# M25 junction 10/A3 Wisley interchange TR010030
# 6.3 Environmental Statement Chapter 10: Geology and soils

Regulation 5(2)(a)
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009


Volume 6
June 2019

**Infrastructure Planning**

**Planning Act 2008**

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

# M25 junction 10/A3 Wisley interchange

**The M25 junction 10/A3 Wisley interchange Development Consent Order 202[x ]**

## 6.3 ENVIRONMENTAL STATEMENT CHAPTER 10: GEOLOGY AND SOILS

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| **Regulation Number:** | Regulation 5(2)(a) |
| **Planning Inspectorate Scheme Reference** | TR010030 |
| **Application Document Reference** | TR010030/APP/6.3 |
| **Author:** | M25 junction 10/A3 Wisley interchange project team, Highways England |

| Version | Date | Status of Version |
|---|---|---|
| Rev 0 | June 2019 | Development Consent Order application |

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# 10. Geology and Soils

## Executive summary

Without mitigation measures, the contaminated land risk assessment identified a number of potentially moderate risks as pollutant-contaminant-linkages (PCLs). However, with the implementation of the proposed design and mitigation measures, the risks of the PCLs were assessed as moderate/low risk and low risk. During construction, the effects of these PCLs with the implementation of design and mitigation measures were mostly assessed as temporary and negligible (not significant), with two permanent moderate beneficial (significant) effects identified, associated with sensitive controlled water bodies in the Scheme and study area. These significant effects would be the result of remediation of any contamination if it is encountered during the ground investigation (GI), subsequently improving the baseline conditions. During operation, the majority of effects have been assessed as negligible and minor beneficial (permanent and not significant), with the two moderate beneficial effects identified during the construction continuing to benefit the controlled water receptors during operation.

With the implementation of design and construction mitigation measures, the geology and geomorphology impact assessment identified one temporary minor adverse effect, associated with potential soil erosion during construction. Other geology and geomorphology effects (including topography and ground stability features) were assessed to be negligible or minor beneficial (due to the anticipated removal of any inadequate material prior to construction) and permanent. None of the anticipated geology and geomorphology effects are considered significant.

A GI for the Scheme is proposed to investigate the existing geology, hydrogeology and soil conditions discussed within this chapter. The DCO includes a requirement that no intrusive construction ground works associated with the Scheme will commence until, for that part a GI and risk assessment have been submitted to and approved by the Secretary of State, following consultation with the Environment Agency and the relevant planning authority.

With the design and mitigation measures proposed, there are no likely significant adverse residual effects concerning geology and soils.

No cumulative effects with regards to geology and soils are likely as a consequence of the development of the Scheme.

## 10.1 Introduction

10.1.1 This chapter has been prepared to identify the likely effects with respect to geology and soils resulting from the Scheme and assesses the following topics:

- Direct impacts on mineral resource sterilisation and geological Sites of Specific Scientific Interest (SSSI);
- Direct impacts on relevant receptors from land or groundwater contamination;
- Effects associated with pre-existing land and groundwater contamination, for example mobilising contamination and introducing new pathways and receptors;
- Physical effects such as changes in topography, soil erosion, aggressive ground and ground stability; and
- The possible cumulative effects of the Scheme on geology and soils, in conjunction with nearby developments.

10.1.2 This chapter discusses hydrology and hydrogeology with respect to the potential contamination impacts of the Scheme on controlled waters[1]. Chapter 8 discusses the potential impacts of the Scheme on the water environment as a resource. Chapter 8 also discusses impacts associated with the potential for polluting substances to reach the water environment during the operation of the Scheme, such as accidental spillage of fuels.

10.1.3 For consideration of the re-use, treatment and disposal of waste soils, refer to Chapter 12 and for direct impacts on agricultural land, soil quality and farming, refer to Chapter 13.

10.1.4 Surrey County Council (SCC) have previously advised that they do not consider the proposed Scheme would pose a significant risk of sterilising mineral resources. The Scheme boundary has altered since those discussions with took place, however with the alterations to the boundary being minor, the position remains as advised.

## 10.2 Competent expert evidence

10.2.1 The geology and soils assessments have been carried out with oversight by the following individuals:

- A Contaminated Land and Hydrogeology Technical Director (BSc (Hons) Applied Biology, Post Graduate Diploma Hazardous Waste Management) with over 35 years of experience in contaminated land, remediation and environmental due diligence, holding professional memberships as Chartered Environmentalist, Chartered Scientist, Chartered Water & Environmental Manager, Chartered Waste Manager, and Specialist in Land Condition;
- A qualified Principal Environmental Consultant (BSc (Hons) Environmental Analysis, MSc Contaminated Land Management, Chartered Scientist), with over 16 years of knowledge and experience in contaminated land and risk assessments, holding professional memberships with the Institute of Environmental Science and the Society of Brownfield Risk Assessment; and

[1] Controlled Waters: As defined in the Water Resources Act (1991)

- A Senior Hydrogeologist (BSc Geology, Post Graduate Diploma Engineering Geology, Post Graduate Diploma Hydrogeology, Chartered Geologist) with over 10 years of experience in hydrogeology, contaminated land and engineering geology, holding professional membership with the Geological Society.

## 10.3 Legislative and policy framework

10.3.1 Table 10.1 identifies legislation, policy and guidance relevant to the assessment of potential geology and soil impacts associated with the Scheme.

**Table 10.1: Legislative and policy framework summaries**

| Legislation / Regulation | Summary of requirements |
|---|---|
| **National** | |
| National Policy Statement for National Networks (NPSNN) (2014)[2] | The NPSNN seeks to ensure that Nationally Significant Infrastructure Projects (NSIPs) are designed to minimise social and environmental impacts and to improve quality of life. Further, in delivering new schemes, opportunities to deliver environmental benefits should also be considered as part of scheme proposals.<br>Water quality and resource guidance and policy is set out in paragraphs 5.219 to 5.231 of the NPSNN. The objective is that new and existing development should be prevented from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution. Key requirements are that the existing status of water quality, water resources and physical characteristics in the water environment must be ascertained and that the impacts of the proposed Scheme, including those associated with any cumulative effects are assessed. Careful design to facilitate adherence to good pollution control practice can reduce the risk of impacts on the water environment. |
| The National Planning Policy Framework (NPPF) (2018)[3] | The NPPF states that local planning policies and decisions should ensure that:<br>• the site is suitable for its new use, taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);<br>• after remediation, as a minimum, land should not be capable of being determined as Contaminated Land as defined under Part 2A of the Environmental Protection Act (EPA) 1990 as amended;<br>• adequate site investigation information, prepared by a competent person, is presented;<br>• "Decisions should contribute to and enhance the natural and local environment by protecting and enhancing…sites of... geological value and soils"; and<br>• "Decisions should support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land." |

[2] Department for Transport (2014) National Networks National Policy Statement (NN NPS), Accessed on 16/10/2018 from https://www.gov.uk/government/collections/national-networks-national-policy-statement
[3] Department for Communities and Local Government (2018) National Planning Policy Framework

| Legislation / Regulation | Summary of requirements |
|---|---|
| | • Policies for water quality and resources within the NPPF are presented in Section 15. The key aspect is to prevent new and existing developments from contributing or being adversely affected by water pollution. |
| Environment Agency & National House Building Council (NHBC) report R&D66 (2008)[4] | Report R&D66 provides guidance on the development and application of the consequence and probability matrix and guidance on conducting a risk assessment. This consequence and probability matrix is used as part of the assessment of potential impacts and assessment of likely significant effects in Table 10.2 of this report. |
| The Environmental Protection Act (EPA) 1990[5] | Part 2A of the EPA provides a statutory regime for the identification and remediation of 'Contaminated Land'. It introduced, for the first time in the UK, a statutory definition of 'Contaminated Land' based on significant harm or the likelihood of significant harm or the pollution or likely pollution of controlled waters (all groundwater, inland waters and estuaries, excluding water perched above the zone of saturation).<br>Local authorities are the primary regulators under the Part 2A regime, with a duty to identify whether the land in their area is 'Contaminated Land', although provision is made for consultation and co-ordination with the Environment Agency in situations where pollution of controlled waters is an issue. |
| Department for Environment, Food and Rural Affairs (Defra) Contaminated Land Statutory Guidance (2012)[6] | The principal objectives of the Contaminated Land Statutory Guidance are to:<br>• identify and remove unacceptable risks to human health and the environment;<br>• seek to ensure that contaminated land is made suitable for its current use; and<br>• ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.<br>These three objectives underlie the 'suitable for use' approach to the assessment and remediation of 'land contamination'. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected. The 'suitable for use' approach consists of three elements:<br>• ensuring that land is suitable for its current use;<br>• ensuring that land is made suitable for any new use; and<br>• limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land. |
| Contaminated Land Report 11 (CLR11)[7] and the Guiding Principles for Land Contamination (GPLC)[8] | Report CLR11 provides a technical framework for the identification and remediation of contamination through the application of a risk management process. |

[4] Environment Agency & NHBC (2008) Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66.
[5] United Kingdom Parliament (1990) Environmental Protection Act
[6] Department for Environment, Food and Rural Affairs (2012) Environmental Protection Act: Part 2A Contaminated Land Statutory Guidance
[7] Environment Agency (2004) The Model Procedures for the Management of Land Contamination (CLR 11)
[8] Environment Agency (2010) Guiding Principles for Land Contamination (GPLC)

| Legislation / Regulation | Summary of requirements |
|---|---|
| | GPLC are a package of three documents which provide generic guidance to help clarify roles and responsibilities, encourage good practice and advise on other relevant documents. |
| The Water Resources Act (1991)[9] | The Water Resources Act provides controls of pollution of water sources in Section III. It contains information about water quality objectives, powers to prevent and control pollution and pollution offences. |
| Environment Agency's approach to groundwater protection (2017)[10] | This document contains position statements on Source Protection Zones identified as drinking water protected areas and aquifer designations. It states that:<br>• the development of infrastructure should be directed to less sensitive groundwater locations;<br>• the Environment Agency will use a risk based tiered approach to regulate activities that may impact groundwater resources; and<br>• the Environment Agency expects developers and operators to take into account all current and future groundwater uses and their dependent ecosystems. |
| Water Framework Directive (WFD) (2000)[11] | The WFD establishes a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. It requires that:<br>• environmental objectives should be set to ensure that good status of groundwater is achieved and that its deterioration is avoided. This includes that any upward sustaining trend in the concentration of a pollutant must be identified and reversed;<br>• a good status of groundwater requires early action and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal; and<br>• monitoring programmes should cover monitoring of the chemical and quantitative status of groundwater. |
| **Regional** | |
| Borough of Elmbridge Council Local Plan which comprise of Core Strategy and Development Management Plan (2015)[12] | The Local Plan establishes planning policies for Elmbridge until 2020. Those most relevant to this chapter are contained in Section DM5 of the Local Plan (Pollution), which includes requirements for development on, or near to land which is suspected to be contaminated, including that:<br>• development affecting contaminated land will be permitted if it is remediated to be suitable for the proposed use;<br>• development of contaminated land must consider the sensitivity of future receptors;<br>• remedial decontamination measures must prevent harm to living conditions, biodiversity, or the buildings themselves; and<br>• all works, including the investigation of the nature of contamination should be conducted without escape of contaminants that cause a risk to health or the environment.<br>Section DM13 (Riverside development and uses) states proposals should demonstrate a development would protect, |

[9] UK Government (1991) The Water Resources Act (Online). Accessed on 16/10/2018 from http://www.legislation.gov.uk/ukpga/1991/57/contents
[10] Environment Agency (2017) The Environment Agency's Approach to Groundwater Protection (Online). Accessed on 16/10/2018 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/620438/LIT_7660.pdf
[11] European Parliament (2000) Water Framework Directive (Directive 2000/60/EC)
[12] Elmbridge Borough Council (2017) Elmbridge Local Plan, November 2017

| Legislation / Regulation | Summary of requirements |
|---|---|
| | conserve and actively enhance the landscape and biodiversity of the river and would not adversely affect water or ecological quality in the area in accordance with the WFD[11]. |
| Guildford Borough Council Draft Local Plan (2003)[13] | A new Local Plan has been submitted to the Secretary of State for examination by the Planning Inspectorate. The existing Local Plan sets out policies for development of Guildford up to 2006 but the Secretary of State for Communities and Local Government gave a direction in 2007 that the Local Plan policies are saved and remain in effect apart from policies H1, H10, S1, RE7, HE11, and proposal U1.<br>The plan contains policies relating to environmental protection and enhancement. Those most relevant to this chapter are contained in paragraphs 4.22 and 4.32 which include requirements for development on, or near to land which is suspected to be contaminated, including that:<br>• developments affecting contaminated land must not give rise to unacceptable risks to the environment or health; and<br>• when proposed development is near contaminated land the applicant must show that the site is safe or can be made so through remedial measures. |
| Woking Borough Council local development document Woking 2027 (2018)[14] | Woking 2027 includes the requirements for Sustainability Appraisal/Strategic Environmental Assessment, which states that appraisals should look for the following aspects with respect to contaminated land and agricultural soils:<br>“Development that helps remediate contaminated land to suitable use”. |
| Surrey County Council Minerals Plan 2011 Core Strategy Policy (MC6)[15] | Non-mineral development has the potential to sterilise mineral resources or prejudice the operation of existing or proposed sites. Development needs to consider the quality and quantity of mineral reserve impacted by the proposed development, if the mineral can be abstracted prior to or during development and whether the proposal can be modified to avoid sterilisation. |
| Thames river basin district: River basin management plan (RBMP) (2015)[16] | The RBMP is designed to protect and improve the quality of the water environment. It includes consideration of the following topics:<br>• plans for the protection and improvement of the water environment;<br>• future plans that may affect the infrastructure sector and its obligations;<br>• development proposal considerations regarding the requirements of the RBMP; and<br>• environmental permit applications. |

## 10.4 Study area

10.4.1 The study area has been determined by (i) the extent of likely impacts from the proposed Scheme, (ii) the soil, geology and hydrogeology surrounding the Scheme (including the predicted presence, flow rate/direction of groundwater) and (iii) the nature of the proposed construction works. The construction stage is not

[13] Guildford Borough (2003) Local Plan. Accessed on 06/04/2018 from http://www.guildford.gov.uk/newlocalplan/CHttpHandler.ashx?id=1068&p=0
[14] Woking 2027 (2017) Local Development Working Document. Accessed on 08/02/2018 from http://www.woking2027.info/
[15] Surrey County Council (2011) Surrey Minerals Plan 2011, Core Strategy, Development Plan Document, adopted 19 July 2011
[16] Department for Environment and Food and Rural Affairs & Environment Agency (2015) Thames River Basin District: River Basin Management Plan. Updated December 2015.

envisaged to require any active dewatering activities, however the works will require localised groundwater control measures to be implemented, these are not envisaged to affect the water table beyond the Scheme. As such, the assessment of geology and soils has considered a study area extending 250 m from the extent of the Scheme boundary. A plan of the study area is provided on the topography figure (Figure 10.1).

