

London Road Fire Station, Manchester

Phase 2 Intrusive Investigation

Curtins Ref: B061230/JB/8131

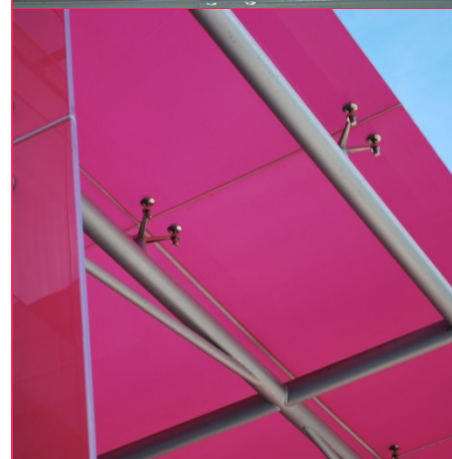
Revision: A

Issue Date: 27 January 2017

Client Name: Allied London

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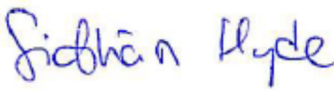


Phase 2 Intrusive Investigation

Rev	Description	Issued by	Checked	Date
-	Phase 2 Intrusive Investigation	JB	SH	27 January 2017
V01	UPDATED 2019 DRAWINGS	KG	DS	03 December 2019

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Executive Summary

Heading	Description
Site Details	National Grid Reference 384670, 397820 with the site covering an area of approximately 0.62Ha.
Current Setting	The site is occupied by a Grade II* Listed historic fire station, currently in disuse. The building comprises of four storeys with basements under the west corner, north, east and south of the building onsite. There is a large courtyard in the centre and a tower on the southern flank.
Development Proposals	It is understood that development proposals comprise refurbishment of the existing structure, construction of a single storey structure in the courtyard. The development is planned to include a hotel, restaurants, bars and retail units, and, from the second floor upwards, residential apartments.
Site History	Historical Ordnance Survey plans indicate the site in the 1850s-90s was developed with high density terraced houses with a road intersecting the site. In the early 20th Century the terraced houses were removed and a single building, named as Chief Fire Station, was constructed with a courtyard in the centre. Later the site is sub-divided into police station and ambulance station, gas meter test station, coroner's court and bank with the rest of the site remaining a fire station and yard. In the 1940s a control room was constructed in the south-east and in the 1950-60s the northwest of the site is used for a motor repairs workshop. By 1992 the additional building in the southeast of the central courtyard has been demolished with the site then remaining relatively unchanged and unoccupied until the present day.
Fieldworks	The intrusive investigation was undertaken between 22 nd August and 5 th September 2016 and comprised one window sample borehole to 5.00m bgl (WS03); three cable percussive boreholes (BH1-BH3) to 10m bgl, with BH2 being extended by rotary drilling to 15m bgl; four machine-excavated trial pits (TP01-TP04), to a maximum depth of 5m bgl; and six hand-excavated trial pits (HP01, HP03, HP04, HP06-HP09) to a maximum depth of 2.5m bgl.
Ground Conditions	Strata encountered comprised surface covering of concrete and/ or brick paving overlying Made Ground to depths of 0.30-2.70m bgl. Anthropogenic fragments within the Made Ground included brick concrete, ash, plastic bags, metal, wood and glass. Directly beneath the Made Ground, Cohesive Glacial Till of firm-stiff, brown, sandy, slightly gravelly clay and Granular Glacial Till / Residual Soil of red, brown, sandy, silty gravel and red, brown, slightly silty, very clayey, fine-coarse sand, with occasional clay bands was present. The underlying sandstone bedrock was partially weathered and recovered as red, brown, slightly gravelly sand. The bedrock was identified at depths of 5.60m, 8.60m and 5.90m bgl, in BH01, BH02 and BH03 respectively. Existing Foundations (Basement Level) - HP01 and HP03 encountered foundations which comprised iron columns on concrete pads. HP04, HP06, HP07 and HP09 encountered foundations comprised of stepped brick wall upon concrete. At the base of the foundations HP06 and HP08 encountered Sand, and HP04 and HP07 encountered Sandstone. Existing Foundations (Courtyard Level) - Existing foundations, of stepped brick wall, were present in TP02-TP04, with TP02 and TP04 encountering concrete below the stepped brick wall. TP01 did not encounter any foundations. Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes. This will require foundation inspection pits to be dug.
Contamination	Given that the proposed end use of the site is commercial use on the lower floors and residential apartments on the upper floors, the report compares the chemistry analysis results from soil samples collected from each exploratory hole against 'Commercial' end-use GAC thresholds. No Tier 1 Threshold exceedances were recorded in the Made Ground and natural soils. Therefore, any potential exposure to contamination, is considered Unlikely to end-users and the associated risks considered as Low . As only limited contamination has been identified within the Made Ground soils onsite, with clayey Glacial Till underlying it and the bedrock containing the Principal Aquifer significantly deeper, the risks to groundwater and surface water receptors (controlled waters) are therefore considered to be Low and Very Low , respectively.
Ground Gas	Three gas monitoring visits have been undertaken to date, with barometric pressure recorded at 1010-1017mb. Maximum readings of 2ppm for hydrogen sulphide (H ₂ S), 3ppm for carbon monoxide (CO) and peak concentrations of 0.5-1.6% for Carbon Dioxide were recorded. Methane (CH ₄) and gas flow were recorded below the instrument's detection limit within all of the monitoring wells throughout the monitoring period. In accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures. It is considered that the risk posed to site end users from ground gases is Low . Upon the completion of the six gas monitoring visits, the results and subsequent recommendations will be issued

Heading	Description
	as an addendum to this report. The site is at a Low risk from Radon, however as the new development incorporates a basement the advice of a specialist Radon assessor must be obtained to fully assess the risk posed to end-users of the site.
Foundations	It is recommended that structural loads are transferred to partially weathered sandstone below basement floor level. The nature of the foundations will depend on construction sequence with regards to underpinning and support of existing structures, and the excavation sequence for basements beneath existing structures and across the basement footprint. The following foundation types may be considered: - Spread Foundations beneath the basement floor assuming very dense sand and extremely weak sandstone is present at the base of the excavation, an allowable bearing pressure about 250kN/m² is considered appropriate for square pad foundations up to 3m by 3m. - Piled Foundations may be used to transfer structural loads to the underlying sandstone. The carrying capacity of piles depends, not only on their size and the ground conditions, but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art methods are often employed before they reach the public domain, perhaps several years ahead. It is recommended that specialist Piling Contractors be consulted as to the suitability and carrying capacity of their piles in the ground conditions found onsite.
Excavation and Support	Excavations <1.00m should stand unsupported in the short term when battered back to a suitable angle of repose. Side support for safety purposes should of course be provided to all excavations which appear unstable. Those >1.20m deep, should be undertaken in accordance with the Health and Safety Regulations. Excavations for basements should be fully supported, and be designed and constructed in accordance with Health and Safety Regulations. Support systems should be designed with due consideration to the current buildings. Conventional mechanical plant should be suitable for excavations through Made Ground, Clay and Sand. Concrete and obstructions within the Made Ground and the excavation of Sandstone may necessitate the use of hydraulic breakers or similar. Groundwater should not be expected in shallow excavations for foundations or services, however it is possible that Perched Groundwater could be present in the Made Ground overlying the natural strata. It is considered that this could be dealt with by localised pumping.
Concrete Design	For overall design purposes, it is recommended that a Design Sulphate Class of DS-1 and ACEC Class of AC-1 be adopted for the site.
Preliminary Waste Classification	The initial assessment revealed that of the twelve soil samples tested, nine samples have indicated to be non-hazardous waste for offsite disposal. However, three samples have indicated to be hazardous waste for offsite disposal owing to the concentrations of Boron classed as hazard property HP6. The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from receiving landfill or treatment facility via the issue of laboratory chemical testing results.

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- Appendix A3 - Laboratory Testing & Monitoring Results
- Appendix A4 - Tier 1 Thresholds
- Appendix A5 - Qualitative/Quantitative Risk Assessment Rationale

1.0 Introduction

1.1 Project Background

In August 2016 Curtins were instructed by Allied London, to undertake a Phase 2 Ground Investigation at the site of the London Road Fire Station building, London Road, Manchester.

The site is approximately centred on National Grid Reference 384670, 397820 and is currently occupied by a Grade II* Listed historic fire station, currently in disuse. There is a large courtyard in the centre and tower on the southern flank.

It is understood that development proposals comprise refurbishment of the existing structure, construction of a new single storey structure in the courtyard and extension of existing basements under the building to extend across the whole development footprint. The development is planned to include a hotel, restaurants, bars and retail units, and from the second floor upwards, residential apartments.

The Phase 2 Ground Investigation has been undertaken in support of the redevelopment of the site with mixed retail, commercial and residential use. The current development plans are included within *Appendix A1* of this report.

1.2 Scope of Works

The Phase 2 Ground Investigation was undertaken in order to provide an assessment of the ground conditions on the subject site with respect to any potential contamination in the underlying soils and or groundwater.

Specifically, the Phase 2 report is intended to determine;

- a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
- b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;
- c) If there is a risk to the end user from soil gases including methane, carbon dioxide, oxygen and hydrogen sulphide;
- d) Recommendations for the design of foundations and building ground floor slabs; and
- e) Recommendations for the specification of sub-structure concrete and water supply pipes.

At the time of writing this report, some ground gas monitoring results remain outstanding. Upon receipt of these results, this report will be updated as a revised version or addendum report, along with any changes in recommendations for this development.

2.0 Site Setting and Existing Reporting

This section of the report presents a summary of the site setting with reference to the Curtins Phase 1 Preliminary Site Assessment (Ref.1) conducted (report ID: B060270.001/APA/6737 Rev A), dated May 2016.

2.1 Current Setting

The development area covers approximately 0.62Ha within the city centre region of Manchester. It is occupied by a Grade II* Listed historic fire station, currently in disuse. It comprises of a four storey building, with basements under the west corner, north, east and south of the building onsite. There is a large courtyard in the centre, tower on the southern flank and potentially an underground tank in the centre-north of the courtyard.

The site is bounded by Minshull Street South to the west, Whitworth Street (A6) to the north and east and Fairfield Street (B6469) to the south). The immediate surrounding area comprises of office, residential and commercial use with Manchester Piccadilly Station to the east of the site.

2.2 Previous Site Uses

Historical Ordnance Survey plans indicate the site in 1850s-90s was developed with a high density terraced houses with a road intersecting the site. By 1908 the terraced houses have been removed and a single building, named as Chief Fire Station, is present with a courtyard in the centre. In 1922 the building is sub-divided into police station and ambulance station in the west, gas meter test station in the north, coroner's court and bank in the east with the rest of the site remaining a fire station and yard. In the 1940s a control room was constructed in the south-east and a chimney is present in the west of the site. By 1950s-60s the ambulance station and gas meter test station are no longer present and motor repairs workshop is located in the northwest of the site. By 1992 the additional building in the southeast of the central courtyard has been demolished.

The surrounding land, in the late 19th century, was predominantly developed for residential and industrial use. By Early 20th Century, a tramway is constructed adjacent to the south of the site and demolition of residential buildings surrounding the site. and used for agriculture. Rochdale Canal is located to the north of the site. By Late 20th Century there is wider urban development across the area.

2.3 Published Geology

A study of the Envirocheck recorded and British Geological Survey (BGS) 1:50,000 mapping recorded (Bedrock and Superficial Editions) for Manchester (Sheet 085) indicates the following geological succession underlying the site:

- **Made Ground** – (Undivided) of *Holocene Age*.

- **Superficial** – Glacial Till (Diamicton) of *Devensian Age*.
- **Bedrock** – Chester Pebble Beds Formation (sandstone) of *Early Triassic Age*.

Five BGS fault lines, trending northwest-southeast are found within 1000m of the site; the closest are 200m northeast and southwest of the site.

There are a number BGS historical borehole records available within the surrounding area from Corporation Sewer Shafts, approximately 10m north of the site (BGS ID: SJ89NW1 at grid location 384628, 397838). They record Made Ground depth is 3.35-8.84m bgl, the Glacial Till is not always present underlying the Made Ground, and the Bedrock was encountered at 8.84-10.06m bgl.

2.3.1 Mining

The site is situated within an area which may be affected by coal mining. The Coal Authority's online interactive mapping suggests a number of mine entry locations >1000m east of the site. The tool outlines the presence of a development high risk area approximately 600m east of the site. No evidence of mining was noted within the historical mapping within the site, or the area immediately surrounding the site.

Based on the foregoing commentary the likelihood of encountering relic mining features on site is considered to be unlikely and therefore has not been considered further.

2.3.2 Radon

The BGS Radon Mapping confirms part of the site is situated in a low probability radon area as less than 1% of homes are above the action level. On this basis, radon protection measures are not considered necessary within the proposed development and have not been considered further.

As this development incorporates a basement the advice of a specialist Radon assessor must be obtained.

2.4 Hydrogeology and Hydrology

2.4.1 Hydrogeology

The Groundwater Vulnerability Map presented within the Envirocheck report indicates that the site is underlain by a Principal Aquifer situated within the bedrock. *Principal Aquifers are layers of rock of drift deposits that have high intergranular and/or fracture permeability – usually providing a high level of water storage.*

The southern proportion of the site is located within a Secondary Undifferentiated Aquifer within the superficial deposits. *Secondary Undifferentiated Aquifers are that that have been assigned*

in cases where it is not possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

The Envirocheck Report notes low permeability drift deposits occurring at the surface and overlying Major and Minor Aquifers are head, clay-with-flints, brickeneath, peat, river terrace deposits and marine and estuarine deposits.

The site is located within an area of High Groundwater Vulnerability but with Limited Potential for Groundwater flooding to occur.

There are two groundwater abstraction sites recorded 252m west of the site for a borehole for non-evaporative cooling, operated by West Contracting since January 2009.

The site is not situated within a designated groundwater Source Protection Zone (SPZ).

2.4.2 Hydrology

The Envirocheck Report identifies a surface water feature 42m north of the site. There are a number of additional watercourses, such as canals and streams identified within the wider region.

The site is not situated in an area that is known to be at risk from extreme flooding or flooding from rivers or sea.

