



Your Environment

PHASE 2: SITE INVESTIGATION REPORT 84-88A JUBILEE ROAD, WATERLOOVILLE, PO7 7RE

For Axis Architecture Ltd

Your Environment

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1.0 Introduction

YourEnvironment (YE) was instructed by Axis Architecture Ltd (Quote No: Q6195, Dated: September 24th 2018) to conduct a Site Investigation (SI) at a site located at 84-88a Jubilee Road, WaterlooVille PO7 7RE.

The SI undertaken is as a result of recommendations made by YE in our previously issued Phase 1: Desktop Study & Risk Assessment Report for the site (Report Reference: YE6027 – Revision 1, Issued: September 2018), to which this report should be read in conjunction with. As such this report seeks to address the potential pollutant linkages identified within the Preliminary Conceptual Site Model contained within our Phase 1: Desktop Study report.

The purpose of this report is to satisfy a particular planning condition, which has been attached to the redevelopment of the site by Havant Borough Council, application reference number 18/00437.

We are content that as a result of the actual site investigation works and subsequent soil testing undertaken, as outlined within this report, we have characterised the ground conditions and consequently the potential for contamination to exist on site. These works and ensuing assessment have been detailed in this report.

The information contained in this report is intended for the use of the named client (or their approved contractors). Should any part of this report be relied on by a third party, that party does so wholly at its own risk and YE disclaims any liability to such parties. Should the purposes for which the report is used, or the proposed use of the site change, this report may no longer be valid and further use of, or reliance upon the report in those circumstances shall be at the client's sole and own risk. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. YE should in all such altered circumstances be commissioned to review and update this report accordingly.

2.0 Proposed Development

We understand current plans for the development of the site include:

- Change of use from business (B1) to special needs school (D1) to provide new food tech and design technology classroom/workshop teaching block;
- External alterations and new canopy;
- Six additional car parking spaces;
- New 1.8m high fencing to parts of the site;
- Change of use of residential garden to school grounds.

The proposed redevelopment plans for the site, at the time of issuing this report can be reviewed within **Appendix A**.

3.0 Physical Setting

3.1 Site Information

Access

The site was accessible from Jubilee Road, via an open driveway.

Topography

The site was fairly flat with a raised area in the northwest corner, which was approximately 0.5m higher than the rest of the site.

Vegetation

There was an area of vegetation in the north-western portion of the site, comprised of a patio with weeds growing through it, a grassed area and a mature tree.

Buildings and Structures / Floor Covering

There was one building located on the site, which was located in the northern section of the site and comprised a brick built, single story industrial unit with a metal roller door and concrete flooring. The structure sat empty at the time of the walkover.

The concrete floor of the structure was noted to be in good condition, with no signs of staining or cracking.

Surface Permeability / Ground Covering

It was estimated that 70% of the site was covered with impermeable hardstanding, with the remaining 30% comprising of the risen soft scaping in the northwest section of the site.

Drainage Features

Two manhole covers were noted on site, as well as two gutters leading directly into ground and two water drains.

Other Services

The site appeared to have access to all services.

Surrounds

The site was in a developed area, with a school to the immediate east, playing grounds to the north, residential dwellings to the west and an industrial estate to the south.

3.2 Geology

The relevant British Geological Survey (BGS) online mapping information indicates that the superficial ground deposits underlying the study site are comprised of Head (diamicton). The bedrock composed of the Bognor Sand Member (clay, silt and sand) with the London Clay Formation (clay, silt and sand) in the southern section.

3.3 Hydrogeology

The Environment Agency designate aquifers in accordance with the Water Framework Directive. These designations reflect not only the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetlands ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey.

As a consequence of the superficial geology on site the aquifer is designated as being a Secondary (Undifferentiated) Aquifer. This type of aquifer is described as layers that cannot be attributed to a category A or B rock type. These layers could have previously been described as a minor or a non-aquifer due to their variable characteristics.

