

A38 Derby Junctions

TR010022

Volume 6

6.1 Environmental Statement
Chapter 10 – Geology and Soils

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

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Infrastructure Planning

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The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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6.1 Environmental Statement Chapter 10 Geology and Soils

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10. Geology and Soils

10.1 Introduction and competent expert evidence

- 10.1.1 This chapter assesses the potential geology and soils impacts associated with the construction and operation of the Scheme, following the methodology set out in Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11: Geology and Soils (Highways Agency, 1993), DMRB Volume 11, Section 3, Part 6: Land Use – Amendment No 1 (Highways Agency, 1993), and associated Interim Advice Notes (IANs) (e.g. IAN 183/14 – Environmental Management Plans (Highways Agency, 2014), IAN 125/15 – Supplementary guidance for users of DMRB Volume 11 Environmental Assessment (Highways Agency, 2015)). This chapter details the methodology followed for the assessment, summarises the regulatory and policy framework related to geology and soils, and describes the existing environment in the area surrounding the Scheme. Following this, the design and mitigation measures proposed to manage and minimise potential impacts are specified, after which residual geology and soils effects of the Scheme are presented. We also provide details of any assumptions and limitations made during the assessment.
- 10.1.2 This geology and soils assessment is supported by Appendices 10.1 to 10.4 [TR010022/APP/6.3] as follows:
- Appendix 10.1: Ground Investigation Report (which presents data from ground investigation undertaken in 2016) (Highways England, 2018).
 - Appendix 10.2: Monitoring Report (which contains results from additional groundwater and surface water monitoring at Markeaton junction undertaken between December 2017 and April 2018) (Highways England, 2018).
 - Appendix 10.3: A38 Derby Junctions Preliminary Sources Study. Highways England (2015).
 - Appendix 10.4: A38 Derby Junctions Preliminary Sources Study Addendum, Link Road K2 (Highways England 2016).
- 10.1.3 All figures cited within this chapter are included within Environmental Statement (ES) Volume 2 [TR010022/APP/6.2].
- 10.1.4 This chapter of the ES has been prepared by competent experts with relevant and appropriate experience. The technical lead for the geology and soils assessment has 22 years of relevant experience and has professional qualifications as follows: Chartered Environmentalist (CEnv), Chartered Scientist (CSci) and Member of the Institution of Environmental Science (MIEnvSc). Further details are provided in Appendix 1.1 [TR010022/APP/6.3].

10.2 Legislative and policy framework

10.2.1 As discussed in Chapter 1: Introduction, the primary basis for deciding whether or not to grant a Development Consent Order (DCO) is the National Policy Statement for National Networks (NPSNN) (Department for Transport (DfT), 2014) which, at Sections 4 and 5, sets out policies to guide how DCO applications will be decided and how the impacts of national networks infrastructure should be considered. Table 10.1 identifies the NPSNN policies relevant to the geology and soils assessment and where in this ES chapter information is provided to address these policy requirements.

Table 10.1: Relevant NPSNN policies for the geology and soils assessment

Relevant NPSNN para. Ref.	Requirement of the NPSNN	Location where information addresses policy requirements
5.117	This paragraph requires the applicants to consider land stability in respect of new development. It states that <i>'Specifically, proposals should be appropriate for the location, including preventing unacceptable risks from land instability. If land stability could be an issue, applicants should seek appropriate technical and environmental expert advice to assess the likely consequences of proposed developments on sites where subsidence, landslides and ground compression is known or suspected.'</i>	Refer to Section 10.7 and Section 10.9.
5.118	This paragraph requires the applicants to carry out preliminary assessment of ground instability at the earliest possible stage before a detailed application for development consent is prepared and undertake any necessary investigations to ascertain that the site will remain stable or can be made so as part of the development. It also requires the applicants to complete a land stability or slope stability risk assessment report, taking into account the surrounding areas where subsidence, landslides and land compression could threaten the development/neighbouring land or property.	Refer to Section 10.7 and Section 10.9.
5.168	This paragraph requires applicants to take into account the economic and other benefits of the best and most versatile agricultural land and, where significant development of agricultural land is demonstrated to be necessary, to seek to use areas of poorer quality land in preference to that of a higher quality. Additionally, this paragraph requires the applicants to identify any effects, and seek to minimise impacts, on soil quality and, for developments on previously developed (brownfield) sites, ensure that they have considered the risk posed by land contamination and how it is proposed to address this.	Refer to Section 10.7 and Section 10.9.

- 10.2.2 Other relevant policies have been considered as part of the geology and soils assessment where these have informed the identification of receptors and resources and their sensitivity; the assessment methodology; the potential for significant environmental effects; and required mitigation. These policies include:
- National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2019) e.g. paragraph 170 in relation to contributing to and enhancing the local environment (including economic and other benefits of the best and most versatile agricultural land), whilst paragraphs 178 - 179 relate to ground conditions and pollution.
 - Derby City Local Plan – Part 1 Core Strategy (2017) (Derby City Council (DCiC), 2017) and saved Policies contained in the City of Derby Local Plan Review: Chapter 9 Environment (2006) (DCiC, 2006): Policy E12: Pollution and Policy E13: Contaminated Land.
 - Derby Local Transport Plan (LTP3) (2011 - 2026) (DCiC, 2011).
 - Erewash Core Strategy (March 2014) (Erewash Borough Council (EBC), 2014), noting that there are some policies saved from the previous 2005 Local Plan (EBC, 2014).
 - Derbyshire Local Transport Plan (2011 - 2026) (Derbyshire County Council (DCC), 2011).
- 10.2.3 In addition to the above, there are numerous pieces of legislation that are of relevance to the geology and soils assessment, namely:
- The Environmental Protection Act 1990 and Part 2A (the Contaminated Land Regime).
 - The Water Act 2003.
 - The Water Resources Act 1991.
 - The Building Act 1984 and the Building Regulations &c. (Amendment) Regulations 2016.
 - The Town and Country Planning (Development Management Procedure) (England) Order 2015.
- 10.2.4 National objectives for the sustainable management of soil are set out in the guidance paper, entitled 'Soil Strategy for England' (Department of the Environment, Transport and the Regions, 2009). The four key objectives detailed in that strategy, which have been taken into account in this assessment, are as follows:
- Agricultural soils will be better managed and threats to them will be addressed.
 - Soils will play a greater role in the fight against climate change and in helping us manage our impacts.

- Soils in urban areas will be valued during development and construction practices will ensure vital soil functions can be maintained.
- Pollution of our soils is prevented, and our historic legacy of contaminated land is being dealt with.

10.3 Assessment methodology

10.3.1 A geology and soils assessment has been undertaken in accordance with the advice provided in DMRB Volume 11, Section 3, Part 11 Geology and Soils (Highways Agency, 1993) and guidance contained in relevant IANs. This guidance defines the scope of the topic, but does not provide formal guidance on the assessment of geology and soils impacts and effects. The impact assessment methodology applied takes account of technical guidance that has been produced in the UK for the assessment of ground conditions and water resources by the government (i.e. Department for Environment, Food and Rural Affairs (DEFRA) and its predecessor and successor departments); agencies such as the Environment Agency and Contaminated Land: Applications in Real Environments (CL:AIRE); and British Standards.

10.3.2 The following standards and guidance documents have been used in the assessment:

- British Standards 10175+A2:2017 Investigation of Potentially Contaminated Sites – Code of Practice (2017).
- British Standard BS5930:2015 Code of Practice for Ground Investigations (2015).
- British Standards BS3882 Specification for Topsoil and Requirements for Use (2015).
- British Standards BS1997-2:2007 Eurocode 7: Geotechnical design Ground Investigation and Testing (1997).
- CIRIA C552 Contaminated Land Risk Assessment. A Guide to Good Practice (2001).
- CIRIA C665 Assessing Risks Posed by Hazardous Ground Gases to Buildings (2007).
- (CL:AIRE The Definition of Waste: Development Industry Code of Practice, V2 (2011).
- CL:AIRE CAR-SOIL™ Control of Asbestos Regulations 2012. Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry Guidance (2016).
- CL:AIRE Definition of Waste: Development Industry Code of Practice v2 (2011).
- DEFRA: Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (2012).

- Environment Agency. Waste Classification, Guidance on the classification and assessment of waste (1st Edition v1.1). Technical Guidance WM3 (2018).
- Environment Agency. Contaminated Land Report (CLR) 11 Model Procedures for the Management of Land Contamination (2004).
- Environment Agency TR P5-065/TR: Technical Aspects of Site Investigation (Volumes 1 & 2) (2002).

10.3.3 With regards to impacts upon agricultural soils, the assessment methodology has taken into account the consultation procedures in which Natural England (Natural England, 2012) has to consider proposals which individually or cumulatively involve the loss of more than 20 hectares (ha) of best and most versatile land.

Baseline conditions

10.3.4 In order to undertake the geology and soils impact assessment, it is first necessary to establish baseline conditions. The baseline assessment has involved reference to the following data sources, consultation with statutory bodies and other organisations, and fieldwork surveys:

- Information available in 'Envirocheck' Reports (Landmark Information Group, 2014a/b/c) (as contained in Appendix 10.3 [TR010022/APP/6.3]).
- Data from British Geological Survey (BGS) Solid and Drift Geology Sheets.
- BGS borehole logs, where appropriate.
- Available site investigation factual and interpretative reports, including the A38 Derby Junctions Ground Investigation Report (refer to Appendix 10.1 [TR010022/APP/6.3]), the Monitoring Report (refer to Appendix 10.2 [TR010022/APP/6.3]), the Preliminary Sources Study (refer to Appendix 10.3 [TR010022/APP/6.3]) and the Preliminary Sources Study addendum (refer to Appendix 10.4 [TR010022/APP/6.3]).
- Human health and controlled waters risk assessments based on findings of the ground investigation works and laboratory testing within the Ground Investigation Report (refer to Appendix 10.1 [TR010022/APP/6.3]).
- Information regarding agricultural land classification (ALC) from surveys undertaken in 2015 and 2018.
- Information on controlled waters as detailed in Chapter 13: Road Drainage and the Water Environment.
- Natural England.
- Environment Agency.
- DEFRA.
- Local authorities.

- 10.3.5 Natural England and the local authorities have been consulted in order to confirm whether there are any statutory or non-statutory designated sites of geological or geomorphological importance in the study area (refer to Section 10.7).
- 10.3.6 Factual and interpretative geotechnical and geo-environmental reports relating to site investigations, soil surveys and ALC surveys have been reviewed and reported as applicable. This includes the results of risk assessments undertaken where land contamination was identified and geotechnical assessment of ground stability. Design mitigation measures identified for land contamination and ground stability initially identified in the Preliminary Environmental Information Report (PEIR) (Highways England, 2018) have also been reviewed.

Evaluation of receptor importance or sensitivity

- 10.3.7 The importance or sensitivity of potential receptors and soil or geological resources to ground condition impacts has been described qualitatively according to the categories in Table 10.2.

Table 10.2: Descriptive scale for importance or sensitivity of geology and soils receptors

Importance	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
High	Attribute has a high quality and rarity on regional or national scale or high sensitivity	<ul style="list-style-type: none"> • Future Site users – residential development • Residential areas or schools within 50m of construction works • Water features deemed to be of high value • Ecological features deemed to be of high value • Allotments, arable farmland, livestock or market gardens on or adjacent to the site 	<ul style="list-style-type: none"> • Internationally and nationally designated sites • Regionally important sites with limited potential for substitution • Soils of high nature conservation or landscape importance • Presence of significant mineral reserves and within a Mineral Consultation Area • Soil/materials disposal required following earthworks resulting in a significant increase in demand on waste management infrastructure 	<ul style="list-style-type: none"> • High quality agricultural soils (Grade 1)
Medium	Attribute has a medium quality and rarity on local scale or medium sensitivity	<ul style="list-style-type: none"> • Future site users - commercial development • Residential areas or schools within 50 to 250m of construction works • Commercial areas within 50m of construction 	<ul style="list-style-type: none"> • Regionally important sites with potential for substitution • Locally designated sites with limited potential for substitution • Soils of medium conservation or 	<ul style="list-style-type: none"> • Good quality agricultural soils (Grade 2 and 3a)

Importance	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
		<ul style="list-style-type: none"> works Water features deemed to be of medium value Ecological features deemed to be of medium value The built environment including buildings and infrastructure 	<ul style="list-style-type: none"> landscape importance Site within a Mineral Consultation Area Soils/materials disposal required following earthworks resulting in a moderate increase in demand on waste management infrastructure 	
Low	Attribute has a low quality and rarity on local scale or low sensitivity	<ul style="list-style-type: none"> Future site users - car park, highways and railway related development Residential areas >250m from construction works Commercial areas within 50 to 250 m of construction works Water features deemed to be of low value Ecological features deemed to be of low value 	<ul style="list-style-type: none"> Undesignated sites of some local earth heritage interest Soils of low nature conservation or landscape importance Limited potential for mineral reserves and site not within a Mineral Consultation Area Soil/materials disposal required following earthworks resulting in a limited increase in a minor increase in demand on waste management infrastructure 	<ul style="list-style-type: none"> Moderate or poor quality agricultural soils (Grade 3b and 4)
Very Low	Attribute has a very low quality and rarity on local scale or very low sensitivity	<ul style="list-style-type: none"> Areas where there are no built structures, crops, or livestock Commercial areas within >250m of construction works Water features deemed to be of low value Ecological features deemed to be of negligible value 	<ul style="list-style-type: none"> Other sites with little or no local earth heritage interest Soils of negligible nature conservation or landscape importance. Negligible potential for mineral reserves to exist 	<ul style="list-style-type: none"> Very poor quality agricultural soils (Grade 5)

Identification and assessment of potential impacts

10.3.8 The magnitude of the geology and soils impact of the Scheme has been determined using the four point scale as shown in Table 10.3.

