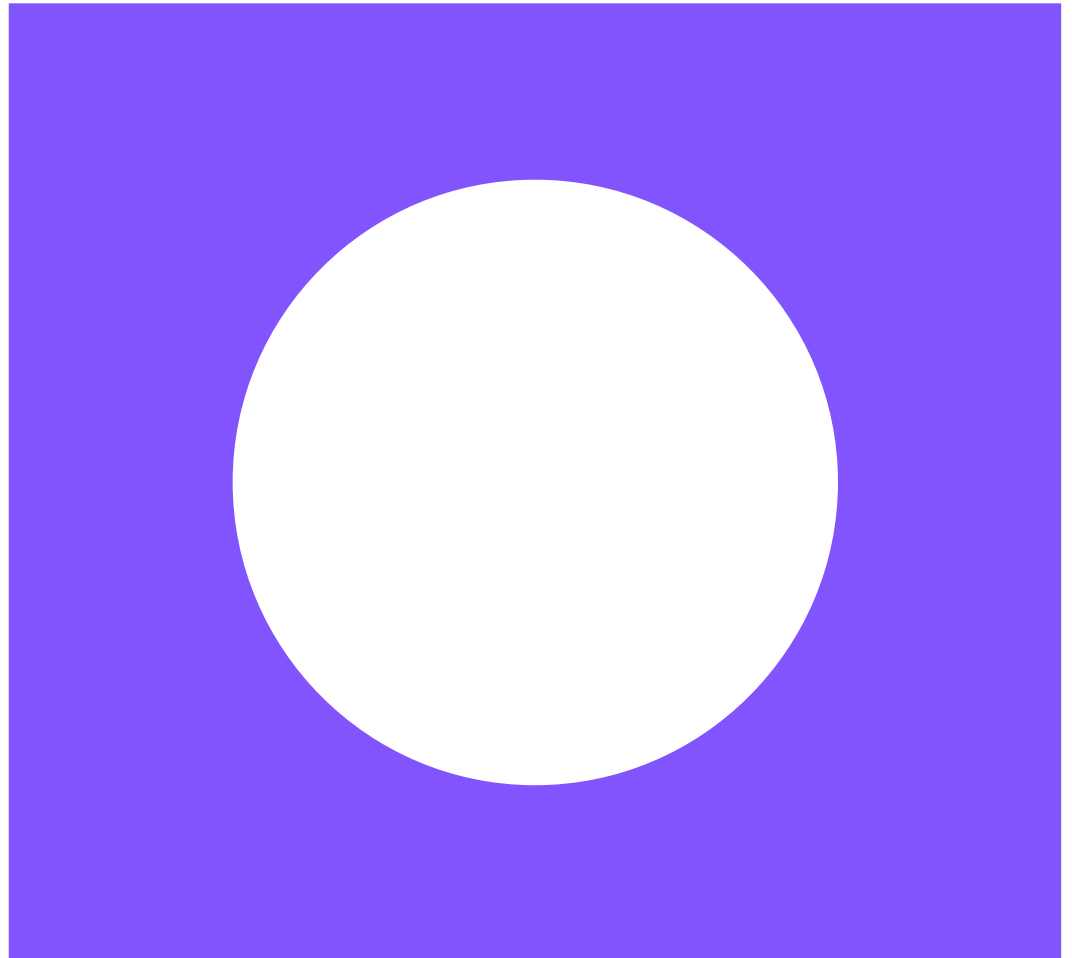




The Christie Advanced Scanning and Imagine Centre Development (CASICD)

Ground Investigation Report

February 2025

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Mott MacDonald
4th Floor
9 Portland Street
Manchester M1 3BE
United Kingdom

T +44 (0)161 914 8880
mottmac.com

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Ground Investigation Report

February 2025

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
P01	13.03.25	A. Ecclestone S. Shanks	C.Y Li C. Stanford C. Smith	A. Simpson	First issue

Document reference: CASICD-MMD-XX-XX-RP-C-00002

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Executive Summary

Mott MacDonald has been commissioned to produce this Ground Investigation Report (GIR) as part of Civil and Structural (C&S) design services through RIBA Stage 3 through IHP for the proposals to demolish existing hospital buildings and re-construct a new CT department.

The 2024 site-specific ground investigation works, along with the 2019 ground investigation for the nearby Paterson Building, found a consistent ground profile across the site. A 0.5 – 2.0m thick layer of Made Ground, comprising predominantly medium dense dark brown SAND, was encountered at the surface. Locally, cohesive Made Ground of soft to firm dark brown gravelly sandy CLAY was encountered. A layer of Weathered Wilmslow Sandstone, comprising medium dense to dense orangish and reddish brown gravelly fine to coarse SAND, of approximately 1.4m thick was recorded beneath the Made Ground. The Weathered Wilmslow Sandstone on-site was underlain by competent Wilmslow Sandstone from approximately 3m bgl. The Wilmslow Sandstone on site was described as extremely weak to weak reddish and orangish brown fine to coarse grained SANDSTONE, locally recovered as sand. Groundwater monitoring and strikes during ground investigation recorded groundwater level between 2.8m and 4.4m bgl, just below competent rockhead within the Wilmslow Sandstone.

Characteristic geotechnical parameters were derived for all strata encountered using data from ground investigations as well as published correlations and advice from standards. The derivation of all parameters is discussed in Section 6 and these parameters are summarised in Table 6.1.

The findings of the ground investigation were used to update the likelihood of risks originally identified in the Geotechnical and Geo-environmental Desk Study. The main residual risks include Variable Made Ground, Obstructions within Made Ground, Buried Services beneath the site and a recorded Fault present southwest of the site. Although no evidence of the fault was identified during ground investigation works, the risk of this fault cannot be ruled out at this stage.

Based on the ground profile encountered and the derived geotechnical parameters, it is anticipated that a piled foundation solution will be required for the new four-storey building. Concrete of Design Sulphate Class DS-1 and AEC class AC-1 would be appropriate for subsurface concrete at the site. The excavatability of Wilmslow Sandstone on site can be described primarily as “Hard Digging” and “Easy Ripping”.

The Generic Quantitative Risk Assessment (GQRA) has concluded an overall low risk to relevant human health and controlled waters receptors. As described above in relation to residual risks; it should be noted that asbestos may be present within the existing building, including unmanaged asbestos within existing basements, associated with the age of the current buildings on site, which date from the 1930s. Note that should the presence of asbestos contamination be suspected during development, Mott MacDonald Limited would recommend the appointment of a specialist contractor to address the issue and would not provide advice on risk or remedial measures.

The risk posed by elevated ground gases is considered to be low and no specific ground gas preclusion measures are considered to be necessary in the construction of new buildings within the Site. The potential risk from ground gases to construction workers working in excavations and other confined spaces will be dealt with by the Contractor, in accordance with Confined Spaces Regulations.

The majority of the Made Ground deposits analysed are likely to be suitable for removal to inert landfill. It is recommended that a suitable waste contractor is engaged to discuss options for disposal if construction works require removal of soils from site. Additional analysis may be required on specific soils to suit the requirements of the receiving waste transfer facility.

Based on the findings in this assessment, a remediation strategy is not required for the development.

A verification report will be produced on completion of site earthworks and submitted to the Council for acknowledgement and review. The verification report will follow the Environment Agency's LCRM guidance and will include; Details of any materials brought onto site including their source location, nature and any testing data obtained to demonstrate suitability for use, Confirmation that no unexpected contamination was encountered. All locations, methodology and testing undertaken to investigate unexpected contamination (if encountered). Details on any mitigation measures implemented for unexpected contamination.

1 Introduction

Mott MacDonald has been commissioned to provide Civil and Structural (C&S) design services through RIBA Stage 3 through IHP for the proposals to demolish existing hospital buildings and re-construct a new CT department. As part of these services, Mott MacDonald have previously scoped a scheme-specific Ground Investigation, the results of which are discussed in this Ground Investigation Report (GIR).

1.1 Site Location and Description

The Christie Hospital campus is in Withington, Greater Manchester and is bordered by Wilmslow Road (including a cycle lane) to the East. The development site consists of existing Blocks 19 and 20 which are to be demolished along with the partial demolition of Block 21 and are to be replaced with a new CT department. The site is surrounded on three sides by existing hospital buildings. An access road is present adjacent to the northern boundary of the site, connecting Wilmslow Road with Palatine Road, to the west of the site. The site plan is shown below in Figure 1.1 and Figure 1.2.

Figure 1.1: Site Location Plan



Source: Day Architectural Ltd

Figure 1.2: Site Map



Source: Adapted from Day Architectural Ltd Briefing Presentation. The site footprint is highlighted in yellow.

1.2 Development Proposals

The Christie Advanced Scanning and Imagine Centre Development (CASICD) seeks to demolish part of the existing two and three storey hospital (Blocks 19 and 20 and part of Block 21) and construct a new principally three-storey building with a level of plant above and additional plant equipment on the roof and a CT scanner, X-ray facility and associated accommodation at ground floor level. Levels 01 and 02 are anticipated to be ward accommodation, however the current proposals are for these levels to be built on a 'shell and core' basis at this stage.

Lateral stability is to be provided through reinforced concrete cores at the north and south ends of the building. There is an existing basement that is used as a conduit for services to feed the wider site. The basement will be demolished, and services rerouted as part of the proposed development (see demolition extents below in Figure 1.3).

Figure 1.3: Basement extents to be demolished



Source: Mott MacDonald

Mott MacDonald have been commissioned to provide Civil and Structural (C&S) design services for RIBA Stage 3 through IHP.

1.3 Report Objectives and Scope

This report aims to provide sufficient information to support discharge of the planning condition 4)a, relating to land contamination for the proposed development on Site (planning application ref: 138282/FO/2023, dated 10th October 2023). Should remediation be required, a remediation strategy will be produced to support discharge of the associated planning condition. The planning condition 4)b, relating to verification reporting, will be complied with as the development progresses.

The objectives of this report are to:

- Review previously compiled information from the geotechnical and geo-environmental desk study and relevant historical ground investigation data;
- Present the findings from the scheme-specific 2024 ground investigation at the site;
- Determine the characteristic geotechnical parameters following analysis of in-situ and laboratory data;
- Present the geotechnical risks associated with the site considering the proposed development;
- Develop a Generic Quantitative Risk Assessment (GQRA);
- Develop a representative conceptual site model; and
- Provide high-level engineering considerations in relation to the proposed development.

1.4 Geotechnical Category

The proposed structures are likely to be classified according to BS EN 1997-2004 [1] as Geotechnical Category 2 structures, i.e:

“conventional types of structure or foundations with no exceptional risk posed by difficult ground or abnormal loading conditions. Design for Geotechnical Category 2 structures should normally include quantitative geotechnical data and analysis to ensure that the fundamental requirements are satisfied.”

2 Existing Information

A summary of relevant geotechnical and geo-environmental background information, taken from the Geotechnical and Geo-environmental Desk Study (CASICD-MMD-XX-XX-RP-C-00001) [2], is presented in Table 2.1.

Table 2.1: Summary of Relevant Site Background Information

Aspect	Description
Site Use	The site comprises three existing blocks surrounded by existing hospital buildings. Access is via an road along the northern boundary of the site that connects Palatine Road and Wilmslow Road.
Site History	Prior to the hospital being constructed on the site in 1934, the northern half of the site comprised undeveloped field with the southern half part of the Withington Green and Lodge landscape garden, yard and buildings. Later the entire site was located within the grounds of Groombridge House. The hospital was originally named the 'Christie Hospital & Holt Radium Institute'.
Published Geology	The BGS does not record artificial ground as being present beneath the site. BGS 1:10,000 scale superficial deposit mapping records Glacial Till across the site. BGS 1:10,000 scale bedrock deposit mapping records the site as being entirely underlain by Sandstone of the Wilmslow Sandstone Formation. Linear mapping records a northwest-southeast trending fault approximately 25-50m southwest of the site. Bedrock northeast of the fault (including that which underlies the site) is recorded as being downthrown. Bedrock in the area is recorded as dipping approximately 10° east.
Hydrology	There are no watercourse mapped within the site boundary. Historical mapping recorded a culverted watercourse approximately 60m west of the site. Shaw Brook is recorded 180m north of the site/
Hydrogeology	Glacial Till recorded as underlying the site is designated a Secondary Undifferentiated Aquifer. The Wilmslow Sandstone Formation is designated a Principal Aquifer by the Environment Agency (EA).
Mining and Ground Workings	There are no recorded underground or surface workings within 500m of the site. The site does not lie within a Coal Mining Reporting Area. Two historical surface ground workings are recorded within 250m of the site. A waterbody was present 85m southeast of the site and a pond 200m southwest.
Radon	The site lies within an area where less than 1% of the homes are estimated to be at or above the radon action level (UK Health Security Agency, 2022). No radon protective measures are considered necessary for construction of new buildings.
Radioactive Substances	The Christie NHS Foundation and the University of Manchester have historically held permissions to store, use and dispose of radioactive materials across the wider Christie Hospital site.
Unexploded Ordnance (UXO) Risk	UXO risk mapping recorded a moderate risk of unexploded bombs at the site. A subsequent detailed desk study recorded a low risk from unexploded ordnance hazard and recommended no further mitigation measures. This detailed desk study is presented in Appendix H.
Sensitive Land Uses	There are no designated environmentally sensitive sites within 500m of the site. The site does, however, fall within an SSSI Impact Risk Zone. Based upon the nature of the proposed developments, it is unlikely that the developments will require consultation.

2.1 Historical Ground Investigations

There are no freely available BGS borehole records within, or in close proximity to, the site.

2.1.1 2019 CC Geotechnical Ground Investigation

A ground investigation was undertaken, adjacent to the site, in 2019 by CC Geotechnical Limited [3]. This ground investigation was carried out as part of the redevelopment of the

Paterson building. The investigation comprised four cable percussive boreholes with rotary follow to depths of up to 25m bgl, one windowless sample borehole to 2.4m bgl, three machine-dug trial pits to 2.9m bgl and nine hand-dug foundation pits.

A summary of the ground conditions encountered during the 2019 CC Geotechnical ground investigation of the Paterson building, immediately south of the site, is presented in Table 2.2.

Table 2.2: Summary of Ground Conditions – 2019 CC Geotechnical Ground Investigation

Stratum	Depth to top of stratum (m bgl) [Elevation, m AOD]	Thickness (m)	Typical Description
Made Ground	0 [34.7 – 35.3]	0.7 – 2.2	Horizon of Topsoil overlying brown clayey, sandy GRAVEL of brick, limestone, concrete and sandstone with organic matter present locally.
Devensian Till	0.70 – 2.20 [32.5 – 34.2]	0.5 – 2.2	Loose to medium dense clayey, silty gravelly SAND and firm to stiff sandy silty CLAY.
Weathered Sandstone	2.20 – 2.70 [31.4 – 33.1]	1.3 – 2.8	Fine to coarse red/brown SAND.
Wilmslow Formation Sandstone	3.50 – 5.00 [29.9 – 31.8]	Not proven	Very weak to weak reddish brown fine to medium grained thickly laminated SANDSTONE. Moderately weathered. Recovered locally as sandy gravel. Discontinuities are extremely close to medium spaced horizontal, clean, rough, tight to open.

