A47/A11 Thickthorn Junction

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6.1 Environmental Statement
Chapter 9 – Geology and Soils

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ENVIRONMENTAL STATEMENT CHAPTER 9 GEOLOGY AND SOILS

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9. Introduction

9.1.1. Highways England (the Applicant) has submitted an application for an order to grant a development consent order (DCO) for the A47/A11 Thickthorn Junction (hereafter referred to as 'the Proposed Scheme'). The Proposed Scheme will create one new connector road between the A11 and A47 and provide a new link road between Cantley Lane South and the B1172 Norwich Road for continued access to the Thickthorn Interchange. Two new underpasses and two new overbridges will also be constructed along with improvements to the Thickthorn roundabout. The Proposed Scheme will reroute traffic away from the existing Thickthorn Interchange, which currently experiences delays and high levels of congestion during peak hours.

9.1.2. Under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, the Proposed Scheme is an Environmental Impact Assessment (EIA) development and as such requires submission of an Environmental Statement presenting the likely significant environmental effects of the Proposed Scheme.

9.1.3. As part of the EIA process, this Environmental Statement (ES) chapter reports the potential significant effects for Geology and Soils as a result of the Proposed Scheme. This assessment includes a review of the existing baseline conditions, consideration of the potential impacts and identification of proportionate mitigation and enhancement.

9.1.4. The approach to this assessment follows the Scoping Report (February 2018) (**TR010037/APP/6.5**) and subsequent agreed Scoping Opinion (March 2018) (**TR010037/APP/6.6**) for the Proposed Scheme, in combination with the most up to date standards in the Design Manual for Roads and Bridges (DMRB), LA109 Geology and Soils.

9.1.5. The main chapter text is supported by ES Appendix 9.1 (**TR010037/APP/6.3**) which contains information on the Agricultural Land Classification (ALC) system.

9.1. Competent expert evidence

9.1.1. The assessment for geology was prepared by a contaminated land specialist (BSc (Hons), Chartered Water and Environmental Manager) with over 14 years of experience across environmental protection, contaminated land, risk assessment and remediation.

9.1.2. The agricultural land section competent expert has been prepared by a Soil Scientist and an EIA Consultant. The Soil Scientist is a Chartered Scientist with a MSc in Soil Chemistry and over 40 years' experience. The EIA Consultant has

a MSc in Environmental Assessment and Management and over five years' experience producing agricultural chapters for EIA.

9.1.3. The competent experts have used their EIA knowledge, experience with DMRB and road schemes and professional judgement in identifying the likely significant impacts associated with the Proposed Scheme and providing technical guidance through the assessment process.

9.2. Legislation and policy framework

9.2.1. Table 9-1 summarises the main legislative framework for the geology and soils chapter (including contaminated land and soils as a national resource) includes the following legislation, regulations, guidance, standards and best practice.

Table 9-1: Summary of legislation, regulations, guidance, standards and best practice

Legislation or regulation	Summary
Environmental Protection Act 1990 (as amended by the Environment Act 1995)	Part IIA of this Act provides a framework for the definition, identification and remediation of contaminated land. Central to the assessment of potentially contaminated land is the concept of a Significant Pollutant Linkage, i.e. a significant connection between a source of contamination and a sensitive receptor via an appropriate environmental pathway. The Part IIA regime is underpinned by the core principles of the 'polluter pays' and that land must be suitable for use.
Environmental Protection (Duty of Care) Regulations 1991 (as amended 2003)	These regulations impose a duty of care on persons who produce, store, carry, treat or dispose of controlled waste or, as a broker, has control of such waste. The duty requires such persons to ensure that there is no unauthorised or harmful deposit, treatment or disposal of the waste, to prevent the escape of the waste from their control or that of any other person, and on the transfer of the waste to ensure that the transfer is only to an authorised person or to a person for authorised transport purposes and that a written description of the waste is also transferred.
Land contamination: risk management. Environment Agency, October 2020	The Land Contamination Risk Management guidance details how to assess and manage risks from land contamination. The guidance covers the use of a tiered approach to risk assessment: Stage 1: Risk assessment Stage 2: Options appraisal Stage 3: Remediation and verification The guidance applies to risks to human health, drinking water supplies, groundwater and surface water, soils ecosystems and property.
Contaminated Land Risk Assessment – A Guide to Good Practice C552 (CIRIA, 2001)	The C552 report examines risk assessment of contaminated land and the key elements of risk assessment practices and procedures. The guide describes the stages involved in identifying risks and assessing their significance.

Legislation or regulation	Summary
The Contaminated Land (England) (Amendment) Regulations 2012	This regulation amends the contaminated land (England) regulations 2006 to provide stronger protection of controlled waters. This is an extension of the existing regulations which is designed to prevent land from being contaminated and to tackle existing contamination.
The Environmental Damage (Prevention and Remediation) (England) Regulations 2015	This regulation covers environmental liability with regard to the prevention and remedying of environmental damage. It specifies the types of damage to a protected species or natural habitat, a site of special scientific interest, water or land which constitute environmental damage. The regulation also deals with prevention of environmental damage, remediation of damage, and recovery of costs.
The Environmental Permitting (England and Wales) Regulations 2016 as amended	The environmental permitting regime requires those carrying out activities that release emissions to land, air and water, or that involve certain waste types, to hold an environmental permit.
Code of Practice for the Sustainable Use of Soils on Construction Sites, (Department for Environment, Food and Rural Affairs (Defra), 2009)	Comprises a code of practice for the sustainable use of soils on construction sites, to assist anyone involved in the construction industry to protect the soil resources with which they work. Outlines current guidance and legislation concerning the use of soil in construction projects, offering stage by stage guidance on the use, management and movement of soil on site.
Guide to assessing development proposals on agricultural land (Natural England, 2018)	This guide explains how local planning authorities can assess proposals to protect the best and most versatile (BMV) agricultural land from inappropriate and unsustainable development.
Agricultural Land Classification: protecting the best and most versatile agricultural land. (TIN049). Second edition (Natural England, 2012)	This note explains the Government Policy to protect agricultural land and the Agricultural Land Classification system and uses.
The Infrastructure Planning (EIA) Regulations 2017	These regulations implement the requirements of the Environmental Impact Assessment (EIA) Directive (85/337/EEC) for EIA procedures in the context of the nationally significant infrastructure regime.
Design Manual for Roads and Bridges (DMRB) LA 104 Environmental assessment and monitoring, Highways England 2019	DMRB LA 104 sets out the requirements for environmental assessment of projects, including reporting and monitoring of significant adverse environmental effects, applying a proportionate and consistent approach using best practice and ensuring compliance with relevant legislation. The approach to deriving impact significance from receptor value and magnitude of effects in DMRB LA 109 is undertaken in accordance with LA 104.
Design Manual for Roads and Bridges (DMRB) LA 109 Geology and Soils (and associated	DMRB LA 109 sets out the requirements for assessing and reporting the effects of highway projects on geology and soils, applying a proportionate and consistent approach using best practice and ensuring compliance with relevant legislation.

