

A47 Blofield to North Burlingham Dualling

Scheme Number: TR010040

Volume 6

6.1 Environmental Statement

Chapter 9 – Geology and Soils

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Planning Act 2008

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

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Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms and
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**CHAPTER 9
GEOLOGY AND SOILS**

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9. Geology and soils

9.1. Introduction

- 9.1.1. As part of the Environmental Impact Assessment (EIA) process, this Environmental Statement (ES) chapter reports the potential significant effects for the Geology and Soils as a result of the proposed A47 Blofield to North Burlingham Dualling scheme ('the Proposed Scheme'). Full details of the Proposed Scheme are provided in chapter 2 The Proposed Scheme (TR010040/APP/6.1).
- 9.1.2. This geology and soils assessment includes a review of the existing baseline conditions, consideration of the potential impacts, proportionate mitigation and enhancement and identification of residual effects. The chapter is supported by Appendix 9.1 - Contaminated Land Preliminary Risk Assessment (PRA) (TR010040/APP/6.2).

9.2. Competent expert evidence

- 9.2.1. The competent expert is a Chartered Engineer with eight years' post-graduate experience in civil engineering, six of which are within the roads and transportation sector. The competent expert obtained their Bachelor of Engineering in Civil Engineering and a Master of Science in Engineering Geology. The competent expert has led similar environmental assessments for various windfarms and road improvement schemes.
- 9.2.2. The competent expert has been heavily involved in the site investigation, earthworks and geotechnical design of this project over the last three years and has experience on a number of large highways projects throughout the UK and Ireland.

9.3. Legislation and policy framework

- 9.3.1. The main legislative framework for the geology and soils chapter (including contaminated land and soils as a national resource) includes the following regulations, guidance, standards and best practice:
- The Town and Country Planning (EIA) Regulations 2017
 - The Contaminated Land (England) (Amendment) Regulations 2012
 - The Environmental Damage (Prevention and Remediation) (England) Regulations 2015
 - The Environmental Permitting (England and Wales) Regulations 2016 as amended

- The Environmental Protection Act 1990 (as amended by the Environment Act 1995)
- DMRB LA 109 Environmental assessment and monitoring (Highways England, 2019a)
- DMRB LA 109 Geology and Soils (Highways England, 2019b)
- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, (Department for Environment, Food and Rural Affairs (Defra), 2009)
- Contaminated Land Risk Assessment – A Guide to Good Practice C552 (Construction Industry Research and Information Association (CIRIA), 2001)
- Guide to assessing development proposals on agricultural land (Natural England, 2018)
- Agricultural Land Classification: protecting the best and most versatile agricultural land. (TIN049). Second edition (Natural England, 2012)
- Land contamination risk management (LCRM) (Environment Agency, 2020)
- Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. (Environment Agency, 2001)

9.3.2. The Proposed Scheme will adhere to guidance detailed in the following Planning Policy documents:

- National Policy Statement for National Networks (Department for Transport, 2014)
- National Planning Policy Framework (Ministry of Housing, Communities & Local Government, 2019)
- Contaminated Land Strategy 2019-2024 (Broadland District Council and South Norfolk District Council, 2019)

9.4. Assessment Methodology

9.4.1. The following section describes the methodology used to determine the likely significant effects on geology and soils as a result of the Proposed Scheme.

9.4.2. A methodology was presented within Chapter 9 of the EIA Scoping Report for the Proposed Scheme issued to the Planning Inspectorate in February 2018 which was based on the standards prevailing at the time of submission.

9.4.3. A Scoping Opinion was received in April 2018 (**TR010040/APP/6.6**) which was based on this Scoping Report and the then prevailing guidance.

9.4.4. Significant changes to guidance applicable to this chapter have been published since the original Scoping exercise.

