Phase II Geoenvironmental Site Assessment

Site: Russell Road, Manchester
Reference: 17-031-R2-2
Date: July 24



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R2-2	Update to proposed development layout	HM	EF	AS	17/07/24

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EXECUTIVE SUMMARY

Site Address	Land north of Russell Road, Whalley Range, Manchester M16 8AT
Grid Reference	E 382621 N395179
Site Area	0.95 Ha
Proposed Development	Rowlinson Construction Ltd intends to construct a 5- storey apartment block and, a 4-storey shared ownership apartment block with associated car parking and utility infrastructure.
Current Site Use	The subject site is a rectangular shaped parcel of land to the north of Rusell Road, Manchester and is currently disused land. Hardstand is present site-wide with concrete foundations present where former buildings were located. The main entrance to the site is off Carlton Road, there are further entrances off Whalley Road and Russell Road however these are currently blocked. Semi-mature and mature trees are present around the boundaries of the site with sporadic trees through the centre of the site.
Site History	A review of the relevant Ordnance Survey maps shows that the Site originally consisted of agricultural land with Whalley Road forming the north western boundary of the site. Circa 1889 a building has been marked in the north of the site with associated gardens across the rest of the site. Smaller buildings are present in the north and east. By 1922 the smaller building in the east has changed configuration. Circa 1932 the original building has been extended towards the east as well as the addition of a separate building in the east connected by a walkway. A chapel has been marked adjoining the original building. Circa 1949 the site was marked as St Joseph's Hospital with one large building covering the majority of the site with a courtyard in the centre of the building. By 1980 the building has been split into two and has been marked as a private hospital. A substation has been marked on the northern boundary of the site. Circa 1986 only one building remains however circa 1991 the building is extended. Google Earth imagery from 2003 shows a large building covering the majority of the site with associated hardstand across the rest of the site. Semi-mature and mature trees are present around the site boundary. By 2020 the building has been demolished with hardstand cover across the site. The site remains the same until the present day.

ENVIRONMENTAL SETTING

Geology	Drift Geology	Glaciofluvial Sheet Deposits – SAND and GRAVEL
	Bedrock Geology	Wilmslow Sandstone Formation – SANDSTONE
	Faults	No geological faults have been recorded in close proximity to the site.
Geomorphology	The site is relatively flat and has little topographical variance this is likely due to historical development and the need for a level development platform, it is likely that significant depths of Made Ground will be present.	
Hydrogeology	A Secondary A Aquifer has been recorded on site in the drift geology with a Principal Aquifer in the bedrock geology.	
	No groundwater abstractions have been identified within 1 km of the site.	
Hydrology	There are no surface water features within 250m of the site.	
	The site is located within Flood Zone 1 - no risk of flooding.	
Utility Locations	A GPR survey of the site has identified electric and drainage channels. Evidence of redundant service can also be seen in the north western corner of the site.	
Landfill Sites and Waste Sites	No landfill sites (current or historic) are located within 250m of the Site.	
Radon	Radon Class 1 - less than 1% of homes are estimated to be at or above the Action Level. No radon protection measures are required.	
Unexploded Ordnance	Moderate risk UXO area. A preliminary desk study assessment was carried out by Zetica in March 2024, which concluded that there was no pre-WWI military activity or WWI military activity on the site. It also identified that there was no WWII military activity identified on the site, however, there were numerous WWII Strategic Targets within 5km of the site. Records indicate that several High Explosive (HE) bombs fell in close to the site. The PDSA concluded that a detailed desk-study is undertaken to assess and zone the UXO level on site.	
PFAS	No potential current or historical sources of PFAS have been identified on-site. No further risk assessment is required.	
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of moderate sensitivity residential dwellings have been identified within influencing distance of the subject site.	

E3P GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising: • 10 x mechanically excavated trial pits, • 7 x window sample boreholes, • 4 x cable percussive boreholes • 6 x BRE365 Soakaways • Construction of environmental monitoring installations.
Ground Conditions	**Made Ground – 0.00 m bgl to 2.30 m bgl** Made Ground deposits were encountered within all exploratory hole locations to a maximum proven depth of 2.30 m bgl. The base of Made Ground could not be identified within seven locations. Made Ground deposits comprise asphalt or concrete from ground level to 0.30 m bgl overlying a subbase of brown sandy gravel, 0.10 – 0.30 m in thickness. This generally overlayed a brown gravelly fine to medium sand or sandy gravel with gravels comprising sandstone, brick, concrete and asphalt. In TP101 a dark brown sandy gravelly clay was encountered with gravels of brick, concrete and asphalt between 0.25 – 0.50 m bgl. A brown gravelly clay was encountered within TP110 (0.90 – 1.00 m bgl) and WS105b (1.00 – 1.30 m bgl) with gravels comprising sandstone, brick, concrete and asphalt. A second layer of concrete was encountered within TP104a (>0.60 m bgl), TP104b (0.60 – 0.70 m bgl), TP108 (>0.90 m bgl), TP109 (>1.00 m bgl), WS101 (>1.50 m bgl), WS105a (>0.65 m bgl), WS106 (>0.60 m bgl) and CP101a (>1.50 bgl).
	Drift – 0.40 m bgl to >15.00 m bgl Drift deposits were encountered within the majority of exploratory locations from 0.50 m ->15.00 m bgl with the exception of seven locations where the full depth of Made Ground could not be proven. The drift deposits across the majority of the site comprise medium dense or dense brown gravelly fine to medium SAND with gravel comprising sandstone. Loose SAND was encountered within WS101 between 1.00 – 1.30 m bgl. In the southeast of the site (TP103 and TP107) a brown sandy CLAY and a dark grey CLAY were encountered from 0.80 – 2.00 m bgl. Within WS104 interlayers of fine to medium SAND and sandy CLAY were encountered. Within TP105 a dark grey clay was encountered from 1.30 – 2.00 m bgl overlying a brown sandy gravel of sandstone and mudstone.

	In the deeper cable percussive boreholes CP102 and CP104 a medium dense or dense brown fine to coarse sand was encountered overlying stiff to very stiff brown CLAY. In CP101b a medium dense brown fine to coarse SAND overlayed a medium dense brown GRAVEL of mudstone overlaying stiff to very stiff brown CLAY. In CP103 a medium dense brown gravel of mudstone was encountered overlying a medium dense brown gravelly SAND overlaying stiff brown CLAY. A layer of brown sandy SILT was encountered between 9.60 – 9.80 m bgl.
	Solid – Not encountered The solid bedrock geology was not encountered within this investigation. There are no boreholes within proximity to the site where bedrock was encountered.
	Groundwater Groundwater was encountered in the site investigation between 3.00 – 5.00 m bgl. All water strikes were in SAND or GRAVEL and encountered as seepages.

CONTAMINATED LAND ASSESSMENT

Human Health	Laboratory analysis has identified asbestos (Chrysotile) within TP109 at 0.40 m bgl. Quantification analysis has been undertaken with a quantification of 0.044%. No visual signs of ACM were encountered during the ground investigation; it is, therefore, likely that only trace fibres are present. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model. No exceedances for heavy metals, TPH, or PAH have been identified when compared to Tier 2 criteria. Chemical analysis of the natural SAND drift deposits has identified these soils to be acceptable for use as subsoil within the proposed landscaped areas; however, further chemical validation samples may be required to meet regulatory sampling frequency. There are no suitable sources of topsoil available on the site.
Controlled Waters	The site is considered to pose a low risk to controlled waters.
Ground Gas	Ground gas monitoring to date shows the site is currently CS1 which suggests that ground gas protection measures are not likely to be required. This will be confirmed once the monitoring programme is complete.
Potable Water Infrastructure	Based on the assessment of current site conditions it is likely that PE pipe will be suitable for the proposed development. This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during the site investigation.

GEOTECHNICAL ASSESSMENT

Underground Obstructions & Subterranean Hazards	Obstructions have been encountered across the site including former foundations. The historical hospital is anticipated to have deep foundations/substructures. As part of the process of creating a suitable platform for development, all subterranean obstructions will need to be excavated and removed beneath new structures and infrastructure. This will facilitate the construction of the proposed plots as intended.
Allowable Bearing Capacity	Within granular soils the suitable founding strata are the medium dense to dense SAND and GRAVEL with an ABC of 100 – 434 kN/m^2 from > 1.00 m bgl. Loose SAND was identified at 1.00 m (WS102) with an ABC of 17 – 52 kN/m^2. The underlying CLAY has been identified as stiff to very stiff from > 5.00 m bgl with an ABC of 85 – 397 kN/m^2.
Foundation Options	It is likely a driven pile foundation solution will be required due to the loadings that the high-rise buildings will require. Within the site, there are areas of variable ground conditions including Made Ground. Therefore, consideration should be given to the use of Ground Improvement by Vibro Stone Column up to 250kN/m^2 to ensure the treatment achieves a suitable design ABC to support the proposed development.
Foundations Near Trees	Foundation depths within the conjectured influence of former, existing or proposed trees will need to be deepened to ensure that structural loading bears within the underlying target founding stratum, which cannot be subject to volumetric instability associated with fluctuation in moisture content.
Heave Precautions Near Trees	Given that the underlying clay is of low volume change potential, heave precautions will not be required to the internal face of a foundation less than 1.5 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 200 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Building Floor Slabs	Ground-bearing floor slabs are not considered viable given the anticipated depths of Made Ground > 600 mm and shallow cohesive soils.
Soakaway Drainage	In two locations (SA101 and SA102) tests showed granular drift deposits to have good soakage potential, however, in locations where clay drift deposits were present, soakage potential was significantly reduced.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
Highway & Infrastructure Construction	Unsuitable materials have been identified across the site where a proposed highway or infrastructure is to be constructed in these areas, remediation works will be required to ensure the site is engineered to a suitable geotechnical design specification.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the subgrade during favourable climatic conditions.

	Natural clay soils will provide a CBR in the order of 3–5% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Enabling Earthworks	Development levels are unknown at this time; however, significant cut-and-fill works are not likely to be required to prepare the development platform. As part of the earthworks design, materials should be assessed and characterised prior to re-use in the construction of upfill to a geotechnical design. All future earthworks should be completed in accordance with a Geotechnical Design Report (GDR) that will consider the ground model within the context of the potential for settlement induced by surcharge from earthworks, dynamic and permanent loading of the development and all know hazards.
Civil Engineering Excavations	The E3P Intrusive Ground Investigation has identified the presence of obstructions including former foundations, the presence of which will impede the excavation materials to form sewerage and drainage infrastructure and foundations. Groundwater has been encountered >3.00 m during the ground investigation and the need for de-watering may be needed during enabling works.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: *Waste Classification – Guidance on the classification and assessment of waste*. This can be done upon request and in line with the Environment Agency sampling frequencies.

RECOMMENDATIONS

Based on the findings of the Geoenvironmental site assessment and the various conclusions drawn, the following additional works are recommended to be completed in due course:

- Foundations to be designed by a Suitably Qualified Structural Engineer.
- Arboricultural Survey.
- Geotechnical Design Report.
- Geotechnical Earthworks Specification
- Remediation and Enabling Works Strategy.

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17-013-R1-003 - Historical Features Plan
17-013-R1-004 - Site Features Plan
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17-013-R1-006 - Depth of Made Ground Plan
17-013-R1-008 - Depth to Founding Strata Plan
17-013-R1-010 - Conceptual Site Model
17-013-R1-015 - Development Constraints Plan
17-013-R1-017 - Obstruction Plan

1. INTRODUCTION

1.1. BACKGROUND

Rowlinson Construction Ltd (the client) commissioned E3P to undertake a Phase II Geoenvironmental Site Assessment at Russell Road, Whalley Range, Manchester; herein

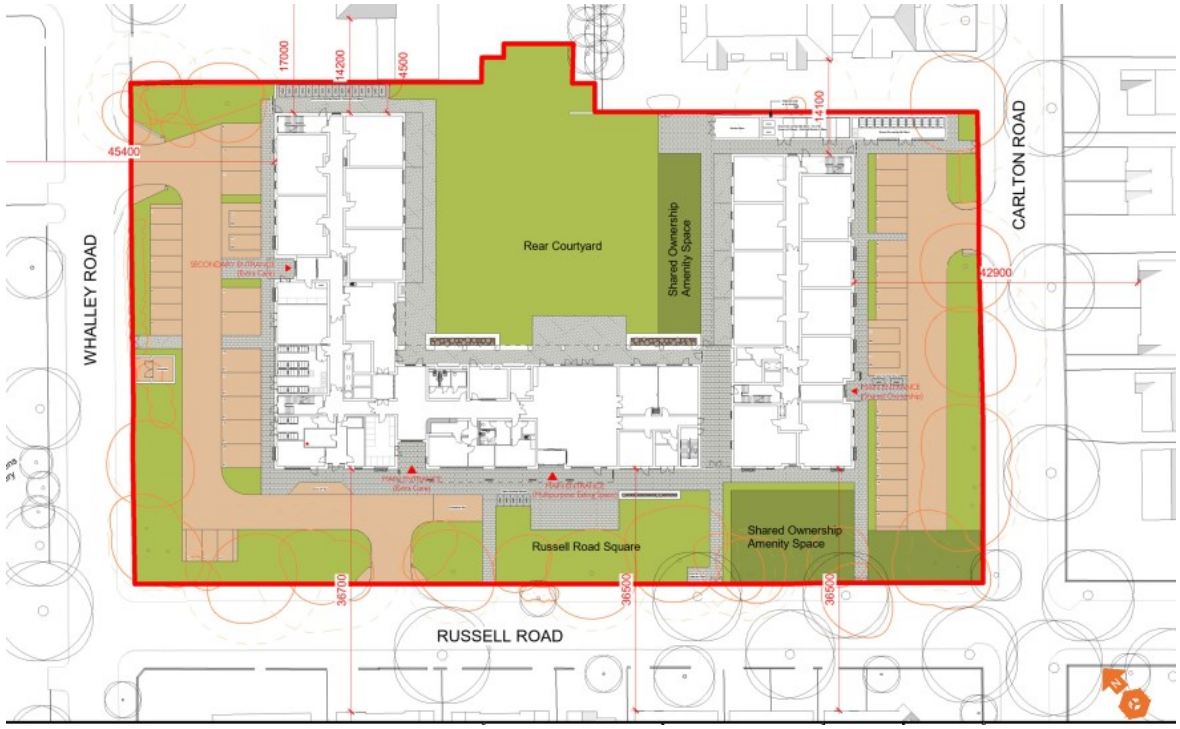
This report is required to determine potential contaminated land liabilities, remediation requirements and geotechnical engineering works that will be required as part of the proposed development.

1.2. PROPOSED DEVELOPMENT

Rowlinson Construction Ltd intends to construct a 5-storey apartment block and, a 4-storey shared ownership apartment block with associated car parking and utility infrastructure.

A snapshot of the Proposed Development Layout is indicated in Figure 1 below and Drawing 17-013-002 (APPENDIX IV).

Figure 1 Snapshot of Proposed Development



1.3. OBJECTIVES AND SCOPE

The objectives of the geoenvironmental investigation are as follows:

- Review historical plans, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available to complete a desk study in line with Environment Agency (EA) document Land Contamination: Risk Management (LCRM) (updated June 2023).
- Undertake a phase of sampling and analysis to provide an overview of the environmental issues identified.
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site concerning the site's future use and off-site receptors.
- Assess the geotechnical information and provide recommendations concerning foundations, pavement construction and floor slabs.
- Assess the coal mining-related information and provide recommendations regarding any future treatment; and,
- Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of works includes the elements included in Table 1.

Table 1 Scope of Works

GROUND INVESTIGATION
- Design of suitable ground investigation; - Window sample probeholes with the construction of environmental monitoring installations; - Deep cable percussive boreholes with the construction of groundwater monitoring installations; - Mechanically excavated trial pits; - Soil and groundwater sampling.
TESTING AND MONITORING
- In-situ geotechnical testing; - Chemical and geotechnical analysis; - Groundwater monitoring; - Ground gas monitoring.

ASSESSMENT AND REPORTING

- Factual and interpretative reporting;
- Contamination risk assessment and conceptual site model;
- Geotechnical assessment and interpretation.

1.5. PREVIOUS REPORTS

E3P are not aware of any previous report for this site.

1.6. LIMITATIONS

The limitations of this report are presented in APPENDIX I.

1.7. RISK CLASSIFICATION

The description of risk classification and the likely action required as set out in CIRIA C552 are included in APPENDIX III.

1.8. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed or with whom an assignment has been agreed. Should any third party wish to use or rely upon the report's contents, written approval must be sought from E3P; a charge may be levied against such consent.

2. E3P GROUND INVESTIGATION

2.1. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between 18th to 21st March 2024. The works are summarised in Table 2.

2.2. SCOPE OF INVESTIGATION

A summary of the fieldwork completed are included in Table 2.

Table 2 Summary of Fieldwork

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (M BGL)	MONITORING WELLS RESPONSE ZONE (M BGL)
General Ground Conditions	WS103	Window Sample Probehole	2.41	1.00–2.00
	TP104a	Mechanically Excavated Trial Pit	0.70	N/A
	TP109		1.05	
Former Hospital	WS101	Window Sample Probehole	1.65	0.50–1.50
	WS102		3.60	1.00–3.00
	WS105a		0.70	–
	WS105b		2.40	0.50–1.50
	WS106		1.40	–
	WS107		2.40	0.50–1.50
	TP102	Mechanically Excavated Trial Pit	2.30	N/A
	TP108		0.95	
	TP110		1.00	
Former Chapel	WS104	Window Sample Probehole	2.39	1.00–2.00
Deeper soil horizons Including the Presence/Nature of Obstructions	CP101a	Cable Percussive Borehole	1.50	–
	CP101b		14.00	–
	CP102		15.00	–
	CP103		14.00	–
	CP104		14.00	–
BRE365 Soakaways	TP101	Mechanically Excavated Trial Pit	1.80	N/A
	TP103		1.90	
	TP104b		2.40	
	TP105		2.40	
	TP106		2.00	
	TP107		1.80	

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

Cable percussive boreholes were advanced to investigate deeper soil horizons and retrieve geotechnical samples.

The sampling locations are illustrated in Drawing 17-013-005 (APPENDIX IV). The ground conditions encountered are indicated on the logs, which are provided in APPENDIX VII.

The locations were surveyed by GPS to Ordnance Survey with an accuracy of <10mm.

Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged and samples of groundwater were recovered for chemical analysis.

2.3. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube.

The results are shown in the probehole logs in APPENDIX VII, presented in Table 19 and discussed in Section 5.0.

2.4. PERMEABILITY TESTS

Six soakaway infiltration tests were carried out in order to assess the likely permeability of the underlying strata to determine the potential suitability for soakaway drainage within the proposed development.

The results are presented in Table 23, and the test certificates are included in APPENDIX XII.

2.5. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analysis, summarised in Table 3.

Table 3 Summary of Laboratory Analysis

CHEMICAL ANALYSIS
Metals
pH, total sulphate, water-soluble sulphate (2:1 extract)
Sulphide
Cyanide
Phenols
Total and speciated polycyclic aromatic hydrocarbons (PAHs)
Asbestos identification and quantification
Banded total petroleum hydrocarbons (TPHs)
Total Organic Carbon (TOC)

GEOTECHNICAL ANALYSIS

- Atterberg limits determinations;
- Moisture content;
- Particle size distribution;
- Single-stage triaxial tests;
- Oedometer tests.

2.6. STORAGE, PRESERVATION AND TRANSPORT OF SAMPLES

Measures taken to ensure the quality and integrity of the collected samples, from collection to receipt of the samples by the laboratory, are summarised in Table 4.

Table 4 Sample Integrity Information

SUBJECT	CHEMICAL SAMPLING	
Storage	**Soil**	**Groundwater**
	Glass jars supplied by the laboratory were used for the collection of soil samples to be analysed for VOCs. Plastic tubs were used to collect soil samples for metals analysis, PFAS testing and asbestos screening.	Glass vials supplied by the laboratory were used for the collection of samples to be analysed for VOCs. Samples to be analysed for lower volatility compounds were stored in laboratory-prepared glass jars. Samples to be tested for PFAS compounds were stored in laboratory-supplied HDPE bottles.
Preservation	Soil and groundwater sample containers were filled to minimise headspace prior to sealing and stored at a low temperature within cool boxes with cooling aids to minimise the loss of volatile contaminants and reduce microbial activity during the collection of samples. Cooling aids that may contain PFAS compounds (such as blue ice) were not utilised to prevent cross-contamination with samples.	
Sample Integrity	**Soil**	**Groundwater**
	Dedicated disposable nitrile gloves were worn and changed between sample collections to prevent cross-contamination. Hand tools were decontaminated with PFAS free detergent and rinsed with PFAS free water between sampling events. PFAS free stationary was used to label all samples.	Groundwater samples were collected using dedicated plastic tubing, which was changed between monitoring well locations to prevent cross-contamination. Interface probes were decontaminated with PFAS free detergent and rinsed with PFAS free water between monitoring wells. PFAS free stationary was used to label all samples.
Transport	Samples were stored and shipped in dedicated sample boxes provided by the laboratory. Sample details were recorded on the laboratory chain of custody form enclosed with the samples prior to dispatch. Scheduling information for the samples was confirmed with the laboratory via email.	

Chemical analysis has been undertaken by an accredited laboratory with the testing results summarised and discussed in Section 4 and the testing certificates included in APPENDIX VIII.

Geotechnical samples were collected as required per location immediately after excavation, labelled and sealed to minimise moisture loss. The geotechnical samples were collected and couriered by a dedicated courier to an accredited geotechnical testing laboratory. The testing results are summarised and discussed in Section 5 and the testing certificates are included in APPENDIX IX.

3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 5.

Table 5 Summary of Strata

HOLE	DEPTH TO STRATUM (M BGL)							
	MADE GROUND	LOOSE SAND	MEDIUM DENSE/ DENSE SAND	SAND	CLAY	STIFF CLAY	DENSE GRAVEL	SANDY SILT
TP101	0.00-0.50	-	-	0.50-1.80	-	-	-	-
TP102	0.00-2.30*	-	-	-	-	-	-	-
TP103	0.00-0.80	-	-	-	0.80-1.90	-	-	-
TP104a	0.00-0.70*	-	-	-	-	-	-	-
TP104b	0.00-0.70	-	-	0.90-2.40	0.70-0.90	-	-	-
TP105	0.00-1.30	-	-	-	1.30-2.00	-	2.00-2.40	-
TP106	0.00-0.80	-	-	0.80-2.00	-	-	-	-
TP107	0.00-0.50	-	-	-	0.50-1.80	-	-	-
TP108	0.00-0.95*	-	-	-	-	-	-	-
TP109	0.00-1.05*	-	-	-	-	-	-	-
TP110	0.00-1.00*	-	-	-	-	-	-	-
WS101	0.00-1.65*	-	-	-	-	-	-	-
WS102	0.00-1.00	1.00-1.30	1.30-3.40	-	-	-	-	-
WS103	0.00-0.75	-	0.75-2.41	-	-	-	-	-
WS104	0.00-0.40	-	1.40-2.00	0.40-0.90	-	0.90-1.40	-	-
WS105a	0.00-0.70	-	-	-	-	-	-	-
WS105b	0.00-1.50	-	1.70-2.40	-	1.50-1.70	-	-	-
WS106	0.00-1.44	-	-	-	-	-	-	-
WS107	0.001.50	-	1.50-2.40	-	-	-	-	-
CP101a	0.00-1.50*	-	-	-	-	-	-	-
CP101b	0.00-1.30	-	1.30-2.60	-	-	2.50-14.00	2.60-5.50	-
CP102	0.00-1.00	-	1.00-5.00	-	-	5.00-15.00	-	-
CP103	0.00-2.30	-	4.00-4.70	-	-	4.70-9.60 9.80-14.00	2.30-4.0	9.60-9.80
CP104	0.00-1.50	-	1.50-4.70	-	-	4.70-14.00	-	-

*Denotes base of Made Ground not identified

3.2. MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to a maximum proven depth of 2.30 m bgl. The base of Made Ground could not be identified within seven locations.

Made Ground deposits comprise asphalt or concrete from ground level to 0.30 m bgl overlying a subbase of brown sandy gravel, 0.10 – 0.30 m in thickness. This generally overlayed a brown gravelly fine to medium sand or sandy gravel with gravels comprising sandstone, brick, concrete and asphalt.

In TP101 a dark brown sandy gravelly clay was encountered with gravels of brick, concrete and asphalt between 0.25 – 0.50 m bgl. A brown gravelly clay was encountered within TP110 (0.90 – 1.00 m bgl) and WS105b (1.00 – 1.30 m bgl) with gravels comprising sandstone, brick, concrete and asphalt.

A second layer of concrete was encountered within TP104a (>0.60 m bgl), TP104b (0.60 – 0.70 m bgl), TP108 (>0.90 m bgl), TP109 (>1.00 m bgl), WS101 (>1.50 m bgl), WS105a (>0.65 m bgl), WS106 (>0.60 m bgl) and CP101a (>1.50 bgl).

Cobbles of brick were encountered within TP108 as well as fragments of plastic (TP102, TP108 and TP109), textile (TP108), ceramic (TP109) and metal (TP109).

A Depth of Made Ground Plan is presented as Drawing 17-013-006 in APPENDIX IV.

3.3. DRIFT DEPOSITS

Drift deposits were encountered within the majority of exploratory locations from 0.50 m – >15.00 m bgl with the exception of seven locations where the full depth of Made Ground could not be proven.

The drift deposits across the majority of the site comprise medium dense or dense brown gravelly fine to medium SAND with gravel comprising sandstone. Loose SAND was encountered within WS101 between 1.00 – 1.30 m bgl.

In the southeast of the site (TP103 and TP107) a brown sandy CLAY and a dark grey CLAY were encountered from 0.80 – 2.00 m bgl.

Within WS104 interlayers of fine to medium SAND and sandy CLAY were encountered. Within TP105 a dark grey clay was encountered from 1.30 – 2.00 m bgl overlying a brown sandy gravel of sandstone and mudstone.

In the deeper cable percussive boreholes, CP102 and CP104 a medium dense or dense brown fine to coarse sand was encountered overlying stiff to very stiff brown CLAY. In CP101b a medium dense brown fine to coarse SAND overlayed a medium dense brown GRAVEL of mudstone overlaying stiff to very stiff brown CLAY. In CP103 a medium dense brown gravel of mudstone was encountered overlying a medium dense brown gravelly SAND overlaying stiff brown CLAY. A layer of brown sandy SILT was encountered between 9.60 – 9.80 m bgl.

3.4. SOLID GEOLOGY

The solid bedrock geology was not encountered within this investigation.

There are no boreholes within proximity to the site where bedrock was encountered.

3.5. GROUNDWATER

Groundwater strikes were encountered as seepages. The depth of the seepages are shown on the exploratory hole records in APPENDIX VII and are summarised in Table 6.

Table 6 Summary of Groundwater Strikes

LOCATION	DEPTH TO STRIKE (M)	NOTES
CP101b	5.00	GRAVEL – Seepage
CP102	3.00	SAND – Seepage
CP103	4.40	SAND – Seepage
CP104	4.40	SAND – Seepage

Monitoring was undertaken using an electronic dip meter to record the depth to groundwater. These results are summarised in Table 14.

3.6. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has not been identified during the site investigation.

3.7. OBSTRUCTIONS

Obstructions were identified in several locations across the site, with their positions summarised in Table 7, marked on the depth of Made Ground drawing 17-013-006 (APPENDIX IV).

Table 7 Summary of Obstructions

LOCATION	DEPTH (M)	STRATUM	NOTES
TP102	>1.50	Made Ground	Concrete obstruction in the north and south of the trial pit from 1.50 m bgl extending into the site by 0.50m.
TP104a	0.70	Made Ground	Concrete in the base of the Trial Pit.
TP108	0.95	Made Ground	Concrete in the base of the Trial Pit.
TP109	1.05	Made Ground	Concrete in the base of the Trial Pit.
TP110	1.00	Made Ground	Compact Made Ground.
WS101	1.65	Made Ground	Concrete.
WS105a	0.70	Made Ground	Concrete.
WS106	1.44	Made Ground	Concrete.
CP101a	1.50	Made Ground	Concrete.

4. TIER 2 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 2 qualitative land risk assessment with respect to human health, controlled waters and ground gas to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

4.1. SAMPLE ANALYSIS POPULATION

Table 8 summarises the chemical analysis testing scheduled.

Table 8 Summary of Testing Schedule

TYPE OF SAMPLE	NO. OF SAMPLES	DETERMINANDS
Made Ground	9	Speciated PAH
	9	pH, total metals, TOC
	9	Banded TPH
	2	Leachable metals
	9	Asbestos ID & Quantification
SAND	4	Speciated PAH
	4	Banded TPH
	4	Metals, pH, TOC

4.2. HUMAN HEALTH RISK ASSESSMENT

At Tier 2 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM/CIEH S4UL (S4UL3267).

Where Tier 2 screening values are not provided by LQM, other screening values have been used and these are referenced in Table 9.

The Tier 2 screening values for residential without plant uptake have been utilised for this assessment due to the proposed development being a residential end use with no proposed gardens only landscaped POS. To remain conservative at an early stage, the screening values based on a 1% SOM have been utilised for this assessment.

The results of the comparison have been summarised in Table 9.

Table 9 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use (without plant uptake)

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PL	ASSESSMENT
Arsenic	mg/kg	40	13	8.5	–	1	No Further Action
Barium***	mg/kg	1340	4	230	–	1	No Further Action
Beryllium***	mg/kg	1.72	4	0.68	–	1	No Further Action
Cadmium	mg/kg	85	13	0.6	–	1	No Further Action
Chromium (VI)	mg/kg	6	13	<1.8	–	1	No Further Action
Lead**	mg/kg	310	13	100	–	1	No Further Action
Mercury	mg/kg	1.2	13	<0.3	–	4	No Further Action
Nickel	mg/kg	180	13	18	–	1	No Further Action
Selenium	mg/kg	430	13	1.5	–	1	No Further Action
Copper	mg/kg	7100	13	46	–	1	No Further Action
Vanadium***	mg/kg	357	4	23	–	1	No Further Action
Zinc	mg/kg	40000	13	440	–	1	No Further Action
Cyanide – Total	mg/kg	791	13	<1.0	–	1	No Further Action
Phenols – Total	mg/kg	440	13	<1.0	–	1	No Further Action
Asbestos	Fibres	NFD	9	Chrysotile	TP109 0.044%	3	Further Action
Naphthalene	mg/kg	2.3	13	0.43	–	4	No Further Action
Acenaphthylene	mg/kg	2900	13	0.08	–	2	No Further Action
Acenaphthene	mg/kg	3000	13	0.37	–	1	No Further Action
Fluorene	mg/kg	2800	13	0.35	–	1	No Further Action
Phenanthrene	mg/kg	1300	13	4.6	–	2	No Further Action
Anthracene	mg/kg	31000	13	0.82	–	2	No Further Action
Fluoranthene	mg/kg	1500	13	4	–	2	No Further Action
Pyrene	mg/kg	3700	13	4.4	–	2	No Further Action
Benzo(a)Anthracene	mg/kg	11	13	1.7	–	2	No Further Action
Chrysene	mg/kg	30	13	2.3	–	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	3.9	13	1.6	–	2	No Further Action
Benzo(k)Fluoranthene	mg/kg	110	13	0.92	–	2	No Further Action
Benzo(a)Pyrene	mg/kg	3.2	13	1.6	–	2	No Further Action
Indeno(123-cd)Pyrene	mg/kg	45	13	0.65	–	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.31	13	0.19	–	2	No Further Action
Benzo(ghi)Perylene	mg/kg	360	13	0.67	–	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	13	<1.0	–	4	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	13	<1.0	–	4	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	13	<1.0	–	4	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	250	13	<2.0	–	4	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	1800	13	<4.0	–	4	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	1900	13	16	–	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1900	13	110	–	1	No Further Action

Notes
PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = vapour/gas inhalation.

Abbreviations: GAC = general assessment criteria, N = number of samples, MC = maximum concentration; Loc of Ex = location of exceedance; PL = Contaminant Pathway; NFD = no fibres detected.

The pathway noted in the table is the primary pathway, however it may not be the only pathway of that contaminant
* The Tier 2 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 2 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 2 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.
** Tier 2 GAC for lead taken from C4SL CL:AIRE
*** Atkins ATRISK

Referring to Table 9, the results of this direct comparison indicate that the data exceeds the screening criteria for residential end-use for the following contaminants:

Inorganics

- **Asbestos**

Organics

- **None identified**

4.2.1. EXPOSURE PATHWAYS

The main exposure pathways based on the Tier 2 exceedances are:

- Fibre/dust inhalation (PL3).

4.2.2. HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

Asbestos

Asbestos in the form of loose chrysotile fibres has been identified in the granular Made Ground in TP109 at 0.40 m bgl. Quantification analysis has been undertaken with a quantification of 0.044%. In line with the proposed development plan (Drawing ref: 17-013-002), this area appears to be present within the footprint of the Shared Ownership building, and will be present underlying the structure and/or hardstanding and therefore future remedial works will be limited, as there is a low risk to human health receptors.

No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 2.

Figure 2 Asbestos Risk Mitigation Conceptual Site Model



Notes
ND None Detect
0.001% Soils may contain ≤ 0.001% asbestos using composite testing to ensure there is no potential risk to human health. This value is present within areas where there may be a short term low level exposure of soils containing trace asbestos fibres by construction workers where an appropriate level of asbestos management is employed (dust suppression)
0.1% Soils at a depth of >1.00m bgl may contain <0.1% asbestos using composite testing where they will not be likely to be disturbed in the future and will therefore be in an area of low sensitivity. Risk assessment completed in accordance with Asbestos JIWG risk assessment tools.
Undefined- this will be dependent upon soils encountered during earthworks, which may be placed at these depths to ensure no potential risk to human health.

Chemical analysis of the natural SAND drift deposits has identified these soils to be acceptable for use as subsoil within the proposed landscaped areas; however, further chemical validation samples may be required to meet regulatory sampling frequency.

There are no suitable sources of topsoil available on the site.

4.3. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the site based on the consideration of the conceptual site model and the sensitive receptors which are summarised in Table 10.

Table 10 Controlled Waters Conceptual Model and Sensitivity Profile

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Made Ground has been identified across the site to a maximum proven depth of 2.30 m bgl. Heavy metal and PAH contamination has not been identified within these Made Ground deposits.		**Low**
Pathway		
Vertical Migration Due to the majority of the site being underlain by granular alluvium deposits, vertical migration of any mobile contaminants is possible as a result of the high permeability of the drift deposits. However, clay deposits are present beneath Made Ground in the centre and southwest of the site. The presence of this low permeability drift will offer some protection to the underlying aquifer.		**High**
Lateral migration Lateral migration of contaminants is considered possible due to the presence of granular alluvium deposits across the site.		**Medium**
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary A aquifer.	**Medium**
Aquifer Classification in Bedrock	Principal aquifer.	**High**
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not affected.	**Low**
Distance to the Closest Groundwater Abstraction Point	None were identified within a 1 km radius.	**Low**
Is the Site Located Within 50 m of a Surface Watercourse?	There are no surface water courses within 250 m.	**Low**

The ICSM developed within the context of the site setting has identified a viable pollutant pathway, which would be the downward migration of potentially mobile phase-soluble contaminants towards the underlying principal aquifer.

The Tier 2 assessment in line with LCRM (2023) has included a comparison of leachate analysis from samples of the Made Ground to drinking water standards (DWS) due to the primary receptor being the underlying principal aquifer.

These are presented in Table 11.

Table 11 Comparison of Leachate Analysis with Tier 2 Screening Levels

DETERMINAND	UNIT	EQS [1,2] AA	DWS [3,4]	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
Arsenic	µg/l	50	10	2	3	–	No Further Action
Cadmium	µg/l	0.08-0.25	5	2	< 0.08	–	No Further Action
Chromium (VI)	µg/l	3.4	–	2	< 5.0	–	No Further Action
Chromium (III)	µg/l	4.7	50	2	13	–	No Further Action
Copper	µg/l	1	2000	2	15	–	No Further Action
Total Cyanide	µg/l	1	50	2	< 1.0	–	No Further Action
Lead	µg/l	1.2	10	2	5.7	–	No Further Action
Mercury	µg/l	–	1.0	2	0.7	–	No Further Action
Nickel	µg/l	4	20	2	2.7	–	No Further Action
Selenium	µg/l	–	10	2	< 4.0	–	No Further Action
Zinc	µg/l	10.9	–	2	25	–	No Further Action
pH	6–9			2	7.6 – 8.4	–	No Further Action
Polycyclic Aromatic Hydrocarbons							
Naphthalene	µg/l	2	10*	2	0.49	–	No Further Action
Anthracene	µg/l	0.1	10*	2	< 0.01	–	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	2	< 0.01	–	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	2	< 0.01	–	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	2	< 0.01	–	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	2	< 0.01	–	No Further Action
Fluoranthene	µg/l	0.0063	10*	2	< 0.01	–	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	2	< 0.01	–	No Further Action
Aromatic Hydrocarbon							
TPH C5-C7 (benzene)	µg/l	10	1	2	< 1.0	–	No Further Action
TPH C7-C8 (toluene)	µg/l	74	700	2	< 1.0	–	No Further Action
TPH C8-C10 (xylene)	µg/l	30	300	2	< 1.0	–	No Further Action
TPH C10-C12 (naphthalene)	µg/l	2	90	2	< 10	–	No Further Action
TPH C12-C16	µg/l	–	90	2	< 10	–	No Further Action
TPH C16-C35	µg/l	–	90	2	<10	–	No Further Action

DETERMINAND	UNIT	EQS [1, 2] AA	DWS [3,4]	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
Aliphatic Hydrocarbon							
TPH C5-C6	µg/l	–	1000[5]	2	< 1.0	–	No Further Action
TPH C6-C8	µg/l	–	1000[5]	2	< 1.0	–	No Further Action
TPH C8-C10	µg/l	–	300	2	< 1.0	–	No Further Action
TPH C10-C12	µg/l	–	300	2	< 10	–	No Further Action
TPH C12-C16	µg/l	–	300	2	< 10	–	No Further Action
TPH C16-C21	µg/l	–	300**	2	< 10	–	No Further Action
TPH C21-C35	µg/l	–	300**	2	< 10	–	No Further Action

Notes
Solubility <0.01µg/l
AA – Annual Average
** Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water*
*** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.*

1. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (legislation.gov.uk)
2. The Water Supply (Water Quality) Regulations 2018 (legislation.gov.uk)
3. Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum (who.int)
4. CL:AIRE publishes Petroleum Hydrocarbons in Groundwater guidance (claire.co.uk)
5. *A total TPH criteria of 1000 mg/kg will act as a surrogate criterion for remaining aliphatic and aromatic TPH fractions.*

DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

Historically, the site has been subjected to infilling with depths of Made Ground >2.00 m bgl in the centre of the site, historical site uses include a chapel and hospital.

As part of the leachate analysis, no contamination has been identified thus the risk posed to the underlying drift and bedrock aquifer is noted to be low. As part of return visits to the site, sufficient groundwater has not been encountered within the monitoring wells to fully assess the risk to controlled waters.

There are no surface water features within 250 m of the site boundary.

The results of the data review and Tier 2 qualitative risk assessment has allowed E3P to draw the following conclusions with respect to the risk to controlled waters:

- Leachate analysis within the Made Ground has identified a low risk to the underlying drift and bedrock aquifer when comparing the data to Tier 2 DWS values.
- Due to the absence of surface water features within 250 m the primary receptor has been identified as the underlying Secondary A aquifer in the drift and the principal aquifer in the bedrock.
- The site is currently covered in hard standing which restricts infiltrations of rainfall into the underlying Made Ground soils. The proposed development will continue to encapsulate the site with hardstanding restricting the pathway for infiltration into underlying Made Ground soils.
- A new drainage system will also serve to capture and divert water across the site, which will reduce infiltration into/through Made Ground.

4.4. GROUND GAS RISK ASSESSMENT

4.4.1. RATIONALE

Hazardous ground gas qualitative risk assessment is based on a conceptual site model (CSM) similar to that used for soil and groundwater contamination sources (i.e., source pathway receptor pollutant linkages).

The risk can be assessed based on knowledge of the ground conditions and CSM and a measure of hazardous gas concentrations and gas flow at the site within monitoring standpipes.

4.4.2. SOURCES AND PATHWAYS OF GROUND GAS

Table 12 summarises the potential sources and pathways of ground gas within the context of the recorded site setting and proposed development.

