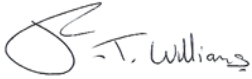


Phase I Desk Study

Dee Park Sports, Reading, RG30 4EP

Reading Borough Council

Report Reference: GWPR6235/DS/October 2024			Status: Final
Issue	Prepared By	Checked By	Verified By
v.1.01			
	Libby Bennett BSc (Hons) Geotechnical and Geoenvironmental Engineer	Miltiadis Mellios MSc(Eng) CGeol FGS MIEnvSc GMICE Principal Engineer	Francis Williams MGeol (Hons) FGS CEnv CGeol Director

Site Investigations | Environmental Consultants | Geotechnical Engineers

2 The Long Barn, Norton Farm, Selborne Road, Alton, Hampshire GU34 3NB
0333 600 1221 enquiries@groundandwater.co.uk **groundandwater.co.uk**

Registered Office: Kineton House, 31 Horse Fair, Banbury, Oxfordshire OX16 0AE Registered in England No. 07032001

Table of Contents

.....	0
Table of Contents.....	i
1. INTRODUCTION.....	1
1.1. General.....	1
1.2. Aims of the Investigation	1
1.3. Conditions and Limitations.....	1
1.4. Technical Glossary.....	1
2. SITE SETTING	2
2.1. Site Location.....	2
2.2. Site Description	2
2.3. Proposed Development	2
2.4. Geology	2
2.5. Hydrogeology and Hydrology.....	3
2.6. Radon	4
2.7. Internet Search (Site Setting)	4
2.7.1. Available Unexploded Ordnance (UXO) Map Review	4
2.7.2. Historical Landfill Tool Review.....	4
3. HISTORICAL REVIEW.....	5
3.1. Historical Map Review.....	5
3.2. Historical Aerial Photography Review.....	5
4. ENVIRONMENTAL AND GEOLOGICAL INSIGHT	7
4.1. Groundsure Datasheets	7
5. ONLINE REVIEW AND HISTORICAL INVESTIGATIONS.....	10
5.1. Online Council Planning Database	10
5.2. Internet Search.....	10
6. PRELIMINARY RISK ASSESSMENT	11
6.1. Contaminant Source-Pathway-Receptor Model	11
6.2. Potential On-site Sources of Contaminants	11
6.3. Potential Off-site Sources of Contaminants.....	12
6.4. Potential Receptors.....	13
6.5. Contaminant Absorption Pathways	13
6.6. Tabulated Conceptual Site Model.....	14
7. RECOMMENDATIONS AND PHASE II OBJECTIVES.....	18

7.1.	Soils	18
7.2.	Services.....	19
7.3.	Groundwater	19
7.4.	Ground-gas.....	19
7.5.	Vapours	19
7.6.	Geotechnical Review	19
7.6.1.	General	19
7.6.2.	Chalk Dissolution Risk Assessment	20
FIGURES.....		1
APPENDIX A: Conditions and Limitations.....		2
APPENDIX B: Technical Glossary		5
APPENDIX C: Site Photographs		6
APPENDIX D: Historical Maps.....		7
APPENDIX E: GroundSure EnviroInsight and GeoInsight Datasheets		8

EXECUTIVE SUMMARY	
PROPOSED DEVELOPMENT	At the time of reporting, October 2024, the proposed development was understood to comprise redevelopment of the site into an updated play area.
GEOLOGY AND HYDROGEOLOGY	The British Geological Survey Solid and Drift Geology Map for the Reading area (Reading Sheet No. 268) revealed that the northern section of the site was underlain by the Lambeth Group (clay, silt and sand) whilst the southern section was underlain by Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated). Areas of Worked Ground were recorded 1m northeast and 224m south of the site. A study of the aquifer maps on the DEFRA website revealed the northern section of the site was underlain by a Secondary A Aquifer comprising bedrock deposits of the Lambeth Group whilst the southern section of the site was underlain by a Principal Aquifer comprising bedrock deposits of the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated). Examination of the Environment Agency records showed that the site did not fall within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater. No surface water features were present within a 250m radius of the site. The nearest surface water feature was identified to be the River Thames ~940m north of the site flowing in an easterly direction. From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth within the Chalk Formation. Some amounts of groundwater however may be present at shallower depths within the Lambeth Group or within Made ground. It was considered that groundwater was flowing in a northern direction toward the River Thames and in line with local topography.
POTENTIAL SOURCES OF CONTAMINATION	Full details can be seen in sections 6.3 and 6.4 of this report. Onsite - The Desk study has revealed the following potential sources of contamination onsite: • Potential for Made Ground (associated with historical construction/demolition onsite) • Infilled historical pit Offsite - The Desk study has revealed the following potential sources of contamination within the site's environs: • Infilled pits • Fire station • Allotments • Electrical substations • Tanks
RECOMMENDATIONS / PHASE II OBJECTIVES	It is recommended that an intrusive ground investigation is undertaken at the site to evaluate the risk that contaminants of concern within the soils and groundwater may affect end-users. This should determine the underlying ground and groundwater conditions and include an assessment of the level of contamination to enable the quantification of the ground-related risks associated with the proposed redevelopment. If analytical results show elevated concentrations of contaminants of concern in the soil samples then there might be a requirement to assess the potential risks of leachability of contaminants migrating into the Principal Aquifer groundwater underlying the site. This might mean leachate testing on soils samples is required or groundwater sampling and testing. The CSM has identified a negligible risk from ground gases and vapours at the site as a result of the proposed development not anticipated to include buildings or confined spaces. Analysis of soil samples should include Total Organic Carbon (TOC) testing in order

	to enable a pragmatic ground gas risk assessment to be undertaken at the site. This approach will only quantify the risk associated with on-site sources.
--	---

1. INTRODUCTION

1.1. General

Ground and Water Limited were instructed by Reading Borough Council on the 24th September 2024 to conduct a Phase I Desk Study on the site at Dee Park Sports, Reading, RG30 4EP. The scope of the investigation was detailed within the email fee proposal, dated the 9th September 2024.

