M3 Junction 9 Improvement

Scheme Number: TR010055

6.1 Environmental Statement Chapter 9 Geology and Soils (Rev 1) Tracked

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6.1 ENVIRONMENTAL STATEMENT - CHAPTER 9: GEOLOGY AND SOILS

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9 Geology and Soils

9.1 Introduction

9.1.1 This chapter presents the findings of the assessment of the construction and operation of the M3 Junction 9 Improvement Scheme (hereafter referred to as the Scheme) on geology and soils. This chapter outlines relevant legislation, policy framework and guidance, describes the assessment methodology, study area, baseline conditions, an overview of potential impacts, mitigation measures, likely residual effects, monitoring and a summary.

9.1.2 This chapter should be read in conjunction with **Figures 9.1 and 9.2 (Document Reference 6.2)** and **Appendices 9.1 and 9.2** of the **ES (Document Reference 6.3)** which comprise:

- ES Appendix 9.1: Phase 1 Ground Conditions Assessment
- ES Appendix 9.2: Agricultural Land Classification and Soil Resources

9.1.3 At the time the Ground Conditions Assessment (GCA) was drafted, the Scheme was anticipated to generate surplus spoil. Therefore, the Application Boundary included areas to permanently deposit excess spoil, and these areas were part of the GCA. However, subsequent updates to the preliminary design (following statutory consultation) propose that the spoil being generated by the Scheme is intended for beneficial use within the Scheme. Therefore, these permanent deposition areas are no longer required as part of the Scheme although the GCA remains valid for some parts of the scheme.

9.1.4 This chapter should be read in parallel to **Chapter 13 (Road Drainage and the Water Environment)** and **Chapter 15 (Cumulative Effects)** of the **ES (Document Reference 6.1).**

9.2 Consultation

Consultation and engagement has informed the geology and soils assessment. Comments and responses to the Scoping Opinion received in November 2020 are provided in **Appendix 4.2 (Scoping Comments and Responses)** of the **ES (Document Reference 6.3)** and comments and responses received during statutory consultation between May and July 2021 are provided in **Appendix K of the Consultation Report (Document Reference 5.1)**. Further to this, the Applicant has engaged directly with the Environment Agency (EA) in relation to Geology and Soils, and this engagement is summarised below.

Table 9.1 Consultation undertaken relevant to Geology and Soils

Reference	Comment	Response
Meeting with EA on 4th October 2021	During the meeting the EA advised of a historical pollution incident (accident) and subsequently forwarded the location and details to Stantec for cross checking against site specific data.	The site specific ground investigation data did not indicate ongoing hydrocarbon contamination at this location.
	During the meeting Stantec advised that further stages of hydrogeological risk assessment (beyond the HEWRAT) had been undertaken using an in house risk assessment tool that had previously been accepted by the EA. The EA requested a copy of the tool.	The in-house risk assessment tool was forwarded to the EA who reviewed and responded that 'the tool could be appropriately robust and conservative applied in this case.'

9.3 Legislative, policy framework and guidance

9.3.1 This assessment has been undertaken considering current legislation, together with national, regional and local plans and policies. A list is provided below and further detail regarding National Policy can be found in the **National Policy Statement National Networks (NPS NN)Accordance Table (Document Reference 7.2):**

- Environmental Protection Act 1990
- National Parks and Access to the Countryside Act 1949
- National Policy Statement for National Networks (2014)
- National Planning Policy Framework (2021)
- Planning Practice Guidance (online resource)
- South Downs Local Plan 2014-2033 (2019)
- The Contaminated Land (England) Regulations 2006
- The Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263)

- The Environmental Damage (Prevention and Remediation) Regulations 2015
- The Environmental Permitting (England and Wales) Regulations 2016
- The Town and Country Planning (Development Management Procedure) (England) Order 2015 (SI 2015/595)
- Wildlife and Countryside Act 1981
- Winchester District Local Plan Part 1 – Joint Core Strategy (2013)
- Winchester District Local Plan Part 2 – Development Management and Site Allocations (2017)
- Winchester District Draft Local Plan 2018 -2038 (emerging)

9.3.2 In addition to the legislation and national and local planning policies listed above, this assessment has also been carried out in accordance with the following professional standards and guidance:

- BS 10175:2011+A2:2017 Investigation of potentially contaminated sites. Code of Practice
- BS EN 1997-1:2004 Eurocode 7 – Geotechnical Design – Part 1 : General Rules. British Standards Institution, London.
- BS EN 1997-2:2007 Eurocode 7 – Geotechnical Design – Part 2: Ground Investigation and testing. British Standards Institution, London.
- CIRIA 552: Contaminated Land Risk Assessment, A guide to good practice (CIRIA, 2001)
- Design Manual for Roads and Bridges (DMRB) LA 109 Geology and soils (Highways England, 2019)
- DMRB LA 113 Road drainage and the water environment (Highways England, 2020)
- DMRB LA 104 Environmental assessment and monitoring (Highways England, 2020)
- Land Contamination: Risk Management (LCRM) (Environment Agency, 2021)
- Technical Information Note TIN049 – Agricultural Land Classification: protecting the best and most versatile agricultural land (Natural England, 2012)

9.4 Assessment methodology

Scope of the assessment

9.4.1 This chapter presents an assessment of impacts upon geology, soils, contamination (human heath, surface water, groundwater) and the built environment during both the construction and operation of the Scheme. The assessment is based on the DMRB LA 109 Geology and soils (Highways England, 2019). As confirmed in the scoping opinion received from the Planning Inspectorate in 2021 this assessment does not cover effects on geology as a valuable resource i.e. sterilisation of mineral resources – this is covered within **Chapter 10 (Material Assets and Waste)** of the **ES (Document Reference 6.1).** The assessment of ground conditions has been undertaken following a tiered approach as recommended by Land Contamination Risk Management (LCRM) (Environment Agency, 2021) (and in accordance with DMRB LA 109 Geology and soils (Highways England, 2019)). LCRM advocates the tiered approach described below:

- Tier 1 – Preliminary Risk Assessment. A qualitative assessment of historical and published information, together with a site reconnaissance, undertaken in order to develop a preliminary conceptual site model and inform a preliminary risk assessment

- Tier 2 – Generic quantitative risk assessment. An assessment of ground condition data using published generic assessment criteria to screen the site and establish whether there are actual, or potential, unacceptable risks; and (if required)

- Tier 3 - Detailed quantitative risk assessment: A detailed quantitative assessment involving the generation of site-specific assessment criteria (SSAC), (if required)

9.4.2 A Tier 1 qualitative assessment based on readily available published information and a Tier 2 generic quantitative risk assessment based upon the findings of a Phase 2 Ground Investigation (undertaken by Soils Ltd between March 2019 and June 2019) have been carried out. Based on the findings of the Tier 2 Assessment there is no requirement to undertake a Tier 3 assessment.

9.4.3 The results of the Tier 1 and Tier 2 assessment form the evidence for the baseline conditions and assessment of effects within this chapter.

9.4.4 It is recognised that certain soils can be a cause of land instability such as dissolution, slope instability, landslides, soil creep, and ground compression, either as a result of natural processes or historical activities. Where there are reasons for suspecting instability, appropriate assessment has been undertaken to determine whether:

- The land is capable of supporting the anticipated loads

- The Scheme could be threatened by unstable slopes on or adjacent to the Scheme
- The Scheme could initiate slope instability which may threaten sensitive receptors
- The Scheme could be affected by ground movements due to natural cavities
- The Scheme could be affected by ground movements due to past, present or foreseeable future mining or excavation activities.

9.4.5 In addition, the assessment includes an appraisal of ground conditions, set out in the interpretive **Ground Investigation Report (Document Reference 7.11)** undertaken by Stantec**,** which is based on the factual information obtained during a site specific Phase 2 Ground Investigation undertaken by Soils Ltd (2019) for the Scheme. The GIR includes a preliminary Tier 2 assessment that has been used to inform this chapter.

9.4.6 In order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences, a source-pathway-receptor methodology is adopted, with the underlying principle that the identification of pollutant linkages consists of the following three elements:

- A source/hazard (a substance or situation that has the potential to cause harm or pollution)
- A pathway (a means by which the hazard moves along / generates exposure)
- A receptor/target (an entity that is vulnerable to the potential adverse effects of the hazard)

9.4.7 Whilst the contamination may be a hazard it would not constitute a risk unless all other elements are present, and a pollutant linkage can be determined. Therefore, in assessing the potential for contamination to cause a significant effect: the extent and nature of the potential source or sources of contamination must be assessed; any pathways present must be identified; and sensitive receptors or resources identified and appraised to determine their value and sensitivity to contamination related impacts.

9.4.8 The methodology adopted in this chapter is qualitative with a progression from factual information (stated with reasonable certainty) regarding the baseline conditions, to appraisal informed by professional judgement and expression of opinions on the relative significance.

