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Desk Study Report

ON

Tavistock House
5 Rockingham Road
Uxbridge

FOR

John Emery
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Beaconsfield
BUCKS
HP9 2DN

September 2016

Report Title: **Geo-environmental Desk Study / Preliminary Risk Assessment for Tavistock House, 5 Rockingham Road, Uxbridge**

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CONTENTS

Page

EXECUTIVE SUMMARY 1

1 INTRODUCTION 3

1.1 Terms of Reference 3

1.2 Proposed Development 3

1.3 Objectives 3

1.4 Scope of Works 4

1.5 Limitations 4

2 SITE SETTING 5

2.1 Site Information 5

2.2 Walkover Survey 5

2.3 Historical Mapping Information 6

2.4 Historical Industrial Sites 8

2.5 Previous Site Investigations 8

2.6 Local Authority Information 8

3 ENVIRONMENTAL SETTING 9

3.2 Solid and Drift Geology 9

3.3 British Geological Survey (BGS) Borehole Data 9

3.4 Hydrogeology & Hydrology 9

3.5 Sensitive Land Uses 12

3.6 Industrial and Statutory Consents 13

3.7 Radon 14

4 POSSIBLE GEOLOGICAL HAZARDS 15

4.1 Database Information Review 15

5 QUALITATIVE RISK ASSESSMENT 17

5.1 Legislative Framework 17

5.2 Conceptual Site Model 18

5.3 Qualitative Risk Estimation 19

5.4 Outcome of Risk Assessment 22

5.5 List of Key Contaminants 23

6 REFERENCES 24

APPENDICES

APPENDIX 1 – FIGURES

APPENDIX 2 – GROUNDSURE REPORTS

APPENDIX 3 – OS HISTORICAL MAPS

APPENDIX 4 – QUALITATIVE RISK ASSESSMENT METHODOLOGY

APPENDIX 5 – BGS BOREHOLE RECORDS

EXECUTIVE SUMMARY

John Emery ('The client') commissioned Bradbrook Consulting ('BC') to undertake a geo-environmental desk study at Tavistock House, 5 Rockingham Road, Uxbridge. The principal objectives of the study were as follows:

- To determine the nature and where possible the extent of contaminants potentially present at the site;
- To establish the presence of significant contaminant linkages, in accordance with the procedures set out within the Environment Agency (EA) report R&D CLR11 and relevant guidance within the National Planning Policy Framework (NPPF);
- To assess whether the site is safe and suitable for the purpose for which it is intended, or can be made so by remedial action.
- To identify and assess potential geotechnical issues that may affect the site.

It should be noted that the table below is an executive summary of the findings of this report and is for briefing purposes only. Reference should be made to the main report for detailed information and analysis.

Desk Study	
Current Site Use	Commercial office building with associated vehicle parking.
Proposed Site Use	It is understood that the proposed development comprises of the conversion of the existing building to provide residential apartments. While no significant structural alterations are proposed, it is understood that part of the development comprises removal of an area of existing hardstanding to provide public soft landscaping.
Site History	A review of historical maps indicates the presence of buildings within the site from at least 1866, at which point the site also includes an unidentified circular structure, possibly a tank (which is no longer shown by 1896). The buildings within the site frequently alter in footprint, and at points appear to form part of an adjacent wharf, although no specific use is identified from mapping. By 1980 these buildings are no longer shown, with the site occupied by a single building identified as Dolphin House. This building remains in place until the map dated 1988, when this building is no longer shown and the site appears broadly as it does today. The surrounding area has been utilised for a combination of residential and commercial uses, with uses of note including a Wharf immediately west of the site, and various works immediately north.
Site Setting	The British Geological Survey indicates that the site is directly underlain by superficial deposits of Alluvium. These superficial deposits are underlain by solid deposits of the Lambeth Group. No artificial deposits are reported within the site. The superficial and solid deposits underlying the site are identified as Secondary A Aquifers. A review of the EnviroInsight Report indicates that there are no source protection zones within 500m of the site. The nearest surface water abstraction is reported 803m west of the site, for spray irrigation. No groundwater or potable water abstractions reported within 1km of the site The nearest detailed river entry is reported 34m west of the site, identified as a Canal. Nearest surface water feature reported 26m west of the site.

