8.0 LAND CONTAMINATION

Introduction

8.1 This chapter of the ES assesses the likely significant effects of the Development on the environment in respect of land contamination. It provides information regarding the Site's ground contamination status, the significance of this and the extent of any mitigation that may be required to ameliorate risks associated with contamination.

8.2 The chapter will consider soil and groundwater conditions both in terms of the current Site condition and expected changes arising from the Development. In particular it will consider the geology and potential contamination from the historical use of the Site and will identify potential sources of contamination, pathways for contaminant migration and potential receptors. An assessment will then be made of the potential risks to establish any plausible 'contaminant linkages'.

8.3 A series of potential mitigation measures will be outlined, and the final phase of this assessment will be to evaluate any residual impacts that may remain on completion of the Development.

Policy Context

8.4 There are several regimes that regulate land and groundwater contamination in the UK, including those related to environmental protection, planning and development control, waste management and pollution control and prevention.

National Legislation

8.5 The following legislation applies to the assessment and management of risks to human health and the environment from ground contamination:

- Part 2A of the Environmental Protection Act (EPA) 1990 (the Contaminated Land Regime). [1]
- Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. [2]
- The Water Resources Act 1991. [3]
- The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009. [4]
- The Water Act 2003. [5]

8.6 In the UK, Part 2A of the EPA was introduced by Section 57 of the Environment Act 1995 [6]. It establishes a legal framework for dealing with contaminated land in England. Under Part 2A,

sites are identified as 'contaminated land' if they are either causing harm or there is a significant possibility of significant harm.

8.7 Statutory Guidance in relation to the Act was published by DEFRA in April 2012[2] and confirmed that for a risk to exist there must be one or more contaminant-pathway-receptor linkages. The guidance explains how local authorities should implement the contaminated land regime, including how they should go about deciding whether land is 'contaminated' in the legal sense of the term. It also elaborates on the remediation provisions of Part 2A, such as the goals of remediation, and how regulators should ensure that remediation requirements are reasonable.

8.8 Under the 2012 Statutory Guidance the following definitions apply:

> "*Contaminated land*"
>
> Land which meets the Part 2A definition of contaminated land. Other terms such as "land affected by contamination", or "land contamination" are used to describe the much broader categories of land where contaminants are present but usually not at a sufficient level of risk to be contaminated land.
>
> "*Contaminant*", "*pollutant*" and "*substance*"
>
> All have the same meaning, i.e. substances in, on or under the land which have the potential to cause significant harm to a relevant receptor or to cause significant pollution of controlled waters.
>
> "*Unacceptable risk*"
>
> A risk of such a nature that it would give grounds for land to be considered contaminated land under Part 2A.

8.9 Four categories of land are identified in the guidance. Category 1 is the least contaminated and Category 4 the most contaminated. Categories 1 and 2 are designated as "Not contaminated" and Categories 3 and 4 are "Contaminated". The distinction between Categories 2 and 3 is made on the basis of risk assessment.

8.10 The Water Act 2003 introduced a revision to the wording of the EPA and 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, subject to a test of reasonableness.

8.11 The Water Resources Act 1991 provides statutory protection for controlled waters (streams, rivers, canals, the marine environment and groundwater) and makes it an offence to make a discharge to controlled waters without the permission or consent of the applicable regulators.

8.12 Other relevant legislation includes:

- Environmental Permitting (England and Wales) Regulations 2010. [7]
- The Hazardous Waste (England and Wales) (Amendment) Regulations 2009. [8]
- Contaminated Land (England) (Amendment) Regulations 2012. [9]
- Environmental Damage (Prevention and Remediation) Regulations 2009. [10]

Policy Context

National Planning Policy Framework (2012)

8.13 The National Planning Policy Framework (NPPF) [11] confirms that land contamination and its risk to health should be a material consideration under planning and development control.

8.14 Section 109 of the NPPF states that: *"The planning system 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."*

8.15 A core planning principle described in the NPPF states that: *"Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value."*

8.16 The NPPF also states that planning policies and decisions should ensure that the Site is suitable for its new use. This should take account of ground conditions and land instability, including from natural hazards or former activities such as mining and pollution arising from previous uses. Any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation should be considered.

8.17 After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A, and adequate site investigation information prepared by a competent person should be presented.

Planning Practice Guidance

8.18 The national Planning Practice Guidance (PPG) [12] was launched on the 6th March 2014 and provides a web-based resource in support of the NPPF. The PPG contains no changes or additional information that are applicable to ground contamination.

The London Plan

8.19 The London Plan is the overall spatial development strategy for London published by the Mayor. Policy 5.21 of the Plan relates to contaminated land. It confirms that the Mayor supports the remediation of contaminated sites and will work with strategic partners to ensure that the development of brownfield land does not result in significant harm to human health or the environment, and to bring contaminated land to beneficial use. The policy states that appropriate measures should be taken to ensure that development on previously contaminated land does not activate or spread contamination. Borough Local Development Frameworks should encourage the remediation of contaminated sites and set out policy to deal with contamination.

