

REPORT

Land Quality Desk Top Study and Preliminary Risk Assessment

Site E Dering Industrial Park, Gravesend

Client: Optimus Access Ltd

Reference: PC3447-RHD-ZZ-XX-RP-Z-0001_6682_PRA

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Executive Summary

Executive Summary	
The site and development	Optimus Access Ltd commissioned Royal HaskoningDHV to carry out a Land Quality Desk Study and Preliminary Risk Assessment for a site known as Site E Dering Industrial Park to support a new planning application. The planning application is for the permanent retention of an office building, raised open storage platform with a timber deck, metal clad shed and open sided shed.
Site Setting and Current Use	The site is located in Gravesend, Kent, approximately 1.70 km west of Gravesend Town Centre and is accessed via Dering Way. The site is currently used as a scaffold storage facility with offices and welfare facilities for staff.
Environmental Setting	A historical landfill is located across the majority of the site and several further historical landfills are located within a 250 m radius.
Historical Land Use	Prior to the site use a scaffold storage facility the site was shown as Denton Marshes until 2014 aerial mapping. A number of drains are shown as present on site and in the surrounding area. Potentially contaminative historical land uses within 100 m of the site include infilled ponds and a sewage works with associated sludge beds, filter beds, sediment tanks and syphon tanks. The site is shown to be a high risk from unexploded ordnance.
Geology and Hydrogeology	Made Ground is likely to be present across the majority of the site. Superficial deposits consisting of alluvial deposits of clay, silt, sand and peat are shown to be present across the site (Secondary Undifferentiated Aquifer). Bedrock beneath the site consist of the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) (Principal Aquifer).
Hydrology	There is a surface water drain present on the site along the eastern boundary. There is potential for flooding from groundwater of property situated below ground level. The site is located with Zone 2 for extreme flooding and Zone 3 for flooding from rivers or sea without defences.
Sensitive Ecological Receptors	The site is located within a nitrate vulnerable zone. The site also formed part of an environmentally sensitive area, the North Kent Marshes which has now been decommissioned.
CSM	Potential on site sources of contamination include Made Ground associated with the historical landfilling activities. Potential off site sources include: Made Ground associated with infilled land and the sewage works located to the east of the site. Potential pathways and receptors include: Direct exposure through contact, ingestion or inhalation by site users and neighbouring site users; leaching, dissolution and migration of contaminants to controlled groundwaters; lateral migration to surface waters; direct contact with concrete and, diffusion into service ducts.
Conclusion	The risk posed to human health, the concrete apron, potable supply pipes and controlled waters by all contamination sources excluding ground gas is considered low. The risk posed by ground gas is considered moderate to low. The risk posed to buildings and services by the lateral migration of groundwater (from off site sources) and ground gas (on and off site sources) is considered to be moderate to low. The risk posed by UXO is considered to be high.
Recommendations	The site in its present layout is not considered to pose an unacceptable risk to site users, controlled waters or other receptors. If in the future layouts change or permanent structures are proposed on the site then the assessment should be re-visited.

1 Introduction

Royal HaskoningDHV has been commissioned by Optimus Access Ltd (the Client) to carry out a Land Quality Desk Study and Preliminary Risk Assessment (PRA) Report for a site known as Site E Dering Industrial Park, Dering Way, Gravesend, Kent, DA12 2FP (herein referred to as the 'site'). The location of the site is shown on Figure 1.

This report has been prepared by Royal HaskoningDHV for the sole benefit of Optimus Access Ltd.

1.1 Development

A planning application (reference: 20211283 dated 13th October 2021) was submitted to Gravesham Borough Council (GBC) for the development and was later withdrawn. The Environment Agency (EA) as a consultee during the planning process were consulted and they raised an objection on the basis that; *"the site history indicates medium polluting potential from previous use which always flags significant concerns about land contamination. The site is also underlain by an aquifer, meaning there is also a risk of pollution to water resources. We need to ensure that the proposals, with associated foundation and drainage designs and the required ground disturbance will not cause an unacceptable risk to the aquifer"*.

A new planning application is in the process of being submitted and this report has been produced to support it. The planning application is for the permanent retention of an office building, raised open storage platform with a timber deck, metal clad shed and open sided shed.

The following development has been constructed, as shown on Figure 2.

- Structure A – Two tier modular building in use as ancillary offices and staff welfare facilities.
- Structure B – Raised storage platform.
- Structure C – Ancillary secure storage shed.
- Structure D – Covered storage area.
- Open Yard – Storage, vehicles and staff parking.

1.2 Objectives

The overall objectives of the PRA are as follows:

- Provide information on the current conditions of site with respect to land contamination.
- Provide an initial Conceptual Site Model (CSM) to identify and assess potential contaminant linkages associated with the site and the development.

1.3 Methodology

The PRA has been completed in general accordance with the recommended approach in Environment Agency (EA) 'Land Contamination: Risk Management Framework', 2021.

The PRA is a desk-based study and forms the initial step in the assessment of potentially contaminated land.

The main purpose of the PRA is to identify potential contamination sources on the site and assist Optimus Access Ltd in identifying potential environmental liabilities that may be present which may have consequences to the site.