As a result of the bedrock geology in the southern section site, the aquifer is designated as being Unproductive. This is defined as rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

As a result of the bedrock geology in the northern section of the site, the aquifer is designated as being Secondary (A). This is defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

3.4 Hydrology

Groundwater Abstraction Licences

There are no active groundwater abstraction licences within 2000m.

Surface Water Abstraction Licences

There are no active surface water abstraction licences within 2000m.

Potable Water Abstraction Licences

There are no active potable abstraction licences within 2000m.

Surface Water Features

There are no records within 250m of the study site.

Source Protection Zones

The study site is not located within a Source Protection Zone.

Detailed River Network

There are eight records within 500m of the study site, the closest of which is 141m east for an inland river. The remaining results are over 195m from the study site.

3.5 Contaminant Sources

On Site Sources

The following possible on site sources have been identified from the historical study:

- Structures of unknown usage;
- Infilled pond;
- Made Ground, from historical development.

The following on site sources have been identified from the site walkover:

- Unknown usage of structure on site.

The following possible on site sources from the EnviroInsight and GeoInsight:

- Engineering services.

The following contaminants are potentially associated with all the on site sources listed above:

- Heavy Metals;
- TPH and PAH;
- Potential asbestos;
- Ground gas – methane and carbon dioxide, from decomposition of organic carbon in Made Ground / infilled material associated with potential considerable depth of Made Ground on site.

Off Site Sources

The following off site sources have been identified from the historical study:

- Weaving mill (20m southwest);
- Works (20-50m southwest);
- Depots (10m west);
- Engineering works (110-200m southwest);
- Builder's yard (110m west);
- Electricity substation (70m west and 150m southwest);
- Garage (50m east);
- Boat building yard (110m west).

The following off site sources have been identified from the site walkover:

- Industrial estate to the south.

The following off site sources have been identified from the GeoInsight and EnviroInsight:

- Infilled pond (88m northwest and 88m west);
- Unspecified works (12m southwest and 73m southeast);
- Unspecified mill (17m southwest);
- Industrial estate (78m southwest and 85m west);
- Electricity substations (49-57m southwest);
- Garage (39m southeast);
- Engineering services (50-93m southwest and 81m west);
- New vehicles (20m southwest);
- Construction tool and hire (45m west);
- Industrial products (47m west and 70-93m southwest).

The following contaminants are potentially associated with all the off site sources listed above:

- Heavy Metals;
- PAH and TPH;
- Asbestos;
- PCBs;
- Ground gas – from the variety of infilled land and activities in the area that could have led to methane and carbon dioxide generation from decomposition of organic carbon in Made Ground /infilled material and hydrocarbon spillages which could volatilise in the subsurface of the site.

4.0 Preliminary Conceptual Site Model and Risk Assessment

This presented Conceptual Site Model has been re-issued from the previous Phase 1: Desktop study (YE6027), to provide information regarding the possible **sources** of contamination on site, the **pathway** in which the contamination can migrate and a vulnerable **receptor** to the contamination, all of which need to be present for there to be a risk. Given the continued end use of the site the generic land use of ‘residential with homegrown produce’ has been applied. Consequently, the following Source – Pathway – Receptor relationships have been identified.

