GREENWOOD PLACE AND HIGHGATE ROAD SITE

Community Resource Centre, Centre for independent living and new residential units

Preliminary Land Quality Statement

September 2013

Camden

Tibbalds
Multidisciplinary Team

CampbellReith
consulting engineers

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Contents

SUMMARY OF ACTIONS

HUMAN HEALTH	Elevated concentrations of lead have been encountered within the shallow Made Ground soils across the site. Should soft landscaping be proposed, a capping layer of 400mm validated [imported] topsoil should be installed at the site. If private gardens are proposed, this should be increased to 600mm in these areas. Any soils imported or reused in soft landscaped areas will require compliance with an agreed set of limiting values which demonstrate that they are suitable for human exposure. Further assessment is required with respect to Volatile Organic Compounds.
CONTROLLED WATERS	No remediation works are required with respect to controlled waters.
BUILDINGS AND STRUCTURES/ SERVICES	Gas protection measures are currently not considered necessary. However, further gas monitoring should be undertaken in areas of the site which have not currently been subject to ground investigation. This should include both bulk gas and VOCs. A separate assessment is required for service pipework by the infrastructure designer.
SITE WORK CONTROLS	A watching brief for contamination should be undertaken and documented by the Contractor throughout groundworks. A Contamination Method Statement is required to detail the relevant provisions by the Contractor. This should include the scope and recording requirements of: the watching brief; materials management; the validation of any soils used in landscaping areas; actions for unforeseen contamination; waste management; and, controls for works which could affect the environment (CIRIA C692). It is noted that asbestos containing materials (ACM) have occasionally been identified in the soils at the site. Type II Asbestos Surveys are available for the buildings, which should be reviewed as necessary, together with surveys of any other on site buildings, prior to demolition.
REGULATORY APPROVAL	This document should be submitted to the Regulators (EA/EHO) for comment via the planning process, in order to discharge conditions relating to desk study and site investigation. Thereafter a Method Statement for Contamination and verification reporting process require agreement via the planning process.
WASTE	This report does not address the classification of waste soils. The soil results, and those of the Waste Acceptance Criteria analysis, can however be utilised as a basis for such assessments, although additional testing may be required. It is noted that such assessments are required to accord with the Environmental Permitting and Planning Legislation and also to control costs during development.
GEOTECHNICAL ACTIONS	Further ground investigation is required, which should comprise: • Additional investigation to provide sufficient data for detailed design, including investigation of the currently inaccessible western part of the site • The construction of additional monitoring wells and additional groundwater monitoring to establish equilibrium groundwater levels for the design of excavations, basements and retaining walls • Additional laboratory testing, including testing for magnesium and ammonium ions, to try to refine the buried concrete classification • Foundation inspection pits to establish the footings to existing

	retaining walls around the site boundary • Consideration of the possible effect of the proposed basement on surrounding structures and infrastructure • Consultations with Thames Water • Proposed basements will require a Basement Impact Assessment Once the development proposals have been sufficiently progressed and the further ground investigation carried out, the conclusions and recommendations of this report should be reviewed.
OTHER	It is recommended that a Japanese Knotweed survey is undertaken by a Specialist Contractor if not already done so. It is also recommended that the exact use of the historical heavy chemical warehouse (formerly operated by ICI) is established in order that appropriate soil and groundwater testing is undertaken in this area during the next phase of ground investigation.
DOCUMENTATION	The Contractor is required to submit this document, prepare a Contamination Method Statement in accord with the planning conditions, Verification Report, Materials Management Plan, Waste Classification Assessments and Health and Safety documentation.

EXECUTIVE SUMMARY

SITE LOCATION	The site is located at Greenwood Place, London, NW5, in the London Borough of Camden, approximately 200m north west of Kentish Town Station. It is proposed to demolish the existing Greenwood Day Centre and construct a new one to three storey community centre with a single storey basement beneath the north west corner of the site. It is also proposed to demolish the existing Highgate Day Centre and construct a new seven storey residential block with limited commercial development at ground floor level. Redevelopment also includes new access links, parking areas, soft landscaping and a shared garden area.
ENVIRONMENTAL SETTING	The geological sequence at the site comprises Made Ground over London Clay. Locally, Alluvial deposits and reworked London Clay were encountered overlying the London Clay. The overall environmental sensitivity of the site is considered to be **Low** comprising: **Hydrogeology (Low):** The site is situated on Unproductive Strata. **Hydrology (Low):** There are no significant surface water receptors within 500m of the site. **Radon (Low):** The site is not situated in an area where radon protection measures are required. **Sensitive Land Uses (Low):** There are no sensitive land uses within 500m of the site.
CURRENT USE AND HISTORY	The site comprises two buildings, the Highgate Day Centre on the north eastern half and the Greenwood Day Centre on the south western half. The site is bisected by Greenwood Place and Lensham House, which is currently in use as A&A Self Storage. The north eastern half of the site historically comprised terraced housing until the Highgate Day Centre was constructed in the early 1970s. The south western half of the site historically comprised unidentified buildings, which were demolished when a bottle store was constructed in 1915. The bottle store was then converted to a heavy chemicals warehouse in the 1950s before being demolished to make way for the Greenwood Day Centre. Immediate surrounding land use has historically been of a predominantly industrial nature. Railway sidings historically bound the site to the south west which were formed in an area of cutting.
GEOTECHNICAL HAZARDS	Hazards identified from the preliminary investigation: • Potential for 'Undivided Worked Ground' in the west of the site • Areas of highly compressible Alluvial deposits • Medium to high volume change potential soils • Shallow groundwater or water bearing strata with a shallow piezometric level • Obstructions and relic foundations • Ground conditions aggressive to buried concrete

	• Retaining walls and level changes around the site boundary
CONTAMINATION ISSUES	A generic quantitative risk assessment has been completed. This has identified a generally **MEDIUM** risk from contamination. Elevated concentrations of lead are present in shallow Made Ground soils across the site. In addition, an observation of asbestos has been noted in the Made Ground at one location in the north of the site. Elevated concentrations of carbon dioxide and methane have not been encountered at the site. However, further ground gas monitoring is required in areas not currently accessible in order to confirm these conclusions. Further consideration is also required with respect to VOCs as a substantially elevated concentration in a single water sample has been identified in the western part of the site which was formerly a chemical warehouse. If found to be widespread in the western apex of the site this could drive additional remedial requirements.
GEOTECHNICAL RECOMMENDATIONS	Further ground investigation is required to facilitate detailed design. For preliminary design, a piled foundation solution is suggested for high rise structures and conventional footings or ground improvement is recommended for low rise structures. Suspended floor slabs are recommended. A design CBR value of 3% is recommended for road pavements. An ACEC AC-4 class is recommended for buried concrete.
ENVIRONMENTAL RECOMMENDATIONS	It is recommended that additional gas and groundwater monitoring is undertaken to assess for the presence of bulk gas and VOCs. This can be undertaken as part of the additional site investigation. Further ground investigation is required in areas of the site not previously accessible. This should comprise further soil and groundwater sampling and ground gas monitoring. For preliminary design, a 400mm capping layer of validated imported material is required for areas where communal landscaping is proposed. Should private gardens be proposed, this should be increased to 600mm in these areas. Material imported to site for use in soft landscaped areas should be validated for human exposure. A watching brief should be undertaken during site works for any unforeseen gross sources of contamination. In particular, recorded inspections should be made beneath former building footprints, including the boiler room and COSHH store areas. Site works should be controlled by a Contamination Method Statement.

1.0 INTRODUCTION

1.1 This report has been produced by Campbell Reith Hill LLP (CampbellReith) on behalf of London Borough of Camden (the Client) to summarise environmental and geotechnical information relating to Greenwood Place and Highgate Road site: Community Resource Centre, Centre for Independent Living and Residential units (hereafter referred to as the site). The references and limitations associated with this report follow the main text. Figures showing the location of the site, the site boundary and the development proposals are presented in Appendix A.

1.2 The report has been produced in general accordance with the procedures for site investigation, interpretation and reporting set out in DEFRA Contaminated Land Report (CLR) 11, BS 5930 (+A2:2010), BS 10175 and BS EN 1997 (Eurocode 7). The objective of the report is to collate and interpret Phase 1 Desk Study information and preliminary Phase 2 exploratory data in order to provide:

a) a conceptual model for the site ground conditions (soil, water and gas);
b) a generic quantitative risk assessment (human health, controlled waters and gas);
c) an initial qualitative risk assessment;
d) preliminary recommendations for land contamination issues;
e) a geotechnical evaluation with preliminary geotechnical design advice; and,
f) recommendations for further investigation and reporting.

1.3 The contamination appraisal is intended to identify remedial requirements necessary to permit the redevelopment of the site as a community centre and residential block.

1.4 This assessment considers the objectives of the National Planning Policy Framework which requires information to demonstrate that a site is suitable for its new use (taking account of ground conditions and land instability) and not be capable of being determined as Contaminated Land under Part IIA of the Environmental Protection Act 1990 (after remediation). This also requires adequate site investigation information, prepared by a competent person (with the minimum requirement comprising a desk study and site reconnaissance).

1.5 It should be recognised that further appraisals, investigations, specification and validation are required to accord with the recommendations stated herein. It is noted that these appraisals do not consider wider development issues, with cost implications, such as waste classification.

1.6 The preliminary geotechnical appraisal has been carried out in accordance with Eurocode 7. Sections 1 to 4, 6 and 8, together with Appendix C, comprise the preliminary Ground

Investigation Report. Preliminary geotechnical recommendations are presented in Section 10 and these should be refined and verified by further investigations and by the production of a Geotechnical Design Report (which will require a more developed proposal).

1.7 The report is based on a recent ground investigation commissioned for this project and a review of readily available information as referenced. The desk study information is presented in Appendix B. The ground investigation report produced by Ground Engineering Ltd in June 2013 is contained in Appendix C.

1.8 The following site specific information, based upon reports produced by others, has been reviewed and is referred to:

TABLE 1.1: EXISTING SITE SPECIFIC INFORMATION

Report Title	Author	Date	Ref
Desk Study Report, The Highgate Centre, Greenwood Place, London, NW5 (ref J10098)	Geotechnical & Environmental Associates (GEA)	June 2010	A
Historic Environmental Assessment, Greenwood Place, Kentish Town, London, NW5	Museum of London Archaeology	June 2010	B
Topographical Survey for Greenwood Place (ref B7106)	Engineering Land & Building Surveys	May 2010	C

2.0 SITE DESCRIPTION

Site Location

2.1 The site location is presented in Figure 1. The site is located at Greenwood Place, London, NW5, in the London Borough of Camden (NGR 528840^{E}, 185400^{N}), approximately 200m north west of Kentish Town Station.

2.2 The site is bound to the north west by Greenwood Place and Deane House, to the north east by Highgate Road, to the south east by Kentish Town Christ Church Apostolic Church, and to the south east and south west by Murphy's Yard. Greenwood Place and A&A Self Storage bisect the site in a north west to south east direction.

Site Layout

2.3 A site reconnaissance was undertaken by a representative of CampbellReith on 14th November 2012 and an annotated site layout plan is presented in Figure 2. The following summary has been produced by reference to the GEA Desktop Study [A], the Historic Environment Assessment [B] and the findings of the aforementioned site walkover. Where indicated, images are provided in Appendix A and should be viewed in conjunction with the following summary.

2.4 The site is broadly rectangular in plan, measuring approximately 80m by 75m and comprises an area of 0.57 Ha. The site comprises two buildings, the Highgate Day Centre on the north eastern half and the Greenwood Day Centre on the south western half. The site is bisected by Greenwood Place and Lensham House, which is currently in use as A&A Self Storage.

2.5 The majority of the site is currently in active use, however, the southern half of the Greenwood Day Centre is disused.

Highgate Day Centre, 19 – 37 Highgate Road *(Access not available)*

2.6 The Highgate Day Centre (Image 1) is a two-storey brick building, which fronts onto Highgate Road. There is a lower ground floor level, which covers part of the building footprint, at a level approximately 1m lower than Highgate Road. Ref [B] concludes that the load-bearing structure is probably a steel frame to which concrete has been applied where the frame would be exposed externally, and the frame has then been in-filled with brick and prefabricated window and door

components. The materials, method of construction and overall appearance of the building suggest that it was constructed in the 1970s.

2.7 Highgate Day Centre car park and an area of soft landscaping are present to the north of day centre. A number of trees are also present, as detailed below.

Greenwood Day Centre, 35 Greenwood Place

2.8 The Greenwood Day Centre is composed of several connected structures forming a single one-storey, flat-roofed complex. The following features were identified within the building:

- **COSHH Store** building (Image 6);
- A below ground store, approximately 4x4m in plan and 1.00 to 1.50 m bgl (Image 7);
- **Boiler Room** (Image 8) located towards the bottom of the 'Mail Out' community space which covers part of the ground floor footprint of Deane House (see Figure 2 for photograph). Staining on the floor of the boiler room was noted (Image 9) suggesting possible leakages during past operation;
- The building additionally contained kitchens, toilets, storage rooms and office space; and,
- Council waste bins and wooden pallets were noted by the delivery entrance/exit of 'Mail Out'.

Topography

2.9 The site has a gentle gradient up from approximately 36m AOD in the south west to 39m AOD in the north east [C]. However, there are significant changes in level at the site boundaries, the most notable of which include:

- The Highgate Day Centre car park in the north east of the site is up to 1m lower than pavement level along Highgate Road. A brick retaining wall is present along the north eastern site boundary to accommodate this level change. The wall was noted to generally be in a good condition. However, a more recent 0.75m high retaining wall has been constructed in front of the centre of the existing retaining wall, which could have been due to former instability in this section. The Highgate Day Centre, whilst partially constructed at this lower level, is accessed from Highgate Road at the higher level;
- The grounds of the Church to the immediate south are higher than the site. At the south west, adjacent to Greenwood Place and close to the Greenwood Centre, the Church is approximately 1.50m higher than street level. However, adjacent to the southern site boundary of the Highgate Day Centre there is a brick retaining wall, retaining

approximately 0.60m of soil. The wall was noted to be in a fair to poor condition with rendering and mortar missing and with individual bricks showing signs of weathering. The wall did not show any signs of bulging or leaning;

- Murphy's Yard, to the south west of the site, is at a level of approximately 33.70m AOD. To the south west of the Greenwood Centre is a pathway at 34.10m AOD with two sets of steps up to Greenwood Place at 36.65m AOD. This change in level is accommodated by brick and mass concrete retaining walls. The ground floor level of the Greenwood Centre is approximately 37.05 to 37.20m AOD and is constructed on a volume of soil which is supported by these retaining walls along the south west.

Vegetation

2.10 The site is mainly devoid of vegetation, however, there are two notable areas of vegetation on site, which have been identified by reference to the topographical survey [C]:

- A small area of soft landscaping in the north east which includes an 8m high Maple, 2 No. 4m high Laurel, 1 No. Eucalyptus sapling and another unidentified sapling, adjacent to a car park and approximately 25m north of Highgate Day Centre; and,
- A tree-line following the eastern site boundary adjacent to Highgate Day Centre comprising a 5m high Cottoneaster, a 6m high Laburnum, 4 No. Cherry ranging from 6-9m in height and a number of unidentified saplings.

2.11 Mature trees are also located directly off site, including a 7m Rhus at the south eastern site boundary and un-identified trees to the immediate south of the Greenwood Day Centre.

2.12 In addition to the above, a 'Stand of Treated Japanese Knotweed' is shown on the topographical survey [C] at south west corner of Lensham House, just off site. However, no further strands of Japanese Knotweed were identified during the walkover (although a specific inspection was not carried out) and it is possible that a wider survey was completed prior to procuring treatment. Nonetheless, and until such time that this can be confirmed, the potential remains for additional stands to be present on site and this should be examined under a specific site survey by a Japanese Knotweed specialist.

Surrounding Land-Use

2.13 The site is set in an area of mixed use and a description of the main surrounding land uses is summarised in Table 2.1.

TABLE 2.1: SUMMARY OF SURROUNDING LAND USES

Type	Description
In between Highgate and Greenwood Centres	A&A Self Storage, Lensham House, 19 Greenwood Place. A one to three storey brick building used as a self-storage facility. Construction / structural details can be found in [B].
North west	Converted warehouses and offices.
North east	Highgate Road, which is largely residential.
South east	Kentish Town Christ Apostolic Church and its boundary wall which are listed. Beyond this is the HMV Forum, which is also listed.
South west	'Murphy's Yard' is present to the south west of the site. Approximately 75m south west is a railway line.

Site After-Use Proposal

2.14 The proposed site redevelopment is shown in Figure 3.

2.15 It is proposed to demolish the existing Greenwood Day Centre and construct a new one to three storey community centre with a single storey basement beneath the north west corner of the site. The proposed basement is to be 3.80m below the finished floor level of the ground floor to allow for 3.50m headroom.

2.16 It is also proposed to demolish the existing Highgate Day Centre and construct a new seven storey residential block with limited commercial development at ground floor level.

2.17 Redevelopment also includes new access links, parking areas, soft landscaping and a shared garden area. Lensham House is currently intended to be retained.

2.18 The development is classified as Geotechnical Design Category 2 with reference to Eurocode 7.

3.0 ENVIRONMENTAL SETTING

Geology

3.1 The site geology and potential geotechnical hazards are summarised in Tables 3.1 and 3.2. The associated references are listed at the rear of the report. The geological sheet for the area [1] and the GroundSure Report [2] indicate that the geology comprises London Clay to around -10m AOD. An area of 'Worked Ground' is shown on geological mapping on the western corner of the site, which would suggest it has a minimum thickness of 5m. It is likely that Made Ground will also be present overlying the London Clay, although this is likely to be of a lesser thickness than the 'Worked Ground' as it is not shown on geological mapping.

TABLE 3.1: SUMMARY OF GEOLOGY

Strata	Depth to base	Description
Made Ground / Worked Ground	Unknown	Man-made granular and cohesive soils of unknown thickness, associated with historical development of the site.
Alluvium	Unknown	A former tributary of the River Fleet is anticipated to be present beneath the site [4]. It is therefore possible that Alluvial deposits may be present on site overlying the London Clay.
London Clay	50m bgl (-10m AOD)	Firm brown clay, becoming stiff to very stiff blue silty clay with depth.

3.2 One historic BGS borehole record, located 85m to the south east, has also been obtained. The borehole was sunk to 9m bgl in 1962 and encountered a geological sequence of Made Ground over London Clay. One metre of Made Ground was recorded over 1m of weathered London Clay, underlain by London Clay to the base of the borehole.

3.3 It is noted that in the report contained in Appendix C, a more recent geological map was referred to, dated 2006, which indicates the presence of Head Deposits in areas of higher ground to the north east.

TABLE 3.2: SUMMARY OF GEOTECHNICAL HAZARDS

Hazard	Distance	Description	Ref
Former Tributary of the River Fleet	On site	A former tributary to the River Fleet is located beneath the site. It is possible that compressible Alluvial deposits may be present beneath the site. It is believed that this has been culverted and diverted off site, as discussed in Section 4.	4
Former Structures	On site	There is the potential for obstructions, relic basements and an increased thickness of Made Ground to be present on site.	-
Retaining Walls and Level	On site	Retaining walls are present along the north eastern, south eastern and south western site boundaries. The effect of the	-

Hazard	Distance	Description	Ref
Changes		proposed development on these retaining walls needs to be considered.	
Worked Ground	On site	A railway locomotive shed and associated railway lines were constructed in cuttings adjacent to the south western site boundary. An area of 'Undivided Worked Ground' encroaches into the western corner of the site, which is likely to be associated with the construction of the railway. There is therefore the potential for a significant thickness of Worked Ground to be present on site.	2
Shrink / Swell Clay	On site	'Moderate' hazard. The London Clay is known to have a high volume change potential and trees were noted during the site walkover. Therefore near surface soils may be desiccated in the region of trees on site.	-
Aggressive Soil	On site	The London Clay, Alluvium and materials derived from it can naturally contain elevated concentrations of minerals that can be aggressive to buried concrete.	6
Shallow Groundwater	On site	Perched water above the London Clay, associated with the former tributary of the River Fleet, may be present.	-

3.4 The GroundSure Report has identified a 'very low' or 'no hazard' risk to the following ground stability hazards: landslides, running sands, faults, landslips, ground dissolution of soluble rocks, compressible deposits, coal and non-coal mining & associated cavities, natural cavities, and brine or gypsum extraction. However, it is possible that compressible Alluvial deposits may be present beneath the site associated with the former tributary of the River Fleet.

3.5 The site is not located within the critical area for shallow or deep foundations and basements [5].

Hydrogeology

3.6 The site hydrogeology is summarised in Table 3.3 and the associated references listed at the rear of the report.

TABLE 3.3: SUMMARY OF HYDROGEOLOGY

Type	Distance	Description	Ref
Superficial Aquifer	On site	None shown on the hydrogeological map.	2
Bedrock Aquifer (London Clay)	On site	Unproductive strata – rock layers or drift deposits that have negligible significance for water supply or river base flow.	2, 3
Source Protection Zone	>1000m	None located within 1km of site.	2
Groundwater Abstractions	655m S	Two boreholes at Kentish Town Sports Centre, Prince of Wales St. Licence no. 28/39/0091. Details: Process water, drinking, cooking, sanitary, washing and laundry use.	2

3.7 The Chalk, located at depth, is a 'Principal Aquifer' [3]. However, the intervening low permeability London Clay is likely to act as an aquitard, thus protecting the Chalk, unless compromised.

3.8 The site is considered to have a **Low** sensitivity with respect to hydrogeology.

Hydrology

3.9 The site hydrology is summarised in Table 3.4 and the associated references listed at the rear of the report.

TABLE 3.4: SUMMARY OF HYDROLOGY

Type	Distance	Description	Ref
Surface Waters	>500m	No surface water features within 500m of site. However, an extended culvert, the Regent's Canal, is shown running north west to south east 210m west of the site.	2, 3
Surface Water Abstractions	>1000m	None located within 1km of site.	2

3.10 Reference to the Lost Rivers of London book [4] indicates that a tributary of the former River Fleet ran through the site. This former tributary is believed to have been diverted and culverted as discussed in Section 4.

3.11 A Flood Risk Assessment is being presented under a separate cover.

3.12 The site is considered to have a **Low** sensitivity with respect to hydrology.

Earthquake Zone

3.13 Clause 3.2.1(1),(2),(3) in the National Annex to BS EN 1998-1:2004 Eurocode 8: Design of structures for earthquake resistance states that in the absence of a project-specific assessment, to adopt the reference ground acceleration for a return period of 2500 years given by the seismic contour map in PD 6698. The map shows that the PGA (peak ground acceleration) for the site is in the region of 0.00 – 0.02g, which indicates a **very low** seismicity.

Radon

3.14 Reference to BRE 211 document [7] and the National Radiological Protection Board (NRPB) Atlas [8] has shown that the site does not fall within an area where basic or full radon protection

measures are necessary for domestic dwellings, nor is it situated in an area requiring a geological assessment for such measures. As such, a **Low** risk is adjudged in relation to radon.

Sensitive Land-Uses

3.15 Reference to the Magic website [12] indicates two Grade II listed buildings; the Christ Apostolic Church, which bounds the south east of the site and the Forum which is located 50m south east of the site.

3.16 The Magic website [12] and GroundSure report [2] do not indicate any other sensitive land uses within 500m of the site.