Legislation or regulation	Summary
supporting standards), Highways England	

9.2.2. The Proposed Scheme will adhere to guidance detailed in the Planning Policy documents summarised in Table 9-2.

Table 9-2: Summary of planning policy

Legislation or regulation	Summary
National Policy Statement for National Networks (NPS NN) (Department for Transport, 2014)	NPS NN sets out the Government's vision and policy for the future development of the Nationally Significant Infrastructure Projects (NSIP) on the national road and rail networks in England, and provides the basis for the examination by the Examining Authority and decisions by the Secretary of State.
National Planning Policy Framework (Ministry of Housing, Communities & Local Government, 2019)	The National Planning Policy Framework sets out the Government's planning policies for England and how these are expected to be applied. It provides a framework within which locally-prepared plans for housing and other developments can be produced.
Joint Core Strategy (JCS) for Broadland, Norwich and South Norfolk 2011-2026 (Greater Norwich Development Partnership)	The JCS sets out the overarching strategy for growth across South Norfolk. It identifies key locations for housing and employment growth and sets out policies to ensure that future development is sustainable.
South Norfolk Local Plan Development Management Policies Document. South Norfolk Council, 2015.	The Development Management Policies document forms part of a set of documents that together constitute a local plan for the future development of the South Norfolk area. It sets out policies which will help the local authority promote sustainable development and help determine planning applications. Policy DM 2.8 Equestrian and other changes of use of agricultural land seeks to ensure that development of agricultural land is appropriate and necessary. Policy DM 3.14 Pollution and, health and safety includes the following guidance on contaminated land; • Land should be suitable for the new use, ensuring that both human health and the environment are safeguarded from unacceptable risk. Sites which are known or suspected to be contaminated should be identified at an early stage. • For such sites, an assessment by a competent person should be submitted with the application determining whether or not the site is contaminated and demonstrating adequate remediation as appropriate for the proposed use. Where the extent or existence of contamination is unclear a precautionary approach should be taken.

9.3. Assessment methodology

9.3.1. The assessment has been undertaken in accordance with the methodology presented in the Design Manual for Roads and Bridges, LA 109 Geology and Soils to establish baseline conditions.

9.3.2. DMRB LA 109, section 3 provides a framework for assessing and managing the effects associated with geology and soils from the delivery of the Proposed Scheme. These include:

- effects on bedrock and superficial geology including sensitive and or valuable features
- effects on soil resources
- effects from contamination on human health and surface water and groundwater

9.3.3. The Scoping Report (February 2018) (**TR010037/APP/6.5**) has been reviewed and compared against the updated standards DMRB LA 109. The effects of the Proposed Scheme upon agricultural land have been moved to this Geology and Soils chapter. The assessment criteria have been updated in line with the DMRB LA 109. No other changes to the standards have been identified to impact on the scope of this chapter.

9.3.4. Existing reports have been used to provide baseline information on the Proposed Scheme. Baseline data has been taken from the following two reports,

- Readily available information on pertinent ground related and regulatory aspects of the scheme has been extracted from the preliminary sources study report (PSSR) (AECOM 2017)
- Geo-environmental data has been based on the findings of a ground investigation undertaken in 2018.

9.3.5. Following the DMRB LA109 Table 3.11, receptors for the assessment for disturbed historical contamination are:

- human health
- surface water
- groundwater

9.3.6. Significance of effect will be determined by the predicted deviation from the baseline conditions and the scale of impact drawing on the criteria provided in DMRB LA 109 Table 3.11 and reproduced in Table 9-3 of this chapter.

Update to guidance and scope of assessment

9.3.7. Following a review of changes to DMRB LA109, the scope presented in the Scoping Report for the Proposed Scheme (2018) (**TR010037/APP/6.5**) requires the additional assessment of potential impacts to soil as a resource and impacts to agricultural land. The sensitivity and magnitude criteria has therefore been updated since issue of the Scoping Report in line with the DMRB LA 109 guidance.

9.3.8. Scoping questions from section 3.2 of DMRB LA 109 are discussed in Table 9-3 below to determine whether they are scoped into or out of this assessment.

Table 9-3: Summary of proposed scope

Scoping question	Comment	Scope in?
Is the project likely to affect designated geological sites (statutory or non-statutory)?	There are no identified Sites of Special Scientific Interest (SSSI) on site. The Proposed Scheme is located within a SSSI Impact Risk Zone (IRZ) designated around a chalk cave system which is not on the Proposed Scheme area. It is understood that the IRZ relates to the potential for bats which use the cave system to roost on the Proposed Scheme area and therefore the SSSI IRZ will not be affected by impacts to geology and soils.	No
Is the project likely to affect the function or quality of soil as a resource?	The Proposed Scheme encroaches on to agricultural land.	Yes
Is the project likely to affect agricultural land classified as best and most versatile (BMV) or prime land?	The Proposed Scheme encroaches on to agricultural land, some of which is classified as BMV agricultural land.	Yes
Is the project likely to disturb historical contamination?	There is the potential for the Cantley Lane landfill and an infilled gravel pit on the south east of the site to be disturbed during construction works.	Yes
Is the project likely to introduce significant sources of contamination?	No significant sources of contamination are likely to be introduced during the construction of the Proposed Scheme.	No

9.3.9. This chapter of the ES concentrates on the effects on human health, soil resource, surface water and groundwater from historical and ongoing potential sources of contamination, as well as the impacts to agricultural land.

Consultation

9.3.10. The potential contaminated land risks have been addressed through assessment of the Ground Investigation results against standards from published guidance and regulations, therefore no further consultation was required relating to guidance levels.

9.3.11. Information on minerals excavation and reprofiling of land with the Proposed Scheme area was requested from Norfolk County Council's Minerals and Waste Policy team and received in August 2020.

9.3.12. The information provided by the Council confirmed the presence of an infilled gravel pit (included as Source 2 in Table 9-9) on the south west of the Study Area and included details of the mineral extraction, infilling, and restoration of the area. This information has been included in the assessment of Source 2.

9.3.13. Statutory consultees did not make any comments relevant to this chapter beyond those discussed above.

Assessment criteria

9.3.14. The assessment for geology and soils has been undertaken in accordance with DMRB LA 109. In this chapter, impacts on Geology and Soils from the Proposed Scheme are assessed by a qualitative comparison by evaluating the sensitivity of particular receptors impacted by the Proposed Scheme and assessment of the magnitude of that impact. The sensitivity of receptor classes and the range of magnitude criteria are established in the DMRB LA 109 table 3.12 for application across all major highways projects.

9.3.15. The assessment on the effects of contamination on the identified receptors, human health, and controlled waters (surface water and groundwater), have been informed by the findings of a 2018 ground investigation. Effects on groundwater are assessed in ES Chapter 13: Road Drainage and the Water Environment (**TR010037/APP/6.1**).

