



Your Environment

PHASE 1: DESKTOP STUDY AND PRELIMINARY RISK ASSESSMENT REPORT AT

THE GARDENERS ARMS,
SURLEY ROW,
EMMER GREEN,
READING,
RG4 8NA

For Caldecotte Group

Your Environment

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1.0 Introduction

YourEnvironment (YE) was instructed by Caldecotte Group (Quote No: Q5010, Dated: July 2nd 2018) to produce a Phase 1: Desktop Study and Preliminary Risk Assessment Report for a site located at The Gardeners Arms, Surley Row, Emmer Green, Reading, RG4 8NA.

We understand current plans for the redevelopment of the site include;

- Construction of nine (9no.) residential dwellings with associated car parking and soft landscaping areas.

The purpose of this report is to accompany other documents for the purposes of obtaining planning permission from the local authority, namely Reading Borough Council.

A proposed site plan provided to YE, at the time of issuing this report can be reviewed within **Appendix A**.

Objectives

The objectives of this Phase 1 report are to:

- Establish the environmental setting, including sensitivity in relation to human health, surface water, groundwater and ecological receptors;
- Review historical and recent uses to assess the potential for contamination to be present from past and current land-use;
- Assess by qualitative means the potential nature and extent of contamination from those uses and the environmental risk and liabilities which may affect the site redevelopment;
- Identify the prevalent source-pathway-receptor linkages present on site by means of a Tier 1 contamination risk assessment which incorporates the formulation of a Conceptual Site Model.

Information Sources

During the production of this report the following information sources have been utilised:

- A review of Historical Ordnance Survey Maps, EnviroInsight and GeoInsight information obtained from Groundsure (4C Group Ltd).

2.0 Site Location

The following table outlines the details of the site:

Site address	The Gardeners Arms, Surley Row, Emmer Green, Reading, RG4 8NA
Grid reference	471545,176139
Total area	0.33ha
Topography	The site is at approximately 79mAOD
Site Layout	The site is an irregular shaped plot of land

Table 1: Site Details

3.0 Site Geology & Geological Hazards

Superficial Ground and Drift Deposits

There are no records of superficial ground deposits underlying the study site, however there is a record of superficial deposits of the Black Park Gravel Member (sand and gravel) 9-12m east.

Bedrock Geology

Underlying the site, the bedrock geology is composed of Lambeth Group (clay, sand and gravel). In addition, records of Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (chalk) are located 9m southeast and 14m south.

Artificial/Made Ground

There are no records of artificial/Made Ground within 50m.

Natural Hazards

On site, there is a moderate risk from shrink-swell hazards and soluble rocks, a low risk from landslides, a very low risk from collapsible rocks and running sand hazards and a negligible risk from compressible ground.

Landslips

There are no records of landslips within 500m.

Linear Features

There are no records of linear features within 500m.

Coal Mining

The study site is not located within 75m of an identified mining area.

Non-Coal Mining

The study site is located within 50m of two identified non-coal mining areas, one of which is on site for chalk. Localised small scale underground mining may have occurred. The remaining record is 9m southeast for chalk. Sporadic underground mining of restricted extent may have occurred. In both cases, potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered.

Johnson Poole and Bloomer Mining

The study site is located within 1000m of a Johnson Poole and Bloomer mining area.

Radon

The study site is not located within a Radon Affected Area, as less than 1% of properties are above the Action Level. Therefore, no radon protective measures are necessary for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment.

Borehole Records

There is one record within 250m of the study site which is located 42m northwest that was drilled to a depth of 7 metres.

4.0 Site Hydrogeology and Hydrology

Aquifer within Bedrock Geology

As a result of the bedrock geology on 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.

Permeability of Bedrock Deposits

The minimum permeability is recorded as being very low with the maximum permeability recorded as being moderate.

Groundwater Abstraction Licences

There are two active groundwater abstraction licences within 2000m, the closest of which is 956m north for spray irrigation - direct. The remaining record is 1741m from the study site.

Surface Water Abstraction Licences

There is one active surface water abstraction licence within 2000m, which is 1990m south for transfer between sources.