4.0 SITE HISTORY AND INDUSTRIAL SETTING

Site History

4.1 Information relating to the site history has been obtained by reference to the GroundSure report [2] and is summarised for the site and its surroundings in Tables 4.1 and 4.2.

TABLE 4.1: SITE HISTORY

Date	Development
1872	The north eastern half of the site comprises terraced housing (fronting onto Highgate Road). A number of buildings labelled Prospect Place are present in the south west and a number of unidentified buildings are located in the north west. The rest of the site comprises soft landscaping/ communal gardens/ allotments.
1894-1896	Site layout largely unchanged. The buildings in the north west are no longer shown.
1915-1916	A 'Bottling Store' to the north has been extended southwards into the north west quadrant of the site. Prospect Place is no longer shown and a new building is shown in its place in the south west.
1936	Site layout remains unchanged.
1952	The 'Bottling Store' is now labelled as 'Heavy Chemicals Warehouse' on site. A platform is indicated in connection with this. The footprint of the building in the south west has been extended north west.
1963-1968	The 'Heavy Chemicals Warehouse' is now only labelled as a 'Warehouse'. Part of the building in the south west of the site has been demolished.
1973-2012	The site layout is as existing with the two day care centres and an area of soft landscaping in the north east of the site.

TABLE 4.2: ADJACENT LAND HISTORY

Date	Development
1872	St John the Baptist's Church and Prospect Place bound the site to the south. Housing is shown to the immediate north west and north east of the site. Railway sidings are shown 25m south west.
1894-1896	Two 'Bottling Stores' are shown 20 and 70m north west. A 'Coal Shed' is labelled 40m south west. Slopes are shown down to the railway sidings to the south west adjacent to the south western site boundary. 'Kentish Town Sheds (Locomotive)' are shown 120m north west. A 'Smithy' and a 'Laundry' are shown 45m north and 55m north west of the site respectively. An 'Omnibus Company's Stables' are labelled 75m south east. A 'Tramway 'is shown along Highgate Road adjacent to the north eastern site boundary.
1915-1916	The railway sidings have now been extended towards the site and now bound the site to the south west. The footprint of the locomotive sheds has doubled, expanding to the north. The 'Omnibus Company's Stables' and 'Smithy' are no longer labelled.
1936	The area bisecting the site now houses a number of unmarked buildings. A 'Depository' and 'Warehouse' are labelled 25m north west. The 'Laundry' 45m north is now labelled a 'Warehouse'. A 'Wallpaper Factory', 'Warehouse', 'Piano Works' and 'Furniture Factory' are labelled 80m north west, 90m east, 150m north east and 220m north east of the site respectively.

Date	Development
1952	The tramway is no longer shown. The buildings bisecting the site are now labelled as 'Coachbuilding Works'. The 'Bottling Stores' to the north west are now labelled as a 'Garage' and 'Wallpaper Factory' and the 'Warehouse' 25m north west is now labelled a 'Cabinet Works'. 'Welding Works' are shown 100m south east. A 'Naphtha Store' is labelled adjacent to the railway sidings 220m south west. Two 'Garages' and a 'Motor Body Factory' are shown 130m east, 150m south east and 130m east respectively.
1963-1968	A large amount of the railway sidings to the south west are no longer shown and the area is now labelled a 'Civil Engineering Depot'. The remaining railway lines are labelled 'Dismantled Railway'. The 'Wallpaper Factory' to the north west is now only labelled a 'Factory'. The 'Depository' and 'Cabinet Works' are now labelled as a 'Clothing Factory' and 'Exhibition Works' respectively. The 'Coachbuilding Works' in the centre of the site is also labelled as an 'Exhibition Works'. The buildings adjacent to the south western site boundary are no longer shown. Vacant land is shown on the northern side of Highgate Road to the immediate north east of the site.
1973-1977	A new building has been constructed bisecting the site, which is labelled a 'Warehouse'. The area of land to the south west of the site is now labelled as a 'Depot' and only the area to the north west is labelled as a 'Civil Engineering Depot'. All the industries previously mentioned are now labelled as 'Works'. A 'Roof Car Park' is labelled 25m north west. The 'Naphtha Store' is no longer labelled.
1981-2012	Surrounding land use largely unchanged.

Liaison with Regulatory Authorities

4.2 A summary of consultation with Regulatory Authorities is provided under Table 4.3 below. Correspondence is contained within Appendix C.

TABLE 4.3: SUMMARY OF CONSULTATIONS WITH REGULATORS

Regulator	Date Issued	Response Received	Key Findings/ Outcomes
Environmental Health Officer London Borough of Camden	23/11/2012	29/11/2012	The site has not been determined as contaminated land under Part IIA of the Environmental Protection Act 1990. However, LB Camden has identified the site as having the potential to be contaminated land through its previous use. Historical land uses at or within 100m of the site include: chemical works, depository (depot); laundry; welding works; coach building works; railway land; garage; unknown industrial use; unknown warehouse; smithy; and, bottling works. It is highly likely that asbestos contamination will be present on site.
Environmental Health Officer	02/07/2013 and	14/08/2013	An enquiry was made to the EHO in order to establish the exact nature of the

Regulator	Date Issued	Response Received	Key Findings/ Outcomes
London Borough of Camden	14/08/2013		historical heavy chemical warehouse on the west of the site. The EHO confirmed that the council holds no further information.
Planning Officer London Borough of Camden	13/11/2012	22/11/2012	Provided links to online information.
Building Control London Borough of Camden	13/11/2012	13/11/20112	Building Control could not provide any information on ground conditions.
Information Manager **Transport for London**	13/11/2012	14/11/2012	The response confirmed that there are no underground assets within 50m of the site.
Communication Officer **Crossrail**	13/11/2012	08/01/2013	The site falls outside the safeguarding zone of Crossrail 1 and 2.
Petroleum Officer	13/11/2013	25/03/2013	No petroleum tank records found.

Unexploded Ordnance (UXO)

4.3 A preliminary review has been made of the UXO risk presented by the site based upon CIRIA C681 'Unexploded Ordnance (UXO) – A guide for the construction industry' [9] and the assessment matrices presented in Tables 5.1 – 5.3 therein.

4.4 A review of the London County Council Bomb Damage Maps 1939-1945 [10] indicates that the site lies in an area that was subject to moderate bombing during the Second World War. The document indicates that one terrace building on the north west of the site suffered 'General Blast Damage' and the depository located to the immediate north was 'Seriously Damaged but Repairable at Cost'. Additionally, the coal shed and locomotive sheds, to the south and west of the site respectively, suffered 'General Blast Damage'. Otherwise, the remaining buildings on site and in the immediate surrounding area were not recorded as damaged.

4.5 By reference to Table 5.1, the potential for aerial delivered ordnance to have landed on the site is considered to be high. However, with reference to Tables 5.2 and 5.3, it is noted that the site has undergone significant post war redevelopment, particularly during the early 1970s when the day centre buildings were constructed.

4.6 At this stage, taking into account the level of post-war development and the survival of buildings on site throughout the war period, the risk of encountering UXOs is considered to be '**Low**'.

4.7 Notwithstanding the above information, UXO hazards should be included as part of the health and safety briefing and tool box talks during the works, such that if any suspicious articles are found, they can be quickly identified and treated appropriately by specialist inspection.

Tunnels and Infrastructure

4.8 CIRIA Report SP69 [5] indicates that a storm relief sewer runs north to south beneath Highgate Road adjacent to the eastern site boundary and that a main sewer runs close to the western boundary of the site. Reference to the London County Council Main Drainage Plan No. 2 [11] also shows both of these sewers at the same location: a storm relief sewer beneath Highgate Road to the east of the site; and, a main sewer to the west of the site. However, the main sewer to the west of the site is labelled the 'Fleet Sewer'.

4.9 Statutory services plans have been obtained for the site by Engineering Land and Building Surveys Limited in January 2013. These should be referred to with regards to the proposed development. Whilst the Thames Water plans show no significant water or sewer pipes on site, it is noted that a large diameter (1.22m) storm relief sewer at approximately 10m bgl is located beneath Highgate Road, believed to be the storm relief sewer indicated in [5] and [11]. The Thames Water plans for the site do not show the main sewer. It is recommended that consultations are undertaken with Thames Water with regards to the proposed development in relation to this sewer.

4.10 By reference to information held locally by CampbellReith, the site is remote from scour hollows, EDF deep cable tunnels, Royal Mail and government communication tunnels. Regulatory responses from Crossrail and London Underground indicate that site is remote from any of their assets and infrastructure.

Current Industrial Setting

4.11 A review of Contemporary Trade Entries has been completed by reference to the GroundSure report [2] and potential sources of contamination within 150m of the site are listed in Table 4.4.

TABLE 4.4: SUMMARY OF POTENTIALLY CONTAMINATIVE TRADE ENTRIES (≤100M FROM SITE)

Name	Distance	Address	Classification
Registered as 'Active'			
A&A Business Centre	Onsite	19 Greenwood Place, London, NW5 1LB	Container & Storage – Transport, Storage & Delivery
London Undercover	10m NE	Unit 1-4 Deane House, 27 Greenwood Place,	Consumer Products/ Luggage, Bags & Travel – Consumer Products

Name	Distance	Address	Classification
		NW51LB	
Alan Pharmaceuticals	25m NW	33 Greenwood Place, NWS 1LB	Medical Equipment, Supplied & Pharma – Industrial Products
Works	30m NW	(Unspecified Address) NW5	Unspecified Works or Factory – Industrial Features
Kentish Town Fire Station	35m E	Kentish Town Fire Station, 20 Highgate Road, NW5 1NS	Fire Brigade Station – Central & Local Government
Millennium Design Ltd.	40m NW	Linton House, 39-51, Highgate Road, London, NW5 1RT	Clothing, Components & Accessories – Consumer Products
Zooid Picture Ltd.	40m NW	Linton House, 39-51, Highgate Road, London, NW5 1RT	Published Goods – Industrial Products
Works	65m NE	(Unspecified Address) NW5	Unspecified Works or Factory – Industrial Features
Charles Wilson Engineers Ltd.	70m E	11-15 Fortress Road, London, NW5 1AD	Construction & Tool Hire – Hire Services
Piano Warehouse Ltd	70m NE	30a Highgate Road, London, NW5 1NS	Musical Instruments – Consumer Products
Court Davis Joinery Ltd	70m NE	30a Highgate Road, London, NW5 1NS	General Construction Supplies - Industrial Products
Works	80m NE	(Unspecified Address) NW5	Unspecified Works or Factory – Industrial Features
Works	80m N	(Unspecified Address) NW5	Unspecified Works or Factory – Industrial Features
Electricity Sub Station	100m NW	(Unspecified Address) NW5	Electrical Features – Infrastructure & Facilities

4.12 Table 4.5 summarises identified industrial features which may present a potential source of contamination to the site by reference to the GroundSure report [2]

TABLE 4.5: INDUSTRIAL SETTING

Type	Distance	Description
Part A(2) and Part B Activities & Enforcements[1] (≤250m)		
Perk Clean 20 Fortress Road, Kentish Town, NW5 2HB	100m E	**Historic** Part B Permit for **Dry Cleaning** processes. No enforcement details or dates are recorded against this entry, however, this has since been re-registered as **Active**; suggesting that this premises has been operating for a period spanning two permit consents as a minimum.
M & A Coachworks II 1-36 Fortress Grove,	115m E	**Current Part B Permit** for **Vehicle Re-spraying** processes. No enforcement details or dates are recorded against this

[1] **Pollution Control – Part A & B Permits**: Some industrial techniques have potential to cause pollution. Since 1990, many of these processes have required an 'authorisation' from the Environment Agency to operate and they are also inspected annually. Some processes have the potential to cause only air pollution (Part B Permitted Processes) and for these operations the Local Authority is responsible for their inspection. Part A permits control activities that may have a range of environmental impacts, including: emissions to air, land and water; energy efficiency; waste reduction; raw materials consumption; noise, vibration and heat; and, accident prevention.

Type	Distance	Description
Kentish Town, NW5 1LE		entry.
Zappeo Dry Cleaners 310 Kentish Town Road, NW5 2TH	135m SE	**Current Part B Permit** for **Dry Cleaning** processes. No enforcement details or dates are recorded against this entry.
Post Office Vehicle Services, Unit A, Kentish Town Business Park, Regis Road, NW5 3RR	165m S	**Historic Part B** Permit for **Vehicle Re-spraying** processes. This entry is recorded twice; however, neither record contains enforcement details or dates.
J Murphy & Sons Ltd. 81 Highgate Road, NW5 1TS	165m NW	**Current Part B** Permit for **Vehicle Refinishing** processes. There is also a record for a superseded (historic) permit at this address for the same process. Neither records contain details on the enforcement dates.
The Kleen Machine Kentish Town, PO16 8UG	245m SE	**Historic Part B** Permit for **Dry Cleaning** Processes. No enforcement details or dates are recorded against this entry.
Sites Determined as Contaminated Land under Part IIA EPA 1990		
8 Ascham Street; 15-23,27,33 and 37-41 Falkland Road; 15a, 25-29 and 35 Lady Margret Road; and, 42,44 and 48 Leverton Street, NW5 2PU	190m E	**Former metal plating works. Lead and Cadmium potential contaminants. Remediated.** Land Identified as 'Contaminated Land' in 2011.
Environment Agency Licensed Waste Sites		
Camden London Borough Council Recycling Centre Regis Road, Kentish Town, London, NW5 3EP	230m S	**Household Waste Amenity Site** <25,000 tonnes/year (recorded annual tonnage of 7,793 tonnes). **Regis Licence Number**: CAM001. **EPR Reference**: EA/EPR/DP3091NK/V003. **Operator** Camden London Borough Council. **Waste Management Licence Number**: 80349. The licence was issued on 10/12/1996, modified on 25/01/2002 and effective from 11/05/2012.

4.13 In addition to the above data, research did not establish the presence of any of the following at or within 500m of the site:

- Historical IPC Authorisations;
- Part A(1) and IPPC Authorised Activities;
- Water Industry Referrals (potentially harmful discharges to the public sewer);
- Red List Discharge Consents (potentially harmful discharges to Controlled Waters);
- Red List 1 Dangerous Substances Inventory Sites;
- Red List 2 Dangerous Substances Inventory Sites;
- Licensed Discharge Consents;
- Planning Hazardous Substance Consents & Enforcements;
- COMAH & NIHHS Sites;

- Environment Agency current or historical landfill data;
- Operational and non-operational landfill sites sourced from Landmark;
- BGS/DoE non-operational landfill sites;
- Local Authority landfill sites; or,
- Underground High Pressure Oil and Gas Pipelines.

4.14 Also, research did not establish any of the following at or within 250m of the site:

- Category 3 or 4 Radioactive Substance Licences;
- List 2 National Incidents Recording System Entries; or,
- List 1 National Incidents Recording System Entries.

5.0 CONCEPTUAL MODEL

5.1 Current practice for land contamination evaluation involves appraisal of contaminant source-pathway-receptor pollutant linkages. These are summarised below, considering the desk study information obtained. This information has been utilised to design the site investigation considering the proposed end use.

Potential Sources of Contamination

5.2 Table 5.1 summarises the potential contamination sources that have been identified on or near the site. The potential contaminant types associated with these is then given based upon a review of CLR 11, industry profiles and anecdotal information.

TABLE 5.1: POTENTIAL SOURCES OF CONTAMINATION

Potential Sources of Contamination	Discussion / Potential Contaminant
Onsite	
Made Ground including areas of **Undivided Worked Ground** and **Surface Ground Workings** that either encroach or are directly adjacent to site.	A significant thickness of Made Ground is anticipated onsite, primarily resulting from historical development. In addition, areas of 'Worked Ground' are indicated to be present on, or in close proximity to the site. Potential contamination associated with Made Ground can be wide-ranging and may include: • **Asbestos Containing Materials** and associated **dispersed fibres** primarily relating to the potential backfilling of demolition arisings onsite. • Where **deleterious materials** have been backfilled onsite, this may represent a potential source of **hazardous ground gases**, primarily comprising **Carbon Dioxide** (CO_2) and **Methane** (CH_4). • Depending upon the nature of the backfilled materials, **metals** and **hydrocarbons** (including **polynuclear aromatic hydrocarbons (PAHs)**) may be present.
Boiler Room located within the basement to Greenwood Day Centre. Staining has been noted on the ground.	Greenwood Place was constructed during the early 1970s and it is therefore possible that the original boiler and heating infrastructure was fuelled by **heating oil**. As such, it is possible that contamination may have occurred locally due to spillages. It is noted that no tanks were recorded during the walkover and the current groundslab/ flooring appears to be in a good state of repair.
COSHH Store located within Greenwood Day Centre.	Inspection of the COSHH Store was not possible at the time of the walkover. It is likely that the store is used for domestic cleaning products.

Potential Sources of Contamination	Discussion / Potential Contaminant
Bottling Store/ Factory directly present to the north-western site boundary and later expanding on to the western portion of site. c.1911 – 1952.	A wide range of contaminants may have arisen from these historical uses, including: **Hydrocarbons** including **lubrication oils**, **degreasing**, **solvents**, **fuel oils**, and **Polynuclear Aromatic Hydrocarbons** (PAHs). **Metals**, including **chromium**, **copper** and **arsenic** **Asbestos Containing Materials** potentially backfilled with general demolition arisings.
Heavy Chemicals Warehouse c.1952 – 1967.	Anecdotal evidence provided under Ref [A] indicates that these buildings were owned by *Imperial Chemical Industries (ICI) Ltd*. who were involved in the production of chemicals, explosives, fertilisers, insecticides, dyestuffs, non-ferrous metals, fabrics and paints, as well as the development and production of pharmaceuticals. However, the buildings onsite are unlikely to have been involved in any form of production and mainly used as storage.
Exhibition Works c.1967-1973	Potential general contaminants include **metals**, **hydrocarbons** and **asbestos**. Additional contaminants may have arisen subject to the particular materials stored within the warehouse.
Warehouse c.1967-1973	
Offsite	
Coachbuilding Works situated in the area between the Greenwood Centre and Highgate Centre c.1952-1967.	Coachbuilding works are manufacturers of bodies for automobiles; potential contaminants include **metals and metalloid compounds**, **hydrocarbons**, **lubrication oils**, **asbestos and Asbestos Containing Materials** and **solvents**.
Clothing Factory <10m to the north of the site. c.1967-1973	Consultation to the DoE Industry Profile for *Textile Works and Dye Works* (1996) includes a section on 'Treatments to Fibres, Yarns & Fabric'. It is unclear whether the factory produced materials in-house or whether the factory simply 'assembled' fabrics – in which case the potential for contamination to have been generated is relatively reduced.
Cabinet Works <10m to the north of the site. c.1952-1967.	Potential general contaminants include **metals**, **hydrocarbons** and **asbestos**.
Railway <10m to the south west of the site. c.1916 - 1952	Potential contaminants include **metals** and **hydrocarbons.**
Wallpaper Factory located 75m to the west of the site c.1936 – 1952.	Consultation to the DoE Industry Profile for *Pulp and paper Manufacturing Works* (1996) suggests that possible contaminants include: • **Metals and Metallic Compounds**, **Inorganic Compounds**, **Acids & Alkalis**, **Solvents** and other **Organic Compounds** that may be associated with 'paper production' – should the factory have included paper production rather than delivery of paper for printing; • **Dye & Pigment Compounds** associated with printing; • **Oils & Asbestos** associated with potential heating systems; and, • **Polychlorinated Biphenyls** (PCBs) associated with potential Electricity Transformer areas onsite.

Potential Sources of Contamination	Discussion / Potential Contaminant
Active Contemporary Trade Directory Entries (within 100m of site)	Potential general contaminants include **metals**, **hydrocarbons, VOCs and SVOCs** and **asbestos.**

Pathways

5.3 In the context of the proposed site uses, the potential pathways presented in Table 5.2 are considered applicable and have been considered in the further site investigation.

TABLE 5.2: EXPOSURE PATHWAYS

Pathway		Phase
Ingestion of soil / dust	Outdoor	C,O
	Indoor	O
Inhalation of soil / dust	Outdoor	C,O
	Indoor	O
Inhalation of vapour from soil / dust / water	Outdoor	C,O
	Indoor	O
Dermal contact with soil / dust / water	Outdoor	C,O
	Indoor	O
Migration of soil gases to confined spaces / structures	Indoor	C,O,B
Migration of water borne contaminants	On site	C,O
	Off site	C,O,E
Leaching of contamination from Made Ground	On site	C,O
	Off site	C,O,E
Movement of contaminants to engineered structures (e.g. water pipes)	On-site	C,O,B
Uptake by flora / fauna	On-site	C, O
Notes: C – Construction. O – Occupation. E – Environmental effect off site. B – Buildings and services.		

Receptors

5.4 In the context of the above the following potential receptors have been identified:

TABLE 5.3: POTENTIAL RECEPTORS

Receptor	Description	Sensitivity
Construction and Maintenance Workers	Construction workers associated with the development are likely to be exposed in the short term only.	Medium
Site end users	Users of the day care centre and residential	Medium – High

Receptor	Description	Sensitivity
	occupants.	
Controlled Waters (Hydrogeological)	The site is situated on Unproductive Strata associated with the presence of the London Clay.	Low
Controlled Waters (Hydrological)	There are no significant surface water receptors within 500m of the site.	Low
Buildings and Service Infrastructure	Water supply pipework may be installed as part of the development.	Medium
Adjacent Site End Users	Commercial and residential end-users are situated in the surrounding area.	Low - Medium

Targeted Pollutant Linkages

5.5 Due to access restrictions, it was not possible to place any exploratory locations in the northern part of the Greenwood Community Centre, which contains a boiler room and COSHH store, and is also the site of the former bottle stores and heavy chemicals warehouse(s). It was also not possible to access the area of 'undivided worked ground'.

5.6 The site investigation was targeted at the following identified pollutant linkages:

TABLE 5.4: TARGETED POLLUTANT LINKAGES

Issue	Exploration
Contamination of shallow soils from historical site activities.	General site coverage. Soil samples obtained in all holes within the upper 1.0m.
Ground gas generation from Made Ground.	Ground gas monitoring installations required to give general site coverage. Installations to extend into the Made Ground and London Clay.

5.7 The findings of the intrusive investigation of the potential contaminant sources and pathways are reported herein. This has informed the Generic Quantitative Risk Assessment presented in Section 7.0 and the subsequent discussion of risk in Section 9.0.

6.0 GROUND INVESTIGATION

Summary of Investigation

Scope of Works

6.1 The exploratory locations are shown on the Exploratory Hole Location Plan within Ground Engineering Ltd.'s factual report presented in Appendix C. The completed site work comprised:

- 2 No. cable percussive boreholes to 20 and 35m bgl; and,
- 5 No. dynamic continuous sampler holes to depths between 2.20 and 6m bgl.

6.2 The installed monitoring wells and associated ground conditions are summarised in Table 6.1. Visits have been made to site on 4 occasions on 13th, 20th, 29th May and 3rd June 2013 to monitor gas and water levels within the installations and to obtain samples. BH2 was not accessible due to vehicles obstructing its location during these dates, and thus an additional monitoring visit was made of this installation on 13th June 2013.