9.4.9 This chapter also provides an assessment of impacts to agricultural land classification (ALC). ALC is graded from 1 to 5. The highest grade goes to land that:

- Gives a high yield or output

- Has the widest range and versatility of use
- Produces the most consistent yield
- Requires less input

9.4.10 Best and most Versatile (BMV) agricultural land is graded 1 to 3a. The bullet points that follow provide a description of each of the grades taken from Natural England's '*Guide to assessing development proposals on agricultural land'* (2021):

- *'Grade 1 – excellent quality agricultural land. Land with no or very minor limitations. A very wide range of agricultural and horticultural crops can be grown and commonly includes:*
  - *Top fruit, for example tree fruit such as apples and pears*
  - *soft fruit, such as raspberries and blackberries*
  - *Salad crops*
  - *Winter harvested vegetables*
  - *Yields are high and less variable than on land of lower quality.*
- *Grade 2 – very good quality agricultural land. Land with minor limitations that affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown. On some land in the grade there may be reduced flexibility due to difficulties with the production of the more demanding crops, such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than grade 1.*
- *Grade 3 – good to moderate quality agricultural land. Land with moderate limitations that affect the choice of crops, timing and type of cultivation, harvesting or the level of yield. Where more demanding crops are grown yields are generally lower or more variable than on land in grades 1 and 2.*
- *Subgrade 3a – good quality agricultural land. Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of crops including:*
  - *Cereals*
  - *Grass*
  - *Oilseed rape*
  - *Potatoes*

- *Sugar beet*
- *Less demanding horticultural crops*

- *Subgrade 3b – moderate quality agricultural land. Land capable of producing moderate yields of a narrow range of crops, principally:*
  - *Cereals and grass*
  - *Lower yields of a wider range of crops*
  - *High yields of grass which can be grazed or harvested over most of the year*
- *Grade 4 – poor quality agricultural land. Land with severe limitations which significantly restrict the range of crops or level of yields. It is mainly suited to grass with occasional arable crops (for example cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties using the land. The grade also includes arable land that is very dry because of drought*
- *Grade 5 – very poor-quality agricultural land. Land with very severe limitations that restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops'*

Study area and baseline approach

9.4.11 The Study Area is defined within **Section 9.5**. Baseline data (and identification of geology and soils features / receptors) is outlined in **Section 9.6** and has been informed through gathering readily available desk-based information, data from stakeholders, previously prepared reports (including the PSSR), together with a Phase 1 Ground Condition Assessment (including a Tier 1 preliminary risk assessment (**Appendix 9.1 (Phase 1 Ground Conditions Assessment)** of the **ES (Document Reference 6.3)**) of areas not previously assessed in earlier studies.

Approach to design, mitigation and enhancement measures

9.4.12 The Scheme has been designed to avoid or minimise effects on geology and soils. Embedded mitigation is listed within **Chapter 4 (Environmental Assessment Methodology)** of the **ES (Document Reference 6.1).** Additional and essential mitigation measures have been identified within this chapter. This mitigation is also included within the **first iteration Environmental Management Pan (fiEMP) (Document Reference 7.3)**.

Geology, soils, contamination (human health, surface water, groundwater) and the built environment assessment approach – value (sensitivity) of receptor

9.4.13 The sensitivity of receptors has been determined in accordance with guidance and criteria provided in DMRB LA 109 Geology and soils (Highways England, 2019) and LA 113 Road Drainage and the Water Environment (Highways England, 2020). **Table 9.2** combines and presents the environmental value (sensitivity) and descriptors from LA 109 and LA 113 of specific receptors.

Table 9.2: Receptor Value (sensitivity) and descriptions

Receptor value (sensitivity)	Description
Very High	Geology: very rare and of international importance with no potential for replacement (e.g. UNESCO World Heritage Sites, UNESCO Global Geoparks, Site of Special Scientific Interest (SSSI) and Geological Conservation Review (GCR) where citations indicate features of international importance). Geology meeting international designation citation criteria which is not designated as such. Soils: ALC grade 1 and 2 (Best and Most Versatile (BMV)) Contamination: 1) human health: very high sensitivity land use such as residential or allotments; 2) surface water: Watercourse having a Water Framework Directive (WFD) classification shown in a River Basin Management Plan (RBMP) and Q95 ≥ 1.0 m^3/s. Site protected/designated under EC or UK legislation (Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI), Ramsar site) 3) groundwater: Principal aquifer providing a regionally important resource, Source Protection Zone 1 Built Environment: Buildings of International importance i.e. World Heritage Site

Receptor value (sensitivity)	Description
High	Geology: rare and of national importance with little potential for replacement (e.g. geological SSSI, Area of Special Scientific Interest (ASSI), National Nature Reserves (NNR)). Geology meeting national designation citation criteria which is not designated as such. Soils: ALC grade 3a (BMV) Contamination: 1) human health: high sensitivity land use such as public open space; 2) surface water: Watercourse having a WFD classification shown in a RBMP and Q95 <1.0m^3/s. 3) groundwater: Principal aquifer providing locally important resource or supporting a river ecosystem, SPZ2. Built Environment: Buildings of national importance i.e. Conservation Areas and Area of Historic Character
Medium	Geology: of regional importance with limited potential for replacement (e.g. RIGS). Geology meeting regional designation citation criteria which is not designated as such. Soils: ALC grade 3b Contamination: 1) human health: medium sensitivity land use such as commercial or industrial; 2) surface water: Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m^3/s. 3) groundwater: Aquifer providing water for agricultural or industrial use with limited connection to surface water, SPZ3

Receptor value (sensitivity)	Description
	Built Environment: Buildings of regional importance
Low	Geology: of local importance / interest with potential for replacement (e.g. non designated geological exposures, former quarries / mining sites). Soils: ALC grade 4 and 5 Contamination: 1) human health: low sensitivity land use such as highways and rail; 2) surface water: Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001m^3/s. 3) groundwater: Unproductive strata Built Environment: Buildings of Local Value (replaceable)
Negligible	Geology: no geological exposures, little / no local interest. Soils: Previously developed land formerly in 'hard uses' with little potential to return to agriculture. Contamination: 1) human health: undeveloped surplus land / no sensitive land use proposed; 2) surface water: not present 3) groundwater: Unproductive strata Built Environment: None

Geology, contamination (human heath, surface water, groundwater) and the built environment assessment approach – magnitude of impact

9.4.14 The magnitude of change would be determined in accordance with the criteria provided in LA 109 and LA 113. The excerpt below presents the relevant magnitude of impact and typical descriptions from LA 109 and LA 113.

Table 9.3: Magnitude of impact and typical descriptions

Magnitude of Impact (change)	Typical Description
Major	Geology: loss of geological feature / designation /receptor and/or quality and integrity, severe damage to key characteristics, features or elements. Contamination: 1) human health: significant contamination identified. Contamination levels significantly exceed background levels and relevant screening criteria (e.g. category 4 screening levels) SP1010 with potential for significant harm to human health. Contamination heavily restricts future use of land; 2) surface water: Loss of regionally important public water supply. Loss or extensive change to a designated nature conservation site. Reduction in water body WFD classification. 3) groundwater: Loss of, or extensive change to, an aquifer. Loss of regionally important water supply. Loss or significant damage to major structures through subsidence or similar effects. Built Environment: Complete destruction of affected receptor
Moderate	Geology: partial loss of geological feature / designation, potentially adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. Contamination: 1) human health: contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria (e.g. category 4 screening

Magnitude of Impact (change)	Typical Description
	levels) SP1010. Significant contamination can be present. Control / remediation measures are required to reduce risks to human health / make land suitable for intended use; 2) surface water: Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. Contribution to reduction in water body WFD classification 3) groundwater: Partial loss or change to an aquifer. Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies. Damage to major structures through subsidence or similar effects or loss of minor structures. Built Environment: Fundamental adverse changes to the affected receptor
Minor	Geology: minor measurable change in geological feature / designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Contamination: 1) human health: contaminant concentrations are below relevant screening criteria (e.g. category 4 screening levels) SP1010. Significant contamination is unlikely with a low risk to human health. Best practice measures can be required to minimise risks to human health; 2) surface water: Minor effects on water supplies. 3) groundwater: Minor effects on an aquifer, abstractions and structures Built Environment: Limited adverse changes to the affected receptor/feature.
Negligible	Geology: very minor loss or detrimental alteration to one or more characteristics, features or elements of

Magnitude of Impact (change)	Typical Description
	geological feature / designation. Overall integrity of resource not affected. Contamination: 1) human health: contaminant concentrations substantially below levels outlined in relevant screening criteria (e.g. category 4 screening levels) SP1010. No requirement for control measures to reduce risks to human health / make land suitable for intended use; 2) surface water; The proposed project is unlikely to affect the integrity of the water environment 3) groundwater: No measurable impact upon an aquifer and/or groundwater receptors Built Environment: No discernible impact.

