

The West Midlands Rail Freight Interchange Order 201X
ES - Vol 1 - Chapter 11: Ground Conditions
Regulation 5(2)(a)
Ramboll - July 2018

11 Ground Conditions

Introduction

- 11.1 This chapter of the ES assesses the likely significant environmental effects of the Proposed Development in respect of Ground Conditions. In particular, this chapter describes the relevant legislation and Ground Conditions policy context; the methods used for assessment and details of the criteria used to determine significance; the baseline Ground Conditions at and surrounding the Site; the potential impacts and effects as a result of the Proposed Development; any mitigation or control measures required to reduce or eliminate adverse effects; and the subsequent residual effects and likely significant effects associated with the Proposed Development.
- 11.2 This chapter is accompanied by the following figures and technical appendices presented within ES Volume 2:
- Technical Appendix 11.1: GroundSure EnviroInsight provided Historical Maps, reference: ENV-1836263, dated 8th January 2015;
 - Technical Appendix 11.2: GroundSure EnviroInsight Database Report reference: ENV-1836264, dated 7th January 2015;
 - Technical Appendix 11.3: Ramboll, Four Ashes Staffordshire, Phase II Environmental Site Assessment, Factual Report, March 2016 (Ref: UK15-22306_Ph 3_Factual);
 - Technical Appendix 11.4: Ramboll, West Midlands Interchange, Southeast Area, Phase II Environmental Site Assessment – Factual Report, February 2018 (Ref: UK15-22306_WMI_SE);
 - Technical Appendix 11.5: Ramboll, West Midlands Interchange – Remediation Safeguarding, dated 19 July 2018 (Ref: R-UK15-22306_5-Remediation Safeguarding Report); and
 - Technical Appendix 11.6: Waldeck Technical Note: Summary of Ground Conditions.
- 11.3 This chapter is written by Ramboll.

Legislation and Policy Context

National Legislation and Policy

National Policy Statement for National Networks, 2015

- 11.4 The National Networks National Policy Statement (NPS)¹ (paragraph 5.168) states that where possible, developments should be on previously developed (brownfield) sites provided that it is not of high environmental value. For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination and how it is proposed to address this.
- 11.5 The NPS also identifies (paragraphs 4.48 to 4.56) that the Secretary of State should be satisfied that development consent can be granted taking full account of environmental impacts, requiring close cooperation with the Environment Agency and/or the pollution control authority and other relevant bodies. In instances of potentially polluting developments the relevant pollution control authority should be satisfied that potential releases can be adequately regulated under the pollution control framework and that the effects of existing

sources of pollution in and around the project are not such that the cumulative effects of pollution when the Proposed Development is added would make that development unacceptable, particularly in relation to statutory environmental quality limits.

- 11.6 The NPS identifies (paragraphs 5.116 to 5.119) that the effects of potential land instability should be considered by the applicant. If potential land instability is an issue, applicants are advised to seek appropriate technical advice and that “A preliminary assessment of ground instability should be carried out at the earliest possible stage before a detailed application for development consent is prepared”.

National Planning Policy Framework, 2012

- 11.7 Section 11 (‘Conserving and enhancing the natural environment’) of the National Planning Policy Framework 2011² is of particular relevance to ground conditions. Here it is stated that the planning system should contribute to and enhance the natural and local environment in a number of ways, including:
- Protecting and enhancing valued landscapes, geological conservation interests and soils (paragraph 109);
 - Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate (paragraph 109); and
 - To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.
- 11.8 Also in Section 11, it is further stated that planning policies and decisions should also ensure that:
- The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts 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;
 - Adequate site investigation information, prepared by a competent person, is presented; and
 - In doing so, local planning authorities should focus on whether the development itself is an acceptable use of the land, and the impact of the use, rather than the control of processes or emissions themselves where these are subject to approval under pollution control regimes.

National Planning Practice Guidance, 2014

- 11.9 Specific guidance on Land Affected by Contamination³ outlines how the planning system works alongside a number of other regimes including the system for identifying and remediating statutorily defined contaminated land under Part IIA of the Environmental Protection Act 1990, Building Regulations and Environmental Permitting Regulations.

¹ Department for Transport, 2014. National Policy Statement for National Networks. London: TSO

² Department for Communities and Local Government, 2012. National Planning Policy Framework. London: TSO

³ Department for Communities and Local Government, 2014. Planning Practice Guidance.

11.10 The guidance stipulates that where there is a reason to believe contamination could be an issue, developers should provide proportionate but sufficient site investigation information (a risk assessment) to determine the existence or otherwise of contamination, its nature and extent, the risks it may pose and to whom/what (the 'receptors') so that these risks can be assessed and satisfactorily reduced to an acceptable level. The risk assessment should also identify the potential sources, pathways and receptors ('pollutant linkages') and evaluate the risks.

Environmental Protection Act, 1990

11.11 Legislation and guidance on the assessment of contaminated sites is provided under Part IIA of the Environmental Protection Act 1990, as introduced by Section 57 of the Environment Act 1995. This came into effect in England on 1st April 2000 as The Contaminated Land (England) Regulations 2000. These Regulations were subsequently revoked with the provision of the Contaminated Land (England) Regulations 2006 (Statutory Instrument (SI 2006/1380)). The Contaminated Land (England) Regulations 2006 have since been replaced by the Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263) which came into force on 6th April 2012.

11.12 The 2012 Regulations make minor changes to the 2006 Regulations to take into account the revised definition of 'controlled waters' under Part IIA. Under the Guidance, a 'significant contaminant linkage' is one which gives rise to a level of risk sufficient to justify a piece of land being determined as contaminated land. Should the authority consider that there is an unacceptably high probability, supported by robust science-based evidence that significant harm would occur if no action is taken to stop it, the land should be deemed a Category 1: Human Health. Land should be placed into Category 2 if the authority concludes, on the basis that there is a strong case for considering that the risks from the land are of sufficient concern, that the land poses a significant possibility of significant harm. Both Category 1 and Category 2 cases would be capable of being determined as contaminated land under Part 2A on the grounds of significant possibility of significant harm to human health. If the legal test for significant possibility of significant harm is not met, the authority should place the land into Category 3. If the local authority considers that there is no risk or that the level of risk posed is low, the land should be placed into Category 4.

Water Resources Act 1991 (Amendment) (England and Wales) Regulations, 2009

11.13 The Water Resources Act 1991, as amended by the Water Act 2003, is also relevant to the consideration of contaminated land with respect to impact on controlled waters. The Water Act 2003 introduced a provision to consider 'significant pollution' of controlled waters in the context of contaminated land (i.e. consistent with the concept of significant harm); however, no enacting legislation has yet been made in this regard. The Water Resources Act states that it is an offence to knowingly discharge any poisonous, noxious or polluting matter or solid waste matter to any controlled waters, including either surface or groundwater, without a discharge consent issued by the Environment Agency (EA) or in accordance with the provisions set out in the Water Industries Act 1991 (if disposed to a sewer).

Water Environment (Water Framework Directive) (England and Wales) Regulations, 2003

11.14 The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 transpose the requirements of the EU Water Framework Directive (2000/60/EC), which introduces a European-wide consistent approach for protecting and enhancing the water environment, including surface waters, groundwater and tidal and coastal waters. The Water Framework Directive places emphasis on improvement of water quality and enhancement of the ecological status of a water body.

⁴ The Environmental Protection Act 1990. London: TSO

⁵ The Building Regulations 2010: Approved Document C. 2004, incorporating 2010 and 2013 amendments.

Building Regulations, 2010

11.15 The Building Regulations 2010 and specifically Approved Document C 'Site Preparation and Resistance to Contaminants and Moisture'⁵ outlines an approach for the assessment of contamination and preparation of sites prior to redevelopment.

Waste Legislation

11.16 In relation to the potential disposal of spoil from the Site, the waste regulation regime is relevant. Disposal requires consideration of the requirements of the Control of Pollution Act 1974, Controlled Waste Regulations 1992 (as amended), Environment Act 1995, Hazardous Waste (England and Wales) Regulations 2005 (as amended) (if applicable), Waste Regulations 2011 and the Duty of Care Regulations 1991.

11.17 Section 34 of the Environmental Protection Act 1990 imposes a duty of care on persons concerned with controlled waste. The duty applies to any person who produces, imports, carries, keeps, treats or disposes of controlled waste, or as a broker has control of such waste. Following on from this requirement, excavated material and excess spoil which is to be discarded should always be classified prior to removal from a site.

Regional Policy

Guide to Redevelopment of Land Affected by Contamination in Staffordshire

11.18 The Guide to Redevelopment of Land Affected by Contamination in Staffordshire⁶ was produced by Staffordshire Local Authorities including South Staffordshire Council.

11.19 The guidance document was prepared for developers and their agents/advisers and outlines the information that Staffordshire Local Authorities require during an assessment of an application for planning consent on land that may be affected by contamination. It outlines the information required by Local Planning Authorities (LPA) in order for them to determine planning applications and then the subsequent discharge of associated land contamination conditions. This guidance document provides an overview of good practice for land contamination management procedures which, if followed, will help meet the information requirements of the LPA during development of that land.

Local Policy

South Staffordshire Core Strategy DPD, 2012

11.20 On the 11th December 2012 South Staffordshire Council formally adopted the Core Strategy (Local Plan) Development Plan Document. Core Policy 3 (Sustainable Development and Climate Change) of the Strategy identifies a requirement to ensure that development on brownfield land affected by contamination or land instability is remediated in accordance with the National Planning Policy Framework.

11.21 The Local Plan defines Brownfield Land (which is relevant for residential properties located within the Site and areas adjacent to the Site) as '*previously developed land is that which is or was occupied by a permanent structure including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be developed) and any associated fixed surface infrastructure. This excludes: land that is or has been occupied by agricultural or forestry buildings; land that has been developed for minerals extraction or waste disposal by landfill purposes where provision for restoration has been made through development control procedures; land in built-up areas such as private residential gardens, parks, recreation grounds and allotments; and land that was previously developed but where*

⁶ Newcastle Under Lyme Borough Council (Endorsed by Staffordshire Local Authorities). A guide for the redevelopment of land affected by contamination in Staffordshire. 3rd edition.

the remains of the permanent structure or fixed surface structure have blended into the landscape in the process of time.'

- 11.22 Under Core Policy 3 of the Local Plan, all development must include pollution prevention measures where appropriate to prevent risk of pollution to controlled waters.

South Staffordshire Contaminated Land Strategy, 2001

- 11.23 South Staffordshire Council published their Contaminated Land Strategy in June 2001⁷, providing guidance on the identification and investigation for potentially contaminated land in its District.
- 11.24 The guidance details measures that the Council will follow to identify and inspect land within the District that is potentially contaminated and also provides detail on the characterisation of land within the region, including reference to protected areas, key water resource protection issues and known areas of contamination.

