PHASE 1: DESKTOP STUDY AND PRELIMINARY RISK ASSESSMENT REPORT FOR HIGH BARN, CRAYS LANE, GOOSE GREEN, PULBOROUGH, RH20 2LR

For Jolliff Developments Limited

Your Environment
Head Office, Unit 2, Woodhorn Business Centre, Oving
Chichester, West Sussex PO20 2BX
Tel: 01243 787150

Report Number: YEX2150, April 2021

James von Mehren
[redacted]

	Name	Position	Signature	Date
Responsible:	James von Mehren	Geo Environmental Engineer	[redacted]	Issue 01 June 2021
Authorised:	Colin Hiscock	Director	[redacted]	Issue 01 June 2021

Revision Record:

Issue	Date	Description	Contributors	Responsible	Authorised
00	15.06.21	Final Report	JvM	JvM	CH

Contents

1.0 Introduction 1
2.0 Environmental and Geological Setting 1
3.0 Past Land Use and Potential Contaminant Sources 5
4.0 Historical Mapping Study 9
5.0 Walkover Survey 10
6.0 Framework for Assessment of Contamination 11
7.0 Possible Contaminant Sources, Pathways and Receptors 12
8.0 Qualitative Risk Assessment 14
9.0 Preliminary Conceptual Site Model 15
10.0 Recommendations 17
11.0 Limitations and Uncertainties 18

Appendices

Appendix A - Proposed Redevelopment and Location Plans
Appendix B – Groundsure Enviro + Geo Insight
Appendix C - Historical Ordnance Survey Maps
Appendix D - Site Walkover Photographs
Appendix E – Zetica Bomb Risk Map

Executive Summary

Summary of Contamination Recommendations

The below table shows a snapshot of the recommendations concerning ground contamination within this report. It is advised that the report is read in its entirety to gain a better understanding of our findings and recommendations. This section is relevant to Contamination ONLY and further recommendations concerning other aspects may be presented later in this report.

Potential Linkage	No Investigation Recommended	Investigation Recommended
Soil Contamination		✓
Ground Gas	✓	

Investigation Recommended

We have identified one or more potential material sources of contamination within the site itself or in the surrounding area that may, if present, represent a risk of harm to users of the development. Investigation of the site is recommended to enable a robust assessment of this risk to be made, and we would further recommend that further development works on the site do not take place until this investigation has been completed and reported.

1.0 Introduction

*Your*Environment (YE) was instructed by Jolliff Developments Limited to produce a Phase 1: Desktop Study and Preliminary Risk Assessment Report for the site located at High Barn, Crays Lane, Goose Green, Pulborough, RH20 2LR (grid ref: 511348 118046; area: 0.08ha).

We understand current plans for the redevelopment of the site comprise:

- Demolition of 2No. agricultural buildings and the erection of 3No. dwellings

The purpose of this report is to support discharge of a planning condition, Condition 3, attached to the conditional consent (Reference DC/20/1870) for the redevelopment of the site granted by Horsham District 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 primary information sources have been utilised:

- Enviro + Geo Insight data obtained from Groundsure
- Historical Ordnance Survey mapping at scales ranging from 1:1,250 to 1:10,560, obtained from Groundsure
- Zetica bomb risk maps

The full information from these sources can be reviewed within **Appendices B & C.**

2.0 Environmental and Geological Setting

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

2.1 Site Geology

Site geology has been assessed by reference to information from British Geological Survey mapping summarised in the Groundsure Enviro + Geo Insight data. Information from these sources referenced in this report has been predominantly limited to that identified within 50m of the site (underlying geology) or 250m of the site (structural features, borehole records), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Superficial Ground and Drift Deposits

There are no superficial deposits underlying the study site.

Bedrock Geology

Underlying the superficial drift deposits is bedrock comprised the Weald Clay Formation (mudstone).

Landslips

There are no records within 250m.

Linear Features

There are no records within 250m.