Desk Study	
Potential Sources	• Potential for contaminated ground associated with previous site use – on site (S1) • Potential for Made Ground associated with previous development operations – on site (S2) • Potential impacted ground associated with possible former tank from historical mapping – on site (S3) • Potential asbestos impacted ground from demolition of previous buildings – on site (S4) • Current and previous industrial use – on and off site (S5) • Potential ground gas generation within underlying alluvial deposits –on site (S6)
Potential Receptors	• Construction and maintenance workers • Neighbouring and future site users • Buried foundations and services • Controlled waters (Secondary A Aquifer, Surface Waters).
Preliminary Risk Assessment	The risk estimation matrix indicates a moderate risk. A high risk has been designated due to possible asbestos. Due to the potential presence of asbestos containing materials, an asbestos survey should be undertaken, with any asbestos containing materials found, removed under suitably controlled conditions. There should be no risk to end users from asbestos if the potential asbestos containing materials are removed by suitably qualified and experienced specialists under controlled conditions. While the development predominantly comprises the conversion of the existing building to provide residential apartments, the proposal also includes the removal of an area of existing hardstanding to provide new soft landscaping. The removal of this hardstanding and consequent exposure of any underlying Made Ground would potentially result in the creation of new pollutant pathways. As a result it is recommended that an intrusive investigation is undertaken to clarify potential risks to the identified receptors, and assess the extent of made ground soils present at the site. A preliminary investigation may comprise a series of window sampler holes or trial pits. It is understood that the existing building is to be converted to provide residential apartments. In view of the construction of the existing building (raised above ground to provide vehicle parking below), if sufficiently vented, this should be sufficient to mitigate any potential soil gas risk. Construction details will be required to confirm.
Potential Geological Hazards	The Groundsure data identifies moderate risks of compressible deposits – for full details see Section 4

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Bradbrook Consulting ("The Client") has commissioned Bradbrook Consulting ('BC'), to assess the risk of contamination posed by the ground conditions at a site referred to as Tavistock House, 5 Rockingham Road, Uxbridge, prior to a change of use from office space to residential land use.

1.1.2 To this end a desk based review has been undertaken in accordance with BC's email proposal dated 23 August 2016.

1.2 Proposed Development

1.2.1 The proposed development is to comprise the conversion of the existing building to provide residential apartments. The removal of an existing car park area to provide communal open space / soft landscaping is also proposed.

1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as 'Residential without plant uptake'.

1.2.3 For the purpose of geotechnical assessment, it is considered that the project could be classified as a Geotechnical Category (GC) 1 site in accordance with BS EN 1997. GC 1 projects are defined as involving:

- Small and simple structures .
- Requiring qualitative investigation and analysis.
- With negligible risk.
- Straightforward ground conditions.
- Routine design and construction methods.
- No excavation below the water table (unless comparable local experience indicates it will be straightforward).

1.2.4 This will be reviewed at each stage of the project

1.3 Objectives

1.3.1 The objectives of BC's investigation were as follows:

- To present a description of the present site status, based upon the published geology, hydrogeology and hydrology of the site and surrounding area;
- To review readily available historical information (i.e., Ordnance Survey maps and database search information) for the site and surrounding areas, with respect to potentially contaminative land uses;
- To provide an assessment of the environmental sensitivity at the site and the surrounding area, in relation to any suspected or known contamination which may significantly affect the site and the proposed development;

- To assess the potential presence of significant pollutant linkages, in accordance with the procedures set out within Part IIA of the Environmental Protection Act 1990, associated statutory guidance and current best practice including the EA report R&D CLR 11;
- To identify and assess geotechnical issues that may affect the site.

1.4 Scope of Works

1.4.1 The following tasks were undertaken to achieve the objectives listed above:

- A walkover survey of the site;
- A desk study, which included the review of third party reports (attached in Appendix 2 and Appendix 3);
- The compilation of this report, which collects and discusses the above data, and presents an assessment of the site conditions, conclusions and recommendations.

1.5 Limitations

1.5.1 Bradbrook Consulting ('BC') has prepared this report for the sole use of Bradbrook Consulting in accordance with the generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon by any other party without the explicit written agreement of BC. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.5.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless BC has actual knowledge to the contrary, information obtained from public sources or provided to BC by site personnel and other information sources, have been assumed to be correct. BC does not assume any liability for the misinterpretation of information or for items not visible, accessible or present on the subject property at the time of this study.

1.5.3 Whilst effort has been made to ensure the accuracy of the data supplied, and analysis derived from it, there may be conditions at the site that have not been disclosed by the investigation, and could not therefore be taken into account. As with any site, there may be differences in soil conditions between exploratory hole positions. Furthermore, it should be noted that groundwater conditions may vary due to seasonal and other effects and may at times be significantly different from those measured by the investigation. No liability can be accepted for any such variations in these conditions.

1.5.4 Any reports provided to BC have been reviewed in good faith. BC cannot be held liable for any errors or omissions in these reports, or for any incorrect interpretation contained within them.

1.5.5 This investigation and report has been carried out in accordance with the relevant standards and guidance in place at the time of the works. Future changes to these may require a re-assessment of the recommendations made within this report.

