B&Q Cricklewood
ES Volume I

Chapter 12: Ground Conditions and Contamination

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Table of Contents

Figures

Tables

12. Ground Conditions and Contamination

12.1 Introduction

12.1.1 This chapter of the Environmental Statement (ES) reports the findings of an assessment of the likely significant effects on ground conditions and contamination as a result of the proposed 'B&Q Cricklewood' development (hereafter referred to as the 'Proposed Development') in the London Borough of Barnet (LBB).

12.1.2 Consideration of impacts and their effects associated with potentially contaminated soil and groundwater is given within the context of the Site (i.e. baseline conditions), throughout the demolition and construction works and once the Proposed Development is complete and occupied.

12.1.3 The assessment of effects is undertaken pre-mitigation, after having previously considered the standard environmental mitigation measures which would be expected to be carried out as best practice demolition and construction techniques, as specified in the Environmental Design and Management section of this chapter. The requirement for any additional mitigation measures during the demolition and construction phase and once the Proposed Development is occupied is then assessed. Following the application of the mitigation measures, the resultant residual effects are assessed in accordance with the set significance criteria.

12.1.4 An Envirocheck® Report[1] has been reviewed, which provides a desk top account of historical and existing operations and services within 1kilometre (km) of the Site boundary, as well as relevant environmental setting information. The report has been reviewed as part of the baseline research and has informed the impact assessment; where relevant the necessary information has been included within this chapter. The Envirocheck® Report, including associated maps and figures, is provided in *ES Volume III: Appendix 12-1*.

12.1.5 The potential for effect interactions on a single receptor (Type 1 effects) are discussed in *Chapter 17: Effect Interactions*. Combined cumulative ground conditions and contamination effects (Type 2 effects) of the Proposed Development with other development schemes are discussed at the end of this chapter.

12.1.6 This assessment and ES chapter has been produced by AECOM Infrastructure & Environment UK (AECOM).

12.2 Legislation and Planning Policy Context

National Legislation

12.2.1 There are five key legislative drivers for dealing with risks to human health and the environment from ground conditions, namely:

- Part 2A of the Environmental Protection Act (EPA) 1990 (the Contaminated Land Regime)[2];
- The Water Resources Act 1991[3] and the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009[4];
- Water Act 2003[5];
- Building Act 1984[6]; and
- The Building Regulations &c. (Amendment) Regulations 2016[7].

12.2.2 In the UK, Part 2A of the EPA, as introduced by Section 57 of the Environment Act 1995[8] provides the legislative framework within which site data relating to ground conditions is to be assessed. Under Part

[1] Landmark Information Group, 2019; Order Number 227657328_1_1.
[2] Her Majesty's Stationery Office (HMSO), 1990; Part IIA of the Environment Protection Act 1990
[3] HMSO, 1991; The Water Resources Act 1991
[4] HMSO, 2009; The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009
[5] HMSO, 2003; The Water Act 2003
[6] HMSO, 1984; The Building Act 1984
[7] HMSO, 2015; The Building Regulations &c (Amendment) Regulations 2016
[8] HMSO, 1995; The Environment Act 1995

2A, sites are identified as *'contaminated land'* if they are causing harm, if there is a significant possibility of significant harm, or if the site is causing, or could cause, pollution of controlled waters (i.e. both surface and groundwaters).

12.2.3 The Water Act 2003[9] introduced a revision to the wording of the EPA, which requires that if a site is causing or could cause significant pollution of controlled waters it may be determined as contaminated land. Once a site is determined to be "*contaminated land*" then remediation is required to render significant pollutant linkages insignificant (i.e. the source-pathway-receptor relationships that are associated with significant harm to human health and/or significant pollution of controlled waters are broken), subject to a test of reasonableness.

12.2.4 The Water Resources Act 1991[10] provides statutory protection for controlled waters (streams, rivers, canals, marine environment and groundwater) and makes it an offence to discharge to controlled waters without the permission or consent of the regulators of these areas.

12.2.5 The Building Act 1984[11] and the Building Regulations &c. (Amendment) Regulations 2016[12] are the two key legislative drivers when considering structural and design aspects of a development in terms of geotechnical properties of the ground. The Building Act 1984 requires that buildings are constructed so that ground movement caused by swelling, shrinkage, freezing, landslip or subsidence of the sub-soils will not impair the stability of any part of the building.

12.2.6 Other legislation of relevance to this topic includes:

- Environmental Permitting (England and Wales) Regulations 2016[13] (as amended);
- Hazardous Waste (England and Wales) (Amendment) Regulations 2009[14];
- Contaminated Land (England) (Amendment) Regulations 2012[15];
- Environmental Damage (Prevention and Remediation) Regulations 2015[16]; and
- Anti-Pollution Works Regulations 1999[17].

National Planning Policy

National Planning Policy Framework (2019)[18]

12.2.7 The revised National Planning Policy Framework (NPPF) was published in July 2018 (last updated February 2019) and sets out the Government's planning policies for England.

12.2.8 Policies and objectives which are of particular relevance to ground conditions are described below.

12.2.9 Section 11, paragraph 118 of the NPPF states that: "*Planning policies and decisions should: … support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land*."

12.2.10 Section 15, paragraph 170 of the NPPF states that: "*Planning policies and decisions should contribute to and enhance the natural and local environment by: … preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability. … and … remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate*."

12.2.11 Section 15, paragraph 178 the NPPF also states that: "*Planning policies and decisions should ensure that: a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts*

[9] HMSO, 2003; The Water Act 2003
[10] HMSO, 2009; The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009
[11] HMSO, 1984; The Building Act 1984
[12] HMSO, 2015; The Building Regulations &c (Amendment) Regulations 2016
[13] HMSO, 2016; Environmental Permitting (England and Wales) Regulations 2016
[14] HMSO, 2009; The Hazardous Waste (England and Wales) (Amendment) Regulations 2009
[15] HMSO, 2012; The Contaminated Land (England) (Amendment) Regulations 2012
[16] HMSO, 2015; Environmental Damage (Prevention and Remediation) Regulations 2015
[17] HMSO, 1999; The Anti-Pollution Works Regulations 1999
[18] DCLG, 2012; National Planning Policy Framework (NPPF)

on the natural environment arising from that remediation)… after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990."

National Planning Practice Guidance[19]

12.2.12 The National Planning Practice Guidance was launched in 2014 and provides additional guidance and interpretation to the Government's strategic policies outlined within the NPPF in a web-based resource. This is updated regularly.

12.2.13 Matters of relevance to the ground conditions assessment include:

- 'Land affected by contamination', which provides guiding principles on how planning can deal with land affected by contamination; (Paragraph 001 Reference ID: 33-001-20140306 to 010 Reference ID: 33-010-20140306); and
- 'Land stability', which provides advice on how to ensure that development is suitable to its ground condition and how to avoid risks caused by unstable land or subsidence; (Paragraph 001 Reference ID: 45-001-20140306 to 012 Reference ID: 45-012-20140306).

Regional Planning Policy

The London Plan – Spatial Development Strategy for Greater London (2016)[20]

12.2.14 The London Plan (consolidated with alterations since 2011) includes the following policies relevant to ground conditions:

- Policy 5.21 Contaminated Land and Policy 5.22 Hazardous Substances and Installations highlight the importance of redeveloping brownfield sites, including contaminated sites that require remediation. It is recommended that "*appropriate measures should be taken to ensure that development on previously contaminated land does not activate or spread contamination*" and that "*the risks should be balanced with the benefits of development and should take account of existing patterns of development*"; and
- Policy 5.12 Flood Risk Management states "*(…) B. Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk[21] over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100 – see paragraph 5.55) and Catchment Flood Management Plans".*

The London Plan – The Spatial Development Strategy for Greater London: Intend to Publish Version to Secretary of State (December 2019)[22]

12.2.15 The London Plan – The Spatial Development Strategy for Greater London includes the following policies of relevance to the ground conditions:

- *"Policy G9 Geodiversity*

  1. In Development Plans, boroughs should:

  1) *establish clear goals for the management of identified sites to promote public access, appreciation and interpretation of geodiversity;*

  2) ensure geological sites of European, national or regional conservation importance are clearly identified.

  2. Development proposals should:

[19] DCLG, 2015; National Planning Practice Guidance
[20] GLA, 2016; The London Plan – The Spatial Development Strategy for London Consolidated with Alterations Since 2011
[21] Technical Guidance to the National Planning Policy Framework, Department for Communities and Local Government, March 2012 or any subsequent guidance on flood risk issued in support of the NPPF
[22] GLA, 2019; The London Plan – Spatial Development Strategy for Greater London – Intend to Publish Version to Secretary of State . December 2019

1) make a positive contribution to the protection and enhancement of geodiversity;

2) protect Regionally Important Geological Sites (RIGS);

3) give Locally Important Geological Sites (LIGS) the level of protection commensurate with their importance".

A Green Future: Our 25 Year Plan to Improve the Environment[23]

12.2.16 A Green Future: Our 25 Year Plan to Improve the Environment is the Mayor of London's Environment Strategy was published in May 2018 and sets out the Mayor's vision of London's environment up to 2050. This document does not include any applicable planning policies of relevance to the ground conditions.

Local Planning Policy

London Borough of Barnet Local Plan

12.2.17 The LBB's Local Plan is comprised of a suite of documents to guide planning and development in the borough. It covers spatial planning – the practice of 'place shaping' to deliver positive social, economic and environmental outcomes and to provide the overarching local policy framework for delivering sustainable development in Barnet. The Local Plan comprises the following key documents of relevance for ground conditions:

- LBB's Core Strategy Development Plan Document (DPD)[24] was adopted on September 2012 and, in conjunction with the London Plan is used to determine planning applications. LBB's Core Strategy DPD includes the following environmental considerations for development of relevance to ground conditions: *"Policy CS13: Ensuring the efficient use of natural resources – … We will make Barnet a water efficient borough and minimise the potential for fluvial and surface flooding by ensuring development does not cause harm to the water environment, water quality and drainage systems."; and*
- LBB's Development Management Policies DPD[25] (September 2012) includes the following environmental considerations for development of relevance to ground conditions: "*Contaminated Land - For potentially contaminated land, the developer will be required to carry out a Preliminary Risk Assessment which will help determine the potential for contamination at a development site. Where necessary a full site investigation, considering both the possible risk to future users of the site and hazards to ground and surface water quality. Before development can start, planning conditions may require that appropriate remedial measures are agreed with the planning authority and carried out in line with current guidelines, having regard to relevant legislation (Part 2A of the Environmental Protection Act and Contaminated Land Regulations). The developer will be required to provide a report verifying that the works have been carried out as agreed. This will normally be achieved by setting conditions on planning permissions. In line with the objectives of the Thames Water River Basin Management Plan the council aims to prevent any development which could lead to a deterioration in the quality of water and work towards improvements. Plans for the remediation of contaminated land or development which could impact water quality will be carefully assessed."*

London Borough of Barnet Draft Local Plan (Reg 18) Preferred Approach Consultation (2020)

12.2.18 The LBB are currently in the process of reviewing and updating the borough's adopted Local Plan documents, and recently published its Draft Local Plan[26] (Regulation 18 document) for public consultation. The consultation period took place between 27 January – 16 March 2020, with the Regulation 19 (i.e. Publication of Local Plan for making representations on soundness issues (NPPF

[23] Mayor of London, 2018; London Environment Strategy
[24] London Borough of Barnet (LBB), 2012; Local Plan (Core Strategy)
[25] LBB, 2012; Development Management Policies DPD
[26] LBB, 2020; Draft Local Plan for Public Consultation – Regulation 18 Document

para 35) document scheduled for publication in Winter 2021. Adoption of the revised Draft/New Local Plan is not expected until Spring 2022.