Natural Ground Subsidence

The following hazard ratings applicable to the site and land within 50m are presented in the Enviro + Geo Insight Report:

Shrink swell clays	Low
Running sands	Negligible
Compressible deposits	Negligible
Collapsible deposits	Very low
Landslides	Very low
Ground dissolution	Negligible

Table 2.1: Natural Ground Subsidence

2.2 Site Hydrogeology and Hydrology

These records are derived by Groundsure from Environment Agency and British Geological Survey data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site (aquifers, surface water) or 1000m of the site (abstractions), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Table 2.2 presents Environment Agency aquifer designations:

Principal Aquifer	Layers with high intergranular and/or secondary permeability capable of supporting water supplies at strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Major Aquifers.
Secondary (A) Aquifer	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.
Secondary (B) Aquifer	Predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water bearing parts of former Non-Aquifers.
Secondary Undifferentiated Aquifer	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.
Unproductive strata	Rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Table 2.2: Aquifer Designations

Aquifer within Superficial Deposits
No superficial deposits are recorded on the site.

Permeability of Superficial Deposits
No superficial deposits are recorded on the site.

Aquifer within Bedrock Geology
As a result of the bedrock geology on site, the Weald Clay Formation is designated as being Unproductive.

Water Framework Directive Groundwater Bodies
The site is not within any groundwater water bodies.

Permeability of Bedrock Deposits
The minimum permeability is recorded as being very low with the maximum permeability recorded as being low.

Groundwater Vulnerability

Table 2.3 presents Environment Agency groundwater vulnerability definitions:

High Vulnerability	Areas able to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits.
Medium Vulnerability	Intermediate between high and low vulnerability.
Low Vulnerability	Areas that provide the greatest protection from pollution. They are likely to be characterised by low leaching soils and/or the presence of superficial deposits characterised by a low permeability.

Table 2.3: Groundwater Vulnerability Definitions

Groundwater Abstraction Licences

There are no groundwater abstraction licences within 1000m.

A single active record was identified 1342m southwest for horticultural watering.

Surface Water Abstraction Licences

There are no licensed surface water abstractions within 1000m.

Potable Water Abstraction Licences

There are no potable abstraction licences within 1000m.

Source Protection Zones

There are no records within 250m.

Ordnance Survey Water Network

A single inland river was identified 159m east.

Surface Water Features

There is one record referring to a surface water body catchment.

Water Framework Directive Surface Water Bodies and Catchments

The site is within the Adur (Hammer pond) river water body catchment.

2.3 Environmentally Sensitive Areas

These records are derived by Groundsure from Environment Agency, Natural England, Historic England, English Heritage, Forestry Commission and UK Government data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified within 500m of the site (environmental designations) or 250m of the site (habitat, visual and cultural designations), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Environmental and Habitat Designations

The site is within an SSSI impact risk zone.

There are four (4no) records of deciduous woodland Priority Habitat Inventories, located 6m southwest, 200m west, and 242m and 246m east.

Visual and Cultural Designations

There are no records of visual or cultural designations such as areas of outstanding natural beauty, scheduled ancient monuments or listed buildings within 250m of the site.

3.0 Past Land Use and Potential Contaminant Sources

Information on past land use and potential contaminant sources is presented in a Groundsure Enviro + Geo Insight Report prepared for the site, a copy of this report is reproduced in **Appendix B.**

3.1 Land Use Records

These records are derived by Groundsure from historical mapping and each record corresponds to a particular map revision date. Thus, several records may refer to the same feature where it is present over time. Groundsure has in some cases grouped such records in the Enviro + Geo Insight report. Differences in distances quoted from the study site may be due to expansion of the feature over time or geolocation errors.

Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site, in order to focus on the information directly relevant to the site. Information from outside this radius will be referenced when deemed relevant.

Historical Industrial Land Uses

There are no records within 250m.

A further afield record of unspecified disused works was identified 309m northeast.

Historical Tanks

There are no records of historical tanks within 250m.

Historical Energy Features

There are no records of historical energy features such as electricity sub-stations within 250m.

Historical Petrol Stations

There are no records of historical petrol stations within 250m.

