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Geo-Environmental Ltd

Consulting Geo-Environmental Engineers

Phase 2 Geo-Environmental Assessment

CRFCA

YH08 – Mirfield Air Training Corps

Report Ref:

23109-PWAG-00-XX-RP-G-2000-P02

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Executive Summary

PWA Geo-Environmental Ltd (PWAG) was commissioned by Integra Buildings Ltd to undertake a Phase 2 Geo-Environmental Assessment for a proposed cadet hut located at Mirfield Air Training Corps. A summary of salient geo-environmental issues is provided below. However, the full report must be read in its entirety.

Key Details	
Site Description	The site is approximately 0.2 hectares, is located on the west of Mirfield and can be located by national grid reference SE 19365 20286. The site currently comprises of an area of hardstanding with two single story modular buildings and a shed. There is a steep landscaped banking along the south and eastern of site with building rubble along the base of the southern bank. Numerous large trees run along the north east and west of site. Metal palisade fencing borders the site on all sides with an access gate to Huddersfield Road on the northern side.
Site History	The earliest maps show in 1855 the site as an undeveloped. There are a number of residential buildings on the east of site between 1888 - 1977. The site remains empty till a building labelled club appears in 1990, with the second building appearing in 2010.
Mapped Geology	The BGS 1:10,000 SE12SE (1999) indicates that the site is comprised of made ground overlying bedrock of Clifton Rock.
Radon	The property is not within a Radon Affected Area. The site is identified as an area where between less than 1% of properties are above the action level. No radon protection measures are required for developments undertaken in these areas. The requirement for radon protection measures for any proposed development should be confirmed with local building control.
Potential Contamination	The preliminary environmental risk assessment for the site identified potential sources of contamination associated with the made ground.

Geo-Environmental Findings	
Site Works	Fieldwork undertaken in December 2023 comprised 2 cable percussive boreholes drilled to depths of between 14.50 to 15.60 m bgl.
Summary of Ground Conditions	Made ground was encountered in all locations and was typically comprised of a layer of tarmac over sometimes yellowish brown or grey clayey silty sandy GRAVEL, silty sandy gravelly CLAY or clayey silty gravelly SAND with medium to high cobble content and rare brick, coal and or pottery. Underlain by superficial deposits of Mostly yellowish or orangish brown, occasional sandy gravelly CLAY or occasionally clayey sandy GRAVEL with a medium to high cobble content. Below which a grey mudstone bedrock was encountered at 13.50 m bgl in CP02.
Contamination	Contamination on site is considered wide spread, with PWA-GeoEnvironmental and G&M Consulting identifying elevated levels above the GAC's for a residential land use for lead, arsenic, and speciated PAH's. G&M Consulting also identified asbestos within the made ground at 1.00 m and 3.00 m bgl.
Foundations and Floor Slabs	Given the depths to suitable founding strata it would be prudent to consider the use of deep foundations such as piles or ground improvement techniques. The unit that is proposed on site is a prefabricated modular unit and therefore will arrive on site with the floor slab already constructed. These floor slabs are suspended.
Road and Paved Areas	The made ground present at shallow depth are likely to provide a CBR value of at least 4%.
Sulphate Class	Sulphate class DS-3, AC-3 within the made ground and DS-1, AC-1 in the underlying natural deposits have been allocated based upon chemical testing of soils done by G&M Consulting.

Contaminated Land Risk Assessment

Based on the information contained in this report, and with due regard to the proposed residential development, the site represents a moderate/low risk with respect to contaminated land liability issues in its current condition. Following remediation the site is expected to represent a low risk.

Recommendations

We recommend that copies of this report should be provided to:

- a structural engineer so that appropriate building foundations, floors and structures can be designed; and
- the appropriate regulator for review and comment before undertaking any additional work; and
- the implementation of 600mm clean cover system.

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Appendices

Appendix A – Drawings

Drawing No.	Title
230711-015.03	Site : layout : proposed
23109-PWA-00-XX-DR-G-2001	Exploratory Hole Plan
23109-PWA-00-XX-DR-G-2002	Ground Model

Appendix B – Exploratory Hole Logs

Appendix C – Geotechnical Laboratory Results

Appendix D – Geochemical Testing Results

Appendix E – Historic Borehole Logs

Appendix F – Dynamic Cone Penetrometer Results

Appendix G – Historic Ground Gas Monitoring Results

Appendix H – Risk Evaluation

1 FOREWORD

This report has been prepared for the sole use and reliance of Integra Buildings Ltd (the Client) and cannot be relied upon by any other parties without the express written authorisation of PWA Geo-Environmental Ltd. Any unauthorised third party relies on this report at their own risk and the authors owe them no duty of care.

The report presents observations and factual data obtained during our site walkover, along with information reviewed during the desk study and intrusive works and provides an assessment of geo-environmental issues with respect to information provided by the Client regarding the site. There may be other conditions on site not encountered during this investigation and which have not been examined. We cannot accept responsibility for any conditions not revealed by this investigation and confirmation of ground conditions between exploratory locations should be undertaken if considered necessary. Any spatial inference of ground conditions between investigation locations are for guidance only and no liability can be accepted for their accuracy.

The groundwater conditions encountered on site and recorded on exploratory records are those observed at the time of investigation. The normal rate of investigation does not enable the recording of an equilibrium water level. Furthermore, groundwater levels are subject to seasonal variation, changes in weather and changes in local drainage conditions. Therefore, this information is provided for guidance only and no liability can be accepted for their accuracy.

The report should be read in its entirety, including all associated drawings and appendices. PWA Geo-Environmental Ltd cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from the sources listed, which PWA Geo-Environmental Ltd understands are reliable. All reasonable skill, care and diligence has been applied in examining the information obtained. However, PWA Geo-Environmental Ltd accepts no responsibility for inaccuracies in the data supplied or for opinions based on any such inaccurate data.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

PWA Geo-Environmental Ltd reserves the right to amend their conclusions and recommendations in the light of further information that may become available.

2 INTRODUCTION

2.1 The Commission and Brief

PWA Geo-Environmental Ltd (PWAG) was commissioned by Integra Buildings Ltd to undertake a Phase 2 Geo-Environmental Assessment for a proposed cadet building development located at Mirfield Air Training Corps. The overall objectives were to:

- Investigate ground conditions to confirm the depth and characteristics of possible made ground, natural superficial deposits and underlying bedrock;
- Provide preliminary geotechnical and geo-environmental recommendations for developing the site; and
- Provide recommendations for further work where necessary.

This report presents the factual information collected during this assessment, interpretation of the data obtained and recommendations relevant to the commission and brief. General notes and limitations relevant to all PWA Geo-Environmental Ltd investigations are described in the Foreword. These should be read in conjunction with this report. Should this report not address particular questions relevant to your requirements then this must be brought to our attention in advance of any works commencing so we can determine what additional work is needed.

2.2 The Proposed Development

The development proposal for the site comprises a one-storey modular cadet hut with associated hardstanding and landscaped areas. A site location plan is shown on Drawing No. 230711-015.03 and is included in **Appendix A**. It is assumed that levels will not be significantly different to those existing. Any changes to the proposed layout, site levels and/ or end use will require amendments to this report.

2.3 Geo-Environmental Assessment Methodology

Key aspects of this Phase 2 are summarised as follows:

- Undertake three days cable percussive drilling to undertake in-situ tests to obtain strength data, and collect geotechnical and geoenvironmental samples;
- Assessment of potential contamination;
- Assessment of anticipated ground conditions;
- Assessment of geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations;
- Preparation of a conceptual site model and preliminary risk assessment including recommendations for further investigation, if required.

This review relied on published information and information provided by the client and other parties, including anecdotal information, during the given time. PWAG cannot accept responsibility for the reliability and authenticity of information or reports prepared by third parties.

3 SITE DETAILS

3.1 Site Location and Description

Table 1. Site Location and Description	
Address	2 Huddersfield Rd, Mirfield WF14 9DQ
National Grid Reference	SE 19365 20286
Area	0.2 Hectares
Site Description	The site is approximately 0.2 hectares, is located on the west of Mirfield and can be located by national grid reference SE 19365 20286. The site currently comprises of an area of hardstanding with two single story modular buildings and a shed. There's a steep landscaped banking along the south and eastern of site with building rubble along the base of the southern bank. Numerous large trees run along the north east and west of site. Metal palisade fencing borders the site on all sides with an access gate to Huddersfield Road on the northern side.
Location	

Table 1. Site Location and Description		
	Figure 1. Site location	
Ground Cover	Ground Cover	Estimated percentage
	Buildings and sheds	35%
	Hardstanding	25%
	Gardens and landscaped areas	40%
Known Services	Known services on site include electricity running from the eastern cadet hut to Huddersfield road, and drainage running from the east from that building, marked by three man holes.	
Current Use	Cadet building	
Proposed Use ¹	cadet building	

3.2 Geology

The geology of the site has been obtained from publicly available information, the British Geological Survey (BGS) published geological map covering the site and the BGS GeoIndex Onshore viewer. These indicate that the geology comprises made ground overlying bedrock of Clifton Rock.

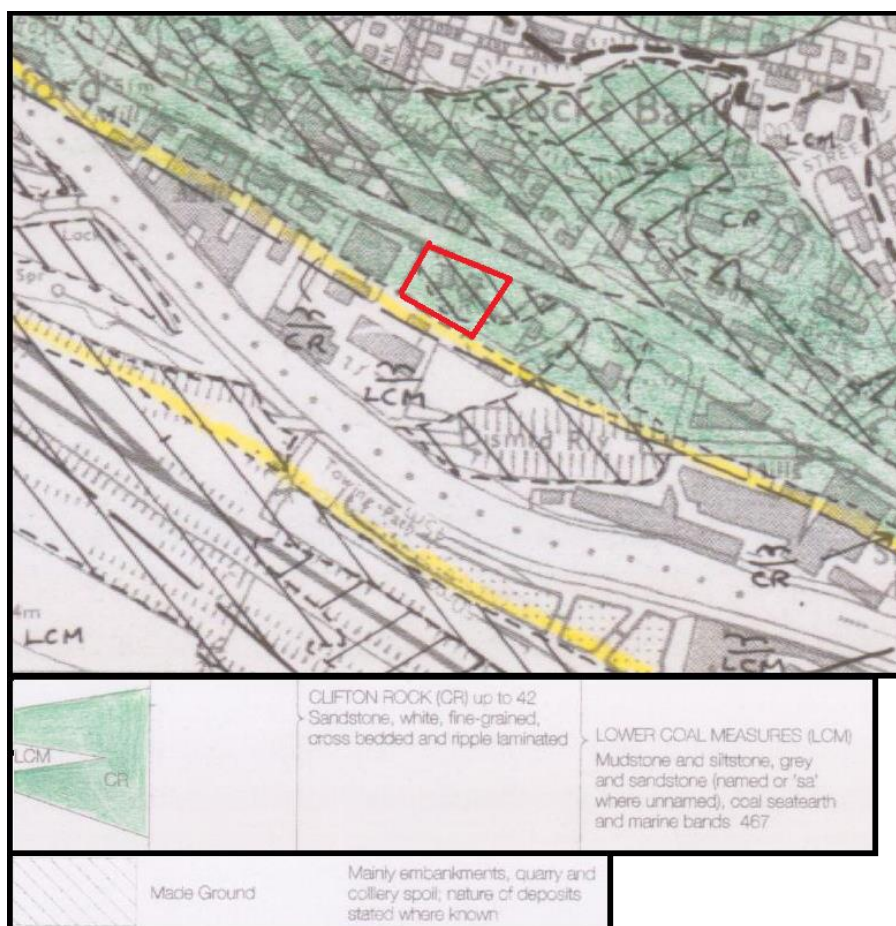


Figure 2: Geological Setting (reproduced from 1:10,000 SE12SE 1999)

1. Different site uses may introduce changes to pollutant linkages that are not considered in this report.

The BGS GeoIndex identifies two borehole records located 250 m north of the site and the historical borehole logs are included in **Appendix E**. These identified 0.3-0.5 m of topsoil over 0.5m of firm silty sandy gravelly CLAY underlain by sandstone bedrock, proven to 1.15m bgl.