Contaminant Source	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
On Site: Made Ground soils on site possibly containing elevated metals, other inorganics and organics such as TPH, PAH, phenols, VOC and SVOCs.	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Medium	Low Likelihood	Moderate	A moderate risk is assessed due to the engineering works and anticipated depth of Made Ground on site. Contact is likely between future residential occupiers/visitors and contaminants in the shallow soil in garden areas of the site, soil/dust tracked back into the house, from ingestion of homegrown produce and from vapour intrusion.
		Construction Workers	Medium	Likely	Moderate	Construction workers are likely to come into direct contact with soils during groundworks. Safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from contact with soils and shallow/perched groundwater.
	Leaching through soils and migration via groundwater or soil pore moisture	Controlled Waters	Medium	Low Likelihood	Moderate	A moderate risk is assessed due to the variety of potentially contaminative sources on site and the presence of a Secondary (Undifferentiated) Aquifer within the superficial deposits and a Secondary (A) and an Unproductive Aquifer within the bedrock underlying the site. There are no groundwater, potable water or surface water abstraction licences within 2000m. In addition, there are no surface water features within 250m. The nearest river network is 141m east for an inland river. The site is within a Source Protection Zone 1c, inner catchment within confined aquifer.
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Likely	Moderate	Hydrocarbons, especially aromatics are known to permeate plastic pipes. Provision of water supply pipes and connectors formed from proprietary “barrier pipe” materials (eg polyethylene-aluminium-polyethylene) may be required by the water supply company.
	Uptake	Plant and Wildlife	Mild	Low Likelihood	Moderate	A moderate risk is assessed as there are indicated areas of soft landscaping on the proposed site plans.
On Site: Asbestos at/near ground surface in Made Ground soils.	Inhalation of fibres in airborne dust	Future end users and site visitors	High	Low Likelihood	Low/ Moderate	Likelihood is considered to be low/moderate as although the site walkover did not identify any potential asbestos containing materials (ACMs), the commercial history of the site creates potential for asbestos contamination. An asbestos survey should be undertaken prior to investigative works proceeding.

		Construction Workers	High	Low Likelihood	Low/Moderate	Despite the lack of identified ACMs during the walkover, safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from asbestos in soils.
On Site: Ground Gases (CH ₄ , CO ₂) from on site Made Ground.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	A moderate risk would be given due to the infilled land from the pond and appreciable depth of potential Made Ground. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation. However, as gas protection measures are to be incorporated into the redevelopment, the risk is reduced.
Off Site: Historical land uses and activities, Made Ground/infilled material possibly containing elevated metals, other inorganics, TPH, PAH, phenols, VOC and SVOCs.	Leaching through soils and migration via groundwater or soil pore moisture	Future end users and site visitors	Mild	Low Likelihood	Moderate	Given the variable permeability of the underlying geology and hydrogeology, there is a moderate risk for the leaching of contaminants. This combined with the variety of potentially contaminative activities in the surrounding area create a risk for contamination on site.
	Inhalation of vapours	Future end users and site visitors	Medium	Low Likelihood	Moderate	A moderate level of risk is assessed due to the potentially contaminative land uses/activities within proximity to the site that could pose a potential risk to the site.
Off Site: Ground Gases (CH ₄ , CO ₂ , H ₂ S) from off site Made Ground historical land uses/activities.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Moderate	The potentially contaminative land uses/activities and infilled land proximal to the site create a potential for ground gas generation. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation. However, as gas protection measures are to be incorporated into the redevelopment, the risk is reduced.

Table 1: Preliminary Conceptual Site Model and Risk Assessment

5.0 Fieldworks

5.1 Site Investigation

All SI works were completed on September 27th 2018 by Geo-Environmental Engineer from YE. In summary the investigation included:

- Three (3no.) hand excavated trial pits (TP01-TP03) were completed to a maximum depth of 1.00mbgl, by a YE Geo-Environmental Engineer.
- The trial pits were logged with any groundwater conditions noted and representative soil samples removed in accordance with current guidelines.
- Soil samples were removed from shallow sub surface locations, with further samples taken at depths of 0.15mbgl, 0.30mbgl, 0.50mbgl 0.70mbgl and 1.0mbgl. Samples were subsequently placed in suitable containers including 1kg tubs and 250ml glass jars and placed in cool boxes with cool packs prior to storage within our *in-house* laboratory fridges and then subsequent forwarding to our designated laboratory for analysis.
- The trial pits were backfilled immediately after excavation.

The positions of exploratory holes in relation to the existing site layout can be reviewed within **Appendix B**, with exploratory trial pit logs located in **Appendix C** and photographs taken during the SI in **Appendix D**.

6.0 Geology & Ground Conditions

The following ground conditions were encountered during the SI;

Topsoil – Encountered in all locations to a maximum depth of 0.30mbgl and consisted a dark brown gravelly, clayey SAND. Gravels are infrequent of chalk and flint. Sand is fine.

