



Combined Investigation Report

at

Willowdene Close, Havant, Hampshire PO9 3QP

for

Wildern Architecture Ltd

Job Reference: 18189/CIR

January 2021

Control Document

Project

Willowdene Close, Havant, Hampshire PO9 3QP

Document Type

Combined Investigation Report

Document Reference

18189/CIR

Document Status

Final

Date

January 2021

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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

Soils Limited was originally commissioned by Wildern Architecture Ltd in 2020 to undertake a Preliminary Investigation on Willowdene Close, Havant, Hampshire, PO9 3QP. The scope of the investigation and subsequent Main Intrusive Investigation was outlined in the Soils Limited quotation reference Q22367/Rev.01 dated 31st January 2020. However, this was in the nature of a speculative development at the time of initial writing and circumstances have since changed to a definitive development proposal as outlined in this report. Soils Limited have therefore revised, updated and combined the initial findings of both reports in light of the new development as outlined in the Soils Limited quotation reference Q23754 dated 24th November 2020.

Caveat

Whilst reasonable skill and care has been taken to determine the site history and the environmental setting within the time constraints applied by the project, it should be appreciated that uncertainties may occur owing to the natural variability of soil material within a defined area or as a result of unknowns that are associated with contaminated land assessment in general. The site conditions may be different from that indicated by this Preliminary Investigation, particularly on a site with a history of past development. No responsibility can be accepted should such conditions alter the recommendations made in this report.

This Preliminary Investigation does not include a detailed UXO risk assessment, it does however contain a basic assessment in accordance with CIRIA C681. In preparing a Preliminary Investigation reference is made to historical maps and web-based sources to assess the risk of the site potentially having been impacted by bombing during the World Wars. The data readily available is not necessarily definitive. Certain areas were bombed heavily such as centres of industrial manufacture, airfields, shipyards, docklands, railways sidings and junctions. The assessment is based on the likely area risk, bomb patterns (i.e. lines of recorded bomb impacts with gaps where an impact would be anticipated) and the age of structures on and in close proximity to the site.

Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011
- BS EN ISO 14688-1:2002+A1:2013 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2004+A1:2013 - Geotechnical investigation and testing - Principles for a classification
- BS 10175:2011+A2:2017 - Investigation of potentially contaminated sites
- NHBC Standards 2019

- SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination December 2014

The chemical analyses were undertaken by i2 Analytical in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial hole.

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Section I Introduction

I.1 Objective

The Preliminary Investigation sections of this Report was undertaken to advise the client on the risk pertaining to the site, with special reference to historic and current potential contaminative activities and processes. This also included the assessment of their impact on current and future sensitive receptors such as human health, controlled waters, ecological features, building structures and services.

Soils Limited were further requested to undertake an intrusive ground investigation and to prepare a Main Investigation Report to supply the client and their designers with information regarding ground conditions and to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site.

The investigation was to be undertaken to provide comment on appropriate foundation options for the proposed residential development. The investigation was to be made by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes, though this later element was not undertaken at this time for reasons outlined below following consultation with the Client.

Soil samples were also taken for chemical laboratory testing to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any contamination identified as dictated by the Conceptual Site Model (CSM).

I.2 Site Location

The site was located at Willowdene Close, Havant, Hampshire PO9 3QP and had an O.S Land Ranger Grid Reference of SU 698 076.

The site location map is presented in Figure 1 and the full Site Walkover is discussed in Section 2.1 of this report.

I.3 Proposed Development

The revised proposal comprised demolition of the existing garages and the erection of two 2 storey residential properties based on the existing garage bases with hard covered open space and access. The noted "green" areas in the drawing could be misleading and are in fact proposed to be retained as concrete slabs and covered in artificial grass and standing planters to provide amenity areas, reduce maintenance and reduce the amount of materials required to be removed and/or replaced, thereby increasing the sustainability of the overall development. Therefore, the open areas of the site will be isolated from any sub-soil.

In compiling this report reliance was placed on drawing W19-009 104 Revision A prepared by Wildern Architecture Ltd. Any further change or deviation from the scheme

outlined in the drawing could invalidate the recommendations presented within this report. Soils Limited must be notified about any such changes.

The proposed development plans have been provided in Appendix A.

1.4 Legislation and Liability

The primary legislative mechanism for contaminated land management in the UK is Part 2A of the Environmental Protection Act, 1990 (EPA). Part 2A was introduced into the EPA under Section 57 of the Environment Act 1995 to help deal with the substantial legacy of land contamination. The legislation provides powers in relation to the identification, remediation and apportionment of liability for contaminated land. Part 2A applies where there is unacceptable risk, assessed on the basis of the current use and the relevant circumstances of the land. It is not directed to assessing risks in relation to a future use of the land that would require a specific grant of planning permission.

Under Part IIA of the Environment Act 1995, Local Authorities are required to identify contaminated land and serve on every person who is an appropriate person a remediation notice setting out what is to be done by way of remediation and the period within which it must be done.

If the person who caused, or knowingly permitted, the contaminating substance cannot be found, the owner and/or, occupier for the time being, of the property can be the appropriate person.

Under the legislation, Contaminated Land is defined as: -

"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused."

Where the Act defines harm as:

"harm to the health of living organisms or other interference with the ecological systems of which they form a part and, in the case of man, includes harm to his property."

and pollution of controlled waters is defined as: -

"the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter."

In addition, The Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006 introduced the supplementary definition of harm to include: lasting exposure to any person resulting from the after-effects of a radiological emergency, past practice or past work activity.

It should be noted that a detailed survey of the possible presence or absence of invasive species, such as Japanese Knotweed, is outside of the scope of investigation.

With regard to contaminated waters, the Environment Act 1995 amends the Water Resources Act 1991 and provides the Environment Agency with the power to force clean-up of historical contamination by issuing a Works Notice, with remediation paid for by the responsible parties.

The Groundwater Regulations (1998) stated that entry of List 1 substances into groundwater must be prevented, and List II substances must be controlled.

1.5 Limitations and Disclaimers

This Preliminary Investigation Report relates to the site located at Willowdene Close, Havant, Hampshire, PO9 3QP and was prepared for the sole benefit of Wildern Architecture Ltd (The "Client") for the brief described in the Commission of this report.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

There may be other sources of information not included in those listed that hold data relevant to the Preliminary Investigation Report undertaken at the site that could materially affect the conclusions made in this report.

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995.

Where a contaminative use is identified in the Preliminary Investigation Report this does not determine whether contamination has actually occurred, or if it has the degree to which it may have taken place. An intrusive investigation(s) and analysis is required to establish the nature and degree of any contamination present.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets, remain with Soils Limited. License is for the sole use of the client and may not be assigned, transferred or given to a third party.

Section 2 Site Conditions

2.1 Site Walkover

A site walkover was undertaken in February 2020, by Soils Limited. A revisit in January 2021 showed no significant changes. During the site walkover observations were made in relation to current activities, evidence of historical activities, sources of potential contamination such as fuel storage tanks, oil drums and chemical storage and evidence of contamination. The walkover also looked for evidence of soil contamination in the form of staining odours and stressed or discoloured vegetation. The notes of the site walkover are presented in Table 2.1 and Table 2.2.

Table 2.1 Site Walkover Record (On-site)

Use of Site	Garages (Photograph 1)
Structures	Two blocks of single storey garages one north and one south, also single garage at southern end (Photograph 2).
Site Topography	Generally flat, slight dip to south east
Site covering	Hard standing concrete and tarmac with small green grass area to rear of single southern garage.
Vegetation	Grass to rear of single garage, central eastern wall and sides of block garages recently cleared of vegetation, some recovery (Photograph 3)
Potential Contamination Sources	Possible asbestos fixtures and roofing including waste asbestos to east of southern block (Photograph 4)
Odour	None noted
Drainage	Mains in Willowdene Close
Notes:	

Table 2.2 Site Walkover Record (Off-site)

Use of Land	North – Residential (Photograph 5) East – Garage – Car Sales (Photograph 6) South – Residential West - Residential
Area Topography	Dips south east and east at variable gradients
Vegetation	Gardens mainly. Open ground with trees beyond Garage and main road to east. (Photograph 7)
Potential Contamination Sources	Garage Sub-Station directly north of northern garage block (Photograph 8)
Notes:	

2.2 Site Drainage

Via surface drainage, which are anticipated to be connected to the mains system. Note that surface water and mains drainage appears to be present towards the adjacent residential property to the west.