The following desk-based information sources have been reviewed to inform the PRA:

- Envirocheck Report comprising historical maps, environmental sensitivity data and permitting records for a search area of up to 1 km around the site boundary, 24th February 2022 (Order No.: 291694588_1_1).
- British Geological Survey (BGS) Onshore GeoIndex web portal, accessed on 9th March 2022.
- BGS Geological Map for Dartford, Solid and Drift (Sheet number 271), 1998, 1:50,000.
- Zetica UXO Unexploded Bomb (UXB) Risk Map, accessed on 10th March 2022.
- Google Earth, accessed on 10th March 2022.
- Multi-Agency Government Information for the Countryside (Magic) map application, accessed 8th March 2022.
- Aerial photography <https://historicengland.org.uk/>, accessed on the 7th April 2022.

A site walkover survey was also undertaken on the 18th March 2022 by a Royal HaskoningDHV Environmental Consultant to verify current conditions at the site.

1.4 Report Format

The remainder of this report comprises the following sections:

- Section 2 – Site Setting and Current Land Use.
- Section 3 – Environmental Setting.
- Section 4 – Historical Land Use.
- Section 5 – Geology, Groundwater, Hydrology and Radon
- Section 6 – Preliminary Conceptual Site Model and Qualitative Risk Assessment.
- Section 7 – Conclusions and Recommendations.
- Section 8 – References.

2 Site Setting and Current Land Use

2.1 Site Location and Description

The site is located in Gravesend, Kent, approximately 1.70 km west of Gravesend Town Centre. The site's location is summarised within Table 2-1 below.

Table 2-1: Site Location

Site Specifics	Details
Full Address	Highfield Works, Site E, Dering Industrial Park, Dering Way, Gravesend, DA12 2QX.
Area	0.35 Hectares.
Ordnance Survey Grid Reference	566560 Eastings, 173950 Northings.
Site Level	1.0 m AOD (metres Above Ordnance Datum).
Shape	The site boundary forms an irregular shape.

Adjacent land uses are summarised within Table 2-2 below.

Table 2-2: Current Surrounding Land Uses

Direction	Description
North	To the north of the site is a storage area and rough grassland.
East	Residential properties and sewage treatment works are located directly to the east.
South	A drainage ditch and Dering Way is located to the south.
West	To the west of the site is an automotive lubricants supplier.

2.2 Site Walkover Survey

A site inspection survey was carried out by Royal HaskoningDHV on the 18th March 2022. A series of photographs are presented within Appendix A and are cross referenced as appropriate in the following Sections. The general site layout is shown in Figure 2.

2.2.1 Current Site Usage

The site is presently used for the storage of scaffolding equipment and temporary office space.

2.2.2 Access and Boundaries

The site is accessed via a courtyard through a metal gate off Dering Way (photographic plate No. 01). The site is bound by metal fencing (2.00 to 2.50 m in height).

2.2.3 Topography

The site is generally flat and gently slopes to the north and south from the centre of the site.

2.2.4 Ground Cover and Vegetation

The site is covered in reinforced concrete, generally in good condition. Anecdotal evidence from the current site operator indicated the site was cleared of all vegetation and an unspecified liner was installed at the

base of rubble fill at a depth of 0.50 to 0.75 metres below ground level (m bgl) prior to the installation of 0.20 m thick reinforced concrete.

2.2.5 On-Site Structures and Fuel Tanks

Staff welfare facilities are located on the western boundary (referenced as Structure A on Figure 2). A storage shed is present in the south western corner (referenced as Structure C on Figure 2). A covered storage area is present in the north eastern corner (referenced as Structure D on Figure 2).

Gas oil drums (not banded) (photographic plate No. 10), a fuel additive tank (banded) (photographic plate No. 03), COSHH storage boxes (containing paint tins) (photographic plate No. 13) and a 1000 litre above ground gas oil tank (banded) (photographic plate No. 09) were observed along the western boundary during the site walkover.

2.2.6 Electricity Substations

A high voltage electricity cabinet was identified in the north western corner (photographic plate No. 04).

2.2.7 Asbestos Containing Materials (ACMs)

The structures were built after 2020 which would suggest that ACMs are unlikely to be present. No ACMs were observed during the site walkover.

2.2.8 Signs of Contamination

No areas of obvious contamination were observed during the site walkover. Localised areas of tipped waste were noted beyond the western boundary.

3 Environmental Setting

3.1 Introduction

Regulatory authority information relevant to the site and its surroundings has been obtained from the undertaking of an environmental database search. The information is summarised below, and the environmental database records are enclosed in Appendix B. Distances stated are approximate and are taken from the boundary of the site to the database recorded entries.

The following summary is generally limited to locations within 250 m of the site boundaries unless it is considered that installations or activities beyond that range could potentially have an impact on the site or be affected by the development at the site.

3.2 Pollution Control

The presence (or absence) of pollution controls related to industrial processes at or within 250 m of the site boundary have been summarised in Table 3-1 below with further detail in Table 3-2.

Table 3-1: Summary of Pollution Controls

Control Type	On Site	Off Site
Contaminated Land Register Entries and Notices	No	No
Integrated Pollution Controls	No	No
Integrated Pollution Prevention and Control	No	Yes
Local Authority Integrated Pollution Prevention and Control	No	No
Local Authority Pollution Prevention Controls	No	No

Table 3-2: Details of Off Site Pollution Controls

Control Type – Off Site	Site Name & Location	Distance (Direction)	Detail
Integrated Pollution Prevention and Control	Southern Water Services Limited, Gravesend Wastewater Treatment Works, Dering Way, DA12 2QF	60 m (south-east)	Authority: Environment Agency – South East Region, Kent & South London Permit Reference: QP3337QC Activity Description: New Medium Combustion Plant Status: Effective

3.3 Waste

The presence (or absence) of waste facilities at or within 250 m of the site boundary have been summarised in Table 3-3 below with further detail in Table 3-4 and Table 3-5.