1.2. Aims of the Investigation

This Phase 1 Desk Study was undertaken to advise the client on risk factors pertaining to the site with special reference to former and present day potential contaminative uses and their impact on sensitive receptors, these being human health, controlled waters, buildings, building materials and services.

This Phase I Desk Study comprises a Tier 1 Preliminary Risk Assessment, under Land Contamination Risk Management (LCRM), with the intention of discharging planning conditions.

1.3. Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

1.4. Technical Glossary

Generic technical terms and their description can be viewed within the glossary provided within Appendix B.

2. SITE SETTING

2.1. Site Location

The site comprised a ~1,600m² rectangular-shaped plot of land, along the north-western side of Glenmore Place. The site was located in the north-western portion of Reading, Berkshire.

The national grid reference for the centre of the site was approximately 468479 173632. A site location plan is given within Figure 1.

2.2. Site Description

A Site Walkover was undertaken on the 3rd October 2024. A description of the site, as noted during the Site Walkover, is tabulated below. Photographs can be seen in Appendix C.

Site Description Sheet	
Use of site	At the time of the site walkover, 3 rd October 2024, the site comprised a children's park, sports court and temporary building.
Site topography	The site was noted to be generally flat.
Area topography	The surrounding area was noted to be generally flat.
Structures onsite	The site is occupied by a singular temporary building/portakabin within the northern portion of the site with a fenced off sports court within the centre of the site and children's play area within the southern section.
Structures off-site	The site was surrounded by residential developments.
Use of surrounding ground	The surrounding ground comprised predominantly residential housing, gardens and parking.
Boundary features	Northern Boundary: An open boundary to residential development Eastern Boundary: An open boundary to residential development Southern Boundary: An open boundary to residential development Western Boundary: An open boundary to community centre
Site covering	The sports court was laid to tarmac hardstanding whilst the children's play area laid to wood chips. The remainder of the site generally comprised soft-landscaping with some tarmac pathways.
Contamination sources onsite	None noted.
Contamination sources off-site	None noted.
Vegetation onsite	Some 3 – 7m mature to semi-mature trees along the perimeters of the site.
Vegetation off-site	Some small shrubs/bushes and 3-5m trees.
Services	Drainage and lampposts along the eastern and western edges of the site.

2.3. Proposed Development

At the time of reporting, October 2024, the proposed development was understood to comprise redevelopment of the site into an updated play area.

The proposed development plan can be seen within Figure 4.

2.4. Geology

The British Geological Survey Solid and Drift Geology Map for the Reading area (Reading Sheet No. 268) revealed that the northern section of the site was underlain by the Lambeth Group (clay, silt and sand) whilst the southern section was underlain by Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated). Areas of Worked Ground were

recorded 1m northeast and 224m south of the site. An inferred bedrock fault was running through the middle of the site, separating the two areas.

Superficial deposits (Drift) are the youngest geological deposits formed during the most recent period of geological time. They rest on older deposits or rocks referred to as bedrock (Solid), which are the main mass forming the Earth. Bedrock is present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

Lambeth Group

The Lambeth Group (formerly known as the Woolwich and Reading Beds) is a sedimentary complex comprising a basal bed (the Upnor Formation also known as the Bottom Bed) composed of glauconitic sand, sandy clay and gravel (well-rounded flint pebbles), with laterally variable sand and clay above. In the eastern part of the area the basal bed is mostly overlain by a shelly grey sandy clay or silty sand and laminated beds (Woolwich Formation). At the top of the sedimentary complex is the Reading Formation, which is made up of multi-coloured mottled clays and silty clays.

Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk

The Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk is a soft white friable microporous limestone composed of coccolith biomicrites with a varying proportion of larger shell fragments. Flint characterises the Undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk, occurring as nodular courses, tabular beds and linings to fractures.

At various levels clay sized material occurs as marl seams and partings. Close to the surface the upper few metres are invariably discoloured brown, due to leaching from the overlying strata. The interface with any overlying stratum is invariably extremely irregular as a result of localised weathering and dissolution. Weathering by frost action may extend to a depth of several metres.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits; can be found in the chalk deposits. These features sometimes manifest themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

A BGS borehole (SU67SE718) located ~290m northeast of the site revealed a 0.10m capping of Topsoil over chalk and clayey chalk fill to 1.20m bgl followed by a brown flinty clay to 1.60m bgl. From here up to 2.20m bgl a remoulded chalk with lumps of intact chalk, clay and flints was identified over remoulded chalk with some intact chalk up to 3.10m bgl. A rubbly chalk with some remoulded chalk and flints was then recorded to the base of the borehole at a depth of 6.0m bgl. No groundwater was recorded.