12.2.19 By virtue of being at an early stage in the adoption process, the Draft Local Plan is considered to be of limited weight and is not a material consideration within this EIA.

12.2.20 The Draft Local Plan comprises the following key policies of relevance for ground conditions:

- Policy ECC02: Environmental Considerations. *"The Council will expect the following in assessing development proposals: d) Proposals on land which may be contaminated should be accompanied by an investigation to establish the level of contamination in the soil and/or groundwater/surface waters and identify appropriate mitigation. Development which could adversely affect the quality of groundwater will not be permitted. … g) Development should demonstrate that it will not cause harm to the water environment, water quality and drainage systems. Development should demonstrate compliance with the London Plan drainage hierarchy for run off especially in areas identified as prone to flooding from surface water runoff. All new development in areas at risk from fluvial flooding must demonstrate application of the sequential approach and exception tests set out in the NPPF (paras 155 to 165) and provide information on the known flood risk potential of the application site. No development should increase the risk of flooding elsewhere. Development should utilise Sustainable Urban Drainage Systems (SUDS) in order to reduce surface water run-off and ensure such run-off is managed as close to its source as possible subject to local geology and groundwater levels."*

12.2.21 The Draft Local Plan includes the following environmental considerations for development of relevance to ground conditions: "*for potentially contaminated land, the developer will be required to carry out a Preliminary Risk Assessment (PRA) which will help determine the level of any contamination at a development site. Where necessary, further site investigations should consider both the possible risk to future users of the site and hazards to ground and surface water quality. Before development can start, planning conditions may require that appropriate remedial measures are agreed with the planning authority and carried out in line with current guidelines, having regard to relevant legislation (Part 2A of the Environmental Protection Act and Contaminated Land Regulations 2012). The developer will be required to provide a report verifying that the works have been carried out as agreed. If monitoring is required, a monitoring schedule should be identified and agreed with the Council and if necessary the Environment Agency at the time of planning permission. In line with the objectives of the Thames Water River Basin Management Plan the Council aims to improve the quality of water courses in the Borough and to prevent any development which could lead to a deterioration in the quality of water. Plans for the remediation of contaminated* land or development which could impact water quality will therefore be carefully assessed."

12.2.22 By virtue of being at an early stage in the adoption process, the Draft Local Plan is considered to be of limited weight and is not a material consideration within this EIA.

12.2.23

Cricklewood, Brent Cross and West Hendon Regeneration Area Development Framework[27]

12.2.24 This document highlights that environmental constraints that exist at the Site and at surrounding areas (to the north of the Site). In particular, the document states that "*the historic industrial development in the area has left a significant level of contamination. These areas are located along the railway line and include a former gas works and rail related contamination. These contamination areas obviously pose a constraint to development and remediation of the sites will be necessary. The northern part of the Cricklewood Railway Lands has historically been used as an unlicensed dump. Significant levels of contamination also remain here too*."

[27] LBB, 2005; Cricklewood, Brent Cross and West Hendon Regeneration Area Development Framework Supplementary Planning Guidance

Other Relevant Policy, Standards and guidance

Additional Policy/Standards/Guidance

12.2.25 Other relevant policy, standards and guidance include the following:

- Environment Agency, (2009); Updated technical Background to the CLEA model; Science Report: SC050021/SR3 (Contaminated land exposure assessment (CLEA) spreadsheet based tool)[28];
- Environment Agency Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination[29];
- Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC050021/SR2[30];
- Environment Agency, 2004; Model Procedures for the Management of Land Contamination, Contaminated Land Report 11 (CLR 11)[31];
- Environment Agency, 2010; Guiding Principles for Land Contamination (GPLC) 1, 2 and 3[32];
- Construction Industry Research and Information Association (CIRIA) Guidance C532, 'Control of Water Pollution from Construction Sites'[33];
- The Chartered Institute of Environmental Health (CIEH) Local Authority Handbooks[34];
- British Standard (BS) 8485:2015 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings[35]; and
- CIRIA Guidance C665, 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' [36].

12.3 Assessment Methodology

12.3.1 This section of this ES chapter presents the following:

- Information sources that have been consulted throughout the preparation of this chapter;
- Details of consultation undertaken with respect to ground conditions and contamination;
- The methodology behind the assessment of ground conditions and contamination effects, including the criteria for the determination of sensitivity of receptor and magnitude of change from the existing of 'baseline' condition;
- An explanation as to how the identification and assessment of potential ground conditions and contamination effects has been reached; and
- The significance criteria and terminology for the assessment of ground conditions and contamination residual effects.

12.3.2 The following sources of information that define the Proposed Development have been reviewed and form the basis of the assessment of likely significant effects on ground conditions and contamination:

[28] Environment Agency (EA), 2009; Updated technical Background to the CLEA model; Science Report: SC050021/SR3 (Contaminated land exposure assessment (CLEA) spreadsheet based tool)
[29] EA, 2006; Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination Environment Agency
[30] EA, 2009; Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC050021/SR2
[31] EA, 2004; Model Procedures for the Management of Contaminated Land: Contaminated Land Report 11.
Note: EA is to publish an update to CLR11. The updated online guidance Land Contamination: Risk Management (LCRM) is available at https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks. This guidance is based on CLR11; the scope, framework and purpose remain the same. The EA are reviewing feedback and will republish the updated guidance in 2020. The EA will withdraw CLR11 when the updated guidance is published.
[32] EA, 2010; Guiding Principles for Land Contamination (GPLC 1, 2 and 3)
[33] Construction Industry Research and Information Association (CIRIA), 2001; CIRIA Guidance C532. Control of water pollution from construction sites. Guidance for consultants and contractors
[34] The Chartered Institute of Environmental Health (CIEH) Local Authority Handbooks (various publication dates, 2006 - 2009)
[35] British Standard (BS) 8485:2015; Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
[36] CIRIA, (2007); CIRIA Guidance C665. Assessing risks posed by hazardous ground gases to buildings

- The Landmark Envirocheck® Report[37] (key extracts in *ES Volume III Appendix 12-1*);
- British Geological Survey (BGS) Onshore Geoindex[38];
- The Department for Environment, Food & Rural Affairs (DEFRA) Multi-Agencies Geographic Information for Countryside (Magic) Map online search tool[39];
- Flood Map for Planning[40]
- Bomb Sight website[41];
- Capita Geo-environmental Investigation and Assessment[42] (provided in *ES Volume III: Appendix 12-2)*.
- The Proposed Development's EIA Scoping Report[43] (AECOM, December 2019) and subsequent Scoping Opinion[44] (LBB, February 2020); and
- Detailed plans and elevations[45].

Methodology for Determining Baseline Conditions and Sensitive Receptors

12.3.3 The information used in the assessment for the baseline characterisation of ground conditions has been obtained from the sources listed above. A review of the baseline conditions has allowed for the identification of the potential sources of land contamination across the Site.

12.3.4 Whilst the focus of the assessment is on land contamination in terms of ground conditions, geology, hydrogeology and hydrology, other ground related aspects have been considered, including underground obstructions, the potential for Unexploded Ordnance (UXO), underground structures and utilities, and other geotechnical considerations, such as land stability.

12.3.5 Current UK guidance[46] advocates the use of a conceptual risk assessment model. The three conditions described in the paragraph below comprise the basis of this approach in that, without each of the three elements ('source', 'pathway' and 'receptor'), there can be no contamination risk. Therefore, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since the contamination must be defined in terms of pollutant linkages and unacceptable risk of harm to a receptor.

12.3.6 The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the intended use of the site, its characteristics, and its surroundings. The potential for harm to occur requires three conditions to be satisfied:

- The presence of a receptor which may be harmed (e.g. the water environment, humans, buildings, fauna or flora) (the 'receptor');
- The presence of substances (potential contaminants / pollutants) that may cause harm (the 'source' of pollution); and
- The existence of a linkage between the source and the receptor (the 'pathway').

12.3.7 Receptors potentially sensitive to changes in ground conditions have been identified following the assessment of baseline conditions and the identified sources of contamination. Each receptor has been assigned a level of sensitivity. The level of sensitivity is based on a variety of considerations including, but not limited to, national, regional and local designations, the function of a receptor (e.g. whether an

[37] Landmark Information Group, 2019; Order Number 227657328_1_1
[38] BGS website, 2019; http://www.bgs.ac.uk/, and www.bgs.ac.uk/discoveringGeology/ geologyOfBritain/ accessed December 2019 for BGS boreholes
[39] The Department for Environment, Food & Rural Affairs (DEFRA) Magic Map online search tool (http://magic.defra.gov.uk/), accessed December 2019
[40] GOV.UK, 2019; Flood Map for Planning https://flood-map-for-planning.service.gov.uk/summary?easting=534040&northing=170847; accessed December 2019
[41] Bomb Sight website; http://bombsight.org/?#16/51.5071/-0.3704. Accessed December 2019
[42] Capita, September 2018; B&Q Cricklewood; Geo-environmental Investigation and Assessment
[43] Aecom, December 2019; B&Q Cricklewood EIA Scoping Report
[44] LBB, 31st January 2020; B&Q Cricklewood EIA Scoping Opinion
[45] EPR Architects, January 2020; Ground Floor Plan
[46] EA, 2009; Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC050021/SR2

aquifer which underlies a site is used as a potable water supply or not) and the end use of parts of a Proposed Development (e.g. residential led mixed-use development).

12.3.8 In terms of ground conditions, the criteria for assessing receptor sensitivity is defined in Table 12-1 and the identified site-specific sensitive receptors are provided in Table 12-5. In defining the criteria for receptor sensitivity, industry standards and best practice guidance have been taken into consideration, where appropriate. It should be noted that the criteria utilised for ground conditions assessment vary very slightly from the standard criteria discussed in *Chapter 7: EIA Methodology*; this is to make it appropriate for this particular discipline.