1.5.6 ***This report is not an engineering design and the figures and calculations contained in the report should be used by the Structural Engineer, taking note that variations may apply, depending on variations in design loading, in techniques used, and in site conditions. Our recommendations should therefore not supersede the Engineer's design.***

2 SITE SETTING

2.1 Site Information

2.1.1 The site location plan is appended to this report as Figure 1.

Table 2.1: Site Information

Name of Site	Tavistock House
Address of Site	5 Rockingham Road, Uxbridge UB8 2UB
Approx. National Grid Ref.	504988, 183879
Site Area (Approx)	0.08ha
Site Ownership	Unknown
Site Occupation	Disused office building with associated vehicle parking
Local Authority	London Borough of Hillingdon
Proposed Site Use	Change of use to residential (maintaining existing buildings)

2.2 Walkover Survey

2.2.1 A site walkover survey was undertaken by Bradbrook Consulting on 30th August 2016.

Table 2.2: Site Description

Area	Item	Details
On-site:	**Current Uses:**	Site is occupied by a 2 storey building, with ground level undercroft car parking. There are small external, uncovered areas however the majority of the site is covered by the building.. Building currently in use as Xerox offices. Neighbouring businesses include Freeway lift services, sign company, Halfords Autocentre and light industrial units. Waste disposal appears to be via commercial wheelie bins that were noted on site.
	Evidence of historic uses:	There was no evidence of historic uses of the site.
	Surfaces:	The site is covered by hardstanding, with no soft landscaping present
	Vegetation:	No vegetation noted
	Topography/Slope Stability:	Overall, the site is noted to be largely level.
	Drainage:	The site appears to be connected to normal drainage facilities.
	Services:	The site is presumed to be connected to normal services.

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Area	Item	Details
	Controlled waters:	No controlled waters were noted on site.
	Tanks:	No tanks were noted on site.
Neighbouring land:	**North:**	Light industrial, Halfords Autocentre, sign company
	East:	School/residential
	South:	Residential, light industrial, school
	West:	Residential/pub

2.2.2 Photos taken during the site walkover are provided in Appendix 2.

2.3 Historical Mapping Information

2.3.1 The historical development of the site and its surrounding areas was evaluated following the review of a number of Ordnance Survey historic maps, procured from GroundSure, and provided in Appendix 3 of this report.

2.3.2 A summary produced from the review of the historical map is given in Table 2.3 below. Distances are taken from the site boundary.

Table 2.3: Historical Development

Dates and Scale of Map	Relevant Historical Information	
	On Site	**Off Site**
1866 – 1:2,500	The site contains a number of possible residential units with associated garden areas. An unidentified circular feature, possibly a tank of unknown use, is shown within the northern portion of the site.	The surrounding area comprises a mixture of agricultural and residential land use, with a Canal passing approximately 30m west of the site. An area of possible commercial buildings is also shown immediately west of the site. A Flour Mill is shown approximately 100m west of the site.
1896 – 1:2,500	The possible tank and a number of other buildings are no longer shown within the site.	The buildings immediately west of the site are identified as a Wharf. A Works is shown approximately 20m south east of the site. The mill is now identified as a Corn Mill. A Water works is shown approximately 80m south east of the site. Residential development has occurred to the surrounding area.
1914 – 1:2,500	Additional unidentified buildings are now shown within the site.	A large Steel Barrel Works is now shown approximately 120m north of the site. A group of unidentified commercial style buildings is shown approximately 140m south of the site. An Iron Works is shown approximately 180m east of the site. Residential development has occurred to the surrounding area.

Dates and Scale of Map	Relevant Historical Information	
	On Site	Off Site
1934 - 1:2,500	No significant changes noted to the site.	The steel barrel works to the north has expanded. The area of the corn mill to the west is now occupied by a number of large, unidentified buildings of general industrial / commercial appearance. The works to the south is now identified as a Barge Works. Further residential development has occurred to the south.
1962/63 – 1:1,250	The earlier buildings are no longer shown, with the site now occupied by commercial style buildings and appearing to form part of Dolphin Wharf	Several buildings immediately north of the site and identified as Works are now shown. A Council Yard is now shown approximately 50m south east of the site. The barge works to the south is now identified as a Works and has significantly expanded, encroaching to within approximately 70m of the site. The works to the west have significantly expanded. The steel barrel works have also expanded and are now identified as a Works.
1980/84 – 1:2,500 (Partial coverage).	The previous buildings are no longer shown with the site occupied by 1 No. individual building identified as Dolphin House.	The area of the wharf immediately west of the site appears to have been redeveloped with possible light industrial units. The works immediately north of the site have expanded, with an **electrical substation** now also shown approximately 30m north of the site. The works to the west also appears to have been redeveloped with numerous commercial / **light industrial style buildings**, 1 No. of which is identified as a **Factory**.
1986 – 1:2,500 (Partial coverage.)	No significant changes noted to the site.	No significant changes noted.
1986 – 88 – 1:2,500	The earlier dolphin house is no longer shown with the site occupied by an unidentified building in the current day orientation	Further residential development has occurred to the surrounding area. The area of the barge works to the south has been redeveloped with **light industrial style units** and is now identified as a Boat Yard.
1992 – 95 – 1:2,500	No significant changes noted to the site.	No significant changes noted.
2002 – 1:10,000	No significant changes noted to the site.	No significant changes noted.
2010 – 1:10,000	No significant changes noted to the site.	No significant changes noted.