10.4.2 For the purposes of this assessment, the identified potential sources, pathways and receptors have been split into those within the Scheme boundary and those within the study area. As such, 'on-site' within Chapter 10 refers to the extent of the Scheme and 'off-site' refers to locations within the 250 m study area but not within the Scheme boundary.

## 10.5 Assessment method

10.5.1 The assessment of the potential impacts of the Scheme on geology and soils has been undertaken over two stages within this document, with the third stage yet to be conducted, as agreed with the Environment Agency:

- Stage 1 - Land contamination risk assessment;
- Stage 2 - Land contamination impact assessment and geology and geomorphology impact assessment; and
- Stage 3 - Proposed GI and associated risk assessments.

10.5.2 Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 1 General Principles and Guidance of Environmental Impact Assessment HA 201/08 (DMRB, 2008) states that the assessment process can follow either that of a 'simple assessment' or a 'detailed assessment'. A simple assessment is considered sufficient where it is 'established confidently that the forecast environmental effect would not be a fundamental issue in the decision-making process' (DMRB, 2008). Where this is not the case a detailed assessment, comprising 'detailed field surveys and/or quantified modelling techniques', is likely to be required. The inference from HA 201/08 is that where a significant adverse impact has the potential to be present then field surveys are required to quantify risk.

10.5.3 Section 55 of the Planning Act 2008 (HMSO, 2008) also sets out various criteria that an application for a DCO should meet. This includes the statement that 'the application (including accompaniments) is of a standard that the Secretary of State considers satisfactory'. The Planning Inspectorate's Advice Note 6 (Preparation and submission of application documents) (Planning Inspectorate, 2016) also states that 'applications should also ensure that all surveys required to be carried out to establish baseline conditions, and to complete the assessment of likely significant effects, are completed before the submission of the application, and reported in the ES'.

10.5.4 The assessment presented herein is based on a phase 1 desk-based assessment and is been developed using the Rochdale approach where appropriate, a 'realistic likely worst case' impact has been assumed which have been mitigated. In line with both HA201/08 and HMSO, 2008 the assessment presented here in is considered robust as it establishes that the forecast environmental effects are not a fundamental issue in the decision-making process.

10.5.5 The approach adopted for the land contamination risk assessment has been based on the guidance document CLR11[7] and Environmental Impact Assessment: Guide to Good Practice and Procedures[17]. These documents are considered key guidance in the UK and provide a technical framework for the application of a risk management process.

10.5.6 A desk study review of available information has been undertaken to develop a Conceptual Site Model (CSM), which identifies the linkages between potential contamination sources, pathways and receptors relevant to the Scheme and study area. Where all three are present or considered likely to be present, these are described as a PCL. Where risks are identified, these will be assessed in the proposed GI and consideration will be given to whether these would be appropriately mitigated through design and/or the development of a remediation strategy and subsequent validation.

10.5.7 The risk assessment applies the principles given in R&D66[4], which provides guidance on the development and application of the consequence and probability matrix for contaminated land risk assessment, presented in Table 10.2 below.

10.5.8 The potential risk to a receptor is the function of the probability and consequence of the PCL being realised. Probability (likelihood of an event occurring) takes into account the presence of the hazard, the receptor and the integrity of the exposure pathway. Consequence takes into account the potential severity of the hazard and the sensitivity of the receptor. Definitions for the classifications of probability and consequence are provided in Appendix 10.1, along with the descriptions of the classified risks.

**Table 10.2: Land quality estimation of the level of risk**

| Probability | Consequence | | | |
|---|---|---|---|---|
| | Severe | Medium | Minor | Negligible |
| 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 |

Table Source: based on R&D66[4]

## Stage 2 - Impact assessment methods

*Land contamination impact assessment method*

10.5.9 The land contamination impact assessment is based on the change of risk (identified in Stage 1) between the baseline and the different phases of the Scheme (i.e. during construction and operation). The calculated increase or decrease in risk identifies the magnitude of impact, as described in Table 10.3, however professional judgement has been used in instances where a receptor is not present during every phase of the Scheme.

[17] Department for Communities and Local Government (2006) Archived Environmental Impact Assessment: A Guide to Good Practice and Procedures (a consultation paper), Accessed on 16/10/2018 from http://webarchive.nationalarchives.gov.uk/20080307004146/http://www.communities.gov.uk/documents/planningandbuilding/pdf/151087

**Table 10.3: Land contamination impact assessment (significance of effects)**

| Classification of significance | 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. |
| 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. |
| 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/low risk. |
| Negligible | Negligible 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/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/low or low risk. |
| 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. |

Table Source: Atkins bespoke system of identifying significance of effect

10.5.10 Following the classification, a clear statement is made 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 has also been applied where appropriate as per section 3.6 of DMRB Volume 11, Section 2, Part 5[18].

10.5.11 The time-period in which the land contamination impacts may have effect for has also been prescribed (temporary or permanent), with construction generally associated with temporary effect and the operational phase associated with permanent effect.

*Geology and geomorphology impact assessment method*

10.5.12 The value and/or sensitivity of a geology and geomorphology baseline condition has been considered when determining the consequence of an impact. The value and/or sensitivity of each of the baseline conditions has been determined using the criteria given in Table 10.4.

**Table 10.4: Criteria for classifying the value and/or sensitivity of geology and geomorphology baseline conditions**

| Value / Sensitivity | Criteria | Examples |
|---|---|---|
| High | Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor.<br>Attribute has a very low capacity to accommodate the proposed change. | Statutory geological sites e.g. Geological SSSI, Regionally Important Geological and Geomorphological sites (RIGS).<br>Sensitive topographic features.<br>High risk ground stability, soil compaction or erosion hazards. |

[18] DMRB (2008). Volume II section 2 Part 5 HA 205/08. Assessment and management of environmental effects.

| Value / Sensitivity | Criteria | Examples |
|---|---|---|
| | | High potential for encountering unexploded bombs. |
| Medium | Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor.<br>Attribute has a low capacity to accommodate the proposed change. | Moderate sensitivity topographic features.<br>Moderate ground stability, soil compaction or erosion hazards.<br>Moderate potential for encountering unexploded bombs. |
| Low | Attribute only possesses characteristics which are locally significant.<br>Attribute has some tolerance/ the capacity to accommodate the proposed change. | Low sensitivity topographic features.<br>Low ground stability, soil compaction or erosion hazards.<br>Low potential for encountering unexploded bombs. |

Table Source: Based on DMRB Volume 11, Section 2, Part 5[18]

10.5.13 Following determination of the value/sensitivity of geology and geomorphology baseline conditions, the magnitudes of construction phase and operational phase potential impacts are determined based on the criteria defined in Table 10.5, assessed assuming design and mitigation measures are implemented.

**Table 10.5: Criteria for classifying magnitude of impact of geology and geomorphology baseline conditions**

| Classification of magnitude | Criteria |
|---|---|
| High | Total loss or major alterations to a key element, feature or characteristic of the baseline. The post-development situation will be fundamentally different. |
| Medium | Partial loss or alteration to a key element, feature or characteristic of the baseline. The post-development situation will be partially changed. |
| Low | Minor loss or alteration to a key element, feature or characteristic of the baseline. Post-development, the change will be discernible, but the underlying situation will remain similar to the baseline. |
| Negligible | Very minor loss or alteration to a key element, feature or characteristic of the baseline, such that post-development, the change will be barely discernible, approximating to the “no change” situation. |

Table Source: Based on DMRB Volume 11, Section 2, Part 5[18]

10.5.14 The potential significance of impact is then calculated using the matrix presented in Table 10.6, which describes the relationship between the value/sensitivity (as defined in Table 10.4) and magnitude (as defined in Table 10.5).

**Table 10.6: Geology and geomorphology baseline conditions impact assessment (significance of effects)**

| Value / sensitivity | Magnitude | | | |
|---|---|---|---|---|
| | High | Medium | Low | Negligible |
| **High** | Major | Major/ moderate | Moderate | Moderate/ minor |
| **Medium** | Major/ moderate | Moderate | Moderate/ minor | Minor |
| **Low** | Moderate | Moderate/ minor | Minor | Negligible |

Table Source: Based on DMRB Volume 11, Section 2, Part 5[18]

10.5.15 The classification of geology and geomorphology baseline condition impacts has been described in Table 10.7.

**Table 10.7: Classification of magnitude of impact for geology and geomorphology baseline conditions**

| Classification | Example of effect |
|---|---|
| Major adverse | Major change in topography which negatively impacts the local community. Significant increase in soil erosion, soil compaction or ground instability.<br>Major loss of destruction of an important geological site.<br>Major sterilisation of a mineral resource. |
| Moderate adverse | Moderate change in topography which negatively impacts the local community.<br>Moderate change which increases soil erosion, soil compaction, or ground instability.<br>Moderate damage to an important geological site.<br>Moderate sterilisation of a mineral resource. |
| Minor adverse | Minor change in topography which negatively impacts the local community. Limited increase in soil erosion, soil compaction, or ground instability.<br>Minor damage of an important geological site.<br>Minor sterilisation of a mineral resource. |
| Negligible | No measurable impact / no change to geology or geomorphology baseline conditions. |
| Minor beneficial | Minor change in topography which has a positive impact on the local community.<br>Minor reduction in existing soil erosion, soil compaction, or ground instability issues.<br>Minor improvement of an important geological site.<br>Minor improvement in access to a mineral resource. |
| Moderate beneficial | Moderate change in topography which has a positive impact on the local community.<br>Moderate reduction in existing soil erosion, soil compaction, or ground instability issues.<br>Moderate improvement of an important geological site.<br>Moderate improvement in access to a mineral resource. |
| Major beneficial | Major change in topography which has a positive impact on the local community.<br>Significant reduction in existing soil erosion, soil compaction or ground instability issues.<br>Major improvement of an important geological site.<br>Major improvement in access to a mineral resource. |

Table Source: Based on DMRB Volume 11, Section 2, Part 5[18]

10.5.16 Following the classification of magnitude of geology and geomorphology impacts, a clear statement has been made 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 has also been applied where appropriate and has also been applied in classifying the time period of the effect (temporary or permanent).

## Stage 3 – Ground Investigation

10.5.17 A phase of GI will be undertaken in 2019 to further inform the design and to confirm appropriate mitigation measures and other recommendations presented within this chapter (full details of the proposed GI can be found in Appendix 10.2). In summary, the GI will:

- target areas where intrusive ground works will be undertaken, including bridges and the area where a gas pipeline will be diverted beneath the A3 just north of the proposed Wisley overbridge;
- target areas of identified potential contamination sources (i.e. the PCLs identified within the risk assessment provided in this chapter) and locations of ground instability;
- provide an assessment of geological boundaries, thickness of strata and geotechnical testing to inform geotechnical parameters for design;
- characterise the groundwater regime;
- sample identified surface water receptors to derive site-specific quality standards;
- determine the extent and nature of fill materials; and
- determine the aggressivity of the ground towards buried concrete.

10.5.18 Using data obtained from the GI, a Ground Investigation Report (GIR) Piling Risk Assessment (PRA) and generic quantitative risk assessments (GQRAs) for human health and controlled water receptors will be undertaken and detailed quantitative risk assessments (DQRAs) and/or remediation strategies (if deemed necessary) will be produced. The GQRA will evaluate whether the concentrations of contaminants in soil, soil-derived leachate, ground gas and groundwater present potential risks to either human health or the environment (including surface water ecology). The risk to receptors from soil and water is assessed through the comparison of the GI results with appropriate generic assessment criteria (GAC). GAC are concentrations of a contaminant in soil or groundwater, below which the level of risk is considered to be acceptable. Ground gas readings will also be assessed.

10.5.19 The proposed GI work is expected to take approximately five months to complete with subsequent baseline monitoring, laboratory analysis, assessments and reporting. The data and documents associated with the GI are not included in this chapter but will be made available as soon as possible. No intrusive groundworks within the Scheme will commence until for that part a GI and risk assessment have been submitted to and approved by the Secretary of State, following consultation with the Environment Agency and the relevant planning authority.

## 10.6 Assumptions and limitations

10.6.1 Based on the preliminary design shown on the Scheme layout plans the following works are assumed to be required for the development of the Scheme.

10.6.2 The proposed development comprises works to improve the junction and the M25 slip roads and widen the A3 carriageways, as well as to construct new access roads and bridges. It has been assumed that this work will include piling, cuttings, temporary stock piling and construction of embankments, retaining walls, underpasses, soakaways, filter/carrier drains and attenuation ponds.

10.6.3 Proposed works close to Ockham Park junction include a pipe diversion beneath the A3, piling, brook diversion and drainage attenuation area associated with the Stratford Brook underbridge. Piling and a drainage attenuation area are also proposed at the new Wisley Lane overbridge, along with retaining walls associated with the A3 slip road upgrade and the new Wisley Lane realignment.

10.6.4 Several retaining walls that involve base slab footing and potential earthworks are proposed near Painshill, the most extensive being along Painshill junction, by Redhill Road and at the existing interchange. Seven replacement bridges are proposed – the new Wisley Lane overbridge; Replacement Cockrow overbridge new Sandpit Hill overbridge, Replacement Clearmount overbridge; new junction east bridge; new junction 10 west bridge; and new Red Hill overbridge.

10.6.5 Detailed design has not been undertaken, however, for the purposes of this assessment, the likely 'realistic likely worse-case' impact from the Scheme has been assumed and sought to be mitigated. The potential for the worst-case scenario to arise is low (given the assumptions listed in 10.6.6) and in comparison to the size of the Scheme, the locations of proposed groundworks are expected to be localised and limited.

10.6.6 The assumptions made in informing the 'realistic likely worst case' scenario are as follows:

- shallow ground disturbance such as stripping of top soil/Made Ground, excavation of drainage/utility conduits either temporary/permanent during the construction phase could be anywhere within the Scheme boundary;
- intrusive GI works and piles/deep foundations could be anywhere within the Scheme boundary;
- there will be areas used for parking of vehicles during the construction phase, which could be anywhere within the Scheme boundary;
- there will be areas used for storage of hazardous materials containers during the construction phase, which could be anywhere within the Scheme boundary;
- compound buildings required during construction will have integral gas protection measures/be raised above ground;
- the Scheme will not introduce buildings/enclosed spaces other than chambers/ducts;
- no active dewatering of groundwater will occur during the construction works, where work extends below the water table; and
- where potential sources of contamination have been identified, contaminants are assumed to be present.

## 10.7 Baseline conditions

10.7.1 This section provides a summary of the baseline geology and soil conditions of the Scheme and study area, on the basis of the available information.

### Current setting

10.7.2 The majority of the Scheme area is currently occupied by the existing M25, A3 and various side roads. The remainder of the land within the Scheme boundary

includes agricultural land, woodland and lakeside recreational areas, part of the former Wisley Airfield and three historical landfills (see section 10.7.60 for further details).

10.7.3 The wider study area comprises public space (woodland recreational areas), the former Wisley Airfield, RHS Wisley, farms, a railway, other agricultural land, surface water features (see 10.7.57) and some mixed development including residential and commercial land uses.

