

5.0 GROUND CONDITIONS

5.1 Summary

A brief summary of the ground conditions encountered is presented in the table below:

Stratum	Range Depths - Top (m bgl)	Range Depths - Base (m bgl)	Range Thickness' (m)	Brief Description
Made Ground	GL	0.90 – 1.20	0..90 – 1.20	CONCRETE, MADE GROUND: Dark brown gravelly clay.
Natural Superficial Strata - Cohesive	0.90 – 1.20	1.70 – 2.00	0.60 – 0.90	Slightly gravelly CLAY.
Natural Superficial Strata - Granular	1.10 – 2.00	2.00 – 3.90	0.30 – 1.90	Sandy / clayey GRAVEL.

Details are provided in the logs in Appendix B and the individual strata are described in the sections below.

5.2 Made Ground

A concrete layer was present across the site. This concrete was cored inside the building and was observed from ground level to between 0.14m and 0.21m bgl. Small round single pieces of metal reinforcement were observed throughout the concrete cores. Concrete was also observed in the yard and was encountered from ground level to between 0.12m and 0.15m bgl in this area.

Made Ground – General

Made ground was encountered within all the exploratory holes across the site and was observed from ground level to depths between 0.90m and 1.20m bgl. The base of the made ground was not observed in HP01 as the hole was terminated due to a possible service.

The composition of the made ground was fairly consistent across the site. The majority comprised dark brown gravelly clay. The gravel generally consisted of brick, chert, concrete, pottery with occasional coal and rare slate.

In WS03, made ground of light brown and grey sandy gravel with medium cobble content was encountered between 0.12m and 0.32m bgl between the concrete and clay made ground.

5.3 Natural Superficial Strata

Two layers of natural superficial strata were encountered beneath the made ground. The first layer encountered was generally a firm clay with varying amounts of sand and gravel minor constituents. This layer was not encountered in WS02, and no natural strata was encountered in HP01.

Beneath the made ground and natural clay, where present, gravel was encountered from between 1.10m and 2.00m bgl to the base of each hole. The gravel had varying amounts of clay and sand within it. At the base of WS01 between 3.50m and 3.60m bgl was a band of black slightly clayey gravel with a slight hydrocarbon odour. The gravel was generally fine to coarse of chert.

5.4 Solid Geology

The solid geology of the London Clay is not thought to have been encountered in this investigation. Previous reports have discovered a BGS borehole (Ref: TQ39SW228) 230m south west of the site which encountered the London Clay at approximately 5.30m bgl.

5.5 Groundwater

The depths to groundwater and locations present are shown in the table below:

Location	Depth During Site Works (m)	Depth During Monitoring Period (range) (m)
WS01	-	2.09
WS02	-	1.97
WS03	-	1.91
WS04	2.60 - Small seepage	2.10
WS05	-	2.21

5.6 Observations

Contamination

During the works undertaken by BSL, observations for both visual and olfactory evidence of contamination were undertaken.

In WS01 a slight hydrocarbon odour was noted from 3.50m to the base of the hole at 3.60m.

Stability of Boreholes

The borehole sidewalls were generally stable and window sampling progressed without the need to install casing. However, a collapse occurred from 3.60m bgl up to 3.00m bgl in WS01.

6.0 TEST RESULTS

6.1 Geotechnical Laboratory Test Results

Plasticity Index Analysis

Plasticity index results ranged between 30% and 67% indicating the cohesive soils to be of low plasticity. Associated water contents ranged between 23.5% and 46.2%.

After modification of particle size in accordance with BRE 240 the modified plasticity indices are in the range 30% to 67% indicating the cohesive soils to be of medium to very high-volume change potential.

6.2 Aggressive Ground Conditions – Geotechnical Chemical Testing

The test results for the assessment of aggressive ground conditions are presented in Appendix C. The results are summarised and assessed within Section 8.0 of this report.

6.3 In Situ Geotechnical Testing

In Situ Standard Penetration Tests

Standard Penetration Tests (SPTs) were carried out within the window at regular 1.0m intervals. The results of the individual blows and the N-values are recorded on the Exploratory Hole Logs in Appendix B.

All SPT N values are uncorrected. Density and strength descriptors are reported in accordance with the guidelines stated in BS 5930:2015+A1:2020, incorporating requirements of BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and BS EN ISO 14689-1:2003.

6.4 Geo-Environmental Testing

Chemical Laboratory Testing

The chemical test results for soils are presented in Appendix C. The results are summarised and assessed within Section 8.0 of this report.

Photo-Ionisation Detection (PID) Monitoring - Soils

PID head space monitoring was undertaken on all environmental soil samples taken during the ground investigation at the site, the results are recorded on the exploratory hole logs.

All of the samples tested recorded PID results of between 0.0ppm and 0.1ppm, indicating that no significant volatile vapour contamination was present within the soils sampled.

Ground Gas Monitoring

Ground gas monitoring installations have been monitored on 2 occasions to date out of 3 visits scheduled. The results are presented in Appendix F and are summarised and assessed within Section 8.0 of this report.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Ground Model Summary

The ground conditions can be summarised as below (top down):

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- Made ground generally comprising concrete surfacing over gravelly clay from ground level to between 0.90m and 1.20m bgl.
 - Natural superficial deposits comprising clay below the made ground proven to depths between 1.70m and 2.00m bgl, with the exception of HP01 and WS02, where no clay was recorded.
 - Natural superficial deposits comprising gravel from between 1.10m and 2.00m bgl proven to depths between 2.00m and 3.90m bgl.
 - Groundwater levels in WS04 at 2.60m bgl during site works.
 - Post site works monitoring levels ranging between 1.91m and 2.21m bgl.
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Made ground was encountered to depths of between 0.90m to 1.20m bgl and comprised predominantly gravelly clay with brick, concrete, occasional pottery. The natural geology at the site was considered likely to comprise the Enfield Silt Member, which according to information on the BGS website varies from a silt to a clay and is commonly yellow brown.

Deposits consistent with the Enfield Silt Member comprising firm clay were encountered to depths of between 1.70m and 2.00m bgl within all locations with the exception of WS02 where it was absent.

Gravels interpreted as the Kempton Park Gravel were encountered underlying the clay, with the exception of WS02 where the gravels were directly underlying the made ground, to depths of between 2.00m and 3.60m bgl. The gravels comprised an orange to brown sandy to clayey gravel.

The site appears to have been cut to form a level development at some point, as there is an embankment 2-3m above the current site levels on the eastern boundary of the site along Watermead Way. Levels also increase northwards as Sedge Road is elevated above current site level.

The absence of the deposits interpreted as the Enfield Silt Member within WS02 could potentially be due to the levelling of the site as discussed above or due to historic development on the site e.g., the construction of the buildings.

According to the Environment Agency the site is situated on unproductive deposits (Enfield Silt Member) however the Kempton Park Gravel formation outcrops 30m east of the site is also considered to be present beneath the site and is classified as a Secondary (A) Aquifer.

The encountered ground conditions indicate that there is a thin layer of low permeability deposits present beneath the made ground which is likely to offer some degree of protection to the possible water bearing deposits underlying the site.

London Clay has been encountered in a nearby BGS boreholes at around 5.30m bgl, beyond the maximum depth of this investigation.

The site lies within a Zone 2 floodplain. Specialist flood risk advice should be sought, and this will require consideration when setting the finished levels for the site.

7.2 Design Soil Parameters

The relevant test results from the prior section have been evaluated to derive geotechnical soil parameters for the site in the following section.

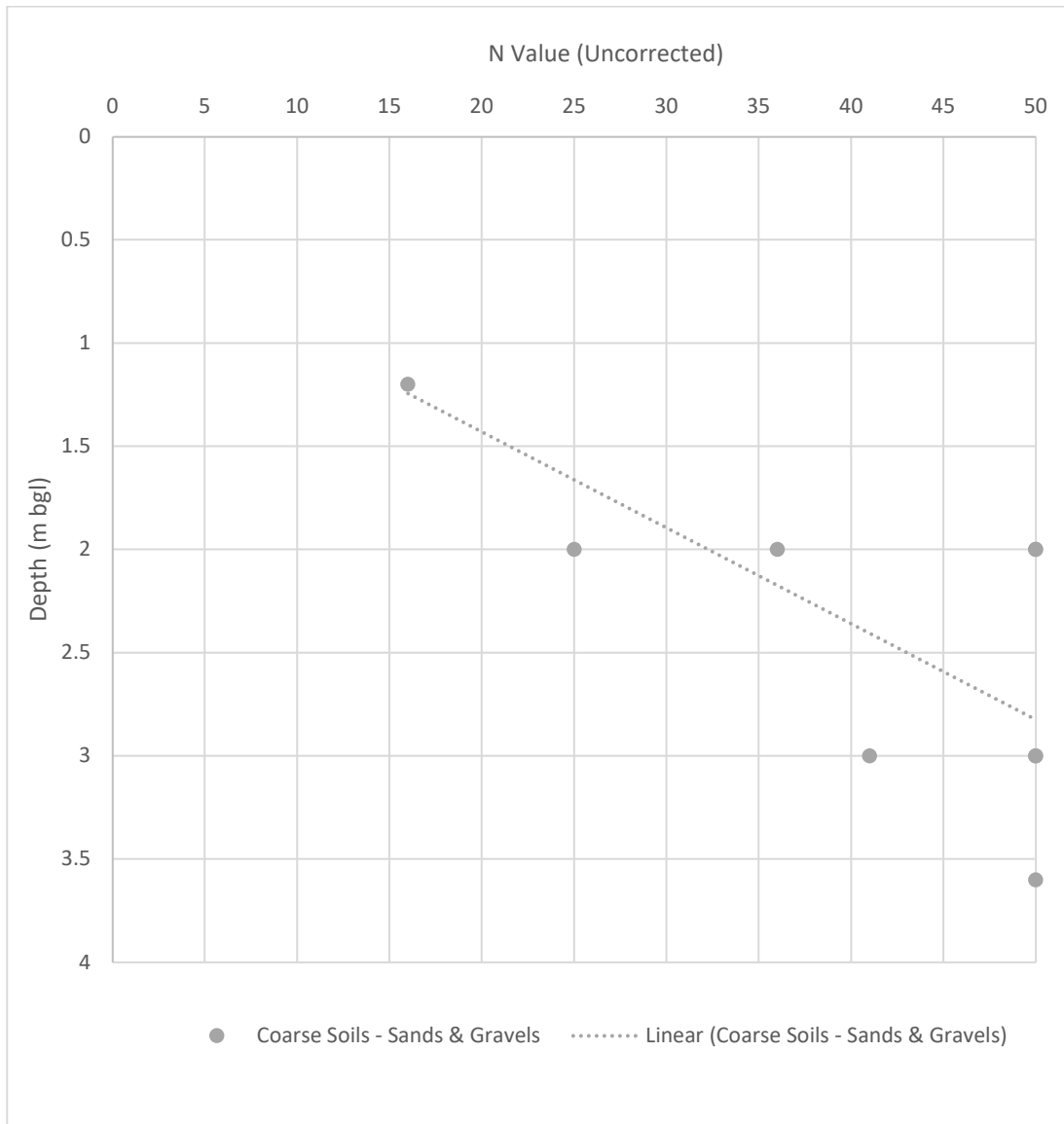
For cohesive (fine) soils, the equivalent approximate undrained shear strengths (C_u) and equivalent approximate coefficients of volume compressibility (m_v) have been calculated from the recorded SPT N values, adopting f_1 and f_2 values respectively, based on the correlation of Stroud (1975) and the 'average' plasticity.

The f_1 and f_2 values of 4.3 and 0.45 respectively have been selected to provide a conservative assessment of the ground bearing capacity.

For granular (coarse) soils, the angle of shearing resistance (ϕ') has been derived from the uncorrected SPT N value data and the correlation of Peck (1967).

A depth (m bgl) vs derived shear strength (C_u) relationship has been calculated. There is limited data for the cohesive deposits as they were only observed in a thin layer and were not observed across the whole site, therefore a graph has not been produced. The SPT data for the cohesive deposits shows an undrained shear strength of 20kPa is achieved at 1.20m bgl. .

A depth (m bgl) vs SPT N value graph is provided below to provide a profile of the granular materials underlying the site.



The above graph shows a general increase in soil density as depth increases.

Characteristic Values

Characterisation of the geotechnical parameters above has been undertaken to obtain characteristic values, which are a cautious estimate of the values affecting the occurrence of the limit state.

The characteristic value for undrained shear strength (C_u) in cohesive deposits at 1.20mbgl is interpreted to be 20kN/m^2 , however this is not recommended as a founding stratum due to its inconsistent presence.