Further information from this ground investigation, including ground and groundwater conditions, laboratory tests and in-situ tests has been included throughout this report where appropriate. As this data was collected adjacent to, but not directly on, the site, it may not entirely accurately reflect site conditions. Therefore, information from this investigation has been reviewed only to supplement that obtained from the on-site investigation.

3 Generic Quantitative Risk Assessment

3.1 Legislative Context

New development is regulated under the Town and Country Planning Act 1990. This regime provides a mechanism for the planning authority to enforce the proper investigation of a development site to ensure that once development has occurred, the site is suitable for its intended use. In England, the National Planning Policy Framework (NPPF) provides guidance on the implementation of contaminated land and pollution management requirements to address contamination risks associated with future site uses through the planning system. Paragraphs 189, 190 and 191 of the NPPF (C.a.L Government, 2023) state the following:

189: Planning Policies and decisions should ensure that:

- a. a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);
- b. after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
- c. adequate site investigation information, prepared by a competent person, is available to inform these assessments.

190: Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

191: Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- a. mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- b. identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
- c. limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

The primary regulatory regime, under which contaminated land in the UK is managed, is Part IIA of the Environmental Protection Act (EPA), 1990 (DEFRA, 2012), although numerous other subsidiary Regulations are also relevant. This report adopts a strategy for the assessment of potential land contamination based on current guidance documents related to Part II A of the EPA. Particular reference is made to R&D66:2008 (R&D 66, 2008) and the Environment Agency (EA's) Land Contamination Risk Management (LCRM) online guidance (Environment Agency, 2023) [4].

Following the procedures in LCRM, a key element of the Preliminary Risk Assessment is the development of a conceptual model which may be refined or revised as more information and understanding is obtained through the risk assessment process. The conceptual model is described in terms of the contaminant Sources, transport Pathways and possible Receptors that

may be present, and the potential 'Pollutant Linkages' between them, as defined in the relevant legislation and guidance.

Preliminary qualitative risk assessment is part of a phased approach as set out in UK guidance including R&D66:2008 (R&D 66, 2008) and EA LCRM (Environment Agency, 2023), the first stage requires development of a conceptual site model (CSM) that takes into consideration the environmental site setting and identifies potential contaminant sources, pathways and receptors. This allows potential pollutant linkages to be identified. The qualitative risk assessment follows on from this and both are presented in the sections below. The methodology is detailed further in Appendix F.

3.1.1 Summary of Potential Source-Pathway-Receptor Linkages

The 2023 Mott MacDonald Desk Study identified potential sources of contamination beneath the site, including potential pathways to the relevant receptors identified:

- S1: Made Ground on site - the site has been occupied by The Christie Hospital since the early 1930s (first mapped on 1934 mapping as 'Christie Hospital & Holt Radium Institute'). Made Ground is anticipated on site as the development platform for the above ground structures, as well as the material within which the existing basements are constructed in. Given the age of the development, Made Ground may contain elevated concentrations of heavy metals and organic compounds (e.g., fuel oils / solvents) (excluding asbestos).
- S2: Wilmslow Road surface water run-off - the site is located adjacent to Wilmslow Road, where elevated heavy metals and organic compounds (e.g., accidental fuel spills) from motorised road traffic may have entered surface water drainage systems and percolated towards the site.
- S3: Hazardous ground gases associated with underlying ground material - the site is anticipated to be underlain by Made Ground, overlying superficial Glacial Till deposits which is underlain by sandstone bedrock of the Wilmslow Sandstone Formation and the Chester Formation. The Glacial Till and sandstone bedrock are not considered to be credible sources of hazardous ground gases, with the Made Ground potentially a credible source of hazardous ground gases (arising from degradable material potentially within it, and the potential historical spillage of organic compounds (e.g., petroleum hydrocarbon, chlorinated solvents)).
- S4: Underlying ground material - the site is anticipated to be underlain by Made Ground overlying Glacial Till and sandstone bedrock of the Wilmslow Sandstone Formation and the Chester Formation. The geochemical condition of these strata may potentially pose an aggressive environment to buried concrete and cementitious structures and services.
- S5: Asbestos - the buildings on site have occupied the site since the early 1930s (first mapped on 1934 mapping), where asbestos would likely have been used during construction. Mott MacDonald Limited's Design Stage Report [5] mentions the presence of unmanaged asbestos within existing basements on site. Given the age of the development, asbestos is also potentially present within Made Ground on site.

The following pathways were considered:

- P1: Human uptake pathways:
 - Ingestion of exposed soils
 - Dermal contact with exposed soils
 - Inhalation of soils/dust/volatilsed compounds
- P2: Overland flow
- P3: Horizontal and vertical percolation within the unsaturated zone

- P4: Horizontal and vertical migration within the saturated zone
- P5: Horizontal and vertical gas migration within the underlying ground material
- P6: Direct contact.

The following receptors were considered:

- R1: Site end users e.g., hospital staff, visitors, pedestrians and cycle path users
- R2: Controlled waters - Glacial Till Secondary Undifferentiated aquifer and sandstone bedrock Principal Aquifer
- R3: Above ground structures
- R4: Buried concrete and cementitious structures.

Therefore, intrusive ground investigations (GI) were designed and implemented to assess the potential impacts on receptors. A review of the risks, based on the results of the GI, is presented in the following sections.

3.1.2 Planning Conditions

The Manchester City Council planning conditions (planning reference: 138282/FO/2023, dated 10 October 2023) include the following conditions relating to land contamination:

4) a) The measures for investigating the site identified in the Geo Technical and Geo Environmental Phase I desk study (Mott MacDonald), received on 10 October 2023, shall be carried out before construction commences and a report prepared outlining what measures, if any, are required to remediate the land (the Site Investigation Report and/or Remediation Strategy) shall be submitted to and approved in writing by the City Council as local planning authority. When the development commences, the development shall be carried out in accordance with the previously agreed Remediation Strategy.

In the event that ground contamination, groundwater contamination and/or ground gas, not previously identified, are found to be present on the site at any time before the development in each phase is occupied, then development shall cease and/or the development shall not be occupied until, a report outlining what measures, if any, are required to remediate the land (the Revised Remediation Strategy) is submitted to and approved in writing by the City Council as local planning authority and the development shall be carried out in accordance with the Revised Remediation Strategy, which shall take precedence over any Remediation Strategy or earlier Revised Remediation Strategy.

b) Prior to the occupation of the development hereby approved, a Contaminated Land Verification Report shall be submitted to and be approved by the City Council as local planning authority.

3.2 Generic Assessment Criteria

3.2.1 Human Health Criteria

The risks to human health from Site soils have been assessed by comparison of laboratory soil testing results with Generic Screening Criteria (GSC) established using the UK Contaminated Land Exposure Assessment (CLEA) framework (Nathanail C. e., 2015) and CL:AIRE (CL:AIRE, 2010). Further information on the methodology is presented in Appendix F.

GSC have been developed for exposure pathways relevant to a range of generic land use categories. The proposed development will primarily comprise demolition of existing structures

with redevelopment of new buildings, as detailed in Section 1.2.. Therefore, the selected GSC for human health criteria is “Commercial”.

Each generic land use scenario has different screening criteria which are dependent on the soil organic matter (SOM). GSC have been derived for SOM contents of 1.0% (most conservative), 2.5% and 6.0% (least conservative). The GSC for SOM of 6.0% have been used to assess the results on a conservative basis due to the range of values of SOM observed (1.89% to 12.01%).

The complete set of laboratory chemical test results are included within the GI Factual Report, included within Appendix D, with the summary screened results included in Appendix G.

3.2.2 Controlled Waters Criteria

Laboratory soil leachate and groundwater data has been compared with UK Drinking Water Standards (DWS) in consideration of the underlying superficial deposits (Secondary (undifferentiated) aquifer within the Glacial Till) and sandstone bedrock geology (Principal Aquifer). Based on the conditions encountered within the GI, where relatively thin granular and cohesive Made Ground generally overlying weathered sedimentary bedrock, no pervasive shallow groundwater body is anticipated beneath the site and no Glacial Till has been recorded, however the results have been considered in relation for the potential for this superficial aquifer to exist in proximity of the site. In addition, no surface watercourses were recorded within 250m of the site. As such, the most relevant receptor in relation to the water environment is considered to be the underlying bedrock aquifer. In the absence of any UK DWS, we have reverted to the World Health Organisation’s (WHO) Guidelines for Drinking Water Quality (4th Edition incorporating first addendum, 2017), and finally in the absence of these guidelines we have reverted to the laboratory limits of detection (LOD). No relevant surface water receptor has been identified in relation to the site, as such surface water is not considered further in this assessment.

3.2.3 Factual Summary

A factual summary of the recent ground investigation contamination data is presented in the following sections. The results have been compared to relevant human health and controlled waters GAC.

3.2.4 Deviating Samples

A number of soil samples were recorded by the testing laboratory as deviating due to exceedance of holding time. The deviations were in relation to pH, cyanide, phenol and hydrocarbon analyses. Details of the deviating tests are included in the Factual Report [6]. The deviating samples are not considered to detract from the overall determination of risk within their respective assessments given no significant time had elapsed between sampling and laboratory receipt and, as such, all results have been utilised.

3.2.5 Visual/Olfactory Evidence of Contamination

During the GI, visual evidence of contamination recorded include the anthropogenic inclusions (all within Made Ground) of asphalt/tarmac/bituminous material.

A “mild to moderate organic odour” was recorded within the hand-dug inspection pit in WS102 (beneath the internal concrete floor slab) within Made Ground described as, “very dark brown slightly gravelly fine to coarse sand” with extraneous fragments including brick and concrete between approximately 0.70m and 1.50m bgl. No other visual or olfactory evidence of contamination was identified during the ground investigations. The typical make up of anthropogenic inclusions recorded within Made Ground and the limited visual or olfactory

evidence of hydrocarbon contamination encountered does not suggest a significant source of contamination to be present on Site.

3.3 Human Health Assessment

3.3.1 Soil Analyses and Screening

Soil laboratory testing has been undertaken within samples of the shallow Made Ground retrieved from the exploratory holes and trial pits, as detailed in Table 4.5, and the results compared to the GAC described in Section 3.2.1. No exceedances of human health screening guidelines were recorded within the samples analysed. The laboratory certificates are included within the factual report and screening of the test results is presented in Appendix G.

3.3.1.1 Interpretation

As above, no exceedances of the GAC were recorded including total petroleum hydrocarbons (TPH). TPH was recorded above the laboratory LOD in four samples, although the majority of these recorded total aliphatic and aromatic concentrations <200mg/kg. BH103A recorded total aliphatic and aromatic concentrations of 1,900mg/kg, primarily within the heavy end aromatic fractions (C16-C21 and greater) typically associated with diesel and heavy fuel oils. No specific source or free-phase product was recorded within BH103A at this depth, although hydrocarbon concentrations may be derived from the tarmacadam recorded throughout the Made Ground at this location, coinciding with slightly higher polycyclic aromatic hydrocarbons (PAH) in this sample than recorded at other locations, which may also be due to the presence of tarmacadam within the sample. Historical mapping indicated that this location was approximately adjacent to the former Groombridge House, prior to development of the hospital, and no specific source from previous site use was indicated. Additionally, the trial pit and borehole logs did not record the presence of any soil constituents which may be considered to represent an overt source of contamination. As such, no significant source has been identified and therefore the potential for human health pollutant linkages to be present is considered to be low.

3.3.1.2 Asbestos

All soil samples retrieved from the shallow Made Ground from the GI were screened for asbestos. No suspected asbestos containing materials were identified in the exploratory hole logs and the laboratory screening did not detect any asbestos fibres within the soil samples analysed.

As detailed within the Design Stage Report [5], asbestos may be present within the existing building including unmanaged asbestos within existing basements associated with the age of the current buildings on site, which date from the 1930s. Note that should the presence of asbestos contamination be suspected during development, Mott MacDonald Limited would recommend the appointment of a specialist contractor to address the issue and would not provide advice on risk or remedial measures.

3.3.2 Soil Leachate Analyses and Screening

Soil leachate laboratory testing has been undertaken within samples of the shallow Made Ground retrieved from the boreholes and trial pits, as detailed in Table 4.5, and the results compared to the standards outlined in Section 3.2.2. Exceedances of the screening values are presented in Table 3.1. The laboratory certificates are included within the factual report and screening of the test results is presented in Appendix G.

Table 3.1: Exceedances of GAC (Soil Leachate Analyses)

Determinant	Location	Sample Depth (m)	Strata	Concentration Measured (µg/l)	UK DWS (µg/l)	WHO (µg/l)	LOD* (µg/l)
Iron	BH102	0.30	MG	1,200	200	-	-
	TP101	0.40	MG	380			
	WS101	0.80	MG	12,000			
Lead	WS101	0.80	MG	41	10	10	-
Manganese	WS101	0.80	MG	210	50	400	-
Phenol	BH102	0.30	MG	7.42	0.5	-	-
	BH103	1.40	MG	17			
	BH104	1.50	MG	18.3			
	TP101	0.40	MG	12.9			
	WS101	0.80	MG	8.52			

Note: MG – Made Ground

* LOD value noted only where utilised in lieu of UK DWS or WHO value

3.3.2.1 Interpretation

The soil leachate analyses identified concentrations of heavy metals and phenol in exceedance of UK DWS (and corresponding WHO guideline in relation to lead). All other determinants were below their respective assessment criteria. No specific source of the potentially leachable concentrations was identified within the Made Ground. A number of samples also recorded concentrations <LOD and it is likely that the concentrations are due to the inherent variability of Made Ground deposits.

It is broadly accepted that soil leachate analysis is a much more aggressive process than would typically occur in nature, and results are generally an over-estimation of the availability of contaminants to dissolve. Additionally, no preferential pathways for the migration of the potentially leachable exceedances identified are anticipated to be created by the site development works. The completed development will also be primarily surfaced by new buildings and otherwise by hardstanding, also incorporating surface water drainage which will further reduce the ingress of surface water and the potential for leachate generation. Additionally, it is anticipated that a proportion of Made Ground will be excavated and removed from site during the redevelopment works to facilitate new foundations, thereby removing a potential source of contamination

The desk study did not identify any groundwater abstractions (>20m³/day) within the site or vicinity and given the urban setting of the site, it is considered unlikely the groundwater would be utilised as a drinking water source. As such, it is considered unlikely that the potentially leachable concentrations identified in exceedance of UK DWS (and WHO) would impact superficial groundwater within Glacial Till deposits (where present) or the underlying groundwater body within the solid strata.