10.7.4 There are no geological SSSI or Local Geological Sites (formerly RIGS) within the Scheme boundary or study area.

10.7.5 There are several designations of sensitive environments within the Scheme boundary and study area. These are:

- Ockham Common and Wisley Common SSSI, which is also part of the designated Thames Basin Heath Special Protection Area (SPA). The site is designated to support important breeding populations of a number of bird species which nest on the ground[19];
- Ockham and Wisley Local Nature Reserve (LNR). This designation occupies the SSSI and SPA mentioned above and extends to cover a wider area. This is also a designated wood pasture and parkland Biodiversity Action Plan (BAP) priority habitat; and
- Ancient Woodland and Priority Habitat deciduous woodland is also present adjacent to the Scheme and within the wider study area.

10.7.6 Further detail on these designated environments is provided in Chapter 7.

## Topography

10.7.7 Topography within the Scheme boundary ranges from 25 m to 50 m above Ordnance Datum (AOD). Topographical highs of 50 m AOD are observed on the A3, adjacent to the Gothic Tower and topographical lows of 25 m AOD are observed at Ockham Park junction on the A3.

10.7.8 No significant topographical features were identified within the Scheme boundary or study area. The topography of the Scheme and study area is displayed on Figure 10.1.

## Site History

10.7.9 The historical maps within the Envirocheck report[20] dated from 1871 to 2016, are presented in Appendix 10.3. A full review of the history is presented in Appendix 10.4.

10.7.10 Historical features and buildings of historical significance are present within the study area, however not all are featured on historical mapping (see Chapter 11 for further information on historical features).

### On-site history (within the Scheme)

10.7.11 The earliest available mapping (1871) displays an unnamed road orientated in a south-west to north-east direction, in the same location as the existing A3 (also

[19] Natural England (2018) MAGIC interactive map. Accessed on 16/10/2018 from http://jncc.defra.gov.uk/page-2050-theme=default
[20] Landmark Information Group (2017) Site specific Envirocheck Report. Purchased 5 December 2017

known as the Portsmouth Road). The Portsmouth Road terminated 2 km to the north-east of the present day M25 junction 10/A3 Wisley interchange at the existing Painshill junction. Road alignments within the Scheme extents remain largely unchanged between 1871 and 1989.

10.7.12 In 1914, a large building with a number of associated outbuildings was illustrated along the northbound side of the Portsmouth Road and labelled Whytethorne, then as a hotel in 1961.

10.7.13 By 1972, Whytethorne had undergone redevelopment and was renamed the Mayflower (later known as the San Domenico restaurant).

10.7.14 Between 1989 and 1992, the M25 and the M25 junction 10/A3 Wisley interchange had been constructed, along the A3, approximately 1.2 km to the north of the M25 junction 10/A3 Wisley interchange. Painshill junction had been developed into its current configuration 2 km to the north-east of the M25 junction 10/A3 Wisley interchange.

10.7.15 By 1992, the M25, A3 and A245 were mapped in their current configuration.

Off-site history (within the study area)

10.7.16 The 1871 to 1872 mapping illustrates that the wider study area comprises large areas of woodland, heathland and rough pasture with intersecting small tracks. Small residential developments are mapped within proximity to the Scheme, including Foxwarren, Elm Corner and Street Cobham.

10.7.17 The 1896-1897 map displays a railway, orientated in a north-east to south-west direction, immediately east of the eastern extent of the Scheme (in the present-day alignment).

10.7.18 A gasworks is mapped to the north-west of Street Cobham on the 1896-1897 map, approximately 2.3 km north-east of the M25 junction 10/A3 Wisley interchange within the north-east extent of the study area.

10.7.19 There are several historical farms located within the study area. Pointers Farm, Chatley Farm, Hatchford Farm, Park Barn Farm, Foxwarren Farm (now Home Farm) and Deers Farm are shown from 1871-1872 to the present day. Silvermere Farm (1897 to present), Long Orchard Farm (1935 to present) and Bramley Hedge (formerly Highlands) Farm (1972 to present) appear at a later stage in the historical maps.

10.7.20 RHS Wisley was developed sometime between 1914 and 1920, located imminently north of the A3 and within the south-east section of the study area.

10.7.21 The 1919 to 1920 maps illustrate a sewage works adjacent to the gasworks at Street Cobham in the north-east extent of the study area. A tank and a well are mapped immediately west of the sewage works. By 1931 the gasworks was longer present.

10.7.22 In 1964, Wisley Airfield was mapped, with a partial overlay with the Scheme but extended eastwards/south-eastwards off-site, and the airfield was present mostly within the wider study area. The development at this time consisted of a runway and four aircraft hangers. By 1977, Wisley Airfield was displayed as disused.

10.7.23 A pipeline was shown within the former Wisley Airfield, 200 m to the south-east of the existing A3 on the 1977 map. An electrical substation was also mapped within

former Wisley Airfield, 500 m south-east of the existing A3 on the 1977 map, in the south-east extent of the study area.

10.7.24 By 1989, the pipeline, electrical substation and three hangers within the former Wisley Airfield were no longer displayed on mapping. The fourth associated structure in the south of the former Wisley Airfield was not present on the 1999 map.

10.7.25 Significant earthworks were carried out between 1989 and 1992 to accommodate road construction within the study area. Overbridges connecting various tracks, paths and roads within the surrounding woodland and heathland are mapped over the M25 and A3, 400 m south, 600 m to the west, 1.2 km to the west, 1.2 km to the south-east and 1.6 km to the south-west of the M25 junction 10/A3 Wisley interchange.

## Unexploded Ordnance (UXO)

10.7.26 A UXO Pre-Desk Study Assessment (PDSA) has been carried out by Zetica[21] and is provided in Appendix 10.5. The PDSA notes that at least two World War II bombs and several other bombs have fallen close to the study area and recommends further investigation. This will be undertaken as part of the GI design.

10.7.27 The Zetica unexploded bomb risk map (also provided in Appendix 10.5) classifies the Scheme as holding a low to moderate risk of encountering unexploded bombs[22].

## Geology

### Historical exploratory hole records

10.7.28 Historical exploratory hole records from the British Geological Survey (BGS) Borehole Scans[23], Highways Agency Geotechnical Data Management System (HAGDMS) reports (Report references: 3093, 4124, 12666, 15378 and 27980)[24] and two reports provided within a former planning application for the area of the Former Wisley Airfield[25] were reviewed, and the information has been used to confirm the anticipated geological sequence within the Scheme and study area, including locations, thickness and descriptions of the anticipated geology. Detailed descriptions are provided within Appendix 10.6 and the relevant reports are provided in Appendix 10.7. The geology is summarised in the following section.

### Structural Geology

10.7.29 The Scheme is located within the London Basin, with the north-east to south-west trending axial trace of the London Basin Syncline located approximately within 10 km to the north of the M25 junction 10/A3 Wisley interchange[26].

[21] Zetica (2017) Preliminary Risk Assessment (Online) Accessed on 08/02/2018 from http://zeticauxo.com/risk-assessment/preliminary-risk-assessment/
[22] Zetica (n.d.) Regional Unexploded Bomb Risk Map - Surrey Accessed on 08/02/2018 from http://www.zetica.com/uxb_downloads.htm
[23] British Geological Survey (2017) Onshore GeoIndex (Online) Accessed on 21/03/2018 from http://mapapps2.bgs.ac.uk/geoindex/home.html
[24] Highway England (2018) Geotechnical Data Management System v.5.12.0., Accessed on 21/03/2018 from http://www.hagdms.co.uk/
[25] Guildford Borough Council (2018) Planning applications, Accessed on 21/03/2019 from http://www2.guildford.gov.uk/publicaccess/applicationDetails.do?activeTab=documents&keyVal=_GUILD_DCAPR_157858
[26] Royse, K.R., de Freitas, M., Burgess, W.G., Cosgrove, J., Ghail, R.C., Gibbard, P., King, C., Lawrence, U., Mortimore, R.N., Owen, H., Skipper, J. (2012) Geology of London, UK. Proceedings of the Geologists' Association. doi:10.1016/j.pgeola.2011.07.005

10.7.30 The BGS GeoIndex[23] suggests that the closest inferred faulting to the Scheme is 12 km to the south-west, in Guildford. However, Royse et al.[26] suggest faulting is more extensive than shown on previous geological maps, and that the London Basin bedrock is more structurally complex than originally thought; this theory is widely accepted within the UK. This will be taken into consideration when determining if faulting is present in the study area and the Scheme during GI.

Artificial deposits

10.7.31 Although not indicated on the geological maps, Made Ground associated with the construction of the M25, A3, A245 Byfleet Road, local access roads, RHS Wisley (including Battleston Hill), San Domenico site, Former Wisley Airfield and Feltonfleet School is anticipated to be present. Former natural/anthropogenic voids and features are also expected to have potentially been infilled with artificial deposits.

10.7.32 There are six potentially infilled features within the Scheme boundary. These are listed in Table 10.8 and shown on Figure 10.2. Also displayed on Figure 10.2 are potentially infilled features present within the study area.

**Table 10.8: Summary of potentially infilled features within the Scheme[20]**

| Feature | Location within the Scheme |
|---|---|
| Infilled non-water land feature (pit) | Along the A3; immediately south of the M25 junction 10/A3 Wisley interchange between the southbound carriageway and the A3 southbound on-slip |
| Infilled non-water land feature (pit) | Beneath the M25 eastbound on-slip; 250 m north-east of the M25 junction 10/A3 Wisley interchange |
| Potentially infilled water body | 2.1 km east of the M25 junction 10/A3 Wisley interchange, beneath the M25 |
| Potentially infilled water body | At the western extent of the Scheme boundary beneath the M25, 1.7 km west of the M25 junction 10/A3 Wisley interchange |
| Potentially infilled water body | At the western extent of the Scheme boundary beneath the M25, 1.9 km west of the M25 junction 10/A3 Wisley interchange |
| Potentially infilled water body | At the western extent of the Scheme boundary beneath the M25, 2.0 km west of the M25 junction 10/A3 Wisley interchange |

10.7.33 Artificial deposits associated with the A3 Spoil landfill, Land at East of Buxton Wood and Old Rectory Farm historical landfills are also expected within the Scheme boundary (see Section 10.7.60 for further information on former landfills).

Superficial deposits

10.7.34 Superficial deposits are not expected across the majority of the Scheme. Alluvium, Kempton Park Gravel Member, Taplow Gravel Member and Lynch Hill Gravel Member have been recorded present beneath the M25 within the western extent of the Scheme and beneath parts of the A3 within the most northern extent of the Scheme at Painshill junction: The same lithology is anticipated beneath the southern extent of the Scheme at Ockham Park junction. Alluvium is expected to be located within proximity to surface water. River Terrace Deposits (undifferentiated) are anticipated to be present in localised deposits within the wider study area[23].

Bedrock geology

10.7.35 The bedrock geology is anticipated to comprise the Bagshot Formation, Claygate Member and London Clay Formation[23].

10.7.36 The Bagshot Formation, an underlying thin band of Claygate Member and the London Clay Formation are anticipated to underlie the entirety of the Scheme, with the exception of the area around Stratford Brook at Ockham Park junction and the south-eastern extent of the M25 near Ockham Lane, where the London Clay Formation is expected to directly underlie the superficial deposits[23].

Mining activity, quarrying and mineral resource

10.7.37 The Scheme is located in an area that is not affected by mining, based upon a review of the Coal Authority Interactive Map viewer, which covers mining activities from coal and other mineral resources[27].

10.7.38 The Envirocheck report[20] identified former pits within the Scheme (listed in Table 10.8) and within the study area (presented on Figure 10.2). There is the possibility that unrecorded mining activities have occurred within the Scheme and study area.

10.7.39 The BGS Mineral Resources Map[28] identifies that the Scheme is situated within sand and gravel mineral resource zones (sub-alluvial inferred resources and River Terrace Deposits) associated with the River Wey and River Mole.

10.7.40 The larger/ more established historical sites of mineral extraction in the study area are listed below and were identified in Envirocheck datasheets[20]:

- Ockham Common Sand Pit (identified on historical maps as 'Sand Pit Hill'), located immediately east of the present day A3, 200 m south of the M25 junction 10/A3 Wisley interchange;
- Former Trotlands Brick Field located 140 m south of the M25, along the eastern limb of the Scheme; and
- Red Hill Sand Pit (labelled as 'Old Sand Pit' on the map dated 1897), located approximately 350 m north-east of M25 junction 10/A3 Wisley interchange.

10.7.41 The Elmbridge Borough Council Planning Policy Map[29] and Surrey Minerals and Waste Map Viewer[30] identify four Mineral Safeguard Areas (MSA) within the study area, located to the north, south, east and west of M25 junction 10/A3 Wisley interchange. Three of the MSAs coincide with the Scheme boundary where they terminate next to existing infrastructure (the M25 and the A3) and one of the MSA is present across the Former Wisley Airfield.

10.7.42 The Surry Core Strategy DPD states that mineral safeguarding areas are to be treated as mineral consolation areas. The strategy also states that a realistic judgment about the likelihood of the mineral being worked in an environmentally acceptable way will be made, and the MPA will not seek to prevent development

[27] BGS (2017) Coal Authority Interactive Map (Online), Accessed on 21/03/2018 from http://mapapps2.bgs.ac.uk/coalauthority/home.html, 2017e
[28] Bloodworth, A.J., Cameron, D.G., Lott, G.K., Evans, D.J., Wood, S.E, Simpson, C., Highley, D.E., 2003. Mineral Resource Information in Support of National, Regional and Local Planning: Surrey (comprising Surrey and the London Boroughs of Croydon, Hounslow, Kingston upon Thames, Richmond upon Thames and Sutton), BGS Commissioned Report CR/03/073N
[29] Elmbridge Borough Council (2018) Planning Policy Map Accessed on 22/11/2017 from http://emaps.elmbridge.gov.uk/ebc_simple.aspx?requesttype=parseTemplate&template=PlanningPolicy.tmplt
[30] Surrey County Council (2017) Minerals and Waste Map Viewer Accessed 22/02/2018 from https://surreycc.maps.arcgis.com/apps/View/index.html?appid=51ccc1c328654e668680dbc9d88da9a7

where it is unlikely that extraction of the mineral would occur in the future. It was confirmed during liaison with Surrey County Council that the potential impact of the Scheme on MSAs need not be covered in the EIA process as the sterilisation of small parts of the larger MSAs would be unlikely to constitute a significant effect (see Appendix 10.8 for correspondence). The Scheme boundary has changed since these discussions were carried out, however, given the limited alterations which have been made to the Scheme boundary and the type of proposed works in the areas where MSAs are marginally encroached upon, the conclusions made by Surrey County Council still apply.

### Ground stability hazards

10.7.43 The potential for the presence of ground stability hazards within the Scheme boundary and study area (based on the 1:50,000 ground stability data[20]) are displayed on Figure 10.3 and are listed below:

- compressible ground: Moderate where Alluvium is anticipated and very low elsewhere;
- collapsible ground: Very low throughout the Scheme;
- landslide: Moderate along the M25 approximately midway along the eastern arm of the Scheme, low adjacent to the River Mole approximately 1 km to the north-east of the M25 junction 10/A3 Wisley interchange and very low elsewhere;
- running sands: Low where Alluvium and Bagshot Formation are anticipated and very low where Kempton Park Gravel Member, Lynch Hill Gravel Member and River Terrace Deposits (undifferentiated) are anticipated; and
- shrinking or swelling clay: Moderate to low where Claygate Member and London Clay Formation is anticipated at or near the surface and very low where Alluvium is anticipated overlying the Bagshot Formation.