The characteristic SPT N value in the granular deposits at 2.00m bgl is interpreted to be 30. Therefore, the characteristic ϕ' value at 2.00m bgl is interpreted to be 36° for Ultimate Limit State conditions. The characteristic SPT N value in the granular deposits at 3.00m bgl is interpreted to be 41, which is the lowest recorded N value, with the other two locations refusing at this depth (N value 50+). Therefore, the characteristic ϕ' value at 3.00m bgl is interpreted to be 38° for Ultimate Limit State conditions.

7.3 Foundations

The development will comprise a commercial end use comprising a six-storey steel framed storage unit building and associated internal/covered car park areas and is considered to be classed as Geotechnical Category 2 in accordance with Eurocode 7.

Preliminary design by calculation has been undertaken to determine the design resistance of the bearing strata in the following section. No proposed structural loads were available at the time of writing; therefore, the following recommendations are provisional and should be reviewed at the detailed design stage. However, for the purpose of this assessment a typical load of 50kN has been assumed per storey.

Shallow Foundations – Pad

No details of the foundation design have been provided, however assuming a steel frame it is assumed the majority of the load will be put through these point loads, making a pad type foundation applicable. As a guide the allowable bearing capacity for a Pad foundation with an area of 1m² has been calculated. This is assumed to have been placed within the natural gravel strata at a minimum depth of 2.00m bgl.

At this depth, an allowable bearing capacity not exceeding 500kN/m² should be assumed for the gravel. This adopts a factor of safety of 3 and limits settlements to within acceptable limits (<25mm).

If the pad foundation is placed at 3.00m bgl an allowable bearing capacity not exceeding 1000kN/m² should be assumed for the gravel. This adopts a factor of safety of 3 and limits settlements to within acceptable limits (<25mm).

The limiting factor for the safe bearing capacity is keeping settlement within 25mm. For foundations bearing within the gravels, the depth to the underlying London Clay is estimated to be circa 5m bgl based on BGS boreholes, and presence of shallow groundwater is a controlling factor. The current investigation has not encountered the London Clay; therefore, it is recommended for initial design purposes pending additional investigation to investigate the depth to the London Clay that a maximum bearing capacity of 500kN/m² for strip foundations is used.

Shallow Foundations – Strip

No details of the foundation design have been provided. However, it is envisaged that structural masonry skin of the building may be supported upon a strip foundation, as a guide the allowable bearing capacity for a shallow strip foundation, 0.6m wide has been calculated, founding within the natural gravel strata at a minimum depth of 2.00m bgl.

At this depth, an allowable bearing capacity not exceeding 500kN/m² should be assumed for the gravel. This adopts a factor of safety of 3 and limits settlements to within acceptable limits (<25mm).

If the strip foundation is placed at 3.00m bgl, an allowable bearing capacity of 1000kN/m² should be assumed. This adopts a factor of safety of 3 and limits settlements to within acceptable limits (<25mm).

The limiting factor for the safe bearing capacity is keeping settlement within 25mm. For foundations bearing within the gravels, the depth to the underlying London Clay is estimated to be circa 5m bgl based on BGS boreholes, and presence of shallow groundwater is a controlling factor. The current investigation has not encountered the London Clay; therefore, it is recommended for initial design purposes pending additional investigation to investigate the depth to the London Clay that a maximum bearing capacity of 500kN/m² for strip foundations is used.

Piles

According to the drawing provided by the client provides indicative drawings of the proposed development, the development will consist of a 6-story building. The indicative drawings also show under-

croft parking, therefore there is likely to be a requirement for columns to support the building above the carparking area.

The under-croft parking will comprise nearly 50% of the ground floor footprint and will need to be considered when designing foundations. These columns would provide a point load to any foundations and therefore the development may require piled foundations.

It may be suitable to utilise pad foundations to support column loads, however this is subject to detailed foundation design. If higher loads are envisaged, or if basement excavation is envisaged then deeper exploratory holes will be required.

7.4 Building Near Trees

Presently, a number of semi-mature trees are located along the eastern site boundary, however the proposed development indicates that these trees will be removed alongside all other vegetation, with no new planting undertaken. The volume change potential for the clay soils is medium to very high. Where foundation excavations (or piles if adopted) encounter cohesive strata in the vicinity of existing, proposed or recently removed trees, foundations should be adjusted in full accordance with BRE 298. All foundations should be deepened below roots of greater than 5mm diameter during excavations for footings.

A survey of all trees and hedges on the site and within influencing distance of the site boundary should be undertaken to identify tree species and heights by a qualified arboriculturist in accordance with BS 5837:2012. This information will be required in order to assess the effects of trees on the cohesive strata.

Where foundation depths due to trees already present or recently removed exceeds 1.50m, there is a possibility for heave to occur on removal of the tree and guidance states that compressible material or void former is required against the inside face of the foundation, unless it can be satisfied that the soil is not desiccated.

This section of the report will be updated with further recommendations once laboratory data has been received.

7.5 Floor Slabs

A suspended floor slab could be adopted at the site supported by a suitable foundation solution. Given the presence of cohesive (shrinkable) strata, the required void size for beneath floor slabs on this site is 300mm based on the medium to very high volume change potential clays.

For buildings where suspended construction is structurally inappropriate, a hardcore thickness in excess of 600 mm may be employed below a ground bearing slab providing it is designed and supervised by an appropriately qualified engineer.

Ground bearing slabs may be adopted providing the following criteria are satisfied:

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- Any other compressible or unsuitable materials are excavated and either improved or removed and replaced with suitable materials.
 - It is demonstrated that desiccation in cohesive soils is not present.
 - Any fill beneath the slab is suitable, well-compacted granular material placed in an appropriate thickness in accordance with a suitable specification (e.g., SHW Series 600) designed and supervised by an appropriately qualified engineer, with the end performance validated.
 - The slab is adequately reinforced.
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- Regular construction joints and ties are provided to allow for differential settlement.

The final floor slab design should be of sufficient thickness and sufficiently reinforced to accept the envisaged applied loads, without unacceptable total or differential movement.

Vertical elements within the structure, such as columns and walls will need to be isolated from the ground bearing slab in order to allow for the slab to expand against them without resulting in cracking.

Prior to the placement of the founding materials and the construction of a ground bearing floor slab, the sub-formation and formation will need to be inspected and checked by a geotechnical engineer to ensure the ground conditions are as expected. If soft spots or hard spots are identified at the formation level, they should be reported to the Geotechnical Engineer immediately and remedial actions agreed.

Results to date do not indicate ground gas protection measures will be required at present, subject to ongoing monitoring and regulatory confirmation.

7.6 Site Preparation and Construction

Topsoil and subsoil should be removed from beneath all buildings and hardstanding areas.

There are a number of services crossing the site, an unknown service crosses through the centre of the factory and multiple service run to the front of the building from Garman Road. To allow construction, all services will need to be disconnected and any suspected dead services are confirmed as dead by testing. Extra care will be required when working near to the 132kv fluid filled cables present to the north and east of the site. Consultation with the operator(s) of the fluid filled cables may also be necessary.

Instability of excavations through natural soils is not anticipated provided they are not exposed to adverse weather conditions for any substantial period of time. Instability of the made ground should be allowed for. All excavations should be carried out in accordance with CIRIA Report 97 'Trenching Practice'.

Excavation depths should generally be readily achieved using conventional plant (JCB or similar) although high specification plant (tracked 360° or similar) is recommended to maintain the build programme. Breaking equipment will also be required to penetrate concrete hardstanding associated with former construction.

7.7 Concrete Classification

The soluble sulphate and Ph test results have been assessed in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005. The Design Sulphate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in the table below.

For the purposes of this assessment, the made ground and natural clay strata are considered to be relatively impermeable, therefore the groundwater has been classed as static. The natural gravel strata is permeable and classed as mobile.

Stratum	No. Samples	Characteristic SO ₄ (mg/l)	Characteristic pH	DS Class	ACEC Class
Made Ground	6	355.50	7.5	DS1	AC-1s
Natural Superficial Strata-Clay	2	459.15	7.9	DS1	AC-1s
Natural Superficial Strata-Gravel	4	358.21	6.5	DS-1	AC-2z

Based on the above, the results of laboratory pH and sulphate content, alongside the BRE full suite tests, indicate that sulphate class DS-1 and ACEC Class AC-1s conditions prevail in made ground and clay whilst DS-1 and AC-2z conditions prevail in gravel in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005.

The site according to the published geology is situated on solid geology of the London Clay Formation, these were not encountered during the investigation, however the London Clay is likely to be pyritic.

The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site-specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

7.8 Highways

Based on Table 5.1 from DMRB IAN 73/06 Rev 1 equilibrium CBR values of between 20 – 60 % are likely to be achieved in undisturbed natural granular soils and 2% for natural clay soils for pavement design purposes, unless proven otherwise by in-situ testing at formation level by a specialist geotechnical engineer. Equilibrium CBR values are likely to be 2% within the made ground.

Where the CBR is found to be less than 2%, the sub-grade is unlikely to be suitable for both the trafficking of site plant and as a permanent highway foundation without improvement of the soils.

To achieve the required design CBR value, improvement works may be required in accordance with DMRB IAN 73/06 Rev 1 Chapter 5 and may include proof rolling, excavation and re-engineering / replacement of weaker soils, the inclusion of a geogrid or use of stabilisation techniques such as the addition of hydraulic binders (e.g., cement/lime).

Based on the fines content of the soils, they are considered to be frost susceptible, therefore highway construction should be a minimum thickness of 450mm to mitigate against the risk.

Care should be taken to ensure the stratum at formation level is protected against inclement weather, as this is likely to lead to surface deterioration and a decrease in soils strengths.

7.9 Sustainable Drainage Systems (SUDS)

The use of sustainable drainage systems, such as traditional soakaways within the shallow soils is not likely to be feasible due to the presence of low permeability cohesive strata underlying the site at shallow depths.

However, should the soakaway be excavated into the underlying sands and gravels, the use of sustainable drainage systems may be feasible.

If the use of sustainable drainage systems, such as traditional soakaways is anticipated, dependant on the location and depth proposed, this drainage system may be feasible. Low permeability, cohesive strata was generally encountered beneath the made ground to circa 2.0m bgl, and soakaway drainage would not be feasible in this zone, however if soakaways are deepened, to sit within the more permeable sand and gravel stratum, then it is possible that soakaways would be feasible. The soakaways should avoid any areas of contamination.

It is recommended that if soakaway drainage is proposed that on-site infiltration testing is undertaken.

8.0 GEO-ENVIRONMENTAL RISK ASSESSMENT

8.1 Introduction

The samples were tested for an assessment of the chemical contamination that may pose a risk to human health. The results were examined with reference to a selection of guidance documents as detailed in Appendix A. In this case the LQM S4ULs and DEFRA C4SLs for a commercial end use have been adopted as Tier 1 generic screening values.

The apparent exceedance of the relevant screening value is taken as indicating further detailed assessment or remedial action is required.

A summary assessment sheet is presented in Appendix C alongside the chemical test results. Results are discussed in detail in the sections below.

8.2 Soils Test Results and Risk Assessment – Human Health

Metals

No metals have been detected above the adopted screening criteria for commercial end use. As well as this, the majority of metals were found to be below the laboratory limits of detection (<LOD).

Asbestos

Chrysotile fibres have been detected in one sample from HP01 at 0.90m. Quantification analysis found the asbestos level to be <0.001% mass and is therefore classified as being trace levels.

Poly Aromatic Hydrocarbons (PAHs)

No PAHs have been detected above the adopted screening criteria. Generally, the PAHs were recorded below the laboratory LOD, with any other results being orders of magnitude below the screening criteria.

Total Petroleum Hydrocarbons (TPH CWG)

No petroleum hydrocarbons have been identified above the adopted screening criteria, including from the sample (WS01 at 3.50m) which was thought to have been identified as having a hydrocarbon odour during the site works.

BTEX and MTBE

No BTEX or MTBE compounds have been identified above the adopted screening criteria, all samples were below the limit of detection.

Volatile Organic Compounds (VOCs)

No VOCs have been identified above the laboratory limit of detection.

8.3 Summary – Human Health Risk Assessment

Based on the testing and assessment undertaken, there are no determinands above the relevant assessment criteria and mitigation measures will not be required in respect to soils.

Chrysotile asbestos fibres have been detected in one sample to date and was found to be at trace levels.

8.4 Controlled Waters Risk Assessment

Based on the lack of contaminants present within soils and the lack of significant on-site sources, there are not considered to be any significant risks with respect to controlled waters.

A slight hydrocarbon odour was noted between 3.50m and 3.60m bgl in WS01 within the gravel, however a sample taken from this location recorded no TPHs, BTEX or PAHs above the laboratory limit of detection.

During the monitoring visit, no sheen, odour, or product was observed on the water recovered.

Based on olfactory evidence of contamination the likelihood of any impact to controlled waters from on-site contamination is considered unlikely.