9.3.16. The ALC system provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. The principal physical factors influencing agricultural production are climate, site (including relief) and soil. By assessing these factors, it is possible to assign land into one of five land classification grades, Grade 1 land being the highest quality and Grade 5 the lowest quality land. Grade 3 is sub-divided into Subgrades 3a and 3b, to identify good quality agricultural land from moderate quality land (see ES Appendix 9.1 (**TR010037/APP/6.3**) for further information on the ALC system).

9.3.17. The criteria for assessing risk to receptors are presented in Tables 9-4 and 9-5.

9.3.18. The sensitivity of the receptor is used in the assessment to determine receptor value. The designation of importance is determined using the criteria provided in Table 9-4.

Table 9-4: Sensitivity of receptor (derived from DMRB LA 109 Table 3.11)

Receptor value	Description
Very high	Soils: Soils directly supporting an EU designated site (e.g. SAC, SPA, Ramsar) and / or ALC grade 1 & 2 or LCA grade 1 & 2. Contamination: Human health – residential use or allotments Controlled waters – site protected under legislation, species protected by legislation, principal aquifer providing a regionally important resource or supporting a protected site.
High	Soils: Soils directly supporting a UK designated site (e.g. SSSI) and / or ALC grade 3a, or LCA grade 3.1. Contamination: Human health – public open space Controlled waters – species protected under legislation; principal aquifer providing locally important resource or supporting a river ecosystem
Medium	Soils: Soils supporting non-statutory designated sites (e.g. Local Nature Reserves (LNR), LGS's, Sites of Nature Conservation Importance (SNCIs)), and / or ALC grade 3b or LCA grade 3.2. Contamination: Human health – commercial/industrial Controlled waters – aquifer providing water for agricultural or industrial use, surface water without classification
Low	Soils: ALC grade 4 & 5 or LCA grade 4.1 to 7, and / or soils supporting non-designated notable or priority habitats. Contamination: Human health – highways/rail. Controlled waters – watercourse without classification, unproductive strata.
Negligible	Soils: Previously developed land formerly in 'hard uses' with little potential to return to agriculture. Contamination: Human health – undeveloped land Controlled waters – watercourse without classification, unproductive strata

9.3.19. The magnitude of impact is a predicted determination of the potential scale of effects and deviation from baseline conditions as a result of the Proposed Scheme. The qualitative impact has been determined according to the criteria provided in Table 9-5.

Table 9-5: Magnitude of impact (derived from DMRB LA 109 Table 3.12)

Magnitude	Description
Major	Soil: Physical removal or permanent sealing of >20ha of agricultural land. Contamination: Human health – significant contamination identified with potential for significant harm to human health. Contamination heavily restricts future use of the land Controlled waters –loss of regionally important water supply, failure of quality criteria. Surface water - loss or extensive change to a fishery. Loss of regionally important public water supply. Loss or extensive change to a designated nature conservation site. Reduction in water body WFD classification. Groundwater: Loss of regionally important water supply. Reduction in water body WFD classification.
Moderate	Soils: Physical removal or permanent sealing of 1ha – 20ha of agricultural land; or permanent loss / reduction of one or more soil function(s) and restriction to current or approved future use (for example through degradation, compaction, erosion of soil resource). Contamination: Human health – contamination concentrations exceed background levels and are in line with relevant screening criteria. Control/remediation measures are required to reduce the risks to human health and make land suitable for use. Controlled waters – degradation/loss of important public water supply but compliance with quality criteria.
Minor	Soils: Temporary loss / reduction of one or more soil function(s) and restriction to current or approved future use (for example through degradation, compaction, erosion of soil resource.) Contamination: Human health – contaminant concentrations below relevant screening criteria and a low risk to human health. Best practice measures can be required to minimise impacts Controlled waters – potential low risk of pollution, minor effect on water supplies.
Negligible	Soils: No discernible loss / reduction of soil function(s) that restrict current or approved future use. Contamination: Human health – contaminant concentrations substantially below relevant criteria, no requirement for control measures Controlled waters – no measurable impact.
No Change	Soils: No loss / reduction of soil function(s) that restrict current or approved future use. Contamination: Human health – reported contaminant concentrations below background levels Controlled waters – no measurable impact.

9.3.20. The significance of impact is derived from receptor value and magnitude of effect. The significance of impact has been determined according to the criteria provided in Table 9-6. Impacts that are moderate and above are considered to be significant effects.

Table 9-6: Significance matrix (derived from DMRB LA 104 Table 3.8.1)

		Magnitude of impact				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Environmental value (sensitivity of receptor)	**Very high**	Neutral	Slight	Moderate or large	Large or very large	Very large
	High	Neutral	Slight	Slight or moderate	Moderate or large	Large or very large
	Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or large
	Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
	Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

Assumptions and limitations

9.3.21. Reported baseline conditions from a preliminary sources study report (PSSR) and previous ground investigations (GI) have been assumed to be accurate. However, owing to the dynamic nature of the environment, conditions may change during the construction and operational phases.

9.3.22. The GI information is limited to the locations investigated and there is the potential for unidentified contamination to be present outside of investigated locations.

9.3.23. A review of the layout of the Proposed Scheme (see ES Figure 1.1 (**TR010037/APP/6.2**)) against the available GI information has identified three data gaps where insufficient information is available for a comprehensive assessment of risk from contaminated land to be made. These data gaps relate to the Cantley Lane landfill, the infilled gravel pit on the south east of the Proposed Scheme, and general coverage across areas of the Proposed Scheme which were included in the design after the 2018 ground investigation. A supplementary GI for the Proposed Scheme has been proposed for completion in Spring 2021 which includes for the investigation of these data gaps.

9.3.24. The agricultural land assessment is based an ALC field assessment carried out in 2018. Where there were uncertainties in the ALC field assessment data, a conservative approach was taken, and a higher agricultural land quality assumed.

Study area

9.3.25. According to Section 3.5 of DMRB LA 109, the study area shall be identified on a project by project basis based on the following:

- The construction footprint or project boundary (including compounds and temporary land take)
- The location of contamination outside the project boundary or footprint that have the potential to migrate on site and effect receptors
- The location of sensitive off site receptors (for example, designated sites) that can be affected by the project, that is, by re-mobilisation or introduction of contaminants

9.3.26. The study area for this assessment considers all locations where physical works and ground disturbance would take place, and professional judgement was used to determine the study area, in addition to Section 3.5 of DMRB LA 109. The study area also extends up to 1km beyond the DCO boundary as shown on ES Figure 9.1 **(TR010037/APP/6.2)** for certain specific features of interest for example for hydrological features and past pollution incidents which may have affected the Proposed Scheme or have the potential to be affected by the Proposed Scheme.