- 9.4.5. To comply with the new guidance, it is necessary to update the scope of this chapter and to deviate from the original Scoping opinion.
- 9.4.6. Baseline conditions have been established by referring to publicly available geological and soils information and site-specific ground investigations.
- 9.4.7. Factual site investigation and geotechnical interpretation reports have been prepared for site investigation works carried out in 1998, 2004 and 2018, as part of the development of the Proposed Scheme. These works have informed subsurface details regarding the soils and geology of the site.
- 9.4.8. The key sources used include:
- Road Investment Strategy East Area 6 Geotechnical Preliminary Sources Study Report, A47 Blofield to North Burlingham (Document Ref: A47IMPS2-AMY-BB-ZZ-DO-J0049) (AMEY, 2017)
 - A47 Improvements Programme – Blofield to North Burlingham Dualling Scheme Addendum Preliminary Sources Study Report (Document Ref: HEBLOFLD-MMSJV-HGT-000-RP-CE-00001) (HAGDMS: 29915) (MMSJV, 2017)
 - Envirocheck Report (Landmark Information Group, 2017)
 - A47 Blofield, Norwich – Factual Ground Investigation Report. Document ref.: HEBLOFLD-BWB-00-XX-RP-YE-0001_FGIR_P2 (BWB Consulting Ltd., 2019)
 - A47 Blofield to Burlingham - Ground Investigation Report (Document Ref: HE551490-GTY-HGT-000-RP-CE-30001) (HAGDMS: 30722) (Sweco, 2020)
 - Available geological, soils, historical Ordnance Survey and agricultural maps
 - A site walkover survey undertaken in February 2018 to determine the accuracy of desk study information and to identify any sites worthy of further investigation
 - 6 Alpha Associates Limited (2017). Special Risk Consultancy, “Detailed Unexploded Ordnance (UXO) Threat Assessment”, Doc. ref P6125, Version 2.0, HAGDMS REF: 29967, 7th September 2017
- 9.4.9. A contaminated land PRA has been carried out for the Proposed Scheme, as request as part of the Scoping Opinion received, which is included in Appendix 9.1 (**TR010040/APP/6.2**).

Update to guidance and scope of assessment

- 9.4.10. Following the Scoping Report of the Proposed Scheme (2018), an update to the Design Manual for Roads and Bridges (DMRB) guidance was published in 2019. The scope of this assessment has been reviewed and changed to reflect the most up to date guidance in DMRB LA 109 Geology and soils.

- 9.4.11. This change to scope also considers further information from a ground investigation completed for the Proposed Scheme in late 2018.
- 9.4.12. Table 9-1 sets out the proposed scope for further assessment of the likely nature and scale of effects on Geology and soils (positive, neutral or negative) during the construction and the operational phases of the Proposed Scheme. The scoping questions in Table 9-1 are derived from DMRB LA 109 (Section 3.2). Where the response to one or more of the scoping assessment questions is 'yes', further assessment shall be undertaken.

Table 9-1 : Scoping questions as outlined in DMRB LA 109.

Scoping Question	Response based on current understanding	Scope in?
Is the project likely to affect designated geological sites (statutory or non-statutory)?	There are no Sites of Special Scientific Interest (SSSI) designated sites within the study area. The Yare Broads and Marshes SSSI is situated 2.1km south-west of the study area. The Decoy Carr, Acle SSSI is situated 1.7km south-east of the study area. These represent the two closest SSSI to the Proposed Scheme. There are no Geological Conservation Review Sites within the study area. Therefore, the Proposed Scheme is not likely to affect designated geological sites.	No
Is the project likely to affect the function or quality of soil as a resource?	According to DMRB LA 109, soil function is defined as <i>'The ability of soil to provide a range of environmental services, such as the support of vegetation growth, ecological habitats and biodiversity'</i> The primary function of the soils within the study area is considered to relate to its use for agriculture purposes. They are not considered to provide significant environmental services (that is for ecological habitats and biodiversity as per DMRB LA109). Therefore, the function or quality of the soils as a resource, outside of their function for agriculture, is not likely to be affected by the Proposed Scheme.	No
Is the project likely to affect agricultural land classified as best and most versatile (BMV) or prime land?	The Proposed Scheme may impact areas of agricultural land classified as BMV (that is land that can best deliver future crops for food and non-food uses). The Agricultural Land Classification (ALC) of the land within the study area are classed as Grade 1 agricultural and Grade 2 land within the Provisional ALC map and are therefore the most sensitive to potential impact.	Yes
Is the project likely to disturb historical contamination?	The Envirocheck report (Landmark Information Group (LIG), 2017) states that there are no known operational or disused licensed waste management facilities within a 500m radius of the site area. The nearest, currently operational landfill is located just over 1km to the north of the centre of the Proposed Scheme, to the northwest of North Burlingham. An investigation of mining and quarrying in the vicinity of the Proposed Scheme has been carried out, informed by the Envirocheck report (LIG, 2017). The report highlighted localised areas where some small extractive industrial activities have been carried out from 1950 to 1980, two British Geological Survey (BGS) recorded mineral sites and two known sand pits. Trial pits and trenches were carried out to investigate the presence of made ground or contamination associated with these features during the ground investigation in 2018, however, no evidence was found. The nearest garages, which are common sources of contamination, are considered to be remote from the proposed works with no reasonably identifiable pollution pathway. The garages are unlikely to represent a plausible risk.	No