8.5 Permanent Ground Gas and Vapours Results

To date, two ground gas monitoring visits have been carried out on 7th April and 21st April 2022. A further 1 visit is scheduled. Results are summarised in the table below:

	CH ₄ (%)		CO ₂ (%)		O ₂ (%)		CO (ppm)		H ₂ S (ppm)		TVOC (ppm)		Steady Flow (l/hr)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Peak	0.1	0.1	0.2	5.8	9.7	19.4	0.1	0.1	0.0	0.0	0.0	0.0	0.1	2.1
Steady	0.1	0.1	0.1	5.8	9.7	19.7							0.1	0.1

Notes: CH₄ = Methane; CO₂ = Carbon dioxide; O₂ = Oxygen; CO = Carbon Monoxide; H₂S = Hydrogen Sulphide; TVOC (PID) = Total Volatile Organic Compounds (as measured with Photo Ionisation Detector); ppm = Parts Per Million.

The highest carbon dioxide concentrations were recorded in WS02 (4.6% v/v) on the first visit and (5.8% v/v) on the second visit. The maximum flow of 2.1 l/hr was recorded in WS04 on the first visit.

The atmospheric pressure ranged between 981mb and 1009mb over the monitoring period, of which visits were conducted over falling pressure trends.

In addition to the above, PID head space monitoring was undertaken on all environmental soil samples taken during the ground investigation at the site, the results are recorded on the exploratory hole logs.

All of the samples tested recorded PID results of 0.0ppm, indicating that no significant volatile vapour contamination was present.

8.6 Ground Gas Risk Assessment

In order to assess the ground gas situation and the requirement for ground gas precautionary measures at the site, guidance was taken from CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' and BS8485:2015+A1:2019 'Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

As the proposed end-use a commercial development, guidance dictates that the gas monitoring results should be assessed in accordance with the Wilson and Card methodology.

The Wilson and Card methodology uses the concept of a Gas Screening Value (GSV) which is derived using the following equation: (max gas concentration / 100) x maximum flow.

A maximum positive steady flow of 0.1l/hr has been used to derive the GSVs. The GSV's for the site are presented below.

Gas	GSV (l/h)	Classification Based on GSV	Typical Threshold Concentration Exceeded
Methane	0.0001	CS-1	No
Carbon Dioxide	0.0058	CS-1	No

The GSV for carbon dioxide and methane place the site the site into Characteristic Situation 1 (CS1).

The concentration of carbon dioxide did exceed the typical threshold value of 5% v/v in WS02 (5.8% v/v) during the second monitoring visit. A value of 4.6% v/v for carbon dioxide was measured in WS02 during the previous monitoring visit. As there has only been one exceedance to date, the site is still considered as CS-1 based on the GSV.

Confirmation of the Characterisation Situation will be made following completion of the current monitoring period.

8.7 Qualitative Risk Assessment

The CSM has been revised based on the findings of the site investigation and laboratory testing results and these are presented overleaf. Unless stated otherwise, in respect to off-site sources, only risks that are assessed as moderate and above within the preliminary CSM have been carried forward to this section, or where a previously unidentified potential source, pathway and / or receptor has been identified from the recent site works.

Human Health						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
On-site Made Ground Metals and organic contamination	Migration into/chemical attack of water supply pipelines	Water Pipelines / End users	Unlikely	Mild	Very Low	Made ground is present across the site and was encountered to proven depths of between 0.90m 1.20m bgl. No contaminants were observed within the made ground. The risk is considered to be very low at this stage.
On-site Made ground Ground Gas (carbon dioxide and methane),	Migration into confined spaces, inhalation, and asphyxiation/explosion	End-users / property / structures	Unlikely	Severe	CS1 (Very Low Risk)	Made ground is present across the site and was encountered to proven depths of between 0.90m 1.20m bgl. It is likely that due to the age of the made ground, the majority of degassing is likely to have ceased. Gas monitoring on-site to date places the site into Characteristic Situation 1 (CS1 – Very Low Risk) however monitoring is underway, and the gas assessment will be updated following completion of the monitoring programme.
On-site furniture works. Solvents, fuels, paints, oils	Inhalation of vapours	End-users / property / structures	Unlikely	Medium	Low	Solvents, fuels, paints, and varnishes may have been used on site in the manufacture of furniture, with vapours accumulating within buildings and being inhaled. However, these are likely to have been used in small volumes. There was no evidence of contamination around the site e.g. surface staining, all samples tested for VOCs and petroleum hydrocarbons were below relevant generic assessment criteria, with the majority also being below the laboratory limits of detection. Given this, it is unlikely that vapour contamination associated with the furniture works will affect end-users, property or structures and risks are considered to be low.
Off-site Natural Geology - Alluvium Ground Gas	Migration into confined spaces, inhalation, and asphyxiation/explosion	End-users / property / structures	Implausible	Severe	No Linkage	It has been assumed that no alluvium was encountered beneath the site. The layer of clay has been interpreted as the Enfield Silt member and the gravel layer has been interpreted as the Kempton Park gravel member.

Controlled Waters						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
On site Works (Paper, Cardboard and furniture manufacturing), including made ground On site PAH's, Metals, solvents, paints, varnishes	Leaching through unsaturated zone / Migration through saturated zone	Superficial Aquifers (Unproductive/ Secondary (A))	Unlikely	Medium	Low	The proposed development includes construction of a structure across the majority of the site. As well as this, site is currently surfaced in hardstanding and any open areas will remain so when developed. The combination of these two factors will significantly reduce the leaching potential of water falling on the site, which will reduce risks to controlled waters. The nearest active groundwater abstraction licence is 0.77km away. The site lies within a Zone II Source Protection Zone. There are several wells in the vicinity of the site, two of which are active and relate to potable drinking water abstraction, they are considered a sensitive receptor. However, two of the aquifers (bedrock and superficial Enfield Silt Member) are unproductive, comprising low permeability clays, limiting the migration and mobilisation of contaminants. Permeable deposits are present on-site underlying the unproductive aquifer. No significant on-site sources of contamination have been encountered, and no contaminants were recorded above their respective screening values within soils. As well as this, the majority of determinands were found to be below the laboratory limits of detection, and therefore it is not thought that any significant contamination is present on-site with respect to the on-site works. The risks to groundwater are considered to be low.
	Overland flow / migration along and within drainage	Pymme's Brook 230m away (Surface waters)	Unlikely	Medium	Low	No contaminants were identified above the commercial GAC, with the majority of determinands being below the laboratory limits of detection. As well as this, if present, any residual contamination would be unlikely to impact the river due to the low permeability of the clays underlying the area, which will inhibit lateral migration to drains. Any contamination reaching the drains is also likely to be diluted and attenuate prior to discharge into river. Risks to the river are considered to be low.

Controlled Waters						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
	Migration through saturated zone	Pymme's Brook 230m away (Surface waters)	Unlikely	Medium	Low	No contaminants were identified above the commercial GAC, with the majority of determinands being below the laboratory limits of detection. The clays underlying the area are of low permeability, which will inhibit vertical migration to the water table. The risks to the river are considered to be low.

8.8 Outline Remedial Measures

The level of protection for the clean potable water supply pipes should be determined using the local water company risk assessment criteria in accordance with UKWIR.

No significant sources of contamination have been identified on site; therefore, no specific remedial measures are required for soils in respect to human health for the proposed end use.

Gas monitoring is ongoing, any remedial measures required will be discussed upon completion of the gas monitoring. At present, not gas protection measures are considered to be required.

8.9 Health and Safety Issues

During the reclamation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk
Made Ground (heavy metals, PAHs, petroleum hydrocarbons)	Ingestion, direct contact, inhalation of dusts.	Construction Workers	Low Likelihood	Mild	Low
Asbestos	Ingestion, direct contact, inhalation of dusts.	Construction Workers	Likely	Medium	Moderate
Ground gas	Inhalation in confined spaces/trenches	Construction Workers	Low likelihood	Severe	Moderate

Trace levels of Chrysotile asbestos has been identified in one sample to date, however seven other samples were tested within the made ground across the site with no trace of asbestos. It is assumed that the asbestos was localised to the area surrounding HP01. Asbestos has previously been identified within the building which will require removal prior to demolition. The risk from asbestos should be highlighted in the method statements and site induction. If further evidence of asbestos is encountered in the soils, work should cease until asbestos control measures have been agreed and put in place. Asbestos is further discussed in Section 8.10 below.

The risk from made ground will be mitigated by standard PPE including gloves. Welfare facilities should be made available to wash before hand to mouth activities.

General guidance on these matters is given in the Health and Safety Executive (HSE) document “Protection of Workers and the General Public during the Redevelopment of Contaminated Land.” In summary, the following measures are suggested to provide a minimum level of protection:

- All ground workers should be issued with the relevant protective clothing, footwear, and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.
- Handwashing and boot-washing facilities should be provided.
- Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
- Good practices relating to personal hygiene should be adopted on the site.

-
- The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety, and welfare of persons on the site.
-

8.10 Asbestos

The investigation of asbestos issues within structures was beyond the scope of this report. However, guidance from UK Government indicates that asbestos should be assumed to be present in buildings unless proven otherwise.

Asbestos was previously detected in the building within cement, flash guards, cement ceiling, floor tiles, cement guttering and cement corrugated profile sheets. These materials were observed externally and within the ladies toilet, lobby, canteen, welfare room, offices, men's toilets, and warehouse. Any asbestos within structures will require removal prior to re-development. This will need to be done by a suitably qualified experienced and licensed contractor, who ensures that adequate PPE is provided to operatives, and that all the relevant legislation is adhered to.

In addition, the presence of asbestos within the ground will require, a safe system of work to be set up on site to deal with the asbestos risk from the made ground. This may include but be not limited to:

-
- The use of qualified personnel where required.
 - Cleaning down of machinery in designated areas.
 - Decontamination unit for ground workers.
 - Damping down of soils to prevent dust migration.
-

Asbestos fibres have been identified in one sample at the site with the asbestos level within the sample being quantified as <0.001% mass and classified as being trace levels. At these concentrations the liberation of fibres is considered to be unlikely and no specific precautionary measures with regards to asbestos are likely to be required at the site. The level of precautions required are at the discretion of the principal contractor on site however good site practices including minimising the generation of dusts should be adhered to and sufficient to mitigate against the risk from asbestos. In addition, site personnel should have the risk communicated at the induction stage. It is recommended that the asbestos in construction materials assessment tool is used at the site to inform asbestos licensing and control measures.

Excavations in soils containing asbestos should comply with the CL:AIRE publication 'Interpretation for Managing and working with Asbestos in Soil and Construction and Demolition Materials' (CARSOIL) and CAR 2012. All such works will need to be agreed with the regulatory bodies (HSE and/or LA).

Additional guidance is provided within the BSL methodology Guidance Note in Appendix A.

9.0 CONCLUSIONS

9.1 Geo-Environmental

Geo-Environmental – Human Health

Testing of the made ground at the site did not reveal any exceedances of heavy metals, PAHs, petroleum hydrocarbons, BTEX or MTBE compounds.

Chrysotile fibres (loose fibres) have been detected in one sample of made ground across the site. On quantification analysis the asbestos level within the sample was <0.001% mass and classified as being trace levels.

Ground gas monitoring has revealed a maximum peak carbon dioxide concentration of 5.8%v/v and methane concentrations of 0.1%v/v. Based on the gas monitoring to date the site is classified as Characteristic Situation 1 and no ground gas protection measures are required.

Geo-Environmental – Controlled Waters

The overall risk to controlled waters is considered to be low.

9.2 Geotechnical

Foundations

It is understood the proposed building is steel framed and will provide point loads to the ground. Shallow pad foundations may be placed within the natural gravel strata at a minimum depth of 2.00m bgl, for a 1m² pad an allowable bearing capacity not exceeding 500kN/ m² should be assumed for the gravel. If higher loads than this are envisaged, or if the undercroft parking is proposed to be at a basement level then deeper site investigation would be required.

Strip foundations may be utilised to support external masonry placed within the natural gravel strata at a minimum depth of 2.00m bgl, for a 0.6m wide foundation an allowable bearing capacity not exceeding 500kN/m² should be assumed for the gravel.

Floor slabs

Given the design choice for undercroft parking, a ground bearing floor slab is likely to be the preferred construction choice for the proposed development, provided the criteria described in Section 7.5 are met.

Concrete classification

Sulphate class DS-1 and ACEC Class AC-1s conditions prevail in the made ground and clay whilst DS-1 and ACEC Class AC-2z conditions prevail within the gravel. The solid geology underlying the site is the London Clay which can be pyritic additional precautions against aggressive ground conditions are likely to be required.

Highways

CBR values of 20-60% are likely to be achieved in undisturbed natural gravel soils and 2% for natural clay soils. Should be confirmed by on-site in-situ testing.

Drainage (SUDS)

Not likely to be feasible within the low permeability cohesive strata. However, these deposits may be locally absent and soakaways could be excavated into the underlying more permeable strata which are likely to be effective.