TABLE 6.1: STANDPIPE SUMMARY

Exploratory Hole	Response Zone (m bgl)	Strata Encountered	
BH1	1.00 – 4.70	0.00 – 1.55	Made Ground (cohesive).
		1.55 – 2.40	Made Ground (Alluvial deposits).
		2.40 – 3.15	Reworked London Clay.
		3.15 – 4.70	London Clay.
BH2	1.00 – 4.15	0.00 – 0.42	Road pavement materials.
		0.42 – 1.00	Made Ground (cohesive).
		1.00 – 3.70	Made Ground (Alluvial deposits).
		3.70 – 4.15	Reworked London Clay.
DCS1	1.00 – 3.00	0.00 – 0.24	Road pavement.
		0.24 – 0.65	Made Ground (granular).
		0.65 – 2.00	Made Ground (cohesive).
		2.00 – 3.00	Made Ground (Alluvial deposits).
DCS2A	1.00 – 2.00	0.00 – 0.09	Pavement slab.
		0.09 – 0.16	Made Ground (granular).
		0.16 – 1.25	Made Ground (cohesive).
		1.25 – 2.00	London Clay.
DCS3	0.60 – 1.00	0.00 – 0.05	Pavement slab.
		0.05 – 0.30	Made Ground (granular).

Exploratory Hole	Response Zone (m bgl)	Strata Encountered	
		0.30 – 0.70	Made Ground (cohesive).
		0.70 – 1.00	Made Ground (granular).
DCS4	1.00 – 2.00	0.00 – 0.20	Concrete.
		0.20 – 0.56	Made Ground (granular).
		0.56 – 0.70	Concrete.
		0.70 – 1.50	Made Ground (cohesive).
		1.50 – 2.00	Reworked London Clay.

Groundwater Observations

6.3 Groundwater monitoring was undertaken between 13th May and 3rd June 2013, and a single observation was made of BH2 on 13th June 2013. The associated observations are summarised in Table 6.2 below.

TABLE 6.2: GROUNDWATER OBSERVATIONS

Exp Hole	Water Strikes				Standing Water Level During Monitoring			
	Struck		Rose to		Min		Max	
	m bgl	m AOD	m bgl	m AOD	m bgl	m AOD	m bgl	m AOD
BH1	NS	-	-	-	2.56	34.34	3.75	33.15
BH2	3.10	33.45	2.70	33.85	1.53	35.02	-	-
DCS1	3.00	33.50	-	-	1.21	35.29	Dry	-
DCS2A	NS	-	-	-	Dry	-	-	-
DCS3	NS	-	-	-	Dry	-	-	-
DCS4	NS	-	-	-	Dry	-	-	-

NS – No strike.

6.4 Groundwater strikes were encountered during drilling in BH2 at 3.10m bgl, which rose to 2.70m bgl and in DCS1 at 3m bgl. The groundwater level in BH1 rose steadily during monitoring from 3.75 to 2.56m bgl. Similarly, the groundwater level in DCS1 rose from dry to 1.34 to 1.21m bgl, and was obstructed by a vehicle on the final monitoring visit. These locations had installations to 4.70 and 3m bgl respectively. In addition, on the single monitoring visit of BH2, groundwater was monitored at 1.53m bgl, which was installed to 4.15m bgl.

6.5 During monitoring of the remaining installations, DCS2A, DCS3 and DCS4, no groundwater was encountered, where the standpipes were installed to shallower depths of between 1 and 2m bgl.

6.6 It is possible that groundwater strikes were not observed in all boreholes during drilling due to slow groundwater ingress. The monitored groundwater levels also showed increase with time,

which would suggest that an equilibrium level had not been reached. It is therefore likely that groundwater is residing at shallow depth in the Made Ground between 34.50 and 35.50m AOD, approximately 1 to 2.50m bgl.

Geotechnical Testing

6.7 In-situ testing was undertaken for geotechnical purposes and samples were obtained for appropriate laboratory analysis. Site based geotechnical testing is summarised in Table 6.3.

TABLE 6.3: IN-SITU TESTS (GEOTECHNICAL)

Test type and Reference	Number
Standard penetration test (BS EN ISO 22476-3:2005)	45
Hand shear vane (UK Specification for Ground Investigation, 2nd Edition)	43
Pocket penetrometer (UK Specification for Ground Investigation, 2nd Edition)	31

6.8 Pocket penetrometer and hand shear vane tests indicate the relative strength of the ground and have been used in combination with laboratory testing to aid determination of the degree of desiccation at the site. Estimates of strength using triaxial equipment and SPTs are generally considered more reliable than estimates made using pocket penetrometer and hand shear vane apparatus; consequently they have been used in preference.

6.9 Geotechnical laboratory testing is summarised in Table 6.4.

TABLE 6.4: LABORATORY TESTS (GEOTECHNICAL)

Test type and reference (BS 1377: 1990 unless stated)	Number
Natural moisture content (Part 2:3.2)	45
Liquid and plastic limits and plasticity index (Part 2:4.3, 5.3 and 5.4)	12
Particle size distribution - wet sieving (Part 2:9.2)	2
Particle size distribution - sedimentation by pipette method (Part 2:9.4)	1
Single stage 100mm UU triaxial compression test (Part 7:8)	21
Water soluble sulphate content 2:1 aqueous extract (BRE SD1 2005)	25
Total sulphur content (BRE SD1 2005)	6
Acid soluble sulphate content (BRE SD1 2005)	6
Soil pH (BRE SD1 2005)	25*
Sulphate content in groundwater (BRE SD1 2005)	1*
Groundwater pH (BRE SD1 2005)	1*

*Additional environmental tests used in subsequent analysis in Section 8

6.10 Moisture content determinations on disturbed samples, including those obtained by dynamic continuous sampling apparatus, may not be wholly representative due to disturbance arising from the sampling process. Obtaining coarse grained soils for particle size distribution analysis from cable tool boreholes can result in a loss of fine materials due to the nature of the sampling process.

6.11 Triaxial tests undertaken on highly fissured samples and disturbance during sampling can result in low values of shear strength being recorded and results have been compared to published data and in situ test results to allow any anomalous data to be identified. Test results are discussed in Section 8.

Contamination Observations and Testing

6.12 Olfactory and visual evidence of potential contamination is summarised in Table 6.5.

TABLE 6.5: SUMMARY EVIDENCE OF CONTAMINATION

Exploratory Hole	Depth (m bgl)	Comment	
BH 1	0.00 – 0.25	Made Ground	Gravel of coal and ash.
	0.25 – 1.10	Made Ground	Gravel of ash and coal. Occasional brown asbestos fragments at 0.50m bgl.
	1.10 – 2.40	Made Ground	Gravel of coal and ash.
BH2	0.00 – 0.05	Made Ground	Asphalt.
	0.42 – 1.00	Made Ground	Gravel of ash.
	1.00 – 3.10	Made Ground	Gravel of ash. Occasional black organic patches.
DCS1	0.00 – 0.05	Made Ground	Asphalt.
	0.39 – 0.65	Made Ground	Gravel of ash.
	0.65 – 3.10	Made Ground	Gravel of coal and ash.
DCS2	0.10 – 2.20	Made Ground	Gravel of metal, coal and ash.
DCS2A	0.09 – 0.16	Made Ground	Gravel of ash.
	0.16 – 1.25	Made Ground	Gravel of ash.
DCS3	0.30 – 0.70	Made Ground	Gravel of metal and ash.
	0.70 – 1.10	Made Ground	Gravel of coal and ash.
DCS4	0.70 – 1.00	Made Ground	Firm black clay. Gravel of ash and coal.
	1.00 – 1.50	Made Ground	Gravel of ash.

6.13 Table 6.6 summarises the chemical suites that were analysed based upon the preliminary conceptual model and observed site conditions.

TABLE 6.6: LABORATORY TESTS (ENVIRONMENTAL)

Test type	Number
SOIL	
CampbellReith Hazardous Properties Assessment (HPA) Suite – pH, moisture content, total sulphate, sulphide, phenols monohydric, total cyanide, arsenic, cadmium, chromium, nickel, lead, mercury, selenium, copper, zinc, speciated polyaromatic hydrocarbons (PAHs), gasoline range organics (GRO) (C6 – C10) and extractible petroleum hydrocarbons (EPH) (C10 – C25, C25 – C40).	12
Total Organic Carbon	3
Fraction of Organic Carbon	3
Total Petroleum Hydrocarbons - Working Criteria Group (TPH WCG)	4
Asbestos screen	11
WATER	
CampbellReith Mandatory Water Suite – arsenic, cadmium, chromium, copper, nickel, zinc, lead, mercury, boron, selenium, hexavalent chromium, soluble sulphate, sulphide, free sulphur, speciated (16) PAHs, phenols, thiocyanate, Total TPH and pH.	3
Total Petroleum Hydrocarbons - Working Criteria Group (TPH WCG)	3
VOCs Target List only	3

7.0 GENERIC QUANTITATIVE RISK ASSESSMENT

Assessment Framework

7.1 Subsequent to the identification and quantification of contaminant species in soils, waters and gases, it is necessary to select a method for assessing their significance in view of the current and proposed future use of the land. The initial assessment comprises comparison of identified contaminant levels to generic screening values that have been prepared to assess the risk to human, controlled water and gas risk receptors. The guidance used to provide this initial screening is listed in Table 7.1.

7.2 With respect to Human Health Risk Assessment, the selection of screening values has been based upon the proposed reuse as a day care centre. Although final development proposals are not yet available, it is likely that residential accommodation is also proposed. The assessment assumes a Soil Organic Matter (SOM) content of 1.0% based on average site derived SOM data from the Made Ground.

7.3 Controlled Water Risk Assessment has been undertaking using as available Environmental Quality Standards (EQS) for the protection of aquatic life where applicable. These are however considered conservative due to the site's location on Unproductive Strata. The specific legislation and/or guidance that dictate the water quality standards adopted are contaminant specific, and these are referenced in Table 7.4. The water quality standards have been chosen in accordance with section 4.2 of the EA's Remedial Targets Methodology (as referenced in the EA's Groundwater Protection: Principles and Practice (GP3), November 2012).

7.4 For further detailed information on the current regulations and selection of appropriate threshold values, please refer to the rear of this report text.

TABLE 7.1: GENERIC QUANTITATIVE SCREENING VALUES

	Key Guidance
SOIL	Environment Agency, Soil Guideline Values based upon Contaminated Land Exposure Assessment Model (CLEA) and the CLEA 1.06 software. SGV Reports SC050021/SGV.
	Generic Assessment Criteria based upon Environment Agency CLEA Version 1.06 software. Environment Agency Science Reports SC050021 SR2/SR3, Toxicological Reports SC050021/Tox. EA Toxicological Reports 1-25.
	Generic Assessment Criteria published by CL:AIRE. The Soil Generic Assessment Criteria for Human Health Risk Assessment. December 2009.
	Generic Assessment Criteria based upon Environment Agency CLEA UK Beta Version 1.0. Environment Agency Toxicological Reports: 1-25.

	Key Guidance
WATER	UK Environmental Quality Standards for the protection of aquatic life.
	EC and UK Drinking Water Standards.
	WHO Drinking Water Standards.
	Background Water Quality.
GAS	CIRIA Report C665, 'Assessing Risks Posed by Hazardous Ground Gases to Buildings'
	CIRIA Report C682, 'VOCs Handbook: investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination'
	British Standard BS:8485, 2007, 'Code of practice for the characterization and remediation from ground gas in affected developments'.
	BS 8576:2013, 'Guidance on investigations for ground gas – permanent gases and VOCs'
	CIRIA Report 150 'Methane Investigation Strategies'.
	BRE 414 'Protective Measures for Housing on Gas Contaminated Land', 2001.
	The Building Regulations 2000, Approved Document C, Section 2. Updated 2004.
	BR211, 'Radon: Guidance on Protective Measures for New Buildings', 2007.
	Health Protection Agency Publication HPA RPD-033, 2007,' Indicative Atlas of Radon in England and Wales.

Statistical Analysis of Soil Analytical Results

7.5 The statistics associated with soil analysis are summarised in Table 7.2. The Mean Value (95%ile) and Maximum Value Tests were undertaken on the sample population for those parameters exceeding the screening levels. If required the Maximum Value Test was undertaken to identify any potential localised areas of increased risk or 'hotspots'. Where the 95%ile exceeds the screening values, these results are highlighted and discussed. The remainder are not considered indicative of significant contamination for the proposed end use.

7.6 The statistical assessment has treated the site as a single averaging area and screened in its entirety. The soil statistics that relate to the upper 1.00m of the ground profile at the site are considered below, on the basis that it is contamination that resides within this depth that would present a potential risk to end users of the site (assuming that finished levels do not change significantly). Soils obtained from greater depths are discussed separately below.

TABLE 7.2: SUMMARY OF SOIL ANALYSIS

Contaminant	Units	Exceeding	Max	95%ile	Tier 2 Screen
Metals					
Arsenic	mg/kg	0/ 8	30	25.79	35[A]
Cadmium	mg/kg	0/ 8	0.92	0.59	85[A]
Chromium	mg/kg	0/ 8	36	28.77	627[A]
Copper	mg/kg	0/ 8	170	109.39	3802[A]

Contaminant	Units	Exceeding	Max	95%ile	Tier 2 Screen
Inorganic Mercury	mg/kg	0/ 8	1.2	1.18	238[A]
Nickel	mg/kg	0/ 8	38	30.65	127[A]
Lead	mg/kg	7/ 8	**2500**	**563.17***	450[B]
Selenium	mg/kg	0/ 8	0.82	0.66	595[A]
Zinc	mg/kg	0/ 8	460	294.47	20,216[A]
Inorganics					
Cyanide	mg/kg	0/ 8	0.5	0.50	22.14[B]
Organics					
Phenol (Total)	mg/kg	0/ 8	<0.3	0.30	309[A]
Speciated Total Hydrocarbons					
TPH C6 – C10	mg/kg	0/ 8	<1	1.00	11[A1]
TPH C10 – C25	mg/kg	0/ 8	24	10.76	53[2]
TPH C25 – C40	mg/kg	0/ 8	20	8.24	1328[3]
Total Petroleum Hydrocarbons Criteria Working Group					
Aliphatics C5 – C6	mg/kg	0/ 2	<0.1	NC	23[A]
Aliphatics C6 – C8	mg/kg	0/ 2	<0.1	NC	47[A]
Aliphatics C8 – C10	mg/kg	0/ 2	<0.1	NC	11[A]
Aliphatics C10 – C12	mg/kg	0/ 2	<1	NC	53[A]
Aliphatics C12 – C16	mg/kg	0/ 2	<1	NC	237[A]
Aliphatics C16 - C21	mg/kg	0/ 2	<1	NC	17,697[A]
Aliphatics C21 – C35	mg/kg	0/ 2	<1	NC	17,697[A]
Aromatics C5 – C7	mg/kg	0/ 2	<0.1	NC	259[A]
Aromatics C7 – C8	mg/kg	0/ 2	<0.1	NC	607[A]
Aromatics C8 – C10	mg/kg	0/ 2	<0.1	NC	18[A]
Aromatics C10 – C12	mg/kg	0/ 2	<1	NC	93[A]
Aromatics C12 – C16	mg/kg	0/ 2	<1	NC	450[A]
Aromatics C16 – C21	mg/kg	0/ 2	5.2	NC	928[A]
Aromatics C21 – C35	mg/kg	0/ 2	6.9	NC	1328[A]
Speciated Polyaromatic Hydrocarbons					
Naphthalene	mg/kg	0/ 8	0.16	0.14	1.637[A]
Acenaphthylene	mg/kg	0/ 8	0.25	0.19	463.5[A]
Acenaphthene	mg/kg	0/ 8	0.63	0.35	338.8[A]
Fluorene	mg/kg	0/ 8	0.13	0.12	855.7[AX]
Phenanthrene	mg/kg	0/ 8	1.1	0.84	494.6[AS]
Anthracene	mg/kg	0/ 8	0.57	0.39	396[A]
Fluoranthene	mg/kg	0/ 8	2.3	1.39	504.2[A]
Pyrene	mg/kg	0/ 8	2	1.15	1201[A]
Chrysene	mg/kg	0/ 8	1.7	0.97	8.839[A]
Benzo(a)anthracene	mg/kg	0/ 8	1.4	0.79	3.72[A]
Benzo(b)fluoranthene	mg/kg	0/ 8	2	1.09	9.822[A]

Contaminant	Units	Exceeding	Max	95%ile	Tier 2 Screen
Benzo(k)fluoranthene	mg/kg	0/ 8	1.2	0.70	10.06[A]
Benzo(a)pyrene	mg/kg	1/ 8	**1.8**	**1.37[#]**	1.00[A]
Indeno(1,2,3 – cd)pyrene	mg/kg	0/ 8	1.6	0.72	6.9[A]
Benzo(ghi)perylene	mg/kg	0/ 8	1.5	0.67	10.27[A]
Dibenzo(ah)anthracene	mg/kg	0/ 8	0.38	0.17	0.865[A]
Other					
Asbestos	NA	1/11	Detected		

Tier 2 Screening Values based on a residential without plant uptake end use. Assuming 1.0 % SOM. [A]GAC from CLEA V1.06 at 1.0% SOM. [B]SGV/GAC based on CLEA UK Beta Version at 3.0% SOM. [X]Oral GAC used, no inhalation GAC derived (inhalation data not available). [S]Soil Saturation limit used as a cap to GAC due to high value of oral GAC and absence of inhalation GAC (No data available). [1] GAC for aliphatic C8-C10 [2] GAC for aliphatic C10-C12. [3]GAC for aromatic C21-C35. NA Not Applicable. NC Not Calculated. *Outliers identified using the maximum value test (omitted from the 95th percentile concentration).# 95th percentile recalculated using Chebychev method.

TABLE 7.3: LIST OF OUTLIERS

Contaminant	Location	Depth (m bgl)	Concentration (mg/kg)
Lead	DCS2	1.00	2500
Lead	BH1	0.50	1400
Lead	DCS4	0.95	770

Metals

7.7 Elevated concentrations of lead have been encountered at all locations across the site, with the exception of DCS1 at 0.90m bgl. The calculated 95%ile concentration of 563.17 mg/kg also exceeds the Tier 2 Screening Value. Elevated concentrations are therefore considered to be a member of the underlying sample population and will require further consideration.

7.8 In addition, the maximum concentrations of 2500 mg/kg (DCS2 at 1.00m bgl), 1400 mg/kg (BH1 at 0.50m bgl) and 770 mg/kg (DCS4 at 0.95m bgl) are considered to be statistical outliers and are indicative of 'hotspot' concentrations.

Inorganics and Organics

7.9 Elevated concentrations of cyanide were not encountered, and phenol concentrations were not recorded above laboratory detection limits.

TPHs

7.10 Concentrations of banded TPH and TPH WCG did not exceed Tier 2 Screening Values.

PAHs

7.11 Concentrations of speciated PAHs do not exceed Tier 2 Screening Values, with the exception of a single concentration of benzo(a)pyrene. The maximum concentration of 1.8 mg/kg was encountered in BH1 at 0.50m bgl. The calculated 95%ile concentration of 1.37mg/kg also exceeds the Tier 2 Screening Value.

7.12 The elevated benzo(a)pyrene concentration was encountered in a sample comprising ash and coal. No other visual or olfactory evidence of contamination was noted here. The presence of ash and coal are likely to be the source of the elevated PAH concentration, and given that these are neither leachable nor mobile, the identified concentration is not considered to pose a significant risk to end users.

Asbestos

7.13 Amosite asbestos, comprising free fibres, was identified in BH1 at 0.50m bgl. It was not detected elsewhere. This observation was associated with a sample of Made Ground containing brick, flint, concrete, slate, ash and coal, with observations of occasional brown asbestos fragments at 0.50m bgl.

Soil Samples Below 1.0m bgl

7.14 Four samples of Made Ground from below 1.0m bgl (BH1 at 1.35m and 1.80m bgl, BH2 at 2.5m bgl and DCS1 at 1.5m bgl) were analysed as per samples from the upper 1.0m. Concentrations from these locations did not exceed Tier 2 Screening Values. In addition, asbestos was not encountered in these samples.

Water Analyses

7.15 Water samples were obtained from BH1 during the monitoring visit of 13th May, DCS1 on 29th May and BH2 on 13th June 2013. All three samples were submitted for analysis of those contaminants listed in Table 6.6.

7.16 The results of the groundwater analyses have been compared to the values contained within the references detailed in Table 7.1 for water quality. The statistics associated with groundwater

analysis are summarised in Table 7.4. In addition, VOC concentrations that have been recorded above laboratory detection limits but do not have Tier 2 Screening Values are also listed.

TABLE 7.4: SUMMARY OF WATER ANALYSIS

Contaminant	Units	Exceeding	Max	50th%	Tier 2 Screen
Metals					
Arsenic	µg/l	0/3	9.6	5.73	50[O,16]
Boron	µg/l	0/3	360	296.66	2000[5]
Cadmium	µg/l	0/3	<0.08	<0.08	0.25[O,16]
Chromium	µg/l	3/3	**13**	**9.26**	4.7[O,16]
Copper	µg/l	0/3	7.9	4.7	28[O,16]
Inorganic Mercury(4)	µg/l	3/3	<0.5	<0.5	0.05[O]
Lead	µg/l	0/3	<1	<1	7.2[O,16]
Nickel	µg/l	1/3	**25**	18.6	20[O,16]
Selenium	µg/l	1/3	**17**	8.7	10[E]
Zinc	µg/l	0/3	120	49.3	125[O,16]
Inorganics					
Cyanide	µg/l	3/3	<50	<50	1[O,16]
Organics					
Phenol (Total)	µg/l	3/3	<30	<30	7.7[O,16]
Poly-aromatic Hydrocarbons (PAH's)					
Total PAH	µg/l	3/3	**<2**	**<2**	0.5[O,16]
Total Petroleum Hydrocarbons					
TPH	µg/l	0/3	33	17.66	100[15,***]
Volatile Organic Compounds (VOCs)					
1,1,1 - Trichloroethane	µg/l	0/3	<1	<1	100[J]
1,1,2 - Trichloroethane	µg/l	0/3	<10	<10	400[J]
1,1 – Dichloroethene	µg/l	-	190	64	-
1,2 – Dichloroethane	µg/l	0/3	6.2	3.4	10[G]
cis 1,2 - Dichloroethene	µg/l	1/3	**140,000**	**46,679**	50[15]
Benzene	µg/l	0/3	8.1	3.36	10[O,16]
Ethylbenzene	µg/l	0/3	<1	<1	20[5]
Hexachlorobutadiene	µg/l	3/3	<1	<1	0.1[F]
MTBE	µg/l	0/3	<1	<1	15[18]
m & p - Xylene	µg/l	0/3	3.4	1.8	13[O,16]
o - Xylene	µg/l	0/3	1.9	1.3	30[O,16]
Styrene	µg/l	0/3	<1	<1	50[5]
Trans - 1,2 - Dichloroethene	µg/l	3/3	**180**	**60.8**	0.05[15]
Tetrachloroethene	µg/l	1/3	**120**	**41.46**	10[G]
Toluene	µg/l	0/3	27	9.6	50[O,16]
Tetrachloromethane	µg/l	0/3	1	1	12[F]
Trichloroethene	µg/l	-	5600	1886	-
Vinyl chloride	µg/l	3/3	**6100**	**2034**	0.5[N]

Source: Environmental Agency Chemical Standards for Water: [5]Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances: Council Directive 76/464/EEC. [15]WHO Guidelines for Drinking Water Quality. Third Edition (2004). [16]Priority Substance Directive 2008, (2008/105/EC). [18] WHO background document for Development of Guidelines for Drinking Water Quality (Odour Threshold). [E]Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996: S.I. 1996/3001. [F]Surface Waters (Dangerous Substances) (Classification) Regulations 1989: S.I. 1989/2286. [G]Surface Waters (Dangerous Substances) (Classification) Regulations 1992: S.I. 1992/337. [J]Surface Waters (Dangerous Substances) (Classification) Regulations 1998: S.I. 1998/389 [N]Water Supply (Water Quality) Regulations 2000: S.I. 2000/3184, as amended byS.I. 2001/2885. [O]River Basin Districts Typology, Standards and Groundwater threshold values (WFD) (England & Wales) Directions 2010. [***]Based on WHO DWS for Aromatic C10-C12. [#]Based on water hardness and a cyprinid fish.