10.7.44 The preliminary engineering assessment provided within the PSSR for the Scheme[31] has also identified the following existing potential ground stability risks associated with the Scheme:

- weathering, fissuring and fracturing of bedrock is likely to have reduced its strength; and
- Made Ground or infilled ground may not have been adequately compacted during previous construction and may be at risk of collapsing.

#### Chemical attack on concrete

10.7.45 Made Ground, Alluvium, Claygate Member and the London Clay Formation are expected to contain pyrite, leading to likely elevated concentrations of sulphate and sulphides, which can have detrimental impacts on concrete structures[32].

[31] Atkins (2017) Regional Investment Programme M25 junction 10/A3 Wisley interchange Improvements Preliminary Sources Study Report Ref. HE551522-ATK-HGN-2-RP-C-4400
[32] BGS (2017) GeoProperties Product Development: sulphates and sulphides. Accessed on 16/10/2018 from https://www.bgs.ac.uk/research/environmentalModelling/GeoProperties/SulphatesSulphides.html

## Hydrogeology

### Aquifer designations

10.7.46 The Environment Agency and BGS aquifer designations for superficial deposits and bedrock formations are presented in Table 10.9.

**Table 10.9: Aquifer designations**

| Unit | BGS Designation[23] | Environment Agency Designation[19] |
|---|---|---|
| Alluvium | Variable | Secondary A - Superficial |
| River Terrace Deposits (Undifferentiated) | Variable | Secondary A - Superficial |
| Kempton Park Gravel Member | Variable | Principal - Superficial |
| Taplow Gravel Member | Variable | Principal - Superficial |
| Lynch Hill Gravel Member | Variable | Secondary A - Superficial |
| Bagshot Formation | Moderately productive aquifer | Secondary A - Bedrock |
| Claygate Member | Rock with essentially no groundwater | Secondary A - Bedrock |
| London Clay Formation | Rock with essentially no groundwater | No designation/Unproductive Strata |

Notes:
Principal aquifer (superficial and bedrock): "these 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".
Secondary A aquifer (superficial and bedrock): "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers".
Unproductive Strata: "rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".

### Groundwater levels

10.7.47 Information on groundwater strikes and rest levels have been collected from publicly available exploratory hole records[23] and other available sources, including HAGDMS[24] and two previous GIs detailed in reports provided on the Guildford Borough Council planning applications website[33]. The data identify a wide range of groundwater strikes between 0.02 m bgl to 16.0 m bgl. The strikes recorded are within Made Ground, granular superficial deposits, River Terrace Deposits or within the Bagshot Formation.

10.7.48 A Capita Symonds interpretative report for GIs carried out in 2010 and 2012 on the north bank of Ockham Stream (east of the A3) Wisley Airfield[34] available on the Guildford Borough Council planning portal[33], included groundwater monitoring results. During November 2012, groundwater levels were monitored between 0.8 and 2.01 m bgl (approximately 19.1 m AOD and 21.9 m AOD).

[33] Guildford Borough (2019). Planning applications portal. Accessed on 04/02/2019 from https://www.guildford.gov.uk/searchforaplanningapplication
[34] Capita Symonds (2013) In-vessel Composting Access Road, Wisley Airfield Interpretative report on the site investigation on north bank of Ockham Stream

10.7.49 A WSP interpretative report (also available on the Guildford Borough Council planning portal[33]) for a GI carried out in 2014 across Wisley Airfield[35], located in the south-east of the study area (with 12 of the exploratory holes located within the Scheme boundary), recorded groundwater elevations during the GI and monitoring between 28.54 and 43.2 m AOD in the Lynch Hill Gravel, between 35 and 42.9 m AOD in the London Clay, and between 28.6 and 42.2 m AOD in the Bagshot Formation. These levels range between 0.02 m bgl and 4.4 m bgl. The highest rest level was recorded in a monitoring well which was screened across the Made Ground and Bagshot Formation. Two monitoring wells which were screened within the Lynch Hill Gravel were recorded as dry, however, the monitoring was carried out during May and therefore seasonal fluctuations were not captured.

10.7.50 Groundwater which has been recorded within the London Clay is considered relatively immobile, due to the low permeability of the formation and is considered to form the base of the overlying Secondary A aquifer of the Bagshot Formation[35].

10.7.51 Localised artesian conditions have been identified in two boreholes (TQ05NE24[36] and TQ05NE25[37]) located in the most southern extent of the Scheme, within 15 m either side of an unnamed stream which is connected to the Mill Tail.

10.7.52 HAGDMS report number 4124 (provided in Appendix 10.7) included findings of a GI carried out in 1973 which expanded across the Scheme and study area. The exact locations of the exploratory holes are not legible due to low resolution of the figures available within report 4124. Groundwater strikes were encountered generally between 1.8 and 3.3 m bgl, between 4.4 and 7.0 m bgl and between 13.0 and 15.0 m bgl across the Scheme and study area. Many logs recorded dry exploratory holes. One of the exploratory hole logs from this GI described a groundwater strike with a fast flow at 9.5 m bgl in the Bagshot Formation within Ockham Common in the south of the east of the study area[38].

10.7.53 HAGDMS report 27980 (provided in Appendix 10.7) included findings of an exploratory hole created in 2010 and described a groundwater strike at 8.50 m bgl on the southbound side of the A3 at Painshill Park in the Bagshot Formation within the northern extent of the Scheme[39]. The report also described groundwater having been encountered at depths of between 3.0 m and 4.5 m bgl in three historic boreholes (within 70 m of each other) in the northern extent of the Scheme, however these readings were obtained prior to the construction of the A3 dual carriageway and therefore these levels are not expected to be representative of the present day groundwater depth below ground level.

10.7.54 Further information on groundwater strikes is provided in Appendix 10.6 and further discussion regarding groundwater levels is provided in Chapter 8.

Groundwater Abstraction

10.7.55 There are no groundwater abstraction licences or groundwater SPZ listed within the Scheme boundary or study area[20]. However, groundwater abstraction licences

[35] WSP (2014). Wisley Airfield: Environmental Interpretative Report, Wisley Property Investments Limited, June 27, 2014.
[36] BGS (2019). BGS viewer. Record of Borehole No. 54. Accessed on 08/05/2019 from http://scans.bgs.ac.uk/sobi_scans/boreholes/570882/images/12187301.html
[37] BGS (2019). BGS viewer. Record of Borehole No. 55. Accessed on 08/05/2019 from http://scans.bgs.ac.uk/sobi_scans/boreholes/570883/images/12187302.html
[38] Cementation Geotechnical (1973). South Orbital Motorway (M25) Supplementary Soil Survey Wisley interchange. Report 390/72/LT/JBG. HAGDMS report 4124.
[39] Amey (2012). Combined Ground Investigating and Geotechnical Design Report. A3 Cartner Message Sign Replacement – Phase 2. Report SETM 0397. HAGDMS report 27980.

have been identified within Chapter 8, for which the assessment has a larger study area of 1.0 km from the Scheme boundary.

Groundwater Vulnerability Zones

10.7.56 Groundwater Vulnerability Zones are designated by the Environment Agency[19]. Within the study area, the following zones are present:

- Minor Aquifer with intermediate vulnerability on-site across the central, eastern and northern parts of the Scheme and within the study area to the east and north of the M25 junction 10/A3 Wisley interchange;
- Minor Aquifer with high vulnerability across the southern and western extents of the Scheme and study area; and
- Major Aquifer with high vulnerability across the western and north-eastern extents of the study area.

## Hydrology

10.7.57 Several surface water features are located within the Scheme and study area as shown on Figure 10.2, including:

- the River Mole which passes under the A3 approximately 20 m to the north of the most northern extent of the Scheme. It is a tributary of the River Thames, discharging approximately 11 km downstream of the study area;
- Stratford Brook passes beneath the Ockham Park junction on the A3 and discharges to the Mill Tail, 700 m to the north-west of Ockham Park junction. Approximately 800 m to the north-west of the A3 alignment at RHS Wisley, the Mill Tail joins the River Wey, which discharges to the River Thames at Weybridge;
- Bolder Mere (a lake of approximately 5.1 ha), situated in Ockham Common approximately 800 m to the south-west of the M25 junction 10/A3 Wisley interchange and immediately adjacent to the A3 southbound. Though Bolder Mere itself does not cross the Scheme, it discharges to an unnamed drainage line, which flows northwards underneath the A3; and
- Guileshill Brook traverses through the south-western edge of the study area, approximately 3 km to the south-west from the centre of the M25 junction 10/A3 Wisley interchange.

10.7.58 There are several smaller surface water features present within the study area, including:

- a pond in Chatley Wood, situated approximately 350 m to the east of the M25 junction 10/A3 Wisley interchange;
- a pond at Pond Farm, situated approximately 450 m to the south-west of the M25 junction 10/A3 Wisley interchange;
- Manor Pond situated adjacent to Byfleet Road, approximately 2 km to the north-east of the M25 junction 10/A3 Wisley interchange and immediately adjacent to the most northern extent of the Scheme; and
- the Lake situated adjacent to Painshill Park, approximately 1.2 km to the north-east of the M25 junction 10/A3 Wisley interchange.

10.7.59 Several surface water abstractions have been identified within the study area[20] which have been discussed in Chapter 8.

## Potential land contamination

### Landfill sites

10.7.60 No authorised active landfill sites have been identified within the study area. Eight historical landfill sites are present[20] and are summarised in Table 10.10 and present in Figure 10.2.

**Table 10.10: Historical landfill sites within the study area**

| Name | Operator | Operation period | Received waste | Distance from Scheme boundary |
|---|---|---|---|---|
| **Within the Scheme** | | | | |
| Old Rectory Farm | (Former) Ministry for Agriculture, Fisheries and Food[34] | 1977-1981 | Inert | Within the Scheme |
| Land at East of Buxton Wood | Balfour Beatty Construction Limited | 1981 - 1984 | Inert | Within the Scheme |
| A3 Spoil landfill[34] | Unknown | Unknown | Expected surplus material from A3 improvement works | Within the Scheme |
| **Study area** | | | | |
| Cobham Bridge | Unknown | 1986 - 1987 | Inert | 20 m north from the A3, in the northern extent of the study area |
| Pointers Farm | Unknown | 1981 - 1983 | Inert | 20 m north from the M25, in the eastern extent of the study area |
| New Barn East | Balfour Beatty | 1996 - 1996 | Unknown | 30 m north from the M25, near Cobham services in the eastern extent of the study area |
| Land at Pond Farm | Balfour Beatty | 1981 - 1982 | Inert | 50 m south of the M25, in the western extent of the study area |
| Chatley Farm | Balfour Beatty Construction Limited | 1982 - 1983 | Inert | 170 m north of the M25, in the eastern extent of the study area |

10.7.61 Further information regarding the landfills was provided by Guildford Borough Council and Surrey County Council. Information was also requested from Elmbridge Borough Council and the Environment Agency, although neither bodies were able to provide any additional information on the historical landfills identified within the study area (consultation records are provided in Appendix 10.8).

10.7.62 The previous GI carried out on the former Wisley Airfield encompassed land of Old Rectory Farm landfill and A3 Spoil landfill. The material encountered in these two locations was considered to be inert fill (see 10.7.77 for details).

10.7.63 The other nearby historical landfill sites listed in Table 10.10 may also be infilled borrow pits from the construction or widening of the M25 and/or A3, similar to the A3 Spoil landfill. This inference has been made on the basis that Balfour Beatty was the licence holder (specified in Appendix 10.3) for the sites, which were operational at the same time as the construction works took place. During consultation with regulatory bodies and councils, it was confirmed that Land at Pond Farm, Chatley Farm landfill, Pointers Farm landfill and land at East of Buxton Wood were filled with surplus excavated material from the past M25 motorway contract.

Industrial and other potentially contaminative land uses

10.7.64 Several land uses with potentially contaminative activities exist or are recorded to have been present within the Scheme, including farming and part of the former Wisley Airfield[20,40].

10.7.65 Several land uses with potentially contaminative activities exist, or are recorded to have been present within the study area, including; vehicle service garages; fuel service stations; waste disposal; asphalt and coated macadam laying contractors; and the remainder of the former Wisley Airfield[20].

10.7.66 A full list of trade directory entries with potentially contaminative activities (both active and inactive) within the Scheme and study area is presented in Appendix 10.9.

Pollution incidents

10.7.67 There have been three pollution incidences within the Scheme and five within the study area[20], all of which were deemed as having minor severity and occurred prior to 1999. A summary of the incidents is provided in Appendix 10.10.

Historical contamination data

10.7.68 As mentioned in 10.7.47 four historical ground investigation reports are available relating to the Scheme and study area. A summary of relevant historical contamination data is provided below.

10.7.69 HAGDMS report 27980[39], relating to a location on the southbound side of the A3 at Painshill Park within the northern extent of the Scheme, and the two reports available on the Guildford Borough Council planning website[33] relating to the former Wisley Airfield[34,35] contain geo-environmental data collected from within the Scheme and study area.

10.7.70 HAGDMS report 27980[39] contains analytical data from two soil samples collected from a single borehole (BH10/+68A) within the northern extent of the Scheme. These samples refer to reworked natural material at 0.5 m bgl and natural sand/silt at 3.2 m bgl (the log says a sample was taken at 3.0 m and it is assumed that this is the sample identified in the chemical results as 3.2 m). The results were not assessed in the report, therefore for the purpose of the assessment for this Scheme, they have been screened against Atkins Soil Screening Values and Land Quality Management Suitable 4 Use Levels (collectively named GAC) for land suitable as public open space 1% soil organic matter (SOM). Screening of the available analytical data against the GAC showed no exceedances and therefore suggests that soil contamination presents a low risk to human health at

[40] Google (2018) Google Maps Accessed on 16/10/2018 from https://www.google.com/maps/@51.3241696,-0.4537924,14.92z

this location. The screening sheet is provided in Appendix 10.7. Soil-derived leachate data (referred to as eluate in the report[39]) were also available for the two soil samples collected. These were screened against water quality standards (WQS) (comprised of Environment Agency Environmental Quality Standards (EQS)[41] and Drinking Water Standards (DWS)[42]) due to the proximity of the River Mole and the Secondary 'A' aquifers associated with the Lynch Hill Gravel Member. The DWS for TPH aromatic C16-C21 (0.09 mg/l) was exceeded in the sample collected from 3.2 m bgl, measured at 0.1 mg/l. No other DWS were exceeded. Eight EQS were exceeded in the results from the two samples, namely zinc (within the same magnitude), the heavier aliphatic and aromatic TPHs (by one or the same orders of magnitude) and three PAHs (greater than two orders of magnitude). However, testing of organic contaminants in leachate is an unreliable method and screening soil-derived leachate against WQS is considered a conservative approach to identifying risk.