3.4 Groundwater

Groundwater monitoring standpipes were installed within BH101 and BH104, with response zones within the solid strata. The GI Factual Report records two visits between April and May 2024, neither of which obtained groundwater samples due to slow groundwater recharge within the monitoring installations.

3.5 Ground Gas Risk

3.5.1 General

Previous GI undertaken for the Paterson Building adjacent to the south of the site, as detailed in Section 2.1.1, included ground gas monitoring of the Made Ground deposits on four occasions, which did not record the presence of any elevated ground gases. It was noted that the visits generally took place during dry conditions with rising atmospheric pressure conditions.

The underlying Wilmslow Sandstone bedrock is considered to be of low gas generation potential.

Due to the Made Ground soils' recorded low organic content (sand and gravel material not degradable so cannot produce methane or carbon dioxide), the absence of putrescible material reported in the exploratory hole logs and no recorded olfactory or visual evidence of contamination, no ground gas monitoring was undertaken as part of the recent GI. Furthermore, a volume of Made Ground is anticipated to be removed to facilitate construction of the new foundations.

The overall risk of the accumulation of elevated ground gas beneath the proposed development is considered low, based on the absence of any appreciable source of elevated ground gases within the Made Ground or from within the solid strata. A proportion of the Made Ground will also be excavated and removed from site to facilitate the foundation construction during the redevelopment works. Additionally, no appreciable off-site source of potentially elevated ground gases was considered to be present from both the desktop researches and the results of previous GI immediately to the south of the site.

No specific gas protection measures are considered necessary for the Site (Characteristic Situation 1, in accordance with BS8485:2015+A1:2019),

3.5.2 Ground Gas Risks to Construction Workers

The potential risk from ground gases to construction workers working in excavations and other confined spaces will be dealt with by the Contractor, in accordance with Confined Spaces Regulations.

3.6 Revised Conceptual Site Model and Risk Assessment

The preceding Sections have summarised available information for the Site and have been used to inform this Generic Quantitative Risk Assessment (GQRA). The proposed development will include the partial demolition of the existing site structures and construction of new buildings, as detailed in Section 1.2.

A key element of an environmental risk assessment is the development of a Conceptual Site Model (CSM) which is done by undertaking a Source-Pathway-Receptor analysis of the Site:

- Sources (S) are potential or known contaminant sources e.g. a former land use
- Pathways (P) are environmental systems through which a contaminant could migrate e.g. air
- Receptors (R) are sensitive environmental receptors that could be adversely affected by a contaminant e.g. Site end-users

Where a source, relevant pathway and receptor are present, a pollutant linkage is considered to exist whereby there is a circumstance through which environmental harm could occur, and a potential environmental liability is considered to exist.

The CSM will assess potential pollutant linkages through both the construction phase and the ongoing end-use of the proposed development.

The sources, pathways and receptors identified (and revised as required) in relation to the site are presented below, with the revised CSM for the Site presented in Table 3.2.

Table 3.2: Revised Conceptual Site Model

Source	Pathway	Receptors	Risk	Comment
S1: Potentially leachable heavy metals and phenol identified at concentrations in exceedance of UK DWS and WHO screening values within shallow Made Ground deposits	P1: Horizontal and vertical percolation within the unsaturated zone	R1: Controlled waters	Probability: Low likelihood Consequence: Mild Risk: Low Risk	Exceedances of potentially leachable contaminants were recorded above the UK DWS (and WHO) screening values. No preferential pathways for the migration of the potentially leachable exceedances are anticipated to be created by the site development works. The completed development will also be surfaced by hardstanding and incorporate surface water drainage, further reducing the ingress of surface water and the potential for leachate generation. It is considered unlikely that the potentially leachable concentrations identified in exceedance of UK DWS (and WHO) would impact controlled waters, specifically the underlying Secondary Undifferentiated aquifer within the glacial till deposits and sandstone bedrock Principal Aquifer.
	P2: Horizontal and vertical migration within the saturated zone	R2: Buried concrete and cementitious structures	Probability: Unlikely Consequence: Mild Risk: Low Risk	Buried concrete / cementitious structures will be in direct contact with underlying ground material(s). The risk to buried concrete has been assessed in accordance with the guidance presented in BRE Special Digest: 2005. Indicative Design Sulphate and ACEC Classes are presented in Section 5.3 of this report. The section concludes DS-1, AC-1 suitable, therefore likely a low risk.

* Mott MacDonald Limited's Design Stage Report mentions the presence of unmanaged asbestos within existing basements on site. Mott MacDonald Ltd is not insured for surveys or to provide guidance to identify and treat asbestos. As the presence of asbestos was previously identified to be present on site, it is recommended that the advice of an asbestos specialist is sought to advise on potential risk and remediation requirements.

It is assumed that a robust Construction Environmental Management Plan (CEMP) will be adopted for the construction works, and as a result, no contamination will occur during construction (e.g. fuel leaks and spills). It is assumed that no contaminated material will be brought onto Site for the proposed development which may act as a potential contaminant source, with only clean, inert materials used. As a minimum, the CEMP will include the following measures:

- Adherence to DEFRA and EA Pollution prevention for businesses guidance (DEFRA & EA, 2023);
- Use of plant nappies beneath all static plant containing hydrocarbons;
- Storage of fuels and oils in bunded areas or double skinned containers;
- Regular inspection of plant and equipment for wear, damage and/or leaks;
- Provision of spill kits;
- Maintaining 10m distance between any soil stockpiles and watercourses;
- Use of silt fencing around material stockpiles and between the working area and watercourses; and
- Covering and/or seeding soil stockpiles to minimise erosion.
- Dust suppression.

It is anticipated that some Made Ground deposits will be removed from beneath the proposed structures during construction. It should be noted that the following does not provide an assessment of risk associated with asbestos or radon, both which should be assessed by a suitably qualified specialist. Furthermore, the CSM is based on the proposed development works as presented in Appendix A. Should the development proposals change, the contamination risk assessment and CSM should be reviewed.

3.7 Risk Estimation & Risk Evaluation

3.7.1 Overview

The GI has not recorded visual or olfactory evidence of contamination on Site. Whilst anthropogenic inclusions were recorded within Made Ground, these, along with the general descriptions of encountered Made Ground and the underlying natural ground material, do not suggest a significant source of contamination is present. The proposed works will be under hardcover/hardstanding on completion, therefore the pathway to human receptors will be broken.

With respect to site workers involved in the preparation and construction of the development, the Principal Contractor is duty bound under the CDM Regulations to undertake their own risk assessments with respect to their employees. Access to the construction works will be controlled and the works will be inaccessible to members of the public, with a robust CEMP be adopted for the construction works.

There were no exceedances of the selected "Commercial" GSC recorded in soil. Made Ground and natural deposits encountered during the GI are considered to be of low ground gas generation potential. The recorded soil leachate exceedance of the water quality standard thresholds is considered to be generally low-level and slightly above (generally within an order of magnitude) of the respective threshold.

Given the reasons mentioned in the respective previous sub-sections, the observed soil leachate exceedances of the water quality standards for iron, lead, manganese and phenol in relation to the proposed development and site setting is not considered to represent a

significant contamination risk to receptors, nor a new contaminant source or worsen existing site conditions.

Based on above, the risk assessment concludes that the risks to identified receptors are low to very low, therefore no specific remediation measures are proposed.

3.7.2 Assumptions

The following assumptions are made as part of the development of the CSM and risk assessment:

- It is assumed that a robust construction environmental management plan (CEMP) will be adopted during construction works to ensure control of dust emissions, surface run-off and suitable storage of materials (including excavated material) during construction work. Furthermore, no contamination will occur as a result of leaks and spills during construction.
- An Unexpected Contamination Protocol will be in place during works, and works should cease should any unexpected contamination be uncovered during works and advice sought from a geo-environmental specialist.
- Best practices should be adopted and followed for construction works.
- It is assumed that no changes are made to the existing arrangements for the delivery and storage of chemicals on site. These are not considered in this assessment.
- It is assumed that the proposed infrastructure will be well maintained.

3.8 Waste and Material Management

3.8.1 Preliminary Waste Classification for Off-site Disposal

An assessment of the laboratory soil results has been conducted using HazWasteOnline™ software (One Touch Data Limited, 2023) in accordance with Landfill Regulations 2002 (Landfill (England and Wales) Regulations, 2002) (as amended) and the waste classification and assessment technical guidance WM3 (NRW, SEPA & EA, 2021).

It is the responsibility of the producer to ensure that all waste created on Site undergoes basic characterisation prior to disposal in an appropriate landfill, and an indication of the likely classification is provided in the following sub-sections.

3.8.2 European Waste Catalogue Codes

The European Waste Catalogue (EWC) classifies waste in accordance with the Hazardous Waste (England and Wales) Regulations 2005 (Hazardous Waste (England and Wales) Regulations, 2005) (as amended). The waste is allotted an EWC code and named as a non-hazardous, hazardous absolute, or mirror entry. An absolute entry represents a material that is hazardous based on its description, regardless of its chemical composition, whereas mirror entries may be hazardous only if hazardous substances are present above certain thresholds. Non-hazardous entries are also classified based on their description, regardless of their chemical composition. The Landfill (England and Wales) Regulations 2002 define waste as inert if:

- *a) it does not undergo any significant physical, chemical or biological transformations;*
- *b) it does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health; and*

- *c) its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water or groundwater'*

The wastes expected to be generated during the construction works on Site, together with their EWC code are included in Table 3.3. This is a non-exhaustive list for guidance only, and the waste producer should record EWC codes for different waste types as they are generated on Site in the Site Waste Management Plan, and on waste transfer or consignment notes.

Table 3.3: EWC Codes for Anticipated Waste

Site Material	EWC Code	EWC Description	Waste Disposal Classification
Made Ground – bituminous mixtures	17 03	Bituminous mixtures containing coal tar or bituminous mixtures other than those mentioned in 17 03 01	TBC
Made Ground – of mixed lithologies	17 05 04	Soil and stones other than those mentioned in 17 05 03	Mirror non-hazardous
Made Ground – of mixed lithologies	17 05 03	Soil and stones containing hazardous substances	Mirror hazardous
Natural deposits – Glacial Till / weathered sandstone and sandstone bedrock	17 05 04	Soil and stones other than those mentioned in 17 05 03	Mirror non-hazardous

3.8.3 HazWasteOnline Assessment

Construction works associated with the proposed scheme are anticipated to generate a volume of excavated soil. Surplus excavated Made Ground and/or excavated material assessed as unsuitable for reuse will be permanently removed from the site. The Made Ground soil samples collected during the GRM 2024 GI have been assessed using HazWasteOnline™ (One Touch Data Limited, 2023) software (Waste Classification Report No. V46ZU-N5QSU-SRBNH) to provide an indication of the likely waste classification of the excavated soils on-site (in accordance with guidance given in WM3). The majority of samples were recorded as 'non-hazardous'. Two samples, BH103A at 0.10m depth and BH104 at 0.30m depth were recorded as 'hazardous' under code HP7 (carcinogenic "waste which induces cancer or increases its incidence") due to the presence of TPH at respective concentrations of 1,900mg/kg and 2,100mg/kg. No evidence of free-phase hydrocarbons was noted at each of these locations and no hydrocarbon odours or staining was noted. It is possible that these results are due to the presence of asphalt, which is recorded in the Made Ground each of these samples were taken from.

The full HazWasteOnline™ report is presented in Appendix H.

It is the responsibility of the waste producer to ensure that all waste created on site undergoes basic characterisation prior to disposal to an appropriately permitted landfill.

3.8.4 Waste Acceptance Criteria

Six WAC tests were completed within samples of the Made Ground between 0.30m and 1.10m bgl. Based on the hazard assessment above and the results of the WAC testing, the majority of samples could be considered 'non hazardous'. However, the following was noted in relation to the WAC analyses:

- BH104, 0.30m: fails inert & stable non-reactive hazardous waste (SNRHW) WAC due to total organic carbon (TOC) >5.0%, recorded as 5.1%.

- TP102, 0.30m: fails inert WAC due to Mineral Oil >C10 to C40 >500mg/kg, recorded as 572mg/kg.
- TP107, 0.40m: fails inert WAC due to TOC >3.0%, recorded as 3.6%.
- WS102, 0.80m: possibly categorised as 'stable non-reactive hazardous waste' due to arsenic >2mg/kg, recorded as 3.9mg/kg.

Taking the above into account, it is considered likely that the soils could be disposed of in a non-hazardous landfill given the marginal failures in relation to inert waste requirements. However, it is recommended that any material disposal is discussed with a suitably qualified waste contractor to allow them to make their own assessment.

It is recommended that a waste contractor is contacted to discuss options for disposal. Additional analysis may be required on specific soils.

4 Field and Laboratory Studies

4.1 Rationale for Ground Investigation

The scheme-specific ground investigation was undertaken by GRM Development Solutions between February and April 2024 to address the geotechnical and geo-environmental risks identified in the Geotechnical and Geo-environmental Desk Study (CASICD-MMD-XX-XX-RP-C-00001) [2]. Table 4.1 identifies the main geological risk and/or the known areas of additional data requirements targeted as part of this investigation as well as the ground investigation undertaken to address these.