9.3.27. The study area for the agricultural land assessment only considers the area within the DCO boundary.

9.4. Baseline conditions

Agricultural soils

9.4.1. Land use within the study area predominantly comprises agricultural uses (mainly arable production) and localised areas of hardstanding including residential and commercial structures. Smaller parcels of land are generally perceived to be used as permanent pasture, parkland and woodland and therefore these smaller spaces indicate little agricultural viability.

9.4.2. A desktop review of agricultural maps was reviewed along with historical site investigation information recorded in close vicinity to the Proposed Scheme.

9.4.3. Hand-held auger borings were made to a depth of 1.2 metres to examine soils. Auger borings were examined at a frequency of one boring per hectare, unless

surveyors deemed that there was no change in the soil environment. In which case greater distances could be used between samples.

9.4.4. In some cases, it was possible to scope out areas for survey, or deem an area as not best and most versatile (non-BMV) land (subgrade 3b or lower), due to characteristics, such as:

- Relief
- Stoniness
- Non-agricultural use

9.4.5. ALC Grades 1, 2 and 3a are classified as BMV land. BMV agricultural land is a finite national resource and is given special consideration in national policy and guidance. Based on the ALC map, ES Figure 9.1 **(TR010037/APP/6.2)** South Norfolk District has a large portion of Grade 3 agricultural land comprising approximately 82% of agricultural land within the district (the Provisional ALC map does not subdivide Grade 3 land into 3a and 3b). The Provisional ALC map does not show any Grade 1 agricultural land within the district and only small areas of Grade 2 agricultural land, making up approximately 10% of the agricultural land within the district.

9.4.6. The Provisional ALC map shows that the ALC grade of the agricultural land across the Proposed Scheme is classed as Grade 3. Post 1998 survey data provided on the Multi Agency Geographic Information for the Countryside (MAGIC) website provides data for a small part of the Proposed Scheme north east of the A47, which indicates that agricultural land is Grade 3b agricultural land.

9.4.7. The detailed field work carried out for the assessment indicated that the agricultural land quality within the Proposed Scheme permanent footprint is a mixture of Grade 3a (good quality) and 3b (moderate quality) agricultural land as shown in ES Figure 9.1 agricultural land classification **(TR010037/APP/6.2**). The areas of Grade 3a agricultural land are considered to be BMV agricultural land.

Geology

9.4.8. Establishment of the baseline environment has involved reference to existing data sources, consultation with appropriate statutory bodies and organisations, and fieldwork surveys. Further details are presented in the following sections.

Desk study

9.4.9. Historical reports have been reviewed and used in establishing the baseline conditions including Preliminary Sources Study Report (PSSR) AECOM, 2017, contained within ES Appendix 9.3 (**TR010037/APP/6.3**)

9.4.10. In addition, information and views concerning the Proposed Scheme were obtained from the following organisations:

- British Geological Survey (BGS)
- The Coal Authority online interactive maps
- Natural England
- Environment Agency
- Ordnance Survey mapping
- Landmark Envirocheck report
- Defra Multi-Agency Geographic Information for the Countryside (MAGIC) website
- Norfolk County Council's Minerals and Waste Policy team
- Information on controlled waters as detailed in ES Chapter 13: Road Drainage and the Water Environment (**TR010037/APP/6.1**)

Ground investigation

9.4.11. An intrusive ground investigation along the alignment of the A47/A11 connector road and the Cantley Lane Link Road was undertaken between March 2018 and July 2018. The overall objective of the ground investigation (GI) was to provide detailed geotechnical (underlying soils, rock and groundwater regime) and geo-environmental (nature and extent of any potential sources of contamination) information on the ground conditions to facilitate design development of the Proposed Scheme.

9.4.12. The design process considered the coverage of historical GI works across the Proposed Scheme. Investigation techniques utilised were considered the most appropriate intrusive investigation methods for the anticipated ground conditions.

9.4.13. The GI works were planned and undertaken in accordance with the principles of BS 5930:2015, and BS 10175:2011+A2:2017.

9.4.14. Baseline conditions are summarised in Table 9-8 below.

Table 9-7: Baseline data

Aspect	Details
Geology	A basic summary of the geological sequence in the area of the Scheme is as follows: **Superficial geology** Topsoil was encountered extensively across the scheme from existing ground level Made ground was encountered predominantly as a coarse-grained material from existing ground level or underlying Topsoil. Two distinct locations of deep made ground are noted to be associated with the Cantley Lane Landfill, south-east of the A11, and the infilled gravel pit east of Cantley Lane South and the existing Cantley Lane footbridge, immediately south of the A47. The depths, extents and nature of made ground at the Landfill and infilled gravel pit were not conclusively confirmed in

Aspect	Details
	the 2018 ground investigation but were found to generally comprise interchanging layers of granular and cohesive material Alluvium was predominantly encountered within close proximity to the Cantley Stream watercourse and comprised fine and coarse-grained material. Cohesive Glacial Till comprising the Lowestoft Formation was generally encountered at shallow depth and in significant thicknesses (up to 8.5 m) underlying the Topsoil or made ground at the northern proposed scheme extents Glacial Sands and Gravels, comprising the Sheringham Cliffs Formation, were generally encountered at shallow depths, underlying topsoil or Made Ground in the southern, eastern and western extents of the Scheme. In the northern extents of the proposed scheme the Glacial Sands and Gravels were typically overlain by Cohesive Glacial Till **Bedrock geology** Chalk bedrock comprising the Lewes Nodular Chalk Formation of the White Subgroup, was encountered across the site in an eroded and highly weathered form. This results in an undulating profile, both of the bedrock surface and within the Chalk itself in the form of varying extents of structureless fine and coarse chalk. Structureless fine chalk, structureless coarse chalk, and structured chalk were encountered on the proposed scheme.
Hydrogeology	The Environmental Agency website indicates that the Proposed Scheme is not within or located near to any groundwater Source Protection Zones (SPZs). The closest SPZ is approximately 30km to the west of the Proposed Scheme. The Environment Agency Superficial and Bedrock Aquifer Designation maps indicate the study area is underlain by a principal aquifer (chalk), which is highly permeable. The formation is overlain by low permeability drift deposits (glacial silt and clay) in the vicinity of Thickthorn Junction and high permeability deposits (glacial sand and gravel) further to the north, east and south. The superficial deposits are designated as either a 'Secondary A' aquifer (Sheringham Cliffs Formation) or 'Secondary (Undifferentiated)' aquifer (Lowestoft Formation). The available borehole information indicates the groundwater table lies within the Chalk at approximately 15 mAOD (above ordnance datum) (16 mbgl) (metres below ground level) at the Thickthorn Junction reducing to approximately 10 mAOD (2 mbgl) within the superficial deposits overlying the Chalk at the A47 railway crossing.
Hydrology	The south east flowing River Yare is located approximately 1.5km north east from the study area. The Yare valley divides Norwich and Cringleford. The Cantley Stream, an east flowing tributary of the River Yare lies approximately 0.6km south of the A47/M11 junction and runs through the southern edge of the Proposed Scheme. This tributary includes a number of secondary and tertiary rivers, most notably to the east of the Proposed Scheme near Meadow farm drive and Cringleford Hall. Refer to Chapter 14: Road Drainage and the Water Environment for more information (**TR010038/APP/6.1**).
Landfill records	An historical landfill site is recorded on old OS plans and by the Environment Agency north of the Cantley Stream where it is culverted below the A11 adjacent to the eastern edge of the A11 (618,161.75E;304,971.25N). Cantley Lane landfill was operated between 1961 and 1969 receiving inert, industrial, commercial and household wastes. There are no details in the PSSR of any monitoring data or any details of environmental / pollution control measures (e.g. landfill liner or peripheral gas vent trench). An infilled gravel pit is located east of Cantley Lane South and the current footbridge, immediately south of the A47. A review of council records identified that the pit was excavated in 1991 to provide construction materials for the A47, the pit was then backfilled with inert materials arising the from the A47 construction works. Backfilling of the gravel pit is understood to have been completed by the end of 1993.