Local Planning Policy

The Hillingdon Local Plan [13]

8.20 The Hillingdon Local Plan is the key strategic planning document for the borough. Strategic objective SO10 of the plan is to: "Improve and protect air and water quality, reduce adverse impacts from noise including the safeguarding of quiet areas and reduce the impacts of contaminated land."

8.21 The Local Plan states that land affected by contamination can present a risk to users of the land, cause damage to buildings and infrastructure and restrict development potential in the developed area of the borough or prevent the introduction of uses involving public access, where it is left untreated. It notes that the prevention of further contamination of land and remediation of land affected by contamination plays a key role in sustainable development. This contributes towards improving land and environmental quality and the quality of life in general for the borough.

8.22 Policy EM8 of the Local Plan states: "The Council will expect proposals for development on contaminated land to provide mitigation strategies that reduce the impacts on surrounding land uses. Major development proposals will be expected to demonstrate a sustainable approach to remediation that includes techniques to reduce the need to landfill."

8.23 Part 2 of the Local Plan [14] sets out the Hillingdon's Development Management Policies. Policy DMEI 12 covers Development of Land Affected by Contamination. It states:

(A) Proposals for development on potentially contaminated sites will be expected to be accompanied by at least an initial study of the likely contaminants. The Council will support the grant of planning permission for any development of land which is affected by contamination where it can be demonstrated that contamination issues have been adequately assessed and the site can be safely remediated so that the development can be made suitable for the proposed use.

(B) Conditions will be imposed where planning permission is given for development on land affected by contamination to ensure all the necessary remedial works are implemented, including the remediation of controlled waters prior to commencement of development.

(C) Where initial studies reveal potentially harmful levels of contamination, either to human health or controlled waters and other environmental features, full intrusive ground investigations and remediation proposals will be expected prior to any approvals.

(D) In some instances, where remedial works relate to an agreed set of measures such as the management of ongoing remedial systems, or remediation of adjoining or other affected land, a S106 planning obligation will be sought.

London Borough of Hillingdon Unitary Development Plan (UDP) Saved Policies [15]

8.24 Saved policy OL22 of the UDP states that: "Proposals relating to damaged, derelict or otherwise degraded land should be accompanied by an assessment of its current condition and of any adverse effects on adjacent land. Such an assessment should also indicate, as far as is practicable, measures that would negate or contain the causes of the land's unsatisfactory condition.

London Borough of Hillingdon Land Contamination Supplementary Planning Guidance [16]

8.25 London Borough of Hillingdon's Environmental Protection Unit published a guidance note in January 2004 which provides policies and information on how to deal with contamination through the planning and development process. In particular it describes the circumstances when a contaminated land assessment is required and out the various work stages required. In broad terms this comprises:

- Stage 1: a desk study, to determine a site's characteristics and possible contamination risks that may exist in relation to the Development.
- Stage 2: a detailed site investigation and risk assessment, to confirm the presence/absence, severity and distribution of contaminants and any complete contaminant-pathway-receptor linkages.

- Stage 3: a remediation strategy, setting out the measures to be taken to reduce any unacceptable risks taking into the account the intended site use.
- Stage 4: validation of any remedial works, comprising a report demonstrating that the remediation has been carried out satisfactorily and has met its objectives.

London Borough of Hillingdon Contaminated Land Inspection Strategy (2013) [17]

8.26 A Contaminated Land Inspection Strategy was first published by LB Hillingdon in July 2001 and outlined how the council would fulfil its statutory duties in collating and reviewing information on land which may be affected by land contamination. The most recent (third) version, produced in 2013 and covering the period 2013-2018 aims to clarify the approach for identifying and determining contaminated land taking particular cognisance of the 2012 DEFRA statutory guidance (ref paragraph 8.7 above).

8.27 The aims of the strategy are listed to be as follows:

1. Fulfil the Council's duties under the Part 2A legislation.

2. Bring about environmental improvements to create a clean and attractive borough.

3. Encourage voluntary remediation and the reuse of brownfield land.

4. Limit the impact of contamination from Council owned land.

5. Raise awareness and promote understanding of land contamination issues.

Published Technical Guidance

8.28 Due cognisance has been taken of the following technical guidance in relation to the assessment of contaminated land:

- British Standard Institution. 2015. Code of practice for ground investigations. BS 5930. BSI, London. [18]
- British Standard Institution. 2015. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BS 8485. BSI, London. [19]
- British Standard Institution. 2013. Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs). BS 8576. BSI, London. [20]
- British Standard Institution. 2011. Investigation of potentially contaminated sites = Code of Practice. BS10175. BSI, London. [21]

- Environment Agency Groundwater Protection Policy - GP3, v 1.1 2013. This policy sets out the approach to be followed for groundwater protection and management before a new development is undertaken. [22]
- Contaminated Land Report CLR11 - Model procedures for the management of land contamination, Environment Agency/DEFRA. [23]

Assessment Methodology

Guidance and Assessment Criteria

8.29 The significance of each potential impact for each attribute or receptor has been assessed. The significance is determined by classifying both the sensitivity of the receptor, the strength of change of the effect and the duration / frequency of change.