Table 4.1: Geotechnical Risks and GI Undertaken

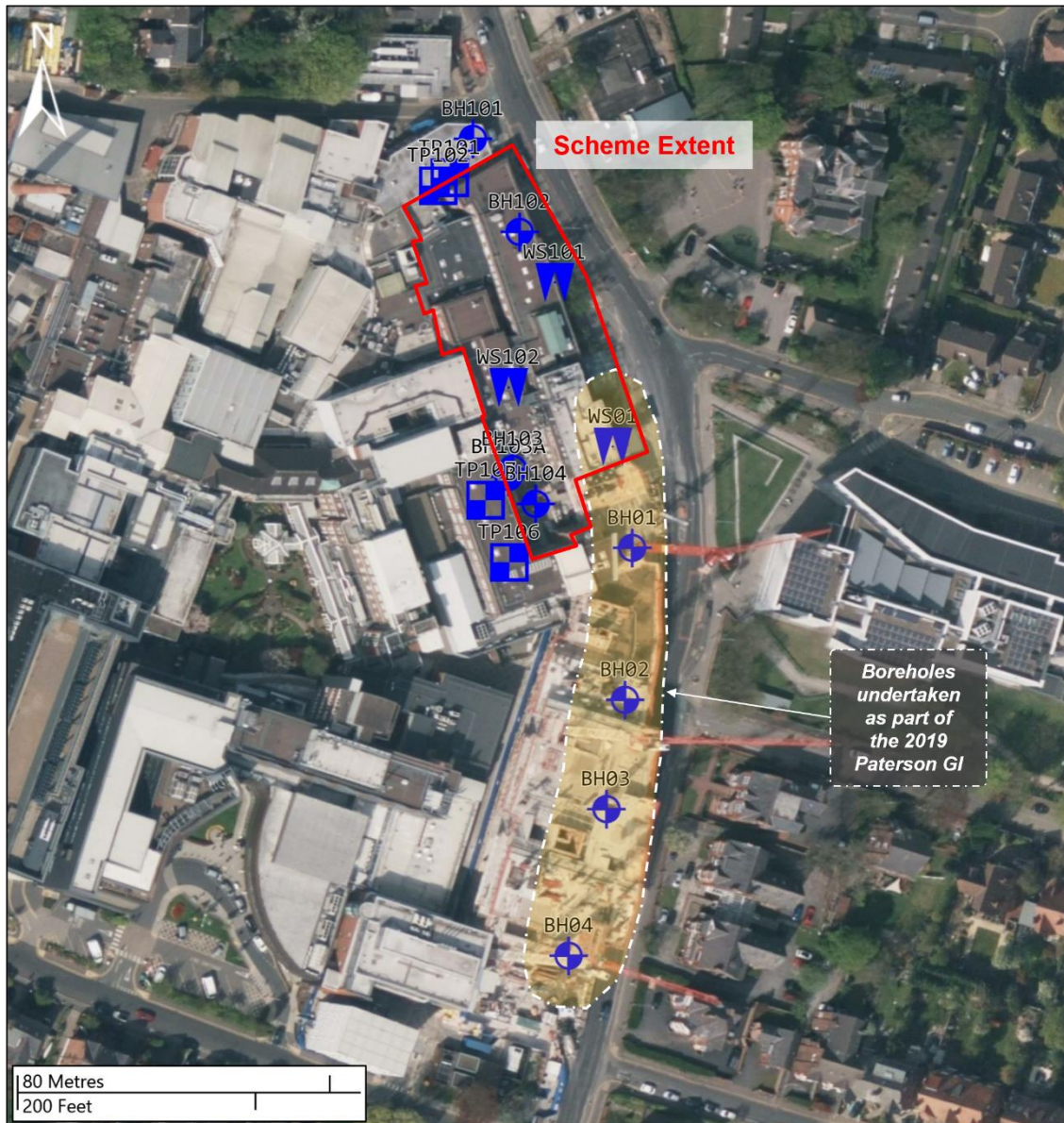
Geotechnical Risks	GI Undertaken
Unknown/unforeseen Ground Conditions (GEO-01)	● Intrusive investigation comprising dynamic sampling with rotary core follow-on, windowless sampling and trial pitting. ● Sampling for geotechnical testing to assess properties of underlying bedrock and characteristics of Made Ground.
Variable Made Ground (GEO-02)	● Sampling for geotechnical and geo-environmental testing to assess characteristics of Made Ground. ● In-situ testing including Standard Penetration Tests (SPTs).
Unknown Groundwater Levels (GEO-04)	● Groundwater monitoring in two boreholes.
Ground Obstructions (GEO-05)	● Intrusive investigation covering the areas for the proposed developments.
Ground Aggressivity to Concrete (GEO-07)	● Sampling for geotechnical and geo-environmental testing to assess characteristics of Made Ground.
Faults present southwest of the Site (GEO-09)	● Intrusive investigation to identify potential fault zone.

A summary of the ground investigation works undertaken between February and April 2024 is presented in Table 4.2. Exploratory hole locations from these ground investigation works, along with those performed as part of the Paterson building redevelopment in 2019, are presented in Figure 4.1.

Table 4.2: Summary of 2024 Scheme Specific Ground Investigation

Technique	Quantity	Completed Depths (m)	Exploratory Hole IDs
Cable Percussion with Rotary Core follow-on	4	14.0 – 18.3	BH101 – 104
Windowless Sampling	3	0.6 – 2.4	WS101 – 103
Trial Pits	7	1.2 – 1.3	TP101 – 107

Figure 4.1: Exploratory Hole Plan



Source: Bing aerial imagery with permission from Microsoft Corporation taken from OpenGround Cloud.

4.2 Summary of In-Situ Testing

4.2.1 Standard Penetration Tests

SPTs were undertaken in all cable percussive boreholes and windowless sampler boreholes from the base of the inspection pits and at approximately 1m intervals thereafter to a depth where SPT values exceed 100/300mm or 50/150mm. The results of SPTs are summarised below in Table 4.3 and presented in Figure 4.2 and Figure 4.3. Appendix The results of standard penetration testing are recorded in full on borehole logs in Appendix D.

Table 4.3: Summary of SPT Results

Stratum	Standard Penetration Test	
	Number of Tests	Range of N Values
Made Ground	5	4 – 26
Weathered Wilmslow Sandstone	9	17 – Refusal
Wilmslow Sandstone	2	Refusal

Figure 4.2: SPT N with Depth

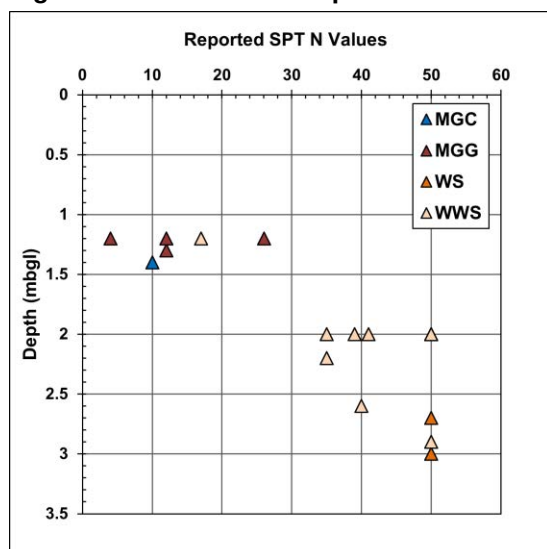
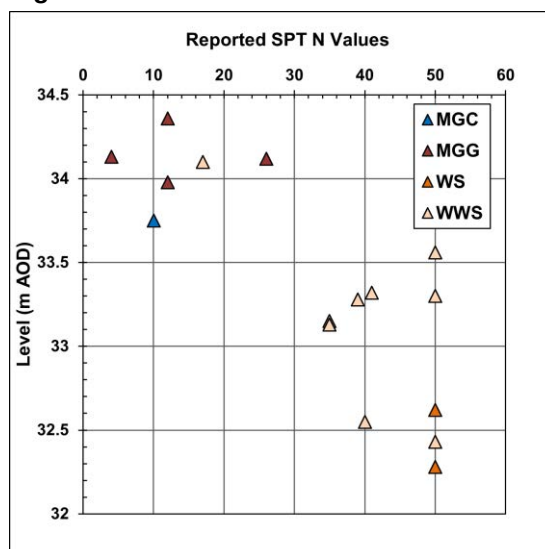


Figure 4.3: SPT N with Elevation



MGC: Cohesive Made Ground, MGG: Granular Made Ground, WS: Wilmslow Sandstone, WWS: Weathered Wilmslow Sandstone.

4.3 Summary of Geotechnical Laboratory Testing

The following geotechnical laboratory testing was scheduled by Mott MacDonald and undertaken by GEOLABS and CTS Group (BRE Testing). Plots of geotechnical testing results are presented in Appendix C, with the full results presented in the Factual Report in Appendix D. Table 4.4 summarises the geotechnical laboratory testing undertaken.

Table 4.4: Summary of Geotechnical Laboratory Testing

Laboratory Test	Made Ground		Weathered Wilmslow Sandstone	Wilmslow Sandstone
	Granular	Cohesive		
Moisture Content	11	4	-	-
Atterberg Limits	-	2	-	-
Particle Size Distribution	5	2	6	-
BRE – pH and Sulphate contents	19	3	-	-
Point Load Index	-	-	-	5
Uniaxial Compressive Strength	-	-	-	7

4.4 Summary of Geo-environmental Laboratory Testing

As part of the ground investigation at the site, targeted geo-environmental testing was conducted in accordance with established procedures including BS10175 (2011+A2:2017) Code of Practice for the Investigation of Potentially Contaminated Sites [7], BS5930:2015 +A1:2020 [8] and Environment Agency Land Contamination Risk Management (LCRM) guidance [4] to determine the presence and degree of contamination. The exploratory investigation did not target any specific contamination sources at the site, but instead comprised non-targeted assessment of ground conditions. Considering the area of the site for the proposed development, the number and location of the exploratory holes were appropriate to determine the representative ground conditions (including potential contamination), beneath the proposed development footprint.

Disturbed environmental soil samples and groundwater samples were collected in appropriate containers and sent to CTS Group (UKAS Accredited Laboratory, No. 4161) for chemical testing. Soil, soil leachate and groundwater testing was undertaken to determine the concentrations of various inorganic and organic contaminants. The scope of laboratory testing on retrieved samples is outlined in Table 4.5.

Table 4.5: Summary of Geo-environmental Laboratory Testing

Laboratory Test	Number of Samples	Rationale
Comprehensive Soil Suite	12	To identify potential contaminants of concern associated with the current and historical operation/maintenance of the hospital, and inform the risk to human health and the classification of waste.
Comprehensive Soil Leachate Suite	5	To identify potential contaminants of concern associated with the current and historical operation/maintenance of the hospital, and inform the risk to controlled waters.
Waste Acceptance Criteria (WAC)	6	WAC testing to identify requirement for disposal of materials to appropriate land fill.

Testing suites comprised the following:

- Comprehensive Soil Suite: Antimony, Arsenic, Asbestos Screen, Barium, Beryllium, Boron, Benzene, Toluene, Ethylbenzene and Xylene (BTEX) (speciated), Cadmium, Chromium (III), Chromium (VI), Copper, Cyanide (Free), Fraction of Organic Carbon, Iron, Lead, Manganese, Total Mercury, Molybdenum, Nickel, pH, Phenols (speciated), Polyaromatic Hydrocarbons (USEPA 16 speciated), Selenium, Sulphate (Water soluble), Sulphur (Total), Total Petroleum Hydrocarbons – CWG Bands (ali/aro split), Vanadium, Volatile Organic Compounds (VOCs), Zinc.
- Comprehensive Soil Leachate Suite: Ammoniacal Nitrogen, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chloride, Chromium (III), Chromium (VI), Copper, Cyanide (Free), Cyanide (complex), Dissolved Organic Carbon, Fluoride, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, pH, Phenols (speciated), Selenium, Sulphate, Vanadium, Zinc.

4.5 Groundwater Monitoring

Five rounds of groundwater and monitoring was undertaken in April and May 2025 across two boreholes (BH101 and BH104) following the completion of intrusive works. From these five rounds, full data from just two of these rounds of groundwater monitoring was made available. This available data recorded groundwater level in the Wilmslow Sandstone between 3.2mbgl and 4.4m bgl, close to the boundary between the Weathered Wilmslow Sandstone and the competent Wilmslow Sandstone underlying it.

Groundwater strikes were recorded within the Wilmslow Sandstone in BH102 and BH103 (boreholes without groundwater monitoring) at 2.8m bgl and 3.9m bgl respectively. These groundwater strikes were encountered less than 1m below the boundary between the Weathered Wilmslow Sandstone and the competent Wilmslow Sandstone.

5 Ground Summary

5.1 Ground Model

A ground model has been created for the site of the proposed Christie building redevelopment based upon the findings of the 2024 scheme-specific ground investigation and also relevant information from the 2019 ground investigation for the Paterson building redevelopment, adjacent to the site. This ground model is presented in a tabulated for in Table 5.1 and a cross-section is presented in Appendix B.

Table 5.1: Ground Model

Strata	Typical Thickness (m) [range]	Typical Top of Strata Depth (m bgl) [Elevation (m AOD)]	Typical Description	Strata Distribution
Made Ground	1.4 [0.5 – 2.0]	0.0 [35.2]	Predominantly granular: Loose to medium dense dark brown silty gravelly subrounded to subangular fine to coarse SAND with brick, concrete, limestone and tile fragments Locally cohesive: Soft to firm dark brown gravelly sandy CLAY with brick and concrete fragments. Locally stiff.	Site-wide. Locally tarmacadam, hardstanding, gravel.
Weathered Wilmslow Sandstone	1.4 [1.0 – 1.4]	1.4 [33.8]	Medium dense to dense orangish and reddish brown gravelly fine to coarse SAND.	Site-wide.
Wilmslow Sandstone	Thickness not proven, 15m+	2.8 [32.4]	Extremely weak to weak reddish and orangish brown fine to coarse grained SANDSTONE, locally poorly cemented or recovered as sand.	Heavily weathered in BH103 from 11.5 to 14.0m bgl. Recorded in drillers logs as potential fault zone.

5.2 Groundwater

Groundwater was consistently encountered within the Wilmslow Sandstone close to rockhead across all exploratory holes that reached bedrock. Groundwater strikes and monitoring data suggests that groundwater level is between 2.8m and 4.4m bgl within competent Wilmslow Sandstone close to the overlying Weathered Wilmslow Sandstone.

Groundwater strikes were encountered in two locations, BH102 and BH103 at 2.8m and 3.9m respectively.

5.3 Ground Aggressivity

High levels of sulphates and acids in the ground can result in damage to buried concrete, posing a risk to proposed foundations on site. The site is characterised as being brownfield with mobile waters.

Chemical tests of BRE SD1 Suite D were carried out on 10 soil samples, from the footprint of the Christie Building, as part of the 2024 GI. Testing was undertaken in accordance with BRE Special Digest 1 [9]. Twelve geo-environmental samples were also tested for pH and sulphate contents as part of the comprehensive soil suite testing. The results from this have also been used to inform a suitable concrete design class for any foundations.

Table 5.2: Ground Aggressivity Summary

Strata	Number of Results	Characteristic Value (BRE Special Digest 1:2005)		Design Sulphate Class (DS)	Aggressive Chemical Environment for Concrete Class (ACEC)
		Water Soluble Sulphate (mg/l)	pH		
Granular Made Ground	19	58 (<10 – 63)	7.4 (7.3 – 9.0)	DS-1	AC-1
Cohesive Made Ground	3	11 (<10 – 11)	7.6 (7.4 – 7.9)	DS-1	AC-1

6 Geotechnical Parameters

The geotechnical parameters presented in this section are characteristics of the ground conditions on site based upon the available data from the 2024 scheme-specific GI and the 2019 Paterson building GI. They should be used to inform design parameters at the next stage that consider relevant foundation designs, loadings and associated factors of safety.

6.1 Made Ground

6.1.1 Bulk Unit Weight

The unsaturated bulk unit weight of each type of Made Ground encountered has been estimated using Figure 1 from BS8004:2015 [10].

- Cohesive Made Ground: 18kN/m³ based upon engineering descriptions from the 2024 and 2019 GI's of soft to firm CLAY. Assumed that the Cohesive Made Ground is above the groundwater table based upon groundwater monitoring from the 2024 GI.
- Granular Made Ground: 19kN/m³ based upon engineering descriptions from the 2024 and 2019 GI's of loose to medium dense GRAVEL. Assumed that the Granular Made Ground is above the groundwater table based upon groundwater monitoring from the 2024 GI.