Table 12-1 Example Receptors and Criteria for Assessing Receptor Sensitivity

Receptor Sensitivity	Receptor Examples
High	Principal Chalk Aquifer – layers of rock or drift deposits that have high inter-granular and / or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply (potable resources) and / or river base flow, and are important in terms of water quantity and quality. Demolition and construction site workers – in relation to human exposure through direct contact, inhalation / dermal uptake of contaminated soils, dusts, gases and particulates, exposure to UXO / flammables, fire and blast damage. Workers are assumed to be 'fit and healthy for the job'. Neighbouring uses, occupiers, and the general public immediately adjacent to or in proximity (i.e. within 100m) of active construction compound / site – high sensitivity due to proximity to demolition and construction works, in addition to the presence of potentially sensitive groups of people – i.e. the elderly, disabled and children. Proposed Development end users – residents, visitors, shoppers and on-site employees for example. Nationally designated/protected area – e.g. Site of Special Scientific Importance (SSSI), Special Protection Area, National Nature Reserve.
Medium	Secondary Aquifers – sub-divided as: • Secondary A – permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers; • Secondary B – predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering; and • Secondary Undifferentiated Aquifers – assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. Existing and Proposed Development introduced materials, structures and services – e.g. foundations based on current understanding / knowledge of local ground conditions e.g. aggressive ground and local geotechnics. Regionally designated habitats or local amenity areas – e.g. Sites of Importance for Nature Conservation (SINCs), the River Thames and local nature reserves, parks, playing fields.
Low	Unproductive Strata – rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Receptor Sensitivity	Receptor Examples
	Land stability – low sensitivity due to regional geographical conditions. Neighbouring uses, occupiers, and the general public >100m from the site boundary of active construction compound – low sensitivity as located at a distance from the site.

12.3.9 Following identification of the potential sources of ground contamination and having taken into consideration other ground related aspects, such as the presence or absence of above and below ground storage tanks, asbestos and other below ground utilities and structures, the likely pathways between the source of contamination or other ground related aspects and the receptor have been identified.

12.3.10 After defining the sources, the pathways and receptors, potential impacts (pre-mitigation) have been qualitatively defined.

12.3.11 Table 12-2 presents an example source-receptor-pathway interaction leading to a potential impact.

Table 12-2: Example of Source-Receptor-Pathway Interaction

Source	Receptor	Receptor Sensitivity	Pathway	Potential Impact
Hydrocarbon contamination in soil materials disturbed and volatised during earth works	Demolition & construction site workers	High	E.g. Inhalation and dermal contact with hydrocarbon impacted soils and dusts.	Impact to human health.

Methodology for Determining Demolition and Construction Effects

12.3.12 Following the determination of the baseline conditions and sensitive receptors, the methodology for identifying the potential ground conditions effects as a result of the demolition and construction of the Proposed Development, is based on the following stages:

- Preparation of a conceptual site model, identifying feasible pollution sources and pathways;
- Determination of the magnitude of change of the potential impacts of the Proposed Development on the sensitive receptors;
- Evaluation of the significance of the effects, relative to the receptor sensitivity;
- Identification of suitable and appropriate mitigation measures; and
- Assessment of the significance of any residual effects.

12.3.13 The Proposed Development will be delivered in phases. Impacts during the construction phase on any future on-site occupants or users of parts of the Site while construction is still on-going will be qualitatively considered as part of the demolition and construction assessment.

Methodology for Determining Complete and Operational Effects

12.3.14 The methodology for determining effects once the Proposed Development is complete and operational is the same as outlined above for the determination of demolition and construction effects.

Significance Criteria

Magnitude of Change from the Baseline Conditions

12.3.15 The magnitude of change, or how considerable the change to the ground conditions is in comparison to the baseline conditions as a result of an activity or action resultant from demolition, construction and complete and operational phases of the Proposed Development, has been classified as either being:

high, medium, low or very low / negligible. The criteria and their respective magnitude of change classification are detailed within Table 12-3.

Table 12-3: Example of Criteria for Assessing Magnitude of Change from Baseline Conditions

Magnitude of Change	Example of Criteria
High	Demolition and construction works: Activities result in a major pollution release[1] or create / remove a pollutant linkage with a substantial pollutant source. Serious risk / improvement to human health / life. Complete and operational development: The development introduces or removes a large-scale source of potential contamination or pollutant linkage.
Medium	Demolition and construction works: Activities result in a moderate pollution release[2] or create / remove a pollutant linkage with moderate pollutant source. Moderate risk / improvement to human health / life. Complete and operational development: The development introduces or removes a relatively small-scale source of potential contamination or pollutant linkage.
Low	Demolition and construction works: Activities result in a minor pollution release[3] or create/remove a pollutant linkage with a minor pollutant source. Temporary pathway or receptor is introduced or removed during construction. Minor risk / improvement to human health. Complete and operational development: The development introduces or removes a minor source of potential contamination or pollutant linkage.
Very low/Negligible	An insignificant pollution release or creation/removal of a pathway with an insignificant pollutant source. No / reversible affect to human health. No foreseeable measurable change to the existing conditions. No appreciable impacts/ reversible impacts.

Footnotes

1. *A major pollution release corresponds to a Category 1 pollution incident, which is defined by the Environment Agency as having persistent and extensive impacts on water, land and air quality, major damage to all ecosystems, closure of a potable abstraction, major impact on land, property, major impact on amenity value, major damage to agriculture and/ or commerce and serious impact upon man.*
2. *A moderate pollution release corresponds to a Category 2 pollution incident, which is defined by the Environment Agency as having a significant impact on water, land and air quality, significant damage to all ecosystems, non-routine notification of abstractors, significant impact on land, property, reduction in amenity value, significant damage to agriculture and/ or commerce and impact on man.*
3. *A minor pollution release corresponds to a Category 3 pollution incident, which is defined by the Environment Agency as having a minimal impact on water, land and air quality, minor damage to local ecosystems, marginal impact on amenity value and minimal impact to agriculture and/ or commerce.*

Assessment of the Significance of Effects

12.3.16 Effects have the potential to be adverse, beneficial or negligible. For example, in terms of beneficial effects, the Proposed Development may remove a source of contamination or it may close a pathway that currently links a source to a receptor.

12.3.17 Effects also have the potential to be temporary – short (weeks / months), medium (several months to a year) or long (several years) term – or permanent (non-reversible), and can occur at local (on-site or in proximity to the Site) or district (within LBB) level.

12.3.18 With regards to the residual effect significance, the level of significance takes into account the sensitivity of the receptor and the magnitude of the change, and also the mitigation measures applied to reduce the likelihood of significant effects to receptors. Mitigation measures implemented have the potential to alter the magnitude of impact through changing the source-receptor-pathway interaction, e.g. construction workers utilising appropriate Personal Protective Equipment (PPE) during the construction phase. Table 12-4 presents the matrix for defining the effect significance.

Table 12-4: Criteria for Assessing Effect Significance

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

12.3.19 Descriptions of the effect significance are outlined within Table 12-5. Potential effects that are determined as being moderate or major are classed as 'significant' effects. Where an effect has been identified as being negligible or minor, these are classed as 'not significant'.

Table 12-5: Description of Effects

Classification of Effect	Description
Major Adverse	• Potential serious or medium risk to human health of site workers or neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site; • Major or moderate pollution release or creation of a pollutant linkage with a substantial or moderate pollutant source to Principal Chalk Aquifer and nationally designated / protected areas; and • Major pollution release or creation of a pollutant linkage with a substantial pollutant source to Secondary Aquifer, Secondary Undifferentiated Aquifer and regionally designated / protected areas or local areas.
Moderate Adverse	• Potential minor risk to human health of site workers or neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site; • Potential serious risk to human health of neighbouring uses, occupiers and the general public >100m from the Site; • Potential serious risk to land stability; • Major pollution release or creation of a pollutant linkage with a major pollutant source to Unproductive Strata; • Moderate pollution release or creation of a pollutant linkage with a moderate pollutant source to Secondary Aquifer and Regionally designated / protected areas or local areas;

Classification of Effect	Description
	• Minor pollution release or creation of a pollutant linkage with a minor pollutant source to Principal Chalk Aquifer and nationally designated / protected areas; and • Introduction of existing or new relatively small-scale source of potential contamination or pollutant linkage (via existing and Proposed Development introduced materials, structures and services).
Minor Adverse	• Potential moderate pollution release or creation of a pollutant linkage with moderate pollutant source to Unproductive Strata; • Potential medium risk to land stability; • Potential medium risk to human health of neighbouring uses, occupiers and the general public >100m from the Site; and • Minor pollution release or creation of a pollutant linkage with a minor pollutant source to Secondary Aquifer, and regionally designated / protected areas. Introduction of existing or new minor source of potential contamination or pollutant linkage (via existing and Proposed Development introduced materials, structures and services).
Negligible	• Potential minor pollution release or creation of a pollutant linkage with minor pollutant source to Unproductive Strata and no / reversible effect to human health of neighbouring uses, occupiers and the general public >100m from the Site; • Potential minor risk to land stability; • An insignificant pollution release or creation / removal of a pathway with an insignificant pollutant source to all remaining sensitive receptors; and • No / reversible effect to human health of site workers or neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site.
Minor Beneficial	• Potential removal of a pollutant linkage with moderate pollutant source to Unproductive Strata; • Potential moderate improvement to human health of neighbouring uses, occupiers and the general public >100m from the Site; • Removal of a minor pollutant linkage with a minor pollutant source to Secondary Aquifer and regionally designated / protected areas; and • Removal of existing minor source of potential contamination or pollutant linkage (via existing and Proposed Development introduced materials, structures and services).
Moderate Beneficial	• Potential minor improvement to human health of site workers or neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site; • Potential serious improvement to human health of neighbouring uses, occupiers and the general public >100m from the Site; • Potential serious improvement to land stability; • Removal of major pollution linkage with a major pollutant source to Unproductive Strata; • Removal of a moderate pollutant linkage with a moderate pollutant source to Secondary Aquifer and Regionally designated / protected areas or local areas;

Classification of Effect	Description
	• Removal of a minor pollutant linkage with a minor pollutant source to Principal Chalk Aquifer and nationally designated / protected areas; and • Removal of existing relatively small-scale source of potential contamination or pollutant linkage (via existing and Proposed Development introduced materials, structures and services).
Major Beneficial	• Potential serious or moderate improvement to human health of site workers or neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site; • Removal of a moderate pollutant linkage with a substantial or moderate pollutant source to Principal Chalk Aquifer and nationally designated / protected areas; and • Removal of a major pollutant linkage with a substantial pollutant source to Secondary Aquifer, Secondary Undifferentiated Aquifer and Regionally designated / protected areas or local areas.

Consultation

12.3.20 An EIA scoping request was sent to the LBB in relation to the Proposed Development on 3rd December 2019, presenting the proposed scope of work and methodology for the ES.