London Clay Formation – Encountered at subsurface depths of 0.20-0.30mbgl to the maximum excavated depth of 1.00mbgl. The stratum generally comprised of a stiff light brown/grey clayey SILT.

7.0 Groundwater Conditions

Groundwater was not encountered in any of the trial pits during investigative works undertaken.

However, it should be noted that groundwater levels are dependent upon seasonal variations and can change after periods of prolonged rainfall or drought. However, as a consequence of the anticipated depth to standing water level such seasonal variations are unlikely to have an effect on site development.

8.0 Visual and Olfactory Observations

With the exception of general anthropogenic material identified, no visual and/or olfactory evidence of potential contamination was noted within any soils encountered as part of the investigative works undertaken.

9.0 Contamination

9.1 Soil Testing

A total of six (6no.) samples have been analysed by The Environmental Laboratory Ltd in their UKAS and MCERTS accredited laboratory-testing facility in accordance with laboratory protocol.

The testing completed comprised of a focused suite of heavy metals, speciated Total Petroleum Hydrocarbons (TPH CWG Aromatic/aliphatic split) and speciated Polycyclic Aromatic Hydrocarbons (PAH) including the more carcinogenic benzo(a)pyrene (BaP) and naphthalene, asbestos, soil organic matter (SOM) content, MTBE & BTEX, cyanide, pH and sulphates.

The results of this laboratory testing have been compared to the Soil Guideline Values (SGVs) as well as the CIEH 'LQM' guideline values for inorganic and organic contaminants in soils. The proposed development of the site is intended to comprise of an extension to the adjacent school. However, this is a non-standard land use and therefore given the sensitive nature of the proposed end use and indeed end users, screening has been made against a land use of 'residential with homegrown produce'. This generic land use of residential with homegrown produce is noted to be overly protective.

9.2 Selection of Screening Criteria

The on site receptors for the study site are considered to be:

- Construction workers (during redevelopment of the site only);
- Future maintenance workers (following redevelopment);
- Future end users and site visitors (following redevelopment); and
- Trespassers (during redevelopment).

No off-site receptors for the site are identified due to the rural nature of the site.

Risks to construction workers during the redevelopment process will be mitigated by adhering to appropriate health and safety legislation, and the wearing of appropriate personal protective equipment (PPE). During redevelopment, the site will be securely fenced to prevent trespassers from accessing the site, and good site management practices will be implemented to mitigate exposure to off-site receptors.

The potential pathways for contaminants within the soil to human health receptors following redevelopment are considered to be:

- Direct ingestion of soil and soil derived dust;
- Dermal contact with soil outside and soil derived dust inside;
- Inhalation of soil derived dust inside and outside; and
- Inhalation of soil derived vapours inside and outside.

The potential pathways for contaminants within the soil to off-site human health receptors following redevelopment are considered to be:

- Direct ingestion of soil and soil derived dust;
- Dermal contact with soil outside and soil derived dust inside;
- Inhalation of soil derived dust inside and outside; and
- Inhalation of soil derived vapours inside and outside if contamination within soil is able to migrate across the site boundary within.

In the first instance, the results of this laboratory testing have been compared to generic assessment criteria (GAC) for the residential with homegrown produce land use scenario. These incorporate the following pathways:

- Direct ingestion of soil and soil derived dust;
- Dermal contact with soil outside and soil derived dust inside;
- Inhalation of soil derived dust inside and outside; and
- Inhalation of soil derived vapours inside and outside.

Given that these incorporate a number of pathways that will not be relevant to the site following redevelopment, this is a highly conservative approach and exceedances will be discussed in this light.

Contaminants have been screened against revised LQM/CIEH S4UL criteria¹ where available. These GAC have been designed for use under planning, using Health Criteria Values based on minimal risk, and updated exposure parameters. The S4UL are intended to replace the previous LQM/CIEH GAC. The S4UL are based on the assumption of a sandy loam soil the 6% and 1.0% soil organic matter (SOM) criteria have been used, where available and appropriate, in the first instance. All soil samples were analysed for %SOM, the range was from 0.1-8.1%, and so this conservative approach is considered appropriate for initial screening.