6.1.2 Angle of Shearing Resistance

6.1.2.1 Granular Made Ground

The critical angle of shearing resistance, ϕ'_{cv} , has been estimated for Granular Made Ground using Equation 4 from BS8004:2015:

$$\phi'_{pk,k} = 30^\circ + \phi'_{ang} + \phi'_{PSD} + \phi'_{dil}$$

Where ϕ'_{ang} is the contribution from the angularity of particles and ϕ'_{PSD} is the contribution from the particle size distribution. Based upon limited engineering descriptions of angularity of sub-angular to sub-rounded, a ϕ'_{ang} of 2° is applicable. Five particle size distribution test performed on Granular Made Ground as part of the 2024 GI, presented in Figure C.2, indicate that the material is generally evenly graded (Uniformity Coefficient, C_u , between 2 and 6). This indicates that a ϕ'_{PSD} of 2° is applicable. Considering the lower bound of the SPT value is 4, ϕ'_{dil} of 0° will be used. Therefore, a characteristic ϕ'_p of 34° is appropriate.

6.1.2.2 Cohesive Made Ground

An angle of shearing resistance, ϕ'_{cv} , of 24° has been estimated for Cohesive Made Ground, using Table 2 from BS8004:2015. As only one measurement of plasticity index (3%) was obtained as part of the 2024 GI, a more conservative plasticity index of 30% is appropriate.

6.1.3 Effective Cohesion

Effective cohesion, c' , is estimated from BS8004:2015, Section 4.3.1.4.9 and a characteristic value of 0kPa is considered applicable.

6.1.4 Undrained Shear Strength (Cohesive Made Ground)

The undrained shear strength, c_u , of encountered Cohesive Made Ground has been derived from in-situ testing results and correlations from literature. Cohesive Made Ground on site was

described as soft to firm CLAY. Soft clay typically possesses an undrained shear strength of 20 – 40kPa. Firm clay possesses undrained shear strength of 40 – 75kPa.

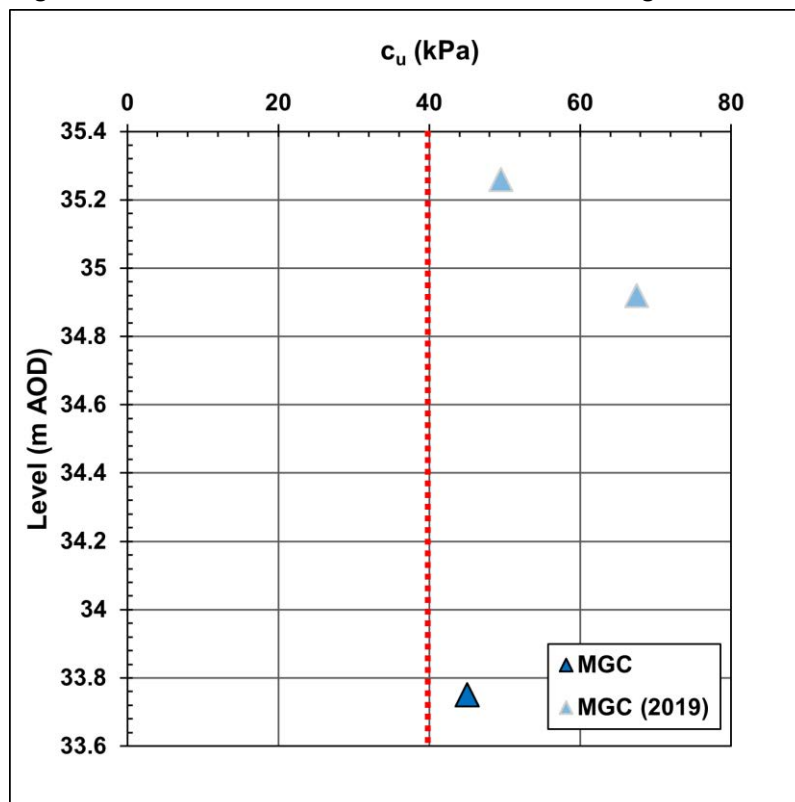
The SPT results in cohesive Made Ground have been used to assess the undrained shear strength using the following relationship from Stroud and Butler (1973) detailed in CIRIA R143 [11]:

$$c_u = f_1 N_{60}$$

Where f_1 is a correlation factor relating to the plasticity of the clay. A correlation factor f_1 of 4.5 has been adopted based upon Figure 31 from CIRIA R143 (1995) assuming a conservative plasticity index of 30%. A plot of SPT correlated undrained shear strength with elevation is presented in Figure 6.1. This correlation indicates undrained shear strengths of 45 – 68kPa. There is no clear relationship between correlated undrained shear strength and depth.

Based upon the SPT correlated undrained shear strength and the engineering descriptions of soft to firm CLAY, a characteristic undrained shear strength of 40kPa is appropriate across Cohesive Made Ground.

Figure 6.1: SPT Correlated Undrained Shear Strength in Cohesive Made Ground



Assuming a correlation factor, f_1 of 4.5. Line in red shows an appropriate characteristic c_u in cohesive Made Ground.

6.1.5 Young's Modulus

6.1.5.1 Undrained Young's Modulus (Cohesive Made Ground)

The undrained Young's Modulus, E_u , of Cohesive Made Ground has been estimated using in-situ and correlations from literature.

The relationship between undrained shear strength, previously estimated from in-situ testing, and undrained Young's Modulus is given in Figure 2.33 from Foundation Design and Construction [12]. Assuming a conservative plasticity index of 30%, a E_u/c_u ratio of 400 is appropriate.

6.1.5.2 Drained Young's Modulus (Granular Made Ground)

The drained Young's Modulus, E' , of Granular Made Ground has been estimated using in-situ testing results and correlations from literature.

The SPT results in Granular Made Ground, presented in Figure C.1, have been used to estimate the drained Young's Modulus using the following relationship from Stroud (1989) detailed in CIRIA R143 [11]:

$$\frac{E'}{N_{60}} = 1 \text{ (MPa)}$$

Six SPTs were performed in Granular Made Ground across the 2019 and 2024 GIs. The SPT results ranged between 4 and 26 with average of 13. Adopting a characteristic values of 10, it can be estimated that the drained Young's Modulus of the Granular Made Ground is approximately 10MPa.

6.2 Weathered Wilmslow Sandstone

6.2.1 Bulk Unit Weight

As no laboratory testing was undertaken measuring the density of Weathered Wilmslow Sandstone, the unsaturated bulk unit weight has been estimated using engineering descriptions and in-situ testing from the 2024 and 2019 investigations. Using Figure 1 from BS8004:2015, a bulk unit weight of approximately 19kN/m³ is anticipated based upon engineering descriptions of medium dense to dense SAND and SPT 'N values' between 17 and 50 (Refusal).

6.2.2 Angle of Shearing Resistance

The critical angle of shearing resistance, ϕ'_{cv} , has been estimated for Weathered Wilmslow Sandstone using Equation 4 from BS8004:2015:

$$\phi'_{pk,k} = 30^\circ + \phi'_{ang} + \phi'_{PSD} + \phi'_{dil}$$

Where ϕ'_{ang} is the contribution from the angularity of particles and ϕ'_{PSD} is the contribution from the particle size distribution. Based upon limited engineering descriptions of angularity of sub-angular to sub-rounded, a ϕ'_{ang} of 2° is applicable. Six particle size distribution test performed on Granular Made Ground as part of the 2024 GI, presented in Figure C.2, indicate that the material is generally evenly graded (Uniformity Coefficient, C_u , around 4). This indicates that a ϕ'_{PSD} of 2° is applicable. Given that the SPT 'N' ranges from 17 to over 50 and is generally greater than 35, with a density index exceeding 65%, ϕ'_{dil} of 3° will be used. Therefore, a characteristic $\phi'_{pk,k}$ of 37° is appropriate.

6.2.3 Drained Young's Modulus

The drained Young's Modulus, E' , of Weathered Wilmslow Sandstone has been estimated using in-situ testing results and correlations from literature.

The SPT results in Weathered Wilmslow Sandstone from the 2024 and 2019 ground investigations, presented in Figure C.1, have been used to estimate the drained Young's Modulus using the following relationship from Stroud (1989) detailed in CIRIA R143 (1995):

$$\frac{E'}{N_{60}} = 1 \text{ (MPa)}$$

Ten SPTs were performed in Weathered Wilmslow Sandstone across the 2019 and 2024 GIs. The SPT results ranged between 15 and 50 (refusal). Adopting a characteristic values of 35, it can be estimated that the drained Young's Modulus of the Weathered Wilmslow Sandstone is approximately 35MPa.

6.3 Wilmslow Sandstone

6.3.1 Bulk Unit Weight

Laboratory measurements of bulk and dry density were undertaken as part of UCS testing. As the groundwater level is recorded to lie close to rockhead, the bulk unit weight is more appropriate for use in design than the dry unit weight. From these measurements of density, the bulk unit weight of the Wilmslow Sandstone was found to range between 19.7kN/m³ and 21.7kN/m³.

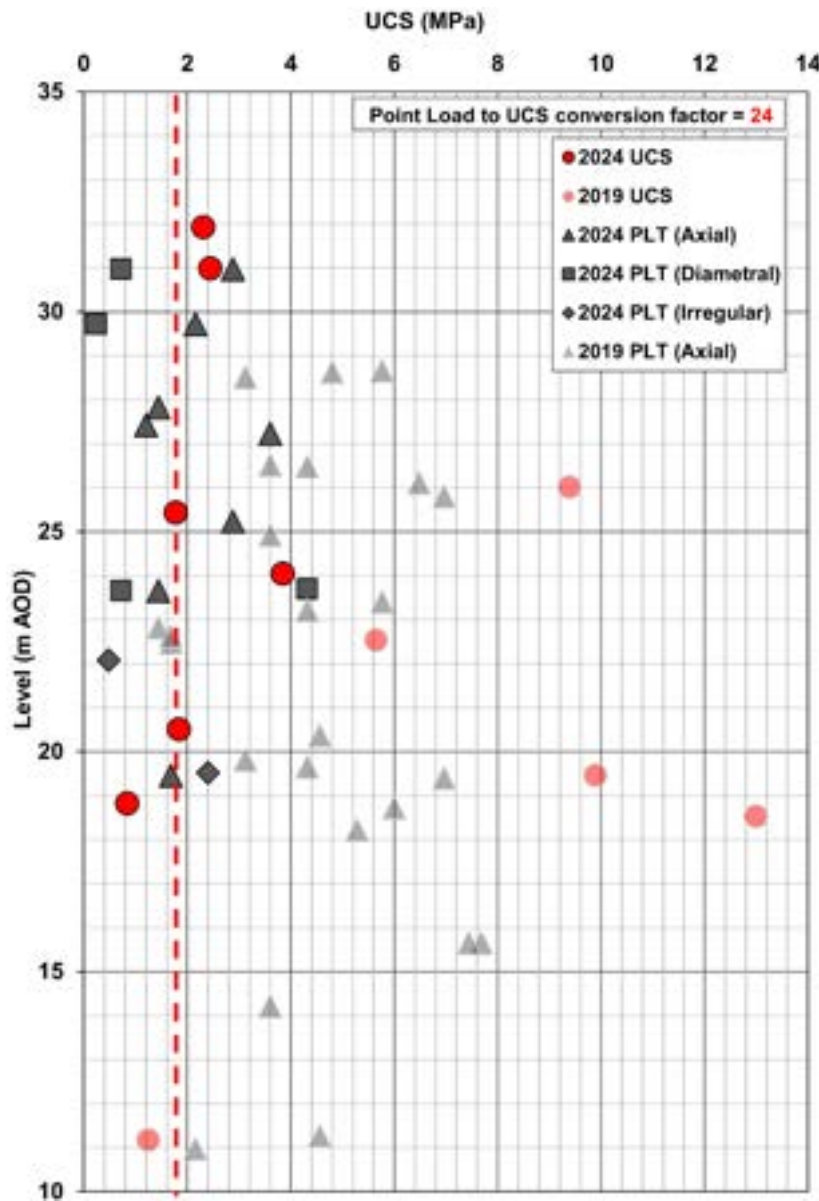
6.3.2 Unconfined Compressive Strength

UCS testing was undertaken as part of both the 2024 and 2019 GI's. The results of UCS testing in the 2024 GI ranged between 0.85MPa and 3.85MPa. These results are lower than those obtained as part of the 2019 GI which ranged between 1.25MPa and 9.95MPa.

A conversion factor of 24 was adopted between I_{s50} from point load testing and UCS. This conversion factor is similar to that adopted in the 2019 investigation and values presented in literature [13]. This conversion factor falls within the range of ratios between UCS and PLT results from the 2019 and 2024 GIs at similar depths.

A plot of UCS and PLT-correlated UCS with elevation is presented in Figure 6.2. This plot does not illustrate a clear relationship between UCS and depth. Therefore an approximate UCS of 1.8MPa is considered characteristic throughout the Wilmslow Sandstone encountered on site.

Figure 6.2: UCS with Elevation



6.3.3 Effective Angle of Shearing Resistance and Effective Cohesion

The angle of shearing resistance, ϕ' , of the Wilmslow Sandstone has been estimated using RSData. The plastic behaviour of the Wilmslow Sandstone was defined by the following:

- UCS: 1.8MPa – mean value from geotechnical testing.
- Geological Strength Index, GSI: ~40 – based upon field descriptions of intersecting joint sets and close bedding.
- Material constant, m_i : 15 – typical range for sandstones 13 – 21.
- Disturbance factor, D: 0

Using Hoek-Brown generalised fit, an effective angle of shearing resistance of 31° with an effective cohesion of 0.1MPa was calculated in RSData.

Effective stress parameters for rock have been determined based on published chart from Yates (Quarterly Journal of Engineering Geology 1992, V25, p107-113). For the existing confining pressure of 0.1MPa and UCS range of 1.8, the following can be determined $c' = 40\text{kPa}$ and $\phi' = 42^\circ$. Hence an angle of shearing resistance of 40° with c' of 40kPa is suggested.

6.3.4 Rock Mass Young's Modulus

Across nine samples, the measured Young's Modulus ranged from 133 MPa to 3.74 GPa, with an average of 859 MPa. From ground level to 10 meters below ground level, the Young's Modulus ranges between 133 MPa and 239 MPa. A characteristic rock mass Young's Modulus of 180MPa is appropriate.