Table 10.3: Criteria for assessing the magnitude of impact upon features/attributes – geology and soils

Magnitude	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
High	Results in loss of attribute and/or quality and integrity of the attribute	<ul style="list-style-type: none"> • Human Health: Acute risk to human health • Surface waters and/or groundwater: Substantial acute pollution or long term degradation of sensitive water resources (Principal Aquifer, groundwater source protection zone, surface waters of good or very good quality) • Ecology: Significant change to the number of one or more species or ecosystems • Built Environment: Catastrophic damage to buildings, structures or the environment • Landscaping/Agriculture: Loss in value of livestock or crops as a result of death, disease, or physical damage 	<ul style="list-style-type: none"> • Loss of feature or attribute • Earthworks resulting in high volume of surplus soil for off-site disposal • Classification of surplus soil as Hazardous Waste where the intention is to discard 	<ul style="list-style-type: none"> • Loss of over 50ha of 'best and most versatile agricultural land' Grades 1, 2 and 3a • Damage to/or loss of all topsoil resource • Soil sealing >75%
Medium	Results in effect on integrity of attribute, or loss of part of attribute	<ul style="list-style-type: none"> • Human Health: Chronic risk to human health • Surface water and/or groundwater: Pollution of non-sensitive water resources or small scale pollution of sensitive water resources (Principal or Secondary Aquifers or water courses of fair quality or below) • Ecology: Change to population densities of non-sensitive species • Built Environment: Damage to buildings, structures or the environment • Landscaping/Agriculture: Non-permanent health effects to vegetation/crops from disease or physical damage, which results in a reduction in value 	<ul style="list-style-type: none"> • Impact on integrity of or partial loss of feature or attribute • Earthworks resulting in moderate volume of surplus soil for off-site disposal 	<ul style="list-style-type: none"> • Loss of between 20 and 50ha of 'best and most versatile agricultural land' Grades 1, 2 and 3a • Damage to/or loss of half of topsoil resource • Soil sealing >50%

Magnitude	Criteria	Receptors susceptible to land contamination and ground hazard impacts	Soil and geological resources	Agricultural soil resources
Low	Results in some measurable change in attributes quality or vulnerability	<ul style="list-style-type: none"> • Human Health: Slight reversible short-term effects to human health • Surface waters and/ or groundwater: Slight pollution of non-sensitive water resources • Ecology: Some change to population densities of non-sensitive species with no negative effects on the function of the ecosystem • Built Environment: Easily reparable effects of damage to buildings or structures • Landscaping/Agriculture: Slight or short term health effects which result in slight reduction in value 	<ul style="list-style-type: none"> • Minor impact on feature or attribute • Earthworks resulting in low volume of surplus soil for off-site disposal 	<ul style="list-style-type: none"> • Loss of less than 20ha of 'best and most versatile agricultural land' Grades 1, 2 and 3a or the loss of any quantity of land not considered 'best and most versatile agricultural land' Grades 3b, 4 or 5 • Re-use of all topsoil resource within the development • Soil sealing <50%
Very Low	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	<ul style="list-style-type: none"> • Human Health: No measurable effects on humans • Surface waters and/or groundwater: Insubstantial pollution to non-sensitive water resource • Ecology: No significant changes to population densities in the environment or in any ecosystem • Built Environment: Very slight non-structural damage or cosmetic harm to buildings or structures • Landscaping/Agriculture: No significant reduction in landscape value 	<ul style="list-style-type: none"> • Impact of insufficient magnitude to affect use or integrity of feature or attribute • No off-site disposal of surplus soil required 	<ul style="list-style-type: none"> • No loss of agricultural land • Minor disturbance to soils. Soil sealing unlikely to occur

Identification of significant effects

- 10.3.9 For each of the potential impacts identified, an assessment has been made of the likely level of significance of the resulting effects. The definition of effect significance was made by taking into account both the importance or sensitivity of the receptor (refer to Table 10.2) and the magnitude of the predicted impact (refer to Table 10.3), using the matrix as presented in Table 10.4, in conjunction with professional judgement of the site-specific factors that may be of relevance.

Table 10.4: Criteria for assessing the significance of effects upon geology and soils

		Magnitude of Impact			
		High	Medium	Low	Very low
Importance/ Sensitivity of resource or receptor	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Very low	Minor	Negligible	Negligible	Negligible

- 10.3.10 Potential geology and soil effects can be either beneficial or adverse. Effects predicted to be minor or negligible are considered to be manageable and are, therefore, not significant, whereas effects assessed as moderate or major are considered to be significant.
- 10.3.11 In accordance with Chapter 4: Environmental Impact Assessment Methodology, Section 4.3, when assessing the potential significance of geology and soil environment effects, impact avoidance measures embedded in the Scheme design have been taken into account, as have standard environmental management activities (refer to Section 10.9). Where potentially significant effects have been predicted, further mitigation and management actions have been defined and the significance of effects with the additional mitigation in place have also been assessed (if applicable).

Agricultural holdings

Agricultural land use

- 10.3.12 The assessment methodology detailed in the sections above cover potential Scheme impacts upon agricultural soils. However, there is also a need to consider potential Scheme effects upon agricultural holdings and their viability (in the vicinity of Little Eaton junction given the absence of agricultural holdings at Kingsway junction and Markeaton junction).
- 10.3.13 With regard to farm holdings, impacts relate primarily to the loss of land and other key farm infrastructure (e.g. dwellings, buildings and other structures such as irrigation reservoirs and slurry pits), the fragmentation of land from the residually farmed area and disruption to existing farm operations from, for example, changes to access arrangements or conflicts of noise and dust from construction activities with sensitive land uses. The magnitude of potential impacts on farm holdings has been determined as detailed in Table 10.5.

Table 10.5: Magnitude of Impacts on farm holdings

Impact Magnitude	Land Take	Severance	Infrastructure	Disruption
High	20%+ of all land farmed	No access to severed land	Direct loss of farm dwelling, building or structure	Disruption discontinues land use or enterprise
Medium	10 - 20% of all land farmed	Access available to severed land via the public highway	Loss of or damage to infrastructure affecting land use	Disruption necessitates change to scale or nature of land use or enterprise
Low	5 - 10% of all land farmed	Access available to severed land via private way	Infrastructure loss/damage does not affect land use	Disruption does not affect land use or enterprise
Negligible	5% or less of all land farmed	No new severance	No impact on farm infrastructure	No disruption to land use or enterprise

- 10.3.14 Farm holding sensitivity is a reflection of the size of an affected holding, with larger holdings generally more able to accommodate change than smaller ones, and the nature of the particular agricultural activity. Complex activities, or ones dependent upon particular infrastructure or regular access to land (for example dairying, intensive livestock and horticulture) have a high degree of sensitivity to development impacts. General arable and grazing enterprises normally have a degree of operational flexibility which can adapt to changing circumstances. Non-commercial activities are deemed to have a low sensitivity. Given the complex nature of farm sensitivity, professional judgement has been applied by suitable qualified specialists (refer to Appendix 1.1 [TR010022/APP/6.3]). Thereafter, the significance of potential farm holding effects has been determined in accordance with Table 10.6.

Table 10.6: Farm holding significance matrix

Sensitivity of receptor	Magnitude of impact			
	High	Medium	Low	Negligible
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Moderate/minor	Minor
Low	Moderate	Moderate/minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

Scoping

- 10.3.15 The proposed scope of the geology and soils assessment was detailed in the Environmental Impact Assessment (EIA) Scoping Report (Highways England, 2018) submitted to The Inspectorate on 15 March 2018 (refer to Chapter 1: Introduction, para. 1.3.5).

10.3.16 An overview of the Inspectorate's Scoping Opinion (refer to Appendix 4.1 [TR010022/APP/6.3]) in relation to geology and soils is presented in Table 10.7 and indicates where comments are addressed within this ES chapter and/or the supporting documents.

Table 10.7: Scoping Opinion and response

Scoping Opinion	Where addressed within the ES
Planning Inspectorate	
The Inspectorate considers that effects on Local Geological Sites may be scoped out at Kingsway Junction, however in the absence of further justification regarding the location of Local Geological Sites (e.g. University of Derby, Kedleston Road and River Derwent and its banks sites) relative to the scheme and due to ongoing design relating to flood mitigation proposals in the vicinity of Little Eaton junction, the Inspectorate does not consider that the Scoping Report demonstrates that there is no potential for likely significant effects on Local Geological Sites and therefore this matter cannot be scoped out based on the information currently provided.	Refer to Section 10.7 and Section 10.10.
The Inspectorate considers that effects of contaminated soils on construction workers may be scoped out, since contractors will be required to adopt safe working practices under relevant health and safety legislation, meaning that significant effects are unlikely to arise.	Refer to Chapter 4: Environmental Impact Assessment Methodology, para. 4.1.13 and para. 10.3.17.
The Inspectorate considers that soils at the Kingsway and Markeaton junction locations are non-agricultural based on the current land use and therefore significant effects are not likely and these matters do not require assessment. The Inspectorate considers that ALC surveys should be undertaken where agricultural land take is required, i.e. at Little Eaton junction.	Refer to Chapter 4: Environmental Impact Assessment Methodology, para. 4.1.13, Section 10.7 and Section 10.10.
Changes to the proposed methodological approach arising from the 2018 NPPF consultation, should also be set out where appropriate.	Refer to Section 10.2.
The Scoping Report does not provide clear justification for the study area extending up to 250m from the proposed scheme boundary for the identification of geological designated sites, controlled waters, historical land uses and potential sources of contamination. The Applicant should provide sufficient justification for the study area applied within the ES, ensuring that it encompasses the extent of the likely impacts of the Proposed Development.	Refer to Section 10.6.
Table 10.3 suggests a medium to high valuation of sensitivity/importance for surface water features. It is unclear whether the valuation is intended to cover more than one water body (i.e. sensitivity is medium for one water body and high for another) or whether an intermediate value is proposed for a single water body. The ES should clearly set out the attributes that have been considered in assigning sensitivity/ importance to each relevant feature.	Refer to Table 10.11 which provides sensitivities for water relevant bodies.
The Scoping Opinion identifies that areas of contamination may be remediated based on the recommendations of a geotechnical design report. The ES should set out how the views of consultation bodies have been considered in the assessment process (e.g. through sharing of ground investigation data), development of the proposed remedial approach and the strategy for validation of remediation work where relevant.	Refer to Section 10.4, Section 10.9 and Section 10.11.

Scoping Opinion	Where addressed within the ES
The Scoping Opinion proposes to take account of UK technical guidance making specific reference to Contaminated Land: Applications in Real Environments (CL:AIRE) and British Standards but does not provide details of other guidance or standards that would be adopted. The high level nature of the proposed methodological approach limits the ability of the Inspectorate to comment on the appropriateness of the proposed approach. The ES should clearly state which guidance and standards have been applied to the assessment of geology and soils effects and include these in the ES reference list.	Refer to Section 10.3.
Derby City Council (DCiC)	
DCiC notes that potential for the scheme to affect gas migration pathways should be of primary concern at Kingsway junction. This is in relation to a large former landfill with relatively high level of gassing.	Refer to Section 10.10.
DCiC – a copy of the ground investigation report is requested for review.	Refer to Appendix 10.1 [TR010022/APP/6.3].
Public Health England	
Public Health England expects the promoter to provide details of any hazardous contamination present on site (including ground gas) as part of the site condition report. Emissions to and from the ground should be considered in terms of the previous history of the site and the potential of the site, once operational, to give rise to issues. Public health impacts associated with ground contamination and/or the migration of material off-site should be assessed and the potential impact on nearby receptors and control and mitigation measures should be outlined.	Refer to Section 10.7, Section 10.8, Section 10.9, Appendix 10.1 [TR010022/APP/6.3].
Environment Agency	
Environment Agency expects the desk study, site investigation and assessments to be submitted as part of the Environmental Statement. If they are in agreement with these assessments, they would ultimately expect further work recommended within these reports to be undertaken (for example through a requirement on the Development Consent Order if not undertaken before this).	Refer to Appendices 10.1, 10.2, 10.3 and 10.4 [TR010022/APP/6.3].
Environment Agency agrees with the proposed approach to undertake location-specific risk assessments in proposed piling areas to ensure it will not cause pollution of controlled waters.	Refer to Section 10.9.
Natural England	
The EIA will need to consider any impacts upon local geological sites	Refer to Section 10.7, Section 10.10.