Table 3-3: Summary of Waste Facilities

Facility Type	On Site	Off Site
BGS recorded Landfill Sites	No	No

Facility Type	On Site	Off Site
Integrated Pollution Control Registered Waste Sites	No	No
Licensed Waste Management Facilities (Landfill Boundaries)	No	No
Licensed Waste Management Facilities (Locations)	No	No
Local Authority Landfill Coverage	Yes	No
Local Authority Recorded Landfill Sites	No	No
Registered Landfill Sites	No	No
Registered Waste Transfer Sites	No	No
Registered Waste Treatment or Disposal Sites	No	No
Historical Landfill Site	Yes	Yes

Table 3-4: Details of On Site Waste Facilities

Facility Type – On Site	Name & Location	Detail
Historical Landfill Site	Denton-Comma Oil, Denton Kent – Located across the majority of the site, apart from a small section along the eastern boundary	Provider Reference: EAHLD19298 Waste Type: included Inert Licence Holder: J Clubb Limited First and Last Input Date: Not Supplied

Table 3-5: Details of Off Site Waste Facilities

Facility Type – Off Site	Site Name & Location	Distance (Direction)	Detail
Historical Landfill Site	Gas Works – Canal Gravesend, Kent	190 m (north-west)	Provider Reference: EAHLD19292 Waste Type: Inert and Commercial Licence Holder: Not Supplied First and Last Input Date: Not Supplied
	Shamrock Road Denton, Kent	230 m (east)	Provider Reference: EAHLD19301 Waste Type: Inert and Household Licence Holder: Gravesham Borough Council First and Last Input Date: Not Supplied
	Norfolk Road Denton, Kent	240 m (north-west)	Provider Reference: EAHLD19290 Waste Type: Inert and Commercial Licence Holder: Not Supplied First and Last Input Date: Not Supplied
	Gas Works – Canal Gravesend, Kent	250 m (north-west)	Provider Reference: EAHLD19294 Waste Type: Inert and Commercial Licence Holder: Not Supplied First and Last Input Date: Not Supplied

3.4 Hazardous Substances and Health & Safety

The presence (or absence) of sites subject to restrictions in relation to Health & Safety at or within 250 m of the site boundary (and 1 km specifically for COMAH) have been summarised in Table 3-6.

Table 3-6: Summary of Facilities Subject to Active Consents

Facility Type	On Site	Off Site
Registered Radioactive Substances	No	No
Control of Major Accident Hazards Sites (COMAH)	No	No
Explosive Sites	No	No
Notification of Installations Handling Hazardous Substances (NIHHS)	No	No
Planning Hazardous Substance Consents	No	No
Planning Hazardous Substance Enforcements	No	No

3.5 Environmentally Sensitive Areas

The presence (or absence) of environmentally sensitive areas at or within 250 m of the site boundary have been summarised in Table 3-7 below with further detail in Table 3-8 and

Table 3-9.

Table 3-7: Summary of Environmentally Sensitive Areas

Feature / Designation	On Site	Off Site
Ancient Woodland	No	No
Areas of Adopted Green Belt	No	No
Areas of Unadopted Green Belt	No	No
Areas of Outstanding Natural Beauty	No	No
Environmentally Sensitive Areas	Yes	Yes
Forest Parks	No	No
Local Nature Reserves	No	No
Marine Nature Reserves	No	No
National Nature Reserves	No	No
National Parks	No	No
Nitrate Sensitive Areas	No	No
Nitrate Vulnerable Zones (NVZ)	Yes	No
Ramsar Sites	No	No
Sites of Special Scientific Interest	No	No
Special Areas of Conservation	No	No
Special Protection Areas	No	No
World Heritage Sites	No	No

Table 3-8: Details of On Site Environmentally Sensitive Areas

Feature / Designation	Detail
Environmentally Sensitive Areas	North Kent Marshes (decommissioned)
NVZ	Name: North Kent, Type: Groundwater
	Name: Coastal Streams to Lower Thames NVZ Type: Surface Water

Table 3-9: Details of Off Site Environmentally Sensitive Areas

Feature / Designation	Site Name & Location	Distance (Direction)	Detail
Environmentally Sensitive Areas	North Kent Marshes	220 m (east)	North Kent Marshes (decommissioned)

3.6 Current Industrial Land Use

The presence (or absence) of current industrial land uses, petrol stations, electricity cables and gas pipelines at or within 250 m of the site boundary have been summarised in Table 3-10 below with further detail in the subsequent Table 3-11.

