ARUP

Unite Students and Manchester Metropolitan University

Cambridge Hall, Manchester

Ground Investigation Report

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Executive Summary

Ove Arup and Partners Ltd (Arup) has been commissioned by Unite Students and Manchester Metropolitan University to prepare a Ground Investigation Report (GIR) for the proposed redevelopment of the existing Manchester Metropolitan University (MMU) Cambridge Halls of Residence site situated on Cavendish Street to the south of Manchester City Centre. The proposed redevelopment involves the demolition of the existing buildings and the construction of a new student accommodation building within the same overall site boundary.

Arup issued a desk study in August 2024, summarising the site history and describing buildings formerly on site including terraced residential buildings and a warehouse. The site is currently occupied by the Cambridge Hall student accommodation, which is a generally 4 to 5 storey development constructed by the late 1990s, with associated courtyard, car parking and landscaped areas.

A ground investigation comprising cable percussion boreholes, rotary coring and infiltration testing pits has been completed. Generally, ground conditions consist of made ground up to 5.2m thick, comprising both granular and cohesive materials. Beneath the made ground, glacial till is present across the site, with glaciofluvial sands and gravel found within the glacial till at boreholes BH01, BH02 and SA01. Sandstone bedrock was encountered between 6.2 and 10.4 mbgl (metres below ground level) with a highly weathered zone within the top 1.0 to 3.2m.

The implementation of bored cast-in-situ or continuous flight auger (CFA) piles is deemed the most suitable method for supporting the proposed buildings and mitigating the risks associated with ground movement, noise, and vibration that may affect adjacent structures. Considering the ground conditions and expected loading, it is anticipated that piles will require a rock socket of around 4m, i.e. installed to depths typically ranging from 12 to 14 mbgl.

Information on the foundations to the existing buildings is currently unknown and one of the significant ground risks is the potential for physical clashes between the existing and proposed foundations.

Buried concrete at the development site should be designed in accordance with DS-1 and AC-1[d].

The geoenvironmental scope of the ground investigation was based on the initial conceptual site model. No visibly contaminated or odorous material was encountered during the ground investigation. Generic quantitative risk assessment and updated conceptual site model for human health, controlled waters and ground gas concluded low or very low risks to identified receptors.

Employing good practice site management procedures will adequately address risks during construction. During ground works if any material containing visible and olfactory evidence of contamination (including suspected asbestos containing material) is encountered a competent geoenvironmental specialist should be consulted to define measures required.

No contamination has been identified by the ground investigation, and contamination is not suspected, that requires specific remediation interventions to be implemented for the proposed development and therefore a remediation strategy is not required. Similarly, no source of contamination has been identified that is potentially a risk to the Principal Aquifer as a result of pathways that may be created by piling and therefore a foundation works risk assessment is not required.

1. Introduction

1.1 Context

Ove Arup and Partners Ltd (Arup) has been commissioned by Unite Students and Manchester Metropolitan University to prepare a ground investigation report to support the detailed design for the proposed Cambridge Hall redevelopment in Manchester (hereafter referred to as the 'proposed development'). The proposed development will comprise the demolition of the existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space (Sui Generis). Ground floor usage includes commercial and community space (Flexible Use Classes E, F1 or F2). The development also includes hard and soft landscaping and associated highway works.

1.2 Objectives of report

The purpose of this report is to:

- Summarise the findings of the intrusive ground investigation and evaluate the potential influence of the ground conditions on the future development.
- Provide an assessment of the geoenvironmental risks and identify appropriate mitigation measures.
- In conjunction with the previously completed desk study report, discharge the relevant land contamination pre-commencement planning conditions.

The report includes an assessment of the ground related risks which should be considered within subsequent design and construction phases.

1.3 Scope of work

An outline of the Arup's scope of work is as follows:

- Design and procure the intrusive ground investigation (GI) works;
- Manage the intrusive works including periodic site visits, test scheduling and reviewing the contractor's factual report;
- Interpret the findings of the factual report and present in an interpretive report identifying key ground related risks and constraints to the proposed development.

1.4 Sources of information

The following sources of data and information has been reviewed as part of this report:

- Arup Geotechnical and Geo-environmental Desk Study (August 2024) [1];
- Igne Detailed Unexploded Ordnance Risk Assessment Report (November 2024) [2];
- CC Geotechnical Ltd Ground Investigation at Cambridge Hall Manchester Draft Factual Report (February 2025)[3];
- Arup observations from site visits conducted during the ground investigation.

Details of the sources used are indicated in subsequent sections and are provided in the references section. Supporting information has been included in the appendices where appropriate.

1.5 Use of report and limitations

This report was prepared by Arup on behalf of the Unite Students and Manchester Metropolitan University (the client). It takes into account our client's particular instructions and requirements. This report was not

intended for, and should not be relied on by, any third party and no responsibility is undertaken to any third party in relation to it.

All reasonable skill, care and diligence have been exercised within the timescale available and in accordance with the technical requirements of the brief.

Notwithstanding the efforts made by the professional team in preparing the report, it is possible that other ground contamination or ground conditions as yet undetected, may exist and consequently reliance on this report must be limited accordingly.

2. Summary of previous desk study

2.1 Site location and description

The site is situated about 1km south of Manchester City Centre and approximately 100m south of the A57(M) Mancunian Way. The site is bounded to the north by Manchester Metropolitan University Faculty of Business and Law, to the west by the A5067 Road and Higher Cambridge Street, to the east by Lower and Higher Chatham Street and to the south by Boundary Street West.

The site is rectangular in shape covering an estimated 0.82ha and is centred on National Grid Reference SJ 84157 96972. The site is relatively flat and ranges between 36mOD to 37mOD.

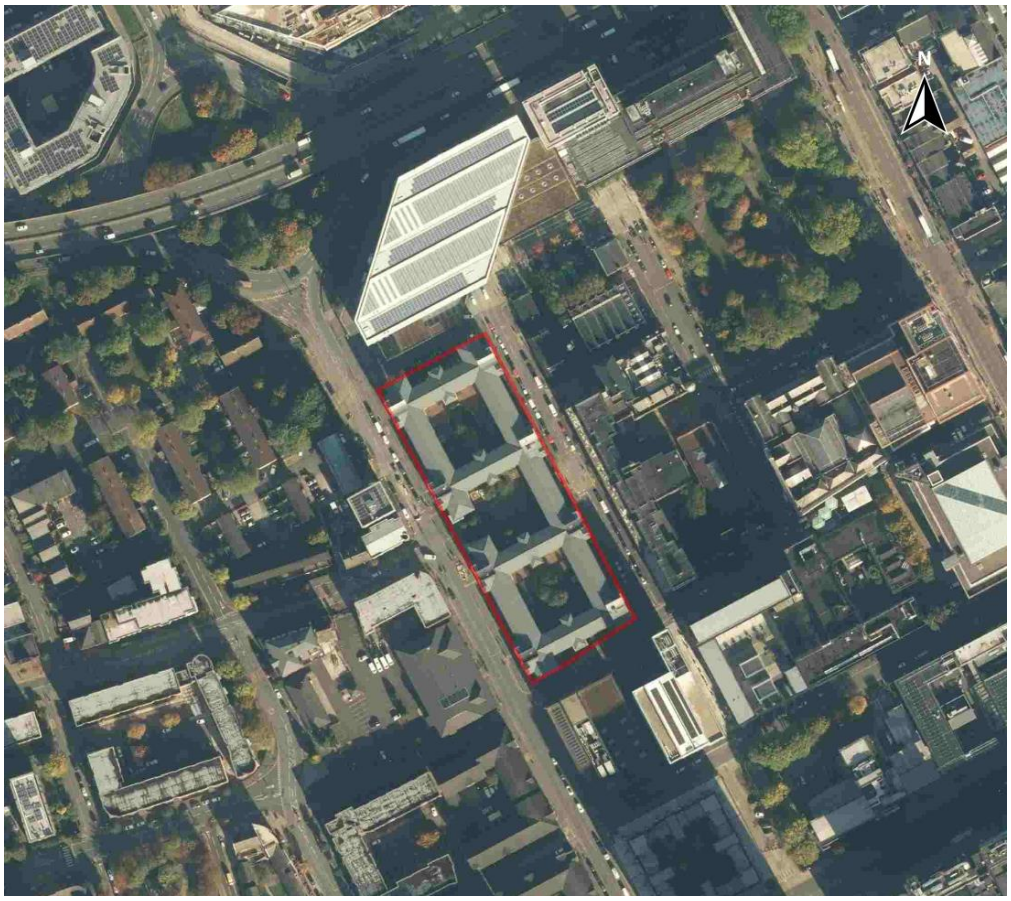


Figure 1 Site location

The site houses a 4 to 5 storey student accommodation building with three distinct courtyard areas and pedestrianised Cavendish Street runs through the centre of the site from west to east.

2.2 Proposed development

The proposed development comprises demolition of the existing halls of residence and erection of two buildings of 30 and 24 storeys above ground, plus basement and rooftop plant levels, comprising purpose-built student accommodation with internal and external rooftop communal amenity space. Ground floor usage includes commercial and community space (Flexible Use Classes E, F1 or F2). The development also includes hard and soft landscaping and associated highway works. Figure 2 identifies a central courtyard with no soft landscaping.

Considering the proposed development comprises buildings and hardstanding across the entire site footprint with no significant changes in levels, reuse of excavated materials is not anticipated.

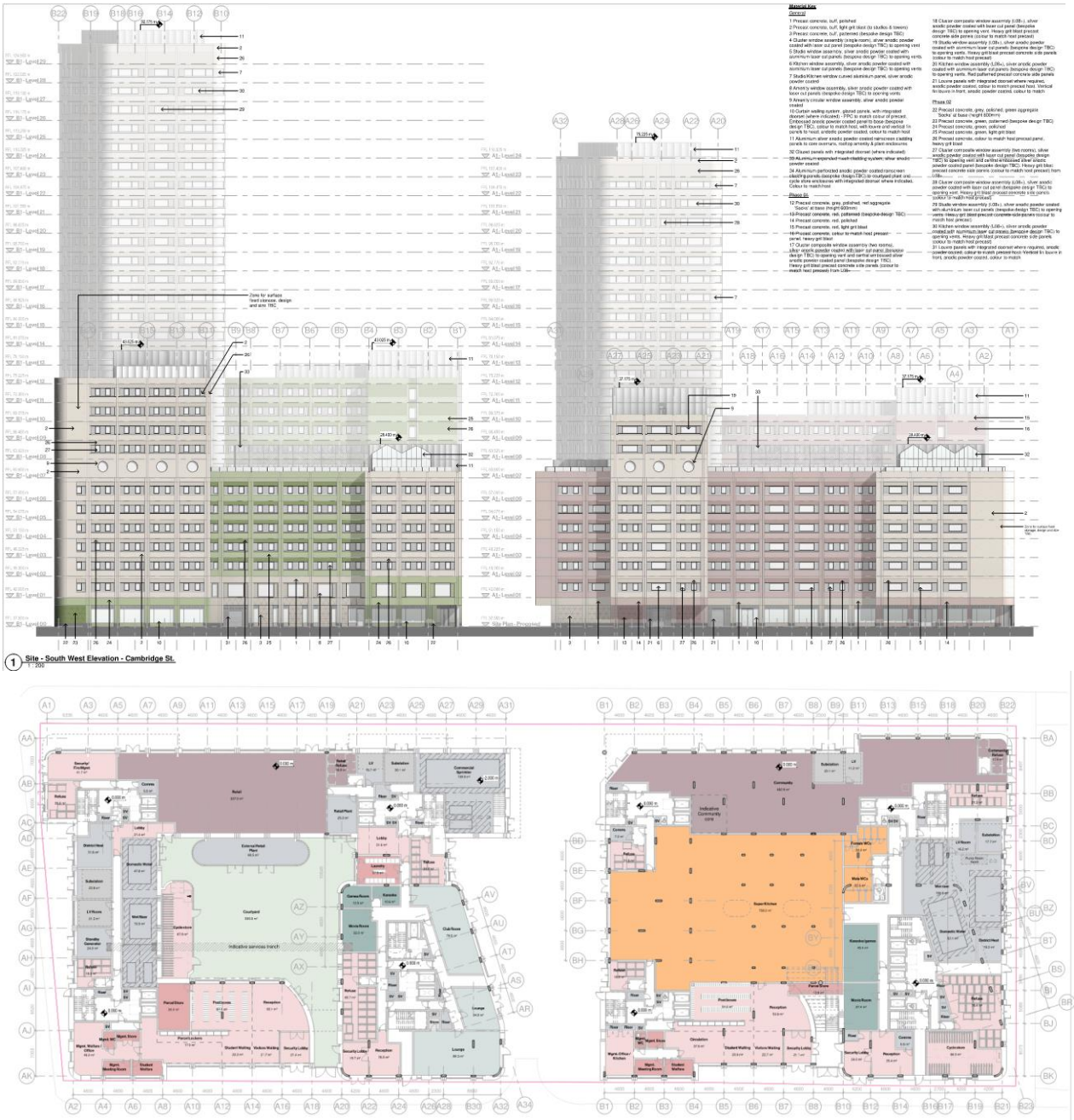


Figure 2 The proposed development as of RIBA Work Stage 2

2.3 Historical site use

A review of the site's historical development is presented in the Arup Desk Study report [1].

Previous development on the site includes terraced housing shown on the earliest historical map records (1848), timber yards, and a warehouse. A tramway operated through the site from the 1880s until it was dismantled in the 1940s. The warehouse and residential properties were demolished by the 1960s. The site was undeveloped in the 1980s, understood to be university playing fields. The most recent development, student accommodation, was constructed by the late 1990s and remains on site today.

2.4 Geology

Published geological mapping indicates superficial deposits are thin and patchy glacial sand and gravels over boulder clay (Glacial Till). Bedrock consists of sandstone of the Chester Formation, part of the Sherwood Sandstone Group.

Several desk studies and ground investigations are available at neighbouring sites including MMU Benzie Building and Chatham Tower, Geoffrey Manton Building and the MMU Arts and Humanities [1].

An historical ground investigation was conducted on the development site in 1993/1994[1]. Made ground was encountered to a depth of between 1m and 4m. This was described as demolition rubble mixed with reworked glacial material. This was underlain by glacial sands and gravels which in turn overlie glacial till. The glacial sands and gravels comprise medium dense granular deposits and the base of the sands and gravels is between 3m and 4m bgl. The till comprises stiff brown silty clay. Sandstone bedrock was encountered at depths of between 6.8m and 9.9m across the site.

2.5 Unexploded ordnance (UXO)

A detailed UXO risk assessment has been conducted by Igne [2]. This concluded an overall Medium Risk level for most of the site and an overall Low Risk level for a northeastern section as presented in Figure 3. This is a reduction from the High Risk level concluded by the preliminary UXO risk assessment [1].



Figure 3 UXO risk map of the site

2.6 Initial contamination conceptual site model

The desk study report [1] presented a contamination source-pathway-receptor conceptual site model summarising potential contamination risks (Table 1).

Table 1: Summary of initial conceptual site model

Sources		Pathways		Receptors	Comments
Made ground	→	Dermal contact with soils	→	Site workers during construction Maintenance workers Future site users Users of future site (only in soft landscaping areas),	Ground investigation is recommended to assess whether contaminated soils are present. Appropriate site management protocols to be adopted during construction and maintenance works. A clean cover system may be required in soft landscaping areas.
		Ingestion of soil, fibres or dust	→		
		Inhalation of soil vapours and ground gases	→	Site workers during construction and site neighbours	

Sources		Pathways		Receptors	Comments
		Inhalation of soil and soil dust	→	Maintenance workers Future site users Users of future site (only in soft landscaping areas),	
Leachable contaminants in the made ground	→	Vertical migration of dissolved phase contamination	→	Groundwater within bedrock geology (Principal Aquifer) and Superficial Deposits (Secondary A Aquifer)	Significant contamination is not anticipated on site. Sampling and analysis to be undertaken during ground investigation.
Ground gases	→	Accumulation of gases in confined spaces producing asphyxiation and explosion risk	→	Users of future site buildings	No potential source of hazardous ground gas identified. Ground gas monitoring will only be considered if significant volume of degradable material identified during ground investigation.
Soils or groundwater aggressive to building materials	→	Contact with aggressive soils and groundwater	→	Buried building materials	Ground investigation is recommended to assess whether contaminated soils are present. Selection of appropriate materials for buried services.

2.7 Geotechnical considerations

The Arup desk study [1] identifies several engineering considerations that necessitate a ground investigation. These include the risk of encountering obstructions, the potential presence of shallow groundwater, and the need to assess ground conditions to inform foundation design.

A main sewer runs below Cavendish Street, extending east-west through the centre of the site. This will be a notable constraint to the proposed development, and any new piles should be positioned outside the easement zone associated with the sewer.

3. Ground investigation

3.1 Objectives and rationale

Following the desk study work, a programme of intrusive investigation was developed to:

- Characterise the thickness and nature of made ground;
- Investigate the nature, extent and depths of the buried obstructions and/or voids;
- Characterise the nature of natural superficial materials and bedrock to inform foundation design;
- Assess soil contamination to inform contamination risk assessment and soil re-use or disposal routes;
- Assess groundwater levels and, if soil contamination is encountered, investigate groundwater contamination via sampling from standpipes.

During the desk study, it was unclear if drilling equipment could access the north and south courtyards through the 2m x 2m openings from the central courtyard. Later talks with contractors clarified that it would be possible.

3.2 Scope and limitations

A ground investigation (GI) scope was designed and specified by Arup and implemented by CC Ground Investigations Ltd (CCG). Arup acted as the Investigation Supervisor.

The scope of the GI included seven boreholes, three infiltration test pits and three utility trench pits as required by the utility consultant. The utility trench pits have not been conducted and will be reported separately.

The intrusive works were limited in access to the central courtyard areas due to presence of existing buildings fronting on to footways. No GI work was possible below the existing building footprints and further work will not be possible until after demolition of these buildings. The ‘as built’ ground investigation locations drawing is presented in Figure 4.

The GI positions were coordinated against known site utilities, in particular the main sewer running below Cavendish Street, extending east-west through the centre of the site.

A magnetometer survey was conducted at all exploratory hole locations in accordance with recommendations from the UXO risk assessment[2].

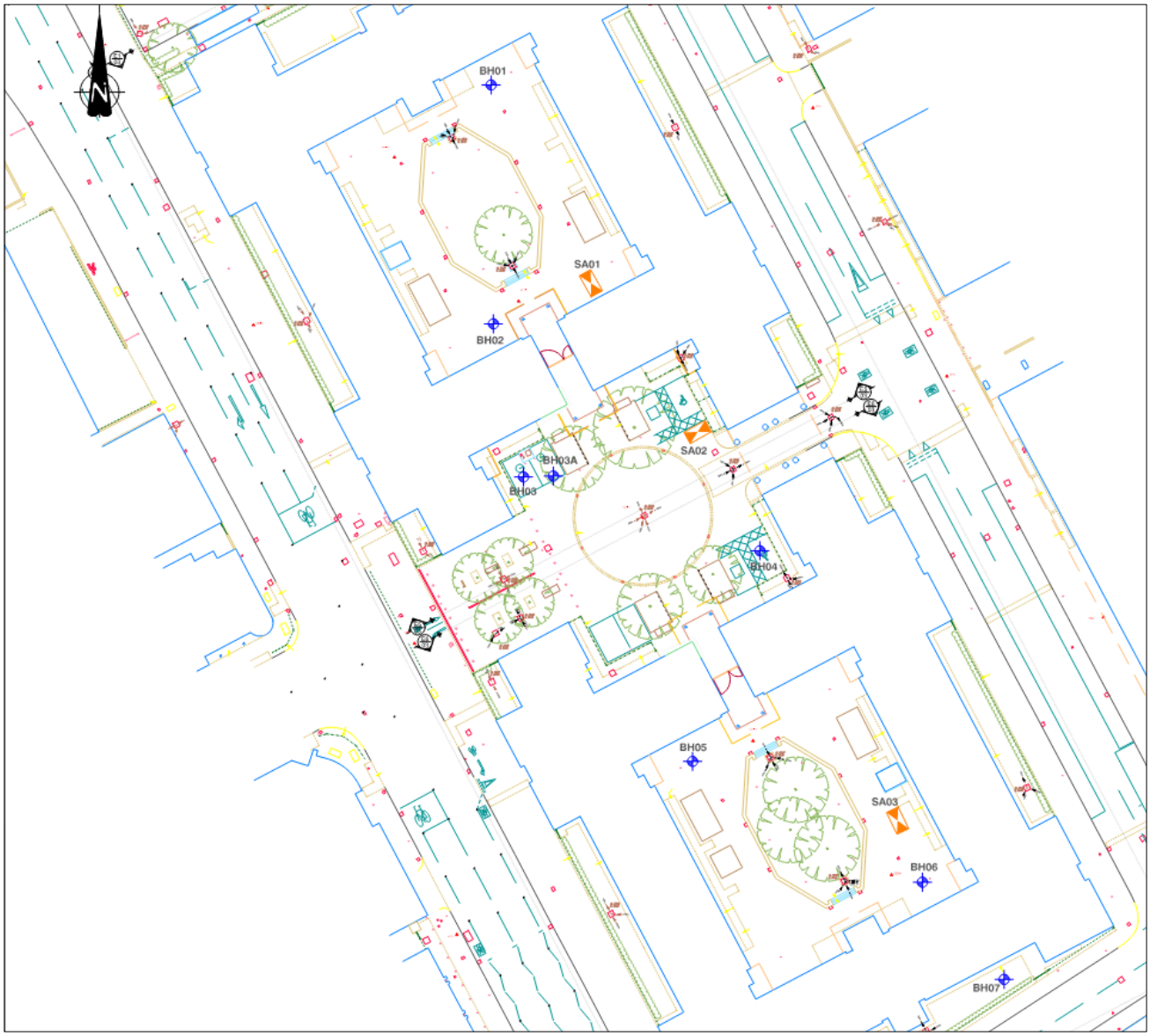


Figure 4 'As built' ground investigation locations[3]

3.3 Fieldwork

The fieldwork was carried out between 16th December 2024 and 6th January 2025.

The findings of the investigations are reported in a factual report produced by CCG [3]. A summary of the fieldwork undertaken is presented in Table 2.

Table 2: Summary of the fieldwork undertaken at the site

Exploratory Hole ID	Description	Installations	Rationale	No.	Min depth (mbgl)	Max depth (mbgl)
BH01 to BH07	Cable percussive boreholes with rotary follow-on.	Gas and groundwater installations provided at BH01, BH03A (dual installation), BH05 and BH07	To provide geotechnical and geoenvironmental data.	7	16.0	16.5
SA01 to SA03	Trial pit (used for infiltration testing)	N/A	Infiltration testing for drainage design.	3	2.0	2.1

3.4 Monitoring

Following completion of the fieldwork, six rounds of gas and groundwater level monitoring over a duration of two months were specified to be undertaken to establish the gas risk and groundwater levels at the site. Six rounds of gas monitoring have been completed to date and this report is based on this data. Monitoring records are presented in the factual report and described in subsequent sections of this report.

Groundwater sampling was conducted from monitoring installations on two occasions 9th January 2025 and 6th February 2025.

3.5 Laboratory testing

A programme of laboratory testing was undertaken to establish the geotechnical and geoenvironmental properties of the soils encountered during the GI. The results of this testing are presented in the factual report and described in subsequent sections of this report. The results of additional asbestos testing are awaited. This report should be updated when the asbestos testing is complete.

4. Ground summary and properties

4.1 Stratigraphy

The stratigraphy of the site is summarised in Table 3. The geological section across the site is presented in Appendix A; this should be read in conjunction with this table.

Plots of the main in-situ and geotechnical test results are presented in Appendix B of this report.

Table 3 Summary of the stratigraphy encountered

Stratum	Top of stratum (mOD)	Thickness (m) where proven	Description
Made ground	36.68 to 36.58	0.9 to 5.2	Grey slightly silty sandy GRAVEL. Low cobble content. Occasional pockets of silty sand. Gravel is fine to coarse angular to sub-angular limestone and sandstone. Black geotextile fabric at base (MADE GROUND) Greyish brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to coarse angular to subangular of sandstone and brick with occasional inclusions of coal (MADE GROUND)
Glacial Sands and Gravels (Encountered only where thin made ground is present)	35.46 to 35.12	1.8 to 2.0	Medium dense brown slightly silty gravelly fine to medium grained SAND with occasional pockets of sand. Gravel is fine to coarse sub-angular to sub-rounded sandstone
Glacial Till	35.76 to 31.35	1.8 to 7.3	Stiff brown slightly sandy slightly gravelly silty CLAY. Gravel is fine to medium sub-angular to sub-rounded sandstone and mudstone
Highly Weathered Sandstone	30.39 to 26.21	0.25 to 3.2	Extremely weak to very weak reddish brown highly weathered SANDSTONE. Recovered locally as slightly silty gravelly sand (Stratum was typically able to be penetrated using cable percussion boring)
Sandstone	28.42 to 24.8	Unproven	Extremely weak to weak reddish brown fine to medium grained SANDSTONE. Moderately weathered (slightly weathered in BH03A). Recovered locally as sandy gravel. Discontinuities are very close to medium spaced, horizontal, clean, rough and tight to wide

4.2 Made ground

4.2.1 Extent and description

Made ground has been encountered with thickness between 0.9m and 5.2m. The deeper made ground was encountered in the central and southern sections of the site (BH03 to BH07). Generally, made ground (granular) described as slightly silty sandy gravel is first encountered followed by made ground (cohesive) described as slightly gravelly silty clay.

Fragments of brick, concrete, sandstone, clinker, plastic, coal and glass were reported in the exploratory holes. Other than these anthropogenic materials, there was no visual or olfactory evidence of contamination.

4.2.2 Geotechnical in-situ and laboratory testing

Particle Size Distribution

A total of twenty-one PSD tests were undertaken on samples described as made ground, see Appendix B1 for made ground PSD soil curves.

Eight tests were conducted on samples of made ground (granular) and these tests indicate that the material is sandy gravel. Thirteen tests were conducted on samples of made ground (cohesive) and indicate that this material is a slightly sandy silty clay with variable gravel content (up to 30% gravel).

Natural Moisture Content and Atterberg Limits
Fifteen natural moisture content tests were undertaken on samples of the made ground (cohesive). These tests returned natural moisture content (w) of between 16 and 26%. Fourteen sets of Atterberg Limit tests were undertaken on samples of made ground (cohesive), these tests recorded a plastic limit between 13 and 21% and a liquid limit of between 24 and 44%.

This testing generally characterises the made ground (cohesive) as a low to intermediate plasticity clay on the Atterberg Chart (Appendix B4).

Standard Penetration Testing
Fifteen SPT tests were carried out on material described as made ground(cohesive). These tests returned corrected $(N_1)_{60}$ values of between 6 and 22 with an average value of 14, suggesting a 'low strength' to 'high strength' material in accordance with BS 5930[5].

Compaction Testing
Four samples of made ground (granular) have been tested for moisture and dry density relationship. Optimum moisture contents of 7.6 to 14% were calculated for these samples to achieve maximum dry density of 1.93 to 2.1Mg/m^3.

Four samples of made ground (cohesive) have been tested for moisture and dry density relationship. Optimum moisture contents of 14 to 15% were calculated for these samples to achieve maximum dry density of 1.84 to 1.86Mg/m^3. The natural moisture content for made ground (cohesive) is generally wet of the optimum.

Triaxial Testing
Three samples of made ground (cohesive) collected in BH04 (2m bgl), BH04(4m bgl) and BH03A (4m bgl) have undergone triaxial testing. Undrained shear strength (c_u) values of 20kPa, 30kPa and 250kPa have been returned respectively.

Hand Shear Vane Testing
One hand shear vane test was recorded as having been undertaken in material interpreted as made ground (cohesive). This recorded an undrained shear strength (c_u) of 90kPa.

California Bearing Ratio
The Dynamic Cone Penetrometer (DCP) method was used to obtain equivalent CBRs in the borehole starter pits and soakaway locations. Refer to Appendix H of the factual report[3] for the results.

4.3 Glacial sands and gravels

4.3.1 Extent and description

Glacial sands and gravels were only encountered in exploratory holes with thin made ground (BH01, BH02 and SA01).

Where encountered, the thickness of this layer ranged between 1.8m to 2.0m and is typically described as medium dense fine to medium grained sand and medium dense slightly silty very sandy gravel.

4.3.2 Geotechnical in-situ and laboratory testing

Particle Size Distribution
Two PSD tests were undertaken on samples described as glacial sands and gravels, see Appendix B2 for PSD soil curves. Generally, testing indicates this superficial material is a sandy gravel and gravelly sand.

Standard Penetration Testing
Two SPT tests were carried out on material described as glacial sands and gravels. These tests returned corrected $(N_1)_{60}$ values of 17 and 26 indicating a 'medium dense' in-situ density.

4.4 Glacial till

4.4.1 Extent and description

Glacial till was encountered in all the boreholes. The thickness of this layer ranges between 1.8m to 7.3m.

This stratum is typically described as a stiff brown slightly sandy slightly gravelly silty clay. The gravel inclusions are fine to medium sub-angular to sub-rounded sandstone and mudstone.

4.4.2 Geotechnical in-situ and laboratory testing

Particle Size Distribution

Nine PSD tests were undertaken on samples described as glacial till, see Appendix B2 for PSD soil curves. Generally, testing indicates the glacial till material is a slightly sandy silty clay (up to 40% sand and gravel).

Natural Moisture Content and Atterberg Limits

Eighteen natural moisture content tests were undertaken on samples of the made ground. These tests returned natural moisture content (w) of between 13 and 34%. Eighteen sets of Atterberg Limit tests were undertaken on samples of glacial till, these tests recorded a plastic limit between 15 and 25% and a liquid limit of between 28 and 54%.

This testing generally characterises the glacial till as a low to intermediate plasticity clay on the Atterberg Chart (Appendix B4). Using the correlation between plasticity index and the constant volume angle of shearing resistance (φ'_{cv}) presented within BS 8002: 2015[4], a φ'_{cv} of around 26^{o} is derived for a remoulded material.

Standard Penetration Testing

Eighteen SPT tests were carried out on material described as glacial till. These tests returned corrected $(N_1)_{60}$ values of between 15 and 40, generally increasing with depth.

Using correlations published by Stroud (1988) [6], an undrained shear strength (c_u) can be estimated for cohesive soils from SPT N values. The undrained shear strength can be estimated by $c_u=f_1 \times N_{60}$. For a typical plasticity index of 15%, a conservative multiplication factor (f_1) of 5 is used. Based on this correlation, undrained shear strength(c_u) ranges from 75kPa to 200kPa. This corresponds with the generally stiff to very stiff description on the logs.

On the basis of log descriptions and SPT results, the bulk density of the glacial till material has been estimated as between 19kN/m^3 and 22kN/m^3.

Triaxial Testing

Eight samples of glacial till have undergone triaxial testing. Undrained shear strength (c_u) values ranged between 47 kPa and 195 kPa. Glacial till encountered on site does not show a clear relationship of increasing undrained shear strength with depth when assessing the results of the unconsolidated undrained triaxial tests. However, the results are broadly consistent with the overall description.

Hand Shear Vane Testing

Hand shear vane testing was undertaken on 20 No. samples of glacial till. These tests returned correlated peak undrained shear strength values of between 80 and 110kPa.

Oedometer Testing

Three U100 samples of glacial till collected from BH01(6m bgl), BH02(6m bgl) and BH04(6m bgl) have been tested for their one-dimensional consolidation properties and results are presented in the factual report.

4.5 Sandstone

4.5.1 Extent and description

Sandstone bedrock was encountered in all boreholes between 6.2 and 10.4m bgl. The top 1.0 to 3.2m of the sandstone is described as extremely weak to very weak reddish brown highly weathered sandstone. The material was recovered without the use of core drilling as silty gravelly sand.

Sandstone was cored below the weathered zone. The sandstone is intact and typically described as very weak to weak reddish brown fine to medium grained, moderately to slightly weathered sandstone. Discontinuities are very close to medium spaced, horizontal, clean, rough and partly open to wide.

Total Core Recovery (TCR) was generally high with minimal loss (see Appendix B9). The Solid Core Recovery (SCR) values varied between boreholes, generally ranging from 0% to 98%. However, it is noted that the majority of recorded values were closer to the upper bound (see Appendix B10).

Rock Quality Designation (RQD) varies significantly between boreholes (See Appendix B11).

4.5.2 Geotechnical in-situ and laboratory testing

Particle Size Distribution

Four PSD tests were undertaken on samples described as weathered sandstone, see Appendix B3 for PSD soil curves. Generally, testing indicates the material is a slightly silty sand.

Standard Penetration Testing

Fifty-three SPT tests were carried out on material described as the sandstone bedrock. These tests returned corrected $(N_1)_{60}$ values of between 36 and 1850, showing a general increase with depth. See Appendix B6 for SPT $(N_1)_{60}$ values plotted against depth.

Uniaxial Compressive Strength and Point Load Testing

Eleven Uniaxial Compressive Strength (UCS) tests were undertaken on the sandstone bedrock, these gave values ranging between 4.8 to 15.6 MPa. This indicates a UCS ranging from Very Weak (1-5 MPa) to Moderately Weak (12.5 – 25 MPa). The UCS results show an increase in strength with depth (see Appendix B13).

Twenty-two Point Load Index (PLI) tests undertaken on the sandstone bedrock ranged from 0.2 to 0.6 MPa with an average of 0. 3MPa.The point load index test can be correlated with uniaxial strength using a factored point load index of 22 based on ISRM [7]. This provides an equivalent uniaxial compressive strength ranging from 4.4 to 13.2MPa (Very weak to Moderately Weak)

4.6 Groundwater

4.6.1 Groundwater encountered during fieldworks

Water seepage was recorded in the drilling of BH01 (3.1m bgl), BH02 (3.1m bgl), BH05 (3.0m bgl), BH05 (3.0m bgl) and BH06 (3.0m bgl).

4.6.2 Groundwater level monitoring

Groundwater monitoring equipment was installed in 4 No. exploratory positions. These comprised a standpipe within a gravel surround and bentonite seal in each case. A summary of the groundwater monitoring installations is provided in Table 4 with a summary of the data collected. A total of six rounds of groundwater monitoring has been undertaken on site (between 9th January to 20th March 2025).

Table 4 Summary of groundwater monitoring results

Location	Complete rounds	Response zone (mbgl)	Response zone stratum	Groundwater depth range (mbgl)
BH01 (50mm)	6	1-4.7	Glacial sands and gravels	3.01 to 4.67

BH03A (19mm)	6	10-15	Sandstone bedrock	10.12 to 10.49
BH03A (50mm)	6	2-5	Made ground	2.98 to 4.48
BH05 (50mm)	6	1-5	Made ground	2.62 to 4.57
BH07 (50mm)	6	7-13	Sandstone bedrock	10.13 to 10.34

4.7 Field evidence of contamination

Fragments of brick, concrete, sandstone, clinker, plastic, coal and glass were reported in the exploratory holes. Other than these anthropogenic materials, no visual or olfactory evidence of contamination was observed during the fieldwork. Where non-zero PID readings were recorded, they were very low up to a maximum of 4.2 ppm.

4.8 Infiltration testing

To determine the feasibility of incorporating infiltration into the surface water drainage design, three BRE365 soil infiltration test pits (SA01 to SA03) were excavated to a depth 2m bgl in made ground and superficial deposits.

Permeability values ranging from 1.01E-06 to 5.96E-06 m/s was obtained from testing; these results can be used to inform the drainage design.

4.9 Summary of derived geotechnical parameters

Where possible, geotechnical parameters have been derived from in-situ tests undertaken during the field work or laboratory tests from appropriate samples. These parameters are summarised in Table 5.

Additional material parameters will be determined and allocated during the subsequent design phase. Specifically, given the heterogeneity of the made ground, conservative values should be used with sensitivity analyses for plausible lower or higher values based on the specific design scenario.

Table 5 Summary of derived parameters from ground investigation

Strata	Parameter	Derived Value (Range of data)	Units	Comments
Made ground (cohesive)	Undrained shear strength (c_u)	<70 (20 to 250)	kPa	Highly variable within made ground
	Optimum moisture content	14 to 15	%	From laboratory testing on four samples
	Natural moisture content	16 to 26	%	From laboratory testing on fifteen samples
Glacial till	Undrained shear strength (c_u)	75 (50 to 200)	kPa	Inferred using SPT N, triaxial testing and hand shear vane testing. Expected to increase with depth
	Weight Density (γb)	20 (19 to 22)	kN/m3	Derived using BS 8004:2015[8]
Sandstone	UCS	4 to16	MPa	From laboratory testing on 11 no. samples for uniaxial compressive testing and 22 no. samples for point load index testing

5. Geoenvironmental risk assessment

5.1 Introduction

Several potential contaminant linkages were identified within the site and are recorded in the initial Conceptual Site Model (CSM) (Table 1) arising from the Desk Study [1]. The potential contaminant linkages have been considered in the context of a conceptual source-pathway-receptor (SPR) model of the site. A preliminary evaluation of the level of risk to each receptor from the identified plausible pathways and the level of mitigation that would be required for the proposed development is provided within the Desk Study.

The ground investigation was designed to address data gaps, inform this risk assessment and enable refinement of the conceptual site model and identify appropriate mitigation.

An environmental risk assessment has been undertaken for each of the receptors for which a potential contaminant linkage has been identified. The process outlined in the Land Contamination Risk Management (LCRM) guidance [9] follows a tiered approach to assessing risk which begins with an initial screening assessment known as a generic quantitative risk assessment (GQRA). The GQRA makes use of published assessment criteria and when a soil/ groundwater concentration exceeds the screening value then further consideration is required. The GQRA is presented in the following sections.

For this assessment, the laboratory analysis results and field data collected during the ground investigation have been screened against current published or internal guideline values in order to provide an initial assessment of the potential contamination status of the planning application site. The data for soil, groundwater and ground gas has been assessed separately, as presented below.

5.2 Human health soil screening assessment

5.2.1 Methodology

To simplify the assessment of ground contamination risks, the statutory guidance suggests that generic soil quality guideline values may be used for the initial screening of soil contamination testing results. Generic assessment criteria (GAC) and site-specific assessment criteria (SSAC) can be calculated using the software version of the Contaminated Land Exposure Assessment (CLEA) model [10]. The model estimates human exposure (children and adults) to soil contaminants for those potentially living, working and/or playing on contaminated sites over long time periods (chronic exposure). The CLEA model does not consider short-term (acute) risks to humans, such as those which may arise during construction activities, or the risks posed by contaminated groundwater.

Soil guideline values (SGVs) generated using the CLEA software and accompanying toxicological reports have been issued by the Environment Agency (EA) for eleven contaminants. Arup has produced GAC using risk assessment software in accordance with the CLEA assessment framework for the four standard CLEA end uses (residential with plant uptake, residential without plant uptake, allotments, and commercial) and for soil organic matter (SOM) values of 1%, 2.5% and 6%. Land Quality Management Ltd (LQM) [11] and the AGS/EIC/CL:AIRE [12] have also produced and published GACs for the standard CLEA end uses, using the CLEA v1.04 software. Arup GACs have been benchmarked against the LQM and AGS/EIC/CL:AIRE GACs and both are similar with respect to the research carried out and the criteria developed.

5.2.2 Soil assessment criteria – residential end use

The soil results have been compared to the Arup human health GACs for a residential end use. It is not considered appropriate to use with plant uptake for these apartments where people will not be planting vegetables. Full details on the input parameters and background research can be provided upon request. The GACs have been developed using a Soil Organic Matter (SOM) value of 1%, which has been selected based on the average SOM content of the soils sampled on site, based on TOC conversion.

The results of the human health screening assessment are presented in Appendix C. A total of 42 soil samples were screened: four were sampled from natural strata and 38 were sampled from made ground. It should be noted that 18 of these 42 samples were tested for asbestos only.

5.2.3 Soil screening results

The screening identified several samples where PAH contaminants exceeded the human health GAC. A summary of these GAC exceedances is presented in Table 6 below.

Table 6 Soil samples exceeding human health GACs

Contaminant	Screening criteria (mg/kg)	No. of samples	Exceedances	
			Number	Location and concentration
Dibenzo(a,h)anthracene	0.31	11	5	BH04 – 2.4 mbgl – 0.59 mg/kg BH05 – 1.6 mbgl – 0.37 mg/kg BH06 – 2.7 mbgl – 0.33 mg/kg BH07 – 3.6 mbgl – 15 mg/kg SA03 – 0.8 mbgl – 0.38 mg/kg
Indeno(1,2,3-cd)pyrene	45	11	1	BH07 – 3.6 mbgl – 70 mg/kg
Naphthalene	2.33	11	1	BH07 – 3.6 mbgl – 27 mg/kg
Benzo(a)anthracene	10.97	11	1	BH07 – 3.6 mbgl – 140 mg/kg
Benzo(a)pyrene	3.17	11	4	BH04 – 2.4 mbgl – 6.7 mg/kg BH06 – 2.7 mbgl – 3.2 mg/kg BH07 – 3.6 mbgl – 120 mg/kg SA03 – 0.8 mbgl – 4.2 mg/kg
Benzo(b)fluoranthene	3.95	11	3	BH04 – 2.4 mbgl – 7.9 mg/kg BH07 – 3.6 mbgl – 140 mg/kg SA03 – 0.8 mbgl – 4.7 mg/kg
Chrysene	29.66	11	1	BH07 – 3.6 mbgl – 140 mg/kg

All contaminants have been reported below their respective screening criteria for a residential end use with the exception of the following PAHs: dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and chrysene. All exceedances of contaminant screening criteria occurred within samples taken from made ground.

Asbestos testing was undertaken on 18 soil samples taken from made ground. Asbestos was not detected in any of the 18 samples tested.

As part of the proposed development, public/open space is expected to be provided on the ground floor through the provision of a central paved courtyard. No areas of soft landscaping are proposed. For these reasons, no exposure pathway to future site users has been identified and risk to future site users is considered very low.

There is a potential risk to construction workers who may come into direct contact with contaminated soils, particularly during earthworks, piling, and utility excavation work. However, exposure periods are generally shorter than those experienced by long term site users and can usually be reduced to an acceptable level through adoption of adequate health and safety procedures.

5.3 Controlled waters screening assessment

5.3.1 Methodology

The initial conceptual site model identified leaching of contaminants from made ground soils as a potential risk. No significant contamination was encountered in the made ground (visual or olfactory evidence) and no leachate testing was scheduled.

The initial conceptual site model did not identify a potential contaminant linkage that required groundwater sampling (Section 2.6) unless significant contamination was encountered during the ground investigation. However groundwater samples were collected and laboratory chemical analysis completed and this data has been assessed and is discussed below.

Groundwater test results have been screened against criteria based on published freshwater Environmental Quality Standards (EQS) to identify potential contaminants of concern. Where no EQS values are available the results have been compared against EU or UK drinking water standards (DWS) or World Health Organisation standards (WHO).

5.3.2 Groundwater screening results

Groundwater samples were obtained from four monitoring installations. BH05 was installed within the made ground and BH07 was installed within the sandstone, whilst BH03A had separate installations within the made ground and sandstone. The results of the controlled waters screening assessment are presented in Appendix D. A total of 7 groundwater samples were screened, with BH03A and BH05 sampled on two dates.

The contaminants which exceed the screening criteria are summarised in Table 7.

Table 7 Groundwater exceedances of water screening criteria

Contaminant	Screening criteria (mg/l)	No. of samples	Conc. Range (mg/l)	Exceedances	
				No.	Location
Manganese	0.05 (DWS)	6	0.0026 to 18	4	BH03A (Sandstone) – 2.0 mg/l BH05 (MG) – 0.25 mg/l BH05 (MG) – 3.9 mg/l BH07 (Sandstone) – 18 mg/l
Sulphate as SO_4	250 (DWS)	4	50.1 to 311	1	BH05 (MG) – 311 mg/l
Fluoranthene	0.000006 (EQS)	2	<0.00001 to 0.0017	1	BH05 (MG) – 0.0017 mg/l
Anthracene	0.0001 (EQS)	2	<0.00001 to 0.00027	1	BH05 (MG) – 0.00027 mg/l
Benzo(a)pyrene	0.00001 (DWS)	2	<0.00001 to 0.00066	1	BH05 (MG) – 0.00066 mg/l

In general, the groundwater testing indicates low levels of contamination with the majority of contaminants recorded below the screening criteria.

The made ground groundwater samples (BH05) show exceedance of the screening criteria for PAHs (fluoranthene, anthracene and benzo(a)pyrene), sulphate and manganese. The exceedances are marginally above screening criteria and not considered to be related to a contamination source within the site.

The sandstone groundwater samples (BH07 and BH03A-19mm) shows no exceedances except for manganese. Manganese is naturally elevated in the Chester Formation and the recorded concentration is not related to a contamination source within the site.

5.4 Ground gas assessment

The initial conceptual site model concluded ground gas monitoring was only required if a significant volume of degradable material identified during ground investigation. The ground investigation did not identify such material. However, ground gas monitoring was undertaken upon completion of the recent ground investigation and a generic quantitative risk assessment has been undertaken.

5.4.1 Methodology

The risk posed to buildings by hazardous ground gases has been assessed in accordance with CIRIA C665 [13], British Standard guidance [14], and NHBC NF94 [15] follows the source-pathway-receptor model. Given that the data has been obtained through a programme of spot-monitoring, the assessment of GSVs has been undertaken by identifying the maximum value recorded for each parameter at any stage during the monitoring programme. Given that the highest values of methane, carbon dioxide and flow may not have been recorded during the same monitoring visit, this approach is considered to be conservative.

5.4.2 Gas monitoring results

A total of six rounds of ground gas monitoring have been undertaken on site (between 9th January to 20th March 2025). CIRIA C665 specifies that residential flats (classified as moderate sensitivity) with a low ground gas potential source require six monitoring visits over two months. The results of this assessment of GSV and the corresponding characteristic situation (CS) is given in Table 8. The ground gas screening assessment is presented in Appendix E.

Monitoring well suitability has been reviewed based on the data collected. Monitoring installation BH03A (19mm) (sandstone) was nearly fully saturated during monitoring, as summarised in Table 4, and is therefore not a suitable well for gas monitoring. Monitoring wells BH03A (50mm) and BH05 are more reliable gas monitoring wells as they are screened across unsaturated made ground.

Table 8 Calculation of SGV and determination of characteristic value

Monitoring well	Strata	CH4 max (% vol)	CO_2 max (% vol)	O_2 min (% vol)	Flow max (l/hr)	GSV for CH_4 (l/hr)	GSV for CO_2 (l/hr)	CS - CH_4	CS - CO_2	Design CS
BH01	Glacial sand & made ground	0	0	9.3	0	0	0	CS1	CS1	CS1
BH03A (50mm)	**Made ground**	**0**	**0**	**18.4**	**0**	**0**	**0**	**CS1**	**CS1**	**CS1**
BH03A (19mm)	Sandstone	0	0	19.1	0	0	0	CS1	CS1	CS1
BH05	**Made ground**	**0**	**2.1**	**17.1**	**0**	**0**	**0**	**CS1**	**CS1**	**CS1**
BH07	Sandstone	0	1.9	15.2	0	0	0	CS1	CS1	CS1

Methane, hydrogen sulphide and carbon monoxide were not detected during the monitoring completed. Carbon dioxide was detected in BH05 at a low concentration (maximum recorded concentration of 2.1 %v/v) during four of the six monitoring rounds. Carbon dioxide was also detected in BH07 at a low concentration (maximum recorded concentration of 1.9 %v/v) during three of the six monitoring rounds.

The made ground encountered during the ground investigation comprised relatively inert material. Occasional fragments of brick, concrete, sandstone, clinker, plastic, coal and glass in a natural granular matrix were reported in the exploratory holes. Other than these anthropogenic materials, there was no visual

or olfactory evidence of contamination of degradable material. The made ground is therefore likely to have a low potential for generating ground gas at significant rates.

Gas monitoring undertaken at the site and the ground conditions recorded indicates no significant ground gas source and the gas regime classified as Characteristic Situation 1. Therefore ground gas protection measures in new buildings on the site are not required. The risk from ground gases based on the gas monitoring results is therefore assessed to be very low.

5.5 Construction material

Contaminants such as sulphates and acidic conditions generally present a low risk to human health but can result in aggressive ground conditions that may results in the degradation of buried concrete. Current UK good practice requires the assessment of this potential risk and appropriate design of buried concrete in line with BRE Special Digest SD1 [16]. An assessment in line with this guidance is presented below, assuming a design life of greater than 100 years for any new below ground concrete structures.