Other Guidance

- 11.25 The 'Model Procedures for the Management of Land Contamination' (CLR11)⁸ provides the technical framework for applying a risk management process when dealing with contaminated land. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK. CLR11 procedures are intended to assist all those involved in dealing with land contamination, including landowners, developers, professional advisors, regulatory bodies and financial providers.
- 11.26 Guidance on the development of Category 4 Screening Levels for Assessment of Land Affected by Contamination⁹ was published in 2014. It constitutes the primary output of a Department for Environment Food and Rural Affairs (DEFRA) funded research project (SP1010), and it incorporates feedback from both the project's Steering Group and the wider contaminated land community. The report presents a suggested methodology for the development of Category 4 Screening Levels (C4SLs). The overall objective of the C4SLs research project has been to assist the provision of technical guidance in support of DEFRA's revised Statutory Guidance (SG) for Part IIA of the Environmental Protection Act 1990.
- 11.27 The Environment Agency's approach to groundwater protection¹⁰ outlines a risk-based approach which includes reference to the 'groundwater protection hierarchy'. The guidance includes position statements for potential developments within source protection zone (SPZ) 1. The guidance outlines specific advice for nationally significant infrastructure schemes whereby the Environment Agency suggest that *"promoters of schemes of national or regional significance to protect groundwater when choosing the location for their activity or development. In the cases where this is not possible due to national or regional interests, the Environment Agency expects to be fully involved in the scheme development to mitigate groundwater risks via EPR where applicable. Promoters are expected (via the environmental impact assessment process) to identify all the potential pollution linkages and apply best available techniques to mitigate the risks"*.
- 11.28 There is no one specific guidance document relating to ground gas measurement methods, risk assessment, and gas protection measures with respect to Human Health. Several documents have been published since the early 1990s and generally provide guidance for new developments, some of which have been more recently revised.
- 11.29 Table 11.1 provides a summary of the guidance documents considered relevant to the proposed redevelopment.

Constituent	Reference Documents
Methane and Carbon Dioxide	Assessing Risks Posed by Hazardous Ground Gases to Buildings. Report C665, Construction Industry Research and Information Association (CIRIA), 2007.
	Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BSi 8485:2015.
	The Building Regulations, Approved Document C: Site preparation and resistance to contaminants and moisture, (2004). Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present. Report Edition No. 4, NHBC, March 2007.
Oxygen	Waste Management Paper 27 – Guidelines for Building Houses near Landfill Sites. Department of the Environment 1991.

- 11.30 Guidance on undertaking ground gas risk assessment is provided by the Construction Industry Research and Information Association (CIRIA), Report C665 "Assessing Risks Posed by Hazardous Ground Gases to Buildings" (2007). The guidance consolidates the requirement for good practice in site investigation, the collection of relevant data and monitoring programmes in the context of a risk based approach to gas contaminated ground.
- 11.31 Two semi-quantitative methods are set out in the guidance for the assessment of ground gas risk, one method for low rise housing with gardens and the other for all remaining development types, including commercial/industrial development.
- 11.32 The method applicable for all developments with the exception of low rise housing is called the 'Modified Wilson and Card Classification'. This method makes no assumption that an underfloor void is present within the development. The method by Wilson and Card was a development of the one proposed in CIRIA publication R149 (1995).
- 11.33 As discussed above, CIRIA 665 was developed to assess the requirement for gas mitigation measures within new buildings and not to determine risk and gas mitigation measures which should be employed with respect to current buildings. CIRIA Report 665 incorporates the methodology within Wilson & Card Reliability and Risk in Gas Protection Design (1999) to develop site specific Gas Screening Values (GSV). The 'Modified Wilson and Card Classification' uses gas concentrations and borehole flow rates to define a characteristic situation for the Site, by calculating a Gas Screening Value (GSV):
- $GSV (l/hr) = \text{borehole flow rate (l/hr)} \times \text{gas concentration (\% v/v)}$.
- 11.34 The GSV is calculated using a worst case scenario (i.e. the maximum gas concentration and flow rates detected) across the entire Site during the monitoring period. The GSV is calculated for both methane and carbon dioxide, and the 'Characteristic Situation' is derived by comparison with a table relevant to each method. It is important to note that GSVs are not absolute thresholds but guideline values.
- 11.35 The Building Regulations, Approved Document C (2004) states that where methane concentrations do not exceed 1% and that the floor of the building to be constructed is suspended and ventilated, no further protection needs to be provided. Above 1% by volume there is a need to consider possible measures to prevent gas ingress into new buildings.
- 11.36 Approved Document C also states that there is a need to consider possible measures to prevent gas ingress into new buildings if concentrations of carbon dioxide above 1.5% are

⁷ South Staffordshire Council. Contaminated Land Strategy. A strategy for the identification and investigation of contaminated land in South Staffordshire. June 2001

⁸ The Environment Agency. Model Procedures for the Management of Land Contamination. Contaminated Land Report 11. September 2004

¹⁰ Environment Agency. The Environment Agency's approach to groundwater protection. March 2017. Version 1.0

detected in the ground, and that measures are definitely required at concentrations above 5%.

- 11.37 Waste Management Paper 27 (WMP27) states that a minimum concentration of 18% oxygen is required to prevent asphyxiation.

Consultation

- 11.38 Consideration has been given in this assessment to the EIA Scoping Request Opinion comments provided by the Secretary of State (SOS) and other consultees relevant to 'Ground Conditions' in respect to the Proposed Development at the Site as summarised in Table 11.2.

Table 11.2: Comments Received During EIA Scoping		
Consultee	Comments Raised	Response to Comments
SoS	Confirm if any private water abstractions are present on-site.	Included in this ES chapter.
	It is necessary to consider safeguarding of remediation works.	A Remediation Safeguarding report has been prepared and is included as Technical Appendix 11.5.
	Consider any potential risk to geological SSSI.	Included in this ES chapter.
Environment Agency (EA)	Our main concern is that the development does not compromise the on-going groundwater remediation works in the south western part of the development area. The need to facilitate these remediation works should be taken into account in designing the layout of the development.	A Remediation Safeguarding report has been prepared and is included as Technical Appendix 11.5.
	The developer should refer to our 'Groundwater Protection: Principles and Practice' (GP3) document.	The updated version of this document is referenced and considered in this ES chapter.

It is noted that the assessment area did not previously include the south-eastern land parcel (area extending south of Station Road to – and parallel along – the Staffordshire and Worcestershire Canal to Woodlands Lane and Stable Lane). Subsequent investigation of the south-eastern land parcel has now been undertaken by Ramboll, as reported in the factual report included as Technical Appendix 11.4. The area covered under previous assessments is illustrated in Technical Appendices 11.3 and 11.4. Figures showing the additional assessment completed in the area to the south-east are included in Technical Appendix 11.4.

Method of Assessment

- 11.41 The assessment of impacts of the Proposed Development and on the surrounding environment, as result of ground conditions at the Site has been completed in the context of the framework established by Part 2A of the 1990 Act.
- 11.42 The framework for considering hazards associated with the development of contaminated, or potentially contaminated land, is risk based, and is undertaken in a tiered fashion:
- Tier 1 requires the development of a conceptual site model to identify the potential presence of pollutant linkages based on information gathered about the Site, and to assess qualitatively if potential pollutant linkages are likely to be significant;
 - Those pollutant linkages that are considered likely to be significant are taken forward to tier 2 of the risk assessment, which requires collection of empirical information about the potential contamination sources at the site, and the site-specific ground conditions, via an intrusive investigation. Known concentrations of contaminant sources at the Site are then typically screened against generic published reference criteria; and
 - Where concentrations of contaminants at the Site are present above the generic assessment criteria, these are taken forward to tier 3, also known as quantitative risk assessment. Tier 3 uses mathematical models to derive site-specific assessment criteria, which are dependent on the proposed end-use of the Site.
- 11.43 The conceptual site model presents the potential pollutant linkage that may be realised during and as a result of the Proposed Development. It is noted that the contaminated land regime specifically considers the pollutant linkages that will arise in the context of an altered end-use, rather than those that may arise during development; however in order to be consistent in respect of impact assessment, construction impacts as a result of ground conditions have been treated in the same way as operational impacts (i.e. consistent with the framework in Part 2A of the 1990 Act).
- 11.44 The significance of the impact has been assessed within the framework laid down in the Statutory Guidance on Part 2A of the 1990 Act. That is, a significant impact for the development would constitute significant harm, or the significant possibility of significant harm, in accordance with the contaminated land regime.
- 11.45 The potential for complete pollutant linkages to exist, and an assessment of their significance, has been completed qualitatively (i.e. at tier 1 of the tiered approach). The qualitative assessment utilises information on the ground conditions, including information obtained from the British Geological Survey regarding the geology and hydrogeology underlying the site, and employ professional judgement to assess significance within the framework laid down by Part 2A of the 1990 Act.

Assessment Methodology

Baseline Characterisation

- 11.39 The following section outlines the methodologies applied to identify and assess the range of potential ground condition impacts likely to result from the Proposed Development.
- 11.40 The existing and future baseline conditions at the Site and in the surrounding area have been characterised through assessment undertaken by Ramboll and further third party information, referenced in paragraph 11.2 and included as Technical Appendices 11.1 to 11.5.

Figure 11.1: Source, pathway, receptor model



- 11.46 Where significant impacts are identified, mitigation measures are proposed that would result in a reduction in risk such that significant harm, or the possibility of significant harm, would be prevented.
- 11.47 With regard to the potential significant effects to arise it is necessary to consider the likelihood for a pollutant source-pathway-receptor linkage to occur, as without such a linkage, it can be concluded that no significant effects are likely.
- 11.48 The varying effects of a contamination source on individual receptors depend largely on the sensitivity of the receptor in question. In general, however, receptors can be divided into a number of groups, depending on the defined land usage. Receptors are defined in Part IIA of the Environmental Protection Act as follows:
- Humans: adjacent land users, and demolition/construction workers;
 - Controlled Waters: surface waters and groundwater;
 - Property: building structures and services and adjacent properties. The current ongoing remediation works are also considered a potential Property receptor;
 - Property: in the form of crops, timber, produce (including domestic, and livestock); and
 - Ecology: an ecological system, or organism within such system, within a location that has been identified for protection under various European, National and local designations (including Site of Special Scientific Interest, Special Protection Area, Special Areas of Conservation, National Nature Reserve).
- 11.49 The risk based methods of assessment used give priority to harm occurring to human health before other receptors. As such, certain land use types are deemed more sensitive than others (in descending level of sensitivity):
- Residential properties;
 - Commercial / industrial land usage; and
 - Wider environmental receptors such as Controlled Waters, Sites of Special Scientific Interest (SSSIs), etc.
- 11.50 Information on the current and historical conditions at the Site are discussed within the Baseline section of this Chapter and followed by a contaminated land assessment, which:
- Considers how construction and operation of the Proposed Development may be constrained by contaminated soils / waters, if present;
 - Recommends remediation measures that would be required to remove the contamination risk, if any;
 - Establishes the nature and extent of any mitigation to be employed during and following construction activities at the Site to protect (if required):
 - Human health and groundwater. surface water resources;

- On and off-site buildings;
- ongoing groundwater remediation works; and
- on and offsite operations following completion of the Proposed Development.
- Defines the nature and the likely impacts arising from any residual contamination, to the Proposed Development.