A small portion of the north and southeast of the courtyard, south, north and northeast boundaries of the site are at low risk (1000 year return period) to flooding from surface water. The north corner of the site is at high (30 year return period) to medium (100 year return period) risk from surface water flooding.

There are seventy-two discharge consents within 1000m of the site; the closest is 53m northwest of the site, operated by United Utilities Ltd on Minshall Street, Manchester for storm Sewage Overflow.

There are twenty-six Pollution Incidents to Controlled Waters noted within 1000m of the site; the closest is 39m north from private sewage system in March 1991.

2.5 Landfill

According to the Envirocheck report there are no recorded Historic or Currently Operational Landfills onsite or within 250m of the site.

There are a number of locations of Potentially Infilled Land within 1000m of the site location; the nearest, located 45m west of the site is described as unknown filled ground (pond, marsh, river, stream, dock etc.) dated 1956.

2.6 Unexploded Ordnance (UXO) Risk Assessment

During WWII, the site was located in an area of Moderate bombing density, as confirmed by official statistics and mapping. UXO risk mapping indicates the site to be in close proximity to areas of Manchester suggested as being of high risk and locations of >1000 bomb tonnage.

Analysis of known bomb drop locations, presented during war years, indicates that a number of positions in close proximity to the western boundary of the site. As such, it stands to reason that UXO existence may be prevalent in locations which were known to be affected by bombing activity during this period.

The nature of the ambient land use; incorporating works, engineering works, emergency service facilities and train stations, suggests the possibility to targeted bombing raids across the region thereby accounting for previously suggested damage and, with regards to future works, the possibility of UXO presence across the region. Limited development across the site during post-war years may suggest limited chance for UXO disturbance or discovery.

The exact nature of the site geology (Till) is not known however is considered likely to comprise fine grained (clay) soils resulting in a large range of potential UXO penetration depths from around 0.50m up to 14.00m below ground level.

At this stage the proposed development works are likely to entail; ground investigations, shallow excavations for earthworks and the emplacement of spread foundations (subject to ground conditions revealed) with localised deep excavations possible, e.g. drainage alignments. In general, the shallow nature or very small footprint (boreholes) of these activities will further reduce the likelihood of UXO being encountered. The consequence of a UXO strike is invariably severe.

Based on the foregoing commentary, as the building was occupied throughout prior to, during and after WWII, and no ammunitions or bomb damage were noted on the site, there is deemed very low risk of UXO being discovered on the site.

2.7 Significant Features Potentially Affecting Re-Development

The site maintains the presence of a Grade II* Listed Building.

3.0 Preliminary Conceptual Model

The following sub-sections present assessments of the potential sources, pathways and receptors that exist within the site conceptual model.

Potential source-pathway-receptor linkages that may arise are identified in the following section, the Qualitative Risk Assessment.

3.1 Potential Sources

- **Made-Ground soils onsite** - may be some localised spillage/leakage of fuels, oils, chemicals, industry related products, ash and clinker deposition associated with coal combustion, and uncontrolled deposition of Made Ground arising from construction/ demolition processes.

The nature and type of general contamination may include, amongst others; ash and clinker, hydrocarbons (e.g. fuel oils), non-metals, heavy metals and asbestos.

- **Made-Ground soils offsite** - deemed the result of periods of construction/ demolition and the industrial history of the surrounding area.

Potential contaminants could arise due to construction activities, atmospheric deposition and land management. The nature and type of general contamination may include, amongst others; ash and fill, hydrocarbons (e.g. fuel oils), industrial chemicals, non-metals, heavy metals and asbestos.

- **Ground Gas generating** - sources may be present within Made Ground deposits surrounding the site anticipated from historical developments and land use. There are no records of organic rich drift deposits (e.g. peat) being present. Noxious and asphyxiate gases may therefore include, but not be limited to; carbon dioxide, carbon monoxide, methane and hydrogen sulphide.

3.2 Potential Pathways

- **Direct contact, ingestion and inhalation (dust and vapours)** - may occur where the end user is exposed to; solid, dust or volatile components of soils on site.
- **Vertical migration** - may occur within the possible natural deposits on site both upwards, due to processes including; capillary action, burrowing animals inducing soil mixing and downwards into the natural deposits due to processes including; infiltration. Vertical migration of soil gases is identified as a specific pathway. Soils of high leaching potential are indicated as being present on the site, leaving potential for downward migration to controlled waters.
- **Lateral migration** - may occur within the natural deposits due to processes including; the influence of perched or natural groundwater flow patterns and natural or man-made high

permeability zones, e.g. sand lenses or drainage runs or pores/voids within natural and made-ground soils for soil and mine gases.

3.3 Potential Receptors

- **End users** - including residents, general public, construction workers and site maintenance staff.
- **Controlled waters (groundwater)** - corresponding with the underlying geology, the site is underlain by a Principal Aquifer. There are two groundwater abstraction points located within 500m of the site.
- **Controlled waters (surface water)** - the nearest surface water feature is located 42m north of the site.
- **Construction workers during development of the site** - construction workers will be exposed to potential sources however, wearing the correct personal protective equipment and adoption of suitable working practices will reduce this risk.
- **Construction materials buried concrete and water supply pipes** - may be compromised by the potential presence of aggressive ground conditions or contamination.
- **Local ecology** - protected species onsite and within local habitats; e.g. woodland, hedgerow, grassland and water.

4.0 Phase 2 Investigation Proposals

A number of potential sources of onsite contamination were identified as detailed in Section 3.1 and the risks presented by ground gases also warrant further investigation.

Potential contaminants of concern associated with the onsite sources include, amongst others; organic compounds including hydrocarbons, polycyclic aromatic hydrocarbons arising from incomplete combustion and inorganic compounds including metals, non-metals and asbestos.

Noxious and asphyxiate ground/mine gases may include, but not be limited to; carbon dioxide, carbon monoxide, methane and hydrogen sulphide.

The Desk Study concluded that there could be a risk of the site end user being adversely impacted upon by material potentially present on the site. A strategy for the initial Phase 2 Ground Investigation was derived accordingly and is detailed in Section 5.0.

5.0 Fieldwork

5.1 General

The site investigation fieldworks were undertaken by Ian Farmers Associates Ltd (IFA) between Monday 22nd August and Monday 5th September 2016.

The scope of the ground investigation was designed in general accordance with current UK guidance including CLR11 (Ref.2), British Standard (BS) 10175 (Ref.3), BS5930:2010 (Ref.4) and Eurocode 7 (Ref.5). A summary of the scope and rationale are summarised in Table 5.1 below.

Table 5.1 Scope and Rationale of Fieldwork Undertaken

Activity	Rationale
One window sample borehole to a maximum depth of 5.00m bgl (WS03).	To determine the shallow ground conditions beneath the development footprint.
Three cable percussive boreholes (BH1-BH3) to 10m bgl with BH2 being extended by rotary drilling techniques to 15m bgl.	To determine the deep ground conditions beneath the development footprint.
Four machine-excavated trial pits (TP01-TP04) to a maximum depth of 5m bgl.	To determine the in-situ condition of the ground to be examined both laterally and vertically, and to allow discontinuities to be recorded, beneath the development footprint.
Six hand-excavated trial pits (HP01, HP03, HP04, HP06-HP08) to a maximum depth of 2.5m bgl.	To determine the in-situ condition of the ground to be examined both laterally and vertically; often to examine existing foundations beneath the development footprint.
Description and logging of soil arisings from exploratory holes.	To provide a characterisation of ground conditions and inform sample selection for laboratory analysis.
Collection of representative soil samples from exploratory hole arisings.	To enable laboratory Environmental and Geotechnical analysis of recovered soil samples.
Installation of monitoring wells in four exploratory holes.	To enable a ground gas and groundwater monitoring to be undertaken.
In-situ testing.	To determine geotechnical properties of the strata revealed.

Curtin's drawings ref. B061230/L001 Rev C and B061230/L002 Rev C records the locations of the exploratory holes at the site, copies of which are contained within *Appendix A1*. Due to site constraints, WS01, WS02 and WS04 were not advanced.

5.2 Soil Logging and Sampling

Exploratory arisings were logged on site by a qualified Engineer. All exploratory holes were logged in accordance with the requirements of BS5930 (Ref.4Error! Bookmark not defined.), including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in *Appendix A2*.

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the Made Ground and natural strata encountered. Selected soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical analysis was Scientific Analysis Laboratories Ltd, a UKAS and MCERTS accredited laboratory.

5.3 Monitoring Well Installations

Gas and groundwater monitoring installations (50mm diameter) were installed within four of the exploratory holes (BH01, BH02, BH03 and WS03). A bentonite seal was placed above and below the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

A summary of the response zones is presented in Table 3.2 below.

Table 5.3 *Monitoring Well Response Zones*

Borehole Reference	Response Zone(s) (m bgl)	Strata Description(s) (Principal strata in capitals)
BH01	3.00 – 5.00	SUPERFICIAL DEPOSITS (clays and gravels)
BH02	9.00 – 12.00	SANDSTONE (weathered)
BH03	1.00 - 6.00	MADE GROUND (clay) & SUPERFICIAL DEPOSITS (clay & sand)
WS03	1.00 – 3.50	SUPERFICIAL DEPOSITS (clay)

Copies of borehole logs can be referred to in *Appendix A2* of this report.

5.4 Post-Investigation Monitoring

5.4.1 Ground Gas Monitoring

As previously highlighted, it is considered that the predominant feature associated with ground gas generation and migration across the site is from suspected Made Ground features;

potentially infilled ground within the surrounding region. An initial programme of six ground gas monitoring visits, over three months, was proposed.

Due to the establishment of an ice rick within the site's courtyard area over the Christmas period, ground gas monitoring was put on hold throughout November and December 2016, with monitoring due to recommence late January 2017.

5.4.2 Groundwater Sampling

If adequate groundwater is available for allow sufficient sample collection, groundwater samples will be collected from three borehole locations across the site and tested by a broad environmental testing suite.

6.0 Laboratory Testing

A programme of environmental chemistry testing was scheduled, with analytical suites developed reflecting the findings of the summary desk study and onsite observations.

Given the potential site wide source of contamination (Made Ground and natural soils) the sampling positions (boreholes) were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site accounting for the historical site use, proposed end use and the immediate environmental setting.

6.1 Soil Analysis

The contaminants of concern potentially present on the site were considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), heavy metals and asbestos, the extent of which is captured by the broad environmental testing suite listed in Table 6.1a and 6.1b below.

Table 6.1a Environmental Chemistry Analysis Suite : Soils

Suite Ref.	Analysis	LOD
Suite A	Asbestos Screen	-
	pH	-
	Soil Organic Matter	0.1 mg/kg
	Arsenic	5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Chromium	5 mg/kg
	Chromium VI	5 mg/kg
	Copper	5 mg/kg
	Lead	5 mg/kg
	Mercury	0.1 mg/kg
	Nickel	5 mg/kg
	Selenium	5 mg/kg
	Zinc	5 mg/kg
	Cyanide (total)	10 mg/kg
	Sulphate (total)	200 mg/kg
	Sulphide	2 mg/kg
	Sulphur (elemental)	20 mg/kg
	Phenols (screen)	1 mg/kg
	PAH's (USEPA16)	0.1 mg/kg
	TPH (Aro/Alk Split)	0.01 mg/kg to 0.1 mg/kg

Table 6.1b Environmental Chemistry Analysis Suite : Soils

Suite Ref.	Analysis	LOD
Suite B	pH	-
	Soil Organic Matter	0.1 mg/kg
	Arsenic	5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Chromium	5 mg/kg
	Chromium VI	5 mg/kg
	Copper	5 mg/kg
	Lead	5 mg/kg
	Mercury	0.1 mg/kg
	Nickel	5 mg/kg
	Selenium	5 mg/kg
	Zinc	5 mg/kg
	Cyanide (total)	10 mg/kg
	Sulphate (total)	200 mg/kg
	Sulphide	2 mg/kg
	Sulphur (elemental)	20 mg/kg
	Phenols (screen)	1 mg/kg
	PAH's (USEPA16)	0.1 mg/kg
	TPH Banded (C10-C40)	10 mg/kg

Eight Made Ground samples were tested for Suite A and four natural soil samples from across the site were tested for Suite B. Copies of the environmental chemistry testing certificates presented in *Appendix A3*.

6.2 Geotechnical Analysis

Soil samples for testing were prepared in accordance with BS1377: Part One: 1990 and representative sub-samples were taken for testing. The following tests were carried out:

No. Tested	Description
3	Moisture Content
3	Plasticity Indices
3	Particle Size Distribution (wet)
3	Undrained shear strength
3	Oedometer consolidation
6	Water soluble sulphate
6	pH value

Copies of the testing certificates are presented in *Appendix A3*.

Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods (Ref.6) and 4 Point Load Index Test (PLT) was carried out. Copies of the rock test results are presented in *Appendix A3*.

7.0 Ground Conditions

The strata encountered during the investigation is generally in agreement with the expected geology from BGS geology mapping. The strata generally comprised of Made Ground overlying clay and sand, underlain by sandstone bedrock.

Curtin's drawings ref. B061230/L001 Rev C and B061230/L002 Rev C record the locations of the exploratory holes on the site, copies of which are contained within *Appendix A1*.

7.1 Made Ground

Made Ground was encountered at all locations from ground level to depths of 0.30-2.70m bgl. Concrete was present in all locations, apart from BH02 and BH03, from ground level to a depth of 0.27m bgl. Brick paving was present in WS03 to 0.05m bgl. BH02 encountered brick paving to 0.10m bgl with concrete directly underlying it to 0.20m bgl.

Beneath the ground covering, varying Made Ground was present comprising coarse soils of sand and gravel with localised clay. A coarse soil, of dark brown, sandy, angular-subangular gravel with localised sand, was present in all locations except TP02, at depths from ground level and 0.27m bgl. Within HP04 and TP01 a Made Ground, of brown, very gravelly, fine-coarse sand, was encountered at depths of 0.05-1.10m bgl.

The coarse soils extended to 0.30-2.65m bgl. Underlying that in BH01, BH03, and TP01-TP03, was Made Ground comprising of very soft-firm, dark brown, sandy, slightly gravelly clay, to depths of 0.25-1.30m bgl. The base of the clay was encountered at 1.53-2.70m bgl.