The design sulphate (DS) and aggressive chemical environment for concrete (ACEC) classes were assessed assuming that the site was classified as a non-pyritic brownfield site with mobile groundwater. A summary of the assessment results for soil samples and groundwater samples is provided in Table 9.

Table 9 Summary of aggressive ground testing related to design sulphate (DS) conditions

Strata	No. of samples		Characteristic pH		Characteristic sulphate (mg/l)		Overall Design sulphate class	Overall ACEC class
	Soil	Groundwater	Soil	Groundwater	Soil	Groundwater		
Made ground	8	1	8.3	7.5	344	311	DS-1	AC-1[d]
Glacial sand and gravel	1	N/A	6.6	N/A	67.7	N/A	DS-1	AC-1[d]
Glacial till	3	N/A	8.3	N/A	467	N/A	DS-1	AC-1[d]
Weathered sandstone	1	1	8.8	6.9	41.4	207	DS-1	AC-1[d]

A design sulphate class of DS-1 and ACEC class of AC-1[d] is recommended for any concrete which is to be incorporated into the design of Cambridge Hall.

5.6 Risk evaluation

5.6.1 Introduction

The screening assessments for the receptors identified in the conceptual site model have identified residual risks at the proposed site. Based on the proposed redevelopment and the plausible pollutant linkages identified in the conceptual site model, these residual risks have been assessed. The risk classifications of Very Low, Low, Moderate or High risk have been based on the CIRIA guidance C552[17]. A brief description of each is provided below:

- High Risk - There is a high probability that severe harm could arise or is occurring to a designated receptor from an identified hazard. Urgent investigation (if not undertaken already) is required and remedial works may be necessary;
- Moderate Risk - It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk. Some remedial works may be required in the longer term;

- Low Risk - It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild;
- Very Low Risk - There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be significant.

In addition to the risk classifications within the CIRIA guidance, a Negligible risk rating has also been used within the assessment where no plausible pollutant linkage exists.

5.6.2 Human health

Construction phase

No gross contamination was encountered during the ground investigation or is anticipated based on the site history. Low concentrations of contaminants (PAHs) exceeding screening criteria for residential end use were recorded in laboratory results for soil. Elevated PAHs are commonly encountered in urban made ground soils. The concentrations recorded may pose a potential risk to construction workers who come into direct contact with contaminated soils during earthworks or other ground disturbing activities. However, exposure periods are generally short and can be reduced to an acceptable level through adoption of adequate health and safety procedures, such as PPE to avoid dermal contact with soils.

No asbestos was detected within the 18 soil samples taken from made ground. Risk posed by asbestos to construction workers is therefore considered very low. However given the extents of made ground at the site, the presence of unrecorded asbestos should not be ruled out.

Good site management practices should be implemented to avoid dust generation and if necessary, dust suppression. If suspected asbestos containing material (ACM) are encountered during construction a competent contractor should advise on appropriate mitigation, likely to require suspected ACM is excavated and removed off site for disposal in accordance with waste regulations.

If appropriate mitigation procedures are implemented during construction, it is assessed that the risk of harm to construction workers and neighbours can be reduced to low.

Operational phase

The proposed development at Cambridge Hall will comprise residential buildings with a paved central courtyard and no soft landscaping. Therefore, no exposure pathway for contaminants in made ground to future site users has been identified and risk to future site users is considered negligible.

5.6.3 Controlled waters

The proposed development is entirely buildings or paved areas. The amount of recharge into the underlying soils is therefore restricted and any infiltration and leaching of contaminants within the made ground will be very low. Leachate testing of soils was not undertaken however no visual or olfactory evidence of contamination was encountered during the ground investigation, soil testing results and groundwater testing do not indicate a source of contamination within the site.

In addition, the site was redeveloped in the 1990s and significant contamination encountered would have been dealt with previously. It is unlikely any significant sources of contamination remain on site. Therefore, controlled waters risk is considered to be very low.

5.6.4 Ground gas

The gas monitoring assessment undertaken in Section 5.4 indicates that the gas regime is classified as Characteristic Situation 1 and therefore ground gas protection measures in new buildings on the site will not be required. The risk from ground gases based on the gas monitoring results is therefore assessed to be very low.

5.6.5 Construction materials and waste

Concrete

The BRE assessment in Section 5.5 did not identify elevated sulphate concentrations within stratum beneath the site. It is considered that all buried concrete at the development site should be designed in accordance with DS-1 and AC-1[d].

Water supply pipes

Risks to potable water supply pipes from contaminated ground at the site should be assessed by undertaking an assessment in accordance United Utilities guidance. At the time of the ground investigation, the proposed routes and depth of potable water supplies within the site has not been established. However the available ground investigation data from across the site does not identify contaminants in soil at concentrations that would present a risk to water supply pipes and this is supported by the preliminary risk assessment and consideration of the site history.

Preliminary waste assessment

Based on an initial assessment (Appendix F), it is likely that any surplus excavated material would be classified as non-hazardous for disposal however further testing and assessment of the material proposed for disposal would be required to confirm this.

5.7 Updated conceptual site model

The initial conceptual model has been refined based on the findings of the risk assessment and contaminant characterisation that has assessed each identified potential contaminant linkage. The remaining contaminant linkages are presented in Table 10 for the construction phase and Table 11 following development.

Table 10 Summary of updated conceptual site model (during construction)

Sources		Pathways		Receptors	Plausibility of linkage / risk
Made ground (asbestos, metals, PAH, petroleum hydrocarbons)	→	Dermal contact with soils	→	Site workers during construction	Ground investigation data indicated low levels of PAH contamination within the made ground. No asbestos identified within the made ground. No source of vapours identified. No significant ground gases identified. Impact to site workers and neighbours is possible – can be mitigated through appropriate operational procedures (such as dust prevention) and Personal Protective Equipment (PPE). Mitigation measures will reduce the risk level to low.
		Ingestion of soil, fibres or dust	→		
		Inhalation of soil vapours and ground gases	→	Site workers during construction and site neighbours	
		Inhalation of soil and soil dust	→		

Table 11 Updated conceptual site model (post construction)

Sources		Pathways		Receptors	Plausibility of linkage / risk
Made ground (asbestos, metals, PAH, petroleum hydrocarbons)	→	Dermal contact with soils	→	Maintenance workers Future site users	Ground investigation data indicated low levels of PAH contamination within the made ground. No asbestos identified within the made ground. No source of vapours identified. No significant ground gases identified. Impact to maintenance worker is possible – can be mitigated through appropriate site management procedures, such as Personal Protective Equipment (PPE). Mitigation measures will reduce the risk level to low. Impact to site users is negligible - no exposure pathway to site users due to buildings/hardstanding throughout.
		Ingestion of soil, fibres or dust	→		
		Inhalation of soil vapours and ground gases	→		
		Inhalation of soil and soil dust	→		

Leachable contaminants in the made ground	→	Vertical migration of dissolved phase contamination	→	Groundwater within bedrock (Principal Aquifer) and Superficial Deposits (Secondary A Aquifer)	Leachate testing of soils was not undertaken however no visual or olfactory evidence of contamination was encountered during the ground investigation, soil testing results and groundwater testing do not indicate a source of contamination within the site. Risk to groundwater is very low
Ground gases	→	Accumulation of gases in confined spaces producing asphyxiation and explosion risk	→	Future site users (residential)	The gas monitoring assessment indicates that the gas regime is classified as Characteristic Situation 1. Risk to future site users negligible – no risk to site users identified.
Soils or groundwater aggressive to building materials	→	Contact with aggressive soils and groundwater	→	Buried concrete Buried water supply pipes	Buried concrete - Assessment has confirmed DC1 and AC-1d, the lowest risk categories. Risk can be mitigated by selection of appropriate grade of concrete. Impact to buried water supply pipes - UU may require a pipeline risk assessment to be completed when the pipeline route is known. Based on the available data it is unlikely that barrier pipe will be required.

Based on the findings of this risk assessment employing good practice site management procedures will adequately address risks during construction. During ground works if any material containing visible and olfactory evidence of contamination (including suspected asbestos containing material) is encountered a competent geoenvironmental specialist should be consulted. It is likely that such material will require disposal off site.

No contamination has been identified by the ground investigation, and contamination is not suspected, that requires specific remediation interventions to be implemented for the proposed development and therefore a remediation strategy is not required. Similarly no source of contamination has been identified that is potentially a risk to the Principal Aquifer as a result of pathways that may be created by piling and therefore a foundations works risk assessment is not required.

6. Geotechnical development considerations

6.1 Building foundations

The proposed structures in the development are of considerable height, reaching up to 30 storeys, resulting in high column loading. Shallow foundations will not be practical, and the depth to rockhead is too great for a rock bearing raft foundation. Piled foundations are recommended due to the smaller footprint of the foundations and the ability to transfer load to deeper strata with greater load capacity and reduced settlements.

The use of bored cast in situ or continuous flight auger (CFA) piles are considered the most appropriate pile types to mitigate ground movement, noise and vibration impacting adjacent buildings, for a site within a busy urban area and the encountered ground conditions.

The pile toe levels will be a function of the loading at each column position, but all piles will require rock sockets within the less weathered sandstone bedrock. Preliminary pile design suggests a 4m rock socket is required for 600mm and 750mm diameter piles with an SLS action of 2,000kN and 3,200kN respectively. Therefore piles lengths of between 12m and 14m will be required. These lengths are considered practically achievable with most standard CFA piling equipment.

A main sewer runs below Cavendish Street, extending east-west through the centre of the site. This will be a notable constraint to the proposed development, and any new piles should be positioned outside the easement zone associated with the sewer.

The pile solution should take account of the locations of the existing piled foundations which are currently unknown and may not be known until demolition has taken place.

6.2 Basement

A small basement with a maximum depth of 4m is to be constructed to accommodate sprinkler tanks and a pump room. Available drawings show this basement to be situated to the north of the site.

The excavation methodology must address stability concerns as sands and gravels are likely to be encountered. Groundwater control will also be necessary as water seepage has been encountered at circa 3m bgl. If the basement cannot be accommodated in an open cut with 1:2.5 slopes, a boxed temporary sheet piled support or permanent contiguous bored pile solution should be used. The most suitable approach should be determined during the detailed design stage.

6.3 Obstructions

The following obstructions were encountered within the made ground:

- BH04- Concrete at 0.12m bgl (100mm thickness)
- BH03- Hard obstruction (suspected concrete/utility) at 0.67mbgl leading to borehole termination

Given the nature of the made ground deposits, further obstructions should be expected.

No information is available on the foundations of the existing building which occupies the site. These are anticipated to be deep piled foundations and would need to be removed or avoided where clashing with proposed foundations.

6.4 Floor slab construction

Given the presence of thick made ground deposits on site with variable strength characteristics leading to a potential for unacceptable settlement in the long term, it is recommended that ground floor slabs are designed as suspended.

6.5 Unexploded ordnance (UXO)

The detailed UXO risk assessment has recommended risk mitigation measures for all intrusive works located in the medium risk zone (see Figure 3 and Appendix G). For the deep intrusive works, this includes an intrusive magnetometer survey for all pile locations down to the maximum bomb penetration depth.

It is likely that the magnetometer survey could be undertaken during an advance probing exercise at each pile position.

6.6 Earthworks and site preparation sequence

A construction sequence will need to be developed in the detailed design stage. Given the relatively low impacts of contamination and therefore low remediation requirements, it is unlikely that a separate enabling works contract would be adopted. However, in relation to the sequence of the geotechnical activities, the following should be considered:

1. Demolish existing buildings on the site to ground level.
2. Remove existing surface pavements and underlying concrete slabs.
3. Excavate existing pile caps, identify and remove sections of the current pile foundation that conflict with the proposed substructure. As complete removal of piles is generally impractical, document the centre and edges of existing piles, and report this information to the design team for suitable offsets, considering anticipated vertical tolerances of both existing and new piles along with appropriate geotechnical separation.
4. Install basement support piles if necessary then excavation to form part basement under one block.
5. General excavation and placement to form the general site platform, at formation level including the provision of a certified piling mattress.
6. Surplus and unsuitable material will need to be removed from site
7. Install main foundation piles from piling mat.
8. Contractor to prepare an earthworks validation report.

7. Updated geotechnical and geoenvironmental risk register

Register reference – Cambridge Hall, Manchester Geotechnical and Geoenvironmental Risk Register

Project	Cambridge Hall, Manchester	**Job number**	303452-00
Package/ topic		**Design stage**	Ground Investigation Report – For Information

Remember: Avoid – Reduce – Control and communicate relevant information to others

Date (+ initials)	Area/location of risk exposure	Description of hazard and risk exposure	Mitigation of risk (potential or achieved)	A	R	C	Further action	By	Status Active/closed
06/03/25 ZO	Site wide	Buried obstructions (especially existing pile foundation) impacting time and cost of construction activities.	Ground investigation has been conducted to assess extent of buried obstructions on site.			✓	Potential enabling works to remove obstructions in advance of construction Avenues of information retrieval should be explored to identify the existing pile foundations 'as built' records.	Contractor	Active
06/03/25 ZO	Site wide	Contamination causing risk to human health of workers during construction and future site users during operation.	Ground investigation has been conducted to assess the risk of contamination at the site. The risk assessment has assigned a very low risk rating.			✓	Contractors RAMS to be developed Good construction practices are to be followed.	Contractor	Active
06/03/25 ZO	Site wide	Migration of contamination into underlying aquifer due to foundation piling.	Ground investigation has been conducted and there is no evidence of significant soil contamination.			✓	Monitor for unforeseen contamination during construction.	Contractor	Active
06/03/25 ZO	Site wide	Shallow groundwater impacting construction works	Groundwater monitoring has confirmed shallow groundwater at the site			✓	Contractor should be aware and if necessary provide groundwater control for excavation works	Contractor	Active

Register reference – Cambridge Hall, Manchester Geotechnical and Geoenvironmental Risk Register

Project	Cambridge Hall, Manchester	**Job number**	303452-00
Package/ topic		**Design stage**	Ground Investigation Report – For Information

Remember: Avoid – Reduce – Control and communicate relevant information to others

Date (+ initials)	Area/location of risk exposure	Description of hazard and risk exposure	Mitigation of risk (potential or achieved)	A	R	C	Further action	By	Status Active/closed
06/03/25 ZO	Site wide	Risk of encountering unexploded ordnance (UXO) during ground investigation and construction works.	Detailed UXO Risk Assessment has been carried out			✓	Follow recommendations of Stage 2 Detailed UXO Risk Assessment (See Appendix G) presented below: Site Specific Explosive Ordinance Safety and Awareness Briefings (UXO Toolbox Briefing) to all personnel conducting intrusive works- All works Site Specific Safety Instructions (SSSI) Training Course- All works Explosive Ordnance Disposal (EOD) Engineer On-Site Support (Watching Brief)- Shallow intrusive works in medium risk zone Support to Borehole Drilling- Deep intrusive works in medium risk zone Intrusive Magnetometer Survey of all pile locations down to maximum bomb penetration depth- Deep intrusive works in medium risk zone	Contractor	Active

Register reference – Cambridge Hall, Manchester Geotechnical and Geoenvironmental Risk Register

Project	Cambridge Hall, Manchester	**Job number**	303452-00
Package/ topic		**Design stage**	Ground Investigation Report – For Information

Remember: Avoid – Reduce – Control and communicate relevant information to others

Date (+ initials)	Area/location of risk exposure	Description of hazard and risk exposure	Mitigation of risk (potential or achieved)	A	R	C	Further action	By	Status Active/closed
06/03/25 ZO	Site wide	Ground gases affecting any construction workers within excavations during ground investigation or construction works.	Gas monitoring has been conducted, there is very low risk from ground gas.			✓			Closed
06/03/25 ZO	Site wide	Potentially high sulphate concentration in the ground can attack any proposed buried infrastructure.	Concrete sulphate class has been determined following ground investigation			✓			Closed
29/07/24 SC	Centre of the site	Foundation works adversely loading the deep 1950mm diameter sewer, resulting in collapse	Foundations are to be designed to minimise additional loads on the sewer			✓	Ensure piles are positioned outside easement zone. CFA pile technique recommended to minimise vibration in close proximity to the sewer	Arup/ Contractor	Active

8. Conclusions and recommendations

A ground investigation has been completed by CC Geotechnical Ltd in January 2025. This ground investigation report is written to support detailed design and full planning application. Generally, ground conditions consist of made ground up to 5.2m thick, comprising both granular and cohesive materials. Beneath the made ground, glacial till is present across the site, with glaciofluvial sands and gravel found within the glacial till at boreholes BH01, BH02 and SA01. Sandstone bedrock was encountered between 6.2 and 10.4m bgl with the weathered zone at the top 1.0 to 3.2m.

Geoenvironmental conclusions

The geoenvironmental scope of the ground investigation was based on the initial conceptual site model. No visibly contaminated or odorous material was encountered during the ground investigation. Analysis of soil samples has identified some low-level contaminants however, risk to future site users for the proposed residential land use is considered negligible due to lack of exposure pathways. The ground gas assessment indicates that risk to human health posed by ground gas is very low. Risk to controlled waters is classified as low risk as no significant sources of contamination were identified and the groundwater aquifer is protected by low permeability clay.

Employing good practice site management procedures will adequately address risks during construction. On any brownfield site there is the possibility that unforeseen contaminated material may be encountered during excavation works. Care should be taken during ground works and excavations should be supervised to ensure any previously unforeseen contamination is appropriately managed.

The ground gas risk assessment indicates Characteristic Situation 1 conditions and therefore ground gas protection is not required in new buildings.

No contamination has been identified by the ground investigation, and contamination is not suspected, that requires specific remediation interventions to be implemented for the proposed development and therefore a remediation strategy is not required. Similarly no source of contamination has been identified that is potentially a risk to the Principal Aquifer as a result of pathways that may be created by piling and therefore a foundations works risk assessment is not required.

All buried concrete at the development site should be designed in accordance with DS-1 and AC-1[d].

Geotechnical conclusions

The use of bored cast in situ or continuous flight auger (CFA) piles are considered the most appropriate pile types to support the proposed buildings and mitigate ground movement, noise and vibration impacting adjacent buildings. Based on the ground conditions and anticipated loading, 600mm and 750mm diameter piles will require 4m rock sockets within the less weathered sandstone strata, with typical pile lengths of 12 to 14m bgl.

Information on the foundations to the existing buildings is currently unknown and one of the significant ground risks is the potential for physical clashes between the existing and proposed foundations.

Ground floor slabs are anticipated to bear onto several metres of variable made ground with a potential for unacceptable settlement in the long term. Therefore, it is recommended that ground floor slabs are designed as suspended.

References

[1] Arup (August 2024) Cambridge Hall, Manchester Geotechnical and Geoenvironmental Desk Study P01. Report reference: CAM-ARUP-ZZ-XX-RP-G-0001

[2] Igne (November 2024) Detailed UXO Risk Assessment. Report reference: 7390-5 RA

[3] CC Geotechnical Ltd (February 2025) Ground Investigation at Cambridge Hall Manchester Draft Factual Report Issue 01. Report reference: CCG-C-24-15079

[4] BSI Standards Publication (2015) BS 8002:2015, Code of practice for earth retaining structures.

[5] BSI Standards Publication (2015) BS 5930:2015, Code of practice for ground investigations.

[6] Stroud. M.A (1988) Standard Penetration Test- Its Application and Interpretation, Penetration Testing in the UK. Thomas Telford. London 1989.

[7] International Society for Rock Mechanics, (1985). Commission on Testing Methods – Working Group on Revision of the Point Load Test Method. Suggested method for determining point load strength.

[8] BSI Standards Publication (2015) BS 8004:2015, Code of practice for foundations.

[9] Environment Agency (2023) Land contamination risk management guidance.

[10] Contaminated Land Exposure Assessment (CLEA) model (2014) CLEA Software Version 1.071.

[11] LQM/CIEH (2014) Generic Assessment Criteria for Human Health Risk Assessment, 2nd edition.

[12] AGS/EIC/CL:AIRE (2010) Updated GAC Report.

[13] CIRIA C665, 2007, Assessing risks posed by hazardous ground gases to buildings.

[14] British Standard, 2019, BS8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.

[15] NHBC Foundation, 2023, NF94 Hazardous ground gas – an essential guide for housebuilders.

[16] BRE, 2005, Special Digest 1: Concrete in Aggressive Ground (including 2017 amendments)

[17] CIRIA C552, 2001, Contaminated land risk assessment: a guide to good practice.

Appendix A- Geological Cross-Section

Distance along baseline (m)

Elevation (mOD)

BH01 (-2.7) · BH02 (11.9) · SA01 (-0.9) · BH03A (15.0) · SA02 (-2.8) · BH04 (-2.0) · BH05 (18.2) · SA03 (0.3) · BH06 (1.5) · BH07 (-1.0)

Glacial sands and gravels

Glacial till

Highly weathered sandstone bedrock

Less weathered sandstone bedrock

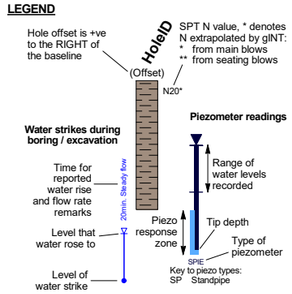
Made ground (Cohesive and granular)

Seepage · SP · 20min Seepage

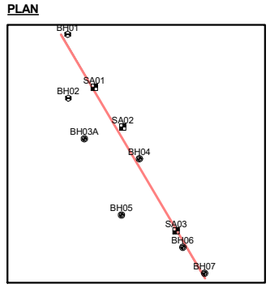
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Database: c:\gint\cambridge hall.gpj Rev:Fr1 (30 - Work in progress)

LEGEND



PLAN



COLOUR LEGEND

- Block Paving or Concrete [Concrete]
- Weathered Sandstone [SDST-WR]
- Made Ground Granular [MG-GR]
- Sandstone [SDST]
- Made Ground Cohesive [MG-CO]
- Glacial Till Cohesive [GT]
- Glaciofluvial Sands and Gravel [Glacial Sands and Gravel]

MATERIALS

- Fill (MADE GROUND)
- Silty sandy gravelly CLAY
- Silty gravelly SAND
- SANDSTONE
- CONCRETE
- Silty sandy gravelly cobbly CLAY
- TOPSOIL
- Clayey SAND
- Clayey silty sandy GRAVEL

ARUP

Job Title
Cambridge Hall, Manchester

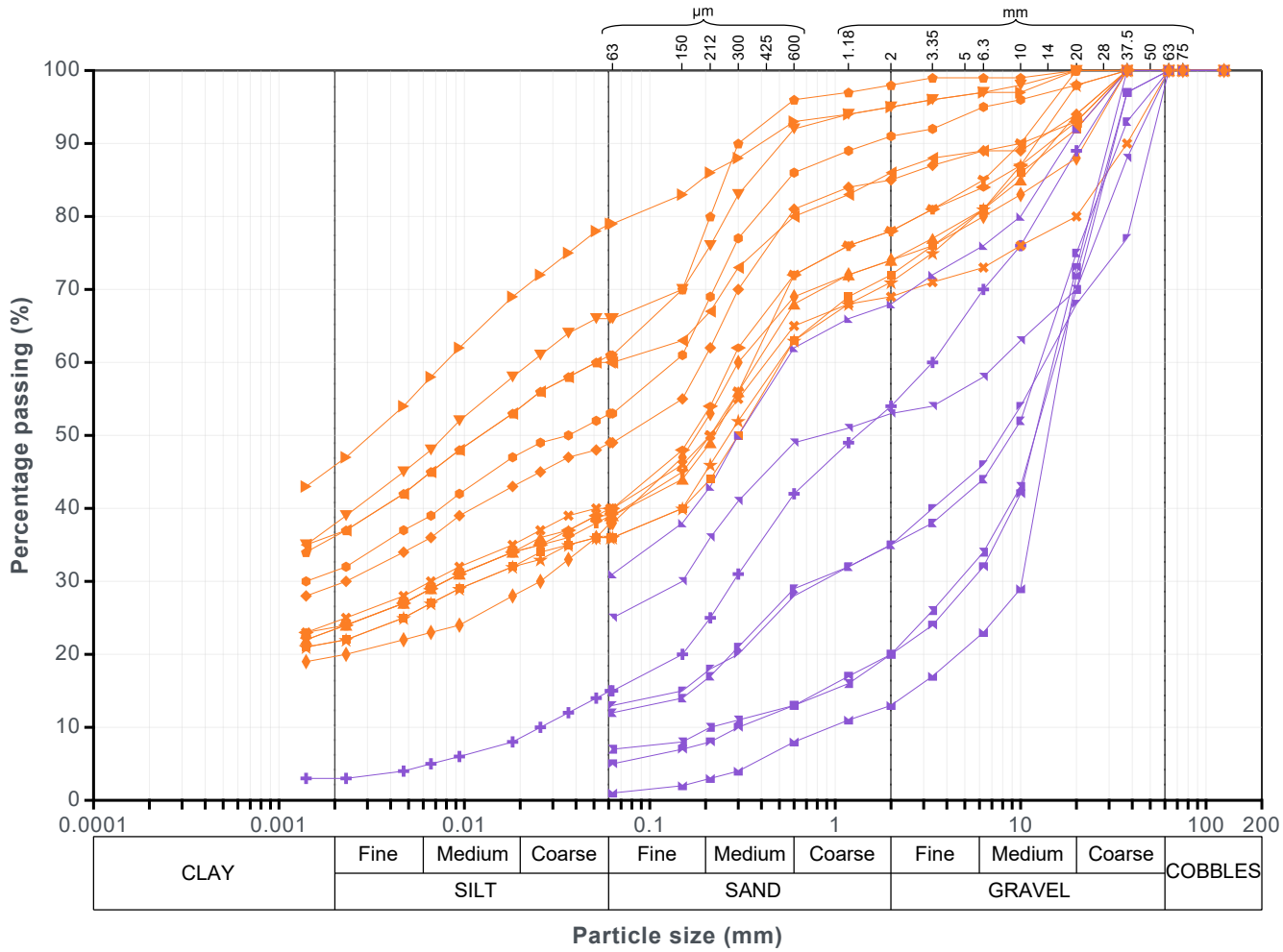
Figure Title
Geological cross section
North to South

Job No
303452-00

Figure No
APPENDIX A1

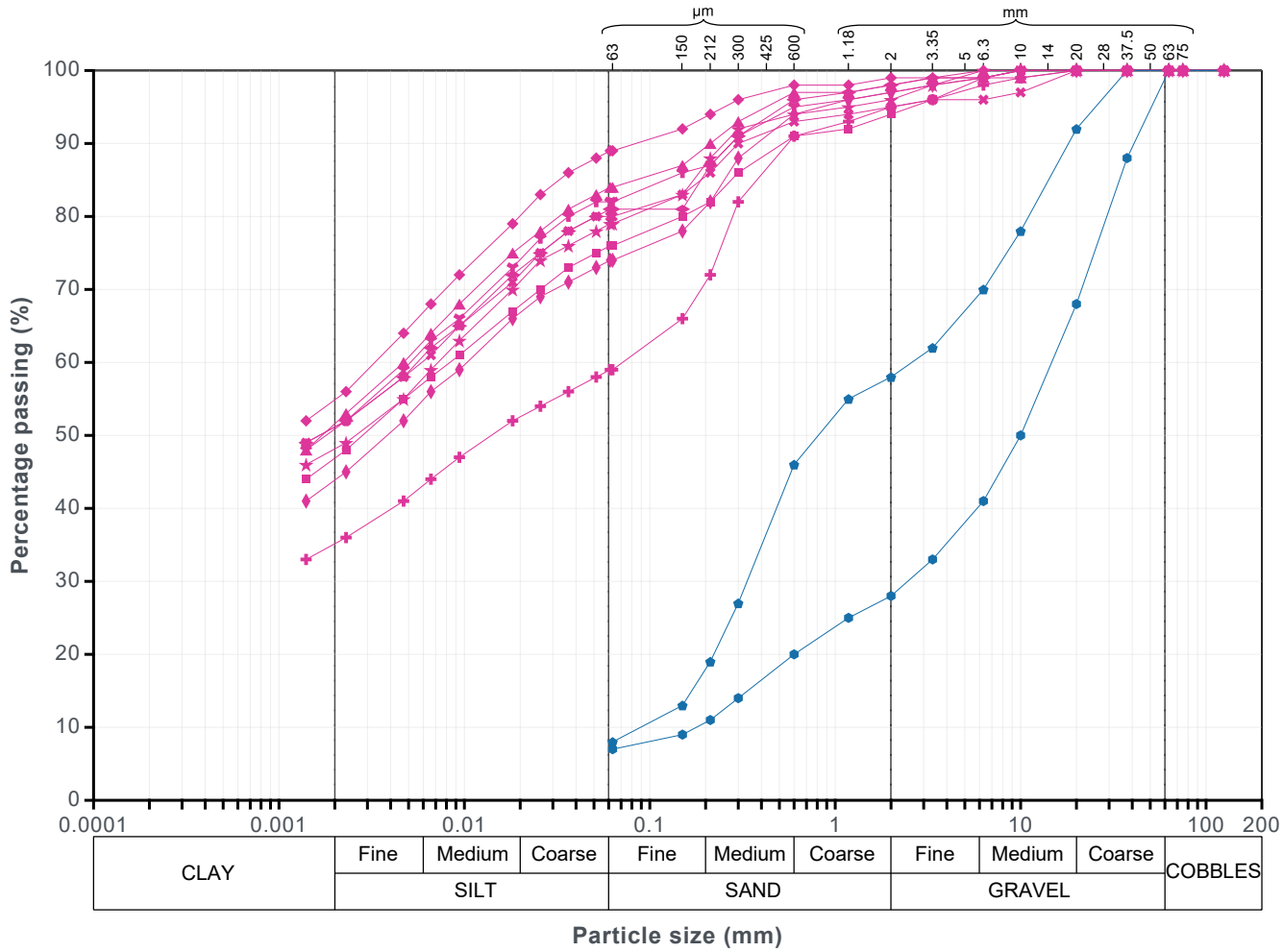
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Appendix B- Plots of In-Situ and Geotechnical Laboratory Testing



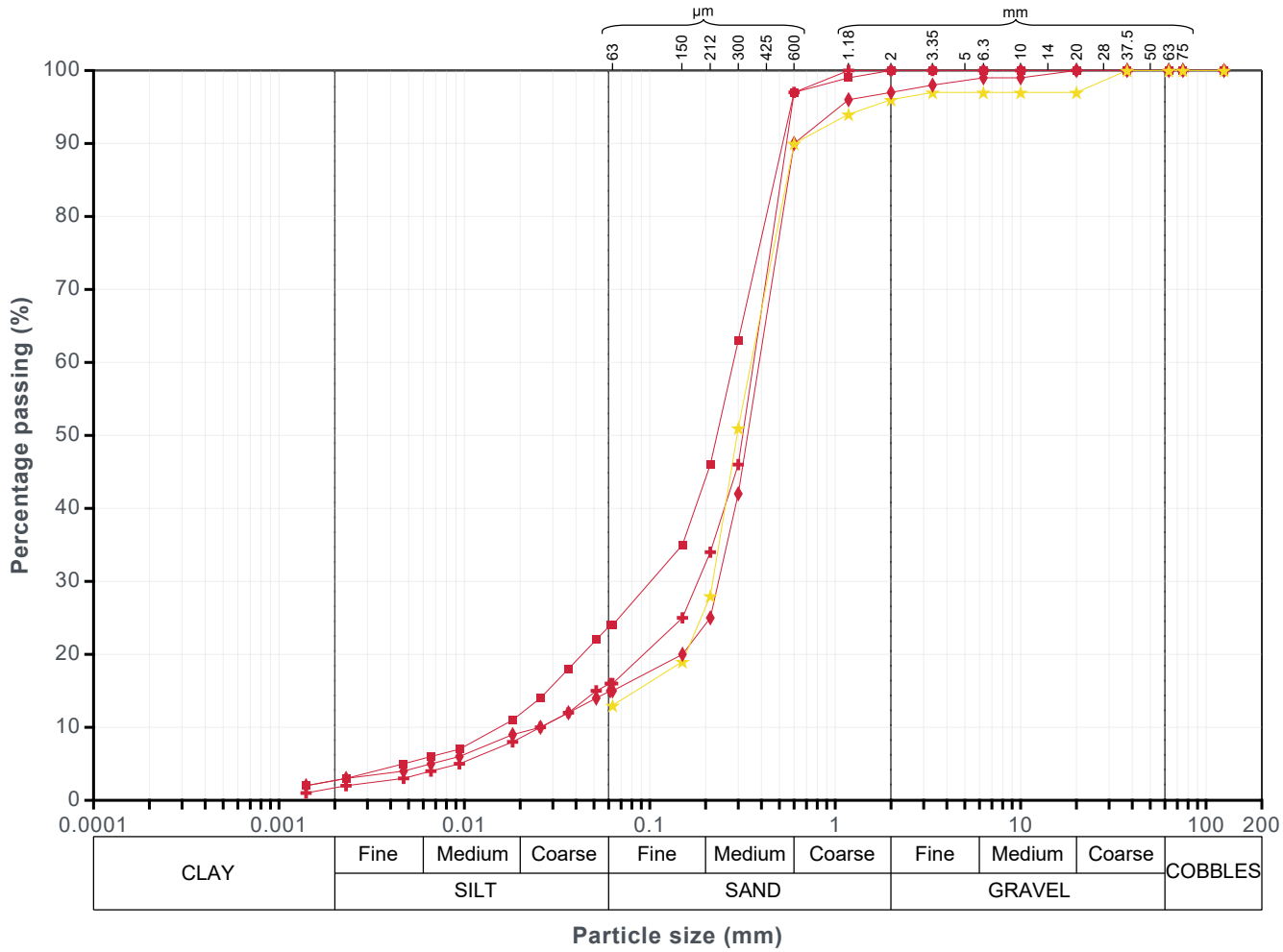
Geology Code	PSD Groups				
MG-Cohesive	BH03A; 2.5m (B)	BH07; 3.9m (B)	BH01; 0.7m (B)	BH05; 0.3m (B)	SA01; 0.7m (B)
MG-Granular	SA03; 0.6m (B)	BH04; 1.5m (B)	BH03A; 0.8m (B)	BH03A; 0.3m (B)	
	BH06; 1.5m (B)	BH04; 4.5m (B)	BH05; 4.5m (B)	BH07; 0.5m (B)	
	BH06; 3.5m (B)	BH07; 1.9m (B)	BH03A; 3.5m (B)	BH06; 0.5m (B)	
	BH05; 1.5m (B)	BH02; 0.8m (B)	BH04; 0.4m (B)	SA02; 0.9m (B)	

Project Cambridge Hall Manchester		**Job number** 303452-00
Report Made Ground (PSD)	**Company** Arup	**Date** 25 Feb 2025
Graph Particle size distribution (PSD) curves	**Client** Unite Students and Manchester Metropolitan University	**Figure** B1



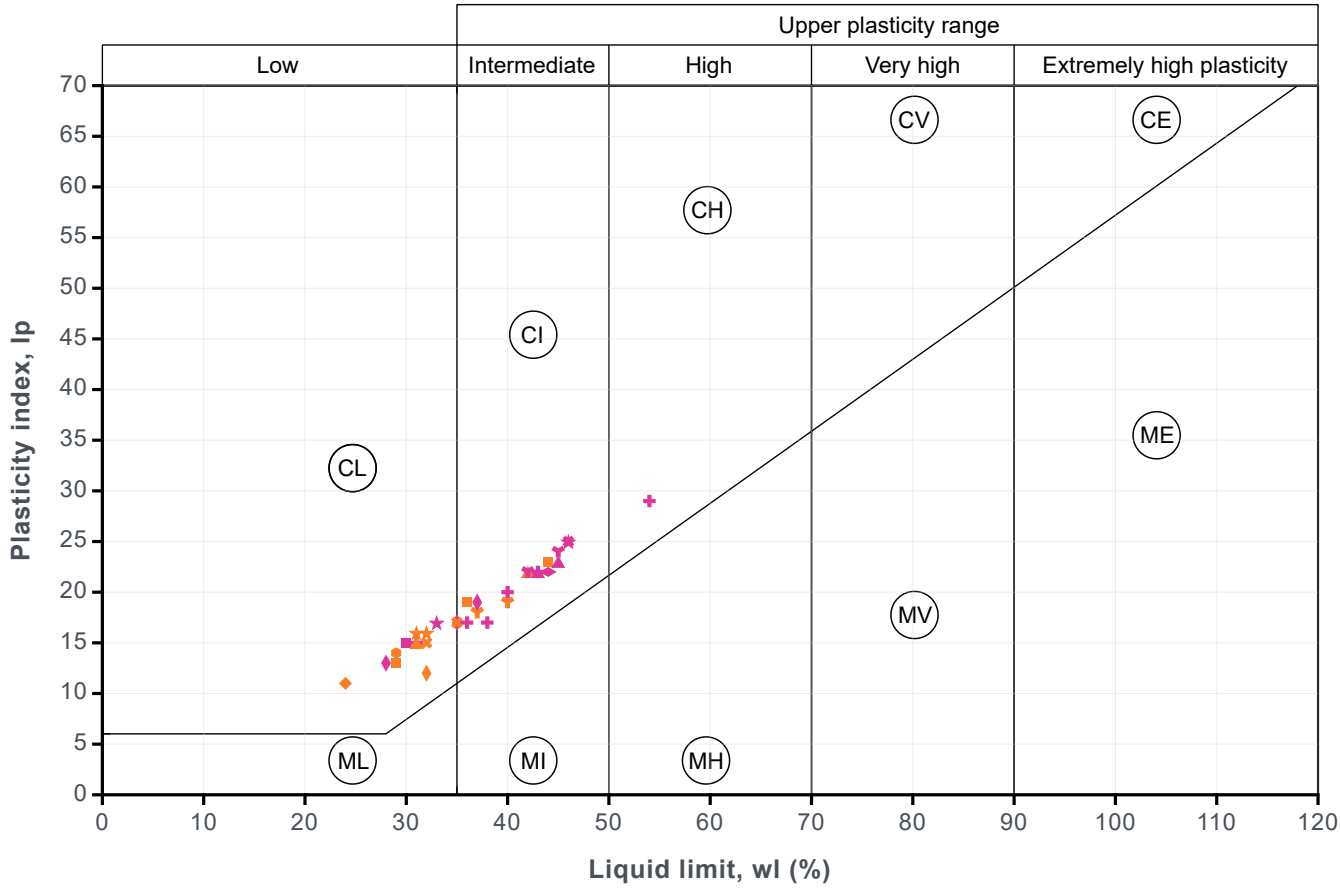
Geology Code	PSD Groups
● Glacial Sands and Gravel ● GT	✚ BH07; 5.9m (B) ⧫ BH01; 9.7m (B) ■ BH06; 5.5m (B) ★ SA01; 1m (B) ▲ BH02; 4.9m (B) ⯅ BH04; 6.5m (B) ✖ BH01; 4.8m (B) ◆ BH05; 6.5m (B) ◆ BH03A; 5.9m (B) ⬢ BH02; 2.8m (B) ⬟ BH01; 2.5m (B)

Project Cambridge Hall Manchester		**Job number** 303452-00
Report Superficials (PSD)	**Company** Arup	**Date** 25 Feb 2025
Graph Particle size distribution (PSD) curves	**Client** Unite Students and Manchester Metropolitan University	**Figure** B2



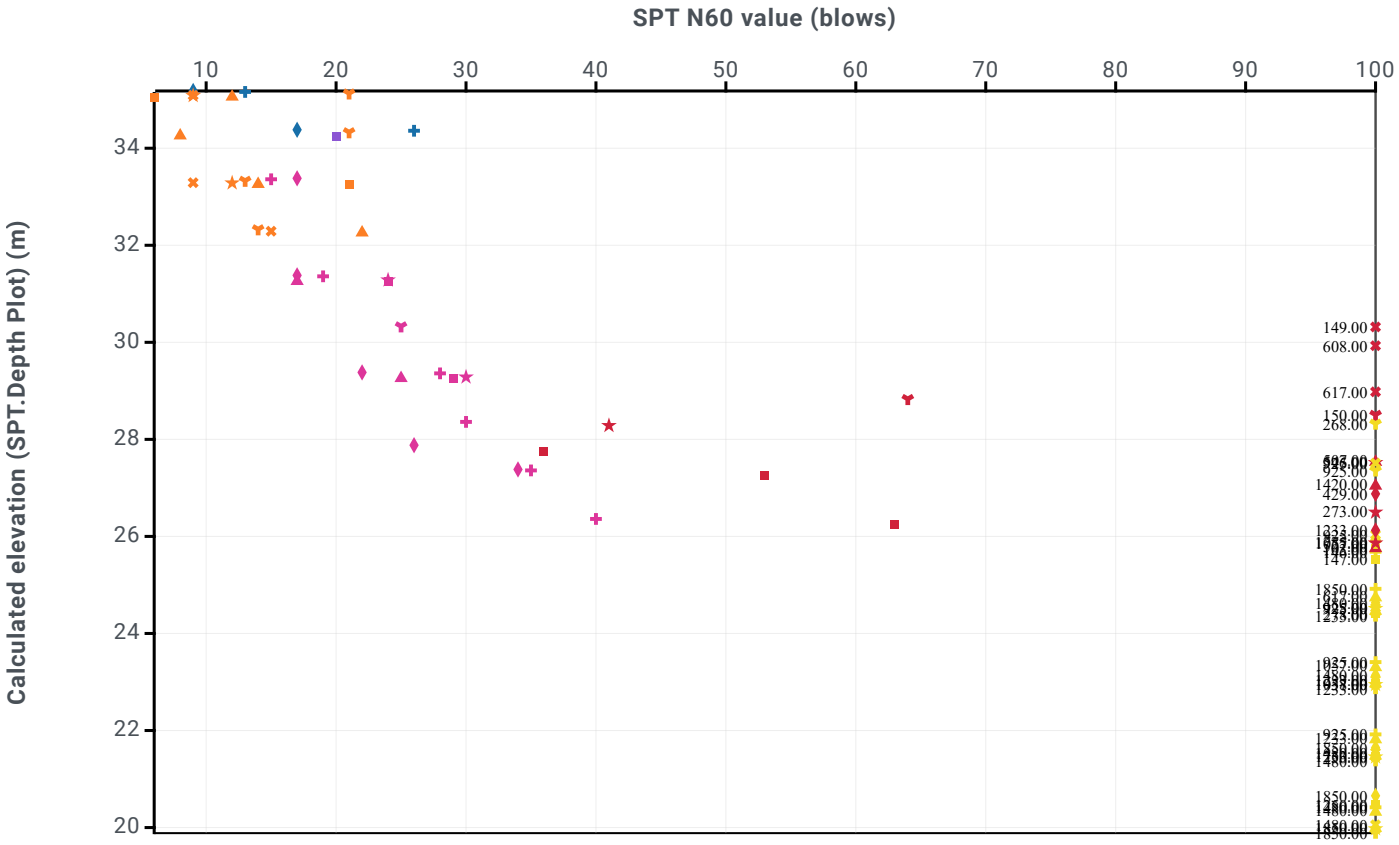
Geology Code	PSD Groups
● SDST ● SDST-WR	✚ BH02; 9.5m (B) ♦ BH03A; 9m (D) ■ BH04; 9.5m (B) ★ BH06; 8.2m (B)

Project Cambridge Hall Manchester		**Job number** 303452-00
Report Bedrock (PSD)	**Company** Arup	**Date** 25 Feb 2025
Graph Particle size distribution (PSD) curves	**Client** Unite Students and Manchester Metropolitan University	**Figure** B3



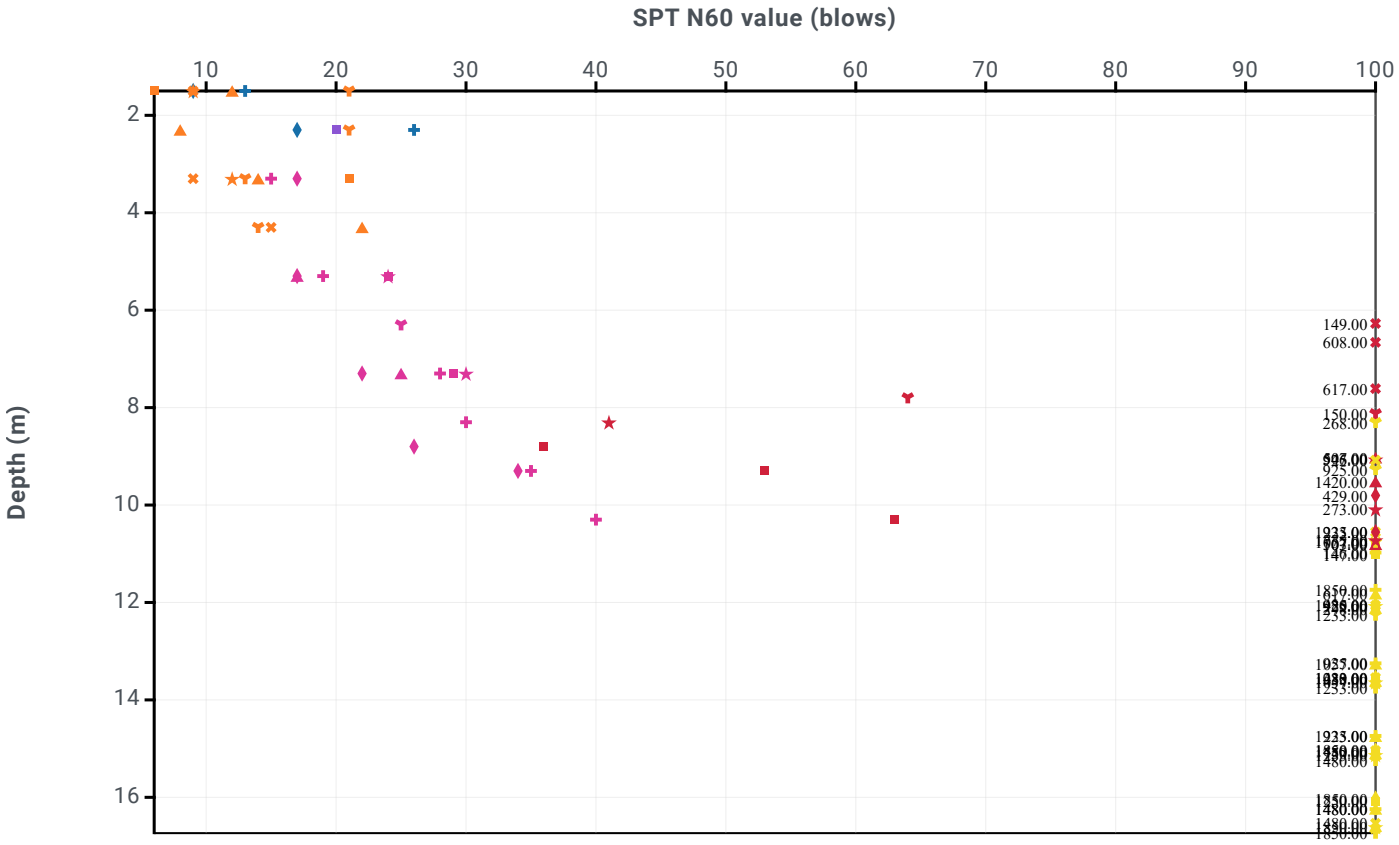
Geology Code	Location ID
● GT ● MG-Cohesive	✚ BH01 ✾ BH06 ♦ BH02 ✖ BH07 ■ BH03A ◆ SA01 ★ BH04 ◆ SA02 ▲ BH05 ⬢ SA03

Project Cambridge Hall Manchester		**Job number** 303452-00
Report Plasticity Chart	**Company** Arup	**Date** 25 Feb 2025
Graph Plasticity chart - Liquid limit (LL) vs. Plasticity...	**Client** Unite Students and Manchester Metropolitan University	**Figure** B4