2.3 Site Photographs

The site photographs have been included within Appendix F.

2.4 Asbestos

The site walkover has identified the presence of potential asbestos containing materials within the fabric and fittings of the domestic garages on site. Sheets of potentially asbestos containing material were also noted as being stored on site (Photograph 4).

Prior to the redevelopment of the site any asbestos containing material on site must be removed from site by an appropriately trained, licenced and competent specialist in accordance with the control of Asbestos Regulations 2012 (CAR2012).

Section 3 Geology, Hydrogeology, Hydrology and Radon

3.1 Anticipated Geology

The 1:50,000 BGS Geology map showed the site to be situated on the London Clay Formation bedrock, with overlying superficial deposits of Head. Additional investigation also determined the potential presence of Alluvium and Made Ground.

3.1.1 Head

Head deposit are drifts produced by solifluxion, the downslope movement of debris outwash during the periglacial period, and characteristically comprise poorly sorted sands gravels and chalk of local derivation

3.1.2 Alluvium

Alluvium is the most recent river or estuarine deposit and generally comprises silty clays usually with an appreciable organic content. Lenses of sand and gravel are also commonly found, as are pockets of peat.

The BSI Code of Practice for Foundations, BS8004: 1986, Clause 2.2.2.3.4 Peat and organic soils, includes the caveat that 'all these soils are highly compressible, and even lightly loaded foundations will be subject to considerable settlements over a long period if placed on them. For this reason, these soils are not suitable for carrying the loads for important structures'.

3.1.3 Made Ground

Made Ground comprises material that has been placed by man, or spread by man. It can comprise demolition material from former structures on the site or imported material placed to raise levels. Its composition can be very variable both laterally and with depth and may contain putrescible matter and voids.

3.1.4 London Clay Formation

The London Clay Formation in the Hampshire region comprises silty and sandy clay, clayey and sandy silt, silty sand; sporadic claystones and thin beds of flint pebbles. The formation includes the Bognor Sand, Whitecliff Sand, Durley Sand, Portsmouth Sand and Nursling Sand Members. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The lowest part of the London Clay Formation rests on the Reading Formation (Lambeth Group).

3.2 Hydrogeology

To assess the vulnerability of groundwater to contamination, consideration must be given to the leaching characteristics of the overlying soils and the characteristics of the strata in the unsaturated zone. Information on the geological strata such as lithological type and permeability characteristics has been combined with the physical properties of the soil to

produce varying degrees of vulnerability. Table 3.1 presents the hydrological data that is relevant to the site.

Table 3.1 Hydrogeological Assessment

Hydrogeological Data		Comment
On-site	Superficial	Secondary Aquifer - undifferentiated
Aquifers	Bedrock	Unproductive strata ¹
Groundwater Vulnerability		Medium Vulnerability
Source Protection Zones (SPZ)		Zone 1c (Inner protection zone) subsurface activity only – Aquifer is Chalk at depth
Abstraction	Potable	SE 1437m Portsmouth Water Bedhampton Ps No 1
	Non-potable	None noted within 2km
Sensitive land uses		SW 289m Ancient Woodland Nitrate Vulnerable Zone
Surface Water Features		N 325m
Flood Risk from Rivers or Seas		N/A
Flood Risk from Surface Water		N/A
Flood Risk from Groundwater		Potential at Surface
Notes: ¹ Unproductive strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.		

Any works or development which has the potential to have an impact on surface water, aquifer or groundwater quality must be approved by the Environment Agency prior to implementation.

3.3 Hydrology

The approximate elevation of the site was ~23m Above Ordnance Datum (AOD). The anticipated groundwater flow direction is given in Table 3.2.

Table 3.2 Hydrological Assessment

Type	Direction	Notes
Surface water	E	Vertically down into underlying Head deposits or via surface drainage to mains from hard standing. May pass east from hard standing downslope
Groundwater	SE	Following topography, geology (Head and Made Ground) and direction of former stream and towards abstraction point
Notes:		

3.4 Radon Gas

The Landmark Report indicates that site was not situated within an area where protection or risk assessment against the ingress of radon was required. Radon protection measures will not be required within the proposed new development. It is not possible in the course of a survey or inspection to determine whether radon gas is present as the gas is colourless and odourless. Tests can be undertaken to assess the concentration of radon in existing structures.

Section 4 Site History

4.1 Historic Map Study

The object of this study was to report on the evidence of site history and redevelopment of the site and its environs from available County Series and Ordnance Survey Maps dating from the mid to late 19th Century to the present day as downloaded from Landmark Environmental.

The published maps only represent a “snap-shot” of the site and its environs at the date of the survey. The detail of the information recorded can vary between epochs, map scale and county areas. It should be noted that changes in land uses, processes or activities may have occurred outside of published epochs and these may not have been recorded on subsequent epochs. Also note that as methods of projection, production and recording have changed over time, this can result in geo-reference errors that may indicate the established site boundary is off-centre from its true location on older historical maps. Where this is potentially significant it will be noted.

Any distances quoted for features remote from the site have been scaled from the maps and are only approximate. Where dates have been noted in brackets, these are the actual dates applicable to the map editions and may not reflect the date of the original survey it is based on. The information reported might not represent all pertinent information that could be obtained. The interpretation of the maps and/or other data commented on in this report is subjective.

As part of the review of the historical plans, only features considered to have or to have had a potential contaminative impact on the site and usually within a notional 250m radius are discussed. The north point and approximate extent of the site are indicated on each figure. The historic maps referred to are appended to this report (Appendix B).

Table 4.1 Historic Development of the Site

Site History	Date Range	
	From	To
Site is woodland within Littlepark Wood. A stream passes through the center of the site from west to east.	1868 ¹	1963
The site is clear with access from Willowdene Close. Garages (and presumably hard standing) are emplaced by 1975.	1963	2020

Notes: ¹ Oldest available map

Table 4.2 Historic Off-site Development

Off-site Development	Date Range	
	From	To
The surrounding area is woodland and open agricultural land. The stream passing through the site continues north east and then eastwards of the site. From 1897 onwards, Hubert Road runs northwest to southeast to within 20-30m east of the site. From the 1930's, housing begins to develop along Hubert Road to reach roughly 350m from the site to the south east.	1868 ¹	1957
The 1957 map indicates that the former stream now sinks 10m east of the site below Hubert Road and rises again 50m east of the site on the opposite side of Hubert Road. A housing estate has been developed directly to the south of the site. A Works Road has been developed to the north of the site passing east to west from Hubert Road to engineering works 200-300m west of the site.	1957	1963
A garage with a central covered area has been developed between the site and Hubert Road to the east. Willowdene Close and five associated houses have been developed to the west of the site. These are joined by 3 more houses west of the site as today by 1975 and an electrical sub-station immediately to the north of the northern garages. The former stream now sinks on the western edge of the Willowdene Close housing 70m southwest of the site. This could indicate it is now culverted and/or local land levels have been raised. The works continue to develop and expand 200-300m west of the site.	1963	1982
A hypermarket, associated parking and access to the south of the Works area has been developed 250m southwest of the site with the north to south A3(M) beyond, 500m to the west. Land to the west of Willowdene housing has been banked for the access road to the hypermarket which joins the new roundabout 100m north of the site. A filling station has been developed on the north side of the hypermarket access road between 80-120m north west of the site.	1982	2006
The hypermarket and parking areas have been redeveloped into their current superstore form by 2006. The area between the works access and supermarket access Roads is redeveloped between 2006 and 2020 as fast food retailers.	2006	2020

Notes: ¹ Oldest available map

Table 4.3 Potential Sources of Pollution Indicated from Historic Maps

Source	Direction	Distance (m)	Date Range	
			From	To
Commercial Garage	E	10m	1963	Present
Electrical Sub-Station	N	5m	1975	Present
Filling Station	NW	80m	1982	Present
Works	W	200-300	1957	Present

Notes:

4.2 Additional Observations and Considerations

The historical plans indicate that the site and its immediate surroundings were in an area of marshy land. It is likely that in order to enable the development of the site, soil/material of unknown origin and composition may have been brought onto site to raise levels.