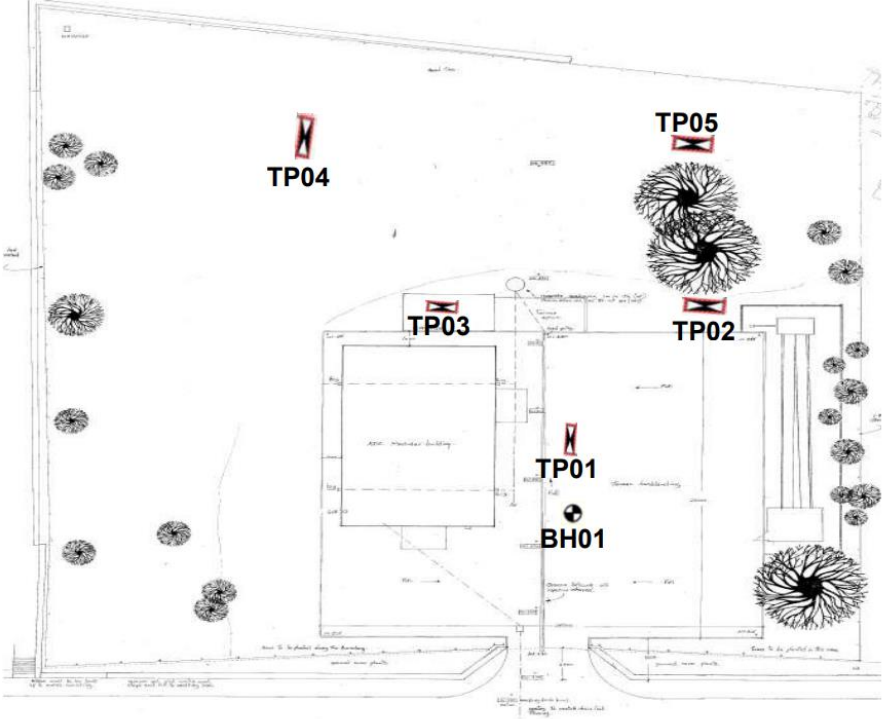
4 PREVIOUS REPORTS

Previous reports include:

- G&M Consulting Ltd (November 2022). Geoenvironmental Appraisal of land at Mirfield Air Training Corps, Huddersfield Road, Mirfield, West Yorkshire.

Key findings of this are summarised below:

Table 2. Summary of Previous Findings	
Site History	The earliest maps show in 1855 the site as an undeveloped. There are a number of residential buildings on the east of site between 1888 - 1977. The site remains empty till a building labelled club appears in 1990, with the second building appearing in 2010.
Published Geology	Area of land fill shown on site with no superficial deposits. Bedrock is the Pennine Lower Coal Measures Formation with the Clifton Rock Within.
Mining and Quarrying	According to the Coal Authority interactive map the site is not positioned within a 'development high risk area'. Inspection of the OS Plans does not indicate evidence of quarrying on site, or in the immediate vicinity.
Hydrogeology	Information provided by the EA indicates that the underlying bedrock (Pennine Lower Coal Measures) is classified as a 'Secondary A'
Hydrology	According to the GroundSure report, the closest identified surface water feature is 111m to the south west and shown as the River Calder. The southern boundary of the site is shown to lie within a Flood Zone 3 area.
Radon	The GroundSure report contains information on Radon Affected Areas as defined by the Health Protection Agency (HPA) and indicates that the site is within an area where less than 1% of properties are affected by Radon.
Scope of Works	Five trial pits were excavated to a maximum depth of 3.90 m bgl and one cable percussive borehole was drilled to 11.45 m bgl. Chemical testing was carried out on nine samples for heavy metals, five for water soluble sulphate and pH, six for phenol, ten samples for speciated PAHs and six for asbestos identification. Geotechnical testing included eight moisture contents, four Atterberg Limits and four water soluble sulphate.
Ground Conditions	Made ground was encountered in all exploratory holes, with proven depths of 1.6-4.3 m bgl and typically consisted of dark brown gravelly clayey fine to coarse SAND with becoming slightly clayey and very gravelly in places, with some cobbles and boulders. The gravel content comprised of brick, concrete, limestone, clinker, slate, and mudstone. Superficial deposits comprised of a soft / firm light brown slightly to very sandy sometimes gravelly CLAY underlain by slightly clayey gravelly SAND and light brown subangular to rounded fine to coarse gravel. Topsoil was not encountered.

Table 2. Summary of Previous Findings	
Exploration Location Plan	
Visual and Olfactory Evidence of Contamination	Probable ACMs were encountered in TP02. No other visual or olfactory evidence of contamination was noted.
Ground Gases	BH1 was installed with gas monitoring equipment, six rounds of monitoring were conducted. The site has been characterized as CS1. Historic ground gas monitoring results are included in Appendix G.
Chemical Testing	When compared to LQM/CIEH and DEFRA C4SL's Generic Assessment Criteria for Human Health Risk Assessment, elevated levels of arsenic, lead and PAH speciates were recorded in samples of the made ground along with asbestos (Chrysotile, amosite, and crocidolite), that was identified in two samples. Ground conditions regarding concrete classification have been calculated at DS-3 in the made ground and DS-1 in the underlying natural soils.
Geotechnical Findings	Made ground was deemed unsuitable for constructing foundations in and was too deep to extend shallow footings through. As such, a piled solution was recommended. An alternate solution of ground improvement was also suggested, utilising a raft foundation on top of the treated made ground.
Recommendations	Recommendations given by G&M are; - Implementation of a clean cover system to deal with the limited contamination identified on site. - Raft foundation solution if the made ground is treated by ground improvement, or a piled foundation solution if not.

5 FIELDWORK

5.1 Scope of Fieldworks

Fieldwork was supervised by PWA Geo-Environmental Ltd and comprised:

Table 3. Scope of Fieldworks			
Start date:		19/12/2023	End date: 21/12/2023
Site Works Summary Fieldwork undertaken in December 2023 comprised two cable percussive boreholes drilled to depths of between 14.50 to 15.60 m bgl.			

Table 3. Scope of Fieldworks			
Technique	Exploratory Holes	Depths	Comments
Cable percussive	CP01-CP02	14.50 – 15.60 m	To characterize shallow ground conditions, undertake in-situ testing to obtain strength data (standard penetration tests (SPTs)), and collect representative samples for laboratory testing. Evaluate potential depth to bedrock. The objective was to determine the suitability of the ground for constructing foundations for the proposed structures.
Hand pits	HP01-HP08	0.1 – 0.2 m	To sample shallow made ground for chemical testing.

Descriptions of strata and groundwater observations made during investigation works, together with samples recovered and the results of all in situ field testing, are presented on the exploratory hole logs in **Appendix B**. Exploratory hole locations are shown on Drawing No 23109-PWAG-00-XX-DR-G-2001-P01 in **Appendix A**.

5.2 Sampling Strategy

The principal objectives were to understand the sub-surface conditions and how they will influence bearing capacity and concrete classification, investigate possible contamination identified in the geoenvironmental appraisal, and provide recommendations for the proposed development. The site investigation was designed to investigate the location of the proposed development and provide general site coverage where access could be gained.

5.3 Geotechnical Laboratory Testing

Geotechnical laboratory testing on selected samples was carried out under subcontract with a UKAS-accredited laboratory. Geotechnical test results are presented in **Appendix C**.

Table 4. Geotechnical Laboratory Testing		
Type of sample	Particle Size Distribution	Water Soluble Sulphate and pH
Superficial deposits	3	3

5.4 Chemical Laboratory Testing

Selected samples of the topsoil and made ground were tested for a range of potential contaminants under subcontract with a UKAS and MCERTS accredited laboratory. Chemical test reports, as received from the laboratory, are presented in **Appendix D**. The testing was designed to supplement the contamination findings discussed in the report by G&M Consulting (November 2022).

Table 5. Chemical Laboratory Testing		
Type of sample	No. of samples	Determinands
Made ground	8	Heavy metals, total petroleum hydrocarbons (TPH), poly aromatic hydrocarbons (PAHs), and asbestos identification

6 GROUND CONDITIONS

6.1 Ground Conditions Encountered

A summary of ground conditions encountered is presented in the Conceptual Ground Model presented as Drawing No. 23109-PWAG-00-XX-G-DR-2002-P01 in **Appendix A**. **Table 6** provides a summary of the strata encountered:

Table 6. Summary of Ground Conditions Encountered		
Summary of Ground Conditions Made ground was encountered in all locations and typically comprised a layer of tarmacadam over sometimes yellowish brown or grey clayey silty sandy GRAVEL, silty sandy gravelly CLAY or clayey silty gravelly SAND with medium to high cobble content and rare brick, coal and or pottery. This was underlain by superficial deposits of mostly yellowish or orangish brown, occasional sandy gravelly CLAY or occasionally clayey sandy GRAVEL with a medium to high cobble content. Grey mudstone bedrock was encountered at 13.50 m bgl in CP02.		
Strata	Depth Encountered (Thickness)	Description and Distribution
Made ground	Ground level (4.30 to 5.30 m)	Made ground was encountered in all locations and was typically comprised of a layer of tarmacadam over sometimes yellowish brown or grey clayey

Table 6. Summary of Ground Conditions Encountered		
		silty sandy GRAVEL, silty sandy gravelly CLAY or clayey silty gravelly SAND with medium to high cobble content and rare brick, coal and or pottery. The Gravel typically constituted of angular to subrounded fine to coarse sandstone and mudstone.
Superficial deposits	4.30 – 5.30 m bgl (9.20 to 10.30 m)	Mostly yellowish or orangish brown, occasional sandy gravelly CLAY or occasionally clayey sandy GRAVEL with a medium to high cobble content. CP01 encountered a yellowish brown, gravelly SAND layer with a high cobble content 6.50 – 8.20 m bgl. Gravel was typically angular to sub-rounded fine to coarse sandstone and mudstone.
Presumed mudstone bedrock	13.50 m (Unknown thickness)	Bedrock was encountered in CP02 at 13.5 m bgl as grey mudstone, recovered as grey angular coarse GRAVEL.

6.2 Stability

No borehole instability was observed during the investigation.

6.3 Obstructions

No obstructions were encountered within superficial strata.

6.4 Visual and Olfactory Evidence of Contamination

There was no visual or olfactory evidence of contamination within any cable percussive or hand pit position.

6.5 Groundwater

Groundwater was encountered in both cable percussive position during this investigation.

Below is a table showing where and at what depth water strikes were encountered during the investigation.

Table 6. Groundwater Observations.		
Location	Depth (bgl)	Comment
CP01	9.60 m	Encountered within gravel.
CP02	9.10 m	Encountered within gravel.

However, water levels are likely to fluctuate with the seasons/rainfall and therefore may be substantially higher at wetter periods of the year, compared to those recorded during this investigation.

6.6 Classification Tests (Particle Size Distribution)

Three particle size distribution (PSD) tests were completed at depths between 6.00 – 10.50 m bgl. The testing has confirmed that the geological logging of the soil at the time of the investigation was generally correct.

The material was classified in accordance with Table 6/1 of the Specification for Highways Works (SHW) Series 600 Earthworks revealing:

Table 7. Material Classification Summary						
Sample & Depth	Description	Cobbles (%)	Gravel (%)	Sand (%)	Silt/Clay (%)	Material Classification
CP01: 9.00 m	Brown sandy clayey GRAVEL	0	72	17	11	Class 1A Well graded granular material
CP01: 10.50 m	Brown sandy slightly silty GRAVEL	0	83	15	2	Class 1A Well graded granular material
CP02: 5.10 m	Brown very sandy very clayey GRAVEL	0	42	28	30	2C Stony cohesive material

6.7 Standard Penetration Tests (SPT) – Fine Grained soils

Three SPTs were undertaken in fine grained soils. At 13.50 m bgl in CP01, and at 5.00 m and 12.00 m bgl in CP02. The corrected N60 value at 13.50 m bgl in CP01 was 143, and was presumed to be weathered bedrock. At CP02 it was 27 at 5.00 m and at 12.00 m it was 55.

The SPT 'N' value within the cohesive material ranged between 27 to 143 blows, the results are indicative of stiff to very stiff deposits, and the results indicate an increase in penetration resistance with depth. Where refusals were observed, engineering judgement was applied regarding whether refusal was due to an obstruction or strength of the material. If the SPT results were considered valid then this was extrapolated using a simple linear extrapolation to determine the estimated N-value per 300 mm.

Indicative undrained shear strengths of cohesive soils can be derived by applying a correlation to SPT 'N' values according to the material's plasticity after Stroud. Based on the average recorded plasticity index of 25% a correlation factor of approximately 5 can be applied. Using Stroud's correlation, the SPT 'N' values indicate undrained shear strengths of:

- $C_u = 137 \text{ kPa @ 5 m bgl in CP02}$
- $C_u = 274 \text{ kPa @ 12 m bgl in CP02}$

These values indicate that the material is high strength.

The result from CP01 has been removed as this is presumed to have encountered weathered bedrock.