9.3 Further Work

The following further work is considered necessary to progress the site to construction phase:

-
- Completion of ground gas monitoring programme.
 - Issue gas assessment / update gas assessment within this report.
 - If higher structural loads are anticipated than discussed in 7.3, or if basement excavation is considered, then deeper exploratory holes will be required to confirm foundation design.
 - Comprising: Cable Percussive boreholes to increase coverage, allow deeper piled foundation design and increase confidence of potential shallow design.
 - Demolition Asbestos survey.
 - Detailed foundation design by a structural engineer, including foundation zonation plan and depth schedule.
-

10.0 ABBREVIATIONS AND DEFINITIONS

GLOSSARY	
Term / Abbreviation	Definition
AST	Above Ground Storage Tank.
B(a)P	Benzo (a) Pyrene.
BGS	British Geological Survey.
BRE	Building Research Establishment.
BS	British Standard.
BSL	Brownfield Solutions Ltd.
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes.
CBR	California Bearing Ratio (used in pavement/highways design).
CAR 2012	Control of Asbestos Regulations (2012).
CBCB	Cheshire Brine Compensation Board.
CBCD	Cheshire Brine Compensation District.
CBR	California Bearing Ratio.
CIEH	Chartered Institute of Environmental Health.
CIRIA	Construction Industry Research Association.
CL:AIRE	Contaminated Land: Applications in Real Environments.
CLEA	Contaminated Land Exposure Assessment.
CLO	Contaminated Land Officer.
COMAH	Control of Major Accident Hazards.
Contamination	Presence of a substance which is in, on or under land, and which has the potential to cause significant harm or to cause significant pollution of controlled water. There is no assumption in this definition that harm results from the presence of the contamination. Naturally enhanced concentrations of harmful substances can fall within this definition of contamination. Contamination may relate to soils, surface water, groundwater, or ground gas.
Controlled Waters	Inland freshwater (any lake, pond, or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three-mile limit of territorial waters.
CPT	Cone Penetration Test.
CSM	Conceptual Site Model. A schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information from the preliminary investigation and refined during subsequent phases of investigation and which is an essential part of the risk assessment process. The conceptual site model is initially derived from the information obtained by the preliminary investigation (i.e., the Phase I Desk Study). This conceptual model is used to focus subsequent investigations, where these are considered to be necessary, in order to meet the objectives of the investigations and the risk assessment. The results of intrusive investigations can provide additional data that can be used to further refine the conceptual site model.
DCP	Dynamic Cone Penetrometer.
DNAPL	Dense Non-Aqueous Phase Liquid.
DoWCoP	Definition of Waste Code of Practice.
DWS	Drinking Water Standard.
EA	Environment Agency.
EHO	Environmental health Officer.
EQS	Environmental Quality Standard.
GAC	Generic Assessment Criteria.

GLOSSARY	
Term / Abbreviation	Definition
GDR	Geotechnical Design Report.
GFR	Geotechnical Feedback Report.
GIR	Ground Investigation Report.
GSV	Gas Screening Value.
Harm	Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of human health, including property/structures and water supply pipelines.
Hazard	Inherently dangerous quality of a substance, procedure, or event.
HDPE	High Density Polyethylene.
HSV	Hand Shear Vane.
K	Modulus of Subgrade Reaction.
LCRM	Land Contamination: Risk Management (EA guidance).
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene).
LOD	Limit of Detection (for particular method adopted).
MMP	Materials Management Plan.
Mv	Modulus of Volume of Compressibility.
ND	Not Detected.
NHBC	National House Building Council.
NR	Not Recorded.
OS	Ordnance Survey.
PAH	Polycyclic Aromatic Hydrocarbon.
Pathway	Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.
PCB	Poly-Chlorinated Biphenyl.
PCSM	Preliminary Conceptual Site Model.
pH	Scale used to specify how acidic or basic a water-based solution is.
PHC	Petroleum Hydrocarbons.
PID	Photo Ionisation Detector.
PNEC	Predicted No-Effect Concentration.
Precision	Level of agreement within a series of measurements of a parameter.
PSD	Particle Size Distribution.
PVC	Polyvinyl Chloride.
Receptor	Human health, living organisms, ecological systems, controlled waters (surface waters and groundwater within aquifers), atmosphere, structures and utilities that could potentially be adversely affected by contaminant(s).
Risk	Probability of the occurrence, magnitude, and consequences of an unwanted adverse effect on a receptor.
Risk Assessment	Process of establishing, to the extent possible, the existence, nature, and significance of risk.
Sampling	Methods and techniques used to obtain a representative sample of the material under investigation.
SOM	Soil Organic Matter.
Source	Location from which contamination is, or was, derived. This could possibly be the location of the highest soil, groundwater, or gas concentration of the contaminant(s).
SPT	Standard Penetration Test.
SVOCs	Semi Volatile Organic Compounds.
TOC	Total Organic Carbon.
TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group).

GLOSSARY	
Term / Abbreviation	Definition
TVOCs	Total volatile organic compounds.
UCS	Unconfined Compressive Strength.
Uncertainty	Parameter, associated with the result of a measurement that characterises the dispersion of the values that could reasonably be attributed to the measurement.
UST	Underground Storage Tank.
UXO	Unexploded Ordnance.
VCCs	Vibro Concrete Columns.
VSCs	Vibro Stone Columns
VOCs	Volatile Organic Compounds.
WAC	Waste Assessment Criteria.
WFD (in waste context)	Waste Framework Directive.
WFD (in water context)	Water Framework Directive.
Units	Definition
°	Degrees
Φ	Phi angle (in degrees)
g/l	Grams per Litre
Km	Kilometres
kPa	Kilo Pascal (Equivalent to kN/m ²)
KN/m ² /mm	Kilo Newton per metered squared per millimeter
kN/m ²	Kilo Newtons per metre squared
kPa	Kilo Pascal (Equivalent to kN/m ²)
l/hr	Litres per hour
MJ/kg	Mega joule per kilogram
MN	Mega Newton
M ² /MN	Mega Newton per metre squared
M	Metres
m bgl	Metres Below Ground Level
m OD	Metres Ordnance Datum (sea level)
µg/l	Micrograms per Litre (parts per billion)
µm	Micrometre
mb	Millibars (atmospheric pressure)
mg/kg	Milligrams per kilogram (parts per million)
mg/m ³	Milligram per metre cubed
mm	Millimetre
ppb	Parts Per Billion
Ppm	Parts Per Million

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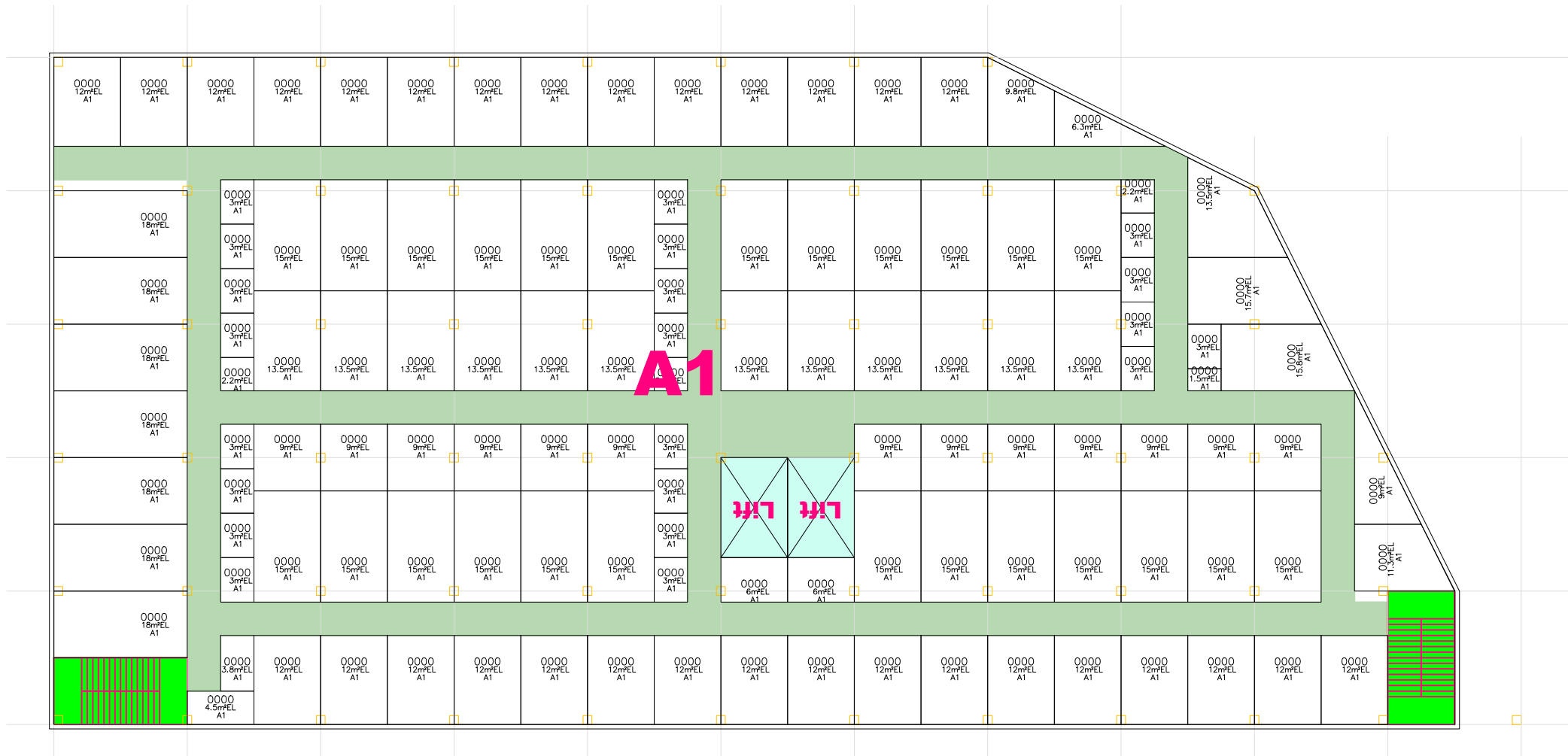
DRAWINGS



DRAWN: EA
DATE: 9 December 2021

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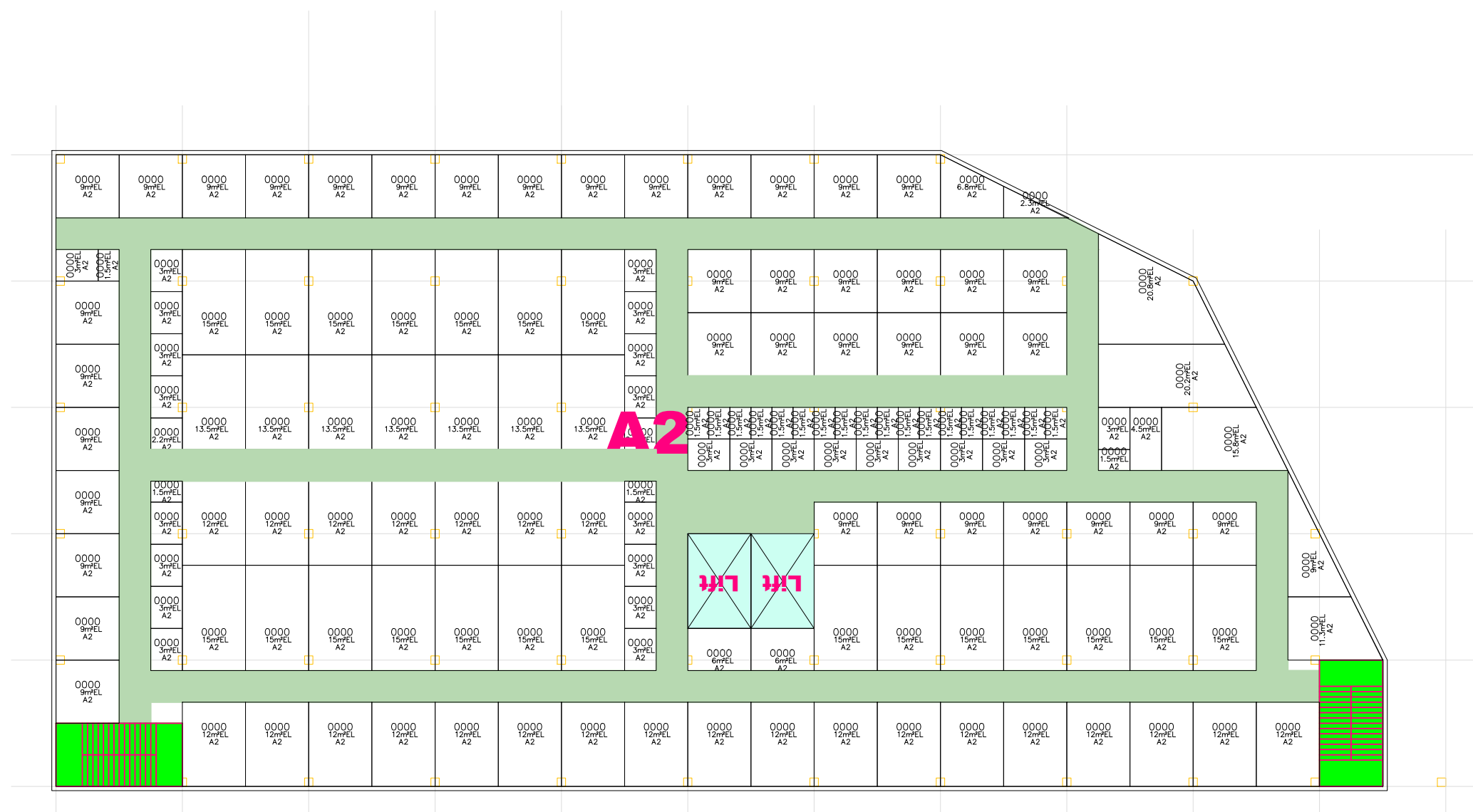