GUIDANCE NOTES: (i) Surface water abstraction is not included. (ii) Protection of shellfish is not included. (iii) Protection of salmon is not included (cyprinid fish only included). (iv) Table defaults to annual average concentrations but there is an option to choose annual maximum or 95 th percentile values. (v) Where values are available for different river classes , the most conservative has been assumed.

Metals

7.17 Elevated concentrations of chromium were encountered in all three samples analysed. Concentrations of 6.5 μg/l were encountered in BH1, 13 μg/l in DCS1 and 8.3 μg/l in BH2.

7.18 A single elevated concentration of nickel (25 μg/l) was encountered in DCS1 on 29th May 2013. The remaining concentrations did not exceed Tier 2 Screening Values and the 50%ile concentration was also not elevated.

7.19 A single elevated concentration of selenium (17 μg/) was encountered in BH1 on 13th May 2013. The remaining concentrations did not exceed Tier 2 Screening Values and the 50%ile concentration was also not elevated.

7.20 Given that no significant sources of contamination have been encountered at the site during site investigation works to date, and due to the site's hydrological and hydrogeological setting, the elevated concentrations of metals are not considered to pose a risk to controlled water receptors.

Inorganics and Organics

7.21 Concentrations of cyanide and phenol were not encountered above laboratory detection limits. Although detection limits exceed Tier 2 Screening Values, given that: no obvious sources of phenol and cyanide were encountered during the ground investigation; no visual or olfactory evidence of contamination was present in groundwater samples; and, the site is situated on Unproductive Strata, any concentrations that are present are not considered to pose a risk to Controlled Water receptors.

TPH and PAH

7.22 Concentrations of total PAH were not encountered above laboratory detection limits. Elevated concentrations of TPH were also not encountered.

VOCs

7.23 Elevated concentrations of some VOCs have been encountered in groundwater beneath the site. An elevated concentration of cis 1,2 – Dichloroethene (140,000 μg/l) was encountered in DCS1. Elevated concentrations of trans-1,2 – dichloroethene were encountered in DCS1 (180 μg/l) and BH2 (1.4 μg/l). Concentrations of this were not encountered in BH1 above laboratory detection limits. An elevated concentration of tetrachloroethene (120 μg/l) was encountered in DCS1 and an elevated concentration of vinyl chloride (6100 μg/l) was also encountered at the same location. Concentrations of vinyl chloride from BH1 and BH2 did not exceed laboratory detection limits.

7.24 Visual and olfactory evidence of VOC contamination was not encountered during the site investigation in soils or groundwater, and it is possible that the result may be anomalous. However, it is acknowledged that DCS1 and BH2 are situated adjacent to the area of the former heavy chemicals warehouse, which could be a source of VOCs.

7.25 Although identified VOC concentrations are not considered a risk to controlled water receptors, further assessment will be required with respect to VOC risk in relation to: health and safety during construction; buildings and structures; and, human health. It is recommended that an additional round of groundwater monitoring is undertaken at the site in the monitoring wells installed during the 2013 ground investigation. In addition, ground investigation, to include soil sampling, water sampling and gas monitoring, should also be undertaken in areas not accessible during the recent phase of intrusive investigation. This should include the area of the former heavy chemical warehouse.

Ground Gas Assessment

7.26 Ground Engineering made four visits to site on 13th, 20th, and 29th May and 3rd June 2013 to monitor for hazardous ground gas. An additional visit was made on 13th June to monitor BH2 only. Recorded barometric pressures ranged between 1001mb on 29th May and 1028mb on 3rd June 2013. The installations contain response zones within the strata as indicated in Table 6.1, to reflect general ground conditions across the site.

7.27 The notable pre-purge results, where carbon dioxide exceeded 1.5%, methane 1% and/or oxygen fell below 18%, are summarised in Table 7.5.

TABLE 7.5: SUMMARY GAS CONCENTRATIONS AND FLOW RATES

Borehole	Date	Gas Concentration (%)			Average Flow Rate (l/hr)
		CO_2	CH_4	O_2	
BH1	13/05/13	1.6	-	-	<0.1
DCS2		1.9	-	-	<0.1
BH1	20/05/13	1.6	-	-	<0.1
DCS2		1.8	-	-	<0.1
BH1	29/05/13	1.7	-	-	<0.1
BH1	03/06/13	1.6	-	-	<0.1

All percentage figures are by measurement of volume. '-' Results do not exceed thresholds.

7.28 Elevated concentrations of methane were not encountered.

7.29 Marginally elevated concentrations of carbon dioxide were encountered at BH1 and DCS2. The maximum concentration was 1.9% v/v in DCS2 on 13th May.

7.30 Nominal VOC concentrations were recorded in BH1 (4.9 ppm), DCS1 (0.4ppm), DCS2 (1.9ppm), DCS3 (0.8ppm) and DCS4 (0.4ppm) during the monitoring visit of 13th May. No organoleptic indications of VOC contamination were identified during the site investigation at these locations. A water sample taken from BH1 on 13th May was analysed for VOCs. Concentrations were not encountered above laboratory detection limits. VOC concentrations were not encountered during the remaining monitoring visits, although detectable concentrations were encountered in groundwater from DCS1 on 29th May and BH2 on 13th June.

7.31 Flow rates were not encountered above the limit of detection of 0.1 l/hr.

7.32 Depressed oxygen concentrations were not encountered during the monitoring.

7.33 Based upon the guidance presented in Table 7.1, an assessment has been made of the requirements for gas protection that consider sources of gas generation, gas flows and concentrations and potential exposure routes. This is summarised below:

- **Potential on-site source of generation.** Carbon dioxide generation is suggested from areas of Made Ground, particularly the area of 'worked ground' in the west of the site.
- **Potential off-site Source of generation.** Any Made Ground and backfilled areas local to the site e.g. 'worked ground' to the west of the site.
- **Gas Flows.** A flow rate of 0.1 l/hr will be applied during calculation of the GSV.
- **Exposure Routes.** Gas at the site primarily presents a concern following ingress into confined spaces both during and after construction.

7.34 The Gas Screening Value (GSV) has been calculated using the maximum carbon dioxide concentration of 1.9% v/v and a maximum flow rate of 0.1 l/hr. The GSV of 0.0019 l/hr for carbon dioxide indicates that the site is classified as a CIRIA Characteristic 1. Based on information presented herein, gas protection measures are not currently considered to be necessary.

7.35 It is recommended however that further gas monitoring is undertaken during the next phase of the ground investigation to confirm the conclusions presented herein, particularly in areas where access has previously been unavailable. This should include the former heavy chemical warehouse and the area of worked ground in the west of the site. Further VOC monitoring should also be undertaken given the elevated concentrations encountered in groundwater.

8.0 GEOTECHNICAL EVALUATION

Ground Conditions

8.1 The ground conditions encountered during the site investigation generally consisted of Made Ground over London Clay with Alluvial deposits locally encountered overlying the London Clay. The upper 0.45 to 0.70m was locally indicated to have been geologically reworked, possibly due to fluvial action or possibly indicating a Head Deposit. The general distribution of each stratum is shown in Table 8.1.

TABLE 8.1: SOIL PROFILE

Stratum	From		To		Thickness (m)
	(m bgl)	(m AOD)	(m bgl)	(m AOD)	
Made Ground	0.00	36.50 – 37.50	1.00 – 2.40	34.50 – 36.40	1.00 – 2.20
Alluvial Deposits (where encountered)	1.00 – 2.00	34.50 – 35.55	3.10 – 3.70	32.85 – 33.40	1.10 – 2.60
Reworked London Clay (where encountered)	1.50 – 3.10	32.85 – 35.20	2.10 – 4.15	32.40 – 34.60	0.45 – 0.70
London Clay	1.10 – 4.15	33.40 – 36.40	>35.00	<1.90	>31.85

8.2 The ground model as encountered in Table 8.1 broadly agrees with the conditions anticipated. Alluvial deposits were encountered at the base of the Made Ground in BH2 and DCS1and coincide with the anticipated location of the former tributary of the River Fleet. Reworked London Clay was encountered as BH1, BH2 and DCS4.

Made Ground

8.3 Made Ground was encountered from surface to depths of between 1 and 2.20m bgl. The Made Ground was heterogeneous in nature, but was predominantly cohesive and locally overlain by granular materials. Where granular, the Made Ground was generally described as brown and grey slightly clayey sand and gravel. Where cohesive the Made Ground was generally described as very soft, soft and firm brown slightly sandy gravelly clay with occasional brick cobbles. The gravel fraction generally comprised angular to rounded fragments of brick, flint, concrete, slate, ceramic, shell and ash. Occasional fragments of coal and ironstone were also recorded.

8.4 Four cohesive samples of Made Ground were subject to Atterberg Limit determinations, which recorded Plasticity Index values in the range of 7 to 39%, indicative of a low to high plasticity clay. In addition, thirteen moisture content determinations were also undertaken which recorded values in the range of 11 to 34%.

8.5 One Standard Penetration Test (SPT) was undertaken in the cohesive Made Ground which recorded an SPT 'N' value of 3 at 1.35m bgl, indicative of a very low strength material. One SPT test commenced at 1.35m bgl in DCS4 has been discarded from subsequent analysis due to it straddling two strata. One undrained shear strength determination was undertaken on a 100mm diameter cohesive sample of Made Ground using triaxial apparatus which recorded a value of 42kPa, indicative of a medium strength material.

8.6 DCS2 was abandoned at 2.20m bgl on encountering a concrete obstruction, which is believed to be, by reference to historic maps, a relic foundation.

TABLE 8.2: SUMMARY OF SOIL PARAMETERS FOR MADE GROUND

Soil Parameters	Range of results	Characteristic value[1]
Liquid Limit (%)	25 – 59	59
Plastic Limit (%)	18 – 20	20
Plasticity Index (%)	7 – 39	39
Modified Plasticity Index (%)[2]	3 – 32	32
Plasticity	CL – CH	CH
Volume Change Potential (NHBC)	Low – Medium	Medium
Moisture Content (%)	11 – 34	24
SPT ' N' Values	3	3

1 Cautious estimate

2 Based on the procedures given in Chapter 4.2 of the NHBC Standards.

Alluvial Deposits

8.7 Alluvial deposits were encountered in BH2 and DCS1 at the base of the Made Ground. Where encountered, the Alluvial deposits were generally described as very soft grey slightly gravelly sandy organic clay with occasional black organic patches. Medium dense brown slightly clayey very sandy gravel was encountered underlying the organic clay in BH2. The presence of manmade materials in this stratum could be explained by such materials sinking into it or by the stratum having been reworked.

8.8 Two samples of Alluvial deposits were subject to Atterberg Limit determinations, which recorded Plasticity Index values of 34 and 35%, indicative of a high plasticity clay. In addition, four moisture content determinations were undertaken on this stratum which recorded values in the range of 22 to 27%.

8.9 One Particle Size Distribution test was undertaken on a granular sample Alluvium using wet sieve analysis and sedimentation by pipette, which indicated a clayey silty sandy gravel, which is in agreement with the field description.

8.10 Three Standard Penetration Tests (SPT) were undertaken in the Alluvial deposits which recorded SPT 'N' values in the range of 2 to 3, indicative of a very low strength material. One SPT 'N' value of 15 was recorded in the granular Alluvium, suggesting a medium dense state.

8.11 One undrained shear strength determination was undertaken on a 100mm diameter on a sample from this stratum using triaxial apparatus which recorded a value of 54kPa, indicating a medium strength material.

TABLE 8.3: SUMMARY OF SOIL PARAMETERS FOR ALLUVIAL DEPOSITS

Soil Parameters	Range of results	Characteristic value[1]
Liquid Limit (%)	55 – 56	55
Plastic Limit (%)	20 – 22	20
Plasticity Index (%)	34 – 35	35
Modified Plasticity Index (%)[2]	32 – 35	35
Plasticity	CH	CH
Volume Change Potential (NHBC)	Medium	Medium
Moisture Content (%)	22 – 27	25
SPT ' N' Values	2 – 15	3

1 Cautious estimate

2 Based on procedures given in Chapter 4.2 of the NHBC Standards.

Reworked London Clay

8.12 The upper 0.45 to 0.70m of London Clay is considered to have been reworked at BH1, BH2 and DCS4. The reworked London Clay was generally described as firm becoming stiff brown and orange brown gravelly clay. The gravel fraction comprised rounded flint and quartzite.

8.13 One sample of this material was subject to an Atterberg Limit determination, which recorded a Plasticity Index value of 45%, indicative of a high plasticity clay. In addition, two moisture content determinations were undertaken on samples from this material which recorded values in the range of 21 to 24%.

8.14 One Standard Penetration Test (SPT) was undertaken in the reworked London Clay which recorded an SPT 'N' value of 9, suggesting a medium strength material.

TABLE 8.4: SUMMARY OF SOIL PARAMETERS FOR REWORKED LONDON CLAY

Soil Parameters	Range of results	Characteristic value[1]
Liquid Limit (%)	65	65
Plastic Limit (%)	20	20
Plasticity Index (%)	45	45
Modified Plasticity Index (%)[2]	44	44

Soil Parameters	Range of results	Characteristic value[1]
Plasticity	CH	CH
Volume Change Potential (NHBC)	High	High
Moisture Content (%)	21 – 24	24
SPT ' N' Values	9	9

1 Cautious estimate
2 Based on procedures given in Chapter 4.2 of the NHBC Standards.

London Clay

8.15 The London Clay was initially described as firm, becoming stiff, fissured brown and grey clay with occasional sand size selenite crystals and orange brown silt partings. With depth the stratum becomes very stiff to hard with rare gravel size pyrite nodules and an absence of selenite.

8.16 Concretionary limestone nodules were recorded in BH1 from 12.30 to 12.45m bgl, in DCS1 between 5.63 and 5.66m bgl and in DCS3 at 2.85m bgl. Abundant and occasional gravel size calcareous concretions were recorded in DCS4 between 2.10 and 4.60m bgl and in DCS2A between 1.25 and 3.20m bgl respectively.

8.17 Five Atterberg Limit determinations were undertaken on samples of the London Clay, which recorded Plasticity Index values in the range of 44 to 63%, indicative of a high to very high plasticity clay. Forty five moisture content determinations were undertaken on this stratum which revealed moisture content values in the range of 23 to 32%.

8.18 Thirty eight SPTs were undertaken in the London Clay, which recorded 'N' values in the range of 4 to 53. Eighteen undrained shear strength determinations were undertaken on 100mm diameter samples using triaxial apparatus which recorded values generally in the range of 52 to 342kPa. One high value of 434kPa was recorded at 27.20m bgl in BH1 has been discarded from subsequent analysis as it is not considered representative of this stratum.

8.19 The SPT 'N' values and triaxial test results both generally increase with depth and together suggest a relationship of Cu=5xN to be broadly appropriate. On this basis, the SPT and triaxial test data are represented graphically on Figure 7, from which the following Cu profile for the London Clay is derived

$$Cu = 40 + 8z, \text{ where z is the depth below 35m AOD}$$

TABLE 8.5: SUMMARY OF SOIL PARAMETERS FOR LONDON CLAY

Soil Parameters	Range of results	Characteristic value[1]
Liquid Limit (%)	66 – 88	73

Soil Parameters	Range of results	Characteristic value[1]
Plastic Limit (%)	22 – 25	24
Plasticity Index (%)	44 – 63	49
Modified Plasticity Index (%)[2]	41 – 62	49
Plasticity	CH – CV	CV
Volume Change Potential (NHBC)	High	High
Moisture Content (%)	23 – 32	N/A
SPT ' N' Values	4 – 53	See discussion above
Undrained Shear Strength (kN/m^2)	52 – 434	See discussion above

1 Cautious estimate

2 Based on procedures given in Chapter 4.2 of the NHBC Standards.

Preliminary Desiccation Assessment

8.20 Three of the exploratory holes were undertaken for use in a preliminary desiccation assessment. BH1 and DCS3 were undertaken in the vicinity of trees and DCS1 was used as a control hole, which was remote from any trees.

8.21 In BH1, the Made Ground was described as friable to 1.10m bgl. Live roots were observed to 2.70m bgl in BH1 and to 1.10m bgl in DCS3. Dead roots were also recorded to 4.20m bgl in DCS1.

8.22 Moisture content, pocket penetrometer and hand shear vane profiles at 0.50m intervals to 6m bgl have been considered and Atterberg Limit determinations undertaken to appraise the extent of desiccation at the time of the investigation.

8.23 The results suggest that soils in BH1 may be desiccated to a depth of 1.20m bgl. Whilst the pocket penetrometer and hand shear vane results do not indicate desiccated soils in DCS3, the presence of live roots and lower moisture content values may suggest the onset of desiccation to 1.10m bgl. DCS1 did not show any signs of the soils being desiccated.

8.24 It is also noted that live roots were encountered to 1.25m bgl in DCS2A.

Buried Concrete

8.25 Twenty five soil samples, comprising five from the cohesive Made Ground, two from the granular Made Ground, three from the Alluvial deposits, two from the reworked London Clay and thirteen from the London Clay were subjected to pH and water soluble sulphate determinations. With reference to BRE Digest SD1 (2005 Ed), the results indicate a DS-1 class for the granular Made Ground, Alluvial deposits and the reworked London Clay, a DS-2 class for the cohesive Made

Ground and a DS-3 class for London Clay. pH values, including those from the environmental analysis, ranged between 6.8 and 11.2, with a characteristic value of 8.4.

8.26 Two samples of cohesive Made Ground, one sample of Alluvial deposits, one sample of reworked London Clay and two samples of London Clay were subjected to total sulphur and acid soluble sulphate content testing to allow an assessment to be made in relation to the potential thaumasite form of concrete attack. One of the oxidisable sulphides values calculated were in excess of 0.3% for the London Clay. This suggests that the London Clay could be associated with a risk from this form of concrete attack. A modification to DS-4 class is therefore currently proposed for the London Clay under certain situations as outlined in BRE Digest SD1.

8.27 Four samples of groundwater obtained during the monitoring programme were subjected to sulphate and pH determinations, three of which formed part of the environmental analysis. The highest recorded value was 3400 mg/l and measured pH values ranged from 6.5 and 7.0, which suggests, with reference to the BRE Digest a DS-4 classification.

Groundwater Conditions

8.28 Groundwater observations during the field and the subsequent monitoring are described in Section 6 and are summarised in Table 6.2.

8.29 Groundwater was encountered between 2.70 and 3.00m bgl (33.85 – 33.50m AOD) at the interface between the London Clay and the Made Ground/reworked London Clay, which was monitored at a minimum depth 1.20m bgl (35.30m AOD). The monitored groundwater levels showed increase with time, which would suggest that an equilibrium level had not been reached. It is therefore likely that groundwater is residing at shallow depth in the Made Ground between 34.50 and 35.50m AOD, approximately 1 to 2.50m bgl.

9.0 QUALITATIVE RISK ASSESSMENT

9.1 Current guidance for contaminated land advocates the assessment of risk by determining the presence of pollutant linkages and weighting the likelihood of harm occurring with the potential severity of that harm. The framework is set out in various publications by the DETR, Environment Agency, Institute for Environment and Health, NHBC and CIRIA.

9.2 Tables 5.1 - 5.3 indicate the potential contaminants, pollutant linkages and receptors that have been considered at the site. Following the investigation of these and Generic Quantitative Risk Assessment (for human health, controlled waters and gas) a Qualitative Risk Assessment for each receptor is presented below in Tables 9.1 - 9.5. For the purpose of this assessment, the descriptions of risk presented in CIRIA C552 should be referred to, which take into account the magnitude of the source contamination identified, likelihood of exposure via a pathway and significance of harm likely to result on the given receptor[2].

TABLE 9.1: GROUNDWORKS (ASSUMING BASIC PPE)*

PATHWAY	RISK	COMMENT
Ingestion of soil / dust	Low - Medium	Elevated concentrations of lead have been encountered in shallow Made Ground soils across the site. Redevelopment or maintainance of the site may involve ground workers coming into contact with the underlying soils and water. Amosite asbestos was encountered in BH1 at 0.5m bgl. The contractor's method statement should consider the associated Health and Safety controls that are appropriate in light of the Control of Asbestos Regulations 2012. Specialist advice should be sought. Further ground investigation should be undertaken across areas of the site not previously accessible, particuarly in the area of worked ground in the west of the site and the former heavy chemical warehouse where VOCs have been detected. Further investigations should include soil sampling, groundwater
Inhalation of soil / dust	Low - Medium	
Inhalation of vapour from soil / dust / water	Medium	
Dermal contact with soil / dust / water	Low	
Migration of soil gases to confined spaces	Low	
Migration of water borne contaminants	Low	

[2]. After IEH 'Guidelines for Environmental Risk Assessment and Management' and CIRIA 552 'Contaminated Land Risk Assessment, Guide to Good Practice'. Section 6.

PATHWAY	RISK	COMMENT
Leaching of contamination from Made ground	Low	sampling and ground gas monitoring in order to confirm the conclusions herein. Normal Health and Safety precautions associated with a site where potential contamination may exist (of the levels identified), will mitigate the general risk. Inspections across the former building footprints should be completed by the Contractor throughout groundworks.

* Separate assessments are required in relation to asbestos risk.

TABLE 9.2: END USERS DURING OCCUPATION

PATHWAY	RISK	COMMENT
Ingestion of soil / dust	Medium	The investigation has identified elevated concentrations of lead in the shallow Made Ground soils across the site. Further site investigation should be undertaken across areas of the site not previously accessible, particularly in the area of worked ground in the west of the site and in areas of proposed soft landscaping. Further site investigation should include soil sampling, groundwater sampling and ground gas monitoring in order to confirm the conclusions herein. Notwithstanding the above, inspections across former building footprints should be completed post demolition and a watching brief completed throughout groundworks.
Inhalation of soil / dust	Medium	
Inhalation of vapour from soil / dust / water	Medium (VOC)	
Dermal contact with soil / dust / water	Medium	
Migration of soil gases to confined spaces/structure	Medium (VOC)	
Migration of water borne contaminants	Low	
Leaching of contamination from Made Ground	Low - Medium	
Movement of contaminants to engineered structures (e.g. water pipes)	Low - Medium	
Uptake by flora / fauna	Low - Medium	

TABLE 9.3: CONTROLLED WATERS

PATHWAY	RISK	COMMENT
Migration of water borne contaminants	Low	Elevated concentrations of metals and VOCs have been encountered within the groundwater at the site. However, given the site location on Unproductive Strata and distance to significant surface water receptors, identified concentrations are not considered to pose a risk to Controlled Waters.
Leaching of contamination from Made Ground	Low	

TABLE 9.4: BUILDINGS

PATHWAY	RISK	COMMENT
Leaching of contamination from Made Ground	Low – Medium	Made Ground is present which may contain both inorganic and organic components. Consideration will be required with respect to potable supply pipework due to the presence of organic contaminants.
Movement of contaminants to engineered structures (e.g. water pipes)	Low – Medium	
Migration and accumulation of flammable gases beneath the building footprint.	Low – Medium	Concentrations of methane have not been encountered at the site. However, further ground gas monitoring will be required in areas of the site not previously investigated in order to confirm the conclusions herein.