Soils assessment approach – magnitude of impact

9.4.15 The assessment of impacts to agricultural land has been undertaken in accordance with DMRB LA 109 Geology and Soils (Highways England, 2019). Definitive ALC grading has been obtained by undertaking a detailed intrusive survey (in 2017 and again in 2019), as reported in **Appendix 9.2 (Agricultural Land Classification and Soil Resource)** of the **ES (Document Reference 6.3)**.

9.4.16 The magnitude of impact to be used within assessments outlined in **Table 9.4** (replicating Table 3.12 of LA 109 Geology and Soils (Highways England, 2019) as updated by Table E/2.1 of LA109 Geology and Soils (Highways England, 2019)).

Table 9.4: Magnitude of impact and typical descriptions - agricultural land

Magnitude of impact (change)	Typical description
Major	Physical removal or permanent sealing of >20ha of agricultural land

Magnitude of impact (change)	Typical description
Moderate	▪ Physical removal or permanent sealing of 1ha - 20ha of agricultural land; or ▪ Permanent loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).
Minor	Temporary loss/reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource)
Negligible	No discernible loss/reduction of soil function(s) that restrict current or approved future use
No change	No loss/reduction of soil function(s) that restrict current or approved future use

Geology, soils, contamination (human heath, surface water, groundwater) and the built environment assessment approach – significance of effect

9.4.17 The significance of effects has been determined in accordance with **Table 9.5**. An effect of Moderate or above is taken to be significant in EIA terms.

9.4.18 Where an effect could be one of two gradings (for example where a Negligible impact interacts with a Medium sensitivity receptor resulting in a Neutral or Slight effect), professional judgement has been used to determine which effect is applicable and this has been explained in the associated commentary.

Table 9.5: Significance of effect matrix

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

	Magnitude of impact (degree of change)					
		No change	Negligible	Minor	Moderate	Major
	Medium	Neutral	Neutral or slight	Slight	Moderate	Moderate or large
	Low	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
	Negligible	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

Reasonable worse case parameters for assessment

9.4.19 An assessment has been conducted within the Limits of Deviation (LoD) outlined within **Chapter 2 (The Scheme and its Surroundings)** of the **ES (Document Reference 6.1)**. The vertical and lateral LoD for the Scheme have been reviewed with respect to sensitive receptors identified within this chapter. Additionally, in undertaking the assessments, a number of reasonable worse-case scenarios are considered for the Scheme. These include:

- An appraisal of the variation in ground conditions including the effects of anthropogenic activities that have already occurred within the study area
- Variability of groundwater conditions including, where appropriate, consideration of seasonal effects
- The potential for yet undiscovered contamination to be present within the Scheme

Assessment assumptions and limitations

9.4.20 This assessment is in part based on published information which is generic to an area rather than specific to land within the Application Boundary. Where this is the case professional judgement has been used to inform and justify the assessment in terms of likelihood and scale of effect associated with the identified land uses and environmental/geological setting. This is accepted practice and therefore does not affect the robustness of the assessment.

9.4.21 The assessment reported in this chapter is based in part on the findings of ground investigation works completed within parts of the Application Boundary (see Drawings 0001 to 0004 in the **Ground Investigation Report (Document Reference 7.11)**). Ground investigation works are by their nature exploratory and there may be ground conditions within the Application Boundary that have not been disclosed by the information reviewed or by the investigative work

undertaken. Such undisclosed conditions cannot be taken into account in any assessment. This is accepted practice and therefore does not affect the robustness of the assessment.

9.4.22 It should be noted that the Application Boundary has changed since the ground investigation works (the information from which has been used to inform this assessment in part) were completed. Areas of the current Application Boundary that were not previously included in the boundary and therefore not investigated by intrusive means, have been assessed based on published information. In accordance with a staged approach to design development, additional intrusive ground investigation would be completed to inform the detailed design.

9.4.23 Historical maps and aerial photographs used as part of the studies provide a 'snap shot' in time about conditions or activities within the study area, and as such cannot be relied upon as indicators of any events or activities that may have taken place at other times.

9.4.24 It should also be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man-made effects.

9.4.25 Only potential contamination from current and historical land-uses has been considered in this chapter. The assessment of the potential for generation of new contamination during the construction phase has been scoped out (as per the Scoping Opinion) of this assessment as it would be minimised through adoption of best practice outlined within the **fiEMP (Document Reference 7.3)**.

9.4.26 In relation to a historical fuel filling station located on both sides of the A33, the northern side has previously been redeveloped for business/office use. It has therefore been assumed that all underground tanks and infrastructure associated with the former filling station on the northern side of the A33 have previously been removed both as a requirement of the planning process (in the context of Part 2A) and to facilitate the new development. See **Section 9.6.40** for further information.

9.4.27 **Appendix 9.2 (Agricultural Land Classification and Soil Resources)** of the **ES (Document Reference 6.3)** reports the results of the ALC survey work undertaken for the Scheme. However, since the time of the most recent survey (spring 2021), a small additional area of agricultural land (see **Figure 9.2 (Agricultural Land Classification)** of the **ES (Document Reference 6.2)** has been included within the Application Boundary, immediately west of the A272 Spitfire Link. This land has not been surveyed for ALC purposes. It is assumed this area is Grade 2, which is consistent with land surveyed in the same field boundary.

9.5 Study area

9.5.1 The study area for the geology and soils assessment for the Scheme comprises the maximum physical extent of the Application Boundary plus a buffer

dependent on the feature/receptor. The distance of 250m is referenced in Guidance for the Safe Development of Housing on Land Affected by Contamination (NHBC 2008) and is typical at the hazard identification stage of an assessment. This study area is considered appropriate for human health, built environment receptors and environmentally sensitive sites. However, for surface water receptors, where the sensitivity is very high, and potential pathways have been identified, the study area aligns with **Chapter 13 (Road Drainage and the Water Environment)** of the **ES (Document Reference 6.1)**; 1km. In relation to specific groundwater receptors, the study area has been extended to 2km based on the combination of the receptor sensitivity and potential pathways.

9.5.2 The potential for features outside of this study area to be affected by the Scheme is based on professional judgement. DMRB LA 109 Geology and soils (Highways England, 2019) does not specify a minimum study area distance for the assessment of impacts to geology and soils but supports the development of a project specific study area.

9.5.3 The study area for the assessment of impacts to agricultural land is the extent of the Application Boundary (the area that land would be affected by permanent and temporary works).

9.6 Baseline conditions

9.6.1 Baseline conditions within the study area have been defined using the following documents (some of which are documents from previous stages of the Scheme):

- BGS online Geology of Britain viewer (BGS 2021)
- BGS web-hosted Onshore Geoindex (British Geological Society 2021)
- British Geological Society (BGS) 1:50,000 Series Geological Map Sheet No. 299 ‘Winchester’ (Solid and Drift ed.), 2002 (BGS 2002)
- Environment Agency Catchment Data Explorer (Environment Agency, 2021)
- Environmental Constraints (Jacobs, January 2019)
- Factual Ground Investigation Report (Soils Limited, August 2019, amended July 2020)
- M3 Junction 9 Scoping Opinion (The Planning Inspectorate (PINS), November 2020)
- MAGIC map - geographic information about the natural environment (Defra, 2021)
- PCF Stage 2 - Environmental Assessment Report (Appendix A drawings) (Appendix B Technical Appendices) (WSP, June 2018)

- PCF Stage 2 – Preliminary Sources Study Report (WSP, September 2017)
- Preliminary Environmental Information Report (PEIR) (Jacobs, June 2019)
- PCF Stage 3B – Phase 1 Ground Conditions Assessment (Contamination and Stability) for Proposed Depositions and Compound (Stantec, January 2021) included in **Appendix 9.1 (Phase 1 Ground Conditions Assessment)** of the **ES (Document Reference 6.3)**
- **Ground Investigation Report** (Stantec 2021) **(Document Reference 7.11)**
- **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)**

Geology (including ground conditions)

9.6.2 The anticipated ground conditions within the Application Boundary have been determined through a review of the published geological mapping, and also site specific intrusive information contained within both the Factual Ground Investigation Report (Soils Limited, 2020) and the **Ground Investigation Report (Document Reference 7.11)**.

Published Geology

9.6.3 The published BGS geological mapping indicates that the majority of the Scheme is underlain by solid geology comprising the Seaford Chalk Formation, with the overlying Newhaven Chalk Formation only present in the area to the east of the M3, in the northern part of the study area. The Seaford Chalk Formation is underlain by the Lewes Nodular Chalk Formation, and in the southern extent of the Application Boundary, the Lewes Nodular Chalk, New Pit Chalk Formation, Holywell Nodular Chalk Formation and Zig Zag Chalk Formation are indicated to outcrop at the ground surface.