The likelihood of the presence of Made Ground has therefore also been considered within the risk assessment as a potential source of contamination on site. This works may be the source of the Council comment (see Section 5.3) regarding an "embankment" close to the site in 1957.

4.3 Bomb damage and the potential for Unexploded Ordnance

In accordance with guidance presented in C681 'Unexploded Ordnance (UXO) A guide for the Construction Industry' and C785 'Unexploded ordnance (UXO) risk management guide for land based projects' a review has been undertaken of the historic maps which has indicated that the site is in an area that is considered to be High Risk from bombing, shelling or has had a previous military use.

Based on the assessment of the historical maps and the Zetica UXO preliminary risk assessment plans (Included in Appendix D), it is not considered that further specialist UXO risk assessment is undertaken to determine the risk to the proposed development.

Section 5 Environmental Records and Consultation

5.1 Dataset Information

The Landmark Envirocheck Report was obtained by Soils Limited and includes site specific information. The extent of the search has initially been limited to a radius of 250m as it is considered that sources of contamination beyond 250m are unlikely to impact on the site. This search radius may however, be increased if a significant source of contamination or sensitive receptor is identified within 1000m of the site. A copy of the report is appended to this report in Appendix C summarised in Table 5.1, Table 5.2 and Table 5.3.

Table 5.1 Environmental Significance of Data

Source	Direction	Distance (m)
Contaminated Land Register Entries and Notices	None	None
Discharge Consents – B&Q	NW	374
Integrated Pollution Prevention and Control	None	None
Local Authority Pollution Prevention and Controls – Little Park Filling Station	E	34
Local Authority Pollution Prevention and Control Enforcements – Air	W	273
Nearest Surface Water Feature	N	325
Pollution Incidents to Controlled Waters (Significant Incidents only) – Gas Oil	E	887
Prosecutions Relating to Authorized Processes	None	None
Registered Radioactive Substances	None	None
Substantiated Pollution Incident Register	NE	62
Nearest Potable Abstraction Point	SE	1437
Nearest Non-Potable Abstraction Point	None	None
Water Industry Act Referrals	None	None
Source Protection Zones – Zone 1c on-site	NE	0
Extreme Flooding from Rivers or Sea Without Defences	None	None
Flooding from Rivers or Sea Without Defences	None	None
Areas Benefiting from Flood Defences	None	None
Flood Water Storage Areas	None	None
Flood Defences	None	None
BGS Recorded Landfill Sites	None	None
Historical Landfill Sites	None	None
Licensed Waste Management Facilities	None	None
Local Authority Recorded Landfill Sites	None	None
Potentially Infilled Land (Non-Water)	E	810
Potentially Infilled Lane (Water) – On Site	N	0
Registered Landfill Sites	None	None
Registered Waste Transfer Sites	None	None
Registered Waste Treatment or Disposal Sites	None	None
Control of Major Accident Hazards Sites (COMAH)	None	None
Notification of Installations Handling Hazardous Substances	None	None
Planning Hazardous Substance Consents	None	None

Notes:

Table 5.2 Contemporary Trade Directory

Contemporary Trade Directory within 250m	Direction	Distance (m)	Status
Victory Vauxhall – Garage Services	E	4	Inactive
Sparshatts of Havant – Car Dealers	NW	5	Active
Asda Petrol	NW	83	Active
Window Maker	W	161	Inactive
Mitchell & James Caravans – Servicing and Repairs	W	201	Active
C&S MOT Testing	W	214	Active
Printer Graphics Ltd – Printers	W	227	Active
Printer Graphics Ltd – Printers	W	227	Inactive

Note:

Table 5.3 Geological Hazards

Source	Nearest Distance from Site/Type
Coal Mining Affected Areas	N/A
Mining Instability	N/A
Natural and Mining Cavities	N/A
Potential for Collapsible Ground Stability Hazards	Very Low
Potential for Compressible Ground Stability Hazards	No Hazard
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Very Low
Potential for Shrinking or Swelling Ground Stability Hazards	Low

Notes:

5.2 Site Sensitivity Maps

No other significant potential sources of contamination were shown on the Landmark Envirocheck Site Sensitivity Maps, which have not been listed in Table 5.1, Table 5.2 and Table 5.3, and copies of which are appended to this report (Appendix C).

5.3 Regulatory Enquires

As part of the Preliminary Investigation Report Soils Limited were provided with a memorandum (Ref: CONS/19/02154) dated 11th November 2019 from Havant Borough Council in regards to the site in relation to a previous application. The information provided by the local authority has been presented in Appendix E. A summary of pertinent information is outlined below:

- The garage premises to the east were consented on appeal in 1956 and include several underground tanks.
- The historical stream is now assumed to pass below the site.
- An embankment was established to the east by 1957 and may contain deleterious materials.

- Consideration of the potential sources identified has lead to concern as to the risk that may be present to end-users given the intended use.
- Further investigation is recommended to determine if the suspected contaminants are actually present prior to development.

5.4 Soil Geochemistry

The BGS soil chemistry for environmental assessments dataset coverage, has been developed from BGS G-BASE and Imperial College Wolfson Atlas data. It contains estimated ambient As, Cd, Cr, Ni and Pb background concentrations for rural topsoils across Great Britain. It also contains the locations and measured concentrations (mg kg⁻¹) of As, Cd, Cr, Cu, Ni, Pb, Sn and Zn in urban topsoil samples, collected from geochemical surveys in 23 major urban centres.

The results of this survey are contoured on the Landmark Environmental check report (Appendix C). The results of the local soil chemistry are presented in Table 5.4.

Table 5.4 Soil Geochemistry

Determinant	Estimated Soil Geochemistry (mg kg ⁻¹)
Arsenic	<15
Cadmium	<1.8
Chromium	60-90
Lead	<100
Nickel	15-30

Note:

Section 6 Data Collection Summary

6.1 General

The findings of the data collection are summarised below:

Table 6.1 summaries the site Environs, which include geology, hydrogeology, the risk from radon and potential risk from flooding.

Table 6.1 Site Environs

Environs	Summary												
Geology	Superficial deposits of Head overlying London Clay Formation bedrock.												
Hydrogeology	Superficial Head classed as a Secondary A undifferentiated aquifer and could support shallow groundwater. The London Clay Formation bedrock was unproductive strata and will act as an aquiclude to the deep groundwater regime.												
Source Protection Zone (SPZ)	Zone 1c (Inner protection zone) subsurface activity only – Aquifer is Chalk at depth												
Surface Water Flow	Anticipated to be vertically down into the granular superficial deposits or in line with the former historical stream passing west to east.												
Groundwater Flow	Anticipated to locally follow topography to the south east and east along the line of the former stream in the superficial aquifer within the Head.												
Radon	No radon risk.												
Flooding	No significant flooding risk identified but potential for flooding to occur at surface.												
Geological Hazard	<table> <tr> <td>Potential for Collapsible Ground Stability Hazards</td><td>Very Low</td></tr> <tr> <td>Potential for Compressible Ground Stability Hazards</td><td>No Hazard</td></tr> <tr> <td>Potential for Ground Dissolution Stability Hazards</td><td>No Hazard</td></tr> <tr> <td>Potential for Landslide Ground Stability Hazards</td><td>Very Low</td></tr> <tr> <td>Potential for Running Sand Ground Stability Hazards</td><td>Very Low</td></tr> <tr> <td>Potential for Shrinking or Swelling Ground Stability Hazards</td><td>Low</td></tr> </table>	Potential for Collapsible Ground Stability Hazards	Very Low	Potential for Compressible Ground Stability Hazards	No Hazard	Potential for Ground Dissolution Stability Hazards	No Hazard	Potential for Landslide Ground Stability Hazards	Very Low	Potential for Running Sand Ground Stability Hazards	Very Low	Potential for Shrinking or Swelling Ground Stability Hazards	Low
Potential for Collapsible Ground Stability Hazards	Very Low												
Potential for Compressible Ground Stability Hazards	No Hazard												
Potential for Ground Dissolution Stability Hazards	No Hazard												
Potential for Landslide Ground Stability Hazards	Very Low												
Potential for Running Sand Ground Stability Hazards	Very Low												
Potential for Shrinking or Swelling Ground Stability Hazards	Low												
Local Authority Response	Concern has been expressed by the Council that given the potential historical sources identified locally (most notably the adjacent garage to the east), that there may be a risk to development that should be further investigated.												
Soil Chemistry	Estimated levels not considered significant.												
Notes:													