Potable Water Abstraction Licences

There are no active potable abstraction licences within 2000m.

Groundwater Vulnerability and Soil Leaching Potential

The on site soil vulnerability category is listed as being 'HU' and 'H1'. 'HU' is defined as soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information. 'H1' is defined as soils which readily transmit liquid discharges because they are shallow or susceptible to rapid flow directly to rock, gravel or groundwater.

Source Protection Zones

The study site is located within a Zone 3 (total catchment) Source Protection Zone.

Ordnance Survey Water Network

There are two records within 500m of the study site, both of which are 369m northeast for an inland river not influenced by normal tidal action.

Surface Water Features

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

Licensed Discharge Consents

There is one records of a site within 500m, which is located 223m west for sewage discharges – pumping station – water company.

5.0 Site Flood Information

The study site is not within 250m of an Environment Agency Zone 2 (fluvial /tidal models) or Zone 3 (fluvial models) floodplain. With this in mind, the highest risk from flooding from rivers and sea (RoFRaS) on site is recorded as very low. There are no areas benefitting from flood defences, flood defences or areas benefitting from flood storage within 250m of the study site.

There are British Geological Survey (BGS) groundwater flooding susceptibility areas within 50m of the boundary of the study site which relate to Clearwater Flooding and therefore the potential susceptibility is from unconfined aquifers.

The BGS confidence rating in respect of this result is high.

6.0 Site Environmental and Industrial Setting

Environmental Permits, Incidents and Registers

Records of Part A(2) and Part B Activities and Enforcements

There is one record of a site within 500m of the study site, which is a Current Part B Permit located 388m east for unloading of petrol into storage at service stations, with no enforcements notified.

Records of National Incidents Recording System, List 2

There are two records of sites within 500m, the closest of which is 321m east for an incident in November 2001 involving smoke that had a Category 4 (no) impact on water, land or air. The remaining record is 462m from the study site.

Sites Determined as Contaminated Land under Part IIA EPA 1990

There are no records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 within 500m.

Landfill and Other Waste Sites

Potentially Infilled Land

There are twenty-seven records of potentially infilled land within 500m, the closest two of which are 27-29m southeast for an unspecified pit. The following records are 29m southeast for an old chalk pit and 33m southeast for an unspecified pit. The remaining records are over 110m from the study site.

Records of Environment Agency Historic Landfill Sites

There are two entries within 1500m, the closest of which is 1411m north that was licensed to accept inert, industrial, commercial, household, liquid sludge waste. The remaining entry is 1443m away from the study area.

Records of BGS/DoE Non-Operational Landfill Sites

There is one record within 1500m of the study site, which is located 853m north at Chambers Copse and poses a risk to the major and minor Aquifer.

Records of Waste Treatment, Transfer or Disposal Sites

There are two records within 500m, both of which are 377m east for a refuse pit.

Workings/Tunnels and Railway Features

Historical Surface Ground Working Features

There are thirteen ground working features within 250m, the closest two of which are 27-29m southeast for an unspecified pit. The following records are 29m southeast for an old chalk pit and 33m southeast for an unspecified pit. The remaining records are over 110m from the study site.

Current Ground Workings

There are eight entries within 1000m of the site, the closest of which is located 41m southeast for Surley Row Chalk Pit, a ceased chalk surface mineral working. The remaining records are over 170m from the study site.

Historical/Current Land Uses

Records of Potentially Contaminative Uses

There are twenty-eight records of sites with a potentially contaminative past land use within 500m, the closest two of which are 27-29m southeast for an unspecified pit. The following records are 29m southeast for an old chalk pit and 33m southeast for an unspecified pit. The remaining entries are over 110m from the study area.

Historical Tanks

There are eight records of sites within 500m, the nearest two of which are 294m southeast for unspecified tanks. The remaining results are over 395m from the study area.

Historical Energy Features

There are sixty records of sites within 500m, the nearest four of which are 32-33m northeast for electricity substations. The remaining entries are over 110m from the study area.

Historical Garage and Motor Vehicles Repairs

There are three records of sites within 500m, all of which are 372-373m east for a garage.

Petrol and Fuel Sites

There is one record within 500m located 399m east for an open petrol or fuel site.