Significance Criteria

- 11.51 There are no established significance criteria for the assessment of 'ground conditions or ground contamination'. Typically assessments are based on the risk that existing and future contamination may pose through the significance of the potential pollutant linkage.
- 11.52 Where historical contamination is identified as being present, or where potential sources of contamination are identified at or within the immediate surroundings of the Site, or could be introduced through the construction and / or operation of the Proposed Development, then a 'contaminant' source can be assumed to exist. However, a potential effect is only present where there is a pathway for the contaminant to affect a receptor.
- 11.53 Where a contaminant linkage is created by a Proposed Development (through introduction of a new contaminant, pollution pathway (due to the mobilisation of an existing contaminant), or introduction of a receptor thus completing a linkage) or where pollution of soil or groundwater¹¹ may be caused, the nature of the impact would typically be assessed as potentially adverse. Where the removal of an existing pollutant linkage is achieved, this would typically be considered as potentially beneficial. Where there is no change anticipated as a result of the Proposed Development, it would be assessed as negligible.
- 11.54 In the absence of published quantitative criteria relating to contamination for the use in EIA, Tables 11.3 and 11.4 have been developed, to enable the consistent and transparent assessment of the Proposed Development likely effect on sensitive receptors.

Table 11.3: Criteria for Assessing Sensitivity of Receptor	
Sensitivity of Receptor	Criteria
High	<ul style="list-style-type: none"> • Land to be in use for residential purposes with plant uptake (i.e. residences with private gardens). • Construction workers (not defined in Part IIA; however relevant in the context of a human receptor during the development process). • On-site maintenance works with increased potential for direct contact with areas of contamination (if present) / working in confined spaces; e.g. to install / repair underground services. • Principal aquifer, which may be used for public water supply. • Source Protection Zone I – Inner Protection Zone. • Source Protection Zone II – Outer Protection Zone. • Surface watercourse located on or adjacent to land under assessment. Watercourse with a high water quality classification. • land located in or directly within the immediate catchment area of an ecologically sensitive area, e.g. Special Protection Area (SPA)/Site of Scientific Interest (SSSI)/Ramsar Site, etc.
Medium	<ul style="list-style-type: none"> • Land to be in use for residential purposes without plant uptake.

¹¹ Assessment of the potential for impact to surface waters is presented in Chapter 16 Water Environment.

Table 11.3: Criteria for Assessing Sensitivity of Receptor	
Sensitivity of Receptor	Criteria
	<ul style="list-style-type: none"> Off-site land in current residential usage and with potential for consumption of home grown produce. Land to be used for agricultural arable usage. Livestock. Third party utilities. Secondary aquifer, which is not used for public water supply. Source Protection Zone III – Total Catchment Area. Surface watercourse located less than 250 m from the Site (however not located on or adjacent to the Site). Watercourse with a medium water quality classification. Not located in an ecologically sensitive area however located within its wider catchment.
Low	<ul style="list-style-type: none"> Land to be in use for commercial/industrial purposes. Off-site commercial land usage. Members of the public accessing the Site for relatively short periods (e.g. dog walkers, bird watchers). Unproductive strata. Groundwater not used for public water supply. Surface watercourse located more than 250 m from the Site. Watercourse with a poor water quality classification. Not located in an ecologically sensitive area or its wider catchment.

Table 11.4: Magnitude of Impact		
Magnitude of Impact	Criteria for Potential Adverse Impact	Criteria for Potential Beneficial Impact
High	Substantial environmental risk to sensitive receptors requiring extensive remedial works.	Substantial reduction in environmental risk to sensitive receptors. Substantial improvement in ground conditions.
Medium	Moderate environmental risk to sensitive environmental receptors requiring monitoring and localised remedial works.	Moderate reduction in environmental risk to sensitive environmental receptors. Moderate improvements in ground conditions.
Low	Minor environmental risk to sensitive environmental receptors requiring no remedial work (or no additional remedial work if remedial works are ongoing).	Minor reduction in environmental risk to sensitive environmental receptors. Minor improvements in ground conditions.
Negligible	Residual risk considered to be so minor to sensitive receptors that it would not be detectable. No appreciable change in environmental risk to sensitive environmental receptors.	

11.55 The magnitude of impact considers potential additional risks upon receptors as a result of the Proposed Development and not any pre-existing conditions. Therefore the magnitude of impact is the adverse or beneficial effect on existing Site conditions as a result of the Proposed Development or the introduction of additional receptors.

11.56 Where a potential impact is identified, the significance of the impact and level of contamination risk is determined by considering the sensitivity and type of receptor, the temporal nature of the impact (i.e. temporary/reversible/permanent, frequent/infrequent/rare and short/medium/long term) and the geographic scope of the impact upon receptors, which can be defined as:

- Temporary - a non-permanent impact occurring for a typically short-lived period such as during demolition or construction works;
- Reversible - an adverse impact which over time can be reversed through natural or man-made interventions such that the original pre-impact condition returns;
- Permanent - a non-reversible impact such as the permanent closure of a groundwater abstraction point or the extinction of a sensitive flora or fauna species from a site or watercourse;
- Frequent - a regularly occurring impact, e.g. from a corroded oil storage tank overflow pipe leaking every time the oil is delivered;
- Infrequent - a less regular occurring impact, e.g. an annual application of a fertiliser or herbicide;
- Rare - a very occasional impact occurring, e.g. through a 1 in 50 year storm event causing a contamination collection pond to burst its banks;
- Short-term - i.e. an impact occurring for a limited duration of time (less than one year);
- Medium-term - i.e. an impact occurring for 1 – 5 years until for example a site is fully remediated;
- Long-term - i.e. an impact that is likely to occur for more than five years;
- Highly localised - confined to a very small section of a site or area;
- Site-wide - affecting a whole site; and
- Locally - affecting a site and areas immediately outside of it (possibly up to Borough-wide); or widespread, affecting a large area, for example river catchment, regional, national, global.

11.57 For the purposes of this assessment, the criteria detailed in Table 11.5 have been used to assign significance:

Table 11.5: Significance Criteria					
Sensitivity of Receptor		Magnitude of Impact			
		High	Medium	Low	Negligible
	High	Major	Moderate/Major	Moderate	Minor
	Medium	Moderate/Major	Moderate	Minor/Moderate	Negligible/Minor
Low	Moderate	Minor/Moderate	Negligible/Minor	Negligible	

11.58 The resulting significance criteria can be described as follows:

- Major Adverse:** Significant environmental risk to a sensitive environmental receptor, and/or humans (construction workers and end users) requiring extensive mitigation works. For example, substantial widespread permanent reduction in quality of potable groundwater and/or surface water resource, substantial and permanent impact on

ecosystems (plant and animal numbers) and/or substantial long-term effect on human health;

- **Moderate Adverse:** Local environmental risk to a sensitive environmental receptor and flora, and/or humans (construction workers and/or end users) requiring monitoring and local mitigation work. For example, substantial short-term/moderate long-term reduction in quality of groundwater and/or surface water resource, substantial short-term/moderate long-term effect on ecosystems and/or human health;
- **Minor Adverse:** Temporary and minor environmental risk to a sensitive environmental receptor, for example minor local reduction in groundwater and/or surface water quality, minor local impact on ecosystems. Effects are reversible. Minor effect on human health;
- **Negligible:** No appreciable environmental risk to a sensitive environmental receptor and/or human health. Any minor adverse effects are reversible;
- **Minor Beneficial:** Minor reduction in environmental risk to humans or a sensitive environmental receptor. For example, minor local improvement in groundwater and/or surface water quality, minor local improvement in impact on ecosystems and minor improvement in human health effects;
- **Moderate Beneficial:** Moderate reduction in environmental risk to humans or a sensitive environmental receptor. Moderate improvement in groundwater and/or surface water quality, moderate improvement in ecosystems effects and moderate improvement in human health effects; and
- **Major Beneficial:** Substantial reduction in environmental risk to humans or a sensitive environmental receptor. Substantial widespread improvement in quality of potable groundwater and/or surface water resource, major improvement in impact on ecosystems and major improvement on human health effects.

11.59 As detailed in Chapter 2: EIA Process and Methodology of this ES, EIA is a process that identifies the likely significant environmental effects (both beneficial and adverse) of a proposed development. The process aims to prevent, reduce and mitigate any adverse significant environmental effects, where these are identified. Significant effects are considered material to the DCO decision process. Based on the above, residual effects of moderate and major scale may be considered significant (as shown by the shaded sections of Table 11.5).

Assumptions

11.60 The following assumptions are relevant to this Chapter:

- The information contained in this Chapter relies in part on desk study information and third party information gathered for the Site. It has been assumed that the information is accurate, however as with any dataset, these may be subject to change, either since being recorded or in the future during the planning determination process, which may influence the findings of the assessment. However, it is considered that any such changes are unlikely to alter the results of this assessment.
- The assessment of effects has been carried out against the baseline ground conditions at the Site developed based upon the findings of intrusive ground investigation. It is noted that as with all site investigations, the results are based on a 'snapshot' of the Site and the potential for further unidentified contamination cannot be completely ruled out. However, the results are considered to provide an appropriate representation of the Site's contamination status.
- The assessment of effects assumes that the Site shall be redeveloped in accordance with the Parameters Plans.
- The standard mitigation measures identified within the Outline Demolition Construction and Environmental Management Plan (ODCEMP), along with measures to protect surface waters in identified in Chapter 16 of this ES, will be implemented.
- There is a known contamination plume with on-going groundwater remediation works in the south-western part of the development area which the Remediation Safeguarding

Report (Technical Appendix 11.5) addresses. The baseline condition assessed in this chapter assumes that potential risks to the potable water supply located 1.39 km west of the Site are satisfactorily being mitigated by ongoing, Environment Agency approved, groundwater remediation works undertaken by SI Group (SIG) and that these remediation works will continue until the risks are mitigated to the satisfaction of the Environment Agency. Therefore this chapter has not assessed the effects associated with the existing potential pollutant linkage associated with the on-going remediation works as this comprises a pre-existing condition. This assessment has considered the potential effects as a result of the Proposed Development impacting this potential pollutant linkage; either by introducing new receptors or by potentially undermining the effectiveness of ongoing remediation works.

Baseline Conditions

Current Baseline

11.61 This section summarises the characteristics of the existing Geology and Ground Conditions of the Site and the surrounding area based on the available information provided in ES Volume 2: Technical Appendix 11.1 to 11.4.

Current Site Setting

11.62 The Site is approximately 10 kilometres to the north of Wolverhampton and immediately west of Junction 12 of the M6 in South Staffordshire. The Site is approximately 297 hectares (ha) in size and is located within the administrative boundary of South Staffordshire District Council (SSDC), within the Civil Parishes of Brewood and Coven, Penkridge and Hatherton.

11.63 The Site forms an approximate horseshoe shape. The topography of the Site is gently undulating with levels rising from west (102 m above Ordnance Datum) to east (116 m above Ordnance Datum).