Historical Garages

There are no records of historical garages within 250m.

Historical Military Land

There are no records of historical military land within 250m.

Current or Recent Industrial Land Uses

There are no records within 250m.

Current or Recent Petrol Stations

There are no records of current or recent petrol stations within 250m.

Electricity Cables

There are no records of high voltage underground electricity cables within 250m.

Gas Pipelines

There are no records of high pressure underground gas pipelines within 250m.

Railway Infrastructure

There are no records of historical or current railway infrastructure or projects within 250m.

3.2 Environmental Permits, Incidents and Registers

These records are derived by Groundsure from local authority, Health and Safety Executive and Environment Agency data. Details of the source and coverage of specific records are

provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site, in order to focus on the information directly relevant to the site. Information from outside this radius will be referenced when deemed relevant.

Sites Determined as Contaminated Land
There are no records of sites determined as contaminated land under Part 2A of the Environmental Protection Act 1990 within 250m.

Control of Major Accident Hazards (COMAH)
There are no records within 250m.

Regulated Explosive Sites
There are no records within 250m. Note that details of some sites may be redacted for security reasons.

Planning Hazardous Substances Consents
There are no records within 250m.

Records of Historic IPC Licensed Activities
There are no records within 250m.

Records of Part A (1) Licensed Activities
There are no records within 250m.

Records of Part A (2)/B Licensed Activities and Pollutant Release
There are no records within 250m.

Records of Radioactive Substance Authorisations
There are no records within 250m.

Licensed Discharges to Controlled Waters
There is a single record within 250m of the study site, identified 104 south relating to trade discharges (site drainage).

Pollutant release to Surface Waters (Red List)
There are no records within 250m.

Pollutant Release to Public Sewer
There are no records within 250m.

List 1 and List 2 Dangerous Substances
There are no records within 250m.

Substantiated Pollution Incidents
There are no records within 250m.

Pollution Inventory Substances
There are no records within 250m.

Pollution Inventory Waste transfers
There are no records within 250m.

Pollution Inventory Radioactive Waste
There are no records within 250m.

3.3 Waste and Landfill

These records are derived by Groundsure from Environment Agency, British Geological Survey, Ordnance Survey (interpreted by Groundsure) and local authority data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report.

Information from these sources referenced in this report has been predominantly limited to that identified within 500m of the site (landfills) or 250m of the site (non-landfill waste operations), in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Active or Recent Landfill

There are no records within 500m of the study site.

Historical Landfill

There are no records within 500m of the study site.

Non-Landfill Waste Records

There are no records within 500m of the study site.

3.4 Mining, Ground Workings and Natural Cavities

These records are derived by Groundsure from British Geological Survey, Ordnance Survey (interpreted by Groundsure), Coal Authority, Peter Brett Associates, Johnson Poole and Bloomer, Cheshire Brine Subsidence Compensation Board, British Gypsum, Mining Searches UK, Kaolin and Ball Clay Association and local authority data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report.

Information from these sources referenced in this report has been predominantly limited to that identified within 250m of the site, in order to focus on the information directly relevant to the site. Information from outside these radii will be referenced when deemed relevant.

Natural Cavities

There are no records within 250m.

Mining Cavities

There are no records within 250m.

BritPits Data (Surface and Underground Mineral Workings)

There is one record within 250m.

There are two (2no) records relating to a ceased surface mineral working for sand, identified 475m northeast.

Historical Mineral Planning Areas

There are three records within 250m.

A record for a sand surface mineral working was identified 293m northeast, named Peacock Lane.

Surface Ground Workings

There are no records within 250m.

Underground Workings

There are no records within 250m.

Coal Mining

There are no records held by the Coal Authority or by Johnson Poole and Bloomer within 250m.

Non-Coal Mining

According to BGS records, the site is located in an area with potential to have been affected by historical non-coal mining for sand/building stone. Localised small scale underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered.

There are no records within 250m for brine extraction or gypsum, tin or clay mining.

