - 19.80	50 (10,14/50 for 265mm)									
19.80 - 20.20	D	1.20								
19.80 - 20.20	50 (10,14/50 for 265mm)									
Hole Diameter		Casing Diameter		Water Strike Details		Chiselling				
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)		
20.20	200	20.00	200	20	7.20					
Remarks: Groundwater encountered at 17.00mbgl rising to 7.2mbgl after 20 minutes. Borehole stable.										

		Cable Percussion Drilling Log					Location Number: CP101		
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 19/11/2024 - 20/11/2024			
Project ID:LKC241317			Contractor: D & I Drilling Ltd						
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By MB		Scale 1:100	Page Number Sheet 2 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description				Level (m)	Water Strikes
19.80 20.00	PP=122.6kPa	20.20		Very stiff consistency high strength brown slightly gravelly sandy silty CLAY. Sand id fine to coarse. Gravel is fine to coarse, subangular comprising quartzite, sandstone and mudstone. End of Borehole at 20.20m					
							21		
							22		
							23		
							24		
							25		
							26		
							27		
							28		
							29		
							30		
							31		
							32		
							33		
							34		
							35		
							36		
							37		
							38		
							39		
							40		
Hole Diameter		Casing Diameter		Water Strike Details			Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	
20.20	200	20.00	200	20	7.20				
Remarks: Groundwater encountered at 17.00mbgl rising to 7.2mbgl after 20 minutes. Borehole stable.									

		Cable Percussion Drilling Log				Location Number: CP102		
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 18/11/2024 - 19/11/2024		
Project ID:LKC241317			Contractor: D & I Drilling Ltd					
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By MB	Scale 1:100	Page Number Sheet 1 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)	
0.20 - 1.00	D			MADE GROUND: Reddish brown sandy GRAVEL with frequent brick fragments, concrete fragments, occasional metal fragments and rare ash. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular comprising sandstone. (Demolition rubble)			1	
1.00 - 1.20	D	1.20						2
1.20 - 1.65	N=12 (2,2/3,3,3,3)			Medium dense brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular comprising quartzite and sandstone.				
1.70 - 2.00	B						3	
2.30 - 2.75	D							
2.30 - 2.75	N=17 (3,3/4,4,4,5)						4	
3.40 - 3.85	D	3.40		Firm to stiff consistency very low to very high strength brownish grey slightly gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subrounded comprising quartzite, sandstone and mudstone.			5	
3.40 - 3.85	N=20 (3,3/4,5,5,6)						6	
3.50	PP=49.0kPa							
4.00 - 4.30	B						7	
4.50 - 4.95	U							
4.50	PP=12.3kPa						8	
5.00 - 5.50	D							
5.00	PP=49.0kPa						9	
5.50 - 5.95	D							
5.50	PP=49.0kPa						10	
5.50 - 5.95	N=19 (3,4/4,5,5,5)							
7.10 - 7.55	D						11	
7.10 - 7.55	N=18 (4,4/4,5,4,5)							
7.50	PP=12.3kPa						12	
8.50 - 8.95	D							
8.50	PP=122.6kPa						13	
8.50 - 8.95	N=39 (6,7/8,9,10,12)							
9.00 - 9.30	B						14	
10.00	PP=171.7kPa							
10.10 -	U						15	
10.55	PP=171.7kPa							
10.50	D						16	
10.60 -								
11.00	PP=196.2kPa						17	
11.50	D							
11.60 -	50 (6,8/50 for 170mm)						18	
11.90								
11.60							19	
13.00 -	D							
13.30	PP=220.7kPa						20	
13.00	50 (7,10/50 for 170mm)							
13.00	PP=147.2kPa							
14.00								
14.70 -	D							
15.00	50 (25 for 70mm/50 for 210mm)							
14.70								
16.50 -	D							
16.90	PP=49.0kPa							
16.50	50 (8,10/50 for 220mm)							
16.50	PP=73.6kPa							
17.50	PP=49.0kPa							
18.00	D							
18.20 -	N=50 (7,9/50 for 255mm)							
18.60								
18.20 -								
18.60								
19.70 -	D							
20.10								
Hole Diameter		Casing Diameter		Water Strike Details		Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)
20.10	200	20.00	200					
Remarks: Borehole dry and stable								

		Cable Percussion Drilling Log					Location Number: CP102			
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 18/11/2024 - 19/11/2024				
Project ID:LKC241317			Contractor: D & I Drilling Ltd							
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level		Logged By MB		Scale 1:100		Page Number Sheet 2 of 2	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description					Level (m)	
19.70 - 20.08 20.00	N=50 (10,10/50 for 235mm) PP=122.6kPa	20.10		Firm to stiff consistency very low to very high strength brownish grey slightly gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subrounded comprising quartzite, sandstone and mudstone. End of Borehole at 20.10m				21		
							22			
							23			
							24			
							25			
							26			
							27			
							28			
							29			
							30			
							31			
							32			
							33			
							34			
							35			
							36			
							37			
							38			
							39			
							40			
Hole Diameter		Casing Diameter		Water Strike Details			Chiselling			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)		
20.10	200	20.00	200							
Remarks: Borehole dry and stable										

LK CONSULT		Cable Percussion Drilling Log					Location Number: CP103	
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 28/10/2024 - 29/10/2024		
Project ID:LKC241317			Contractor: D & I Drilling Ltd					
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By CK	Scale 1:100	Page Number Sheet 1 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)	Water Strikes
0.20	D			MADE GROUND: Medium dense reddish brown sandy GRAVEL with frequent brick fragments, concrete fragments, occasional metal fragments and rare glass fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone. (Demolition Rubble)		1		
1.00	D					2		
1.20 - 1.65	SPT					3		
1.20 - 1.65	N=12 (2,2/3,3,3,3)					4		
2.20 - 2.65	SPT					5		
2.20	N=17 (3,3/7,3,3,4)					6		
3.20 - 3.65	SPT	3.10		Medium dense greyish brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.		7		
3.20	N=16 (3,3/4,4,4,4)					8		
3.70	D					9		
4.10 - 4.55	SPT					10		
4.10	N=15 (3,3/3,4,4,4)					11		
4.90 - 5.35	SPT	4.70		Firm to stiff consistency brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.		12		
4.90	N=21 (4,4/5,5,5,6)					13		
5.40 - 5.70	B					14		
6.10 - 6.55	SPT					15		
6.10	N=19 (3,4/4,5,5,5)					16		
7.60 - 8.05	SPT					17		
7.60	N=15 (3,3/3,4,4,4)					18		
8.00 - 8.30	B					19		
9.00 - 9.45	SPT					20		
9.00	N=15 (3,3/3,4,4,4)							
10.40 - 10.85	SPT							
10.40	N=24 (3,4/5,5,6,8)							
10.40	B							
10.90 - 11.20	SPT							
11.20	50 (5,7/50 for 190mm)							
11.50 - 11.90	B							
11.50								
12.00 - 12.30	SPT							
12.30	50 (5,10/50 for 180mm)							
13.00 - 13.35								
13.00	SPT	13.90		Dense brown silty SAND. Sand is fine to coarse.				
14.00 - 14.45	N=32 (6,7/8,8,8,8)							
14.45	B							
14.00	SPT	14.90		Stiff to very stiff consistency brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.				
14.50 - 14.80	N=47 (10,10/47 for 275mm)							
14.80	B							
15.00 - 15.40								
15.40	SPT							
15.70 - 16.00	N=50 (8,12/50 for 245mm)							
16.00								
16.60 - 17.00								
17.00	SPT							
16.60								
18.10 - 18.50	SPT							
18.50	N=50 (7,10/50 for 255mm)							
18.10								
19.70 - 20.10	SPT	19.60		Very dense orangish brown SAND. Sand is fine to coarse.				
20.10	N=50 (8,8/50 for 255mm)							
Hole Diameter		Casing Diameter		Water Strike Details		Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)
20.10	200	20.10	200	20	10.00	11.50	14.00	01:00
				20	13.10	15.00	19.70	02:00
Remarks: Borehole stable.								

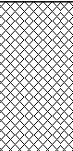
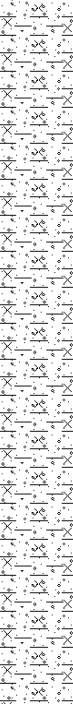
		Cable Percussion Drilling Log					Location Number: CP103		
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 28/10/2024 - 29/10/2024			
Project ID:LKC241317			Contractor: D & I Drilling Ltd						
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By CK		Scale 1:100	Page Number Sheet 2 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description				Level (m)	Water Strikes
19.70		20.10		Very dense orangish brown SAND. Sand is fine to coarse. End of Borehole at 20.10m					
							21		
							22		
							23		
							24		
							25		
							26		
							27		
							28		
							29		
							30		
							31		
							32		
							33		
							34		
							35		
							36		
							37		
							38		
							39		
							40		
Hole Diameter		Casing Diameter		Water Strike Details			Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	
20.10	200	20.10	200	20 20	10.00 13.10	11.50 15.00	14.00 19.70	01:00 02:00	
Remarks: Borehole stable.									

Remarks:	
Borehole stable.	

		Cable Percussion Drilling Log					Location Number: CP104		
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 29/10/2024 - 31/10/2024			
Project ID:LKC241317			Contractor: D & I Drilling Ltd						
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By CK		Scale 1:100	Page Number Sheet 2 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description				Level (m)	Water Strikes
19.80		20.10		Very stiff consistency brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone. End of Borehole at 20.10m					
							21		
							22		
							23		
							24		
							25		
							26		
							27		
							28		
							29		
							30		
							31		
							32		
							33		
							34		
							35		
							36		
							37		
							38		
							39		
							40		
Hole Diameter		Casing Diameter		Water Strike Details			Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	
20.10	200	20.10	200	20	6.10	10.60	19.80	03:30	
Remarks: Borehole stable.									

		Cable Percussion Drilling Log					Location Number: CP105				
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 21/11/2024 - 22/11/2024					
Project ID:LKC241317			Contractor: D & I Drilling Ltd								
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level		Logged By MB		Scale 1:100		Page Number Sheet 1 of 2		
Depth (m)		Samples / Tests		Depth (m)	Legend	Stratum Description					Level (m)
0.50 - 1.00		D		1.20		MADE GROUND: Reddish brown gravelly SAND with frequent brick fragments, concrete fragments, occasional metal fragments and rare ash. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular comprising sandstone. (Demolition rubble)				1	
1.20 - 1.65		D									
1.20		N=14 (2,3/3,3,4,4)									
1.70 - 2.00		B		2.20		Medium dense brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular comprising quartzite and sandstone.				2	
2.20 - 2.65		D									
2.20		N=16 (3,3/4,4,4,4)									
3.30 - 3.75		D		3.20		Firm to stiff consistency brownish grey slightly gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subrounded comprising quartzite, sandstone and mudstone.				3	
3.30		N=23 (3,3/5,5,6,7)									
3.70 - 4.00		B									
4.40 - 4.85		D								4	
4.40		N=22 (3,4/5,5,6,6)									
5.50 - 5.95		U								5	
6.00 - 6.50		D									
7.20 - 7.65		D								6	
7.20		N=17 (3,3/3,4,5,5)									
8.70 - 9.10		D								7	
8.70		N=50 (5,5/50 for 285mm)									
9.00 - 9.30		B									
10.50 - 10.95		U								8	
12.20 - 12.65		D								9	
12.65		N=41 (5,6/8,10,11,12)									
12.20											
13.60 - 14.00		D								10	
14.00		50 (8,10/50 for 255mm)									
13.60											
15.10 - 15.50		D								11	
15.50		50 (9,11/50 for 265mm)									
15.10											
16.60 - 17.00		D								12	
17.00		N=50 (5,7/50 for 275mm)									
16.60											
18.20 - 18.65		D								13	
18.65		N=32 (5,6/6,7,9,10)									
18.20											
19.80 - 20.25		D								14	
		N=35 (6,6/7,8,10,10)									
										15	
										16	
										17	
										18	
										19	
										20	
Hole Diameter		Casing Diameter		Water Strike Details		Chiselling					
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)			
20.25	200										
Remarks: Borehole dry and stable.											

		Cable Percussion Drilling Log					Location Number: CP105			
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 21/11/2024 - 22/11/2024				
Project ID:LKC241317			Contractor: D & I Drilling Ltd							
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level		Logged By MB		Scale 1:100		Page Number Sheet 2 of 2	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description					Level (m)	
19.80		20.25		Firm to stiff consistency brownish grey slightly gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subrounded comprising quartzite, sandstone and mudstone.				21		
				End of Borehole at 20.25m				22		
								23		
								24		
								25		
								26		
								27		
								28		
								29		
								30		
								31		
								32		
								33		
								34		
								35		
								36		
								37		
								38		
								39		
								40		
Hole Diameter		Casing Diameter		Water Strike Details			Chiselling			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)		
20.25	200									
Remarks: Borehole dry and stable.										

		Cable Percussion Drilling Log				Location Number: CP106		
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 02/12/2024 - 03/12/2024		
Project ID:LKC241317			Contractor: D & I Drilling Ltd					
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By MB	Scale 1:100	Page Number Sheet 1 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)	Water Strikes
1.20 - 1.65 1.20	D N=12 (2,3/3,3,3,3)	2.00		MADE GROUND: Medium dense reddish brown sandy GRAVEL with frequent brick fragments, concrete fragments, occasional metal fragments and rare glass fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone. (Demolition Rubble)			1	
2.20 - 2.65 2.20	D N=18 (6,5/4,4,5,5)			Medium dense brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular comprising quartzite and sandstone.			2	
2.70 - 3.00	B						3	
3.30 - 3.75 3.30	D N=19 (3,4/4,5,5,5)	4.00					4	
4.20 - 4.65 4.20	D N=15 (3,3/3,4,4,4)			Firm to stiff consistency medium to very high strength brownish grey slightly gravelly slightly sandy silty CLAY. Sand is fine to medium. Gravel is fine to medium, subrounded comprising quartzite, sandstone and mudstone.			5	
4.50	PP=73.6kPa						6	
4.70 - 5.00	B						7	
5.30 - 5.75 5.30	D N=17 (3,3/4,4,4,5)						8	
5.50	PP=73.6kPa						9	
							10	
7.00 - 7.45 7.00	U PP=73.6kPa	19.50					11	
7.50 - 7.70 7.50	D PP=98.1kPa						12	
8.50	PP=73.6kPa						13	
8.60 - 9.05 8.60	D N=37 (5,7/7,10,10,10)						14	
9.00 - 9.30	B						15	
10.00 - 10.55 10.00	U PP=49.0kPa						16	
10.60 - 11.00 11.00	D						17	
11.50 - 11.90 11.90	D PP=122.6kPa						18	
11.50	50 (7,8/50 for 295mm)						19	
13.00	PP=171.7kPa						20	
13.10 - 13.50 13.10	D 50 (6,10/50 for 285mm)							
14.50	PP=73.6kPa							
14.80 - 15.20 14.80	D N=50 (7,9/50 for 235mm)							
16.50 - 16.90 16.90	D PP=196.2kPa							
16.50	N=50 (6,10/50 for 235mm)							
16.50								
18.00	PP=171.7kPa							
18.10 - 18.50 18.10	D 50 (7,11/50 for 295mm)							
19.60 - 20.05 19.60	D N=45 (7,8/10,10,12,13)							
Hole Diameter		Casing Diameter		Water Strike Details		Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Duration (hh:mm)	
20.05	150	20.05	150	20 20	12.50 10.00			
Remarks: Groundwater encountered at 13.00mbgl and 19.50mbgl rising to 10.00mbgl and 12.50mbgl respectively after 20 minutes. Borehole stable.								

		Cable Percussion Drilling Log					Location Number: CP106		
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 02/12/2024 - 03/12/2024			
Project ID:LKC241317			Contractor: D & I Drilling Ltd						
Equipment: Cable Percussive Drilling Rig / Shell and Auger Rig			Level	Logged By MB		Scale 1:100	Page Number Sheet 2 of 2		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description				Level (m)	Water Strikes
		20.05		Very dense brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular comprising quartzite and sandstone. End of Borehole at 20.05m				21	
								22	
								23	
								24	
								25	
								26	
								27	
								28	
								29	
								30	
								31	
								32	
								33	
								34	
								35	
								36	
								37	
								38	
								39	
								40	
Hole Diameter		Casing Diameter		Water Strike Details			Chiselling		
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Time Elapsed (mins)	Depth Water (m)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	
20.05	150	20.05	150	20 20	12.50 10.00				
Remarks: Groundwater encountered at 13.00mbgl and 19.50mbgl rising to 10.00mbgl and 12.50mbgl respectively after 20 minutes. Borehole stable.									

Window Sample Borehole Log

Location Number:

WS101

Project Name: Chorlton Baths

Client: Caddick Construction (NW) Ltd

Date: 01/11/2024

Project No. : LKC241317

Contractor: D & I Drilling Ltd

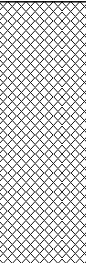
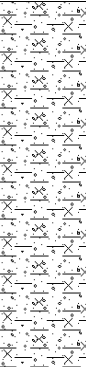
Equipment: Window Sample Rig: Premier
Compact 110 Series

Level

Logged By
CK

Scale
1:40

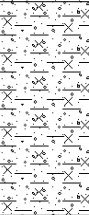
Page Number
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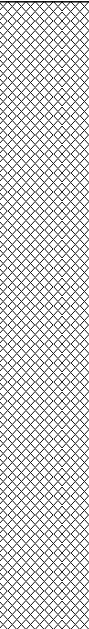
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)	Water Strikes
0.40 - 1.40	ES PID=0.3ppm			MADE GROUND: Medium dense dark brown gravelly silty SAND with frequent brick fragments, concrete fragments, occasional clinker, rare ash, slate fragments and whole bricks. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.			
1.20	N=14 (5,6/3,3,4,4)				1		
1.40 - 1.80	ES PID=0.0ppm	1.40		Very dense light brownish grey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.			
1.80 - 3.00	D				2		
2.00	N=50 (8,8/50 for 275mm)						
3.00	N=19 (4,4/4,5,5,5)	3.00		No Recovery	3		
3.50 - 4.00	D	3.50		Firm consistency medium strength brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.			
3.75	PP=58.9kPa				4		
4.00	N=16 (3,3/3,4,4,5)						
4.50 - 5.00	D				5		
4.75	PP=49.0kPa						
5.00	N=16 (3,4/4,4,4,4)	5.45		End of Borehole at 5.45m	6		
					7		
					8		

Remarks:

Borehole stable.

Groundwater strike at 2.80mbgl.

		Window Sample Borehole Log				Location Number: WS102	
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd		Date: 01/11/2024		
Project No. : LKC241317			Contractor: D & I Drilling Ltd				
Equipment: Window Sample Rig: Premier Compact 110 Series			Level	Logged By CK	Scale 1:40	Page Number Sheet 1 of 1	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)	Water Strikes
0.50 - 1.20	ES	0.50		MADE GROUND: Brown gravelly silty SAND with frequent brick fragments and concrete fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.	1		
0.50 - 1.20	PID=0.1ppm			MADE GROUND: Orangish brown and grey gravelly silty SAND with occasional concrete fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.			
1.20 - 2.00	D	1.20		Medum dense to dense greyish brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.	2		
1.20	N=18 (2,2/3,5,5,5)			2.00m to 2.70mbgl - Sand is dense.			
2.00 - 2.70	D	2.70		Medium dense brown SAND and GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.	3		
2.00	N=37 (6,6/7,10,10,10)						
2.70 - 3.30	D	3.30		Firm consistency medium strength brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.	4		
3.00	N=10 (2,2/2,2,3,3)						
3.30 - 4.00	D	4.43		End of Borehole at 4.43m	5		
3.80	PP=61.3kPa				6		
4.00	N=50 (8,8/50 for 275mm)				7		
					8		
Remarks: Borehole terminated at 4.43mbgl due to SPT refusal. Borehole stable. Groundwater strike at 3.00mbgl.							

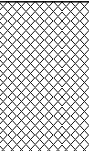
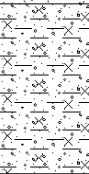
		Window Sample Borehole Log				Location Number: WS103				
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 01/11/2024				
Project No. : LKC241317			Contractor: D & I Drilling Ltd							
Equipment: Window Sample Rig: Premier Compact 110 Series			Level		Logged By CK		Scale 1:40		Page Number Sheet 1 of 1	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description					Level (m)	
1.20	N=12 (4,3/3,3,3,3)			MADE GROUND: Loose to dense dark brown gravelly silty SAND with frequent brick fragments, concrete fragments, rare ash, coal fragments, plastic fragments and clinker. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.					1	
2.00 - 3.00 2.00 - 3.00 2.00	ES PID=0.3ppm N=6 (3,3/3,1,1,1)							2		
3.00	N=50 (8,8/50 for 275mm)							3		
		3.33		End of Borehole at 3.33m						
									4	
									5	
									6	
									7	
									8	
Remarks: Borehole terminated at 3.33mbgl due to SPT refusal on dense made ground. Borehole undertaken 2.00m above normal ground level on stockpile of demolition rubble.										

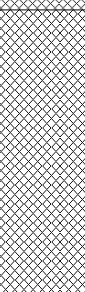
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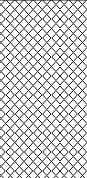
Contractor:

Page Number
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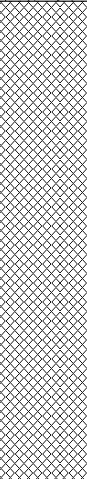
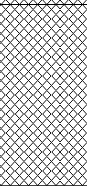
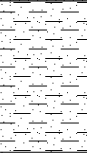
Groundwater strike at 2.90mbgl.

		Window Sample Borehole Log			Location Number: WS105	
Project Name: Chorlton Baths			Client: Caddick Construction (NW) Ltd		Date: 01/11/2024	
Project No. : LKC241317			Contractor: D & I Drilling Ltd			
Equipment: Window Sample Rig: Premier Compact 110 Series			Level	Logged By CK	Scale 1:40	Page Number Sheet 1 of 1
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)
0.00 - 0.80 0.00 - 0.80	ES PID=0.2ppm			MADE GROUND: Brown gravelly silty SAND with frequent brick fragments, concrete fragments, rare ash, clinker, textile fragments and timber fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.		
0.80 - 1.20 0.80 - 1.20	ES PID=0.0ppm	0.80		Loose to medium dense greyish brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.		1
1.20 - 2.00 1.20	D N=22 (4,5/5,6,6,5)					
2.00 - 3.00 2.00	D N=8 (2,2/2,2,2,2)					2
3.00	N=15 (2,2/2,3,5,5)	3.10		Firm consistency medium strength brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.		3
3.50 - 4.00 3.75	D PP=61.3kPa					
4.00 - 5.00 4.00	N=18 (2,3/3,5,5,5)	4.00		Medium dense brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and mudstone.		4
5.00	N=11 (2,2/2,3,3,3)					5
		5.45		End of Borehole at 5.45m		6
						7
						8
Remarks: Borehole stable. Groundwater strike at 2.80mbgl.						

		Trial Pit Log				Location Number: TP101	
Project: Chorlton Baths			Client: Caddick Construction (NW) Ltd		Date: 12/09/2024		
Project No. : LKC241317			Contractor: LKC				
Equipment: Excavator: 9 Tonne Tracked			Level	Logged By MB	Scale 1:25	Page Number Sheet 1 of 1	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)
0.05 - 1.00 0.05 - 1.00	B ES	0.05		MADE GROUND: Tarmacadam. MADE GROUND: Dark grey gravelly silty SAND with frequent ash, brick fragments, occasional whole bricks, concrete fragments, tarmacadam and rare glass. Sand is fine to coarse. Gravel is fine to coarse, angular comprising sandstone.		0.5	
1.00 - 2.00 1.00 - 2.00	B ES	1.00		Light brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded comprising quartzite and sandstone.		1.0	
		2.30		End of Trial Pit at 2.30m		2.5	
						3.0	
						3.5	
						4.0	
						4.5	
						5.0	
			Pit Dimensions			Pit Stability	
			Length (m)	Width (m)	Depth (m)	Unstable	
			2.10	2.10	2.30		
			Remarks:				
Trial pit dry.							
Trial pit terminated at 2.30mbgl due to reaching target depth.							

LKCONSULT		Trial Pit Log				Location Number: TP102	
Project: Chorlton Baths		Client: Caddick Construction (NW) Ltd		Date: 12/09/2024			
Project No. : LKC241317		Contractor: LKC					
Equipment: Excavator: 9 Tonne Tracked		Level	Logged By MB	Scale 1:25	Page Number Sheet 1 of 1		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)
0.00 - 0.60 0.00 - 0.60	B ES	0.60		MADE GROUND: Brown gravelly SAND with occasional brick fragments. . Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded comprising quartzite.		0.5	
0.60 - 1.50 0.60 - 1.50	B ES			Light brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded comprising quartzite and sandstone.			
1.50 - 2.50	B	2.70		End of Trial Pit at 2.70m		1.5	
						2.0	
						2.5	
						3.0	
						3.5	
						4.0	
						4.5	
						5.0	
			Pit Dimensions			Pit Stability	
			Length (m)	Width (m)	Depth (m)	Unstable	
			3.10	2.10	2.70		
			Remarks: Trial pit dry. Trial pit terminated at 2.70mbgl due to reaching target depth.				