12.3.21 A copy of the EIA Scoping Report (dated December 2019) and LBB's Scoping Opinion (dated February 2020) can be found in *ES Volume III: Appendix 7-1*.

12.3.22 Comments relating to ground conditions are shown in Table 12-6 below, along with AECOM's response.

Table 12-6 Comments raised in the LBB EIA Scoping Opinion

Comments Raised	Response Provided in the ES/Planning Application
The SR concludes that the assessment of the ground conditions and contamination at the site during both the demolition and construction phase, and once the Proposed Development is complete and operational should be scoped in to the ES. This conclusion and the assessment methodology has been reviewed the Council's Environmental Health officer who concurs with the scoping in and is satisfied with the methodology.	Noted.

Limitations and Assumptions

12.3.23 The ground conditions impact assessment has been based on details of the Proposed Development provided by the Applicant and wider design team (i.e. parameter plans) at the time of assessment, and reports made available for review (e.g. BGS borehole logs, extracts of the Landmark Envirocheck® Report (*ES Volume III: Appendix 12-1*) and the previous investigation report (*ES Volume III: Appendix 12-2*)). AECOM has not independently verified the data included within other consultants' reports.

12.4 Baseline Conditions

Geological Conditions

12.4.1 Based on a review of British Geological Survey (BGS) Geoindex[47], the Site is directly underlain by the London Clay Formation.

12.4.2 The deeper geology below the London Clay comprises Lambeth Group (formerly Woolwich and Reading Beds and Upnor Formation) and Chalk, as summarised in Table 12-7.

Table 12-7: Geological Setting and Description

Geological Strata	Composition
London Clay Formation	Clay and silt. Sedimentary bedrock.
Lambeth Group	Clay, silt and sand. Sedimentary bedrock.
Chalk	Sedimentary bedrock.

12.4.3 A review of the BGS Geoindex did not identify any borehole records located on-site as being available to view. However, two boreholes have been identified with 250m from the Site; and they have been reviewed to gain information on deeper geology in the proximity of the Site.

12.4.4 The BGS boreholes show the deeper geology of the area as they extend to 45.70mbgl (below ground level) and 145.10m bgl. The shallow geology on-site was identified during the 2018 Capita Site investigation. Table 12-8 and Table 12-9Table 12-9 summarise the stratigraphy reported in the BGS and Capita borehole records.

Table 12-8: Identified Geological Stratigraphy in proximity of the Site (BGS borehole)

BGS Reference	Location	Hole depth in Mbgl	Strata Encountered (mbgl)
TQ28NW12	100m west	45.70m	• From ground level to 0.60m: made ground, described as ash, hardcore, etc. above firm brown clay and gravel. • From 0.60m to 7.31m: London Clay, described as firm-stiff brown silty clay containing gypsum crystal. • From 7.31m to 8.99m: London Clay, described as stiff brown silty clay with thin sand layers. • From 8.99m to 20.42m: London Clay, described as very stiff fissured brown and blue silty clay, and blue silty clay with occasional claystone boulders. • From 20.42m to 23.47m: London Clay, described as very stiff fissured blue silty clay with thin layers of fine sand. • From 23.47m to 45.70m: London Clay, described as very stiff fissured blue silty clay containing occasional claystone boulders.
TQ28NW1	200m west	145.10m	• From ground level to 0.30m: Topsoil. • From 0.30m to 66.45m: London Clay, described as yellow, brown, blue and grey (hard) clay.

[47] BGS website, 2019; http://www.bgs.ac.uk/, and www.bgs.ac.uk/discoveringGeology/ geologyOfBritain/ accessed December 2019 for BGS boreholes

- From 66.45m to 78.33m: Woolwich and Reading Beds, described (in sequence) as mottled blue clay, mottled brown clay, blue marl, green sand and pebbles,
- From 78.33 to 83.82m: Thanet Sands, described as hard grey sand and brown sand.
- From 83.82m to 145.10m: Chalk.

12.4.5 Table 12-9 below summarises the stratigraphy reported in the historical borehole records (Capita, 2018).

Table 12-9: Identified Geological Stratigraphy beneath the Site (Capita, 2018)

Geological Strata	Average thickness (m)
Hardstanding	A layer of hardstanding, typically tarmac, with a thickness of 0.07 – 0.10m. At two locations (BH2 and WS10, both in service yard areas), a layer of concrete hardstanding was encountered with thickness of 0.4m to greater than 0.5.
Made ground	A layer of made ground beneath the hardstanding typically comprising a layer of ballast material (cobbly sandy gravel) overlying other material. Lower made ground deposits typically comprised sandy and/or clayey gravel with included fragments of brick, concrete, glass and tarmac. The thickness of made ground overall, inclusive of overlying hardstanding ranged generally from 0.55 to 2.6m.
London Clay	The London Clay Formation bedrock was encountered beneath the made ground at depths between 0.55 and 2.6mbgl. The London Clay was encountered typically as a locally soft to firm brown silty clay, with a subsequent layer consisting of a stiff grey clay encountered at between 6.5 and 8mbgl.

12.4.6 The borehole records generally align with the expected geological conditions from the geological mapping.

Geotechnical Considerations

12.4.7 Table 12-10 summarises the potential geotechnical hazards identified at the Site in the Landmark Envirocheck® Report (*ES Volume III: Appendix 12-1*).

Table 12-10: Potential Geotechnical Hazards

Hazard Type	Reported Hazard Potential
Coal Mining Affected Area	None
Potential for Collapsible Ground Stability Hazards	Very low
Compressible Ground Stability	No Hazard
Ground Dissolution Stability	No Hazard
Landslide Ground Stability	Very Low
Running Sand Ground Stability	Very Low
Shrinking or Swelling Clay Ground Stability	Moderate
Radon Affected Areas	No, as less than 1% of homes are above action level
Radon Protection Measures	None required

Site Designations

12.4.8 The Site is not located within 1km of any sensitive land uses such as Green Belt, Areas of Outstanding Natural Beauty (AONB), Environmentally Sensitive Area, Forest Park, National Nature Reserve (NNR), nitrate sensitive area, nitrate vulnerable zone, Ramsar site, Sites of Special Scientific Interest (SSSI) or Special Protection Areas (SPA).

12.4.9 The Site is approximately 800m north-west of Westbere Copse Local Nature Reserve.

Hydrogeological and Hydrological Conditions

12.4.10 A review of the Defra website[48] indicates that the London Clay is designated as unproductive strata, which are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow. The significant thickness of these strata expected beneath the Site (approximately 66m, according to BGS borehole record, located 200m from the Site) will limit the vertical migration of contaminants from the made ground into the deep aquifers (Lambeth Group and Chalk).

12.4.11 The underlying solid geology of Lambeth Group is classified as a Secondary A Aquifer, defined by the Environment Agency as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

12.4.12 The Chalk strata, which is at depth beneath the Lambeth Group, is classified as a Principal Aquifer. These are layers of rock or drift deposits that have inter-granular and/or fracture permeability and can often provide a high level of water storage. They may support water supply and/or river base flow in a strategic scale. Due to their high permeability, Principal Aquifers are considered to be highly vulnerable to pollutants. In terms of receptor sensitivity, the Principal Aquifer is assessed as being of 'High Sensitivity'.

12.4.13 No water strikes were observed during borehole drilling for the Capita geo-environmental investigation in 2018, despite the presence of groundwater in the three monitoring rounds. Resting water was recorded in most of the monitoring wells at depths of between 0.60 and 4.90mbgl, during the groundwater monitoring rounds in August 2018 (Capita, 2018). This is most likely to represent pockets of perched water within the London Clay.

12.4.14 The Envirocheck Report® indicates that there are no licensed groundwater abstractions located within 1km of the Site and no discharge consents to groundwater within 500m of the Site.

12.4.15 The Site is not located within a Source Protection Zone (SPZ), and there are no SPZs identified within 1km of the Site[49].

12.4.16 The nearest surface water feature to the Site is an unnamed water course, located approximately 500m north of the Site. The Envirocheck Report® does not indicate any licensed surface water abstraction located within 1km of the Site.

12.4.17 The Envirocheck Report® indicates that there were three Category 2 (Significant) pollution incidents to controlled waters reported over a two year period between 1990 and 1991, within 500m of the Site (with the closer incident at 455m north-west of the Site).

12.4.18 The Site lies within Environment Agency Flood Zone 1 (land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)) and hence it has a low probability of fluvial flooding[50]. The Site generally lies in an area characterised by a very low to low risk[51] from surface water; medium to high flood risk from surface water is indicated along the existing building's eastern and northern boundaries. High risk means that each year this area has a chance of flooding from surface water of greater than 3.3%. Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%.

[48] DEFRA Magic Map online search tool (http://magic.defra.gov.uk/), accessed December 2019
[49] DEFRA Magic Map online search tool (http://magic.defra.gov.uk/), accessed December 2019
[50] GOV.UK, 2019; Flood Map for Planning https://flood-map-for-planning.service.gov.uk; accessed December 2019
[51] GOV.UK, 2019; https://flood-warning-information.service.gov.uk/long-term-flood-risk/map; accessed December 2019

Contamination Potential

12.4.19 The assessment of the potential for the on-site contamination of soils and groundwater has been based on the land-use history of the Site and surrounding area, and on the review of information obtained from the geo-environmental investigation and assessment report (Capita, September 2018).

Historical Uses - On-Site

12.4.20 Historical Ordnance Survey (OS) maps supplied as part of the Landmark Envirocheck® Report (*ES Volume III: Appendix 12-A*) dating back to 1864 have been reviewed in order to identify potentially contaminative historic land uses.

12.4.21 Earliest detailed mapping from 1868 indicates that the Site includes a green area probably associated with the adjacent residential properties (Rockhall Terrace and Rockhall Lodge) located immediately west of the Site. The Site also includes a number of small ponds, a vegetated area in the south-eastern corner, and three small buildings in the north-eastern area.

12.4.22 The OS maps dated between 1896 and 1963 show the Site to be occupied by a series of rail sidings (labelled Child's Hill Sidings) and associated sheds, linked to the Midland Railway, located immediately east of the Site. The Site appears to have been raised compared to the previous map and the adjacent railway is shown on an embankment.

12.4.23 OS mapping from 1970 indicates that most of the rail sidings were dismantled (except from some in the northern extent of the Site) and a warehouse occupies the eastern part of the Site. Few small buildings are shown along the western boundary of the Site.

12.4.24 By 1991, the Site is fully developed, including a superstore occupying the south-eastern area, car parking and access roads.

12.4.25 The historical aerial photography dated 1999 shows vegetated areas in the south-eastern corner of the Site.

12.4.26 No further significant changes are evident in subsequent map editions.

Historical Uses - Off-Site

12.4.27 The following summary of off-site historic land uses includes those immediately adjacent to and within a 500m radius of the Site boundary.