Low to medium cobble content and anthropogenic fragments, including brick concrete, ash, plastic bags, metal, wood and glass, were present throughout the Made Ground. Made Ground was present to depths of 0.30-2.70m bgl, except in HP01, TP01, TP02 and TP04 where the base of the Made Ground was not proven as they terminated at depths of 1.76-2.65m bgl.

Laboratory analysis of Made Ground recorded pH values of 8.4-8.8 and soluble SO₄ contents of 44-150mg/l.

7.2 Cohesive Glacial Till

Cohesive Glacial Till was recorded underlying Made Ground comprising of firm to stiff, brown, sandy, slightly gravelly clay, in BH01-BH03, HP03, HP07 and WS03 at depths of 0.30-2.10m bgl with a thickness ranging between 0.40m-3.00m. The base of the clay was proven to a maximum depth of 4.00m bgl in BH03.

The consistencies of the clay were determined by logging, laboratory tests and derivation from in-situ tests (reported in Section 10.1). Laboratory analysis of the clay recorded pH values of 8.3-8.6 and soluble SO₄ contents of 49-350mg/l.

7.3 Granular Glacial Till / Residual Soils from Completely Weathered Bedrock

Within BH01-BH03, HP02, HP06, HP08 and WS03 coarse soil, of sand and gravel, was encountered at depths in range of 0.33-4.00m bgl, and may represent more granular soils of Glacial Till or residual soil derived from completely weathered sandstone. The proven base of the coarse soils was encountered in BH01-BH03 at depths of 5.60-8.60m bgl.

Red, brown, sandy, silty gravel was present in BH01 and BH02 at 3.70m bgl and 3.60m bgl, respectively. Red, brown, slightly silty, very clayey, fine-coarse sand, with occasional clay bands, at depths of 0.33-4.00m was present in BH03, HP02, HP06, HP08 and WS03.

Laboratory analysis of the coarse soil has given pH values of 8.4 and soluble SO₄ contents of 120mg/l.

7.4 Bedrock

Sandstone bedrock was encountered beneath the Glacial till / Residual soils and recovered as partially weathered red, brown, slightly gravelly sand at depths of 5.60m, 8.60m and 5.90m bgl, in BH01, BH02 and BH03 respectively. HP04 and HP07 were advanced from the floor of the basements and encountered sandstone bedrock at depths of 1.40m and 0.77m bgl respectively. The base of the bedrock was not proven as BH01, BH02 and BH03 were terminated at depths of 8.00m, 17.00m and 8.00m bgl in the sandstone.

7.5 Existing Foundations – Basement Level

Existing foundations were present in HP01, HP03, HP04, and HP06-HP08. Due to service restrictions HP02, HP05 and HP09 were cancelled.

HP01 and HP03 encountered foundations which comprised iron columns on concrete pads; the top of the concrete pads were at 0.75m and 0.30m bgl respectively, and bases at 0.79m and 1.55m bgl respectively. A second layer of concrete in HP01 was encountered at 0.79m bgl. Overall the base of the foundations in HP01 and HP03 were at 1.90m in Made Ground and 1.37m bgl in Sand, respectively.

HP04, HP06, HP07 and HP09 encountered foundations comprised of stepped brick wall upon concrete at depths of 0.12-0.62m bgl, with the base of the concrete at 0.94-1.65m bgl. HP06 and HP07 had foundation step out of 0.20m and 0.05m respectively, and HP08 had multiple step outs of 0.05-0.50m giving an overall length of 0.85m. No step out was present in HP04. At the base of the foundations HP06 and HP08 encountered Sand, and HP04 and HP07 encountered Sandstone.

The dimensions of the foundations in HP01, HP03, HP04 and HP06-HP08 are shown in *Appendix A2*.

Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes.

7.6 Existing Foundations – Courtyard Level

Existing foundations, of stepped brick wall, were present in TP02-TP04, with TP02 and TP04 encountering concrete below the stepped brick wall. TP01 did not encounter any foundations.

TP02 and TP04 have an approximate step out of 0.50m and total step out of 0.20-0.36m, upon concrete at depth of 1.46m and 1.42m bgl respectively. TP02 had a concrete step out of 0.18m and encountered a clay pipe at 0.50m bgl. The base of the foundations were not proven; TP02 was terminated in Made Ground at 2.00m bgl and TP04 was terminated due to an obstruction in Made Ground at 1.76m bgl.

TP03 has an approximate step out of 0.05m on each step, with a total step out of 0.45m, and the base of the brick at 1.15m bgl within Clay.

The dimensions of the foundations in TP02-TP04 are shown in *Appendix A2*.

Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes.

7.7 Groundwater

Groundwater was not encountered in any of the exploratory holes during site investigation, however it was encountered in one exploratory hole during subsequent site visits. The observed groundwater depths recorded shown in Table 7.7 below. Information recorded to date during monitoring may be referenced within Curtins Gas Monitoring Sheets contained within *Appendix A3*.

Table 7.7 Groundwater Gauging Data

Exploratory Hole Reference ID	Depth to groundwater to date (m bgl)		
	Visit 1: 27/09/2016	Visit 2: 12/10/2016	Visit 3: 25/10/2016
BH01	Dry	Dry	Dry
BH02	Dry	11.74	11.78
BH03	Dry	Dry	Dry
WS03	Dry	Dry	Obstructed by parked car

8.0 Geochemical Ground and Groundwater Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref.7).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted in order to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required in order for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in Section 8.0 of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

8.1 Generic Quantitative Risk Assessment – Human Health

Detailed guidance on human health risk assessment is available within a number of documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.06 model (Ref.8).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

- i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for a number of contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and

- dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;
- ii) **Supplementary Screening Values:** In addition to the SGVs developed by the EA other third party organisations have derived GACs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds.
 - iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref.9) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

The proposed end use of the site is for mixed commercial and residential use with basement under the building footprint and courtyard. The basement, ground and first floors are proposed to be for commercial use, with residential accommodation on the second and third floors. Therefore, this site is considered to be most analogous with a *Commercial* end-use scenario and so assessment has been undertaken against this criteria.

Details of the GAC's adopted for the GQRA are provided in *Appendix A4*.

8.1.1 Site Soils

Representative samples from shallow site soils were taken from twelve exploratory sample holes across the site with Made Ground samples tested for Suite A and natural strata samples tested for Suite B respectively, as previously described in Section 6.1. The samples were collected at variable depths in accordance with observed ground conditions noted during the drilling process.

As discussed within the previous section, comparison of the soil analysis results has been undertaken against Generic Assessment Criteria (GAC) for a *Commercial* end-use scenario.

The results of the environmental testing can be referred to in *Appendix A3*. Copies of the adopted Tier 1 thresholds are contained within *Appendix A4*.

Soil organic matter (SOM) has a strong bearing on the availability of potential contaminants and therefore influences the Tier 1 thresholds. Soil organic matter (SOM) values for the site soils ranged 1.8-24.0%.

With consideration for a calculated geometric average, shallow soil samples features determine an SOM of 6.66% while the deeper soils maintain a lower valuation of 2.07%. As such, a comparison against Tier 1 thresholds for a conservative SOM of 1.0% for a *Commercial* end-use has been adopted for all soil samples analysed.

With respect to the proposed end-use of the site, and the implementation of previously discussed thresholds, no contaminant exceedances have been recorded within the investigated soil samples. Consequently, the risk from Made Ground and natural soils to the end-user is considered **Low**.

Asbestos was not detected in any of the samples analysed as part of this investigation.

8.2 Generic Quantitative Risk Assessment – Controlled Water

Insufficient groundwater is available within the exploratory holes to allow groundwater sampling. Groundwater was found within BH02 at 11.74-11.78m bgl within bedrock strata.

As limited soil contamination has been recorded in the Made Ground soils, with clayey Glacial Till underlying it and the bedrock containing the Principal Aquifer significantly deeper, the risks to groundwater and surface water receptors (controlled waters) are therefore considered to be **Low** and **Very Low**, respectively.

8.3 Generic Quantitative Risk Assessment – Ground Gas

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref.10), BSI Publication (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015 (Ref.11) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref.12).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Preliminary Site Assessment Desk Study (Ref.1) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.3.1 Land Gas Monitoring Results

The ground investigation revealed a ground model predominantly consistent with the preliminary conceptual site model. Generally, the strata encountered was Made Ground deposits, Glacial Till superficial deposits (Clay, Gravel and Sand) and bedrock deposits (Sandstone).

In order to characterise the site's gas regime and validate the qualitative assessment of ground gas risk, standpipe installations were incorporated within four exploratory borehole locations as detailed in Section 5.3 and the logs contained within *Appendix A2* of this report.

An initial programme of six gas monitoring visits over three months was proposed. At the time of writing this report, three visits have been undertaken (27th September 2016, 12th October 2016 and 25th October 2016), with barometric pressure recorded at 1010-1017mb.

Due to the establishment of an ice rick within the site's courtyard area over the Christmas period, ground gas monitoring was put on hold throughout November and December 2016, with monitoring due to recommence early February 2017.

A summary of the soil gas monitoring results to date is presented in Tables 8.3.1 below and copies of the log sheets presented in *Appendix A3*.

Table 8.3.1 *Summary of Soil Gas Monitoring Results*

Borehole Reference	Maximum Gas Flow (l/hr)	Maximum CO ₂ Concentration (% vol/vol)	Maximum CH ₄ Concentration (% vol/vol)	Minimum Steady O ₂ Reading	Response Zone
BH01	<0.1	0.6	<0.1	20.1	Open (2m)
BH02	<0.1	1.1	<0.1	14.6	Open (3m)
BH03	<0.1	1.6	<0.1	19.9	Open (5m)
WS03	<0.1	0.5	<0.1	13.9	Open (3.5m)

Maximum reading of 2ppm for hydrogen sulphide (H₂S) and 3ppm for carbon monoxide (CO) were recorded. Methane (CH₄) and gas flow were recorded below the instrument's detection limit within all of the monitoring wells throughout the monitoring period. Carbon Dioxide was recorded in peak concentrations between 0.5-1.6%.

8.3.2 Land Gas Assessment

The Conceptual Site Model presented within the Phase I Preliminary Site Assessment identified possible Made Ground deposits as a potential source of Ground Gas generation both onsite and offsite resulting from historical development and land use. The report suggests no records of organic rich drift deposits (e.g. peat) being present. Additionally, coal deposits are noted to not underlie the site. Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide. The consequence was evaluated as a High risk.

The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Made Ground soils were encountered to depths of between 0.30m to

2.70m bgl but with limited putrescible content generally, and natural deposits were generally clay, sand and gravel with no significant putrescible/organic content.

Consideration of the recorded soil gas flow rates, presented above, enables hazardous gas flow rates to be evaluated. Q_{hg} can be derived for both 'worst credible' and 'worst possible' scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a 'worst credible' scenario steady state flow rates are adopted, whilst for a 'worst possible' scenario peak flows are adopted.

Evaluation of the 'worst credible scenario' (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) and 'worst possible scenario' (highest Q_{hg} across the entire dataset irrespective of location and discrete monitoring events) records a maximum Q_{hg} of 0.0016 l/hr for carbon dioxide.

This worst possible scenario has been adopted as the sites Gas Screening Value (GSV) and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures. It is considered that the risk posed to sites end users from ground gases is **Low** risk.

This recommendation is however subject to the results of the outstanding gas monitoring visits, the results of which together with any recommendations will be issued within an addendum or revised version of this report.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

8.4 Materials Management

8.4.1 Re-use of Site Soils

Based on the geochemical testing results presented as part of this investigation it is considered that there is no specific requirement to remove soils from site as a result of them presenting an unacceptable risk to human health or the environment.

The re-use of site-won soils may therefore be undertaken if the following principles are met:

- i) the geotechnical suitability of the material needs to be confirmed;
- ii) the re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits;
- iii) the volume of the material being re-used needs to be confirmed and traceable; and
- iv) regulatory approval from the relevant authorities has been sought.

These principles are outlined within the CL:AIRE Development Industry Code of Practice (v2) (Ref.13) and if and where the re-use of site-won soils is proposed as part of the development works it is recommended that a Materials Management Plan is produced in line with the Code of Practice to detail and document the process.

8.4.2 Preliminary Waste Classification

Where any site soils are to be disposed of offsite guidance on the disposal of contaminated soils is provided within the following document published by the Environment Agency, the Guidance on the classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015) (Ref.14).

Guidance states that the Principal Contractor (or any other sub-contractor undertaking excavations) should, in conjunction with the proposed disposal facility, use where possible the relevant environmental chemistry analysis results to classify any surplus material identified for offsite disposal. However, it should be noted that this information is for guidance only and material identified for disposal will have to be tested and assessed in accordance with WM3 to enable classification during the works.

An initial assessment for the waste classification of the shallow site soils encountered on site has been undertaken through a comparison of the soil testing results against the Tier 1 Thresholds and using the Waste Soils Characterisation Assessment Tool, Cat-WasteSoil, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous (stable non-reactive hazardous waste) waste, it should be noted that this tool does not classify inert waste.

The initial assessment revealed that of the twelve soil samples tested, nine samples have indicated to be non-hazardous waste for offsite disposal. However, three samples have indicated to be hazardous waste for offsite disposal owing to the concentrations of Boron in borehole BH02, TP02 and WS03 at depths of 2.70m, 0.5m and 0.80m bgl respectively, classed as hazard property HP6.

As discussed, preliminary waste classification is undertaken to offer indicative advice with respect to disposal requirements. Landfill operators are not obliged to accept waste and, if they were to do so, may have specific requirements beyond those outlined above prior to acceptance. The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from receiving landfill or treatment facility via the issue of laboratory chemical testing results.

9.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) discussed in Section 3.0 of this report has been revised following the GQRA in Section 8.0 above. The Conceptual Site Model (CSM) is presented in the table on the following page and a Diagrammatic Conceptual Site Model is presented in *Appendix A1*.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM concerns risk to human health and Water Environment with additional, more specific risk assessment protocols contained within the main body of this reporting, as detailed below.