Table 3-10: Summary of Current Industrial Land Uses

Feature	On Site	Off Site
Contemporary Trade Directory Entries	No	Yes
Fuel Station Entries	No	No
Gas Pipelines	No	No
Underground Electrical Cables	No	No

Table 3-11: Details of Off Site Current Industrial Land Uses

Feature – Off Site	Site Name & Location	Distance (Direction)	Detail
Active Contemporary Trade Directory Entries	Cleanwise Ltd, Unit 7 Block B, Lion Business Park, Dering Way, Gravesend, DA12 2DN	100 m (south)	Classification: Commercial Cleaning Services
	R S Dawe, Unit 21 Block D, Lion Business Park, Dering Way, Gravesend, DA12 2DN	130 m (south-east)	Classification: Car Body Repairs
	London Used Office Furniture, Unit 20 Black D, Lion Business Park, Dering Way, Gravesend, DA12 2DN	140 m (south-east)	Classification: Office Furniture & Equipment
	Moove, Dering Way, Gravesend, DA12 2QX	160 m (west)	Classification: Lubricant Manufacturers & Distributors
	Comma, Comma Works, Dering Way, Gravesend, DA12 2QX	170 m (west)	Classification: Lubricant Manufacturers & Distributors
	J&M Crane & Transport Ltd, Denton Wharf, Mark Lane, Gravesend, DA12 2PL	180 m (north-east)	Classification: Road Haulage Services
	Mechanical Movements & Enabling Services Ltd, Mark Lane, Gravesend, DA12 2QB	210 m (north)	Classification: Industrial Engineers

4 Historical Land Uses

4.1 Introduction

The historical development of the site and surrounding area has been assessed using information available from historical Ordnance Survey (OS) maps within the Environmental Database Report for the site which are presented in Appendix B of this report.

In the context of the summary of historical development of the surrounding area, the descriptions are limited to within approximately 100 m of the site boundary, unless specified in the following section.

4.2 Site History

Table 4-1 below provides a detailed account of the review of available OS mapping coverage dating back to 1864. Google Earth imaging has been viewed dating back to 1940.

Table 4-1: Summary of On Site Historical Data

Feature	Map Years	Notes
Denton Marshes	1869 – 2013	Earliest maps shows the site and surrounding area to be the Denton Marshes. The marshes are no longer shown on 2014 google imaging. An area of hardstanding is shown on google imaging of 2014. There is possibly a stockpile on the northern end of the site in 2011.
Drain	Pre 1869 – Present	Running in a north – south alignment along eastern boundary.
Drain	Pre 1869 – 1931	Running in a north west – south east alignment from the north west corner of the site to the centre. No longer present by 1955 mapping.
Undeveloped Land	2014 – 2019	Area of undeveloped land is shown on google imaging from 2014. Google imaging from 2019 shows that development of the site has began.
Storage Yard	2020 – Present	The present day buildings and storage yard are shown on google imaging from 2020.

4.3 Surrounding History

There are number of potentially contaminative uses near to the site; the main ones within 100 m of the site boundary are listed in Table 4-2 below.

Table 4-2: Summary of Off Site Historical Data

Feature	Map Years	Distance (Direction)	Notes
Sewage Works	1932 – Present	Adjacent (east)	A sewage works and associated tanks. Expanded by 1936 mapping to include sludge beds, filter beds, sediment tanks and syphon tanks.
Pipe Line	1960 – Present	10 m (south-west)	Associated with the sewage works.
Drain	1955 – 1982	20 m (south-west)	No longer shown on 1982 mapping.
Drain	1954 – 1975	50 m (north-west)	Assumed infilled or culverted. No longer shown on 1975 mapping.
Cutting / Embankment	1869 – Present	90 m (north)	

4.4 Unexploded Ordnance

An Unexploded Bomb (UXB) risk map has been obtained from Zetica and is presented as Appendix C. The site is shown to be in an area with a high risk from UXB and a historic Luftwaffe target located directly to the east of the site. As such it is recommended that a detailed UXB risk study is undertaken prior to any ground breaking activities.

5 Geology, Groundwater, Hydrology and Radon

5.1 Geology

5.1.1 Geological Conditions

Information on geological conditions below the site has been collated from the Envirocheck Report provided in Appendix B and BGS datasets, including the 1:50,000 scale geological mapping. Geological conditions are summarised in Table 5-1.

Table 5-1: Geology Summary

Stratum	Unit	Description
Made Ground	Artificial Deposits	Made Ground present along the western boundary
Superficial Deposits	Alluvium	Clay, Silt, Sand and Peat.
Bedrock	Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated)	Chalk

British Geological Survey (BGS) logs have been referred to for information only. The presence (or absence) of BGS logs at or within 250 m of the site boundary have been summarised in Table 5-2 below with further detail in Table 5-3 and Table 5-4.

Table 5-2: Summary of BGS Borehole Logs

Feature	On Site	Off Site
BGS borehole logs	Yes	Yes

Table 5-3: Details of On Site BGS Borehole Logs

Reference Number (Hole Type and Depth) – On Site	Details
TQ67SE315	Confidential
TQ67SE309	Confidential

Table 5-4: Details of Off Site BGS Borehole Logs

Reference Number (Hole Type and Depth) – Off Site	Distance (Direction)	Details
TQ67SE317	10 m (south)	Confidential
TQ67SE316	10 m (south-west)	Confidential
TQ67SE39 (Rotary Borehole, 76 m)	150 m (east)	0.0 to 2.0 m Made Ground, 2.0 to 12.0 m Soft silty clay/peat, 12.0 to 17.0 m light grey/green clay, 17.0 to 18.5 m dark blue clay, 18.5 to 20.0 m clay and stones, 20.0 to 25.5 m sand and gravel, 25.5 to 29.0 m rubble chalk and flints, 29.0 to 76.0 m chalk and flints.
TQ67SE310	220 m (south)	Confidential

The potential ground stability hazards on site, as obtained from the environmental database have been summarised in Table 5-5 below.

