



Your Environment

PHASE 1: DESKTOP STUDY AND
PRELIMINARY RISK ASSESSMENT
REPORT AT
SOUTHCOTE MILL,
SOUTHCOTE FARM LANE,
READING,
RG30 3DZ
For Z. Puddephatt

Your Environment

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1.0 Introduction

YourEnvironment (YE) was instructed by Z. Puddephatt to produce a Phase 1: Desktop Study and Preliminary Risk Assessment Report for a site located at Southcote mill, Southcote farm, Reading, RG30 3DZ (grid ref: 469267, 171226; area: 0.26ha).

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

- Change of use and construction of new café, holiday let apartment;
- Manager's accommodation;
- Inclusion of areas of soft landscaping.

The purpose of this report is to accompany other documents for the purpose of obtaining planning permission from 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).

It should be noted that the information taken from these sources has been predominantly limited to within 100m of the site, in order to relate only the most pertinent information. Information from outside this 100m radius will be included when deemed relevant. The full information from these sources can be reviewed within **Appendices B & C**.

2.0 Site Geology & Geological Hazards

Superficial Ground and Drift Deposits

The superficial ground deposits underlying the study site are comprised of Alluvial Fan Deposits (clay, silt, sand and gravel).

Bedrock Geology

Bedrock and solid geology are composed of Lambeth group Formation (clay, slit and sand).

Artificial/Made Ground

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

Landslips

There are no records of landslips on site.

Linear Features

There are no records of linear features within 500.

Coal Mining

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

Non-Coal Mining

The study site is not located within 50m of an identified non-coal mining area.

Johnson Poole and Bloomer Mining

The study site is located within 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 are six records within 100m of the study site the closest of which is located 22m north that was drilled to a depth of 49.53 metres. The following records are 30m north that was drilled to a depth of 19.2 metres, 32m north that was drilled to a depth of 21.12 metres, 76m north that was drilled to -1 metre, 80m north that was drilled to -1 metre, 87m north that was drilled to a depth of -1 metre. The remaining entries are over 100m from the site.

Borehole Ref. No.	Distance (m) & Direction	Drilled Depth (m)	Natural Encountered (m)
SU67SE435	22.0 north	49.53	3.66

Table 1: Borehole Records.

The borehole logs within the table above can be found in [Appendix E](#).

3.0 Site Hydrogeology and Hydrology

Aquifer within Superficial Deposits

As a consequence of the superficial geology on site the aquifer is designated as being a Secondary (A) Aquifer. These are 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 Superficial Geology

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

Aquifer within Bedrock Geology

As a result of the bedrock geology on site, the aquifer is designated as being Secondary (A).

Permeability of Bedrock Deposits

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

Groundwater and Surface Water Abstraction Licences

There are thirteen active groundwater and surface water abstraction licences within 2000m, the closest of which is 944m east for a portable water supply direct. The remaining records are over 1000m from the study site.

Potable Water Abstraction Licences

There are ten active potable abstraction licences within 2000m, the closest is 944m. The remaining records are over 1000m from the study site.

Groundwater Vulnerability and Soil Leaching Potential

The onsite soil vulnerability category is listed as being 'H1', this 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 not located within a Source Protection Zone.

Ordnance Survey Water Network

There are ninety records within 250m of the study site, the closest two are on site for an inland river not influenced by normal tidal action. There are further entries from the study site which includes 6m south for the River Kennet and 8m north for Kennet and Avon Canal. There are further entries from 10m north and 13m south, however, these are also deemed to represent the Kennet and Avon Canal and the River Kennet.

Surface Water Features

There are seventeen records within 250m of the study site, the closest of which is on site for a canal. There are further entries from 10m north and 20m south which also represent the Kennet and Avon Canal and the River Kennet.

Licensed Discharge Consents

There is one record of site within 100m, which is located 33m southwest for sewage discharges - final/treated effluent. There are further records over 200m from the study site.

4.0 Site Environmental and Industrial Setting

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-four records of potentially infilled land within 500m, one of which is on site for a canal. The next seven records are located 1-5m north for canals. There are five entries for ponds located 40-44m north and a gravel pit 52m south. The remaining records are over 200m from the study site.