9.6.4 Along the course of the River Itchen, which traverses the northern part of the Scheme, the solid geology is overlain by superficial deposits comprising alluvium. There are also smaller transects of superficial deposits, comprising head, overlying the solid geology, located to the north and to the south of the existing junction, and in the northern parts of the Application Boundary.

9.6.5 In the area to the east of the M3 and to the south of the River Itchen, the geological mapping also indicates there may be an area of Clay with Flints and head deposits overlying the Newhaven Chalk Formation (which overlies the Seaford Chalk Formation where present).

9.6.6 In addition to the published geology described above, it is anticipated that made ground is also present within the Application Boundary, associated with the construction of the M3, A34, A33 and other infrastructure. It is anticipated that this made ground material would predominantly comprise reworked natural strata, and the overlying road carriageway construction.

9.6.7 Extracts of the published geological mapping are included in **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)**.

Published Information

9.6.8 A review of the available information has identified records for two historical landfills within the Application Boundary and a further three within the study area (250m from the Application Boundary considered to be appropriate for historical landfills). These are shown on **Figure 9.1 (Environmental Information)** of the **ES (Document Reference 6.2)**. The landfills identified within the Application Boundary are located beneath the existing M3 J9 roundabout (Spitfire Link) and on the southern extents of the Application Boundary on the M3 (King George V Playing Fields). The further three within the study area are located on the western side of the A34 at the northern tip of Wykeham Industrial Estate (land between Old Newbury Railway and A33), between the A34/A33 and M3 carriageways, south of the River Itchen (land adjacent to Winchester Bypass) and adjacent to the southern extent of the Application Boundary to the south of the M3 (Land at Morestead Waste Water Treatment Works). Further information for the historical landfills was sought from Winchester City Council and received from them in April 2021. Commentary on the historical landfills including the information provided by Winchester City Council is given below.

9.6.9 The 'Spitfire Link, Easton Lane' landfill was investigated by Soils Limited (2020) with six exploratory holes undertaken within or immediately adjacent to the mapped extents of the landfill, the locations of which are shown on Drawing HE551551-VFK-HGT-X XXXX-XX-DR-GE-0001-04 contained within the **Ground Investigation Report (Document Reference 7.11)**. No evidence of waste or made ground was indicated on those exploratory hole records. As such the presence and extent of any deposited materials and its composition is unknown. Winchester City Council did not have any licensing information about the landfill, however anecdotal evidence suggests the landfill was used for the disposal of soils generated from the construction of the M3 and that it is not monitored. It is therefore considered likely that any waste materials present would be reworked natural materials and predominantly inert in nature, therefore not representing a risk of significant contamination.

9.6.10 There is no readily available information regarding 'King George V Playing Fields' landfill in relation to the waste accepted or dates, and although the boundary of the potential historical landfill plots across the Application Boundary, the King George V Playing Fields themselves are located to the west of the M3. It is considered possible that the historical landfill boundary is incorrect. Given this, and that the proposed works in this area are limited, it is not considered that this historical landfill represents a risk of significant contamination.

9.6.11 The 'Land Adjacent to Winchester Bypass, Abbots Worth, Hampshire' landfill is recorded as accepting inert waste from 1967 through to 1968. The licence holder is recorded as D Hewetson-Brown. The recorded operational period broadly corresponds with the widening of the Winchester Bypass and

construction of a gantry crossing the River Itchen. Winchester City Council confirmed that this location was used for earth spoil and that it is not monitored and not identified as gassing. It is considered that this historical landfill does not represent a risk of significant contamination.

9.6.12 The 'Land Between Old Newbury Railway and A33' was confirmed by Winchester City Council to contain earth spoil from the construction of the A34 and that this location is not monitored and not identified as gassing. It is considered that this historical landfill does not represent a risk of significant contamination.

Site Specific Ground Condition Information

9.6.13 A Phase 2 ground investigation was undertaken across parts of the Scheme between March 2019 and June 2019.

9.6.14 The **Ground Investigation Report (Document Reference 7.11)**, provides information from the Phase 2 ground investigation, and has confirmed that the geology in the area of the Scheme typically comprises made ground/engineered fill overlying the Seaford Chalk Formation. However, locally around the River Itchen the Scheme lies on alluvium and head deposits overlying the Seaford Chalk Formation. The information from the ground investigation generally confirms the anticipated/published ground conditions with the exception of a limited extent of peat present in some of the exploratory holes in the valley floor.

Land Stability/Geological Hazards

9.6.15 Chalk can be affected by both natural erosion features and manmade cavities, and a number of chalk pits and natural features (solution pipes) have been identified within the study area.

9.6.16 A Cavities Occurrence Assessment has been undertaken to assess the risk from natural cavities and non-coal mining cavities within the Application Boundary as part of the **Ground Investigation Report (Document Reference 7.11)**. The assessment of the potential risk from unidentified natural cavities was informed by a review of the geological, hydrogeological and geomorphological setting of the Scheme. The assessment identified a medium risk for the majority of the road development area, with much of the surrounding areas having a low or very low risk rating.

9.6.17 The risk rating is defined as a function of the land use vulnerability (impact) and the hazard rating, which is determined through the likelihood of occurrence (probability). A high and medium risk rating is defined as having a moderate to high probability and a medium or high impact on the Scheme.

9.6.18 The Cavities Occurrence Assessment also assessed the risk from mining cavities within the Application Boundary. From a review of the history of land within the Application Boundary, the risk rating for mining cavities within the Application Boundary is considered to range from very low to very high although

the majority of land within the Application Boundary is within the very low risk rating. The very high risk rating areas are localised where historical mining activity (chalk pits) are recorded. Mapping indicating the hazard rating from mining cavities within the Application Boundary is shown within Appendix A of the **Ground Investigation Report (Document Reference 7.11)**.

9.6.19 Based on the anticipated ground conditions, it is considered that there is a moderate risk of compressible ground being present in parts of the Application Boundary, associated with the alluvium and any non-engineered made ground. The baseline data indicates a worst-case low risk of landslide and running sand potential, and a very low risk of shrinking/swelling clay or collapsible ground. The engineering assessment and geotechnical risk register within the **Ground Investigation Report (Document Reference 7.11)** indicates that there are suitable, appropriate and robust design and mitigation measures readily available to mitigate potential land stability risks. A review (in the **Ground Investigation Report (Document Reference 7.11)** of the geotechnical risk register classified the Scheme as a Geotechnical Category 2 project where there is no abnormal risk or unusual/exceptional ground conditions identified. Therefore, whilst the geotechnical risk register would be further reviewed, refined and re-assessed as additional intrusive ground investigation and the detailed design is completed, it is considered unlikely that there would be significant effects in relation to land stability.

Hydrogeology

9.6.20 The Seaford Chalk Formation (see Figures 3.1 and 3.2 in **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)** is designated as a Principal Aquifer, and the overlying superficial deposits are designated as Secondary Aquifers, the alluvium as a Secondary A Aquifer, and the head deposits as a Secondary (undifferentiated) Aquifer.

9.6.21 These designations reflect the importance of the aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.

9.6.22 The Defra MAGIC map indicates that there are two sets of groundwater SPZs within the study area, associated with two licensed groundwater abstraction sites that are used for public drinking water supply. SPZs are identified in Figure 3.14 of **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)**.

9.6.23 Parts of the land within the Application Boundary are also covered by a Drinking Water Groundwater Safeguard Zone (DWGSZ), associated with Zone 1 and 2 of the SPZ. The groundwater body associated with the DWGSZ is the River Itchen Chalk and this is indicated (Environment Agency Catchment Data Explorer) to be in poor overall water body condition.

9.6.24 Information requests identified four private water abstractions within 1km of the Application Boundary. It was subsequently identified that there are an additional

two private groundwater abstractions located within 1km of the Application Boundary (close to an abstraction at Mansard House). The closest (known as the Shoulder of Mutton abstraction) is some 40m to 60m to the east of the Application Boundary. Further details of these abstractions can be found within **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES** (**Document Reference 6.3)**. All these abstractions are located within the Chalk and are located up or across hydraulic gradient from the Application Boundary~~.~~, although the Shoulder of Mutton abstraction is noted to be very close to the Application Boundary and the Scheme's proposed drainage elements (see **Chapter 13 (Road Drainage and the Water Environment) of the Environmental Statement (ES) (6.1, Rev 1)**). The assessment presented in **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (6.3, Rev 1)** identifies that the ~~The~~ Scheme is unlikely to impact any of these abstractions, therefore significant effects are unlikely and these abstractions are not considered further.

9.6.25 Groundwater monitoring wells were installed across land within the Application Boundary during the ground investigation completed in 2019 and groundwater monitoring has been undertaken, the locations of which and assessment of the data is included within **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)** and the **Ground Investigation Report (Document Reference 7.11)**. Continuous groundwater monitoring was carried out between June 2019 and July 2020 in four boreholes using data loggers and in 21 boreholes during the post fieldwork monitoring period between June and August 2019.