10.7.71 There were no olfactory or visual signs of contamination described in the logs for exploratory holes in HAGDMS report number 4124[38] and HAGDMS report 27980[39] (provided in Appendix 10.7).

10.7.72 Two phases of GI were conducted (2010 and 2012) at the former Wisley Airfield reported by Capita Symonds[34]. These investigations partially coincide with the Scheme immediately north-east of Ockham junction and with the locations of the Old Rectory Farm Landfill and the A3 Spoil Landfill. The 2010 investigation comprised two boreholes, seven trial pits and four soakaway tests to a maximum depth of 20 m bgl. Seven of the exploratory holes were located within the Scheme boundary. The 2012 investigation comprised four boreholes to a maximum depth of 5.1 m bgl and were all within the Scheme boundary (this is an estimation based on the location map within the report, as the correct coordinates were not provided). The general strata description for Old Rectory Farm Landfill that falls within the Scheme comprised 0.1 m topsoil overlying 2.0 m of Made Ground consisting of slightly gravelly sand/clay of chalk, brick, flint, concrete, clinker and rare glass. This was underlain by <1.6 m gravelly clayey peat, which was subsequently underlain by sand. Material in the A3 Spoil Landfill within the Scheme generally consisted of topsoil overlaying 1.2 m of Made Ground, comprising sandy gravelly clay with flint, clinker, brick, asphalt, concrete and chalk. This was generally underlain by silty sand/silty clay[34]. The logs suggest the material is inert and likely to be infilled ground, with no evidence of putrescible waste or significant or widespread visual or olfactory signs of contamination noted; only one of the exploratory holes within the Scheme boundary (BH103) recorded a possible hydrocarbon odour at 1.0 m bgl, which was located within the Old Rectory Farm Landfill in BH103. No PID readings were obtained however the soil sample collected from 1.0 m bgl in BH103 contained 300 mg/kg total PAHs and 120 mg/kg TPHs (mostly the heavier aromatic bands).

10.7.73 Geochemical analysis of soil, soil-derived leachate and water samples, and ground gas monitoring was undertaken[34]. The soil analytical data were screened within the Capita Symonds report[34] against GAC available at the time (Contaminated Land Exposure Assessment[43] former version 1.06 for open space land use). For the samples collected within the Scheme boundary, there were no

[41] Environment Agency (2011). Chemical standards database Accessed on 26/04/2019 from http://evidence.environment-agency.gov.uk/chemicalstandards/
[42] European Commission (1998). Drinking Water Standards Directive 98/83/EC
[43] Environment Agency (n.d.) Contaminated land exposure assessment tool. Accessed on 26/04/2019 from https://www.gov.uk/government/publications/contaminated-land-exposure-assessment-clea-tool#history

exceedences of Benzene, Toluene, Ethylbenzene and Xylene (BTEX), metals or speciated TPHs. Slight exceedences (and all within the same order of magnitude of the GAC) of four PAHs were identified within the Scheme. No asbestos was identified in any of the soil samples screened. The report concluded that a number of PAHs would present a risk to human health in an open space land use scenario and that detailed quantitative risk assessment and / or remediation would be required.

10.7.74 A number of PAHs in soil-derived leachate exceeded GAC however, PAH testing in leachate is an unreliable method and screening soil-derived leachate against WQS is considered a conservative approach to identifying risk.

10.7.75 It was reported that there were no exceedences of WQS (comprised of Environment Agency EQS[41] and DWS[42]) within the groundwater samples collected from monitoring wells located within the Scheme[34] and it was suggested within the report that the localised pockets of soils with low level PAH impact were not leaching to groundwater. Surface water samples were also collected and analysed and there were no exceedences of WQS reported. The report concluded that no impacts were anticipated to controlled water receptors[34].

10.7.76 In November 2012, one round of ground gas monitoring was carried out. Carbon monoxide was recorded as 188 ppm in BH107 within the Scheme. However, this is considered likely to be naturally occurring due to the well screening Alluvium, River Terrace Deposits and sand. Methane was recorded as less than 0.0 %, carbon dioxide was recorded at concentrations less than 3.0 % and the lowest concentration of oxygen recorded was 17.1 % in wells within the Scheme. It was noted in the report that ground gas monitoring was undertaken to supplement the controlled waters risk assessment and was not intended to facilitate detailed quantitative risk assessment for ground gas, however a brief assessment of carbon dioxide and methane concentrations provided within the report concluded there was a low risk to future site users (i.e. maintenance staff in unenclosed spaces) from ground gas, however there would be some residual risk to construction and/or drainage maintenance workers in confined working spaces and therefore further ground gas investigation and/or mitigation would be required.

10.7.77 The GI completed in 2014 at the former Wisley Airfield[35] comprised five cable percussive boreholes, nine windowless boreholes, 112 trial pits and subsequent groundwater monitoring, 12 of these exploratory holes were located within the Scheme boundary.

10.7.78 The following results relevant to land within the Scheme boundary were reported as part of the 2014 GI[35]:

- TP101 (located in Old Rectory Farm Landfill) contained rare plastic bags and metal wires from 0.0-0.8 m bgl. A sample collected from TP101 at 0.4 m bgl exceeded the GAC for Benzo(a)pyrene. WS103 (in the hanger area) was noted to contain a hydrocarbon odour at 0.25-0.5 m bgl and again at 3.5 m bgl. A soil sample was collected from 3.5 m bgl in WS103 however no exceedences of the GAC were identified and a Photoionization detector (PID) reading taken at 3.5 m bgl recorded only 1 ppm. No visual or olfactory signs of contamination were noted on the remaining 10 logs for exploratory holes located within the Scheme boundary;

- benzo(a)pyrene exceeded the GAC used in the human health risk assessment provided within the report in one location within the Scheme (TP101), however the GAC used was residential with plant uptake[43,44] which is considered highly conservative for the end use of the Scheme. No other human health GAC exceedences were identified within the Scheme boundary;
- no analytical data from soil samples collected from below 1.0 m bgl within exploratory holes located in the Scheme exceeded the GAC;
- analytical data from the soil sample collected from TP103 located 25 m east from the Scheme, within the vicinity of Old Rectory Farm Landfill exceeded the GAC for several PAHs, including chrysene and aromatic hydrocarbons bands;
- asbestos (amosite) was identified within a sample collected at 0.2 m bgl within TP103 within the footprint of Old Rectory Farm Landfill, 25 m from the Scheme boundary;
- a Photoionization detector (PID) recorded 91 ppm in TP119a at 1.5 m bgl, located 5 m south of the Scheme boundary. A strong solvent odour was noted between 1.2 and 1.8 m bgl in the Bagshot Formation, however a soil sample collected from 1.5 m bgl was reported to not exceed any GAC;
- there was one exceedence of WQS from soil-derived leachate samples collected from within the Scheme boundary which was lead in a sample collected from WS103 at 3.5 m bgl. A number of PAHs and heavy metals exceeded the corresponding WQS in TP103 (0.2 m bgl) and TP111 (0.3 m bgl) which are both within 25 m of the Scheme. However, PAH testing in leachate is an unreliable method and screening soil-derived leachate against WQS is considered a conservative approach to identifying risk;
- analytical data of groundwater samples collected from within the Scheme boundary exceeded WQS for ammonium, arsenic, chromium VI, copper, mercury, nickel, phenol and several PAHs. The groundwater data were also screened against site-specific Level 3 Remedial Target Values[45] generated for the controlled waters in the DQRA within the report. Exceedences were noted for ammonium, copper and nickel;
- the report concluded that based on the data available, the site was unlikely to pose a significant risk to controlled waters given the conservative assumptions and single exceedences of the site-specific values; and
- results from only one ground gas monitoring round were available in the report for the six monitoring wells installed during the GI. Methane was recorded at a maximum concentration of 63.9 % and at a steady rate of 38.6 % and carbon dioxide was recorded at 8.9 % with a slight negative flow, in one well (WS103) located within the former hangar area on the boundary of the Scheme. Hydrocarbon odours were noted during drilling, however the strata in which these were noted did not correspond with the screen of the well and PID readings were 2 ppm or less when they were taken. The well screened from 1.0-2.3 m bgl in the Lynch Hill Gravel Member and Bagshot Formation which contained some organic material. Data from monitoring wells elsewhere within the Scheme suggested oxygen was slightly low however there were no other elevated concentrations of methane (<1 %) or carbon dioxide (<5 %) recorded.

[44] Defra (2014) Category 4 Screening Level (C4SL)
[45] Environment Agency (2006) Remedial Targets Worksheet v3.1 Hydrogeological Risk Assessment for Land Contamination

The report concluded a very low risk from ground gas was present, using the risk assessment methodology provided within CIRIA C665[46].

10.7.79 The areas where soil contamination and ground gas were identified will be further investigated during the proposed GI. The historical data summarised above will be rescreened against up to date WQS and up to date GAC relevant to the proposed land uses within the Scheme, along with the data obtained during the proposed GI, within the associated risk assessments.

## Potential Contaminant Linkages

### Potential sources of contamination

10.7.80 Potential sources of contamination (including soil, water, vapours and ground gases) within the Scheme include:

- Historical pollution from vehicles using the current M25, A3, A245 and local access roads;
- Made Ground/infill material of unknown quality associated with the construction of the M25, A3, A245 Byfleet Road, local access roads, Former Wisley Airfield, San Domenico site and other existing infrastructure within the Scheme;
- material of unknown quality associated with the infilling/potential infilling of former water features and mineral extraction pits within the Scheme;
- three historical landfills (understood to be inert fill);
- three recorded pollution incidents (minor severity and occurred prior to 1999);
- part of former Wisley Airfield and associated activities (historical GI reports[34,35] identified some contamination within the Scheme); and
- farms and agricultural land use.

10.7.81 Potential sources of contamination (including soil, water, vapours and ground gases) within the study area include:

- Made Ground/infill material of unknown quality associated with the construction of Feltonfleet School, the railway, RHS Wisley and other existing infrastructure in the study area;
- material of unknown quality associated with the infilling/potential infilling of former water features and mineral extraction pits in the study area;
- five recorded pollution incidents (minor severity and occurred prior to 1998);
- wider area of the former Wisley Airfield and associated activities (historical GI reports[34,35] identified some contamination within the study area);
- farms and agricultural land use;
- the railway;
- five historical landfills; and
- potentially contaminative land uses (current and historical), including vehicle service stations, electricity substation, sewage treatment, gas works, asphalt

[46] CIRIA (2007) Assessing risks posed by hazardous ground gasses to buildings C665

and coated macadam laying contractors, garden machinery services, vehicle dealers, wood and furniture polishers, picture frame renovators, pest control service, small business park and stationery printers.

10.7.82 Potential contaminants of concern that are associated with identified land uses include the following:

- inorganics: cyanide, ammonia, nitrates, metals and sulphur;
- organics: BTEX, phenols, chlorinated solvents, polychlorinated biphenyls (PCBs), PAHs and other TPHs, perfluorooctanesulfonic acid (PFOS) and polyfluoroalkyl substances (PFAS);
- ground gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
- pesticides, insecticides and fertilisers; and
- asbestos.

Identified receptors

10.7.83 Identified receptors within the study area have been categorised relating to human health, controlled waters and structural receptors.

10.7.84 Potential human health receptors include:

- Scheme construction workers and future site maintenance workers;
- members of the public using public rights of way (non-motorised users) within the Scheme and study area;
- residents within the study area (including Elm Corner);
- school children and staff within the study area (e.g. Feltonfleet school); and
- workers and visitors to commercial premises and recreational facilities within the study area.

10.7.85 It is considered that exposure to members of the public using the highways (motorised users) from potential sources of contamination will be of limited frequency and duration therefore they have not been considered.

10.7.86 Potential controlled waters receptors include:

- The superficial Secondary A and superficial Principal aquifers to the west, north and south of the junction and the bedrock Secondary A aquifer beneath the majority of the Scheme boundary; and
- Surface waters supportive of aquatic life, including Stratford Brook, River Mole, River Wey, Bolder Mere, Pond Farm Pond, the Lake, Manor Pond and several unnamed drains, ditches and ponds.

10.7.87 Potential ecological receptors include:

- Thames Basin Heath SPA/Ockham Common and Wisley Common SSSI and BAP;
- Ockham and Wisley LNR; and
- Ancient Woodland.

10.7.88 Potential property receptors include:

- on-site (existing) piles, foundations and underground services;
- off-site (including residential, commercial and industrial) piles, foundations and underground services; and
- on-site and off-site historic features (historic remains/structures and listed buildings).

Potential pathways

10.7.89 Plausible exposure pathways include:

- inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres;
- inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater;
- migration and accumulation of ground gases followed by inhalation or ignition, causing asphyxiation and/or explosion;
- inhalation, ingestion and dermal contact with contaminants within surface water;
- inhalation of vapours from contaminated soil and/or water;
- leaching/vertical migration of contaminants in soils to underlying groundwater (followed by lateral migration from off-site sources to on-site receptors);
- vertical migration of contaminants via preferential pathways such as piles to deeper groundwater (followed by lateral migration from off-site sources to on-site receptors);
- lateral migration of contamination in groundwater;
- migration of contaminants entrained in surface water run-off;
- migration of contamination via surface waters;
- Leaching/vertical migration of contaminants followed by lateral migration of contamination in groundwater connected to bog/surface water (within sites of designated ecological importance);
- chemical attack from aggressive chemical constituents in soil or groundwater; and
- migration of ground gases or vapours along preferential pathways, including permeable ground, service trenches and service entry points and accumulation in enclosed spaces such as service ducts or access points.

10.7.90 Figure 10.2 displays the identified potential sources and receptors associated with geology and soils.

## 10.8 Potential impacts

10.8.1 The Scheme has the potential to impact geology and soils. A summary of the potential impacts has been provided below in two sections; impacts associated with land contamination and those associated with geology and geomorphology.

Land contamination potential impacts

10.8.2 The following construction phase activities could contribute to the creation of new PCLs:

- potential disturbance and mobilisation of existing sources of contamination;
- introduction of additional receptors on-site including construction workers, future site workers and new foundations;
- piling or excavation during construction could create new pathways between contaminated soils and the underlying groundwater;
- earthworks, potentially leading to increased runoff with a high sediment load (and associated potential contamination) impacting surface water receptors; and
- groundwater control methods have the potential to mobilise contaminated groundwater and enhance lateral migration of contamination within the superficial and bedrock aquifers and potentially into surface water features.

10.8.3 During the operational phase, new receptors may be introduced by workers entering any confined spaces, such as manholes and service chambers/ducts, within which ground gas has the potential to accumulate. It is anticipated that no other new pathways are likely to be created, however accidents/incidents have the potential to introduce new sources. It is anticipated that an Environmental Management Plan (EMP) for the Scheme will address how these incidents will be managed and detail the emergency management procedures to be implemented in such an event. Further details are provided in Chapter 8.

10.8.4 A summary of the potential impacts arising from creation of PCLs as a result of the Scheme is shown in Table 10.11 below. The mitigation measures listed in the table are described in detail in section 10.9. The full contaminated land risk assessment is presented in Appendix 10.11.