Records of Landfill Sites

There are forty-four entries within 500m, the closest of which is 20m southeast for a historic landfill site that was licensed to accept inert waste. There are two more historic landfill sites located 186m and 383m south both licensed to accept inert waste. The following records are 404m southeast for an Environment Agency/Natural Resources Wales landfill licenced for waste land filling excluding inert waste and 481m for a leachate treatment plant/landfill. The remaining entries are more than 500m away from the study area.

Workings/Tunnels and Railway Features

Historical Surface Ground Working Features

There are fifteen ground working features within 100m, the closest three of which are on site for canals. The next seven records are located 1-7m north for canals. There are ponds 40-44m north and gravel pit 52m south. The remaining records are over 200m from the study site.

Current Ground Workings

There are no records within 100m of the site, the closest is 166m southeast for Burghfield Gravel Pit, a ceased surface mineral working for sand and gravel. The remaining records are over 200m from the study site.

Historical/Current Land Uses

Records of Potentially Contaminative Uses

There are twenty records of sites with a potentially contaminative past land use within 500m. The nearest is 8m north for a water works, followed by 15m north for unspecified works. There are additional records located 1619m north for water works, 18m north for an unspecified mill and 52m south for a gravel pit. The remaining entries are over 200m from the study area

Historical Tanks

There are five records within 500m, four of which are on site for tanks and the last record is located 39m north for an unspecified tank

Historical Energy Features

There are three records of sites within 500m, the nearest of which is 324m north for electricity substations. The remaining entries are over 400m from the study area for electricity substations.

Records of Potentially Contaminative Industrial Sites

There are twelve records of sites with a potentially contaminative industrial usage within 250m, the closest nine are located onsite for tanks. There is a gravel pit located 138m south. The remaining entries are over 200m from the study area

Designated Environmentally Sensitive Sites

The study site is not located within any environmentally sensitive designations.

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**.

5.0 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. Any maps with no discernible changes will not be commented on in this report.

The interpretation of the maps and/or other data commented on in this report is subjective.

Year	On site	Off site
1872	➤ The site is an irregular plot of land with no discernible features on site.	➤ Off site, no discernible features on site.
1882	➤ There is wire mill building on site. ➤ A sluice located on west side of site	➤ A water works is 40m north. ➤ A road located 10m east of site which runs down up 120m south of site. ➤ A river is located to the immediate north of the site, flowing in a west-east orientation, with two locks immediately north of the site. ➤ A meandering river with an approximate southwest-northeast orientation is located from immediately south.
1899	➤ The structure on site is now longer labelled as a wire mill.	➤ There is a bridge 10m northeast of site. ➤ Marshland is located 20-100m south of site. ➤ Level crossing 120m northwest of site ➤ The site is surrounded by canals which extends from a river Kennet which is located 120m east of site.
1990	➤ No discernible changes.	➤ The canal which runs along site is tagged

		Kennet and Avon Canal. ➤ There is railway which runs north 300m from site and railway over river located 300m east of site.
1932	➤ There are tanks located on the north side of the site.	➤ The river 60m southwest has been expanded with what appears to be a channel extending to the west.
1967	➤ No discernible changes.	➤ Marshland with canal located 20-100m north of site. ➤ An additional channel, believed to be a canal is now located 80m southwest, flowing in a southwest-northeast orientation. ➤ A drain is located 50m west of site and further drains located 120m north and west of site, 250m northwest of site
1979	➤ No discernible changes.	➤ Railway track located 300m north and 300m east of site is tagged boro const bdy. ➤ A large gravel pit is located 250m south of the site.
1991	➤ No discernible changes.	➤ There are further gravel pits located 250m south and 350m southwest of site.
1993	➤ No discernible changes	➤ There is a Southcote mills located 40m northwest of site. ➤ Electricity transmission line located 120m northeast and east of site. ➤
2002	➤ No discernible changes.	➤ No discernible changes.
2010	➤ No discernible changes.	➤ There is are workings located 250m north of site ➤ Possible rail way station located 350m north of site

Table 1: *Historical Mapping Review*

The Historical Ordnance Survey Maps were obtained from Groundsure and are available for review within [Appendix C](#).