Aspect	Details
Current land use and man-made features	The greater area surrounding Thickthorn Junction is mainly agricultural, with a small area occupied by residential and commercial structures. The area around Newmarket Road at the east of the site is mainly residential with agricultural land occupying the areas adjacent to the roundabout. South of the roundabout, between A11 and Cantley Lane Street, a number of cottages are present. East of the junction a large commercial complex exists. Two sites of antiquity ('Tumulus') are shown on OS mapping and have been identified as Scheduled Monuments. These are situated at Cantley Wood which is located south-east of the A47/A11 junction.
Route history	The historical development of the area has been summarised from historical mapping contained within the Landmark Envirocheck Report in ES Appendix 9.3 (**TR010038/APP/6.3**). Prior to the construction of the A11 Wymondham to Cringleford improvement in the 1980's the area of Thickthorn Interchange was mixed farmland, traversed by the A11 Norwich Road and Cantley Lane. The improvement established the A11 on its current alignment as a dual carriage road, and also saw the construction of the Thickthorn Interchange allowing traffic to access local routes into Hethersett and to Cantley Road from the new dual carriageway. The construction of the Norwich Southern Bypass (A47) in the early 1990's saw the remodelling and enlargement of the interchange to accommodate the A47 embankment, overbridges and slip roads. A service area, including a petrol filling station, was established between the A11 northbound and B1172, immediately behind the cut slopes of the interchange circulatory. A Park and Ride facility is present adjacent to the service area which resulted in some remodelling of the B1172 approach to the interchange. The disused Cantley Lane landfill is located in a former gravel pit at Cantley Wood and was in operation between 1961 and 1969. An infilled gravel pit is located east of Cantley Lane South and the current footbridge, immediately south of the A47, from which minerals were excavated in 1991 and backfilling completed by the end of 1993. The Great Eastern Railway is shown on the earliest OS maps examined which date to 1887 and run east-west along the southern extent of the Proposed Scheme. The railway line is now called the Breckland Railway (Norwich to Ely).
Agricultural land	Detailed field work carried out for the assessment indicated that the agricultural land quality within the Proposed Scheme footprint is a mixture of Grade 3a (good quality) and 3b (moderate quality) agricultural land. The areas of Grade 3a agricultural land are considered to be Best and Most Versatile (BMV) agricultural land.
Geological sites / features	There is one Site of Special Scientific Interest (SSSIs) or sites of geological interest within 2km of Thickthorn junction. The Eaton Chalk Pit Site of SSSI is located approximately 1.5km to the east of the site and is designated for its underground chalk caves providing a winter hibernation site for three bat species. Bats from this SSSI potentially use the Thickthorn site for summer roosting, commuting and foraging, and therefore no further consideration is necessary within this chapter. According to the Envirocheck report, in ES Appendix 9.3 (**TR010038/APP/6.3**), five BGS mineral sites have been recorded in the area of study. The status for all the mineral sites is given as 'ceased'. It is considered that the workings exploited the glacial, Sheringham Cliffs Formation.
Potential contamination risks	No major or significant environmental incidents have been recorded in the study area. The potential sources of contamination which may be present at or near the Proposed Scheme comprise of: • Cantley Lane Landfill • Infilled gravel pit on south east of site • Petrol filling station located approximately 20m to the west of the Thickthorn Junction • Railway land adjacent to the south and intersecting the south eastern corner of the site

Aspect	Details
	These potential sources present theoretical risks to site workers, site users and controlled water.

9.4.15. It is considered unlikely that the current state of the environment would change without implementation of the project and therefore an assessment of the future baseline scenario is not required.

Contamination assessment

9.4.16. The following assessment was undertaken and informed by the 2018 ground investigation findings.

Potential sources of contamination

9.4.17. Potential current and historical sources that have been identified are summarised in Table 9-9 below.

Table 9-8: Potential sources of contamination

Source	Detail
Source 1	Cantley Lane Landfill, located on and adjacent to the south west of the Proposed Scheme.
Source 2	Infilled Gravel Pit (South east of Proposed Scheme) – Unknown Fill deposited from previous A47 construction works to reinstate a mineral extraction operation.
Source 3	Petrol Filling Station, located approximately 20m to the west of Thickthorn Junction.
Source 4	Railway Land, located adjacent to the south and intersecting the south eastern corner of the Proposed Scheme.

Receptors

9.4.18. Receptors are the entities which may be adversely affected by construction or operation of the Propose Scheme and include:

- Future site occupiers including maintenance crews.
- Off-site human receptors (adjacent agricultural workers, residential).
- The Cantley Stream runs across the site from the centre of the western boundary flowing south east to the south eastern corner of the Proposed Scheme.
- Groundwater comprising a principal aquifer (chalk), a ‘Secondary A’ aquifer (Sheringham Cliffs Formation), and a ‘Secondary (Undifferentiated)’ aquifer (Lowestoft Formation).

9.4.19. An assessment of the sensitivity of each receptor is included in Table 9-11.

Potentially active contaminant linkages

9.4.20. The potential active contaminant linkages for the Proposed Scheme are summarised in Table 9-10 below.

Table 9-9: Potentially active contaminant linkages

Source	Pathway	Receptor
Source 1: Cantley lane Landfill and Source 2: Infilled Gravel pit	Direct contact with soils/dusts Inhalation or ingestion of soils/dusts Inhalation of gas	Future site users Neighbouring site users Future maintenance workers
	Leaching/dissolution of contaminants from made ground Migration of contaminants through permeable strata into groundwater Migration of contaminants in groundwater towards surface water	Groundwater and surface water
Source 3: Petrol Filling Station on Adjacent Site	Inhalation of vapours	Future site users Future maintenance workers
	Leaching/dissolution of contaminants from made ground Migration of contaminants through permeable strata and on to the Proposed Scheme Migration of contaminants through permeable strata into groundwater Migration of contaminants in groundwater towards surface water	Groundwater and surface water
Source 4: Railway Land	Leaching/dissolution of contaminants from made ground Migration of contaminants through permeable strata and on to the Proposed Scheme Migration of contaminants through permeable strata into groundwater Migration of contaminants in groundwater towards surface water	Groundwater and surface water

Human health - potential contaminant linkages

9.4.21. Future users of the road, neighbouring site users and future workers (maintenance of the road and infrastructure) are considered to be potential receptors via dermal contact, inhalation or digestion of soil, soil dust, ground gases or vapours.