The CSM follows the framework outlined within CIRIA C552 which is summarised within *Appendix A5*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

9.1 Additional Risk Assessments

The following risk assessments, listed below, are not included within the main CSM and GQRA but none-the-less can be of critical importance to the onward development of the site.

- The risk presented by Mining is discussed and assessed in Section [2.3.1](#).
- The risk presented by Radon is discussed and assessed in Section [2.3.3](#).
- The risk presented by UXO is discussed and assessed in Section [2.6](#).

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model. Reference should be given to the environmental testing results discussed within Section 8.0 and presented within *Appendix A3*.

Qualitative Risk
Assessment

Generic
Quantitative Risk
Assessment

Detailed
Quantitative Risk
Assessment or;
Remedial Action

- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- In order for a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to negligible risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made in order to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.

Conceptual Site Model			Quantitative Risk Assessment			Action
Identified Sources	Pathway(s)	Receptor(s)	Consequence (Potential Severity)	Likelihood of Occurrence	Risk Rating	
Onsite Sources of Potential Contamination: Made Ground was encountered in all exploratory holes across the site beneath a surface covering of concrete and/or brick paving, with a maximum depth of 2.70m bgl encountered in BH03.	Direct contact, ingestion, inhalation (dust and vapours)	End users of site Residents, employees and general public	Medium Chronic health risk	Unlikely Limited soil contamination, not exceeding relevant thresholds, was recorded within the site soils. Furthermore, the redevelopment of the site will involve the removal of much of the Made Ground for basements, therefore, any potential exposure to contamination, although unlikely given the isolated nature, will be mitigated.	Low	No further action recommended
	Vertical migration through the superficial deposits (soils) May occur due to processes including; capillary action, burrowing animals inducing soil mixing and downwards into the natural deposits through infiltration.	Groundwater Principal Aquifer. No groundwater abstractions identified within 500m of the site. The site is not within a Source Protection Zone.	Medium Pollution of sensitive water resources	Unlikely Due to limited soil contamination, with clayey Glacial Till underlying the Made Ground and the bedrock containing the Principal Aquifer significantly deeper, there is limited potential for impact to underlying groundwater body.	Low	No further action recommended
	Horizontal migration over and through the superficial deposits (soils) May occur due to the influence of perched or natural groundwater flow patterns and natural or man-made high permeability zones, e.g. sand lenses or drainage runs.	Surface Water Environment There is a surface water feature noted 41m northwest of the site.	Low Pollution of non-sensitive water resources	Unlikely Due to limited soil contamination and clayey Glacial Till underlying the Made Ground, there is limited potential for impact for contaminants to migrate into surface water bodies.	Very Low	No further action recommended
Potential on and offsite soils with the potential to generate ground gases include: Made Ground soils on & off site.	Vertical and horizontal migration through the superficial and bedrock deposits	End user of site Residents, employees and general public	Medium Human health risk	Unlikely No significant onsite sources of ground gas noted in the Made Ground or natural soils, in the monitoring visits carried out so far.	Low	Gas monitoring visits to be completed and risk assessment updated with final results and any recommendations

10.0 Geotechnical Assessment

10.1 Structural Design Details

It is understood that the proposed development comprises of:

- The excavation of a new basement across the existing courtyard area and into areas underneath the existing building where there isn't existing basement, and
- The construction of one storey new building in the courtyard.

The current development plans are presented within *Appendix A1*.

The comments and discussion below do not fall within the requirement of EC7 (Ref.5) and are offered for guidance. The comments and recommendations below should be reviewed as development details become available.

10.2 Geotechnical Testing Results

Copies of the geotechnical testing certificates are presented in *Appendix A3*.

10.2.1 Standard Penetration Test Results

Made Ground - Four SPT 'N' values in the range of 1-20 were attained, indicating variable strength within the Made Ground.

Cohesive Glacial Till - Six SPT 'N' values in the range of 11-40 were attained within the clay. The SPT 'N' values have been used to obtain approximate C_u values in clay. The derived C_u values, excluding the highest value, in the range of 55-200N/m² have been determined where full penetration was achieved and have been based on an f_1 value of about 5. The derived values indicate medium, high and very high strength material.

Granular Glacial Till/Residual soils – Seven SPT 'N' values in the range of 14-50 blows with a penetration of 130-220mm were obtained, indicating relative densities of medium dense to dense and very dense. The three highest SPT values of 50 blows for 220mm, 180mm and 130mm were recorded at 5.00m bgl (BH01), 6.00m and 7.50m bgl (BH02); these values may signify sandstone bedrock. The outstanding four SPT 'N' values range from 14-48 representative of a medium dense and dense strata.

Sandstone Bedrock – Six SPT 'N' values recorded >50 blows with penetration of 60-147mm. Extrapolation of those values to 300mm penetration results in 'N' values of 102-250.

The strength of the bedrock may be approximately based on: $\sigma_c > 10N$ (kN/m²) [where σ_c – unconfined compressive strength (UCS), and N – SPT 'N' value] (approach based on CIRIA

Report 143 (1995) represents a lower bound value of UCS). On this basis lower bound strengths are 1.02-2.5MN/m² for the sandstone; indicating a very weak material.

10.2.2 Cohesive Glacial Till

Geotechnical Testing Results - The Atterberg Limit and moisture content determination tests were undertaken on three clay soil samples from the Glacial Till. The results are summarised in Table 10.2.2a below:

Table 10.2.2a Atterberg Limits and Moisture Contents

Description	Results
Moisture Content	15-18.3%
Plastic Limit	18-20%
Plasticity Index ¹	18-20
Material passing through 425µm sieve	83-93%

¹ Corrected in accordance with NHBC Chapter 4.2

Based on the above results the Glacial Till maybe classified as Intermediate Plasticity Clay. From on the measured plastic index values the Glacial Till is classified as low volume change.

Consolidation - Three samples of Glacial Till were assessed for consolidation and recorded coefficient of compressibility (mv) of 0.11m²/MN, 0.18m²/MN and 0.12m²/MN at pressure stages rising from overburden. The values indicate medium compressibility.

Unconsolidated Undrained Triaxial Compression - Three samples of the Glacial Till were tested for undrained shear strength (Cu) and the results are detailed in Table 10.2.2b below:

Table 10.2.2b Unconsolidated Undrained Triaxial Compression Results

Sample	Depth (m)	Cu (kN/m ²)
BH01	3.00	303
BH02	2.00	310
BH03	3.00	184

These values indicate very high and extremely high strength material.

10.2.3 Granular Glacial Till / Residual Soils - Particle Size Distribution (PSD)

Six samples of the coarse soil were recovered and the results recorded a coarse constituent of 23-40% and fine (silt and clay) component of 7-18%. Therefore, the material is medium and fine gravel with secondary sand content.

10.3 Foundations

The investigation in the courtyard proved Made Ground to depths of 0.60-2.70m bgl underlain by Glacial Till and residual soils with weathered sandstone bedrock present at depths of 5.60m, 8.60m and 5.90m bgl. It is recommended that structural loads are transferred to weathered sandstone below basement floor level.

The nature of the foundations will depend on construction sequence with regards to underpinning and support of existing structures, and the excavation sequence for basements beneath existing structures and across the basement footprint.

The following foundation types may be considered:

- **Spread Foundations** beneath the basement floor - assuming very dense sand and extremely weak sandstone is present at the base of the excavation, an allowable bearing pressure about 250kN/m² is considered appropriate for square pad foundations up to 3m by 3m.
- **Piled Foundations** – may be used to transfer structural loads to the underlying sandstone. The carrying capacity of piles depends, not only on their size and the ground conditions, but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art methods are often employed before they reach the public domain, perhaps several years ahead. It is recommended that specialist Piling Contractors be consulted as to the suitability and carrying capacity of their piles in the ground conditions found onsite.

10.4 Floor Slabs

It is expected that the weathered sandstone bedrock will be encountered below the basement floor level. Based on this assumption, a Ground Bearing Floor Slab may be utilised for the basement floor. Ground floor slabs will be suspended on columns extending to both pad foundations of pile caps.

10.5 Excavations

Based on onsite observations, and the results of in-situ and laboratory tests, it is considered that excavations to <1.00m should stand unsupported in the short term. Side support for safety purposes should, of course, be provided to all excavations which appear unstable, and those >1.20m deep in accordance with Health and Safety Regulations.

Excavations for basements should be fully supported, and be designed and constructed in accordance with Health and Safety Regulations. Support systems should be designed with due consideration to the current buildings.

Conventional mechanical plant should be suitable for excavations through Made Ground, Clay and Sand. Concrete and obstructions within the Made Ground and the excavation of Sandstone may necessitate the use of hydraulic breakers or similar.

Groundwater should not be expected in shallow excavations for foundations or services, however it is possible that Perched Groundwater could be present in the Made Ground overlying the natural strata. It is considered that this could be dealt with by localised pumping.

10.5.1 Bedrock

Point Load Tests (PLT) – four PLT tests were carried out on sandstone recovered from rotary cores and gave PLT $Is_{(50)}$ values ranging <0.04 – <0.09 MPa. The Unconfined Compressive Strength (UCS) can be derived from $PLT Is_{(50)} \times 20 = UCS$. This indicates UCS values of 0.8–1.8MN/m² and signifies extremely weak and very weak materials.

10.6 Buried Concrete

The site has been classified in accordance with BRE Special Digest 1 (Ref.15), as Greenfield without the presence of pyrite, and laboratory testing undertaken accordingly. It is recommended that the guidelines given in BRE Special Digest 1 be implemented, and that the groundwater should be regarded as mobile.

The following table shows the results of laboratory sulphate concentration testing as 2:1 water/soil extract, and the concrete class based on the laboratory results.

Table 10.6 Sulphate Concentration Results and Recommended Concrete Class

Strata	Sulphate Concentration (mg/l)	pH	Design Sulphate Class	ACEC Class
Made Ground	44 – 150	8.4 – 8.8	DS-1	-
Natural Strata	49 – 350	8.3 – 8.6	DS-1	AC-1

For overall design purposes, it is recommended that a Design Sulphate Class of DS-1 and ACEC Class of AC-1 be adopted for the site.

10.7 Additional Structural Investigation Works

Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes. This will require foundation inspection pits to be dug.

11.0 Conclusions & Recommendations

11.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in Section 9.0.

11.1.1 Ground Model

Made Ground - was encountered at all locations from ground level to depths of 0.30-2.70m bgl. Concrete and/ or brick paving was present in all locations. Beneath the ground covering, varying Made Ground was present comprising coarse soils of sand and gravel with localised clay. The coarse soil comprised dark brown, sandy, angular-subangular gravel with localised sand, or brown, very gravelly, fine-coarse sand, or very soft-firm, dark brown, sandy, slightly gravelly clay. Low to medium cobble content and anthropogenic fragments, including brick concrete, ash, plastic bags, metal, wood and glass, were present throughout the Made Ground.

Glacial Till / Residual Soil - directly beneath the Made Ground a Cohesive Glacial Till, of firm-stiff, brown, sandy, slightly gravelly clay (in BH01-BH03, HP03, HP07 and WS03), underlain by Granular Glacial Till / Residual Soil of red, brown, sandy, silty gravel (in BH01 and BH02 at 3.70m bgl and 3.60m bgl, respectively) and red, brown, slightly silty, very clayey, fine-coarse sand, with occasional clay bands (at depths of 0.33-4.00m in BH03, HP02, HP06, HP08 and WS03).

Bedrock - the sandstone bedrock was partially weathered and recovered as red, brown, slightly gravelly sand. The bedrock was present at depths of 5.60m, 8.60m and 5.90m bgl, in BH01, BH02 and BH03 respectively.

Existing Foundations (Basement Level) - HP01 and HP03 encountered foundations which comprised iron columns on concrete pads; the top of the concrete pads were at 0.75m and 0.30m bgl respectively, and bases at 0.79m and 1.55m bgl respectively. Overall the base of the foundations in HP01 and HP03 were at 1.90m in Made Ground and 1.37m bgl in Sand, respectively. HP04, HP06, HP07 and HP09 encountered foundations comprised of stepped brick wall upon concrete at depths of 0.12-0.62m bgl, with the base of the concrete at 0.94-1.65m bgl. HP06 and HP07 had foundation step out of 0.20m and 0.05m respectively, and HP08 had multiple step outs of 0.05-0.50m giving an overall length of 0.85m. No step out was present in HP04. At the base of the foundations HP06 and HP08 encountered Sand, and HP04 and HP07 encountered Sandstone.

Existing Foundations (Courtyard Level) - Existing foundations, of stepped brick wall, were present in TP02-TP04, with TP02 and TP04 encountering concrete below the stepped brick

wall. TP02 and TP04 have an approximate step out of 0.50m and total step out of 0.20-0.36m, upon concrete at depth of 1.46m and 1.42m bgl respectively. TP02 had a concrete step out of 0.18m and encountered a clay pipe at 0.50m bgl. The base of the foundations were not proven; TP02 was terminated in Made Ground at 2.00m bgl and TP04 was terminated due to an obstruction in Made Ground at 1.76m bgl. TP03 has an approximate step out of 0.05m on each step, with a total step out of 0.45m, and the base of the brick at 1.15m bgl within Clay. TP01 did not encounter any foundations.

11.1.2 Risk Assessments

The environmental chemistry soil results have been compared with the Tier 1 criteria for soils with respect to human health against '*Commercial*' thresholds.

With respect to the proposed end use of the site, no Tier 1 Threshold exceedances were recorded. As part of the redevelopment of the site, the Made Ground is being excavated for basements across the site. Therefore, the source of any potential contamination is being removed and so exposure to contamination to the end-user is considered Low.

As only limited contamination has been identified within the Made Ground soils onsite, with clayey Glacial Till underlying it and the bedrock containing the Principal Aquifer significantly deeper, the risks to groundwater and surface water receptors (controlled waters) are therefore considered to be **Low** and **Very Low**, respectively.

Three rounds of gas monitoring have been completed to date, with three visits yet to be undertaken. Evaluation of the 'worst credible scenario' and 'worst possible scenario' records a maximum Q_{Hg} of 0.0016 l/hr for carbon dioxide. This worst possible scenario has been adopted as the sites Gas Screening Value (GSV) and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures. It is considered that the risk posed to sites end users from ground gases is **Low** risk.