2.5. Hydrogeology and Hydrology

A study of the aquifer maps on the DEFRA website revealed the northern section of the site was underlain by a Secondary A Aquifer comprising bedrock deposits of the Lambeth Group whilst the southern section of the site was underlain by a Principal Aquifer comprising bedrock deposits of the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated).

Examination of the Environment Agency records showed that the site **did not** fall within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

No surface water features were present within a 250m radius of the site. The nearest surface water feature was identified to be the River Thames ~940m north of the site flowing in an easterly direction.

From analysis of hydrogeological and topographical maps the actual groundwater table was anticipated to be encountered at depth within the Chalk Formation. Some amounts of groundwater however may be present at shallower depths within the Lambeth Group or within Made ground. It was considered that groundwater was flowing in a northern direction toward the River Thames and in line with local topography.

Examination of the Environment Agency records showed that the site was located within a Flood Zone 1, i.e. an area with a very low probability of flooding.

The Groundsure Datasheets revealed the site was at a low risk of flooding from rivers and the sea. The datasheets also revealed the site was at low risk of groundwater flooding. The risk of surface water flooding at the site ranged from low to high.

2.6. Radon

A review of the freely available UK Health Security Agency radon database, UK Radon, indicated that majority of the site was located within a 1km grid square, where the maximum radon potential of 1 – 3% was recorded for above ground structures. A small section of the site within the northeastern corner of the site and extending offsite to the east was within an area of where the maximum radon potential of less than 1% for above ground structures. Basic radon protection measures are required in areas where more than 3% of houses are at or above the Action Level.

The site was in an area where a risk assessment was not required.

2.7. Internet Search (Site Setting)

2.7.1. Available Unexploded Ordnance (UXO) Map Review

A review of the data available on www.zeticauxo.com/ revealed the site was located within a low -risk area associated with unexploded ordnance (UXO), as indicated by having <15 bombs dropped per 1000 acres.

2.7.2. Historical Landfill Tool Review

A review of the data available on www.groundsure.io/ revealed no records of historical landfilling within a 250m radius of the site. The nearest record was noted ~925m northwest of the site.

3. HISTORICAL REVIEW

3.1. Historical Map Review

The object of this search was to report on the history of the site and its environs from available County Series and Ordnance Survey Maps dating from the mid to late 19th Century to the present day and downloaded from Groundsure. In the following sections dealing with individual maps, only features considered to have a potential contaminative impact on the site and usually within a notional 250 metre radius of the site boundaries are discussed. Any distances quoted for features remote from the site have been scaled from the maps and are only approximate. The north point and approximate extent of the site are indicated on each figure. The historical maps referred to are given within Appendix D. The implications of the map search are discussed later within this report.

Environmental Significance of Data from Historical Maps		
Maps Dated Between	Site	Environs
1881 – 1899	The site comprised a part of an undeveloped open plot of land, likely agricultural land/fields. An Old gravel pit adjacent to the east of the site encroaches slightly along the eastern border of the site.	The site environs generally comprised undeveloped agricultural land/fields. Two old gravel pits were identified adjacent to the east and northeast of the site. An additional old gravel pit was identified ~175m north of the site within a woodland.
1899 – 1911	No significant change recorded.	The old gravel pit adjacent to the east of the site appeared to have been infilled slightly.
1911 – 1932	No significant change recorded.	Allotment gardens were identified ~240m north of the site.
1932 – 1962	No significant change recorded.	Allotment gardens were identified ~50m east of the site and ~30m southwest of the site.
1962 – 1971	No significant change recorded.	The previously identified allotment gardens to the north and east of the site were no longer detailed on mapping. Additional allotments are noted ~75m north and ~110m northeast of the site. Residential development has occurred to the northeast as close as ~75m from site.
1971 – 1991	A playground was identified within the southwestern corner of the site. The area of pit previously identified to encroach over the eastern boundary of the site appears to have been infilled.	The aforementioned pits adjacent to the site and to the north were no longer detailed on mapping and presumably been infilled. Residential development has occurred in all directions surrounding the site with electricity substations noted ~160m north, ~90m east, ~50m south and ~55m northwest of the site.
1991 - 2024	No significant change recorded.	Continued development surrounding the site.

3.2. Historical Aerial Photography Review

The object of this search was to report on the history of the site and its immediate environs from available Aerial Photography dating from the late-20th Century to the present day and downloaded from Google Earth and Groundsure. Any distances quoted for features remote from the site have been scaled from the photography and are only approximate.

At the time of the earliest aerial photography, 1999, majority of the site appears to comprise part of an undeveloped playing field with a small playground within the southwestern corner of the site. The playing field extends to the north and east of the site with residential development noted adjacent to the west of the site and as close as ~40m to the north and east. A school and other development is

noted adjacent to the south of the site. Within the aerial photography from 2010 shows a sports court to have been constructed within the centre of the site whilst the playing field to the east/northeast appears to be under development with groundworks in progress. The remaining surrounding area and site itself remain unchanged. The photography from 2013 shows the development to the east/northeast to have been completed and comprises 2no. parallel rows of terraced properties.

From the 2019 photography a single structure is noted within the northern section of the site. Throughout the remaining photographs up to 2020 the site remains unchanged however off-site demolition and construction appears to have occurred to the west and further afield to the east.