Where no S4UL are available, the EIC/ AGS/ CL:AIRE/ GAC² have been used. The toxicological criteria within these are also based on minimal risk. It is recognised that these criteria have not recently been updated, and in particular, do not incorporate the slightly higher inhalation rates that have been used within the S4UL. However, given that they incorporate additional pathways, they are considered suitable for an initial screen. The EIC/ AGS/ CL:AIRE/ GAC are also based on a sandy loam soil and the 1% SOM criteria have been used in the first instance.

There is neither an S4UL nor a EIC/ AGS/ CL:AIRE/ GAC available for lead. In the absence of a GAC based on minimal risk, the C4SL for lead has been used. It is recognised that this is based on a “low level of toxicological concern” rather than on a minimal risk level. However, it is considered appropriate for use under planning, especially for a site where there will effectively be no pathways for inorganic metals following redevelopment.

All the GAC are based on a sandy loam soil. This is considered appropriate for use for initial screening. Although it is apparent from the laboratory soil descriptions, that the Made Ground, by its very nature is heterogeneous, and often has a significant sand/gravel component, especially at shallow depths, it is noted that many of the soil descriptions have a significant clay component at increasing depth.

¹ Nathanail et al. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, 2015. Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3495

² CL:AIRE (2010) The EIC/AGS/CL:AIRE Generic Assessment Criteria for Human Health Risk Assessment

All of the GAC assume unsaturated soils. However, the use of the GAC are considered to be conservative, because they assume a certain air-filled porosity and water-filled porosity. The GAC also assume that no free phase product is present, and are not intended for use in this instance. No free product was observed within soils during the site investigation.

9.3 Soil Testing Results & Screening

All metals, PAHs, and TPH CWG analytes are presented in the following tables. Other potential contaminants of concern are only shown where there is at least one result exceeding the limit of detection. All of the soil contamination laboratory analytical results are presented within **Appendix E**.

Metalloids

Determinant	Min	Max	GAC	Number of exceedances
Arsenic	10.0	15.7	37*	0
Cadmium	<0.5	<0.5	11*	0
Chromium (III)	20.6	43.7	910*	0
Chromium (VI)	<0.8	<0.8	6*	0
Copper	13.7	50.0	2400*	0
Lead	17.2	265	200*	1
Mercury	<0.5	<0.5	40* ^a	0
Nickel	12.5	23.5	180* ^b	0
Selenium	<1	<1	250*	0
Zinc	61.3	319	3700*	0
Total Phenols	<6	<6	420*	0
Total Cyanide	<1	<1	140*	0

Table 2: Metalloids Soil Exceedances

*LQM/CIEH GAC for Residential with homegrown produce land use scenario based on a sandy loam soil and 1% SOM.

- a) Based on the inorganic mercury GAC as the conceptual site model does not suggest that other forms of mercury are likely to be present on site.
- b) LQM issued an update to the nickel S4ULs in August 2015 and this has been taken into account.

- There is one exceedance for metalloids screened, which is for lead in TP01 at a depth of 0.15mbgl, at concentrations of 265mg/kg (GAC of 200mg/kg).

Organics

Determinant	Min	Max	GAC	Number of exceedances
Naphthalene	<0.1	<0.1	5.6*	0
Acenaphthylene	<0.1	<0.1	420*	0
Acenaphthene	<0.1	<0.1	510*	0
Fluorene	<0.1	<0.1	400*	0

Phenanthrene	<0.1	0.3	220*	0
Anthracene	<0.1	<0.1	5400*	0
Fluoranthene	<0.1	0.8	560*	0
Pyrene	<0.1	0.7	1200*	0
Benzo(a)anthracene	<0.1	<0.4	11*	0
Chrysene	<0.1	0.5	22*	0
Benzo(b)fluoranthene	<0.1	1.0	3.3*	0
Benzo(k)fluoranthene	<0.1	0.3	93*	0
Benzo(a)pyrene	<0.1	0.4	2.7*	0
Indeno(1,2,3-cd)pyrene	<0.1	0.5	36*	0
Dibenz(a,h)anthracene	<0.1	0.1	0.28*	0
Benzo(ghi)perylene	<0.1	0.6	340*	0

Table 3: PAH Soil Exceedances

- There are no exceedances noted from the screening undertaken on PAH congeners.

