

CHAPTER 12

**GROUND
CONDITIONS,
HYDROGEOLOGY AND
CONTAMINATION**



U and I (8AE) Limited and the London Fire
Commissioner (LFC)

8 ALBERT EMBANKMENT

Volume I: Chapter 12 - Ground Conditions





U and I (8AE) Limited and the London Fire
Commissioner (LFC)

8 ALBERT EMBANKMENT

Volume I: Chapter 12 - Ground Conditions

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70016347

DATE: MARCH 2019

WSP

4th Floor
6 Devonshire Square
London
EC2M 4YE

Phone: +44 20 7337 1700

Fax: +44 20 7337 1701

WSP.com



CONTENTS

12.	GROUND CONDITIONS, HYDROGEOLOGY AND CONTAMINATION	1
12.1.	INTRODUCTION	12-1
12.2.	LEGISLATION, POLICY AND GUIDANCE	12-1
12.3.	RELEVANT ELEMENTS OF THE PROPOSED DEVELOPMENT	12-5
12.4.	ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA	12-6
12.5.	BASELINE CONDITIONS	12-13
12.6.	SENSITIVE RECEPTORS	12-27
12.7.	ASSESSMENT OF EFFECTS, MITIGATION AND RESIDUAL EFFECT	12-28
12.8.	LIMITATIONS AND ASSUMPTIONS	12-32
12.9.	SUMMARY	12-32
12.10.	REFERENCES	12-37

12. GROUND CONDITIONS, HYDROGEOLOGY AND CONTAMINATION

12.1. INTRODUCTION

- 12.1.1. This Chapter reports the likely significant effects of the Proposed Development on the Site and surrounding area in terms of Ground Conditions, Hydrogeology and Contamination. This includes an assessment of likely significant effects on identified receptors as part of the Proposed Development. Where appropriate it also identifies proposed mitigation measures to prevent, minimise or control likely negative ground conditions effects arising from the Proposed Development and the subsequent anticipated residual effects.
- 12.1.2. This Chapter (and its associated figures and appendices) should be read together with the Introductory Chapters of this ES (**Chapters 1 – 5**), as well as **Chapter 15 Cumulative Effects**.

12.2. LEGISLATION, POLICY AND GUIDANCE

LEGISLATIVE FRAMEWORK

- 12.2.1. The applicable legislative framework is summarised as follows:
- § Part IIA of the Environmental Protection Act (EPA), 1990 (**Ref. 12.1**), is the contaminated land regime which provides a risk based approach to the identification of risks to human health or the environment from contaminated land, based on the pathway-receptor concept;
 - § Environment Act, 1995 (**Ref. 12.2**) sets out liabilities relating to contaminated land;
 - § Control of Substances Hazardous to Human Health, 2002 (as amended) (**Ref. 12.3**) requires employers to control substances that are hazardous to health;
 - § The Water Environment (Water Framework Directive) (England and Wales) Regulations, 2017 (2000/60/EC) (**Ref. 12.4**) sets out the basis for assessing quality of surface waters and groundwaters;
 - § Groundwater Directive 2006/118/EC (**Ref. 12.5**) sets out the regime for groundwater quality standards and introduces measures to prevent or limit pollution of groundwater;
 - § Water Resources Act 1991 (**Ref.12.6**) regulates water resources, water quality and pollution, and flood defense;
 - § Dangerous Substances Directive (Amendment), 2006 (**Ref. 12.7**) focuses on pollution caused by certain dangerous substances discharged into the aquatic environment;
 - § Environmental Damage (Prevention and Remediation) Regulations, 2015 (**Ref. 12.8**) sets out the requirements where damage to land or water by pollution is caused;
 - § The Environmental Permitting (England and Wales) Regulations, 2016 (**Ref. 12.9**) set out the environmental permitting regime;
 - § Control of Asbestos Regulations, 2012 (**Ref. 12.10**) sets out the duties for managing risk of asbestos in buildings;
 - § Contaminated Land (England) (Amendment) Regulations, 2012 (**Ref. 12.11**) sets out the actions for remediation of contaminated land; and
 - § Construction (Design & Management) Regulations, 2015 (**Ref. 12.12**) requires consideration of the health and safety of workers during the construction phase of a project.

PLANNING POLICY

NATIONAL PLANNING POLICY

NATIONAL PLANNING POLICY FRAMEWORK

12.2.2. Chapter 15 of the National Planning Policy Framework (NPPF) (February 2019) (**Ref. 12.13**) set out the provisions for planning decisions in relation to ground conditions and pollution issues as follows:

- § Paragraphs 178 states that ‘*Planning policies and decisions should ensure that: a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination.....*’;
- § Paragraph 179 states that ‘*Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.*’; and
- § Paragraph 180 states that ‘*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.*’

12.2.3. In addition, under Chapter 11 “Making effective use of land”, Paragraph 118 states “Planning policies and decisions should: c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated and unstable land”.

LONDON PLANNING POLICY

THE LONDON PLAN STRATEGY FOR LONDON CONSOLIDATED WITH ALTERATIONS SINCE 2011 (REVISED MARCH 2016)

12.2.4. “The London Plan: The Spatial Strategy for London Consolidated with Alterations since 2011” (the London Plan) (**Ref. 12.14**) came into force in March 2016 and forms part of the development plan for Greater London. Key policies of the London Plan relating to contaminated land are set out in Policy 5.21 Contaminated Land. This policy states that such land affected by contamination should be recycled into new uses, reducing the risk to the environment and may require measures to prevent contamination being activated or spread when building takes place.

12.2.5. The policy is set out as follows:

Policy 5.21 Contaminated Land

Strategic

a) *The Mayor supports the remediation of contaminated sites and will work with strategic partners to ensure that the development of brownfield land does not result in significant harm to human health or the environment, and to bring contaminated land to beneficial use.*

Planning decisions

b) *Appropriate measures should be taken to ensure that development on previously contaminated land does not activate or spread contamination.*

Local Development Framework (LDF) preparation

c) LDFs should encourage the remediation of contaminated sites and set out policy to deal with contamination.

- 12.2.6. Section 5.95 states that wherever practicable, brownfield sites, including those affected by contamination, should be recycled into new uses. This also provides an opportunity to deal with any threats to health and the environment posed by contamination. Any land that is affected by contamination, whether or not identified under the regulations, may require measures to prevent contamination being activated or spread when building takes place.
- 12.2.7. Section 5.95A states that where potentially contaminating activities are proposed, development should include appropriate measures to mitigate any harmful effects.
- 12.2.8. The Draft London Plan was published on 18th August 2018 and includes Policy D9 – Basement Development, which requires the consideration of land stability issues for the construction of large basements.

LAMBETH LOCAL PLAN SEPTEMBER 2015

12.2.9. The Lambeth Local Plan (the Local Plan) (**Ref. 12.15**) is a strategic document that establishes the land use and planning framework for the London Borough of Lambeth (LBL) and is the primary reference for all planning decisions.

12.2.10. The following Policy is relevant to this assessment:

Policy EN4 Sustainable Design and Construction

(e) Adequate remedial treatment of any contaminated land will be required before development can commence.

12.2.11. Section 9.22 states that where contamination exists, a remediation strategy should be submitted to the council for approval and implemented by a suitably qualified person prior to development commencing.

LAMBETH CONTAMINATED LAND STRATEGY

12.2.12. Lambeth's Contaminated Land Strategy (October 2001) (**Ref 12.16**) sets out how the LBL will deal with potentially contaminated sites. It also summarises the locations where previous land uses may have led to land contamination. The LBL will seek to advise those proposing development on sites with known or potential land contamination issues, or development likely to pose a new risk of contamination, consulting with the Environment Agency.

GUIDANCE

12.2.13. The following guidance documents have been used during the preparation of this Chapter:

CONTAMINATED LAND STATUTORY GUIDANCE 2018

12.2.14. The Contaminated Land Statutory Guidance 2018 (**Ref. 12.17**) describes a risk assessment methodology in terms of 'significant pollutants' and 'significant pollutant linkages' within a source-pathway-receptor conceptual model. The model comprises:

- § The principal pollutant hazards (sources) associated with a site;
- § The principal receptor(s) at risk from the identified hazards (for example, people, environmental assets, surface water and / or groundwater); and

§ The existence, or absence, of plausible pathways which may exist between the identified hazards and receptor(s).

12.2.15. For land to be determined as 'contaminated' in a regulatory sense, and therefore requiring remediation (or a change to less sensitive use), all three elements (source-pathway-receptor) of a significant pollutant linkage must be present. The legislation places a responsibility on the Local Planning Authority to determine whether the land in its area is contaminated by consideration of whether:

§ Significant harm is being caused to human health or controlled waters;

§ There is a possibility of significant harm being caused; and

§ With regard to radioactivity:

- Harm is being caused; or
- There is a significant possibility of such harm being caused.

NATIONAL PLANNING PRACTICE GUIDANCE

12.2.16. First published in March 2014 (and last updated on 24 July 2018), the Department for Communities and Local Government (DCLG) launched the National Planning Practice Guidance (NPPG) web-based resource (**Ref. 12.18**). The following guidance from this resource are relevant to this Chapter:

§ Brownfield land registers (28 July 2017) – provides guidance to local planning authorities in preparing and publishing brownfield land registers;

§ Land affected by contamination (12 June 2014) – sets out the legislative regime for dealing with land that may be affected by contamination;

§ Land stability (06 March 2014) – sets out the requirement for consideration of land stability issues in planning;

§ Natural environment (21 January 2016) - encourages the use of brownfield land; and

§ Water supply, wastewater and water quality (23 March 2015) – consideration of the protection and enhancement of surface water and groundwater at the planning application stage.

ENVIRONMENT AGENCY GUIDANCE

12.2.17. All pollution prevention guidance, known as PPGs, previously maintained by the EA were withdrawn from use on 17 December 2015. And have been replaced by web-based resource. The following guidance from this resource are relevant to this Chapter:

§ Pollution prevention for businesses (**Ref. 12.19**);

§ Discharge to surface or ground water (**Ref. 12.20**);

§ Manage business and commercial waste (**Ref. 12.21**); and

§ Store oil and oil storage regulations for businesses (**Ref. 12.22**).

MODEL PROCEDURES FOR THE MANAGEMENT OF LAND CONTAMINATION: CONTAMINATED LAND REPORT 11

12.2.18. Environment Agency and Department for Environment, Food and Rural Affairs (Defra) guidance; Model Procedures for the Management of Land Contamination: Contaminated Land Report 11 (CLR11) (2004) (**Ref. 12.23**) advocates the use of a conceptual risk assessment model.