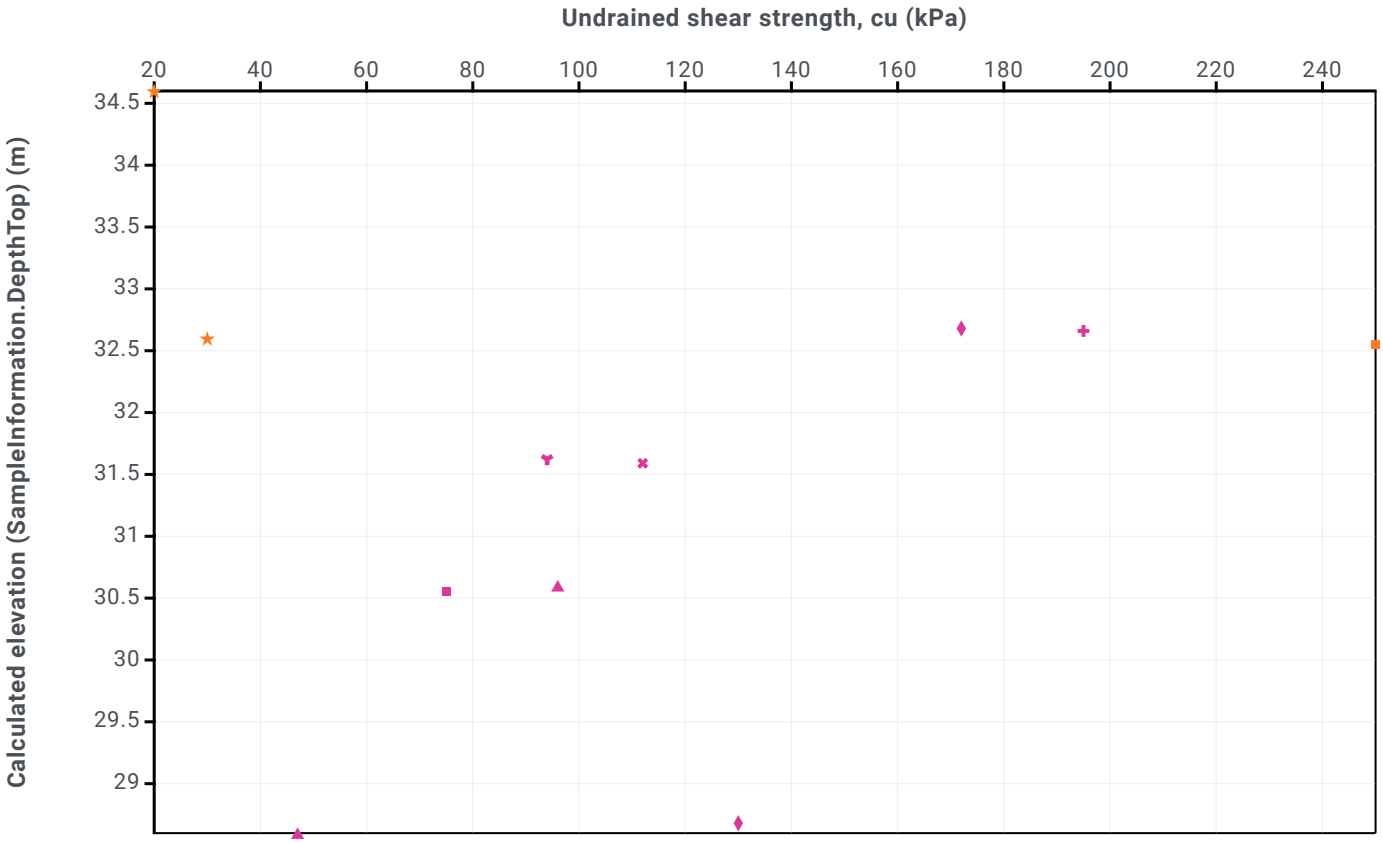
Geology Code		Location ID	
Glacial Sands and Gravel	SDST-WR	BH01	BH06
GT		BH02	BH07
MG-Cohesive		BH03A	
MG-Granular		BH04	
SDST		BH05	

Project		Job number
Cambridge Hall Manchester		303452-00
Report -	**Company** Arup	**Date** 07 Mar 2025
Graph Standard penetration test (SPT) - N60 value (4)	**Client** Unite Students and Manchester Metropolitan University	**Figure** B5



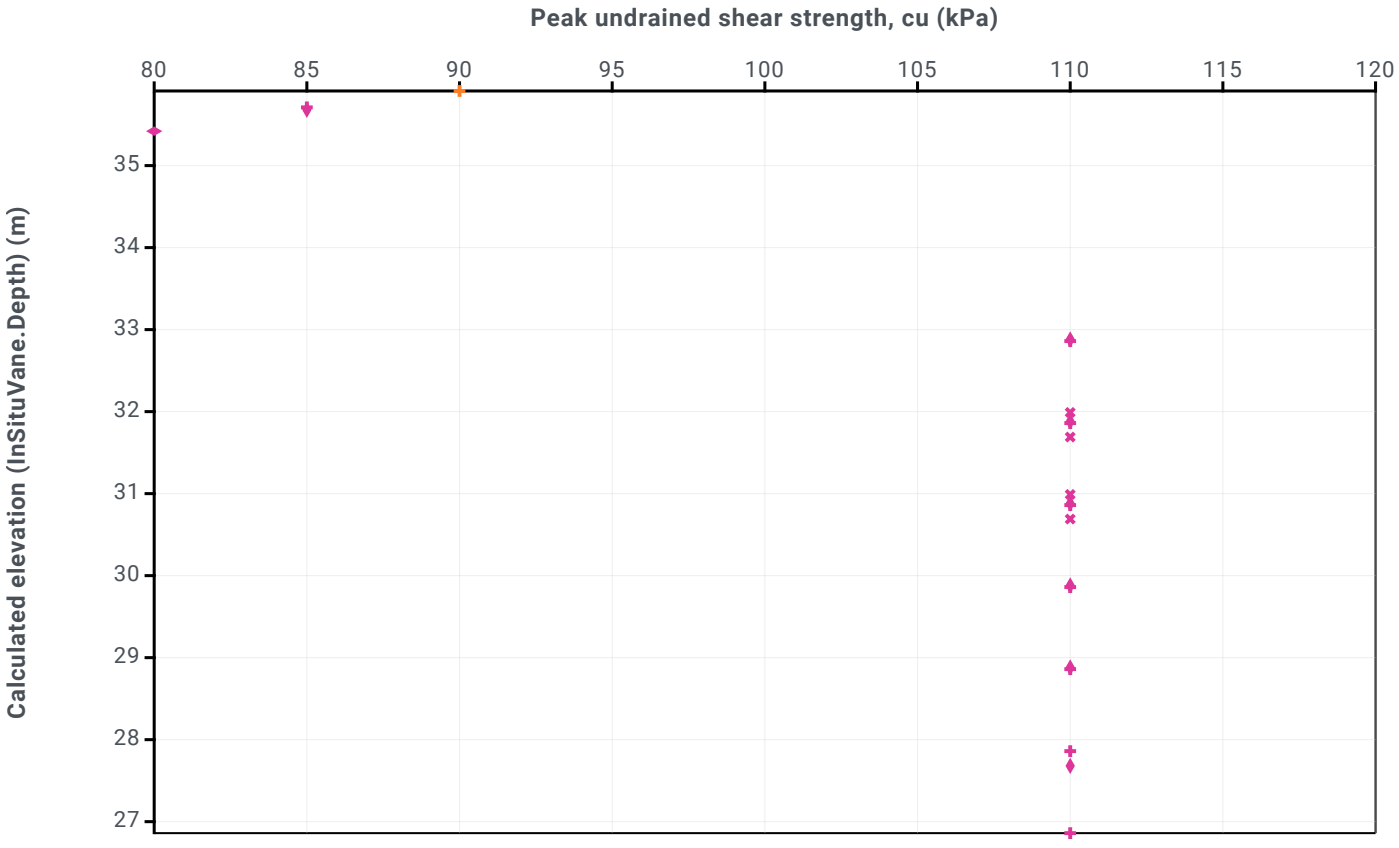
Geology Code		Location ID	
Glacial Sands and Gravel	SDST-WR	BH01	BH06
GT		BH02	BH07
MG-Cohesive		BH03A	
MG-Granular		BH04	
SDST		BH05	

Project		Job number
Cambridge Hall Manchester		303452-00
Report	**Company**	**Date**
-	Arup	05 Mar 2025
Graph	**Client**	**Figure**
Standard penetration test (SPT) - N60 value (4)	Unite Students and Manchester Metropolitan University	B6



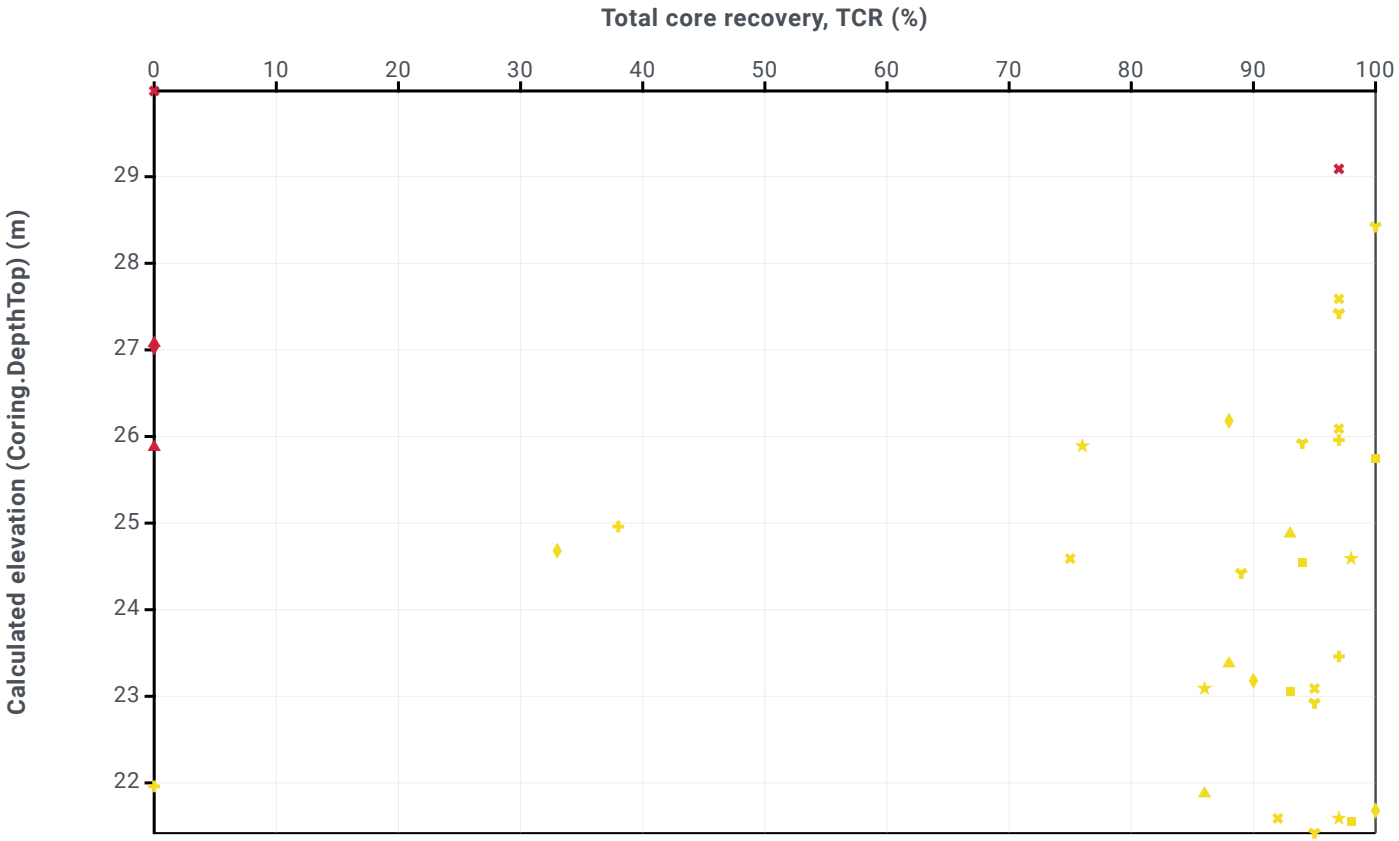
Geology Code	Location ID
GT MG-Cohesive	BH01 BH06 BH02 BH07 BH03A BH04 BH05

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 25 Feb 2025
Graph Triaxial undrained shear strength (Cu) at fail...	**Client** Unite Students and Manchester Metropolitan University	**Figure** B7



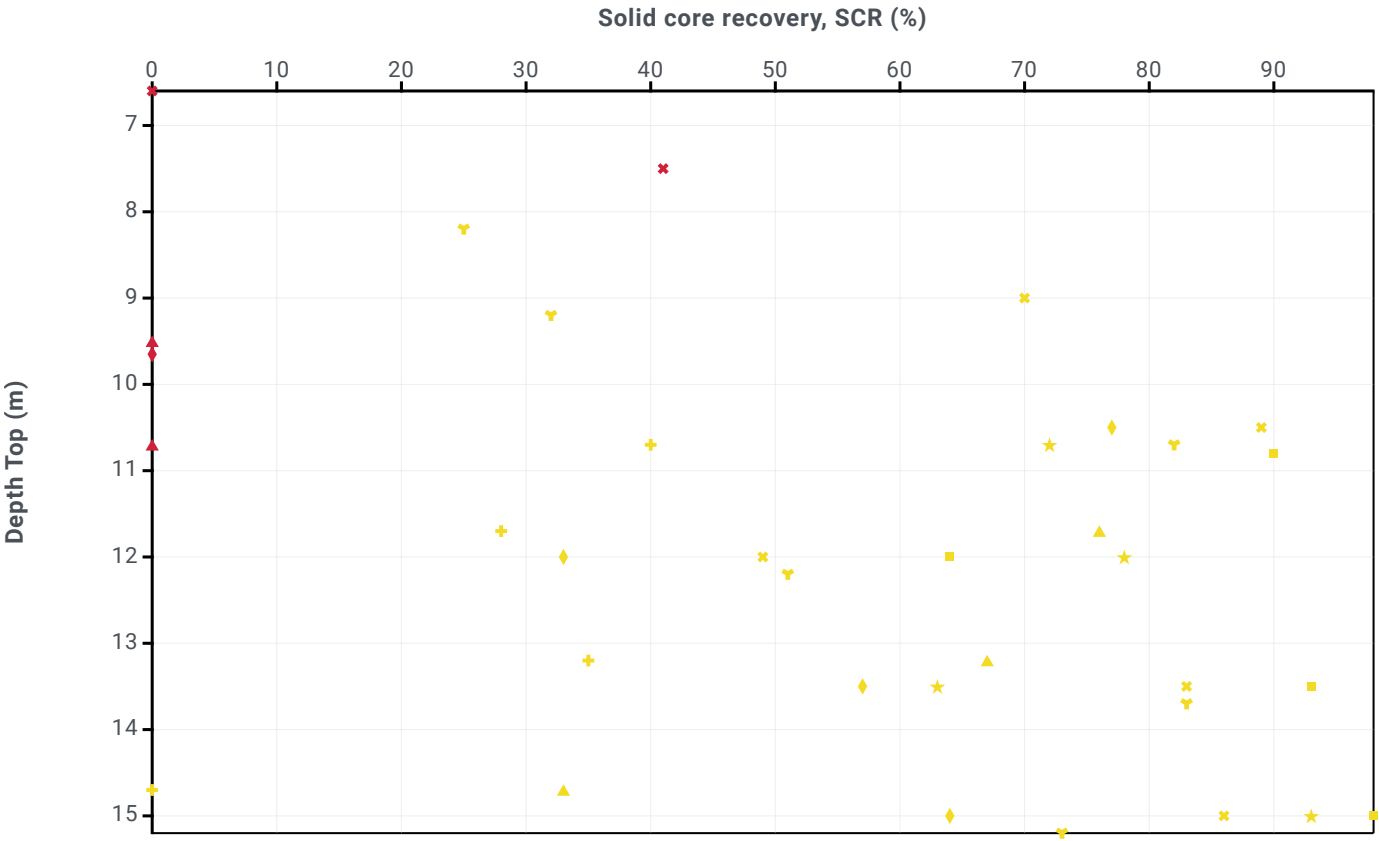
Geology Code	Location ID
GT MG-Cohesive	BH01 BH02 BH07 SA01

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 25 Feb 2025
Graph In-situ hand vane shear test - Peak strength (...	**Client** Unite Students and Manchester Metropolitan University	**Figure** B8



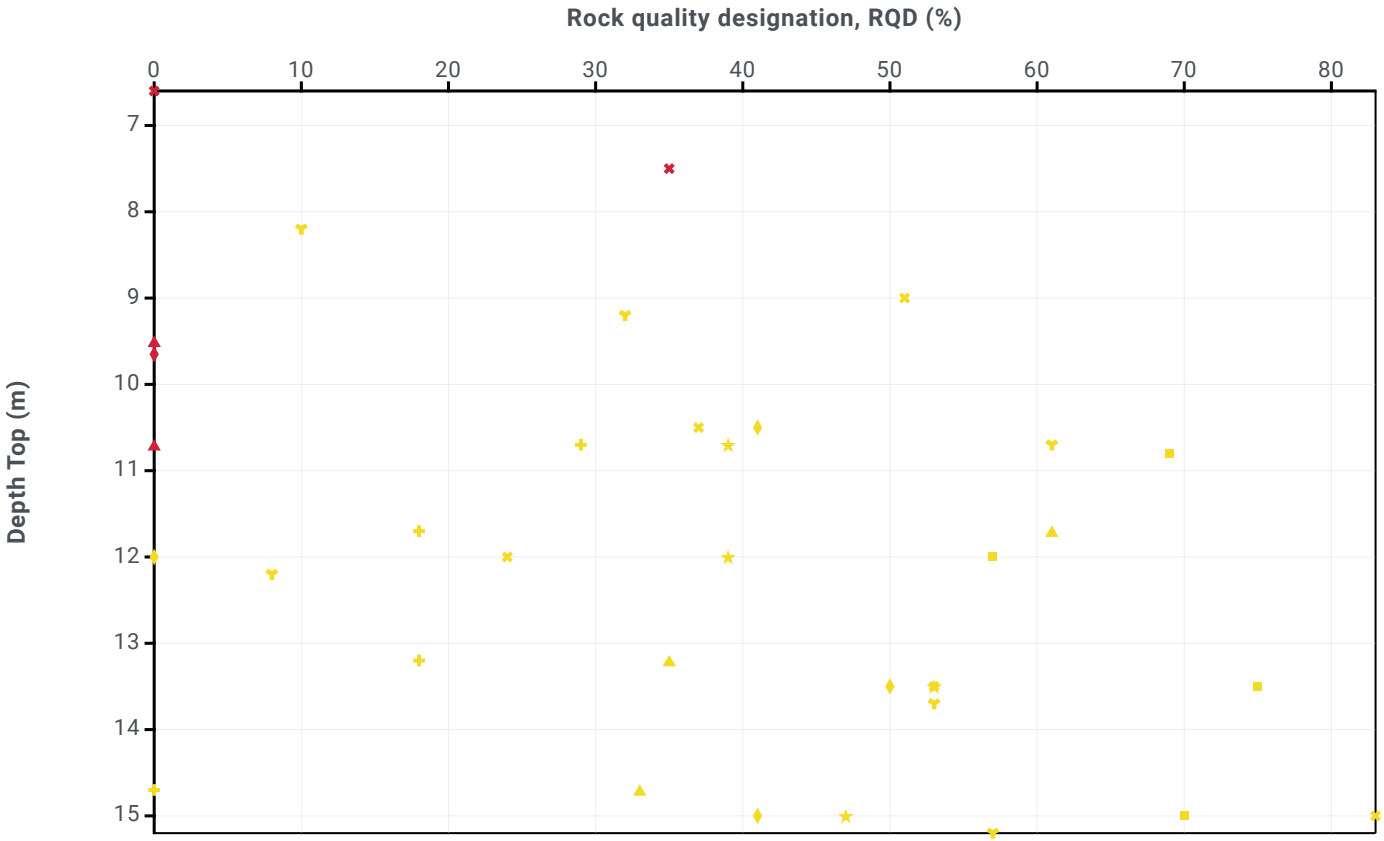
Geology Code	Location ID
SDST SDST-WR	BH01 BH06 BH02 BH07 BH03A BH04 BH05

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 07 Mar 2025
Graph Total core recovery (TCR)	**Client** Unite Students and Manchester Metropolitan University	**Figure** B9



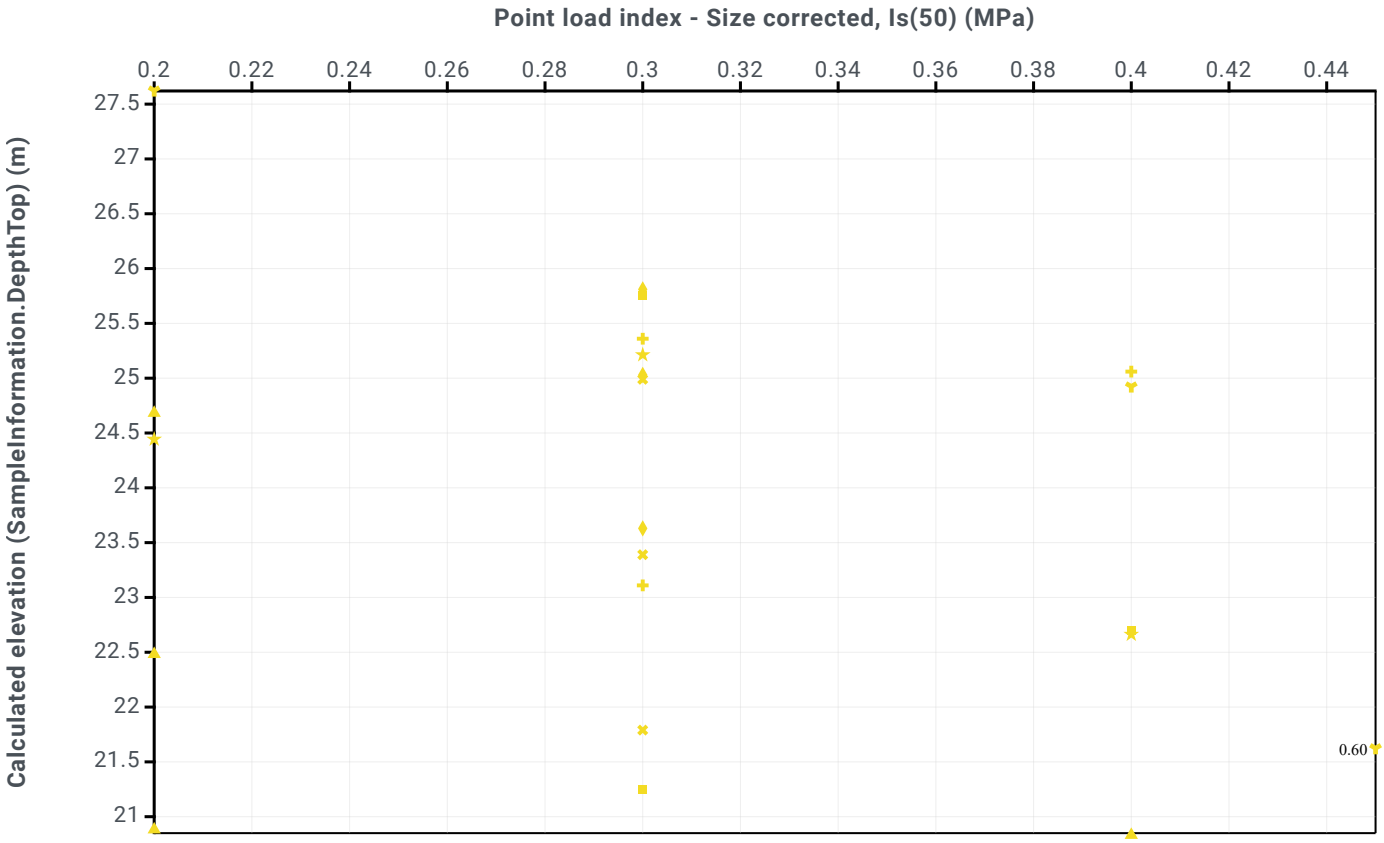
Geology Code	Location ID
SDST SDST-WR	BH01 BH06 BH02 BH07 BH03A BH04 BH05

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 07 Mar 2025
Graph Solid core recovery (SCR)	**Client** Unite Students and Manchester Metropolitan University	**Figure** B10



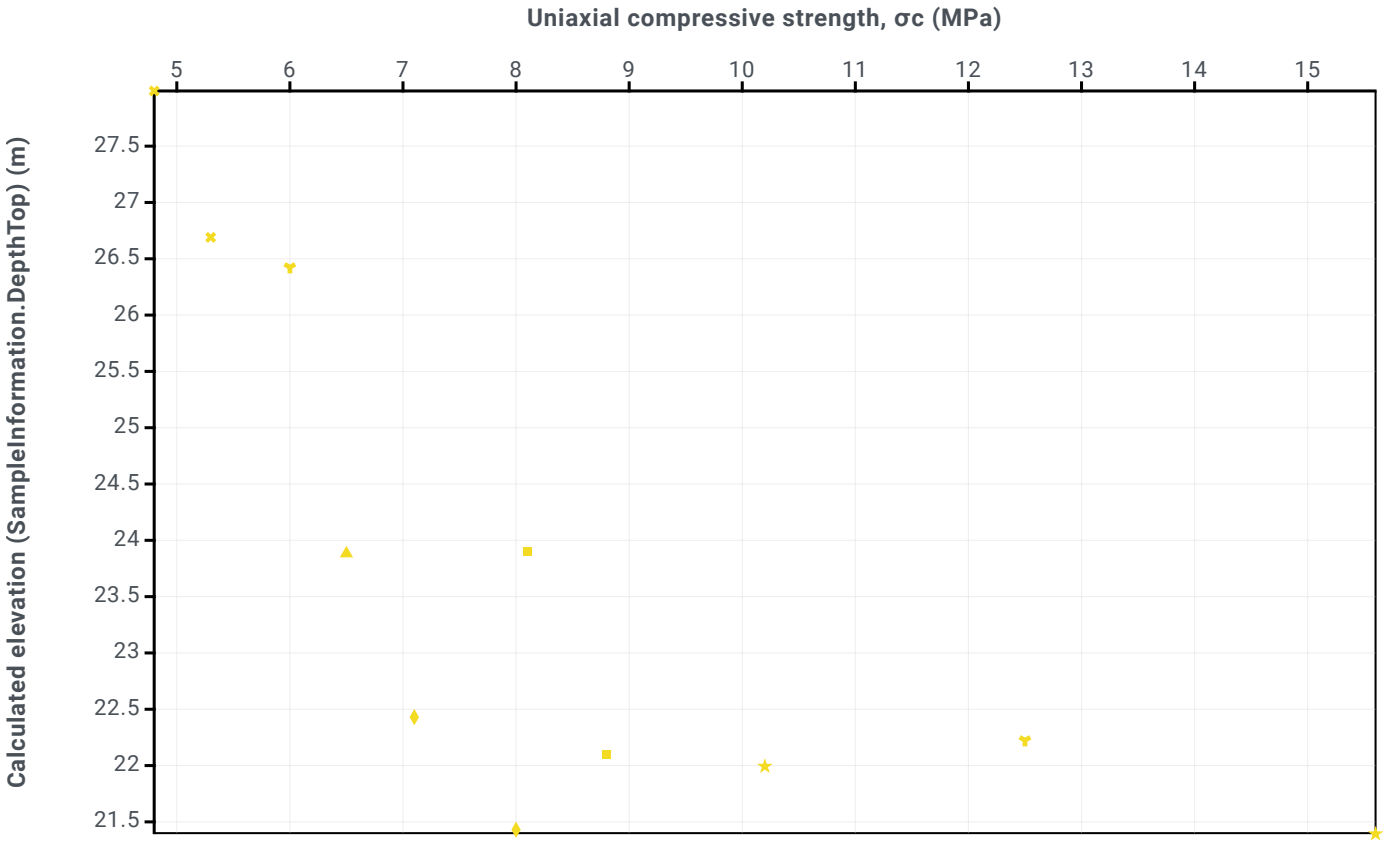
Geology Code	Location ID
SDST SDST-WR	BH01 BH06 BH02 BH07 BH03A BH04 BH05

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 07 Mar 2025
Graph Rock quality designation (RQD) (2)	**Client** Unite Students and Manchester Metropolitan University	**Figure** B11



Geology Code	Location ID
SDST	BH01 BH02 BH03A BH04 BH05 BH06 BH07

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 25 Feb 2025
Graph Point load (PL) index - Size corrected	**Client** Unite Students and Manchester Metropolitan University	**Figure** B12



Geology Code	Location ID
SDST	BH02 BH07 BH03A BH04 BH05 BH06

Project Cambridge Hall Manchester		**Job number** 303452-00
Report -	**Company** Arup	**Date** 25 Feb 2025
Graph Uniaxial compressive strength (UCS)	**Client** Unite Students and Manchester Metropolitan University	**Figure** B13

Appendix C- Human Health Screening Assessment

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	BH01	BH01	BH01	BH01	BH02	BH02	BH03	BH03A	BH03A	BH03A
Hole Ref										BH01	BH01	BH01	BH01	BH02	BH02	BH03	BH03A	BH03A	BH03A
Sample Ref																			
Easting										384136.9	384136.9	384136.9	384136.9	384137.18	384137.18	384140.8	384144.49	384144.49	384144.49
Northing										397020.81	397020.81	397020.81	397020.81	396991.69	396991.69	396973	396973.14	396973.14	396973.14
Hole Elevation (mOD)										36.66	36.66	36.66	36.66	36.68	36.68	36.55	36.55	36.55	36.55
Sample Depth (mbgl)										0.2	0.3	0.6	0.8	0.4	0.5	0.3	0.9	1.7	2.5
Sample Date																			
Investigation																			
Geology										Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground
Metal																			
Antimony (aqua regia extractable)	617.5682	AGAC	mg/kg	7 of 16	0	<0.017	3.5		0	<0.017		3.5		1.9				<0.017	
Arsenic (aqua regia extractable)	39.9	C4SL/S4UL	mg/kg	15 of 16	0	<0.01	11		0	0.0221		11		4.7				0.0199	
Beryllium (aqua regia extractable)	1.7	AGAC/S4UL	mg/kg	7 of 7	0	0.11	1.1		0			0.78		0.45					
Cadmium (aqua regia extractable)	85	AGAC/S4UL	mg/kg	4 of 16	0	<0.001	1.1		0	<0.001		0.5		0.3				<0.001	
Chromium (aqua regia extractable)	907	AGAC (Cr III	mg/kg	16 of 16	0	0.0043	29		0	0.0089		19		14				0.018	
Chromium (hexavalent)	6	AGAC/S4UL	mg/kg	0 of 7	0	<1.8	<1.8		0			<1.8		<1.8					
Copper (aqua regia extractable)	7130	AGAC	mg/kg	15 of 16	0	<0.007	60		0	<0.007		60		27				0.023	
Lead (aqua regia extractable)	310	C4SL	mg/kg	10 of 16	0	<0.01	120		0	<0.01		120		120				<0.01	
Mercury (aqua regia extractable)	56	AC (inorgan	mg/kg	0 of 16	0	<0.005	<0.3		0	<0.005		<0.3		<0.3				<0.005	
Nickel (aqua regia extractable)	181.4	AGAC	mg/kg	14 of 16	0	<0.003	31		0	<0.003		18		11				<0.003	
Selenium (aqua regia extractable)	430	AGAC/S4UL	mg/kg	2 of 16	0	<0.04	<1		0	<0.04		<1		<1				<0.04	
Vanadium (aqua regia extractable)	1200	JL (pentavale	mg/kg	7 of 7	0	5.5	30		0			25		17					
Zinc (aqua regia extractable)	40400	AGAC	mg/kg	15 of 16	0	<0.004	93		0	0.01		93		54				<0.004	
Asbestos																			
Asbestos in Soil			Type	No GAC	-				0		Not-detected		Not-detected		Not-detected	Not-detected	Not-detected		Not-detected
Inorganic																			
pH			pH Units	No GAC	-	7.8	11.6		0										
Total Cyanide	24	AC (free, acı	mg/kg	1 of 7	0	<1	7.7		0			7.7		<1					
Boron (water soluble)	10775	AGAC	mg/kg	7 of 7	0	0.4	0.9		0			0.6		0.8					
Dissolved organic carbon (DOC) 10:1			mg/kg	No GAC	-	32	174		0	32								58	
Total Organic Carbon (TOC)			%	No GAC	-	<0.1	1.7		0	<0.1		1.1		0.6				0.7	
Sulphate (water soluble)			mg/kg	No GAC	-	22	630		0	22								81	
Total Phenols (monohydric)	440	L (direct con	mg/kg	1 of 16	0	<0.1	<1		0	<0.1		<1		<1				<0.1	
PAH																			
Acenaphthene	2995	AGAC	mg/kg	10 of 11	0	<0.05	100	57.0	1	0.08								0.05	
Di-benzo(a,h)anthracene	0.310292	AGAC/S4UL	mg/kg	8 of 11	5	<0.05	15		0	<0.05								<0.05	
Fluoranthene	1526.396	AGAC	mg/kg	10 of 11	0	<0.05	410		0	0.54								0.54	
Fluorene	2795	AGAC	mg/kg	9 of 11	0	<0.05	44	30.90	1	0.09								<0.05	
Indeno(1,2,3-cd)pyrene	45	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	70		0	0.09								0.16	
Phenanthrene	1292	AGAC	mg/kg	10 of 11	0	<0.05	450	36.0	1	0.46								0.37	
Pyrene	3661.13	AGAC	mg/kg	10 of 11	0	<0.05	340		0	0.43								0.52	
Naphthalene	2.33327	AGAC	mg/kg	10 of 11	1	<0.05	27		0	0.05								0.09	
Speciated Total EPA-16 PAHs			mg/kg	No GAC	-	<0.8	60.6		0										
Total 17 PAHs			mg/kg	No GAC	-	2.76	2260		0	2.76								3.41	
Acenaphthylene	2893	AGAC	mg/kg	4 of 11	0	<0.05	0.84	86.0	0	<0.05								<0.05	
Anthracene	30604	AGAC	mg/kg	10 of 11	0	<0.05	120	1.170	4	0.12								0.08	
Benzo(a)anthracene	10.97436	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0	0.17								0.26	
Benzo(a)pyrene	3.167392	AGAC/S4UL	mg/kg	10 of 11	4	<0.05	120		0	0.16								0.27	
Benzo(ghi)perylene	355.1437	AGAC	mg/kg	10 of 11	0	<0.05	76		0	0.1								0.19	
Benzo(b)fluoranthene	3.953995	AGAC	mg/kg	10 of 11	3	<0.05	140		0	0.24								0.28	
Benzo(k)fluoranthene	105.6374	AGAC	mg/kg	9 of 11	0	<0.05	46		0	<0.05								0.18	
Chrysene	29.65853	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0	0.22								0.3	
BTEX																			
Benzene	0.378	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0	<0.005								<0.005	
Toluene	880	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005	869.0	0	<0.005								<0.005	
Ethylbenzene	82.4	AGAC	mg/kg	0 of 6	0	<0.005	<0.005		0	<0.005								<0.005	
o-xylene	88.3	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0	<0.005								<0.005	
p- & m-xylene	79	AC (p-xyler	mg/kg	0 of 6	0	<0.008	<0.008		0	<0.008								<0.008	
Total BTEX			mg/kg	No GAC	-	<0.01	<0.01		0	<0.01								<0.01	
Mineral Oil (C10 - C40)			mg/kg	No GAC	-	<10	62		0	12								<10	
PCBs																			
PCB Congener 101			mg/kg	No GAC	-	<0.001	<0.001		0	<0.001								<0.001	
PCB Congener 118	0.000171	K urban con	mg/kg	0 of 6	0	<0.001	<0.001		0	<0.001								<0.001	
PCB Congener 138			mg/kg	No GAC	-	<0.001	<0.001		0	<0.001								<0.001	
PCB Congener 153			mg/kg	No GAC	-	<0.001	<0.001		0	<0.001								<0.001	
PCB Congener 180			mg/kg	No GAC	-	<0.001	<0.001		0	<0.001								<0.001	
PCB Congener 28			mg/kg	No GAC	-	<0.001	<0.001		0	<0.001								<0.001	
PCB Congener 52			mg/kg	No GAC	-	<0.001	<0.001		0	<0.001								<0.001	
Barium 10:1			mg/kg	No GAC	-	0.242	4.45		0	4.45								0.252	
Chloride 10:1			mg/kg	No GAC	-	3.8	120		0	3.8								65	
Coronene			mg/kg	No GAC	-	<0.05	23		0	<0.05								0.11	
Fluoride 10:1			mg/kg	No GAC	-	1.9	7		0	3.1								7	
Molybdenum 10:1			mg/kg	No GAC	-	0.0249	0.159		0	0.0249								0.0854	
Total ICES-7 PCBs			mg/kg	No GAC	-	<0.007	<0.007		0	<0.007								<0.007	
Total dissolved solids 10:1			mg/kg	No GAC	-	300	9600		0	300								690	

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH03A	BH03A	BH04	BH04	BH04	BH04	BH04	BH05	BH05	BH05
										Sample Ref										
										Easting	384144.49	384144.49	384169.66	384169.66	384169.66	384169.66	384169.66	384161.46	384161.46	384161.46
										Northing	396973.14	396973.14	396964.03	396964.03	396964.03	396964.03	396964.03	396938.34	396938.34	396938.34
										Hole Elevation (mOD)	36.55	36.55	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6
										Sample Depth (mbgl)	3.7	5	1.1	1.5	1.6	2.4	4.5	0.8	2.5	1.6
										Sample Date										
										Investigation										
										Geology	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground
Metal																				
Antimony (aqua regia extractable)	617.5682	AGAC	mg/kg	7 of 16	0	<0.017	3.5		0		2		2			<0.017				
Arsenic (aqua regia extractable)	39.9	C4SL/S4UL	mg/kg	15 of 16	0	<0.01	11		0		7.3		6.7			<0.01				
Beryllium (aqua regia extractable)	1.7	AGAC/S4UL	mg/kg	7 of 7	0	0.11	1.1		0		1.1		0.83							
Cadmium (aqua regia extractable)	85	AGAC/S4UL	mg/kg	4 of 16	0	<0.001	1.1		0		<0.2		0.2			<0.001				
Chromium (aqua regia extractable)	907	AGAC (Cr III	mg/kg	16 of 16	0	0.0043	29		0		29		22			0.023				
Chromium (hexavalent)	6	AGAC/S4UL	mg/kg	0 of 7	0	<1.8	<1.8		0		<1.8		<1.8							
Copper (aqua regia extractable)	7130	AGAC	mg/kg	15 of 16	0	<0.007	60		0		22		20			0.045				
Lead (aqua regia extractable)	310	C4SL	mg/kg	10 of 16	0	<0.01	120		0		13		24			<0.01				
Mercury (aqua regia extractable)	56	GAC (inorgan	mg/kg	0 of 16	0	<0.005	<0.3		0		<0.3		<0.3			<0.005				
Nickel (aqua regia extractable)	181.4	AGAC	mg/kg	14 of 16	0	<0.003	31		0		31		23			0.0089				
Selenium (aqua regia extractable)	430	AGAC/S4UL	mg/kg	2 of 16	0	<0.04	<1		0		<1		<1			0.045				
Vanadium (aqua regia extractable)	1200	JL (pentavale	mg/kg	7 of 7	0	5.5	30		0		30		24							
Zinc (aqua regia extractable)	40400	AGAC	mg/kg	15 of 16	0	<0.004	93		0		61		51			0.05				
Asbestos																				
Asbestos in Soil			Type	No GAC	-				0			Not-detected		Not-detected				Not-detected	Not-detected	Not-detected
Inorganic																				
pH			pH Units	No GAC	-	7.8	11.6		0											
Total Cyanide	24	AC (free, acı	mg/kg	1 of 7	0	<1	7.7		0		<1		<1							
Boron (water soluble)	10775	AGAC	mg/kg	7 of 7	0	0.4	0.9		0		0.9		0.7							
Dissolved organic carbon (DOC) 10:1			mg/kg	No GAC	-	32	174		0							86.5				
Total Organic Carbon (TOC)			%	No GAC	-	<0.1	1.7		0		0.7		0.7			1				
Sulphate (water soluble)			mg/kg	No GAC	-	22	630		0							160				
Total Phenols (monohydric)	440	L (direct con	mg/kg	1 of 16	0	<0.1	<1		0		<1		<1			<0.1				
PAH																				
Acenaphthene	2995	AGAC	mg/kg	10 of 11	0	<0.05	100	57.0	1						0.25	3.7				0.86
Di-benzo(a,h)anthracene	0.310292	AGAC/S4UL	mg/kg	8 of 11	5	<0.05	15		0						0.12	**0.59**				**0.37**
Fluoranthene	1526.396	AGAC	mg/kg	10 of 11	0	<0.05	410		0						2.4	17				6.7
Fluorene	2795	AGAC	mg/kg	9 of 11	0	<0.05	44	30.90	1						0.19	2.7				0.61
Indeno(1,2,3-cd)pyrene	45	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	70		0						0.49	3				1.4
Phenanthrene	1292	AGAC	mg/kg	10 of 11	0	<0.05	450	36.0	1						1.5	15				5.2
Pyrene	3661.13	AGAC	mg/kg	10 of 11	0	<0.05	340		0						2.2	15				5.9
Naphthalene	2.33327	AGAC	mg/kg	10 of 11	1	<0.05	27		0						0.11	2.3				0.26
Speciated Total EPA-16 PAHs			mg/kg	No GAC	-	<0.8	60.6		0						13.2					37.1
Total 17 PAHs			mg/kg	No GAC	-	2.76	2260		0							98.8				
Acenaphthylene	2893	AGAC	mg/kg	4 of 11	0	<0.05	0.84	86.0	0						<0.05	0.07				<0.05
Anthracene	30604	AGAC	mg/kg	10 of 11	0	<0.05	120	1.170	4						0.41	3.9				1
Benzo(a)anthracene	10.97436	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0						1.1	6.9				2.9
Benzo(a)pyrene	3.167392	AGAC/S4UL	mg/kg	10 of 11	4	<0.05	120		0						1.1	**6.7**				2.9
Benzo(ghi)perylene	355.1437	AGAC	mg/kg	10 of 11	0	<0.05	76		0						0.58	3.3				1.7
Benzo(b)fluoranthene	3.953995	AGAC	mg/kg	10 of 11	3	<0.05	140		0						1.3	**7.9**				3.1
Benzo(k)fluoranthene	105.6374	AGAC	mg/kg	9 of 11	0	<0.05	46		0						0.46	2.7				1.5
Chrysene	29.65853	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0						1.1	6.5				2.8
BTEX																				
Benzene	0.378	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0							<0.005				
Toluene	880	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005	869.0	0							<0.005				
Ethylbenzene	82.4	AGAC	mg/kg	0 of 6	0	<0.005	<0.005		0							<0.005				
o-xylene	88.3	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0							<0.005				
p- & m-xylene	79	GAC (p-xyler	mg/kg	0 of 6	0	<0.008	<0.008		0							<0.008				
Total BTEX			mg/kg	No GAC	-	<0.01	<0.01		0							<0.01				
Mineral Oil (C10 - C40)			mg/kg	No GAC	-	<10	62		0							<10				
PCBs																				
PCB Congener 101			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 118	0.000171	K urban con	mg/kg	0 of 6	0	<0.001	<0.001		0							<0.001				
PCB Congener 138			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 153			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 180			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 28			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 52			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
Barium 10:1			mg/kg	No GAC	-	0.242	4.45		0							0.587				
Chloride 10:1			mg/kg	No GAC	-	3.8	120		0							24				
Coronene			mg/kg	No GAC	-	<0.05	23		0							1.5				
Fluoride 10:1			mg/kg	No GAC	-	1.9	7		0							6.4				
Molybdenum 10:1			mg/kg	No GAC	-	0.0249	0.159		0							0.112				
Total ICES-7 PCBs			mg/kg	No GAC	-	<0.007	<0.007		0							<0.007				
Total dissolved solids 10:1			mg/kg	No GAC	-	300	9600		0							840				

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH05	BH05	BH05	BH06	BH06	BH06	BH06	BH06	BH06	BH06
										Sample Ref										
										Easting	384161.46	384161.46	384161.46	384189.48	384189.48	384189.48	384189.48	384189.48	384189.48	384189.48
										Northing	396938.34	396938.34	396938.34	396923.61	396923.61	396923.61	396923.61	396923.61	396923.61	396923.61
										Hole Elevation (mOD)	36.6	36.6	36.6	36.62	36.62	36.62	36.62	36.62	36.62	36.62
										Sample Depth (mbgl)	2.7	3.8	6.8	0.3	0.7	1.5	1.7	2.7	3.5	3.7
										Sample Date										
										Investigation										
										Geology	Made ground	Made ground	Natural	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground	Made ground
Metal																				
Antimony (aqua regia extractable)	617.5682	AGAC	mg/kg	7 of 16	0	<0.017	3.5		0		<0.017	<0.017	1.9	<1				0.035		<0.017
Arsenic (aqua regia extractable)	39.9	C4SL/S4UL	mg/kg	15 of 16	0	<0.01	11		0		0.0293	0.0484	7.4	2				0.117		0.02
Beryllium (aqua regia extractable)	1.7	AGAC/S4UL	mg/kg	7 of 7	0	0.11	1.1		0				1.1	0.11						
Cadmium (aqua regia extractable)	85	AGAC/S4UL	mg/kg	4 of 16	0	<0.001	1.1		0		<0.001	<0.001	<0.2	1.1				<0.001		<0.001
Chromium (aqua regia extractable)	907	AGAC (Cr III	mg/kg	16 of 16	0	0.0043	29		0		0.026	0.057	29	7.6				0.024		0.095
Chromium (hexavalent)	6	AGAC/S4UL	mg/kg	0 of 7	0	<1.8	<1.8		0				<1.8	<1.8						
Copper (aqua regia extractable)	7130	AGAC	mg/kg	15 of 16	0	<0.007	60		0		0.019	0.2	22	4.2				0.25		1
Lead (aqua regia extractable)	310	C4SL	mg/kg	10 of 16	0	<0.01	120		0		<0.01	0.077	11	24				0.059		<0.01
Mercury (aqua regia extractable)	56	GAC (inorgan	mg/kg	0 of 16	0	<0.005	<0.3		0		<0.005	<0.005	<0.3	<0.3				<0.005		<0.005
Nickel (aqua regia extractable)	181.4	AGAC	mg/kg	14 of 16	0	<0.003	31		0		0.019	0.037	30	3.4				0.018		0.11
Selenium (aqua regia extractable)	430	AGAC/S4UL	mg/kg	2 of 16	0	<0.04	<1		0		<0.04	<0.04	<1	<1				<0.04		0.045
Vanadium (aqua regia extractable)	1200	JL (pentavale	mg/kg	7 of 7	0	5.5	30		0				29	5.5						
Zinc (aqua regia extractable)	40400	AGAC	mg/kg	15 of 16	0	<0.004	93		0		0.086	0.2	54	35				0.049		0.046
Asbestos																				
Asbestos in Soil			Type	No GAC	-				0							Not-detected			Not-detected	
Inorganic																				
pH			pH Units	No GAC	-	7.8	11.6		0		8.8									11.6
Total Cyanide	24	AC (free, acı	mg/kg	1 of 7	0	<1	7.7		0				<1	<1						
Boron (water soluble)	10775	AGAC	mg/kg	7 of 7	0	0.4	0.9		0				0.5	0.4						
Dissolved organic carbon (DOC) 10:1			mg/kg	No GAC	-	32	174		0		108	110						99.7		174
Total Organic Carbon (TOC)			%	No GAC	-	<0.1	1.7		0		1	0.8	0.8	0.2				0.9		1.4
Sulphate (water soluble)			mg/kg	No GAC	-	22	630		0		320	320					630	570		370
Total Phenols (monohydric)	440	L (direct con	mg/kg	1 of 16	0	<0.1	<1		0		<0.1	<0.1	<1	<1				<0.1		0.1
PAH																				
Acenaphthene	2995	AGAC	mg/kg	10 of 11	0	<0.05	100	57.0	1			0.98			0.34			0.66		
Di-benzo(a,h)anthracene	0.310292	AGAC/S4UL	mg/kg	8 of 11	5	<0.05	15		0			0.24			0.11			**0.33**		
Fluoranthene	1526.396	AGAC	mg/kg	10 of 11	0	<0.05	410		0			6.2			2.7			7.2		
Fluorene	2795	AGAC	mg/kg	9 of 11	0	<0.05	44	30.90	1			0.87			0.23			0.6		
Indeno(1,2,3-cd)pyrene	45	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	70		0			1.2			0.57			1.6		
Phenanthrene	1292	AGAC	mg/kg	10 of 11	0	<0.05	450	36.0	1			5.8			2			4.9		
Pyrene	3661.13	AGAC	mg/kg	10 of 11	0	<0.05	340		0			5.6			2.5			6.8		
Naphthalene	2.33327	AGAC	mg/kg	10 of 11	1	<0.05	27		0			1			0.1			0.4		
Speciated Total EPA-16 PAHs			mg/kg	No GAC	-	<0.8	60.6		0						15.8					
Total 17 PAHs			mg/kg	No GAC	-	2.76	2260		0			35.7						40.8		
Acenaphthylene	2893	AGAC	mg/kg	4 of 11	0	<0.05	0.84	86.0	0			0.09			<0.05			0.1		
Anthracene	30604	AGAC	mg/kg	10 of 11	0	<0.05	120	1.170	4			1			1.2			1.1		
Benzo(a)anthracene	10.97436	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0			2.3			1.1			2.9		
Benzo(a)pyrene	3.167392	AGAC/S4UL	mg/kg	10 of 11	4	<0.05	120		0			2.3			1.2			**3.2**		
Benzo(ghi)perylene	355.1437	AGAC	mg/kg	10 of 11	0	<0.05	76		0			1.3			0.68			1.7		
Benzo(b)fluoranthene	3.953995	AGAC	mg/kg	10 of 11	3	<0.05	140		0			2.7			1.3			3.6		
Benzo(k)fluoranthene	105.6374	AGAC	mg/kg	9 of 11	0	<0.05	46		0			1.3			0.6			1.6		
Chrysene	29.65853	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0			2.8			1.2			3.4		
BTEX																				
Benzene	0.378	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0			<0.005						<0.005		
Toluene	880	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005	869.0	0			<0.005						<0.005		
Ethylbenzene	82.4	AGAC	mg/kg	0 of 6	0	<0.005	<0.005		0			<0.005						<0.005		
o-xylene	88.3	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0			<0.005						<0.005		
p- & m-xylene	79	GAC (p-xyler	mg/kg	0 of 6	0	<0.008	<0.008		0			<0.008						<0.008		
Total BTEX			mg/kg	No GAC	-	<0.01	<0.01		0			<0.01						<0.01		
Mineral Oil (C10 - C40)			mg/kg	No GAC	-	<10	62		0			24						31		
PCBs																				
PCB Congener 101			mg/kg	No GAC	-	<0.001	<0.001		0			<0.001						<0.001		
PCB Congener 118	0.000171	K urban con	mg/kg	0 of 6	0	<0.001	<0.001		0			<0.001						<0.001		
PCB Congener 138			mg/kg	No GAC	-	<0.001	<0.001		0			<0.001						<0.001		
PCB Congener 153			mg/kg	No GAC	-	<0.001	<0.001		0			<0.001						<0.001		
PCB Congener 180			mg/kg	No GAC	-	<0.001	<0.001		0			<0.001						<0.001		
PCB Congener 28			mg/kg	No GAC	-	<0.001	<0.001		0			<0.001						<0.001		
PCB Congener 52			mg/kg	No GAC	-	<0.001	<0.001		0			<0.001						<0.001		
Barium 10:1			mg/kg	No GAC	-	0.242	4.45		0		0.414	0.541						0.242		1.35
Chloride 10:1			mg/kg	No GAC	-	3.8	120		0		44	49						89		120
Coronene			mg/kg	No GAC	-	<0.05	23		0			<0.05						0.67		
Fluoride 10:1			mg/kg	No GAC	-	1.9	7		0		4.9	4.5						5.5		1.9
Molybdenum 10:1			mg/kg	No GAC	-	0.0249	0.159		0		0.101	0.0906						0.103		0.128
Total ICES-7 PCBs			mg/kg	No GAC	-	<0.007	<0.007		0			<0.007						<0.007		
Total dissolved solids 10:1			mg/kg	No GAC	-	300	9600		0		920	890						1100		9600