Table 5-5: Ground Stability Hazards

Ground Stability Hazard	Risk
Potential for Collapsible Ground Stability Hazards	No Hazard
Potential for Compressible Ground Stability Hazards	Very Low to High
Potential for Ground Dissolution Stability Hazards	No Hazard to Very Low
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Low to Very Low
Potential for Shrinking or Swelling Clay Ground Stability Hazards	Low

5.1.2 Mining and Mineral Extraction

The site is not located in an area which may be affected by coal mining.

5.2 Groundwater

5.2.1 Hydrogeology

Hydrogeological information for the site has been collated from an Envirocheck Report (Appendix B) and DEFRA MAGIC map application and comprises the following:

- Made Ground – not classified.
- Superficial Deposits – Secondary Undifferentiated Aquifer.
- Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) – Principal Aquifer.

The Alluvium superficial deposits are classified as a Secondary Undifferentiated Aquifer. This has been assigned in cases where it has not been possible to attribute either a Secondary A or B aquifer to the soil type due to the variable characteristics. 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.

The Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) bedrock is designated as a Principal Aquifer. These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

The Envirocheck Report indicates that the site is located within an area of high groundwater vulnerability.

5.2.2 Groundwater Abstractions

The absence or presence of groundwater abstraction wells at or within 1 km of the site boundary have been summarised in Table 5-6 below with further detail in Table 5-7.

Table 5-6: Summary of Groundwater Abstraction Wells

Feature	On Site	Off Site
Potable Abstraction Well	No	No
Other Type of Abstraction Well	No	Yes

Table 5-7: Details of Off Site Abstraction Wells

Reference Number– Of Site	Distance and Direction	Details
9/40/01/0508/G	90 m (north-east)	Name: Southern Water Services Ltd Annual Rate (m ³): Not supplied Daily Rate (m ³): Not supplied Details: General washing/process washing
9/40/01/0498/G	380 m (north-east)	Name: J Clubb Ltd Annual Rate (m ³): Not supplied Daily Rate (m ³): Not supplied Details: Mineral Products: Mineral Washing

5.2.3 Groundwater Source Protection Zones

Groundwater Source Protection Zones (SPZs) are defined around abstraction boreholes used for potable water supply to delineate the area where release of a contaminant into the aquifer could impact on the abstraction. The site is not located within an SPZ.

5.3 Hydrology

5.3.1 Surface Waters

The absence or presence of surface water features at or within 250 m of the site boundary have been summarised in Table 5-8Table 5-14 with further detail in Table 5-9 and Table 5-10.

Table 5-8: Summary of Surface Water Features and Monitoring

Feature	On Site	Off Site
Surface Water Features	Yes	Yes
OS Water Network Lines	No	Yes
River Quality	No	No
River Quality Biology Sampling Points	No	No
River Quality Chemistry Sampling Points	No	No

Table 5-9: Details of On Site Surface Water Features and Monitoring

Feature – On Site	Details
Drain	Drain running in a north to south alignment on the eastern boundary.

Table 5-10: Details of Off Site Surface Water Features and Monitoring

Feature – Off Site	Distance (Direction)	Details
OS Water Network Lines	Directly north-east	Watercourse Form: Inland river
	10 m (south and west)	Watercourse Form: Inland river
	120 m (north)	Watercourse Form: Canal Watercourse Name: Thames and Medway Canal

Feature – Off Site	Distance (Direction)	Details
	150 m (south-east)	Watercourse Form: Inland river
	200 m (north-west)	Watercourse Form: Inland river

5.3.2 Flooding

The absence or presence of flood potential and events at or within 250 m of the site boundary have been summarised in Table 5-11 below with further detail Table 5-12 and Table 5-13.

Table 5-11: Summary of Flooding Potential and Events

Designation Type	On site	Off Site
Flooding from Groundwater of Property Below Ground Level	Yes	Yes
Extreme Flooding from Rivers or Sea Without Defences	Yes	Yes
Flooding from Rivers or Sea Without Defences	Yes	Yes
Areas Benefiting from Flood Defences	Yes	Yes
Flood Water Storage Area	No	No
Flood Defences	No	No

Table 5-12: Details of On Site Flooding Potential and Events

Designation Type – On Site	Detail
Flooding from Groundwater of Property Below Ground Level	Potential for Ground Water of Property Situated Below Ground Level.
Extreme Flooding from Rivers or Sea Without Defences	Zone 2
Flooding from Rives of Sea Without Defences	Zone 3
Areas Benefiting from Flood Defences	Yes

Table 5-13: Details of Off Site Flooding Potential and Events

Designation Type – Off Site	Distance (Direction)	Detail
Flooding from Groundwater of Property Below Ground Level	20 m (E)	Limited Potential for Groundwater Flooding to Occur
Extreme Flooding from Rivers or Sea Without Defences	0 to 250 m	Zone 2
Flooding from Rives of Sea Without Defences	0 to 250 m	Zone 3
Areas Benefiting from Flood Defences	0 to 250 m	Yes

5.3.3 Surface Water Abstractions

The absence or presence of surface water abstractions at or within 250 m of the site boundary have been summarised in Table 5-14.

Table 5-14: Summary of Surface Water Abstractions

Feature	On Site	Off Site
Surface Water Abstractions	No	No

5.3.4 Discharges to Controlled Waters

The absence or presence of discharges to controlled waters at or within 250 m of the site boundary have been summarised in Table 5-15 below.

Table 5-15: Summary of Discharges to Controlled Waters

Feature	On Site	Off Site
Licensed Discharges	No	No

5.3.5 Pollution Incidents and Inventories

The absence or presence of pollution incidents at or within 250 m of the site boundary have been summarised in Table 5-16 below with further detail in Table 5-17.