- 10.3.17 As detailed in the EIA Scoping Report (Highways England, 2018), the Scheme construction and operational maintenance phases would be undertaken in a manner that appropriately protects the health and safety of workers (legal compliance requirement), whilst the Scheme would use materials that are appropriate for the identified ground conditions. As such, construction, operational (maintenance) workers and construction materials have been scoped out of the assessment (also refer to Chapter 4: Environmental Impact Assessment Methodology, para. 4.1.13). In addition, given the absence of agricultural soils at Kingsway and Markeaton junctions, the agricultural soils assessment and the farm viability assessment focuses upon impacts at Little Eaton junction.

10.4 Consultation

- 10.4.1 The PEIR was published in September 2018 (Highways England, 2018) and presented the environmental information collected together with the preliminary findings of the assessment of likely significant environmental effects of the Scheme at the time. During statutory consultation, the Environment Agency provided comment (dated 5 October 2018) on the PEIR. Their letter makes reference to the EIA Scoping Report (Highways England, 2018) as well as the PEIR. Key comments from the Environment Agency are summarised in Table 10.8. No other comments from statutory consultees were received of relevance to the geology and soils assessment.

Table 10.8: Consultation comments and response

PEIR	Where addressed within the ES
Environment Agency	
Detailed Quantitative Risk Assessments (DQRA) – Environment Agency must have an opportunity to review and provide comments on the relevant reports (only the PEIR has been provided)	Refer to Appendix 10.1 [TR010022/APP/6.3] (Ground Investigation Report); Section 10.9 (which details that a remediation strategy would be provided).
Groundwater: Environment Agency concludes that some form of remediation is likely to be necessary based on risks posed to controlled waters. This is based on their review of the PEIR.	Refer to Section 10.9.
Groundwater: Environment Agency notes that future applicants must bear in mind that mitigation measures during construction and operational phases of a scheme may not always reduce the risks posed by historic sources of contamination.	Refer to Section 10.9.

- 10.4.2 As detailed in Section 10.7, agricultural land holdings at Little Eaton junction have been consulted with in order to determine potential Scheme effects upon their prevailing agricultural practices. This includes discussions with the turf production site (located to the south of the existing A38 and east of the River Derwent) regarding their site access requirements during Scheme construction and operation.

10.5 Assessment assumptions and limitations

- 10.5.1 The geology and soils assessment presented herein has been based on information obtained from the Environment Agency, BGS, Envirocheck Reports and other available sources as detailed in Section 10.3.
- 10.5.2 The geology and soils assessment presented in this chapter has been undertaken using available baseline data obtained and evaluated at the time of reporting, and is based on the Scheme design as described in Chapter 2: The Scheme and the maximum likely extents of land take required for its construction and operation (refer to Section 10.6).

10.6 Study area

- 10.6.1 A desk based study of available sources has been undertaken in order to identify potential impacts of the Scheme on geology and geomorphology, soils and contaminated land, as required by DMRB (Volume 11, Section 3, Part 11 – Geology and Soils) (Highways Agency, 1993).
- 10.6.2 The review of information has been confined to the following distances from the Scheme in the area of each junction:
- Geography and topography: geographical and topographic conditions along the route of the Scheme.
 - Geology: along the route of the Scheme.
 - Geological designated sites: applicable sites within 500m of the Scheme boundary.
 - Historical land uses and potential sources of contamination: sites within 500m of the Scheme boundary.
 - Controlled waters: water bodies within 500m of the Scheme boundary.
 - Agricultural land and holdings: immediately adjacent to the existing highway and within the Scheme boundary.
 - Other land designations e.g. Local Nature Reserves (LNRs): immediately adjacent to the existing highway boundary.
- 10.6.3 The study areas are shown in Figures 10.1, 10.2 and 10.3 [TR010022/APP/6.2]. The study areas shown include the Scheme layout along the length of each junction and a buffer zone of 500m around the main Scheme construction works.

- 10.6.4 The 500m maximum extent of the study areas from the main Scheme construction works is considered appropriate for the above topics and aligns with established industry practice for defining study areas for the geology and soils topic in EIA.

10.7 Baseline conditions

Published geology

- 10.7.1 The 1:50,000 scale geological maps (Derby Sheet 125) (BGS, 1972 and 2014) and associated Memoir (BGS, 1979), and the 1:10,560 geological map sheets (SK33NW (BGS, 1969a) – Kingsway and Markeaton junction and SK33NE (BGS, 1969a) and SK34SE (BGS, 1969c) – Little Eaton junction) provide information on the published geology in the area of the junctions. It should be noted that bedrock geology group and formation names were modified for the 2014 mapping (BGS, 2014) along with their relative locations and the positions of faults. Superficial deposit names have been revised, but remain relatively unchanged in location:
- Kingsway junction: Mapping (BGS, 1972 and 2014) indicates that superficial deposits comprise a zone of Alluvium crossing through the site in an approximately south-west to east direction along the course of Bramble Brook. This continues in an easterly direction towards the River Derwent. Made Ground and Infilled Ground associated with the Rowditch Tip Landfill are shown approximately 100m to the east of the junction (refer to Figure 10.1 [TR010022/APP/6.2]). The bedrock geology is shown to comprise the Tarporley Siltstone Formation, with a south-east to north-west trending fault crossing the alignment approximately 100m north of the junction. The dip of the strata is indicated to be 5° to the south-east. The Sidmouth Mudstone Formation - Gunthorpe Member is shown to the north of the fault. Siltstone and sandstone beds (skerries) are indicated within both formations. The bedrock geology sequence is considered to indicate the weathering profile within the predominantly argillaceous material with subordinate units described as siltstone to sandstone. Therefore, the material is also variously described as clay, silt and gravel. Weathered skerry bands may have been identified in the exploratory holes.
 - Markeaton junction: Mapping (BGS, 1972 and 2014) indicates River Terrace Deposits (Allenton Sand and Gravel Member), previously indicated to be 1st Terrace Deposits (BGS, 1979), approximately 150m north-east of the junction to the area of Markeaton Lake. Alluvium is shown north-east of this to Kedleston Road junction. The bedrock geology is shown to comprise of the Sidmouth Mudstone Formation - Gunthorpe Member to the south of the junction and Tarporley Siltstone Formation to the north. Sandstone and siltstone beds (skerries) are indicated on geological mapping to the south-east of the junction. The bedrock geology sequence is considered to indicate the weathering profile within the predominantly argillaceous material with subordinate units described as siltstone to sandstone. Therefore, the material is also variously described as clay, silt and gravel.

- Little Eaton junction: Mapping indicates that the superficial deposits beneath and immediately surrounding the junction consist of Alluvium. Glacio-fluvial (undifferentiated sand and gravel) and Head deposits are shown approximately 600m to the north of the junction and Head deposits are shown approximately 300m to the south of the junction. Made Ground is shown approximately 100m north and west, and 400m south of the junction. The bedrock geology beneath the junction is shown to comprise Millstone Grit Group - Morridge Formation potentially with a transition into the Marsden Formation and Ashover Grit towards the north. Published dip readings indicate bedding to be inclined at approximately 5 - 8° towards the north-east at a distance of approximately 1.5km to the west of the junction. The bedrock geology sequence is considered to indicate the weathering profile within the predominantly argillaceous material with sandstone units present further to the north. Therefore, the material is also variously described as comprising clay, silt and sand near to surface.

Site topography

Kingsway junction

- 10.7.2 The existing Kingsway roundabout is situated primarily on embankment (refer to Figure 2.1 [TR010022/APP/6.2]), with at-grade sections and a cut slope located on the southern and eastern sides at the junction with the A5111. The centre of the roundabout comprises a deep vegetated depression, which is crossed by the channels of Bramble Brook and local culverts and forms a sunken area relative to carriageway level.
- 10.7.3 The ground in the centre of the roundabout is at a level of approximately 68m above ordnance datum (AOD), and rises steeply towards the south-east to a level of approximately 86m AOD, approximately 150m to the south-east of the junction. The land rises more gently to the north-west to a level of approximately 75m AOD over the same distance.
- 10.7.4 The A38 approaches the roundabout from the south-west at-grade and in cutting, at a level of approximately 75m AOD. The carriageways then divide, with the northbound carriageway being predominantly on embankment with a section at-grade and the southbound carriageway being at-grade with a section of embankment approximately 150m from the roundabout. The wide central reservation is deepened locally by Bramble Brook leaving the verge at-grade and is densely vegetated. The roundabout carriageway level is approximately 75 – 76m AOD. The A38 continues in a north-easterly direction with both carriageways on embankment rising to a level of approximately 81m AOD approximately 0.5km north of the roundabout. The A5111 approaches the roundabout reducing in elevation from approximately 84m AOD in the south-east to approximately 76m AOD where it joins the roundabout, formed in cutting on the southern side and on to embankment on the north-eastern side.
- 10.7.5 To the north-east and east lie industrial and retail parks, and to the south is the Kingsway hospital site which is undergoing sequential redevelopment. To the south-west and west is Mackworth Park and the public open space adjacent to Greenwich Drive south, with residential areas beyond.

- 10.7.6 Bramble Brook runs through the junction from south-west to north-east.
- Markeaton junction*
- 10.7.7 The existing Markeaton roundabout is at-grade, situated in a built-up urban area with adjoining parkland with Markeaton Park (refer to Figure 2.2 [TR010022/APP/6.2]).
- 10.7.8 The A38 crosses from south-west to north-east, while the A52 crosses from south-east to north-west. The A52 approaches to the roundabout are at grade. The A38 northbound carriageway is in cutting approximately 200m south of the roundabout and the A38 is also formed in cutting approximately 600m to the north at Kedleston Road junction.
- 10.7.9 The A38 falls from a level of approximately 81m AOD approximately 0.5km south-west, to a level of approximately 65m AOD at the roundabout. The carriageway then falls to a level of approximately 57m AOD in the vicinity of Markeaton Lake, approximately 0.5km to the north-east. The general topography falls from the west and south-west to east and north-east.
- 10.7.10 The junction is surrounded by residential developments to the east and south, whilst to the north lies Markeaton Park, comprising both open and wooded areas. Mill Pond is located to the south of the existing A38 (east of the junction). Immediately west of the roundabout is the Esso petrol station and McDonald's restaurant, beyond which lie residential developments.
- Little Eaton junction*
- 10.7.11 The existing Little Eaton roundabout is at-grade to the north and north-west, whilst being raised above the land to the east, south and west on low embankment (refer to Figure 2.3 [TR010022/APP/6.2]). Gabion basket retaining walls were installed along the western and southern approaches as part of the 2015 Pinch Point Programme (refer to Chapter 2: The Scheme, para. 2.3.6).
- 10.7.12 The A38 approaches the roundabout from the west on embankment crossing over the River Derwent and the Midland Mainline railway line located approximately 500m and 200m west of the roundabout respectively. The embankment level falls from approximately 57m AOD adjacent to the river bridge to approximately 53m AOD at the junction roundabout. The A38 continues north on embankment, rising to a level of approximately 69m AOD approximately 0.6km north of the junction. The A61 approaches the roundabout from the south at-grade and on low embankment.
- 10.7.13 The land surrounding the junction to the east, south and west consists of flat farmland. The natural ground level rises from approximately 49m AOD adjacent to the River Derwent, along the alignment of the A38 to approximately 51m AOD at the junction roundabout. To the immediate north and north-west lies the Ford Farm Mobile Home Park and Starbucks cafe, beyond which lies hummocky, grassy open land within a former landfill site. The ground level rises to the east from the edge of the River Derwent floodplain.

Encountered ground conditions

- 10.7.14 Ground investigation works and reports have previously been carried out in the vicinity of the junctions, including:
- HA GDMS No. 30092 A38 Derby Junctions, Ground Investigation Report (Highways England, 2018) (refer to Appendix 10.1 [TR010022/APP/6.3]).
 - HA GDMS No. 30195 A38 Derby Junctions Ground Investigation – Factual Report on Ground Investigation (Environmental Scientifics Group Limited (ESGL), 2017).
 - HA GDMS No. 28093 A38 Derby Junctions Preliminary Sources Study (Highways England, 2015) (refer to Appendix 10.3 [TR010022/APP/6.3]).
 - HA GDMS No. 29038 A38 Derby Junctions Preliminary Sources Study Addendum Link Road K2 (Highways England, 2016) (refer to Appendix 10.4 [TR010022/APP/6.3]).
- 10.7.15 The Preliminary Sources Study also includes details of previous ground investigations that were not related to the Scheme, but were located in the vicinity of the Scheme.
- 10.7.16 An intrusive investigation was undertaken by ESGL (now SOCOTEC) and supervised by AECOM in 2016 at Kingsway junction, Markeaton junction and Little Eaton junction. The following sections present a summary of the ground conditions encountered at each junction during the investigation. This information is based on data contained within the Ground Investigation Factual Report prepared by ESGL (2016).
- 10.7.17 The ground conditions encountered at Kingsway junction, Markeaton junction and Little Eaton junction during the 2016 ground investigation are summarised in Table 10.9 (also refer to Appendix 10.1 [TR010022/APP/6.3]).