		Trial Pit Log					Location Number: TP103			
Project: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 12/09/2024				
Project No. : LKC241317			Contractor: LKC							
Equipment: Excavator: 9 Tonne Tracked			Level		Logged By MB		Scale 1:25		Page Number Sheet 1 of 1	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description					Level (m)	
0.30 - 1.00 0.30 - 1.00	B ES	0.05		MADE GROUND: Floor tiles.						
			MADE GROUND: Concrete.							
0.30 - 1.00		0.30		Light brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded comprising quartzite and sandstone.				0.5		
						1.0				
1.00 - 2.00	B							1.5		
								2.0		
								2.5		
				End of Trial Pit at 2.50m				3.0		
								3.5		
								4.0		
								4.5		
								5.0		
			Pit Dimensions					Pit Stability		
			Length (m)		Width (m)		Depth (m)		Unstable	
			2.60		2.00		2.50			
			Remarks:							
Trial pit dry.										
Trial pit terminated at 2.50m due to continued collapse in sand.										

LKCONSULT		Trial Pit Log				Location Number: TP104	
Project: Chorlton Baths		Client: Caddick Construction (NW) Ltd		Date: 12/09/2024			
Project No. : LKC241317		Contractor: LKC					
Equipment: Excavator: 9 Tonne Tracked		Level	Logged By MB	Scale 1:25	Page Number Sheet 1 of 1		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)
0.20 - 1.00 0.20 - 1.00	B ES	0.20		MADE GROUND: Concrete.			
				MADE GROUND: Brown gravelly SAND with brick fragments, whole brick, concrete fragments and rare tarmacadam. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded comprising quartzite.		0.5	
		1.80		MADE GROUND: Yellow brick floor.			
		1.90		MADE GROUND: Brown gravelly SAND with brick fragments, whole brick, concrete fragments and rare tarmacadam. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded comprising quartzite.		2.0	
2.50 - 3.00 2.50 - 3.00 2.60	B ES SV=35.00kPa	2.50		Firm consistency low strength brown sandy CLAY. Sand is fine to coarse.		2.5	
		3.00	End of Trial Pit at 3.00m		3.0		
						3.5	
						4.0	
						4.5	
						5.0	



Pit Dimensions			Pit Stability
Length (m)	Width (m)	Depth (m)	Unstable in made ground
2.40	1.50	3.00	

Remarks:
Trial pit dry.
Trial pit terminated at 3.00mbgl due to reaching target depth.

		Trial Pit Log				Location Number: TP105		
Project: Chorlton Baths			Client: Caddick Construction (NW) Ltd			Date: 12/09/2024		
Project No. : LKC241317			Contractor: LKC					
Equipment: Excavator: 9 Tonne Tracked			Level	Logged By MB	Scale 1:25	Page Number Sheet 1 of 1		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)	
0.00 - 0.50	B			Stiff consistency medium to high strength light brown very sandy CLAY. Sand is fine to coarse.				
0.00 - 0.50	ES							
0.10	SV=62.00kPa							
0.50	SV=75.00kPa					0.5		
0.70 - 1.00	B	0.70		Brown grey gravelly clayey SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded comprising quartzite.		1.0		
		1.10		End of Trial Pit at 1.10m		1.5		
						2.0		
						2.5		
						3.0		
						3.5		
						4.0		
						4.5		
						5.0		
		Pit Dimensions			Pit Stability			
		Length (m)	Width (m)	Depth (m)	Stable			
		1.50	1.00	1.10				
		Remarks:						
Trial pit dry.								
Made ground stripped during knotweed remediation. Current ground level approximately 0.70m lower than original ground level.								
Trial pit terminated at 1.10mbgl due to reaching target strata.								

IN SITU

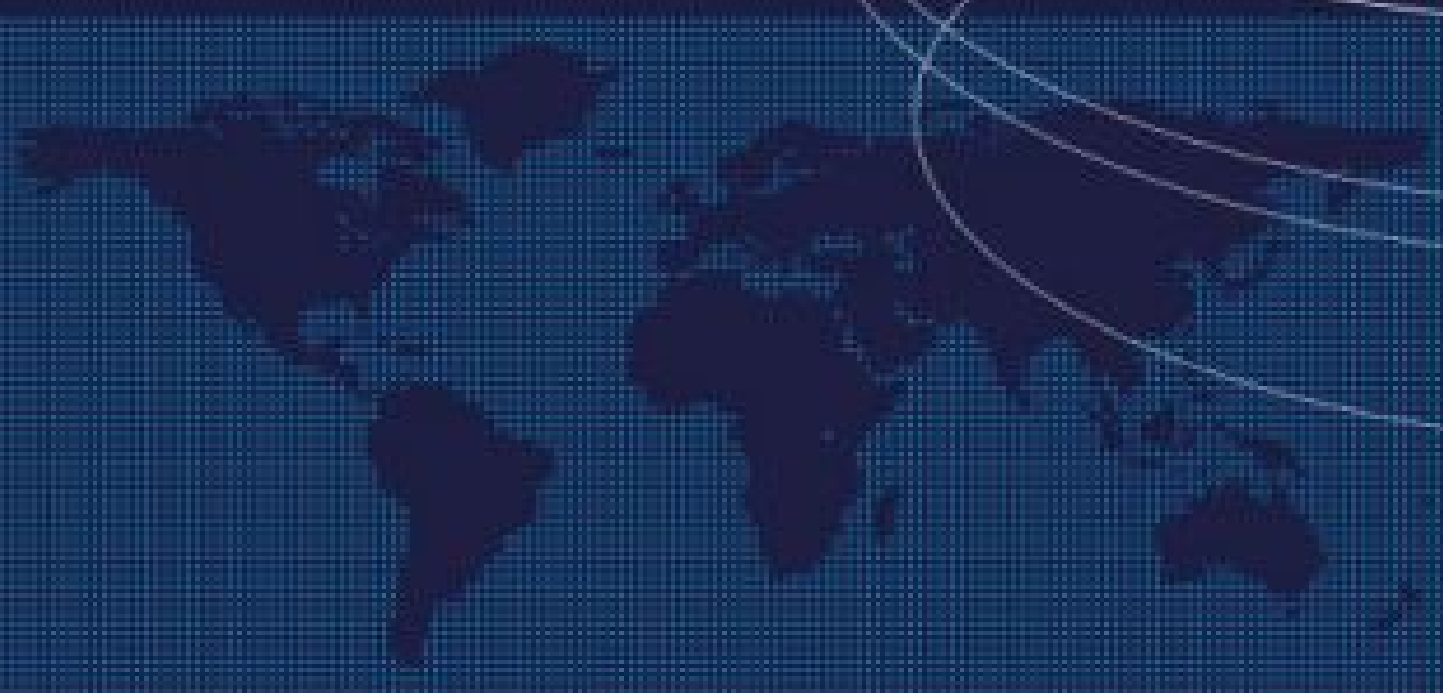
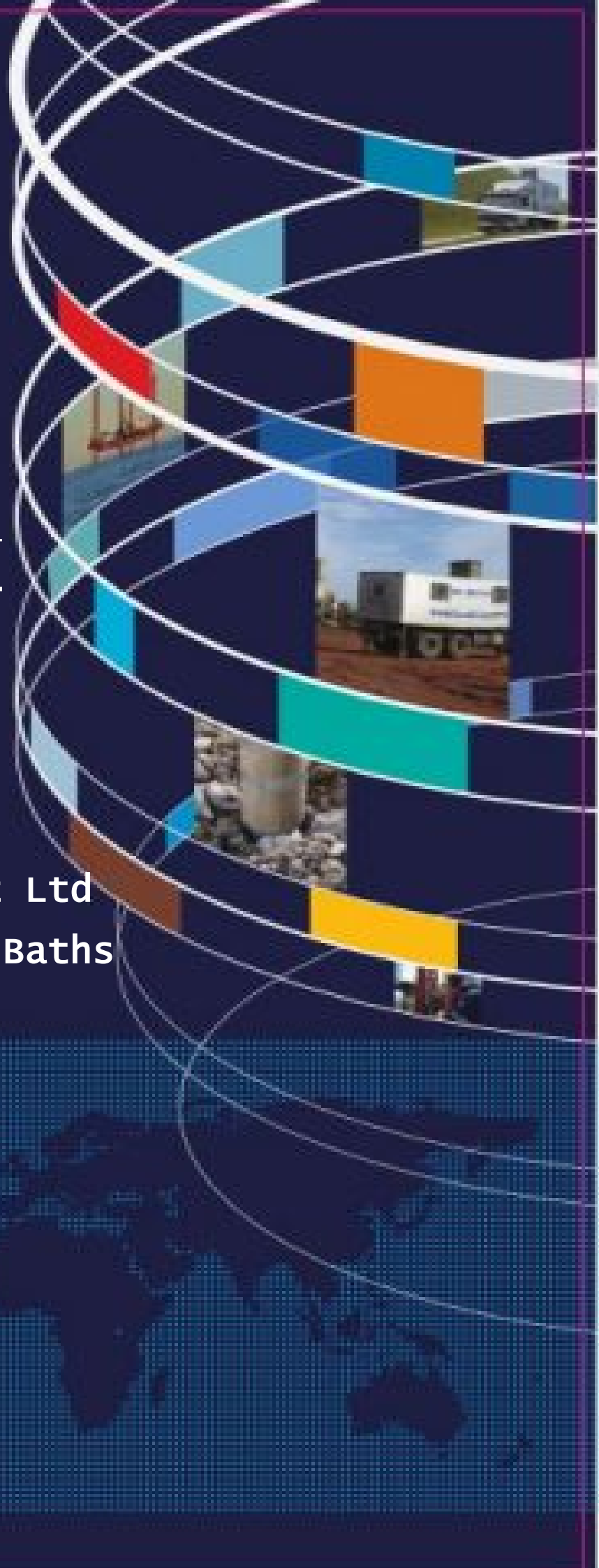
SITE INVESTIGATION

STATIC CONE PENETRATION TEST

FACTUAL REPORT

CLIENT: LK Consult Ltd

PROJECT: Chorlton Baths



Project	Chorlton Baths
Project No.	1240458
Client	LK Consult Ltd
Address	Eton Hill Business Park, Eton Hill Road, Manchester, M26 2ZS

Attention: Peter Dunn

Dear Peter,

We have pleasure in providing a digital copy of our report and data in AGS format for the above project.

We hope that you are satisfied with the performance of our staff, equipment and reporting on this project. If you should have any queries about any aspect of the works carried out, please do not hesitate to contact us. We look forward to being of service to you in the future.

Yours faithfully,

In Situ Site Investigation Limited



Darren Ward
Director

Report Issue

Issue	Date	Prepared	Sign	Checked	Sign	Approved	Sign
01	28/10/2024	Chloe Donovan		Darren Ward		Darren Ward	

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1.0 INTRODUCTION

In Situ Site Investigation Limited (In Situ) was engaged in a geotechnical site investigation at Chorlton Baths at the request of LK Consult Ltd. The site investigation consisted of completing 11 Static Piezocone Penetration Tests (CPTU), to provide information on the soil conditions and derived geotechnical parameters at:

Former Chorlton Leisure Centre at Manchester Rd,
Chorlton-cum-Hardy,
Manchester
M21 9PG

All test locations were provided by the client. A site map is included in the end of Appendix A of this report (if provided by the client). The tests were stopped when they reached the target depth as per the client's technical specifications or for other technical reasons, as detailed in the *Project Summary Table* in *Appendix A.1* and on each CPTU log included in Appendix B of this report.

The fieldwork was carried out on 24th October 2024 as per the client's request.

The work on site and the final factual reporting have been undertaken in accordance with the international technical standard *ISO 22476-1:2022(E)*.

2.0 FIELDWORK

2.1 CONE PENETRATION TESTS

The fieldwork activity is summarised in Table 2.1.

Table 2.1 Fieldwork Summary	
CPT Operator/s	Dave Roberts
Date Started	24 th October 2024
Date Finished	24 th October 2024
In Situ S.I. Project Manager	Darren Ward
Main Contractor's Site Manager	Aaron Astley

2.1.1 Rig Information

Details of CPTU rig used in this project are shown in Table 2.2. Full data sheet for the rig is presented in *Appendix A.2*.

Table 2.2 Rig Summary	
Rig Name	Rig Description
CPT017	20 Tonne Track Mounted CPT Rig

2.1.2 CPTU Cone

Details of electric CPTU cone (Type TE2) used in this project conforming to the requirements of Application Class 2 of *ISO 22476-1:2022*, are shown in Table 2.3.

Table 2.3 Cone Summary		
Number	Cross-section area	Filter position
S15-CFIP.2136	15cm ²	U ₂

A full datasheet of the cone used is shown in *Appendix A.3*.

The cone's measured parameters are shown in Table 2.4.

Table 2.4 Completed Fieldwork Summary
11 CPTU to a maximum depth of 15.00m. Each test measured Cone Resistance, q_c , Sleeve Friction, f_s , Porewater Pressure in the shoulder position, u_2 , Inclination in X and Y axes.
<i>Provision of factual report with estimated soil type, derived geotechnical parameters & AGS data file.</i>

2.1.3 CPTU Cone Calibration

The cone resistance and sleeve friction are recorded by calibrated load cells in the cone. The CPTU load cells and pressure transducers are regularly calibrated in line with *ISO 22476-1:2022(E)* standard by the cone manufacturer. The cone calibration certificate for the cone used at this site are presented in *Appendix A.4*.

2.1.4 CPTU Cone Saturation

The pore water pressure is recorded using a calibrated pressure transducer located in the piezocone. To ensure pore water pressure measurements are not affected by the presence of air in the measuring transducer, a de-airing procedure is carried out prior to each test. The cone and filter are saturated using a glycerine fluid with a viscosity of 10,000 CST.

2.1.5 Test Procedure

The tests are carried out in accordance with the *International Standard for Electrical Cone and Piezocone Penetration Test ISO 22476-1:2022(E)*.

The final depths of the tests were determined by either completion to the specified test depth or when the maximal safe capacity of the equipment was reached. A schedule of the tests performed is shown in *Appendix A.1*, which has been compiled from the operators' daily progress reports.

The data is transmitted from the digital CPTU through an umbilical cable that runs through the push rods to the data acquisition system. Results are displayed instantaneously on the computer logging screen. The results are recorded on the computer hard disc.

The rate of penetration is kept constant at 20 mm/s $\pm$ 5 mm/s except when penetrating very dense or hard strata. Before each test is carried out zero values are taken of the cone to check if it is within calibration. At the end of each test, zero values are taken again to see if there has been any drift during the test. These values are inspected during the post processing stage. This is a quality check on the data and the testing procedure. Individual test zero values are shown on their corresponding test results in *Appendix B*.

2.1.6 In Situ Pore Pressure (u_0)

The in situ or hydrostatic pore pressure is required for the calculation of several derived parameters included in this report. For this report, the groundwater level is assumed at 0.5m below ground surface, for calculation purposes. The in situ pore pressure, u_0 values are presented on the pore pressure plot, on *CPT Log 01*, which is included in *Appendix B*.

2.2 POSITIONING

Positioning and surveying of all investigated locations was the responsibility of the client.

3.0 CONE PENETRATION MEASURED PARAMETERS

All measured parameters of tests carried with the CPTU cone are shown in *Appendix B* and all the information about data processing and results are given in sections 3.1, 3.2 and 3.3.

3.1 DATA PROCESSING

The measured parameters, cone end resistance, q_c , sleeve friction, f_s , porewater pressure measurements with filter in shoulder position, u_2 and inclination for x and y axis, I_x , I_y , were recorded for every 10 mm of penetration keeping a constant speed of 20 mm/s $\pm$ 5 mm/s, which may slightly change when the cone is penetrating hard strata.

The measured data from the site works is processed and presented using specialised CPT software. The interpretations on the CPTU results were carried out following the recommendations of *ISO 22476-1:2022(E)*, *Lunne et al. (1997)* and *Robertson (2015)*. Measured parameters, mentioned in *Sections 3.2* and *3.3*, were used to derive all the geotechnical parameters, which are presented in *Chapter 4.0*. The soil behaviour type method used on this report is *Robertson et al. (1986)*, shown in *Figure 3.2*.

3.1.1 Zero Measurements

Before and after each CPTU test, zero measurements are recorded for each channel of the cone. The zero measurements are presented on the logs in *Appendix B*. This is a routine quality check carried out on site.

3.2 MEASURED PARAMETERS

3.2.1 Cone Resistance (q_c)

Cone resistance, q_c , is measured as the total force acting on the cone, divided by the projected area of the cone. The results are presented in MPa, on *CPT Log 01*, in *Appendix B*, scale 0-20 MPa with a minor scale printing on the same graph at 0-4 MPa.

3.2.2 Sleeve Friction (f_s)

Sleeve friction, f_s , is measured as the total frictional force acting on the friction sleeve divided by its surface area. The results are presented in kPa, on *CPT Log 01*, in *Appendix B*, using a scale of 0-500 kPa.

3.2.3 Porewater pressure (u_2)

The pore pressure, u_2 , is measured during the test. If the material is free draining and saturation is maintained it will normally measure hydrostatic pore pressure. In materials that are not free draining, it will record the total pore pressure (hydrostatic plus any excess pore pressures generated) created by the cone penetration through this material.

The filter element can be mounted in one of three positions. For all tests carried out in this project the filter was mounted in the u_2 position (see *Figure 3.1*).

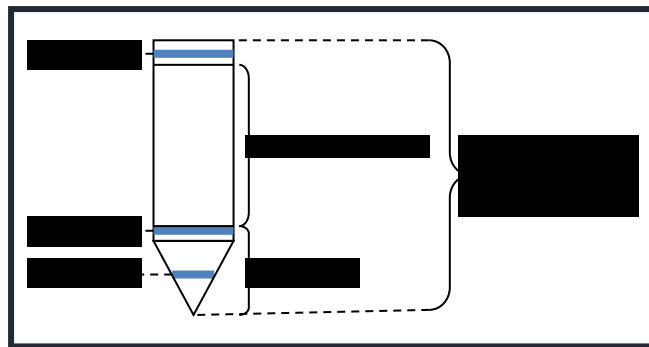


Figure 3.1: Diagram showing pore pressure filter locations (after Lunne et al., 1997)

3.2.4 Inclination (I_x , I_y)

The CPT rig was set up to obtain a thrust direction as near as possible to vertical. The CPTU cones have inclinometers incorporated to measure the non-verticality of the test. For test depths less than 15 m, significant non-verticality is unusual, provided the initial thrust direction is vertical.

3.3 ESTIMATED SOIL BEHAVIOUR TYPE

3.3.1 Friction Ratio (R_f)

The friction ratio, R_f is the ratio between the sleeve friction and the cone resistance (Lunne et al., 1997).

$$\text{Friction Ratio } (R_f) = \left(\frac{\text{Sleeve Friction } (f_s)}{\text{Cone Resistance } (q_c)} \right) \times 100$$

3.3.2 Estimated Soil Behaviour Type (SBT)

The estimation of soil behaviour type, *SBT*, using measurements of cone resistance and sleeve friction is based upon the variations of the friction ratio and cone resistance. The friction

ratio varies depending upon whether the soil is cohesive or granular. The cone resistance varies depending on the strength and densities of the soil.

The interpretation used in this report is *Robertson et al. (1986)*, which is shown in Figure 3.2. The results are presented on *CPT Log 01*, in *Appendix B*.

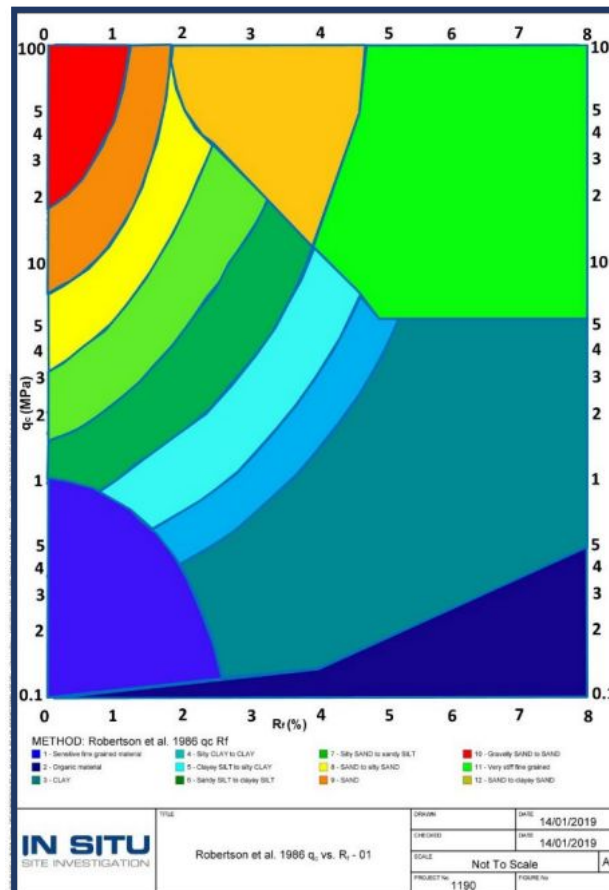


Figure 3.2: *Robertson et al., 1986 soil behaviour type chart.*

3.3.3 Pore Pressure Ratio (B_q)

Pore pressure ratio, B_q is the ratio between the measured pore pressure generated during penetration and the corrected cone resistance minus the total overburden stress.

Pore pressure ratio as defined by *Senneset and Janbu (1985)* is defined as:

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

where

- u_2 is pore pressure measured between the cone and the friction sleeve
- u_0 is equilibrium pore pressure
- σ_{vo} is total overburden stress
- q_t is cone resistance corrected for unequal end area effects

3.4 APPLIED CORRECTIONS

3.4.1 Corrected Cone Resistance (q_t)

For each penetration test, the measured cone resistance, q_c , can be corrected for the “unequal area effect” due to the influence of the ambient pore water pressure acting on the cone.

The correction has been applied using the following equation by Lunne et al., 1997:

$$q_t = q_c + [u_2 \cdot (1 - \alpha)]$$

where

α is the cone area ratio

The cone area ratio used for this project is stated on both the cone calibration certificate and the data footer. This value is geometrically measured.

3.4.2 Depth Correction

All tests in the report have been corrected for depth difference caused by inclination. This has been calculated using the method described in *ISO 22476-1:2022*.

To calculate the corrected depth the following formula is used:

$$z = \int_0^l C_{inc} \cdot dl$$

where

z is penetration depth, in m

l is penetration length, in m

C_{inc} is correction factor for the effect of the inclination of the CPTU relative to the vertical axis.

The equation for calculating the correction factor for the influence of the inclination for a bi-axial inclinometer is:

$$C_{inc} = \frac{1}{\sqrt{(1 + \tan^2 \beta_1 + \tan^2 \beta_2)}}$$

where

β_1 is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane, in degrees

β_2 is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane that is perpendicular to the plane of angle β_1 , in degrees

4.0 GEOTECHNICAL DERIVED PARAMETERS

A number of empirical correlations can be used to derive geotechnical parameters from CPTU data. This report includes only the parameters which are described in this chapter. The results of all correlations used to obtain the geotechnical derived parameters are presented on *CPT Log 02* and *CPT Log 03* in *Appendix B*.

Please, note that each empirical correlation is derived for a certain type of soil, and may not be appropriate for all the soil types encountered on this project.

4.1 SOIL BEHAVIOUR TYPE INDEX (I_c)

The soil behaviour type index, I_c , was derived by *Jefferies and Davies (1991)*, and was created to simplify the application of CPTU SBT chart shown in *Chapter 3, Figure 3.2*. This approach has been modified for use with the *Robertson (1990)* normalised CPT soil classification chart, *Figure 4.1*. The normalised cone parameters Q_t and F_r (for definitions see *Appendix A5 Symbol List*) can be combined into one Soil Behaviour Type Index, I_c , (*Lunne et al., 1997*).

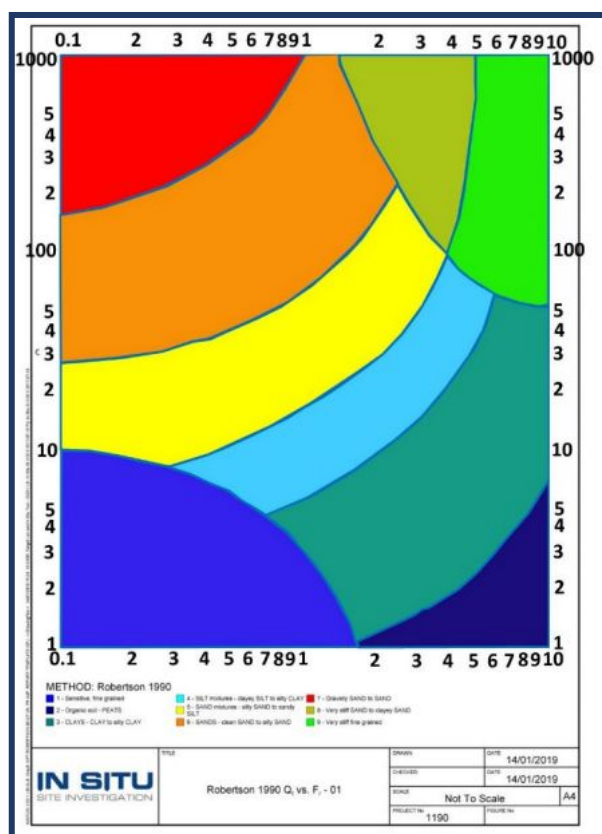


Figure 4.1: Robertson 1990 soil behaviour type chart.

The soil behaviour type index, I_c , can then be defined using *Robertson (2010)* formula, given below:

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

where

Q_t is the normalized cone resistance which represents the simple normalization with a stress exponent (n) of 1.0, which applies well to clay-like soils

F_R is the normalized friction ratio, in %

The boundaries of soil behaviour type are then given in terms of the index, I_c , presented in *Table 4.1* below.

The soils behaviour type index does not apply to zones 1, 8 and 9. The profiles of I_c provide a simple guide to the continuous variation of soil behaviour type in a given soil profile based on CPTU results, with a reliability greater than 80% compared with soil samples (*Robertson, 2015*).