9.6.26 Monitoring from the data loggers for continuous groundwater monitoring indicated that groundwater levels during the monitoring period ranged between about 37.2m and 39.4m above Ordnance Datum (AOD). This is the same elevation as the River Itchen and surrounding areas. The groundwater levels varied across the monitoring period by approximately 2m, with all locations showing the same seasonal trend with increasing levels from mid-summer to winter and then a decline through spring and early summer. Groundwater flow direction is likely to be towards the River Itchen, and this would be confirmed through additional ground investigation proposed to inform the detailed design.

9.6.27 The spot monitoring data indicates groundwater levels generally at about 37.5m AaOD during the shorter monitoring period.

9.6.28 The BGS Hydrogeology map of Hampshire and the Isle of Wight shows the groundwater contours in the Upper Chalk within the study area generally mirror the topography and indicates groundwater flow towards the River Itchen.

9.6.29 Further details of the Hydrogeology within the study area are contained within **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)**.

Hydrology

9.6.30 The River Itchen flows from the north-east to the south-west through the study area and its channel runs below the M3, and A34/A33 alignment. The flood plain of the river spreads out between the A33 and M3 carriageways in the north part of the Application Boundary, and there are several cross cutting and interlinked channels forming the river. In addition, Nun's Walk stream is present adjacent and flowing parallel to the River Itchen. Further detail on the surface water bodies can be found in **Chapter 13 (Road Drainage and the Water Environment)** in the **ES (Document Reference 6.1)**.

Environmentally Designated Sites

9.6.31 The River Itchen is designated a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) due to its ecological status. The Scheme only intersects these features where the River Itchen flows underneath the A34. The north eastern part of the Scheme lies within the South Downs National Park and the eastern and southern parts of the Scheme border the South Downs National Park.

Historical Land Use

9.6.32 The historical land use (relevant to the potential for contamination) has previously been described at statutory consultation and in the Preliminary Sources Study Report (PSSR) and further information is contained in **Appendix 9.1 (Phase 1 Ground Condition Assessment)** of the **ES (Document Reference 6.3)**. The descriptions are based on historical Ordnance Survey maps obtained with environmental information reports. The historical land use has been re-reviewed using old-maps.co.uk (2020), and historical Google Earth Aerial Imagery. A summary is presented below.

9.6.33 The area of the current M3 J9 gyratory roundabout and its immediate surroundings had remained undeveloped until the construction of the A33 in the late 1930s and later, in the early 1980s, when junction 9 of the M3 is shown to have been constructed.

9.6.34 From the late 1800s, there are several chalk pits indicated to be present within the study area, the closest located on the south side of the River Itchen flood plain between the A34 and M3 carriageways. One of these chalk pits remained evident on OS mapping until the late 1980s.

9.6.35 The Didcot, Newbury and Southampton railway line is indicated to have been constructed in the late 1890s 200m to the west of the Application Boundary, along the eastern bank of the River Itchen, crossing the northern section of the site. The railway line remained until the 1960s when it was dismantled. Also, at this time, the Vulcan Iron Works was developed on the eastern side of the railway line to the north of the site and north of the River Itchen, adjacent to the north eastern boundary of the site. By the early 1960s this is no longer indicated to be 'Vulcan Iron Works', instead shown as 'Works'.

9.6.36 In the early 1900s, Winnall Gas Works was developed approximately 100m to the west of the Application Boundary, within the current Wykeham Industrial Estate. The gas works had been extended by the 1930s and included tanks and a gasometer which remained until at least the late 1970s, although the main part of the gas works was redeveloped earlier.

9.6.37 By the early 1950s the Winchester by-pass (within the Application Boundary) had been constructed adjacent to the gas works, and in the 1960s there appears to have been some modification to some of the channels in the River Itchen flood plain, to the east of the Winchester by-pass. The spoil from the construction may have been deposited to form what has been identified as the 'Land Adjacent to Winchester Bypass' landfill.

9.6.38 Between the early 1960s and early 1970s, the gas works and surrounding land, now the Wykeham Industrial Estate, are shown to have been developed for a variety of industrial uses including saw mills, rubber moulding works and engineering works. Other potentially contaminative activities within the industrial estate include and fire service depot, abattoir and garage.

9.6.39 The mapping indicates that the northern part of the study area comprised predominantly open fields from the early 1870s, and also the development of Kings Worthy. The Didcot, Newbury and Southampton railway line had been constructed by the late 1890s within the west part of the study area. There was a general expansion of Kings Worthy between the late 1800s and present day and some general industrial use (works, saw mills and including the Vulcan Iron Works discussed above).

9.6.40 In addition to the review of the historical maps undertaken above, a request was submitted to the relevant Local Planning Authorities for any information on historical land use within the Application Boundary. Winchester City Council provided a Historical Land Use Enquiry Report which contained information in relation to two former service stations on the northbound and southbound A33. These first appear on the 1951 mapping and are labelled as filling stations. The report identified that both filling stations remained in operation until 1987. The northbound station comprised 4 tanks with a capacity of approximately 72,000 litres and were installed in 1969 and also 2 further tanks which were made safe at an earlier date. The southbound service station comprised of 2 underground tanks with a capacity of approximately 31,000 litres, with one tank installed in 1947 and a further tank in 1983, and 2 above ground tanks with an approximate capacity of 12,000 litres which were removed from site for remote disposal. Further enquires to the Lead Petroleum Officer at Hampshire County Council confirmed that the tanks within the northbound and southbound service station were filled with concrete slurry in November 1987 to the satisfaction of the Petroleum Officer at the time. A further review of Google Earth aerial images shows that the northbound service station was redeveloped by 2005, and therefore it is likely that any tanks in this location would have been remediated and removed (although this is unconfirmed). Therefore, these are not considered any further in this assessment.

9.6.41 Contrary to the 'published information' outlined above, a review of the available historical OS mapping has not specifically identified the presence of infilled workings/landfills within the study area.

Current Land Use

9.6.42 The majority of land within the Application Boundary comprises the carriageways of the M3, A33 and A34. In the area to the east of the M3, the land use both within the Application Boundary and the study area is predominantly agricultural.

9.6.43 In the areas to the west of the A34, the land use within the Application Boundary is predominantly highway land or undeveloped land adjacent to the highway. However, in the wider study area, the land use is varied including flood plain, residential and mixed use industrial.

9.6.44 In the northern part of land within the Application Boundary, the predominant current land use outside of the Application Boundary is mixed, comprising residential, agricultural and flood plain.

Geoenvironmental Conditions – Soils

9.6.45 The **Ground Investigation Report (Document Reference 7.11)** has identified that all of the soil geoenvironmental laboratory test results (126 No.) were below the selected assessment criteria for Public Open Space land use, with one exception of a marginal exceedance of the assessment criteria for beryllium (in DS107, as shown on Drawing HE551511-VFK-HGT-X_XXXX_XX-DR-GE-0003 in the **Ground Investigation Report (Document Reference 7.11)**.

9.6.46 Therefore, it is considered that there is a worst-case **Low** potential for a significant contamination hazard within the Application Boundary.

9.6.47 Ground gas monitoring was undertaken at 21 monitoring locations on 5 occasions as part of the preliminary ground investigation undertaken by Soils Limited. The data from the monitoring can be found in Appendix D of the Soils Limited Factual Ground Investigation Report (Soils Limited, 2019). All the monitoring wells were installed within the Seaford Chalk Formation.

9.6.48 In accordance with Figure 6 within BS 8576:2013 the gas generation potential of the made ground/engineered fill, alluvium and peat is considered to be **Low** to **Very Low** given the limited degradable content or limited extent indicated within the exploratory hole records.

9.6.49 It has been assessed from the ground gas monitoring data that the gas regime within the Seaford Chalk Formation is a Characteristic Situation 1 (CS1) whereby no gas protection measures are required and therefore the potential for a significant ground gas risk to arise from the works is considered to be **Very Low** in accordance with BS8485+A1 (2019). Although this classification is

designed for new buildings, it does give a reasonable indication of the ground gas risk.

Geoenvironmental Conditions – Controlled Waters

9.6.50 Groundwater samples were recovered from eight boreholes on two separate occasions as part of the ground investigation undertaken by Soils Limited in 2019. A total of nine samples were submitted for geoenvironmental laboratory testing during each monitoring visit. The data from the geoenvironmental lab testing can be found in Appendix C of the Soils Limited Factual Ground Investigation Report (Soils Limited, 2020). All the monitoring wells were installed into the Seaford Chalk Formation, the locations of which can be found within **Appendix 13.2 (Hydrogeological Risk Assessment)** of the **ES (Document Reference 6.3)**.