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH06	BH07	BH07	BH07	BH07	BH07	BH07	SA01	SA01	SA02
										Sample Ref										
										Easting	384189.48	384199.43	384199.43	384199.43	384199.43	384199.43	384199.43	384149.05	384149.05	384162
										Northing	396923.61	396911.76	396911.76	396911.76	396911.76	396911.76	396911.76	396996.64	396996.64	396978.5
										Hole Elevation (mOD)	36.62	36.59	36.59	36.59	36.59	36.59	36.59	36.62	36.62	36.62
										Sample Depth (mbgl)	4.7	0.5	0.9	1.6	2.9	3.6	6.6	0.7	1.7	0.5
										Sample Date										
										Investigation										
										Geology	Natural	Made ground	Made ground	Made ground	Made ground	Made ground	Natural	Made ground	Natural	Made ground
Metal																				
Antimony (aqua regia extractable)	617.5682	AGAC	mg/kg	7 of 16	0	<0.017	3.5		0				1.8	<0.017		<0.017				
Arsenic (aqua regia extractable)	39.9	C4SL/S4UL	mg/kg	15 of 16	0	<0.01	11		0				6	0.0532		0.0578				
Beryllium (aqua regia extractable)	1.7	AGAC/S4UL	mg/kg	7 of 7	0	0.11	1.1		0				0.88							
Cadmium (aqua regia extractable)	85	AGAC/S4UL	mg/kg	4 of 16	0	<0.001	1.1		0				<0.2	<0.001		<0.001				
Chromium (aqua regia extractable)	907	AGAC (Cr III	mg/kg	16 of 16	0	0.0043	29		0				22	0.0043		0.034				
Chromium (hexavalent)	6	AGAC/S4UL	mg/kg	0 of 7	0	<1.8	<1.8		0				<1.8							
Copper (aqua regia extractable)	7130	AGAC	mg/kg	15 of 16	0	<0.007	60		0				32	0.048		0.029				
Lead (aqua regia extractable)	310	C4SL	mg/kg	10 of 16	0	<0.01	120		0				13	<0.01		0.05				
Mercury (aqua regia extractable)	56	GAC (inorgan	mg/kg	0 of 16	0	<0.005	<0.3		0				<0.3	<0.005		<0.005				
Nickel (aqua regia extractable)	181.4	AGAC	mg/kg	14 of 16	0	<0.003	31		0				23	0.0049		0.013				
Selenium (aqua regia extractable)	430	AGAC/S4UL	mg/kg	2 of 16	0	<0.04	<1		0				<1	<0.04		<0.04				
Vanadium (aqua regia extractable)	1200	JL (pentavale	mg/kg	7 of 7	0	5.5	30		0				22							
Zinc (aqua regia extractable)	40400	AGAC	mg/kg	15 of 16	0	<0.004	93		0				46	0.02		0.11				
Asbestos																				
Asbestos in Soil			Type	No GAC	-				0			Not-detected			Not-detected			Not-detected		Not-detected
Inorganic																				
pH			pH Units	No GAC	-	7.8	11.6		0					7.8						
Total Cyanide	24	AC (free, acı	mg/kg	1 of 7	0	<1	7.7		0				<1							
Boron (water soluble)	10775	AGAC	mg/kg	7 of 7	0	0.4	0.9		0				0.5							
Dissolved organic carbon (DOC) 10:1			mg/kg	No GAC	-	32	174		0					127		122				
Total Organic Carbon (TOC)			%	No GAC	-	<0.1	1.7		0				0.7	0.4		1.7				
Sulphate (water soluble)			mg/kg	No GAC	-	22	630		0			440	190	94		260	83			
Total Phenols (monohydric)	440	L (direct con	mg/kg	1 of 16	0	<0.1	<1		0				<1	<0.1		<0.1				
PAH																				
Acenaphthene	2995	AGAC	mg/kg	10 of 11	0	<0.05	100	57.0	1							100			<0.05	
Di-benzo(a,h)anthracene	0.310292	AGAC/S4UL	mg/kg	8 of 11	5	<0.05	15		0							**15**			<0.05	
Fluoranthene	1526.396	AGAC	mg/kg	10 of 11	0	<0.05	410		0							410			<0.05	
Fluorene	2795	AGAC	mg/kg	9 of 11	0	<0.05	44	30.90	1							44			<0.05	
Indeno(1,2,3-cd)pyrene	45	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	70		0							**70**			<0.05	
Phenanthrene	1292	AGAC	mg/kg	10 of 11	0	<0.05	450	36.0	1							450			<0.05	
Pyrene	3661.13	AGAC	mg/kg	10 of 11	0	<0.05	340		0							340			<0.05	
Naphthalene	2.33327	AGAC	mg/kg	10 of 11	1	<0.05	27		0							**27**			<0.05	
Speciated Total EPA-16 PAHs			mg/kg	No GAC	-	<0.8	60.6		0										<0.8	
Total 17 PAHs			mg/kg	No GAC	-	2.76	2260		0							2260				
Acenaphthylene	2893	AGAC	mg/kg	4 of 11	0	<0.05	0.84	86.0	0							0.84			<0.05	
Anthracene	30604	AGAC	mg/kg	10 of 11	0	<0.05	120	1.170	4							120			<0.05	
Benzo(a)anthracene	10.97436	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0							**140**			<0.05	
Benzo(a)pyrene	3.167392	AGAC/S4UL	mg/kg	10 of 11	4	<0.05	120		0							**120**			<0.05	
Benzo(ghi)perylene	355.1437	AGAC	mg/kg	10 of 11	0	<0.05	76		0							76			<0.05	
Benzo(b)fluoranthene	3.953995	AGAC	mg/kg	10 of 11	3	<0.05	140		0							**140**			<0.05	
Benzo(k)fluoranthene	105.6374	AGAC	mg/kg	9 of 11	0	<0.05	46		0							46			<0.05	
Chrysene	29.65853	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0							**140**			<0.05	
BTEX																				
Benzene	0.378	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0							<0.005				
Toluene	880	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005	869.0	0							<0.005				
Ethylbenzene	82.4	AGAC	mg/kg	0 of 6	0	<0.005	<0.005		0							<0.005				
o-xylene	88.3	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0							<0.005				
p- & m-xylene	79	GAC (p-xyler	mg/kg	0 of 6	0	<0.008	<0.008		0							<0.008				
Total BTEX			mg/kg	No GAC	-	<0.01	<0.01		0							<0.01				
Mineral Oil (C10 - C40)			mg/kg	No GAC	-	<10	62		0							62				
PCBs																				
PCB Congener 101			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 118	0.000171	K urban con	mg/kg	0 of 6	0	<0.001	<0.001		0							<0.001				
PCB Congener 138			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 153			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 180			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 28			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
PCB Congener 52			mg/kg	No GAC	-	<0.001	<0.001		0							<0.001				
Barium 10:1			mg/kg	No GAC	-	0.242	4.45		0					0.248		0.426				
Chloride 10:1			mg/kg	No GAC	-	3.8	120		0					18		23				
Coronene			mg/kg	No GAC	-	<0.05	23		0							23				
Fluoride 10:1			mg/kg	No GAC	-	1.9	7		0					3.8		5.6				
Molybdenum 10:1			mg/kg	No GAC	-	0.0249	0.159		0					0.159		0.0902				
Total ICES-7 PCBs			mg/kg	No GAC	-	<0.007	<0.007		0							<0.007				
Total dissolved solids 10:1			mg/kg	No GAC	-	300	9600		0					660		830				

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	SA03	SA03
										Sample Ref		
										Easting	384186.44	384186.44
										Northing	396931.12	396931.12
										Hole Elevation (mOD)	36.58	36.58
										Sample Depth (mbgl)	0.3	0.8
										Sample Date		
										Investigation		
										Geology	Made ground	Made ground
Metal												
Antimony (aqua regia extractable)	617.5682	AGAC	mg/kg	7 of 16	0	<0.017	3.5		0			
Arsenic (aqua regia extractable)	39.9	C4SL/S4UL	mg/kg	15 of 16	0	<0.01	11		0			
Beryllium (aqua regia extractable)	1.7	AGAC/S4UL	mg/kg	7 of 7	0	0.11	1.1		0			
Cadmium (aqua regia extractable)	85	AGAC/S4UL	mg/kg	4 of 16	0	<0.001	1.1		0			
Chromium (aqua regia extractable)	907	AGAC (Cr III	mg/kg	16 of 16	0	0.0043	29		0			
Chromium (hexavalent)	6	AGAC/S4UL	mg/kg	0 of 7	0	<1.8	<1.8		0			
Copper (aqua regia extractable)	7130	AGAC	mg/kg	15 of 16	0	<0.007	60		0			
Lead (aqua regia extractable)	310	C4SL	mg/kg	10 of 16	0	<0.01	120		0			
Mercury (aqua regia extractable)	56	GAC (inorgan	mg/kg	0 of 16	0	<0.005	<0.3		0			
Nickel (aqua regia extractable)	181.4	AGAC	mg/kg	14 of 16	0	<0.003	31		0			
Selenium (aqua regia extractable)	430	AGAC/S4UL	mg/kg	2 of 16	0	<0.04	<1		0			
Vanadium (aqua regia extractable)	1200	JL (pentavale	mg/kg	7 of 7	0	5.5	30		0			
Zinc (aqua regia extractable)	40400	AGAC	mg/kg	15 of 16	0	<0.004	93		0			
Asbestos												
Asbestos in Soil			Type	No GAC	-				0		Not-detected	
Inorganic												
pH			pH Units	No GAC	-	7.8	11.6		0			
Total Cyanide	24	AC (free, acı	mg/kg	1 of 7	0	<1	7.7		0			
Boron (water soluble)	10775	AGAC	mg/kg	7 of 7	0	0.4	0.9		0			
Dissolved organic carbon (DOC) 10:1			mg/kg	No GAC	-	32	174		0			
Total Organic Carbon (TOC)			%	No GAC	-	<0.1	1.7		0			
Sulphate (water soluble)			mg/kg	No GAC	-	22	630		0			
Total Phenols (monohydric)	440	L (direct con	mg/kg	1 of 16	0	<0.1	<1		0			
PAH												
Acenaphthene	2995	AGAC	mg/kg	10 of 11	0	<0.05	100	57.0	1			1.9
Di-benzo(a,h)anthracene	0.310292	AGAC/S4UL	mg/kg	8 of 11	5	<0.05	15		0			**0.38**
Fluoranthene	1526.396	AGAC	mg/kg	10 of 11	0	<0.05	410		0			11
Fluorene	2795	AGAC	mg/kg	9 of 11	0	<0.05	44	30.90	1			1.3
Indeno(1,2,3-cd)pyrene	45	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	70		0			2
Phenanthrene	1292	AGAC	mg/kg	10 of 11	0	<0.05	450	36.0	1			9.3
Pyrene	3661.13	AGAC	mg/kg	10 of 11	0	<0.05	340		0			10
Naphthalene	2.33327	AGAC	mg/kg	10 of 11	1	<0.05	27		0			0.61
Speciated Total EPA-16 PAHs			mg/kg	No GAC	-	<0.8	60.6		0			60.6
Total 17 PAHs			mg/kg	No GAC	-	2.76	2260		0			
Acenaphthylene	2893	AGAC	mg/kg	4 of 11	0	<0.05	0.84	86.0	0			<0.05
Anthracene	30604	AGAC	mg/kg	10 of 11	0	<0.05	120	1.170	4			2.3
Benzo(a)anthracene	10.97436	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0			4.2
Benzo(a)pyrene	3.167392	AGAC/S4UL	mg/kg	10 of 11	4	<0.05	120		0			**4.2**
Benzo(ghi)perylene	355.1437	AGAC	mg/kg	10 of 11	0	<0.05	76		0			2.2
Benzo(b)fluoranthene	3.953995	AGAC	mg/kg	10 of 11	3	<0.05	140		0			**4.7**
Benzo(k)fluoranthene	105.6374	AGAC	mg/kg	9 of 11	0	<0.05	46		0			1.7
Chrysene	29.65853	AGAC/S4UL	mg/kg	10 of 11	1	<0.05	140		0			4.3
BTEX												
Benzene	0.378	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0			
Toluene	880	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005	869.0	0			
Ethylbenzene	82.4	AGAC	mg/kg	0 of 6	0	<0.005	<0.005		0			
o-xylene	88.3	AGAC/S4UL	mg/kg	0 of 6	0	<0.005	<0.005		0			
p- & m-xylene	79	GAC (p-xyler	mg/kg	0 of 6	0	<0.008	<0.008		0			
Total BTEX			mg/kg	No GAC	-	<0.01	<0.01		0			
Mineral Oil (C10 - C40)			mg/kg	No GAC	-	<10	62		0			
PCBs												
PCB Congener 101			mg/kg	No GAC	-	<0.001	<0.001		0			
PCB Congener 118	0.000171	K urban con	mg/kg	0 of 6	0	<0.001	<0.001		0			
PCB Congener 138			mg/kg	No GAC	-	<0.001	<0.001		0			
PCB Congener 153			mg/kg	No GAC	-	<0.001	<0.001		0			
PCB Congener 180			mg/kg	No GAC	-	<0.001	<0.001		0			
PCB Congener 28			mg/kg	No GAC	-	<0.001	<0.001		0			
PCB Congener 52			mg/kg	No GAC	-	<0.001	<0.001		0			
Barium 10:1			mg/kg	No GAC	-	0.242	4.45		0			
Chloride 10:1			mg/kg	No GAC	-	3.8	120		0			
Coronene			mg/kg	No GAC	-	<0.05	23		0			
Fluoride 10:1			mg/kg	No GAC	-	1.9	7		0			
Molybdenum 10:1			mg/kg	No GAC	-	0.0249	0.159		0			
Total ICES-7 PCBs			mg/kg	No GAC	-	<0.007	<0.007		0			
Total dissolved solids 10:1			mg/kg	No GAC	-	300	9600		0			

Appendix D- Controlled Waters Screening Assessment

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	95th %ile	Hole Ref	BH03A (19mm)	BH03A (50mm)	BH03A (19mm)	BH03A (50mm)	BH05
									Sample Ref	421909	421910	447248	447249	421911
									Easting	384144.49	384144.49	384144.49	384144.49	384161.46
									Northing	396973.14	396973.14	396973.14	396973.14	396938.34
									Hole Elevation (mOD)	36.55	36.55	36.55	36.55	36.6
									Sample Depth (mbgl)	10.12	3.34	10.36	3.03	2.68
									Piezometer top (mbgl)	10	2	10	2	1
									Piezometer base (mbgl)	15	5	15	5	5
									Sample Date	09/01/25	09/01/25	06/02/2025	06/02/2025	09/01/2025
									Aquifer	Sandstone	Made ground	Sandstone	Made ground	Made ground
Metal														
Antimony (dissolved)	0.005	DWS	mg/l	2 of 6	0	<0.0004	0.0011	0.00095		<0.0004		0.0005	<0.0004	0.0011
Arsenic (dissolved)	0.01	DWS	mg/l	6 of 6	0	0.00037	0.00273	0.00228		0.0004		0.00037	0.0005	0.00094
Beryllium (dissolved)	0.004	USEPA	mg/l	0 of 6	0	<0.0001	<0.0001	0.0001		<0.0001		<0.0001	<0.0001	<0.0001
Cadmium (dissolved)	0.005	DWS	mg/l	3 of 6	0	<0.00002	0.00036	0.00029		<0.00002		0.00004	<0.00002	0.00007
Calcium (dissolved)		-	mg/l	No GAC	-	63	150	145.0		63		110	74	130
Chromium (dissolved)	0.05	DWS	mg/l	6 of 6	0	0.00003	0.0047	0.0041		0.00003		0.0016	0.0023	0.0005
Chromium (hexavalent)	0.0034	EQS	mg/l	0 of 6	0	<0.005	<0.005	0.005		<0.005		<0.005	<0.005	<0.005
Copper (dissolved)	2	DWS	mg/l	6 of 6	0	0.0007	0.0039	0.0038		0.0013		0.0039	0.0023	0.0035
Lead (dissolved)	0.01	DWS	mg/l	2 of 6	0	<0.0002	0.0004	0.0004		<0.0002		<0.0002	<0.0002	0.0004
Manganese (dissolved)	0.05	DWS	mg/l	6 of 6	4	0.0026	18	14.475		0.0041		**2**	0.0026	**0.25**
Mercury (dissolved)	0.001	DWS	mg/l	2 of 6	0	<0.00005	0.00013	0.00011		<0.00005		<0.00005	<0.00005	0.00005
Nickel (dissolved)	0.02	DWS	mg/l	5 of 6	0	<0.0005	0.0087	0.0084		<0.0005		0.0075	0.0006	0.0041
Selenium (dissolved)	0.01	DWS	mg/l	3 of 6	0	<0.0006	0.0074	0.0058		0.0008		<0.0006	<0.0006	0.0074
Vanadium (dissolved)	0.02	EQS*	mg/l	3 of 6	0	<0.0002	0.001	0.00093		<0.0002		<0.0002	<0.0002	0.0007
Zinc (dissolved)	5	USEPA	mg/l	6 of 6	0	0.0012	0.041	0.03288		0.0012		0.041	0.0032	0.0045
Inorganic														
pH	<6 - >9	EQS*	pH Units	No GAC	-	6.9	7.9	7.90		7.9	7.9	7.4	7.8	7.5
Total Cyanide (low level)	0.05	DWS	mg/l	0 of 6	0	<0.001	<0.001	0.001		<0.001		<0.001	<0.001	<0.001
Free Cyanide (low level)	0.05	DWS	mg/l	0 of 2	0	<0.001	<0.001	0.001						
Boron (dissolved)	1	DWS	mg/l	2 of 2	0	0.11	0.23	0.224						
Chloride	250	DWS	mg/l	6 of 6	0	43	110	106.250		43		82	60	110
Ammoniacal Nitrogen as N	0.39	DWS	mg/l	4 of 6	0	<0.015	0.1	0.08375		<0.015		0.1	<0.015	0.028
Ammoniacal Nitrogen as NH3		-	mg/l	No GAC	-	<0.015	0.12	0.10075		<0.015		0.12	<0.015	0.034
Dissolved Organic Carbon (DOC)		-	mg/l	No GAC	-	1.46	7.62	6.865		4.01		1.94	1.46	7.62
Total Organic Carbon (TOC)		-	mg/l	No GAC	-	2.26	4.6	4.483						
Hardness - Total as CaCO3		-	mgCaCO3/l	No GAC	-	189	535	531.750		189		535	225	384
Sulphate as SO4	250	DWS	mg/l	4 of 4	1	50.1	311	295.40		50.2	50.1			
Sulphide		-	mg/l	No GAC	-	<0.005	<0.005	0.005						
Total Phenols (monohydric)	0.0077	EQS	mg/l	0 of 6	0	<0.01	<0.01	0.01		<0.01		<0.01	<0.01	<0.01
TPH														
TPH - Aliphatic >C10 - C12	0.3	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01						
TPH - Aliphatic >C12 - C16	0.3	WHO	mg/l	1 of 2	0	<0.01	0.04	0.0385						
TPH - Aliphatic >C16 - C21		-	mg/l	No GAC	-	<0.01	0.036	0.0347						
TPH - Aliphatic >C21 - C35		-	mg/l	No GAC	-	<0.01	0.25	0.238						
TPH - Aliphatic >C5 - C35		-	mg/l	No GAC	-	<0.01	0.32	0.3045						
TPH - Aliphatic >C5 - C6	15	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001						
TPH - Aliphatic >C6 - C8	15	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001						
TPH - Aliphatic >C8 - C10	0.3	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001						
TPH - Aromatic >EC10 - EC12	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01						
TPH - Aromatic >EC12 - EC16	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01						
TPH - Aromatic >EC16 - EC21	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01						
TPH - Aromatic >EC21 - EC35	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01						
TPH - Aromatic >EC5 - EC7	0.01	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001						
TPH - Aromatic >EC7 - EC8	0.7	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001						
TPH - Aromatic >EC8 - EC10	0.3	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001						
TPH - Aromatic >EC5 - EC35			mg/l	No GAC	-	<0.01	<0.01	0.01						
PAH														
Acenaphthene	2	USEPA	mg/l	1 of 2	0	<0.00001	0.00039	0.00037						
Di-benzo(a,h)anthracene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001						
Fluoranthene	0.000006	EQS	mg/l	1 of 2	1	<0.00001	0.0017	0.00162						
Fluorene		-	mg/l	No GAC	-	<0.00001	0.00023	0.00022						
Indeno(1,2,3-cd)pyrene		-	mg/l	No GAC	-	<0.00001	0.00035	0.00033						
Phenanthrene		-	mg/l	No GAC	-	<0.00001	0.0012	0.00114						
Pyrene		-	mg/l	No GAC	-	<0.00001	0.0015	0.00143						
Naphthalene	0.002	EQS	mg/l	1 of 2	0	<0.00001	0.00058	0.00055						
Total EPA-16 PAHs		-	mg/l	No GAC	-	<0.00016	0.00868	0.00825						
Acenaphthylene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001						
Anthracene	0.0001	EQS	mg/l	1 of 2	1	<0.00001	0.00027	0.00026						
Benzo(a)anthracene		-	mg/l	No GAC	-	<0.00001	0.0007	0.00067						
Benzo(a)pyrene	0.00001	DWS	mg/l	1 of 2	1	<0.00001	0.00066	0.00063						
Benzo(ghi)perylene		-	mg/l	No GAC	-	<0.00001	0.00039	0.00037						
Benzo(b)fluoranthene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001						
Benzo(k)fluoranthene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001						
Chrysene		-	mg/l	No GAC	-	<0.00001	0.00072	0.00068						
BTEX														
Benzene	0.001	DWS	mg/l	0 of 2	0	<0.001	<0.001	0.001						
Toluene	0.074	EQS	mg/l	0 of 2	0	<0.001	<0.001	0.001						
Ethylbenzene	0.02	EQS*	mg/l	0 of 2	0	<0.001	<0.001	0.001						
o-xylene	0.03	EQS*	mg/l	0 of 2	0	<0.001	<0.001	0.001						
p- & m-xylene	0.03	EQS*	mg/l	0 of 2	0	<0.001	<0.001	0.001						
Methyl-t-butyl ether (MTBE)	0.015	WHO	mg/l	0 of 2	0	<0.003	<0.003	0.003						

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	95th %ile	BH05	BH07
Hole Ref									BH05	BH07
Sample Ref									447250	447251
Easting									384161.46	384199.43
Northing									396938.34	396911.76
Hole Elevation (mOD)									36.6	36.59
Sample Depth (mbgl)									3.12	10.25
Piezometer top (mbgl)									1	7
Piezometer base (mbgl)									5	13
Sample Date									06/02/2025	06/02/2025
Aquifer									Made ground	Sandstone
Metal										
Antimony (dissolved)	0.005	DWS	mg/l	2 of 6	0	<0.0004	0.0011	0.00095	<0.0004	<0.0004
Arsenic (dissolved)	0.01	DWS	mg/l	6 of 6	0	0.00037	0.00273	0.00228	0.00273	0.00077
Beryllium (dissolved)	0.004	USEPA	mg/l	0 of 6	0	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Cadmium (dissolved)	0.005	DWS	mg/l	3 of 6	0	<0.00002	0.00036	0.00029	<0.00002	0.00036
Calcium (dissolved)		-	mg/l	No GAC	-	63	150	145.0	150	100
Chromium (dissolved)	0.05	DWS	mg/l	6 of 6	0	0.00003	0.0047	0.0041	0.0005	0.0047
Chromium (hexavalent)	0.0034	EQS	mg/l	0 of 6	0	<0.005	<0.005	0.005	<0.005	<0.005
Copper (dissolved)	2	DWS	mg/l	6 of 6	0	0.0007	0.0039	0.0038	0.0007	0.0026
Lead (dissolved)	0.01	DWS	mg/l	2 of 6	0	<0.0002	0.0004	0.0004	0.0004	<0.0002
Manganese (dissolved)	0.05	DWS	mg/l	6 of 6	4	0.0026	18	14.475	**3.9**	**18**
Mercury (dissolved)	0.001	DWS	mg/l	2 of 6	0	<0.00005	0.00013	0.00011	0.00013	<0.00005
Nickel (dissolved)	0.02	DWS	mg/l	5 of 6	0	<0.0005	0.0087	0.0084	0.0087	0.0062
Selenium (dissolved)	0.01	DWS	mg/l	3 of 6	0	<0.0006	0.0074	0.0058	0.001	<0.0006
Vanadium (dissolved)	0.02	EQS*	mg/l	3 of 6	0	<0.0002	0.001	0.00093	0.001	0.0002
Zinc (dissolved)	5	USEPA	mg/l	6 of 6	0	0.0012	0.041	0.03288	0.0017	0.0085
Inorganic										
pH	<6 - >9	EQS*	pH Units	No GAC	-	6.9	7.9	7.90	7.5	6.9
Total Cyanide (low level)	0.05	DWS	mg/l	0 of 6	0	<0.001	<0.001	0.001	<0.001	<0.001
Free Cyanide (low level)	0.05	DWS	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
Boron (dissolved)	1	DWS	mg/l	2 of 2	0	0.11	0.23	0.224	0.11	0.23
Chloride	250	DWS	mg/l	6 of 6	0	43	110	106.250	95	87
Ammoniacal Nitrogen as N	0.39	DWS	mg/l	4 of 6	0	<0.015	0.1	0.08375	0.035	0.03
Ammoniacal Nitrogen as NH3		-	mg/l	No GAC	-	<0.015	0.12	0.10075	0.043	0.036
Dissolved Organic Carbon (DOC)		-	mg/l	No GAC	-	1.46	7.62	6.865	4.6	2.26
Total Organic Carbon (TOC)		-	mg/l	No GAC	-	2.26	4.6	4.483	4.6	2.26
Hardness - Total as CaCO3		-	mgCaCO3/l	No GAC	-	189	535	531.750	522	518
Sulphate as SO4	250	DWS	mg/l	4 of 4	1	50.1	311	295.40	**311**	207
Sulphide		-	mg/l	No GAC	-	<0.005	<0.005	0.005	<0.005	<0.005
Total Phenols (monohydric)	0.0077	EQS	mg/l	0 of 6	0	<0.01	<0.01	0.01	<0.01	<0.01
TPH										
TPH - Aliphatic >C10 - C12	0.3	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01	<0.01	<0.01
TPH - Aliphatic >C12 - C16	0.3	WHO	mg/l	1 of 2	0	<0.01	0.04	0.0385	0.04	<0.01
TPH - Aliphatic >C16 - C21		-	mg/l	No GAC	-	<0.01	0.036	0.0347	0.036	<0.01
TPH - Aliphatic >C21 - C35		-	mg/l	No GAC	-	<0.01	0.25	0.238	0.25	<0.01
TPH - Aliphatic >C5 - C35		-	mg/l	No GAC	-	<0.01	0.32	0.3045	0.32	<0.01
TPH - Aliphatic >C5 - C6	15	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
TPH - Aliphatic >C6 - C8	15	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
TPH - Aliphatic >C8 - C10	0.3	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
TPH - Aromatic >EC10 - EC12	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01	<0.01	<0.01
TPH - Aromatic >EC12 - EC16	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01	<0.01	<0.01
TPH - Aromatic >EC16 - EC21	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01	<0.01	<0.01
TPH - Aromatic >EC21 - EC35	0.09	WHO	mg/l	0 of 2	0	<0.01	<0.01	0.01	<0.01	<0.01
TPH - Aromatic >EC5 - EC7	0.01	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
TPH - Aromatic >EC7 - EC8	0.7	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
TPH - Aromatic >EC8 - EC10	0.3	WHO	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
TPH - Aromatic >EC5 - EC35			mg/l	No GAC	-	<0.01	<0.01	0.01	<0.01	<0.01
PAH										
Acenaphthene	2	USEPA	mg/l	1 of 2	0	<0.00001	0.00039	0.00037	0.00039	<0.00001
Di-benzo(a,h)anthracene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001	<0.00001	<0.00001
Fluoranthene	0.000006	EQS	mg/l	1 of 2	1	<0.00001	0.0017	0.00162	**0.0017**	<0.00001
Fluorene		-	mg/l	No GAC	-	<0.00001	0.00023	0.00022	0.00023	<0.00001
Indeno(1,2,3-cd)pyrene		-	mg/l	No GAC	-	<0.00001	0.00035	0.00033	0.00035	<0.00001
Phenanthrene		-	mg/l	No GAC	-	<0.00001	0.0012	0.00114	0.0012	<0.00001
Pyrene		-	mg/l	No GAC	-	<0.00001	0.0015	0.00143	0.0015	<0.00001
Naphthalene	0.002	EQS	mg/l	1 of 2	0	<0.00001	0.00058	0.00055	0.00058	<0.00001
Total EPA-16 PAHs		-	mg/l	No GAC	-	<0.00016	0.00868	0.00825	0.00868	<0.00016
Acenaphthylene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001	<0.00001	<0.00001
Anthracene	0.0001	EQS	mg/l	1 of 2	1	<0.00001	0.00027	0.00026	**0.00027**	<0.00001
Benzo(a)anthracene		-	mg/l	No GAC	-	<0.00001	0.0007	0.00067	0.0007	<0.00001
Benzo(a)pyrene	0.00001	DWS	mg/l	1 of 2	1	<0.00001	0.00066	0.00063	**0.00066**	<0.00001
Benzo(ghi)perylene		-	mg/l	No GAC	-	<0.00001	0.00039	0.00037	0.00039	<0.00001
Benzo(b)fluoranthene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001	<0.00001	<0.00001
Benzo(k)fluoranthene		-	mg/l	No GAC	-	<0.00001	<0.00001	0.00001	<0.00001	<0.00001
Chrysene		-	mg/l	No GAC	-	<0.00001	0.00072	0.00068	0.00072	<0.00001
BTEX										
Benzene	0.001	DWS	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
Toluene	0.074	EQS	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
Ethylbenzene	0.02	EQS*	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
o-xylene	0.03	EQS*	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
p- & m-xylene	0.03	EQS*	mg/l	0 of 2	0	<0.001	<0.001	0.001	<0.001	<0.001
Methyl-t-butyl ether (MTBE)	0.015	WHO	mg/l	0 of 2	0	<0.003	<0.003	0.003	<0.003	<0.003

Appendix E- Ground Gas Screening Assessment

Cambridge Hall Ground Gas Monitoring

Round	BH	Date	Unit	Atm pressure	Depth to GW (m)	Flow rate (l/hr)	Methane (%)	Carbon dioxide (%)	Hydrogen Sulfide (%)	Oxygen (%)	GSV Methane (%)	GSV Carbon dioxide (%)	Initial CS	CS methane	CS CO2	Design CS
1	BH01	09/01/2025	Glacial sand & made ground	997 to 1000	4.3	0.0	0.0	0.0	0.0	9.3	0.0	0.0	CS1	CS1	CS1	CS1
2	BH01	23/01/2025		996	3.1	0.0	0.0	0.0	0.0	9.5	0.0	0.0	CS1	CS1	CS1	CS1
3	BH01	06/02/2025		1035	4.7	0.0	0.0	0.0	0.0	20.0	0.0	0.0	CS1	CS1	CS1	CS1
4	BH01	20/02/2025		1005	Dry	0.0	0.0	0.0	0.0	20.8	0.0	0.0	CS1	CS1	CS1	CS1
5	BH01	06/03/2025		1010 to 1011	3.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	CS1	CS1	CS1	CS1
6	BH01	20/03/2025		1019 to 1020	3.1	0.0	0.0	0.0	0.0	20.1	0.0	0.0	CS1	CS1	CS1	CS1
All	BH01	N/A				0.0	0.0	0.0	0.0	9.3	0.0	0.0	CS1	CS1	CS1	CS1
1	BH03A	09/01/2025	Sandstone	997 to 1000	10.1	0.0	0.0	0.0	0.0	19.1	0.0	0.0	CS1	CS1	CS1	CS1
2	BH03A	23/01/2025		996	10.2	0.0	0.0	0.0	0.0	19.0	0.0	0.0	CS1	CS1	CS1	CS1
3	BH03A	06/02/2025		1035	10.4	0.0	0.0	0.0	0.0	18.4	0.0	0.0	CS1	CS1	CS1	CS1
4	BH03A	20/02/2025		1005	10.2	0.0	0.0	0.0	0.0	18.6	0.0	0.0	CS1	CS1	CS1	CS1
5	BH03A	06/03/2025		1010 to 1011	10.4	0.0	0.0	0.0	0.0	19.0	0.0	0.0	CS1	CS1	CS1	CS1
6	BH03A	20/03/2025		1019 to 1020	10.5	0.0	0.0	0.0	0.0	19.3	0.0	0.0	CS1	CS1	CS1	CS1
All	BH03A	N/A				0.0	0.0	0.0	0.0	18.4	0.0	0.0	CS1	CS1	CS1	CS1
1	BH03A	09/01/2025	Made ground	997 to 1000	3.3	0.0	0.0	0.0	0.0	19.1	0.0	0.0	CS1	CS1	CS1	CS1
2	BH03A	23/01/2025		996	4.5	0.0	0.0	0.0	0.0	19.5	0.0	0.0	CS1	CS1	CS1	CS1
3	BH03A	06/02/2025		1035	3.0	0.0	0.0	0.0	0.0	19.5	0.0	0.0	CS1	CS1	CS1	CS1
4	BH03A	20/02/2025		1005	3.5	0.0	0.0	0.0	0.0	19.2	0.0	0.0	CS1	CS1	CS1	CS1
5	BH03A	06/03/2025		1010 to 1011	2.9	0.0	0.0	0.0	0.0	19.4	0.0	0.0	CS1	CS1	CS1	CS1
6	BH03A	20/03/2025		1019 to 1020	3.0	0.0	0.0	0.0	0.0	19.6	0.0	0.0	CS1	CS1	CS1	CS1
All	BH03A	N/A				0.0	0.0	0.0	0.0	19.1	0.0	0.0	CS1	CS1	CS1	CS1
1	BH05	09/01/2025	Made ground	997 to 1000	2.7	0.0	0.0	0.0	0.0	17.7	0.0	0.0	CS1	CS1	CS1	CS1
2	BH05	23/01/2025		996	4.6	0.0	0.0	0.0	0.0	17.9	0.0	0.0	CS1	CS1	CS1	CS1
3	BH05	06/02/2025		1035	3.1	0.0	0.0	2.1	0.0	17.1	0.0	0.0	CS1	CS1	CS1	CS1
4	BH05	20/02/2025		1005	3.3	0.0	0.0	1.6	0.0	19.8	0.0	0.0	CS1	CS1	CS1	CS1
5	BH05	06/03/2025		1010 to 1011	3.3	0.0	0.0	1.6	0.0	19.2	0.0	0.0	CS1	CS1	CS1	CS1
6	BH05	20/03/2025		1019 to 1020	3.4	0.0	0.0	1.3	0.0	19.4	0.0	0.0	CS1	CS1	CS1	CS1
All	BH05	N/A				0.0	0.0	2.1	0.0	17.1	0.0	0.0	CS1	CS1	CS1	CS1
1	BH07	09/01/2025	Sandstone	997 to 1000	10.2	0.0	0.0	0.0	0.0	19.6	0.0	0.0	CS1	CS1	CS1	CS1
2	BH07	23/01/2025		996	10.1	0.0	0.0	0.0	0.0	19.5	0.0	0.0	CS1	CS1	CS1	CS1
3	BH07	06/02/2025		1035	10.3	0.0	0.0	0.0	0.0	15.5	0.0	0.0	CS1	CS1	CS1	CS1
4	BH07	20/02/2025		1005	10.1	0.0	0.0	1.9	0.0	15.2	0.0	0.0	CS1	CS1	CS1	CS1
5	BH07	06/03/2025		1010 to 1011	10.2	0.0	0.0	1.6	0.0	15.3	0.0	0.0	CS1	CS1	CS1	CS1
6	BH07	20/03/2025		1019 to 1020	10.3	0.0	0.0	1.2	0.0	15.7	0.0	0.0	CS1	CS1	CS1	CS1
All	BH07	N/A				0.0	0.0	1.9	0.0	15.2	0.0	0.0	CS1	CS1	CS1	CS1

Saturated response zone

Exceeds 1% CH4 or 5% CO2 (BS8485)

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Appendix F- Indicative Waste Assessment

ARUP

HazWasteOnline™
Report created by Lottie Harold on 24 Feb 2025

Waste Classification Report

HazWasteOnline™ classifies waste as either **hazardous** or **non-hazardous** based on its chemical composition, related legislation and the rules and data defined in the current UK or EU technical guidance (Appendix C) (note that HP 9 Infectious is not assessed). It is the responsibility of the classifier named below to:

a) understand the origin of the waste
b) select the correct List of Waste code(s)
c) confirm that the list of determinands, results and sampling plan are fit for purpose
d) select and justify the chosen metal species (Appendix B)
e) correctly apply moisture correction and other available corrections
f) add the meta data for their user-defined substances (Appendix A)
g) check that the classification engine is suitable with respect to the national destination of the waste (Appendix C)

To aid the reviewer, the laboratory results, assumptions and justifications managed by the classifier are highlighted in pale yellow.

GU551-400EM-KFEK4

Report is invalid if pages are removed.

Job name

Cambridge Hall

Description/Comments

Project

Cambridge Hall GIR

Site

Cambridge Hall

Classified by

Name:
Lottie Harold
Date:
24 Feb 2025 13:59 GMT
Telephone:
07711093533

Company:
Ove Arup
6th floor, 3 Piccadilly Place
MANCHESTER
M1 3BN

HazWasteOnline™ provides a two day, hazardous waste classification course that covers the use of the software and both basic and advanced waste classification techniques. Certification has to be renewed every 3 years.

HazWasteOnline™ Certification: CERTIFIED

Course	Date
Hazardous Waste Classification	06 Jun 2024

Next 3 year Refresher due by Jun 2027

Purpose of classification

2 - Material Characterisation

Address of the waste

Manchester Metropolitan University Cambridge Halls **Post Code** M156TT

SIC for the process giving rise to the waste

Description of industry/producer giving rise to the waste

Redevelopment of university residential housing

Description of the specific process, sub-process and/or activity that created the waste

Excavation of soils for earthworks

Description of the waste

Grey slightly silty sandy GRAVEL. Low cobble content. Occasional pockets of silty sand. Gravel is fine to coarse angular to sub-angular limestone and sandstone. Fragments of brick, concrete, sandstone, clinker, plastic, coal and glass.