3.5 Radon and Background Soil Chemistry

These records are derived by Groundsure from British Geological Survey and Public Health England data. Details of the source and coverage of specific records are provided in the Enviro + Geo Insight Report. Information from these sources referenced in this report has been predominantly limited to that identified on or within 50m of the site.

Radon

The study site is not located within a Radon Affected Area, as between 3% and 5% of properties are above the Radon Action Level. No radon protective measures are necessary for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment.

Background Soil Chemistry

Values estimated by BGS for background concentrations of five potentially harmful elements are provided as follows:

Arsenic	15 mg/kg
Bio-accessible arsenic	No data
Lead	100 mg/kg
Bio-accessible lead	60 mg/kg
Cadmium	1.8 mg/kg
Chromium	60-90 mg/kg
Nickel	15-30 mg/kg

Table 3:1 Background Soil Chemistry

These values are not considered to be elevated with respect to guideline values for residential end-uses.

3.6 Unexploded Ordnance (UXO)

According to bomb risk maps made available online by Zetica and the site is in an area considered to be at low risk from wartime unexploded ordnance.

The Zetica bomb risk map is reproduced in Appendix E.

4.0 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 at scales ranging from 1:1,250 to 1:10,560 dating from the mid to late 19th Century to the present day, and Getmapping PLC aerial photography dating from the late 1990s to the recent past, as provided by Groundsure.

Information in the historical mapping study has been predominantly limited to that identified on the site or within 100m of the site, in order to focus on the information directly relevant to the site. Information from outside this radius will be referenced when deemed relevant.

Each map or photographs only represents a "snap-shot" of the site and its environs at the date of the survey. Changes that had occurred at other times may not have been recorded on the maps and could represent an unidentified 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	On site	Off site
1875	The site is undeveloped	The surrounding area is largely undeveloped and in assumed agricultural use. Crays barn 100m north Crays farm 200m southwest
1876	No discernible changes	No relevant changes
1896-1897	No discernible changes	No relevant changes
1909	No discernible changes	No relevant changes
1911-1912	No discernible changes	No relevant changes
1939	No discernible changes	No relevant changes
1946	No discernible changes	No relevant changes
1957	No discernible changes	No relevant changes
1973-1974	No discernible changes	Unspecified buildings 75m north Lower Crays farm 100m north Upper crays farm 200m southwest
1980	No discernible changes	(Disused) works 450m northeast
1984	No discernible changes	Partial map- no relevant changes
1993	No discernible changes	No relevant changes
1999	One large building covers whole site	No relevant changes
2001	No discernible changes	No relevant changes
2003	No discernible changes	No relevant changes
2009	No discernible changes	No relevant changes
2010	No discernible changes	No relevant changes
2012	No discernible changes	No relevant changes
2015	No discernible changes	No relevant changes
2018	No discernible changes	No relevant changes
2021	No discernible changes	No relevant changes

Table 4.1: Historical Mapping Review

The Historical Ordnance Survey Maps were obtained from Groundsure and are available for review within Appendix C. The aerial photographs are included in the Groundsure Enviro + Geo Insight Report and are available for review within Appendix B.

5.0 Walkover Survey

*Your*Environment attended the site on 29th April 2021, and the weather was dry and sunny at the time.

Current Site Use

The site is currently being used to store some agricultural mechanical equipment, as well as some waste products such as old tyres and discarded wood pieces.

Access

The site is accessible via a public access driveway from the west of Crays Lane.

Topography

The general groundslope in the area is flat and level.

Buildings and Structures

The following buildings are present on the site:

One large stone-built storage barn with corrugated roofing makes up the majority of the site.

Hard Surfaced Areas

The hard-surfacing for the main building and a portion of the surrounding material are comprised of concrete and asphalt.

Landscaped and Vegetated Areas

A small area of soft landscaping was identified at the south of the study site, comprised of dry mud and aggregate material, as well as a small area laid to grass.

Surface Permeability / Ground Covering

It is estimated that approximately 10% of the site is permeable soft landscaping and hardcore with approximately 90% comprising impermeable asphalt and concrete.

