



The Sizewell C Project

6.8 Volume 7 Yoxford Roundabout and Other Highway Improvements Chapter 11 Geology and Land Quality

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None provided.

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None provided.

Appendices

Appendix 11A: Yoxford Roundabout: Phase 1 Desk Study Report

Appendix 11B: Conceptual Site Models

Appendix 11C: Impact Assessment Tables

11 Geology and Land Quality

11.1 Introduction

11.1.1 This chapter of **Volume 7** of the **Environmental Statement (ES)** presents an assessment of the geology and land quality effects arising from the construction and operation of the proposed Yoxford roundabout and other highway improvements (referred to throughout this volume as the ‘proposed development’). This includes an assessment of potential impacts, the significance of effects, the requirements for mitigation and the residual effects.

11.1.2 The proposed improvement works are:

- the roundabout at the junction between the A12 and B1122 in Yoxford (referred to throughout as ‘Yoxford roundabout’);
- improvements at the A1094/B1069 junction south of Knodishall;
- improvements at the A12/A144 junction south of Bramfield; and
- improvements at the A12/B1119 junction at Saxmundham.

11.1.3 Road safety analysis has also identified potential highway safety issues at two sites (the B1078 and B1079 junction east of Easton and Otley College and the A140 and B1078 junction west of Coddendam). Highway safety measures at these sites will be secured by an obligation in the Section 106 Agreement (see the **Draft Heads of Terms, Appendix J** to the **Planning Statement** (Doc. Ref. 8.4). This chapter includes an assessment of these highway safety measures.

11.1.4 Detailed descriptions of the proposed development sites (referred to throughout this volume as the ‘site’ as relevant to the location of the works), the proposed development, safety measures and different construction and operation phases are provided in **Chapter 2** of this volume of the **ES**. A glossary of terms and list of abbreviations used in this chapter is provided in **Volume 1** of the **ES**.

11.1.5 The Government’s Good Practice Guide for Environmental Impact Assessment¹ (EIA) (Ref. 11.1) outlines the potential environmental effects that should be considered for geology and land quality for example physical effects of the development, effects on geology and effects on contamination. Further information on these potential environmental effects

¹ It should be noted that this document has been withdrawn; however, it still constitutes good advice and should be referred to in the absence of alternative guidance documents.

and those which have been scoped in to the geology and land quality assessment can be found in **Volume 1 Appendix 6N**.

11.1.6 This assessment has been informed by data from other assessments as following:

- **Chapter 10:** Soils and agriculture.
- **Chapter 12:** Groundwater and surface water.

11.1.7 This assessment has been informed by data presented in the following technical appendices:

- **Appendix 11A:** Yoxford Roundabout: Phase 1 Desk Study Report.
- **Appendix 11B:** Conceptual Site Models.
- **Appendix 11C:** Impact Assessment Tables.

11.2 Legislation, policy and guidance

11.2.1 **Volume 1, Appendix 6N** identifies and describes legislation, policy and guidance of relevance to the assessment of the potential geology and land quality impacts associated with the Sizewell C Project across all **ES** volumes.

11.2.2 This section provides an overview of the specific legislation, policy and guidance of relevance to the assessment of the proposed improvement works.

a) International

11.2.3 International legislation or policy relevant to the geology and land quality assessment includes the Water Framework Directive (WFD) 2000/60/EC and the Waste Framework Directive 2008. The requirements of these, as relevant the geology and land quality assessment, are described in **Volume 1 Appendix 6N**.

b) National

11.2.4 National legislation and policies relating to the geology and land quality assessment includes:

- Part IIA of the Environmental Protection Act 1990.
- Water Resources Act 1991.

- The Control of Substances Hazardous to Human Health Regulations 2002.
- Construction (Design and Management) Regulations (CDM Regulations) 2015.
- Waste Management Regulations 2016.
- Landfill (England and Wales) Regulations 2005.
- Hazardous Waste (England and Wales) Regulations 2005.
- The Environmental Permitting (England and Wales) Regulations 2016.

11.2.5 The requirements of these, as relevant to the geology and land quality assessment, are set out in **Volume 1 Appendix 6N**.

i. [Planning policies](#)

11.2.6 National Policy Statements (NPS) set out national policy for energy infrastructure. The overarching NPS for Energy (EN-1) (Ref. 11.2) and NPS for Nuclear Power Generation (EN-6) (Ref. 11.3) provide the primary policy framework within which the proposed development will be considered. A summary of the relevant planning policy, together with consideration of how this has been taken into account is provided in **Volume 1 Appendix 6N**.

11.2.7 Other national policies relevant to the geology and land quality assessment include the National Planning Policy Framework 2019 (Ref. 11.4), Planning Practice Guidance 2019 (Ref. 11.5) and the Government's 25 Year Environment Plan 2018 (Ref. 11.6). The requirements of these are described in **Volume 1 Appendix 6N**.

c) [Regional](#)

11.2.8 No regional policy is deemed relevant to the assessment of geology and land quality for this site.

d) [Local](#)

11.2.9 **Volume 1 Appendix 6N** summarises the requirements of Suffolk Coastal District Council Local Plan Core Strategy and Development Management Policies (Ref. 11.7), and the Suffolk Coastal District Council Final Draft Local Plan (Ref. 11.8), as relevant to the geology and land quality assessment.

e) Guidance

Guidance relating to the geology and land quality assessment include:

- The Department for Environment, Food and Rural Affairs Contaminated Land Statutory Guidance 2012 (Ref. 11.9).
- Contaminated Land Report, CLR11² (Ref. 11.10).
- Guiding Principles for Land Contamination (Ref. 11.11).
- The Definition of Waste: Development Industry Code of Practice (Ref. 11.12).
- The Design Manual for Roads and Bridges (DMRB) (2008) Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects (Ref. 11.13).
- DMRB (1993) Volume 11, Section 3, Part 11 Geology and Soils (Ref. 11.14).
- Department of the Environment (1995) Industry Profiles for previously developed land, Environment Agency (Ref. 11.15).
- Construction Industry Research and Information Association (CIRIA) C552 (2001) Contaminated Land Risk Assessment – A Guide to Good Practice (Ref. 11.16).
- National House-Building Council and Environment Agency (2008) Guidance on the Safe Development of Housing on Land Affected by Contamination (R&D66) (Ref. 11.17).
- CIRIA C665 (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings (Ref. 11.18).
- British Standards (2015) BS 8485 +A1:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (Ref. 11.19).
- CIRIA C681 (2009) Unexploded Ordnance (UXO) – A Guide for the Construction Industry (Ref. 11.20).
- CIRIA C733 (2014) Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks (Ref. 11.21).

² It is noted that CLR11 is due to be withdrawn early 2020 and replaced by updated online guidance: Environment Agency, Land contamination: Risk Management (LCRM).

- CIRIA C682 (2009) The Volatile Organic Contaminants Handbook (Ref. 11.22).
- British Standards (2015) BS 5930 – Code of practice for ground investigations (Ref. 11.23).
- British Standards (2017) BS 10175:2011+A2:2017 – Code of Practice for Investigation of Potentially Contaminated Sites (Ref. 11.24).

11.2.10 Further detail on this guidance, as relevant to the geology and land quality assessment is set out in **Volume 1, Appendix 6N**.

11.3 Methodology

a) Scope of the assessment

11.3.1 The generic EIA methodology is detailed in **Volume 1 Chapter 6** of the **ES**.

11.3.2 The full method of assessment for geology and land quality that has been applied for the Sizewell C Project is included as in **Volume 1 Appendix 6N**.

11.3.3 This section provides specific details of the geology and land quality screening exercise and methodology applied to the assessment of the proposed development.

11.3.4 The scope of assessment considers the impacts of the construction and operation use of the proposed highway improvement works and safety measures. Where the highway improvement works proposed or safety measures have the potential for likely significant effects, these have been assessed in further detail.

11.3.5 The scope of this assessment has been established through a formal EIA scoping process undertaken with the planning inspectorate. A request for an EIA scoping opinion was initially issued to the planning inspectorate in 2014, with an updated request issued in 2019, see **Volume 1 Appendix 6A**.

11.3.6 Comments raised in the EIA scoping opinion received in 2014 and 2019 have been taken into account in the development of the assessment methodology. These are detailed in **Volume 1 Appendices 6A to 6C**.

11.3.7 The Government's Good Practice Guide for EIA³ states that the following potential environmental effects should be considered for geology and land quality:

- physical effects of the development: such as changes in topography, soil compaction, soil erosion, ground stability, etc.;
- effects on geology as a valuable resource: such as mineral resource sterilisation, loss or damage to regionally important geological sites, geological sites of special scientific interest (SSSIs) etc.;
- effects on soil as a valuable resource: such as loss or damage to soil of good agricultural quality;
- effects associated with ground contamination that may already exist on-site: such as introducing or changing pathways and receptors;
- effects associated with the potential for polluting substances used (during the various phases) to cause new ground contamination issues on-site, such as introducing or changing the source of contamination and, or pathways; and
- effects associated with re-use of soils and waste soils: such as re-use of site-sourced materials on or off-site, disposal of site-sourced materials off-site, importation of materials to the site etc.