6.0 Walkover Survey

The site was visited by YE on January 24th, 2019. The weather was dry and icy but sunny at the time.

Access

The site is accessible via wooden pedestrian gates that can be unlocked and opened. Once inside, the footing is low due to the water tanks in the area, so walking is only possible along the top edge of the brick tank walls.

The site leads from a pedestrian footpath, with an access bridge over the river from a residential dwelling and woodland surrounding the site.

Vehicle access is not permitted on the site through any access means, this was noted on the day of the walkover.

Topography

The site is relatively flat and level with the area surrounding the site gently sloping from north to south.

Old disused water storage tanks are located in the ground of the site ranging from approximately two metres to one metre deep.

Vegetation

The site is covered in vegetation from weeds, brambles to newly grown trees ranging from approximately one metre to two metres in height. Surrounding the site is a grassed floor covering with weeds and brambles growing upon with trees extending to approximately fifteen metres in height. Ivy weed and bushes grow upon the exterior boundary wall.

Buildings and Structures / Floor Covering

There are no complete buildings on the site, however, a brick walled area is located on the northern end of the site with no roofing. It is not known whether this structure would have originally had a roof. The walls are constructed from brick and stone and are approximately three metres in height from the ground level which is approximately one metre below the external ground level due to the water tanks. The floor covering in this area looks to be soft permeable landscaping with growing grass.

The southern area of the site has brick-built surrounding walls and water tanks located within, which is constructed from brick with some metal framing approximately one metre high.

Surface Permeability / Ground Covering

It is estimated that approximately 85% of the site is soft permeable landscaping with 15% comprising impermeable concrete.

Drainage Features

No drainage features were observed during the walkover.

Other Services

No services were observed during the walkover.

Ancillary Information

Moving water or rivers are located both north and south of the site.

Surrounds

The site is located in a pocket of land with moving water on the north and south of the site. One residential dwelling is located north of the site.

Direction	Description of Site boundary
North	A stone-built wall approximately two metres high.
East	A stone-built wall approximately two metres high with a further brick wall approximately one metre high.
South	Brick wall approximately one metre high.
West	A stone-built wall approximately two metres high with a further brick wall approximately one metre high.

Table 3: Summary of site boundaries

Direction	Description of Surrounding Land Use
North	River, residential dwelling and its respective garden area, woodland.
East	Woodland.
South	Woodland.
West	River and woodland.

Table 4: Summary of Surrounding Land Uses

Potentially Contaminative Land Uses

On site sources:

- None identified.

Offsite sources:

- None identified.

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

7.0 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.

8.0 Contaminant Sources

On Site Sources

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

- Tanks - (It should be noted that the walk over study indicates that these are water storage tanks);
- Wire mill.
- Possible made ground- Due to historical development

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:

- Tanks. Walk over study indicate that these are water storage tanks;
- Canals (potential infilled)- Mapping shows canals not infilled.

The following contaminants are potentially associated with these sources:

- 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.
- Heavy metals and split fuels

Off Site Sources

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

- Southcote water works (40m north);
- Southcote mills (40m northwest)

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:

- Water works (8m north);
- Unspecified works (15-19m north);
- Unspecified mill (18m north)
- Potentially infilled ponds (40-44m north);
- Gravel pit (52m south);
- Unspecified tank (39m north)
- Historical landfill (20m southeast)

The following contaminants are potentially associated with these sources.

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

9.0 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
Made Ground	On site	Potential for limited Made Ground from historical development, however there is potential a low risk for ground gas generation as Made Ground not confirmed by walkover survey.
Wire mill	On site	Potential for localised contamination in form of heavy metals and split fuels.
Water works	Off site	Potential for contamination from hydrocarbons, fuels and ammonia.
Unspecified works/mill	Off site	Potential for localised contamination, from a wide range of contaminants due to the unknown contents at work sites.
Unspecified tank	On and Off site	On site tanks identified as water storage tanks. Tanks 39m north possible potential contamination from hydrocarbons from spillage and leakage. However, the distance from the site reduces the risk.
Potentially infilled pond	Off site	Potential for ground gas generation from the decomposition of organic carbon due to the unknown constituents of the infilled land.
Gravel pit	Off site	Potential for localised contamination and ground gas generation potentially infilled ground. However, the distance from the site reduces the risk
Landfill (Historic)	Off site	Potential for localised contamination and

		ground gas generation from potentially infilled ground.
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Table 4: Sources