4. ENVIRONMENTAL AND GEOLOGICAL INSIGHT

4.1. Groundsure Datasheets

Groundsure Environmental and Geological Datasheets were obtained for the site. Unless the data indicates a significant risk, only information within a 250m buffer zone has been included. The GroundSure Datasheets are also presented in Appendix E and a summary is given below and overleaf(s).

Environmental Insight	
Source	Nearest Distance from Site/Dated/Type
Past Land Use	
Historical industrial land uses	5x on-site and 18 off-site records within a 250m radius: 2x record of an unspecified pit on-site (1932-1961), 3x records of old gravel pits on-site (1900 – 1910). 4x records of unspecified pits 2m northeast (1961), 141m northeast, 145m northeast and 148m northeast (1931-1961). 2x records of unspecified ground workings 6m northeast (1938) and 198m south (1961). 3x records of old gravel pits 136-141m northeast (1900-1910), 2x records of a fire station 188m south (1976-1991), 2x records of a clay pit 198m south (1932-1938), 2x records of unspecified tanks 237-240m south (1932-1961), 1x record of an unspecified heap 243m south (1961), 2x records of an unspecified depot 249m northeast (1976-1982).
Historical Tank Database	1x record within a 250m radius: 1x record 244m south of the site relating to an unspecified tank.
Historical Energy Features Database	12x off-site records within a 250m radius: 12x records of electricity substations 44m north (1993), 46m south (1971-1987), 51m north (1971-1987), 61m south (1993), 84m east (1990-1994), 85m east (1970), 160m north (1970-1994), 169m south (1971-1993), 173m southwest (1971-1993), 194m southeast (1981-1993), 239m west (1993) and 242m west (1971-1987).
Waste and Landfill	
Waste exemptions	1x record within a 250m radius: 1x record 100m east relating to non-agricultural waste and the use of waste in construction.
Current Industrial Land Use	
Recent Industrial Land Uses	8x record within a 250m radius: 7x records of electricity sub-stations 50m south-east, 89m east, 171m south-west, 172m south, 197m southeast and 246m west. 1x record of a Gas Governor 181m northwest.
Current or recent petrol stations	1x record within a 250m radius: 1x record 229m southeast relating to an obsolete petrol station located on Spey Road, Reading.
Hydrogeology	
Superficial Aquifer	No records on-site. 1x record 173m north relating to a Secondary A Aquifer.
Bedrock Aquifer	2x record onsite: 1x Principal Aquifer

	1x Secondary A Aquifer.
Groundwater Vulnerability – Soluble Rock Risk	2.0% of grid square covered by maximum risk Very significant soluble rocks are likely to be present with a high possibility of localised subsidence or dissolution-related degradation of bedrock occurring naturally, especially in adverse conditions such as concentrated surface or subsurface water flow.
Hydrology	
WFD Surface Water Body Catchments	1 record within a 250m radius: 1x River Catchment (Thames Wallingford to Caversham) on-site.
WFD Groundwater Bodies	1 record within a 250m radius: 1x Berkshire Downs Chalk on-site.
Environmental Designations	
Visual and Cultural Designations	
Agricultural Designations	
Agricultural Land Classification	1x record within a 250m radius: 1x Urban on-site.
Habitat Designation	

Geological Insight	
Source	Nearest Distance from Site/ Type
Artificial and Made Ground (1:10,000 Scale)	2x records within a 250m radius: 1x record of worked ground 1m northeast 1x record of worker ground 224m south.
Superficial Geology (1:10,000 Scale)	1x record within a 250m radius: 1x record 172m north – Head Deposits (Clay, Silt, Sand and Gravel).
Bedrock Geology (1:10,000 Scale)	2 on-site records: 1x Undifferentiated Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (Chalk), 1x Lambeth Group (Clay, Silt and Sand).
Bedrock Faults and Other Linear Features (1:10,000 Scale)	1 record within a 250m radius: 1x record of a fault on site. Recorded as a normal fault.
Superficial Geology and Permeability (1:50,000 scale)	1x record within a 250m radius: 1x record 172m north – Head Deposits (Clay, Silt, Sand and Gravel).
Bedrock Geology and Permeability (1:50,000 scale)	2 records onsite: 1x Newhaven Chalk Formation and Seaford Chalk Formation (Undifferentiated). Flow Type – Fracture, Maximum Permeability – Very High, Minimum Permeability – Very High. 1x Lambeth Group. Flow Type – Mixed, Maximum Permeability – Moderate, Minimum Permeability – Very Low.
Bedrock faults and other linear features (60k)	1 record within a 250m radius: 1x record of a fault on site. Recorded as a normal fault.
Natural Hazard Findings	
Shrink-Swell Clay	Negligible to Moderate hazard onsite.
Running Sands	Negligible to Very Low hazard onsite.
Compressible Deposits	Negligible hazard onsite.
Collapsible Deposits	Very Low hazard onsite.
Landslides	Negligible to Very Low hazard onsite.
Ground Dissolution of Soluble Rocks	Low to Moderate hazard onsite.
Mining, Ground Working and Natural Cavities	
Records of BritPits	4x records within a 250m radius: 3x records relating to Penham's Shaw Gravel Pit 21m southeast, 27m northeast and 164m northeast. All recorded as a Type A Surface mineral working. Recorded as ceased. 1x record 241m south relating to Grovelands Brick, Tile and Pottery Works. Recorded as ceased.