11.3.8 The proposed development is considered unlikely to have an impact on important geological sites as no geological SSSIs or local geological sites have been identified within the study area (described below in section **11.3d**). However, given the comments in the revised scoping opinion received in 2019 in relation to effects on geology as a valuable resource, an assessment of the effects on mineral resources has been included.

11.3.9 The proposed development will involve minor earthworks comprising, the removal of topsoil, and excavations for limited foundations (such as signage, barriers, etc.) as well as a new roundabout (the proposed Yoxford roundabout) and road upgrades, changes to drainage (where required) and services/utilities. Given existing ground conditions and the proposed works, the proposed development is considered unlikely to have an impact on soil compaction and ground stability. Physical effects in relation to changes in topography are discussed in **Chapter 6** (landscape and visual) of this volume.

³ It should be noted that this document has been withdrawn; however, it still constitutes good advice and should be referred to in the absence of alternative guidance documents.

- 11.3.10 The effects on soil as a valuable resource are discussed in **Chapter 10** (soils and agriculture) of this volume. Management of site-sourced waste materials, other than site soils (i.e. general waste materials from the construction and operation phases) is summarised in **Chapter 2** of this volume, with further details provided in the **Waste Management Strategy (Volume 2 Appendix 8A)** (Doc Ref. 6.3).
- 11.3.11 Therefore, the following remaining environmental effects have been considered and form part of the assessment in this chapter:
- physical effects including soil erosion;
 - mineral resource loss, damage or sterilisation;
 - effects associated with existing ground contamination and potential new ground contamination issues; and
 - effects associated with the re-use or disposal of site sourced soils and waste soils.
- 11.3.12 Potential impacts from existing and new contamination sources on controlled waters have been considered as part of the geology and land quality assessment to determine and classify potential effects. Further description of the effects from contamination to groundwater and surface water is provided in **Chapter 12** of this volume.
- 11.3.13 This chapter provides an initial indication of chronic long-term risks to construction and maintenance workers. In accordance with the **Code of Construction Practice (CoCP)** (Doc Ref. 8.11), short-term acute risks should be assessed, managed and mitigated by the contractor with appropriate risk assessments and methods statements, and subsequent control measures.
- b) **Consultation**
- 11.3.14 The scope of the assessment has also been informed by ongoing consultation and engagement with statutory consultees throughout the design and assessment process as outlined in **Volume 1 Appendix 6N**.
- c) **Environmental Screening**
- 11.3.15 An environmental screening exercise was undertaken to identify which of the four highway improvement works and two safety measures proposed may give rise to environmental effects that have the potential to be significant. The outcome of this environmental screening exercise

concluded that the proposed Yoxford roundabout should be taken forward to the assessment of likely effects on geology and land quality.

11.3.16 The remaining three highway improvement works and two safety measures have been screened out of the geology and land quality assessment as they are not likely to give rise to significant environmental effects.

11.3.17 **Table 11.1** provides a summary of the environmental screening exercise.

Table 11.1: Summary of environmental screening exercise

Proposed Highways Improvement / safety measures	Summary of Potential Effects	Screened In or Out of the Assessment
<p>The A12/B1122 Yoxford roundabout.</p>	<p>The proposed improvement works would involve the construction of a new roundabout and access road, the construction of an infiltration basin and a realignment of the existing A12 and B1122.</p> <p>Physical effects including changes in soil erosion associated with stripping of topsoil, earthworks and associated machine movements are anticipated. The proposed works may also disturb and mobilise existing sources of contamination and introduce new pathways for migration of existing contamination.</p> <p>The works would be completed in accordance with current best practice. Potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods.</p> <p>There is the potential for the proposed improvement works to impact on soil, geological receptors and land contamination and therefore this is considered further in the assessment.</p>	<p>Screened in.</p>
<p>Improvements at the A1094/B1069 junction south of Knodishall.</p>	<p>The highway improvement works would involve improvements of visibility splays and provision of signage and road markings and would be undertaken generally within the existing road boundaries and adjacent land.</p> <p>The works would be completed in accordance with current best practice. Potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods. Therefore, no significant effects on geology and land quality are</p>	<p>Screened out.</p>

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Proposed Highways Improvement / safety measures	Summary of Potential Effects	Screened In or Out of the Assessment
	anticipated.	
Improvements at the A12/A144 junction south of Bramfield.	<p>The minor junction improvement works would involve a provision of a central reservation island and waiting area and would be undertaken generally within the existing road boundaries and adjacent land.</p> <p>The works would be completed in accordance with current best practice. Potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods. Therefore, no significant effects on geology and land quality are anticipated.</p>	Screened out.
Improvements at the A12/B1119 junction at Saxmundham.	<p>The minor junction improvement works would involve widening of lanes at junction approach, improvements of visibility splays and provision of signage and road markings and would be undertaken generally within the existing road boundaries and adjacent land.</p> <p>The works would be completed in accordance with current best practice. Potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods. Therefore, no significant effects on geology and land quality are anticipated.</p>	Screened out.
Safety measures at the B1078/B1079 junction east of Easton and Otley College.	<p>The highway improvement works would include improvements of visibility splays and provision of signage and road markings which would be undertaken generally within the existing road boundaries and adjacent land.</p> <p>The works would be completed in accordance with current best practice. Potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods. Therefore, no significant effects on geology and land quality are anticipated.</p>	Screened out.
Safety measures at the A140/B1078 junction west of Coddham.	<p>The minor junction improvement works would involve improvements of visibility splays and provision of signage and road markings and would be undertaken generally within the existing road boundaries and adjacent land.</p> <p>The works would be completed in accordance</p>	Screened out.

Proposed Highways Improvement / safety measures	Summary of Potential Effects	Screened In or Out of the Assessment
	with current best practice. Potential geology and land quality impacts during the construction and operation phases would be managed through primary and tertiary mitigation methods. Therefore, no significant effects on geology and land quality are anticipated.	

d) Study area

- 11.3.18 To consider the physical effects of the proposed Yoxford roundabout and the effects associated with the mineral resources, re-use of soils and waste soils, the study area is defined as the area within the site boundary. The site boundary of the proposed Yoxford roundabout is presented in **Chapter 1, Figure 1.2** of this volume.
- 11.3.19 The study area for the consideration of effects on human receptors, controlled waters, ecological receptors and property receptors includes the site and land immediately beyond it to a distance of 500 metres (m). This takes into account the transport and final destination of potential contaminants of concern in the environment and the connectivity of these contaminants via pathways of migration or exposure to the receptors identified.
- 11.3.20 Based on the contaminated land desk study provided in **Appendix 11A**, this study area was considered sufficient for the assessment of the potential land contamination and associated potential contaminant linkages (PCL)⁴ Error! Bookmark not defined. risks as the land has previously undergone limited development and as such contamination, if present, is likely to be limited in extent or have a limited lateral mobility if present.

e) Assessment scenarios

- 11.3.21 The assessment of effects on geology and land quality includes the assessment of the construction and operational phases of the proposed development, rather than specific assessment years.

⁴ Where a linkage exists or is considered likely to be present between a potential contamination hazard/source, pathway and receptor relevant to the site.

f) Assessment criteria

11.3.22 As described in **Volume 1 Chapter 6**, the EIA methodology considers whether impacts of the proposed development would have an effect on any resources or receptors. For physical effects, and effects associated with mineral resources, waste soils and soil re-use, the assessments broadly consider the magnitude of impacts and value or sensitivity of resources or receptors that could be affected in order to classify effects. For land contamination the assessment considers the change in the level of contaminative risks to the relevant receptors in order to classify effects.

11.3.23 A summary of the two assessment methods and assessment criteria used in the geology and land quality assessment is presented in the following sub-sections.

i. Physical effects, and effects associated with mineral resources, waste soils and soil re-use

11.3.24 An impact assessment of the potential physical effects of the proposed Yoxford roundabout on geology and the effects associated with mineral resources, soils re-use and waste soils has been undertaken using a qualitative which considers the effects of the construction and operational phases of the proposed development.

Value/sensitivity

11.3.25 The value/sensitivity of a receptor is considered when determining the consequence of an effect in the impact assessment. Where the attribute falls within two value/sensitivity criteria, the worst case value/sensitivity is selected. The value/sensitivity of soil and geological receptors has been determined using the classifications given in **Table 11.2**.