Table 5-16: Summary of Incidents and Inventories

Feature	On Site	Off Site
Prosecutions Relating to Controlled Waters	No	No
Prosecutions Relating to Authorised Processes	No	No
Enforcement and Prohibition Notices	No	No
Local Authority Pollution Prevention and Control Enforcements	No	No
Substantiated Pollution Incident Register	No	Yes
Water Industry Act Referrals	No	No
Pollution Incidents to Controlled Waters	No	Yes

Table 5-17: Details of Off Site Incidents

Feature – Off Site	Distance (Direction)	Details
Pollution Incidents to Controlled Waters	60 m (south)	Incident ID: 197043 Incident Date: 16/12/1997 Pollutant: Oils – Unknown Description: Possible Contaminated Land Incident Severity: Category 3 – Minor Incident
Substantiated Pollution Incident Register	100 m (south)	Incident ID: 234990 Incident Date: 07/05/2004 Pollutant: Crude Sewage Water: Category 2 – Significant Incident
Pollution Incidents to Controlled Waters	130 m (south-east)	Incident ID: 197260 Incident Date: 03/08/1998 Pollutant: Sewage Sludge Description: Sludge Lost From Digester To Drainage Ditch Incident Severity: Category 3 – Minor Incident
	130 m (west)	Incident ID: 94T429 Incident Date: 06/12/1994 Pollutant: Fire water / foam Incident Severity: Category 3 – Minor Incident

Feature – Off Site	Distance (Direction)	Details
Substantiated Pollution Incident Register	190 m (west)	Incident ID: 218671 Incident Date: 23/02/2004 Pollutant: Other specific waste material Land Impact: Category 2 – Significant Incident
Pollution Incidents to Controlled Waters	250 m (north-west)	Incident ID: 1141 Incident Date: 27/05/1999 Pollutant: Contaminated Water Mixed with Contaminants Incident Severity: Category 2 – Significant Incident

5.4 Radon Gas

The presence of radon gas is assessed in the UK according to the number of homes likely to be above the Action Level (200 Becquerel per cubic metre (Bq m³)). Under Building Regulations, the requirement for protection measures (as described in BRE, 2001) in the construction of new buildings, conversions or extension is dependent on Radon Potential.

Information presented within the Envirocheck Report indicates that the site is located within an area where <1 % homes are at or above the Action Level. Therefore, radon protection measures are not required within new buildings.

6 Conceptual Site Model and Qualitative Risk Assessment

Land contamination is assessed through the identification of Potential Contaminative Linkages (PCLs). The assessment involves the development of a Conceptual Site Model (CSM) which describes the relationship between on and off site potential sources of contamination (and contaminants), potential receptors to such contamination and anticipated pathways between the two. Where all three (source-pathway-receptor linkage) are present or considered to be present, they are described as a PCL which can be subject to the risk assessment process.

The following discusses the potential sources, pathways and receptors present.

6.1 Potential Sources

Table 6-1: Potential On Site Sources

Potential Source	Associated Contaminants
Made Ground associated with historic landfill and infilled land although it is worth noting the aerial photographs do not show direct evidence of on site landfill activities having occurred.	Contaminants of potential concern include asbestos, metals, cyanides, sulphates, phenols, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) including oils, greases, solvents, Volatile Organic Compounds (VOCs) and Semi Volatile Organic Compounds (SVOCs) and ground gas.

Table 6-2: Potential Off Site Sources

Potential Source	Associated Contaminants
Made Ground associated with infilled land	Contaminants of potential concern include asbestos, metals, cyanide, sulphates, phenols, PAHs, TPHs including soils, greases, solvents, VOCs, SVOCs and ground gas.
Sewage Works located to the east of the site	Contaminants of potential concern include leachates potentially including metals, organic compounds, inorganic compounds, asbestos and ground gas (DOE, 1995).

6.2 Potential Receptors and Pathways

Table 6-3: Potential Receptors and Pathways

Receptors	Pathways
Human Health	
Current and future site users (commercial)	Direct exposure through dermal contact, ingestion or inhalation of soils/dusts and asbestos fibres in areas visited by site users not covered in hardstanding.
Neighbouring site users (commercial)	Inhalation of volatile contaminants and hazardous ground gases (carbon dioxide and methane).
Maintenance Workers	If maintenance of the site includes breaking of ground, there is the potential for workers to be exposed to contaminants through: Direct exposure through dermal contact, ingestion or inhalation of soils and dusts during construction works. Inhalation of asbestos containing soils and dusts.
Controlled Waters	
Superficial Deposits – Secondary Undifferentiated Aquifers	Leaching, dissolution and migration of contaminants from existing unsaturated soils.
Seaford Chalk Formation – Principal Aquifer	Vertical migration through the creation of preferential pathways.

Receptors	Pathways
Surface Waters – Drains	Lateral migration and discharge of groundwater and surface water runoff.
Buildings and Utilities	
Concrete apron	Direct contact with concrete.
Potable Supply pipes	Diffusion into services.

Flora and Fauna has been removed as there are no soft landscaping in the development.

The North Kent Marshes (Environmentally Sensitive Area) has not been included in the assessment below, as the Environmentally Sensitive Area has been decommissioned.