12.4.28 The 1864 mapping indicates that the Site is located within a predominantly rural setting with residential houses immediately west. Marshland is shown 80m to the north.

12.4.29 By 1873, the OS maps indicate the Midland Railway line and a train station along the eastern boundary of the Site. The London General Omnibus Company's Depot is adjacent south-east of the Site, Imperial Works 250m west of the Site and a smithy 300m east of the Site.

12.4.30 By 1991 a subway is shown crossing under the railway line adjacent to the south-eastern of the Site.

12.4.31 By 1915, the OS maps indicate a carriage shed 100m north of the Site. By 1953, the OS maps indicate coal bunkers adjacent west of the Site, a milk depot 50m east, a caravan depot 50m west, a timber yard 60m west, motor engineering works 80m west, printing works 200m east, a factory 200m west and printing works 200m west.

12.4.32 By 1950, the OS maps indicate motor works and aeroplane works from 230m north-east of the Site.

12.4.33 By 1990s, the area surrounding the Site shows a residential character, except for the land to the east of the railway line which still includes a number of depots.

12.4.34 Historical aerial photography dated 1999 shows the area to the east of the railway line to have been redeveloped in residential properties and a care home.

12.4.35 No further significant changes are evident in subsequent map editions.

12.4.36 The Envirocheck® report indicates that there was a registered waste transfer site, authorised for construction and demolition wastes and for household and commercial waste, located adjacent north of the Site.

Present Uses - On-Site

12.4.37 A Site reconnaissance visit was undertaken on the 10th December 2019. The Site visit involved a walk-through tour of the Site and general surrounding area.

12.4.38 Photographs from the Site visit and a plan indicating the location and aspect of the photographs are included in *ES Volume III: Appendix 12-3*.

12.4.39 The Site is currently occupied by a range of retail outlets, including a large B&Q DIY Store (photo 1), Pound Stretcher (photo 2) and Tile Depot (photo 3). These large warehouse buildings are situated in the south-western aspect of the Site. The northern and eastern aspects of the Site mainly consist of car parking (photo 4) associated with the previously identified retail outlets, as well as soft landscaping adjacent to the southern entrance to the Site (photo 5). A gas governor station is located in the south-western corner of the Site (photo 6).

12.4.40 The B&Q DIY Store consists of a two storeys building, including the main retail area (photo 7), a storing area and an electrical switch room at the ground level. The store includes an outdoor area consisting in a garden centre (photo 8) and a service yard (Photo 9). The service yard includes a number of waste containers (i.e. carboard, shrink-wrap, metal, clean timber, polystyrene and ceramics) (photo 10), a number of sealed drums (labelled as 'aerosols', 'caustic', 'bulbs', 'consume returned batteries', 'valpar', 'sand and absorber from spillages', 'rags and wipes from spillage') (photo 11), a container for paint (photo 12), LPG (Liquefied Petroleum Gas) canisters (photo 13) and a number of barriers and pallets. All the above mentioned containers are situated on hardstanding and above ground. White staining was noted in the proximity of the paint container (photo 12). The back yard pavement is concrete, in generally good conditions.

12.4.41 The Pound Stretcher consists of a one storey building with the retail area and a storage area in the eastern extent (photo 14) and a back yard to the west (photo 15), including a recycling skip and a number of pallets. The back yard is concrete, in generally good condition; vegetation was present around edges of this area. Evidence of the previous site investigation (BH2 borehole covers from Capita 2018 site investigation) were observed in the back yard (photo 15).

12.4.42 The Tile Depot consists of a one storey building with the retail area (photo 16), a storage area (photo 17) and an electricity switch room.

12.4.43 The Site has a gentle topography: the car park is generally flat, but the Site is elevated compared to Cricklewood Lane (photo 18). The Site is accessed by a ramped road from Cricklewood Lane. Another access is from Depot Approach to the B&Q service yards.

12.4.44 Most of the site (>90%) is covered by hardstanding and existing buildings. Car parking occupy the eastern and northern sections of Site; at the time of visiting, there was limited traffic and parked cars in the car park. A limited amount of fly tipping was noted on the surface of the car park area. The car park is mainly tarmac, the integrity of which appeared to be largely intact.

12.4.45 Evidence of the previous site investigation (BH1 and BH3 borehole covers) were observed in the parking area (photo 4). There are hedges and bushes along the site boundary to the east and sparse trees and plant islands in the car park.

12.4.46 Several manholes were present in the car park area and service yards.

12.4.47 Evidence of the previous site investigation (trial pit scars or borehole covers) carried out by Capita in 2018 were observed during the Site reconnaissance.

12.4.48 During the site reconnaissance no evidence of obvious asbestos containing material (ACM) was observed, however it is noted that ACM was identified in the samples during the historical site investigation (Capita, 2018) (refer to paragraph 12.4.59).

Present Uses - Off-Site

12.4.49 The Site's surrounding land uses consist of a mixture of residential and commercial/retail units, to the south and west. The Site is bordered by Network Rail lines to the east, with the closest railway station being Cricklewood station. The southern Site boundary is adjacent to Cricklewood Lane and a soft landscaped public footpath, with residential properties and small retail units beyond. To the west is a construction site and the car park for Cricklewood Travelodge. To the north is a car parking area with a building material supplier beyond. Cricklewood Bus Garage is 200m to the west of the Site. An electrical substation is located adjacent south-west of the Site on Cricklewood Lane.

12.4.50 The Envirocheck® report indicates that there is a registered waste transfer site, 210m north of the Site, held by P B Donaghue (Haulage & Plant Hire) Ltd, authorised for inert waste.

12.4.51 The Envirocheck® report identifies a number of active industrial land uses within 500m of the Site. These include builders' merchants, car painters and sprayers, garage services, car body repairs, painting and decorating supplies, bakery equipment manufacturers and suppliers, dry cleaners, metal works (tungsten tool manufacturers and distribution), garage services, tyre dealers, car manufacturers and paint and varnish stripping.

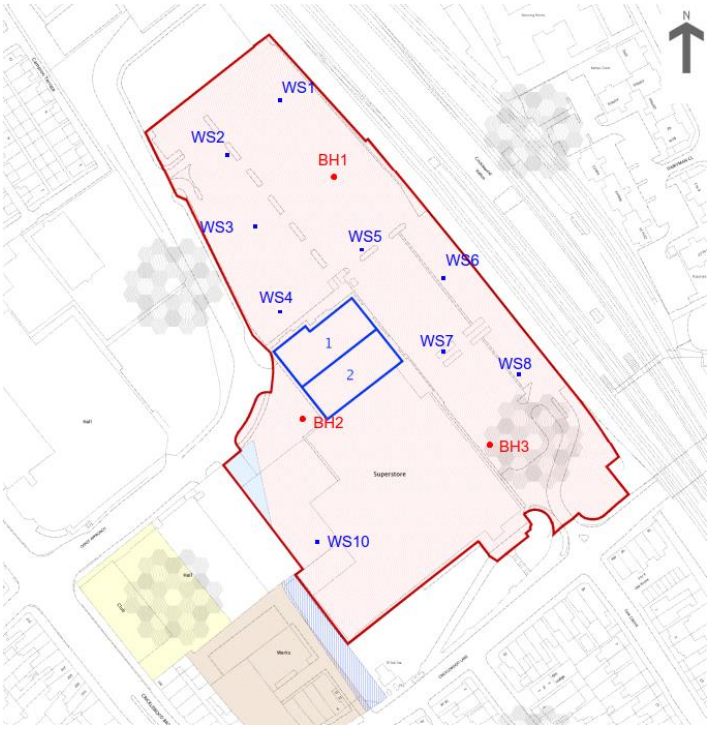
Previous Site Investigations

Capita Property and Infrastructure Limited, Geo-environmental Investigation and Assessment B&Q Cricklewood, Cricklewood, London, September 2018

12.4.52 Capita Property & Infrastructure Ltd (Capita) was commissioned by B&Q Properties to carry out a geo-environmental investigation and assessment at the Site. The investigation was required to characterise ground, groundwater and ground gas conditions and to gain geotechnical information for divestment by B&Q.

12.4.53 The investigation was carried out between July and August 2018 and included 3 cable percussion boreholes to 25m depth (BH1 to BH3) and 9 window sample boreholes (WS1 to WS10, excluding WS9, which failed to get to significant depth). The groundwater and ground gas monitoring installations were spread across the Site. In-situ geotechnical testing was undertaken at regular intervals during the investigation. Site investigation location are shown in Figure 12-1.

Figure 12-1 Historical Site Investigation Location (Capita, 2018)



12.4.54 The ground conditions encountered generally comprised of a layer of hardstanding, made ground and London Clay. Made ground was reported to have generally a thickness from 0.55m to 2.6m and being a mixture of sand, gravel, clay, and silt with fragments of other material including primarily concrete, brick and (less commonly) glass, bitumen, clinker and ash. London Clay was described as soft to firm brown silty clay, with a subsequent layer consisting of stiff grey clay at between 6.5 and 8m bgl. During the investigation, there were no obvious visual or olfactory signs of ground contamination. No water strikes were observed during borehole drilling.

12.4.55 Resting water was encountered during the ground gas monitoring rounds at depths of between 0.60m and 4.90m bgl.

12.4.56 Laboratory chemical analysis was undertaken on 11 soil samples for a broad range of contaminants. The analytes included metals and metalloids (arsenic, boron, cadmium, chromium, chromium VI, copper, lead, mercury, nickel, selenium, vanadium and Zinc), total petroleum hydrocarbons (TPH), polyaromatic hydrocarbons (PAH), VOCs, BTEX (Benzene, Toluene, Ethylbenzene and Xylene), Volatile Organic Compound (VOCs), asbestos, water soluble sulphate and pH.

12.4.57 Laboratory chemical analysis was undertaken on five water samples and included a range of environmental contaminants (metal and metalloids, TPH, PAH and BTEX) with two included for additional screening against a suite of VOCs.

12.4.58 The boreholes were monitored for ground gas on three separate occasions after the completion of the intrusive site works (13th, 17th and 29th August 2018).

12.4.59 The results of the chemical analysis indicate that there is a degree of localised chemical impact associated with petroleum hydrocarbons and PAH compounds in the made ground. The assessment identified few exceedances of Generic Assessment Criteria (GACs) for TPH and PAH and one exceedance for VOCs (naphthalene) for a residential scenario; and exceedances of GACs for PAH for a commercial scenario. It is also noted that asbestos fibres were detected in four of eleven soil samples screened (chrysotile and/or amosite), most likely attributable to small amounts of asbestos containing material entrained within the shallow made ground.

12.4.60 No contaminants of concern were identified in controlled waters, with the exception of selenium, which was observed marginally above the GAC of 10 µg/l.