Table 12 Identified Potential Sources of Ground Gas

SOURCE
Made Ground Made Ground was encountered within all exploratory hole locations to a maximum proven depth of 2.30 m bgl. Made Ground deposits comprise asphalt or concrete from ground level to 0.30 m bgl overlying a subbase of brown sandy gravel, 0.10 – 0.30 m in thickness. This generally overlayed a brown gravelly fine to medium sand or sandy gravel with gravels comprising sandstone, brick, concrete and asphalt. In TP101 a dark brown sandy gravelly clay was encountered with gravels of brick, concrete and asphalt between 0.25 – 0.50 m bgl. A brown gravelly clay was encountered within TP110 (0.90 – 1.00 m bgl) and WS105b (1.00 – 1.30 m bgl) with gravels comprising sandstone, brick, concrete and asphalt. No materials of potential gassing risk have been identified within the Made Ground.
Drift Strata The drift deposits across the majority of the site comprise brown gravelly fine to medium SAND with gravel comprising sandstone. Loose SAND was encountered within WS101 between 1.00 – 1.30 m bgl. In the southeast of the site (TP103 and TP107) a brown sandy CLAY and a dark grey CLAY were encountered from 0.80 – 2.00 m bgl. Within WS104 interlayers of fine to medium SAND and sandy CLAY were encountered. Within TP105 a dark grey clay was encountered from 1.30 – 2.00 m bgl overlying a brown sandy gravel of sandstone and mudstone. In the deeper cable percussive boreholes, CP102 and CP104 a brown fine to coarse sand was encountered overlying stiff brown CLAY. In CP101 a brown fine to coarse SAND overlayed a brown gravel of mudstone overlaying stiff brown CLAY. In CP103 brown gravel of mudstone was encountered overlying a brown gravelly SAND overlaying stiff brown CLAY. A layer of brown sandy SILT was encountered between 9.60 – 9.80 m bgl. No materials of potential gassing risk have been identified within the drift strata underlying the site.
Solid Strata The solid bedrock geology was not encountered within this investigation. There are no boreholes within proximity to site where bedrock was encountered. The site is not located within a Coal Mining Reporting Area. There are no mine entries, coal outcrops, past or probable shallow coal mine workings beneath or close to the site. The risk from underground coal workings is therefore considered to be very low and no further works are deemed to be required in relation to coal mining.
Landfill Sites There are no active or historical landfills within 250 m of the site.
Other Gases The BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions. PAH analysis has not identified levels above the laboratory limits of detection (LOD) throughout the site.

The CIRIA C665 guidance on gas risk assessment includes recommendations for periods and frequencies for monitoring visits. These recommendations take into account the nature of the proposed development and the likely generation potential of the source.

The proposed development comprises private residential properties, which would be classified as a Type A development (high sensitivity) in accordance with BS8485:2015+A1:2019. However, it is considered that the likely generation potential of the identified gas sources (taking into account the likelihood of future increases in gas generation) would be best classified as low.

Therefore within the context of the proposed residential end-use and ground gas generation potential, the gas assessment requires nine visits over six months, with at least two sets of readings at low or falling atmospheric pressure.

4.4.3. GROUND GAS RISK ASSESSMENT METHODOLOGY

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in:

- CIRIA Report 665 – Assessing risks posed by hazardous ground gases to buildings (2007).
- BS8485:2015+A1:2019 – Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.

BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation (CS) and the proposed development based on building type.

Therefore, in accordance with BS8485, based on the measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) shall be derived for each monitoring point, from which the site characteristic hazardous gas flow rate (Q_{hgs}), and then the Characteristic Situation (CS) can be determined.

The following equation should be utilised:

$$Q_{hg} = q\left(\frac{C_{hg}}{100}\right)$$

Where:
q is the measured flow rate (in litres per hour) of combined gases from the monitoring standpipe
C_{hg} is the measured hazardous gas concentration (in percentage volume/volume).

The subsequent derived gas screening value (GSV) should be the maximum Q_{hg} (flow rate x concentration as a percentage volume) for all the monitoring events.

A 'worst case check' may be carried out using the maximum recorded flow in any hole with the maximum concentration in any hole to present the plausible worst case conditions. Adoption of the worst case Q_{hg} requires thorough justification and reference to the CSM.

The final derived GSV can then be used to characterise the site as summarised in Table 13.

Table 13 Site Characterisation by GSV (BS8485:2015)

CS	HAZARD POTENTIAL	GSV (L/HR) FOR METHANE AND CARBON DIOXIDE	ADDITIONAL FACTORS
CS1	Very Low	< 0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2).
CS2	Low	< 0.70	Typical measured flow rate <70 l/h (otherwise consider an increase to CS3).
CS3	Moderate	< 3.5	N/A.
CS4	Moderate to High	< 15	N/A.
CS5	High	< 70	N/A.
CS6	Very High	> 70	N/A.

Notes

1) *The CS is equivalent to the characteristic GSV in CIRIA C665.*
2) *The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter should be considered.*
3) *Gas Screening Value is the Borehole Gas Volume Flow Rate, in litres per hour, multiplied by the concentration in the air stream of the particular gas being considered.*
4) *The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.*

It should be noted that in the first instance, this assessment has been carried out in accordance with BS8485:2015+A1(2019) and the thresholds given.

4.4.4. MONITORING METHODOLOGY

Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) (hydrogen sulphide) were measured using a calibrated infrared gas analyser (GFM435) with gas flow rates measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 300 seconds (5 minutes) at each location, increasing to 600 seconds if elevated concentrations were identified, at which point the maximum concentration of CH_4 and CO_2, together with the lowest concentration of O_2 were recorded.

The results of the ground gas monitoring are presented in Table 14.

In addition to the raw data, the results for each individual standpipe have been assessed with reference to guidance provided in BS8485:2015. Based on the initial peak measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) have been derived for each monitoring point, from which an individual Characteristic Situation (CS) can ultimately be determined.

4.4.5. SUMMARY OF MONITORING RESULTS

Table 14 presents of the ground gas and groundwater monitoring results to date.

Table 14 Summary of Ground Gas Monitoring Results

WELL	STRATA	DATE	CH_4 PEAK (%V/V)	CH_4 STEADY (%V/V)	CH_4 Q_{hg} (l/hr)	CO_2 PEAK (%V/V)	CO_2 STEADY (%V/V)	CO_2 Q_{hg} (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	PEAK FLOW (l/hr)	STEADY FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	Made Ground	03/04/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	20.3	990	Falling	0.10	0.10	0.50 – 1.50	1.42	1.35
		03/05/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	20.2	1002	Falling	0.10	0.10		1.42	1.41
WS102	SAND	03/04/2024	0.10	0.10	0.0001	1.60	1.60	0.0016	17.1	989	Falling	0.10	0.10	1.00 – 3.00	3.00	2.94
		03/05/2024	0.10	0.10	0.0001	0.10	2.30	0.0023	16.3	1001	Falling	0.10	0.10		3.00	2.95
WS103	SAND	03/04/2024	0.10	0.10	0.0001	3.40	3.40	0.0034	13.0	989	Falling	0.10	0.10	1.00 – 2.00	2.00	DRY
		03/05/2024	0.10	0.10	0.0001	1.30	3.90	0.0039	13.1	1001	Falling	0.10	0.10		2.00	DRY
WS104	SAND	03/04/2024	0.10	0.10	0.0001	0.70	0.70	0.0007	17.0	988	Falling	0.10	0.10	1.00 – 2.00	1.60	DRY
		03/05/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	20.7	1000	Falling	0.10	0.10		2.00	DRY
WS105b	Made Ground	03/04/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	20.4	988	Falling	0.10	0.10	0.50 – 1.50	1.60	DRY
		03/05/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	20.3	1000	Falling	0.10	0.10		1.60	DRY
WS107	Made Ground	03/04/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	19.8	988	Falling	0.10	0.10	0.50 – 1.50	1.71	DRY
		03/05/2024	0.10	0.10	0.0001	0.10	0.10	0.0001	19.8	999	Falling	0.10	0.10		1.71	DRY

Notes

CIRIA Characteristic Situation		*Q_{hg}*		
	CS1	*<0.07*	*Typical Max CO2 <5 % Typical Max CH4 <1 %*	*Values in BOLD exceed CS1 Thresholds*
	CS2	*<0.7*	*Flow rate not to exceed 70 l/hr otherwise consider increase to CS3*	*Values in BLUE denote water above level of response zone (flooded)*
	CS3	*<3.5*		
	CS4	*<15*	*Quantitative Risk Assessment required to evaluate scope of protective measures*	

4.4.6. GROUNDWATER

Groundwater levels within WS101 and WS102 were noted at 1.35 m and 2.94 m bgl respectively during the first monitoring visit. Groundwater levels were then noted at 1.41 m and 2.95 m bgl respectively during the second monitoring visit.

Four monitoring wells (WS103, WS104, WS105b and WS107) were noted to be dry during the two initial rounds of monitoring.

4.4.7. BAROMETRIC PRESSURE

The first visit was undertaken during low falling pressure with pressure recorded at 990 m bar at the start of monitoring and fell to 988 mbar at the end of monitoring.

The pressure was noted t be falling low pressure, falling from 1002 mbar to 999 mbar.

4.4.8. GAS FLOW

Throughout the monitoring period, flow rates were recorded to be 0.10 l/hr (limit of detection of the analyser).

4.4.9. GAS CONCENTRATIONS

The maximum methane value recorded within the monitoring wells was 0.10% v/v (limit of detection of the analyser).

Carbon dioxide concentrations were recorded at concentrations ranging from 0.10% v/v to 3.90% v/v (WS103).

4.4.10. RADON RISK

Ground gas monitoring to date suggests that the site will fall into the bracket for Characteristic Situation 1, however, the site is in an area where less than 1% of homes are above the Radon Action Level.

All sites registered from 1st December 2022 onwards will have been assessed against the updated radon maps by NHBC and will be required to have radon protection measures installed in accordance with the updated mapping.

Figure 3 indicates that based on the less than 1% area observed, the site falls under a Radon Potential Class of 1 within the User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain (Ref: IR/11/044, dated 2011).

A Radon potential class of 1 indicates that basic Radon Measures are not required in all new dwellings, as shown in Figure 4.

Figure 3 Radon Affected Area Potential Class

Radon Potential Class*	Is the property in a Radon Affected Area?	Additional information
1	No	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). The property is not in a radon affected area.
2	Yes	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
3	Yes	The property is an Intermediate probability radon area (3 to 5% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
4	Yes	The property is in an Intermediate probability radon area (5 to 10% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
5	Yes	The property is in a Higher probability radon area (10 to 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.
6	Yes	The property is in a Higher probability radon area (more than 30% of homes are estimated to be at or above the Action Level). The property is in a radon affected area.

*The Radon Potential Class number should not be included in answers.

Source: User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain (Ref: IR/11/044, dated 2011)

Figure 4 Radon Affected Area Measures Required

Radon Potential Class*	What level of radon protective measures are required for new buildings in England and Wales?	What level of radon protective measures are required for new dwellings in Scotland?
1	None**	None**
2	None	Stage 1
3	Basic	Stage 1
4	Basic	Stage 1
5	Full	Stage 2
6	Full	Stage 2

*The Radon Potential Class number should not be included in answers.

** in 2008 HPA recommended that building regulations be amended to ensure that all new buildings, extensions etc. include basic radon protective measures. At the time of writing, relevant UK authorities were considering this advice.

Source: User Guide for the HPA-BGS Joint Radon Potential Dataset for Great Britain (Ref: IR/11/044, dated 2011)

4.4.11. CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is presented in Table 15. This indicates that based on the peak flow rates the majority of the monitoring visits classify as Characteristic Situation (CS)1 – Very Low Gas Risk.

Table 15 Gas Risk Profile and Location

WELL	DEPTH TO WATER (m bgl)	MAX FLOW (l/hr)	MAX CH_4 (%V/V)	MAX CH_4 Q_{hg} (l/hr)	MAX CO_2 (%V/V)	MAX CO_2 Q_{hg} (l/hr)	CHARACTERISTIC SITUATION
WS101	1.41	0.10	0.10	0.0001	0.10	0.0001	CS1
WS102	2.95	0.10	0.10	0.0001	2.30	0.0023	CS1
WS103	DRY	0.10	0.10	0.0001	3.90	0.0039	CS1
WS104	DRY	0.10	0.10	0.0001	0.70	0.0007	CS1
WS105b	DRY	0.10	0.10	0.0001	0.10	0.0001	CS1
WS107	DRY	0.10	0.10	0.0001	0.10	0.0001	CS1

It is recommended that the full ground gas assessment and recommended protection measures (if applicable) are agreed with the local authority prior to their adoption on-site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

4.5. POTABLE WATER SUPPLY

This section provides a summary of the site investigation data with reference to the selection of potable water supply pipework. The assessment is made with reference to the UK Water Industry Research (UKWIR) publication "Guidance on the selection of Water Supply Pipes to be used in Brownfield Sites"

Table 16 Pipeline Selection PE Threshold Concentrations

CONTAMINANT GROUP	PE-THRESHOLD (MG/KG)	CONCENTRATIONS AT CURRENT PIPELINE DEPTH (MG/KG)
Total VOC	0.5	<1.0
Total BTEX And MTBE	0.1	N/A
Total SVOCs (Excluding PAH and those substances marked with an *)	2	N/A
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.0
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	<4.0
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	24
Phenols (From SVOC Analysis)*	2	N/A
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	N/A
Ethers*	0.5	NA
Nitrobenzene*	0.5	NA
Ketones*	0.5	NA
Aldehydes*	0.5	NA
Amines	Fail	NA
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	None identified.	
Is free product present in soil and groundwater?	None identified.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	No – groundwater levels are generally significantly deeper than pipeline depth.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	No.	
Will soils be imported to site as part of any future earth works	Currently unknown, however it is unlikely soils will be required to be imported to site.	

Notes - Pipe line depth normally between 0.75m–1.35m

Based on the assessment of current site conditions it is likely that PE pipe will be suitable for the proposed development.

4.6. DEVELOPED CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 17 has been prepared for the site.

Table 17 Developed Conceptual Model

CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	**MIGRATION PATHWAYS**	**RECEPTORS**				
SOIL						
HUMAN HEALTH						
Made Ground Heavy metals **Made Ground** PAHs	Accidental ingestion and/or dermal contact with contaminated soil and/or leachate. **PL1/PL2** Inhalation of contaminated dust. **PL3**	Human Health – construction workers Human Health – end users	Unlikely	Low	No elevated concentrations of heavy metals or PAH have been identified when comparing to Tier 2 criteria. **Recommendation:** Construction works to be completed with appropriate PPE and welfare facilities.	Low
		Human Health – end users	Unlikely	Low	Development of the road, hardstanding and engineered clean cover system shall break migration pathways to end users. **Recommendation:** Cover system to landscaped areas will prevent exposure to future site users.	Low

CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	MIGRATION PATHWAYS	RECEPTORS				
Made Ground VOCs, hydrocarbons, volatile PAHs	Inhalation of vapours. **PL4** Migration through permeable strata and preferential pathways.	Human Health – end users Human Health – Off-site receptors	Unlikely	Low	No source of hydrocarbons or volatile contaminants has been identified. **Recommendation:** A watching brief should be completed during remediation works to monitor if any visual or olfactory hydrocarbon impact is identified.	Low
Made Ground Asbestos (Asbestos containing materials (ACM) and loose fibres)	Inhalation (of fibres). Construction works disturbing bound material and releasing fibres. **PL3**	Human Health - Site personnel, end land users, and users of adjacent sites	Likely	High	Asbestos has been identified within TP109 at 0.40 m bgl with a quantification of 0.044%. Risk of inhalation of fibres during Ground Investigation and construction works. Disturbance of ACMs and dust derivatives from construction would increase risk to adjacent sites. **Recommendation:** The soils will require placement in accordance with the asbestos CSM. Cover system to landscaped areas will prevent exposure to future site users. Construction works completed with PPE and provision of welfare.	Low

CONTAMINANT RISK			LIKELIHOOD	SEVERITY	MITIGATION DISCUSSION	RESIDUAL RISK
SOURCES	**MIGRATION PATHWAYS**	**RECEPTORS**				
Made Ground Sulphate from potential ash within the Made Ground.	Sulphate attack on concrete. **PL6**	Building concrete	Unlikely	Low	Soils meet classification DS-1, AC-1. **Recommendation:** Concrete should be designed in accordance with chemical testing results. Construction works to be completed with appropriate PPE and welfare facilities.	Low
Made Ground Organic contaminants such as hydrocarbons, solvents	Ingestion of tainted water supply. **PL7**	Human Health – End Users Water pipeline	Unlikely	Low	Unlikely probability as significant contamination has not been identified at pipeline depth across the west of the Site (0.75–1.35 m). **Recommendation:** PE pipe is likely to be suitable. This will need to be confirmed following a pipeline risk assessment.	Low
Made Ground Phytotoxic contaminants	Direct contact (plant uptake). **PL8**	Flora	Unlikely	Low	Unlikely probability as contamination has not been identified landscaping/gardens. **Recommendation:** Cover system to all proposed landscaped areas.	Low

CONTROLLED WATERS						
Made Ground	Leaching of contaminants from Made Ground through infiltration and percolation of rainwater. PL5	Controlled waters, underlying principal aquifer	Unlikely	Low	Leachate analysis has not identified a source of mobile contamination.	Low
		Infrastructure and services	Unlikely	Low	The development of the proposed road (hardstanding and drainage) will reduce the leachate produced from contaminated soils. Infrastructure and services shall be designed to resist chemical attack and ingress.	Low
Groundwater	Contact with contaminated groundwater. PL2	Human Health – site personnel	Unlikely	Low	Upon return visits to the site, insufficient water levels have been recorded within monitoring wells to receive a sample. Groundwater is known to be below construction level and as such, is expected to not rise above ground level or the final level of the road.	Low
	Contaminants leached from the Made Ground and from off-site sources may be mobilised to greater distances through advective flow. PL5	Human Health – end users	Unlikely	Low	Impacted groundwater could transport contaminants vertically and horizontally through permeable strata. However, the site works will not exacerbate this, and site work will be undertaken above the water table. Groundwater will need to be considered for surrounding developments.	Low

GROUND GAS						
Ground gases (methane and carbon dioxide in the landfill areas as monitored during previous studies)	Inhalation of ground gas. **PL4** Accumulation of ground gas in confined spaces (asphyxiation or explosion)	Human Health – site personnel	Unlikely	Low	Ground gas monitoring to date shows the site classified as CS1, however this will need to be confirmed following the completion of the gas monitoring programme.	Low
		Human Health – end users	Unlikely	Low		Low
		Infrastructure and services	Unlikely	Low		Low
Radon	Inhalation of ground gas. **PL4** Accumulation of ground gas in confined spaces (carcinogenic)	Human Health – site personnel	Unlikely	Low	The site is an area between 1% and 3% of homes are above the radon action level. Radon measures are not required in all new dwellings.	Low
		Human Health – end users	Unlikely	Low		Low

Main Exposure Pathways:
PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = vapour/gas inhalation; PL5 = vertical / lateral migration; PL6 = corrosion of concrete; PL7=tainting of water supply; PL8 = uptake by plants.

LEVEL OF RISK	
Very Low	
Low	
Low/Moderate	
Moderate	
Moderate/High	
High	

5. GEOTECHNICAL ASSESSMENT

5.1. SOIL CONSISTENCY

Undrained shear strength values were measured using laboratory undrained triaxial tests. Results of the tests are presented in Table 18, which indicate the clay soils to vary between stiff and very stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 19.

Table 18 Summary of Undrained Shear Strength in Triaxial Compression – Laboratory Test

LOCATION	SAMPLE DEPTH (m)	LAB DESCRIPTION	UNDRAINED SHEAR STRENGTH (kN/m^2)	CONSISTENCY
CP102	8.00	Brown silty slightly sandy slightly gravelly CLAY	112	Stiff
CP104	6.50	Brown silty slightly sandy slightly gravelly CLAY	78	Stiff

5.2. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation.

The presence of brick and concrete cobbles within the Made Ground deposits meant that in certain places, excavation was slow through the Made Ground and in some places, Made Ground could not be fully penetrated. The natural strata was excavated with relative ease.

Table 19 Standard/Cone Penetration Test Results

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING CAPACITY (kN/m^2)*
WS101	1.00	MG: Sand	6	6.05	Loose	N/A	N/A	N/A	60.49
	1.50	MG: Concrete	50	47.51	Dense	N/A	N/A	N/A	475.08
WS102	1.00	Clayey SAND	4	4.03	Loose	N/A	N/A	N/A	40.33
	2.00	Gravelly SAND	11	10.05	Medium Dense	N/A	N/A	N/A	100.49
	3.00	Gravelly SAND	50	43.48	Dense	N/A	N/A	N/A	434.83
WS103	1.00	Gravelly SAND	12	12.10	Medium Dense	N/A	N/A	N/A	120.98
	2.00	Gravelly SAND	50	45.68	Dense	N/A	N/A	N/A	456.77
WS104	1.00	Sandy CLAY	17	17.14	N/A	High Strength	Very Stiff	85.69	176.18
	2.00	Gravelly SAND	50	45.68	Dense	N/A	N/A	N/A	456.77
WS105b	1.00	MG: Clay	16	16.13	N/A	High Strength	Very Stiff	80.65	165.82
	2.00	Gravelly SAND.	50	45.68	Dense	N/A	N/A	N/A	456.77
WS106	1.00	MG: Concrete	50	50.41	Very Dense	N/A	N/A	N/A	504.07
WS107	1.00	MG: Clay	12	12.10	N/A	Medium Strength	Stiff	60.49	124.37
	2.00	Gravelly SAND	50	45.68	Dense	N/A	N/A	N/A	456.77
CP102	1.00	Gravelly SAND	14	14.11	Medium Dense	N/A	N/A	N/A	141.14
CP102	2.00	Gravelly SAND	25	22.84	Medium Dense	N/A	N/A	N/A	228.38
CP102	3.00	Gravelly SAND	31	26.96	Medium Dense	N/A	N/A	N/A	269.59
CP102	4.00	Gravelly SAND	28	23.66	Medium Dense	N/A	N/A	N/A	236.56
CP102	5.00	CLAY	16	13.27	N/A	Medium strength	Stiff	66.37	136.46
CP102	6.50	CLAY	19	15.51	N/A	High strength	Very Stiff	77.56	159.46
CP102	8.00	CLAY	50	40.47	N/A	Very high strength	Very Stiff	202.37	416.07
CP102	9.50	CLAY	22	17.73	N/A	High strength	Very Stiff	88.65	182.27
CP102	11.00	CLAY	27	20.88	N/A	High strength	Very Stiff	104.40	214.65

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING CAPACITY (kN/m^2)*
CP102	12.00	CLAY	31	23.07	N/A	High strength	Very Stiff	115.36	237.18
CP102	14.00	CLAY	50	34.64	N/A	Very high strength	Very Stiff	173.18	356.06
CP102	15.00	CLAY	50	33.48	N/A	Very high strength	Very Stiff	167.41	344.20
CP103	1.00	MG: Gravel	28	28.23	Medium Dense	N/A	N/A	N/A	282.28
CP103	2.00	MG: Gravel	16	14.62	Medium Dense	N/A	N/A	N/A	146.17
CP103	3.00	GRAVEL	23	20.00	Medium Dense	N/A	N/A	N/A	200.02
CP103	4.00	Gravelly SAND	20	16.90	Medium Dense	N/A	N/A	N/A	168.97
CP103	5.00	CLAY	11	9.13	N/A	Medium strength	Stiff	45.63	93.81
CP103	6.50	CLAY	14	11.43	N/A	Medium strength	Stiff	57.15	117.49
CP103	8.00	CLAY	17	13.76	N/A	Medium strength	Stiff	68.80	141.46
CP103	9.50	CLAY	13	10.48	N/A	Medium strength	Stiff	52.39	107.71
CP103	11.00	CLAY	18	13.92	N/A	Medium strength	Stiff	69.60	143.10
CP103	12.50	CLAY	50	36.53	N/A	Very high strength	Very Stiff	182.65	375.53
CP103	14.00	CLAY	50	34.64	N/A	Very high strength	Very Stiff	173.18	356.06
CP104	1.00	MG: Gravel	15	15.12	Medium Dense	N/A	N/A	N/A	151.22
CP104	2.00	SAND	21	19.18	Medium Dense	N/A	N/A	N/A	191.84
CP104	3.00	Gravelly SAND	18	15.65	Medium Dense	N/A	N/A	N/A	156.54
CP104	4.00	Gravelly SAND	19	16.05	Medium Dense	N/A	N/A	N/A	160.52
CP104	5.00	CLAY	10	8.30	N/A	Medium strength	Stiff	41.48	85.29
CP104	6.50	CLAY	50	40.82	N/A	Very high strength	Very Stiff	204.10	419.62
CP104	8.00	CLAY	16	12.95	N/A	Medium strength	Stiff	64.76	133.14
CP104	9.50	CLAY	17	13.70	N/A	Medium strength	Stiff	68.50	140.85
CP104	11.00	CLAY	19	14.69	N/A	Medium strength	Stiff	73.47	151.05
CP104	12.50	CLAY	50	36.53	N/A	Very high strength	Very Stiff	182.65	375.53

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m^2)	ALLOWABLE BEARING CAPACITY (kN/m^2)*
CP104	14.00	CLAY	50	34.64	N/A	Very high strength	Very Stiff	173.18	356.06

NOTES
* The Allowable Bearing Capacity (ABC) should be considered indicative.
The interpretation of in situ mass undrained shear strength (cu) data from SPT Blow Count (N) results and the influence of the Plasticity Index (PI) was reported in Standard Penetration Test in Insensitive Clays and Soft Rocks. Stroud (1974). The standard penetration test and the engineering properties of glacial materials subsequently. Stroud and Butler (1975) and (1989).
Allowable bearing capacity on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996.

5.3. CONSOLIDATION

Two undisturbed samples were submitted for oedometer analysis. The results are provided in Table 20.

Table 20 Oedometer Consolidation Results

LOCATION	DEPTH (M)	SAMPLE TYPE	MOISTURE CONTENT (%)	OEDOMETER CONSOLIDATION		
				PRESSURE RANGE (kPa)	Mv (m^2/MN)	Cv (m^2/year)
CP102	8.00	U100	13.5	0–165	0.27	4.15
				165–330	0.11	2.84
				330–660	0.06	2.43
				660–1320	0.04	2.66
				1320–165	0.01	–
CP104	6.50	U100	13.5	0–135	0.15	1.16
				135–270	0.11	1.42
				270–540	0.07	1.89
				540–1080	0.04	2.48
				1080–135	0.01	–

When considered at over-burden pressure with an additional load of 110 kPa the coefficient of volume compressibility (Mv) ranged from 0.15 m^2/MN up to 0.27 m^2/MN. The material is considered to be low to medium compressibility.

The rate at which settlement is likely to occur is determined by the coefficient of consolidation (Cv). As shown in Table 20, the coefficient ranges from 1.16 m^2/yr to 4.15m^2/yr. The rate at which settlement will occur is increased by the presence of sand within the Glacial Till and it is likely that settlement will occur over a period of months to years.

5.4. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of granular material via wet sieve to obtain information on the soil fractions.

The results are included in Table 21. The full results can be found in APPENDIX IX.

Table 21 Summary of Particle Size Distribution Test Results

LOCATION	DEPTH (M)	SOIL FRACTION (%)			
		COBBLES	GRAVEL	SAND	SILT/CLAY
TP101	1.00	1	18	68	13
TP106	1.50	0	13	82	5
TP110	0.50	8	77	10	5
CP101a	4.00	0	93	7	0
CP104	4.00	0	85	8	7

5.5. SOIL DENSITY/MOISTURE CONTENT RELATIONSHIP

Dry density / moisture content relationship analysis has been conducted on soils using via utilising a 4.5kg rammer. The results of the tests has been summarised in Table 22.

The full test results can be found in APPENDIX IX.

Table 22 Summary of Dry Density and Moisture Content

LOCATION	LABORATORY DESCRIPTION	TOP DEPTH (M)	METHOD OF COMPACTION	INITIAL MOISTURE CONTENT (%)	OPTIMUM MOISTURE CONTENT (%)	MATERIAL RETAINED ON 37.5 MM SIEVE (%)	MAX DRY DENSITY (MG/M³)	MATERIAL RETAINED ON 20.0 MM TEST SIEVE (%)
TP101	Brown silty gravelly SAND	1.00	4.5kg	14.5	11	3	1.83	11
TP106	Brown silty gravelly SAND	1.50	4.5kg	10.4	11	0	1.75	2

The proctor compaction tests have indicated that the materials on site are variable with the material in TP101 being wet of the optimum. It should be noted that if this material is excavated for use in a cut/fill operation careful consideration should be taken in the stabilisation of this material.

Engineering of this type of material will need to be completed during dry weather periods only.

In TP106, the material was noted to be dried than the optimum.

5.6. SOIL INFILTRATION

In-situ BRE 365 Soakaway tests were undertaken over a 48 hour period within trial pits completed as TP101 and TP103-TP107.

The results are presented in Table 23 and the test certificates are included within APPENDIX IX.

Table 23 Soil Infiltration Results

LOCATION	DEPTH (M)	MATERIAL	TEST NO.	SOIL INFILTRATION RATE (M/S)
TP101/SA101	1.80	Gravelly SAND with pockets of CLAY	1	3.66E-05
			2	N/A
TP104b/SA102	2.40	SAND	1	5.11-05
			2	2.76E-05
			3	2.05E-05
TP106/SA103	1.90	Gravelly SAND	1	N/A
TP105/SA104	2.40	CLAY overlying GRAVEL	1	N/A
TP107/SA105	1.80	Sandy CLAY	1	N/A
TP103/SA106	1.90	Sandy CLAY	1	N/A

Soil infiltration was taken over the wetted area from between 75% and 25% of the effective depth. In two locations tests showed granular drift deposits to have good soakage potential, however, in locations where clay drift deposits were present, soakage potential was significantly reduced.

Therefore, considering the significant volumes of permeable Sand and Gravel on the site, it is considered that soakaway drainage may be suitable for the proposed development. However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.

5.7. SOIL PLASTICITY

The liquid and plastic limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average plasticity index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth.

E3P typically only consider a soil to be shrinkable if the proportion finer than 63 µm is > 35%.

PI results are compared against guidance given in the NHBC standards, Chapter 4.2 (revised January 2014), which advocates the use of modified plasticity index (I'p), defined as:

$$I'p = Ip \times (\% < 425\ \mu m/100)$$

In other words, if PI is 30%, but the soil contains 80% < 425 µm, then I'p = 30 × 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425 µm sieve is routinely reported by testing labs.

E3P apply engineering judgement where PI results are spread over a range of classifications. Consideration is given to the average values for each particular soil type (differentiate between residual soil and alluvium), the number of results in each class and the actual values.

The Atterberg limits determinations, summarised in Table 24, show the clay to be of low plasticity clay.

Table 24 Summary of Plasticity Index Test results

LOCATION	DEPTH (M)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 MM SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS104	1.00	18.1	10	26	16	96	15.36	Low
CP102	5.00	15.8	10	24	14	96	13.44	Low
CP104	7.00	15.8	10	25	15	92	13.8	Low

The results of the Atterberg limits testing confirmed that the soils would be deemed to be "Low Volume Change Potential" in accordance with the classification system utilised by the LABC/NHBC industry guidance.

5.8. PH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in APPENDIX VIII (summarised in Table 25), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

Table 25 Summary of pH and Sulphate Data

LOCATION	DEPTH (M)	SO_4 IN 2:1 WATER/SOIL (G/L)	PH VALUE	CLASSIFICATION
TP102	1.00	0.0326	8.4	DS-1, AC-1s
TP104a	0.40	0.0073	8.0	DS-1, AC-1s
TP108	0.60	0.3600	9.5	DS-1, AC-1s
TP109	0.40	0.1120	10.8	DS-1, AC-1s
WS101	0.80	0.0086	7.9	DS-1, AC-1s
WS102	1.50	0.0487	9.8	DS-1, AC-1s
WS103	0.90	0.0028	7.9	DS-1, AC-1s
WS104	1.60	0.0082	8.6	DS-1, AC-1s
WS107	1.80	0.0228	7.8	DS-1, AC-1s

5.8.1. HIGHWAYS AND CONCRETE

MCHW Series 600 provides a criteria of 1500mg/l for water-soluble sulphate within 500mm of any concrete structure. A second criteria of 300 mg/l is given with respect to soils within 500mm of steel structures.

5.9. GROUNDWATER

Table 26 Summary of Groundwater Strikes

LOCATION	DEPTH (M BGL)	DESCRIPTION OF STRIKE	STRATA	EVIDENCE OF CONTAMINATION
Site Investigation Waterstrike Information				
CP101	5.00	Seepage	GRAVEL	None
CP102	3.00	Seepage	SAND	None
CP103	4.40	Seepage	SAND	None
CP104	4.50	Seepage	SAND	None
Location	**Depth Range (m bgl)**	**Period of monitoring (May-September)**	**Weather conditions during monitoring**	**Comments**
Groundwater Monitoring Summary from Installations				
WS101	1.35	April	Drizzle	–
WS102	2.94	April	Drizzle	–
WS103	DRY	April	Drizzle	–
WS104	DRY	April	Drizzle	–
WS105b	DRY	April	Drizzle	–
WS107	DRY	April	Drizzle	–

Groundwater levels were between 1.35 m – 2.94 m bgl during the first visit. The remaining four monitoring wells were noted to be dry.

Water strikes encountered during the site investigation were typically associated with SAND and GRAVEL drift deposits below 3.00 m bgl. Surrounding locations did not present any plausible trend with a shallow groundwater flow.

5.9.1. INFLUENCING FUNCTIONAL WATERBODIES

Long-term monitoring of groundwater has not been conducted as a part of this investigation and interpreted levels are approximate and may be dependant on seasonal variation. It should be noted that seasonal variation is likely to result in potentially significant changes in groundwater levels beneath the site.

The water table can have significant effects on the foundation of a building, including:

- **Soil settlement**: Changes in the water table can cause soil to expand or contract, which can result in foundation settlement or movement. This can lead to cracks in the foundation, walls, or floors of a building.
- **Soil erosion**: High water tables can cause soil erosion, which can lead to the loss of soil support beneath the foundation. This can result in foundation settling or movement, which can be dangerous for the stability of the structure.
- **Hydrostatic pressure**: When the water table rises, the water exerts hydrostatic pressure on the foundation. This can cause foundation walls to crack or bow, which can compromise the structural integrity of the building.
- **Moisture infiltration**: High water tables can result in moisture infiltration into the foundation and surrounding soil. This can lead to mold growth, decay, and deterioration of building materials.
- **Drainage problems**: Poor drainage around a building can cause water to pool around the foundation, increasing the likelihood of soil erosion and hydrostatic pressure. This can lead to foundation settling or movement, and can also cause flooding in the basement or crawl space.

It is important to consider the effects of the water table on the foundation when designing and constructing a building. Proper drainage and foundation waterproofing can help to mitigate the effects of the water table on the foundation and improve the longevity and stability of the structure.

5.10. SITE PREPARATION

Our assessment has been based on the fact that the site will be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Manual of Contract Documents for Highway Works (MCHW).* This should include the following:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
- Removal of all hard standing.
- Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
- Buried structures and old foundations have been encountered on site. These should be excavated from below the proposed development footprint with the resulting void backfilled.

5.11. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the safe allowable bearing capacity (ABC) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 27.

Table 27 Summary of ABC

GRANULAR SOILS			
Description	**Depth (Range m bgl)**	**Relative Density**	**Allowable Bearing Capacity (kN/m²)**
Clayey SAND (1 location)	1.00	Loose	40
Gravelly SAND	1.00 – 2.00	Medium Dense	100 - 228
Sandy GRAVEL	3.00 – 5.00	Medium Dense	177 - 200
Gravelly SAND / GRAVEL	3.00 – 5.00	Medium Dense	156 – 269
Gravelly SAND (1 location)	3.00	Dense	434
COHESIVE SOILS			
Description	**Depth (range m bgl)**	**Undrained Shear Strength (Cu) (kN/m²)**	**Allowable Bearing Capacity (kN/m²)**
Stiff CLAY	5.00 – 8.00	41 – 68	85 – 141
Stiff CLAY	9.50 – 11	52 – 73	107 – 151
Very stiff CLAY	1.00	85	176
Very stiff CLAY	6.50 – 9.50	77 – 88	159 – 182
Very stiff CLAY	11.00 – 15.00	104 – 193	214 – 397

The above ABC data demonstrates that within granular soils the suitable founding strata is the medium dense to dense SAND and GRAVEL with an ABC of 100 – 434 kN/m^2.

Loose SAND was identified at 1.00 m bgl (WS102) with an ABC of 17 – 52 kN/m^2.

The underlying CLAY has been identified as stiff to very stiff with an ABC of 85 – 397 kN/m^2.

5.12. FOUNDATIONS OPTIONS APPRAISAL

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe allowable bearing capacity, the following recommendations have been developed for the site of the potential foundation solutions that may be adopted for the future residential development. The suitable target founding stratum has been identified as the underlying medium-dense to dense SAND and GRAVEL and stiff to very stiff CLAY.

The proposed buildings are to be constructed either utilising full brick masonry with precast floors, or a lightweight steel frame (metsec), with an approximate load of 250 kN/m^2.

Wider trenches may be required for the taller block if full brick masonry and precast floors are utilised to achieve a load of 250 kN/m^2.

To determine if VSC is viable at the subject site, E3P has completed a Ground Improvement Design Risk Matrix that is summarised in Table 28.

Table 28 Ground Improvement Design Risk Matrix

RISK ITEM	COMMENT	PASS/FAIL
Soft clays with an undrained shear strength less than 30 kN/m^2	CLAY soils are generally stiff with Cu > 85 kN.	PASS
Ground with peat layers close to foundation level or the base of the stone column, or where intermediate layers of peat are thicker than 200 mm, either as a single layer or the sum of the thicknesses of individual layers throughout the length of the stone column	Peat has not been encountered on-site.	PASS
Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading	Made Ground beneath the site will require removal and processing to render the site suitable for VSC. The existing buildings substructure will also require excavation and processing into a graded aggregate suitable for vibro treatment.	PASS – on completion of enabling works
Loose or non-engineered fill not previously subject to rising or fluctuating water levels saturation	None identified.	PASS
Filled ground still settling or expected to settle under its own weight or due to the effects of surcharging/upfilling where there is a high organic content or where decay is continuing	None identified – buildings were present on-site circa 1890 – 2020.	PASS
Fill, containing degradable material where organic material forms more than 15% of fill by volume	None identified.	PASS
Clays with a plasticity index greater than 40%	None identified.	PASS
Highly sensitive soils liable to collapse or remoulding	None identified.	PASS
Cohesive soils with trees in influencing distance	Plots where tree influence has been modelled and will either be subject to a piled or mass trench-fill solution.	PASS
Overall Risk Rating and Suitability for Vibratory Ground Improvement		**PASS**

It is advisable to consult with geotechnical engineers and foundation specialists who can assess the specific ground conditions and design an appropriate Vibro Stone Column system to meet the project's requirements up to 250 kN/m^2. They will consider factors such as soil composition, depth, and spacing of the stone columns to ensure effective ground improvement and proper load distribution.

Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.
It is recommended that at working drawing stage a foundation schedule is prepared for the development, taking account of the physical change of natural clay soils and the current/proposed locations of trees.

At this time it is not possible to accurately define the foundation types due to the absence of a detailed tree survey and final development levels; however, based on our extensive experience of similar sites, we would anticipate that the final foundation solution would be the following:

- A driven pile to accommodate the large buildings and in areas of tree influence and/or significant level change.
- Vibro Stone Columns (VSC) may be possible at the site, up to 250 kN/m^2, subject to further input from a VSC specialist.

5.13. GROUND FLOOR SLABS

Current building control regulations require that where the infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance, it is considered that for the majority of substructures, the underlying stratum would have in excess of 600 mm of infill and, as such, a suspended floor slab will be required.

Where a cast in-situ suspended slab is utilised with no subfloor void, appropriate compressible material (heave precautions) will be required in the construction of the substructure.

In clay soils if the foundation depth is greater than 1.50 m, allowance should be made in the design for heave. This must incorporate either a clear void of a specified minimum depth under the suspended floor, or a proprietary compressible material/void former below the underside of the floor construction.

Ground bearing slabs should not be used in ground conditions where heave can occur or where the foundation depth is greater than 1.50 m. Under these circumstances a suspended floor construction should be used.

5.14. SETTLEMENT

The site has been appraised through desk based information and site investigation data in order to inform geotechnical risk where possible. Table 29 below has been formulated to determine if settlement risks are required to be further appraised.

Where any item is determined to be appraised a settlement appraisal for the site should be prepared upon receipt of development levels and layout.

Table 29 Summary of Geotechnical Information for Settlement

RISK	COMMENT	ASSESSMENT
Site is located in an area deemed to be at Risk from Ground Dissolution from desk based information	The site is a low-risk area of ground dissolution based on BGS data searches.	No Further Assessment
Site is in an area where geology is reported as having a compressible risk from desk based information	Peat deposits and soft alluvium have not been identified on the site.	No Further Assessment
Do historical maps indicate relic excavation features such as opencast or ponds that have been infilled.	None identified.	No Further Assessment
Has the site been proven to be underlain by anthropogenic materials to an unknown specification?	Yes Made Ground deposits have been encountered from 0.00 – 2.30 m bgl	Further Assessment
Have Oedometers and/or ground conditions reported compressible stratum on site?	No, materials reported a low compressibility.	No Further Assessment
Have High walls been identified on site that could result in differential settlement?	None identified.	No Further Assessment
Has any evidence been observed on site indicating settlement (non structural assessment)	None identified.	No Further Assessment
Is voided ground present beneath the site?	None identified.	No Further Assessment
Is the site in an area where a mobile groundwater regime is present in influencing distance of foundations and infrastructure?	None identified.	No Further Assessment
Will the site be subject to changes in site levels that may induce heave or settlement?	Site levels are unknown at this time.	Further Assessment

The site has been appraised as having a potential future settlement risk. In order to determine the level of risk and appropriate mitigation options a detailed settlement appraisal is required for the site. This does not form a part of the structural engineers settlement calculations associated with the sub structure however loadings will need to be considered for surcharge both static and variable pressures.