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DATE: 9 December 2021

SK02

FIRST FLOOR

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SECOND FLOOR

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TOTTENHAM
GARMAN ROAD 45-47

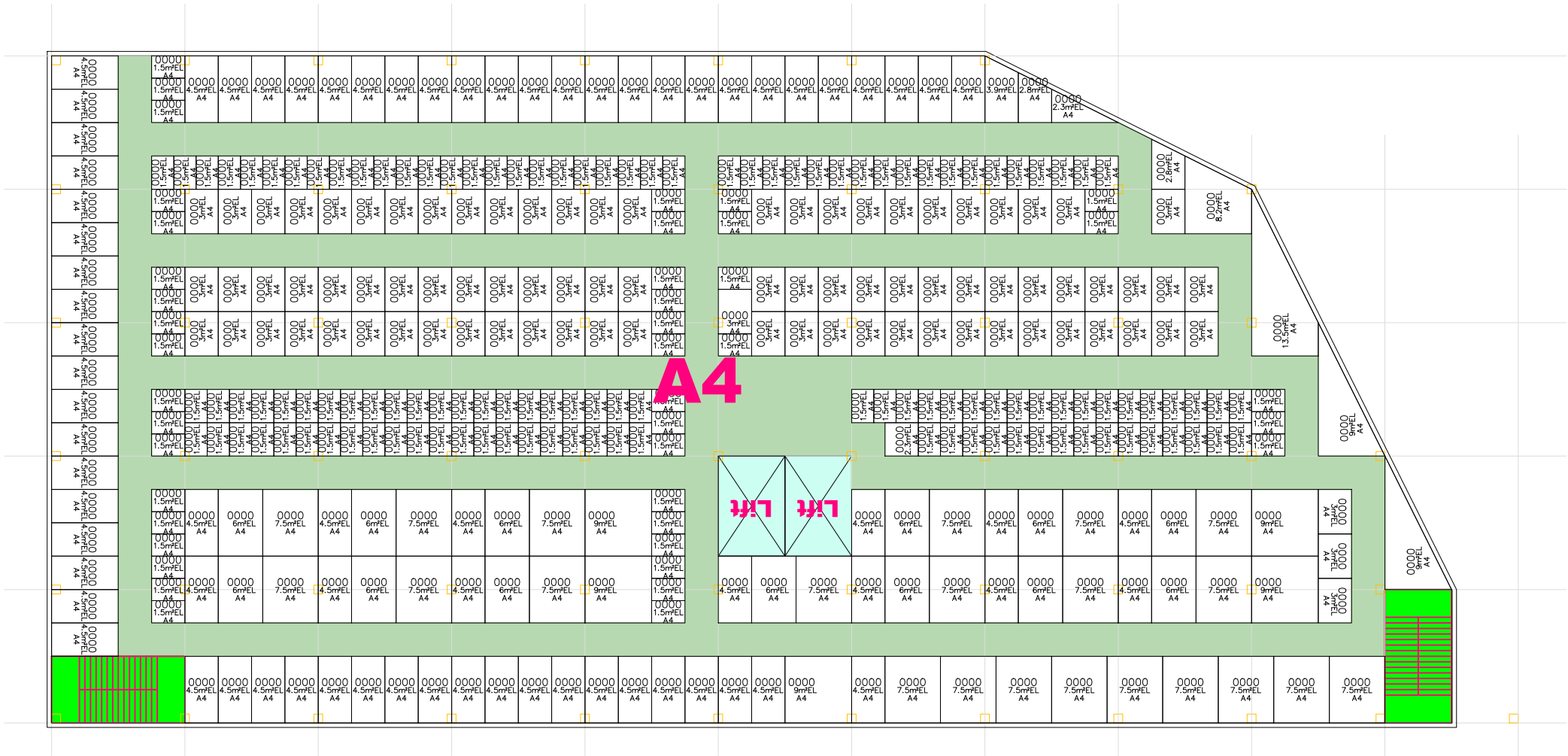


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THIRD FLOOR

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GARMAN ROAD 45-47



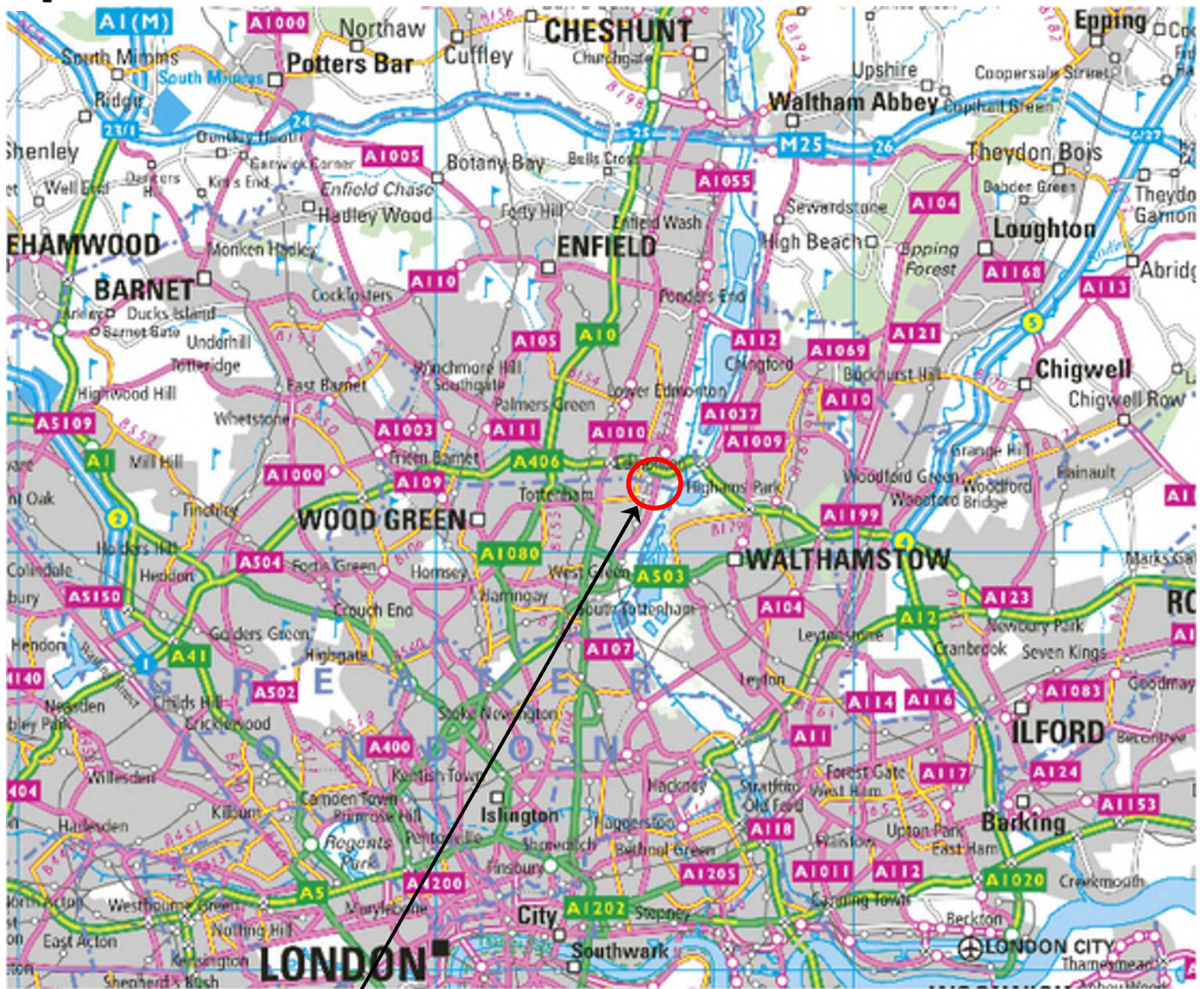
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GARMAN ROAD 45-47



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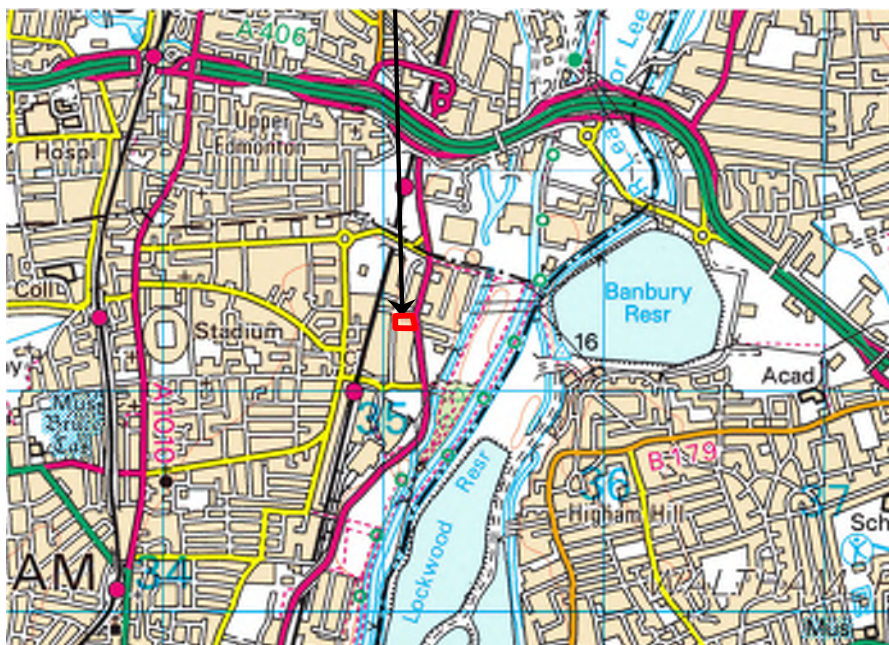
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FIFTH FLOOR



SITE LOCATION

NEAREST POSTCODE: N17 0UR



REV	DATE	DESCRIPTION	BY	CKD
 BROWNFIELD SOLUTIONS LTD SEO ENVIRONMENTAL ENGINEERING EXCELLENCE				
CLIENT SHURGARD UK				
PROJECT TITLE GARMAN ROAD, TOTTENHAM				
DRAWING TITLE SITE LOCATION PLAN				
DRAWING No. C4993/01		REVISION -	SCALE NTS	DATE 04/03/22
DRAWN BY SRP			CHECKED BY JW	



SITE ACCESS

PEDESTRIAN
ACCESS

DUST EXTRACTION UNIT

PROPANE GAS STORAGE

CANOPY



VEGETATION

ELECTRICAL
SUBSTATION

KEY

— APPROXIMATE SITE BOUNDARY

REV	DATE	DESCRIPTION	BY	CKD



CLIENT

SHURGARD UK

PROJECT TITLE

GARMAN ROAD, TOTTENHAM

DRAWING TITLE

MH0 SITE FEATURES PLAN

DRAWING No.	REVISION	SCALE	DATE
M4993/02	-	NTS	04/03/22
DRAWN BY		CHECKED BY	
SRP		JW	

Slide 1

MHO The electrical substation on drawing is not clear where it is
Mark Holland, 2022-03-03T12:40:20.762



ELECTRICAL
SUB-STATION

WOOD BURNING FURNACE

PROPANE GAS STORAGE

CANOPY

KEY

— APPROXIMATE SITE BOUNDARY



REV	DATE	DESCRIPTION	BY	CKD



CLIENT			
SHURGARD UK			
PROJECT TITLE			
GARMAN ROAD, TOTTENHAM			
DRAWING TITLE			
SITE FEATURES PLAN			
DRAWING No.	REVISION	SCALE	DATE
M4993/02	-	NTS	04/03/22
DRAWN BY		CHECKED BY	
SRP		JW	



KEY

- APPROXIMATE SITE BOUNDARY
- WSXX WINDOW SAMPLE BOREHOLE
- HP01 HAND EXCAVATED TRIAL PIT
- BOREHOLE INSTALLATION
- BUILDING OUTLINE
- OFFICE AND SHOWROOM OUTLINE

REV	DATE	DESCRIPTION	BY	CKD



CLIENT
SHURGARD UK

PROJECT TITLE
GARMAN ROAD, TOTTENHAM

DRAWING TITLE
EXPLORATORY HOLE LOCATION PLAN

DRAWING No. M4993/04	REVISION -	SCALE NTS	DATE 23/03/22
DRAWN BY SRP		CHECKED BY JW	

PHOTOGRAPHS



PHOTO 1



PHOTO 2



PHOTO 3



PHOTO 4

Photo Descriptions

PHOTO NO.	DETAILS
1	Completed WS01.
2	Completed WS02.
3	Completed WS03.
4	Completed WS04.