6.4 Summary of Characteristic Geotechnical Parameters

Table 6.1: Characteristic Geotechnical Parameters

Strata	Bulk Unit Weight, γ_{bulk} (kN/m ³)	Effective Angle of Shearing Resistance, φ' (°)	Effective Cohesion, c' (kPa)	Undrained Shear Strength, c_u (kPa)	Young's Modulus, $E'/E_u/(E_m)$ (MPa) <i>Assuming Axial Strain ~10⁻¹%</i>	Uniaxial Compressive Strength, UCS (MPa)
Cohesive Made Ground	18	24	0	40	$E_u = 400c_u$	-
Granular Made Ground	19	34	-	-	10	-
Weathered Wilmslow Sandstone	19	37	-	-	35	-
Wilmslow Sandstone	21.5	40	40	-	180	1.8

7 Engineering Assessment

7.1 Foundation Assessment

Based on the ground conditions outlined in Section 5, the geotechnical parameters encountered in Section 6 and the development proposals outlined in Section 1.2, it is anticipated that a piled foundation solution will be required for the new four-storey building.

At this stage, the proposed loadings are not known but it can be assumed that any proposed piles will terminate in Wilmslow Sandstone.

7.2 Subsurface Concrete

Concentrations of sulphate and values of pH were obtained from samples of Made Ground retrieved during the 2023 ground investigation works. Results of the testing, in accordance with BRE Special Digest 1 [9] are discussed in full in Section 5.2.

Results indicate that concrete of Design Sulphate Class DS-1 and ACEC class AC-1 would be appropriate for subsurface concrete at the site.

7.3 Excavatability and Subsurface Obstructions

7.3.1 Subsurface Obstructions

Obstructions may be present in Made Ground across the site in the form of cobbles, boulder of mixed lithologies, hardstanding, existing services and historical buried foundations. Only one obstruction was encountered during the 2024 ground investigation works.

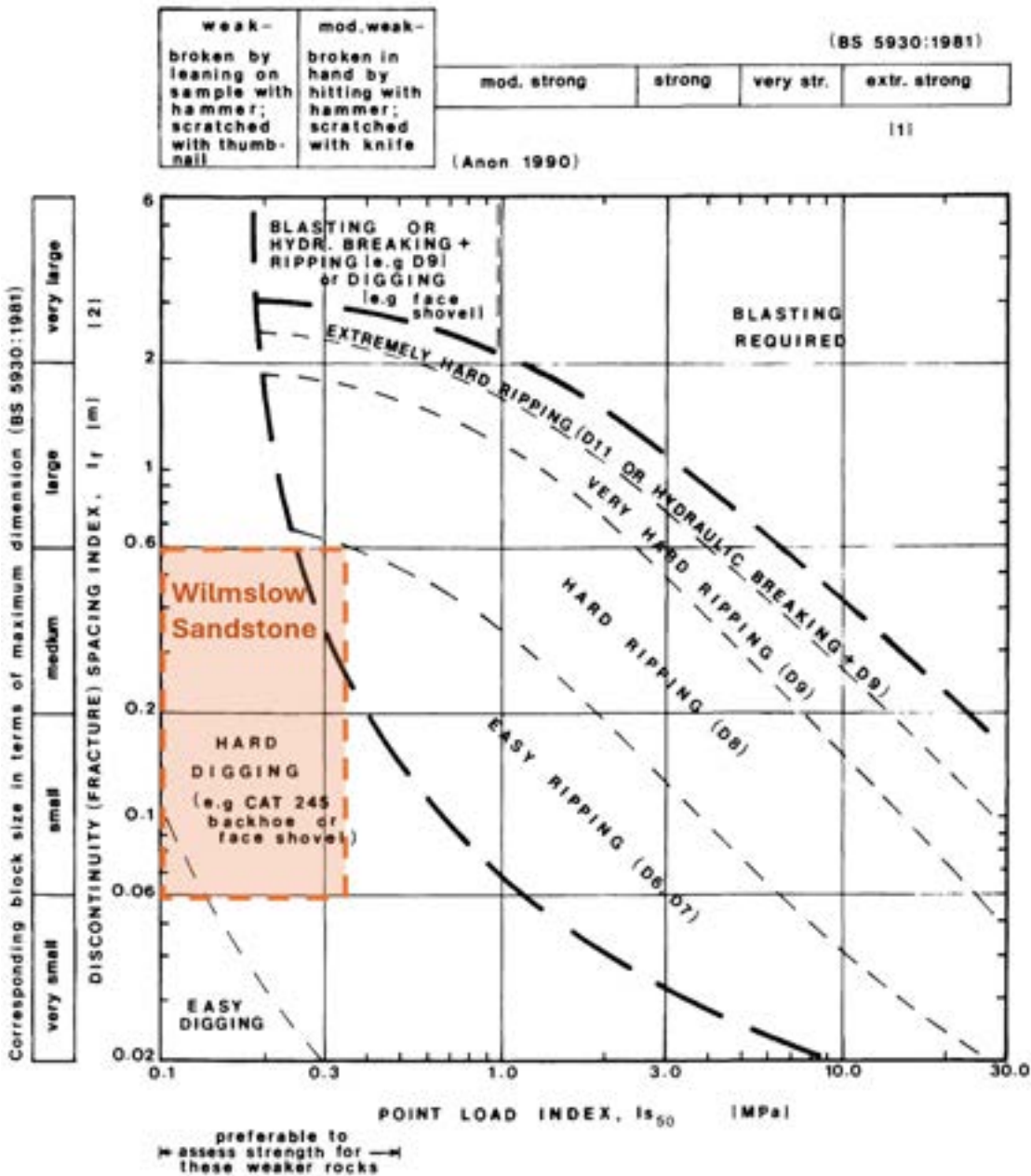
It is anticipated that some of the existing Made Ground is to be excavated as part of the proposed works. Should obstructions be encountered at shallow depths in the Made Ground during construction, removal will be required.

7.3.2 Excavatability

An excavatability assessment has been carried out according to the excavatability chart from Pettifer and Fookes [14] presented in Figure 8.1. The assessment of excavatability considered field descriptions of discontinuity spacing and point load index/field descriptions of rock strength.

The ranges presented on Figure 7.1 indicate that the Wilmslow Sandstone on site can be described primarily as “Hard Digging” and “Easy Ripping” with localised areas of “Easy Digging” and “Hard Ripping”.

Figure 7.1: Excavatability for Wilmslow Sandstone



Source: Quarterly Journal of Engineering Geology, Pettifer and Fookes, 1994.

7.4 Variable Made Ground

Intrusive ground investigation works identified variable Made Ground across the site with Cohesive and Granular Made Ground recorded in close proximity to one another. Consequently, differences in Made Ground across the footprint of the development proposals may lead to variations in geotechnical properties that complicates design if Made Ground isn't to be excavated and replaced.

Logging of excavation works during construction shall be undertaken to ensure that the materials and properties accounted for in design are correct.

7.5 Groundwater

During the ground investigation works, groundwater level across the site was consistently recorded close to rockhead within the Wilmslow Sandstone, between 2.8m and 4.2m bgl. Therefore groundwater level should be assumed to lie at approximately 3m bgl in design.

This relatively shallow groundwater level may result in the flooding of excavations. The contractor should be made aware of this risk during constructions. The contractor shall also remain vigilant for changes in groundwater levels and employ suitable groundwater controls where appropriate.

7.6 Potential Fault Zone

The Geotechnical and Geo-environmental Desk Study (CASICD-MMD-XX-XX-RP-C-00001) identified a fault recorded in BGS mapping southwest of the site. Scheme-specific ground investigation at the site aimed to identify where this fault zone might be present beneath the site.

Core recovery parameters, recorded as part of the 2024 ground investigation works and presented in Figure C.5, showed no evidence of a fault zone beneath the site. A notable drop in core recovery parameters would be anticipated should faulted bedrock be present. No such relationship was observed in the plots presented in Figure C.5.

There are numerous reasons why the fault recorded in BGS mapping southwest of the site may not have been identified as part of the 2024 ground investigation works:

- The recorded fault may dip steeply beneath the site and may be present at depths greater than that investigated.
- The presence of the fault may have been obscured by poor core recovery in what is generally weak Sandstone.
- The mapped fault may not extend to rockhead and may be present at significant depth beneath the surface.

8 Geotechnical Risk Register

Based on the findings of the 2024 ground investigation, the geotechnical risk register presented in the Geotechnical and Geo-environmental Desk Study (CASICD-MMD-XX-XX-RP-C-000001) has been updated. The updated geotechnical risk register is presented in Table 8.1.

Table 8.1: Geotechnical Risk Register

Risk ID	Hazard	Consequence	Risk Rating (Pre-GI)	Mitigation Measures Undertaken / Further Actions to be Undertaken	Current Risk Rating (Post-GI)
GEO-01	Unknown/unforeseen ground conditions	Ground conditions could adversely affect the design if different from assumptions. Risk of failure or excessive settlement of structures	Medium risk	A site-specific ground investigation has been undertaken, along with geotechnical testing, to produce a detailed ground model presented in Table 5.1 and Appendix B. Characteristic geotechnical parameters to be used in design have been presented in Section 6 and Table 6.1. Detailed ground model and characteristic geotechnical parameters shall be used to inform design.	Low risk
GEO-02	Variable Made Ground	Made Ground may be encountered and can offer poor founding material. Risk of failure or excessive settlement.	Medium risk	A site-specific ground investigation has been undertaken, along with geotechnical testing, to characterise and establish typical geotechnical properties of Made Ground encountered on site. During ground investigation works, Made Ground of varied nature and properties was encountered. Therefore the risk of variable Made Ground remains. Logging of excavation works during construction to ensure that the materials and properties accounted for in design are correct.	Medium risk
GEO-03	Contaminated Made Ground	Potential for contaminants of concern to be present in Made Ground. Human health risks to staff working with site won materials.	Medium risk	Site-specific ground investigation undertaken and appropriate geo-environmental sampling and testing undertaken. Contaminated land risk assessment produced for the site. No exceedances of human health screening guidelines were recorded within the samples analysed. An absence of any appreciable source of elevated ground gases within the Made Ground or from within the solid strata. The Contractor should ensure standard health and safety procedures are in place and best practices are followed during construction and maintenance works.	Low risk
GEO-04	Unknown groundwater levels	Incorrect assumptions could lead to inappropriate design.	Medium risk	As part of site-specific ground investigation works, groundwater strikes were recorded and groundwater monitoring was undertaken. During the monitoring period, groundwater level was recorded to be broadly consistent close to rockhead (2.8m to 4.2m bgl). Data from the groundwater monitoring can be used to inform design. During excavation works, the contractor shall be made aware of potentially shallow groundwater and remain vigilant for changes in groundwater levels and employ suitable control measures where appropriate.	Low risk
GEO-05	Ground obstructions	Potential for obstructions to be encountered e.g. historical foundations and/or basement structure. Difficult excavation to form foundations. Impact on project cost and programme.	High risk	During ground investigation works, obstructions were recorded when encountered. Only one obstruction was encountered in BH103A at approximately 1.2m bgl. The nature of this obstruction is unknown.	Medium risk

Risk ID	Hazard	Consequence	Risk Rating (Pre-GI)	Mitigation Measures Undertaken / Further Actions to be Undertaken	Current Risk Rating (Post-GI)
				The contractor shall be made aware of the potential for obstructions within Made Ground close to the surface. Where significant obstructions, such as buried historical foundations, are encountered the designer shall be informed.	
GEO-06	Buried services strike	Potential delays to programme, affect businesses or users served by any existing utility and safety risks to operatives.	High risk	A PAS128 survey was undertaken as part of the ground investigation works. The results of which are presented in the appendices of the factual report (Appendix D). Although a utilities survey has been undertaken, the contractor shall be aware that buried service strike remains possible and a competent person shall clear any excavation area prior to breaking ground.	Medium risk
GEO-07	Ground aggressivity to concrete	Certain ground conditions containing sulphates, nitrates and chloride can be aggressive to concrete, causing foundations to fail.	Medium risk	Geo-environmental testing (including BRE Suite D testing) was performed on samples of Made Ground at the site. The results of testing, presented in Table 5.2, record largely low sulphate concentrations. The results of testing shall be used to inform an appropriate class of concrete to be specified in design.	Low risk
GEO-08	UXO	Potential delays to programme and safety risks to operatives.	High risk	A detailed desk study for the site has been undertaken by Zetica UXO Ltd and is presented in Appendix H. The desk study reports a low risk of UXO hazard and states that additional further mitigation measures are not required.	Low risk
GEO-09	Faults present southwest of the site	Movement of faults could impact design of structures and impact on construction.	Medium risk	No evidence of a fault zone was encountered during the site-specific ground investigation works. No distinct areas of poor core recovery were identified on plots presented in Figure C.5. Although not identified as part of these ground investigation works, the contractor shall be made aware of potentially faulted bedrock and should remain vigilant for areas of non-competent bedrock at depth during piling.	Low risk

9 Conclusions and Recommendations

9.1 Conclusions

9.1.1 Geotechnical

9.1.1.1 Ground Conditions

The ground profile across the site is broadly consistent, with a 0.5 – 2.0m thick layer of Made Ground at the surface. This Made Ground was observed to be predominantly granular loose to medium dense dark brown SAND with fragments of brick, concrete, limestone and tile. Locally cohesive Made Ground of soft to firm dark brown gravelly sandy CLAY with brick and concrete fragments was encountered. This Made Ground was underlain by a layer of Weathered Wilmslow Sandstone typically 1.4m thick. This layer is typically medium dense to dense orangish and reddish brown gravelly fine to coarse SAND. Approximately 3m bgl, competent bedrock of Wilmslow Sandstone is present beneath the layer of Weathered Wilmslow Sandstone. The Wilmslow Sandstone on site was described as extremely weak to weak reddish and orangish brown fine to coarse grained SANDSTONE, locally recovered as sand. Groundwater monitoring and strikes during ground investigation recorded groundwater level between 2.8m and 4.4m bgl, just below competent rockhead within the Wilmslow Sandstone.

9.1.1.2 Geotechnical Risks

The production of a detailed ground model and the undertaking of groundwater monitoring has reduced the anticipated risk level for a number of geotechnical risks

- Variable Made Ground: During ground investigation works, Made Ground of varied nature and properties was encountered. Although the Made Ground encountered was primarily granular, locally cohesive Made Ground was encountered. This may result in design assumptions not matching conditions in reality and issues such as differential settlement.
- Ground Obstructions: Although only one obstruction was encountered during ground investigation works, there remains the possibility of obstructions, including historical foundations, being encountered during construction.
- Buried Services Strike: Numerous buried services were identified as part of the utilities survey undertaken. Despite this survey, a buried service strike remains possible.
- Fault Present Southwest of the Site: Although no clear evidence of faulted bedrock was encountered during the ground investigation works on site, there remains a possibility that a fault is present beneath the site.

9.1.2 Geo-environmental Conclusions

The GQRA has assessed the identified pollutant linkages at the site as low risk overall.

9.1.2.1 Human Health

No exceedances of human health GAC were recorded within the soil samples analysed when assessed against relevant “Commercial” land use criteria. No asbestos was identified in any of the samples tested. The risk to human health from the identified soil conditions is concluded to be low.