Table 6.2 provides a summary of potential on-site and off-site contamination sources identified during the study of the historic maps, the Landmark Envirocheck Dataset Report and the Site Walkover

Table 6.2 Summary of Potential Contamination Sources

Contaminative Sources/Environmental Impact	Direction	Distance (m)	Date Range		Data Source
			From	To	
On-Site					
Imported Made Ground from ground improvement and possible raising of site levels, diversion or culverting of stream			1957	1975	HM
Domestic Garages			1975	Present	HM/SW

Contaminative Sources/Environmental Impact	Direction	Distance (m)	Date Range		Data Source
			From	To	
Off-Site					
Commercial Garage	E	10	1963	Present	HM/SW
Electrical Sub-Station	N	5	1975	Present	HM/SW
Filling Station	NW	80	1982	Present	HM/SW
Works	W	200-300	1957	Present	HM

Notes: SW – Site walkover, HM – Historic Maps, DS – Datasheet, GC – Geochemistry, LA – Local Authority, GE Google Earth

Section 7 Preliminary Conceptual Site Model

7.1 General

Environment Agency guidance provided in CLR11 indicates that the Conceptual Site Model should identify those contaminants, pathways and receptors which are 'likely' to represent an 'unacceptable' risk either to human health or the surrounding environment. The following sections present potential contaminants, pathways and receptors based on the information collected during the desktop study. Pathways have been established based on scientific knowledge of the behaviour of the contaminants in the ground.

7.2 Sources and Pathways of Contamination

The Landmark Site Specific Envirocheck Report and Site Walkover have been used to identify potential contaminative sources. These sources have been presented in Table 6.2. An assessment of the likely pathways and the likelihood of each contaminative source that was considered a risk has been presented in Sections Potential Pathways to 7.2.5

7.2.1 Potential Pathways

A review of the potential pathways on and off the site has been undertaken based on the site, ground conditions, hydrology and scientific knowledge of the behaviour of the contaminants in the ground. The pathways applicable to the site and the proposed development have been marked in Table 7.1.

Table 7.1 Applicable Pathways

Pathway	Present	Comment
Inhalation of dust	✓	
Inhalation of vapour/gases	✓	
Ingestion and absorption via direct contact	✓	
Migration via surface runoff		Hard Cover or into underlying granular Head
Migration in solution via groundwater	✓	
Migration of gases via permeable soils	✓	
Direct contact with construction material	✓	
Services and Utilities	✓	
Notes:		

7.2.2 Potential Sources of On-site Contamination.

A study of Landmark Envirocheck Report and Site Walkover has identified the following potential on-site sources of contamination which may present a risk to future uses of the proposed development. The sources have presented in Table 7.2.

Table 7.2 On-site Potential Contamination Sources

Source	Likely	Reasoning
Made Ground	✓	Possible contaminated soils/material imported to site to improve ground conditions
Domestic garages	✓	Hard Standing makes oils and metals unlikely to be significant. Possible waste ACM behind southern garages ¹

Notes: ¹See Photograph 4 Appendix F

7.2.3 Potential Off-site Sources of Contamination

A study of Landmark Envirocheck Report and Site Walkover has identified the following potential off-site sources of contamination which may present a risk to future uses of the proposed development.

These sources have been presented in given in Table 7.3.

Table 7.3 Off-site Potential Contamination Sources

Source	Direction	Distance (m)	Likely	Reasoning
Commercial Garage	E	10	✓	Presence of known fuel tanks
Electrical Sub-Station	N	5		Appeared relatively clean and only minor amounts present. Contamination would be limited in extent and pass east towards commercial garage if mobile.
Filling Station	NW	80		Unlikely given distance and nature of intervening materials
Works	W	200-300		Unlikely given distance and nature of intervening materials

Notes:

7.3 Potential Contaminants

To ascertain the chemicals associated with identified potential onsite and offsite sources, the Department of the Environment Industry Profiles have been reviewed. In cases where the DOE profiles have no, or limited information other sources have been reviewed detailing the processes involved in the activity carried out on-site.

Table 7.4 presents the range of possible contaminants associated with the onsite and off-site activities and sources identified following a review of historical maps and datasets.

Table 7.4 Potential Contaminants

Potential Contaminative Sources/Activities/Processes	Contaminants/Chemical Properties
Imported Made Ground	Asbestos ¹ , heavy metals, non-metals and metalloids, PAHs
Domestic Garages	Asbestos, heavy metals, non-metals and metalloids, PAHs and TPHs
Garage (Car Body Repairs, Garage Services, fuel dispensing, etc.).	Metals, Semi-metals and non-metals, PAHs, TPHs, Asbestos, pH

Notes: ¹ May include materials from post war redevelopment of local military areas (i.e. Leigh Park) which may include asbestos.

7.4 Potential Exposure Receptors

The receptors to any potential contamination have been evaluated from our understanding of the current and planned land use of the site, an assessment of surrounding land uses and currently available information pertaining to the site.

The assessment for potential receptors is presented in Table 7.5.

Table 7.5 Potential Receptors

Potential Receptor		Present
Human Health	Future users of the site	✓
	Construction workers on-site	✓
	Service and maintenance workers	✓
	Site neighbours and wider public	✓
Groundwater/Controlled Waters	Surface Water	
	Groundwater/Future Potable Water Supply	✓
Buildings & Materials	Buildings and confined spaces	✓
	Construction materials	✓
	Services and Utilities (e.g drinking water pipes)	✓
Ecosystems	Flora and fauna	✓

Notes:

7.5 Preliminary Conceptual Site Model and Risk Assessment

A preliminary risk assessment has been undertaken based on the proposed development. The assessment has been based on the likelihood of the presence of a pollutant linkage.

A pollutant linkage is the relationship between a contaminant source, a pathway and a receptor. Unless all three elements of a pollutant linkage are present, a risk is not considered to exist. Each of the three elements has been considered within Table 7.1 to Table 7.5. The preliminary conceptual site model and risk assessment is presented in Table 7.6. The classification tables on which the level of risk has been determined have been modified from 'Contaminated land risk assessment: A guide to good practice, 2001, CIRIA C552' and are presented in Appendix G.

Table 7.6 Preliminary Conceptual Site Model and Risk Assessment Methodology

Source (See Table 7.3 and Table 7.3)	Potential Contaminant (See Table 7.4)	Exposure Pathway (See Table 7.1)	Receptor (See Table 7.1)	Initial Assessment from Preliminary Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Domestic Garages And Made Ground On-site history and current site usage.	Metals, Semi-volatile and non-volatile, PAHs, Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Medium	Unlikely	Low	Site located on bedrock of the London Clay Formation, which was classified as unproductive strata and would act as an aquiclude to any deeper groundwater receptors.	Phase II ground investigation to confirm the ground conditions present and chemical testing prior to undertaking a generic quantitative risk assessment.
			End Users	Medium	Low	Moderate/Low		
			Off-site Users	Medium	Unlikely	Low		
	PAHs, TPHs	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Mid	Low	Low	Surface water will be drained from site hardstanding or pass into underlying Head of Lake system.	
			End Users	Mid	Low	Low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-volatile and non-volatile, PAHs, TPHs, Asbestos, pH	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Low	Moderate/Low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-volatile and non-volatile, PAHs, TPHs, pH	Migration via surface runoff Migration in solution via groundwater	Surface Water	-	-	-		
			Surface Water	-	-	-		
			Shallow Aquifer	Medium	Low	Moderate/Low		
	PAHs, TPHs	Direct contact with construction material Migration of gases via permeable soils	Deep Aquifer	-	-	-		
			Buried structures	Mid	Low	Low		
			Buried Services	Minor	Unlikely	Very low		
Garage including underground fuel and oil storage Off-site sources from which potential contamination would have migrated onto the site.	Metals, Semi-volatile and non-volatile, PAHs, Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Medium	Unlikely	Low	Site located on bedrock of the London Clay Formation, which was classified as unproductive strata and would act as an aquiclude to any deeper groundwater receptors.	Phase II ground investigation to confirm the ground conditions present and chemical testing prior to undertaking a generic quantitative risk assessment.
			End Users	Medium	Low	Moderate/Low		
			Off-site Users	Medium	Unlikely	Low		
	PAHs, TPHs	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Mid	Low	Low	Surface water will be drained from site hardstanding or pass into underlying Head of Lake system.	
			End Users	Mid	Low	Low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-volatile and non-volatile, PAHs, TPHs, Asbestos, pH	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Low	Moderate/Low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-volatile and non-volatile, PAHs, TPHs, pH	Migration via surface runoff Migration in solution via groundwater	Surface Water	-	-	-		
			Surface Water	-	-	-		
			Shallow Aquifer	Medium	Low	Moderate/Low		
	PAHs, TPHs	Direct contact with construction material Migration of gases via permeable soils	Deep Aquifer	-	-	-		
			Buried structures	Mid	Low	Low		
			Buried Services	Minor	Unlikely	Very low		
	PAHs, TPHs	Migration of gases via permeable soils	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Unlikely	Low		
			Off-site Users	Minor	Unlikely	Very low		
			Building and confined spaces	Minor	Unlikely	Very low		