### Table 10.11: Land contamination risk assessment summary

| Sources | Receptors | Pathways | Classification of risk baseline (assuming reasonable worst case) | Classification of risk construction without mitigation | Mitigation measures (design and construction) | Classification of risk (construction with mitigation) | Classification of risk (operation) |
|---|---|---|---|---|---|---|---|
| Potential sources of contamination (including soil, water, vapours and ground gases) within the Scheme include:<br><br>•historical pollution from vehicles using the current M25, A3, A245 and local access roads;<br>•Made Ground/infill material of unknown quality associated with the construction of the M25, A3, A245 Byfleet Road, local access roads, the railway, Former Wisley Airfield, San Domenico site and other existing infrastructure;<br>•material of unknown quality associated with the infilling/potential infilling of former water features and mineral extraction pits;<br>•three historical landfills (understood to be inert fill);<br>•three recorded pollution incidents (minor severity and occurred prior to 1999);<br>•part of former Wisley Airfield and associated activities (historical GI identified some contamination); and<br>•farms and agricultural land use. | Human Health (within the Scheme)<br>•Construction workers and future site maintenance workers. | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Receptor not present during baseline | Moderate/ Low Risk | GI and risk assessment as necessary to define risk.<br>Remediation / removal of existing contamination if risk assessments deem necessary.<br>Use of ventilated temporary structures during construction if risk assessments deem necessary.<br>Use of appropriate hazard signage and / or ground gas protection measures within below ground chambers and ducts if risk assessments deem necessary.<br>Implementation of measures in the EMP such as good management of stockpiles in accordance with Environment Agency Pollution Prevention Guidelines (PPG), implementation of pollution incident control e.g. plant drip trays and spill kits.<br>Implementation of dust management systems.<br>Risk Assessment and Method Statements (RAMS) to be completed prior to construction and risk management with appropriate PPE.<br>See section 10.9 for further details. | Low Risk | Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | | Moderate/ Low Risk | | Low Risk | Low Risk |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | | Moderate/ Low Risk | | Low Risk | Low Risk |
| | | Inhalation of vapours from contaminated soil and / or water | | Moderate/ Low Risk | | Low Risk | Low Risk |
| | Human Health (within the Scheme)<br>•Members of the public using public rights of way (non motorised users). | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Moderate/ Low Risk | Receptor not present during construction | | Receptor not present during construction | Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Moderate/ Low Risk | | | | Low Risk |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | Moderate/ Low Risk | | | | Moderate / Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Moderate/ Low Risk | | | | Low Risk |
| | | Inhalation of vapours from contaminated soil and / or water | Low Risk | | | | Low Risk |
| | Human Health (within the study area)<br>•Local residents (including Elm Corner)<br>•School children and staff (e.g. Feltonfleet School)<br>•Workers and visitors at nearby commercial premises and recreational facilities<br>•Members of the public using public rights of way (non motorised users). | Inhalation, ingestion and dermal contact with contaminants in windblown soil-derived dust/fibres | Moderate/ Low Risk | Moderate Risk | | Low Risk | Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Low Risk | Low Risk | | Low Risk | Low Risk |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Low Risk | Moderate/ Low Risk | | Low Risk | Low Risk |
| | | Inhalation of vapours from contaminated soil and / or water | Low Risk | Low Risk | | Low Risk | Low Risk |
| | Controlled Waters (within the Scheme)<br>•Groundwater (superficial Principal and Secondary A aquifers and bedrock Secondary A aquifer)<br>•Surface water (Stratford Brook, River Mole, unnamed drains and ditches). | Leaching/ vertical migration of contaminants in soils to underlying groundwater | Moderate Risk | Moderate Risk | GI and risk assessment as necessary to define risk.<br>Remediation / removal of existing contamination if risk assessments deem necessary.<br>Controlled Waters PRA and use of appropriate piling methods.<br>Implementation of measures in the EMP such as good management of stockpiles in accordance with Environment Agency PPG, implementation of pollution incident control e.g. plant drip trays and spill kits.<br>Control of run off and implementation of dust management systems. | Low Risk | Low Risk |
| | | Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater | Low Risk | Moderate Risk | | Low Risk | Low Risk |
| | | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate Risk | | Moderate/ Low Risk | Low Risk |
| | | Migration of contamination via surface waters | Moderate/ Low Risk | Moderate Risk | | Moderate/ Low Risk | Low Risk |
| | Controlled Waters (within the study area)<br>•Groundwater (Superficial Principal and Secondary A aquifers and bedrock Secondary A aquifer) | Leaching/ vertical migration of contaminants in soils to underlying groundwater followed by lateral migration | Moderate Risk | Moderate Risk | | Low Risk | Low Risk |
| | | Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater followed by lateral migration | Low Risk | Moderate Risk | | Low Risk | Low Risk |
| | | Lateral migration of contamination in groundwater | Moderate/ Low Risk | Moderate Risk | | Moderate/ Low Risk | Low Risk |

| Sources | Receptors | Pathways | Classification of risk baseline (assuming reasonable worst case) | Classification of risk construction without mitigation | Mitigation measures (design and construction) | Classification of risk (construction with mitigation) | Classification of risk (operation) |
|---|---|---|---|---|---|---|---|
| | •Surface water (River Wey, Bolder Mere, Pond Farm Pond, Manor Pond and unnamed drains, ditches and ponds). | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate Risk | See section 10.9 for further details. | Moderate/ Low Risk | Low Risk |
| | | Migration of contamination via surface waters | Moderate/ Low Risk | Moderate Risk | | Moderate/ Low Risk | Low Risk |
| | Ecology •Thames Basin Heath SPA, Ockham Common and Wisley Common SSSI, Ockham and Wisley LNR and Ancient Woodland. | Leaching / vertical migration of contaminants followed by lateral migration of contamination in groundwater connected to bog/ surface water | Moderate/ Low Risk | Moderate/ Low Risk | GI and risk assessment as necessary to define risk. Remediation / removal of existing contamination if risk assessments deem necessary. Implementation of measures in the EMP such as good management of stockpiles in accordance with EA PPG, implementation of pollution incident control e.g. plant drip trays and spill kits. Control of run off and implementation of dust management systems. See section 10.9 for further details. | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | Property (within the Scheme) •Piles and other foundations •Historic remains/structures and listed buildings •Underground services. | Chemical attack from aggressive chemical constituents in soil or groundwater | Low Risk | Moderate/ Low Risk | GI and risk assessment as necessary to define risks. Remediation / removal of existing contamination if risk assessments deem necessary. Appropriate assessment and design of services resistant to chemical attack if risk assessments deem necessary. Use of appropriate hazard signage and / or ground gas protection measures within below ground chambers and ducts if risk assessments deem necessary. See section 10.9 for further details. | Low Risk | Low Risk |
| | | Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | Property (within the study area) •Residential, commercial and industrial properties •Historic remains/structures and listed buildings •Underground services. | Chemical attack from aggressive chemical constituents in soil or groundwater | Low Risk | Moderate/ Low Risk | | Low Risk | Low Risk |
| | | Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| Potential sources of contamination (including soil, water, vapours and ground gases) within the study area include: •Made Ground/infill material of unknown quality associated with the construction of Feltonfleet School, the railway, RHS Wisley and other existing infrastructure; •material of unknown quality associated with the infilling/potential infilling of | Human Health (within the Scheme) •Construction workers and future site maintenance workers. | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Receptor not present on-site during baseline | Moderate/ Low Risk | GI and risk assessment as necessary to define risks. Use of ventilated temporary structures during construction if risk assessments deem necessary. Use of appropriate hazard signage and / or ground gas protection measures within below ground chambers and ducts if risk assessments deem necessary. RAMS to be completed prior to construction and risk management with appropriate PPE. | Low Risk | Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Inhalation of vapours from contaminated soil and / or water | | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | Human Health (within the Scheme) •Members of the public using public rights of way | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Low Risk | Receptor not present on-site during construction | | Receptor not present on-site during construction | Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Low Risk | | | | Low Risk |

| Sources | Receptors | Pathways | Classification of risk baseline (assuming reasonable worst case) | Classification of risk construction without mitigation | Mitigation measures (design and construction) | Classification of risk (construction with mitigation) | Classification of risk (operation) |
|---|---|---|---|---|---|---|---|
| former water features and mineral extraction pits;<br>• five recorded pollution incidents (minor severity and occurred prior to 1998);<br>•wider area of the former Wisley Airfield and associated activities (historical GI identified some contamination);<br>•farms and agricultural land use;<br>•the railway;<br>•five historical landfills; and<br>•potentially contaminative land uses (current and historical), including vehicle service stations, electricity substation, sewage treatment, gas works, asphalt and coated macadam laying contractors, garden machinery services, vehicle dealers, wood and furniture polishers, picture frame renovators, pest control service, small business park and stationery printers. | (non motorised users) | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | Moderate/ Low Risk | | See section 10.9 for further details. | | Moderate/ Low Risk |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Moderate/ Low Risk | | | | Moderate/ Low Risk |
| | | Inhalation of vapours from contaminated soil and / or water | Low Risk | | | | Low Risk |
| | Controlled Waters (within the Scheme)<br>•Groundwater (superficial Principal and Secondary A aquifers and bedrock Secondary A aquifer)<br>•Surface water (Stratford Brook, River Mole, unnamed drains, ditches and ponds). | Leaching/ vertical migration of contaminants in soils to underlying groundwater followed by lateral migration | Moderate/ Low Risk | Moderate/ Low Risk | GI and risk assessment as necessary to define risks. | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater followed by lateral migration | Low Risk | Low Risk | | Low Risk | Low Risk |
| | | Lateral migration of contamination in groundwater | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Migration of contamination via surface waters | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | Ecology<br>•Thames Basin Heath SPA, Ockham Common and Wisley Common SSSI, Ockham and Wisley LNR and Ancient Woodland. | Leaching / vertical migration of contaminants followed by lateral migration of contamination in groundwater connected to bog/ surface water | Moderate/ Low Risk | Moderate/ Low Risk | GI and risk assessment as necessary to define risk.<br>Remediation / removal of existing contamination if risk assessments deem necessary.<br>Implementation of measures in the EMP such as good management of stockpiles in accordance with EA PPG, implementation of pollution incident control e.g. plant drip trays and spill kits.<br>Control of run off and implementation of dust management systems.<br>See section 10.9 for further details. | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |
| | Property (within the Scheme)<br>•Piles and other foundations<br>•Historic remains/ structures and listed buildings<br>•Underground services. | Chemical attack from aggressive chemical constituents in soil or groundwater | Moderate/ Low Risk | Moderate/ Low Risk | GI and risk assessment as necessary to define risks.<br>Appropriate assessment and design of services resistant to chemical attack if risk assessments deem necessary.<br>Use of appropriate hazard signage and / or ground gas protection measures within below ground chambers and ducts if risk assessments deem necessary.<br>See section 10.9 for further details. | Moderate/ Low Risk | Moderate/ Low Risk |
| | | Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points | Moderate/ Low Risk | Moderate/ Low Risk | | Moderate/ Low Risk | Moderate/ Low Risk |

Geology and geomorphology potential impacts

10.8.5 The Scheme has the potential to impact the topography during construction with the presence of stockpiles. New bridges may also have a localised impact on topography. This is discussed in Chapter 9.

10.8.6 Construction activities and land clearance have the potential to increase soil erosion and degrade soil quality.

10.8.7 In areas with a high water table, the Scheme could potentially impact stability due to groundwater ingress.

10.8.8 Groundworks have the potential to detonate any UXO which may be present.

10.8.9 Compressible and low strength material such as Made Ground, infilled ground, Head and Alluvium Deposits (peat) as well as cohesive elements of the superficial deposits could cause settlement after construction, due to increased loadings on these materials.

10.8.10 The risk of landslides can increase by removing the toe or increasing the load at the crest of existing embankments. Construction works within the Claygate Member and the London Clay Formation have the potential to activate pre-existing shear surfaces, or where slopes are not adequately battered could create new slip surfaces.

10.8.11 Clay strata are susceptible to shrink-swell and volume changes which may cause differential settlement of any structures associated with the Scheme.

10.8.12 Made Ground, Alluvium, Claygate Member and London Clay Formation are expected to have elevated concentrations of pyrite, sulphate and sulphides which can have a detrimental impact on concrete structures.

10.8.13 Mineral resources and MSA are located within the study area. In compliance with Policy MC6 and MC7 of the Surrey Minerals Plan Core Strategy Development Plan Document[15], discussions were carried out with Surrey County Council regarding this potential receptor and confirmation was received from a Surrey County Council representative on the 6th March 2018 that the Scheme could result in the sterilisation of a limited area of two MSAs, however, within the context of the overall size of the MSAs, it would be unlikely to constitute a significant impact. Therefore, Surrey County Council considered that consideration of the impact of the Scheme on MSAs was not required within the ES. Correspondence is provided in Appendix 10.8. Since these discussions were carried out, the Scheme design has changed and resulted in small alterations to the Scheme boundary. However, given the limited alterations to the design, the potential impacts on MSAs are still considered unlikely to be significant and as such this aspect has not been assessed further in this ES.

## 10.9 Design, mitigation and enhancement measures

Design measures

10.9.1 The mitigation hierarchy presented in the Environment Agency's Environmental Impact Assessment: Guide to Good Practice and Procedures[17] aims to ensure consideration of environmental effects is carried out during the design stages of a development. One of the objectives of the GI is to inform the design and confirm/optimise any proposed mitigation measures identified within this chapter.

10.9.2 Geotechnical risk will be managed in accordance with HD 22/08[47] and the GI will assess the potential for ground collapse/investigate settlement and provide data from which adequate foundation solutions can be designed. Following GI, a Ground Investigation Report (GIR) will be produced which will inform the Geotechnical Design Report (GDR) and the PRA. The GDR will include stability analyses and design calculations for new and modified earthworks and structures, ensuring their short and long-term stability. Chemical testing of pyrite, sulphate and sulphides has been included in the GI scope and an assessment of the aggressivity of the ground and groundwater conditions will be undertaken in accordance with British Research Establishment Special Digest[48]. Given this, the geology and geomorphology baseline condition impacts have been assessed assuming geotechnical design and mitigation measures will be in place.

10.9.3 Drainage design will consider the risks from residual contamination and designers may be required to use lined drainage systems in areas where contamination may be left in-situ. Sustainable urban drainage design aims to ensure the operational phase of a development is an improvement from baseline with regards to management of potentially polluted surface water run-off. Further information and assessment on drainage design is presented in Chapter 8.

10.9.4 Where the assessment identifies unacceptable risk from contamination and ground gas appropriate design measures shall be integrated into the design. Mitigation may consist of appropriate piling design to mitigate risks to controlled waters and appropriate hazard signage and / or ground gas protection measures within below ground chambers and ducts where elevated gas levels are identified among other things.