Determinant	Min	Max	GAC	Number of exceedances
Aliphatic >C5 - C6	< 0.01	< 0.01	78*	0
Aliphatic >C6 - C8	< 0.01	< 0.01	230*	0
Aliphatic >C8 - C10	< 1	< 1	65*	0
Aliphatic >C10 - C12	< 1	< 1	330*	0
Aliphatic >C12 - C16	< 1	< 1	2400*	0
Aliphatic >C16 - C21	< 1	< 1	92000*	0
Aliphatic >C21 - C35	< 1	< 1	92000*	0
Aromatic >C5 - C7	< 0.01	< 0.01	140*	0
Aromatic >C7 - C8	< 0.01	< 0.01	290*	0
Aromatic >C8 - C10	< 1	< 1	83*	0
Aromatic >C10 - C12	< 1	< 1	180*	0
Aromatic >C12 - C16	< 1	< 1	330*	0
Aromatic >C16 - C21	< 1	2.7	540*	0
Aromatic >C21 - C35	< 1	17.1	1500*	0

Table 4: TPH CWG Aliphatic/Aromatic Soil Exceedances

* LQM/CIEH GAC Residential with Homegrown Produce land use scenario based on a sandy loam soil and 1.0% SOM. It is noted that the LQM/CIEH S4UL guidance recommends an additive approach for the TPH fraction, so that a hazard index approach is used. Based on a preliminary conservative comparison of maximum concentrations to S4ULs, no forward modelling is necessary to prove that this would still result in no exceedances at the site.

- There are no exceedances noted from the screening undertaken on the respective TPH CWG bands.

Others

- The asbestos screening returned a negative result for the presence of fibrous material from all samples analysed.
- BTEX/MTBE screening returned a negative result for any congeners.

The soil contamination laboratory certificates can be reviewed within **Appendix E**.

10.0 Site Investigation Findings

10.1 Risks to Human Health

No visual and/or olfactory evidence of potential contamination was noted within any soils encountered during the SI works undertaken, which focussed in the proposed garden area adjacent to the proposed new classroom.

All but one of the selected soil samples from the SI which were submitted for the range of inorganic and organic analyses have returned concentrations below the available SGVs and LQM guidance values for each determinant which were adopted as Generic Assessment Criteria (GAC) within YE's risk assessment for the site. There was an exceedance of lead in TP01 at a depth of 0.15mbgl, the result was 265mg/kg compared to the guideline value of 200mg/kg.

However, given the conservative nature of the adopted screening value and the low risk in terms of ingestion of homegrown produce based on it being an area of soft landscaping within a school, the risk is reduced.

10.2 Risks to Plants and Wildlife

A negligible risk has been attributed given the concentrations of phytotoxic contaminants below elevated concentrations often below the limit of detection returned.

10.3 Risks to Site Workers

Due to there being the presence of elevated concentrations of determinants precautions should be taken to minimise exposure of site workers during ground works through the implementation of site safety procedures and the use of suitable personal protective equipment (PPE). Such precautions should include, but not be limited to:

- Personal hygiene, washing and changing procedures;
- Availability of site welfare;
- Provision of PPE appropriate to the task; and
- Daily safety briefings and tool box talks.

All site works will be undertaken in accordance with the guidelines prepared by the Health and Safety Executive (1991) and all work will be carried out in accordance with the Principal Contractor's Health and Safety Plan.

10.4 Risks to Proposed Structures

A low risk has been attributed given the limited Made Ground on site, the low organic content in the samples tested and the lack of hydrocarbons returned from the laboratory thus giving a low risk for potential volatilisation. Furthermore, we are informed that the

client is to install a metallic core membrane into the structure on site. This would reduce the risk of any potential ground gas.