Section 8 Initial Recommendations

8.1 General

Based on the information obtained during the compilation of the Preliminary Investigation and the preliminary conceptual site model, a potential for a **very low to moderate** risk of contamination was identified, an intrusive investigation was therefore recommended to further quantify the risks identified.

Subsequent intrusive investigation (detailed below) revealed no additional on-site sources of contamination that were not identified in the Preliminary Investigation and Site Walkover. Any additional sources of contamination or unexpected ground conditions that may promote the migration of contamination will be included and assessed in terms of significance within an updated Conceptual Site Model.

8.2 UXO

Based on the assessment of the historical maps and the ZeticaUXO assessment (Included in Appendix D), it is not considered that further specialist UXO risk assessment is undertaken to determine the risk to the proposed development.

8.3 Proposed Further Site Works

An intrusive investigation was considered necessary to quantify the potential risks and remaining uncertainties that have been identified within the preliminary CSM. The preliminary CSM identified the test parameters relevant to the sources that have a pathway to a receptor. Dependant on the findings of an intrusive investigation the test parameters may be modified. The intrusive investigation will be designed to investigate and assess the pollutant linkages identified in the preliminary Conceptual Site Model.

The general requirements for environmental investigation are presented in Table 8.1.

Table 8.1 Proposed Further Environmental Investigation

Proposed Works	General Purpose	Required
Investigatory Holes	To collect sufficient samples for a robust assessment	✓
Laboratory Testing	To quantify the risks identified in the Conceptual Site Model	✓
Risk Assessment	Assess pollutant linkages based on current contaminated land guidance and screening criteria's	✓

Notes:

Section 9 Site Works

9.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions, to aid the design of foundations for a proposed residential development and determine if potential risks and unknowns identified in the PIR were present and could present potential risks to receptors identified in the initial conceptual site model (CSM).

The intended investigation, as outlined within the Soils Limited quotation (Q22367/Rev.01 dated 31st January 2020), was to comprise the following items:

- 4No up to 4m deep windowless sampler boreholes
- 4No up to 6m deep dynamic probes
- Geotechnical laboratory testing
- Contamination laboratory testing.

9.1.1 Actual Project Works

The actual project works were undertaken on 6th February 2020 and comprised:

- 4No up to 4m deep windowless sampler boreholes
- 4No up to 6m deep dynamic probes
- Contamination laboratory testing.

All windowless sampler boreholes were backfilled with gravel. All trial hole locations have been presented in Figure 2.

Following completion of site works, soil cores were logged and sub sampled so that samples could be sent to the laboratory for both contamination testing. An initial review of the windowless sampler logs, dynamic probe results and subsequent discussion with the client suggested that a shallow foundation was unlikely to be viable and therefore the geotechnical laboratory testing was delayed until more appropriate samples can be obtained.

9.2 Ground Conditions

On 6th February 2020 four windowless sampler boreholes (WS1 – WS4) were drilled, using a Premier type tracked windowless sampler drilling rig, to depths ranging between 1.50 and 4.00m below ground level (bgl) at locations selected by Soils Limited using a development plan provided by the client.

Four dynamic probes, super heavy, (DP1 – DP4) were driven prior and adjacent to their corresponding windowless sampler borehole to depths ranging between 2.00 and 6.00m bgl. DP4 was attempted three times due to obstructions being encountered at 0.30 and 0.50m bgl on the first and second attempts.

The maximum depths of trial holes have been included in Table 9.1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 9.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Probe Hole	Depth (m bgl)
WS1	1.50	DP1	2.00
WS2	4.00	DP2	6.00
WS3	4.00	DP3	6.00
WS4	4.00	DP4	6.00

Note:

The approximate trial hole locations are shown on Figure 2.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots, or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report. No Topsoil was encountered during this investigation.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix I, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised as:

Made Ground (MG)
Alluvium (ALV)
Head (H) – not encountered
Weathered London Clay Formation (WLCF)

The ground conditions encountered in the trial holes are summarised in Table 9.2.

Table 9.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Recent	GL	1.50 ¹ -2.00	1.90	Firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY, with brick, clinker and concrete.
ALL	Quaternary	1.90	2.00-3.10	0.65	Very soft brown mottled black blueish grey slightly sandy silty CLAY with decomposing rootlets and faint odour of decomposition.
WLCF	Eocene	2.00	>4.00 ¹	Not proven ²	Firm, blueish grey and brown mottled, slightly sandy silty CLAY.

Note: ¹ Final depth of trial hole. ² Base of strata not encountered

9.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix I.

9.3.1 Made Ground

Soils described as Made Ground were encountered in all locations from ground level to depths of ranging between 1.50m (WS1 – final base of hole) and 2.00m bgl (WS4).

The Made Ground typically comprised firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.

The depths of Made Ground have been included in Table 9.3.

Table 9.3 Final Depth of Made Ground

Trial Hole	Depth (m bgl)
WS1	1.50 ¹
WS2	1.90
WS3	1.70
WS4	2.00

Note: ¹ Final depth of trial hole.

9.3.2 Alluvium

Soils described as Alluvium were encountered in three out of the four trial holes immediately underlying the Made Ground to depths of between 2.00 and 3.10m. Where encountered the Alluvium was described as very soft brown mottled black blueish grey slightly sandy silty CLAY with decomposing rootlets and faint odour of decomposition.

The final depth of the Alluvium is presented in Table 9.4.

Table 9.4 Final Depth of Alluvium

Trial Hole	Depth (m bgl)
WS1	Not encountered
WS2	2.00
WS3	2.65
WS4	3.10
Note:	

9.3.3 Head

Soils matching the typical description of the Head deposits were not encountered during drilling. The site lies on the edge of the BGS mapped position of Head deposits and it is likely that these deposits have been removed by the stream and replaced with Alluvium.

9.3.4 Weathered London Clay Formation

Material described as Weathered London Clay Formation encountered within three out of the four trial hole locations from immediately underlying the Alluvium and was present to the base of the investigation, 6.00m bgl.

The soils of the Weathered London Clay Formation typically comprised firm, blueish grey and brown mottled, slightly sandy silty CLAY.

The depth of Weathered London Clay Formation has been included in Table 9.5.

Table 9.5 Final Depth of Weathered London Clay Formation

Trial Hole	Depth (m bgl)
WS1	Not encountered
WS2	4.00 ¹
WS3	4.00 ¹
WS4	4.00 ¹
Note: ¹ Final depth of trial hole.	

9.4 Roots

Live roots were encountered in only one location (WS4) to a depth of 3.60m bgl. It is extremely difficult to determine the maximum depth of root penetration from a narrow diameter borehole, should this information be crucial to the proposed design then supplementary investigation by means of machine excavated trial pit and careful inspection of the arisings will be required. It should also be noted that it is very hard to prove whether a root fragment recovered in a sampler tube is "live" or "dead", particularly in the case of ancient soils.

9.5 Groundwater

Groundwater was encountered at all locations during the investigation but at variable depths. WS1 and WS2 encountered potentially perched water at 1.00m. WS3 and WS4 encountered groundwater at 2.30m bgl, within the Alluvium.