8.30 From the baseline information it is possible to assess the sensitivity of a receptor, which will be classified as Low, Medium or High. The methodology for determining sensitivity is set out in Table 8.1.

Table 8.1: Criteria for Assessing Sensitivity

Sensitivity	Examples of receptor
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character, and is of significant environmental importance.
Medium	The receptor/resource has moderate capacity to absorb change without significantly altering its present character.
Low	The receptor/resource is tolerant of change without detriment to its character and is of low environmental importance.

8.31 The strength of change for each identified receptor, and the duration / frequency of change, are also assessed using a Low, Medium or High scale.

8.32 The methodology for assessing the magnitude of impact arising from the strength and duration of change and sensitivity of the receptor is as follows:

Table 8.2: Criteria for Assessing Magnitude

Magnitude of Impact	Criteria for assessing impact
Major	Total loss or major/substantial alteration to key elements/features of the baseline (pre development) conditions such that the post development character/composition/attributes will be fundamentally changed.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of the baseline will be materially changed.
Minor	A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre development circumstances/situation.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.

Significance of Effects

8.33 It is noted that the degree of 'significance' is not the same as the legal definition of 'significant harm' as defined by the EPA 1990. In addition, effects are judged to be adverse or beneficial and temporary or permanent.

8.34 The significance of an environmental effect is determined by the interaction of magnitude and sensitivity, whereby the impacts can be beneficial or adverse. The Effects Significance Matrix is set out in Table 8.3:

Table 8.3: Effects Significance Matrix

Magnitude	Sensitivity		
	High	**Moderate**	**Low**
Major	Major Adverse/Beneficial	Major - Moderate Adverse/Beneficial	Moderate - Minor Adverse/Beneficial
Moderate	Major - Moderate Adverse/Beneficial	Moderate - Minor Adverse/Beneficial	Minor Adverse/Beneficial

Magnitude	Sensitivity		
	High	**Moderate**	**Low**
Minor	Moderate - Minor Adverse/Beneficial	Minor Adverse/Beneficial	Minor Adverse/Beneficial - Negligible
Negligible	Negligible	Negligible	Negligible

8.35 Any effect other than Minor or Negligible is considered to be 'significant' in respect of its potential environmental impact.

Limitations and Assumptions

8.36 It is assumed that information obtained from third parties and publicly available information provided by the various organisations/agencies referenced in this report is accurate at the time of publication.

8.37 It is also assumed that baseline environmental conditions are accurate as at the time of the various desk-based studies, site surveys and monitoring activities. Further intrusive on-site work with respect to ground conditions and contamination may be required, as described in this chapter.

Baseline Conditions

8.38 The baseline conditions for soil and groundwater contamination for the study area have been determined from the following data sources:

Whole Site:

- Geo-environmental Investigation and Assessment, ref. CS075666-PE-14-211-R Revision A dated 24 November 2014. [24]
- Letter report titled Update on Groundwater Monitoring Results post September-14 round dated 23 October 2014. [25]
- Subsurface Asbestos Investigation: Main Building Undercroft & South-Eastern Surrounding Area. Project ref. GCU0124025 dated July 2014. [26]
- Phase 2 Environmental Assessment of the Nestlé UK Ltd Facility in Hayes, Middlesex. Project ref. GCU0124024 dated June 2014. [27]
- Phase 1 Environmental Assessment of the Nestlé UK Ltd Facility in Hayes, Middlesex. Project ref. GCU0124020 dated September 2013. [28]

Barratt London Site:

- Former Nestle Factory, Hayes. Desk Study and Ground Investigation, ref. R/151867/002, dated April 2017. 29

SEGRO Site:

- Nestle Hayes – Commercial Redevelopment – Remediation Strategy, ref. CS-075666-PE-16-131-R dated July 2016. 30
- Further Geo-environmental Assessment (for the Commercial Development), ref. CS-075666-PE-16-113-R dated 6 June 2016. 31

Geology

8.39 British Geological Survey online mapping indicates the Site to be underlain by 'Worked Ground' over natural soils of the Lynch Hill Gravel Member. The Lynch Hill Gravel is part of the Maidenhead Formation and typically comprises river terrace sands and gravels. The underlying solid geology comprises the London Clay Formation (silty clay), which is expected to be circa 60m thick.

8.40 Below the London Clay is the Lambeth Group which is in turn underlain by the Chalk Group.

8.41 Site investigation works undertaken by Capita in 2014 and 2016, and by Hydrock in 2016, comprised a series of cable percussion boreholes (to depths of up to 25m below existing ground level) dynamic percussive window sample holes (to depths up to 2.45m below existing ground level) and mechanically excavated trial pits.