Table 11.2: Criteria for classifying the value and/or sensitivity of environmental resources/receptors

Value / Sensitivity	Criteria	Description
High	<p>Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor.</p> <p>Attribute has a very low capacity to accommodate the proposed change.</p>	<p>Regionally important mineral resource. Within a mineral safeguarding area.</p> <p>Major ground stability, soil compaction or erosion hazards currently present at the site.</p> <p>High potential for soils re-use.</p>

Value / Sensitivity	Criteria	Description
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a low capacity to accommodate the proposed change.	Moderately economically viable mineral resource. Adjacent to a mineral safeguarding area. Moderate ground stability, soil compaction or erosion hazards currently present at the site. Moderate potential for soils re-use.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Low economically viable minerals. Low ground stability, soil compaction or erosion hazards currently present at the site. Limited opportunity for soils re-use.
Very low	Attribute characteristics do not make a significant contribution to local character or distinctiveness. Attribute is generally tolerant and can accommodate the proposed change.	No economically viable minerals. No ground stability, soil compaction or erosion hazards currently present at the site. No opportunity for soils re-use.

Magnitude

11.3.26 Following determination of the value/sensitivity of the receptors, the magnitude of potential impacts are determined. The criteria for the assessment of impact magnitude for physical effects and effects associated with mineral resources, waste soils and soil re-use are defined in **Table 11.3**.

Table 11.3: Assessment of magnitude of impacts for physical effects and effects associated with mineral resources, waste soils and soil re-use

Magnitude	Criteria
High	Total loss or major alterations to one of more of the key elements, features or characteristics of the baseline. The situation will be fundamentally different.
Medium	Partial loss or alteration to one of more of the key elements or characteristics of the baseline. The situation will be partially changed.
Low	Minor loss or alteration to one or more of the key elements, features or characteristics of the baseline. The change will be discernible but the underlying situation will remain similar to the baseline.
Very low	Very minor loss or alteration to one or more of the key elements, features or characteristics of the baseline, such that the change will be barely discernible, approximating to the 'no change' situation.

Effect definitions

- 11.3.27 The overall potential significance of physical effects and effects associated with mineral resources, waste soils and soil re-use is defined using the matrix presented below in **Table 11.4**, which describes the relationship between the value/sensitivity of the receptor as defined in **Table 11.2** and the magnitude (change) of the potential impact as defined in **Table 11.3**.
- 11.3.28 Following the classification of an effect, a clear statement is made in the assessment as to whether the effect is 'significant' or 'not significant'. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement is also applied where appropriate.

Table 11.4: Criteria for determining the significance of physical effects and effects associated with mineral resources, waste soils and soil re-use

		Value / Sensitivity of receptor			
		Very low	Low	Medium	High
Magnitude	Very low	Negligible	Negligible	Minor	Minor
	Low	Negligible	Minor	Minor	Moderate
	Medium	Minor	Minor	Moderate	Major
	High	Minor	Moderate	Major	Major

- 11.3.29 Physical effects, and effects associated with mineral resources, waste soils and soil re-use are described as adverse/negative or beneficial/positive, considering the value of the receptor, area over which the impact may occur, whether the impact is direct or indirect, the duration of the impact (short-term: less than 3 years, medium term: less than 3 years but more than 10 years or long-term: greater than 10 years), and whether the impact is permanent or temporary.
- 11.3.30 The classifications of physical effects and effects associated with mineral resources, waste soils and soil re-use are described in **Table 11.5**.

Table 11.5: Classification of effects

Classification	Effect
Major adverse	<p>Major sterilisation of mineral resources from either an active mining/quarrying site or mineral safeguarding area.</p> <p>Major soil erosion, soil compaction or ground instability that is permanent in nature.</p> <p>The generation of major volumes of soils classified as hazardous waste requiring off-site disposal.</p>

Classification	Effect
Moderate adverse	Moderate sterilisation of a mineral resource or mineral safeguarding area. Moderate soil erosion, soil compaction, or ground instability that is either permanent or long-term in nature. The generation of moderate volume of waste requiring off-site disposal.
Minor adverse	Minor sterilisation of a mineral resource or mineral safeguarding area. Limited medium-term soil erosion, soil compaction, or ground instability. The generation of a minor amount of waste soil requiring off-site disposal.
Negligible	No change to a mineral resource or mineral safeguarding area. No measurable impact on soil erosion, soil compaction, waste volumes, or ground instability or impacts that are only temporary in nature (less than three years). No change in contamination risks.
Minor beneficial	Minor improvement in access to a mineral resource potentially facilitating future mineral extraction. Limited medium-term reduction in existing soil erosion, soil compaction, or ground instability issues. A minor amount of materials re-use on-site, thereby reducing off-site disposal volumes.
Moderate beneficial	Moderate improvement in access to a mineral resource facilitating future mineral extraction. Moderate permanent or long-term reduction in existing soil erosion, soil compaction, or ground instability issues. A moderate amount of materials reuse as part of the development, thereby reducing off-site disposal volumes by a significant extent.
Major beneficial	Major improvement in access to a mineral resource facilitating future mineral extraction. Major permanent reduction in existing soil erosion, soil compaction or ground instability issues. Sustainable reuse of materials on-site with no, or only minimal, offsite disposal of waste soils.

ii. Land contamination

11.3.31 The generic EIA methodology as described in **Volume 1 Chapter 6** is not used to consider the effects on land contamination from the proposed development. Instead, the assessment considers the risks to various receptors from land contamination and the change in this risk profile during construction and operation. As such the magnitude of the impact is not determined, being replaced by the change in risk level to the various receptors, which is subsequently used to define the effect.

11.3.32 The assessment of the potential impacts of the proposed development on land contamination has been undertaken over two stages including:

- Stage 1 – a land contamination risk assessment; and
- Stage 2 – a land contamination impact assessment.

Stage 1 – Risk assessment

11.3.33 A Phase 1 Desk Study Report (**Appendix 11A**) was prepared for Yoxford roundabout which sets out the baseline environmental characteristics. The baseline assessment was undertaken using existing data, publicly available information and historical records. This Phase 1 Desk Study Reports also defines the preliminary conceptual site models (PCSMs).

11.3.34 Based on the PCSMs, qualitative risk assessments have been undertaken in accordance with relevant guidance (see **section 11.3.35**), considering the potential sources, pathways and receptors present during the baseline, construction and operational phases and are included in **Appendix 11B**.

11.3.35 To assist in the risk assessment process by helping to determine the consequence of contamination being present, a value/sensitivity has been assigned to each of the contaminated land receptors. The definition of each of these is given in **Table 11.6**.

Table 11.6: Assessment of the value or sensitivity of receptors associated with land contamination

Value / Sensitivity	Criteria	Description
High	<p>Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor.</p> <p>Attribute has a very low capacity to accommodate the proposed change.</p>	<p>Principal aquifer providing potable water to a large population, within an inner or outer groundwater source protection zone (SPZ) (SPZ 1 or SPZ 2).</p> <p>WFD high status water body (surface water) providing potable water to a small population.</p> <p>Sensitive human health receptors, for example young children/other users of residential areas, schools and parks.</p> <p>Buildings, including services and foundations but of high historic value or other sensitivity for example statutory historic designations, schools, residential dwellings.</p> <p>Ecological statutory designations with high sensitivity or international designations for example Special Area of Conservation, Special Protection Area, Ramsar etc.</p> <p>Crops and livestock with a high</p>

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Value / Sensitivity	Criteria	Description
		commercial/economic value.
Medium	<p>Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor.</p> <p>Attribute has a low capacity to accommodate the proposed change.</p>	<p>Principal aquifer beyond an SPZ, secondary aquifer providing single private potable water supplies, abstraction water for agricultural or industrial use.</p> <p>WFD good status water body (surface water).</p> <p>Moderate sensitivity human health receptors, for example commercial/industrial users.</p> <p>Buildings and infrastructure of high regional value or high sensitivity for example schools, hospitals, residential dwellings.</p> <p>Ecological statutory designations with medium sensitivity or national designations for example SSSI, National Nature Reserve, Area of Outstanding Natural Beauty, Marine Conservation Zone, etc.</p> <p>Local geological site or regionally important geological sites.</p> <p>Crops and livestock with a medium commercial/economic value.</p>
Low	<p>Attribute only possesses characteristics which are locally significant.</p> <p>Attribute has some tolerance to accommodate the proposed change.</p>	<p>Secondary aquifer not currently used for groundwater abstraction.</p> <p>WFD moderate status (surface water).</p> <p>Less sensitive human health receptors, for example construction workers using mitigation measures.</p> <p>Buildings and infrastructure of local importance or low sensitivity (commercial/industrial buildings, main roads, railways).</p> <p>Ecological statutory designations with low sensitivity or sites with local designations for example local nature reserve.</p> <p>Crops and livestock with a low commercial/economic value.</p>
Very low	<p>Attribute characteristics do not make a significant contribution to local character or distinctiveness.</p> <p>Attribute is generally tolerant and can accommodate the proposed change.</p>	<p>Non-productive strata (groundwater).</p> <p>WFD poor status (surface water).</p> <p>No sensitive human receptors.</p> <p>Locally important infrastructure (local roads, bridges, footpaths).</p>

Value / Sensitivity	Criteria	Description
		Land with low sensitivity and/or non-statutory designations. No crop or livestock receptors.