Drainage Features

No drainage features were observed during the site walkover.

Other Services

The site did not appear to have any services.

Direction	Description of Site boundary
North	No defined boundary/small adjacent wood-built, corrugated roof building
East	Overgrown vegetation
South	1m wooden fence
West	No defined boundary/side of main building

Table 5.1: Summary of site boundaries

Direction	Description of Surrounding Land Use
North	Agricultural
East	Agricultural
South	Agricultural
West	Agricultural

Table 5.2: Summary of Surrounding Land Uses

Potentially Contaminative Land Uses

On site sources:

- Corrugated roofing
- Storage of agricultural machinery

Off site sources:

- Corrugated roofing

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

6.0 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 in accordance with the Land Contamination Risk Management Framework (LCRM) prepared by the Environment Agency on 8 October 2020. Which considers 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 considers the potential contaminant linkages between potential contaminant sources, the receptors that could be affected by the contaminants, and the pathways by which the receptors could be exposed to the contaminants.

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 - a substance that is capable of causing pollution or harm
- A receptor - something which could be adversely affected by the contaminant
- A pathway - 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 Potential Contaminant Linkages outlined.

7.0 Possible Contaminant Sources, Pathways and Receptors

Potential Sources

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

Source	Identified by	Location	Description
Historical development/corrugated roofing	Walkover/historical mapping	On site 75m north	Historic development can be associated with general construction waste, but Potentially Asbestos Containing Materials are the main concern. PACMs can pose a severe risk to human health depending on friability and availability to the surrounding environs. PACMs may require an asbestos survey to be carried out by a competent person.
Non-coal mining activity	Envirosearch report	On site	Ground workings may present a ground gas risk.
Machinery stored on site	Walkover	On site	Due to the high use of Hydrocarbon based products, A wide variety of contaminants are associated with these types of land use. TPH, BTEX, MTBE, heavy metals, VOCs, SVOCs, and PAH, and Asbestos, are all associated with these types of land use
Agriculture	Walkover/historical mapping	On site 100m north 200m southwest	Potential for contaminants such as Asbestos, PAH, TPH, agrochemicals pesticides, herbicides, heavy metals, VOCs, and SVOCs.

Table 7.1: Potential Sources

The following contaminants are potentially associated with the on-site sources:

- Heavy Metals
- TPH
- PAH
- PACMs/Asbestos
- VOCs
- SVOCs

The following contaminants are potentially associated with the off-site sources:

- Heavy Metals
- PAH
- TPH
- PACMs/Asbestos
- Agrochemicals
- VOCs
- SVOCs
- Ground gas

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

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 ground.
Foundations and Underground Infrastructure and Obstructions	Preferential flow	Contaminants will flow the path of least resistance which can be gaps around foundations, services, and floor construction
Migration of Ground Gas	Gaseous flow	Infilled land material is likely to be variable in composition. Migration through granular material within superficial deposits is possible.

Table 7.2: Pathways

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. Potential contact with ground gas within enclosed buildings
	Construction workers	Reworking of contaminant impacted materials in underlying soil 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 an Unproductive aquifer within the bedrock deposits.
Plant (species and uptake) and Wildlife	Various	Attributes will be influenced by factors such as relative quality, scale, rarity and substitutability.

Table 7.3: Receptors

8.0 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 Annex 4 of the National House Building Council/Environment Agency/Chartered Institute of Environmental Health R&D publication 66, Guidance for the Safe Development of Housing on Land Affected by Contamination (NHBC/EA/CIEH, 2008) which updates and supersedes 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. Where it is considered that there is no credible linkage, this is indicated in the table. In accordance with the R&D66 guidance, if there is no pollution linkage then there is no need to apply tests for probability and consequence.

The assessment is undertaken based on the current proposals for the site, at the time of issuing this report, which would be classed as a generic end land use of 'residential (with consumption of homegrown produce)'. Any change in the development proposals for the site involving a change in end use class may result in a requirement for this assessment to be revised.