Table 10.9: Summary of strata encountered during 2016 ground investigation

Strata	Top of strata (m bgl) (approximate)		Depth to base (m bgl) (approximate)		Thickness (m) (approximate)	
	Min	Max	Min	Max	Min	Max
Kingsway junction						
Topsoil	0.00	0.00	0.20	0.40	0.20	0.40
Made Ground	0.20	0.40	0.50	>20.50	0.30	>20.30
Alluvium (Clay and Silt)	0.20	5.20	1.20	6.80	0.50	5.15
Bedrock (Siltstone, Mudstone and Sandstone)	1.20	9.00	>5.45	>35.00	>0.95	>30.80
Markeaton junction						
Topsoil	0.00	0.00	0.20	0.40	0.20	0.40
Made Ground	0.00	0.40	0.50	4.50	0.50	4.50

Strata	Top of strata (m bgl) (approximate)		Depth to base (m bgl) (approximate)		Thickness (m) (approximate)	
	Min	Max	Min	Max	Min	Max
Alluvium (Clay, Silt, Sand & Gravel)	0.00	2.50	1.40	12.00	0.90	11.80
Bedrock (Siltstone, Mudstone and Sandstone)	1.00	12.00	>3.00	>30.20	>1.00	>26.56
Little Eaton junction						
Topsoil	0.00	0.00	0.20	0.50	0.20	0.40
Made Ground	0.00	0.50	0.30	2.45	0.10	2.25
Alluvium (Clay, Silt, Sand & Gravel)	0.20	2.45	0.60	11.20	0.40	9.50
Bedrock (Siltstone, Mudstone and Sandstone)	3.10	11.20	>3.20	>30.15	>0.10	>22.15

Bgl – below ground level

Made Ground

- 10.7.18 The Made Ground is described as embankment fill and road construction material at each junction. Parts of Kingsway junction are on an embankment constructed up to approximately 10m high.
- 10.7.19 Previous investigations have encountered historic landfill material to the east of Kingsway junction (in the vicinity of the proposed Kingsway Park Close link road) and in a former railway cutting, crossing the junction on an east-west alignment. Material encountered has included domestic refuse and is described as varied waste comprising flint, concrete, brick, timber, glass and plastic fragments. The waste included evidence of possible asbestos containing materials (ACM). The maximum depth of landfill encountered was approximately 18.7m bgl without proving the base of the landfill. However, the base of the landfill was generally encountered at shallower depths.

Alluvium

- 10.7.20 Historic ground investigations at Kingsway junction described the Alluvium as soft mottled marly clay with peat.
- 10.7.21 At Markeaton junction, the Alluvium is described as predominantly silty clay or sandy silty clay. Clay, clayey silt and marly clay with sand and gravel were also recorded. Occasionally the inclusion of pebbles and organic material are described.

- 10.7.22 At Little Eaton junction the Alluvium was found to comprise two main soil types: i) predominantly silt and clay; and ii) predominantly sand and gravel. The silt and clay is described as typically firm to stiff beneath embankment fill, sometimes soft to firm clay with secondary constituents in varying proportions of sand, gravel and silt. High organic content is reported in some horizons. The sand and gravel is described as gravel with less frequent horizons of sand and sand and gravel.

River Terrace Deposits

- 10.7.23 The River Terrace Deposits encountered at Markeaton junction are described as poorly to well graded, fine to coarse sand and/ or gravel, sometimes silty or clayey. Occasionally, they were described as containing cobbles and organic material was sometimes recorded.

Bedrock Geology

- 10.7.24 The Sidmouth Mudstone Formation (Kingsway junction, Markeaton junction) is described as mainly mudstone and siltstone, which is red-brown with common grey-green reduction patches and spots. It also includes beds of grey-green dolomitic siltstone.
- 10.7.25 The Tarporley Siltstone Formation (Kingsway junction, Markeaton junction) is described as interbedded siltstones, mudstones (both reddish brown) and fine sandstones (typically pale grey brown).
- 10.7.26 The Morridge Formation (Little Eaton junction) is described as dark grey mudstone with beds of pale grey proto-quartzitic siltstone and sandstone and marine beds.

Mining and mineral sites

- 10.7.27 Mining and mineral site (historical) details for each junction are detailed below.

Kingsway junction

- 10.7.28 Rowditch Brick Works which has ceased to operate is located approximately 190m to the east of Kingsway junction (Landmark Information Group, 2014a). The site was an opencast quarry extracting common clay and shale. Historical mapping indicates a large area of historical gravel pits and brick works to the east of the junction between 1883 and 1955. The area is shown as infilled land up to the boundary of Kingsway junction in 1972 (refer to Figure 10.1 [TR010022/APP/6.2]).

Markeaton junction

- 10.7.29 Rowditch Brick Works which has ceased to operate is located approximately 25m to the south-east of Markeaton junction (refer to Figure 10.2 [TR010022/APP/6.2]). The site was an opencast quarry extracting common clay and shale. This entry in the Envirocheck Report (Landmark Information Group, 2014b) relates to a small gravel pit shown on historical mapping and not the large area of former gravel pits to the east of Kingsway junction (as detailed in para. 10.7.28).

Little Eaton junction

- 10.7.30 Breadsall Gravel Pit which has ceased to operate is located approximately 270m to the north-east of Little Eaton junction (Landmark Information Group, 2014c) (refer to Figure 10.3 [TR010022/APP/6.2]). The site was an opencast quarry extracting sand and gravel.

Geologically designated sites

- 10.7.31 The baseline data review indicates that there are no sites with statutory designation for geological features within the defined study areas.
- 10.7.32 There are three Local Geological Sites (formerly Regionally Important Geological Sites (RIGS)) within the defined study areas, namely:
- The Mercia Mudstone exposure, University of Derby Campus, Kedleston Road, Allestree, Derby.
 - The Mercia Mudstone exposure and underlying deposits adjacent to Broadway, Allestree, Derby.
 - Croft Wood, City of Derby.
- 10.7.33 The Local Geological Sites are indicated on Figure 10.2 and Figure 10.3 [TR010022/APP/6.2] which indicates that the Mercia Mudstone Local Geological Sites are located to the north of Kedleston Road junction, whilst the Croft Wood Local Geological Site is located to the south of Little Eaton junction.

Hydrological and hydrogeological information

- 10.7.34 Refer to Chapter 13: Road Drainage and the Water Environment for details regarding surface water and groundwater features and abstractions in the vicinity of the Scheme. However, key information related to potential impacts on geology and soils have been summarised in the following sections.

Hydrogeology

Kingsway junction

- 10.7.35 The superficial geology associated with Bramble Brook underlying Kingsway junction is classified by the Environment Agency as a Secondary 'A' Aquifer (Alluvium). The bedrock deposits underlying the junction are classified as a Secondary 'B' Aquifer (Mercia Mudstone Group Mudstone) and as a Secondary Undifferentiated Aquifer (Mercia Mudstone Group Siltstone Dolomitic).
- 10.7.36 The underlying groundwater body is within the "Derwent – Secondary Combined" catchment. The overall classification for 2016 was Poor, based on the most recent data available on Catchment Data Explorer (<https://environment.data.gov.uk>, last accessed 18/10/18). The quantitative quality (2016 assessment) of the groundwater body is classed as 'Good' by the Environment Agency. The chemical quality of the groundwater body in 2016 was classed as 'Poor', with an objective of a 'Good' classification by 2027. The Derwent – Secondary Combined catchment is a Drinking Water Protected Area.

- 10.7.37 The Groundwater Vulnerability Zone Map (Sheet 23, Leicestershire) indicates that Kingsway junction is not within an area of groundwater vulnerability. There are no groundwater abstraction licenses within 500m of the Scheme. In addition, there are no groundwater Source Protection Zones (SPZ) listed in the Envirocheck Report (Landmark Information Group, September 2014a) within 500m of the Scheme at Kingsway junction.
- 10.7.38 Groundwater monitoring undertaken between November 2016 and October 2017 indicated that the average groundwater depths at the monitoring locations ranged from approximately 3.9m to 7.4m bgl within Made Ground (historic landfill) and 2.5m to 12.3m bgl within the natural strata (refer to Appendix 10.1 [TR010022/APP/6.3]).
- Markeaton junction*
- 10.7.39 The superficial geology (Alluvium) at the Markeaton junction is classified by the Environment Agency as a Secondary A Aquifer. The Mercia Mudstone underlying the junction is classified by the Environment Agency as a Secondary 'B' Aquifer (Mercia Mudstone Group – Mudstone) and as a Secondary Undifferentiated Aquifer (Mercia Mudstone Group – Siltstone Dolomitic).
- 10.7.40 The Groundwater Vulnerability Map, 1:100,000 (Sheet 23, Leicestershire, <https://magic.defra.gov.uk>) indicates that Markeaton junction is located at the intersection of an area of high vulnerability (to the east), an area of intermediate vulnerability (to the north) and an area with no groundwater vulnerability (to the south and west). The areas of intermediate and high vulnerability are associated with River Terrace Deposits and Alluvium lying to the north-east of the junction.
- 10.7.41 The underlying groundwater body is within the "Derwent – Secondary Combined" catchment. The overall groundwater body classification for 2016 was Poor, based on the most recent data available on Catchment Data Explorer (<https://environment.data.gov.uk>). The quantitative quality (2016 assessment) of the groundwater body is classed as 'Good' by the Environment Agency. The chemical quality of the groundwater body in 2016 was classed as 'Poor', with an objective of a 'Good' classification by 2027. The Derwent – Secondary Combined catchment is a Drinking Water Protected Area.
- 10.7.42 There are no groundwater abstraction licenses within 500m of the Scheme at Markeaton junction. In addition, there are no groundwater SPZs within 500m of the Scheme at Markeaton junction.
- 10.7.43 Groundwater monitoring undertaken between November 2016 and October 2017 and from December 2017 to April 2018 indicated that average depths for the monitoring wells ranged from 1.0m to 10.0m bgl (refer to Appendix 10.2 [TR010022/APP/6.3]).

Little Eaton junction

- 10.7.44 The Environment Agency classifies the bedrock (Morridge Formation – Mudstone, Siltstone and Sandstone) and the superficial Alluvium deposits at the junction as Secondary ‘A’ Aquifers. The Environment Agency Groundwater Vulnerability Map (Sheet 23) indicates that Little Eaton junction is situated on land that classifies the soil as high vulnerability (Class H2 soil), suggesting that the soil has a low attenuation potential for pollutants, and that it drains rapidly. To the west of the junction, the classification alters to that of medium vulnerability (Class I1 soil), indicating that it could possibly transmit a wide range of pollutants.
- 10.7.45 The underlying groundwater body is within the “Derwent – Secondary Combined” catchment. The overall classification for 2016 was Poor, based on the most recent data available on Catchment Data Explorer (<https://environment.data.gov.uk>). The quantitative quality (2016 assessment) of the groundwater body is classed as ‘Good’ by the Environment Agency. The chemical quality of the groundwater body in 2016 was classed as ‘Poor’, with an objective of a ‘Good’ classification by 2027. The Derwent – Secondary Combined catchment is a Drinking Water Protected Area.
- 10.7.46 There are no current groundwater abstractions within the study area.
- 10.7.47 The majority of the study area at Little Eaton junction overlies Zone 3 of a groundwater SPZ. This SPZ relates to historic Severn Trent Water (STW) filter tunnels located along each side of the river which are no longer used for potable water abstraction (see Chapter 13: Road Drainage and the Water Environment).
- 10.7.48 Groundwater monitoring undertaken at Little Eaton junction between November 2016 and October 2017 indicated groundwater depths ranging from 0.4m to 3.7m bgl (refer to Appendix 10.1 [TR010022/APP/6.3]).

Hydrology

Kingsway junction

- 10.7.49 The following surface water features have been identified within the study area:
- Bramble Brook (partly in culvert within the junction).
 - Tributaries associated with Bramble Brook (surrounding area).
- 10.7.50 These surface water bodies and their associated water quality are discussed in Chapter 13: Road Drainage and the Water Environment.

Markeaton junction

- 10.7.51 The following surface water features have been identified within the study area:
- Markeaton Brook (north of the junction).
 - Mackworth Brook (north-west of the junction).
 - Middle Brook (north-west of the junction).
 - Markeaton Lake (north of the junction within Markeaton Park).

- Mill Pond (east of the A38, north of the junction).

10.7.52 These surface water bodies and their associated water quality are discussed in Chapter 13: Road Drainage and the Water Environment.

Little Eaton junction

10.7.53 The following surface water features have been identified within the study area:

- River Derwent (west of the junction).
- Dam Brook (south and east of the junction).
- Boosemoor Brook (north-east of the junction).

10.7.54 These surface water bodies and their associated water quality are discussed in Chapter 13: Road Drainage and the Water Environment.

Unexploded ordnance (UXO) risk assessment

10.7.55 A detailed UXO risk assessment was undertaken by 1st Line Defence on 14 July 2016 for land in the vicinity of Markeaton junction due to the presence of the Army Reserves Centre (located to the south of the junction, off Windmill Hill Lane) and given that Markeaton Park was home to an army camp during World War II (refer to Chapter 6: Cultural Heritage, para. 6.9.39). The report indicates that there is a Low Risk of German dropped UXO in the vicinity of the junction, with the risk of Allied Military UXO varying from Low Risk to Medium Risk dependant on the location.

Land contamination

Historical land uses and potential source of contamination

10.7.56 The following provides a summary of environmental information obtained from the Envirocheck Reports (Landmark Information Group Ltd, September 2014a, 2014b and 2014c – contained within Appendix 10.3 [TR010022/APP/6.3]) and data from the Environment Agency website, which is now largely held on <https://magic.defra.gov.uk>.