Job summary

#	Sample name	Depth [m]	Classification Result	Hazard properties	Page
1	BH01	0.2	Non Hazardous		3
2	BH01[2]	0.6	Non Hazardous		5
3	BH02	0.4	Non Hazardous		7
4	BH03A[2]	1.7	Non Hazardous		9
5	BH03A[3]	3.7	Non Hazardous		11
6	BH04	1.1	Non Hazardous		13
7	BH04[2]	1.6	Non Hazardous		15
8	BH04[3]	2.4	Non Hazardous		17
9	BH05	1.6	Non Hazardous		19
10	BH05[2]	2.7	Non Hazardous		21
11	BH05[3]	3.8	Non Hazardous		22
12	BH05[4]	6.8	Non Hazardous		24
13	BH06	0.3	Non Hazardous		26
14	BH06[2]	0.7	Non Hazardous		28
15	BH06[4]	2.7	Non Hazardous		30
16	BH06[5]	3.7	Hazardous	HP 8	32
17	BH07	0.9	Non Hazardous		34
18	BH07[2]	1.6	Non Hazardous		36
19	BH07[3]	3.6	Non Hazardous		37
20	SA01	1.7	Non Hazardous		39
21	SA03	0.8	Non Hazardous		41

Related documents

#	Name	Description
1	Metals, PAH, TPH, BTEX	waste stream template used to create this Job

Report

Created by: Lottie Harold

Created date: 24 Feb 2025 13:59 GMT

Appendices	Page
Appendix A: Classifier defined and non GB MCL determinands	43
Appendix B: Rationale for selection of metal species	44
Appendix C: Version	45

Classification of sample: BH01

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH01
Sample Depth:
0.2 m
Moisture content:
1.7%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 1.7% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.0221 mg/kg	1.32	0.0292 mg/kg	0.00000292 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.0089 mg/kg	1.462	0.013 mg/kg	0.0000013 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		<0.007 mg/kg	1.126	<0.0078 mg/kg	<0.000000788 %		<LOD
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	<0.01 mg/kg	1.56	<0.0156 mg/kg	<0.000001 %		<LOD
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		<0.003 mg/kg	2.976	<0.0089 mg/kg	<0.000000893 %		<LOD
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.01 mg/kg	2.774	0.0277 mg/kg	0.00000277 %		
11	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
12	benzene	601-020-00-8	200-753-7	71-43-2		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
13	toluene	601-021-00-3	203-625-9	108-88-3		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
14	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
15	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.008 mg/kg		<0.008 mg/kg	<0.0000008 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16	●	acenaphthene				0.08	mg/kg		0.08	mg/kg	0.000008 %		
			201-469-6	83-32-9									
17		dibenz[a,h]anthracene				<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-041-00-2	200-181-8	53-70-3									
18	●	fluoranthene				0.54	mg/kg		0.54	mg/kg	0.000054 %		
			205-912-4	206-44-0									
19	●	fluorene				0.09	mg/kg		0.09	mg/kg	0.000009 %		
			201-695-5	86-73-7									
20	●	indeno[123-cd]pyrene				0.09	mg/kg		0.09	mg/kg	0.000009 %		
			205-893-2	193-39-5									
21	●	phenanthrene				0.46	mg/kg		0.46	mg/kg	0.000046 %		
			201-581-5	85-01-8									
22	●	pyrene				0.43	mg/kg		0.43	mg/kg	0.000043 %		
			204-927-3	129-00-0									
23		naphthalene				0.05	mg/kg		0.05	mg/kg	0.000005 %		
		601-052-00-2	202-049-5	91-20-3									
24	●	acenaphthylene				<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
			205-917-1	208-96-8									
25	●	anthracene				0.12	mg/kg		0.12	mg/kg	0.000012 %		
			204-371-1	120-12-7									
26		benzo[a]anthracene				0.17	mg/kg		0.17	mg/kg	0.000017 %		
		601-033-00-9	200-280-6	56-55-3									
27		benzo[a]pyrene; benzo[def]chrysene				0.16	mg/kg		0.16	mg/kg	0.000016 %		
		601-032-00-3	200-028-5	50-32-8									
28	●	benzo[ghi]perylene				0.1	mg/kg		0.1	mg/kg	0.00001 %		
			205-883-8	191-24-2									
29		benzo[b]fluoranthene				0.24	mg/kg		0.24	mg/kg	0.000024 %		
		601-034-00-4	205-911-9	205-99-2									
30		benzo[k]fluoranthene				<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-036-00-5	205-916-6	207-08-9									
31		chrysene				0.22	mg/kg		0.22	mg/kg	0.000022 %		
		601-048-00-0	205-923-4	218-01-9									
										Total:	0.00032 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH01[2]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH01[2]
Sample Depth:
0.6 m
Moisture content:
9.3%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 9.3% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		3.5 mg/kg	1.197	4.19 mg/kg	0.000419 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		11 mg/kg	1.32	14.524 mg/kg	0.00145 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		0.78 mg/kg	2.775	2.165 mg/kg	0.000216 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		0.5 mg/kg	1.142	0.571 mg/kg	0.0000571 %		
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		19 mg/kg	1.462	27.77 mg/kg	0.00278 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8 mg/kg	2.27	<4.086 mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		60 mg/kg	1.126	67.553 mg/kg	0.00676 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	120 mg/kg	1.56	187.178 mg/kg	0.012 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3 mg/kg	1.353	<0.406 mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		18 mg/kg	2.976	53.573 mg/kg	0.00536 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1 mg/kg	2.554	<2.554 mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		25 mg/kg	1.785	44.63 mg/kg	0.00446 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		93 mg/kg	2.774	257.996 mg/kg	0.0258 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				7.7 mg/kg	1.884	14.507 mg/kg	0.00145 %		

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.6	mg/kg	3.22	1.932	mg/kg	0.000193 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		**<LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0617 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH02

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH02
Sample Depth:
0.4 m
Moisture content:
11%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 11% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		1.9	mg/kg	1.197	2.274	mg/kg	0.000227 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		4.7	mg/kg	1.32	6.206	mg/kg	0.000621 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		0.45	mg/kg	2.775	1.249	mg/kg	0.000125 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		0.3	mg/kg	1.142	0.343	mg/kg	0.0000343 %		
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		14	mg/kg	1.462	20.462	mg/kg	0.00205 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8	mg/kg	2.27	<4.086	mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		27	mg/kg	1.126	30.399	mg/kg	0.00304 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	120	mg/kg	1.56	187.178	mg/kg	0.012 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3	mg/kg	1.353	<0.406	mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		11	mg/kg	2.976	32.739	mg/kg	0.00327 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1	mg/kg	2.554	<2.554	mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		17	mg/kg	1.785	30.348	mg/kg	0.00303 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		54	mg/kg	2.774	149.804	mg/kg	0.015 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.8	mg/kg	3.22	2.576	mg/kg	0.000258 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		**<LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0406 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH03A[2]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH03A[2]
Sample Depth:
1.7 m
Moisture content:
14%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 14% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.0199 mg/kg	1.32	0.0263 mg/kg	0.00000263 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.018 mg/kg	1.462	0.0263 mg/kg	0.00000263 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.023 mg/kg	1.126	0.0259 mg/kg	0.00000259 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	<0.01 mg/kg	1.56	<0.0156 mg/kg	<0.000001 %		<LOD
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		<0.003 mg/kg	2.976	<0.0089 mg/kg	<0.000000893 %		<LOD
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		<0.004 mg/kg	2.774	<0.0111 mg/kg	<0.00000111 %		<LOD
11	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
12	benzene	601-020-00-8	200-753-7	71-43-2		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
13	toluene	601-021-00-3	203-625-9	108-88-3		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
14	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
15	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.008 mg/kg		<0.008 mg/kg	<0.0000008 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16		acenaphthene											
			201-469-6	83-32-9		0.05	mg/kg		0.05	mg/kg	0.000005 %		
17		dibenz[a,h]anthracene											
		601-041-00-2	200-181-8	53-70-3		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
18		fluoranthene											
			205-912-4	206-44-0		0.54	mg/kg		0.54	mg/kg	0.000054 %		
19		fluorene											
			201-695-5	86-73-7		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
20		indeno[123-cd]pyrene											
			205-893-2	193-39-5		0.16	mg/kg		0.16	mg/kg	0.000016 %		
21		phenanthrene											
			201-581-5	85-01-8		0.37	mg/kg		0.37	mg/kg	0.000037 %		
22		pyrene											
			204-927-3	129-00-0		0.52	mg/kg		0.52	mg/kg	0.000052 %		
23		naphthalene											
		601-052-00-2	202-049-5	91-20-3		0.09	mg/kg		0.09	mg/kg	0.000009 %		
24		acenaphthylene											
			205-917-1	208-96-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
25		anthracene											
			204-371-1	120-12-7		0.08	mg/kg		0.08	mg/kg	0.000008 %		
26		benzo[a]anthracene											
		601-033-00-9	200-280-6	56-55-3		0.26	mg/kg		0.26	mg/kg	0.000026 %		
27		benzo[a]pyrene; benzo[def]chrysene											
		601-032-00-3	200-028-5	50-32-8		0.27	mg/kg		0.27	mg/kg	0.000027 %		
28		benzo[ghi]perylene											
			205-883-8	191-24-2		0.19	mg/kg		0.19	mg/kg	0.000019 %		
29		benzo[b]fluoranthene											
		601-034-00-4	205-911-9	205-99-2		0.28	mg/kg		0.28	mg/kg	0.000028 %		
30		benzo[k]fluoranthene											
		601-036-00-5	205-916-6	207-08-9		0.18	mg/kg		0.18	mg/kg	0.000018 %		
31		chrysene											
		601-048-00-0	205-923-4	218-01-9		0.3	mg/kg		0.3	mg/kg	0.00003 %		
										Total:	0.00038 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH03A[3]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH03A[3]
Sample Depth:
3.7 m
Moisture content:
15%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 15% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		2	mg/kg	1.197	2.394	mg/kg	0.000239 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		7.3	mg/kg	1.32	9.638	mg/kg	0.000964 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		1.1	mg/kg	2.775	3.053	mg/kg	0.000305 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.2	mg/kg	1.142	<0.228	mg/kg	<0.0000228 %		<LOD
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		29	mg/kg	1.462	42.385	mg/kg	0.00424 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8	mg/kg	2.27	<4.086	mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		22	mg/kg	1.126	24.77	mg/kg	0.00248 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	13	mg/kg	1.56	20.278	mg/kg	0.0013 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3	mg/kg	1.353	<0.406	mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		31	mg/kg	2.976	92.264	mg/kg	0.00923 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1	mg/kg	2.554	<2.554	mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		30	mg/kg	1.785	53.556	mg/kg	0.00536 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		61	mg/kg	2.774	169.223	mg/kg	0.0169 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.9	mg/kg	3.22	2.898	mg/kg	0.00029 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		**<LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0423 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH04

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH04
Sample Depth:
1.1 m
Moisture content:
15%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 15% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		2	mg/kg	1.197	2.394	mg/kg	0.000239 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		6.7	mg/kg	1.32	8.846	mg/kg	0.000885 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		0.83	mg/kg	2.775	2.304	mg/kg	0.00023 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		0.2	mg/kg	1.142	0.228	mg/kg	0.0000228 %		
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		22	mg/kg	1.462	32.154	mg/kg	0.00322 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8	mg/kg	2.27	<4.086	mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		20	mg/kg	1.126	22.518	mg/kg	0.00225 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	24	mg/kg	1.56	37.436	mg/kg	0.0024 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3	mg/kg	1.353	<0.406	mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		23	mg/kg	2.976	68.454	mg/kg	0.00685 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1	mg/kg	2.554	<2.554	mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		24	mg/kg	1.785	42.844	mg/kg	0.00428 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		51	mg/kg	2.774	141.481	mg/kg	0.0141 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.7	mg/kg	3.22	2.254	mg/kg	0.000225 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		**<LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0357 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH04[2]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH04[2]
Sample Depth:
1.6 m
Moisture content:
15%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 15% No Moisture Correction applied (MC)

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
1	●	acenaphthene	201-469-6	83-32-9		0.25	mg/kg		0.25	mg/kg	0.000025 %		
2		dibenz[a,h]anthracene	200-181-8	53-70-3		0.12	mg/kg		0.12	mg/kg	0.000012 %		
3	●	fluoranthene	205-912-4	206-44-0		2.4	mg/kg		2.4	mg/kg	0.00024 %		
4	●	fluorene	201-695-5	86-73-7		0.19	mg/kg		0.19	mg/kg	0.000019 %		
5	●	indeno[123-cd]pyrene	205-893-2	193-39-5		0.49	mg/kg		0.49	mg/kg	0.000049 %		
6	●	phenanthrene	201-581-5	85-01-8		1.5	mg/kg		1.5	mg/kg	0.00015 %		
7	●	pyrene	204-927-3	129-00-0		2.2	mg/kg		2.2	mg/kg	0.00022 %		
8		naphthalene	202-049-5	91-20-3		0.11	mg/kg		0.11	mg/kg	0.000011 %		
9	●	acenaphthylene	205-917-1	208-96-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
10	●	anthracene	204-371-1	120-12-7		0.41	mg/kg		0.41	mg/kg	0.000041 %		
11		benzo[a]anthracene	200-280-6	56-55-3		1.1	mg/kg		1.1	mg/kg	0.00011 %		
12		benzo[a]pyrene; benzo[def]chrysene	200-028-5	50-32-8		1.1	mg/kg		1.1	mg/kg	0.00011 %		
13	●	benzo[ghi]perylene	205-883-8	191-24-2		0.58	mg/kg		0.58	mg/kg	0.000058 %		
14		benzo[b]fluoranthene	205-911-9	205-99-2		1.3	mg/kg		1.3	mg/kg	0.00013 %		
15		benzo[k]fluoranthene	205-916-6	207-08-9		0.46	mg/kg		0.46	mg/kg	0.000046 %		
16		chrysene	205-923-4	218-01-9		1.1	mg/kg		1.1	mg/kg	0.00011 %		
										Total:	0.00134 %		

Key	
	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Below limit of detection

Classification of sample: BH04[3]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH04[3]
Sample Depth:
2.4 m
Moisture content:
20%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 20% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		<0.01 mg/kg	1.32	<0.0132 mg/kg	<0.00000132 %		<LOD
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.023 mg/kg	1.462	0.0336 mg/kg	0.00000336 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.045 mg/kg	1.126	0.0507 mg/kg	0.00000507 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	<0.01 mg/kg	1.56	<0.0156 mg/kg	<0.000001 %		<LOD
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.0089 mg/kg	2.976	0.0265 mg/kg	0.00000265 %		
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		0.045 mg/kg	2.554	0.115 mg/kg	0.0000115 %		
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.05 mg/kg	2.774	0.139 mg/kg	0.0000139 %		
11	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
12	benzene	601-020-00-8	200-753-7	71-43-2		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
13	toluene	601-021-00-3	203-625-9	108-88-3		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
14	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
15	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.008 mg/kg		<0.008 mg/kg	<0.0000008 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16		acenaphthene											
			201-469-6	83-32-9		3.7	mg/kg		3.7	mg/kg	0.00037 %		
17		dibenz[a,h]anthracene											
		601-041-00-2	200-181-8	53-70-3		0.59	mg/kg		0.59	mg/kg	0.000059 %		
18		fluoranthene											
			205-912-4	206-44-0		17	mg/kg		17	mg/kg	0.0017 %		
19		fluorene											
			201-695-5	86-73-7		2.7	mg/kg		2.7	mg/kg	0.00027 %		
20		indeno[123-cd]pyrene											
			205-893-2	193-39-5		3	mg/kg		3	mg/kg	0.0003 %		
21		phenanthrene											
			201-581-5	85-01-8		15	mg/kg		15	mg/kg	0.0015 %		
22		pyrene											
			204-927-3	129-00-0		15	mg/kg		15	mg/kg	0.0015 %		
23		naphthalene											
		601-052-00-2	202-049-5	91-20-3		2.3	mg/kg		2.3	mg/kg	0.00023 %		
24		acenaphthylene											
			205-917-1	208-96-8		0.07	mg/kg		0.07	mg/kg	0.000007 %		
25		anthracene											
			204-371-1	120-12-7		3.9	mg/kg		3.9	mg/kg	0.00039 %		
26		benzo[a]anthracene											
		601-033-00-9	200-280-6	56-55-3		6.9	mg/kg		6.9	mg/kg	0.00069 %		
27		benzo[a]pyrene; benzo[def]chrysene											
		601-032-00-3	200-028-5	50-32-8		6.7	mg/kg		6.7	mg/kg	0.00067 %		
28		benzo[ghi]perylene											
			205-883-8	191-24-2		3.3	mg/kg		3.3	mg/kg	0.00033 %		
29		benzo[b]fluoranthene											
		601-034-00-4	205-911-9	205-99-2		7.9	mg/kg		7.9	mg/kg	0.00079 %		
30		benzo[k]fluoranthene											
		601-036-00-5	205-916-6	207-08-9		2.7	mg/kg		2.7	mg/kg	0.00027 %		
31		chrysene											
		601-048-00-0	205-923-4	218-01-9		6.5	mg/kg		6.5	mg/kg	0.00065 %		
										Total:	0.00978 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH05

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH05
Sample Depth:
1.6 m
Moisture content:
17%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 17% No Moisture Correction applied (MC)

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	●	acenaphthene		201-469-6	83-32-9		0.86	mg/kg		0.86	mg/kg	0.000086 %		
2		dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		0.37	mg/kg		0.37	mg/kg	0.000037 %		
3	●	fluoranthene		205-912-4	206-44-0		6.7	mg/kg		6.7	mg/kg	0.00067 %		
4	●	fluorene		201-695-5	86-73-7		0.61	mg/kg		0.61	mg/kg	0.000061 %		
5	●	indeno[123-cd]pyrene		205-893-2	193-39-5		1.4	mg/kg		1.4	mg/kg	0.00014 %		
6	●	phenanthrene		201-581-5	85-01-8		5.2	mg/kg		5.2	mg/kg	0.00052 %		
7	●	pyrene		204-927-3	129-00-0		5.9	mg/kg		5.9	mg/kg	0.00059 %		
8		naphthalene	601-052-00-2	202-049-5	91-20-3		0.26	mg/kg		0.26	mg/kg	0.000026 %		
9	●	acenaphthylene		205-917-1	208-96-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		**<LOD**
10	●	anthracene		204-371-1	120-12-7		1	mg/kg		1	mg/kg	0.0001 %		
11		benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		2.9	mg/kg		2.9	mg/kg	0.00029 %		
12		benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		2.9	mg/kg		2.9	mg/kg	0.00029 %		
13	●	benzo[ghi]perylene		205-883-8	191-24-2		1.7	mg/kg		1.7	mg/kg	0.00017 %		
14		benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		3.1	mg/kg		3.1	mg/kg	0.00031 %		
15		benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		1.5	mg/kg		1.5	mg/kg	0.00015 %		
16		chrysene	601-048-00-0	205-923-4	218-01-9		2.8	mg/kg		2.8	mg/kg	0.00028 %		
											Total:	0.00372 %		

Key	
	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Below limit of detection

Classification of sample: BH05[2]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH05[2]
Sample Depth:
2.7 m
Moisture content:
24%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 24% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.0293 mg/kg	1.32	0.0387 mg/kg	0.00000387 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.026 mg/kg	1.462	0.038 mg/kg	0.0000038 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.019 mg/kg	1.126	0.0214 mg/kg	0.00000214 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	<0.01 mg/kg	1.56	<0.0156 mg/kg	<0.000001 %		<LOD
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.019 mg/kg	2.976	0.0565 mg/kg	0.00000565 %		
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.086 mg/kg	2.774	0.239 mg/kg	0.0000239 %		
11	pH			PH		8.8 pH		8.8 pH	8.8 pH		
12	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
								Total:	0.00006 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH05[3]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH05[3]
Sample Depth:
3.8 m
Moisture content:
21%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 21% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.0484 mg/kg	1.32	0.0639 mg/kg	0.00000639 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.057 mg/kg	1.462	0.0833 mg/kg	0.00000833 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.2 mg/kg	1.126	0.225 mg/kg	0.0000225 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	0.077 mg/kg	1.56	0.12 mg/kg	0.0000077 %		
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.037 mg/kg	2.976	0.11 mg/kg	0.000011 %		
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.2 mg/kg	2.774	0.555 mg/kg	0.0000555 %		
11	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
12	benzene	601-020-00-8	200-753-7	71-43-2		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
13	toluene	601-021-00-3	203-625-9	108-88-3		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
14	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
15	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.008 mg/kg		<0.008 mg/kg	<0.0000008 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16	●	acenaphthene				0.98	mg/kg		0.98	mg/kg	0.000098 %		
			201-469-6	83-32-9									
17		dibenz[a,h]anthracene				0.24	mg/kg		0.24	mg/kg	0.000024 %		
		601-041-00-2	200-181-8	53-70-3									
18	●	fluoranthene				6.2	mg/kg		6.2	mg/kg	0.00062 %		
			205-912-4	206-44-0									
19	●	fluorene				0.87	mg/kg		0.87	mg/kg	0.000087 %		
			201-695-5	86-73-7									
20	●	indeno[123-cd]pyrene				1.2	mg/kg		1.2	mg/kg	0.00012 %		
			205-893-2	193-39-5									
21	●	phenanthrene				5.8	mg/kg		5.8	mg/kg	0.00058 %		
			201-581-5	85-01-8									
22	●	pyrene				5.6	mg/kg		5.6	mg/kg	0.00056 %		
			204-927-3	129-00-0									
23		naphthalene				1	mg/kg		1	mg/kg	0.0001 %		
		601-052-00-2	202-049-5	91-20-3									
24	●	acenaphthylene				0.09	mg/kg		0.09	mg/kg	0.000009 %		
			205-917-1	208-96-8									
25	●	anthracene				1	mg/kg		1	mg/kg	0.0001 %		
			204-371-1	120-12-7									
26		benzo[a]anthracene				2.3	mg/kg		2.3	mg/kg	0.00023 %		
		601-033-00-9	200-280-6	56-55-3									
27		benzo[a]pyrene; benzo[def]chrysene				2.3	mg/kg		2.3	mg/kg	0.00023 %		
		601-032-00-3	200-028-5	50-32-8									
28	●	benzo[ghi]perylene				1.3	mg/kg		1.3	mg/kg	0.00013 %		
			205-883-8	191-24-2									
29		benzo[b]fluoranthene				2.7	mg/kg		2.7	mg/kg	0.00027 %		
		601-034-00-4	205-911-9	205-99-2									
30		benzo[k]fluoranthene				1.3	mg/kg		1.3	mg/kg	0.00013 %		
		601-036-00-5	205-916-6	207-08-9									
31		chrysene				2.8	mg/kg		2.8	mg/kg	0.00028 %		
		601-048-00-0	205-923-4	218-01-9									
										Total:	0.0037 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH05[4]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH05[4]
Sample Depth:
6.8 m
Moisture content:
16%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 16% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		1.9	mg/kg	1.197	2.274	mg/kg	0.000227 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		7.4	mg/kg	1.32	9.77	mg/kg	0.000977 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		1.1	mg/kg	2.775	3.053	mg/kg	0.000305 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.2	mg/kg	1.142	<0.228	mg/kg	<0.0000228 %		<LOD
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		29	mg/kg	1.462	42.385	mg/kg	0.00424 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8	mg/kg	2.27	<4.086	mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		22	mg/kg	1.126	24.77	mg/kg	0.00248 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	11	mg/kg	1.56	17.158	mg/kg	0.0011 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3	mg/kg	1.353	<0.406	mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		30	mg/kg	2.976	89.288	mg/kg	0.00893 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1	mg/kg	2.554	<2.554	mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		29	mg/kg	1.785	51.77	mg/kg	0.00518 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		54	mg/kg	2.774	149.804	mg/kg	0.015 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1	mg/kg	1.884	<1.884	mg/kg	<0.000188 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.5	mg/kg	3.22	1.61	mg/kg	0.000161 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		<**LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0396 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH06

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH06
Sample Depth:
0.3 m
Moisture content:
3.8%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 3.8% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<1 mg/kg	1.197	<1.197 mg/kg	<0.00012 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		2 mg/kg	1.32	2.641 mg/kg	0.000264 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		0.11 mg/kg	2.775	0.305 mg/kg	0.0000305 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		1.1 mg/kg	1.142	1.257 mg/kg	0.000126 %		
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		7.6 mg/kg	1.462	11.108 mg/kg	0.00111 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8 mg/kg	2.27	<4.086 mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		4.2 mg/kg	1.126	4.729 mg/kg	0.000473 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	24 mg/kg	1.56	37.436 mg/kg	0.0024 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3 mg/kg	1.353	<0.406 mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		3.4 mg/kg	2.976	10.119 mg/kg	0.00101 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1 mg/kg	2.554	<2.554 mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		5.5 mg/kg	1.785	9.819 mg/kg	0.000982 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		35 mg/kg	2.774	97.095 mg/kg	0.00971 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.4	mg/kg	3.22	1.288	mg/kg	0.000129 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		<**LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0173 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH06[2]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH06[2]
Sample Depth:
0.7 m
Moisture content:
13%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 13% No Moisture Correction applied (MC)

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	●	acenaphthene		201-469-6	83-32-9		0.34	mg/kg		0.34	mg/kg	0.000034 %		
2		dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		0.11	mg/kg		0.11	mg/kg	0.000011 %		
3	●	fluoranthene		205-912-4	206-44-0		2.7	mg/kg		2.7	mg/kg	0.00027 %		
4	●	fluorene		201-695-5	86-73-7		0.23	mg/kg		0.23	mg/kg	0.000023 %		
5	●	indeno[123-cd]pyrene		205-893-2	193-39-5		0.57	mg/kg		0.57	mg/kg	0.000057 %		
6	●	phenanthrene		201-581-5	85-01-8		2	mg/kg		2	mg/kg	0.0002 %		
7	●	pyrene		204-927-3	129-00-0		2.5	mg/kg		2.5	mg/kg	0.00025 %		
8		naphthalene	601-052-00-2	202-049-5	91-20-3		0.1	mg/kg		0.1	mg/kg	0.00001 %		
9	●	acenaphthylene		205-917-1	208-96-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
10	●	anthracene		204-371-1	120-12-7		1.2	mg/kg		1.2	mg/kg	0.00012 %		
11		benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		1.1	mg/kg		1.1	mg/kg	0.00011 %		
12		benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		1.2	mg/kg		1.2	mg/kg	0.00012 %		
13	●	benzo[ghi]perylene		205-883-8	191-24-2		0.68	mg/kg		0.68	mg/kg	0.000068 %		
14		benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		1.3	mg/kg		1.3	mg/kg	0.00013 %		
15		benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		0.6	mg/kg		0.6	mg/kg	0.00006 %		
16		chrysene	601-048-00-0	205-923-4	218-01-9		1.2	mg/kg		1.2	mg/kg	0.00012 %		
											Total:	0.00159 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Below limit of detection

Classification of sample: BH06[4]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH06[4]
Sample Depth:
2.7 m
Moisture content:
15%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 15% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		0.035 mg/kg	1.197	0.0419 mg/kg	0.00000419 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.117 mg/kg	1.32	0.154 mg/kg	0.0000154 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.024 mg/kg	1.462	0.0351 mg/kg	0.00000351 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.25 mg/kg	1.126	0.281 mg/kg	0.0000281 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	0.059 mg/kg	1.56	0.092 mg/kg	0.0000059 %		
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.018 mg/kg	2.976	0.0536 mg/kg	0.00000536 %		
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.049 mg/kg	2.774	0.136 mg/kg	0.0000136 %		
11	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
12	benzene	601-020-00-8	200-753-7	71-43-2		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
13	toluene	601-021-00-3	203-625-9	108-88-3		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
14	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
15	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.008 mg/kg		<0.008 mg/kg	<0.0000008 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16	●	acenaphthene				0.66	mg/kg		0.66	mg/kg	0.000066 %		
			201-469-6	83-32-9									
17		dibenz[a,h]anthracene				0.33	mg/kg		0.33	mg/kg	0.000033 %		
		601-041-00-2	200-181-8	53-70-3									
18	●	fluoranthene				7.2	mg/kg		7.2	mg/kg	0.00072 %		
			205-912-4	206-44-0									
19	●	fluorene				0.6	mg/kg		0.6	mg/kg	0.00006 %		
			201-695-5	86-73-7									
20	●	indeno[123-cd]pyrene				1.6	mg/kg		1.6	mg/kg	0.00016 %		
			205-893-2	193-39-5									
21	●	phenanthrene				4.9	mg/kg		4.9	mg/kg	0.00049 %		
			201-581-5	85-01-8									
22	●	pyrene				6.8	mg/kg		6.8	mg/kg	0.00068 %		
			204-927-3	129-00-0									
23		naphthalene				0.4	mg/kg		0.4	mg/kg	0.00004 %		
		601-052-00-2	202-049-5	91-20-3									
24	●	acenaphthylene				0.1	mg/kg		0.1	mg/kg	0.00001 %		
			205-917-1	208-96-8									
25	●	anthracene				1.1	mg/kg		1.1	mg/kg	0.00011 %		
			204-371-1	120-12-7									
26		benzo[a]anthracene				2.9	mg/kg		2.9	mg/kg	0.00029 %		
		601-033-00-9	200-280-6	56-55-3									
27		benzo[a]pyrene; benzo[def]chrysene				3.2	mg/kg		3.2	mg/kg	0.00032 %		
		601-032-00-3	200-028-5	50-32-8									
28	●	benzo[ghi]perylene				1.7	mg/kg		1.7	mg/kg	0.00017 %		
			205-883-8	191-24-2									
29		benzo[b]fluoranthene				3.6	mg/kg		3.6	mg/kg	0.00036 %		
		601-034-00-4	205-911-9	205-99-2									
30		benzo[k]fluoranthene				1.6	mg/kg		1.6	mg/kg	0.00016 %		
		601-036-00-5	205-916-6	207-08-9									
31		chrysene				3.4	mg/kg		3.4	mg/kg	0.00034 %		
		601-048-00-0	205-923-4	218-01-9									
										Total:	0.00411 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH06[5]

Hazardous Waste
Classified as **17 05 03 ***
in the List of Waste

Sample details

Sample name:
BH06[5]
Sample Depth:
3.7 m
Moisture content:
28%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 03 * (Soil and stones containing hazardous substances)

Hazard properties

HP 8: Corrosive "waste which on application can cause skin corrosion"

pH; pH "Assumed to be irritant/corrosive because of pH value"

Because of determinand:

pH (conc.: 11.6 pH)

Determinands

Moisture content: 28% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017	mg/kg	1.197	<0.0204	mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.02	mg/kg	1.32	0.0264	mg/kg	0.00000264 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001	mg/kg	1.142	<0.0011	mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.095	mg/kg	1.462	0.139	mg/kg	0.0000139 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		1	mg/kg	1.126	1.126	mg/kg	0.000113 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	<0.01	mg/kg	1.56	<0.0156	mg/kg	<0.000001 %		<LOD
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005	mg/kg	1.353	<0.0067	mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.11	mg/kg	2.976	0.327	mg/kg	0.0000327 %		
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		0.045	mg/kg	2.554	0.115	mg/kg	0.0000115 %		
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.046	mg/kg	2.774	0.128	mg/kg	0.0000128 %		
11	pH			PH		11.6	pH		11.6	pH	11.6 pH		
12	phenol	604-001-00-2	203-632-7	108-95-2		0.1	mg/kg		0.1	mg/kg	0.00001 %		
										Total:	0.0002 %		

Key	
	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Hazardous result
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH07

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH07
Sample Depth:
0.9 m
Moisture content:
13%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 13% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		1.8 mg/kg	1.197	2.155 mg/kg	0.000215 %		
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		6 mg/kg	1.32	7.922 mg/kg	0.000792 %		
3	beryllium { beryllium oxide }	004-003-00-8	215-133-1	1304-56-9		0.88 mg/kg	2.775	2.442 mg/kg	0.000244 %		
4	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.2 mg/kg	1.142	<0.228 mg/kg	<0.0000228 %		<LOD
5	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		22 mg/kg	1.462	32.154 mg/kg	0.00322 %		
6	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<1.8 mg/kg	2.27	<4.086 mg/kg	<0.000409 %		<LOD
7	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		32 mg/kg	1.126	36.028 mg/kg	0.0036 %		
8	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	13 mg/kg	1.56	20.278 mg/kg	0.0013 %		
9	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.3 mg/kg	1.353	<0.406 mg/kg	<0.0000406 %		<LOD
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		23 mg/kg	2.976	68.454 mg/kg	0.00685 %		
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<1 mg/kg	2.554	<2.554 mg/kg	<0.000255 %		<LOD
12	vanadium { divanadium pentaoxide; vanadium pentoxide }	023-001-00-8	215-239-8	1314-62-1		22 mg/kg	1.785	39.274 mg/kg	0.00393 %		
13	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		46 mg/kg	2.774	127.611 mg/kg	0.0128 %		
14	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }	006-007-00-5				<1 mg/kg	1.884	<1.884 mg/kg	<0.000188 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
15		boron { diboron trioxide }				0.5	mg/kg	3.22	1.61	mg/kg	0.000161 %		
		005-008-00-8	215-125-8	1303-86-2									
16		phenol				<1	mg/kg		<1	mg/kg	<0.0001 %		<**LOD**
		604-001-00-2	203-632-7	108-95-2									
										Total:	0.0341 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH07[2]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH07[2]
Sample Depth:
1.6 m
Moisture content:
11%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 11% No Moisture Correction applied (MC)

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1		antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2		arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.0532 mg/kg	1.32	0.0702 mg/kg	0.00000702 %		
3		cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.0043 mg/kg	1.462	0.0062 mg/kg	0.000000628 %		
5		copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.048 mg/kg	1.126	0.054 mg/kg	0.0000054 %		
6		lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	<0.01 mg/kg	1.56	<0.0156 mg/kg	<0.000001 %		<LOD
7		mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8		nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.0049 mg/kg	2.976	0.0146 mg/kg	0.00000146 %		
9		selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10		zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.02 mg/kg	2.774	0.0555 mg/kg	0.00000555 %		
11		pH			PH		7.8 pH		7.8 pH	7.8 pH		
12		phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
									Total:	0.00004 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: BH07[3]

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
BH07[3]
Sample Depth:
3.6 m
Moisture content:
14%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 14% No Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<0.017 mg/kg	1.197	<0.0204 mg/kg	<0.00000204 %		<LOD
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		0.0578 mg/kg	1.32	0.0763 mg/kg	0.00000763 %		
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		<0.001 mg/kg	1.142	<0.0011 mg/kg	<0.000000114 %		<LOD
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		0.034 mg/kg	1.462	0.0497 mg/kg	0.00000497 %		
5	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		0.029 mg/kg	1.126	0.0327 mg/kg	0.00000327 %		
6	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	0.05 mg/kg	1.56	0.078 mg/kg	0.000005 %		
7	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		<0.005 mg/kg	1.353	<0.0067 mg/kg	<0.000000677 %		<LOD
8	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		0.013 mg/kg	2.976	0.0387 mg/kg	0.00000387 %		
9	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		<0.04 mg/kg	2.554	<0.102 mg/kg	<0.0000102 %		<LOD
10	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		0.11 mg/kg	2.774	0.305 mg/kg	0.0000305 %		
11	phenol	604-001-00-2	203-632-7	108-95-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
12	benzene	601-020-00-8	200-753-7	71-43-2		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
13	toluene	601-021-00-3	203-625-9	108-88-3		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
14	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.005 mg/kg		<0.005 mg/kg	<0.0000005 %		<LOD
15	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.008 mg/kg		<0.008 mg/kg	<0.0000008 %		<LOD

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16		acenaphthene											
			201-469-6	83-32-9		100	mg/kg		100	mg/kg	0.01 %		
17		dibenz[a,h]anthracene											
		601-041-00-2	200-181-8	53-70-3		15	mg/kg		15	mg/kg	0.0015 %		
18		fluoranthene											
			205-912-4	206-44-0		410	mg/kg		410	mg/kg	0.041 %		
19		fluorene											
			201-695-5	86-73-7		44	mg/kg		44	mg/kg	0.0044 %		
20		indeno[123-cd]pyrene											
			205-893-2	193-39-5		70	mg/kg		70	mg/kg	0.007 %		
21		phenanthrene											
			201-581-5	85-01-8		450	mg/kg		450	mg/kg	0.045 %		
22		pyrene											
			204-927-3	129-00-0		340	mg/kg		340	mg/kg	0.034 %		
23		naphthalene											
		601-052-00-2	202-049-5	91-20-3		27	mg/kg		27	mg/kg	0.0027 %		
24		acenaphthylene											
			205-917-1	208-96-8		0.84	mg/kg		0.84	mg/kg	0.000084 %		
25		anthracene											
			204-371-1	120-12-7		120	mg/kg		120	mg/kg	0.012 %		
26		benzo[a]anthracene											
		601-033-00-9	200-280-6	56-55-3		140	mg/kg		140	mg/kg	0.014 %		
27		benzo[a]pyrene; benzo[def]chrysene											
		601-032-00-3	200-028-5	50-32-8		120	mg/kg		120	mg/kg	0.012 %		
28		benzo[ghi]perylene											
			205-883-8	191-24-2		76	mg/kg		76	mg/kg	0.0076 %		
29		benzo[b]fluoranthene											
		601-034-00-4	205-911-9	205-99-2		140	mg/kg		140	mg/kg	0.014 %		
30		benzo[k]fluoranthene											
		601-036-00-5	205-916-6	207-08-9		46	mg/kg		46	mg/kg	0.0046 %		
31		chrysene											
		601-048-00-0	205-923-4	218-01-9		140	mg/kg		140	mg/kg	0.014 %		
										Total:	0.224 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: SA01

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
SA01
Sample Depth:
1.7 m
Moisture content:
10%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 10% No Moisture Correction applied (MC)

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
1	●	acenaphthene	201-469-6	83-32-9		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
2		dibenz[a,h]anthracene	200-181-8	53-70-3		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-041-00-2											
3	●	fluoranthene	205-912-4	206-44-0		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
4	●	fluorene	201-695-5	86-73-7		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
5	●	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
6	●	phenanthrene	201-581-5	85-01-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
7	●	pyrene	204-927-3	129-00-0		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
8		naphthalene	202-049-5	91-20-3		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-052-00-2											
9	●	acenaphthylene	205-917-1	208-96-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
10	●	anthracene	204-371-1	120-12-7		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
11		benzo[a]anthracene	200-280-6	56-55-3		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-033-00-9											
12		benzo[a]pyrene; benzo[def]chrysene	200-028-5	50-32-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-032-00-3											
13	●	benzo[ghi]perylene	205-883-8	191-24-2		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
14		benzo[b]fluoranthene	205-911-9	205-99-2		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-034-00-4											
15		benzo[k]fluoranthene	205-916-6	207-08-9		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-036-00-5											
16		chrysene	205-923-4	218-01-9		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<LOD
		601-048-00-0											
										Total:	0.00008 %		

Key	
	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Below limit of detection

Classification of sample: SA03

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:
SA03
Sample Depth:
0.8 m
Moisture content:
11%
(no correction)

LoW Code:
Chapter: 17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Entry: 17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 11% No Moisture Correction applied (MC)

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
1		acenaphthene	201-469-6	83-32-9		1.9	mg/kg		1.9	mg/kg	0.00019 %		
2		dibenz[a,h]anthracene	200-181-8	53-70-3		0.38	mg/kg		0.38	mg/kg	0.000038 %		
		601-041-00-2											
3		fluoranthene	205-912-4	206-44-0		11	mg/kg		11	mg/kg	0.0011 %		
4		fluorene	201-695-5	86-73-7		1.3	mg/kg		1.3	mg/kg	0.00013 %		
5		indeno[123-cd]pyrene	205-893-2	193-39-5		2	mg/kg		2	mg/kg	0.0002 %		
6		phenanthrene	201-581-5	85-01-8		9.3	mg/kg		9.3	mg/kg	0.00093 %		
7		pyrene	204-927-3	129-00-0		10	mg/kg		10	mg/kg	0.001 %		
8		naphthalene	202-049-5	91-20-3		0.61	mg/kg		0.61	mg/kg	0.000061 %		
		601-052-00-2											
9		acenaphthylene	205-917-1	208-96-8		<0.05	mg/kg		<0.05	mg/kg	<0.000005 %		<**LOD**
10		anthracene	204-371-1	120-12-7		2.3	mg/kg		2.3	mg/kg	0.00023 %		
11		benzo[a]anthracene	200-280-6	56-55-3		4.2	mg/kg		4.2	mg/kg	0.00042 %		
		601-033-00-9											
12		benzo[a]pyrene; benzo[def]chrysene	200-028-5	50-32-8		4.2	mg/kg		4.2	mg/kg	0.00042 %		
		601-032-00-3											
13		benzo[ghi]perylene	205-883-8	191-24-2		2.2	mg/kg		2.2	mg/kg	0.00022 %		
14		benzo[b]fluoranthene	205-911-9	205-99-2		4.7	mg/kg		4.7	mg/kg	0.00047 %		
		601-034-00-4											
15		benzo[k]fluoranthene	205-916-6	207-08-9		1.7	mg/kg		1.7	mg/kg	0.00017 %		
		601-036-00-5											
16		chrysene	205-923-4	218-01-9		4.3	mg/kg		4.3	mg/kg	0.00043 %		
		601-048-00-0											
										Total:	0.00601 %		

Key	
	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
<LOD	Below limit of detection

Appendix A: Classifier defined and non GB MCL determinands

- **chromium(III) oxide (worst case)** (EC Number: 215-160-9, CAS Number: 1308-38-9)

Description/Comments: Data from C&L Inventory Database
Data source: https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/33806
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4; H332 , Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Resp. Sens. 1; H334 , Skin Sens. 1; H317 , Repr. 1B; H360FD , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

- **ethylbenzene** (EC Number: 202-849-4, CAS Number: 100-41-4)

GB MCL index number: 601-023-00-4
Description/Comments:
Additional Hazard Statement(s): Carc. 2; H351
Reason for additional Hazards Statement(s):
20 Nov 2021 - Carc. 2; H351 hazard statement sourced from: IARC Group 2B (77) 2000

- **acenaphthene** (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Aquatic Chronic 2; H411

- **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Hazard Statements: Acute Tox. 4; H302 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

- **fluorene** (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

- **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Carc. 2; H351

- **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Carc. 2; H351 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Skin Irrit. 2; H315

- **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Hazard Statements: Skin Irrit. 2; H315 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

- **acenaphthylene** (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4; H302 , Acute Tox. 1; H330 , Acute Tox. 1; H310 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315

- **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

benzo[ghi]perylene (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 23 Jul 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex

GB MCL index number: 006-007-00-5
Description/Comments: Conversion factor based on a worst case compound: sodium cyanide
Additional Hazard Statement(s): EUH032 >= 0.2 %
Reason for additional Hazards Statement(s):
20 Nov 2021 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

pH (CAS Number: PH)

Description/Comments: Appendix C4
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: None.

Appendix B: Rationale for selection of metal species

antimony {antimony trioxide}

Worst case CLP species based on hazard statements/molecular weight and low solubility. Industrial sources include: flame retardants in electrical apparatus, textiles and coatings (edit as required)

arsenic {arsenic trioxide}

Reasonable case CLP species based on hazard statements/molecular weight and most common (stable) oxide of arsenic. Industrial sources include: smelting; main precursor to other arsenic compounds (edit as required)

cadmium {cadmium oxide}

Reasonable case CLP species based on hazard statements/molecular weight, very low solubility in water. Industrial sources include: electroplating baths, electrodes for storage batteries, catalysts, ceramic glazes, phosphors, pigments and nematocides. (edit as required) Worst case compounds in CLP: cadmium sulphate, chloride, fluoride & iodide not expected as either very soluble and/or compound's industrial usage not related to site history (edit as required)

chromium in chromium(III) compounds {chromium(III) oxide (worst case)}

default

copper {dicopper oxide; copper (I) oxide}

Reasonable case CLP species based on hazard statements/molecular weight and insolubility in water. Industrial sources include: oxidised copper metal, brake pads, pigments, antifouling paints, fungicide. (edit as required) Worse case copper sulphate is very soluble and likely to have been leached away if ever present and/or not enough soluble sulphate detected. (edit as required)

lead {lead chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

mercury {mercury dichloride}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

nickel {nickel chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

selenium {nickel selenate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

zinc {zinc chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

beryllium {beryllium oxide}

Reasonable case CLP species based on hazard statements/molecular weight. Industrial sources include: most common (non alloy) form, used in ceramics (edit as required)

chromium in chromium(VI) compounds {chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex}

Worst case species based on hazard statements/molecular weight (edit as required)

vanadium {divanadium pentaoxide; vanadium pentoxide}

default

cyanides {salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex}

Harmonised group entry used as most reasonable case as complex cyanides and those specified elsewhere in the annex are not likely to be present in this soil: [Note conversion factor based on a worst case compound: sodium cyanide] (edit as required)

boron {diboron trioxide}

Reasonable case CLP species based on hazard statements/ molecular weight, physical form and low solubility. Industrial sources include: fluxing agent for glass/enamels; additive for fibre optics, borosilicate glass (edit as required)

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition v1.2.GB - Oct 2021
HazWasteOnline Classification Engine Version: 2025.24.6453.11761 (25 Jan 2025)
HazWasteOnline Database: 2025.24.6453.11761 (25 Jan 2025)

This classification utilises the following guidance and legislation:
WM3 v1.2.GB - Waste Classification - 1st Edition v1.2.GB - Oct 2021
CLP Regulation - Regulation 1272/2008/EC of 16 December 2008
1st ATP - Regulation 790/2009/EC of 10 August 2009
2nd ATP - Regulation 286/2011/EC of 10 March 2011
3rd ATP - Regulation 618/2012/EU of 10 July 2012
4th ATP - Regulation 487/2013/EU of 8 May 2013
Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013
5th ATP - Regulation 944/2013/EU of 2 October 2013
6th ATP - Regulation 605/2014/EU of 5 June 2014
WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014
Revised List of Waste 2014 - Decision 2014/955/EU of 18 December 2014
7th ATP - Regulation 2015/1221/EU of 24 July 2015
8th ATP - Regulation (EU) 2016/918 of 19 May 2016
9th ATP - Regulation (EU) 2016/1179 of 19 July 2016
10th ATP - Regulation (EU) 2017/776 of 4 May 2017
HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017
13th ATP - Regulation (EU) 2018/1480 of 4 October 2018
14th ATP - Regulation (EU) 2020/217 of 4 October 2019
15th ATP - Regulation (EU) 2020/1182 of 19 May 2020
The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use)(Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1567 of 16th December 2020
The Waste and Environmental Permitting etc. (Legislative Functions and Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1540 of 16th December 2020
GB MCL List - version 1.1 of 09 June 2021
GB MCL List v2.0 - version 2.0 of 20th October 2023
GB MCL List v3.0 - version 3.0 of 11th January 2024
GB MCL List v4.0 - version 4.0 of 2nd March 2024
GB MCL List v5.0 - version 5.0 of 26th June 2024

Appendix G- Detailed UXO Risk Assessment

Detailed Unexploded Ordnance Risk Assessment

Cambridge Hall, Manchester

7390-5 RA











Unit 3, The Courtyard Campus Way, Gillingham Business Park, Gillingham, Kent, ME8 0NZ

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This Report has been produced in compliance with the Construction Industry Research and Information Association guidelines for the preparation of Detailed Unexploded Ordnance Risk Assessments in the management of UXO risks in the construction industry. This report has been compiled using all due diligence and expertise and having made all proper but reasonable enquiries within given time limitations. However, in accepting and implementing the recommendations contained in this report, the client does so strictly at his own risk.

Distribution

Version	Format	Recipient	Author	Review	Authorisation	Date
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Report Summary

Project Site Information	
Project site address	Manchester Metropolitan University – All Saints Campus, Boundary Lane, First Street, Hulme, Manchester, Greater Manchester, M15 6JD
NGR Centre Point	SJ 84156 96974
Scope of proposed works	The development will involve the construction of a new 22 and 28 storey building with piled foundations (approx. 15-20m depth) as well as excavations for foundations and utilities generally undertaken within the upper 1.5m of the site. Ground investigation will comprise of boreholes drilled to a maximum depth of 16m and trial pits with depths not greater than 4.5m.
Overall Risk Rating	**Zones of LOW and MEDIUM risk**

Summary of Risk Ratings

Low Risk Zone

Hazard	Average Depth of Hazard	pE	cD	Risk Analysis (pE x cD)	Risk Rating
HE	<12m bgl[1]	1	5	5	**Low**
IB	<1m bgl	1	4	4	**Low**
AA	<5m bgl	1	4	4	**Low**
LSA	<2m bgl	1	4	4	**Low**
SAA	<1m bgl	1	2	2	**Low**

Medium Risk Zone

Hazard	Average Depth of Hazard	pE	cD	Risk Analysis (pE x cD)	Risk Rating
HE	<12m bgl	3	5	15	**Medium**
IB	<1m bgl	1	4	4	**Low**
AA	<5m bgl	2	4	8	**Medium**
LSA	<2m bgl	1	4	4	**Low**
SAA	<1m bgl	1	2	2	**Low**

Recommended Mitigation Measures

Proposed Works	Risk Mitigation Recommendation
All	• Site Specific Explosive Ordnance Safety and Awareness Briefings (UXO Toolbox Briefing) to all personnel conducting intrusive works • Site Specific Safety Instructions (SSSI) Training Course

[1] See Section 7.6. A site-specific maximum bomb penetration depth is assumed between 8-10m below WWII ground level.

Shallow intrusive works	• Explosive Ordnance Disposal (EOD) Engineer On-Site Support (Watching Brief)
Boreholes	• Support to Borehole Drilling
Piling	• Intrusive Magnetometer Survey of all pile locations down to the maximum bomb penetration depth

In accordance with CIRIA guidelines this assessment has carried out research, analysed the evidence and considered the likelihood that the site has been contaminated with unexploded ordnance; that such items remained on site; the risk that they could be encountered during any intrusive works and the consequences that could result. Appropriate risk mitigation measures have been proposed.

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Appendix 1 Generic Types of German Air-Delivered Ordnance

Appendix 2 Generic Types of British / Allied Ordnance

Glossary of Terms

AAA	Anti-Aircraft Artillery
ALARP	As Low As Reasonably Practicable
AP	Anti-Personnel
ARP	Air-raid Precautions
BDO	Bomb Disposal Officer
BPD	Bomb Penetration Depth
EOD	Explosive Ordnance Disposal (current term for “bomb” disposal)
HAA	Heavy Anti-Aircraft
HE	High Explosive
HG	Home Guard
IB	Incendiary Bomb
LAA	Light Anti-Aircraft
LM	Land Mine
LSA	Land Service Ammunition (includes grenades, mortars, etc.)
Luftwaffe	German Air Force
m bgl	Metres Below Ground Level
MoD	Ministry of Defence
NGR	National Grid Reference
OB	Oil Bomb
PM	Parachute Mine
RAF	Royal Air Force
SI	Site Investigation
SAA	Small Arms Ammunition (small calibre cartridges used in rifles & machine guns)
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	“Doodlebug” the first cruise type missile, used against London from June 1944. Also known as ‘Flying Bomb’
V-2	The first ballistic missile, used against London from September 1944
WWI	First World War (1914 -1918)
WWII	Second World War (1939 – 1945)

Detailed Unexploded Ordnance Risk Assessment

In respect of

Cambridge Hall, Manchester

1. Introduction

Groundsure Ltd, on behalf of Unite Group ("the client"), has commissioned Igne to conduct a Detailed Unexploded Ordnance Risk Assessment of Cambridge Hall, Manchester ("the site").

Unexploded Ordnance (UXO) poses significant risks to UK construction projects due to past conflicts and military activity. Buried unexploded air-dropped bombs and anti-aircraft projectiles, with an estimated failure rate of 10%, can be found at various depths depending on their characteristics and the ground conditions. Furthermore, it is estimated that over 20% of the UK land mass has been utilised by the military.

Despite efforts to locate and render safe UXO, ongoing discoveries during construction-related ground works continue to occur.

Increased risk awareness and proactive safety measures have reduced the risk to personnel. However, even the discovery of a suspected device can disrupt production and lead to delays and expenses. Site-specific risk understanding and appropriate mitigation measures can help address these risks effectively.

2. Construction Industry Duties and Responsibilities

2.1 The UK Regulatory Environment

The construction industry is not legally required to control and mitigate UXO risk. However, CIRIA (C681): Unexploded Ordnance (UXO) A Guide for the Construction Industry provides guidelines for good practice and information on managing UXO risk. These guidelines include a process for risk assessment and implementation of site-specific mitigation strategies. While these is no specific legislation for UXO risk, health and safety regulations address the responsibility of the construction industry to protect workers engaged in ground-intrusive operations from foreseeable UXO risks.

2.2 The Health and Safety at Work Act, 1974

The Act places a duty of care on an employer to put in place safe systems of work to address, as far as is reasonably practicable, all risks (to employees and the general public) that are reasonably foreseeable.

2.3 Construction (Design and Management) Regulations 2015

CDM 2015 ensures that health and safety within the construction industry is continually improved:

- Works are sensibly planned and managed.
- Competent staff are engaged in the works.
- Risks are identified and managed.
- All parties cooperate and coordinate activities.
- Communication flows to those who require it.
- Workers are consulted and engaged about risks and how they are being managed.

In line with CDM 2015 legislation, Igne are able to assist parties in their discharge of CDM duties as follows:

- Assist Principal Designers with pre-construction information and risk assessments.
- Assist the Designer with the Designer's Risk Assessment.
- Issue UXO risks as have been identified and manage risks accordingly.
- Assist the Principal Contractor with the construction phase information, in particular risk assessments and mitigation strategies.
- Plan, manage and monitor survey and clearance works under Igne's control.

2.4 Other Legislation

Other relevant legislation includes the "Management of Health and Safety at Work Regulations 1999" and "The Corporate Manslaughter and Corporate Homicide Act 2007".

3. The Role of the Authorities and Commercial Contractors

3.1 The Authorities

The Police coordinate emergency services in ordnance-related incidents on construction sites. They assess the risk and may establish a safety cordon, evacuate the area, and contact the military authorities (JSEODOC – Joint Services Explosive Ordnance Disposal Operations Centre) for investigation or disposal. If no EOD specialist is present, the Police impose precautions and away JSEODOC advice.

The response time from JSEODOC depends on the assessed risk and resource availability. They may remove or dispose of the ordnance on site if deemed necessary, potentially requiring additional cordons and evacuations. In routine cases, JSEODOC may not treat each occurrence as an emergency and may advise the construction company to engage a

commercial contractor for managing the situation and reducing pressure on JSEOD disposal teams.

3.2 Commercial Contractors

In addition to pre-construction site surveys and follow-on clearance work, a commercial contractor is able to provide a reactive service on construction sites. The presence of a qualified EOD Engineer with ordnance recognition skills will avoid unnecessary callouts to the authorities and the contractor will be able to arrange for the removal and disposal of low-risk ordnance. If high risk ordnance is discovered actions will be co-ordinated with the authorities with the objective of causing the minimum possible disruption to site operations whilst putting immediate, safe and appropriate measures in place.

4. This Report

4.1 Aims and Objectives

The aim of this report is to examine the probability of encountering and detonating any explosive ordnance during any intrusive works at the site. Risk mitigation measures will be recommended in line with the CIRIA C681 guidelines, to reduce the risk of detonating UXO, and the subsequent risk of harm / damage during the envisaged works to as low as reasonably practicable (ALARP).