11.3.36 The risk assessment then applies the principles given in the National House Building Council and Environment Agency report R&D66 and CIRIA C552 which provide guidance on the preparation and application of the consequence and probability matrix (as presented in **Table 11.7**) for contaminated land risk assessment.

11.3.37 The potential risk to a receptor is a function of the probability and the consequence of a PCL being realised. Probability (likelihood of an event occurring) takes into account both the presence of the hazard and the receptor and the integrity of the exposure pathway. Consequence takes into account both the potential severity of the hazard and the value/sensitivity of the receptor. Definitions of probability, consequence and the classified risks adopted for this assessment are detailed in **Volume 1 Appendix 6N**.

Table 11.7: Land quality estimation of the level of risk by comparison of consequence and probability

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

11.3.38 The descriptions of the classified risks and likely action required as given in R&D66 are detailed in **Volume 1 Appendix 6N**.

Stage 2 – Impact assessment

11.3.39 The impact assessment has been undertaken by comparing the baseline risk assessments with the construction and operational phase risk assessments. This approach enables changes in the contaminated land status during the various phases to be identified and recorded.

Effect definitions

11.3.40 The effects of the proposed development are described as adverse/negative or beneficial/positive and major, moderate, minor or negligible on the basis of **Table 11.8**.

Table 11.8: Classification of effects

Classification	Effect
Major adverse	An increase in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Moderate adverse	An increase in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part IIA.
Minor adverse	An increase in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate to low risk.
Negligible	No change in contamination risks.
Minor beneficial	A reduction in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a moderate to low contamination risk in the baseline becomes a low risk.
Moderate beneficial	A reduction in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate to low or low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.
Major beneficial	A reduction in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part IIA.

11.3.41 Following the classification of an effect as presented in **Table 11.8**, a clear statement is made as to whether the effect is 'significant' or 'not significant'. Major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant.

11.3.42 It should be noted that, given the information known at the time of writing, professional judgement has been applied in certain circumstances where the introduction or removal of a receptor has automatically triggered a minor adverse or minor beneficial effect.

g) Assessment methodology

11.3.43 Detailed assessment methodologies for geology and land quality are presented in **Volume 1 Appendix 6N**. A summary is provided in the following sections.

i. General approach

11.3.44 The approach to the geology and land quality assessment comprises:

- establishing the baseline conditions for the study area with respect to geology, ground stability, hydrology, hydrogeology, contaminated land (including the potential for unexploded ordnance and ground gases) and historical uses;
- identification of potential impacts on identified resources and receptors from the construction and operation phases of the proposed development;
- assessment of the significance of likely effects from the proposed development including the consideration of mitigation measures; and
- identification of any residual effects and secondary mitigation where required.

ii. Establishing the baseline

11.3.45 The baseline assessment for the proposed Yoxford roundabout site has relied on existing data, previous desk study and historical records. The following sources have been reviewed:

- historical mapping and additional environmental information including historical landfill information and contemporary trade directories provided in an Envirocheck report, which is appended to the Yoxford roundabout Phase 1 Desk Study Report (**Appendix 11A**);
- publicly available information from the British Geological Survey (BGS) (Ref. 11.25) online mapping resource;
- Suffolk County Council Minerals Local Plan (Ref. 11.26);
- Suffolk Biodiversity Information Service website (Ref. 11.27);
- publicly available information from the Department of Environment, Food and Rural Affairs Multi-Agency Geographic Information for the Countryside (MAGIC) website (Ref. 11.28);

- the Yell website (Ref. 11.29); and
- Zetica online UXO risk maps (Ref. 11.30).

iii. Assessment of effects

11.3.46 An assessment of the potential physical effects of the proposed Yoxford roundabout on geology and the effects associated with soils re-use and waste soils has been undertaken using a qualitative approach considering the effects on soil erosion, mineral resources, the potential for soil re-use and waste soil generation in accordance with methods outlined in the section above.

11.3.47 The assessment of the potential effects of the construction and operation phases of the proposed Yoxford roundabout on land contamination has been undertaken in accordance with the methodology.

h) Assumptions and limitations

11.3.48 The following assumptions have been made in this assessment:

- all assessment considers development within the site parameters as set out in the description of development in **Chapter 2** of this volume of the **ES** and as illustrated on the **Work Plans** reproduced in **Appendix 2B** of this volume;
- stockpiling of materials during construction (where required) would stay on the land within the site boundary;
- vegetation, topsoil and potentially subsoil would be stripped in accordance with the **Outline Soil Management Plan (Volume 2, Appendix 17C)**; and
- for the operational phase assessment, it has been assumed that all primary, tertiary and secondary mitigation measures proposed for construction have been adopted/implemented.

11.3.49 The following limitations have been identified:

- ground investigation data is not available for the site and the baseline has been prepared using BGS mapping.

11.4 Yoxford Roundabout

a) Baseline environment

11.4.1 This section presents a description of the baseline environmental characteristics within the study area. Further detail can also be found in **Appendix 11A**.

i. Current baseline

Site visit

11.4.2 A site visit was undertaken during March 2019 to gain further information on the site setting and study area, to consider the context of the site, and to support the desk study mapping and aerial photographs. Additionally, it was an opportunity to identify potential visual or olfactory contamination present at the site at the time of the visit.

11.4.3 The site was noted to comprise the existing A12 and B1122 roads and an area of agricultural land. No ground hazards or evidence of contamination were observed during the site visit. Further details on observations made during the site visit including photographs can be found in the Phase1 Desk Study Report (**Appendix 11A**).

Site history

11.4.4 **Table 11.9** summarises the key historical land use information for the study area. This has been compiled using an Envirocheck report (included in **Appendix 11A**).

Table 11.9: Historical development of the site

Map Date	Key Contamination Sources On-Site	Key Contamination Sources in Study Area
1884 (1:2,500)	The majority of the site is shown as open fields with an unnamed road (current Main Road/A12) located along the western boundary and a further unnamed road (in the current position of Middleton Road) located along the southern boundary.	The village of Yoxford is present adjacent to the west of the site. Pins Wood is present adjacent to the south-west of the site and The Rookery (parkland) is present 270m to the south-east of the site.
1884 / 1885 (1:10,560)		The East Suffolk line is located approximately 250m east of site running north to south.
1904 (1:2,500) & 1905 (1:10,560)	No substantial changes.	No substantial changes.

Map Date	Key Contamination Sources On-Site	Key Contamination Sources in Study Area
1927 (1:2,500) & 1928 (1:10,560)	No substantial changes.	The Cottage is present 20m south of the site. The Rookery is now labelled Rookery Park. A dam and a septic tank are labelled 50m and 200m south of the site within Rookery Park.
1950 / 1951 (1:10,560)	The roads to the west and south are now labelled as the A12 and B1122 respectively.	No substantial changes.
1957 / 1958 (1:10,000)	No substantial changes.	No substantial changes.
1976-1978 (1:2,500)	Road embankments are shown adjacent to the northern carriage way of the A12.	The area to the east of site has undergone some development and the sewage works and The Piggeries are now labelled 100m to the east and north-east.
1982-1984 (1:10,000)	The western road is now labelled as the A12 (T).	No substantial changes.
1988 (1:2,500) & 1991 (1:10,000)	No substantial changes.	No substantial changes.
1995 (1:2,500)	No substantial changes.	No substantial changes.
2000 (1:2,500) & 2000 (1:10,000)	No substantial changes.	A coal yard is identified 250m north of site, adjacent to the A12.
2006 (1:10,000)	No substantial changes.	No substantial changes.
2018 (1:10,000)	No substantial changes.	A pond is located in the agricultural fields between the north-eastern site boundary and The Piggeries. The coal yard is no longer labelled, and historical BGS logs for this area refer to the site as a former coal yard.

Geology

- 11.4.5 Made Ground is not shown on the BGS online mapping, however the areas adjacent to the existing roads have the potential to include Made Ground. Due to the nature of the site there is the potential for fly tipping as well as the potential for farmers tips, the constituents of which will be unknown.