9.4.22. The generic risk assessment which was undertaken on the available soil data did not identify any unacceptable risks to human health from the soils on the Proposed Scheme.

9.4.23. The ground gas and soil vapour risk assessments did not identify any unacceptable risks to human health from ground gas. However, data gaps have been identified as discussed in 9.5.26 and 9.5.27 below.

Controlled waters – potential contaminant linkages

9.4.24. The most sensitive groundwater receptors are the Principal Aquifer (chalk), the 'Secondary A' aquifer (Sheringham Cliffs Formation), and the Secondary (Undifferentiated)' aquifer (Lowestoft Formation), and the most sensitive surface water receptor is the Cantley Stream. Surface and groundwater are considered to be potential receptors via leaching and dissolution of contamination from made ground.

9.4.25. The generic risk assessment which was undertaken on soil leachate, groundwater and surface water data identified marginal exceedances of the guidance criteria, however due to the low frequency and low magnitude of the recorded exceedances, the exceedances of the guidance criteria were not considered to represent an unacceptable risk to controlled waters. However, data gaps have been identified as discussed in 9.4.28 and 9.4.29 below.

Data Gaps

9.4.26. Refinement of the Proposed Scheme layout subsequent to the 2018 ground investigation has resulted in an expanded land take across areas of ground which were not investigated in 2018. A review of available data against the updated land take has identified data gaps.

9.4.27. Further targeted ground investigation will be undertaken prior to construction of the Proposed Scheme to provide information to fill in the identified data gaps. Supplementary ground investigation will include:

- General coverage across areas of the Proposed Scheme areas which have not recently been investigated. Data should be gathered to provide recent geo-environmental data on ground conditions
- Gas monitoring and assessment will be undertaken on the Cantley Lane Landfill to better understand the risk posed from the landfill
- Targeted investigation of the gravel pit on the south east of the Proposed Scheme in the location of proposed structures, including a drainage pond and the footbridge access ramp, to better understand the nature and condition of fill materials in the former gravel pit.

9.5. Potential impacts

9.5.1. Potential impacts are presented below; those associated with land contamination and those associated with agricultural land. Potential impacts have been subsequently split into construction and operational phases.

9.5.2. Considering the information available pertaining to potential contamination sources 3 (off-site petrol station) and 4 (off-site railway land) and the results of the contaminated land risk assessment, these sources are considered to be a low risk in the context of the construction and development of the Proposed Scheme and therefore have not been considered further in this assessment.

Potential land contamination impacts

9.5.3. The following construction phase activities have the potential to result in an adverse impact to surface waters, groundwater or both of these receptors:

- ground disturbance on top of and within close proximity to the Cantley Lane landfill which could lead to the creation of new pathways for the migration of contamination
- ground disturbance on top of and within close proximity to the infilled gravel pit on the south east of the proposed scheme which could lead to the disturbance of potentially contaminated materials
- storage of excavated made ground soils in stockpiles which could lead to the release of contamination to the ground through rainwater run-off and infiltration
- importation of unsuitable materials which have the potential to introduce new sources of contamination
- dewatering activities which could lead to the discharge of contaminated water to surface water or groundwater.

9.5.4. The following operational phase activities have the potential to result in an adverse impact to human health, surface waters, groundwater or all three of these receptors:

- risk to the Human Health of maintenance workers from ground gas which has the potential to migrate and accumulate in structures located close to potential ground gas sources e.g. the Cantley Lane landfill, and the infilled gravel pit on the south east of the proposed scheme
- leaching of contamination from the soils which will be exposed to form the drainage pond within the infilled gravel pit on the south east of the study area
- re-use of made ground in sensitive areas of the Proposed Scheme which could increase the risk to human health and controlled waters

Potential impacts to agricultural land

9.5.5. The construction and operational phases activities will result in both the permanent and temporary loss of agricultural land including BMV agricultural land.

Construction

9.5.6. Construction impacts include:

- the formation of temporary access tracks requiring the stripping of topsoil and compaction of the ground which would result in a temporary reduction in ALC land or long term damage to soil quality
- all land take, both temporary and permanent, resulting in the loss of ALC land
- stripping and storage of soils and materials which could adversely impact soil quality as a resource resulting in a reduction in soil quality and/or the production of waste soils if they become unusable.

Operational

9.5.7. It is predicted that operation of the Proposed Scheme is unlikely to give rise to any significant effects upon geology or soils, beyond the permanent loss of 14.88 hectares of agricultural land.

Determination of magnitude of potential impact

9.5.8. The magnitude of potential impacts has been determined based on the baseline conditions identified and are presented in Table 9-11.

Table 9-10: Determination of the magnitude of potential impact

Receptor	Sensitivity and magnitude	Reasoning
Future-site users	High sensitivity Moderate adverse magnitude	Human health receptors (public) will be present on pathways and areas of soft landscaping, and maintenance workers during the operational phase. No significant risks have been identified to Human Health from soils or ground gas on the Proposed Scheme, however the presence of the Cantley Lane landfill and the infilled gravel pit on the south east of the study area may require control or remediation measures to be employed to protect maintenance workers who work in enclosed spaces and/or within drainage. The current assessment of magnitude has been made using a precautionary approach and assumes that contaminated land will be identified within the additional ground investigation works which has the potential to impact on future site users. The magnitude of the impact should be reviewed following additional preconstruction ground investigation within the landfill and infilled gravel pit.

Receptor	Sensitivity and magnitude	Reasoning
Off-site human receptors	Very high sensitivity Minor adverse magnitude	Human health receptors on adjacent residential properties and agricultural workers in close proximity to the Proposed Scheme. Contaminant concentrations in soils are below relevant screening criteria.
Controlled waters (Surface water and groundwater)	High sensitivity – Principal Aquifer (Chalk), Secondary aquifers and the Cantley Stream. Negligible adverse magnitude	The most sensitive controlled waters receptors in the study area are the Principal Aquifer in the chalk bedrock, the secondary aquifers within superficial deposits, and the Cantley Stream which runs adjacent to the south of the proposed scheme. Risk of pollution from spillages is <0.5% due to the incorporation of the reasonable capture measures within the drainage infrastructure No measurable impact on the aquifer is anticipated.
Agricultural land – ALC Grade 3a Permanent Take	High sensitivity Moderate adverse magnitude	Approximately 12.64 hectares of ALC grade 3a agricultural land would be removed and/or permanently sealed beneath new carriage ways which will be constructed as part of the Proposed Scheme.
Agricultural land – ALC Grade 3a Temporary Take	High sensitivity Moderate adverse magnitude	Temporary land take resulting in the potential for reduction of soil functions due to degradation, compaction and erosion of soil resource during the construction period.
Agricultural land – ALC Grade 3b	Medium sensitivity Moderate adverse magnitude	Approximately 2.24 hectares of ALC grade 3b agricultural land would be removed and/or permanently sealed beneath new carriage ways which will be constructed as part of the Proposed Scheme.