Records of Surface Ground Workings	20x records within a 250m radius: 7x records on site relating to Unspecified pits (1932-1961) and Old gravel pits (1900-1910) 5x records of unspecified pits – 2m northeast (1961), 141m northeast (1938), 145-148m northeast (1932-1961). 2x records of Unspecified ground workings 6m northeast (1938) and 198m south (1961) 3x records of an old gravel pit 136-141m northeast (1900-1910) 2x records of a clay pit 198m south (1932-1938) 1x record of an unspecified heap 243m south (1961).
Records of Historical Mineral Planning Areas	1x record with a 250m radius: 1x record 157m southwest relating to Groveland Tile and Pottery Works recorded as a surface mineral working for loam with sand.
Researched mining	1x record on site relating to stone mining.
Radon	
Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The majority of the site was located within a 1km grid square, where the maximum radon potential of 1 – 3% was recorded for above ground structures. A small section of the site within the northeastern corner of the site and extending offsite to the east was within an area of where the maximum radon potential of less than 1% for above ground structures.
Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary.
Estimated Background Soil Chemistry	
Records of BGS estimated background soil chemistry	4 records within a 250m radius: On-site (x3) and 20m southeast: Arsenic: 15mg/kg Lead 100mg/kg (60mg/kg bioaccessible) Cadmium: 1.8mg/kg Chromium: 60 – 90mg/kg Nickel: 15 – 30mg/kg
Railway Infrastructure and Projects	

5. ONLINE REVIEW AND HISTORICAL INVESTIGATIONS

5.1. Online Council Planning Database

A review of the Reading Borough Council Planning Database revealed that no planning applications had been filed for the site.

5.2. Internet Search

An internet search did not identify any other information pertinent to this report.

6. PRELIMINARY RISK ASSESSMENT

6.1. Contaminant Source-Pathway-Receptor Model

In the UK, the assessment of risk from contamination follows the source-pathway-receptor (SPR) approach. For a risk to be present there must be a source of contamination, a receptor or receptors, and a pathway for contaminants to migrate or be absorbed. If one of these three elements are absent, it is considered that there is no risk of harm. If, however, there is a linkage between any given source and any given receptor, then a risk-based approach is used to assess the significance or impact of the pollutant linkage.

This Phase 1 Desk Study has been used to identify potential on-site and off-site sources of contamination, which are summarised in this section of the report. Additional potential sources of contamination identified within the Desk Study have been discounted based on the absence of a realistic SPR linkage (i.e. the distance from the site or the nature or age of any potential contamination sources).

In line with the requirements of BS 21365:2020, *Soil Quality – Conceptual site models for potentially contaminated sites*, the Conceptual Site Model (CSM) can be described in text, tabulated or presented as a figure. A tabulated CSM is provided in Section 6.6 of this report, where each component is discussed in the following sections.

6.2. Potential On-site Sources of Contaminants

This Desk Study revealed that at the time of the earliest historical mapping (1881) the site comprised an undeveloped plot with a small section of an off-site pit noted to encroach onto the eastern boundary of the site. Within the 1971 mapping the pit was noted to have been infilled and a playground was then noted within the southwestern corner of the site. The aerial photography from 2010 identified a sports court to be constructed within the centre of the site whilst a single structure identified as a temporary building within the site walkover was noted on site from 2019.

The Phase 1 Desk Study revealed the following on-site sources of contamination:

- The site has undergone some phases of construction/demolition and as a result various thicknesses of Made Ground resulting from these activities are likely to be encountered.

Contaminants of concern associated with Made Ground deposits include; metals, Petroleum Hydrocarbons (TPHs), Polycyclic aromatic hydrocarbons (PAHs), asbestos, sulphates, volatile organic compounds (VOCs) and ground gases.

- The historical maps and Groundsure datasheets identified a portion of an off-site pit to be present on the eastern side of the site which is understood to have been backfilled ~1971.

Decomposition of the organic matter and waste material potentially used to infill the pit is likely to occur which could generate harmful ground gases such as methane and carbon dioxide. Contaminants of concern associated with the infill material may also include metals, Petroleum Hydrocarbons (TPHs), Polycyclic aromatic hydrocarbons (PAHs), asbestos, sulphates and volatile organic compounds (VOCs).

In this instance as the proposed development not anticipated to include buildings or confined spaces the ground gas risk is considered to be negligible but the risk of contamination from infilled material should be investigated further.

6.3. Potential Off-site Sources of Contaminants

The Phase 1 Desk Study revealed the following potential off-site sources of contamination:

Infilled Pits

The historical maps and Groundsure datasheet identify a number of pits and ground workings within a 250m radius of the site with the closest being adjacent to the east of the site which appears to become infilled around 1971. Putrescible material may have been used to backfill the feature which in turn could be decaying to produce ground gases. Due to the proposed development not anticipated to include buildings or confined spaces the ground gas risk is considered to be negligible.

Allotment Gardens

The historical mapping identified several allotment gardens within a 250m radius of the site, the closest of which being ~30m southwest of the site. Pesticides/herbicides may have been used on a regular basis across the allotment gardens. Heavy metals and semi-metals may also have been used. Isolated leaks from farm machinery and storage containers may have resulted in fuel/lubrication oil contamination. Therefore, it was considered likely that there may be remnants of these chemicals left in the near surface soils. Given the distance of the allotment gardens from site and time passed since their active use the risk to site is considered negligible.