Records of Potentially Contaminative Industrial Sites

There are six records of sites with a potentially contaminative industrial usage within 250m, the closest of which is 27m northeast for an electricity substation. The remaining entries are over 110m from the study site.

Designated Environmentally Sensitive Sites

The study site is located within a Nitrate Vulnerable Zone.

Information on the environmental and geological setting of the site is presented in a Groundsure EnviroInsight and GeoInsight Report prepared for the site, a copy of this report is reproduced in **Appendix B**.

7.0 Historical Mapping Study

The object of this search 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 Groundsure.

Maps only represent a “snap shot” of the site and its environs at the date of the survey. Changes that had occurred either to the site and/or the environs may well not have been recorded on the maps and could represent a hazard to the site.

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.

Year	Information
1878	The site is an irregular shaped plot of land comprised of a vacant field. Off site, a road runs in a north-south orientation immediately west. There are several residential properties with associated land situated throughout the immediate surrounding environs.
1882	The site remains unchanged. Off site, The Gardeners Arms public house is located immediately south, however this is considered to be an error in the mapping as later maps show one building of the public house to be on site. An old chalk pit is located 40m south and an old clay pit is located 180m south. A small pond is located 10m south.
1898	The mapping is shifted to show one of the Gardeners Arms public house buildings on site. In addition, the area to the west of the site has had its trees removed and has been sectioned off from the east of the site. Off site, the old chalk pit appears to have been infilled, a pond is located 80m north and a gravel pit is located 220m southeast.
1900	There have been no discernible changes to the site or immediate surrounding environs.
1910	The site remains unchanged. Off site, the old chalk pit is once again labelled 40m south and the gravel pit 220m southeast has been extended to 180m southeast.
1913	The area to the west of the site appears to be an orchard. Off site, additional orchards are located immediately north and 80m southeast.
1915	There have been no discernible changes to the site or immediate surrounding environs.
1932	A building labelled Gardeners' Arms public house is located to just west of the centre of the site and the orchard to the east has been mostly removed, except for a small portion that remains in the northeast. Off site, tree planting has occurred in the areas of the old chalk and clay pits and the gravel pit 180m southeast appears to have been turned over to rough pastureland.
1936	A small building associated with the public house is located just north of the centre of the site and the remains of the orchard in the northeast corner now appears to be brush woodland. Off site, the orchard immediately north has been removed.
1938	There have been no discernible changes to the site or immediate surrounding environs.
1956	An additional small building is located to the north of the site. Off site, there has been urban expansion of suspected residential properties within the immediate surrounding environs. Electricity substations are located 180m northeast and 210m north.
1958	The mapping is incomplete and therefore it is not possible to ascertain whether any changes have occurred on site or until 100m south. From the limited mapping available, there have been no discernible changes to the immediate surrounding environs.
1962	There have been no discernible changes to the site or immediate surrounding environs.
1970	An additional small building is located to the north of the site. Off site, there has been further urban expansion within the immediate surrounding environs. Additional electricity substations are located 50m northeast, 120m west and 150m south and the small pond 10m south appears to have been infilled.
1973	The site remains unchanged. Off site, there has been urban expansion from 180m north.
1978	The mapping is incomplete and therefore it is not possible to ascertain whether any changes have occurred on site or until 30m west and 100m south. From the limited mapping available, an electricity substation is located 230m southwest.
1989	The two small buildings to the north of the site have been removed and another small building has been constructed to the north of the site. Off site, several suspected residential buildings are located from 40m southwest.
1990	There have been no discernible changes to the site or immediate surrounding environs.
1993	There have been no discernible changes to the site or immediate surrounding environs.
1995	There have been no discernible changes to the site or immediate surrounding environs.
2002	The site remains unchanged. Off site, there has been urban expansion from 170m southeast.
2010	There have been no discernible changes to the site or immediate surrounding environs.

2014	There have been no discernible changes to the site or immediate surrounding environs.
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Table 2: *Historical Mapping Review*

Therefore, from the historical maps we can consider the following:

On site sources of possible contamination;

- Orchard.