9.6. Design mitigation and enhancement measures

9.6.1. The first principle of the Proposed Scheme design was to ensure that the footprint was reduced as much as practicable, without adversely affecting the design, in order to minimise the total area of agricultural land affected. The area of agricultural land impacted by the Proposed Scheme has been minimised as far as reasonably practicable.

9.6.2. Additional ground investigation and assessment will be undertaken preconstruction to provide a thorough assessment of the risk from localised areas of infilled ground beneath the Proposed Scheme and to provide coverage across areas which have not recently been subject to ground investigation. Design interventions and mitigation should be reviewed so that any newly identified risks are fully understood and quantified prior to the commencement of construction.

Mitigation measures

Construction

9.6.3. The implementation of an Environmental Management Plan (EMP) (**TR010037/APP/7.4**) will set out controls to ensure that all identified environmental risks are appropriately managed and minimised. Mitigation measures within the EMP will include best practice environmental management procedures and appropriate waste management, such as:

- ensuring adequate space for storage of topsoil and subsoil which must be segregated during excavation
- protection of watercourses from entry of polluting matter
- stripping, storing and reinstating of soils using best practice measures to minimise the risk of degradation to soils, and
- suppression of odour and dust using best practice measures.

9.6.4. It is not possible to mitigate the permanent loss of agricultural land. However, in order to mitigate impacts on temporary land take areas, the EMP will include a Soil Management Plan (SMP) incorporating guidance provided by the “Code of Practice for the Sustainable Use of Soils on Construction Sites”, will be produced to ensure the use of best practice measures for soil handling.

9.6.5. The SMP will include a Soil Resource Plan and a Soil Handling Strategy which will set out how soils are to be managed, methods to ensure the quality of soil resources won from the site are maintained during construction, and methods to ensure that areas of temporary agricultural land take are restored satisfactorily. The SMP will ensure that soils in the areas subject to temporary land take are properly handled, stored and reinstated.

9.6.6. The SMP will be informed by a soil resource survey. An ALC survey will also be carried out at the same time as a soil resource survey to confirm the ALC of the agricultural land.

9.6.7. A Materials Management Plan (MMP) will also be put in place to minimise excavation of soils and ensure that soils will be reused as much as possible within the Proposed Scheme.

9.6.8. Construction compounds and working areas will include a clear demarcation (fence) of the construction area and prevent access onto adjacent areas of agricultural land that could result in compaction or damage of soils. Construction vehicles will be confined to designated haul routes to minimise areas of soil compaction.

9.6.9. Made ground underlies areas of the Proposed Scheme, and localised areas of infilled ground are present. Management of any potential risks associated with

made ground or infilled ground will be undertaken in accordance with good practice including:

- design of in-ground structures to appropriate concrete design class

9.6.10. Human health risks relating to construction workers during the construction of the scheme have been assessed and discussed in ES Appendix 9.4. Risks to construction workers have not been discussed in this section due to construction workers being temporary receptors, and the risk to construction workers, as required by The Construction (Design and Management) Regulations 2015, will only be undertaken with an acceptable level of risk. Therefore construction workers do not need to be considered in the assessment of environmental impact for the Proposed Scheme.

Operational

9.6.11. The need for operational mitigation measures has not yet been identified however should future contamination be identified, for example form the potential sources identified in the Data Gaps section (9.4.28 and 9.4.29) then mitigation will be required. Based on the understanding of the potential sources then the following mitigation measures may be required:

- Inclusion of a break layer between contaminated materials and areas of soft landscaping to remove the pathway between contamination and receptors
- Gas protection installed into service ducting in areas where ground gas production is considered to be a potential risk
- The inclusion of gas monitoring and mitigation strategies for all maintenance work within confined spaces

9.7. Assessment of likely significant residual effects

9.7.1. Table 9-12 shows the approximate permanent and temporary land take associated with the Proposed Scheme.

Table 9-11: Agricultural land take

ALC grade	Approximate permanent land take (ha)	Approximate temporary land take (ha)	Approximate total construction land take (ha)
Grade 3a agricultural soils	12.64	13.02	25.66
Grade 3b	2.24	3.54	5.78
Other (woodland and existing roads)	32.59	2.60	35.19

9.7.2. During the construction phase, the Proposed Scheme would result in permanent land take of approximately 12.64 hectares and temporary land take of approximately 13.02 hectares of Grade 3a agricultural land. The Proposed Scheme would also result in the permanent land take of approximately 2.24 hectares and temporary land take of approximately 3.54 hectares of Grade 3b agricultural land.

9.7.3. Not all of the permanent land take would be covered in hardstanding. Approximately 5.58 hectares of Grade 3a land and 1.41 hectares of Grade 3b land would be used for landscaping. This is included in the land take figure provided in table 9-12. Although this land would be lost to agriculture, the soil resources would still be used to provide some ecosystem services. As none of this land would be retained for commercial agriculture, it is all considered as lost agricultural land for the purpose of this assessment.

9.7.4. Approximately 19.16 hectares of temporary land take would be restored and available for agricultural use following completion of the construction phase. Land temporarily used for construction may be subject to changes in soil structure and characteristics due to compaction by heavy plant and vehicles and handling and storage. Compacted soil reduces water infiltration and can lead to increased rates of surface water run-off and associated soil erosion as well as reduced agricultural productivity.

9.7.5. The proposed mitigation for agricultural soils aims to maintain the quality of retained and excavated soils through best practice soil handling methods and techniques. The temporary land take areas would be restored to agriculture following the completion of the construction phase.

9.7.6. The temporary loss of Grade 3a agricultural land during the construction phase is considered to be of minor magnitude and slight adverse significance. Provided that the mitigation measures are effective and areas of temporary land take are restored back to their former condition, the long-term residual effects on agricultural soils would be limited to the permanent loss of agricultural land. There would be a permanent loss of 12.64 hectares of Grade 3a agricultural land which is considered to be of moderate magnitude and large adverse significance. The permanent loss of approximately 2.24 hectares of Grade 3b agricultural land associated with the road construction is considered to be of moderate magnitude and moderate adverse significance. Grade 3a agricultural land is considered to be BMV agricultural land.

9.7.7. The residual effects on the identified receptors have been determined as presented in Table 9-13. The significance of effect has been determined using Table 3.8.1 of DMRB 104.