- 11.4.6 The BGS website indicates that the majority of the site has no recorded superficial deposits. Approximately 20% of the northern section of the site is underlain by superficial deposits of the head formation, which comprises of clay, silt, sand and gravel.
- 11.4.7 According to the BGS website, bedrock geology beneath the site comprises sand of the Crag Group, which comprises a suite of shallow-water marine and estuarine sands, gravels, silts and clays. There are no geological faults features located on or within the study area.
- 11.4.8 The Envirocheck report (included in **Appendix 11A**) indicates that there is either no hazard or very low potential for collapsible ground stability hazards, compressible ground stability hazards, ground dissolution stability hazards and landslide ground stability hazards. A low potential for running sand and for shrinking or swelling clay stability hazards are indicated.
- 11.4.9 Borehole logs which are available from the BGS website have identified three areas of borehole coverage within the study area, as summarised in the below:
- Former coal yard – Eight window samples were drilled in 2005 within the former coal yard located 250m north of the site to a maximum depth of 4 metres below ground level (m bgl). The logs indicate the underlying geology in this area comprises Made Ground (brown/dark green silty sand) to a maximum depth of 1.1m bgl overlying the Crag Group bedrock (fine-coarse sand). Groundwater was not recorded as being present in the eight boreholes.
 - Test pumping at the piggeries (BGS reference TM46NW27) – A single pumping borehole was drilled approximately 10m north-east of the site. Ground conditions generally comprised topsoil from ground level to 0.2 m bgl, overlying sand from 0.2m to 15.5m bgl, overlying grey clay with silt from 15.5m to 16.5m bgl and green sand and shells from 16.5m to 31.5m bgl. Groundwater was recorded at 4.4m bgl, with a pumping rate of 3m³/hr for a single day.
 - Land at Shean – Nine trial pits were excavated in 2002 approximately 500m south-west of the site to a maximum depth of 1.1m bgl, with chemical soil tests undertaken at each location. The chemical data was not available as part of the log for review. Hydrocarbon odours were identified in one trial pit (TM36NE44). Made Ground of light brown/orange silty sandy topsoil was recorded at each location. Groundwater was not recorded in any of the trial pits.

Mineral extraction

- 11.4.10 The Envirocheck report (included in **Appendix 11A**) indicates that the site is in an area that is unlikely to be affected by mining for coal or other mineral resources.
- 11.4.11 The historical map review identified a coal yard 250m north of site. However, the site is listed as a former coal yard in historical borehole logs and appears to have been small scale in nature. The nature of the activities conducted at this site are unknown but do not appear in the Coal Authority's maps and therefore the area is likely to have been used for storage of materials rather than an extraction site.
- 11.4.12 There are no historical extractive activities listed within 500m of the site within the Envirocheck report (included in **Appendix 11A**). The Suffolk County Council Minerals Local Plan also indicates that there are no planned areas of mineral extraction within the study area.

Local geological sites

- 11.4.13 According to mapping on the Suffolk Biological Records Centre website the study area is not located within a geological SSSI or a local geological site.

Hydrogeology

- 11.4.14 The small section of superficial head deposits in the north of the site are classified by the Environment Agency as a secondary (undifferentiated) aquifer⁵.
- 11.4.15 According to MAGIC and the Envirocheck report (included **Appendix 11A**), the Crag Group bedrock underlying the site is classified as a principal aquifer⁶. The study area does not lie within or adjacent to a SPZ.
- 11.4.16 The Envirocheck report indicates that there are two licensed groundwater abstractions for wells located at The Limes and Rookery Park approximately 100m west and 300m south of the site. The licences are for the abstraction of groundwater within the Crag Group for general farming and domestic use.

⁵ Secondary Undifferentiated Aquifers have been classified where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type

⁶ Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

- 11.4.17 There is the potential for unknown private water supplies to be in use within the study area. Should any private water supplies exist, they would likely be associated with the farm buildings and residential properties in the study area.
- 11.4.18 Further baseline hydrogeology information for the site is provided in **Chapter 12** of this volume.

Hydrology

- 11.4.19 A single small pond is located approximately 10m to the north-east of the site. The pond is visible on current ordnance survey mapping and aerial photographs included in the Envirocheck report (included in **Appendix 11A**). However, the water level within the pond appears to be variable with different water levels indicated on historical and current aerial photographs.
- 11.4.20 The River Yox, a tributary of the Minsmere River, is present adjacent to the north of the site. An unnamed tributary of the River Yox is located 100m to the east of the site. Drains associated with this river and the lake at Rookery Park are present 250m to the south of the site, as well as an unmarked water body associated with the Yoxford sewage works.
- 11.4.21 The Envirocheck report indicates that there is one surface water abstraction located 240m to the east of the site. The licence is for the abstraction of water from the Minsmere 'New Cut' River for general agriculture spray irrigation use.
- 11.4.22 The Envirocheck report (included in **Appendix 11A**) indicates that there have been three recorded pollution incidents within the study area, as follows:
- A category 3 (minor incident) was recorded 141m north of site on 23 February 1998 involving the accidental spillage/leakage of oil (diesel including agricultural) into a tributary of the River Yox;
 - A category 3 (minor incident) was recorded 236m north of site on 9 January 1996 involving an accidental spillage/leakage of oil (diesel including agricultural) into a tributary of the River Yox; and
 - A category 2 (significant incident) involving an unknown pollution incident into the River Yox was recorded 417m west of site on 17 December 1992.
- 11.4.23 Further consideration of the hydrology of the site is provided in **Chapter 12** of this volume.

Flood risk

- 11.4.24 The majority of the site is located in Flood Zone 1, and therefore has a low risk of flooding from tidal or fluvial sources. The northern extent of the site in the area of the A12 bridge over the River Yox is located in Flood Zone 2. Risks associated with groundwater, sewer and reservoir flooding at the site are also considered to be low.
- 11.4.25 The Environment Agency's long-term flood risk mapping shows that the majority of the site is also at very low risk of flooding from surface water. However, there are two areas of surface water flood risk identified within the site. These include an area of low risk on the B1122 at the eastern extent of the site and another area at high risk is located on the A12 at the western extent of the site.
- 11.4.26 Further details on flood risk are provided in the **Yoxford Roundabout and Other Highway Improvements Flood Risk Assessment** (Doc. Ref. 5.7).

Historic and environmentally sensitive sites

- 11.4.27 Twelve Grade II listed buildings are located within the study area. Two are Grade II* (Church of St Mary and St Andrew) and the remaining ten are Grade II and generally relate to buildings within the villages of Stratford St Andrew and Farnham and are located within Yoxford conservation area.
- 11.4.28 The MAGIC website indicates that the site lies within a surface (Leiston Beck and Minsmere Old River nitrate vulnerable zone and groundwater (Yoxford) nitrate vulnerable zone).
- 11.4.29 No statutory ecological designations have been recorded within the study area. However, a non-statutory designated ecological site is located adjacent to the site and is designated for a rare species of fungi (sandy stilt puffball).
- 11.4.30 Further consideration of designated sites, for ecology and historic environment both statutory and non-statutory is given in **Chapter 7** and **Chapter 9** of this volume respectively.

Waste management and other permitted sites

- 11.4.31 The Envirocheck report (included in **Appendix 11A**) confirms that there are none of the following within 500m of the site:
- historic landfill sites;
 - authorised landfill sites;

- waste transfer sites;
- Control of Major Accident Hazards sites;
- explosive sites;
- notification of installations handling hazardous substances;
- planning hazardous substance consents; and
- planning hazardous substance enforcements.

Service Stations

11.4.32 According to the Envirocheck report and the Yell website there are no service stations on or within the study area.

Industrial and other potentially contaminative land uses

11.4.33 The Envirocheck report (included in **Appendix 11A**) indicates that there are no active trade establishments that have the potential to use contaminants of concern in their processes on or within 500m of the site. However, it is noted that the site is currently used as a road and for agricultural purposes and there are several farms including The Piggeries and a sewage works present within the study area which have the potential to use contaminants of concern.

Potential for UXO

11.4.34 A Zetica UXO map was obtained to assess the risk of encountering UXO at the proposed development. The map indicates that the site is within an area with a low risk of encountering UXO.

Previous Investigations

11.4.35 There have been no previous ground investigations undertaken at the site.

ii. Future baseline

11.4.36 There are two committed developments which have been identified within the study area as summarised in **Table 11.10**.

Table 11.10: Committed developments

Planning Application Ref.	Site Address	Description of Development	Date of Approval	Status	Distance (m)
DC/16/2077/OUT	Cavan Cottage High	New additional detached three bed	07/12/2016	Construction not	79

Planning Application Ref.	Site Address	Description of Development	Date of Approval	Status	Distance (m)
	Street Yoxford Saxmundham Suffolk IP17 3EU	dwelling within the curtilage of Cavan Cottage		commenced	
DC/18/1394/FUL	Beaubelle, Part Side Garden Westleton Road Yoxford IP17 3LD	Construction of two new two storey private residential dwellings with upgraded vehicular access, parking & turning area.	26/08/2016	Construction not commenced	276

11.4.37 The construction timeline for these committed developments is unconfirmed. However, planning permissions generally require construction to commence within three years of the grant of planning permission or reserved matters upon which the planning permission lapses. As such and for the purposes of this assessment, it has been assumed, given the nature and scale of the applications, that the developments will have been constructed prior to 2022. These committed developments have therefore been considered as future receptors as part of the baseline for the land contamination risk assessments and within the assessment of physical effects and effects associated with mineral resources, soils re-use and waste soils.

iii. Preliminary Conceptual Site Model

11.4.38 A PCSM identifies the potential or known sources of contamination, receptors and pathways between the two. Where all three are present or are considered likely to be present (source-pathway-receptor linkage), they are called a PCL.