Off-site sources of possible contamination;

- Orchard (immediately north, 80m southeast);
- Potentially infilled pond (10m south);
- Old chalk pit (40m south);
- Electricity substations (50m and 180m northeast, 120m west, 150m south, 210m north);
- Old clay pit (180m south);
- Gravel pit (180m southeast, 220m southeast).

The Historical Ordnance Survey Maps were obtained from Groundsure and are available for review within **Appendix C**.

8.0 Walkover Survey

The site was visited by YE on July 13th 2018. The weather was dry and sunny at the time.

Access

The site is accessible from Surley Row via an open access point located on the sites western boundary which leads into a car parking area. Double gates lead from the car park into the rear garden area located on the sites eastern end.

Topography

The site and surrounding area slopes gently from north to south with a slope from east to west also lying on the sites eastern end. Local undulations are located throughout.

Vegetation

The sites northern and southern boundary lines are bordered with vegetation in the form of trees approximately ten to fifteen metres high as well as lower level bushes and shrubbery. The northwest corner of the site is more dense with trees extending from the vegetated/woodland area lying north of the site.

The sites eastern end is used as the garden area for the building and has a grassed floor covering.

Buildings and Structures / Floor Covering

There are 4 structures on site, with two permanent ones and two temporary ones.

The main building is a two-storey public house and restaurant constructed from brick with a tiled pitched roof and concrete floor covering. It was not identifiable at the time of walkover whether the building has a basement or cellar.

The second building is located toward the northeast corner and is a single storey brick built building with a flat felt roof and concrete floor covering used as a games room.

There are two temporary buildings located in the northeast corner of the site in the form of a touring and static caravan.

Surface Permeability / Ground Covering

It is estimated that 70% of the site is impermeable concrete with 30% comprising soft permeable landscaping.

Drainage Features

A number of manholes were located surrounding the main building on all flanks with surface water drains located in the car parking area on the southwest end of the site.

Other Services

The site has access to all services.

Surrounds

The site is located within a residential area and has residential dwellings on all flanks. An area of vegetation/woodland with a public footpath within is located north of the site.

Direction	Description of Site boundary
North	Vegetation approximately ten to fifteen metres high
East	Wooden panelled fencing approximately two metres high
South	Wooden panelled fencing approximately two metres high
West	Brick wall approximately 0.2m high with access point and vegetation located in the northwest corner

Table 3: Summary of site boundaries

Direction	Description of Surrounding Land Use
North	Area of vegetation and woodland with residential properties beyond this
East	Residential dwellings and their respective garden areas
South	Residential dwellings and their respective garden areas
West	Surley Row, residential dwellings and their respective garden areas

Table 4: Summary of Surrounding Land Uses

Potentially Contaminative Land Uses

On site sources:

- None identified.

Off site sources:

- None identified.

Photographs taken during the walkover of the site and surrounds, can be reviewed within **Appendix D**.

9.0 Framework for Assessment of Contamination

Environmental risks are assessed within the risk management framework established in Part IIA of the Environmental Protection Act (EPA) 1990 introduced by Section 57 of the Environment Act 1995 which provides a statutory definition of contaminated land. To fall

within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

(a) Significant harm is being caused or there is a significant possibility of such harm being caused;

or

(b) Pollution of controlled water is being, or is likely to be caused.

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted.

The key aspect of the framework is the development of a Conceptual Site Model (CSM) which illustrates the spatial interaction between the potential sources and receptors on site.

The information presented in this report was collated and evaluated to develop an initial CSM to assess ground contamination issues at the site.

For a risk of pollution or environmental harm to occur as a result of ground contamination, **all** of the following elements must be present:

- A source, i.e., a substance that is capable of causing pollution or harm;
- A receptor, i.e., something which could be adversely affected by the contaminant;
- A pathway, i.e., a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

Potential sources, pathways and receptors are identified in the sections below and the risks associated with possible pollutant linkages outlined.

10.0 Contaminant Sources

On Site Sources

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

- Orchard.

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

- None identified.

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

- None identified.

The following contaminants are potentially associated with these sources:

- Heavy Metals, particularly lead and arsenic;
- Pesticides.