Controlled Waters as an Ecological Receptor

9.6.51 The Controlled Waters Risk Assessment, which is contained within the **Ground Investigation Report (Document Reference 7.11)** indicates that at the majority of locations, concentrations of the potential contaminants tested are below the relevant assessment criteria. The exception to this was nickel and mercury which were identified above the assessment criteria in two specific locations which are located close to two of the historical landfills however, the potential risk to controlled waters is considered to be **Low**.

9.6.52 In addition, some laboratory limits of detection were above the assessment criteria that Stantec use for cadmium, hexavalent chromium and cyanide. However none of these determinants were identified above the limit of detection of the testing and are therefore considered unlikely to represent a risk to sensitive receptors. The full assessment and conclusions can be found within Appendix E of the **Ground Investigation Report (Document Reference 7.11)**.

9.6.53 Based on the information available, there is no evidence to suggest that the groundwater within the study area has been significantly impacted by any existing contamination arising from within the Application Boundary. Therefore, the potential for impacts to groundwater affecting ecological receptors, from existing contamination in relation to the Scheme are considered to be Low.

Controlled Waters as a Drinking Water Resource

9.6.54 The Controlled Waters Risk Assessment, included within the **Ground Investigation Report (Document Reference 7.11)** indicates that the majority of the groundwater samples did not record any exceedances of the Drinking Water Standards (DWS) for the parameters tested. The exceptions to this were exceedances recorded within DS110, DS203 and DS216 for Mercury, Nickel and Nitrate as NO_3. The full assessment and conclusions can be found within Appendix E of the **Ground Investigation Report (Document Reference 7.11)**.

9.6.55 Based on the information available, there is no evidence to suggest that the groundwater within the study area has been significantly impacted by existing contamination arising from within the Application Boundary. Therefore, the potential for significant impacts to groundwater, affecting public water supply, from existing contamination in relation to the Scheme are considered to be **Low**.

Agricultural Land Classification

9.6.56 Paragraph 3.9 of DMRB LA 109 (Highways England, 2019) requires a description / indication of the ALC types within a region (i.e. the Winchester City Council area where the Scheme is located). There is approximately 62,000 ha of agricultural land within the Winchester City Council area, with approximately 44% (nearly 28,000 ha) of agricultural land assumed to be classified as BMV agricultural land. This is a similar but slightly lower proportion than those estimated for the south east (48%) and England (47%). These calculations are based on the assumption that that there is an even distribution of subgrades 3a and 3b (the provisional data does not identify / differentiate between grades 3a and 3b - only 3a is classed as BMV). The principal physical factors influencing agricultural production are climate, site and soil. These factors together with interactions between them form the basis for classifying agricultural land as BMV land (grades 1, 2 and 3a) and non BMV land (grades 3b, 4 and 5).

9.6.57 A baseline survey was undertaken in spring 2021 (reported in **Appendix 9.2 (Agricultural Land Classification and Soil Resources)** of the **ES (Document Reference 6.3)**) further to a survey undertaken (WSP, June 2018) which identified the ALC results for a previous iteration of the Application Boundary. Eighty-one soil profiles were examined across the two assessment periods using hand augers and seven pits were excavated by spade to examine sub soil structures. Thirty soil samples were submitted for laboratory determination.

9.6.58 The total area the Application Boundary is 113 ha, and the total area of agricultural land that would be affected by the construction of the Scheme would be 50.3ha. The Scheme would require both temporary and permanent land take, as well as for wider mitigation and enhancement as part of the Scheme. A review of the agricultural land within the Application Boundary was undertaken, is presented in **Table 9.6** and presented on **Figure 9.2 (Agricultural Land Classification)** in the **ES (Document Reference 6.2)**.

Table 9.6: Agricultural Land Classification

Permanent/temporary works	ALC grade	Area ha
Permanent works	Grade 2	12.4
Permanent works	Grade 3a	6.9
Permanent works	Grade 3b	7.9
Permanent works	Grade 4	0.1
Temporary works	Grade 2	6.6
Temporary works	Grade 3a	5.5
Temporary works	Grade 3b	4.3
Temporary works	Grade 4	0
Total agricultural land affected		43.7

9.6.59 In addition to the areas identified in **Table 9.6**, a total of 65.3 ha was identified as non-agricultural land. Note, the agricultural and non-agricultural land affected by the Scheme above amounts to 109ha due to rounding factors.

Identification of Sensitive Receptors

9.6.60 **Table 9.7** below summarises sensitive receptors which could be affected by works during the construction and operation phases of the Scheme. The sensitivity of each has been determined according to the descriptors given in **Table 9.2**.

Table 9.7: Identified receptors and sensitivity

Receptor	Description	Sensitivity	Construction or Operation Phase
Groundwater	Aquifers beneath the Scheme area are classified by the Environment Agency and the British Geological Survey as Principal and Secondary A aquifers. Also, parts of the study area in the north are covered by both Zones 1 and 2 groundwater SPZs. Two abstraction points for	Very High	Construction and Operation

Receptor	Description	Sensitivity	Construction or Operation Phase
	potable drinking supply are also located in the north of the Scheme area.		
Surface Water	The River Itchen flows across the north and along the west of the Scheme area with several associated water courses. The River Itchen is designated a SSSI and a Special Area of Conservation (SAC). Nun's Walk Stream flows in a channel approximately parallel to the River Itchen and is classified by the EA as a Main River.	Very High	Construction and Operation
Environmentally Sensitive/Designated Sites	The nearest environmentally sensitive area is the River Itchen SSSI and SAC and flows through the study area. The Scheme area also lies partly within the South Downs National Park.	Very High	Construction and Operation
Built Environment	Mixed use surrounding the M3 J9 Improvement site. including residential, school and commercial properties and agricultural land.	Medium	Construction
Human Health – Construction/ maintenance Workers	The Scheme is considered likely to include extensive earthworks which could expose construction workers to any potential contamination in the soil material. There is potential for maintenance workers to be	High	Construction and Operation

Receptor	Description	Sensitivity	Construction or Operation Phase
	exposed to potential contaminants associated with spills, leaks and accidents during operation of the Scheme.		
Human Health - End Users	The Scheme is for improvements to highways and therefore lower sensitivity with no exposure to any potential contamination associated with the geology and soils.	Low	Operation
Human Health - Neighbours	Mixed use surrounding the site including residential, school and commercial.	High	Construction
Agricultural Land – Grade 2 (see **Figure 9.2 (Agricultural Land Classification)** of the **ES (Document Reference 6.2)** for further information.	The intrusive survey identified grade 2 agricultural land (BMV).	Very High	Construction and Operation
Agricultural Land – Grade 3a (see **Figure 9.2 (Agricultural Land Classification)** of the **ES (Document Reference 6.2)** for further information.	The intrusive survey identified grade 3a agricultural land (BMV).	High	Construction and Operation

Receptor	Description	Sensitivity	Construction or Operation Phase
Agricultural Land – Grade 3b (see **Figure 9.2 (Agricultural Land Classification)** of the **ES (Document Reference 6.2)** for further information.	The intrusive survey identified grade 3b agricultural land (not BMV).	Medium	Construction and Operation
Agricultural Land – Grade 4 (see **Figure 9.2 (Agricultural Land Classification)** of the **ES (Document Reference 6.2)** for further information.	The intrusive survey identified grade 4 agricultural land (not BMV)	Low	Construction and Operation

Baseline evolution

9.6.61 In the absence of the Scheme (no development scenario), the land uses within the Application Boundary would be retained and there would be no impacts upon geology and soils. Those areas within the Application Boundary currently in agricultural use would be retained in their current use and land undisturbed.

9.6.62 **Appendix 15.1 (Long List of Cumulative Developments)** of the **ES (Document Reference 6.3)** provides a full list of schemes which have been identified as being likely to be in operation prior to the construction of the Scheme. These schemes form part of the future baseline scenario and have been taken into account in the assessment of likely significant effects from the Scheme (construction and operation) presented in this chapter.

9.7 Potential impacts

Construction (including site preparation)

9.7.1 In relation to potentially contaminative land uses, the following adverse impacts could potentially arise during the construction phase of the Scheme in relation to geology and soils:

- Mobilisation of existing identified and unidentified contamination in soils as a result of ground disturbance
- Introducing new receptors such as construction workers who could be exposed to identified and unidentified contamination
- Creation of new preferential pathways for the migration of contamination to sensitive receptors (e.g. new piled foundations, below ground service routes)
- Land instability from unknown naturally occurring geological hazards and/or inappropriate design

9.7.2 Construction also has the potential to result in beneficial impacts such as the removal of potentially contaminated soils and/or covering of potentially contaminated soils through the introduction of new hardstanding.