11.4.39 Three PCSMs (baseline, construction, and operational) have been produced for the proposed Yoxford roundabout using the information summarised above. A summary of potential contamination sources is provided in **Table 11.11** and a summary of potential pathways and receptors identified is provided in **Table 11.12**.

Table 11.11: Existing potential sources of contamination for the proposed development

Potential Source of Contamination	Potential Contamination	Approximate Location
Made Ground associated with the construction of the existing roads including A12 and B1122 as well as	A range of inorganic and organic contaminants including polycyclic aromatic hydrocarbons (PAHs), coal	On-site

NOT PROTECTIVELY MARKED

Potential Source of Contamination	Potential Contamination	Approximate Location
activities associated with their operation.	tars, asbestos and ground gases. Fuels and oils attributed to spills from vehicles on the roads included within the site boundary, plus exhaust particulates.	
Farmland within site boundary. Potential for unmapped farmers tips.	Risk of inorganic and organic contamination including metals and hydrocarbons, polychlorinated biphenyls (PCBs), asbestos, herbicides, pesticides, silage, effluent, and fuel/engine oils.	
Sewage works (approximately 100m east of the site boundary). Historic septic tank 200m south.	Metals, organic contaminants including biological contaminants.	Off-site
Farms (including The Piggeries) within 500m of the site. Potential for unmapped farmers tips/soakaways.	Risk of inorganic and organic contamination including herbicides, pesticides, silage effluent, and fuel/engine oil.	
Made Ground associated with the construction of the roads extending off-site including the A12 and B1122 as well as activities associated with their operation.	A range of inorganic and organic contaminants including PAHs, coal tars, asbestos and ground gases. Fuels and oils attributed to spills from vehicles on the roads included within the site boundary, plus exhaust particulates.	
East Suffolk line approximately 250m east of the site.	A range of inorganic and organic contaminants including hydrocarbons, PCBs, PAHs, solvents and creosote, metals and ash and fill used in the construction of the railway.	
Former coal yard 250m north of the site.	A range of inorganic and organic contaminants including the potential for asbestos associated with the Made Ground present and spills and leaks, etc.	

Table 11.12: Potential receptors and contaminant exposure and migration pathways at baseline and resulting from the proposed development

Receptor Group	Receptor	Principal Contaminant Migration Pathways
Human health (on-site).	Construction/maintenance workers.	Dermal contact with and ingestion of contaminants in soils, soil-derived dusts and water; and inhalation of soil-derived dust, fibres, gas and vapours.
	Current pedestrians and road users using existing roads and footpaths within the site.	

Receptor Group	Receptor	Principal Contaminant Migration Pathways
	<p>Pedestrians and road users using future roads, roundabout and footpaths within the site.</p> <p>Farmers and workers on agricultural land.</p>	
Human health (off-site).	<p>Farmers on adjoining agricultural land.</p> <p>Pedestrians accessing surrounding roads and footpaths.</p> <p>Occupants of nearby residential and commercial properties.</p>	<p>Dermal contact with and ingestion of contaminants in soil-derived dusts and water that may have migrated off-site; and inhalation of soil-derived dust, fibres, gas and vapours which may have migrated off-site.</p>
Controlled waters: groundwater (on-site and off-site).	<p>Groundwater in principal bedrock aquifer.</p> <p>Groundwater in secondary undifferentiated superficial aquifer.</p>	<p>Leaching of contaminants in soil to groundwater in underlying aquifers; and migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.</p>
Controlled waters: surface waters (off-site).	<p>Surface water bodies including ponds, River Yox, ditches and drains off-site.</p>	<p>Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow; and discharge of contaminants entrained in groundwater and/or surface water run-off followed by overland flow and discharge.</p>
Property (on-site and off-site).	<p>Existing on-site services and structures on-site and off-site including listed buildings.</p> <p>Proposed on-site services and structures.</p>	<p>Direct contact of contaminants in soil and/or groundwater with existing and proposed structures and buried services; and migration of contaminated groundwater, ground gas and/or vapours along strata and preferential pathways such as service routes or differentially permeable strata.</p>
	<p>Crops and livestock.</p>	<p>Direct contact, ingestion, inhalation and uptake of soil and water contamination by crops and/or livestock; and migration of contaminated waters/dust/fibres and subsequent uptake by crops or ingestion/inhalation/dermal contact by livestock.</p>
Ecological receptors (off-site).	<p>Non-statutory designation for fungi: sandy stilt puffball.</p>	<p>Migration of contaminated waters/dust/fibres and subsequent uptake by fungi.</p>

b) Environmental design and mitigation

11.4.40 As detailed in **Volume 1, Chapter 6**, a number of primary mitigation measures have been identified through the iterative EIA process and have been incorporated into the design and construction planning of the proposed development. Tertiary mitigation measures are legal requirements or are standard practices that would be implemented as part of the proposed development.

11.4.41 The assessment of likely significant effects of the proposed development assumes that primary and tertiary mitigation measures are in place. For geology and land quality, these measures are identified below, with a summary provided on how the measures contribute to the mitigation and management of potentially significant environmental effects.

i. Primary mitigation

11.4.42 Primary mitigation is often referred to as ‘embedded mitigation’ and includes modifications to the location or design to mitigate impacts; these measures become an inherent part of the proposed development.

11.4.43 Primary mitigation measures for the proposed development would include:

- the design of the roundabout and highways realignment, as well as selection of construction materials, would be in accordance with the DMRB, British Standards and best practice guidance at the time of the design. The design would be required to take into account the ground conditions including the potential for ground movement, compaction, ground gas and ground aggressivity; and
- the use of appropriate drainage systems in accordance with the **Drainage Strategy (Volume 2, Appendix 2A)** to reduce the potential for contamination to migrate and impact on the ground, ground waters and surface waters. This would include the use of SuDS and bypass separators for the removal of hydrocarbon contaminants where necessary, to protect the ground and underlying groundwater and separate out oils/hydrocarbons for suitable off-site disposal.

ii. Tertiary mitigation

11.4.44 Tertiary mitigation will be required regardless of any EIA assessment, as it is imposed, for example, as a result of legislative requirements and/or standard sectoral practices.

11.4.45 Tertiary mitigation measures to be incorporated into the proposed Yoxford roundabout during the construction phase, as set out in the **CoCP** include:

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- prior to stockpiling or other groundworks, topsoil present would be removed and appropriately stored for potential re-use in landscaping areas, subject to demonstrating suitability for reuse criteria. This process would reduce the potential for buried topsoil to generate ground gas beneath the proposed Yoxford roundabout which may pose a risk to human health;
- development of health and safety risk assessments and method statements by the contractor (including emergency response procedures), and provision of appropriate personal protective equipment for the protection of construction workers;
- implementation of a contamination watching brief by suitably qualified and experienced personnel would be completed for the proposed development when excavating areas of potential contamination risk. If unidentified contamination is encountered, works will be temporarily suspended in the area and appropriate investigations and remediation will be discussed and agreed with stakeholders and completed in accordance with current best practice;
- implementation of appropriate dust suppression measures to reduce migration of contaminated dust, further details are provided in the air quality chapter (**Chapter 5**);
- minimising the area and duration of soil exposure and timely reinstatement of vegetation or hardstanding to reduce soil erosion and reduce temporary effects on soil compaction;
- stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) to reduce windblown dust and surface water run-off;
- clear segregation between stockpiled material including imported material, excavated material stockpiled for re-use and excavated waste material stockpiled for treatment and/or off-site disposal;
- stockpiles would be located a minimum of 10m from the nearest watercourse;
- implementation of working methods during construction to ensure that surface water run-off from the works, stockpiles or working area is minimised and captured prior to entry into adjacent surface watercourses or leaching into underlying groundwater in accordance with best practice;

- implementation of appropriate pollution incident control e.g. plant drip trays and spill kits and suitable training and toolbox talks completed; and
- implementation of appropriate and safe storage of fuel, oils, chemicals and equipment during construction in accordance with the control of substances hazardous to human health regulations and oil storage regulations.

11.4.46 Additional tertiary mitigation that would be anticipated and referenced in the **CoCP** includes:

- implementation of an appropriate materials management strategy to document how the excavated materials would be dealt with via materials management plan(s) and verification report(s) to record the excavation and placement of materials at the site. Further details are provided in the **Materials Management Strategy** provided in **Appendix 3B** of **Volume 2** of the **ES**;
- implementation of a site waste management plan in accordance with the **Conventional Waste Management Strategy** provided in **Appendix 8A** of **Volume 2** of the **ES**; and
- implementation of an **Outline Soil Management Plan** provided in **Appendix 17C** of **Volume 2** of the **ES**;
- storage and disposal of wastes and hazardous substances where required would be managed in accordance with current guidance and legislative requirements.

c) [Assessment](#)

i. [Introduction](#)

11.4.47 This section presents the findings of the geology and land quality assessment for the construction and operation phases of the proposed development.