Scoping Question	Response based on current understanding	Scope in?
<p>Is the project likely to disturb historical contamination?</p>	<p>The contaminated land PRA carried out for the Proposed Scheme concluded that the risk associated with contaminated land is considered to be low. This is included in Appendix 9.1 (TR010040/APP/6.2).</p> <p>Overall, limited made ground was identified in exploratory holes in the historical ground investigations. No visual or olfactory evidence of contamination was identified in the most recent ground investigations (2018).</p> <p>Several phases of ground investigation works have been carried out from 1998 to 2018. The results of tests on soils (BWB, 2019) indicate that the concentrations of key contaminants were generally below the limit of detection with the exception of a single localised location (a farmer's pond, referred to as Pond 1). The test results were also compared to the relevant soil screening values which are published and used throughout industry in contamination assessments for human health; known as <i>Suitable 4 Use Levels</i> (S4UL) (Land Quality Management Ltd, 2015). No exceedances of the S4UL values were observed.</p> <p>A detailed Unexploded Ordnance (UXO) threat report prepared by 6 Alpha Associates Ltd (6AAL) (2017) described the UXO risk along the Proposed Scheme as Very High. The most probable UXO threat is posed by World War II German high explosive bombs and British anti-aircraft ammunition projectiles, whilst incendiary bombs pose a residual threat. It is noted that there has not been any evidence of UXO identified in any ground investigations carried out for the scheme. Appropriate risk mitigation measures for UXO have been captured as part of the CD 622 geotechnical risk management framework by inclusion in the geotechnical risk register in the geotechnical interpretive report (HE551490-GTY-HGT-000-RP-CE-30001-P02 (03/04/2020) – HAGDMS ref.: 30722) and are, therefore, embedded in the Proposed Scheme design. These measures will be put in place for all groundworks associated with the Proposed Scheme as part of the contractor's health and safety plan which will also specify appropriate actions to be undertaken in the event of a suspected or real UXO discovery. Considering the implementation of risk mitigation measures, the Proposed Scheme is unlikely to disturb UXO. Based on the results of ground investigation works the Proposed Scheme is not likely to disturb historical contamination.</p> <p>Based on the results of ground investigation works the Proposed Scheme is not likely to disturb historical contamination.</p>	<p>No</p>
<p>Is the project likely to introduce significant sources of contamination?</p>	<p>An Environmental Management Plan (EMP) (TR010040/APP/7.7), which outlines reliable pollution prevention measures to be employed during construction and operation, will be implemented as part of the Proposed Scheme development. This will contain good practices relating to earthworks, soils and geology, which include but are not limited to:</p> <ul style="list-style-type: none"> • Mitigating the mobilisation of contaminants from spillages during works, by the implementation of best practice measures • Suppression of dust from construction activities using best practice methods such as the use of netting, wheel washing facilities and road sweeping vehicles to prevent the spread of potentially contaminated windblown material • Implementing emergency procedures to respond to potential accidental spillages and leaks • Storing, handling, transporting and disposing of hazardous substances such as any excavated contaminated land, fuels, chemicals, waste and construction materials 	<p>No</p>