GROUNDWATER PROTECTION GUIDES

12.2.19. Groundwater Protection: Principals and Practices (2012) (**Ref. 12.24**) was withdrawn on 14th March 2017 and has been replaced by a number of Groundwater Protection Guides by DEFRA and EA including:

- § Protect groundwater and prevent groundwater pollution (14th March 2017) (**Ref. 12.25**);
- § Groundwater protection technical guidance (14th March 2017) (**Ref. 12.26**);
- § Groundwater protection position statements (14th March 2017) (**Ref. 12.27**); and
- § Land contamination groundwater compliance points: quantitative risk assessments (14th March 2017) (**Ref. 12.28**).

12.2.20. These documents contain the conceptual method for risk-based decision making and developing policy statements in areas such as the control of groundwater abstraction and diffuse pollution of groundwater. The Policy is presented as a framework within which decisions should be made and sets out the Environment Agency's broad approach to existing risks and new developments. The Policy is underpinned by published groundwater vulnerability maps and groundwater Source Protection Zones (SPZ).

12.2.21. The protection of key groundwater resources, and in particular, those used for public drinking water supply, is accomplished by the establishment of SPZ. The SPZ provide an indication of the potential risk of pollution, based on the local soil and geological conditions and the depth of the water table. Generally, the closer a polluting activity or release is to a groundwater source, the greater the risk. Three zones (an inner, outer and total catchment) are usually defined. These zones are used to control the activities and discharges in the area to protect the aquifer.

Other Guidance

12.2.22. Other relevant guidance is as follows:

- § Health and Safety Executive (HSE) (1991) Guidance Note HS (G) 66, Protection of Workers and the General Public during the Development of Contaminated Land (**Ref. 12.29**);
- § CIRIA C532 (2001) Control of Pollution from Construction Sites (**Ref. 12.30**);
- § HSE (2006) INDG258 Safe Work in Confined Spaces (**Ref. 12.31**);
- § CIRIA C665 (2007) Assessing Risks Posed by Hazardous Gases to Buildings (**Ref. 12.32**);
- § CIRIA C682 (2009) The VOCs Handbook (**Ref. 12.33**);
- § BS 10175:2011+A2 (2017) Investigation of Potentially Contaminated Sites – Code of Practice (**Ref. 12.34**);
- § DEFRA, Contaminated Land Statutory Guidance April 2012 (**Ref. 12.35**);
- § BS 8576 (2013) Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds (**Ref. 12.36**);
- § CIRIA C552 (2001) Contaminated Land Risk Assessment. A Guide to Good Practice (**Ref. 12.37**); and
- § CIRIA C733 (2014) Asbestos in soil and made ground: a guide to understanding and managing risks (**Ref. 12.38**).

12.3. RELEVANT ELEMENTS OF THE PROPOSED DEVELOPMENT

12.3.1. The assessment adopts the approach outlined in **Chapter 2 Approach to the Assessment** and is based on the Application Plans as described in **Chapter 4 The Proposed Development**.

12.3.2. Relevant elements of the Proposed Development in the context of Ground Conditions, Hydrogeology and Contamination and identified significant effects are:

- § The Demolition and Construction Stage (including the construction of the proposed basements on the West and Central Sites) has the potential to result in effects through introducing contamination source to the ground/controlled waters/humans and/or creating pathways thought releasing existing ground contamination to controlled waters/humans. These works are likely to have a duration of 3.5 to 4 years and will be phased;
- § The proposed basements (West and Central Sites) have the potential to result in ground stability issues; and
- § The future uses of the Proposed Development represent new receptors to potential contamination sources.

12.4. ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

SCOPE OF THE ASSESSMENT

- 12.4.1. **Chapter 2 Approach to the Assessment** confirms the position on the EIA Scoping exercise, and the Scoping Report and subsequent EIA Scoping Opinion are available at **Appendix 2.1** and **2.2**. This section provides an overview on the scope of the assessment.
- 12.4.2. The Scoping Opinion from LBL was received on 31st August 2018. A summary of the relevant responses are provided in **Table 12.1**.
- 12.4.3. **Chapter 2 Approach to Assessment** and **Appendix 2.2** provide further detail on individual consultee responses.

INSIGNIFICANT EFFECTS

- 12.4.4. It is anticipated that any contaminants found during the Demolition and Construction Stage will be remediated in line with the proposed uses, under a planning condition. It is assumed that clean cover layers (and any imported material), if required, will be validated for depth and chemical quality prior to occupation. This negates the requirement for consideration of potential impacts to future Site users, adjacent Site users and plants during the Operational Stage of the Proposed Development. Therefore, the potential exposure of future Site users, adjacent Site users, plants and potable water supply to contamination during the Operational Stage will be insignificant and will not be assessed in this Chapter. However, risks to adjacent Site users during the Demolition and Construction Stage of the Proposed Development is considered to be potentially significant and will be considered within this assessment.
- 12.4.5. It is assumed that any potential effects arising from ground gas (including radon and volatile vapours) will be appropriately mitigated prior to the completion of the Demolition and Construction Stage via a condition of planning post determination. Therefore, the potential for the presence of ground gas to pose an increased risk to future Site users (explosive and asphyxiant) during the Operational Stage is considered insignificant and will not be reported in this Chapter.
- 12.4.6. During the Operational Stage of the Proposed Development there is a potential for the localised spillage of fuel, which may be carried to the surface water drainage system. However, the Proposed Development will implement an appropriate permanent drainage strategy, outlined in the Flood Risk Assessment and Outline Drainage Strategy in **Appendix 11.1** of this ES (adopted as a condition on the implementation of the Application Plans). Contaminants from fuel spillages which are likely to

occur on areas of hardstanding (e.g. car parking areas) will be subject to a controlled drainage scheme and therefore will minimise contaminants reaching surface water features. Therefore, the potential release / migration of contamination from accidental spillages on surface water receptors during the Operational Stage is considered to be insignificant and will not be assessed in this Chapter.

LIKELY SIGNIFICANT EFFECTS

12.4.7. Potentially significant effects are summarised below:

CONSTRUCTION STAGE

- § Effect on demolition and construction workers and third-party neighbours from possible on-Site contamination; and
- § Potential for impact to Controlled Waters from possible on-Site contamination.

OPERATIONAL STAGE

- § Future Site users could be exposed to potentially contaminated soil within areas of soft landscaping.

CONSULTATION

12.4.8. **Table 12-1** provides a summary of the consultation activities undertaken in support of the preparation of this Chapter including responses from regulators and other stakeholders within the Scoping Opinion received 31st August 2018.

Table 12-1 - Summary of Consultation

Body / organisation	Individual / stat body/organisation	Meeting dates and other forms of Consultation	Summary of Outcome of Discussions
London Fire and Emergency Planning Authority (Now Fire Commissioner)	Barry Walford - Assistant Commissioner (Fire Safety)	22nd September 2016	<p>A response was received on 19th October 2016 (Ref: 09/01157/BCW). The records indicate there to be two below ground tanks onsite, both single skinned.</p> <p>Both tanks are reported as petrol tanks and date to 1936. The capacity of each tank is 4546L. There were no records of any leaks or spills.</p> <p>There is an undated statement on the archived file papers stating that the Site was “water filled at some time between 10 November 1962 and 1 September 1967. Due to difficulty in lifting the access covers the tanks have not been regularly inspected for soundness”.</p>
Transport for London - London Underground (LU)	Shahina Inayathusein – Information Manager	22nd September 2016	<p>A response was received on 27th September 2016 (Ref. 20406-SI-3-270916) No LU assets are known to be present within 50m of the Site</p>

Body / organisation	Individual / stat body/organisation	Meeting dates and other forms of Consultation	Summary of Outcome of Discussions
			boundary. However, cable ducts are present in the area.
Lambeth Borough Council	Hannah Radlowska – Sustainability Officer	22nd September 2016	A response was received on 30th September 2016 (Ref. ESH_CONTLAND_120) Information provided was limited to a list of potentially contaminating Site uses (historical and current) within the vicinity of the Site but not within the Site boundary itself.
Lambeth Borough Council/ Temple Group	Peter Cole	31st August 2018	Section 4.7 of the Scoping Opinion (Appendix 2.2) states: 'The Council would like to clarify that the intention of the original point within Temple's review, was to establish (using the findings of the ground investigations) whether any potential pathways to the River Thames exist. If the 'Ground Conditions, Hydrogeology and Contamination' and 'Water Resources and Flood Risk' assessment cannot demonstrate within the ES that no likely pathway exists, then it will be necessary to scope Ecology back in.' No further comment was made on contents of the Scoping Report in relation to the assessment within this Chapter. Consideration of potential contamination pathway risks to the River Thames is considered within this chapter, in sections 12.5 and 12.7 of this chapter.
Environment Agency	Kayleigh Wyatt - Planning Specialist, Major Projects Officer	20th August 2018	Response within Scoping opinion received on 31st August 2018 (Ref. SL/2018/118449/01-L01). In relation to groundwater and land contamination the EA note that the Site is over a Secondary Aquifer. The EA confirmed it considered the stated approach to the assessment, as outlined in CLR 11 (Ref.12.23) to be acceptable (for Controlled Waters only).

EXTENT OF THE STUDY AREA

12.4.9. The study areas considered for the purpose of the Ground Conditions, Hydrogeology and Contamination Assessment consists of the area within the red line boundary as well as identified receptors within the immediate vicinity.

METHOD OF BASELINE DATA COLLATION

DESK STUDY

12.4.10. Data for the baseline conditions at the Site was taken from the Preliminary Environmental Risk Assessment (PRA) dated September 2016 (included as **Appendix 12.1**). It is understood there have been no significant changes to the Site since this date and therefore the data remains accurate in our professional opinion. The desk study includes an Envirocheck report, referenced 84629768_1_1, the datasheet of which is included within **Appendix 12.1**. Regulatory responses are included as **Appendix 12.2**.

12.4.11. A Site Investigation was undertaken in November 2008 and is available from the Lambeth Council Planning Portal. This was to support a planning application submitted and subsequently withdrawn in 2010 (Ref. No: 10/04473/FUL, Ref. No: 10/04475/LB & 10/04476/CON). Pertinent details from this report have been incorporated into the PRA (**Appendix 12.1**).

GROUND INVESTIGATION

12.4.12. A Ground Investigation was completed by Concept Site Investigations Ltd within the Central Site during October and November 2016 based upon a scope specified by WSP (**Appendix 12.3**). The Ground Investigation was designed to allow for geotechnical and environmental assessment, however this Chapter will focus upon environmental aspects only. In areas where no specific contamination sources were identified, investigation was undertaken to meet sampling density requirements in general accordance with BS10175:2011.