However, where piled foundations are utilised, settlement analysis will not be required.

5.15. HEAVE PRECAUTIONS

The site has been proven to be underlain by clay soils which are susceptible to volumetric instability due to fluctuations in moisture content, particularly within influencing distance of trees as per the NHBC/LABC conjectures zones of influence.

The clay has been determined as being of low volume change potential. Table 30 shows where heave precautions are required for a trench fill, pier and beam and pile and beam foundation types which are in the zone of influence of trees which are to remain or be removed.

Table 30 Position of Heave Precautions

SITUATION	TRENCH FILL	PIER AND BEAM	PILE AND BEAM
External trench fill and pier foundations. Unless NHBC is satisfied that the soil is not desiccated compressible material should be provided to the:	Inside faces of external wall foundations deeper than 1.5m, based on the appropriate tree height.	All faces of pier foundations deeper than 1.5m, based on the appropriate tree height.	N/A
External ground beams. Unless NHBC is satisfied that the soil is not desiccated, compressible material or void formers should be provided to the:	N/A	Inside faces	Inside faces
Internal trench fill foundations and ground beams. Compressible material required:	No	No	No
External and internal ground beams. Compressible material, void former or void should be provided to the underside of:	N/A	All	All
Heave precautions required for proposed trees where the soil is not desiccated:	No	No	No

Note: Information taken from NHBC Standards 2024, Chapter 4.2, Table 8 – Position of heave precautions

A summary of heave precautions is presented in Table 31.

Table 31 Summary of Heave Precautions

VOLUME CHANGE POTENTIAL	VOID DIMENSION AGAINST SIDE OF FOUNDATION AND GROUND BEAM	VOID DIMENSION UNDER GROUND BEAMS, AND SUSPENDED IN-SITU CONCRETE GROUND FLOOR	VOID DIMENSION UNDER SUSPENDED PRECAST CONCRETE AND TIMBER FLOORS(1)
High	35mm	150mm	300mm
Medium	25mm	100mm	250mm
Low	0mm	50mm	200mm

In addition to the requirements of the 'Drainage' section, drainage near trees should incorporate additional provisions. Where there is a volume change potential within the ground, the provisions include:

- Increased falls to cater for any ground movement.
- Deeper and wider backfill of granular material.
- A drainage system that is capable of movement should heave and shrinkage occur.
- Drainage pipes should not be encased in concrete.
- Additional clearance is required where drains pass through the structure of a building to allow for additional movement.

5.16. HIGHWAYS CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the Manual of Contract Documents for Highway Works Volume 1 Specification For Highway Works (Series 600-Earthworks) for a method compaction.

5.17. DRAINAGE

Where loose or soft materials have been identified at drainage invert levels, there will need to be consideration for the use of reinforced pipe bedding.

Shrinkage and heave of clay soils can affect pipelines. To protect against the effects of heave, drainage should be designed:

- To take account of potential ground movement as shown in Table 32 , including where pipes and services pass through substructure walls or foundations.
- With gradients which may need to be steeper.
- To use alternative means of catering for the movement when sufficient falls cannot be provided, for example, by deepening the excavation and laying pipework on a granular bedding of suitable thickness to reduce the extent of potential movement.

Table 32 Potential Ground Movement for Drainage

VOLUME CHANGE POTENTIAL	HIGH	MEDIUM	LOW
Potential ground movement	150mm	100mm	50mm

5.18. EXCAVATIONS

Trial pits were generally stable in both Made Ground and natural strata; as such, it is considered that near-surface excavations will be feasible.

Site observations indicated that excavations should be feasible in the near surface with normal plant; however, obstructions were identified in the near surface, including former foundations and former floor slabs. It is anticipated that any obstructions will be grubbed out during the reduced-level dig for the substructure works.

However, due to the depth and variability of the Made Ground and likelihood of trench collapse, it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations then consideration should be given to the potential for dewatering gravels in the surrounding areas that may cause structural damage to building substructures in close proximity to the site.

Table 33 Civil Engineering Excavation Risk Matrix

RISK ITEM	PRESENT	COMMENT
Running Sands	No	No running sand has been identified.
Minor Water Ingress	No	Minor water ingress will require localised dewatering/sump pumping during the construction of site drainage infrastructure. Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed.
Shallow Bedrock	No	Shallow bedrock has not been identified.

5.19. 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 formations and subformations 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 should be utilised.
- It is considered that dewatering 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, to include the use of personnel protective equipment (PPE).

5.20. DEVELOPED GEOTECHNICAL RISK REGISTER

POTENTIAL ABNORMAL CONSTRAINT	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils	On site	0	No exceedances within Made Ground or natural soils have been encountered.
Obstructions	All	100	Site has been subject to significant historical development and, while above-ground structures have been removed, subsurface obstruction from relict foundations and slabs remain.
Artificially levelled and filled platforms	All	100	The site has been levelled and artificially backfilled with Made Ground deposits encountered from 0.00 – 2.30 m bgl.
Trench collapse	All	100	Made Ground present beneath the site is likely to be loosely compacted and possibly prone to collapse.
Drainage Invert levels	All	100	Loose materials present at drainage invert levels – reinforced pipe bedding will be required.
Mature trees	Boundaries and centre	20	Arboriculture survey required to determine areas of potential tree influence. The site is predominantly surfaced by hardstanding, however a number of semi mature trees are present in the centre of the site and around the boundaries of the site.
Volume change potential clay	On site	80	The site is underlain by cohesive and granular soils. The cohesive soils have been assessed as having a low volume change potential, and therefore heave precautions may not be required at the site.
Running sands	N/A	N/A	Data searches indicate low risk.
Ground dissolution	N/A	N/A	Data searches indicate no hazard.
Concrete design	All	100	Concrete classification is DS-1, AC-1s.
Low-permeability ground	All	50	In two locations (SA101 and SA102) tests showed granular drift deposits to have good soakage potential, however in locations where clay drift deposits were present, soakage potential was significantly reduced.
Services/sensitive structures	All	100	A GPR survey of the site has identified electric and drainage channels. Evidence of redundant service can also be seen.
Abnormal foundation solutions	All	100	Deep Made Ground deposits have been identified on site, that will be subject to volume change and abnormal foundation solution (MTF, VSC, Pile) may be required. It is assumed that a piled foundation will be required due to the high rise development load.

POTENTIAL ABNORMAL CONSTRAINT	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Enabling Earthworks	All	100	All proposed earthworks will need to be designed by a suitably qualified geotechnical engineer in accordance with NHBC Chapter 4.6. The earthworks design will incorporate a Geotechnical Specification for Earthworks that will define protocols to ensure no unacceptable future risk.

5.21. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Arboricultural survey.
- Geotechnical Design Report (GDR)
- Geotechnical Earthworks Strategy (infrastructure).
- Remediation and Enabling Works Strategy.

END OF REPORT

APPENDIX I
LIMITATIONS



GENERAL

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P “Terms of Business” or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.

2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.

3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.

4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEOENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

5. Coverage: This section covers reports with the following titles or combination of titles: Phase 1; Desktop Study; Geoenvironmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Baseline Environmental Assessment; Project Scope Summary Report (PSSR), Program Environmental Impact Report (PEIR), Geotechnical Development Risk Register; Agricultural Land Assessment; Mineral Safeguarding Assessment; Desk Top Coal Mining Risk Assessment; Hydrogeological Appraisal; Construction Environmental Management Plan; and Site Water Management Plan.

6. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.

7. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.

8. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.

9. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and does not constitute or replace full and proper surveys completed by suitably qualified and experienced specialists in these fields.

10. E3P does not warrant work/data undertaken/provided by others.

INTRUSIVE INVESTIGATION REPORTS

11. Coverage: The following report titles (or combination) may cover this category of work: Geoenvironmental Site Investigation; Geotechnical Assessment; GIR (Ground Investigation Reports); Preliminary Environmental And Geotechnical Risk Assessment; Preliminary Summary; Coal Mining Risk Assessment, Ground Gas Addendum; and, Geotechnical Risk Register.

12. The investigation has been undertaken to provide information concerning either:

    I. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or

    II. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.

13. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

14. Unless otherwise specified in the scope of works, any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

15. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.

16. For geotechnical investigations, the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.

17. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.

18. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

19. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, E3P has used reasonable skill and care to extrapolate conditions between these points based on assumptions to develop our interpretation and conclusions.

20. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation and at the time of the investigation.

21. Conditions can change between investigation points both spatially and over time and these interpretations should therefore be considered indicative. The assessment of extreme weather events and their impact on ground conditions is not within the scope of E3P's work.

22. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the risk assessment process have been outlined within the body or associated appendix of the report.

23. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.

24. Where soil contamination concentrations recorded as part of this investigation are used for commentary on the potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed and the waste classification and any subsequent disposal option agreed upon with licenced subcontractors and/or the relevant regulators.

25. The results of the asbestos testing are factually reported and interpretation is given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.

26. If costs have been included in relation to additional site works, and/or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

27. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.

28. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIATION AND ENABLING WORK STRATEGY REPORTS

29. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected based on the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.

30. The outputs of the Detailed Quantitative Risk Assessments are based upon the manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.

31. Before adoption on-site, assessment criteria will need to be discussed and agreed upon with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of E3P. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

32. E3P does not accept liability for any subcontract work that has not been completed in strict accordance with an approved E3P Remediation and Enabling Works Strategy.

GEOTECHNICAL DESIGN REPORT (GDR)

33. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS AND BUILD PHASE MITIGATION)

34. These reports are factual and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of earthworks or remedial works.

35. The data is presented and will be compared with assessment criteria.

APPENDIX II
GLOSSARY



TERMS

ACM	Asbestos-containing material	**MMP**	Materials management plan
ADS	Acoustic design statement	**ND**	Not detected
AST	Above-ground storage tank	**NDP**	Nuclear density probe
BGS	British Geological Survey	**NMP**	Noise management plan
BSI	British Standards Institute	**NPSE**	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	**NR**	Not recorded
CA	Coal Authority	**PAH**	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	**PCB**	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	**PI**	Plasticity index
CIRIA	Construction Industry Research Association	**PID**	Photo ionisation detector
CLEA	Contaminated land exposure assessment	**POS**	Public open space
CML	Council of Mortgage Lenders	**PPE**	Personnel protective equipment
CoC	Contaminants of concern	**ProPG**	Professional practice guidance
CSM	Conceptual site model	**QA**	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	**SGV**	Soil guideline value
DWS	Drinking water standard	**SPH**	Separate-phase hydrocarbon
EA	Environment Agency	**SPT**	Standard penetration test
EQS	Environmental quality standard	**SVOC**	Semi-volatile organic compound
FFL	Finished floor level	**TPH**	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	**UKWIR**	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	**UST**	Underground storage tank
HCV	Health criteria value	**VCC**	Vibro-concrete column
ICSM	Initial conceptual site model	**VOC**	Volatile organic compound
LEL	Lower explosive limit	**VRSC**	Vibro-replacement stone columns

LMRL	Lower method reporting limit	**VSC**	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	**WHO**	World Health Organisation
MCV	Moisture condition value	**WRAP**	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	**WTE**	Water table elevation
m	Metres	**ppm**	Parts per million
km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	Kilonewtons per metre squared
ppb	Parts per billion	**µm**	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	**SSRT**	Site Specific Remediation Target
PSD	Particle Size Distribution	**DD**	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	**Mc**	Moisture Content
ρ	Bulk Density	**GPR**	Ground Penetrating Radar
NDP	Nuclear Density Probe	**FFL**	Finished Floor Level
LEL	Lower Explosive Limit	**UKWIR**	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	**LOD**	Limit of Detection

APPENDIX III
RISK CLASSIFICATION



RISK CLASSIFICATION

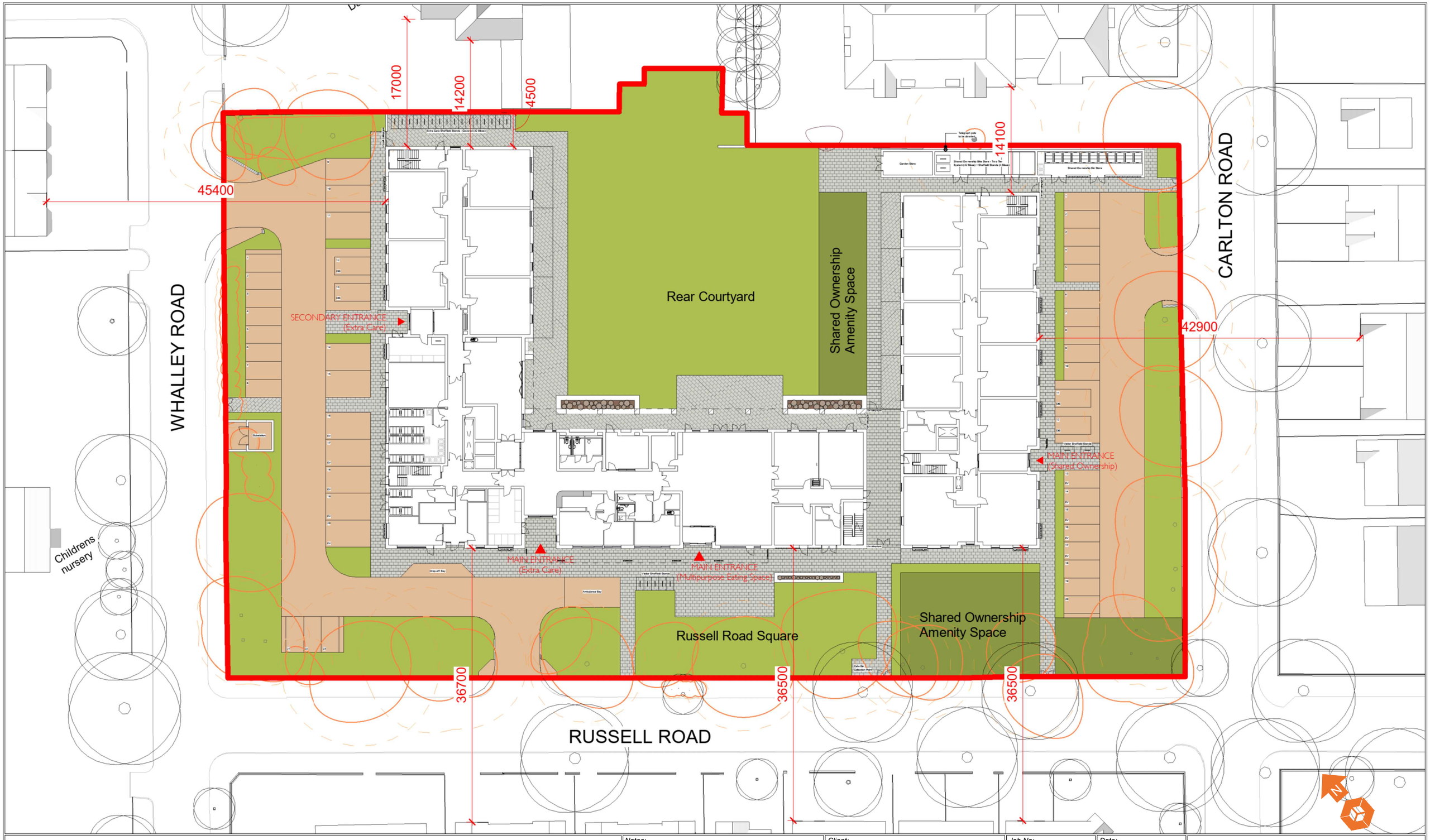
RISK	DEFINITION
Low	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property.
Low Moderate	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property with regard to the proposed use. However, minor issues may require further consideration in the event of future redevelopment of the Site.
Moderate	Some potential contaminated land liabilities/geotechnical constraints are likely to affect the property as a result of historical and/or current activities. The risks identified are unlikely to pose an immediate significant issue but the purchaser/developer may wish to make further enquiries of the vendor or undertake further environmental improvements. Redevelopment of the Site will likely require further site investigation.
Moderate High	Some potentially significant contaminated land liabilities/geotechnical constraints have been identified at the property that requires further assessment, including intrusive ground investigations.
High	Significant potential contaminated land liabilities/geotechnical constraints have been identified at the property. Further assessment including intrusive ground investigation will be required to determine the level of risk and associated liability.

APPENDIX IV
DRAWINGS



DRAWING 17-013-001 – SITE LOCATION PLAN





P1	REVB	17.07.2024	CB	EF	EF
P1	REVA	04.04.2024	EB	EF	EF
Phase	Issue	Date	Drawn	Checked	PM

Notes:

Client: Rowlinson

Job No: 17-013

Date: 17.07.2024

Drawing No: 002

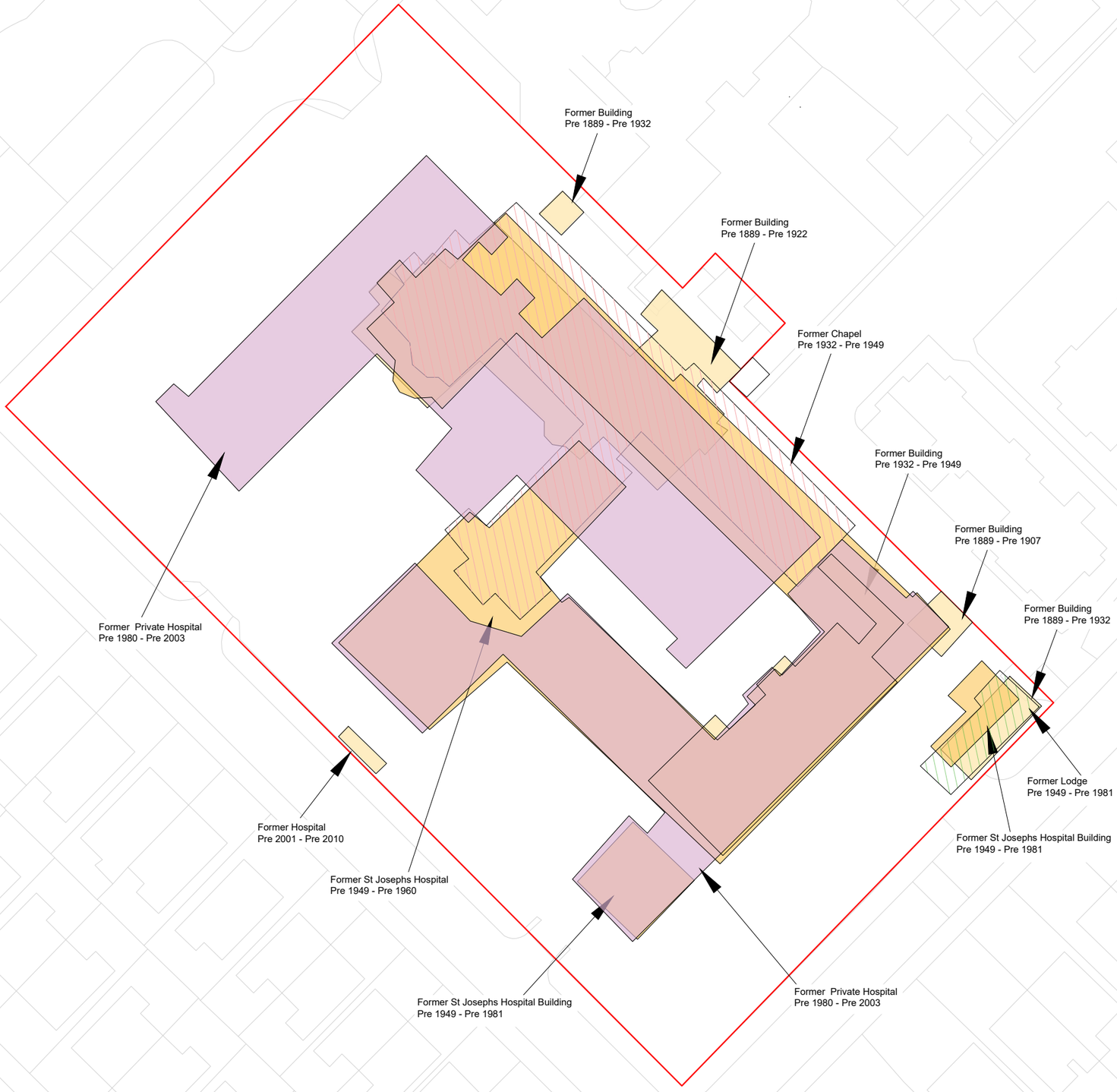
Scale: NTS @ A3

Job Title: Russell Road Extra Care Housing

Drawing Title: Proposed Development Plan

e3p
Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Historical Features

- Former Chapel
- Former Building
- Former St Josephs Hospital
- Former Private Hospital
- Former Lodge

Notes:

Client: Rowlinson

Job No: 17-013

Date: 21.03.2024

Drawing No: 003

Scale: NTS @ A3

P1	REVA	21.03.2024	OW	HM	EF
Phase	Issue	Date	Drawn	Checked	PM

Job Title: Russell Road Extra Care Housing

Drawing Title: Historical Features Plan

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Site Features

- Substation
- Access Points (Blocked)
- Main Entrance
- Hardstanding
- Trees/Vegetation

Notes:

P1	REVA	21.03.2024	OW	HM	EF
Phase	Issue	Date	Drawn	Checked	PM

Client: Rowlinson

Job No: 17-013

Date: 21.03.2024

Drawing No: 004

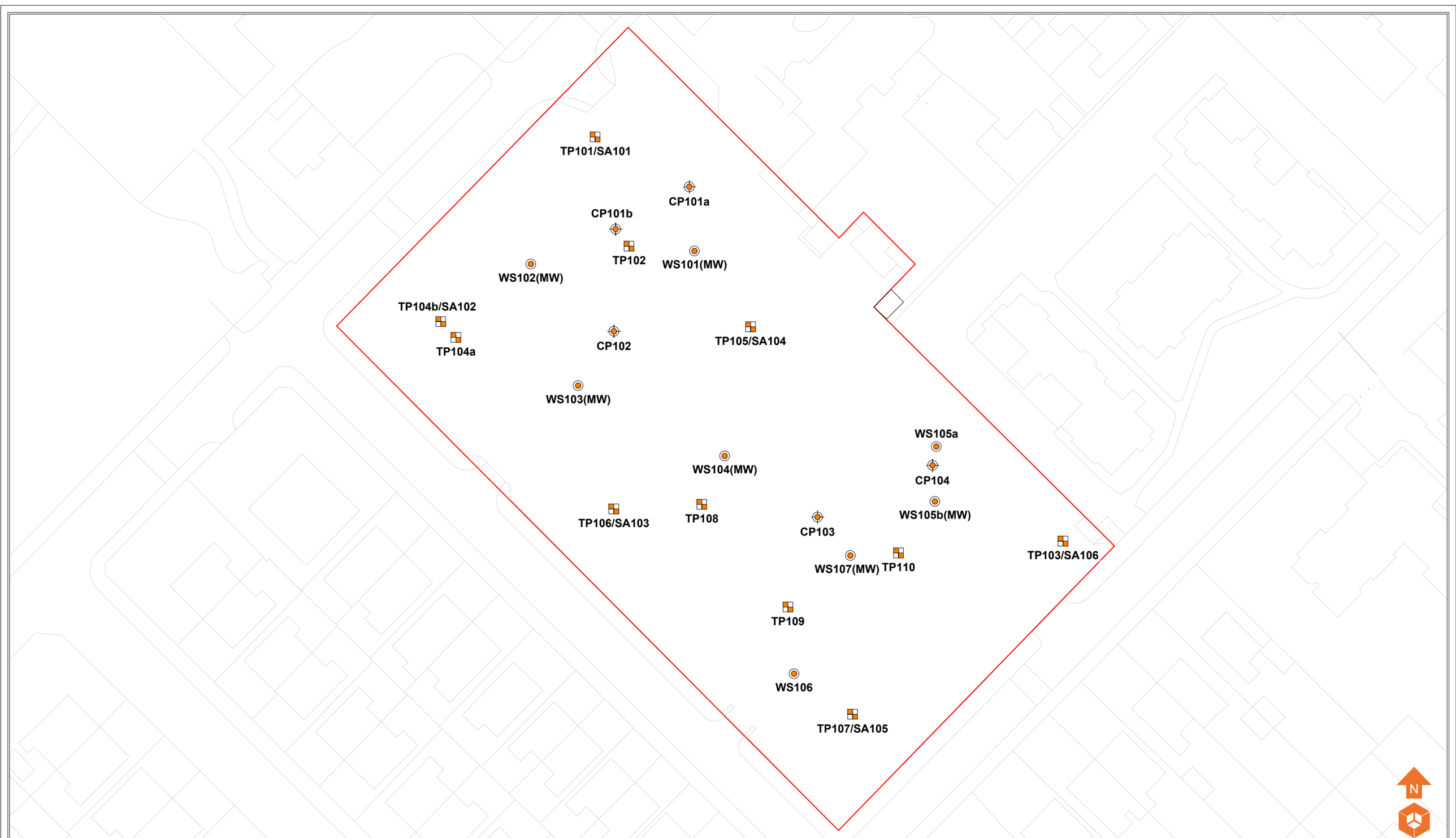
Scale: NTS @ A3

Job Title: Russell Road Extra Care Housing

Drawing Title: Site Features Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P March 2024)
- Approximate Trial Pit Location (E3P March 2024)
- Approximate Soakaway Test Location (E3P March 2024)
- Approximate Window Sample Probehole Location with Install (E3P March 2024)

Notes:

Client: Rowlinson

Job No: 17-013

Date: 30.04.2024

Drawing No: 005

Scale: NTS @ A3

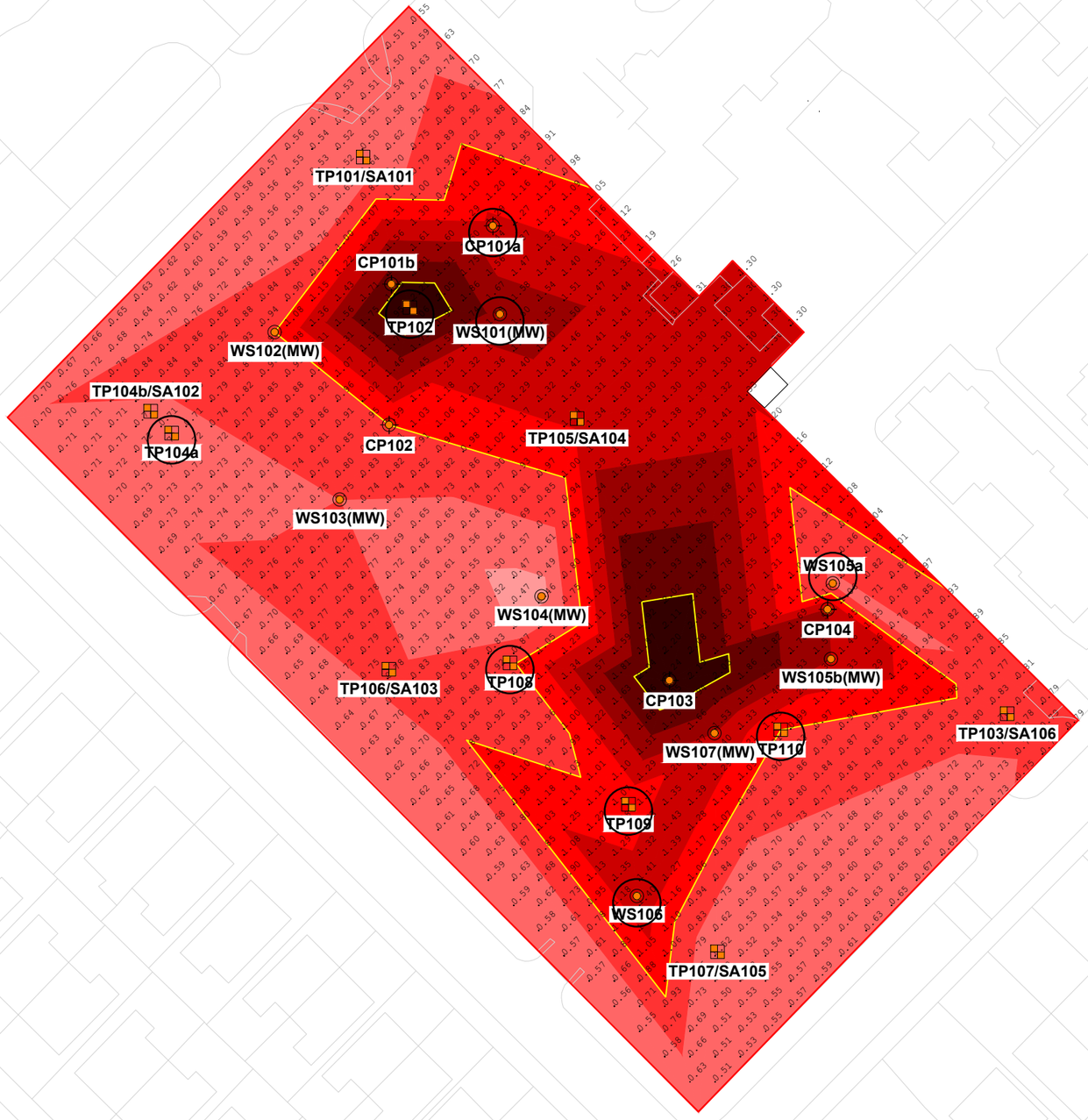
Phase	Issue	Date	Drawn	Checked	PM
P1	REVB	30.04.2024	EB	HM	EF
P1	REVA	04.04.2024	EB	EF	EF

Job Title: Russell Road Extra Care Housing

Drawing Title: Exploratory Hole Location Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P March 2024)
- Approximate Trial Pit Location (E3P March 2024)
- Approximate Soakaway Test Location (E3P March 2024)
- Approximate Window Sample Probehole Location with Install (E3P March 2024)

Made Ground Depth (m)

- Depth of Made Ground 0.25 - 0.49m
- Depth of Made Ground 0.50 - 0.74m
- Depth of Made Ground 0.75 - 0.99m
- Depth of Made Ground 1.00 - 1.24m
- Depth of Made Ground 1.25 - 1.49m
- Depth of Made Ground 1.50 - 1.74m
- Depth of Made Ground 1.75 - 1.99m
- Depth of Made Ground >2.00m
- Base of Made Ground Not Encountered

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVB	30.04.2024	EB	HM	HM
P1	REVA	04.04.2024	EB	EF	EF

Client:

Rowlinson

Job No: 17-013

Date: 30.04.2024

Drawing No: 006

Scale: NTS @ A3

Job Title:

Russell Road Extra Care Housing

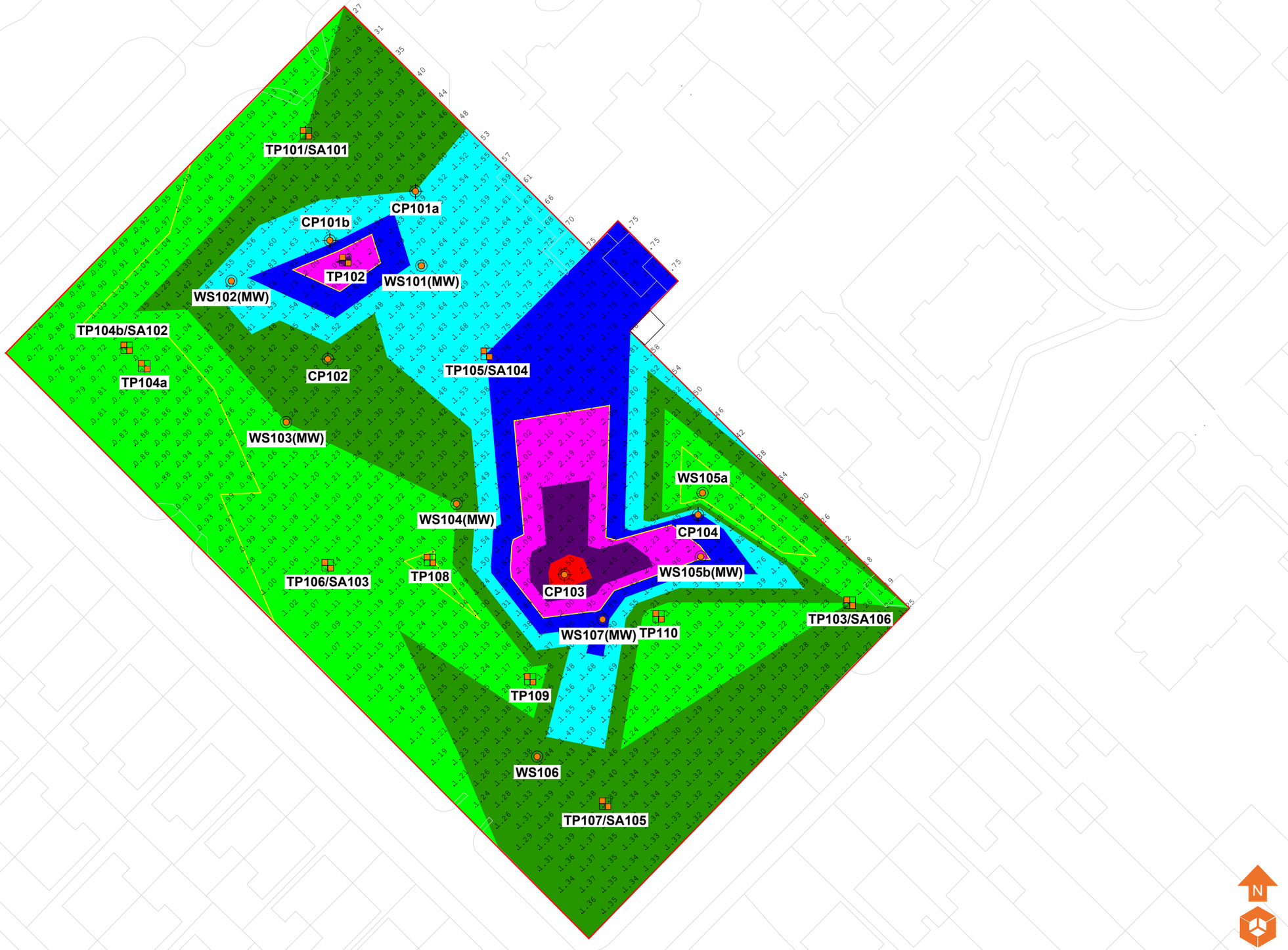
Drawing Title:

Depth of Made Ground Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P March 2024)
- Approximate Trial Pit Location (E3P March 2024)
- Approximate Soakaway Test Location (E3P March 2024)
- Approximate Window Sample Probehole Location with Install (E3P March 2024)

Shallow Spread Footings

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVA	30.04.2024	EB	HM	EF

Client: Rowlinson

Job No: 17-013

Date: 30.04.2024

Drawing No: 008

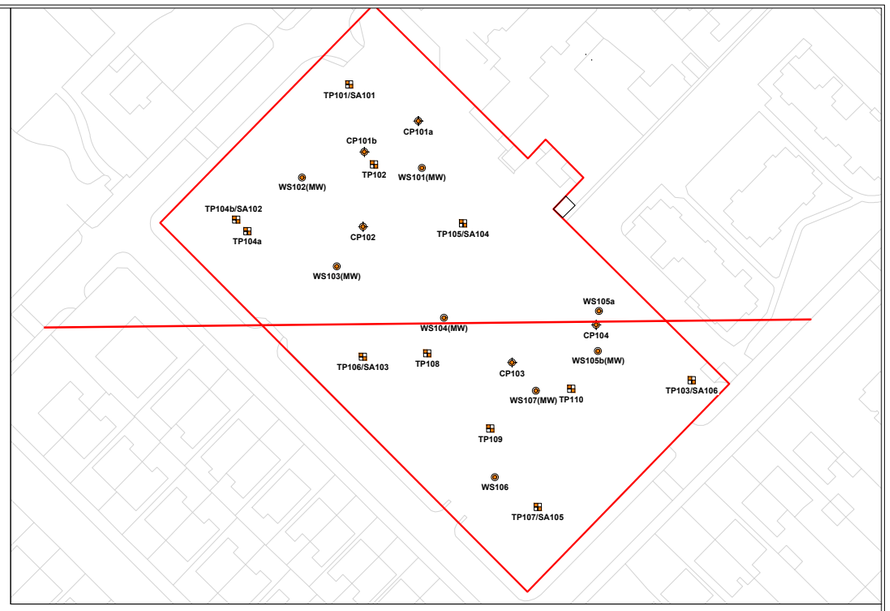
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Job Title: Russell Road Extra Care Housing

Drawing Title: Depth to Founding Strata Plan

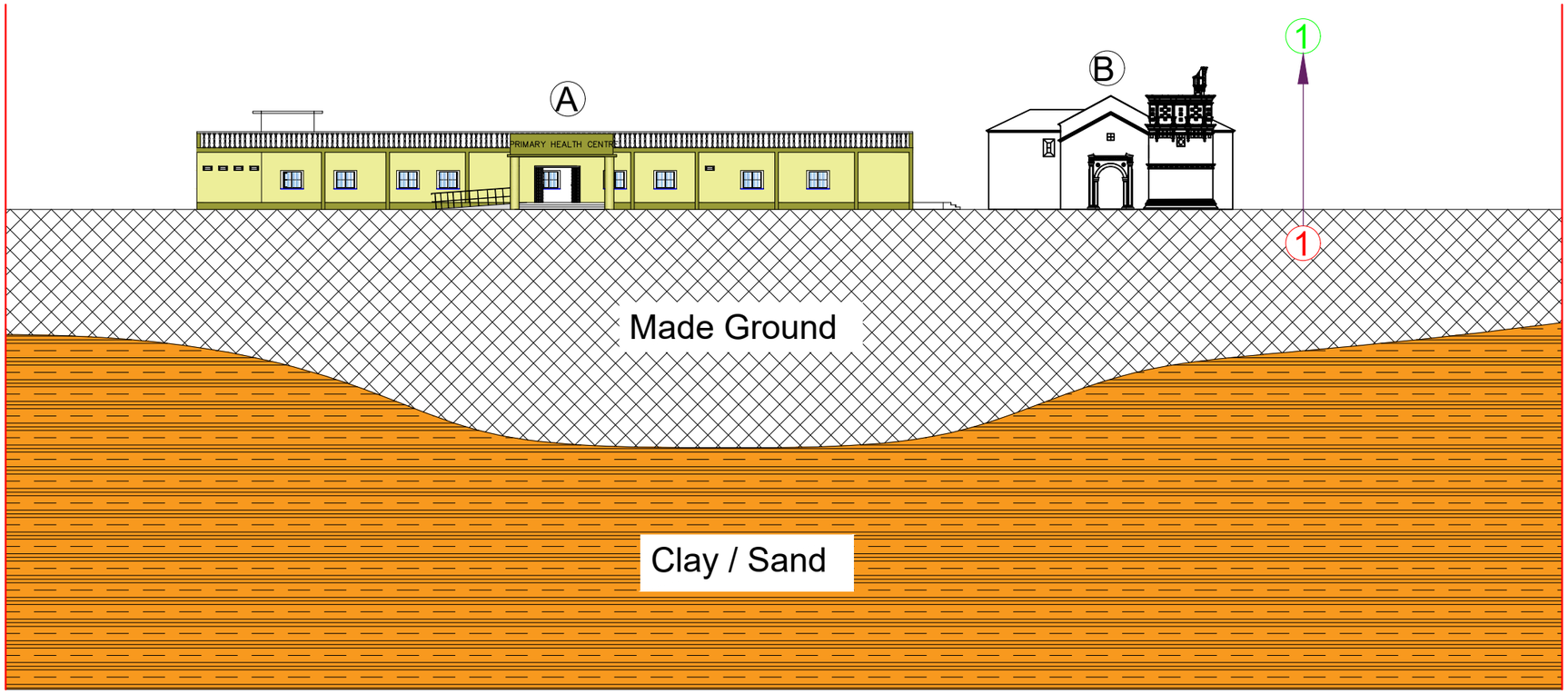
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W