The BGS Radon Mapping confirms the site is situated in an area where less than 1% of homes are above the radon action level. Radon protection measures are therefore not considered necessary within the proposed development. It is considered that the risk posed to sites end users from radon is **Low** risk. However, as the new development incorporates a basement the advice of a specialist Radon assessor must be obtained.

No evidence of shallow coal mining or intact coal was encountered beneath the site and therefore the probability of shallow coal mining posing a risk to the proposed development is considered to be **Unlikely**.

11.2 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

- 1) In general, it is recommended that construction workers are provided with appropriate PPE and sanitary facilities with reference to the environmental testing results presented herein and within *Appendix A3*.
- 2) Gas monitoring to date has classified the site in line with Characteristic Situation 1 (CS1) gas regime and therefore no gas protection measures are required. Upon the completion of the three remaining gas monitoring visits, the results and subsequent recommendations will be issued as an addendum to this report.
- 3) As the new development incorporates new foundations, advice of a specialist Radon assessor must be obtained to fully assess the risk posed to end-users of the site.
- 4) Additional investigations of existing foundations will need to be carried out to confirm the details of existing foundations, for structural design and to avoid clashes. This will require foundation inspection pits to be dug.

12.0 References

- 1 Curtins Consulting, Phase 1 Preliminary Site Assessment for London Road Fire Station, May 2016 (report ID: B060270.001 Rev A/APA/6737).
- 2 Environment Agency (2004) Model Procedures for the management of land Contamination Contaminated Land Report 11 (CLR11).
- 3 British Standards Institution (2011) Investigation of Potentially Contaminated Sites (report no. BS10175).
- 4 British Standards Institution BSI (2010) Code of Practice for Site Investigations (report no.BS5930).
- 5 British Standards Institution (2006) Eurocode 7: Geotechnical Design (report no. BS EN 1997).
- 6 Brown, E. T. (1981) Rock Characterization, Testing and Monitoring: ISRM Suggested Methods.
- 7 British Standards Institution (2013) Guidance on Investigations for Ground Gas, Permanent Gas and Volatile Organic Compounds (VOCs) (report no.BS8576:2013).
- 8 Environment Agency (2014) Contaminated Land Exposure (CLEA) Tool (version 1.06).
- 9 Department of Environment Food and Rural Affairs (DEFRA) (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).
- 9 CIRIA (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings (report no. C665).
- 11 British Standards Institution (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (report no.BS8485).
- 12 S Wilson, G Card, S Haines (2009) Ground Gas Handbook Cathness, Scotland, Whittles Publishing.
- 13 CL:AIRE (2011) Development Industry Code of Practice (Version 2).
- 14 Environment Agency (2015) Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015).
- 15 Building Research Establishment (2005) Special Digest 1, 'Concrete in Aggressive Ground'.

Appendix A1 – Drawings

- Curtins Proposed Borehole Location Plans for London Road Fire Station:
 - Ground Floor, drawing ref. B061230/L001 Rev C, dated May 2016.
 - Basement Floor, drawing ref. B061230/L002 Rev C, dated May 2016.
- Levitt Bernstein Architects Ltd drawings:
 - **Proposed Basement Plan** Rev P15, drawing no. 3336 - D109, dated August 2016.
 - **Proposed Ground Floor Plan** Rev P14, drawing no. 3336 - D110, dated August 2016.
- Diagrammatic Conceptual Site Model (CSM)

Rev:	Description:	Date:	By:	Chkd:
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INFORMATION

Project

London Rd. Fire & Police Station

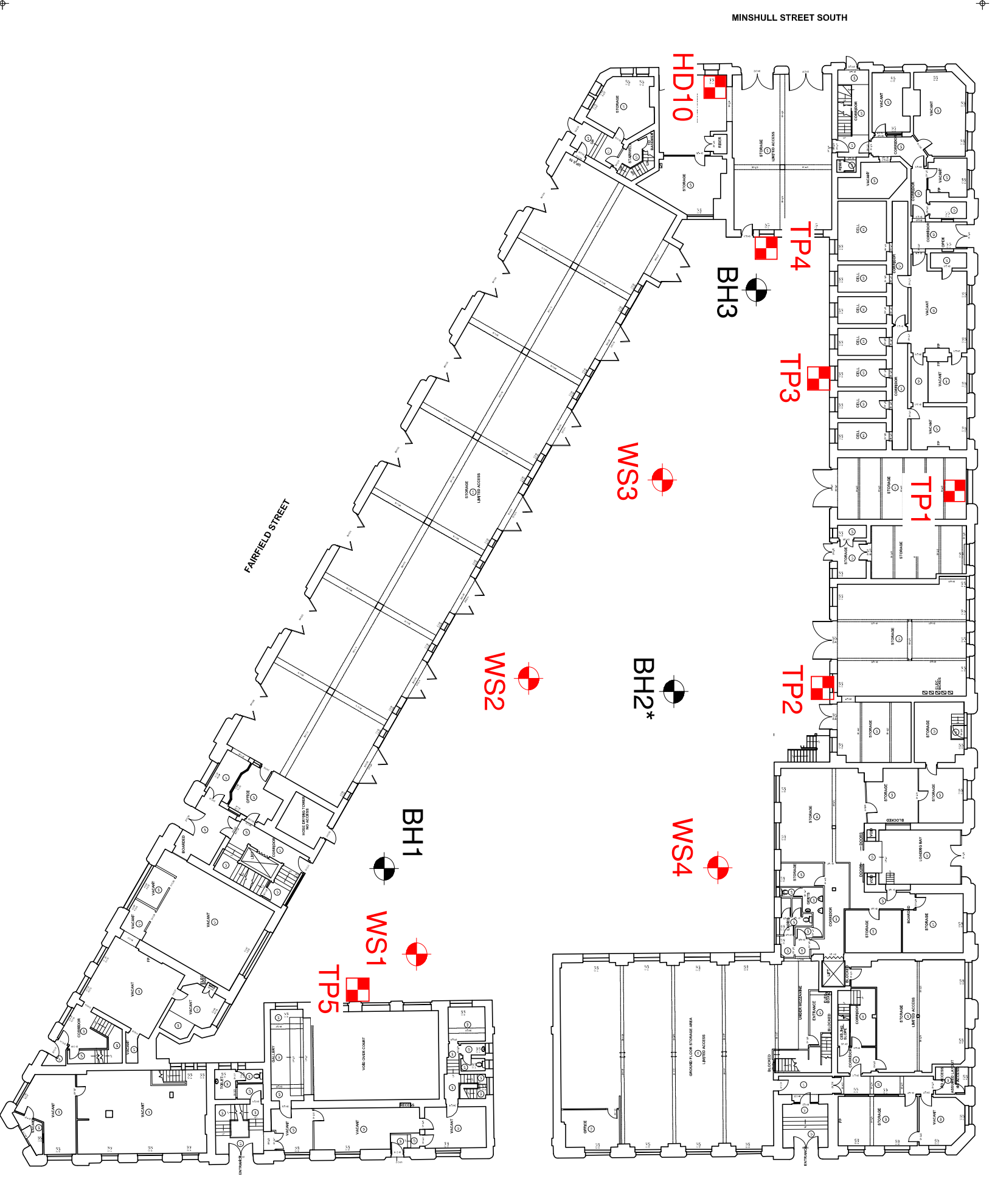
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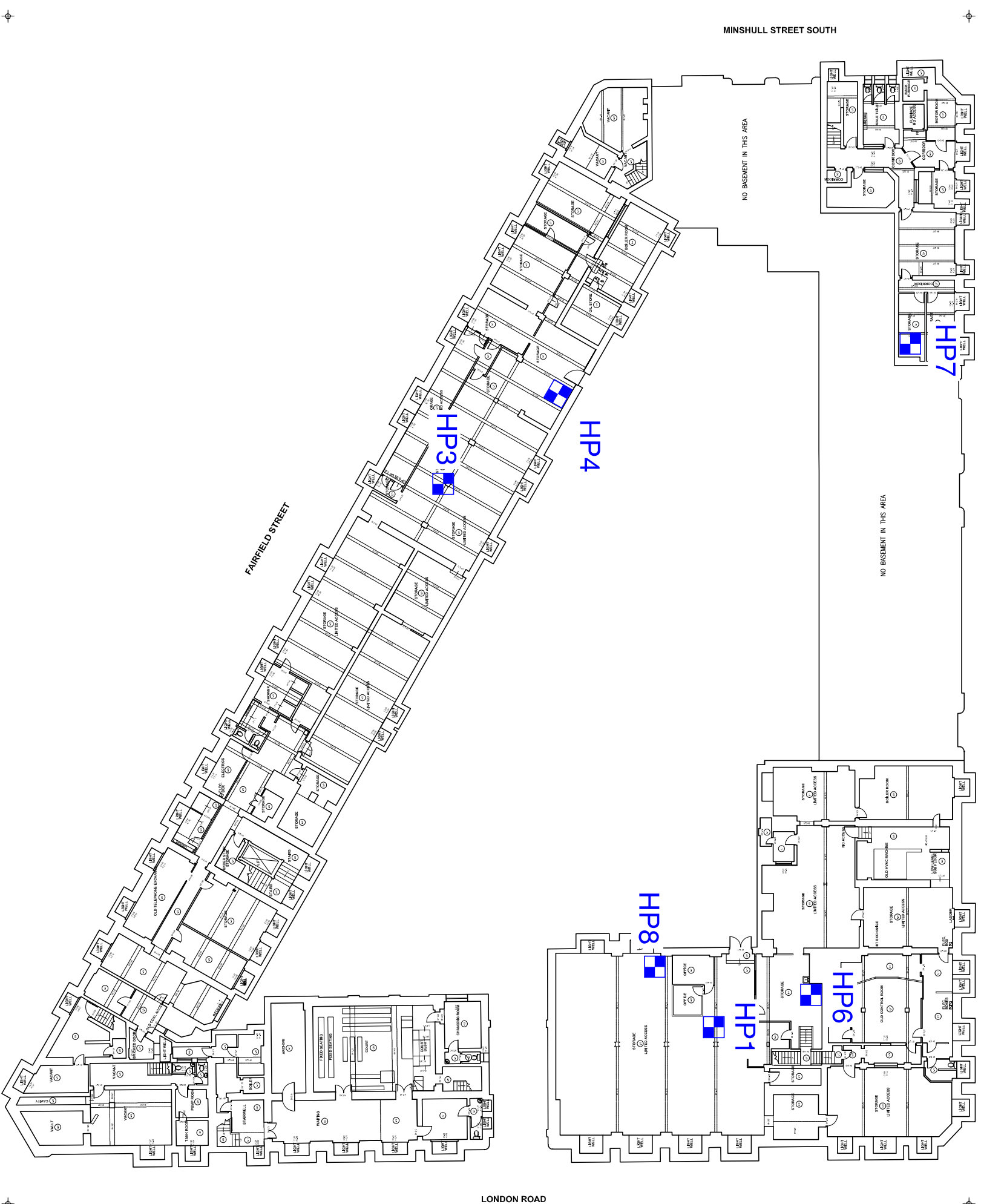
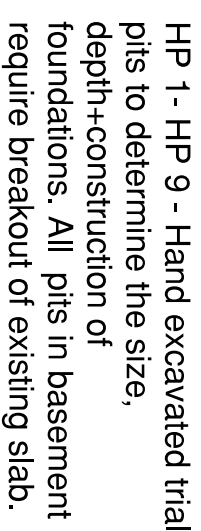
Proposed Exploratory Hole Location Plan-Ground Floor

Scale:	Size:	First Issue:	Drawn:	Checked:
	A3	17.05.2016	LR	SH

Drg No: B061230/L001

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Rev:	Description:	Date:	By:	Chkd:
				
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Status:				
INFORMATION				
Project:				
London Rd. Fire & Police Station				
Dwg Title:				
Proposed Exploratory Hole Location Plan-Basement Floor				
Scale:	Size:	First Issue:	Drawn:	Checked:
	A3	17.05.2016	LR	SH
Dwg No:	B061230/L002			Rev:
				C
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Minshull Street South



London Road

Notes:

Drawings are based on survey data and may not accurately represent what is physically present.

Do not scale from this drawing. All dimensions are to be verified on site before proceeding with the work.

All dimensions are in millimeters unless noted otherwise.

Purcell shall be notified in writing of any discrepancies.