12.4.13. A Generic Quantitative Risk Assessment (GQRA) (**Ref. 12.39**) has been completed by WSP dated April 2017 (Ref. 70016347 and included as **Appendix 12.4**) which assessed risks to human health and Controlled Waters within the Central Site only. An assessment of the results for the West Site is not yet available.

12.4.14. A Ground Investigation Report (GIR) (**Ref. 12.40**) has also been produced by WSP dated January 2017 (Ref. 70016347 and included as **Appendix 12.5**) which assessed geotechnical aspects of the development for the Central and West Sites.

12.4.15. A further Ground Investigation was completed by Concept Site Investigations Ltd within the West Site during April and May 2017 based upon a scope specified by WSP. A Factual Report was by Concept Site Investigations Ltd in July 2017 detailing these works (Ref 17/2948 and included in **Appendix 12.6**).

12.4.16. Pertinent details from these reports have been used to inform the baseline study within this ES chapter. Further site investigations will be required prior to works starting, through a planning condition for the Proposed Development, as set out in section 12.7 of this chapter. It is considered that the desk study and ground investigation information currently available is sufficient to allow assessment of the potential effects of the Proposed Development on ground conditions, and identification of the required mitigation measures.

SITE VISIT / OTHER ASSESSMENT

12.4.17. Several Site walkovers were carried out in September 2016 by representatives of the WSP team undertaking this Ground Conditions, Hydrogeology and Contamination Chapter.

12.4.18. Consultations with the statutory consultees and other relevant authorities have been undertaken as mentioned above and the advice and guidance provided have been used to inform this assessment. A summary of consultation is outlined in **Table 12-1**.

OTHER SOURCES

12.4.19. The following other sources of information may be read in conjunction with this chapter:

- § **Chapter 10 Archaeology;**
- § **Chapter 11 Water Resources Flood Risk and Drainage;** and
- § All relevant legislation and guidance noted in Section 12.2.

SIGNIFICANCE CRITERIA

12.4.20. The assessment of potential effects as a result of the Proposed Development has taken into account both the Demolition and Construction Stage, and Operational Stage. The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Development and the sensitivity of the affected receptor/receiving environment to change, as well as a number of other factors that are outlined in more detail in **Chapter 2 Approach to the Assessment**. Magnitude of change and the sensitivity of the affected receptor/receiving environment are both assessed on a scale of high, medium, low and negligible (as shown in **Chapter 2 Approach to the Assessment**). A summary of the significance matrix can be seen in **Table 12-2**.

Table 12-2 - Matrix for Determining the Significance of Effects

		Magnitude of Change/Effect			
		High	Medium	Low	Negligible
Sensitivity of Receptor	High	Major	Moderate to major	Minor to moderate	Negligible
	Medium	Moderate to Major	Moderate	Minor	Negligible
	Low	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

12.4.21. **Table 12-3** indicates the general approach taken in assessing the sensitivity of identified receptors as part of this assessment. Negligible sensitivity has been removed, as it is deemed irrelevant as no receptor (in terms of ground conditions and contamination) is classed as negligible.

Table 12-3 - Classification of Sensitivity

Sensitivity	Criteria	Examples
Very High	Attribute has a very high quality and / or rarity on local to regional scale	Construction and maintenance workers (where extensive earthworks, and demolition of buildings are proposed); Groundwater aquifers currently used, or likely to be suitable for use as public potable supplies (e.g. Principal Aquifers, Source Protection Zone for a potable groundwater supply), such as the Principal Aquifer; and Controlled water bodies with national or international ecological designations.
High	Attribute has a high quality and / or rarity on local scale	Construction and maintenance workers (where extensive earthworks, and demolition of buildings are proposed); Groundwater aquifers currently used, or likely to be suitable for use as public potable supplies (e.g. Principal Aquifers, Source Protection Zone for a potable groundwater supply), such as the Principal Aquifer; and Controlled water bodies with national or international ecological designations.
Medium	Attribute has a medium quality and / or rarity on local scale	Construction workers (where limited earthworks, are proposed); Groundwater aquifer providing abstraction water for agricultural or industrial use (groundwater); Commercial landscaping or open space areas; and Buildings, including services and foundations.
Low	Attribute has a low quality and / or rarity on local scale.	Construction and maintenance workers (Minimal disturbance of ground); Unproductive strata (groundwater) such as Made Ground; No local surface water features; and Infrastructure (roads, bridges, railways).

12.4.22. Significance criteria have been developed based on professional judgement and relevant experience. They are determined using the matrix in **Table 12-4** based on magnitude of change and the sensitivity of the receptor, with the likely duration of the effect and likelihood of the effect occurring also considered when assessing each effect.

Table 12-4 - Development of Significance Criteria

Magnitude of Potential Change	Sensitivity of Receptor			
	Very High	High	Medium	Low
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

12.4.23. The sensitivities which may affect a potential receptor have been assigned based on professional judgement and experience. Factors that may affect the sensitivity of the likely receptor include:

- § Age, weight, sex, duration on-site and distance from the Site. (Human receptors).
- § Distance from the Site and resource potential. (Controlled Waters receptors).

12.4.24. The criterion for determining magnitude of change/effect is detailed in **Table 12-5**.

Table 12-5 - Classification of Magnitude of Effect

Magnitude of Effect	Example Criteria
High	<p>Change in soil quality or ground gas regime for a large area (>20ha) of land, sufficient to alter land use (e.g. remediation of 20ha of industrial land sufficient to enable mixed residential / commercial use).</p> <p>Change in groundwater conditions sufficient to change aquifer use (e.g. contamination that prevents abstraction for potable supplies, or remediation of impacted aquifer sufficient to enable potable abstractions).</p> <p>Generation of large volumes of non-inert waste materials for disposal off-site to landfill.</p>
Medium	<p>Change in soil quality or ground gas regime for a moderate area of land (<20ha) to a degree sufficient to alter land use in localised portions of the Site or to a degree requiring a change in management / mitigation measures for Site use.</p> <p>Change in groundwater conditions that may be sufficient to change local groundwater regime and potential aquifer uses (e.g. localised contaminant impact, localised change in groundwater levels).</p>
Low	<p>Measurable but relatively small scale change in an area of contaminated land or ground gas regime, but insufficient to alter end land use.</p> <p>Change in groundwater conditions that are insufficient to change status or potential use of the water body.</p>
Negligible	<p>Very limited mass of contamination mobilised – just detectable.</p> <p>Very limited change in area of agricultural land.</p> <p>Very limited barely discernible change to groundwater regime.</p>

12.4.25. **Table 12-6** describes the terms that have been used to define the significance of the effects identified.

Table 12-6 - Defining Significance of Effects Criteria

Criteria	Description
Major Adverse	High risk site classification – acute or severe chronic effects to human health and / or animal / plant populations predicted. Effect on a potable groundwater or surface water resource of regional importance e.g. Principal Aquifer, public water reservoir or inner protection zone of a public supply borehole
Moderate Adverse	Medium risk site classification and proven (or likely significant) pollutant linkages with human health and / or animal / plant populations, with harm from long-term exposure. Effect on a potable groundwater or surface water resource at a local level e.g. effect on an outer groundwater Source Protection Zone. Temporary alteration to the regional hydrological or hydrogeological regime or permanent alteration to the local regime.

Criteria	Description
Minor Adverse	Medium risk site classification and potential pollutant linkages with human health and / or animal / plant populations identified. Reversible, localised reduction in the quality of groundwater or surface water resources used for commercial or industrial abstractions, Secondary Aquifer, etc.
Negligible/Neutral	Low risk site classification – no appreciable effect on human, animal or plant health, potable groundwater or surface water resources.
Minor Beneficial	Risks to human, animal or plant health are reduced to acceptable levels. Local scale improvement to the quality of groundwater or surface water resources used for commercial or industrial abstraction.
Moderate Beneficial	Significant reduction in risks to human, animal or plant health, to acceptable levels. Significant local improvement to the quality of potable groundwater or surface water resources. Significant improvement to the quality of groundwater or surface water resources used for public water supply.
Major Beneficial	Major reduction in risks to human, animal or plant health. Significant regional scale improvement to the quality of potable groundwater or surface water resources

12.5. BASELINE CONDITIONS

EXISTING BASELINE

EXISTING USES OF THE SITE

- 12.5.1. The Site is approximately 1.06 hectares in size and is located in the London Borough of Lambeth.
- 12.5.2. The Site is split into three areas; the West Site fronts onto Albert Embankment and includes the Former Headquarters Building. The Central Site is occupied by The Workshop, and the East Site comprising a car park associated with the Fire Station, which is currently leased for temporary use as a community garden.
- 12.5.3. The West Site comprises the Grade II listed Former Headquarters Building of the London Fire Brigade, which operates as the Lambeth Fire Station. This is a large, stepped 9-10 storey brick building with a basement and is separated from the River Thames by the A3036, Albert Embankment.
- 12.5.4. There is a 3-storey concrete built extension (built in the 1980's) to the Headquarters in the southern part of this area, the former Communication Mobilising Centre (CMC). In the north-east corner of the West Site is a brick built Drill Tower which is also Grade II listed. There is a ventilation shaft on the northern boundary of this plot which provides emergency access to the underlying basement. A basement is present below much of the area of the West Site. It is understood that the basement was formerly used as workshops and storage areas and the following potential contaminative uses of this basement area have been recorded; dry storage of cleaning materials, boiler rooms – currently gas fired but historically oil fired with heavy staining on the concrete floor, paint storage, acid battery storage, pump rooms, former fuel storage rooms etc. Visual observation from outside of the Site suggests a generator / boiler room is present in the structure at the base of the Drill Tower as a fume exhaust and a possible fuel filling point can be observed on the side of the structure.
- 12.5.5. The Central Site comprises The Workshop which is currently in use as the London Fire Brigade Museum. It ranges between two and five stories in height, of masonry construction with an A frame

metal structure supporting the roof. The building was formally used as a vehicle workshop and office building associated with the Fire Station. Three vehicle inspection pits are present in the west of the main building. Former uses of this comprised general storage and vehicle maintenance. A small basement is present in the south of the structure. The basement is understood to contain the historical boilers and three oil tanks. A walkover of the basement was not possible due to the possible presence of asbestos containing materials.

- 12.5.6. The East Site comprises a small area of hard standing surfaces and was previously used as an informal area of car parking by the Lambeth Fire Station. It is currently not accessible to the public and is surrounded by a secure fence and gate. The area is occupied by small raised beds with small shrubs surrounded by concrete blocks for seating. The area is bound to the north by a masonry wall and to the west, south and east by a metal fence. A mature tree is present in the south-western edge of the Site.