Zone	Soil Behaviour Type	I_c
1	Sensitive fine grained	N/A
2	Organic Soils – clay	>3.6
3	Clays – silty clay to clay	2.95 – 3.6
4	Silt mixtures – clayey silt to silty clay	2.60 – 2.95
5	Sand mixtures – silty sand to sandy silt	2.05 – 2.6
6	Sands – clean sand to silty sand	1.31 – 2.05
7	Gravelly sand to dense sand	<1.31
8	Very stiff sand to clayey sand*	N/A
9	Very stiff fine grained *	N/A

* Heavily over consolidated or cemented

Table 4.1: Normalized CPTU Soil Behaviour Type (SBT_n) Index values, I_c . (*Robertson, 2010*)

4.2 N VALUE OF STANDARD PENETRATION TEST (SPT) (N_{60})

The derived N value of SPT, N_{60} , is strongly and directly related to the cone resistance, q_c .

In this report the N_{60} value is derived using the following correlations, developed by *Robertson and Wride (1998)*, *Jefferies and Davies (1998)* and *Robertson (2012)*:

1) *Robertson & Wride (1998)*

$$N_{60} = \frac{q_c}{8.5 \cdot p_a \left(1 - \frac{I_c}{4.6}\right)}$$

2) *Jefferies and Davies (1993)*

$$N_{60} = \frac{q_c}{0.85 \cdot \left(1 - \frac{I_c}{4.75}\right)}$$

3) *Robertson (2012)*

$$N_{60} = \frac{\frac{q_c}{p_a}}{10^{1.1268 - 0.2817 I_c}}$$

where

- q_c is the cone resistance
- p_a is the atmospheric pressure equal to 100 kPa
- I_c is the soil behaviour type index calculated as given in *section 4.1*

It is suggested that these methods provide a better estimation of the N_{60} value than the actual measured N , due to the poor repeatability of SPT test. However, in fine grained soil with high sensitivity these methods may overestimate N_{60} (*Jefferies and Davies, 1991*). The third method suggested by *Robertson (2012)* provides improved estimates of N_{60} for insensitive clays.

4.3 RELATIVE DENSITY (D_r)

Relative density, D_r , is an intermediate parameter for coarse grained soils, widely used to describe sand deposits. All the research on deriving the relative density from CPTU tests results are carried out for **clean predominantly quartz sands**. The studies have shown that CPTU resistance in granular soils is controlled by sand relative density, in situ effective stresses and compressibility. The more compressible sands tend to give lower penetration resistance for a given relative density than less compressible sands.

In this report relative density is calculated using the methods suggested by *Baldi et al., (1986)*, *Jamiolkowski et al., (2001)* and *Kulhawy and Mayne (1990)* as shown in the equations below:

1) Baldi et al., (1986)

$$D_r = \frac{1}{C_2} \cdot \ln \left(\frac{q_c \cdot Wehr}{C_1 \cdot (\sigma'_{v0})^{0.55}} \right) \cdot 100$$

where

C_1 is a consolidation coefficient which is 157 for normally consolidated soils and 181 for over consolidated soils

C_2 is a consolidation coefficient which is 2.41 for normally consolidated soils and 2.46 for over consolidated soils

Wehr is a correction coefficient for calcareous soils

2) Jamiolkowski et al., (2001)

$$D_r = 100 \cdot \left[0.268 \cdot \ln \left(\frac{q_t / \sigma_{atm}}{\sqrt{\sigma'_{v0} / \sigma_{atm}}} \right) + C_1 \right]$$

where

C_1 is a compressibility coefficient which is -0.675 for average compressible soils, ≤ 1.0 for high compressible soils and carbonate or calcareous sands and ≥ -2.0 for low compressible soils

q_t is corrected cone resistance

σ_{atm} is the atmospheric pressure

3) Kulhawy and Mayne, (1990)

$$D_r = \left[\frac{q_{c1}}{305 \cdot C_1 \cdot OCR^{0.18} \cdot (1.2 + 0.05 \cdot \log(t/100))} \right]^{0.5} \cdot 100$$

where

q_{c1} is the cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula

$$q_{c1} = \frac{q_c}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

where

q_c is the cone resistance in kPa

σ'_{v0} is the initial vertical effective stress in kPa

C_1 is a compressibility coefficient which is -0.91 for low compressible sands, 1.0 for medium compressible sands and 1.09 for high compressible sands

t is time in years

4.4 FRICTION ANGLE (ϕ')

Friction angle, ϕ' , is used to express the shear strength of uncemented, coarse grained soils. In this report friction angle is derived by the correlations of *Mayne and Campanella (2005)*, *Robertson and Campanella (1983)* and *Kulhawy and Mayne (1990)*.

- 1) Mayne and Campanella, (2005)

$$\phi' = 29.5^0 \cdot B_q^{0.121} \cdot [0.256 + 0.336 \cdot B_q + \log Q_t]$$

where

B_q is the pore pressure ratio, calculated as in Session 3.3

Q_t is the normalized cone resistance

- 2) Robertson and Campanella, (1983)

$$\phi' = \tan^{-1} \left(0.1 + 0.38 \cdot \log \left(\frac{q_t}{\sigma'_{v0}} \right) \right)$$

where

q_c is the cone resistance in *kPa*

σ'_{v0} is the initial vertical effective stress in *kPa*

- 3) Kulhawy and Mayne, (1990)

$$\phi' = 17.6^0 + 11.0^0 \cdot \log(q_{t1})$$

where

q_{t1} is the corrected cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula

$$q_{t1} = \frac{q_t}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

The method suggested by *Mayne and Campanella (2005)* will not provide reliable results for heavily over consolidated soils, fissured geomaterials and highly cemented or structures clays. This approach gives reliable results when pore pressure is positive and varies $0.1 < B_q < 1.0$. The correlation suggested by *Robertson and Campanella (1983)* estimates the peak friction angle for uncemented, unaged, moderately compressible, predominately quartz sands. For sands of higher compressibility, the method will tend to predict low friction angles. The method suggested by *Kulhawy and Mayne (1990)* is an alternate relationship for clean, rounded, uncemented, quartz sands.

4.5 FINES CONTENT (FC)

The fines content, FC , in this report is estimated using two different methods, one from *Robertson and Wride (1998)* and the other, *Suzuki et al. (1998)* as presented below:

- 1) Robertson and Wride (1998)

$$I_c < 1.26: FC = 0$$

$$1.26 \leq I_c \leq 3.5: FC(\%) = 1.75I_c^{3.25} - 3.7$$

$$3.5 < I_c: FC = 100\%$$

- 2) Suzuki et al. (1998)

$$FC(\%) = 2.8I_c^{2.6}$$

where

I_c is the soil behaviour type index, calculated as in section 4.1

4.6 UNDRAINED SHEAR STRENGTH (s_u)

Estimation of undrained shear strength, s_u , from CPTU tests using corrected cone resistance is carried out using the following correlation from *Lunne et al. (1981)*:

$$S_u = \frac{(q_t - \sigma_{vo})}{N_{kt}}$$

where

N_{kt} is the empirical cone factor, which varies from 10 (6 for very soft sensitive fine grained soils) to 20. In this report 3 values are considered: 15, 17.5 and 20. N_{kt} tends to increase with increasing plasticity and decrease with increasing soil sensitivity. It decreases as B_q increases. (*Lunne et al., 1997*)

σ_{vo} = total overburden stress.

This report only presents the undrained shear strength data on soils with soil behaviour type index, I_c values greater than 2.60.

The value of undrained shear strength, s_u to be used in analysis depends on the design problem. In general, the simple shear in the direction of loading often represents the average undrained strength. For larger, moderate to high risk projects, where high quality field and laboratory data may be available, site specific correlations should be developed based on appropriate and reliable values of s_u .

4.7 SENSITIVITY (S_t)

The sensitivity, S_t of clays is defined as the ratio of undisturbed peak undrained shear strength to totally remoulded undrained shear strength.

In this report S_t is calculated using two correlations developed by *Schmertmann (1978)* and *Mayne (2007)*.

1) Schmertmann (1978)

$$S_t = \frac{s_u}{s_{u(rem)}} = \frac{q_t - \sigma_v}{N_{kt}} \left(\frac{1}{f_s} \right)$$

where

$s_{u(rem)}$ is the remoulded undrained shear strength. It can be assumed equal to the sleeve resistance, f_s .

2) Mayne (2007)

$$S_t = \frac{0.073 \cdot (q_t - \sigma_{v0})}{f_s}$$

For relatively sensitive clays, $S_t > 10$, the value of f_s can be very low and not very accurate, hence the estimate of sensitivity should be used as a guide only.

4.8 SOIL UNIT WEIGHT (γ)

Soil unit weight, γ in this report is calculated by using one method for sands, considered under dry conditions and two methods for clays, considered under saturated conditions. These relationships are developed by *Mayne (2007)* and the equations are presented below:

Dry unit weight for sands:

$$\gamma_{dry} = 1.89 \cdot \log(q_{t1}) + 11.82$$

Saturated unit weight for clays method 1

$$\gamma_{sat} = 8.32 \cdot \log(V_s) - 1.61 \cdot \log(z)$$

Saturated unit for clays method 2

$$\gamma_{sat} = 2.60 \cdot \log(f_s) + 15 \cdot G_s - 26.5$$

where

q_{t1} is the corrected cone resistance corrected for initial vertical effective stress and atmospheric pressure, calculated by the following formula:

$$q_{t1} = \frac{q_t}{\sqrt{\sigma'_{v0} \cdot \sigma_{atm}}}$$

z is the depth

V_s is the shear wave velocity, calculated as $V_s = 118.8 \cdot \log(f_s) + 18.5$

G_s is the specific gravity of solids, typically between 2.40 and 2.90

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APPENDIX A

APPENDIX A1 – Project Summary Sheet

Piezocene Tests Summary Sheet

HOLE ID	Final Depth (m)	Date of Test	Cone Used	Test Remarks
CPT101	0.17	24/10/2024	S15-CFIP.2136	Test refused on inclination.
CPT101A	0.24	24/10/2024	S15-CFIP.2136	Test refused on inclination.
CPT101B	1.62	24/10/2024	S15-CFIP.2136	Test refused on total pressure.
CPT101C	10.48	24/10/2024	S15-CFIP.2136	Test refused on inclination.
CPT102	14.98	24/10/2024	S15-CFIP.2136	Test completed at target depth.
CPT103	14.99	24/10/2024	S15-CFIP.2136	Test completed at target depth.
CPT104	15.00	24/10/2024	S15-CFIP.2136	Test completed at target depth.
CPT105	13.33	24/10/2024	S15-CFIP.2136	Test refused on total pressure.
CPT106	12.58	24/10/2024	S15-CFIP.2136	Test refused on total pressure.
CPT107	1.10	24/10/2024	S15-CFIP.2136	Test refused on inclination.
CPT107A	13.11	24/10/2024	S15-CFIP.2136	Test refused on total pressure.

APPENDIX A2 – CPT Rig Datasheet

RIGS

20 TONNE CPT TRACK MOUNTED RIG (CPT017)

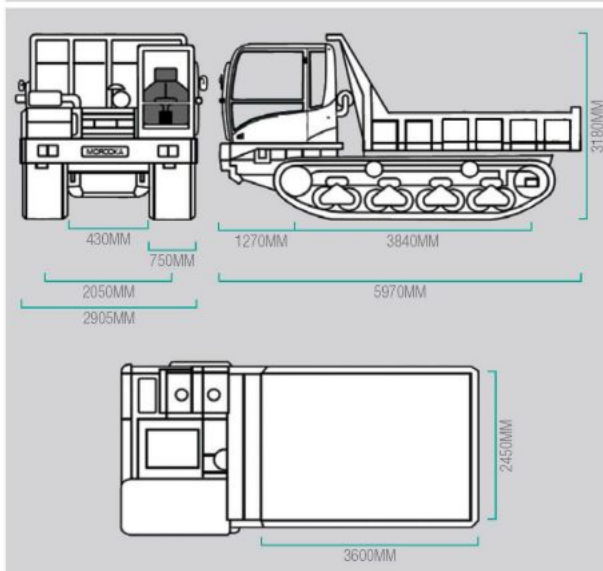
We have a variety of rigs giving us the capacity to meet our clients' needs and specifications for each individual project.

This rubber tracked rig weighs 20 tonnes and is able to push up to a depth of 40 metres, depending on the ground conditions. It has low ground bearing pressure and is ideal for soft, boggy sites which are inaccessible for our wheeled rigs.

CPT RIG DETAILS

DRIVE SYSTEM	RUBBER TRACKED
TOTAL WEIGHT	20 TONNES
GROUND BEARING PRESSURE	35kPa
CPT RAM THRUST CAPACITY	20 TONNES
MAXIMUM PENETRATION	30-40M DEPENDING ON THE GROUND CONDITIONS.
PERFORMANCE RATES	100-150M OF TESTING A DAY, DEPENDING ON ACCESS TO POSITIONS.
TYPICAL SITES FOR THIS RIG	SOFT, BOGGY SITES. THE RIG HAS LOW GROUND BEARING PRESSURE.

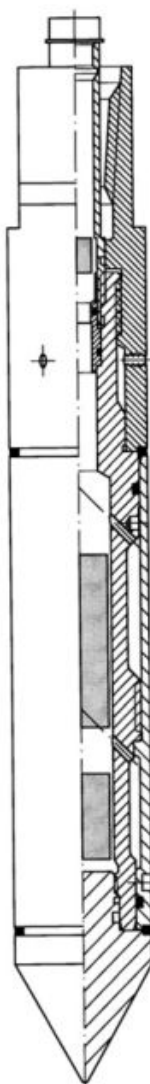
CPT RIG DIMENSIONS



APPENDIX A3 – Cone Datasheet



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 2171 AL Sassenheim
 Tel. : +31 71 301 92 51
 Fax : +31 71 301 92 52
 E-mail : info@geopoint.nl
 ING bank : 68.23.01.396
 Postbank : 5226758
 BTW nr. : NL806331677801



SPECIFICATIONS

S15 SERIES

ELECTRICAL CONES

The electronic subtraction cones have been developed to address the durability problems inherent in other cone designs. The unit consists of a single element temperature compensated strain gauge transducer for measuring both cone resistance and local sleeve friction. This design is therefore more robust than a compression type cone. The cone support electronics package is located directly behind the transducer. The precision strain gauge amplifiers and power supply eliminate the effects of cable resistance on the measurements. A standard subtraction cone is capable of measuring simultaneously the following channels: Tip, Local friction, Pore pressure, Temperature and Inclination.

GENERAL SPECIFICATIONS

Cone Tip Section Area	1,500 mm ²
Friction Sleeve Surface	22,500 mm ²
Total Length	325 mm
Weight	4200 g
Power Supply	± 15 VDC, 100 mA.
Output	0 – 10 VDC*
Working Temperature	0 - 60°C
Storage Temperature	- 40 to + 85°C
Connector	Lemo 10 pins (others on request)

TIP RESISTANCE

Range	100/150* kN
Accuracy	0.25 % FS
Maximum Load	150 % of range
Cone Area Ratio	0.75

LOCAL SLEEVE FRICTION

Range	100/150* kN
Accuracy	0.50 % FS
Maximum Load	150 %
Sleeve Area Ratio	1.0 (EA)

PORE PRESSURE

Range	1/2/5/10* MPa
Accuracy	0.5 % FS
Maximum Load	150 % of range

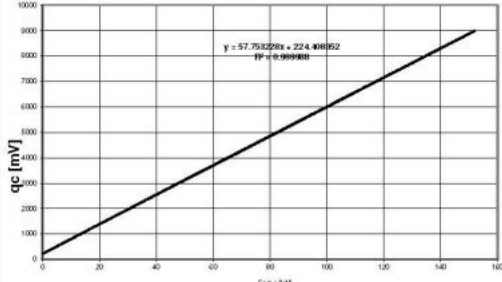
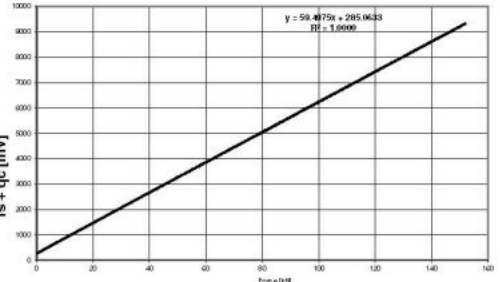
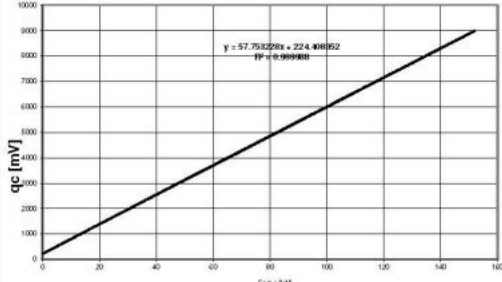
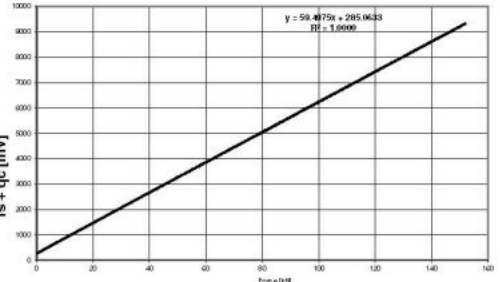
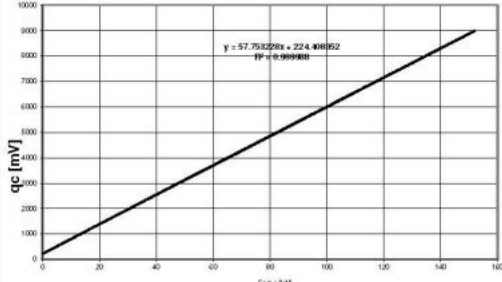
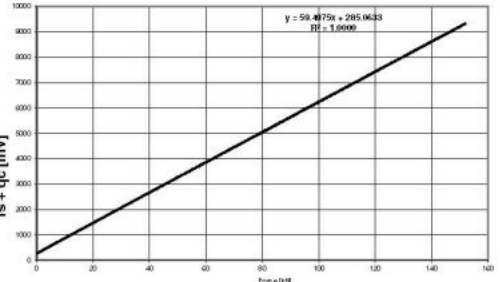
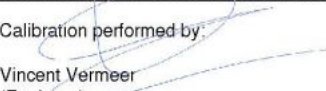
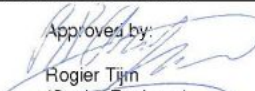
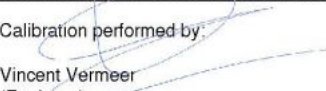
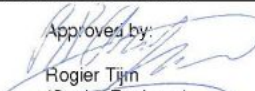
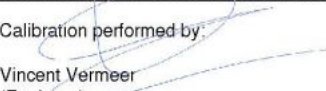
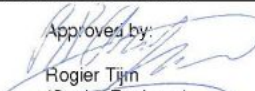
INCLINATION

Range	25 ° (biaxial)
Accuracy	< 2 °

All our equipment complies with the ISSMGE, ASTM, DIN and NEN Standards.

**Other output and voltage ranges available on request. Loadcells may be calibrated for lower ranges.*

APPENDIX A4 – Cone Calibration Certificate

 WWW.GOUDA-GEO.COM Down to Earth	Gouda Geo-Equipment B.V. Satellietbaan 8 2181 MH Hillegom The Netherlands Tel. + 31 (0)715.318.475 E-mail: info@gouda-geo.com																					
Certificate of Calibration Certificate No. CMI 24.05.6608																						
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="3" style="text-align: center;">Instrument</th> </tr> <tr> <td style="width: 33%;">Instrument Type:</td> <td style="width: 33%;">Electrical Subtraction Cone</td> <td style="width: 34%;">Calibration Result: Certified</td> </tr> <tr> <td>Manufacturer:</td> <td>GP calibrated by Gouda Geo-Equipment BV</td> <td>Date Calibrated: 2-5-2024</td> </tr> <tr> <td>Model No.:</td> <td>S15-CFIIP</td> <td>Next Due Date: 2-5-2025</td> </tr> <tr> <td>Serial No.:</td> <td>2136</td> <td></td> </tr> <tr> <td>Cone area factor:</td> <td>0,86</td> <td></td> </tr> <tr> <td colspan="2">Used Calibration Procedure: GGECP008, ISO 22476-1:2012</td> <td>Location: Hillegom (The Netherlands)</td> </tr> </table>		Instrument			Instrument Type:	Electrical Subtraction Cone	Calibration Result: Certified	Manufacturer:	GP calibrated by Gouda Geo-Equipment BV	Date Calibrated: 2-5-2024	Model No.:	S15-CFIIP	Next Due Date: 2-5-2025	Serial No.:	2136		Cone area factor:	0,86		Used Calibration Procedure: GGECP008, ISO 22476-1:2012		Location: Hillegom (The Netherlands)
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APPENDIX A5 – Symbol List

English

a	is area ratio of the cone ($= A_n/A_c$)
A	is area
A _c	is projected area of the cone
A _n	is cross sectional area of load cell or shaft
A _s	is area of friction sleeve
A _{sb}	is bottom end area of friction sleeve
A _{st}	is top end area of friction sleeve
B _q	is pore pressure parameter ($= (u_2 - u_0)/(q_t - \sigma_{v0})$)
C _h	is horizontal coefficient of consolidation
C _v	is vertical coefficient of consolidation
D	is diameter
D _r	is relative density ($= \frac{e_{max}-e}{e_{max}-e_{min}} \times 100\%$)
e	is void ratio
e _{max}	is maximum void ratio
e _{min}	is minimum void ratio
E	is Young's modulus
f _s	is unit sleeve friction resistance
f _t	is sleeve friction corrected for pore pressure effects
F _s	is total force acting on friction sleeve
F _R	is normalized friction ratio ($= f_s/(q_t - \sigma_{v0})$)
FoS	is factor of safety
FC	is fines content
g	is acceleration due to gravity
G ₀	is initial or maximum shear modulus, shear stiffness
I _c	is soil behavior type index
I _r	is rigidity index ($= G/s_u$)
I _p	is plasticity index
k	is coefficient of permeability
k _h	is coefficient of permeability in horizontal direction
k _v	is coefficient of permeability in vertical direction
K ₀	is coefficient of earth pressure at rest ($= \sigma'_{h0}/\sigma'_{v0}$)
L	is length
m _v	is coefficient of volume change
M	is constrained deformation modulus
M7.5	is earthquake magnitude of 7.5 Richter scale
N	is number of blows of SPT
N ₆₀	is SPT energy ratio
N _k	is cone factor
N _{ke}	is cone factor
N _{kt}	is cone factor
N _{Δu}	is cone factor
p _a	is reference stress ($= 100 \text{ kPa}$)
q _c	is measured cone resistance
q _e	is effective cone resistance ($= q_t - u_2$)
q _n	is net cone resistance ($= q_t - \sigma_{v0}$)
q _t	is corrected cone resistance ($= q_c - (1 - a)u_2$)
Q _c	is total force acting on the cone
Q _t	is normalized cone resistance ($= q_t - \sigma_{v0}/\sigma'_{v0}$)

R_f	is friction ratio $(= (f_t/q_t) \times 100\%)$ or alternatively $(= (f_t/q_t) \times 100\%)$
s_u	is undrained shear strength
s_{ur}	is remoulded undrained shear strength
S_t	is sensitivity
t	is time
t_{50}	is time for 50% dissipation of excess pore water pressure
T_{50}	is time factor at $U = 50\%$
u	is pore water pressure
u_0	is in situ pore pressure
u_1	is pore pressure measured on the cone
u_2	is pore pressure measured behind the cone
u_3	is pore pressure measured behind sleeve friction
Δu	is excess pore water pressure
U	is normalized excess pore pressure
V_s	is shear wave velocity
z	is depth

Greek

α	is constant
α	is cone roughness
β	is constant
β_1	is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane, in degrees
β_2	is the angle between the vertical axis and the projection of the axis of the CPTU on a vertical plane that is perpendicular to the plane of angle β_1 , in degrees
γ	is unit weight of soil
γ_w	unit weight of water
Δ	is change
Δu	is excess pore pressure $(= u - u_0)$
μ	is Poisson's ratio
ρ	is density
ψ	is state parameter
σ, σ'	is normal stress (total, effective)
σ_h, σ'_h	is horizontal stress (total, effective)
σ_v, σ'_v	is horizontal stress (total, effective)
$\sigma_{v0}, \sigma'_{v0}$	is overburden stress (total, effective)
T_{av}	is average cyclic shear stress
T_{cy}	is cyclic shear stress
ϕ'	is effective friction angle

APPENDIX A6 – Abbreviations

ASTM	American Society for Testing and Materials
CPTU	Cone Penetration Test with Pore Pressure Measurement (Piezocone Test)
CRR	Cyclic Resistance Ratio
CSR	Cyclic Stress Ratio
GWT	Ground Water Table
NC	Normally Consolidated
OC	Over consolidated
OCR	Over consolidation Ratio
PL	Limit Pressure
SCPT	Seismic Cone Penetration
SDMT	Seismic Dilatometer Marchetti
SPT	Standard Penetration Test
TC	Technical Committee

APPENDIX A7 – Glossary

CPT

Cone Penetration Test.

Cone

The part of the cone penetrometer on which the end bearing is developed.

Cone Penetrometer

The assembly containing the *cone*, *friction sleeve*, any other sensors and measuring systems, as well as the connections to the *push-rods*.

Cone resistance, q_c

The total force acting on the cone, Q_c , divided by the projected area of the cone, A_c . $q_c = Q_c / A_c$

Corrected cone resistance, q_t

The *cone resistance*, q_c corrected for pore water pressure effects.

Corrected sleeve friction, f_t

The *sleeve friction* corrected for pore water pressure effects on the ends of the *friction sleeve*.

Data acquisition system

The system used to measure and record the measurements made by the *cone penetrometer*.

Dissipation Test

A test when the decay of the pore water pressure is monitored during a pause in penetration.