Scoping Question	Response based on current understanding	Scope in?
	<ul style="list-style-type: none"> • Adopting appropriate construction methods to minimize exposure to potentially harmful substances and suitable personal protective equipment employed • Specifying clean drilling methods for drilling any boreholes • Storing and bunding chemicals, fuels, oils and materials appropriately in secured compounds, in accordance with appropriate regulations as detailed in the Control of Pollution (Oil Storage) (England) Regulations 2001 and relevant Control of Hazardous Substances to Health Regulations 1994 • Undertaking earthworks in accordance with BS6031:2009, Code of Practice for Earthworks. Construction practice will include Guidance detailed in relative Pollution Prevention Guidelines (PPG), as detailed in PPG01, General Guide to the Prevention of Pollution <p>An earthworks specification will also be produced as part of the Proposed Scheme development, which would provide geotechnical and chemical acceptability criteria to which site-won and imported materials should comply before being used during construction.</p> <p>A drainage system using infiltration drainage has been included in the design of the Proposed Scheme. This drainage system will be subject to detailed design and will include measures to prevent any potential pollution from road surface runoff entering the soils below the Proposed Scheme. This includes filter drains, penstocks and soakaways which will be designed in accordance with the relevant standards for highway drainage. Effects relating to the introduction of sources of significant contaminants through the infiltration drainage system are, therefore, unlikely.</p> <p>Owing to the reliable measures included in the design and construction methodology of the Proposed Scheme, the project is not likely to introduce significant sources of contamination.</p>	

9.4.13. The proposed changes to the scope of this chapter since scoping in 2018 and receipt of the 2018 ground investigation information, being in line with the new DMRB LA 109 guidance, can be summarised as follows:

- To de-scope effects relating to designated geological sites from the assessment due to the distance the nearest designated site is from the Proposed Scheme study area
- To de-scope effects relating to function or quality of soil as a resource from the assessment, beyond its function as an agricultural resource
- To de-scope effects relating to the disturbance of historical contamination from the assessment, which includes the disturbance of any potential UXO

9.4.14. It should be noted that some elements discussed in the Scoping Report under geology and soils will now fall under more appropriate chapters as follows:

- Hydrogeology and groundwater will now be addressed in chapter 14 Road drainage and the water environment (**TR010040/APP/6.1**). As it unlikely that the scheme will disturb historical contamination or introduce significant

sources of contamination, an assessment of the risk of contamination to groundwater is not deemed necessary in this geology and soils chapter.

- Safeguarded mineral areas will now be addressed in chapter 11 Material assets and waste (**TR010040/APP/6.1**).

- 9.4.15. All of the elements mentioned above will be addressed considering the revisions to their applicable DMRB guidance.
- 9.4.16. The number of ALC surveys has also been rationalised from two surveys as proposed in the original Scoping Report (the first prior to the EIA and a second survey prior to construction) to a single survey prior to construction.
- 9.4.17. The ES assumes the most conservative conditions in relation to the ALC, which is considered an appropriate approach which will ensure that full information is provided on likely significant effects.
- 9.4.18. An ALC survey will be carried out prior to construction only.
- 9.4.19. Key stakeholders have been consulted in relation to this revised approach and survey programme as it diverges from the original methodology set out in Scoping.

Consultation

- 9.4.20. Natural England, the Environment Agency, Norfolk County Council and the Planning Inspectorate were consulted on the updated scope following changes in DMRB after the submission of the Scoping Report and receipt of the Scoping Opinion.
- 9.4.21. The Environment Agency response requested for the contaminated land Preliminary Risk Assessment to agree the de-scoping of effects relating to historical contamination.
- 9.4.22. The PRA (Appendix 9.1 (**TR010040/APP/6.2**)) was completed and issued to the Environment Agency in October 2020.
- 9.4.23. No additional comments or concerns on the updated scope were raised by Natural England or Norfolk County Council.