TANKS

Central Site

- 12.5.7. The following tanks were observed:

- § A small suspended fuel tank was observed in the centre of the main building at ground level (above the basement).
- § A waste oil tank enclosed within a concrete bund was observed in the south-eastern corner of the main building. The internal areas of the bund were stained black.
- § An unknown tank is present in the eastern car park. It is not known if this tank is being stored and was formally present somewhere else on Site as it is not connected to any building pipework.
- § Buried interceptors tanks are suspected to be present in the eastern car park however, this was not observed during the walkover.
- § A gas oil filling point and gauge, two fume extractors possibly associated with tanks, and an exhaust fume pipe is present on the southern external building boundary. These are assumed to be associated with tanks and a generator which may be present within the basement but was not accessible during the Site walkover. Access to the basement is via an external door and staircase from the outside of the southern external building.

ASBESTOS CONTAINING MATERIALS

- 12.5.8. A Type 2 asbestos survey of the Site was undertaken in June 2008 by Blues Consultants Limited (**Ref.12.41**). Asbestos is present in many areas of the former structures.

HISTORICAL SITE USES

- 12.5.9. A study of available historical maps has been undertaken to identify any potentially contaminative former land uses. **Table 12-7** provides a summary of this information.

On Site

Table 12-7 - Overview of the Historical Land Uses

Date	Land use
1875	Plots A and B are divided by Lambeth High Street. The West Site is occupied by Lambeth Pottery. On the northern boundary of the Central Site are terraced houses and to the south of these houses are further unspecified works buildings associated with Lambeth Pottery. The railway viaduct is present on the eastern boundary of the Central Site. The East Site is occupied by terraced houses.
1896	As above - a dry dock is now shown in the north west corner of the West Site.
1916	As above.
1950	The London Fire Brigade Headquarters has been built on the West Site together with the workshop building on the Central Site. Terraced housing is still shown on the East Site.
1958	No significant change on Plots A and B. New buildings are shown on the East Site.
1978 to date	No significant change on Plots A and B. Buildings on the East Site are not shown post 1975, and a new road junction is shown at the junction of Newport Street and Black Prince Road.

Off Site

12.5.10. Generally, the surrounding area is occupied by commercial and residential buildings. The 'Old Paradise Gardens' is present approximately 50m to the north of the Site. The environmental pertinent or significant historical land uses surrounding the Site is summarised in **Table 12-8**.

Table 12-8 - Adjacent Historical Land Use

Dates	Land use	Direction
1875 to 1879	Terraced Housing. Pottery. Soap Works. Malt House.	South, North South South South
1896	Rubber Works.	South
1916	No significant change.	-
1950 - 1951	Unidentified office/commercial buildings. Ruins (indicative of bomb damage).	North and South South
1951 - 1969	No significant change.	-
1973 - 1974	Engineering Works.	South

1978	No significant changes but bank and depot shown.	South
1991	No significant changes.	-
1992 - 1995	No significant changes (partial coverage).	-

REGULATORY DATABASE

12.5.11. The data shown in **Table 12-9** has been obtained from databases reported in the Envirocheck Report (ref. 84629768_1_1), dated 15th April 2016 and presented within **Appendix 12.1**.

Table 12-9 - Summary from Environmental Database

Environmental Data	On Site	Within 250m	Within 500m	Details
Discharge Consents	0	2	3	<p>211m West (Wood Street) Operator: Thames Water Utilities Limited Discharge Type: sewerage discharge/storm overflow Receiving Water: River Thames Status: Post NRA</p> <p>248m West – Grosvenor Ditch Operator: Thames Water Utilities Limited Discharge Type: sewerage discharge/storm overflow Receiving Water: River Thames Status: Varied under EPR 2010 Note – there are 3 entries for this discharge consent – with differing statuses.</p> <p>Beyond 250m – see Envirocheck Report</p>
Prosecutions Relating to Controlled Waters	N/A	N/A	N/A	N/A
Local Authority Pollution Prevention Controls (LAPPC)	0	0	1	Beyond 250m – see Envirocheck Report
Pollution Incidents To Controlled Waters	0	1	2	<p>105m West (1997) Location: Lambeth Pollutant: Oils Category: 3 – minor incident Beyond 250m – see Envirocheck Report</p>

Environmental Data	On Site	Within 250m	Within 500m	Details
Prosecutions Relating to Authorised Processes	0	0	0	N/A
Registered Radioactive Substances	0	8	3	182m North East – All 8 licenses are held at 109 Lambeth Road – SE1 &LU Name: Forensic8 Ltd Dated Various Status: Various – see Envirocheck report
Substantiated Pollution Incident Register	0	0	0	N/A.
Water Abstractions	0	0	6	Abstractions beyond 250m include Drinking, Cooking, Sanitary, Washing, (Small Garden) (330m, 473m, 473m, 473m), ground source heat pump (321m, 370m).
Control of Major Accident Hazards Sites (COMAH)	0	0	0	N/A.
Contemporary Trade Entries	0	38	38	Active trade directories include the following within 50m of the Site: Pest control, furniture shop, printers, pharmaceutical manufacturers, cleaning services, rubbish clearance, col company, carpet cleaners, temperature monitoring system manufacturers, lingerie manufacturer, frozen food processors, car body repairs. Full details are presented in the Envirocheck Report.

BOMB DAMAGE (WORLD WAR II)

12.5.12. The 'Bomb Sight' website (<http://www.bombsight.org>) indicates 4 bombs fell close to the Site during WW2.

12.5.13. It should be noted that on the Site area, historical maps before and after WW2 (1916 and 1951-1952) show very similar configurations suggesting no direct bomb strikes.

12.5.14. An Unexploded Ordnance (UXO) Desk Study was undertaken for the Site by EOD Contracts Limited dated 3rd October 2016 (**Ref.12.42**) (contained within the factual report in **Appendix 12.3**). The assessment concluded that the risk of UXO being present on the Site was low and no further risk mitigation was required.

ENVIRONMENTAL SETTING

Geology

12.5.15. Based on BGS mapping (Sheet 270, 1:50 000 series) the geology of the Site is summarised in **Table 12-10**.

Table 12-10 - Summary of Published Geology

Geological Unit	Description	~Depth to Base of Stratum (m bgl)	Aquifer Designation
River Terrace Deposits	Medium dense to very dense orange brown, very sandy gravel. Gravel is angular to rounded flint and quartzite with occasional clay layers.	8	Secondary A Aquifer
London Clay Formation	Stiff to very stiff becoming hard, closely fissured, dark grey or grey / brown clay.	38	Unproductive Strata
Lambeth Group	Variable sequences of clay, some silty or sandy with sands and gravel.	50	Secondary A Aquifer
Thanet Sand Formation	Glauconite-coated, nodular flint at base, overlain by pale yellow-brown, fine-grained sand that can be clayey and glauconitic.	60	Principal Aquifer
Upper Chalk	Chalk, with or without flint and discrete limestone, marl (calcareous mudstone), sponge, calcarenite, phosphatic, hardground and fossil-rich beds.	>150	Principal Aquifer

Hydrogeology

- 12.5.16. The superficial drift deposits are classified as a ‘Secondary Aquifer – A’ (permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The River Terrace Gravels are likely to be in hydraulic continuity with the River Thames. Groundwater has been monitored at about 4.5 to 5.0mbgl at the Site.
- 12.5.17. The Site is underlain at depth by the London Clay. The London Clay is classified as ‘Unproductive Strata’. The Lambeth Group Beds is classified as a ‘Secondary Aquifer – A’. The Thanet Sands is classified as a ‘Secondary Aquifer – A’. The Chalk underlying the Site at depth is classified as ‘Principal Aquifer’.

Hydrology

- 12.5.18. The River Thames (downstream of high water mark) is located approximately 30m to the west of the Site flowing in a northerly direction. However, the River Thames is noted to be tidal at this section of the river.
- 12.5.19. The EA classifies the River as having Moderate ecological status where it passes the Site; and ‘Fair’ with regard to chemical quality.
- 12.5.20. The Site is located within Flood Zone 2 and 3, classified as an ‘area at risk from flooding and extreme flooding from River and Sea without Defences’ although is located in an area benefiting from flood defences. The Site is protected by existing flood prevention measures and the risk stems from both a flood event and a failure of the defences concurrently.
- 12.5.21. There are no reported licensed surface water abstractions within 250 m of the Site.

Preliminary Hydrogeological Model

- 12.5.22. The geology underlying the Site is likely to consist of Made Ground overlying the River Terrace Deposits underlain by a significant thickness of London Clay according to available information obtained from BGS. Groundwater within the Made Ground, if present, is considered unlikely to be a continuous groundwater unit, but rather as perched, isolated pockets of water associated with permeable lenses within the Made Ground. Recharge is anticipated to be limited due to the presence of hardstanding preventing surface water infiltration. Perched groundwater present within the Made Ground is likely to be in continuity with a groundwater body present within the underlying River Terrace Deposits, the base of which is formed by the low permeability London Clay Formation underlying the gravels.
- 12.5.23. The London Clay Formation is thought to act as a low permeability barrier (due to its anticipated thickness of approximately 30 m) between the shallow groundwater in the River Terrace Deposits and the underlying Lambeth Group, Thanet Sands and Upper Chalk Formation preventing vertical migration of potential contaminants from the upper aquifer (River Terrace Deposits) to the lower aquifers (Thanet Sand Formation and Chalk). Notwithstanding this, the Proposed Development will likely require deep piles, which could potentially penetrate the London Clay and create preferential pathways for contamination to migrate vertically to the Principal Thanet Sand Formation and Chalk Aquifers.
- 12.5.24. The Site's location in an urban environment is likely to result in highly modified ground conditions (e.g. basement and sewers) with a locally variable groundwater table. However, overall groundwater flow direction is anticipated to be towards the River Thames located to the west of the Site.

Potential Sources of Contamination

- 12.5.25. Based on Site conditions and potential contaminant linkages, potential sources of contamination that may affect the development have been identified as follows:
- § Potential contaminants of concern in Made Ground (from on-site and off-site sources);
 - § Historical and current tanks located on-site;
 - § Ground Gas; and
 - § Various historical industrial uses.

Potential Pathways

- 12.5.26. Potential Pathways in the context of the proposed redevelopment include:
- § Direct contact, ingestion or inhalation of soil bound contaminants/dust;
 - § Inhalation of vapours associated with volatile organic compounds;
 - § Leaching of contamination into groundwater from soil followed by migration of groundwater to the wider groundwater environment or surface waters;
 - § Migration of ground gas through pore spaces into enclosed spaces;
 - § Direct contact with potentially impacted groundwater; and,
 - § Ingress of contaminated groundwater into water supply pipes.