8.42 A summary of the stratigraphy encountered during the ground investigations is presented in Table 8.4:

Table 8.4: Description of the Geology Encountered Beneath the Site

Lithology	Description	Typical Thickness Range (m)
Hard surfacing or topsoil	Concrete or macadam hard surfacing. Brown clayey sandy gravelly topsoil.	0.1 to 0.4
Made Ground	Clayey gravel or gravelly clay with fragments of concrete, brick and stone. The coarse grained fraction also included chalk, flint, charcoal, ash, slag and metal fragments.	0.15 to 1.5 (average 0.8)

Lithology	Description	Typical Thickness Range (m)
Discontinuous Langley Silt	Observed in about half of the Capita exploratory holes and comprising firm gravelly and/or sandy silty clay.	0.1 to 1.6 (average 0.5)
Lynch Hill Gravel	Medium dense and dense orange-brown and dark brown sandy flint gravel, with occasional sand lenses.	0.9 to 6.9 (average 3.2)
London Clay	Comprised firm to stiff grey-brown silty clay.	Base not proven (>25mbgl)

Hydrogeology

8.43 The following aquifer designations apply to the various lithologies underlying the Site:

- Lynch Hill Gravel – Principal Aquifer
- London Clay Formation – Unproductive Stratum
- Lambeth Group – Secondary Aquifer
- Chalk Group – Principal Aquifer

8.44 The Site is not situated within an Environment Agency designated Groundwater Source Protection Zone.

8.45 Resting groundwater depths ranged between 0.8 and 3.3mbgl within the Lynch Hill Gravel aquifer. Flow was reported to be generally directed towards the south-east.

8.46 There are two deep groundwater abstraction wells within the Site boundaries. Both extend down to the Chalk aquifer. One was in use by Nestlé until 2014, whilst the other is understood never to have been commissioned (due to insufficient productivity). The previously operational well is located centrally at the northern end of the Main Building and was licensed for use as a boiler feed and for evaporative cooling. The permitted abstraction rate was up to 54m3/hour (1,296 m3/day). The well was decommissioned by Nestle prior to vacating the Site and the abstraction licence was revoked.

Hydrology

8.47 The nearest significant surface watercourse is the Grand Union Canal, which defines much of the Site's northern boundary.

8.48 The River Crane is located about 175m east of the Site and flows in a southerly direction, discharging into the River Thames about 10km to the south.

Site History

8.49 The Site comprised agricultural land from at least the 1860s until the 1910s. It was first developed for a cocoa factory circa 1914, when the earliest part of the present day Main Building was completed.

8.50 During the First World War much of the Site was commandeered by the UK government for use as a munitions factory. The land surrounding the Main Building was occupied by numerous wooden huts used for shell manufacturing, with the huts linked to each other by raised walkways. Railway sidings connected the munitions works to the mainline to the north.

8.51 The munitions factory closed in 1919 and the Site reverted to cocoa (and later coffee) production. The Main Building was extended in the 1930s and further modified and added to in the 1960s. The factory complex continued to expand throughout the second half of the twentieth century and many of the larger warehouse-type buildings now present on the Site were constructed in the 1970s.

8.52 The factory ceased production at the end of 2014 and the Site was vacated by Nestle at the end of June 2015, since when it has been disused.

Landfills and Waste Management

8.53 Land immediately northeast of the Site, beyond the Grand Union Canal, and also about 250m to the east (beyond the A312) is recorded to have been historically used for landfilling. The landfill to the northeast was licensed to the London Borough of Ealing for inert, commercial and household waste and the last waste input date was 1936. The landfill to the east had a last waste input date of 31st December 1949 and was used for inert, industrial, commercial, household and special waste.

Radon

8.54 The Indicative Atlas of Radon in England and Wales (2007) produced by the Health Protection Agency (now part of Public Health England) indicates that the number of homes within the vicinity of the Site that are above the radon action level is less than 1%. Therefore the Site is considered low risk in this regard and is not an area likely to be affected by naturally occurring radon gas.

Contamination Sources

8.55 This section discusses known and potential sources of ground contamination at the Site, based on the data sources listed in paragraph 8.38 above.

Previous Environmental Incidents

8.56 The following historical environmental incidents are reported to have taken place at the Site:

- Heavy Fuel Oil (HFO) and diesel spill in 1998.

  This incident involved a spill of heavy fuel oil and/or diesel into the Grand Union Canal following the over-filling of a fuel storage tank on the north-western Site boundary in July 1998, and led to an EA prosecution under the 1991 Water Resources Act. The Site area adjacent to the Grand Union Canal was subsequently subject to extensive soil excavation and replacement works, following the identification and remediation of fuel contamination. Therefore, whilst there may be some residual impact following this incident, the majority of affected soil is expected to have been removed.

- Diesel (Gas Oil) Fuel Leak (underground leakage up to early 1990s).

  Diesel-impacted soils were detected during excavations formed for a new de-aerator tank for the boiler house. The source was attributed to leaking underground fuel lines.

- Mercury losses to ground up to early 1990s.

  Suspected but unproven mercury contamination of soils was observed by Nestlé operatives (or their subcontractors) in shallow soils during construction of the coffee ground combustion plant. The source was concluded to have been switches such as outlet damper controls and boiler pressure controls used within the former (now demolished) boiler house. Such switches used a small ball of elemental mercury to allow the switch to move. The number of boilers was apparently no more than 3-4 so the number of mercury switches is expected to have been small.