11.4.48 This section identifies any likely significant effects that are predicted to occur and **section 11.4 d)** highlights the secondary mitigation and monitoring measures that are proposed to minimise any adverse significant effects (if required).

ii. Construction

Physical effects: Soil erosion

- 11.4.49 A qualitative approach has been undertaken to assess the likely physical effects of the proposed development. The effects have then been categorised in accordance with the methodology outlined in **Volume 1, Appendix 6N**, and summarised in **section 11.3**, and confirmed as either adverse or beneficial, and **significant** (moderate or major effects) or **not significant** (minor or negligible).
- 11.4.50 The construction phase of the proposed Yoxford roundabout may result in soil erosion associated with stripping of topsoil, vegetation clearance, stockpiling, earthworks and construction of new infrastructure and landscaping.
- 11.4.51 Earthworks, including areas for temporary works, are anticipated for the construction of the proposed Yoxford roundabout and topsoil and potentially subsoil may be stored in temporary stockpiles on the site during construction works.
- 11.4.52 There is therefore the potential for increased soil erosion and surface water runoff with a high sediment load which may impact local surface waters. Earthworks would be managed in accordance with the **CoCP** to minimise soil exposure as far as practicable and areas required for temporary works during the construction phase would be reinstated as soon as possible when they are no longer required. Stockpiles would be managed in accordance within primary and tertiary measures set out in **section 11.5** to reduce soil erosion and dust generation by management practices which may include water spraying and hydroseeding. The impacts on soil erosion during the construction phase are therefore considered to be temporary, short-term, and direct.
- 11.4.53 Given that there are limited soil erosion hazards at the site, the value/sensitivity of the receptor is classed as low. With the primary and tertiary mitigation measures set out in **section 11.5** the magnitude of the impact is considered to be very low. The overall effect is therefore considered to be negligible and **not significant**.

Mineral resources

- 11.4.54 A qualitative approach has been undertaken to assess the likely effects of the proposed Yoxford roundabout on mineral resources in accordance with the methodology outlined in **Volume 1, Appendix 6N** and summarised in **section 11.3**.

- 11.4.55 The proposed Yoxford roundabout has the potential to impact upon mineral resources and associated mineral safeguarding areas through the loss, damage or sterilisation of an important mineral resource.
- 11.4.56 The baseline assessment indicates that the site and study area is not located within a coal mining area. A coal yard is located 250m north of the site. However, it is considered that this premise is likely to have been used for storage of materials rather than an extraction site. The site and study area are also not located within an area of historical or planned mineral extraction or a minerals safeguarding area. Therefore, there would be a limited impact on the regional mineral resources from the proposed Yoxford roundabout. The impacts on mineral resources during the construction phase are therefore considered to be temporary, short-term and direct.
- 11.4.57 Given that there are no protected mineral resources and no previous extraction located within the study area, the value/sensitivity of the receptor is classed as very low. The magnitude of the impact is considered to be very low as there would be limited loss of regional mineral resources.
- 11.4.58 The overall effect is therefore considered to be negligible and classed as **not significant**.

Effects associated with ground contamination

- 11.4.59 The construction PCSM and risk assessment are presented in **Appendix 11B** and the impact assessment in **Appendix 11C**. The construction impact assessment is undertaken by comparing the baseline land contamination risks to those predicted during construction, while considering any new sources and pollution pathways introduced by construction activities.
- 11.4.60 The construction phase would potentially introduce new sources of contamination and disturb and mobilise existing sources of contamination. Construction activities, such as excavation may introduce new pathways for migration of existing contamination and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off and ground gas migration. Potential changes to the baseline situation creating PCLs, which have been assessed within this chapter are:
- the potential for mobilising contaminants by excavation and stockpiling of material, increasing the risk to controlled water receptors through leaching and run-off. Earthworks could provide opportunities for run-off to contain suspended solids if not carried out in line with required management procedure;

- the potential for introducing new sources of contamination i.e. from spillages and leaks;
- the potential for exposure of human receptors by generation of potentially contaminated dust and vapours released by the construction works; and
- the potential for creation of new pathways to groundwater during groundworks, through opening up ground temporarily and construction activities, such as earthworks, installation of drainage and other below-ground services and foundations.

11.4.61 The impacts on land contamination are considered to be permanent, and direct. Primary and tertiary mitigation measures would be incorporated into the construction process as outlined in **section 11.4 b)**. These would include the adoption of working methods during construction to manage groundwater appropriately, implementation of appropriate pollution incident control and implementation of appropriate and safe storage of fuel, oils and equipment.

11.4.62 A summary of the construction phase PCSM and impact assessment is provided in **Table 11.13**, and includes the risks identified to the receptors. A more detailed assessment of construction risk and impact assessment is provided in **Appendices 11B** and **11C**.

11.4.63 It is considered that with the primary and tertiary mitigation measures adopted, the risks identified to human health, controlled waters and property receptors during construction would range between very low and moderate/low. Compared to the existing baseline, the level of risk to receptors has generally remained the same or increased during the construction phase. An overall negligible to minor adverse effect has therefore been predicted, which is classed as **not significant**.

Table 11.13: Construction phase effects for the proposed development

Receptor	Value / Sensitivity	Baseline Risk	Construction Risk	Classification of Effect
Human (on-site)	High	Low	Low	Negligible (not significant)
Human (off-site)	High	Very low	Very low	Negligible (not significant)
Controlled waters: groundwater (on-site and off-site)	Medium	Low	Moderate / low	Minor adverse (not significant)
Controlled waters: surface	Low	Very low	Very low	Negligible (not

Receptor	Value / Sensitivity	Baseline Risk	Construction Risk	Classification of Effect
water (off-site)				significant)
Property: existing and future structures and services (on-site and off-site)	Medium	Very low	Very low	Negligible (not significant)
Property: crops and livestock (on-site and off-site)	Medium	Very low	Very low	Negligible (not significant)
Ecological receptors (sandy stilt puffball: off-site fungi)	Medium	Very low	Very low	Negligible (not significant)

Effects associated with waste soils and soil re-use

- 11.4.64 Waste soils would be generated during construction through excavations and the installation of drainage/services. There is the potential that waste soil generated from the earthworks and roundabout and road construction is classified as geo-technically and/or chemically unsuitable for reuse on-site or hazardous, therefore requiring removal from site. Waste soils would be dealt with in accordance with the **Waste Management Strategy** presented in **Appendix 8A** of **Volume 2** of the **ES**.
- 11.4.65 A materials management plan would set out how material is managed on-site during construction in accordance with appropriate guidance such as the Contaminated Land: Applications in Real Environments Development Industry Code of Practice (Ref. 11.12), to allow the sustainable re-use of suitable soils during the construction of the proposed Yoxford roundabout. An **Outline Soil Management Plan** provided in **Appendix 17C** of **Volume 2** of the **ES**, would also be implemented to manage the reinstatement of agricultural land.
- 11.4.66 In line with the waste hierarchy, the design would seek, as far as reasonably practicable, to reduce the amount of soil/materials excavated and/or of a hazardous nature, to reuse and recycle waste soils/materials on-site where possible and to manage soils/materials suitably including off-site disposal of waste, if required, in accordance with relevant legislation. Therefore, the impacts on waste soils and soil re-use during the construction stage are considered to be temporary, short-term and direct.
- 11.4.67 Given that Made Ground is likely to be limited or absent at the proposed Yoxford roundabout, the value/sensitivity of the receptor is classed as medium. With the primary and tertiary mitigation measures, the magnitude

of the impact is considered to be very low. The overall effect is therefore considered to be minor adverse and therefore **not significant**.

Inter-relationship effects

- 11.4.68 This section provides a description of the identified inter-relationship effects that are anticipated to occur on geology and land quality receptors between the individual environmental effects arising from construction of the proposed development.
- 11.4.69 There are anticipated to be inter-relationship effects between geology and land quality, soils and agriculture, ecology, heritage and groundwater and surface water in relation to potential receptors which could be impacted by ground contamination during the construction of the proposed Yoxford roundabout.
- 11.4.70 Potential impacts include the contamination of sensitive/high value receptors such as good quality or best and most versatile agricultural land, SSSIs, listed buildings, principal aquifers, WFD rivers and groundwater SPZs during construction works. Construction activities may introduce new sources of contamination, new pathways for migration of contamination and disturb and mobilise existing sources of contamination.
- 11.4.71 However, given the primary and tertiary mitigation measures proposed in relation to these disciplines as outlined in **section 11.5**, it is not expected that the combined impact of these inter-relationship effects would be greater than those effects predicted for the geology and land quality assessment as presented within this chapter. Only minor adverse inter-relationship effects are anticipated, which are classified as **not significant**. Further details are provided in **Chapter 10** and **Chapter 12** of this volume.

iii. Operation

Physical effects: Soil erosion

- 11.4.72 Physical effects are considered to be mainly related to the construction phase. During operation, there would be limited effects on soil erosion through maintenance operations. Suitable design and subsequent maintenance works would also minimise physical effects and the proposed Yoxford roundabout would be operated in accordance with the relevant regulations and best practicable measures. The impacts on soil erosion during the operational phase are therefore considered to be temporary, short-term, and direct.
- 11.4.73 Given that there are limited soil erosion hazards at the site and hazards will be mitigated during the construction phase, the value/sensitivity of the

receptor is classed as low. With the primary and tertiary mitigation measures the magnitude of the impact is considered to be very low. Therefore, it is considered that physical effects would remain as negligible and are classed as **not significant**.