POTENTIAL RECEPTORS

12.5.27. Relevant Potential Receptors are considered to include:

Human Health

- § Future Site users;
- § Construction/demolition and ground workers; and,
- § Adjacent residents.

Controlled Waters

- § River Terrace Deposits (Secondary 'A' Aquifer);
- § Lambeth Formation (Secondary 'A' Aquifer);
- § Thanet Sand Formation and Chalk (Principal Aquifers); and,
- § River Thames.

Other

- § Below ground services e.g. potable water supply pipes; and,
- § Building structures.

GROUND INVESTIGATION – CENTRAL SITE

12.5.28. The Central Site ground investigation comprised 8No. cable percussion borehole and 13 No. dynamic sampling boreholes (**Appendix 12.3**). A GQRA reporting on the results of the ground investigation are provided in **Appendix 12.4**.

12.5.29. In total, 21 No. exploratory locations were undertaken, which equates to a sampling density of one location per 20 m².

Site Investigation

12.5.30. A summary of both phases of Site investigation undertaken is presented in **Table 12-11**, below.

Table 12-11 - Summary of Fieldworks

Method	Number	Maximum depth (m bgl*)
Cable percussive borehole	8	48.10
Window sample borehole	13	6.00

*Metres below existing ground level.

12.5.31. The ground investigation and sampling strategy were designed to provide an assessment of identified potential sources of contamination (such as the identified tanks) and to provide information to assist in assessing the potential pollutant linkages. However due to a number of Site constraints, including Site buildings and inaccessible areas, exploratory locations were predominately positioned to obtain sufficient spatial coverage.

Laboratory Chemical Analysis

12.5.32. Soil samples were collected from all exploratory hole locations which were targeted to obtain information relating to areas of contamination risk based on the Site history and observations made

during the Site inspection. A total of 35 no. soils samples were collected during the ground investigation.

12.5.33. Two rounds of groundwater sampling were undertaken at seven monitoring wells and submitted for chemical analysis.

Groundwater and Gas Monitoring

12.5.34. Following completion of the ground investigation, six rounds of ground gas and groundwater level monitoring were undertaken between 17th December 2016 and 30th January 2017. Groundwater sampling of accessible boreholes was undertaken on 5th January and 16th January 2017.

Encountered Ground Conditions

12.5.35. A summary of the strata encountered during investigation of the Site is presented in **Table 12-12**.

Table 12-12 - Summary of the Strata Encountered

Stratum Name	Elevation of Upper Surface (m aod)	Typical Thickness (m)	Typical Description
Hardstanding	+4.41 to +4.15	0.20 to 0.42	Concrete / asphalt (all locations)
Made Ground	+4.14 to +3.78	1.45 to 3.20	Variable granular and cohesive compositions with gravel recorded as brick, flint and concrete. Fragments of ceramics and clinker were also commonly recorded.
River Terrace Deposits	+2.56 to +0.91	4.40 to 6.00	Brown to yellowish brown clayey sandy gravel. Gravel recorded as fine to coarse angular to rounded flint.
London Clay	-2.95 to -3.91	26.20 to 27.10	Firm to stiff, closely to extremely closely fissured slightly sandy silty clay.
Harwich Formation	-29.60 to -30.22	0.50 to 1.65	Dense, dark grey and dark green slightly gravelly very silty glauconitic fine to medium sand. Gravel is well rounded fine to medium black flint.
Lambeth Group	-30.51 to -31.70	NP	Stiff to very stiff rarely fissured sandy silty clay.

NP – Full extent of layer not been proven.

Groundwater Levels

12.5.36. Shallow groundwater was identified within the River Terrace Deposits at a depth of approximately between -0.23 m AOD to -0.94m AOD. Triangulation of groundwater indicates groundwater flow is moving in a westerly direction towards the River Thames. Groundwater was not recorded during monitoring within the Made Ground.

12.5.37. The GIR also concluded that below the River Terrace deposits, groundwater strikes at elevations of circa -7.0m AOD and -22.0m AOD, -25.0m AOD and -30.0m AOD.

Field Observations of Contamination

12.5.38. During the ground investigation the following visual and olfactory evidence of contamination was noted, along with corresponding photo-ionisation detector (PID) readings, as detailed in **Table 12-13** below:

Table 12-13 - Visual and Olfactory Evidence of Contamination

Exploratory Hole Location	Depth (m bgl)	Stratum	Evidence of Contamination	PID result (ppm)
BH04	1.50 – 3.50	Made Ground	Slight acidic odour	4.1
WS02	2.50 – 5.50	Kempton Park Gravel Formation	Slight hydrocarbon odour	0.3
WS05	2.00 – 2.30	Kempton Park Gravel Formation	Slight hydrocarbon odour	2.4
	3.60 – 6.00	Kempton Park Gravel Formation	Slight hydrocarbon odour	1.1
WS07	2.00 – 3.00	Kempton Park Gravel Formation	Hydrocarbon odour	8.3
WS09	3.20 – 3.70	Kempton Park Gravel Formation	Slight acidic odour	0.1
WS15	3.20 – 6.00	Kempton Park Gravel Formation	Acidic odour	666.2

12.5.39. Non aqueous phase liquids (NAPLs) were not detected during groundwater monitoring.

Assessment of Human Health Risks

12.5.40. Exceedances of the relevant residential without gardens Generic Assessment Criteria (GAC) are presented in **Table 12-14**. Note only those contaminants recording exceedances of their respective screens are summarised below.

Table 12-14 - Exceedances of Generic Soil Assessment Criteria: Residential Area

Analyte	No. Samples Tested	No. Samples Exceeding GAC	Max Result and Location (mg/kg)	Assessment Criteria (mg/kg)	Stratum Where Elevated Concentration(s) Identified
Arsenic	31	2	55.5 WS15 at 0.4m bgl	40	Made Ground
Lead	31	7	944 WS1 at 0.4m bgl	310	Made Ground
Aliphatic >C8 - C10	31	1	28.2 WS15 at 5.5m bgl	26.8	River Terrace Deposits

- 12.5.41. A single isolated and marginal exceedance of Aliphatic C8 – C10 was recorded above the relevant GAC (residential without gardens) of 26.8 mg/kg. The marginal exceedance of 28.2 mg/kg was recorded in the Made Ground at WS15. WS15 is located along the southern boundary of the Site, given the isolated and marginal nature of the exceedance, there is not considered to be a significant risk.
- 12.5.42. Two locations (WS8 and WS15) exceeded the published C4SL value (residential without gardens) for arsenic of 40 mg/kg. The two exceedances were recorded within the Made Ground with a maximum concentration of 55.5 mg/kg at WS15. Made Ground in the vicinity of WS15 is likely to be excavated as part of the proposed basement. WS8 (northeast of the Site) recorded a concentration of 43.1 mg/kg marginally exceeding the relevant C4SL value (40 mg/kg). This marginal exceedance is not considered to be a significant risk.
- 12.5.43. Seven locations (WS1, WS3, WS5, WS8, WS10, WS11 and WS15) exceeded the published C4SL value (residential without gardens) for lead of 310 mg/kg. The exceedances were recorded within the Made Ground with a maximum concentration of 944 mg/kg at WS15. Made Ground in the vicinity of WS3, WS10, WS11 and WS15 is likely to be excavated as part of the proposed basement. Lead concentrations exceeding the relevant assessment criteria at WS1, WS5 and WS8 are not considered to be a significant risk due to proposed hardstanding effectively breaking a potential pathway.
- 12.5.44. It should be noted that identified tanks on-site should be degassed and decommissioned by a licenced contractor.

Asbestos in Soil

- 12.5.45. A total of 22 no. soil samples were subject to asbestos fibre screening. Asbestos containing material was not detected in samples analysed.

Soil Vapour Risk

- 12.5.46. Olfactory evidence of hydrocarbon contamination was recorded within the Made Ground (one location) and Kempton Park Gravel Formation (five locations) (see Section 7.2). Notwithstanding one location (WS15), PID readings were typically low (>10 ppm), which reflected low laboratory petroleum hydrocarbon concentrations. WS15 recorded a PID reading of 662 ppm, however given the isolated elevated reading and close proximity of soils recording low PID readings at BH8, WS6 and WS14 (all within 15 m of WS15), soils vapour risks at the Site is considered to be low.

Human Health Assessment Conclusions

- 12.5.47. Exceedances of arsenic, lead, and petroleum hydrocarbons were identified at concentrations exceeding the residential without gardens GAC. However, these exceedances are not considered to represent a significant risk to human health due to the development design largely mitigating against any potential risks through the excavation of the basement which will remove the material that is the source of the elevated concentration, effectively breaking the critical exposure pathway for these contaminants of direct contact and ingestion.
- 12.5.48. Risk to ground workers as a result of potential direct contact with contaminated soil can be mitigated through the use of appropriate PPE/RPE and correct working practices during the excavation of impacted soils in the construction of the basement.

12.5.49. Therefore, the ground conditions beneath the Central Site are not considered to represent a significant risk to human health receptors and no remedial measures are considered to be required as part of the redevelopment of the Central Site to safeguard the future Site occupants.

Assessment of Controlled Waters

12.5.50. Two rounds of groundwater sampling were undertaken at seven monitoring wells. Chemical data from the groundwater samples has been screened, and exceedances of Water Quality Standards (WQS) summarised below in **Table 12-15**.

Table 12-15 - Groundwater Exceedances

Determinand	DWS	EQS	# Exceeding DWS	# Exceeding EQS	Average Concentration (µg/l)	Max Concentration (µg/L)
Nickel	20	4	0	2	5.1	6
Anthracene	0.1	0.6	2	1	0.09	0.74
Naphthalene	2.4	2	1	1	0.31	3.48
Fluoranthene	-	0.006 3	0	14	0.4	4.45
Benzo(a)pyrene	0.001	0.000 17	6	7	0.14	1.38
Aromatics >C21-C35	90	-	2	0	45	414
Total Aliphatic/Aromatic C5-C40	10	-	9	0	111	1180

Note – Concentrations in mg/l unless stated.

h - Hardness related, site average >250 mg/L used.

w - WHO Drinking Water Standard 2009 in lieu of UK standards.

12.5.51. Groundwater laboratory results reported elevated nickel, a number of PAHs (including anthracene, naphthalene, fluoranthene and benzo(a)pyrene) and petroleum hydrocarbons above their respective screening values protective of groundwater (River Terrace Deposits) and surface water (River Thames). Elevated groundwater concentrations, notwithstanding BH06, were generally marginal and not considered to be a significant risk to controlled waters. Maximum concentrations of PAHs and petroleum hydrocarbons were recorded at BH06 (southeast of the Site). Groundwater concentrations in the vicinity of BH06, which could potentially be of a significant risk to controlled waters (if consistently recorded across the Site), are considered to be localised. BH06 is located in the vicinity of a historic waste oil tank, which could potentially have leaked as long chain length exceedances correspond to oils which were stored in the tank.