Assessment criteria

Sensitivity of receptors

- 9.4.24. The sensitivity of the receptors is a determination of receptor importance. The receptor value is determined using the criteria provided in Table 9-2.

9.4.25. Table 9-2 has been reproduced from DMRB LA 109 to reflect only the subtopics (i.e. agricultural soils) which have been scoped in.

Table 9-2 : Criteria to determine receptor value (Reproduced from Table 3.11 of DMRB LA 109)

Receptor value (sensitivity)	Description
Very High	Soils: 1) soils directly supporting an EU designated site (e.g. Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar); and / or 2) ALC Grade 1 & 2 or Land Capable of Agriculture (LCA) Grade 1 & 2
High	Soils: 1) soils directly supporting a UK designated site (e.g. SSSI); and / or 2) ALC Grade 3a, or LCA Grade 3.1.
Medium	Soils: 1) soils supporting non-statutory designated sites (e.g. Local Nature Reserves (LNR), Local Geological Sites (LGS), Sites of Nature Conservation Importance (SNCIs)); and / or 2) ALC Grade 3b or LCA Grade 3.2.
Low	Soils: 1) ALC Grade 4 & 5 or LCA Grade 4.1 to 7; and / or 2) soils supporting non-designated notable or priority habitats.
Negligible	Soils: previously developed land formerly in 'hard uses' with little potential to return to agriculture.

Magnitude of impact

9.4.26. Table 9-3 has been reproduced from DMRB LA 109 to reflect only the subtopics (i.e. Soils) which have been scoped in.

Table 9-3 : Criteria to determine impact magnitude (Reproduced from Table 3.12 of DMRB LA109)

Magnitude of impact	Typical description
Major	Soils: physical removal or permanent sealing of >20 hectares of agricultural land.
Moderate	Soils: physical removal or permanent sealing of 1 – 20 hectares of agricultural land; or permanent loss or reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).
Minor	Soils: temporary loss or reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource.)
Negligible	Soils: no discernible loss or reduction of soil function(s) that restrict current or approved future use.
No change	Soils: no loss or reduction of soil function(s) that restrict current or approved future use

Significance of effects

- 9.4.27. The significance of effects will be determined in accordance with Table 3.7, Table 3.8.1 and Section 3.9 of DMRB LA 104.
- 9.4.28. Residual effects that are of moderate, large or very large magnitude will give rise to significant effects in accordance with Note 3 of the DMRB LA 104.
- 9.4.29. The significance of effects of the Proposed Scheme on sensitive receptors is reported in section 9.10 assessment of likely significant residual effects.

9.5. Assessment assumptions and limitations

- 9.5.1. Effects relating to historical contamination have been de-scoped from the assessment based on information obtained through a detailed desk study and targeted ground investigations and tests made in the field and laboratory as part of the development of the Proposed Scheme.
- 9.5.2. This information has been obtained from a number of statutory and non-statutory bodies, previous reports (by others) and external subcontractors.
- 9.5.3. Even with these efforts, there may be conditions existing at the site which have not been disclosed by the investigations available which may include limited and localised occurrences of soil contamination. To address this limitation, the EMP (**TR010040/APP/7.7**) will include an earthworks construction specification which will set out appropriate actions and methods for dealing with any unforeseen occurrences of soil contamination.
- 9.5.4. The baseline assessment has used the Provisional Agricultural Land Classification maps to determine the ALC grade. Natural England guidance is that the Provisional maps should only be used as a general guidance as they are not at a suitable scale and not accurate enough for individual sites.
- 9.5.5. To address this limitation, the assessment has been based on the worst case assumption that all of the land is designated the highest land quality.

9.6. Study Area

- 9.6.1. 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 (i.e. designated sites) that can be affected by the project, i.e. by re-mobilisation or introduction of contaminants

- 9.6.2. The scoping exercise considered an area which extends 1km beyond the red line boundary of the Proposed Scheme including all temporary land take to identify any potential contamination sources.
- 9.6.3. No contamination sources with potential to migrate onto site and effect receptors were identified.
- 9.6.4. No sensitive off-site receptors that could be affected were identified.
- 9.6.5. The assessment of effects therefore, considers an appropriate extent from the construction footprint/project boundary including compounds and temporary land take and the gas pipe diversion for the Proposed Scheme as further described in chapter 2 The Proposed Scheme (**TR010040/APP/6.1**).