Mineral resources

- 11.4.74 Effects in relation to mineral resources during the operation phase relate to the permanent sterilisation/loss of minerals, preventing future extraction. The impacts on mineral resources during the operational phase are therefore considered to be permanent and direct.
- 11.4.75 Given that there are no protected mineral resources and no previous mineral extraction located within the study area, the value/sensitivity of the receptor is classed as very low. The magnitude of the impact from the operation of the proposed Yoxford roundabout is considered to be very low as there would be limited loss of regional mineral resources. Effects in relation to loss, damage or sterilisation of mineral resources would be considered as negligible and are classed as **not significant**.

Effects associated with ground contamination

- 11.4.76 The operational PCSM and risk assessment are presented in **Appendix 11B** and the impact assessment in **Appendix 11C**. The operational impact assessment has been undertaken by comparing the baseline land contamination risks to those predicted during operation, while considering any new sources and pollution pathways introduced by operational activities.
- 11.4.77 The operation of the proposed development would potentially introduce new sources of contamination. Spillages and leaks may occur and below ground services could create additional potential pathways for the migration of potential contamination that were not present at baseline. The impacts on land contamination during the operational phase are considered to be permanent and direct.
- 11.4.78 A summary of the operation phase contamination effects is provided in **Table 11.14**. A more detailed assessment of operational risk and impact assessment is provided in **Appendices 11B** and **11C**. It is considered that with proposed mitigation, risks identified to human health, controlled waters, property receptors during operation are assessed as very low to moderate/low. Compared to the existing baseline, the level of risk to receptors has generally remained the same or slightly decreased. An overall negligible to minor beneficial effect is therefore anticipated which is classed as **not significant**.

Table 11.14: Operational phase effects for the proposed development

Receptor	Sensitivity / Value	Baseline Risk	Operation Risk	Classification of Effect
Human (on-site).	High	Low	Very low	Minor beneficial (not significant)
Human (off-site).	High	Very low	Very low	Negligible (not significant)
Controlled waters: groundwater (on-site and off-site).	Medium	Low	Very low	Minor beneficial (not significant)
Controlled waters: surface water (off-site).	Low	Very low	Very low	Negligible (not significant)
Property: existing and future structures and services (on-site and off-site).	Medium	Very low	Very low	Negligible (not significant)
Property: crops and livestock (on-site and off-site).	Medium	Very low	Very low	Negligible (not significant)
Ecological receptors (sandy stilt puffball: off-site fungi).	Medium	Very low	Very low	Negligible (not significant)

Effects associated with waste soils and soil re use

- 11.4.79 The proposed Yoxford roundabout development may also generate limited waste soils during operation due to maintenance requirements which may include excavations for landscaping and for repairs, upgrades or installation of services. The proposed Yoxford roundabout would also be operated in accordance with the relevant regulations and best practice pollution prevention guidance. The impacts associated with waste soils and soils reuse during the operational phase are assessed to be temporary, short-term and indirect.
- 11.4.80 Given that there is less potential for soil reuse during the operational phase, the value/sensitivity of the receptor is classed as low. With the primary and tertiary mitigation measures, the magnitude of the impact is considered to

be very low. The overall effect is therefore assessed to be negligible and classed as **not significant**.

Inter-relationship effects

- 11.4.81 This section provides a description of the identified inter-relationship effects that are anticipated to occur on geology and land quality receptors between the individual environmental effects arising from operation of the proposed Yoxford roundabout.
- 11.4.82 There are anticipated to be inter-relationship effects between geology and land quality, soils and agriculture, ecology, heritage and groundwater and surface water in relation to potential receptors which could be impacted by ground contamination during the operation of the proposed development.
- 11.4.83 Potential impacts would include the contamination of sensitive/high value receptors such as good quality or best and most versatile agricultural land, SSSIs, listed buildings, principal aquifers, WFD rivers and groundwater SPZs during operation. Operation of the proposed Yoxford roundabout may introduce new sources of contamination, new pathways for migration of contamination.
- 11.4.84 However, given the primary and tertiary mitigation measures proposed in relation to these disciplines as outlined in **section 11.5**, it is not expected that the combined impact of these inter-relationship effects would be greater than those effects predicted for the geology and land quality assessment as presented within this chapter. Only minor adverse inter-relationship effects are anticipated, which are classified as **not significant**. Further details are provided in **Chapter 10** and **Chapter 12** of this volume.

d) Mitigation and monitoring

i. Introduction

- 11.4.85 Primary and tertiary mitigation measures which have been accounted for as part of the assessment are summarised in **section 11.5**. Where further mitigation is required this is referred to as secondary mitigation, and where reasonably practicable, secondary mitigation measures have been proposed.
- 11.4.86 This section describes the proposed secondary mitigation measures for geology and land quality as well as describing any monitoring required of specific receptors/resources or for the effectiveness of a mitigation measure.

ii. Mitigation

- 11.4.87 A ground investigation would be undertaken to inform the detailed design of the proposed Yoxford roundabout and confirm ground conditions, contamination status and other ground related risks. This would be completed prior to the commencement of construction works. Where the ground investigation and subsequent generic risk assessments identify unacceptable levels of contamination and ground related risks, further detailed quantitative risk assessment followed by, where necessary, the remediation of soil and groundwater contamination prior to construction may be required.

iii. Monitoring

- 11.4.88 A programme of short-term gas and groundwater monitoring would be designed as part of the ground investigation and would be required prior to construction works commencing. The results of this short-term monitoring would determine whether further long-term gas and groundwater monitoring is required during the construction and operational phases.
- 11.4.89 A contamination watching brief by suitably qualified and experienced personnel would be implemented when excavating areas of potential contamination risk.

11.5 Other highway improvements

- 11.5.1 As identified in **section 10.3c**, the other highway improvements and safety measures are not considered to have the potential to result in significant environmental effects and therefore none require further assessment in this section.

11.6 Residual effects

- 11.6.1 **Table 11.15** and **Table 11.16** present a summary of the geology and land quality assessment. They identify the receptor(s) likely to be impacted, the level of effect and, where the effect is deemed to be significant, the tables include the mitigation proposed and the resulting residual effect.

Table 11.15: Summary of effects for the construction phase

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Secondary Mitigation	Residual Effects
Geology	Soil erosion.	Health and safety risk assessments, method statements and appropriate personal protective equipment for the protection of construction workers. Implementation of measures in the CoCP during construction works. Design and selection of construction materials in accordance with best practice.	Negligible	Ground investigation and relevant risk assessments completed prior to detailed design and construction works. Remediation of soil and groundwater, if necessary. Longer term gas and groundwater monitoring, if necessary.	Negligible (not significant).
Mineral resources.	Loss, damage or sterilisation.		Negligible		Negligible (not significant).
Human health.	Contamination from on-site and off-site sources.		Negligible		Negligible to minor beneficial (not significant).
Controlled waters (groundwater).	Contamination from on-site and off-site sources.		Minor adverse.		Minor beneficial (not significant).
Controlled waters (surface water off-site).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Property (existing and future structures and services).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Property (crops and livestock).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Ecological receptors (sandy stilt puffball: off-site fungi).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Soils	Impacts from waste soils generated during construction works.		Minor adverse.		Minor adverse (not significant).

Table 11.16: Summary of effects for the operational phase

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Geology	Soil erosion.	Use spill response kits and adequate staff training. Use of hardstanding to reduce impact from spills and leaks. Incorporation of petrol and oil interceptors within the drainage design where considered necessary. The use of appropriate sustainable urban drainage system schemes. The use of grid connections for electricity rather than generators. Appropriate storage and disposal of chemicals, oils, fuels, materials and wastes in accordance with current guidance.	Negligible	Longer term gas and groundwater monitoring if necessary.	Negligible (not significant).
Mineral resources.	Loss, damage or sterilisation.		Negligible		Negligible (not significant).
Human health.	Contamination from on-site and off-site sources.		Negligible to minor beneficial.		Negligible to minor beneficial (not significant).
Controlled waters (groundwater).	Contamination from on-site and off-site sources.		Minor adverse.		Minor beneficial (not significant).
Controlled waters (surface water off-site).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Property (existing and future structures and services).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Property (crops and livestock).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Ecological receptors (sandy stilt puffball: off-site fungi).	Contamination from on-site and off-site sources.		Negligible		Negligible (not significant).
Soils	Impacts from waste soils generated during operation.		Negligible		Negligible (not significant).

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