Dates and Scale of Map	Relevant Historical Information	
	On Site	Off Site
2014 – 1:10,000	No significant changes noted to the site.	No significant changes noted.

Potentially polluting/contaminating uses/activities shown in **bold**

2.4 Historical Industrial Sites

2.4.1 Groundsure have provided some information on historical industrial sites on and in the vicinity of the site. Table 2.4 below, summarises the information provided, which is presented in further detail in the Enviroinsight in Appendix 2. Where the identified features have appeared on more than one map they have been counted multiple times and therefore the reported numbers are higher than the actual count.

Table 2.4: Industrial and Statutory Consents

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Potentially Contaminative Uses identified from 1:10,000 scale mapping	2 No. on site for Unspecified Works	109 No. reported within 500m of the site. Nearest reported 28m west of the site, identified as a Flour Mill.	✓
Additional Information - Historical Tank Database	1 No. on site for an unspecified tank.	39 No. reported within 500m of the site.	✓
Historical Energy Features Database	None	58 No. reported within 500m of the site. Nearest reported 30m north east of the site, identified as an Electricity Substation.	✓
Historical Petrol & Fuel Site Database	None	None reported within 500m of the site.	X
Historical Garage & Motor Vehicle Repair Database	None	12 No. reported within 500m of the site. Nearest reported 319m east of the site, identified as a Garage.	X
Potentially infilled land	None	35 No. reported within 500m of the site. Nearest reported 17m west of the site, identified as a Canal.	✓

2.5 Previous Site Investigations

2.5.1 No previous site investigation reports were provided at the time of writing.

2.6 Local Authority Information

2.6.1 Bradbrook Consulting have made a request to London Borough of Hillingdon for information relating to contamination on the site and surrounding areas. A response is pending.

3 ENVIRONMENTAL SETTING

3.1.1 The following section summarises the principal environmental resources (geological, hydrogeological and hydrological) of the site and its surroundings. The data discussed herein is generally based on the information given within the EnviroInsight Report and published information provided by the Environment Agency and British Geological Survey.

3.2 Solid and Drift Geology

3.2.1 Information provided by the British Geological Survey indicates that the site is mainly directly underlain by superficial deposits of Alluvium.

3.2.2 The BGS describes Alluvium as consisting of

> *"Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present."*

3.2.3 These superficial deposits overlie solid deposits of the Lambeth Group. These are indicated by the BGS to consist of

> *"Vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate."*

3.2.4 No artificial deposits are reported within the site area.

3.3 British Geological Survey (BGS) Borehole Data

3.3.1 As part of the assessment, publicly available BGS borehole records were obtained and reviewed from the surrounding area. The local records obtained are presented in Appendix 5.

3.3.2 The nearest such record was located approximately 41m south west of the site, and showed the underlying ground conditions to comprise an initial 1.2m of 'soil' (possibly Made ground) overlying 'River Gravel' to a depth of approximately 5.3m bgl. Below this were various bands of interbedded clays and sands, with a noted horizon of 'black rocks' was reported to a depth at approximately 29.8m bgl. These horizons were identified as the Reading Beds (a now obsolete term) and likely represent the Lambeth Group. Below this and to the base of the borehole at approximately 37m bgl a horizon of Chalk with flints was reported.

3.3.3 All depths and measurements should be viewed as approximately, due to the age of the borehole and corresponding use of imperial measurements.

3.4 Hydrogeology & Hydrology

3.4.1 General information about the hydrogeology of the site was obtained from the EnviroInsight and/or Environment Agency website.

Groundwater Vulnerability

3.4.2 Since 1 April 2010, the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. This comprises;

- **Secondary A** - 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** - predominantly lower permeability layers which may store and 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 the former non-aquifers.
- **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- **Principal Aquifer** – this is a formation with a high primary permeability, supplying large quantities of water for public supply abstraction.
- **Unproductive Strata** - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Source Protection Zones (SPZ)

3.4.3 In terms of aquifer protection, the EA generally adopts a three-fold classification of SPZs for public water supply abstraction wells.

- Zone I - or 'Inner Protection Zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source.
- Zone II - or 'Outer Protection Zone' is defined by a 400-day travel time to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- Zone III - or 'Total Catchment' is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Hydrology

3.4.4 The hydrology of the site and the area covers water abstractions, rivers, streams, other water bodies and flooding.

3.4.5 The Environment Agency defines a floodplain as the area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.

3.4.6 There are two different kinds of area shown on the Flood Map for Planning. They can be described as follows:

Areas that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5 per cent (1 in 200) or greater chance of happening each year;
- or from a river by a flood that has a 1 per cent (1 in 100) or greater chance of happening each year.