REV	DATE	DESCRIPTION	BY	CKD



CLIENT	SHURGARD UK
PROJECT TITLE	GARMAN ROAD, TOTTENHAM
TITLE	SITE WORKS PHOTOGRAPHS
Associated Document Ref No. SRP/M4993/10981	PAGE 1 of 2
COMPILED BY SRP	CHECKED BY MH

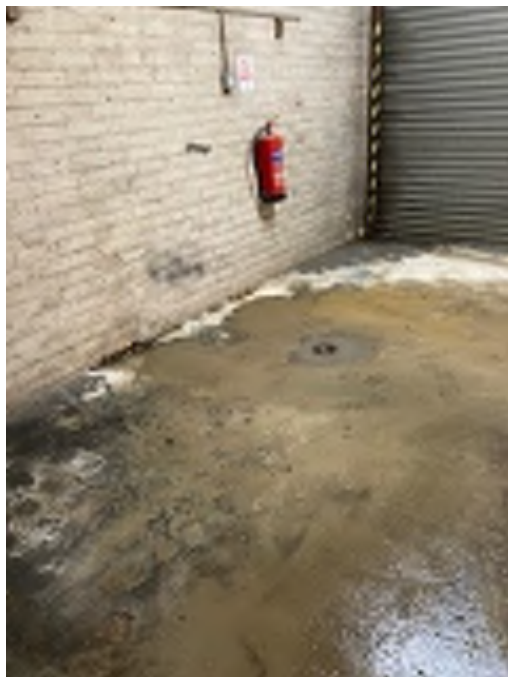


PHOTO 5



PHOTO 6



PHOTO 7

Photo Descriptions

PHOTO NO.	DETAILS
5	Completed WS05.
6	Completed HP01.
7	Concrete Cores.

REV	DATE	DESCRIPTION	BY	CKD



CLIENT	SHURGARD UK
PROJECT TITLE	GARMAN ROAD, TOTTENHAM
TITLE	SITE WORKS PHOTOGRAPHS
Associated Document Ref No. SRP/M4993/10981	PAGE 2 of 2
COMPILED BY SRP	CHECKED BY MH

APPENDIX A

BSL Methodology and Guidance

BSL Methodology and Guidance – Geo-Environmental Assessment Reports

This Appendix provides information on the approaches, methods and guidance used by Brownfield Solutions Ltd in the preparation of this report.

The term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential soils and groundwater contamination). The term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements). It should be noted that this is an integrated investigation and these two main aspects are related, unless otherwise specified within the report (i.e. as a standalone environmental or geotechnical assessment).

Desk Studies are written in broad agreement with BS 10175:2011+A2:2017. The first stage of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011+A2:2017), often referred to as a Phase 1 Desk Study Assessment, comprising a desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed. From this are identified any geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them.

From the geo-environmental perspective, the hazard Identification process uses professional judgement to evaluate all the hazards in terms of possible contaminant linkages (of source-pathway-receptor). Possible contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The second stage is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The Ground Investigation comprises field work and laboratory testing based on the findings of the Preliminary Risk Assessment, to reduce uncertainty in the geotechnical and geo-environmental hazard identification. This may include an exploratory, a detailed or/and supplementary Investigations as described in BS 10175:2011+A2:2017. Phase II Assessments are produced in general accordance with the recommendations for a Tier 2 Generic Quantitative Risk Assessment as described in LCRM guidance and are also intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2:2007.

Legislative Background

Environmental liabilities and risks have been evaluated in terms of a source -pathway - target relationship in accordance with the approach set out in:

- The 1995 Environment Act;
- The Contaminated Land (England) Regulations 2000;
- The DETR circular 02/2000 Environmental Protection Act 1990: Part IIA Contaminated Land.

Contaminated land is defined within the legislative framework as land which is in such condition by reason of substances in, on or under the land that:

- 1) Significant harm is being caused or there is a significant possibility of such harm being caused;
- 2) Significant pollution of controlled waters is being or is likely to be caused.

The potential for harm is based on the presence of three factors:

- **Source** - substances that are potential contaminants or pollutants that may cause harm;
- **Pathway** - a potential route by which contaminants can move from the source to the receptor;
- **Receptor** - a receptor that may be harmed, for example the water environment, humans and water.

Where a source, pathway and target are all present a pollutant linkage exists and there is potential for harm to be caused. The presence of a source does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and unacceptable risk of harm. The nature and importance of both pathways and receptors are site specific and will vary according to the intended end use of the site, its characteristics and its surroundings.

The key principle which supports the SPR approach is 'suitable for use' criteria. This requires remedial action only where contamination is considered to pose unacceptable actual or potential risks to health or the environment and, taking into account the proposed use of the site.

Relevant Guidance Documents

This report has been prepared in accordance with the list of guidance below however the list is not exhaustive:

- DETR Circular 02/2000, Contaminated Land: Implementation of Part IIA of the Environmental Protection Act 1990.
- CLR11 – Model Procedures.
- Brownfields – Managing the development of previously developed land – A client's guide, CIRIA 2002.
- DEFRA and Environment Agency publications CLR7 – 10, supported by the TOX guides and SGV guides, dated March 2002.
- Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the EPA1990, May 2002.
- Contamination and Environmental Matters - Their implications for Property Professionals (2nd Edition RICS Nov 2003).
- BS 10175:2011+A2:2017.

Relevant Legislative Documents

The following is a non-exhaustive list of legislative framework documents that has been considered in the production of this report:

- The Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (2012).
 - The Environment Protection Act (1990).
 - The Water Resources Act (1991).
 - The Environment Act (1995).
 - The Contaminated Land (England) Act (2000).
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 - The Landfill (England and Wales) (Amendment) Regulations (2004).
 - Contaminated Land (England) Regulations (2012).
 - Health and Safety at Work Act.
-

Contaminated Land Risk Assessment

Contaminated Land Risk Assessment is a technique that identifies and considers the associated risk, determines whether the risks are significant and whether action needs to be taken. The four main stages of risk assessment are:

Hazard Identification ➡ Hazard Assessment ➡ Risk Estimation ➡ Risk Evaluation

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. The starting point of the risk assessment is to identify the context of the problem and the objectives of the process. Under CLR11, three tiers of risk assessment exist - Preliminary, Generic Quantitative and Detailed Quantitative.

Formulating and developing a conceptual model for the site is an important requirement of risk assessment, this supports the identification and assessment of pollutant linkages. Development of the conceptual model forms the main part of preliminary risk assessment, and the model is subsequently refined or revised as more information and understanding is obtained through the risk assessment process.

Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk.

The risk assessment process needs to take into account the degree of confidence required in decisions. Identification of uncertainties is an essential step in risk assessment.

The likelihood of an event is classified on a four-point system using the following terms and definitions from CIRIA C552:

- **High likelihood:** There is a pollution linkage and an event appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution;
- **Likely:** There is a pollution linkage and all the elements are present and in the right place, which means it is probable that an event will occur. Circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term;
- **Low likelihood:** There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain even over a longer period such event would take place, and is less likely in the short term;
- **Unlikely:** There is a pollution linkage but circumstances are such that it is improbable the event would occur even in the long term.

The severity is also classified using a system based on CIRIA C552. The terms and definitions are:

- **Severe:** Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. A short-term risk to a particular ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);
Examples – High concentrations of contaminant on surface of recreation area, major spillage of contaminants from site into controlled waters, explosion causing building to collapse;
- **Medium:** Chronic damage to human health ('significant harm' as defined in DETR 2000). Pollution of sensitive water resources. A significant change in a particular ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);
Examples - Concentrations of contaminants exceed the generic assessment criteria, leaching of contaminants from a site to a Principal or Secondary Aquifer, death of species within a designated nature reserve;
- **Mild:** Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures, services or the environment;
Examples – Pollution of non-classified groundwater or damage to buildings rendering it unsafe to occupy.
- **Minor:** harm, not necessarily significant harm, which may result in financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by use of personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.

Examples – Presence of contaminants at such concentrations PPE is required during site work, loss of plants in landscaping scheme or discolouration of concrete.

Once the likelihood and severity have been determined, a risk category can be assigned using the table below.

		Consequences			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very Low	Very low
	No Linkage	No risk			

Definitions of the risk categories obtained from the above table are as follows together with an assessment of the further work that might be required:

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

Some linkages may be identified which constitutes a theoretical connection between a source and a receptor, but professional judgement shows them not to be possible for some reason. These are labelled 'no linkage' in the summary table and no further action is required.

Ground Gas Guidance

Redevelopment on brownfield sites is an ever increasing occurrence, including those sites where a potential ground gas issue is present.

BS8485:2015+A1:2019 and CIRIA C665 is the current guidance which gives up-to-date advice on all aspects of ground gas. It outlines good practice in investigation, the collection of relevant data and monitoring programmes in a risk-based approach to gas contaminated land. Two semi-quantitative methods are set out for the assessment of risk:

- 1 For low rise housing with a ventilated under floor void at minimum 150 mm (Boyle and Witherington);
- 2 For all other development types (Wilson and Card).

Both methods use the concept of Gas Screening Values (GSVs) to identify levels of risk. The mitigation and management of potentially unacceptable risk is described with reference to both passive and active systems of gas. Source removal is also discussed as an option.

CIRIA C665 and the advice it contains has been prepared to be generally consistent with CLR11 *Model Procedures for the management of land contamination* (Defra and Environment Agency, 2004a). The aim of CIRIA C665 is a consistent approach to decision making, particularly relating to the scope of protective design measures on a site specific basis.

Legislative Framework

CIRIA C665 provides technical guidance however also recognises the context into which the guidance has to be employed. Government policy is based upon a “suitable for use approach”, which is relevant to both the current and proposed future use of land. When considering the current use of land, Part IIA of the Environment Protection Act 1990 provides the regulatory regime. The presence of hazardous ground gases could provide the “source” in a “pollutant linkage” which could lead the regulator to determine that considerable harm or there is a significant possibility of such harm being caused. Under such circumstances, the regulator would determine the land to be “contaminated land” under the provisions of the Act, setting out the process of remediation as described in the DETR Circular 02/2000 *Statutory guidance on contaminated land* (DETR, 2000a).

Frequency and Duration of Monitoring

The monitoring period for a specific site covers the “worst case” scenario. A “worst case” scenario will occur during falling atmospheric pressure and, in particular, weather conditions such as rainfall, frost and dry weather.

The benefits of the additional information and whether it is likely to change the scope of gas protection should be considered, as are the consequences of failing to characterise adequately pollutant linkages. Investigations concerned with soil gas are required to provide monitoring data sufficient to allow prediction of worst case conditions enabling the confident assessment of risk and subsequent design of appropriate gas protection schemes. Monitoring programmes should not be an academic exercise in data collection.

Below are matrices that will aid in determining an appropriate number of gas monitoring visits and the length of monitoring period.

Typical/idealised periods of monitoring

		Generation of Potential Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of Development	Low (Commercial)	1 month	2 months	3 months	6 months	12 months
	Moderate (Flats)	2 months	3 months	6 months	12 months	24 months
	High (Residential with Gardens)	3 months	6 months	6 months	12 months	24 months

Typical/idealised frequency of monitoring

		Generation of Potential Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of Development	Low (Commercial)	4	6	6	12	12
	Moderate (Flats)	6	6	9	12	24
	High (Residential with Gardens)	6	9	12	24	24

Note

- 1 NHBC guidance also recommends this period of monitoring (Boyle and Witherington, 2007).
- 2 There is no industry consent over “high”, “medium” or “low” generation potential of source.
- 3 At least two sets of readings should be at low and falling atmospheric pressure (but not restricted to periods below <1000 mb) known as worst case conditions. Historical data can be used as part of the data set (Table 5.5b).

It is recommended that newly installed monitoring wells are left for 24 hours to allow the soil gas to reach equilibrium. It should be recognised, however, that some soil gas regimes could take considerably longer (up to seven days). Interpretation of any initial readings should take this equilibrium process into account.

Contaminated Land Screening Values

In assessing the potential for contamination Brownfield Solutions Limited (BSL) follows UK guidance and current best practice.