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 5: 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.
	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 superficial deposits and a Secondary (A) Aquifer within the bedrock underlying the site. The nearest groundwater and surface are 944m east for portable water supply direct. In addition, the nearest portable water abstraction licence is 944m east for water supply direct-Thames water. The site is not within a source protection zone and the nearest surface water feature is onsite
Plant (species and	Various	Attributes will be influenced by factors such as

uptake) and Wildlife		relative quality, scale, rarity and substitutability.
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Table 6: Receptors

10.0 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', due to the presence of the managers accommodation and private garden area.

11.0 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 inorganics 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 to low risk is assessed due to the wire mill identified 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	Low/Moderate ●●	A low to moderate risk is assessed due to the lack of potentially contaminative land uses on site despite the fact that there is a record of the site having a Secondary (A) Aquifer within the superficial deposits and a Secondary (A) Aquifer within the bedrock underlying the site. The nearest groundwater and surface are 944m east for portable water supply direct. In addition, the nearest portable water abstraction licence is 944m east for water supply direct-Thames water. The nearest surface water feature is onsite, nearest water network is onsite for inland river and the site is not within a source protection zone
	Permeation of water pipes	Construction materials, future end users and site visitors	Medium	Likely	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	Moderate/Low ●●	A moderate to low risk is assessed due to the historical wire mill on site and 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 age of buildings on site creates potential for asbestos contamination.
		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 onsite Made Ground.	Gas migration and build up within buildings (explosion/ asphyxiation risk)	Future end users and building structures.	High	Low Likelihood	Moderate/ Low ●●	A moderate to low risk is given due to the historic development onsite, historical landfill (20m southeast) and potentially infilled ponds. 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	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/ Low ●●	A moderate to low 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 offsite 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 which includes a historical landfill 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.

Table 7: Preliminary Conceptual Site Model

12.0 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.

12.1 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 delineate the extent of any possible contamination that may exist at the site by using intrusive soil sampling and testing techniques.

12.2 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 drilling of five (5no.) 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 3-4 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 all four (4no.) of the windowless sample holes are installed with gas monitoring standpipes in order to quantify potential gas and groundwater risks.

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

12.3 Monitoring Regime

The installed positions should be monitored for ground gases and groundwater, monitoring will commence approximately 7-10 days after completion of the holes to enable equilibration of the underlying soils and groundwater. Monitoring will be completed on a fortnightly basis on six (6no.) occasions.

Gas monitoring should be completed in accordance with CIRIA C665 *Assessing Risks Posed by Hazardous Ground Gases to Buildings*, when atmospheric pressure is either falling and/or below 1005 millibars (mb).

A portable Gas Analyser (GA5000) should be used to monitor soil gases (Oxygen, Carbon Dioxide, Methane and Hydrogen Sulphide) within the positions. A Photo Ionisation Detector

(PID- MiniRae 2000 lamp 10.6eV) meter should also be used during monitoring rounds to analyse the presence of Volatile Organic Compounds (VOCs) as a matter of course.

Once gas monitoring has been completed, a dip meter will be used to test for groundwater depth. If groundwater is encountered the positions will be adequately purged and samples subsequently removed in accordance with BS 6068-6.18: 2001 *Water Quality Sampling: Part 18 - Guidance on Sampling of Groundwater at Contaminated Sites*.

12.4 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, 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.

Groundwater samples should be submitted for a similar suite of analysis to that of soils.

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.

12.5 Guidance

The results from the proposed SI shall be compared against standards, such as the revised LQM/CIEH S4UL criteria¹ where available.

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).

13.0 Recommendations

13.1 Consultees

It is highly recommended 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, otherwise further works may be required.

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

13.2 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.

13.3 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.

13.4 Johnson Poole and Bloomer Mining

It is noted that the study site is located within 1000m of a Johnson Poole and Bloomer mining area and we would recommend that this information should be obtained to ascertain the potential risks this may pose to the site.

14.0 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 they are 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 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.