(For planning and development purposes, this is the same as Flood Zone 3, in England only.)

- The additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1 per cent (1 in 1000) chance of occurring each year.

(For planning and development purposes, this is the same as Flood Zone 2, in England only.)

3.4.7 These two areas show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

3.4.8 Outside of these areas flooding from rivers and the sea is very unlikely. There is less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year. The majority of England and Wales falls within this area. (For planning and development purposes, this is the same as Flood Zone 1, in England only.)

3.4.9 Some areas benefit from flood defences and these are detailed on Environment Agency mapping.

3.4.10 Flood defences do not completely remove the chance of flooding, however, and can be overtopped or fail in extreme weather conditions.

Table 3.1: Summary of Hydrogeological & Hydrology

Feature		On Site	Off Site	Potential Receptor?
Aquifer	**Superficial:**	Secondary A Aquifer	Principal Aquifer	✓
	Solid:	Secondary A Aquifer	Unproductive	✓
Source Protection Zone		None	None reported within 500m of the site.	**X**

Feature		On Site	Off Site	Potential Receptor?
Abstractions		None	Nearest surface water abstraction reported 803m west of the site, for spray irrigation. No groundwater or potable water abstractions reported within 1km of the site.	✓
Surface Waters		None	Nearest detailed river entry reported 34m west of the site, identified as a Canal. Nearest surface water feature reported 26m west of the site.	✓
Flood Risk	**EA Flood Zone 2**	None	23m west of the site	**X**
	EA Flood Zone 3	None	23m west of the site	**X**
	RoFRaS	Very Low		**X**
	Flood Defences	There are areas benefiting from Flood Defences within 250m of the study site		
	BGS	BGS has a "Moderate" confidence that there is the potential for below surface "Clearwater" flooding		

3.5 Sensitive Land Uses

3.5.1 The site is reported to lie within a Nitrate Vulnerable Zone.

3.5.2 A Nitrate Vulnerable Zone (NVZ) is a conservation designation of the Environment Agency for areas of land that drain into nitrate polluted waters, or waters which could become polluted by nitrates. Nitrate Vulnerable Zones were introduced by the UK government in response to the EU mandate that all EU countries must reduce the nitrate in Drinking Water to a maximum of 50 mg/l.

3.5.3 The NVZs cover large areas of land that have been identified as exceeding or being at risk of exceeding 50 mg NO_3/l.

3.5.4 No other sensitive land uses have been identified within influencing distance of the site.

3.6 Industrial and Statutory Consents

3.6.1 The Groundsure EnviroInsight Report also provides information on various statutory and industrial consents on and in the vicinity of the site. The following section summarises the information collected from the available sources.

Table 3.2: Industrial and Statutory Consents

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Industrial Sites holding licences and/or authorisations.	None	3 No. reported within 500m of the site. Nearest reported 239m west of the site, for enamel processing.	✓
Discharge Consents.	None	18 No. reported within 500m of the site. Nearest reported 97m west of the site for site drainage.	✓
Water Industry Act Referrals	None	1 No. reported 205m north west of the site. No further details provided.	X
Red List Discharges	None	None reported within 500m of the site	X
List 1 and List 2 Dangerous Substances	None	2 No. List 1 substances reported within 500m of the site. Nearest reported 106m north of the site, no further details provided.	✓
Control of Major Accident Hazards (COMAH) and Notification of Installations Handling Hazardous Substances (NIHHS) Sites.	None	None reported within 500m of the site	X
Planning Hazardous Substance Consents	None	None reported within 500m of the site	X
Category 3 or 4 Radioactive substances Authorisations	None	None reported within 500m of the site	X
Pollution Incidents (List 2).	None	6 No. reported within 500m of the site. Nearest reported 92m south west of the site, for oils and fuels. Minor impact reported to water, no impacts reported to land or air.	✓
Pollution Incidents (List 1)	None	1 No. reported 175m west of the site, for groundwater. Significant impact reported.	✓
Contaminated Land Register Entries and Notices.	None	None reported within 500m of the site	X
Registered Landfill Sites.	None	None reported within 500m of the site	X
Waste Treatment and/or Transfer Sites.	None	None reported within 500m of the site	X
Fuel Station Entries	None	1 No. reported 482m south west of the site, identified as Obsolete.	X

Type of Consent/Authorisation	On site	Off-site (within 500m of site, unless stated otherwise)	Potential to Impact Site*
Current Industrial Site Data.	None	39 No. reported within 250m of the site. Nearest reported 3m north of the site for mooring and unloading facilities. Other uses include unspecified works or factories and electrical features.	✓

***** *From a land contamination perspective*

3.7 Radon

3.7.1 As reported, the site is within a Radon affected area, as between 1 and 3% of properties are above the action level.

3.7.2 However, no radon protective measures are necessary in the construction of new dwellings or extensions as described in publication BR211 (BRE, 2007).