- Small Diesel loss (2009)

  A tank on a fuel delivery truck ruptured whilst making a delivery to the Site leading to the loss of approximately 700 litres of diesel. The precise location of this event is unknown but it is anticipated to have occurred at the northern end of the Site close to the existing fuel storage tanks.

Ground Investigation Findings

8.57 The ground investigations undertaken in 2014 and 2016 included laboratory chemical analysis of soil and groundwater samples, and on-Site measurement of ground gas and volatile vapour concentrations within monitoring wells.

8.58 The following key findings were reported:

- There is evidence of a degree of hydrocarbon impact, comprising both total petroleum hydrocarbons (TPH) and poly nuclear aromatic hydrocarbons (PAH), to shallow Made Ground soils at the northern / north-western end of the Site, mostly around the old boiler house and fuel (diesel and heavy fuel oil) storage tanks. This is likely to be a result of historical fuel spillages and potentially from further unrecorded fuel losses.
- Shallow perched groundwater may have been impacted to some extent by hydrocarbons but there is no indication that the Principal Lynch Hill Gravel aquifer has been affected.
- PAH impacts to shallow soils were also detected to the south-east of the Main Building, locally below its undercroft, and in the south-eastern part of the Site. Some marginally elevated lead concentrations were recorded in isolated locations within the Made Ground. These lead and PAH impacts are most likely attributable to sporadic fragments of ash, slag or similar debris entrained within the Made Ground.
- Fragments of asbestos-containing material and/or loose asbestos fibres have been detected in shallow soils locally, including below the former boiler house, on the northern Site boundary and in the south-eastern sector.
- Asbestos has also been detected – albeit at low concentrations – in a number of soil samples obtained from below the Main Building undercroft.
- Elevated mercury concentrations were not encountered within the Capita or Hydrock investigations.
- Hazardous ground gases and volatile vapours were not detected at elevated concentrations.

Relevant Sensitive Receptors

8.59 This assessment evaluates the significance of the identified ground contamination conditions for a number of receptors including end users (with regards to human health), building services and controlled waters.

8.60 For the purposes of this assessment the sensitivity of these receptors has been summarised in Table 8.5 below.

Table 8.5: Sensitive Receptors

Receptor	Assessment of Sensitivity of Receptor / Resource
Human Health – construction workers	High
Human Health – future Site occupants (residents and commercial workers)	High
Human Health – adjacent Site occupants (residents to the south and commercial workers to the west)	High
Controlled Water – Lynch Hill Gravel aquifer	High
Controlled Water – Grand Union Canal	High
Building Services (including potable water supply)	High
Ecological Receptors	High

Likely Significant Effects

8.61 The assessment of environmental effects is divided into two phases:

- Construction phase, which includes Site clearance, Site preparation and construction.
- Operational phase, which starts when construction is complete and the Development comes into use.

8.62 The potential impacts (pre / post mitigation) have been defined based on the baseline research undertaken to date on the sources and degree of ground contamination at the Site, the sensitivity of the receptors and the magnitude of impact resulting from any complete contaminant-pathway-receptor linkages. This risk based approach is in line with CLR 11 and the technical guidance referred to above.

8.63 It is recognised that the Development will be phased such that the commercial element will be operational whilst parts of the residential scheme are still being constructed.

Construction Phase

Impacts during Demolition and Construction – Human Health

8.64 The demolition and construction phase may lead to effects on Site workers, who are assigned a high sensitivity. Baseline conditions are such that earthworks (including demolition of the existing buildings and removal / crushing of concrete floor slabs, basement excavations, foundations and areas of external hardstanding) could disturb and expose workers to localised ground contamination through dermal contact, inhalation and / or ingestion pathways. These pathways were previously contained and isolated by the prevailing hard ground cover.

8.65 Following earthworks, any contaminants present in stockpiled soils may volatilise, leading to human exposure through vapour inhalation, gases, dusts and particulates. Dispersal of contaminated dust by wind dispersal is also possible.

8.66 Demolition and construction workers may also come into contact with underground structures containing potentially hazardous substances.

8.67 There may be a requirement to control groundwater ingress during construction activities, for example during formation of excavations for new buried services. This could include active dewatering alongside ingress prevention. There is a potential risk associated with the management and disposal of such groundwater (likely to be to foul sewer via a suitable treatment mechanism). The management of groundwater is therefore considered to present a short-term temporary, moderate adverse effect to human health, prior to mitigation.

8.68 The magnitude for change resulting from hazardous material and ground contamination is defined as high because the activities will include significant disturbance of the ground. However, the potential effects upon demolition and construction workers would be limited for the duration of the demolition and construction phase activities (i.e. medium-term). The overall pre-mitigation effect upon the health of workers during the demolition and construction phases is considered to be a short-term, temporary, moderate adverse effect.

8.69 Neighbouring land users, most notably residents located on the southern side of Nestles Avenue, could also be affected by demolition and construction works. Following earthworks, should any contaminated soils that have been excavated be stockpiled on-Site and be exposed to the wind, contaminant dispersal could occur through the spread of dust. Under these conditions, neighbouring users, occupiers and the general public could be exposed via inhalation.