Electricity Substations

The Groundsure datasheet identified 12no. records of electricity substations within a 250m radius of the site with the closest being 44m north (1993) followed by 46m south (1971-1987) and 51m north. PCB oils and other cable/transformer oils, together with a series of waxes are commonly used in mainly high voltage applications. PCBs are generally toxic; however, newer forms of non-toxic oils and waxes have replaced the use of PCBs. All cable oils are extremely viscous and adhere strongly to soil particles and do not tend to migrate far from the point of leakage or spillage. Therefore, the potential risk of encountering PCBs on the site was negligible.

Fire Station

A fire station was recorded within the Groundsure Datasheets 188m south of the site between 1976 and 1991. Contaminants of concern associated with Fire Stations include; metals, Petroleum Hydrocarbons (TPHs), Polycyclic aromatic hydrocarbons (PAHs), asbestos, volatile organic compounds (VOCs) and Per- and Polyfluoroalkyl Substances (PFAS). The risk to site was however considered to be negligible given the distance from site and time elapsed since the station was in use.

Tanks

The Groundsure Datasheet identified unspecified tanks 237-240m south of the site (1932-1961). The use of the tanks was unknown but may have contained oil/fuel hydrocarbons. Spillages/leakages may have occurred over time and affected the soils and groundwater underlying the site. The risk from the tanks was considered to be low given the distance from site and the time elapsed since they were

recorded which will have allowed time for any hydrocarbons to have steadily attenuated over time therefore reducing risk.

6.4. Potential Receptors

At the time of reporting, October 2024, the proposed development was understood to comprise redevelopment of the site into an updated play area. The proposed development plan can be seen within Figure 4.

Based on the proposed development, the potential receptors are presented below and comprise:

Human Health

- End users of the site (Residents/Future site visitors);
- Construction workers during redevelopment;
- Site operatives during maintenance works; and
- Neighbours and members of the public.

Flora and Fauna

- Vegetation within soft landscaped areas;

Building Materials and Services

- Buried concrete; and
- Underground services (Water Pipes) (if to be included in the proposed development).

Controlled Waters

- Secondary A Aquifer (Lambeth Group); and
- Principal Aquifer (Lewes Nodular, Seaford and Newhaven Chalk Formation (undifferentiated)).

6.5. Contaminant Absorption Pathways

The potential pathways for contaminant absorption between the identified sources and the identified receptors are as follows:

Human Health:

- Direct ingestion of soil and soil derived dust;
- Dermal contact of soil and soil derived dust;
- Inhalation of dust (indoors and outdoors) with elevated concentration of determinands;
- Ingestion of home-grown produce, and soil attached;
- Direct ingestion of groundwater;
- Inhalation of volatile vapour (indoors and outdoors);
- Inhalation of ground gases.; and
- Explosion.

Flora and Fauna

- Direct uptake of groundwater; and
- Direct uptake of contaminants in the soil.

Controlled Waters

- Vertical and lateral migration in permeable strata horizons;
- Via anthropogenic pathways (infilled ground and service runs);
- Surface water Runoff.

6.6. Tabulated Conceptual Site Model

The tabulated Conceptual Site Model developed as part of this Desk Study is outlined overleaf. For ease of reference and understanding, the risks have been classified within this risk assessment against four possible levels / categories, summarised in the table below.

Risk Categories used in the Tabulated CSM	
Negligible	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is no plausible risk. Therefore, there is no need to further assess this potential source of contamination.
Low Risk	Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is not considered to be an unacceptable risk to receptors. However, it is considered that further investigation to confirm this is recommended.
Moderate Risk	Regarding this potential SPR linkage, the site may not be suitable for the proposed end-use in its current condition and there may be an unacceptable risk to receptors. Further investigation is required to confirm this.
High Risk	Regarding this potential SPR linkage, the site is probably or certainly not suitable for proposed end-use and there is likely to be an unacceptable risk to receptors. Contaminants probably or certainly present and urgent action required in the short term.

Tabulated Conceptual Site Model – Pollutant Linkage Summary			(On-Site Sources)
Potential Sources	Potential Absorption Pathways	Potential Receptors	Risk Classification
Made Ground from construction/ demolition activities and infill of pit: - Asbestos, - PAHs, - TPHs, - VOCs,-negligible - Sulphates, and - Metals.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Ingestion of home-grown produce, and soils attached - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Site workers/Future site visitors) - Construction workers during development - Site operatives during maintenance works - Neighbours and public	Moderate
	- Direct uptake of groundwater - Direct uptake of determinands in the soil	Flora and Fauna Vegetation within soft landscaped areas	Moderate
	- Anthropogenic (man-made) pathways - Vertical and lateral migration in permeable strata - Surface water runoff	Controlled Waters - Principal Aquifer (Lewes Nodular, Seaford and Newhaven Chalk Formation (undifferentiated)) - Secondary A Aquifer (Lambeth Group).	Low
Aggressive ground conditions with Made Ground and natural ground, including groundwater: - Sulphates, - PAH/TPH.	Direct contact with aggressive ground conditions	Building Materials and Services - Buried Concrete - Underground services (water pipes)	Low
Ground gases generated by Made Ground: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide.	- Migration through anthropogenic & natural pathways - Inhalation of Asphyxiating gases - Explosion (methane only)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces - Neighbours and public	Negligible
	- Migration through anthropogenic & natural pathways - Explosion (methane only)	Building Materials and Services - Buildings - Confined spaces - Underground services	Negligible