9.7.8. Long term residual effects from contaminated land have been assessed based on the assumption that there will be a risk to at least one receptor from the infilled ground in the Cantley Lane Landfill and the infilled gravel pit.

Table 9-12: Determination of residual effects significance.

Receptor	Summary of effects	Mitigation measures	Significance category
Agricultural soils	Stripping of topsoil across the proposed scheme footprint required for the permanent works (road, structures, utilities, environmental bunds etc)	Inclusion of a Materials Management Plan (MMP) and Soil Management Plan (SMP). Minimising over-excavation of soils. Reuse of soils as much as possible on the Proposed Scheme Use of best practice measures for soil handling Logistical planning of site layout and access Identifying soils subject to earthworks and construction activities	**Receptor sensitivity:** High **Magnitude:** Moderate adverse **Significance:** Moderate **Duration:** Permanent
Agricultural soils	Stripping of soil across the Proposed Scheme footprint required for the temporary works (construction compounds, haul roads, utilities)	Inclusion of a Materials Management Plan (MMP) and Soil Management Plan (SMP). Minimising over-excavation of soils. Reuse of soils as much as possible on the Proposed Scheme Use of best practice measures for soil handling Protection of the agricultural soils within the temporary land take Logistical planning of site layout and access Identifying soils subject to earthworks and construction activities Specifying areas of soils to be stripped, stored and replaced to their baseline condition	**Receptor sensitivity:** High **Magnitude:** Moderate adverse **Significance:** Moderate **Duration:** Temporary
Future-site users	Public use of areas of soft landscaping, and maintenance workers on soft landscaping and in confined spaces e.g. services chambers and ducting exposing future site users to contamination or accumulations of ground gas.	Inclusion of a break layer between contaminated materials and areas of soft landscaping to remove the pathway between contamination and receptors. Gas protection installed into service ducting in areas where ground gas production is considered to be a potential risk. The inclusion of gas monitoring and mitigation strategies for all maintenance work within confined spaces.	**Receptor sensitivity:** High **Magnitude:** Minor adverse **Significance:** Slight **Duration:** Permanent
Off-site human receptors	Occupation of adjacent areas of the site during earthworks which could be impacted by emissions including soil dust.	Use of best practice measures for earthworks including dust management strategies for the handling of contaminated materials	**Receptor sensitivity:** High **Magnitude:** Minor adverse

Receptor	Summary of effects	Mitigation measures	Significance category
			Significance: Slight **Duration:** Permanent
Controlled waters (Surface water and groundwater)	Risk of pollution from spillages or the creation of pathways from on-site contamination during earthworks.	Inclusion of spill prevention and management procedures within the Environmental Management Plan including the use of bunded storage for hazardous materials. Inclusion of a Materials Management Plan (MMP) which identifies contaminated materials and appropriate management strategies to manage working with contaminated materials.	**Receptor sensitivity:** High **Magnitude:** Negligible adverse **Significance:** Slight **Duration:** Temporary

9.8. Monitoring

9.8.1. Soil stripping, handling and storage will be monitored to ensure that it follows the procedures outlined in the SMP. Following reinstatement of the temporary land take, there would be a programme of monitoring of soil conditions to across the reinstated area to identify any potential problems. This would include an assessment of the problem and design of a suitable remediation strategy such as sub-soiling or drainage followed by crop establishment.

9.8.2. If any previously unidentified contaminated land is encountered during the monitoring of earthworks then a suitably experienced and qualified specialist should be notified and appropriate actions taken to assess and address any associated risks. Actions may include:

- sampling and assessment of soils to understand suitability for use.
- remediation of unsuitable materials either by on-site treatment, off-site treatment, or off-site disposal.
- assessment of mitigation strategies to enable contaminated soils to be re-used for example, inclusion of break layer to remove the pathway between contamination and sensitive receptors.

9.9. Summary

9.9.1. Potential sources of contaminated land have been identified which could result in an adverse impact of moderate significance to the construction and operation of the Proposed Scheme. The identified potential sources are the Cantley Lane

Landfill and an infilled gravel pit, these sources have not been fully investigated and therefore the risk has not been confirmed. Mitigation measures included in this report are based on the assumption that contamination is present at both sources which could impact on the Proposed Scheme. These sources will be investigated prior to construction of the Proposed Scheme and risks from contaminated land will be reviewed following completion of the ground investigation.

9.9.2. The Proposed Scheme has the potential to result in an adverse effect of moderate significance on agricultural soils. Construction of the Proposed Scheme will result in the permanent land take of 12.64 hectares of Grade 3a (BMV) and 2.24 hectares of Grade 3b agricultural land and the temporary land take of 13.02 hectares of Grade 3a agricultural land and 3.54 hectares of temporary land take.

9.9.3. A Soils Management Plan (SMP) will be developed to help preserve land quality on the temporary land take areas and to make effective reuse of the soils taken from the areas of permanent land take. The SMP is included within the Environmental Management Plan (**TR010037/APP/7.4**). Provided that the mitigation measures are effective, and areas of temporary land take are restored back to their former condition, the long-term residual effects on agricultural soils would be limited to the permanent loss of agricultural land.

9.9.4. An updated ALC survey and a soil resource survey will be carried out preconstruction to inform the SMP.

9.9.5. Provided that the mitigation measures are effective and areas of temporary land take are restored back to their former condition, the long-term residual effects on agricultural soils would be limited to the permanent loss of agricultural land. The permanent loss of 12.64 hectares of Grade 3a (BMV) agricultural land is considered to be of moderate magnitude resulting in a large adverse significance of effect. The permanent loss of 2.24 hectares of Grade 3b agricultural land is considered to be of moderate magnitude and moderate adverse significance of effect.

9.10. References

- Design Manual for Roads and Bridges (DMRB) LA104 Environmental assessment and monitoring, Highways England.
- Design Manual for Roads and Bridges (DMRB) LA109 Geology and Soils (and associated supporting standards), Highways England.
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- Defra Multi-Agency Geographic Information for the Countryside (MAGIC) website https://magic.defra.gov.uk/
- The Coal Authority online interactive maps https://mapapps2.bgs.ac.uk/coalauthority/home.html

9.11. Glossary

ALC – Agricultural Land Classification

BGS – British Geological Survey

BMV – Best and Most Versatile Land

CIRIA – Construction Industry Research and Information Association

Defra – Department for Environment, Food and Rural Affairs

EMP – Environmental Management Plan

EU – European Union

GI – Ground Investigation

GIR – Ground Investigation Report

HAGDMS – Highways Agency Geotechnical Data Management System

MAGIC – Multi Agency Geographic Information for the Countryside

MMP – Materials Management Plan

PPE – Personal Protective Equipment

SMP – Soil Management Plan

SNCI – Site of Nature Conservation Interest

SPA – Special Protection Areas

SRP – Soil Resource Plan

SSSI – Site of Special Scientific Interest