12.4.61 Three rounds of ground gas monitoring were carried out in August 2018. Low concentrations of methane were generally recorded during the three events, except for one concentration (1.6% in WS7) above the trigger value of 1%. Carbon dioxide levels were recorded above the trigger value of 5% (as defined in BS 8485:2007) in 2 wells (WS1 and WS8) during one monitoring round (maximum 6.3%). Carbon monoxide and hydrogen sulphide were not included in the assessment.

12.4.62 The assessment identified hot spots of potentially contaminated soil around WS5 and possibly in the area of BH3. The report concluded that "*the hot spots can likely be readily excavated and treated ex situ or removed from site to prevent any longer term risk to controlled water resources. There is no indication of impacts to groundwater. It is possible that upgraded water supply pipes may be required in this part of the site, although this may be mitigated by any soil remediation works. The relevant water authority (Thames Water) should be consulted in this regard at the appropriate time. A cover layer of at least 600mm topsoil may be necessary in areas of new soft landscaping or gardens, to provide a barrier between end users and shallow soils affected by hydrocarbons. Asbestos in the ground may present a potential risk to future construction (and demolition) workers, as well as to future site occupants. No 'active' remediation is considered necessary in this regard, but a watching brief and reactive asbestos removal strategy during the demolition period is recommended. Ground gas protection comprising a carbon dioxide resistant membrane, installed and verified in accordance with current guidelines and procedures, is recommended for all new buildings*".

Ground Gas

12.4.63 The previous geo-environmental investigation and assessment (capita, 2018) detected concentrations of carbon dioxide (CO_2) above the trigger value (5%) in two boreholes (WS1 and WS8, 5.1% and 6.3% respectively). Methane (CH_4) was generally reported in low concentrations (except for 1.6% in WS7), and no putrescible materials were noted within either the made ground or natural deposits encountered

during site works. Hydrogen sulphide and carbon monoxide (CO) were not measured during any monitoring rounds.

Underground Structures

12.4.64 A number of underground assets are anticipated to be located beneath the Site associated with supplying utilities such as water, electricity, gas and telecommunications to the existing site buildings.

12.4.65 Further data collection and review will be undertaken prior to the commencement of demolition and construction work to confirm the presence or absence, and precise locations of such assets.

12.4.66 The Site was previously occupied by railway sidings and a warehouse. The presence and extent of relict foundations, associated with these structures, remaining in-situ is unknown. Piled and/or shallow foundations may be present across the Site.

12.4.67 An obstruction was identified at 3.3m in WS3 (north-western section of the Site) (Capita, 2018).

Unexploded Ordnance

12.4.68 On-line sources, such as the Bomb Sight website[52], show records of a high-explosive bomb in the south-eastern extent of the Site, along Crickewood Lane. Part of the Site (including the south-eastern extent) has never been developed, meaning that below ground excavations may have never been carried out at the Site.

12.4.69 Although it is recognised that a site investigation has been carried out on-site and therefore the risk of relict ordnance on the Site is somewhat reduced, this risk cannot be discounted.

Asbestos

12.4.70 An asbestos survey report[53] of the buildings located on-site was produced by Bes Consulting in May 2005. No asbestos containing materials (ACMs) were detected at the properties located on-site during the survey. The asbestos survey report is provided in *ES Volume III: Appendix 12-4*.

12.4.71 Whilst there is no evidence of ACMs at the current on-site buildings, asbestos containing materials (ACMs) may be associated with made ground from former buildings and rail sidings.

12.4.72 The former geo-environmental investigation and assessment (Capita, 2018) identified loose asbestos fibres in shallow soil samples. Of the 11 samples screened for the presence of asbestos containing materials, asbestos was detected in four of them (BH2-ES2, BH3-ES3, WS6-1 and WS7-1). Asbestos encountered on-site included chrysotile and amosite.

Contamination Potential Summary

12.4.73 The review of historical mapping indicates that potential sources of ground based contamination have been present on-site and in the surrounding areas, in particular from the railway sidings and warehouse historically present on-site from late 1890s to late 1970s. The former geo-environmental investigation and assessment (Capita, 2018) detected localised chemical impact to shallow soil in the centre of the Site and in the southern area, related to petroleum hydrocarbon and PAH compounds; and asbestos fibres in made ground.

12.4.74 Current potential contamination sources include localised soil contamination in made ground. Potential off-site sources of contamination include the railway line adjacent to the east of the Site and an electrical substation adjacent south-west of the Site.

12.4.75 Groundwater across the Site was found to be of reasonable quality, i.e. commensurate with that of an area with an industrial urban legacy (Capita 2018).

[52] Bomb Sight website, http://bombsight.org/bombs/30841/. Accessed December 2019.
[53] BES Consulting, May 2005; Asbestos Survey Report.

Baseline Summary - Conceptual Site Model

Potential Sources of Contamination

12.4.76 Potential sources of contamination or hazard at the Site have been identified as:

- Soil contamination (including asbestos) in the made ground; and
- UXO.

Potential Receptors

12.4.77 The site-specific receptors were identified based on the proposed land-use as well as the environmental setting of the Site. Table 12-11 presents the identified potentially sensitive receptors that will be considered within the ground conditions assessment.

Table 12-11: Summary of Potentially Sensitive Receptors

Identified Receptor	Receptor Sensitivity
Human health – Contractors carrying out demolition and construction works	High
Human health – Neighbouring uses, occupiers and the general public immediately adjacent to the Site	High
Human health – Neighbouring uses, occupiers, and the general public >100m from the Site boundary	Low
Human health – Proposed Development end users (including occupants or users of parts of the Site while construction is on-going)	High
Perched Groundwater	Low
Secondary A Aquifers (Lambeth Group)	Medium
Principal Aquifer (Chalk)	High
Existing and proposed new utilities and infrastructure both on–site and in close proximity (e.g. foundations, tunnels, utilities and associated pipework)	Medium
Land stability (based on known geology in the area)	Low

12.4.78 Given the distance to the nearest surface water receptor (an unnamed water drain located 500m north) no plausible pollutant linkages to surface waters have been identified. Therefore, surface water receptors will not be considered further in the assessment.

Potential Pathways

12.4.79 Human health exposure pathways are dependent on the proposed end-use of the Site (in this case residential led mixed-use development). The human health exposure pathways that are considered viable based on UK guidance[54] (Environment Agency, Contaminated Land Exposure Model "CLEA UK") are listed below:

- Dermal contact with soil, dust and groundwater;
- Ingestion of soil, dust and groundwater;
- Inhalation of dust and fibres; and
- Inhalation of vapours (from soils and groundwater).

12.4.80 The evaluation of exposure pathways for controlled waters receptors requires an understanding of geological and hydrogeological pathways beneath the Site. The controlled waters pathways considered viable with respect to the Site are as follows:

[54] EA, 2009; Updated technical Background to the CLEA model; Science Report: SC050021/SR3 (Contaminated land exposure assessment (CLEA) spreadsheet based tool

- Downward vertical migration of contaminants from the made ground into the underlying unproductive strata;
- Downward vertical migration of contaminants from the made ground into the Lambeth Group Secondary Aquifer and the Chalk Principal Aquifer (via preferential pathways created through piling); and
- Lateral migration of perched water and surface runoff off-site.

12.5 Environmental Design and Management

12.5.1 A number of environmental mitigation measures are expected to be employed as standard to minimise impacts to both human health and controlled waters during the demolition and construction phases of the Proposed Development. The mitigation measures are anticipated to be implemented in order to avoid, prevent, reduce or offset the following potential impacts:

- Human exposure through direct contact / inhalation / dermal uptake of contaminants;
- Creation of preferential pathways and mobilisation of contamination;
- Contamination of natural soils, driving of contamination into an aquifer during piling, contamination of groundwater with concrete, paste or grout;
- Pollution and degradation of water quality of any underlying aquifer;
- Infiltration and / or run off into the local drainage / sewerage network – pollution of drainage and sewerage network;
- Run-off and infiltration of contaminants from material stockpiles;
- Contamination of drainage and sewerage network and / or groundwater; and
- Spread of nuisance dusts and soils to the wider environment and local roads.

12.5.2 Table 12-12 lists the primary (inherent) and tertiary (inexorable) mitigation measures expected to be employed throughout the enabling works and demolition and construction processes; as defined by IEMA:

- Primary mitigation measures - modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken; and
- Tertiary mitigation measures - actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects.

12.5.3 The assessment of potential effects set out in the following sections accounts for these measures being implemented.

Table 12-12: Demolition and Construction Standard Environmental Mitigation Measures

Demolition and Construction Standard Environmental Mitigation Measures
Tertiary Mitigation Measures Regulatory / Guidance 1. Work will be carried out in accordance with relevant Construction Design Management (CDM) Regulations 2015[55], details of these measures will be presented within the Health and Safety Plan (H&SP), and the Construction Environmental Management Plan (CEMP). 2. The CEMP will be prepared prior to commencement of the works, setting out the management, monitoring, auditing and training procedures, and the mitigation measures that will be put in place during demolition and construction, to maintain compliance with the applicable regulations. In order to reduce the likelihood of contamination and protect human health and controlled waters from effects related to ground conditions, the CEMP will include mitigation measures such as those presented here.

[55] HMSO, 2015; The Construction (Design and Management) Regulations

Demolition and Construction Standard Environmental Mitigation Measures

3. A competent/licensed contractor will survey (pre site preparation survey as defined by the HSE) and remove asbestos containing materials and other materials and structures contaminated with asbestos fibres.
4. A Pollution Response Plan will be drafted prior to the commencement of the works. The plan will outline key pollution mitigation measures including a Control of Substances Hazardous to Health (COSHH) / fuel inventory and key contacts to be notified in the event of a significant pollution incident, which may subsequently lead to the contamination of controlled waters. Tanks and dispensing pumps will be locked when not in use to prevent unauthorised access. Information regarding spill prevention and disposal of COSHH items will be provided as part of the standard site induction presentations and during regular toolbox talks and as the works progress.
5. Piling will be carried out in accordance with the Environment Agency Guidance Note on Piling / Penetrative Ground Improvement Methods on Land Affected by Contamination[56] and ground investigations will inform the Foundation / Piling Works Risk Assessment which will define the appropriate piling methods and foundation design to mitigate risk.
6. Specification of concrete used in foundations and building structures will be selected based on the results of the chemical composition of the Site's soil and groundwater. Guidance is provided by the Building Research Establishment series 'Concrete in Aggressive Ground'[57].