9.7. Baseline conditions

- 9.7.1. The majority of the Proposed Scheme lies within undeveloped agricultural land which is currently in use by a number of farms.
- 9.7.2. The Proposed Scheme extent also includes a very small area that includes domestic gardens and allotments.
- 9.7.3. The existing A47 road infrastructure is the most prominent man-made feature and the land associated with the existing road forms the remainder of the lands within the Proposed Scheme extent. The existing road infrastructure will be de-trunked and served as local access as part of the Proposed Scheme (chapter 2 The Proposed Scheme (**TR010040/APP/6.1**)).

Agricultural soils

- 9.7.4. The Multi-Agency Geographical Information for the Countryside (MAGIC) online map viewer includes data layers displaying the soilscape of England. The entirety of the Proposed Scheme is underlain by one soil type, namely “freely draining slightly acid loamy soils of low fertility (type 6)”.
- 9.7.5. 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 Grades 3a and 3b, to identify good quality

agricultural land from moderate quality land (see Appendix 10.1 (TR010040/APP/6.2) for further information on the ALC system).

- 9.7.6. 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 Provisional ALC map, Grade 1 agricultural land makes up approximately 6% of the agricultural land within Broadland District, while Grade 2 agricultural land makes up approximately 24% of the agricultural land within the district. Approximately 67% of the agricultural land within the district is Grade 3 (the Provisional ALC map does not subdivide Grade 3 land into 3a and 3b).
- 9.7.7. The Provisional ALC map shows that the ALC grade of the agricultural land across the Proposed Scheme is predominantly classed as Grade 1 (excellent quality agricultural land) with a small area at the western end of the Proposed Scheme near the proposed Blofield overbridge classed as Grade 2 (very good quality agricultural land). An extract of the Provisional ALC map is shown in Figure 9.1 (Agricultural Land Classification) (TR010040/APP/6.3). Grade 1 and Grade 2 agricultural land is considered to be BMV agricultural land.
- 9.7.8. The Likelihood of BMV Agricultural Land - Strategic scale map of the Eastern Region (ALC020) also indicates that there is a high likelihood of BMV land with more than 60% of the land likely to be BMV land.
- 9.7.9. The Provisional ALC map indicates that large areas of land between Norwich and Acle are covered by Grade 1 and Grade 2 agricultural land. The small areas where detailed post 1988 ALC surveys have been completed mainly identified Grade 2 agricultural land. No detailed post 1988 ALC survey has been completed in the area of the Proposed Scheme. The closest post 1988 ALC surveys have been completed to the west of Acle (Grade 2 agricultural land), north of Lingwood (Grade 2 agricultural land) and west of Blofield (a mixture of Grades 2, 3a, 3b and 4 agricultural land).
- 9.7.10. The provisional ALC classification has not been confirmed by recent surveys, however, based on the available information, the route of the Proposed Scheme is highly likely to contain BMV agricultural land.
- 9.7.11. It is not proposed to undertake an ALC survey for the purpose of the assessment. It is conservatively assumed for the purpose of this assessment that all land within the Proposed Scheme footprint is Grade 1 agricultural land.
- 9.7.12. An ALC survey will be carried out prior to construction of the Proposed Scheme to confirm the ALC classification within the permanent and temporary land take areas.

9.7.13. Knowledge of the ALC classification of the agricultural land across the site will inform the management of soils during construction and inform the restoration of the temporary land take to return it to agricultural use.

Baseline receptor summary

9.7.14. The baseline data above has been used to determine the receptors that have the potential to be affected by the Proposed Scheme. These are summarised in Table 9-4.

Table 9-4 : Principal receptors

Receptor	Details
Agricultural soils	Removal of Grade 1 agricultural land across the Proposed Scheme will take place as a result of the planned works.