11.64 The horseshoe can be arbitrarily split into four sections for ease of description – referred to as the western, northern, eastern and south-eastern parts.

11.65 A railway line bisects the western arm of the horseshoe creating a parcel of land between the railway and the A449 ('the western part'). The 'northern part' of the horseshoe is formed by land located between the railway (to the west) and Calf Heath Reservoir (to the east). The Staffordshire and Worcestershire Canal runs approximately north-south through the centre of the northern part, bisecting it. The 'eastern part' is the land aligned along Vicarage Road and is formed by six fields and part of Calf Heath Wood. The south-eastern part of the Site extends in a southerly direction to, and runs parallel along, the Staffordshire and Worcestershire Canal with the eastern boundary formed by Woodlands Lane and Stable Lane.

Western Part

11.66 The western part comprises a narrow section of open agricultural land, characterised by drainage channels, hedges and trees, and bisected by Gravelly Way running west – east. The eastern boundary is formed by the railway line, which is sited in a cutting (rail corridor) that is approximately 1 – 4 m variably below Site levels. Fir Tree Cottage (off-site residential property) is located adjacent to the south-western Site boundary. A small copse of trees is located adjacent to the railway line, and a small pond is located in the south. A copse and marsh is located in the north-west. There are remediation and abstraction and monitoring wells in the south of this area.

Northern Part

11.67 The northern part primarily comprises open agricultural land, interspersed with trees, hedgerows and small ponds. A canal runs through this area, set approximately 0.5 m below Site levels, and is lined with trees on the east side. Two copses of woods, one with ponds, and a number of scattered individual landscape trees, are located between the railway and

the canal. Inset into this area but off-site are a number of residential and light commercial properties aligned along Croft Lane and the northern part of the canal. To the west of the canal, between it and Calf Heath Wood, there is a small derelict building known as Gailey Magazine, and two small locked, unmarked storage buildings.

Eastern Part

- 11.68 The east of this area is occupied by an active sand and gravel quarry (Salop Quarry) and access road linking with the A5. Calf Heath Quarry has been in operation since March 2012 and an Environmental Permit is in place to enable sand and gravel extraction from six fields in a phased manner over a total of 25 years. During the Site inspection in January 2015, it was noted that the quarry operates a number of machines, including two diggers, four dumpers, four loading shovels, and two processing wash plants with conveyors. The vehicles were understood to be diesel fuelled, and refuelled onsite from three diesel aboveground storage tanks (ASTs). The processing plants were electrically powered using electricity generated on-site by two diesel fuelled generators with associated ASTs. Servicing of plant and vehicles occurs on site. Quarry workings are also situated in the south of this area, north of Vicarage Road. The operations include quarrying, material stockpiling and the inclusion of settlement ponds.
- 11.69 A number of balancing ponds (generally 2.0m but locally up to circa 7m deep) were noted across the eastern part of the Site, associated with ongoing quarrying activities. It is understood that water entering an active excavation is pumped for temporary storage, prior to use as process water as part of the quarrying activities. Any remaining water is subsequently moved to a new holding area for future use. The process is repeated, with water pumped between excavations and recycled, and hence the water is not discharged off-site. Due to their temporary nature, these transient water bearing ponds are not considered to represent potential receptors to contaminants (if generated) associated with Site activities.
- 11.70 The eastern part also comprises open agricultural land lined with hedgerows and part of Calf Heath Wood. Its boundary is formed by Vicarage Road and Woodside Farm is located adjacent off-site.

South-Eastern Part

- 11.71 The south-eastern part of the Site predominantly comprises open agricultural land, with Straight Mile road bisecting the southern section from west to east. A number of farm buildings are present in the southern and north-western area of the land part with residential housing also present in the western area.

Surrounding Area

- 11.72 The majority of the immediate surrounding area comprises open land of agricultural appearance with no potentially significant contaminative land uses.
- 11.73 The Bericote Development (under construction), Four Ashes Industrial Estate and the SI Group (chemical works) are located within the central area of the horseshoe and these comprise numerous large units of industrial / commercial appearance with potentially contaminative activities. In addition, other potentially contaminative activities include a petrol station 42m north of the Site and a boat yard / servicing centre situated adjacent to the north-west corner of the Site.

Historical Land Use

- 11.74 Historical mapping of the Site and surrounding area dated between 1883 and 2014 was obtained by Ramboll on 7th January 2015. The maps are included as Technical Appendix 11.1 with a summary of the findings presented below.
- 11.75 The earliest maps dated 1883 identified the Site to have comprised undeveloped agricultural land with some areas of woodland located in the south-east and east. Small gravel pits were present in the north-west and north-east of the Site. The Staffordshire and Worcestershire Canal intersects the centre of the Site from the north to the south. Approximately four small

ponds (understood to still be present in current day) were marked in the north, east and west of the Site. Multiple drains were depicted across the entirety of the Site and there was also a small area of marshland evident in the north-west. The surrounds of the Site were also largely occupied by undeveloped agricultural land at this time. Calf Heath Reservoir was situated immediately off-site to the north-east, beyond which Watling Street Plantation was located. Stafford Road bordered the Site to the west and Watling Street bordered the Site to the north. A railway line followed a route through the Site similar to the present day alignment, with residential properties and Gailey train station located adjacent to the north-western corner of the Site.

- 11.76 By 1900 a sand pit was marked 250 m south-west of the Site, and by 1902 a gravel pit recorded in the north-west of the Site was occupied by marshlands.
- 11.77 From 1924 a number of changes of land use were recorded within the surrounding area. By 1924 two chemical works were constructed within the central area (in what is now the Four Ashes Industrial Estate and not associated with the SIG production facility), located adjacent to railway tracks in the west and adjacent to the canal, 200 m from the Site boundary. The two chemical works appeared to not be connected to one another and the maps depicted a series of buildings but no presence of tanks. Gailey Wharf was shown to be present along the Staffordshire and Worcestershire Canal, off-site to the north of the Site.
- 11.78 By 1954 the central area, later referred to as Four Ashes Industrial Estate, had been significantly re-developed to be occupied by over 25 industrial units. This included two unnamed works located 25 m and 85 m off-site and a factory 250 m off-site. A sand and gravel quarry was also depicted on mapping dated 1954, approximately 100 m to the south of the Site with works buildings and tanks located 200 m south.
- 11.79 Further development was shown in the surrounding area between 1957 and 1975. A works (tar and chemical works) was constructed to the north of the Four Ashes Industrial Estate (current SIG production facility). A works was constructed immediately off-site to the north-west and the Stafford Road (A449) which bordered the Site to the west had widened to form a dual carriageway. On a map dated 1967 a 'Works' and area annotated as 'Corporation Yard' was depicted as being present adjacent to the railway off-site beyond the north-west corner of the Site. The M6 motorway was constructed immediately off-site to the east and north-east and a large section of the sand and gravel pit immediately beyond the Staffordshire and Worcestershire Canal to the south of the Site appeared to have been infilled. A garage (Gailey Service Station) was also shown constructed approximately 40 m north of the Site.
- 11.80 By 1978 further industrial development was evident within this area. The chemical works had expanded to the north and to the east of the canal into Calf Heath Wood. The works comprised approximately ten units and multiple tanks (at least 25). In the east of the Four Ashes Industrial Estate, a chemical works (not associated with the SIG production facility) was marked 90 m from the Site and a carbon works, with associated chimneys and hoppers had been constructed 80 m from the Site boundary. Three electrical sub-stations had been constructed with the closest located 60 m south of the Site. The factory 250 m east was re-developed into a warehouse, the works 25 m east had expanded and an engineering works was constructed in the centre, 200 m from the Site border.
- 11.81 By 1988 a sewage works with associated filter beds and digesters was constructed 95 m south and further extension of the Industrial Estate was shown on the 1990 map.
- 11.82 The mapping dated 1994 identified the carbon works 80 m off-site and the chemical works 90 m off-site had been cleared prior to the construction of two buildings of industrial appearance.
- 11.83 By 2002 an off-site sand and gravel quarry had expanded to be located immediately beyond the Staffordshire and Worcestershire Canal to the south of the Site. The portion of the chemical works immediately adjacent to Calf Wood had been largely cleared by 2014.
- 11.84 At the time of writing the Bericote Development (adjacent to the Site – south-west of the central wooded area) was under construction.