11.0 Updated Conceptual Site Model and Risk Assessment

The Conceptual Site Model has been re-formulated based upon the results from the SI in accordance with BS10175:2015. It aims to provide information regarding the sources of contamination and the pathways in which contamination can migrate to a vulnerable receptor, all of which need to be present for there to be a risk. This is in relation to the proposed end use being classified as 'residential with homegrown produce'. The following linkages have been identified:

Contaminant Source	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
On Site: Made Ground soils on site containing Hydrocarbons (TPH, PAH) Heavy metals, phenols, BTEX, MTBE.	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Medium	Likely	Low/Moderate	A low to moderate level of risk is considered due to the returned results, which identified a single exceedance for lead in the shallow soil of TP01. Given the conservative nature of the adopted GAC and low likelihood for the consumption of homegrown produce, the risk is reduced.
		Construction Workers	Medium	Likely	Low/Moderate	Construction workers are likely to come into direct contact with soils during groundworks. Safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from contact with soils and shallow/perched groundwater.
	Leaching through soils and migration via groundwater or soil pore moisture	Controlled Waters	Mild	Low Likelihood	Low	A low risk is as the identified exceedance is for lead which is relatively immobile in soil. The risk is further reduced by the clay content of the underlying soils. The site is recorded as being underlain by a Secondary (Undifferentiated) Aquifer within the superficial deposits and a Secondary (A) and an Unproductive Aquifer within the bedrock underlying the site. There are no groundwater, potable water or surface water abstraction licences within 2000m. In addition, there are no surface water features within 250m. The nearest river network is 141m east for an inland river. The site is within a Source Protection Zone 1c, inner catchment within confined aquifer.
	Permeation of plastic water pipes	Construction materials, future end users and site visitors	Medium	Likely	Low	There were no exceedances for any hydrocarbons tested in the laboratory analysis, so the risk posed to the permeation of the pipes is low. Provision of water supply pipes and connectors formed from proprietary "barrier pipe" materials (eg polyethylene-aluminium-polyethylene) may be required by the water supply company.
On site: Phytotoxic Contamination.	Uptake	Plant and Wildlife	Mild	Low Likelihood	Negligible	Negligible risk given the returned laboratory results which indicates there to be no significant concentrations of phytotoxic contamination.
On Site: Asbestos at/near ground surface in	Inhalation of fibres in airborne dust	Future end users and site visitors	High	Low Likelihood	Low	Although screening has revealed no asbestos to be present within the samples analysed from exploratory holes undertaken, it cannot be guaranteed that asbestos is not present within the soils across the site.

made ground soils.		Construction Workers	High	Low Likelihood	Low	Asbestos fibres have not been identified in the samples returned from laboratory analysis. However, Safe working practices should be implemented and appropriate personal protective equipment (PPE) should be used to mitigate any potential risk from asbestos in soils.
On Site: Ground Gases (CH ₄ , CO ₂) from on site Made Ground.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation. Furthermore, the client intends to install a metallic core damp proof membrane. This would act as an impermeable barrier, which any ground gas/vapour could not penetrate.
Off Site: Limited off site development.	Leaching through soils and migration via groundwater or soil pore moisture	Future end users and site visitors	Mild	Unlikely	Low	The results of preliminary screening and subsequent assessment of risk undertaken on soils samples retrieved from investigative works shows little risk as a result of off site historical/current land uses and activities in proximity to the study site. Contaminants present in Made Ground off site are considered unlikely to exhibit potential leachability.
	Inhalation of vapours	Future end users and site visitors	Medium	Low Likelihood	Low	A low risk is attributed due to the lack of volatile exceedances identified from the investigation.
Off Site: Ground Gases (CH ₄ , CO ₂ , H ₂ S) from off site Made Ground.	Gas migration and build up within buildings (explosion/asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Low	The client intends to install a metallic core damp proof membrane. This would act as an impermeable barrier, which any ground gas/vapour could not penetrate.

Table 5: Updated Conceptual Site Model and Risk Assessment

12.0 Recommendations

The following recommendations are based on the results of chemical laboratory testing to date.