All levels encountered rose within 30 minutes of observation as presented in Table 9.6.

Table 9.6 Groundwater Strikes

Trial Hole	Depth to Water (m bgl)	
	Strike	Rose To
WS1	1.00	0.50
WS2	1.00	0.50
WS3	2.30	1.83
WS4	2.30	1.15

Note: Time rose = 20 minutes

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in February (2020), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells.

Section 10 Discussion of Geotechnical In-Situ Testing

10.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at four locations (DP1 to DP4) adjacent and prior to the drilling of their respective windowless sampler boreholes to depths ranging between 2.00 and 6.00m bgl. The results were converted to equivalent SPT "N60" values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix J Table J.2.1.

The SPT "N60" values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig efficiency, borehole depth, overburden factors etc. Further correction of the 'N' values should therefore not be necessary. The energy ratio of the drilling rig was 87.96%. The energy ratio for each location is presented on the individual logs within Appendix J.

The Alluvium recorded equivalent SPT "N60" values between ≤ 4 and 8. Classifying the cohesive soils as very low to low strength and inferred undrained cohesive strength of $\leq 20\text{kPa}$ to 40kPa .

The Weathered London Clay Formation recorded equivalent SPT "N60" values between 4 and 21 within cohesive beds. The cohesive beds were classified as low to high, typically low to medium strength with an inferred undrained cohesive strength of between 20 and 105kPa typically between 20 and 85kPa and improving with depth.

A full interpretation of the DPSH tests are outlined in Appendix J, Table J.2.1.

In light of the results obtained in this investigation, and its obvious implications for shallow foundation solutions (i.e. largely impractical) and following consultation with the Client, no geotechnical analysis was scheduled on existing samples as they would have been inappropriate for the analysis required to advise on piling solutions and not to sufficient depth.

Additional investigation utilising cable percussive or similar methods to greater depths will be required to obtain appropriate class samples for further analysis in line with current guidance.

Section 11 Foundation Design

11.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the trial holes.

11.1.1 Made Ground and Topsoil

The terms *Fill* and *Made Ground (non-engineered fill)* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:2015, Clause 4.1.2.2 states, *'Spread foundations should not be placed on non-engineered fill unless such use can be justified on the basis of a thorough ground investigation and detailed design.'*

Peat and organic soils highly compressible, and even lightly loaded foundations will be subject to considerable settlements over a long period if placed on them. For this reason, these soils are not suitable for carrying the loads for important structures.

Soils described as Made Ground were encountered in all locations from ground level to depths of ranging between 1.50m (WS1 – final base of hole) and 2.00m bgl (WS4). The Made Ground typically comprised firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.

A result of the inherent variability, particularly of uncontrolled Topsoil, Fill and/or Made Ground is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Topsoil and/or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

11.1.2 Alluvium

Soils described as Alluvium were encountered in three out of the four trial holes from immediately underlying the Made Ground to depths of between 2.00 and 3.10m bgl. Where encountered the Alluvium was described as very soft brown mottled black blueish grey slightly sandy silty CLAY with decomposing rootlets and faint odour of decomposition.

The Alluvium recorded equivalent SPT "N60" values between ≤ 4 and 8. Classifying the cohesive soils as very low to low strength and inferred undrained cohesive strength of $\leq 20\text{kPa}$ to 40kPa .

Soils of the Alluvium are normally consolidated, predominantly soft cohesive or loose granular soils with a high organic content and as such are expected to display very low bearing capacities with high and variable settlement characteristics. The soils of the Alluvium were not considered suitable for the proposed development due to their low strength, high degree of variability and likely uncontrolled settlement.

11.1.3 Weathered London Clay Formation

Soil described as Weathered London Clay Formation encountered within three out of the four trial hole locations from immediately underlying the Alluvium and was present to the base of the investigation, 6.00m bgl. The soils of the Weathered London Clay Formation typically comprised firm, blueish grey and brown mottled, slightly sandy silty CLAY.

The Weathered London Clay Formation recorded equivalent SPT "N60" values between 4 and 21 within cohesive beds. The cohesive beds were classified as low to high, typically low to medium strength with an inferred undrained cohesive strength of between 20 and 105kPa typically between 20 and 85kPa and improving with depth.

The soils of the London Clay Formation are heavily overconsolidated and would typically be expected to display moderate to high bearing capacities and low to moderate settlement characteristics. The soils encountered were heavily weathered and should therefore be expected to behave as a normally consolidated soil. The Weathered London Clay Formation is therefore anticipated to provide low to moderate bearing capacities and moderate to high settlement characteristics.

The Weathered London Clay Formation is therefore not considered suitable for the proposed development.

11.1.4 Roots

Live roots were encountered in only one location (WS4) to a depth of 3.60m bgl. Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

11.1.5 Groundwater

Groundwater was encountered at all locations during the investigation but at variable depths. WS1 and WS2 encountered potentially perched water at 1.00m. WS3 and WS4 encountered groundwater at 2.30m bgl, within the Alluvium. All levels encountered rose within 30 minutes of observation as presented in Table 9.6.

11.2 Foundation Scheme General

As noted, the site-specific proposals comprise demolition of the existing garages and the erection of two 2 storey residential properties with hard standing. In light of previous findings and further investigations into the condition and status of the existing concrete garage bases, the site-specific solution to be adopted in this case is to re-use the existing bases.

In compiling this report reliance was placed on drawing W19-009 104 Revision A prepared by Wildern Architecture Ltd. Any further change or deviation from the scheme outlined in the drawing could invalidate the recommendations presented within this report. Soils Limited must be notified about any such changes.

Development plans provided by the client are presented in Appendix A.

11.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on 'best practice' for the design and construction of foundations on shrinkable soils.

Due to the encountered ground conditions being unsuitable for the proposed development no laboratory testing was commissioned following consultation with the client and therefore it should be assumed that precautions in line with **high volume change** potential soils, in accordance with the NHBC Standards and the BRE240, will be required unless proven otherwise.

The BRE Digest 241 states: "An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used".

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building. It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and cracking of brickwork might occur.

The BRE Digest 240 suggests: *"Two courses of action are open:*

Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.

Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage."

The design of foundations suitable to withstand movements is presented in BRE Digest 241 "Low-rise buildings on shrinkable clay soils: Part 2"

11.3 Foundation Scheme

Foundations **must not** be constructed within any Made Ground/Topsoil, Alluvium or Weathered London Clay Formation due to the likely variability and potential for large load induced settlements both total and differential.

Roots were encountered in four out of the five trial holes to a maximum depth of 3.60m bgl. If roots are encountered during the construction phase foundations **must not be placed within any live root penetrated or desiccated cohesive soils or those with a volume change potential**. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils. Excavations must be checked by a suitable person prior to concrete being poured.

The below factors were taken into account when recommending a foundation solution;

- The presence of Made Ground to depths of between 1.70 and 2.00m bgl requiring that foundations be placed below a depth of 2.30m bgl and therefore ruling out the effective use of a raft foundation;
- The presence of Alluvium of variable thickness immediately underlying the Made Ground typically to a depth of 2.65m bgl;
- The highly compressible and variable nature of Alluvium ruling out the possibility of founding within this stratum;
- The presence of soft Weathered London Clay Formation to a depth of between 3.50 and 4.00m bgl, well below 2.50m bgl which is typically considered to be the maximum depth to which traditional strip footings can be economically viable and reasonably practicable to construct;
- The presence of very dense obstructions within the Made Ground;
- The presence of perched groundwater at circa 1.00m bgl and another layer of water under pressure within the Alluvium.

Based on the above factors it was initially recommended that a piled foundation solution was adopted to bypass the soft and variable soils of the Made Ground, Alluvium and Weathered London Clay Formation to bear within the (unweathered) London Clay Formation.

Additional investigation by means of Cable Percussive Borehole or CPTu was also recommended to inform the design of a piled foundation solution. Additional samples

should be taken for a range of geotechnical classification and strength tests.