General

The current recommended method for assessing contamination is on the basis of:

Source-Pathway-Receptor

Where any one of these “pollution linkages” is absent there is deemed to be no risk.

Fundamentally receptors can be considered as humans and controlled waters (surface and ground waters).

The purpose of using Tier 1 screening levels is to have a simple means of assessing the potential contamination of a site and to inform decisions on whether further investigation is warranted or whether an option to undertake clean up based on the data to hand is cost effective.

Human Health

Current UK guidance is provided by DEFRA and the Environment Agency (EA). Publications forming part of the guidance include; CLEA Model, toxicological reports and soil guideline values (SGV), collectively referred to as the CLEA Guidance. The CLEA Guidance has included a number of publications which have provided initial screening values for soil contamination based on standard land uses and soil assumptions.

CLEA guidance has gone through a number of revisions, all of the original SGV's that were published have been withdrawn and publication of new SGV's commenced in 2009.

For determinands where no SGVs are available, S4UL values have been published using the CLEA 1.06 Model. These are the third set of generic assessment criteria generated by CIEH, and replace the previous two sets of GACs. The revised S4UL values are based on greater knowledge of relevant toxicology and further consideration of exposure frequencies.

No SGV or S4UL is available for lead as this is derived based on blood lead levels. C4SL values for six determinands including lead was published by DEFRA/CL:AIRE in December 2014 and they represent a low risk as opposed to minimal risk. The C4SL values are based on a sandy loam with 6% Soil Organic Matter. These screening values were published by DEFRA for Part 2A use, although with the dual purpose for use under planning. However these have not been officially accepted by Local Government for use under planning. S4ULs remain the first reference due to the broader range of end uses and soil organic content.

The preference from the EA is that site specific screening levels are used wherever possible. Due to numerous factors it is not always possible to utilise site specific values. In these instances the following data sources are used in the order of preference given below:

- CIEH S4UL values (derived by CIEH/LQM)
- DEFRA/CL:AIRE C4SL's
- CL:AIRE GAC values
- Current UK SGV's
- Guidance from other European countries
- Guidance from the outside Europe

Controlled Waters

The European Water Framework Directive (WFD) became UK law in December 2003. It was created to ensure that European countries manage their rivers, groundwater and lakes so that they stay healthy for people and for wildlife.

This is achieved by the use of chemical standards for surface waters and groundwater. These values describe concentrations of chemicals that are not expected to cause harm to environmental organisms or human health, provided they are not exceeded. The same chemical may have several standards for different environmental regimes, and for different protection objectives.

Statutory Standards are set in legislation and if exceeded, this constitutes non-compliance with statutory obligations. European Directives are implemented in England and Wales by corresponding statutory instruments (i.e. regulations). The statutory instruments can be the exact same standards as they appear in the Directive or be more stringent.

A number of non-statutory standards also exist, these are set by various organisations (including the EA) for chemicals that are considered to be of concern, but are not covered by any specific legislation.

The chemical standards used in the UK to control impact of contamination on controlled waters are Environmental Quality Standards (EQS). The EQS's cover a large number of compounds.

Where certain compounds are not covered by the EQS these are commonly compared to the UK Drinking Water Standards (DWS).

Further Assessment

When screening values are exceeded then further consideration is required. This could include the use of simple measures to break the pollution pathway and mitigate the risk, further more detailed investigation, including the deriving of site specific values to better define the risk and to design appropriate remedial measures.

Re-Use Of Waste - Guidance Note

Definition of Waste

The Environment Agency considers waste to be “...any material that is discarded, or intended to be discarded...” This includes any soil from trenches, footing, site strip etc. It is no longer required in its original location, therefore it is considered to be waste.

CL:AIRE: Code of Practice

Where materials are excavated for construction purposes, wherever possible these should be retained on site for engineering purposes if they are suitable for use. This can be implemented under the CL:AIRE “Development Industry Code of Practice for the Definition of Waste” (CL:AIRE DoWCoP), also commonly referred to as a “Materials Management Plan”.

The developer/contractor is advised to complete all works under the DoWCoP.

Potential scenarios where soils may be able to be re-used:

- Material capable of being used in another place on the same site without treatment.
- Material capable of being used in another place on the same site following ex-situ treatment on site.
- Material capable of being used in another development site without treatment (Direct Transfer).
- Material capable of being used in another development site following ex-situ treatment on another site eg Hub site.

The Code of Practice requires 4 No. Factors to be addressed:

1. Protection of human health and protection of the environment.
2. Suitability of use, without further treatment.
3. Certainty of use.
4. Quantity of material.

In order to satisfy these requirements the following are required:

- i) Consultation/approval with Local Authority & Environment Agency to confirm they have no objections to the proposed re-use of waste soils, or the risk assessments for the site.
- ii) Risk Assessments to demonstrate that the site does not present an Environmental Hazard.
- iii) Remediation Strategy for contaminated sites (or Design Statement for non-contaminated sites).
- iv) Materials Management Plan (MMP) which details material generated stockpiles and the end use.
- v) Volume calculations.
- vi) Planning permission for the development.
- vii) Contractual details to be clear, regarding who steps in if a contractor goes into administration/liquidation.

The use of the CoP is effectively industry regulated, there is a requirement to appoint an independent Qualified Person (QP) who checks all the requirements have been met and registers the documentation with the Environment Agency. This person must not have had any involvement with the preparing of the risk assessments or remedial strategy on the site.

Soils which require treatment on site (eg bioremediation, stabilisation) will require an Environmental Permit for treatment, together with justification and validation to prove, once treated, this material is suitable for use.

Site management procedures need to be in place to ensure that material is tracked through from excavation stockpiling, treatment and remediation processes. Should the process of material tracking be considered non-robust, or not adhered to, this may fail the test whether excavated materials may be considered non-waste.

Waste Classification For Soils

Introduction

Waste producers have a duty of care to classify the waste they are producing:

- before it is collected, disposed of or recovered.
- to identify the controls that apply to the movement of the waste.
- to complete waste documents and records.
- to identify suitably authorised waste management options.
- to prevent harm to people and the environment.

The most sustainable and economic method of dealing with waste soil is usually the retention and re-use on site. Where this is not possible there are three main options for the disposal of soils:

1. Disposal to a permitted waste recycling facility.
2. Re-use on another site (subject to the suitability).
3. Disposal to a landfill site.

The disposal to a permitted facility will be subject to the **specific conditions of the permits for each individual facility** and will vary dependent on location and environmental sensitivity of the receiving site. Re-use on another site will also be subject to the acceptability criteria of that site.

The guidance below relates to disposal to **landfill sites only**.

Background for Landfill Disposal

In July 2005 the United Kingdom implemented the European Directive 1999/31/EC (The Landfill Directive), this introduced the current regime for waste and waste disposal to landfill. The Landfill Directive places controls on waste disposal. These controls include requirements to follow the waste acceptance procedures and criteria that have been agreed by the Council of the European Union and are laid out in Council Decision 2003/33/EC.

Before a waste can be accepted at a landfill site, the landfill **operator** must be satisfied that the waste meets his permit conditions, the waste acceptance procedures (WAP) and waste acceptance criteria (WAC).

If disposal to landfill is the best management option for the waste soils, these procedures **must** be followed or the operator may refuse to accept the waste.

Key Points

- Not all waste can be landfilled
- Landfills are classified according to whether they can accept **hazardous, non-hazardous** or **inert** wastes.
- Wastes can only be accepted at a landfill if they meet the waste acceptance criteria (WAC) for that class of landfill.
- Most wastes must be treated before you can send them to landfill.
- There are formal processes for identifying and checking wastes that must be followed before wastes can be accepted at a landfill site.

Classification

Wastes are listed in the European Waste Catalogue (EWC 2002) and grouped according to generic industry, process or waste types. Wastes within the EWC are either hazardous or non-hazardous. Some of these wastes are hazardous without further assessment (absolute entries) or are 'mirror' entries that require further assessment of their hazardous properties in order to determine whether they are hazardous waste.

Waste soil has mirror entries on the EWC and as such the first phase of the waste classification process is that of determining if the waste is hazardous or not i.e the hazard assessment. The most common EWC waste codes related to soil are:

17 05	soil (including excavated soil from contaminated sites), stones and dredging spoil
17 05 03*	soil and stones containing dangerous substances
17 05 04	soil and stones other than those mentioned in 17 05 03

Soils may contain certain contaminants (eg asbestos, oil,) which have prescribed concentration thresholds, that if breached will render the material hazardous waste. These are based on specific "hazardous properties" which include hazards such as carcinogenicity, flammability and toxicity.

In the first instance the concentrations of plausible contaminants within the soil should be identified and wastes should be **classified based on their total concentrations**.

Waste Definitions

Inert	- Will not undergo any significant physical, chemical or biological transformations. - Will not dissolve. - Will not burn. - Will not physically or chemically react. - Will not biodegrade. - Will not adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health. - Has insignificant total leachability and pollutant content. - Produces a leachate with an ecotoxicity that is insignificant (if it produces leachate).
Non-Hazardous	Is not inert (see above) Is not hazardous (see below)
Hazardous	Soil has hazardous properties as defined in WM3 (Guidance on the classification and assessment of waste (1st edition 2015)- Technical Guidance)
Stable Non-reactive hazardous waste#	Hazardous waste, the leaching behaviour of which will not change adversely in the long-term, under landfill design conditions or foreseeable accidents either: in the waste alone (for example, by biodegradation), under the impact of long-term ambient conditions (for example, water, air, temperature or mechanical constraints) or by the impact of other wastes (including waste products such as leachate and gas).

This option allows hazardous waste that is stable and thus has a low leaching potential to be deposited in cells with a standard of containment consistent with non-hazardous wastes.

WAC Testing

The purpose of WAC analysis is to confirm that the waste complies with the relevant WAC for the receiving landfill. If the waste has any disposal route other than a landfill site (e.g. recycling facility, incineration etc) the **WAC is not relevant**. Furthermore the WAC limits **cannot be used to make an assessment of whether a waste is hazardous**. WAC testing does however define if a non-hazardous waste is suitable for an inert landfill.

Classification based on Total Concentrations ¹	Non-Hazardous Waste		Hazardous Waste	
	Below inert WAC limit values:	Above inert WAC limit values:	Below hazardous WAC limit values	Above hazardous WAC limit values
WAC testing				
Landfill requirements	INERT landfill	NON-HAZARDOUS landfill ²	HAZARDOUS landfill	PRE-TREATMENT ³

1 Total concentrations are defined as tests results on solids as opposed to leachate (i.e. a liquid).

2 Individual sites may have certain limit values pre-determined in their licence.

3 After pre-treatment the material characteristics may have changed to an extent that allow the soil to be re-classified.

Hydrocarbons in Soils

WM3 uses the term Oil or Waste Oil to cover hydrocarbons products such as fuel oil, petrol or diesel. These are defined by WM3 as hazardous under an absolute entry in the List of Wastes. However hydrocarbons in soils are a mixture rather than a pure product and are therefore not absolute entries.

Known Oils

The simplest scenario is where the identity of the contaminating oil is known or can be identified. If the oil is known the manufacturer's or supplier's REACH compliant safety data sheet for the specific oil can be obtained and the hazard statement codes on that Safety Data Sheet can be used for the hazardous waste assessment.

Where the identity of the oil can only be identified down to a petroleum group level (i.e. the contaminating oil is known to be diesel, but the specific type/brand is unknown), then the classification of that petroleum group should be used in the assessment. The marker compounds associated with that petroleum group may be used to confirm carcinogenicity.

Oils may contain a range of hydrocarbons, so the presence of for instance Diesel Range Organics (DRO) does not enable the assessor to conclude that diesel is present. These hydrocarbons may have arisen from other oils, the laboratory needs

to provide an interpretation of the chromatograph to determine if it is consistent with diesel or weathered diesel as a whole.

The concentration of known oils should be determined using a method that as a minimum spans the range in which the carbon numbers for that known oil fall.

Unknown Oils

Where hydrocarbons are contaminating soils it is likely that the oil will be unknown or cannot be determined.

WM3 states that:

For contaminated land specific consideration must be given to the following before proceeding;

- The presence of other organic contaminants, for example solvents or coal tar that could be detected as hydrocarbons. Coal Tar is not an oil and is considered separately in WM3 example 2. Where the site history or investigation indicates the presence of hydrocarbons from oil and other sources (e.g. coal tar), and the origin of the hydrocarbons cannot reliably be assigned to either, then a worst case approach of considering the hydrocarbons both as waste oil (in accordance with this example) and from other sources, for example coal tar should be taken.
- The presence of diesel, or weathered diesel, should be specifically considered by the laboratory and where this is confirmed by the hydrocarbon profile the oil should be assessed as a known or identified oil (diesel).