12.5.52. The underlying River Terrace Deposits are classified as a Secondary A Aquifer. Although there are no records of the formation being utilised locally for groundwater abstraction at present, it is considered to have future resource potential. However, it is unlikely to be used for potable water supply. Furthermore, the River Thames is located 80m to the west of the Site.

- 12.5.53. The Proposed Development includes a basement across the majority of the footprint of the Site. It is considered that the basement dig and extensive hardstand covering of the proposed development provide betterment of the groundwater quality beneath the Site by removing the majority of Made Ground and upper superficial materials within the Site and limiting rainwater infiltration and therefore the potential for contaminant migration.
- 12.5.54. Remedial action is not considered necessary (notwithstanding tank decommission) in this instance taking the Proposed Development into consideration (i.e., removal of Made Ground and upper superficial soils) and localised nature of significantly elevated groundwater concentrations (BH06). Currently the London Clay Formation (approximately 27m to 29m in thickness, where proven) is acting as an aquitard providing protection to the underlying Principal Aquifers. If the Proposed Development requires piles capable of penetrating through the London Clay, a Piling Works Risk Assessment will be required as a condition of planning.

Controlled Water Assessment Conclusions

- 12.5.55. Elevated concentrations of nickel, PAHs and petroleum hydrocarbons were noted within the groundwater. Maximum concentrations were recorded at BH06 (southeast of the Site) which indicates a historic waste oil tank may have leaked. The exceedances in this location were considered to be localised.
- 12.5.56. Remedial action is not considered necessary taking the Proposed Development into consideration and risks to onsite and offsite Controlled Waters are considered to be low. However, Site workers should remain vigilant for unexpected contamination during bulk excavation and potential dewatering works.

Assessment of Ground Gas

- 12.5.57. Exceedances of the relevant residential without gardens Generic Assessment Criteria (GAC) are presented in **Table 12-13**. Note only those contaminants recording exceedances of their respective screens are summarised below.
- 12.5.58. Ground gas monitoring was undertaken at the Site on six events between December 2016 and January 2017. Measurements were taken largely during periods of high atmospheric pressure conditions (between 1013mB and 1036mB).
- 12.5.59. Elevated methane concentrations were not recorded. A maximum carbon dioxide concentration of 3.1% was recorded at WS08. Oxygen concentrations between 16.5% and 21.9% represent well aerated soil conditions. Elevated flow readings were not recorded. Gas Screening Values (calculated as the gas concentration (% v/v) by the borehole flow rate (l/h)) were calculated in line with CIRIA 665 guidance (**Ref 12.15**). Due to elevated flow readings not being recorded, a flow reading of 0.1 l/h (limit of detection) was used for conservatism. Given the flow rate and concentrations noted, a maximum GSV of 0.0031 was calculated for carbon dioxide. As such, the ground gas regime of the Site conforms to Characteristic Situation 1 (very low risk) and ground gas protection measures are not required.
- 12.5.60. Additionally, the basement will be used for car parking which will be ventilated as part of the design.

Waste Classification

- 12.5.61. The Made Ground and River Terrace Deposits have been classified in terms of waste acceptance criteria and likely routes for disposal off-site. The classifications range from inert, through to non-

hazardous and hazardous. Therefore, it will be important that soil excavation, segregation and classification are carefully managed and controlled to minimise the volumes of hazardous waste.

GROUND INVESTIGATION – WEST SITE

12.5.62. The West Site ground investigation comprised 5No. cable percussion borehole, 8No. dynamic sampling boreholes, and 1No. hand pit (**Appendix 12.6**).

12.5.63. In total, 13No. exploratory locations were undertaken, which equates to a sampling density of one location per 20m².

Site Investigation

12.5.64. A summary of both phases of site investigation undertaken is presented in **Table 12-16**, below.

Table 12-16 - Summary of Fieldworks

Method	Number	Maximum Depth (M BGL*)
Cable percussive borehole	5	40.00
Window sample borehole	13	5.00
Hand pit	1	1.31

*Metres below existing ground level.

12.5.65. The ground investigation and sampling strategy were designed to provide an assessment of identified potential sources of contamination (such as the identified tanks) and to provide information to assist in assessing the potential pollutant linkages. However due to a number of Site constraints, including Site buildings and inaccessible areas, exploratory locations were predominately positioned to obtain sufficient spatial coverage.

Laboratory Chemical Analysis

12.5.66. Soil samples were collected from all exploratory hole locations which were targeted to obtain information relating to areas of contamination risk based on the Site history and observations made during the Site inspection. A total of 35 no. soils samples were collected during the ground investigation.

12.5.67. Two rounds of groundwater sampling were undertaken at seven monitoring wells and submitted for chemical analysis.

Groundwater and Gas Monitoring

12.5.68. Following completion of the ground investigation, six rounds of ground gas and groundwater level monitoring were undertaken between 9th May 2017 and 23rd June 2017. Groundwater sampling of accessible boreholes was undertaken on 30th May 2017 and 13th June 2017.

Encountered Ground Conditions

12.5.69. A summary of the strata encountered during investigation of the Site is presented in **Table 12-17**.

Table 12-17 - Summary of the Strata Encountered

Stratum Name	Elevation of Upper Surface (m AOD)	Typical Thickness (m)	Typical Description
Hardstanding	+4.48 to +4.33	0.35 to 0.70	Concrete (all locations)
Made Ground	+4.08 to +3.71	0.78 to 3.85	Brown to brownish grey sandy to very sandy gravel with occasional brick cobbles and occasional pockets of soft, brownish grey clay. Gravel comprises subangular to subrounded fine to coarse flint, brick, concrete and rare clinker fragments.
Alluvium	+3.08	0.80	Soft brown occasionally mottled orangish brown sandy slightly gravelly clay. Gravel is angular to sub rounded fine to coarse flint.
River Terrace Deposits	+3.03 to -0.12	3.80 to 6.80	Brown to yellowish brown sandy subangular to rounded fine to coarse flint gravel.
London Clay	-3.48 to -4.52	26.00 to 26.50	Firm to stiff, closely to extremely closely fissured slightly sandy silty clay.
Harwich Formation	-29.68 to -30.68	0.20 to 1.00	Dense, dark grey and dark green slightly gravelly very silty glauconitic fine to medium sand. Gravel is well rounded fine to medium black flint.
Lambeth Group	-30.52 to -30.88	NP	Stiff to very stiff rarely fissured sandy silty clay.

NP – Full extent of layer not been proven.

Groundwater Levels

12.5.70. Shallow groundwater was identified within the River Terrace Deposits at a depth of approximately between -0.40 m AOD to -0.57m AOD. Installations within the Made Ground were found to be dry. Triangulation of groundwater indicates groundwater flow is moving in a westerly direction towards the River Thames. Groundwater was not recorded during monitoring within the Made Ground and would be undertaken under a planning condition as part of the site investigations required prior to works on-site commencing.

12.5.71. The GIR also concluded that below the River Terrace deposits, groundwater strikes at elevations of circa 0.0m AOD and throughout the London Clay.

12.6. SENSITIVE RECEPTORS

12.6.1. The following are the sensitive receptors which are considered in the following assessment:

- § Demolition and Construction Workers;
- § Third Party Neighbours (and future Site occupants); and
- § Controlled Waters (Secondary A Aquifer, Principal Aquifer and River Thames).

12.7. ASSESSMENT OF EFFECTS, MITIGATION AND RESIDUAL EFFECT

DEMOLITION AND CONSTRUCTION STAGE

DESIGN SOLUTIONS AND ASSUMPTIONS

- 12.7.1. A ground investigation has been carried out within the Central Site during October and November 2016 (**Appendix 12.2**). The GQRA (**Appendix 12.4**) assessed risks to human health (including future Site users, visitors and construction /maintenance workers) and Controlled Waters. Following the assessment, remedial action is not considered necessary as part of the redevelopment of the Central Site taking the Proposed Development into consideration. However, Site workers should remain vigilant for unexpected contamination during the Demolition and Construction Stage. This is capable of being secured via a planning condition.
- 12.7.2. Further investigations for the West Site and the East Site were underway at the time of writing this report. Prior to works starting, an assessment of potential contaminant linkages will be undertaken within both the West and East Sites in line with CLR 11 which can be secured by way of condition of planning. If any unexpected contamination is found, it will be sufficiently remediated prior to construction works on that part of the Site.
- 12.7.3. If the ground investigation identifies contaminant linkages a Remediation Strategy will be produced for the West and/or East Site to specify protective measures for the Demolition and Construction Stage of the development. These works are also anticipated to be secured by way of condition of planning.
- 12.7.4. A Remediation Strategy will set out measures to break the pollutant linkages, where identified. The measures could include the removal of contaminated soil, the removal of UST, or the placement of a barrier between the contaminant source and the receptor, amongst others. The Remediation Strategy would consider the available options for each contaminant linkage and will establish the most effective and sustainable approach.
- 12.7.5. Validation of remedial measures would be required, and will be reported in a Verification Report.
- 12.7.6. It has been assumed that the following practices are adhered to as standard good practice during the demolition of remaining buildings and the subsequent construction. These measures are proposed as part of a framework Construction Environmental Management Plan (**Appendix 5.1**) and a more detailed construction environmental management plan will be prior to construction commencement:
- § Use of appropriate Personal Protective Equipment at all times during the construction works;
 - § Provision of adequate hygiene facilities for washing and changing;
 - § Excavated soils will be used on-site wherever possible;
 - § Implementation of an appropriate temporary drainage system will be required in order to minimise the potential risks of contamination or excess sediment reaching nearby surface water;
 - § Any contaminated material encountered on-site, the handling, storage and removal will be subject to current waste management legislation and guidance;
 - § The presence of contaminants and the associated risks will be explained to ground workers before they begin work;
 - § Fuel storage on-site to be carried out under best practice i.e. integrally bunded containers; Plant refuelling to be carried out using best practice techniques and any spills to be controlled with spill kit;
 - § Dust suppression measures (e.g. damping down) will be implemented to minimise the potential for dust generation; and,

§ Wheel washing of Site vehicles will be carried out in order to minimise the potential for dust generation.

12.7.7. An Asbestos Survey has been undertaken of the buildings on Site which has indicated the presence of asbestos containing materials, especially throughout the basements of the West and Central Sites. Any identified asbestos containing materials will be removed in line with best practice prior to demolition of the buildings under the legislative requirements of the Control of Asbestos Regulations, 2012.