Environmental Setting

- 11.85 A GroundSure EnviroInsight Database was obtained by Ramboll Environ on 7th January 2015, which is included as Technical Appendix 11.3, with a summary of information provided below.
- 11.86 No contaminated land register entries/notices were recorded within a 1 km radius of the Site.
- 11.87 There were records of two (2) historic landfills previously located on-site, all within the south, south-eastern part:
- Four Ashes Quarry which was authorised to receive inert waste; the first input date was given as 5th July 1982 and the last input date 31st December 1985. There is evidence of leachate control for the landfill however no further details were given (based on information from the Environment Agency web-site¹²); and
 - Four Ashes Pit, Straight Mile Farm Landfill which was authorised to receive industrial and inert waste; the landfill was licensed to receive waste from 26th October 1978 with the licensed surrender dated as 23rd March 1993 (no further information provided on Environment Agency web-site¹², accessed in January 2017).
- 11.88 There were a further five (5) records of historic landfill sites recorded within an approximate 250 m radius of the Site (i.e. the “planning consultation zone”). The historic landfill sites are located to the north-east, south, and south-east of the Site:
- Field Off Deepmore Lane Landfill, identified to have accepted waste from a factory or industrial process, excluding waste from mines, quarries and agricultural wastes. The first input date was given as 4th May 1990 and the last input date 18th September 1991;
 - Barr Farm, situated 157m south of the Site, licensed from 1991 to receive inert waste. The licensed address is listed as Hilton Lane, Shareshill;
 - Four Ashes Pit (adjacent to the south-east), Long Molls Bridge, Four Ashes which was authorised to receive industrial and inert waste; the landfill was licensed to receive waste from 26th October 1978 with the licensed surrender dated as 23rd March 1993;
 - A site described as ‘Landfill Site near Motorway’, situated 255m north-east. No further licenses details or information relating to the type of waste deposited is provided; and
 - Situated approximately 80 m south of the Site: Brindley Asphalt, Pennymore Hay Farm Landfill Site identified to have accepted ‘other’ wastes and licensed from 24th July 1981. The landfill is recorded as closed by the Environment Agency but no closure dates were identified on the available information.
- 11.89 There were twelve (12) current Environmental Permits to operate waste management facilities within 250 m and a further two within 1 km. The nearest was registered to Enterprise A O L Limited, located 30 m east for inert and excavation waste transfer station and treatment plant.
- 11.90 There were nine (9) Environmental Permits to operate Part A (1) Installations (formerly referred to as Integrated Pollution Prevention and Control (IPPC) within 500 m. The closest of which is registered to SI Group UK Limited located approximately 200 m east for co-incineration of hazardous waste, organic chemicals, nitrogen containing compounds e.g. amines and organic chemicals; oxygen containing compounds e.g. alcohols.
- 11.91 There were no records of Environmental Permits to operate PPC Part A(2) Installations (formerly referred to as Local Authority IPPC Authorisations), within 500 m of the Site.
- 11.92 There were four (4) Environmental Permits to operate a PPC Part B process (formerly referred to as Local Authority Air Pollution Control Permits) within 500 m. The closest is licensed to Gailey Service Station located 42 m north to allow a Petrol Vapour Recovery Process.
- 11.93 There are no Radioactive Consents registered within 500 m of the Site. Due to public security restrictions, certain information on closed or mobile radioactive substance authorisations has been removed from the public register and is not available to Ramboll.
- 11.94 There are records of one (1) Historical Installations Handling Hazardous Substances located in the southern part of the Site. This was registered to Inspec Fine Chemicals Ltd. However, whilst no further information was provided, it is considered likely that the record relates to the off-site chemical works rather than on-site activities.
- 11.95 According to the database there was one (1) record of a Control of Major Accident Hazard (COMAH) sites within a 500 m radius of the Site. This is registered to SI Group UK Limited located approximately 200 m east and categorised as a COMAH Upper Tier Operator. Ramboll are aware of another COMAH facility (Carver (Wolverhampton) Limited) which is located off Gravelly Way approximately 20 m from the Site at its nearest point.
- 11.96 There have been fourteen (14) pollution incidents recorded within 1 km. The nearest of these was located 30 m north-west of the Site and associated with an un-identified pollutant. The incident occurred in August 2006 and was classified by the Environment Agency as a category 2 incident (significant) with regards to water, a category 4 incident (no impact) with regards to land and air.
- 11.97 The Site is located in an area where less than 1% of residential properties are above the action level for Radon set by the Health Protection Agency (formerly the National Radiological Protection Board). No radon protection measures are considered necessary by the British Geological Survey.
- 11.98 There is one (1) fuel station entry within a 500m radius. This is a BP petrol station (Gailey Service Station) located approximately 40 m north of the Site.
- 11.99 There was one (1) record of a designated sensitive site within a 1 km radius of the Site this is for Four Ashes Pit, a geological Site of Special Scientific Interest (SSSI) located approximately 140 m south. Further review of information provided by Natural England¹³ identified that Four Ashes Pit is the type site for the Devensian Stage of the Quarternary Period ca. 50,000 years ago. It consists of a sequence of sands and gravels, overlain by till lying on top of Triassic Sandstone bed rock. Organic deposits and periglacial features, both within and below the gravels, have provided a substantial body of information on environmental conditions during the last (Ipswichian) interglacial phase and the early and middle Devensian Stage of the Ice Ages, while periglacial features and the till in the upper part of the succession record the late Devensian cold episode.

Initial Regulatory Authority Enquires

- 11.100 Ramboll received correspondence from the Pollution Control Officer (PCO) at South Staffordshire Council dated 22nd January 2015 (which was updated on 23rd May 2017), which provided the following information with regards to the Site:
- The Site is not held on the council’s Contaminated Land Register, required under Part IIA of the Environmental Protection Act 1990. As of 23rd May 2017 the information held by the council does not support the presence of a significant contaminant linkage which would lead the council to prioritise the Site for detailed inspection;
 - The PCO advised that there are no known contamination issues associated with the Site or in the near vicinity;
 - There were two Environment Agency permitted processes within 250 m of the Site: SI Chemical Plant and Energy Recovery Facility;
 - Calf Heath Mortar Plant (EPR75/14) and Accumix Concrete Ltd (EPR 77/15) are Local Authority Permitted Processes located on Site;

- The Council had not received any contact from occupants of the Site or neighbouring sites in relation to any evidence of land contamination of their property; and
- There were no known current or former nuisance issues, prosecutions or enforcements associated with the Site or adjoining properties due to noise, odour or dust.

11.101 An enquiry was also submitted by Ramboll to the Petroleum Officer (PO) at Staffordshire County Council in order to establish if the Site was currently or had previously been licensed for the bulk storage of petroleum products. The PO confirmed in correspondence dated 9th January 2015 (which was updated on 22nd May 2017) that at that time there are no records of current or historical petroleum storage on Site other than 'canned' storage, no further information regarding quantities and locations was available.

Geology & Hydrogeology

11.102 Desk-based research of the local geology, hydrogeology and hydrology was carried out in order to establish the potential for migration of contamination onto or away from the Site, and to assess the sensitivity and vulnerability of the Site's setting with respect to surface water, groundwater and ecological resources. Information was obtained from a number of sources, including:

- examination of published geological maps produced by the British Geological Survey (BGS): Sheet 153, Wolverhampton;
- review of the Groundsure environmental database; and
- Regulatory Authority websites including the Environment Agency (EA) 'What's in Your Backyard'¹⁴.

11.103 According to the BGS website¹⁵ the nearest available-to-view borehole logs are located in the north-east and east of the Site and show fine and medium grained sand (topsoil) to depths 0.45 m below ground level (bgl). This is further underlain by glacial till (sandy clay) to 1.3 m which is further underlain by glacial sands and gravels to up to 4.9 m bgl. The superficial deposits were recorded to be underlain by completely disintegrated Wildmoor Sandstone to confirmed depths of 10.2 m below ground level (bgl).

11.104 There are multiple records borehole logs and trial pits in the south-eastern portion of the Site which show fine and medium grained, slightly gravelly sand (topsoil) to depths of between 0.2 m and 0.3 m bgl. This is underlain by made ground generally described as demolition waste. The Made Ground comprised gravelly, clayey sand with occasional cobbles, occasional brick and concrete gravel and rare asbestos tiles, ash, wood, glass and metal to depths of up to 4.8m bgl. The Made Ground is further underlain by completely and partly disintegrated Wildmoor Sandstone to confirmed depths of 10.0 m bgl.

11.105 Another borehole, located immediately off-site within Four Ashes Industrial estate recorded top soil to 0.3 m bgl underlain by glacial drift to 4.8 bgl. The superficial deposits are further underlain by bedrock of the Bromsgrove Sandstone Formation to confirmed depths of 91.4 m bgl.

11.106 A summary of the geological and hydrogeological setting of the Site is provided in Table 11.6 below.

Formation	Description	Thickness	EA Aquifer Designation	Hydrogeological Significance
Glaciofluvial Deposits	Sand and gravel (across the south-west and north parts of the Site)	Unknown	Secondary A	These have permeable layers capable of supporting water supplies at a local rather than

Formation	Description	Thickness	EA Aquifer Designation	Hydrogeological Significance
				strategic scale, and in some cases forming an important source of base flow to rivers.
Till	Diamicton (c. in a small portion of the south-west of the Site)	Unknown	Secondary A	These have 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.
Alluvium	Clay, silt, sand and gravel (across the Site in the east and north-west)	Unknown	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
Bromsgrove Sandstone Formation	Sandstones inter-bedded with siltstone and mudstone in the north-western area of the Site	30 m to 140 m thickness	Principal	Highly permeable, with significant water storage. Able to support large abstractions.
Wildmoor Sandstone Formation	Sandstones, with subordinate siltstone and mudstone (across much of the east, south-east and south-west of the Site)	20 m to 240 m thickness	Principal	Highly permeable, with significant water storage. Able to support large abstractions.

11.107 The Environment Agency (EA) groundwater vulnerability map (Sheet 22; South Staffordshire & East Shropshire) confirmed that the Site comprises either soils of high leaching potential or soils with low leachability.

11.108 The EA currently classifies the Staffordshire Trent Valley groundwater body (sandstone) at the Site as being of 'poor' chemical quality and of 'poor' quantitative status under the Water Framework Directive classification scheme.

11.109 According to EA information presented in the environmental database, there are fifteen (15) licensed groundwater abstractions located within a 1 km radius of the Site. There are a further eight (8) abstractions within a 2 km radius, two (2) of which are reportedly for potable water supply located 1.39 km west and 1.49 km south. The groundwater abstractions identified within 1km of the Site are detailed on Table 11.7 below.

¹⁴ <http://apps.environment-agency.gov.uk/wiyby/default.aspx>, accessed 9 January 2015 and 6 November 2017

¹⁵ <http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html>, accessed 7 December 2017

Table 11.7: Licensed Groundwater Abstractions within 2km of the Site		
Distance from Site	Abstraction source	Purpose of Abstraction
On-site	Borehole C, D, E, F and G	General Use Relating To Secondary Category (High Loss)
20 m S	Borehole at Gravelly Way	General Use Relating To Secondary Category (Medium Loss)
30 m E	Borehole 14 and 15	General Use Relating To Secondary Category (High Loss)
30 m E	Borehole B	General Use Relating To Secondary Category (High Loss)
60 m E	Borehole 145	General Use Relating To Secondary Category (High Loss)
70 m W	Land Off Stafford Road	General Farming & Domestic
75 m E	Borehole 144	General Use Relating To Secondary Category (High Loss)
80 m W	Evergreen Farm	General Farming & Domestic
90 m E	Borehole 143	General Use Relating To Secondary Category (High Loss)
130 m SE	Borehole at Four Ashes Treatment Works	General Washing/Process Washing
140 m E	Borehole A	General Use Relating To Secondary Category (High Loss)
140 m E	Borehole at Calf Heath, Four Ashes	Process Water
160 m E	Borehole 141	General Use Relating To Secondary Category (High Loss)
270 m SW	Borehole At Four Ashes	Process water
990 m N	Borehole at Rodbaston College	General Farming & Domestic
Entries in bold represent abstractions for sensitive uses.		

11.110 The majority of the Site (approximately 95% of the total Site area: encompassing all but the north-west tip) is situated within a Zone 3 EA designated groundwater Source Protection Zone¹⁶. The remainder of the Site (approximately 5% of the total area, encompassing the north-western corner) is situated within a Zone 2 EA designated groundwater Source Protection Zone¹⁷.

11.111 The PCO from South Staffordshire District Council confirmed that there are three (3) private water abstractions within 2 km of the Site. All are groundwater abstractions for domestic use and are located off-site as follows:

- 1.0 km north-east;
- 0.3 km north-east; and
- 0.6 km north-east.

Coal Authority Report

11.112 A Coal Authority Report dated 9th January 2015 stated that the Site is not within a zone of likely physical influence on the surface from past, present or future underground or open-cast workings. However, coal reserves do exist in the local area which may be potentially worked at some time in the future. There are no known coal entries on-site or within 20 m of the Site.

Hydrology

11.113 The Staffordshire and Worcestershire Canal is located on Site in the west, several ponds are also present on Site in the south-west, north-west and north-east. Calf Heath Reservoir is located immediately off-site to the north-east and several ponds are marked in the immediate vicinity of the Site. Under the Water Framework Directive the EA classifies the Staffordshire and Worcestershire Canal as being of 'moderate' ecological quality and 'good' chemical quality. The EA had not classified Calf Heath Reservoir.