8.70 Neighbours and the general public proximal to the Site are assigned a high sensitivity. The magnitude of change resulting from ground contamination is defined as high as the main

pathway of potential contaminant migration would be through inhalation of dust, gas or volatile vapours. It is noted that the potential impact upon these receptors would be limited for the duration of the demolition and construction phase activities. As such, the overall pre-mitigation effect on the health of neighbouring users and the general public during the demolition and construction phase is considered to be short-term, temporary, moderate adverse effect.

Impacts during Demolition and Construction – Controlled Water

8.71 Following removal of existing hardstanding there could, in the short term, be an increase in rainwater infiltration through shallow soils into the underlying aquifer. Contaminated run-off could be generated from rainwater percolation through chemically-impacted stockpiled soil arisings, or from the operational use of water during demolition and construction works (e.g. for dust suppression and wheel washing).

8.72 There is an attendant risk to the underlying aquifer, and to existing surface water drainage networks through such increased infiltration/percolation rates and the possible vertical and horizontal mobilisation of contaminants. The effect is expected to be temporary, moderate adverse prior to mitigation.

8.73 New sources of contamination are expected to be stored at the Site during demolition and construction, for example diesel fuel for plant and machinery. Good working practices will need to be adopted in order to minimise the risk of pollution to controlled water occurring as a result of spillage or leakage of fuels or any other chemicals used during re-development.

8.74 These potential impacts represent a high magnitude of change to the underlying Lynch Hill Gravel aquifer, the Grand Union Canal and to existing and proposed new utilities and infrastructure (i.e. the local sewerage network). These are all classified as receptors of high sensitivity. The demolition and construction phase is considered to present a short-term temporary, major adverse effect on these receptors, prior to mitigation.

Impacts during Demolition and Construction – Ecological Receptors

8.75 Ecological receptors such as existing flora are assigned a high sensitivity and could potentially be impacted by dust generated from exposed contaminated soils, or possibly by migration of chemically impacted groundwater mobilised during the works. The potential effect on ecological receptors is considered to be Moderate adverse prior to mitigation.

Operational Phase

Impacts during the Operational Phase – Human Health

8.76 This section considers the potential impacts from ground contamination during the operational phase of the Development on future residents, employees, visitors, and neighbouring site users.

8.77 Contaminant pathways associated with these receptors include direct ingestion; inhalation of airborne particles or hazardous gases and/or volatile vapours; direct dermal contact; plant uptake via root systems; permeation into drinking water supply pipes; and horizontal migration through permeable soils and groundwater.

8.78 During the operational phase, ingestion, dermal contact and root uptake pathways will generally only exist in areas of soft landscaping. Elsewhere the areas of hardstanding (i.e. the building floor slabs, commercial service yards, car parks, pavements,) will break these pathways. There is considered to be a potentially major adverse effect via these pathways prior to mitigation, once the Development is completed and occupied.

8.79 In respect of the indoor inhalation pathway, the presence of chemical contamination (unless removed during the construction phase) could also present a risk to human health. The operational phase is considered to present a long-term, major adverse effect to future residents, employees, visitors, and neighbouring site users prior to any mitigation.

8.80 Following construction there will be designated car parking areas external to the new residential buildings, and commercial vehicles will be situated in service yards of the new light industrial units. Such vehicle parking may produce surface water runoff containing trace amounts of hydrocarbon oils from occasional sump seal leakage. Furthermore, on-Site maintenance of plant may be undertaken in these areas and may involve the accidental release of small volumes of lubricants. On this basis the impact of any vehicle parking or plant storage is expected to be moderate adverse.

Impacts during the Operational Phase – Controlled Water

8.81 Typical sources of contamination / pollution from developments, once completed and occupied, include oil leaks and petrol spillages from vehicles or plant and from application of fertilisers, pesticides and herbicides to landscaped areas. Pollutants can then be mobilised in either surface water runoff or via vertical migration directly into the underlying aquifer.

8.82 The pre-mitigation effect on the controlled water during the operational phase is considered to be a long-term, major adverse.

8.83 It is noted that the use of infiltration drainage is not proposed at the Site, and therefore there is no risk of introducing contaminants to the aquifer via this pathway.

Impacts during Operational Phase – Ecological Receptors

8.84 Chemically impacted soil and/or groundwater could interact with new planting associated with the Development landscaping proposals. In this regard there is considered to be a potentially Moderate adverse effect on ecological receptors during the operational phase.

Impacts during the Operational Phase – Building Services

8.85 During the operational phase any subsurface chemical contamination coming into contact with buried services has the potential for a major adverse effect on this receptor. Potable water supply pipes are a particularly sensitive receptor in this regard.

Mitigation Measures

8.86 This section considers measures required to mitigate the adverse effects identified during both the construction and subsequent operation of the Development. Particular relevance will be given to Human Health and Controlled Water and the mitigation measures required to reduce or eliminate the identified risks to an acceptable level. These measures can be secured through suitably worded conditions attached to the planning permission.