TABLE 9.5: OFFSITE RECEPTORS (ADJACENT COMMERCIAL AND RESIDENTIAL PROPERTIES)

PATHWAY	RISK	COMMENT
Dermal contact with soil / dust / water	Low	Site investigation and chemical analysis has not identified the presence of gross soil or groundwater contamination that is considered to present a risk to off-site receptors. In addition, a continuous groundwater body has not been identified beneath the site that could act as a migration pathway.
Inhalation of vapour from soil / dust / water	Low	
Migration of soil gases to confined spaces/structure	Low	
Movement of contaminants to engineered structures (e.g. water pipes)	Low	

10.0 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

10.1 It is proposed to demolish the existing Greenwood Day Centre and construct a new one to three storey community centre with a single storey basement beneath the north west corner of the site. The proposed basement is to be 3.80m below the finished floor level of the ground floor to allow for 3.50m headroom.

10.2 It is also proposed to demolish the existing Highgate Day Centre and construct a new seven storey residential block with limited commercial development at ground floor level.

10.3 Redevelopment also includes new access links, parking areas, soft landscaping and a shared garden area. Lensham House is currently intended to be retained.

10.4 The preliminary ground investigation has identified a number of geotechnical risks, which are discussed below, along with outline geotechnical design advice and recommendations for further work.

10.5 Further ground investigation will be required, and once the proposals have been sufficiently developed, the conclusions and recommendations of this report should be reviewed. Of particular note are the areas of the site which were not available for investigation at this stage. Once the proposals have been fully developed, and such investigations have been completed for final design, a Geotechnical Design Reports in accordance with Eurocode 7 should be prepared.

10.6 UXO risk is considered **Low**. UXO hazards should be included as part of the health and safety briefing and tool box talks during the works, such that if any suspicious articles are found, they can be quickly identified and treated appropriately by specialist inspection.

10.7 A preliminary desiccation assessment has been undertaken only. A full assessment is recommended to establish the extent of desiccated soils across the site.

Key Considerations

10.8 This report has identified the following geotechnical risks at the site:

- Localised areas of highly compressible Alluvial deposits associated with the former tributary of the River Fleet
- Desiccated soils in the region of trees
- Medium to high volume change potential soils

- The potential for shallow groundwater or water bearing strata with a shallow piezometric level
- The potential for obstructions associated with previous phases of development
- Ground conditions are aggressive to buried concrete
- Potential for 'Undivided Worked Ground' in the west of the site
- Retaining walls and level changes around the site boundary

Excavation and Basement Design

10.9 The proposed development includes a single storey basement beneath the north west corner of the Greenwood Centre.

10.10 Groundwater was encountered between 2.70 and 3.00m bgl (33.85 – 33.50m AOD) and was monitored at a minimum depth 1.20m bgl (35.30m AOD). The monitored groundwater levels showed increase with time, which would suggest that an equilibrium level had not been reached. It is therefore likely that groundwater is residing at shallow depth in the Made Ground between 34.50 and 35.50m AOD, approximately 1 to 2.50m bgl. For the design of basements and retaining walls, an equilibrium groundwater level of 1.20m bgl (35.30m AOD) is currently suggested, however, this should be confirmed by additional monitoring in the next phase of ground investigation.

10.11 Consideration will need to be given to the hydrostatic uplift pressures acting on the underside of any proposed basement slabs, once the design has been established. The heave generated by stress relief in the underlying London Clay will also require consideration.

10.12 The site is in close proximity to existing structures and infrastructure. Therefore, for any proposed basements, consideration would need to be given to their construction and any resulting ground movements in the surrounding area.

10.13 The proposed basement is in close proximity to Deane House and Greenwood Place, and as such it is unlikely that construction in open cut will be possible. Therefore, it is recommended that an embedded retaining wall be considered. Either secant or sheet pile walls or a reinforced concrete basement constructed using temporary sheet piles could be adopted. It is recommended that further groundwater monitoring is undertaken to establish the feasibility of a contiguous bored pile wall.

10.14 As the site is in the London Borough of Camden, any proposed basements will require a Basement Impact Assessment to be submitted at planning stage.

Foundations

10.15 As described in Section 8, much of the site is underlain by Made Ground over London Clay. Alluvial Deposits and reworked London Clay were locally encountered overlying the undisturbed London Clay.

10.16 Without treatment, the Made Ground and Alluvial deposits are not considered suitable founding strata due to their high variability and poor load bearing and settlement characteristics. For high rise structures, such as the Highgate Road residential development, piled foundations are recommended. However, for low rise structures, such as the Greenwood Centre, conventional footings or ground improvement are recommended, as outlined below.

10.17 The ground conditions are likely to be amenable to CFA or bored piles, although both could be hampered if there are significant underground obstructions. Due to the setting of the site, driven piles are not likely to be permitted.

10.18 A bored pile solution would require casing through the Made Ground and Alluvial deposits. In relation to CFA piles, good workmanship would be required to ensure piles are adequately constructed in the highly variable strata at the site.

10.19 Should a piled solution be adopted where a proposed basement is to be constructed, consideration will need to be given to tensile forces generated by any soil heave.

10.20 The advice of a reputable piling specialist, experienced in the ground conditions considered present here, should be sought. They should be responsible for the selection of the appropriate piling equipment and the final design of the piles.

10.21 In areas where the Made Ground and Alluvial deposits have a lesser thickness, it may be possible to adopt conventional footings for low rise structures. Similarly, with suitable ground improvement, it may also be possible to adopt conventional footings for low rise structures in areas of increased thicknesses of Made Ground and Alluvial deposits. However, it is recommended that further investigation is undertaken to confirm this, which should include organic content testing of the Alluvial deposits, and consideration given to the proposed structural loads.

10.22 In due course, consideration should be given to the potential need for heave protection measures in relation to spread foundations, piles, ground beams and floor slabs by reference to chapter 4.2

of the NHBC standards. However, given the relative paucity of trees at the site and the limited depths of desiccation encountered in the preliminary investigation, should such measures be required, they are likely to only be needed in limited areas of the site. As discussed subsequently, whilst a piled foundation solution is currently suggested, should further ground investigation enable consideration of spread footings, their founding depths should also be determined by reference to chapter 4.2 of the NHBC Standards.

Floor slabs

10.23 Due to the thickness of Made Ground and Alluvial deposits, suspended ground floor slabs are recommended. However, should ground treatment be adopted, ground bearing floor slabs could be considered.

10.24 In the region of trees, Chapter 4.2 of the NHBC Standards should be referred to with respect to the minimum void dimension required under floor slabs for medium to high volume change potential soils.

Road Pavements

10.25 With reference to TRL Report 1132, the Atterberg Limit tests on cohesive samples of Made Ground indicate a CBR value of 3% may be appropriate for preliminary design. To achieve this value it is recommended that the road formation level is proof rolled, inspected and any soft or loose material is removed and replaced with compacted granular fill. The CBR value provided above assumes a thin road pavement, low water table and average construction conditions, along with the aforementioned treatment. The CBR value should be refined by further testing.

10.26 Plasticity Index tests indicate that the Made Ground is not frost susceptible.

10.27 A flexible road pavement construction is recommended due to the high volume change potential soils at the site. Geogrids may be required to control settlements in the Alluvial deposits.

Buried Concrete

10.28 In the consideration of sulphate attack on buried concrete, reference has been made to BRE Special Digest 1 which classifies the site as a brownfield site with mobile groundwater conditions. Additionally, as the London Clay can be pyrite bearing, it has also been necessary to assess the potential for the thaumasite form of attack. The results of the concrete classification tests to

date have indicated a DS-4 classification, together with the pH values indicates that an ACEC AC-4 class should be adopted.

10.29 Additional testing may enable the DS class to be reduced. The additional testing should include testing for magnesium and ammonium ions.

Drainage

10.30 The ground conditions render the use of soakaway drainage unfeasible.

10.31 In the region of trees, Chapter 4.2 of the NHBC Standards should be referred to with respect to the minimum potential ground movements to be accommodated for new drainage, based on medium to high volume change potential soils.

General Construction Advice

10.32 It should be possible to use conventional excavators to form excavations in the soils encountered during the investigation. However, hard surfacing, old foundations, relict basement construction and the like, may require the use of breaking apparatus. A concrete obstruction was encountered in DCS2 at 2.20m bgl, which is believed to be a relic foundation.

10.33 For any load bearing formations, careful inspection should be undertaken to ensure placement in competent natural strata unless ground treatment has been carried out and properly validated. Any soft spots identified should be excavated and replaced with compacted granular fill or lean mix concrete. Concrete should be placed as soon as possible following excavation to avoid softening of the ground. A similar recommendation is also made for road pavement formations, although compacted granular fill could be used instead of concrete.

10.34 Any relic foundations or other subterranean structures beneath the footprint of the proposed buildings should be fully grubbed out. Such excavations should be surveyed and backfilled with an acceptable granular fill. Such fill should be placed and compacted to an engineering specification, unless treatment by vibro stone or vibro concrete columns is to be adopted. The same recommendations are made for excavations that may be required to remove soil contamination.

10.35 In areas of road pavements and hard standing, relic subterranean structures should be broken down to around 1m below finished site level to minimise the risk of differential settlement due to

the presence of hard spots. In soft landscaped areas it may be possible to limit such operations to 0.50m bgl.

10.36 In excavations, the stability of the Made Ground and Alluvial deposits cannot be relied upon, even in the short term. Support or battering of any excavation faces to a safe angle of repose will be required for all excavations where man entry is necessary, the nature and extent of which will need to be evaluated under CDM regulations.

10.37 It is anticipated that groundwater seepages encountered at shallower depths in excavations could be controlled by pumping from screened sumps.

Recommendations for Further Work

10.38 Outline geotechnical design recommendations are given above. However, there are a number of potential geotechnical risks which require further investigation and analysis to facilitate detailed design. Further investigation should comprise:

- Additional exploratory holes in the west of the site to delineate the sequence of strata and to identify the thickness and geotechnical properties of any 'Undivided Worked Ground'
- Additional ground investigation appropriate for final design
- The construction of additional monitoring wells and additional groundwater monitoring to establish equilibrium groundwater levels for the design of excavations, basements and retaining walls
- Additional laboratory testing, including testing for magnesium and ammonium ions to try to further assess the buried concrete classification
- Foundation inspection pits to establish the footings to existing retaining walls around the site boundary
- Consideration of the possible effect of the proposed basement on surrounding structures and infrastructure
- Consultations with Thames Water
- A Basement Impact Assessment

11.0 ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

Introduction

11.1 The ground investigation commissioned by CampbellReith incorporated contamination testing of soil and monitoring of groundwater and ground gas across the site. In addition, available Desk Study information has been consulted.

11.2 Additional ground investigation will be required in areas not currently accessible, particularly in the area of recorded 'worked ground' and the former in the west of the site and in any areas of proposed soft landscaping in order to confirm the conclusions stated herein.

11.3 It is also noted that relatively high levels of Volatile Organic Compounds (VOC) were found in a water sample from one hole on the west of the site (DCS1) in the area which was formerly an ICI chemical warehouse and, as such, it may infer greater contamination on this portion of the site which has not yet been wholly investigated.

11.4 The site is considered to lie in area of **Low** environmental sensitivity with respect to the site location on Unproductive Strata and distance to the nearest significant surface water receptor. The proposed end use as a day care centre and associated residential accommodation is considered to be of **Medium - High** end user sensitivity.

Overview of Key Issues

11.5 Desk study and subsequent site investigation and chemical analysis has identified the following key contamination issues at the site:

- **Soils:** Elevated concentrations of lead have been encountered in the shallow Made Ground soils across the site.
- **Groundwater:** Elevated concentrations of metals and VOCs have been encountered in the groundwater beneath the site. Given the site location on Unproductive Strata and distance to significant surface water receptors, these are not considered to pose a risk to Controlled Waters. However, further consideration will be required with respect to: health and safety during construction; buildings and structures; and, human health.
- **Ground gas:** The site is classified as a CIRIA Characteristic Situation 1. Gas protection measures are not considered necessary at present. However further assessment is required for the presence of VOCs and this could affect this requirement.

11.6 A number of actions will be required to address land contamination issues at the site and these are described below. These relate to:

- **Additional site Investigation**
- **Remedial Recommendations and Options Appraisal**
- **Remediation and Verification Control Documents**
- **Regulatory approval**
- **Waste Management**

Additional Site Investigation

11.7 It is recommended that an additional round of gas and groundwater monitoring is undertaken in boreholes installed during the 2013 investigation, in order to assess the presence of VOCs.

11.8 In addition, further ground investigation should be undertaken in areas not currently accessible, particularly the area of the former heavy chemical warehouse, the worked ground in the west of the site, and in any areas of proposed soft landscaping. Further ground investigation should include additional soil and groundwater sampling, and ground gas monitoring.

Outline Remedial Recommendations

11.9 The following section details outline remedial recommendations. These should be considered in light of the recommendations for any further works presented above which could lead to their modification. Detailed remedial works should be confirmed on completion of the additional ground investigation and risk assessment works and finalised in a Groundworks / Remediation Specification.

End Users

11.10 The qualitative assessment generally identified a **MEDIUM RISK** for site end users associated with the presence of elevated lead concentrations in shallow Made Ground soils across the site.

11.11 The identified contaminants primary exposure pathways are direct contact and ingestion driven. As such, in order to mitigate risks to end users it is recommended that a soft cover system of chemically validated soils is installed within any areas of soft landscaping that directly overlie impacted soils. The thickness of this capping layer should be 400mm in communal landscaped areas. Should private gardens be proposed, this should be increased to 600mm in these areas.

11.12 In addition, any excavations should be backfilled with imported chemically validated soils and in accordance with the appropriate Remediation and/or Groundworks Specification compiled by the Engineer.

11.13 Imported materials for soft landscaped areas will require provision for testing in accordance with the Remediation Specification, compliance with an agreed set of limiting values will be required. Records as detailed within the Remediation Specification should be maintained to certify the source, chemical suitability and appropriate placement of the soils.

11.14 Further investigation and assessment will be required in relation to the presence of VOCs in groundwater. **If** this is found to be a widespread issue on the west of the site this would require additional vapour risk assessments for the protection of human health and it could reflect additional remedial works and health and safety controls during any excavation works.

Construction Workers

11.15 The qualitative assessment identified a potentially **LOW - MEDIUM RISK** to construction workers who may come into contact with contaminated soils and waters (elevated lead has been encountered in soils across the site), although are they likely to be exposed in the short-term only. The Site Health and Safety Plan should consider worker protection from skin contact, ingestion and inhalation of contaminants and vapours, working in confined spaces below ground and follow guidance for working on sites affected by contamination.

11.16 It is noted that asbestos in soils has been identified, in 1 of 11 samples. Whilst the information collected does not indicate its widespread occurrence it should be considered as a possibility in the Made Ground and the contractor's method statement should consider the associated Health and Safety controls that are appropriate in light of the Control of Asbestos Regulations 2012. Specialist advice should be sought in this regard. Type II Asbestos Surveys are available for the buildings, which should be reviewed as necessary, together with surveys of any other on site buildings prior to demolition.

11.17 In order to achieve satisfactory control, CampbellReith recommend that Health and Safety provisions in accordance with HSE Publication HS (G) 66 and CIRIA Report 132 are considered. The Contractor must also control matters such as any contracted CDM responsibilities.

11.18 Further investigation and assessment will be required in relation to the presence of VOCs in groundwater.

Controlled Waters

11.19 The qualitative assessment identified a potentially **LOW RISK** for surface waters due to the distance to the nearest surface water receptor.

11.20 The qualitative assessment identified a potentially **LOW RISK** for groundwater due to the presence of Unproductive Strata beneath the site.

11.21 Taking into account the above information remedial works are not required for controlled waters.

Inspections for Contamination

11.22 A watching brief by the Contractor should be undertaken during construction in those areas where previously undetected contamination could exist and include:

- the boiler room in Greenwood Day Centre;
- the COSHH store in the Greenwood Day Centre;
- in the area of worked ground on the west of the site; and,
- beneath current building footprints, particularly the area of the former chemical warehouse.

11.23 If the works encounter fuel tanks, pipelines or similar, these should be decommissioned in accordance with an appropriate and specific method statement.

11.24 In addition, in the area where asbestos has been identified, an inspection should be completed and documented.

11.25 We would not consider it necessary to complete further sampling as part of these inspections, unless distinct ground conditions indicating contamination are visually identified during the watching brief.

Ground Gas

11.26 The ground gas risk assessment indicates that the site can be classified as a CIRIA Characteristic Situation 1.

11.27 Gas protection measures are not currently considered necessary due to the presence of 'permanent or bulk' ground gas (carbon dioxide or methane) although further gas monitoring

should be undertaken to confirm this. However localised evidence of VOCs have been identified. Further investigation and assessment will be required in relation to this matter. During subsequent phases of investigation across the footprint of the Greenwood Place Centre VOC gas samples should be obtained and the associated results reviewed in accordance with CIRIA C682.

Services

11.28 The presence of TPH and PAH concentrations in the soil and localised occurrence of VOCs in water indicate a possible need for protection of public water supply pipework, such as the use of organic resistant pipework. The infrastructure designer should assess requirements for pipework with respect to soil contamination and consult statutory utility companies and relevant guidance as necessary. Guidance on this topic is presented in UKWIR Report *'Publication UKWIR Report Ref 10/WM/03/21: Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites - Final Project Report'.*

Other

11.29 It is recommended that a survey for Japanese knotweed is undertaken by a Specialist Contractor if not already done so.

11.30 It is also recommended that the exact use of the historical heavy chemical warehouse is established in order that appropriate soil, water and gas testing is undertaken in this area during the next phase of ground investigation.

Remediation and Verification Control Documents

11.31 Following on from the recommendations made herein, in order to control the environmental works on site and the collection of records required for the Verification Report, a Remediation/ Groundworks Specification will be required. The Specification should detail necessary requirements for inspections, record keeping, and actions for unforeseen contamination and detail the requirements for the control of imported material and waste management.

11.32 The specification will require submission to the Local Authority for review and approval as part of the planning process, to fulfil the requirements of the anticipated land quality planning condition. Additional discussions may be required with the NHBC and/or Building Control; such matters are not detailed herein. Once approved it will be the Contractor's obligation to fulfil the agreed requirements of the Specification.

11.33 Whilst not anticipated from the work to date, should the groundworks encounter fuel tanks, removal of any such features is required in accordance with an appropriate tank removal specification and Contractor's method statements which meet the requirements of the appropriate Environment Agency Pollution Prevention Guidelines (PPG).

11.34 It will be the Contractor's responsibility to collate the records as detailed within the specifications for submission to the Engineer for inclusion with the Site Verification Report on the completion of works. The Verification Report will be required for submission to the Regulators via the planning process for discharge of the anticipated land contamination planning condition.

Regulatory Approval

11.35 In order to fulfil requirements of Planning Policy it is likely that this document will require submission and approval by the Regulatory Authorities (Local Authority and Environment Agency). As such this document should be submitted as part of the planning process and discussion held with the Regulators as to further information required to fulfil any land quality planning conditions which may be imposed as part of the planning consent. It may be that other investigations/ risk assessments/ specifications and verification reporting will be required prior to final condition discharge. Discussions should be held with the relevant officer at an early stage to ensure all necessary information is obtained and collated for their review and approval.

11.36 Failure to submit the required documentation could result in refusal to discharge associated land quality planning conditions.

Waste Management

11.37 A hazardous properties assessment of waste soils has not been undertaken as part of this report and is recommended as a basement is proposed for the site. The soil results can however be utilised as a basis for such assessments, however additional testing may be required.

11.38 All waste related activities must be undertaken in accordance with the Waste Management and Landfill Regulations. Any proposed reuse of materials must be in accordance with the Waste (England and Wales) Regulations 2011. With respect to waste soils disposal, as a minimum, the following information should be collected and retained by the Contractor for subsequent validation:

- source and origin of the waste;
- information on the process producing the waste;
- European Waste Catalogue code and characteristics of material;

- for hazardous waste, definition of the relevant properties according to the Hazardous Waste Directive (Annex III 91/689/EC);
- confirmation that waste is not prohibited waste;
- appearance of the waste;
- landfill class; and,
- Duty of Care records including full and completed chain of custody documentation.

11.39 The final waste classification is the responsibility of the Contractor and should be determined in conjunction with the receiving landfill and in liaison with the Environment Agency (and their technical guidance). It is noted that, depending on the landfill selected, additional soils testing information and independent verification of the materials of the materials being received by the landfill may be required.

11.40 As the correct classification of waste is likely to have a significant impact on the redevelopment budget, the waste classification should be reviewed independently by a consultant at an early stage in the project management stage. In addition, contractors should be asked to confirm that their tenders consider the full requirements of the Landfill Directive and associated waste legislation. This is to ensure waste is correctly classified and costed at the inception of the project.

11.41 The Landfill Directive states that all hazardous and non-hazardous waste requires treatment prior to disposal to landfill. Treatment must provide a 'three – point step'. As such, provision for treating (including physical separation) should be made for all arisings that are likely to be classified as hazardous or non-hazardous so that each of the above three requirements are met.

11.42 It is mandatory for all construction projects in England over £300,000 in value to implement a Site Waste Management Plan (SWMP). Local Authorities and the Environment Agency will enforce the SWMP and Site Managers must be able to produce one for review if requested by the above parties.

Appendix

TECHNICAL REFERENCES

Ref	Reference Title	Type
1	Sheet 256 North London, Geological Survey of England and Wales 1:50,000	Geological Map
2	EMapSite GroundSure, *EnviroInsight*, *GeoInsight* and *MapInsight* report packages Ref: EMS-184935_271161 dated 8th November 2012	GroundSure Report
3	Environment Agency Website (http://www.environment-agency.gov.uk)	Website
4	Barton N. J., *The Lost Rivers of London: A Study of Their Effects Upon London and Londoners, and the Effects of London and Londoners on Them*, 3rd Edition, 7th December 1992	Publication
5	The Engineering Implications of Rising Groundwater Levels in the Deep Aquifer Beneath London.	CIRIA Special Publication 69
6	Building Research Establishment (BRE) Special Digest (SD) 1, *Concrete in Aggressive Ground*, 3rd Edition, 2005	BRE Publication
7	Radon: Guidance on Protection Measures for New Dwellings. 2007.	BRE Publication BR211
8	HPA NRPB R290. Radon Atlas of England. 2002.	NRPB Radon Atlas
9	CIRIA C681 – Unexploded Ordnance (UXO): A Guide for the Construction Industry	Publication
10	London County Council Bomb Damage Maps, *London Topographical Survey*, 2005.	Publication
11	London County Council Main Drainage Map 2: Main, Intercepting, Storm Relief, and Outfall Sewers. Pumping Stations and Outfall Works. November 1930.	Drainage Map
12	MAGIC Website [www.magic.gov.uk]	MAGIC Website

ENVIRONMENTAL RISK ASSESSMENT SUPPORTING INFORMATION

Soil Screening Values: CLEA Values

The Environment Agency has published non statutory technical guidance for Regulators and their advisors to assess the chronic risk posed to human health from land contamination, known as the Contaminated Land Exposure Assessment (CLEA) Framework.