In practice, a broad contaminant screen should be analysed for to ensure that potential contaminants are not omitted.

Off Site Sources

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

- Orchard (immediately north, 80m southeast);
- Potentially infilled pond (10m south);
- Old chalk pit (40m south);
- Electricity substations (50m and 180m northeast, 120m west, 150m south, 210m north);
- Old clay pit (180m south);
- Gravel pit (180m southeast, 220m southeast).

There are further entries present but these are considered far enough from the site to pose no risk.

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

- None identified.

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

- Unspecified pit (27-33m southeast);
- Old chalk pit (29m and 41m southeast);
- Electricity substations (27-33m northeast).

The following contaminants are potentially associated with these sources.

- Heavy Metals;
- PAH and TPH;
- Pesticides;
- 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.

It should be noted that considering the size of the potentially infilled pond and the distance from the receptors on the proposed redevelopment plans, the risk from ground gas generation is reduced.

11.0 Source / Pathway / Receptor

Sources

The *main sources* of potential contamination that have been identified at the site or in the vicinity of the site are summarised above and below:

Source	Location	Description
Orchard	On and Off site	Potential for localised contamination in the form of pesticides and heavy metals, particularly lead and arsenic.
Potentially infilled	Off site	Potential for ground gas generation from the

pond		decomposition of organic carbon due to the unknown constituents of the infilled land. The risk is considered to be reduced due to the small size of the pond and the distance from potential receptors.
Unspecified pits and old chalk pit	Off site	Potential for infilled land and potential contamination from unknown materials used to infill the pits. The risk of ground gas is reduced given the distance from the site.
Electricity substations	Off site	Potential contamination PCBs, although the distance from the site reduces the risk.

Table 5: Sources

Receptors

The site specific **receptors** that could be potentially affected by the contamination hazards identified during this preliminary appraisal are summarised below:

Category	Receptor	Properties
Humans	End users (such as residents and visitors)	Potential contact with contaminated soils in existing/proposed soft landscaping areas.
	Construction workers	Reworking of the contaminant impacted materials in Made Ground during construction works can expose workers to contamination.
Property	Materials and site structures	Foundations and site services may be damaged by potentially aggressive compounds present in soils.
Controlled Waters	Underlying superficial / bedrock Aquifer and surface water	The site is recorded as having a Secondary (A) Aquifer within the bedrock underlying the site. The nearest groundwater abstraction licence is 956m north for spray irrigation - direct and the nearest surface water abstraction licence is 1990m south for transfer between sources. There are no potable water abstraction licences within 2000m. The nearest water network record is 369m northeast for an inland river not influenced by normal tidal action and there are no surface water features within 250m of the site. The site is within a Zone 3 (total catchment) source protection zone.
Plant (species and uptake) and Wildlife	Various	Attributes will be influenced by factors such as relative quality, scale, rarity and substitutability.

Table 6: Receptors

Pathways

In order for contaminants to reach potential receptors, there has to be a viable **pathway** for the contaminant. Potential pathways that may affect the migration of contaminants are listed below:

Pathway	Medium	Properties
Direct Contact	Dust, solid and liquid phase	There may be direct contact with potentially impacted soil and Made Ground across the site. There is a possibility of dust fumes being produced during earthworks in the construction phase. Dermal contact and ingestion of

		potentially contaminated soils during construction or operational phase of the site.
Leaching through Made Ground	Unsaturated flow	Potential for leaching and migration of potential contaminants along preferential flow paths in the Made Ground due to its heterogeneity.
Foundations and Underground Infrastructure and Obstructions	Preferential flow	Depending on the foundation solution adopted, preferential flow paths for the vertical migration of potential contaminants to the underlying groundwater could be created.
Migration of Ground Gas	Gaseous flow	Made Ground is known to be highly variable in composition. Migration through granular material in Made Ground and alongside buried utility pipes / cables or along preferential flow paths.

Table 7: Pathways

12.0 Qualitative Risk Assessment

Potential pollutant linkages are identified using the source-pathway-receptor framework detailed above. An assessment of the potential significance of each linkage is then made by consideration of the likely magnitude and mobility of the source, the sensitivity of the receptor and nature of the migration/exposure pathways.