Waste

7. Demolition and construction waste will be disposed of by the contractor/s to appropriate recycling facilities or appropriately licensed landfills in line with the Construction Resource Management Plan (CRMP) or similar. The appropriate landfill for the disposal of any contaminated soil off-site will depend on the waste classification determined from the chemical analysis or Waste Acceptance Criteria testing as necessary.
8. Waste effluent will be tested for appropriate physical and chemical parameters and where necessary, disposed of at the correctly licensed facility by a licensed specialist contractor/s.
9. Complaints about dust will be investigated at the earliest opportunity and appropriate action taken to control the source or remedy the impact as appropriate.
10. Access roads will be regularly cleaned and damped down with water.
11. All vehicles entering and leaving the Site during the demolition and construction period will pass through a wheel washing facility. Vehicles used to transport materials and aggregates will be enclosed or covered in a tarpaulin. Vehicle movements will be kept to a minimum and vehicle speeds within the Site will be limited.
12. Appropriate use of Personal Protective Equipment (PPE) and implementation and adherence to Health & Safety Protocols, Plans and Procedures. Demolition and construction workers will remain vigilant of ground conditions at all times and will report to the Principal Contractor any suspect areas of potential contamination.
13. Potentially contaminated made ground will be removed from excavations.
14. Advice should be sought from an environmental specialist should materials suspected of being contaminated be uncovered.

Construction Related

15. Oils and hydrocarbons will be stored in designated locations with specific measures to prevent leakage and release of their contents, include the siting of storage areas away from surface water drains, on an impermeable base with an impermeable bund that has no outflow and is of adequate capacity to contain 110% of the contents. Valves and trigger guns will be protected from vandalism and kept locked up when not in use. Details of appropriate storage and handling measures will be presented within the CEMP.
16. Vehicles should be well maintained to prevent accidental pollution from leaks. Static machinery and plant should include drip trays beneath oil tanks/engines/gearboxes/hydraulics, which will be checked and emptied regularly via a licensed waste disposal operator.
17. The appropriate utility company will be consulted on the potential requirement for an oil interceptor and sediment trap at the point where site surface water runoff enters the sewerage network.
18. A spillage Emergency Response Plan will be produced (and could form part of the CEMP), which site staff will be required to have read and understood. On-site provisions will be made to contain a serious spill or leak through the use of booms, bunding and absorbent material.

[56] EA, 2001; Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention
[57] Building Research Establishment (BRE), 2005; 'Concrete in Aggressive Ground'

Demolition and Construction Standard Environmental Mitigation Measures

19. CEMP will set out mitigation to ensure for appropriate handling and disposal of pile arisings, concrete, pastes and/or grouts during the laying of foundations.
20. During the earthworks, the contractor/s will employ dust suppression measures when necessary to prevent the potential mobilisation of contaminated dust particles and their migration off site, in line with the CEMP.
21. Stockpiles and material handling areas will be kept as clean as practicable to avoid nuisance from dust. Dusty materials will be dampened down using water sprays in dry weather or covered.
22. The length of time materials are stockpiled on-site before being removed for re-use, recycling or disposal is to be kept to a minimum and stockpiles are to be covered with tarpaulins prior to disposal.
23. Dust generating equipment e.g. mobile crushing and screening equipment will be located to minimise potential nuisance impacts to receptors, as far as practicable.

12.6 Assessment of Effects and Significance

Effects during Demolition and Construction

12.5.4 The potential effects have been defined based on the research undertaken to date on the likely sources and level of contamination across the Site, the sensitivity of the receptor and the magnitude of impact resulting from an interaction between the source and the receptor via a pathway. This risk based approach is in line with the Defra and Environment Agency guidance 'Contaminated Land Report 11: Model Procedures for the Management of Land Contamination, September 2004 (CLR11)'[58] and the Environment Agency's Guiding Principles for Land Contamination (GPLC 1, 2 and 3)[59], which provide a risk based approach for the management of land affected by contamination.

12.5.5 The assessment takes into account only those effects which would not already be mitigated through the standard inherent mitigation measures as detailed in the Environmental Design and Management section above. As such the pre-mitigation effect is set out in the paragraphs below, with the recommended additional mitigation measures following on.

12.5.6 The demolition and construction works are anticipated to last for a duration of approximately 5 years. Prior to the construction of buildings on any parts of the Site, site clearance (including the demolition of all structures on the Site), enabling works, remediation (if required) and utilities diversion will be undertaken across the Site. Subsequently, it is expected that the demolition and construction works will be carried out in phases with part occupation occurring throughout this process.

12.5.7 The Proposed Development does not include basements. Piling to a depth of approximately 25m is likely to be required, however a detailed piling strategy will be confirmed at the detailed design stage of the Proposed Development.

12.5.8 Details regarding the demolition and construction activities are provided in *Chapter 6: Demolition and Construction* of this ES.

Effects of Hazardous Material and Ground Contamination during Demolition and Construction on Human Health

12.5.9 Following a review of baseline conditions for the Site, it is considered that earthworks, (including excavation, piling and breaking up of the existing hard standing, and demolition of the existing buildings and structures where required), could disturb potentially localised ground contamination, asbestos or UXO, and expose demolition and construction workers through dermal contact, inhalation and / or ingestion pathways. There is also the potential for ground gas to emanate from any made ground and infill beneath the Site, and accumulate in poorly ventilated confined spaces, in which construction workers could be required to work.

12.5.10 The likelihood of significant contamination associated with any made ground present is medium as the historical review highlights exceedances for PAHs and TPHs, and the presence of asbestos fibres throughout the Site.

12.5.11 Demolition and construction workers are assigned a high sensitivity due to the potential for human exposure to contaminated soils, dusts, gases, particulates and UXO. The magnitude of change resulting from exposure is defined as medium for contaminated soils, dusts, gases and particulates and for UXO. The potential effects upon demolition and construction workers would be limited to the duration of the demolition and construction phase activities (i.e. approximately five years, long-term). As such, the overall impact upon the health of demolition and construction workers during these phases from contaminated soils, dusts, gases, particulates and UXO is considered to be a local, long-term, temporary and major adverse effect.

12.5.12 In addition to demolition and construction workers, on-site occupants or users of parts of the Site while construction is still on-going, neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site could also be affected by exposure to contaminated soils, dust, gases,

[58] EA, 2004; Model Procedures for the Management of Contaminated Land: Contaminated Land Report 11.
[59] EA, 2010; Guiding Principles for Land Contamination (GPLC 1, 2 and 3).

particulates and UXO during demolition and construction works, and therefore are assigned as high sensitivity receptors.

12.5.13 The magnitude of change resulting from exposure is defined as medium for contaminated soils, dusts, gases and particulates and for UXO. In addition, the potential effects upon the on-site occupants or users of parts of the Site while construction is still on-going, neighbouring uses, occupiers and the general public immediately adjacent to or in proximity of the Site would be limited to the duration of the demolition and construction phase activities. As such, the overall impact upon the health of on-site occupants or users of parts of the Site while construction is still on-going, neighbouring uses, occupiers and the general public during the demolition and construction phase from contaminated soils, dusts, gases, particulates and UXO is considered to be a local, long-term, temporary and major adverse effect.

12.5.14 There is also potential that neighbouring uses, occupiers and the general public located more than 100m from the Site will also be affected by impacts stated in the preceding paragraphs. Neighbouring uses, occupiers and the general public located more than 100m from the Site are assigned a low sensitivity due to the distance from the Site. The magnitude of change resulting from exposure is defined as low. In addition, the potential effects upon the neighbouring uses, occupiers and the general public located more than 100m from the Site would be limited to the duration of the demolition and construction phase activities. As such, the overall effect upon the health of neighbouring uses, occupiers and the general public during the demolition and construction phase is considered to be a local, long-term temporary and negligible effect.

Effects of Hazardous Material and Ground Contamination during Demolition and Construction on Controlled Waters

12.5.15 The Site is identified as being directly located on an Unproductive Strata. As such, a significant shallow water table is not expected beneath the Site. Notwithstanding this, perched water was identified within the made ground and natural deposits during previous monitoring (Capita, 2018), and is considered to be of low sensitivity.

12.5.16 Disturbance of made ground during the demolition and construction phase may increase the leaching potential of contaminants through the creation of preferential pathways along the stratigraphic column. It is also possible that areas of contamination not previously identified as part of the baseline assessment or further ground investigation works may be disturbed during the demolition and construction works. This further increases the potential for mobilisation of contaminants into the underlying strata and controlled waters.

12.5.17 The increased use of water during demolition and construction works (e.g. for dust suppression and wheel washing) may lead to increased potential for contaminated water and increased surface water run-off. This could pose a risk to the shallow perched groundwater through increased percolation rates, downward transfer of contaminants, lateral migration of perched water and surface runoff.

12.5.18 The abovementioned impacts represent a very low/negligible magnitude of change to the perched water receptor, considering the expected quality of water within made ground.

12.5.19 Therefore, it is expected that the demolition and construction phase would present a negligible effect on the perched groundwater.

12.5.20 It is identified that the construction phase is unlikely to give rise to potential effects upon the Secondary A Aquifer (Lambeth Group) and the Upper Chalk Principal Aquifer, given that a significant aquitard strata (i.e. 60m of London Clay, 200m west of the Site) has been identified separating the superficial deposits from the deeper aquifers, meaning they are unlikely to be in hydraulic continuity. The Secondary A aquifer is assigned a medium sensitivity and the Upper Chalk is assigned a high sensitivity due to its national importance as a potable groundwater source.

12.5.21 The foundations for the Proposed Development (25m long piled foundation, from an initial assessment) are not likely to extend through the London Clay and into the underlying strata hence would not create preferential pathways for contamination to migrate into the deeper aquifers. As such the magnitude of change to groundwater in the Lambeth Group and Chalk aquifers is defined as negligible.

12.5.22 The potential effects upon the Lambeth Group Secondary Aquifer and the Upper Chalk would be limited to the duration of the construction phase. As such, the impact upon these aquifers during the demolition and construction phase would result in a local, long-term temporary and negligible effect.

Effects of Hazardous Material and Ground Contamination during Demolition and Construction on Utilities and Infrastructure

12.5.23 The disturbance of potentially localised ground contamination along with increased use of water during demolition and construction works (e.g. for dust suppression and wheel washing) may lead to increased potential for contaminated water and increased surface water run-off. This poses a risk to the existing and proposed new utilities and infrastructure (local sewerage network), which represent a medium sensitivity receptor. The magnitude for change resulting from exposure is defined as low.

12.5.24 The demolition and construction phase would, therefore, present a local, long-term, temporary and minor adverse effect on utilities and infrastructure.

Effects of Excavation during Demolition and Construction on Land Stability and Proposed Structures / Surrounding Properties

12.5.25 Earthworks including excavations for foundations and removal of previous foundations and obstructions could adversely affect land stability and, subsequently, the proposed and surrounding structures through uncontrolled settlement. After the implementation of a CEMP and a Demolition and Construction Method Statement (DCMS), it is considered that any settlement of land would represent a low magnitude of change to land stability, which is of low sensitivity. Therefore, the demolition and construction activities would result in a local, long-term, temporary negligible effect on land stability and, subsequently, the proposed and surrounding structures.