The CLEA Framework documents and associated risk assessment model are subject to ongoing technical review. The most recent and significant revision was in July 2008, with the withdrawal of guidance documents CLR7 to 10, which previously underpinned the CLEA Framework. In January 2009 the Environment Agency published CLEA V1.04 risk assessment software and associated guidance documents[3] as a replacement to the previous CLEA UK Beta Version and documents CLR 7 to 10. More recent revisions have been made in September 2009 to CLEA V1.05 and October 2009 to CLEA 1.06 risk assessment software.

The Environment Agency has produced several Soil Guideline Values (SGVs) based upon the revised framework. At the time of writing SGVs exist for the following substances: Benzene; Toluene; Ethylbenzene; Xylenes; Dioxins and dioxin like polychlorinated biphenyls; Arsenic; Cadmium, Mercury; Nickel; Phenol and Selenium. SGV reports are currently being compiled by the Environment Agency for: Chromium; Cyanide; Lead and PAHS.

In the absence of a comprehensive list of SGVs, CampbellReith have generated Generic Assessment Criteria (GAC) utilising CLEA 1.06 and the associated software. This is a rolling review and will continue as further Environment Agency publications become available. Contaminant specific toxicological data for GACs has been obtained from Environment Agency and DEFRA toxicological reports where available, or secondary 'authoritative literature references (as detailed in Appendix A of SR2).

In the case of lead, the absence of a Regulator endorsed toxicological endpoint from which to derive a Health Criteria Value makes the derivation of a GAC problematic. In the absence of such a value the withdrawn SGV will be applied for generic assessments. This is considered a suitable course of action until further guidance is published.

Where CLEA compliant SGVs or GAC are not available reference may also be made to GAC derived using the CLEA UK model (beta version) or other values. These are currently used for lead and cyanide. Where referred to, the non-compliant standing of these values is considered.

The recently published GACs within CL:AIRE Publication 'The Soil Generic Assessment Criteria for Human Health Risk Assessment', December 2009 have been applied where CLEA compliant CampbellReith GACs are not available.

Selection of Appropriate [Tier 2] Soil Screening Values

The CLEA model is based upon defined exposure scenarios and three generic land uses are defined within the model. These set out a discrete set of circumstances where exposure may occur, including a source, the pathways, and the exposed population.

The three generic land use scenarios used in the development of SGVs are:

- **commercial / Industrial;**
- **allotments; and,**
- **residential (with or without plant uptake).**

It is noted that the CLEA screening values are generic and not always applicable. Where the CLEA conceptual model is not appropriate it will be necessary to develop site specific Detailed Quantitative Risk Assessment screening values as a further stage of assessment.

It is noted that the CLEA model does not consider risks from contaminated waters beneath the site to human health and the model also assumes that no free product is present. Should such conditions exist at the subject site the requirement for application of an alternative risk assessment model should be assessed. Alternatively, construction workers are potentially exposed to acute risk and therefore require separate consideration.

[3] Environment Agency Report Ref: SC050021/SR2 - *Human Health Toxicological Assessment of Contaminants in Soil.* January 2009. Environment Agency Report Ref: SC050021/SR3 – *Updated background to the CLEA model.* January 2009.

Statistical Analysis of Soil Analytical Results

Statistical analysis of soil based analytical results has been undertaken as detailed in Appendix A of CLEA R&D Publication CLR7, 2002. Although CLR 7 has recently been withdrawn, the use of the Mean Value Test and Maximum Value Test is still considered appropriate for site assessments given current guidance[4]. This guidance advocates use of the one - sample t test, which is a variation of the mean value test and establishes the confidence level at which the assessor can determine whether a particular screening level has / has not been succeeded. The mean value test used herein is set at the 95th percentile confidence limit in order to be risk conservative.

The Maximum Value Test is a statistical tool that is used to identify outlier values from a numerical distribution of results for a given determinant. These outlier values can be excluded and considered separately, and the remaining values are then used to calculate upper bound 95th percentile values ($95^{\%ile}$) (Mean Value Test) for comparison with the screening values.

Unless specifically stated within the report text the statistical assessment has treated the site as a single averaging area and screened in its entirety. Additional tables are presented where appropriate to reflect distinct ground characteristics relevant to the conceptual model.

Water Screening Values

This assessment considers potential risks to controlled waters (groundwater and surface waters) in relation to risks from any historical contamination. The most stringent test is that defined for Contaminated Land under Part 2A of the Environmental Protection Act, 1990. However, it should be recognised that a wider evaluation of risk is considered within the planning regime and CLR 11.

The Environment Agency has a wider policy agenda for the protection of controlled waters that will impinge upon judgements in relation to land contamination issues. This includes those for the Water Framework Directive and Groundwater Directive and wider legislation for both groundwater, surface water and associated elements (such as fisheries)[5].

The results of water analysis have been compared to screening values selected to assess the potential risk to the identified controlled water receptors in the Conceptual Model. The specific standards utilised for this purpose are considered in the assessment table footnotes and typically comprise: Environmental Quality Standards for the protection of aquatic life; Surface Water Standards; EC and UK Drinking Water Standards; or Background water quality (where no applicable standard exists).

The initial assessment considers the sensitivity of the receptor in the selection of the screening value. Advice for this purpose has been obtained principally from Environment Agency Technical Advice to Third Parties on Pollution of Controlled Waters for Part 2A of the Environmental Protection Act 1990, No 07/02. EA, 2002. (INFO-RA2-3e).

Where a viable pollutant linkage is considered to be present and the screening criteria exceeded, a Qualitative Risk Assessment is presented with associated recommendations. Depending on the specific objectives, policy and practice of the Environment Agency, discussion of water screening values may be subsequently required.

[4]Guidance on Comparing Soil Contamination Data with a Critical Concentration, CL:AIRE, May 2008.
[5] Refer to Environment Agency Publications for Groundwater Protection Policy and Practice. http://publications.environment-agency.gov.uk/pdf/GEHO0708BOGU-e-e.pdf?lang=_e

LIMITATIONS

Environmental & Geotechnical Interpretative Reports

1. This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the client.
2. Where any data or information supplied by the client or other external source, including that from previous studies, has been used, it has been assumed that the information is correct. No responsibility can be accepted by CampbellReith for inaccuracies within this data or information. In relation to historic maps the accuracy of maps cannot be guaranteed and it should be recognized that different conditions on site may have existed between and subsequent to the various map surveys.
3. This report is limited to those aspects of historical land use and enquiries related to environmental matters reported on and no liability is accepted for any other aspects. The opinions expressed cannot be absolute due to the limit of time and resources implicit within the agreed brief and the possibility of unrecorded previous uses of the site and adjacent land.
4. The material encountered and samples obtained during on-site investigations represent only a small proportion of the materials present on the site. There may be other conditions prevailing at the site which have not been revealed and which have therefore not been taken into account in this report. These risks can be minimised and reduced by additional investigations. If significant variations become evident, additional specialist advice should be sought to assess the implications of these few findings.
5. The generalised soil conditions described in the text are intended to convey trends in subsurface conditions. The boundaries between strata are approximate and have been developed on interpretations of the exploration locations and samples collected.
6. Water level and gas readings have been taken at times and under conditions stated on the exploration logs. It must be noted that fluctuations in the level of groundwater or gas may occur due to a variety of factors which may differ from those prevailing at the time the measurements were taken.
7. Please note that CampbellReith cannot accept any liability for observations or opinions expressed regarding the absence or presence of asbestos or on any product or waste that may contain asbestos. We recommend that an asbestos specialist, with appropriate professional indemnity insurance, is employed directly by the client in every case where asbestos may be present on the site or within the buildings or installations. Any comments made in this report with respect to asbestos, or asbestos containing materials, are only included to assist the client with the initial appraisal of the project and should not be relied upon in any way.
8. The findings and opinions expressed are relevant to those dates of the reported site work and should not be relied upon to represent conditions at substantially later dates.
9. This report is produced solely for the benefit of the client, and no liability is accepted for any reliance placed upon it by any other party unless specifically agreed in writing.

APPENDIX A: FIGURES

Figure 1: Site Location

Figure 2: Annotated Site Layout

Figure 3a: Greenwood Place: Proposed Development Plan

Figure 3b: Highgate Road Residential: Proposed Development Plan

Figure 4: Historical Composite Plan

Figure 5: SPT vs. Reduced Depth Plot

Figure 6: Undrained Shear Strength vs. Reduced Depth Plot for London Clay

Site Photographs (14th November 2012)

Greenwood Place Community Centre

Client: London Borough of Camden

Figure 1:
Site Location Plan

Scale:	1:15000@A4
CampbellReith OS Copyright: © Crown copyright. All rights reserved. Licence number 100020027	
Contains Ordnance Survey data © Crown copyright and database right 2013.	
Job Number:	11167
Drawn by - Checked by:	SC - MJ
Drg No - Status/Revision:	GIS012 - A
File location:	O:\11000 - 11249\11167 - Greenwood Place Community Centre\Workspaces\Transportation (pdf in Outputs)
Date (Revision History):	19/07/2013 (updating boundary 13/08/13, KM)

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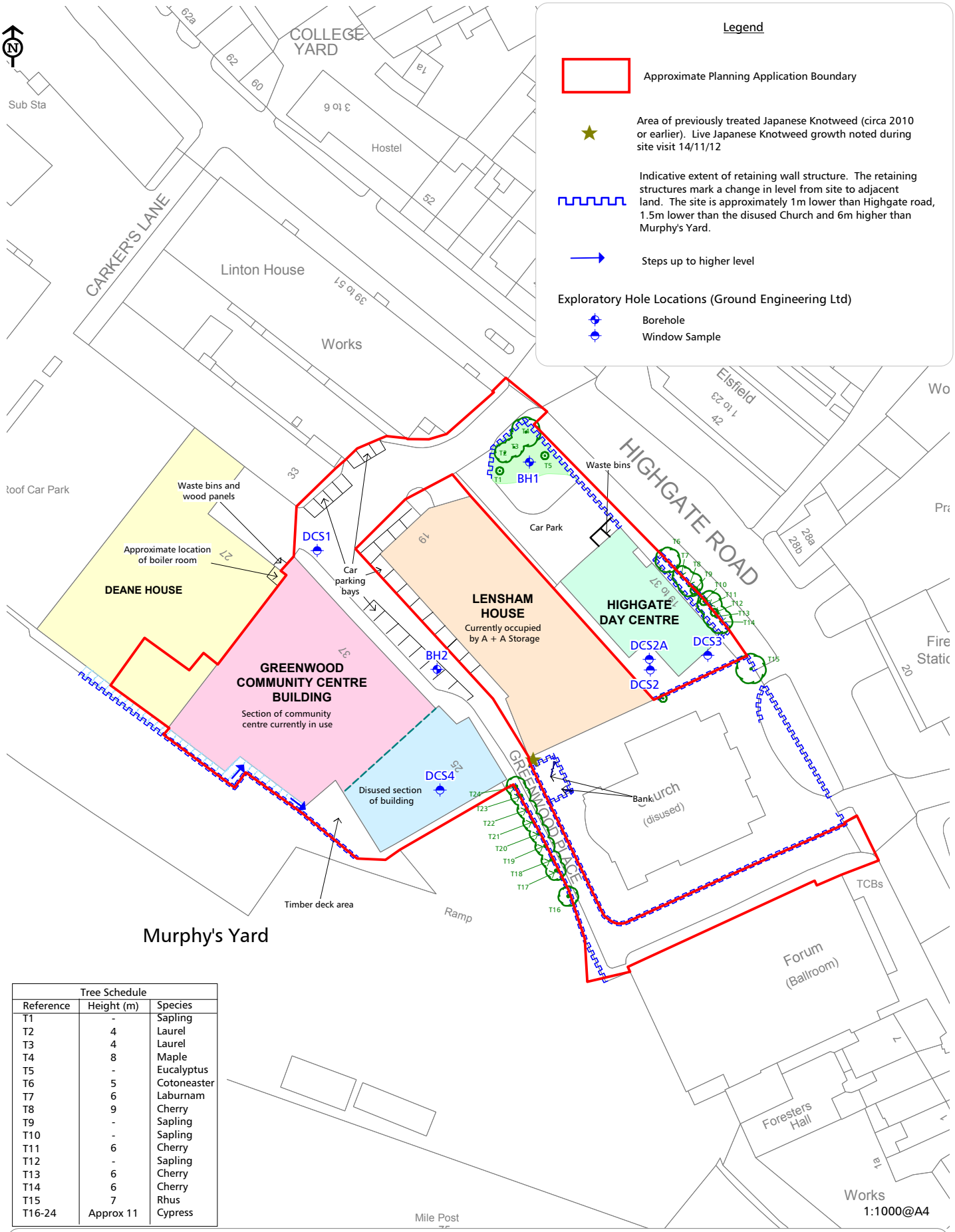

Tree Schedule		
Reference	Height (m)	Species
T1	-	Sapling
T2	4	Laurel
T3	4	Laurel
T4	8	Maple
T5	-	Eucalyptus
T6	5	Cotoneaster
T7	6	Laburnam
T8	9	Cherry
T9	-	Sapling
T10	-	Sapling
T11	6	Cherry
T12	-	Sapling
T13	6	Cherry
T14	6	Cherry
T15	7	Rhus
T16-24	Approx 11	Cypress

Greenwood Place Community Centre

Client: London Borough of Camden

Figure 2: Annotated Site Layout and Exploratory Hole Location Plan

Job Number: 11167
Date: 20/02/2013
Drawn by: SC
Checked by: RW
Drg No: GIS012
Status/Revision: B
File location: O:\11000 - 11249\11167 - Greenwood Place Community Centre\Workspaces\Desk Study (pdf in Outputs)
Revision History: A, First Issue, 20/12/12, SC; B, amended 13/08/2013

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Greenwood Place Community Centre

Client: London Borough of Camden

Figure 3a):
Greenwood Centre: Proposed Development Plan

Approx. 1:200@A3

Scale: 1:200@3

Based on drawing no. SK100 Rev E by PCK Architects
Job Number: 11167
Drawn by - Checked by: KM-EB
Drg No - Status/Revision: GIS014 - A
File location: O:\11000 - 11249\11167 - Greenwood Pl. Commu\Workspaces (pdf in Outputs)
Date (Revision History): 13/08/2013

Approximate location of proposed basement

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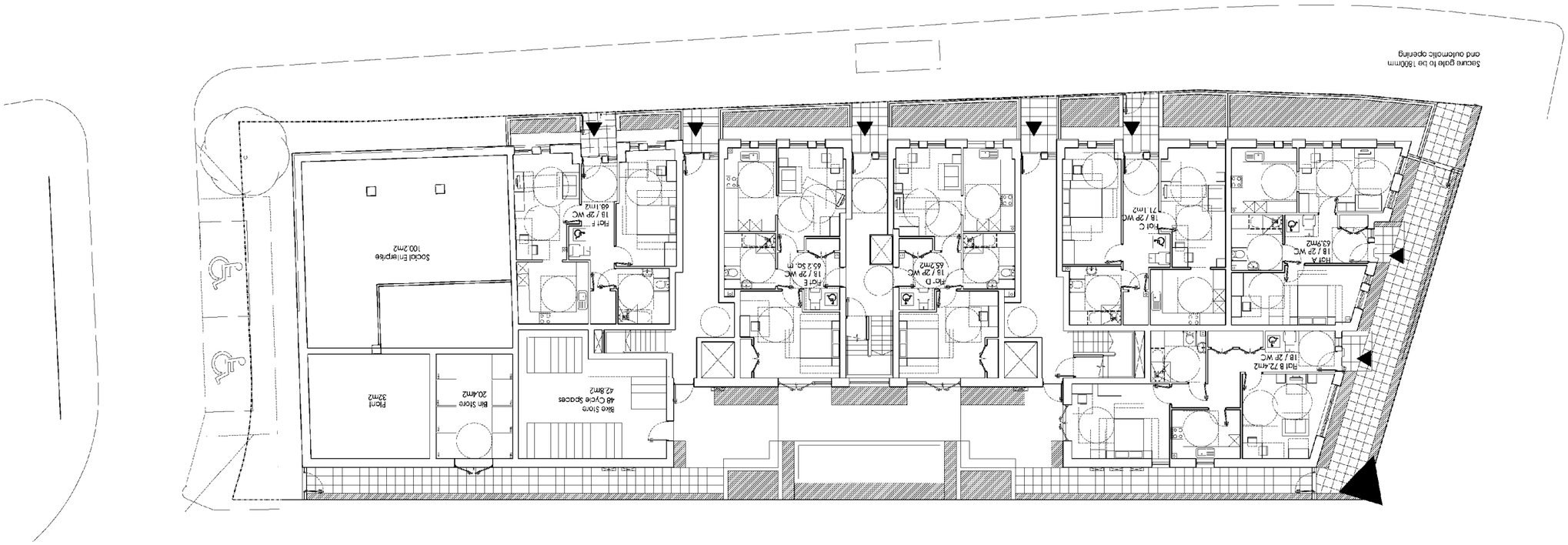
Ground Floor Plan



Greenwood Place Community Centre

Client: London Borough of Camden

Figure 3b):
Highgate Road Residential: Proposed Development Plan

Approx. 1:250@A3

Scale: Approx. 1:250@A3
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Based on drawing no. SK400 Rev A by PCK Architects
Job Number: 11167
Drawn by - Checked by: KM-EB
Drg No - Status/Revision: GIS015 - A
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Date (Revision History): 13/08/2013

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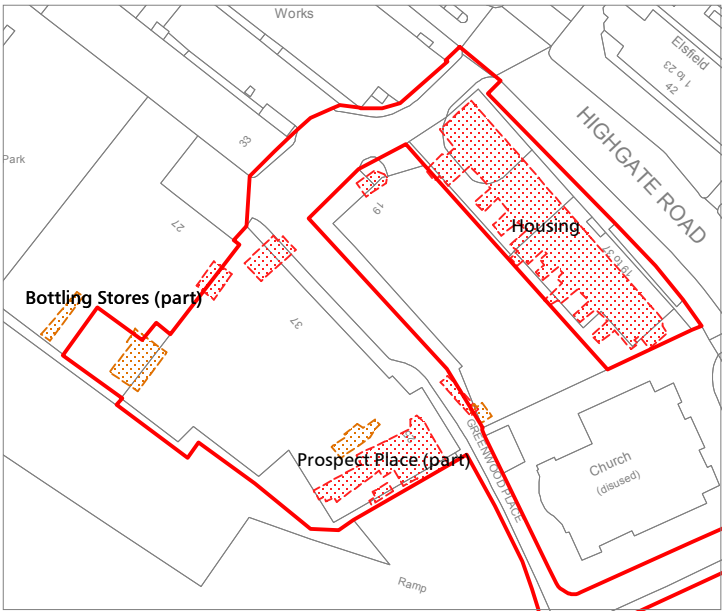
Legend

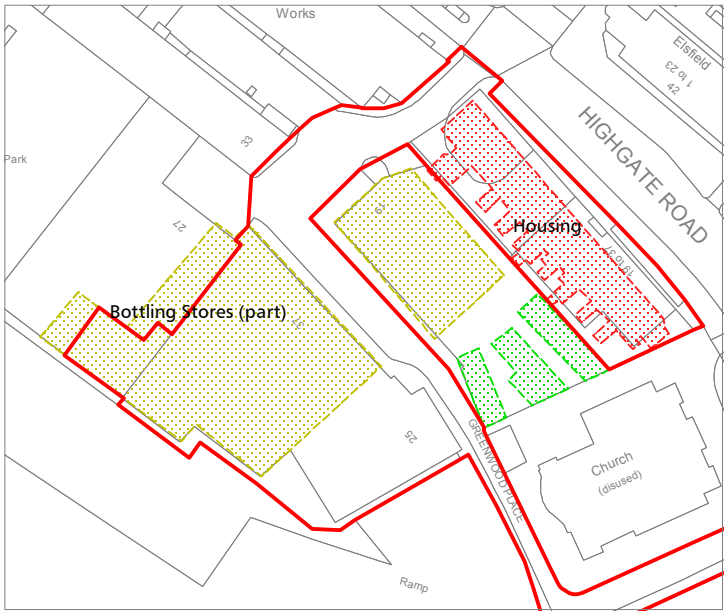
Year in which feature first appeared on historical map (approximate location)

- 1872
- 1894-1896
- 1915-1916
- 1936
- 1952
- 1967 onwards

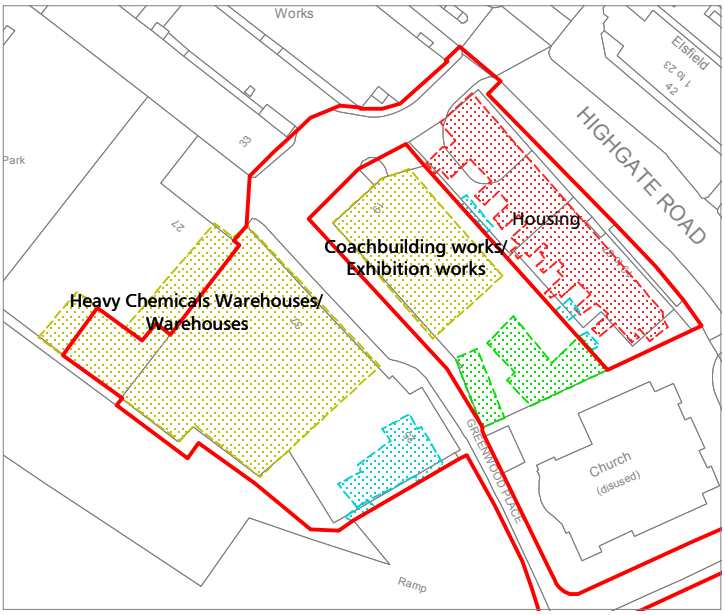
1:1500@A4



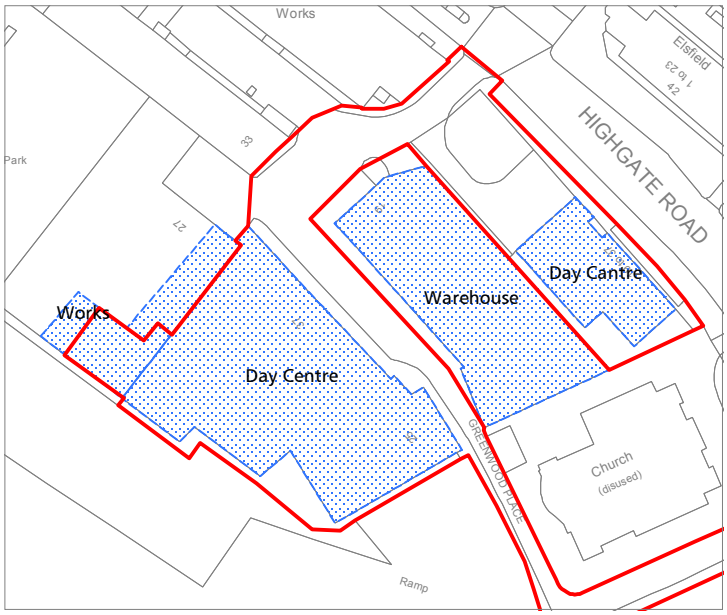
1872 - 1896



1915 - 1936



1952 - 1967



1973 to date

Greenwood Place Community Centre

Client: London Borough of Camden

Figure 4:
Historical Composite Plan

Job Number: 11167
Date: 20/02/2013
Drawn by: SC/KM
Checked by: EB
Drg No: GIS016
Status/Revision: A
File location: O:\11000 - 11249\11167 - Greenwood Place Community Centre\Workspaces\Desk Study (pdf in Outputs)
Revision History: A, First Issue, 13/08/2013 KM