E



Geology Key
- Made Ground
- Clay / Sand

Sources
- (1) ACM

Pathways
- Dust Inhalation

Receptors
- (1) Current / Future End Users

Site Features
- (A) Former Hospital
- (B) Former Chapel

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVA	30.04.2024	EB	HM	EF

Client: Rowlinson

Job No: 17-013

Date: 30.04.2024

Drawing No: 010

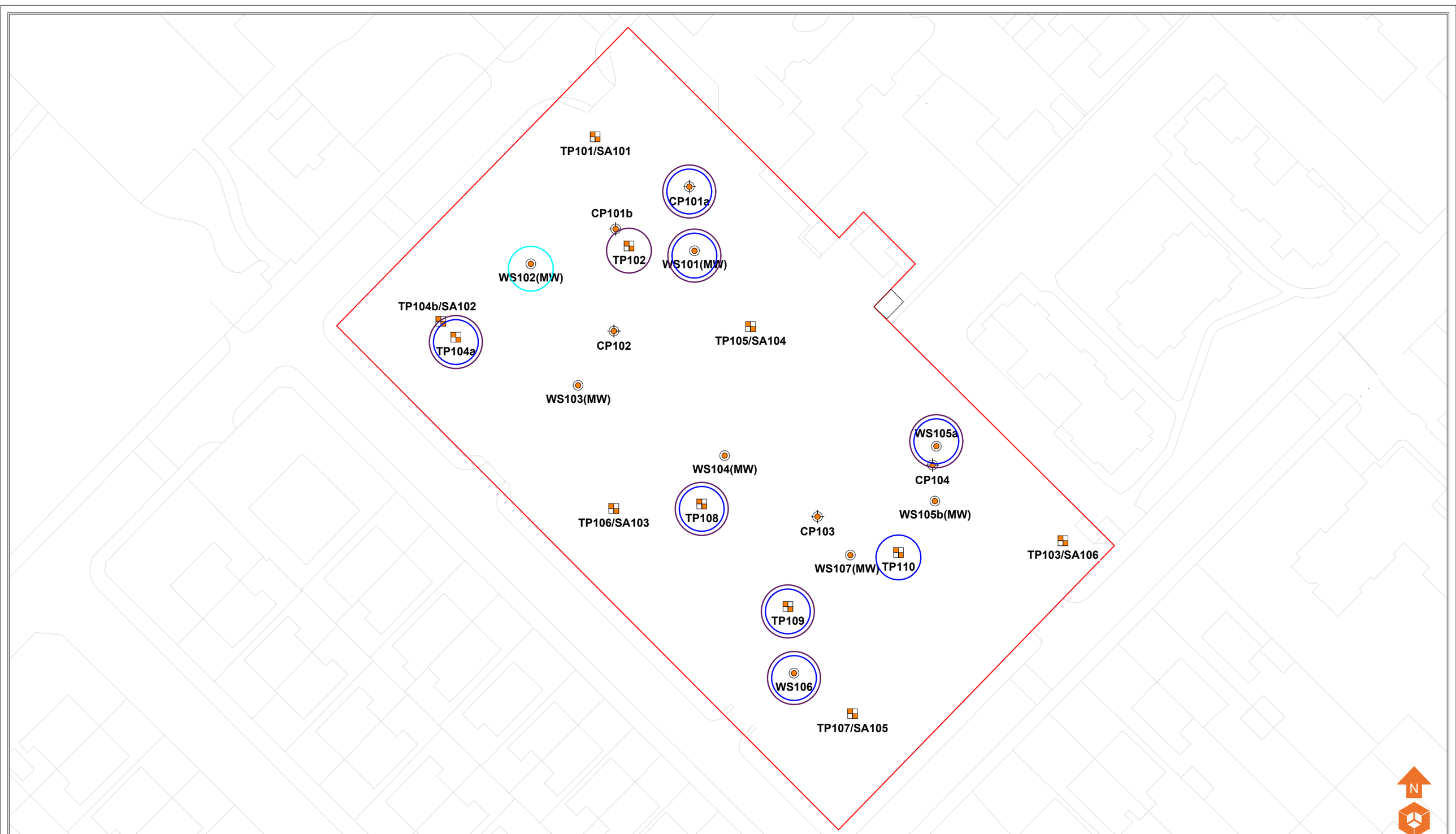
Scale: NTS

Job Title: Russell Road Extra Care Housing

Drawing Title: Conceptual Site Model

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Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
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Location Symbols

- Approximate Window Sample Probehole Location (E3P March 2024)
- Approximate Trial Pit Location (E3P March 2024)
- Approximate Soakaway Test Location (E3P March 2024)
- Approximate Window Sample Probehole Location with Install (E3P March 2024)

Development Constraints

- Base of Made Ground Not Encountered
- Loose Sand
- Construction Obstruction

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVA	30.04.2024	EB	HM	EF

Client: Rowlinson

Job No: 17-013

Date: 30.04.2024

Drawing No: 015

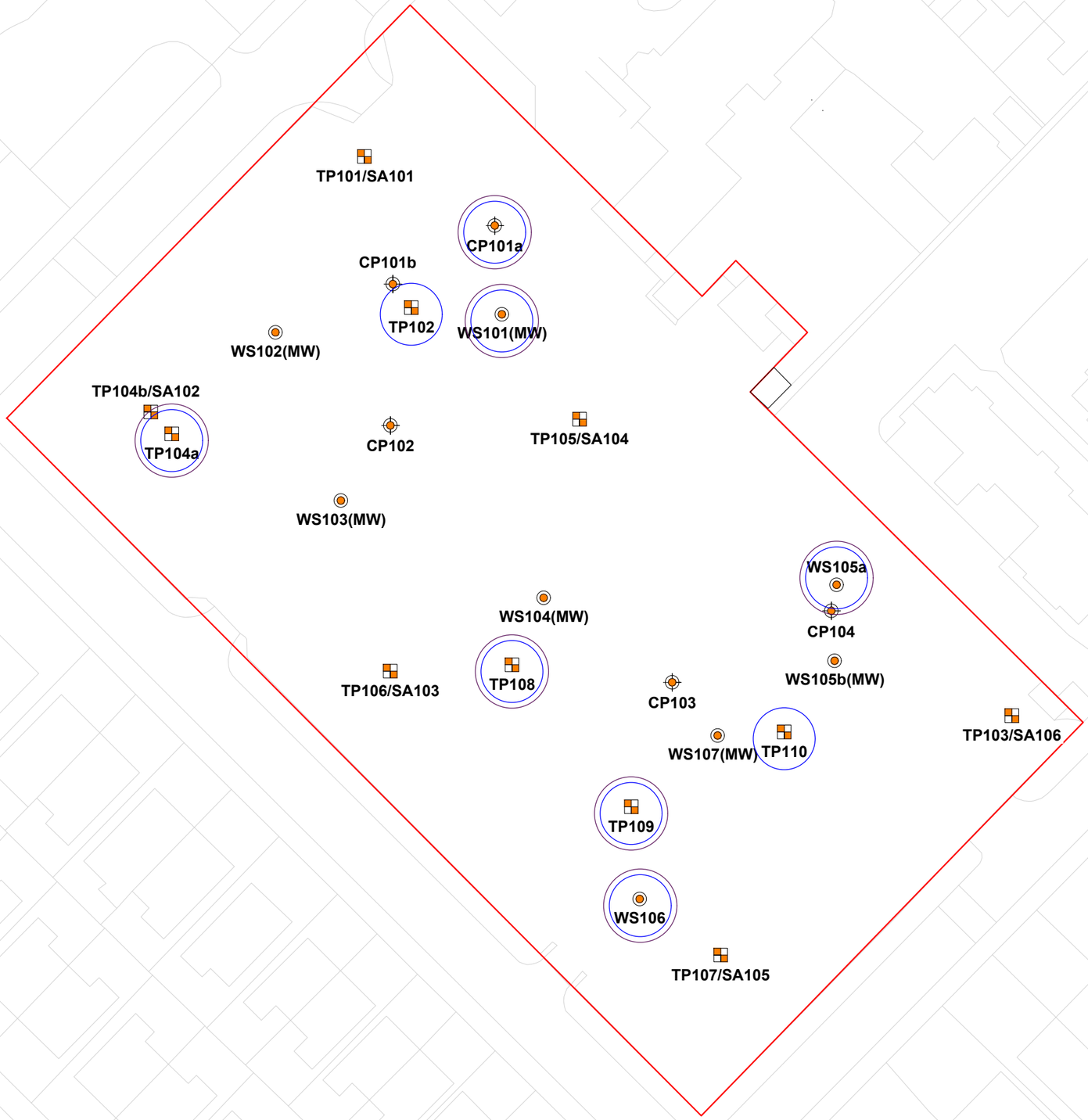
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Job Title: Russell Road Extra Care Housing

Drawing Title: Development Constraints Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P March 2024)
- Approximate Trial Pit Location (E3P March 2024)
- Approximate Soakaway Test Location (E3P March 2024)
- Approximate Window Sample Probehole Location with Install (E3P March 2024)

Obstructions

- Base of Made Ground Not Encountered
- Construction Obstruction

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVA	30.04.2024	EB	HM	EF

Client: Rowlinson

Job No: 17-013

Date: 30.04.2024

Drawing No: 017

Scale: NTS @ A3

Job Title: Russell Road Extra Care Housing

Drawing Title: Obstructions Plan

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APPENDIX V
PHOTOGRAPHS



PLATE 1 ACROSS THE SITE – FACING EAST



PLATE 2 CENTRAL SITE



PLATE 3 TP102 – CONCRETE OBSTRUCTIONS



PLATE 4 SITE ENTRANCE



APPENDIX VI
HISTORICAL MAPS





Groundsure INSIGHTS

Site Details:

1, WHALLEY AVENUE,
WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

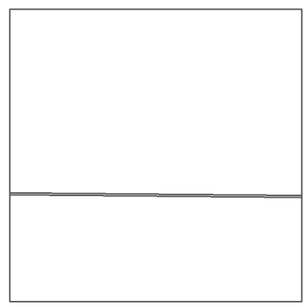
Map date: **1881**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1881
Revised N/A
Edition 1881
Copyright N/A
Levelled N/A



Surveyed 1881
Revised N/A
Edition 1881
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Map legend available at:
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Groundsure INSIGHTS

Site Details:

1, WHALLEY AVENUE,
WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

Map date: **1889-1894**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1889
Revised N/A
Edition 1889
Copyright N/A
Levelled N/A

Surveyed 1894
Revised N/A
Edition 1894
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Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf



Groundsure INSIGHTS

Site Details:

1, WHALLEY AVENUE,
WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

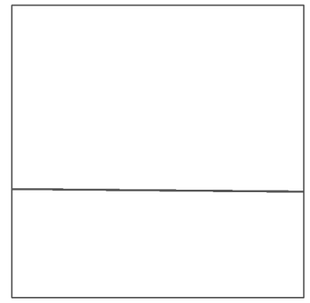
Map date: **1907-1908**

Scale: 1:2,500

Printed at: 1:2,500

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Revised 1905
Edition 1908
Copyright N/A
Levelled N/A



Surveyed 1891
Revised 1905
Edition 1907
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Production date: 13 March 2024

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf



Groundsure INSIGHTS

Site Details:

1, WHALLEY AVENUE,
WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

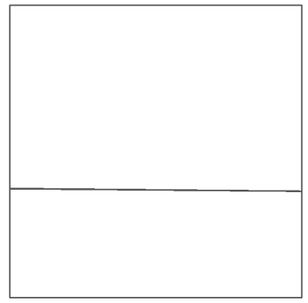
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Scale: 1:2,500

Printed at: 1:2,500

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Edition 1922
Copyright N/A
Levelled 1915



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Revised 1916
Edition 1922
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Levelled 1915

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Groundsure INSIGHTS

Site Details:

1, WHALLEY AVENUE,
WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

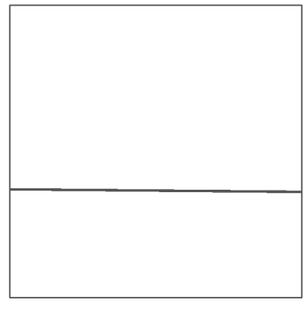
Map date: **1932-1933**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1873
Revised 1932
Edition N/A
Copyright N/A
Levelled 1927



Surveyed 1873
Revised 1933
Edition N/A
Copyright N/A
Levelled 1927

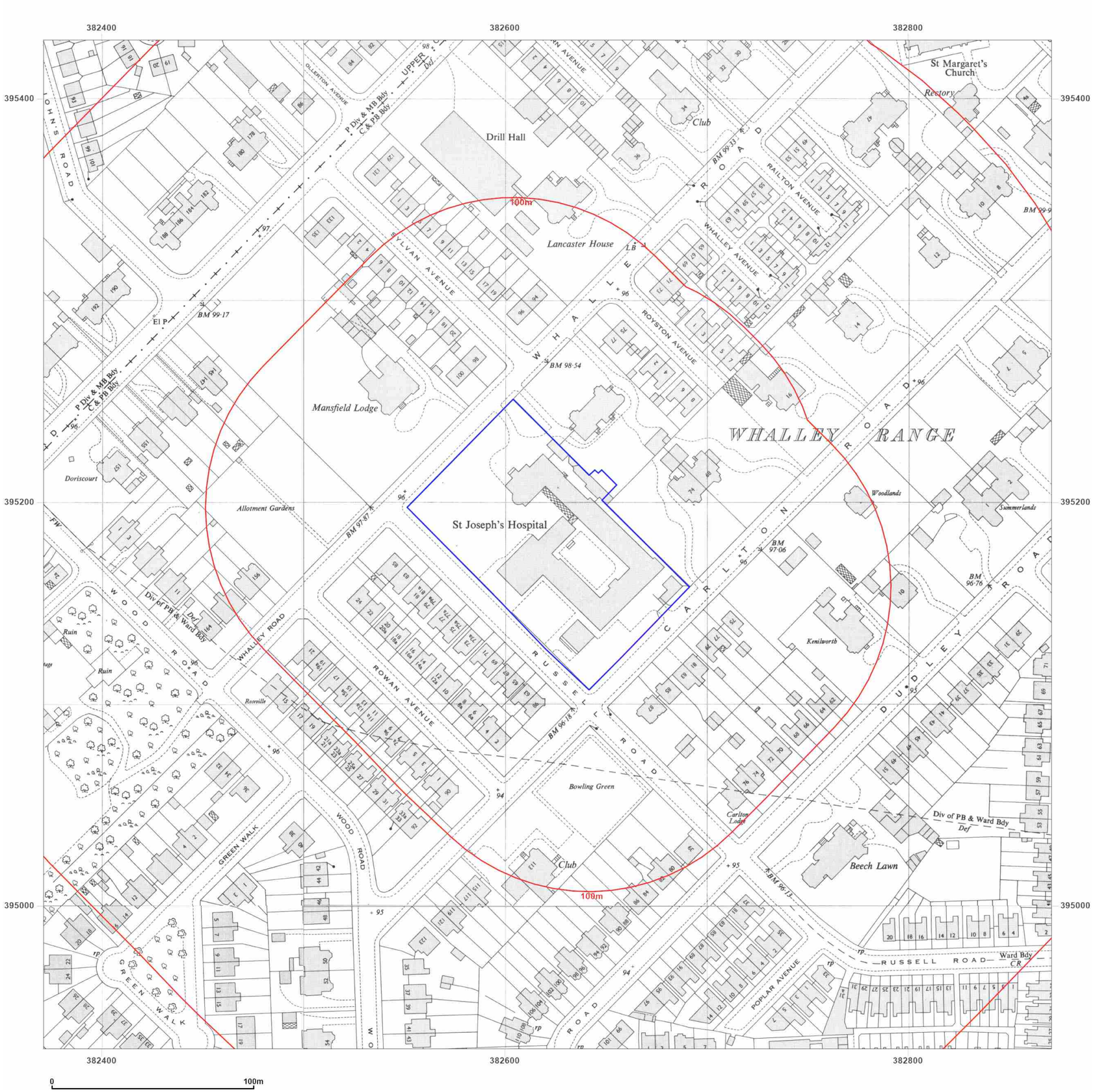
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Site Details:

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1949-1950**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed 1949 Revised 1949 Edition N/A Copyright N/A Levelled N/A		Surveyed 1949 Revised 1949 Edition N/A Copyright N/A Levelled 1927
Surveyed 1950 Revised 1950 Edition N/A Copyright N/A Levelled 1927		Surveyed 1950 Revised 1950 Edition N/A Copyright N/A Levelled 1927

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Site Details:

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1949-1950**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1949
Revised 1949
Edition N/A
Copyright N/A
Levelled 1927

Surveyed 1950
Revised 1950
Edition N/A
Copyright N/A
Levelled 1927

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Site Details:

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1951-1956**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1956
Revised 1956
Edition 1964
Copyright 1964
Levelled 1958

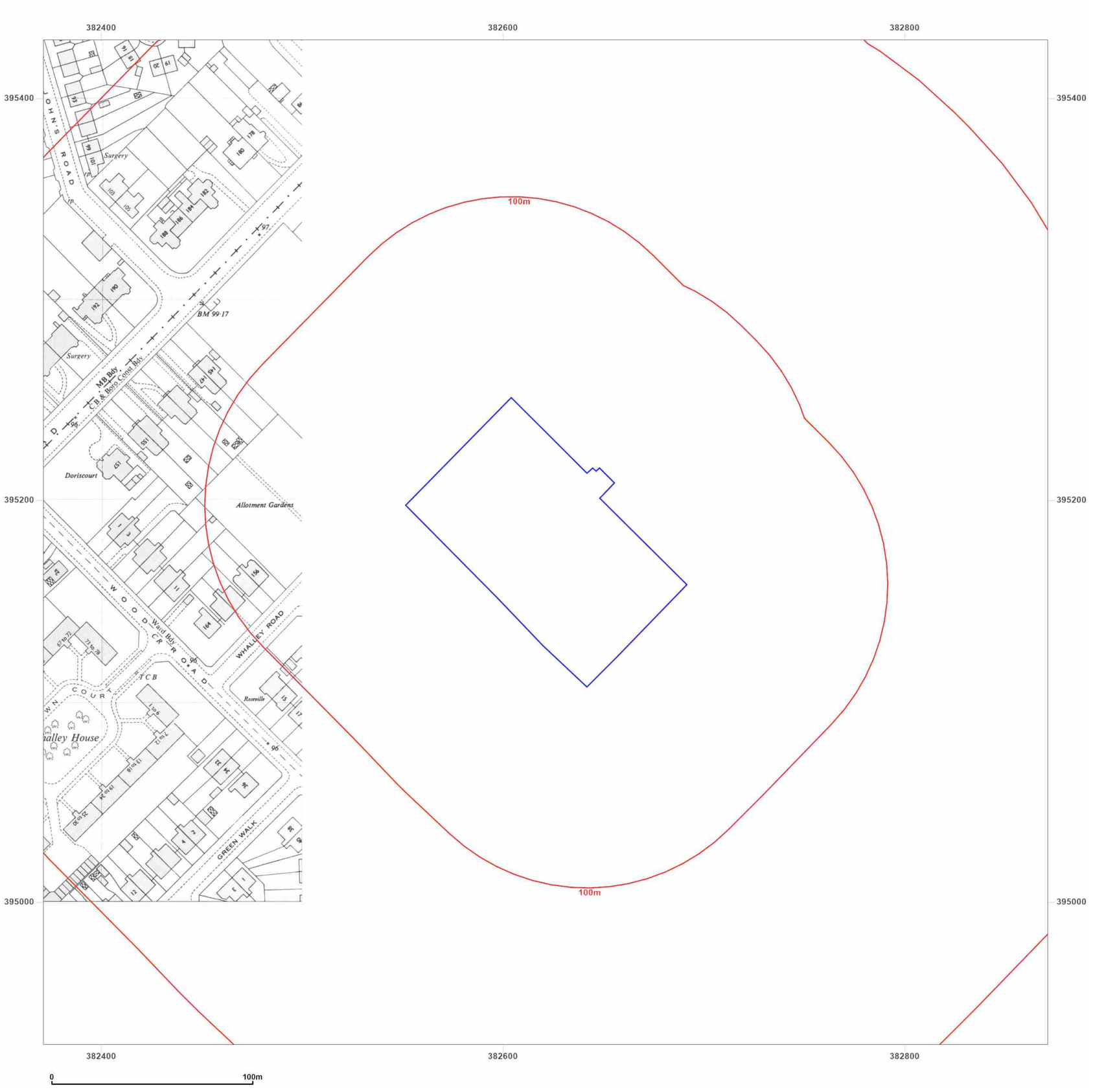
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1959**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1959-1960**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed 1949 Revised 1958 Edition N/A Copyright 1959 Levelled 1927	Surveyed 1949 Revised 1960 Edition N/A Copyright 1960 Levelled 1958
	Surveyed 1950 Revised 1960 Edition N/A Copyright 1960 Levelled 1958

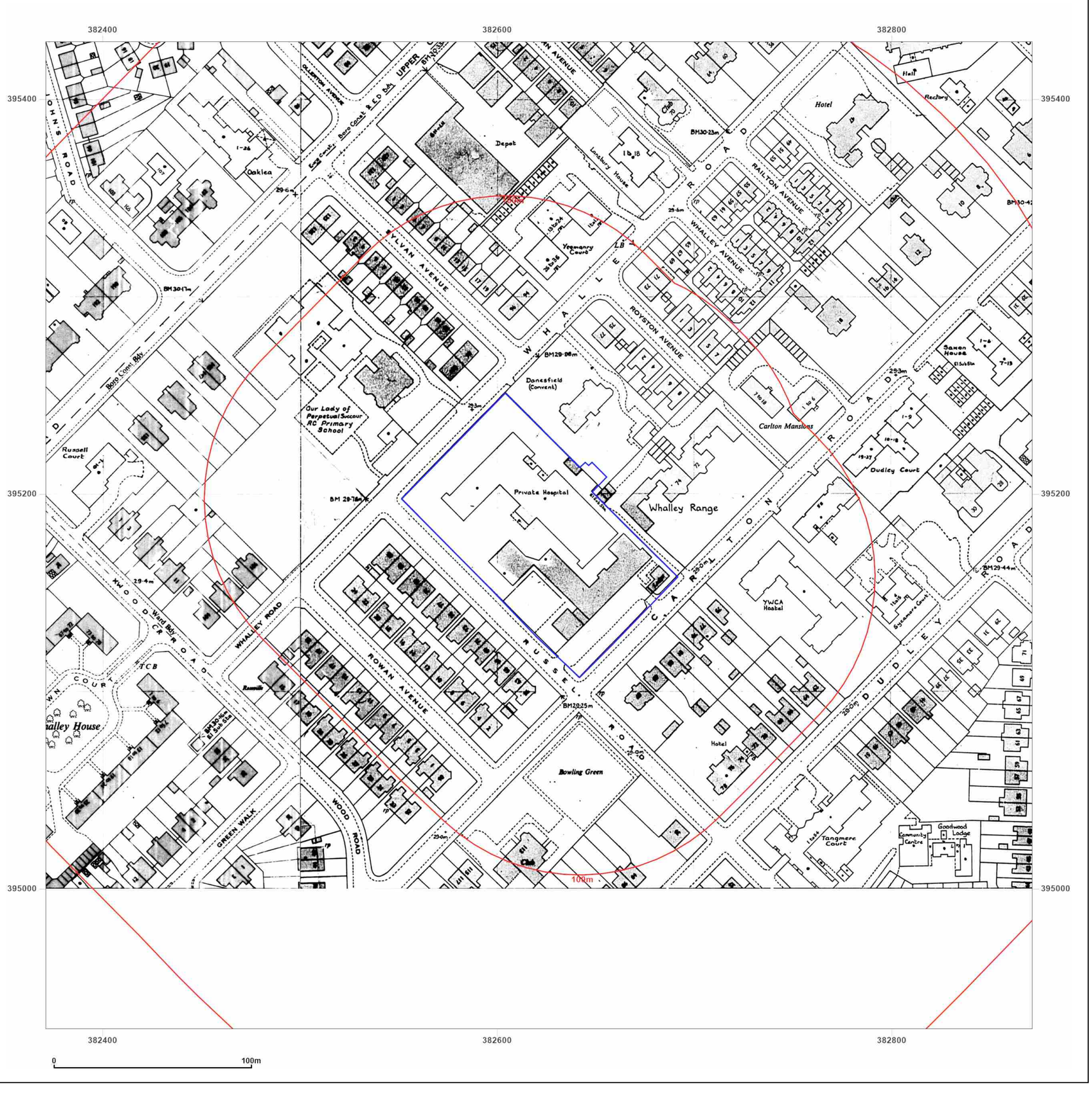
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1980-1981**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A	Surveyed N/A
Revised N/A	Revised N/A
Edition N/A	Edition N/A
Copyright N/A	Copyright 1981
Levelled N/A	Levelled 1968

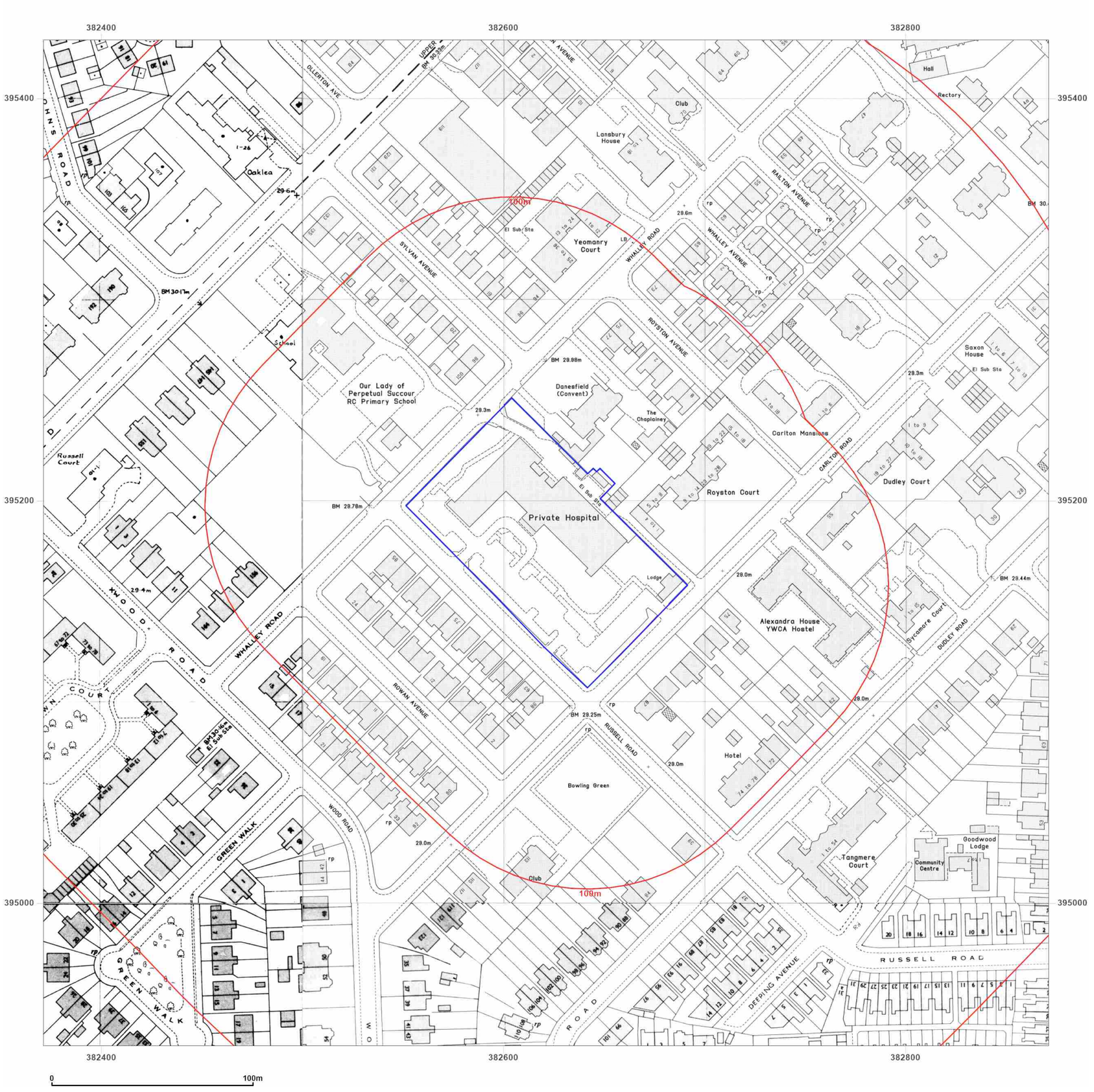
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1986-1989**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed 1958 Revised 1989 Edition N/A Copyright 1989 Levelled 1958		Surveyed 1949 Revised 1986 Edition N/A Copyright 1987 Levelled 1958
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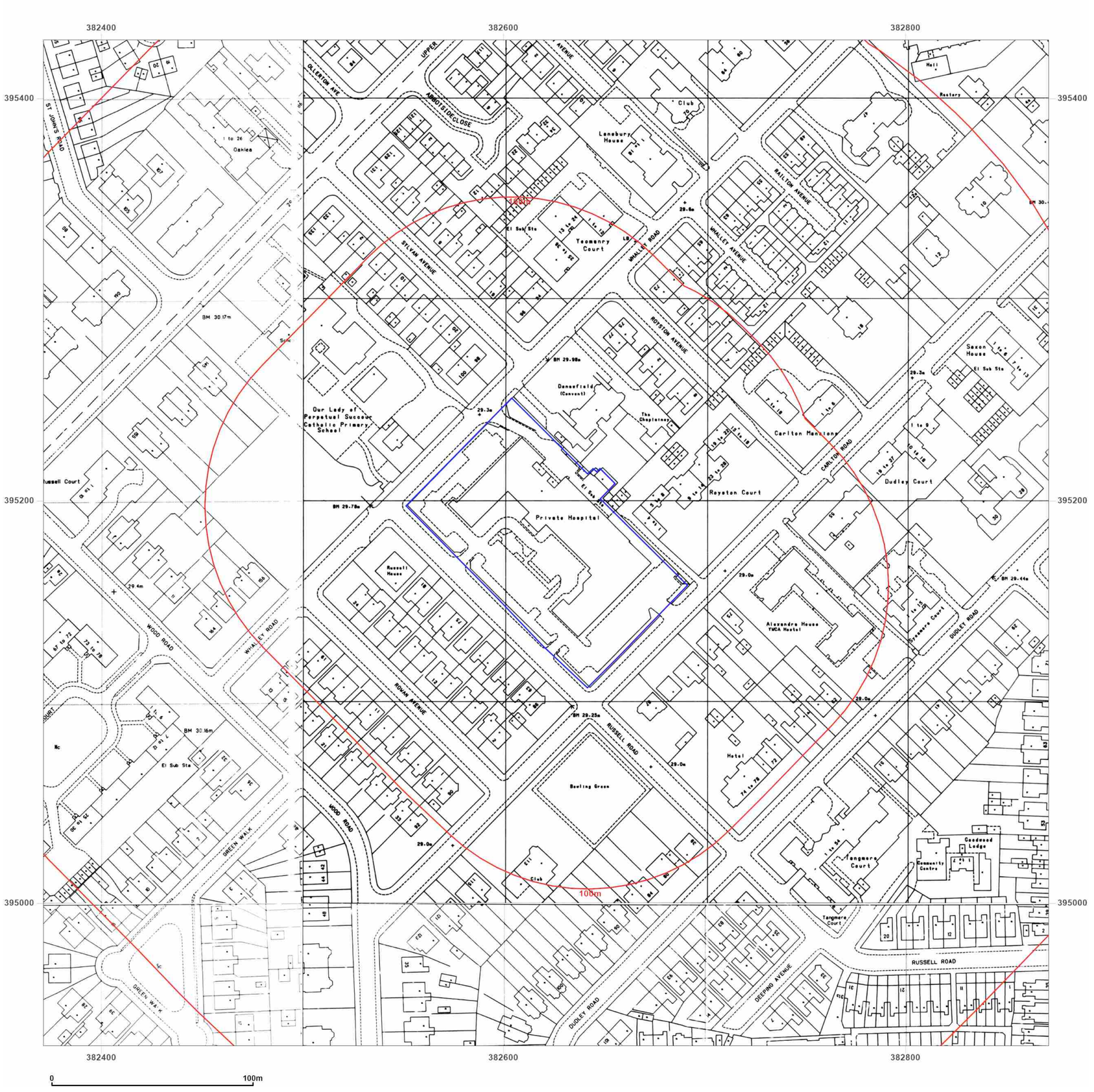
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1991-1992**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A Revised N/A Edition N/A Copyright 1992 Levelled N/A		Surveyed 1949 Revised 1986 Edition N/A Copyright 1991 Levelled N/A
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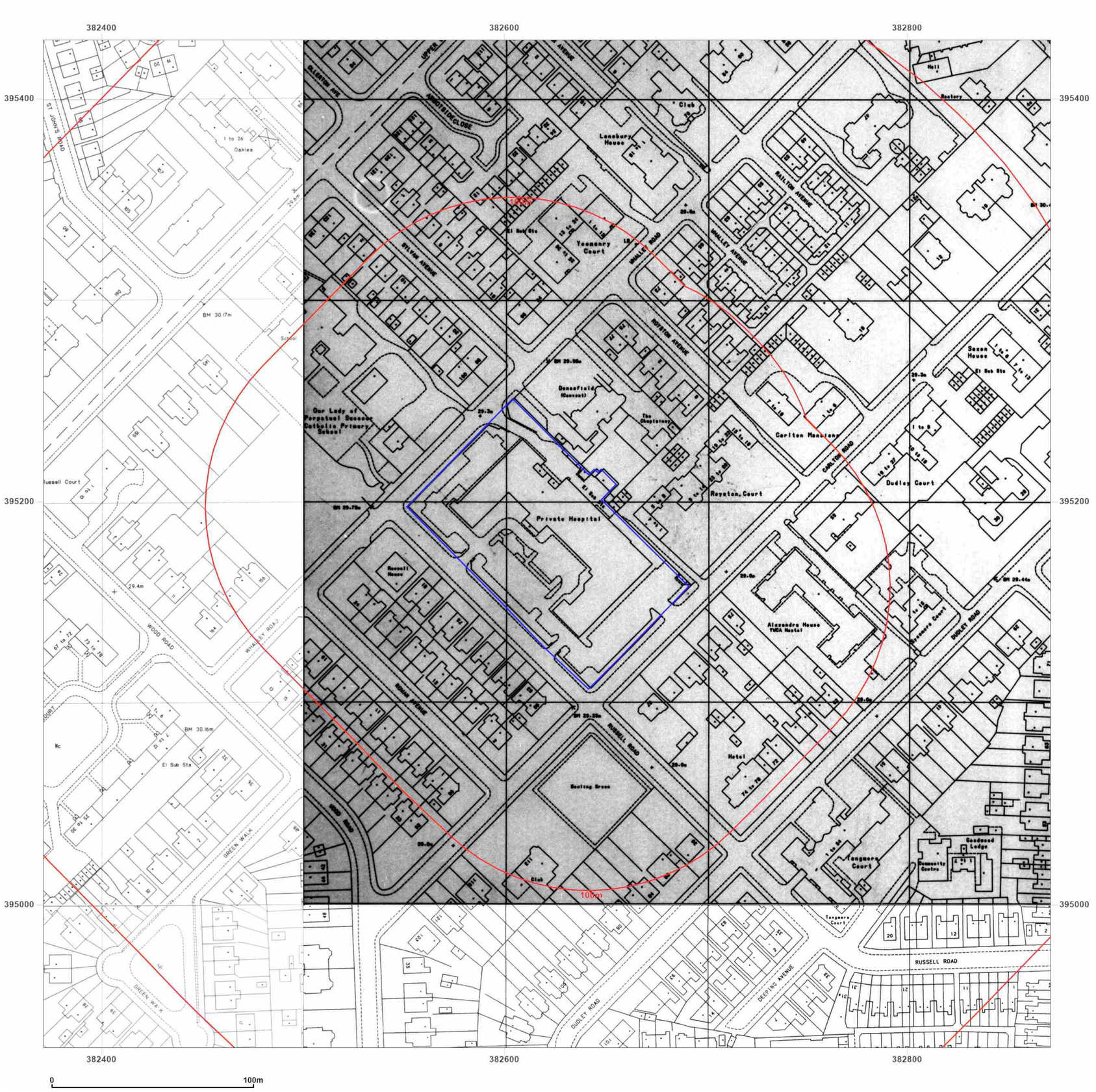
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1991-1992**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed 1992 Revised 1992 Edition N/A Copyright N/A Levelled N/A		Surveyed 1949 Revised 1949 Edition N/A Copyright 1991 Levelled N/A
Surveyed 1992 Revised 1992 Edition N/A Copyright N/A Levelled N/A		Surveyed 1950 Revised 1960 Edition N/A Copyright 1992 Levelled N/A

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1992**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1992
Levelled N/A

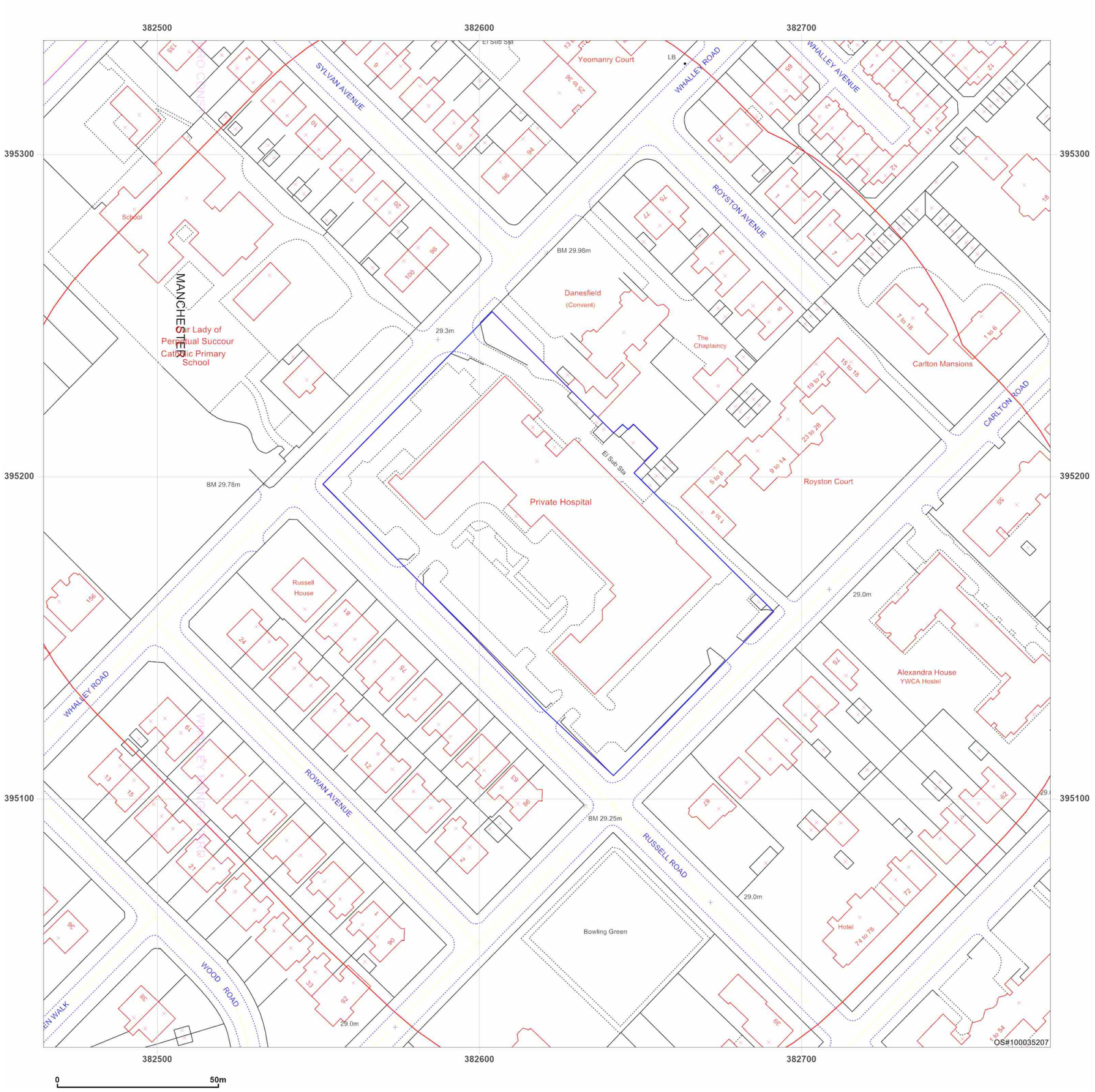
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: LandLine
Map date: **2003**
Scale: 1:1,250
Printed at: 1:1,250