Filter element

The porous element inserted into the cone penetrometer to allow transmission of the pore water pressure to the pore pressure sensor, while maintaining the correct profile of the *cone penetrometer*.

Friction ratio, R_f

The ratio, expressed as a percentage of the *sleeve friction*, f_s , to the *cone resistance*, q_c , both measured at the same depth.

Friction reducer

A local enlargement on the push-rod surface, placed at a distance above the cone penetrometer, and provided to reduce the friction on the *push-rods*.

Friction sleeve

The section of the *cone penetrometer* upon which the *sleeve friction* is measured.

Normalized cone resistance, Q_c or Q_t

The *cone resistance* expressed in a non-dimensional form and taking account of stress changes *in situ*, $Q_c = (q_c - \sigma_{v0}) / \sigma'_{v0}$, or when the *corrected cone resistance* is used $Q_t = (q_t - \sigma_{v0}) / \sigma'_{v0}$. Where σ_{v0} and σ'_{v0} are the total and effective vertical stress respectively.

Net cone resistance, q_n

The *corrected cone resistance* minus the vertical total stress. $q_n = q_t - \sigma_{v0}$

Normalized friction ratio, F_r

The *sleeve friction* normalized by the *net cone resistance*.

Piezocone

A *cone penetrometer* containing a pore pressure sensor.

Pore pressure, u

The pore pressure generated during penetration and measured by a pore pressure sensor, u_1 when measured on the cone, u_2 when measured just behind the cone and u_3 when measured just behind the friction sleeve.

Pore pressure ratio, B_q

The *net pore pressure* normalized with respect to the *net cone resistance*.

Push-rods

The thick-walled tubes or rods used for advancing the cone penetrometer.

Rig machine

The equipment which pushes the cone penetrometer and rods into the ground.

Sleeve friction, f_s

The total frictional force acting on the *friction sleeve*, F_s , divided by its *surface area*, A_s . $f_s = F_s / A_s$

APPENDIX A8 – Soils Description Tables

GRANULAR SOILS (Sands and Gravels)

Description	Relative Density D_r (%)	SPT N value, N_{SPT}
Very Loose	0 – 15	0 - 4
Loose	15 – 35	4 - 10
Medium Dense	35 – 65	10 - 30
Dense	65 – 85	30 - 50
Very Dense	>85	>50

COHESIVE SOILS (Clays and Silts)

Term based on measurement	Undrained Shear Strength Classification, s_u (kPa)
Extremely low	<10
Very low	10 - 20
Low	20 - 40
Medium	40 - 75
High	75 - 150
Very high	150 - 300
Extremely high	>300

APPENDIX B

Cone Penetration Measured Parameters and Geotechnical Derived Parameters

PointID

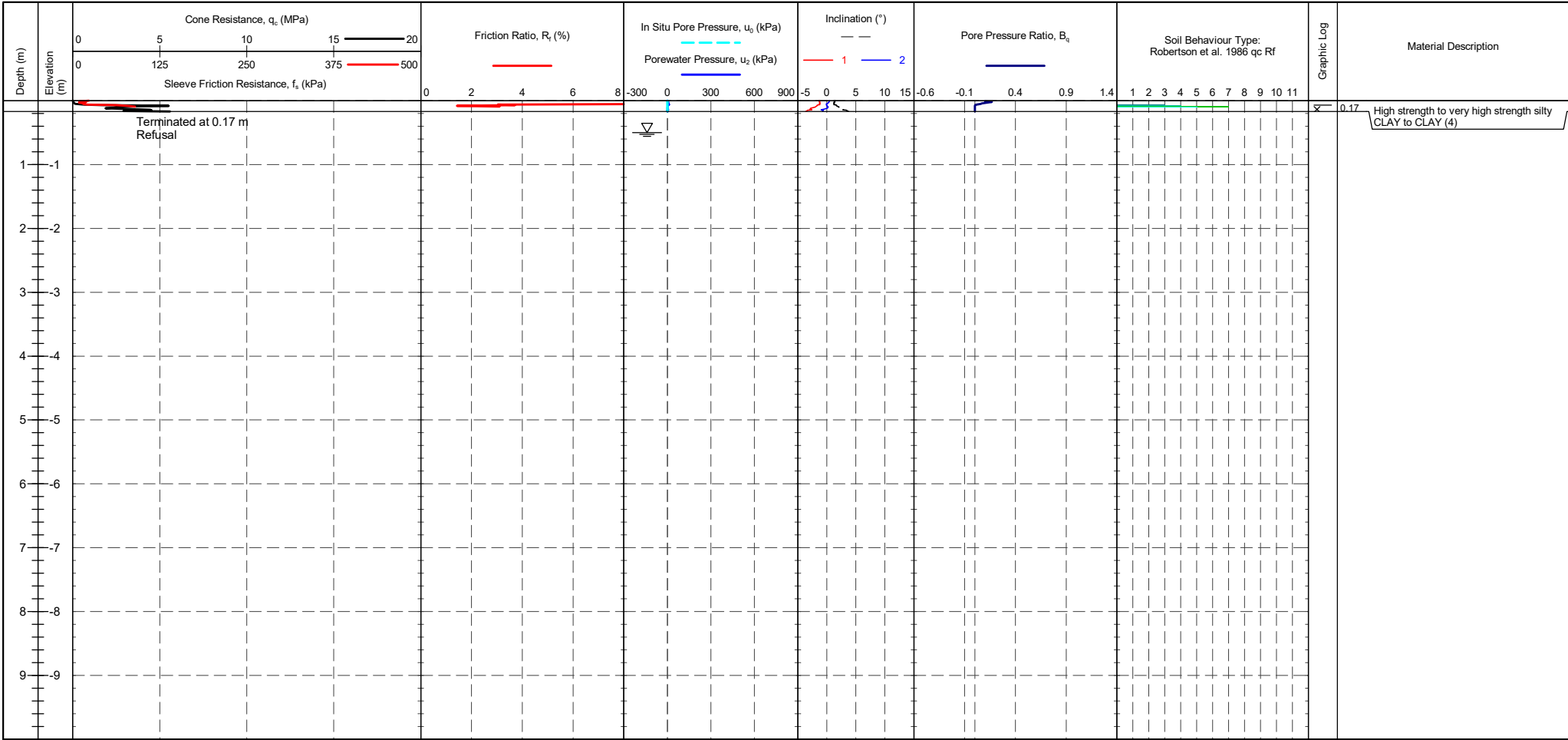
CPT101

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES
Transducer Pre Post Difference
Tip 264 mV 264 mV 0 MPa
Sleeve 338 mV 338 mV 0 kPa
Pore Pressure 2 256 mV 269 mV 0.003 kPa
X-Y Inclinator 2424 mV 2412 mV

METHOD: Robertson et al. 1986 qc Rf
1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater Level
Dissipation Test

PointID

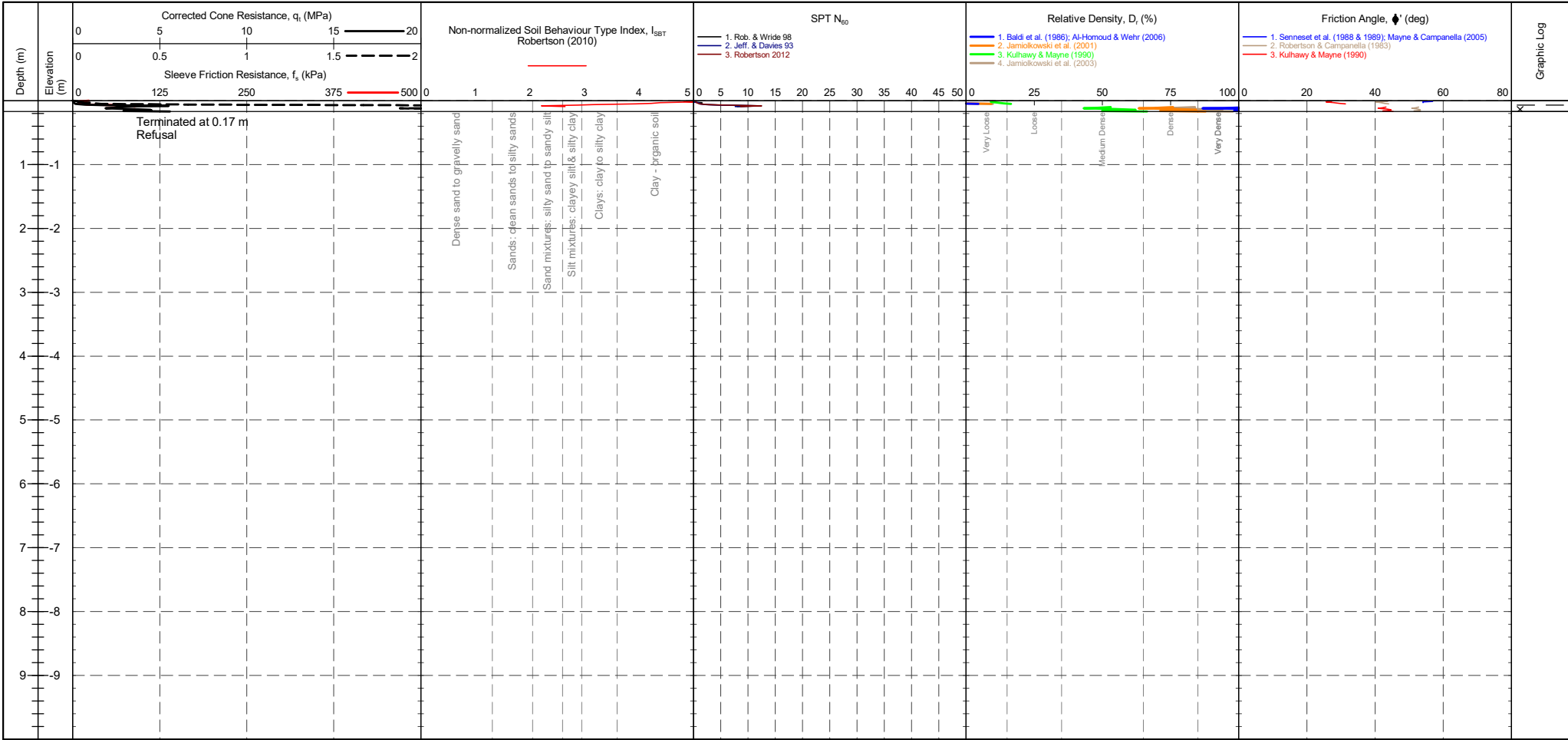
CPT101

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	264 mV	264 mV	0 MPa
Sleeve	338 mV	338 mV	0 kPa
Pore Pressure 2	256 mV	269 mV	0.003 kPa
X-Y Inclinator	2424 mV	2412 mV	

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

Description	SBT Index, I_c	Description	SPT N value, NSPT	Description	Relative Density D_r (%)
Clays	2.95-3.60	Very Loose	0 - 4	Very Loose	0 - 15
Silt mixtures	2.60-2.95	Loose	4 - 10	Loose	15 - 35
Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense	35 - 65
Sands	1.31-2.05	Dense	30 - 50	Dense	65 - 85
Gravelly sand	<1.31	Very Dense	>50	Very Dense	>85

Groundwater Level
Dissipation Test

PointID

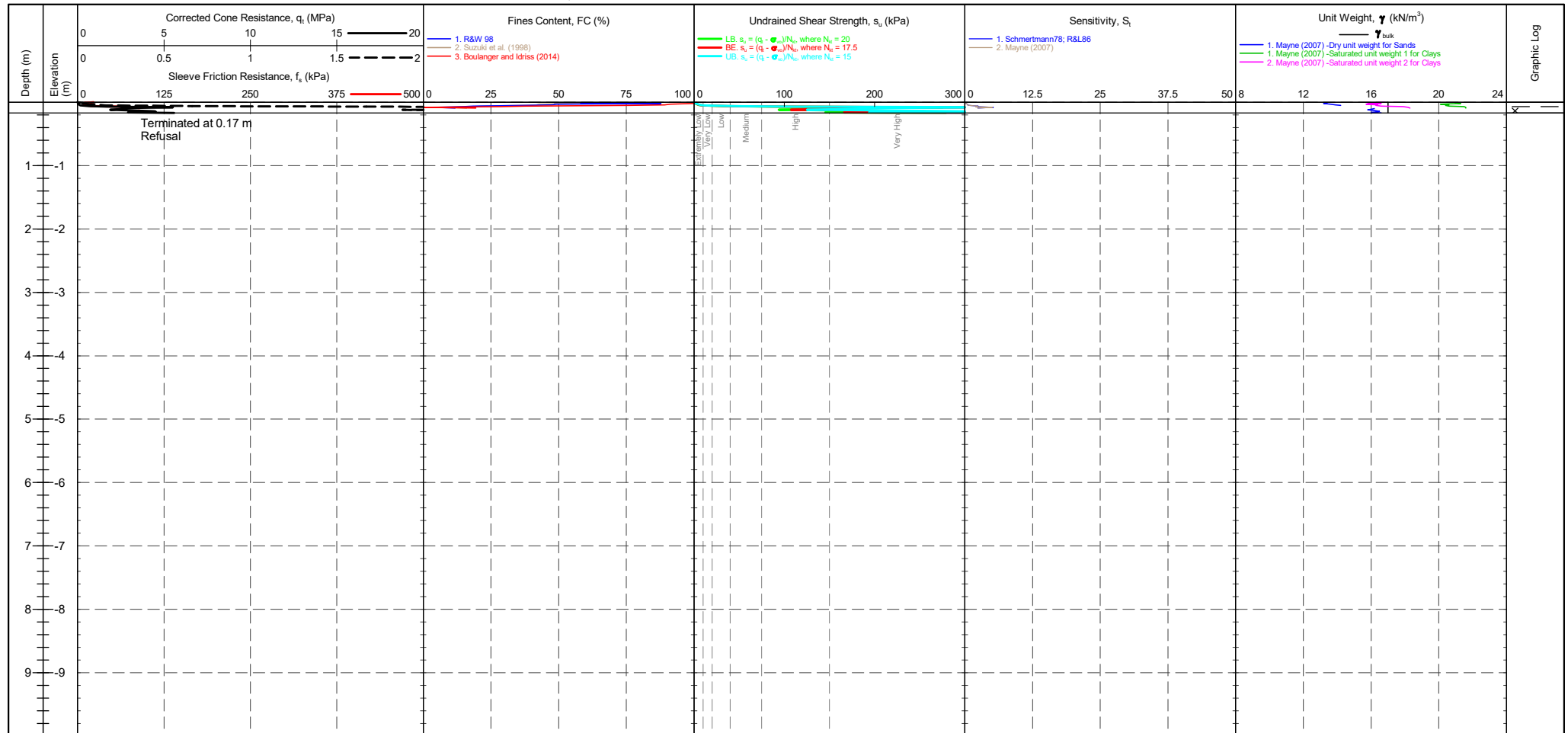
CPT101

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer Pre Post Difference
Tip 264 mV 264 mV 0 MPa
Sleeve 338 mV 338 mV 0 kPa
Pore Pressure 2 256 mV 269 mV 0.003 kPa
X-Y Inclinator 2424 mV 2412 mV

CPTU ZERO VALUES

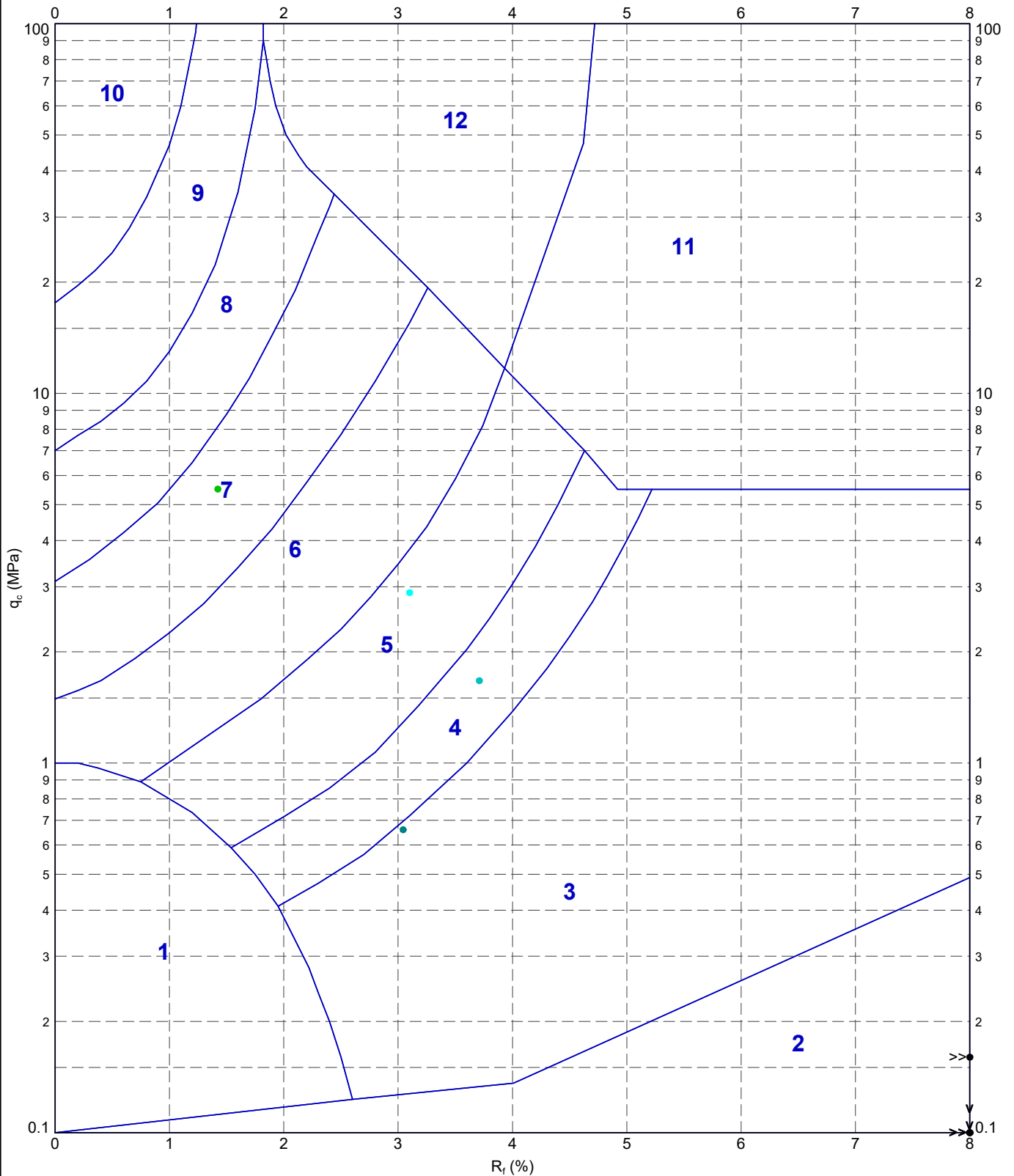
COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level

Dissipation Test

22069-ADVANCED REPORT INSTITUSI 202.1 LUB - CHLOE GLB Graph CPT ROBERTSON ET AL. 86 QC VS. RF AP 1240458 CHORLTON BATHS LK GROUP GPJ <<DrawingFile>> 25/10/2024 16:25 10.03.00.09 Dargel Lab and in Situ Tool - DGD | Lib in Situ SI 2.02.0 2017-07-10 Pjt in Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 q_c vs. R_f

- | | | | |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

TITLE

LK Group
Manchester
Chorlton Baths
Robertson et al. 1986 q_c vs. R_f - CPT101

DRAWN

DATE

25/10/2024

CHECKED

DATE

25/10/2024

SCALE

Not To Scale

A4

PROJECT No

1240458

FIGURE No

PointID

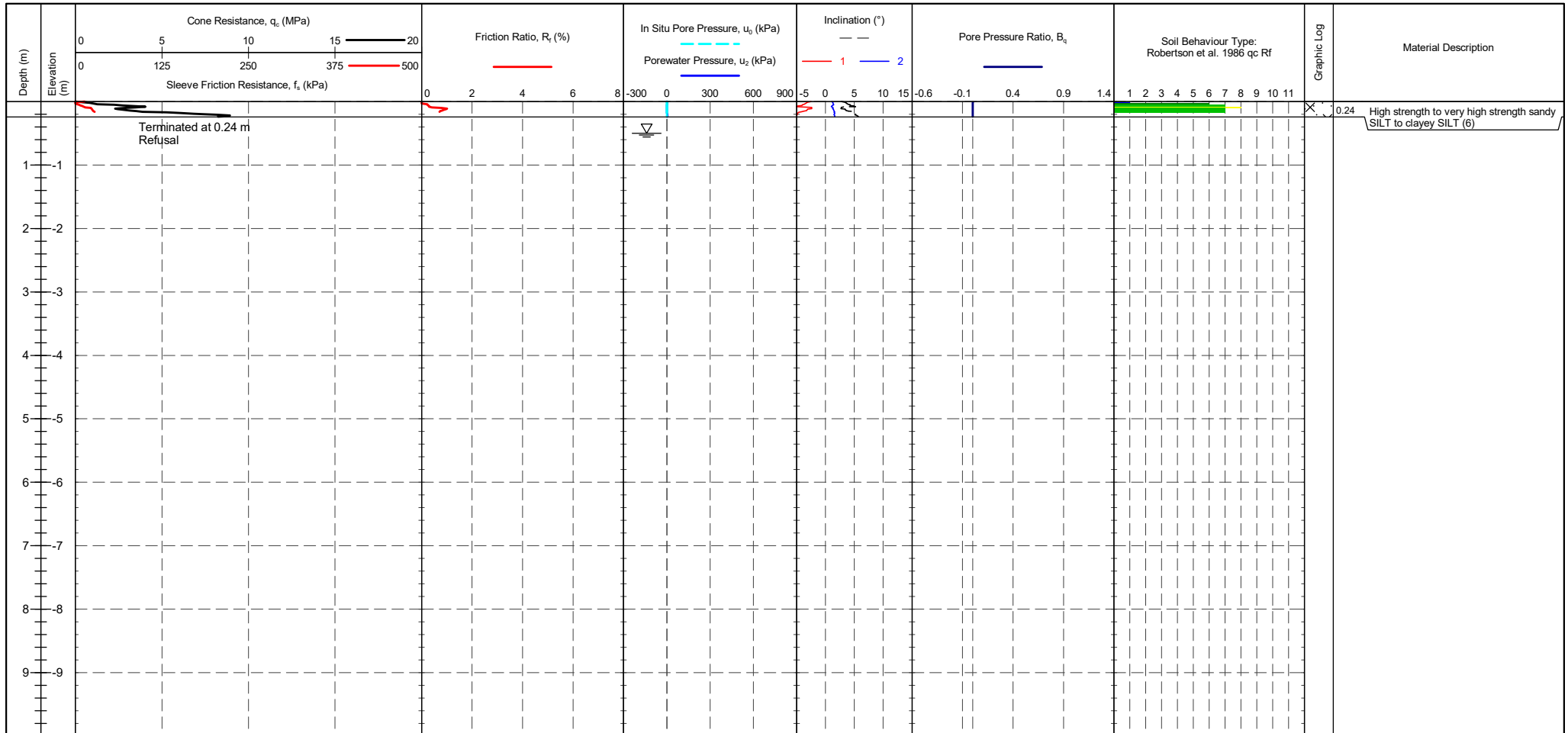
CPT101A

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE
TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES
Transducer Pre Post Difference
Tip 264 mV 263 mV -0.012 MPa
Sleeve 338 mV 338 mV 0 kPa
Pore Pressure 2 269 mV 272 mV 0.001 kPa
X-Y Inclinator 2293 mV 2305 mV