11.3.1 Ground Floor Slab

NHBC Standards 2019 states ground floors should be constructed as suspended floors where:

- *"the foundation depth dictated by the NHBC Standards 2019, Chapter 4.2.10 would exceed 1.5m bgl;"*
- *"ground floor construction is undertaken when the surface soils are seasonally desiccated;"*
- *"the depth of fill exceeds 600mm;"*
- *"there is shrinkable soil that could be subject to movement, expansive material or other unstable soils;"*
- *"the ground has been subject to vibratory improvement;" or*
- *"ground or fill is not suitable to support ground-bearing slabs."*

Based on up to 2.00m thickness of Made Ground (fill) a suspended floor construction must be adopted.

11.4 Subsurface Concrete

Geotechnical laboratory testing was not commissioned at this stage and therefore it was not possible to recommend a concrete classification. Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, 'Concrete in Aggressive Ground' taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

11.5 Excavations

Shallow excavations in the Made Ground/Topsoil and Alluvium are likely to rapidly become unstable, especially if progressed below the groundwater table.

Deeper excavations taken into the Weathered London Clay Formation are likely to be stable in the short term, depending on the thickness of overlying Alluvium and Made Ground. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose before excavations are entered by personnel. Excavations beneath the groundwater table are likely to be unstable and dewatering of foundation trenches may be necessary.

11.6 Conclusions

Following presentation of the above to the designers, and following further investigation into the condition and status of the existing pad foundations of the garages, the foundation and surfacing details were revised to take advantage of the existing

foundations and hard standing and also thereby improving the overall sustainability of the project, in line with current guidance.

Additional works will be required to consolidate the pads and are further detailed in the Clients proposal.

Section 12 Determination of Chemical Analysis

12.1 Site Characterisation and Revised Conceptual Site Model

The Preliminary Investigation Report undertaken by Soils Limited as reported above identified a very low to moderate risk of ground contamination from previous development of the site and the off-site source of the adjacent garage facility.

The Main Investigation Report identified Made Ground to depths of 2.00m reflecting the findings of the initial CSM whereby it appeared that the area was historically landfilled probably to locally raise and consolidate levels for the development of the garages and adjacent properties, involving the diversion of the historical stream passing west to east across the site. The Made Ground comprised a mixture of firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.

Potential hydrocarbon staining and odours were identified in both WS2 and WS4 at depth.

Superficial deposits of Alluvium were encountered underlying the Made Ground at depth and may have been reworked in places. Shallow groundwater, probably perched, was encountered within the Made Ground and at depth in the Alluvium and rose on all occasions suggesting underlying waters are under pressure. The conceptual site model was updated to take account of the shallow groundwater encountered at the site and is presented in Appendix K.1

The groundwater flow direction, if not confined by the variable Made Ground and Alluvium deposits is still anticipated to be generally eastwards following the local topography and the former historical stream direction. It was interesting to note the contrast between the depth of water encountered on the southern side of the assumed former course of the historical stream at 1.00m (WS1 and WS2) in the Made Ground and on the northern side (WS3 and WS4) at 2.30m in the Alluvium.

12.2 Soil Sampling

A non-targeted sampling strategy is appropriate when there is:

- No adequate information available regarding the likely locations of contamination;
- No sensitive areas where there is a need for a high degree of confidence.

A targeted sampling strategy is appropriate when there is:

- Adequate information available regarding the likely locations of contamination
- Sensitive areas where there is a need for a high degree of confidence.

The CSM identified only one potentially significant external source (the adjacent garage facility to the east containing historical tanks) and internally the fill materials potentially

historically used to raise and consolidate levels on site prior to development and the potentially imported material associated with the development of the garages themselves, which do contain asbestos roofing, fixtures and fittings. A targeted sampling pattern based on site access with a bias towards the adjacent external source and presumed centre of the historical filling was adopted and a general screen for asbestos only in more recent demolition-based granular materials. Table 12.1 outlines the sampling undertaken.

Table 12.1 Sampling Strategy

Sample	Strategy	Proposed Use
WS1:0.30	Garage Area – Made Ground Demolition	Garden adjacent to house
WS1:0.70	Garage Area – Made Ground	Garden adjacent to house
WS2:0.80	Garage Area – Made Ground Demolition	Garden adjacent to house
WS2:1.90	Garage Area – Potentially hydrocarbon impacted soil	Garden adjacent to house
WS3:1.10	Garage Area – Made Ground	Garden area
WS3:2.20	Garage Area – Alluvium	Garden area
WS4:0.10	Garage Area – Made Ground Demolition	Garden area
WS4:1.90	Garage Area – Potentially hydrocarbon impacted soil	Garden area

12.3 Determination of Chemical Analysis

The driver for determination of the analysis suite was the information obtained from the Preliminary Investigation Report and Main Investigation Report intrusive investigation.

Table 12.2 outlines the specification for each sample tested.

Table 12.2 Chemical Analysis Specification

Substance	Locations:Depths (m bgl)					
	WS1:0.70 ^s	WS2:1.90 ^s	WS3:2.20 ^s	WS4:1.90 ^s	WS1:0.30 ^s WS2:0.80 ^s	WS3:1.10 ^s WS4:0.10 ^s
Asbestos Screen	✓	✓	✓	✓	✓	✓
Total Phenols	✓	✓	✓	✓		
Organic Matter	✓	✓	✓	✓		
pH	✓	✓	✓	✓		
Metals	✓	✓	✓	✓		
Metalloids	✓	✓	✓	✓		
Organics	✓	✓	✓	✓		
PAHs	✓	✓	✓	✓		
TPH-Texas	✓	✓	✓	✓		
BTEX	✓	✓	✓	✓		

Notes: **Metals:** Cd, CrVI, Cr, Cu, Pb, Hg, Ni, Se, V, Zn. **metalloids:** As, Bo. **Organics:** USEPA 16 speciated PAH, TPH-Texas (Banded TPH) **Asbestos screening** was undertaken in accordance with HSG 248. ^s = Soil sample.

Section 13 Qualitative Risk Assessment

13.1 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix K.3.

13.2 Representative Contamination Criteria - Soil

The proposal comprised demolition of the existing garages and the erection of two 2 storey residential properties retaining the existing hard standing with no gardens.

Based on the proposed development, the results of the chemical analysis have been compared against generic guidance values for a Residential without home grown produce, end use, as presented in SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination December 2014 (C4SL), derived for the protection of human health. Where this document has not published screening values for determinants, generic screening values derived for the same end use have been adopted from the following published guidance; DEFRA Soil Guideline Values (SGV) and LQM/CIEH/Suitable 4 Use Level (S4UL).

To assess the potential toxicity of organic determinants (Petroleum Hydrocarbons and Polyaromatic Hydrocarbons) to the human health, soils samples were analysed for Soil Organic Matter (SOM). The selected samples analysed recorded, SOM values of between 0.8% and 3.8%. For each soil sample tested, the resultant Soil Organic Matter allowed for the correct comparison to be made with the appropriate guideline value for each organic determinants analysed.

Table 13.1 outlines the samples that have exceeded their relevant assessment criteria. The full laboratory report is presented in Appendix K.2.

Table 13.1 Summary of Chemical Analysis of Soils Sample Exceedance

Substance	Sample locations where SGV, C4SL or S4UL adopted were exceeded for the 'Residential' with home grown produce land-use scenario
PAHs	Di-benzo(a,h)anthracene 0.56mg/kg against 0.32mg/kg – WS4:1.90m (S4UL)
Asbestos locations where material found (no threshold just presence)	
	Chrysotile Loose Fibres – WS3 1.10m

In summary, one of the samples tested (WS4:1.90m) showed concentrations of PAH Di-benzo(a,h)anthracene of 0.56mg/kg against 0.28mg/kg in excess of the relevant S4UL for a residential without plants land-use scenario. A PAH ratio analysis indicates that this material is probably coal rather than oil based. None of the other substances tested recorded concentrations above the residential end-use screening values.

13.2.1 Asbestos

Asbestos (Chrysotile as fibres) was detected within the sample from WS3 at 1.10m bgl. As asbestos containing material was identified in one of the samples tested it is possible that asbestos is present in other areas of the site. If encountered, care must be taken to ensure any such material is separated and disposed of in an appropriate manner to a licensed waste facility.

13.3 Risk to Groundwater

Groundwater was not considered to be at risk from the site in the initial PIR and was therefore beyond the scope of this investigation and water was not sampled during this investigation.