This qualitative risk assessment has been undertaken in accordance with CIRIA C552: Contaminated Land Risk Assessment, A Guide to Good Practice (Rudland et al., 2001).

An assessment of the likelihood of the risk being realised and the magnitude of potential risk is presented below to give an estimation of the significance of each potential pollutant linkage identified.

The assessment is undertaken based on the current proposals for the site, at the time of issuing this report, which would be classed as been a generic end land use of 'residential with homegrown produce'.

13.0 Preliminary Conceptual Site Model

Contaminant Source	Pathways	Receptor	Potential Severity	Probability of Risk	Level of Risk	Justification
On Site: Made Ground soils on site possibly containing elevated metals and pesticides.	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 historic orchard land uses 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 home grown 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/ Low	A moderate to low risk is assessed due to the orchard on site and the presence of a Secondary (A) Aquifer within the bedrock underlying the site. The nearest groundwater abstraction licence is 956m north for spray irrigation - direct and the nearest surface water abstraction licence is 1990m south for transfer between sources. There are no potable water abstraction licences within 2000m. The nearest water network record is 369m northeast for an inland river not influenced by normal tidal action and there are no surface water features within 250m of the site. The site is within a Zone 3 (total catchment) source protection zone.
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Likely	Low	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 given the potential for phytotoxic contaminants to be present on site and 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	Likelihood is considered to be low as the site walkover did not identify any potential asbestos containing materials (ACMs). However, the age of the buildings on site does not preclude the presence of asbestos, therefore an asbestos survey should be undertaken prior to investigative works proceeding.
		Construction Workers	High	Low Likelihood	Low	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 is given due to the lack of infilled land and limited depth of potential Made Ground on site. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation.
Off Site: Historical land uses and activities, Made Ground/infilled material possibly containing elevated metals, other inorganics, TPH, PAH, PCBs, phenols, VOC and SVOCs.	Leaching through soils and migration via groundwater or soil pore moisture	Future end users and site visitors	Mild	Low Likelihood	Low/ Moderate	Given the variable permeability of the underlying geology and hydrogeology, there would be a moderate risk for the leaching of contaminants. However, the lack of proximal potentially contaminative activities in the surrounding area that could pose a risk to the site result in a low to moderate risk for contamination on site.
	Inhalation of vapours	Future end users and site visitors	Medium	Low Likelihood	Low	A low level of risk is assessed due to the lack of 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	Low/ Moderate	A moderate risk would be considered given the potentially infilled pond and unspecified pits off site, however given the distance from the site and the small size of the potentially infilled pond, the risk is considered to be reduced. Current guidance indicates that Made Ground is generally classified as low risk in terms of potential for gas generation.

Table 8: *Preliminary Conceptual Site Model*

14.0 Proposed Site Investigation

Based on the information obtained for formation of this report, we would recommend that an intrusive contaminated land investigation is undertaken to determine the actual pollution linkages and to quantify the risk to the receptors as outlined with the Preliminary Conceptual Site Model.

The intrusive investigation may reveal on-site sources of contamination that were not established by the Phase I Desk Study and Site Walkover and thus require modification of the conceptual site model.

14.1 Testing Regime

The testing regime has been devised in accordance with BS10175:2015 Guidelines for the Code of Practice for Contaminated Land and CLR Report No. 4 Sampling Strategies. The objective at this stage of the report is to attempt to delineate the extent of any possible contamination that may exist at the site by using intrusive soil sampling and testing techniques.

14.2 Sampling Strategy

A service search should be completed prior to any subsequent investigation to determine the service locations by lifting up any manhole/drain covers, therefore locations may be subject to change depending upon these results.

The SI should incorporate the excavation of four (4no.) trial pits. These exploratory holes will be completed to a maximum depth of 1.0 metres below ground level (mbgl), positions logged and samples removed in accordance with current protocol, with any visual/olfactory observations noted.

Soil samples will be taken through the soil profile at depths of 0.15mbgl, 0.30mbgl, 0.50mbgl, 0.70mbgl and 1.00mbgl with the deepest sample to be obtained from the natural strata. The proposed sampling strategy is relative to the intended risk assessment.