4 POSSIBLE GEOLOGICAL HAZARDS

4.1 Database Information Review

4.1.1 The following are brief findings extracted from the GroundSure GeoInsight Report, that relate to factors that may have a potential impact upon the engineering of the proposed development.

Table 4.1: Geological Hazards

Potential Hazard	Site check Hazard Rating	Details	Further Action Required?
Shrink swell	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.	No
Landslides	Very low	Slope instability problems are unlikely to be present.	No
Ground dissolution soluble rocks	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks	No
Compressible deposits	Moderate	Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes. Extra construction costs are likely.	Yes
Collapsible Rock	Negligible	No indicators for collapsible deposits identified. No actions required to avoid problems due to collapsible deposits. No special ground investigation required, or increased construction costs or increased financial risk due to potential problems with collapsible deposits	No
Running sand	Low	Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand	Yes
Coal mining	No	-	No

Potential Hazard	Site check Hazard Rating	Details	Further Action Required?
Non-coal mining	No	-	No
Brine affected areas	No	-	No

4.1.2 In addition, the GeoInsight report notes the following:

- 21 No. historical surface ground working features are reported within 250m of the site, although some records may relate to multiple reportings. Nearest reported 23m west of the site, identified as a Canal.
- No historical underground working features are reported within 1km of the site.
- 8 No. BGS Current Ground Working Features are reported within 1km of the site. The nearest is reported 520m south east of the site, identified as producing Sand and Gravel. The operational status is given as Ceased.

4.1.3 Due to the site history a thickness of Made Ground should be expected on the site.

4.1.4 Clearance of the site (including services and ensuring former foundations are removed) is likely to increase the depth of Made Ground. Foundations should not be formed within Made Ground or Topsoil due to the unacceptable risk of total and differential settlement.

4.1.5 Given that the BGS has identified a "potential for clearwater flooding to occur below the surface" and the fact that historical boreholes have encountered groundwater within the encountered sandy gravels a relatively high groundwater table should be expected. This groundwater table is likely to be mobile. The affects that this may have include (bit is not limited to):

- Permanent excavations – i.e. for items such as basements and drainage. This is likely to need waterproofing / tanking and may have flotation issues.
- Temporary excavations – likely to affect side stability especially where the excavations are formed in granular materials. May require dewatering or groundwater exclusion techniques to be used.
- Foundation design – likely to reduce the allowable bearing capacity that could be achieved in the sandy gravels.
- Soakaways – likely to affect the permeability and therefore the effective use of soak-away drainage.
- Concrete classification on the site (in accordance with BRE SD-1) due to the potential for a mobile groundwater table.

4.1.6 A geotechnical investigation is recommended to inform foundation design should any significant alterations to / extension of the existing building be proposed.

5 QUALITATIVE RISK ASSESSMENT

5.1 Legislative Framework

5.1.1 A qualitative risk assessment has been prepared for the site, based on the information collated. This highlights the potential sources, pathways and receptors. Intrusive investigations will be required to confirm the actual site conditions and risks.

5.1.2 Under Part IIA of the Environmental Protection Act 1990, the statutory definition of contaminated land is:

"*land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:*

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or
(b) significant pollution of controlled waters is being caused, or there is significant possibility of such pollution being caused."

5.1.3 The Statutory Guidance provided in the DEFRA Circular 04/2012 lists the following categories of significant harm to **human health**:

- death; life threatening diseases (e.g. cancers); other diseases likely to have serious impacts on health; serious injury; birth defects; and impairment of reproductive functions.

5.1.4 Other health effects may also be considered by the local authority to constitute significant harm with a wide range of conditions that may or may not constitute significant harm (alone or in combination) including: physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts.

5.1.5 In deciding whether or not land is contaminated land on grounds of significant possibility of significant harm to human health there are four categories to be considered. Categories 1 and 2 would encompass land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health. Categories 3 and 4 would encompass land which is not capable of being determined on such grounds.

5.1.6 For non-human receptors the following types of harm should be considered to be significant harm:

Ecological System Effects

- Harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or
- Harm which significantly affects any species of special interest within that location and which endangers the long-term maintenance of the population of that species at that location.
- In the case of European sites, harm should also be considered to be significant harm if it endangers the favourable conservation status of natural habitats at such locations or species typically found there. In deciding what constitutes such harm, the local authority should have regard to the advice of Natural England and to the requirements of the Conservation of Habitats and Species Regulations 2010.

Property Effects

- Crops: A substantial diminution in yield or other substantial loss in their value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage.
- Buildings: Structural failure, substantial damage or substantial interference with any right of occupation. The local authority should regard substantial damage or substantial interference as occurring when any part of the building ceases to be capable of being used for the purpose for which it is or was intended. In the case of a scheduled Ancient Monument, substantial damage should also be regarded as occurring when the damage significantly impairs the historic, architectural, traditional, artistic or archaeological interest by reason of which the monument was scheduled.