METHOD: Robertson et al. 1986 $q_c R_f$

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

Groundwater
Level

Dissipation Test

PointID

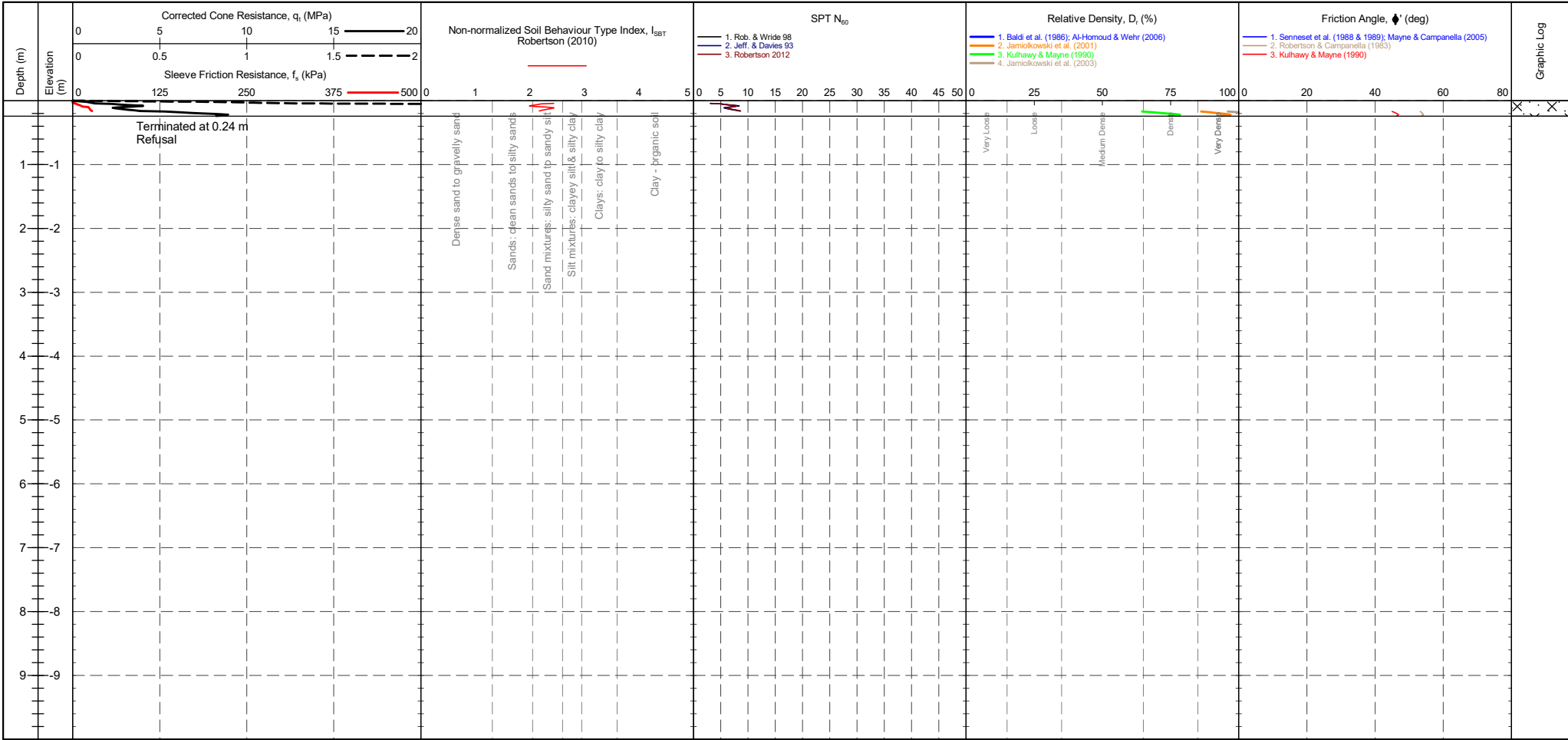
CPT101A

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136	TEST TYPE : TE2	CPTU ZERO VALUES				GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12						 Groundwater Level
CONE MODEL : Subtraction	APPLICATION CLASS : 2	Transducer	Pre	Post	Difference	Description	SBT Index, I _c	Description	SPT N value, NSPT	Description	Relative Density Dr (%)	
CONE AREA : 15cm ²	RIG : CPT 017 - Griffen	Tip	264 mV	263 mV	-0.012 MPa	Clays	2.95-3.60	Very Loose	0 - 4	Very Loose	0 - 15	
CONE AREA RATIO : 0.79	OPERATOR : DR	Sleeve	338 mV	338 mV	0 kPa	Silt mixtures	2.60-2.95	Loose	4 - 10	Loose	15 - 35	
FILTER POSITION : u2	FRICTION REDUCER : None	Pore Pressure 2	269 mV	272 mV	0.001 kPa	Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense	35 - 65	
FILTER TYPE : HDPE	WEATHER : Sunny & Cold	X-Y Inclinometer	2293 mV	2305 mV		Sands	1.31-2.05	Dense	30 - 50	Dense	65 - 85	
						Gravelly sand	<1.31	Very Dense	>50	Very Dense	>85	

 Dissipation Test

PointID

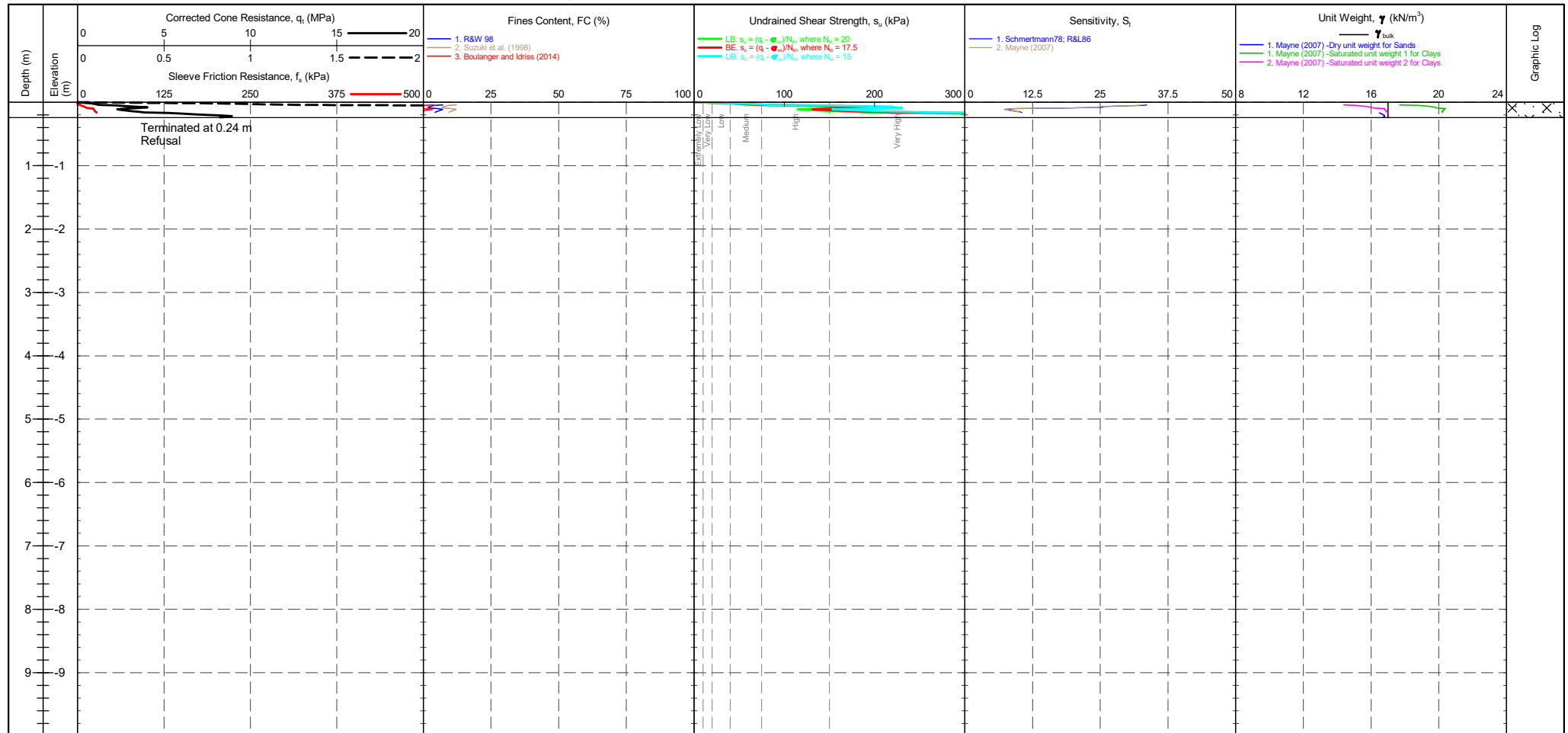
CPT101A

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer

Pre	Post	Difference
Tip	264 mV	263 mV
Sleeve	338 mV	338 mV
Pore Pressure 2	269 mV	272 mV
X-Y Inclinator	2293 mV	2305 mV

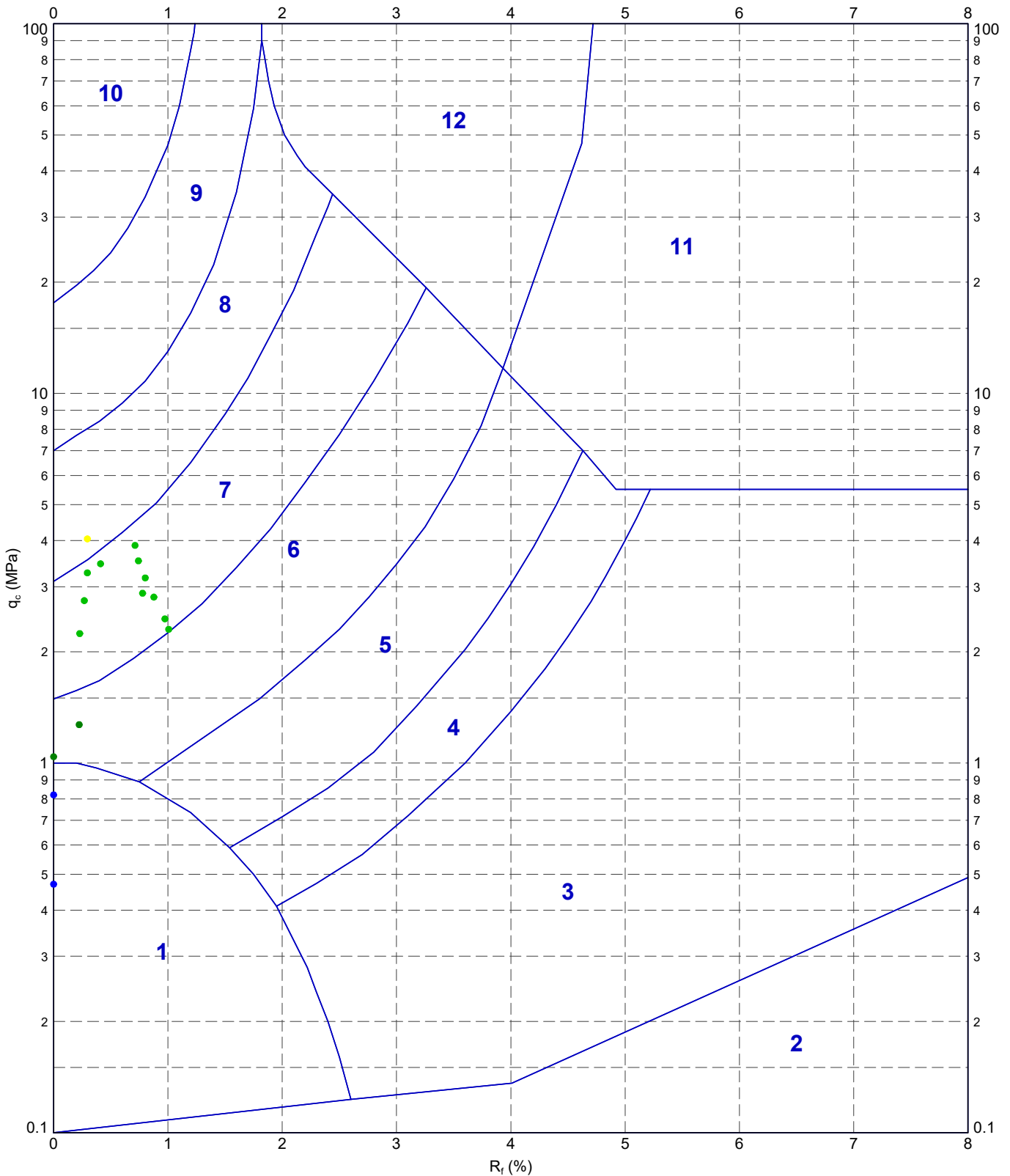
CPTU ZERO VALUES

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11			
Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level

Dissipation Test

22069-ADVANCED REPORT INSTITUSI 202.1 LUB - CHLOE GLB Graph CPT ROBERTSON ET AL. 86 QC VS. RF AP 1240458 CHORLTON BATHS LK GROUP GPJ <<DrawingFile>> 25/10/2024 16:26 10.03.00.09 Dargel Lab and in Situ Tool - DGD | Lib in Situ SI 2.02.0 2017-07-10 PJH in Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 q_c R_f

- | | | | |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

LK Group
Manchester
Chorlton Baths
Robertson et al. 1986 q_c vs. R_f - CPT101A

DRAWN	DATE	25/10/2024
CHECKED	DATE	25/10/2024
SCALE	Not To Scale	
PROJECT No	FIGURE No	A4
1240458		

PointID

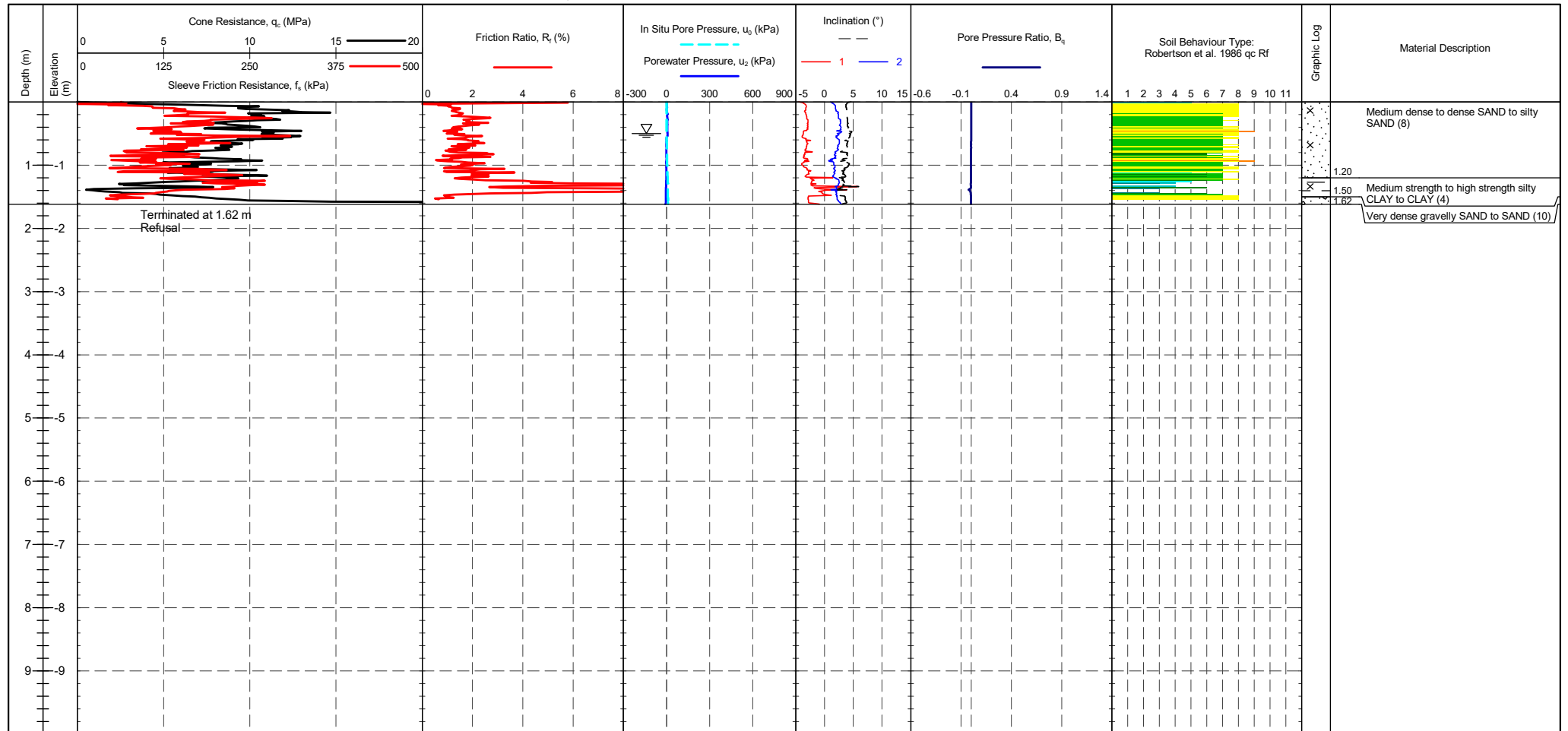
CPT101B

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	264 mV	264 mV	0 MPa
Sleeve	338 mV	338 mV	0 kPa
Pore Pressure 2	274 mV	249 mV	-0.006 kPa
X-Y Inclinator	2110 mV	2125 mV	

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

PointID

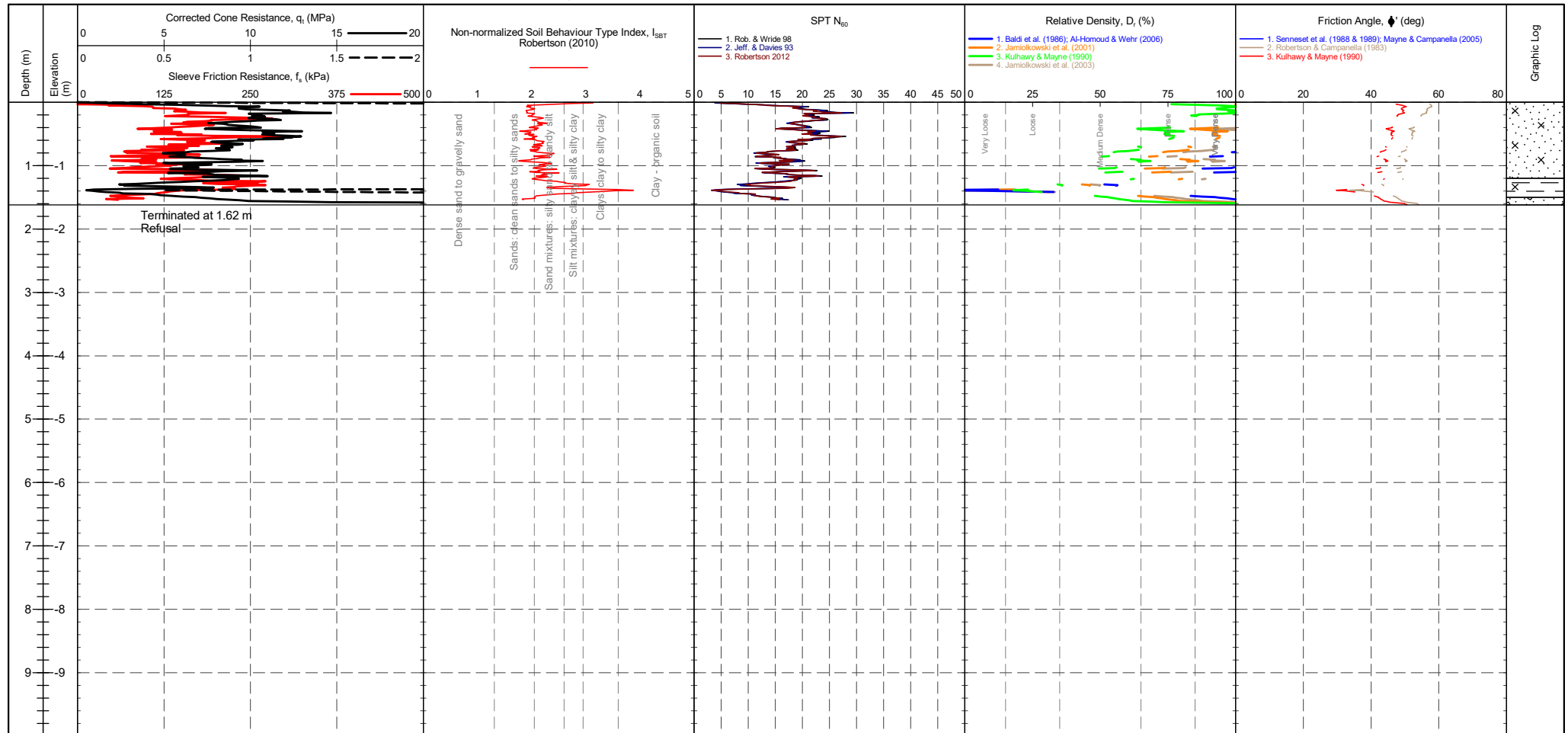
CPT101B

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer
Tip
Sleeve
Pore Pressure 2
X-Y Inclinator

CPTU ZERO VALUES

Pre	Post	Difference
264 mV	264 mV	0 MPa
338 mV	338 mV	0 kPa
274 mV	249 mV	-0.006 kPa
2110 mV	2125 mV	

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

Description	SBT Index, I_c	Description	SPT N value, NSPT	Description	Relative Density D_r (%)
Clays	2.95-3.60	Very Loose	0 - 4	Very Loose	0 - 15
Silt mixtures	2.60-2.95	Loose	4 - 10	Loose	15 - 35
Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense	35 - 65
Sands	1.31-2.05	Dense	30 - 50	Dense	65 - 85
Gravelly sand	<1.31	Very Dense	>50	Very Dense	>85

Groundwater Level
Dissipation Test

PointID

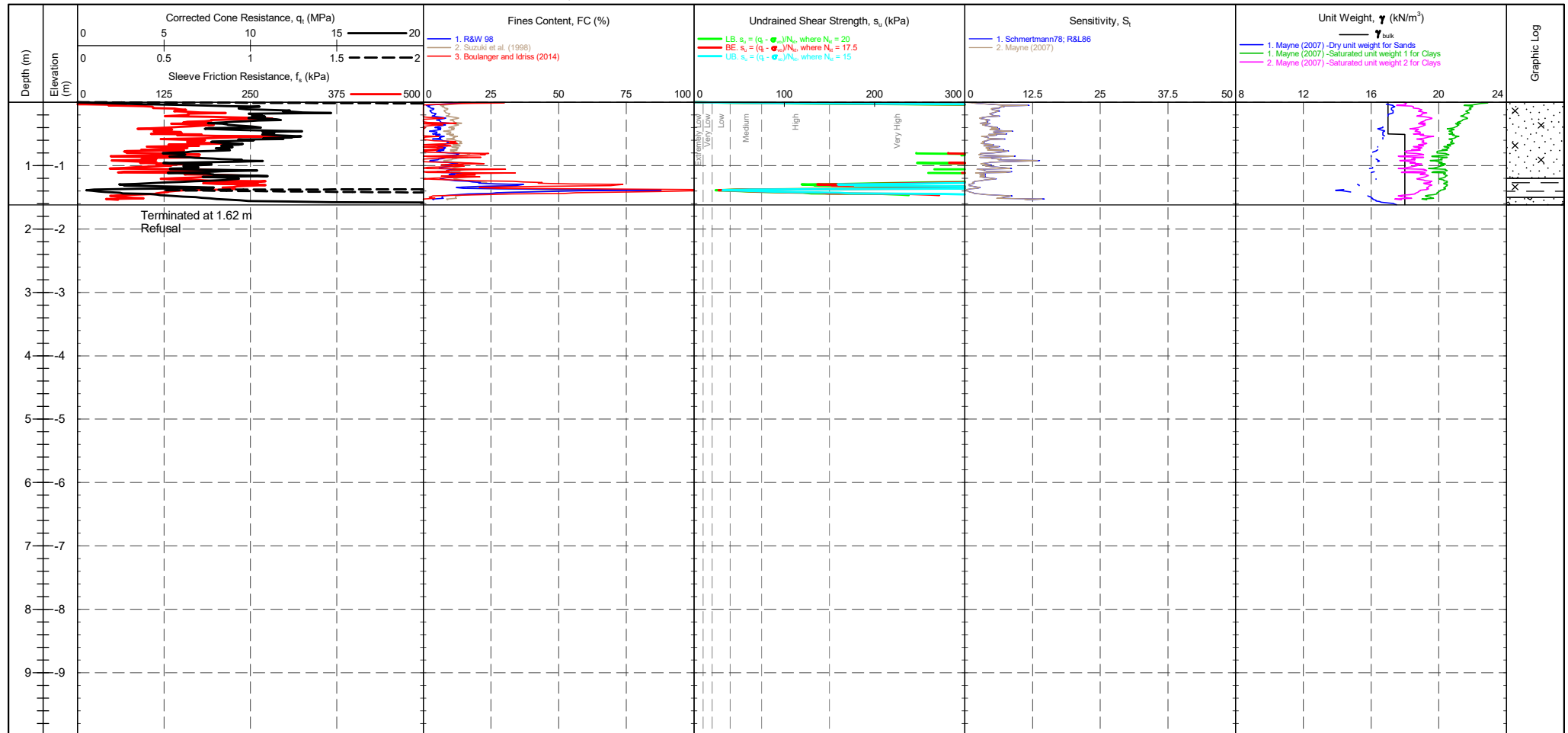
CPT101B

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on total pressure.