6.8 Standard Penetration Tests (SPT) - Coarse Grained Soils

Seven standard penetration tests (SPTs) were undertaken in coarse grained soils, at 1.20 m bgl, and metre intervals following that, until 7.50 m bgl, at which point the intervals became 1.50 m intervals until 12.00 m in CP01, and 10.50 m in CP02. The corrected N60 values range between 14 – 117 blows, with three being >50 blows. The remaining values range between 14 – 27 indicating them to be medium dense gravels. The areas where > 50 blows were needed was believed to have been areas of very dense gravel, that required chiseling.

The SPT results have been used to derive a conservative characteristic friction angle, of 36° .

6.9 Field Determination of California Bearing Ratio

One Dynamic Cone Penetrometer Tests (DCP) were undertaken within the existing car parking area to determine California Bearing Ratio (CBR) values to inform car park design. The testing was undertaken in accordance with Transport Research Laboratory (TRL) methodology. The results of the testing are presented as **Appendix F**.

Before testing began a small area of tarmac was excavated and the DCP was carried out on the underlying soils. The DCP tests showed a CBR value in the top 100-250mm around 40-50% which sharply increased for the next 50mm returning values in the hundreds with a peak of 431%. Below which the CBR stabilized out to an average CBR value of 15-20%. The average overall CBR value was 74.5% with the minimum being 4%.

The peak values likely correlate to the obstruction within the soil, likely a cobble. As such the average CBR given is likely greater than reality. Taking that into consideration, a typical CBR value of 3% is considered suitable for pavement design purposes in the made ground although this must be confirmed by plate load testing.

6.10 Soluble Sulphate and pH

The Aggressive Chemical Environment for Concrete classifications for the soil types identified at the site have been determined in general accordance with BRE Special Digest 1:2005 (SD1). SD1 requires that sites are first identified as being in one of four categories based on natural ground / 'Brownfield' conditions and pyrite content. The site has been categorized as: Brownfield - Non-pyrite with a mobile groundwater regime.

The Water-Soluble Sulphate Values (mg/l SO_4) of natural soils at the site based on the testing carried out varied from 100 to 510 mg/l and the pH value ranged from 7.1 to 8.1. As the characteristic value of sulphate is less than 3,000 mg/l and the characteristic pH is greater than 5.5, the concentrations of magnesium, nitrate and chloride are not considered significant in determining the design sulphate class.

G&M Consulting carried out testing on three samples from the made ground and recorded Water-Soluble Sulphate Values of 41 to 1900 mg/l and pH values of 7.8 to 9.5. Testing was also conducted on two samples of natural soil which returned values of 60 mg/l and 120 mg/l and pH of 7.7 and 8.0.

Given the values the design sulphate class for the made ground is DS-3 and the underlying natural soil is DS-2.

7 RESULTS OF CHEMICAL TESTING

7.1 Assessment Criteria

All laboratory test data were reviewed for completeness and consistency. Those determinants that indicate potential contamination were subject to further evaluation. In this instance the dataset was considered representative of conditions encountered in those samples analysed.

For each potential contaminant of concern, analytical data for soil samples were compared to the relevant Generic Assessment Criteria (GAC) taken from the LQM/CIEH Suitable for Use Levels (S4ULs)². Taking into consideration the proposed land use we have used values derived for a residential with homegrown produce end use. For those potential contaminants of concern where the selected GAC is dependent on Soil Organic Matter (SOM) content we have assumed 1% SOM unless otherwise indicated.

Where there are no applicable generic assessment criteria (GAC) for a given contaminant / parameter, it has been excluded from the table. Where analysis returned a concentration in excess of the GAC, the relevant sample is highlighted orange. In the cases where all the samples tested for a given substance were below the GAC, no further consideration is necessary for that substance.

Usually, statistical analysis of the results is undertaken in accordance with CL:AIRE statistics guidance. The purpose is to determine whether there is enough evidence that the true mean concentration of each determinant is less than the relevant GAC for that substance. On this occasion, statistical analysis has not been carried out due to the small data set.

7.2 Chemical Analysis - Soils

The chemical analysis certificates as received from the laboratory are presented in **Appendix D**. The information is summarised in **Table 8** and the samples analysed have the high total shown.

Table 8. Summary of Soils Analysis.				
Determinand	GAC for residential with homegrown produce	Made Ground (Max)	Made Ground (Min)	Number of exceedances
Arsenic	37	42.3	14.2	1
Cadmium	11	1.8	0.4	0
Chromium	910	119	26.4	0
Copper	2400	93.7	44.2	0
Lead	200	884.8	124.6	4
Mercury, inorganic	40	0.6	<0.5	0
Nickel	180	54.5	22.9	0
Selenium	250	1	<0.5	0
Zinc	3700	796.1	246.5	0
Acenaphthene	210	0.47	<0.11	0
Acenaphthylene	170	0.28	<0.11	0
Anthracene	2400	0.84	0.4	0
Benzo[a]anthracene	7.2	3.31	0.9	0
Benzo[a]pyrene	2.2	3.28	1.02	3
Benzo[b]fluoranthene	2.6	3.86	1.2	3
Benzo[g,h,i]perylene	320	2.01	0.51	0
Benzo[k]fluoranthene	77	1.57	0.64	0
Chrysene	15	2.59	0.94	0
Dibenzo[a,h]anthracene	0.24	0.53	0.16	7
Fluoranthene	280	5.74	2.53	0

2. Nathanail, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathanail, J. F. 2015. The LQM/CIEH <0.11S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.0.5

Table 8. Summary of Soils Analysis.

Determinand	GAC for residential with homegrown produce	Made Ground (Max)	Made Ground (Min)	Number of exceedances
Fluorene	170	0.35	<0.11	0
Indeno[1,2,3-cd]pyrene	27	2.06	0.5	0
Naphthalene	2.3	0.69	0.15	0
Phenanthrene	95	3.38	0.91	0
Pyrene	620	5.05	2.13	0
Total PAH 16	NA	5.05	12.6	0
Asbestos	NA	NAIIS	NAIIS	0

*Note: All units mg/kg unless otherwise stated. GAC = LQM/CIEH S4ULs. NA = Not applicable.

7.2.1 Made Ground

Eight samples were taken from the made ground from depths between 0.10 – 0.20 m bgl. A key objective was to evaluate the contamination findings from the G&M Consulting (November 2022) report. In summary, our findings were similar regarding arsenic, lead and PAHs. However, we did not identify asbestos in any of the samples tested.

Metals and inorganic analytes

One sample (from HP05) exceeded the GAC for arsenic of 37 mg/kg with a value of 42.3 mg/kg. This exceedance was considered quite minor although G&M (November 2022) reported 4 out of 9 samples tested above the GAC with results ranging from 37 to 140 mg/kg.

Four samples (from HP01, HP02, HP03, and HP05) exceeded the GAC for lead of 200 mg/kg with values in exceedance ranging between 252.8 - 884.8 mg/kg. G&M (November 2022) reported 4 out of 9 samples tested above the GAC with results ranging from 200 to 740 mg/kg.

All other samples were found to be below the GAC for metals and inorganic analytes.

Organics

Three samples (from HP03, HP05, and HP08) exceeded the GAC for benzo[a]pyrene of 2.2 mg/kg with values in exceedance ranging between 2.77 - 3.28 mg/kg. G&M (November 2022) reported 2 out of 10 samples tested above the GAC with results ranging from 11 to 20 mg/kg. It should be noted that G&M are using a less stringent GAC of 5 mg/kg.

Three samples (from HP03, HP05, and HP08) exceeded the GAC for benzo[b]fluoranthene of 2.6 mg/kg with values in exceedance ranging between 3.33 - 3.86 mg/kg. G&M (November 2022) reported 4 out of 10 samples tested above the GAC with results ranging from 2.8 to 17 mg/kg.

Seven samples (from HP01, HP02, HP03, HP04, HP05, HP06, and HP08) exceeded the GAC for Dibenzo[a,h]anthracene of 0.24 mg/kg with values in exceedance ranging between 0.26 – 0.47 mg/kg. G&M (November 2022) reported 4 out of 10 samples tested above the GAC with results ranging from 0.49 to 2.9 mg/kg.

While PWAG identified no samples in exceedance of the Benzo[a]anthracene GAC of 7.2 mg/kg, G&M (November 2022) reported 2 out of 10 samples tested above the GAC with results ranging from 10 to 18 mg/kg.

Asbestos

No asbestos was identified in any of the shallow PWAG samples. G&M (November 2022) reported 2 out of 6 samples tested had positive asbestos identification. Loose fibrous debris of amosite was identified in TP2 at 3.00 m bgl and loose fibrous debris of chrysotile, amosite, and crocidolite was identified in TP2 at 1.00 m bgl.

7.2.2 Phytotoxicity

Chemical testing results were compared with phytotoxicity criteria to determine if the soils could be harmful to plant life. The results are summarised in **Table 9**.

Table 9. Summary of Soils Analysis.				
Determinand	Unit	Assessment criteria	Source Reference	Made ground (Max)
Arsenic	mg/kg	250	MAFF 1998	42.3
Chromium	mg/kg	25	ICRCL 70/90 1990	119
Copper	mg/kg	<100	BS3882:2015	93.7
Nickel	mg/kg	<60	BS3882:2015	54.5
Zinc	mg/kg	<200	BS3882:2015	796.1

Based on the above results the soils tested at this site are potentially phytotoxic to plants, however current vegetation on site showed no sign of hardship.

8 RISK ASSESSMENT AND REVISED CONCEPTUAL SITE MODEL

8.1 Introduction

The preliminary conceptual site model given by G&M Consulting (November 2022) has been revised in light of the ground investigation and associated chemical analysis results, updating our understanding of surface and sub-surface features and contaminant sources.

Potential risks associated with asbestos containing materials in the fabric of the building are not considered in this assessment. We assume that these risks are identified on the facility's asbestos register and managed appropriately. At some time in the future, when the buildings require renovation/ demolition, we recommend that a further and more detailed pre-demolition asbestos survey is undertaken. Before renovation/demolition, all asbestos containing material must be removed from site by a suitably qualified contractor and supported by a detailed verification report.

Contaminated materials and their sources identified on site present concern on the condition that a potential impermissible risk exists. The possibility for harm to occur on site requires the fulfilment of three conditions:

- Source: The presence of substances (potential contaminants/pollutants), that may cause harm or pollution.
- Receptor: The existence of an entity that may become harmed from the Source.
- Pathway: A route that the Source takes to reach the Receptor.

Potential sources of contamination considered in the conceptual site model included the made ground. Generally, the potential risks were considered moderate/low. This was on the basis that the contamination is wide spread across the site including the landscaped areas. Given the buildings use as a cadet training hut it is likely that people will come into contact with the contaminated soil.

These findings have been used to update our understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors.

Table 10. Source, Pathway and Receptors		
Potential Sources of Contamination	Potential Transport Pathways and Pollutant Linkages	Potential Receptors
On-site sources Made ground.	• Direct exposure to potentially contaminated soils (direct contact, ingestion and dust inhalation). • Potential leaching of contaminants from made ground and the risk of infiltration into underlying groundwater. • Direct contact with conditions potentially aggressive to building materials and underground services.	Controlled waters
		• Underlying groundwater. • Surface water
		Human Health
		• Current site users. • Future site users. • Construction workers during redevelopment works.
		Construction Materials
		• Future buildings and services. • Underground services.

8.2 Qualitative Risk Assessment and Revised Conceptual Site Model

A qualitative risk assessment is undertaken of potential pollutant linkages following the guidance presented in **Appendix H**, and is based on consideration of both:

- The likelihood of an event (probability – considers both the presence of the hazard and receptor and the integrity of the pathway);
- The severity of the potential consequence (considers both the potential severity of the hazard and the sensitivity of the receptor).

Potential risks related to these plausible linkages are based on redevelopment of the site with a proposed residential end use assuming no mitigation is implemented. These are summarised in **Table 11**.