6.3 Preliminary Conceptual Site Model and Qualitative Risk Assessment

The CSM and Preliminary Risk Assessment are presented in Table 6-4. Definitions of probability and consequence have been based on guidance in CIRIA 552 and summarised in Appendix D.

A combination of probability and consequences produces a risk level based on the risk evaluation and likely action required. The land contamination risk, which is a function of the probability and the consequence, can be defined using the risk matrix. The limitations associated with the assessment are provided in Appendix E.

Table 6-4: Preliminary Conceptual Site Model

Source	Pathway	Receptor	Associated Hazard	Potential Consequence of Contaminant Linkage	Likelihood of Contaminant Linkage	Risk Classification	Justification
Made Ground associated with historic landfill and infilled land.	Dermal contact, ingestion and inhalation of soils, dust and asbestos fibres.	Humans – current and future on-site users and site neighbours.	Human Health	Medium	Unlikely	Low risk	The site is fully hardstanding and it is unlikely current or future site users will come into contact with the Made Ground in the finished development.
	Inhalation of volatile contaminants.	Maintenance Workers			Unlikely	Low risk	The short-term risks associated with the maintenance works would be managed through proper implementation of PPE and good working and hygiene practices, hence the low classification.
	Leaching and migration from unsaturated contaminated soils.	Groundwater: Secondary Undifferentiated Aquifer (Superficial Deposits) Principal Aquifer (Seaford Chalk Formation)	Controlled Waters	Medium	Unlikely	Low risk	Contaminants present in the Made Ground have the potential to migrate into the underlying aquifer. The site is covered in hardstanding, which is likely to reduce infiltration. No preferential pathways have been created via the foundation arrangements for the structures, this reduces the leaching and migration potential from unsaturated soils.
	Lateral migration and discharge of groundwater and surface water runoff.	Surface Waters: Drains					A surface water drain runs along the eastern boundary of the site. The surface water runoff is increased due to hardstanding (concrete) ground cover, however, this is intercepted by the site having a dedicated drainage system.
	Direct contact and diffusion through drinking water pipes.	Concrete Apron and Potable Water Supplies	Concrete corrosion and Human Health	Medium	Unlikely	Low risk	Potential contamination if present could impact the integrity of concrete by creating aggressive ground conditions, however, the construction make up indicates that there is a layer of rubble fill between the deeper Made Ground and the concrete which would limit the direct contact with underlying site soils. Potential organic contaminants could permeate into potable water supply lines having an adverse impact on human health. It is understood that the new potable pipes were laid in a clean service trench and are laid within the rubble fill directly below the concrete therefore the potential for direct contact is limited.
	Gas and vapour migration and accumulation in buildings.	Existing buildings associated / human health and utilities.	Health risk (methane, carbon dioxide and volatiles)	Severe (Asphyxiation)	Unlikely	Moderate to low risk	The apparent former landfill on the development accepted inert material which by its nature should not produce ground gas.
			Building Damage explosion	Severe (Explosion)			It is understood that the current on site structures have a ventilated cavity beneath the floor. The void below the reduces the likelihood of the potential of ground gas and vapours to accumulate
Off Site sources	Lateral and vertical migration of groundwater.	Groundwater: Secondary Undifferentiated Aquifer (Superficial Deposits) Principal Aquifer (Seaford Chalk Formation)	Pollution of controlled waters and human health risk	Medium	Low Likelihood	Moderate to low risk	There is a potential for contaminants to migrate onto the site through permeable Superficial deposits and Bedrock.
	Gas and vapour migration and accumulation in buildings.	Existing buildings associated / human health and utilities.	Health risk (methane, carbon dioxide and volatiles)	Severe (Asphyxiation)	Unlikely	Moderate to low risk	Ground gas associated with off site landfills within 250 m have the potential to migrate to the site via permeable superficial deposits and bedrock or to migrate along preferential pathways such as buried service routes. However the current on site structures have a ventilated cavity beneath the floor which will limit this pathway.
			Building Damage explosion	Severe (Explosion)			

7 Conclusions and Recommendations

7.1 Conclusions

The key objectives of the desk study and PRA were to provide information on the current condition of the site with respect to contamination, characterise the environmental setting and identify potential land quality risks and constraints associated with the scheme.

7.1.1 Summary of Human Health Risk Assessment

Based on the findings of the PRA, the following conclusions can be made for human health:

- The risk posed by sources of contamination with the exception of ground gas is considered to be **Low**.
- The risk posed by potential on and off site sources of ground gas to human health receptors is considered to be **Moderate to Low**.

7.1.2 Summary of Controlled Waters Risk Assessment

Based on the findings of the PRA, the following conclusions can be made for controlled waters:

- The risk posed by on site sources of contamination to groundwater and surface water receptors is considered to be **Low**.
- The risk posed by off site sources of contamination to groundwater underlying the site is considered to be **Low**.

7.1.3 Summary of Other Receptors

Based on the findings of the PRA, the following conclusions can be made for concrete, buildings and utilities:

- The risk posed by potential sources of ground gas to buildings is considered to be **Moderate to low**.
- The risk posed by sources of potential organic contaminants permeating into potable water supply lines and from aggressive ground conditions is considered to be **Moderate to low**.

7.1.4 Other Identified Risks

The risk posed by UXO to the site has been found to be **High**.

7.2 Recommendations

The site in its present layout is not considered to pose an unacceptable risk to site users, controlled waters or other receptors. If in the future layouts change or permanent structures are proposed on the site then the assessment should be re-visited to consider construction workers, foundation arrangements, potential ground gas mitigation and the potential risk to controlled waters.