9.7.3 With regard to soil resources, the construction phase has the potential to result in the following adverse impacts:

- The temporary and permanent loss of BMV agricultural soils through land-take
- Degradation of soil resources (including damage to soil structure, reduced biological function, mixing of soil types) resulting from soil compaction due to heavy construction vehicle movements, and the exacerbation of soil erosion through handling and storage of soils
- Change to the function or quality of soil as a resource, including the deposition of dust on sensitive land uses, disruption to drainage, irrigation and water supply systems, unintentional pollution of soil and water courses, and spread of injurious weeds to adjacent agricultural land from soil and material stockpiles. This could lead to the generation of waste soils that cannot be reused elsewhere on the Scheme, requiring off-site disposal as waste

Operation

9.7.4 Contamination that was determined to be a significant risk to the Scheme or sensitive receptors would have been removed, remediated or mitigated during the construction phase and any potential impacts would have been addressed through the design of the Scheme. The potential for environmental impacts in

relation to geology and soils during operation would be limited. However, the following adverse impacts could arise during the operational phase of the Scheme:

- Introduction of new/additional sources of potential contamination into the environment as a result of spills/leaks during ongoing use of the motorway and major accidents

9.7.5 Impact to soil resources would occur during the construction phase of the Scheme. Following the opening of the Scheme, it is not considered that any additional soil resources would be affected.

9.8 Design, mitigation and enhancement measures

9.8.1 Mitigation measures incorporated into the design of the Scheme are reported as embedded mitigation in **Chapter 4 (Environmental Assessment Methodology)** of the **ES (Document Reference 6.1)**, and those relevant to geology and soils are included below. This section also outlines essential mitigation required. Essential mitigation is outlined within the **fiEMP (Document Reference 7.3)**. Prior to the implementation of mitigation, the Scheme has the potential to have geology and soils impacts during construction and operation, both beneficial and adverse.

Embedded mitigation

Construction (including site preparation)

9.8.2 The Scheme is designed to avoid and mitigate potential adverse effects in relation to geology and soils (that could lead to ground instability) through the process of design development and adoption of good design principles.

9.8.3 In relation to ground instability, any potential impacts are mitigated through site specific and phased ground investigation that informs appropriate geotechnical design of features such as cuttings, embankments, retaining structures and landscape features.

9.8.4 Any geotechnical design of the Scheme would be undertaken in general accordance with the principles set out in Eurocode 7 and its supporting standards to reduce the potential for land instability occurring.

Operation

9.8.5 The drainage and any surface water discharge are designed to mitigate any significant effects to groundwater. Further information regarding this is contained within **Chapter 13 (Road Drainage and the Water Environment)** of the **ES (Document Reference 6.1).**

Essential mitigation

Construction (including site preparation)

9.8.6 In relation to the potential for ground instability; where the Scheme design has identified the need for mitigation of potential risks, additional phased site specific intrusive ground investigation would be carried out to inform measures such as treatment of solution features, use of geogrids or other risk-based solutions as appropriate. Any features identified during construction would be appropriately treated or mitigated by design and construction methodology. A preliminary Geotechnical Risk Register and Engineering Assessment has been carried out and is presented in the **Ground Investigation Report (Document Reference 7.11)**.

9.8.7 In relation to the potential for land contamination from historical land use, site specific intrusive ground investigation has been used to inform risk assessments that have not identified a requirement, at this stage, for specific remediation/mitigation measures.

9.8.8 Additional phases of site specific intrusive ground investigation, and risk assessment undertaken to inform the detailed design would further inform and refine the mitigation requirements for both land instability and land contamination.

9.8.9 Essential mitigation is outlined within the **first iteration Environmental Management Plan (fiEMP) (Document Reference 7.3)** and includes proposals for additional risk assessment and refinement of the conceptual site model and mitigation / remediation requirements in relation to land contamination following additional site specific intrusive ground investigation.

9.8.10 The **fiEMP (Document Reference 7.3)** also includes measures to address any existing unacceptable contamination risks during construction as well as measures to deal with unexpected contamination that might be encountered during construction. The fiEMP includes good practice and measures to preventing the release of new contamination.

9.8.11 Furthermore, construction methods such as appropriate piling techniques (if required) to minimise the risk of mixing of aquifer bodies through the creation of new pathways form part of the essential mitigation. This includes the provision of a Foundation Works Risk Assessment (FWRA) in accordance with Environment Agency guidance ‘Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination’ (Environment Agency, 2001), which would be undertaken once the proposed foundation solutions are known. This is outlined within the fiEMP (Document Reference 7.3).

9.8.12 A second iteration EMP (siEMP) and associated Method Statements would be prepared prior to construction and would include measures such as standard good practice to be implemented by the contractor (Principal Contractor) to further reduce potential environmental effects.

9.8.13 At the current time, temporary dewatering is not anticipated to facilitate construction with the exception of dewatering the temporarily isolated areas of the River Itchen to install the drainage outfalls (see **Chapter 13 (Road Drainage and the Water Environment)** of the **ES (Document Reference 6.1)**. The dewatering would be undertaken in accordance with all required licences and permits, in agreement with the Environment Agency.

9.8.14 Potential impacts to soil resources would be mitigated through the following measures to be incorporated into a Soil Management Plan, a Soil Resources Plan and the **fiEMP (Document Reference 7.3)** (a draft Soil Management Plan is appended to the **fiEMP (Document Reference 7.3)**):

- Works would be undertaken in compliance with the Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. (Defra, 2009) and 'Specification for Topsoil' (BS3882: 2015)

- Soil sampling, testing, assessment and re-use criteria would be defined in an earthworks specification for the construction works. This specification would be prepared in accordance with the Specification for Highway Works, Series 600 Earthworks

- The Soil Management Plan would detail the areas and type of top/subsoil to be stripped, stripping method, haul routes and the management of the soil stockpiles. This would ensure high standards in the handling, storage and reinstatement of soils following construction

- The Soil Resources Plan would detail the areas and type of soil to be stripped, haul routes, the methods to be used, and the location, type and management of each soil stockpile to help protect and enhance soil resources on site. This plan would be prepared by the Principal Contractor during the detailed design stage and included within the siEMP

- Topsoil would be handled only in the appropriate conditions of weather and soil moisture, and with suitable machinery in line with the Defra Construction Code of Practice and relevant British Standards

- Topsoil excavated from areas of known high quality agricultural land would be stored separately and, where possible, reused in areas that would be returned to agricultural use

- The stockpiling of soils would be avoided wherever possible. Where stockpiling is unavoidable, heaps would be tipped loosely and the surface firmed and shaped to shed water. Where soils are to be stockpiled for more than six months the surface would be seeded with an appropriate seed mix

- Any soils that do not meet chemical acceptability criteria for reuse on site would be treated or disposed of to a suitable licenced facility

- The movement of traffic would be confined to designated haul routes to reduce the amount of heavy machinery going over soil materials which could cause compaction of soil materials

9.8.15 Following the completion of construction activities, agricultural land taken on a temporary basis would be restored and returned to the landowner for unrestricted use in the same agricultural condition (ALC) grade that currently exists. This would require monitoring as set out in the Soil Management Plan.

Operation

9.8.16 Potential risks posed to maintenance workers would be mitigated through adherence to appropriate health and safety documentation and good practice measures.

Enhancements

9.8.17 Enhancement is defined by DMRB LA 104 as *"a measure that is over and above what is required to mitigate the adverse effects of a project".*

9.8.18 No enhancements in relation to geology and soils are anticipated

9.9 Assessment of likely significant effects

9.9.1 This section presents the assessment of likely significant effects for construction and operation on geology and soils. The assessment of effects takes into account the potential impacts to each receptor following the implementation of embedded and essential mitigation measures to determine the significant of the residual effects.

Construction (including site preparation) - Geology, contamination (human heath, surface water, groundwater) and the built environment

Human Health

9.9.2 Potential contamination within the soils and groundwater from identified and unidentified sources has the potential to affect construction workers and neighbours, and cause health impacts as a result of direct or indirect contact with contaminated materials. A Tier 2 geoenvironmental risk assessment and GQRA has been undertaken as part of the **Ground Investigation Report (Document Reference 7.11)** which concluded that there is a very low risk from existing potential contamination sources within the study area (as no significant sources anticipated). On that basis, the requirement for further Tier 3 risk assessment has not been identified and risks to construction workers and neighbours have not been identified, resulting in a negligible/minor magnitude of impact and a slight adverse effect, which is not significant. Risks to construction workers from potential unexpected contamination would be adequately mitigated through the essential mitigation measures. Therefore, the

magnitude of impact is likely to be negligible to the receptor of high sensitivity, resulting in a slight adverse effect which is not significant.

Controlled Waters (groundwater and surface water)

9.9.3 Pollution releases during the construction phase have the potential to affect groundwater and surface water receptors, which are considered to have a very high sensitivity. With the implementation of essential mitigation measures, the magnitude of impact is anticipated to be negligible, which would result in a temporary slight adverse effect which is not significant.