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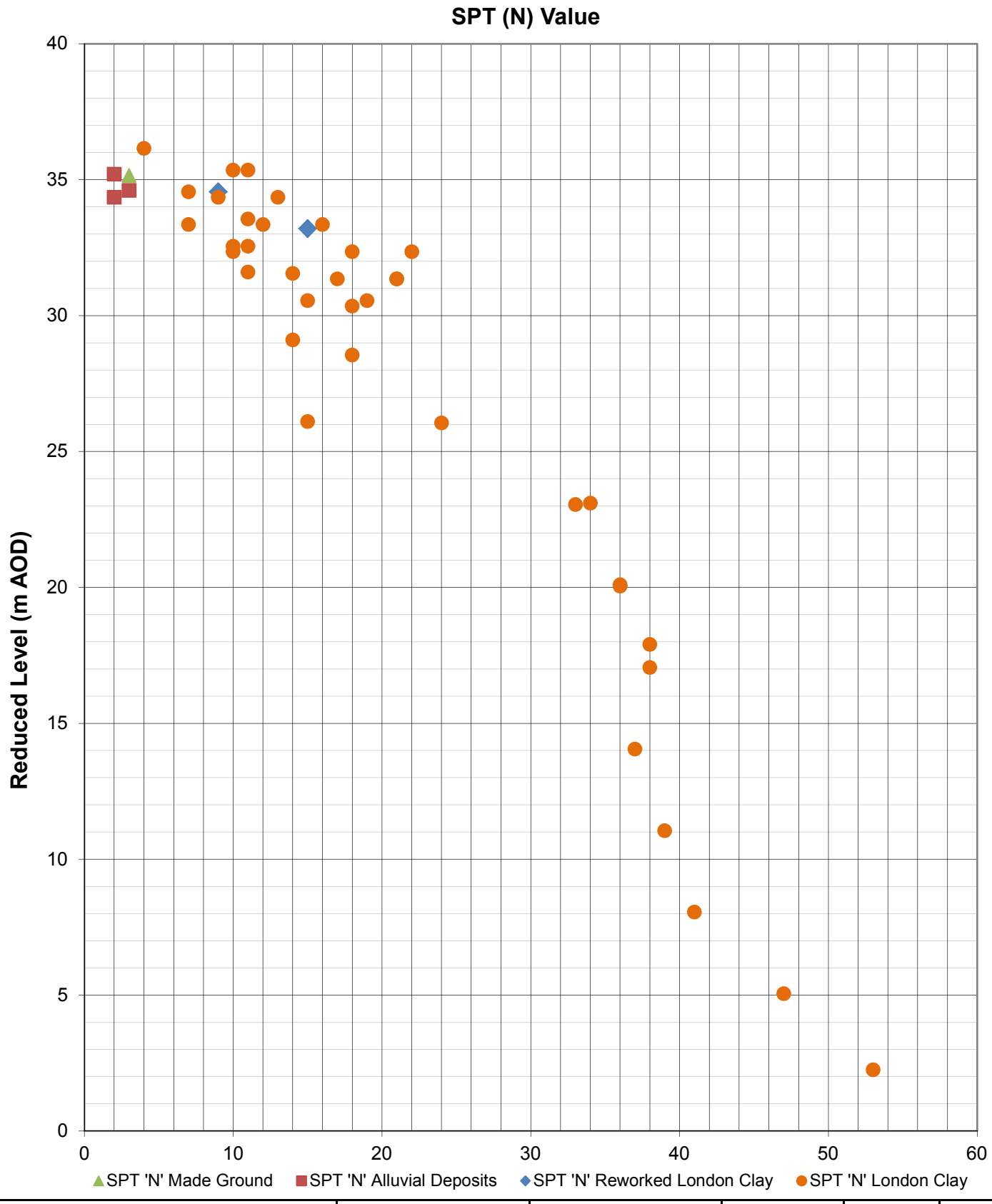
SPT (N) Value Vs Reduced Depth

Client	London Borough of Camden	Job No.	11167
Site	Greenwood Place Community Centre	Date Drawn	12/08/2013



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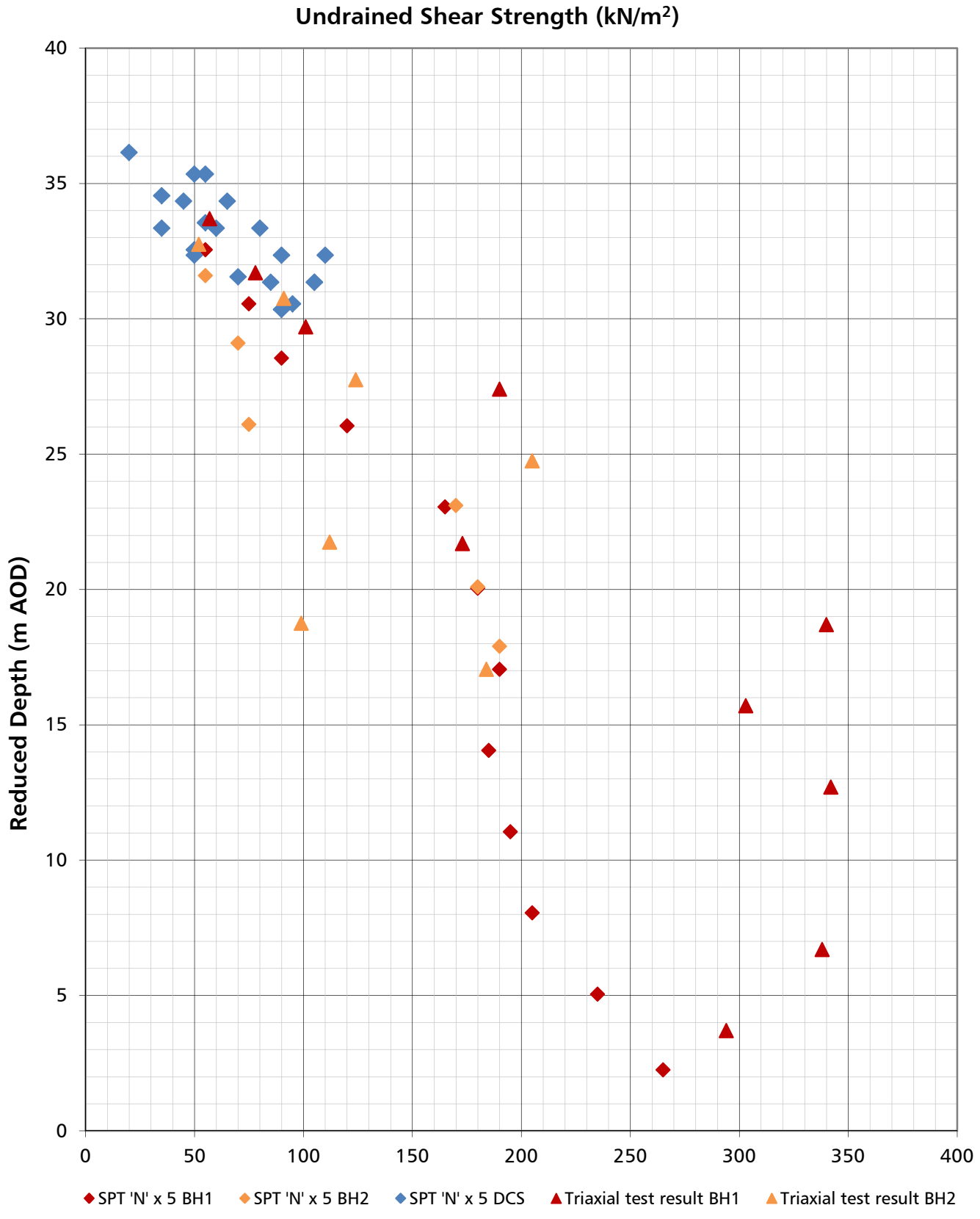
Status	S	Fig:
Rev.	D	5

Undrained Shear Strength Vs Reduced Depth for London Clay

Site	Greenwood Place Community Centre	Job No.	11167
Client	London Borough of Camden	Date Drawn	12/08/2013



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BRISTOL 0117 916 1066

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Status	S	Fig:
Rev.	D	6

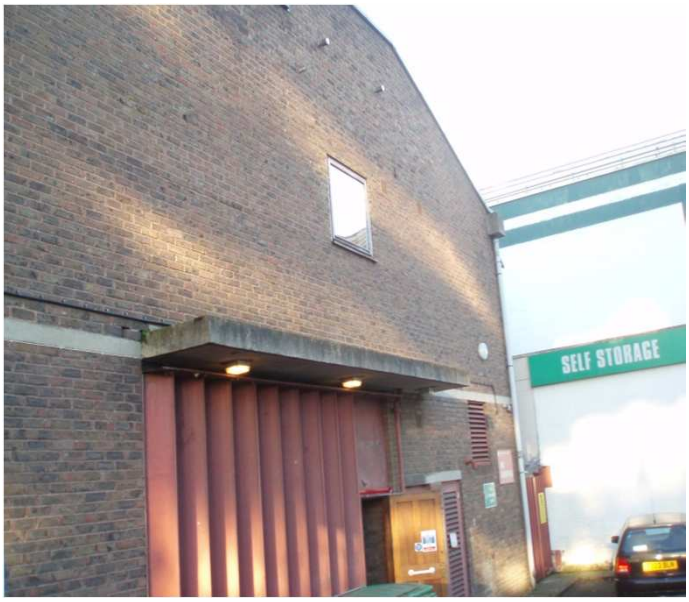

Image 1: Highgate Building

Image 2: Car Park (Highgate Building)

Image 3: Frontage of Greenwood Place

Image 4: Active Part of Greenwood Place

Greenwood Place Community Centre

Client: London Borough of Camden

Site Photographs
1 – 4

Job Number:	11167
Date:	20/02/2013
Drawn by:	EJ
Checked by:	RW
Drg No:	GIS001
Status/Revision:	A
File location:	\\RED-DATA1\Admin-Data\Documents\11000-11249\11167 - HCA Greenwood Place Community Centre\CR Docs\Reports\Prelim LQS
Revision History:	A, First Issue, 16/08/2013

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Image 5: Outside Area Greenwood Place

Image 6: COSH Store

Image 7: Steps Leading down to store in active part of Greenwood Place

Image 8: Boiler Room

Greenwood Place Community Centre

Client: London Borough of Camden

Site Photographs
5 – 8

Job Number:	11167
Date:	20/02/2013
Drawn by:	EJ
Checked by:	RW
Drg No:	GIS001
Status/Revision:	A
File location:	\\RED-DATA1\Admin-Data\Documents\11000-11249\11167 - HCA Greenwood Place Community Centre\CR Docs\Reports\Prelim LQS
Revision History:	A, First Issue, 16/08/2013

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Image 9: Staining in Boiler Room

Image 10: Front of Disused Section of Greenwood Place

Image 11: Secure Entrance to Disused Section of Greenwood Place

Image 12: A Room within the Disused Building

Greenwood Place Community Centre

Client: London Borough of Camden

Site Photographs
9 – 12

Job Number:	11167
Date:	20/02/2013
Drawn by:	EJ
Checked by:	RW
Drg No:	GIS001
Status/Revision:	A
File location:	\\RED-DATA1\Admin-Data\Documents\11000-11249\11167 - HCA Greenwood Place Community Centre\CR Docs\Reports\Prelim LQS
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Image 13: Roof in Poor State of Repair (Disused Building)

Image 14: Kitchen in poor state of repair (Disused Building)

Image 15: Entrance and drop off zone for 'Mail Out' (ground space is under Deane House)

Image 16: Access off Greenwood Place (Deane House is at the back of the image)

Greenwood Place Community Centre

Client: London Borough of Camden

Site Photographs
13 – 16

Job Number:	11167
Date:	20/02/2013
Drawn by:	EJ
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Drg No:	GIS001
Status/Revision:	A
File location:	\\RED-DATA1\Admin-Data\Documents\11000-11249\11167 - HCA Greenwood Place Community Centre\CR Docs\Reports\Prelim LQS
Revision History:	A, First Issue, 16/08/2013

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APPENDIX B: DESK STUDY INFORMATION

EMapSite GroundSure, *EnviroInsight*, *GeoInsight* and *MapInsight* reports, ref: EMS-184935_271161 dated 8th November 2012.

London Borough of Camden Environmental Health Officer consultation dated 29th November 2012.

London Borough of Camden Planning Officer consultation dated 21st November 2012.

London Borough of Camden Building Control consultation dated 13th November 2012.

Transport for London consultation dated 14th November 2012.

Crossrail consultation dated 8th January 2013.

Petroleum licence search dated 25th March 2013.

EmapSite
Masdar House, ,
Eversley, RG27 0RP

GroundSure Reference:	EMS-184935_271161
Your Reference:	EMS_184935_271161
Report Date:	Nov 8, 2012
Report Delivery Method:	**Email - pdf**
Client Email:	sales@emapsite.com

GroundSure EnviroInsight

Address: Greenwood Place Community Centre

Dear Sir/Madam,

Thank you for placing your order with emapsite. Please find enclosed the GroundSure EnviroInsight as requested

If you would like further assistance regarding this report then please contact the emapsite customer services team on 0118 9736883 quoting the above report reference number.

Yours faithfully,

emapsite customer services team

Enc.
GroundSure EnviroInsight

GroundSure EnviroInsight

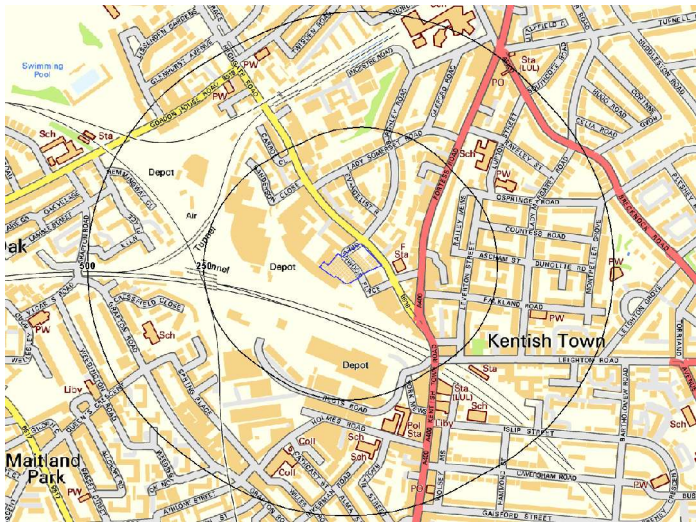
Address: Greenwood Place Community Centre

Date: Nov 8, 2012

GroundSure Reference: EMS-184935_271161

Your Reference: EMS_184935_271161

Client: EmapSite



Brought to you by emapsite

Aerial Photograph of Study Site

NW ▲ N NE

◄W

E►

SW S ▼ SE

Site Name: Greenwood Place Community Centre
Grid Reference: 528833,185396
Size of Site: 0.57 ha

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Report Section	Number of records found within (X) m of the study site boundary					
1. Environmental Permits, Incidents and Registers	on-site	0-50	51-250	251-500	501-1000	1000-1500
1.1 Industrial Sites Holding Environmental Permits and/or Authorisations						
Records of historic IPC Authorisations	0	0	0	0	-	-
Records of Part A(1) and IPPC Authorised Activities	0	0	0	0	-	-
Records of Water Industry Referrals (potentially harmful discharges to the public sewer)	0	0	0	0	-	-
Records of Red List Discharge Consents (potentially harmful discharges to controlled waters)	0	0	0	0	-	-
Records of List 1 Dangerous Substances Inventory sites	0	0	0	0	-	-
Records of List 2 Dangerous Substances Inventory sites	0	0	0	0	-	-
Records of Part A(2) and Part B Activities and Enforcements	0	0	10	8	-	-
Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	2	-	-
Records of Licensed Discharge Consents	0	0	0	0	-	-
Records of Planning Hazardous Substance Consents and Enforcements	0	0	0	0		
1.2 Records of COMAH and NIHHS sites	0	0	0	0	-	-
1.3 Environment Agency Recorded Pollution Incidents						
National Incidents Recording System, List 2	0	0	0	-	-	-
National Incidents Recording System, List 1	0	0	0	-	-	-
1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990	0	0	1	0	-	-

2. Landfill and Other Waste Sites	on-site	0-50	51-250	251-500	501-1000	1000-1500
2.1 Landfill Sites						
Environment Agency Registered Landfill Sites	0	0	0	0	0	-
Landfill Data – Operational Landfill Sites	0	0	0	0	0	-
Environment Agency Historic Landfill Sites	0	0	0	0	0	0
Landfill Data – Non-Operational Landfill Sites	0	0	0	0	0	-
BGS/DoE Landfill Site Survey	0	0	0	0	0	0
GroundSure Local Authority Landfill Sites Data	0	0	0	0	0	0
2.2 Landfill and Other Waste Sites Findings						
Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	1	-	-
Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	1	-	-
Environment Agency Licensed Waste Sites	0	0	2	0	0	2

3. Current Land Uses

	on-site	0-50	51-250	251-500	501-1000	1000-1500
3.1 Current Industrial Sites Data	1	6	33	-	-	-
3.2 Records of Petrol and Fuel Sites	0	0	0	1	-	-
3.3 Underground High Pressure Oil and Gas Pipelines	0	0	0	0	-	-

4. Geology

	Description
4.1 Are there any records of Artificial Ground and Made Ground present beneath the study site? *	Yes
4.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site? *	No
4.3 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	

Source: Scale: 1:50,000 BGS Sheet 256

* This includes an automatically generated 50m buffer zone around the site.

5. Hydrogeology and Hydrology

	on-site	0-50	51-250	251-500	501-1000	1001-2000
5.1 Are there any records of Productive Strata in the Superficial Geology within 500m of the study site?			No			
5.2 Are there any records of Productive Strata in the Bedrock Geology within 500m of the study site?			Yes			
5.3 Groundwater Abstraction Licences (within 2000m of the study site).	0	0	0	0	3	2
5.4 Surface Water Abstraction Licences (within 2000m of the study site).	0	0	0	0	0	4
5.5 Potable Water Abstraction Licences (within 2000m of the study site).	0	0	0	0	1	0
5.6 Are there any Source Protection Zones within 500m of the study site?					No	

5.7 River Quality	on-site	0-50	51-250	251-500	501-1000	1001-1500
Is there any Environment Agency information on river quality within 1500m of the study site?	No	No	No	No	No	Yes
5.8 Detailed River Network entries within 500m of the site	0	0	1	0	-	-
5.9 Surface water features within 250m of the study site	No	No	No	-	-	-

6. Flooding

6.1 Are there any Environment Agency indicative Zone 2 floodplains within 250m of the study site?	No
6.2 Are there any Environment Agency indicative Zone 3 floodplains within 250m of the study site?	No
6.3 Are there any Flood Defences within 250m of the study site?	No
6.4 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
6.5 Are there any areas used for Flood Storage within 250m of the study site?	No
6.6 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Negligible
6.7 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	Not Applicable

7. Designated Environmentally Sensitive Sites	on-site	0-50	51-250	251-500	501-1000	1001-2000
7.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
7.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
7.3 Records of Local Nature Reserves (LNR)	0	0	0	0	0	1
7.4 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
7.5 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
7.6 Records of Ramsar sites	0	0	0	0	0	0
7.7 Records of World Heritage Sites	0	0	0	0	0	0
7.8 Records of Environmentally Sensitive Areas	0	0	0	0	0	0
7.9 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
7.10 Records of National Parks	0	0	0	0	0	0
7.11 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
7.12 Records of Nitrate Vulnerable Zones	0	0	0	0	0	0
7.13 Records of Ancient Woodlands	0	0	0	0	0	0

8. Natural Hazards

8.1 What is the maximum risk of natural ground subsidence?	Moderate

9. Mining

9.1 Are there any coal mining areas within 75m of the study site?	No
9.2 What is the risk of subsidence relating to shallow mining within 150m of the study site?	Negligible
9.3 Are there any brine affected areas within 75m of the study site?	No

Using this Report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client. The document contains the following sections:

1. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

2. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

3. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure underground oil and gas pipelines.

4. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

5. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licenses, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

6. Flooding

Provides information on surface water flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

7. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites. These searches are conducted using radii of up to 500m.

8. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence.

9. Mining

Provides information on areas of coal and shallow mining.

10. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, GroundSure provide a free Technical Helpline (08444 159000) for further information and guidance.

Note: Maps

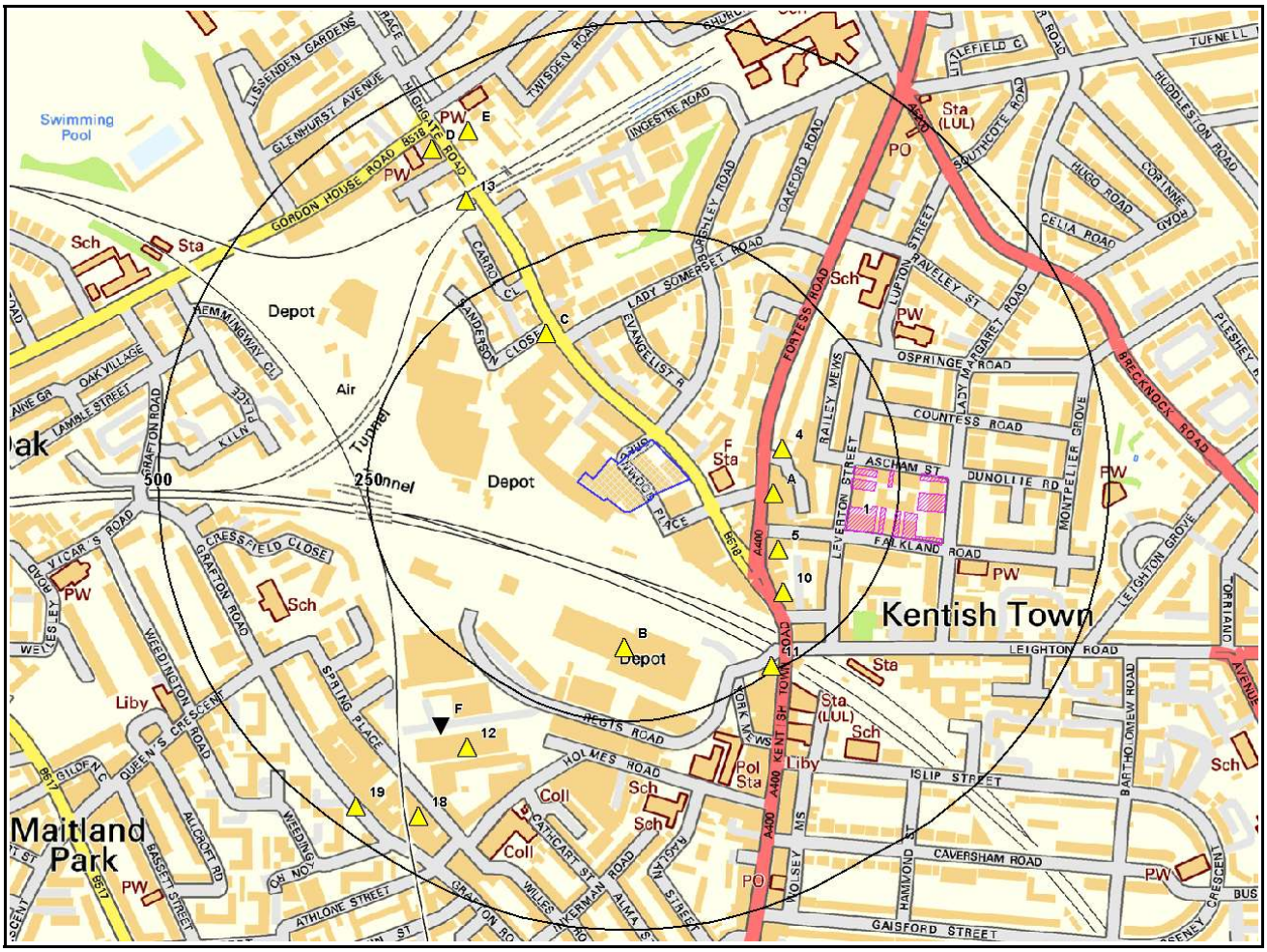
Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier "A" on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as "Not Shown".