10.7.57 Unless otherwise stated, the features listed below are all located at least partly within the study areas presented in Figures 10.1 – 10.3 [TR010022/APP/6.2]. Where distances are indicated, these relate to the distance from the existing junctions.

- Kingsway junction (Figure 10.1 [TR010022/APP/6.2]):
 - Rowditch Tip to the east of the junction operated by Par Development Limited between 1990 and 1991. First shown as a Refuse Tip on maps between 1967 and 1972. The current license holder is J Sainsbury PLC and Leigh Interests PLC. Accepted the following wastes: inert; industrial; commercial; household; special waste and liquid sludge. The mapped landfill area encroaches the eastern edge of the Scheme boundary.

- The route of a dismantled railway line to the west of the junction is noted as a historic landfill. The historic landfill is called 'Disused Railway Cutting and Tunnel off Station Road' and was operated by Northern Land Agriculture Improvements Limited. This site received inert waste between 31 August 1981 and 31 March 1993. The landfill is a linear feature running from east to west which encroaches the western edge of the Scheme boundary.
- Two pollution incidents to controlled waters were recorded at the junction in 1998 and 1999, involving milk flow into drains (as a result of a road traffic accident) classed as a Major incident and an accidental spillage of diesel into Markeaton Brook classed as a Minor incident.
- A petrol station is located at the Sainsbury supermarket on the eastern side of the junction (within the Kingsway Retail Park) – the petrol station is approximately 300m east of the existing roundabout.
- A 2005 ground investigation identified that the embankments at Kingsway junction contained Made Ground of old road surface materials and foundry sand with high concentrations of lead, iron and Total Petroleum Hydrocarbons (TPHs).
- Suspected asbestos contamination was observed within the former Rowditch Tip landfill area during the 2016 ground investigation (refer to Appendix 10.1 [TR010022/APP/6.3]).
- Markeaton junction (Figure 10.2 [TR010022/APP/6.2]):
 - The Esso service station is located directly west of the roundabout at Markeaton junction. This has permitted status under Local Authority Pollution and Prevention Controls.
 - Inactive car painters and sprayers on the A38, Queensway; approximately 200m north-east of the roundabout.
 - Two pollution incidents to controlled waters, Category 3 Minor Incidents, occurred at the junction in 1995 and 1999.
 - Historic landfill immediately to the east of the A38, Queensway, approximately 530m north-east of the roundabout. Licensed to Tarmac National Construction between 1982 and 1984 for inert waste.
 - Historic landfill to the east of the Scheme, approximately 300m east of the roundabout. Licensed to the Royal School for the Deaf between 1978 and 1982 for inert, industrial and commercial waste.
- Little Eaton junction (Figure 10.3 [TR010022/APP/6.2]):
 - Located within a nitrate vulnerable zone.
 - A total of nine pollution incidents to controlled waters are recorded in the study area. Two incidents are recorded to the immediate east of the roundabout, related to oils and diesel from accident or collision and two incidents are recorded near the road alignment approximately 350 – 450m west of the roundabout, related to a spillage of milk caused by a

leaking tank and an animal carcass. The incidents occurred between 1996 and 1999 and were classed as Minor to Significant Incidents; the receiving waters were watercourses within the Trent catchment.

- Substantiated pollution incident register entry for inert materials (soils and clay) and special waste materials (vehicle and vehicle parts) in May 2008. Significant impact to land occurred approximately 150m north-west of the roundabout.
- A river quality sampling point is located in the western part of the study area, on the River Derwent, approximately 500m west of the roundabout. The most recent water quality General Quality Assessment (GQA) Grade, for 2009, was Grade A – Very Good for biology and chemistry.
- Registered landfill site/licensed waste management facility approximately 150m north of the roundabout, operational since at least 1977. Licensed to take construction, demolition and dredging wastes.
- Water reclamation works approximately 500m north of the roundabout – this has a Planning Hazardous Substance Consent in relation to chlorine.
- Road haulage service and a commercial vehicle dealer located approximately 50m north and 100m north-west of the roundabout, respectively, and identified as 'Active' in 2014.
- Alignment of the former Derby Canal is located to the north of and crosses Little Eaton junction (refer to Chapter 6: Cultural Heritage).
- Ground investigation undertaken in 2012 noted a hydrocarbon odour in one of the exploratory holes. Gas monitoring indicated the presence of low concentrations of carbon dioxide and methane.

Human health risk assessment

10.7.58 A human health risk assessment was undertaken and reported in the Ground Investigation Report (Highways England, 2018) (Appendix 10.1 [TR010022/APP/6.3]). Key findings are summarised below:

- Kingsway junction:
 - The Tier 1 Screening of soil samples did not identify any exceedances of metal, inorganic or organic determinands when compared against the corresponding Generic Assessment Criteria (GAC) (commercial and industrial end use) value. Therefore, it was considered that for the development of the Scheme, the risk to human health from metal, inorganic and organic determinands is negligible.
 - Four trial pits located within the former landfill were terminated at depths between 1m and 2m bgl due to suspected asbestos. Forty samples taken in Made Ground from ground level to approximately 7.5m were tested for asbestos. Asbestos in the form of free fibres (chrysotile, amosite and crocidolite) and lagging was identified in seven

of the samples. It is estimated that approximately 7,000m³ of ACM would require excavation due to the Scheme (refer to Section 10.9 for details and options for re-use).

- Markeaton junction:
 - The Tier 1 Screening of soil samples did not identify any exceedances in metal, organic or inorganic determinands when compared against their corresponding GAC (commercial and industrial end use) value. Therefore, it was considered that for the development of the Scheme, the risk to human health from metal, inorganic and organic determinands is negligible.
 - Nineteen soil samples taken from Made Ground and Natural Strata between ground level to a depth of approximately 3m bgl were tested for asbestos identification. Chrysotile (free fibres) was identified in two of the nineteen samples, one from Made Ground at BM03 (0.5m bgl) located on land to the south of Markeaton roundabout and one within ground material in BM13 (0.5m bgl) located near a former miniature railway immediately to the north of the junction. There is currently no evidence to suggest that any ACM would need to be disposed of at this junction during the Scheme construction phase. However, a watching brief for the presence of asbestos should be in place during earthworks (refer to Section 10.9).
- Little Eaton junction:
 - The Tier 1 Screening of soil samples did not identify any exceedances in metal, organic or inorganic determinands when compared against their corresponding GAC (commercial and industrial end use) value. Therefore, it is considered that for the development of the Scheme, the risk to human health from metal, inorganic and organic determinands is negligible.
 - Three soil samples taken from ground level to 3.0m bgl were tested for asbestos identification. The samples were taken from Topsoil, Made Ground and Natural Strata. No asbestos was identified in any of the samples analysed.

Controlled waters risk assessment

Critical receptors

10.7.59 The critical controlled waters receptors within the defined study areas are as follows:

- Kingsway junction:
 - Secondary 'A' Aquifer of superficial deposits and Secondary 'B' Aquifer of the Mercia Mudstone.
 - Bramble Brook (located on-site).

- Markeaton junction:
 - Secondary 'A' Aquifer of superficial deposits and Secondary 'B' Aquifer of the Mercia Mudstone.
 - Markeaton Lake and Mill Pond (approximately 400m north-east of the roundabout), fed by Markeaton Brook.
- Little Eaton junction:
 - Secondary 'A' Aquifers of Alluvium (superficial) and Morridge Formation (bedrock).
 - Network of mainly secondary rivers located to the north, east and south of the junction (includes Dam Brook).
 - River Derwent (approximately 400m west of the roundabout), flowing south.
 - Zone 3 (Total Catchment Area) SPZ, related to an historical surface water potable abstraction from the River Derwent (refer to para. 10.7.47).

Risk assessment

- 10.7.60 During the 2016 ground investigation (refer to Appendix 10.1 and Appendix 10.2 [TR010022/APP/6.3]), soil leachates and groundwater samples from all three junctions were assessed to determine the potential risks to the identified controlled water receptors at each junction. The leachates and groundwater tests results were initially compared with the relevant screening criteria (environmental quality standards (EQS) or drinking water standards (DWS)). A DQRA was undertaken for contaminants recorded at concentrations exceeding the screening criteria.
- 10.7.61 Following the completion of the controlled waters risk assessment and subsequent DQRA, no organic contaminants were identified as potential risks to controlled waters at any of the three junctions.
- 10.7.62 The results of the DQRA indicate that there are potential risks to controlled waters from hexavalent chromium, copper, cyanide, lead, nickel, zinc and ammoniacal nitrogen at Kingsway junction. This was based on risks to freshwater ecosystems (Bramble Brook).
- 10.7.63 At Markeaton junction, potential risks to controlled waters were identified from cadmium, copper, lead, zinc, hexavalent chromium and cyanide. This was based on risks to freshwater ecosystems (Markeaton Brook).
- 10.7.64 The DQRA undertaken for Little Eaton junction indicates there are potential risks to controlled waters from cadmium and selenium. This was based on risks to drinking water resources (River Derwent – SPZ).

Ground gas risk assessment

- 10.7.65 A ground gas risk assessment was undertaken as part of the Ground Investigation Report (refer to Appendix 10.1 [TR010022/APP/6.3]), the findings of which are summarised below.

- Kingsway junction:
 - The area overlying an historic landfill has been classified as Characteristic Situation 3 (Moderate Risk) in accordance with the classification scheme for site gas risk assessment presented in CIRIA C665 (CIRIA, 2007). The area outside of the landfill has been classified as a Characteristic Situation 1 (Very Low Risk).
 - Risks due to short-term or prolonged exposure to carbon monoxide are only considered to be present in the area overlying the historic landfill.
 - There is considered to be a risk from prolonged exposure to hydrogen sulphide within the historic landfill area. The risk due to short-term or prolonged exposure to hydrogen sulphide is considered not to be present outside of the historic landfill.
- Markeaton junction:
 - Markeaton junction has been classified as a Characteristic Situation 1 (Very Low Risk).
 - The risk from methane is considered to be low.
 - There is considered there is a negligible risk from carbon monoxide.
 - The risk due to short-term or prolonged exposure to hydrogen sulphide is not considered to be present.
- Little Eaton junction:
 - Little Eaton junction has been classified as a Characteristic Situation 2 (Low Risk).
 - There is considered to be a low risk from carbon monoxide.
 - The risk due to short-term or prolonged exposure to hydrogen sulphide is not considered to be present.

Geotechnical assessment

10.7.66 A geotechnical risk register was prepared as part of the Ground Investigation Report (refer to Appendix 10.1 [TR010022/APP/6.3]). The possible risks identified in this risk register are summarised as follows:

- Potential ground instability during construction works (all three junctions).
- Depth to suitable bearing stratum for structure foundations greater than anticipated (all three junctions).
- Rockhead/hard stratum at shallower depth than expected (all three junctions).
- Ground chemistry/solution features (all three junctions).
- Soft/unsuitable material at pavement formation level (all three junctions).

- Potential risk to long-term ground heaving due to deep cutting into Mercia Mudstone (over-consolidated) on the new road formation (all three junctions).
- Proportions of acceptable/unacceptable material from cuttings different to those predicted (all three junctions).
- Presence of Made Ground, including old road surface (all three junctions) and foundry sand (Kingsway junction).
- Existing earthwork defects (all three junctions).
- Existing structure foundations (all three junctions).
- Existing services, in particular those installed after previous studies (all three junctions).
- Soft ground (cutting at Kingsway junction).
- Made Ground material at the former landfill (Kingsway junction), which is likely to be unsuitable for re-use in the Scheme.
- Soft/ compressible ground (structures at all three junctions).
- Fault disturbed ground (Kingsway and Markeaton junctions).
- Artesian groundwater (Kingsway and Little Eaton junctions).
- Shallow groundwater levels (cutting and structure – Markeaton junction).
- Potential for UXO to be disturbed during construction at Markeaton junction.
- Shallow groundwater levels (embankment and structures within the River Derwent floodplain).
- Flooding adjacent to earthworks (River Derwent floodplain).
- Soft/ compressible ground (embankment on alluvium material and historic route of Derby Canal at Little Eaton junction).

Agricultural land and soils

- 10.7.67 There are no areas in agricultural use in the vicinity of Kingsway junction or Markeaton junction – thus effects upon agricultural soils for these junctions has been scoped out of the assessment (refer to para.10.3.17).
- 10.7.68 Agricultural soils are present at Little Eaton junction. As such, an ALC quality investigation was undertaken in 2015 covering the Scheme footprint. A further ALC survey was undertaken in 2018, including the survey of the floodplain compensation area to the west of the River Derwent at Little Eaton junction (refer to Figure 2.10 [TR010022/APP/6.2]).
- 10.7.69 These investigations indicate that agricultural soils within the Scheme boundary at Little Eaton junction are predominantly of ALC subgrades 3a and 3b (refer to Figure 10.4 [TR010022/APP/6.2]). Best and most versatile agricultural land is defined as land in ALC grades 1, 2 and 3a.