Key Plan

not to scale

-  Coroner's Court (Sui generis)
-  Hotel (C1)
-  Unit A (A1, A3, A4)
-  Unit D (B1, A3, A4, D2, C1)
-  Unit E (A1, A3, A4)
-  Unit F (A1, A3, A4, D2)
-  Unit G (A1, A3, A4)
-  Unit H (A1, A3, A4)
-  Courtyard (A1, A3, A4, D2)
-  Courtyard External (A1, A3, A4, D2)
-  Landlord Areas

All furniture is shown indicatively

Hotel (C1)	598 m ²
Landlord Areas	127 m ²
Live & Work (B1, C3)	827 m ²
Live & Work External (B1, C3)	85 m ²
Unit L (B1, A3, A4)	149 m ²
Workspace (B1)	576 m ²
Workspace External (B1)	69 m ²
Grand total: 92	2430 m ²

 Existing
 Proposed

1	02/12/19	For planning
2	03/12/19	For Planning
3	06/12/19	For Planning

REV	DATE	DESCRIPTION
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CLIENT

Allied London

PROJECT

London Road Fire Station

IOB NUMBER

240242

TITLE

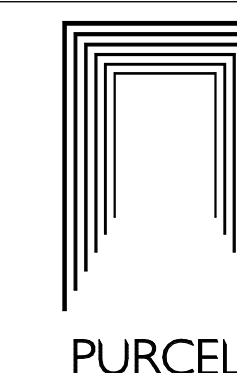
Proposed Ground Floor Plan

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REV	SUITABILITY/REASON FOR ISSUE
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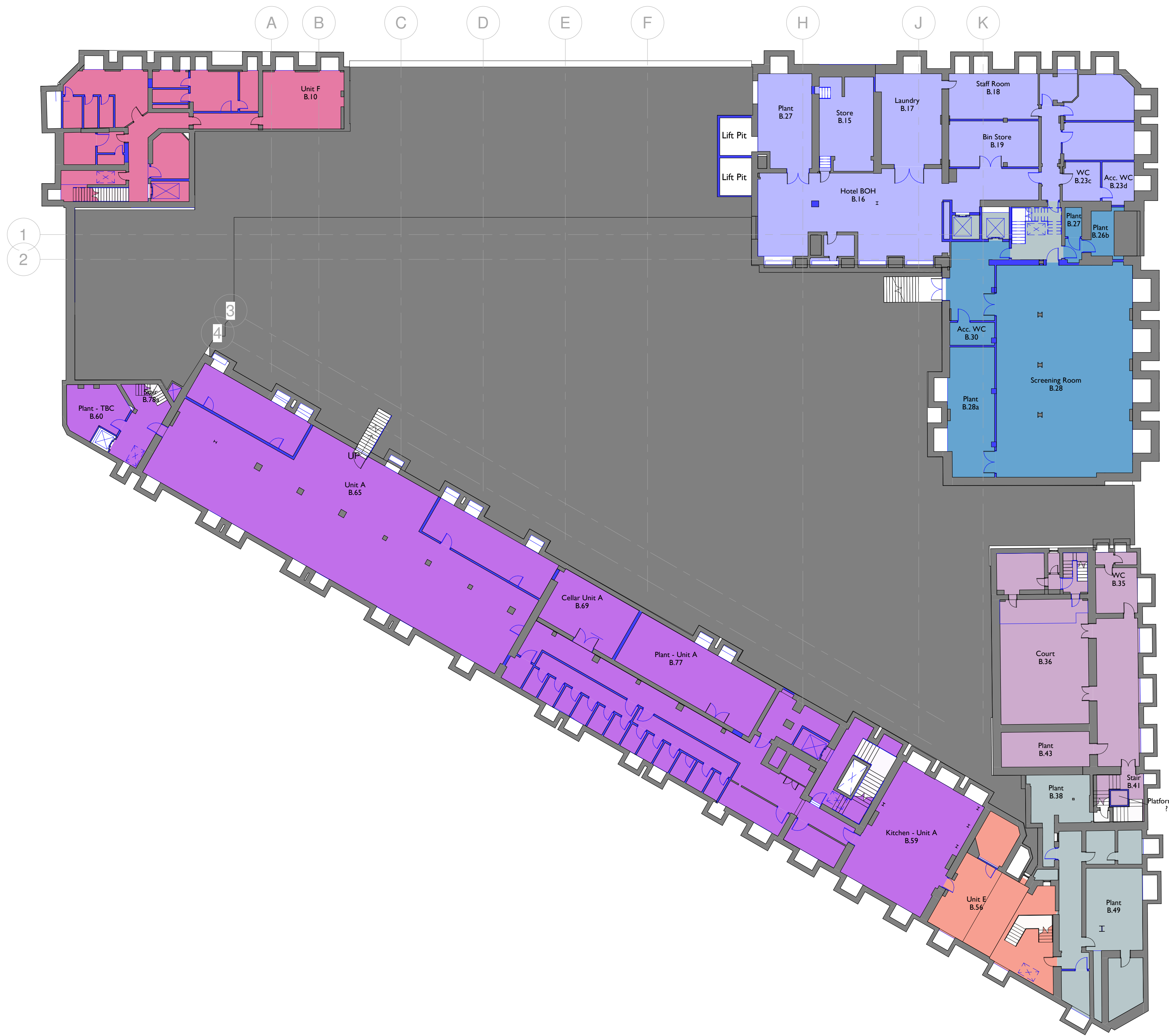
St James', 79 Oxford Street, Manchester, M1 6FQ



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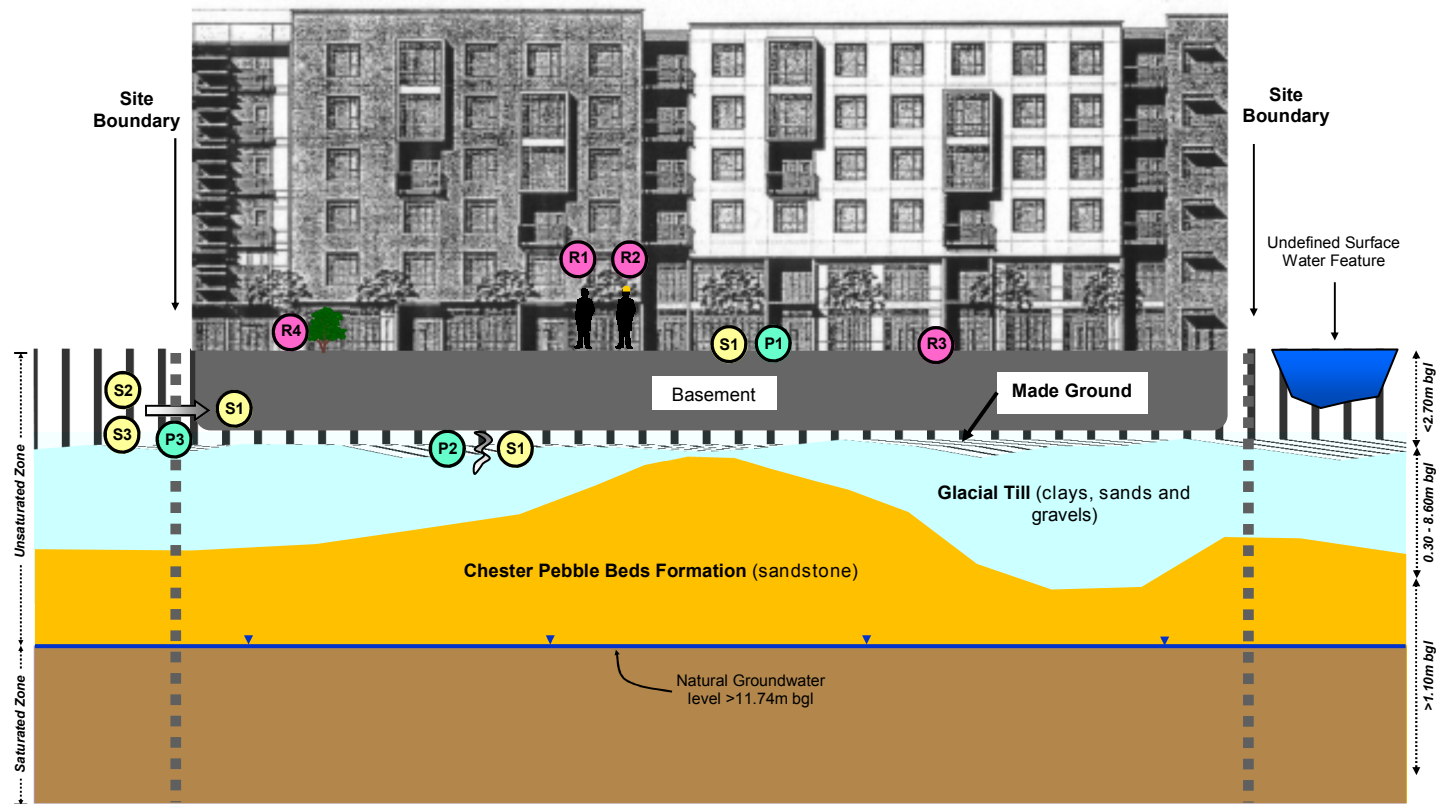


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A horizontal number line representing distance in meters. It starts at 0 and ends at 20m. Major tick marks are labeled at 0, 2m, 4m, 6m, 8m, 10m, and 20m. The segments between 0 and 2m, 4m and 6m, and 8m and 10m are shaded gray.

London Road Fire Station, Manchester (M1)



Sources

- S1** Made-ground (On site)
- S2** Made-ground (Off site)
- S3** Natural soils (On & off site)
- S4** Ground gas sources

Pathways

- P1** Direct contact, ingestion and or inhalation
- P2** Vertical migration
- P3** Horizontal migration

Receptors

- R1** End users
- R2** Construction workers
- R3** Construction materials
- R4** Local ecology



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Project

London Road Fire Station

Drawing Title

Diagrammatic Conceptual Model

Job Reference

B061230

Date

09/01/2017

Author

JB

Checked

SH

Client

Allied London

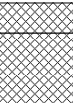
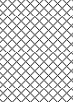
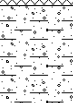
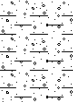
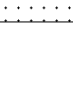
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Appendix A2 – Exploratory Hole Logs, Section, Photos & Drawings

- Window Sample Borehole Logs, WS03
- Borehole Logs, BH01-BH03
- Hand Dug Pit Logs, HP01, HP03, HP04, and HP06-HP09
- Trial Pit Logs, TP01-TP04
- Nominal Section: Strata from Ground Level (BH01-BH03 and WS03)
- Hand Pit Photographs, HP01, HP03, HP04, and HP06-HP08
- Hand Pit Drawings, HP01, HP03, HP04, HP06 and HP08
- Trial Pit Photographs, TP02-TP04
- Trial Pit Drawings, TP02-TP04
- Borehole Core Photographs, BH02

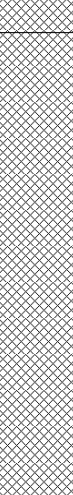
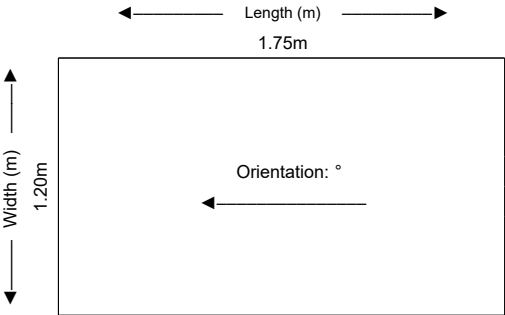
	Contract Name: London Road Fire Station, Manchester			Client: Allied London			Borehole ID: WS03					
	Contract Number: 41953	Date Started: 31/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1						
Dynamic Sample Borehole Log	Easting:		Northing:		Ground Level:		Plant Used:		Print Date: 02/11/2016		Scale: 1:50	
Weather:			Termination:				SPT Hammer: N/R, Energy Ratio: N/R					
Samples & In Situ Testing				Strata Details						Groundwater		
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description				Water Strike	Backfill/Installation	
				0.05		MADEGROUND: Brick.						
				0.24		MADE GROUND: Concrete.						
0.40	D7			(0.36)		MADE GROUND: Brown, dark brown, sandy, angular to subrounded, fine to coarse GRAVEL including brick, ash, coal and concrete.						
0.40	ES9			0.60		Stiff, brown, mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone, limestone, quartzite and occasional coal.				1		
0.80	D6	SPT(S) N=22 (3,4/5,5,6,6)										
0.80	ES8											
1.00												
1.50	D5											
2.00		SPT(S) N=27 (4,6/6,6,7,8)		(3.00)						2		
2.50	D4											
3.00		SPT(S) N=40 (6,6/10,7,11,12)								3		
3.50	D3											
3.60		SPT(S) 50 (27 for 135mm/50 for 115mm)		3.60		Dense, reddish brown, fine to coarse SAND (Possible weathered sandstone).						
3.80 - 4.05	D2			(0.45)						4		
				4.05		End of Borehole at 4.05m						
										5		
										6		
										7		
										8		
										9		
										10		
Borehole Diameter		Installation		Remarks:								
Depth (m)	Dia (m)	Depth Top	Base (m)	Diameter	Pipe Type	Service inspection pit hand excavated from GL to 1.20m.						
		0.00	0.20		PLAIN							
		0.20	1.00		PLAIN							
		1.00	3.50		SLOTTED							
Water Strikes												
Depth Strike	Depth Casing	Depth Sealed	Time (mins)	Rose to (m)	Remarks							
IFA DS Template Issue Number: 3 Issue Date: 07-09-16												

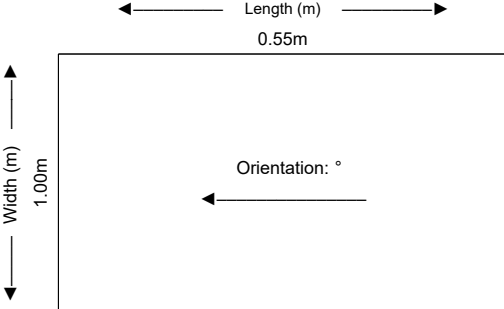
	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Borehole ID: BH01							
	Contract Number: 41953	Date Started: 26/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT								
Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016	Sheet 1 of 1							
					Scale: 1:50								
Weather:		Termination:			SPT Hammer: N/R, Energy Ratio: N/R								
Samples & In Situ Testing			Strata Details				Groundwater						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike						
0.20	D2	SPT(S) N=14 (2,3/3,4,3,4)		0.20		MADE GROUND: Concrete.	1						
0.20	ES1			(1.10)		MADE GROUND: Dark brown grey, sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content. Including brick, concrete and sandstone.							
0.50 - 1.00	B3												
1.00	D5	SPT(S) N=13 (2,3/3,3,4,3)		1.30		MADE GROUND: Firm, dark brown, sandy, very gravelly CLAY. Gravel is angular to subrounded, fine to coarse including brick, ash, concrete, sandstone and occasional wood.	2						
1.00	ES4			(0.80)									
1.20	B6												
1.20 - 1.65	D8	SPT(S) N=48 (7,7/7,9,13,19)		2.10		Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including sandstone, siltstone, limestone, occasional quartzite and coal.	3						
1.70	ES7			(1.60)									
2.00	B9												
2.00 - 2.45	ES10	115 blows. 100% recovery		3.70		Dense, reddish brown, silty, sandy, subangular to rounded, fine and coarse GRAVEL including sandstone, siltstone, limestone, occasional quartzite and coal.	4						
2.70	U12			(1.90)									
3.00 - 3.45	D13												
3.50	D14	SPT(S) 50 (10,11/50 for 220mm)		5.60		Weathered SANDSTONE recovered as, dense red brown, slightly gravelly, fine to coarse sand. Gravel is subangular to subrounded, fine to coarse including sandstone.	5						
3.70	D15			(2.40)									
4.00	B15												
4.00 - 4.45	D16	SPT(S) 50 (25 for 87mm/50 for 147mm)		8.00		End of Borehole at 8.00m	6						
4.00 - 4.45	D16												
5.00	B17												
5.00 - 5.45	D19	SPT(S) 50 (25 for 85mm/50 for 85mm)					7						
5.00 - 5.45	D19												
5.60	D18												
6.00	B20	SPT(S) 50 (25 for 85mm/50 for 85mm)					8						
6.00 - 6.45	D21												
6.00 - 6.45	D21												
7.00	D22	SPT(S) 50 (25 for 85mm/50 for 85mm)					9						
7.50	B23												
7.50 - 7.67	D24												
7.50 - 7.67	D24						10						
Start & End of Shift Observations			Borehole Diameter		Casing Diameter		Remarks:						
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)		Depth (m)	Dia (mm)				
					8.00	150	7.50	150	Service inspection pit hand excavated from GL to 1.20m.				
Chiselling			Installation		Water Strikes								
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
5.00	5.00	00:30		0.00	3.00	PLAIN					0		
7.70	8.00	01:00		3.00	5.00	SLOTTED							
IFA CP Template Issue Number: 5 Issue Date: 04/10/16													