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2003

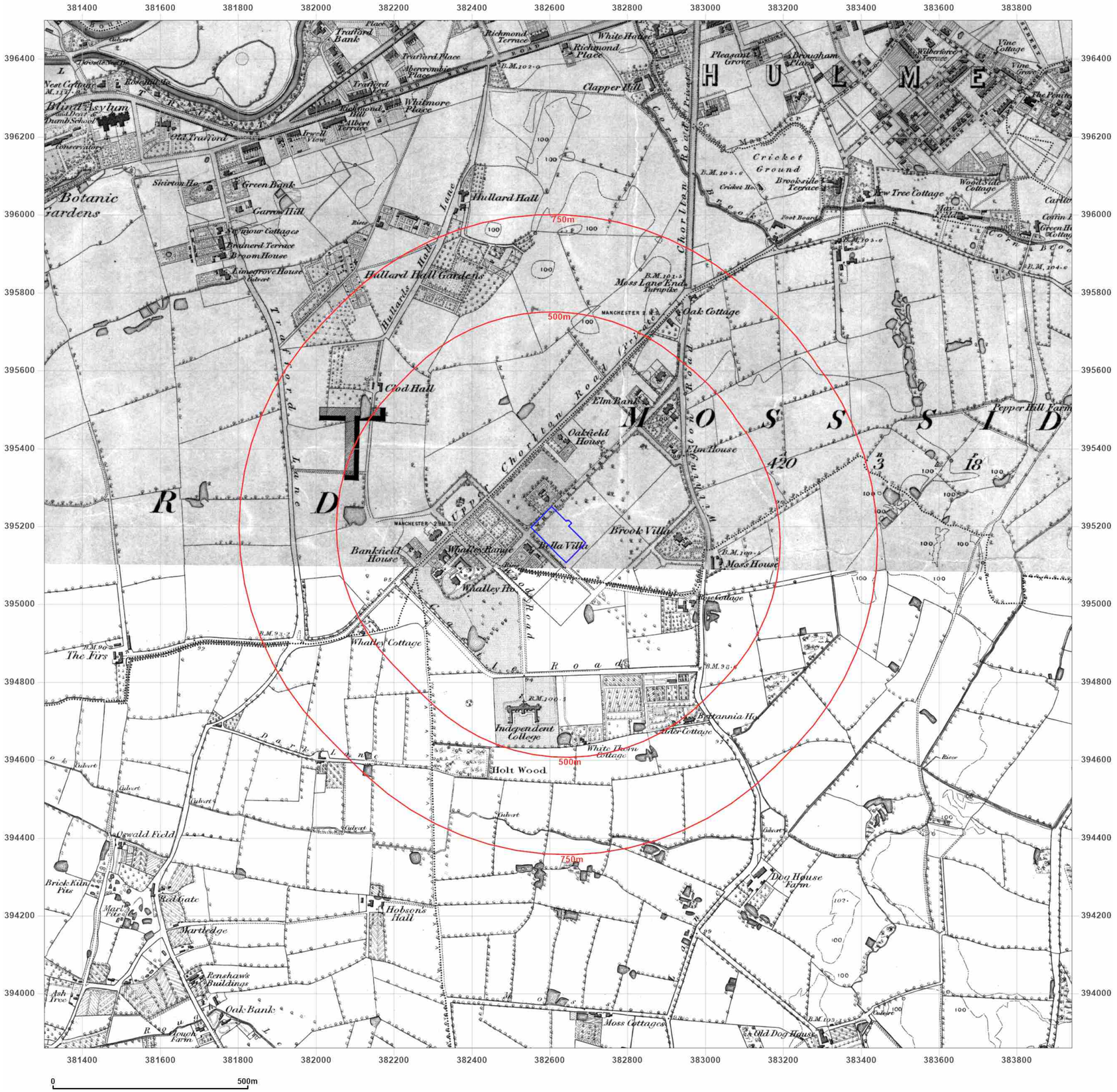
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Site Details:

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

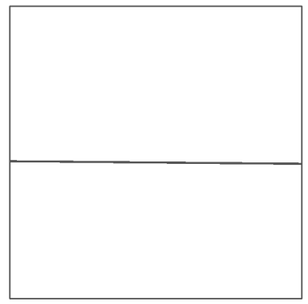
Map date: **1848-1849**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1845
Revised N/A
Edition 1848
Copyright N/A
Levelled N/A



Surveyed 1845
Revised 1849
Edition 1849
Copyright N/A
Levelled N/A

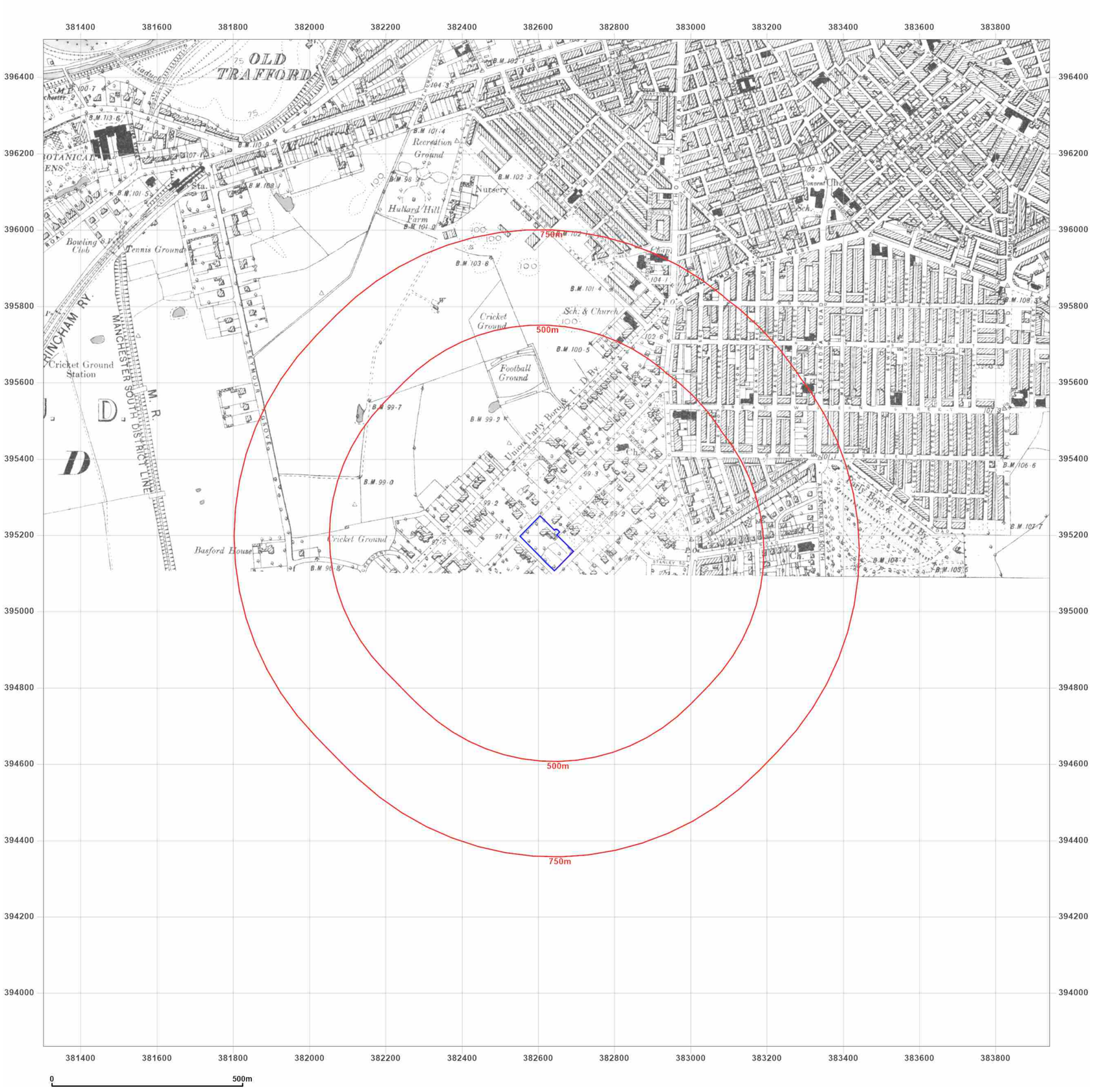
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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

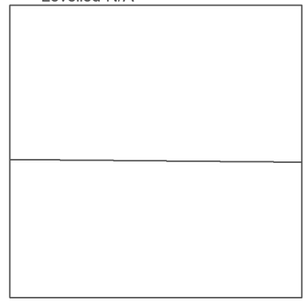
Map date: **1896**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1894
Revised 1896
Edition 1896
Copyright N/A
Levelled N/A



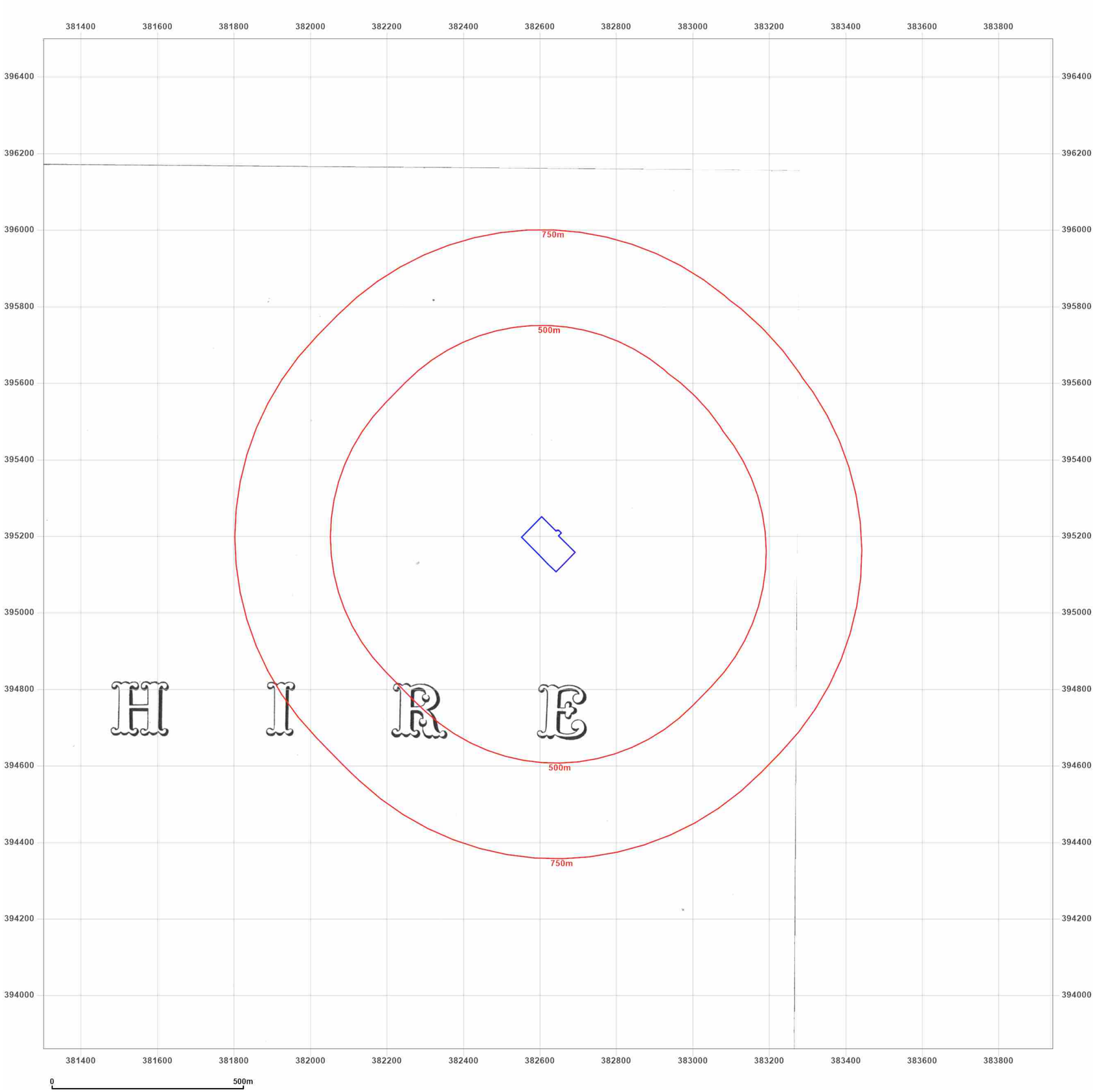
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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

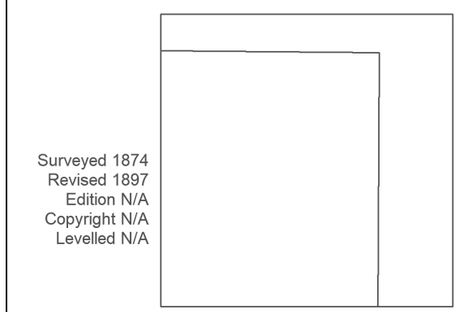
Map Name: County Series

Map date: **1897**

Scale: 1:10,560

Printed at: 1:10,560

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

Map date: **1905**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1844
Revised 1905
Edition 1905
Copyright N/A
Levelled N/A

Surveyed 1892
Revised 1905
Edition 1905
Copyright N/A
Levelled N/A

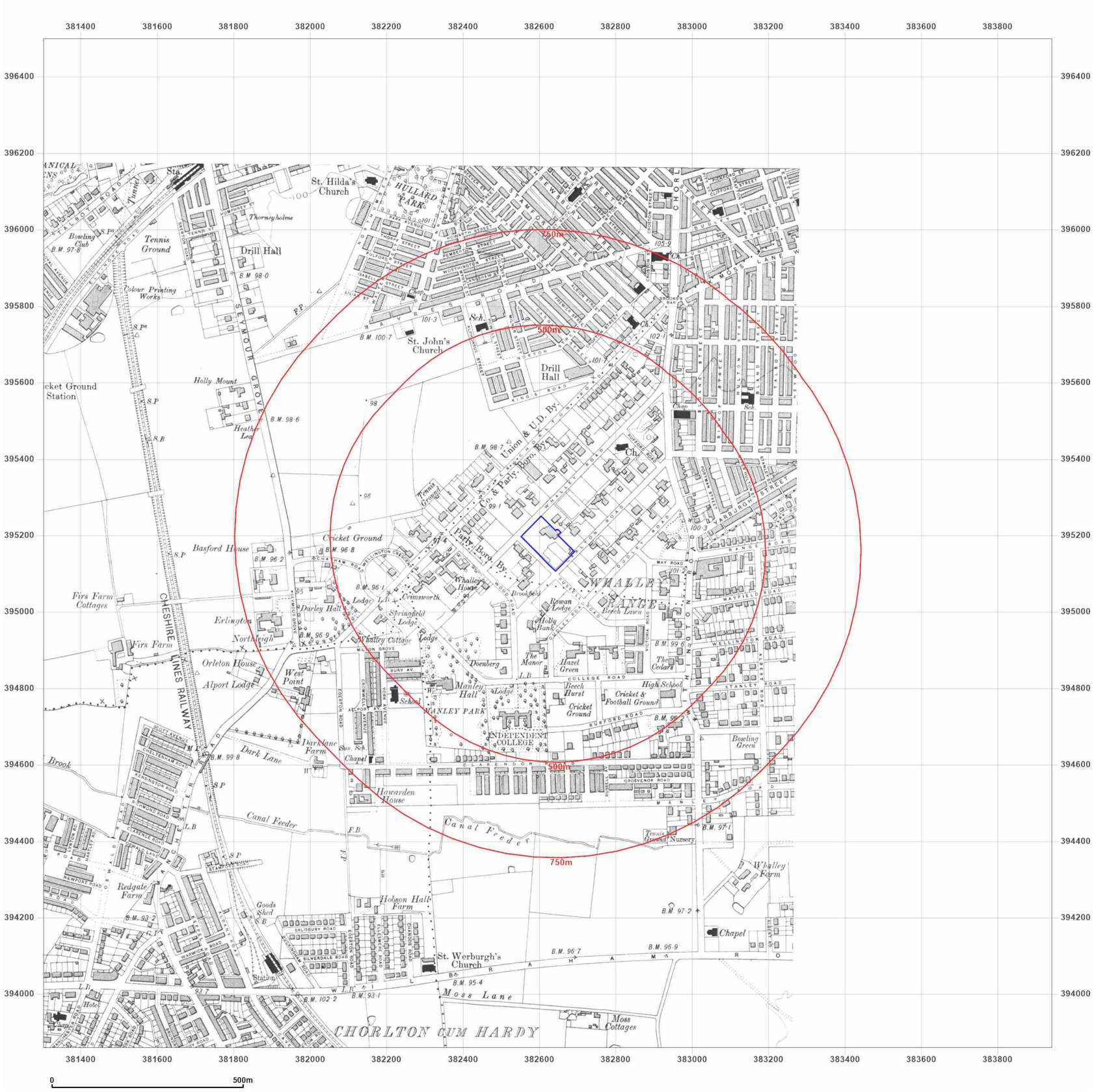
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

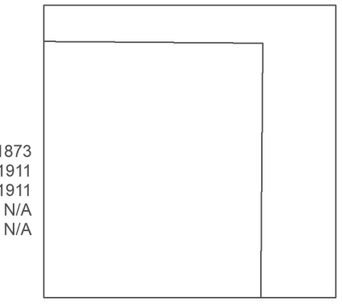
Map Name: County Series

Map date: **1911**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1873
Revised 1911
Edition 1911
Copyright N/A
Levelled N/A

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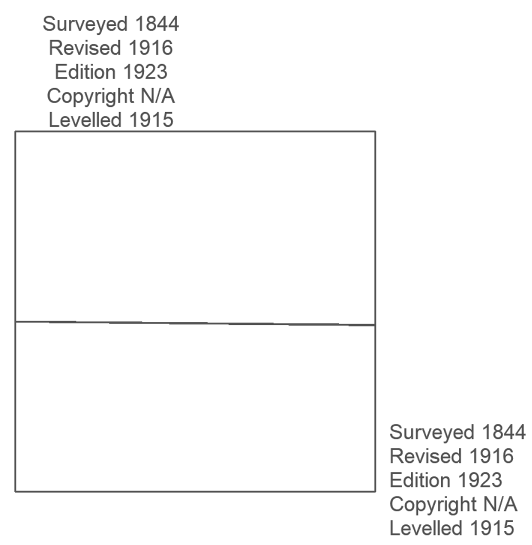
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Site Details:

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

Map date: **1923**

Scale: 1:10,560

Printed at: 1:10,560

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

Map date: **1923**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1844
Revised 1916
Edition 1923
Copyright N/A
Levelled 1915

Surveyed 1844
Revised 1916
Edition 1923
Copyright N/A
Levelled 1915

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

Map date: **1932-1934**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1844
Revised 1932
Edition 1932
Copyright N/A
Levelled 1927

Surveyed 1844
Revised 1934
Edition 1934
Copyright N/A
Levelled 1927

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: County Series

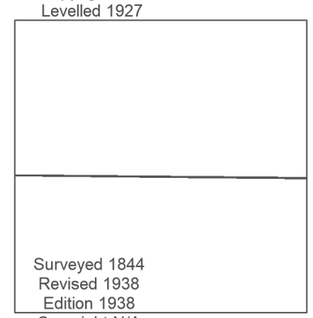
Map date: **1938**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1844
Revised 1938
Edition 1938
Copyright N/A
Levelled 1927



Surveyed 1844
Revised 1938
Edition 1938
Copyright N/A
Levelled 1927

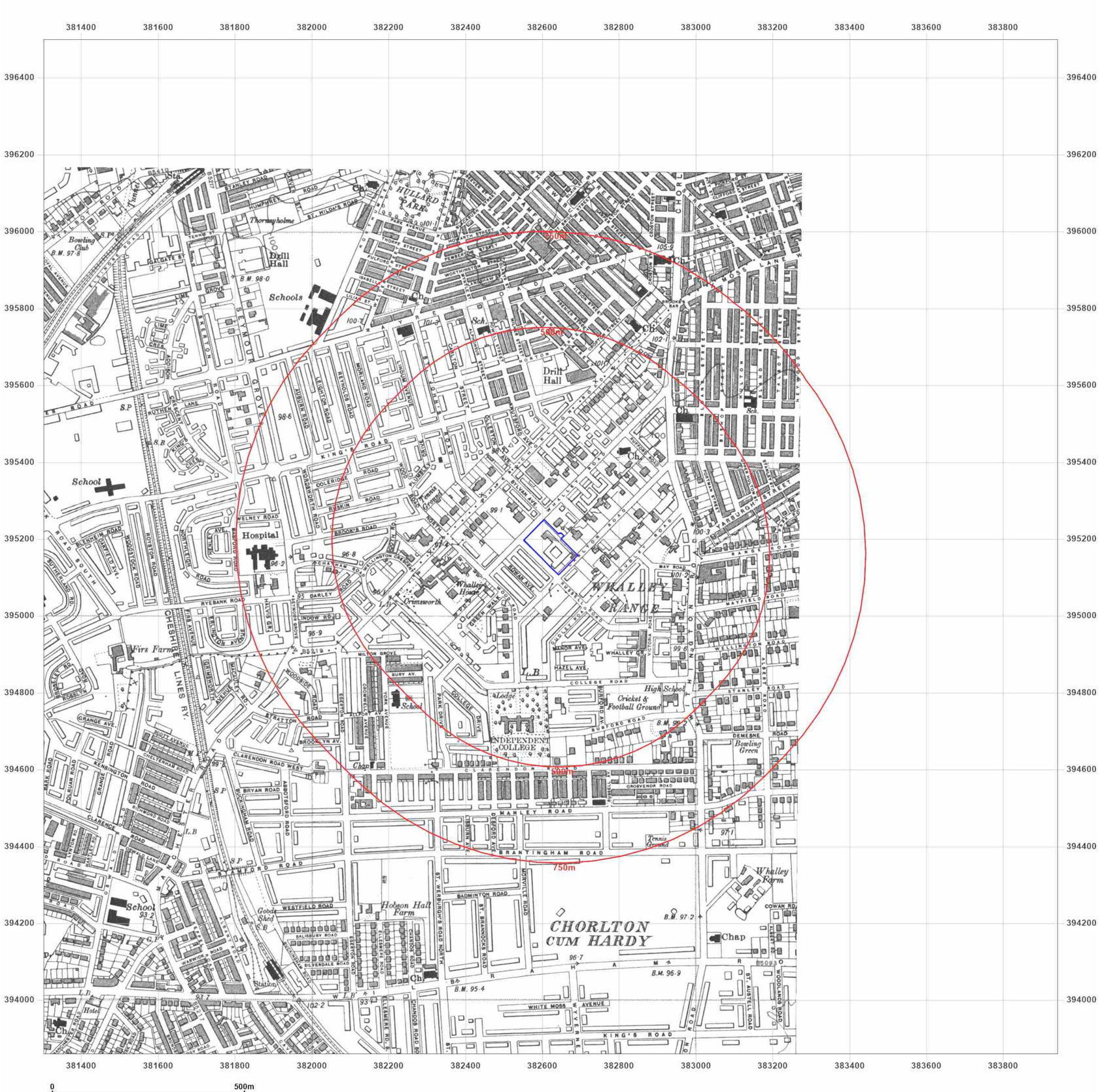
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Site Details:

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WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

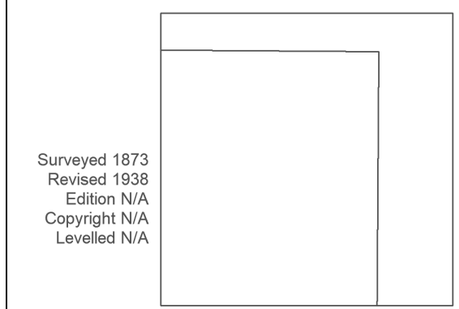
Map Name: County Series

Map date: **1938**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1873
Revised 1938
Edition N/A
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: Provisional

Map date: **1955-1956**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1956
Revised 1956
Edition N/A
Copyright 1956
Levelled N/A

Surveyed N/A
Revised 1955
Edition N/A
Copyright 1955
Levelled N/A

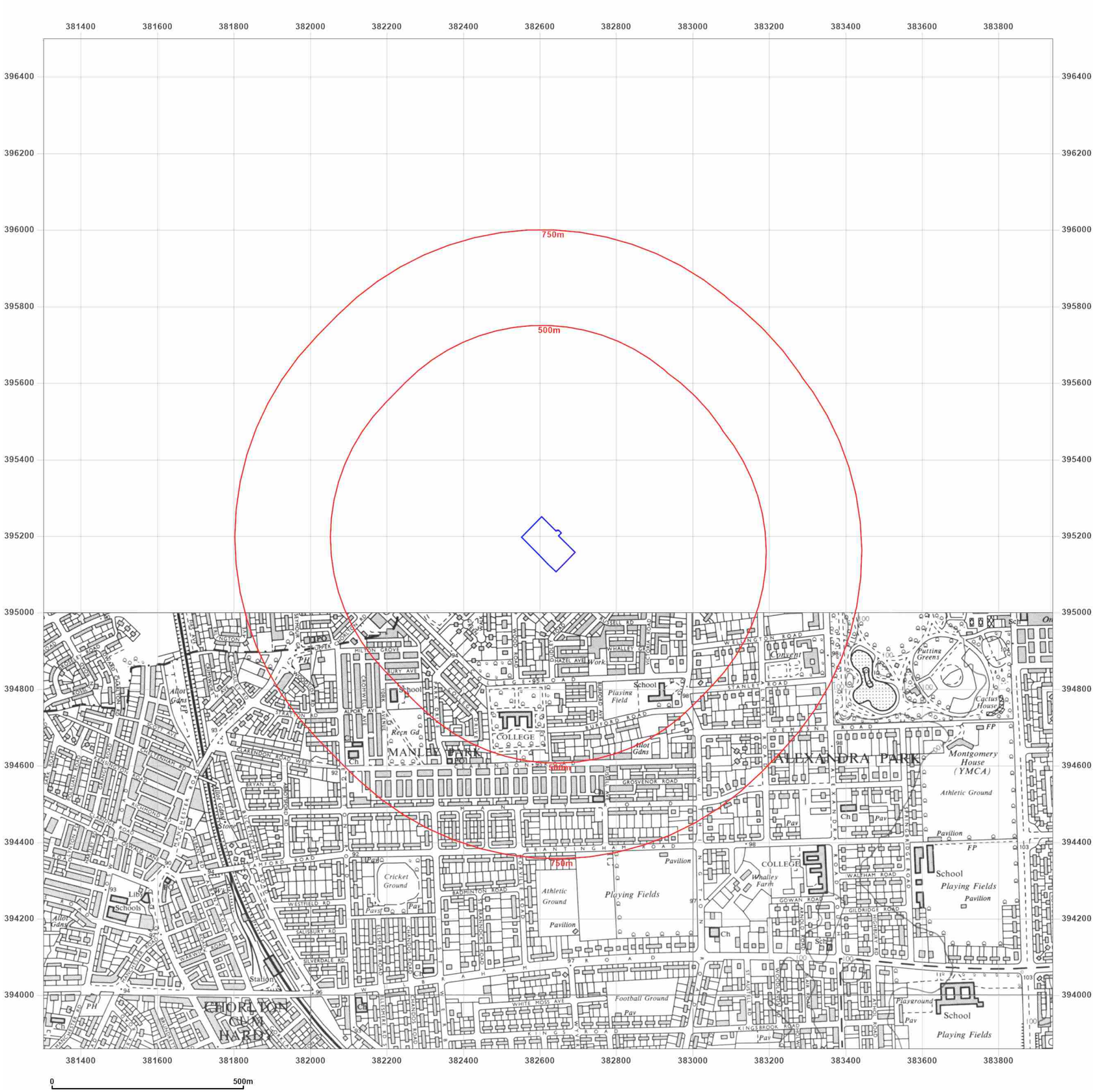
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: Provisional

Map date: **1966**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1966
Revised 1966
Edition N/A
Copyright 1966
Levelled N/A

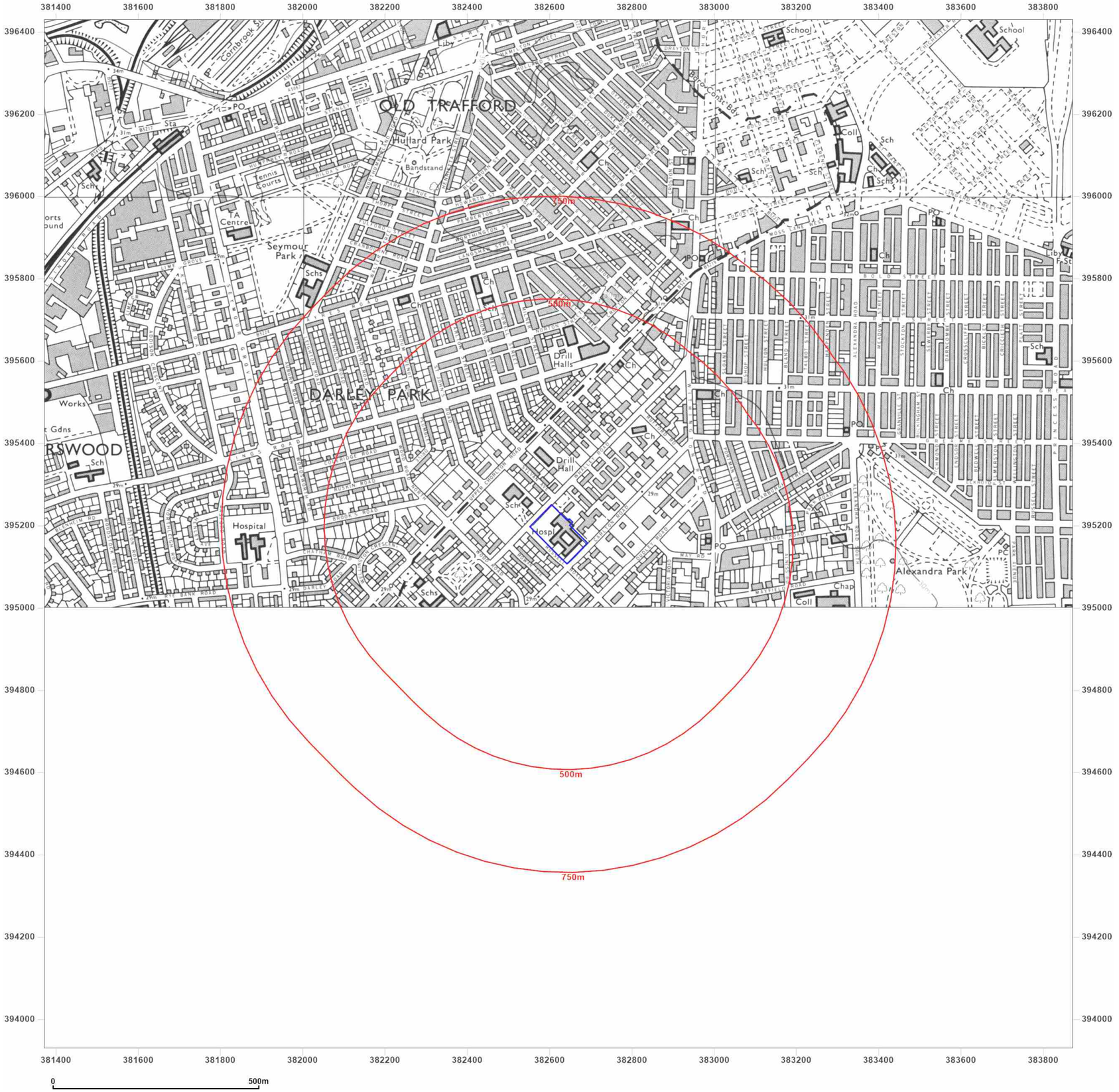
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1972**

Scale: 1:10,000

Printed at: 1:10,000

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Surveyed 1971
Revised 1972
Edition N/A
Copyright 1972
Levelled 1972

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1980-1981**

Scale: 1:10,000

Printed at: 1:10,000

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Surveyed 1976
Revised 1980
Edition N/A
Copyright 1980
Levelled 1976

Surveyed 1977
Revised 1981
Edition N/A
Copyright 1981
Levelled 1976

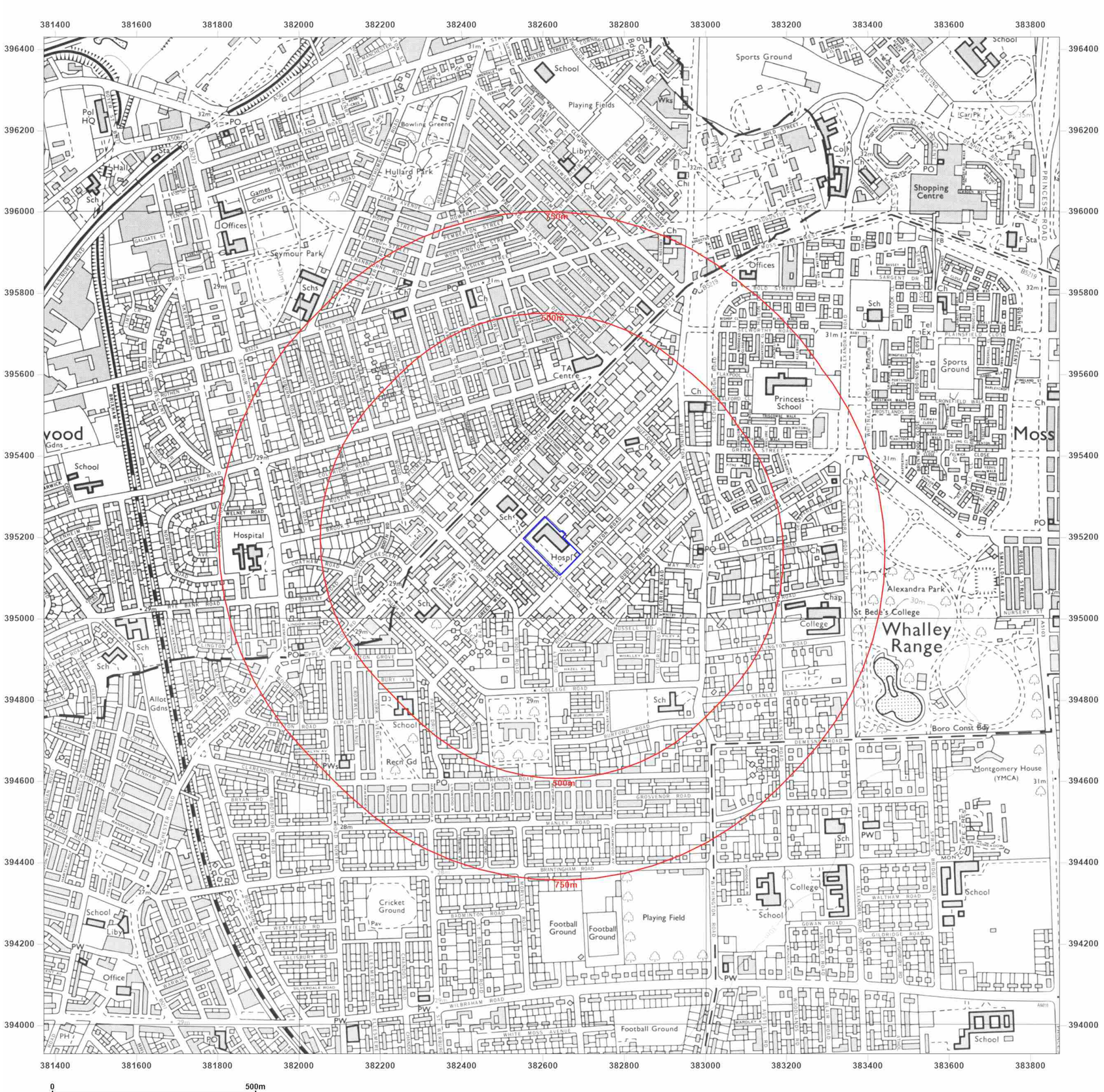
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Groundsure INSIGHTS

Site Details:

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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1985-1988**

Scale: 1:10,000

Printed at: 1:10,000

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Surveyed 1983
Revised 1985
Edition N/A
Copyright 1985
Levelled 1981

Surveyed 1985
Revised 1988
Edition N/A
Copyright 1988
Levelled 1981

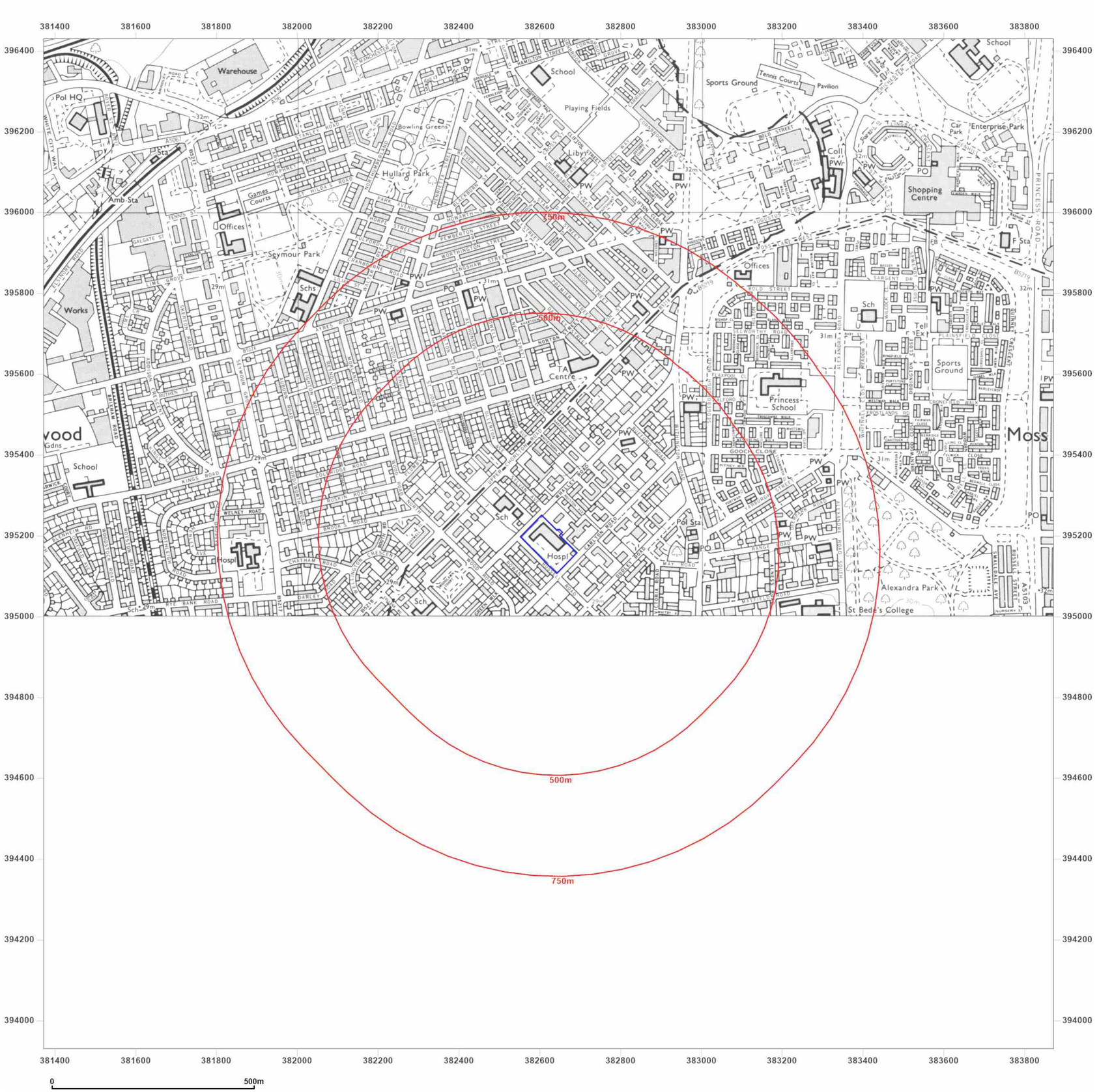
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1988**

Scale: 1:10,000

Printed at: 1:10,000

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Surveyed 1986
Revised 1988
Edition N/A
Copyright 1988
Levelled 1981

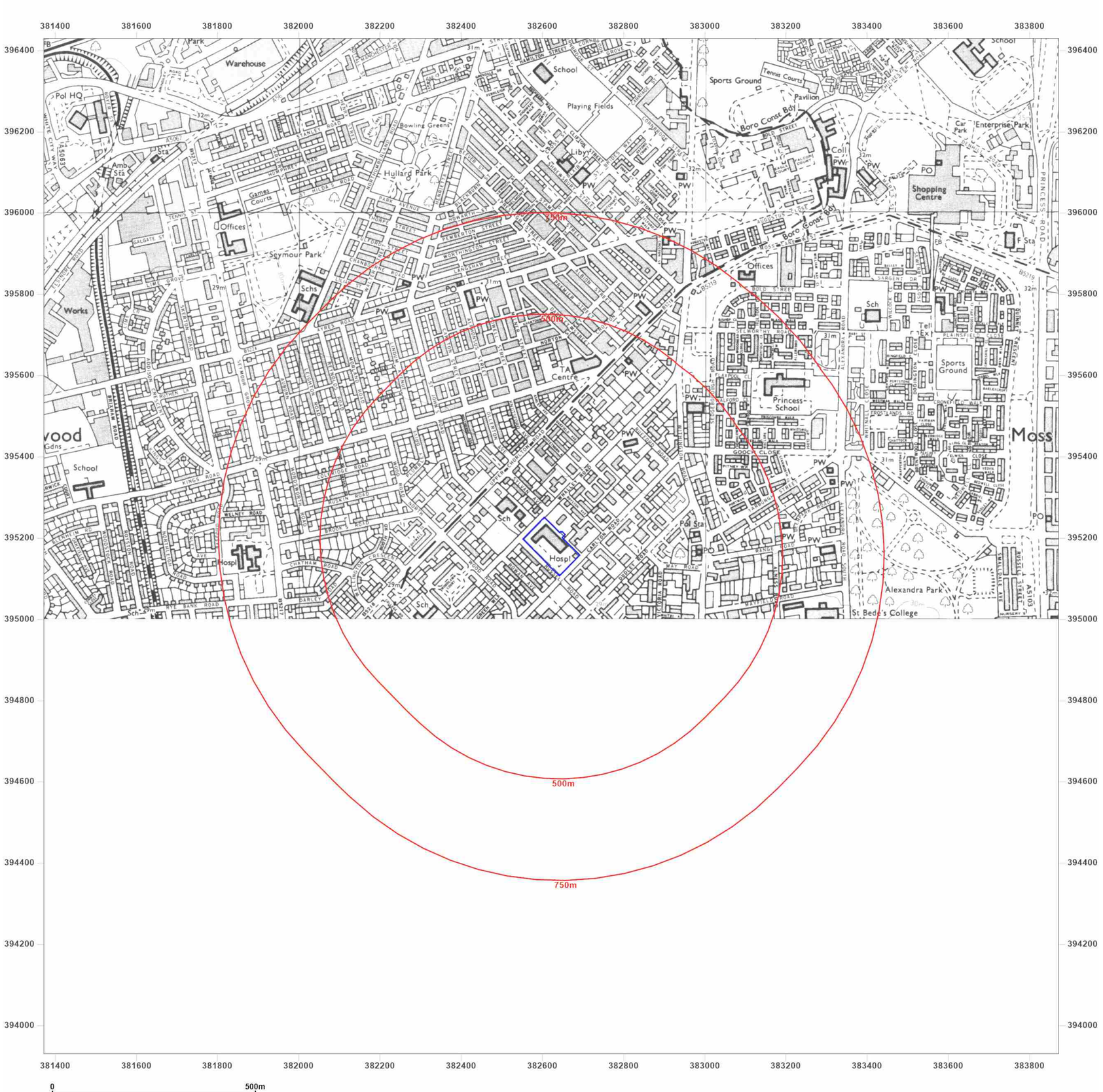
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Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **1994**