Table 11. Preliminary Environmental Risk Assessment					
Source	Pathways to Receptor	Receptors	Associated Hazard [Potential severity]	Likelihood / Potential Mitigation	Potential Risk
Made ground	Direct contact, ingestion and dust inhalation	Current site users. Future site users.	Effect on human health [medium]	Low likelihood: Given the sites intended use, there is a chance that the cadets will come into direct contact with the surface material. No asbestos was identified in the surface samples collected. Potential mitigation measures include separating site users from the made ground. This could be achieved through a combination of the hardcover of the development and a clean cover system in landscaped areas.	Moderate/low
		Construction workers.		Unlikely: Any risks can be mitigated by appropriate site management and use of suitable PPE during construction stage.	Low
	Leaching and infiltration	Controlled waters - groundwater	Leaching and infiltration into groundwater [Minor]	Low likelihood: Bedrock is secondary A aquifer and is of medium vulnerability.	Very low
		Controlled waters – surface water	Surface water runoff entering the river Calder. [Minor]	Likely: The site is in close proximity of the river Calder.	Low
	Direct contact	New in ground services and construction materials	Degradation [Mild]	Unlikely: Use of appropriate construction materials, chemical resistant supply pipes and use of oversized service trenches with clean fill can mitigate the risk	Very low

9 ENVIRONMENTAL RISK ASSESSMENT AND RECOMMENDATIONS

9.1 Human Health

G&M Consulting identified elevated levels above the GAC for a residential with plant uptake end land use for lead, arsenic, and speciated PAHs and identified asbestos within the soil. PWAGs following investigation identified elevated levels above the GAC for a residential with home grown vegetables end land use for lead, arsenic, and speciated PAHs. While residential with home grown vegetables end land is quite stringent land use for the site, we consider that a commercial end land use would not have been stringent enough for the end land use case.

Given the depth to the asbestos contamination it is unlikely that end users of the site will come into contact and the metal and organic contamination is not server, it is considered prudent that remediation measures are taken to protect the end user.

Where possible, the ground works on-site should be designed and planned to minimise the exposure of workers to contaminated soil. This should be considered in the Health and Safety plan under the CDM Regulations. Where risks cannot be removed entirely at the planning stage, mitigation measures should include the use of personal protective clothing (PPE) including gloves. Dust suppression measures should also be incorporated into the works to reduce ingestion and inhalation of contaminated dust.

9.2 Plant Life

Whilst there are large mature trees on site, the risk assessment indicates that the natural soils on site are considered potentially harmful to plant life. This should be reviewed by a suitably qualified landscape architect.

9.3 Radon

The site is within an area where no radon protection measures are required. This should be confirmed with local building control.

9.4 New Utilities and Water Supply Pipes

Given the contamination of the site we recommend that the use of barrier water supply pipes (such as Protecta-Line) may be acceptable. In addition, we recommend that the pipes are laid in trenches backfilled with clean granular material. However, we recommend that this is discussed with the water supply company before development starts to ensure they agree.

9.5 Outline Remediation Requirements

The made ground contamination is widespread across the site and as such it is recommended to implement a clean cover system. This should include 450 mm of clean topsoil and subsoil in gardens and landscaped areas, or hardstanding to act as a barrier between the contamination and future end users. Alternatively, the contaminated soil could be removed from site, but due to the extent of the contamination this is likely to be uneconomical.

Potential risks associated with asbestos containing materials in the fabric of the building are not considered in this assessment. We assume that these risks are identified on the facility's asbestos register and managed appropriately. At some time in the future, when the buildings require renovation/ demolition, we recommend that a further and more detailed pre-demolition asbestos survey is undertaken. Before renovation/demolition, all asbestos containing material must be removed from site by a suitably qualified contractor and supported by a detailed verification report.

9.6 Waste Management

The handling, re-use or disposal of waste is regulated by the Environment Agency. Any material excavated on-site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. One of the ways this can be achieved is set out in the Definition of Waste: Development Industry Code of Practice (DoWCoP). This builds on the Environment Agency guidance document Definition of waste: developing greenfield and brownfield sites (2006). The Agency will consider the use of the DoWCoP in deciding whether to regulate materials as waste. If materials are dealt with in accordance with the DoWCoP, the Agency considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development.

Good practice has three basic elements:

- Ensuring that an adequate Materials Management Plan (MMP) is in place, covering the use of materials on a specific site.
- Ensuring that the MMP is based on an appropriate risk assessment, concluding that the objectives of preventing harm to human health and pollution of the environment will be met if materials are used in the proposed manner.
- Ensuring that the requirements of the MMP are met.

All material proposed for off-site disposal (e.g. during future construction works) should be given a proper description and waste classification as required by the Environmental Protection Duty of Care Regulations, and in accordance with WM3 and the Environment Agency Technical Guidance on the assessment and classification of Hazardous Waste. Advice on the classification of wastes containing asbestos is provided in Chapter 3 of Environment Agency document 'Guidance on the classification and assessment of waste Technical Guidance WM3'.

9.7 Reuse of Site Won Material

This project may require the reuse of natural soils on site. Therefore, the contractor may need to prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011). Alternatively, where quantities are small, a suitable exemption may be more appropriate.

The MMP will document how all of the materials to be excavated during the proposed site preparatory earthworks are to be dealt with. The MMP should also detail how materials will be tracked throughout the earthworks in order that the subsequent Verification Report can provide an auditable trail. Finally, the MMP will have to set out a Verification Plan that identifies how the placement of materials is to be recorded and the quantities of material to be used. It will contain a statement on how the use of the materials relate to the remediation or design objectives.

In the event that materials from this site are required to be transferred to other locations, or material is imported for landscaping, the MMP will assist with verification for regulatory authorities.

Once completed, the MMP will need to be reviewed by a Qualified Person (QP), who will sign a Declaration for submission to CL:AIRE and send a copy to the Client.

9.8 Unexpected finding protocol

If unexpected potentially contaminated materials (such as those with an unusual colour, odour or containing drums, chemicals or asbestos, etc) are encountered at any time during redevelopment then work should stop, and a suitably qualified environmental consultant contacted to provide advice on the appropriate course of action. This could be associated with former hydrocarbon storage equipment such as disused steel tanks and dispensing pumps.

10 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

10.1 Proposed Development

This assessment has been prepared on the understanding that the development proposal for the site comprises a one-storey modular cadet hut with associated hardstanding and landscaped areas. A site location plan is shown on Drawing No. 230711-015.03 and is included in **Appendix A**. Finished floor levels have not been provided, therefore we have also assumed that the proposed levels will not be significantly different to those existing. If any of these assumptions are incorrect then the conclusions in this report will require reassessment.

10.2 Geotechnical Categorisation of the Proposed Development

Eurocode 7, Section 2 advocates the use of geotechnical categorisation of the proposed structure(s) to establish the design requirements. Initial categorisation can be made before site investigation and can be used to define the scope and extent of geotechnical investigation required. For the purposes of this investigation, the proposed structures have been classed as Geotechnical Category 2.

10.3 Mining

The possibility of risk from shallow coal mine workings to the proposed development was assessed as **low** and no further assessment is considered necessary.

10.4 Gas Risk

G&M Consulting conducted six rounds of gas monitoring in 2022. Based on the results, a characteristic situation of CS1 was allocated for the site. G&M Consulting's full ground gas monitoring results are included in **Appendix G**.

A review of the complete gas monitoring data indicates a maximum concentration of 0.3% v/v carbon dioxide, non-detect methane, minimum oxygen concentration of 17.4% v/v, and non-detect flow.

A site characteristic gas screening value (GSV) is calculated based on the borehole hazardous gas flow rate – Q_{hg} . This is calculated for methane and carbon dioxide in accordance with BS:8485:2015+A1:2019 based on the measured gas flows, gas concentrations or a limit of detection (taken as 0.1 l/hr for flow and 0.1% for gas concentration), whichever is higher. The derived GSV is used to determine a characteristic gas situation (CS).

The GSV for carbon dioxide was calculated using the maximum steady state flow and maximum steady gas concentrations. A GSV of 0.0003 l/hr was derived that equates to CS1.

The GSV for methane was not calculated as no methane was detected throughout the course of the monitoring.

As such, no special precautions are required in regard to a ground gas risk.

10.5 Site Preparation and Stability of Excavations

Comments relating to the stability of excavations (i.e. trial pits) and groundwater seepages are included in the logs in **Appendix B**.

Based on observations made during fieldwork, shallow (<1.0 m) excavations should not require shoring to maintain stability in the short term. However, for deeper excavations further advice should be sought from the temporary works designer. The following factors should be considered:

- No ground can be relied upon to stand unsupported in all circumstances. Therefore, man entry into any excavation should only be undertaken where a suitable risk assessment has been carried out by a competent person.
- All trenches should be excavated in accordance with CIRIA Report 97 (1983) 'Trenching Practice';
- Trench shoring should be keyed into basal materials beneath the base of the trench. The embedment depth may be significantly deeper than the depth of the excavation being supported; and
- Consideration should be given to the re-use of arisings from foundation trenches / drainage runs etc. Where contamination has been encountered, it may be possible to reuse foundation arisings subject to risk assessment; however, certainty of use and volume should be confirmed in accordance with the requirements of CLAIRE guidance.

In line with BS6031, all excavations should be examined daily by a competent person to ensure that they remain safe. Where the sides cannot be sloped back to a safe angle, as approved by a competent and experienced person, their continued stability should not be taken for granted. Vertical or steep faces should be provided with support unless instructed otherwise by a competent person. No work should take place until the excavation is safe.

Groundwater was encountered below 9.00 m bgl in both exploratory positions. As such, it is envisaged that at shallow depths (<2.00 m) any groundwater seepages should be minor and may be controlled by sump pumping methods. However, at greater depth, significant groundwater ingress may be encountered and if present, a specialist dewatering contractor may be required. Groundwater should be controlled in accordance with CIRIA report 113 Control of Groundwater for Temporary Works.

It should be noted that groundwater levels may vary from those at the time of the investigation, for example in response to seasonal fluctuations.

Presumed bedrock was encountered in the form of mudstone at depth of 13.50 m bgl. Further obstructions, not encountered during the investigation, could be present such as unknown services. Based on observed ground conditions, shallow excavations in superficial deposits should be suitable for standard plant.

10.6 Preliminary Foundation Recommendations

Made ground was encountered in all three boreholes drilled on site and was present to depths of between 4.3 and 5.3 m bgl. As such, shallow foundations have been discounted.

Given the depths to suitable founding strata it would be prudent to consider the use of deep foundations such as piles or ground improvement techniques such as vibro stone columns to support structural loads. Both piling and vibro replacement contractors have their own proprietary methods of installation. Therefore, we recommend that discussions with specialist contractors take place at an early stage in the development. Settlement of superficial deposits and made ground could give risk to negative skin friction on driven piles. Due allowance should be made for down drag forces in the design of piles.

All foundations should be designed by a suitably qualified Structural Engineer.

10.7 Floor Slabs

The unit that is proposed on site is a prefabricated modular unit and therefore will arrive on site with the floor slab already constructed. These floor slabs are suspended.

10.8 Roads and Pavements

If the current tarmacadam is removed from site made ground is expected to be present across the site. Based on DCP results, the made ground is expected to be able to achieve a CBR design value of >3% over much of the site and can be used for preliminary design subject to insitu testing during construction.

Once design levels have been constructed, proof rolling of the formation will be required and any loose or soft spots must be removed and replaced with an engineered fill, in accordance with a suitable specification. Fine grained soils are susceptible to change during inclement weather and the formation level must be protected from deterioration. In addition, good practice shall be followed whereby all slopes are trimmed to falls to shed rain water and the surface sealed to limit infiltration.

Prior to the placement of the founding materials and the construction of the road pavement, the sub-formation and formation will need to be inspected and checked in accordance with a suitable specification, to ensure the ground conditions are as expected. All testing should be carried out in accordance with DMRB IAN 73/06 and confirm that the ground conditions at the time of construction are consistent with the previous design parameters.

Whilst the CBRs estimated above should be achievable, significant deterioration during/after periods of significant rainfall is likely and/or site trafficking. Consequently, it would be prudent to consider flexibility in the groundworks programme to enable highway construction during prolonged dry/warm weather when formation will be least vulnerable to deterioration. Alternatively, a minimum 200 mm thickness of suitable granular fill (ie a "blanket" of 6F2) could be placed along the line of proposed highways to protect formation during the construction phase.

All road designs should be discussed with the relevant local authority if highways are to be subject to a Section 38 agreement.

10.9 Buried Concrete

Based on the samples tested by PWAG and G&M Consulting, and in accordance with BRE Special Digest 1 (2005), a Design Sulphate (DS) Class of DS-3, AC3 within the made ground and DS-2, AC-2 within the natural underlying strata.

RECOMMENDATIONS FOR FUTURE WORKS

It is recommended that:

- copies of this report should be provided to a structural engineer so that appropriate building foundations, floors and structures can be designed;
- all ground investigation information is passed over to a suitable specialist piling contractor to advise on foundation design for the proposed development; and
- a remediation strategy is written for the site to set out how the minor concentrations of contamination should be dealt with.

11 REGULATORY APPROVALS

The conclusions and recommendations presented in this report are considered reasonable based on the information that was available. However, these are not guaranteed to gain approval from regulatory authorities or warranty providers. Therefore, we recommend that copies of this report are passed to the appropriate regulator or warranty provider for review and comment before undertaking any additional work.