9.8. Potential impacts

9.8.1. The following sections identify the potential impacts on the agricultural soils that may occur as a consequence of the Proposed Scheme. The potential effects are first assessed assuming no mitigation.

Receptor Sensitivity

9.8.2. Receptor sensitivity for the Grade 1 agricultural soils (considered to be BMV agricultural land) has been determined as very high in accordance with Table 9-2.

Construction

9.8.3. The construction of the Proposed Scheme will include the following works relevant to the agricultural soils:

- Stripping of topsoil and subsoil across the Proposed Scheme footprint required for the permanent works (road, structures, drainage network, environmental bunds etc) and temporary works (construction compounds, haul roads)
- Excavation of road cuts and the drainage networks
- Excavation of soft or unsuitable founding materials below embankments, structures and the road formation which may include excavation of contaminated material, in the unlikely event that this is encountered
- Installation of ground measures such as vertical drains and stone columns
- Construction of embankments

- Construction of bridge foundations which may consist of reinforced concrete spread foundations or reinforced concrete or steel pile foundations where piles may be bored and cast in place or driven into the ground
- Excavation of topsoil and subsoil for the gas pipe diversion
- Temporary storage of earthworks materials, topsoil, subsoil and spoil
- Reuse of topsoil for landscaping and on earthworks slopes

9.8.4. Table 9-5 shows the approximate permanent and temporary land take associated with the Proposed Scheme.

Table 9-5 : Agricultural land take

ALC grade	Approximate permanent land take (ha)	Approximate temporary land take (ha)	Approximate total construction land take (ha)
Grade 1*	42.2	40.2	90.9

* It is assumed that all land is Grade 1 agricultural land as a worst-case.

9.8.5. During the construction phase, the Proposed Scheme would result in permanent land take of approximately 42.2 hectares of Grade 1 agricultural land and temporary land take of approximately 40.2 hectares of Grade 1 agricultural land.

9.8.6. Not all of the permanent land take would be covered in hardstanding. Approximately 32 hectares of land would be used for landscaping. Although this land would be lost to agriculture, the soil resources would still be used to provide some ecosystem services. However, 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.

9.8.7. Approximately 50.7 hectares land take would be restored and available for agricultural use following completion of the construction phase. However, land temporarily used for construction may be subject to changes in soil structure and characteristics due to compaction by heavy plant, vehicles, handling and storage.

9.8.8. 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.

Magnitude of Potential Impacts

9.8.9. The magnitude of potential impacts during construction has been determined with reference to Table 9-3. This has been done to account for both permanent and temporary land take during the construction of the Proposed Scheme.

- 9.8.10. The magnitude for the temporary loss of Grade 1 agricultural soils has been assessed as Moderate. This is due to the 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.
- 9.8.11. The magnitude for the permanent loss of Grade 1 agricultural soils has been assessed as Major due to the physical removal or permanent sealing of over 20 hectares of agricultural land as part of the permanent land take.

Operational

- 9.8.12. In general, geology and soil impacts from road schemes primarily tend to be limited to the construction phase. The loss of agricultural land occurs during the construction phase and no additional loss of agricultural land is expected during the operational phase. Therefore, it is anticipated that the operation of the Proposed Scheme would not give rise to any additional significant effects upon geology and soils.

9.9. Design, mitigation and enhancement measures

- 9.9.1. A design intervention is a recommended mitigation from the environment team that has been embedded into the design.
- 9.9.2. The most applicable mitigation for reducing impacts on agricultural soils is through effective design and route selection.
- 9.9.3. Alternative routes were considered for the Proposed Scheme in terms of their effect on agricultural soils. Further information is provided in Chapter 3 Consideration of alternatives (**TR010040/APP/6.1**).
- 9.9.4. Whilst the option of upgrading the existing road online would have less agricultural land take, assessment and feedback from the consultation process concluded that the offline Proposed Scheme option (albeit with a greater agricultural land take) was the better performing option and provided a more robust route in the long term. The Proposed Scheme option was also favoured by the public by a significant margin.
- 9.9.5. Given the surrounding lands are of similarly high agricultural quality, the overall effect on agricultural soils of alternatives would be very similar for other offline route options.
- 9.9.6. The key principle considered to minimise effects on soils is to ensure that the footprint of the Proposed Scheme is reduced as much as practicable, without adversely affecting the design.