This report is a live document and should be updated if any new information comes to light after issue.

4.2 Risk Assessment Methodology

The following issues will be addressed in the report:

- The probability that the site was contaminated with unexploded ordnance.
- The probability that unexploded ordnance remains on site.
- The probability that ordnance may be encountered during any intrusive works.
- The probability that ordnance may be detonated.
- The consequences of detonating or encountering ordnance.

Risk mitigation measures, appropriate to the assessed level of risk and site conditions, will be recommended.

4.3 Approach

In preparing this Unexploded Ordnance Risk assessment, Igne has considered general and, as far as possible, site-specific factors including:

- Evidence of German bombing and delivery of UXBs.

- Site history, occupancy and conditions during WWII.
- The legacy of Allied military activity.
- Details of any known EOD clearance activity.
- The extent of any post war redevelopment.
- Scope of the current proposed works.

4.4 Sources of Information

Igne has carried out detailed historical research for this Unexploded Ordnance Risk Assessment including accessing military records and archived material held in the public domain and in the MoD.

Material from a range of sources has been consulted, including but not limited to:

- The National Archives.
- The University of Manchester.
- The Greater Manchester Record Office.
- The Commonwealth War Graves Commission.
- RAF Aerial Collection.
- Landmark Maps.
- Relevant information supplied by the client.
- Igne's extensive archives built up over many years of research and hands-on Explosive Ordnance Disposal activities in the UK.
- Open sources such as published books, local historical records and the internet.

4.5 Reliability of Historical Records

4.5.1 General Considerations

This report is based upon research of historical evidence. Whilst every effort has been made to locate all relevant material Igne cannot be held responsible for any changes to the assessed level of risk or risk mitigation measures based on documentation or other information that may come to light at a later date.

The accuracy and comprehensiveness of wartime records is frequently difficult or impossible to verify. As a result, conclusions as to the exact location, quantity and nature of the ordnance risk can never be definitive but must be based on the accumulation and careful analysis of all accessible evidence. Igne cannot be held responsible for inaccuracies or gaps in the available historical information.

4.5.2 Bombing Records

During WWII, considerable efforts were expended in recording enemy air raids. Air Raid Precautions (ARP) wardens were responsible for making records of bomb strikes either through direct observation or by post-raid surveys. However, their immediate priority was to deal with casualties and limit damage, so it is to be expected that records are often incomplete and sometimes contradictory. Record keeping in the early days of bombing was not comprehensive and details of bombing in the early part of the war were sometimes destroyed in subsequent attacks. Some reports may cover a single attack, others a period of months or the entire war.

Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are not always reliable; records of attacks on military or strategic targets were often maintained separately from the general records and have not always survived.

5. The Site and Scope of Proposed Works

Details for the site and the proposed works are presented in the following table.

Site Address	Manchester Metropolitan University – All Saints Campus, Boundary Lane, First Street, Hulme, Manchester, Greater Manchester, M15 6JD	
OS National Grid Reference	SJ 84156 96974	
Site Description	The site encompasses the Cambridge North Hall building, associated with Manchester Metropolitan University. This large multi-storey structure is accompanied by 3no. quads, comprising paving and garden areas. Access to the site is provided by Higher Cambridge Street to the west and High Chatham Street to the east.	
Proposed Works	The development will involve the construction of a new 22 and 28 storey building with piled foundations (approx. 15-20m depth) as well as excavations for foundations and utilities generally undertaken within the upper 1.5m of the site. Ground investigation will comprise of boreholes drilled to a maximum depth of 16m and trial pits with depths not greater than 4.5m.	
References	Site Location Maps	Figure 1.0
	Recent Aerial Photograph	Figure 2.0

6. WWII Site Conditions

Available mapping and photography were sought for the site, in order to assess site conditions pre, during and post-wartime.

6.1 Pre and Post-WWII OS Mapping

The following historic OS mapping for the site was obtained and reviewed.

	Date	Observations	Reference	Source
Pre-WWII	1932-1933	• The northern section of the site consists of residential terraces, facing onto *Hadfield Street, Lee Street and West Street* respectively. • The southern section of the site comprises a large structure labelled *Warehouses*. • The site is bisected by *Cavendish Street*, running from east to west through the study area. • The surrounding area is densely urbanised, comprising residential, commercial, educational and religious/recreational buildings.	Figure 3.1	Landmark Maps
Post-WWII	1950-1951	• The site remains mostly consistent with early pre-war OS mapping. However, the row of terraces on the northern side of *Hadfield Street* have been cleared. • In addition, large areas of clearance can be seen in the surrounding area, within close proximity to the site. • Redeveloped buildings can be identified to the west and south of the site, the closest example located 70m south. • Evidence of clearance and redevelopment is often indicative of bomb damage on early post-WWII OS mapping.	Figure 3.2	

6.2 WWII-era RAF Aerial Photography

The following WWII-era aerial photography was obtained and reviewed.

Date	16th May 1948	
Source	RAF Aerial Collection	
Image quality	Small scale, low resolution	
Observations	• The site is consistent with conditions presented in post-war OS mapping, as the cleared area within the northern extent of the site can be identified. • In addition, signs of bomb damage can be observed at previously identified areas of clearance and redevelopment. • The presence of new roof panelling on the warehouse building within the site's southern section suggests possible damage to this area.	
Reference		Figure 4.0

7. The Threat from Aerial Bombing

7.1 General Bombing History of Manchester

7.1.1 First World War

A series of bombing raids took place in the UK during WWI. Zeppelin airships, “Gotha” and “Giant” bombers conducted a succession of attacks in which high explosive bombs and incendiary devices were dropped. Although Zeppelin airship raids were recorded in the north-west, no raids were recorded across the Manchester region specifically.

WWI bombs were generally smaller than those used in WWII and were dropped from a lower altitude, resulting in limited UXB penetration depths. Aerial bombing was often such a novelty at the time that it attracted public interest and even spectators to watch the raids in progress. For these reasons, there is a limited risk that UXBs passed undiscovered. When combined with the relative infrequency of attacks and an overall low bombing density the risk from WWI UXBs is considered low and will not be further addressed in this report.

7.1.2 Second World War

At the start of WWII, the Luftwaffe planned to destroy key military installations, including RAF airfields and Royal Navy bases, during a series of daylight bombing raids in 1940. After the Battle of Britain in the south-east, these tactics were modified to include both economic and industrial sites throughout the UK.

In the north-west the Greater Manchester area was heavily bombed during late 1940 / early 1941, due primarily to the industry located within the city; with targets including dock facilities, railway infrastructure, power stations, weapon manufacturing plants and gas works. The importance of the Manchester Ship Canal and Salford Docks to the Allied war effort was not overlooked and this infrastructure was heavily targeted. Many local companies were involved in vital war production work and putting the city’s docks and industry out of action would have had serious consequences for the Allied war effort. As a result of aircraft losses, daylight raids were reduced in favour of attacking targets under the cover of darkness.

A Luftwaffe Target Map of Manchester (**Figure 5**) shows a high density of targets highlighted for bombing by the Luftwaffe. The site itself lies close to Manchester Victoria University (situated 360m south-east) Further targets are present within the wider area, including the Dunlop Rubber Works 300m north and a Gas Works approximately 450m north-west.

Between July 1940 and July 1942, Greater Manchester suffered repeated and widespread bombing. The Luftwaffe mounted consecutive heavy attacks on the nights of the 22/23rd and 23/24th December 1940, leaving large areas of Manchester, Salford and Stretford devastated. In total these two successive nights involved a total of 441 German bombers and became known as the ‘Manchester Blitz’.

During these attacks 6 conflagrations, 20 major fires and over 600 smaller fires were reported. This, coupled with concentrated HE bombing, resulted in the total destruction of over 4,000 houses as well as serious damage to a further 12,000.[2] In total, 467 tonnes of HE bombs were dropped over Manchester in December 1940 alone. The damage was so extensive, that the government ordered a ban on damage photographs being by the media. 684 fatalities were recorded across the city and a further 2,364 injured, however full casualty details were not disclosed at the time to deny the Germans any propaganda material.

During 1941 two further large-scale raids occurred on the 9th January and 1st June. Although each involved half as many aircraft as the 22nd December 1940 raid, these two attacks still delivered a further 208 tonnes of HE bombs onto the Manchester area. After June 1941, the raids became more infrequent, but by this time serious damage had been caused to industrial premises, the city centre and the docks. Small scale attacks carried on throughout the rest of 1941 and 1942.

From mid-1944 the "V-weapon" (for Vengeance) campaign, using unmanned rockets and missiles, represented Hitler's final attempt to reverse Germany's imminent defeat. The V1 (Flying Bomb or Doodlebug) and the V2 (Long Range Rocket) were launched from bases in occupied France, Belgium and Holland as well as from Germany itself. In December 1944, after a two-year lull in bombing, several V1s fell in Greater Manchester. One landed in Oldham killing 27 people, the region's last bombing casualties of the war.

Although these weapons caused considerable destruction their relatively low numbers allowed accurate records of strikes to be maintained and these records have mostly survived. There is a negligible risk from unexploded V-weapons today since even if an unexploded 1,000kg warhead had survived impact the remains of the munition's body would have left incontrovertible evidence of the strike and it would have been dealt with at the time.

7.2 Generic Types of WWII German Air-delivered Ordnance

The nature and characteristics of the ordnance used by the Luftwaffe allows an informed assessment of the hazards posed by any unexploded items that may remain today.

HE Bombs	In terms of weight of ordnance dropped, HE bombs were the most frequent weapon deployed. Most bombs were 50kg, 250kg or 500kg (overall weight, about half of which was the high explosive) though large bombs of up to 2,000kg were also used. HE bombs had the weight, velocity and shape to easily penetrate the ground intact if they failed to explode. Post-raid surveys would not always have spotted the entry hole or other indications that a bomb penetrated the ground and failed to explode, and contemporary ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded 50kg bomb. Unexploded HE bombs therefore present the greatest risk to present–day intrusive works.

[2] P. J. C. Smith, *Luftwaffe Over Manchester*

Blast Bombs / Parachute Mines	Blast bombs generally had a slow rate of descent and were extremely unlikely to have penetrated the ground. Non-retarded mines would have shattered on most ground types if they had failed to explode. There have been extreme cases when these items have been found unexploded, but this was where the ground was either very soft or where standing water had reduced the impact. Igne does not consider there to be a significant risk from this type of munition on land.
Large incendiary bombs	This type of bomb ranged in size from 36kg to 255kg and had a number of inflammable fill materials (including oil and white phosphorus), and a small explosive charge. They were designed to explode and burn close to the surface, but their shape and weight meant that they did have penetration capability. If they penetrated the ground, complete combustion did not always occur, and, in such cases, they remain a risk to intrusive works.
1kg Incendiary Bombs (IB)	These bombs, which were jettisoned from air-dropped containers, were just over 30cm in size and therefore highly likely to go unnoticed. They had the potential to penetrate soft ground and left a very small entry hole. Furthermore, if bombs did not initiate and fell in water or dense vegetation or became mixed with rubble in bomb damaged areas, they could have remained hidden to this day. Some variants had explosive heads, and these present a risk of detonation during intrusive works, particularly due to their shape, which leads them to often be misidentified.
Anti-personnel (AP) Bomblets	AP bombs had little ground penetration ability and should have been located by the post-raid survey unless they fell into water, dense vegetation or bomb rubble.
Specialist Bombs (smoke, flare, etc)	These types do not contain high explosive and therefore a detonation consequence is unlikely. They were not designed to penetrate the ground.
Examples of the most commonly deployed German bombs are presented at Appendix 1.	

7.3 Second World War Bombing Statistics

The following table summarises the quantity of German bombs (excluding 1kg incendiaries and anti-personnel bombs) falling on the County Borough of Manchester between 1940 and 1945.

Record of Ordnance Dropped on the County Borough of Manchester									
Area Acreage	**HE bombs (all)**	**Para-chute Mines**	**Oil Bombs**	**Phos. Bombs**	**Fire Pots**	**V1**	**V2**	**Total**	**Items per 1000 acres**
27,255	712	18	7	-	-	1	-	738	**27.1**

Source: Home Office Statistics

This table does not include UXO found during or after WWII.

Detailed records of the quantity and locations of the 1kg incendiary and anti-personnel bombs were not routinely maintained by the authorities as they were frequently too numerous to record.

Although the incendiaries are not particularly significant in the risk they pose, they nevertheless are items of ordnance that were designed to cause damage and inflict injury and should not be overlooked in assessing the general risk to personnel and equipment. The anti-personnel bombs were used in much smaller quantities and are rarely found today but are potentially more dangerous.

7.4 Site Specific WWII Bombing Records

7.4.1 Manchester Damage & Bomb Plot Map

A review was conducted of the Manchester bomb damage maps, compiled by Manchester City Council and obtained from the University of Manchester. These maps records bomb damage of the city, as well as the location of HE bomb and fire bomb strikes.

These maps were created between 1940-1941. It therefore does not record any incidents or damage following 1941 and should not be considered a consolidated record of bombing. Note, the degree of some damage is not specified; however, properties outlined in red are likely those that suffered minor / blast damage.

Nearest incident to site	Onsite (1 x HE bomb strike & 3 x Fire bomb strikes on site)
Number of local incidents	Approx. 39
Weapon(s)	~30 x Fire bombs 8 x HE bombs 1 x Parachute mine
Damage on site	• Damage is recorded for half of the warehouse building. • Bomb strikes within the northern section of the site correspond with clearance identified on post-war OS mapping. • Further damage is present within and adjacent to the north of the site. • Demolished buildings can be identified to the north-west and south of the study area.
Reference	Figure 6.0

7.4.2 Manchester Blitz Civilian Deaths Map – 25th December 1940

A review was conducted of an interactive Manchester Blitz Civilian Deaths Map, obtained from Manchester Evening News. The map provides the locations of all reported bombing incidents during the 1940 Christmas Blitz that resulted in civilian deaths. The data for this map was provided by the Commonwealth War Graves Commission.

Location	Details
55 Boundary Street West, adjacent to the site's southern boundary	One fatality
41 Higher Chatham Street, 40m south of the site	One fatality
Cowcill Street, between 20m and 300m south of the site	One fatality
No. 10 Livingstone Street – located within 300m of the site	Five fatalities

7.4.3 Original ARP Bombing Incident Records

Throughout WWII, records of bombing incidents were kept by the ARP and Civil Defence Office. These records were kept in the form of typed or hand-written notes and/or presented on bomb plot maps. Some other organisations, such as port authorities and railways, maintained separate records.

Written ARP records were reviewed for		County Borough of Manchester
Source		Greater Manchester Record Office
Date	**Weapon**	**Details**
Unknown	HE bomb	HE bombs recorded in Oxford Street, possibly within 1km to 400m of the site

7.4.4 Home Office Intelligence Reports

The Home Office Intelligence reports document enemy action on British domestic soil and were prepared twice a day for the Home Security War Room. The summaries were prepared by intelligence staff, who compiled reports received from the twelve civil defence regions.

Approximately 40no. air raid incidents were recorded over Manchester during WWII. However, available records only document time and general location of attack and numbers of casualties. The intelligence officials generally only recorded locations on municipal level (town, village, or city), rarely providing specific addresses.

7.4.5 Secondary Source / Anecdotal Evidence

Anecdotal evidence of local bombing incidents was sought from publications and web resources. The following references to incidents on site or in the surrounding area were found.

Date	Weapon	Details
1939 - 1945	Various	*"My mother had found a job at Dunlop's Rubber Co. in Cambridge Street and had to work nights when the Blitz was on. It was every boy for himself - you heard the sirens and either stayed in the bedroom and watched the bombs coming down, and then watched the city burn, or you dashed down to the back yard into the shelter."*[3] The Dunlop Works were located approximately 300m north of the site.

7.4.6 Bombing Decoy Sites

In July 1940, a national decoy authority led by Colonel John Fisher Turner was established. Urban lighting decoys, known as "Civil" sites, were set up following earlier experiments in Glasgow and Sheffield. These sites, designated as "QL" for urban lighting simulation and "QF" for dummy fires, used electrical and pyrotechnical apparatus to imitate various sources of light and flare. Additional sites simulated small fired caused by incendiary bombs, including special "SF" sites known as "Starfish" sites that attracted enemy bombers away from populated areas and defence installations. Decoy sites were quite successful, with airfield decoys receiving 359 attacks compared to 358 attacks on real airfields by the end of 1941.

A bombing decoy site was established in close proximity to the site	✖

7.4.7 Abandoned Bombs

After an air raid, a survey would be conducted to search for bomb entry holes. If evidence was found, Bomb Disposal Officer teams would be called to locate and dispose of the bomb. However, sometimes UXBs were discovered but could not be accessed or rendered safe due to various reasons. These incidents could be recorded as Abandoned Bombs. Due to inaccurate records and the nature of these abandoned bombs, their locations are not definitive, and the lists may not be exhaustive. The MoD would only take action to make the devices safe if they were deemed unstable. It should be noted that aside from officially abandoned bombs, there may be unrecorded UXBs.

Igne holds records of officially registered abandoned bombs at or near the site	✖

[3] https://www.bbc.co.uk/history/ww2peopleswar/stories/85/a1974585.shtml

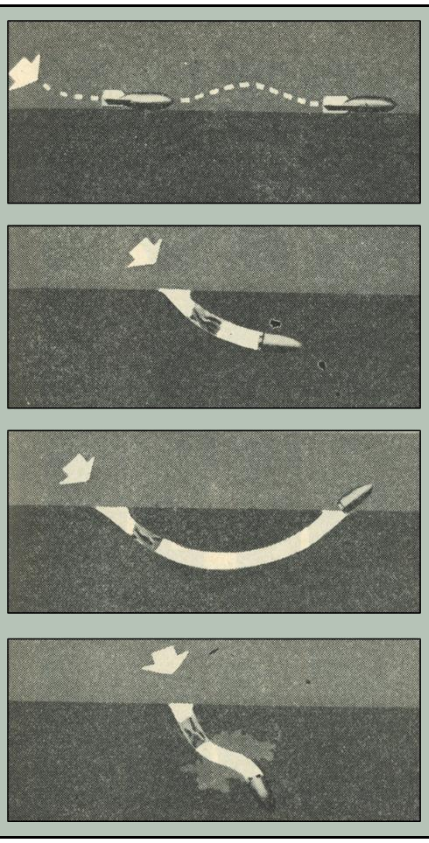
7.5 UXB Ground Penetration

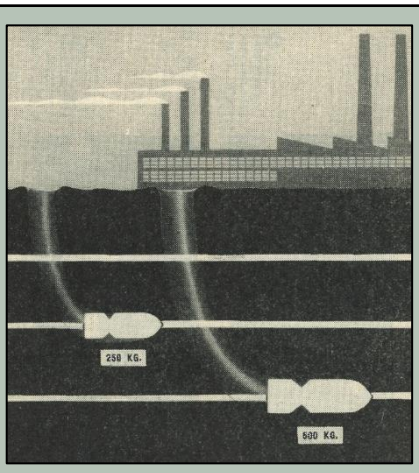
7.5.1 General Considerations

The depth bombs penetrate the ground depends on factors such as their mass, shape, velocity, angle of impact, and the characteristics of the ground cover. Softer ground allows for greater penetration, with peat, alluvium and soft clays being easier to penetrate compared to gravel and sand. Bedrock or large boulders can bring bombs to a stop or cause deflection.

7.5.2 The "J" Curve Effect

When an air-dropped bomb is released from a normal bombing altitude (approximately 5,000m), it can reach a terminal velocity of 350-400 ms-1. The bomb enters the earth at an angle or approximately 15° from the perpendicular, making its exact path hard to trace. As the bomb travels through the ground, it undergoes an upward curve due to energy transfer. The slower nose of the bomb experiences more drag/friction compared to the faster-moving rear. This causes the bomb's location to be offset from the entry hole. The offset is generally one-third of the penetration depth but can reach up to 15m (50') depending on ground conditions and the bomb's angle of impact. The J-Curve effect illustrated below demonstrates not UXBs can come to rest beneath undamaged buildings in homogeneous ground.





A UXB can come to rest beneath undamaged buildings due to the J-Curve effect if it lands in nearby soft ground.

Image source: *Field Manual for Unexploded Bombs: Organisation and Operation For Disposal, United States War Department 1943*

Left: Path of UXB in soft ground:

1. Ricochet resulting from low level attack: UXB stays perpendicular to ground and rests at surface.
2. Buried UXB with J-Curve: Bomb curves horizontally and rests perpendicular to surface.
3. UXB returning to surface due to J-Curve: Bomb points towards surface but may remain partially or completely below ground level.

7.5.3 Second World War Bomb Penetration Studies

During WWII, the Ministry of Home Security undertook a major study on actual bomb penetration depths, carrying out statistical analysis on the measured depths of 1,328 bombs as reported by Bomb Disposal, mostly in the London area. They then came to conclusions as to the likely average and maximum depths of penetration of different sized bombs in different geological strata.

The table below presents the maximum and average penetration depths observed during this survey. Note, the table includes the most commonly dropped HE bomb sizes, from 50kg to 1000kg.

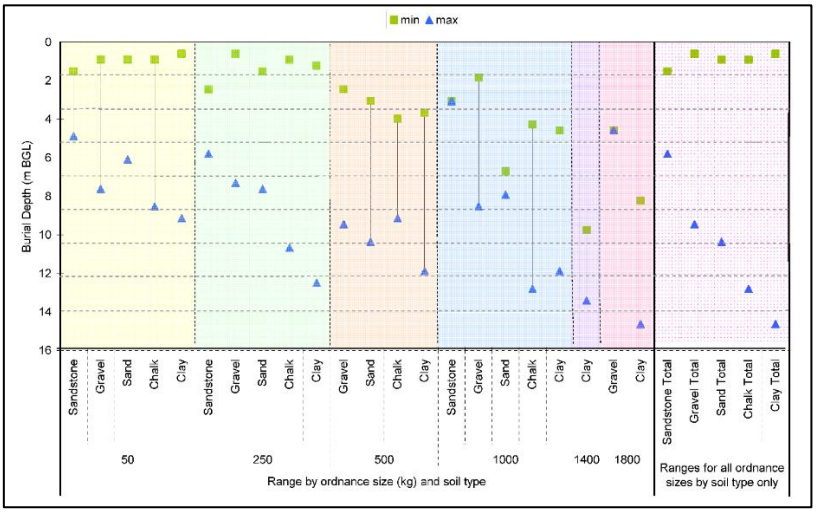
		Bomb penetration depth							
		Max.	Av.	Max.	Av.	Max.	Av.	Max.	Av.
HE bomb size		50kg		250kg		500kg		1000kg	
Ground Type	Sandstone	6.1m	2.7m	10.4m	4.6m	13.1m	5.8m	16.5m	7.3m
	Gravel	7.8m	2.8m	13.7m	4.8m	17.3m	6.0m	21.9m	7.6m
	Sand	7.8m	2.8m	13.7m	4.8m	17.3m	6.0m	21.9m	7.6m
	Chalk	7.7m	3.5m	13.1m	6.0m	16.4m	7.6m	20.7m	9.6m
	Clay	9.1m	4.0m	15.8m	6.8m	19.8m	8.7m	24.9m	10.9m

Note, theoretical calculations suggested that significantly greater penetration depths were probable.

7.5.4 CIRIA Bomb Penetration Depth Specifications

As stated within C681, the ground conditions at any individual site are likely to be highly variable and this results in a large range of burial depths for each different size bomb.

The chart to below shows the observed variation in burial depths of various sizes of air-delivered UXO for different ground conditions.



7.5.5 Site Specific Bomb Penetration Considerations

When considering an assessment of the bomb penetration at the site, the following parameters would be used:

Parameter	Details		
Geology	British Geological Survey Borehole	Borehole Reference	SJ89NW4180
		Location	80m north-east
		Date	Circa. 2008
		Recorded Shallow Geology	• 1.0m of Made Ground. • 4.0m of Alluvial deposits. • 2.0m of Clay with Sand horizons. • 21.0m of soft, red Sand.
	British Geological Survey Mapping	Superficial Deposits	Glaciofluvial Sheet Deposits, Devensian – Sand and Gravel
		Bedrock	Chester Formation – Sandstone
Impact Angle and Velocity	80-90° from horizontal and 267 metres per second		
Bomb Mass and Configuration	The 500kg SC (General Purpose) HE bomb, without retarder units or armour piercing nose. This was the largest of the common bombs used against Britain.		

7.5.6 Deductions

Based on WWII-era studies, a 500kg bomb could have penetrated up to approximately 19.8m below ground level (bgl), with an average depth of around 8.7m bgl. However, considering the varied strata and limited data, it is estimated that the bomb's maximum bomb penetration depth (BPD) during that era was likely between 10-12m bgl, as per CIRIA guidelines.

The current ground level should be evaluated to determine its impact on the BPD. If the UXB is larger, the BPD could potentially be greater, although only 4% of German bombs used in WWII over Britian were of that size.

UXBs can be found at any depth between just below WWII ground level and the maximum BPD. It should be noted that ground conditions can vary significantly on site, and these guidelines may change once on-site conditions are assessed prior to any necessary mitigation works.

7.6 Likelihood of Post-Raid UXO Detection

Utilising the available historical bombing records as reviewed in Section 7.4, it is possible to make an assessment of the likelihood that evidence of UXO would have been noted on a site during the war and the incident dealt with or recorded at the time. Factors such as bombing density, frequency of access, ground cover, damage and failure rate have been taken into consideration.

Factor	General Considerations	Site Specific Considerations
Density of bombing	Bombing density impacts the likelihood of UXBs remaining in an area. A high density of bombs increases the chance of record-keeping errors, due to overwhelmed civil defence and emergency response personnel. It also raises the total number of actual UXBs in a given area. The type and location of recorded bomb strikes are significant factors. If a stick of bombs is plotted in line with or straddling a side, it suggests the possibility of an unrecorded UXB from the same stick hitting that site.	• High local bombing density • At least 5no. bomb strikes recorded on/adjacent to the site. • Several additional bomb strikes within a 300m radius of the site. • Site was located close to demarcated Luftwaffe target (Gas and Rubber Works, situated 300m to 450m north).
Bomb damage	In Blitzed cities and towns across Britain, bomb sites were often left uncleared until after the war. Mid-war repairs were focused on vital facilities, while buildings with upper floor damage had their ground floor damage reported and dealt with at the time. HE bomb strikes on open ground created visible craters and soil disturbance. Subsequent UXB strikes in disturbed ground would go unnoticed without identifiable entry holes. The German V1 and V2 campaigns caused widespread devastation in London and south-east England. However, damage from these weapons does not necessarily indicate increased risk of Luftwaffe freefall UXB contamination, as they were used after significant Luftwaffe air raids. Damage from earlier Luftwaffe raids may have been erased by subsequent V weapon strikes.	• Residential buildings within the site's northern section were cleared. • The warehouse building within the site's southern section were highlighted in Manchester damage maps. • Large areas of clearance and redevelopment in the surrounding area.
Ground conditions	The entry hole of a 50kg UXB (common German HE bomb) could be as small as 20cm in diameter. Records confirm that even small 1kg German incendiary bombs could penetrate soil, leaving tiny entry holes (5cm) or burying completely. During WWII, the quantity and type of ground cover affected the visibility of buried UXBs. Dense vegetation, soft ground, rubble, railway ballast or stockpiled material could obscure evidence. UXB strikes in waterlogged areas or open water would be hidden beneath the waterline. Tidal mudflats or river banks would temporarily cover entry holes with water and sediment. Elevated risk ground cover could cause UXBs to end up beneath neighbouring undamaged buildings or hardstanding due to the "J Curve" Effect. UXB strikes on intact or superficially damaged buildings	• The site was occupied by residential terraces, accompanying roadways and a warehouse complex. • It is likely that sections of the site and the surrounding area would have been covered by rubble/debris during the heaviest raids over Manchester. • Had a UXB strike landed within bomb-damaged material, its entry hole is

Factor	General Considerations	Site Specific Considerations
	and hardstanding would cause significant damage or leave easily identifiable entry holes. Well-maintained lawns or gardens are less likely to overlook an HE UXB entry hole, with such incidents reported and the UXB removed.	unlikely to have been observed within the debris.
Frequency of access	A UXB strike in a site with infrequent human access would have a lower chance of being observed, reported and recorded compared to a developed site with regular access. Strikes during nighttime raids are also more likely to go unnoticed compared to daytime attacks when German aircraft could be detected more easily. In frequently bombed cities / towns, ARP Wardens searched for UXBs in recently bombed residential areas and schools. Important facilities had dedicated ARP teams or Fire Watchers responsible for observing air raids and reporting UXB strikes. However, anecdotal evidence suggests that Fire Watchers were not always present, so their activities cannot be assumed without specific evidence. Less important buildings damaged by bombs would be abandoned until the German bombing campaign ceased, reducing access to those sites. Schools closed due to evacuations were often used as First Aid posts and reception centres, increasing access to those locations.	• Undamaged buildings on site are likely to have seen regular access. • However, damaged/destroyed buildings are likely to have been abandoned for a period.
German air-delivered ordnance failure rate	Empirical evidence suggests that approximately 10% of German HE bombs dropped during WWII failed to explode as intended. This estimate, based on recovered UXB statistics, likely underestimates the true number as unrecorded UXBs were not accounted for at the time. The reasons for failures include: • Fuze or gaine malfunction due to manufacturing fault, sabotage (by forced labour) or faulty installation. • Clockwork mechanism failure in delayed action bombs. • Failure of the bomber aircraft to arm the bombs (charge the electrical condensers which supplied the energy to initiate the detonation sequence) due to human error or equipment defect. • Jettison of the bomb before it was armed or from a very low altitude. Most likely if the bomber was under attack or crashing. According to War Office statistics, an average of 84 malfunctioning bombs were dropped on civilian targets in Britain per day from 21/09/1940 to 05/07/1941. About 1 in 12 of these bombs, likely those with time delay fuzes, exploded after landing, while the rest unintentionally failed to detonate. From 1940 to 1945 bomb disposal teams dealt with a total of 50,000 explosive items of 50kg and over	• No evidence has been found to suggest the ordnance failure rate in this area was higher than 10%.

Factor	General Considerations	Site Specific Considerations
	(German bombs), 7,000 AAA shells and 300,000 beach mines. These operations resulted in the deaths of 394 officers and men. However, UXO is still regularly encountered across the UK. Note, due to manufacturing fault or failure of the bomber crew to correctly arm their munitions, whole bomb loads often failed to detonate. Therefore, the presence of reported UXBs increases the likelihood of an additional unrecorded UXB in the vicinity.	

8. The Threat from Allied Military Ordnance

The following potential historical and modern sources of UXO contamination on site or in the surrounding area have been considered:

- Army, Navy & RAF bases & installations
- Military training areas & weapons ranges
- Ordnance / explosives factories & storage depots
- Sites requisitioned for military use
- Sites used or occupied by the Home Guard
- Military fortifications & coastal defences
- Locations of Army Explosive Ordnance Clearance (EOC) tasks
- WWII heavy and light anti-aircraft batteries
- WWII pipe-mined locations and beach minefields

The risk of contamination from Allied UXO on site is discussed below.

8.1 Land Service and Small Arms Ammunition (LSA/SAA)

It is estimated that around 20% of the UK's landmass has been used by the military at some point. As such, a large proportion of sites can remain at risk from military related UXO, through training, testing, storage, disposal or manufacture.

8.1.1 Defensive Fortifications

After the defeat at Dunkirk in May 1940, Britain rushed to establish defences against the imminent invasion. Coastlines and inland areas were fortified with anti-tank obstacles, ditches, pillboxes and gun emplacements. The goals of these defences were to prevent enemy landings at sea or by aircraft, protect ports and harbours, stop armoured columns from advancing, and safeguard vulnerable locations. Stop lines were created to halt German

armoured units, with anti-tank obstacles and pillboxes strategically positioned. The defences were manned by Home Guard and military personnel.

8.1.2 Home Guard Activity

The Home Guard (HG) was a British Army defence organisation active from 1940-44. Comprising 1.5 million local volunteers ineligible for military service, it served as a secondary defence force against enemy invasion. The HG protected coastal areas, important facilities and urban centres. Official records were scarce, making present-day evidence mostly anecdotal. HG personnel conducted training, including weapons training, in rural areas near towns and cities. Present-day discoveries of HG-related ordnance indicate a culture of lax discipline regarding live ammunition. HG members purposefully buried caches of weapons and ammunition in strategic locations for future use, some of which were forgotten and have been found as UXO in recent years. The table below provides several examples: [4]

Home Guard UXO Finds:	
	Live unexploded WWII grenade found in a residential garden, Devon – March 2023
	A cache of phosphorous grenades found buried underneath a school during construction works in Swindon – November 2022
	Unexploded Spigot Mortar Round, used by the Home Guard in WWII, found and disposed of in Hayle, Cornwall – January 2021
	24 x WWII grenades found buried in a field in Sibton, Suffolk – May 2019

[4] Various News Sources

Home Guard UXO Finds:	
	A cache of 80 phosphorous grenades buried by the Home Guard found in Eastbourne – September 2015
	Home Guard Phosphorous Grenades found buried beneath a bridge in Herne Bay – July 2015

8.1.3 Generic Types of WWII British / Allied UXO (LSA/SAA)

The nature and characteristics of the ordnance used by the military allows an informed assessment of the hazards posed by any unexploded items that may remain today.

Hazard Type	Description		
Land Service Ammunition	The term Land Service Ammunition covers all items of ordnance that are propelled, placed or thrown during land warfare. They may be filled or charged with explosives, smoke, incendiary or pyrotechnics. They can be broken into five main groups: 1. Mortars 2. Grenades 3. Projectiles 4. Rockets 5. Landmines	Mortars	A mortar bomb is a fin-stabilised munition with a nose fuze and its own propelling charge. Additional propellant can be added to increase range. They come in HE or Carrier types and are typically tear-dropped in shape (though older variants may have parallel sides) with a finned ‘spigot tube’ at the rear housing the propellant. Detonation of a mortar relies on the striker hitting a detonator, which may already be in contact, requiring only slight pressure for initiation. Discarded augmenting charges are commonly found near mortar firing areas/bases.
		Grenades	A grenade is a short-range weapon that can be thrown by hand, fired from a rifle, or launched from a specialised grenade launcher. There are two categories: HE and carrier (typically smoke). Like mortars, a grenade’s striker may either be in close contact with the detonator or held by a tensioned spring, so shock can cause it to function. Grenades have an explosive range of 15-20m. Older variants often have a classic “pineapple” shape, while modern grenades are usually smooth-sided.

Hazard Type	Description
	Unexploded or partially unexploded Mortars and Grenades are among the most common items of UXO encountered in the UK. They are commonly encountered in areas used by the military for training and are often found discarded on or near historic military bases.
Small Arms Ammunition	The most likely type of ordnance to be encountered on site are items of SAA (bullets), especially .303" ammunition which was the standard British and Commonwealth military cartridge from 1889 until the 1950s. However even if an item such as this functioned, the explosion would not be contained within a barrel and detonation would only result in local overpressure and very minor fragmentation from the cartridge case. Some LAA guns and RAF fighter cannons in use with British forces during WWII utilised the 20mm round. These bullets had a small fuse and a ~4gram HE or incendiary charge. Although small, this fill quantity still has the potential to cause serious injury.
Examples of the most commonly used British / Allied ordnance types are presented in Appendix 2.	

8.1.4 Site Specific Threat from LSA / SAA

The following table discusses site-specific potential UXO contamination from military activity.

Potential Source	Details
Defensive features within the vicinity	No recorded defensive emplacements were located within a 1km radius of the site.
Home Guard Activity on site	• Five HG battalions were based in close proximity to the site during WWII; with the 61st Battalion stationed at Burlington Street Drill Hall, approximately 500m south. • In addition, a *Drill Hall* was situated approximately 70m west of the site. This building was used by a number of Manchester based military units during the 19th and early 20th centuries. [5]It is unknown whether this building was used by military personnel during WWII. • Although typically HG battalions would take part in training exercises in areas occupied by open countryside, there are several examples of HG units carrying out invasion training in urban areas. • However, given the density of urban development, the site's location within the city centre, and the absence of open ground, it is highly unlikely that any such HG activity would have occurred onsite.

8.2 Anti-Aircraft Gun Batteries

At the war's outset, two types of AAA guns were used: Heavy Anti-Aircraft (HAA) and Light Anti-Aircraft (LAA). LAA batteries targeted fast, low-flying aircraft near airfields and strategic

[5] https://web.archive.org/web/20071114202128/http://www.regiments.org/regiments/uk/volmil-england/vinf-no/la-M6.htm

sites. These mobile batteries, equipped with four guns each, could rapidly fire multiple rounds. Unexploded AAA shells from WWII are still occasionally found today.

Initially, the maximum firing height was about 11,000m. However, improved versions of the 3.7” gun and larger 5.25” weapons with higher firing ceilings (over 18,000m) were introduced from 1942.

The 3.7” AA gun was said to have a maximum firing range of around 5.6km when fired horizontally or 12km when fired at an angle. The 5.25” AA gun had a potential maximum firing range of 14.2km, with naval versions capable of reaching up to 22km. Other types, like the 4.5” AA gun and the Bofors 40mm, had a maximum range of approximately 12.5km.

When Switzerland stopped supplying clockwork fuses, Britain had to produce its own. Due to a lack of engineering expertise, many AA shells prematurely detonated, causing casualties or becoming UXBs. In January 1944, more people in London were killed by HAA shells than by German bombs.

Unexploded AA shells are frequently found across the UK. The table below provides several examples:[6]

Anti-Aircraft Artillery UXO Finds:	
	AA shell found in a canal, Ashton-under-Lyne, June 2022.
	AA shell found in the River Great Ouse, Bedford town centre, July 2021.

[6] Various News Sources

	Several AA shells found during construction in Somersham, November 2017.
	AA shell found in a residential garden, Potters Bar, October 2015.
	AA shell found on a construction site, Waltham Abbey, May 2015.

8.2.1 Generic Types of WWII British / Allied Unexploded Ordnance (Artillery)

The nature and characteristics of the ordnance used by the military allows an informed assessment of the hazards posed by any unexploded items that may remain today.

<table>
<tr><th>Hazard Type</th><th colspan="5">Description</th></tr>
<tr><td rowspan="5">Anti-Aircraft Shells</td><td colspan="5">At the start of WWII, two types of AAA guns were used: HAA with large calibre weapons like the 3.7” QF gun, and LAA with smaller calibre weapons like the 40mm Bofors gun. The Bofors gun could fire up to 120 shells per minute. Due to AAA shortages, older WWI guns were also deployed. These shells, often mistaken for German bombs, can be identified by the copper driving band. Unexploded larger projectiles are found close to ground level and pose a significant risk due to their HE fill and fragmentation. Smaller 40mm projectiles resemble SAA and present a lower risk. Details of the most commonly deployed WWII AAA projectiles are shown below:</td></tr>
<tr><td>Gun type</td><td>Calibre</td><td>Shell Dimensions</td><td>Shell Weight</td><td>HE Fill Weight</td></tr>
<tr><td>3.7 Inch</td><td>94mm</td><td>94mm x 438mm</td><td>12.7kg</td><td>1.1kg</td></tr>
<tr><td>4.5 Inch</td><td>114mm</td><td>114mm x 578mm</td><td>24.7kg</td><td>1.7kg</td></tr>
<tr><td>40mm</td><td>40mm</td><td>40mm x 311mm</td><td>0.84kg</td><td>70g</td></tr>
<tr><td colspan="6">Examples of the most commonly used British / Allied ordnance types are presented in Appendix 2.</td></tr>
</table>

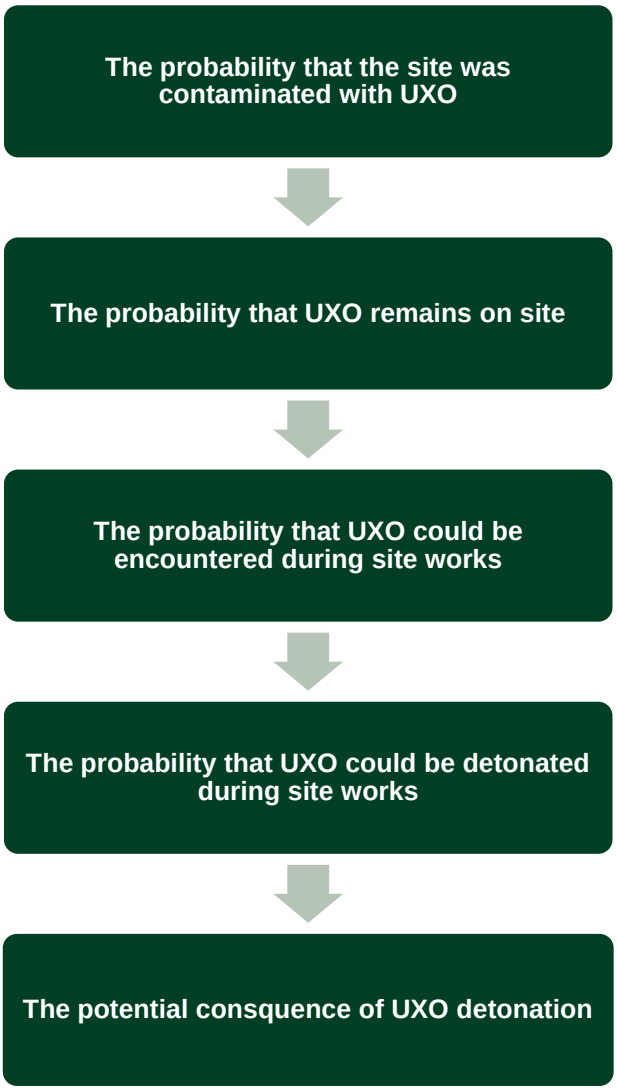
8.2.2 Site-Specific Threat from Anti-Aircraft Artillery

The following table discusses site-specific potential UXO contamination from anti-aircraft artillery.

Potential Source	Details
Threat to the site from unexploded AA shells	• At least 9no. permanent HAA (heavy anti-aircraft) batteries were situated within effective range of the site, the nearest of which was located approximately 2.3km south-east. • It is also possible that additional temporary LAA batteries may have been brought to the area during the heaviest raids over the city. • At the locations of bomb damage onsite, it is likely that a significant volume of rubble / debris would have occupied the area for some time. • In such conditions, an unexploded AA shell falling onsite could easily have been overlooked, particularly as many of these areas would not be subject to formal post-raid checks for UXO. • Furthermore, given the high bombing density of the area and proximity of bombing targets, it is likely that a significant volume of AA shells was expended over the wider area in order to defend such targets from bombing. • However, an unexploded AA shell falling on undamaged buildings / hard-standing roadways onsite would have caused obvious damage or a persistent, easily identifiable entry hole, which would have been reported and subsequently removed.

9. Overview of UXO Risk Assessment Methodology

Taking into account the quality and nature of the historical evidence, the assessment of the overall risk to any intrusive works from UXO must evaluate the following factors:



Each of these steps will be evaluated in the following sections in order to conclude the total risk from UXO to the proposed works to be undertaken within the project site.

9.1 The Probability of UXO Contamination on Site

9.1.1 Contamination Factors

The table below presents generalised factors used to determine the probability that the site was contaminated with unexploded ordnance. Note that additional site-specific information can adjust UXO risk beyond these criteria:

	Probability of Contamination Definitions	
	German Air-Delivered Ordnance / Allied Anti-Aircraft Shells	**British / Allied Land Service or Small Arms Ammunition**
Probable	• High local bombing density or evidence of bombing /bomb damage on or adjacent to the site. Confirmed finds of WWII UXB. • Ground conditions that would have immediately and completely obscured the existence of UXB. • Site may be completely obscured from view or subject to very infrequent access.	• Evidence of weapons testing or disposal on or adjacent to the site. • Evidence of UXO finds on or in the vicinity of the site.
Possible	• Moderate to High local bombing density or evidence of bombing / bomb damage on or close to the site. • Ground conditions that allow for bomb penetration. • Site located in an area that was infrequently observed or accessed, with a low likelihood that a UXB strike would have been noticed.	• Clear evidence of military training activity on site involving live ammunition / munitions. • Military sites which have not undergone clearance operations or redevelopment since use. • Evidence of weapons storage on site. • Open or unmaintained ground that may have been used for disposal or caching of munitions.
Unlikely	• No evidence of bombing / bomb damage on site coupled with low local bombing density. • Ground conditions that would prevent UXB penetration or lead to easily identifiable entry holes. • Site was occupied and accessed fully throughout the bombing campaign.	• No evidence of Allied military activity on or near the site. Or • Military sites which have been cleared / redeveloped since their use Or • Military-owned sites which have not been used for training with live munitions. • Developed areas that are unlikely to have been used for military exercises.

The following sections assess the probability of contamination from German UXO and British / Allied UXO, based on the evidence discussed in the previous sections.

9.1.2 The Probability of Contamination from German UXO

The following table discusses the overall probability of contamination from German UXO, based on the evidence discussed in Section 7.

Overview of the Potential Sources of German Air-Delivered UXO		Overall Probability of Contamination
Bombing density	• Moderate bombing density • At least 2no. bomb strikes recorded on site. • Several bomb strikes within a 300m radius of the site. • Site was located close to demarcated Luftwaffe target (Gas and Rubber Works, situated 300m to 450m north).	**Possible**
Bomb Damage	• Residential buildings within the site's northern section were cleared. • The warehouse building within the site's southern section were highlighted in Manchester damage maps. • Large areas of clearance and redevelopment in the surrounding area.	
Ground Conditions	• The site was occupied by residential terraces, accompanying roadways and a warehouse complex. • It is likely that sections of the site and the surrounding area would have been covered by rubble/debris during the heaviest raids over Manchester.	
Frequency of Access	• Undamaged buildings on site are likely to have seen regular access. • However, damaged/destroyed buildings are likely to have been abandoned for a period.	
J-Curve Effect	• Had any UXB landed within the abandoned buildings/rubble on site, it could have come to rest up to 15m away from its original entry point, beneath the adjacent undamaged buildings.	
Other considerations	• n/a	

9.1.3 The Probability of Contamination from British / Allied UXO

The following table discusses the overall probability of contamination from British / Allied UXO, based on the evidence discussed in Section 8.

Overview of the Potential Sources of British / Allied UXO		Overall Probability of Contamination
Land Service Ammunition / Small Arms Ammunition	• Five HG battalions were based in close proximity to the site during WWII. • There are several examples of HG units carrying out invasion training in urban areas. • However, it is highly unlikely that any such HG activity would have occurred onsite.	**Unlikely**

Anti-Aircraft Projectiles	• At least 9no. HAA batteries were situated within effective range of the site. • At the locations of bomb damage onsite, it is likely that a significant volume of rubble / debris would have occupied the area for some time. • In such conditions, an unexploded AA shell falling onsite could easily have been overlooked. • However, an unexploded AA shell falling on undamaged buildings / hard-standing roadways onsite would have been reported and subsequently removed.	**Possible**

9.2 The Probability that UXO Remains on Site

9.2.1 General

The extent to which any ordnance clearance activities have taken place on site or extensive ground works have occurred is relevant, since they may indicate previous ordnance contamination but also may have reduced the risk that ordnance remains undiscovered.

9.2.2 EOD Bomb Disposal, Clearance Tasks and UXO Finds

Post-WWII UXO finds are vital, as they can tell us locations where UXO was dropped or buried, the types of munitions used and the numbers that went unnoticed for years after the war ended.

Igne holds a number of official records of explosive ordnance disposal operations during and following WWII, obtained from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (EOD), British Army.

Igne have also sought news articles, publications, anecdotal records and local Igne projects to determine post-WWII UXO encounters on or near to the site.

UXO found	Details
Mortar shell	03/04/2007 – An unexploded mortar shell was discovered on Cambridge Street approximately 200m north of the site.[7]
Unexploded bomb	08/10/2007 – A suspected unexploded bomb was discovered on Middlewood Street, 2km north-west of the site.[8]
Unexploded shell	24/06/2024 – A WWII-era shell was discovered on Hadfield Street, Stretford approximately 1.8km west.[9]

[7] http://news.bbc.co.uk/1/hi/england/manchester/6521811.stm

[8] http://news.bbc.co.uk/1/hi/england/manchester/7033808.stm

[9] https://www.manchestereveningnews.co.uk/news/greater-manchester-news/bomb-disposal-unit-called-trafford-9520495

9.2.3 Post War Redevelopment

The nature of post-WWII ground works, redevelopment and construction has been considered. Significant structural redevelopment on site can, in some cases, provide a level of mitigation, particularly from shallow buried items. However, if a site has not undergone any extent of redevelopment, the likelihood of UXO remaining within its boundaries can remain.