Ramboll Intrusive Site Investigation

11.114 Based on the findings of previous assessment, Ramboll completed intrusive investigation on two separate occasions to characterise the Site, as follows:

- October / November 2015: initial scope of investigation covering the majority of the Site but excluding the South-east Area – a factual report included as Technical Appendix 11.3; and
- September / October 2017: subsequent stage of investigation covering the South-east Area of the Site when access was possible – a factual report included as technical Appendix 11.4.

11.115 The factual investigation reports included as Technical Appendices 11.3 and 11.4 contain details on investigation rationale, sample locations, adopted methodology and findings, and should be referred to for technical detail. The sampling and analysis strategy was designed based on potential sources of contamination due to historic and current site use (as summarised in earlier sections of this chapter).

11.116 Correspondence was received from both the EA (correspondence dated 30th September 2015) and SSDC (correspondence dated 25th September 2015) confirming acceptance of the proposed initial 2015 investigation approach, with the following points noted:

- The EA indicated that given the industrial usages in the western area of the Site there was potential for contamination to have occurred and consideration should be given to a further borehole in this portion of the Site. The EA also provided details of petroleum loss at a Petrol Filling Station on Watling Street (National Grid Reference: SJ 9191 1047). The Petrol Filling Station site was redeveloped in 2013 with the old tanks and pipework

¹⁶ A Total Catchment or Zone 3 Source Protection Zone is defined by the EA as 'the area around a source within which all groundwater is presumed to be discharged at the source.'

¹⁷ An Outer Zone or Zone 2 Source Protection Zone is defined by the EA as the extent of the area around an abstraction point that 'has a 400 day travel time from a point below the water table'.

replaced. This facilitated soil remediation; reportedly 3,337 tonnes of hydrocarbon impacted soils were excavated and disposed of off-site. This was considered to account for approximately 90% of the contamination with some areas (close to the A5 and adjacent buildings) being inaccessible. The EA considered it unlikely that hydrocarbon impact associated with the Petrol Filling Station would be recorded as part of the proposed Site investigation, with the details provided for information only.

- SSDC indicated that further ground gas monitoring would be required at a later stage (i.e. post granting of the DCO) to assess potential ground gas implications (if any) once specific warehouse building footprints are proposed. The additional monitoring shall be undertaken at the detailed design stage.

11.117 Both the EA and SSDC were also provided the scope for the subsequent investigation of the previously inaccessible South-east Area of the Site. Following review of the scope, the EA responded on 17th October 2016 to confirm acceptance to the proposed scope. No response was however received from SSDC.

11.118 The initial Phase II Geo-environmental Site Assessment was undertaken between 19th October and 6th November 2015. The land parcel that was not accessible in the south-eastern portion of the Site was subsequently investigated between 11 September and 26 October 2017.

Initial Intrusive Investigation (2015) Key Findings and Conclusions

11.119 The geology encountered comprised generally glacial till with variable mudstone, sandstone and quartzite gravel underlain by weathered upper layers of the Bromsgrove Sandstone. No significant hardstanding was identified at the Site.

11.120 The soil and groundwater analytical results were screened against assessment criteria for current Site users (human health) and future Site users in the context of commercial / industrial use, as well as with respect to the controlled waters environment.

11.121 None of the soil samples analysed were found to contain an exceedance of the Commercial/Industrial guideline values for inorganic and organic compounds, with one minor exception (chloromethane detected at WS313) which is not considered significant given the proposed hardstanding to be present across the majority of the Site.

11.122 Asbestos was encountered in one soil sample taken from the Site (BH112 – a location in the south of the Site within reported landfilling). Further consideration of this location will be required once the development layout is finalised; preferably minimising earthworks required at this location (or adopting suitable mitigation measures during construction if applicable).

11.123 For groundwater samples a number of isolated exceedances for heavy metals was observed including copper and lead in BH212, copper in BH209, nickel in BH107 and BH203 and selenium in BH210; all of which are considered isolated exceedances and not an indication of significant impact to groundwater or surface waters.

11.124 In groundwater, zinc was detected at concentrations in excess of the relevant screening criteria in BH221, BH201, BH203, BH212, BH215, BH223, BH222 and BH106. Exceedances were generally within one order of magnitude above the relevant screening criteria and are limited to locations within the woodland area (approximate centre of the Site) and in the southern part of the Site, east of the railway line.

11.125 In addition, in groundwater an elevated concentration of ammoniacal nitrogen was detected within a sample taken from BH112; the elevated concentration is potentially indicative of filled material and the production of leachate. A number of exceedances for organic compounds was also noted within BH217 which comprised individual volatile organic compounds and chlorinated solvents, lighter individual aromatic and aliphatic petroleum hydrocarbon fractions and speciated phenols. Also pyridine was identified in BH217 above the method detection limit and it is understood that pyridine was historically used at the adjacent, off-site SI Group facility.

11.126 Ground gas monitoring was carried out and based on the results of four rounds of monitoring a general Site wide Gas Characteristic Situation 2 'Low Risk' has been calculated.

11.127 Overall in conclusion no significant widespread contamination of shallow soils or groundwater has been identified, therefore the identified contaminative profile is unlikely to preclude the proposed redevelopment of the Site. However a number of notable, localised impacts were observed across the Site which will require attention prior to redevelopment:

- Area of landfill in the south: this area of the Site is proposed for redevelopment into a warehouse Unit with extensive hardstanding and/or building cover anticipated. The fill material identified within BH112 is considered to be limited in cover; but its specific extent, vertically and horizontally, and therefore volume, is unknown; however, the fill material was not detected within the nearest two boreholes (BH221 and WS322). Findings to date do not indicate a significant constraint to development in this location, however in accordance with standard good practice further assessment is required at the detailed design stage (i.e. once specific warehouse building footprints are finalised). In particular the ground gas regime at this specific location requires further assessment with ground gases potentially produced by the fill material. Furthermore an isolated detection of asbestos was recorded in a soil sample taken at this location. This area should therefore also be further assessed at the detailed design stage.
- Woodland area: Exceedances of polycyclic aromatic hydrocarbons within groundwater obtained from BH212 were identified, additionally an exceedance for the screening criteria for chloromethane was detected at WS313 in shallow soils. Further assessment is recommended within the woodland in particular further assessment of the soils at the detailed design stage.
- South-western land area: The shallow groundwater identified within BH217 (south-west of the Site) was observed to be impacted from volatile organic compounds, phenols and lighter individual hydrocarbon fractions. This impact is considered to originate from the underlying groundwater contaminant plume currently being remediated. No further exceedances were observed with regards to the above contaminants within groundwater samples across the Site, indicating that although the aquifer is impacted at this location the migration is limited (within shallow groundwater). The shallow impacted groundwater requires management during the construction phase for any future redevelopment, this particularly relates to any dewatering required (excavations etc.). Furthermore, any permanent structures below the water table in this area will require design consideration to mitigate potential contamination impacts. Any buildings in this location may require hydrocarbon membranes / passive venting to ensure the volatilisation pathway is addressed. These issues are considered further in Technical Appendix 11.5.
- Ground Gas: Based on a general site-wide Gas Characteristic Situation 2 'Low Risk' it is likely that basic gas protection measures may be required within new buildings at the Site. Findings to date do not indicate a significant constraint to development and the type of gas protection measures which may be required are typical for many developments. However, further assessment and/or monitoring is likely to be required at the detailed design stage.

South-east Area (2017) Key Findings and Conclusions

11.128 The intrusive investigation in the south-east area of the Site comprised an assessment similar in nature to the initial investigation and included the completion of a series of intrusive investigation locations, soil and groundwater sampling and analysis, and ground gas monitoring. Soil and groundwater samples were analysed for a suite of analysis similar to the initial (2015) phase of investigation.

11.129 A round of groundwater sampling has been undertaken across the well network installed to assess the south-east area of the Site. Four (4) gas monitoring rounds have also been undertaken.

11.130 Made ground was present at all exploratory positions located in an area identified as previously having been landfilled (i.e. within the horse paddocks to the south of Straight Mile

and the sheep field to the north). Where encountered, made ground was observed to a maximum depth of approximately 4.0 m bgl. In general, made ground comprised gravelly silt and gravelly sand with brick, concrete and road materials with rare fragments of glass and wood. Made ground was not identified at the exploratory positions situated outside of the former landfill area.

- 11.131 Shallow deposits (<1m bgl) observed in the area investigated consisted of topsoil and/or grass or crop cover. Superficial drift deposits generally consisted of brown/orange/red fine to coarse sand with varying amounts of sandstone, mudstone and quartzite gravel with occasional sandy gravel deposits present. Shallow sandy clay was also present at select exploratory locations. The solid geology observed in this area of the Site consisted of weathered Sandstone (Bromsgrove Sandstone) comprising red/brown silty, fine to medium sand underlying the superficial drift at the Site and tending to increase in strength with depth. The depth to the top of the Sandstone varied and in general was observed within 6m of the ground surface.
- 11.132 None of the soil samples analysed were found to exceed the Commercial/Industrial guideline values available for inorganic and organic compounds. Three separate compounds included in the pesticide / herbicide analysis suite were detected (each at different sample locations). The pesticide detections were marginally above the limit of detection adopted by the laboratory and are not considered to present a significant risk in the context of the Proposed Development. Asbestos was encountered in seven soil samples collected from fill material within the former landfill area.
- 11.133 Groundwater results were reported to be below Ramboll criteria derived to safeguard human health (e.g. from a potential volatilisation pathway). Inorganic determinands detected in groundwater were above the respective Controlled Waters assessment criteria for select heavy metals, sulphate, nitrate and nitrite. In addition organic determinands including select PAH compounds and two detections of chloroform exceeded their respective Controlled Waters screening criterion. The exceedances are considered to be isolated in nature with results generally less than one order of magnitude above the respective screening value. The concentrations reported are not considered significant in the context of the Proposed Development and impact upon identified sensitive receptors.
- 11.134 Ground gas monitoring was carried out over four monitoring events. The results indicate a Gas Characteristic Situation 2 'Low Risk' which is consistent with the classification determined in the initial (2015) intrusive investigation across the wider portion of the Site.
- 11.135 In conclusion, the soil results reported for the south-east area of the Site are below the adopted screening criteria and do not indicate significant contamination issues precluding this area of the Site from the Proposed Development. However, within the footprint of the former landfill area there were reported detections of asbestos within shallow made ground deposits. However, on the basis of the reported soil results it is considered that control measures would need to be adopted for development of this area given the presence of asbestos in soils. Development control measures (such as measures to prevent made ground containing asbestos from presenting a potential exposure hazard during or following development) should be determined at the detailed design stage. This would comprise ensuring suitable 'capping' of these areas (either underneath proposed hardstanding or suitable topsoil capping using on-site materials).
- 11.136 The reported groundwater results show Controlled Water exceedances for select inorganic and organic determinands. However, where detected, the reported concentrations are generally less than one order of magnitude above the adopted criteria and detections are isolated in occurrence (not widespread). The reported concentrations are not considered to present significant contamination issues in the context of the Proposed Development of the Site, given the Site setting (i.e. the absence of potable surface water and groundwater abstractions on-site).
- 11.137 As with the 2015 assessment carried out across the wider Site area, the preliminary Gas Characteristic Situation 2 'Low Risk' determined for the south-east area suggests that basic

gas protection measures may be required within new buildings that may cover this portion of the Site.