Agricultural land holdings

- 10.7.70 Farm assessment interviews with the affected landowners via face-to-face meetings were carried out in March 2015 to establish baseline conditions and agricultural circumstances of the land potentially affected by the Scheme. The baseline conditions and agricultural circumstances were updated with telephone calls with affected landowners, including two additional landowners, in October 2018.
- 10.7.71 The interviews and resultant discussions were based around a standard questionnaire designed to establish the agricultural circumstances of the land affected by the Scheme, identify the main impacts of the Scheme on agricultural land holdings and identification of potential means of mitigating impacts.
- 10.7.72 Questions asked included the nature of the agricultural business run from the holding, the total land area farmed by the affected party, whether the land affected is managed under any environmental stewardship schemes, how the Scheme would affect the farm business and any necessary mitigation measures.
- 10.7.73 Table 10.10 provides details of the land holdings that would be affected by the Scheme (refer to Figure 10.5 [TR010022/APP/6.2]) and the associated sensitivity to change (refer to para. 10.3.14). Note that the holding areas in Table 10.10 include other land plots used by the applicable landowners for their respective enterprises (if applicable).

Table 10.10: Farm holdings potentially impacted by the Scheme

Holding No	Enterprise type	Holding area (approximately) (ha)	Sensitivity to change
1	Turf production	72.9	High
2	Grazing	3.1	Low
3	Grazing	9.0	Low
4*	Grazing and woodland (although the area affected by the Scheme is predominantly woodland)	10.0	Low
5	Dairy, beef, arable and grazing	263.3	Medium
6	Grazing	18.2	Low
7	Grazing	4	Low

* plot held under various family names

Future baseline

- 10.7.74 As detailed within Chapter 4: Environmental Impact Assessment Methodology, in order to identify the effects of the Scheme on environmental features, it is important to understand the baseline at the year of construction and the future baseline at year of Scheme opening/operation, as these may be different from those that currently exist. Such changes could alter the sensitivity of existing environmental receptors, as well as introduce new sensitive receptors.

Construction year baseline (2020)

- 10.7.75 The baseline details as reported in the sections above describe the geology and soils in the years that surveys/desk top baseline studies were undertaken (2015 - 2018).
- 10.7.76 Preliminary works associated with the Scheme are anticipated to start in late 2020, subject to securing a DCO (refer to Chapter 2: The Scheme, Section 2.6), with the main works starting in 2021.
- 10.7.77 The majority of the land that would be impacted by the Scheme (and in its vicinity) at Kingsway junction and Markeaton junction comprise the existing A38 highway and other highway infrastructure, as well as surrounding residential areas and areas of public open space. At Little Eaton junction, the majority of the land that would be impacted by the Scheme (and in its vicinity) comprises agricultural land as well as the existing A38 highway and other highway infrastructure, plus residential and commercial areas. As such, environmental baseline conditions within the geology and soils study area are not anticipated to change significantly by 2020 from the conditions as detailed above.
- 10.7.78 With regards to committed developments which may be implemented by 2020 (refer to Chapter 15: Assessment of Cumulative Effects), it is assumed that appropriate measures would be incorporated into those developments such that there would be no effect on land contamination status within the geology and soils study area.

Opening year baseline (2024)

- 10.7.79 It is not possible to accurately predict baseline environmental conditions for the year of Scheme opening (2024); however, it is anticipated that baseline geology and soils conditions in the vicinity of the Scheme and within the associated study area in 2024 will largely be the same as at 2020.
- 10.7.80 Taking into account the use of appropriate mitigation measures to address geotechnical and contamination risks identified as associated with the Scheme (refer to Section 10.10), the following changes to the geology and soils baseline are anticipated in 2024 (Scheme opening year):
- Changes in the near-surface geology and geomorphology as a result of Scheme ground engineering works, including cut and fill. This would result in deeper areas of Made Ground in some areas and conversely removal of Made Ground, plus natural superficial deposits or bedrock geology in other areas of the Scheme.

- Changes in geotechnical soil properties as a result of Scheme ground improvement works, such as improvements to soft or compressible ground and stabilisation of fault disturbed ground.
- Potential improvements in groundwater quality, reduced landfill gas emissions/migration and contamination status of specific areas as a result of any remediation work carried out during the Scheme construction stage.
- Minor losses of agricultural land as associated with the Scheme at Little Eaton junction.

10.8 Potential impacts

10.8.1 Mitigation measures incorporated into the Scheme design and measures to be taken to manage geology and soil effects during Scheme construction are set out in Section 10.9. Prior to implementation of such mitigation measures, the Scheme has the potential to affect geology and soils (either positively or negatively), both during construction and once in operation, in the following ways.

Construction

10.8.2 In relation to potentially contaminative land uses, the following adverse impacts could potentially arise as a result of Scheme construction (unmitigated):

- Mobilising existing contamination in soil and groundwater as a result of ground disturbance (including disturbance in areas of former landfilling) and de-watering during construction.
- Increasing the potential for contaminants in unsaturated soils to leach into groundwater in open excavations during construction.
- Increasing the potential for contaminated surface run off to migrate to surface water and groundwater receptors as a result of leaching from uncovered stockpiles.
- Introducing new sources of contamination, such as fuels, chemicals and oils used during construction activities.
- Creating preferential pathways for the migration of soil contamination and ground gases, for example along new below ground service routes, service ducts and as a result of dewatering.

10.8.3 The impacts as detailed above have the potential to affect human, ecological and controlled waters receptors.

10.8.4 With regard to existing geological and soil resources, construction has the potential to result in the following adverse impacts (unmitigated):

- Degradation of soil resources from the compaction of soil due to heavy construction vehicle movements, changes in topography, exacerbation of erosion through the handling and storage of soils, or ground stability impacts.

- The temporary and permanent loss of agricultural soils at Little Eaton junction.
- The generation of waste soils (such as ground materials impacted with ACM) that cannot be reused on the Scheme, requiring off-site disposal as waste.

10.8.5 Some, albeit limited, potential exists for construction to result in beneficial impacts through the following:

- Removal or treatment of contaminated soil, with the effect that existing adverse effects on receptors are removed.
- A reduction in soil erosion through improved drainage.

10.8.6 With regard to agricultural land and farm-based enterprises at Little Eaton junction, Scheme construction could result in the loss of agricultural soils (following the restoration of land required temporarily to former agriculture use), potential severance, and the loss of, or disruption to, land, property, buildings, operational infrastructure and access. Other potential construction effects include the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; unintentional pollution of soil and water courses; spread of injurious weeds to adjacent agricultural land from soil and material stockpiles; and construction noise on farm and farm-based enterprises.

Operation

10.8.7 No potential adverse impacts are likely to result from the long term operation of the Scheme, other than the potential risk for controlled waters or geology and soils to be affected by spillages arising from road accidents or faulty vehicles. In addition, agricultural land quality within the floodplain compensation area at Little Eaton junction could change due to an increase in the frequency and duration of flooding.

10.8.8 Should beneficial impacts be identified during the construction phase (refer to para. 10.8.5), it is expected that some of these could continue into the Scheme operational phase, for example the removal or treatment of contaminated soil would provide a benefit in future years.

10.8.9 With regard to agricultural land and farm-based enterprises at Little Eaton junction, permanent impacts would comprise a reduction in the net area of agricultural land; permanent severance; and the permanent loss of, or effect on, farm infrastructure (such as property, buildings and structures), and the consequential effects on land uses and farm enterprises.

10.9 Design, mitigation and enhancement measures

10.9.1 Where possible, proportionate measures to avoid or minimise impacts on geology, soils and agricultural land holdings have been embedded within the Scheme design (refer to Chapter 2: The Scheme). Measures taken to avoid or minimise Scheme impacts include the following:

- The Scheme would require temporary land take from agricultural land holdings at Little Eaton junction – such areas would be suitably restored and returned to the landowner for continued agricultural use.
- The Scheme at Little Eaton would require the closure of the Ford Lane access to the A38 for safety reasons. Vehicles from a land plot engaged in commercial turf production located to the south of the existing A38 and east of the River Derwent, currently uses the Ford Lane access (via the Flood Relief Arch) to access the site and distribute its products. Loss of access to the A38 would have a significant impact upon the turf production business. As such, in order to enable continued access to the turf production site, it is proposed that turf vehicles would use Ford Lane to access the A6 Duffield Road, which in turn connects with the A38 Palm Court junction. In order to facilitate turf truck use of this route, some strengthening works may be required to the Ford Lane bridge over the River Derwent, whilst there would be a need to realign Ford Lane and reconfigure the junction with Lambourn Drive.

Construction

- 10.9.2 This section contains details of measures included in the Scheme design and best practice techniques (comprising legal requirements and construction guidance) which would be implemented in order to mitigate and manage, as far as is practicable, potential impacts to geology and soils due to Scheme construction.
- 10.9.3 Construction of the Scheme would be subject to measures and procedures as defined within the Outline Environmental Management Plan (OEMP) for the Scheme (refer to Appendix 2.1 [TR010022/APP/6.3]). The OEMP includes a range of measures to enable compliance with relevant standards and legislation as associated with geology and soils. The measures detailed within the OEMP would be developed into a Construction Environmental Management Plan (CEMP) which would be implemented by the selected construction contractor (refer to Chapter 2: The Scheme, para. 2.6.107). The CEMP would set out the environmental mitigation requirements and also the project level expectations on how the Scheme would be constructed. Measures contained within the CEMP would be designed to limit the possibility for dispersal and accidental releases of potential contaminants, soil derived dusts and uncontrolled run-off to occur during Scheme construction. For example, the CEMP would set out how material would be excavated, segregated and stockpiled to minimise the possibility for run-off, soil quality degradation and wind dispersal of dusts. The CEMP would also establish procedures for dealing with unexpected soil or groundwater contamination that may be encountered. As detailed in Chapter 13: Road Drainage and the Water Environment (refer to Section 13.10), the OEMP (refer to Appendix 2.1 [TR010022/APP/6.3]) contains a range of measures to protect controlled waters during the Scheme construction phase.

- 10.9.4 The main construction compound for the Scheme would be located at the site of the former landfill to the north of Little Eaton junction. Historic ground investigation data indicates the potential for the presence of soft ground and contaminated materials and leachate. Therefore, the surface of the construction compound area would be covered by approximately 600mm (subject to detailed design) of compacted stone to form a trafficable surface for site vehicles and to provide a separation layer from the underlying landfill materials to prevent their disturbance and trafficking to other parts of the site.
- 10.9.5 Mitigation measures as related to geology and soils are anticipated to include the following (and which would be included in the CEMP):
- Handling of topsoil and subsoil in a manner to retain their potential for plant growth including careful stripping, segregation and placement for reuse (where possible) as part of landscaping, earthworks or any areas of agricultural handback. Such measures would be applied to soils removed from the A38 Roundabout Local Wildlife Site (LWS) at Kingsway junction which would be translocated to a site within Markeaton Park in order to create a new species rich grassland (refer to Chapter 8: Biodiversity).
 - The characterisation and disposal of waste soils as either hazardous or non-hazardous waste (in accordance with a Site Waste Management Plan (SWMP) – refer to the OEMP in Appendix 2.1 [TR010022/APP/6.3]).
 - Minimisation of compaction of underlying soils from construction plant, and routine testing of soils during ground works to confirm material suitability for use.
 - Groundwater level controls (as necessary).
 - Adequate fuel and chemical storage facilities e.g. bunded tanks, hard standing and associated emergency response and spillage control procedures.
 - The use of well-maintained plant and associated emergency response and spillage control procedures.
 - The implementation of an Asbestos Management Plan to ensure asbestos can be identified, removed and disposed of in a legally compliant manner, primarily for the area of the link road to Kingsway Park Close which would be constructed through the former Rowditch Tip landfill.
 - The covered storage of contaminated material on sheeting to minimise the potential for leachate and run off from the stockpile being generated.
- 10.9.6 Construction activities would be undertaken by the appointed contractor in accordance with industry best practise and in line with measures set out in the CEMP, with emphasis placed on ensuring legal compliance and managing risks to construction workers.

- 10.9.7 The following risk mitigation measures are recommended to support the proposed works at Markeaton junction with regard to UXO:
- Site-specific UXO awareness briefings to all personnel conducting intrusive works (all works).
 - UXO specialist presence on site to support shallow intrusive works.
- 10.9.8 During the detailed design stage, additional ground investigation works would be carried out, including at the sites identified as historic landfills (at Kingsway junction and Little Eaton junction) and at the current Esso petrol station at Markeaton junction. DQRA would be undertaken to further assess the existing contamination risks identified at the junctions as related to leachate and groundwater. This DQRA would be used to inform the remediation strategy which would be prepared in advance of the Scheme construction works. This remediation strategy would be developed to identify any mitigation measures required to reduce any identified impacts to controlled waters and to prevent any future impacts related to the construction and operational phases of the Scheme. This would include measures to ensure that any disturbance of the historic landfill at Kingsway junction would not create new pathways (either temporary or permanent) for migration of contamination to controlled waters; migration of ground gas or disturbance and mobilisation in air of asbestos fibres that could impact human receptors and building infrastructure. Location-specific piling risk assessments would also be carried out in relation to any piled structures or ground improvement works required as part of the Scheme. This is due to the presence of known or suspected contamination at Kingsway junction (former landfill), Markeaton junction (petrol station) and Little Eaton junction (former landfill) and the presence of a groundwater SPZ at Little Eaton junction.
- 10.9.9 In the event that unexpected contamination is identified during the construction works, including contaminated groundwater, the contractor would follow the procedures set out in the CEMP.
- 10.9.10 All materials proposed for re-use would be required to meet risk-based acceptability criteria, whilst soils would be protected from accidental contamination during storage and transit (refer to Chapter 11: Material Assets and Waste - refer to Section 11.9 therein). Methods of soil handling and storage, including measures to prevent erosion by wind and surface water, would be detailed in a Soil Management Plan that would be prepared prior to the commencement of Scheme construction activities.
- 10.9.11 The re-use of excavated soils during Scheme construction would be governed by a Materials Management Plan (MMP) (included within the CEMP) which would be developed in accordance with CL:AIRE Code of Practice which is a voluntary framework for excavated materials management and re-use. Following this framework would result in a level of information being generated sufficient to demonstrate that excavated material has been re-used appropriately and is suitable for its intended use. It demonstrates that unsuitable material or waste has not been used in the development. The MMP would detail the procedures and measures that would be taken to classify,

track, store, reuse and dispose of all excavated materials that would be encountered during the construction phase.