As detailed within the Design Stage Report [5], asbestos may be present within the existing building including unmanaged asbestos within existing basements associated with the age of

the current buildings on site, which date from the 1930s. Note that should the presence of asbestos contamination be suspected during development, Mott MacDonald Limited would recommend the appointment of a specialist contractor to address the issue and would not provide advice on risk or remedial measures.

9.1.2.2 Water Environment

Soil leachate testing identified limited exceedances of water quality standards due to the presence of heavy metals and phenol within the shallow Made Ground deposits. The overall risk to the water environment is concluded to be low.

9.1.2.3 Ground Gas

The risk posed by elevated ground gases is considered to be low based on the following conditions encountered during ground investigation:

- Previous GI immediately to the south of the site did not record any significantly elevated ground gases or flow rates. No additional off-site potential sources were identified.
- The Made Ground recorded within the GI on site did not record any constituents which would be considered to represent a source of elevated ground gases. The sedimentary solid strata are not considered to represent a source of elevated ground gases.
- A proportion of Made Ground is anticipated to be removed from the site during development works to facilitate foundation construction.

As such, no specific ground gas preclusion measures are required.

The potential risk from ground gases to construction workers working in excavations and other confined spaces will be dealt with by the Contractor, in accordance with Confined Spaces Regulations.

9.1.2.4 Waste Considerations

The majority of the Made Ground deposits analysed are likely to be suitable for removal to inert landfill. Waste considerations are detailed in Section 3.8. It is recommended that a suitable waste contractor is engaged to discuss options for disposal if construction works require removal of soils from site. Additional analysis may be required on specific soils to suit the requirements of the receiving waste transfer facility.

9.2 Recommendations

9.2.1 Geotechnical

The geotechnical recommendations are summarised as follows:

- During construction, any excavations are to be logged to ensure that the materials and properties accounted for in design are correct. If unexpected conditions are encountered during construction, design parameter should be verified through in-situ testing. Very soft Cohesive Made Ground or very loose Granular Made Ground may require excavation and replacement.
- The contractor shall ensure that they have consulted all available pre-construction information including utility plans to reduce the risk of buried service strikes.
- Any encountered subsurface obstructions should be excavated and replaced with appropriate fill material.

9.2.2 Geo-environmental

The geo-environmental recommendations are summarised as follows:

- While it is not considered that any materials generated on site are being considered for reuse, it should be recognised that any material reuse should be undertaken under the requirements of Environment Agency WM3 guidance.
 - It is recommended that a waste contractor is contacted to discuss appropriate options for disposal if construction works require removal of soils from site.
- Based on the site's history, there is the potential for contamination to be encountered during the development works which has not been identified in the course of the ground investigations. An unexpected contamination protocol should be produced and adhered to throughout the development works.
- Construction and maintenance works should use site specific risk assessments and method statements and, where necessary, the use of personal protective equipment (PPE).
- No significant shallow groundwater is anticipated to be encountered during construction works, however should appreciable quantities be encountered, suitable dewatering provision should be made, and appropriate disposal measures considered to mitigate the risk to the water environment.
- For new fresh water supply pipes, a water supply pipe risk assessment should be undertaken in accordance with UKWIR guidance in order to select an appropriate water supply pipe material for the development.
- Based on the findings in this assessment, a remediation strategy is not required for the development.
- A verification report will be produced on completion of site earthworks and submitted to the Council for acknowledgement and review. The verification report will follow the Environment Agency's LCRM guidance and will include;
Details of any materials brought onto site including their source location, nature and any testing data obtained to demonstrate suitability for use, Confirmation that no unexpected contamination was encountered. All locations, methodology and testing undertaken to investigate unexpected contamination (if encountered). Details on any mitigation measures implemented for unexpected contamination.

10 References

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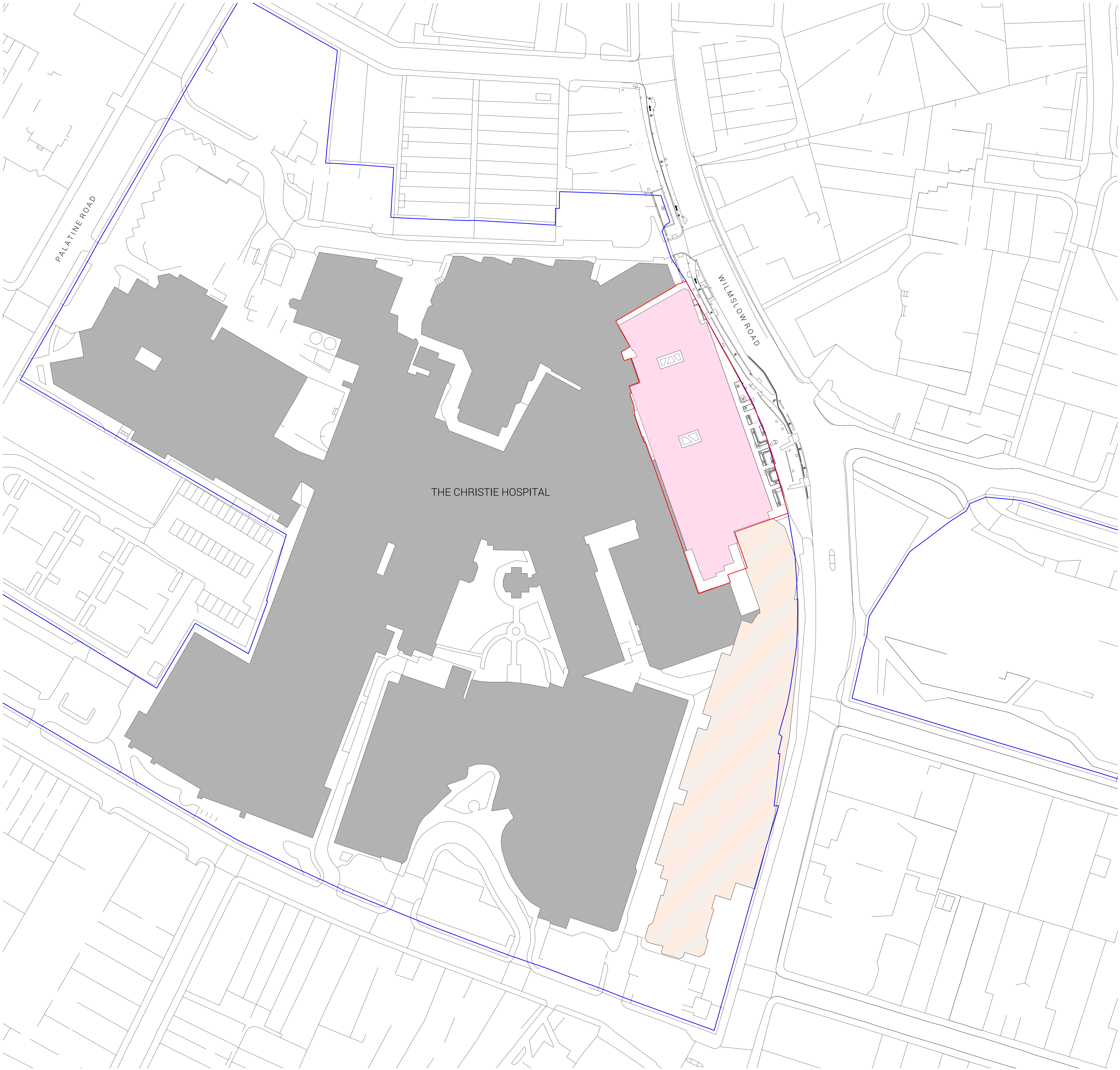
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Appendices

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A. Proposed Scheme Layout

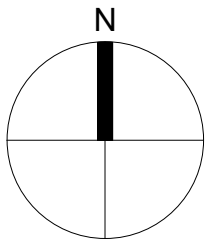
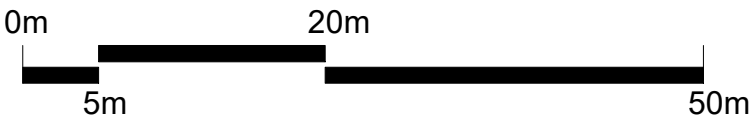
Source: DAY Architecture



- LEGEND
- Site boundary line
 - Other land owned by the Trust
 - Location of new Paterson Cancer Research Centre
 - Proposed Building

Proposed Site Location Plan
1:500

GENERAL NOTES:
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1. All boundaries, dimensions and levels are to be checked on site before construction and any discrepancies reported to the Architect / Designer.
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P03	Planning Issue	15.09.2023	JAK
P02	Draft Planning Issue for Trust/Planning Consultant comment	25.08.2023	SB
P01	For Trust/Planning Consultant Review	28.07.2023	SB
REV	DESCRIPTION	DATE	REVIEW

CLIENT The Christie NHS Foundation Trust			
PROJECT Advanced Scanning & Imaging Centre Development			

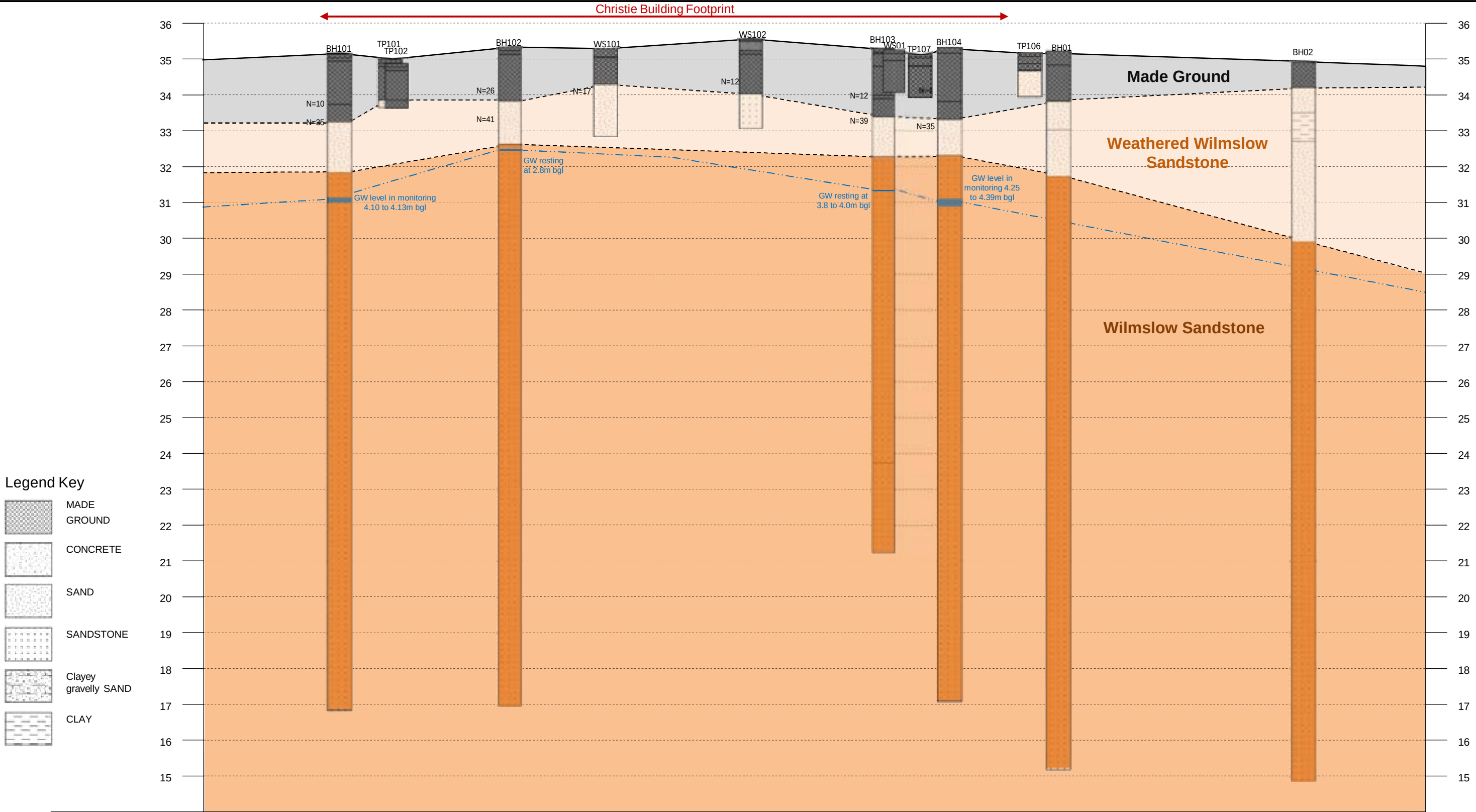
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SCALE As indicated @ A0		FIRST ISSUED 28/07/23	
PROJECT 1282-21	CLIENT REF CASICD	DRAWN BY SB	CHECKED BY JK
ORIGIN DAY	VOLUME XX	LEVEL ZZ	TYPE DR
DRAWING STATUS S3 - PLANNING		ROLE A	NUMBER / REVISION 090003 / P03



B. Ground Model Cross Sections

Project Id: 100114293
Project Title: HEA The Christie CT Redevelopment
Location: Manchester
Client: IHP

Title: North-South Cross-Section of Christie Building Footprint
Vertical Scale: 1:106
Horizontal Scale: 1:590
Engineer: Mott MacDonald