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Environmental Permits, Incidents and Registers Map

NW N NE



W E

SW S SE

Authorisations,Incidents and Registers Legend

- Site Outline
- Search Buffers (m) — 250 — 500
- Recorded Pollution Incident
- Dangerous Substances (List 1)
- Dangerous Substances (List 2)
- Water Industry Referrals
- Licenced Discharge Consents
- Red List Discharge Consents
- RAS 3 & 4 Authorisations
- Part A(1) Authorised Processes and Historic IPC Authorisations
- Part A(2) and Part B Authorised Processes
- COMAH / NIHHS Sites
- Sites Determined as Contaminated Land
- Hazardous Substance Consents and Enforcements

1.Environmental Permits, Incidents and Registers

1.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency and Local Authorities reveal the following information:

Records of historic IPC Authorisations within 500m of the study site: **0**

Database searched and no data found.

Records of Part A(1) and IPPC Authorised Activities within 500m of the study site: **0**

Database searched and no data found.

Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site: **0**

Database searched and no data found.

Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site: **0**

Database searched and no data found.

Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site: **0**

Database searched and no data found.

Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site: **0**

Database searched and no data found.

Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site: **18**

The following Part A(2) and Part B Activities are represented as points on the Authorisations, Incidents and Registers map:

ID	Distance	Direction	NGR	Details	
2A	102.0	E	528997, 185376	Address: Perk Clean , 20 Fortess Road, Kentish Town, NW5 2HB Process: Dry Cleaner Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
3A	102.0	E	528997, 185376	Address: Perk Clean , 20 Fortess Road, Kentish Town, NW5 2HB Process: Dry Cleaner Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

4	115.0	E	529007, 185429	Address: M & A Coachworks, II 1-36 Fortess Grove, Kentish Town, London, NW5 1LE Process: Vehicle Respraying Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
5	136.0	SE	529002, 185308	Address: Zappeo Dry Cleaners, 310 Kentish Town Road, NW5 2TH Process: Dry Cleaner Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
6B	164.0	S	528819, 185191	Address: Post Office Vehicle Serivices Unit A Kentish Town Business Park, Regis Road, London, NW5 3RR Process: Vehicle respraying Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
7B	164.0	S	528819, 185191	Address: Post Office Vehicle Serivices, Unit A, Kentish Town Business Park, Regis Road, London, NW5 3RR Process: Vehicle respraying Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
8C	165.0	NW	528726, 185567	Address: J Murphy & Sons Ltd , 81 Highgate Road, NW5 1TS Process: Vehicle Refinishing Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
9C	165.0	NW	528726, 185567	Address: J Murphy & Sons Ltd , 81 Highgate Road, NW5 1TS Process: Vehicle Refinishing Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
10	177.0	SE	529008, 185257	Address: Zappeo , 310 Kentish Town Road, NW5 1TH Process: Dry Cleaners Status: Revoked Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
11	246.0	SE	528994, 185169	Address: The Kleen Machine , Kentish Town, PO16 8UG Process: Dry Cleaners Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
12	340.0	SW	528632, 185071	Address: Hexagon of Highgate 1 Browns Lane, Regis Road, Kentish Town, London, NW5 3EX Process: Vehicle respraying Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
13	350.0	NW	528631, 185726	Address: M & A Coachworks, 135 Highgate Road, Kentish Town, London, NW5 1LE Process: Vehicle respraying Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
14D	424.0	NW	528590, 185788	Address: Perfect Dry Cleaners , 151 Highgate Road, NW5 1JL Process: Dry Cleaner Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
15D	424.0	NW	528590, 185788	Address: Perfect Dry Cleaners , 151 Highgate Road, NW5 1JL Process: Dry Cleaner Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
16E	425.0	NW	528633, 185810	Address: ASF Garage Ltd, 138 Highgate Road, London, NW5 1PB Process: Petrol Station Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
17E	425.0	NW	528633, 185810	Address: ASF Garage Ltd, 138-140 Highgate Road, London, NW5 1PB Process: Petrol Station Status: Current Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
18	440.0	SW	528574, 184989	Address: Solus London Ltd, 3-6 Spring Place, NW5 4BA Process: Unknown Status: Historic Permit Type: Part B	Enforcement: Enforcement Notified Date of Enforcement: 20070526 Comment: Not given

19	472.0	SW	528500, 185000	Address: Jt Coachwks Spring Pl, Kentish Town,NW5 3BH Process: Vehicle Re-spray Process Status: Historic Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

Records of Category 3 or 4 Radioactive Substance Licences within 500m of the study site: **2**

The following RAS Licence (3 or 4) records are represented as points on the Authorisations, Incidents and Registers map:

ID	Distance [m]	Direction	Address	Operator	Type	Permission Number	Dates	Status
22F	332.0	SW	Hexagon Of Highgate Ltd, Body Shop Dept,1 Browns Lane, London, NW5 3EX	Hexagon Of Highgate Ltd	Keeping And Use Of Radioactive Materials (was Rsa60 Section 1).	AO2051	Date of Approval:- Effective from:- Last date of update:2001-06-01	-
23F	332.0	SW	Hexagon B.m.w, 1 Browns Lane,regis Road,kentish Town, London, NW5 3EX	Hexagon B.m.w	Keeping And Use Of Radioactive Materials (was Rsa60 Section 1).	BB8362	Date of Approval:- Effective from:- Last date of update:2001-06-01	-

Records of Licensed Discharge Consents within 500m of the study site: **0**

Database searched and no data found.

Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site: **0**

Database searched and no data found.

1.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: **0**

Database searched and no data found.

1.3 Environment Agency Recorded Pollution Incidents

Records of National Incidents Recording System, List 2 within 250m of the study site: **0**

Database searched and no data found.

Records of National Incidents Recording System, List 1 within 250m of the study site: **0**

Database searched and no data found.

1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990

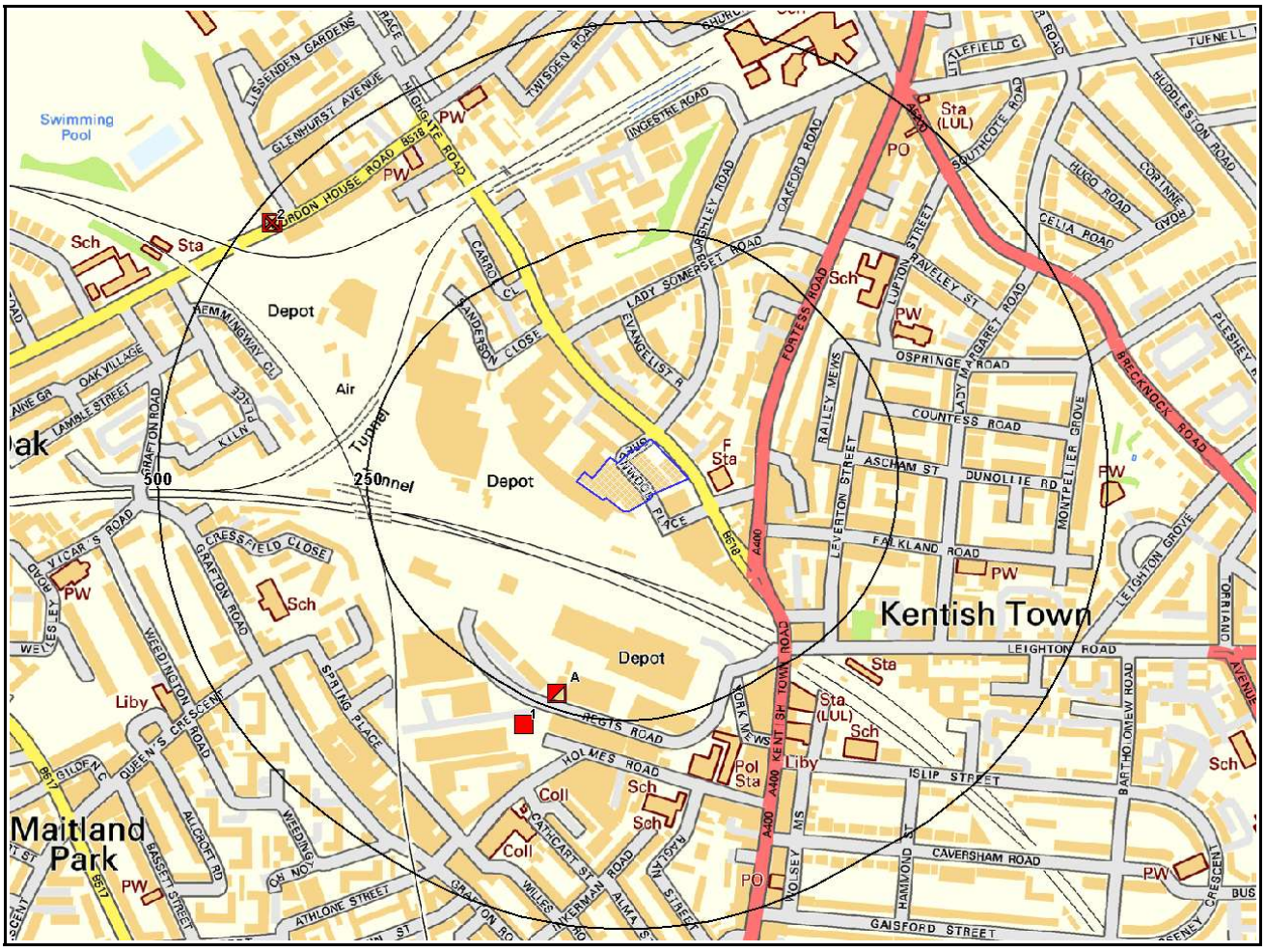
How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site? **1**

The following records are represented as polygons on the Authorisations, Incidents and Registers Map:

ID	Distance	Direction	NGR	Description	Location	Category	Year Identified
1	191.0	E	529101, 185346	Former metal plating works. Lead and Cadmium potential contaminants. Remediated.	8 Ascham Street, 15-23, 27, 33, 37-41 Falkland Road, 15a, 25-29, 35 Lady Margeret Road, 42, 44, 48 Leverton Street, NW5 2PU.	Contaminated Land	2011

2. Landfill and Other Waste Sites Map

NW N NE



W ◄ ► E

SW S SE

Landfill & Other Waste Sites Legend

- Site Outline
- Search Buffers (m): 250, 500
- E.A. Active Landfill
- E.A. Historic Landfill (Area Data)
- E.A. Historic Landfill (Point Data)
- BGS / DoE Survey Landfill
- Local Authority Landfill (Area Data)
- Local Authority Landfill (Point Data)
- Operational Waste Treatment Licence
- Closed Waste Treatment Licence
- REGIS Waste Licence
- Operational Landfill
- Closed Landfill

2. Landfill and Other Waste Sites

2.1 Landfill Sites

Records from Environment Agency landfill data within 1000m of the study site: **0**

Database searched and no data found.

Records of operational landfill sites sourced from Landmark within 1000m of the study site: **0**

Database searched and no data found.

Records of Environment Agency historic landfill sites within 1500m of the study site: **0**

Database searched and no data found.

Records of non-operational landfill sites sourced from Landmark within 1000m of the study site: **0**

Database searched and no data found.

Records of BGS/DoE non-operational landfill sites within 1500m of the study site: **0**

Database searched and no data found.

Records of Local Authority landfill sites within 1500m of the study site: **0**

Database searched and no data found.

2.2 Other Waste Sites

Records of operational waste treatment, transfer or disposal sites within 500m of the study site: **1**

The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance	Direction	NGR	Details	
1	281.0	SW	528700, 185100	Site Address: Regis Road Recycling Centre, CAMDEN, London, NW5 3EP Landfill Licence: G15AAKAL EA Reference: EAWML80349 Waste Type: Difficult Rating: Difficult Transfer, Difficult Treatment Known Restrictions: No known restriction on source of waste	Record Date: 01-Dec-1996 Transfer Date: Modification Date: 01-Aug-1998 Status: Operational as far as is known Category: RECYCLING / RECLAMATION Regulator: EA - Thames Region - North East Area (Isleworth) Size: Very Small (<10,000 tonnes/year)

Records of non-operational waste treatment, transfer or disposal sites within 500m of the study site: **1**

The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance	Direction	NGR	Details	
2	477.0	NW	528400, 185700	Site Address: BR Goods Depot, Gordon House Road, CAMDEN, London, NW5 Landfill Licence: 176AFXAL EA Reference: - Waste Type: Non-Hazardous Waste Description: Non-Hazardous Known Restrictions: No known restriction on source of waste	Record Date:01-May-1982 Transfer Date: Modification Date: 01-Feb-1983 Status: Licence lapsed/cancelled/defunct/not applicable/surrendered Category: TRANSFER Regulator: EA - Thames Region - North East Area (Hatfield-London N) Size: Medium (< 75,000 tonnes/year)

Records of Environment Agency licensed waste sites within 1500m of the study site: 4

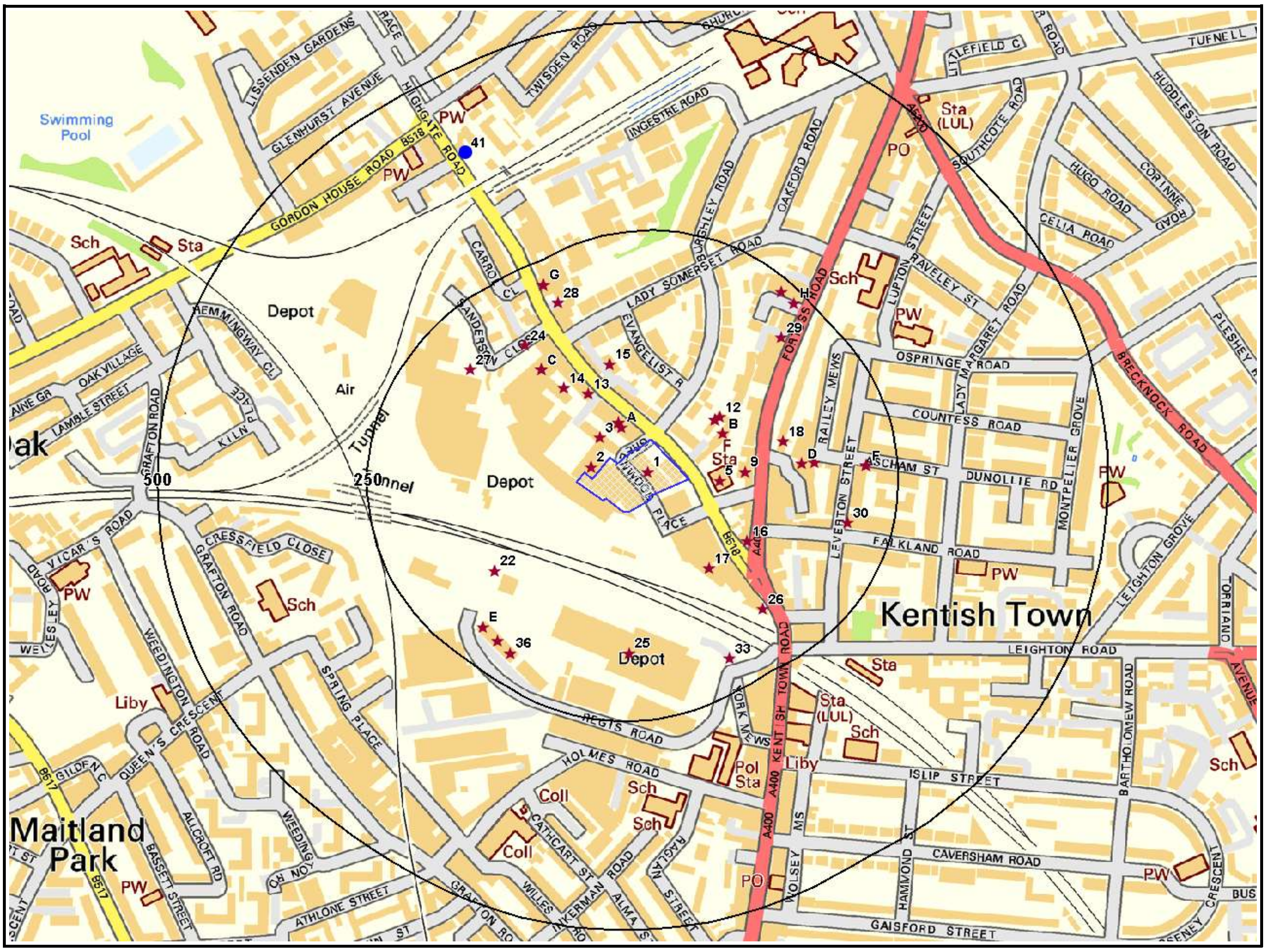
The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance	Direction	NGR	Details	
3A	231.0	S	528740, 185138	Site Address: Camden London Borough Council, Recycling Centre, Regis Road, Kentish Town, London, NW5 3EP Type: Household Waste Amenity Site Size: < 25000 tonnes Regis Licence Number: CAM001 EPR reference: EA/EPR/DP3091NK/V003 Operator: Camden London Borough Council Waste Management licence No: 80349 Annual Tonnage: 7793.0	Issue Date: 10/12/1996 Effective Date: - Modified: 25/01/2002 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Regis Road Recycling Centre Correspondence Address: -, -
4A	231.0	S	528740, 185138	Site Address: Camden London Borough Council, Recycling Centre, Regis Road, Kentish Town, London, NW5 3EP Type: Household Waste Amenity Site Size: < 25000 tonnes Regis Licence Number: LWL001 EPR reference: EA/EPR/GB3230DW/T001 Operator: Londonwaste Limited Waste Management licence No: 80349 Annual Tonnage: 7793.0	Issue Date: 10/12/1996 Effective Date: 11/05/2012 Modified: 25/01/2002 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Transferred Site Name: Regis Road Recycling Centre Correspondence Address: -, -
Not shown	1329.0	S	528667, 184035	Site Address: - Type: Household Waste Amenity Site Size: Unknown Regis Licence Number: CAM003 EPR reference: - Operator: Camden London Borough Council Waste Management licence No: 80482 Annual Tonnage: 0.0	Issue Date: 15/10/1994 Effective Date: - Modified: - Surrendered Date: 25/07/1997 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: Jamestown Road Ca Site Correspondence Address: Camden LB Council, Town Hall Extension, Argyle Street, London, WC1H 8EQ
Not shown	1329.0	S	528667, 184035	Site Address: - Type: Household Waste Amenity Site Size: < 25000 tonnes Regis Licence Number: CAM003 EPR reference: EA/EPR/UP3697NB/S002 Operator: Camden London Borough Council Waste Management licence No: 80482 Annual Tonnage: 20000.0	Issue Date: 15/10/1994 Effective Date: - Modified: - Surrendered Date: 25/07/1997 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: Jamestown Road CA Site Correspondence Address: -, -

3. Current Land Use Map

NW N NE

W E



SW S SE

Current Land Use Legend

Enabled by Ordnance Survey

Site Outline

Search Buffers (m)

Current Industrial Sites

Petrol & Fuel Sites

Underground High Pressure Oil & Fuel Pipelines

3. Current Land Uses

3.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 40

The following records are represented as points on the Current Land Uses map.

ID	Distance	Direction	Company	Address	Activity	Category
1	0.0	On Site	A & A Business Center	19, Greenwood Place, London, NW5 1LB	Container and Storage	Transport, Storage and Delivery
2	9.0	NE	London Undercover	Unit 1-4 Deane House 27, Greenwood Place, London, NW5 1LB	Luggage, Bags, Umbrellas and Travel Accessories	Consumer Products
3	26.0	NW	Alan Pharmaceuticals	33, Greenwood Place, London, NW5 1LB	Medical Equipment, Supplies and Pharmaceuticals	Industrial Products
4A	31.0	NW	Works	NW5	Unspecified Works Or Factories	Industrial Features
5	37.0	E	Kentish Town Fire Station	Kentish Town Fire Station 20, Highgate Road, London, NW5 1NS	Fire Brigade Stations	Central and Local Government
6A	38.0	NW	Millenium Designs Ltd	Linton House 39-51, Highgate Road, London, NW5 1RT	Clothing, Components and Accessories	Consumer Products
7A	38.0	NW	Zooid Pictures Ltd	Linton House 39-51, Highgate Road, London, NW5 1RT	Published Goods	Industrial Products
8B	66.0	NE	Works	NW5	Unspecified Works Or Factories	Industrial Features
9	68.0	E	Charles Wilson Engineers Ltd	11-15, Fortess Road, London, NW5 1AD	Construction and Tool Hire	Hire Services
10 B	71.0	NE	Piano Warehouse Ltd	30a, Highgate Road, London, NW5 1NS	Musical Instruments	Consumer Products
11 B	71.0	NE	Court Davis Joinery Ltd	30a, Highgate Road, London, NW5 1NS	General Construction Supplies	Industrial Products
12	78.0	NE	Works	NW5	Unspecified Works Or Factories	Industrial Features
13	80.0	N	Works	NW5	Unspecified Works Or Factories	Industrial Features
14	100.0	NW	Electricity Sub Station	NW5	Electrical Features	Infrastructure and Facilities
15	102.0	NW	Works	NW5	Unspecified Works Or Factories	Industrial Features
16	102.0	SE	S & A Electricals	1a, Fortess Road, London, NW5 1AA	Electrical Equipment Repair and Servicing	Repair and Servicing
17	107.0	SE	Works	NW5	Unspecified Works Or Factories	Industrial Features
18	121.0	E	M & A Coachworks Ltd	36, Fortess Road, London, NW5 2HB	Vehicle Repair, Testing and Servicing	Repair and Servicing
19 C	133.0	NW	Kinnerton Confectionery Co Ltd	Highgate Studios 53-79, Highgate Road, London, NW5 1TL	Baking and Confectionery	Foodstuffs
20 C	133.0	NW	Reproductive Health Matters	Highgate Studios 53-79, Highgate Road, London, NW5 1TL	Published Goods	Industrial Products
21 D	135.0	E	Depot	NW5	Container and Storage	Transport, Storage and Delivery
22	145.0	SW	Tank	NW5	Tanks (Generic)	Industrial Features