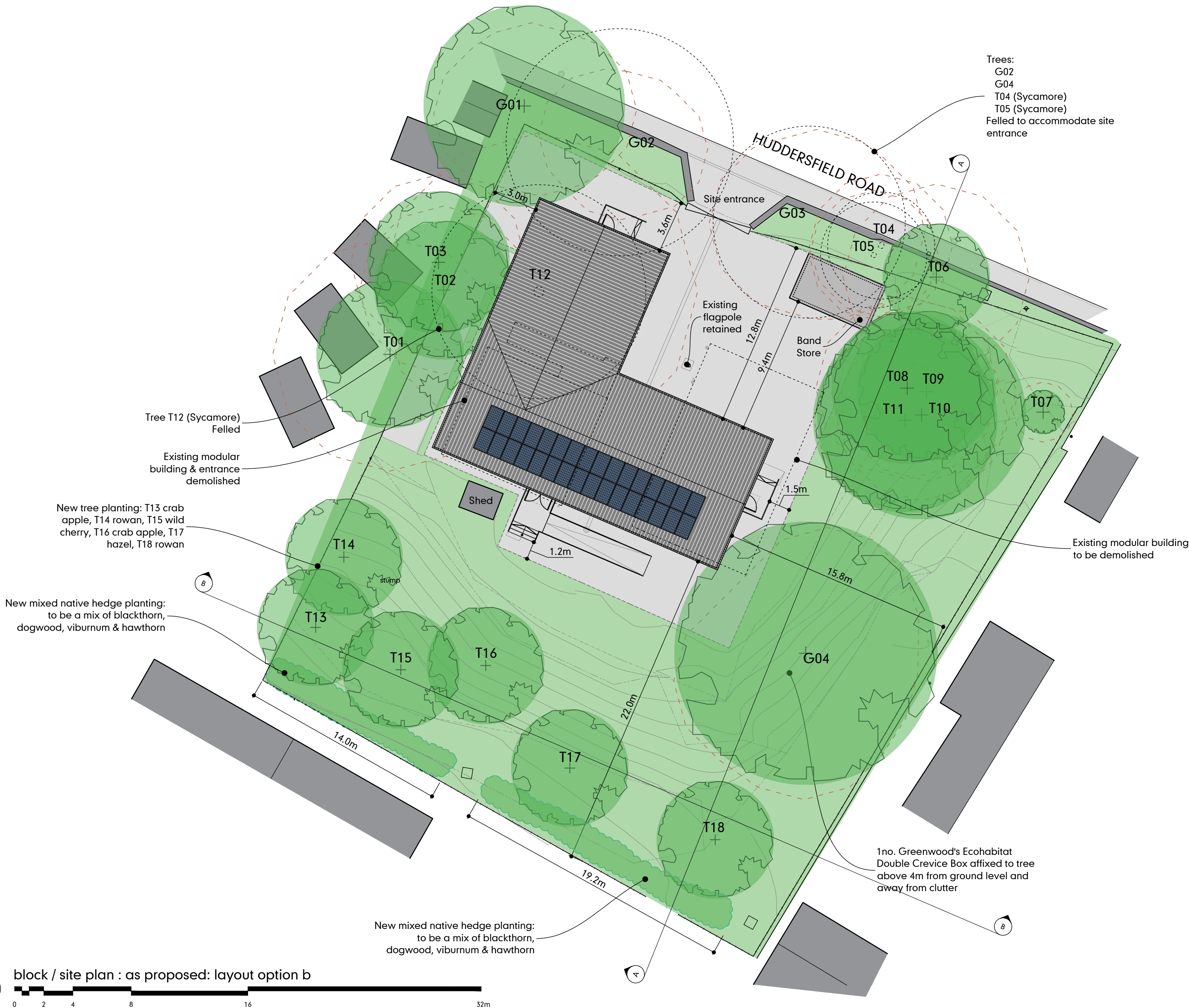
Appendix A

Drawings

notes

Do not scale from this drawing — use stated levels and dimensions only.

If in doubt, contact Williams Architects Ltd.



.03	Northern steps reversed, additional planting information, site section lines added.	11dec23
.02	Stairs and ramps amended to new dimensions.	29nov23
ver	notes	date



williamsarchitects

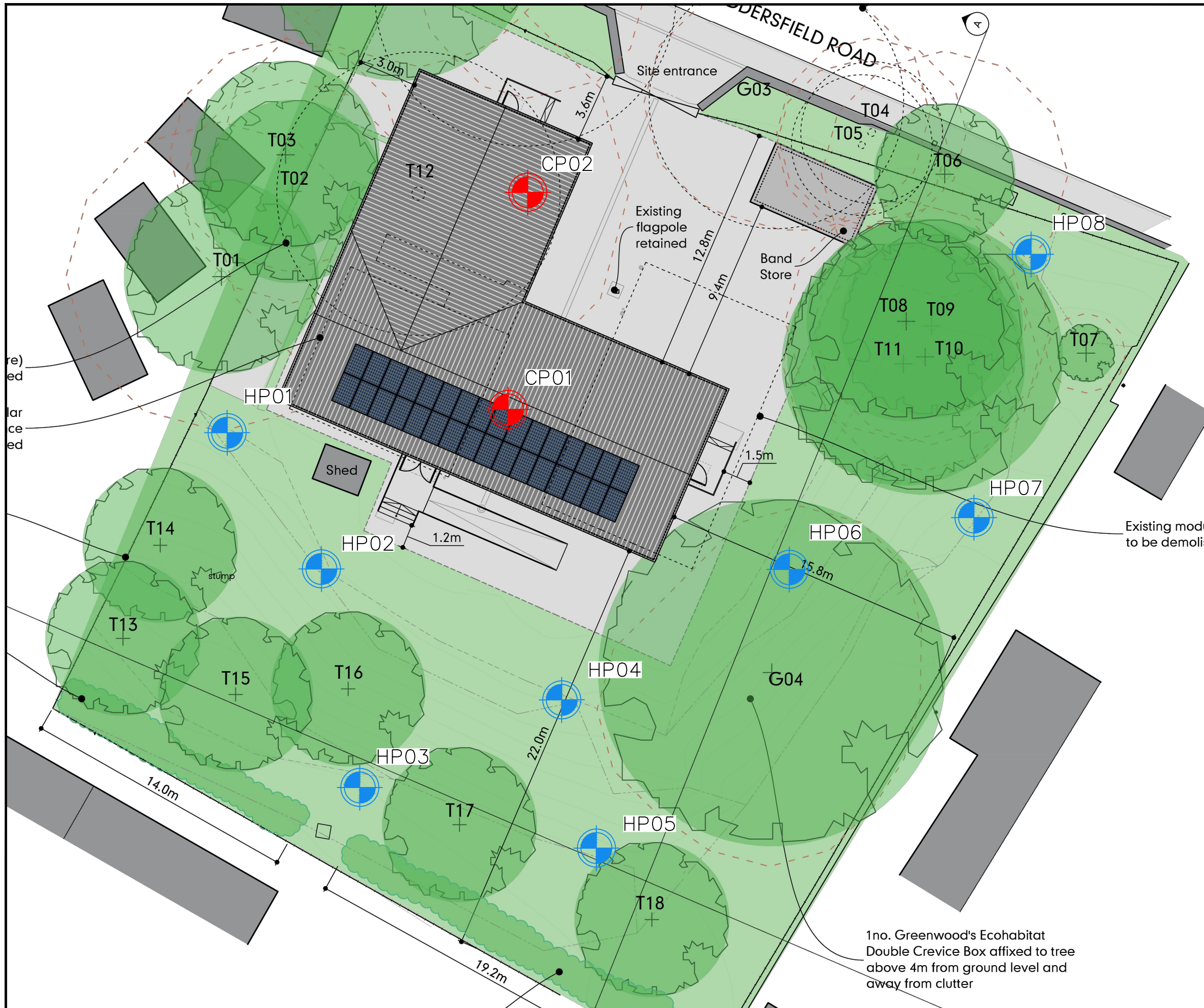
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client	Integra Buildings Ltd	created	01nov23
project	CRFCA Mirfield	job N°	230711
title	site : layout : proposed	scale	1:200 @ A2



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KEY:

-  CABLE PERCUSSIVE BORE HOLE
-  HAND PIT

Rev	Date	Remarks	Drawn	Chk'd
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Client				
INTEGRA BUILDINGS LTD				
Project				
MIRFIELD AIR TRAINING CORPS				
Title				
EXPLORATORY HOLE PLAN				
Size	Scale	Designed	Checked	Date
A3	NTS	CK	TW	MAR 24
Drawing Status				
PRELIMINARY				
Job Number	Originator	Zone	Level	Type
23109 - PWA - 00 - XX - DR - G - 2001				
Rev	Role	Drawing No.		
P01				

Appendix B

Exploratory Hole Logs

BOREHOLE LOG

Project Name:	Mirfield Air Cadets	Project Number: 23109	Elevation:	Hole Type: CP
Project Location:	2 Huddersfield Rd, Mirfield WF14 9DQ	Coordinates: E419364, N420281		Scale: 1:50
Client Name:	Integra Buildings Ltd	Dates: 19/12/2023 - 20/12/2023		Logged By: AE

Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results				
					0.12		Tarmacadam. MADE GROUND	
		0.60	B		0.49		Light grayish yellow slightly sandy gravelly angular to sub angular COBBLES of sandstone. Gravel is angular to sub rounded fine to coarse sandstone.	1
		0.60	ES				MADE GROUND	
		1.20	SPT(C)	N=4 (1,1/1,1,1,1)			Dark greyish brown silty gravelly CLAY with rare brick and medium cobble of angular to rounded coarse sandstone and mudstone. Gravel is angular to rounded fine to coarse sandstone and mudstone.	2
		2.00	SPT(C)	N=7 (2,1/2,2,3,0)	2.40		MADE GROUND	
		3.00	SPT(C)	N=4 (1,1/1,1,1,1)			Greyish brown gravelly medium to coarse SAND with rare brick and medium cobble content of angular to rounded fine to coarse sandstone and mudstone. Gravel is angular to sub rounded fine to coarse sandstone and mudstone.	3
		4.00	SPT(C)	N=4 (1,0/1,1,1,1)	4.10		MADE GROUND	4
		5.00	SPT(C)	N=10 (2,2/3,2,2,3)	5.00		Very dark greyish brown clayey sandy gravelly SILT with rare brick. Gravel is angular to sub angular fine to coarse sandstone and slate.	5
		5.40	D		5.30		MADE GROUND <i>Anthropogenic material (fabric) encountered.</i>	
		6.00	U				Orangish brown with dark brown mottling slightly silty slightly sandy gravelly CLAY with rare brick glass and coal. Gravel is angular to sub rounded fine to coarse mudstone and sandstone.	6
		6.30	D		6.50		MADE GROUND	
		6.50	B				Firm orangish brown slightly silty gravelly CLAY. Gravel is angular to rounded fine to coarse mudstone and sandstone.	7
		7.30	D		7.30		Yellowish brown gravelly fine to coarse SAND with high cobble content. Gravel is angular to round fine to coarse sandstone and mudstone.	8
		7.50	SPT(S)	N=69 (7,12/15,16,19,19)			Yellowish brown gravelly fine to coarse SAND with high cobble content. Gravel is angular to round fine to coarse sandstone and mudstone.	9
		7.50	D				Yellowish brown sandy angular to rounded fine to coarse GRAVEL of sandstone and mudstone with high cobble content.	
		8.20	B		8.20		Gravel content increases with depth.	
		9.00	SPT(C)	N=17 (2,3/4,4,5,4)				
		9.00	B					
								10

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 15.6m bgl.
Groundwater was encountered at 9.6m depth.
Upon completion cable percussion hole was backfilled with arisings.

ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test

Approved by: TW



Project Name:	Mirfield Air Cadets	Project Number: 23109	Elevation:	Hole Type: CP
Project Location:	2 Huddersfield Rd, Mirfield WF14 9DQ	Coordinates: E419364, N420281		Scale: 1:50
Client Name:	Integra Buildings Ltd	Dates: 19/12/2023 - 20/12/2023		Logged By: AE

Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results				
		10.50 10.50	SPT(C) B	N=90 (14,11/20,50,20,0)			Yellowish brown sandy angular to rounded fine to coarse GRAVEL of sandstone and mudstone with high cobble content.	11
		12.00 12.00	SPT(C) B	N=98 (15,10/20,41,9,28)				12
		13.00 13.00	SPT(S) D	N=14 (2,3/4,3,4,3)	13.30			13
		13.50 13.50 14.00	SPT(C) D B	N=120 (17,8/50,50,20,0)			Stiff dark yellowish brown slightly silty gravelly CLAY with medium Cobble content. Gravel is angular to sub rounded fine to coarse sandstone and mudstone.	14
		14.80 15.00 15.00	B SPT(S) D	N=84 (50,14/14,50,20,0)	14.80			15
					15.60			16
								17
								18
								19
								20

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 15.6m bgl.
Groundwater was encountered at 9.6m depth.
Upon completion cable percussion hole was backfilled with arisings.

ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test

Approved by: TW

BOREHOLE LOG

Project Name:		Mirfield Air Cadets				Project Number: 23109		Elevation:		Hole Type: CP	
Project Location:		2 Huddersfield Rd, Mirfield WF14 9DQ				Coordinates: E419363, N420297				Scale: 1:50	
Client Name:		Integra Buildings Ltd				Dates: 20/12/2023 - 21/12/2023				Logged By: AE	
Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description			Scale	
		Depth (m)	Type	Results							
					0.12		Tarmacadam.				
		0.40	B		0.46		MADE GROUND				
		0.65	D		0.90		Light yellowish brown slightly silty sandy gravelly CLAY with high cobble content rare brick and pottery. Gravel is angular to sub rounded fine to coarse mudstone and sandstone.			1	
		1.20	SPT(C)	N=4 (1,1/1,1,1,1)	1.70		MADE GROUND				
		2.00	SPT(C)	N=4 (1,1/1,1,1,1)	2.80		Light yellowish brown with cream mottling slightly clayey silty sandy GRAVEL with high cobble content rare brick and coal. Gravel is angular to sub rounded fine to coarse mudstone and sandstone.			2	
		3.00	SPT(C)	N=4 (1,1/1,1,1,1)	3.00		MADE GROUND				
		3.00	D		4.00		Dark yellowish brown slightly silty sandy gravelly CLAY with high cobble content and rare brick. Gravel is angular to sub rounded fine to coarse mudstone and sandstone.			3	
		4.00	SPT(C)	N=8 (1,1/1,2,2,3)	4.30		MADE GROUND				
		4.50	D		4.80		Yellowish brown slightly silty sandy gravelly CLAY with medium cobble content and rare brick. Gravel is angular fine to coarse sandstone and mudstone.			4	
		5.00	SPT(S)	N=27 (4,5/6,6,7,8)	5.00		MADE GROUND				
		5.00	B		5.10		Orangish brown slightly sandy gravelly CLAY with high cobble content and rare brick. Gravel is angular to sub rounded fine to coarse sandstone and mudstone.			5	
		5.10	B		6.00		MADE GROUND				
		6.00	U		6.70		<i>Gravel and cobble content increase with depth.</i> Firm dark orangish brown slightly silty sandy gravelly CLAY with high cobble content. Gravel is angular to rounded fine to coarse mudstone and sandstone			6	
		7.50	SPT(C)	N=19 (3,3/4,4,5,6)	7.50		Firm Light brown sandy gravelly CLAY with medium cobble content. Gravel is angular to rounded fine to coarse sandstone and mudstone.			7	
		7.50	B		7.50		Brown slightly clayey sandy angular to sub rounded medium to coarse GRAVEL of sandstone and mudstone with medium cobble content.			8	
		7.50	B		9.00						
		9.00	SPT(C)	N=12 (7,8/2,3,4,3)	9.00					9	
		9.00	B		10.00						
					10.00					10	

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 14.5m bgl.
Groundwater was encountered at 9.1m depth.
Upon completion the cable percussion hole was backfilled with arisings.

ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test

Approved by: TW



Project Name:	Mirfield Air Cadets	Project Number: 23109	Elevation:	Hole Type: CP
Project Location:	2 Huddersfield Rd, Mirfield WF14 9DQ	Coordinates: E419363, N420297		Scale: 1:50
Client Name:	Integra Buildings Ltd	Dates: 20/12/2023 - 21/12/2023		Logged By: AE

Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results				
		10.50 10.50	SPT(C) B	N=23 (4,4/5,5,6,7)			Brown sandy angular to round fine to coarse GRAVEL sandstone and mudstone with medium cobble content.	11
		11.50	B					
		12.00 12.00 12.00 12.50	SPT(S) B D B	N=46 (7,8/10,11,12,13)	12.00 12.40		Stiff dark brown slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to medium sandstone and mudstone.	12
							Brown sandy angular to rounded fine to coarse GRAVEL of sandstone and mudstone with medium cobble content.	13
		13.50 13.50 14.00	SPT(S) D B	N=100 (11,14/50,30,20,0)	13.50 14.50		Presumed bedrock recovered as angular coarse GRAVEL of mudstone. MUDSTONE	14
								15
								16
								17
								18
								19
								20

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 14.5m bgl.
Groundwater was encountered at 9.1m depth.
Upon completion the cable percussion hole was backfilled with arisings.

ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test

Approved by: TW

BOREHOLE LOG

Project Name:		Mirfield Air Cadets				Project Number: 23109		Elevation:		Hole Type: CP	
Project Location:		2 Huddersfield Rd, Mirfield WF14 9DQ				Coordinates: E419364, N420281				Scale: 1:50	
Client Name:		Integra Buildings Ltd				Dates: 19/12/2023 - 20/12/2023				Logged By: AE	
Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description			Scale	
		Depth (m)	Type	Results							
					0.12		Tarmacadam. MADE GROUND			1 	

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 15.6m bgl on presumed bedrock.
Groundwater was encountered at 9.6m depth.
Upon completion cable percussion hole was backfilled with arisings.

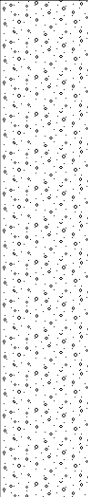
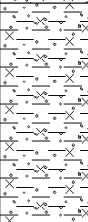
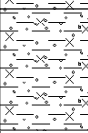
Key:
ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test



PWA Geo-environmental
Summit House,
Riparian Way
BD20 7BW

BOREHOLE LOG

Borehole ID:
CP01
Sheet 2 of 2

Project Name:		Mirfield Air Cadets				Project Number: 23109		Elevation:		Hole Type: CP	
Project Location:		2 Huddersfield Rd, Mirfield WF14 9DQ				Coordinates: E419364, N420281				Scale: 1:50	
Client Name:		Integra Buildings Ltd				Dates: 19/12/2023 - 20/12/2023				Logged By: AE	
Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description	Scale			
		Depth (m)	Type	Results							
		10.50 10.50	SPT(C) B	N=90 (14,11/20,50,20,0)	13.30		Medium dense becoming very dense yellowish brown sandy angular to rounded fine to coarse GRAVEL of sandstone and mudstone with high cobble content.	11			
		12.00 12.00	SPT(C) B	N=98 (15,10/20,41,9,28)				12			
		13.00 13.00	SPT(S) D	N=14 (2,3/4,3,4,3)				13			
		13.50 13.50 14.00	SPT(C) D B	N=120 (17,8/50,50,20,0)			Stiff dark yellowish brown slightly silty gravelly CLAY with medium cobble content. Gravel is angular to sub rounded fine to coarse sandstone and mudstone.	14			
		14.80 15.00 15.00	B SPT(S) D	N=84 (50,14/14,50,20,0)					Firm yellowish grey silty gravelly CLAY with low cobble content. Gravel is angular to sub rounded fine to coarse mudstone.	15	
							15.60			16	
									17		
									18		
									19		
									20		

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 15.6m bgl on presumed bedrock.
Groundwater was encountered at 9.6m depth.
Upon completion cable percussion hole was backfilled with arisings.

Key:
ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test

BOREHOLE LOG

Project Name:		Mirfield Air Cadets				Project Number: 23109		Elevation:		Hole Type: CP	
Project Location:		2 Huddersfield Rd, Mirfield WF14 9DQ				Coordinates: E419363, N420297				Scale: 1:50	
Client Name:		Integra Buildings Ltd				Dates: 20/12/2023 - 21/12/2023				Logged By: AE	
Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description	Scale			
		Depth (m)	Type	Results							
					0.12		Tarmacadam. MADE GROUND				
		0.40	B		0.46		Light yellowish brown slightly silty sandy gravelly CLAY with rare brick and pottery and high cobble content. Gravel is angular to sub rounded fine to coarse mudstone and sandstone. MADE GROUND	1			
		0.65	D		0.90						
		1.20	SPT(C)	N=4 (1,1/1,1,1,1)	1.70						
		2.00	SPT(C)	N=4 (1,1/1,1,1,1)	2.80		Light yellowish brown with cream mottling slightly clayey silty sandy GRAVEL with rare brick and coal and high cobble content. Gravel is angular to sub rounded fine to coarse mudstone and sandstone. MADE GROUND	2			
		3.00	SPT(C)	N=4 (1,1/1,1,1,1)	3.00						
		3.00	D		4.00						
		4.00	SPT(C)	N=8 (1,1/1,2,2,3)	4.30		Dark yellowish brown slightly silty sandy gravelly CLAY with rare brick and high cobble content. Gravel is angular to sub rounded fine to coarse mudstone and sandstone. MADE GROUND	3			
		4.50	D		4.80						
		5.00	SPT(S)	N=27 (4,5/6,6,7,8)	5.00						
		5.00	B		5.10		Yellowish brown slightly silty sandy gravelly CLAY with rare brick and medium cobble content. Gravel is angular fine to coarse sandstone and mudstone. MADE GROUND	4			
		5.10	B		6.00						
		6.00	U		6.70						
					6.70		Orangish brown slightly sandy gravelly CLAY with rare brick and high cobble content. Gravel is angular to sub rounded fine to coarse sandstone and mudstone. MADE GROUND	5			
							Firm dark orangish brown slightly silty sandy gravelly CLAY with high cobble content. Gravel is angular to rounded fine to coarse mudstone and sandstone MADE GROUND	6			
							Firm light brown sandy gravelly CLAY with medium cobble content. Gravel is angular to rounded fine to coarse sandstone and mudstone. MADE GROUND	7			
							Medium dense brown slightly clayey sandy angular to sub rounded medium to coarse GRAVEL of sandstone and mudstone with medium cobble content. MADE GROUND	8			
								9			
								10			

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 14.5m bgl on bedrock.
Groundwater was encountered at 9.1m depth.
Upon completion the cable percussion hole was backfilled with arisings.

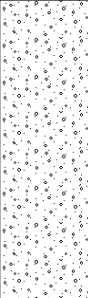
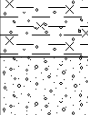
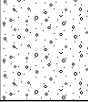
Key:
ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test



PWA Geo-environmental
Summit House,
Riparian Way
BD20 7BW

BOREHOLE LOG

Borehole ID:
CP02
Sheet 2 of 2

Project Name:		Mirfield Air Cadets				Project Number: 23109		Elevation:		Hole Type: CP	
Project Location:		2 Huddersfield Rd, Mirfield WF14 9DQ				Coordinates: E419363, N420297				Scale: 1:50	
Client Name:		Integra Buildings Ltd				Dates: 20/12/2023 - 21/12/2023				Logged By: AE	
Install.	Water Strike	Samples and In Situ Tests			Depth (m)	Legend	Stratum Description	Scale			
		Depth (m)	Type	Results							
		10.50 10.50	SPT(C) B	N=23 (4,4/5,5,6,7)			Dense brown sandy angular to rounded fine to coarse GRAVEL sandstone and mudstone with medium cobble content.	11			
		11.50	B								
		12.00 12.00 12.00 12.50	SPT(S) B D B	N=46 (7,8/10,11,12,13)	12.00 12.40		Stiff dark brown slightly gravelly CLAY with low cobble content. Gravel is angular to rounded fine to medium sandstone and mudstone.	12			
		13.50 13.50 14.00	SPT(S) D B	N=100 (11,14/50,30,20,0)	13.50 14.50		Very dense brown sandy angular to rounded fine to coarse GRAVEL of sandstone and mudstone with medium cobble content.	13			
							Presumed bedrock recovered as angular coarse GRAVEL of mudstone. MUDSTONE	14			
								15			
								16			
								17			
								18			
								19			
								20			

Remarks: No olfactory evidence of contamination.
Cable Percussion was refused at 14.5m bgl on bedrock.
Groundwater was encountered at 9.1m depth.
Upon completion the cable percussion hole was backfilled with arisings.