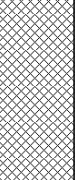
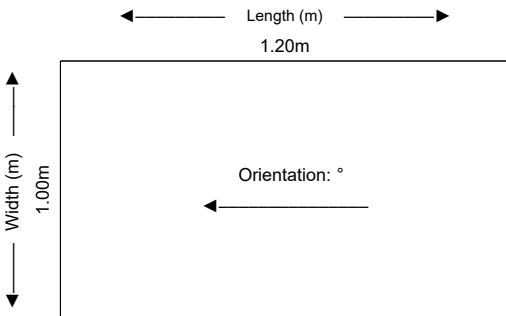
		Contract Name: London Road Fire Station, Manchester			Client: Allied London			Borehole ID: BH02						
		Contract Number: 41953	Date Started: 30/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT								
Cable Percussion Borehole Log		Easting:		Northing:		Ground Level:		Plant Used:		Print Date: 02/11/2016		Scale: 1:50		
Weather:				Termination:				SPT Hammer: N/R, Energy Ratio: N/R						
Samples & In Situ Testing						Strata Details						Groundwater		
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/ Installation	
0.20	ES1			0.07		MADE GROUND: Brick paving.								
				0.20		MADE GROUND: Concrete.								
0.50 - 1.00	B2					MADE GROUND: Dark brown, slightly clayey, sandy, angular to subrounded fine to coarse GRAVEL with medium cobble content., including brick, ash, concrete, sandstone and occasional wood.								
0.70	ES3			(1.60)								1		
1.20		SPT(S) N=20 (3,5/5,4,5,6)												
1.20 - 1.65	B4													
1.70	ES5			1.80		Stiff, brown, slightly mottled grey, slightly sandy, slightly gravelly CLAY with medium cobble content. Gravel is subangular to rounded, fine and medium including sandstone. siltstone, limestone, occasional wood.						2		
1.80	D6	120 blows. 100% recovery												
2.00 - 2.45	U7					At 2.00m: very high strength								
2.50	D8			(1.80)										
2.70	ES9													
3.00		SPT(S) N=34 (4,5/6,8,10,10)										3		
3.00 - 3.45	B10													
3.00 - 3.45	D11													
3.60	D12			3.60		Dense, reddish brown, silty, sandy, subangular to rounded, fine and coarse GRAVEL with clay bands including sandstone, siltstone, limestone, occasional quartzite and coal.						4		
4.00		SPT(S) N=39 (5,8/8,9,10,12)												
4.00 - 4.45	B13													
5.00		SPT(S) N=43 (6,7/9,10,11,13)										5		
5.00 - 5.45	B14													
6.00		SPT(S) 53 (8,11/53 for 180mm)		(5.00)								6		
6.00 - 6.33	B15													
6.00 - 6.33	D16													
6.80	D17											7		
7.50		SPT(C) 50 (25 for 95mm/50 for 130mm)												
7.50 - 7.91	B18											8		
8.60	D19			8.60		Weathered SANDSTONE recovered as very dense, reddish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone.						9		
9.00		SPT(S) 50 (25 for 35mm/50 for 60mm)		(1.40)										
9.00 - 9.10	D20													
				10.00								10		
Start & End of Shift Observations			Borehole Diameter		Casing Diameter		Remarks:							
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m. Chiselling: 9.70m to 10.00m = 1hr					
					10.00	150	9.00	150						
									Water Strikes					
Chiselling									Strike (m) Casing (m) Sealed (m) Time (mins) Rose to (m) Remarks					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)						
6.20	6.50	01:15			0.00	9.00	PLAIN							
6.90	7.20	01:00			9.00	12.00	SLOTTED							
7.60	7.00	01:30							IFA CP Template Issue Number: 5 Issue Date: 04/10/16					

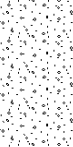
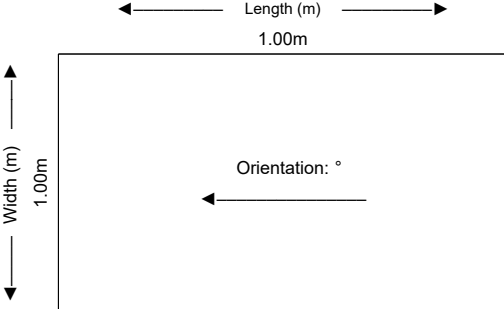
IAN FARMER ASSOCIATES						Contract Name: London Road Fire Station, Manchester				Client: Allied London				Borehole ID: BH02					
Rotary Core Drilling Log						Contract Number: 41953		Date Started: 30/08/2016		Logged By: JM		Checked By: HH		Status: DRAFT		Sheet 2 of 2			
						Easting:		Northing:		Ground Level:		Plant Used:		Print Date: 02/11/2016		Scale: 1:50			
Weather:						Termination:						SPT Hammer: N/R, Energy Ratio: N/R							
Coring Details						Strata Details										Groundwater			
Depth		TCR	SCR	RQD	Fracture Spacing	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description							Water Strike	Backfill/Installation		
10.00 - 11.50		67	41	0	10		(1.00)		Extremely weak, thinly bedded, reddish brown, medium and coarse grained SANDSTONE. Distinctly weathered. Subhorizontal (80 to 85 degrees), very closely spaced, undulating, rough, moderately open to open, sand infilled discontinuities. <i>At 10.15m, 10.16m, 10.42m, 10.75m and 10.80m, drilling induced fractures.</i>										
					NR		11.00		Extremely weak, thinly bedded, reddish brown, medium and coarse grained SANDSTONE. Distinctly weathered. Horizontal to subhorizontal (80 to 90 degrees), closely spaced, undulating, rough, moderately open to open, sand infilled discontinuities. <i>Between 11.00m to 12.20m: assumed zone of core loss.</i>							11			
11.50 - 13.00		53	15	8	NI											12			
					18														
13.00 - 14.50		89	25	0	12		(6.00)									13			
					26														
					NI														
					15														
					NI														
					12														
14.50 - 16.00		0	0	0	NR											15			
16.00 - 17.00		85	31	11	NI		17.00									16			
					18														
					6														
					26														
									End of Borehole at 10.000m							17			
																18			
																19			
																20			
Start & End of Shift Observations						Borehole Diameter		Casing Diameter		Remarks:									
Date		Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)	Service inspection pit hand excavated from GL to 1.20m. Chiselling: 9.70m to 10.00m = 1hr									
						10.00	150	9.00	150										
										Water Strikes									
Strike (m)		Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks													
Flush Information						Installation													
Top (m)		Base (m)	Flush Type	Return	Flush Colour	Top (m)	Base (m)	Type	Dia (mm)										
						0.00	9.00	PLAIN											
						9.00	12.00	SLOTTED											
										Fracture spacing as Fl or Min, Average and Max in mm. TCR, SCR and RQD reported in %									
										IFA RC Issue Number: 2 Issue Date: 13/07/16									

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Borehole ID: BH03			
	Contract Number: 41953	Date Started: 25/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT				
Cable Percussion Borehole Log	Easting:	Northing:	Ground Level:	Plant Used:	Print Date: 02/11/2016	Sheet 1 of 1			
					Scale: 1:50				
Weather:		Termination:			SPT Hammer: N/R, Energy Ratio: N/R				
Samples & In Situ Testing			Strata Details				Groundwater		
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike		
0.20 0.20 - 0.70	ES1 B2			(0.30) 0.30		MADE GROUND: Brown, sandy, angular to subrounded, fine to coarse GRAVEL including brick, concrete, occasional sandstone and wood with medium cobble content.	1		
0.70	ES3					MADE GROUND: Very soft, dark brown, sandy, very gravelly CLAY with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, ash, occasional concrete, sandstone and wood.			
1.20 1.20 - 1.65	B4	SPT(S) N=1 (1,0/0,0,1,0)		(2.40)			2		
1.70	ES5								
2.00 2.00 - 2.45	B6	SPT(S) N=2 (1,0/1,0,0,1)					3		
2.70 2.70	D8 ES7 U9	63 blows. 100% recovery				Firm, brown, slightly mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including sandstone, siltstone, limestone, occasional quartzite and coal. <i>At 3.00m: very high strength</i>			
3.00 - 3.45				(1.30)			4		
3.50	D10								
4.00 4.00 - 4.45 4.00 - 4.45	B11 D12	SPT(S) N=11 (2,2/3,3,3,2)		4.00		Medium dense, reddish brown, silty, fine and medium SAND with clay bands.	5		
5.00 5.00 - 5.45 5.00 - 5.45	B13 D14	SPT(S) N=14 (2,3/3,4,4,3)		(1.90)					
6.00 6.00 - 6.20 6.00 - 6.20	B15 D16	SPT(S) 50 (25 for 100mm/50 for 100mm)		5.90		Weathered SANDSTONE recovered as, dense, reddish brown yellow, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone.	6		
7.00	D17			(2.10)					
7.50 7.50 - 7.70 7.50 - 7.70	B18 D19	SPT(S) 50 (25 for 100mm/50 for 100mm)		8.00	End of Borehole at 8.00m		7		
							8		
							9		
							10		
Start & End of Shift Observations			Borehole Diameter		Casing Diameter		Remarks:		
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)		Depth (m)	Dia (mm)
					8.00	150	7.50	150	Service inspection pit hand excavated from GL to 1.20m.
Chiselling			Installation		Water Strikes				
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	
7.70	8.00	01:00		0.00	0.20	PLAIN			
				0.20	1.00	PLAIN			
				1.00	6.00	SLOTTED			
IFA CP Template Issue Number: 5 Issue Date: 04/10/16									

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: HP01										
	Contract Number: 41953	Date: 22/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1										
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: Hand excavated	Date Printed: 02/11/2016	Scale: 1:40										
	Weather:		Hole Termination:		Stability: Hand pit remained dry and stable during excavation											
Samples & In Situ Testing			Strata Details					Water								
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description										
0.20 - 1.00	B2			0.20		MADE GROUND: Concrete.		1								
0.50	ES1			(2.45)		MADE GROUND: Brown, very sandy, angular to subrounded, fine to coarse GRAVEL with high cobble contents. Including concrete, brick, sandstone, siltstone and occasional wood.										
1.50	D5							2								
1.50	ES3							3								
1.50 - 2.50	D4			2.65		End of Trial Pit at 2.65m		4								
								5								
								6								
Dimensions:					General Remarks:											
Final Depth: 2.65m					Refer to sketch for further details.											
																
					Water Strikes											
					<table><tr><td>Strike (m)</td><td>Time (mins)</td><td>Rose to (m)</td><td>Remarks</td></tr><tr><td></td><td></td><td></td><td></td></tr></table>				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Strike (m)	Time (mins)	Rose to (m)	Remarks													
					HBSI TP Template Issue Number: 2 Issue Date: 27/04/16											

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: HP03										
	Contract Number: 41953	Date: 24/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1										
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used:	Date Printed: 02/11/2016	Scale: 1:40										
	Weather:		Hole Termination:		Stability: Hand excavated.											
Samples & In Situ Testing			Strata Details					Water								
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description										
0.13 - 0.30	D3			0.13		MADE GROUND: Concrete.		1								
0.30 - 0.70	B2			0.30		MADE GROUND: Orangish brown, sandy, angular to subrounded, fine to coarse GRAVEL with low cobble content. including brick, concrete .										
				(0.40)		Stiff, greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone and quartzite.										
0.70 - 1.46	B1			0.70		Dense, brown, clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, siltstone and quartzite.										
				(0.76)												
				1.46		End of Trial Pit at 1.46m		2								
								3								
								4								
								5								
								6								
Dimensions:					General Remarks:											
Final Depth: 1.46m					Refer to sketch for further details.											
																
					Water Strikes											
					<table><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Strike (m)	Time (mins)	Rose to (m)	Remarks													
					HBSI TP Template Issue Number: 2 Issue Date: 27/04/16											

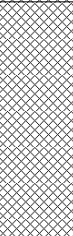
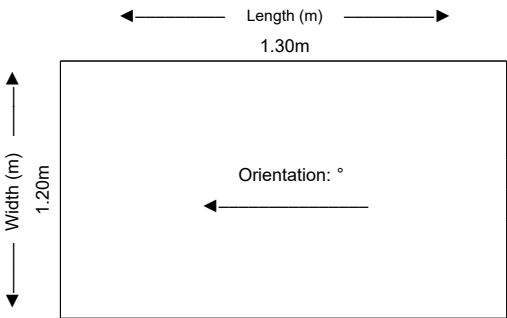
	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: HP04									
	Contract Number: 41953	Date: 24/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1									
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: Hand excavated	Date Printed: 02/11/2016	Scale: 1:40									
	Weather:		Hole Termination:		Stability: Hand pit remained dry and stable during excavation.										
Samples & In Situ Testing			Strata Details					Water							
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description									
0.10 - 1.10	B1			0.10		MADE GROUND: Concrete.		1							
				(1.00)		MADE GROUND: Brown, very gravelly, fine to coarse SAND with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, concrete, sandstone, plastic, occasional wood, plastic bags, cans and glass.									
1.10 - 1.40	B2			1.10 (0.30) 1.40		Extremely weathered SANDSTONE recovered as, reddish brown, slightly gravelly, fine to coarse sand. Gravel is subangular to subrounded, fine to coarse including sandstone.									
						End of Trial Pit at 1.40m		2							
								3							
								4							
								5							
								6							
Dimensions:				General Remarks:											
Final Depth: 1.40m				Refer to sketch for further details.											
															