5.1.7 Contaminated land will only be identified when a 'pollutant linkage' has been established.

5.1.8 A 'pollutant linkage' is defined in Part IIA as:

"A linkage between a contaminant Source and a Receptor by means of a Pathway".

5.1.9 Therefore, this report presents an assessment of the potential pollutant linkages that may be associated with the site, in order to determine whether additional investigations are required to assess their significance.

5.1.10 In accordance with the National Planning Policy Framework, where development is proposed, the developer is responsible for ensuring that the development is safe and suitable for use for the purpose for which it is intended, or can be made so by remedial action. In particular, the developer should carry out an adequate investigation to inform a risk assessment to determine:

- whether the land in question is already affected by contamination through source – pathway – receptor pollutant linkages and how those linkages are represented in a conceptual model;
- whether the development proposed will create new linkages, e.g. new pathways by which existing contaminants might reach existing or proposed receptors and whether it will introduce new vulnerable receptors; and
- what action is needed to break those linkages and avoid new ones, deal with any unacceptable risks and enable development and future occupancy of the site and neighbouring land.

5.1.11 A potential developer will need to satisfy the Local Authority that unacceptable risk from contamination will be successfully addressed through remediation without undue environmental impact during and following the development.

5.2 Conceptual Site Model

5.2.1 On the basis of the information summarised above, a conceptual site model (CSM) has been developed for the site. The CSM is used to guide the investigation activities at the site and identifies potential contamination sources, receptors (both on and off-site) and exposure pathways that may be present. The identification of such potential "pollutant linkages" is a key aspect of the evaluation of potentially contaminated land.

5.2.2 The site investigation is then undertaken in order to prove or disprove the presence of these potential source-pathway-receptor linkages. Under current legislation an

environmental risk is only deemed to exist if there are proven linkages between all three elements (source, pathway and receptor).

5.2.3 This part of the report lists the potential sources, pathways and receptors at the site, and assesses based on current and future land use, whether pollution linkages are possible.

5.2.4 Potential pollutant linkages identified at the site are detailed below:

Table 5.1: Potential Sources, Pathways and Receptors

Source(s)	Pathway(s)	Receptor(s)
• Potential for contaminated ground associated with previous site use – on site (S1) • Potential for Made Ground associated with previous development operations – on site (S2) • Potential impacted ground associated with possible former tank from historical mapping – on site (S3) • Potential asbestos impacted ground from demolition of previous buildings – on site (S4) • Current and previous industrial use – on and off site (S5) • Potential ground gas generation within underlying alluvial deposits and infilled ground – on site and off site (S6)	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) • Horizontal and vertical migration of contaminants within groundwater (P4) • Accumulation and Migration of Soil Gases (P5) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5) • Controlled waters – aquifer, surface waters (R6)

5.3 Qualitative Risk Estimation

5.3.1 Based on information previously presented in this report, a qualitative risk estimation was undertaken.

5.3.2 For each potential pollutant linkage identified in the conceptual model, the potential risk can be evaluated, based on the following principle:

Overall contamination risk = Probability of event occurring x Consequence of event occurring

5.3.3 In accordance with CIRIA C552, the consequence of a risk occurring has been classified into the following categories:

- Severe
- Medium

- Mild
- Minor

5.3.4 The probability of a risk occurring has been classified into the following categories:

- High Likelihood
- Likely
- Low Likelihood
- Unlikely

5.3.5 This relationship can be represented graphically as a matrix (Table 5.2).

Table 5.2: Overall Contamination Risk Matrix

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate risk	Low risk
	Low Likelihood	Moderate risk	Moderate risk	Low risk	Very low risk
	Unlikely	Low risk	Low risk	Very low risk	Very low risk

5.3.6 The risk assessment process is based on guidance provided in CIRIA C552 (2001) *Contaminated Land Risk Assessment – A Guide to Good Practice*. Further information including definitions of descriptive terms used in the risk assessment process is included in Appendix 4.

5.3.7 The degree of risk is based on a combination of the potential sources and the sensitivity of the environment. The risk classifications can be cross checked with reference to Table A4.4 in Appendix 4.

5.3.8 Hazard assessment was also carried out, the outcome of which could be:

- Urgent Action (UA) required to break existing source-pathway-receptor link.
- Ground Investigation (GI) required to gather more information
- No action required (NA)

5.3.9 The preliminary risk assessment for the site is presented in Table 5.3 below.

Table 5.3: Preliminary Risk Assessment for the Site

Sources	Pathways (P)	Receptors	Consequence	Probability of pollutant linkage	Risk Estimation	Hazard Assessment
• Potential for contaminated ground associated with previous site use – on site (S1) • Potential for Made Ground associated with previous development operations – on site (S2) • Potential impacted ground associated with possible former tank from historical mapping – on site (S3) • Potential asbestos impacted ground from demolition of previous buildings – on site (S4) • Current and previous industrial use – on and off site (S5) • Potential ground gas generation within underlying alluvial deposits and infilled ground – on site and off site (S6))	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium Severe for Asbestos	Low-Likely (Site to be covered entirely with hardstanding)	Moderate High for Asbestos	GI – Ground Investigation
	• Accumulation and migration of soil gases (P5)		Medium	Unlikely (ventilated ground floor parking proposed)	Low	
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff. (P3) • Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Controlled Waters (Aquifer) (R6) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium	Likely	Moderate	