9.0 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, other 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/ Low ●●	A moderate/low risk rating has been assessed due to the history of potentially contaminative land uses on site although the contamination potential is not considered to be high. 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	Mild	Low Likelihood	Low ●	A low risk rating has been assessed due to the presence of potentially contaminative sources on site and the Unproductive aquifer within the bedrock deposits. The nearest groundwater and potable water abstraction licence is 699m northwest for drinking, cooking, sanitary, washing, commercial, industrial and public services. In addition, the nearest surface water feature is 10m east for a dock, there are no river networks within 250m of the site and the site is not within a source protection zone.
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Low Likelihood	Moderate/ 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	Low ●	A low risk rating was assessed as there are very few potentially contaminative sources on site but there is an appreciable risk as there is soft landscaping in the plans.
On Site: Asbestos at/near ground surface in Made Ground soils.	Inhalation of fibres in airborne dust	Future end users and site visitors	Medium	Low Likelihood	Moderate/ Low ●●	A moderate/low risk rating has been assessed as corrugated roofing was observed during the site walkover which is potentially an asbestos containing material. There is low likelihood that future end users would make contact with this material.
		Construction Workers	Medium	Low Likelihood	Moderate/ Low ●●	A moderate/low risk rating has been assessed as corrugated roofing was observed during the site walkover which is potentially an asbestos containing material. During subsequent normal groundworks, safe working practices should be implemented and appropriate personal protective

						equipment (PPE) should be used to mitigate any potential risk from residual asbestos in soils.
On Site: Ground Gases (CH4, CO2) from on site Made Ground.	Gas migration and build up within buildings (explosion/ asphyxiation risk)	Future end users and building structures.	Medium	Low Likelihood	Moderate/ Low 🟢🟡	A moderate/low risk rating has been assessed due to the historical use of the area for non-coal mining which has an associated potential for ground gas.
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	Low 🟢	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 upgradient of the site in the surrounding area result in a low risk for contamination on site.
	Ingestion, dermal contact, inhalation of dusts/vapours	Future end users and site visitors	Mild	Low Likelihood	Low 🟢	A low level of risk rating has been assessed as the potentially contaminative land uses/activities are distal to the study site, but they may not have been redeveloped.
Off Site: Ground Gases (CH4, CO2, H2S) from off site historical landfilling activities.	Gas migration and build up within buildings (explosion/ asphyxiation risk)	Future end users and building structures.	Mild	Low Likelihood	Low 🟢	There is a historical of surface mineral workings in the surrounding area, which has the potential to produced ground gas. However, the likelihood is considered low.

Table 10.1: Preliminary Conceptual Site Model

10.0 Recommendations

10.1 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.

The proposed scope of investigation is outlined below.

Scope of Proposed Investigation

Testing Regime

The testing regime has been devised in accordance with BS10175:2017 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 identify the extent of any possible contamination that may exist at the site by using intrusive soil sampling and testing techniques.

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 drilling of four (4no.) window sampler boreholes in order to gain a suitable spread of the site and enable adequate analysis of the soil conditions. This will be completed to a maximum depth of 4-5 metres below ground level (mbgl) or refusal or where groundwater is encountered.

All positions should be logged, and samples removed in accordance with current protocol. In addition, groundwater conditions, if encountered, shall be logged and visual/olfactory observations noted.

We would recommend that the test locations be based on the findings contained with this report, to enable a broad coverage of the site.

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, VOCs, SVOCs, 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.

Guidance

The results from the proposed SI shall be compared against standards, such as the revised LQM/CIEH S4UL criteria[1] where available.

Results from gas monitoring shall be used to calculate a Gas Screening Value (GSV) in accordance with BS8485: 2015.

10.2 Consultees

It is highly recommended that this report be forwarded to the relevant Local Authority Environmental Health and Planning Departments to seek their comments and subsequent approval, otherwise further works may be required.

10.3 Groundworks Watching Brief

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.

If any landscaping materials are to be imported on site they should be tested to check that they are suitable for the intended use.

10.4 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. Further details on site flood information can be found within the appendices.

11.0 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 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

[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

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.