Key:
ES - Environmental sample
B - Bulk sample
D - Disturbed sample
SPT - Std. Penetration Test

Appendix C

Geotechnical Laboratory Results

Test Amendment Notice

Date:	18.01.24
PSL Contract Reference:	0062
Contract Title:	MILFILL ATC
Engineer/Client Details:	E PWA GEO - ENVIRONMENTAL
Sample Details:	QUT - CPO2 @ 6.0 collapsed open extraction CPO1 @ 6.0 insufficient intact material
Testing required:	QUT

Details of Unsuitability

The above sample cannot be performed due to the following reasons:

- 1 The Sample has not been received
- 2 There is insufficient material for the required testing:
- Sample Mass received (g)
- Sample Mass required (g)
- 3 The sample has been previously tested
- 4 The sample has been misplaced in the laboratory
- 5 The sample is unsuitable for testing because:
-
-

Please advise action required:

- | | | |
|---|---|-------|
| 1 | Perform the testing on the following sample | |
| 2 | Combine samples has follows for testing: | |
| 3 | Perform the following alternative testing: | |
| 4 | Perform a non standard test: | |
| 5 | Take no further action | |
| 6 | Undertake the following instructions: | |
| | | |
| | | |

Signed
(Project Engineer)

Date



Appendix D

Geochemical Testing Results

Certificate of Analysis

Client: PWA Geo-Environmental

Project: 23122705

Quote: BEC230228988 V2.1

Project Ref: 23109

Site: Mirfield ATC

Contact: Theo Wood

Address: Summit House
Riparian Way, The Crossings Cross Hills
Keighley
West Yorkshire
BD20 7BW

E-Mail:

Phone:

No. Samples Received: 8

Date Received: 23/12/2023

Analysis Date: 10/01/2024

Date Issued: 10/01/2024

Report Type: Final Version 01

This report supersedes any versions previously issued by the laboratory

Reported by Customer Service Co-Ordinator
Julie Dickinson
01283 554496



Client: PWA Geo-Environmental
Project Name: 23109-Mirfield ATC
Project No: 23122705
Date Issued: 10/01/2024

Samples Analysed

<u>Text ID</u>	<u>Sample Reference</u>	<u>Sampling Date</u>	<u>Sample Type</u>	<u>Sample Description</u>
23122705-001	HP01-7-ES-0.10	21/12/2023 00:00:00	SOLID	Soil Sample
23122705-002	HP02-6-ES-0.20	20/12/2023 00:00:00	SOLID	Soil Sample
23122705-003	HP03-8-ES-0.20	20/12/2023 00:00:00	SOLID	Soil Sample
23122705-004	HP04-4-ES-0.10	19/12/2023 00:00:00	SOLID	Soil Sample
23122705-005	HP05-5-ES-0.15	20/12/2023 00:00:00	SOLID	Soil Sample
23122705-006	HP06-3-ES-0.10	19/12/2023 00:00:00	SOLID	Soil Sample
23122705-007	HP07-2-ES-0.10	19/12/2023 00:00:00	SOLID	Soil Sample
23122705-008	HP08-1-ES-0.10	19/12/2023 00:00:00	SOLID	Soil Sample



Client: PWA Geo-Environmental
Project Name: 23109-Mirfield ATC
Project No: 23122705
Date Issued: 10/01/2024



Analysis Results

Analysis	Method Code	MDL	Units	Accred.	Sample ID	001	002	003	004	005	006	007
					Customer ID	HP01-7-ES-0.10	HP02-6-ES-0.20	HP03-8-ES-0.20	HP04-4-ES-0.10	HP05-5-ES-0.15	HP06-3-ES-0.10	HP07-2-ES-0.10
					Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
					Sampling Date	21/12/2023	20/12/2023	20/12/2023	19/12/2023	20/12/2023	19/12/2023	19/12/2023
Arsenic as As	ICPMSS	0.3	mg/kg^	UM		14.2	26.2	36.7	26.0	42.3	25.3	18.9
Cadmium as Cd	ICPMSS	0.2	mg/kg^	UM		0.9	0.8	0.8	0.6	1.1	1.8	0.4
Copper as Cu	ICPMSS	1.6	mg/kg^	UM		50.2	75.7	91.4	58.0	93.7	86.4	46.4
Lead as Pb	ICPMSS	0.7	mg/kg^	UM		884.8	271.7	252.8	168.5	533.9	124.6	150.9
Mercury as Hg	ICPMSS	0.5	mg/kg^	UM		<0.5	<0.5	<0.5	<0.5	0.6	0.5	<0.5
Nickel as Ni	ICPMSS	2	mg/kg^	UM		22.9	30.4	29.0	32.4	54.5	35.5	33.7
Selenium as Se	ICPMSS	0.5	mg/kg^	UM		<0.5	<0.5	<0.5	<0.5	1.0	<0.5	<0.5
Total Chromium as Cr	ICPMSS	1.2	mg/kg^	UM		33.9	48.2	42.9	30.6	66.1	119.4	27.8
Zinc as Zn	ICPMSS	16	mg/kg^	UM		796.1	442.7	596.9	246.5	659.3	532.2	303.8
Acenaphthene	PAHMSUS	0.08	mg/kg^	UM		<0.13	0.11	0.11	<0.11	0.20	0.19	0.13
Acenaphthylene	PAHMSUS	0.08	mg/kg^	U		<0.13	0.11	0.11	<0.11	0.18	0.20	0.12
Anthracene	PAHMSUS	0.08	mg/kg^	U		0.48	0.64	0.69	0.40	0.72	0.60	0.42
Benzo[a]anthracene	PAHMSUS	0.08	mg/kg^	UM		1.44	1.69	2.17	1.20	2.45	1.44	0.90
Benzo[a]pyrene	PAHMSUS	0.08	mg/kg^	UM		1.86	2.04	2.99	1.58	2.77	1.97	1.02
Benzo[b]fluoranthene	PAHMSUS	0.08	mg/kg^	UM		2.26	2.49	3.76	1.83	3.33	2.30	1.20
Benzo[g,h,i]perylene	PAHMSUS	0.08	mg/kg^	UM		1.15	1.12	2.01	0.89	1.52	1.18	0.51
Benzo[k]fluoranthene	PAHMSUS	0.08	mg/kg^	UM		1.03	1.15	1.52	0.95	1.57	1.10	0.64
Chrysene	PAHMSUS	0.08	mg/kg^	UM		1.43	1.63	2.13	1.25	2.41	1.50	0.94
Dibenzo[a,h]anthracene	PAHMSUS	0.08	mg/kg^	UM		0.31	0.35	0.53	0.26	0.45	0.33	0.16

Client: PWA Geo-Environmental
Project Name: 23109-Mirfield ATC
Project No: 23122705
Date Issued: 10/01/2024



Analysis Results

					Sample ID
					008
					Customer ID
					HP08-1-ES-0.10
					Sample Type
					SOLID
					Sampling Date
					19/12/2023
Analysis	Method Code	MDL	Units	Accred.	
Arsenic as As	ICPMSS	0.3	mg/kg^	UM	18.0
Cadmium as Cd	ICPMSS	0.2	mg/kg^	UM	0.4
Copper as Cu	ICPMSS	1.6	mg/kg^	UM	44.2
Lead as Pb	ICPMSS	0.7	mg/kg^	UM	142.3
Mercury as Hg	ICPMSS	0.5	mg/kg^	UM	<0.5
Nickel as Ni	ICPMSS	2	mg/kg^	UM	32.1
Selenium as Se	ICPMSS	0.5	mg/kg^	UM	<0.5
Total Chromium as Cr	ICPMSS	1.2	mg/kg^	UM	26.4
Zinc as Zn	ICPMSS	16	mg/kg^	UM	287.4
Acenaphthene	PAHMSUS	0.08	mg/kg^	UM	0.47
Acenaphthylene	PAHMSUS	0.08	mg/kg^	U	0.28
Anthracene	PAHMSUS	0.08	mg/kg^	U	0.84
Benzo[a]anthracene	PAHMSUS	0.08	mg/kg^	UM	3.31* _B
Benzo[a]pyrene	PAHMSUS	0.08	mg/kg^	UM	3.28
Benzo[b]fluoranthene	PAHMSUS	0.08	mg/kg^	UM	3.86
Benzo[g,h,i]perylene	PAHMSUS	0.08	mg/kg^	UM	1.96
Benzo[k]fluoranthene	PAHMSUS	0.08	mg/kg^	UM	1.37
Chrysene	PAHMSUS	0.08	mg/kg^	UM	2.59
Dibenzo[a,h]anthracene	PAHMSUS	0.08	mg/kg^	UM	0.47

Analysis Results

Analysis	Method Code	MDL	Units	Accred.	Sample ID	001	002	003	004	005	006	007
					Customer ID	HP01-7-ES-0.10	HP02-6-ES-0.20	HP03-8-ES-0.20	HP04-4-ES-0.10	HP05-5-ES-0.15	HP06-3-ES-0.10	HP07-2-ES-0.10
					Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
					Sampling Date	21/12/2023	20/12/2023	20/12/2023	19/12/2023	20/12/2023	19/12/2023	19/12/2023
Fluoranthene	PAHMSUS	0.08	mg/kg^	UM		3.71	4.21	5.07	3.13	5.74	3.76	2.53
Fluorene	PAHMSUS	0.08	mg/kg^	UM		<0.13	0.14	0.12	<0.11	0.15	0.17	0.12
Indeno[1,2,3-cd]pyrene	PAHMSUS	0.08	mg/kg^	UM		1.11	1.15	1.69	0.89	1.48	1.12	0.50
Naphthalene	PAHMSUS	0.08	mg/kg^	UM		0.17	0.17	0.21	0.15	0.32	0.30	0.16
Phenanthrene	PAHMSUS	0.08	mg/kg^	UM		1.08	1.50	1.53	0.91	1.78	1.49	1.08
Pyrene	PAHMSUS	0.08	mg/kg^	UM		3.27	3.60	4.46	2.80	5.05	3.22	2.13
Total PAH 16	PAHMSUS	1.28	mg/kg^	U		19.7	22.1	29.1	16.6	30.1	20.9	12.6
Total Moisture at 35°C	CLANDPREP	0.1	%	N		35.9	23.3	26.1	26.7	27.1	33.8	30.5
Colour of Material	CLANDPREP		-	N		Black	Brown	Black	Brown	Brown	Brown	Brown
Major Constituents	CLANDPREP		-	N		SILT	SILT	SILT	SILT	SILT	SILT	SILT
Minor Constituents	CLANDPREP		-	N		Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
Miscellaneous Constituents	CLANDPREP		-	N		Organic Matter	Organic Matter	Wood	Organic Matter	Organic Matter	Organic Matter	Organic Matter
Asbestos Identification	SUB020		-	N		NAIIS	NAIIS	NAIIS	NAIIS	NAIIS	NAIIS	NAIIS

Client: PWA Geo-Environmental
 Project Name: 23109-Mirfield ATC
 Project No: 23122705
 Date Issued: 10/01/2024



Analysis Results

					Sample ID
					008
					Customer ID
					HP08-1-ES-0.10
					Sample Type
					SOLID
					Sampling Date
					19/12/2023
Analysis	Method Code	MDL	Units	Accred.	
Fluoranthene	PAHMSUS	0.08	mg/kg^	UM	5.69
Fluorene	PAHMSUS	0.08	mg/kg^	UM	0.35
Indeno[1,2,3-cd]pyrene	PAHMSUS	0.08	mg/kg^	UM	2.06
Naphthalene	PAHMSUS	0.08	mg/kg^	UM	0.69
Phenanthrene	PAHMSUS	0.08	mg/kg^	UM	3.38
Pyrene	PAHMSUS	0.08	mg/kg^	UM	4.93
Total PAH 16	PAHMSUS	1.28	mg/kg^	U	35.5
Total Moisture at 35°C	CLANDPREP	0.1	%	N	28.9
Colour of Material	CLANDPREP		-	N	Brown
Major Constituents	CLANDPREP		-	N	SILT
Minor Constituents	CLANDPREP		-	N	Gravel
Miscellaneous Constituents	CLANDPREP		-	N	Organic Matter
Asbestos Identification	SUB020		-	N	NAIIS

CERTIFICATE OF ANALYSIS

ANALYSIS REQUESTED BY: SOCOTEC UK Ltd
Environmental Chemistry
PO Box 100
Burton upon Trent
Staffordshire
DE15 0XD

CONTRACT NO: S38061-20

DATE OF ISSUE: 10.01.24

DATE SAMPLES RECEIVED: 03.01.24

DATE ANALYSIS COMPLETED: 10.01.24

DESCRIPTION: Eight soil/loose aggregate samples.

ANALYSIS REQUESTED: Qualitative analysis of samples for determination of presence/type of asbestos.

METHODS:

Our method involves initial examination of the samples followed by detailed analysis of representative sub-samples. Each sub-sample was analysed qualitatively for asbestos by polarised light and dispersion staining as described by the Health and Safety Executive in HSG 248.

RESULTS:

Initial Screening

No asbestos was detected in any of the soil samples by stereo-binocular and polarised light microscopy.