Effects once Complete and Operational

Effects of Hazardous Materials and Ground Contamination on the Complete and Operational Proposed Development

12.5.26 Upon completion and operation of the Proposed Development, the Site will be covered by a combination of buildings, hardstanding, landscaped areas and gardens. The buildings and hardstanding will both form an effective barrier to any residual contamination at the Site. The implementation of a remediation strategy would reduce any residual contamination. This may include excavation of contaminated made ground and the importation and placement of clean fill within the green areas which create an effective barrier to any residual contamination. Therefore, there is little potential for the Proposed Development's end users to be exposed to contamination once the Proposed Development is completed and operational.

12.5.27 The Proposed Development's end users (residents, employees, and visitors) are considered to be of high sensitivity. The magnitude of change resulting from ground contamination is defined as very low / negligible as the risks would be dealt with through the remediation works prior to the completion and occupation of the Proposed Development. Therefore, this would result in a local, permanent, negligible effect on the health of the Proposed Development's end users once the Proposed Development is complete and operational.

Effects from Construction Excavation during Operation on Land Stability and Proposed Structures / Surrounding Properties

12.5.28 In order to address effects of land settlement which may arise during demolition and construction works, mitigation measures (such as dewatering and shoring of excavations as appropriate) will be implemented during the demolition and construction phase of the Proposed Development. Therefore, it is considered that the effects of the complete and occupied Proposed Development on land stability (low sensitivity) will be local, permanent, negligible effect.

12.7 Additional Mitigation and Monitoring Measures

Mitigation during Demolition and Construction

12.7.1 A number of mitigation measures, in addition to the standard inherent mitigation detailed in Table 12-12 will be employed during the demolition and construction phase to minimise impacts to human health, land stability and proposed and surrounding properties. These additional mitigation measures are detailed in Table 12-13.

Table 12-13: Demolition and Construction Additional Mitigation Measures

Potential Impact	Mitigation Measures
Impact to human health through mobilisation of contaminants within the made ground.	The geo-environmental investigation and assessment (Capita, 2018) recommended delineating the identified hotspots (surrounding WS5 and BH3) during the demolition and construction works, and excavating and treating ex situ the contaminated soil or removing it from the Site. In addition, it was recommended that a cover layer of at least 600mm topsoil may be necessary in soft landscaping areas to provide a barrier between future end users and shallow soil affected by contamination. As asbestos has been detected in the ground, '*a watching brief and reactive asbestos removal strategy during the demolition period*' is recommended (Capita, 2018). Specific ground gas protection comprising the installation of carbon dioxide resistant membrane for all new buildings is recommended (Capita, 2018). The former geo-environmental investigation and assessment (Capita, 2018) advised that '*it may be prudent to implement a Materials Management Plan for the Site in accordance with the CL:AIRE Development Industry Code of Practise (CoP) entitled 'The Definition of Waste' (September 2008). This CoP allows the risk-based re-use of materials within the site boundary without the need for exemptions and adoption of waste classification'.*
Impact to human life - Human contact with UXO / flammables, fire / blast damage.	Commissioning an Explosive Ordnance Threat Assessment prior to substantial site investigation, excavation and piling works. The Explosive Ordnance Threat Assessment will provide recommendations for site specific mitigation measures and / or further works.
Lowering of the groundwater / water table – settlement / consolidation of land, subsidence, land instability, property damage.	Selection of appropriate methods to dewater excavations, for example, prior to dewatering, the perimeter of the excavation could be enclosed with either secant-pile or diaphragm wall. Piezometers (standpipes) could then be placed outside the pile wall to monitor groundwater levels. Seepage analysis and groundwater level monitoring will be carried out as appropriate to assess deformation and stability of surrounding structures, including neighbouring property, as considered necessary. Resting water was recorded between 0.60m and 4.90m bgl during the 2018 geo-environmental investigation. This is likely to represent perched water, which may be encountered in shallow excavations during the development. Should it be encountered during excavation works, it will likely require removal through pumping and appropriate disposal by a licensed contractor.
Deterioration and contamination of new materials and built structures, utilities and infrastructure.	Implementation of an appropriate foundation design and piling methods will be required to address the ground conditions at the Site in terms of settling, subsidence, instability and the creation of preferential pathways. Review of the geotechnical appraisal included in the geo-environmental Investigation and Assessment (Capita, 2018) at the detailed design stage, to determine the potential for

Potential Impact	Mitigation Measures
	aggressive ground and to fully assess the risks to materials and services; and enable the correct specification and selection of materials for services (including potable water supply). It is anticipated that designed sulphate (DS) class DS3 and an "*Aggressive Chemical Environment for Concrete" (ACEC) classification of AC-2 would be appropriate for buried concrete at the Site"* (Capita, 2018). The geo-environmental Investigation and Assessment (Capita, 2018) suggests that "*upgraded water supply pipes (for example Protecta-Line or a similar proprietary system) may be required at the potentially contaminated hot spots (WS5 and BH3), although this may be mitigated by any soil remediation works*". It is recommended that liaison with the relevant water authority (Thames Water) in this regard would be prudent.

Mitigation Once the Proposed Development is Complete and Operational

12.7.2 As mitigation will be implemented during the demolition and construction phase of the Proposed Development, resulting in a negligible effect once the Proposed Development is complete and occupied, no further mitigation measures would be required during this phase.

12.8 Residual Effects and Conclusions

12.8.1 Following the implementation of mitigation measures, it is anticipated that all demolition and construction effects will be reduced so that residual effects are **Negligible** (not significant).

12.8.2 The effects to ground conditions resulting from the complete and operational Proposed Development are considered to be **Negligible** (not significant) and as such no further mitigation measures are required. A summary of residual effects of the Proposed Development on ground conditions is provided in Table 12-14.

Table 12-14: Ground Conditions and Contamination Summary of Potential Effects

Description of Effect	Receptor	Sensitivity of Receptor	Nature of Effect / Geographic Scale	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect and Significance
Demolition and Construction							
Impact to human health through mobilisation of contaminants within the made ground.	Construction Workers	High	Local Long-term Temporary	Medium	Major Adverse	Remediation, where required, of existing localised contaminated hotspots will be undertaken as a component of construction works under a Remediation Strategy. Cover layer of at least 600mm topsoil in soft landscaping areas.	**Negligible (Not Significant)**
	Proposed Development end users (including on-site occupants or users of parts of the Site while construction is on-going) Neighbouring uses, occupiers and the general public immediately adjacent to the Site	High		Medium	Major Adverse		**Negligible (Not Significant)**
	Neighbouring uses, occupiers, and the general public >100m from the Site boundary	Low		Low	Negligible		**Negligible (Not Significant)**
Risk of disturbance of UXO	Construction Workers	High	Local Long-term Temporary	Medium	Major Adverse	The commissioning of a desk based UXO Assessment. Follow the recommendations in the report to mitigate the potential risks.	**Negligible (Not Significant)**
	Proposed Development end users (including on-site occupants or users of parts of the Site while construction is still on-going) Neighbouring uses, occupiers and the general public immediately adjacent to the Site	High		Medium	Major Adverse		**Negligible (Not Significant)**
		Low		Low	Negligible		**Negligible**

Description of Effect	Receptor	Sensitivity of Receptor	Nature of Effect / Geographic Scale	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect and Significance
	Neighbouring uses, occupiers, and the general public >100m from the Site boundary						**(Not Significant)**
Disturbance of contaminated made ground and increased water use during construction works increasing leaching potential	Perched Groundwater	Low	Local Long-term Temporary	Very low/ Negligible	Negligible	None required	**Negligible (Not Significant)**
	Secondary A Aquifer (Lambeth Group)	Medium	Local Long-term Temporary	Very low/ Negligible	Negligible	None required	**Negligible (Not Significant)**
	Principal Aquifer (Chalk)	High	Local Long-term Temporary	Very low/ Negligible	Negligible	None required	**Negligible (Not Significant)**
Effects from construction excavation during construction on land stability and proposed structures / surrounding properties	Land stability and proposed structures / surrounding properties	Low	Local Long-term Temporary	Low	Negligible	Selection of appropriate methods to dewater excavations. Use of CEMP and DCMS.	**Negligible (Not Significant)**
Disturbance of contaminated made ground and increased water use during demolition and construction	Existing and proposed new utilities and infrastructure	Medium	Local Long-term Temporary	Low	Minor Adverse	Correct specification and selection of materials for services (including potable water supply)	**Negligible (Not Significant)**

Description of Effect	Receptor	Sensitivity of Receptor	Nature of Effect / Geographic Scale	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation	Residual Effect and Significance
works increasing leaching potential							
Complete and Occupied							
Contact with residual contaminated ground	Proposed Development end users	High	Local Permanent	Negligible	Negligible	None required as the Site will mainly be covered by a combination of buildings and hardstanding forming an effective barrier to any residual contamination at the Site. The importation and placement of clean fill within the green areas will also create an effective barrier to any residual contamination.	**Negligible (Not Significant)**

12.9 Statement of Effect Significance

12.9.1 No significant effects on ground conditions have been identified as a result of the demolition, construction and operation of the Proposed Development.

12.10 Cumulative Effects Assessment

12.10.1 Cumulative effects occur when a single receptor is affected by more than one effect at any point in time. An exercise which tabulates the residual effects of this ES against relevant receptors, and so identifies the potential for combined cumulative effects has been undertaken. Reference should be made to *Chapter 17: Effect Interactions* of this ES for further details.

Demolition and Construction

12.10.2 There are eight other development schemes (referred to as cumulative schemes) in the vicinity of the Proposed Development which have the potential to result in cumulative effects (further details of the schemes are provided in *Chapter 7: EIA Methodology* of this ES). Three of these are developments for mixed use commercial and residential units,and will result in some degree of excavation or ground disturbance. The remaining development schemes are related to the Cricklewood Regeneration Area extending adjacent east and north of the Site. These schemes include the use of railway land for the transportation of aggregates and non-putrescible waste (construction) by rail; the construction of a waste transfer station for reception, bulking and onward transportation of municipal waste, food waste, dry mixed recycling, bulky waste, street sweeping and street cleansing wastes; and the construction of a train stabling facility involving the installation of railway tracks and the realignment of existing Midland Main Line railway tracks to serve the new Train Station.

12.10.3 Provided that the requirements of relevant policy and legislation relating to land contamination and remediation are integrated within the design and appropriate mitigation measures are applied during the demolition and construction phases of each cumulative scheme, it is considered that the cumulative effect on ground conditions will be negligible.

Complete and Operational

12.10.4 It is considered that there would be a beneficial cumulative effect to the local environment as any identified contamination within each cumulative scheme will be managed as part of the development works. In addition, should any remediation works, or the removal of contaminated soils associated with the preparatory ground works, basement and foundation excavations, be carried out on these sites as part of their redevelopment, this would be expected to result in a moderate to major beneficial effect to the local environment.