13.4 Tier 1 Quantitative Risk Assessment

Quantitative risk assessments are undertaken for the soil, groundwater and soil gas. The CSM has been updated to take account of the assessments below and presented in Appendix K.1. The full laboratory chemical report is presented in Appendix K.2.

13.4.1 Soils

One of the samples tested (WS4:1.90m) showed concentrations of a single PAH in excess of the relevant S4UL's for a residential with no plants land-use scenario. Furthermore, Asbestos as Chrysotile fibre was detected within the sample from WS3 at 1.10m bgl.

Given the depth to these samples in relation to the proposed ground levels (1.90m and 1.10m below current ground levels respectively), neither the PAH exceedance nor the presence of asbestos as fibre is considered likely to significantly affect the development as proposed with hardstanding blocking any potential pathways that may be present. Most pathway linkages associated with garden areas are considered likely to be significant only in the top 0.60m (2 spade depths). As such there is a potential risk during development should any works be proposed for services etc. which penetrate the hard standing and lead to the exposure of underlying materials. This should be investigated at the time of development.

The Tier 1 Quantitative risk assessment screening therefore established that there was a **theoretical risk to the human health receptors** of construction workers or future end-users, but that in the context of the proposed development, it cannot be considered significant and risk is considered low to negligible as no pathway is likely to be present from this depth to a longer term vulnerable human receptor. However, a potential risk during the development works at such times as any underlying material is exposed and/or excavated is present and will require some additional confirmatory analysis and/or mitigation during works.

13.4.2 Groundwater

Groundwater is not considered to be at risk from this site and does not appear to have been significantly influenced below the site by the adjacent identified potential

garage source. However, given the slightly unusual and possibly perched water levels noted on site during this investigation, and the contention that the area has been historically reworked, a potential does remain for oily materials to be encountered during the works which cannot be completely discounted.

13.4.3 Soil Gas

No significant sources of soil gas or vapour were identified in the preliminary assessment CSM and the logs would appear to indicate that the underlying material in general is either waterlogged and/or cohesive, both of which considerations would significantly reduce the potential for both generation and transmission of gas. The lack of any materials identified in the C6-C10 TPH range (even in "oily" samples) as well as the PAH ratio indication of a coal rather than oil-based source, also strongly suggests that there can be only minimal to negligible risk from vapours as VOC's.

13.5 Remedial Objective

Soil chemical analysis recorded one sample (WS4:1.90m) with PAH levels in excess of their representative guideline values and one positively identified asbestos containing soil (ACS). Therefore, there was a potential risk to the Human Health of future receptors. However, this is not considered significant in context of the proposed development and proposed hard standing and foundation solution.

The remedial objective for any site is to ensure that its application removes any unacceptable risk to identified receptors. In essence the remedial objective should sever any potentially significant source-pathway-receptor pollutant linkages that may have been established. Once this has been achieved, by whatever means, there can theoretically be no risk. As noted above, no realistic theoretical pathway has been established or confirmed in the context of the proposed development by this investigation.

13.6 Development of Soil Remediation Strategy

Production of a remediation strategy report was not considered part of the original brief for the Main Investigation Report Intrusive Investigation which was precautionary and speculative in nature at the time. Following investigation, analysis and appraisal of the identified risks, none of which are considered or have been proven significant, and in the context of the proposed development, no remediation strategy as such is considered necessary. However, potential H&S risks on exposure remain and a precautionary approach is recommended to the actual development works.

A number of considerations, concerns and potential issues in relation to the proposed development are outlined below.

13.6.1 Further Chemical Testing and Human Health Risk Assessment

It is **recommended** that further precautionary testing and analysis is undertaken during any works intending to breach the site hard standing given the mixed nature

of the underlying materials encountered and the potential presence of asbestos in some parts. Such analysis may also be advised for waste determination and characterisation if removal of materials is required at this site i.e. for service emplacement and foundation extensions.

13.6.2 Asbestos

Asbestos-containing soils (ACSs) were identified at the site in one sample at 1.10m bgl at WS3 associated with imported demolition-based materials. The asbestos matrix identified was described as loose fibres of Chrysotile.

Asbestos-containing soils (ACSs) do not necessarily require removal or treatment, and at this depth are unlikely to significantly mix with overlying materials or present any risk to future users. However, all future works should have suitable health and safety procedures in place to protect workers from airborne asbestos fibres if any similar materials are encountered during the development. Such works can be incorporated easily into the above proposed analysis by a suitably competent person.

13.7 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather. To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access.

Washing facilities should be provided and eating restricted to mess huts.

In light of potential asbestos risks identified, all intrusive works and demolition should be undertaken with due regard for the H&S requirements by appropriate, competent persons and with awareness and application of the discovery strategy as outlined in Section 13.11, which will be required by planning.

13.8 Excavated Material

Excavated material as waste must be defined or classified prior to any disposal, transport, recycling or re-use at or by an appropriately licensed or exempt carrier and/or off-site disposal facility. The requirements inherent in both Duty of Care and Health and Safety must also be complied with. In order to determine what is to happen, what is suitable, appropriate and most effective in the disposal of wastes, especially those subject to CDM waste management plan requirements, several factors must be considered and competent advice should always be sought.

The amount, type and nature of the material to be removed will in part determine the amount and type of analysis that may be required to comply with current waste

guidance, and thereby allow a competent person to suitably classify the material. Often this data is uncertain or unavailable, especially in the early stages of a project, and therefore further investigation, testing and analysis may be required as additional information regarding the development becomes available.

Wastes must be classified and defined by their solid characteristics to comply with current waste guidance. Existing information and analysis derived for environmental purposes may therefore be suitable for use in this context. Waste Acceptance Criteria (WAC) report the leachability of materials and therefore cannot be used to classify, characterise or define wastes. The only purpose of a WAC analysis is to determine the suitability of a given material for acceptance at one of the three different types of available licenced landfills (inert, stable non-reactive hazardous or hazardous).

Other options are available that may lead to significant savings against disposal to landfill and expert advice should always be sought from a competent person to advise on their relative costs or benefits and advise on any additional analysis, sampling or investigation that may be required to reduce remaining uncertainties and comply with current guidance. Further consideration of results using HazWasteOnline™ can be undertaken on request to give an indication of potentially hazardous properties in the materials analysed.

In this case excavated material is considered unlikely to be considered hazardous on the basis of the results of this investigation, but may require additional analysis prior to disposal especially if to landfill where the organic material concentrations (if >3%) may affect the potential disposal routes available.

13.9 Re-use of Excavated Material On-site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site-specific risk assessment for the receptor site to demonstrate that

the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment. Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a 'Qualified Person' as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

Re-use of excavated materials on this site (i.e. during service emplacement) should not present a significant issue as long as the materials are geotechnically suitable and appropriate for the replacement of the overlying hard standing on completion. Additional analysis to confirm the material is suitable (and the appropriate pipework has been chosen) may be required by the service provider and should also be undertaken at the time of installation as validation.

13.10 Imported Material

No materials are planned to be imported, but any material which is to be imported onto the site, must undergo appropriate analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

13.11 Discovery Strategy

There may be areas of contamination not identified during the course of the investigation. Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Care should be taken during excavation works especially to investigate any soils which appear by eye (e.g. such as fibrous materials, large amounts of ash and unusual discolouration), odour (e.g. fuel, oil and chemical type odours or unusual odours such as sweet odours or fishy odours) or wellbeing (e.g. light headedness and/or nausea, burning of nasal passages and blistering or reddening of skin due to contact with soil) to be contaminated or of unusual and/or different character to standard soils or those analysed.

In the event of any discovery of potentially contaminated soils or materials, this discovery should be quarantined and reported to the most senior member of site staff or the

designated responsible person at the site for action. The location, type and quantity must be recorded, and the Local Authority and a competent and appropriate third-party Engineer/Environmental consultant notified immediately. An approval from the Local Authority must be sought prior to implementing any proposed mitigation action.

The discovery strategy must remain on-site at all times and must demonstrate a clear allocation of responsibility for reporting and dealing with contamination. A copy of the strategy must be placed on the health and safety notice board and /or displayed in a prominent area where all site staff are able to take note of and consult the document at any time. Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the discovery strategy.