- 10.9.12 The fate of potentially contaminated or geotechnically unsuitable material (for example excavated landfill material at Kingsway junction) would be determined in the remediation strategy and in the earthworks strategy. The preference would be to re-use such materials within the construction by carrying out remediation or soil improvement, where feasible, in order to mitigate any contamination or geotechnical risks. For example, ACM could potentially be used at depth within the construction, as this would break the contamination pathways to future site users.
- 10.9.13 Where there is a requirement to dispose of surplus or unsuitable soils off-site as waste, the material would be characterised to determine firstly whether it is hazardous or non-hazardous waste in accordance with the Environment Agency's Technical Guidance WM3 (Environment Agency, 2018). Once this is established, the appropriate disposal facility would be determined through Waste Acceptance Criteria (WAC) analysis as required.
- 10.9.14 With regard to agricultural holdings, where agricultural land is required for temporary works, the soil resources would be appropriately protected and replaced post construction to reinstate pre-existing agricultural capability. In this regard, a Soil Management Plan would be prepared and implemented by the contractor, taking into account the guidance provided in the DEFRA Code of Practice for Sustainable Use and Management of Soils on Construction Sites (Defra, 2009). The code of practice, which would be adopted and implemented via the Soil Management Plan, encourages:
- Identification of soil resources at an early stage in the development process.
 - Improved planning of soil use.
 - A better level of soil management during project implementation, including sustainable use of surplus soil.
 - Maintenance of soil quality and function both on and off site.
 - Avoidance of soil compaction and erosion (with a consequent reduction in flooding and water pollution).
 - An improved knowledge and understanding of soil at all levels in the construction industry, including soil amelioration techniques.
- 10.9.15 Topsoil and subsoil would be removed during construction in order to prevent permanent burial beneath other earthworks. Topsoil excavated from areas of known high quality agricultural land would be stored separately and, where possible, would be reused on-site in areas to be landscaped, or in areas that would be re-graded and returned to agricultural use. Similarly topsoil removed from the A38 Roundabout LWS at Kingsway junction would be segregated and suitably stored prior to its translocation into Markeaton Park.

- 10.9.16 The impacts on soil resources would be mitigated by employing high standards of soil handling and management during construction, and by avoiding the creation of bare areas of permanently exposed soil that would be vulnerable to erosion processes.
- 10.9.17 Topsoil stripped during the construction would be re-used within the Scheme appropriately and stored in such a way as to minimise structural damage from weathering, construction traffic movements, and multiple handling, and which would also minimise the potential for leaching of nutrients from soils. All materials proposed for re-use would be required to meet risk based acceptability criteria. Soils would be protected from accidental contamination during storage and transit. Methods of soils handling and storage, including measures to prevent erosion by wind and surface water, would be detailed in a method statement that would be prepared in accordance with the Code of Practice for Sustainable Use and Management of Soils on Construction Sites (Defra, 2009) (as detailed in para. 10.9.14) before the commencement of construction activities.
- 10.9.18 In addition, compliance with measures set out within the OEMP (Appendix 2.1 [TR010022/APP/6.3]) would avoid or reduce environmental impacts on agricultural holdings during the construction phase. Those measures that are particularly relevant to agriculture include:
- Arrangements for the maintenance of farm and field accesses affected by construction (including arrangements for the continued use of the Flood Relief Arch beneath the A38 by the turf production site).
 - The protection and maintenance of livestock water supply systems, where reasonably practicable.
 - The protection of agricultural land adjacent to the construction site, including the provision and maintenance of appropriate stock-proof fencing.
 - The adoption of measures to control the deposition of dust on adjacent agricultural crops.
 - The control of invasive and non-native species and the prevention of the spread of weeds generally from the construction site to adjacent agricultural land (also refer to Chapter 8: Biodiversity and the outline biosecurity management plan contained in Appendix B of the OEMP (Appendix 2.1 [TR010022/APP/6.3])). The adoption of measures to prevent, insofar as reasonably practicable, the spread of soil-borne, tree, crop and animal diseases from the construction area.
 - Liaison and advisory arrangements with affected landowners, occupiers and agents, as appropriate.

Operation

- 10.9.19 The mitigation measures detailed in Chapter 13: Road Drainage and the Water Environment (refer to Section 13.9 – Scheme design and operation) would prevent the pollution of controlled waters during the Scheme operational phase.
- 10.9.20 Potential risks posed to maintenance workers would be mitigated through adherence to appropriate site and task specific health and safety documentation (required for legal compliance).
- 10.9.21 Any spillages on the A38 following road accidents would be routinely managed by Highways England who is responsible for the maintenance of trunk road assets with the Area 7 East Midlands Region (refer to Chapter 13: Road Drainage and the Water Environment, Section 13.9).

10.10 Assessment of likely significant effects

Geology and soils

- 10.10.1 Taking into account the mitigation measures as detailed in Section 10.9, an analysis of likely effects relating to geology and soils associated with Scheme construction and operation has been undertaken – this analysis is presented in Table 10.11. The table summarises the pre-mitigation and post-mitigation geology and soils effects during the construction and operation of the Scheme.

Table 10.11: Summary of key geology and soil effects and potential pollutant linkage for the Scheme

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
Construction						
Impact on human health receptor	Residential areas or schools within 50m of the proposed junctions (all junctions) – soil and groundwater contamination impacts.	High	Low	Moderate	See Section 10.9	Minor
	Residential areas or schools within 50m of the works at Kingsway junction – potential landfill gas impacts.	High	Medium	Major	See Section 10.9	Minor
	Residential areas or schools within 50m of the construction compound at Little Eaton junction – potential landfill gas impacts.	High	Low	Moderate	See Section 10.9	Negligible
	Residential areas or schools within 50m of works at Markeaton junction – disturbance of UXO.	High	High	Major	See Section 10.9	Minor
	Residential areas or schools within 50m to 250m of the proposed works. Commercial areas within 50m of the proposed works – soil and groundwater contamination impacts.	Medium	Low	Minor	See Section 10.9	Negligible
	Residential areas or schools within 50m to 250m of the works at Kingsway junction. Commercial areas within 50m of works at Kingsway junction – landfill gas impacts.	Medium	Medium	Moderate	See Section 10.9	Negligible
	Residential areas, schools or commercial areas within 50m to 250m of works at Markeaton junction.	Medium	High	Major	See Section 10.9	Minor

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
	Commercial areas within 50m of works at Markeaton junction – disturbance of UXO.					
	Residential areas >250m from the proposed works. Commercial areas within 50m to 250m of the proposed junctions – soil and groundwater contamination impacts.	Low	Low	Negligible	See Section 10.9	Negligible
	Residential areas >250m from works at Kingsway junction. Commercial areas within 50m to 250m of works at Kingsway junction – landfill gas impacts.	Low	Medium	Minor	See Section 10.9	Negligible
	Residential areas >250m from the works at Markeaton junction. Commercial areas within 50m to 250m of works at Markeaton junction – disturbance of UXO.	Low	Medium	Minor	See Section 10.9	Negligible
Impact on controlled waters	Bramble Brook (Kingsway junction) – soil and groundwater contamination impacts on freshwater ecosystem.	Medium	Medium	Moderate	See Section 10.9	Minor
	Markeaton Lake, Mill Pond and Markeaton Brook (Markeaton junction) – soil and groundwater contamination impacts on freshwater ecosystem.	High	Medium	Major	See Section 10.9	Minor
	Secondary rivers, including un-named watercourses, Boosemoor Brook and Dam Brook (Little Eaton junction) – soil and groundwater contamination impacts	High	Medium	Major	See Section 10.9	Minor

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
	on freshwater ecosystem.					
	River Derwent (Little Eaton junction) – soil and groundwater contamination impacts on freshwater ecosystem and potable abstraction.	High	High	Major	See Section 10.9	Minor
	Underlying Secondary A aquifers – superficial deposits (all junctions) – soil and groundwater contamination impacts on baseflow to watercourses.	Medium	Medium	Moderate	See Section 10.9	Minor
	Underlying Secondary A aquifer (Little Eaton junction) – superficial deposits – soil and groundwater contamination impacts on SPZ Zone 3, private abstractions and baseflow to watercourses.	Medium	High	Major	See Section 10.9	Minor
	Underlying Secondary A aquifers – Morridge Formation (Little Eaton junction) – soil and groundwater contamination impacts on SPZ (Zone 3), private abstractions and baseflow to watercourses.	Medium	High	Major	See Section 10.9	Minor
	Underlying Secondary B/undifferentiated aquifer – Mercia Mudstone (Kingsway and Markeaton junctions) – soil and groundwater contamination impacts on baseflow to rivers and local supplies (if applicable).	Low	Medium	Minor	See Section 10.9	Negligible

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
Impact on development infrastructure	Damage to buried concrete in foundations (chemical attack).	Medium	Medium	Moderate	See Section 10.9	Negligible
	Damage to infrastructure due to unsuitable earthworks materials (e.g. landfill waste).	Medium	Medium	Moderate	See Section 10.9	Negligible
	Damage to infrastructure due to ground instability impacts (e.g. deep cuttings, fault disturbed ground, existing earthworks defects).	Medium	Medium	Moderate	See Section 10.9	Negligible
	Damage to development infrastructure due to existing buried foundations (e.g. differential settlement).	Medium	Medium	Moderate	See Section 10.9	Negligible
	Damage to infrastructure due to shallow groundwater levels.	Medium	Medium	Moderate	See Section 10.9	Negligible
	Damage to infrastructure due to flooding adjacent to earthworks (River Derwent floodplain).	Medium	Medium	Moderate	See Section 10.9	Negligible
	Damage to existing services caused by construction activities.	Medium	Medium	Moderate	See Section 10.9	Minor
	Property damage due to disturbance of UXO (Markeaton junction).	Medium	Medium	Moderate	See Section 10.9	Negligible
Impacts on agricultural land	Loss of Grade 3a agricultural land – less than 20ha (Little Eaton junction).	Medium	Low	Minor	See Section 10.9	Minor
Geology and soil resources	Loss of topsoil and subsoil.	Medium	Low	Minor	See Section 10.9	Minor
	Impact on local geological sites.	High	Low	Moderate	See Section 10.9	Negligible

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
Operation						
Impact on human receptors	Residential areas or schools within 50m of the new junctions (all junctions) – soil and groundwater contamination impacts.	High	Low	Moderate	See Section 10.9	Negligible
	Residential areas or schools within 50m of new Kingsway junction – potential landfill gas impacts.	High	Medium	Major	See Section 10.9	Negligible
	Residential areas or schools within 50m to 250m of the new junctions. Commercial areas within 50m of the new junctions – soil and groundwater contamination impacts.	Medium	Low	Minor	See Section 10.9	Negligible
	Residential areas or schools within 50m to 250m of the new Kingsway junction Commercial areas within 50m of new Kingsway junction – landfill gas impacts.	Medium	Medium	Moderate	See Section 10.9	Negligible
	Residential areas >250m from the new junctions. Commercial areas within 50m to 250m of the new junctions – soil and groundwater contamination impacts.	Low	Low	Negligible	See Section 10.9	Negligible
	Residential areas >250m from the new Kingsway junction. Commercial areas within 50m to 250m of the new Kingsway junction – landfill gas impacts.	Low	Medium	Minor	See Section 10.9	Negligible

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
Impact on controlled waters	Bramble Brook (Kingsway junction) – soil and groundwater contamination impacts on freshwater ecosystem.	Medium	Low	Minor	See Section 10.9	Negligible
	Markeaton Lake and Markeaton Brook (Markeaton junction) – soil and groundwater contamination impacts on freshwater ecosystem.	High	Low	Moderate	See Section 10.9	Negligible
	Secondary rivers, including un-named watercourse, Boosemoor Brook and Dam Brook (Little Eaton junction) – soil and groundwater contamination impacts on freshwater ecosystem.	High	Low	Moderate	See Section 10.9	Negligible
	River Derwent (Little Eaton junction) – soil and groundwater contamination impacts on freshwater ecosystem and potable abstraction.	High	Low	Moderate	See Section 10.9	Negligible
	Underlying Secondary A aquifers – superficial deposits (all junctions) – soil and groundwater contamination impacts on baseflow to watercourses.	Medium	Low	Minor	See Section 10.9	Negligible
	Underlying Secondary A aquifer (Little Eaton junction) – superficial deposits – soil and groundwater contamination impacts on SPZ Zone 3, private abstractions and baseflow to watercourses.	Medium	Medium	Moderate	See Section 10.9	Negligible
	Underlying Secondary A aquifers – Morridge Formation (Little Eaton junction) – soil and groundwater contamination	Medium	Medium	Moderate	See Section 10.9	Negligible