SHEET : 1 OF 1
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer

Pre	Post	Difference
Tip	264 mV	264 mV
Sleeve	338 mV	338 mV
Pore Pressure 2	274 mV	249 mV
X-Y Inclinator	2110 mV	2125 mV

CPTU ZERO VALUES

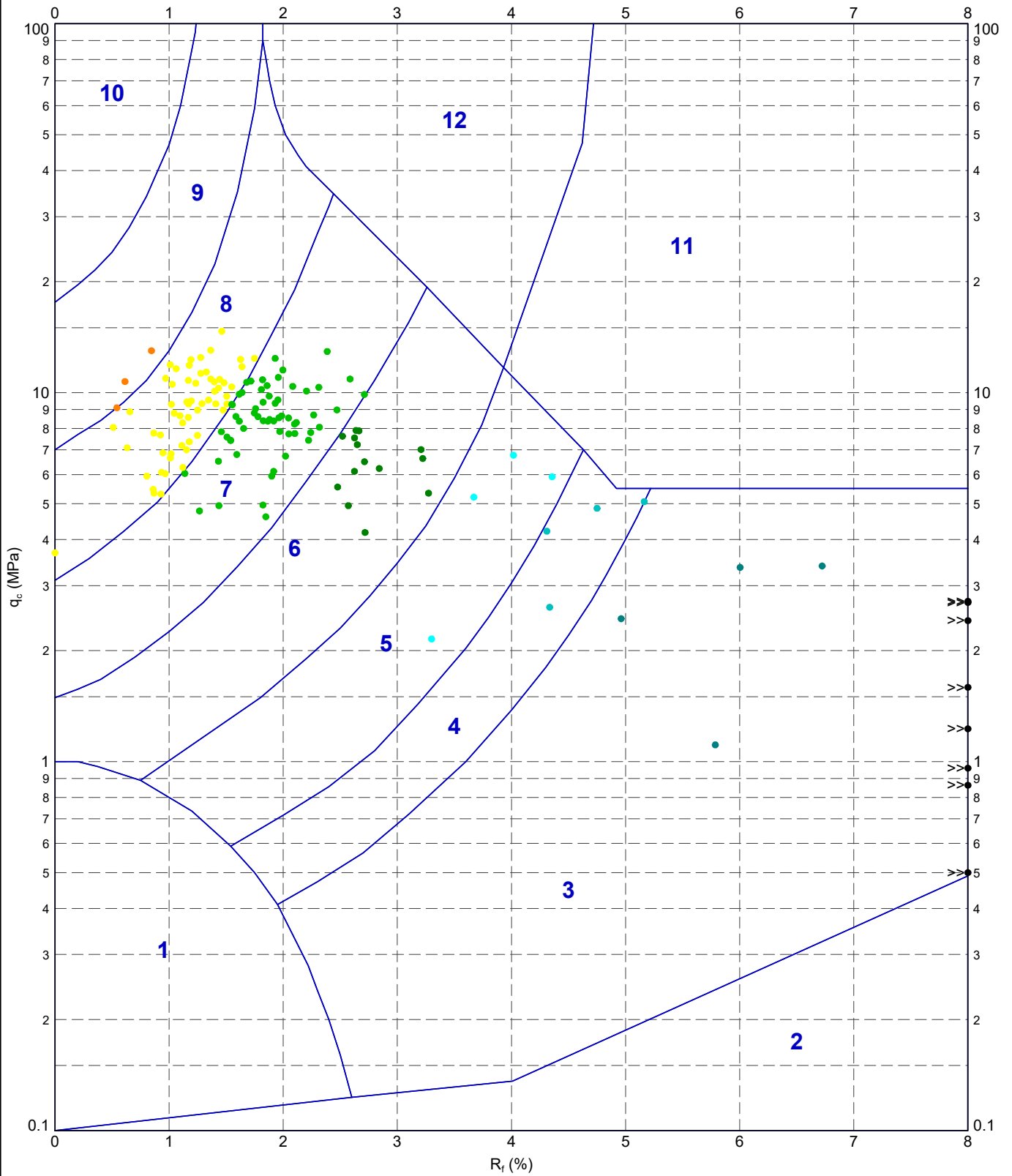
COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level

Dissipation Test

22069-ADVANCED REPORT INSTITUSI 202.1 LIB - CHLOE GLB Graph CPT ROBERTSON ET AL. 86 QC VS. RF MAP 1240458 CHORLTON BATHS LK GROUP GPJ <<DrawingFile>> 25/10/2024 16:27 10.03.00.09 Dargel Lab and in Situ Tool - DGD | Lib in Situ SI 2.02.0 2017-07-10 PJT in Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 qc Rf

- 1 - Sensitive fine grained material

2 - Organic material

3 - CLAY
- 4 - Silty CLAY to CLAY

5 - Clayey SILT to silty CLAY

6 - Sandy SILT to clayey SILT
- 7 - Silty SAND to sandy SILT

8 - SAND to silty SAND

9 - SAND
- 10 - Gravelly SAND to SAND

11 - Very stiff fine grained

12 - SAND to clayey SAND

	TITLE LK Group Manchester Chorlton Baths Robertson et al. 1986 q _c vs. R _f - CPT101B	DRAWN	DATE 25/10/2024		
		CHECKED	DATE 25/10/2024		
		SCALE Not To Scale			A4
		PROJECT No 1240458		FIGURE No	

PointID

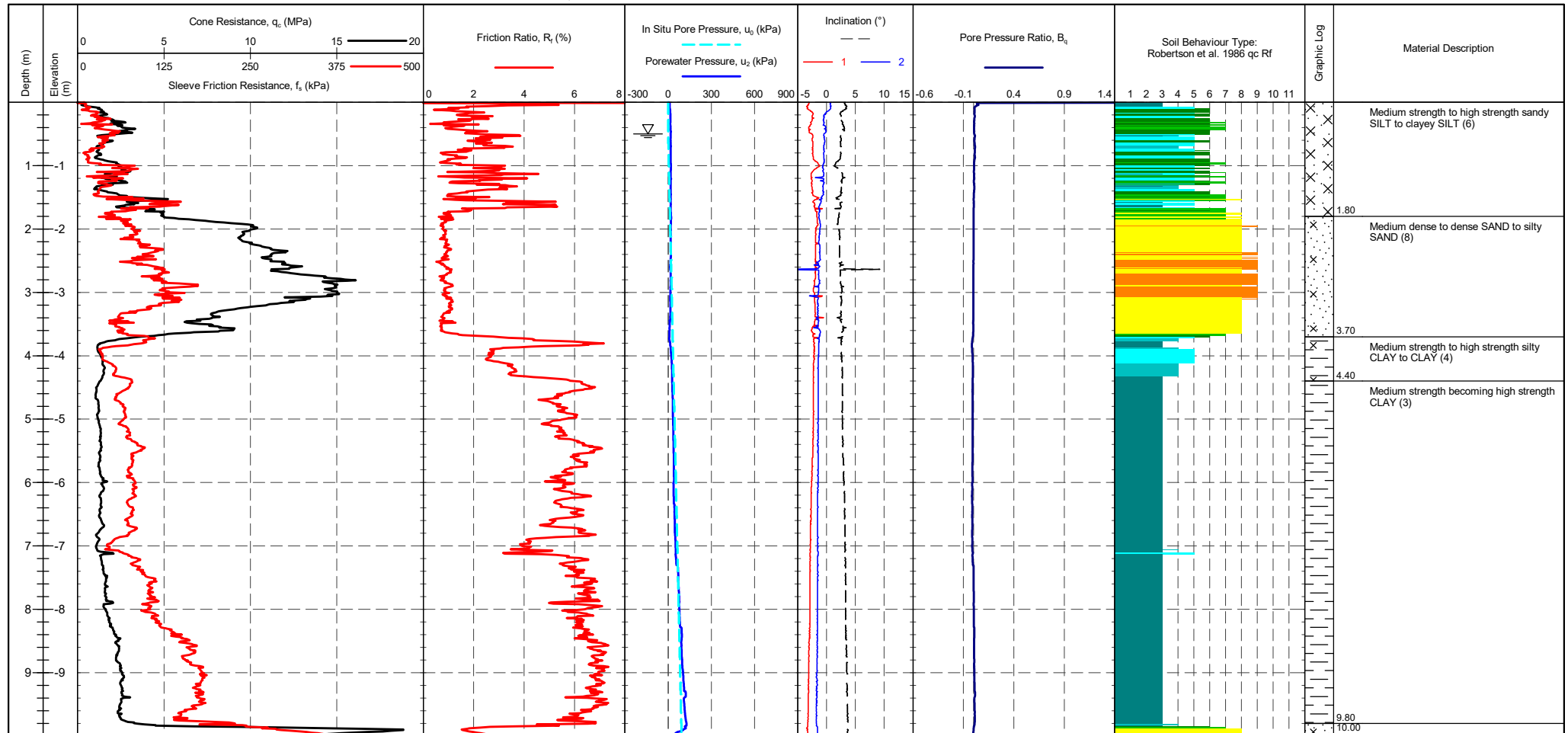
CPT101C

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	262 mV	262 mV	0 MPa
Sleeve	337 mV	335 mV	-0.001 kPa
Pore Pressure 2	193 mV	249 mV	0.015 kPa
X-Y Inclinator	2246 mV	2269 mV	

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravely SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

PointID

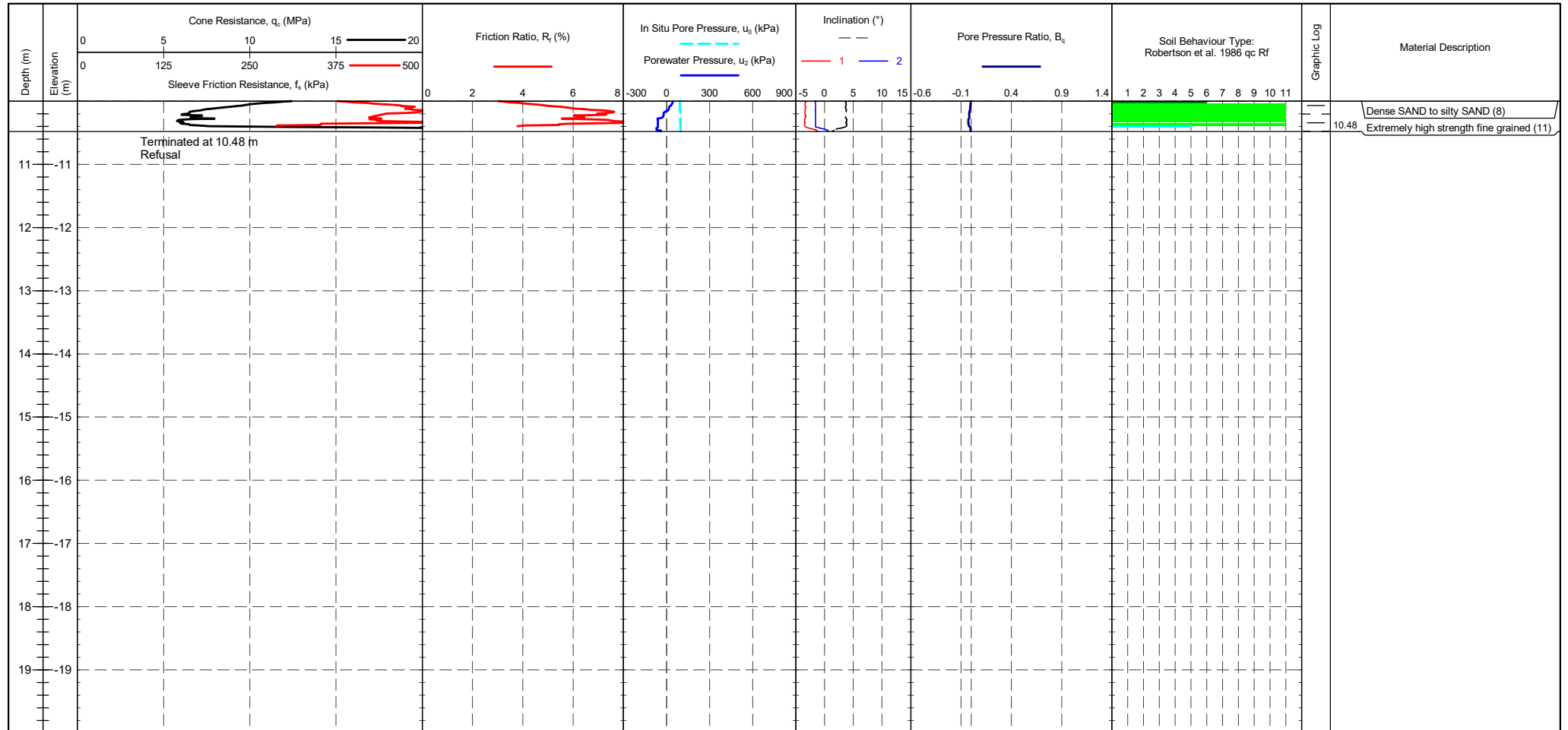
CPT101C

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136	TEST TYPE : TE2	CPTU ZERO VALUES				METHOD: Robertson et al. 1986 qc Rf				Groundwater Level Dissipation Test
CALIBRATION DATE : 20/06/2023	APPLICATION CLASS : 2	Transducer	Pre	Post	Difference	1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND		
CONE MODEL : Subtraction	RIG : CPT 017 - Griffen	Tip	262 mV	262 mV	0 MPa	2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravely SAND to SAND		
CONE AREA : 15cm ²	OPERATOR : DR	Sleeve	337 mV	335 mV	-0.001 kPa	3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained		
CONE AREA RATIO : 0.79	FRICTION REDUCER : None	Pore Pressure 2	193 mV	249 mV	0.015 kPa	4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND		
FILTER POSITION : u2	WEATHER : Sunny & Cold	X-Y Inclinator	2246 mV	2269 mV						
FILTER TYPE : HDPE	GROUNDWATER DEPTH : Assumed for calculation purposes									

PointID

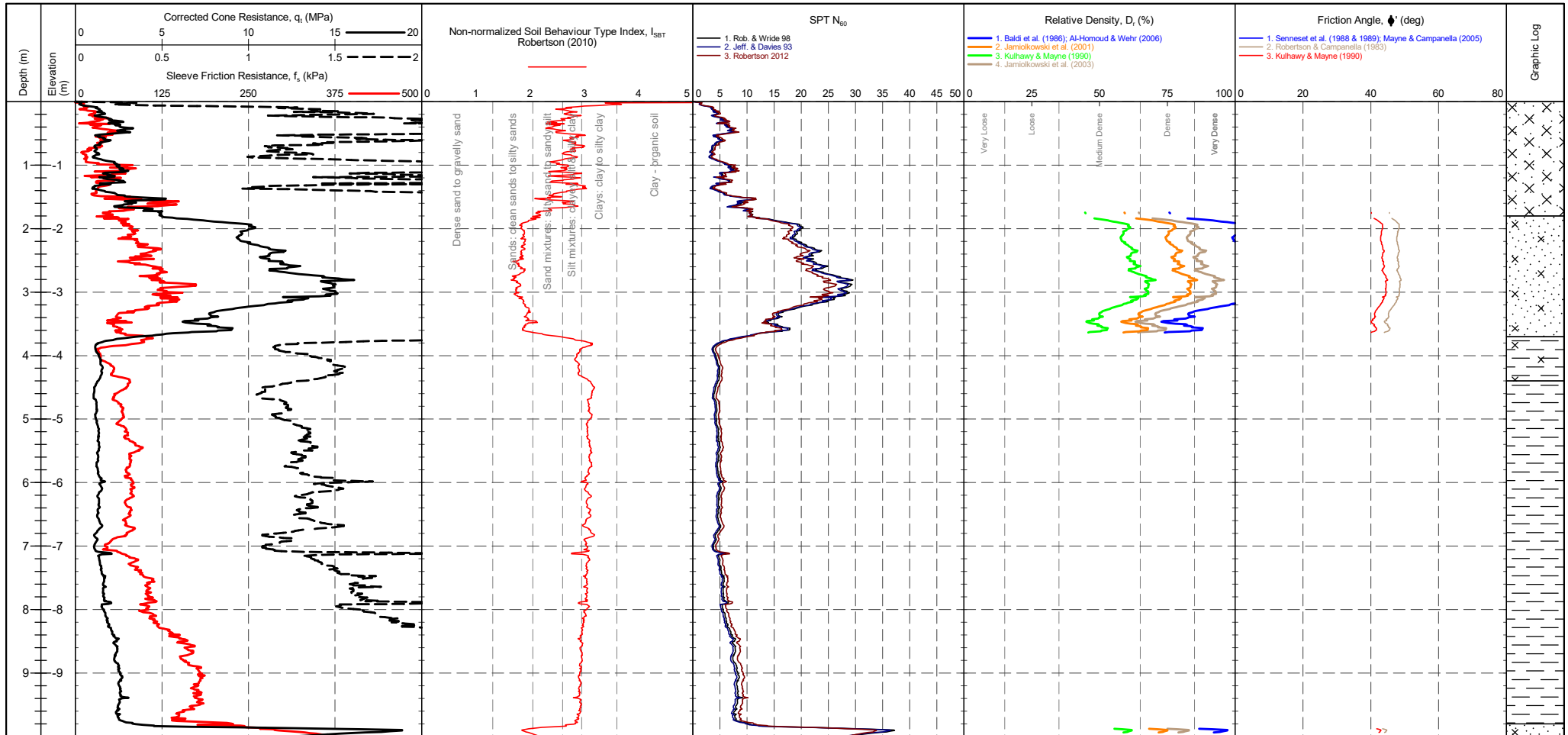
CPT101C

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	262 mV	262 mV	0 MPa
Sleeve	337 mV	335 mV	-0.001 kPa
Pore Pressure 2	193 mV	249 mV	0.015 kPa
X-Y Inclinator	2246 mV	2269 mV	

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12			
Description	SBT Index, I_c	Description	SPT N value, NSPT
Clays	2.95-3.60	Very Loose	0 - 4
Silt mixtures	2.60-2.95	Loose	4 - 10
Sand mixtures	2.05-2.60	Medium Dense	10 - 30
Sands	1.31-2.05	Dense	30 - 50
Gravelly sand	<1.31	Very Dense	>50

Groundwater Level
Dissipation Test

PointID

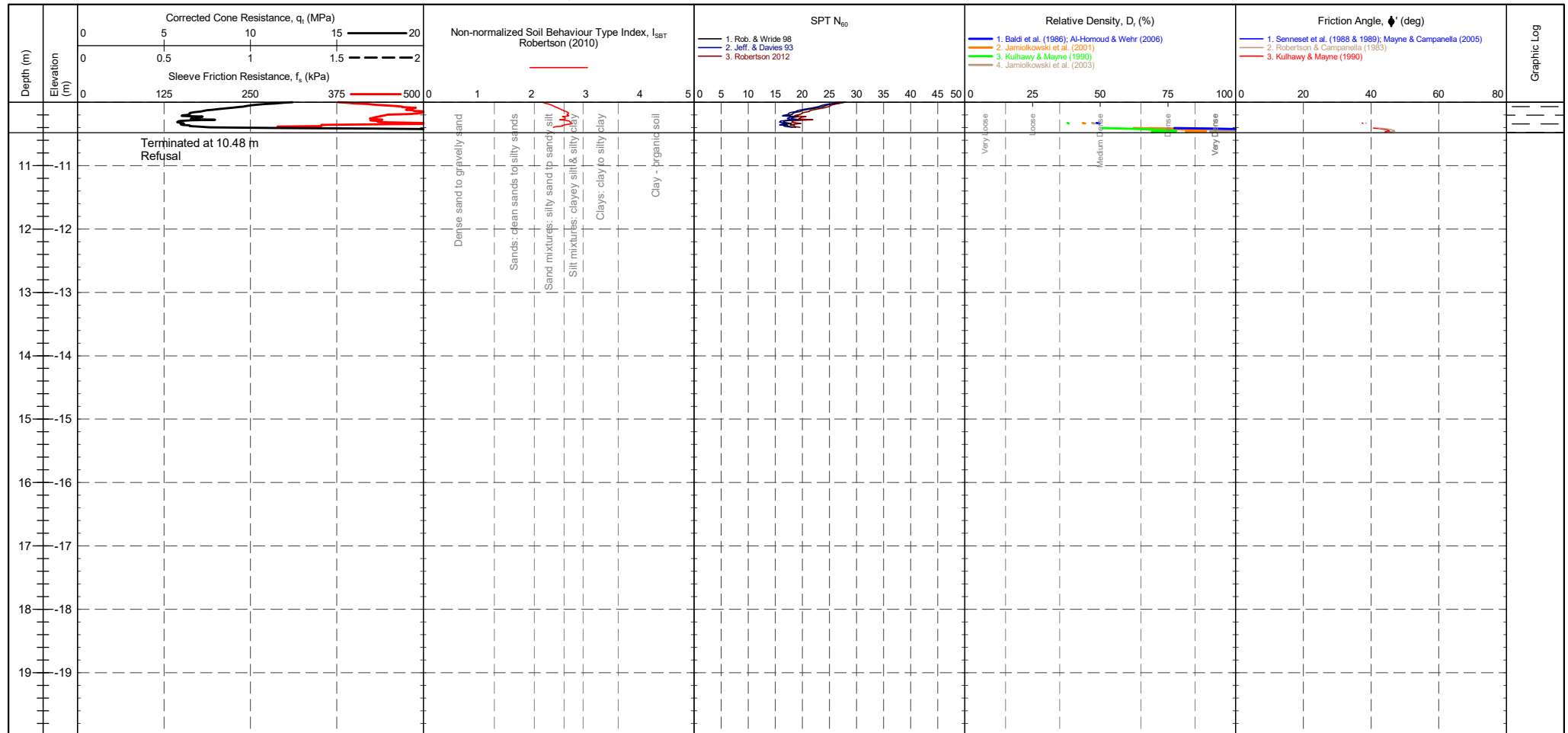
CPT101C

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer :
Tip :
Sleeve :
Pore Pressure 2 :
X-Y Inclinator :
CPTU ZERO VALUES
Pre :
Post :
Difference :
262 mV :
262 mV :
0 MPa :
337 mV :
335 mV :
-0.001 kPa :
193 mV :
249 mV :
0.015 kPa :
2246 mV :
2269 mV :

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12

Description	SBT Index, I_c	Description	SPT N value, NSPT	Description	Relative Density D_r (%)
Clays	2.95-3.60	Very Loose	0 - 4	Very Loose	0 - 15
Silt mixtures	2.60-2.95	Loose	4 - 10	Loose	15 - 35
Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense	35 - 65
Sands	1.31-2.05	Dense	30 - 50	Dense	65 - 85
Gravelly sand	<1.31	Very Dense	>50	Very Dense	>85

Groundwater Level
Dissipation Test

PointID

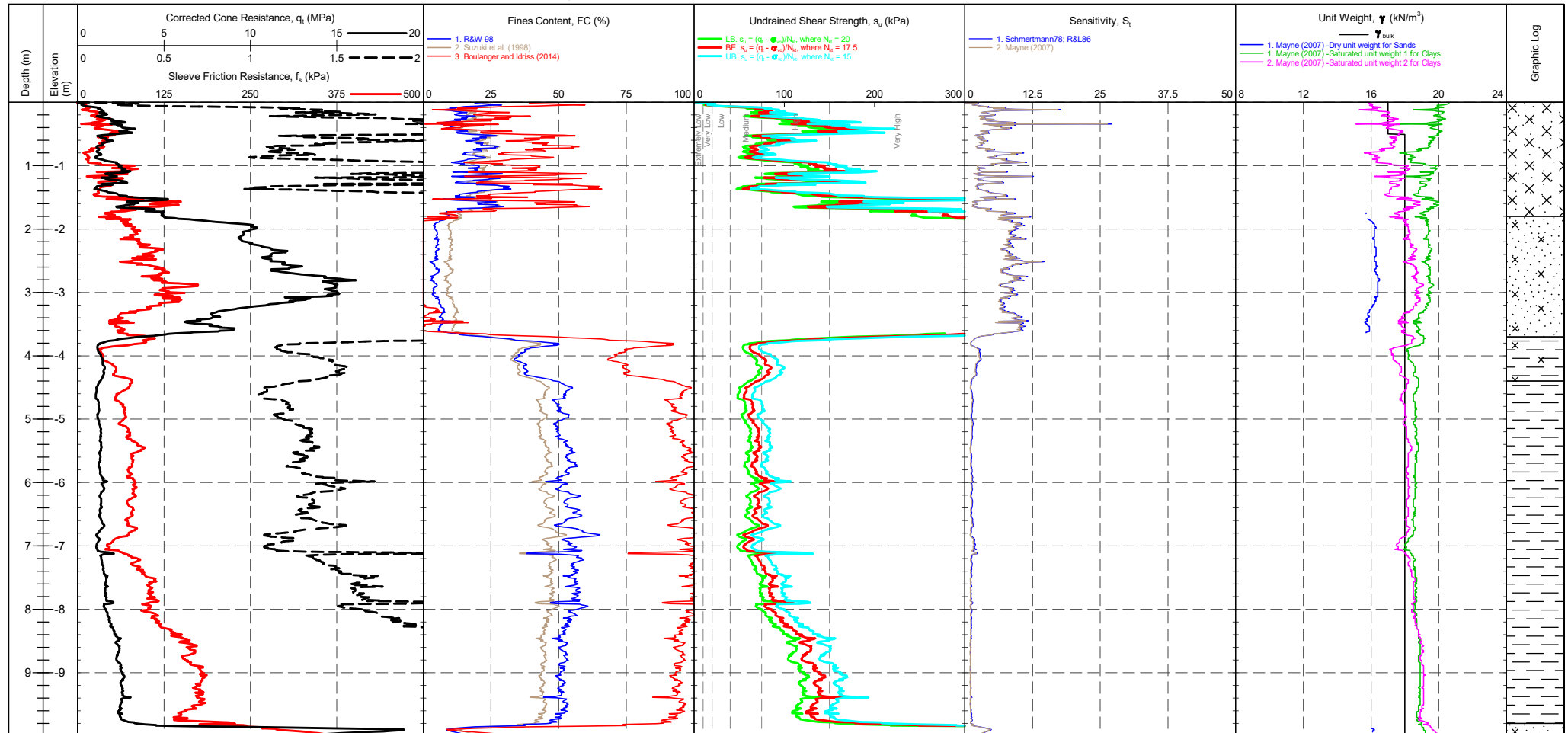
CPT101C

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer : Pre Post Difference
Tip : 262 mV 262 mV 0 MPa
Sleeve : 337 mV 335 mV -0.001 kPa
Pore Pressure 2 : 193 mV 249 mV 0.015 kPa
X-Y Inclinator : 2246 mV 2269 mV