Scale: 1:10,000

Printed at: 1:10,000

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **2001**

Scale: 1:10,000

Printed at: 1:10,000

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Site Details:

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MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

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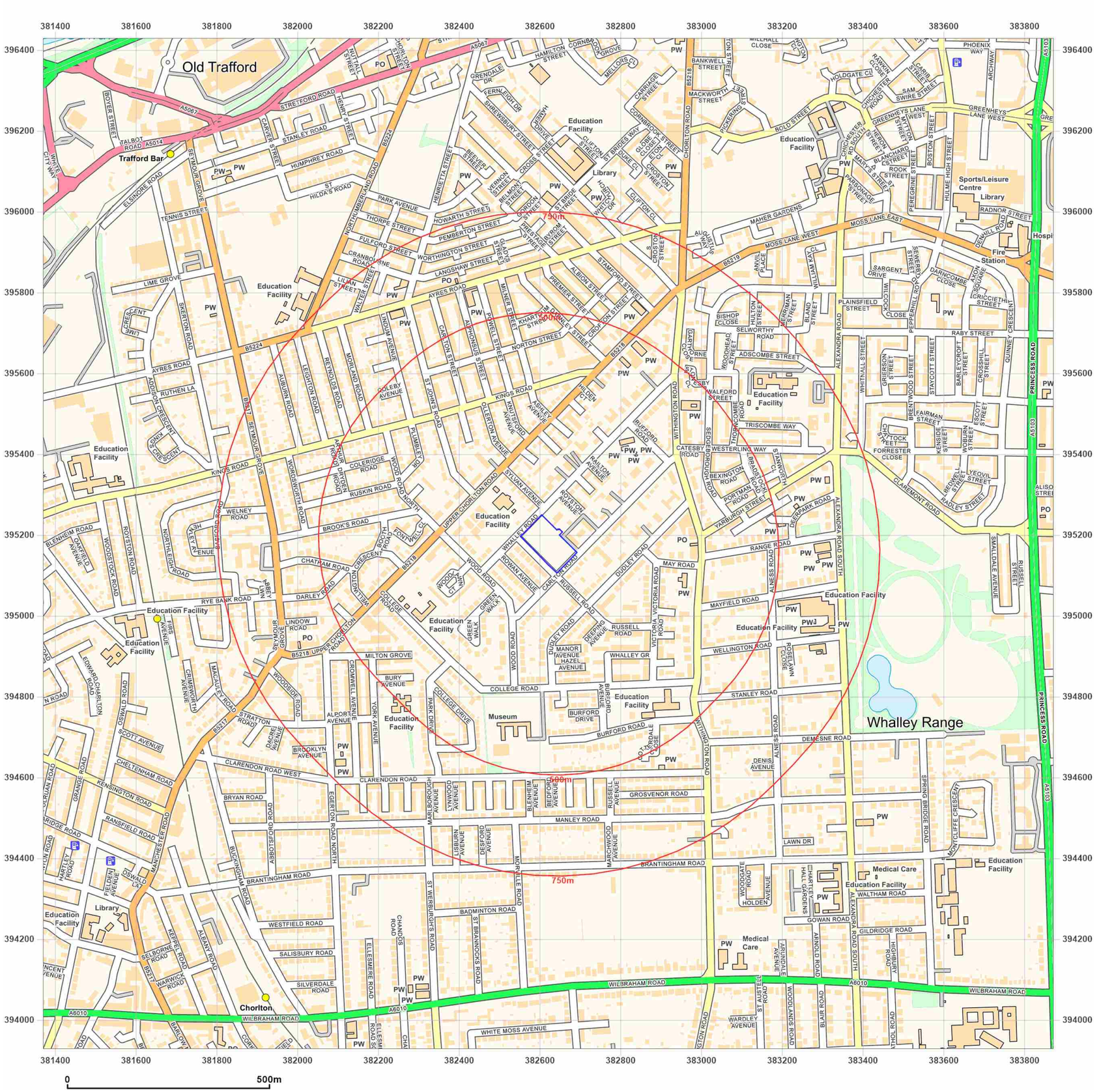
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Site Details:

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WHALLEY RANGE,
MANCHESTER, M16 8AT

Client Ref: 17-013 - 007697 - HM
Report Ref: GS-RQM-S3C-23M-FXM
Grid Ref: 382621, 395179

Map Name: National Grid

Map date: **2024**

Scale: 1:10,000

Printed at: 1:10,000

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APPENDIX VII
EXPLORATORY HOLE LOGS



Trial Pit Log

TrialPit No TP101/ SA101
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 1.80	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Asphalt.
				0.25			MADE GROUND: Light brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone. (Subbase).
	0.40	ES		0.50			MADE GROUND: Dark brown sandy gravelly clay. Gravel is fine to coarse subangular to subrounded of brick, concrete and asphalt.
							Brown gravelly fine to medium SAND with pockets of brown CLAY. Gravel is fine to coarse subangular to subrounded of sandstone with occasional roots and wood.
				1.80			End of Pit at 1.80m

1
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4

Trial Pit Photographs



Trial Pit 101/ Soakaway 101



Trial Pit 101/ Soakaway 101 Spoil

Remarks: 1. Complete. 2. Soakaway testing carried out in Trial Pit.

Stability: STABLE

Trial Pit Log

TrialPit No: TP102
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 2.30	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Concrete with rebar.
				0.50			MADE GROUND: Light brown greyish clayey sandy gravel. Gravel is fine to coarse subangular to subrounded of concrete. (Subbase).
	1.00	ES					MADE GROUND: Brown gravelly fine to medium sand. Gravel is fine to coarse subangular to subrounded of sandstone and brick with occasional fragments of plastic.
				2.30			End of Pit at 2.30m

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4

Trial Pit Photographs



Trial Pit 102



Trial Pit 102 Spoil

Remarks: 1. Terminated due to lack of bucket room between concrete. 2. Concrete obstruction in the north and south of trial pit from 1.50 bgl. Concrete extended into trial pit 0.50 m. 3. Redundant plastic pipe encountered at 0.80 m bgl.

Stability: STABLE

Trial Pit Log

TrialPit No TP103/ SA106
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 20/03/2024
Location: Whalley Range		Dimensions (m): Depth 1.90 — 2.00 × 1.00	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.15			MADE GROUND: Asphalt.
				0.35			MADE GROUND: Brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete.
				0.80			MADE GROUND: Dark brown slightly clayey gravelly sand. Gravel is fine to coarse subangular to subrounded of sandstone and brick.
							Brown very sandy CLAY.
				1.90			End of Pit at 1.90m

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Remarks: 1. Complete. 2. Soakaway testing carried out in Trial Pit.

Stability: STABLE

Trial Pit Log

TrialPit No: TP104a
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 0.70	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Asphalt.
	0.40	ES					MADE GROUND: Dark brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
				0.60			MADE GROUND: Concrete.
				0.70			End of Pit at 0.70m

Trial Pit Photographs



Trial Pit 104a

Remarks: 1. Terminated due to concrete base.

Stability: STABLE

Trial Pit Log

TrialPit No TP104b/ SA102
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 2.40	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Asphalt.
				0.60			MADE GROUND: Dark brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
				0.70			MADE GROUND: Concrete.
				0.90			Dark brown sandy CLAY with frequent roots and rootlets.
				2.40			Brown fine to medium SAND.
							End of Pit at 2.40m

1
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Trial Pit Photographs



Trial Pit 104b/ Soakaway 102

Remarks: 1. Complete. 2. Soakaway testing carried out in trial pit.

Stability: STABLE

Trial Pit Log

TrialPit No TP105/ SA104
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 20/03/2024
Location: Whalley Range		Dimensions (m): Depth 2.40 (2.00 × 1.00)	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			MADE GROUND: Concrete with rebar.
				0.45			MADE GROUND: Light brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete.
				1.30			MADE GROUND: Dark brown slightly clayey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and brick.
				2.00			Dark grey CLAY.
				2.40			Brown sandy GRAVEL. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone.
							End of Pit at 2.40m

1
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Trial Pit Photographs



Trial Pit 105/ Soakaway 104



Trial Pit 105/ Soakaway 104 Spoil

Remarks: 1. Complete. 2. Soakaway testing carried out in Trial Pit.

Stability: STABLE

Trial Pit Log

TrialPit No TP106/ SA103
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 2.00	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Asphalt.
	0.70	ES					MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of concrete.
				0.80			Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
				1.00			Brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
				2.00			End of Pit at 2.00m

Trial Pit Photographs



Trial Pit 106/ Soakaway 103



Trial Pit 106/ Soakaway 103 Spoil

Remarks: 1. Complete. 2. Soakaway testing carried out in trial pit.

Stability: STABLE

Trial Pit Log

TrialPit No TP107/ SA105
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 20/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 1.80	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Asphalt.
				0.50			MADE GROUND: Dark brown slightly clayey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and brick and rebar.
				1.80			Brown very sandy CLAY.
							End of Pit at 1.80m

Trial Pit Photographs



Trial Pit 107/ Soakaway 105



Trial Pit 107/ Soakaway 105 Spoil

Remarks: 1. Complete. 2. Soakaway testing carried out in Trial Pit.

Stability: STABLE

Trial Pit Log

TrialPit No: TP108
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): Depth 0.95 (2.00 × 1.00)	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10			MADE GROUND: Asphalt.
				0.30			MADE GROUND: Dark brown sandy gravel. Gravel is fine to coarse subangular to subrounded of asphalt and concrete.
	0.60	ES					MADE GROUND: Brown sandy gravel with frequent cobbles. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete with frequent fragments of textile and plastic. Cobbles are angular of brick.
				0.90			MADE GROUND: Concrete.
				0.95			End of Pit at 0.95m

1
2
3
4

Trial Pit Photographs



Trial Pit 108



Trial Pit 108 Spoil

Remarks: 1. Terminated due to concrete in the base of the trial pit, scraping for 5 minutes but made no progress. 2. Slow/hard digging through Made Ground.

Stability: STABLE

Trial Pit Log

TrialPit No: TP109
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): 2.00 x 1.00 Depth 1.05	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.05			MADE GROUND: Stone Flag.
				0.20			MADE GROUND: Light brown fine to medium gravelly sand. Gravel is fine to coarse subangular to subrounded of sandstone. (Subbase).
	0.40	ES					MADE GROUND: Dark brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete with frequent fragments of ceramic, metal and plastic.
				1.00			MADE GROUND: Concrete.
				1.05			End of Pit at 1.05m

Trial Pit Photographs



Trial Pit 109



Trial Pit 109 Spoil

Remarks: 1. Terminated due to concrete in the base of the trial pit, scraping for 5 minutes but made no progress. 2. Slow/hard digging through Made Ground.

Stability: STABLE

Trial Pit Log

TrialPit No: TP110
Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: - Level:	Date 18/03/2024
Location: Whalley Range		Dimensions (m): Depth 1.00 (2.00 × 1.00)	Scale 1:30
Client: Rowlinson			Logged H. Mason

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			MADE GROUND: Concrete with rebar.
	0.50	B		0.35			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete. (Subbase).
							MADE GROND: Brown sandy gravel. Gravel is fine to coarse subangular to subrounded and sandstone, brick and concrete.
	0.95	ES		0.90			MADE GROUND: Dark brown gravelly clay with occasional cobbles. Gravel is fine to coarse subangular to subrounded of brick. Cobbles are angular of brick.
				1.00			End of Pit at 1.00m

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4

Trial Pit Photographs



Trial Pit 110



Trial Pit 110 Spoil

Remarks: 1. Terminated due to compact Made Ground, scraping for 5 minutes but made no progress. 2 Slow/hard digging through Made Ground.

Stability: STABLE

Borehole Log

Borehole No. **WS101**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			MADE GROUND: Ceramic Tile.
					0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete. (Subbase).
		0.80	ES					MADE GROUND: Brown gravelly fine to medium sand. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
		1.00		N=6 (2,2/1,1,2,2)				
		1.50		50 (25 for 75mm/50 for 75mm)	1.50			MADE GROUND: Concrete.
					1.65			End of borehole at 1.65 m

Remarks

1. Refused on concrete. 2. Monitoring well installed (response zone 0.50 - 1.50 m bgl).

Borehole Log

Borehole No. **WS102**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			MADE GROUND: Concrete.
		0.50	ES		0.30			MADE GROUND: Brown clayey gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete.
		1.00		N=4 (2,1/1,1,1,1)	1.00			MADE GROUND: Brown gravelly fine to medium sand. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
		1.50	ES		1.30			Loose brown slightly clayey fine to medium SAND.
		2.00		N=11 (2,2/2,3,3,3)				Medium dense greyish brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
		3.00		50 (5,9/50 for 255mm)	2.60			Dense brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
					3.40			End of borehole at 3.40 m

Remarks

1. Refused on dense SAND. 2. Monitoring well installed (response zone 1.00 - 3.00 m bgl).

Borehole Log

Borehole No. **WS103**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			MADE GROUND: Asphalt.
					0.20			MADE GROUND: Brown clayey gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete. (Subbase).
		0.60	ES		0.50			MADE GROUND: Brown gravelly fine to medium sand. Gravel is fine to coarse subangular to subrounded of sandstone and brick.
		0.90	ES		0.75			MADE GROUND: Brown very sandy CLAY.
		1.00		N=12 (3,3/3,3,3,3)	1.20			Medium dense brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
					1.50			Medium dense brown clayey fine to medium SAND.
		2.00		50 (3,5/50 for 265mm)				Dense brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
					2.41			End of borehole at 2.41 m

Remarks

1. Refused on dense SAND. 2. Monitoring well installed (response zone 1.00 - 2.00 m bgl).

Borehole Log

Borehole No. **WS104**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			MADE GROUND: Asphalt.
		0.35	ES		0.30 0.40			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete. (Subbase).
		1.00		N=17 (2,3/3,5,4,5)	0.90			MADE GROUND: Dark brown gravelly clay. Gravel is fine to coarse subangular to subrounded of brick and concrete.
		1.60	ES		1.40			Orangey brown fine to medium SAND.
		2.00		50 (4,5/50 for 245mm)				Very stiff high strength brown slightly sandy CLAY.
					2.39			Dense greyish brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
								End of borehole at 2.39 m

Remarks

1. Refused on dense SAND. 2. Monitoring well installed (response zone 1.00 - 2.00 m bgl).

Borehole Log

Borehole No. **WS105a**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Concrete with rebar.
					0.65			MADE GROUND: Brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
					0.70			MADE GROUND: Concrete.
								End of borehole at 0.70 m

Remarks
1. Refused on concrete.

Borehole Log

Borehole No. **WS105b**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Concrete with rebar.
					0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and brick.
		0.80	ES					
		1.00		N=16 (4,5/4,4,4,4)	1.00			MADE GROUND: Brown sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and brick.
					1.30			MADE GROUND: Greyish brown gravelly clay. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
					1.50			
					1.70			MADE GROUND: Brown sandy gravelly clay. Gravel is fine to coarse subangular to subrounded of brick.
		1.90	ES					
		2.00		50 (7,8/50 for 255mm)				Brown sandy CLAY.
					2.40			Dense brown gravelly fine to medium SAND. Gravel is fine to coarse subangular to subrounded of sandstone.
								End of borehole at 2.40 m

Remarks

1. Refused on dense SAND. 2. Monitoring well installed (response zone 0.50 - 1.50 m bgl).

Borehole Log

Borehole No. **WS106**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Concrete with rebar.
					0.60			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of brick and concrete.
		1.00		50 (5,5/50 for 295mm)				MADE GROUND: Concrete.
					1.44			End of borehole at 1.44 m

Remarks
1. Refused on concrete.

Borehole Log

Borehole No. **WS107**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type WS
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10			MADE GROUND: Concrete with rebar.
					0.20			MADE GROUND: Grey gravelly clay. Gravel is fine to coarse subangular to subrounded of concrete.
		1.00		N=12 (4,3/3,3,3,3)	1.00			MADE GROUND: Brown slightly clayey gravelly fine to medium sand. Gravel is fine to coarse subangular to subrounded of sandstone and concrete with occasional brick.
		1.40	ES		1.50			MADE GROUND: Brown gravelly clay. Gravel is fine to coarse subangular to subrounded of concrete and brick.
		1.80	ES					Dense brown gravelly fine to medium SAND.
		2.00		50 (3,3/50 for 255mm)				
					2.40			End of borehole at 2.40 m

Remarks

1. Refused on dense SAND. 2. Monitoring well installed (response zone 0.50 - 1.50 m bgl).

Borehole Log

Borehole No. **CP101a**

Sheet 1 of 1

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05			MADE GROUND: Ceramic Tile.
					0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse subangular to subrounded of sandstone and concrete. (Subbase).
								MADE GROUND: Brown gravelly fine to medium sand. Gravel is fine to coarse subangular to subrounded of sandstone, brick and concrete.
					1.50			MADE GROUND: Concrete.
					1.65			End of borehole at 1.65 m

Remarks
1. Refused on concrete.

Borehole Log

Borehole No. **CP101b**

Sheet 1 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 19/04/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Concrete.
					1.30			MADE GROUND: Red gravel. Gravel is fine to coarse, angular of brick.
					2.60			Medium dense brown fine to coarse SAND.
					5.50			Medium dense brown GRAVEL. Gravel is fine to coarse angular to subangular of mudstone.
								Stiff medium strength brown CLAY (boulder clay). Very stiff high strength from 9.50 m bgl. Very stiff very high strength from 11.00 m bgl.
								Continued on next sheet

1 2 3 4 5 6 7 8 9 10

Remarks

1. Refused on stiff CLAY. 2. Cased to 4.70 m bgl. 3. Water strike at 5.00 m bgl.

Borehole Log

Borehole No. **CP101b**
Sheet 2 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 19/04/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					14.45			End of borehole at 14.00 m

11 12 13 14 15 16 17 18 19 20

Remarks
1. Refused on stiff CLAY. 2. Cased to 4.70 m bgl. 3. Water strike at 5.00 m bgl.

Borehole Log

Borehole No. **CP102**

Sheet 1 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			MADE GROUND: Asphalt.
								MADE GROUND: Brown slightly clayey gravel. Gravel is fine to coarse angular to subangular of brick, concrete and mudstone.
		1.00		N=14 (2,3/3,3,4,4)	1.00			Medium dense brown gravelly fine to coarse SAND. Gravel is fine to coarse angular of mudstone.
		2.00		N=25 (3,5/6,6,7,6)				
	▼	3.00 3.00	B	N=31 (5,6/7,7,7,10)				
		4.00		N=28 (4,6/6,7,7,8)				
		5.00 5.00 5.00	B D	N=16 (3,3/4,4,4,4)	5.00			Stiff medium strength brown CLAY (boulder clay). Very stiff high strength from 6.50 m bgl. Very stiff very high strength from14.00 m bgl.
		6.50 6.50 6.50	B D	N=19 (3,3/4,5,5,5)				
		8.00 8.00	U	0 (0 for 0mm/0 for 0mm)				
		9.50		N=22 (3,4/5,5,6,6)				

Continued on next sheet

Remarks

1. Complete. 2. Cased to 2.90 m bgl. 3. Water strike at 3.00 m bgl.

Borehole Log

Borehole No. **CP102**
Sheet 2 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 18/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.50	D					
		11.00		N=27 (3,5/6,7,7,7)				Firm brown CLAY (boulder clay).
		11.50	D					
		12.00		N=31 (4,6/7,7,8,9)				Stiff brown CLAY (boulder clay).
		12.50	D					
		14.00		50 (4,6/50 for 225mm)	14.00			Very stiff brown CLAY (boulder clay).
					14.45			
		15.00		50 (4,5/50 for 225mm)	15.00			End of borehole at 15.00 m
					15.00			

Remarks
1. Complete. 2. Cased to 2.90 m bgl. 3. Water strike at 3.00 m bgl.

Borehole Log

Borehole No. **CP103**

Sheet 1 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 21/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			MADE GROUND: Asphalt
					0.50			MADE GROUND: Red gravel. Gravel is fine to coarse angular of brick and mudstone.
		1.00		N=28 (2,5/6,12,5,5)				MADE GROUND: Red sandy gravel. Gravel is fine to coarse angular of brick.
		2.00		N=16 (3,4/4,6,3,3)				
					2.30			Medium dense brown GRAVEL. Gravel is fine to coarse angular to subangular of mudstone.
		3.00		N=23 (3,4/5,5,6,7)				
		4.00		N=20 (3,4/4,5,5,6)	4.00			Medium dense brown gravelly fine to coarse SAND. Gravel is fine to coarse angular of mudstone.
	▼				4.70			Stiff medium strength brown CLAY (boulder clay).
		5.00	D					
		5.00		N=11 (2,2/3,3,2,3)				
		6.00	D					
		6.50		N=14 (2,3/3,4,4,3)				
		7.00	D					
		8.00	D					
		8.00		N=17 (2,3/4,4,4,5)				
		9.00	D					
		9.50		N=13 (2,2/3,3,3,4)				
					9.60			Brown sandy SILT.
					9.80			Stiff medium strength brown CLAY (boulder
								Continued on next sheet

Remarks

1. Refused on stiff CLAY. 2. Cased to 4.20 m bgl. 3. Water strike at 4.40m bgl.

Borehole Log

Borehole No. **CP103**
Sheet 2 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 21/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								clay). Very stiff very high strength from 12.50 m bgl.
		11.00		N=18 (3,3/4,4,5,5)				
		12.50		50 (4,7/50 for 265mm)				
		14.00		50 (4,9/50 for 265mm)	14.00			End of borehole at 14.00 m

11 12 13 14 15 16 17 18 19 20

Remarks
1. Refused on stiff CLAY. 2. Cased to 4.20 m bgl. 3. Water strike at 4.40m bgl.

Borehole Log

Borehole No. **CP104**

Sheet 1 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 20/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			MADE GROUND: Concrete.
					0.50			MADE GROUND: Red gravel. Gravel is fine to coarse angular of brick and mudstone. MADE GROUND: Brown sandy gravel. Gravel is fine to coarse angular of mudstone.
		1.00		N=15 (2,5/5,3,3,4)				
					1.50			Medium dense brown fine to coarse SAND.
		2.00		N=21 (2,3/5,5,5,6)				
					2.60			Medium dense brown gravelly fine to coarse SAND. Gravel is fine to coarse angular of mudstone.
		3.00		N=18 (3,4/4,4,5,5)				
		4.00	B					
	▼	4.00		N=19 (4,5/5,5,4,5)				
					4.70			Stiff medium strength brown CLAY (boulder clay). Very stiff very high strength from 6.50 m bgl. Stiff medium strength from 8.00 m bgl. Very stiff very high strength from 12.50 m bgl.
		5.00		N=10 (2,2/2,3,2,3)				
		6.50	U					
		6.50		0 (0 for 0mm/0 for 0mm)				
		7.00	D					
		8.00		N=16 (2,2/3,4,5,4)				
		9.00	D					
		9.50	B					
		9.50		N=17 (3,3/4,4,4,5)				
		10.00	D					

Continued on next sheet

Remarks

1. Refused on stiff CLAY. 2. Cased to 4.30 m bgl. 3. Water strike at 4.50m bgl.

Borehole Log

Borehole No. **CP104**
Sheet 2 of 2

Project Name: Russell Road	Project No. 17013	Co-ords: -	Hole Type CP
Location: Whalley Range		Level:	Scale 1:50
Client: Rowlinson		Dates: 20/03/2024 -	Logged By H. Mason

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		11.00 11.00	D	N=19 (2,3/4,4,5,6)				Stiff brown CLAY (boulder clay).
		12.50		50 (4,7/50 for 225mm)				
		14.00		50 (5,9/50 for 225mm)	14.00 14.00			End of borehole at 14.00 m

11
12
13
14
15
16
17
18
19
20

Remarks
1. Refused on stiff CLAY. 2. Cased to 4.30 m bgl. 3. Water strike at 4.50m bgl.

APPENDIX VIII
CHEMICAL TESTING RESULTS



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Analytical Report Number : 24-009860

Project / Site name:	Russell Road	**Samples received on:**	19/03/2024
Your job number:	17 013	**Samples instructed on/ Analysis started on:**	19/03/2024
Your order number:	007755	**Analysis completed by:**	25/03/2024
Report Issue Number:	1	**Report issued on:**	26/03/2024
Samples Analysed:	13 soil samples - 2 leachate samples		

Signed:

Dominika Liana
PL Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149210	149211	149212	149213	149214
Sample Reference				TP101	TP102	TP104a	TP106	TP108
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	0.40	0.70	0.60
Date Sampled				18/03/2024	18/03/2024	18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	72.5	< 0.1	< 0.1	63.6	< 0.1
Moisture Content	%	0.01	NONE	20	7.3	11	7.8	13
Total mass of sample received	kg	0.1	NONE	0.4	0.9	0.3	0.3	0.9
Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	SCA	PDO	SCA	SCA	PDO
Actinolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Amosite detected	Type	N/A	ISO 17025	-	-	-	-	-
Anthophyllite detected	Type	N/A	ISO 17025	-	-	-	-	-
Chrysotile detected	Type	N/A	ISO 17025	-	-	-	-	-
Crocidolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Tremolite detected	Type	N/A	ISO 17025	-	-	-	-	-
Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	-	-	-
Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	-	-	-
General Inorganics								
pH (L099)	pH Units	N/A	MCERTS	-	8.4	8	-	9.5
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO_4	mg/kg	50	MCERTS	-	160	300	-	4000
Water Soluble SO_4 1hr extraction	mg/kg	2.5	MCERTS	-	65	15	-	720
Water Soluble SO_4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	32.6	7.36	-	360
Sulphide	mg/kg	1	MCERTS	-	< 1.0	3.7	-	3.6
Total Sulphur	mg/kg	50	MCERTS	-	88	220	-	1500
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	0.5	1.5	-	0.9
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	< 1.0	-	< 1.0

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149210	149211	149212	149213	149214
Sample Reference				TP101	TP102	TP104a	TP106	TP108
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	0.40	0.70	0.60
Date Sampled				18/03/2024	18/03/2024	18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.09
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.19	0.67	0.09	0.22
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.16	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.07	0.2	1.5	0.1	0.34
Pyrene	mg/kg	0.05	MCERTS	0.09	0.2	1.4	0.11	0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.09	0.63	0.05	0.17
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.1	0.65	0.07	0.19
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.11	0.63	0.07	0.23
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	0.44	< 0.05	0.07
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.09	0.65	0.05	0.13
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.34	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.1	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.45	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	0.98	7.57	< 0.80	1.74
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.2	3	7.5	4.2	13
Barium (aqua regia extractable)	mg/kg	1	MCERTS	82	-	-	47	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.62	-	-	0.2	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.3	-	-	< 0.2	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.6	0.6	0.6
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	6.9	6.9	-	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	16	13	11	9.4	30
Lead (aqua regia extractable)	mg/kg	1	MCERTS	29	11	59	13	100
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	14	9	9.7	7.2	18
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	1.5	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	16	-	-	9	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	26	21	68	52	440

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149210	149211	149212	149213	149214
Sample Reference				TP101	TP102	TP104a	TP106	TP108
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	1.00	0.40	0.70	0.60
Date Sampled				18/03/2024	18/03/2024	18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Petroleum Hydrocarbons								
TPH (>C5 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (>C6 - C8) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C8 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (>C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (>C16 - C21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	12	< 10	14
TPH (>C21 - C35) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	93	110	56
TPH (>C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	17	25	20
TPH Total >C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	< 10	< 10	120	150	89
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	120	150	89

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149215	149216	149217	149218	149219
Sample Reference				TP109	WS101	WS102	WS103	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	0.80	1.50	0.60	0.90
Date Sampled				18/03/2024	18/03/2024	18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	42.9	< 0.1	36.4	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	14	9.4	3.7	15	9.5
Total mass of sample received	kg	0.1	NONE	0.3	0.3	0.3	0.2	0.4
Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Detected	Not-detected	-	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	MJN	KWB	-	PDO	-
Actinolite detected	Type	N/A	ISO 17025	Not-detected	-	-	-	-
Amosite detected	Type	N/A	ISO 17025	Not-detected	-	-	-	-
Anthophyllite detected	Type	N/A	ISO 17025	Not-detected	-	-	-	-
Chrysotile detected	Type	N/A	ISO 17025	Detected	-	-	-	-
Crocidolite detected	Type	N/A	ISO 17025	Not-detected	-	-	-	-
Tremolite detected	Type	N/A	ISO 17025	Not-detected	-	-	-	-
Asbestos % by hand picking/weighing	%	0.001	ISO 17025	0.044	-	-	-	-
Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	Loose Fibrous Debris	-	-	-	-
General Inorganics								
pH (L099)	pH Units	N/A	MCERTS	10.8	7.9	9.8	-	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO_4	mg/kg	50	MCERTS	3400	210	290	-	85
Water Soluble SO_4 1hr extraction	mg/kg	2.5	MCERTS	220	17	97	-	5.8
Water Soluble SO_4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	112	8.67	48.7	-	2.88
Sulphide	mg/kg	1	MCERTS	16	1.1	< 1.0	-	< 1.0
Total Sulphur	mg/kg	50	MCERTS	1300	140	110	-	51
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.8	0.4	0.3	-	0.4
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	< 1.0

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149215	149216	149217	149218	149219
Sample Reference				TP109	WS101	WS102	WS103	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	0.80	1.50	0.60	0.90
Date Sampled				18/03/2024	18/03/2024	18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	0.06	0.43	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	0.08	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.37	0.18	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.35	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.2	4.6	1.1	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.82	0.1	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.4	4	1.5	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.39	4.4	1.4	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.19	1.7	1.3	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.21	2.3	1.3	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.25	1.6	1.6	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.09	0.92	0.52	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.18	1.6	1.1	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.08	0.65	0.54	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.15	0.19	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.11	0.9	0.67	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	2.17	24.9	11.4	< 0.80	< 0.80
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.5	3.8	2	1.6	2.4
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	16	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	-	-	0.15	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	-	-	< 0.2	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	8.9	6.6	-	5.2
Copper (aqua regia extractable)	mg/kg	1	MCERTS	46	13	14	7.9	7.9
Lead (aqua regia extractable)	mg/kg	1	MCERTS	100	25	8.9	7.3	4.6
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	11	6.9	3.1	4.9
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	-	9.2	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	250	30	18	6.6	22

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149215	149216	149217	149218	149219
Sample Reference				TP109	WS101	WS102	WS103	WS103
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	0.80	1.50	0.60	0.90
Date Sampled				18/03/2024	18/03/2024	18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Petroleum Hydrocarbons								
TPH (>C5 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (>C6 - C8) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C8 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (>C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (>C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (>C16 - C21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	16	< 10	< 10	< 10
TPH (>C21 - C35) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	30	24	25	< 10	< 10
TPH (>C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH Total >C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	41	47	40	< 10	< 10
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	41	47	40	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149220	149221	149222
Sample Reference				WS104	WS105b	WS107
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.60	0.80	1.80
Date Sampled				18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	27.3	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	5.7	8.6	6.1
Total mass of sample received	kg	0.1	NONE	0.4	0.3	0.3
Asbestos						
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	-	PDO	-
Actinolite detected	Type	N/A	ISO 17025	-	-	-
Amosite detected	Type	N/A	ISO 17025	-	-	-
Anthophyllite detected	Type	N/A	ISO 17025	-	-	-
Chrysotile detected	Type	N/A	ISO 17025	-	-	-
Crocidolite detected	Type	N/A	ISO 17025	-	-	-
Tremolite detected	Type	N/A	ISO 17025	-	-	-
Asbestos % by hand picking/weighing	%	0.001	ISO 17025	-	-	-
Asbestos Containing Material Types Detected (ACM)	Type	N/A	ISO 17025	-	-	-
General Inorganics						
pH (L099)	pH Units	N/A	MCERTS	8.6	-	7.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO_4	mg/kg	50	MCERTS	68	-	150
Water Soluble SO_4 1hr extraction	mg/kg	2.5	MCERTS	17	-	46
Water Soluble SO_4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	8.25	-	22.8
Sulphide	mg/kg	1	MCERTS	4.6	-	< 1.0
Total Sulphur	mg/kg	50	MCERTS	< 50	-	69
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.2	-	0.7
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149220	149221	149222
Sample Reference				WS104	WS105b	WS107
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.60	0.80	1.80
Date Sampled				18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.57	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.13	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	1.3	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	1.4	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.62	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.87	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.68	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.27	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.53	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.28	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.07	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.37	< 0.05
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	7.12	< 0.80
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	1.5	3.5	7.4
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	230	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	0.68	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	< 0.2	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.3	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	6.2	-	11
Copper (aqua regia extractable)	mg/kg	1	MCERTS	8.7	8.5	9.6
Lead (aqua regia extractable)	mg/kg	1	MCERTS	4.4	23	7.6
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	7.6	17	9.5
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	23	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	16	53	16

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Lab Sample Number				149220	149221	149222
Sample Reference				WS104	WS105b	WS107
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.60	0.80	1.80
Date Sampled				18/03/2024	18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Petroleum Hydrocarbons						
TPH (>C5 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (>C5 - C6) HS_1D_TOTAL	mg/kg	0.1	NONE	< 0.1	< 0.1	< 0.1
TPH (>C6 - C8) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (>C8 - C10) HS_1D_TOTAL	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (>C10 - C12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH (>C12 - C16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0
TPH (>C16 - C21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH (>C21 - C35) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH (>C35 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10
TPH Total >C5 - C40 EH_CU+HS_1D_TOTAL	mg/kg	10	NONE	< 10	< 10	< 10
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-009860
Project / Site name: Russell Road
Your Order No: 007755

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006 based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
149215	TP109	0.40	183	Loose Fibrous Debris	**Chrysotile**	0.044	**0.044**

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

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The results included within the report are representative of the samples submitted for analysis.

4041

Analytical Report Number: 24-009860
Project / Site name: Russell Road

Your Order No: 007755

Lab Sample Number				149211	149214
Sample Reference				TP102	TP108
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	0.60
Date Sampled				18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
General Inorganics					
pH (automated)	pH Units	N/A	ISO 17025	7.6	8.4
Total Cyanide (Low Level 1 µg/l)	µg/l	1	NONE	< 1.0	< 1.0
Total Phenols					
Total Phenols (monohydric) low level	µg/l	1	NONE	1.3	1.6
Speciated PAHs					
Naphthalene	µg/l	0.01	ISO 17025	0.49	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01
Total PAH					
Total EPA-16 PAHs	µg/l	0.16	NONE	0.49	< 0.16

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UKAS TESTING
4041

Analytical i2 Environmental Science

Analytical Report Number: 24-009860
Project / Site name: Russell Road

Your Order No: 007755

Lab Sample Number				149211	149214
Sample Reference				TP102	TP108
Sample Number				None Supplied	None Supplied
Depth (m)				1.00	0.60
Date Sampled				18/03/2024	18/03/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Heavy Metals / Metalloids					
Arsenic (dissolved)	µg/l	1	ISO 17025	< 1.0	3
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	3.5	13
Copper (dissolved)	µg/l	0.7	ISO 17025	15	6.8
Lead (dissolved)	µg/l	1	ISO 17025	5.6	5.7
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	0.7
Nickel (dissolved)	µg/l	0.3	ISO 17025	2.7	0.4
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	15	25
Petroleum Hydrocarbons					
TPH - Aliphatic >C5 - C6 HS_1D_AL	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aliphatic >C6 - C8 $_{HS\_1D\_AL}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aliphatic >C8 - C10 $_{HS\_1D\_AL}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aliphatic >C10 - C12 $_{EH\_1D\_AL\_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C12 - C16 EH_1D_AL_MS	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C16 - C21 $_{EH\_1D\_AL\_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C21 - C35 $_{EH\_1D\_AL\_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aliphatic >C5 - C35 $_{HS+EH\_1D\_AL\_MS}$	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aromatic >EC7 - EC8 HS_1D_AR	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aromatic >EC8 - EC10 EH_1D_AR_MS	µg/l	1	NONE	< 1.0	< 1.0
TPH - Aromatic >EC10 - EC12 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC12 - EC16 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC16 - EC21 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10
TPH - Aromatic >EC21 - EC35 EH_1D_AR_MS	µg/l	10	NONE	< 10	< 10
TPH (C10 - C40) $_{EH\_1D\_TOTAL\_MS}$	µg/l	10	NONE	< 10	< 10
VOCs					
MTBE (Methyl Tertiary Butyl Ether)	µg/l	3	NONE	< 3.0	< 3.0
Benzene	µg/l	3	NONE	< 3.0	< 3.0
Toluene	µg/l	3	NONE	< 3.0	< 3.0
Ethylbenzene	µg/l	3	NONE	< 3.0	< 3.0
p & m-xylene	µg/l	3	NONE	< 3.0	< 3.0
o-xylene	µg/l	3	NONE	< 3.0	< 3.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 24-009860
Project / Site name: Russell Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
149210	TP101	None Supplied	0.4	Brown clay and loam with stones and vegetation
149211	TP102	None Supplied	1	Brown sandy clay
149212	TP104a	None Supplied	0.4	Brown loam and sand with gravel and vegetation
149213	TP106	None Supplied	0.7	Brown sandy clay with gravel and stones
149214	TP108	None Supplied	0.6	Brown loam and sand with gravel and vegetation
149215	TP109	None Supplied	0.4	Brown loam and sand with stones and vegetation
149216	WS101	None Supplied	0.8	Brown sand with gravel
149217	WS102	None Supplied	1.5	Brown sand with stones and vegetation
149218	WS103	None Supplied	0.6	Brown sand with gravel
149219	WS103	None Supplied	0.9	Brown sand
149220	WS104	None Supplied	1.6	Brown sand with stones
149221	WS105b	None Supplied	0.8	Brown sand with gravel
149222	WS107	None Supplied	1.8	Brown sand with gravel

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Analytical Report Number : 24-009860
Project / Site name: Russell Road

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references	HSE Report No: 83/1996, HSG 248 (2021), HSG 264 (2012) & SCA Blue Book (draft)	A006B	D	ISO 17025
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	In-house method	L010	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038B	D	MCERTS
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-MS/GC-MS HS in leachate	Determination of total petroleum hydrocarbons in leachate by GC-MS/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L070B/L088	W	NONE
Total petroleum hydrocarbons by GC-MS/GC-MS HS in leachate	Determination of total petroleum hydrocarbons in leachate by GC-MS/GC-MS HS	In-house method	L070B/L088	W	NONE
BTEX and/or Volatile organic compounds in leachate	Determination of volatile organic compounds in leachate by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	NONE

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Analytical Report Number : 24-009860
Project / Site name: Russell Road

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	MCERTS
Monohydric phenols (low level) in leachate	Determination of phenols in leachate by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
Total cyanide (low level) in leachate	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS
pH at 20°C in leachate (automated)	Determination of pH in leachate by electrometric measurement	In-house method	L099	W	ISO 17025
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in leachate	SVOCs and PAHs in leachate	In-house method	L102B		ISO 17025

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Project / Site name: Russell Road

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Organic 2:1 Leachate		In-house method	L020B	W	NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

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APPENDIX IX
GEOTECHNICAL TESTING RESULTS



MURRAY RIX
CONSULTANCY, SITE INVESTIGATION
CONSTRUCTION MATERIALS TESTING

TEST REPORT

Client e3p

Address Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

Contract 17-013 -
Russel Road

Job Number MRN 24005/72
Date of Issue 03 May 2024
Page 1 of 15

Approved Signatories

S J Hutchings, O P Davies

Notes

1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.

2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.

3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.

4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.