Redevelopment Details
The site has been redeveloped into the Cambridge Hall complex, associated with Manchester Metropolitan University. Quad areas comprising pavement and gardens are located throughout the centre of the site. It is likely that deeper intrusive works will have been necessary for this development.

9.2.4 Site-Specific Analysis

The following table discusses the likelihood that UXO could remain on site, following any post-WWII activity.

Mitigating factors during post-WWII period	Evidence shows that the site has been redeveloped significantly post-WWII. The maximum depth to which these post-war works were carried out is not known during the timeframe of this report. However, it is likely that a range of shallow and deeper construction methodologies will have been undertaken. It is also likely that some areas on site have not seen intrusive ground works down to the maximum potential bomb penetration depth.
Further comments	Within the footprints of the post-war redevelopment / ground works, the risk of shallow buried UXO (especially German 1kg incendiaries) remaining will have been partially mitigated since any such items could have been encountered and removed during soil stripping and levelling. **Within the exact confines of areas which have been redeveloped after WWII, such as any current basement levels, we would deem the UXO risk to be Low to Negligible since any such items could have been encountered and removed during these works.** **However, this is only within the exact footprint and maximum depth of the post-WWII redevelopment. Beyond the maximum depth of, outside the footprint of, and amongst (i.e. between piles) the post-WWII redevelopments, the UXO risk is unmitigated and will remain medium down to 12m bgl (maximum bomb penetration depth).**

9.3 The Probability that UXO may be Encountered during the Works

UXO may be encountered during constructions works, particularly piling, drilling or bulk excavations. The risk depends on the extent of the works, such as the number of boreholes / piles, and excavation volume. Shallow excavations near the original WWII ground level may also pose a risk. If the works are within post-WWII fill material, the risk of encountering WWII UXBs is lower. However, the risk significantly increases if the works are below the WWII ground level. The probability of encounter can be determined using the table below.

Probability of Encounter	
1	Rare
2	Unlikely
3	Possible
4	Probable
5	Highly Probable

9.4 The Probability that UXO may be Detonated

Items of ordnance do not become inert or lose their effectiveness with age. Time can indeed cause items to become more sensitive and less stable. This applies equally to items submerged in water or embedded in silts, clays or similar materials. The greatest risk occurs when an item of ordnance is struck or interfered with. This is likely to occur when mechanical equipment is used or when unqualified personnel pick up munitions.

9.4.1 Detonation of Unexploded Bombs

In the case of unexploded German bombs discovered within the construction site environment, there are a number of potential initiation mechanisms:

Direct Impact onto the main body of the bomb	Unless the fuze or fuze pocket is struck, there needs to be a significant impact to initiate a buried HE bomb.
Re-starting the clock timer in the fuze	Only a small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion has taken place within the fuze since the end of WWII that would prevent clockwork mechanisms from functioning, nevertheless it was reported that the fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did recommence.
Induction of a static charge, causing a current in an electric fuze	The majority of German WWII bombs employed electric fuzes. It is probable that significant corrosion has taken place within the fuze mechanism since the end of WWII such that the fuze circuit could not be activated.
Friction impact initiating the (shock-sensitive) fuze explosive	This is the most likely scenario resulting in the bomb detonating.

9.4.2 Activities that may Result in the Detonation of UXO

Unexploded bombs do not spontaneously explode. All high explosive requires significant energy to create the conditions for detonation to occur. The risk that UXO could be initiated if encountered will depend on its condition, how it is found and the energy with which it is struck. However certain activities pose a greater risk than others.

Percussive piling or deep mechanical excavations	The most violent activity on most construction sites is percussive piling or deep mechanical excavations. If an item is struck with a significant enough impact, be it direct or through friction/vibration, it risks detonation.
Shallow excavation	Soil levelling and shallow excavation such as trial pits can pose a similar risk to deeper excavations, since UXO can be found at any depth between ground level and the maximum bomb penetration depth. In addition to risk of initiation by violent impact or vibration, detonation can also occur if discovered items are mishandled by unqualified personnel. This is particularly common when onsite personnel are not trained in the recognition of ordnance.
Non-intrusive works	In the case of non-intrusive planned works, little risk is posed by items of UXO that are buried beneath the ground. However, risk can arise from unburied munitions, particularly items of ordnance discarded in periphery areas of military sites. These items are frequently discovered by onsite personnel and remain live and liable to activate if mishandled.

9.4.3 The Consequences of Encountering or Detonating UXO

An inadvertent detonation of UXO during construction operations would have catastrophic consequences, including a serious risk to life, damage to equipment and a complete site shutdown for subsequent investigations. Appropriate mitigation measures can significantly reduce the risk of initiating ordnance, but the most significant consequence of ordnance discovery is economic, especially in high-profile locations that may require a public evacuation. The unsuspected discovery of ordnance can lead to site closure for a period ranging from a few hours to a week, resulting in substantial lost time costs. Additionally, involving authorities for handling suspected ordnance may further disrupt production, as the police would typically isolate the area while waiting for military assistance, even if it proves unnecessary.

The following table details several recent UK-based UXO incidents:

Recent UK-Based UXO Incidents	
	February 2021-March 2023 – A WWII-era German 1000kg HE UXB was discovered in Exeter, Devon, February 2021. Consequences to the project included: • Halt to construction works while 400m cordon was implemented. • Approximately 2600 properties in the vicinity were evacuated for 2 days. • Structural damage within blast radius during in-situ disposal. • Insurance claim was declined by insurers (March 2023).
	February 2023 – A WWII UXB unexpectedly exploded at the site of a construction project in Great Yarmouth, Norfolk. Consequences to the project included: • Resulted in a 4-day major incident. • Minor damage to the road, and damage to the river wall.
	February 2018 – WWII UXB found in King George V dock, London. Consequences to the project included: • 214m exclusion zone implemented. • Closure of London City Airport with all flights cancelled.
	March 2017 – Construction workers found a WWII UXB in Brondesbury Park, London. Consequences to the project included: • Evacuation or residents and 2 schools. • Halt to construction and delays to project.

10. UXO Risk Analysis and Risk Rating

10.1 Risk Analysis Methodology

In order to identify appropriate risk ratings and recommended risk mitigation measures, a semi-quantitative assessment has been undertaken, using all available information discussed in this report.

This risk assessment is designed to determine the level of risk associated with the planned works / actions on site. Igne will identify the hazards and investigate the potential receptor that could be affected. The pathway to the hazard will determine the risk on site. This relationship is usually described as Source – Pathway – Receptor.

Source (or Hazard): Based on the information discussed throughout the report, the most likely potential sources of hazard include:

- HE bombs
- Incendiary bombs
- AA Projectiles
- Land Service Ammunition
- Small Arms Ammunition

Pathway: this is defined as the route in which a hazard could reach the receptor. This will usually include any intrusive ground works.

Receptors: Taking into account the proposed project details, potential receptors could include:

- Personnel (people, workers, engineers, public)
- Equipment & infrastructure
- Environment
- Reputation

An evaluation of the risk rating on site will be determined by several factors; the probability of UXO to remain on site, the probability that it could be encountered / initiated during the proposed works, and the consequences of an accidental detonation. A total risk rating for the site will be determined by considering these factors.

The final risk rating is based upon:

Probability of Encounter (pE) x Consequence of Detonation (cD)

using the definitions below:

Probability of Encounter (pE)		Consequence of Detonation (cD)	
1	Rare	1	Insignificant or Very Low
2	Unlikely	2	Minor or Low
3	Possible	3	Moderate or Medium
4	Probable	4	Major or High
5	Highly Probable	5	Catastrophic or Very High

Conse-quence Level	Potential Consequences				
	Personnel	Assets and Equipment		Environment	Reputation
		Plant & Equipment	Infrastructure		
1	Minor injury, first aid required	No noticeable impact	No noticeable impact	Minor disturbance	No noticeable impact
2	Injury with time lost (<3 days)	Slight superficial damage	Slight superficial damage	Significant disturbance	Minor impact
3	Serious injury, hospital treatment required	Minor component repair or replacement required	Non-structural repairs required	Moderate damage to habitats	Moderate impact
4	Localised fatalities	Significant component repair or placement required	Structural repairs required	Moderate damage to habitats with minor long-term impact	Major impact
5	Fatalities over a substantial area	Irreparable damage or loss of unit	Localised structural destruction, collapse or failure	Localised destruction of habitats with moderate long-term impact	Significant Impact

10.2 Risk Matrix

Using the classifications presented in section 10.1, the risk matrix below will be utilized to determine the final risk rating for the site.

		Consequence of Detonation (cD)				
		1	2	3	4	5
Probability of Encounter (pE)	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Risk Ratings Definitions	
High (16-25)	Significant or unacceptable risk. Action required to mitigate the risk before works commence to prevent a significant incident.
Medium (6-15)	Tolerable level of risk if controls lower the risk to ALARP. Workers should proceed with extra caution. Increased monitoring and evaluation required.
Low (1-5)	Acceptable risk. Minimum proactive risk mitigation measures are recommended on site prior to further site works.

10.3 Final Risk Rating & Recommended Risk Mitigation Measures

The risk rating across the site is heterogenous and therefore has been divided into Risk Zones. These are presented on a Risk Map in **Figure 7.0**. The following tables discuss the risk ratings across the entire site by Risk Zone:

10.3.1 Low Risk Zone

Risk Zone features:

- Moderate bombing density
- No recorded bomb strikes within this area of the site
- This section of the study area was entirely developed & evidence of bombing is likely to have been observed

Hazard	Average Depth of Hazard	pE	cD	Risk Analysis (pE x cD)	Risk Rating
HE bombs	<12m bgl	1	5	5	**Low**
IB	<1m bgl	1	4	4	**Low**
AA	<5m bgl	1	4	4	**Low**
LSA	<2m bgl	1	4	4	**Low**
SAA	<1m bgl	1	2	2	**Low**

10.3.2 Medium Risk Zone

Risk Zone features:

- Recorded bomb damage on site
- Bomb strikes on/adjacent to this zone
- Abandoned structures, rubble and debris could have concealed evidence of a UXB
- 15m buffer to account for ‘J’ curve effect

Hazard	Average Depth of Hazard	pE	cD	Risk Analysis (pE x cD)	Risk Rating
HE bombs	<12m bgl	3	5	15	**Medium**
IB	<1m bgl	1	4	4	**Low**
AA	<5m bgl	2	4	8	**Medium**
LSA	<2m bgl	1	4	4	**Low**
SAA	<1m bgl	1	2	2	**Low**

10.3.3 Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended in order to lower the overall risk during the proposed works to ALARP. Additional information regarding these methods can be found in Section 10.4. In the event of significant additions or alterations to the proposed scope of works, please refer to Section 10.4 for a comprehensive list of risk mitigation details. Furthermore, in the event of any such changes to the proposed works on site, Igne should be contacted to ensure correct mitigation methods are applied based on specific scope of works.

Low Risk Zone

Pathway	Risk Rating	Recommended Risk Mitigation Measure(s)
All works	**Low**	• Site Specific Explosive Ordnance Safety and Awareness Briefings (UXO Toolbox Briefing) to all personnel conducting intrusive works • Site Specific Safety Instructions (SSSI) Training Course

Medium Risk Zone

Pathway	Risk Rating	Recommended Risk Mitigation Measure(s)
All works	**Medium**	• Site Specific Explosive Ordnance Safety and Awareness Briefings (UXO Toolbox Briefing) to all personnel conducting intrusive works • Site Specific Safety Instructions (SSSI) Training Course
Shallow Intrusive Works	**Medium**	• Explosive Ordnance Disposal (EOD) Engineer On-Site Support (Watching Brief)
Deep intrusive works	**Medium**	• Support to Borehole Drilling • Intrusive Magnetometer Survey of all pile locations down to the maximum bomb penetration depth

10.4 Risk Mitigation Overview

An overview of Risk Mitigation Measures is presented below.

Site-Specific Proposed Works	Risk Mitigation Measures	Further Detail
All	Site Specific Explosive Ordnance Safety and Awareness Briefings (UXO Toolbox Briefing) to all personnel conducting intrusive works	These briefings are intended to make site operatives aware of the nature of explosive ordnance that may be encountered on their project site. • Delivered by a specialist Explosive Ordnance Disposal Engineer. • Provides information on the site-specific explosive ordnance risk. • Basic ordnance identification. • What to do in the event of an encounter with a suspicious object. • Provide UXO response procedures.
All	Site Specific Safety Instructions (SSSI) Training Course	For longer term projects that require Explosive Ordnance Safety and Awareness Briefings as part of the Explosive Ordnance Risk Mitigation measures for the project, SSSIs can be provided to allow nominated site representatives to deliver these briefings after initial training. • 2/3-hour presentation and training course. • Delivered by a fully qualified senior EOD Engineer. • Suitable for Project Site Manager HSE representative and supervisors. • Includes briefing pack. This provides a cost-effective solution to ensure that the Explosive Ordnance Safety and Awareness Briefings can be delivered effectively and efficiently to the required standard.
Open excavation Shallow intrusive works	Explosive Ordnance Disposal (EOD) Engineer On-Site Support (Watching Brief)	In areas where the risk posed by the potential presence of explosive ordnance is low or where the conditions are not suitable for pro-active survey, EOD On-Site Support can provide a reactive response to any suspicious object that may be encountered during open excavation works. The presence of the EOD Engineer (sometimes referred to as 'high risk dig wardens') on-site in support of shallow intrusive work allows for a direct monitoring of works using visual recognition and instrumentation and provides an immediate response to reports of suspicious objects or suspected items of ordnance that have been recovered by ground workers. Igne EOD personnel on-site also have the additional benefit of providing Explosive Ordnance Safety and Awareness briefings (UXO TBB) to any staff that have not received them earlier and can advise staff of the need to modify working practices to take account of the ordnance threat. The EOD Engineer will also aid potential

Site-Specific Proposed Works	Risk Mitigation Measures	Further Detail
		incident management which would involve liaison with the local authorities and police should ordnance that presents an explosive hazard be identified. • Specialist Explosive Ordnance Disposal Engineer. • Maintains a watching brief over all excavations. • Provides safety and awareness briefings to construction personnel as required. • Provides immediate identification of any suspicious item that is encountered. • Identifies whether any UXO item is live or inert. • Provides liaison assistance with the relevant authorities when dealing with any live UXO. Avoids on site delays which can be caused by the incorrect identification of a suspect item being potential UXO.
Boreholes	Support to Borehole Drilling	For cost effective risk mitigation for site investigation work, the site operative can conduct intrusive surveys for borehole and window sample locations working in conjunction with the site investigation team. The On-Site Support will also provide a reactive response to any suspicious object that may be encountered during open excavation works. • Works in conjunction with the drilling team to survey all borehole and window sample locations in real-time using a staged drilling and magnetometer survey procedure. • Avoids on site delays which can be caused by the incorrect identification of a suspect item being potential UXO. *Technical Information* 1. In optimum ground conditions each survey using the borehole technique will have a 1 metre look ahead capability. 2. Any steel casing used for borehole surveys will need to be retracted by 3 metres to allow the magnetometer survey to be conducted. Non-ferrous pipe will be required to support the borehole during the survey minimum diameter 60mm (to be supplied by the client).
Shallow intrusive works (max. 2m bgl)	Search & Clear	Where a non-intrusive magnetometer survey is not possible (e.g. wooded areas) Igne can deploy a two-man Explosive Ordnance Disposal Engineer team using handheld magnetometer equipment who will proactively survey either in search lanes or boxes, investigating each reading with the support of an operated excavator. The survey is suited to detecting suspicious ferro-magnetic buried objects that may be munitions and/or explosive ordnance related. All Igne personnel involved with the Search and Clearance Works will be former military personnel who have gained formal NATO

Site-Specific Proposed Works	Risk Mitigation Measures	Further Detail
		Military Explosive Ordnance Disposal Qualifications, having completed training at the Defence Explosive Ordnance Disposal School (DEODS) Chattenden, Kent or similar establishment throughout their military service. The client will be responsible for: • Demarcating the areas to be searched. • Providing services clearance and permit to dig. • Providing operated excavator to access deeper targets if required (Igne can provide this service at additional cost). • Providing coordinates of positions where debris have been identified (if information required in report). • Providing storage for recovered debris. Output will depend upon terrain and contamination (number of readings to be investigated).
Shallow intrusive works (max. 2m bgl)	Non-Intrusive Magnetometer Survey and Target Investigation (greenfield land only)	*Non-Intrusive Survey* This survey type is designed for use on magnetically 'clean' land commonly referred to as 'greenfield'. Brownfield land is often described as that which has had previous industrial or commercial use. In this context it specifically encompasses sites with are underlain by 'made ground' which may contain metallic contamination. Non-intrusive magnetometry or electromagnetic equipment which is used in the search for buried UXO relies upon the detection of small changes between clear ground and that containing UXO. The technique operates very successfully in environments where there is minimal ground contamination from other sources such as fired bricks, reinforced concrete, discarded scrap metal and buried services. There are also man-made ambient effects on magnetic and electromagnetic non-intrusive survey systems which include moving plant vehicles, power cables, electric trains etc. Non-Intrusive survey is carried out using either total-field or gradiometer magnetometry, dependent upon site conditions. Data is recorded and then interpreted using advanced AGSPRoc software in order to map magnetic fields and model discrete magnetic anomalies (variations in the Earth's magnetic field caused by ferro-magnetic objects electrical fields or geology). The location of such anomalies is determined, and mathematical modelling used to estimate their mass and depth. The survey will also locate any buried services with a magnetic signature and indicate any areas of gross magnetic "contamination" which may indicate the presence of

Site-Specific Proposed Works	Risk Mitigation Measures	Further Detail
		unknown obstructions. Additionally, the survey can provide information on archaeological features. The system can detect the magnetic field from a 50kg WWII air-dropped bomb at a depth of 4m and smaller items such as Land Service Ammunition to depths of up to 1.5m in ground with a low ambient magnetic field. In the case of soft geology, it should be noted that a 50kg high explosive bomb may be buried greater than 4 metres below ground level and therefore may not be detected by the survey. In this instance intrusive surveys may be required. The non-intrusive survey system will be deployed utilising the pedestrian survey frame. The output for the pedestrian frame is estimated at up to 2Ha per day. *Technical information:* • Client to clearly demarcate area to be surveyed prior to start and highlight any known services/underground obstructions. • Ground must be level, free of obstacles / obstructions and clear of undergrowth. Height of any crops should be no more than 400mm and where crops are present Igne would require written approval from the landowner or client to walk over the site area. • When working adjacent to existing infrastructure the survey may be ineffective due to the ferro magnetic interference caused by passing vehicles and the presence of underground buried services. A site visit may be recommended prior to commencement. • Note: the survey will be ineffective on Brownfield sites due to the magnetic nature of building rubble, which typically masks the weaker magnetic signatures of buried objects. If parts of the site are contaminated, then alternative risk mitigation measures may need to be considered. *Target Investigation* If a buried anomaly is detected that cannot be discounted as a potential UXO / UXB then the object will need to be investigated to positively identify the item. The process will include; • Specialist two-man Explosive Ordnance Disposal Team. • Combination of manual and mechanical excavation techniques. • Excavator shafting, shoring and dewatering equipment can be provided by Igne if required. • Excavation techniques will be defined and agreed prior to the commence. A factual report with clearance certificate will be issued on completion of the investigation.

Site-Specific Proposed Works	Risk Mitigation Measures	Further Detail
Piling	Intrusive Magnetometer Survey of all pile locations down to the maximum bomb penetration depth	Igne can deploy a range of intrusive magnetometry techniques to clear ahead of all the pile locations. The appropriate technique is governed by a number of factors, but most importantly the site's ground conditions. The appropriate survey methodology would be confirmed once the enabling works have been completed. A site meeting would be required between Igne and the client to determine the methodology suitable for this site. Target investigation or avoidance will be recommended as appropriate.

Bibliography

The key sources consulted during this assessment are listed below;

1. Bates, H, E., *Flying Bombs over England*, (Frogletts Publications Ltd. 1994).
2. Dobinson, C., *AA Command: Britain's Anti-Aircraft Defences of the Second World War*, (Methuen 2001).
3. Fegan, T., *The Baby Killers': German Air raids on Britain in the First World War*, (Leo Cooper Ltd. 2002).
4. Fleischer, W., *German Air-Dropped Weapons to 1945*, (Midland Publishing. 2004).
5. Jappy, M. J., *Danger UXB: The Remarkable Story of the Disposal of Unexploded Bombs during the Second World War*, (Channel 4 Books, 2001).
6. Price, A., *Blitz on Britain, The Bomber Attacks on the United Kingdom 1939 – 1945*, (Purnell Book Services Ltd. 1977).
7. Ramsey, W., *The Blitz Then and Now, Volume 1*, (Battle of Britain Prints International Limited. 1987).
8. Ramsey, W., *The Blitz Then and Now, Volume 2*, (Battle of Britain Prints International Limited. 1988).
9. Ramsey, W., *The Blitz Then and Now, Volume 3*, (Battle of Britain Prints International Limited. 1990).
10. Whiting, C., *Britain Under Fire: The Bombing of Britain's* Cities 1940-1945, (Pen & Sword Books Ltd. 1999).

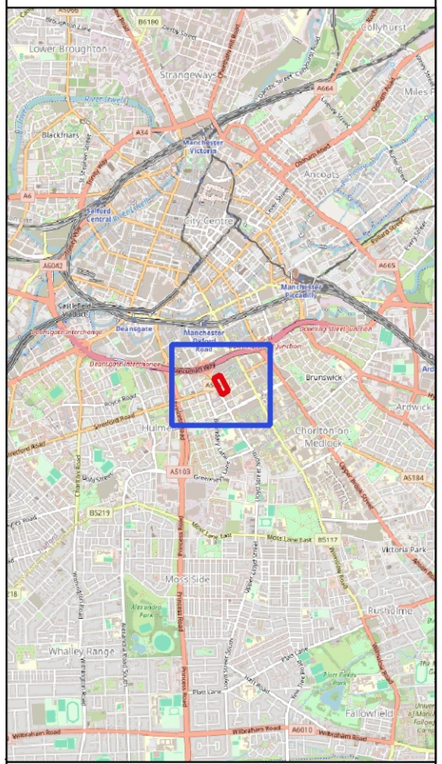
Figures

Figure 1.0

Site Location Maps

Key

Site boundary



N

W E

S

Source:
OpenStreetMap

Document Reference: 7390-5

igne

0 50 100 150 200 250 m

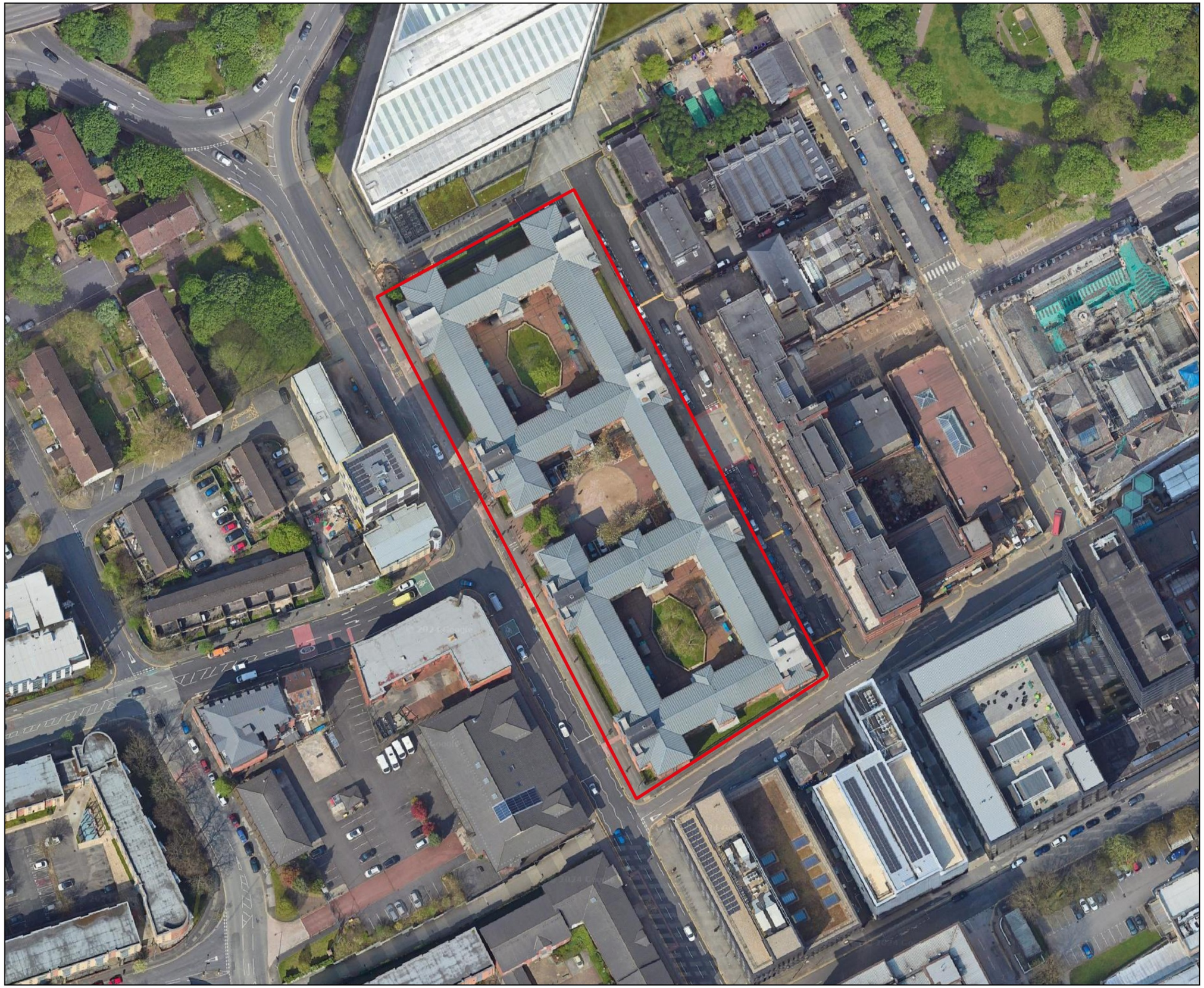


Figure 2.0

Recent Aerial Photograph

Key

Site boundary

N
W
E
S

Notes:

Source:
Google Earth Mapping Services

Document Reference: 7390-5

igne



Figure 3.1

1932 - 1933 OS Map

Key

Site boundary

Notes:

Source:
Landmark Maps

Document Reference: 7390-5

Figure 3.2

1950 - 1951 OS Map

Key

Site boundary

Clearance

Redevelopment

Notes:

Source:
Landmark Maps

Document Reference: 7390-5

igne

0 20 40 60 80 100 m



16th May 1948

Figure 4.0

RAF Aerial Photograph

Key

Site boundary

Bomb damage

N
W
E
S

Notes:

Source:
RAF Aerial Collection

Document Reference: 7390-5

igne



Figure 5.0

Luftwaffe Target Map

Key

Site boundary

Designated bombing target(s)

N
W
E
S

Notes:

Source:
National Archives

Document Reference: 7390-5

igne



Figure 6.0

Manchester Damage and Bomb Map

Key

Site boundary

Notes:

Source:
University of Manchester

Document Reference: 7390-5



Figure 7.0

Risk Map

Key

Site boundary
Low risk zone
Medium risk zone

N
W
E
S

Notes:

Source:
IGNE

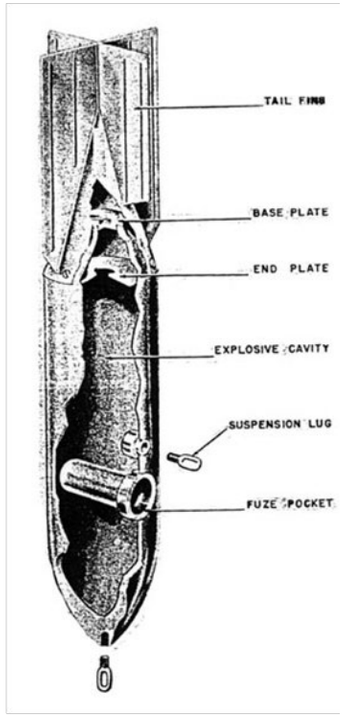
Document Reference: 7390-5

igne

Appendices

Sprengbombe Cylindrisch 50 (SC50)







Bomb weight: 40-54kg

Fuze Type: Impact fuze / electro-mechanical time delay fuze

Bomb Dimensions: 1090 x 280mm

Body Diameter: 200mm

Use: Used against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to 3-storeys.

Remarks: The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.

SC50 found on site

In May 2015, an SC50 was found at a building site on Empire Way, Wembley, London. (*Image source: The Guardian*)



Appendix 1.1

Generic Types of German Air-Dropped Ordnance

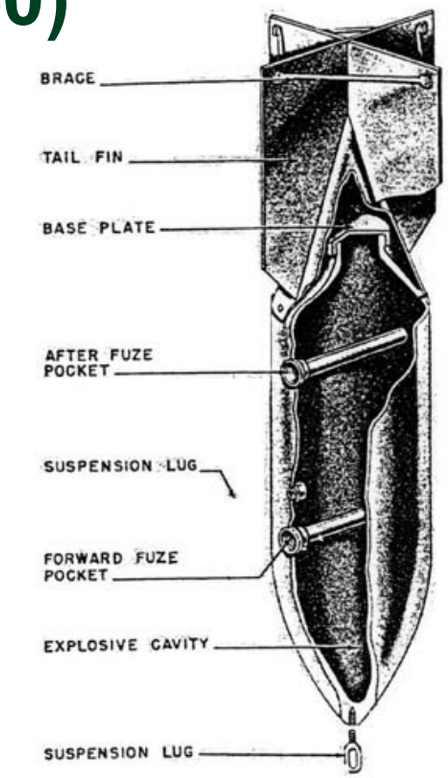
Additional Notes:

Sources:
Various news sources
Open source images

igne

Sprengbombe Cylindrisch 250 (SC250)

Bomb weight: 245-256k
Explosive Weight: 125-130kg
Fuze Type: Electrical impact / mechanical time delay fuze
Bomb Dimensions: 1640x512mm
Body Diameter: 368mm
Use: Used against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations





SC250 found on site

In 2000, Igne discovered an SC250 whilst supervising construction work at Hawkinge, Kent.



SC250 found on site

In 2015, a 250kg HE bomb was found on a construction site in Bermondsey, London.

Appendix 1.2

Generic Types of German Air-Dropped Ordnance

Additional Notes:

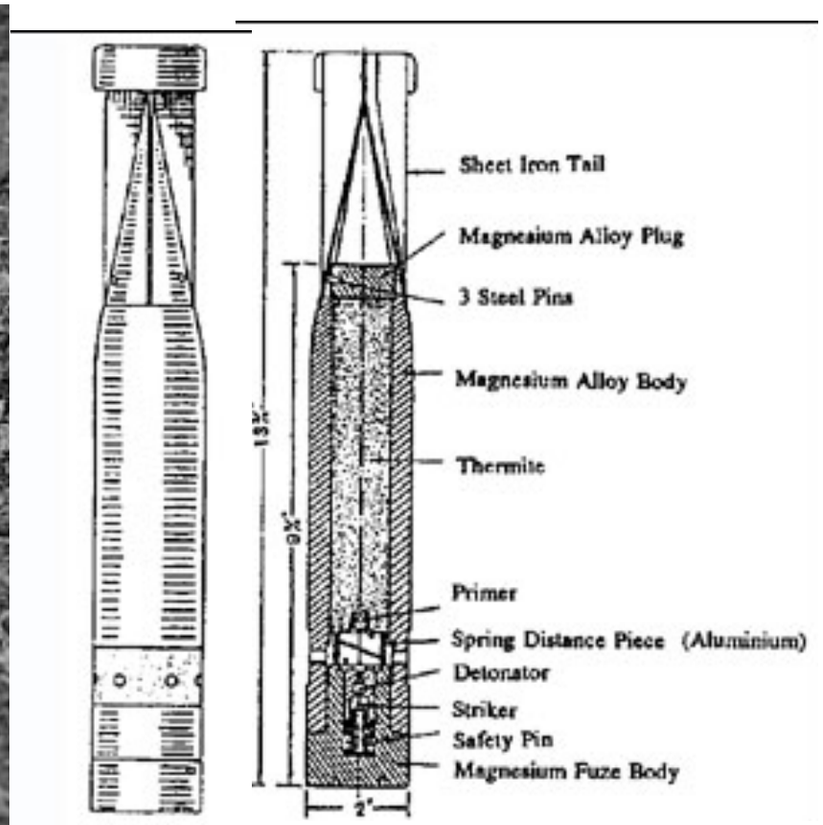
The images show SC250 bombs facing upwards in the ground, illustrating the J-Curve Effect.

Sources:
Various news sources
Open source images

igne

1kg Incendiary Bomb (IB)







Bomb weight: 1.0 & 1.3kg
Filling: 680g Thermite
Fuze Type: Impact fuze
Body Dimensions: 350 x 50mm
Body Diameter: 50mm
Use: As incendiary – dropped in clusters against towns and industrial complexes
Remarks: Jettisoned from air-dropped containers. Magnesium alloy case. Sometimes filled with high explosive charge.



Left: ordinary scaffold pipe

Centre: 1kg incendiary bomb

Right: incendiary bomb found on site in UK

Appendix 1.3

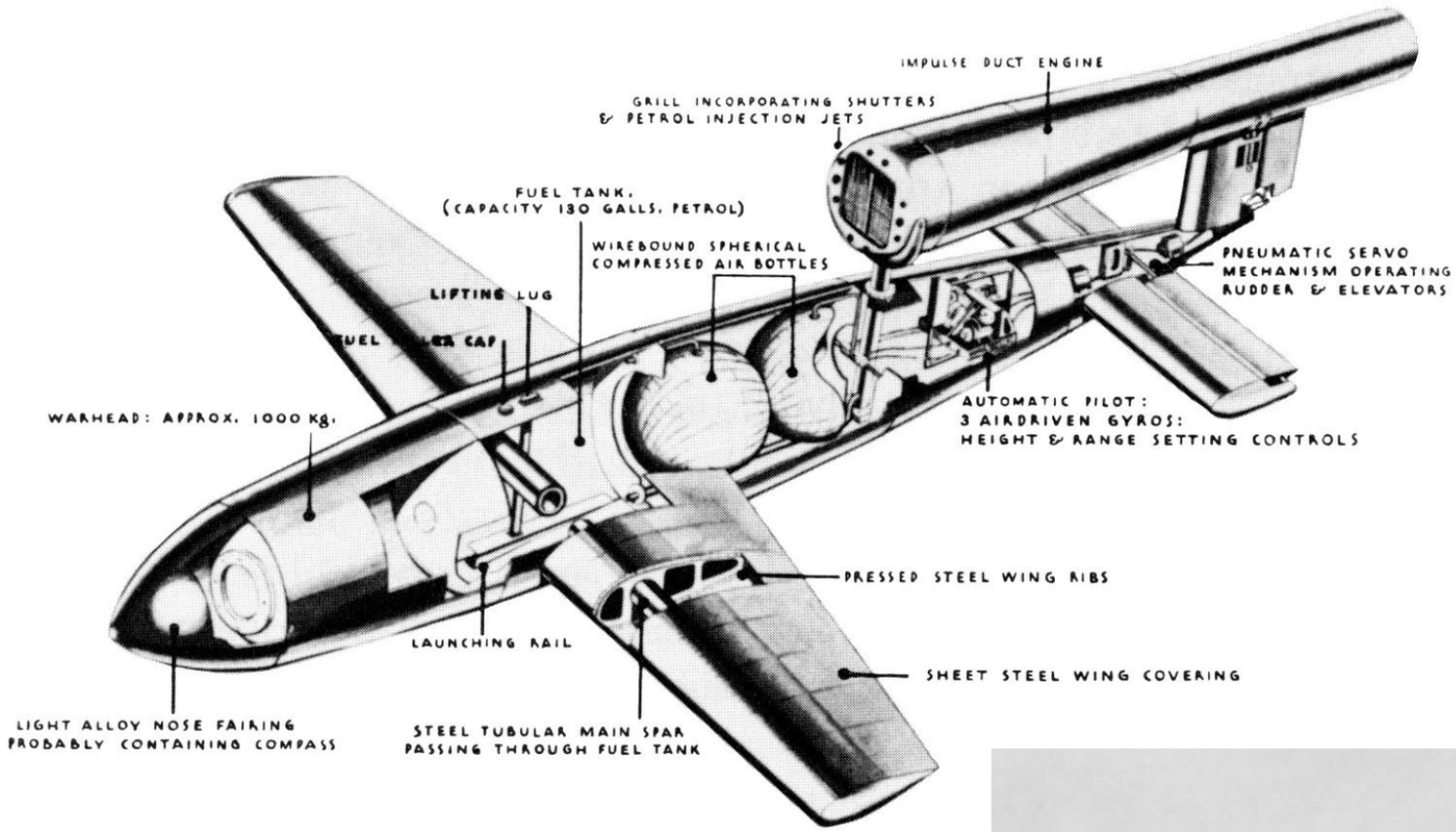
Generic Types of German Air-Dropped Ordnance

Additional Notes:

Sources:
Various news sources
Open source images

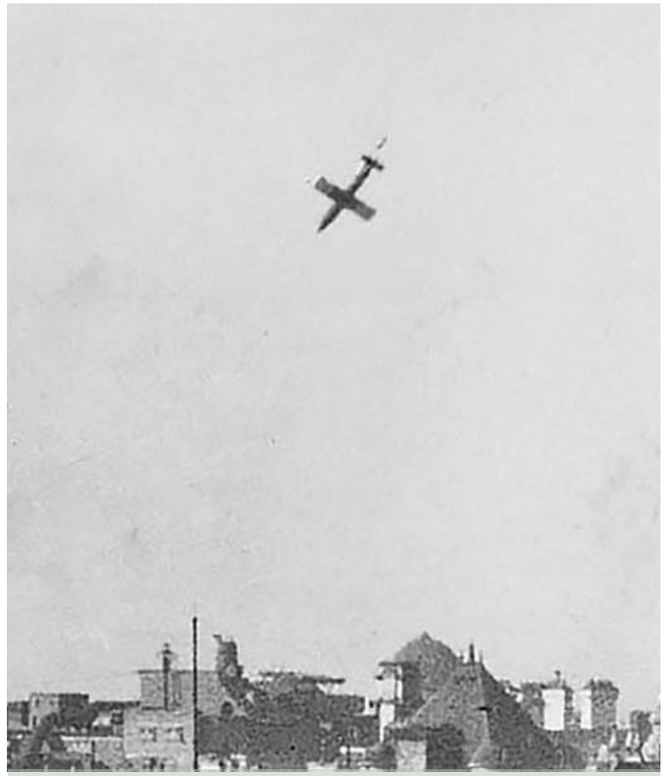
igne

Vergeltungswaffe 1 (V1) “Fly” Bomb



Missile Weight: 2,150kg

Fuze Type: Electric Impact Fuze
Missile Length: 8.32m
Width: 5.37m
Range: 250km
Use: Pulsejet-powered guided cruise missile, designed to attack Allied cities.
Remarks: Armed with an 850kg warhead, around 10,000 V-1 flying bombs were fired at England, causing significant damage and killing approximately 6,000 people . There is a negligible risk from unexploded V-1s today, since the remains would have left incontrovertible evidence of the impact.



A V-1 ‘Fly’ Bomb, captured over London, seconds before impacting

Appendix 1.4

Generic Types of German Air-Dropped Ordnance

Additional Notes:

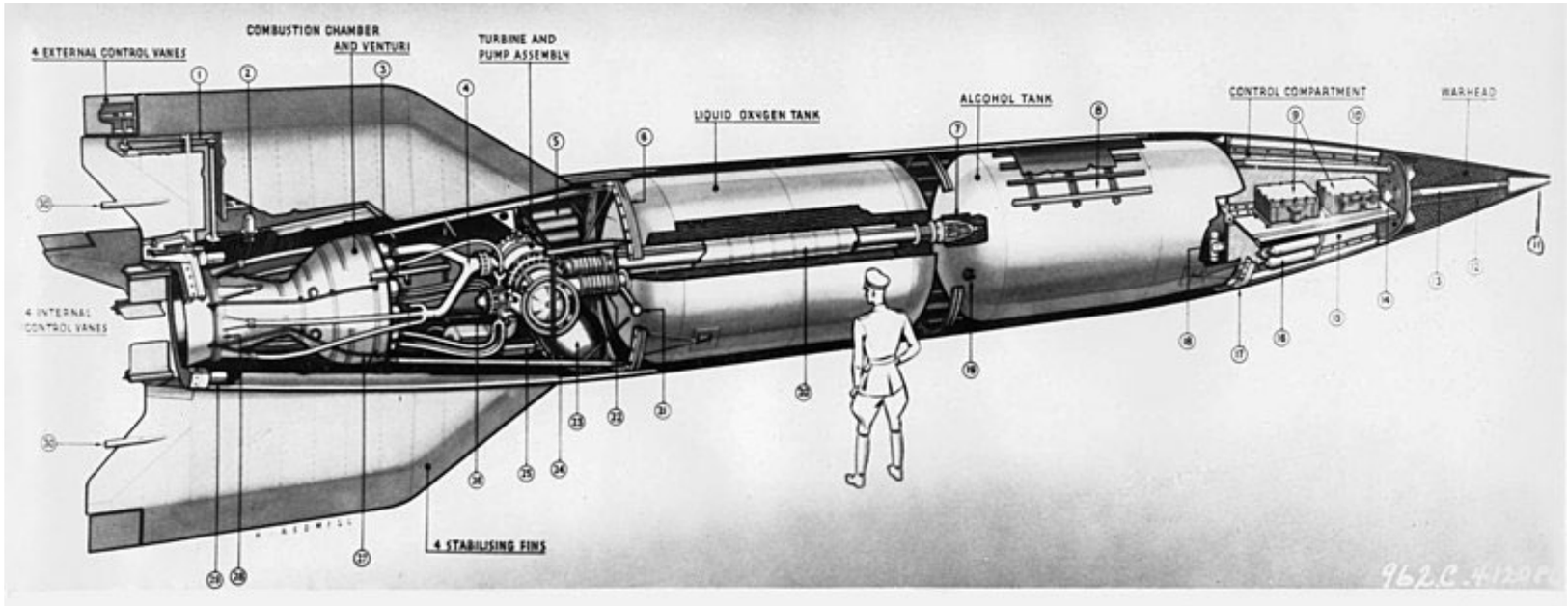
Sources:
Various news sources
Open source images

igne

Vergeltungswaffe 2 (V2) Rocket

Rocket Weight: 12,500kg
Fuze Type: Electric Impact Fuze
Rocket Length: 14m
Body Diameter: 1.65m
Range: 320km
Use: Long-range ballistic missile, designed to attack Allied cities.
Remarks: Armed with a 975kg warhead and travelling at three times the speed of sound, the V-2 could cause widespread destruction. There is a negligible risk from unexploded V-2s today, since the remains would have left incontrovertible evidence of the impact.





1 CHAIN DRIVE TO EXTERNAL CONTROL VALVE
2 ELECTRIC MOTOR
3 BURNER CUPS
4 ALCHOL SUPPLY FROM PUMP
5 AIR BOTTLES
6 REAR JOINT RING AND STRONG POINT FOR TRANSPORT
7 SERVO-OPERATED ALCOHOL OUTLET VALVE
8 ROCKET SHELL
9 RADIO EQUIPMENT
10 PIPE LEADING FROM ALCOHOL TANK TO WARHEAD
11 NOSE PROBABLY FITTED WITH NOSE SWITCH, OR OTHER DEVICE FOR OPERATING WARHEAD FUZE
12 CONDUIT CARRYING WIRES TO NOSE OF WARHEAD
13 CENTRAL EXPLODER TUBE
14 ELECTRIC FUZE FOR WARHEAD
15 PLYWOOD FRAME
16 NITROGEN BOTTLES
17 FRONT JOINT RING AND STRONG POINT FOR TRANSPORT
18 PITCH AND AZIMUTH GYROS
19 ALOCHOL FILLING POINT
20 DOUBLE WALLED ALCOHOL DELIVERY PIPE TO PUMP
21 OXYGEN FILLING POINT
22 CONCERTINA CONNECTIONS
23 HYDROGEN PEROXIDE TANK
24 TUBULAR FRAME HOLDING TURBINE AND PUMP ASSEMBLY
25 PERMANGANATE TANK (GAS GENERATOR UNIT BEHIND THIS TANK)
26 OXYGEN DISTRIBUTOR FROM PUMP
27 ALCOHOL PIPES FOR SUBSIDIARY COOLING
28 ALCOHOL INLET TO DOUBLE WALL
29 ELECTRO-HYDRAULIC SERVO MOTORS
30 AERIAL LEADS

Appendix 1.5

Generic Types of German Air-Dropped Ordnance

Additional Notes:

Sources:
Various news sources
Open source images

igne

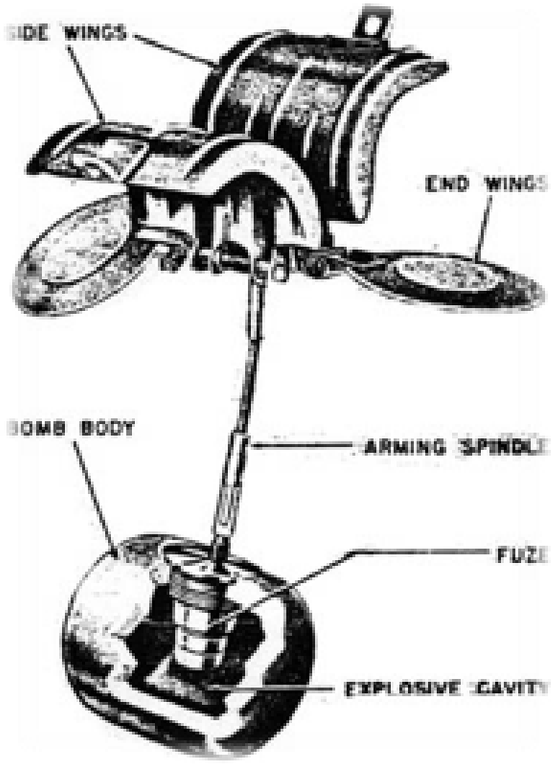
SD-2 & SD-2 B “Butterfly Bomb”

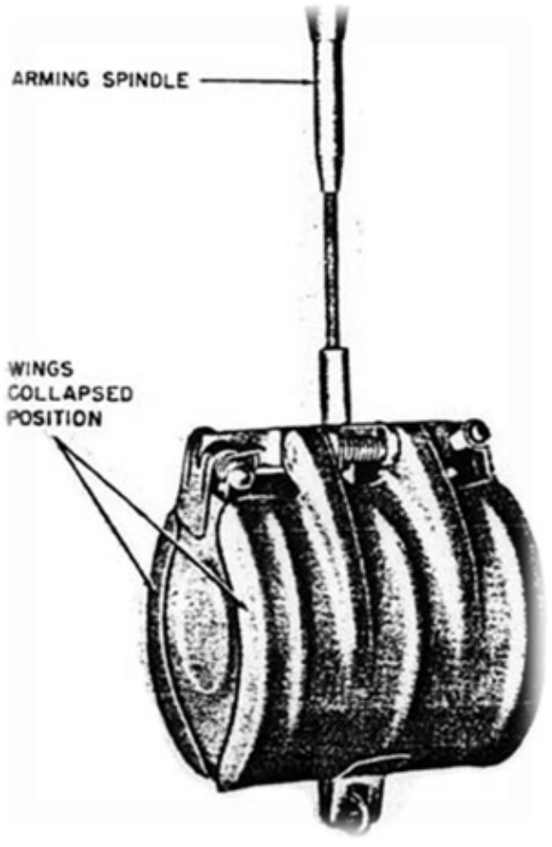
Bomb Weight: 2.0kg
Explosive Weight: 0.225kg
Explosive Filling: 225g of TNT
Fuze Type: Mechanical (41) clockwork fuze only in SD-2
Bomb Dimensions: 200x76mm with cable attachment but without brake airscrews
Bomb Diameter: 76mm
Use: Against living targets and with Störzünder (deterrent fuze) as mine
Remarks: Jettisoned from air-dropped containers. Generally lethal to anyone within a radius of 25m and could injure people as far away as 150m.