Mitigation measures

10.9.5 The assessment of GI data will identify if remediation of contaminated land is required prior to construction in specific locations. Beyond completion of the GI and risk assessments appropriate to the Scheme (such as GQRAs, DQRAs and PRA), mitigation measures noted in Table 10.11 to be incorporated into the construction process are likely to include (but are not limited to):

- if soil and/or groundwater contamination is identified during the GI which poses a risk to sensitive receptors, appropriate remediation will be undertaken. This could include excavation and appropriate landfill or off-site Soil Treatment Centre disposal of contaminated soils; imported clean cover material, on-site bio-remediation etc, depending on the type of contamination identified;
- development of risk assessments and method statements (RAMS) and PPE for the protection of construction and future site maintenance workers in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations[49];
- a Materials Management Plan (MMP) and Site Waste Management Plan (SWMP) will be developed cognisant of the GI data, as discussed in Chapter 12;

[47] DMRB (2008) Volume 4 Geotechnics and drainage Section 1 Earthworks Part 2 HD 22/08 Managing Geotechnical Risk
[48] BRE (2005) Special Digest 1:2005 Concrete in aggressive ground, third edition. BRE Bookshop, Watford, UK
[49] Health and Safety Executive (2013) Control of Substances Hazardous to Health. Sixth Edition

- implementation of appropriate dust suppression measures to prevent migration of contaminated dust and fibres as appropriate, as set out in Chapter 5;
- working methods during construction to manage groundwater and surface water appropriately and ensure that there is no run-off from the works including from any material/waste stockpiles, and storage containers into adjacent surface watercourses in accordance with Defra and the Environment Agency's PPG and replacement Guidance for Pollution Prevention documents[50];
- implementation of measures in the Outline CEMP in accordance with the PPG[50] e.g. plant drip trays and spill kits;
- stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) and timely removal of stockpiled soil to prevent windblown dust and surface water run-off;
- covering of stockpiled materials and use of battering (i.e. smoothing surfaces) of exposed soil slopes to reduce entrainment of soils in runoff;
- effective design of traffic control measures to reduce dust generation and minimise the amount of traffic within working areas, use of wheel washes and spraying of working areas and roadways;
- restricting the size of excavations in sensitive areas;
- limiting the area of earthworks at any one time to reduce temporary effects on topography, soil compaction and erosion;
- programming of works and management of excavated and imported materials to limit the duration that materials will be stockpiled and the size of these stockpiles;
- limiting the duration of soil exposure and timely reinstatement of vegetation or hardstanding to prevent soil erosion;
- prioritising the re-use of mineral resources (sand and gravel) within the Scheme;
- implementing appropriate and safe storage of fuel, oils and equipment during construction;
- implementation of suitable piling methodologies, as defined by the PRA;
- the implementation of a watching brief and discovery strategy. If unexpected contamination is encountered during proposed earthworks, further assessment will be required. Following assessment, further mitigation measures such as remediation or removal of contamination may be required;
- if required, groundwater controls will be implemented for construction, however, methods will be selected such that groundwater levels outside of the Scheme will not be adversely impacted;

[50] Environment Agency (2000 – 2017) Archived Pollution Prevention Guidance and Guidance for Pollution Prevention Accessed on 16/10/2018 from http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/

- inspection of existing infrastructure and assessment of movements which can be tolerated;
- design of the temporary and permanent works to minimise movement (including appropriate analysis to predict magnitude of movements);
- monitoring during the construction works to measure movements, with agreed trigger levels and action plans;
- further monitoring to inform risk assessments and to define further mitigation measures which may be required;
- completion of a detailed desk study to further assess the UXO hazard level within the Scheme and to inform whether intrusive UXO investigation or supervision of a UXO specialist is required; and
- during the GI, there will be an inspection of existing infrastructure and assessment of movements which can be tolerated. Monitoring/ measurement of movements may be carried out during the construction works to form an agreement on trigger levels and action plans.

10.9.6 It has been assumed that hardstanding will be placed across the majority of the proposed works associated with the carriageway with only a minor amount of soft-landscaping. Hardstanding will minimise the generation of dust, direct contact and ingestion pathways and will minimise infiltration during the operational phase. Soft landscaping and imported 'clean' material are also likely to have the same mitigating affect.

10.9.7 It is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques and PPG[50]. It is anticipated that an Environmental Management Plan (EMP) for the Scheme will address how future accidents/incidents will be managed and detail the emergency management procedures to be implemented in such an event. Further details are provided in Chapter 8.

## 10.10 Assessment of effects

### Effects associated with land contamination

10.10.1 The land contamination impact assessment is summarised in Table 10.12 and the full land contamination impact assessment is provided in Appendix 10.11.

**Table 10.12: Land contamination impact assessment summary**

| Source | Receptor | Pathway | Classification of risk (baseline - assuming reasonable worst case) | Classification of risk (construction without mitigation) | Impact (construction without mitigation) | Classification of risk (construction with mitigation) | Impact (construction with mitigation) | Classification of risk (operation) | Impact (during operation phase assuming mitigation was implemented) |
|---|---|---|---|---|---|---|---|---|---|
| Potential sources of contamination (including soil, water, vapours and ground gases) within the Scheme include:<br><br>•historical pollution from vehicles using the current M25, A3, A245 and local access roads;<br>•Made Ground/infill material of unknown quality associated with the construction of the M25, A3, A245 Byfleet Road, local access roads, the railway, Former Wisley Airfield, San Domenico site and other existing infrastructure;<br>•material of unknown quality associated with the infilling/potential infilling of former water features and mineral extraction pits;<br>•three historical landfills (understood to be inert fill);<br>•three recorded pollution incidents (minor severity and occurred prior to 1999);<br>•part of former Wisley Airfield and associated activities (previous GI identified some contamination); and<br>•farms and agricultural land use. | Human Health (within the Scheme)<br>•Construction workers and future site maintenance workers. | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Receptor not present on-site during baseline | Moderate/Low Risk | (Impact predicted to be moderate adverse given sensitivity of receptor) | Low Risk | (Impact predicted to be negligible given reduced likelihood of pathway being realised) | Low Risk | (Impact predicted to be negligible given reduced likelihood of pathway being realised) |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | | Moderate/Low Risk | | Low Risk | | Low Risk | |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | | Moderate/Low Risk | | Moderate/Low Risk | | Moderate/Low Risk | |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | | Moderate/Low Risk | | Low Risk | | Low Risk | |
| | | Inhalation of vapours from contaminated soil and/or water | | Moderate/Low Risk | | Low Risk | | Low Risk | |
| | Human Health (within the Scheme)<br>•Members of the public using public rights of way (non motorised users). | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Moderate/Low Risk | Receptor not present on-site during construction | | | | Low Risk | Minor Beneficial |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Moderate/Low Risk | | | | | Low Risk | Minor Beneficial |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | Moderate/Low Risk | | | | | Moderate/ Low Risk | Negligible |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Moderate/Low Risk | | | | | Low Risk | Minor Beneficial |
| | | Inhalation of vapours from contaminated soil and/or water | Low Risk | | | | | Low Risk | Negligible |
| | Human Health (within the study area)<br>•Local residents (including Elm Corner)<br>•School children and staff (e.g. Feltonfleet School)<br>•Workers and visitors at nearby commercial premises and recreational facilities<br>•Members of the public using public rights of way (non motorised users). | Inhalation, ingestion and dermal contact with contaminants in windblown soil-derived dust/fibres | Moderate/Low Risk | Moderate/Low Risk | Negligible | Low Risk | Minor Beneficial | Low Risk | Minor beneficial |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Low Risk | Low Risk | Negligible | Low Risk | Negligible | Low Risk | Negligible |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | Moderate/Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Low Risk | Moderate/Low Risk | Minor Adverse | Low Risk | Negligible | Low Risk | Negligible |
| | | Inhalation of vapours from contaminated soil and/or water | Low Risk | Low Risk | Negligible | Low Risk | Negligible | Low Risk | Negligible |
| | Controlled Waters (within the Scheme)<br>•Groundwater (superficial Principal and Secondary A aquifers and bedrock Secondary A aquifer)<br>•Surface water (Stratford Brook, River Mole, unnamed drains and ditches). | Leaching/vertical migration of contaminants in soils to underlying groundwater | Moderate Risk | Moderate Risk | Negligible | Low Risk | Moderate Beneficial | Low Risk | Moderate beneficial |
| | | Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater | Low Risk | Moderate Risk | Moderate Adverse | Low Risk | Negligible | Low Risk | Negligible |
| | | Migration of contaminants entrained in surface water run-off | Moderate/Low Risk | Moderate Risk | Minor Adverse | Moderate/Low Risk | Negligible | Low Risk | Minor beneficial |
| | | Migration of contamination via surface waters | Moderate/Low Risk | Moderate Risk | Minor Adverse | Moderate/Low Risk | Negligible | Low Risk | Minor beneficial |

| Source | Receptor | Pathway | Classification of risk (baseline - assuming reasonable worst case) | Classification of risk (construction without mitigation) | Impact (construction without mitigation) | Classification of risk (construction with mitigation) | Impact (construction with mitigation) | Classification of risk (operation) | Impact (during operation phase assuming mitigation was implemented) |
|---|---|---|---|---|---|---|---|---|---|
| | Controlled Waters (within the study area)<br>•Groundwater (Superficial Principal and Secondary A aquifers and bedrock Secondary A aquifer).<br>•Surface water (River Wey, Bolder Mere, Pond Farm Pond, Manor Pond and unnamed drains, ditches and ponds). | Leaching/vertical migration of contaminants in soils to underlying groundwater followed by lateral migration | Moderate Risk | Moderate Risk | Negligible | Low Risk | Moderate Beneficial | Low Risk | Moderate beneficial |
| | | Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater followed by lateral migration | Low Risk | Moderate Risk | Moderate Adverse | Low Risk | Negligible | Low Risk | Negligible |
| | | Lateral migration of contamination in groundwater | Moderate/Low Risk | Moderate Risk | Minor Adverse | Moderate/Low Risk | Negligible | Low Risk | Minor beneficial |
| | | Migration of contaminants entrained in surface water run-off | Moderate/Low Risk | Moderate Risk | Minor Adverse | Moderate/Low Risk | Negligible | Low Risk | Minor beneficial |
| | | Migration of contamination via surface waters | Moderate/Low Risk | Moderate Risk | Minor Adverse | Moderate/Low Risk | Negligible | Low Risk | Minor beneficial |
| | Ecology<br>•Thames Basin Heath SPA, Ockham Common and Wisley Common SSSI, Ockham and Wisley LNR and Ancient Woodland. | Leaching / vertical migration of contaminants followed by lateral migration of contamination in groundwater connected to bog/ surface water | Moderate/Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Migration of contaminants entrained in surface water run-off | Moderate/Low Risk | Moderate Risk | Minor Adverse | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | Property (within the Scheme)<br>•Piles and other foundations<br>•Historic remains/structures and listed buildings<br>•Underground services. | Chemical attack from aggressive chemical constituents in soil or groundwater | Low Risk | Moderate/Low Risk | Minor Adverse | Low Risk | Negligible | Low Risk | Negligible |
| | | Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points | Moderate/Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | Property (within the study area)<br>•Residential, commercial and industrial properties<br>•Historic remains/structures and listed buildings<br>•Underground services. | Chemical attack from aggressive chemical constituents in soil or groundwater | Low Risk | Moderate/Low Risk | Minor Adverse | Low Risk | Negligible | Low Risk | Negligible |
| | | Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points | Moderate/Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| Potential sources of contamination (including soil, water, vapours and ground gases) within the study area include:<br><br>•Made Ground/infill material of unknown quality associated with the construction of Feltonfleet School, the railway, RHS Wisley and other existing | Human Health (within the Scheme)<br>•Construction workers and future site maintenance workers. | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Receptor not present on-site during baseline | Moderate/Low Risk | (Impact predicted to be moderate adverse given sensitivity of receptor) | Low Risk | (Impact predicted to be negligible given the reduced likelihood of pathway being realised) | Low Risk | (Impact predicted to be negligible given reduced likelihood of pathway being realised) |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | | Moderate/Low Risk | | Moderate/Low Risk | | Moderate/Low Risk | |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | | Moderate/Low Risk | | Moderate/Low Risk | | Moderate/Low Risk | |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | | Moderate/Low Risk | | Moderate/Low Risk | | Moderate/Low Risk | |
| | | Inhalation of vapours from contaminated soil and/or water | | Moderate/Low Risk | | Moderate/Low Risk | | Moderate/Low Risk | |

| Source | Receptor | Pathway | Classification of risk (baseline - assuming reasonable worst case) | Classification of risk (construction without mitigation) | Impact (construction without mitigation) | Classification of risk (construction with mitigation) | Impact (construction with mitigation) | Classification of risk (operation) | Impact (during operation phase assuming mitigation was implemented) |
|---|---|---|---|---|---|---|---|---|---|
| infrastructure;<br>•material of unknown quality associated with the infilling/potential infilling of former water features and mineral extraction pits;<br>•five recorded pollution incidents (minor severity and occurred prior to 1998);<br>•wider area of the former Wisley Airfield and associated activities (previous GI identified some contamination);<br>•farms and agricultural land use;<br>•the railway;<br>•five historical landfills; and<br>•potentially contaminative land uses (current and historical), including vehicle service stations, electricity substation, sewage treatment, gas works, asphalt and coated macadam laying contractors, garden machinery services, vehicle dealers, wood and furniture polishers, picture frame renovators, pest control service, small business park and stationery printers. | Human Health (within the Scheme)<br>•Members of the public using public rights of way (non motorised users) | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Low Risk | Receptor not present on-site during construction | | | | Low Risk | Negligible |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Low Risk | | | | | Low Risk | Negligible |
| | | Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion | Moderate/ Low Risk | | | | | Moderate/ Low Risk | Negligible |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Moderate/ Low Risk | | | | | Moderate/ Low Risk | Negligible |
| | | Inhalation of vapours from contaminated soil and/or water | Low Risk | | | | | Low Risk | Negligible |
| | Controlled Waters (within the Scheme)<br>•Groundwater (superficial Principal and Secondary A aquifers and bedrock Secondary A aquifer).<br>•Surface water (Stratford Brook, River Mole, unnamed drains, ditches and ponds). | Leaching/vertical migration of contaminants in soils to underlying groundwater followed by lateral migration | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Vertical migration of contaminants via preferential pathways such as via piles to deeper groundwater followed by lateral migration | Low Risk | Low Risk | Negligible | Low Risk | Negligible | Low Risk | Negligible |
| | | Lateral migration of contamination in groundwater | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Migration of contamination via surface waters | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | Ecology<br>•Thames Basin Heath SPA, Ockham Common and Wisley Common SSSI, Ockham and Wisley LNR and Ancient Woodland. | Leaching / vertical migration of contaminants followed by lateral migration of contamination in groundwater connected to bog/ surface water | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Migration of contaminants entrained in surface water run-off | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | Property (within the Scheme)<br>•Piles and other foundations<br>•Historic remains/structures and listed buildings<br>•Underground services. | Chemical attack from aggressive chemical constituents in soil or groundwater | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |
| | | Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points | Moderate/ Low Risk | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible | Moderate/Low Risk | Negligible |

10.10.2 If no mitigation measures are implemented, the construction phase impacts associated with potential sources have been typically assessed as temporary, negligible, minor adverse or moderate adverse (significant). Where adverse impacts have been identified, design and mitigation measures will be implemented. With the implementation of design and mitigation measures, the temporary impacts to the identified receptors during construction have been reassessed as negligible with two moderate beneficial effects, as the level of risk to receptors is expected to remain generally the same as baseline or improve (namely for existing receptors within the study area). The reason for the beneficial effects is under the reasonable worst-case scenario, anywhere that potential sources of contamination have been identified, contamination has been assumed to be present, therefore any necessary remediation would improve the conditions from baseline.