5.3.10 It should be noted that the identification of potential pollutant linkages does not necessarily signify that the site is unsuitable for its current or proposed land use. It does however act as a way of focussing data collection at the site in accordance with regulatory guidance in CLR 11.

5.4 Outcome of Risk Assessment

5.4.1 It is understood that the proposed development comprises of the conversion of the existing building to provide residential apartments. While no significant structural alterations are proposed, it is understood that part of the development comprises removal of an area of existing hardstanding to provide public soft landscaping.

5.4.2 The risk estimation matrix indicates a moderate risk as defined above. A high risk has been designated due to possible asbestos.

5.4.3 It is noted that there is the potential presence of asbestos containing materials within the existing building. Given the current use of the building as commercial offices, an Asbestos Management Plan (AMP) should be in place. It is recommended that this is obtained and assessed to determine the presence or otherwise of asbestos within the building. If this is not available, an asbestos survey should be undertaken. Dependant on the AMP or survey, asbestos containing materials found on site should be removed under suitably controlled conditions.

5.4.4 There should be no risk to end users from asbestos if the potential asbestos containing materials are removed by suitably qualified and experienced specialists under controlled conditions.

5.4.5 A review of historical maps indicates the presence of buildings within the site from at least 1866, at which point the site also includes an unidentified circular structure, possibly a tank (which is no longer shown by 1896). The buildings within the site frequently alter in footprint, and at points appear to form part of the adjacent wharf, although no specific use is identified from mapping. By 1980 these buildings are no longer shown, with the site occupied by a single building identified as Dolphin House. This building remains in place until the map dated 1988, when this building is no longer shown and the site appears broadly as it does today.

5.4.6 The surrounding area has been utilised for a combination of residential and commercial uses, with uses of note including a Wharf immediately west of the site, and various works immediately north.

5.4.7 While the development predominantly comprises the conversion of the existing building to provide residential apartments, the proposal also includes the removal of an area of existing hardstanding to provide new soft landscaping. The removal of this hardstanding and consequent exposure of any underlying Made Ground would potentially result in the creation of new pollutant pathways.

5.4.8 As a result it is recommended that an intrusive investigation is undertaken to clarify potential risks to the identified receptors, and assess the extent of made ground soils present at the site.

5.4.9 A preliminary investigation may comprise a series of window sampler holes or trial pits.

5.4.10 It is understood that the existing building is to be converted to provide residential apartments. In view of the construction of the existing building (raised above ground to provide vehicle parking below), if sufficiently vented, this should be sufficient to mitigate any potential soil gas risk. Construction details will be required to confirm.

5.5 List of Key Contaminants

The possible contamination implications for both on-site and off-site sources have been assessed based on the information presented in the report. This has been achieved using guidance publications by the Environment Agency, together with other sources.

5.5.2 Based on recommendations within the guidance publications, an initial soil and water chemical testing suite would need to consider a range of contaminants as follows:

- *Metals*: cadmium, chromium, copper, lead, mercury, nickel, zinc;
- *Semi-metals and non-metals*: arsenic, boron, sulphur;
- *Inorganic chemicals*: cyanide, nitrate, sulphate and sulphide;
- *Organic chemicals*: aromatic hydrocarbons, aliphatic hydrocarbons, petroleum hydrocarbons, phenol, polyaromatic hydrocarbon;
- *Others*: pH, Asbestos

6 REFERENCES

Groundsure EnviroInsight Report Ref HMD-377-3257333 August 2016

Groundsure GeoInsight Report Ref HMD-377-3257334 August 2016
BRE Report BR211 ;Radon: Protective measures for new dwellings, 2007

Environment Agency (2004) *Model procedures for the management of land contamination*. CLR11. Bristol: Environment Agency

National Planning Policy Framework. Department for Communities and Local Government, March 2012

Code of Practice for Site Investigations BS5930: 2015

Investigation of Potentially Contaminated Sites – Code of Practice BS10175: 2011

APPENDICES

APPENDIX 1 – FIGURES

APPENDIX 2 – SITE WALKOVER PHOTOGRAPHS

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APPENDIX 3 - GROUNDSURE REPORTS

APPENDIX 4 – OS HISTORICAL MAPS

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APPENDIX 5 – BGS BOREHOLE RECORDS

APPENDIX 6 – QUALITATIVE RISK ASSESSMENT METHODOLOGY

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