Construction Phase

8.87 Further phases of investigation and assessment will be undertaken after completion of demolition in the footprints of occupied buildings which currently prevent comprehensive evaluation of ground conditions. Remediation will be undertaken to industry standard methods in agreement with the regulatory authorities.

8.88 In respect of the localised asbestos impact to soils, the asbestos is to be removed from the Site as far as reasonably practicable. The methodology for undertaking these works will be detailed within a Remediation Strategy. This will take due cognisance of applicable regulations and guidance including:

- The Control of Asbestos Regulations (CAR) 2012 [32]
- The CL:AIRE Industry Guidance 2016 [33]
- CIRIA C733 2014. [34]

8.89 A watching brief is to be maintained during the demolition of all existing buildings with regular inspections of the ground formation. Where possible, asbestos will be hand-picked by suitably qualified and experienced personnel, and removed from the Site to a licenced facility.

8.90 If there is evidence of abundant fragments of asbestos containing materials that cannot reasonably be removed by handpicking, it may be necessary to remove, on a localised basis, the entire soil mass affected.

8.91 Assuming these measures are implemented, the risk to human health should reduce to minor adverse.

8.92 In addition to any active remediation implemented as described above, a series of additional mitigation measures may be warranted to manage residual risks.

8.93 All measures implemented are to be in line with best practice and compliant with applicable regulations including, the Construction (Design and Management) Regulations 2015, the Health and Safety at Work Act 1974, and Health and Safety Executive document HSG66 Protection of Workers and the General Public during the Development of Contaminated Land (1991).

8.94 Handling and clearance of waste will be carried out under UK legislation in compliance with the EU Waste Framework Directive.

8.95 A Construction Environmental Management Plan (CEMP) will also be prepared, setting out the methods which the Principal Contractor will be required to adopt as a minimum. Further information on the CEMP is provided in Chapter 5 of the ES.

8.96 The following areas may require specific risk mitigation:

- Management of surface water run-off

  Temporary drainage arrangements are to be deployed in the event that chemically contaminated soils are encountered and there is a potential adverse effect on the underlying aquifer via vertical migration. This, alongside removal of any contaminated soil hotspots if discovered, is expected to reduce the effect to minor adverse.

- Dewatering Activities

  To mitigate any adverse effect of dewatering on construction workers, appropriate PPE should be worn in any areas of chemical impacts. In addition any seepage water should be controlled by capturing the water in sumps or temporary storage. The water will be tested prior to discharge to public sewer under license. Any contaminated water generated from dedicated remediation activities will require specific treatment prior to disposal. On the basis that these measures are implemented the risk should reduce to negligible.

- Dust

Appropriate airborne dust monitoring (including Site boundary monitoring) will inform any decisions over off-Site exposure. On the basis that suppression measures are implemented (e.g. persistent damping down during dry periods, the covering of any stockpiled earthworks arisings and possibly a boundary misting system and) the risk should be reduced to negligible.

- Stockpiled material earthworks

  Stockpiled earthworks arisings should have a best practice construction management and water management system. This is expected to include temporary drainage, sumps, sediment traps and an emergency response plan in the vicinity of earthworks. This should reduce the potential impacts to minor.

- Fuel Storage and Refuelling Areas

  To mitigate the effects of hydrocarbon storage, use of best practice construction practice for environmental management (e.g. bunding, emergency procedures and surface water collection systems) will be required. Assuming these measures are implemented the risk should reduce to minor.

- Car parking and Plant Machinery Storage Areas

  Best practice construction management will ensure runoff from car park areas is collected and treated using sediment traps and oil/water separators before discharge. Any spill incidents will be reported and treated immediately (e.g. by use of absorbent materials). Assuming these measures are implemented the risk should reduce to minor.

Operational Phase

8.97 The potential impact during the operation of the Development relates to the risks posed to human health, the environment and buried services by any contaminated soil and any soil gas present on the Site.

8.98 Remediation will be undertaken prior to or during the demolition phase, as described above. A validation report will be prepared for submission to the London Borough of Hillingdon.

8.99 Notwithstanding this, additional measures may be required during the operational phase such as:

- Ground gas / volatile vapour protection

Dependant on the post-remediation levels of gas and/or volatile vapours encountered, control measures may need to be incorporated into the design of the proposed new buildings to prevent the accumulation of soil gases and attendant risks to human health.

Assessment and mitigation should be undertaken in accordance with guidance provided in CIRIA C665 (2007)[35], CIRIA 716 (2012)[36], CIRIA 735 (2014)[37] and BS8485 (2015)[18]. Assuming appropriate measures are provided the resulting risk is assessed as minor adverse.

- Landscaping

  The installation of an engineered cover system may be required in areas of new soft landscaping, designed in accordance with guidance and in agreement with the regulators. Additional measures such as tree boxes could also be considered. This would include suitably tested and certified imported topsoil to the landscape architect's specification. On completion, the operational phase effect associated with dermal contact / dust inhalation / direct ingestion in such areas will be reduced negligible. Adverse effects on ecological receptors – i.e. new planting – would also be reduced to negligible.