Tabulated Conceptual Site Model – Pollutant Linkage Summary			(Off-Site Sources)
Potential Sources	Potential Absorption Pathways	Potential Receptors	Risk Classification
Made Ground from nearby works/development: - Asbestos, - PAHs, - TPHs, - VOCs,-negligible - Sulphates, and - Metals.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works	Low
	Direct uptake of groundwater	Flora and Fauna Vegetation within soft landscaped areas	Low
Aggressive ground conditions associated with impacted groundwater; - Sulphates, - PAH/TPH.	Direct contact with aggressive ground conditions	Building Materials and Services - Buried Concrete - Underground services (water pipes)	Low
Ground gases generated by infilled pits/Made Ground: - Methane, - Carbon Dioxide, - Hydrogen Sulphide, and - Carbon Monoxide.	- Migration through anthropogenic & natural pathways - Inhalation of Asphyxiating gases - Explosion (methane only)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development (especially in confined spaces) - Site operatives during maintenance works in confined spaces	Negligible
	- Migration through anthropogenic & natural pathways - Explosion (methane only)	Building Materials and Services - Buildings - Confined spaces - Underground services	Negligible
Electricity Sub-station: PCBs	Migration through anthropogenic & natural pathways	Human Health End Users (Residents/Future site visitors)	Negligible
Nearby Allotments: - Pesticides/herbicides, - Metals, - PAHs, - TPHs, - Sulphates and - VOCs.	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works	Negligible
	Direct uptake of groundwater	Flora and Fauna Vegetation within soft landscaped areas	Negligible

Tabulated Conceptual Site Model – Pollutant Linkage Summary			(Off-Site Sources)
Potential Sources	Potential Absorption Pathways	Potential Receptors	Risk Classification
Leaks/spills associated with tank ~240m south: - Metals and Semi-Metals, - Asbestos and ACMs, - PAHs, - TPHs, - BTEX, - Sulphates, - Phenol, - Harmful pH, - VOCs and SVOCs	- Direct ingestion of soil and soil derived dust - Dermal contact of soil and soil derived dust - Inhalation of dust (indoors and outdoors) with elevated concentration of determinands - Direct ingestion of groundwater - Inhalation of volatile vapour (indoors and outdoors)	Human Health - End Users (Residents/Future site visitors) - Construction workers during development - Site operatives during maintenance works	Negligible
	Direct uptake of groundwater	Flora and Fauna - Vegetation within soft landscaped areas; - Ecological receptors and habitat networks.	Negligible

7. RECOMMENDATIONS AND PHASE II OBJECTIVES

This section of the report will present recommendations for the further investigation of each plausible pollutant linkage identified by the Conceptual Site Model.

It is recommended that an intrusive ground investigation is undertaken at the site to evaluate the risk that contaminants of concern within the soils and groundwater may affect end-users. This should determine the underlying ground and groundwater conditions and include an assessment of the level of contamination to enable the quantification of the ground-related risks associated with the proposed redevelopment.

Consideration should be given to the testing of soil samples recovered from exploratory holes for chemical laboratory testing. The testing should be for a broad range of contaminants in accordance with DEFRA / CLEA methodologies and include the contaminants of concern identified within the Conceptual Site Model.

7.1. Soils

It is possible that asbestos and asbestos containing materials will be incorporated within any Made Ground. An asbestos management strategy should be implemented to ensure that any asbestos uncovered during the investigation does not pose a risk to members of the public that use the site.

On the basis of the Phase 1 Site Assessment the following contaminants of concern have been identified and should be included in the chemical analysis suite for the ground investigation:

- Asbestos.
- Semi-metals and heavy metals;
- Poly-cyclic aromatic hydrocarbons (PAHs);
- Speciated TPH including full aliphatic/aromatic split;
- Volatile/semi-volatile organic compounds – BTEX Used as marker compounds; and
- Sulphates.

The list above does not imply that these determinands are present on-site or that they are likely to cause contamination issues at the site. The ground investigation will be used to prove the presence or absence of these contaminants. The sampling and testing strategy must be in line with current standards. Given the site has undergone various phases of building and demolition, random sampling should be adopted across the site. Sampling should be undertaken on the eastern side of the site with the aim of targeting the infilled pit. Targeted sampling of proposed soft landscaped areas may be deemed appropriate. Results should be assessed against suitable assessment criteria to be protective of human health as well as vegetation.

Sub-surface concrete may be damaged due to being in contact with aggressive ground conditions. Sampling should be undertaken where the proposed foundations will be in contact with Made Ground and/or natural ground and tested for aggressive ground conditions (sulphates/pH). Classification should then be undertaken of the ground conditions in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

7.2. Services

The CSM has identified a low/moderate risk for aggressive ground conditions that may affect water supply pipes as part of the development (if they are to be included). Consideration should be given to the targeted sampling (0.75 – 1.50m bfgl) and scheduling for contaminants of concern: TPH, Naphthalene, Phenols, BTEX, VOCs and SVOCs.

7.3. Groundwater

If analytical results show elevated concentrations of contaminants of concern in the soil samples then there might be a requirement to assess the potential risks of leachability of contaminants migrating into the Principal Aquifer groundwater underlying the site. This might mean leachate testing on soils samples is required or groundwater sampling and testing.