10.10.3 With design and mitigation measures including the adoption of Best Available Techniques (BAT), it has been considered that during operation there will be negligible, minor beneficial and moderate beneficial effects to baseline conditions. The anticipated negligible and minor effects are considered to be permanent and not significant and the moderate effects are considered to be permanent and significant.

## Effects associated with Geology and Geomorphology

10.10.4 A qualitative approach has been taken to assess the potential effects of the overall Scheme on geology and geomorphology baseline conditions.

10.10.5 The geology and geomorphology baseline conditions have all been assigned a low value/sensitivity based on the rationale presented in Table 10.4. Mitigation methods have been factored in to the geology and geomorphology impact assessment, with the GI expected to provide further information related to the identified potential risks. The assessment is presented in Table 10.13 below.

**Table 10.13: Geology and Geomorphology impact assessment summary (assuming design and mitigation measures are implemented)**

| Sub topic | Value/ sensitivity | Construction (assuming design and mitigation measures are implemented) | | Operation (assuming design and mitigation measures are implemented) | |
|---|---|---|---|---|---|
| | | Magnitude of impact | Significance of effect | Magnitude of impact | Significance of effect |
| Topography | Low | Negligible | Negligible | Negligible | Negligible |
| Soil erosion | Low | Low | Minor adverse | Negligible | Negligible |
| Compressible ground | Medium | Negligible | Minor beneficial | Negligible | Negligible |
| Collapsible ground (including anthropogenic cavities) | Low | Negligible | Negligible | Negligible | Negligible |
| Landslides | Low | Negligible | Negligible | Negligible | Negligible |
| Running sands | Low | Negligible | Negligible | Negligible | Negligible |
| Aggressive ground | Low | Negligible | Negligible | Negligible | Negligible |
| Shrinking or swelling clay | Low | Negligible | Negligible | Negligible | Negligible |

| Sub topic | Value/ sensitivity | Construction (assuming design and mitigation measures are implemented) | | Operation (assuming design and mitigation measures are implemented) | |
|---|---|---|---|---|---|
| | | Magnitude of impact | Significance of effect | Magnitude of impact | Significance of effect |
| UXO | Medium | Negligible | Minor beneficial | Negligible | Negligible |

10.10.6 Potential changes in geology and geomorphology baseline conditions as a result of the Scheme are discussed below.

- Topography. Earthworks will be required in places to facilitate the design which is expected to cause localised changes to the topography within the Scheme. The existing topography is considered to be of low value as there are no significant topographic features in the Scheme. As per Table 10.4, topography only possesses characteristics which are locally significant and have the capacity to accommodate the proposed change. The magnitude of impact that construction will have on topography is considered temporary and negligible as there will be very minor topographical changes during construction. The mitigation measures proposed for the construction works will reduce potential impacts to topography, which includes timely removal of stockpiles and therefore the construction impacts are not considered significant. During operation, the effect on topography is considered to be negligible and permanent, as the changes in topography from baseline will be localised and the impact is therefore considered to be not significant.
- Soil erosion. There is likely to be a temporary increase in soil erosion as a result of the stripping of topsoil, vegetation clearance, earthworks, temporary stockpiling and the movement of heavy plant during construction. There is also potential for increased runoff during groundworks with a high sediment load to impact surface water receptors during construction. However, mitigation measures such as those outlined in Section 10.9 will reduce the potential for soil erosion and areas required for temporary works will be reinstated. Consequently, the effect on soil erosion during construction is considered to be (temporary) minor adverse and during operation the effect is considered permanent and negligible, therefore the effects are considered to be not significant.
- Compressible ground. There is a localised moderate risk of compressible ground where Alluvium or Made Ground/ infilled land is present, and low risk elsewhere within the Scheme. Where compressible ground is confirmed during the proposed GI, the risks to proposed engineering structures will be mitigated by design (likely either by excavation and replacement with more competent material or the use of foundations). In the scenario of the compressible ground being excavated and replaced with more competent material, the effect of the development would be permanent minor beneficial during construction and is considered to be not significant. Assuming mitigation measures have been adopted during construction, only a potential negligible magnitude will be present during operation and this corresponds to a negligible (not significant) effect.
- Collapsible ground. There is a very low potential for collapsible ground under baseline conditions. The likely degree of change to this risk rating as a result of the Scheme is considered negligible during construction and operation and therefore the overall effect is considered to be not significant and permanent.

- Landslides, running sands, aggressive ground and shrinking and swelling clay.
- There is a localised potential moderate risk of landslide along the M25, midway along the eastern arm of the Scheme and a low risk adjacent to the River Mole, approximately 1 km to the north-east of the M25 junction 10/A3 Wisley interchange. There are no other landslide risks considered present elsewhere throughout the Scheme.
- There is a low risk of running sands where Alluvium and Bagshot Formation are anticipated, and a very low risk where the Kempton Park Gravel Member, Lynch Hill Gravel Member and River Terrace Deposits are anticipated.
- There is an unknown risk from aggressive ground, which is generally associated with high sulphate, sulphide and phosphate concentrations within clay, Made Ground and Alluvium.
- There is a medium to low risk for shrinking and swelling clay where the London Clay Formation is anticipated under baseline conditions.
- If the proposed GI identifies a possible risk from landslides, running sands, aggressive ground or shrinking and swelling clay, proposed structures will be mitigated by design therefore it is considered that no change to these geological features will occurring as a consequence of the development relative to the baseline. The effects during construction are considered to be permanent minor beneficial and not significant. Assuming mitigation measures have been adopted during construction, only a potential negligible magnitude will be present during operation and this corresponds to a negligible and permanent effect.
- UXO. There is a moderate to low risk of encountering unexploded bombs in the study area[22]. A detailed UXO desk study will be obtained prior to the GI which will inform whether further mitigation is required prior to ground works. Any clearance required would result in the removal of any UXO encountered, therefore the significance of effect during construction is considered to be permanent minor beneficial and not significant. Assuming mitigation measures have been adopted during construction only a potential negligible magnitude will be present during operation and this corresponds to a negligible effect.

10.10.7 Suitable design and construction works will minimise impacts and it is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying BAT. This will therefore further reduce impacts to geology and geomorphology baseline conditions. Consequently, the overall effect of the Scheme during the construction and operational phase on geology and geomorphology is considered permanent negligible to minor beneficial and not significant.

## Significant effects

10.10.8 Table 10.12 and Table 10.13 suggest that with the implementation of mitigation measures, there are no predicted significant adverse effects with regards to geology and soils.

10.10.9 With regards to the contaminated land impact assessment, there are two moderate beneficial (permanent) significant effects predicted to be associated

with controlled water receptors within the Scheme and study area, associated with the expected remediation of any contamination identified during the GI.

10.10.10 There are no significant effects associated with the geology and geomorphology features.

## Residual effects

10.10.11 Residual effects typically refer to permanent effects that will remain following the implementation of the design and mitigation measures (discussed in Section 10.9). There are no predicted adverse residual effects after mitigation associated with geology and soils.

10.10.12 The geology and geomorphology residual effects are summarised in Table 10.14.

**Table 10.14: Geology and soils residual effects after mitigation**

| Contaminated land residual effects (after mitigation) | | | |
|---|---|---|---|
| **Source** | **Receptor** | **Pathway** | **Significance of effect** |
| Potential sources of contamination within the Scheme | Members of the public (within the Scheme). | Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres | Minor Beneficial |
| | | Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater | Minor Beneficial |
| | | Inhalation, ingestion and dermal contact with contaminants within surface water | Minor Beneficial |
| | Local residents, school children/staff, workers/visitors at nearby premises (within the study area). | Inhalation, ingestion and dermal contact with contaminants in windblown soil-derived dust/fibres | Minor Beneficial |
| | Controlled Waters (within the Scheme) | Leaching / vertical migration of contaminants in soils to underlying groundwater | Moderate Beneficial |
| | | Migration of contaminants entrained in surface water run-off | Minor Beneficial |
| | | Migration of contamination via surface waters | Minor Beneficial |
| | Controlled Waters (within the study area) | Leaching/ vertical migration of contaminants in soils to underlying groundwater followed by lateral migration | Moderate Beneficial |
| | | Lateral migration of contamination in groundwater | Minor Beneficial |
| | | Migration of contaminants entrained in surface water run-off | Minor Beneficial |

| Contaminated land residual effects (after mitigation) | | | |
|---|---|---|---|
| **Source** | **Receptor** | **Pathway** | **Significance of effect** |
| | | Migration of contamination via surface waters | Minor Beneficial |

| Geology and geomorphology residual effects (after mitigation) | | | |
|---|---|---|---|
| **Topic** | **Feature** | **Value** | **Significance of effect** |
| Changes in physical properties and ground stability | Compressible ground | Low | Minor beneficial |
| Other geological risk | UXO | Low | Minor beneficial |

## 10.11 Cumulative effects

10.11.1 The cumulative effects are those that result from the additive impacts of both the Scheme's components and any past, present or future developments within the study area.

10.11.2 An assessment of cumulative effects is outlined in Table 10.15.

**Table 10.15: Cumulative effects**

| Development | Cumulative impact on assets affected by Scheme | Additional significant construction effects | Additional significant operation effects |
|---|---|---|---|
| Jn10-16 Smart Motorway Programme (SMP) - M25 Jn10 to Jn16 includes upgrading the M25 between Jn10(A3) and Jn16(M40) through a mixture of enhancements, e.g. hard shoulder running between Jn15 and Jn16 and four lane through-junction, between Jn10 and Jn12. | The development may have a minor adverse effect on the geology and soil which may impact human health and controlled waters receptors in the area. Therefore, there is potential that there may be cumulative effects. However, the Jn10-16 SMP programme will implement best practice and follow appropriate design and mitigation measures; therefore likely impacts and effects are not considered to significant. | None anticipated | None anticipated |
| The former Wisley Airfield - Residential led mixed use development, to be delivered between 2022/23 to 2033/2034 (Site allocation A35 App No. 15/P/00012). | The development may have a minor adverse effect on the geology and soil which may impact human health and controlled waters receptors in the area. Therefore, there is potential that there may be cumulative effects. The residential development has the potential to disturb and facilitate the migration of any existing contaminants, both directly and | None anticipated | None anticipated |

| Development | Cumulative impact on assets affected by Scheme | Additional significant construction effects | Additional significant operation effects |
|---|---|---|---|
| | indirectly. There is limited overlap with the M25 Jn10/A3 Wisley interchange proposed works, and the Scheme is expected to follow appropriate design and mitigation measures, so no significant cumulative effects are anticipated. | | |
| RHS Gardens, Wisley Lane, Wisley, Woking, GU23 6QS (Planning ref. 16/P/01080, granted 30/11/2016) | None anticipated. Work will have limited potential to impact sources, pathways, or receptors, either directly or indirectly. | None anticipated | None anticipated |
| RHS Gardens, Wisley Lane, Wisley, Woking, GU23 6QS (Planning ref. 16/P/00976, granted 30/11/2016) | None anticipated. Work will have limited potential to impact sources, pathways, or receptors, either directly or indirectly. | None anticipated | None anticipated |
| Nutberry Farm, Portsmouth Road, Ripley, Woking, GU23 9XX (Planning ref. 17/W/00068) | Given the nature of works and the unknown time frame, this development will have limited potential to impact sources, pathways, or receptors, either directly or indirectly. | None anticipated | None anticipated |
| Former San Domenico Restaurant (Planning ref. 2017/0524) (validated 21/03/2017) | The development may have a minor adverse effect on the geology and soil which may impact human health and controlled waters receptors in the area. As there is no proposed timeline for this development, it is possible that it may occur at the same time as the Scheme. Although there may be cumulative effects, they are not considered significant, primarily because the Former Dan Domenico development is expected to follow appropriate design and mitigation measures. | None anticipated | None anticipated |
| Feltonfleet School Byfleet Road Cobham Surrey KT11 1DR, Permission granted 24/11/17 (Planning ref. 2017/2106) | Given the nature of the Feltonfleet School works, no adverse impacts are anticipated which may impact human health and controlled waters receptors in the area. Further, no M25 junction 10/A3 Wisley interchange related intrusive works are currently planned near this proposed development and thus no cumulative effects are anticipated. | None anticipated | None anticipated |

## 10.12 NPSNN compliance

10.12.1 The Scheme aims to comply with the NPSNN by leaving the area in better condition than prior to development where possible. In accordance with the NPSNN, the Scheme development will aim to adhere to the following:

- The Scheme will be designed to minimise environmental impacts and to improve quality of life, as well as aim to identify "opportunities to deliver environmental benefits"; and
- New and existing development will be prevented from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution.

10.12.2 The design and mitigation measures outlined in Section 10.9 and the conclusions and recommendations of the documents associated with the proposed GI will be adhered to and considered throughout all stages of the Scheme to ensure compliance to NPSNN guidance.

## 10.13 Monitoring

10.13.1 The proposed GI will inform design and confirm / optimise mitigation measures detailed in Section 10.9. The GI specification allows for the installation of groundwater and ground gas monitoring wells and a subsequent preliminary monitoring programme to establish baseline conditions prior to construction.

10.13.2 If required, monitoring plans will be developed and submitting to appropriate authority for approval.

## 10.14 Summary

10.14.1 The anticipated effects of the Scheme on geology and soils have been assessed in this chapter in accordance with the regulatory policy framework presented in section 10.3.

10.14.2 With respect to land contamination, the assessment of baseline conditions under the reasonable worst-case scenario used for the purposes of the assessment with the potential magnitude of the impact that the Scheme could have during construction without mitigation or the proposed GI has been assessed as likely to have a negligible to moderate adverse temporary, significant effect. However, with information anticipated from the proposed GI, combined with the application of the identified design and mitigation measures, the majority of potential impacts of the Scheme have been assessed as likely to have a temporary, negligible, not significant effects during construction. Two moderate beneficial, and therefore significant effects have been identified associated with the remediation of contamination if encountered during the GI, which would improve baseline conditions for controlled water receptors within the Scheme and study area. During operation, the potential impacts are anticipated to have negligible, minor beneficial and moderate beneficial effects (assuming the implementation of design and mitigation measures).

10.14.3 With respect to geology and geomorphology conditions, the assessment indicated that with the proposed design and mitigation measures, the overall construction phase will have a permanent negligible to minor beneficial, not significant effect and a temporary minor adverse effect (associated with soil erosion during construction) which is considered not significant. The operational phase is likely to have a negligible effect.

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Highways England Company Limited registered in England and Wales number 09346363