The intended depths of investigative positions reflect the particular receptor of concern which is driven by the exposure of scenario of concern, namely human health. Surface samples in the top 0.15mbgl for direct ingestion and inhalation, with samples obtained at 0.30mbgl to 0.50mbgl for vegetable uptake. The samples to be obtained at greater depths are to ensure any potential contamination has not impacted natural soils at depth.

It is recommended that exploratory holes are excavated within locations based on the findings within this report, with at least three trial pits to be located within areas of proposed soft landscaping and gardens.

14.3 Monitoring Regime

Based on the information contained within this report we do not anticipate the need for completing any gas and/or groundwater monitoring for this site. The historical, current and proposed use of the site along with the hydrological setting indicates that there is no significant risk. Furthermore, whilst we anticipate Made Ground to be present on site we believe this will be of limited depth that the associated risks from gassing will be

negligible. However, if hydrocarbon contamination is identified within the trial pits and from subsequent risk assessment works is considered to pose a risk, it may be that a more thorough investigation, with ground gas monitoring to assess the risk of potential volatilisation and risk posed to proposed structures is required.

14.4 Laboratory Analysis

An appropriate and consistent analytical suite of contaminants should be applied to any soil samples retrieved from the site.

Based on the findings contained within this report, we would recommend that a comprehensive range of testing should be undertaken to comprise 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, soil organic matter (SOM) content, pesticides, pH, and sulphates.

In addition, selected samples retrieved from the Made Ground, if encountered, will also be submitted for a screen to determine the presence, or otherwise, of asbestos.

It should be noted that not all samples retrieved from the proposed investigative works will be laboratory analysed and a UKAS and MCERTS accredited laboratory testing organisation should carry out all analysis.

14.5 Guidance

The results from the proposed SI shall be compared against standards, such as, 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. Or alternatively criteria such as, Soil Guideline Values (SGVs) and LQM 'CIEH' Generic Assessment Criteria for the land use classification appropriate to the end use, namely; 'residential with homegrown produce'.

Results from gas monitoring shall be used to calculate a Gas Screening Value (GSV) in accordance with CIRIA C665 '*Assessing Risks Posed by Hazardous Ground Gases to Buildings*'.

Groundwater analysis, if encountered, would be compared against the Drinking Water Standards (DWS) for the United Kingdom (UK). At present, there are no current UK DWS guidance for TPH, however, to enable suitable characterisation of the site the old UK DWS guidance values will be utilised for correlative purposes.

15.0 Recommendations

15.1 Consultees

We would recommend that this report be forwarded to the relevant Local Authority Environmental Health and Planning Department prior to the proposed site investigation works commencing to seek their comments and subsequent approval.

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

15.2 Groundworks Watching Brief

During construction works visual and olfactory appraisal of the underlying soils should be made. If during construction works any material is noted to show visual and/or olfactory signs of contamination an environmental consultant should be contacted to supervise/guide further works. This material should be stockpiled separately and tested prior to its appropriate removal off site or re-use as necessary.

If any landscaping materials are to be imported on site they should be tested to check that they are suitable for the intended use. Clean, uncontaminated rock, subsoil brick rubble, crushed concrete, ceramics and topsoil only should be permitted as infill material.

15.3 Soakaways

Soakaways are for the disposal of clean uncontaminated surface water only and must not be constructed in contaminated land, or land suspected of having contamination present.

15.4 Flood Risk Assessment

This report does not replace a full hydrogeological survey and specialist studies may need to be undertaken to ascertain the risks posed from flooding.

15.5 Asbestos Survey

We would recommend that an asbestos survey is carried out on site, prior to construction works proceeding. If any asbestos containing material (ACMs) are identified these will need to be dealt with in accordance with current guidance.

15.6 Mining

Given the historic nature of mining activities identified to have taken place on site, it is recommended that a mining search is undertaken to establish what risks these features may pose to the study site.

In addition, this mining report and risk assessment may dictate whether a more onerous site investigation is required, to that outlined, as it will provide information on the extent of the workings present, and their depth in relation to the water table.

16.0 Limitations and Uncertainties

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 phase 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.