Geotechnical Summary

- 11.138 The Waldeck Summary of Ground Conditions (Technical Appendix 11.7) identified a number of geotechnical features that required consideration as part of the Proposed Development:
- Alluvium running along the route of a minor tributary of the River Penk situated west of the Site from the A449 to the Staffordshire and Worcestershire canal;
 - Potential for unexpected ground conditions associated with glacial till valleys;
 - Potential for differential settlement across large structures;
 - Existing watercourses; and
 - Unconsolidated backfilled materials associated with current and historical mineral extraction (quarrying).
- 11.139 The Waldeck Summary of Ground Conditions (Technical Appendix 11.7) notes that in general the encountered ground conditions were suitable to enable the use of standard concrete pad foundations or strip footings, with the exception of Calf Heath Quarry and former landfilled areas. The preferred foundation solution in these areas will depend on the layout of the specific warehouse buildings, however typical alternative solutions could comprise deeper mass concrete foundations, compaction of strata or in-situ ground improvement.
- 11.140 An extensive cut to fill exercise will also be required to support construction of large warehouse buildings included as part of the Proposed Development.
- 11.141 According to geotechnical assessment undertaken, there are no identified significant effects of land instability which could affect the Proposed Development or nearby receptors. Geotechnical ground condition issues can be addressed as part of typical options for foundation design. Therefore geotechnical / land instability issues are not considered further in this chapter.

Sensitive Receptors

Existing Sensitive Receptors

- 11.142 The baseline section confirms the following sensitive receptors that may be affected by the Proposed Development:

Controlled Waters

- (High Sensitivity) underlying Groundwater in the superficial deposits and Wildmoor / Bromsgrove Sandstone Formation (Principal Aquifer);
 - Calf Heath Reservoir (High Sensitivity) which is situated immediately off-site to the north-east. Calf Heath Reservoir is situated up gradient of the predicted groundwater flow direction, reducing the potential for impact from the Site;
 - Staffordshire and Worcestershire Canal (Medium Sensitivity; located on-site but likely to be lined and not in total continuity with regional groundwater) which is located on-site in the west;
 - River Penk (Low Sensitivity) to the west of the Site;
 - Saredon Brook (Low Sensitivity) to the south of the Site;
 - Site is situated in a Source Protection Zone III – Total Catchment Area (Medium Sensitivity), with the exception of approximately 5% of the total area, encompassing the north-western corner) which is situated within a Zone II. There are potable abstraction wells recorded over 1km west of the Site; and
- According to groundwater data the regional groundwater flow direction is predominantly east to west and as such private groundwater abstractions to the north-east of the Site are located up hydraulic gradient of the Site and are unlikely to be affected by the Proposed Development and not considered receptors.

Human Health

- Site maintenance workers (High Sensitivity) such as to address rail lines and on-site sections of canal, where increased chance of direct contact exposure to contaminants (if present). It is understood that mineral extraction works shall cease at the Site prior to commencement of the Proposed Development and therefore consideration of risks to quarry workers is not included;
- A small number of residential properties (Medium Sensitivity) adjacent to Site boundary and further within 100m of the Site;
- Members of the public (Low Sensitivity) such as dog walkers that may currently access the Site for relatively short periods; and
- Off-site commercial workers (Low Sensitivity) including users of Four Ashes Industrial Estate, agricultural land and the chemical works in the immediate surrounding area.

Other

- The ongoing groundwater remediation works were designed to mitigate risks to regional groundwater resources. Any action to the detriment of the ongoing groundwater remediation could ultimately adversely impact groundwater resources. Therefore the ongoing remediation works (e.g. associated infrastructure) is considered to represent a receptor (Medium Sensitivity);
- Current agricultural arable land usage (Medium Sensitivity) across a portion of the Site (noting that land use will change upon development); and
- Four Ashes Pit, a geological Site of Special Scientific Interest (SSSI) located approximately 140 m south of the Site. It is understood that regional groundwater flow is from east to west within the vicinity of the Proposed Development and hence the SSSI is not considered to be influenced by groundwater concentrations at the Site and the ongoing remediation works. However, assessment of potential risks associated with non-mitigated construction effects such as due to dust have been considered.

New Sensitive Receptors

- 11.143 Future sensitive receptors introduced to the Site by the Proposed Development, would include:
- Human Health (during development phase works) – Construction Workers;
 - Human Health (following development) – Future commercial Site Users; and
 - Built Environment (following development) including buildings and utilities – Migration of ground gases into commercial buildings and structures and chemical attack to buried service lines.
- 11.144 General Public access (e.g. for dog walkers) to the Site is included as part of the Proposed Development within proposed community parks, with the remaining areas predominantly hard standing covered and thereby reducing the potential risks to Site users.

Migration Pathways

- 11.145 The following migration pathways are considered relevant in respect of the construction of the Proposed Development:
- Migration of mobile contaminants (if present) via the underlying groundwater body within the within the superficial deposits and upper weathered Sandstone;
 - Migration via drainage introduced as part of the Proposed Development;
 - Lateral migration of contaminated groundwater (if any);
 - Migration of contaminants via the disturbance of ground and unconsolidated materials, particularly within the former quarried areas;
 - Volatilisation and inhalation of volatile contaminants (such as hydrocarbons) during construction activities; and

- Ingestion or inhalation of contaminated materials (if present) during construction phase activities only.

Embedded Mitigation

- 11.146 An Outline Demolition and Construction Environmental Management Plan (ODCEMP) has been prepared and is provided in Technical Appendix 2.3. The plan details incorporated measures intended to mitigate the impact of the Proposed Development. The ODCEMP will be supported by Demolition and Construction Environmental Management Plans (DCEMP) prepared for each phase of development to reflect Site conditions. Wherever DCEMP is mentioned in this ES it is a collective term and includes multiple versions for differing phases of development.
- 11.147 Further embedded mitigation includes the Proposed Development progressing in accordance with the remediation Safeguarding Report (Technical Appendix 11.5).
- 11.148 Monitoring wells and infrastructure (including underground pipework) associated with an ongoing groundwater remediation are present in the south-western portion of the Site. Uncontrolled construction works (e.g. during cut to fill works) could prevent access to, damage or destroy infrastructure associated with the ongoing remediation works. Control measures are required for excavation works, stockpiling and storage of Site retained materials as well as fuels, oils, chemicals and equipment. In addition, it will be necessary to reroute current underground pipework as well as decommission and replace monitoring wells in order to facilitate the Proposed Development (as per the Remediation Safeguarding Report, Technical Appendix 11.5).
- 11.149 Localised deeper excavation works, particularly during construction of the rail freight terminal, as well as installation of services and foundations and works, could impact groundwater flow direction and groundwater levels which could, if not controlled, impact the efficiency of the ongoing remediation. Mitigation measures as per the Remediation Safeguarding Report (Technical Appendix 11.5) will be implemented.
- 11.150 Embedded mitigation (as outlined in the ODCEMP and Remediation Safeguarding Report) has been fully integrated into the Proposed Development to limit any otherwise potentially adverse effects on sensitive receptors. The impact assessment presented in Paragraph 11.153 onwards of this chapter is undertaken assuming the incorporation of measures set out in the ODCEMP and the Remediation Safeguarding Report. It is anticipated that these will be secured by suitably worded DCO Requirements giving high confidence that these measures will be implemented.

Potential Effects

- 11.151 Potential impacts are considered in the context of the source-pathway-receptor framework outlined by Part 2A of the 1990 Act and associated guidance identified in the Legislation and Policy Context Section outlined above.
- 11.152 The findings of desk based and intrusive investigation undertaken across the Site, including soil and groundwater monitoring and ground gas monitoring, have not identified widespread contamination at the Site. However, in the absence of additional mitigation (i.e. beyond measures stated in the ODCEMP and Remediation Safeguarding Report), the Proposed Development could give rise to a range of potential impacts during the construction phase works and during occupation of the Site upon completion.

Potential Demolition & Construction Effects

- 11.153 The demolition and construction phase works for the Proposed Development could give rise to a range of potential impacts. A number of standard mitigation measures to address potential impacts are identified in the ODCEMP. However, in the absence of further specific control measures to address the Ground Conditions identified at the Site (i.e. measures in addition to those stated in the embedded mitigation section above), the construction phase

activities could lead to potential impacts as summarised below (the potential effects are listed based on the assumption that measures outlined in the ODCEMP (Technical Appendix 2.3) and Remediation Safeguarding Report (Technical Appendix 11.5) are implemented):

- Construction workers may come into direct contact with potentially contaminated soils, particularly as part of the required cut to fill works, such as isolated asbestos recorded a depth in the eastern portion of the Site (within Zone A6 of the Parameters Plan) and the isolated chloromethane concentration recorded within the woodland area (within Zone A6 of the Parameters Plans);
 - As with any former site, a potential exists for further limited contamination hotspots to be discovered during construction works and in the absence of mitigation there is a risk associated with any works in areas of made ground;
 - Without mitigation, controlled waters could be affected during demolition and construction by accidental spillage of oil and diesel from infiltration of polluted runoff through the soil. This could potentially affect groundwater in the underlying groundwater source protection zones II and III. According to groundwater data the regional groundwater flow direction is predominantly east to west and as such private groundwater abstractions to the north-east of the Site are located up hydraulic gradient of the Site and are unlikely to be affected by the Proposed Development and not considered receptors;
 - As noted above, according to groundwater data the regional groundwater flow direction is predominantly east to west and as such it is not anticipated that the Proposed Development will significantly affect the hydrogeological regime of the geological SSSI (140 m to the south of the Site). The demolition and construction phases of the Proposed Development, providing mitigation measures are implemented as per the ODCEMP (Technical Appendix 2.3), will not introduce significant pollutants, additional discharges to underlying groundwater or comprise groundwater abstraction and therefore will not affect the hydrogeological regime of the geological SSSI 140 m to the south of the Site; and
 - Encountering and mobilisation of pre-existing localised contamination (if present) during construction phase works may occur which includes historically infilled materials.
- 11.154 The demolition and construction phases of the Proposed Development, providing mitigation measures are implemented as per the ODCEMP (Technical Appendix 2.3), will not introduce significant pollutants / additional discharges to underlying groundwater and therefore not affect the groundwater source protection zones II and III underlying the Site. Furthermore, it is proposed that the ongoing remediation will continue without the Proposed Development undermining these remedial works by following remediation safeguarding measures as per Technical Appendix 11.5. Therefore, it is intended that the Proposed Development will not increase the risk to groundwater resources. Considering the Environment Agency's approach to groundwater protection the Proposed Development will not result in additional potential pollutant linkages which would affect the underlying groundwater source protection zones II and III.