9.9.4 A potential effect of the construction of specific elements (such as piled foundations) of the Scheme is the mobilisation of any contamination present in made ground, and the creation of new preferential pathways for the migration of contamination to groundwater and surface water which are considered to have a very high sensitivity.

9.9.5 A Tier 2 geoenvironmental risk assessment and Generic Quantitative Risk Assessment (GQRA) for controlled waters, included within the **Ground Investigation Report (Document Reference 7.11)** has been undertaken and concluded that there is a low risk of significant existing contamination within the Application Boundary and therefore a low risk to surface water and groundwater from existing potential contamination sources. On that basis, the requirement for Tier 3 risk assessment has not been identified. Therefore, the magnitude of impact is expected to be negligible. To receptors of very high sensitivity this results in a slight adverse effect which is not significant.

Environmentally Sensitive Sites

9.9.6 Pollution releases during the construction phase have the potential to affect environmentally sensitive sites, which are considered to have a very high sensitivity. With the implementation of essential mitigation measures, the magnitude of impact is anticipated to be negligible, which would result in a temporary slight adverse effect which is not significant.

9.9.7 A potential effect of the construction of specific elements (such as piled foundations) of the Scheme is the mobilisation of any contamination present in made ground, and the creation of new preferential pathways for the migration of contamination to environmentally sensitive sites which are considered to have a very high sensitivity.

9.9.8 A Tier 2 geoenvironmental risk assessment, included within the **Ground Investigation Report (Document Reference 7.11)** has been undertaken and concluded that there is a low risk of significant existing contamination within the Application Boundary and therefore a low risk to environmentally sensitive sites from mobilisation of existing potential contamination sources. On that basis, the requirement for Tier 3 risk assessment has not been identified. Therefore, the magnitude of impact is expected to be negligible. To receptors of very high sensitivity this results in a slight adverse effect which is not significant.

Built Environment

9.9.9 The natural strata present within the study area are such that there is the potential for naturally occurring geological hazards and other land stability constraints to be present which could affect the Built Environment (medium sensitivity), end users (low sensitivity) and construction workers (high sensitivity).The engineering assessment and geotechnical risk register, within the **Ground Investigation Report (Document Reference 7.11)** indicates that there are suitable, appropriate and robust mitigation measures readily available to mitigate potential land stability risks. With the implementation of the embedded mitigation, the magnitude of impact is anticipated to be negligible resulting in a temporary neutral effect for medium and low sensitivity receptors, and a slight adverse effect for high sensitivity receptors which is not significant.

Construction (including site preparation) – Soils/Agricultural Land

9.9.10 The construction of the Scheme would require permanent works on 18.7ha of BMV agricultural land; 11.8ha of grade 2 (very high sensitivity) and 6.9ha of grade 3a (high sensitivity). This land is shown on **Figure 9.2 (Agricultural Land Classification)** of the **ES (Document Reference 6.2)**. For the grade 2 land, this would lead to a moderate magnitude of impact (given the Scheme would require permanent loss of less than 20ha of agricultural land). Given the permanent nature of the impact and that the loss of grade 2 land cannot be mitigated it would constitute a permanent very large adverse effect which is significant.

9.9.11 For grade 3a land, this would lead to a moderate magnitude of impact (given the Scheme would require permanent loss of less than 20ha of agricultural land). Given the permanent nature of the effect, the loss of grade 3a land and that it cannot be mitigated, this would constitute a permanent large adverse effect which is significant.

9.9.12 The permanent loss of 8ha of ALC grade 3b (medium sensitivity) agricultural land would result in a moderate magnitude of impact given the permanent loss of less than 20ha of agricultural land. Given the permanent nature of the effect, and that the loss of grade 3b land cannot be mitigated this would lead to a permanent moderate adverse effect which is significant.

9.9.13 The permanent loss of 0.1ha of ALC grade 4 agricultural land (low sensitivity) would result in a negligible impact. This would then result in a permanent slight adverse effect which is not significant.

9.9.14 The Scheme would also require the temporary loss of agricultural land which would take soil out of agricultural use during construction. Following completion of construction, all temporary facilities would be removed, and the soil reinstated in accordance with the agreed end use for the land. The agricultural soil temporarily displaced by the Scheme would, after restoration, be able to fulfil its primary soil functions on-site. This would be managed by the Soil Management Plan and Soil Resources Plan to be developed by the Principal Contractor, a

draft Soil Management Plan is appended to the **fiEMP (Document Reference 7.3)** which would ensure the soil is returned to an agreed condition.

9.9.15 The temporary loss of 6.6ha of ALC grade 2 agricultural land would result in a minor impact given the temporary loss of soil function and the proposal to manage soils during construction and return the land to agriculture. This minor impact combined with the very high value of grade 2 land, would result in a temporary large adverse effect which is significant (as there is a loss of between 1ha and 20ha BMV which is defined as significant in DMRB LA 109).

9.9.16 The temporary loss of 5.5ha of ALC grade 3a agricultural land would result in a minor impact given the temporary loss of soil function and the proposal to manage soils during construction and return the land to agriculture. This minor impact combined with the high value of grade 3a land, results in a temporary moderate adverse effect which is significant (as there is a loss of between 1ha and 20ha BMV which is defined as significant in DMRB LA 109).

9.9.17 The temporary loss of 4.3ha of ALC grade 3b agricultural land would result in a minor impact given the temporary loss of soil function and the proposal to manage soils during construction and return the land to agriculture. This minor impact combined with the medium value of grade 3b land, results in a temporary slight adverse effect which is not significant (grade 3b not considered to be BMV).

Operation - Geology, contamination (human heath, surface water, groundwater) and the built environment

Human Health

9.9.18 Potential impacts from the introduction of new potential contaminants to the environment as a result of spills during ongoing routine use of the motorway, together with major accidents has the potential to affect end users (low sensitivity) and maintenance workers (high sensitivity) through exposure to fuels and oils etc. With the implementation of the mitigation measures within the design mentioned above, the magnitude of impact is considered to be negligible to the receptors, resulting in slight adverse effects which are not significant.

Controlled Waters (groundwater and surface water) & Environmentally Sensitive Sites

9.9.19 Potential impacts from the introduction of new potential contaminants to the environment as a result of run off from spills during ongoing routine use of the motorway, together with major accidents has the potential to affect controlled waters (very high sensitivity) and also environmentally sensitive sites (very high sensitivity) through the introduction of potential contaminants to surface water and groundwater.

Potential impacts on controlled waters associated with drainage and surface water discharge proposals are considered within **Chapter 13 (Road Drainage and the Water Environment)** of the **ES (Document Reference 6.1)**.

Operation – Soils

9.9.20 There would be no additional effects to soils during operation above those identified under construction.

9.10 Monitoring

9.10.1 Both temporary and permanent significant effects are predicted, owing to the loss of BMV agricultural land. However, this is due to land take for the Scheme which cannot be mitigated (other than through compensation payments). There would be ongoing discussions with relevant land-owners as appropriate to discuss extent of land-take and operational issues that may arise, and mitigation but no monitoring is proposed.

9.11 Summary

9.11.1 The assessment of ground conditions for the Scheme has been undertaken following a tiered approach[1]. The findings of this chapter have been informed through a Tier 1 qualitative assessment and Tier 2 generic risk assessment based upon the findings of an intrusive investigation, as recommended within industry guidance.

9.11.2 Following assessment of the baseline conditions it was identified that controlled waters (groundwater and surface water) and environmentally sensitive sites have a very high sensitivity and the built environment and human health (construction workers and neighbours) have a high sensitivity.

9.11.3 The Tier 1 and Tier 2 risk assessments undertaken identified that the potential for significant contamination to be present within the Application Boundary was considered to be Low. A Controlled Waters Risk Assessment also identified a Low risk to controlled water receptors from existing contamination. Therefore, whilst there are very high sensitivity receptors (groundwaters and surface waters), as mentioned above, the impact assessment has not identified any significant effects.

9.11.4 It is also considered that through ongoing appropriate design and construction methods these would provide mitigation against many of the potential issues and reduce any residual impacts further.

9.11.5 The assessment of effects on agricultural land has been informed by intrusive investigation and detailed classification of agricultural land within the Application Boundary. It has been identified that the permanent loss of grade 2, 3a and 3b

[1] Note: The assessment relies upon the Phase 1 Ground Condition Assessment which was a preliminary investigation. Mitigation would be further informed by further phases of ground investigation during the detailed design and mitigation updated within the siEMP as part of the discharge of DCO Requirements process.

land would result in a permanent adverse effect which is significant, while the temporary loss of grade 2 and 3a land would result in a temporary adverse effect which is significant.

9.11.6 The permanent loss of grade 4 land, and temporary loss of grade 3b land is not considered to be significant.