Appendix 1.6

Generic Types of German Air-Dropped Ordnance

Additional Notes:

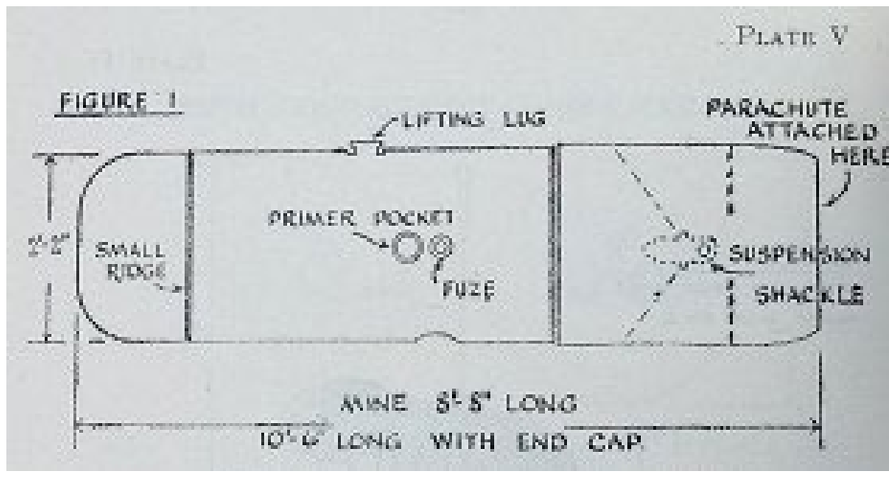
Sources:
Various news sources
Open source images

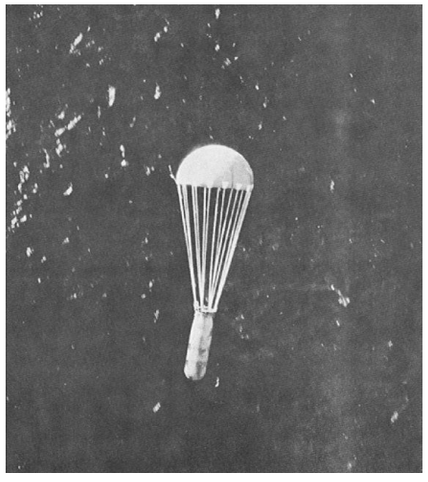
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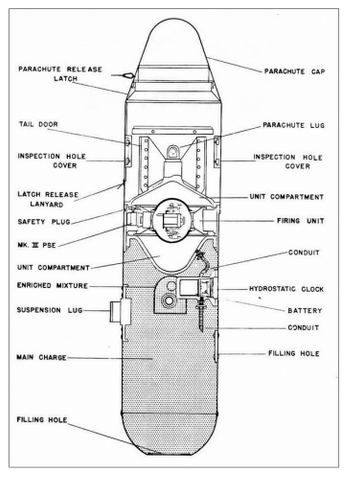
Luftmine A/B “Parachute Mine”











Bomb Weight: A- 500kg, B – 1000kg
Fuze Type: Mechanical clockwork fuze
Bomb Dimensions: A – 1768mm, B – 2682mm
Use: Capable of creating severe blast damage in built-up areas
Remarks: Parachute mines were standard German sea mines fitted with a suitable detonator. They were widely used against British cities.

Appendix 1.7

Generic Types of German Air-Dropped Ordnance

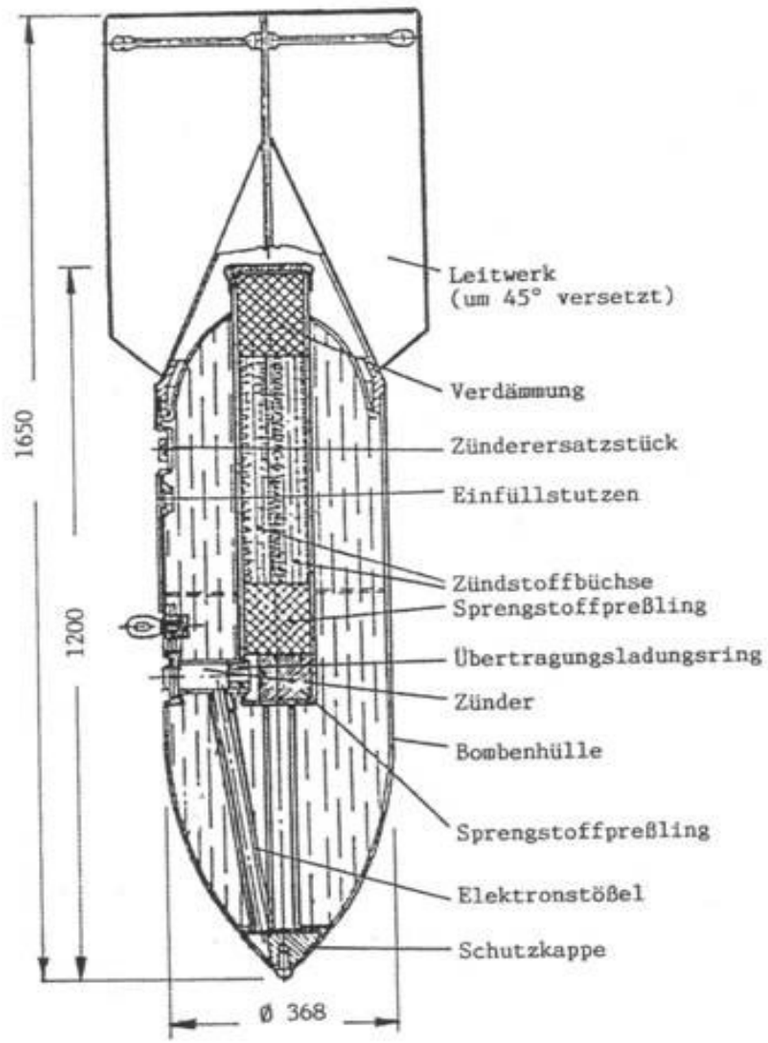
Additional Notes:

Sources:
Various news sources
Open source images

igne

Flam C-250 “Oil Bomb”

Bomb Weight: 125kg
Explosive Weight: 1kg
Flammable Weight: 74kg
Filling: Mixture of 30% petrol and 70% crude oil
Fuze Type: Super-fast electrical impact fuze
Bomb Dimensions: 1650 x 512.2mm
Body Diameter: 368mm
Use: Often used for surprise attacks on living targets, against troop barracks and industrial installations
Remarks: Thin casing – not designed for ground penetration





Appendix 1.8

Generic Types of German Air-Dropped Ordnance

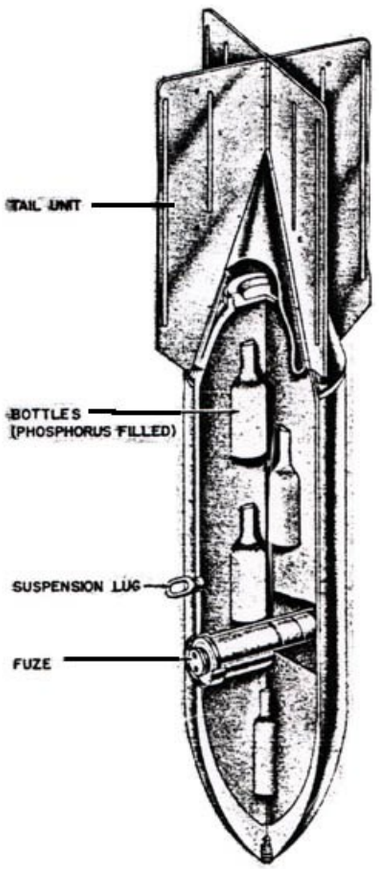
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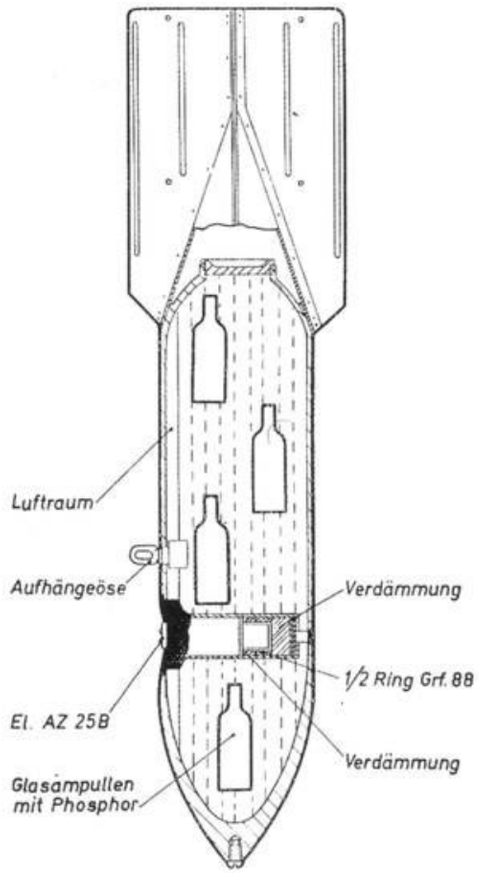
Sources:
Various news sources
Open source images

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C-50 A Phosphorous Bomb







Bomb Weight: c.41kg
Explosive Weight: 0.03kg
Incendiary Filling: 12kg liquid filling with phosphor igniters in glass phials
Fuze Type: Electrical impact fuze
Bomb Dimensions: 1100 x 2800mm
Body Diameter: 200mm
Use: Against all targets where an incendiary effect is to be expected
Remarks: Early fill was a phosphorus / carbon disulphide incendiary mixture

Appendix 1.9

Generic Types of German Air-Dropped Ordnance

Additional Notes:

Sources:
Various news sources
Open source images

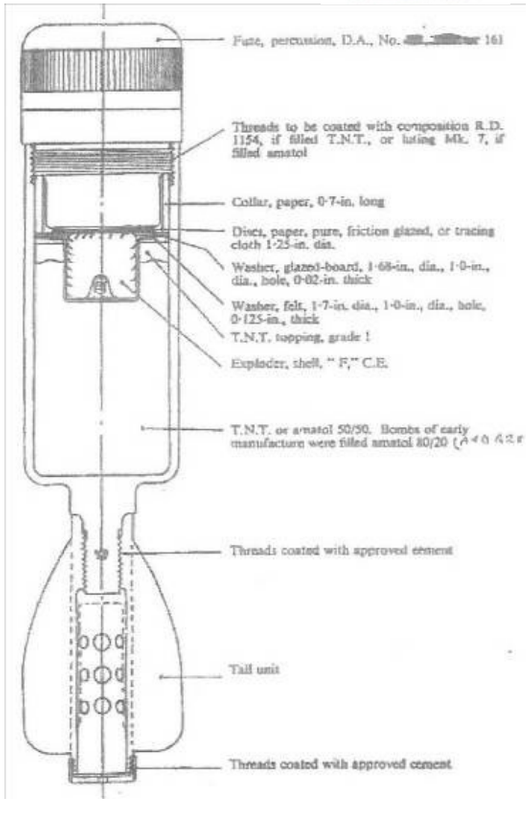
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Typical 2” High Explosive Mortar

Bomb weight: 1.02kg
Fuze Type: High Explosive
Bomb Dimensions: 51 x 290mm **Filling**: 200g RDX/TNT
Remarks: Fitted with an impact fuze which detonates the fuze booster charge (exploder) and, in turn, the high explosive charge. The main charge shatters the mortar bomb body, producing near optimum fragmentation and blast effect at the target.







Appendix 2.1

Generic Types of British / Allied Land Service Ammunition

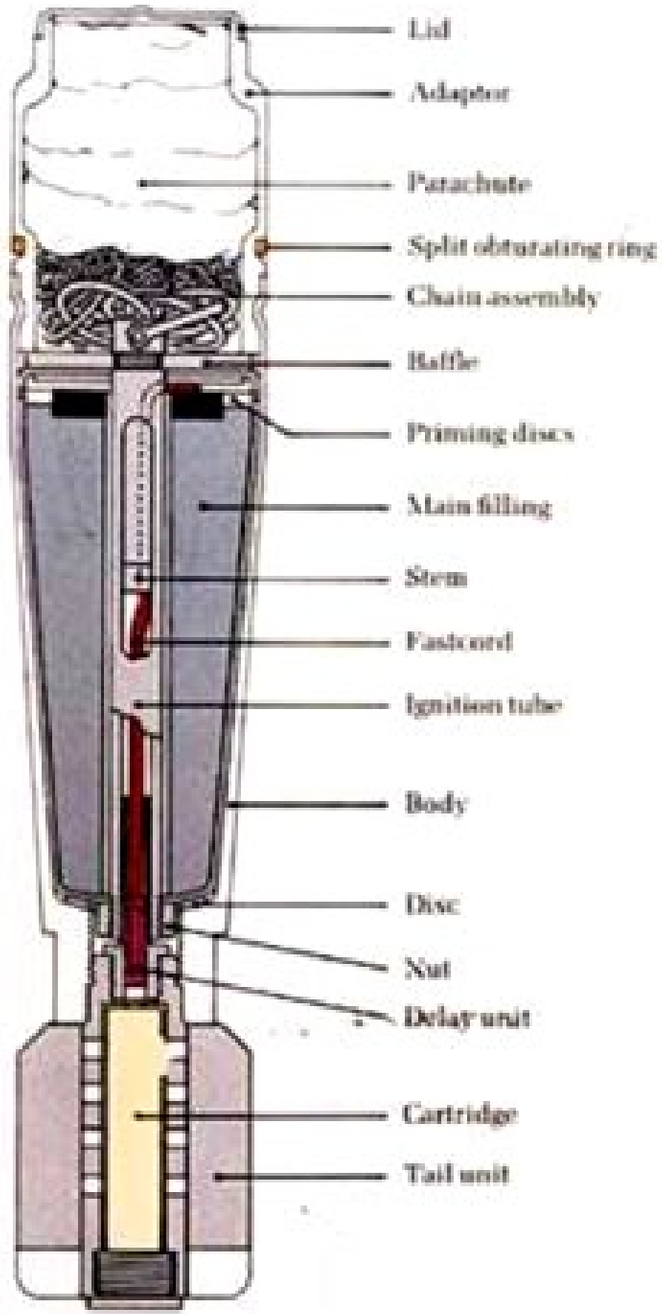
Additional Notes:

Sources:
Various news sources
Open source images

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Typical 2” Illuminating Mortar

Fuze Type: Illuminating
Bomb Dimensions: 51 x 290mm
Filling: Various
Remarks: The expulsion charge ignites and ejects the candle assembly. A spring ejects the parachute from the tail cone. The parachute opens, slowing the descent of the burning candle which illuminates the target.





Appendix 2.2

Generic Types of British / Allied Land Service Ammunition

Additional Notes:

Sources:
Various news sources
Open source images

igne

Typical 3” Smoke Mortar

Fuze Type: Smoke
Bomb Dimensions: c.490 x 76mm
Filling: Typically, white phosphorus
Remarks: On impact, the fuze functions and initiates the bursting charge. The bursting charge ruptures the mortar bomb body and disperses the white phosphorous filler. The white phosphorous produces smoke upon exposure to the air.





Appendix 2.3

Generic Types of British / Allied Land Service Ammunition

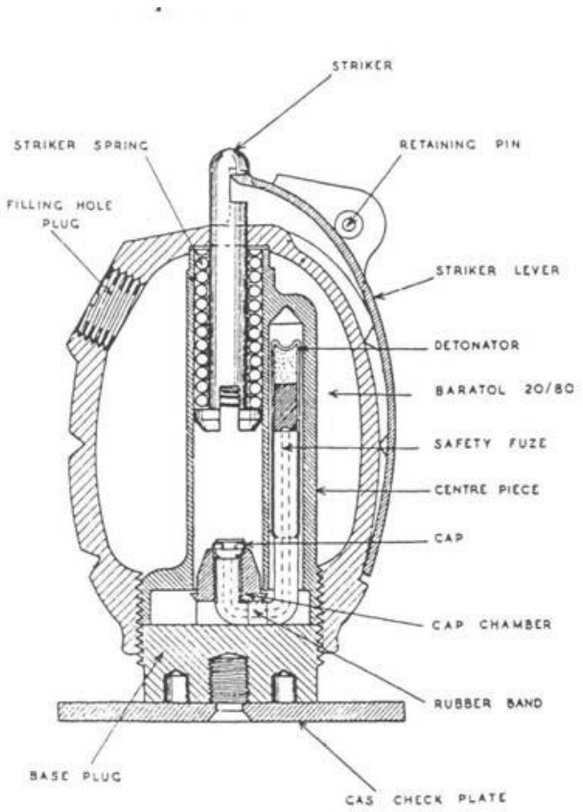
Additional Notes:

Sources:
Various news sources
Open source images

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No. 36 “Mills” Grenade





Grenade, .303 inch rifle, No. 36M, Mark I.







Weight: 0.7kg filled
Type: Hand or discharger, fragmentation
Dimensions: 95 x 61mm
Filling: Alumatol, Amatol 2 or TNT
Remarks: 4 second hand-throwing fuze with approximate range of 30m. First introduced May 1918.

Appendix 2.4

Generic Types of British / Allied Land Service Ammunition

Additional Notes:

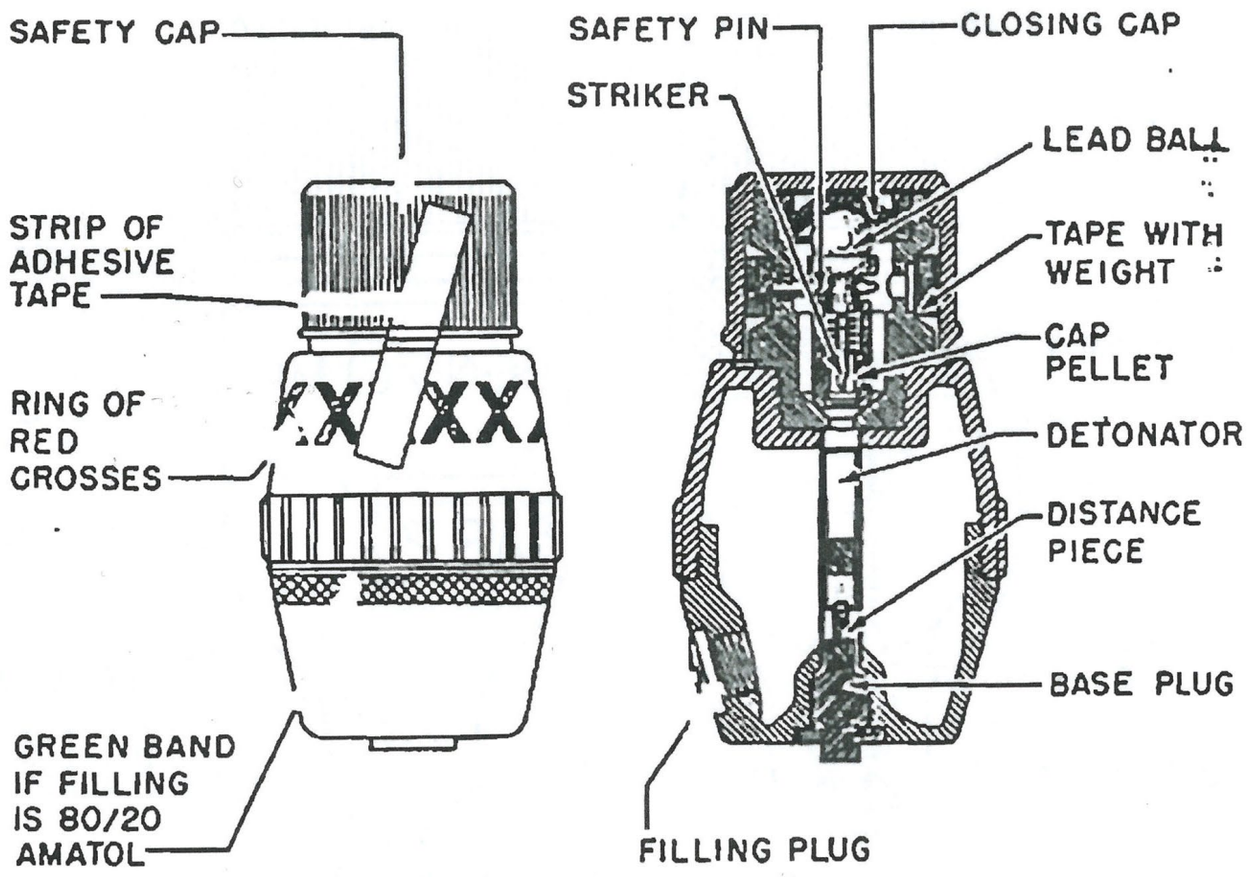
Sources:
Various news sources
Open source images

igne

No. 69 Grenade

Weight: 038kg filled
Type: Percussion / Blast
Date Introduced: December 1940
Remarks: Black Bakelite body. Blast rather than fragmentation type. After unscrewing the safety cap, a tape is held when throwing the grenade releasing the safety bolt in the throwing motion. Detection is problematic due to its very low metal content.







Appendix 2.5

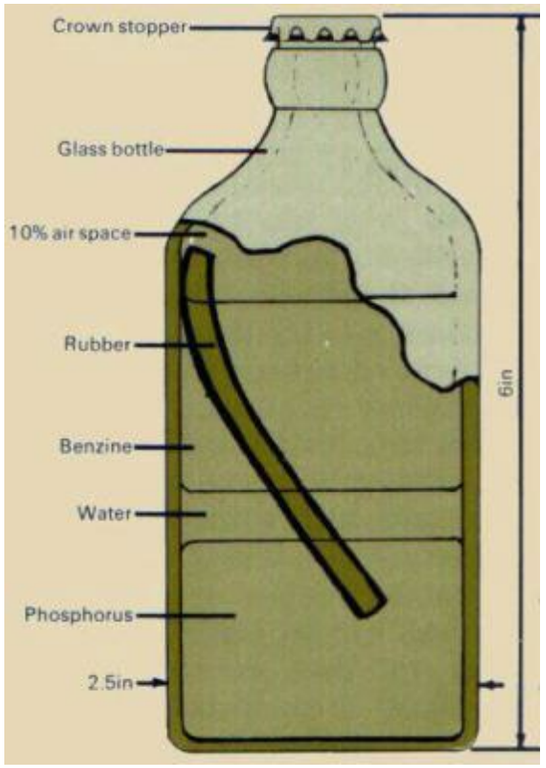
Generic Types of British / Allied Land Service Ammunition

Additional Notes:

Sources:
Various news sources
Open source images

igne

Self-Igniting Phosphorous (SIP) Grenade



Sometimes called the “A&W (Albright & Wilson)” grenade.

The grenade comprised a glass bottle with a total volume of approximately 1 pint. It was filled with white phosphorous, benzene, a piece of rubber and water. Over time, the rubber dissolved to create a sticky fluid which would self-ignite when the bottle broke.

Fired by hand or Northover Projector.





Appendix 2.6

Generic Types of British / Allied Land Service Ammunition

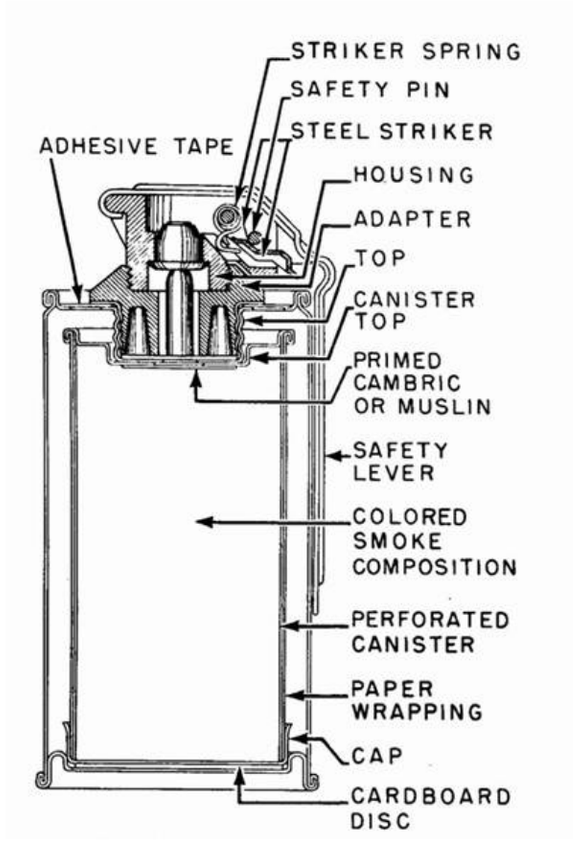
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Sources:
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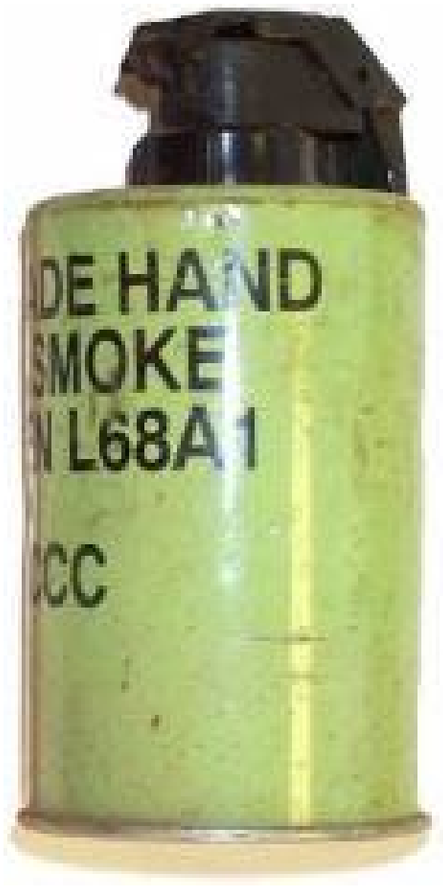
igne

Typical Smoke Grenade

Dimensions: Approx. 65 x 115mm
Type: Smoke
Date Introduced: Current MoD issue
Remarks: Smoke grenades are used as ground-to-ground or ground-to-air signalling devices, target or landing zone marking devices, and screening devices for unit movement.







Appendix 2.7

Generic Types of British / Allied Land Service Ammunition

Additional Notes:

Sources:
Various news sources
Open source images

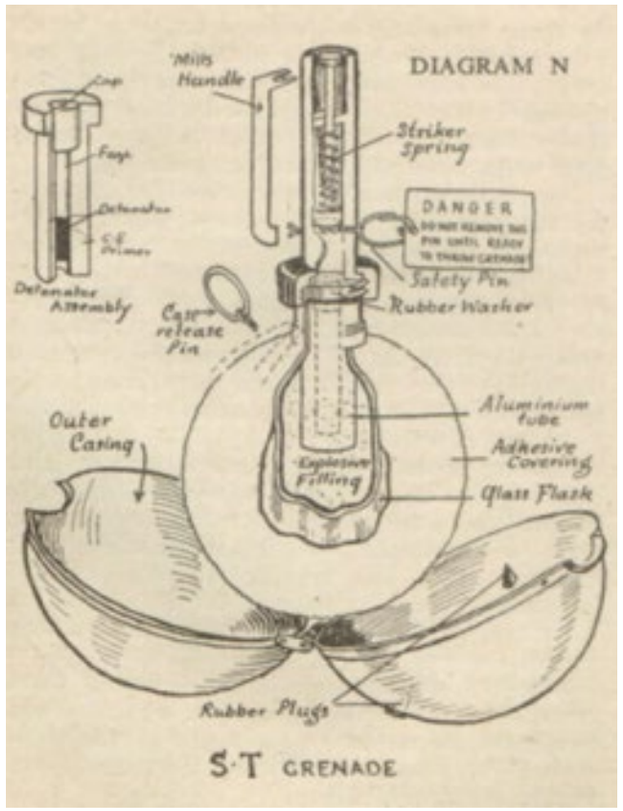
igne

No. 74 Grenade (“Sticky Bomb”)

Designed as an anti-tank grenade and used by the Home Guard. The grenade consisted of a glass ball on the end of a Bakelite (plastic) handle. Inside the glass ball was an explosive filling whilst on the outside was a very sticky adhesive covering. Until used, this adhesive covering was encased in a metal outer casing.







Appendix 2.8

Generic Types of British / Allied Land Service Ammunition

Additional Notes:

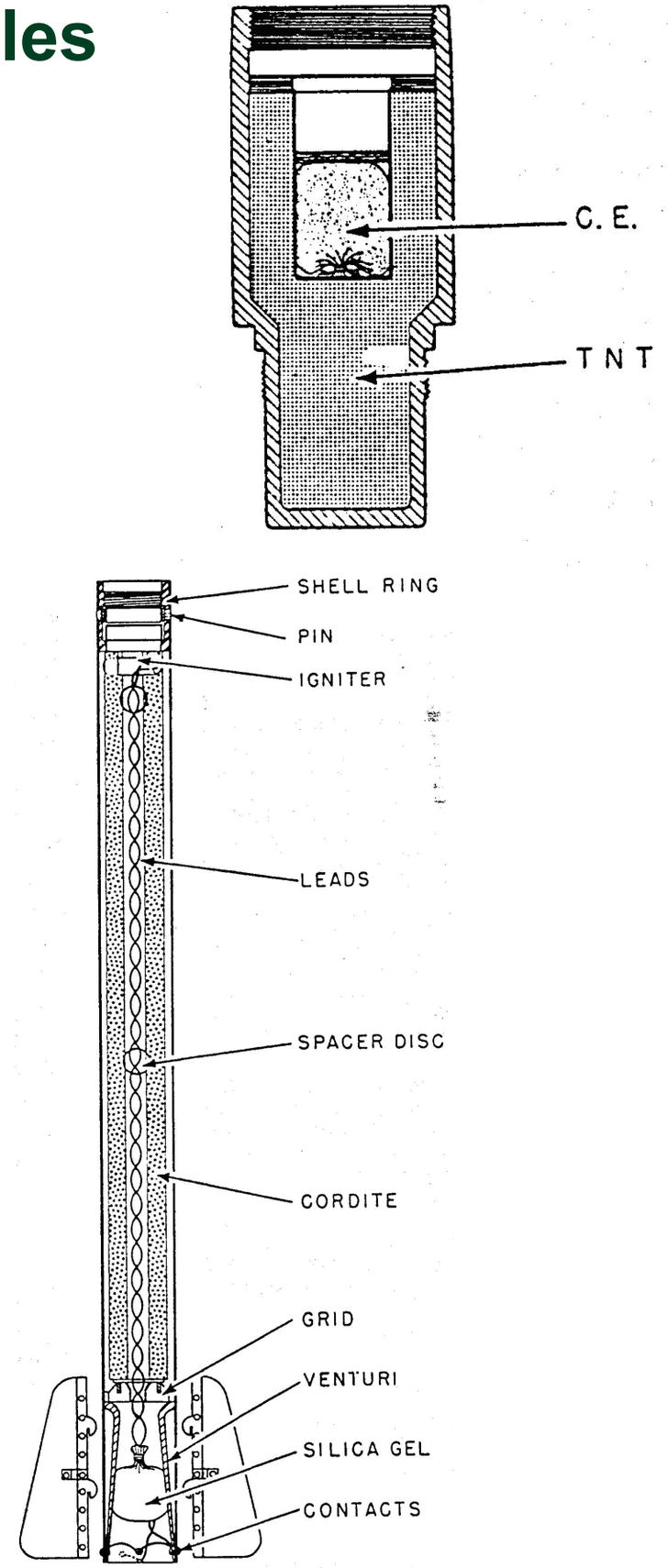
Sources:
Various news sources
Open source images

Rockets / Un-rotating Projectiles

Weight: 24.5kg
Bomb Dimensions: 94 x 360mm
Carriage: Typically, white phosphorus
Rate of Fire: 10-20 rounds per minute
Ceiling: 9,000-18,000m
Muzzle Velocity: 72m/s
Remarks: 4.5” projectiles were also commonly utilized.



Home Guard soldiers load an anti-aircraft rocket at a 'Z' Battery



Appendix 2.9

Generic Types of British / Allied Anti-Aircraft Ordnance

Additional Notes:

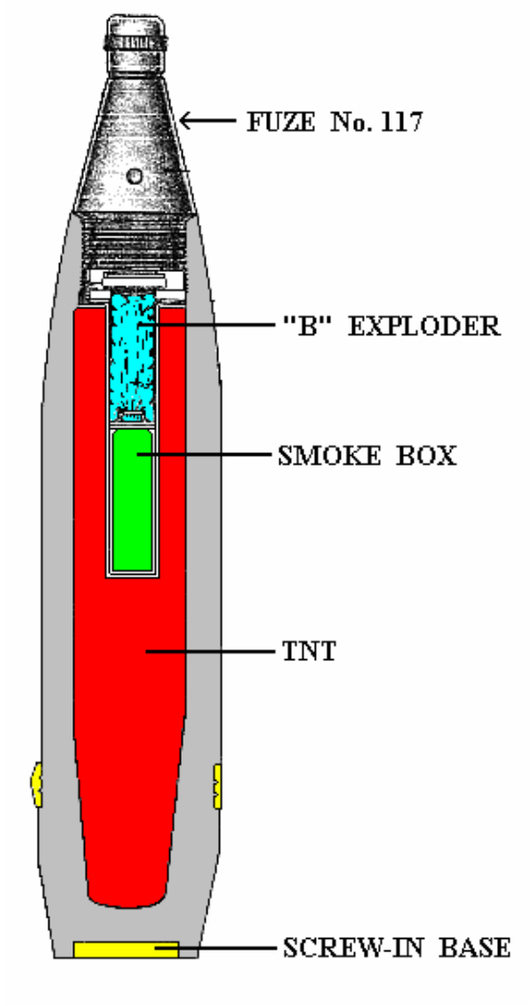
Sources:
Various news sources
Open source images

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High Explosive Projectile: Fragmentation & Blast

Features:

a) Long, pointed ogival nose and streamlined body.
b) Square or tapered base. Boat tailed/streamlined.
c) One-piece body construction.
d) Base plate screwed or welded to the base, occasionally of one piece construction.
e) Copper driving band near the base of the projectile.
f) Body construction normally thin.
g) Low charge to weight ratio.
h) Fuzed with point-initiating and/or base-detonating fuze.
i) If no driving band is present, it may use two bourrelets.





4in HE Projectile



2in HE Projectile

Appendix 2.10

Generic Types of British / Allied Land Service Ammunition

Additional Notes:

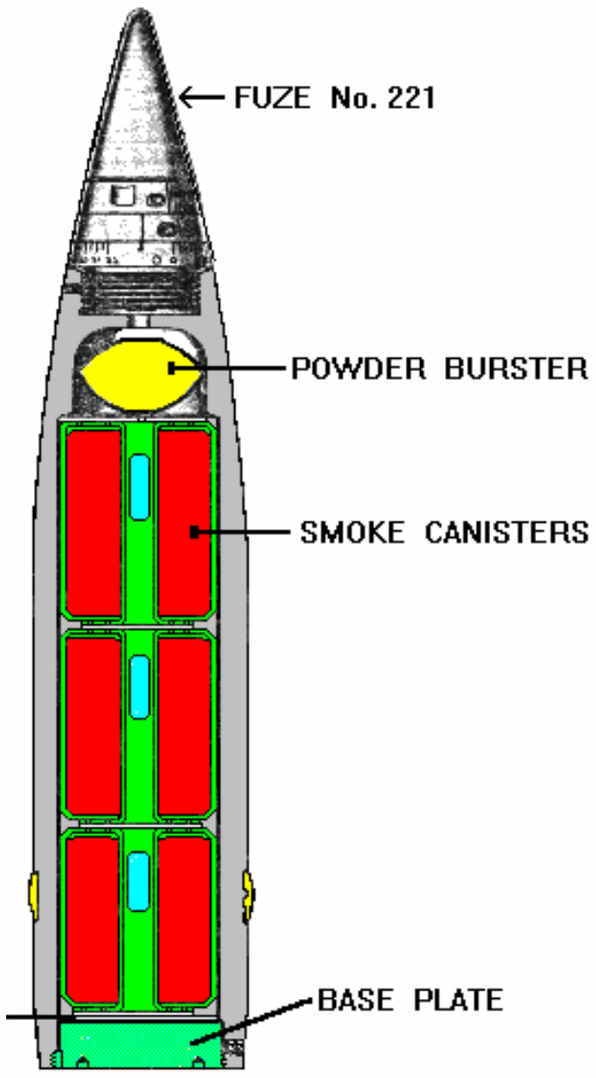
Sources:
Various news sources
Open source images

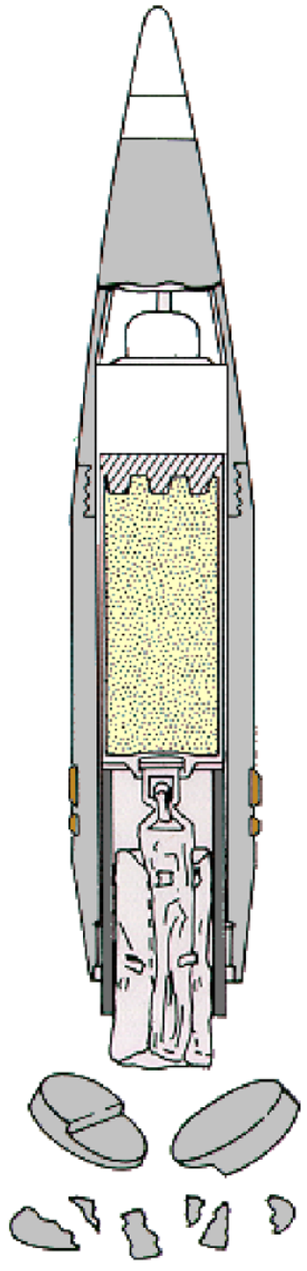
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Carrier Projectiles: Base Ejection

Features:

a) Ogival streamlined nose.
b) Nose/Time fuzed.
c) Parallel sides (on older items).
d) Square or tapered base.
e) One or two-piece body construction.
f) Base plate held in place by weakened PVC ring or shear pins.
g) Copper driving band may be fitted.
h) Base plate ejected if the munition has functioned.
i) Contains a small low explosive burster/expulsion charge.









Appendix 2.11

Generic Types of British / Allied Land Service Ammunition

Additional Notes:

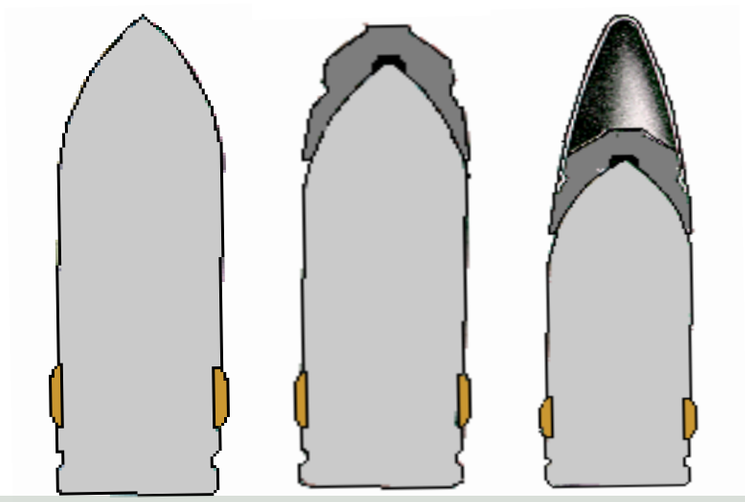
Sources:
Various news sources
Open source images

Shot Projectiles

Features:

a) Driving bands (early designs) or obturators (current designs).
b) Tracer pockets common.
c) Ballistic caps and piercing caps (current designs).
d) Early shot projectiles were made of hard high grade steel. Current designs use tungsten carbide or Depleted Uranium (DU) cores or penetrators.
e) Most current shot projectiles now use discarding sabots, either of the post or petal type
f) Proof shot projectiles have flat heads and are used to test guns.
g) No fuzes are present.





Shot AP Capped AP Capped BC



4in Solid Shot

Appendix 2.12

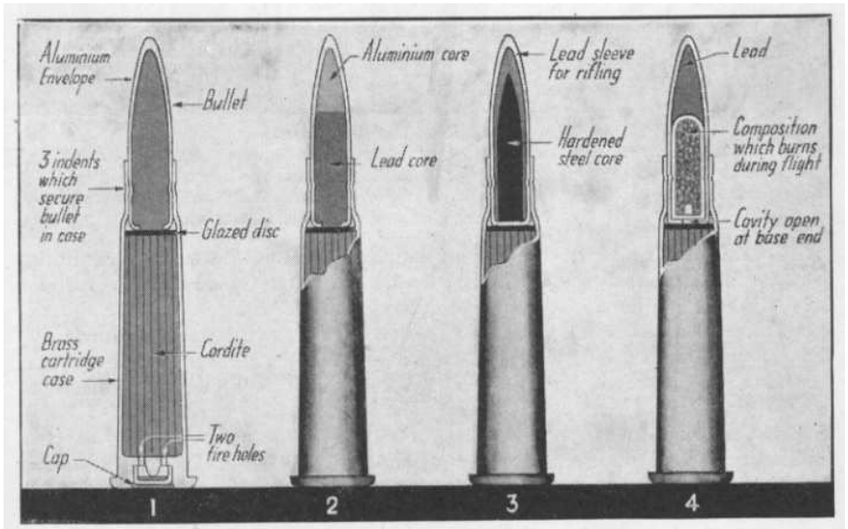
Generic Types of British / Allied Land Service Ammunition

Additional Notes:

Sources:
Various news sources
Open source images

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.303” Ammunition



TYPES OF SMALL ARMS AMMUNITION

Fig. 1. *Four types of ammunition used by modern infantry. 1 and 2 are ball cartridges, 3 is an armour-piercing bullet, and 4 a tracer bullet which burns and makes its flight visible.*



PLAN OF BASE.



Type: Rifle / machine gun round
Markings: Regular round – none. Tracer round – red primer
Bullet Weight: 150 – 180g
Dimensions: Total cartridge / projectile length – 182mm
Filling: Regular round – none. Tracer round – small incendiary fill
Threat: Explosive cordite within unspent cartridge
Deployment: Royal Navy, RAF and British Army Light Anti-Aircraft guns, machine guns and rifles. Standard British and Commonwealth military cartridge from 1889 until the end of the 1950s.
Remarks: Cartridges are belted or supplied loose in cartons

Appendix 2.13

Generic Types of British / Allied Small Arms Ammunition

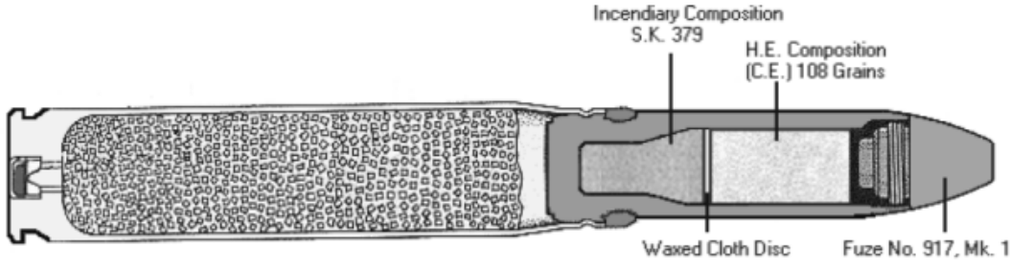
Additional Notes:

Sources:
Various news sources
Open source images

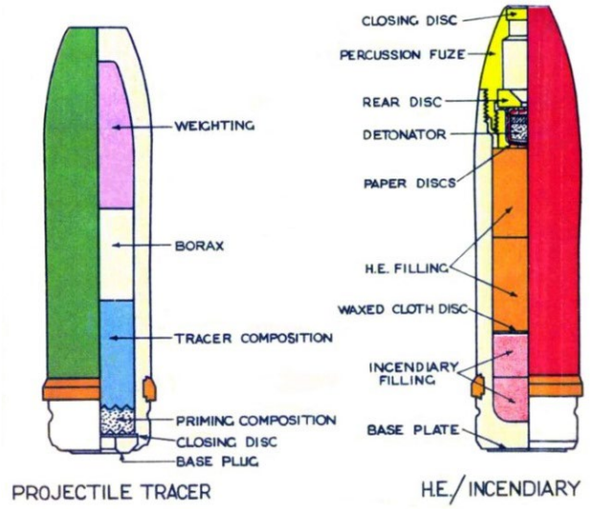
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200mm Hispano HEI Ammunition









COLOUR IDENTIFICATION

BRITISH

NATURE OF SHELL	H.E. FILLING	COLOUR
H.E. TRACER	T.N.T.	
H.E.	T.N.T.	
PROJ. PRACTICE		
PROJ. TRACER		
H.E. INCENDIARY	T.N.T.	
H.E. INCENDIARY TRACER	T.N.T.	

Type: Live cannon round
Markings: Upper half of projectile painted “buff” colour, lower half is red
Cartridge Weight: 256g
Dimensions: Total cartridge / projectile length – 182mm
Fuze: Contact fuze – No. 253, No. 254 or No. 917
Filling: 108 grains of contact explosive & 68 grains of SR. 379 incendiary composition
Threat: Explosives within unspent cartridge as well as the projectile
Deployment: Royal Navy, RAF and British Army Light Anti-Aircraft guns, and RAF aircraft cannons.
Remarks: Cartridges are belted or supplied loose in cartons.

Appendix 2.14

Generic Types of British / Allied Small Arms Ammunition

Additional Notes:

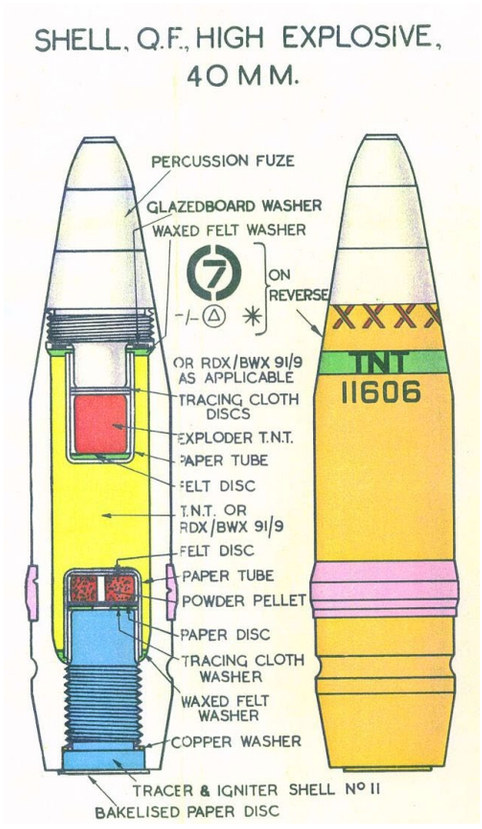
Sources:
Various news sources
Open source images

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40mm Bofors Gun Projectile









Weight: 0.86kg
Bomb Dimensions: 40mm x 310mm
Rate of Fire: 120 rounds per min
Ceiling: 7,000m
Muzzle Velocity: 881m/s
Remarks: Mobile batteries – normally few records of where these guns were located

Appendix 2.15

Generic Types of British / Allied Anti-Aircraft Ordnance

Additional Notes:

Sources:
Various news sources
Open source images

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3.7” Anti-Aircraft Projectile

Weight: 12.7kg (28lb)

Dimensions: 94 x 360mm (3.7 x 14.7in)

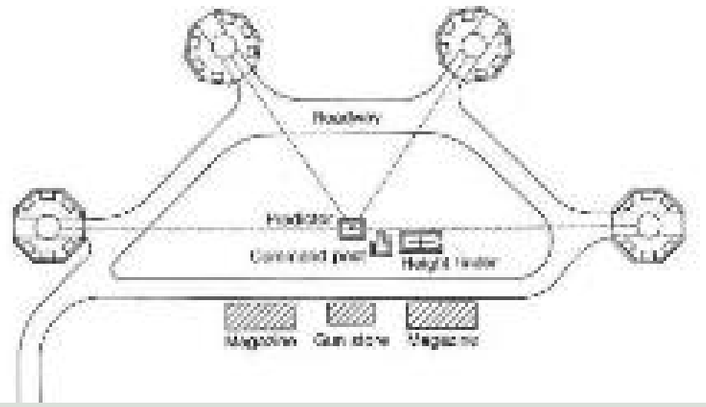
Carriage: Mobile and Static Versions

Rate of Fire: 10-20 rounds per minute

Ceiling: 9-18,000m (29-59,000ft)

Muzzle Velocity: 792m/s (2,598ft/s)

Remarks: 4.5 inch projectiles were also commonly utilised



Layout plan for a typical HAA battery site.



3.7 inch AA Projectile, Minus Fuze.



This AA shell was uncovered on a construction site in North London in February 2009.



Hyde Park 1939 3.7 Inch QF gun on mobile mounting.

Appendix 2.16

Generic Types of British / Allied Anti-Aircraft Ordnance

Additional Notes:

Sources:
Various news sources
Open source images

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