The following recommendations made do not constitute a formal remediation strategy and/or validation report. A remediation strategy should be agreed with the relevant local authority prior to such works commencing and/or the production of a validation report.

12.1 Soils

One hotspot of inorganic contamination has been identified from within the shallow soil identified during the SI predominately in the form of TP01 at 0.15mbgl (lead at 265mg/kg).

A review of the proposed redevelopment plans for the site indicate that this exploratory hole falls within an area of soft landscaping. However, given the nature of the proposed end land use, there is a low risk in terms of the consumption of homegrown produce. With this in mind, and the limited amount of time that the future end users are likely to spend in the garden area, the risk is considered minimal.

Therefore, we believe that the identified exceedance does not represent an appreciable risk to end users.

12.2 Watching Brief and Discovery Strategy

A watching brief should be maintained by the Main Contractor at all times during the groundworks stage. Should any unforeseen contamination, such as oils or soils/groundwater with an unusual colour or odour, be encountered during groundworks then the following procedure should be implemented:

- Work to cease in that area to prevent exposure to ground workers and potential contaminants being spread around;
- Notify a Geo-Environmental Consultant, to attend site and sample material;
- Notify the Environmental Health Department / Contaminated Land Officer(s) of the Local Planning Authority.

If the nature and extent of the contamination is unmanageable under the procedure set out above, then a suitable management, mitigation or remediation procedure will be agreed with the CLO. However, this is considered unlikely at this particular site.

12.3 Asbestos

Although screening has revealed no asbestos to be present within the samples analysed from exploratory holes undertaken, it cannot be guaranteed that asbestos is not present within the soils across the remainder of the site. Consequently, we would recommend that a watching brief be adopted with regards to the site for the potential of finding any Asbestos Containing Materials (ACMs). If any ACMs are identified these need to be dealt with accordingly in relation to the Hazardous Waste Regulations 2005.

12.4 Services

If new services will be installed as part of the redevelopment of the site, we would recommend the local water board be contacted to determine their specification for the type of pipework which should be used on this site.

All services and in particular potable water supply pipework should comprise of material that is resistant to attack and degradation to chemical attack.

Further information can be found within the published guidance for the '*Selection of Water Supply Pipes to be used in Brownfield Sites*', issued in January 2011 by the UK Water Industry Research (UKWIR), this supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note – '*Laying Pipes in Contaminated Land*' which has been withdrawn.

12.5 Surface Water

It should be noted that the Environment Agency does not recommend that soakaways be placed within Made Ground, potentially contaminative land or in ground previously identified as contaminated.

12.6 Verification Reporting

It is recommended that you confirm with the relevant environmental consultees whether they require a validation and/or closure report providing documentation/audit trail for the completion of any remediation/mitigation works completed on site.

If a verification Report is required it should include, but not be limited to, the following:

- Site visit records and photographic records from the watching brief;
- Site visit records and photos from visits completed by a Geo-Environmental Consultant;
- Duty of care records for disposal of waste material including the landfill site(s) or disposal facility where the material has been disposed and a copy of the Contractor's current waste carrier's licence (to be provided by Contractor);
- Records and test certificates relating to the management and disposal or unforeseen contaminants and/or ACMs (if any);
- Details of source and chemical test results for imported materials; and
- Confirmation of water supply pipe materials installed.

13.0 Limitations

This report has been prepared by YE with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources, together with a site walkover inspection of the site.

The opinions given in this report have been dictated by the finite data on which are they based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site. This report is an environmental stage 1 report and does not consider the

geotechnical implications for the site, its redevelopment and proposed future use. Further advice should be sought on geotechnical investigation requirements for the proposed development.

The 'vicinity' of the site for the purposes of the report, is defined as locations situated within an approximate 250m radius of the site, although certain source of contamination and/or sensitive targets further than 250m of site have also been included.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such are not guarantee that the sites are free of hazardous, or potentially hazardous materials, or conditions.

This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent from YE. YE disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.