				Water Strikes											
				<table><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Strike (m)	Time (mins)	Rose to (m)	Remarks												
				HBSI TP Template Issue Number: 2 Issue Date: 27/04/16											

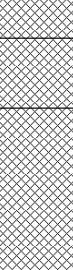
	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: HP06			
	Contract Number: 41953	Date: 23/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1			
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: Hand excavated	Date Printed: 02/11/2016	Scale: 1:40			
	Weather:		Hole Termination:		Stability: Hand pit remained dry and stable during excavation.				
Samples & In Situ Testing			Strata Details					Water	
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description			
0.10 - 0.33	B2			0.10		MADE GROUND: Concrete.		1	
0.33 - 1.00	B1			0.33		MADE GROUND: Grey, slightly sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content, including brick, concrete and sandstone.			
				(0.87)		Reddish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone.			
				1.20	End of Trial Pit at 1.20m				
								2	
								3	
								4	
								5	
								6	
Dimensions:			General Remarks:						
Final Depth: 1.20m			Refer to sketch for further details.						
									
			Water Strikes						
			Strike (m)				Time (mins)	Rose to (m)	Remarks
			HBSI TP Template Issue Number: 2 Issue Date: 27/04/16						

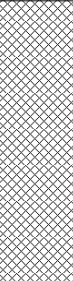
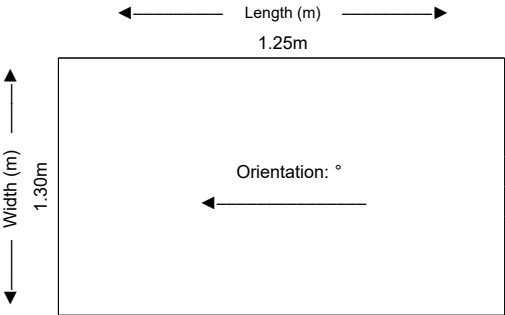
	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: HP07													
	Contract Number: 41953	Date: 25/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1													
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: Hand excavated	Date Printed: 02/11/2016	Scale: 1:40													
	Weather:		Hole Termination:		Stability: Hand pit remained dry and stable during excavation														
Samples & In Situ Testing			Strata Details					Water											
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description													
0.10 - 0.33	D3			0.10		MADE GROUND: Concrete.		1											
0.33 - 0.77	B2			0.33		MADE GROUND: Dark brown grey, sandy, angular to subrounded, fine to coarse GRAVEL with low cobble content. Including brick, concrete and occasional wood.													
0.77 - 1.20	D1			(0.44)		Stiff, greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including siltstone, sandstone and quartzite.													
				0.77		Reddish brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including sandstone and extremely weathered sandstone (Weathered sandstone).													
				(0.43)															
				1.20		End of Trial Pit at 1.20m		2											
								3											
								4											
								5											
								6											
Dimensions:			General Remarks:																
Final Depth: 1.20m			Refer to sketch for further details.																
← Length (m) → 0.69m ↑ Width (m) ↓ 0.66m Orientation: ° ←																			
			<table><tr><th colspan="4">Water Strikes</th></tr><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>					Water Strikes				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Water Strikes																			
Strike (m)	Time (mins)	Rose to (m)	Remarks																
			HBSI TP Template Issue Number: 2 Issue Date: 27/04/16																

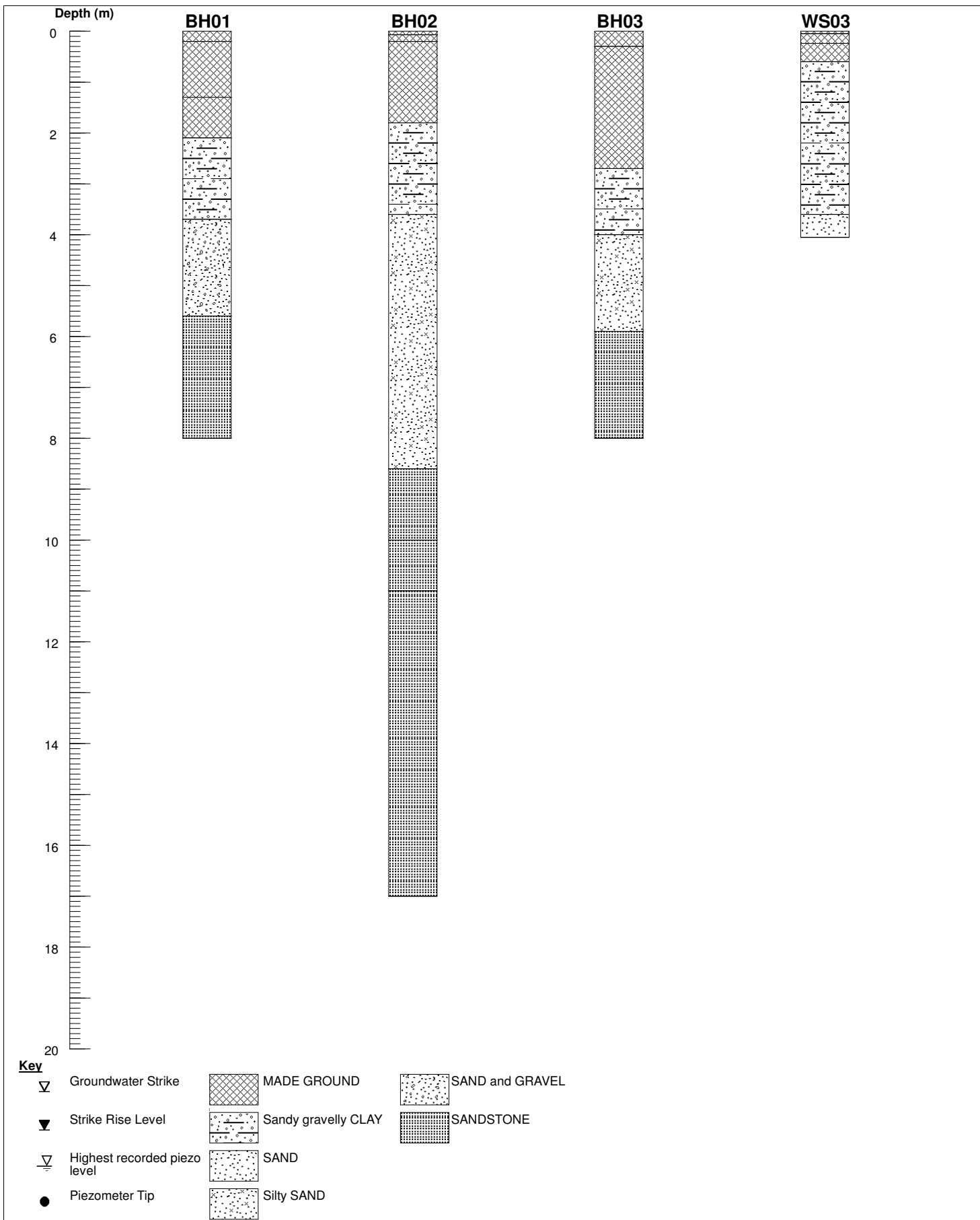
	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: HP08													
	Contract Number: 41953	Date: 22/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1													
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: Hand excavated	Date Printed: 02/11/2016	Scale: 1:40													
	Weather:		Hole Termination:		Stability: Hand pit remained dry and stable during excavation.														
Samples & In Situ Testing			Strata Details					Water											
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description													
0.20 - 0.30	B1			0.12		MADE GROUND: Concrete.		1											
0.40 - 0.70	B2			0.35		MADE GROUND: Brown, slightly clayey, sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content. Including concrete, brick, occasional wood and ash.													
0.70 - 1.50	B3			(0.35)		Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse including sandstone and siltstone.													
				0.70		Brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine and medium including sandstone.													
				(1.20)				2											
				1.90		End of Trial Pit at 1.90m		3											
								4											
								5											
								6											
Dimensions:			General Remarks:																
Final Depth: 1.90m			Refer to sketch for further details.																
← Length (m) → 0.77m ↑ Width (m) ↓ 1.50m Orientation: ° ←																			
			<table><tr><th colspan="4">Water Strikes</th></tr><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>					Water Strikes				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Water Strikes																			
Strike (m)	Time (mins)	Rose to (m)	Remarks																
			HBSI TP Template Issue Number: 2 Issue Date: 27/04/16																

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: TP01										
	Contract Number: 41953	Date: 05/09/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1										
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator	Date Printed: 02/11/2016	Scale: 1:40										
	Weather:		Hole Termination:		Stability: Trial pit remained dry and stable during excavating											
Samples & In Situ Testing			Strata Details					Water								
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description										
				0.05		MADE GROUND: Concrete.		1								
				0.25		MADE GROUND: Brown, slightly clayey, gravelly, fine to coarse SAND with low cobble content. Gravel is angular to subangular, fine to coarse including brick, concrete, mudstone and coal.										
0.50 0.50 0.70	D2 ES1 B3					MADE GROUND: Firm, brown, mottled blackish red, sandy, gravelly CLAY. With low cobble content. Gravel is angular to subangular, fine to coarse including brick, concrete, mudstone, ceramic and coal.										
1.00	ES4			(1.75)												
1.70	B5							2								
2.00 2.00	D7 ES6			2.00		End of Trial Pit at 2.00m										
								3								
								4								
								5								
								6								
Dimensions:					General Remarks:											
Final Depth: 2.00m					No foundations encountered.											
← Length (m) → 1.15m ↑ Width (m) ↓ 1.25m Orientation: ° ←																
					Water Strikes											
					<table><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Strike (m)	Time (mins)	Rose to (m)	Remarks													
					HBSI TP Template Issue Number: 2 Issue Date: 27/04/16											

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: TP02														
	Contract Number: 41953	Date: 01/09/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1														
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator	Date Printed: 02/11/2016	Scale: 1:40														
	Weather:		Hole Termination:		Stability:															
Samples & In Situ Testing			Strata Details					Water												
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description														
0.18 - 1.00	B1			0.18		MADE GROUND: Concrete with rebar.		1												
0.50	ES2			(1.30)		MADE GROUND: Firm, dark brown, sandy, gravelly CLAY with medium cobble content. Gravel is angular to subrounded, fine to coarse including brick, ash, concrete, slab and sandstone.														
1.48 - 2.00	B3			1.48		MADE GROUND: Stiff, brown, mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is angular to rounded, fine and medium including sandstone, siltstone, limestone, brick, concrete and coal (Reworked natural).			2											
1.50	ES4	(0.52)	End of Trial Pit at 2.00m																	
				2.00				3												
								4												
								5												
								6												
Dimensions:			General Remarks:																	
Final Depth: 2.00m			Refer to sketch for further details.																	
																				
			<table><tr><th colspan="4">Water Strikes</th></tr><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>						Water Strikes				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Water Strikes																				
Strike (m)	Time (mins)	Rose to (m)	Remarks																	
			HBSI TP Template Issue Number: 2 Issue Date: 27/04/16																	

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: TP03														
	Contract Number: 41953	Date: 01/09/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1														
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator.	Date Printed: 02/11/2016	Scale: 1:40														
	Weather:		Hole Termination:		Stability: Trial pit remained dry and stable during excavation															
Samples & In Situ Testing			Strata Details					Water												
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description														
				0.23		MADE GROUND: Concrete with rebar.		1												
0.50 0.60	D1 ES2			(0.37) 0.60		MADE GROUND: Dark grey, dark brown, slightly clayey, very sandy, angular to subrounded, fine to coarse GRAVEL with medium cobble content. Including brick, concrete, ash and slate.														
1.00	B3			(0.93)		MADE GROUND: Dark brown, soft, sandy, gravelly CLAY with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, concrete, ash and slate.														
1.60 1.60	B4 ES5			1.53 1.70		Stiff, brown mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including limestone, siltstone, sandstone, occasional quartzite and coal.		2 3 4 5 6												
						End of Trial Pit at 1.70m														
Dimensions:			General Remarks:																	
Final Depth: 1.70m			Refer to sketch for further details.																	
← Length (m) → 1.29m ↑ Width (m) ↓ 1.27m Orientation: ° ←																				
			<table><tr><th colspan="4">Water Strikes</th></tr><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>						Water Strikes				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Water Strikes																				
Strike (m)	Time (mins)	Rose to (m)	Remarks																	
			HBSI TP Template Issue Number: 2 Issue Date: 27/04/16																	

	Contract Name: London Road Fire Station, Manchester		Client: Allied London			Trial Pit ID: TP04										
	Contract Number: 41953	Date: 30/08/2016	Logged By: JM	Checked By: HH	Status: DRAFT	Sheet 1 of 1										
Trial Pit Log	Easting:	Northing:	Ground Level:	Plant Used: 1 ton tracked excavator	Date Printed: 02/11/2016	Scale: 1:40										
	Weather:		Hole Termination:		Stability:											
Samples & In Situ Testing			Strata Details					Water								
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description										
0.27 - 1.76	B1			0.27		MADE GROUND: Concrete.		1								
				(1.49)		MADE GROUND: Orangish brown, sandy, angular to subrounded, fine to coarse GRAVEL including brick, concrete, occasional wood and clinker.										
1.50	D2			1.76		End of Trial Pit at 1.76m		2								
								3								
								4								
								5								
								6								
Dimensions:					General Remarks:											
Final Depth: 1.76m					Concrete encountered at 1.76m. Refer to sketch for further details.											
																
					Water Strikes											
					<table><tr><th>Strike (m)</th><th>Time (mins)</th><th>Rose to (m)</th><th>Remarks</th></tr><tr><td></td><td></td><td></td><td></td></tr></table>				Strike (m)	Time (mins)	Rose to (m)	Remarks				
Strike (m)	Time (mins)	Rose to (m)	Remarks													
					HBSI TP Template Issue Number: 2 Issue Date: 27/04/16											



Site London Road Fire Station, Manchester	Date Drawn 08/11/2016	Date Checked	Sheet 1/1	Job Number 41953
Client Allied London	Drawn By	Checked By	Scale 1:100[V]	Figure No. Figure A1.3

Hand pit Photographs HP01