- Water Supply Pipes

  Upgraded water supply pipes resistant to chemical permeation could be considered where necessary, to reduce any potential adverse effects to negligible.

- Vehicle parking areas

  Permanent parking is proposed at the Development. Such areas will be designed with surface water drainage systems incorporating suitable interceptor systems prior to discharge. On this basis the resultant risk to controlled water has been assessed as negligible.

Residual Effects

8.100 With full implementation of the outlined mitigation measures, it is anticipated that all residual adverse effects will be reduced to minor or negligible, through the demolition, construction and operation phases of the Development. These residual effects are not considered to be significant. Where necessary, standard conditions can be attached to the planning permission to secure the mitigation measures outlined.

Cumulative Effects

8.101 This section of the chapter assesses the potential effects of the Development in combination with other committed and reasonably foreseeable developments in the area. Further details of the cumulative schemes considered is provided in Chapter 2 of the ES.

Construction Phase

8.102 The construction of the identified cumulative schemes is expected to be carried out in accordance with construction site best practice as specified through a construction management plan (or equivalent document) that will be agreed by the relevant Local Authorities. Mitigation will need to be implemented at each individual scheme's construction site to prevent significant environmental effects arising beyond their boundaries and the use of monitoring, where applicable, to confirm the effectiveness of these measures. Therefore, it is considered that effects during construction would be managed to avoid the potential for significant cumulative effects in the local area. The cumulative effects of the construction phase are therefore considered to be temporary, local, minor adverse and not significant overall.

Operational Phase

8.103 On completion and occupation of the Development and the identified cumulative schemes, there should be a negligible to minor beneficial cumulative effect to the local environment as a result of mitigation and remediation of any identified ground contamination.

Summary

8.104 This chapter of the ES has considered the likely effects of the Development on the environment in respect of land contamination. It concludes that there are a number of sensitive receptors that could potentially be adversely affected by chemically contaminated soil or groundwater, including controlled waters (the Site is underlain by a Principal aquifer and is situated adjacent to the Grand Union Canal) and human health (including demolition/construction workers and future residents and employees at the Site). However several phases of ground investigations have been completed and these do not indicate high levels of contamination to be present.

Where potentially complete ‘contaminant linkages’ do exist there is adequate scope to mitigate the effects to Minor or Negligible.

8.105 Table 8.6 contains a summary of the likely significant effects of the Development.

Table 8.6: Table of Significance - Land Contamination

Potential Effect	Nature of Effect (Permanent/Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)
				I	UK	E	R	C	B	L	
Construction											
Dermal contact / dust and vapour inhalation / direct ingestion of contaminated soil by site workers	Temporary	Moderate adverse	Implementation of remediation strategy to remove any contaminated hot spots. Use of personal protective equipment.							✓	Minor
Dust and/or inhalation by neighbouring land users	Temporary	Moderate adverse	Dust suppression during demolition and construction works							✓	Negligible
Adverse impact to Controlled water – leaching of soil contaminants into the gravel aquifer	Temporary	Moderate adverse	Implementation of remediation strategy to remove any contaminated hot spots. Installation of temporary drainage arrangements to control run-off if required.							✓	Minor adverse
Existing drainage networks – leaching of contaminants from soils to surface water drains	Temporary	Moderate adverse	Implementation of remediation strategy to remove contaminated hot spots.							✓	Negligible
Spillages from on site storage of fuels or chemicals	Temporary	Major adverse	Implementation of construction environmental management plan							✓	Negligible
Adverse impacts to construction workers from dewatering activities	Temporary	Moderate adverse	Implementation of remediation strategy to remove contaminated hotspots. Use of personal protective equipment.							✓	Negligible
Ecological receptors – plant uptake of contaminants in soil or groundwater	Temporary	Moderate adverse	Dust suppression and removal of contaminated hotspots.							✓	Negligible

Completed Development / Operational Phase											
Site occupants – dermal contact / dust and vapour inhalation / direct ingestion of contaminated soil, in areas of soft landscaping	Permanent	Major adverse	Use of a cover layer to break contaminant linkages.							✓	Negligible
Ecological receptors – plant uptake of contaminants in soil or groundwater	Permanent	Moderate adverse	Use of a cover layer and/or tree boxes to break contaminant linkages.							✓	Negligible
Permeation of contaminants into drinking water supply pipes	Permanent	Major adverse	Use of sterile trenches / upgraded plastics (e.g. 'Protectline').							✓	Negligible
Chemically impacted surface water run-off from parked cars or from plant maintenance areas reaching the aquifer or drainage networks	Permanent	Moderate adverse	Use of petrol interceptors within drainage networks.							✓	Negligible
Cumulative Effects											
Construction											
Effects on sensitive receptors	Temporary	Major Adverse	Appropriate remediation and other necessary mitigation at each site.							✓	Minor Adverse
Operation										✓	
Effects on sensitive receptors	Temporary	Major Adverse	Appropriate remediation and other necessary mitigation at each site.							✓	Negligible to Minor Beneficial.

*** Geographical Level of Importance**

I = International; UK = United Kingdom; E = England; R = Regional; C = County; B = Borough; L = Local

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