CPTU ZERO VALUES

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level

Dissipation Test

PointID

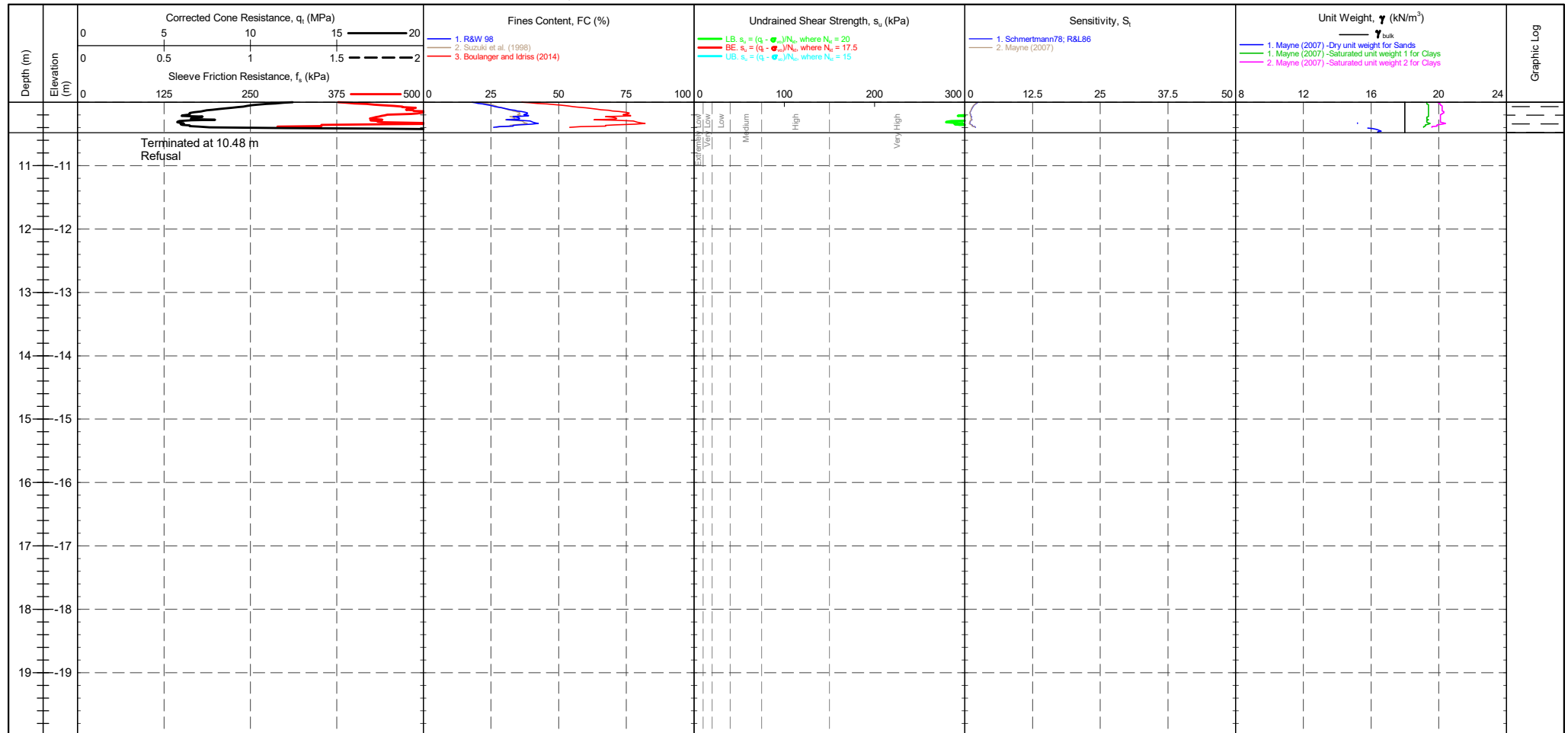
CPT101C

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Refusal

Remark:
Test refused on inclination.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer Pre Post Difference
Tip 262 mV 262 mV 0 MPa
Sleeve 337 mV 335 mV -0.001 kPa
Pore Pressure 2 193 mV 249 mV 0.015 kPa
X-Y Inclinator 2246 mV 2269 mV

CPTU ZERO VALUES

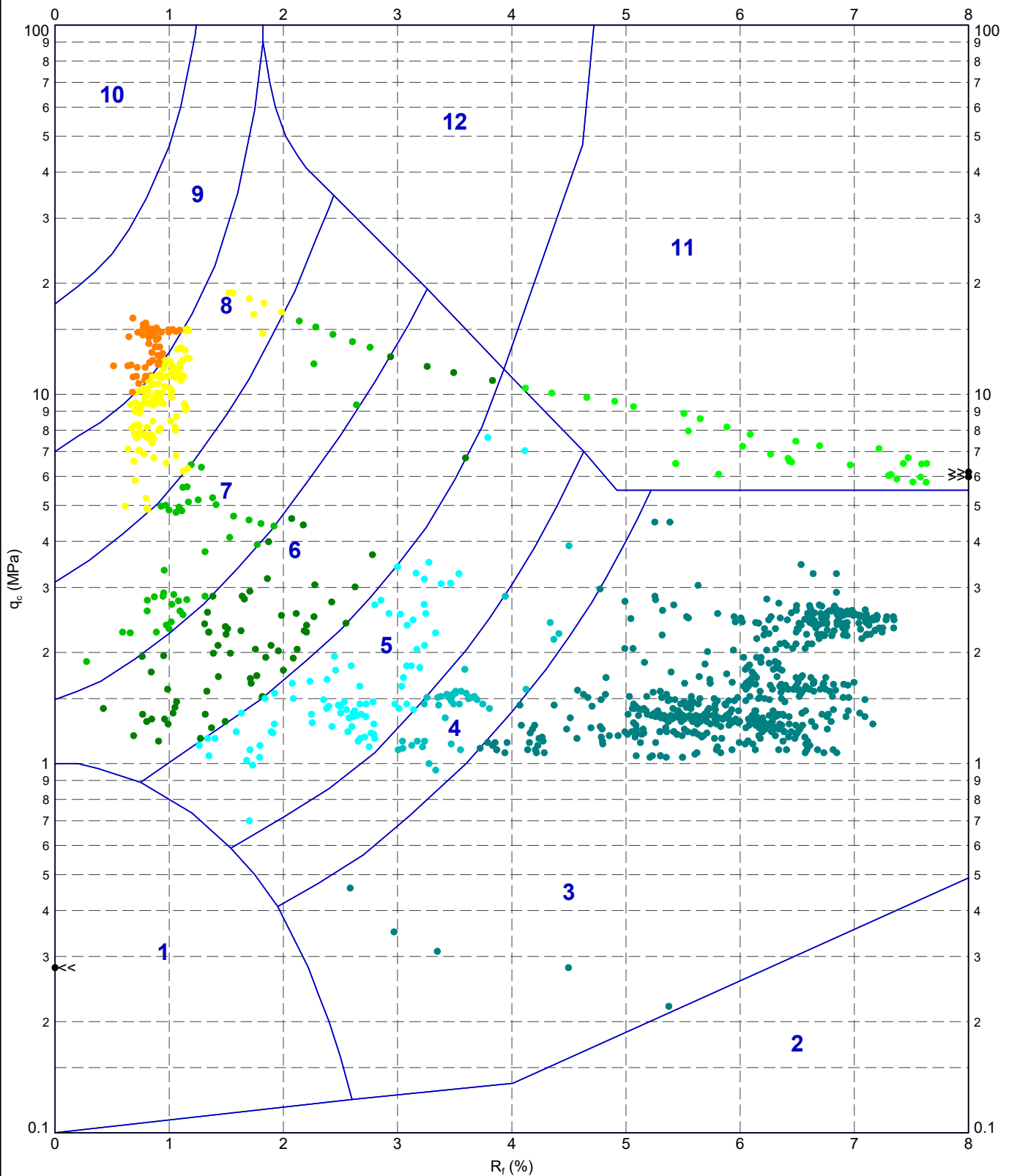
COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level

Dissipation Test

22069-ADVANCED REPORT INSTITUSI 202.1 LUB - CHLOE GLB Graph CPT ROBERTSON ET AL. 86 QC VS. RF - AP 1240458 CHORLTON BATHS LK GROUP GPJ <<DrawingFile>> 25/10/2024 16:28 10.03.00.09 Dargel Lab and in Situ Tool - DGD | Lib in Situ SI 2.02.0 2017-07-10 PJH in Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 q_c R_f

- | | | | |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

LK Group
Manchester
Chorlton Baths
Robertson et al. 1986 q_c vs. R_f - CPT101C

DRAWN	DATE	25/10/2024
CHECKED	DATE	25/10/2024
SCALE	Not To Scale	
PROJECT No	FIGURE No	A4
1240458		

PointID

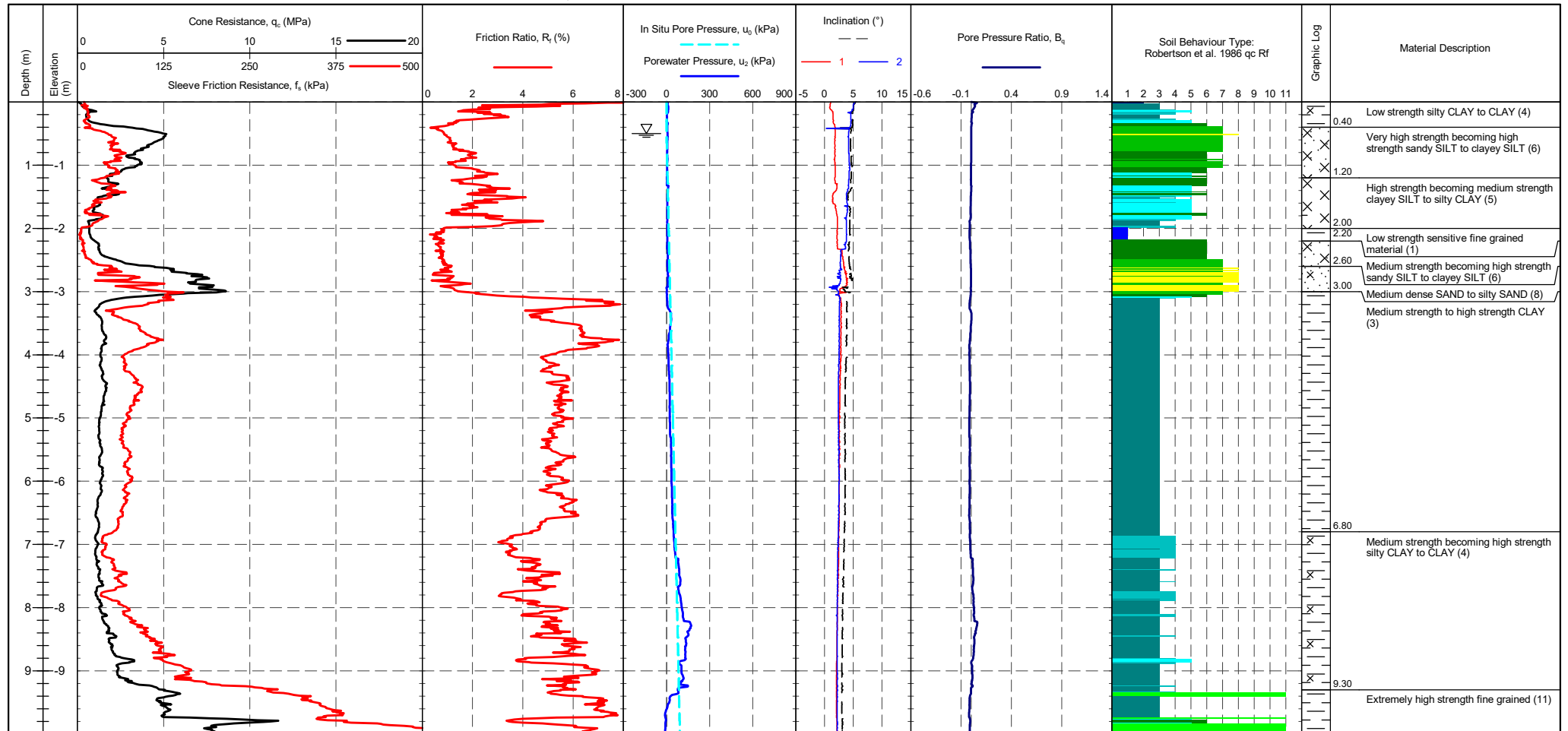
CPT102

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	263 mV	264 mV	0.012 MPa
Sleeve	338 mV	339 mV	0.001 kPa
Pore Pressure 2	259 mV	256 mV	-0.001 kPa
X-Y Inclinator	2661 mV	2838 mV	

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravelly SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level

Dissipation Test

PointID

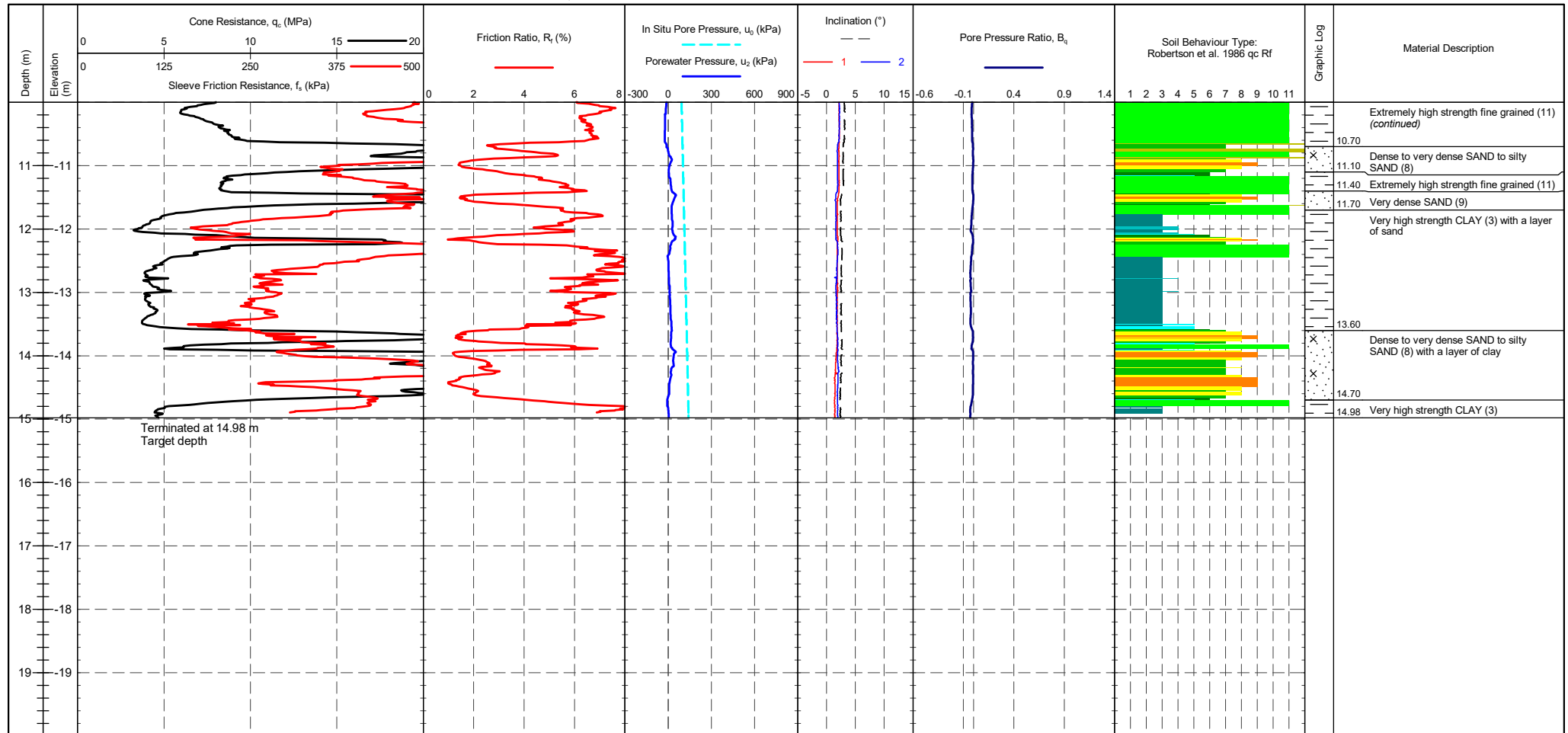
CPT102

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	263 mV	264 mV	0.012 MPa
Sleeve	338 mV	339 mV	0.001 kPa
Pore Pressure 2	259 mV	256 mV	-0.001 kPa
X-Y Inclinator	2661 mV	2838 mV	

METHOD: Robertson et al. 1986 $q_c R_f$

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravely SAND to SAND
3 - CLAY	7 - Silty SAND to sandy SILT	11 - Very stiff fine grained
4 - Silty CLAY to CLAY	8 - SAND to silty SAND	12 - SAND to clayey SAND

Groundwater Level
Dissipation Test

PointID

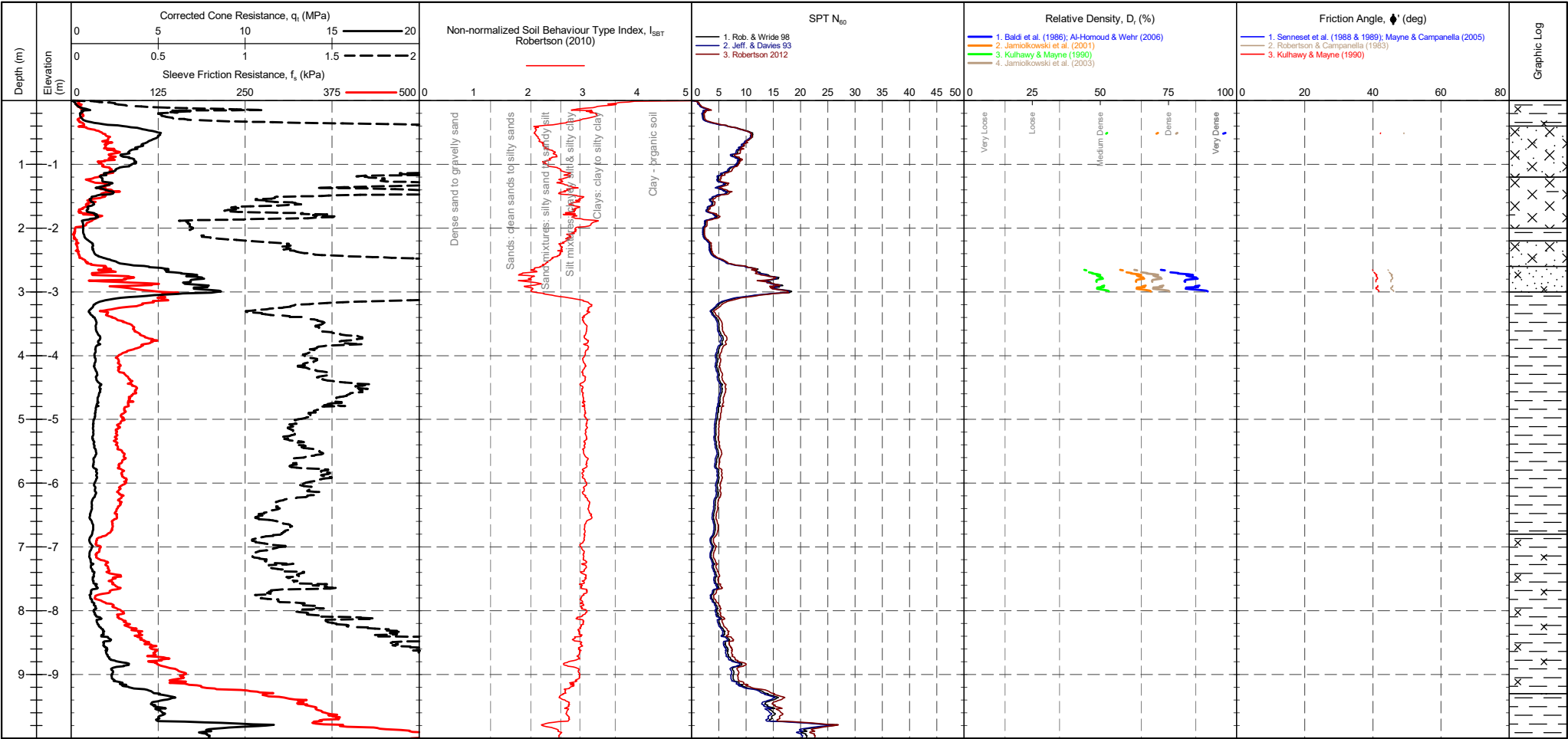
CPT102

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	263 mV	264 mV	0.012 MPa
Sleeve	338 mV	339 mV	0.001 kPa
Pore Pressure 2	259 mV	256 mV	-0.001 kPa
X-Y Inclinator	2661 mV	2838 mV	

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12				
Description	SBT Index, I _c	Description	SPT N value, NSPT	Description
Clays	2.95-3.60	Very Loose	0 - 4	Very Loose
Silt mixtures	2.60-2.95	Loose	4 - 10	Loose
Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense
Sands	1.31-2.05	Dense	30 - 50	Dense
Gravelly sand	<1.31	Very Dense	>50	Very Dense

Groundwater Level
Dissipation Test

PointID

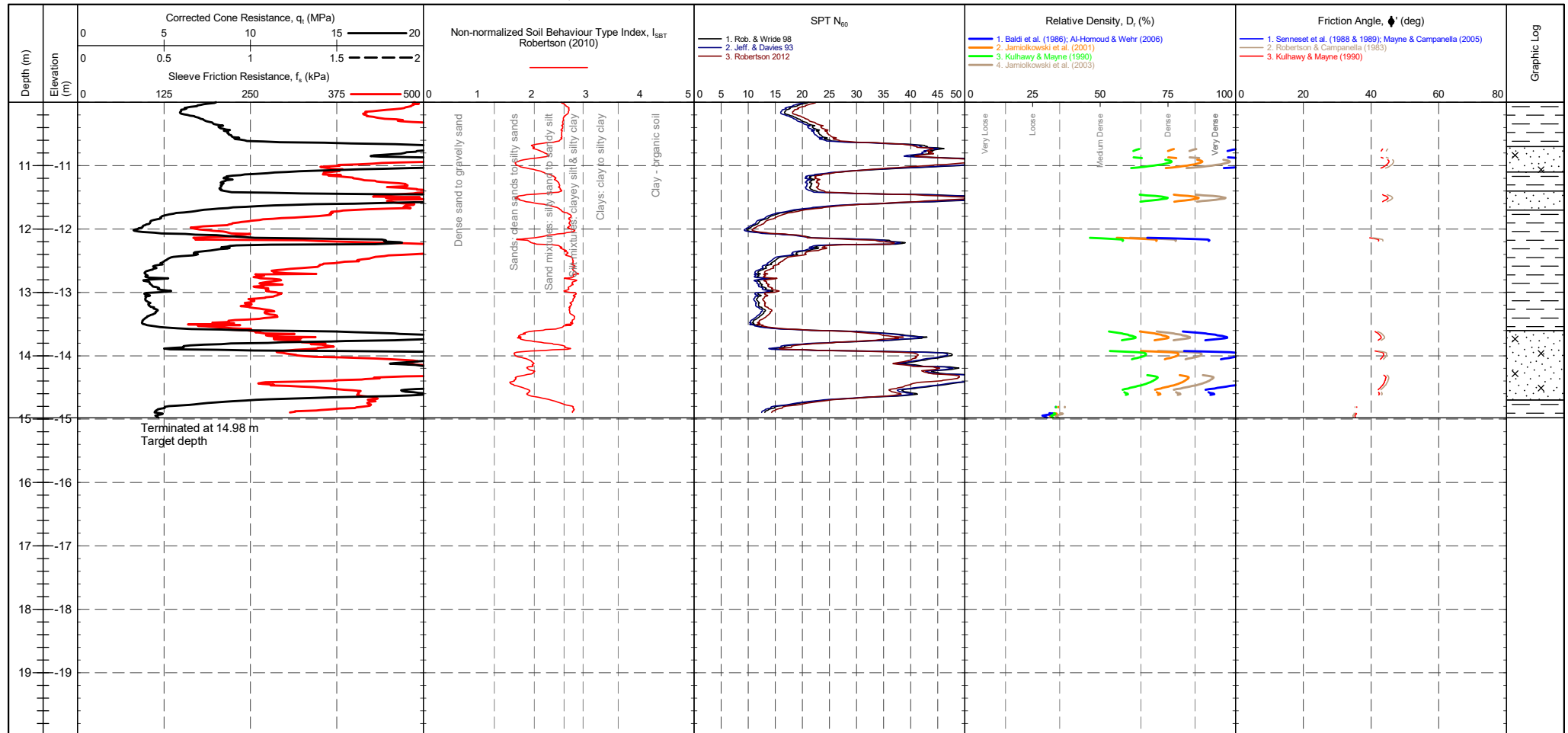
CPT102

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer
Tip
Sleeve
Pore Pressure 2
X-Y Inclinator

CPTU ZERO VALUES

Pre	Post	Difference
263 mV	264 mV	0.012 MPa
338 mV	339 mV	0.001 kPa
259 mV	256 mV	-0.001 kPa
2661 mV	2838 mV	

GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12					
Description	SBT Index, I_c	Description	SPT N value, NSPT	Description	Relative Density D_r (%)
Clays	2.95-3.60	Very Loose	0 - 4	Very Loose	0 - 15
Silt mixtures	2.60-2.95	Loose	4 - 10	Loose	15 - 35
Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense	35 - 65
Sands	1.31-2.05	Dense	30 - 50	Dense	65 - 85
Gravelly sand	<1.31	Very Dense	>50	Very Dense	>85