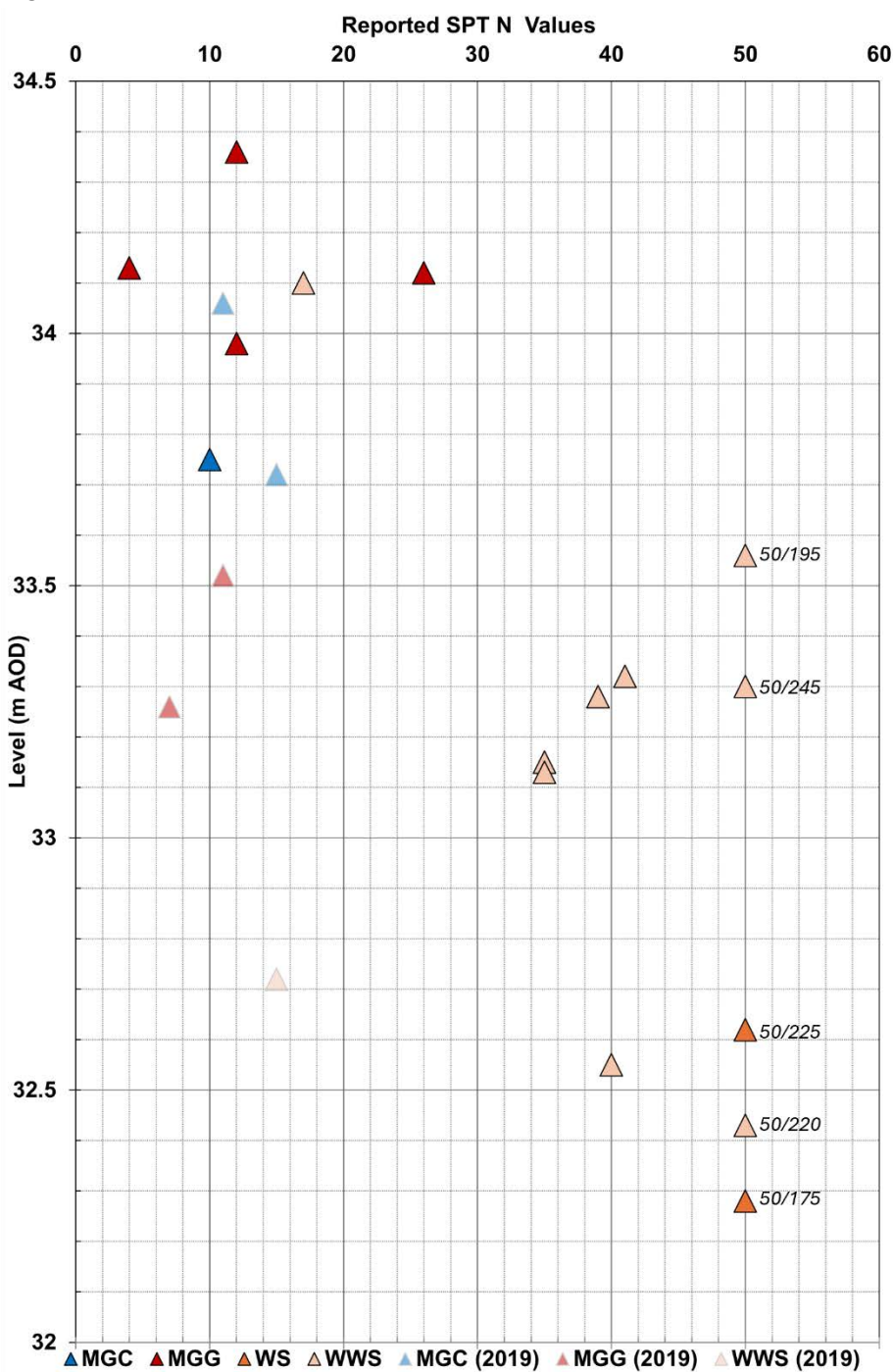
Legend Key

- MADE GROUND
- CONCRETE
- SAND
- SANDSTONE
- Clayey gravelly SAND
- CLAY

Chainage (m)	0.00	8.39	16.32	34.78	49.78	72.36	92.80	94.58	98.53	103.12	115.57	120.99	157.98	164.20
Elevation (mAOD)		35.15	35.00	35.32	35.30	35.56	35.28	35.26	35.14	35.33	35.19	35.26	34.92	
Offset (m)		3.69	4.86	8.51	13.53	5.53	10.43	10.99	19.39	7.18	18.09	13.45	0.62	

C. Geotechnical Plots

Figure C.1: SPTs with Elevation



Note: This plot includes the historical information from the 2019 ground investigation works for the Paterson Building redevelopments, adjacent to the Christie Building.

Figure C.2: Particle Size Distribution – Made Ground

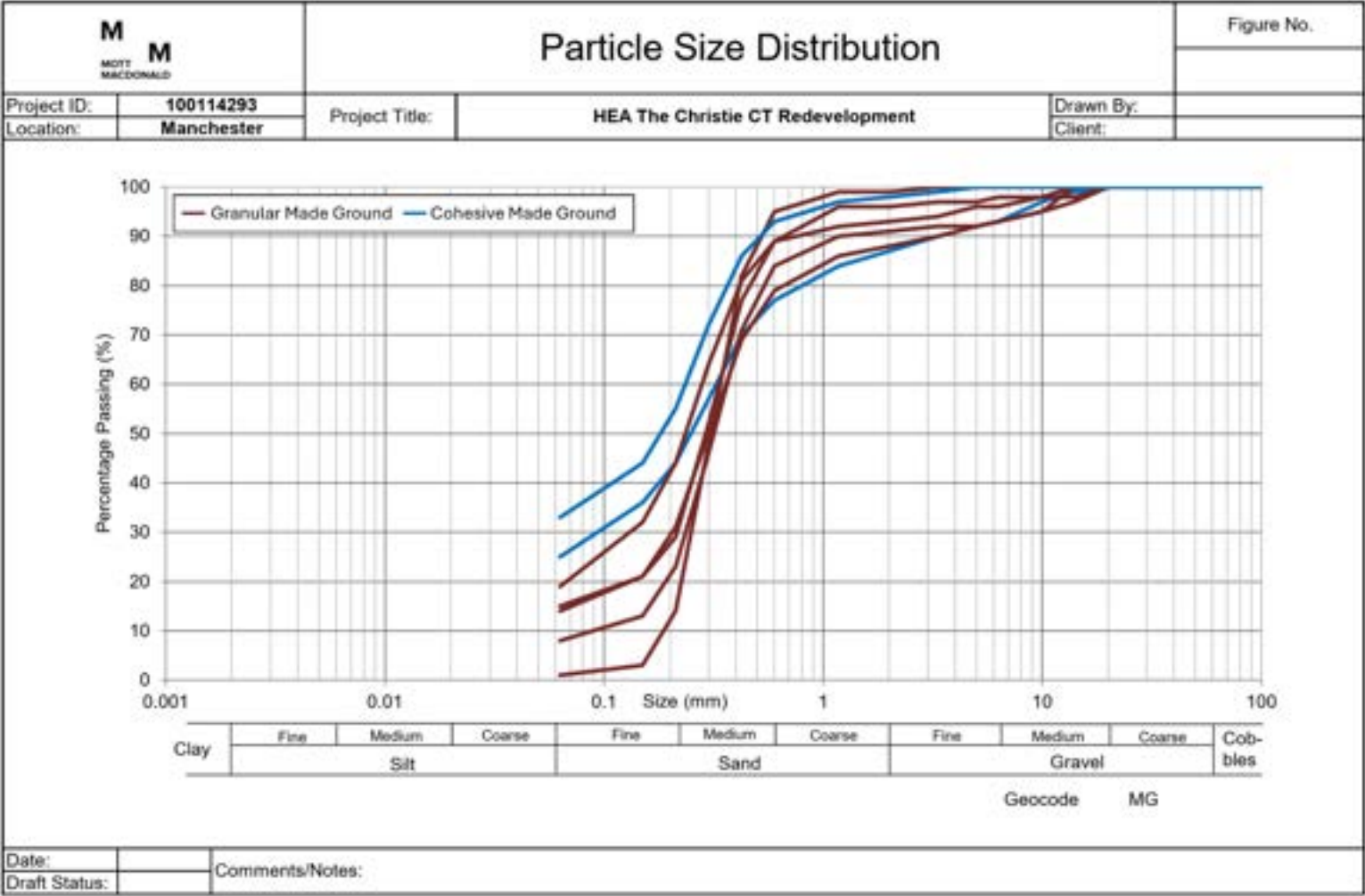


Figure C.3: Particle Size Distribution – Weathered Wilmslow Sandstone

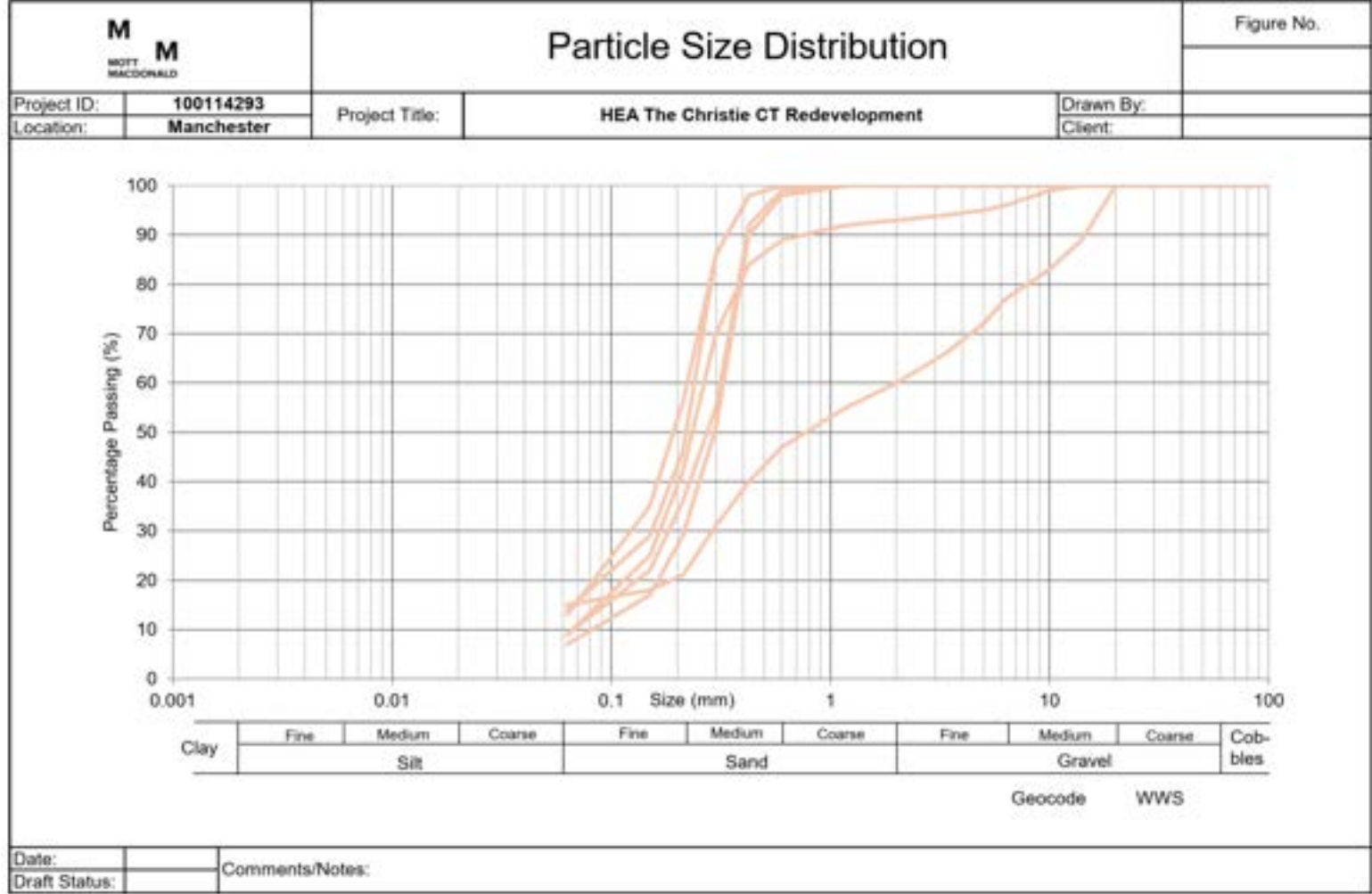


Figure C.4: Moisture Content with Elevation

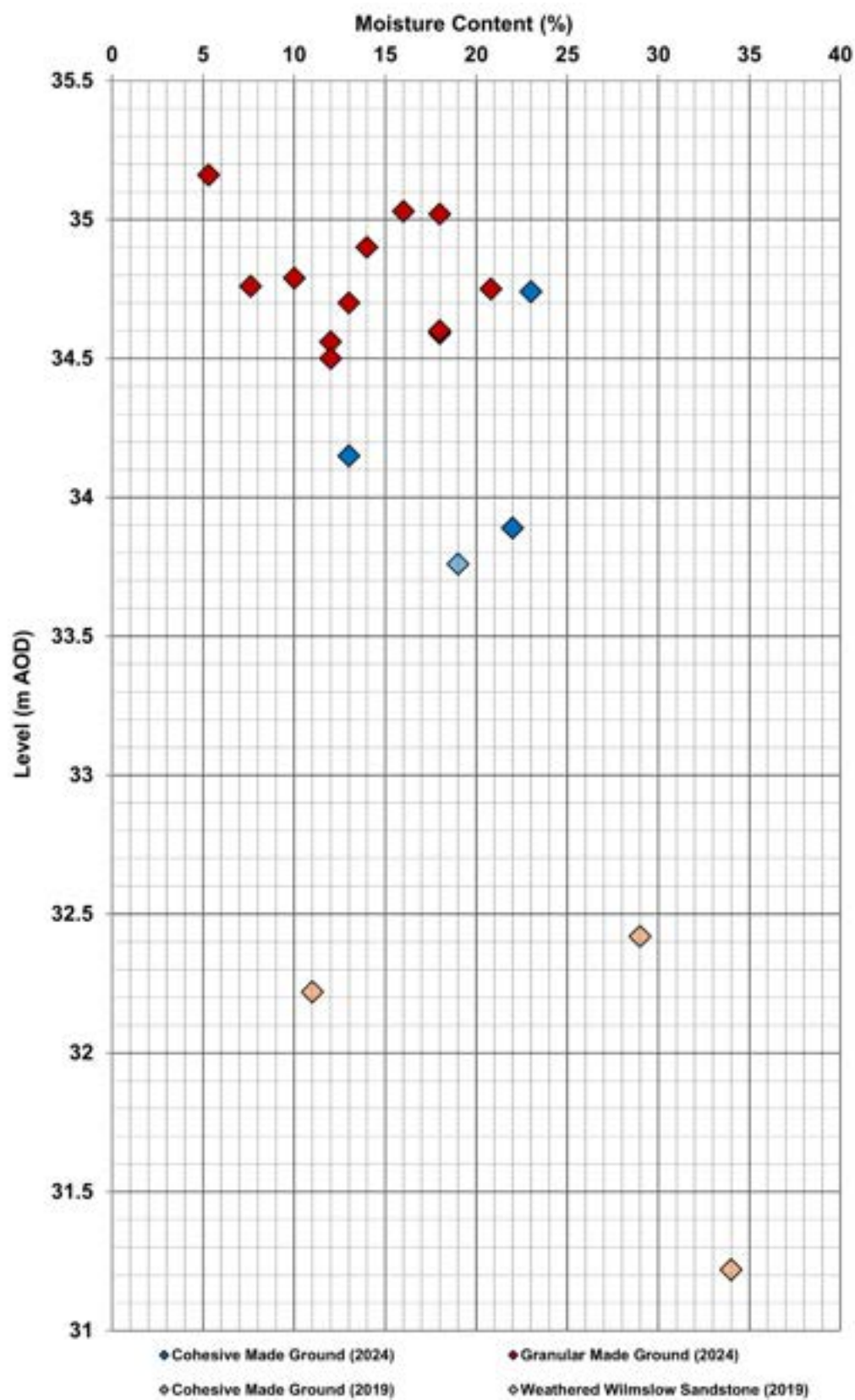


Figure C.5: Core Recovery Parameters with Depth