5 The results included within the report are representative of the samples submitted for analysis.

6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

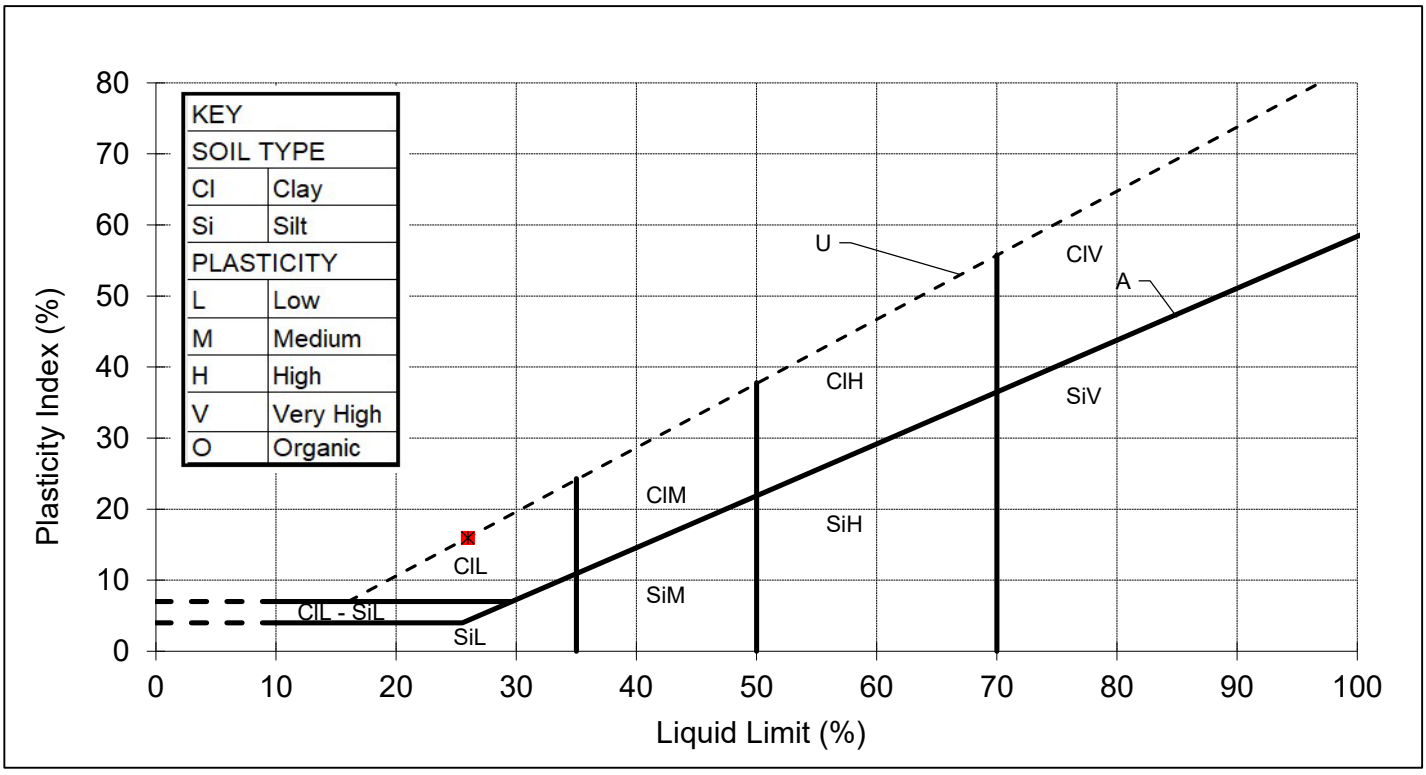
CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	WS104 1 SPT	DATE SAMPLED	Not advised
SAMPLE No.	446804	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	23.5	27.1	0.957	
Determination 2 (avg)	23.9	27.2		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
18.1	26	10	16	96



REMARKS

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

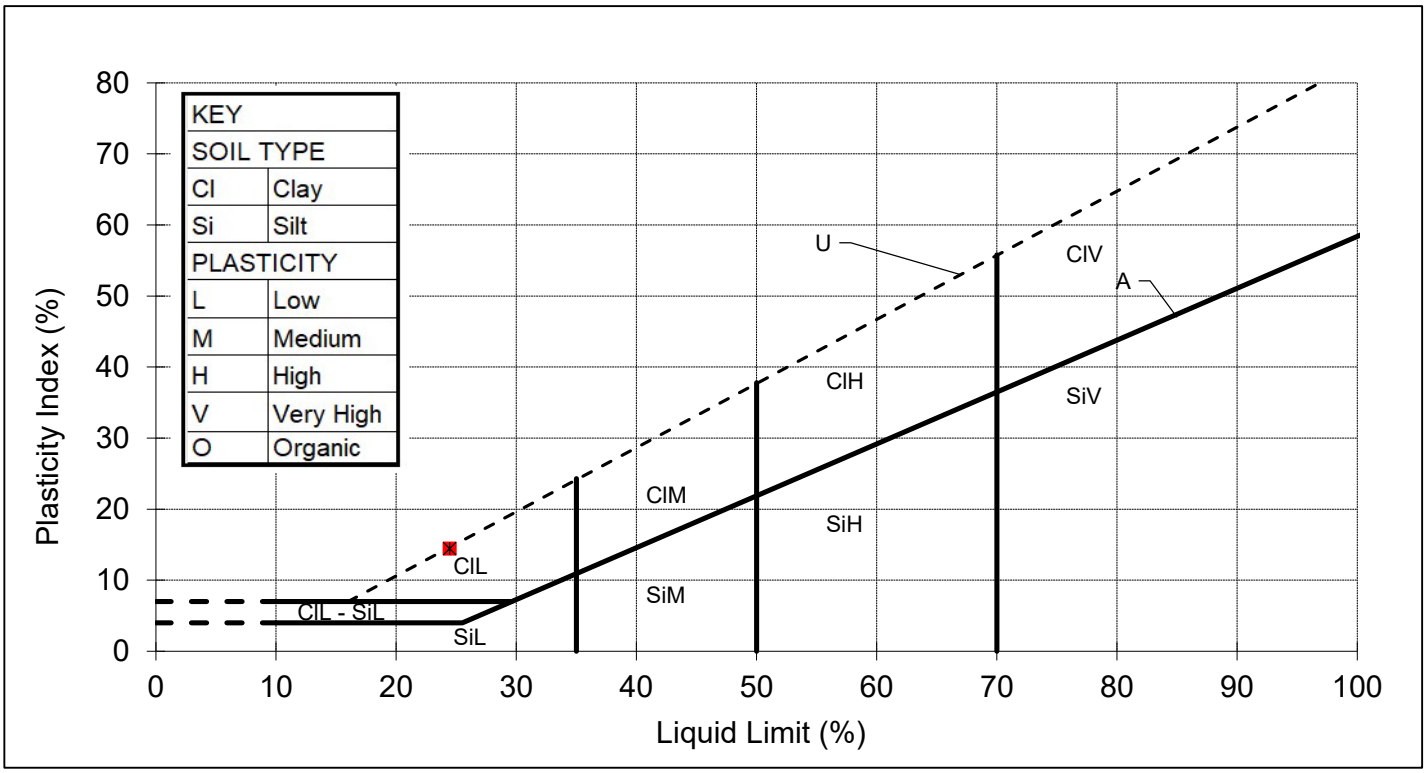
CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP102 5.0 SPT	DATE SAMPLED	Not advised
SAMPLE No.	446807	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	21.8	25.0	0.978	
Determination 2 (avg)	21.1	25.0		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
15.8	24	10	14	96



REMARKS

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
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UKAS TESTING 1580

TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD
PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5
WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

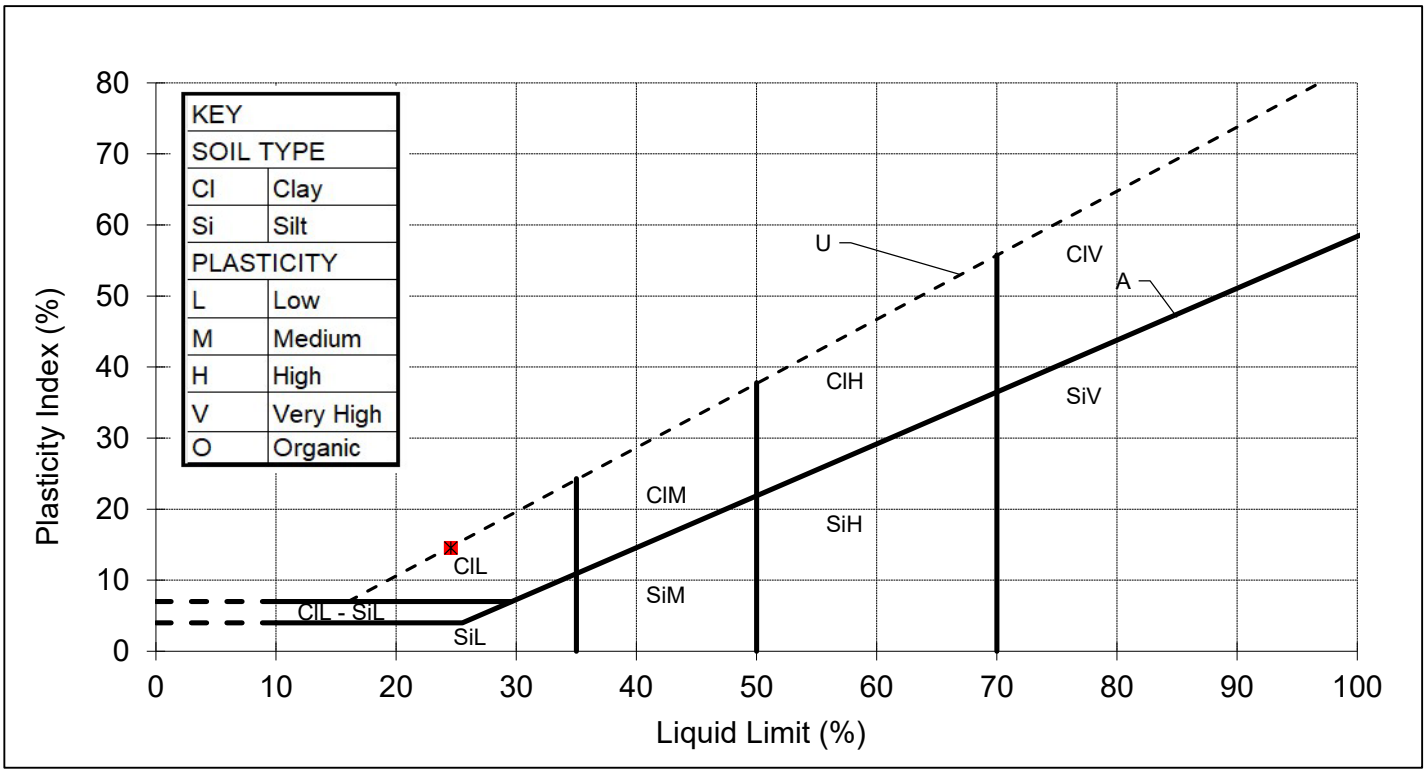
CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP104 7.0 SPT	DATE SAMPLED	Not advised
SAMPLE No.	446810	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	22.3	25.5	0.969	
Determination 2 (avg)	22.2	25.2		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
15.8	25	10	15	92



REMARKS

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

M U R R A Y R I X

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

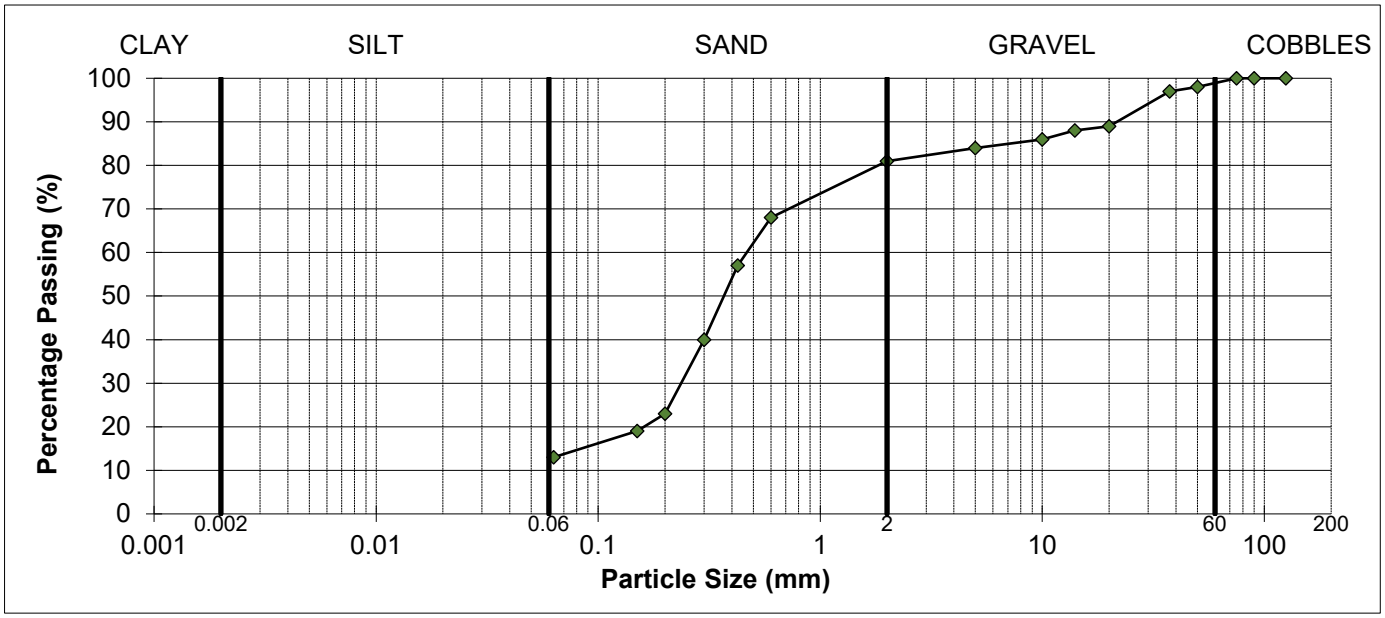
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	TP101 1.0	DATE SAMPLED	Not advised
LAB SAMPLE No	446801	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty gravelly SAND
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100	95-100	5	84	
90	100		2	81	
75	100		0.6	68	
50	98		0.425	57	
37.5	97		0.3	40	
20	89		0.2	23	
14	88		0.15	19	
10	86		0.063	13	<15



SOIL FRACTIONS			
COBBLES	1%	SAND	68%
GRAVEL	18%	SILT / CLAY	13%

As received water content	14.5%

REMARKS

Sample complies with the advised grading specification for a 1B material (SHW 2016), Uniformity coefficient = <10

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 4.5kg RAMMER
BS 1377-2:2022 Cl.11
PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

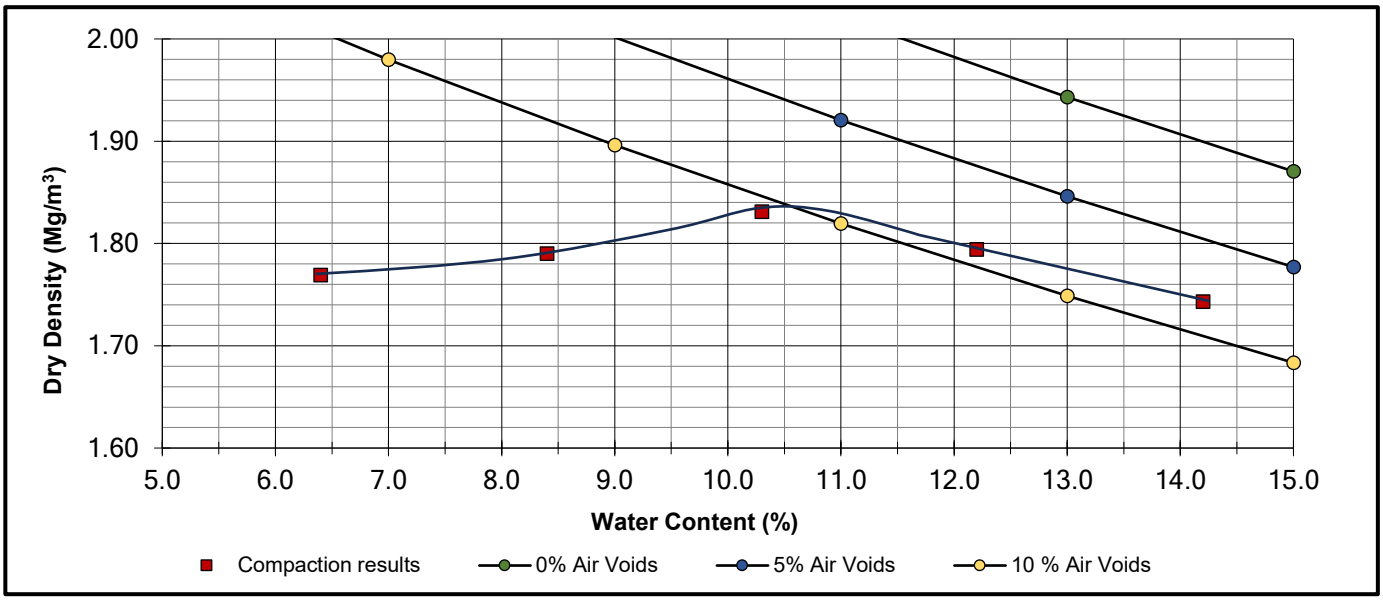
CLIENT	e3p
SITE	17-470 - Holden Fold
JOB NUMBER	MRN 24005/68

SAMPLE LABEL	TP101 1.0	DATE SAMPLED	Not advised
SAMPLE NUMBER	446801	DATE RECEIVED	27-Mar-24
DATE TESTED	15-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty gravelly SAND
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	3 %	GRADING ZONE	Zone 4
RETAINED 20mm	11 %	PARTICLE DENSITY	2.60 Mg/m3 (Assumed)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m^3)
1	6.4	1.769
2	8.4	1.790
3	10.3	1.831
4	12.2	1.794
5	14.2	1.743



OPTIMUM WATER CONTENT	**11**	(%)
MAXIMUM DRY DENSITY	**1.83**	(Mg/m^3)

REMARKS

NAME O.P. Davies BA (Hons) (Laboratory Manager) SIGNED DATE 03-May-24

M U R R A Y R I X
ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

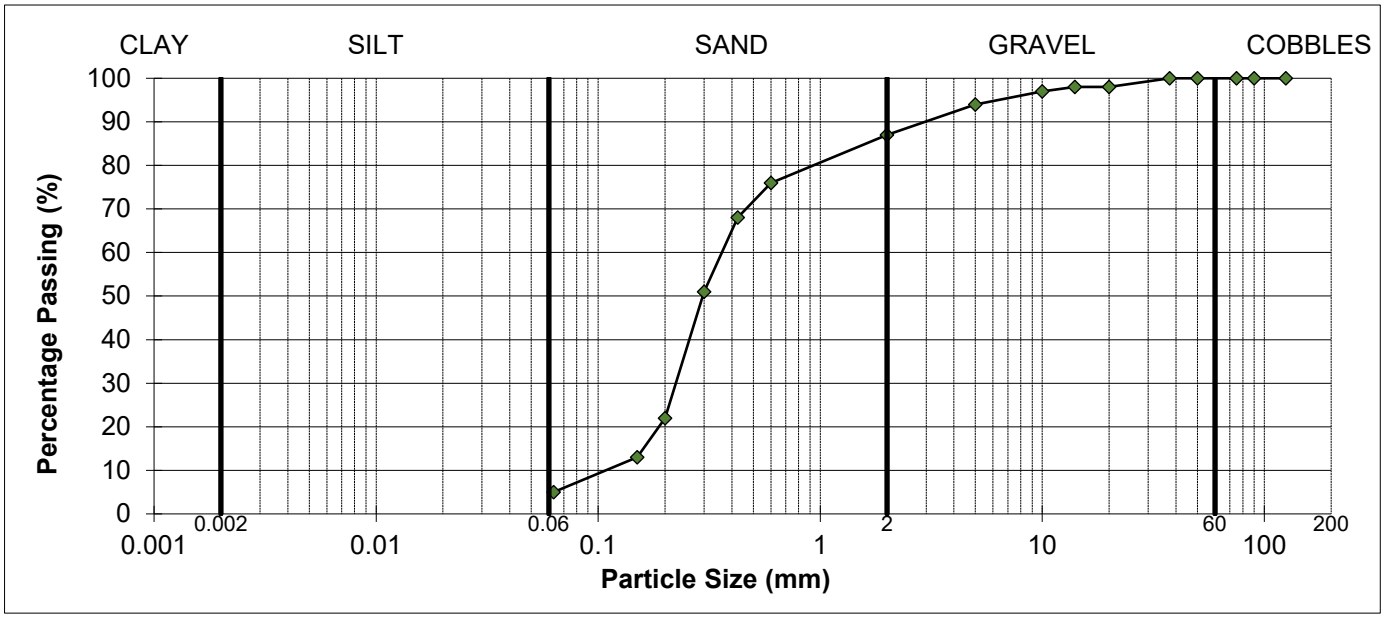
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	TP106 1.5	DATE SAMPLED	Not advised
LAB SAMPLE No	446802	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty gravelly SAND
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100	95-100	5	94	
90	100		2	87	
75	100		0.6	76	
50	100		0.425	68	
37.5	100		0.3	51	
20	98		0.2	22	
14	98		0.15	13	
10	97		0.063	5	<15



SOIL FRACTIONS			
COBBLES	0%	SAND	82%
GRAVEL	13%	SILT / CLAY	5%

As received water content	10.4%

REMARKS

Sample complies with the advised grading specification for a 1B material (SHW 2016), Uniformity coefficient = <10

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

MURRAY RIX

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UKAS TESTING 1580

TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 4.5kg RAMMER
BS 1377-2:2022 Cl.11
PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

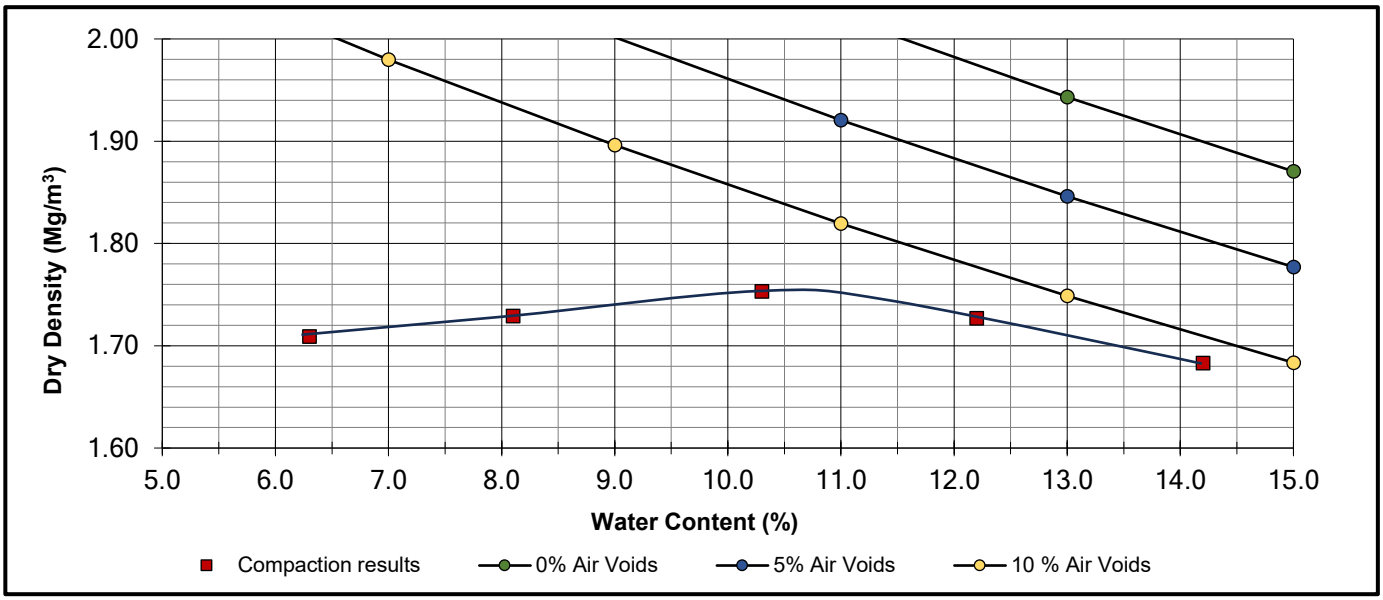
CLIENT	e3p
SITE	17-470 - Holden Fold
JOB NUMBER	MRN 24005/68

SAMPLE LABEL	TP106 1.5	DATE SAMPLED	Not advised
SAMPLE NUMBER	446802	DATE RECEIVED	27-Mar-24
DATE TESTED	15-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty gravelly SAND
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	0 %	GRADING ZONE	Zone 2
RETAINED 20mm	2 %	PARTICLE DENSITY	2.60 Mg/m3 (Assumed)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m^3)
1	6.3	1.709
2	8.1	1.729
3	10.3	1.753
4	12.2	1.727
5	14.2	1.683



OPTIMUM WATER CONTENT	**11**	(%)
MAXIMUM DRY DENSITY	**1.75**	(Mg/m^3)

REMARKS

NAME O.P. Davies BA (Hons) (Laboratory Manager) SIGNED DATE 03-May-24

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DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

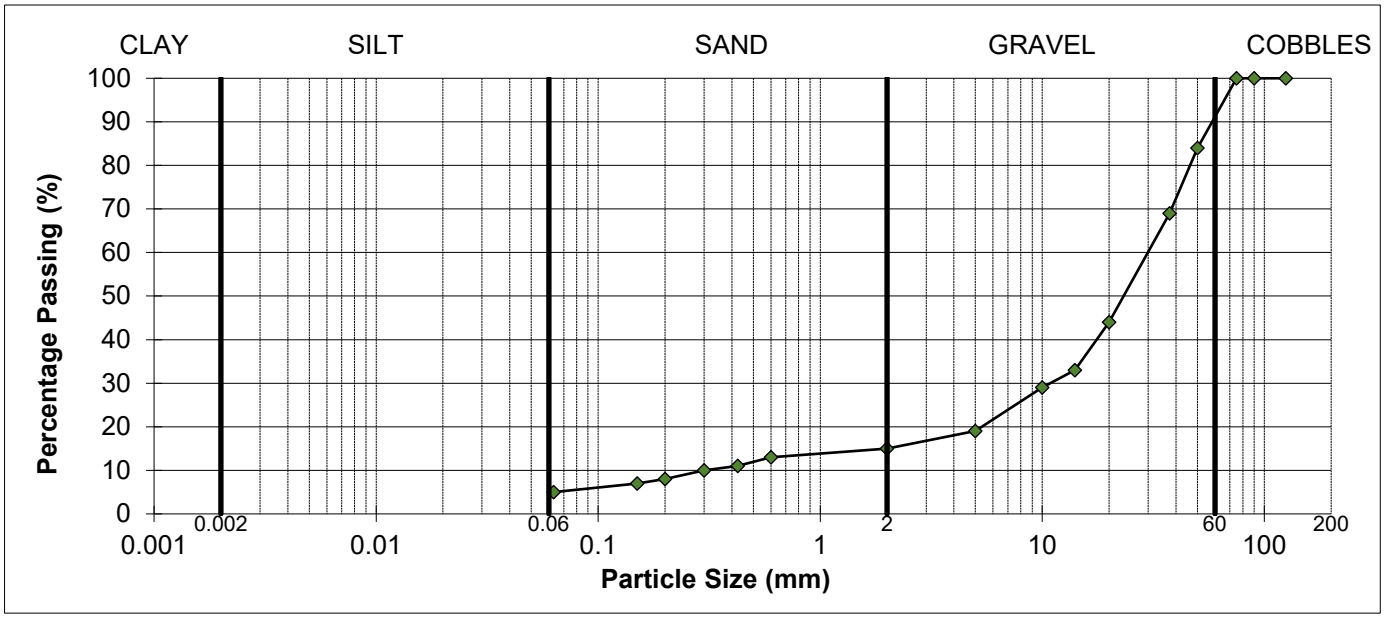
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	TP110 0.5	DATE SAMPLED	Not advised
LAB SAMPLE No	446803	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty sandy GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100	95-100	5	19	
90	100		2	15	
75	100		0.6	13	
50	84		0.425	11	
37.5	69		0.3	10	
20	44		0.2	8	
14	33		0.15	7	
10	29		0.063	5	<15



SOIL FRACTIONS			
COBBLES	8%	SAND	10%
GRAVEL	77%	SILT / CLAY	5%

As received water content	9.8%

REMARKS

Sample complies with the advised grading specification for a 1A material (SHW 2016), Uniformity coefficient = >10

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

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DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

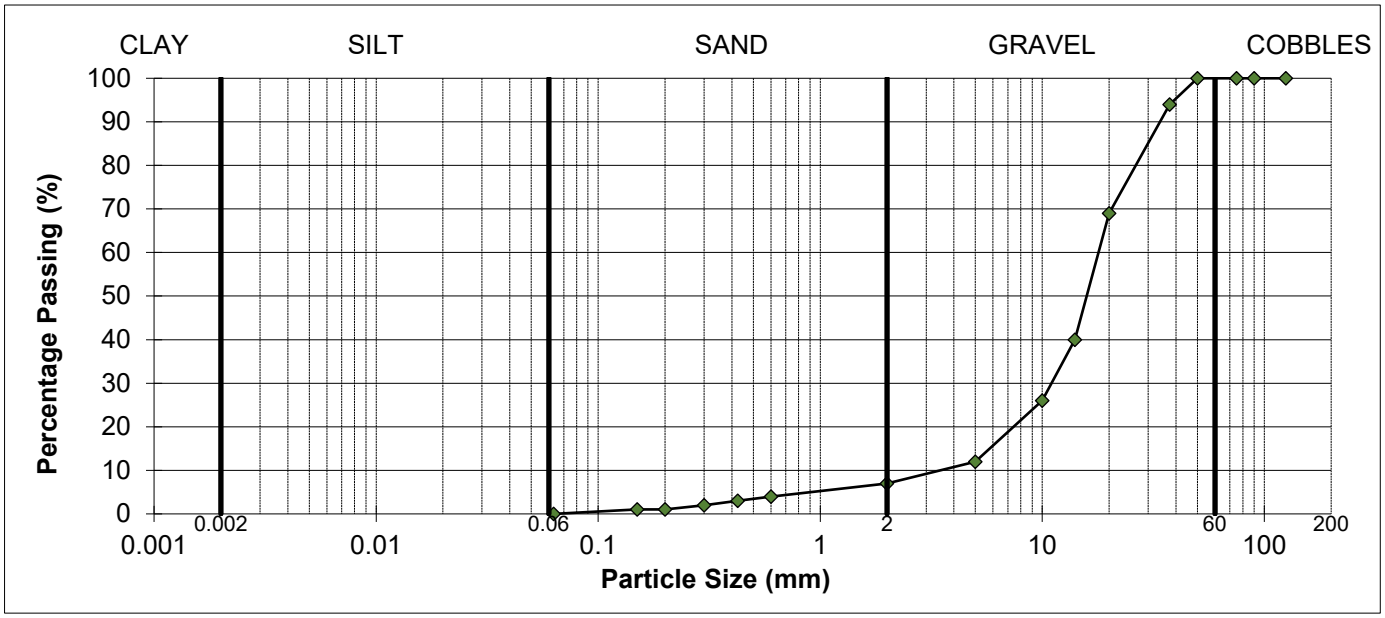
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP101a 4.0	DATE SAMPLED	Not advised
LAB SAMPLE No	446805	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty sandy GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100	95-100	5	12	
90	100		2	7	
75	100		0.6	4	
50	100		0.425	3	
37.5	94		0.3	2	
20	69		0.2	1	
14	40		0.15	1	
10	26		0.063	0	<15



SOIL FRACTIONS			
COBBLES	0%	SAND	7%
GRAVEL	93%	SILT / CLAY	0%

As received water content	4.6%

REMARKS

Sample complies with the advised grading specification for a 1B material (SHW 2016), Uniformity coefficient = <10

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

M U R R A Y R I X
ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

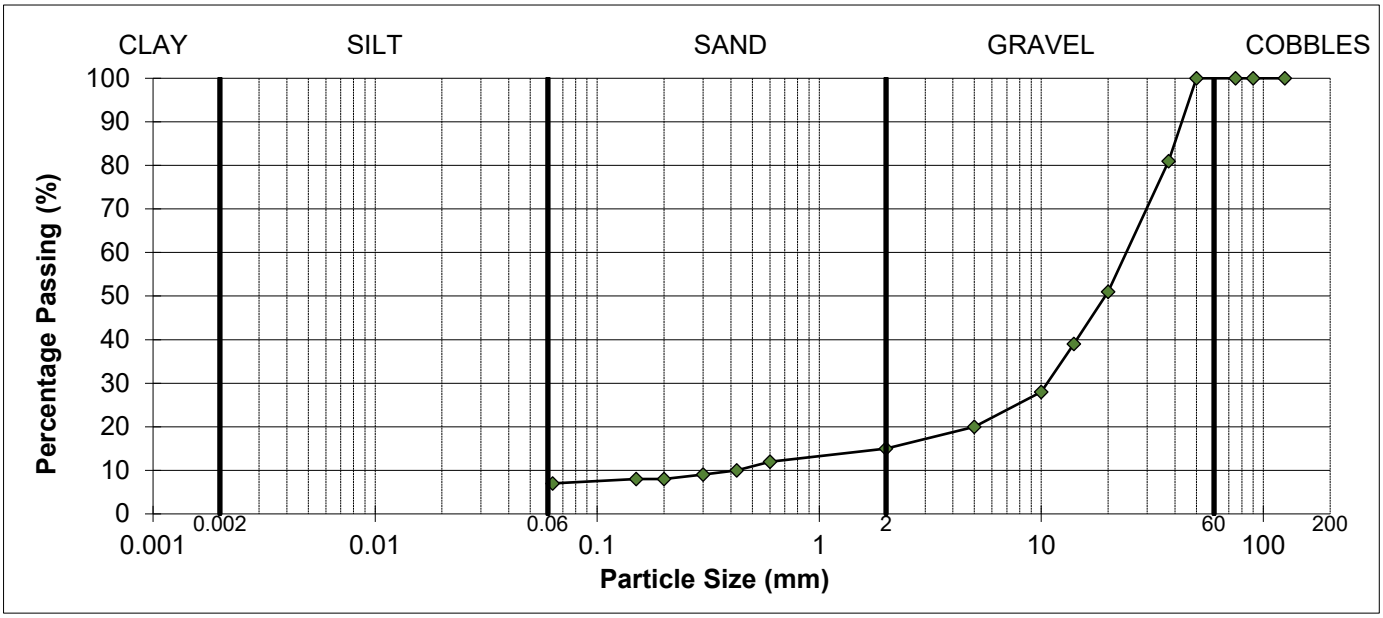
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP104 4.0	DATE SAMPLED	Not advised
LAB SAMPLE No	446808	DATE RECEIVED	27-Mar-24
DATE TESTED	08-Apr-24	SAMPLED BY	Client

MATERIAL	Brown silty sandy GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100	95-100	5	20	
90	100		2	15	
75	100		0.6	12	
50	100		0.425	10	
37.5	81		0.3	9	
20	51		0.2	8	
14	39		0.15	8	
10	28		0.063	7	<15



SOIL FRACTIONS			
COBBLES	0%	SAND	8%
GRAVEL	85%	SILT / CLAY	7%

As received water content	4.0%

REMARKS

Sample complies with the advised grading specification for a 1A material (SHW 2016), Uniformity coefficient = >10

SIGNED

NAME O.P. Davies BA (Hons) (Laboratory Manager) DATE 03-May-24

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
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TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION
BS EN ISO 17892-8:2018

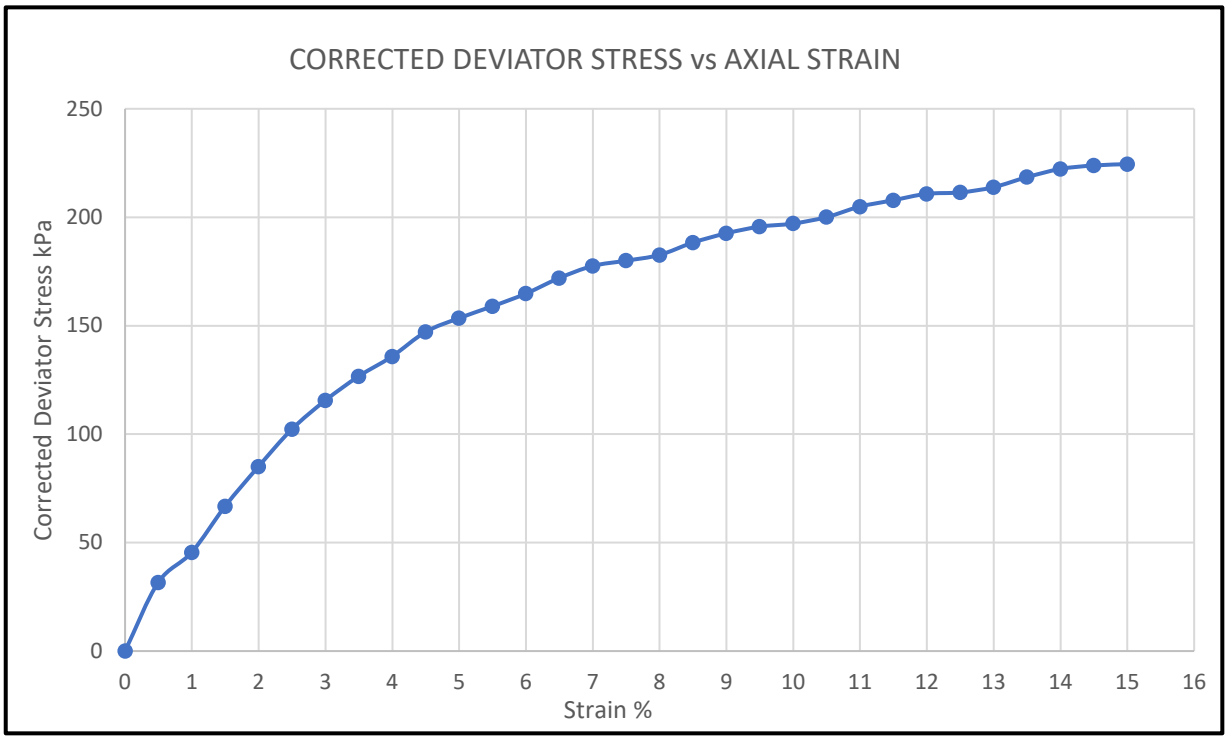
CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP102 8.0	**DATE SAMPLED**	Not advised
LAB SAMPLE No.	446806	**DATE RECEIVED**	27-Mar-24
DATE TESTED	17-Apr-24	**SAMPLED BY**	Client
MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample		

INITIAL CONDITIONS

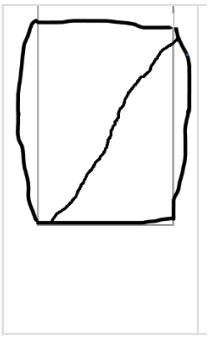
Specimen Location 

Sample Length (mm)	450	Specimen depth from top of Sample (mm)	20
Sample Orientation	Vertical	Specimen Condition	Undisturbed
Specimen Length (mm)	201	Specimen Water Content (%)	12.7
Specimen Diameter (mm)	101	Specimen Bulk Density (Mg/m3)	2.27
Membrane Thickness (mm)	0.4	Specimen Dry Density (Mg/m3)	2.01
Membrane Correction	3.39		



TEST TYPE
SINGLE STAGE

SKETCH OF SPECIMEN AT FAILURE



COMBINED

Cell Pressure (kPa)	Failure Strain (%)	Rate of Strain (%/min)	Corrected Deviator Stress (kPa)	Shear Strength Cu (kPa)
165	15.0	2.0	224	112