The use of **marker compounds** is optional; however it is recommended that where possible the marker compounds should be used. WM3 states:

If the identity of the oil is unknown, and the petroleum group cannot be established, then the oil contaminating the waste can be classified as non-carcinogenic/mutagenic due to the presence of oil if all three of the following criteria are met:

- The waste contains benzo[a]pyrene (BaP) at a concentration of less than 0.01% (1/10,000th) of the TPH concentration (This is the carcinogenic limit specified in table 3.1 of the CLP for BaP)
- This has been determined by an appropriate and representative sampling approach in accordance with the principles set out in Appendix D of WM3, and
- The analysis clearly demonstrates, for example by carbon bands or chromatograph, and the laboratory has reasonably concluded that the hydrocarbons present have not arisen from petrol or diesel.

For example:

TPH Concentration (mg/kg)	Petrol or Diesel	BaP (mg/kg)	Classification
10,000	No	0.9	Non- Hazardous
1,000	No	Not available	Hazardous
1,000	Yes	Not relevant	Hazardous

References

1. Environmental Permitting (England and Wales) Regulations 2010 (as amended) (EP Regulations), the Landfill Directive (1999/31/EC) and the subsequent Council Decisions.
2. Environment Agency Environmental Permitting Regulations: "Inert Waste Guidance- Standards and Measures for the Deposit of Inert Waste on Land" 2009.
3. Environment Agency "Waste acceptance at landfills - Guidance on waste acceptance procedures and criteria" Nov 2010.
4. Environment Agency "Guidance on the classification and assessment of waste (Technical Guidance WM3)".
5. Classification, Labelling and Packaging of Substances Regulation (EC 1272/2008) (CLP).
6. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
7. 2014/955/EU: Commission Decision of 18 December 2014 amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC of the European Parliament
8. Environmental Permitting Guidance The Landfill Directive For the Environmental Permitting (England and Wales) Regulations 2010 Updated March 2010 Version 3.1
9. Classification, Labelling and Packaging of Substances Regulation (EC 1272/2008) (CLP).

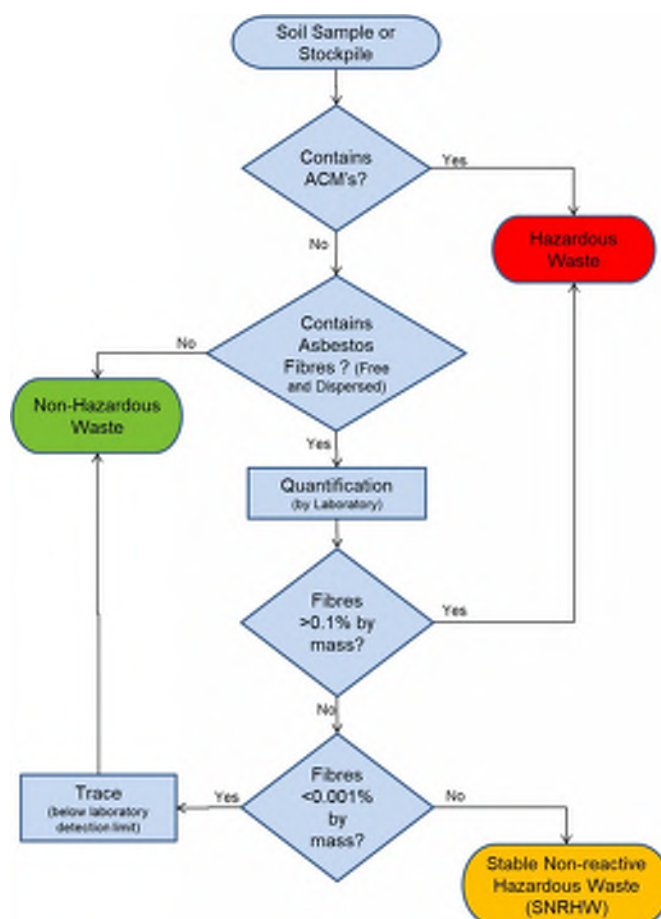
Additional Asbestos Guidance Notes

Disposal

The 1st Edition of WM3 “Guidance on the classification and assessment of waste”, details the way in which Asbestos is assessed within soils.

The assessment of asbestos containing waste is dependent on whether the asbestos is present as:

- Fibres that are free and dispersed, or
- Identifiable pieces of asbestos containing materials (ACM's)



Identifiable pieces of asbestos are any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye. The result is that commonly soils with visible ACM's are sorted and the ACM's removed by hand picking and separate disposal.

Asbestos concentrations below 0.001% by mass are below standard laboratory detection limits and are not currently regarded as containing asbestos for the purposes of disposal and may be disposed of to an inert landfill site¹. These levels are often termed “trace” by laboratories.

Asbestos concentrations between 0.001% and 0.1% are stable non-reactive hazardous waste (SNRHW)¹. Waste transfer stations where soil recycling takes place may be able to take SNRHW, but are unlikely to take soils containing asbestos above trace concentrations.

The following codes should be assigned to the asbestos waste as appropriate:

17 06	Insulation materials and asbestos-containing construction materials
17 06 01	Insulation materials containing asbestos
17 06 03	Other insulation materials consisting of or containing hazardous substances
17 06 04	Insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05	Construction material containing asbestos

WM3 indicates that 17 06 05 would normally be used in preference to 17 06 01 for the asbestos in asbestos contaminated soil and stones.

Construction materials containing asbestos and “*other suitable materials*” may be landfilled at landfills for non-hazardous waste in accordance with the Landfill Directive without testing.

This means that wastes that are only hazardous because of their asbestos content can be disposed of at landfills for non-hazardous waste in separate landfill cells that only accept asbestos wastes and other suitable materials. The Landfill Directive requires that stable non-reactive hazardous waste shall not be deposited with biodegradable waste (for example organic material, household waste, paper etc..) and must meet the waste acceptance criteria set out in accordance with Annex II.

Construction

Health and Safety Executive (HSE) guidance on asbestos is not directly related to soil and much of the guidance focuses on the removal of asbestos from buildings. The overarching legislation is the Control of Asbestos Regulation (CAR 2012). However where work involves (or is likely to involve) contact with asbestos then CAR 2012 requires a risk assessment including whether or not the work is licensed or notifiable non-licensed work and may require an Asbestos Management Plan. Work becomes notifiable if it is considered that the control limit could be exceeded.

Brownfield sites frequently have soils that contain asbestos and the presence of asbestos needs to be considered within the context of construction, particularly in relation to groundworks. The exposure of soils and the use of excavators and plant to move soil around increases the possibility of fibres becoming airborne. However it is good site practice to not generate dusts and to employ dust suppression on all sites regardless of the presence of asbestos.

The legal control limit for asbestos is 0.1f/ml over a continuous four hour period. The control limit is not a ‘safe’ level and exposure from work activities involving asbestos must be reduced to as far below the control limit as possible.

Clearly the higher the concentrations in the soil the greater potential there is for fibres to be released, however IOM publication TM/88/14 “the release of dispersed asbestos fibres from soil” 1988 concludes that:

- Mixtures of asbestos in dry soils with asbestos content as low as 0.001% can produce airborne respirable asbestos concentrations greater than 0.1f/ml in dust clouds where the respirable dust concentrations are less than 5mg/m³.
- An action limit is recommended of no higher than 0.001% asbestos in soils above which steps should be taken to minimise exposure to airborne fibres (eg by wetting).
- The addition of relatively small quantities (10%) of water can reduce the airborne fibre concentrations by an order of magnitude.

Where asbestos has been identified at concentrations above 0.001% as free and dispersed fibres in the soil precautions need to be adopted. Concentrations below this are considered to be normal background, although good site practice dictates that the generation of dusts should be avoided and therefore any fugitive fibre release from minor concentrations should be kept to a practical minimum.

End Use

The use of materials containing asbestos and material containing asbestos is prohibited under EU legislation. There is currently a Joint Industry Working Group (JIWG) tasked with producing a Code of Practice for Asbestos in Soil, Made Ground and Construction & Demolition Material that will clarify in due course the position of the various government agencies.

Asbestos containing materials can remain in situ under a suitable cover system which may be hardsurfacing or soft landscaping (with or without hard dig layers and markers).

There is a risk that future maintenance may compromise such systems and details of the presence of asbestos should be kept in the Health and Safety File.

Preliminary publications from JIWG (April 2015) provide guides for decision making in relation to construction. These are at a “Beta” test stage and further publications will be provided in due course.

The re-use of waste soils should be undertaken in accordance with the CL:AIRE Code of Practice and is subject to suitable risk assessments demonstrating low risk. There is nothing that specifically excludes the re-use of soils containing asbestos as fill to raise levels. However the movement of materials increases the risk of fibres becoming airborne and suitable precautions will be required.

The re-use of soils containing asbestos at concentrations above hazardous waste levels is likely to meet with regulatory opposition. Assuming a suitable strategy could be agreed this would take a considerable amount of time and is only likely to be feasible where there is a long program for implementation.

APPENDIX B

Exploratory Hole Logs



Borehole Log

No.

HP01

Sheet 1 of 1

PROJECT NO: M4993

CO-ORDS:

Hole Type

Hole Type

PROJECT NAME: GARMAN ROAD, TOTTENHAM

LEVEL:

Scale

1:50

CLIENT: SHURGARD UK

DATES: 21/03/22

Logged

Checked

SRP

JW

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.12			MADE GROUND: CONCRETE.	1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0	
		0.50	ES PID	0.0PPM	0.60					MADE GROUND: Firm light brown gravelly clay. Gravel is sub-angular fine to coarse of chert and occasional brick.
		0.90	ES PID	0.0PPM	1.00					MADE GROUND: Firm dark brown slightly gravelly clay. Gravel is sub-angular fine to coarse of chert, brick and concrete.
		Concrete with power signal detected on CAT and Genny at 1.00m bgl. End of Borehole at 1.00m								

Remarks

1. Location scanned and cleared with CAT and Genny.
2. Hand-dug inspection pit excavated to 1.00m bgl.
3. No groundwater encountered.
4. Borehole terminated due to concrete and suspect service at 1.00m bgl.
4. Borehole backfilled with arisings.

ES = Environmental Sample
D = Disturbed Sample
B = Bulk Sample
LB = Large Bulk Sample
U = Undisturbed Sample
UT = Undisturbed Thin Wall Sample
SPT = Standard Penetration Test
PID = Photoionization Detector (ppm)
PPM = Part Per Million
HSV = Hand Shear Vane

BROWNFIELD SOLUTIONS LTD						Borehole Log		Window Sampler No.				
PROJECT NO: M4993						CO-ORDS:		WS01				
								Sheet 1 of 1				
PROJECT NAME: GARMAN ROAD, TOTTENHAM						LEVEL:		Hole Type				
								WS				
CLIENT: SHURGARD UK						DATES: 21/03/22		Scale				
								1:30				
								Logged	Checked			
								SRP	JW			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m OD)	Legend	Stratum Description				
		Depth (m)	Type	Results								
											MADE GROUND: CONCRETE.	
		0.40	ES PID	0.0PPM							MADE GROUND: Firm to stiff dark brown slightly sandy gravelly clay. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse of brick, limestone and chert with occasional pottery and slate.	
		1.00	ES PID	0.0PPM							Occasional coal gravel between 1.10m and 1.20m bgl.	1.0
		1.20	SPT	N=4 (1,1/1,1,1,1)				1.20			Firm brown slightly sandy CLAY. Sand is fine to coarse.	
		1.50	ES PID	0.0PPM								
		2.00	SPT	N=34 (3,4/6,8,10,10)				2.00			Brown slightly clayey sandy GRAVEL. Sand is fine to coarse. Gravel is sub-rounded to rounded fine to medium of chert and siltstone.	2.0
		2.30						2.30			Brown sandy GRAVEL. Sand is medium to coarse. Gravel is sub-angular to rounded fine to coarse of chert.	
		2.60	ES PID	0.0PPM								
		3.00	SPT	N=41 (8,10/11,11,11,8)							Collapse from 3.60m bgl up to 3.00m bgl.	3.0
		3.50	ES PID	0.0PPM							Black slightly clayey gravel with slight hydrocarbon odour between 3.50m and 3.60m bgl.	
3.60	SPT	N≥50 (25 for 120mm/50 for 165mm)										
			3.90		End of Borehole at 3.90m	4.0						
										5.0		
										6.0		
Remarks		1. Location scanned and cleared with CAT and Genny. 2. Hand-dug inspection pit excavated to 1.20m bgl. 3. No groundwater encountered. 4. Borehole installed; GL to 1.00m bgl plain, 1.00m to 3.00m bgl slotted.						ES = Environmental Sample D = Disturbed Sample B = Bulk Sample LB = Large Bulk Sample U = Undisturbed Sample UT = Undisturbed Thin Wall Sample SPT = Standard Penetration Test PID = Photoionization Detector (ppm) PPM = Part Per Million HSV = Hand Shear Vane				