A summary of the results is given in Table 1.



CONTRACT NO: S38061-20
DATE OF ISSUE: 10.01.24

RESULTS: (cont.)

Table 1: Qualitative Results

SOCOTEC Job I.D: 23122705

IOM sample number	SOCOTEC Sample ID	Client Sample ID	ACM type detected	PLM result
S38061-66	23122705-001	HP01-7-ES-0.10	-	No Asbestos Detected
S38061-67	23122705-002	HP02-6-ES-0.20	-	No Asbestos Detected
S38061-68	23122705-003	HP03-8-ES-0.20	-	No Asbestos Detected
S38061-69	23122705-004	HP04-4-ES-0.10	-	No Asbestos Detected
S38061-70	23122705-005	HP05-5-ES-0.15	-	No Asbestos Detected
S38061-71	23122705-006	HP06-3-ES-0.10	-	No Asbestos Detected
S38061-72	23122705-007	HP07-2-ES-0.10	-	No Asbestos Detected
S38061-73	23122705-008	HP08-1-ES-0.10	-	No Asbestos Detected

Our detection limit for this method is 0.001%.

COMMENTS:

IOM Consulting cannot accept responsibility for samples that have been incorrectly collected or despatched by external clients.

Any opinions and interpretations expressed herein are out with the scope of our UKAS accreditation.

AUTHORISED BY:

D Third
Laboratory Analyst



Client: PWA Geo-Environmental
Project Name: 23109-Mirfield ATC
Project No: 23122705
Date Issued: 10/01/2024

Deviating Sample Report

All samples received in an appropriate condition with no deviancies noted with the samples.

Analysis Method

<u>Method Code</u>	<u>Method Description</u>	<u>Analysis Method</u>
CLANDPREP	DW35 - CLand Prep and Dry Weight Correction to 35°C	As Received
CLANDPREP	Solid Material Description	As Received
ICPMSS	Arsenic in Solids by ICPMS	Air Dried & Ground
ICPMSS	Cadmium in Solids by ICPMS	Air Dried & Ground
ICPMSS	Chromium in Solids by ICPMS	Air Dried & Ground
ICPMSS	Copper in Solids by ICPMS	Air Dried & Ground
ICPMSS	Lead in Solids by ICPMS	Air Dried & Ground
ICPMSS	Mercury in Solids by ICPMS	Air Dried & Ground
ICPMSS	Nickel in Solids by ICPMS	Air Dried & Ground
ICPMSS	Selenium in Solids by ICPMS	Air Dried & Ground
ICPMSS	Zinc in Solids by ICPMS	Air Dried & Ground
PAHMSUS	16 PAHs by GCMS	As Received
SUB020	Asbestos Stage 1: Screen & ID	

Result Report Notes

Letters alongside results signify that the result has associated report notes.
The report notes are as follows:

<u>Letter</u>	<u>Note</u>
A	Due to the matrix of the sample the laboratory has had to deviate from our standard protocols to be able to process the sample and provide a result. Where applicable the accreditation has been removed and this should be taken into consideration when utilising the data.
B	The QC associated with this result has not wholly met the QMS requirements, the accreditation has therefore been removed. However, the Laboratory has confidence in the performance of the method as a whole and that the integrity of the data has not been significantly compromised.
C	Due to matrix interference, the internal standard and/or surrogate has not met the QMS requirements. This should be taken into consideration when utilising the data.
D	A non-standard volume or mass has been used for this test which has resulted in a raised detection limit.
E	Due to the parameter value being beyond our calibration range (and following the maximum size of dilution allowed, where applicable), the result cannot be quantified and as such the result will appear as a greater than symbol (>) with the accreditation removed. This data should be used for indicative purposes only.
F	Based on the sample history, appearance and smell a dilution was applied prior to testing. Unfortunately, the result is either above (>) or below (<) our calibration range. Results above our calibration range have accreditation removed. The data should be used for indicative purposes only.
G	The day 5 oxygen reading was below the capability of the instrument to detect, and therefore the calculated BOD has been reported unaccredited for guidance purposes only.



Client: PWA Geo-Environmental
Project Name: 23109-Mirfield ATC
Project No: 23122705
Date Issued: 10/01/2024

HWOL Acronym Key

<u>Acronym</u>	<u>Description</u>
HS	Headspace Analysis
EH	Extractable Hydrocarbons - i.e everything extracted by the solvent(s)
CU	Clean up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
+	Operator to indicate cumulative e.g. EH_CU+HS_1D_Total

Additional Information

This report refers to samples as received. SOCOTEC UK Ltd takes no responsibility for accuracy or competence of sampling by others.

Results within this report relate only to the samples tested.

The accreditation codes are as follows:

U = UKAS accredited analysis
M = MCERT accredited analysis
N = Unaccredited analysis

Any units marked with ^ signify results are reported on a dry weight basis of 35 °C.

All Air Dried and Ground Samples (ADG) are oven dried at less than 35 °C.

This report shall not be reproduced except in full, without written approval of the laboratory.

Opinions and interpretations given are outside the scope of our UKAS accreditation.

Any samples marked with * are not covered by our scope of UKAS accreditation. If applicable, further report notes have been added.

Any solid samples where the Major Constituents are not one of the following (Sand, Silt, Clay, Made Ground) are not one of our accredited matrix types.

Any samples marked with ‡ have had MCERTS accreditation removed for this result

Any samples marked with a tick in the deviant table is deviant for the specific reason.

Any samples reported as IS, NA, ND mean the following:

IS = Insufficient Sample to complete analysis
NA = Sample is not amenable for the required analysis
ND = Results cannot be determined

Items listed with a 'SUB' method code prefix have been carried out by an external subcontracted laboratory.

Our deviating sample report does not include deviancy information for Subcontracted analysis. Please see the report from the subcontracted lab for information regarding any deviancies for this analysis.

Summaries of analysis methods are available upon request.

End of Certificate of Analysis

Appendix E

Historic Bore Holes

			Borehole Record		BH No		CP1		
					Contract No		C541		
Method:	Cable percussive drilling using a Dando 150 - 150mm diameter		Site	Mirfield ATC		Date		28/10/22	
			Scale			1:50			
			Logged By			AS			
Sample Details			Client	John Hill Associates					
Type	Depth To-from (m)	Records	Description			Depth (m)	Level (mAOD)	Legend	
SPT D	1.0-1.45	N=1 (1,1/0,0,0,1)	MADE GROUND: Tarmacadam		0.10				
			MADE GROUND: Yellowish cream clayey sandy subangular fine to coarse GRAVEL sized fragments of limestone and sandstone (Type 1 Fill)		0.60				
SPT D	2.0-2.45	N=3 (0,1/2,0,1,0)	MADE GROUND: Dark brown locally black slightly clayey very gravelly fine to coarse SAND of ash locally a very sandy gravel with a low cobble content. Gravel is subangular fine to coarse of clinker, brick, sandstone and limestone. Cobbles are subangular fine to coarse of brick and sandstone.						
SPT D	3.0-3.45	N=5 (2,2/1,1,1,2)							
SPT D	4.0-4.45	N=6 (16,6/1,2,1,2)							
SPT D	5.0-5.45	N=23 (2,5/7,6,5,5)	From 1.80m: becoming clayey		4.30				
SPT D	6.0-6.45	N=27 (16,9/8,6,6,7)							
B	6.0-7.0								
SPT D	7.0-7.45	N=16 (5,4/4,5,4,3)	Firm, yellowish brown gravelly very sandy CLAY with a low cobble content. Sand is fine to coarse, gravel is subangular to rounded fine to coarse of quartzite and sandstone. Cobbles are subangular of sandstone.						
SPT D	8.0-8.45	N=21 (5,5/6,5,5,5)							
SPT D	9.0-9.45	N=16 (6,6/6,4,3,3)							
B	9.0-10.0		Medium dense, light brown sandy subangular to rounded fine to coarse GRAVEL of quartzite and sandstone with a low cobble content. Sand is fine to coarse. Cobbles are subrounded to rounded of quartzite		8.30				
Remarks			Sample Types						
Monitoring well installed to 4m bgl. Borehole backfilled with arisings and bentonite below well			D - Disturbed		W - Water				
Failed U100 - 5.00-5.45m - High granular content			U - Undisturbed						
No groundwater encountered					Sheet 1 of 2				

			Borehole Record		BH No		CP1
Method:			As Sheet 1		Contract No		C541
			Site		Date		28/10/22
			Mirfield ATC		Scale		1:50
			Client		Logged By		AS
Sample Details			John Hill Associates				
Type	Depth To-from (m)	Records	Description	Depth (m)	Level (mAOD)	Legend	
CPT	10.0-10.45	N=14 (2,4/3,3,4,4)	Medium dense, light brown sandy subangular to rounded fine to coarse of quartzite and sandstone with a low cobble content. Sand is fine to coarse, cobbles are subrounded to rounded of quartzite				
B	10.0-11.0						
CPT	11.0-11.45	N=23 (8,11/7,6,5,5)					
Borehole complete at 11.45m							

Remarks

Sample Types

D - Disturbed

U - Undisturbed

W - Water

Sheet 2 of 2

Appendix F

Dynamic Cone Penetrometer Results

Dynamic Cone Penetrometer: DCP01

Job No: 23109
Job Name: Mirfield Air Training Corps
Client: Integra buildings Ltd
Test Date: 19/12/2023
Tested by: AE
Approved by: CK



IMPACT (TRL) Dynamic Cone Penetrometer¹

Blow count	Depth (mm)	Cumulative blows	Depth Difference (mm)	CBR	Stiffness Modulus (Mpa)	Comments
0	108	0	108			
1	114	1	6	45	202	
1	119	2	5	55	229	
3	130	5	11	76	282	
2	142	7	12	45	202	
2	155	9	13	42	192	
2	163	11	8	70	266	
2	175	13	12	45	202	
2	185	15	10	55	229	
2	198	17	13	42	192	
2	209	19	11	50	215	
2	224	21	15	36	174	
2	238	23	14	39	182	
3	245	26	7	123	384	
3	255	29	10	85	301	
3	259	32	4	223	560	
7	264	39	5	431	854	
7	270	46	6	355	755	
10	285	56	15	197	517	
10	303	66	18	162	457	
10	420	76	117	22	129	
5	553	81	133	9	74	
1	612	82	59	4	43	
2	642	84	30	17	109	
2	675	86	33	16	102	
2	708	88	33	16	102	
2	741	90	33	16	102	
2	776	92	35	15	98	
2	830	94	54	9	73	
2	855	96	25	21	123	
3	885	99	30	26	143	
3	922	102	37	21	124	
2	950	104	28	19	114	
Max:				430.98	854.21	
Min:				4.06	43.13	
Average:				74.62	241.71	
Remarks: Test carried out in accordance with operating instructions for the dynamic cone penetrometer.						Approved by:
						CK

¹ SL970, TRL Road Note 8, 60 deg. cone.

Appendix G

Historic Ground Gas Monitoring Results

Appendix H

Risk Evaluation

Risk Evaluation

To ensure consistency in our qualitative method for risk evaluation we have used the classification scheme presented CIRIA C552 Contaminated Land Risk Assessment – A Guide to Good Practice, 2001. The overall risk rating for any potential contaminant linkage is set out in **Table I** and based upon a combination of the:

- Magnitude of the potential consequence (severity) of risk occurring (defined in **Table II**); and
- Magnitude of the probability (likelihood) of the risk occurring (defined in **Table III**).

The definition of the overall risk rating and likely action required is defined in **Table IV**.

Table I: Comparison of consequence against likelihood

		Consequence (severity)			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

Table II: Classification of Consequence (Severity)

Class ⁿ	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in significant harm. Short term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short term risk to a particular ecosystem, or organism forming part of such ecosystem.	• High concentrations of cyanide on the surface of an informal recreation area. • Major spillage of contaminants into controlled water. • Explosion, causing building collapse (can also equate to a short term human health risk if buildings are occupied).
Medium	Chronic damage to human health. Pollution of sensitive water resources. A significant change in a particular ecosystem, or organism forming part of such an ecosystem.	• Concentrations of a contaminant from site exceed the generic, or site specific assessment criteria. • Leaching of contaminants from site to an aquifer. • Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/ structures/ services or the environment.	• Pollution of non-classified groundwater. • Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by PPE). Easily repairable effects of damage to buildings, structures and services.	• The presence of contaminants at such concentrations that PPE is required during site works. • The loss of plants in a landscaping scheme. • Discoloration of concrete.

Table III: Classification of Likelihood (Probability)

Class ⁿ	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are in the right place, which means that it is probable that an event will occur.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table IV: Classification of risks and likely action required

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



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