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
	impacts on SPZ (Zone 3), private abstractions and baseflow to watercourses.					
	Underlying Secondary B/undifferentiated aquifer – Mercia Mudstone (Kingsway and Markeaton junctions) – soil and groundwater contamination impacts on baseflow to rivers and local supplies (if applicable).	Low	Low	Negligible	See Section 10.9	Negligible
Impact on development infrastructure	Buried concrete for foundations.	Medium	Very low	Negligible	See Section 10.9	Negligible
	Damage to infrastructure due to unsuitable earthworks materials (e.g. landfill waste).	Medium	Low	Minor	See Section 10.9	Negligible
	Damage to infrastructure due to ground instability impacts (e.g. deep cuttings, fault disturbed ground, existing earthworks defects).	Medium	Low	Minor	See Section 10.9	Negligible
	Damage to development infrastructure due to existing buried foundations (e.g. differential settlement).	Medium	Low	Minor	See Section 10.9	Negligible
	Damage to infrastructure due to shallow groundwater levels.	Medium	Low	Minor	See Section 10.9	Negligible
	Damage to infrastructure due to flooding adjacent to earthworks (River Derwent floodplain).	Medium	Low	Minor	See Section 10.9	Negligible

Potential impacts	Description of resource/receptor and impact	Sensitivity of receptor	Magnitude of impact	Significance of effects (pre-mitigation)	Mitigation measures	Significance of effects (post-mitigation)
Impact on agricultural land	Potential gradual degradation of agricultural soils in the floodplain compensation area during Scheme operation (Little Eaton junction).	Medium	Very low	Negligible	See Section 10.9	Negligible
Geology and soil resources	Loss of topsoil and subsoil.	Medium	Very low	Negligible	See Section 10.9	Negligible
	Impact on local geological sites.	High	Very low	Minor	See Section 10.9	Negligible

- 10.10.2 Table 10.11 indicates that given the appropriate design of the Scheme, adherence to appropriate construction and operational practices that accord with legal compliance and best practice guidance when working with or around contaminated materials (as detailed in Section 10.9), effects associated with soils and geology are predicted to be either negligible or at worst minor, and thus effects would not be significant.

Agricultural soils

- 10.10.3 Figure 10.4 [TR010022/APP/6.2] shows the results of ALC surveys undertaken at Little Eaton junction. As detailed in paragraph 10.3.17, there is an absence of agricultural soils at Kingsway junction and Markeaton junction.
- 10.10.4 Soils within agricultural land affected by the Scheme at Little Eaton junction are primarily associated with superficial alluvial deposits supporting mainly clayey or clay loam soils. It is considered that the main limitation to the agricultural land quality in the vicinity of Little Eaton junction is soil wetness and workability which restricts soil quality to ALC Subgrades 3a and 3b. Moderate quality Subgrade 3b land predominates, with flood risks limiting the land to the west of the A61 Alfreton Road to no higher than ALC Subgrade 3a.
- 10.10.5 Taking into account the ALC characteristics as detailed in Figure 10.4 [TR010022/APP/6.2] and the Scheme design, it is estimated that approximately 18.60ha of agricultural soil would be potentially impacted by Scheme construction, of which approximately 10.20ha would be of ALC Subgrade 3a and approximately 8.40ha of ALC Subgrade 3b. Of this total, approximately 6.46ha of agricultural soils would be lost permanently (approximately 1.48ha being ALC Subgrade 3a, and approximately 4.98ha being ALC Subgrade 3b), with the remainder being restored following Scheme construction and returned to the landowner. As detailed in Section 10.9, where agricultural land is required for temporary works, soil resources would be appropriately protected and replaced post-construction to reinstate pre-existing agricultural soil capability.
- 10.10.6 Given that the Scheme construction would result in the permanent loss of less than 20ha of best and most versatile agricultural land (i.e. ALC grades 1, 2 and 3a), agricultural soil effects during the construction phase are assessed as being minor, and thus effects would not be significant.
- 10.10.7 During Scheme operation, whilst there would be no additional agricultural soil losses, agricultural land quality within the floodplain compensation area to the west of the River Derwent may gradually change with time due to an increase in the frequency and duration of flooding. Flooding of the land would introduce additional silt material which may increase fertility. However, any treading of the area, when the soils are waterlogged, by animals or trafficking by vehicles, could cause deterioration of soil physical properties. Effects are assessed as being negligible, and thus effects would not be significant.

Agricultural holdings

- 10.10.8 The acquisition and use of land for the Scheme would interfere with existing uses of that land and, in some locations, preclude existing land use practices. This could result in potential effects associated with the ability of affected agricultural interests to access and use residual parcels of land. The Scheme seeks to reduce this disruption and, where appropriate and reasonably practicable, facilitate access during the construction phase.
- 10.10.9 Land used to construct the Scheme would fall into the following main categories when work is complete:
- Part of the operational road or its associated landscaping and kept under the control of the Scheme operator (Highways England).
 - Returned to unrestricted agricultural use (with aftercare management to ensure stabilisation of the soil structure).
- 10.10.10 Land would be required for the Scheme from agricultural holdings temporarily, during the construction period (for construction access and logistical purposes), and permanently. In all cases, the temporary and permanent land requirement would occur simultaneously at the start of the Scheme construction period and it is the combined effect of both that would have the most impact on the affected agricultural holdings.
- 10.10.11 Following the completion of construction activities on the land plots in question, agricultural land taken on a temporary basis would be restored and returned to the landowner for unrestricted agricultural use in the same agricultural condition that currently exists (refer to Section 10.9). Following the restoration and return of agricultural land, the impact on the individual holdings would reduce. Agricultural areas taken on a temporary basis to the east of the River Derwent would be required for the duration of the Scheme construction period. However, works to create the floodplain compensation area to the west of the River Derwent would be completed within approximately three months, with such works being completed as part of the preliminary works (refer to Chapter 2: The Scheme, Table 2.3), after which the area would be restored for continued agricultural use.
- 10.10.12 The effects of the Scheme on individual agricultural holdings during the construction and operation phases are detailed in Table 10.12 (taking into account the mitigation measures as detailed in Section 10.9). This table shows the total area of land required from the particular land holding (refer to Figure 10.5 [TR010022/APP/6.2]) in absolute terms (temporary and permanent) and as a percentage of the total area farmed (which in some cases is larger than the affected land plot due to the availability of other land parcels – refer to Table 10.10). The area of agricultural land that would be returned to the holding following the construction period (temporary land take requirements) is also indicated. The degree of impact is based on the percentage of the land holding taken, rather than the absolute area of land affected, as well as taking into account issues associated with severance, impacts upon infrastructure and

disruption (refer to Figure 10.5 [TR010022/APP/6.2] for the location of affected land holdings).

Table 10.12: Farm holdings impacted by the Scheme (refer to Figure 10.5 [TR010022/APP/6.2])

No	Sensitivity to change	Land take (ha) (approximate)	Impacts (C – construction) (O – operation)	Effects
1	High	Temporary: 1.47 Permanent: 0.61 (0.84%) Total: 2.08 (2.85%) (some land taken temporarily would be returned with shrubs and intermittent trees)	Land take: Negligible (C); Negligible (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Medium (C); Medium (O)	Construction: Minor Operation: Minor (due to combination of access disruption and proportion of land take)
2	Low	Temporary: 0.41 Permanent: 1.24 (39.96%) Total: 1.64 (53.04%) (land taken temporarily would be returned as species rich grassland)	Land take: High (C); High (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Negligible (C); Negligible (O)	Construction: Moderate Operation: Moderate (due to proportion of land take)
3	Low	Temporary: 2.25 Permanent: 2.29 (25.48%) Total: 4.54 (50.48%) (land taken temporarily would be returned as agricultural pasture)	Land take: High (C); High (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Low (C); Low (O)	Construction: Moderate Operation: Moderate (due to proportion of land take)

No	Sensitivity to change	Land take (ha) (approximate)	Impacts (C – construction) (O – operation)	Effects
4	Low	Temporary: 0.87 Permanent: 1.52 (15.24%) Total: 2.39 (23.93%) (most land taken temporarily would be returned with woodland planting)	Land take: High (C); High (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Medium (C); Medium (O)	Construction: Moderate Operation: Moderate (due to proportion of land take)
5	Medium	Temporary: 0.92 Permanent: 1.98 (0.75%) Total: 2.90 (1.10%) (some land taken temporarily would be returned with woodland planting)	Land take: Negligible (C); Negligible (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Negligible (C); Negligible (O)	Construction: Negligible Operation: Negligible
6	Low	Temporary: 7.75 Permanent: 0.00 (0.0%) Total: 7.75 (42.57%) (all land taken temporarily would be returned as agricultural pasture)	Land take: High (C); Negligible (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Medium (C); Negligible (O)	Construction: Moderate Operation: Negligible (due to proportion of temporary land take)
7	Low	Temporary: 0.18 Permanent: 0.16 (3.94%) Total: 0.33 (8.35%) (land taken temporarily would be returned as agricultural pasture)	Land take: Low (C); Negligible (O) Severance: Negligible (C); Negligible (O) Infrastructure: Negligible (C); Negligible (O) Disruption: Negligible (C); Negligible (O)	Construction: Minor Operation: Negligible (due to proportion of temporary land take)

No	Sensitivity to change	Land take (ha) (approximate)	Impacts (C – construction) (O – operation)	Effects
Total		Temporary: 13.84 Permanent: 7.80 Total: 21.64		

- 10.10.13 Table 10.12 indicates that a total of seven agricultural land ownership interests would be affected by the Scheme, with six holdings being permanently affected. Only two of the affected interests relate to commercial agricultural activity (Plots 1 and 5), with the remaining five parcels of land mainly being used for non-commercial grazing.
- 10.10.14 Table 10.12 indicates that the Scheme would have a temporary moderate adverse effect on the land holding affected by the works to create the floodplain compensation to the west of the River Derwent (Plot 6), although effects would be negligible following area restoration and the land returned to agricultural use. In addition, the Scheme would have permanent moderate adverse effects on three land holdings (Plots 2, 3, 4) due to the proportion of land taken. However, none of these holdings are engaged in commercial agricultural practices. One holding engaged in commercial turf production (Plot 1) would experience a permanent minor adverse effect, mainly due to disruption caused by access rearrangements, whilst Plot 7 would experience a minor adverse effect during the Scheme construction phase.

10.11 Monitoring

- 10.11.1 The assessment indicates that the Scheme would have significant effects upon a number of agricultural land holdings, principally due to the proportion of temporary and permanent land take requirements. Such significant effects cannot be monitored. However, where agricultural land taken on a temporary basis is restored and returned to the landowner for continued agricultural use, post-construction monitoring would be required to determine whether pre-existing agricultural soil capability had been reinstated. Such monitoring requirements would be detailed in a Soil Management Plan, the requirement for which is detailed in the OEMP (refer to Appendix 2.1 [TR010022/APP/6.3]).
- 10.11.2 No other significant geology and soils effects are predicted, and on that basis, no other monitoring of significant effects is proposed.
- 10.11.3 As detailed in para. 10.9.8, during the detailed design stage, additional ground investigation works would be carried out, including at the sites identified as historic landfills (at Kingsway junction and Little Eaton junction) and at the current Esso petrol station at Markeaton junction. Information obtained would be used to inform the remediation strategy. The remediation strategy would outline monitoring requirements during Scheme construction. This would include gas and groundwater monitoring at the historic landfill on both sides of the cutting associated with the link road onto Kingsway Park Close at Kingsway junction. This would involve monitoring in advance of any intrusive works and during the Scheme construction phase. Groundwater quality monitoring would also be required following construction of the cutting into bedrock at Kingsway junction. Monitoring would be carried out at existing monitoring locations,

where available. Additional monitoring wells would be installed if suitable locations are not available or to replace existing wells if they have been destroyed. The remediation strategy would also require gas and groundwater monitoring at the main construction compound to the north of Little Eaton junction. Monitoring requirements are detailed in the OEMP (refer to Appendix 2.1 [TR010022/APP/6.3]).

10.12 Summary of assessment

- 10.12.1 The assessment indicates that there are a number of locations along the Scheme where contaminated materials may be encountered (e.g. areas of historic landfilling), whilst agricultural soils would be impacted at Little Eaton junction.
- 10.12.2 The assessment indicates that, subject to the implementation of defined standard best practice mitigation measures as detailed in Section 10.9, the Scheme is not anticipated to result in any significant adverse effects with respect to geology and soils during Scheme construction or operation. However, the assessment also indicates that the Scheme would have a temporary significant adverse effect upon one agricultural land holding, and permanent significant adverse effects upon three agricultural land holdings, principally due to the proportion of temporary and permanent land take requirements.

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