Remarks/Abnormalities

Name O.P Davies BA (Hons) (Laboratory Manager) Signed  Date 03 May 2024

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

TEST CERTIFICATE

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION
BS EN ISO 17892-8:2018

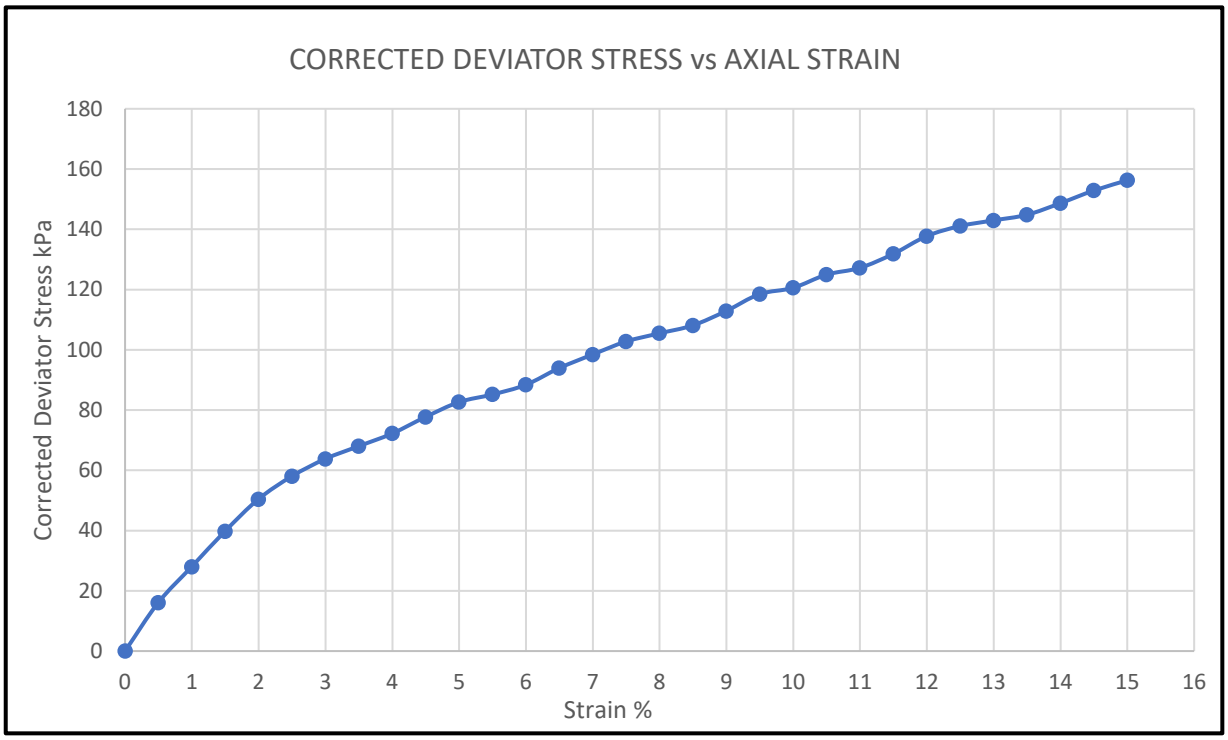
CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP104 6.5	**DATE SAMPLED**	Not advised
LAB SAMPLE No.	446809	**DATE RECEIVED**	27-Mar-24
DATE TESTED	17-Apr-24	**SAMPLED BY**	Client
MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample		

INITIAL CONDITIONS

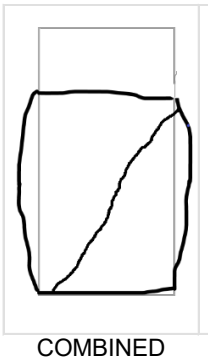
Specimen Location 

Sample Length (mm)	450	Specimen depth from top of Sample (mm)	20
Sample Orientation	Vertical	Specimen Condition	Undisturbed
Specimen Length (mm)	201	Specimen Water Content (%)	15.5
Specimen Diameter (mm)	101	Specimen Bulk Density (Mg/m3)	2.31
Membrane Thickness (mm)	0.4	Specimen Dry Density (Mg/m3)	2.00
Membrane Correction	3.39		



TEST TYPE
SINGLE STAGE

SKETCH OF SPECIMEN AT FAILURE



COMBINED

Cell Pressure (kPa)	Failure Strain (%)	Rate of Strain (%/min)	Corrected Deviator Stress (kPa)	Shear Strength Cu (kPa)
135	15.0	2.0	156	78

Remarks/Abnormalities

Name O.P Davies BA (Hons) (Laboratory Manager) Signed  Date 03 May 2024

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870

UKAS TESTING 1580

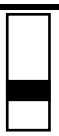
TEST CERTIFICATE

INCREMENTAL LOADING OEDOMETER TEST
BS EN ISO 17892-5:2017

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP102 8.0	**DATE SAMPLED**	Not advised
LAB SAMPLE No.	446806	**DATE RECEIVED**	27-Mar-24
DATE TESTED	17-Apr-24	**SAMPLED BY**	Client
MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample		

Specimen Location



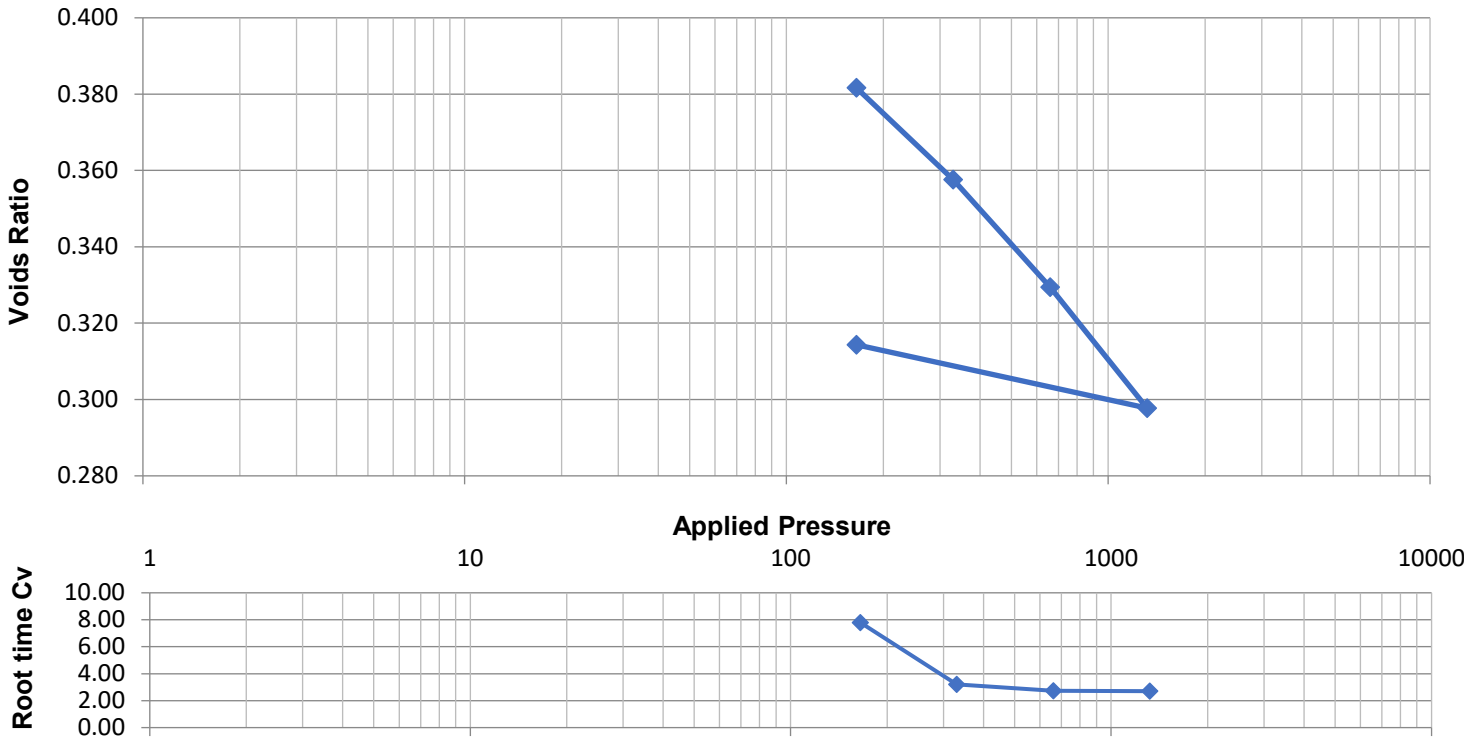
Sample Length (mm)	450	Specimen depth from top of Sample (mm)	250
Sample Orientation	Vertical	Specimen Condition	Undisturbed

INITIAL CONDITIONS

Height	20.1	mm	Particle density	2.65	Ass
Diameter	70.1	mm	Initial void ratio	0.45	
Weight wet	160.9	g	Deg. of sat.	80	%
Water cont.*	13.5	%	Swell. press.	0	kN/m^2
Bulk Density	2.08	Mg/m^3	Dry density	1.83	Mg/m^3

*determined from specimen trimmings

Load No.	Applied Pressure kPa	Sample Height mm	Void Ratio	Mv m^2/MN	Temp °C	Cv t90 root m^2/yr	Cv t50 log m^2/yr
1	165	19.17	0.382	0.27	20	7.79	4.15
2	330	18.84	0.358	0.11	20	3.22	2.84
3	660	18.44	0.329	0.06	20	2.74	2.43
4	1320	18.01	0.298	0.04	20	2.70	2.66
5	165	18.23	0.314	0.01	20		
6							
7							



Remarks/Abnormalities

Name O.P Davies BA (Hons) (Laboratory Manager)

Signed

Date 03 May 2024

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
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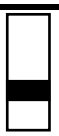
UKAS TESTING 1580

TEST CERTIFICATE

INCREMENTAL LOADING OEDOMETER TEST
BS EN ISO 17892-5:2017

CLIENT	e3p
SITE	17-013 - Russel Road
JOB NUMBER	MRN 24005/72

SAMPLE LABEL	CP104 6.5	**DATE SAMPLED**	Not advised
LAB SAMPLE No.	446809	**DATE RECEIVED**	27-Mar-24
DATE TESTED	17-Apr-24	**SAMPLED BY**	Client
MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample		

Specimen Location 

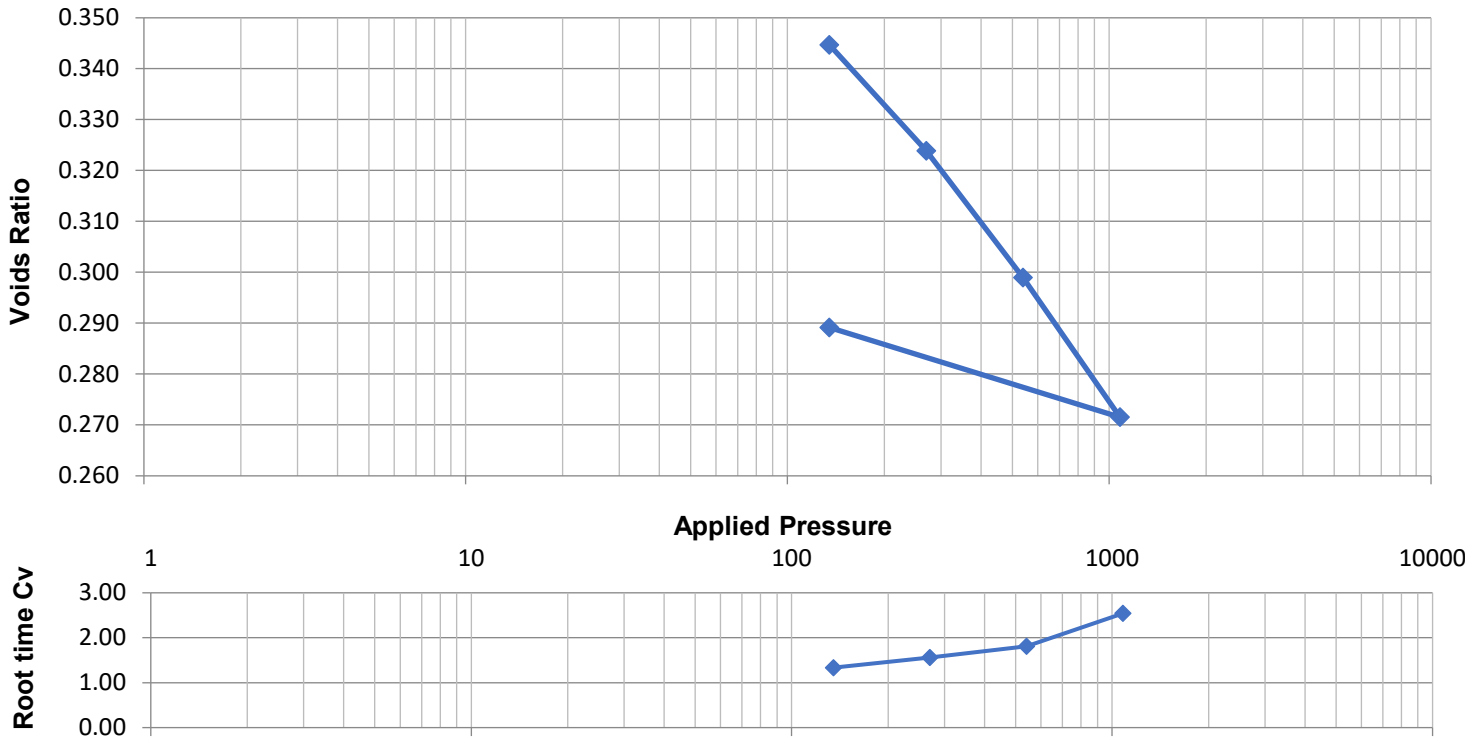
Sample Length (mm)	450	Specimen depth from top of Sample (mm)	250
Sample Orientation	Vertical	Specimen Condition	Undisturbed

INITIAL CONDITIONS

Height	20.0	mm	Particle density	2.65	Ass
Diameter	70.0	mm	Initial void ratio	0.37	
Weight wet	168.1	g	Deg. of sat.	96	%
Water cont.*	13.5	%	Swell. press.	0	kN/m^2
Bulk Density	2.19	Mg/m^3	Dry density	1.93	Mg/m^3

*determined from specimen trimmings

Load No.	Applied Pressure kPa	Sample Height mm	Void Ratio	Mv m^2/MN	Temp °C	Cv t90 root m^2/yr	Cv t50 log m^2/yr
1	135	19.54	0.345	0.15	20	1.33	1.16
2	270	19.24	0.324	0.11	20	1.56	1.42
3	540	18.88	0.299	0.07	20	1.81	1.89
4	1080	18.48	0.272	0.04	20	2.54	2.48
5	135	18.73	0.289	0.01	20		
6							
7							



Remarks/Abnormalities

Name O.P Davies BA (Hons) (Laboratory Manager)

Signed 

Date 03 May 2024

APPENDIX X
ORIGIN OF CHEMICAL ASSESSMENT CRITERIA



CONSTITUENT	ORIGIN OF RISK ASSESSMENT VALUE
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs – methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide – Total	2014 LQM/CIEH S4ULs
Phenols – Total	2014 LQM/CIEH S4ULs
Naphthalene	General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene (iii)	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C_5-C_6 (aliphatic)	
TPH C_6-C_8 (aliphatic)	
TPH C_8-C_{10} (aliphatic)	
TPH C_{10}-C_{12} (aliphatic)	
TPH C_{12}-C_{16} (aromatic)	
TPH C_{16}-C_{21} (aromatic)	
TPH C_{21}-C_{35} (aromatic)	

APPENDIX XII
BRE365 SOAKAWAY PERMEABILITY TESTS



Site:	Russell Road	**Trial Pit Number:**	SA101
Job Number:	17-013	**Length:**	0.90 m
Date of Test:	18/03/2024	**Width:**	0.90 m
		Depth:	1.80 m
		Groundwater Level:	m
		Proportion of Pit Volume Occupied by Gravel Solids (Pg)	0.00

Drafted	Rev	Auth

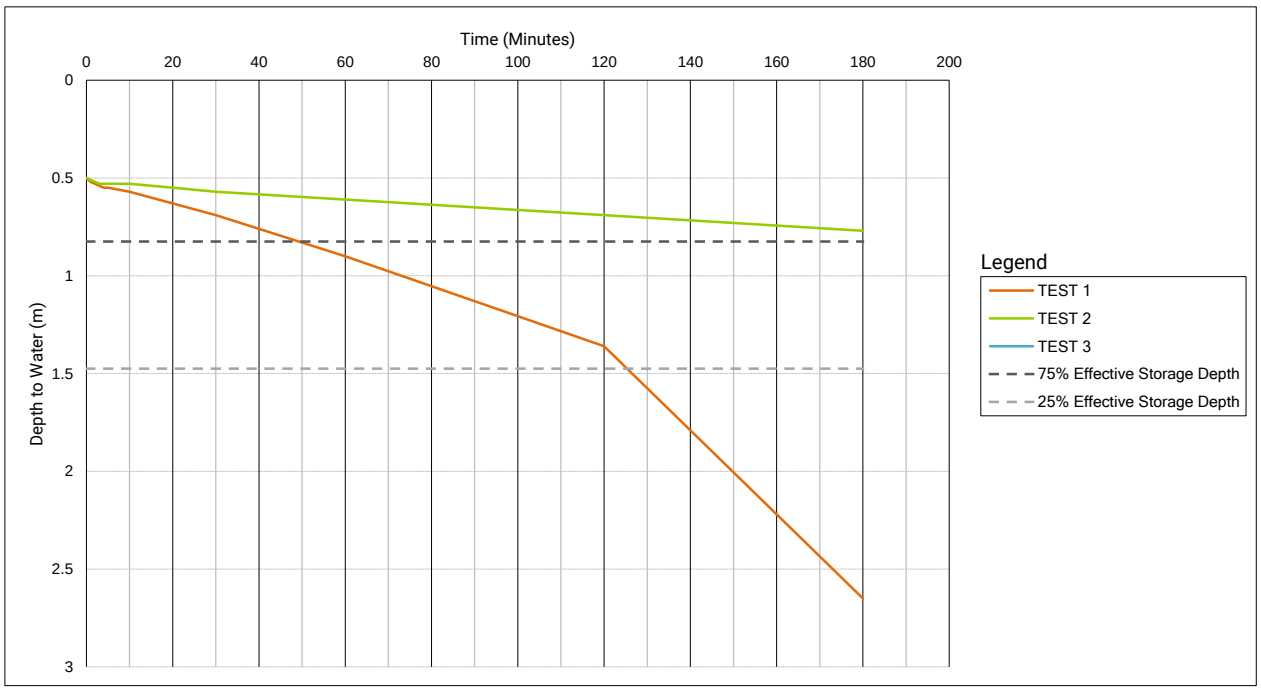
Remarks

Effective Depth - For a standard test in which the pit is filled with water, the effective depth will be equal to the actual depth. If the pit is not completely filled, it will be equal to the depth at the start of each test.

Gravel Filled Pits - Typically, the proportion of volume occupied by gravel is 0.70 (i.e. 70%), leaving 30% free storage volume. If the pit is left open (gravel is not used) then Pg = 0

		TEST 1		TEST 2		TEST 3	
		Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
		0	0.50	0	0.50		
		1	0.52	1	0.51		
		2	0.53	2	0.52		
		3	0.54	3	0.53		
		4	0.55	4	0.53		
		5	0.55	5	0.53		
		10	0.57	10	0.53		
		20	0.63	20	0.55		
		30	0.69	30	0.57		
		60	0.90	60	0.61		
		90	1.13	90	0.65		
		120	1.36	120	0.69		
		180	2.65	180	0.77		
Effective Storage Depth	m		1.30		1.30		N/A
75% Effective Storage Depth	m		0.98		0.98		N/A
(i.e. depth below GL)	m		0.83		0.83		N/A
25% Effective Storage Depth	m		0.33		0.33		N/A
(i.e. depth below GL)	m		1.48		1.48		N/A
Effective Storage Depth 75%-25%	m		0.65		0.65		N/A
Time to fall to 75% effective depth	mins		49		N/A		N/A
Time to fall to 25% effective depth	mins		125		N/A		N/A
Effective Volume of Pit - V(75%-25%) x (1-Pg)	m3		0.53		0.53		N/A
Area of Pit - ap50 (50%)	m2		3.15		3.15		N/A
t (75%-25%)	mins		76.06		N/A		N/A
SOIL INFILTRATION RATE	m/s		**3.66E-05**		**N/A**		**N/A**

DESIGN SOIL INFILTRATION RATE, f **3.66E-05**



Site:	Russell Road			**Trial Pit Number:**	SA102
Job Number:	17-013			**Length:**	2.40 m
Date of Test:	18/03/2024			**Width:**	1.20 m
				Depth:	2.20 m
Drafted	Rev	Auth		**Groundwater Level:**	m
HM	EF	AS		**Proportion of Pit Volume Occupied by Gravel Solids (Pg)**	0.00

Remarks

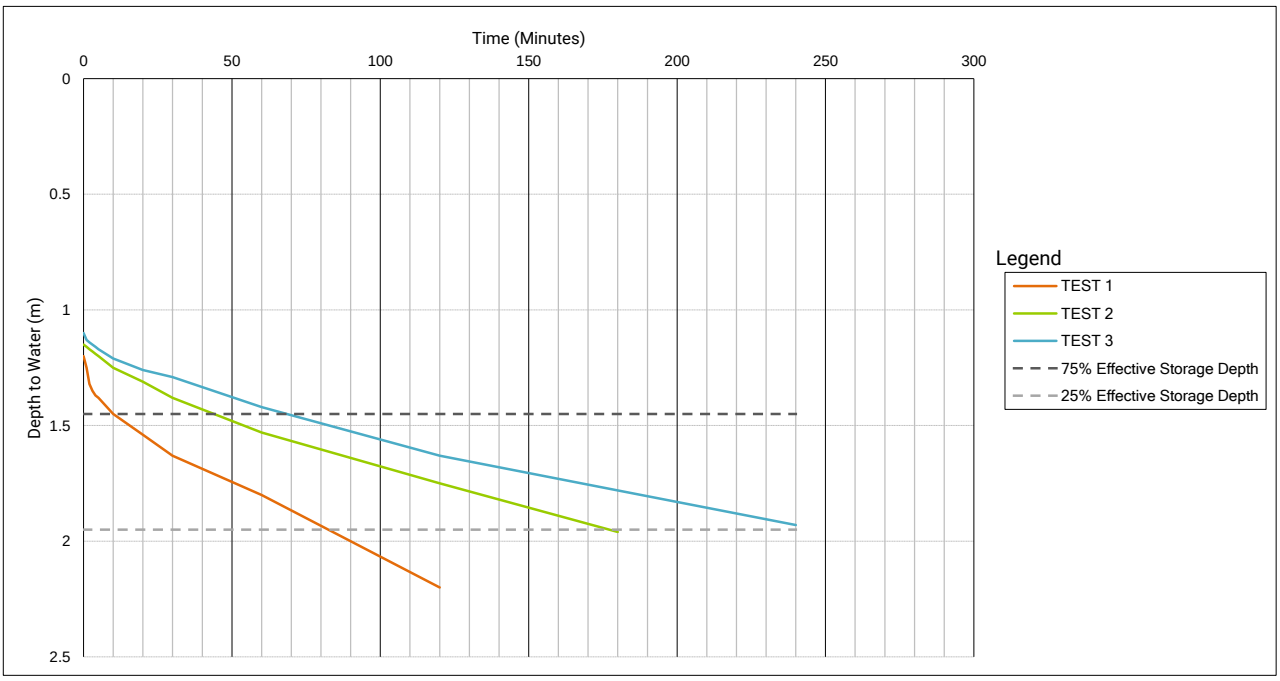
Effective Depth - For a standard test in which the pit is filled with water, the effective depth will be equal to the actual depth. If the pit is not completely filled, it will be equal to the depth at the start of each test.

Gravel Filled Pits - Typically, the proportion of volume occupied by gravel is 0.70 (i.e. 70%), leaving 30% free storage volume. If the pit is left open (gravel is not used) then Pg = 0

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	1.20	0	1.15	0	1.10
1	1.25	1	1.16	1	1.13
2	1.32	2	1.17	2	1.14
3	1.35	3	1.18	3	1.15
4	1.37	4	1.19	4	1.16
5	1.38	5	1.20	5	1.17
10	1.45	10	1.25	10	1.21
20	1.54	20	1.31	20	1.26
30	1.63	30	1.38	30	1.29
60	1.80	60	1.53	60	1.42
120	2.20	120	1.75	120	1.63
		180	1.96	180	1.78
				240	1.93

		TEST 1	TEST 2	TEST 3
Effective Storage Depth	m	1.00	1.05	1.10
75% Effective Storage Depth	m	0.75	0.79	0.83
(i.e. depth below GL)	m	1.45	1.41	1.38
25% Effective Storage Depth	m	0.25	0.26	0.28
(i.e. depth below GL)	m	1.95	1.94	1.93
Effective Storage Depth 75%-25%	m	0.50	0.53	0.55
Time to fall to 75% effective depth	mins	10	37	50
Time to fall to 25% effective depth	mins	83	174	238
Effective Volume of Pit - V(75%-25%) x (1-Pg)	m3	1.44	1.51	1.58
Area of Pit - ap50 (50%)	m2	6.48	6.66	6.84
t (75%-25%)	mins	72.50	137.07	188.38
SOIL INFILTRATION RATE	m/s	**5.11E-05**	**2.76E-05**	**2.05E-05**

DESIGN SOIL INFILTRATION RATE, f **2.05E-05**



Site:	Russell Road			**Trial Pit Number:**	SA103
Job Number:	17-013			**Length:**	2.40 m
Date of Test:	18/03/2024			**Width:**	0.90 m
				Depth:	1.90 m
Drafted	Rev	Auth		**Groundwater Level:**	m
HM	EF	AS		**Proportion of Pit Volume Occupied by Gravel Solids (Pg)**	0.00

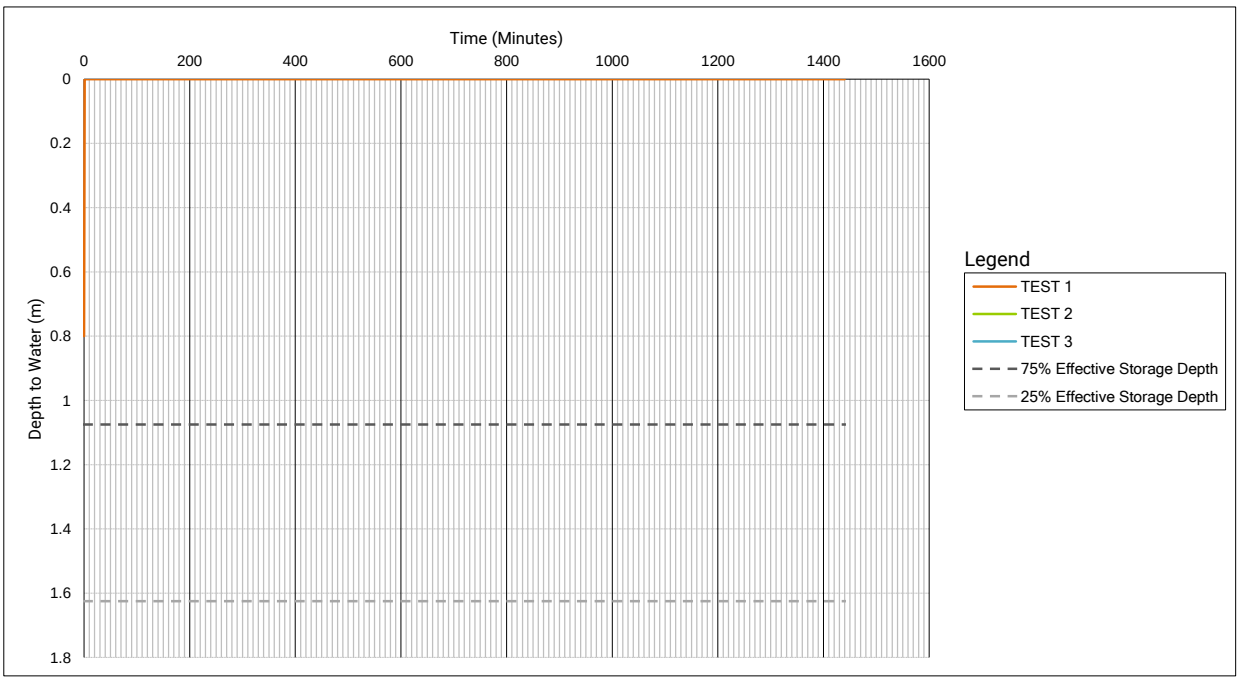
Remarks

Effective Depth - For a standard test in which the pit is filled with water, the effective depth will be equal to the actual depth. If the pit is not completely filled, it will be equal to the depth at the start of each test.

Gravel Filled Pits - Typically, the proportion of volume occupied by gravel is 0.70 (i.e. 70%), leaving 30% free storage volume. If the pit is left open (gravel is not used) then Pg = 0

		TEST 1		TEST 2		TEST 3	
		Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
		0	0.80				
		1	0.83				
		2	0.85				
		3	0.87				
		4	0.88				
		5	0.88				
		10	0.91				
		20	0.96				
		30	1.01				
		60	1.19				
		120	1.21				
		180	1.31				
		240	1.31				
		300	1.31				
		360	1.31				
		420	1.31				
		480	1.31				
		1320	1.33				
		1380	1.33				
		1440	1.33				
Effective Storage Depth	m		1.10		N/A		N/A
75% Effective Storage Depth	m		0.83		N/A		N/A
(i.e. depth below GL)	m		1.08		N/A		N/A
25% Effective Storage Depth	m		0.28		N/A		N/A
(i.e. depth below GL)	m		1.63		N/A		N/A
Effective Storage Depth 75%-25%	m		0.55		N/A		N/A
Time to fall to 75% effective depth	mins		N/A		N/A		N/A
Time to fall to 25% effective depth	mins		N/A		N/A		N/A
Effective Volume of Pit - V(75%-25%) x (1-Pg)	m3		1.19		N/A		N/A
Area of Pit - ap50 (50%)	m2		5.79		N/A		N/A
t (75%-25%)	mins		N/A		N/A		N/A
SOIL INFILTRATION RATE	m/s		**N/A**		**N/A**		**N/A**

DESIGN SOIL INFILTRATION RATE, f **N/A**



	Site:	Russell Road	**Trial Pit Number:**	SA104	
	Job Number:	17-013	**Length:**	2.10	m
	Date of Test:	18/03/2024	**Width:**	0.90	m
			Depth:	2.40	m
	Drafted	Rev / Auth	**Groundwater Level:**		m
	HM	EF / AS	**Proportion of Pit Volume Occupied by Gravel Solids (Pg)**	0.00	

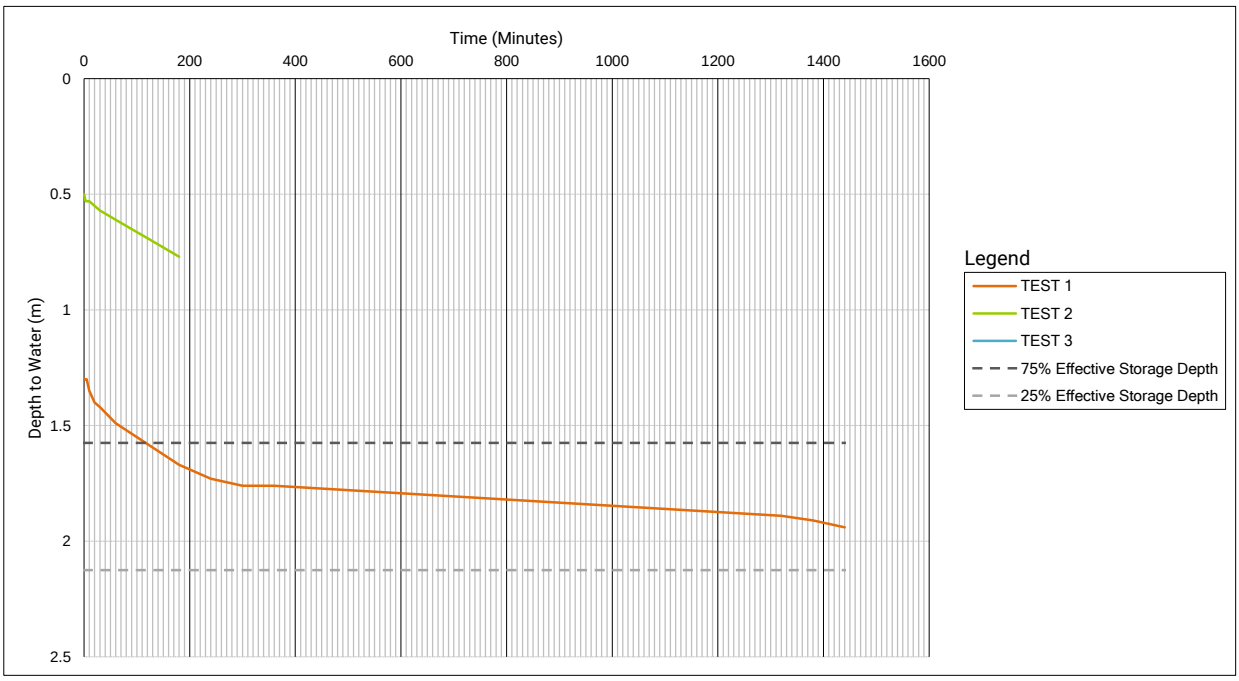
Remarks

Effective Depth - For a standard test in which the pit is filled with water, the effective depth will be equal to the actual depth. If the pit is not completely filled, it will be equal to the depth at the start of each test.

Gravel Filled Pits - Typically, the proportion of volume occupied by gravel is 0.70 (i.e. 70%), leaving 30% free storage volume. If the pit is left open (gravel is not used) then Pg = 0

		TEST 1		TEST 2		TEST 3	
		Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
		0	1.30	0	0.50		
		1	1.30	1	0.51		
		2	1.30	2	0.52		
		3	1.30	3	0.53		
		4	1.30	4	0.53		
		5	1.30	5	0.53		
		10	1.35	10	0.53		
		20	1.40	20	0.55		
		30	1.42	30	0.57		
		60	1.49	60	0.61		
		120	1.58	90	0.65		
		180	1.67	120	0.69		
		240	1.73	180	0.77		
		300	1.76				
		360	1.76				
		1320	1.89				
		1380	1.91				
		1440	1.94				
Effective Storage Depth	m		1.10		1.90		N/A
75% Effective Storage Depth	m		0.83		1.43		N/A
(i.e. depth below GL)	m		1.58		0.98		N/A
25% Effective Storage Depth	m		0.28		0.48		N/A
(i.e. depth below GL)	m		2.13		1.93		N/A
Effective Storage Depth 75%-25%	m		0.55		0.95		N/A
Time to fall to 75% effective depth	mins		117		N/A		N/A
Time to fall to 25% effective depth	mins		N/A		N/A		N/A
Effective Volume of Pit - V(75%-25%) x (1-Pg)	m3		1.04		1.80		N/A
Area of Pit - ap50 (50%)	m2		5.19		7.59		N/A
t (75%-25%)	mins		N/A		N/A		N/A
SOIL INFILTRATION RATE	m/s		**N/A**		**N/A**		**N/A**

DESIGN SOIL INFILTRATION RATE, f **N/A**



Site:	Russell Road		**Trial Pit Number:**	**SA105**	
Job Number:	17-013		**Length:**	2.20	m
Date of Test:	18/03/2024		**Width:**	0.90	m
			Depth:	1.80	m
Drafted	Rev	Auth	**Groundwater Level:**		m
HM	EF	AS	**Proportion of Pit Volume Occupied by Gravel Solids (Pg)**	0.00	

Remarks

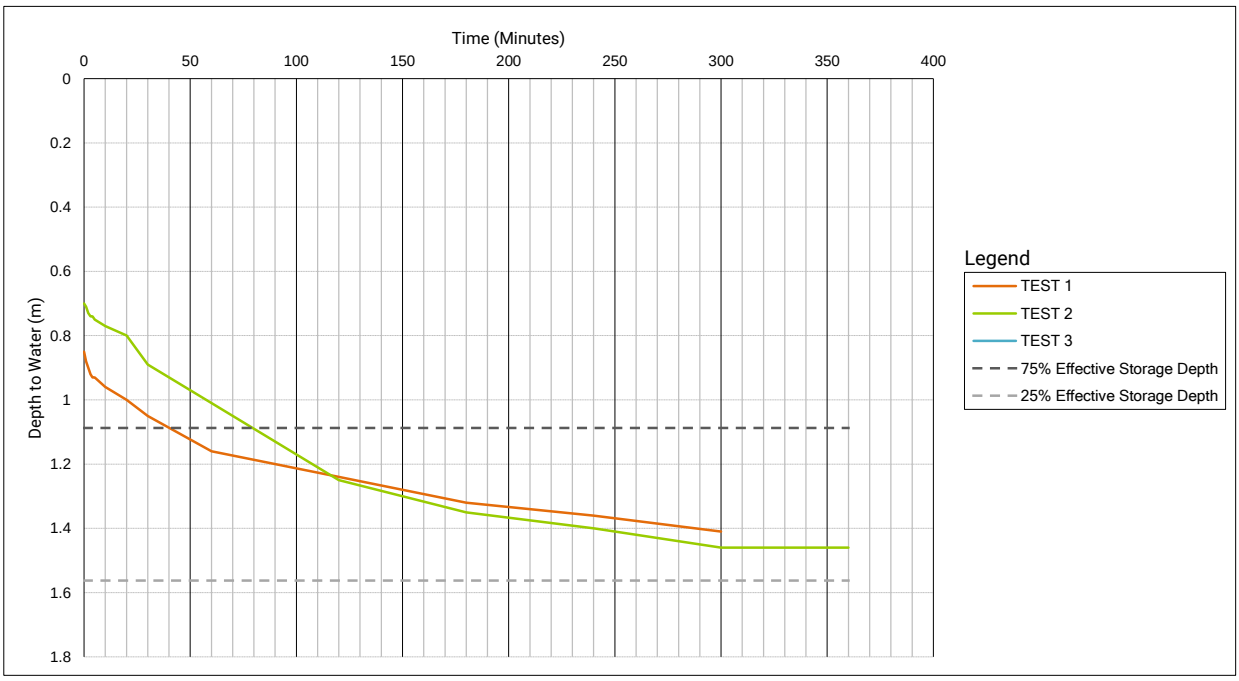
Effective Depth - For a standard test in which the pit is filled with water, the effective depth will be equal to the actual depth. If the pit is not completely filled, it will be equal to the depth at the start of each test.

Gravel Filled Pits - Typically, the proportion of volume occupied by gravel is 0.70 (i.e. 70%), leaving 30% free storage volume. If the pit is left open (gravel is not used) then Pg = 0

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.85	0	0.70		
1	0.88	1	0.71		
2	0.90	2	0.73		
3	0.92	3	0.74		
4	0.93	4	0.74		
5	0.93	5	0.75		
10	0.96	10	0.77		
20	1.00	20	0.80		
30	1.05	30	0.89		
60	1.16	60	1.01		
120	1.24	120	1.25		
180	1.32	180	1.35		
240	1.36	240	1.40		
300	1.41	300	1.46		
		360	1.46		

		TEST 1	TEST 2	TEST 3
Effective Storage Depth	m	0.95	1.10	N/A
75% Effective Storage Depth	m	0.71	0.83	N/A
(i.e. depth below GL)	m	1.09	0.98	N/A
25% Effective Storage Depth	m	0.24	0.28	N/A
(i.e. depth below GL)	m	1.56	1.53	N/A
Effective Storage Depth 75%-25%	m	0.48	0.55	N/A
Time to fall to 75% effective depth	mins	40	51	N/A
Time to fall to 25% effective depth	mins	N/A	N/A	N/A
Effective Volume of Pit - V(75%-25%) x (1-Pg)	m3	0.94	1.09	N/A
Area of Pit - ap50 (50%)	m2	4.93	5.39	N/A
t (75%-25%)	mins	N/A	N/A	N/A
SOIL INFILTRATION RATE	m/s	**N/A**	**N/A**	**N/A**

DESIGN SOIL INFILTRATION RATE, f **N/A**



	Site:	Russell Road	**Trial Pit Number:**	SA106	
	Job Number:	17-013	**Length:**	2.10	m
	Date of Test:	18/03/2024	**Width:**	0.90	m
			Depth:	1.90	m
			Groundwater Level:		m
	Drafted	Rev	Auth		
	HM	EF	AS	**Proportion of Pit Volume Occupied by Gravel Solids (Pg)**	0.00

Remarks

Effective Depth - For a standard test in which the pit is filled with water, the effective depth will be equal to the actual depth. If the pit is not completely filled, it will be equal to the depth at the start of each test.

Gravel Filled Pits - Typically, the proportion of volume occupied by gravel is 0.70 (i.e. 70%), leaving 30% free storage volume. If the pit is left open (gravel is not used) then Pg = 0

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.80				
	1	0.81				
	2	0.83				
	3	0.83				
	4	0.84				
	5	0.85				
	10	0.85				
	20	0.90				
	30	0.96				
	60	1.03				
	120	1.11				
	180	1.13				
	240	1.16				
	300	1.18				
	1260	1.49				
	1320	1.49				
	1380	1.49				
	1440	1.49				
Effective Storage Depth	m	1.10		N/A		N/A
75% Effective Storage Depth	m	0.83		N/A		N/A
(i.e. depth below GL)	m	1.08		N/A		N/A
25% Effective Storage Depth	m	0.28		N/A		N/A
(i.e. depth below GL)	m	1.63		N/A		N/A
Effective Storage Depth 75%-25%	m	0.55		N/A		N/A
Time to fall to 75% effective depth	mins	94		N/A		N/A
Time to fall to 25% effective depth	mins	N/A		N/A		N/A
Effective Volume of Pit - V(75%-25%) x (1-Pg)	m3	1.04		N/A		N/A
Area of Pit - ap50 (50%)	m2	5.19		N/A		N/A
t (75%-25%)	mins	N/A		N/A		N/A
SOIL INFILTRATION RATE	m/s	**N/A**		**N/A**		**N/A**

DESIGN SOIL INFILTRATION RATE, f **N/A**