- 9.9.7. A design intervention was recommended and the total agricultural land take has been reduced as much as is feasible given the scale of the Proposed Scheme.
- 9.9.8. There are no opportunities for enhancement on this Proposed Scheme as the land is already likely to be BMV.

Mitigation measures

- 9.9.9. There are no measures that can mitigate the permanent land take required and therefore, the permanent loss of agricultural soils associated with the Proposed Scheme.
- 9.9.10. However, in order to mitigate impacts on temporary land take areas, a Soil Management Plan (SMP), incorporating guidance provided by the *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites* (Defra, 2009), will be produced to ensure the use of best practice measures for soil handling. The SMP will ensure that soils in the areas subject to temporary land take are properly handled, stored and reinstated.
- 9.9.11. The SMP will include a Soil Resource Plan and a Soil Handling Strategy, based on a soil resource survey. A Materials Management Plan (MMP) will be put in place to minimise over-excavation of soils and ensure that soils will be reused as much as possible within the Proposed Scheme.
- 9.9.12. The SMP and MMP would outline areas of soil to be protected from earthworks and construction activities; the areas and types of topsoil and subsoil to be stripped, haul routes, stockpile locations; the methods for stripping, stockpiling, re-spreading and ameliorating landscape soils and restoring temporary land take areas, and a cut and fill balance to ensure as much material as possible is re-used in the Proposed Scheme. All affected soil will be stripped, including topsoil and subsoil, and stored separately.
- 9.9.13. Construction compound 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 further compaction or damage of soils. Construction vehicles will be confined to designated haul routes to reduce the amount of compaction of soil.
- 9.9.14. Where there are excess soils generated, these will be saved and reused outside the Proposed Scheme where there are opportunities to do so.
- 9.9.15. Where necessary for protection from earthworks and construction activities, agricultural soils will be stripped, stored and replaced to their baseline condition, as far as possible.

9.10. Assessment of likely significant residual effects

- 9.10.1. Following identification of the baseline conditions, impacts and implementation of proposed mitigations, the residual effects on the identified receptors have been determined as presented in Table 9-6.
- 9.10.2. 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. The temporary loss of agricultural land during the construction phase is considered to be of minor magnitude and moderate 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.
- 9.10.3. As it is not possible to mitigate the permanent loss of agricultural land, the magnitude of impact is still considered to be Major and the significance of the effect of the loss of BMV land (ALC Grade 1) is deemed Very Large.

Table 9-6 : 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, drainage network, 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: Very high Magnitude: Major Significance: Very large Duration: Permanent
Agricultural soils	Stripping of soil across the Proposed Scheme footprint required for the temporary works (construction compounds, haul roads, gas pipeline diversion)	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: Very high Magnitude: Minor Significance: Moderate Duration: Temporary

9.11. Monitoring

9.11.1. Soil stripping, handling and storage will be monitored/audited to ensure that it follows the procedures outlined in the SMP. Following the reinstatement of the temporary land take, there would be a programme of monitoring of soil conditions to identify if there are soil problems which need to be remediated. This would include an assessment of the problem and design of a suitable remediation strategy such as subsoiling or drainage followed by crop establishment.

9.12. Summary

9.12.1. The Proposed Scheme has the potential to result in a significant effect on agricultural soils. Any other effects relating to the geology and soils of the study area are considered unlikely and were scoped out of the assessment in accordance with DMRB LA 109.

9.12.2. Due to the permanent land take of over 20 hectares of Grade 1 agricultural land, which is classed as Best and Most Versatile (BMV) agricultural land, the significance of effects on agricultural soils have been deemed Very Large.

9.12.3. 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 (**TR010040/APP/7.7**). 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.

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