7.4. Ground-gas

The CSM has identified a negligible risk from ground gases at the site as a result of the proposed development not anticipated to include buildings or confined spaces. Analysis of soil samples should include Total Organic Carbon (TOC) testing in order to enable a pragmatic ground gas risk assessment to be undertaken at the site. This approach will only quantify the risk associated with on-site sources.

7.5. Vapours

As the proposed developed is not set to contain buildings or confined spaces the vapour risk is considered to be negligible to future site users.

7.6. Geotechnical Review

7.6.1. General

The BGS have identified the following natural hazards on-site and within a 50m buffer.

Natural Hazards	
Shrink-Swell Clay	Negligible to Moderate hazard onsite.
Running Sands	Negligible to Very Low hazard onsite.
Compressible Deposits	Negligible hazard onsite.
Collapsible Deposits	Very Low hazard onsite.
Landslides	Negligible to Very Low hazard onsite.
Ground Dissolution of Soluble Rocks	Low to Moderate hazard onsite.

Based on the above, it was considered that further investigation in the form of a chalk dissolution risk assessment is carried out for the site.

From review of the historical mapping two old gravel pits were identified adjacent to the east of the site with a small portion of the pit encroaching onto the eastern boundary of the site. An additional gravel pit was also noted ~175m north of the site whilst the Groundsure datasheet recorded additional records of pits and groundworks to the south and northeast of the site. The main commodity is understood to be gravel.

When designing foundations, the potential presence of aggressive ground conditions should be taken into consideration. Further investigation may be required in accordance with the guidance established in BRE Special Digest 1 (SD1) (2005) 'Concrete in aggressive ground'. The BGS do not record any details regarding the potential for aggressive ground conditions within shallow units identified at the site.

It is recommended that as part of the site-specific ground investigation on-site, geotechnical testing is undertaken to determine the underlying ground conditions and to evaluate any geotechnical related risks associated with the proposed redevelopment of the site.

The Groundsure datasheets have indicated that bedrock deposits of the Lambeth Group (north) is likely to have very low to moderate permeability and so may not be suitable for surface water disposal. The Chalk bedrock within the southern area of the site was recorded to have a very high permeability and therefore would be suitable for surface water disposal. These will be subject to on-site testing. The water discharge into chalk may worsen/create dissolution features and therefore soakaways should be remote from structures and undertaken in accordance with the current guidance.

7.6.2. Chalk Dissolution Risk Assessment

The presence of dissolution features on-site can prove problematic, as they often provide inconsistency within the underlying geology. Often formed during glacial and periglacial conditions, the depth and width of these features can vary substantially, often providing inconsistency in geological strength data.

If a dissolution feature is suspected, a geotechnical engineer and structural engineer should be contacted for suitable engineering designs, based on further works identifying and classifying the area the feature occupies.

The Groundsure Geosight datasheets, presented Appendix C of this report, revealed the following information which may be pertinent to this risk assessment.

- Ground Dissolution of Soluble Rocks – The northern section of the site was classified as a Low risk of ground dissolution of soluble rocks whilst the southern section of the site was classified as Moderate risk.
 - Low Risk was described as *“Soluble rocks are present within the ground. Some dissolution features may be present. Potential for difficult ground conditions are at a level where they may be considered, localised subsidence need not to be considered except in exceptional circumstances”*.
 - Moderate risk was described as *“Soluble rocks are present within the ground. Many dissolution features may be present. Potential for difficult ground conditions are at a level where they should be considered. Potential for subsidence is at a level where it may need to be considered”*.
- An on-site Class B Non-coal Mining area was identified on-site. A Class B area was described as *“Underground mine workings may have occurred in the past or current mines may be working at significant depth to modern engineering standards. Potential for difficult ground conditions are unlikely and are at a level where they need not be considered.”*. However, this is generally a precautionary statement attributed to all areas associated with chalk within the ground profile.
- 1no. record of researched mining on site relating to stone.
- 1No. Natural cavity, solution pipe and sinkhole, was identified 355m southeast of the site.
- 4No. Britpits were noted within 250m radius of the site, 21m south-east, 27m northeast, 164m northeast relating to gravel pits and 241m south relating to a brick, tile and pottery works.

- 7No. on-site and 13No. records of surface ground workings were noted. The on-site records correspond to old gravel and unspecified pits (1900-1961), with the off-site features comprising pits and ground workings.
- 1no. record of underground workings was noted within a 500m radius of the site located 396m south and relating to unspecified workings.
- 2no. records of Mining Cavities within 500m of the site relating to chalk located 305m south and 403m northwest.
- No records of JPB Mining Areas were noted within a 500m radius of the site.
- The Edmonds Procedure (Edmonds, C.N., 2001. Predicting natural cavities in chalk. Geological Society, London, Engineering Geology Special Publications, 18(1), pp.29-38.); highlighted a moderate subsidence hazard classification.

The historical mapping review undertaken in section 3.1 of this report confirmed the findings of the Groundsure datasheets discussed above. Pits were identified adjacent to the east of the site (also noted to overlap into eastern section of the site) and ~175m north of the site.

From a review of LiDAR data for the site and surrounding area a feature assumed to be a pit is noted ~440m northwest of the site.

This risk assessment indicates that there is a moderate risk from the dissolution of soluble rocks at the site. Furthermore, along the eastern boundary and extending off-site to the east a pit has been identified from historical mapping. The presence of potential dissolution features and former infilled pits should not be discounted and it is recommended a site investigation is undertaken to investigate further.