12.7.8. It has been assumed that excavated material from the Site will be appropriately classified and disposed to licenced facilities.

12.7.9. The Demolition and Construction Stage is likely to have a duration of 3.5 to 4 years. It is assumed that only the Fire Station will be occupied prior to completion of the Proposed Development.

EFFECT ON DEMOLITION AND CONSTRUCTION WORKERS AND THIRD-PARTY NEIGHBOURS/FUTURE SITE OCCUPANTS FROM POSSIBLE ON-SITE CONTAMINATION

12.7.10. Construction workers will be exposed to any contaminants that are present in the Made Ground, or that are present in the ground after migrating from contaminant sources, during any earthworks or Site clearance that includes disturbing or clearing the Made Ground. There is potential for exposure to asbestos or other contaminants during any earthworks or Site clearance if it is present in the Made Ground. They will be affected by inhalation of dusts, gases or vapours, dermal contact with soil and groundwater; and ingestion of soil and dust. However, the length of direct exposure will be limited to the duration of Site works in which they are directly involved, and thus the effect will be short term. Any health effects from the potentially contaminated soil and groundwater could have a medium to long term effect.

12.7.11. The sensitivity of construction workers is medium to high and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, permanent, medium to long-term moderate to major negative effect (significant) on construction workers prior to the implementation of mitigation measures.

Mitigation

12.7.12. Assuming the conditions detailed above in Section 12.7.10 – 12.7.11, demolition and construction workers would be required to wear PPE such as gloves and face masks (where appropriate) to prevent dermal contact and inhalation or ingestion. Appropriate Site hygiene facilities will be put in place.

12.7.13. Water can be sprayed onto material being worked to damp down any potentially contaminated dust and prevent it from becoming airborne. Wheel washing of Site vehicles may also be implemented to prevent tracking of contaminated material off-site.

12.7.14. Appropriate covering of onsite stockpiled materials and during transport to/from the Site to prevent dust generation.

Residual Effect

12.7.15. The sensitivity of demolition and construction workers and third party neighbours/future site occupants (where development is phased) is medium to high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a direct, temporary, short-term **negligible** effect (**not significant**) on construction workers following the implementation of mitigation measures.

POTENTIAL FOR IMPACT TO CONTROLLED WATERS FROM POSSIBLE ON-SITE CONTAMINATION

- 12.7.16. Removal of surface cover (buildings and hardstanding) has the potential to increase the rate of infiltration of rainfall and therefore leaching of contaminants from shallow soils.
- 12.7.17. There is potential for the generation of preferential pathways through construction techniques (e.g. piling) to the Principal Aquifer below the London Clay Formation. This risk will be addressed through the production of a Piling Risk Assessment (to be conditioned as part of planning consent) and a Basement Impact Assessment.
- 12.7.18. The use of machinery and plant associated with construction activities (including the establishment of a Site construction compound and storage of chemicals or fuels) could give rise to a localised contamination that may represent a risk to groundwater and surface water features through accidental fuel / oil and chemical spills and leaks. There could also be a risk of contaminated runoff, including hydrocarbon contamination, associated with the operation of vehicles. This has the potential to create overland migration pathways.
- 12.7.19. The sensitivity of the Controlled Waters is high and the magnitude of change, prior to mitigation, is medium. There is likely to be a direct, temporary, long-term, moderate to major negative effect (significant) on underlying groundwater prior to the implementation of mitigation measures.

Mitigation

- 12.7.20. The ground investigation completed within the Central Site did not identify ground conditions which would require remediation. The ground investigations within the West and East Sites will identify areas of contamination if present, which will be remediated prior to the Operational Stage (if required).
- 12.7.21. The temporary drainage strategy (as outlined in the framework Construction Environmental Management Plan (fCEMP) (**Appendix 5.1**)) will be designed to reduce the risk of mobilisation of contamination to Controlled Waters during construction. The Principal Contractor must take precautions during construction stage to protect the entire drainage from siltation or pollution.
- 12.7.22. The Proposed Development includes:
- § A two-storey basement below the entire footprint of the Central Site. The majority of the basement will be founded at -4.75m AOD with plant room at -5.75m AOD;
 - § A single-story basement beneath western half (river side) of the West Site to a depth of +1.03m AOD extending to -1.0m AOD beneath the hotel (land side); and
 - § A single storey basement beneath the building footprint on the East Site extending to a depth of +0.5m AOD.
- 12.7.23. This is likely to involve the removal of the majority if not all the superficial deposits (above the London Clay) from beneath the proposed development including Made Ground and the River Terrace Gravels (Secondary A Aquifer). A secant pile wall will also form the walls of the basement box reducing the potential for off-site Controlled Waters (River Terrace Gravels and River Thames) to be impacted by any on-site contamination.
- 12.7.24. A Piling Risk Assessment should be carried out prior to the works if the depth of piles is likely to extend beyond the London Clay into the underlying aquifers and recommendations protective of the Controlled Waters should be incorporated into the construction method statement.

12.7.25. Existing ground level at the Site is circa +4.45m AOD. Shallow groundwater was identified within the River Terrace Deposits at a depth of approximately between -0.23 m AOD to -0.94m AOD. A Basement Impact Assessment has been undertaken by WSP which assesses risks to Controlled Water from the basement development.

12.7.26. In addition, the following recommendations are set out in the Preliminary Risk Assessment (see **Appendix 12.1**) which would be implemented through a planning condition:

- § A site specific ground investigation is required. This site investigation will define ground conditions, assess ground gas, ground and groundwater contamination risks (both in terms of onsite risks and risks posed to offsite sources from onsite conditions) and to provide parameters for geotechnical design;
- § A UXO Desk Study should be obtained;
- § A full demolition survey will be required. It is recommended an asbestos specialist is consulted;
- § A Ground Investigation Report (GIR) will be required to confirm the ground and groundwater conditions beneath the site and the geotechnical design parameters in accordance with the Eurocodes;
- § A Geotechnical Design Report (GDR) should be produced in accordance with the Eurocodes for the Proposed Development;
- § A risk assessment will need to be completed to confirm the structures / assets at risk from ground movements and which assets will require a ground movement assessment to be completed. Liaison with the adjacent asset holders will be required to discuss the ground movements, monitoring strategy and any remedial measures required or monitoring actions plans (MAPs) which will be required to be implemented during the works. These are likely to be associated with the nearby listed buildings, the NR assets and any buried TW assets.
- § A Generic Quantitative Environmental Risk Assessment (GQRA) will be required. This will inform the requirement for a Remediation Strategy and Detailed Quantitative Environmental Risk Assessment (DQRA).

Residual Effect

12.7.27. The sensitivity of the Controlled Waters is high and the magnitude of change, following mitigation, is **negligible**. Therefore, there is likely to be a direct, temporary, long-term, **negligible** effect (**not significant**) on groundwater in the underlying aquifers following the implementation of mitigation measures.

OPERATIONAL STAGE

FUTURE SITE USERS COULD BE EXPOSED TO POTENTIALLY CONTAMINATED SOIL WITHIN AREAS OF SOFT LANDSCAPING

12.7.28. Future Site users could be exposed to any contaminants that are present in the areas of soft landscaping. They will be affected through inhalation of dust, dermal contact with soil, and ingestion of soil and dust.

12.7.29. The sensitivity of the future Site users (including maintenance workers) is high and the magnitude of change, prior to mitigation, is high. Therefore, there is likely to be a direct, temporary, medium to long-term, moderate to major negative effect (significant) on future Site users prior to the implementation of mitigation measures.

Mitigation

- 12.7.30. All superficial materials will be removed from Site during the basement excavation and therefore any areas of soft landscaping are likely to be formed from imported soils.
- 12.7.31. All imported soils should be chemically validated as suitable for use prior to being imported to Site.

Residual Effect

- 12.7.32. The sensitivity of future users is medium to high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a direct, temporary, medium to long-term, **negligible** effect on existing Site users following the implementation of mitigation measures (**not significant**).

12.8. LIMITATIONS AND ASSUMPTIONS

- 12.8.1. The work undertaken to provide the basis of this chapter comprised a study of available documented information from a variety of sources and discussions with relevant authorities and other interested parties.
- 12.8.2. It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following further surveys and physical intrusive investigation of the Site.

12.9. SUMMARY

- 12.9.1. The Site is approximately 1.06 hectares in size and is located in the London Borough of Lambeth. The Site is split into three areas; the West Site fronts onto Albert Embankment and is the Former Headquarters Building. The Central Site lies to the east of the West Site and is bounded to the north by Whitgift Street, and to the west by a railway viaduct. The East Site is located to the west of the railway viaduct and is a square plot of land at the junction of Black Prince Road and Newport Street.
- 12.9.2. The West Site comprises the Grade II listed former Headquarters of the London Fire Brigade, which operates as the Lambeth Fire Station. This is a large, part nine, part ten storey brick building with a basement and is separated from the River Thames by the A3036, Albert Embankment. There is a three-storey concrete built extension (built in the 1980's) to the Headquarters in the southern part of this area. In the north-east corner of the West Site is a brick built Drill Tower which is also Grade II listed. A basement is present below much of the area of the West Site. It is understood that the basement was formerly used as workshops and storage areas and the following potential contaminative uses of this basement area have been recorded; dry storage of cleaning materials, boiler rooms – currently gas fired but historically oil fired with heavy staining on the concrete floor, paint storage, acid battery storage, pump rooms, former fuel storage rooms etc.
- 12.9.3. The Central Site is currently in use as the London Fire Brigade Museum and exhibition space. The building was formally used as a vehicle workshop and office building associated with the Fire Station. Three vehicle inspection pits are present in the west of the main building. A small basement is present in the south of the structure. The basement is understood to contain the historical boilers and three oil tanks. A walkover of the basement was not possible due to the possible presence of asbestos containing materials.
- 12.9.4. The East Site is a small area of hard standing which is understood to be the car park for the Former Headquarters building but which is currently temporary leased as a community garden. This area is currently not accessible to the public and is surrounded by a secure fence and gate. The area is

occupied by small raised beds with small shrubs surrounded by concrete blocks for seating. The area is bound to the north by a masonry wall and to the west, south and east by a metal fence. A mature tree is present in the south-western edge of the Site.