Groundwater Level

Dissipation Test

PointID

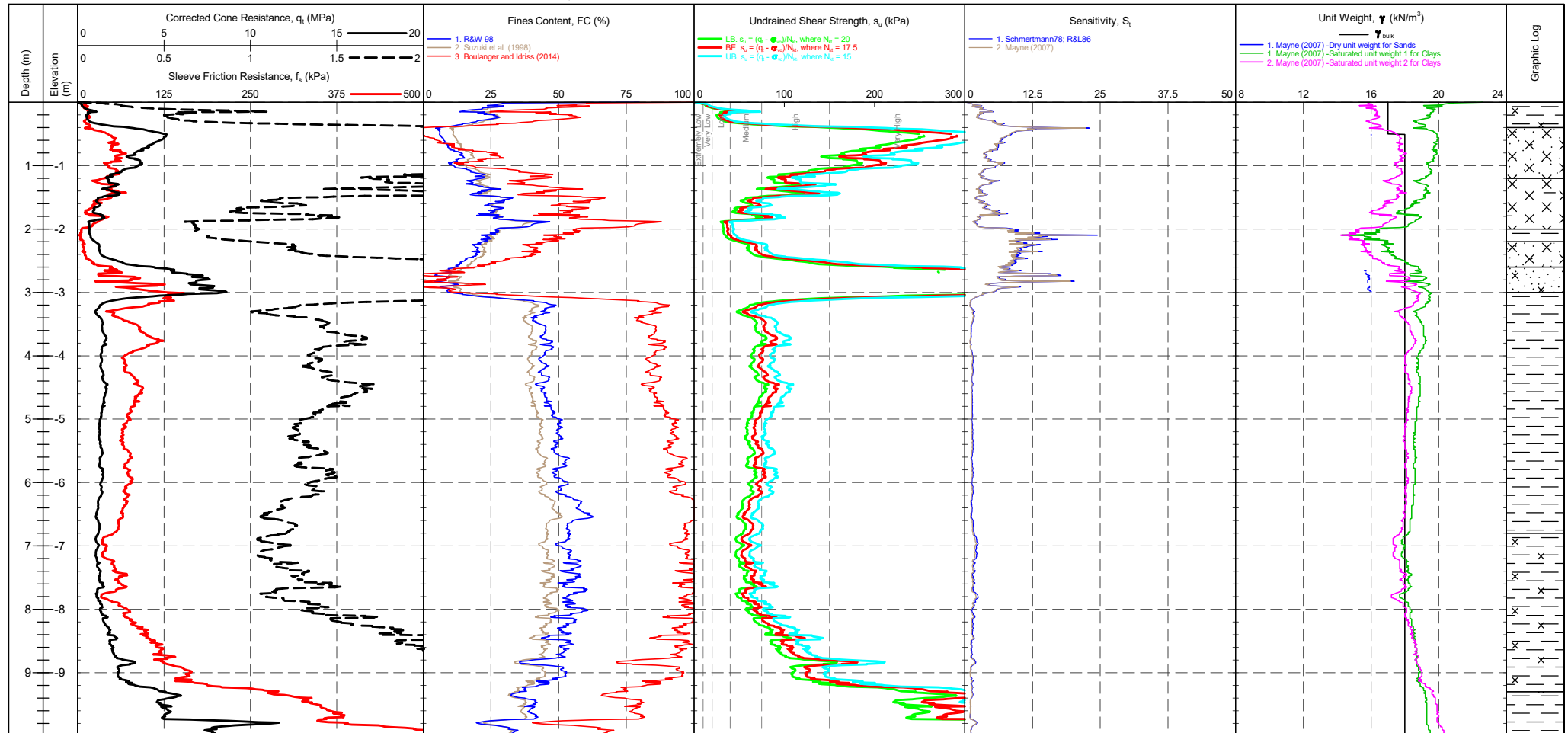
CPT102

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	263 mV	264 mV	0.012 MPa
Sleeve	338 mV	339 mV	0.001 kPa
Pore Pressure 2	259 mV	256 mV	-0.001 kPa
X-Y Inclinator	2661 mV	2838 mV	

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level

Dissipation Test

PointID

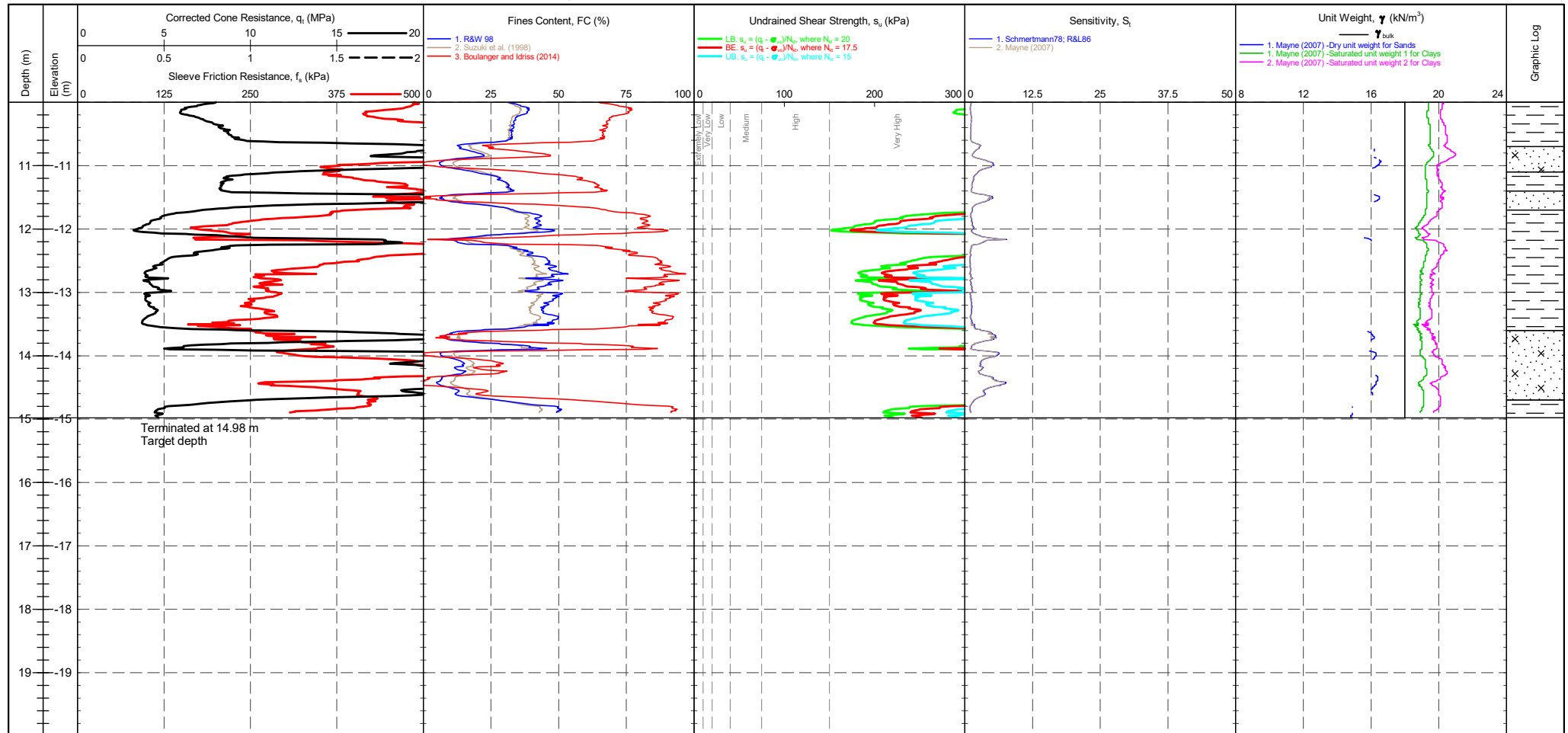
CPT102

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 2 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold

Transducer
Tip
Sleeve
Pore Pressure 2
X-Y inclinometer

CPTU ZERO VALUES

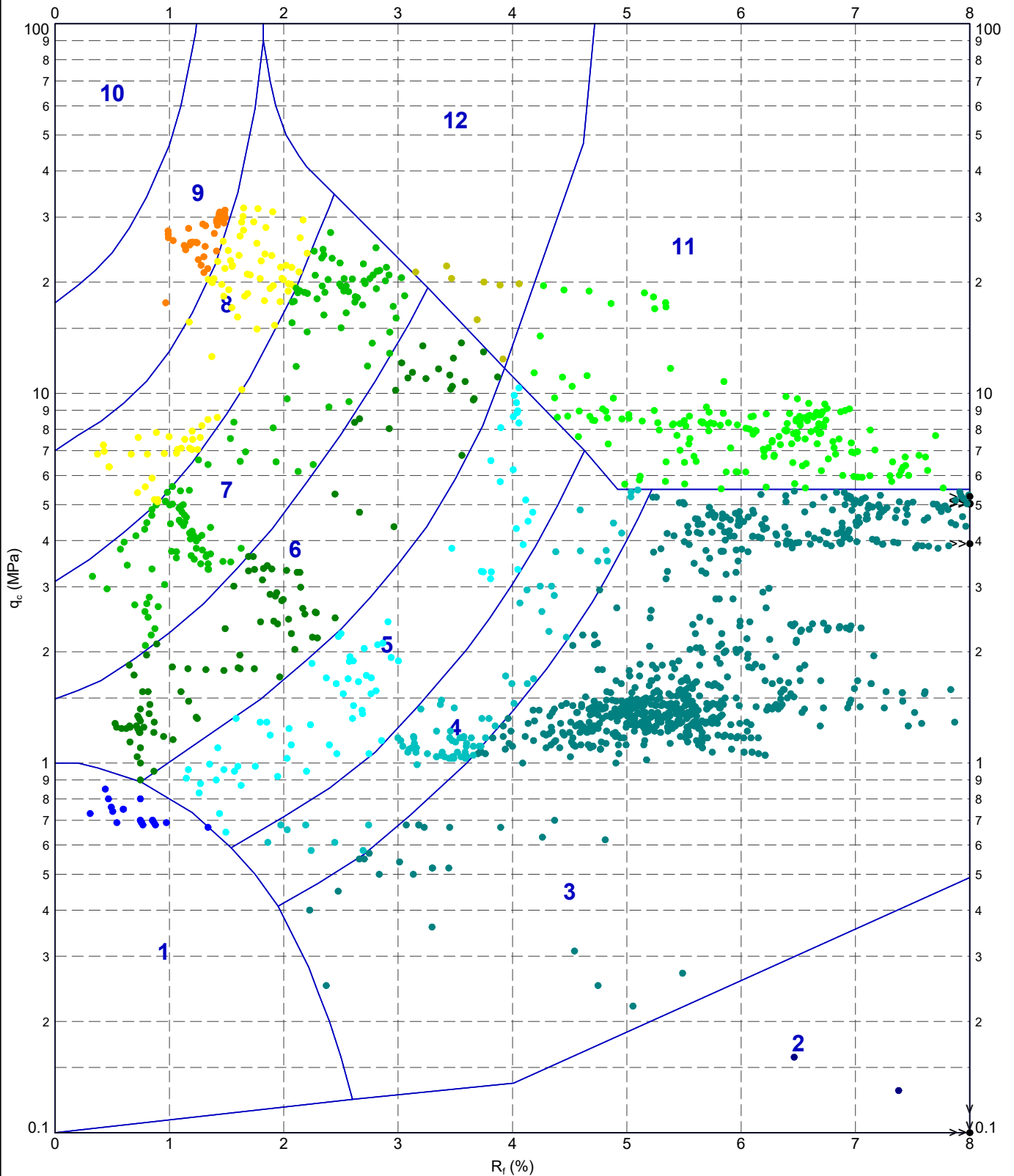
Pre	Post	Difference
263 mV	264 mV	0.012 MPa
338 mV	339 mV	0.001 kPa
259 mV	256 mV	-0.001 kPa
2661 mV	2838 mV	

COHESIVE SOILS (Clays & Silts) Robertson et al. 1986 Zones 1-6 and Zone 11

Term based on measurement	s_u (kPa)	Term based on measurement	s_u (kPa)
Extremely low strength	<10	Medium strength	40-75
Very low strength	10-20	High strength	75-150
Low strength	20-40	Very high strength	150-300
		Extremely high strength	>300

Groundwater Level
Dissipation Test

220629-ADVANCED REPORT INSTITUTION 2.02.1 LUB - CHLOE GLB Graph: CPT ROBERTSON ET AL. 86 QC VS. RF - APF 1240458 CHORLTON BATHS LK GROUP GPJ <<DrawingFile>> 25/10/2024 16:30 10.03.00.09 Dargel Lab and in Situ Tool - DGD | Lib in Situ SI 2.02.0 2017-07-10 PJT in Situ SI 2.02.0 2017-07-10



METHOD: Robertson et al. 1986 q_c vs. R_f

- | | | | |
|-------------------------------------|-------------------------------|------------------------------|------------------------------|
| 1 - Sensitive fine grained material | 4 - Silty CLAY to CLAY | 7 - Silty SAND to sandy SILT | 10 - Gravelly SAND to SAND |
| 2 - Organic material | 5 - Clayey SILT to silty CLAY | 8 - SAND to silty SAND | 11 - Very stiff fine grained |
| 3 - CLAY | 6 - Sandy SILT to clayey SILT | 9 - SAND | 12 - SAND to clayey SAND |

IN SITU
SITE INVESTIGATION

TITLE

LK Group
Manchester
Chorlton Baths
Robertson et al. 1986 q_c vs. R_f - CPT102

DRAWN

DATE

25/10/2024

CHECKED

DATE

25/10/2024

SCALE

Not To Scale

A4

PROJECT No

1240458

FIGURE No

PointID

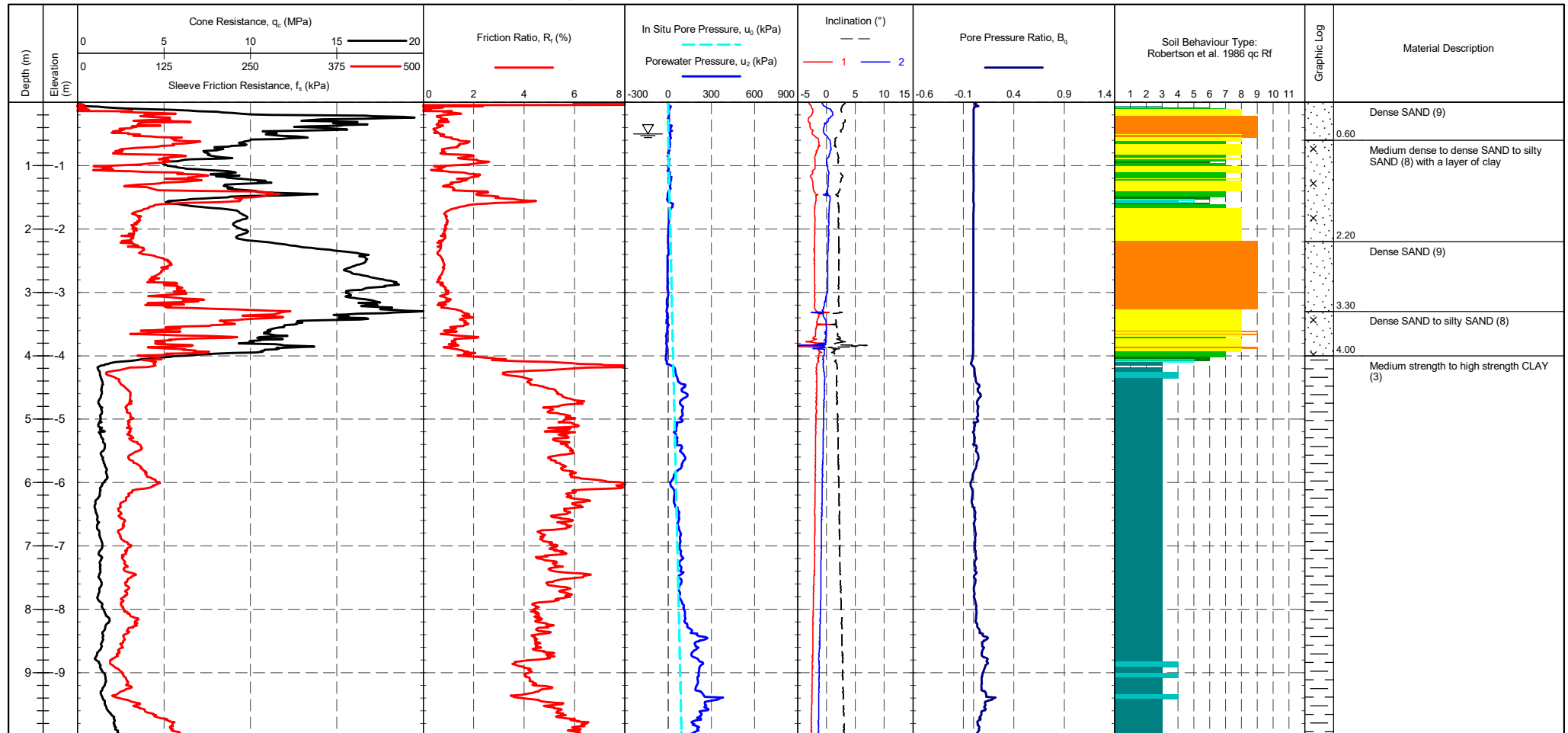
CPT103

CLIENT : LK Group
PROJECT: Chorlton Baths
LOCATION : Manchester
PROJECT No. : 1240458

EASTING : 0.000 m
NORTHING : 0.000 m
ELEVATION : 0.000 m OD
CHECKED BY : DW
TERMINATION REASON : Target depth

Remark:
Test completed at target depth.

SHEET : 1 OF 2
STATUS : Final
TEST DATE : 24/10/2024
PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



CONE ID : S15-CFIP.2136
CALIBRATION DATE : 20/06/2023
CONE MODEL : Subtraction
CONE AREA : 15cm²
CONE AREA RATIO : 0.79
FILTER POSITION : u2
FILTER TYPE : HDPE

TEST TYPE : TE2
APPLICATION CLASS : 2
RIG : CPT 017 - Griffen
OPERATOR : DR
FRICTION REDUCER : None
WEATHER : Sunny & Cold
GROUNDWATER DEPTH : Assumed for calculation purposes

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	264 mV	267 mV	0.035 MPa
Sleeve	338 mV	340 mV	0.001 kPa
Pore Pressure 2	287 mV	261 mV	-0.007 kPa
X-Y Inclinator	2246 mV	2257 mV	

METHOD: Robertson et al. 1986 $q_c R_f$

1 - Sensitive fine grained material	5 - Clayey SILT to silty CLAY	9 - SAND
2 - Organic material	6 - Sandy SILT to clayey SILT	10 - Gravely SAND to SAND
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Groundwater
Level

Dissipation Test

PointID

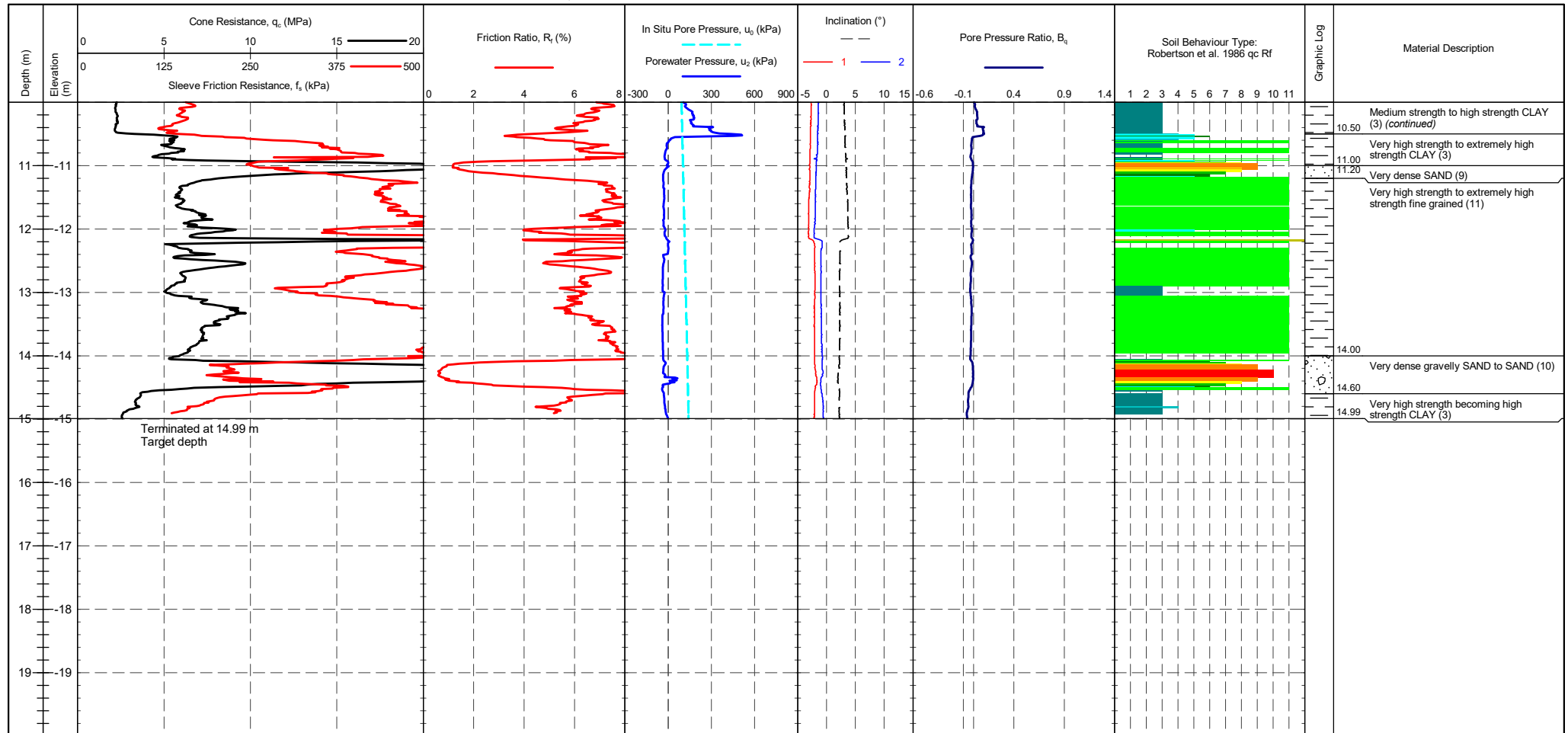
CPT103

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LOCATION : Manchester
PROJECT No. : 1240458

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ELEVATION : 0.000 m OD
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SHEET : 2 OF 2
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PLOT DATE : 25/10/2024
METHOD : ISO 22476-1:2022



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Groundwater
Level

Dissipation Test

PointID

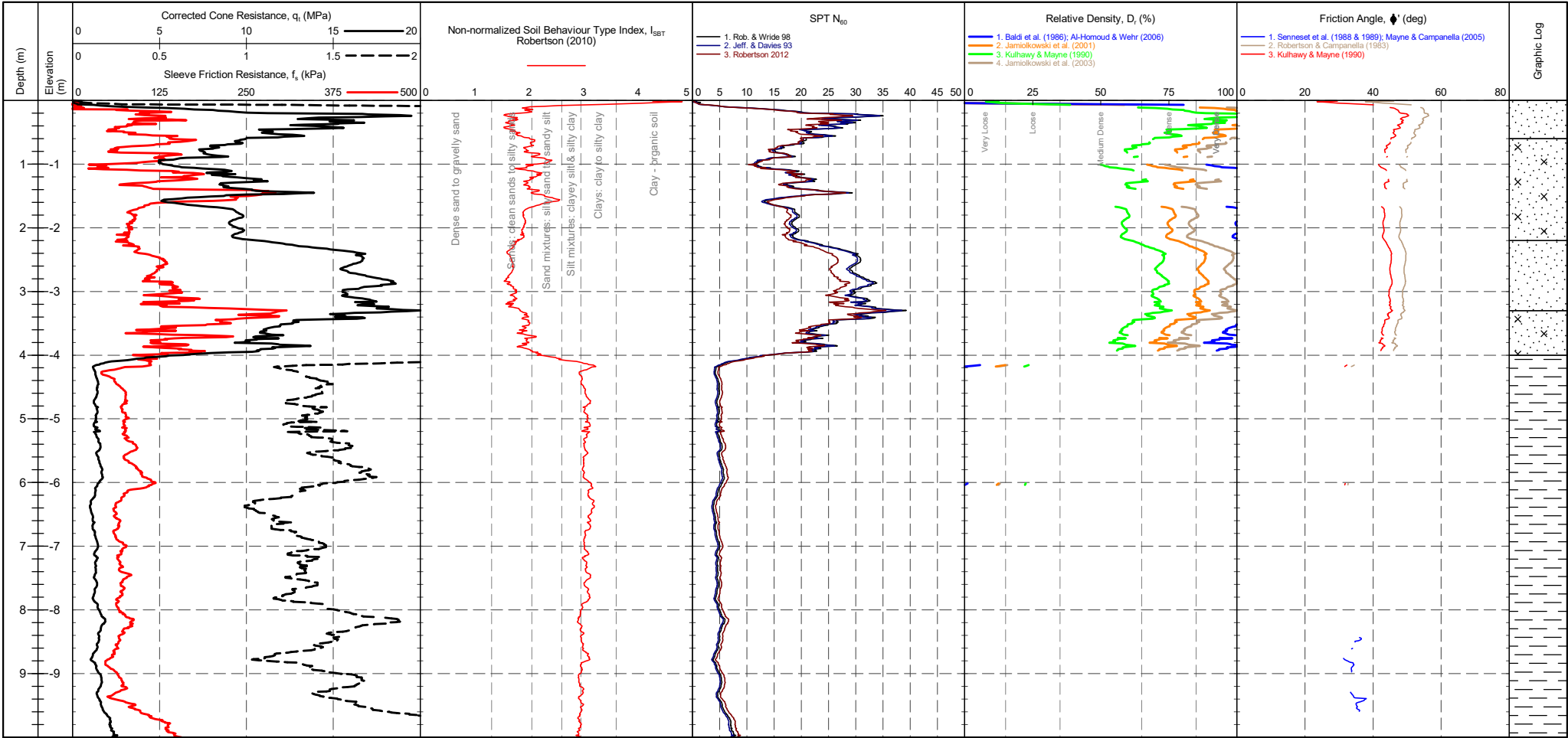
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GRANULAR SOILS (Sands & Gravels) Robertson et al. 1986 Zones 7-10 and Zone 12					
Description	SBT Index, I _c	Description	SPT N value, NSPT	Description	Relative Density D _r (%)
Clays	2.95-3.60	Very Loose	0 - 4	Very Loose	0 - 15
Silt mixtures	2.60-2.95	Loose	4 - 10	Loose	15 - 35
Sand mixtures	2.05-2.60	Medium Dense	10 - 30	Medium Dense	35 - 65
Sands	1.31-2.05	Dense	30 - 50	Dense	65 - 85
Gravelly sand	<1.31	Very Dense	>50	Very Dense	>85

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