8 References

- **CIRIA, 2001** 552 Contaminated Land Risk Assessment, A Guide to Good Practice 2001.
- **CL:AIRE 2012** “A Pragmatic Approach to Ground Gas Risk Assessment”, November, 2012
- **DEFRA, 2012** DEFRA ‘Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance’. PB13735 (2012).
- **DOE, 1995** Sewage works and sewage farms, Department of the Environment Industry Profile, 1995
- **Environment Agency, 2021** Land Contamination: Risk Management Guidance <https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>
- **The Water Framework Directive** (Standards and Classification) Directions (England and Wales) 2015 The revised Water Framework Directive (rWFD) (2008/98/EC).
- **Public Health England, undated** UK maps of radon. Available via URL: ukradon.org/information/ukmaps.
- **UK Government, 2022** Flood map for planning. Available via URL: <https://flood-map-for-planning.service.gov.uk/>.
- **Environment Agency, 2018** Groundwater Protection Position Statements.

Figures & Drawings

Figure 1 – Site Location Plan

Figure 2 – Site Layout

Appendix A - Site Walkover Photographs

Appendix B – Envirocheck Report

Appendix C – Zetica UXB Map

Appendix D – Qualitative Human Health and Environmental Risk Assessment Methodology

Qualitative Methodology

The risk assessment considers the sources and potential receptors identified, together with linking pathways. These linkages are summarised in the Preliminary Conceptual Site Model and Qualitative Risk Assessment within the report, where the associated environmental risk is assessed for a given source and the end-use of the site. This assessment also takes account of specific chemicals of concern or groups of similar chemicals of concern. The column designated as 'Potential Consequence of Source- Pathway – Receptor-Linkage' in the Preliminary Conceptual Site Model and Qualitative Risk Assessment gives an indication of the sensitivity of a given receptor to a particular source/chemical of concern being considered. It is a worst case classification and is based on full exposure via the particular linkage being examined. The derivation of the classes used to rank this particular aspect is as follows based on CIRIA 552 'Contaminated Land Risk Assessment, A Guide to Good Practice' 2001:

Classification	Human Health	Controlled Water	Ecological	Built Environment
Severe	Acute risk to human health likely to result in 'significant harm' as defined by the Environmental Protection Act 1990, Part 2A	Substantial pollution of sensitive water resources	Significant change to the number of one or more species or ecosystems	Catastrophic damage to buildings, structures or the environment
Moderate	Chronic damage to human health ('significant harm').	Pollution of sensitive water resources	Change to population densities of non-sensitive species	Damage to sensitive buildings, structures or the environment
Mild	Harm but not necessarily significant harm to humans	Pollution to non-sensitive water resources	Some change to population densities but with no negative effects on the function of the ecosystem	Easily repairable effects of damage to buildings or structures
Minor	Harm but not necessarily significant harm to humans which can easily be prevented with the use of PPE.	Slight pollution to non-sensitive water resources	No significant changes to population densities in the environment or in any ecosystem	Very slight non-structural damage or cosmetic harm to buildings or structures

Subsequently, in the column designated 'Likelihood of PCL, an assessment is made of the probability of the selected source and receptor being linked by the identified pathway. This assessment is ranked based on-site specific conditions as follows:

Classification of probability	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur in the very long term

The 'Risk Classification' column is an overall assessment of the actual risk, which considers the likely consequence of a given risk being realised and the likelihood of that risk being realised. The risk classifications are assigned using the following consequence/likelihood matrix:

Classification of probability	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term
Low likelihood	There is a pollution linkage and circumstances are possible under which an even could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur in a very long term.

Matrix				
Severe	Moderate to low	Moderate	High	Very High
Medium	Low	Moderate to Low	Moderate	High
Mild	Very Low	Low	Moderate to Low	Moderate
Minor	Very Low	Very Low	Low	Moderate to Low
Likelihood	Unlikely	Low likelihood	Likely	High likelihood

Overall risks are described as follows:

Very Low	The presence of the identified source does not give rise to the potential to cause unacceptable harm.
Low	It is possible that harm could arise to a designated receptor from an identified source, however, this is unlikely to be unacceptable.
Moderate	It is possible that harm could arise to a designated receptor from an identified source, but it is likely that such harm would be relatively localised or non-permanent - remedial action may be necessary.
High	A designated receptor is likely to experience unacceptable harm from an identified source without remedial action.
Very High	There is a high probability that severe unacceptable harm could arise to a designated receptor from an identified source without appropriate remedial action.

In cases of physical features, such as foundations and underground services, harm is defined as impact which would result in non-serviceability of the identified receptor or extra over build costs associated with redevelopment.

Appendix E - Limitations

Limitations

The direct assessments and judgements given in this report are limited by both the finite data on which they are based and the proposed works to which they are addressed. The acquisition of data is constrained by both physical and economic factors and, by definition, is subject to limitations. Conditions at the site will change over time due to natural variations and may be affected by human activities.

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The findings and opinions are relevant to the dates of the information reviewed and should not be relied upon to represent conditions at later dates. The opinions included herein are based on the information obtained from the assessments undertaken in the study area and from the experience of the reviewers.

This Phase I Land Quality Assessment has utilised a variety of publicly available data sources such as the Environment Agency, Groundsure, historical maps and the British Geological Survey. Therefore, the study is limited by the age and limitations inherent in the data described.



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