- 12.9.5. The Site is anticipated to be underlain by limited quantities of Made Ground. This may be then underlain by superficial deposits of the Lynch Hill Gravel Member. However, this strata may have been removed during the development of the existing basement level. The bedrock is indicated to be the London Clay Formation. The Lynch Hill Gravel Member is classified as a Secondary A Aquifer, whilst the London Clay Formation is designated as Unproductive Strata.
- 12.9.6. The London Clay Formation is thought to act as a low permeability barrier (due to its anticipated thickness of approximately 30 m) between the shallow groundwater in the River Terrace Deposits and the underlying Lambeth Group, Thanet Sands and Upper Chalk Formation preventing vertical migration of potential contaminants from the upper aquifer (River Terrace Deposits) to the lower aquifers (Thanet Sand Formation and Chalk). Notwithstanding this, the Proposed Development will likely require deep piles, which could potentially penetrate the London Clay and create preferential pathways for contamination to migrate vertically to the Principal Thanet Sand Formation and Chalk Aquifers.
- 12.9.7. The location of the Site, in an urban environment, is likely to result in a highly modified ground conditions (e.g. basement and sewers) with a locally variable groundwater table. However, overall groundwater flow direction is anticipated to be towards the River Thames located to the west of the Site.
- 12.9.8. A ground investigation has been carried out within the Central Site during October and November 2016. The GQRA assessed risks to human health (including future Site users, visitors and construction /maintenance workers) and Controlled Waters. Following the assessment, remedial action is not considered necessary as part of the redevelopment of the Central Site, taking the Proposed Development into consideration. However, Site workers should remain vigilant for unexpected contamination during the Demolition and Construction Stage. A ground investigation is currently underway within the West Site. A future ground investigation is planned for the East Site.
- 12.9.9. Likely significant sources identified include:
- § Potential contaminants of concern in Made Ground (from on-site and off-site sources);
 - § Historical and current tanks located on-site;
 - § Ground Gas; and
 - § Various historical industrial uses.

POTENTIAL PATHWAYS

- 12.9.10. Potential Pathways in the context of the proposed redevelopment include:
- § Direct contact, ingestion or inhalation of soil bound contaminants/dust;
 - § Inhalation of vapours associated with volatile organic compounds;
 - § Leaching of contamination into groundwater from soil followed by migration of groundwater to the wider groundwater environment or surface waters;
 - § Migration of ground gas through pore spaces into enclosed spaces;
 - § Direct contact with potentially impacted groundwater; and
 - § Ingress of contaminated groundwater into water supply pipes.

12.9.11. Likely significant receptors identified include:

- § Demolition and Construction Workers;
- § Third Party Neighbours; and
- § Underlying Controlled Waters.

12.9.12. Proposed mitigation measures include (to be implemented through planning conditions):

- § Appropriate use of Personal Protective Equipment (PPE) and hygiene regime by construction workers during demolition, construction and maintenance, through the implementation of a CEMP;
- § Dust suppression during the construction stage, through the implementation of a CEMP;
- § Appropriate fuel storage and good practice during fuelling of Site vehicles during development, through the implementation of a CEMP;
- § Appropriate Site drainage including use of interceptor systems in areas where motor vehicles are used, through the implementation of a CEMP;
- § Undertaking a piling risk assessment. Selection of appropriate piling technique will be important to limit vertical migration of contaminants;
- § A ground investigation will be carried out to identify potential contaminant linkages as a condition of planning for the West and East Site areas. If the ground investigation identifies contaminant linkages a Remediation Strategy will be produced for the Site to specify protective measures for the construction stage of the development;
- § If potential contaminant linkages are identified following the ground investigation a remediation strategy will be produced in agreement with the Regulators and National House Building Council on that strategy and subsequent verification report requirements (In accordance with CLR 11) as a condition of planning within the West and East Site areas; and
- § Chemical validation of imported soils for soft landscaping areas.

12.9.13. The majority of residual effects during operation have all been assessed as **not significant**, based upon the above mitigation measures being implemented appropriately.



Table 12-18 - Summary of Effects for Ground Conditions, Contamination and Hydrogeology

DESCRIPTION OF SIGNIFICANT EFFECTS	RECEPTOR	SIGNIFICANCE OF EFFECTS					SUMMARY OF MITIGATION / ENHANCEMENT MEASURES	SIGNIFICANCE OF EFFECTS					RELEVANT POLICY	RELEVANT LEGISLATION
		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		
Demolition and Construction														
Effect on demolition and construction workers and third-party neighbours from possible on-site contamination	Demolition and construction workers and third-party neighbours	Moderate to major	Negative	P	D	MT-LT	CEMP to include the following measures (adopted through planning condition): <ul style="list-style-type: none"> Requirement to wear PPE. Appropriate hygiene facilities to be provided. Water spray to damp down any potentially contaminated dust. 	Negligible	N/A	T	D	ST	NPPF	Part IIA Environment Act 1995
Potential for impact to controlled waters from possible on-site contamination	Controlled Waters such as Secondary A Aquifer (River Terrace Deposits above London Clay) and Principal Aquifer beneath London Clay, and River Thames	Moderate to major	Negative	T	D	LT	Planning conditions to include: <ul style="list-style-type: none"> Ground investigation post planning to identify areas of contamination. Construction of basement (including secant 	Negligible	N/A	T	D	LT	NPPF	Part IIA Environment Act 1995 Water Act 2003 Water Framework Directive 2006

DESCRIPTION OF SIGNIFICANT EFFECTS	RECEPTOR	SIGNIFICANCE OF EFFECTS					SUMMARY OF MITIGATION / ENHANCEMENT MEASURES	SIGNIFICANCE OF EFFECTS					RELEVANT POLICY	RELEVANT LEGISLATION
		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		
							piled wall around basement box). · Production of a Piling Risk Assessment prior to works.							
Operation														
Exposure to any contaminants within areas of soft landscaping.	Effect on Future Occupiers and Visitors (including maintenance works)	Moderate to major	Negative	T	D	MT-LT	· Construction of basement as part of the consented scheme. · Planning condition to ensure chemical verification of imported soils.	Negligible	N/A	T	D	MT-LT	NPPF	Part IIA Environment Act 1995 NHBC

Key to table:

P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term

N/A = Not Applicable.

12.10. REFERENCES

- Ref. 12.1 HMSO (1990) Part IIA of the Environmental Protection Act, 1990.
- Ref. 12.2 HMSO (1995) Environment Act, 1995.
- Ref. 12.3 HMSO (2002) Control of Substances Hazardous to Human Health Regulations, 2002 (as amended).
- Ref. 12.4 HMSO (2003) The Water Environment (Water Framework Directive) (England & Wales) Regulations (2000/60/EC), 2003.
- Ref. 12.5 HMSO (2006) Groundwater Directive 2006/118/EC.
- Ref. 12.6 HMSO Water Resources Act (1991).
- Ref. 12.7 HMSO (2006) Dangerous Substances Directive (Amendment) Regulations, 2006.
- Ref. 12.8 HMSO (2009) Environmental Damage and Liability (Prevention and Remediation) Regulations, 2009.
- Ref. 12.9 HMSO (2010) Environmental Permitting (England and Wales) Regulations, 2010.
- Ref. 12.10 HMSO (2012) The Control of Asbestos Regulations.
- Ref. 12.11 HMSO (2012) The Contaminated Land (England) (Amendment) Regulations.
- Ref. 12.12 HMSO (2015) Construction (Design & Management) Regulations.
- Ref. 12.13 Ministry of Housing, Communities and Local Government (2019) National Planning Policy Framework.
- Ref. 12.14 HMSO The London Plan (2016).
- Ref. 12.15 The Lambeth Local Plan (2015).
- Ref. 12.16 Lambeth's Contaminated Land Strategy (October 2001).
- Ref. 12.17 Department for Environment, Food and Rural Affairs, Contaminated Land Statutory Guidance, April 2012.
- Ref. 12.18 Ministry of Housing, Communities and Local Government. National Planning Practice Guidance (online) (2018) Available at: <http://planningguidance.planningportal.gov.uk/>
- Ref. 12.19 Environment Agency (2016) Pollution prevention for businesses (<https://www.gov.uk/guidance/pollution-prevention-for-businesses>).
- Ref. 12.20 Environment Agency (2016) Discharge to surface or ground water (<https://www.gov.uk/guidance/discharges-to-surface-water-and-groundwater-environmental-permits>).
- Ref. 12.21 Environment Agency (2016) Manage business and commercial waste (<https://www.gov.uk/managing-your-waste-an-overview>).
- Ref. 12.22 Environment Agency (2016) Store oil and oil storage regulations for businesses (<https://www.gov.uk/oil-storage-regulations-and-safety>).

- Ref. 12.23 Environment Agency (2004) Model Procedures for the Management of Contaminated Land (CLR11).
- Ref. 12.24 Environment Agency (2012) Groundwater Protection: Policy and Practice (GP3).
- Ref. 12.25 Environment Agency (2017) Protect groundwater and prevent groundwater pollution.
- Ref. 12.26 Environment Agency (2017) Groundwater protection technical guidance.
- Ref. 12.27 Environment Agency (2017) Groundwater protection position statements.
- Ref. 12.28 Environment Agency (2017) Land contamination groundwater compliance points: quantitative risk assessments.
- Ref. 12.29 Health and Safety Executive (HSE) (1991) Guidance Note HS (G) 66, Protection of Workers and the General Public during the Development of Contaminated Land.
- Ref. 12.30 Construction Industry Research and Information Association (2001) C532 – Control of Pollution from Construction Sites.
- Ref. 12.31 Health and Safety Executive (2006) INDG258 Safe Work in Confined Spaces.
- Ref. 12.32 Construction Industry Research and Information Association (2007) C665 – Assessing Risks Posed by Hazardous Gases to Buildings, Wilson, Oliver, Hutchings and Card.
- Ref. 12.33 Construction Industry Research and Information Association (2009) C682 – The VOCs Handbook.
- Ref. 12.34 British Standards Institution BS10175+A2 (2017) Investigation of Potentially Contaminated Sites – Code of Practice.
- Ref. 12.35 Department for Environment, Food and Rural Affairs, Contaminated Land Statutory Guidance April 2012.
- Ref. 12.36 BS 8576 (2013) Guidance on investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds.
- Ref. 12.37 CIRIA C552 (2001) Contaminated Land Risk Assessment. A Guide to Good.
- Ref. 12.38 CIRIA (2014) C733 – Asbestos in soil and made ground: a guide to understanding and managing risks.
- Ref. 12.39 WSP A Generic Quantitative Risk Assessment (GQRA) has been completed by WSP dated April 2017 (Ref. 70016347).
- Ref. 12.40 WSP Ground Investigation Report (GIR) has also been produced by WSP dated January 2017 (Ref. 70016347).
- Ref. 12.41 Type 2 asbestos survey of the site was undertaken in June 2008 by Blues Consultants Limited.
- Ref. 12.42 Unexploded Ordnance (UXO) Desk Study was undertaken for the Site by EOD Contracts Limited dated 3rd October 2016.



4th Floor
6 Devonshire Square
London
EC2M 4YE

wsp.com