Operational Development

- 11.155 The Proposed Development is expected to generate a range of potential significant direct and indirect Ground Condition effects, including:
- Future commercial Site users and members of public accessing the Site may come into contact with residual contaminants in areas of soft landscaping;
 - Future maintenance workers may come into direct contact with potentially contaminated soils (such as isolated area of asbestos and further made ground deposits recorded at the Site) and to a lesser extent groundwater;
 - Ground gas and / or residual volatile contaminants (where identified) could pose a risk to future occupants of Site buildings, e.g. via ingress through service cavities and accumulation within confined spaces;

- Residually contaminated soils (where identified) may impact future buried utility supply lines; and
- Potential to restrict access to infrastructure (monitoring wells and underground pipework) associated with an ongoing groundwater remediation scheme.

11.156 Based on adoption of standard good practice, compliance with the Control of Pollution (Oil Storage) Regulations 2001 and the nature of the proposed activities the operational phase of the Proposed Development is unlikely to introduce significant pollutants / additional discharges to underlying groundwater and therefore not affect the groundwater source protection zones II and III underlying the Site. There is however the possibility of minor leaks / spillages associated with the Proposed Development (especially activities associated with the rail freight terminal).

11.157 The operational phase of the Proposed Development will not introduce additional discharges to underlying groundwater or undertake groundwater abstraction and therefore will not affect the hydrogeological regime of the geological SSSI 140 m to the south of the Site.

Mitigation and Residual Effects

Mitigation

11.158 In the context of the Proposed Development, comprising commercial land usage, the findings of multiple rounds of ground gas monitoring identified the Site to correspond to Characteristic Situation 2, ('Low Risk') as defined within Construction Industry Research and Information (CIRIA) Guidance C665 'Assessing Risks Posed by Ground Gases to Buildings', 2007. The required mitigation measures will be established based on finalised development proposals, including determining whether it is appropriate to zone the Site into different Characteristic Situations (based on additional ground gas monitoring data to be secured via a DCO Requirement). The final mitigation measures will accord with the requirements of BS8485:2015, meaning some on-site buildings may require a combination of in-situ floor slab, gas proof membrane and / or ventilation layer. It is recommended that final mitigation measures in relation to ground gas are devised based on further ground gas monitoring data to be obtained following completion of cut and fill works as this will be more representative of the ground gas regime for each particular relevant location.

11.159 Given the recorded volatile organic compounds (VOCs), phenols and lighter individual hydrocarbon fractions in groundwater in the south-west of the Site, buildings in this location may require hydrocarbon membranes / passive venting to ensure the volatilisation pathway is addressed. It is recommended that final mitigation measures in relation to potential vapours in Zone A1 are devised based on vapour monitoring data to be obtained following completion of cut and fill works (to be secured as a DCO Requirement for further Site monitoring assessment works) and this will be more representative of the potential for vapours within Zone A1.

11.160 Redevelopment of the Site for commercial use will increase the hardstanding present on-site. This will decrease the potential pathways for residual contaminants (such as isolated asbestos fibres and general made ground deposits) to impact upon future on-site users. However there will be areas of soft landscaping and as such there is a requirement for suitable materials in these areas to provide an acceptable growth medium for future planting. The required thickness of topsoil / subsoil will be dependent upon the chemical characteristic of the soil to be used as well as the contaminative profile of the underlying soils in those specific locations, and the specific planting regime within each area, however in Ramboll's experience an approximate thickness of between 300mm and 600mm may be required (only for areas of potential concern). Topsoil materials were recorded to be present at the Site as part of the intrusive investigation and there are no proposals to import topsoil materials to be used on-site.

11.161 In light of the former 'Brownfield' usage of certain areas of the Site, the ongoing groundwater remediation works to address impacted groundwater and the identified residual soil and

groundwater concentrations the pipework specification for potable water supply will need to be appropriate to prevent effects from aggressive ground conditions.

Construction

11.162 Management and control measures integral to the development proposals during the construction stage are discussed in Chapter 5: Demolition and Construction. These measures, to be included in a Demolition and Construction Environmental Management Plan (DCEMP) which shall be implemented for each phase of development at the Site. The DCEMP shall build upon the principles of the Outline Demolition and Construction Environmental Management Plan (ODCEMP) and provide management techniques to avoid, minimise and (where this are not possible) mitigate the magnitude of potential environmental impacts and thereby the likelihood of significant effects.

11.163 This assessment assumes that measures outlined in the ODCEMP will be implemented.

11.164 A number of measures will be required during the construction phase to protect the ongoing groundwater remediation works in the south-western part of the Site. These are outlined in more detail in Technical Appendix 11.5.

Operational Development

11.165 In consideration of the Proposed Development, operational mitigation measures at the Site would relate solely to safeguarding of the ongoing groundwater remediation. It is proposed that warehouse buildings within Zone A1 (as per the Parameters Plans) will not be constructed until on-going remediation works are complete (and approved by the Environment Agency). Therefore mitigation measures relating to the operational phase are only relevant for the rail terminal operation, which affects a smaller area of the remediation area when compared to Zone A1.

11.166 In accordance with the Construction (Design and Management) Regulations 2015, a copy of relevant environmental assessment information would be retained on-site within the construction phase Health and Safety file, to assist with the production of appropriate risk assessments and method statements for any proposed future work (such as maintenance activities).

Summary of Mitigation Measures

11.167 A summary of the identified Mitigation Measures for the Proposed Development is presented in Table 11.10 below.

Table 11.10: Summary of Proposed Mitigation and Enhancement Measures	
Potential Effects Identified	Proposed Mitigation/Control & Enhancement Measures
Construction	
Dust emissions impacting off-site commercial site users, and members of the public and the geological SSSI situated 140m to the south of the Site.	In accordance with the ODCEMP, appropriate mitigation measures, such as damping down and cleaning roadways shall be undertaken throughout the works, whilst also giving due regard to minimisation of surface water runoff.
Introduction of preferential pathways to underlying groundwater both as a receptor and source (where impacted with volatile organic contaminants).	In accordance with the ODCEMP, redundant boreholes shall be appropriately decommissioned. The method of decommissioning shall accord with Environment Agency guidance.

Table 11.10: Summary of Proposed Mitigation and Enhancement Measures	
Adverse impact to ongoing groundwater remediation works being undertaken in the south-western portion of the Site.	Safeguarding measures to implemented as per Remediation Safeguarding Report (Technical Appendix 11.5).
Completed Development	
Site workers and visitors may come into contact with residual contaminants in area of soft landscaping.	A clean layer of topsoil would be provided in areas of soft landscaping as required.
Potential impact to human health and the built environment via the pathway of upward migration and containment of ground gases and vapours within buildings.	Appropriate ground gas and vapour mitigation measures shall be installed in accordance with current UK Authoritative Guidance and British Standards.
Adverse impact to ongoing groundwater remediation works being undertaken in the south-western portion of the Site.	Safeguarding measures to implemented as per Remediation Safeguarding Report (Technical Appendix 11.5). This includes proposals that warehouse buildings within Zone A1 (as per the Parameters Plans) will not be constructed until on-going remediation works are complete.
Potential degradation to potable water pipes and other buried services from direct contact with residual contamination.	Appropriate specification of buried services to be identified based on the ground conditions identified at the Site.
Operational activities potentially introducing significant pollutants / additional discharges to underlying groundwater and therefore affecting the groundwater source protection zones II and III underlying the Site.	Storage of fuels / oils to comply with the Control of Pollution (Oil Storage) Regulations 2001.

Summary of Residual Effects

11.168 Table 11.11 provides a tabulated summary of the outcomes of the Ground Condition of the Proposed Development.

Table 11.11: Summary of Residual Effects							
Receptor	Description of Residual Effect	Nature of Residual Effect*					
		Significance**	+	D	P	R	St
Construction							
Human Health – Construction Workers / off-site residential properties / on-site and off-site commercial land usage occupants	Residual risks from direct contact and inhalation of ground contamination.	Negligible / Minor	-	D	T	R	St
Controlled Waters - Groundwater, including underlying groundwater source protection zones II and III and surface watercourses	Leaching and migration of contaminants associated with the Proposed Development via groundwater.	Minor	-	D	T	R	St
Ongoing Remediation Works	Potential reduction in remediation efficiency / operation. Although remediation safeguarding proposals and the proposal that Zone A1 will not be developed until active remediation works are complete minimises the likelihood of undermining remedial objectives.	Minor / Moderate	-	D / I	T	R	Mt
Off-site Geological Site of Special Scientific Interest (SSSI)	Risks of degradation of the SSSI through dust / vapour release.	Minor	-	D	P	I	R St
Completed Development							
Human Health - Site	Residual risks from direct contact and inhalation of ground contamination.	Negligible	-	D	T	R	Lt

Table 11.11: Summary of Residual Effects							
Workers and Public access							
Controlled Waters – Groundwater, including underlying groundwater source protection zones II and III and surface watercourses	Leaching and migration of contaminants associated with the Proposed Development via groundwater.	Minor	-	D	T	R	Lt
Ongoing Remediation Works (during operation of rail terminal)	Potential reduction in remediation efficiency / operation. Although remediation safeguarding proposals and the proposal that Zone A1 will not be developed until active remediation works are complete minimises the likelihood of undermining remedial objectives.	Minor / Moderate	-	D / I	T	R	Lt

Notes:

* - = Adverse/ + = Beneficial; D = Direct/ I = Indirect; P = Permanent/ T = Temporary; R=Reversible/ IR= Irreversible; St- Short term/ Mt –Medium term/ Lt –Long term.

**Negligible/Minor/Moderate/Major

Likely Significant Environmental Effects

11.169 Following the implementation of the mitigation strategies outlined above, no significant environmental effects are predicted to occur with respect to Ground Condition receptors considered in this chapter during either the construction, or the operational phase of the Proposed Development.

Decommissioning

11.170 The Proposed Development is expected to be operational indefinitely, as long as it is viable and fit for purpose.

11.171 In the long term, it may likely to be re-developed or adapted on a piecemeal basis as operator requirements change and new occupiers move to the Site. Any such piecemeal redevelopments would be expected to be undertaken in accordance with current and future legislation and guidance in relation to Ground Conditions and would be subject to separate planning applications and planning requirements and conditions.

11.172 On this basis the potential effects on the Ground Conditions for decommissioning are considered to be negligible.

Cumulative Effects

- 11.173 In assessing the effects of the Proposed Development, consideration has been given to the potential cumulative effects which might arise in conjunction with alternate development schemes within influencing distance of the Site.
- 11.174 A full list of the off-site schemes considered as part of the Cumulative Impacts Section is provided as Technical Appendix 2.7.
- 11.175 All development activities associated with cumulative developments must be carried out in accordance with relevant legislative requirements and best practice guidance (including relevant assessment and remediation). On this basis, and subject to the implementation of best practice development measures, there would be no cumulative effects on contamination arising from the construction of the Proposed Development and the other developments.
- 11.176 In consideration of the Proposed Development combined with the mitigation measures described above (relating to other developments) and the distance to the alternate development schemes, the overall cumulative effect arising from other developments would be Negligible.